MST Workshop

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Windows Version 12.1

Math Science and Technology Workshop

This application lets you create programs by connecting components. There are hundreds of components available. The menus on the top left group components into categories. Select a menu and look for the component you need. You can place the component anywhere on this workspace (window). Start with a component that generates a value, for example, the **Slider** in the **Controls** menu. Then place some function to the right of the **Slider**. For example the **Square** component in the **Functions** menu. Now you can connect the two components by letting their terminals touch. Alternatively, you can click on one of the terminals and drag the cursor to the other terminal. Now we need to display the output of the **Square** function. Use the **Display List** component in the **Controls** menu. Connect it to the output of the **Square** function. Finally, you can drag the "knob" (white circle) in the **Slider** and instantly view the square of the number selected. An easy way to search for a component is to start typing the component's name. In the example above, to find the slider type "SLIDE" - all the components will dim and only the components with "SLIDE" in their name will remain bright. To clear your search use either the Enter or the Esc key on the keyboard. You can also search by clicking the **Find** button in the upper right corner of the workspace. Type a word and hit OK. The program searches through the names and details of all the components. All the matching components will be listed. Now you can click on any of the lines in that dialog to create that component.

Inputs and Outputs

Some components have inputs, some have outputs and some have both. You can connect components by snapping an input to an output or using a wire. The values carried between output and input terminals can be numerical values, string,s or images. When a wire is carrying a single numerical value it is a thin black line. If it is carrying a string it is a thin green line. If the wire is carrying an array the colored line becomes thicker. Numerical values are what is called Double Precision which means that it is in the range of ±10 to the ±308 power. This wide range of numbers has at most 16 decimal digits of resolution. Strings can be any length only limited by your computer's memory available. Some components can handle more than 16 digits of precision by accepting strings of digits.

Arrays

Some Components take arrays for inputs or yield arrays as outputs. For example, the **Count** component takes an array at its input and outputs a number that is the number of elements in the array. An example of a component that takes numbers and outputs an array is the **Synthesizer** component, it takes numbers and synthesizes an array specified by those inputs.

Additionally, many components that normally take single numbers can also take arrays. For example that **Add** component takes two numbers and outputs a number that is the sum. You can connect an array to one of the **Add** component's inputs and the output will be an array that has the same number added to each element. You can also connect two arrays of the same size and the **Add** component will add the arrays and output an array that is the sum of the respective elements.

Time

Most components respond instantly to changes in their inputs by updating their outputs. There are also components that are time-based. These components consider time in their calculations. An example of a time-based component is the **Square Wave** component. Normally its output doesn't change, but when the workspace clock is running, the output changes based on the **Square Wave**'s inputs and settings.

You can control the workspace clock with the buttons at the bottom left of the workspace. These buttons are disabled when there are no components in the workspace that are time-based. When you place a time-based component in the workspace these buttons will become active. Time-based components also change their color. When the clock is not running, time-based components are gray, when the clock is running they change to the color of their menu.

Connections

There are a few ways to connect components. The simplest is to make their terminals touch (when close they should snap together). Another way is to connect them with a virtual wire. Click and hold the mouse button on any terminal and drag away, a wire will follow the cursor. Move to another terminal and release the mouse button to connect the terminals. Note: While you are dragging, you can click the right mouse button to put a bend at that point. This is handy when you need to go around another component.

To delete a wire you can right-click anywhere along the line. You can also delete a wire by clicking on one end of the wire and dragging it off the terminal. You can also bend wires after they are created by clicking and dragging at any point along the wire. To remove a bend, right-click on the point where the wire is bent and it will straighten. Wires can have as many bends as needed to look neat.

Another way to connect components is with bus components. One type is the **Bus In** and **Bus Out** components. Bus components act like invisible wires. One **Bus In** component will connect to all the **Bus Out** components with the same name. If you need multiple independent buses you can give buses names by double clicking on the **Bus In** or **Bus Out** then tap **Enter Name**.

Another type of bus is the **Bus 2 In** and **Bus 2 Out** components. These buses can have multiple inputs with names, you can think of them as a cable with several wires inside. Set the number of inputs on the **Bus 2 In** component, then set the name of each input. When you place a **Bus 2 Out** component, the program will search for the matching **Bus 2 In** component and automatically set up the number and names of the outputs.

Subroutines

When your workspace gets cluttered or confusing often you can break things into pieces. This is where the subroutine feature comes into play. For example, suppose you are calculating the volume of a cylinder. That calculation takes several components. Instead of putting that calculation in the main workspace, you can open a subroutine (click the **Edit 1** button in the **Subroutines** menu) and put the components there. To get variables into this new page you use an **Input** component (on the **Controls** menu). To get your results back out of the page you use the **Output** component. After creating this new page, return to the Main workspace (click **Subroutines** then the first **Edit**). Next, select the **Subroutines** menu again and you will see the **Place 1** button is active. Click and drag that button and a **Sheet** component will be placed on the main workspace. The **Sheet** component will now take inputs from the left terminals and pass those values to the subroutine's **Input** components. Next, it will calculate the volume of a cylinder and take the value of the **Output** components and pass it to the **Sheet's** right terminals on the main workspace. You can place this **Sheet** component anywhere you need to calculate a cylinder volume on your Main workspace. You can add labels to the **Input** and **Output** components for clarity. You can also name the **Sheet** by clicking **Subroutines** then the **Sub 1** button and giving it a title. See an example in the **Input** or **Output** descriptions below.

Scrolling and Zooming

You can shift the workspace by right-clicking in a blank area where there are no components, holding the right button down, and then dragging the mouse. You can also use the arrow keys and **Home** key (when no **Keyboard** component is in the workspace). There are also buttons in the Options menu that shift the workspace: **Page Left, Page Right, Page Up, and Page Down. Reset Page** returns you to the center of the workspace. If you have some components selected, the arrow keys move the selection up, down, left, or right by one pixel at a time.

To get a closer look at something in the workspace or to zoom out for a wider view, you can use the wheel on the mouse to zoom in or out. If your mouse doesn't have a wheel, you can use the **Zoom In** and **Zoom Out** menu buttons in the controls area. **Reset Zoom** restores the original screen size and position. The mouse wheel is also a button, if you activate that button while scrolling the wheel you will get a ten times magnification of the zoom effect.

A few controls can be operated using the mouse wheel. Hover over the control you want to move vertically and rotate the mouse. The components with this ability are Slider, Slide Factor, Slide Offset, Knob, Knob Factor, Knob Offset, Rack, Rack Factor, Rack Offset, Function, Function X1, Function X2, Switch, Switch 2, Gate, and Display List. Note: When you are trying to get an exact number and using the mouse is too coarse and skips the number you want, try the wheel.

Selection

To modify a component right click on the component and a menu will pop up. You can **Delete**, get **Details**, **Duplicate,** or give the component a label. Some components have extra buttons. Often you can change the inputs that are available. This allows you to only have inputs that you need and minimize complex components. Some components have **Options** that are available from this menu and are different for each component.

To select a group of components for deletion or duplication, start by clicking where there are no components, then drag to select some components. the workspace where there are no wires or components. A red frame will appear as you drag, when you release the mouse the selected components will become bold. Now you can drag the components as a group. You can also right-click on one of the components in the group to **Delete** or **Duplicate** the group. Note: After duplicating and while the group is still bold, you can drag the new copy to a more desirable location.

Hovering

If you hover the mouse over an input terminal a text will appear at the bottom right of the workspace indicating the component's number followed by the word “dim” followed by the dimensions of the data being input to that component. Next will be a description of the type of input: numerical, string, or image. Lastly will be the first few values of the data. Similar results will be displayed when you hover over an output terminal.

When you hover over a component, the text will usually show “operating normally” to indicate that the component's inputs are satisfied. When there is a problem with the inputs, the component will change its color to gray and the message will describe which input is not connected to an acceptable value. If the component is designed to operate when the clock is running (buttons at the lower left of the workspace), it will be gray and say “requires clock running.”

Colors

Several dialogs control graphics colors in the workspace. The colors of the seven menus at the top of the workspace are set from a dialog that is activated by clicking the **Set Button Colors...** item in the **Options** menu. The **Chart**, **XY Chart**, **Recorder,** and **XY Recorder** pen colors are controlled in dialog activated from the **Set Pen Colors...** dialog. The Workspace background, various charts, and control backgrounds are activated from the **Set Background Colors...** dialog. The major and minor gridlines in the charts and recorders, the wire colors, and the lines that connect the various knobs are activated from the **Set Line Colors...** dialog. The various texts shown in and around components are controlled by the **Set Text Colors...** dialog. You can also check the **Dark Theme** item to reverse video everything in the workspace. Finally, if you want to return to the colors that were originally set you can select the **Restore Default Colors** item.

Errors

When a component's inputs are not sufficient to allow the component to operate, the component will change color to gray. If you hover the mouse over the component, the text will appear in the lower right of the workspace indicating the problem. Components that require a changing time will also be gray when the time is not running as described above.

Automatic Backup

After you save a file the first time or after opening a file, the Automatic Backup will be activated. You can disable it from the checkbox in the Options menu. When enabled, a copy of the program will be saved periodically as you make progress on your solution. The file name will be the name you have chosen with the word *backup* added.

Default Values

Most component imputs have a default value of zero. Some color inputs default to 255 to make the view in the 2D or 3D window look reasonable when nothing is connected. A new features allows you to change the default values for many inputs. The advantage is that you don't need to create a constant for every input. The disadvantage is that unlike a constant you can't see the default value. I suggest you only use the “Defaults...” menu when knowing the default value is not critical to understanding the overall diagram (solution).

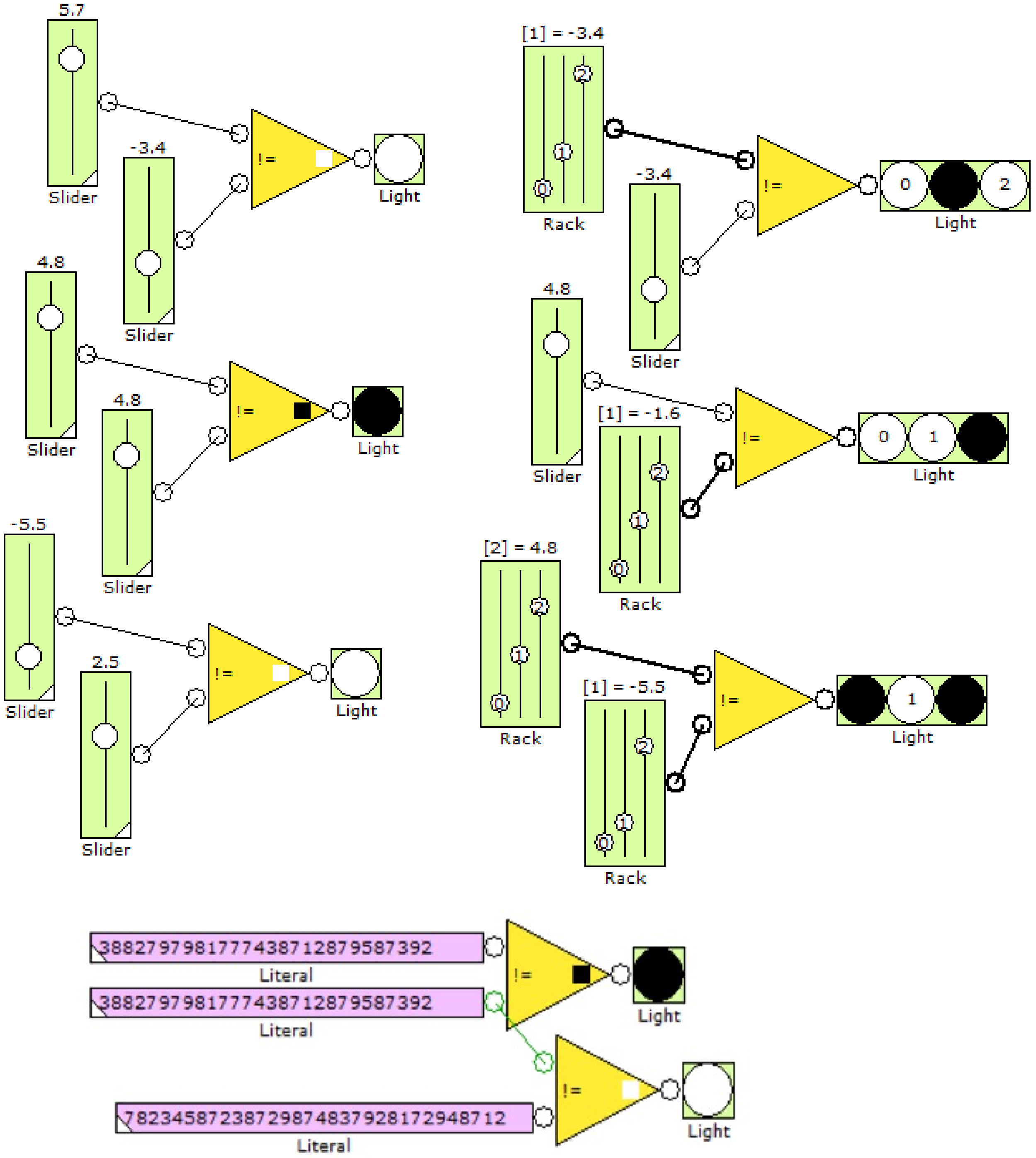
Printing

You can print the Workspace or the 2D View. I noticed that after printing that a second printing has problems. While I figure out how to fix it, I added a warning dialog that recommends saving your work and restarting MST Workshop.

Table of Contents

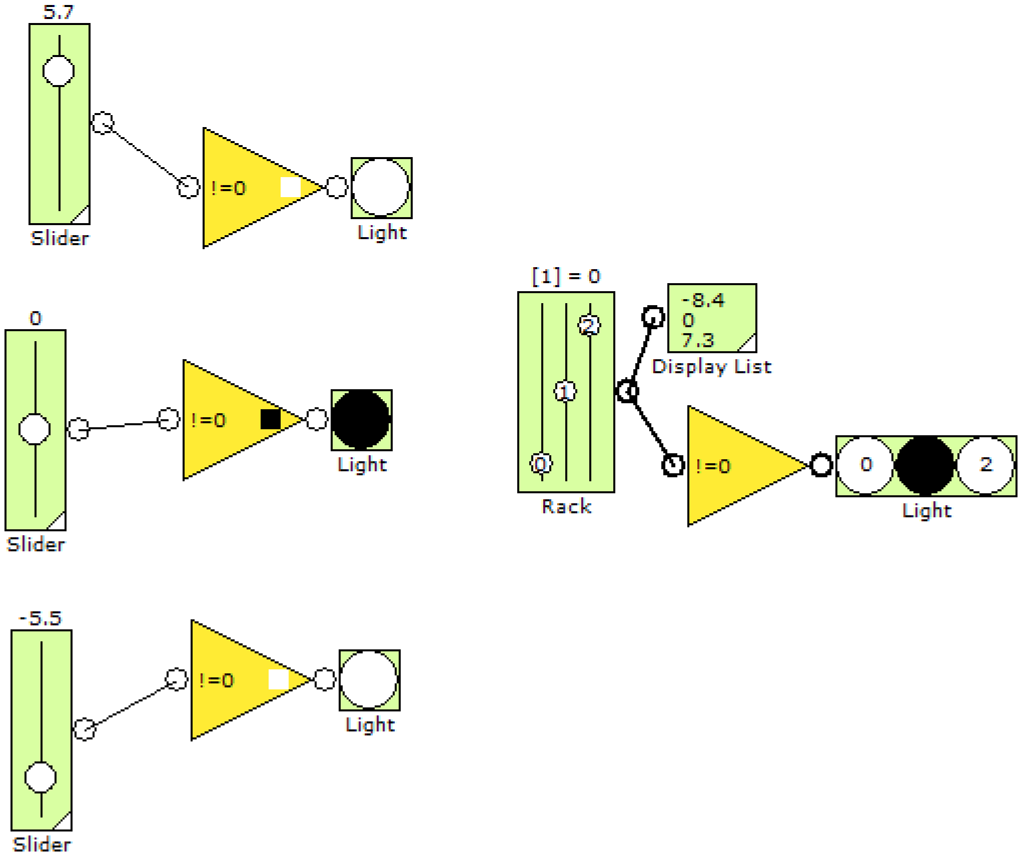
!= (not equal to)

The != component compares the inputs and returns true if the top value is not equal to the bottom value. Inputs can be scalars or arrays.   Functions - column 4



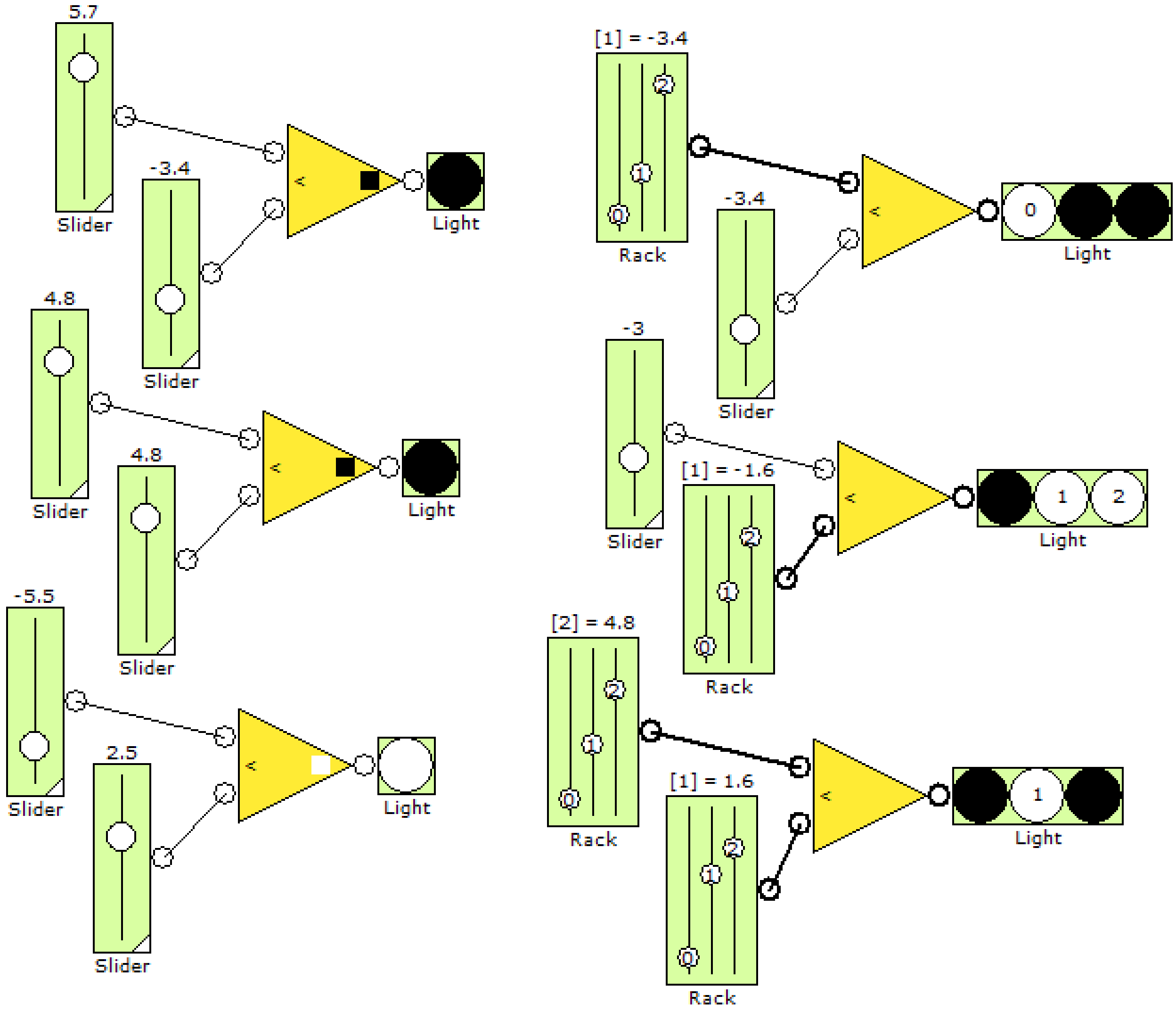
!=0 (not equal to zero)

The !=0 component returns true if the input value is not equal to zero. Input can be scalar or an array.
Functions - column 4



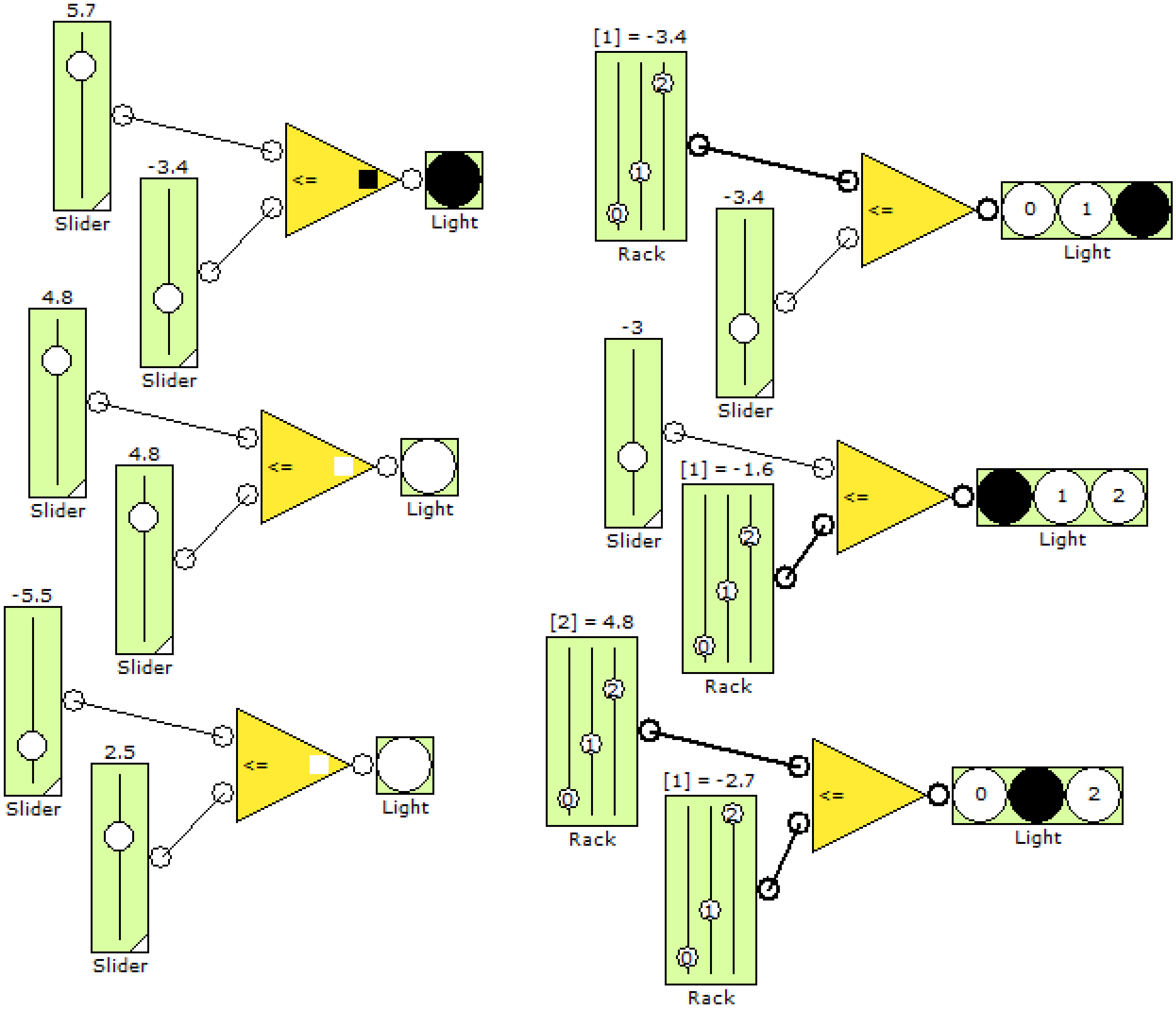
< (less than)

The < component compares the inputs and returns true if the top value is less than the bottom value. Inputs can be scalars or arrays. Functions - column 4



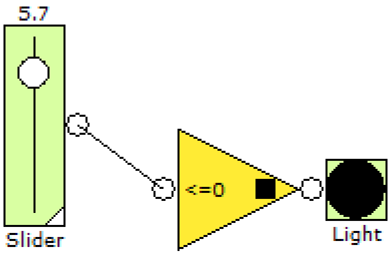
<=   (less or equal to)

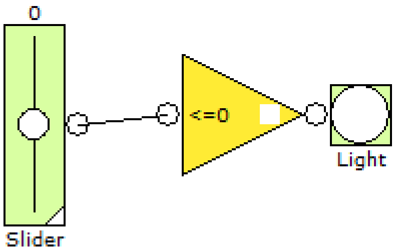
The <= component compares the inputs and returns true if the top value is less than or equal to the bottom value. Inputs can be scalars or arrays.   Functions - column 4

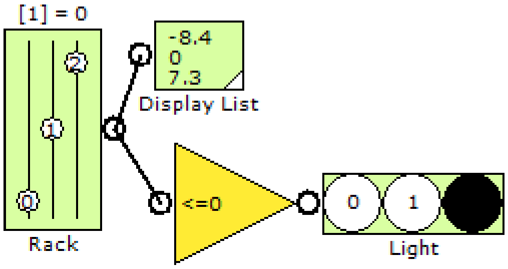


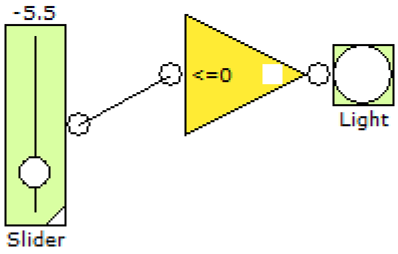
<=0   (less or equal to zero)

The <=0 component returns true if the input value is less than or equal to zero. Input can be scalar or an array.   Functions - column 4

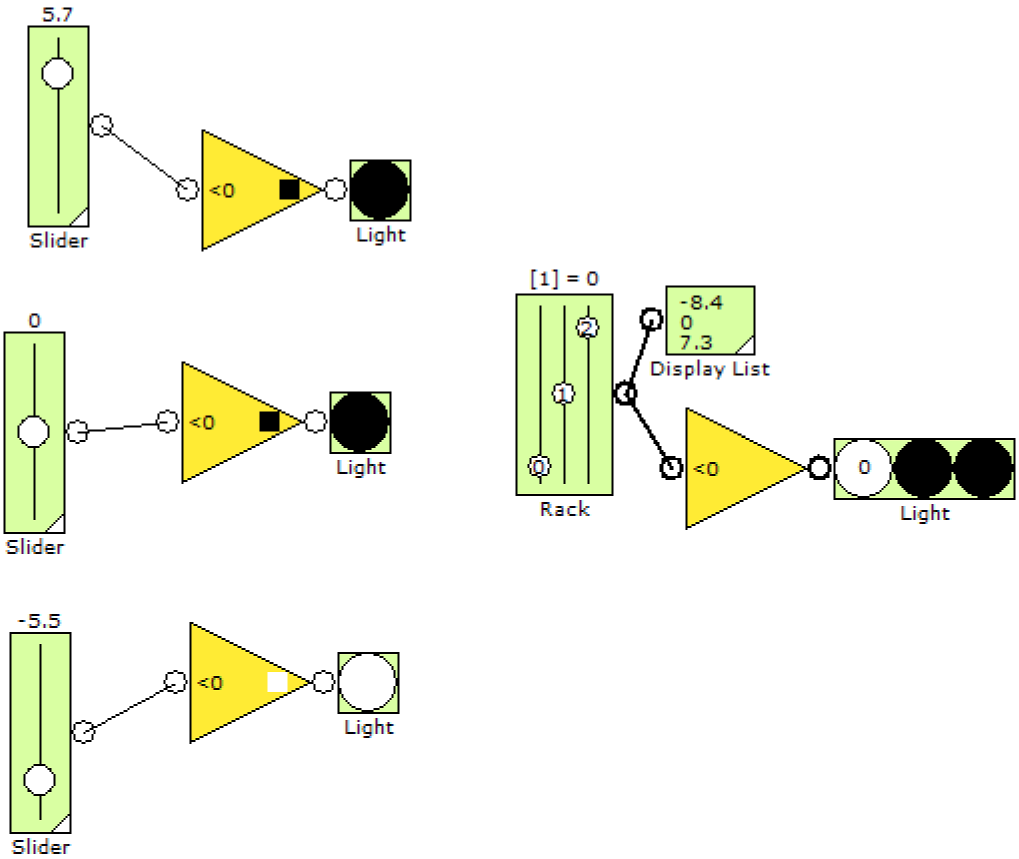








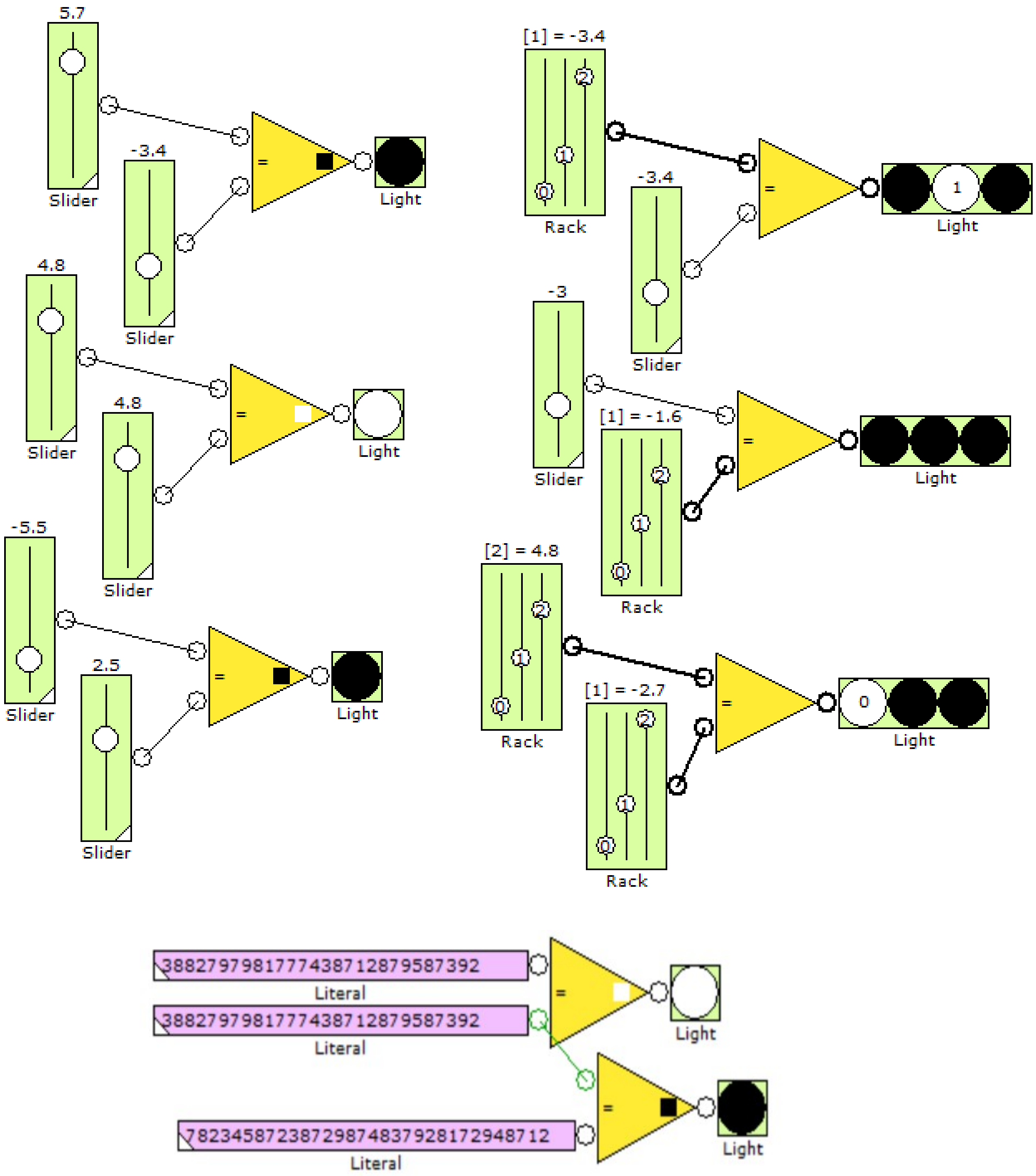
<0   (less than zero)



The <0 component returns true if the input value is less than than zero. Input can be scalar or an array.
Functions - column 4

= (equals)

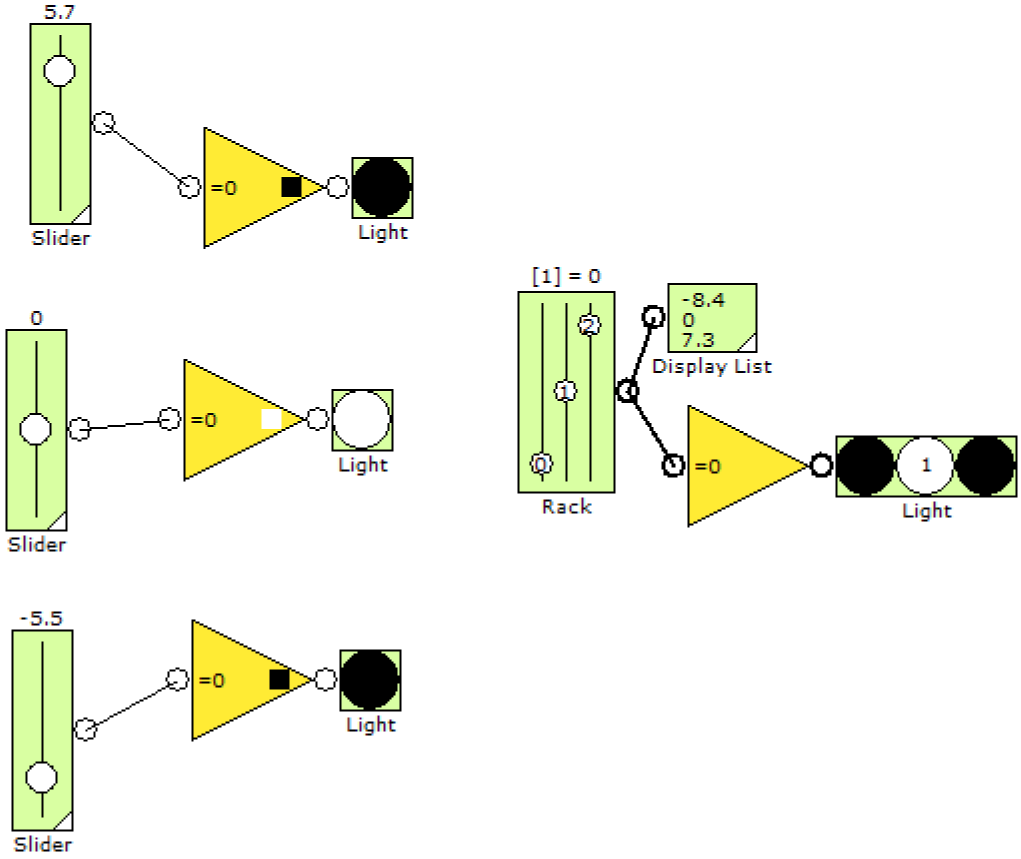
The = component compares the inputs and returns true if the top value is equal to the bottom value. Inputs can be scalars or arrays. Functions - column 4



=0 (equals zero)

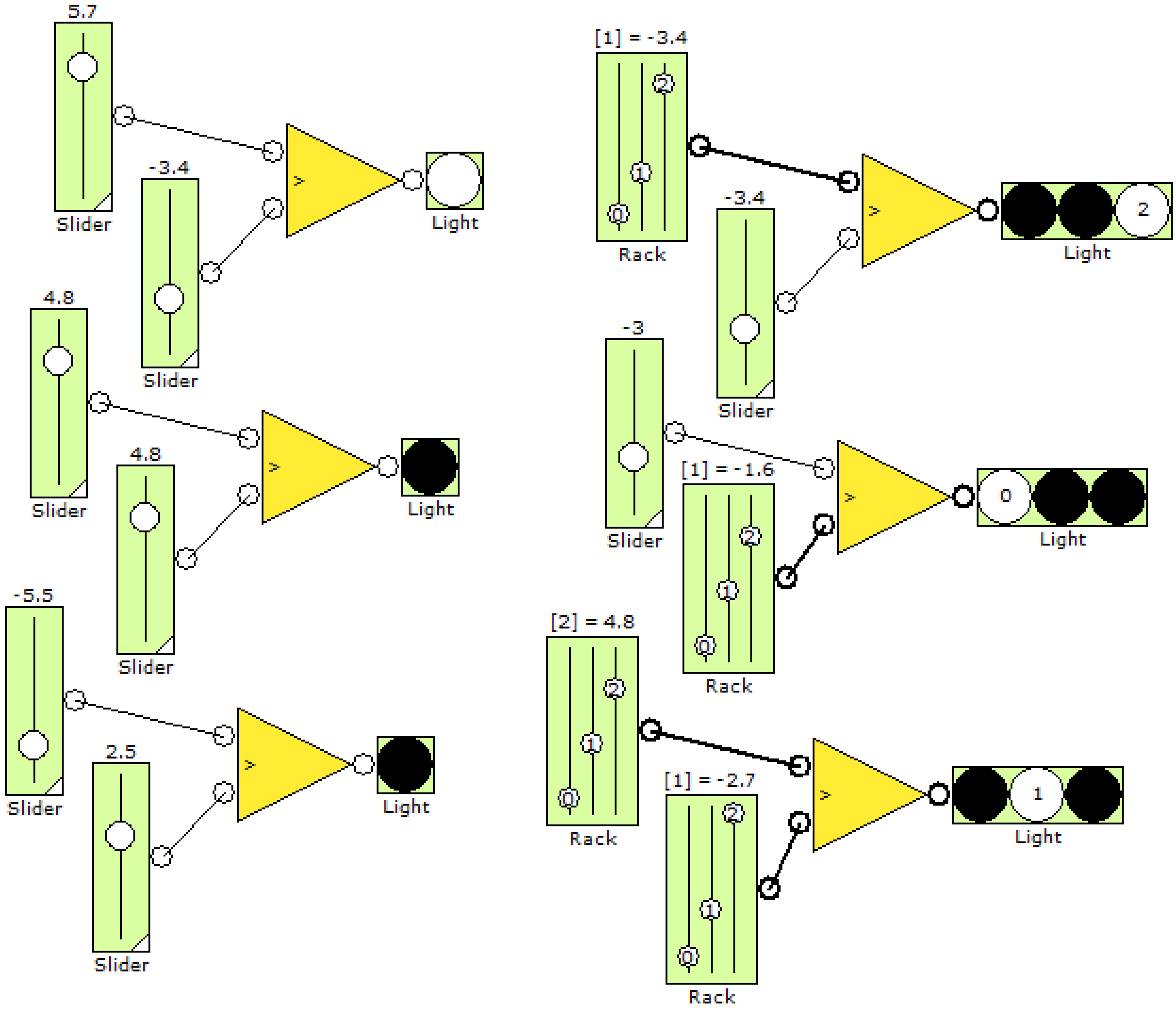
The =0 component returns true if the input value is equal to zero. Input can be scalar or an array.

Functions - column 4



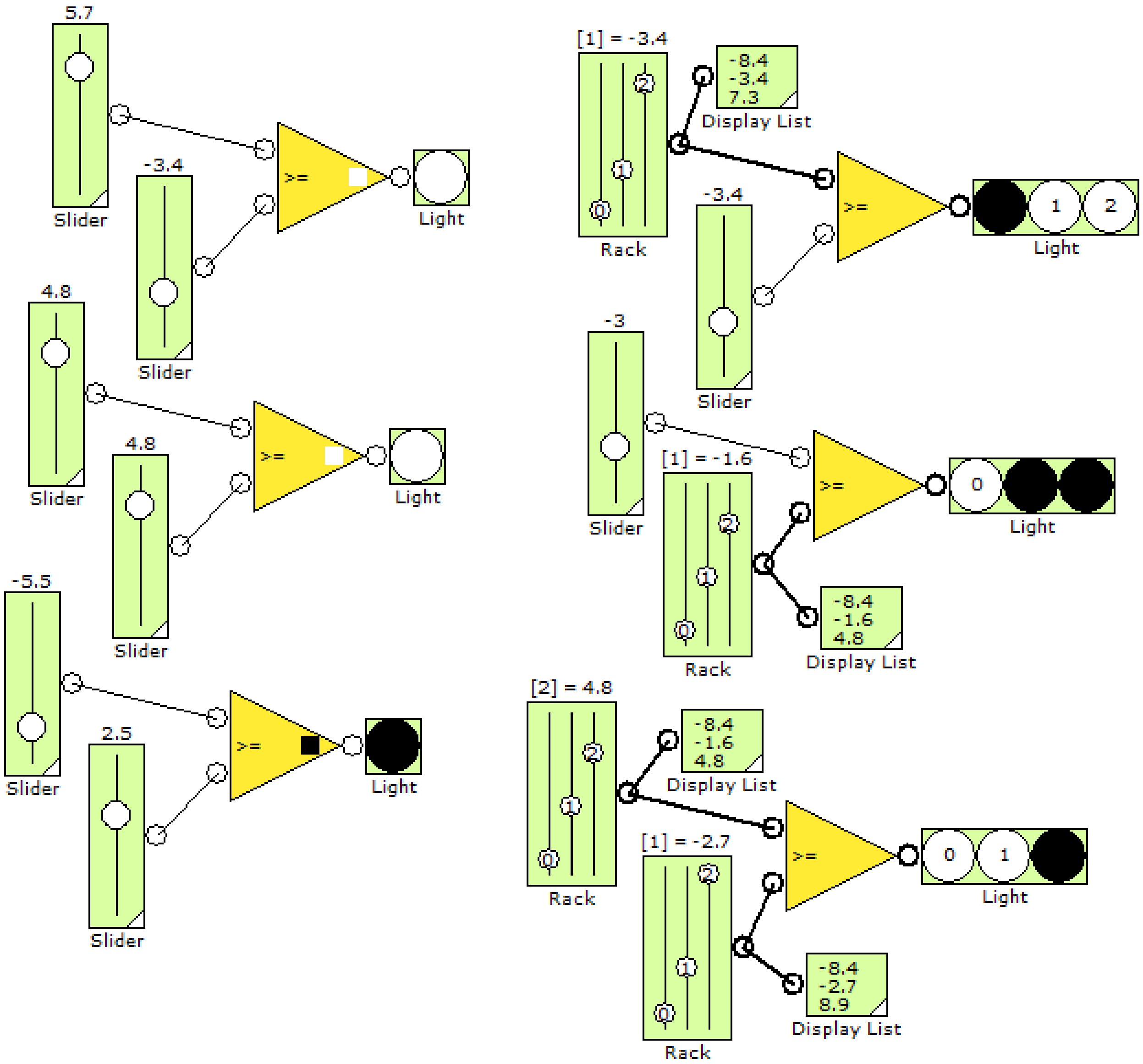
>   (greater than)

The > component compares the inputs and returns true if the top value is greater than the top value. Inputs can be scalars or arrays.   Functions - column 4



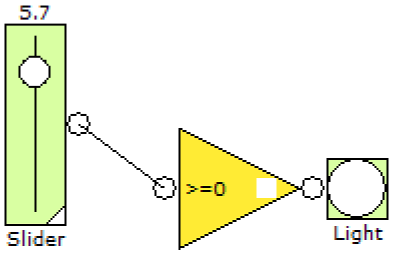
>= (greater or equal to)

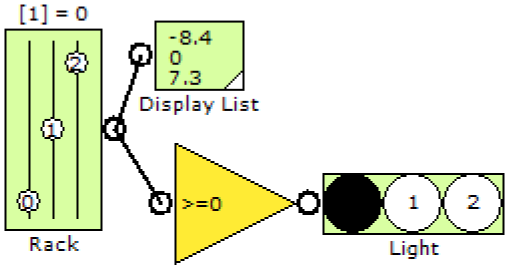
The >= component compares the inputs and returns true if the top value is greater than or equal to the bottom value. Inputs can be scalars or arrays.   Functions - column 4

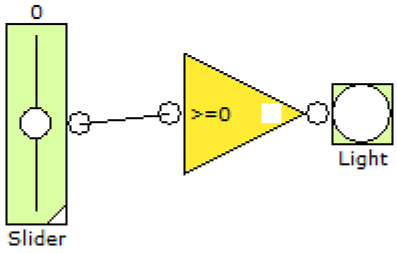


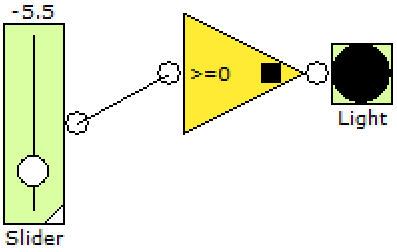
>=0 (greater or equal to zero)

The >=0 component returns true if the input value is greater than or equal to zero. Input can be scalar or an array. Functions - column 4



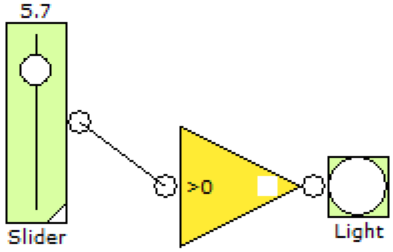


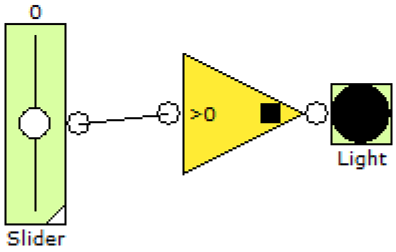


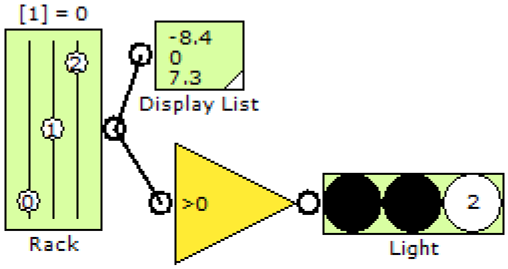


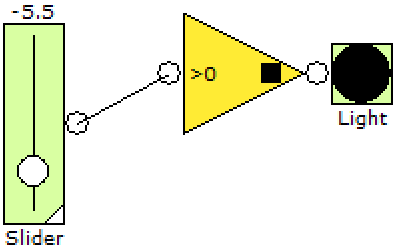
>0   (greater than zero)

The >0 component returns true if the input value is greater than zero. Input can be scalar or an array.
Functions - column 4



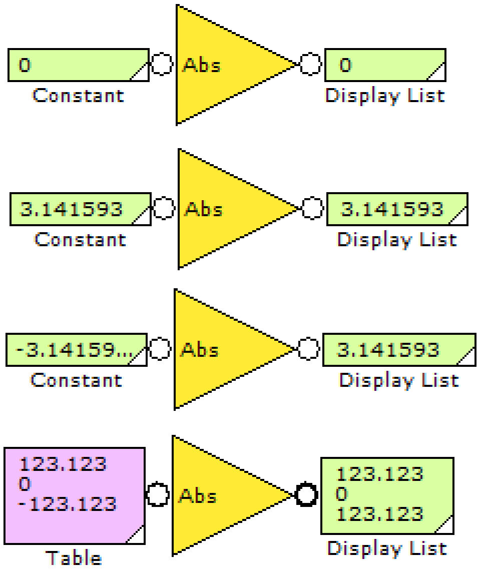






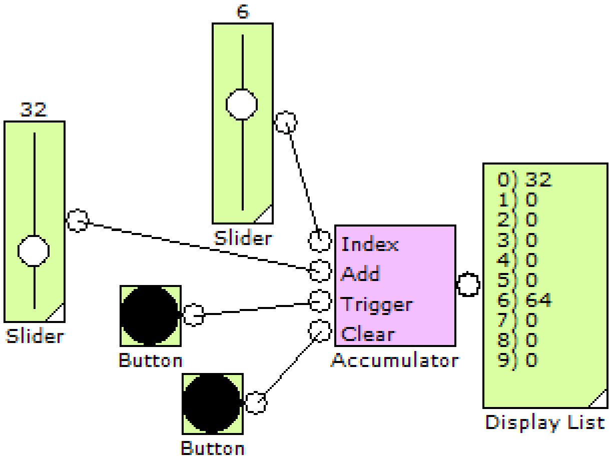
Abs (absolute value)

The Abs component outputs the absolute value of the input value. Input can be scalar or an array.
Functions - column 1



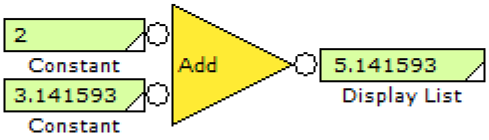
Accumulator

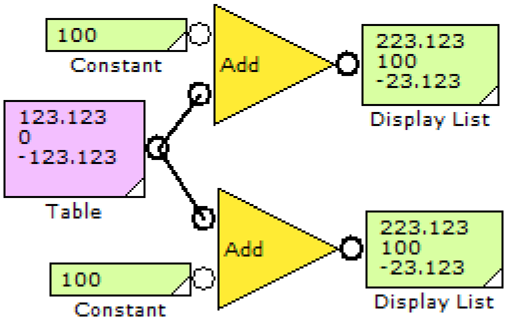
The Accumulator component accumulates data into an internal buffer and outputs the data. When the trigger goes true the value at the Add input is added to the total of the item in the Cell input. The cell number can be the index of any of the items in the array. You can put a negative number at the Add input to decrease the value in the array.   Arrays - column 1

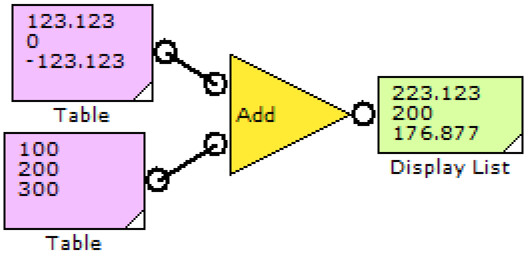


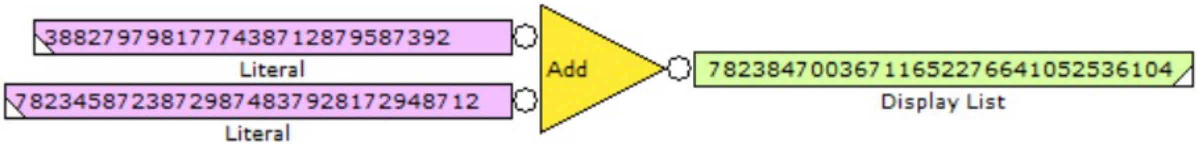
Add

The Add component adds the inputs together. Inputs can be scalar and /or arrays. Functions - column 1



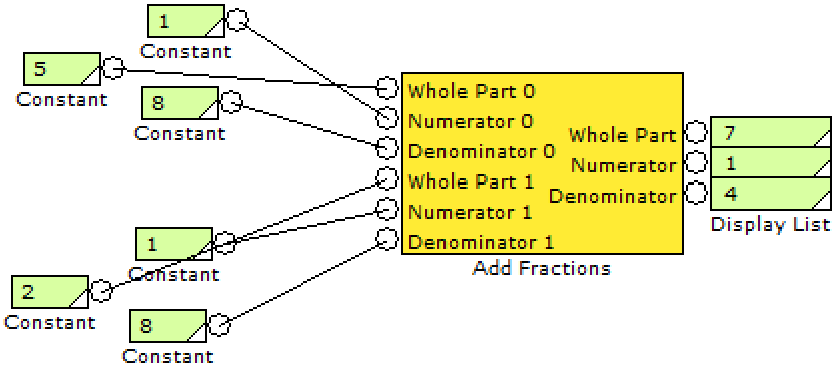


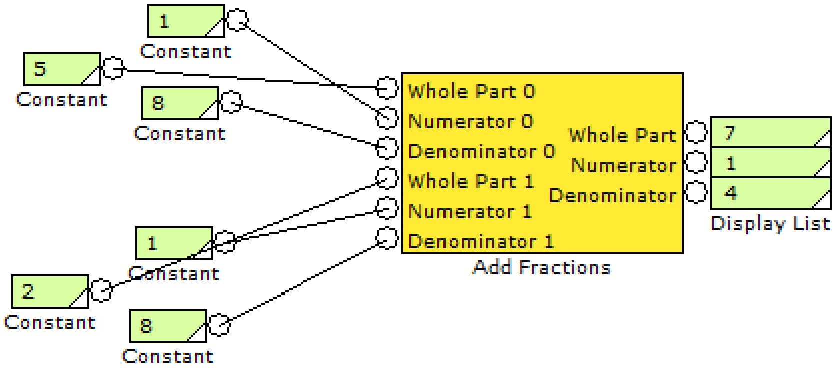




Add Fractions

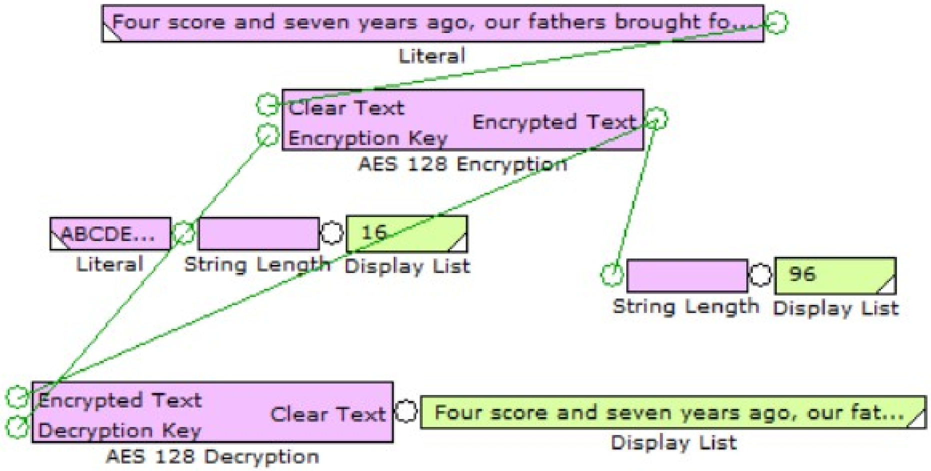
The Add Fractions component adds two numbers with fractions. The output is a whole number with a fraction as needed.   Functions - column 9





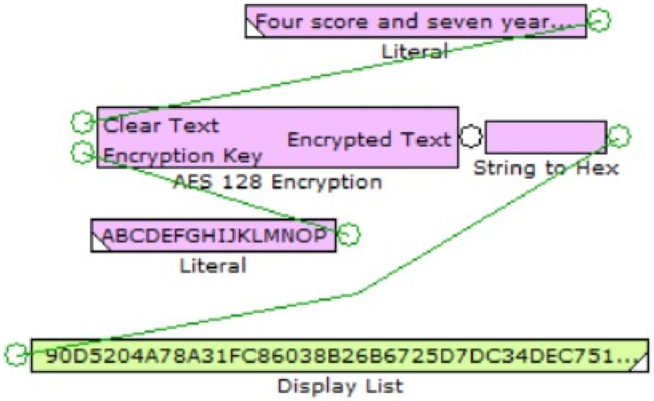
AES 128 Decryption

The AES 128 Decryption component decrypts the input string using AES 128 bit decryption. Arrays – column 5



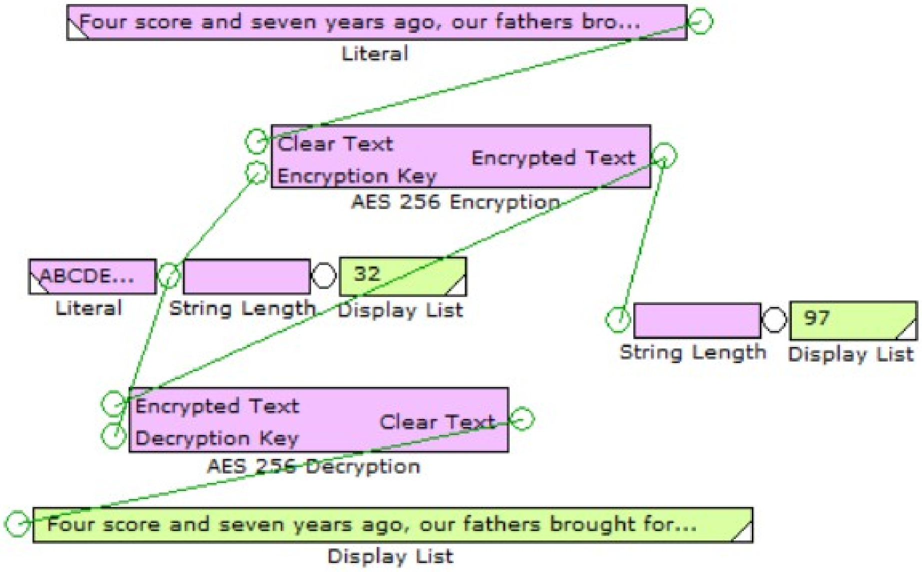
AES 128 Encryption

The AES 128 Encryption component encrypts the input string using AES 128 bit encryption. Arrays – column 5



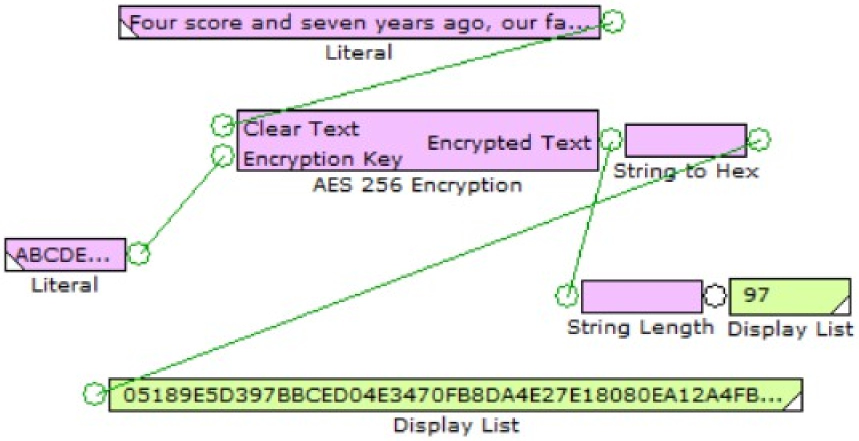
AES 256 Decryption

The AES 256 Decryption component decrypts the input string using AES 256 bit decryption. Arrays – column 5



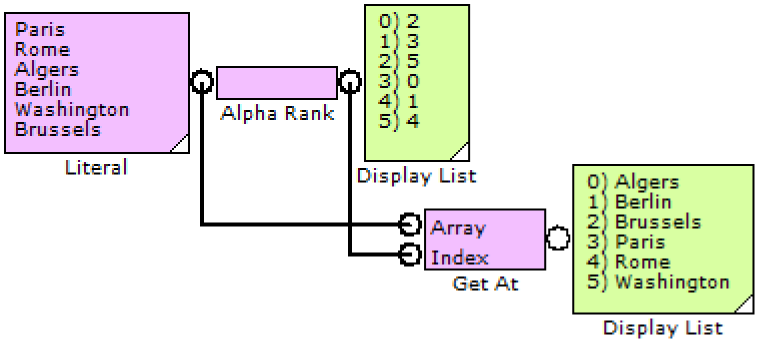
AES 256 Encryption

The AES 256 Encryption component encrypts the input string using AES 256 bit encryption. Arrays – column 5



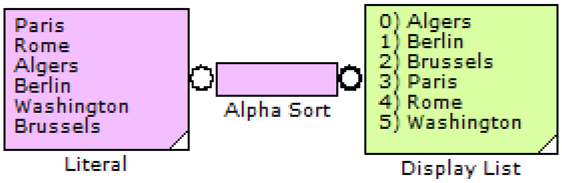
Alpha Rank

The Alpha Rank component outputs a list of numbers in the order of the sorted alpha numerical input.
Arrays - column 6



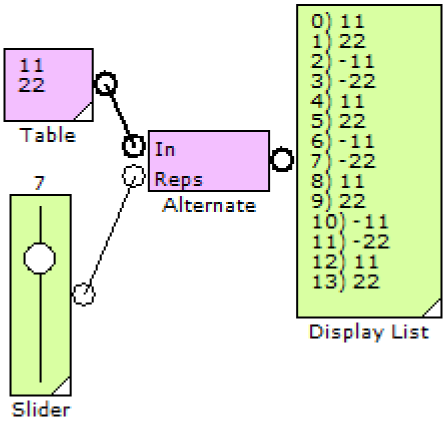
Alpha Sort

The Alpha Sort component sorts the input strings into alpha numerical order. Arrays - column 6



Alternate

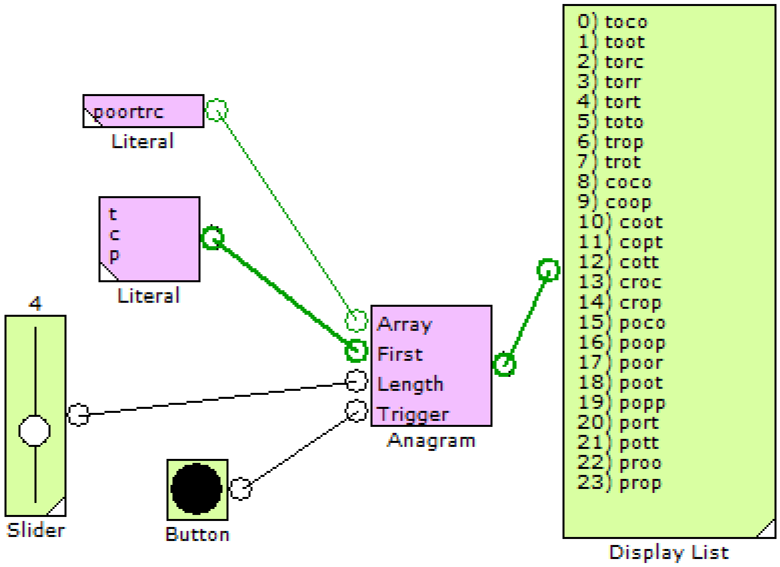
The Alternate component outputs the input alternated in sign repeatedly.   Arrays - column 3



```
0) 11
1) 22
2) -11
3) -22
4) 11
5) 22
6) -11
7) -22
8) 11
9) 22
10) -11
11) -22
12) 11
13) 22
```

Anagram

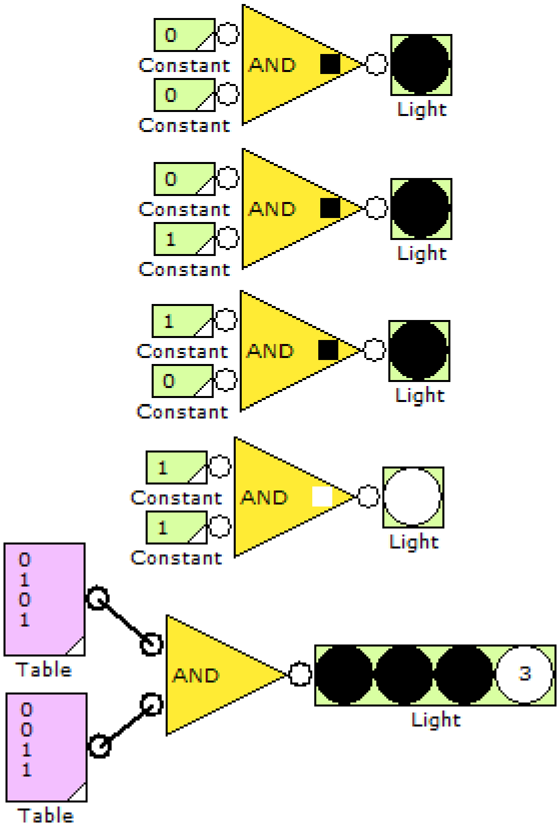
The Anagram lists anagrams of the input letters. Set Trigger to true to generate the list.



```
0) toco
1) toot
2) torc
3) torr
4) tort
5) toto
6) trop
7) trot
8) coco
9) coop
10) coot
11) copt
12) cott
13) croc
14) crop
15) poco
16) poop
17) poor
18) poot
19) popp
20) port
21) pott
22) proo
23) prop
```

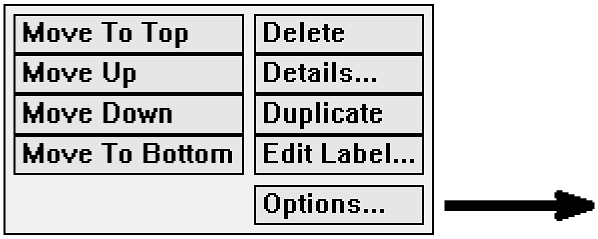
AND

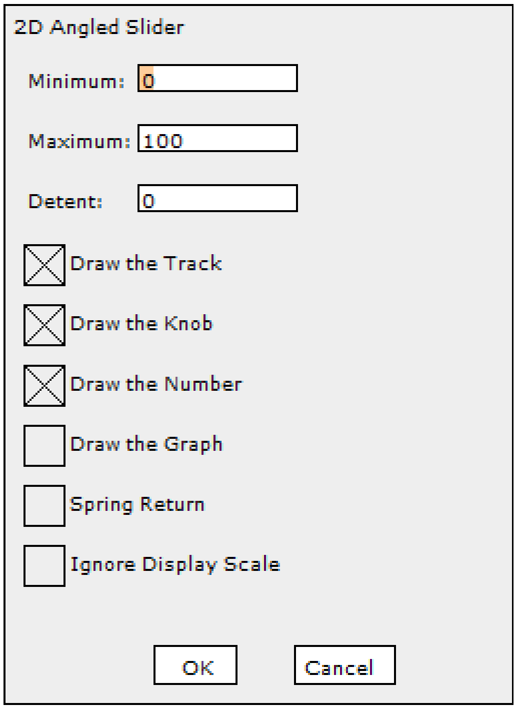
The AND component compares the inputs and returns true if both values are true. Inputs can be scalars or arrays.   Functions - column 3



2D Angled Slider

The 2D Angled Slider component outputs a number based on its dial position.   Controls - column 1




2D Angled Slider

Minimum: 0

Maximum: 100

Detent: 0

☒ Draw the Track

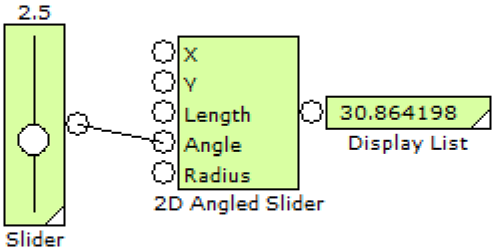
☒ Draw the Knob

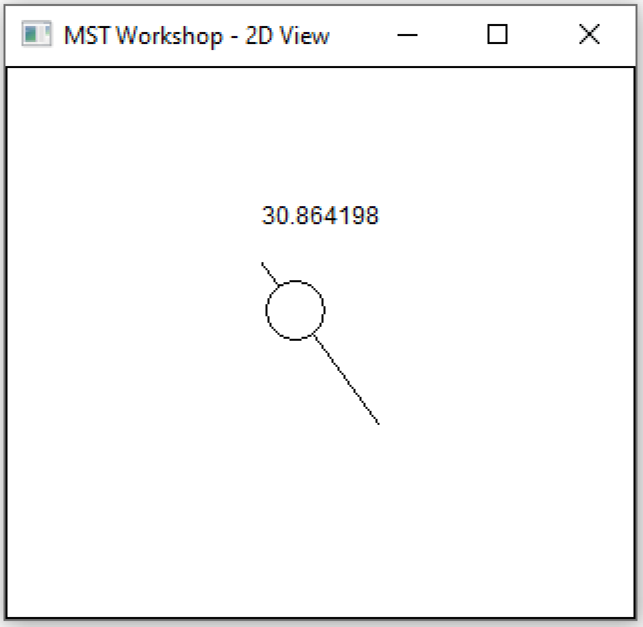
☒ Draw the Number

□ Draw the Graph

□ Spring Return

□ Ignore Display Scale

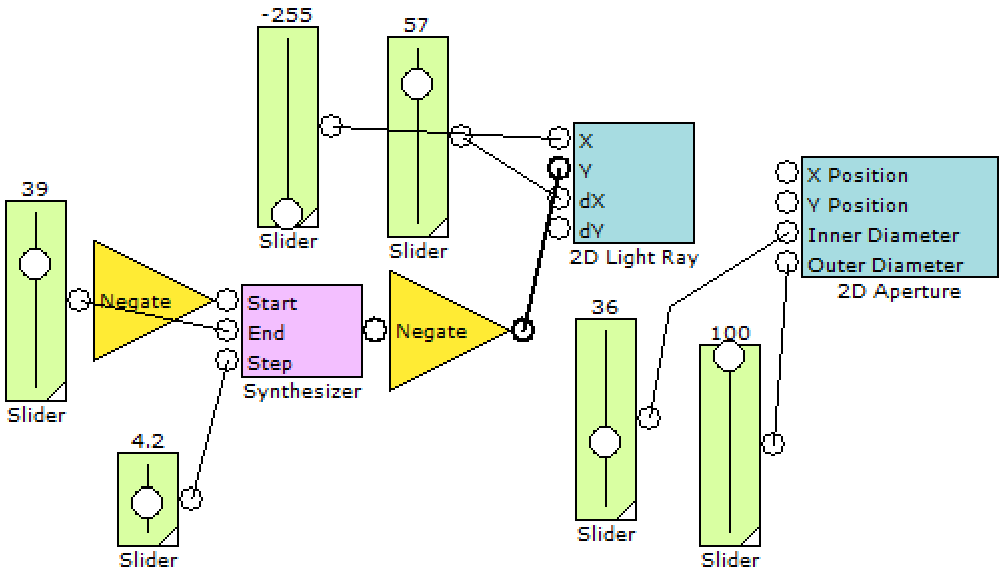


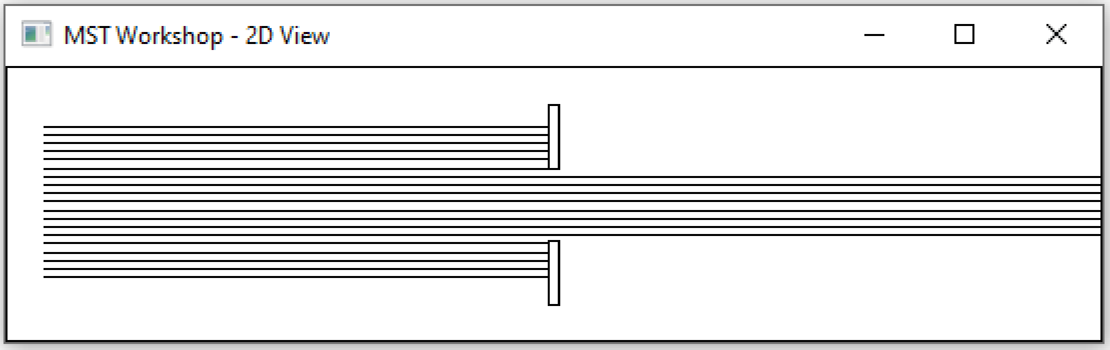

MST Workshop - 2D View

30.864198

2D Aperture

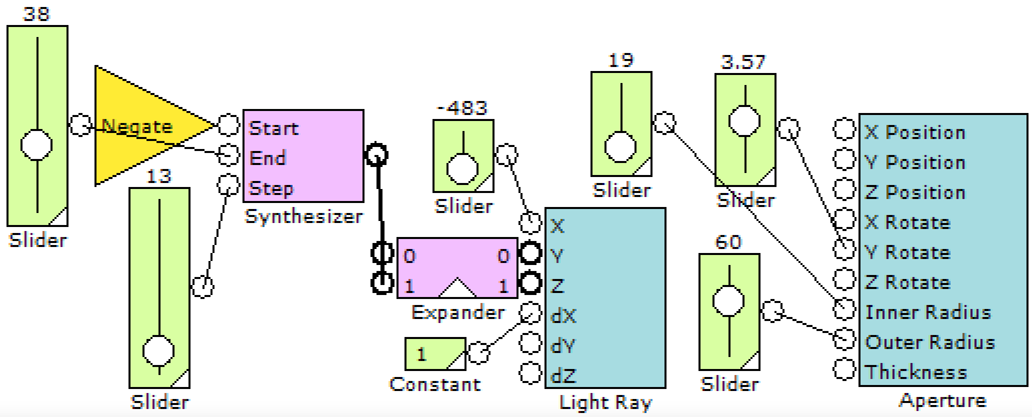
The 2D Aperture component passes some light rays and block others in the 2D view window. The settings determine the size of the opening in the center of the aperture. Light will pass through the center but will be blocked by the rest of the aperture. 2D - column 3

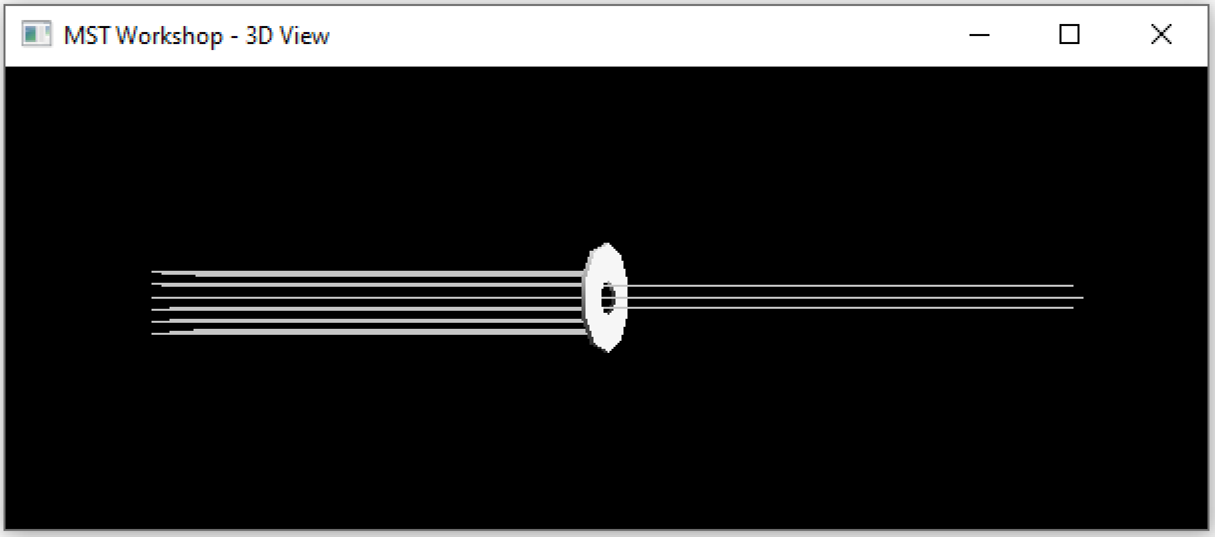




3D Aperture

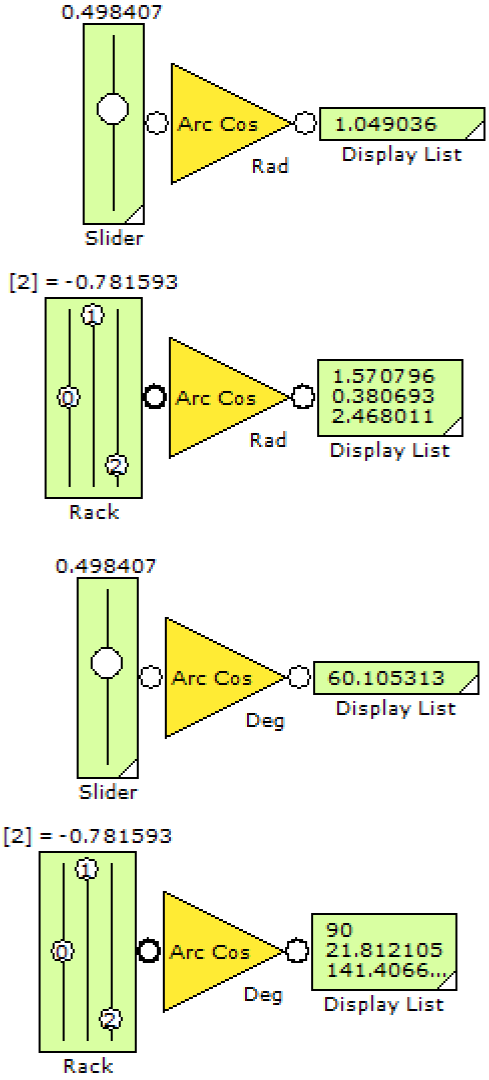
The 3D Aperture component passes some light rays and block others in the 3D view window. The settings determine the size of the opening in the center of the aperture. Light will pass through the center but will be blocked by the rest of the aperture. The Affine [4x4] array input modifies the size, position and orientation of the aperture.   3D - column 5





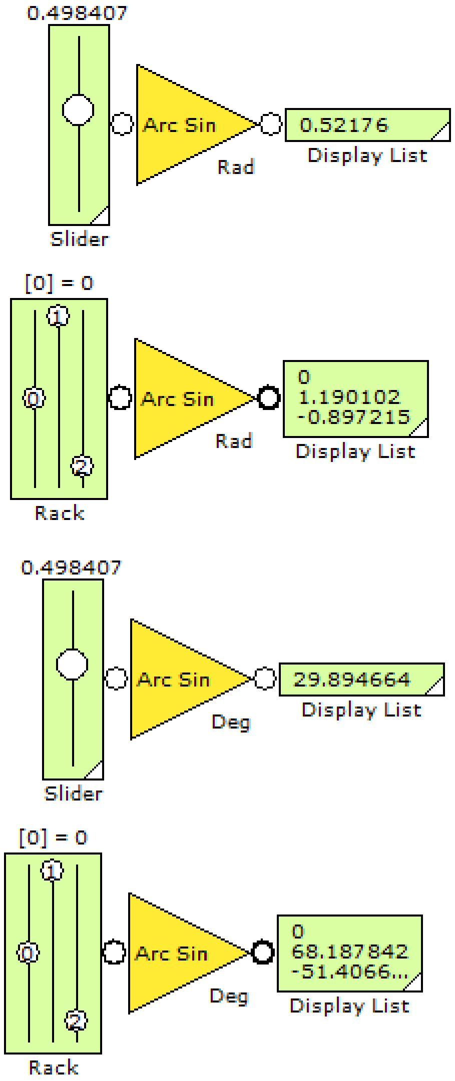
Arc Cos

The Arc Cos component calculates (in radians or degrees) the inverse trigonometric cosine of the input. Input can be scalar or an array.   Functions - column 5



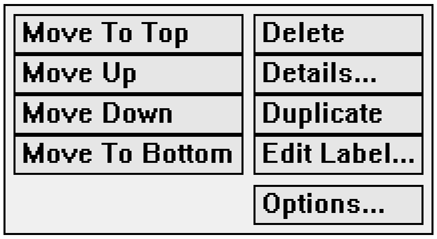
Arc Sin

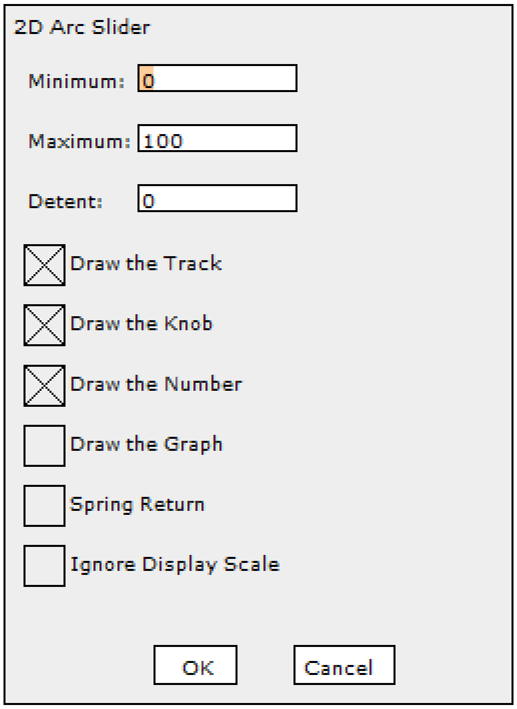
The Arc Sin component calculates (in radians or degrees) the inverse trigonometric sine of the input. Input can be scalar or an array.   Functions - column 5



2D Arc Slider

The 2D Arc Slider component outputs a number based on its dial position. Controls - column 2




2D Arc Slider

Minimum: 0

Maximum: 100

Detent: 0

☒ Draw the Track

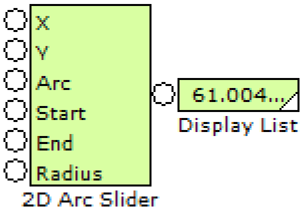
☒ Draw the Knob

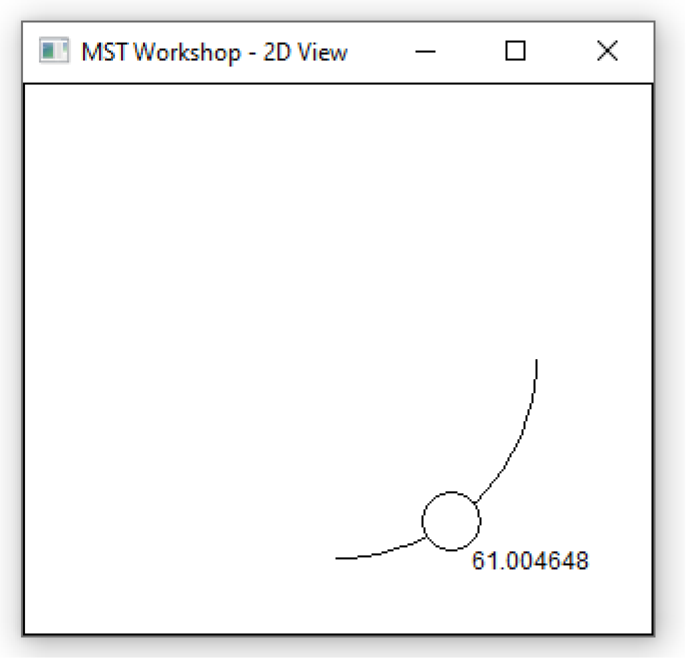
☒ Draw the Number

☐ Draw the Graph

☐ Spring Return

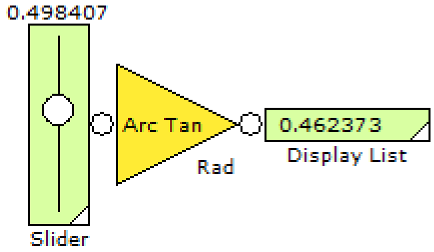
☐ Ignore Display Scale

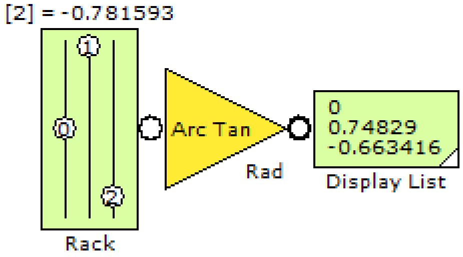


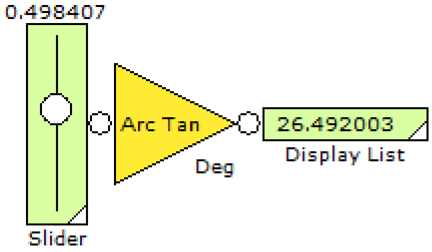


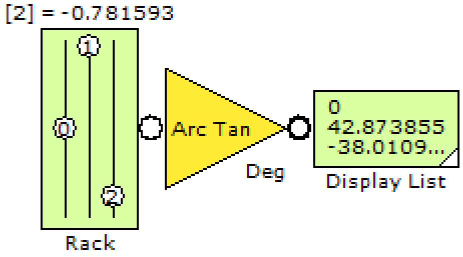
Arc Tan

The Arc Tan component calculates (in radians or degrees) the inverse trigonometric tangent of the input. Input can be scalar or an array.   Functions - column 5



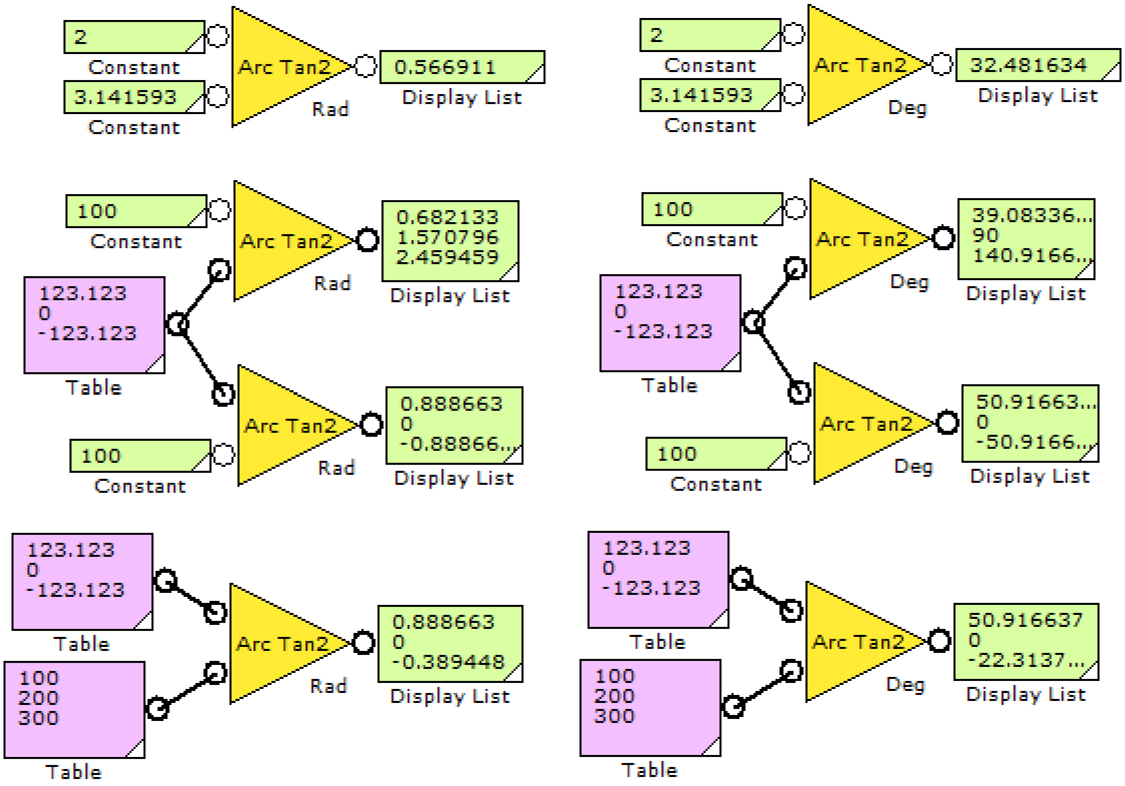






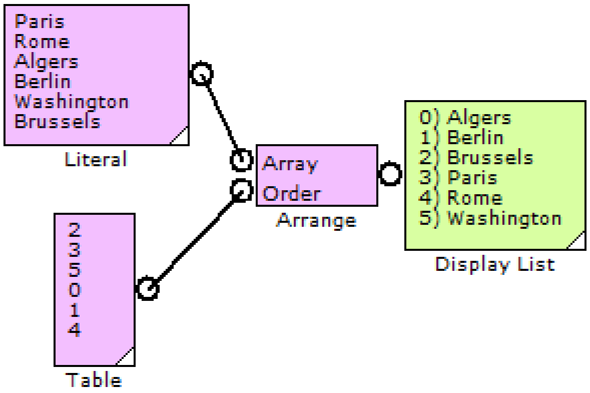
Arc Tan2

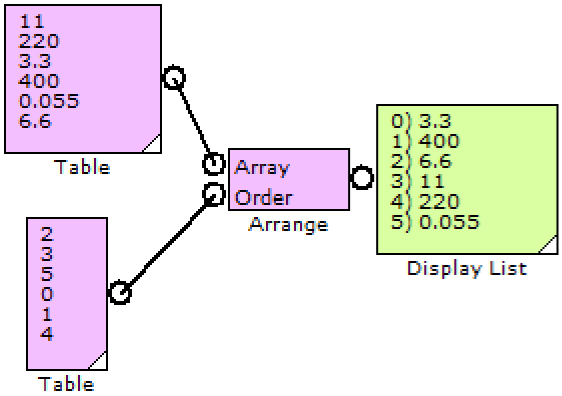
The Arc Tan2 component calculates (in radians or degrees) the inverse trigonometric tangent of the inputs after dividing them. Inputs can be scalar or arrays.   Functions - column 5



Arrange

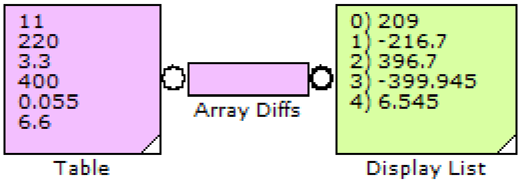
The Arrange component rearranges the input array values based on the array connected to the Order input.   Arrays - column 2





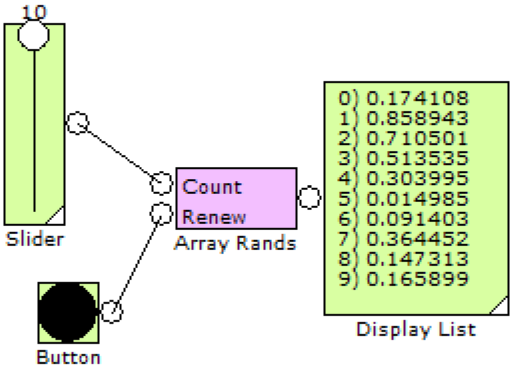
Array Diffs

The Array Diffs component creates an array from the differences in the input array.   Arrays - column 3



Array Rands

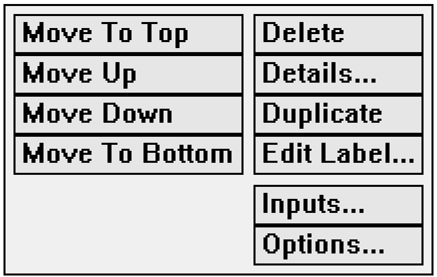
The Array Rands component creates an array of random numbers between 0.0 and 1.0. If connected the Renew input provides a new array of random numbers.   Arrays - column 3

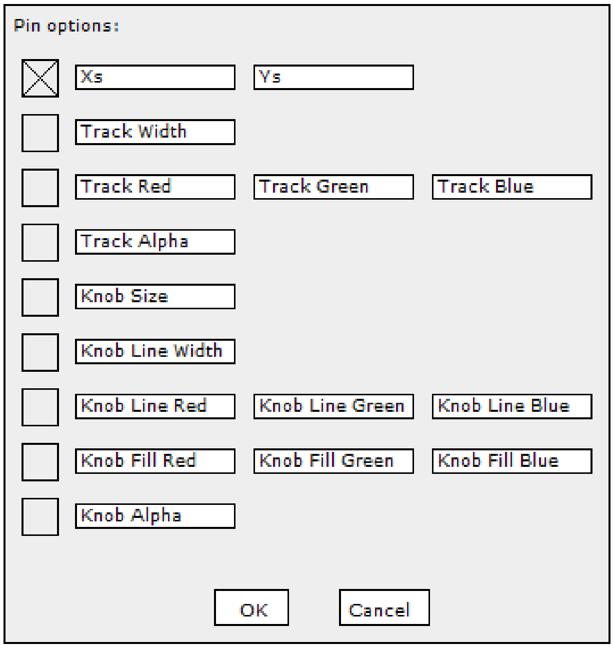


```
0) 0.174108
1) 0.858943
2) 0.710501
3) 0.513535
4) 0.303995
5) 0.014985
6) 0.091403
7) 0.364452
8) 0.147313
9) 0.165899
```

2D Array Slider

The 2D Array Slider gives you a control that is an array of XY points on 2D canvas. The output(s) are integer positions of the slider(s).   Controls - column 1





Pin options:

☒ Xs Ys

□ Track Width

□ Track Red Track Green Track Blue

□ Track Alpha

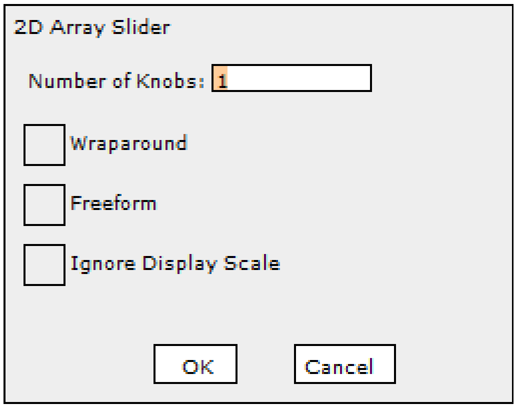
□ Knob Size

□ Knob Line Width

□ Knob Line Red Knob Line Green Knob Line Blue

□ Knob Fill Red Knob Fill Green Knob Fill Blue

□ Knob Alpha



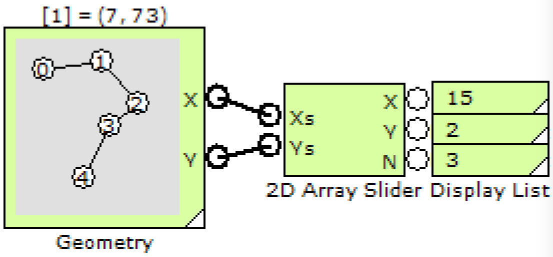
2D Array Slider

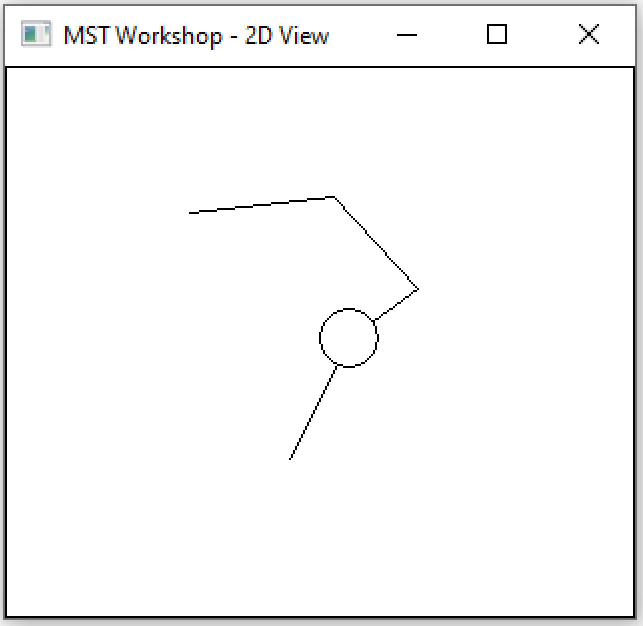
Number of Knobs: 1

□ Wraparound

□ Freeform

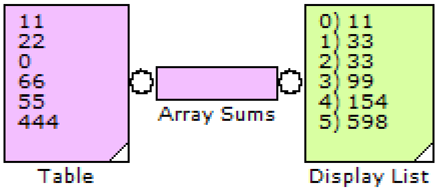
□ Ignore Display Scale





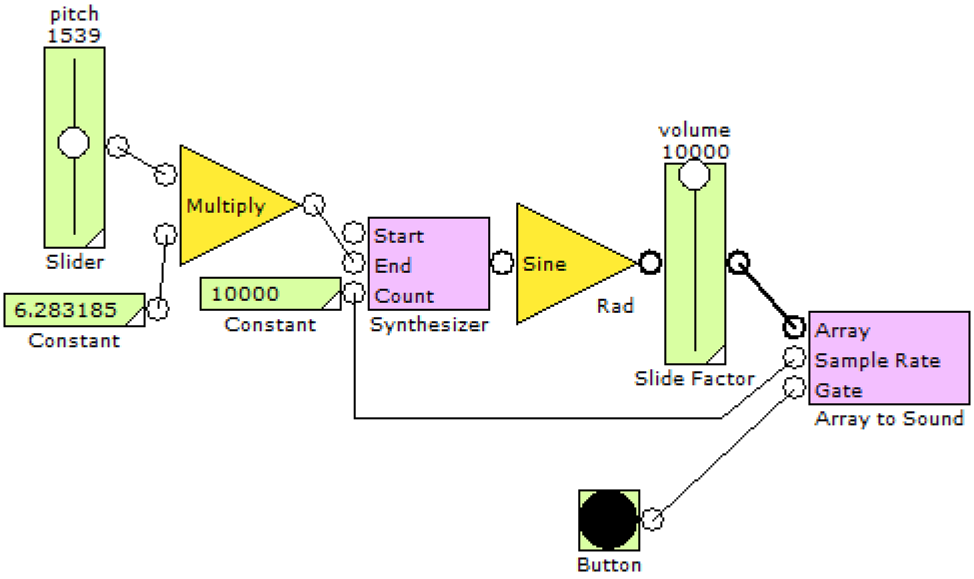
Array Sums

The Array Sums component creates an array from the sums of the input array. Arrays - column 3



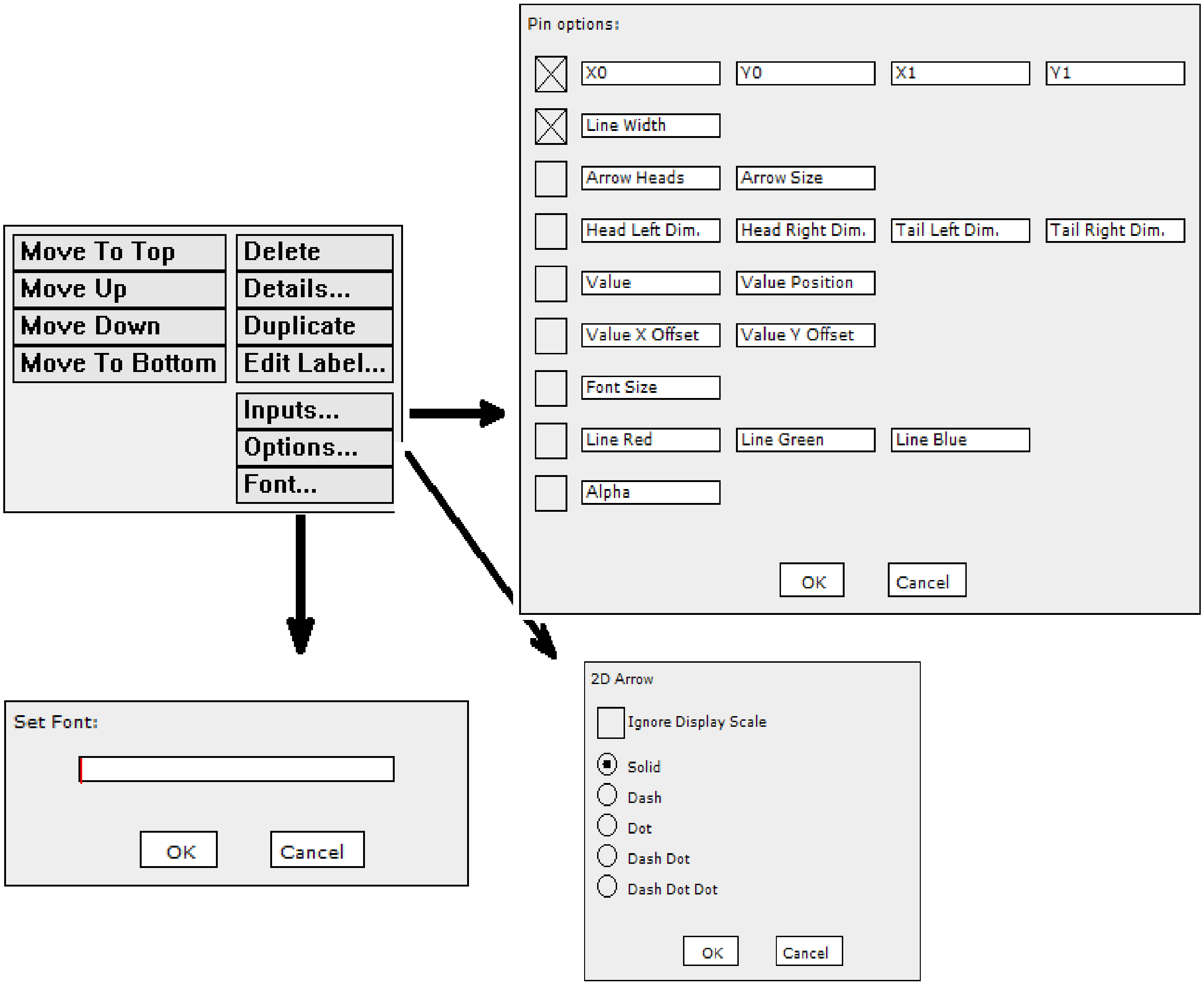
Array to Sound

The Array to Sound component sends the array at the input to the system speaker. Arrays - column 7



2D Arrow

The 2D Arrow component draws one or more arrows on the 2D canvas.   2D - column 1



Pin options:

☒ X0 Y0 X1 Y1

☒ Line Width

□ Arrow Heads Arrow Size

□ Head Left Dim. Head Right Dim. Tail Left Dim. Tail Right Dim.

□ Value Value Position

□ Value X Offset Value Y Offset

□ Font Size

□ Line Red Line Green Line Blue

□ Alpha

OK Cancel

Set Font:

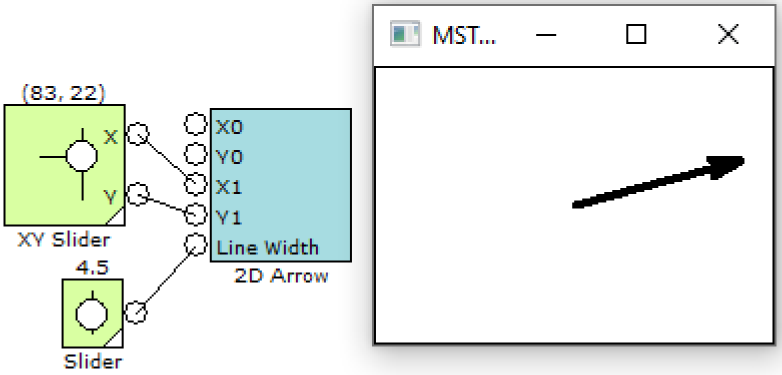
OK Cancel

2D Arrow

□ Ignore Display Scale

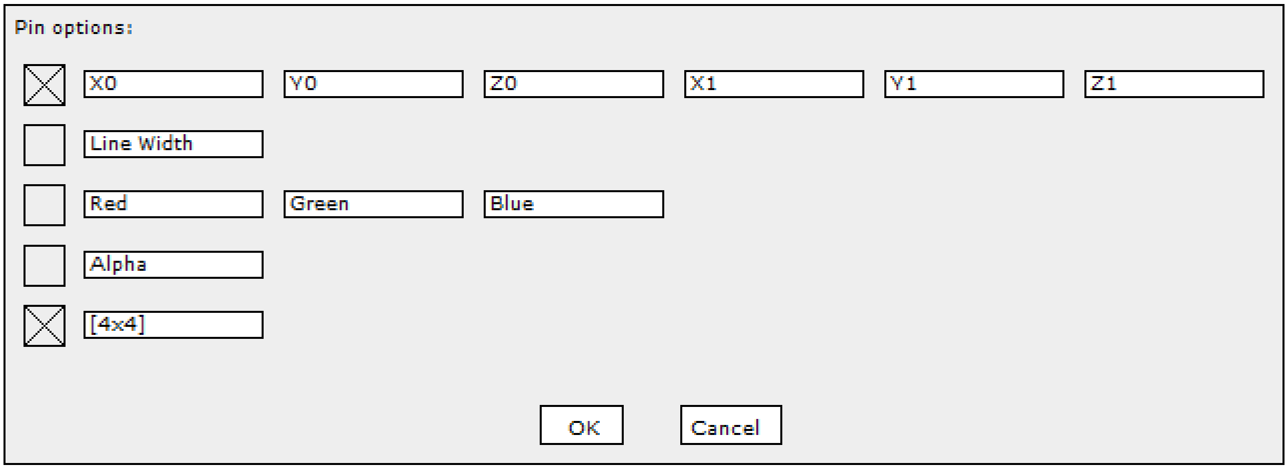
● Solid
○ Dash
○ Dot
○ Dash Dot
○ Dash Dot Dot

OK Cancel



3D Arrow

The 3D Arrow component draws multiple arrows in the 3D view window. The X, Y, and Z inputs set the start and end points. The Affine [4x4] array input modifies the size, position and orientation.3D - column 4



Pin options:

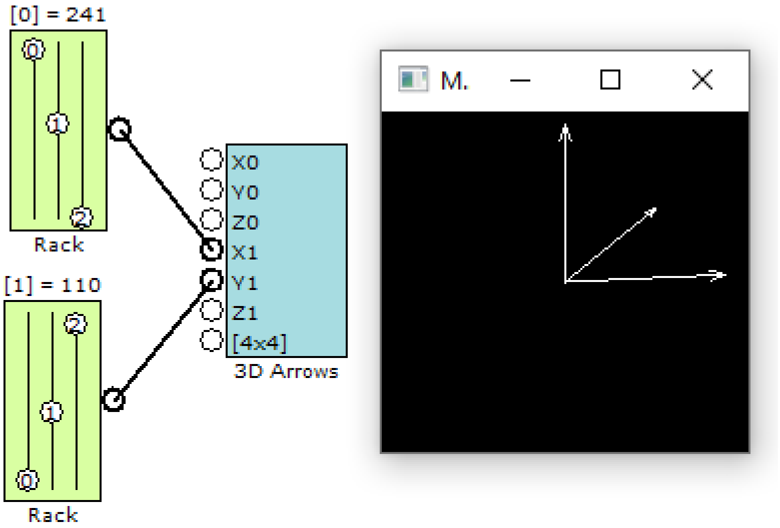
☒ X0 Y0 Z0 X1 Y1 Z1

☐ Line Width

☐ Red Green Blue

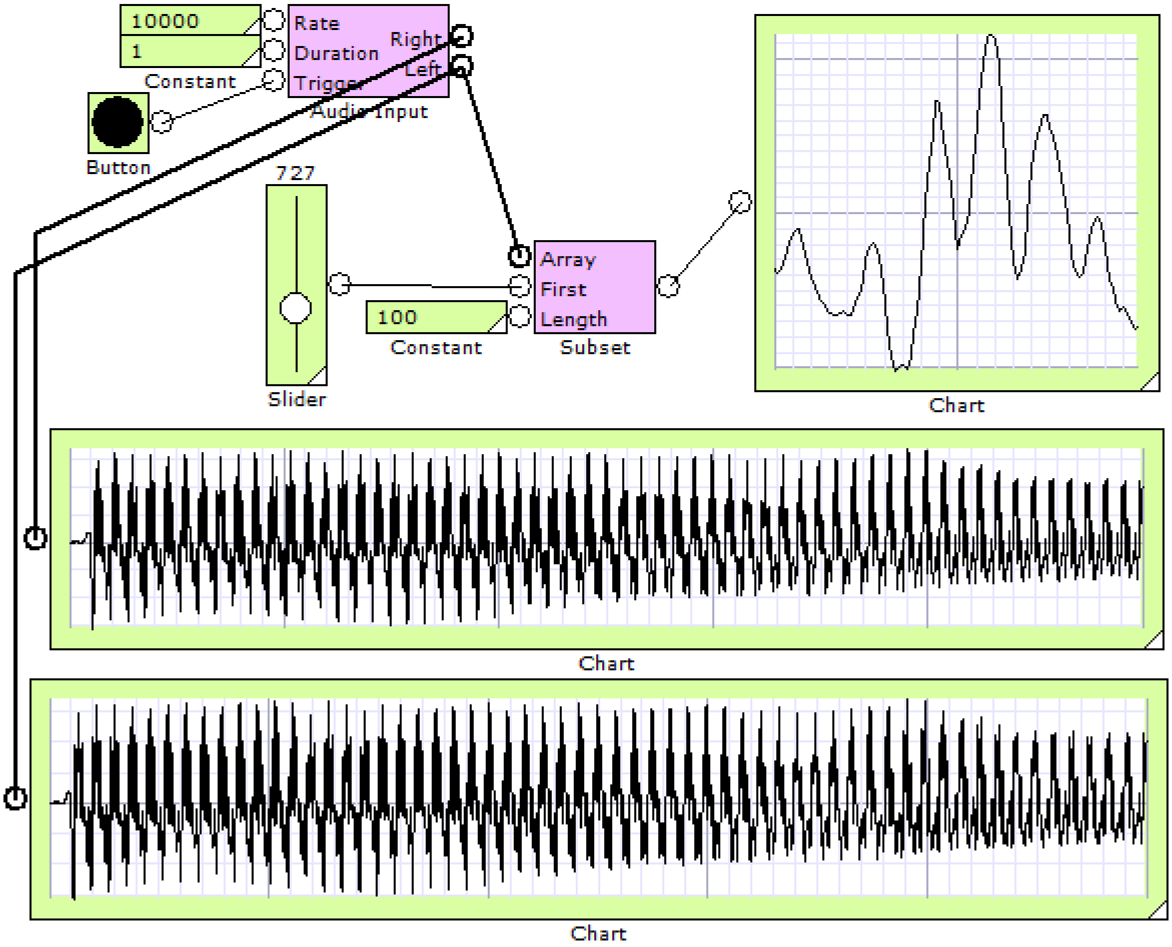
☐ Alpha

☒ [4x4]



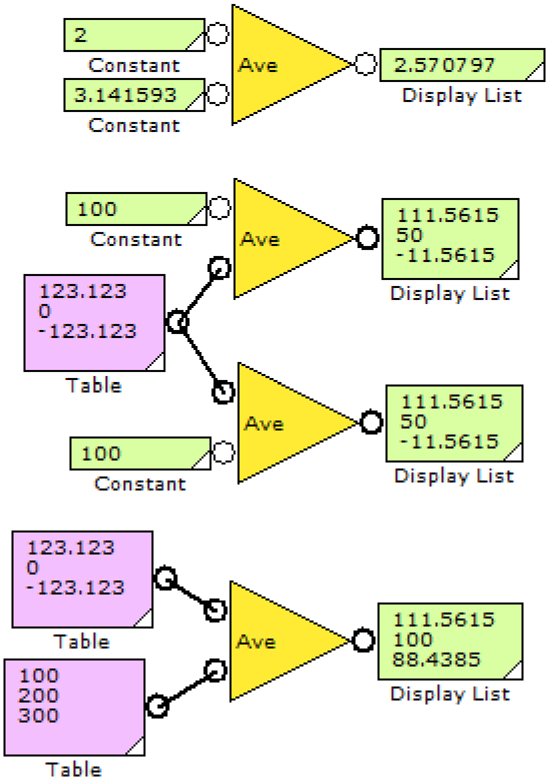
Audio Input

The Audio Input component reads the default audio input channel. Arrays - column 7



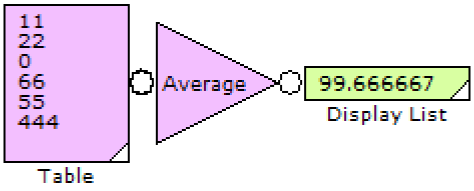
Ave

The Ave component outputs the average of the inputs. Inputs can be scalars or arrays.   Functions - column 2



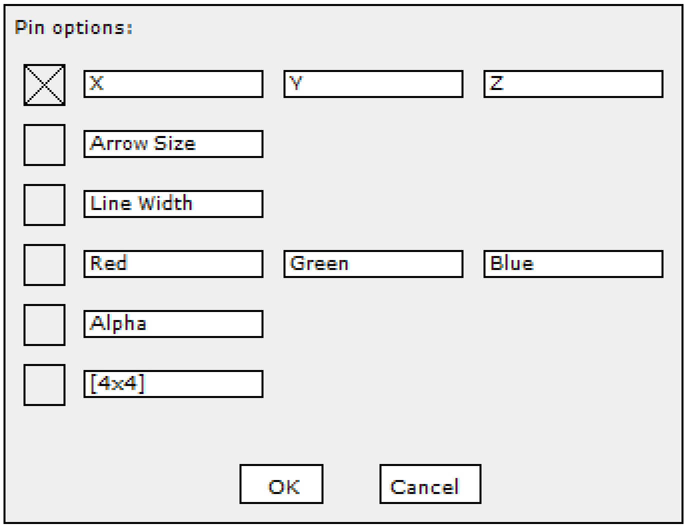
Average

The Average component scans the input array and averages the values. Arrays - column 3



3D Axis

The 3D Axis draws an X, Y, Z axis in the 3D view window. The Affine [4x4] array input modifies the size, position and orientation.3D - column 4



Pin options:

☒ X Y Z

□ Arrow Size

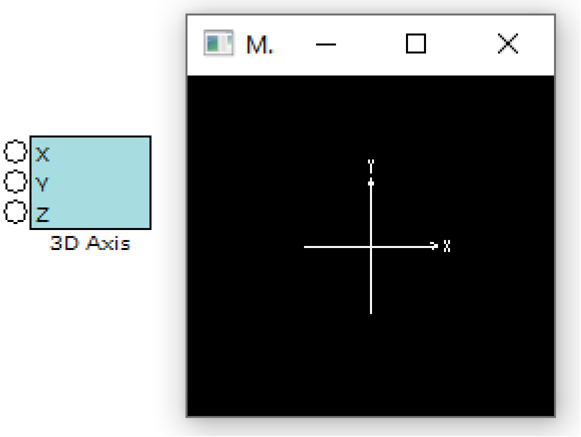
□ Line Width

□ Red Green Blue

□ Alpha

□ [4x4]

OK Cancel

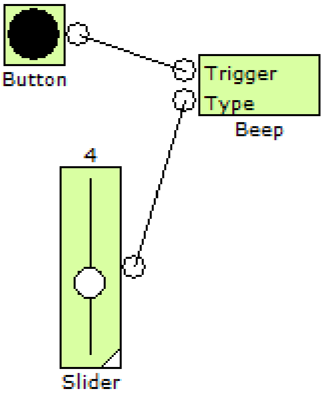


Beep

The Beep component plays the sound of one of the system beeps. The code ranges from 0 to 8.

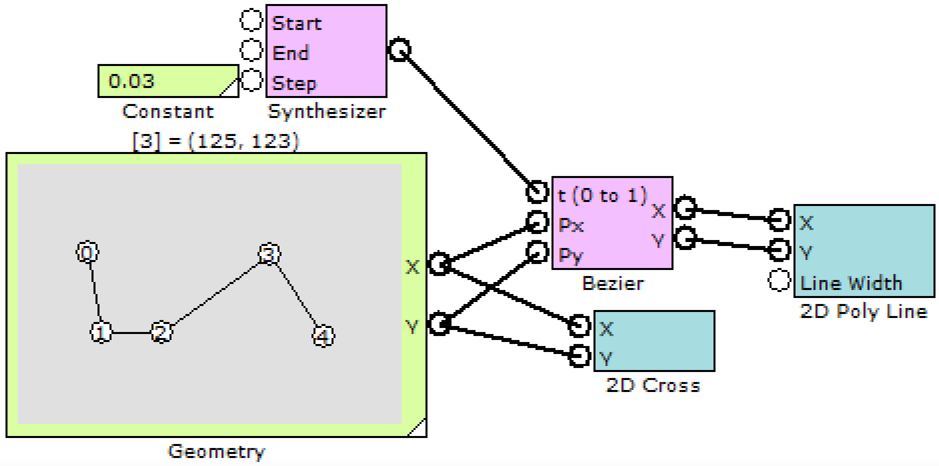
0 = MB_OK
1 = MB_ICONASTERISK
2 = MB_ICONEXCLAMATION
3 = MB_ICONERROR
4 = MB_ICONHAND
5 = MB_ICONINFORMATION
6 = MB_ICONQUESTION
7 = MB_ICONSTOP
8 = MB_ICONWARNING

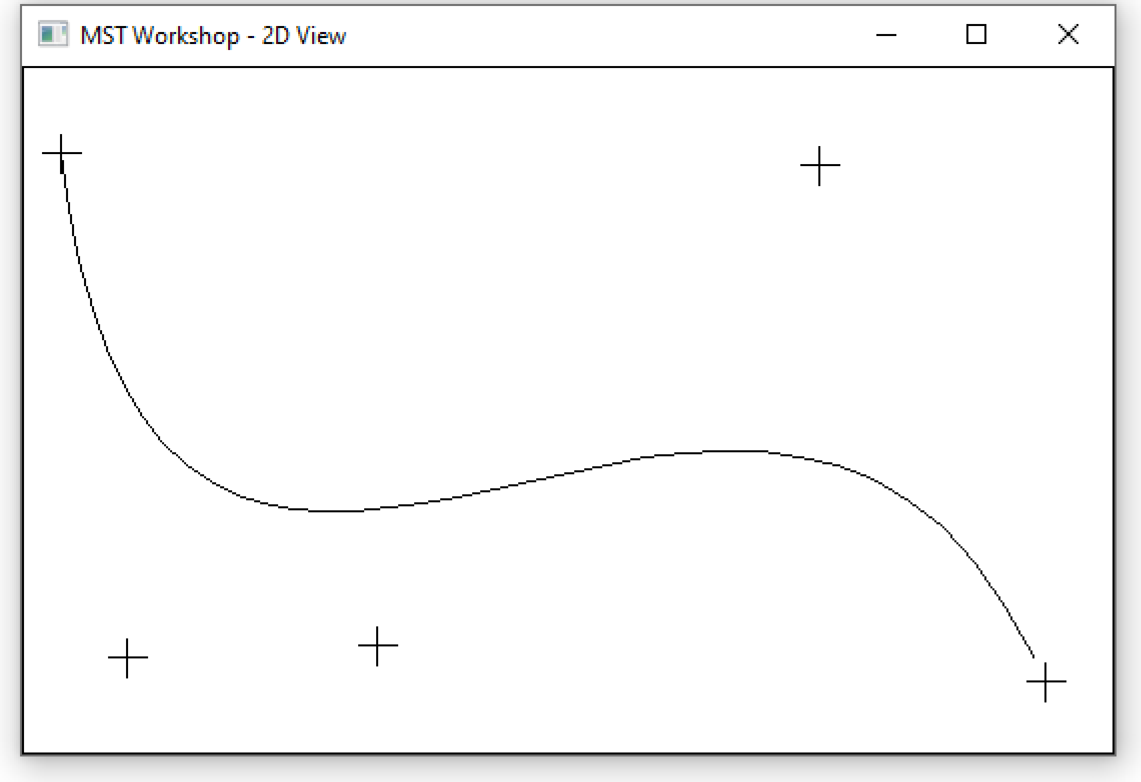
Controls - column 4



Bezier

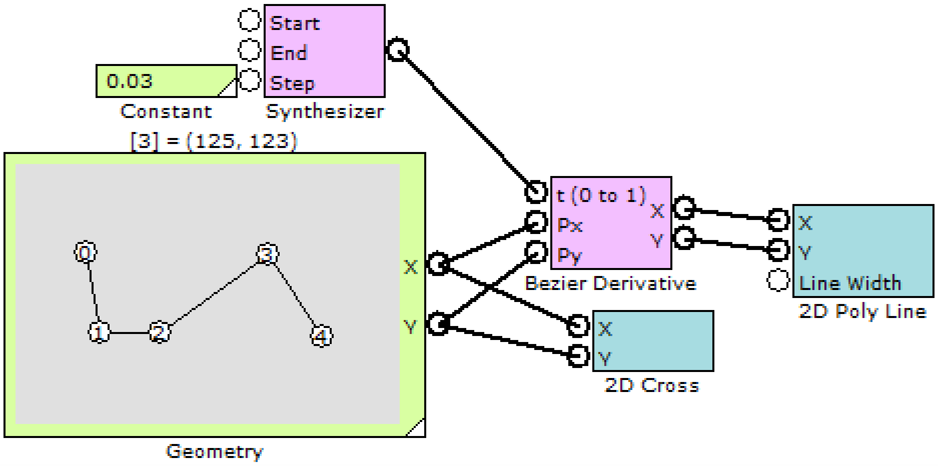
The Bezier component interpolates a Bezier curve based on up to 10 input points. It outputs the X and Y value(s) at the positions given by t, ranging from 0 to 1. Arrays - column 4

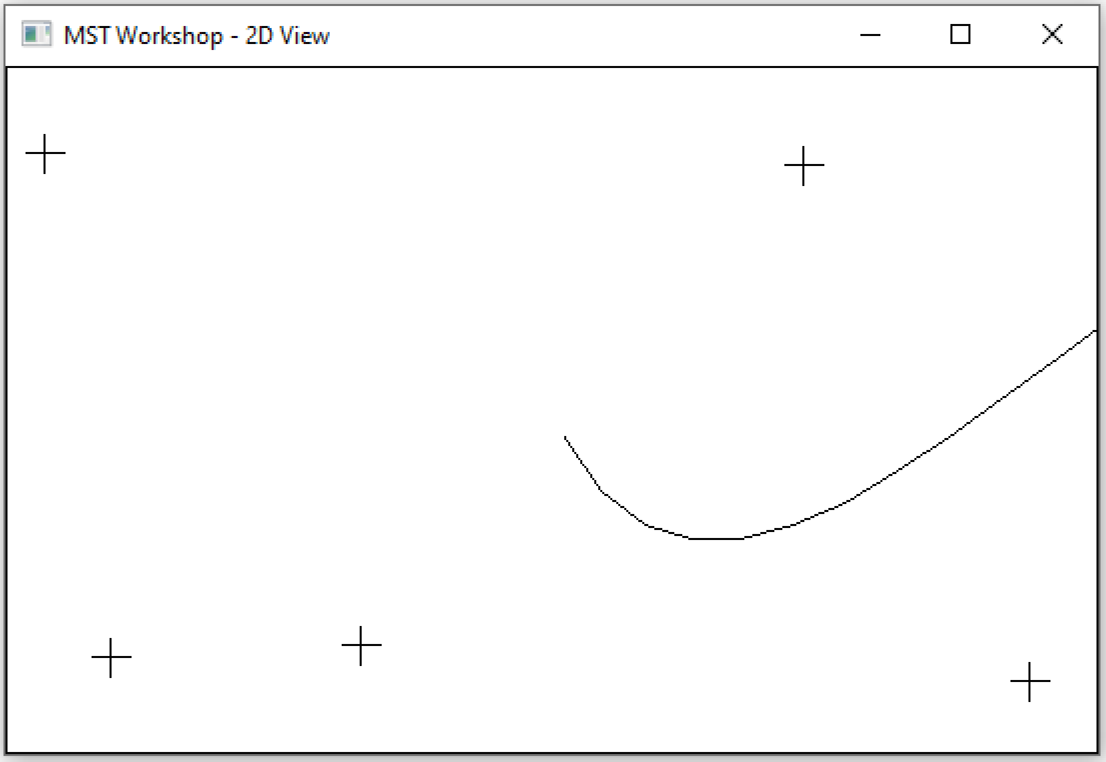




Bezier Derivative

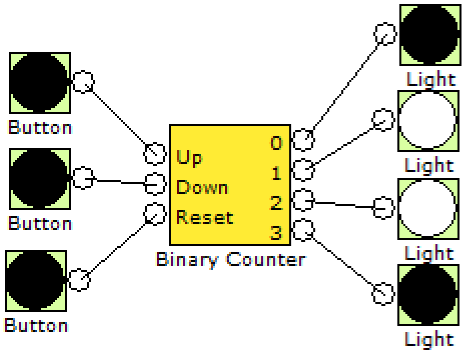
The Bezier Derivative component interpolates a Bezier's Derivative curve based on up to 10 input points. It outputs the X and Y value(s) at the positions given by t, ranging from 0 to 1.   Arrays - column 4

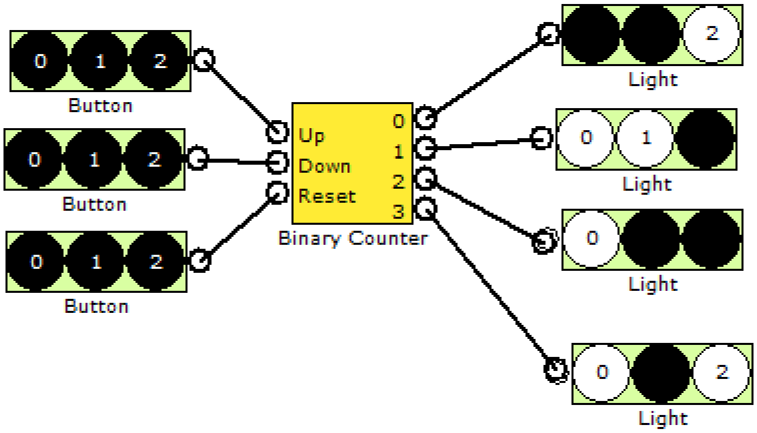


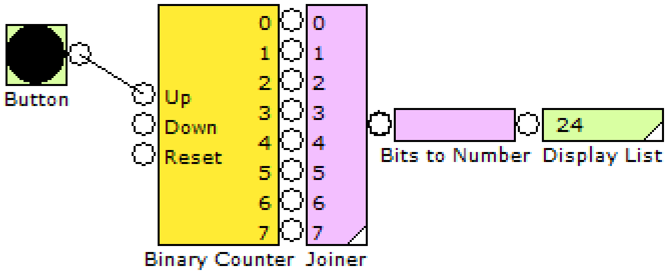


Binary Counter

The Binary Counter component counts up or down and outputs binary bits. You can set the number of outputs desired.   Functions - column 8

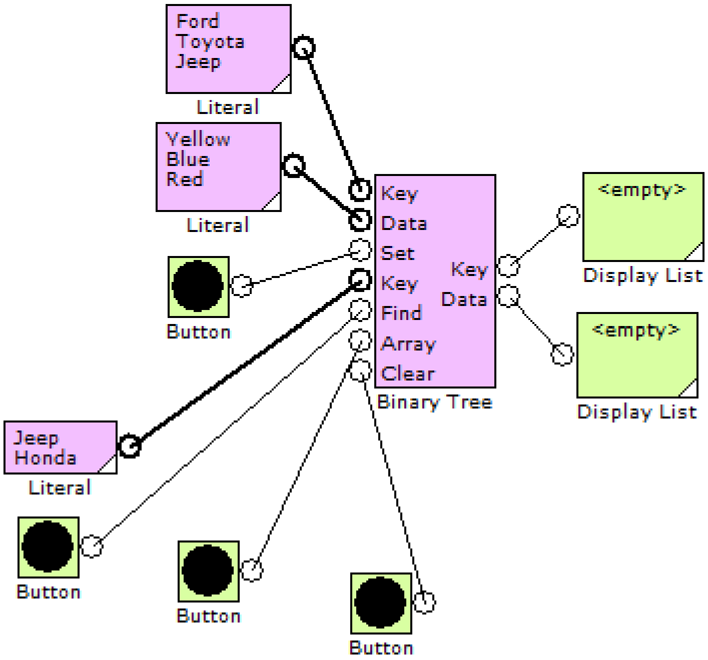






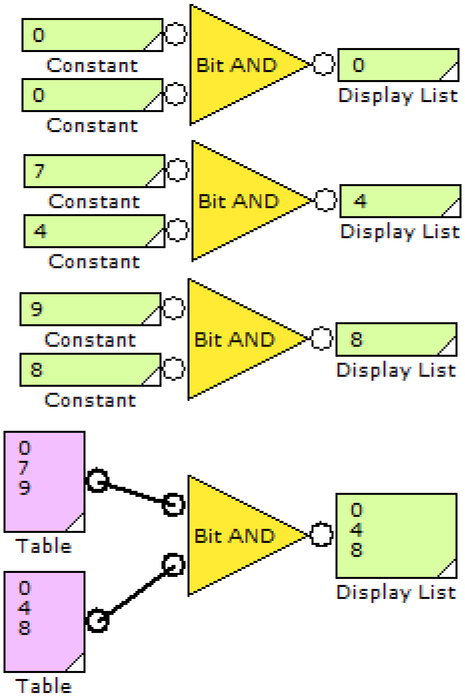
Binary Tree

The Binary Tree can save key/data pairs in a binary tree on Set, then recall the data given the key on Find.   Arrays - column 5



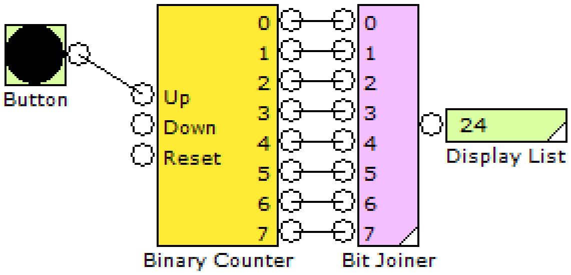
Bit AND

The Bit AND component compares the inputs and returns the result of a bitwise AND process on the inputs Functions - column 3



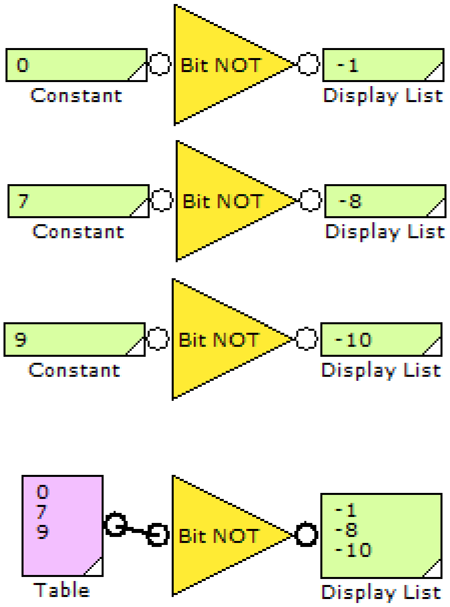
Bit Joiner

The Bit Joiner component joins all the bits for all its inputs into a single output. You can set the number of inputs.   Arrays - column 4



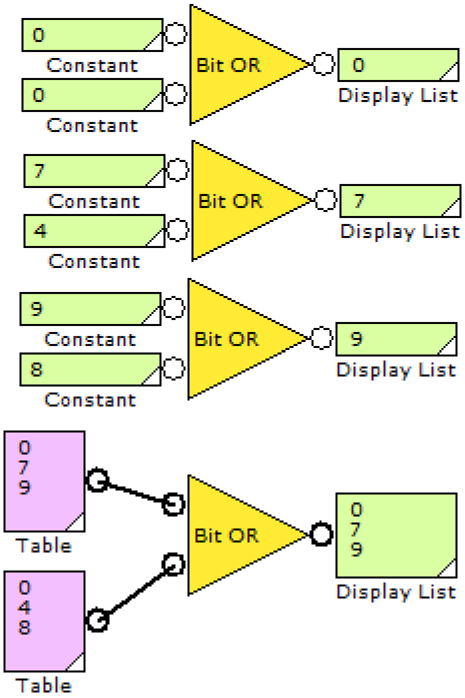
Bit NOT

The Bit NOT component compares the inputs and returns the result of a bitwise inversion process on the input.	Functions - column 3



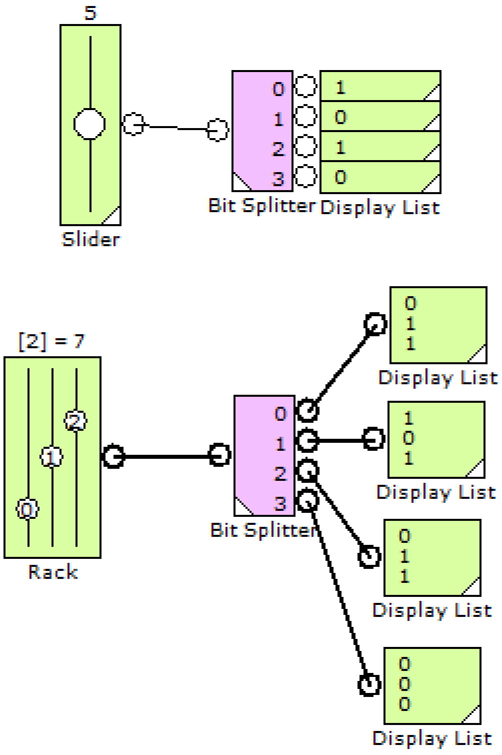
Bit OR

The Bit OR component compares the inputs and returns the result of a bitwise OR process on the inputs. Functions - column 3



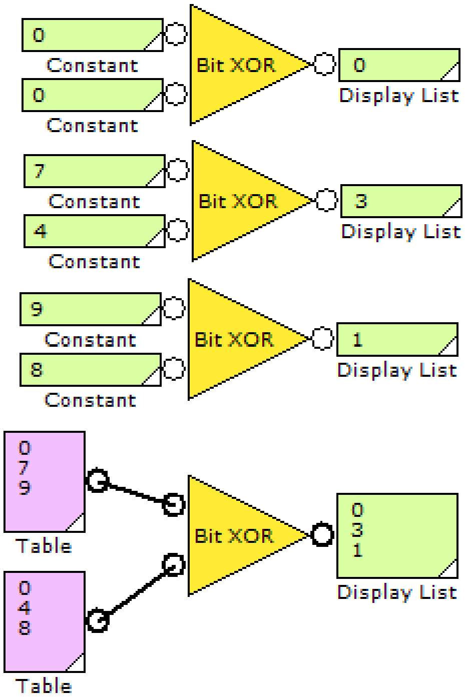
Bit Splitter

The Bit Splitter component breaks the input into separate bits. You can set the number of outputs desired. Arrays - column 4



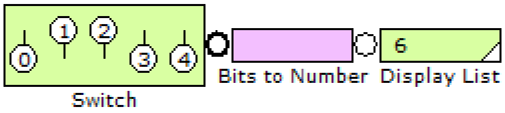
Bit XOR

The Bit XOR component compares the inputs and returns the result of a bitwise Exclusive OR process on the inputs. Functions - column 3



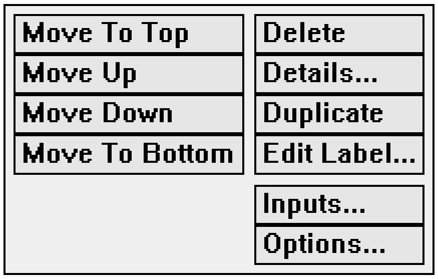
Bits to Number

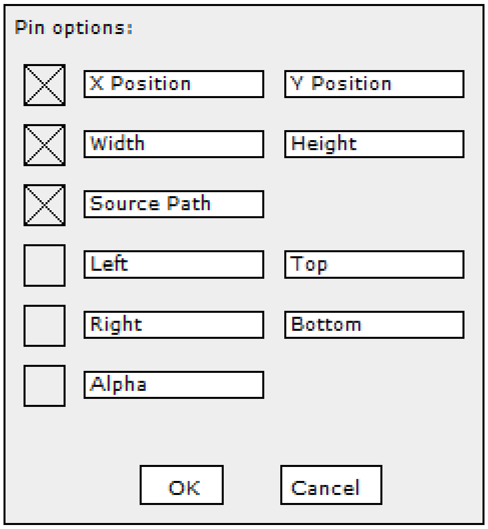
The Bits to Number component joins an array of bit values into a single output.   Arrays - column 4



2D Bitmap

The 2D Bitmap reads a BMP image file given its path. It then paints that bitmap in the 2D View at the specified location and size. You can paint part of a bitmap by specifying the top, left, bottom, and right pixel values of the bitmap.   2D - column 2




Pin options:

☒ X Position | Y Position

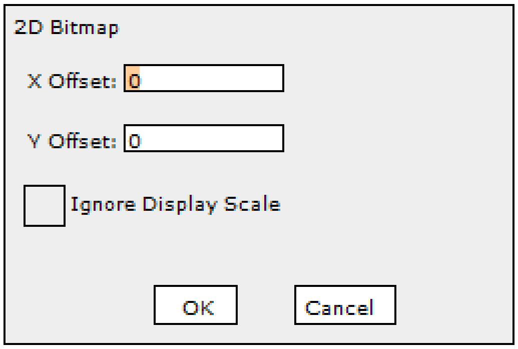
☒ Width | Height

☒ Source Path

□ Left | Top

□ Right | Bottom

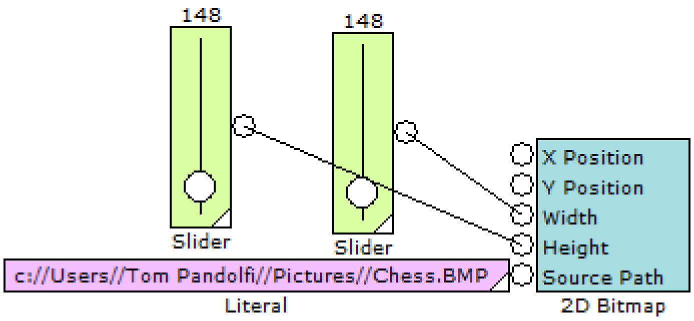
□ Alpha

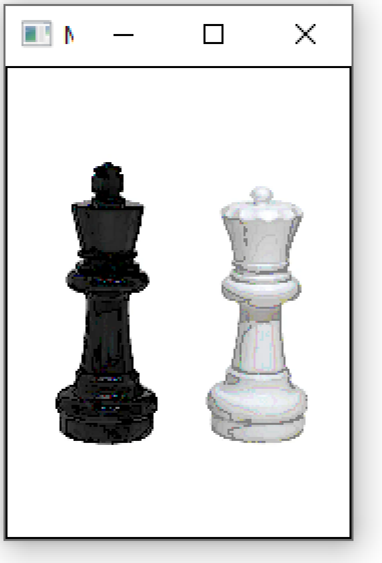

2D Bitmap

X Offset: 0

Y Offset: 0

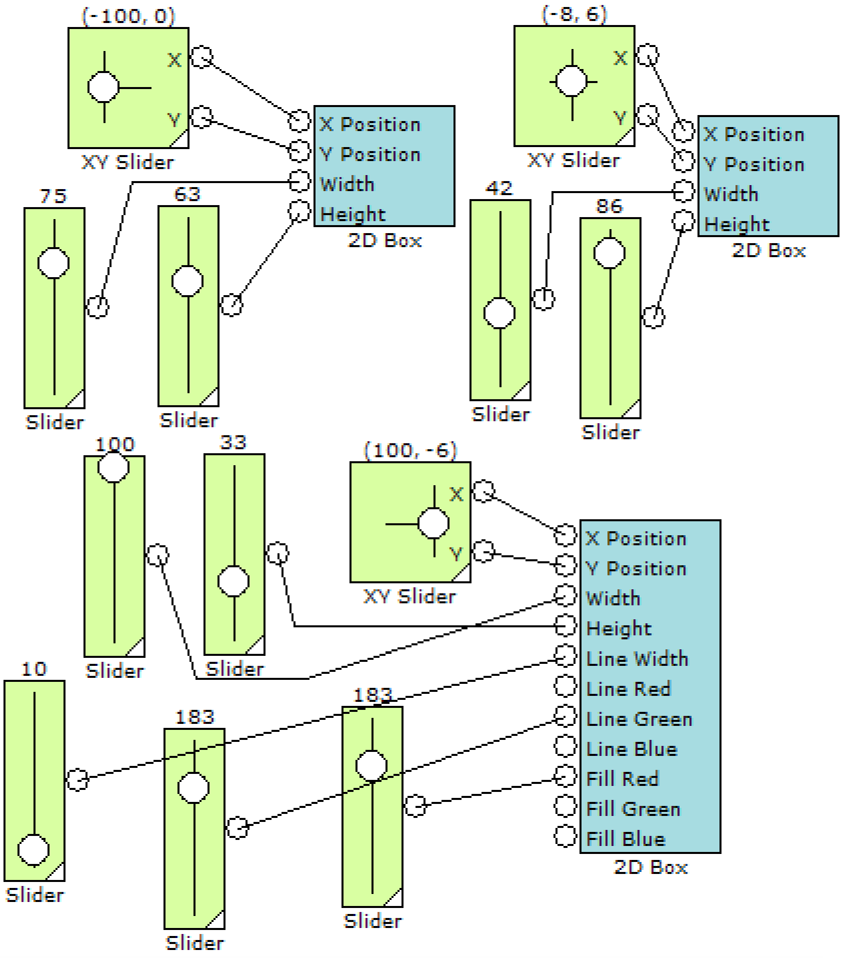
□ Ignore Display Scale

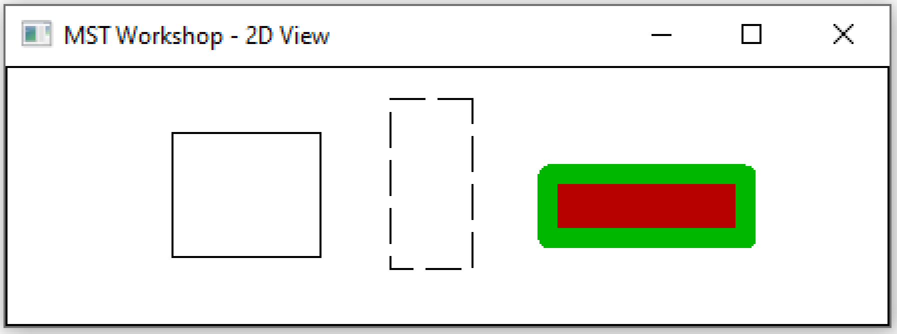




2D Box

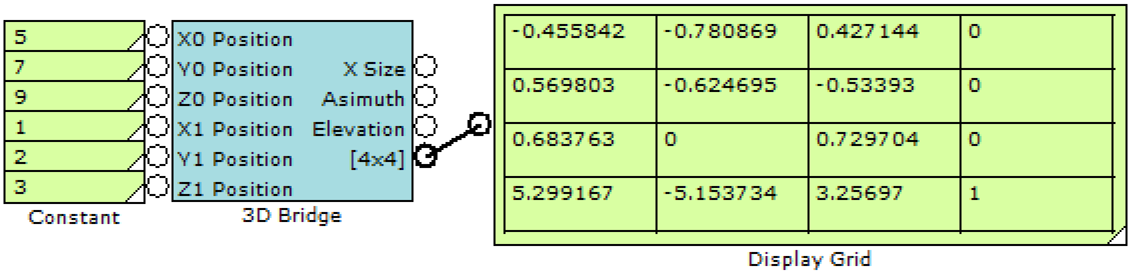
The 2D Box component draws a rectangle on the 2D canvas. 2D - column 1





3D Bridge

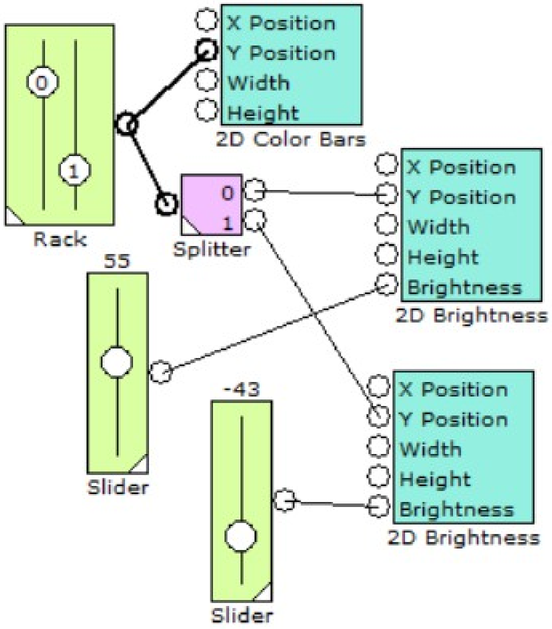
The 3D Bridge takes a pair of X, Y, Z coordinates, then returns information about how to bridge the two points including a matrix that will connect to a 3D Cube to bridge the two points. 3D - column 3

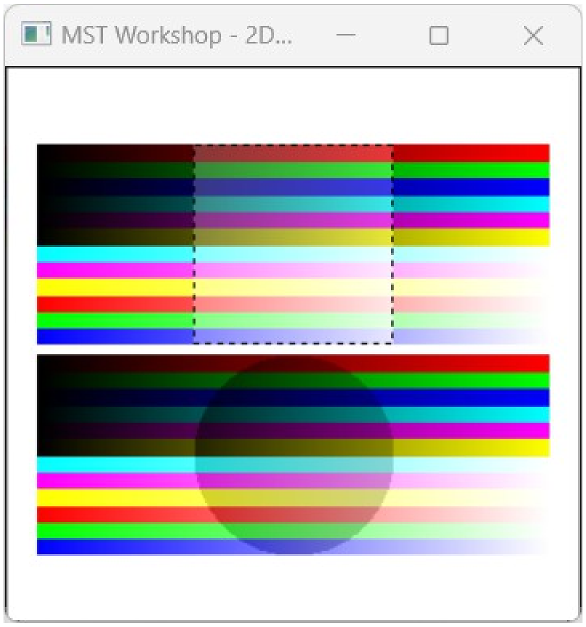


-0.455842	-0.780869	0.427144	0
0.569803	-0.624695	-0.53393	0
0.683763	0	0.729704	0
5.299167	-5.153734	3.25697	1

2D Brightness

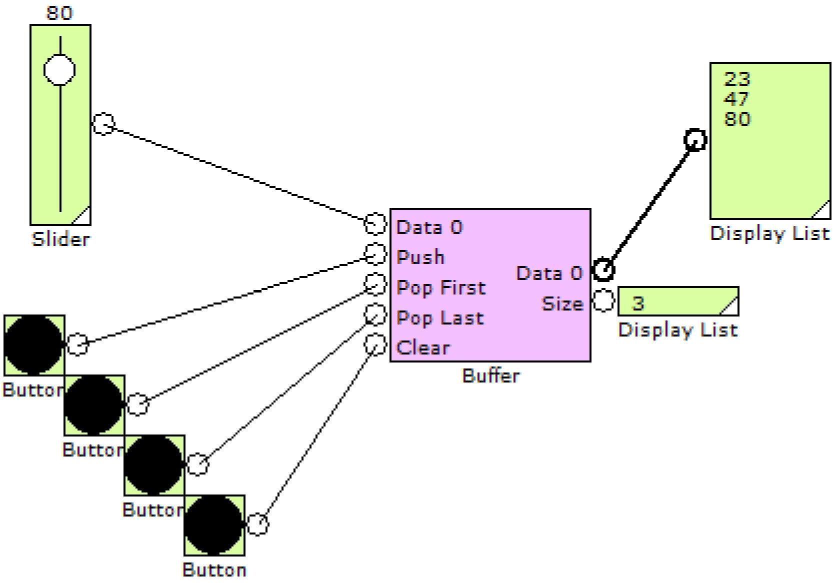
The 2D Brightness lightens or darkens the 2D drawing it covers. 2D – column 1





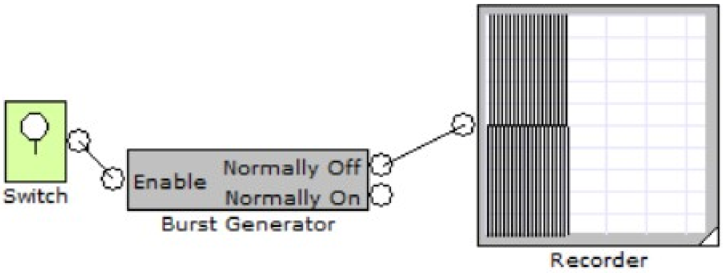
Buffer

The Buffer lets you create a list that you can insert values into or delete values from. Arrays - column 1



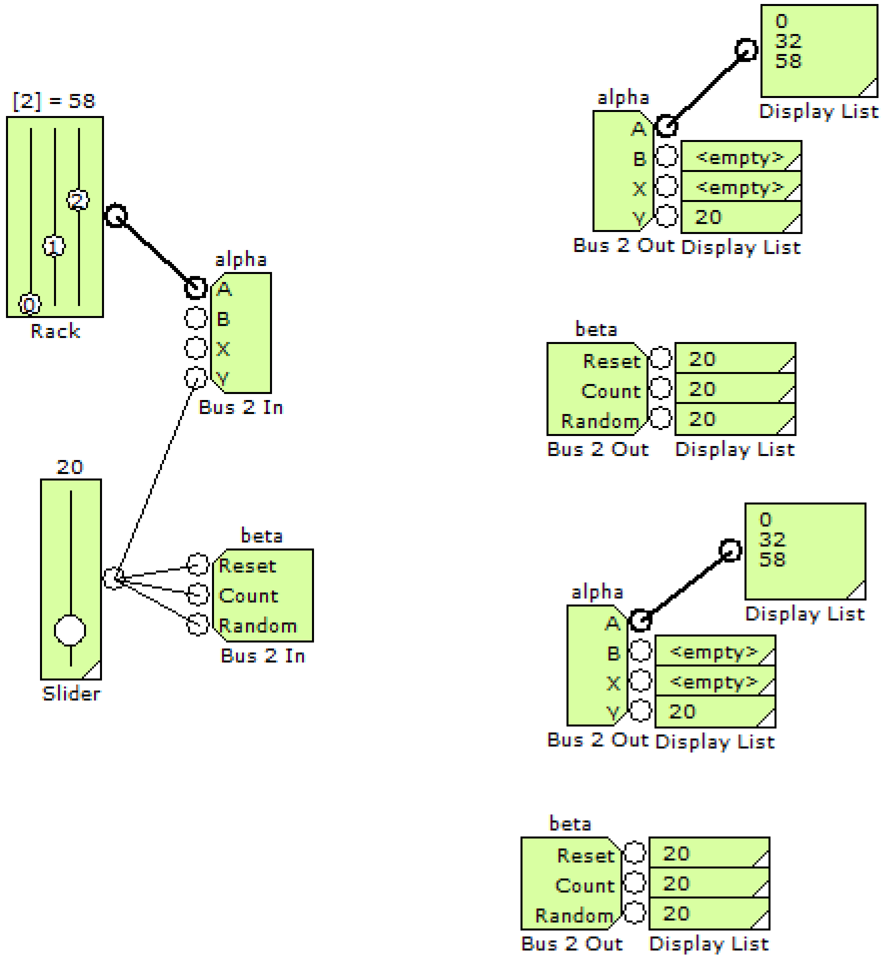
Burst Generator

The Burst Generator component outputs rapid pulses alternating between output A and B at half the current clock rate. Functions – column 8



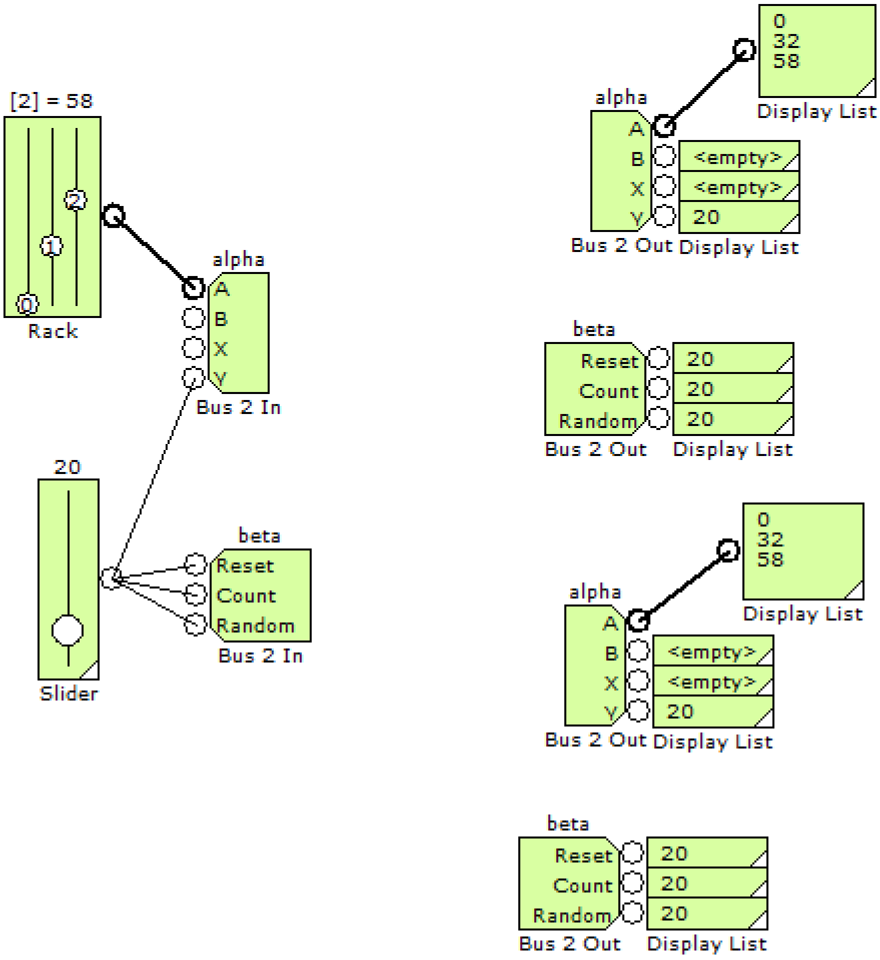
Bus 2 In

The Bus 2 In component passes a value to all the Bus 2 Out components with the same name.
Controls - column 5



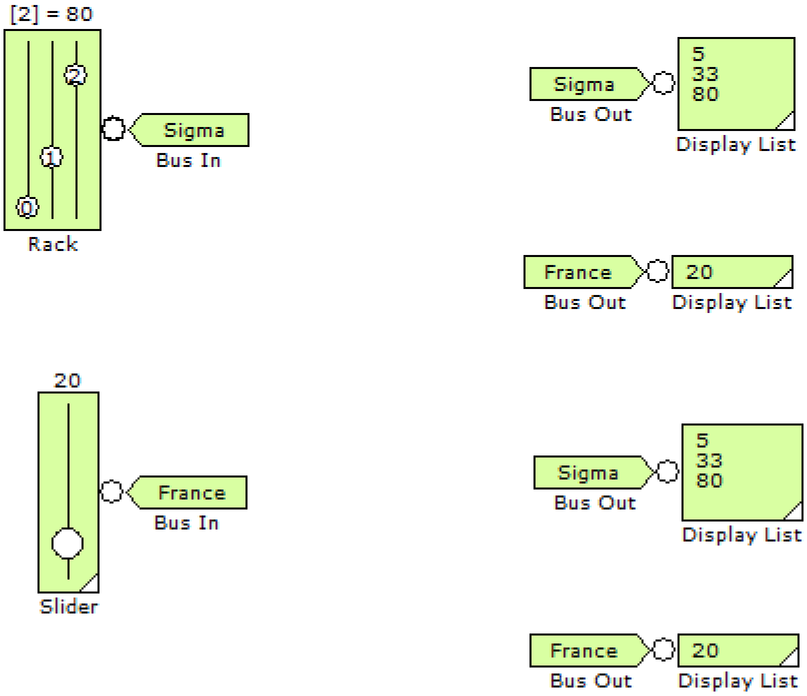
Bus 2 Out

The Bus 2 Out component outputs the value that is connected to the Bus 2 In of the same name.
Controls - column 5



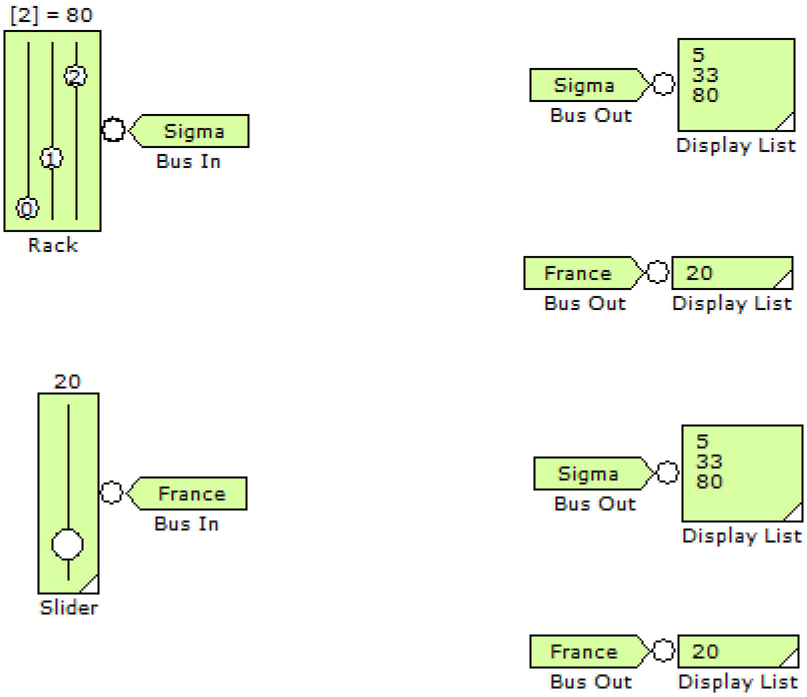
Bus In

The Bus In component passes a value to all the Bus Out components with the same name.
Controls - column 5



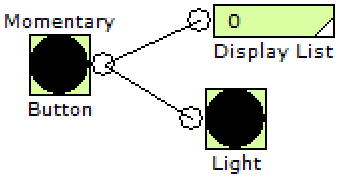
Bus Out

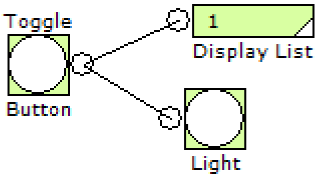
The Bus Out component outputs the value that is connected to the Bus In of the same name.
Controls - column 5

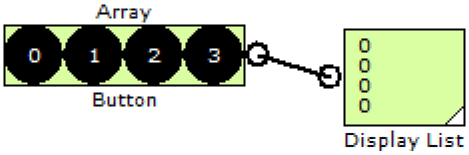


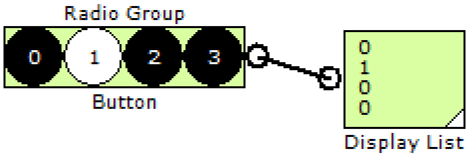
Button

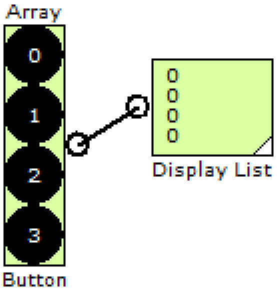
The Button is a one dimensional array of buttons. They can be momentary, toggle, or radio buttons..
Controls - column 4

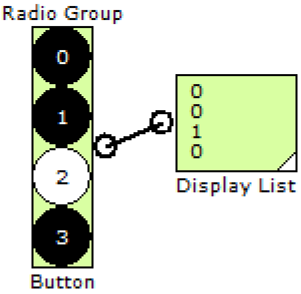






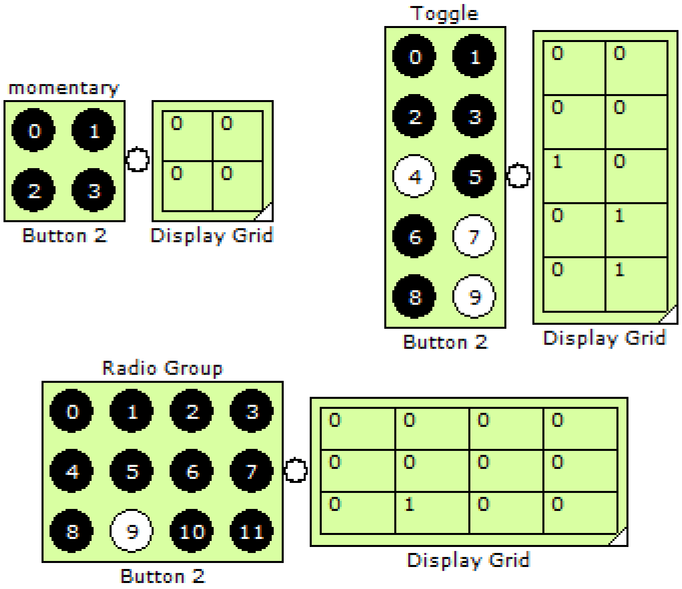






Button 2

The Button 2 is a 2 dimensional array of buttons. They can be momentary, toggle, or radio buttons.
Controls - column 4



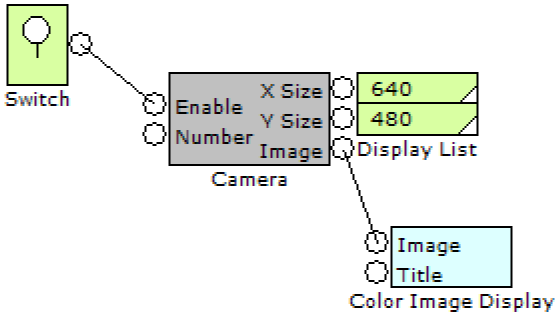
0	0
0	0

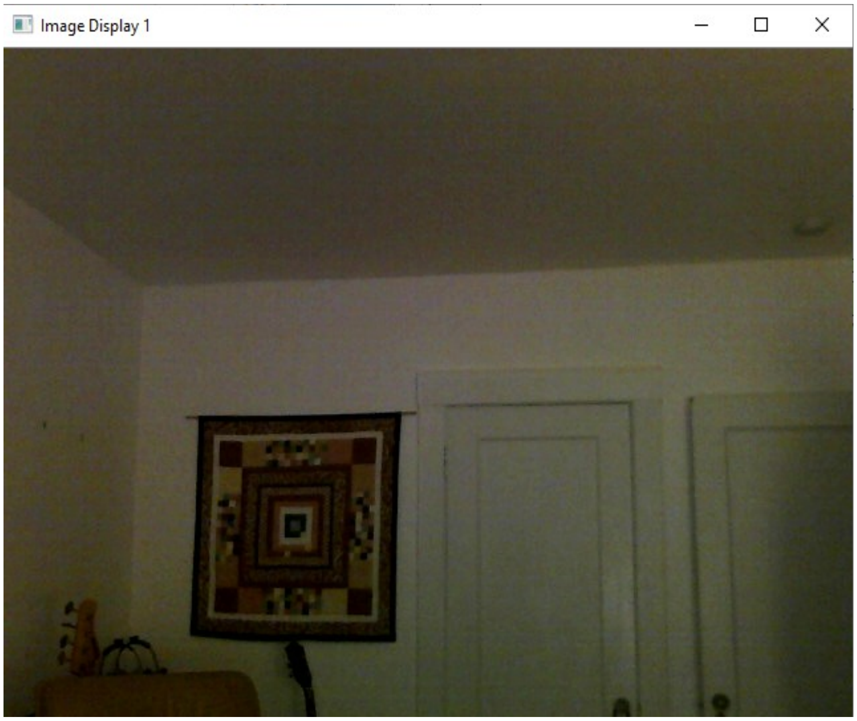
0	0
0	0
1	0
0	1
0	1

0	0	0	0
0	0	0	0
0	1	0	0

Camera

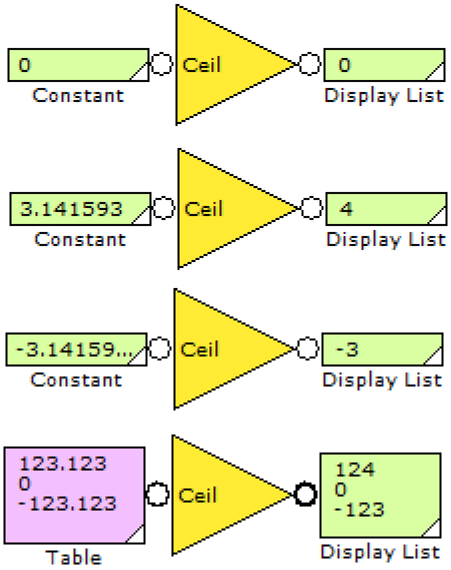
The Camera component grabs a frame from a camera connected to the computer. Images - column 1





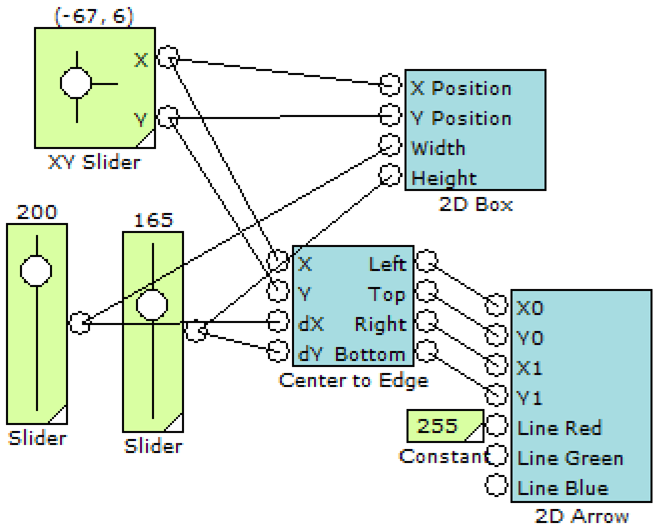
Ceil

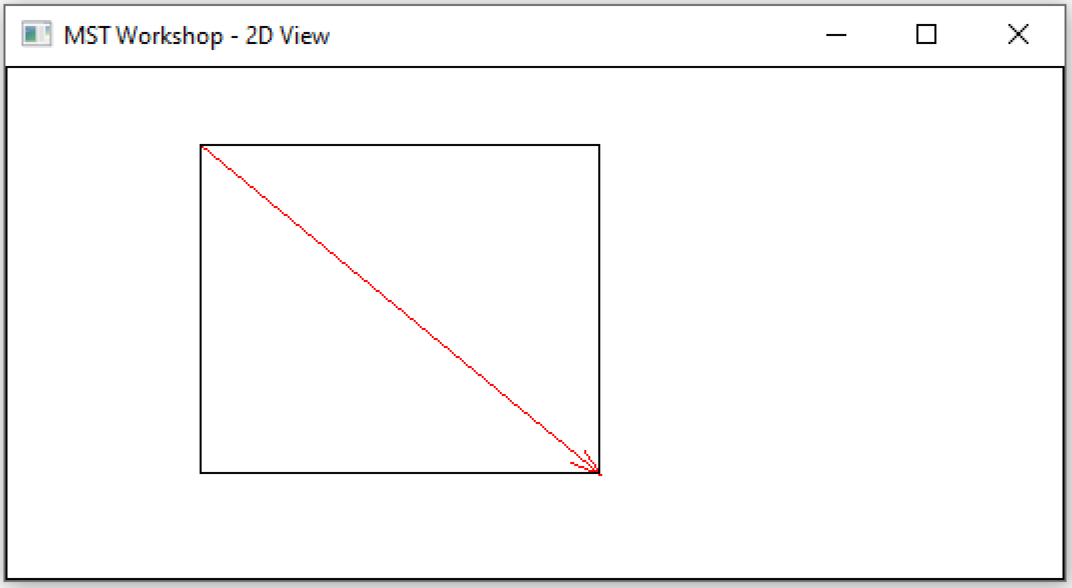
The Ceiling component outputs an integer greater than or equal to the input. Input can be scalar or an array.   Functions - column 2



Center to Edge

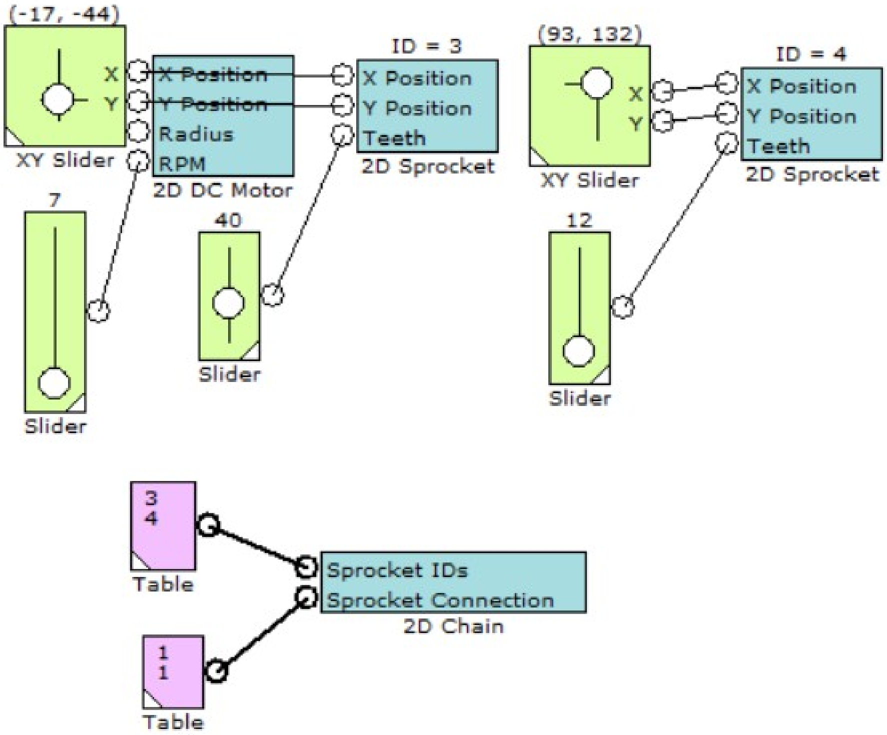
The Center to Edge component takes X Y coordinates and deltas and outputs values that can be used to put a vector from corner to corner to corner. 2D - column 8

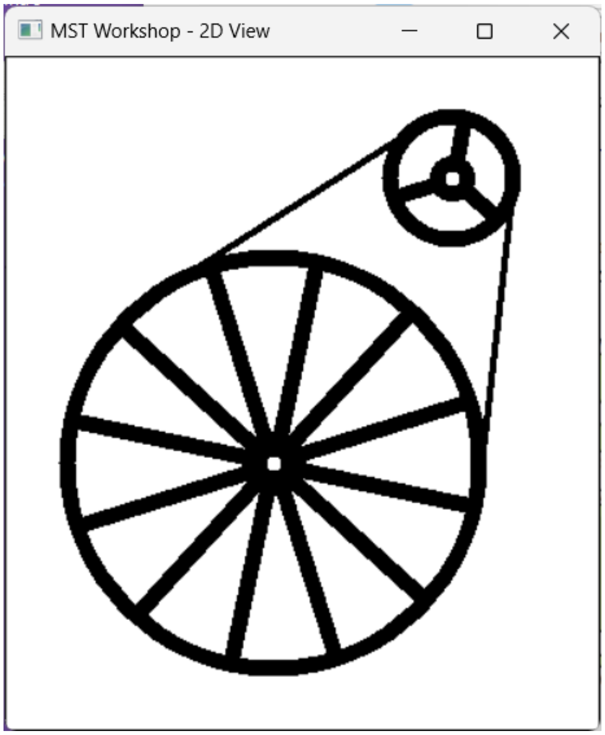




2D Chain

The 2D Chain component creates a Chain that can connect multiple sprockets. Indicate the ID of each sprocket and the direction of rotation. 2D - column 3

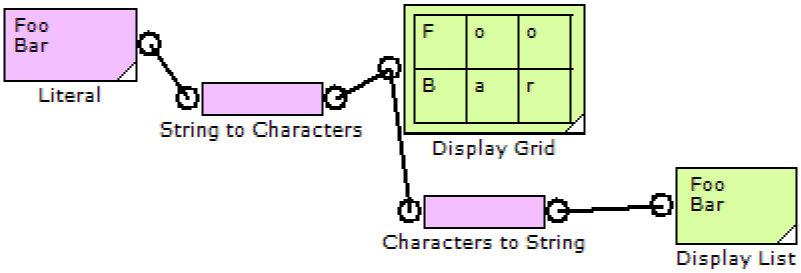




Characters to String

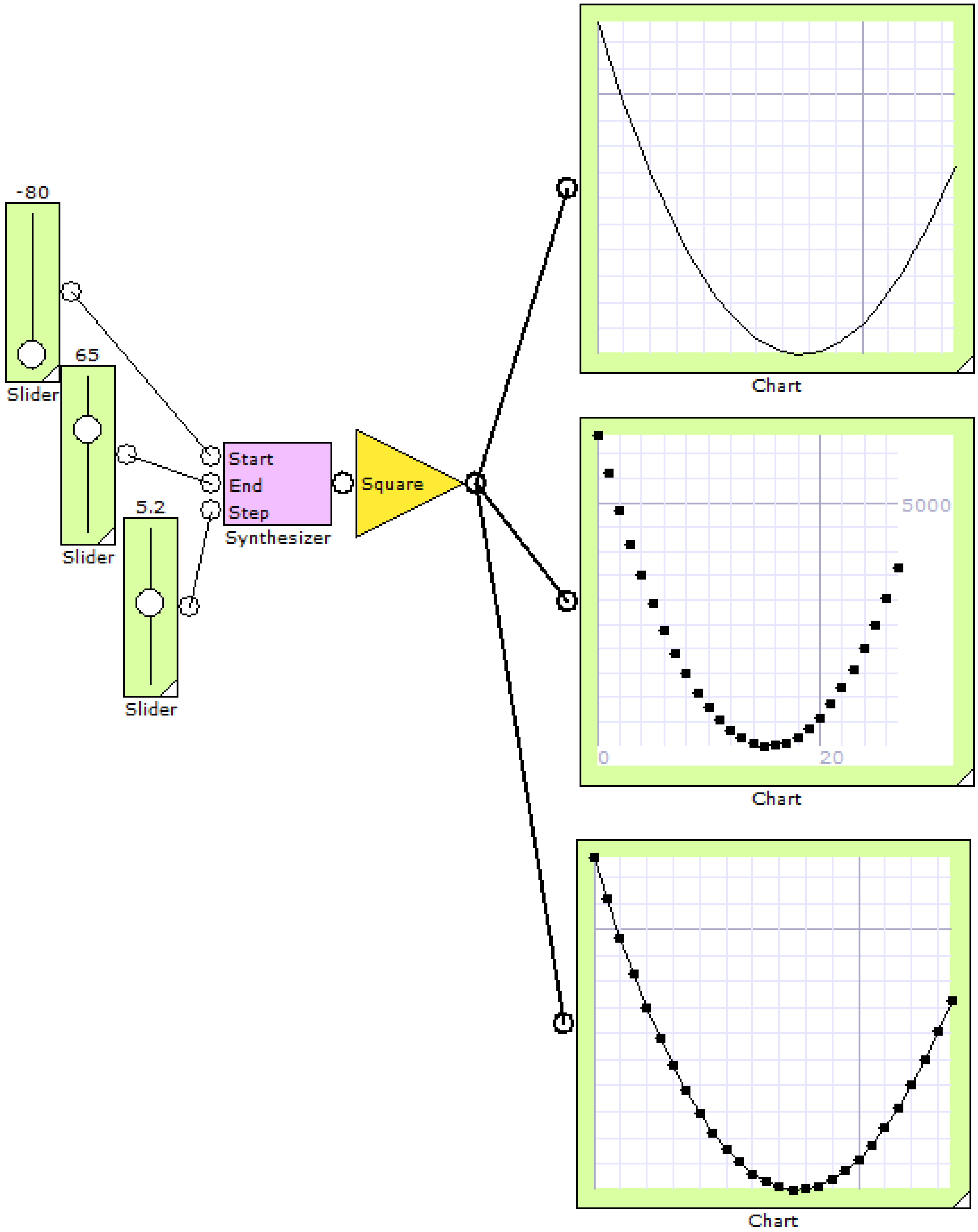
The Characters to String component takes a string of characters and creates an array of characters.

Arrays - column 7



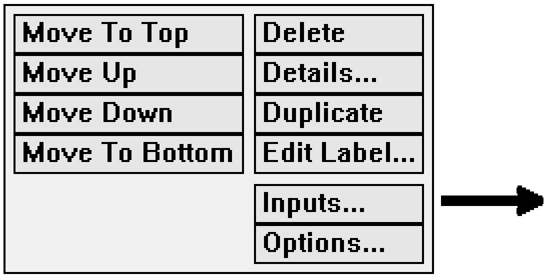
Chart

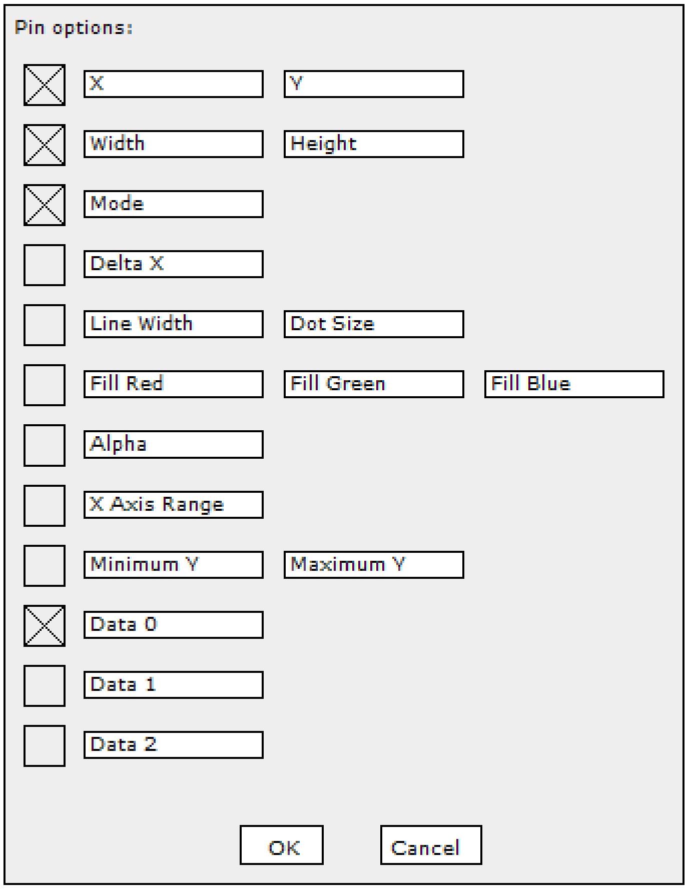
The Chart shows a line or dot chart of the array at its input. Controls - column 4



2D Chart

The 2D Chart shows the array at its input in the 2D display window.   2D - column 2




Pin options:

☒ X   Y

☒ Width   Height

☒ Mode

□ Delta X

□ Line Width   Dot Size

□ Fill Red   Fill Green   Fill Blue

□ Alpha

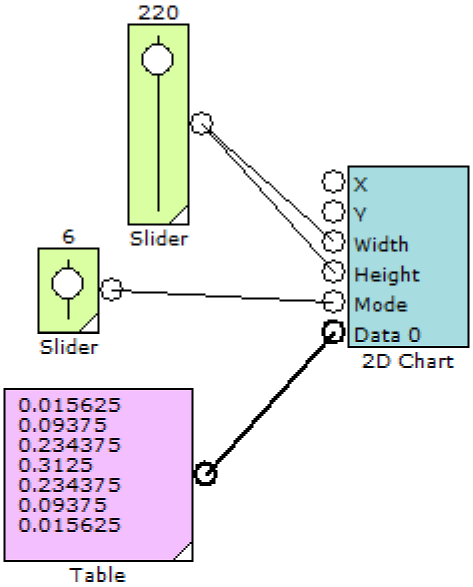
□ X Axis Range

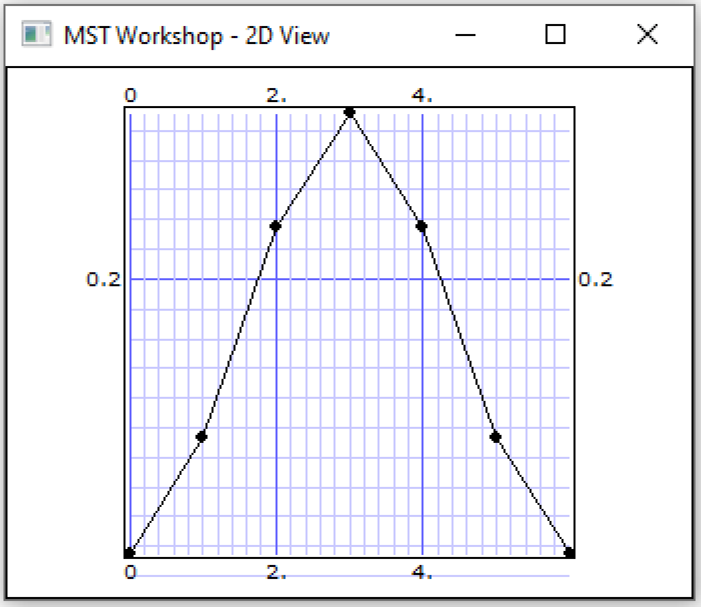
□ Minimum Y   Maximum Y

☒ Data 0

□ Data 1

□ Data 2





2D Checkbox

The 2D Checkbox is used to enable an event by clicking on it.

The X, Y and Size inputs control the position and font size of the text.

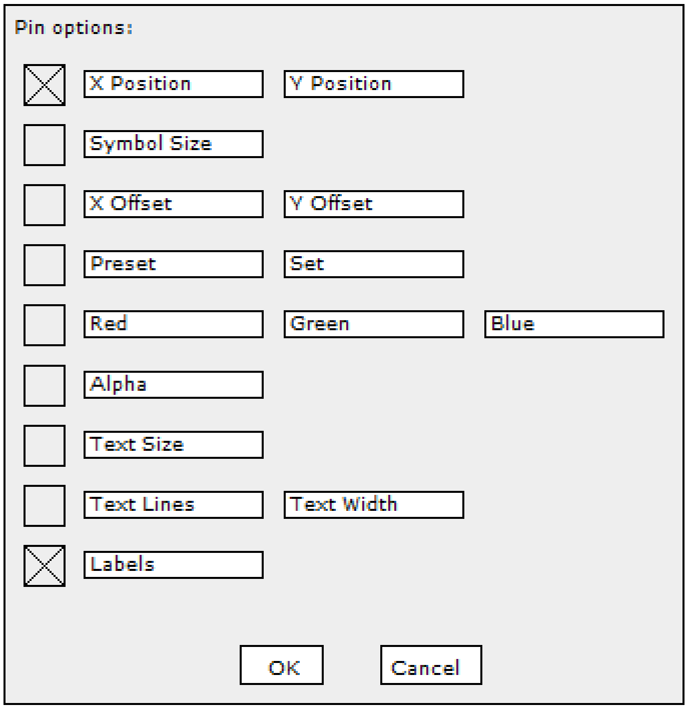
The Offsets control the position of the text relative to the boxes.

The Preset inputs allow external setting of the selections. Use an array of ones and zeros to set the individual boxes.

The Color input sets the color of the boxes and text.

The Alpha input fades the boxes and text.

The List output provides an array with a one at the selected positions.   Controls - column 2



Pin options:

☒ X Position | Y Position

☐ Symbol Size

☐ X Offset | Y Offset

☐ Preset | Set

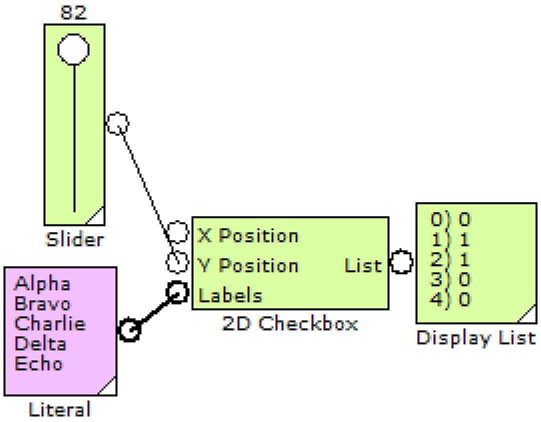
☐ Red | Green | Blue

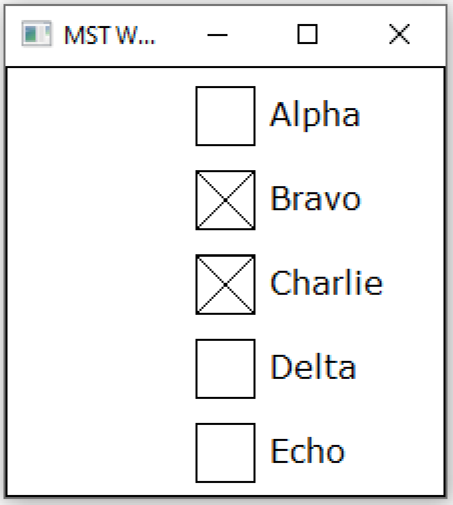
☐ Alpha

☐ Text Size

☐ Text Lines | Text Width

☒ Labels





☐ Alpha

☒ Bravo

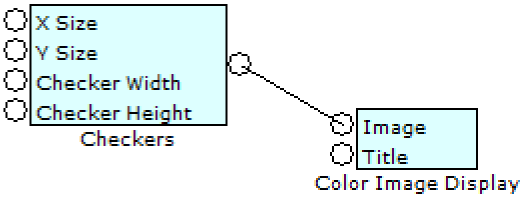
☒ Charlie

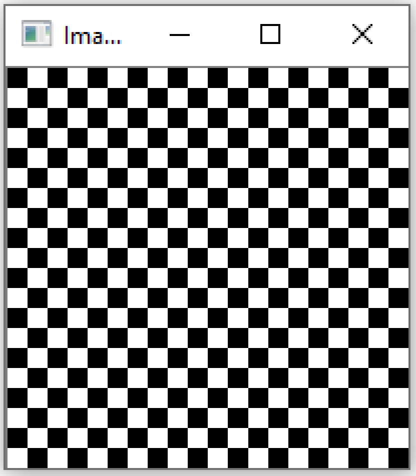
☐ Delta

☐ Echo

Checkers

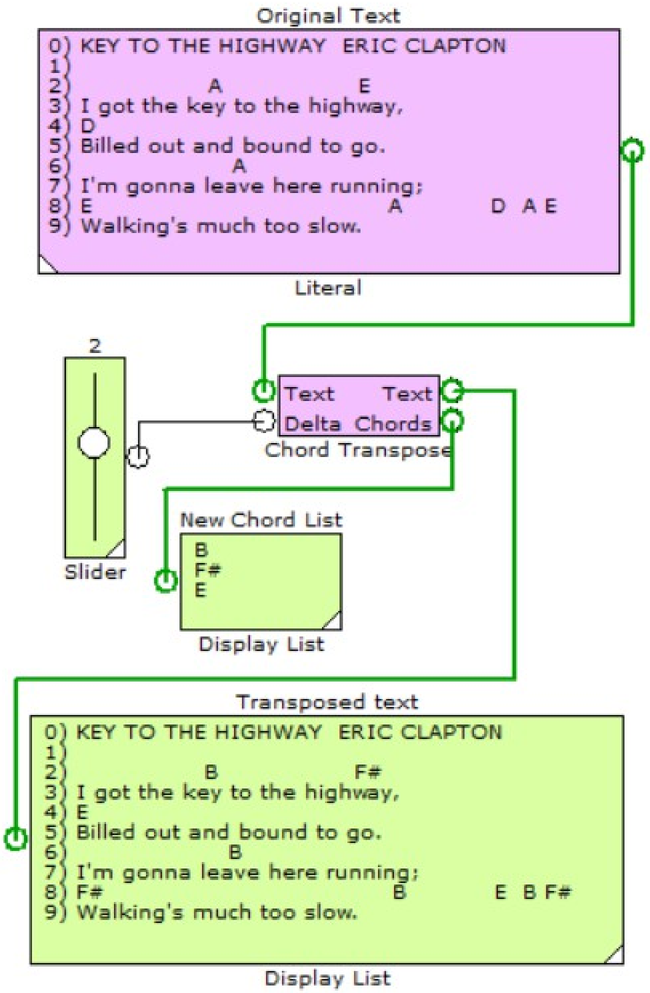
The Checkers component creates an image with a checkered test pattern. Images - column 1





Chord Transpose

The Chord Transpose component takes an array of text lines and transposes the chord progression to a new key by the delta indicated. Only lines that contain A through G followed by a blank or a sharp (#) or flat (b) then a space are considered. Text from Rich Text Format files also works correctly.



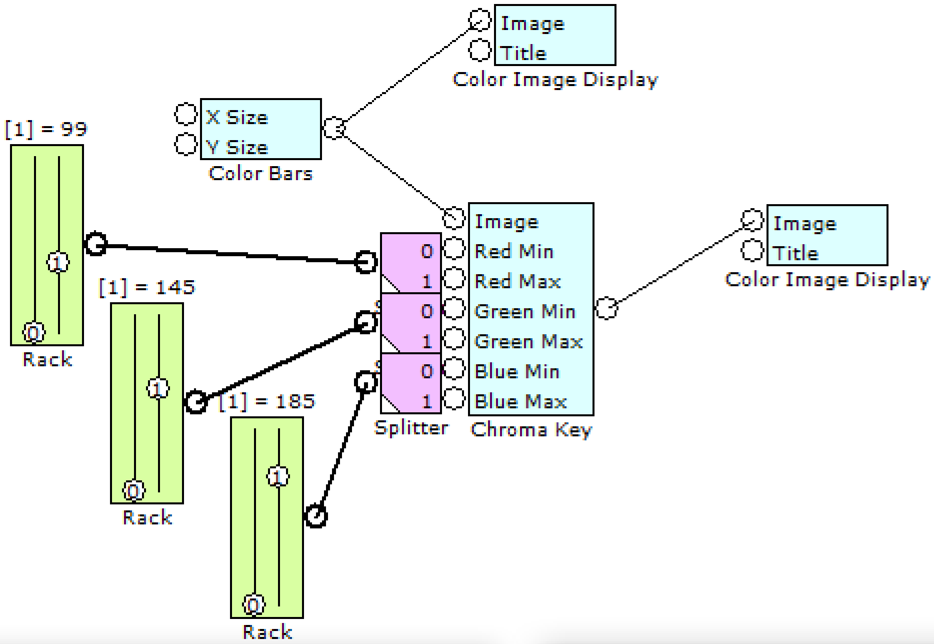
```
0) KEY TO THE HIGHWAY  ERIC CLAPTON
1)
2)           A           E
3) I got the key to the highway,
4) D
5) Billed out and bound to go.
6)             A
7) I'm gonna leave here running;
8) E                        A       D  A E
9) Walking's much too slow.
```

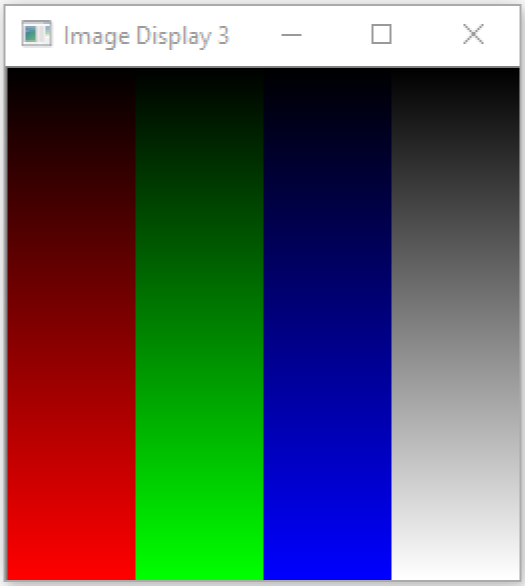
```
B
F#
E
```

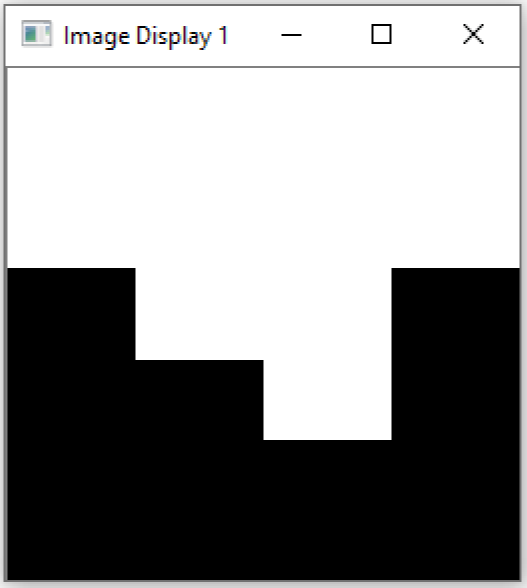
```
0) KEY TO THE HIGHWAY  ERIC CLAPTON
1)
2)           B           F#
3) I got the key to the highway,
4) E
5) Billed out and bound to go.
6)             B
7) I'm gonna leave here running;
8) F#                       B       E  B F#
9) Walking's much too slow.
```

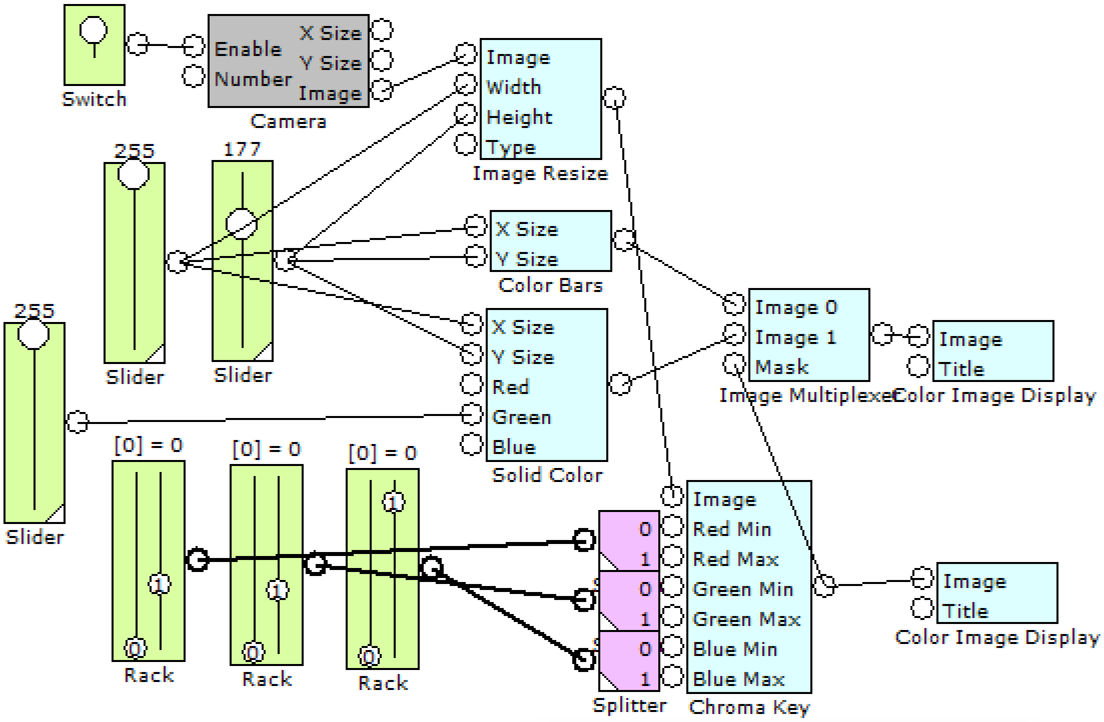
Chroma Key

The Chroma Key component outputs white where it finds pixels that are within the limits of the three color inputs.   Images - column 2








Switch
Enable
Number
X Size
Y Size
Image
Camera
Image
Width
Height
Type
Image Resize
255
177
Slider
Slider
X Size
Y Size
Color Bars
255
Slider
X Size
Y Size
Red
Green
Blue
Solid Color
Image 0
Image 1
Mask
Image Multiplexer
Image
Title
Color Image Display
[0] = 0
[0] = 0
[0] = 0
Rack
Rack
Rack
0
1
0
1
0
1
Splitter
Image
Red Min
Red Max
Green Min
Green Max
Blue Min
Blue Max
Chroma Key
Image
Title
Color Image Display

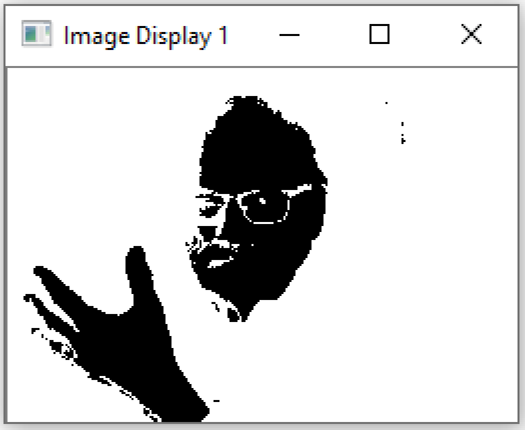


Image Display 1

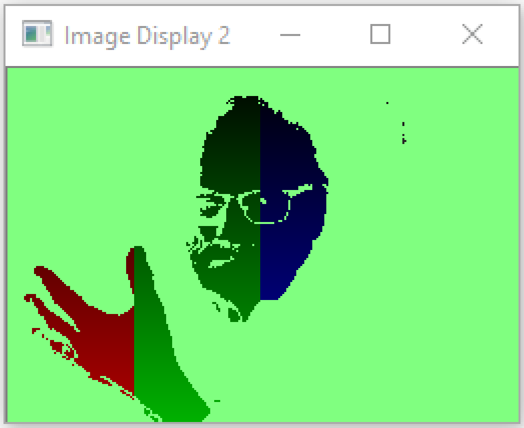
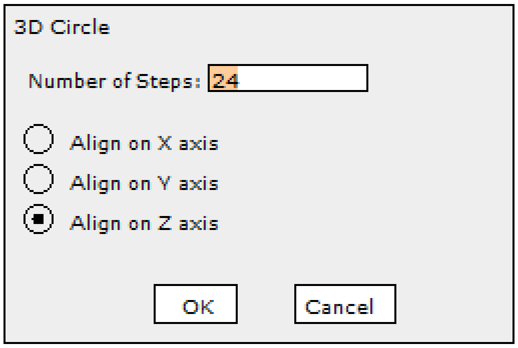


Image Display 2

3D Circle

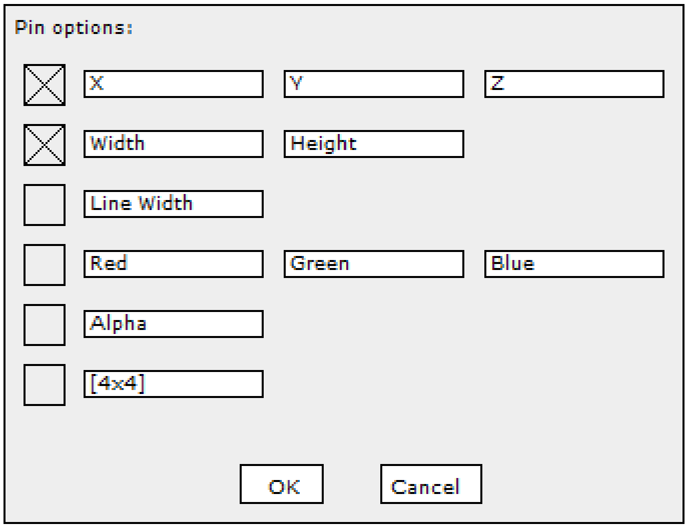
The 3D Circle draws a disc in the 3D view window. The X, Y, and Z inputs set the position and size of the circle. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 4



3D Circle

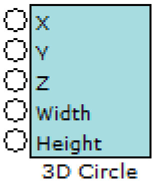
Number of Steps: 24

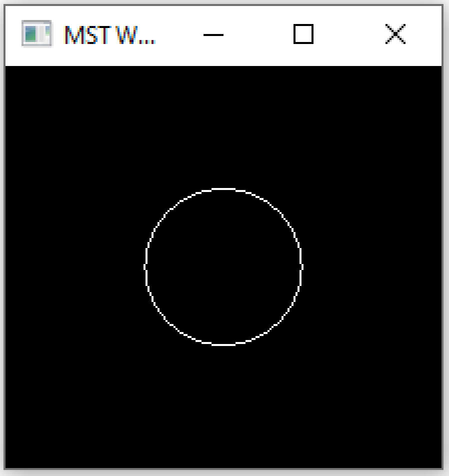
○ Align on X axis
○ Align on Y axis
● Align on Z axis



Pin options:

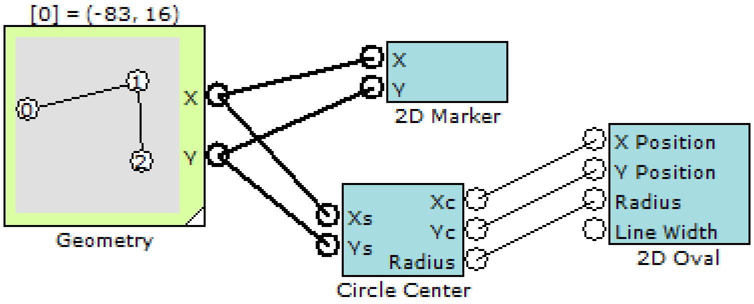
☒ X | Y | Z
☒ Width | Height
□ Line Width
□ Red | Green | Blue
□ Alpha
□ [4x4]

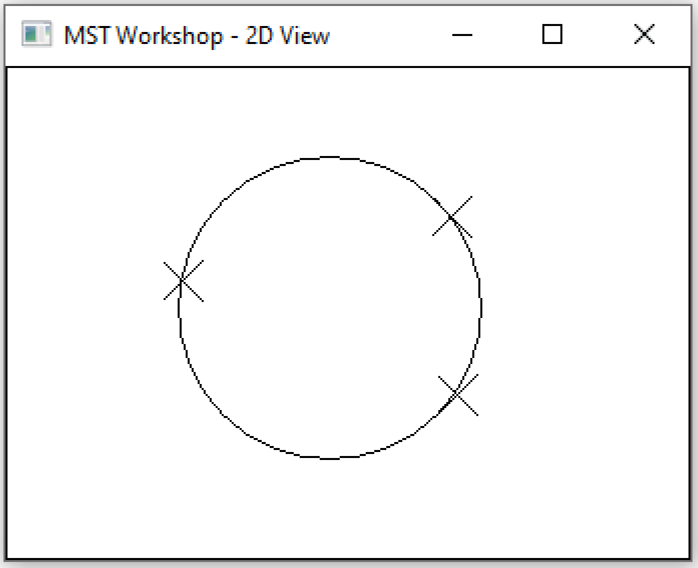




Circle Center

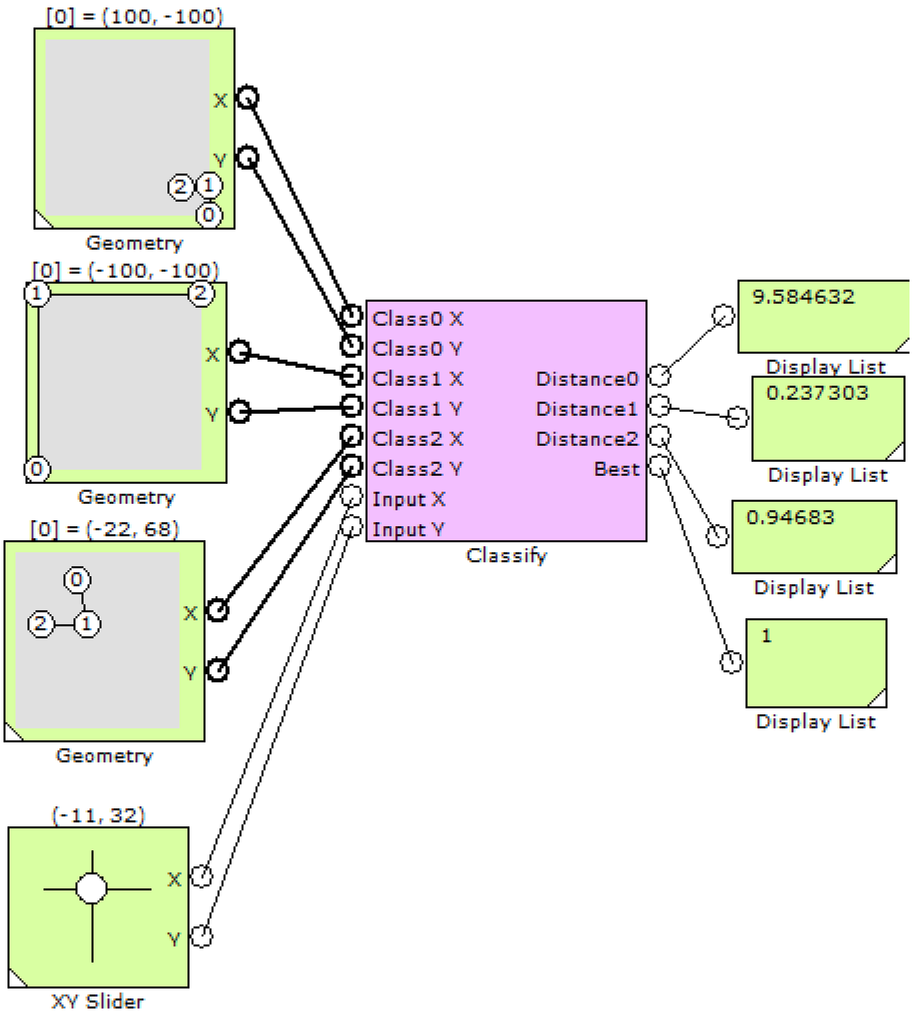
The Circle Center calculates the center of a circle from 3 points on its circumference. 2D - column 2





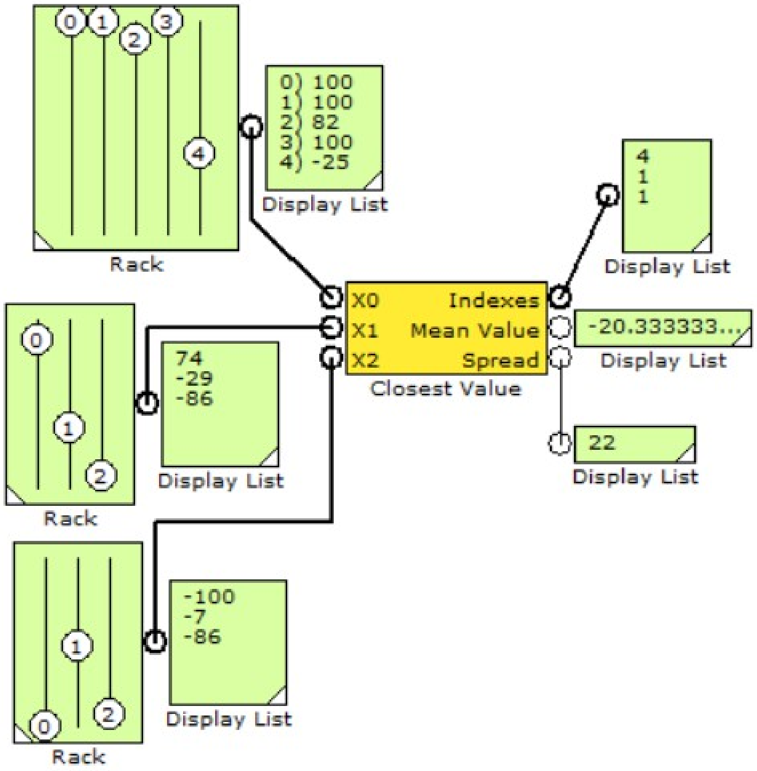
Classify

The Classify component is given coordinates of a number of classes. The centroid and standard deviation are calculated for each class. The distance from the centroid of the class to the input is given in standard deviation units, along with the index of the closest class. Arrays – column 2



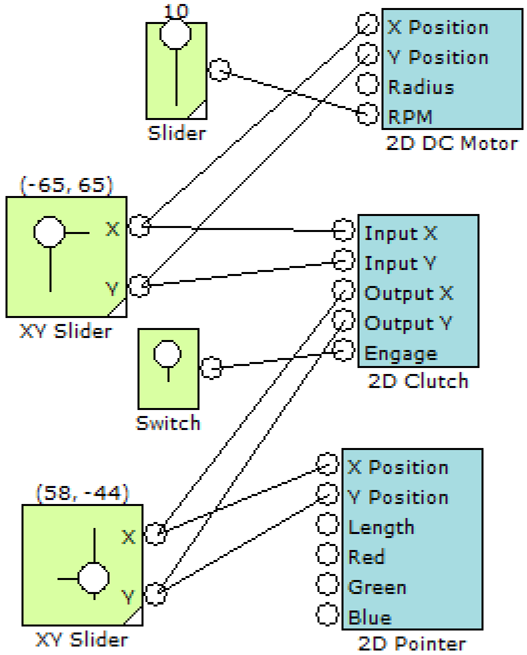
Closest Value

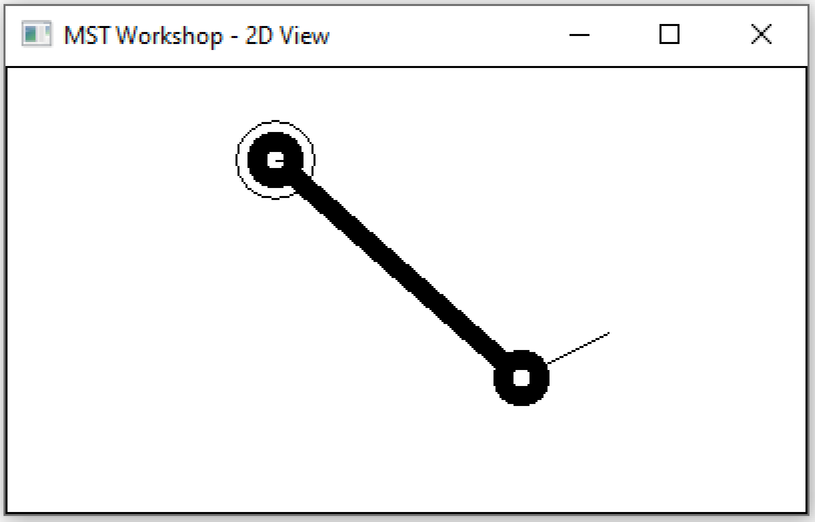
The Closest Value component takes arrays of coordinates at several inputs and outputs the indexes of the closest value in 1, 2, or 3 dimensions. Functions – column 8



2D Clutch

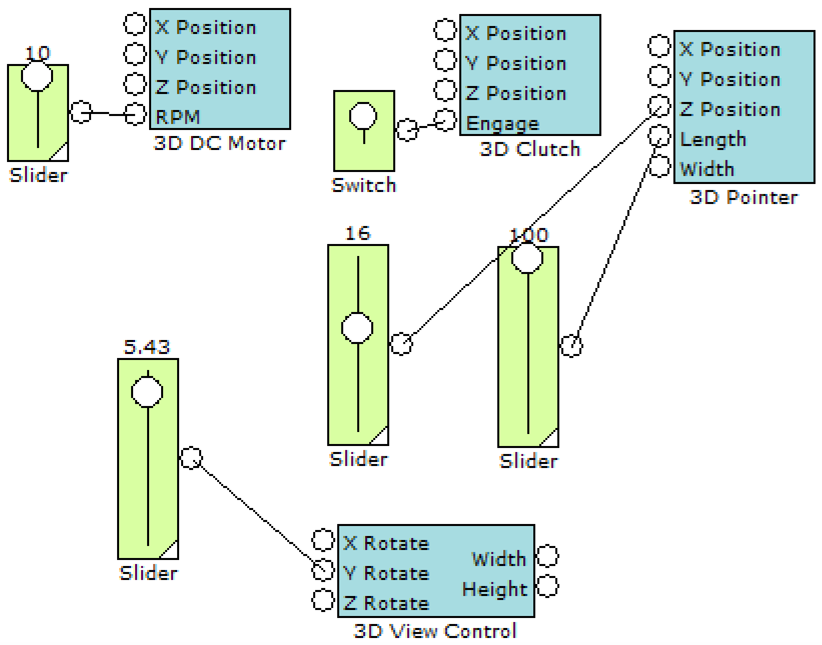
The Clutch component creates a connection between two shafts that can be connected or disconnected. You can attach a driver to one shaft and drive something at the other shaft. Place the Clutch at the same X, Y position as a motor and place a gear at the X, Y coordinates as the other shaft.   2D - column 3

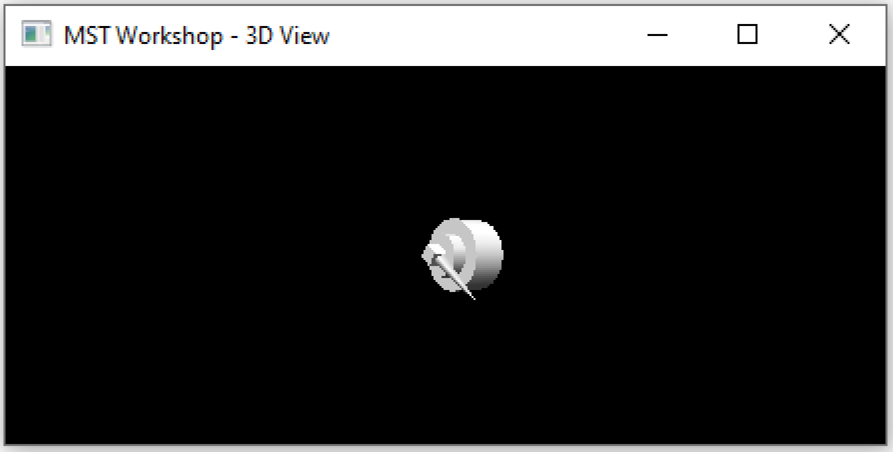




3D Clutch

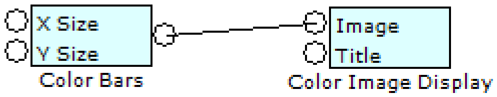
The 3D Clutch component creates a connection between two shafts that can be connected or disconnected. Values between 0 and 1 cause a fraction of the input to get to the output. You can attach a driver to the input and drive something at the end of the shaft. Place the Clutch at the same X, Y, Z position as a motor and place a gear at the X, Y, Z coordinates as the other end.   3D - column 4

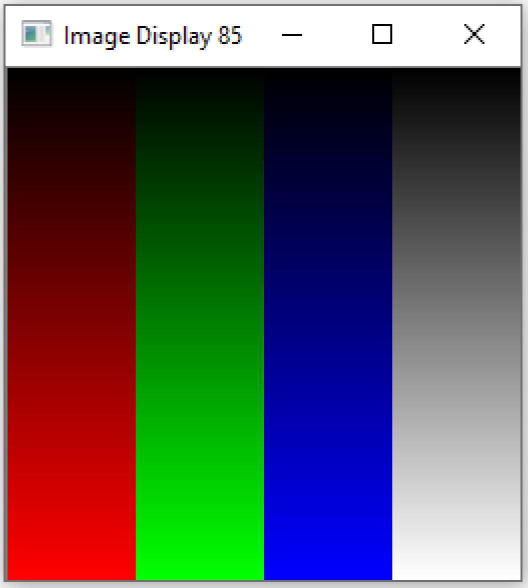




Color Bars

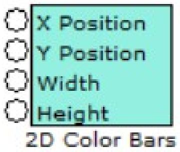
The Color Bars component creates an image with a test pattern of color bars. Images - column 1

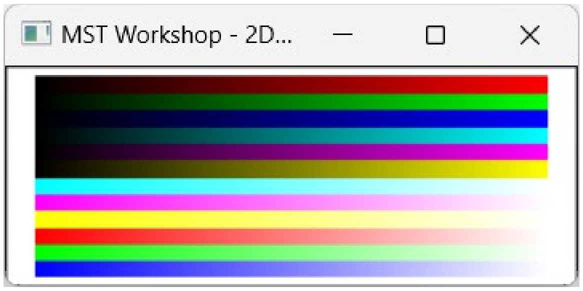




2D Color Bars

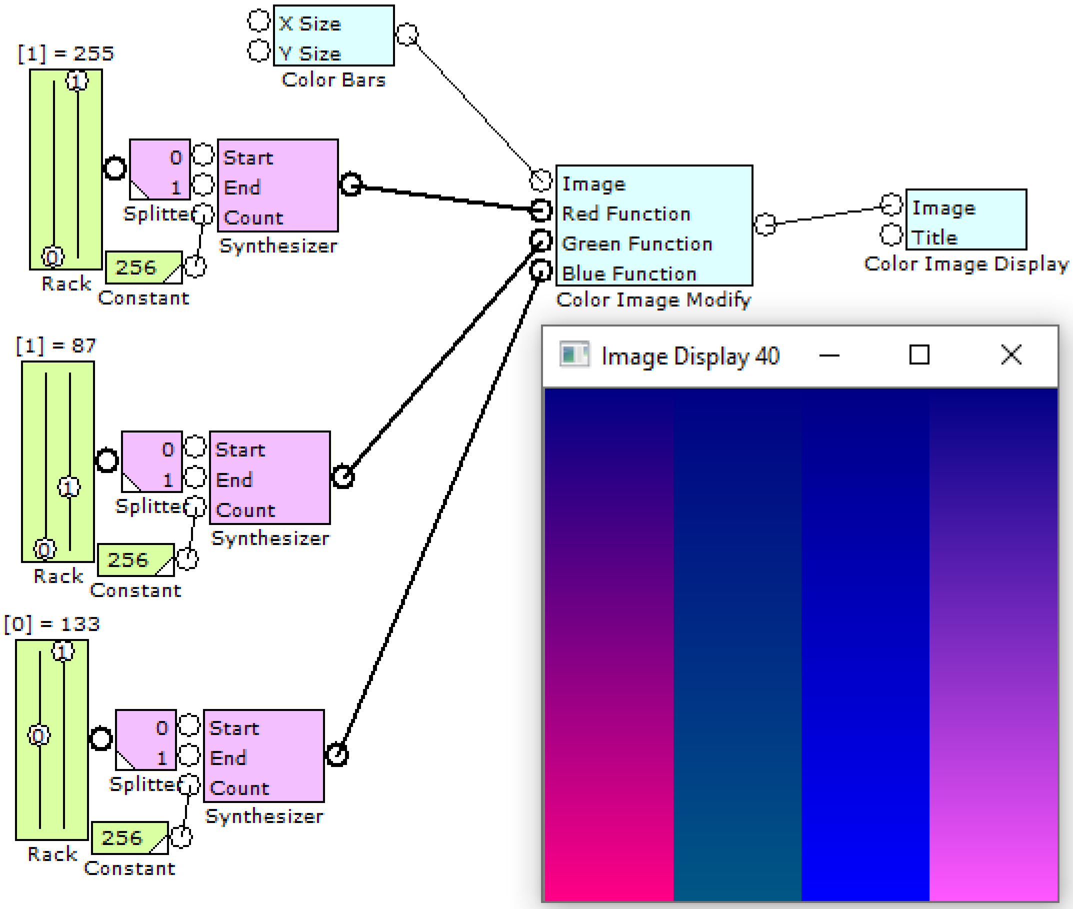
The 2D Color Bars component draws color bars on the 2D view canvas. 2D – column 2





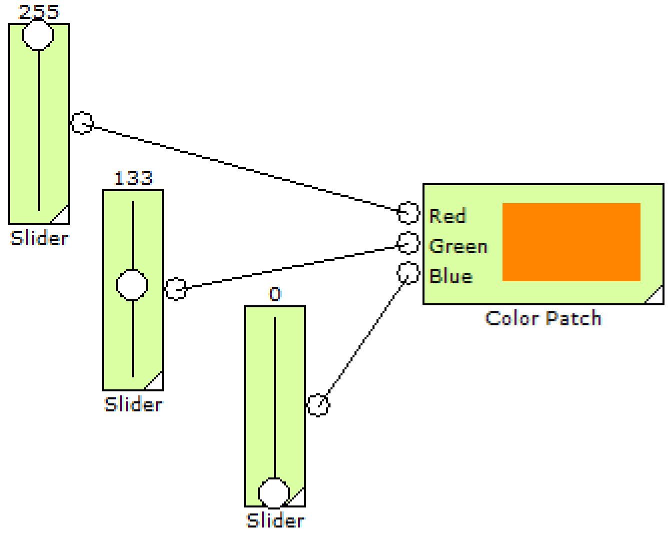
Color Image Modify

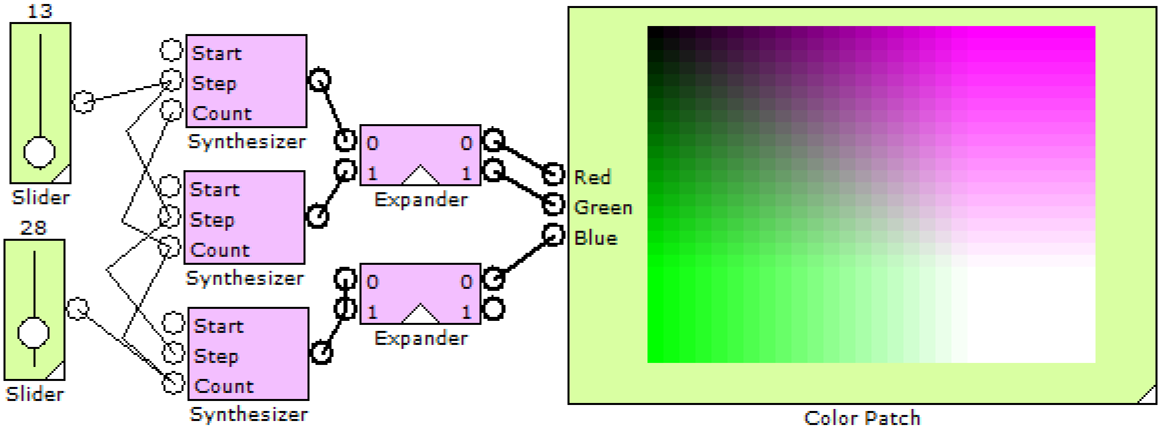
The Color Image Modify component remaps the color image based on the 3 color function inputs.
Images - column 2



Color Patch

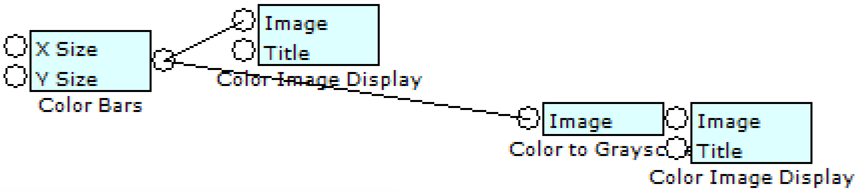
The Color Patch shows you any color based on the Red, Green and Blue inputs.   Controls - column 4

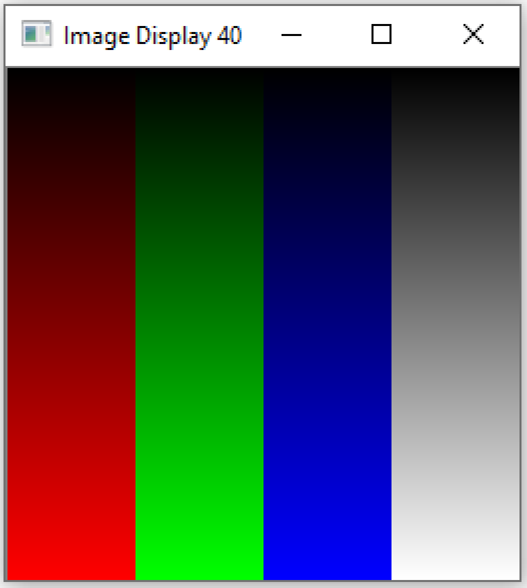


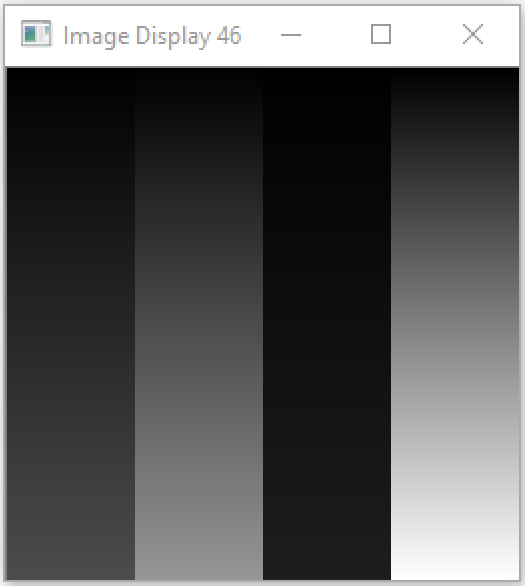


Color to Grayscale

The Color to Grayscale component converts the color image to grayscale. Images - column 1

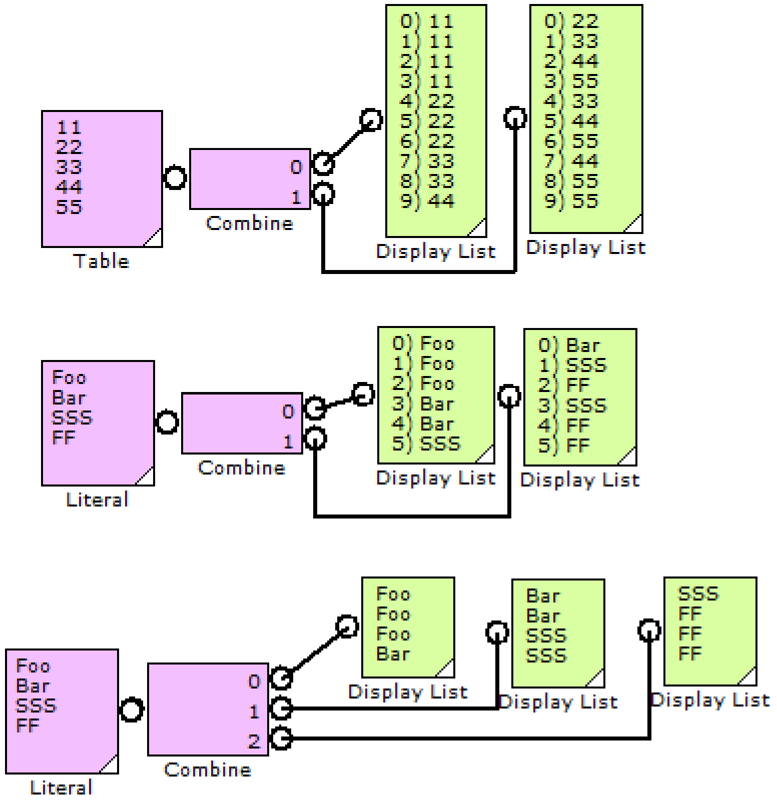






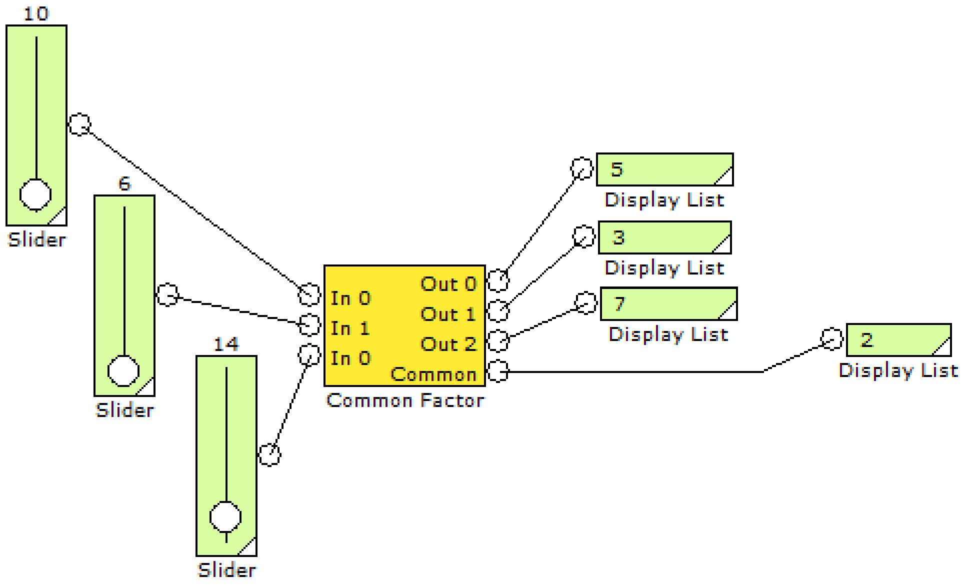
Combine

The Combine component outputs a list of numbers taken from the Pool input with the specified Group Size.   Arrays - column 5



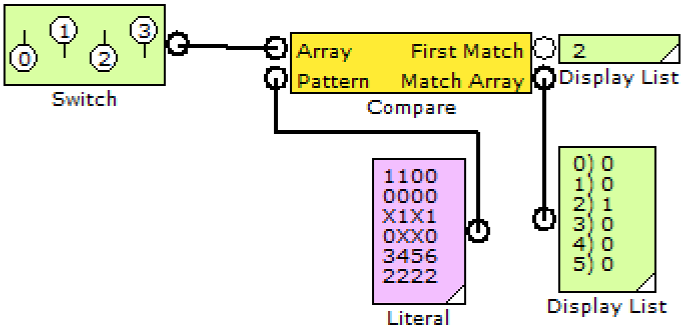
Common Factor

The Common Factor component takes a list of numbers then removes and outputs the common factor.
Functions - column 9



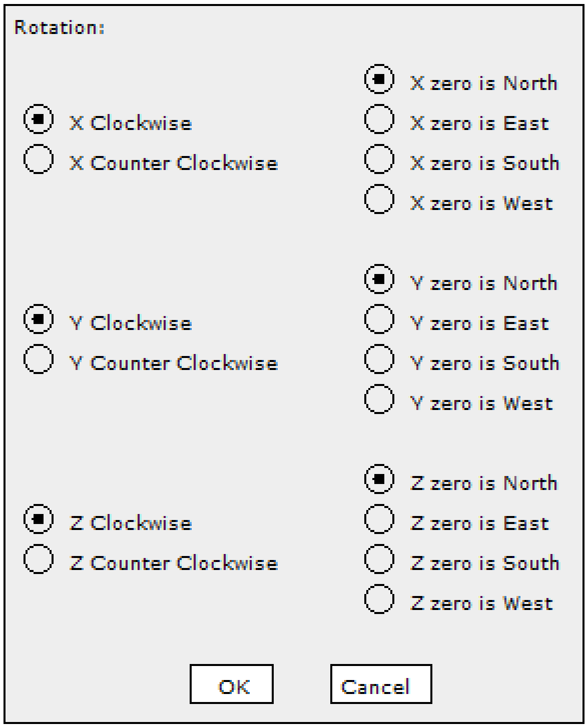
Compare

The Compare component compares the input array of Booleans with the patterns. The output is the first pattern that matches and an array of all the patterns that match. Use 'X' for don't care. You can start the string with 'ALL ' or 'ANY ' to control if ALL the bits must match or if ANY matching bits are a match. An 'X' in place of a '1' or '0' skips the comparison.   Functions - column 2



3D Cone

The 3D Cone draws a cone in the 3D view window. The X, Y, and Z inputs set the position and size of the cone. The Affine [4x4] array input modifies the size, position and orientation.3D - column 4



Rotation:

● X Clockwise
○ X Counter Clockwise

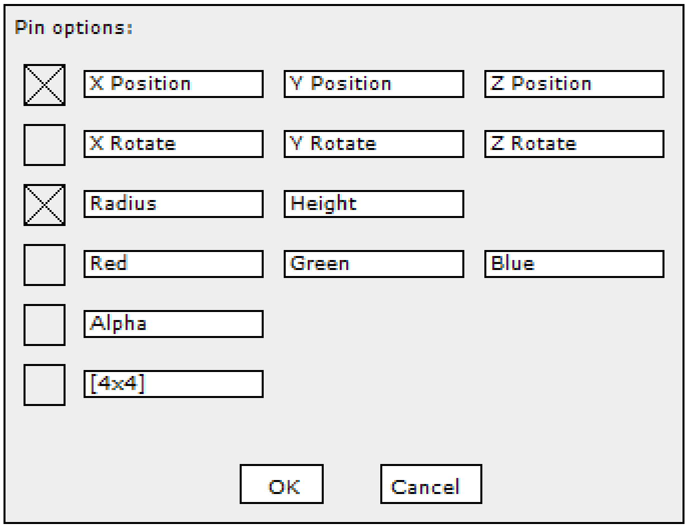
● X zero is North
○ X zero is East
○ X zero is South
○ X zero is West

● Y Clockwise
○ Y Counter Clockwise

● Y zero is North
○ Y zero is East
○ Y zero is South
○ Y zero is West

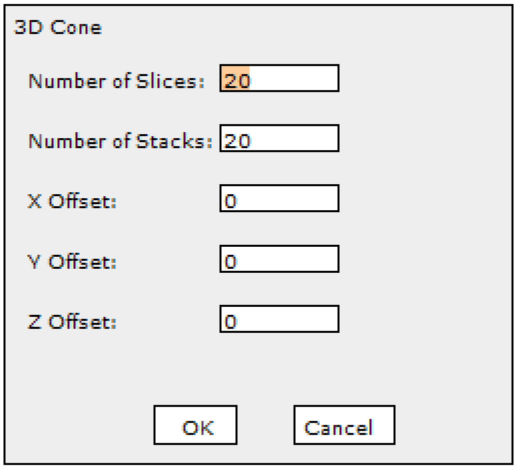
● Z Clockwise
○ Z Counter Clockwise

● Z zero is North
○ Z zero is East
○ Z zero is South
○ Z zero is West



Pin options:

☒	X Position	Y Position	Z Position
□	X Rotate	Y Rotate	Z Rotate
☒	Radius	Height	
□	Red	Green	Blue
□	Alpha		
□	[4x4]		



3D Cone

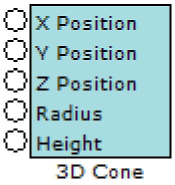
Number of Slices: 20

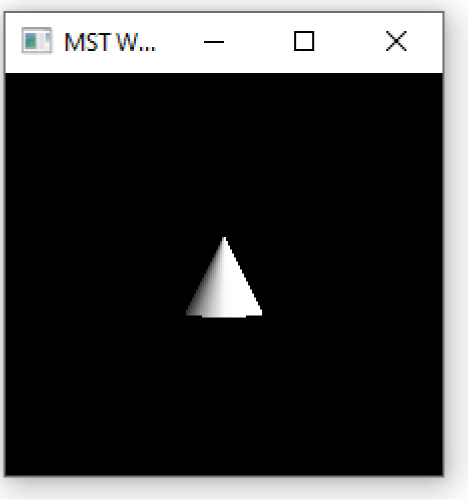
Number of Stacks: 20

X Offset: 0

Y Offset: 0

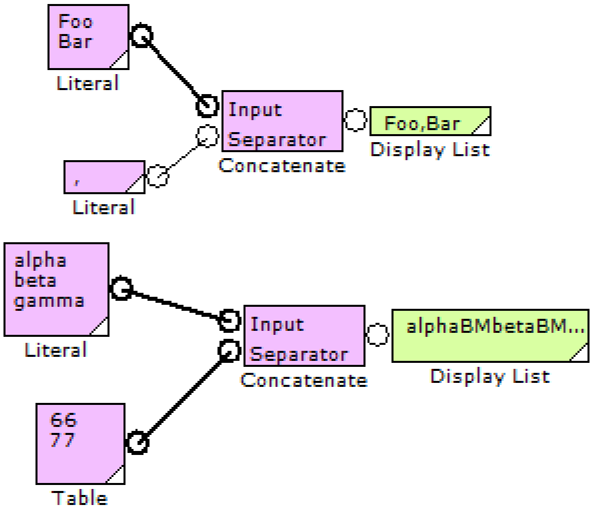
Z Offset: 0





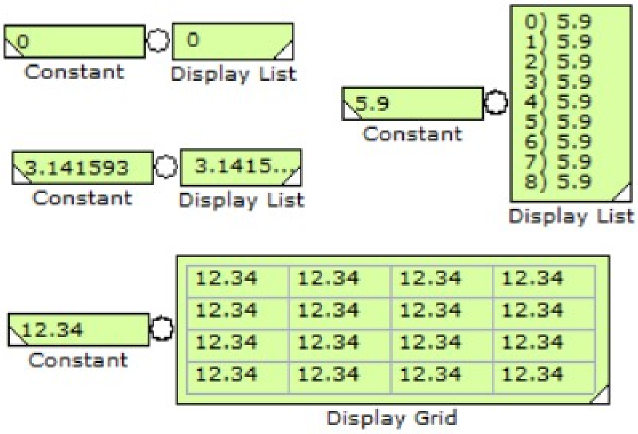
Concatenate

The Concatenate component combines all the values at its input into a single output. You can optionally provide a separator. The separator can be either a string or an array of ASCII values.   Arrays - column 6

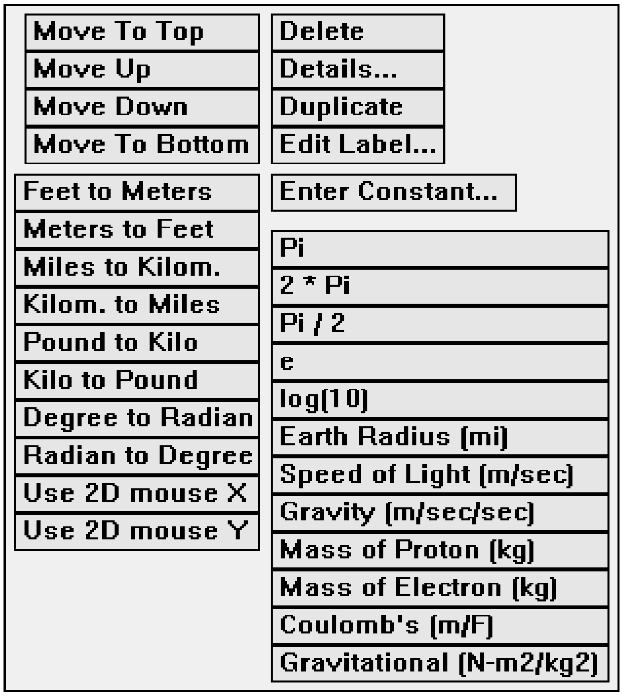


Constant

The Constant component is used to create a single number or an array of that number.   Controls - column 1

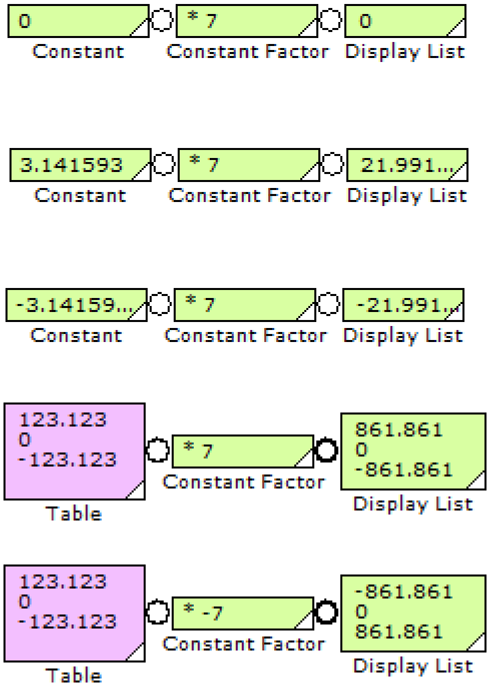


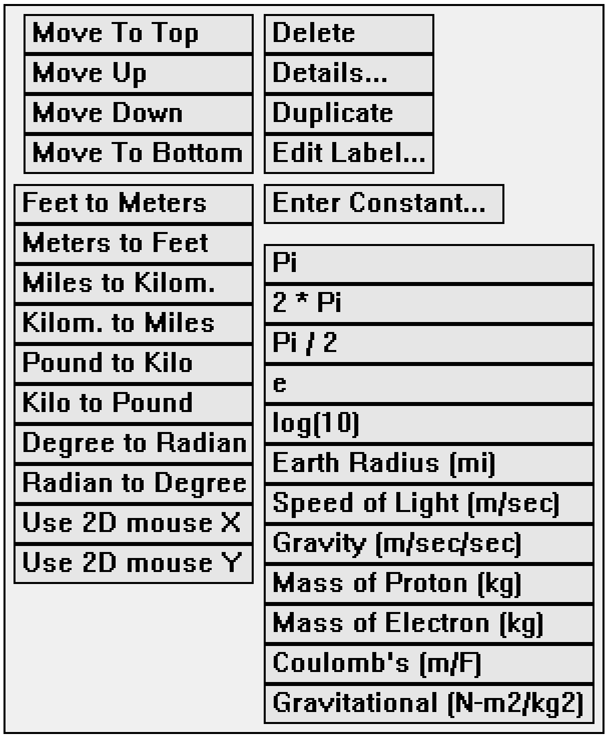
12.34	12.34	12.34	12.34
12.34	12.34	12.34	12.34
12.34	12.34	12.34	12.34
12.34	12.34	12.34	12.34



Constant Factor

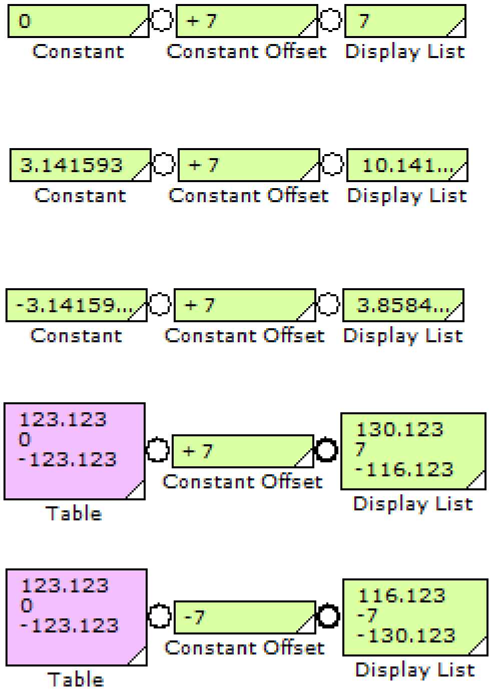
The Constant Factor component multiplies its inputs by a single number. Controls - column 2

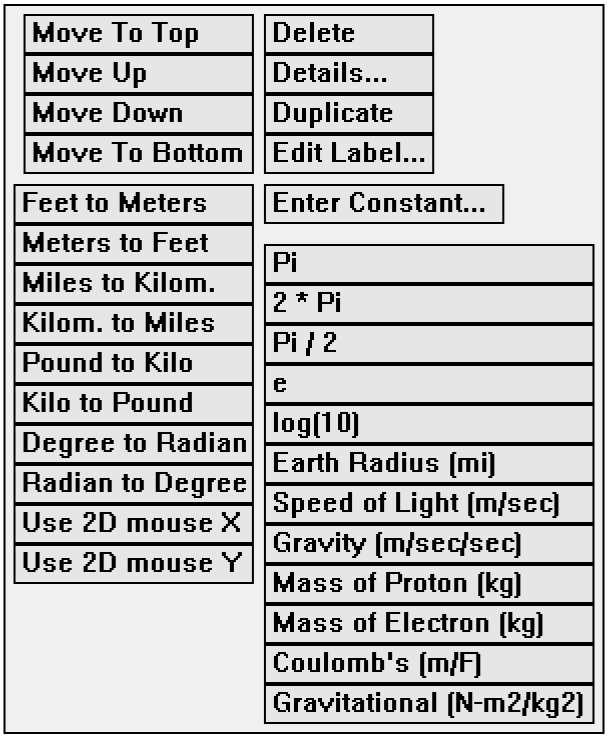




Constant Offset

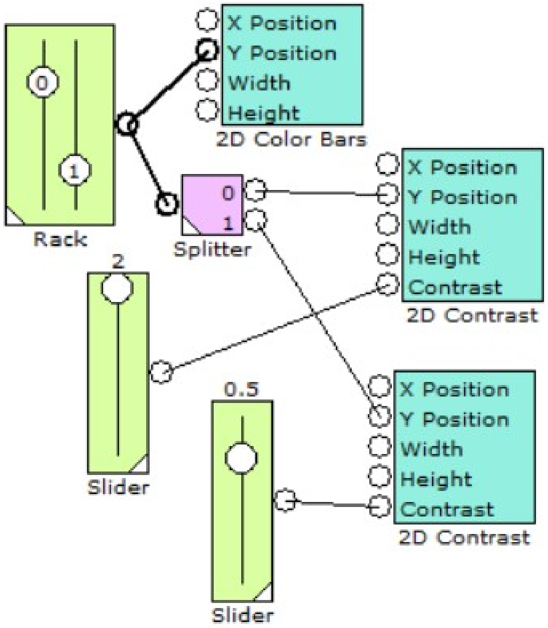
The Constant Offset component add a constant number to its inputs. Controls - column 3

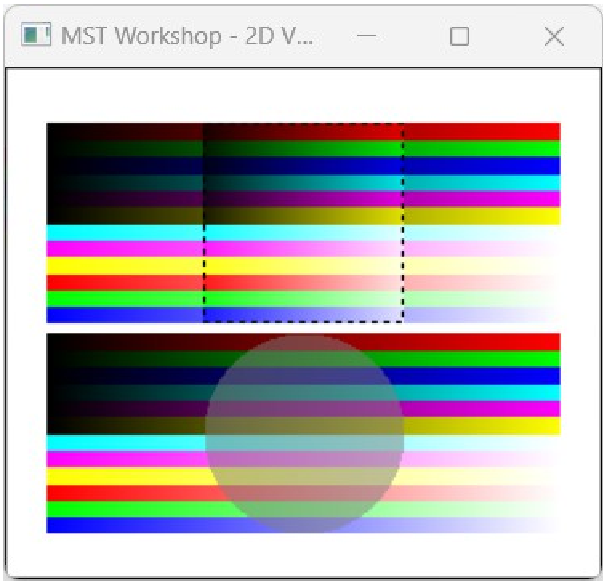




2D Contrast

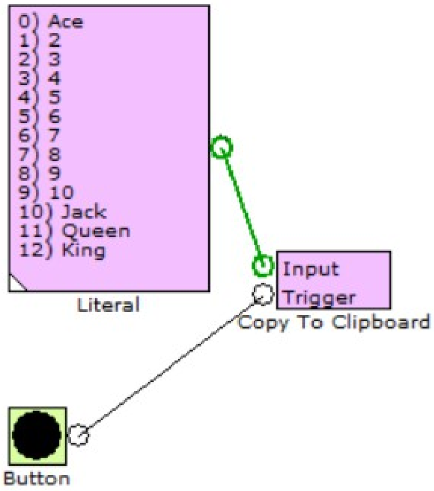
The 2D Contrast component intensifies or softens the 2D drawing it covers. 2D – column 1





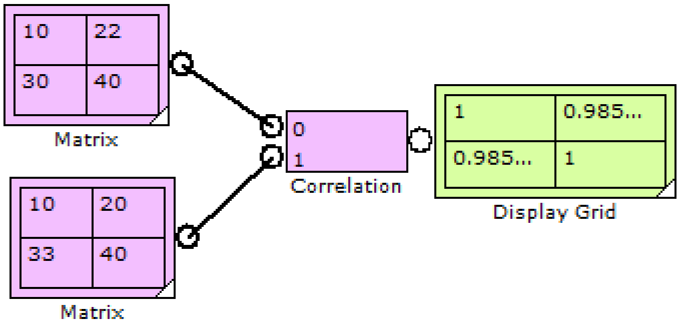
Copy To Clipboard

The Copy To Clipboard component puts text into the clipboard. Arrays – column 5



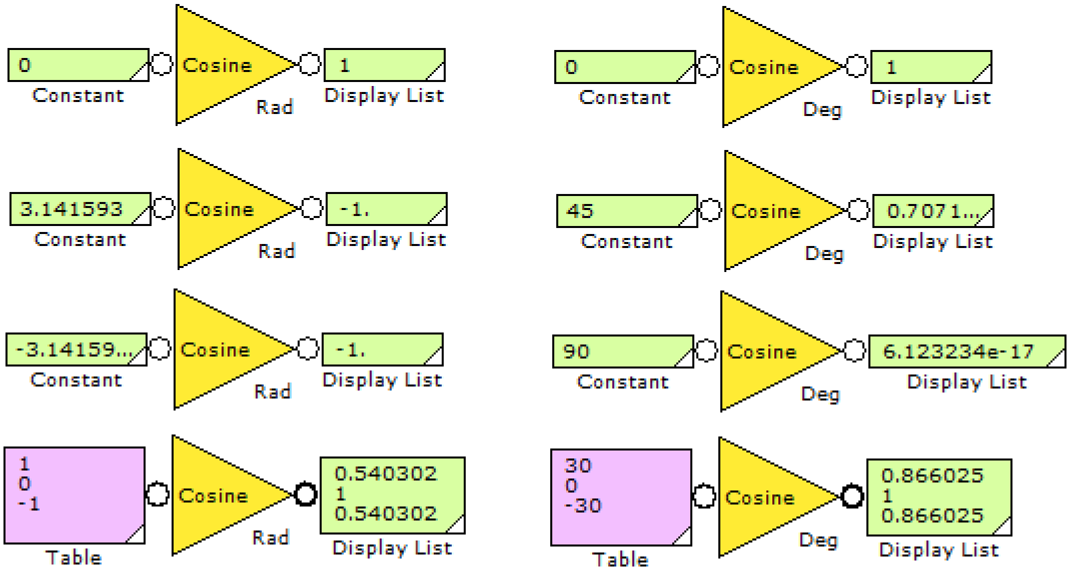
Correlation

The Correlation component calculates the Pearson Correlation matrix for the input matrix. Arrays - column 3



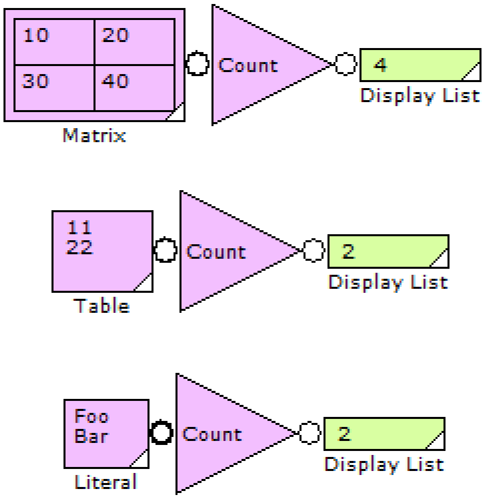
Cosine

The Cosine component calculates the trigonometric cosine of the input (in radians). Input can be scalar or an array.   Functions - column 5



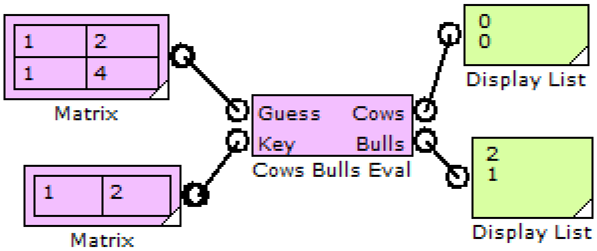
Count

The Count component scans the input array and outputs the number of elements in the array.   Arrays - column 3



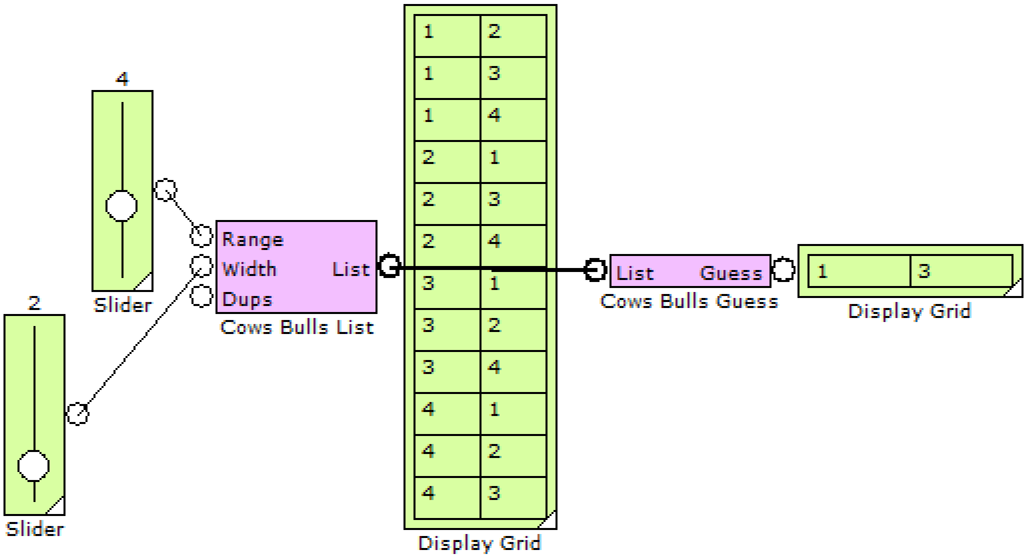
Cows Bulls Eval

The Cows Bulls Eval component evaluates the Guess inputs against the Key input and outputs Cows and Bulls based on how the values match. Arrays - column 5



Cows Bulls Guess

The Cows Bulls Guess component the best guess to minimize future steps to success. Arrays - column 5

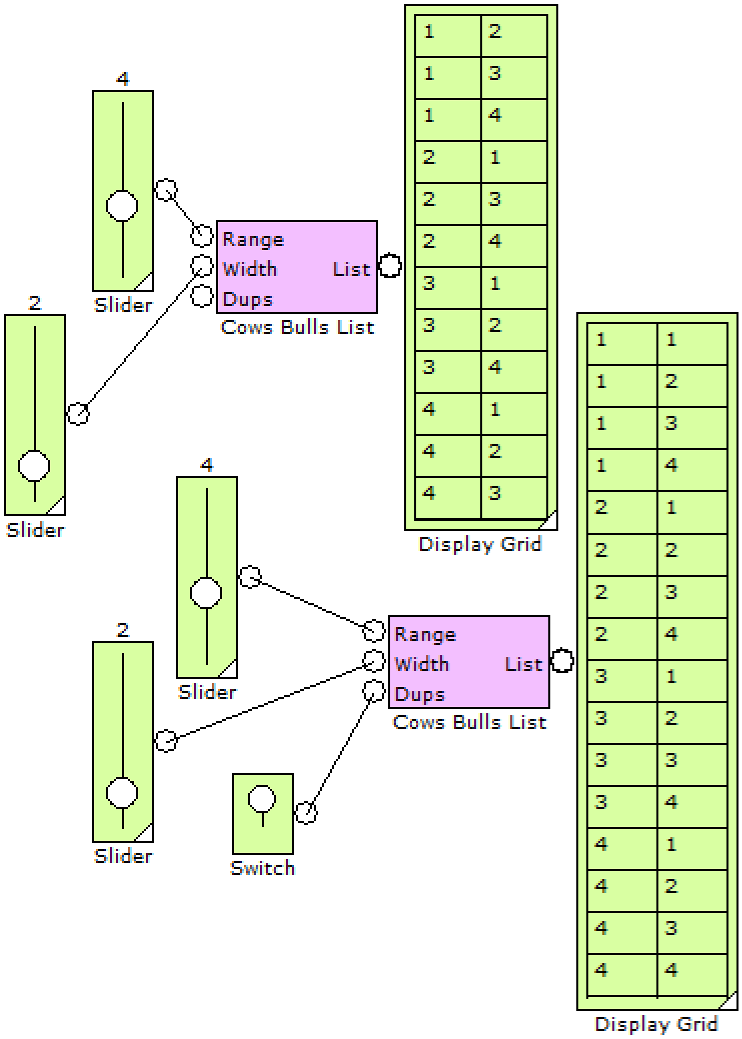


1	2
1	3
1	4
2	1
2	3
2	4
3	1
3	2
3	4
4	1
4	2
4	3

1	3

Cows Bulls List

The Cows Bulls List component creates a list of all possible combinations based on the inputs. Arrays - column 5

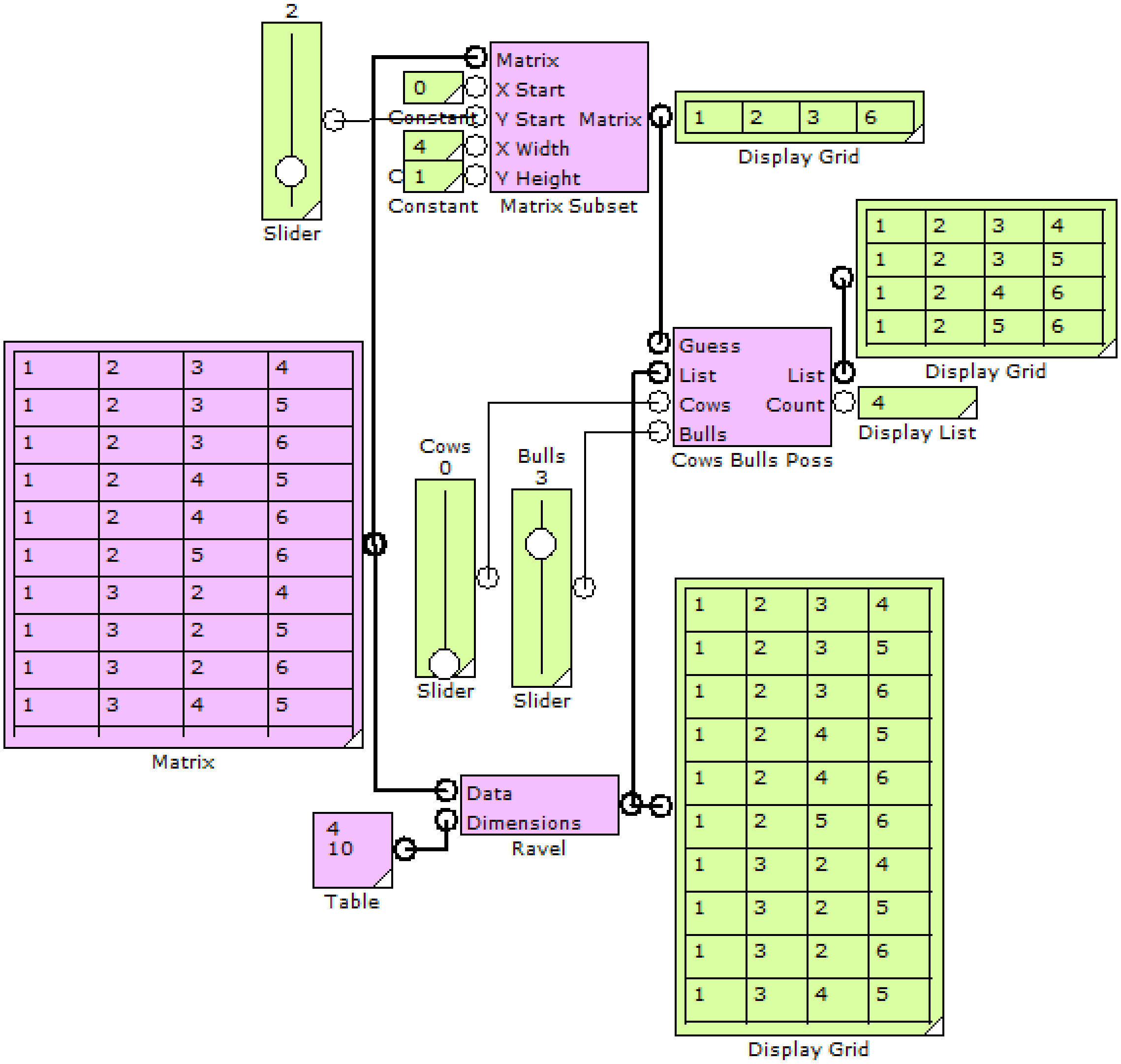


1	2
1	3
1	4
2	1
2	3
2	4
3	1
3	2
3	4
4	1
4	2
4	3

1	1
1	2
1	3
1	4
2	1
2	2
2	3
2	4
3	1
3	2
3	3
3	4
4	1
4	2
4	3
4	4

Cows Bulls Poss

The Cows Bulls Poss component lists all the possible combinations that match the inputs. Arrays - column 5



Matrix

1	2	3	4
1	2	3	5
1	2	3	6
1	2	4	5
1	2	4	6
1	2	5	6
1	3	2	4
1	3	2	5
1	3	2	6
1	3	4	5

Display Grid

1	2	3	6

Display Grid

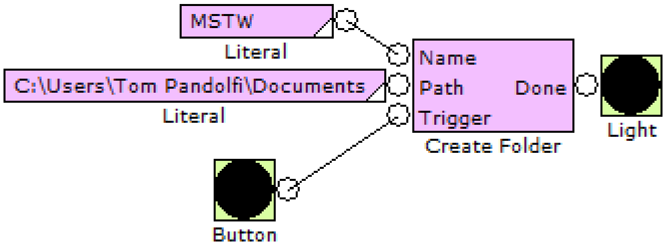
1	2	3	4
1	2	3	5
1	2	4	6
1	2	5	6

Display Grid

1	2	3	4
1	2	3	5
1	2	3	6
1	2	4	5
1	2	4	6
1	2	5	6
1	3	2	4
1	3	2	5
1	3	2	6
1	3	4	5

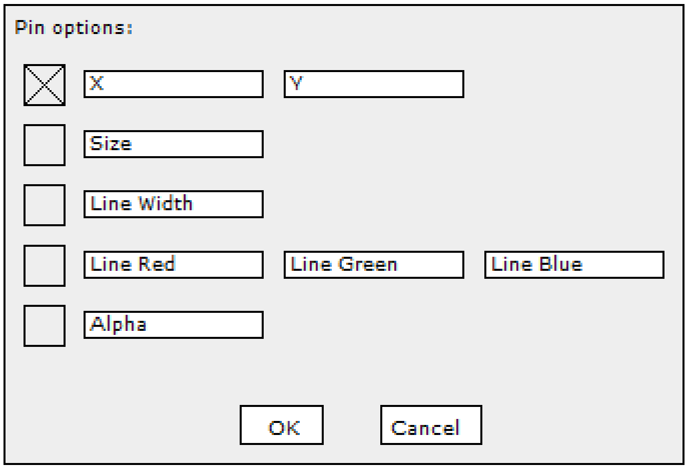
Create Folder

The Create Folder component creates a new folder with the specified name. Arrays - column 7



2D Cross

The 2D Cross component draws a small cross at the X, Y location.   2D - column 1



Pin options:

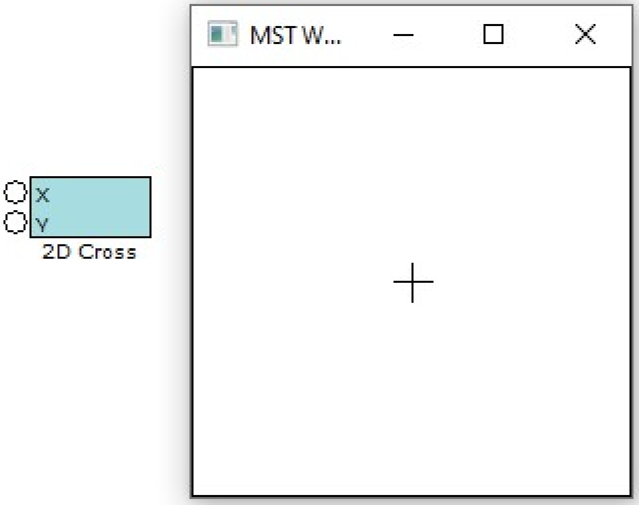
☒ X Y

□ Size

□ Line Width

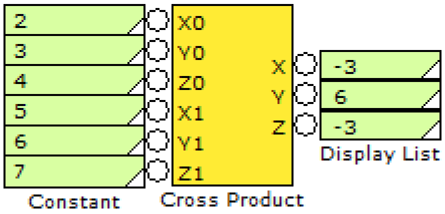
□ Line Red Line Green Line Blue

□ Alpha



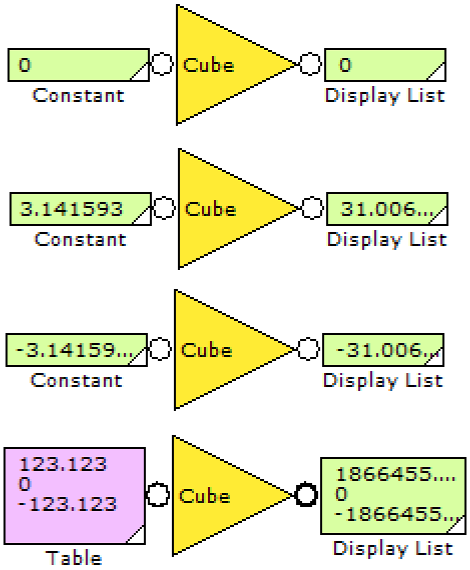
Cross Product

The Cross Product component calculates the cross product of 2 3D vectors. The result is a vector that is perpendicular to both inputs. Functions - column 8



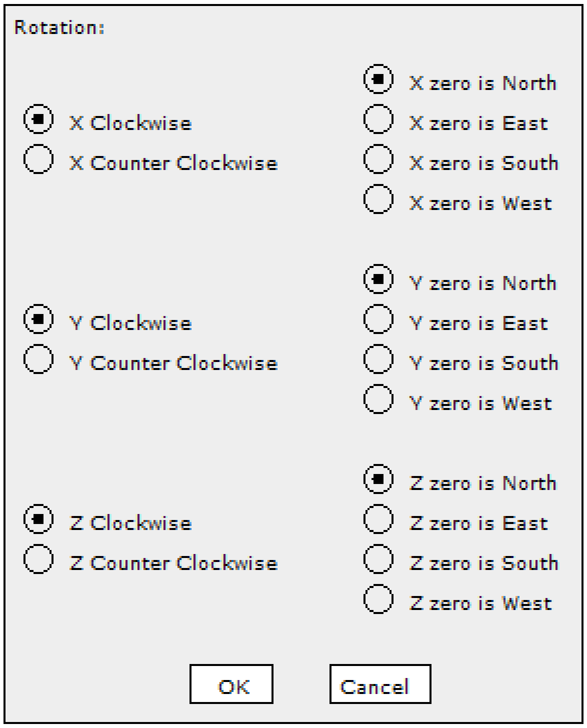
Cube

The Cube component multiplies the input value times itself twice. Input can be scalar or an array.
Functions - column 1



3D Cube

The 3D Cube draws a box in the 3D view window. The X, Y, and Z inputs set the position and size of the box. The Affine [4x4] array input modifies the size, position and orientation. 3D - column 4



Rotation:

● X Clockwise
○ X Counter Clockwise

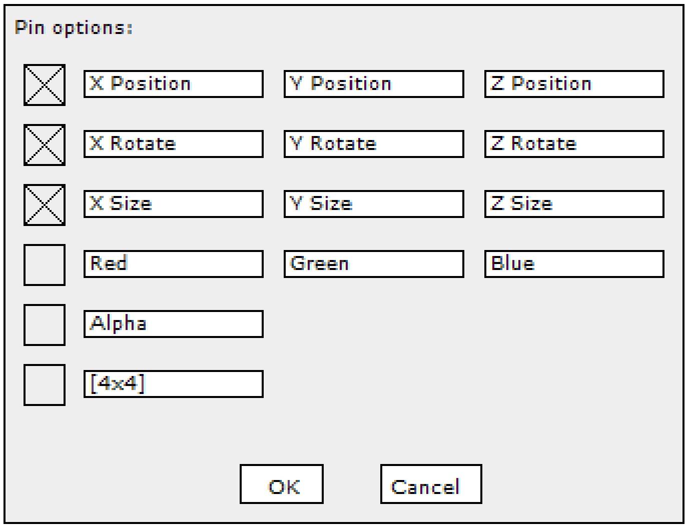
● X zero is North
○ X zero is East
○ X zero is South
○ X zero is West

● Y Clockwise
○ Y Counter Clockwise

● Y zero is North
○ Y zero is East
○ Y zero is South
○ Y zero is West

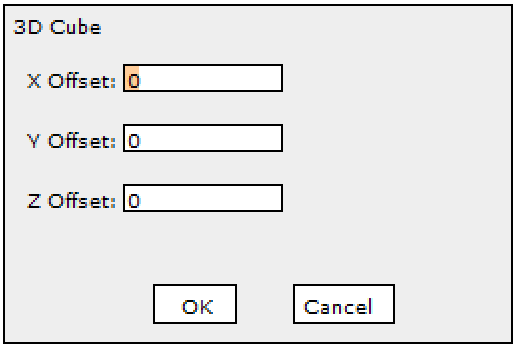
● Z Clockwise
○ Z Counter Clockwise

● Z zero is North
○ Z zero is East
○ Z zero is South
○ Z zero is West



Pin options:

☒ X Position | Y Position | Z Position
☒ X Rotate | Y Rotate | Z Rotate
☒ X Size | Y Size | Z Size
□ Red | Green | Blue
□ Alpha
□ [4x4]

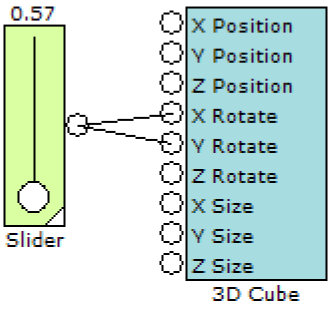


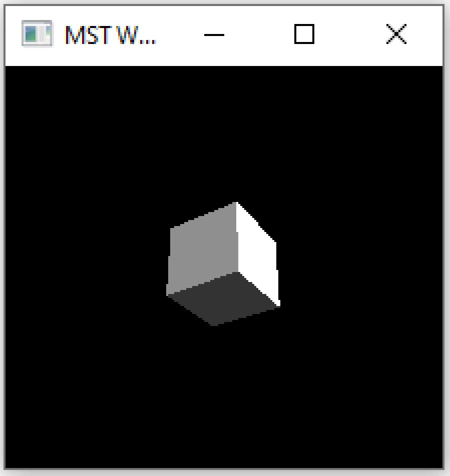
3D Cube

X Offset: 0

Y Offset: 0

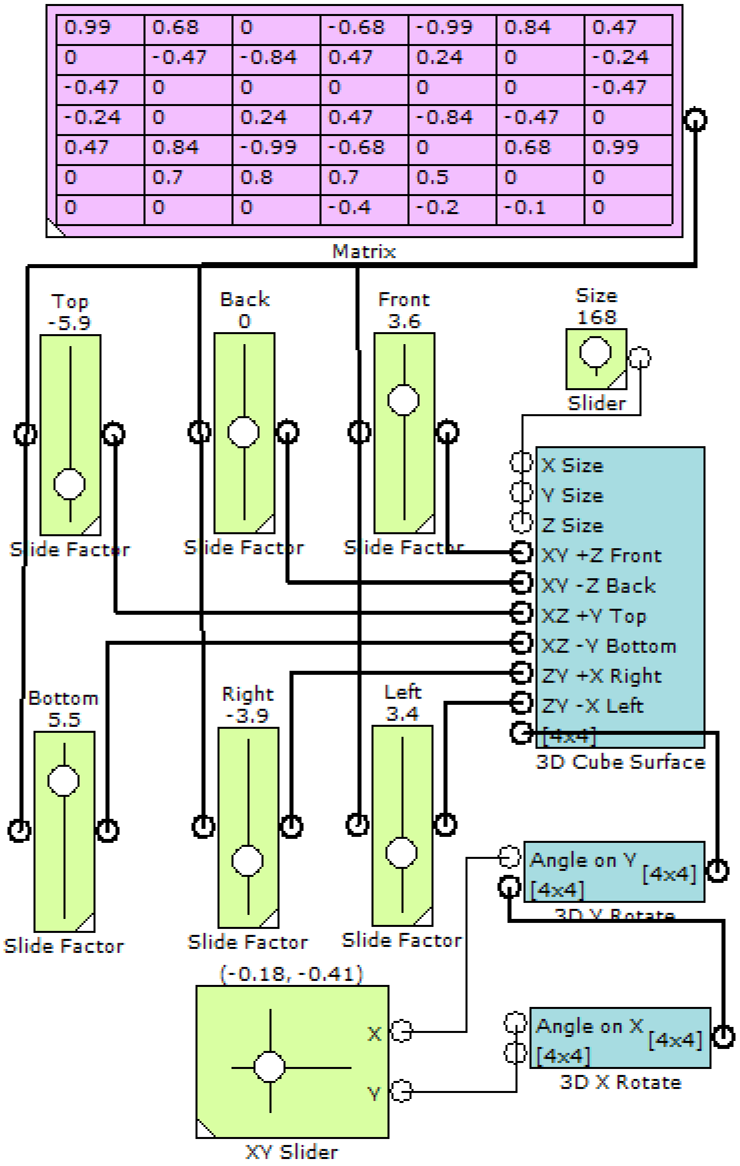
Z Offset: 0



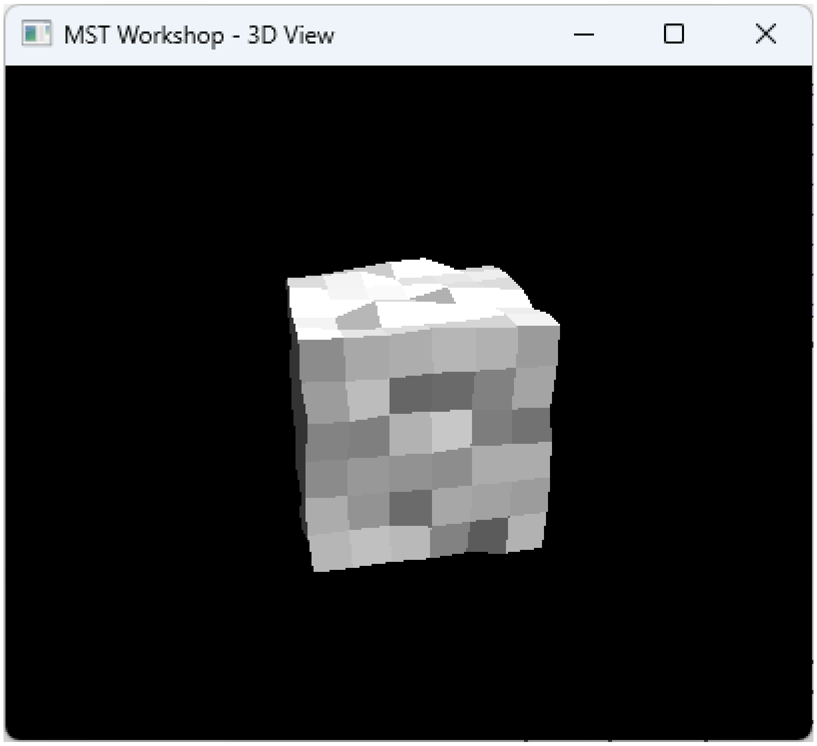


3D Cube Surface

The 3D Cube Surface component draws a cube in the 3D view window using up to 6 surfaces. The 6 surfaces are enabled in the Options menu. Each surface must be a 2D matrix. Each surface matrix must match the others in X, Y, and Z sides of the matrix. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 5

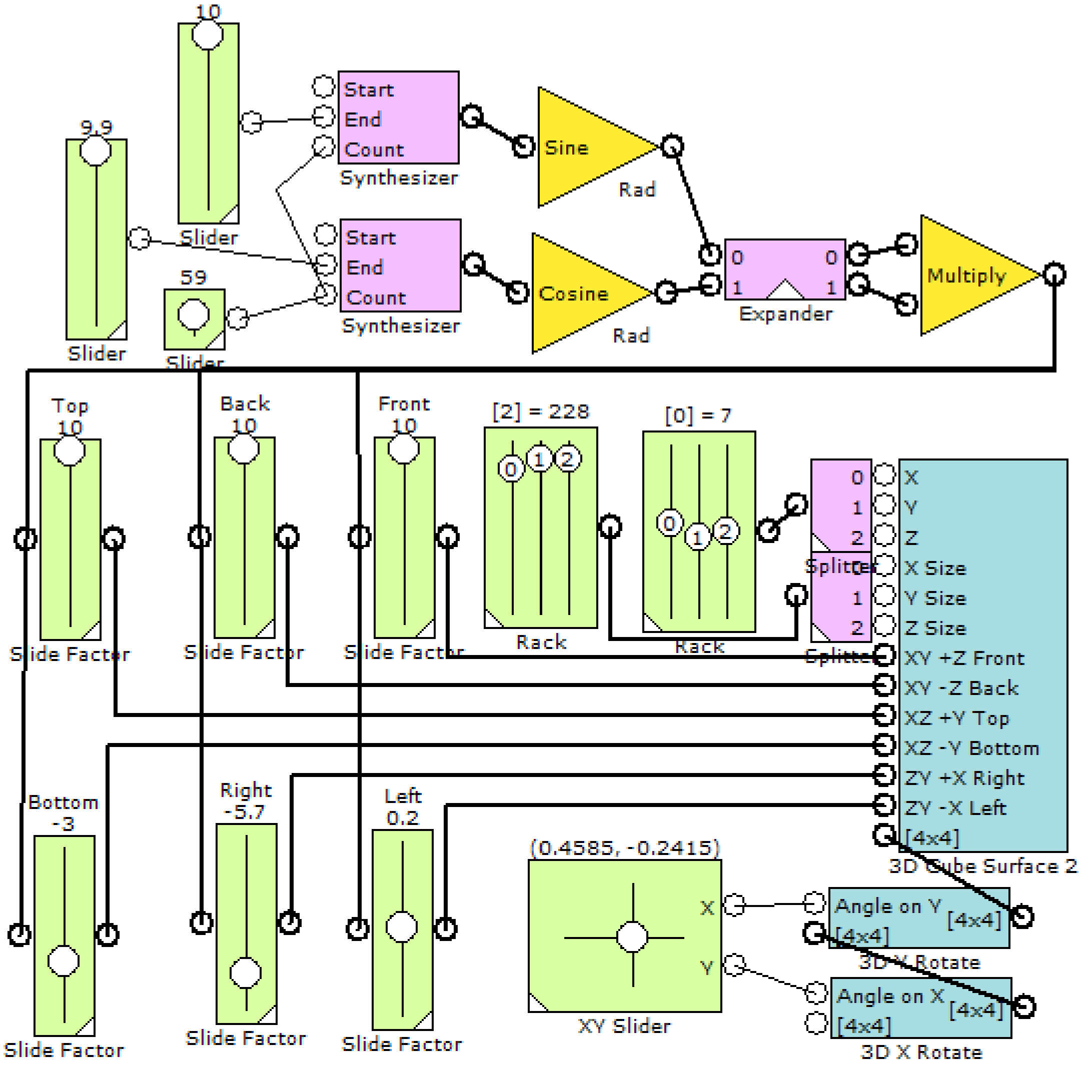


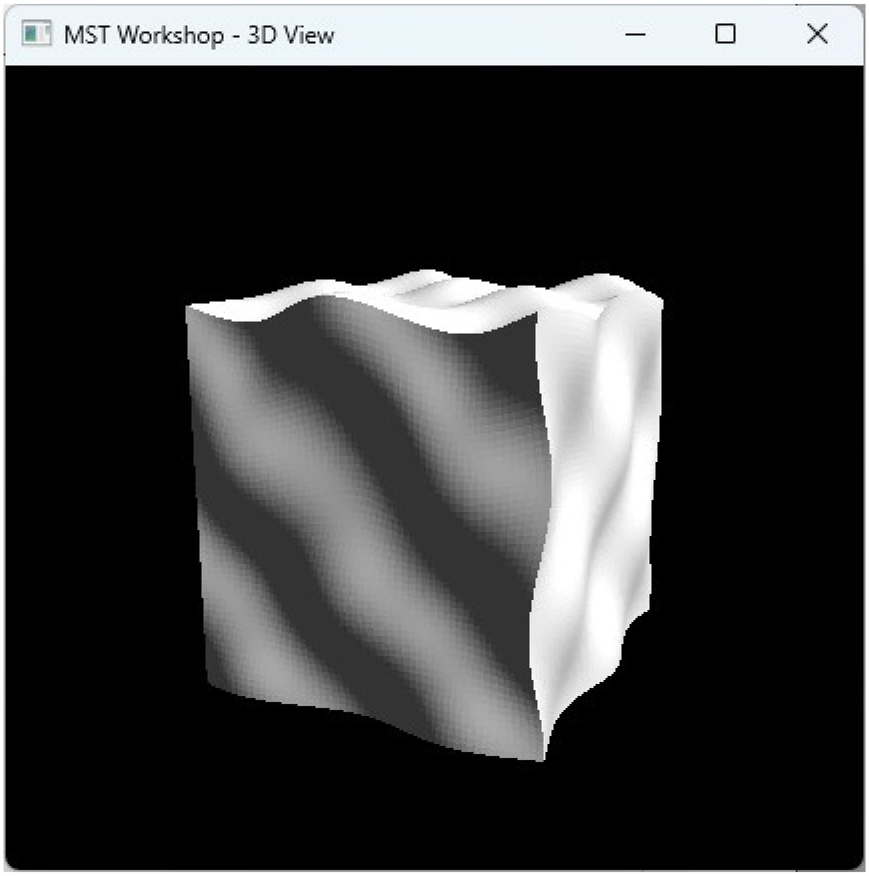
0.99	0.68	0	-0.68	-0.99	0.84	0.47
0	-0.47	-0.84	0.47	0.24	0	-0.24
-0.47	0	0	0	0	0	-0.47
-0.24	0	0.24	0.47	-0.84	-0.47	0
0.47	0.84	-0.99	-0.68	0	0.68	0.99
0	0.7	0.8	0.7	0.5	0	0
0	0	0	-0.4	-0.2	-0.1	0

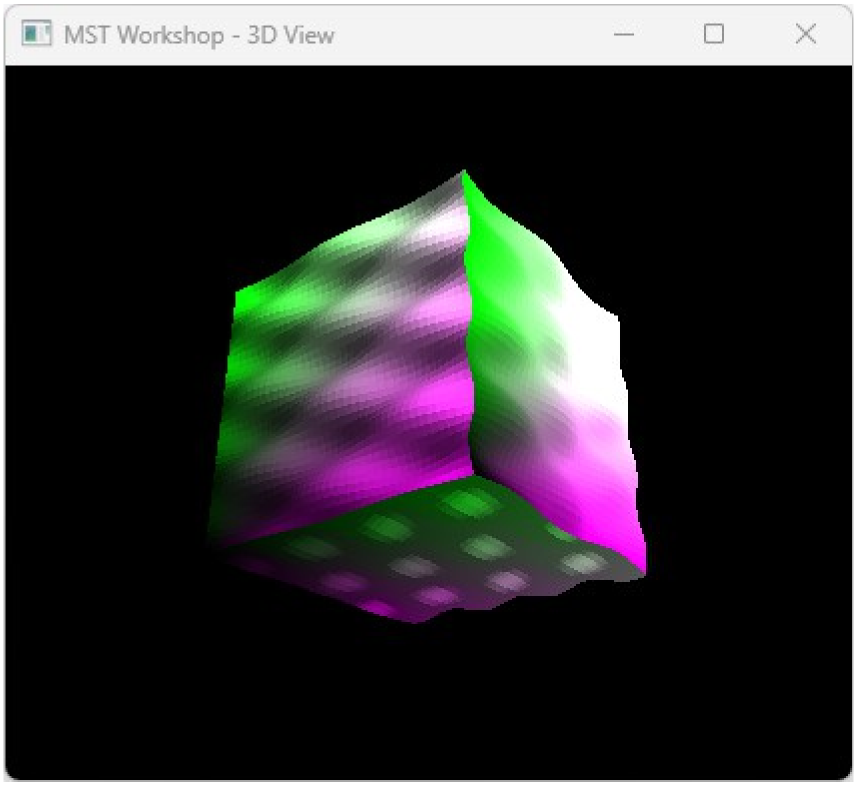

MST Workshop - 3D View

3D Cube Surface 2

The 3D Cube Surface 3D Cube Surface 2 component draws a cube in the 3D view window using up to 6 surfaces. The 6 surfaces are enabled in the Options menu. Each surface must be a 2D matrix. Each surface matrix must match the others in X, Y, and Z sides of the matrix. The Affine [4x4] array input modifies the size, position and orientation. Each surface can be a different color or if arrays are input to the colors each facet will be a unique color.   3D - column 5

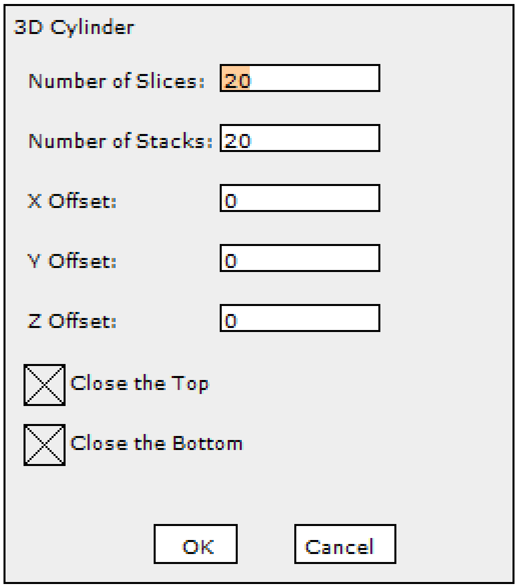



MST Workshop - 3D View


MST Workshop - 3D View

3D Cylinder

The 3D Cylinder draws a cylinder in the 3D view window. The X, Y, and Z inputs set the position and size of the cylinder. The Affine [4x4] array input modifies the size, position and orientation. 3D - column 4



3D Cylinder

Number of Slices: 20

Number of Stacks: 20

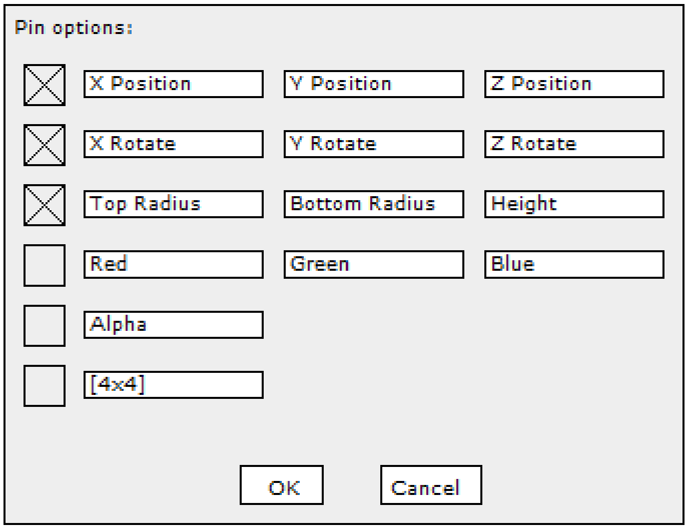
X Offset: 0

Y Offset: 0

Z Offset: 0

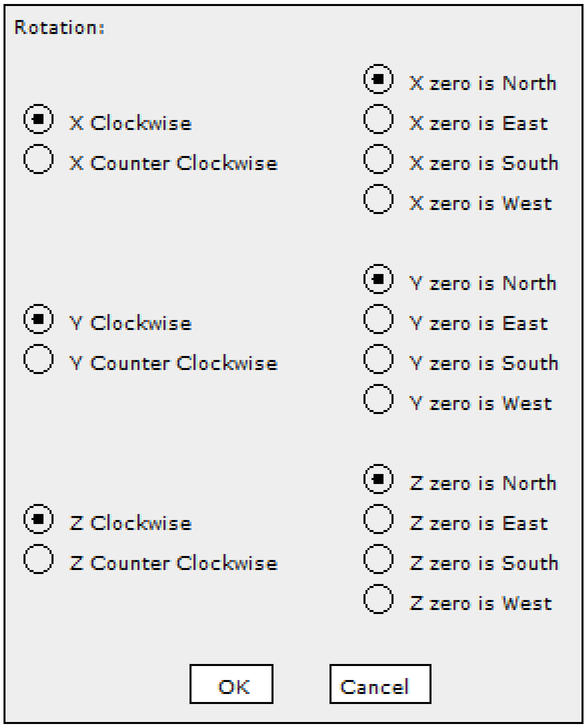
☒ Close the Top

☒ Close the Bottom



Pin options:

☒	X Position	Y Position	Z Position
☒	X Rotate	Y Rotate	Z Rotate
☒	Top Radius	Bottom Radius	Height
□	Red	Green	Blue
□	Alpha		
□	[4x4]		



Rotation:

● X Clockwise
○ X Counter Clockwise

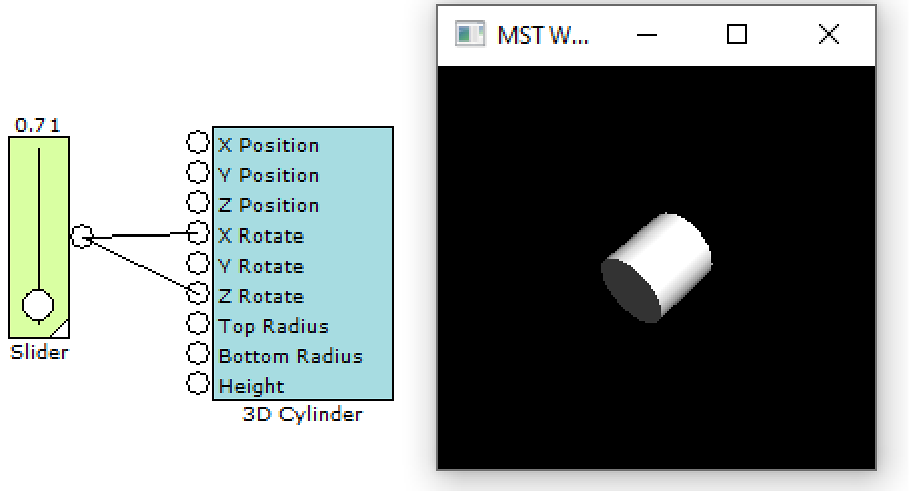
● X zero is North
○ X zero is East
○ X zero is South
○ X zero is West

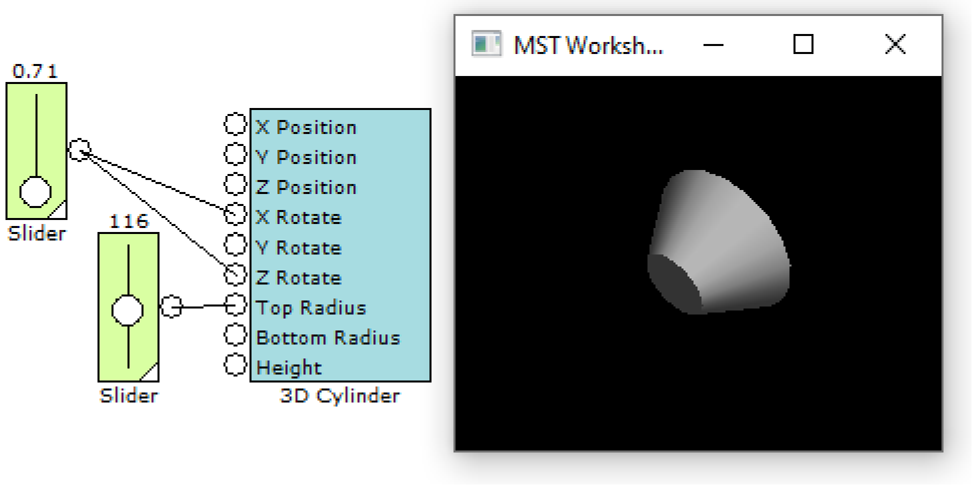
● Y Clockwise
○ Y Counter Clockwise

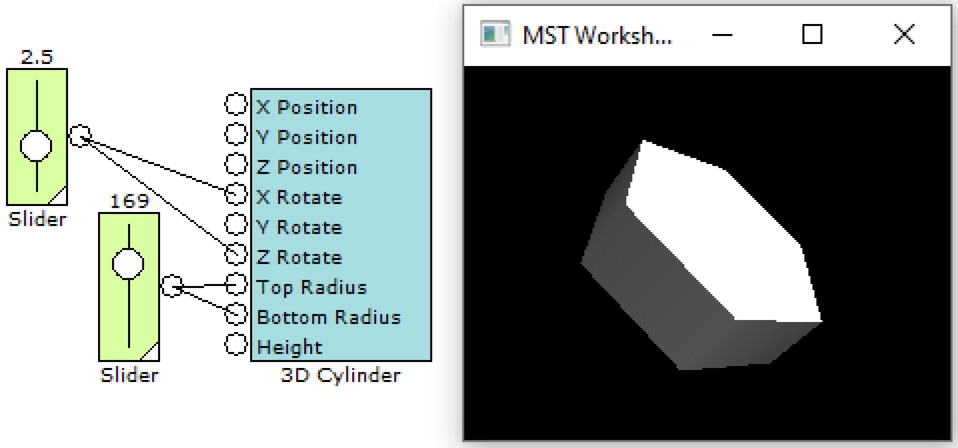
● Y zero is North
○ Y zero is East
○ Y zero is South
○ Y zero is West

● Z Clockwise
○ Z Counter Clockwise

● Z zero is North
○ Z zero is East
○ Z zero is South
○ Z zero is West

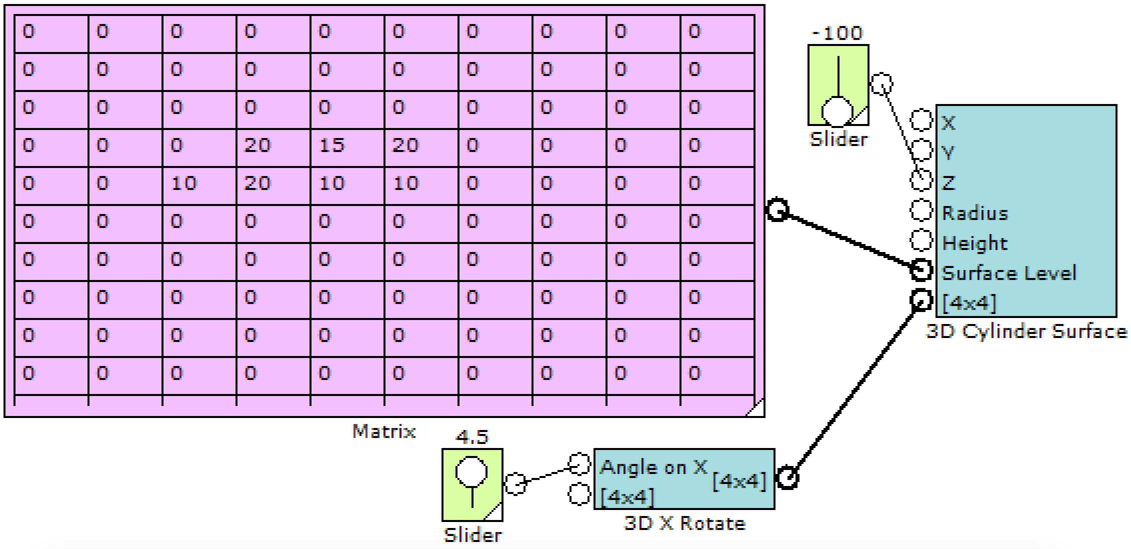

0.71
Slider
X Position
Y Position
Z Position
X Rotate
Y Rotate
Z Rotate
Top Radius
Bottom Radius
Height
3D Cylinder
MST W...


0.71
Slider
116
Slider
X Position
Y Position
Z Position
X Rotate
Y Rotate
Z Rotate
Top Radius
Bottom Radius
Height
3D Cylinder
MST Worksh...

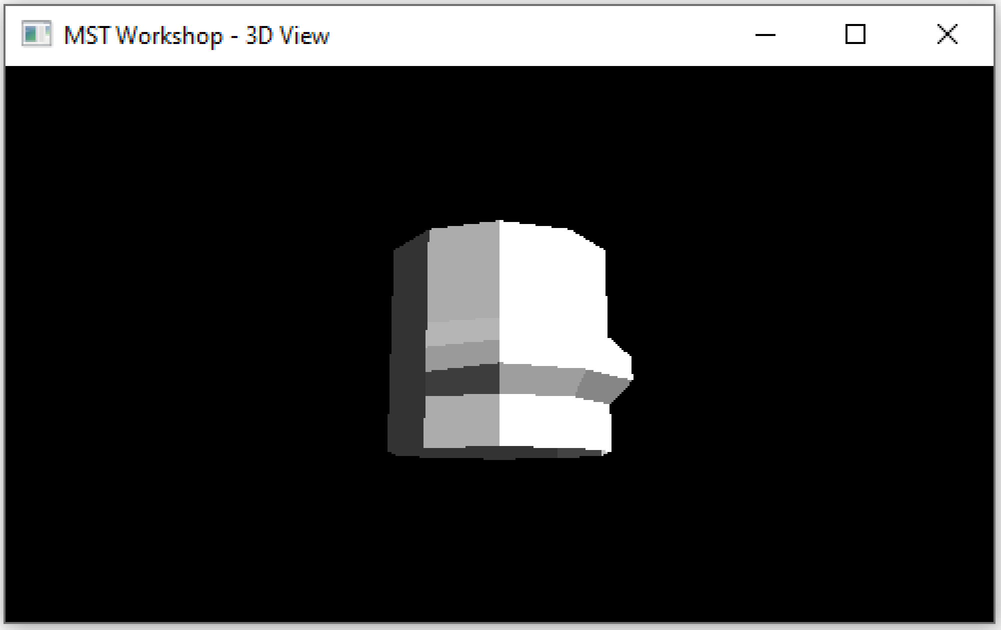

2.5
Slider
169
Slider
X Position
Y Position
Z Position
X Rotate
Y Rotate
Z Rotate
Top Radius
Bottom Radius
Height
3D Cylinder
MST Worksh...

3D Cylinder Surface

The 3D Cylinder Surface component draws a cylinder with an embossed surface in the 3D view window. The Matrix and Mat Row Size inputs set the 2D data to be plotted. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 5

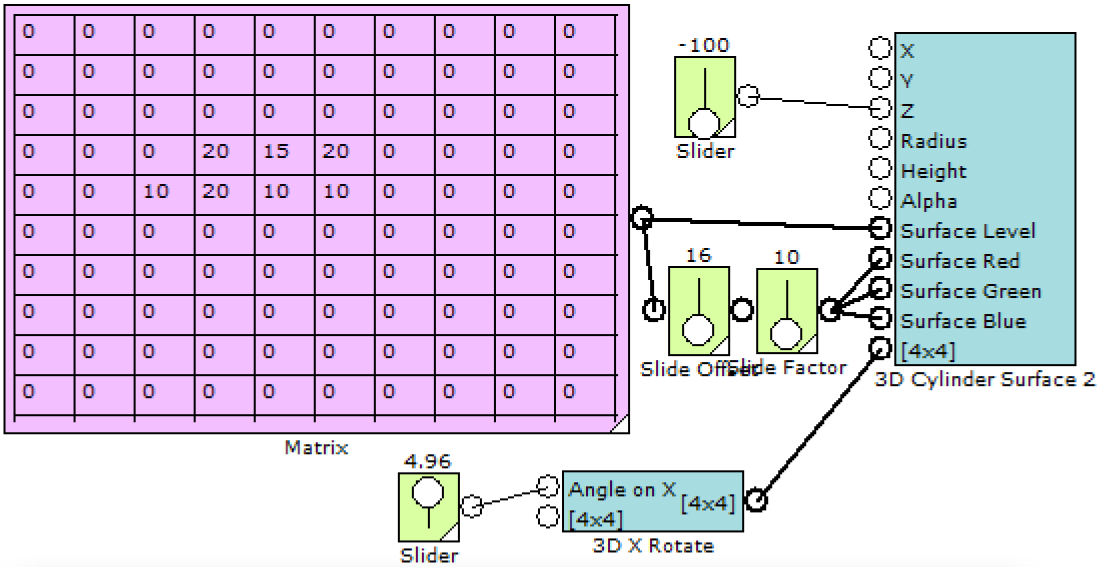


0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	20	15	20	0	0	0	0
0	0	10	20	10	10	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

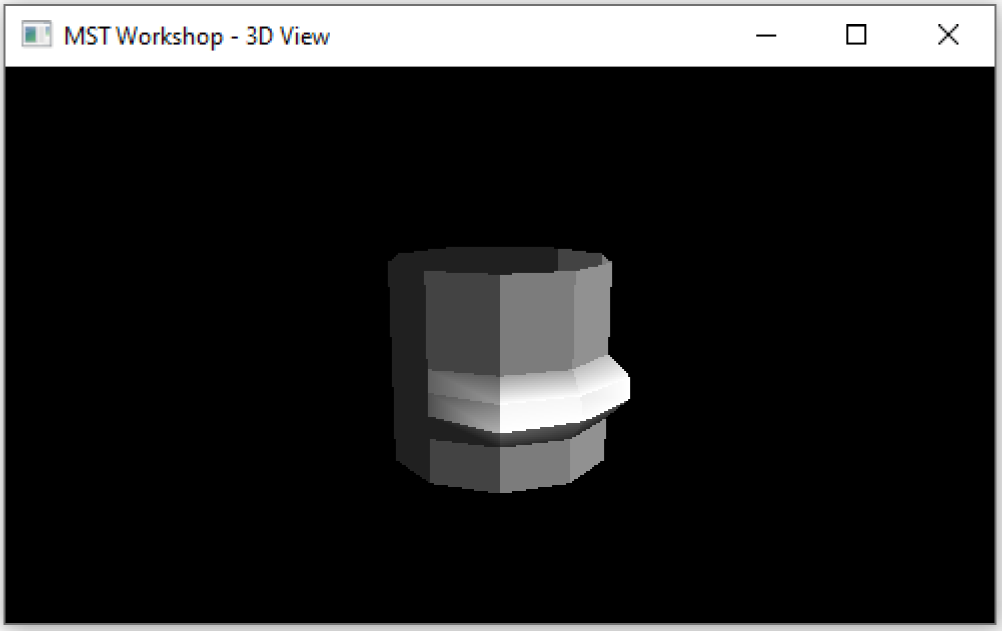


3D Cylinder Surface 2

The 3D Cylinder Surface 2 component draws a cylinder with an embossed and color surface in the 3D view window. The Matrix and Mat Row Size inputs set the 2D data to be plotted. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 5

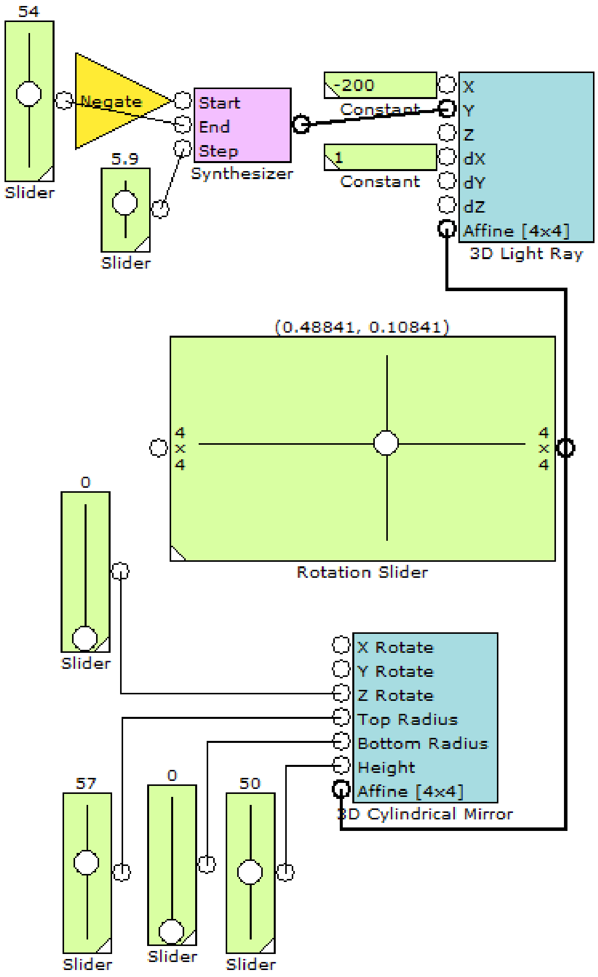


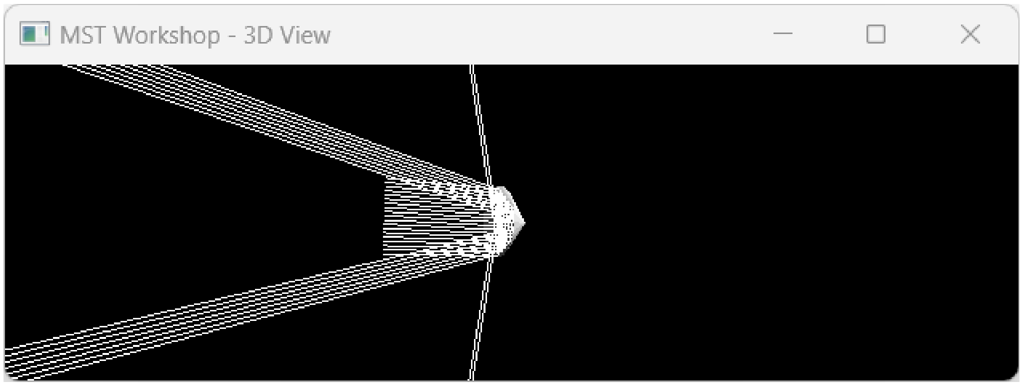
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	20	15	20	0	0	0	0
0	0	10	20	10	10	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0



3D Cylindrical Mirror

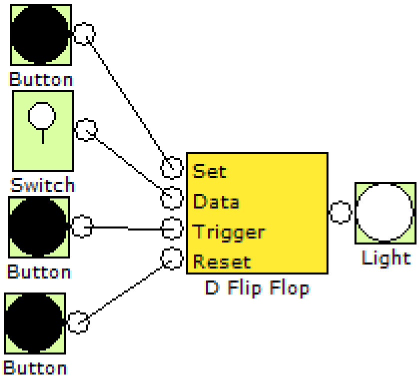
The 3D Cylindrical Mirror component reflects light rays in the 3D view window. The settings determine the fraction of light that reflects and passes through. The Affine [4x4] array input modifies the size, position, and orientation of the mirror. 3D - column 5

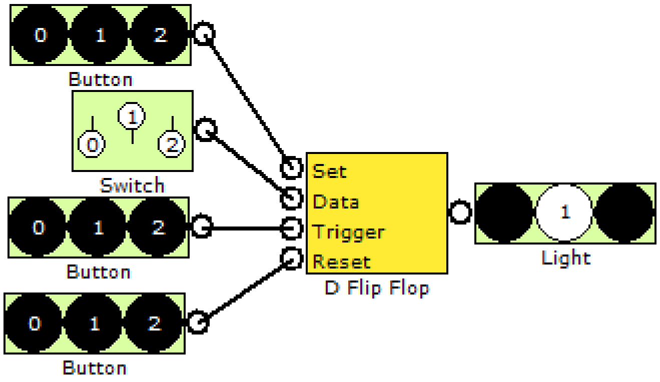




D Flip Flop

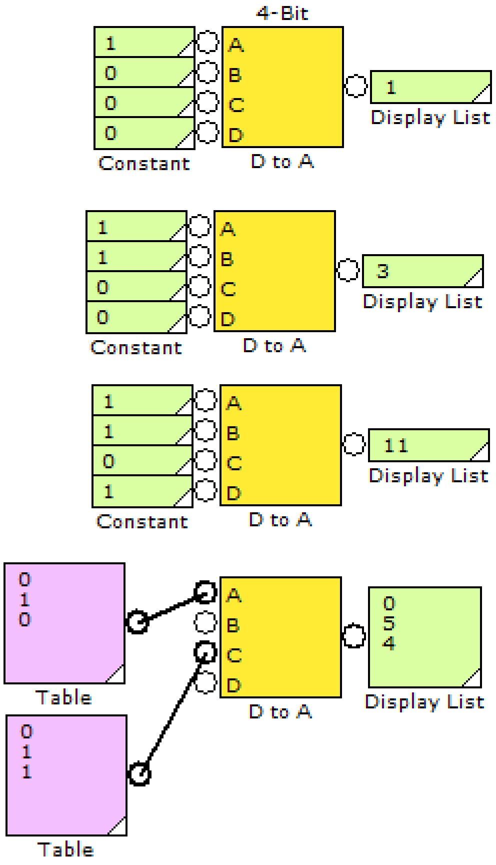
The D Flip Flop component is a memory device that can toggle between true and false. Functions - column 3





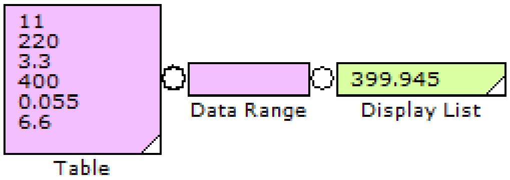
D to A

The D to A component lets you convert digital input into analog outputs. Functions - column 3



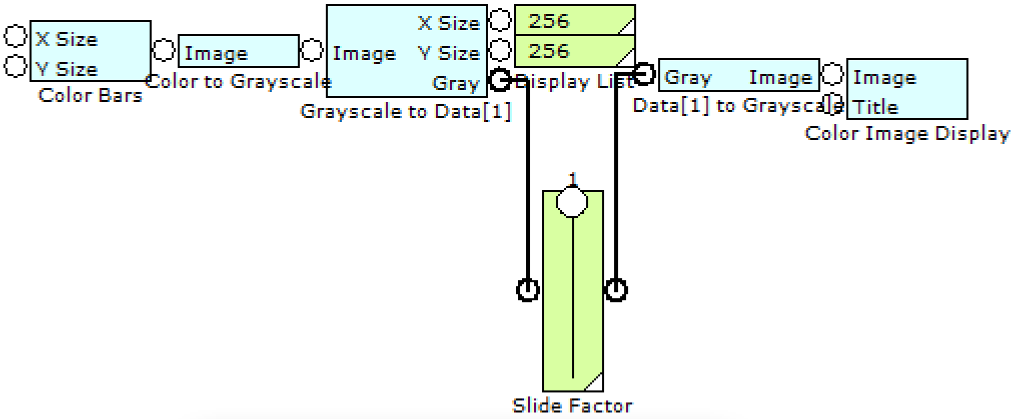
Data Range

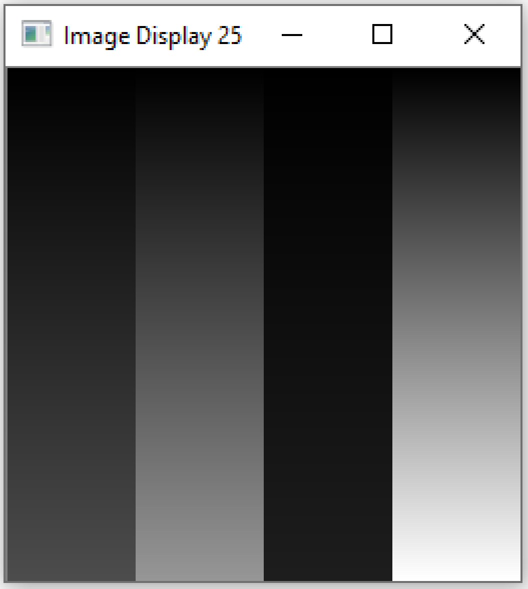
The Data Range component scans the input array and outputs the maximum value minus the minimum value. Arrays - column 3



Data[1] to Grayscale

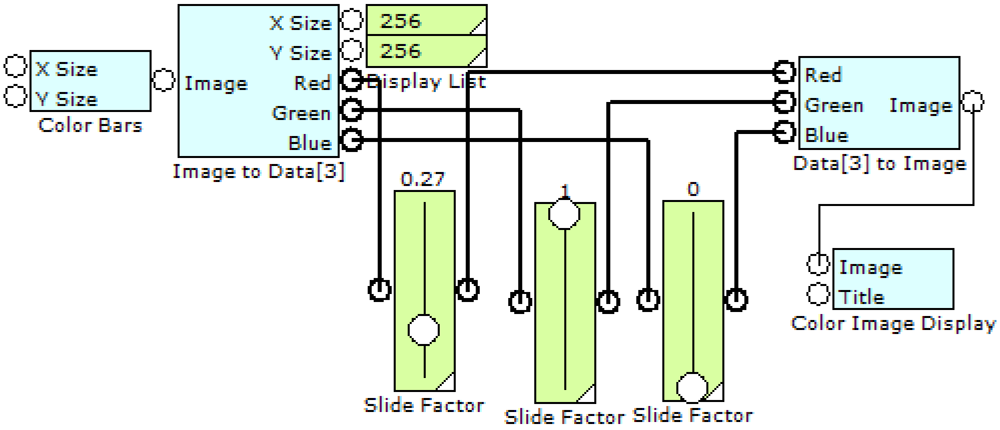
The Data[1] to Grayscale component creates a grayscale image from the input data. Images - column 5

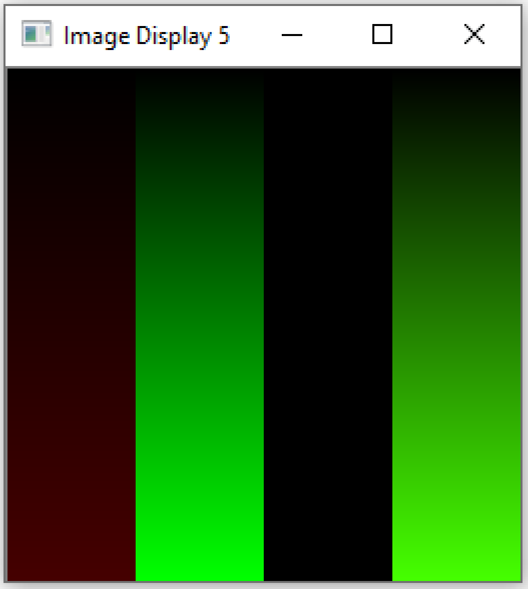




Data[3] to Image

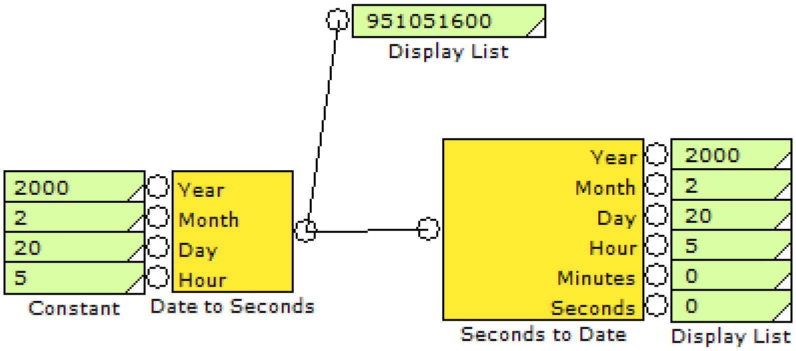
The Data[3] to Image component creates a three color image from the color data provided.   Images - column 5





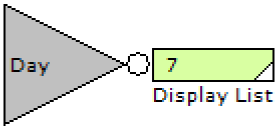
Date to Seconds

The Date to Seconds component takes a date and converts it to a number of seconds. when the input is not connected it uses the computer's internal clock. Functions - column 6



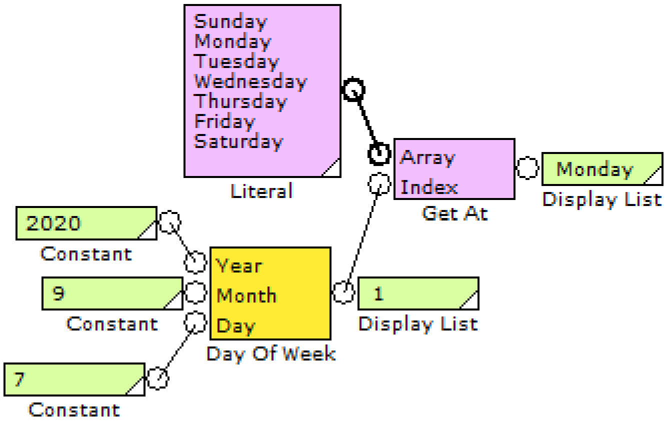
Day

The Day component outputs the current calendar day of the month. Functions - column 7



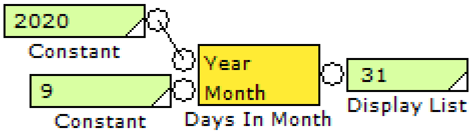
Day Of Week

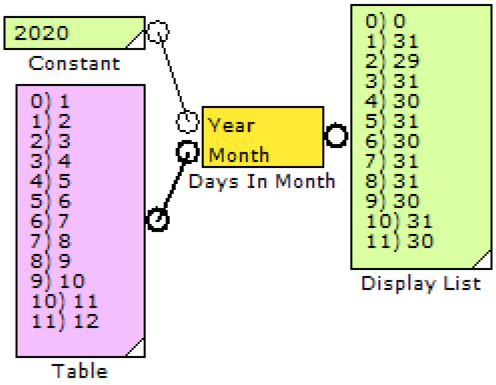
The Day Of Week component outputs 0 for Sunday, 1 for Monday... 6 for Saturday.   Functions - column 7



Days In Month

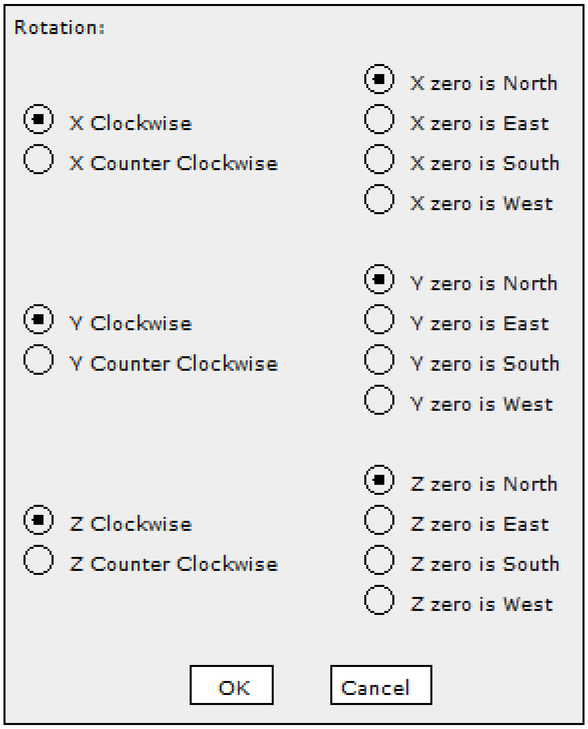
The Days In Month component outputs the number of days in the given month.   Functions - column 7





2D DC Motor

The 2D DC Motor creates a motor that can drive other simulation objects like Gears. Place a Gear at the same X, Y position to connect the motor to the gear.   2D - column 3



Rotation:

● X Clockwise
○ X Counter Clockwise

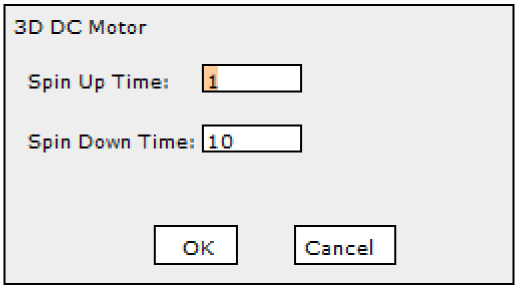
● X zero is North
○ X zero is East
○ X zero is South
○ X zero is West

● Y Clockwise
○ Y Counter Clockwise

● Y zero is North
○ Y zero is East
○ Y zero is South
○ Y zero is West

● Z Clockwise
○ Z Counter Clockwise

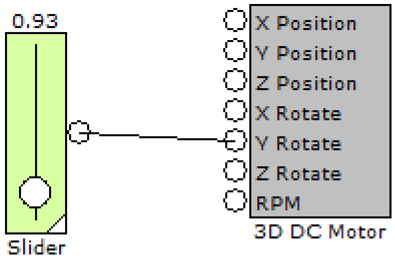
● Z zero is North
○ Z zero is East
○ Z zero is South
○ Z zero is West

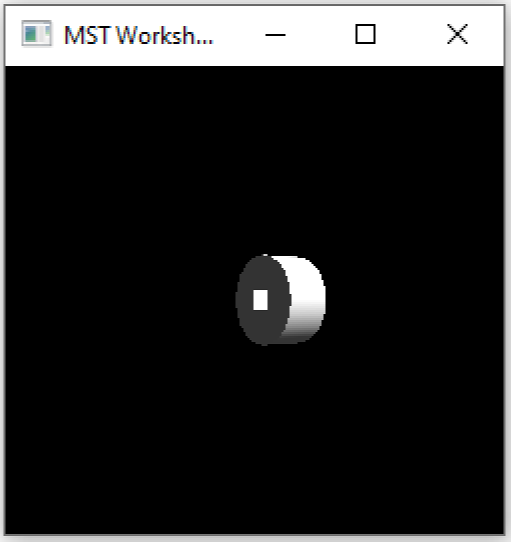


3D DC Motor

Spin Up Time: 1

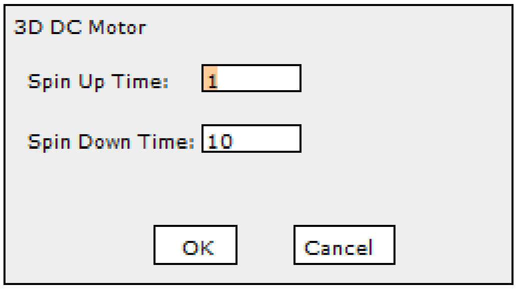
Spin Down Time: 10





3D DC Motor

The 3D DC Motor creates a motor that can drive other 3D simulation objects like 3D Gears. Place a Gear at the same X, Y, Z position and orientation to connect the motor to a gear. You specify the RPM of them motor.   3D - column 4

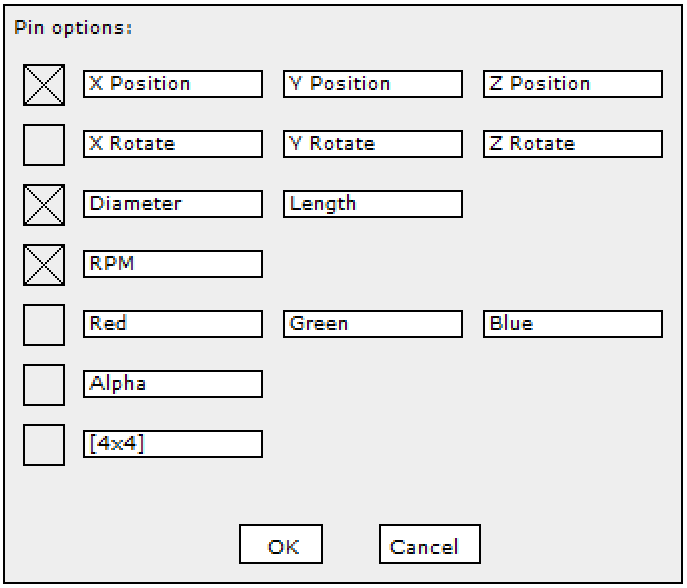


3D DC Motor

Spin Up Time: 1

Spin Down Time: 10

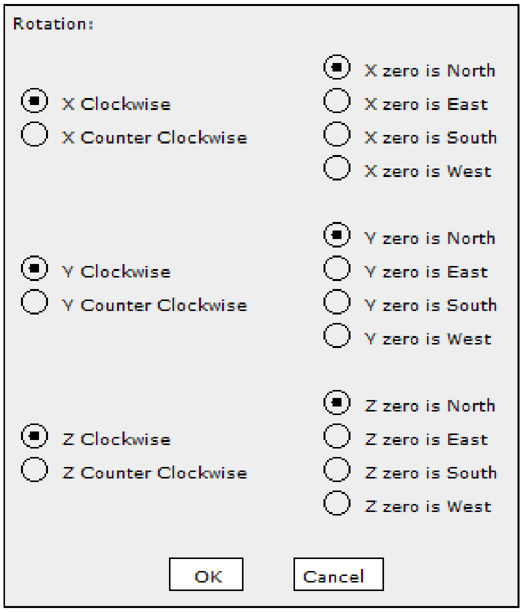
OK Cancel



Pin options:

☒	X Position	Y Position	Z Position
□	X Rotate	Y Rotate	Z Rotate
☒	Diameter	Length	
☒	RPM		
□	Red	Green	Blue
□	Alpha		
□	[4x4]		

OK Cancel



Rotation:

● X Clockwise
○ X Counter Clockwise

● X zero is North
○ X zero is East
○ X zero is South
○ X zero is West

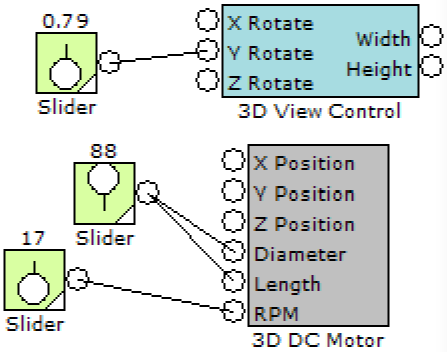
● Y Clockwise
○ Y Counter Clockwise

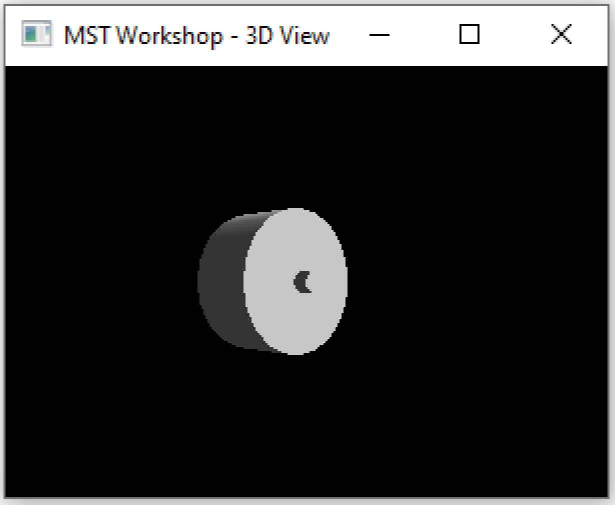
● Y zero is North
○ Y zero is East
○ Y zero is South
○ Y zero is West

● Z Clockwise
○ Z Counter Clockwise

● Z zero is North
○ Z zero is East
○ Z zero is South
○ Z zero is West

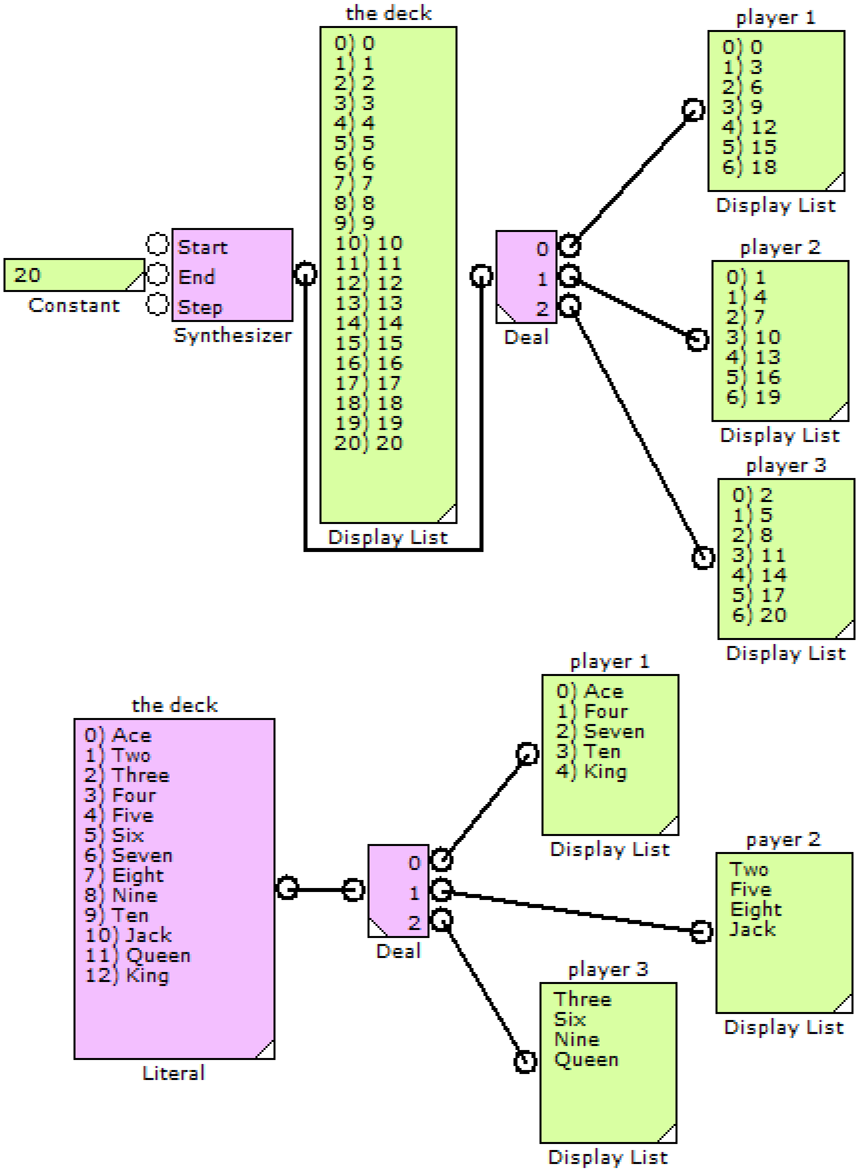
OK Cancel





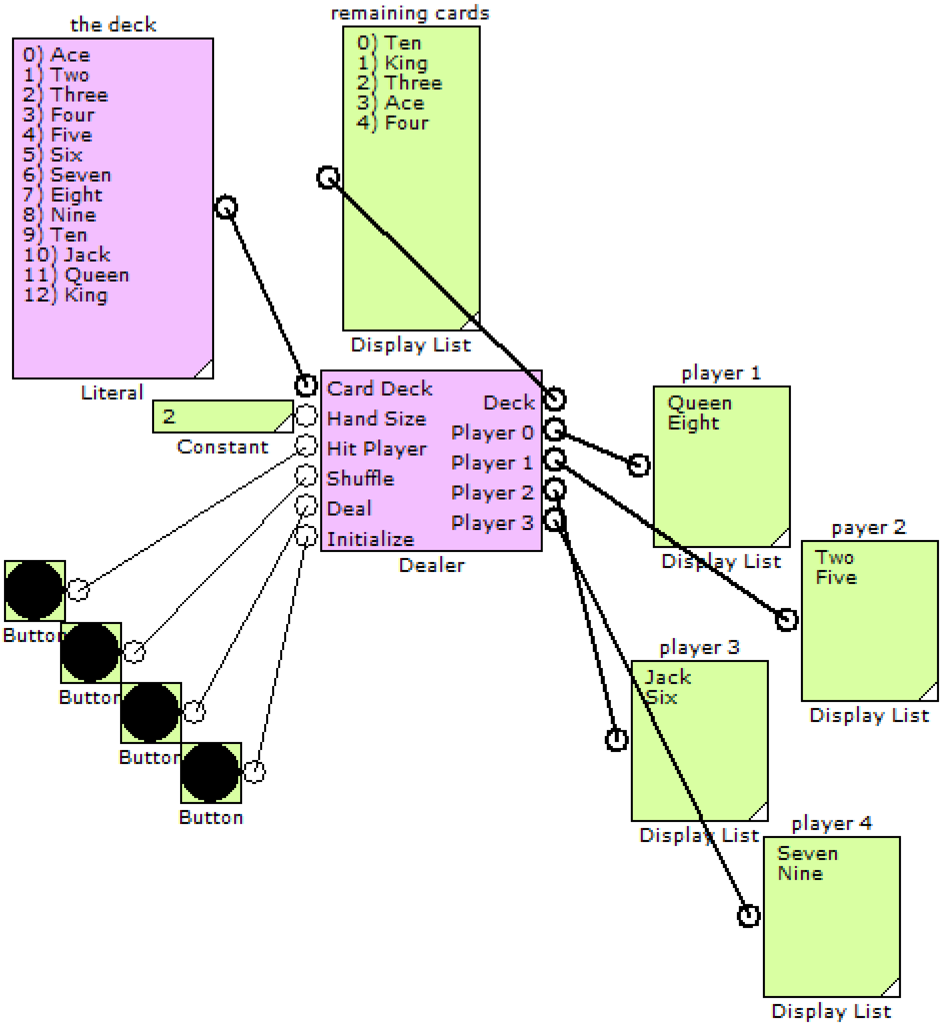
Deal

The Deal component breaks the input into separate outputs. The outputs each receive one value at a time, like in a card game. You can set the number of outputs desired.   Arrays - column 1



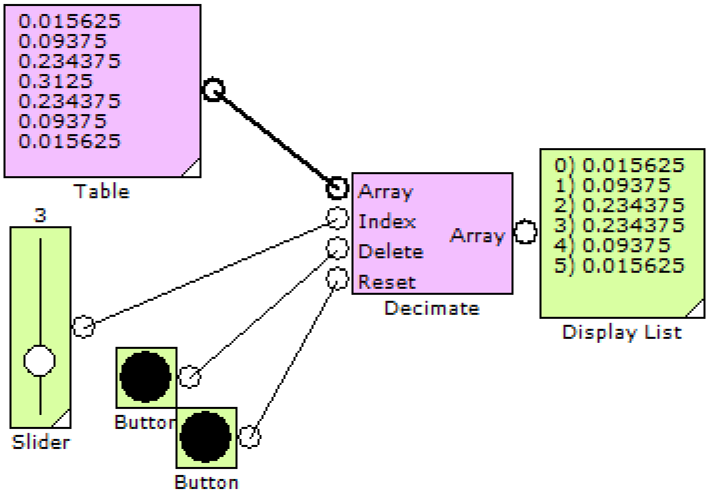
Dealer

The Dealer component simulates a dealer in a card game.   Arrays - column 6



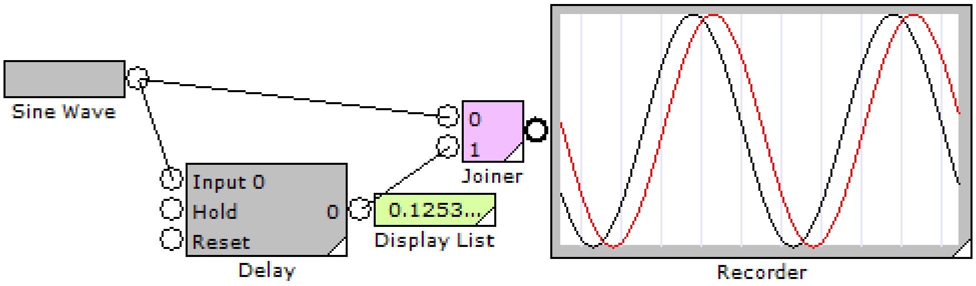
Decimate

The Decimate component starts with a copy of the Array input. Each time the Delete input goes true an element of the array is removed from the output indicated by the Index input. The input Array is copied to the output when the Reset input goes true. Arrays - column 2



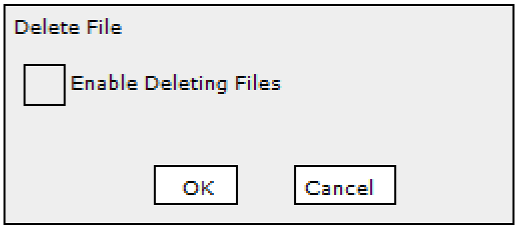
Delay

The Delay component delays a signal for the number of clock ticks set in the Options dialog.
Functions - column 3



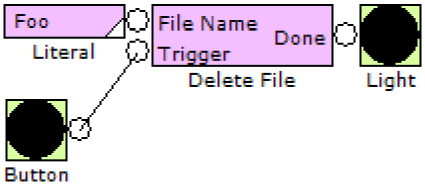
Delete File

The Delete File component permanently deletes the specified file. BE CAREFUL! To insure that programs you load from outside sources cannot delete your files, you must enable the component each time it is loaded using the component's Options menu.   Arrays - column 7



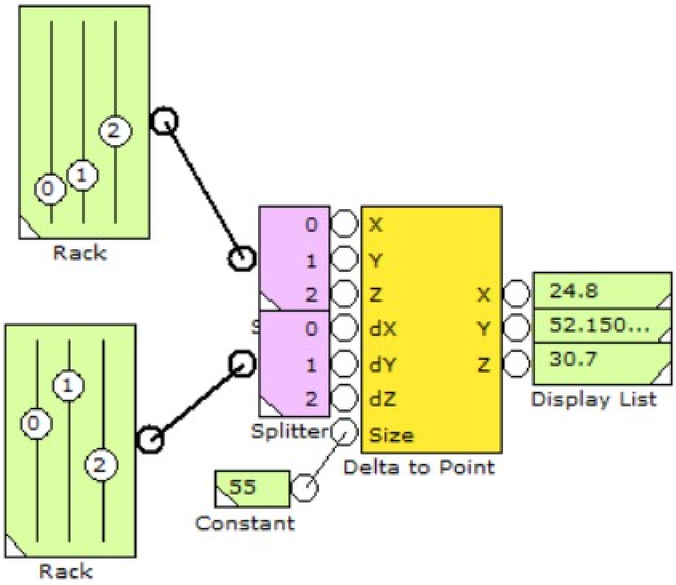
Delete File

□ Enable Deleting Files



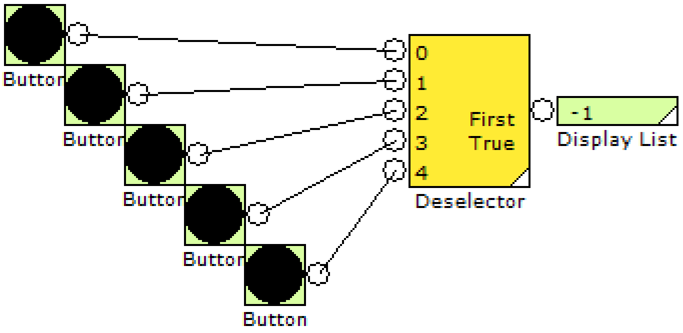
Delta to Point

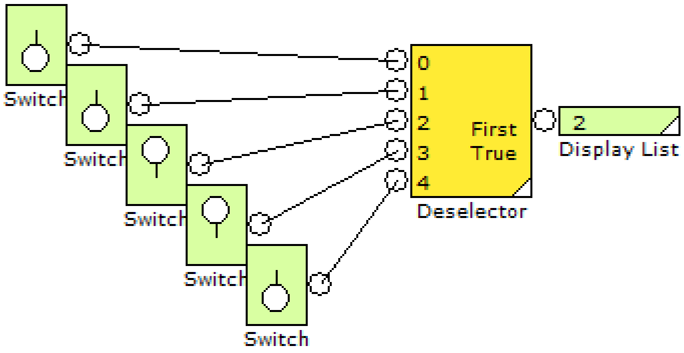
The Delta to Point component calculates a point from the start point, a delta vector and a size.
Functions – column 8



Deselector

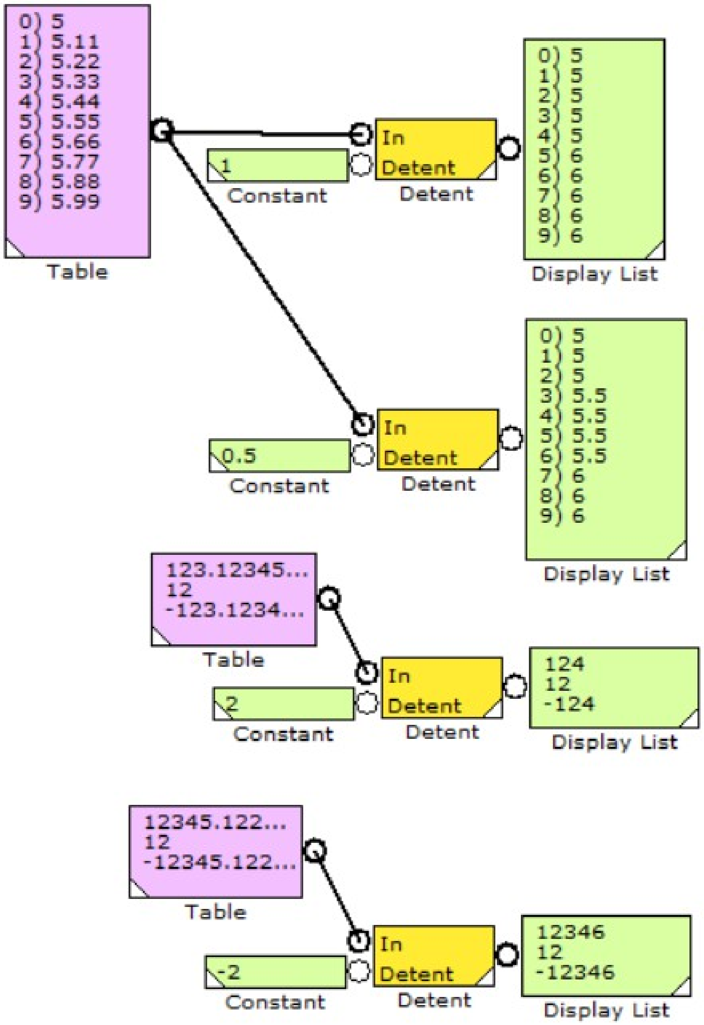
The Deselector component scans the inputs and outputs the number of the first true input. You can set the number of inputs. Functions - column 6





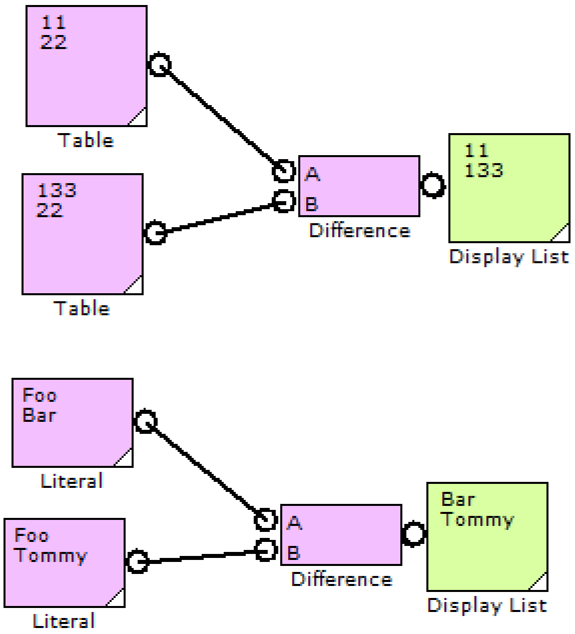
Detent

The Detent component outputs a value with the specified detent. Inputs can be scalar or arrays.
Functions - column 2



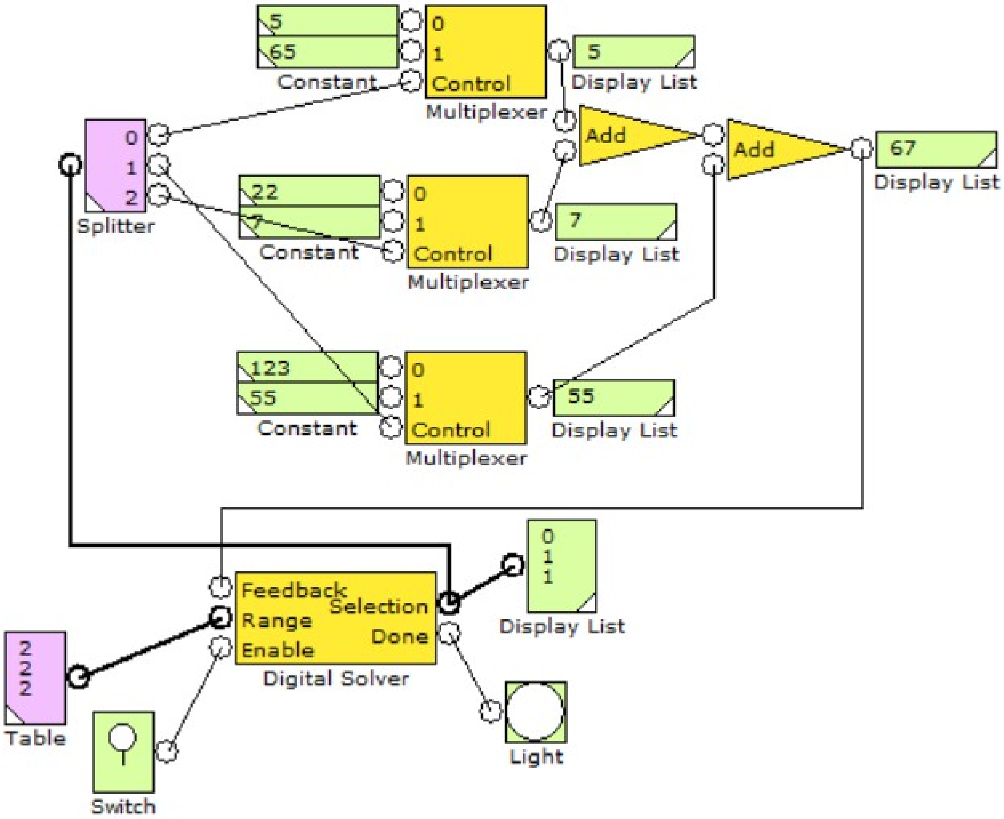
Difference

The Difference component scans the input arrays and outputs the elements that are not present at both inputs. Arrays - column 5



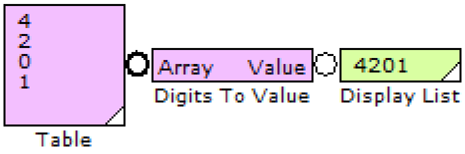
Digital Solver

The Digital Solver component finds the selection that results in the minimum feedback. Functions – column 6



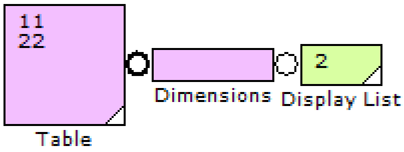
Digits To Value

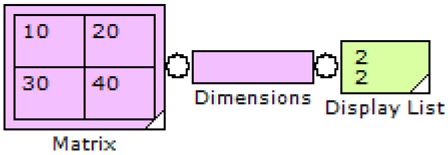
The Digits To Value component converts an array of digits into a value. -1 indicates a blank in the input. 10 indicates a negative sign. 11 indicates a plus sign.   Arrays - column 5



Dimensions

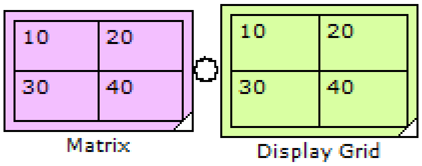
The Dimensions component shows the dimensions for the input data. Use it to tell a scalar from a vector from a matrix. Arrays - column 2





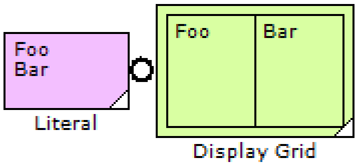
Display Grid

The Display Grid is used to show matrix values. Make it larger to see matrix values better.
Controls - column 4



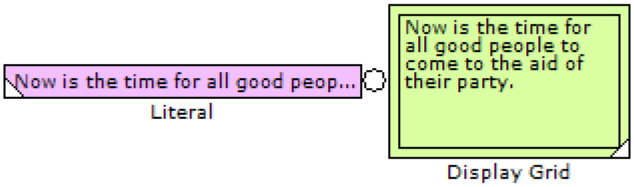
10	20
30	40

10	20
30	40



Foo
Bar

Foo	Bar

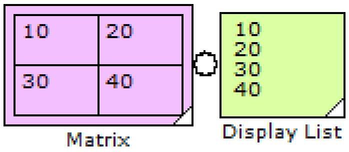


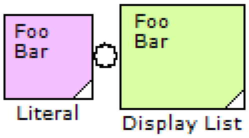
Now is the time for all good peop...

Now is the time for all good people to come to the aid of their party.

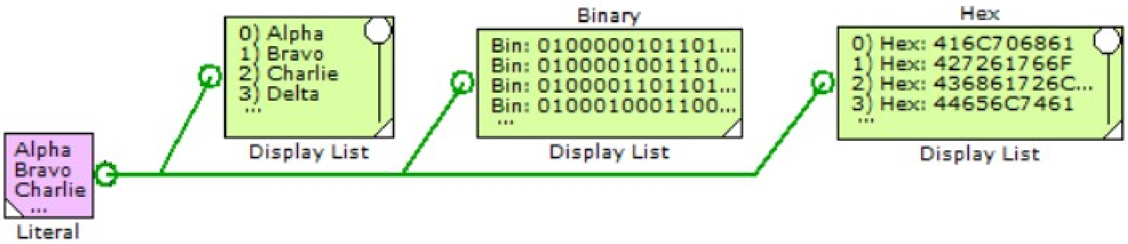
Display List

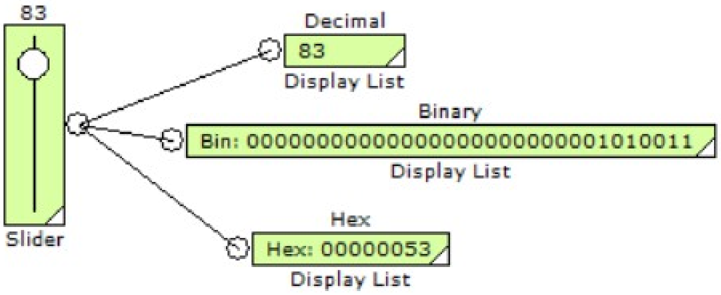
The Display List is used to show the values at any terminal. Make it taller to see array values better. Note: This component can be operated using the wheel on the mouse.   Controls - column 4





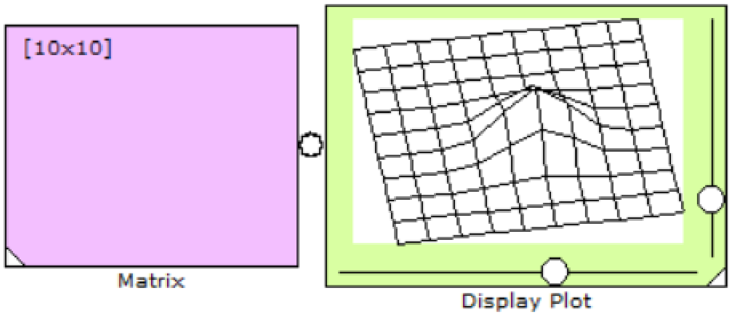
You can also change the base of the output from base 10 to binary (base 2) or Hex (base16) as shown below:





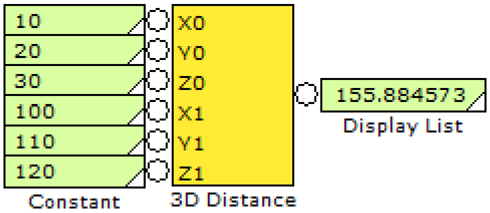
Display Plot

The Display Plot draws a graphic from a 2-dimensional data set. Rotate the display using the side and bottom controls. Controls – column 4



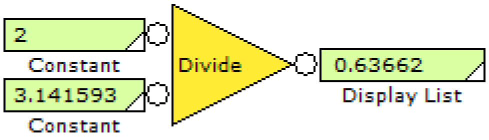
3D Distance

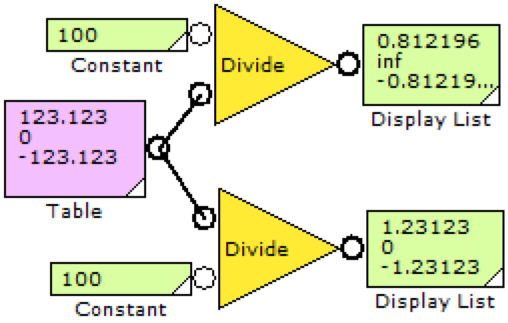
The 3D Distance component calculates the distance between two points in space. Functions - column 8

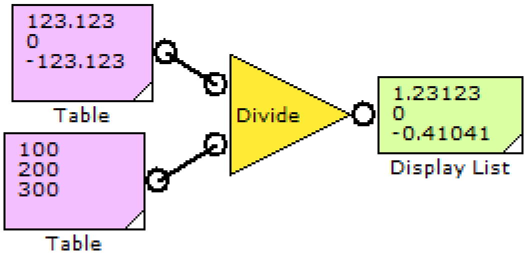


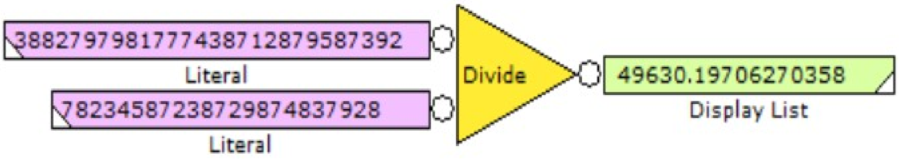
Divide

The Divide component divides the inputs. Inputs can be scalar and /or arrays.   Functions - column 1



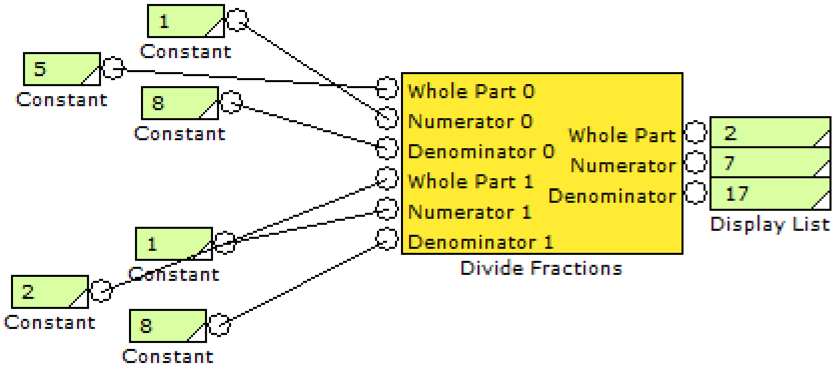






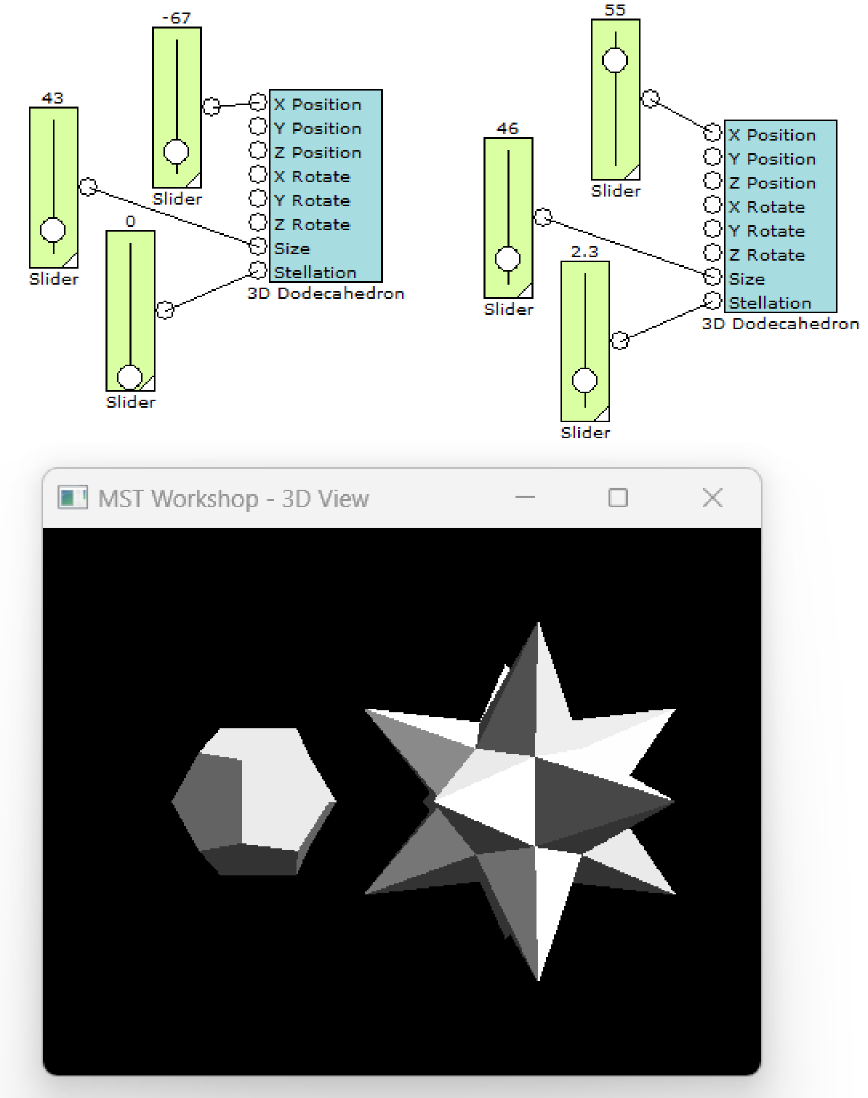
Divide Fractions

The Divide Fractions component divides two numbers with fractions. The output is a whole number with a fraction as needed.   Functions - column 9



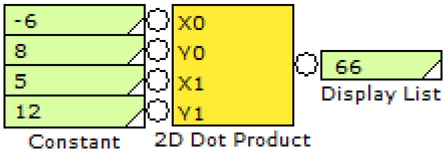
3D Dodecahedron

The 3D Dodecahedron draws a dodecahedron in the 3D view window. The X, Y, and Z inputs set the position and size of the dodecahedron. The Affine [4x4] array input modifies the size, position, and orientation of the dodecahedron. 3D – column 4



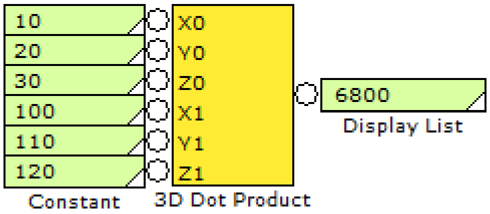
2D Dot Product

The 2D Dot Product component calculates the dot product of 2 2D vectors. Functions - column 8



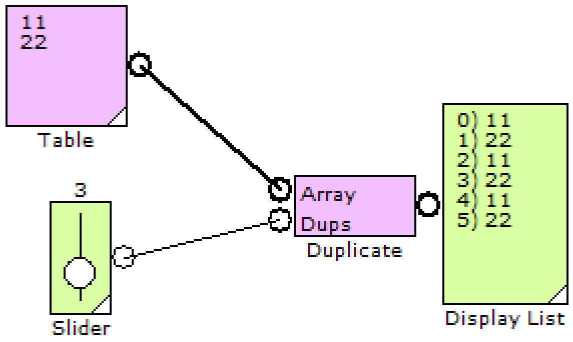
3D Dot Product

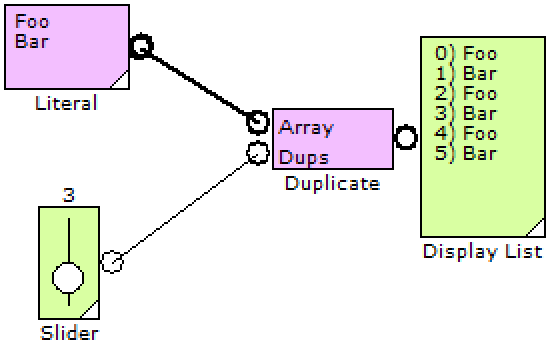
The 3D Dot Product component calculates the dot product of 2 3D vectors. Functions - column 8



Duplicate

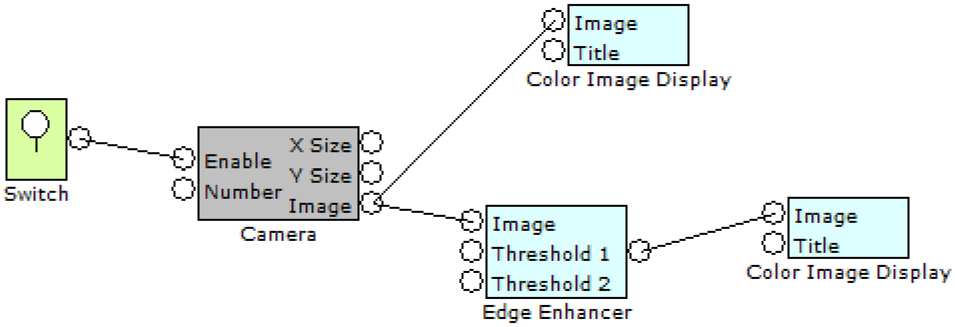
The Duplicate component builds an array by duplicating each element at the Array input. The Array input can be a scalar or an array. For example: an input of 1, 2, 3 with a Dups input of 2 will output 1, 2, 3, 1, 2, 3.   Arrays - column 2

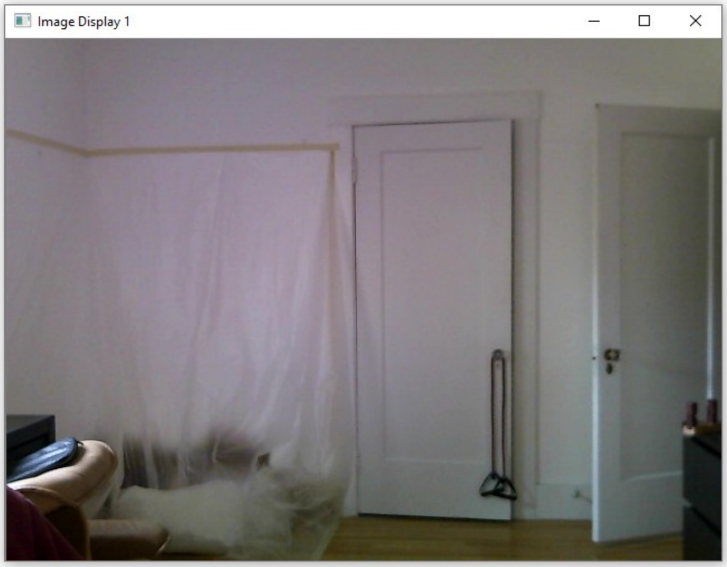


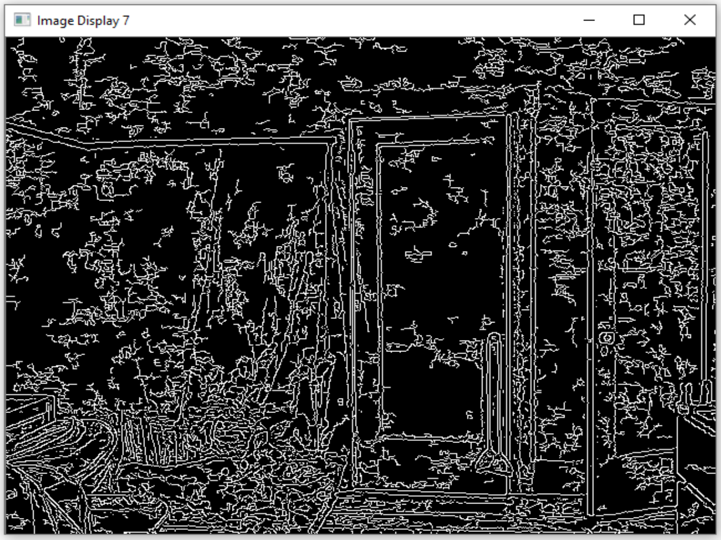


Edge Enhancer

The Edge Enhancer component creates lines based on the gradient of the image. Images - column 2

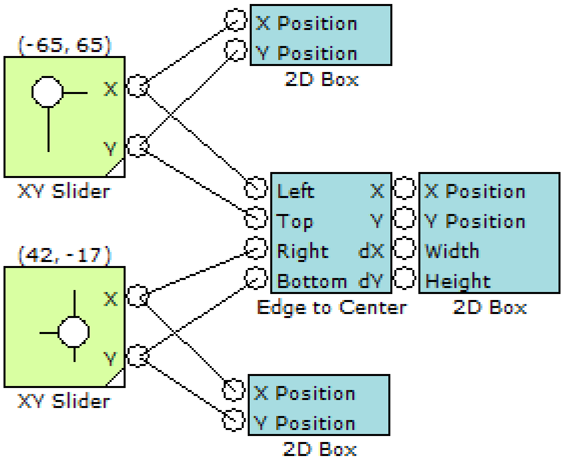


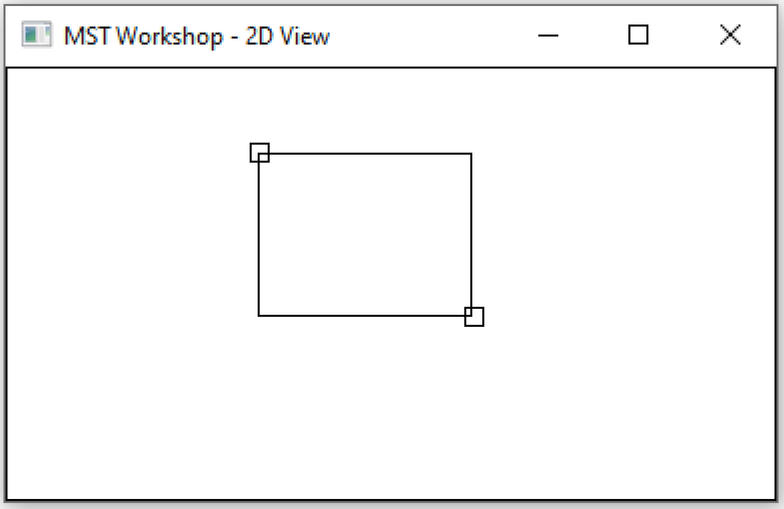




Edge to Center

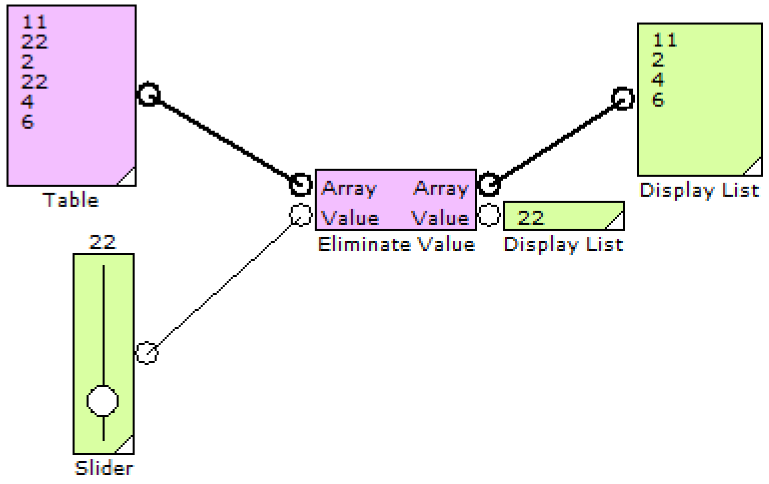
The Edge to Center component takes bounding coordinates and outputs the center and size values that could be used to draw an object there. 2D - column 8

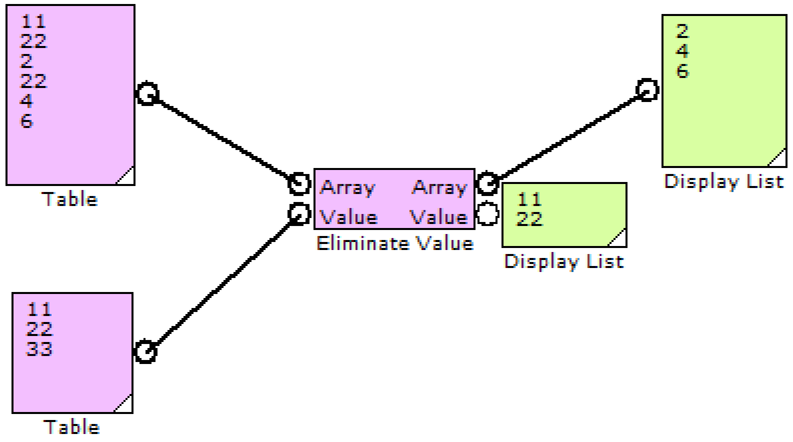




Eliminate Value

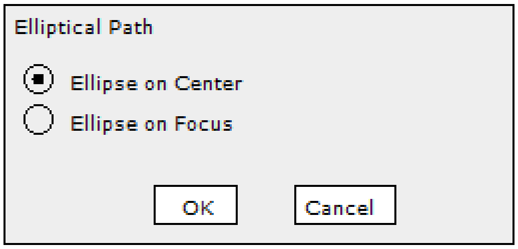
The Eliminate Value component removes elements found on the Value input.   Arrays - column 5



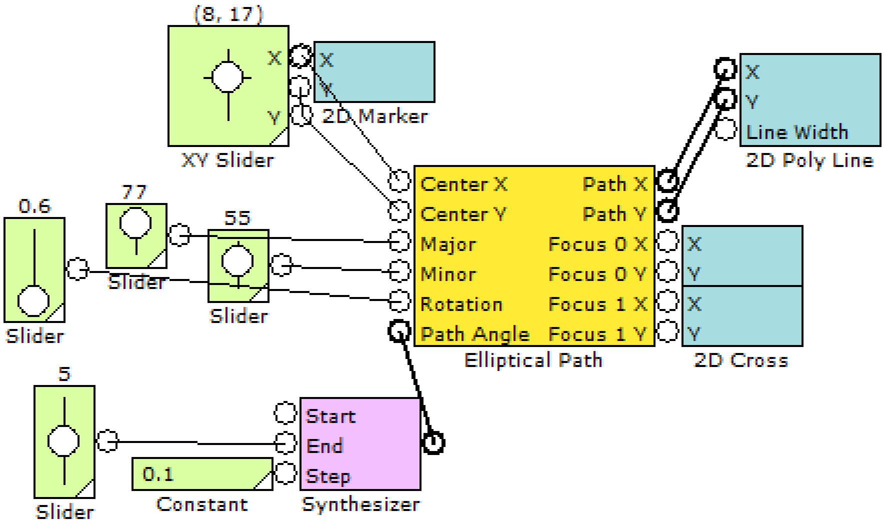


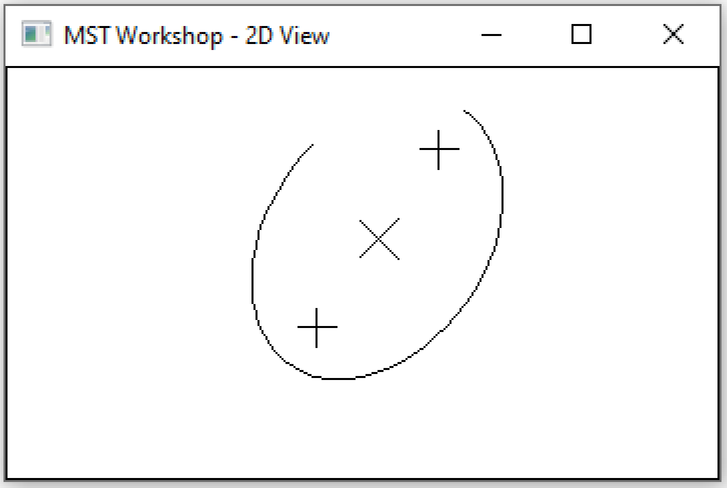
Elliptical Path

The Elliptical Path component traces the ellipse (X, Y) given the inputs and a range of angles.
Functions - column 9


Elliptical Path

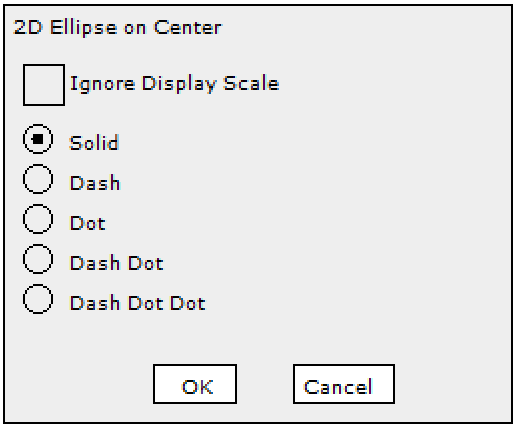
● Ellipse on Center
○ Ellipse on Focus





2D Ellipse on Center

The 2D Ellipse on Center component draws a ellipse outline using the X and Y points given. You can control the line thickness.   2D - column 1

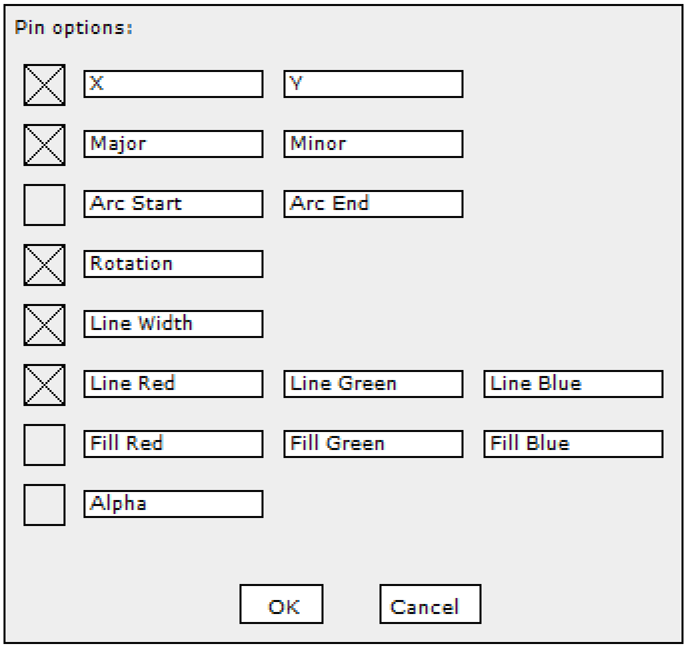


2D Ellipse on Center

☐ Ignore Display Scale

● Solid
○ Dash
○ Dot
○ Dash Dot
○ Dash Dot Dot

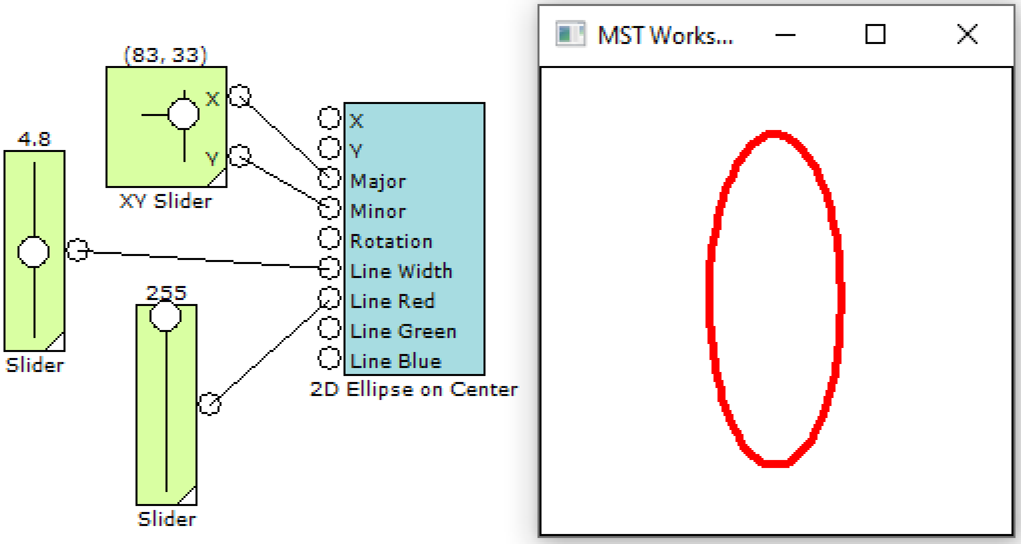
OK   Cancel



Pin options:

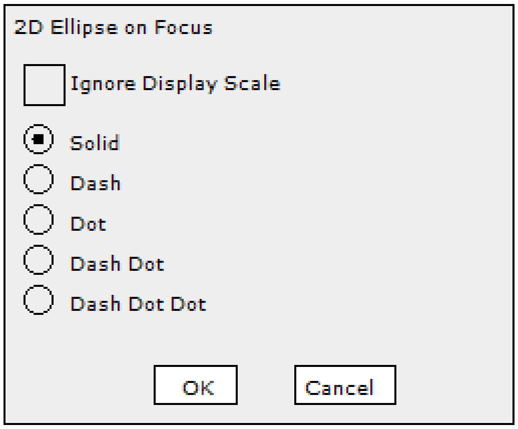
☒ X   Y
☒ Major   Minor
☐ Arc Start   Arc End
☒ Rotation
☒ Line Width
☒ Line Red   Line Green   Line Blue
☐ Fill Red   Fill Green   Fill Blue
☐ Alpha

OK   Cancel



2D Ellipse on Focus

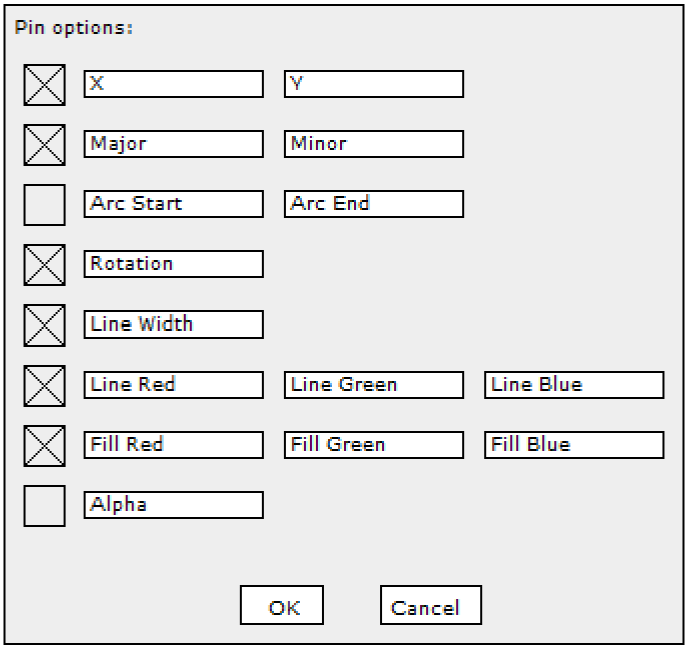
The 2D Ellipse on Focus component draws a ellipse outline using the X and Y points given. You can control the line thickness.   2D - column 1



2D Ellipse on Focus

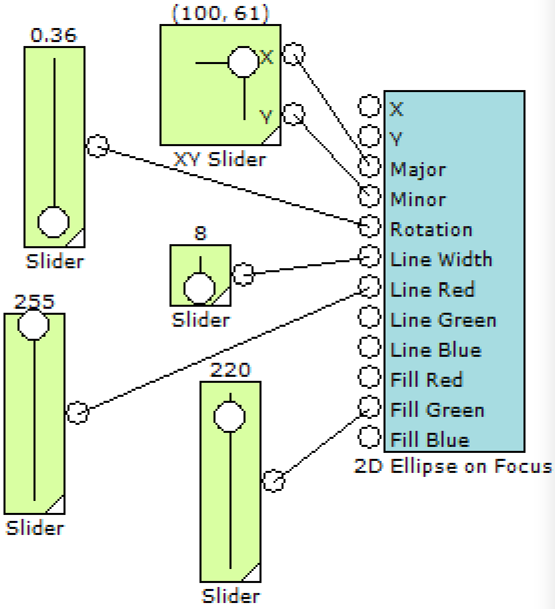
□ Ignore Display Scale

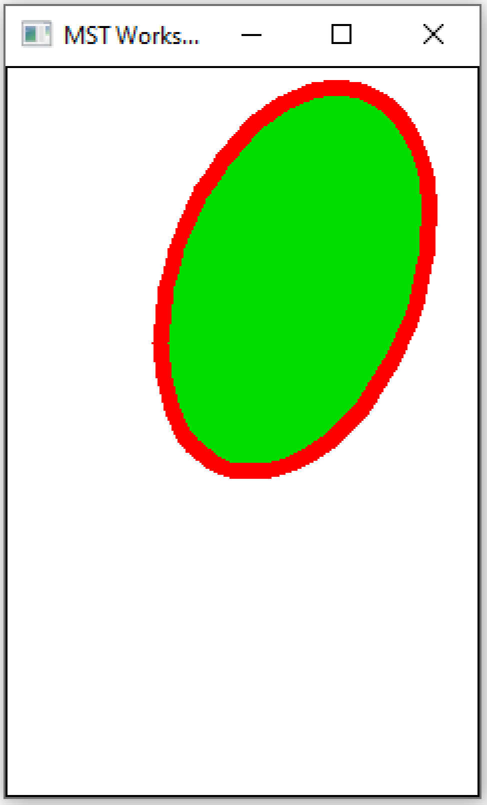
● Solid
○ Dash
○ Dot
○ Dash Dot
○ Dash Dot Dot



Pin options:

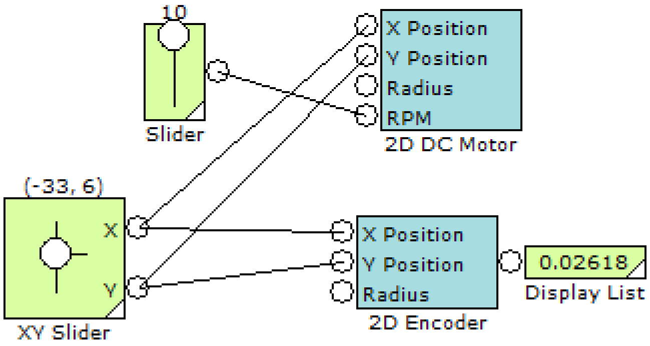
☒ X Y
☒ Major Minor
□ Arc Start Arc End
☒ Rotation
☒ Line Width
☒ Line Red Line Green Line Blue
☒ Fill Red Fill Green Fill Blue
□ Alpha

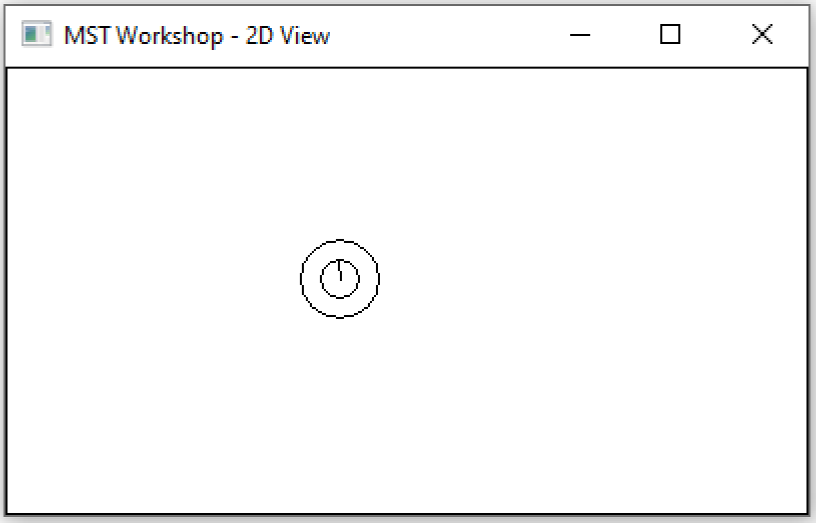




2D Encoder

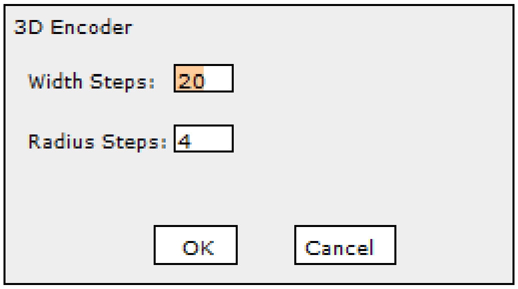
The Rotation Encoder outputs the angle of the shaft. You can attach it to Gears or other simulation objects like Motors. Place the encoder at the same X, Y position as a gear to connect them.   2D - column 3





3D Encoder

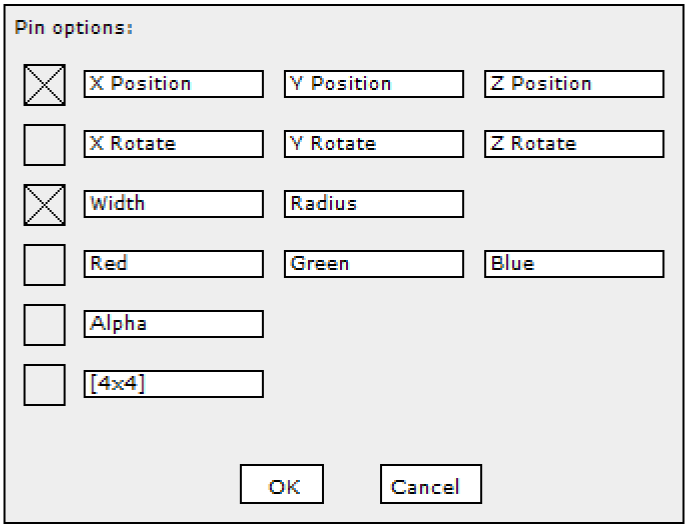
The 3D Encoder component reads the position and rotational speed of a motor or shaft. Place the encoder at the X, Y, Z coordinates of the motor or end of the shaft.3D - column 4



3D Encoder

Width Steps: 20

Radius Steps: 4



Pin options:

☒ X Position | Y Position | Z Position

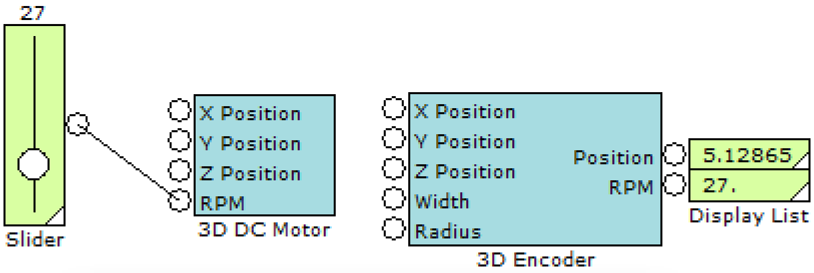
□ X Rotate | Y Rotate | Z Rotate

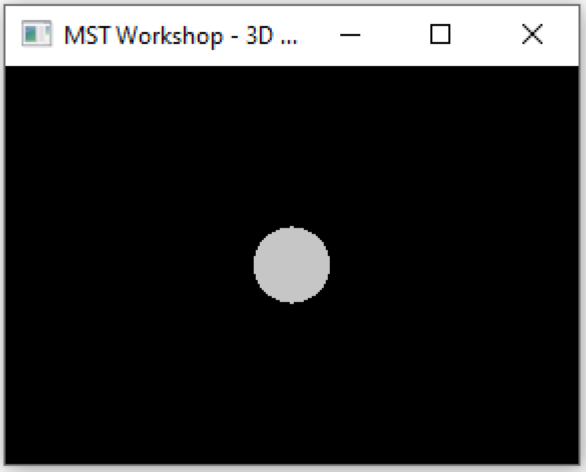
☒ Width | Radius

□ Red | Green | Blue

□ Alpha

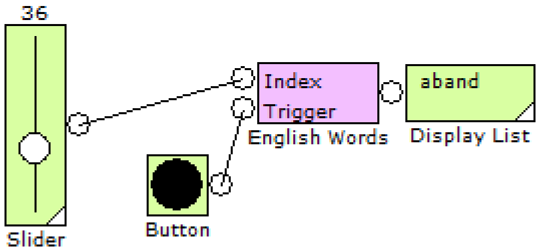
□ [4x4]

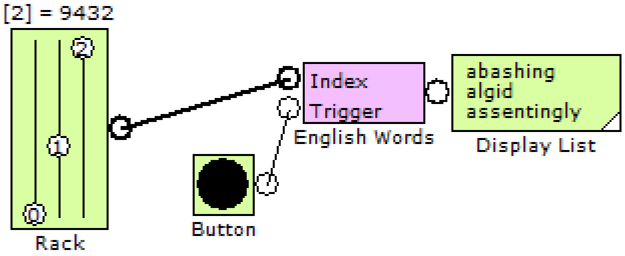




English Words

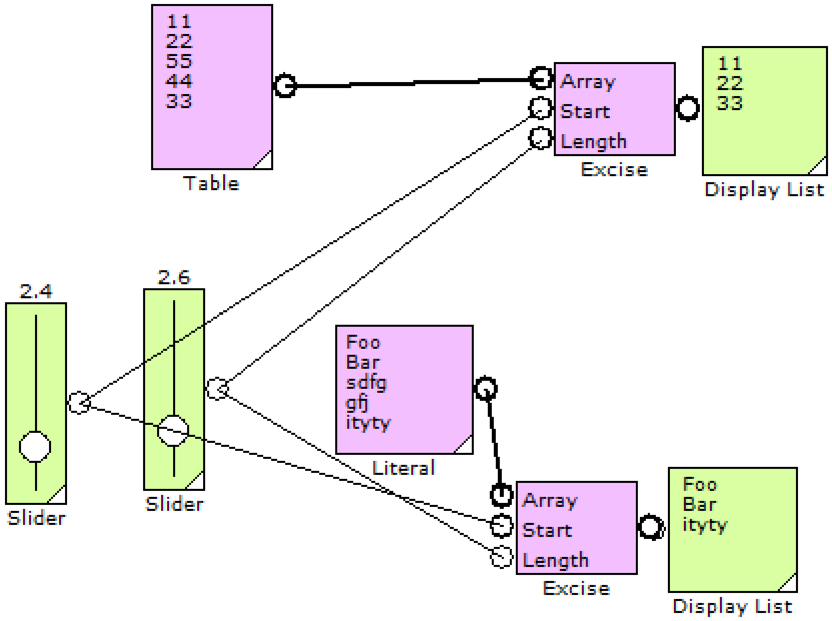
The English Words component is a list of 58,000 English words downloaded from the Mieliestronk website.





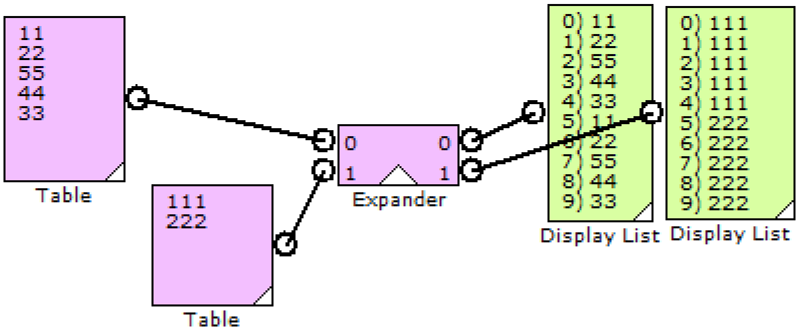
Excise

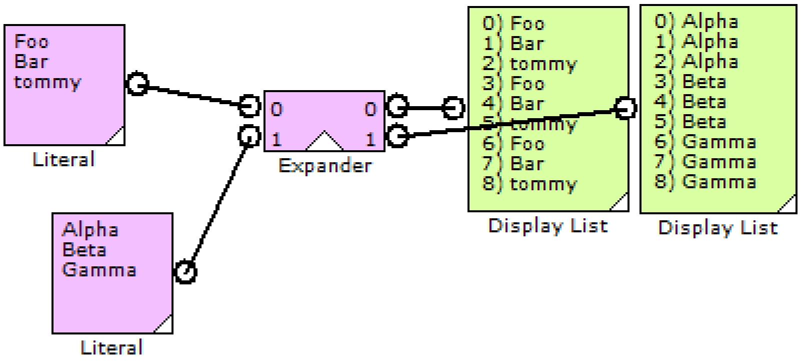
The Excise component eliminates a portion of the values in an array. Input the number of the first value and the number of values you want to remove.   Arrays - column 1



Expander

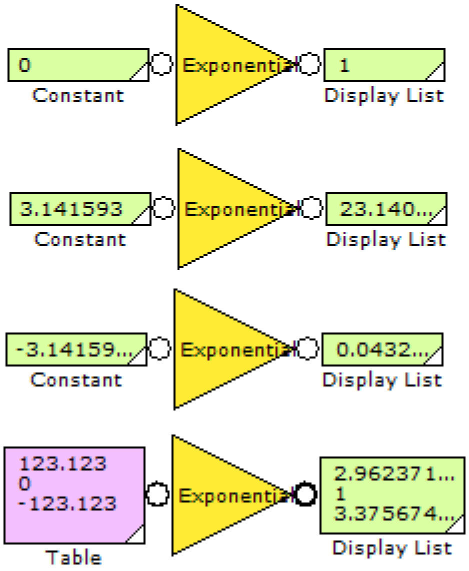
The Expander component outputs all the combinations for all its inputs. You can set the number of inputs/outputs.   Arrays - column 1





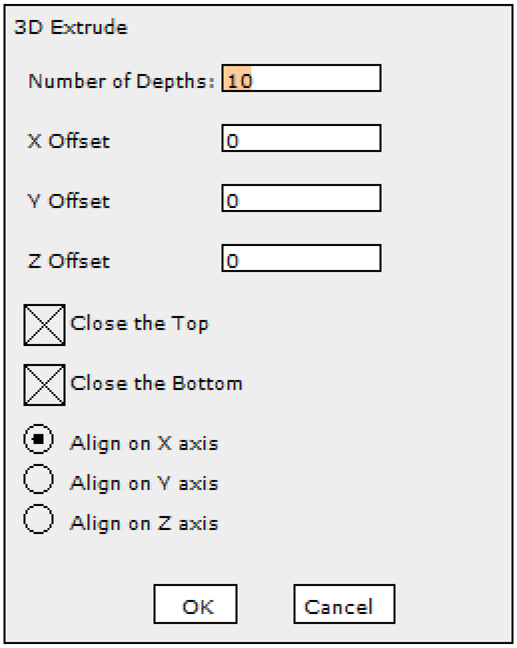
Exponential

The Exponential component calculates the exponential of the input base e.Input can be scalar or an array.   Functions - column 1



3D Extrude

The 3D Extrude draws a 2D shape extruded into the 3D view window. The X, Y, and Z inputs set the position and size of the extrude. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 5



3D Extrude

Number of Depths: 10

X Offset 0

Y Offset 0

Z Offset 0

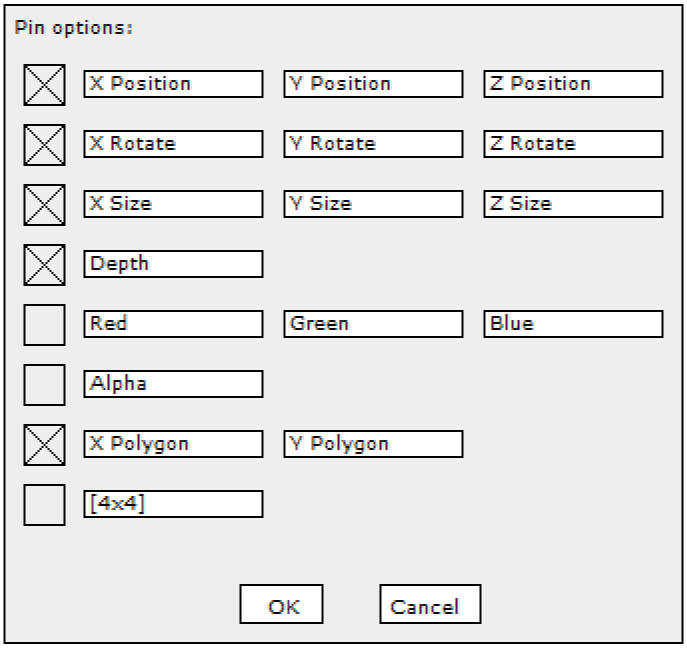
☒ Close the Top

☒ Close the Bottom

● Align on X axis

○ Align on Y axis

○ Align on Z axis



Pin options:

☒ X Position | Y Position | Z Position

☒ X Rotate | Y Rotate | Z Rotate

☒ X Size | Y Size | Z Size

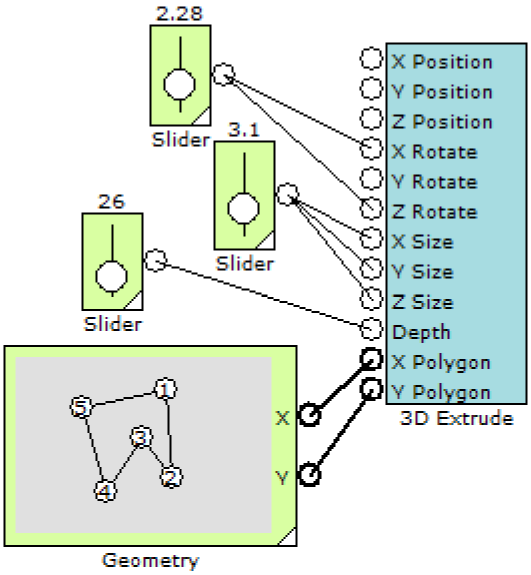
☒ Depth

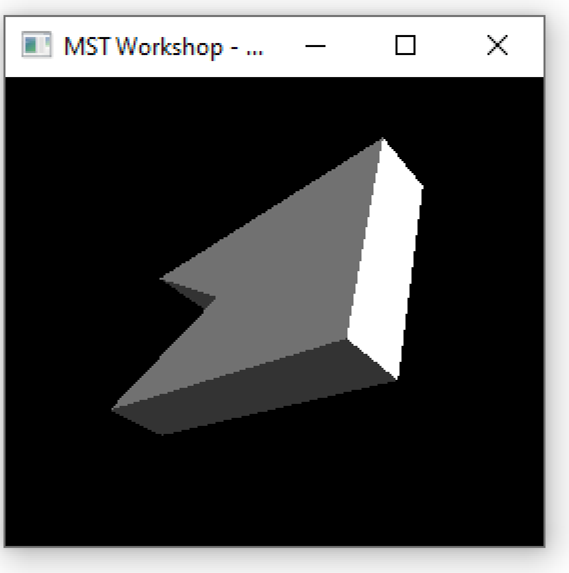
□ Red | Green | Blue

□ Alpha

☒ X Polygon | Y Polygon

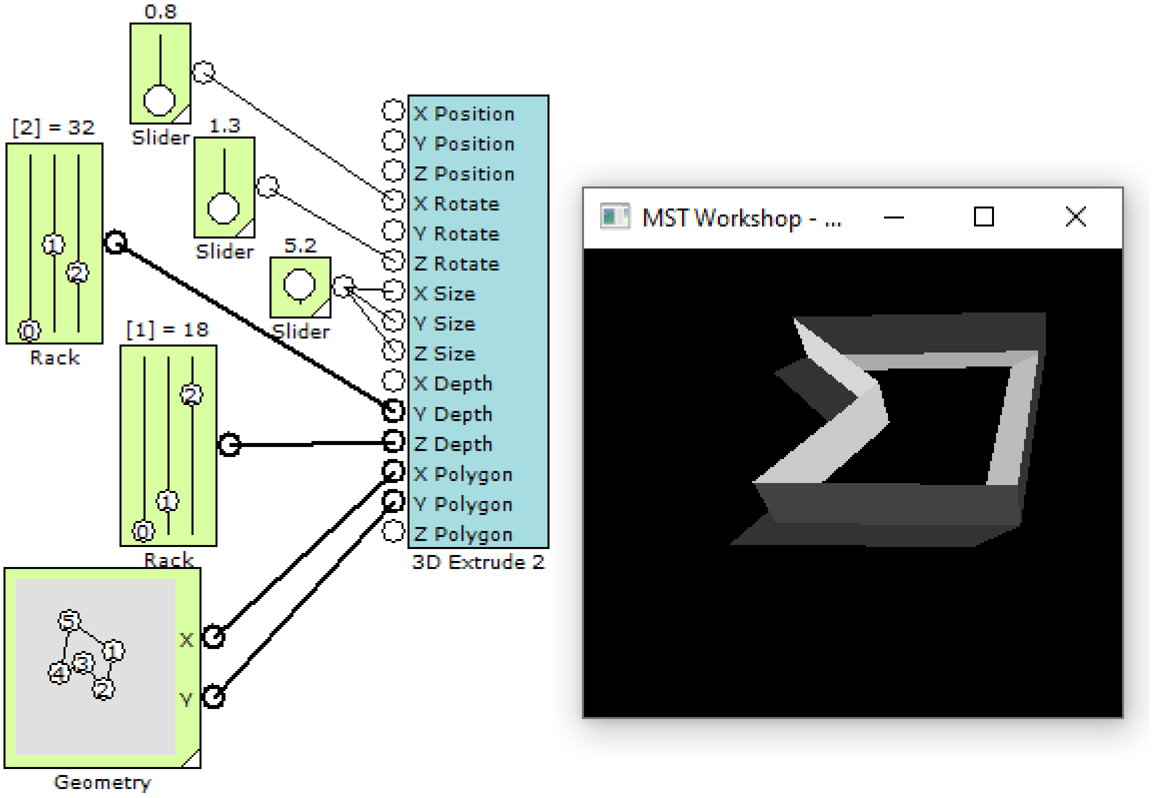
□ [4x4]





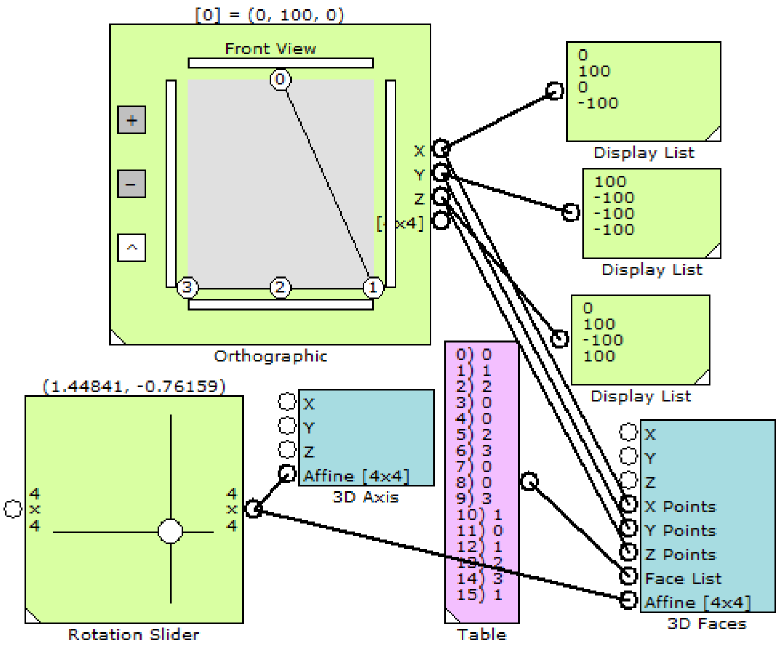
3D Extrude 2

The 3D Extrude 2 draws a 2D shape extruded into the 3D view window. The X, Y, and Z inputs set the position and size of the extrude. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 5



3D Faces

The 3D Faces component draws a shape in the 3D view window. The X-, Y-, and Z-Points establish points in 3-dimensions. Then create a list of faces by listing the point for each face. For example if you specify 4 3D coordinates to create a tetrahedron, you would create the first face by specifying 0, 1, 2, 0 for the first face. Then 0, 2, 3, 0 for the second face, then 0, 3, 1, 0 for the third face and 1, 3, 2, 1 for the bottom. Be sure to start and end each face with the same point number. Also the order of the points in the list indicates the normal direction (right hand rule). The Affine [4x4] array input modifies the size, position, and orientation. 3D - column 5

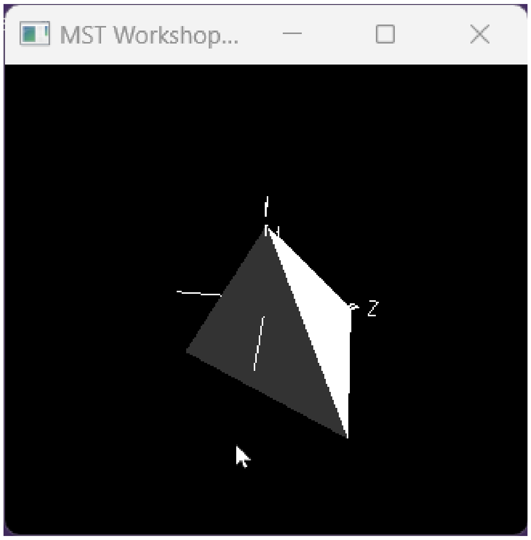


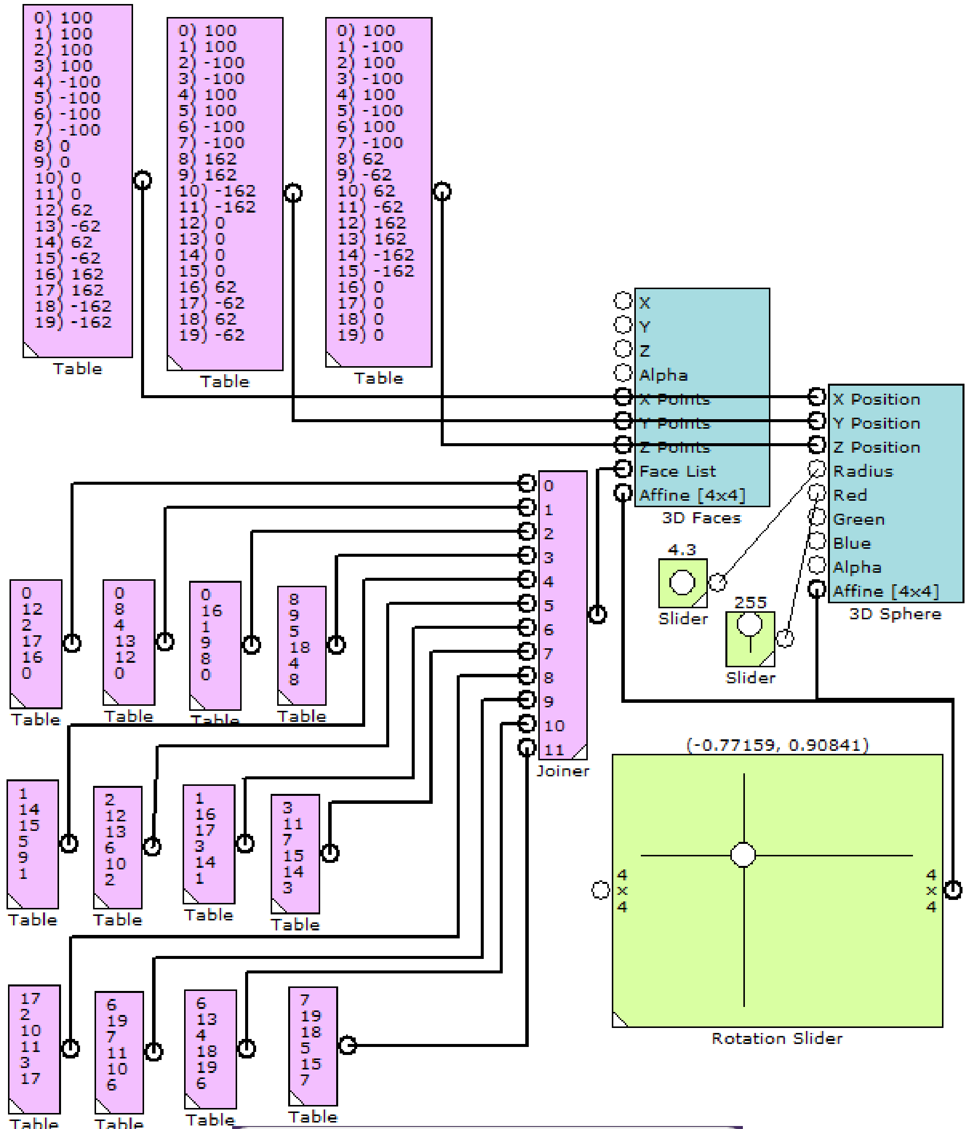
```
0
100
0
-100
```

```
100
-100
-100
-100
```

```
0
100
-100
100
```

```
0) 0
1) 1
2) 2
3) 0
4) 0
5) 2
6) 3
7) 0
8) 0
9) 3
10) 1
11) 0
12) 1
13) 2
14) 3
15) 1
```





```
0) 100
1) 100
2) 100
3) 100
4) -100
5) -100
6) -100
7) -100
8) 0
9) 0
10) 0
11) 0
12) 62
13) -62
14) 62
15) -62
16) 162
17) 162
18) -162
19) -162
```

```
0) 100
1) 100
2) -100
3) -100
4) 100
5) 100
6) -100
7) -100
8) 162
9) 162
10) -162
11) -162
12) 0
13) 0
14) 0
15) 0
16) 62
17) -62
18) 62
19) -62
```

```
0) 100
1) -100
2) 100
3) -100
4) 100
5) -100
6) 100
7) -100
8) 62
9) -62
10) 62
11) -62
12) 162
13) 162
14) -162
15) -162
16) 0
17) 0
18) 0
19) 0
```

```
0
12
2
17
16
0
```

```
0
8
4
13
12
0
```

```
0
16
1
9
8
0
```

```
8
9
5
18
4
8
```

```
1
14
15
5
9
1
```

```
2
12
13
6
10
2
```

```
1
16
17
3
14
1
```

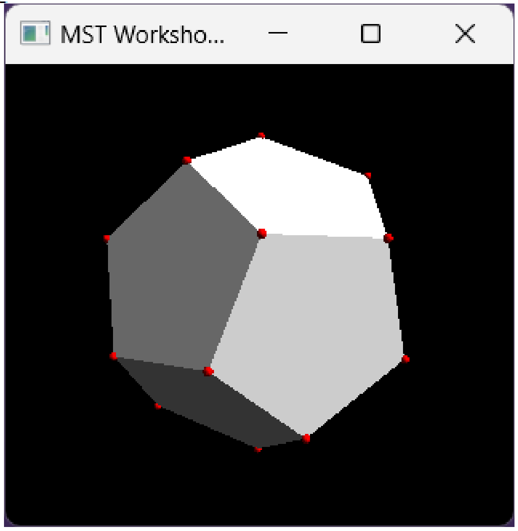
```
3
11
7
15
14
3
```

```
17
2
10
11
3
17
```

```
6
19
7
11
10
6
```

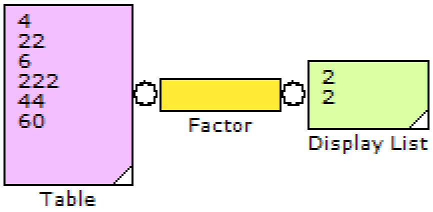
```
6
13
4
18
19
6
```

```
7
19
18
5
15
7
```



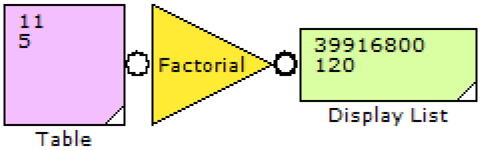
Factor

The Factor component returns a list of the prime factors of the input. Functions - column 9



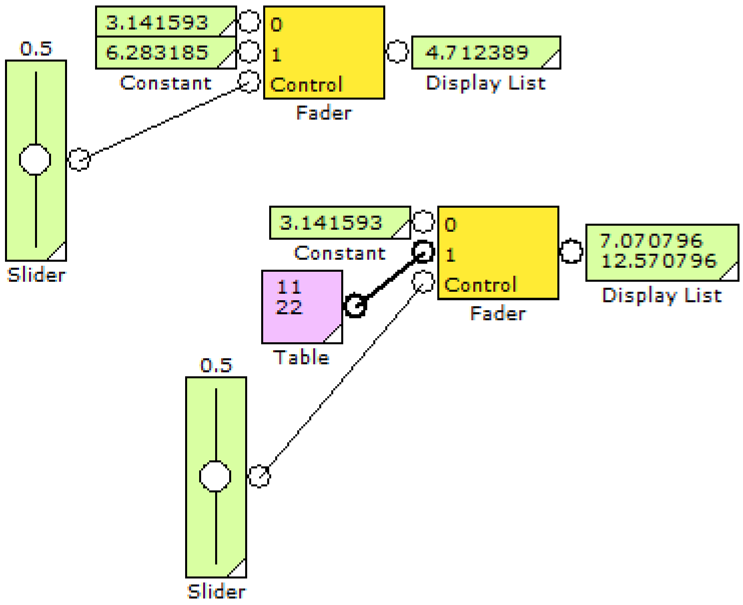
Factorial

The Factorial component calculates the factorial of a number.   Functions - column 5



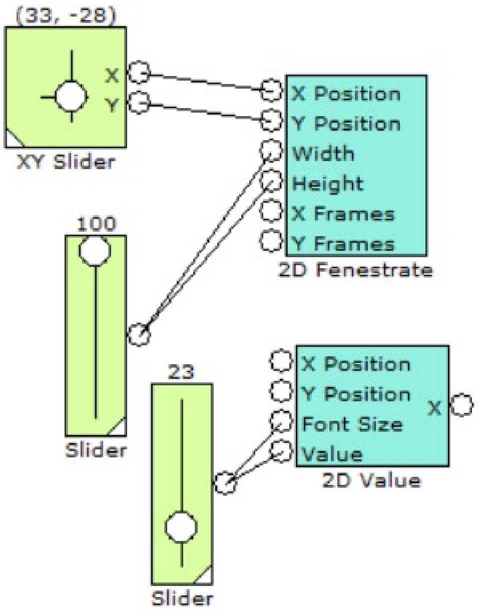
Fader

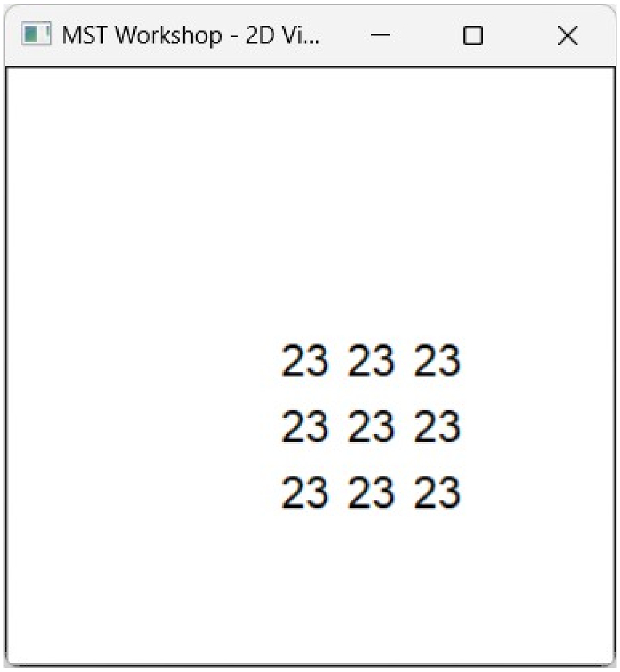
The Fader can fade between inputs based on the Control input going from zero to one.   Functions - column 6



2D Fenestrate

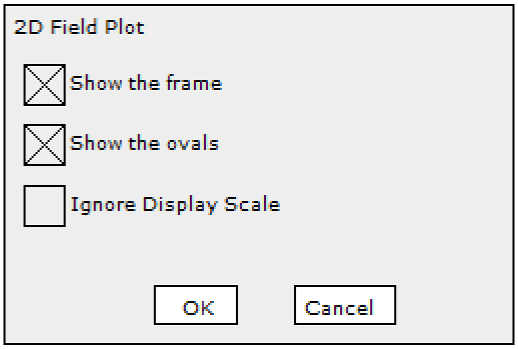
The 2D Fenestrate creates the repeating windows effect on the image in the 2D drawing it covers. Note: This component only affects the items in the 2D View window that are under it. 2D – column 7





2D Field Plot

The 2D Field Plot plots 2D data creating a field plot of the data in the 2D display window. The inputs to the X Values and Y Values must be two 2 dimensional arrays.   2D - column 2

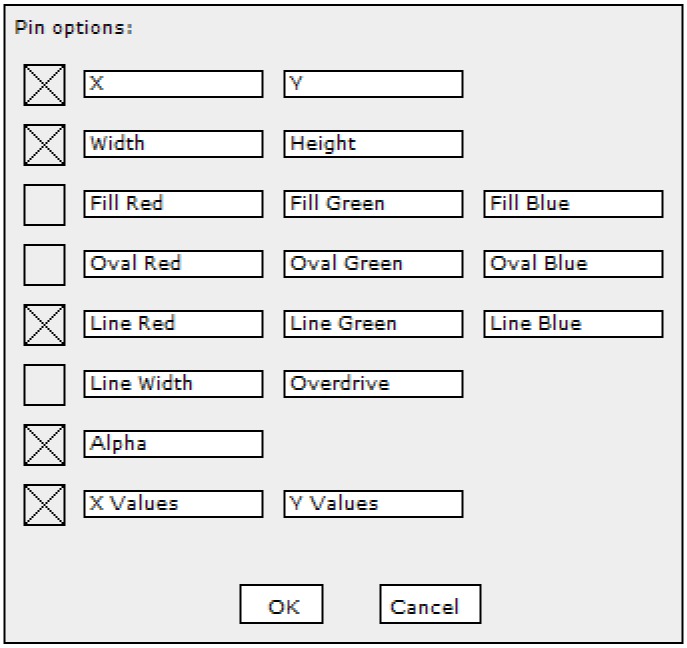


2D Field Plot

☒ Show the frame

☒ Show the ovals

☐ Ignore Display Scale



Pin options:

☒ X | Y

☒ Width | Height

☐ Fill Red | Fill Green | Fill Blue

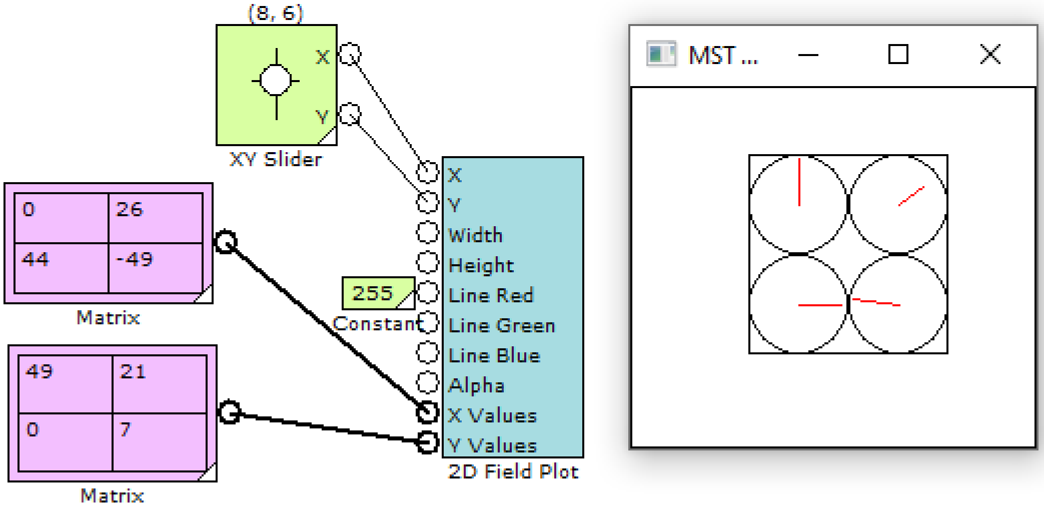
☐ Oval Red | Oval Green | Oval Blue

☒ Line Red | Line Green | Line Blue

☐ Line Width | Overdrive

☒ Alpha

☒ X Values | Y Values

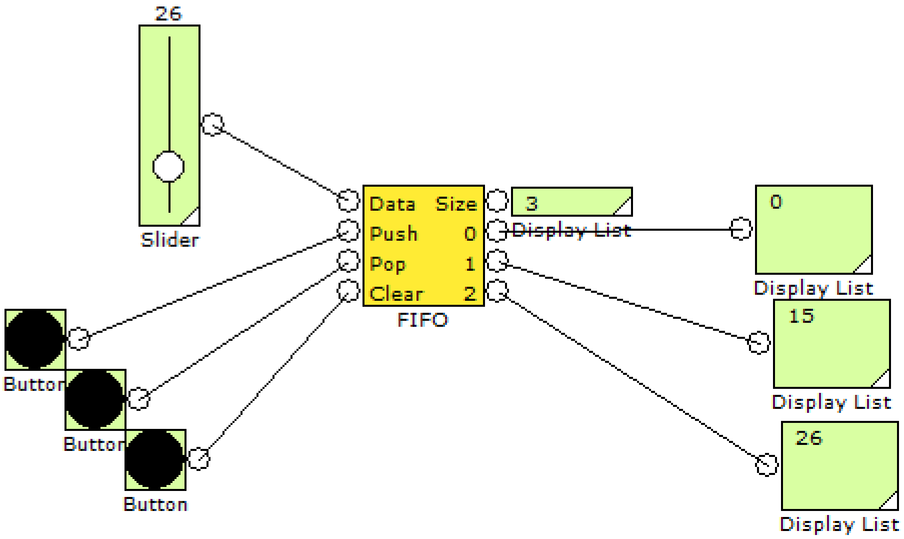


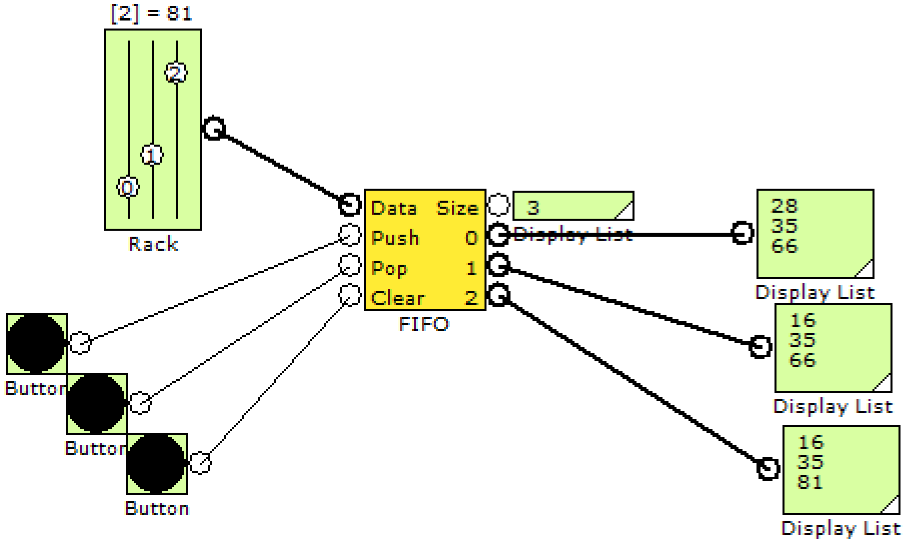
0	26
44	-49

49	21
0	7

FIFO

The FIFO component stores data each time the in clock goes true. The output changes when the out clock goes true.   Functions - column 4

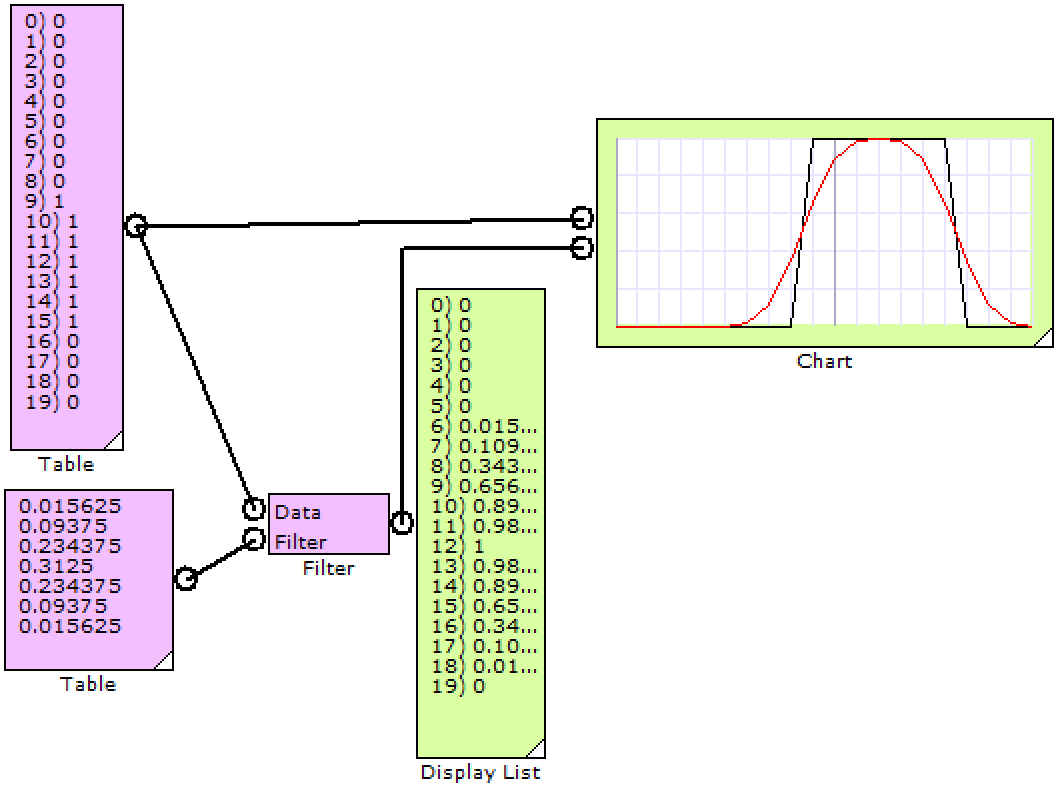




Filter

The Filter component processes the Data array with the Filter array. The output is the filtered array.

Arrays - column 2



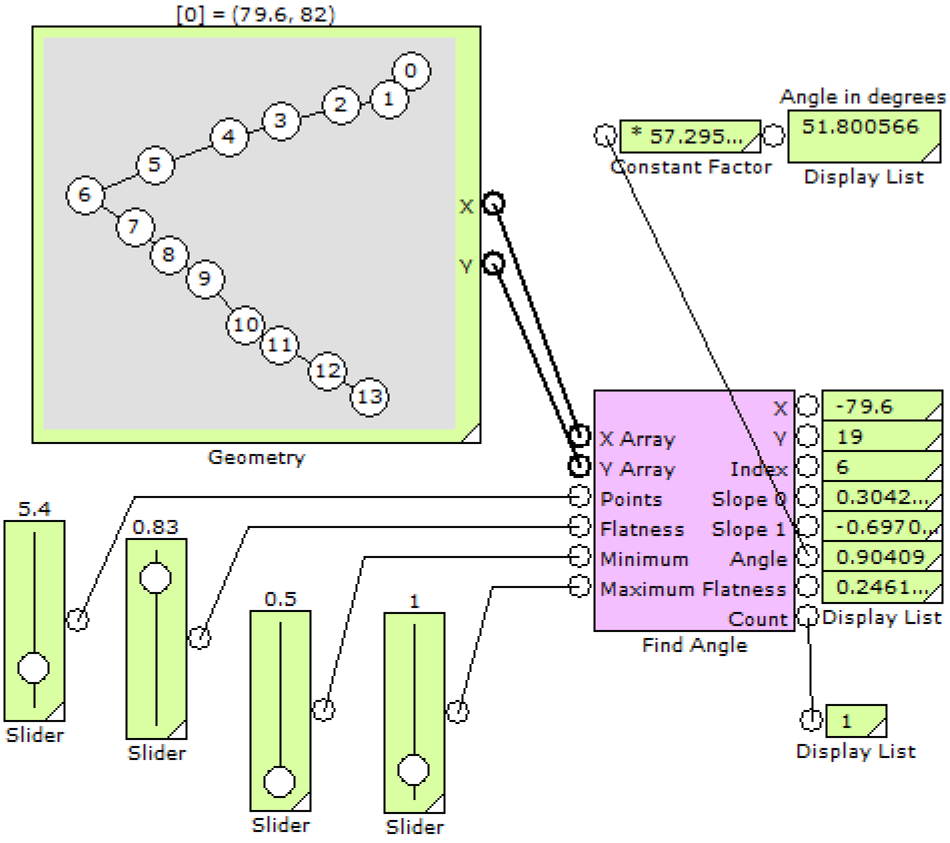
```
0) 0
1) 0
2) 0
3) 0
4) 0
5) 0
6) 0
7) 0
8) 0
9) 1
10) 1
11) 1
12) 1
13) 1
14) 1
15) 1
16) 0
17) 0
18) 0
19) 0
```

```
0.015625
0.09375
0.234375
0.3125
0.234375
0.09375
0.015625
```

```
0) 0
1) 0
2) 0
3) 0
4) 0
5) 0
6) 0.015...
7) 0.109...
8) 0.343...
9) 0.656...
10) 0.89...
11) 0.98...
12) 1
13) 0.98...
14) 0.89...
15) 0.65...
16) 0.34...
17) 0.10...
18) 0.01...
19) 0
```

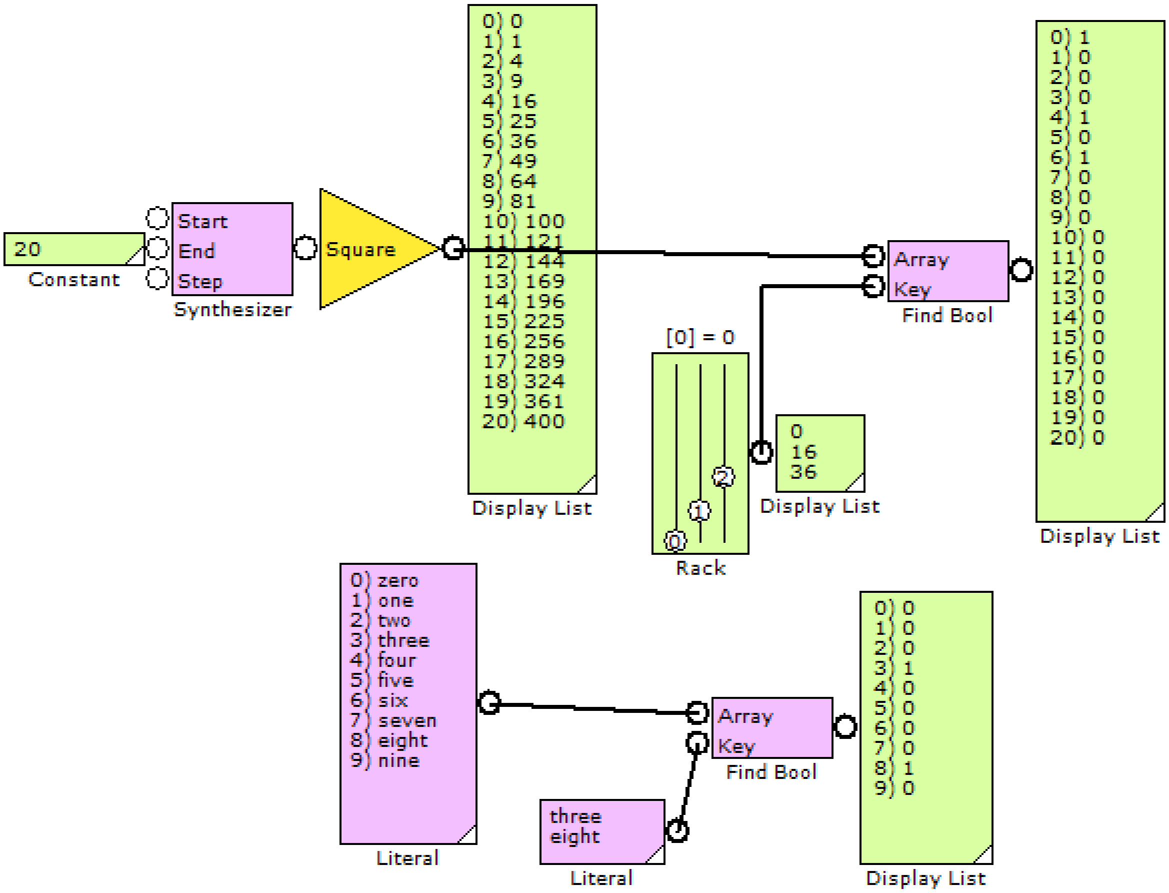
Find Angle

The Find Angle scans along a 2D polyline looking for a sharp change in direction. It breaks the segment into two segments and fits each to a straight line. Arrays - column 5



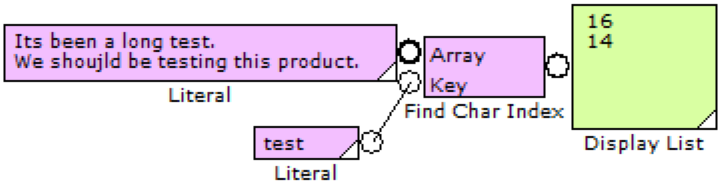
Find Bool

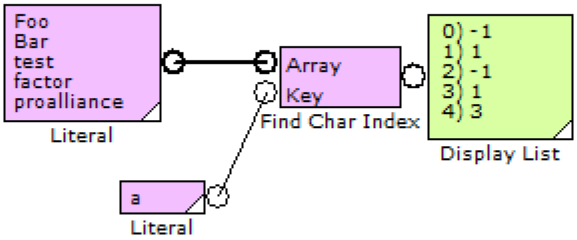
The Find Bool component scans the Array for values matching the Key input. It outputs an array with true in positions that matched and false where it didn't match.   Arrays - column 2



Find Char Index

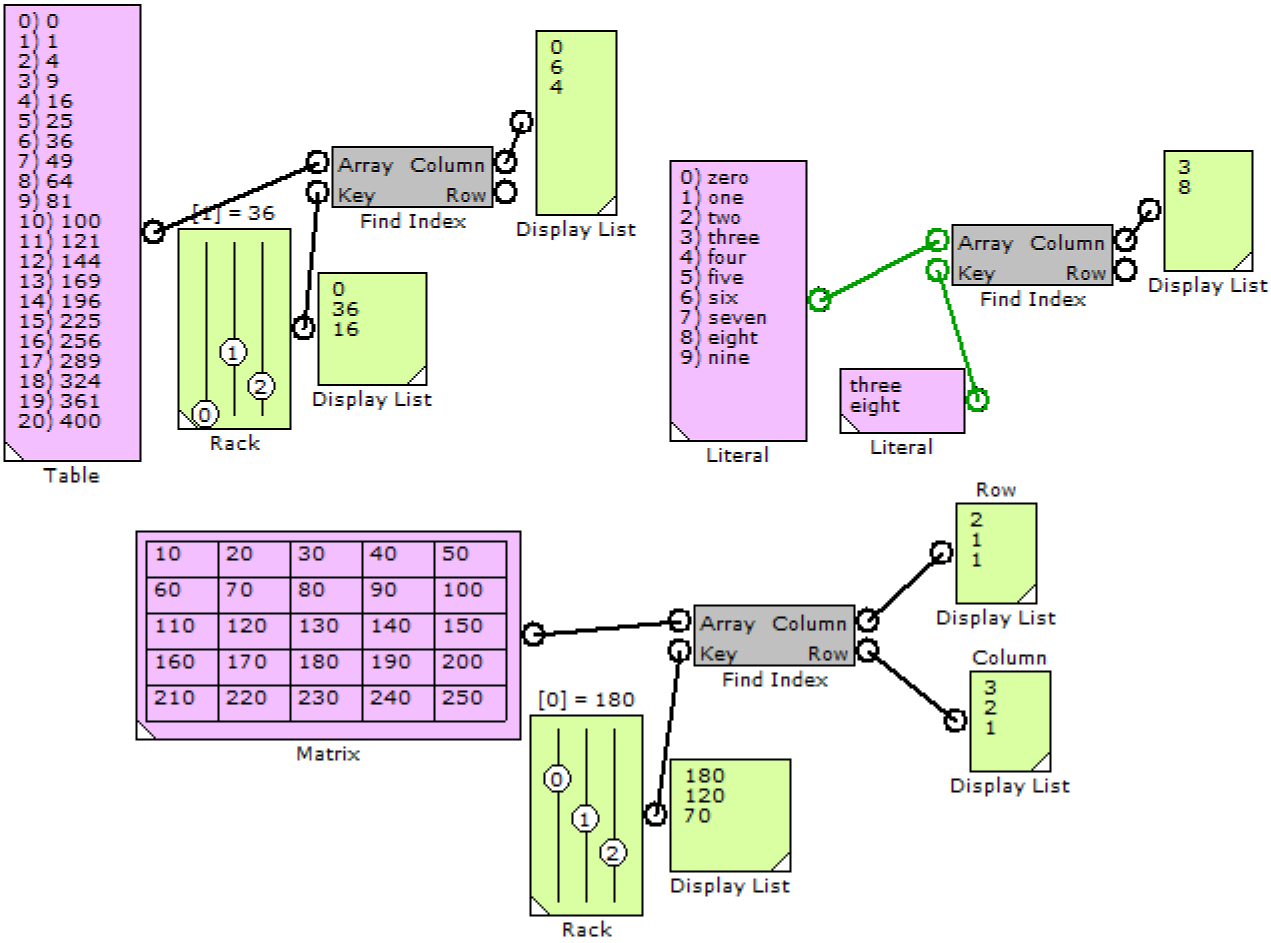
The Find Char Index component outputs the position of the key in the input array. Arrays - column 6





Find Index

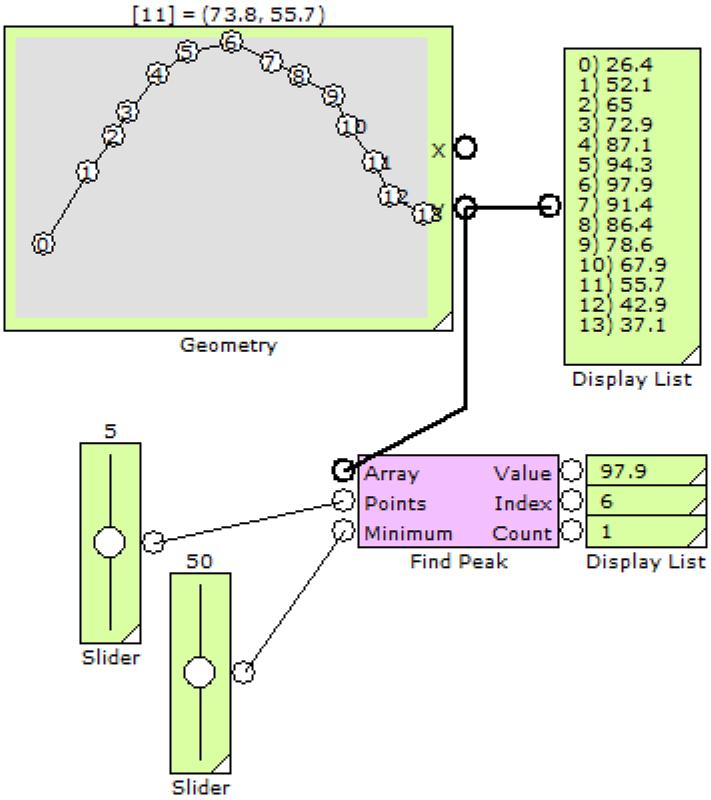
The Find Index component searches the Array for values matching the Key input. It outputs the index of each match in the Array.   Arrays - column 2



10	20	30	40	50
60	70	80	90	100
110	120	130	140	150
160	170	180	190	200
210	220	230	240	250

Find Peak

The Find Peak scans along an array looking for peaks. Peaks must be in a group of Points that is at least Minimum in value.   Arrays - column 5

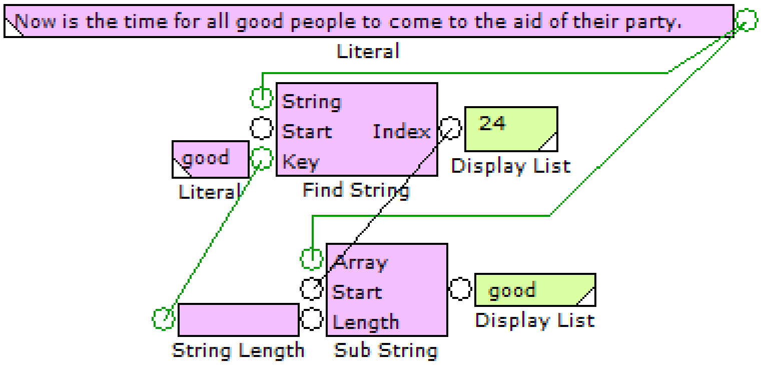


```
0) 26.4
1) 52.1
2) 65
3) 72.9
4) 87.1
5) 94.3
6) 97.9
7) 91.4
8) 86.4
9) 78.6
10) 67.9
11) 55.7
12) 42.9
13) 37.1
```

```
97.9
6
1
```

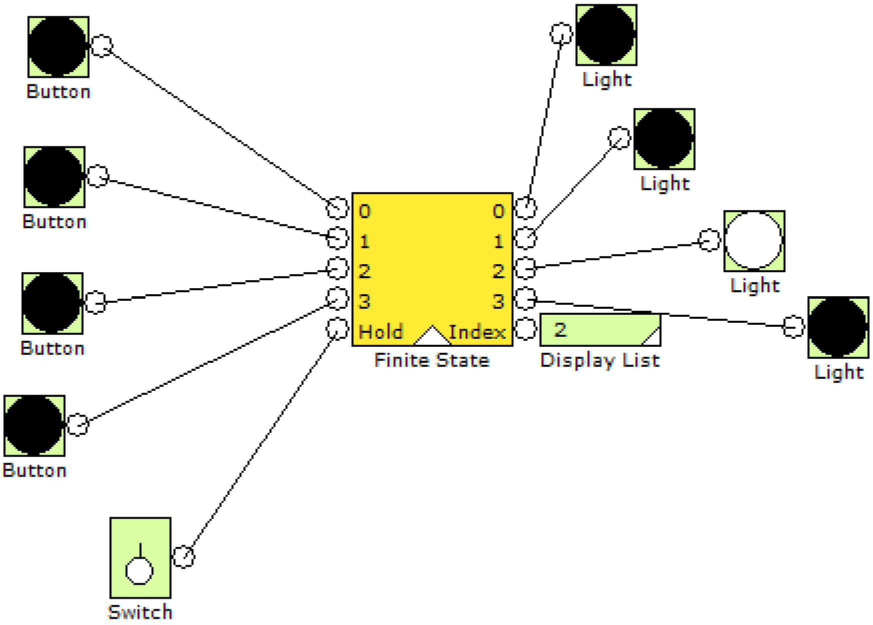
Find String

The Find String component outputs the index of where it finds the Key string of the String input. If the Start input is connected, the search starts at that index. If the Start input is negative, the search is started from the end of the string. Arrays – column 6



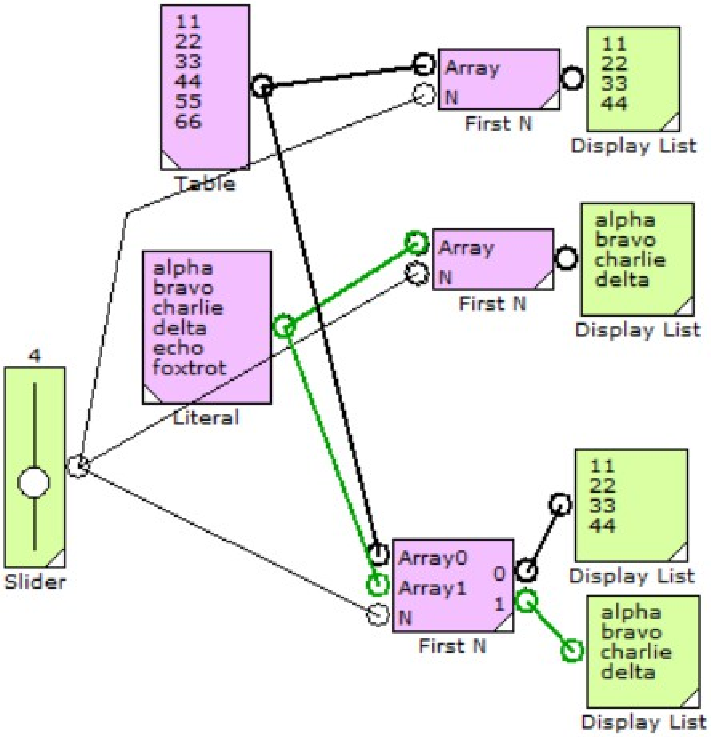
Finite State

The Finite State component is used to create sequences. Only one output will be true at any time. To change states the input for that state has to be true. Functions - column 2



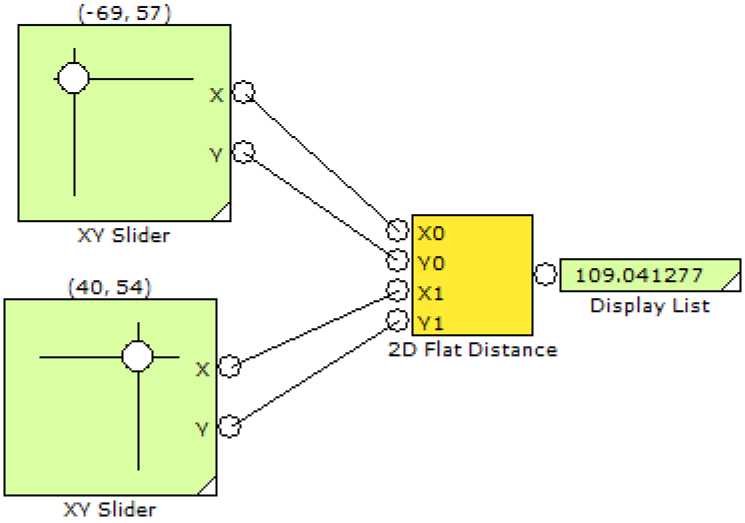
First N

The First N component outputs just the first few values in an array. Input the number N to indicate the number of values you want at the output.   Arrays - column 1



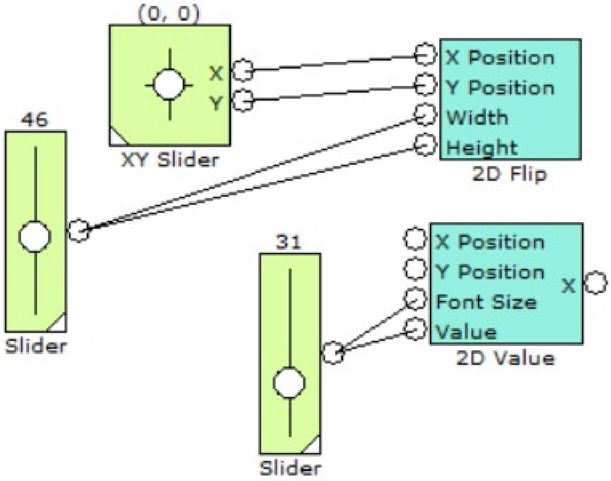
2D Flat Distance

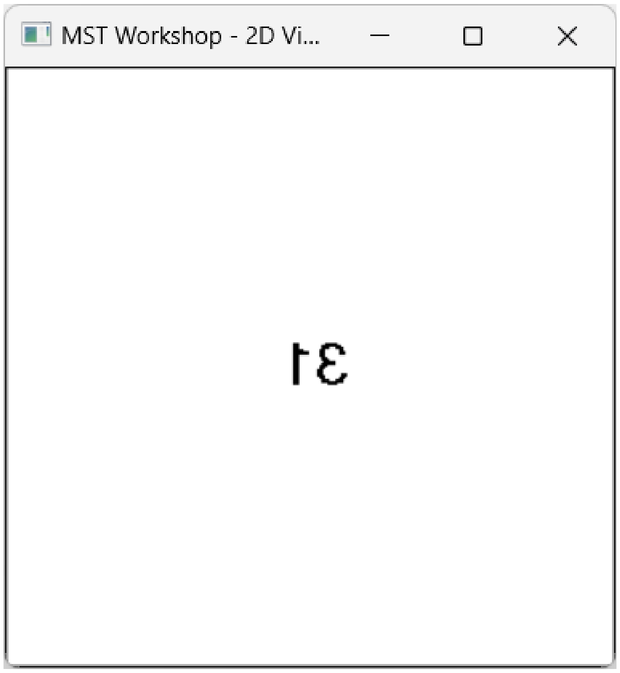
The 2D Flat Distance component calculates the distance between two points on a plane. Functions - column 8



2D Flip

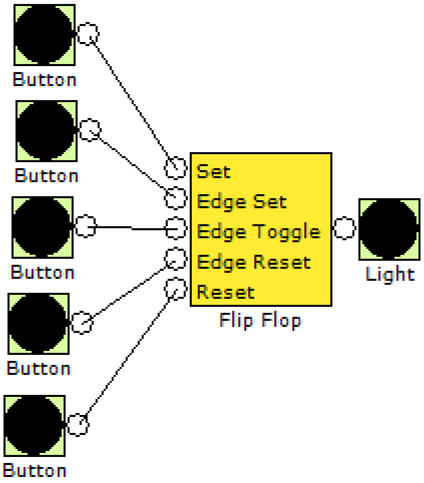
The 2D Flip component can flip the image in the 2D Window. Optionally you can flip horizontally or vertically or both. Note: This component only affects the items in the 2D View window that are under it. 2D – column 7

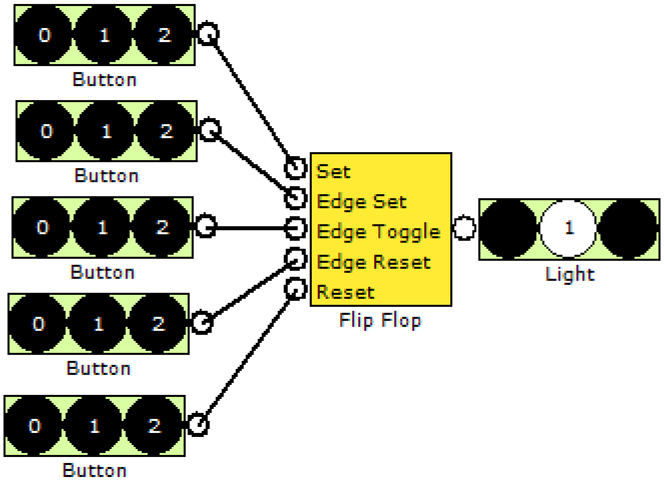




Flip Flop

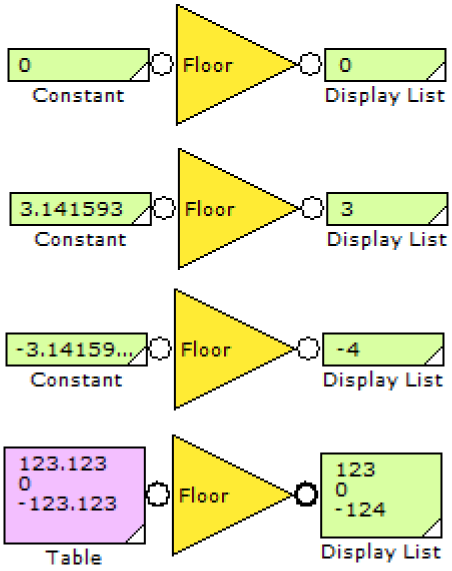
The Flip Flop component is a memory device that can toggle between true and false. Functions - column 3





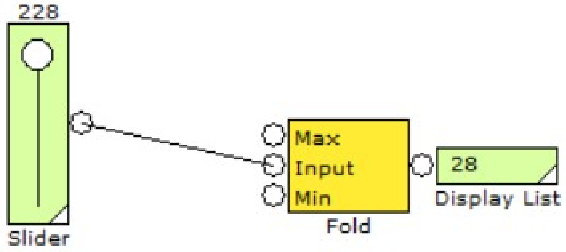
Floor

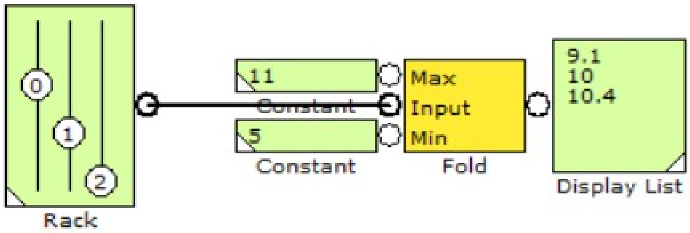
The Floor component outputs an integer less than or equal to the input. Input can be scalar or an array.
Functions - column 2



Fold

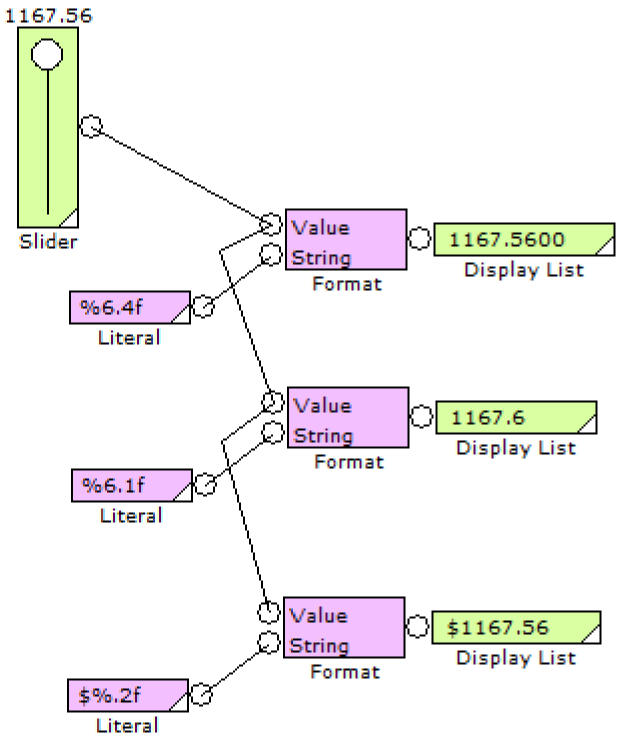
The Fold component folds the input value until it is between the High and Low values. Functions – column 2





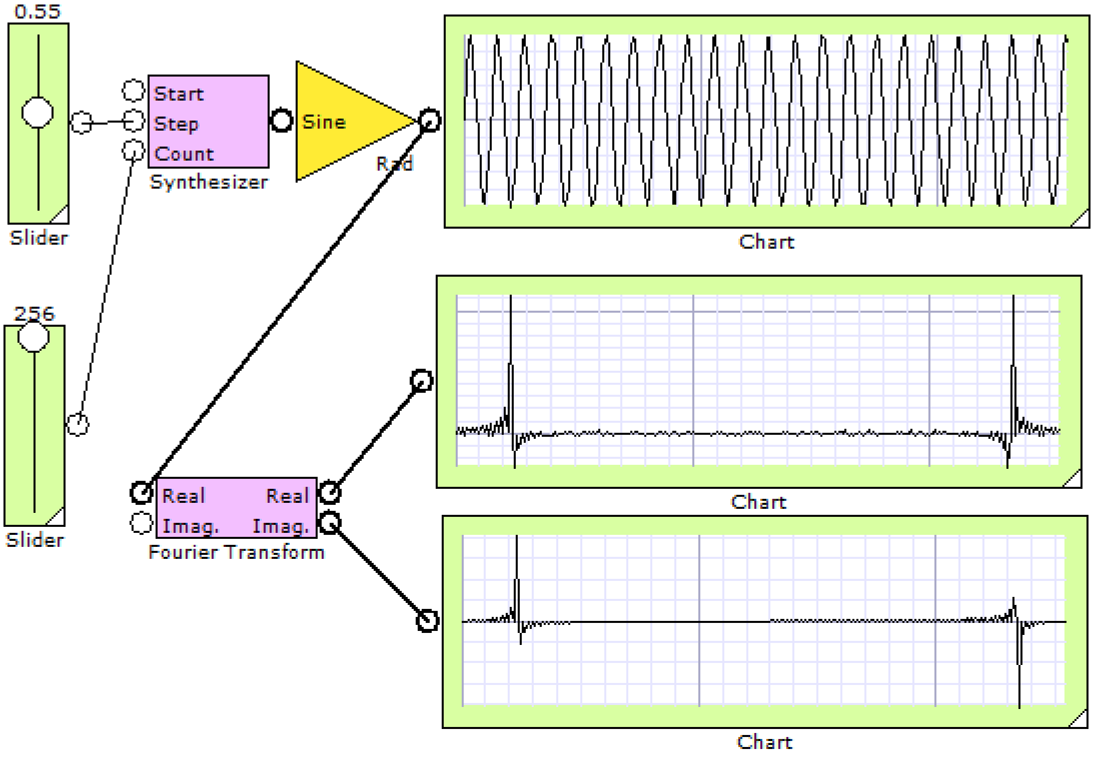
Format

The Format component converts the input numbers to strings. Arrays - column 6



Fourier Transform

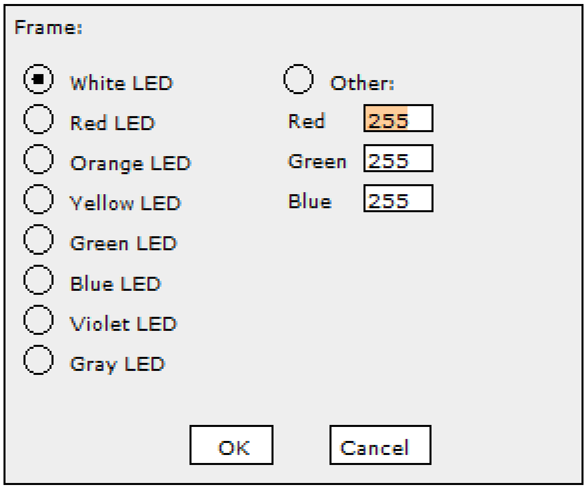
The Fourier Transform calculates the Fourier transform of the input. The result is to generate a spectrum analysis of the input.   Arrays - column 5



Frame

The Frame component is used to draw a frame around a section of your solution for clarity only.

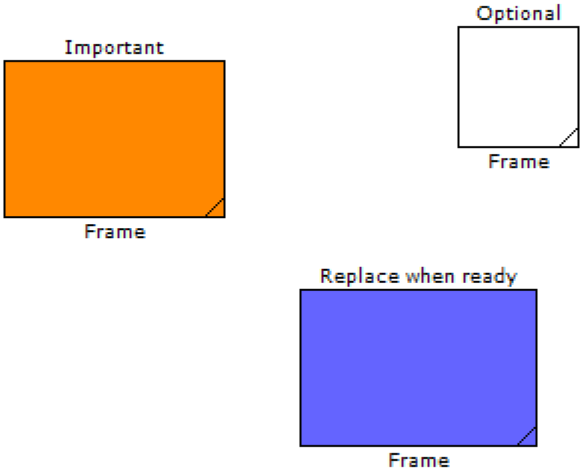
Controls - column 5



Frame:

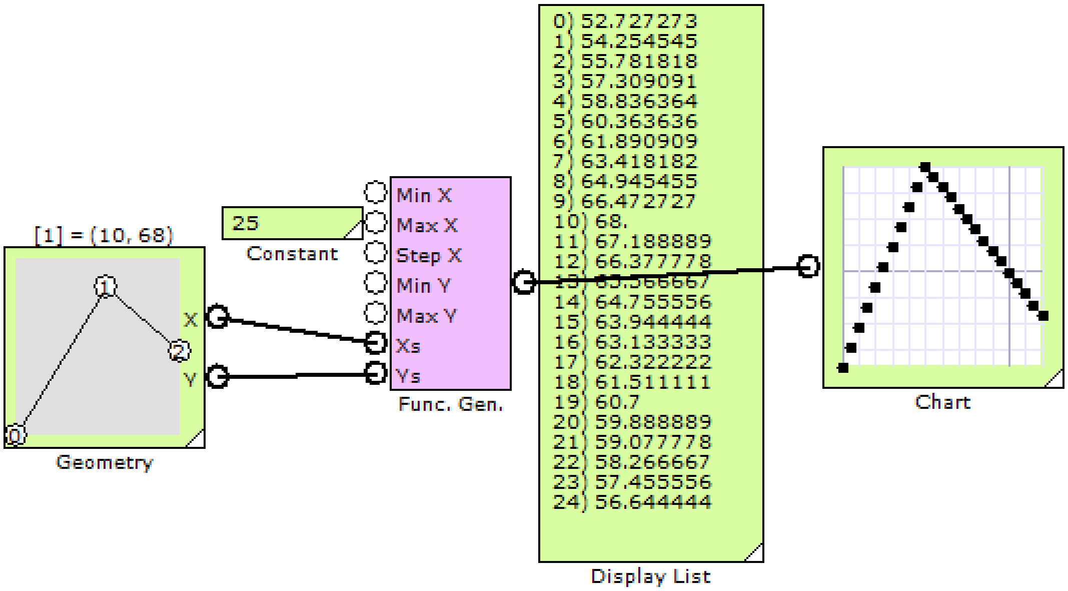
● White LED
○ Red LED
○ Orange LED
○ Yellow LED
○ Green LED
○ Blue LED
○ Violet LED
○ Gray LED

○ Other:
Red 255
Green 255
Blue 255



Func. Gen.

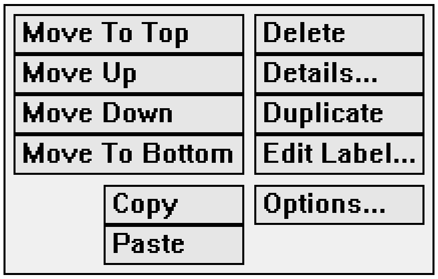
The Func. Gen. component takes a few xy points and creates a function in the range specified at the inputs. Arrays - column 1

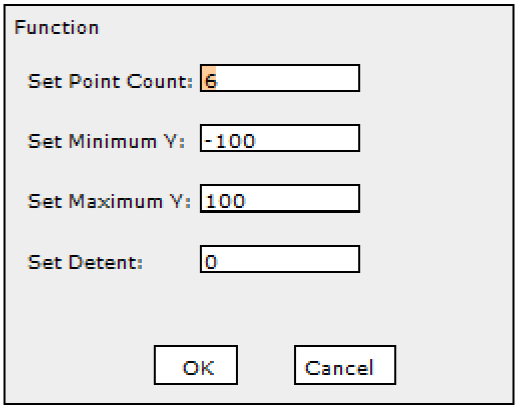


```
0) 52.727273
1) 54.254545
2) 55.781818
3) 57.309091
4) 58.836364
5) 60.363636
6) 61.890909
7) 63.418182
8) 64.945455
9) 66.472727
10) 68.
11) 67.188889
12) 66.377778
13) 65.566667
14) 64.755556
15) 63.944444
16) 63.133333
17) 62.322222
18) 61.511111
19) 60.7
20) 59.888889
21) 59.077778
22) 58.266667
23) 57.455556
24) 56.644444
```

Func. Points

The Func. Points lets you create a function by setting the Y values on the surface of the component component. Note: This component can be operated using the wheel on the mouse. Controls - column 1



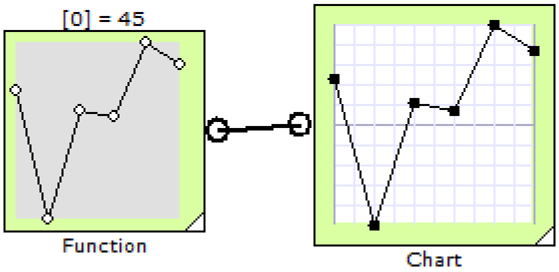

Function

Set Point Count: 6

Set Minimum Y: -100

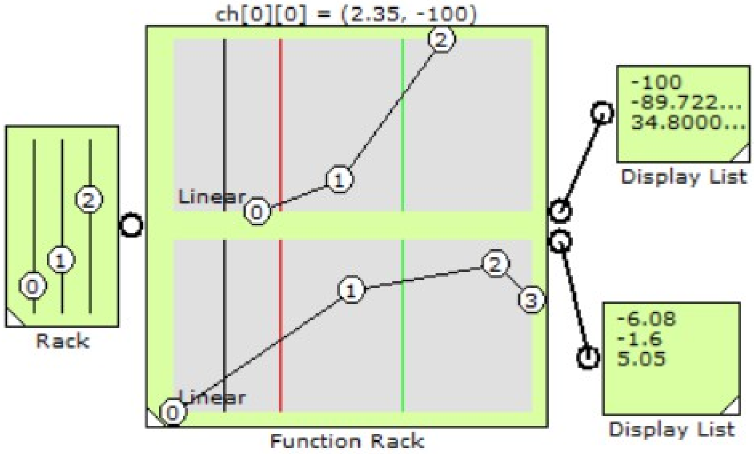
Set Maximum Y: 100

Set Detent: 0



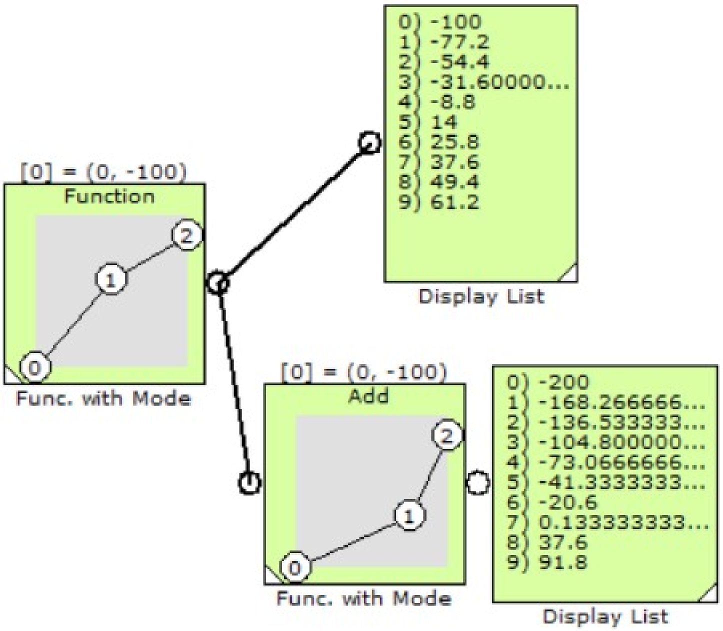
Func. Rack At

The Func. Rack At component lets you create several functions by drawing them on the surface of the component. This version outputs a value for each channel. You can have up to 8 channels. This version allows you to change the X and Y position of each point. The output cam be linear interpolation, a sinusoid between points, a spline, or simple stair steps. Note: This component can be operated using the wheel on the mouse. Controls – column 1



Func. with Mode

The Function with Mode component lets you create a function by setting the XY position of points on the surface of the component. This version outputs an array based on the positions of the knobs. This version allows you to change the X and Y position of each point. The output can be a linear interpolation, a sinusoid between points, a spline, or simple stair steps. Note: This component can be operated using the wheel on the mouse. Controls - column 1

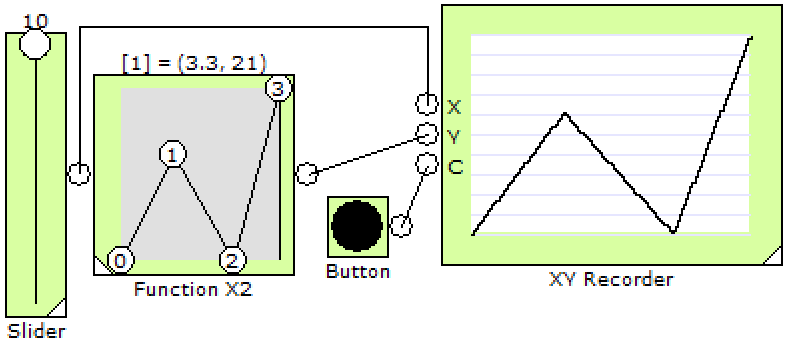


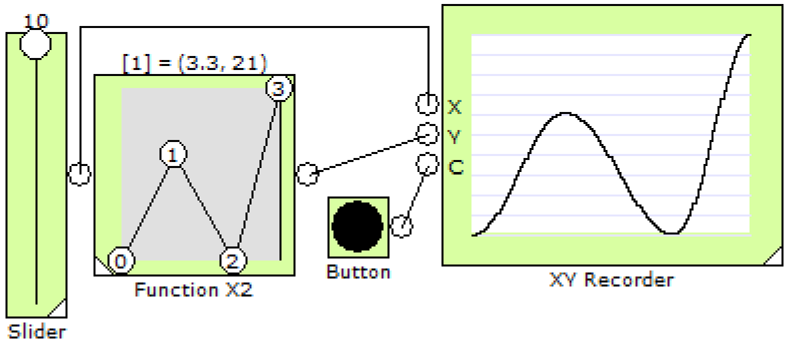
```
0) -100
1) -77.2
2) -54.4
3) -31.60000...
4) -8.8
5) 14
6) 25.8
7) 37.6
8) 49.4
9) 61.2
```

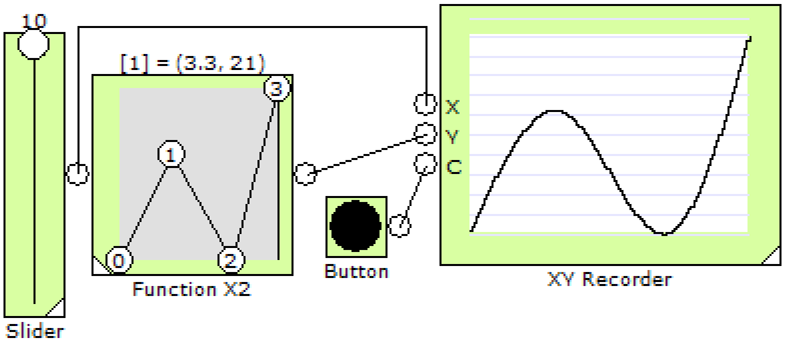
```
0) -200
1) -168.266666...
2) -136.533333...
3) -104.800000...
4) -73.0666666...
5) -41.3333333...
6) -20.6
7) 0.133333333...
8) 37.6
9) 91.8
```

Func. XY At

The Func. XY At lets you create a function by setting the XY position of points on the surface of the component. This version outputs a single value based on a single input or an array of outputs if the input is an array. This version allows you to change the X and Y position of each point. The output can be a linear interpolation, a sinusoid between points or a simple stair step. Note: This component can be operated using the wheel on the mouse.Controls - column 1

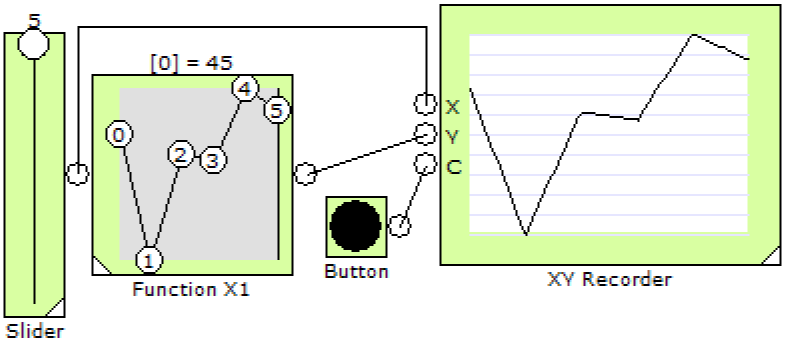


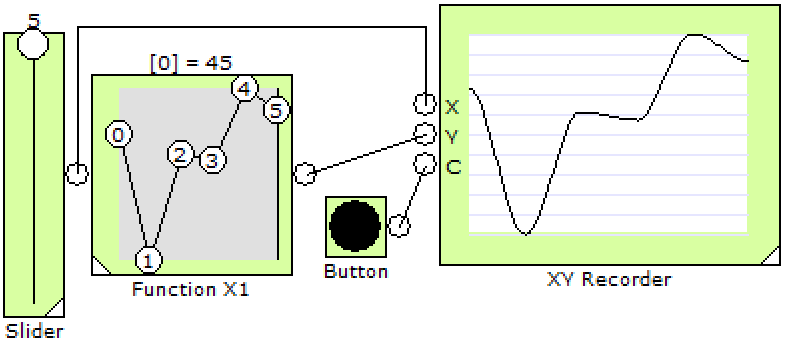


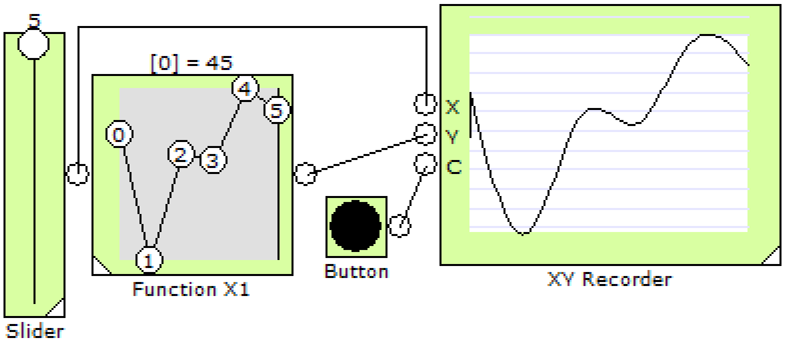


Func. Y At

The Function Y At lets you create a function by setting the Y position of points on the surface of the component. This version outputs a single value based on a single input or an array of outputs if the input is an array. This version allows you to change the Y position of each point. The output can be a linear interpolation, a sinusoid between points or a simple stair step. Note: This component can be operated using the wheel on the mouse. Controls - column 1

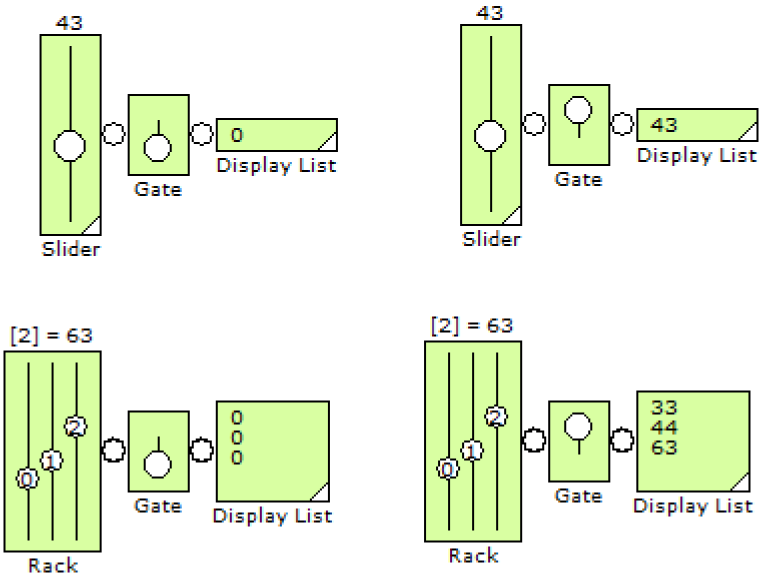






Gate

The Gate component is connects the input to the output when it is on. When it is off, the output is zero. Note: This component can be operated using the wheel on the mouse.   Controls - column 4



Gather

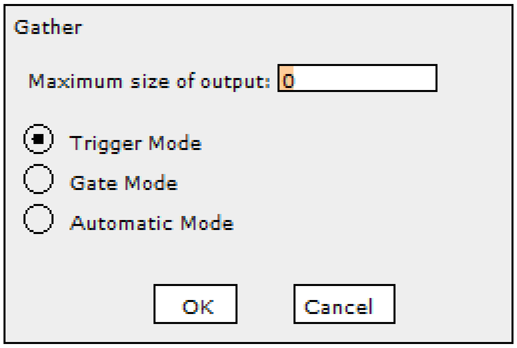
The Gather component stores the data at the input terminal each time the trigger goes true. The input can be numbers or strings and scalar or an array. There are three modes:

Trigger mode gathers inputs on the positive edge of the Trigger input.

Gate mode gathers inputs when the Gate is true and the clock is running.

Automatic mode gathers inputs when the Automatic input is true and any input changes.

Arrays - column 1



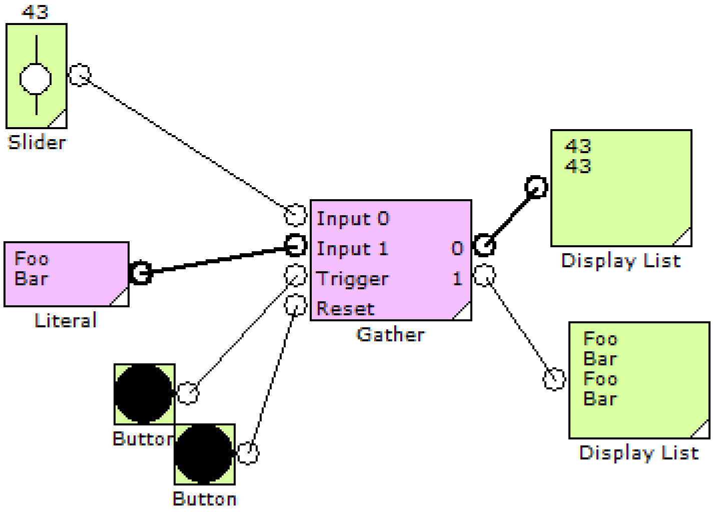
Gather

Maximum size of output: 0

● Trigger Mode

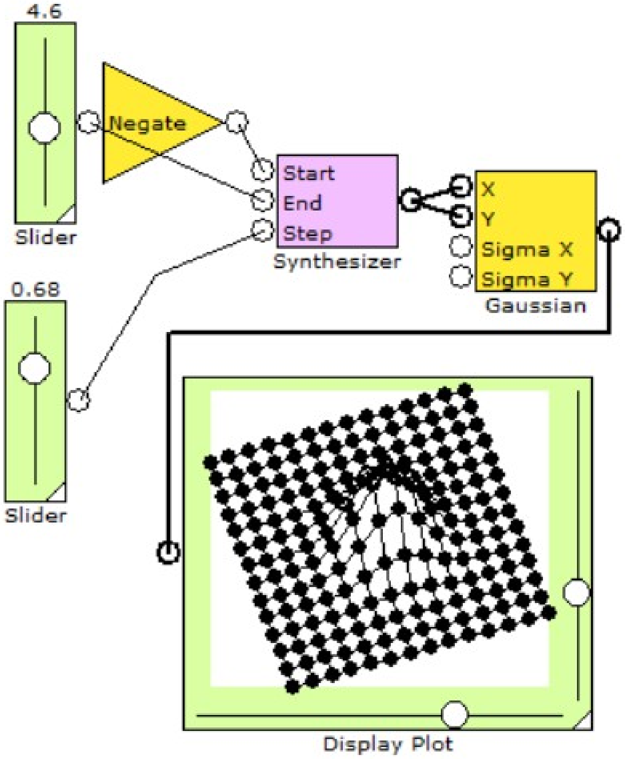
○ Gate Mode

○ Automatic Mode



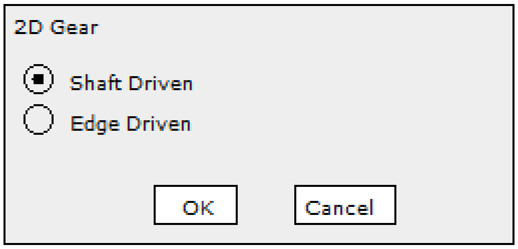
Gaussian

The Gaussian component calculates the Gaussian in 1, 2, or 3-Dimensions. Functions – column 5



2D Gear

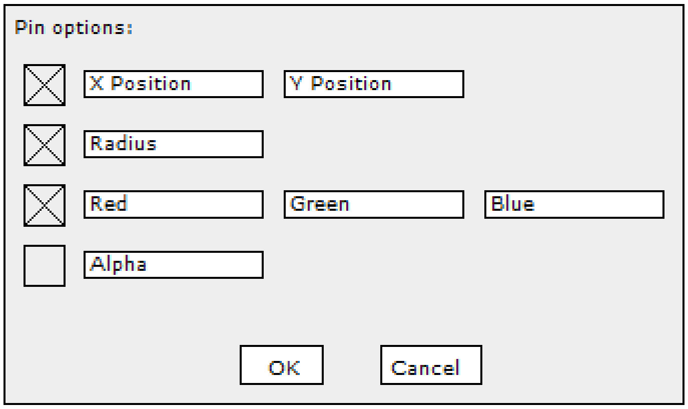
The Gear component creates a gear that can attach to other Gears or other simulation objects like Motors. Place the Gear at the same X, Y position as a motor to connect the gear to the motor.   2D - column 3



2D Gear

● Shaft Driven

○ Edge Driven



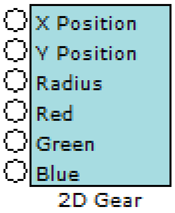
Pin options:

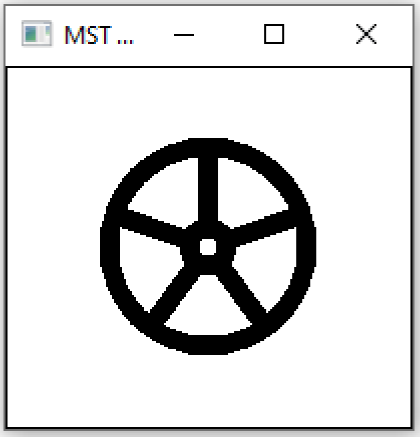
☒ X Position   Y Position

☒ Radius

☒ Red   Green   Blue

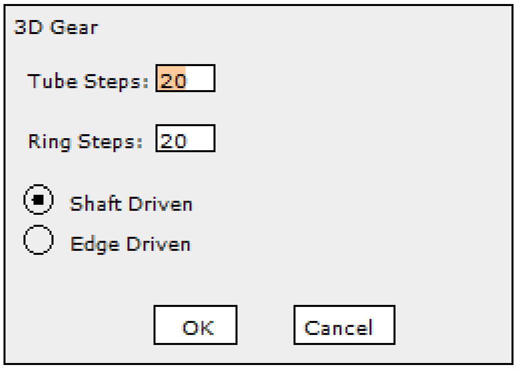
□ Alpha





3D Gear

The 3D Gear component creates a gear that can attach to other 3D Gears or other simulation objects like 3D Motors. Place the Gear at the same X, Y, Z position and orientation as a motor to connect the gear to the motor.   3D - column 4



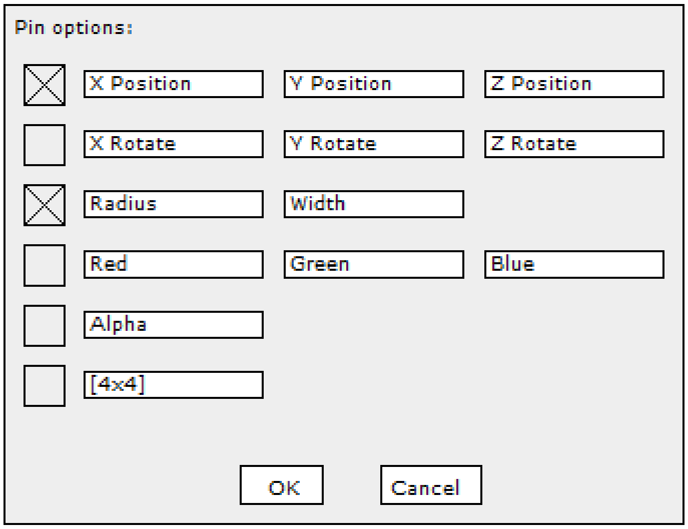
3D Gear

Tube Steps: 20

Ring Steps: 20

● Shaft Driven
○ Edge Driven

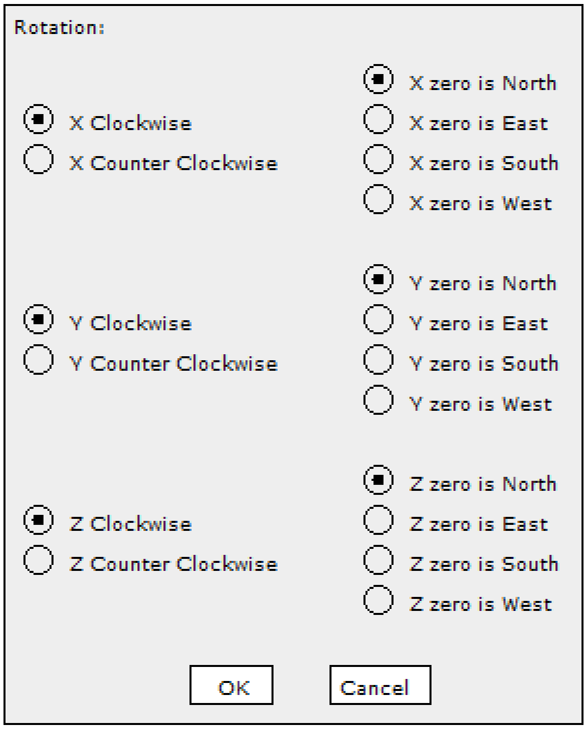
OK Cancel



Pin options:

☒ X Position | Y Position | Z Position
□ X Rotate | Y Rotate | Z Rotate
☒ Radius | Width
□ Red | Green | Blue
□ Alpha
□ [4x4]

OK Cancel



Rotation:

● X Clockwise
○ X Counter Clockwise

● X zero is North
○ X zero is East
○ X zero is South
○ X zero is West

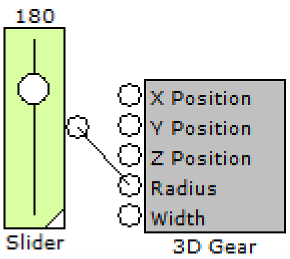
● Y Clockwise
○ Y Counter Clockwise

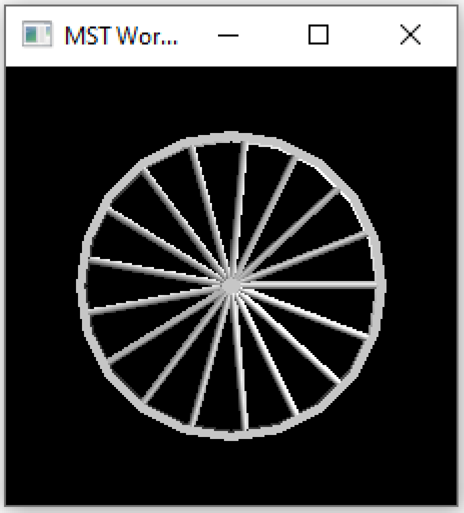
● Y zero is North
○ Y zero is East
○ Y zero is South
○ Y zero is West

● Z Clockwise
○ Z Counter Clockwise

● Z zero is North
○ Z zero is East
○ Z zero is South
○ Z zero is West

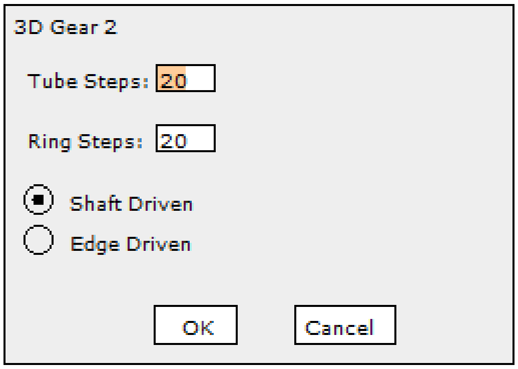
OK Cancel





3D Gear 2

The 3D Gear 2 component creates a gear that can attach to other 3D Gear 2s or other simulation objects like 3D Motors. Place the Gear 2 at the same X, Y, Z position and orientation as a driven object then the opposite end will drive another object.   3D - column 4



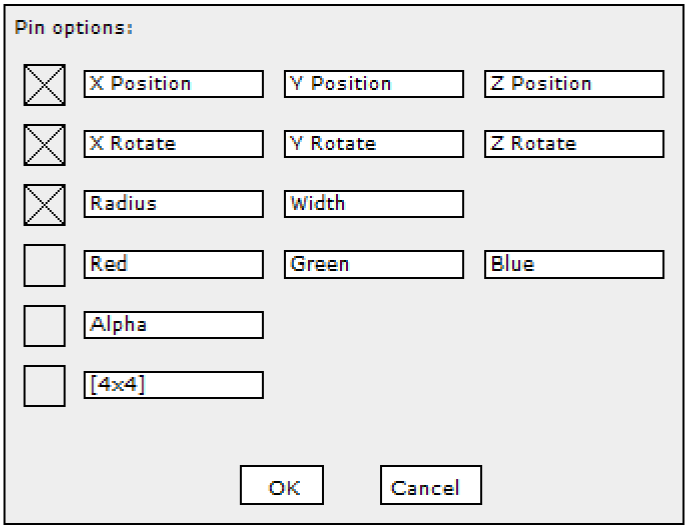
3D Gear 2

Tube Steps: 20

Ring Steps: 20

● Shaft Driven
○ Edge Driven

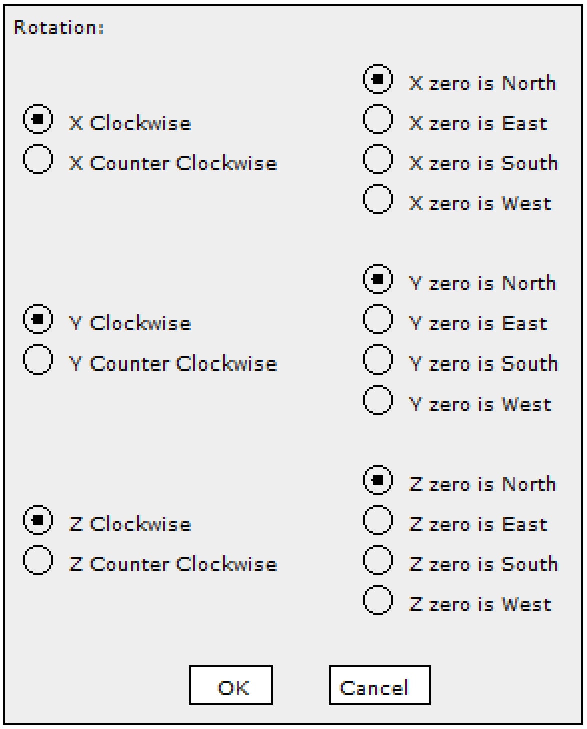
OK   Cancel



Pin options:

☒	X Position	Y Position	Z Position
☒	X Rotate	Y Rotate	Z Rotate
☒	Radius	Width	
□	Red	Green	Blue
□	Alpha		
□	[4x4]		

OK   Cancel



Rotation:

● X Clockwise
○ X Counter Clockwise

● X zero is North
○ X zero is East
○ X zero is South
○ X zero is West

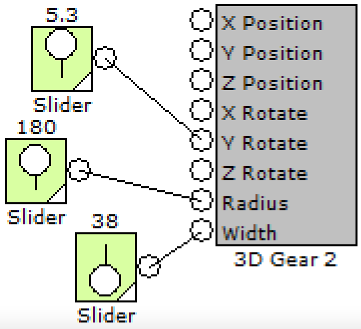
● Y Clockwise
○ Y Counter Clockwise

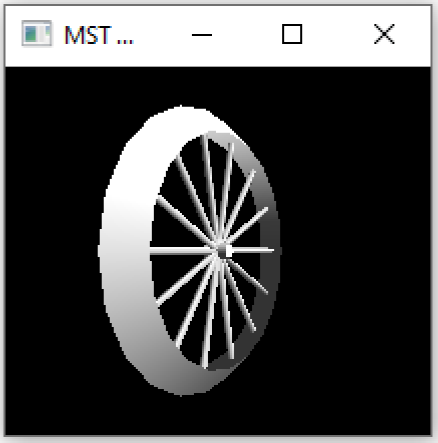
● Y zero is North
○ Y zero is East
○ Y zero is South
○ Y zero is West

● Z Clockwise
○ Z Counter Clockwise

● Z zero is North
○ Z zero is East
○ Z zero is South
○ Z zero is West

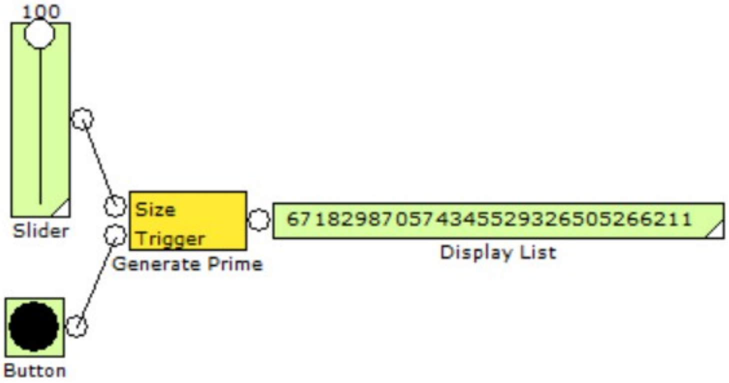
OK   Cancel





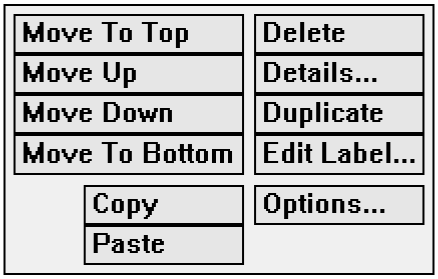
Generate Prime

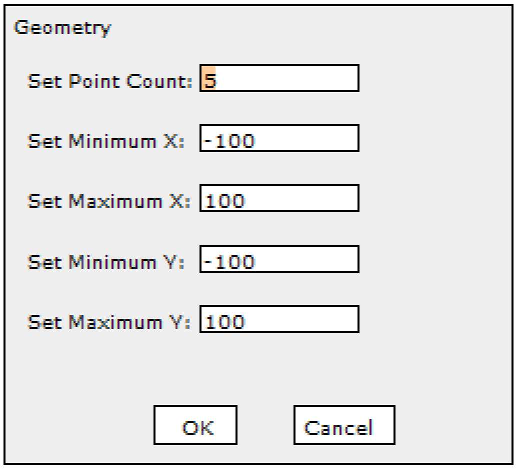
The Generate Prime component finds a prime number with the number of bits specified. The output is a string. Functions - column 8



Geometry

The Geometry lets you control a number of constants in two directions, horizontal (x) and vertical (y).
Controls - column 1




Geometry

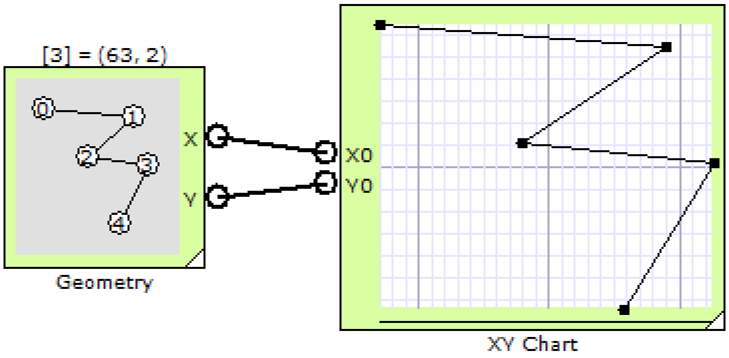
Set Point Count: 5

Set Minimum X: -100

Set Maximum X: 100

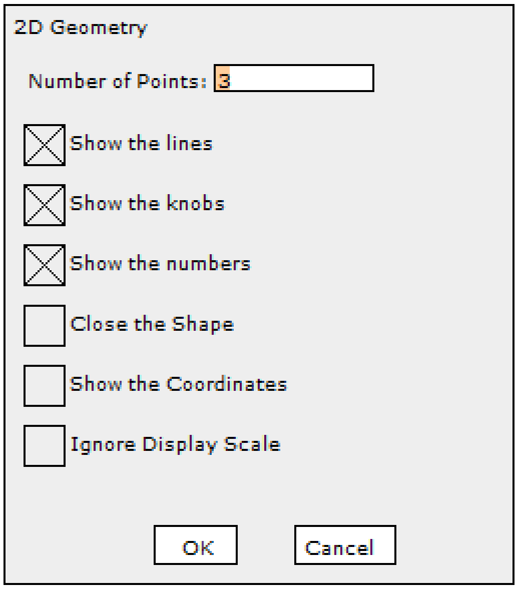
Set Minimum Y: -100

Set Maximum Y: 100



2D Geometry

The 2D Geometry lets you control a number of constants on the 2D canvas. Controls - column 2



2D Geometry

Number of Points: 3

☒ Show the lines

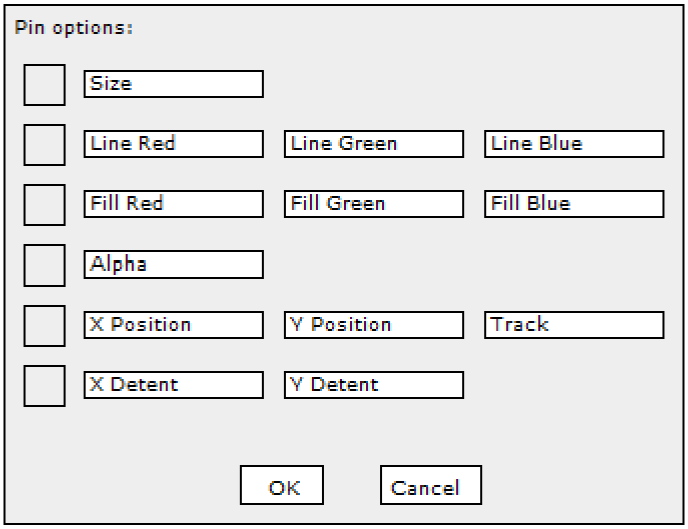
☒ Show the knobs

☒ Show the numbers

□ Close the Shape

□ Show the Coordinates

□ Ignore Display Scale



Pin options:

□ Size

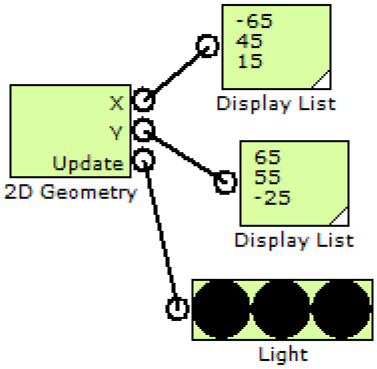
□ Line Red | Line Green | Line Blue

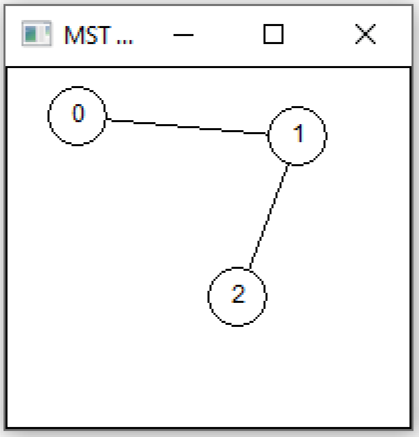
□ Fill Red | Fill Green | Fill Blue

□ Alpha

□ X Position | Y Position | Track

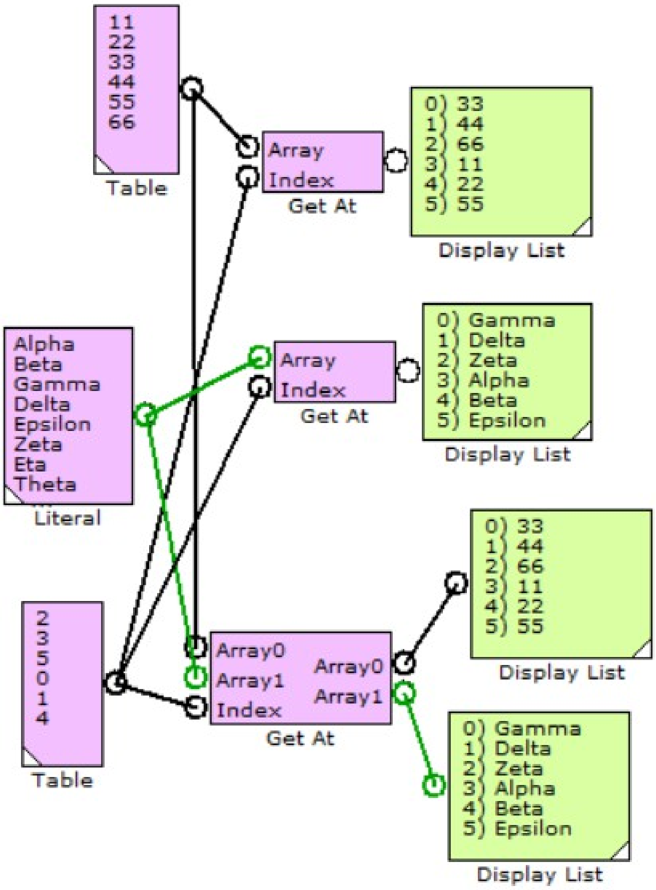
□ X Detent | Y Detent





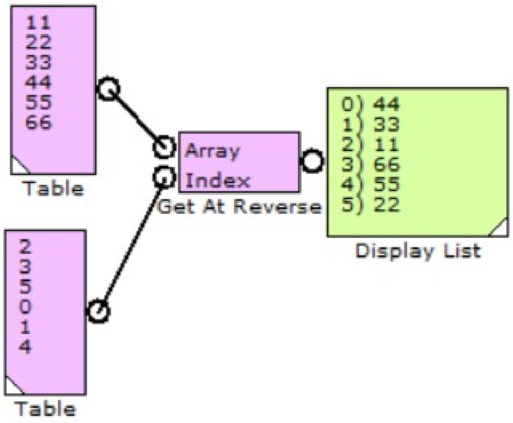
Get At

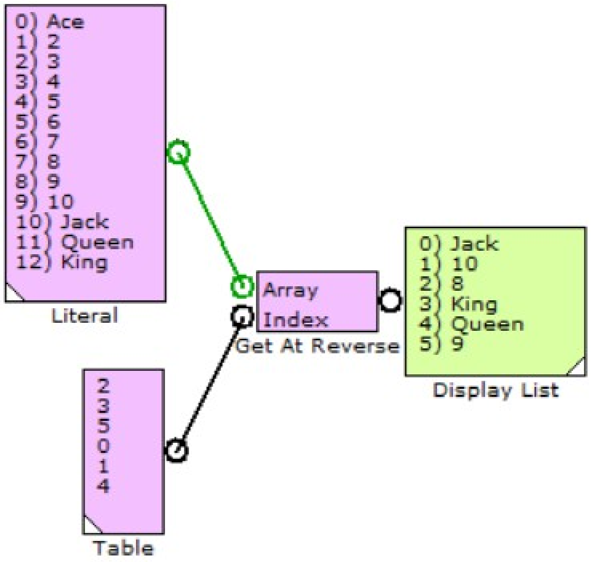
The Get At component gets the Array value at the Index input. It outputs the value(s) at the positions given by the Index(s). Optionally you can specify what to return when the Index is out of the Array's range. Arrays - column 2



Get At Reverse

The Get At Reverse component gets the Array value at the Index input starting at the end of the Array. It outputs the value(s) at the positions taken from the end of the array. An index of zero returns the last element of the Array. Optionally you can specify what to return when the Index is out of the Array's range. Arrays - column 2



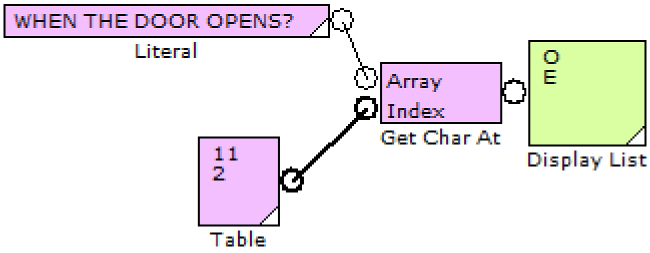


Get Bitmap

The Get Bitmap reads a BMP image file given its path. It outputs the Width and Height of the bitmap in the file.   2D - column 2

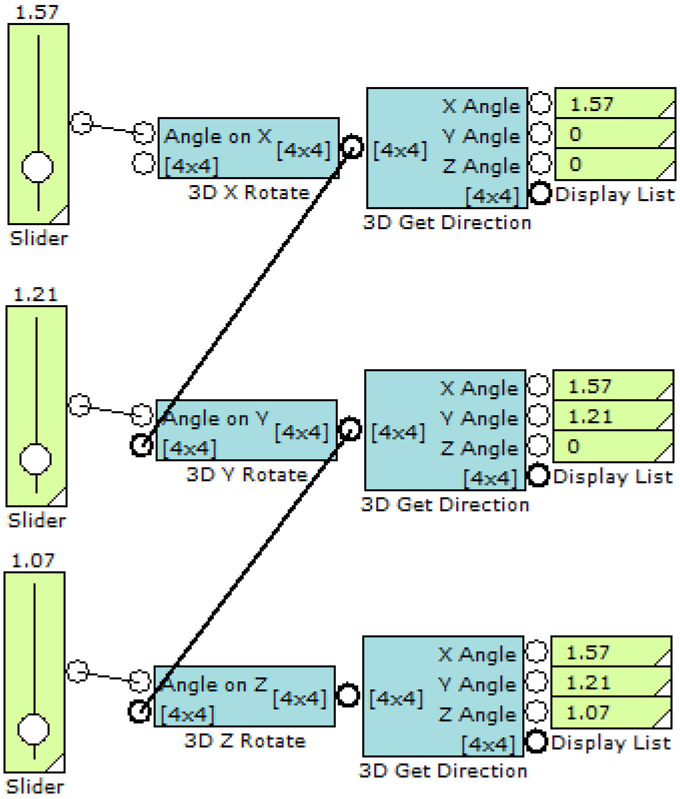
Get Char At

The Get Char At component outputs one character of the input string.   Arrays - column 6



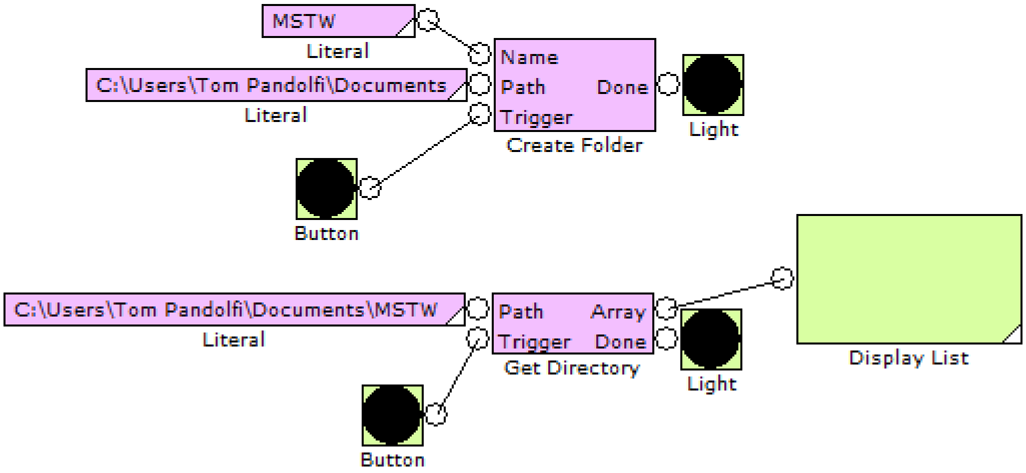
3D Get Direction

The 3D Get Direction returns the rotation angles of a 4 by 4 matrix on the X, Y, and Z axies and also returns the matrix with the rotation removed.   3D - column 3



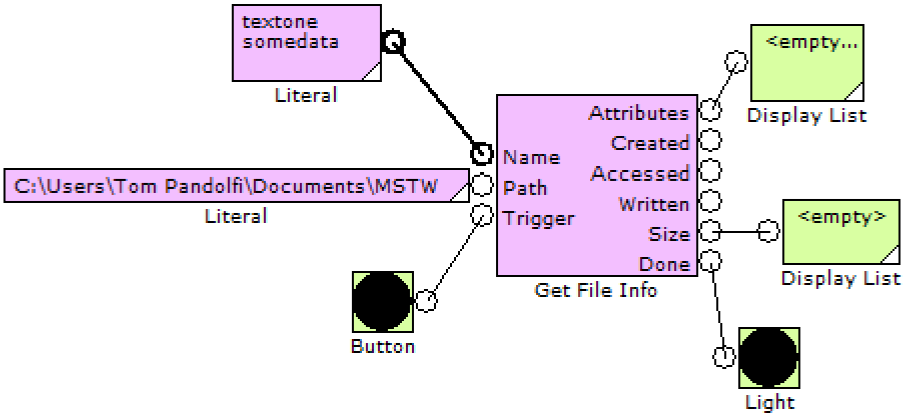
Get Directory

The Get Directory component lists the contents of the specified directory. You can specify if you want files or sub directories to be listed.   Arrays - column 7



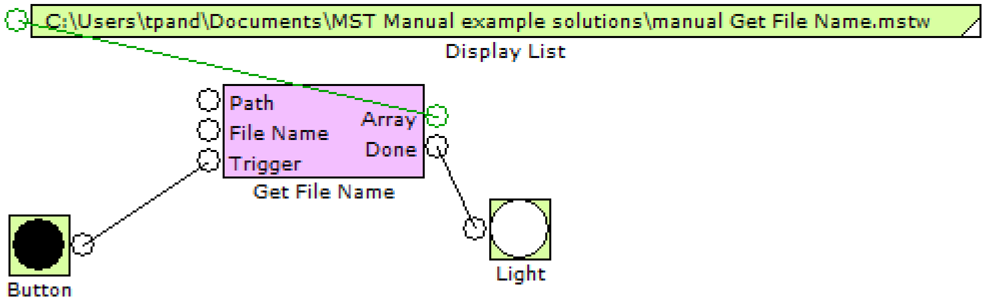
Get File Info

The Get File Info component outputs information about the file specified. Including the size and time of creation.   Arrays - column 7



Get File Name

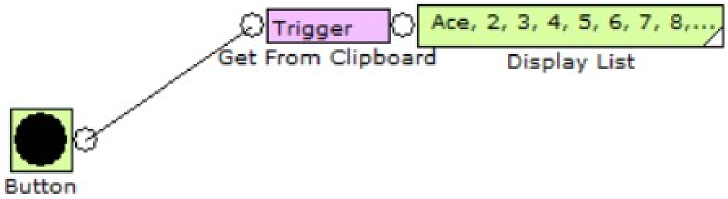
The Get File Name component asks the user to select a file to open or save. Arrays - column 7



C:\Users\tpand\Documents\MST Manual example solutions\manual Get File Name.mstw
Display List
Path
File Name
Trigger
Array
Done
Get File Name
Button
Light

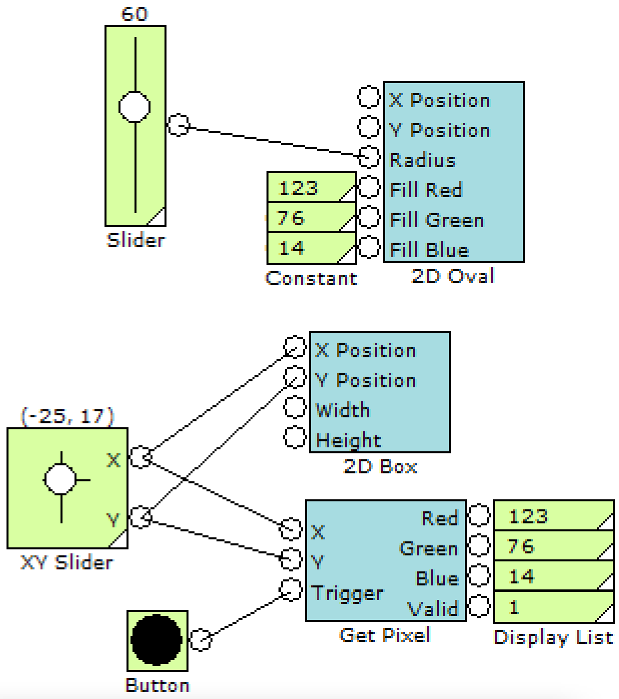
Get From Clipboard

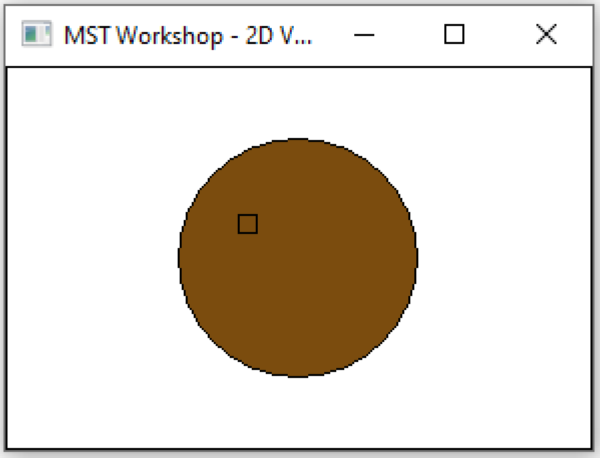
The Get From Clipboard component gets the text from the clipboard. Arrays – column 5



Get Pixel

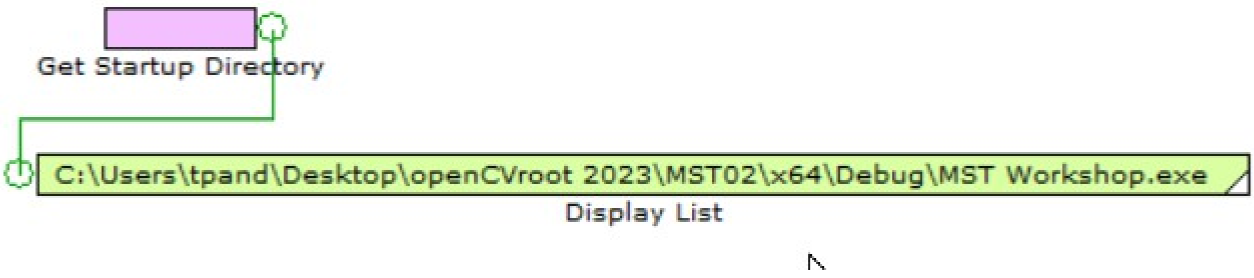
The Get Pixel component reads the canvas and outputs the color components of the pixel at the x, y coordinate.   2D - column 2





Get Startup Directory

The Get Startup Directory component gets the directory path to where this program started. Arrays – column 7

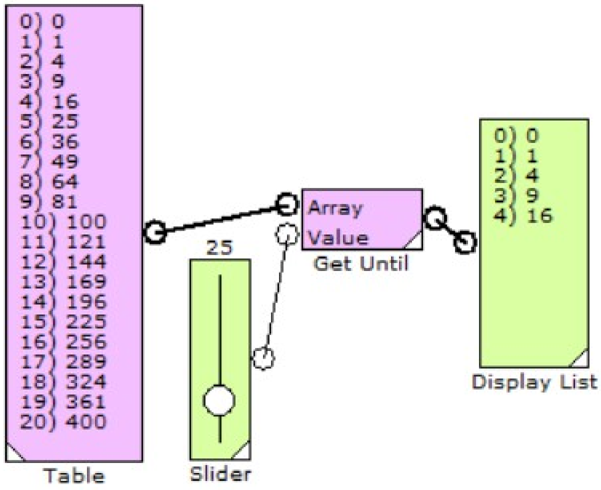


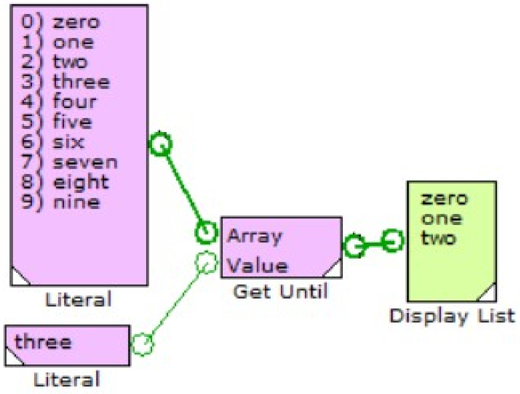
```
C:\Users\tpand\Desktop\openCVroot 2023\MST02\x64\Debug\MST Workshop.exe
```

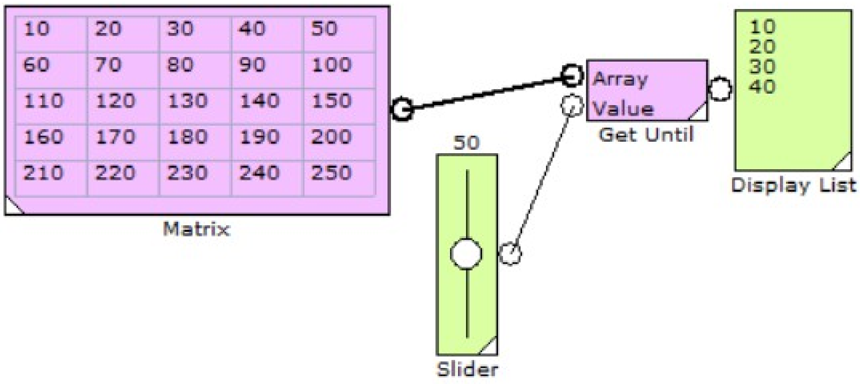
Get Until

The Get Until component copies the Array values until the value at the Until input is reached. If nothing is connected to the Until input, then the array is copied until a blank item in the array is found.

Arrays - column 2

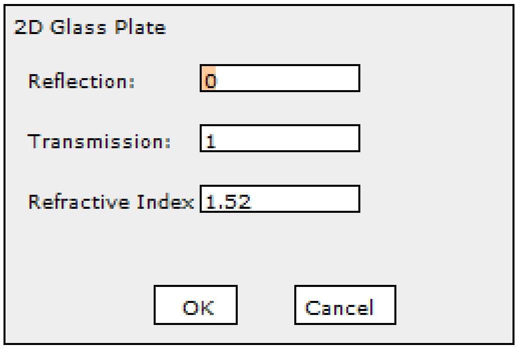






2D Glass Plate

The 2D Glass Plate component passes light rays through a solid piece of glass in the 2D view window. The settings determine the refractive index of the glass. 2D - column 3

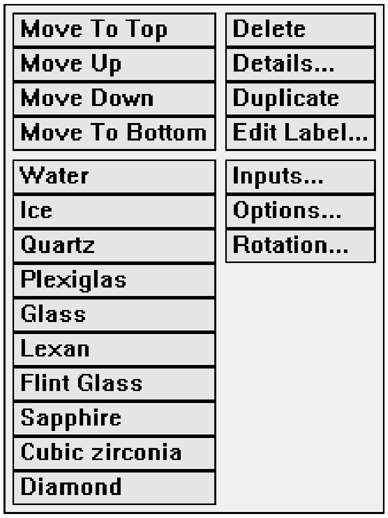


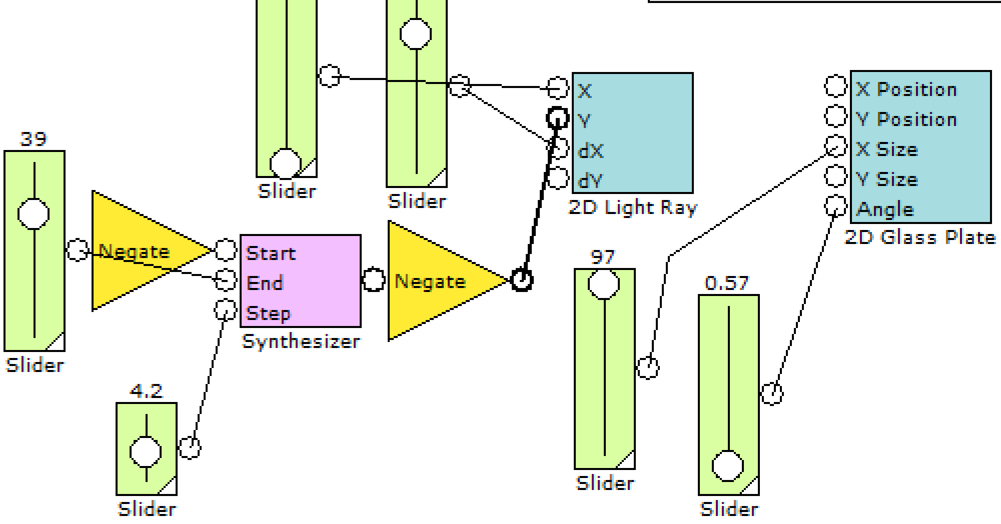
2D Glass Plate

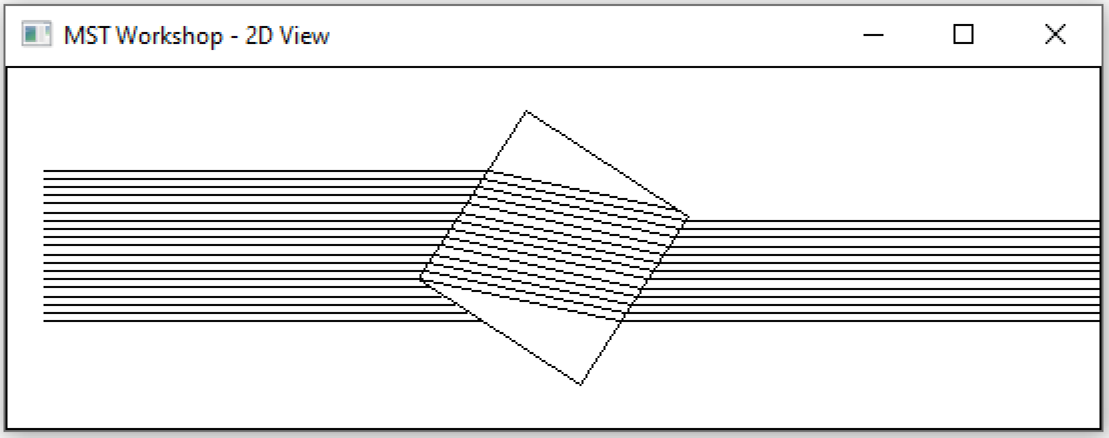
Reflection: 0

Transmission: 1

Refractive Index 1.52

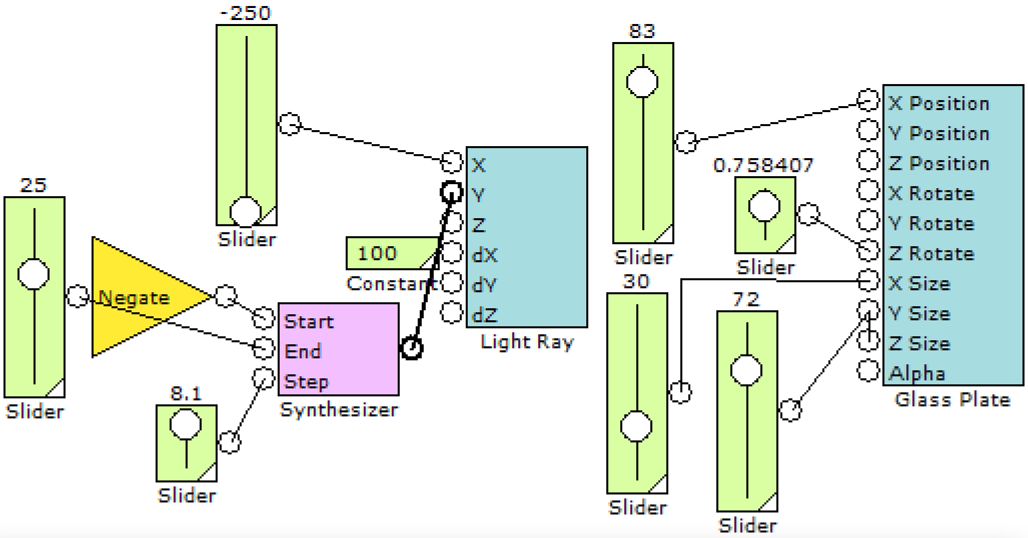


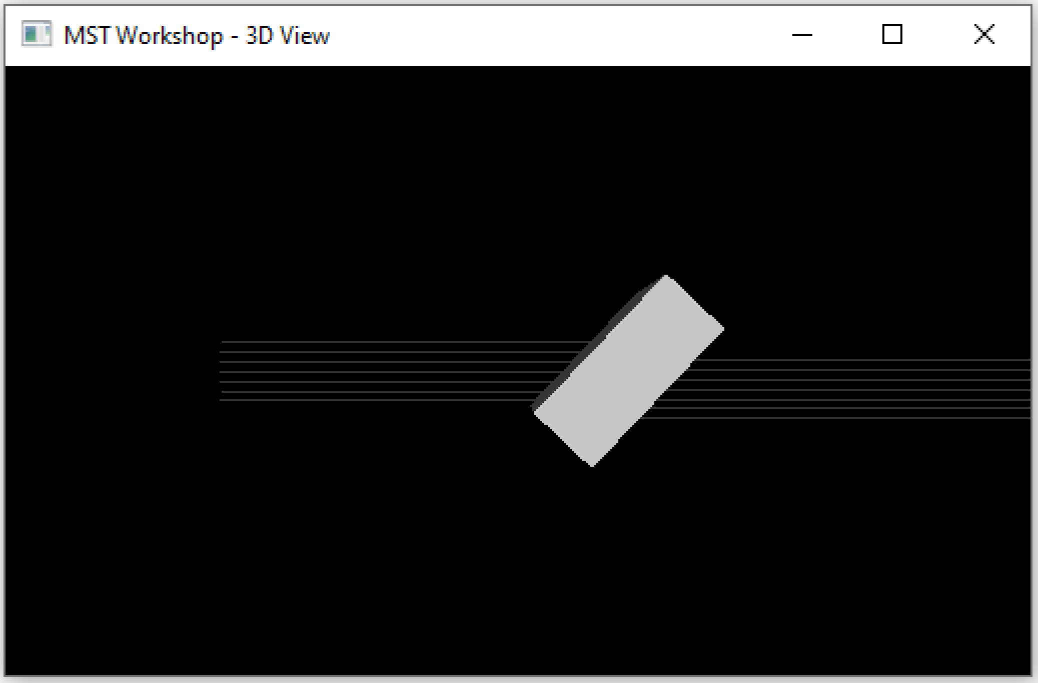




3D Glass Plate

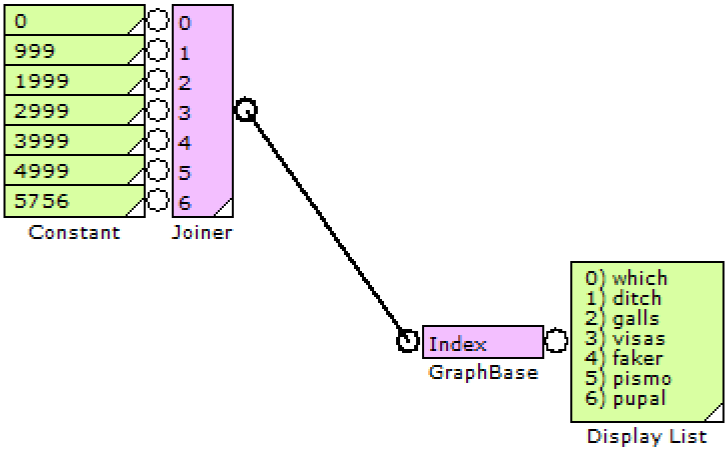
The 3D Glass Plate component passes light rays through a solid piece of glass in the 3D view window. The settings determine the refractive index of the glass. The Affine [4x4] array input modifies the size, position and orientation of the glass plate.   3D - column 5





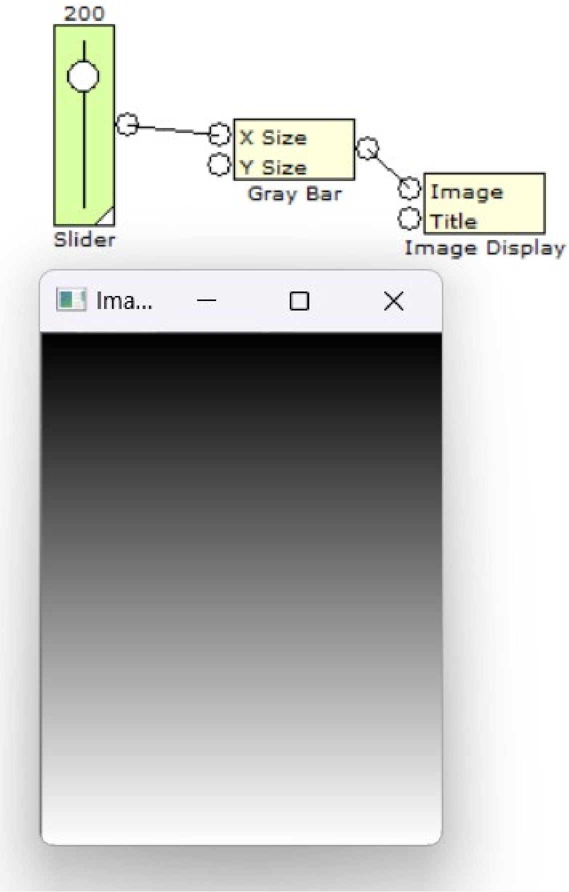
GraphBase

The GraphBase Words component is a list of 5757 five letter words provided by the Stanford University GraphBase.   Arrays - column 7



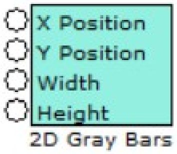
Gray Bar

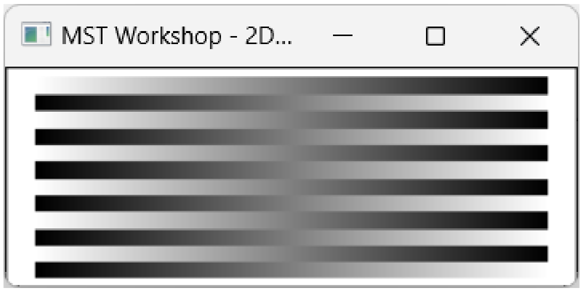
The Gray Bar component creates an image with a test pattern of a Grayscale bar. Images – column 1



2D Gray Bars

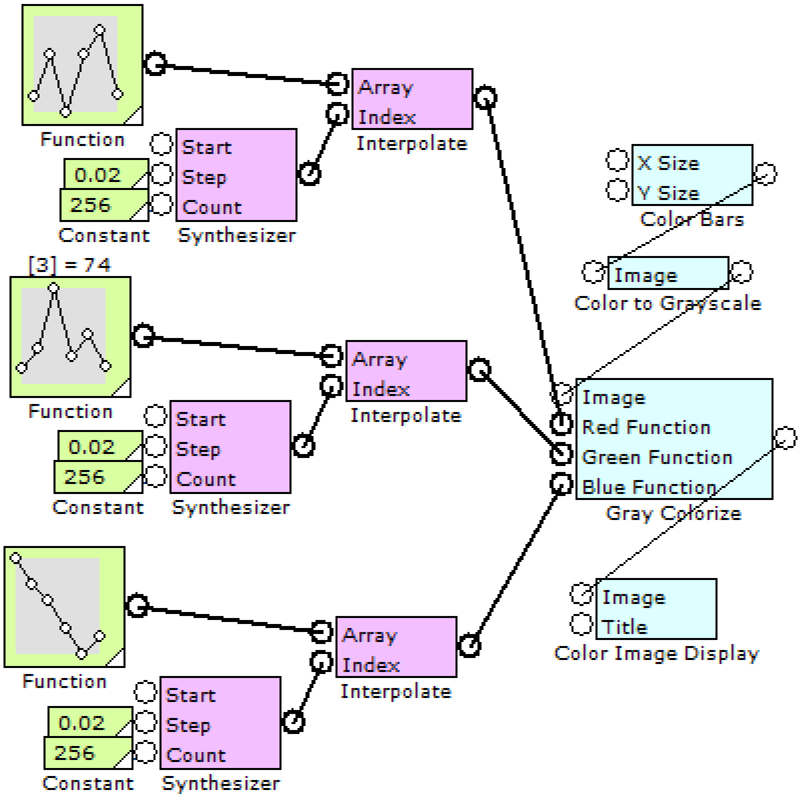
The 2D Gray Bars component draws grayscale bars on the 2D view canvas. 2D – column 2

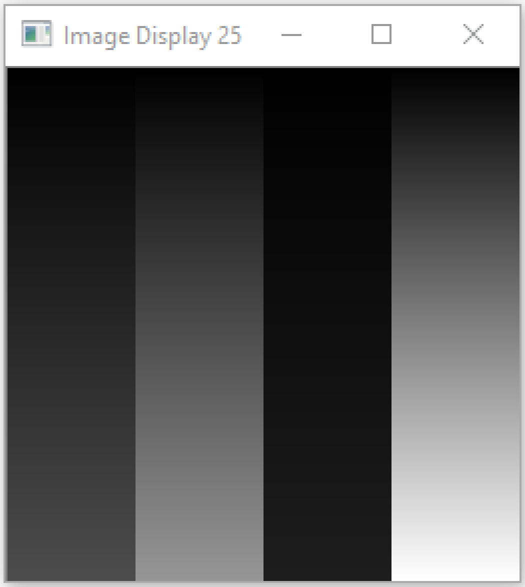


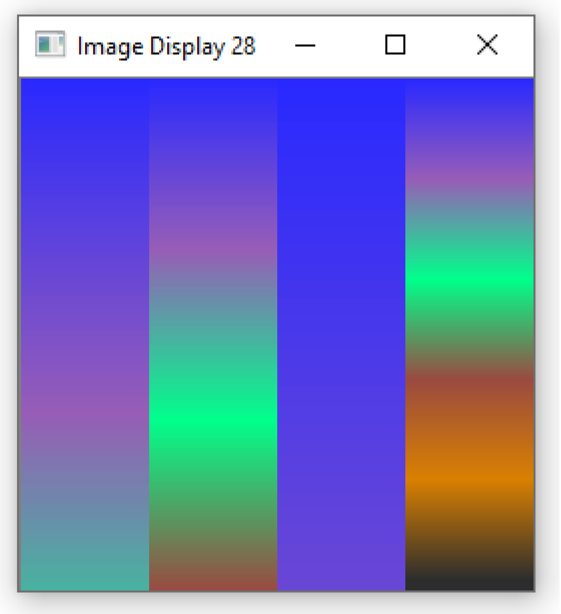


Gray Colorize

The Gray Colorize component remaps the grayscale image based on the 3 color function inputs. Images - column 2

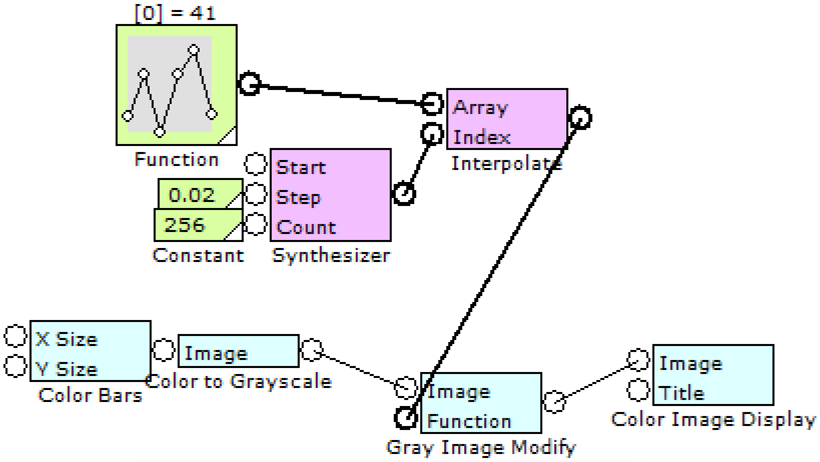


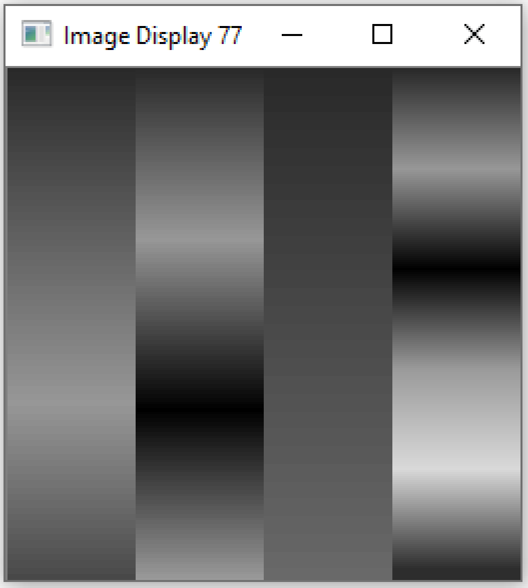




Gray Image Modify

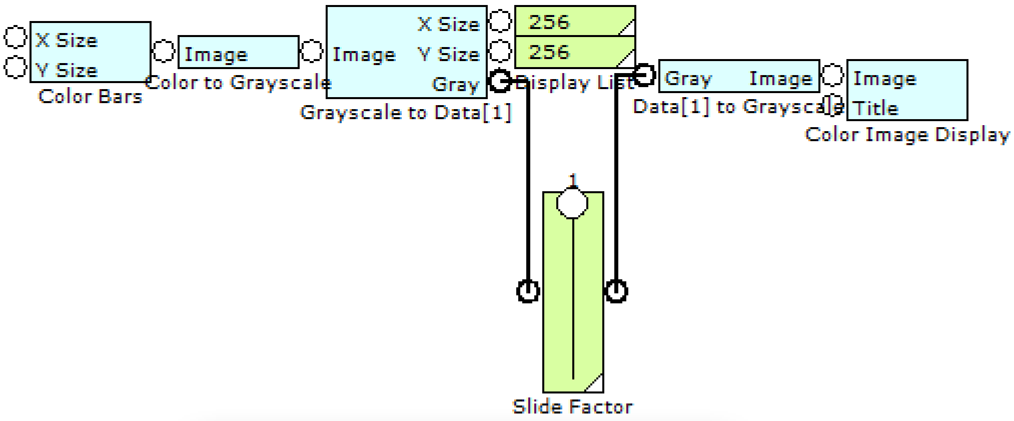
The Gray Image Modify component remaps the gray data based on the input function.   Images - column 2

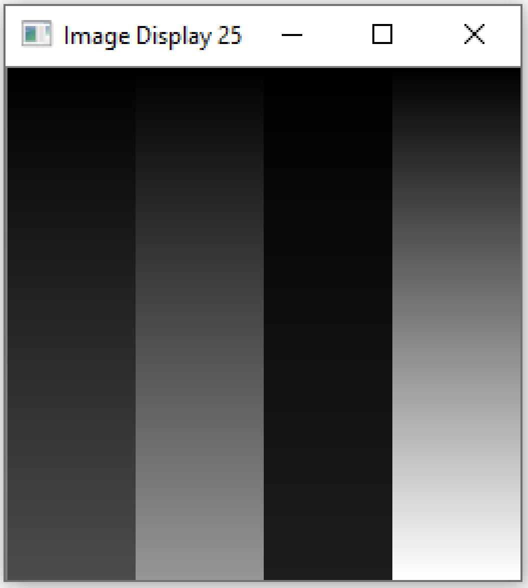




Grayscale to Data[1]

The Grayscale to Data[1] component outputs the grayscale data for the image.   Images - column 5

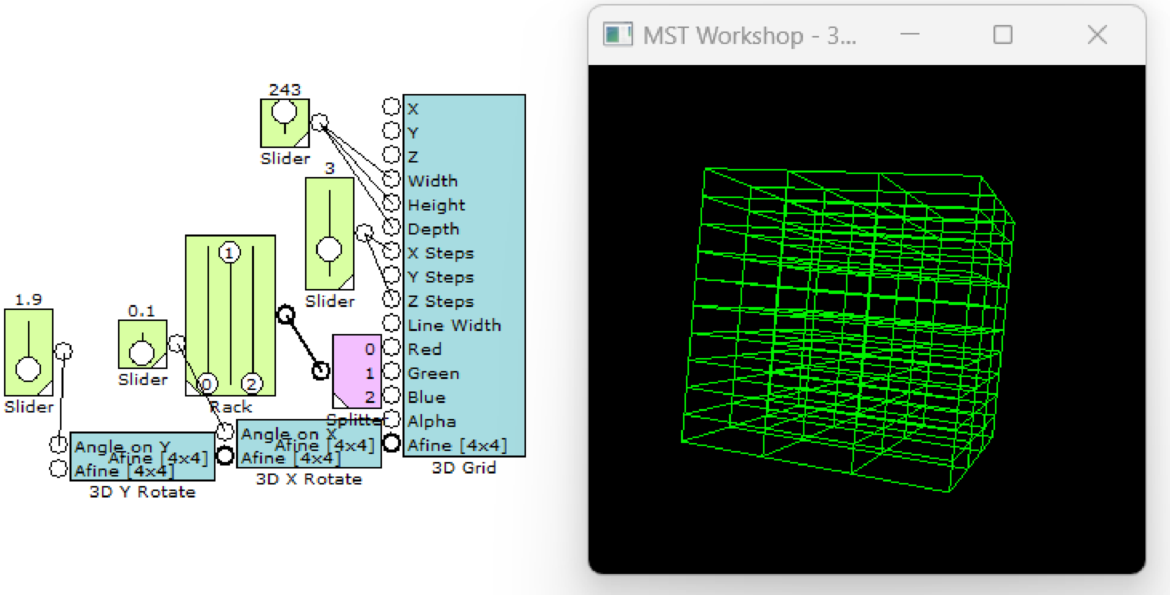




3D Grid

The 3D Grid component draws a grid of lines in the 3D view window. The inputs control the size and number of the grid lines. The Affine [4x4] array input modifies the size, position and orientation.

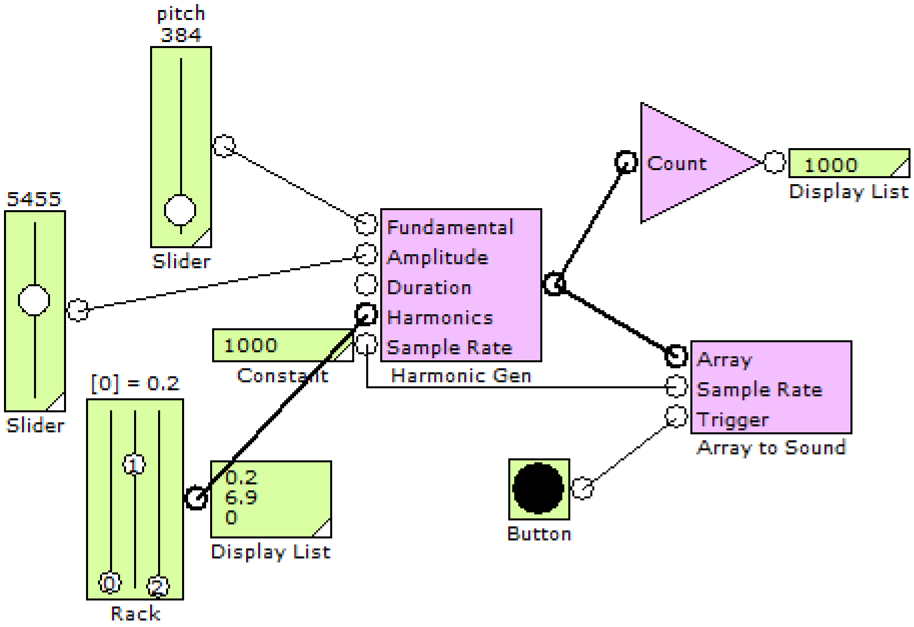
3D - column 4



Harmonic Gen

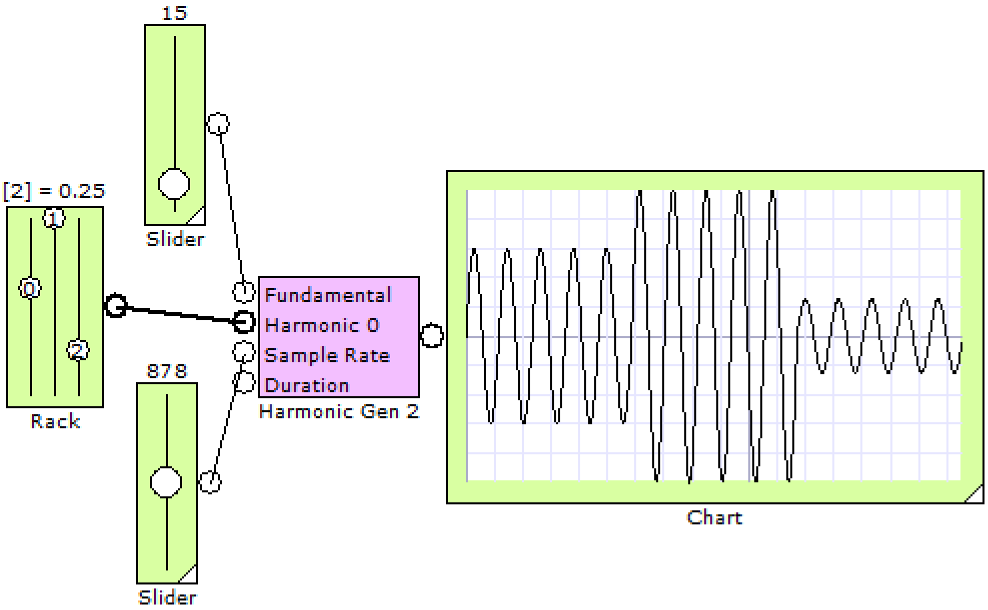
The Harmonic Gen component creates a wave output based on the inputs. The output can be heard by connecting it to an Array to Sound component. The Fundamental, Amplitude, and Duration inputs can be arrays of the same size. This will generate a wave with multiple pitches. The Harmonics input can also be an array of any size, this array should be the relative amplitudes of the desired harmonics.

Arrays - column 7



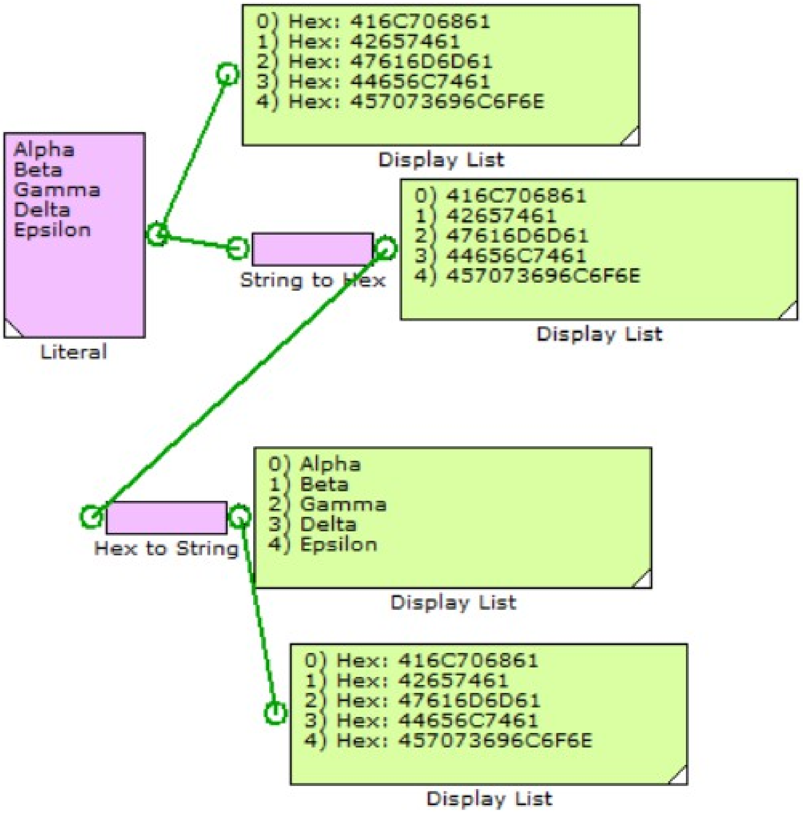
Harmonic Gen 2

The Harmonic Gen 2 component creates a wave output based on the inputs. If the Fundamental and Harmonic inputs are arrays, the wave will change over the duration specified. The Fundamental input can be an array of any size and will allow the changing of the overall pitch. The Harmonic N inputs are amplitudes of the harmonics, they can also change over time independently.   Arrays - column 7



Hex to String

The Hex to String component converts a string to its Hexadecimal string representation. Arrays – column 3



```
Alpha
Beta
Gamma
Delta
Epsilon
```

```
0) Hex: 416C706861
1) Hex: 42657461
2) Hex: 47616D6D61
3) Hex: 44656C7461
4) Hex: 457073696C6F6E
```

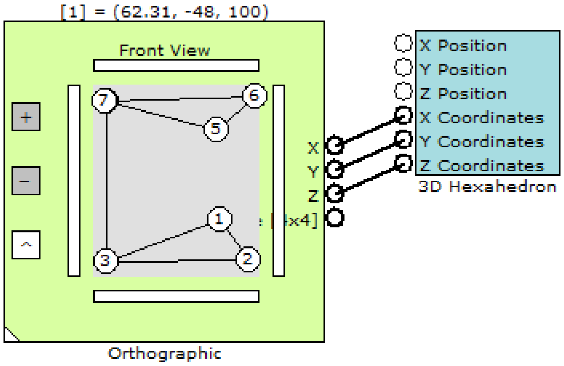
```
0) 416C706861
1) 42657461
2) 47616D6D61
3) 44656C7461
4) 457073696C6F6E
```

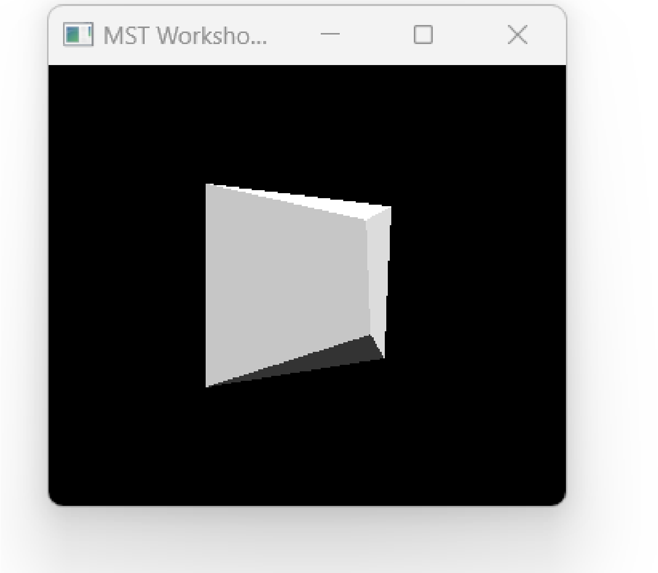
```
0) Alpha
1) Beta
2) Gamma
3) Delta
4) Epsilon
```

```
0) Hex: 416C706861
1) Hex: 42657461
2) Hex: 47616D6D61
3) Hex: 44656C7461
4) Hex: 457073696C6F6E
```

3D Hexahedron

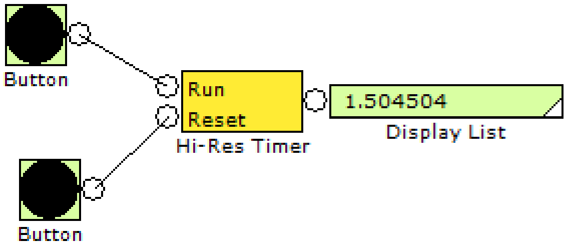
The 3D Hexahedron draws a hexahedron in the 3D view window. The X, Y, and Z inputs set the position and size of the hexahedron. The Affine [4x] array input modifies the size, position, and orientation. 3D – column 4





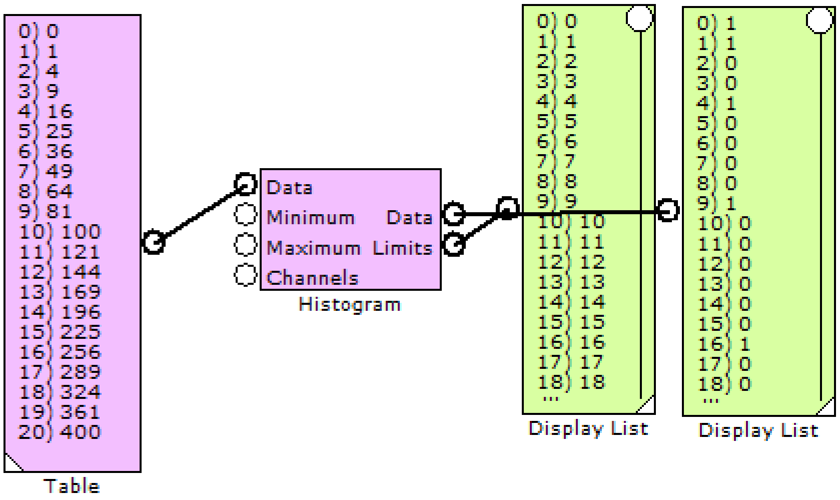
Hi-Res Timer

The Hi-Res Timer component starts when the Run input goes high and runs until the Run input goes low. It is reset when the Reset input goes high. This timer runs in real-time and quietly continues when the local time is stopped or reset.   Functions - column 7



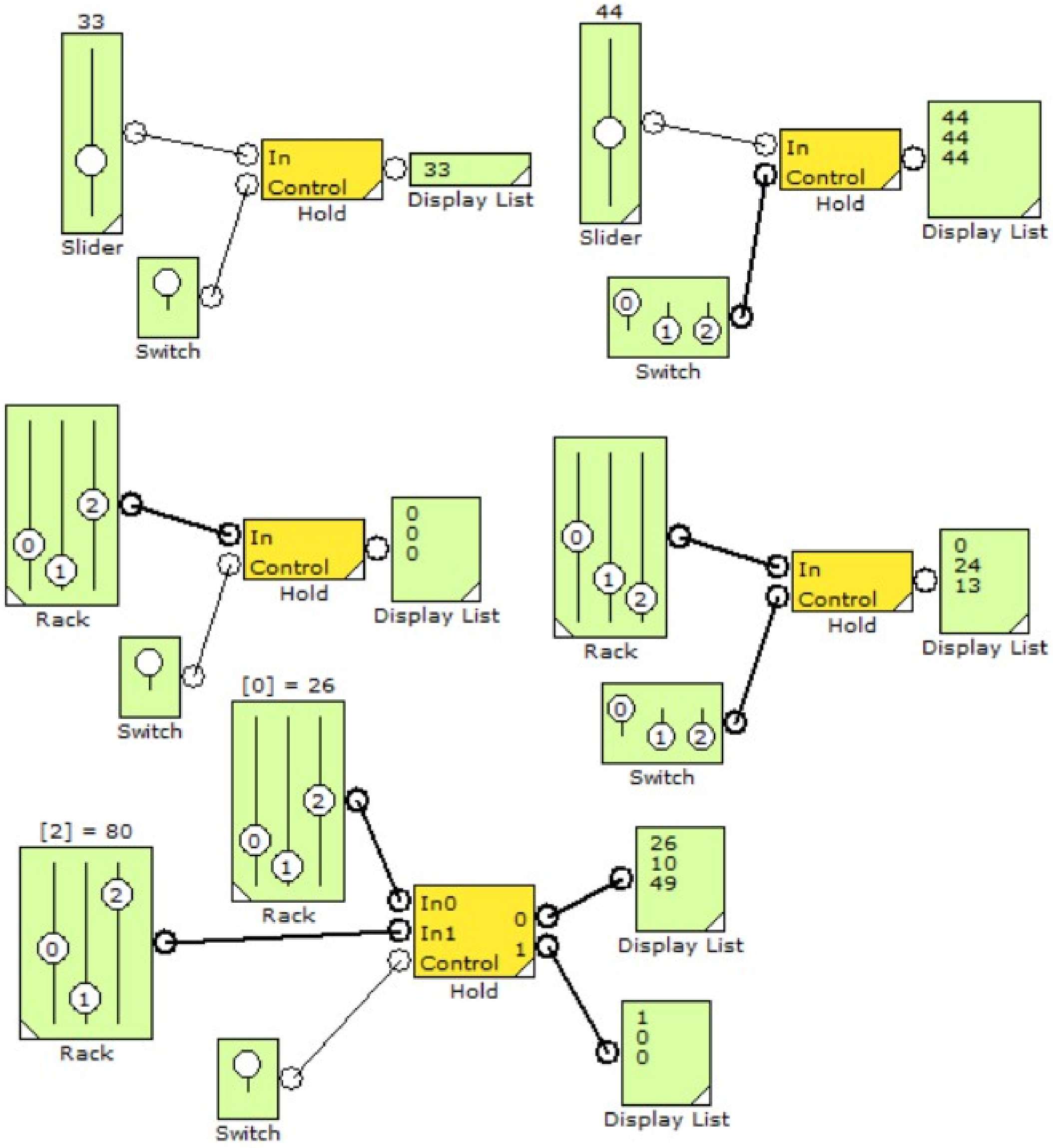
Histogram

The Histogram component scans the input array and outputs a histogram of the data. Arrays - column 4



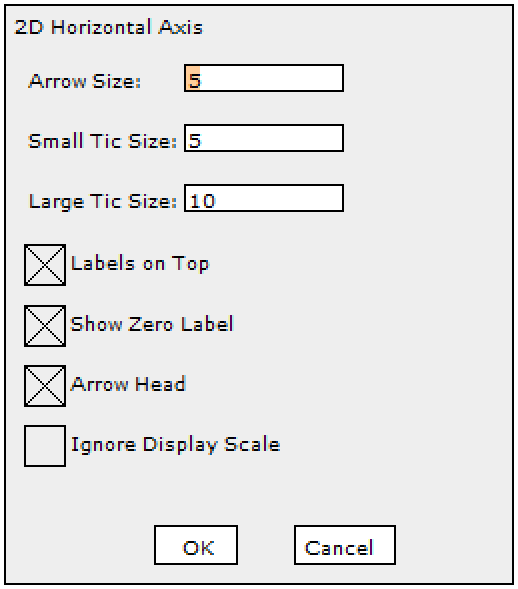
Hold

The Hold will hold the input at the output when the control input is true.   Functions - column 2



2D Horizontal Axis

The 2D Horizontal Axis component draws labeled axes on the 2D canvas. 2D - column 1



2D Horizontal Axis

Arrow Size: 5

Small Tic Size: 5

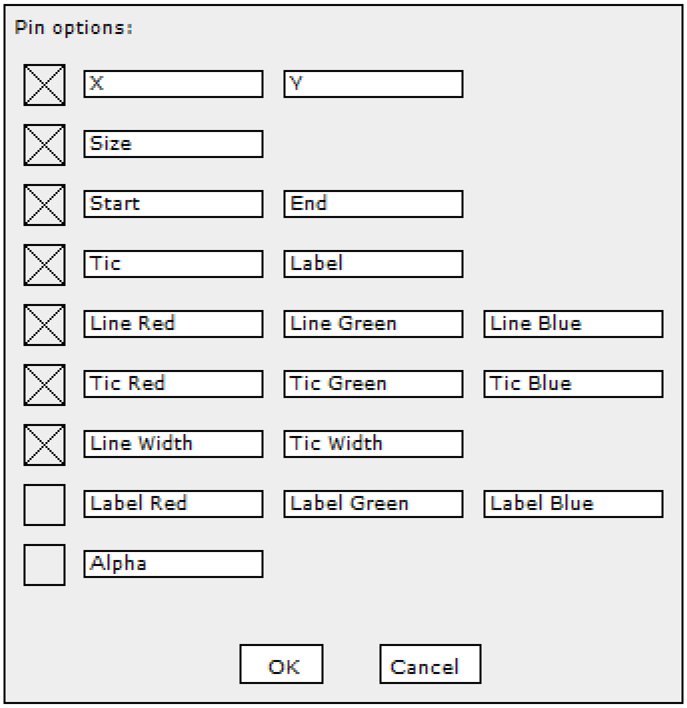
Large Tic Size: 10

☒ Labels on Top

☒ Show Zero Label

☒ Arrow Head

☐ Ignore Display Scale



Pin options:

☒ X Y

☒ Size

☒ Start End

☒ Tic Label

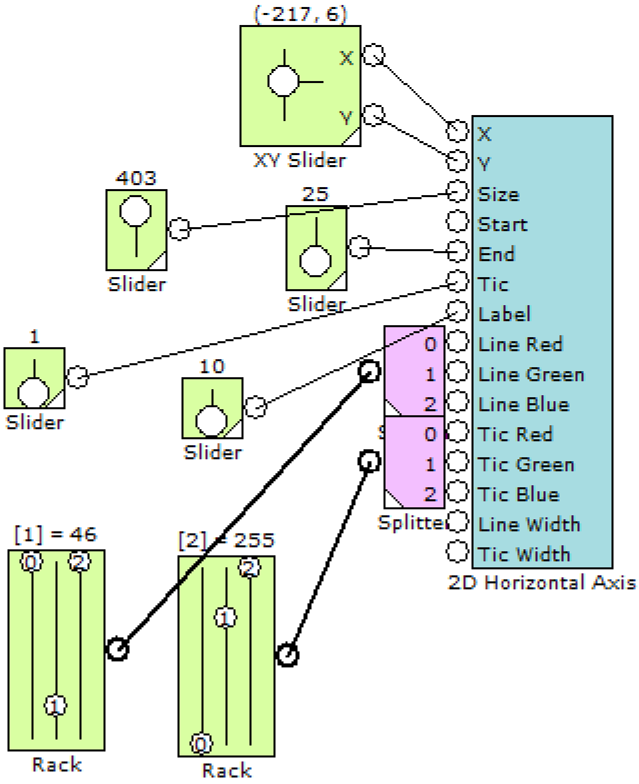
☒ Line Red Line Green Line Blue

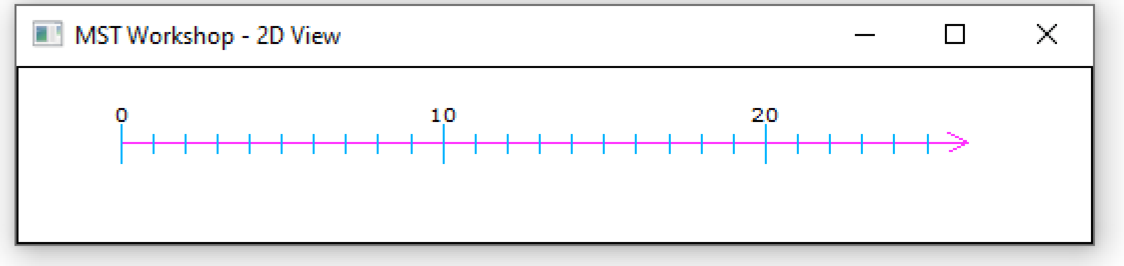
☒ Tic Red Tic Green Tic Blue

☒ Line Width Tic Width

☐ Label Red Label Green Label Blue

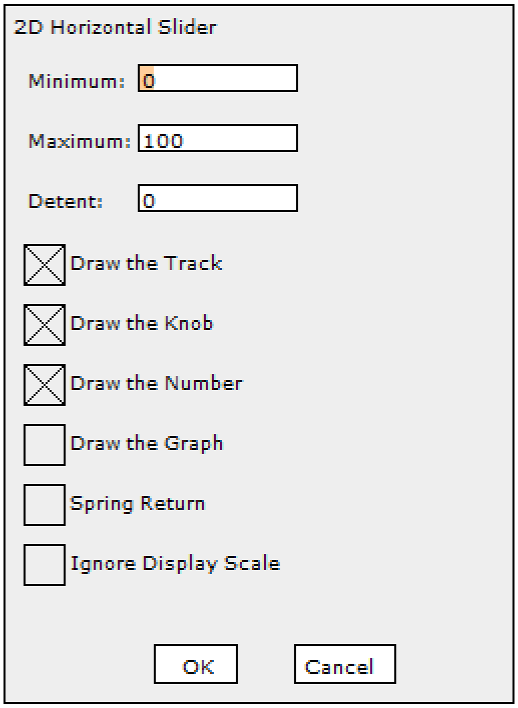
☐ Alpha


(-217, 6)
X
Y
XY Slider
403
Slider
25
Slider
1
Slider
10
Slider
0
1
2
0
1
2
Splitter
X
Y
Size
Start
End
Tic
Label
Line Red
Line Green
Line Blue
Tic Red
Tic Green
Tic Blue
Line Width
Tic Width
2D Horizontal Axis
[1] = 46
0
2
1
Rack
[2] = 255
2
1
0
Rack


MST Workshop - 2D View
0
10
20

2D Horizontal Slider

The 2D Horizontal Slider component outputs a number based on its dial position. Controls - column 2



2D Horizontal Slider

Minimum: 0

Maximum: 100

Detent: 0

☒ Draw the Track

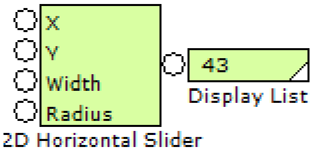
☒ Draw the Knob

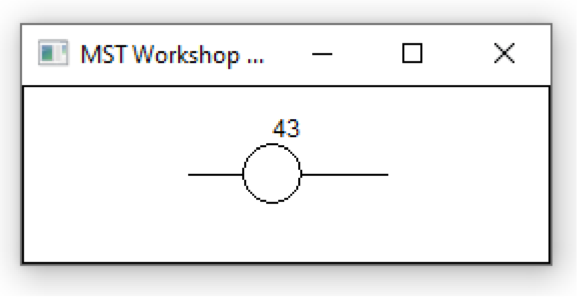
☒ Draw the Number

□ Draw the Graph

□ Spring Return

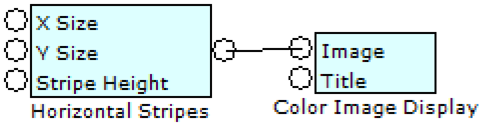
□ Ignore Display Scale

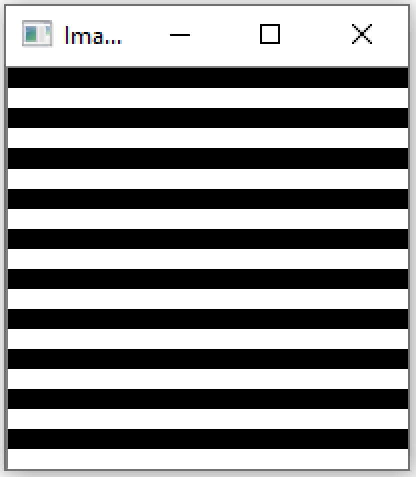




Horizontal Stripes

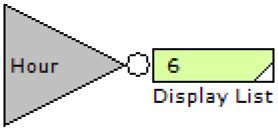
The Horizontal Stripes component creates an image with a horizontal stripped test pattern. Images - column 1





Hour

The Hour component outputs the hour from the computers internal clock. Functions - column 7

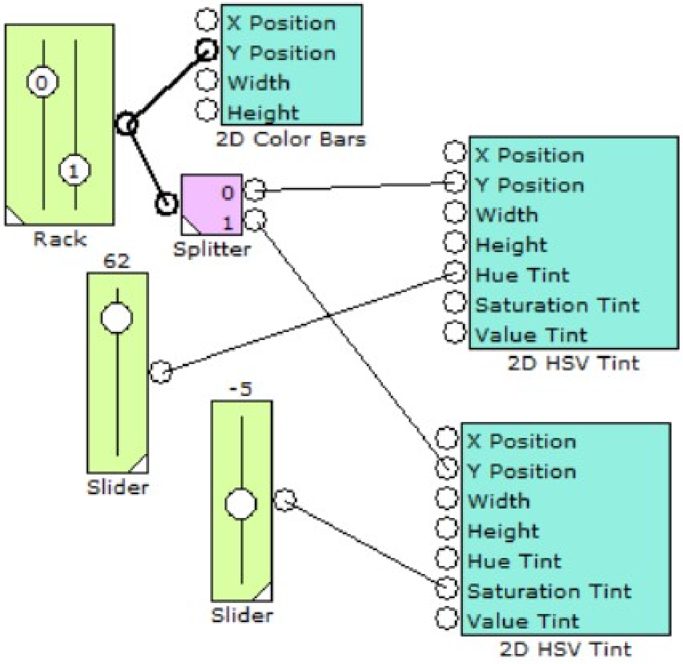


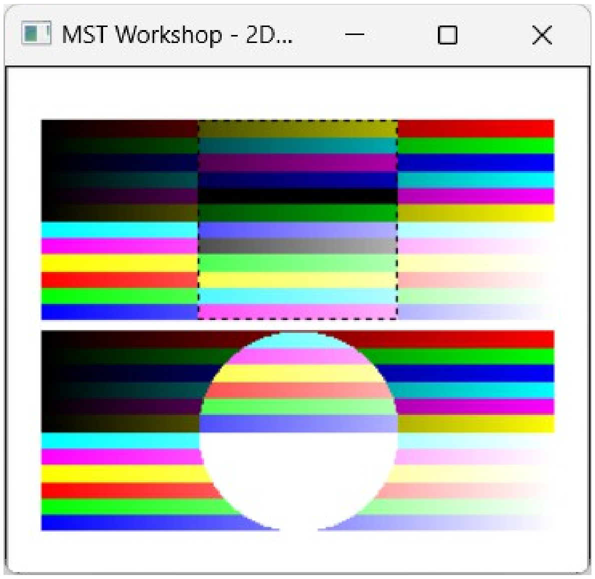
HSV to RGB

The HSV to RGB component converts the image from HSV color to RGB color. Images - column 1

2D HSV Tint

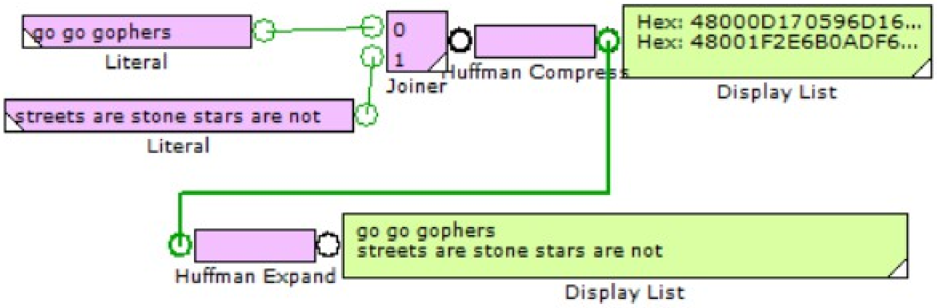
The 2D HSV Tint lightens or darkens each of the Hue Saturation and Value of the components in the 2D drawing it covers. 2D – column 1





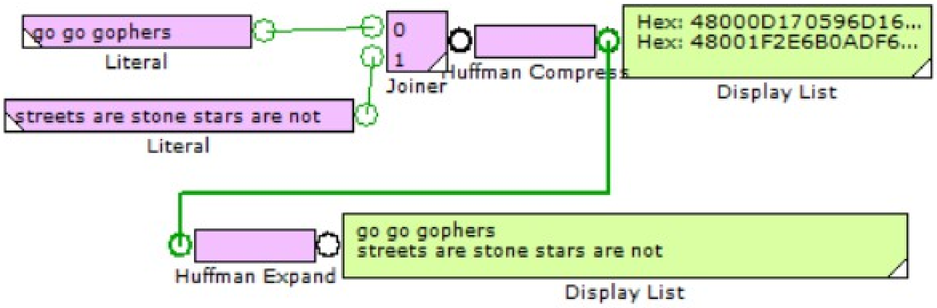
Huffman Compress

The Huffman Compress component uses Huffman compression to compress a string into compressed bits.



Huffman Expand

The Huffman Expand component uses Huffman decompression to return compressed bits into a string.



```
Hex: 48000D170596D16...
Hex: 48001F2E6B0ADF6...
```

```
go go gophers
streets are stone stars are not
```

Image Angle

The Image Angle component inputs a grayscale image and returns the angles and sizes of the major and minor axies of the object in the image.   Images - column 4

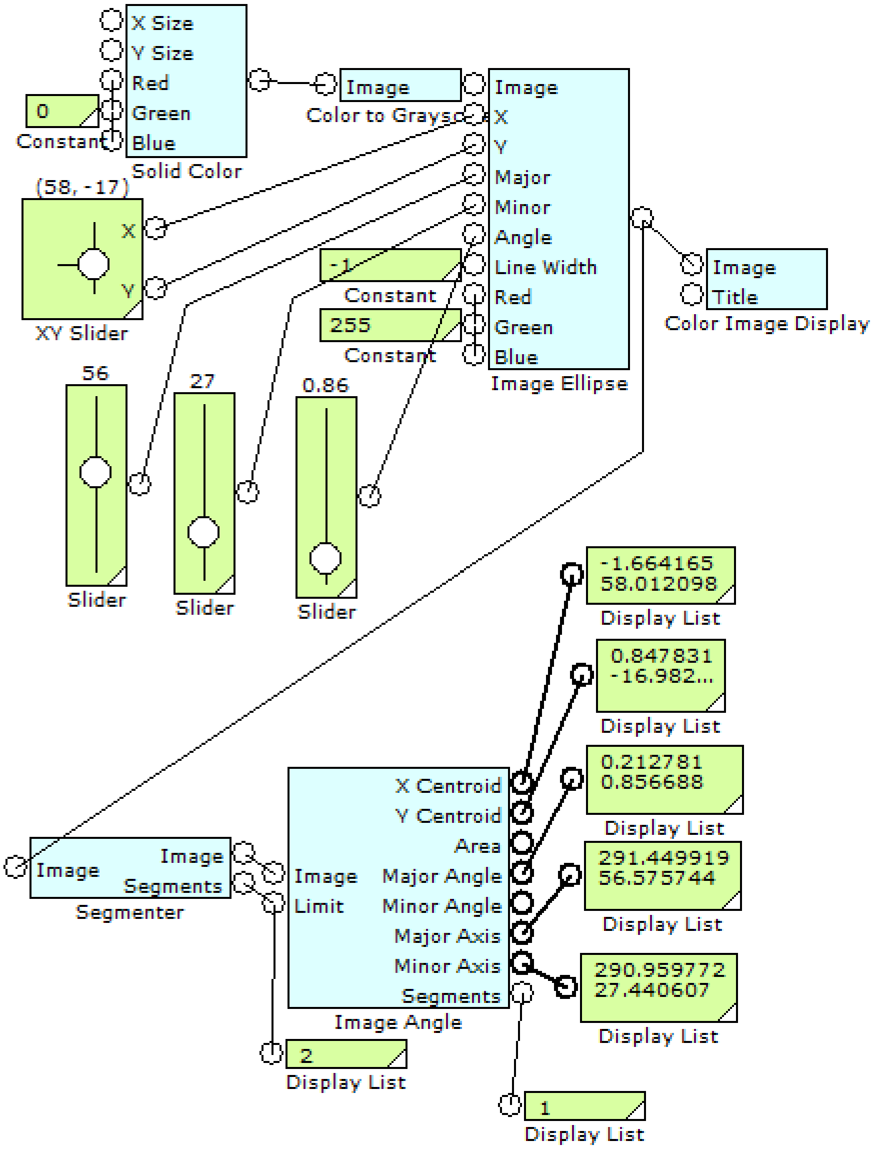


Image Area

The Image Area component inputs a grayscale image and returns the area of the object in the image.
Images - column 4

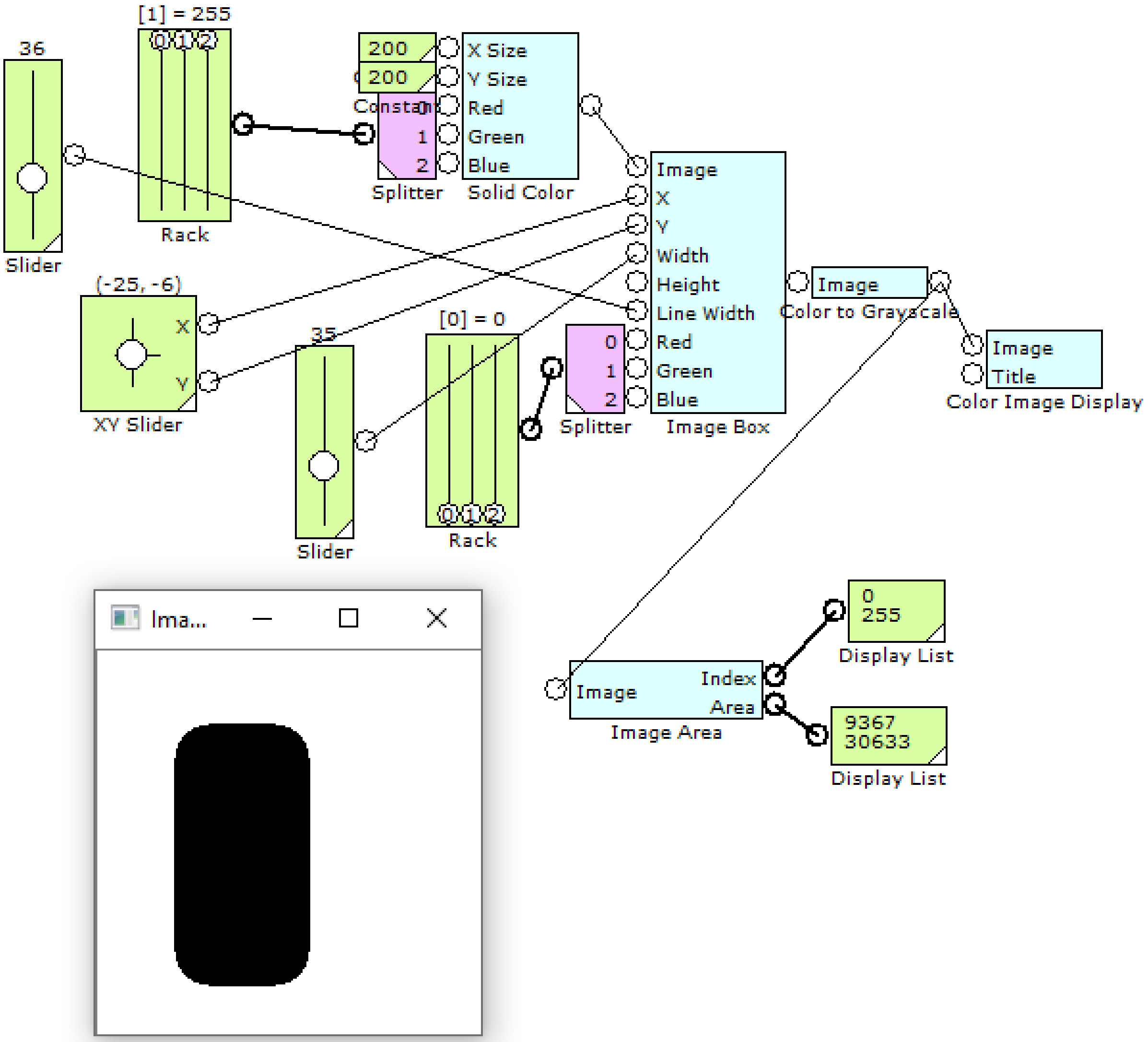


Image Arrow

The Image Arrow component draws an arrow on an image.Images - column 3

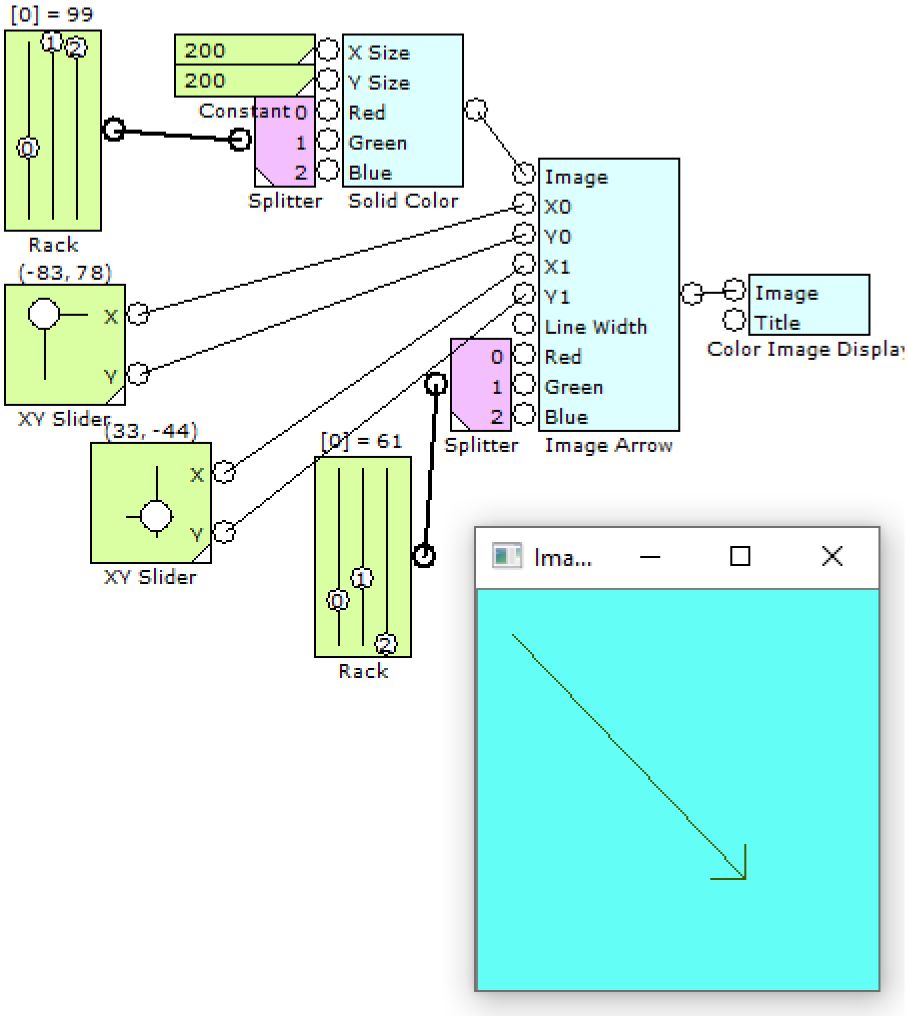


Image Bilateral Filter

The Image Bilateral Filter component smooths an image based on a bilateral filter. Images - column 2

Image Bounds

The Image Bounds component scans a grayscale image and returns the bounding box for pixels above the threshold. Images - column 4

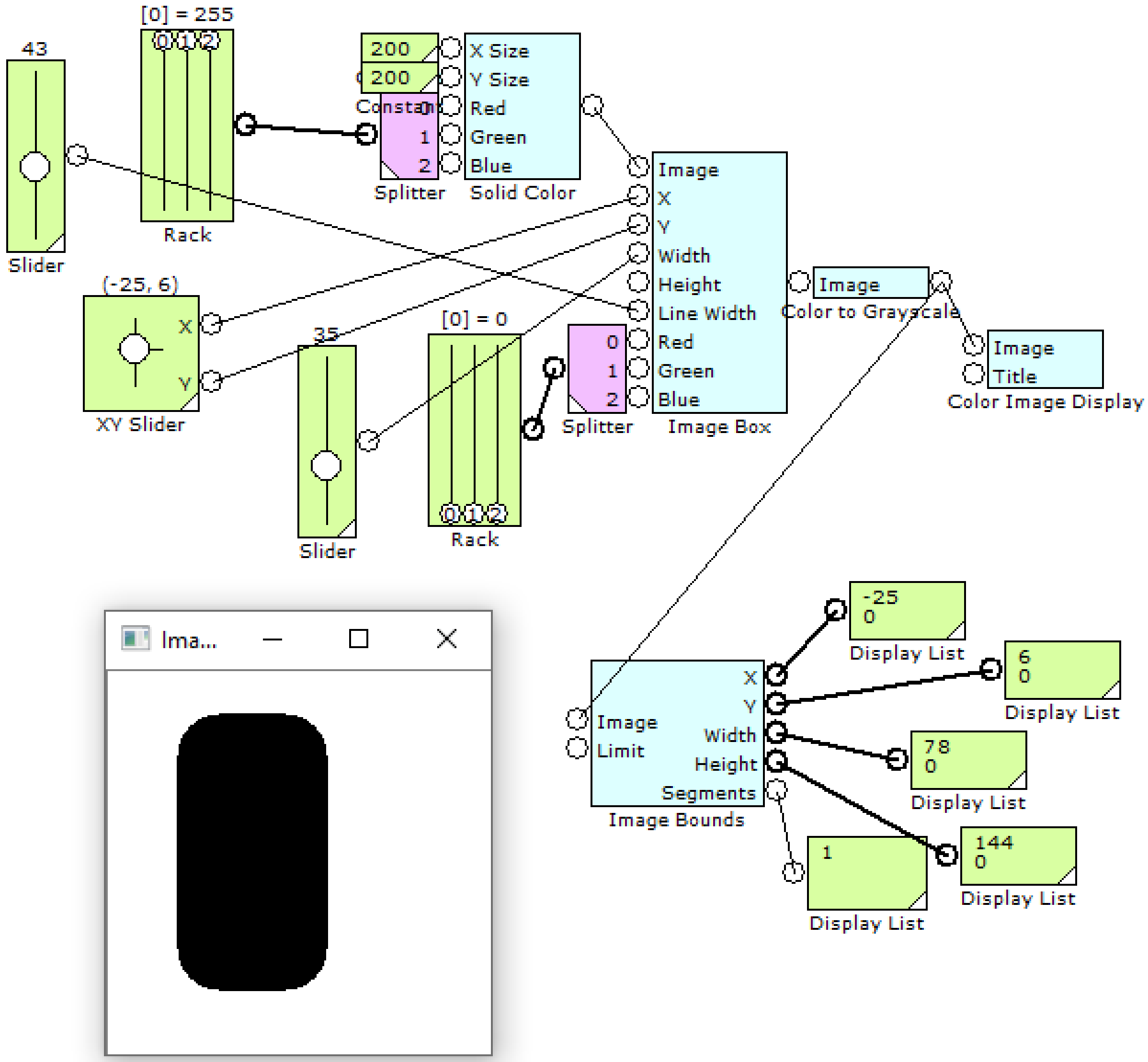


Image Box

The Image Box component draws a box on an image. Images - column 3

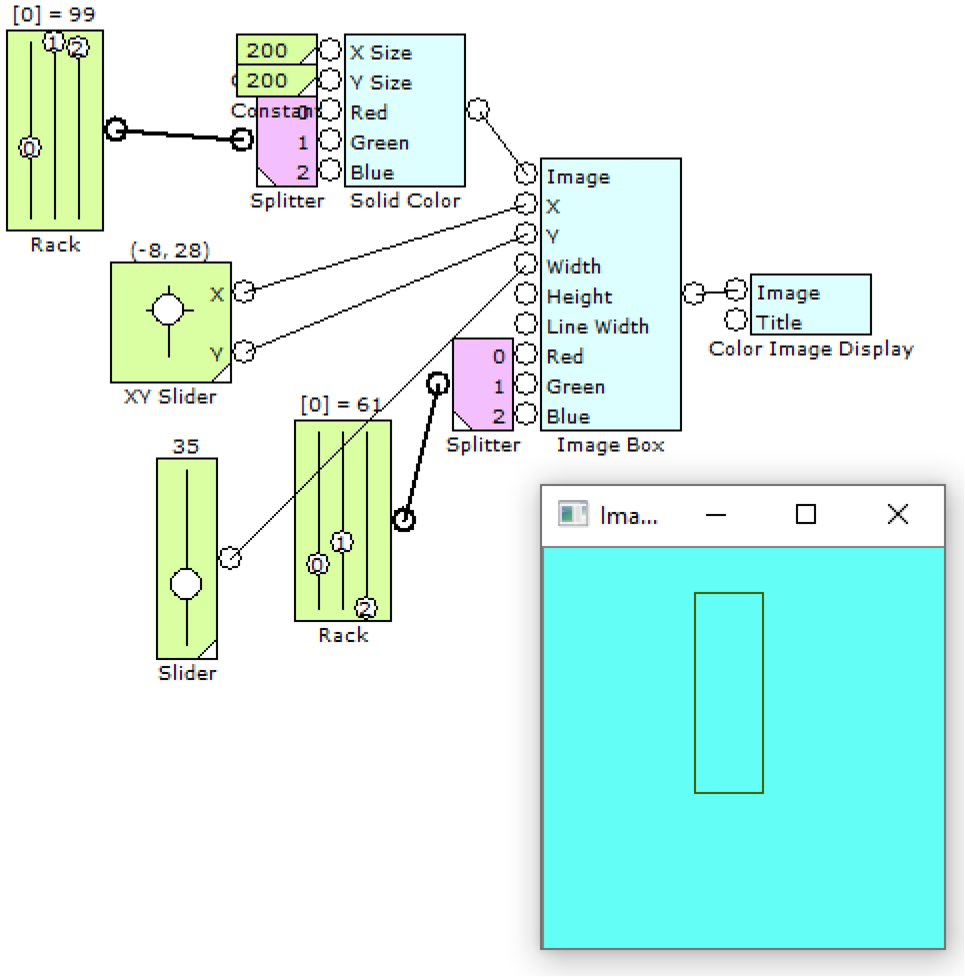


Image Brightness

The Image Brightness component changes the brightness of an image. Images - column 2

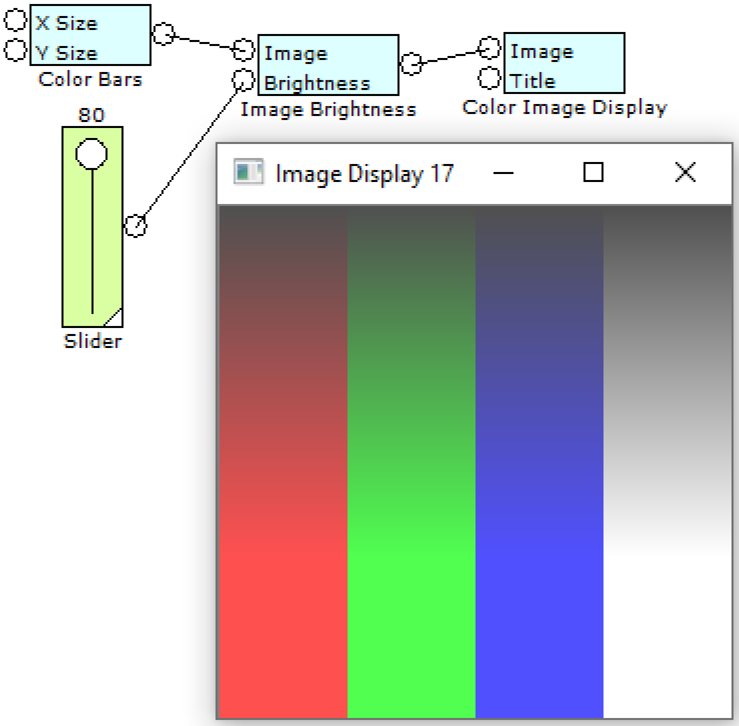


Image Centroid

The Image Centroid component inputs a grayscale image and returns the x and y centroids of the object in the image.   Images - column 4

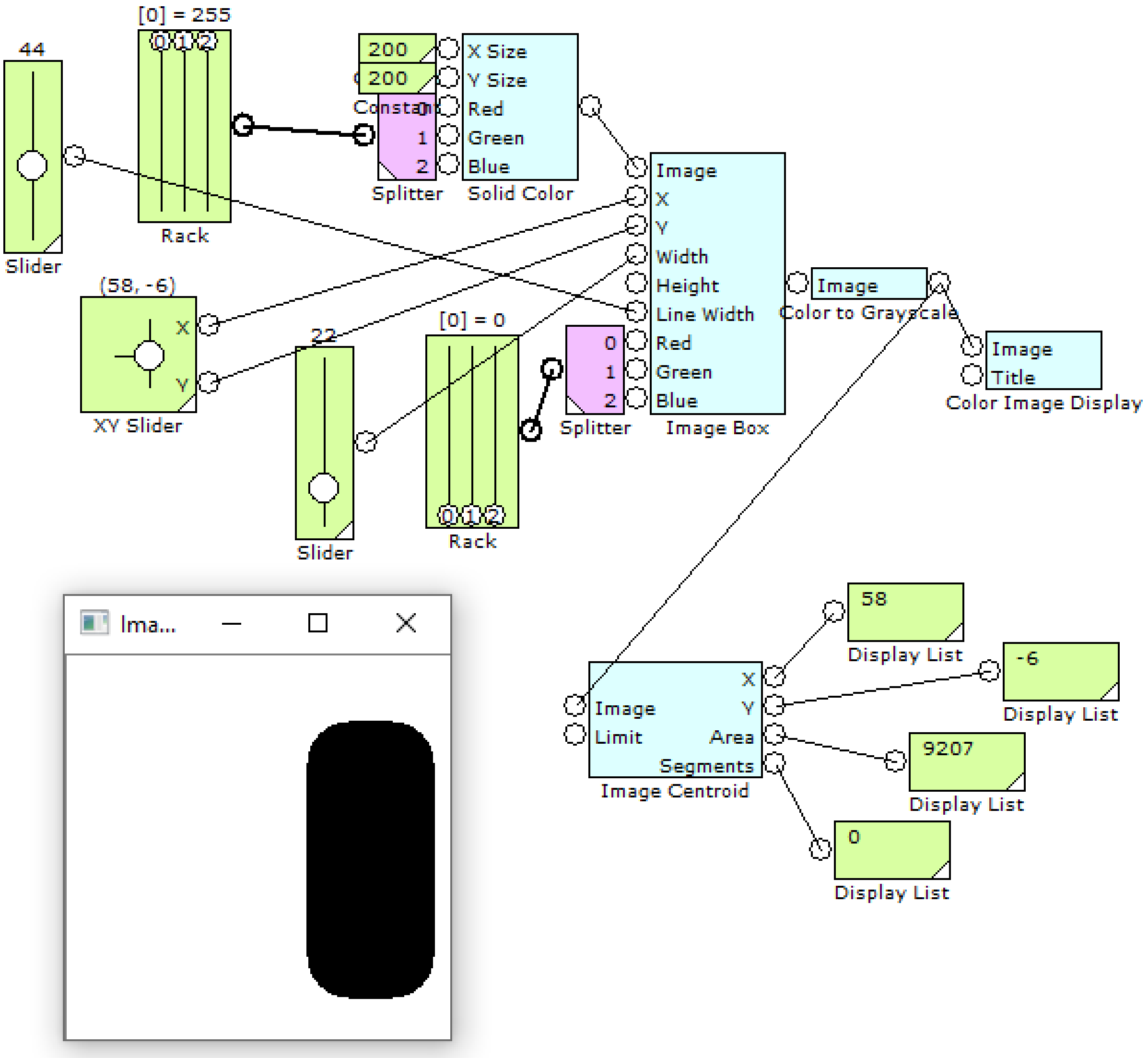


Image Circle

The Image Circle component draws a circle on an image. Set the Line Width to a negative number to fill the circle. Images - column 3

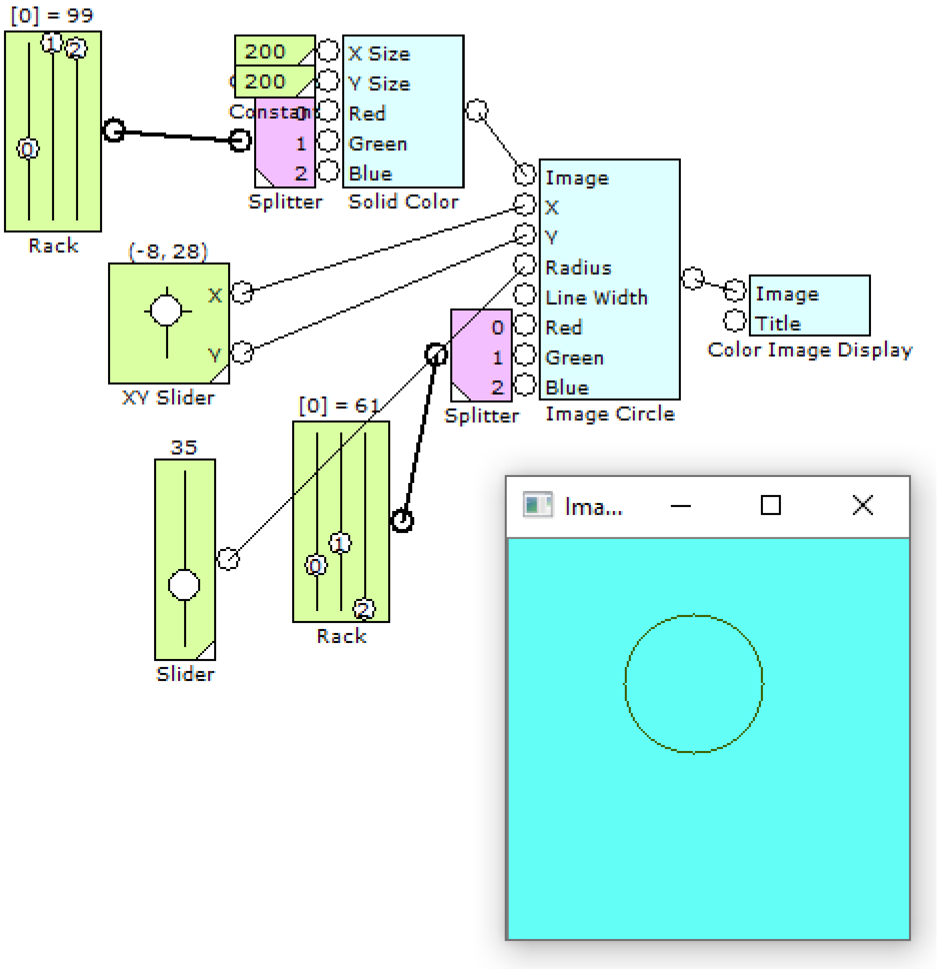
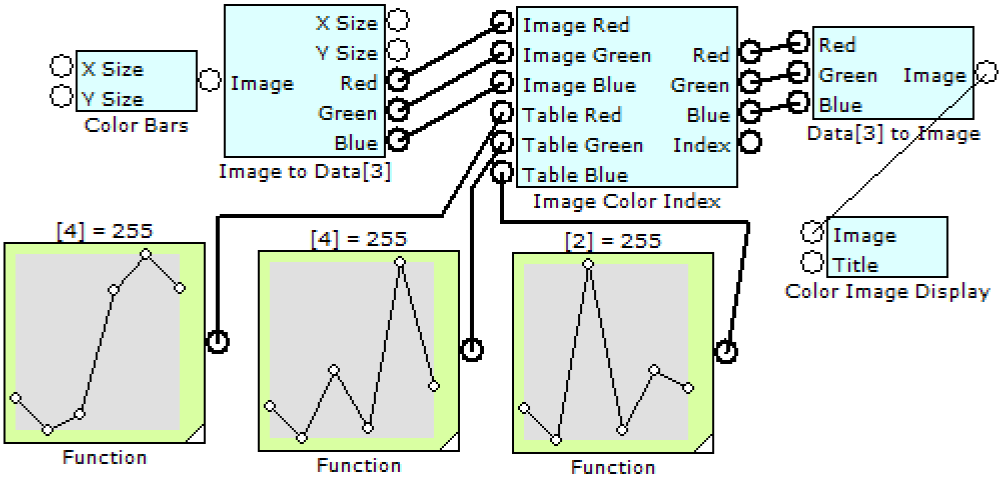


Image Color Index

The Image Color Index searches the table of colors for the closest match to each pixel in the image.
Images - column 5



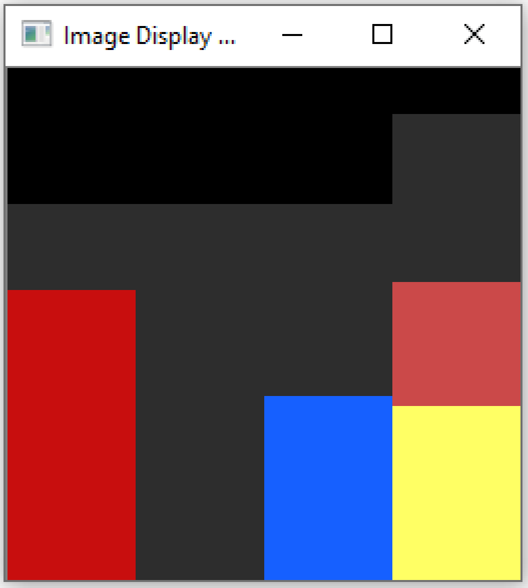
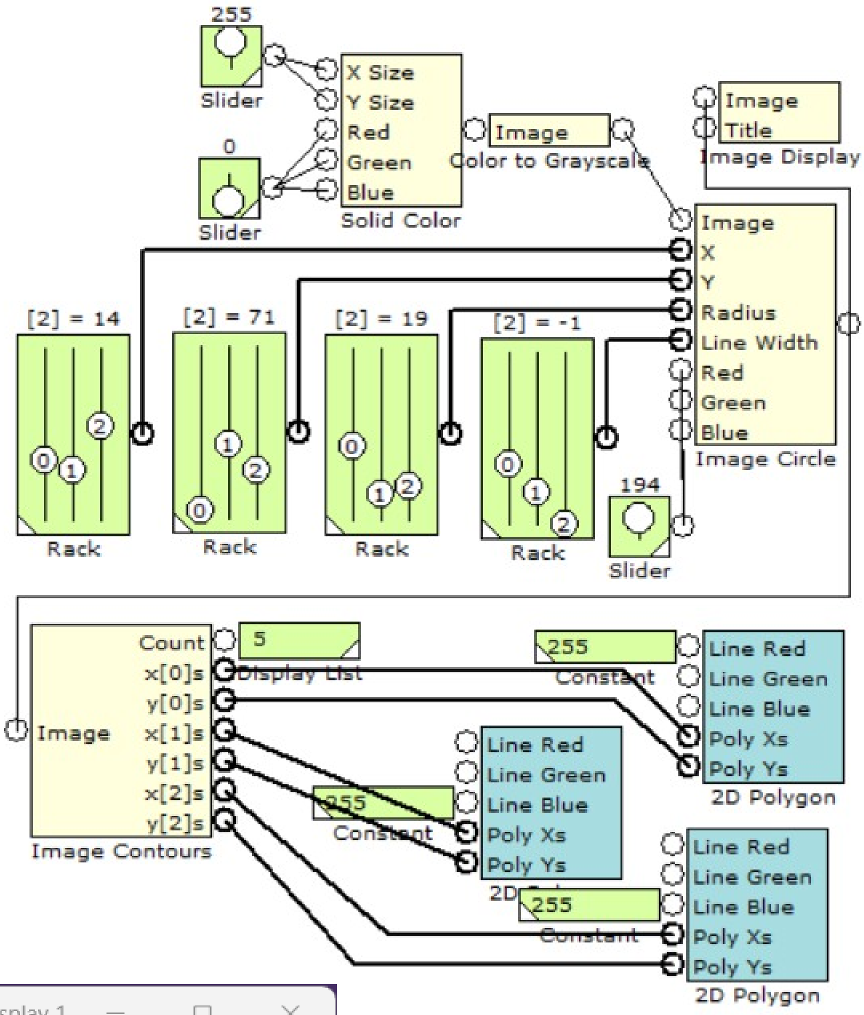
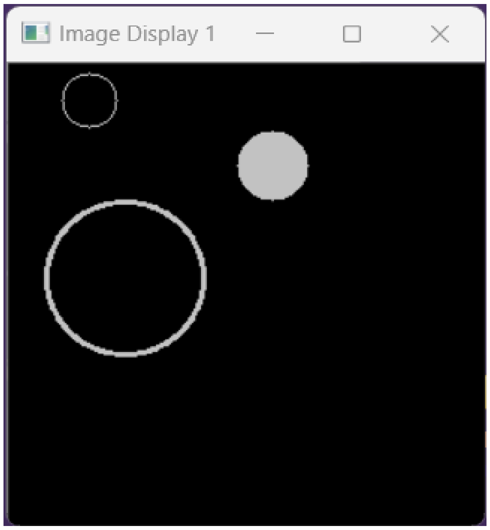


Image Contours

The Image Contours component inputs a grayscale image and returns the contours. Images – column 4





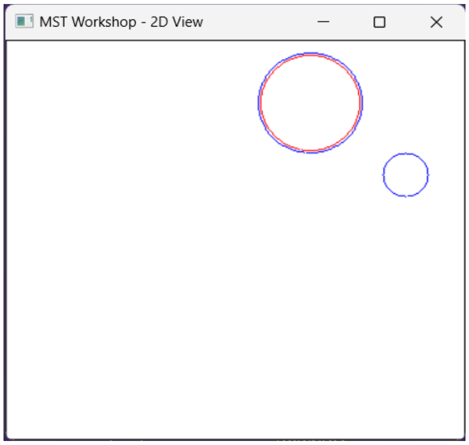


Image Contrast

The Image Contrast component changes the contrast of an image. Images - column 2

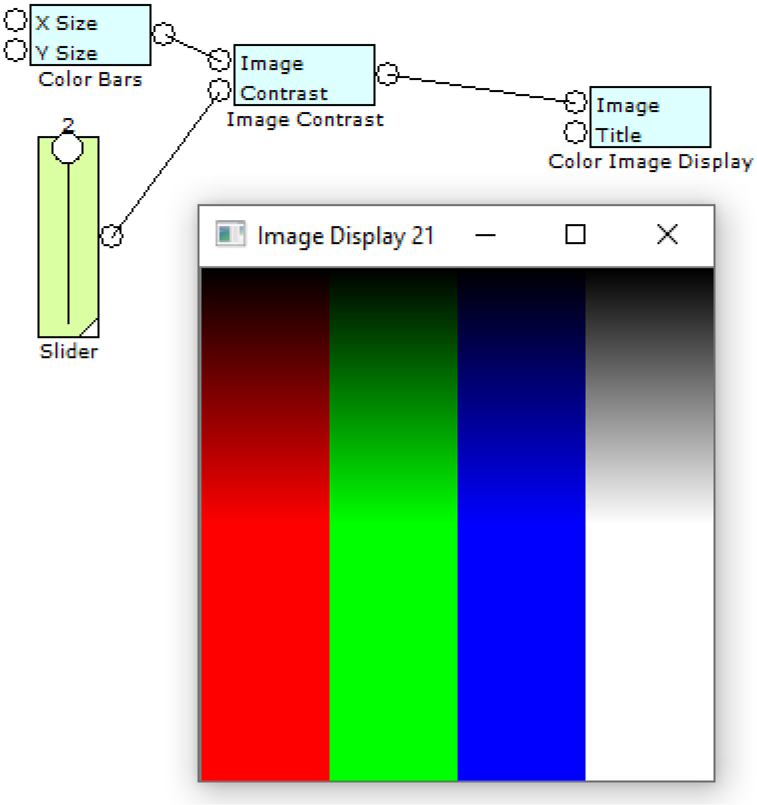


Image Crop

The Image Crop component crops the image at the specified offset to the desired size.   Images - column 1

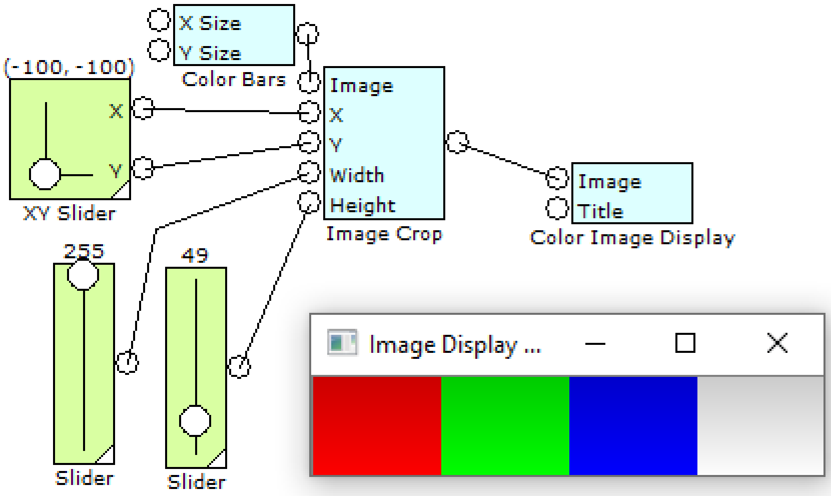


Image Cross

The Image Cross component draws a cross on an image.   Images - column 3

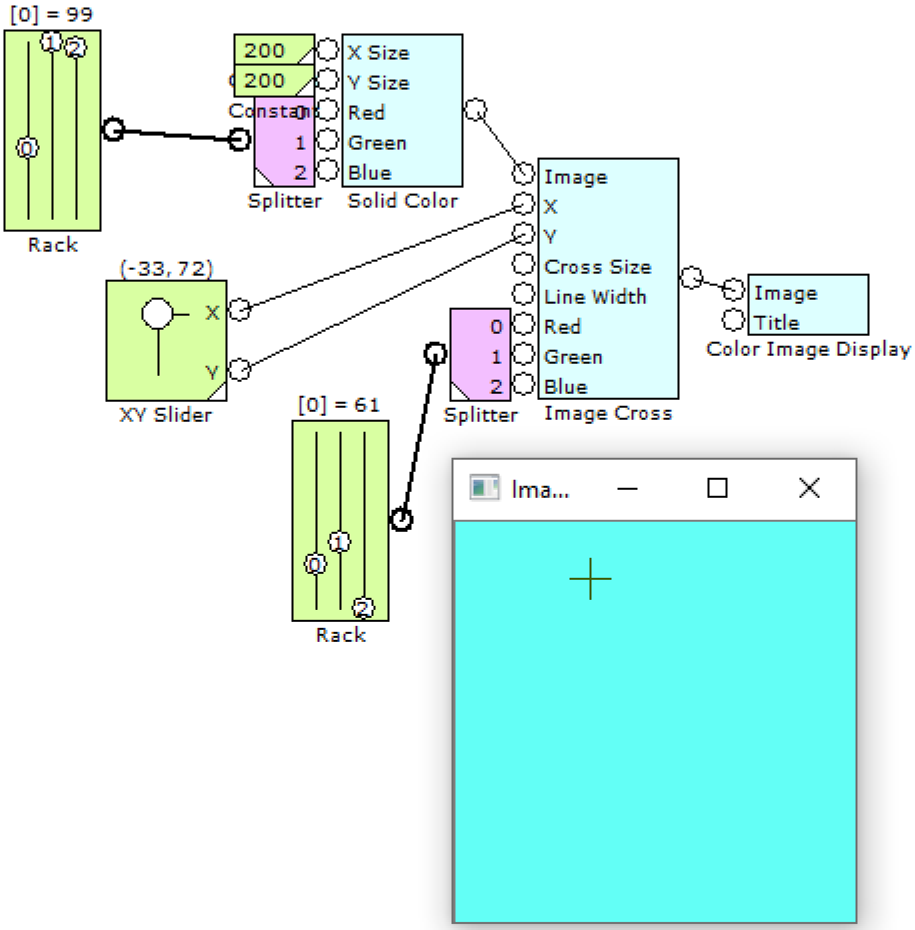


Image Dilate

The Image Dilate component grows darker areas in an image. Images - column 2

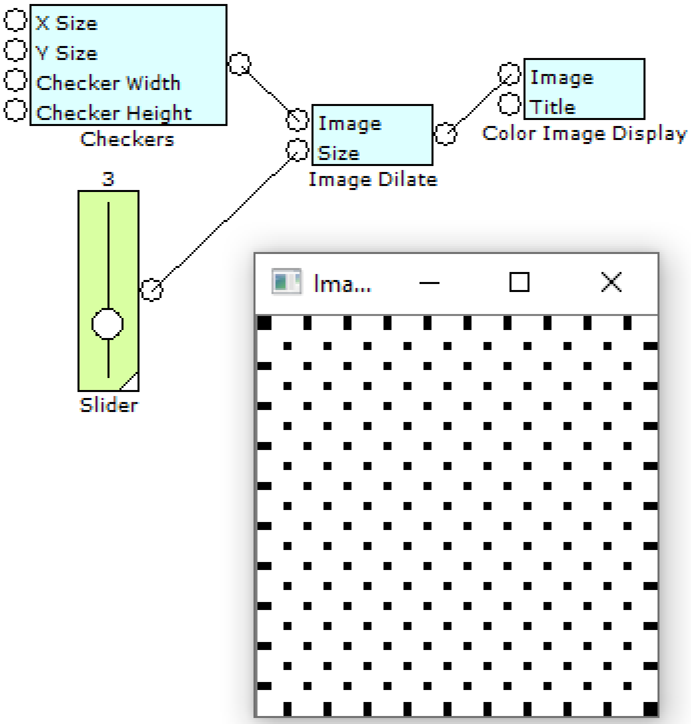
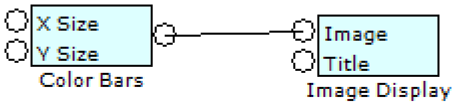


Image Display

The Image Display component shows an image preview in color. Images - column 5



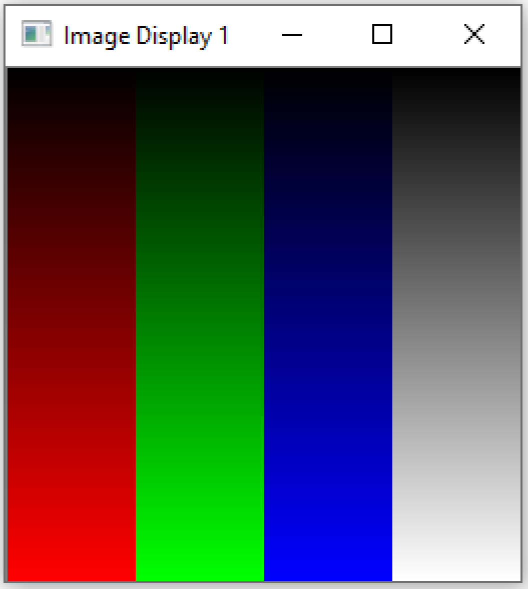


Image Ellipse

The Image Ellipse component draws an ellipse on an image. Set the Line Width to a negative number to fill the ellipse.   Images - column 3

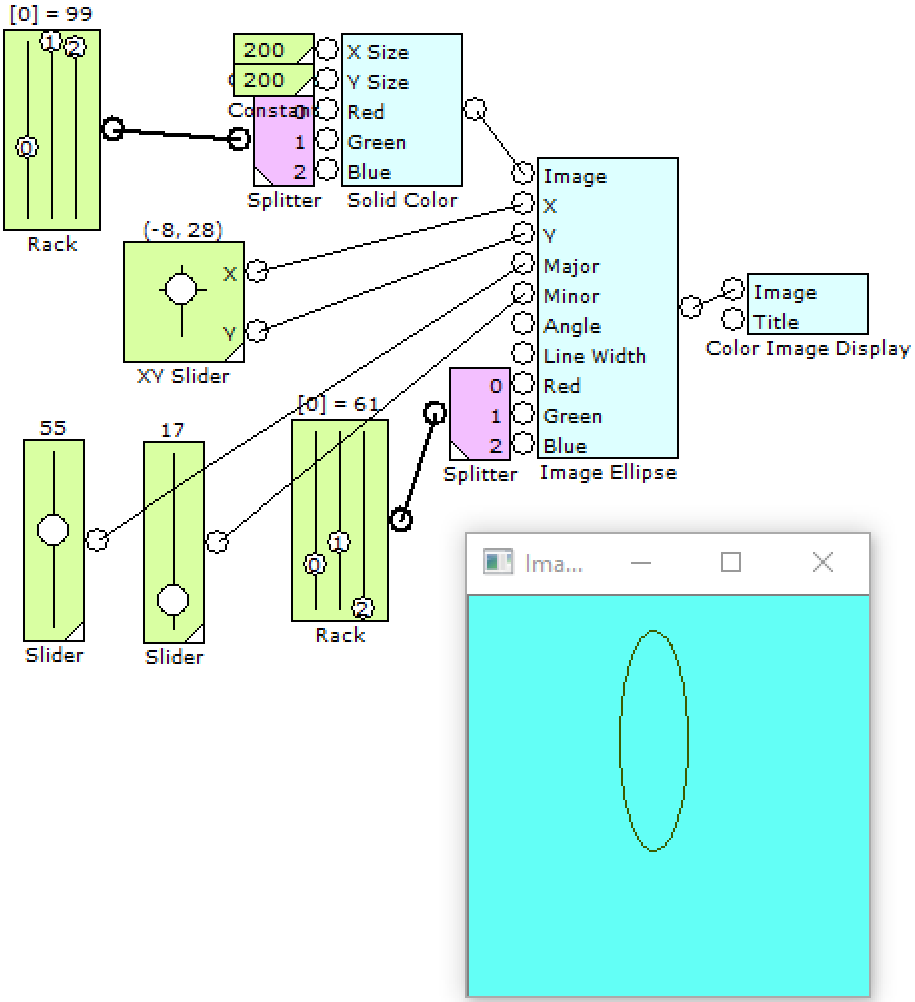
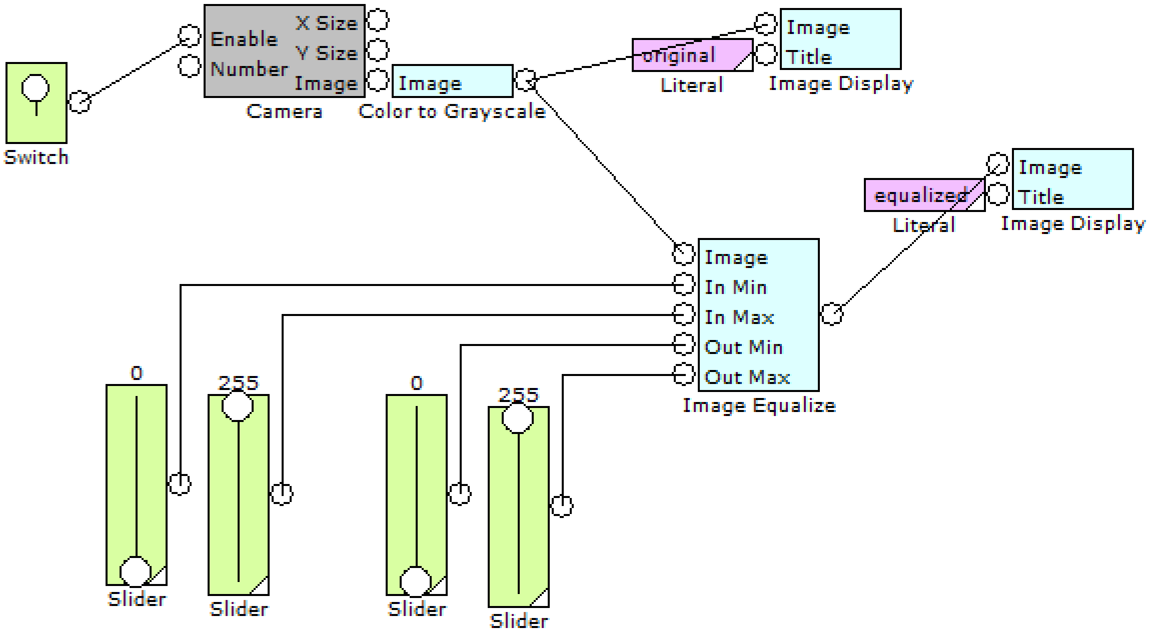
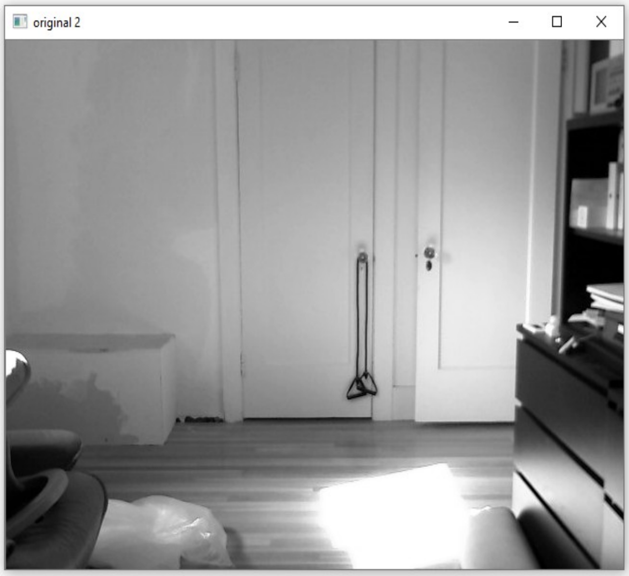


Image Equalize

The Image Equalize component spreads the levels equally over the image based on the number of times they are used in the image.   Images - column 3





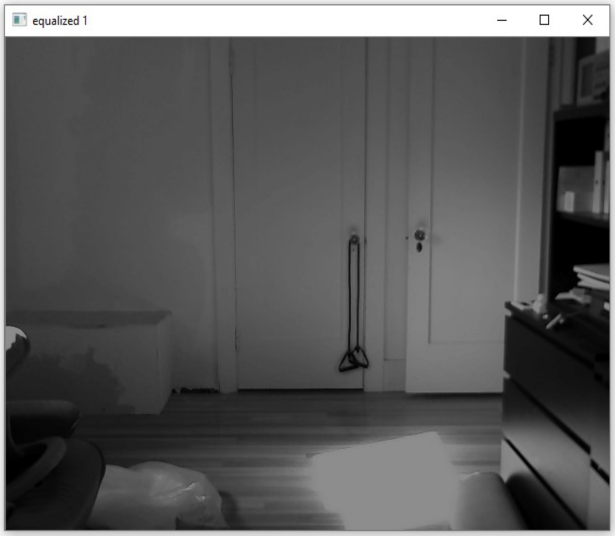


Image Erode

The Image Erode component grows lighter areas in an image.   Images - column 2

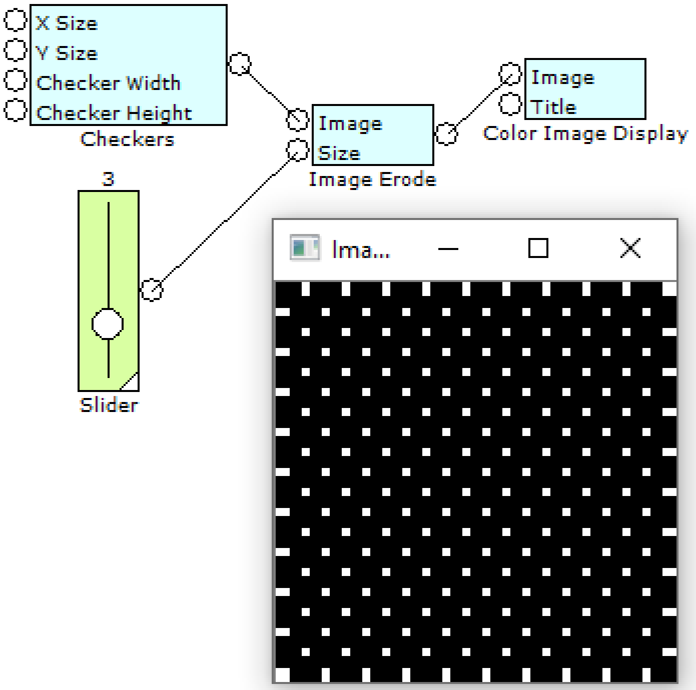


Image Fader

The Image Fader component creates an image by fading between the 2 input images based on the Control input. The Control value is between 0.0 and 1.0.   Images - column 3

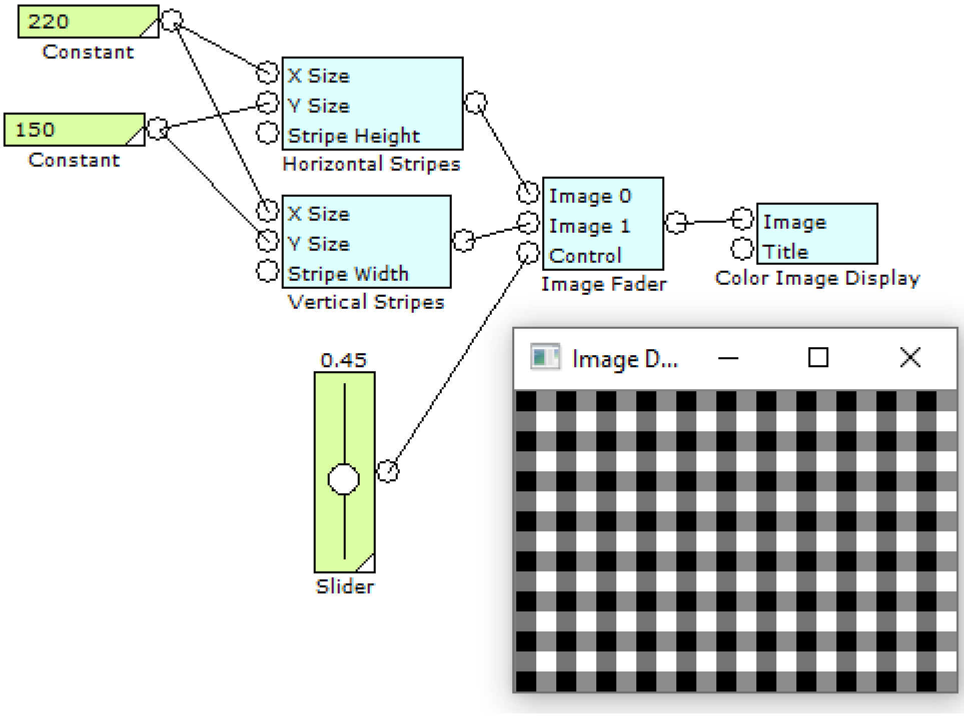
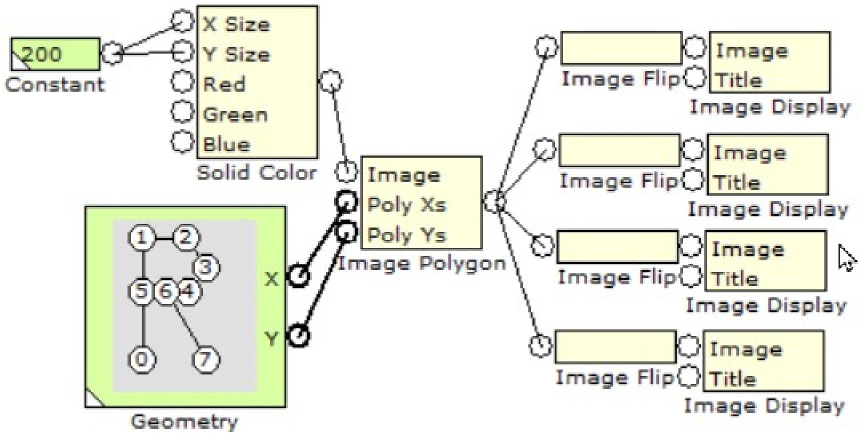


Image Flip

The Image Flip component flips the image either horizontally, vertically, or both. Images – column 1



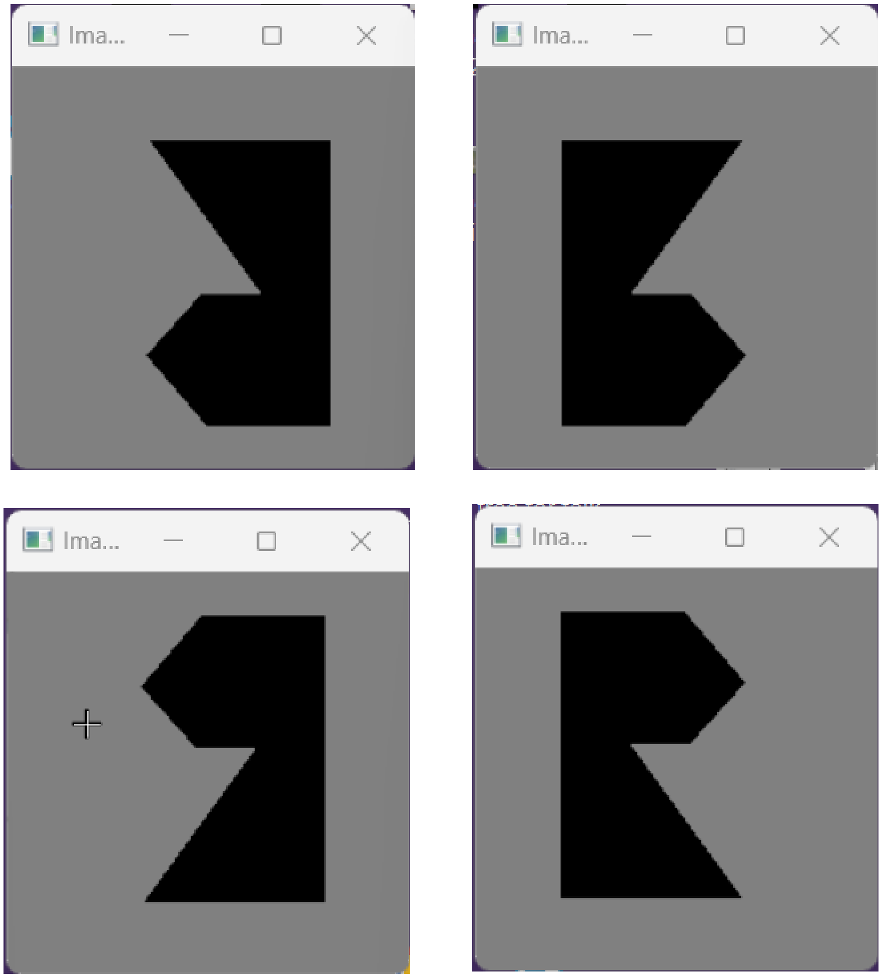


Image Gaussian

The Image Gaussian component smooths an image using a two dimensional Gaussian filter.

The Size input is the size of a two dimensional filter and can range from 3 to 31 and has a default of 7.

The Sigma input is the intensity of the filtering and has a default of 1.5.

The Size and Sigma inputs can be a single value or a pair to give different values in x and y.

Images - column 2

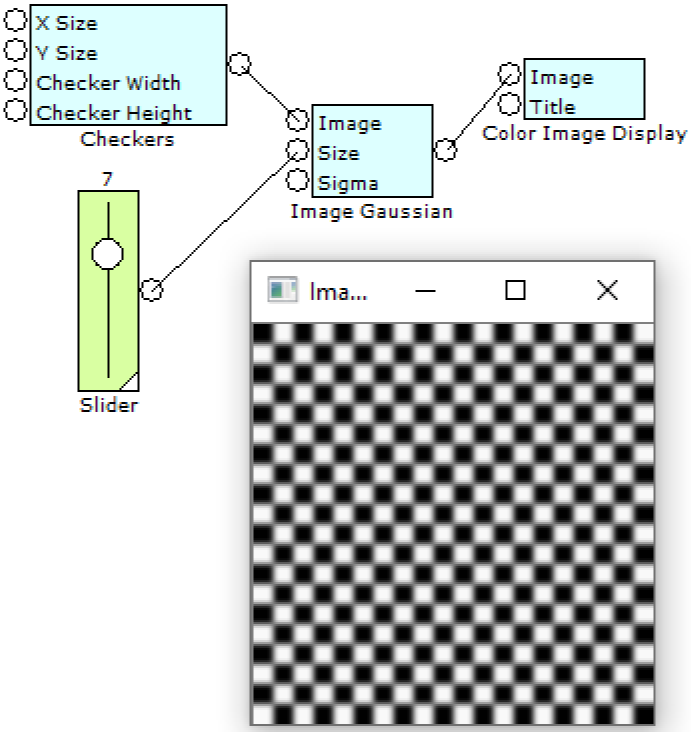
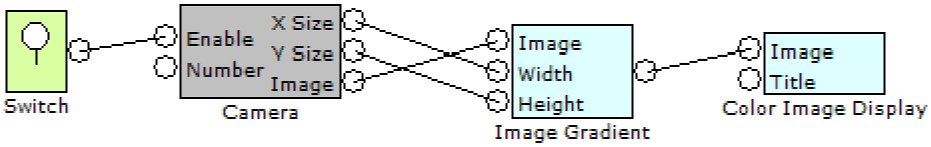


Image Gradient

The Image Gradient component finds gradients in x and y and creates an image where red is the x gradient and green is the y gradient. Images - column 2



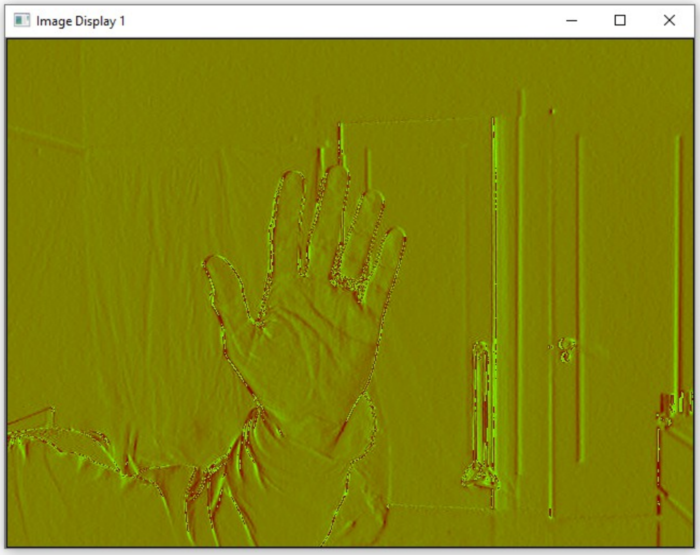
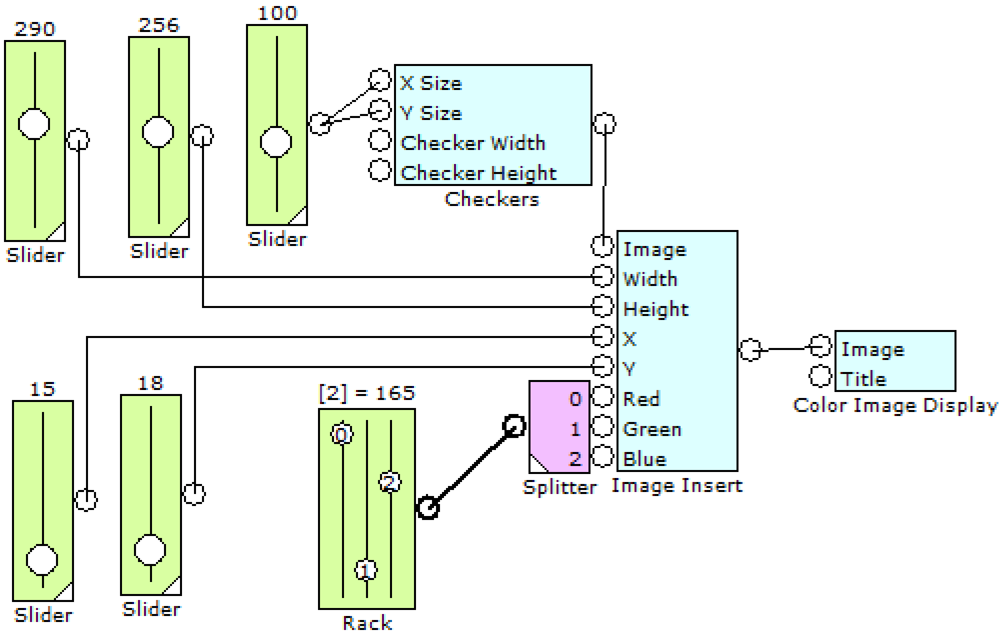


Image Insert

The Image Insert component inserts the image at the specified offset into an otherwise blank image.
Images - column 1



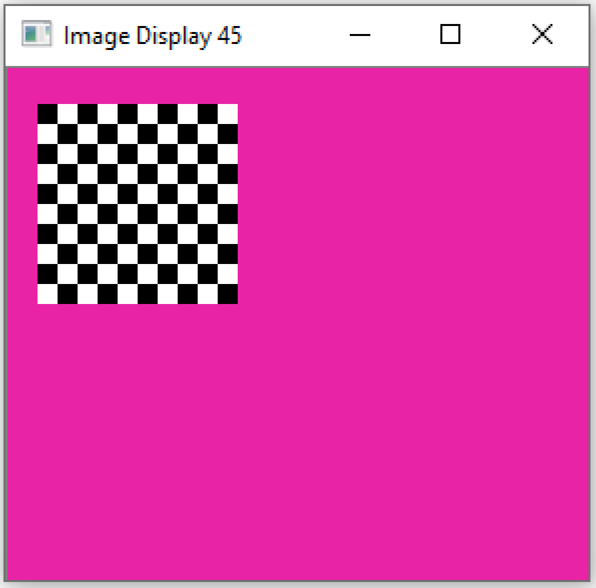
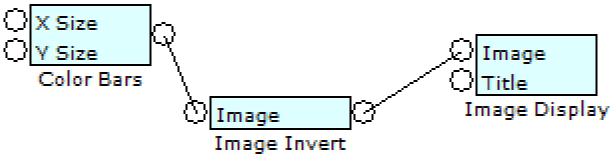


Image Invert

The Image Invert component creates a negative of an image. Images - column 2



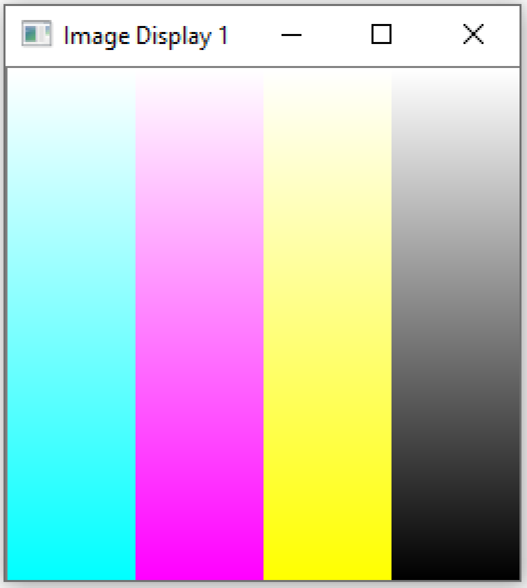


Image Line

The Image Line component draws a line on an image.   Images - column 3

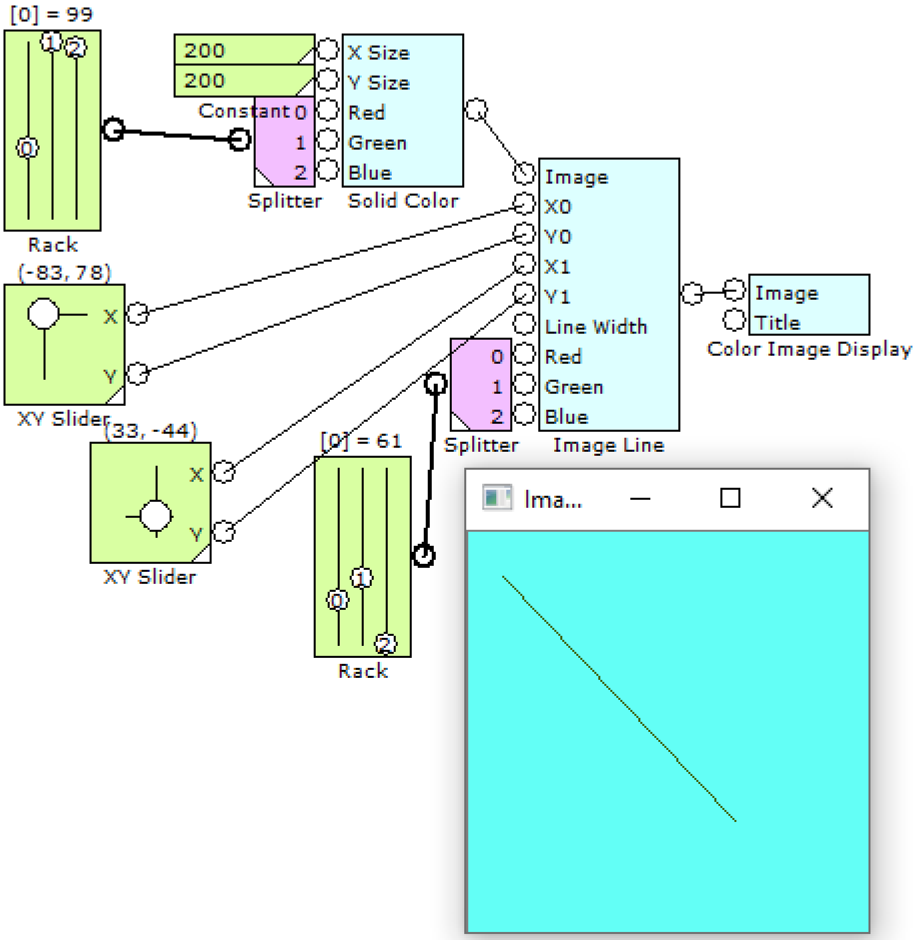


Image Median Blur

The Image Median Blur component smooths an image based on a median filter. The aperture must be greater than 1 and less then 102.   Images - column 2

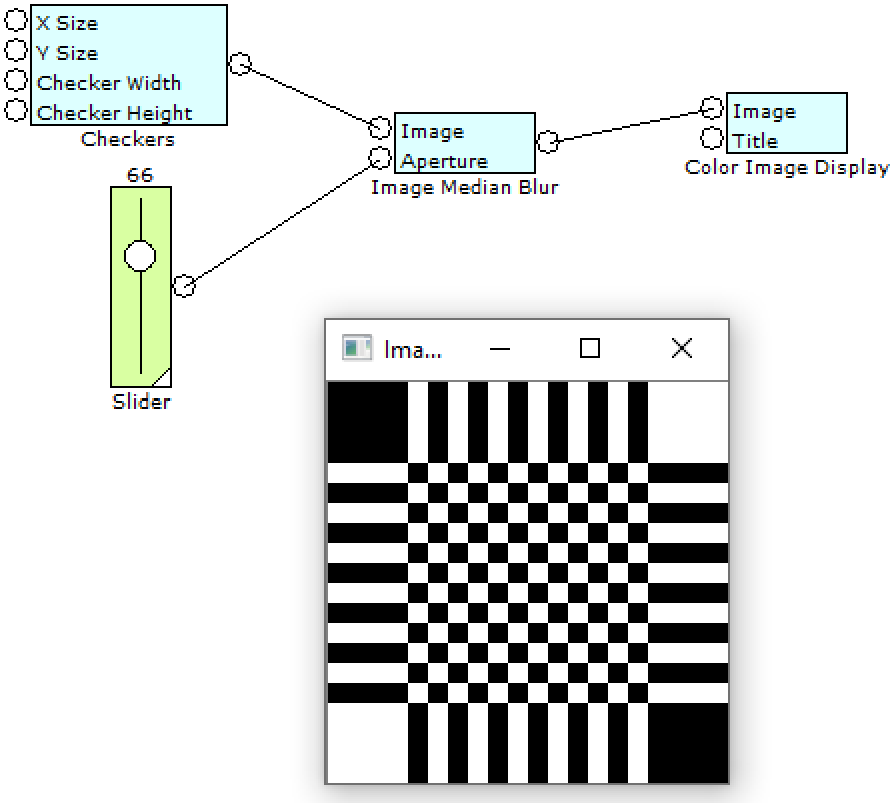


Image Moments

The Image Moments component inputs a grayscale image and returns the moments. Images – column 4

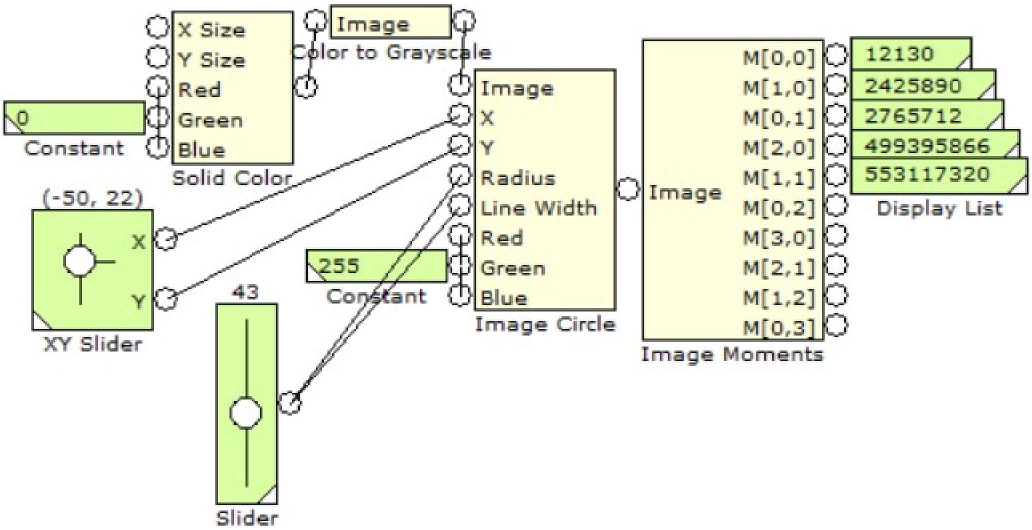
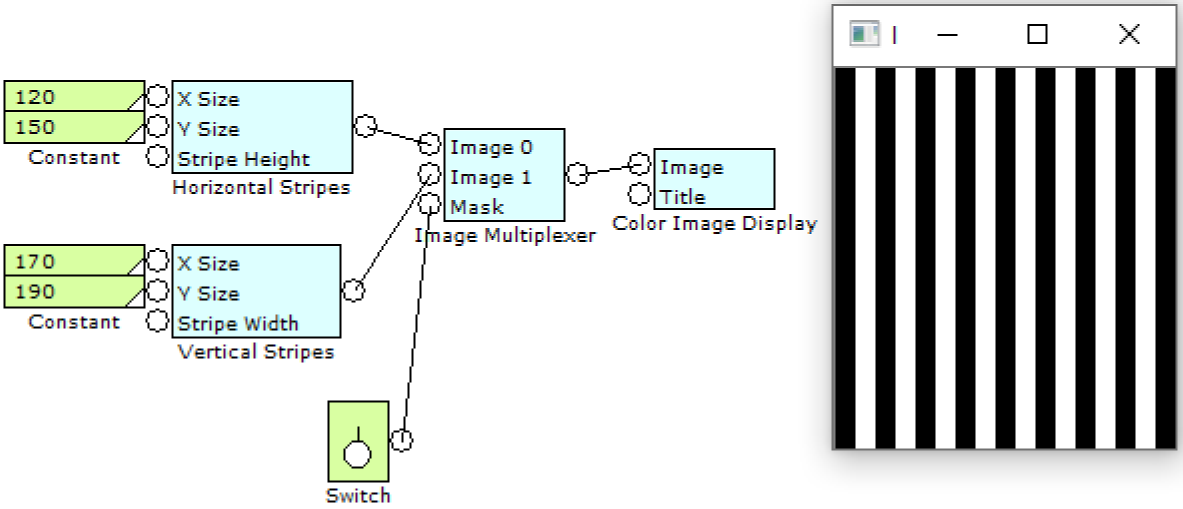
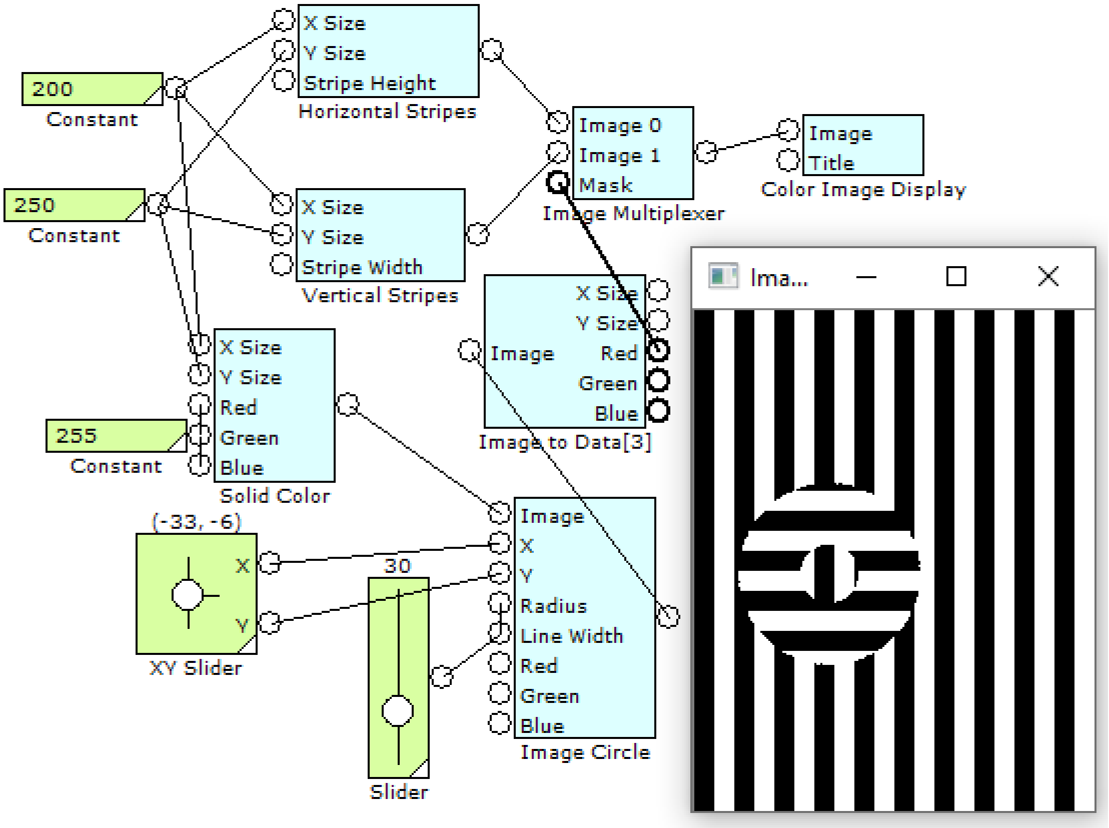
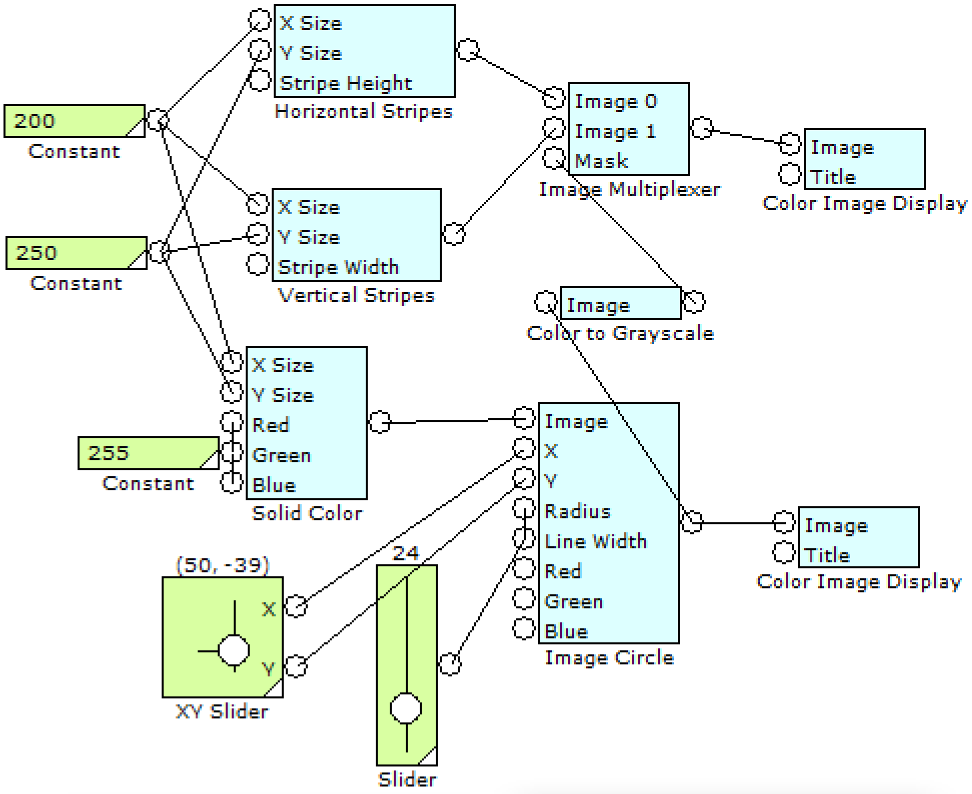


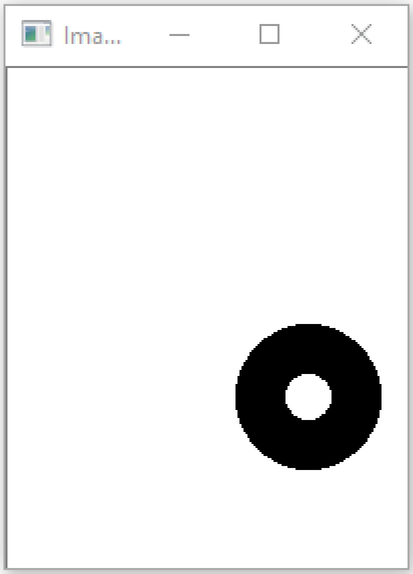
Image Multiplexer

The Image Multiplexer component creates an image by switching between the 2 input images based on the Mask input.   Images - column 3






X Size
Y Size
Stripe Height
Horizontal Stripes
200
Constant
250
Constant
X Size
Y Size
Stripe Width
Vertical Stripes
Image 0
Image 1
Mask
Image Multiplexer
Image
Title
Color Image Display
Image
Color to Grayscale
X Size
Y Size
Red
Green
Blue
Solid Color
255
Constant
Image
X
Y
Radius
Line Width
Red
Green
Blue
Image Circle
Image
Title
Color Image Display
(50, -39)
X
Y
XY Slider
24
Slider


Ima...

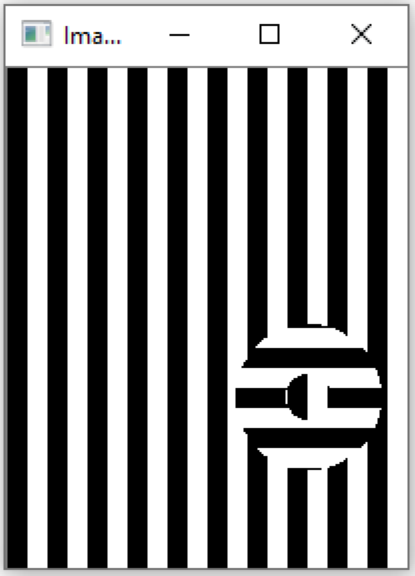

Ima...

Image Polygon

The Image Polygon component draws a polygon on an image. Set the Line Width to a negative number to fill the polygon.   Images - column 3

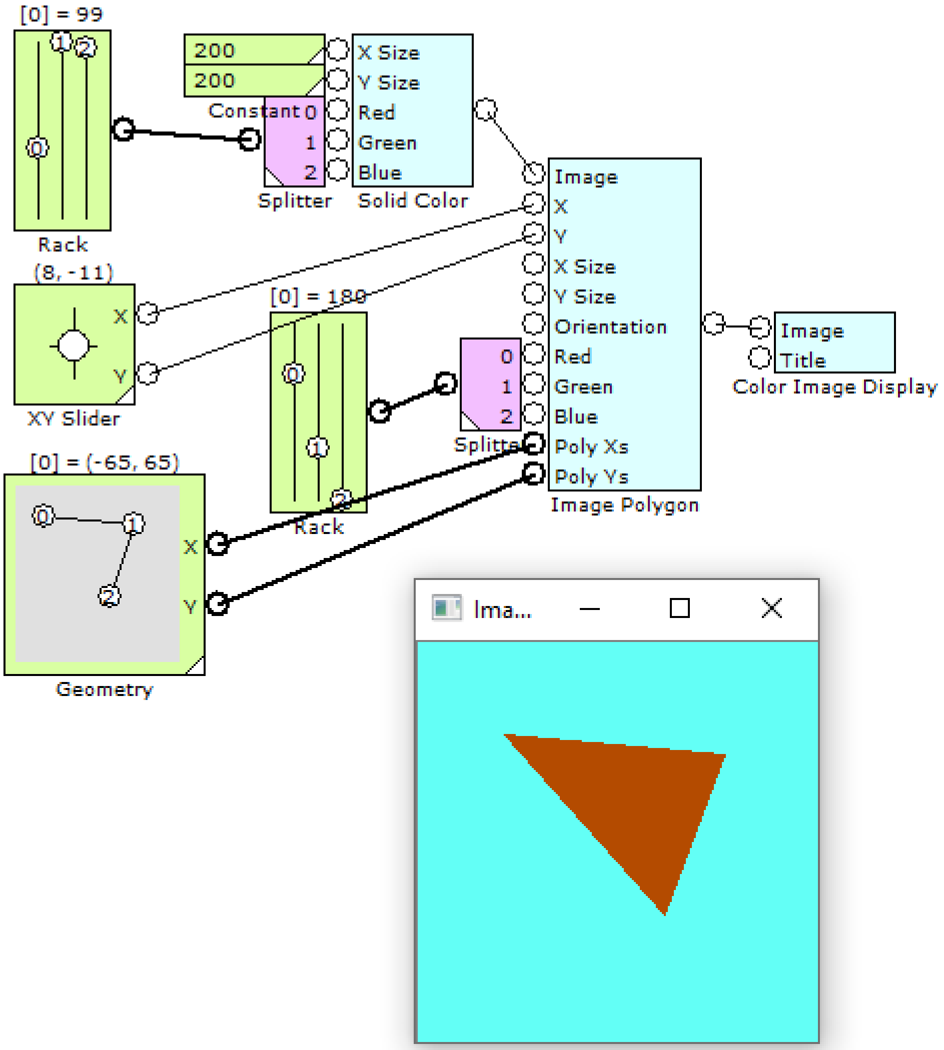
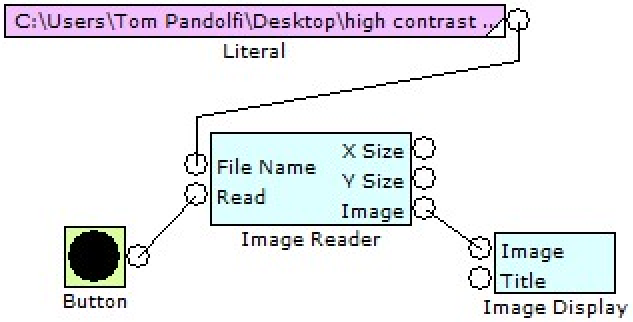


Image Reader

The Image Reader component reads a color or grayscale image at the path given. Images - column 5



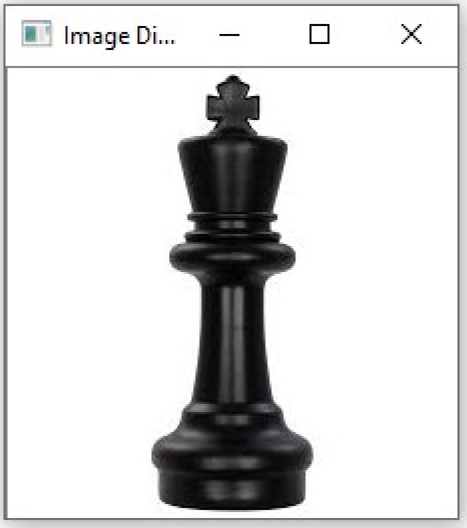
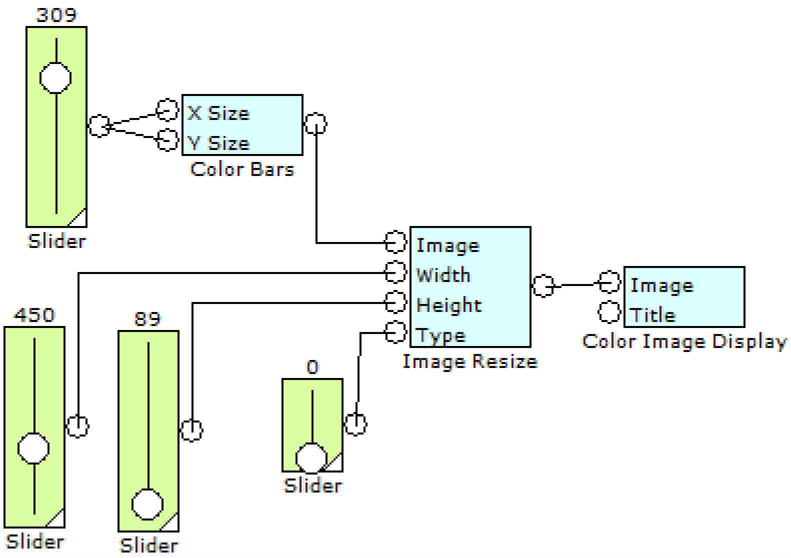


Image Resize

The Image Resize component resizes the image to the width and height given. Type: 0-Nearest neighbor, 1-Bi-linear, 2-Bi-cubic, 3-Area, 4-Lanczos (8x8), 5-Bit exact bi-linear. Images - column 1



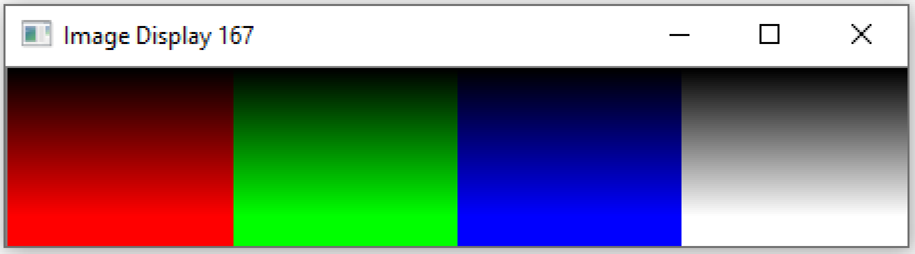
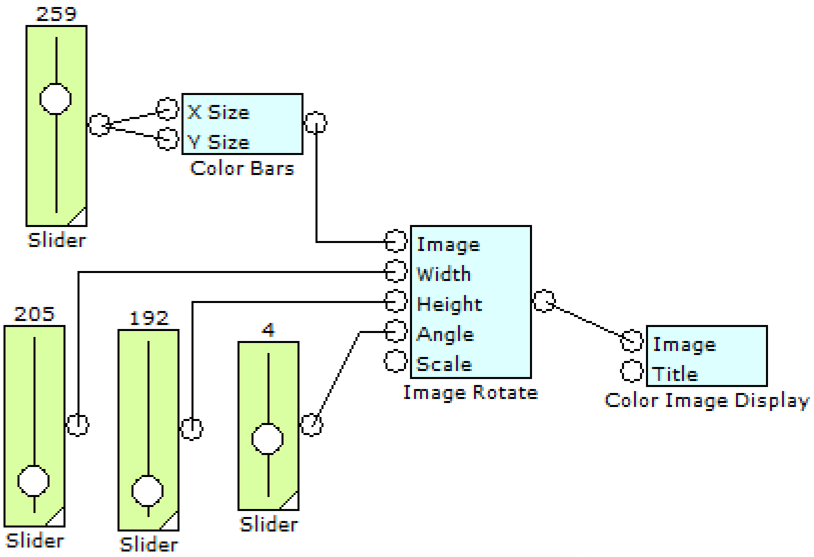


Image Rotate

The Image Rotate component rotates the image at the specified angle and scale into an otherwise blank image. Images - column 1



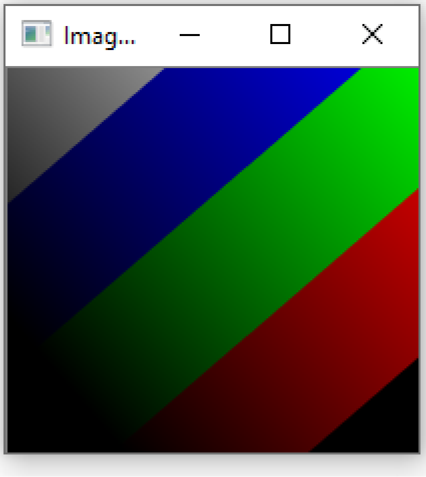


Image Size

The Image Size component reads the image width, height, and number of channels. Images - column 1

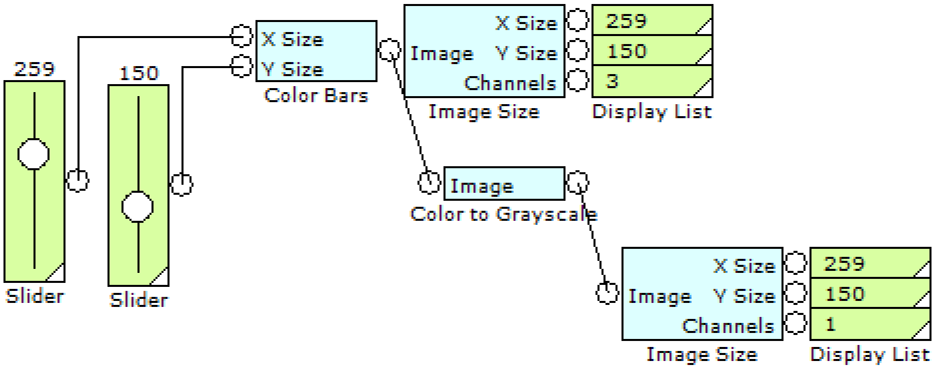


Image Subtract

The Image Subtract component subtracts the pixels of the second image from the first image. Images – column 2

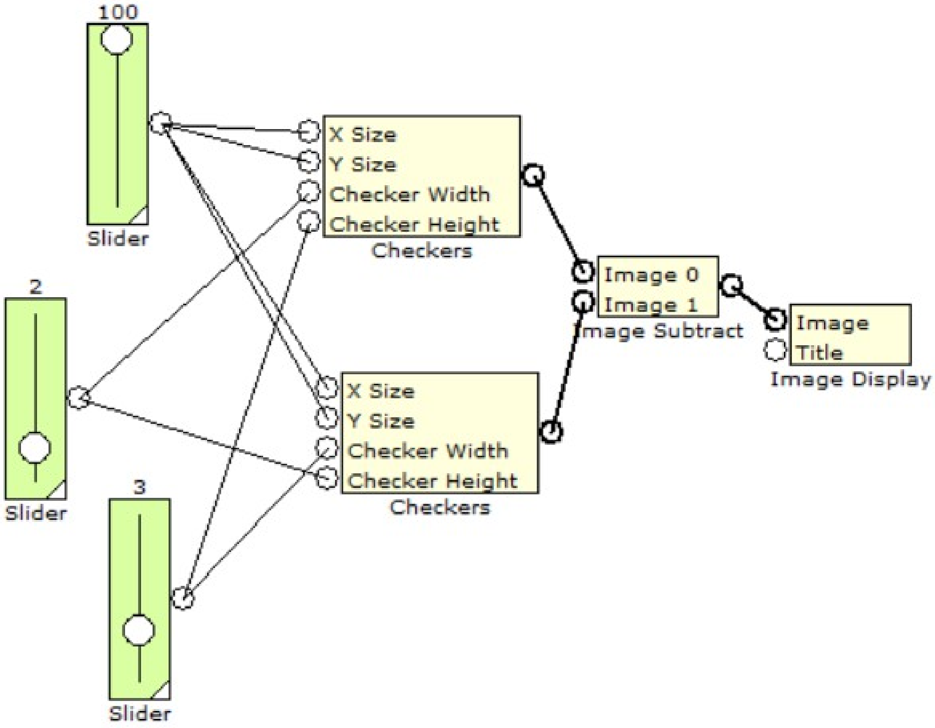


Image Text

The Image Text component draws the text given on an image. Images - column 3

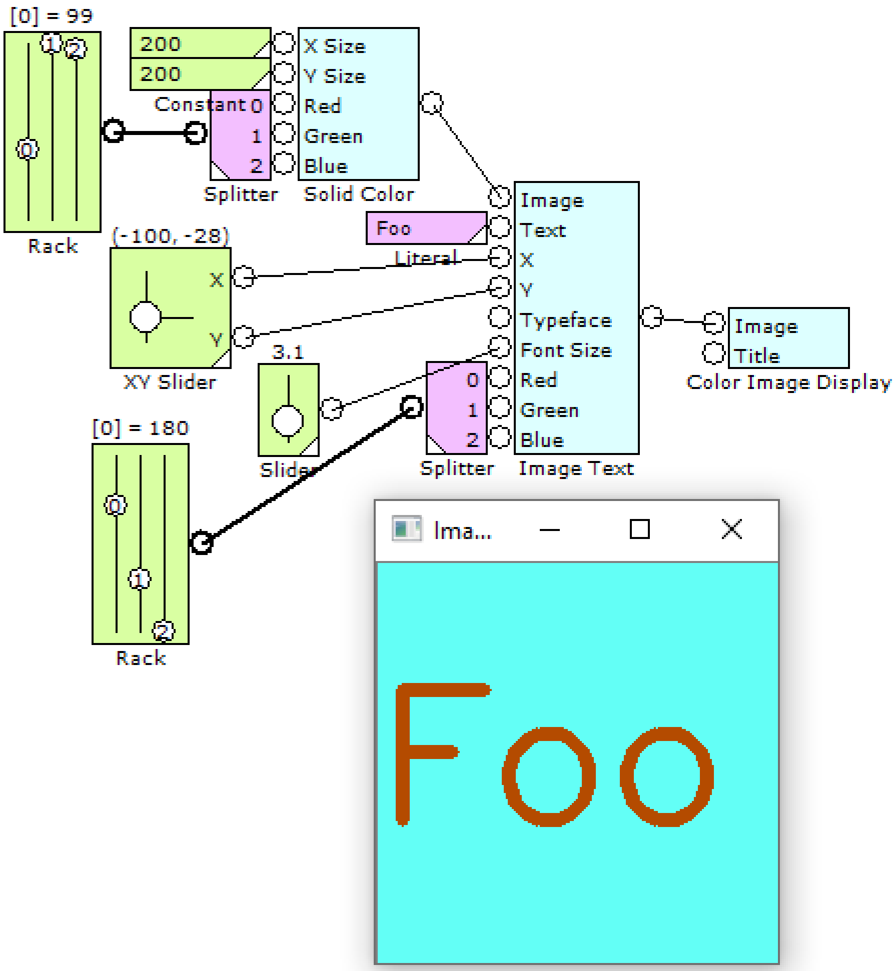
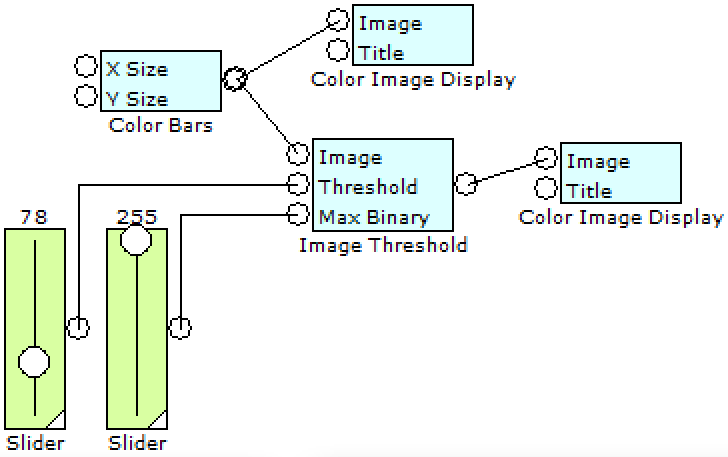
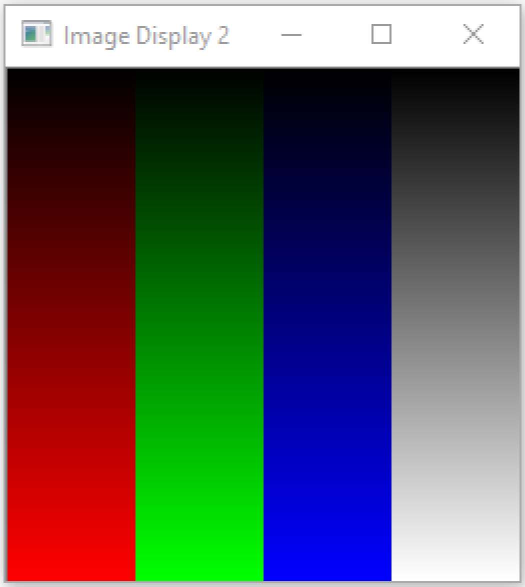


Image Threshold

The Image Threshold component converts an image to grayscale usually with higher contrast.   Images - column 2





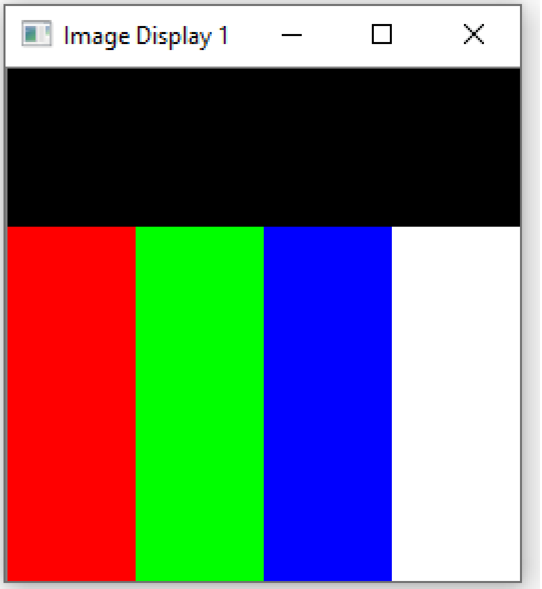
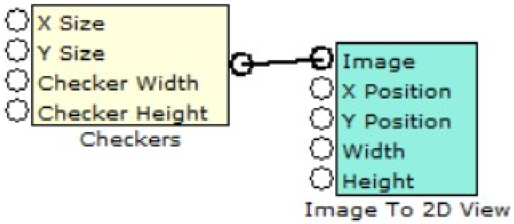


Image to 2D View

The Image to 2D View component takes an Image and position and size coordinates and draws the image in the 2D view canvas. 2D – column 2



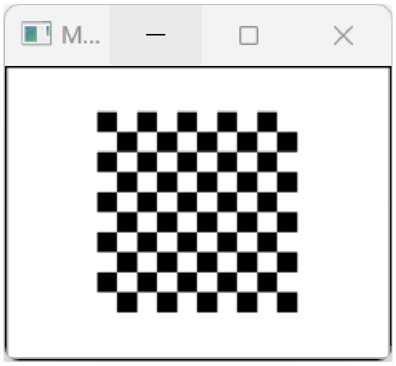
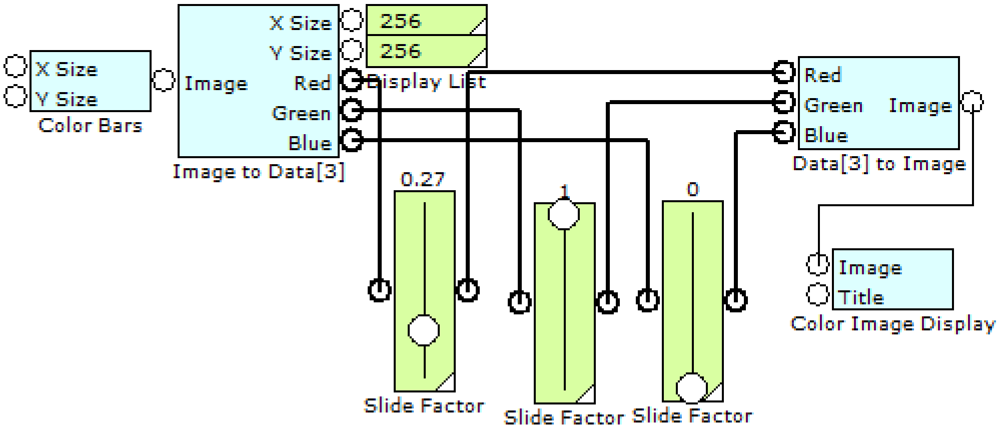


Image to Data[3]

The Image to Data[3] component outputs the three color matrices from the image. Images - column 5



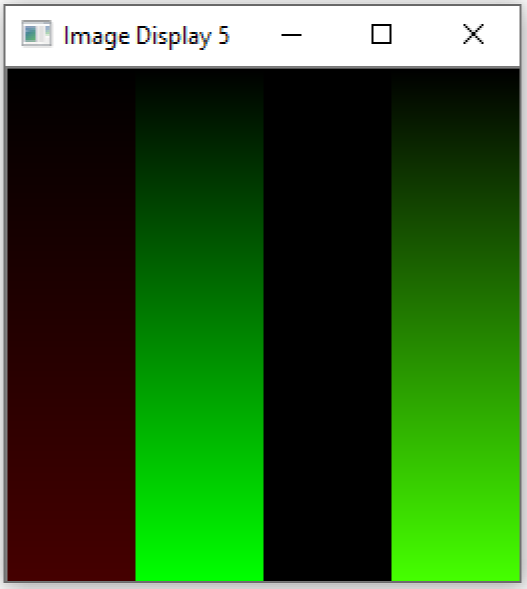
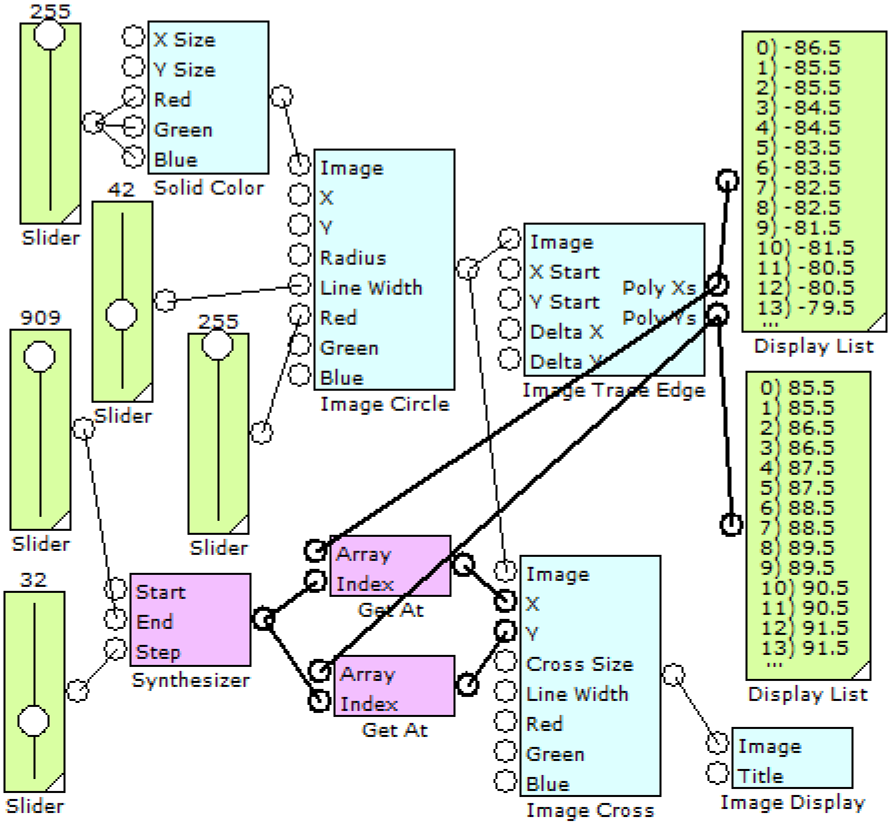


Image Trace Edge

The Image Trace Edge component follows an edge and outputs X and Y coordinates along that polyline.   Images - column 3



```
0) -86.5
1) -85.5
2) -85.5
3) -84.5
4) -84.5
5) -83.5
6) -83.5
7) -82.5
8) -82.5
9) -81.5
10) -81.5
11) -80.5
12) -80.5
13) -79.5
...
```

```
0) 85.5
1) 85.5
2) 86.5
3) 86.5
4) 87.5
5) 87.5
6) 88.5
7) 88.5
8) 89.5
9) 89.5
10) 90.5
11) 90.5
12) 91.5
13) 91.5
...
```

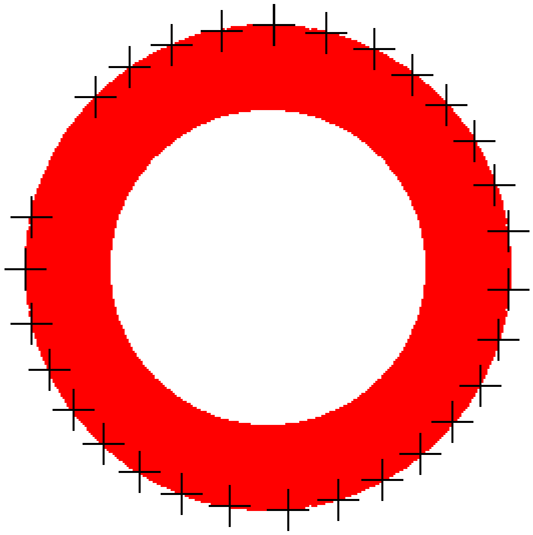
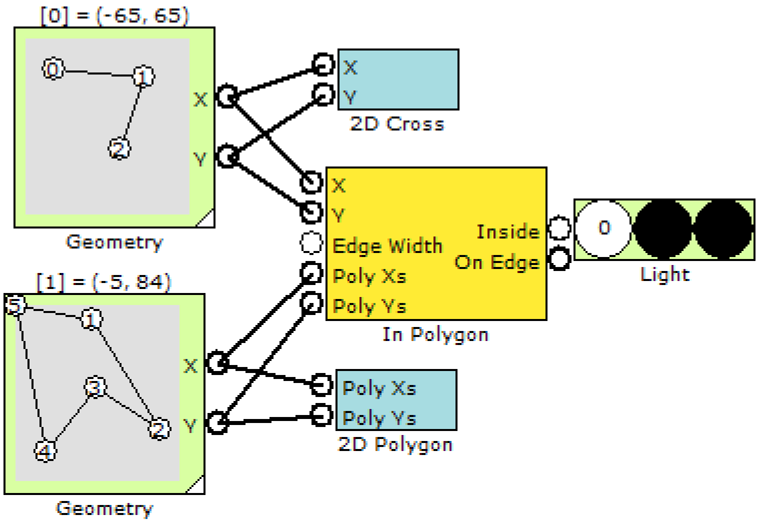


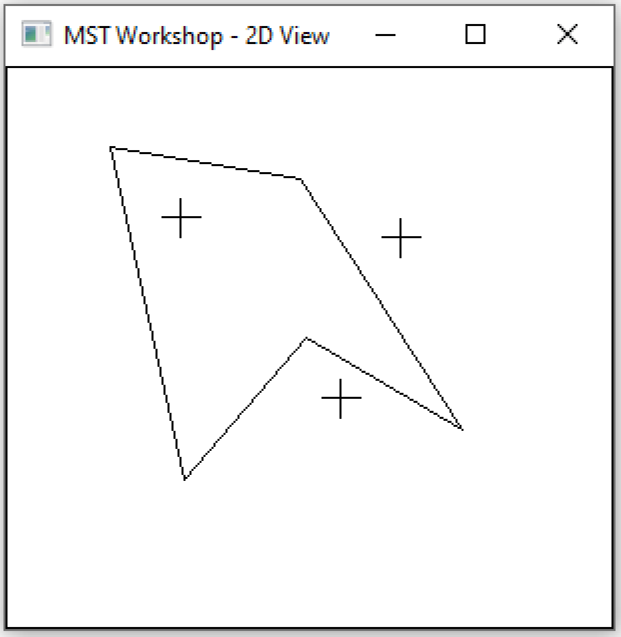
Image Writer

The Image Writer component writes an image to the path given.   Images - column 5

In Polygon

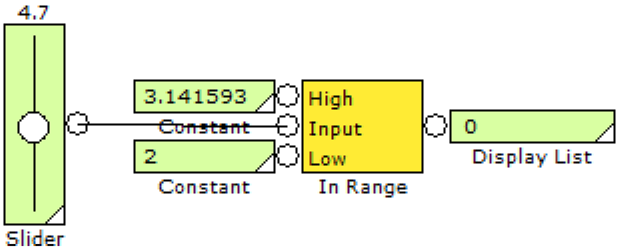
The In Polygon component gives true if the input is inside the polygon. The edge output is the number of the edge when you are on an edge or -1 when you are not on an edge.   Functions - column 2

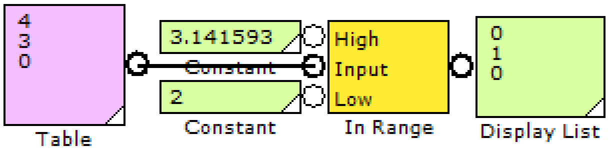




In Range

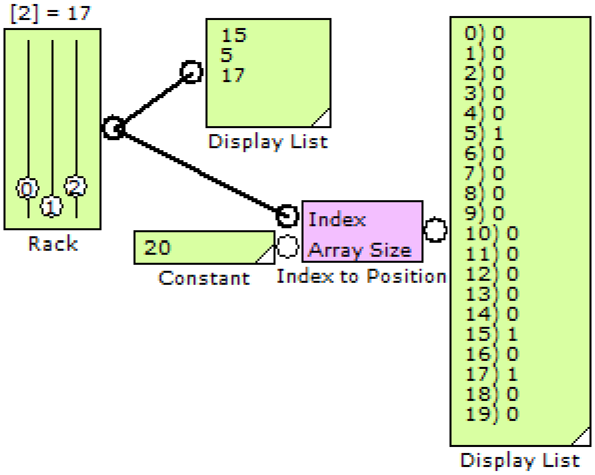
The In Range component gives true if the input is between the High and Low values. Functions - column 2





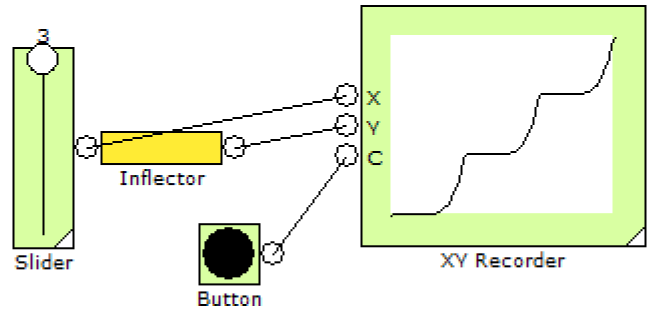
Index to Position

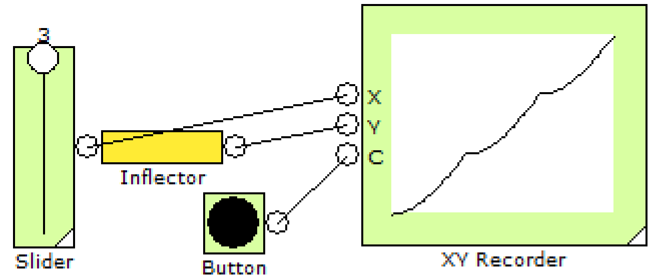
The Index to Position component creates an array of Array Size and puts 1's in the positions specified by the Index input.   Arrays - column 4



Inflector

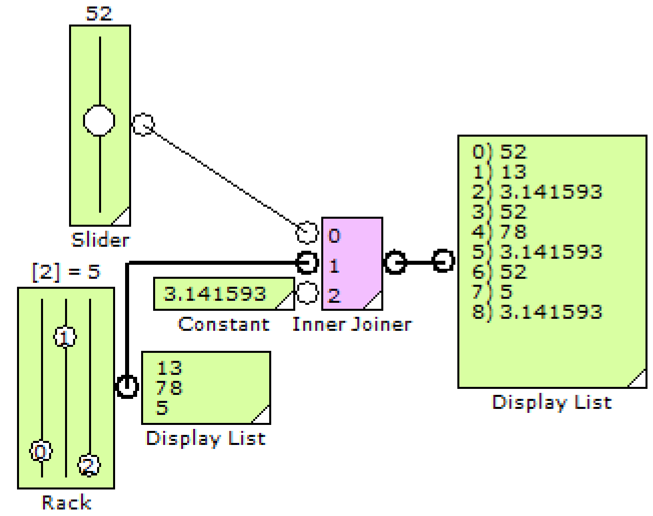
The Inflector component modifies the input to provide inflection at each integer value. Input can be scalar of an array. Functions – column 1

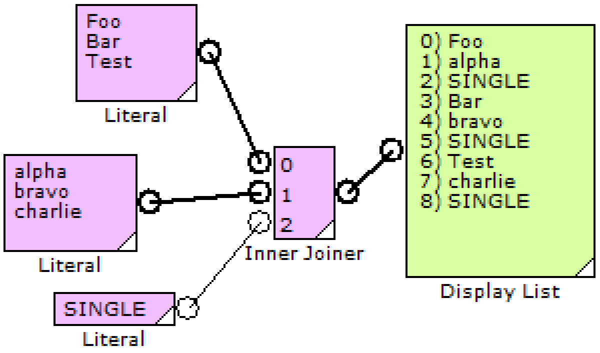




Inner Joiner

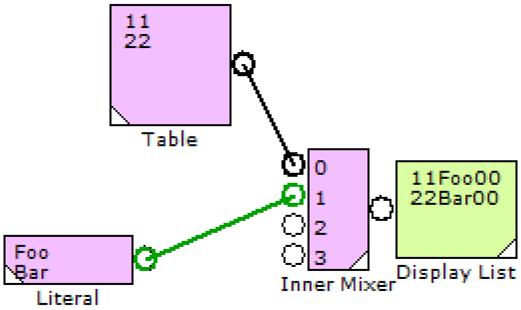
The Inner Joiner component builds an array by sequencing through all the inputs. Each pass uses the next element in that input's array. The inputs can be a scalar, array, string or an array of strings. Arrays - column 2





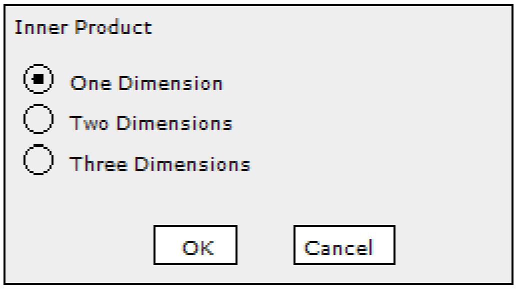
Inner Mixer

The Inner Mixer component builds a string array by sequencing through all the inputs. Each pass uses the next element in that input's array. The inputs can be a scalar, array, string or an array of strings.



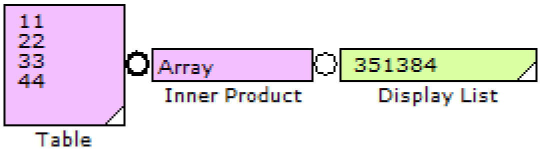
Inner Product

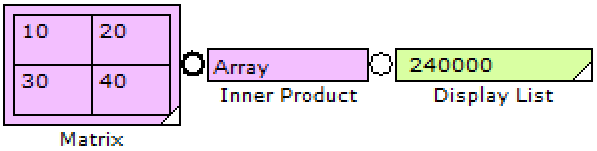
The Inner Product component scans the input array multiplying the values together. You can set the number of dimensions. Arrays - column 3

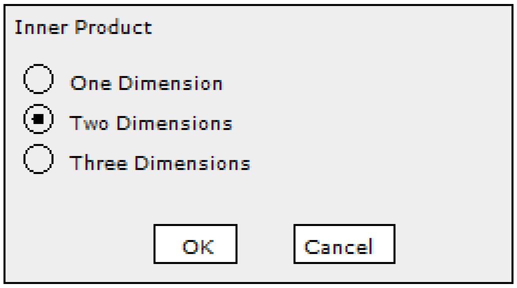


Inner Product

● One Dimension
○ Two Dimensions
○ Three Dimensions

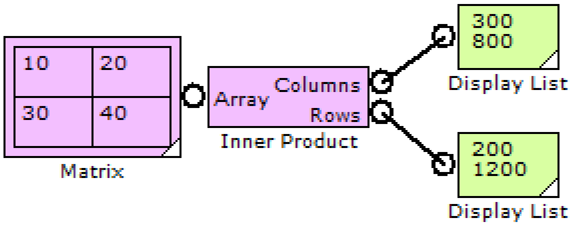


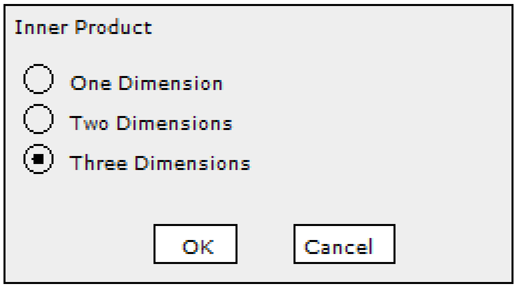




Inner Product

○ One Dimension
● Two Dimensions
○ Three Dimensions



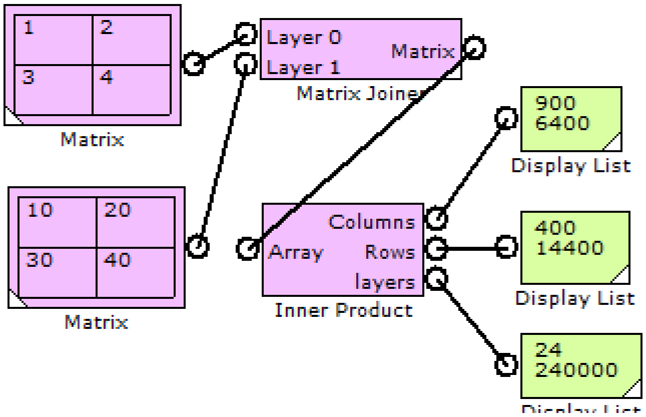


Inner Product

○ One Dimension

○ Two Dimensions

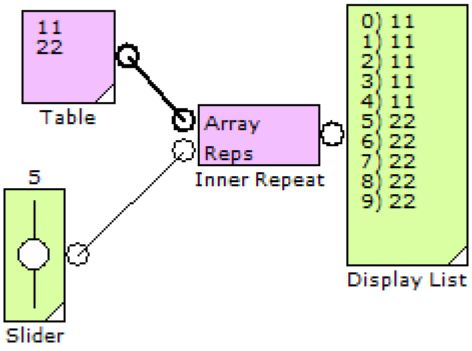
● Three Dimensions



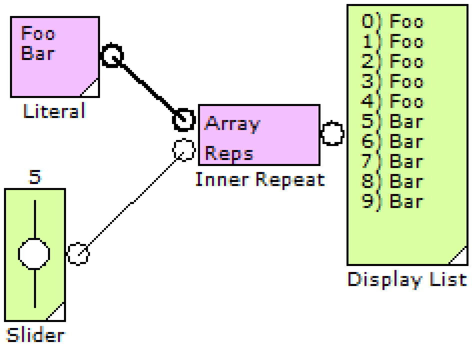
Inner Repeat

The Inner Repeat component builds an array by repeating the Array input. The Array input can be a scalar or an array. For example: an input of 1, 2, 3 with a Reps input of 2 will output 1, 1, 2, 2, 3, 3.

Arrays - column 2



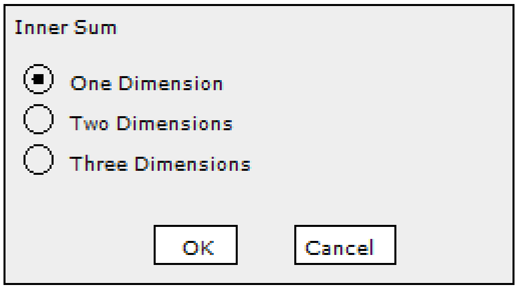
```
0) 11
1) 11
2) 11
3) 11
4) 11
5) 22
6) 22
7) 22
8) 22
9) 22
```



```
0) Foo
1) Foo
2) Foo
3) Foo
4) Foo
5) Bar
6) Bar
7) Bar
8) Bar
9) Bar
```

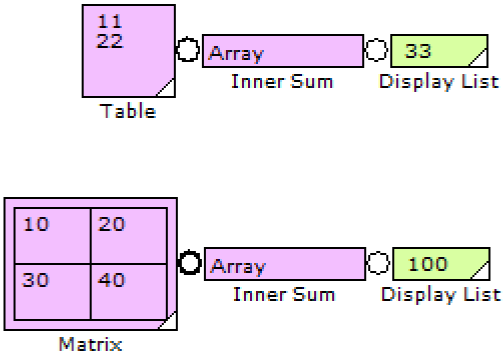
Inner Sum

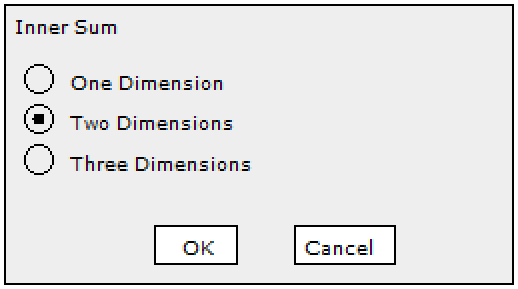
The Inner Sum component scans the input array summing the values together. You can set the number of dimensions.Arrays - column 3



Inner Sum

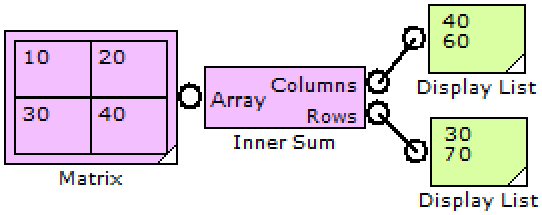
● One Dimension
○ Two Dimensions
○ Three Dimensions

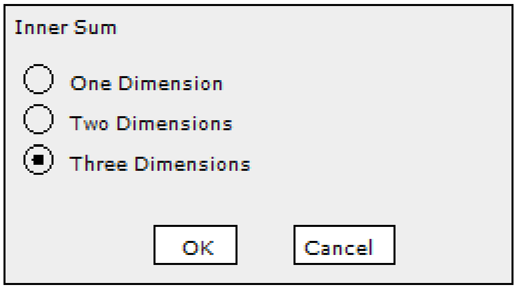




Inner Sum

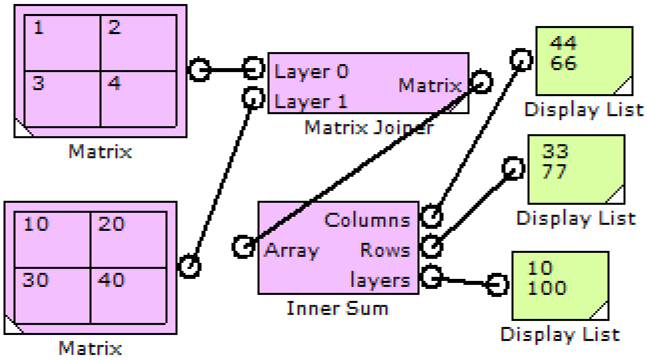
○ One Dimension
● Two Dimensions
○ Three Dimensions





Inner Sum

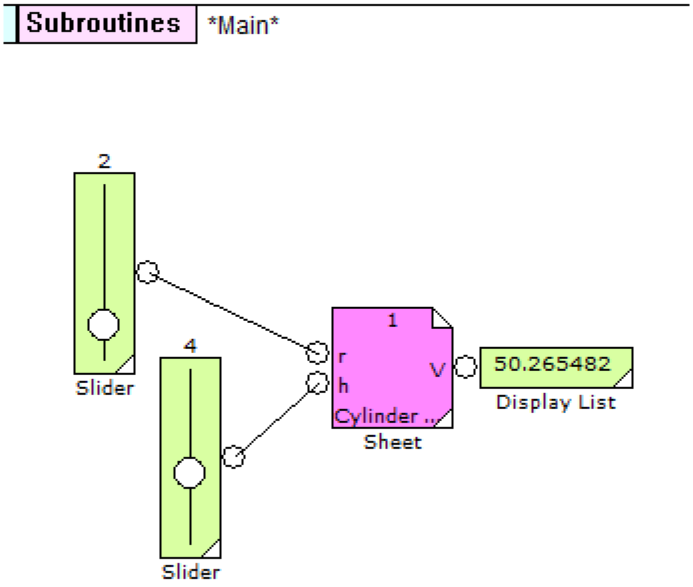
○ One Dimension
○ Two Dimensions
● Three Dimensions



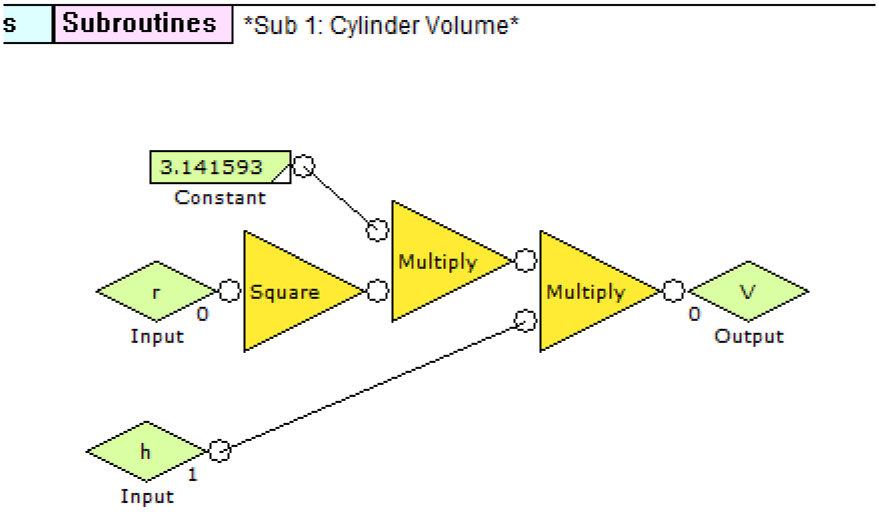
Input

The Input component is used in a subroutine to carry values into the subroutine. Each Input shows as an input pin on the subroutine icon. You can set a Default Value when nothing is connected to this input pin.   Controls - column 5

In the main workspace:

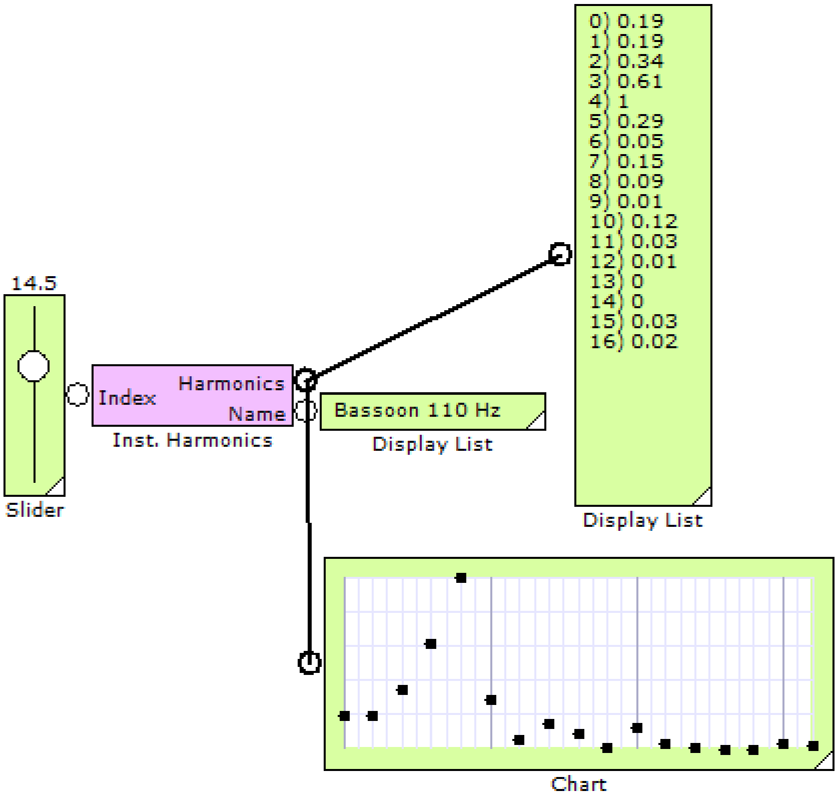


In the subroutine:



Inst. Harmonics

The Inst. Harmonics component lets you choose from a list of instruments and provides the harmonic amplitudes of the instrument's sound.   Arrays - column 7

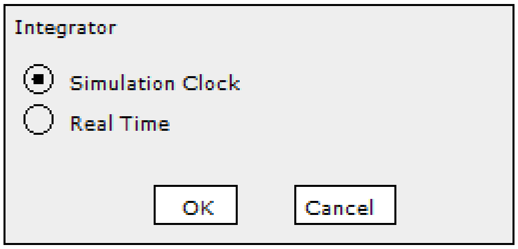


```
Bassoon 110 Hz
```

```
0) 0.19
1) 0.19
2) 0.34
3) 0.61
4) 1
5) 0.29
6) 0.05
7) 0.15
8) 0.09
9) 0.01
10) 0.12
11) 0.03
12) 0.01
13) 0
14) 0
15) 0.03
16) 0.02
```

Integrator

The Integrator component integrates the inputs over time. Functions - column 6

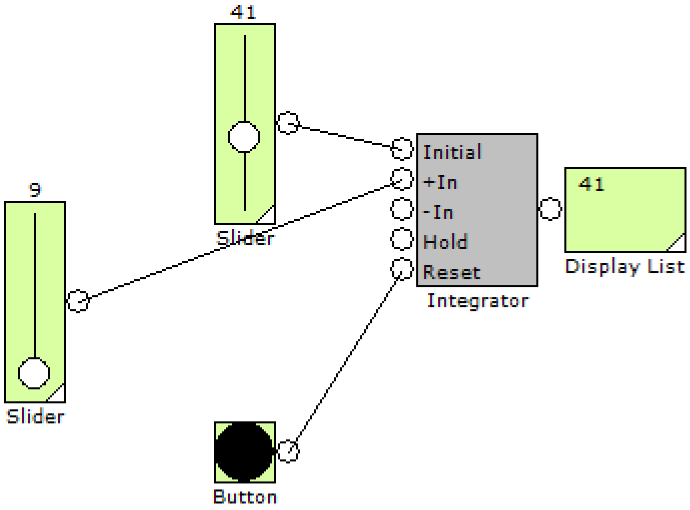


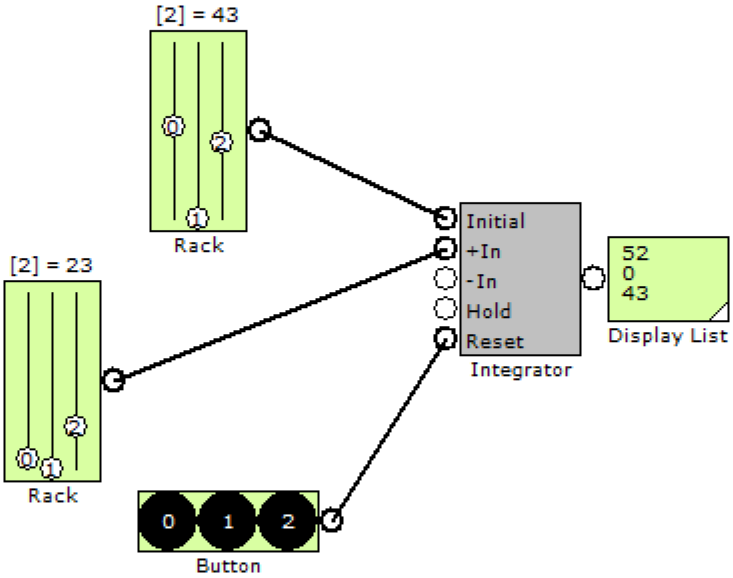
Integrator

● Simulation Clock

○ Real Time

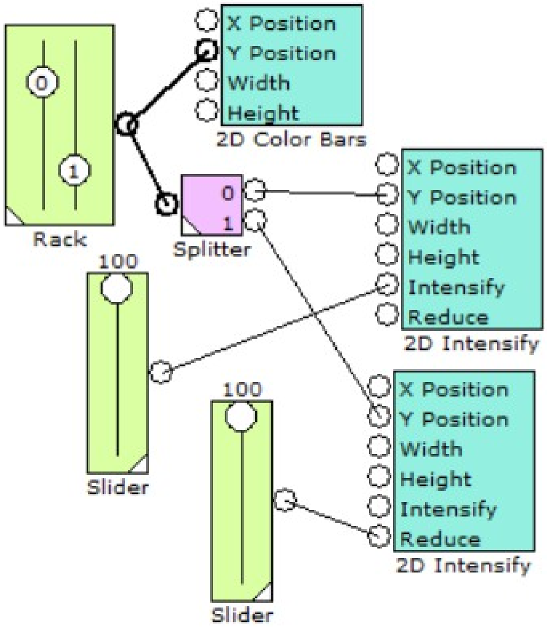
OK   Cancel

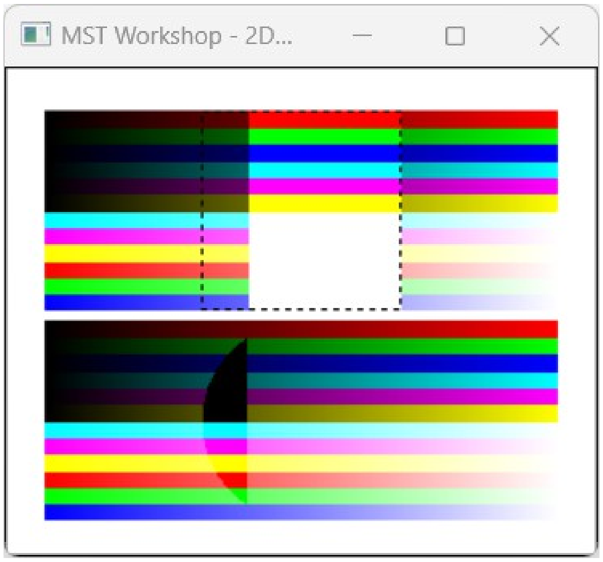




2D Intensify

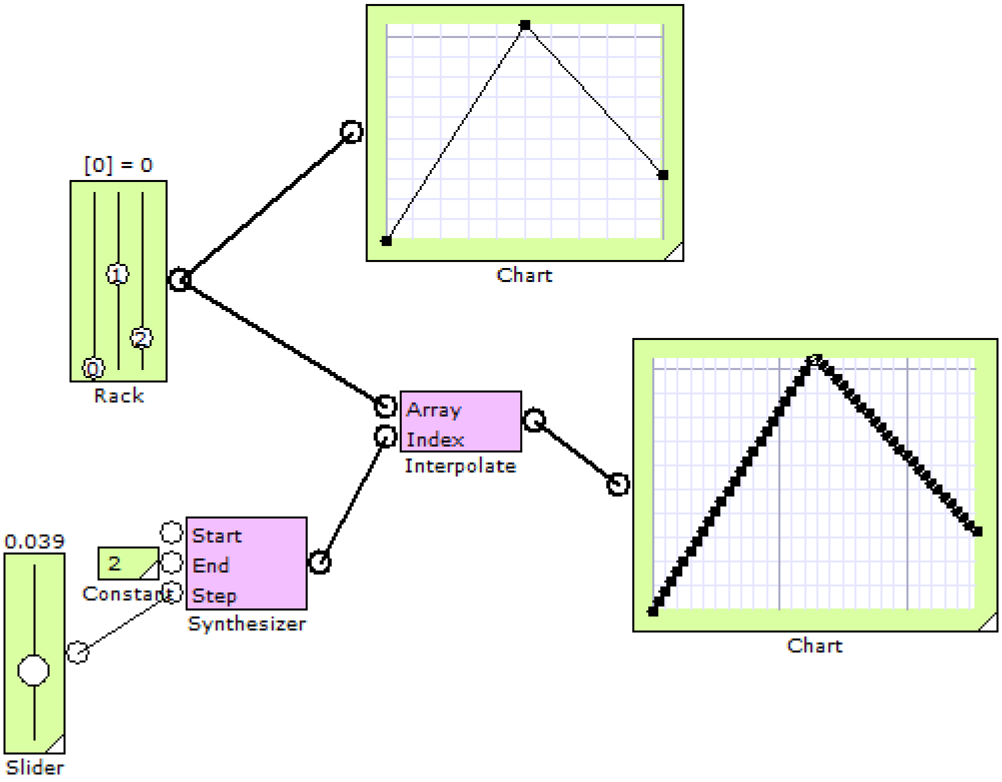
The 2D Intensify reduces or intensifies the 2D drawing it covers. 2D – column 1





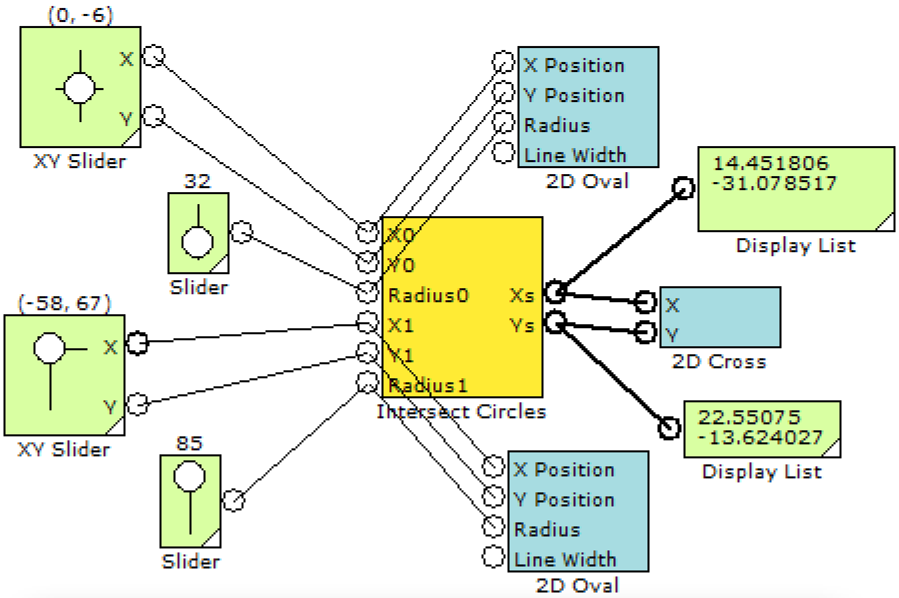
Interpolate

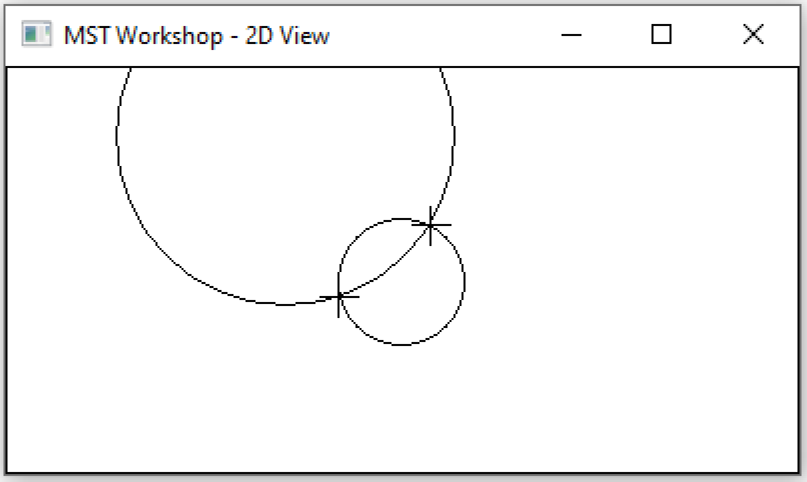
The Interpolate component gets the Array values around the Index input and interpolates. It outputs the value(s) at the positions given by the Index(s).   Arrays - column 2



Intersect Circles

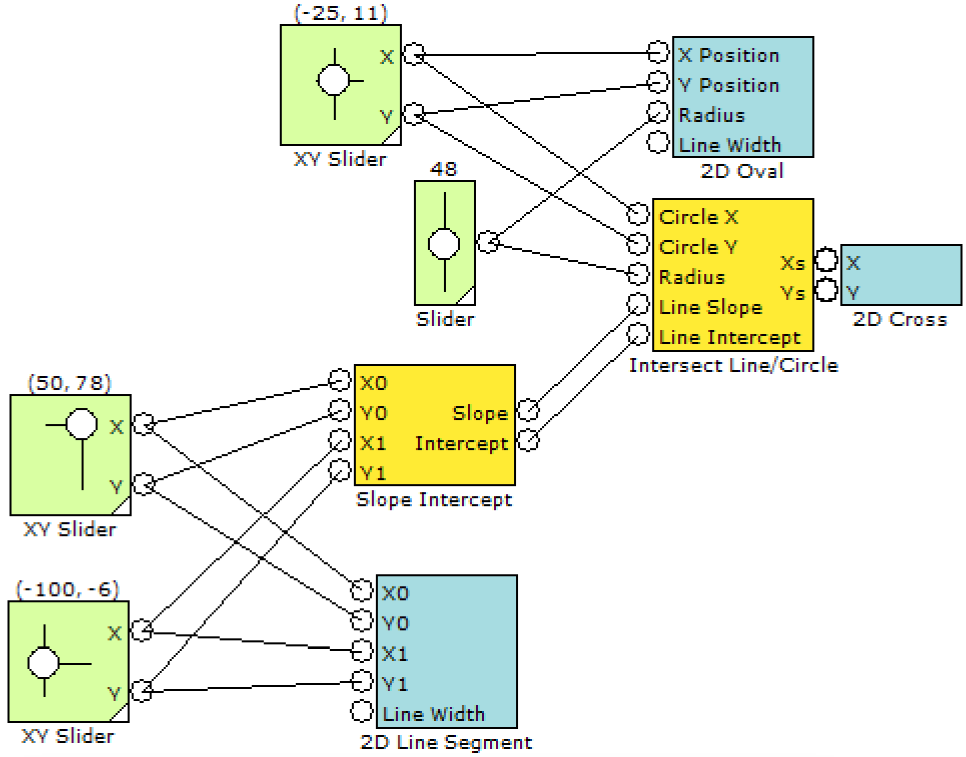
The Intersect Circles component calculates the intersection between two circles. Functions - column 8

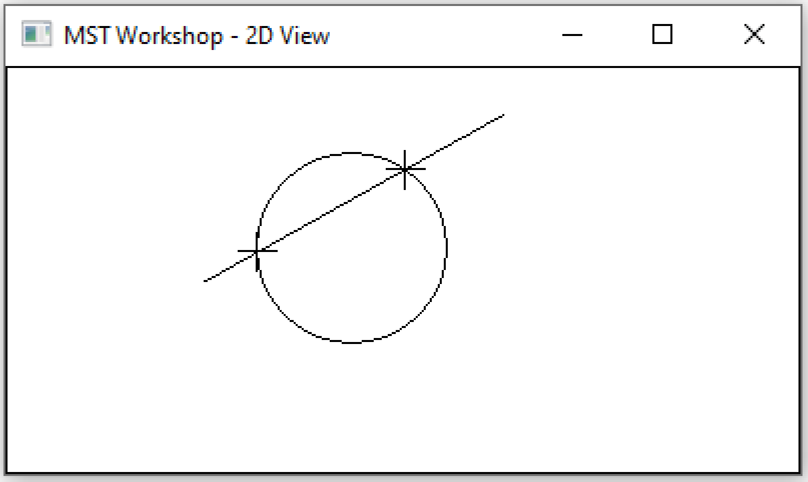




Intersect Line/Circle

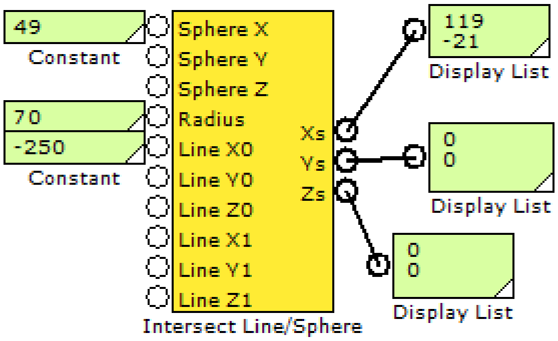
The Intersect Line/Circle component calculates the intersection of a line and a circle.   Functions - column 8





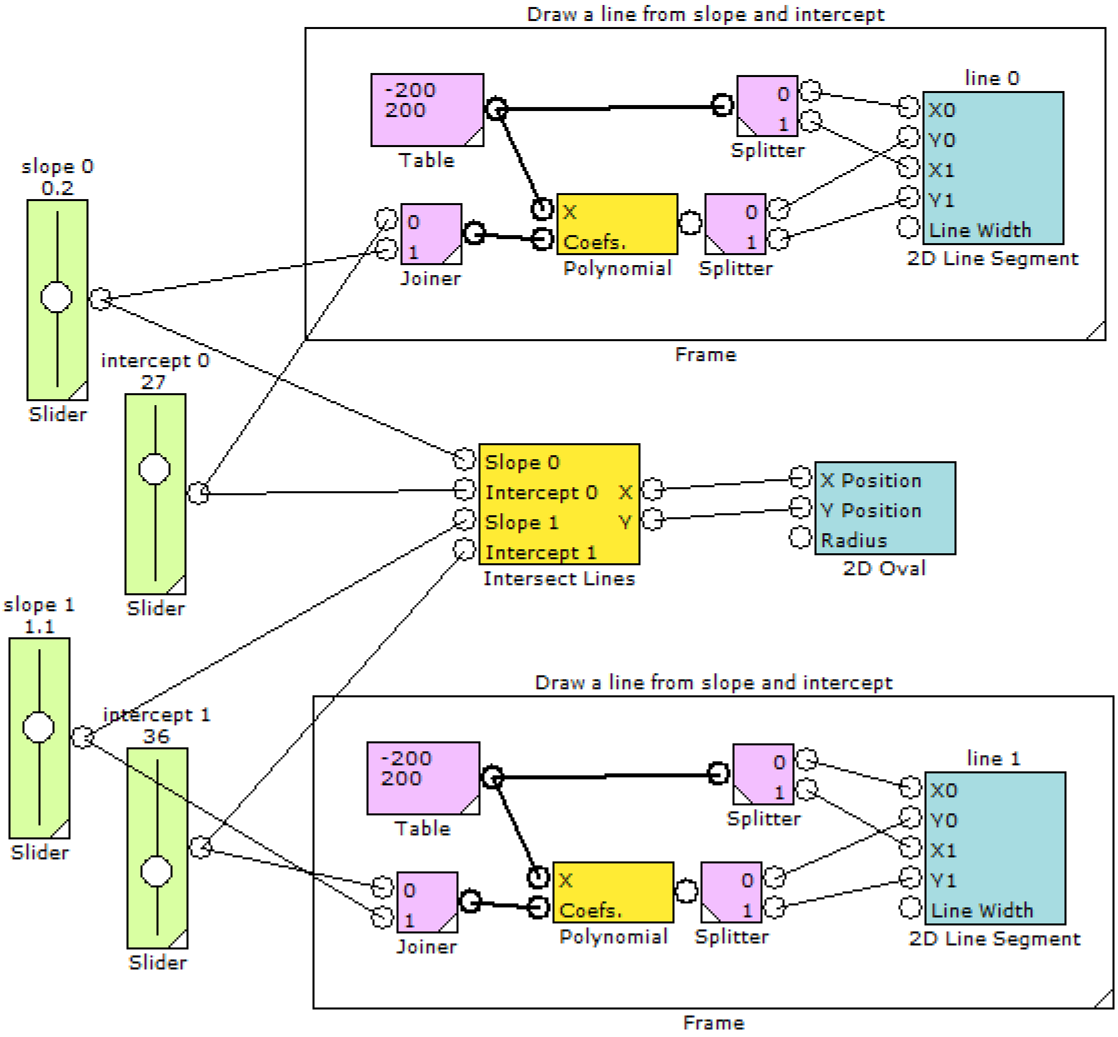
Intersect Line/Sphere

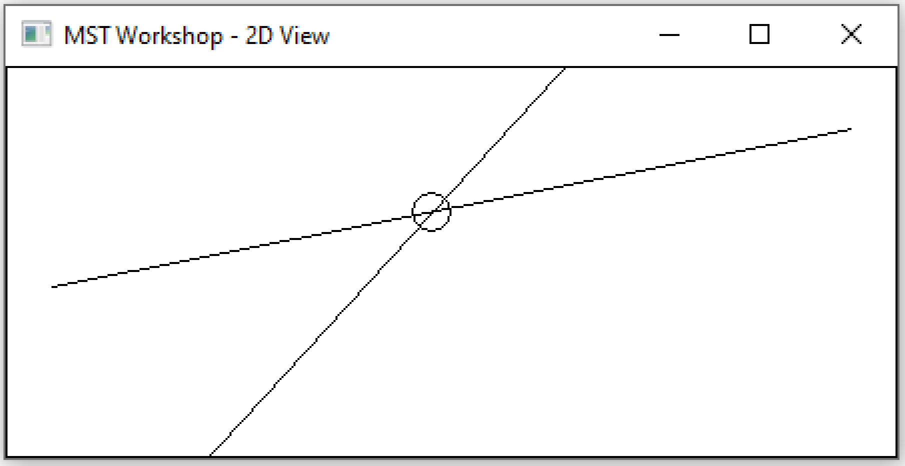
The Intersect Line/Sphere component calculates the intersection of a line and a sphere.



Intersect Lines

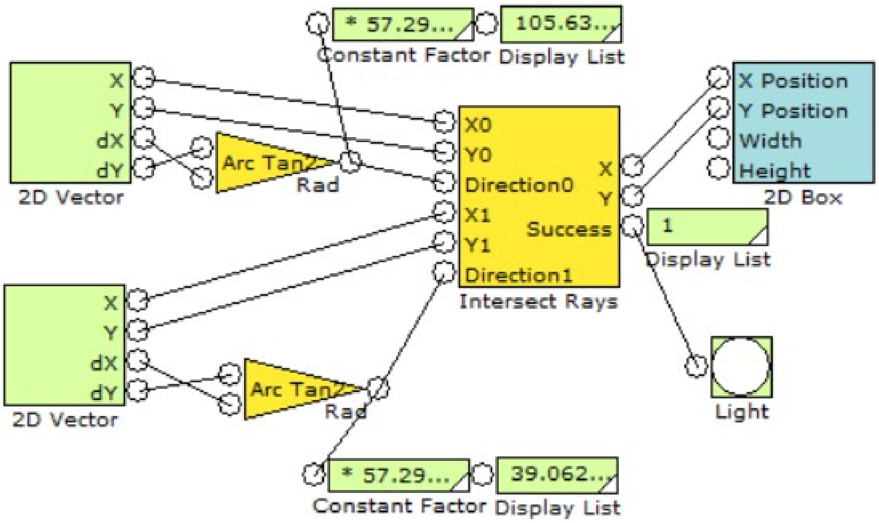
The Intersect Lines component calculates the intersection between two lines. Functions - column 8

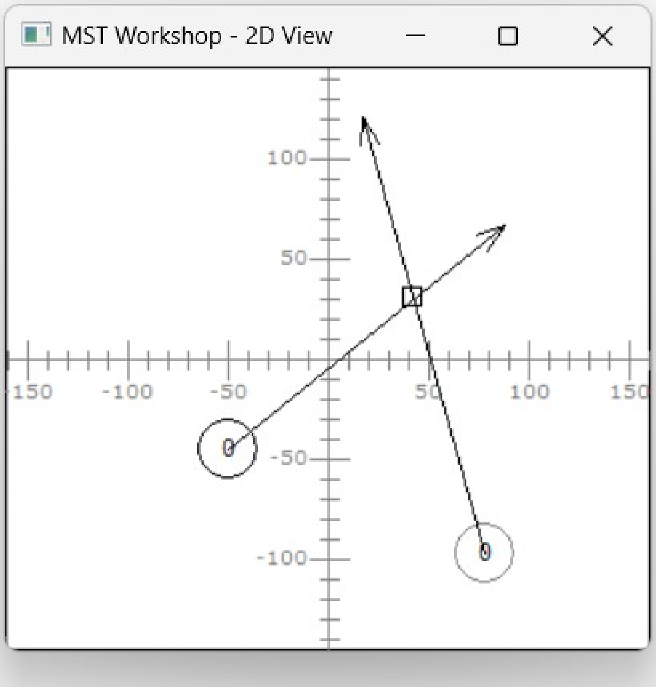




Intersect Rays

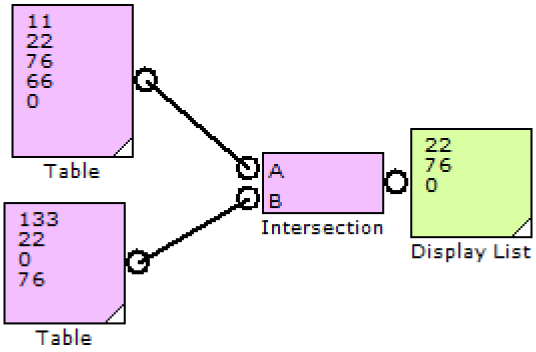
The Intersect Rays component calculates the intersection between two rays. Functions – column 8

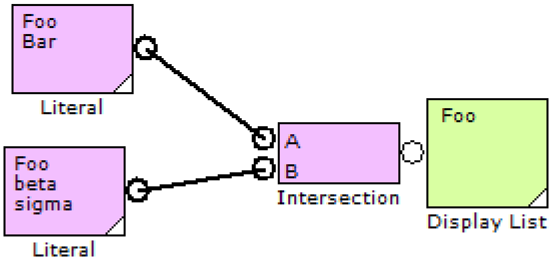




Intersection

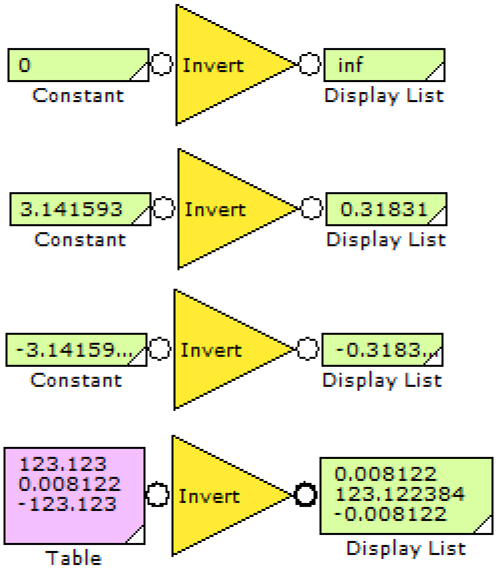
The Intersection component scans the input arrays and outputs the elements common to both inputs.
Arrays - column 5





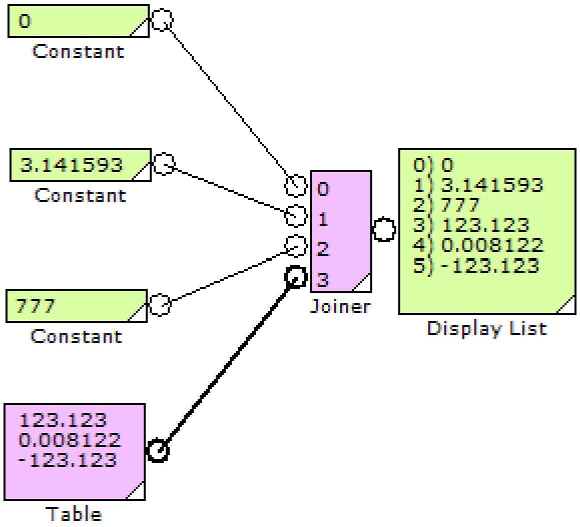
Invert

The Invert component calculates one over input. Input can be a scalar or an array. Functions - column 1



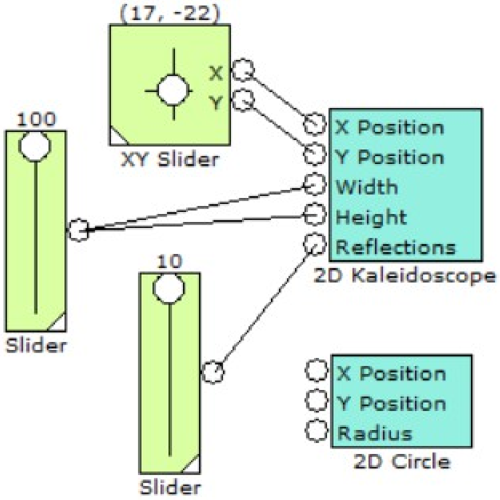
Joiner

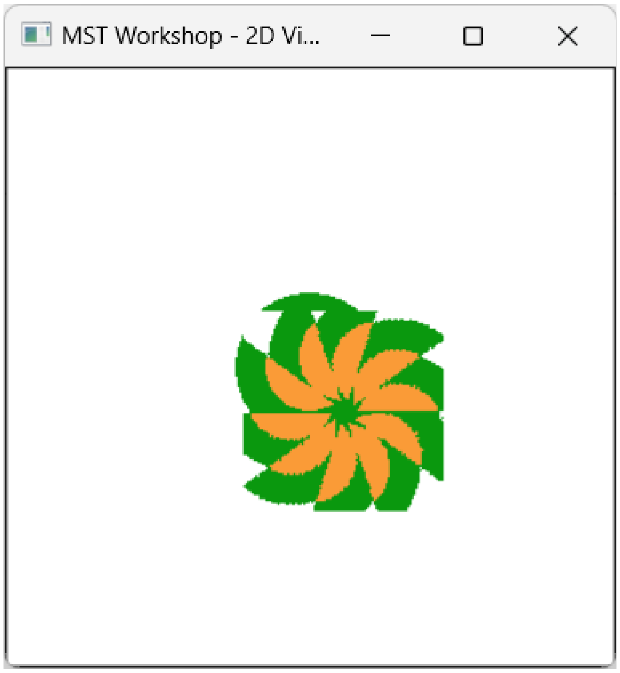
The Joiner component joins all the values for all its inputs into a single output. You can set the number of inputs.   Arrays - column 1



2D Kaleidoscope

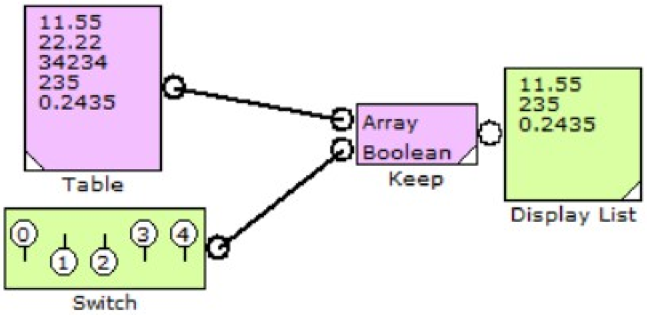
The 2D Kaleidoscope creates the repeating kaleidoscope effect on the image in the 2D drawing it covers. Note: This component only affects the items in the 2D View window that are under it. 2D – column 7

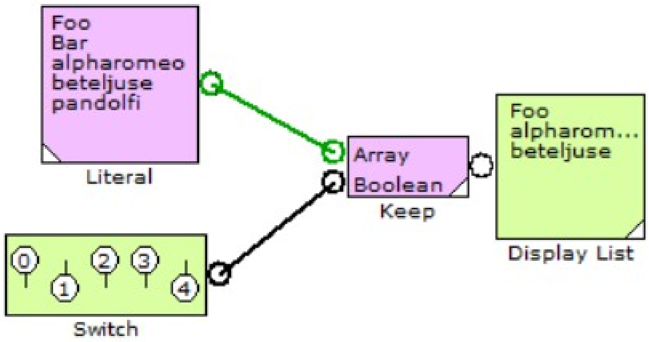




Keep

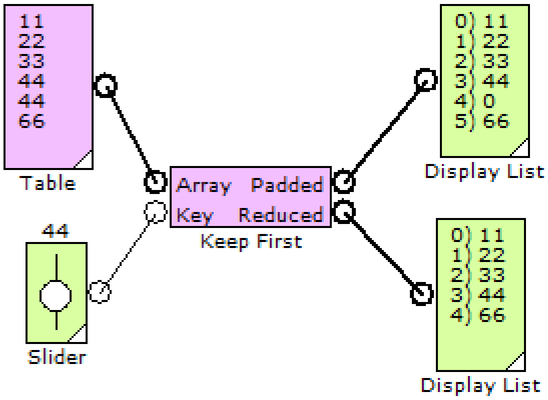
The Keep component outputs only the values of the input array that correspond to the true values in the Boolean input.Arrays - column 2

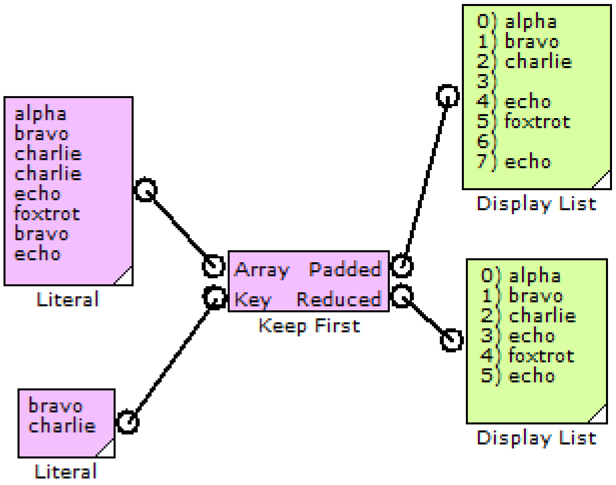




Keep First

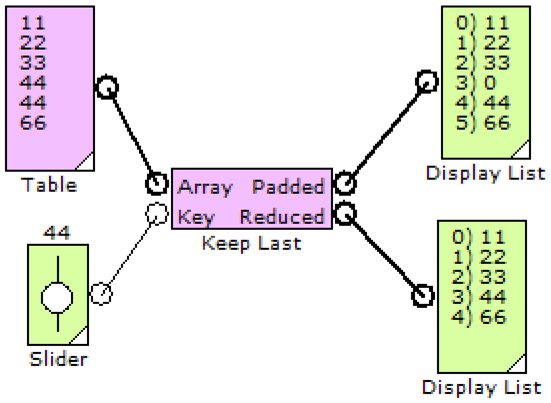
The Keep First component outputs the values of the input array but removes extra copies of the key, keeping only the first occurrence.   Arrays - column 2

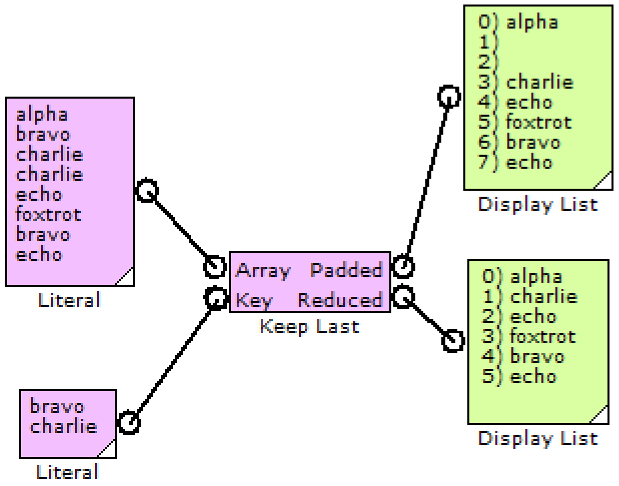




Keep Last

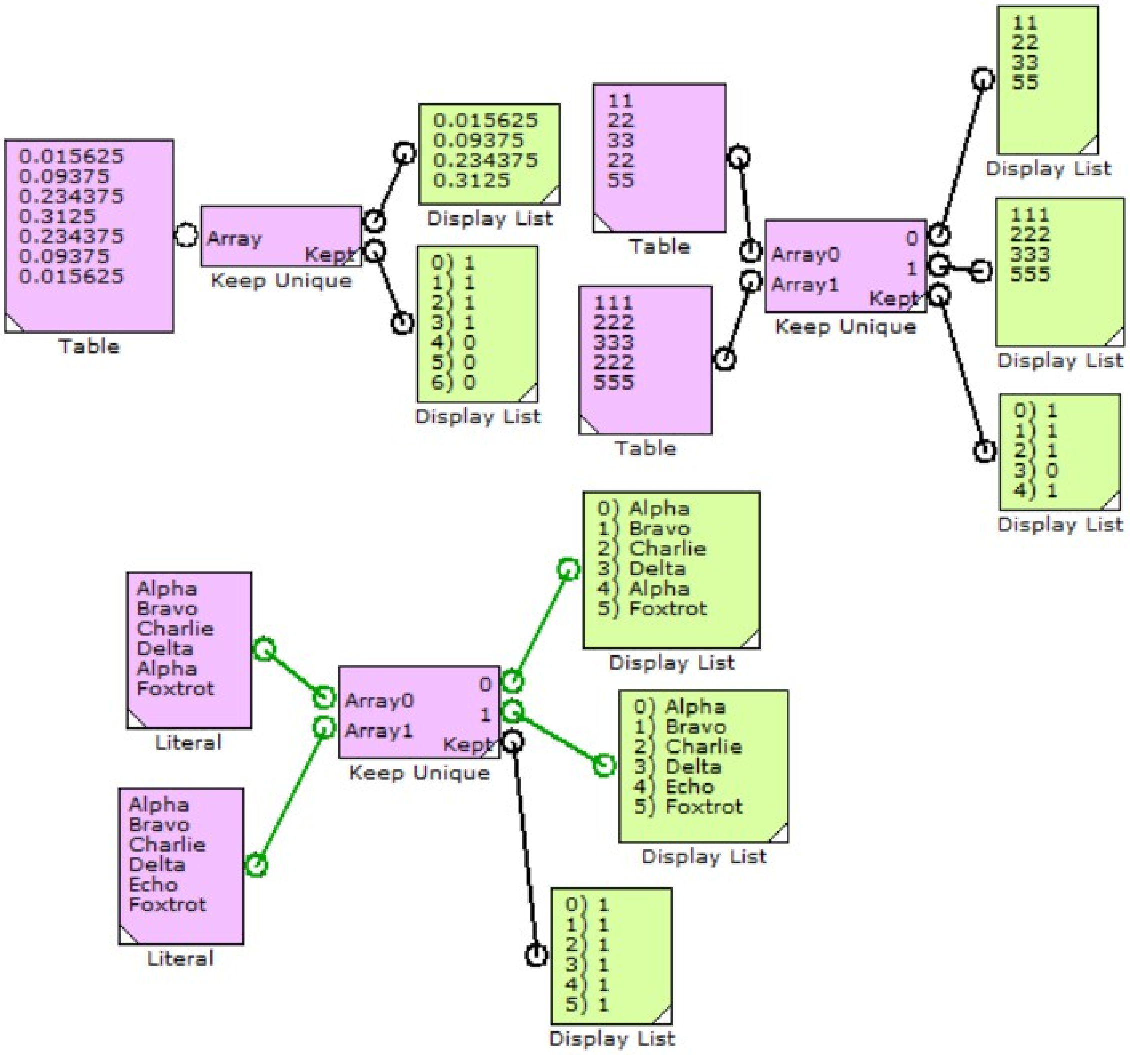
The Keep Last component outputs the values of the input array but removes extra copies of the key, keeping only the last occurrence.   Arrays - column 2





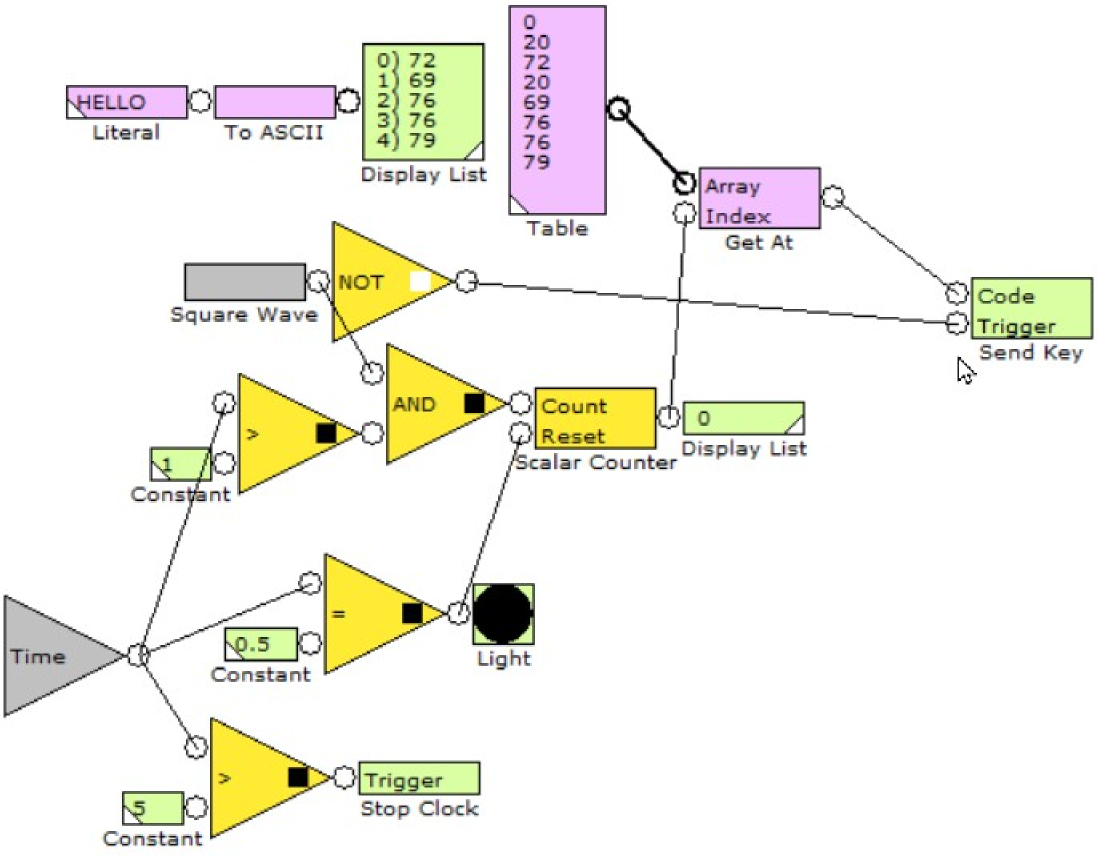
Keep Unique

The Keep Unique component outputs only the values of the input array that are unique. In other words it removes duplicates. When multiple inputs are enabled, all inputs are considered as a group. Arrays – column 2



Key Send

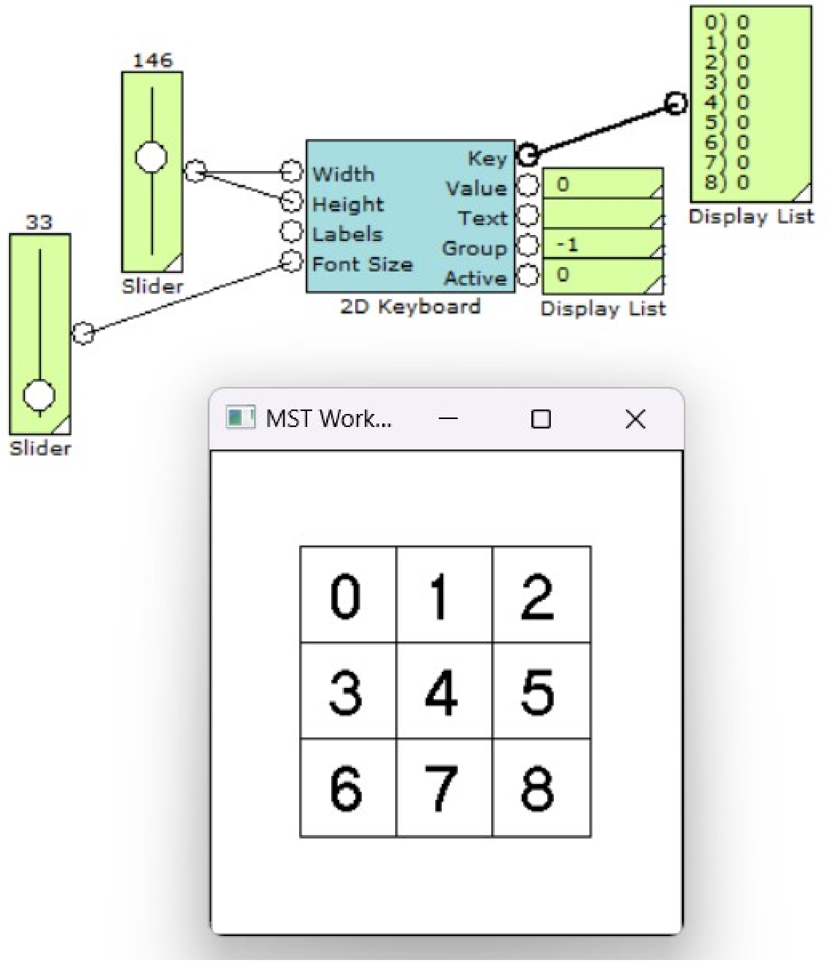
The Key Send component simulates a key click as if someone is typing on the computer's keyboard. The Code input is the Virtual Key Code not ASCII. For example you can click the Caps Lock key using a Code of 20. The Ctrl key is 17. Controls – column 4



This solution will type the word "Hello" one second after the clock is started. Notice the code of 20 before and after the "H" key is sent to make it a capital.

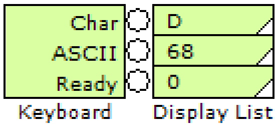
2D Keyboard

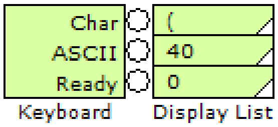
The 2D Keyboard draws a keyboard in the 2D View window. 2D – column1

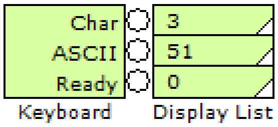


Keyboard

The Keyboard outputs the ASCII value and the character typed at the computer's keyboard.
Controls - column 4



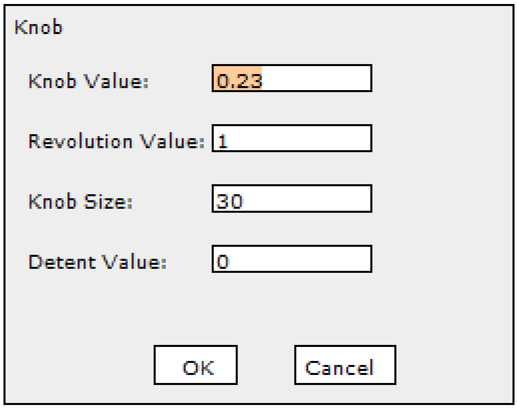




Knob

The Knob is used to create a constant value by setting the dial. You can control how much change you get from each revolution. Note: This component can be operated using the wheel on the mouse.

Controls - column 1



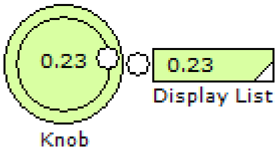
Knob

Knob Value: 0.23

Revolution Value: 1

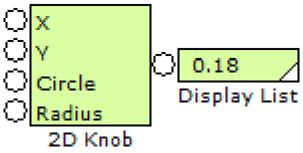
Knob Size: 30

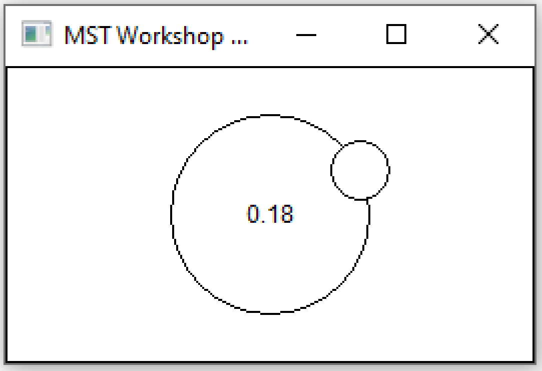
Detent Value: 0



2D Knob

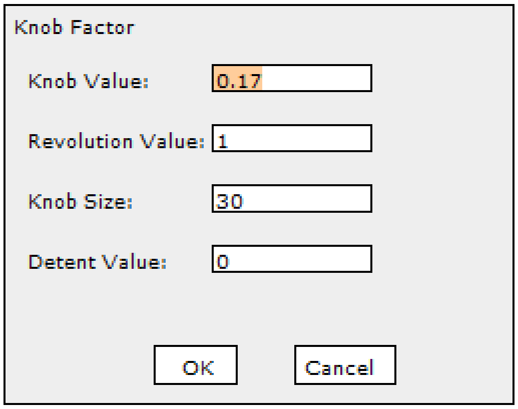
The 2D Knob is used to create a constant value by setting the dial. You can control how much change you get from each revolution.   Controls - column 1





Knob Factor

The Knob Factor multiplies the inputs by the constant in the dial. Controls - column 2



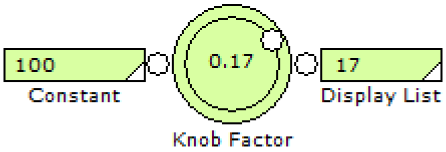
Knob Factor

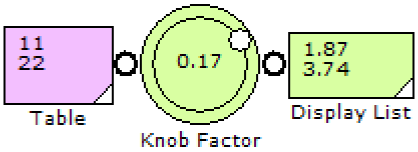
Knob Value: 0.17

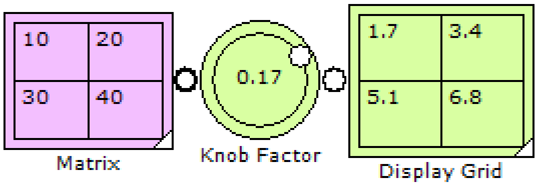
Revolution Value: 1

Knob Size: 30

Detent Value: 0





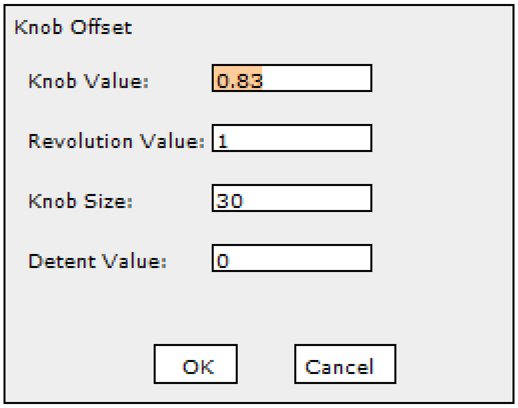


10	20
30	40

1.7	3.4
5.1	6.8

Knob Offset

The Knob Offset adds its value to each of its inputs. Controls - column 3



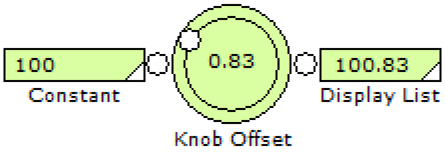
Knob Offset

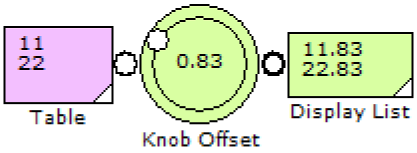
Knob Value: 0.83

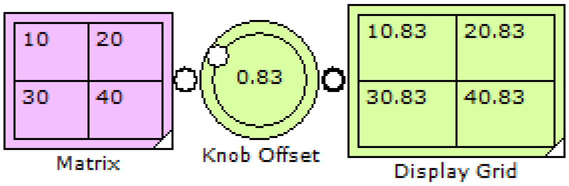
Revolution Value: 1

Knob Size: 30

Detent Value: 0

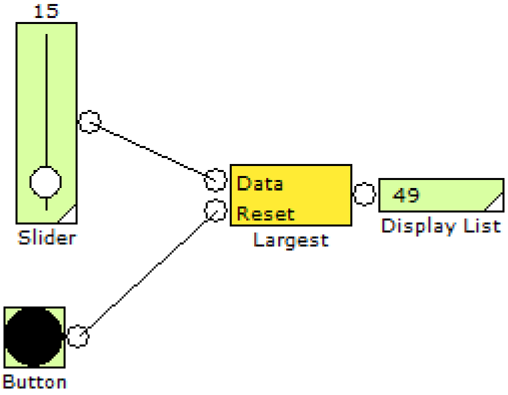






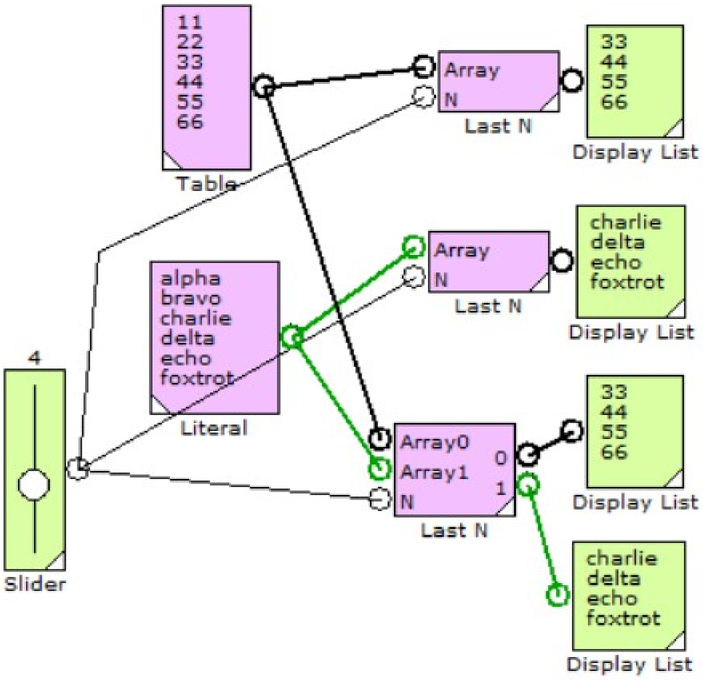
Largest

The Largest component watches the Data input and outputs the largest value since it was reset.
Functions - column 2



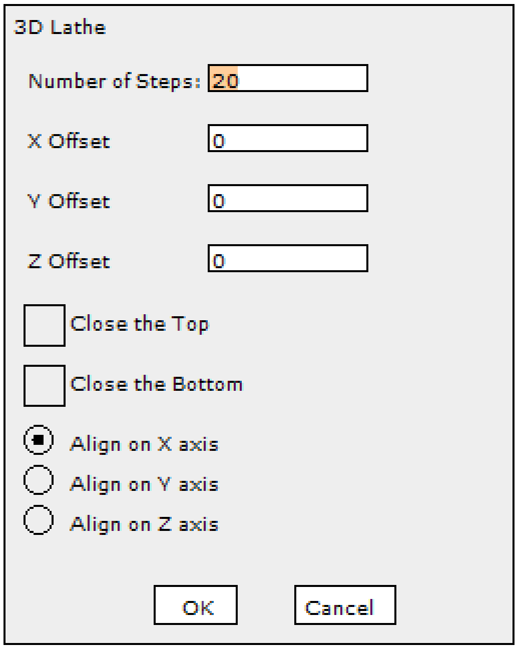
Last N

The Last N component outputs just the last few values in an array. Input the number N to indicate the number of values you want at the output.   Arrays - column 1



3D Lathe

The 3D Lathe rotates a 2D line into the 3D object. The X, Y, and Z inputs set the position and size of the object. The Affine [4x4] array input modifies the size, position and orientation. 3D - column 5



3D Lathe

Number of Steps: 20

X Offset 0

Y Offset 0

Z Offset 0

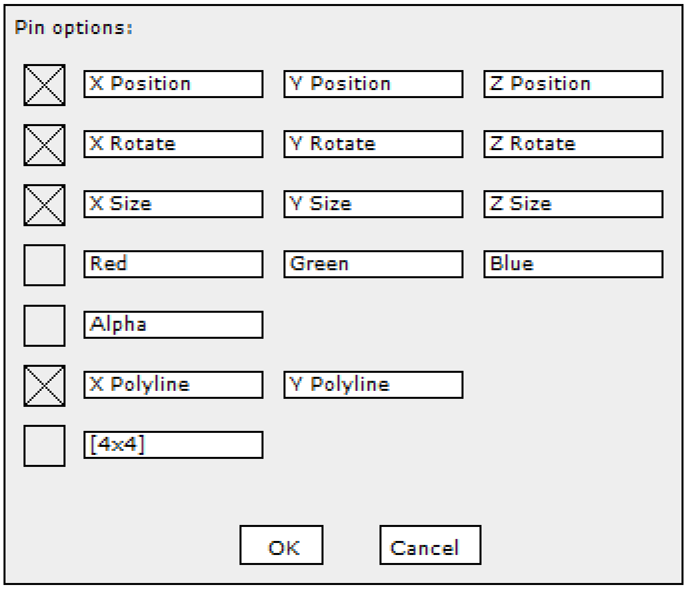
□ Close the Top

□ Close the Bottom

● Align on X axis

○ Align on Y axis

○ Align on Z axis



Pin options:

☒ X Position | Y Position | Z Position

☒ X Rotate | Y Rotate | Z Rotate

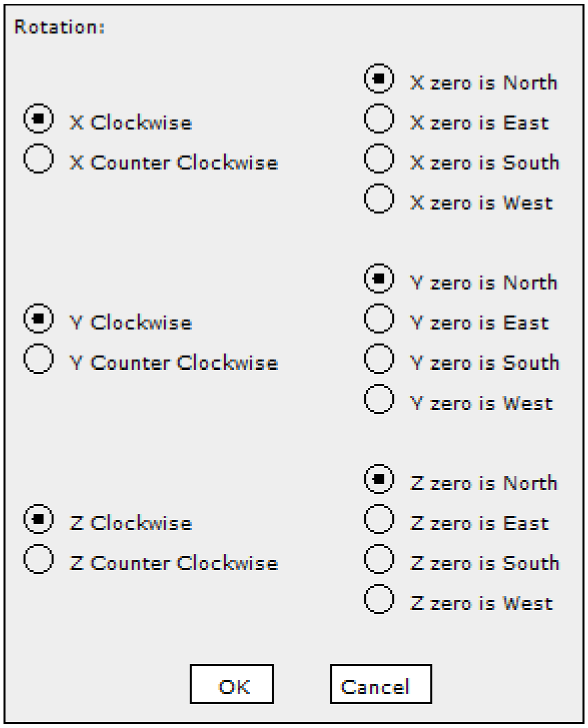
☒ X Size | Y Size | Z Size

□ Red | Green | Blue

□ Alpha

☒ X Polyline | Y Polyline

□ [4x4]



Rotation:

● X Clockwise
○ X Counter Clockwise

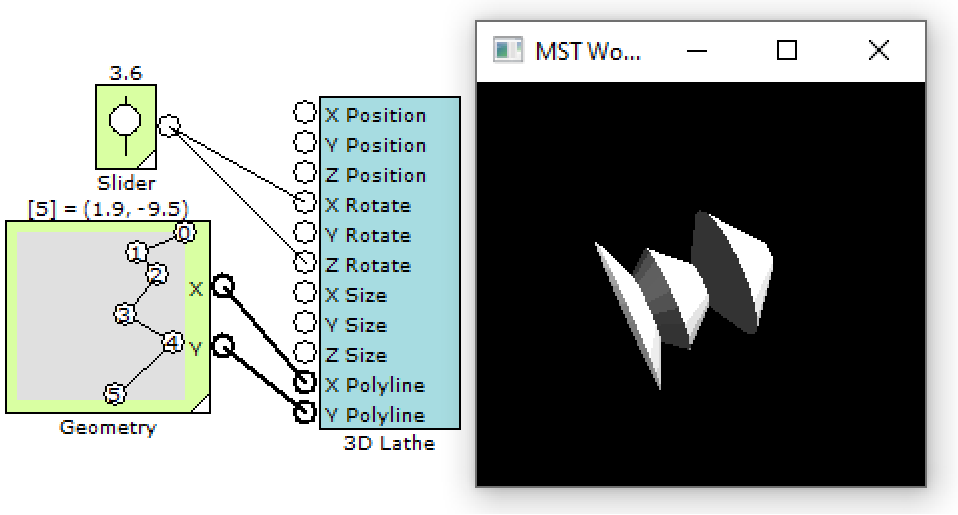
● X zero is North
○ X zero is East
○ X zero is South
○ X zero is West

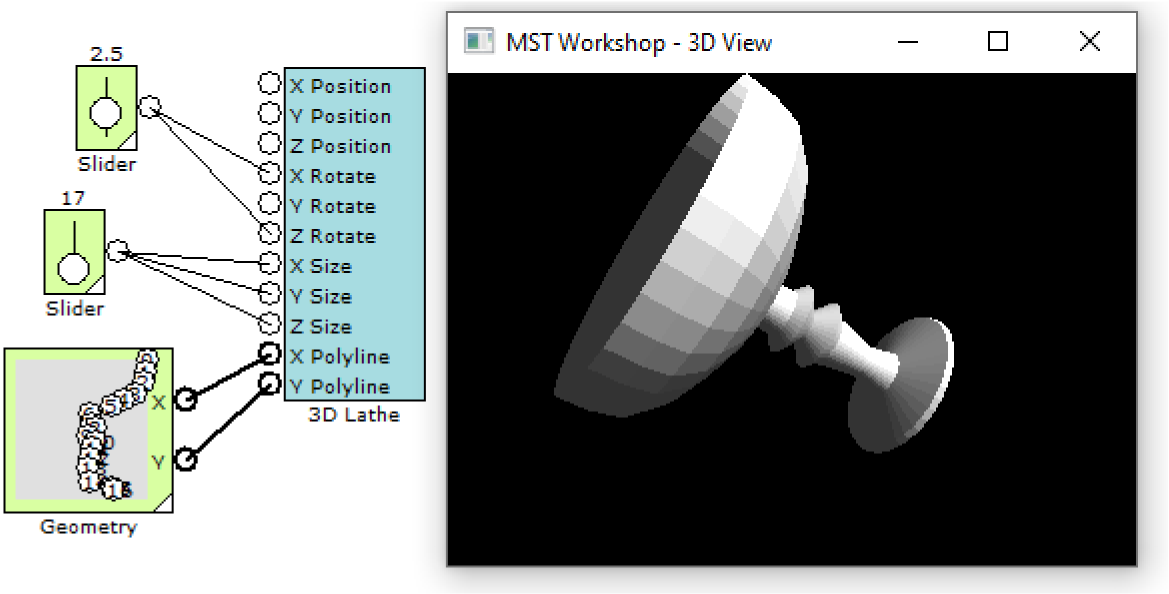
● Y Clockwise
○ Y Counter Clockwise

● Y zero is North
○ Y zero is East
○ Y zero is South
○ Y zero is West

● Z Clockwise
○ Z Counter Clockwise

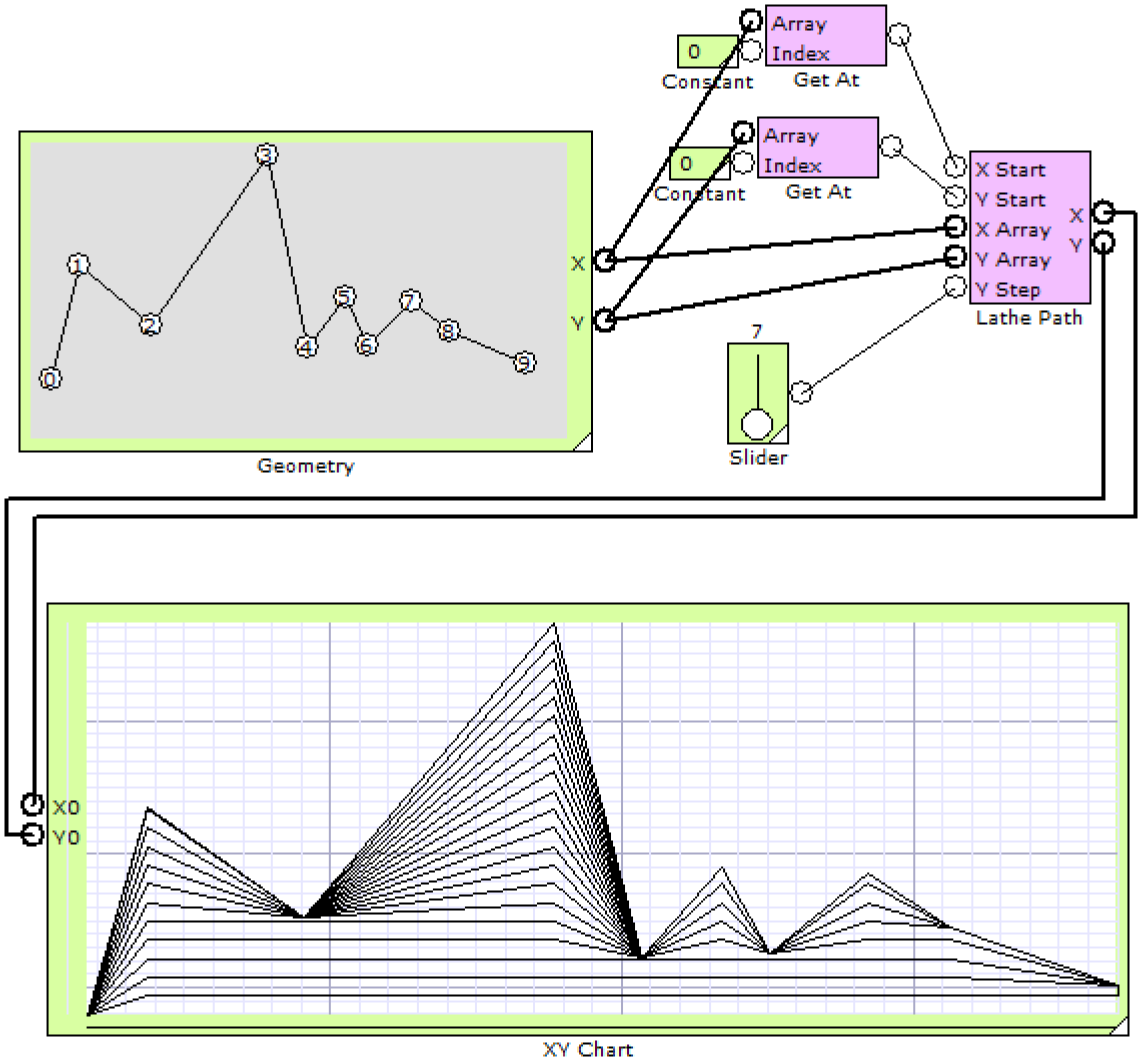
● Z zero is North
○ Z zero is East
○ Z zero is South
○ Z zero is West


3.6
Slider
[5] = (1.9, -9.5)
0
1
2
3
4
5
X
Y
Geometry
X Position
Y Position
Z Position
X Rotate
Y Rotate
Z Rotate
X Size
Y Size
Z Size
X Polyline
Y Polyline
3D Lathe
MST Wo...


2.5
Slider
17
Slider
X
Y
Geometry
X Position
Y Position
Z Position
X Rotate
Y Rotate
Z Rotate
X Size
Y Size
Z Size
X Polyline
Y Polyline
3D Lathe
MST Workshop - 3D View

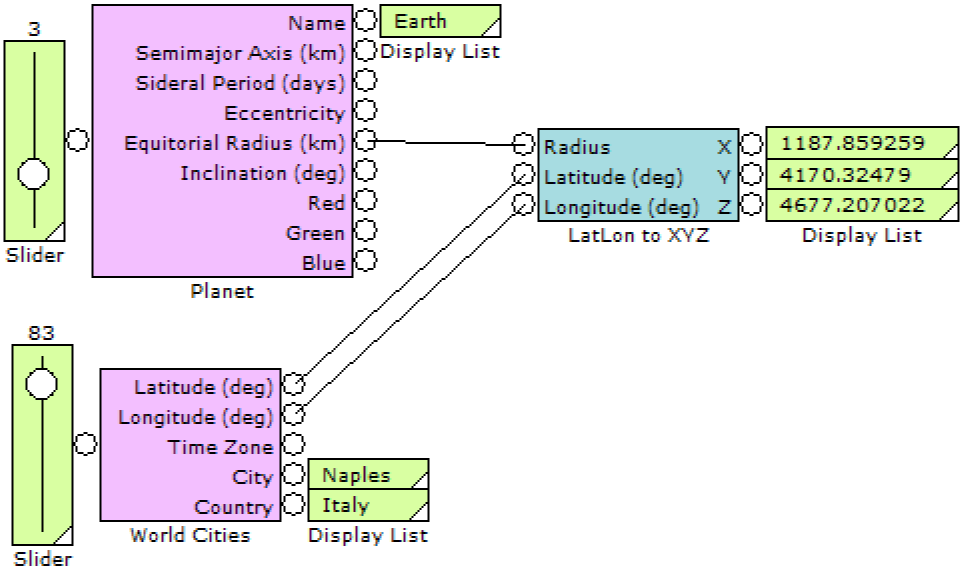
Lathe Path

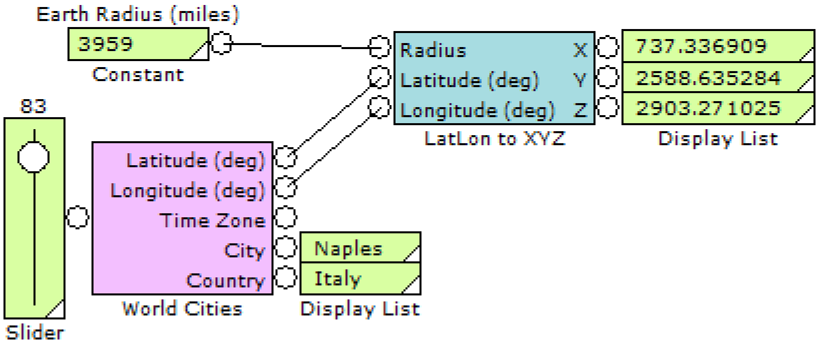
The Lathe Path component builds an array of X, Y points to guide a lathe cutter to achieve the input array.   Arrays - column 7



LatLon to XYZ

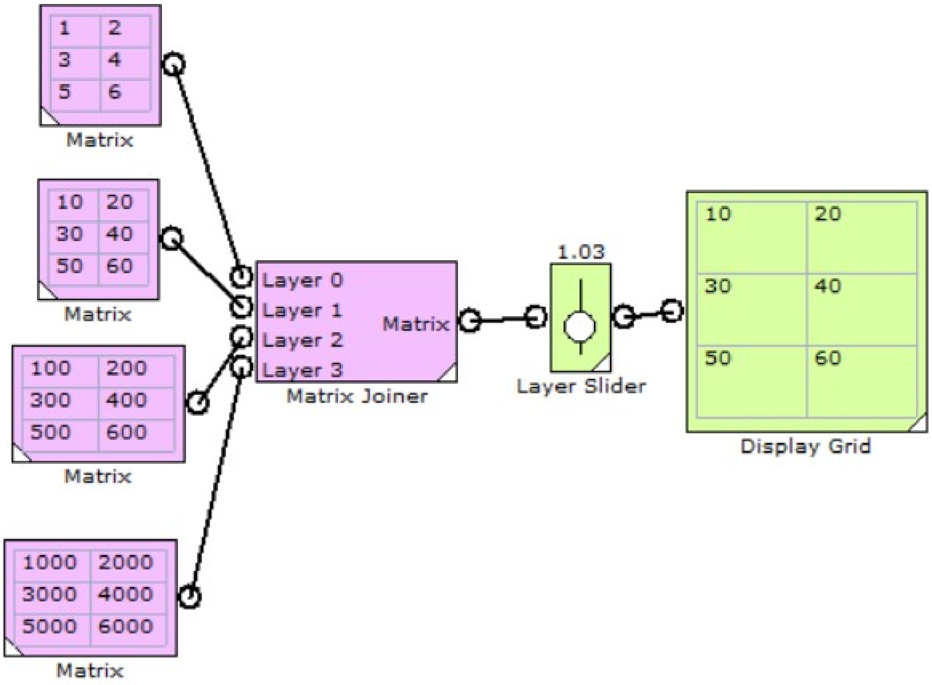
The LatLon to XYZ component takes a Radius, Latitude, and Longitude then returns an X, Y, and Z coordinate.   3D - column 6





Layer Slider

The Layer Slider component selects one layer from a 3D array of values and outputs a 2D Matrix of that layer. Controls – column 2.



1	2
3	4
5	6

10	20
30	40
50	60

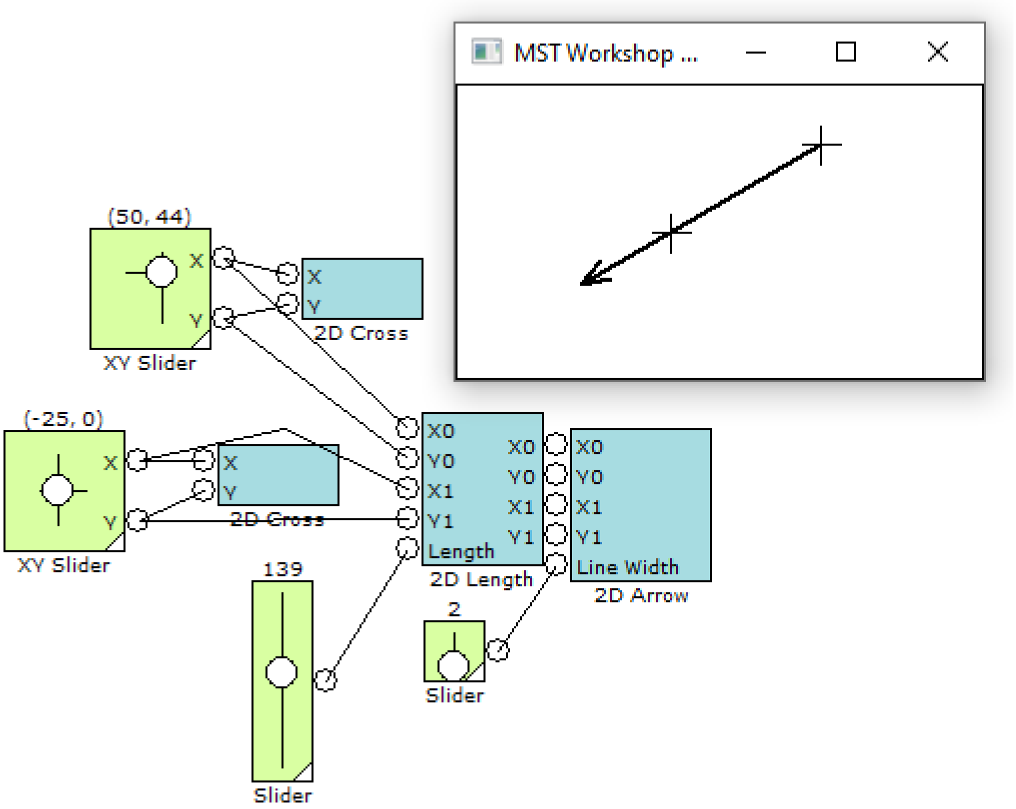
100	200
300	400
500	600

1000	2000
3000	4000
5000	6000

10	20
30	40
50	60

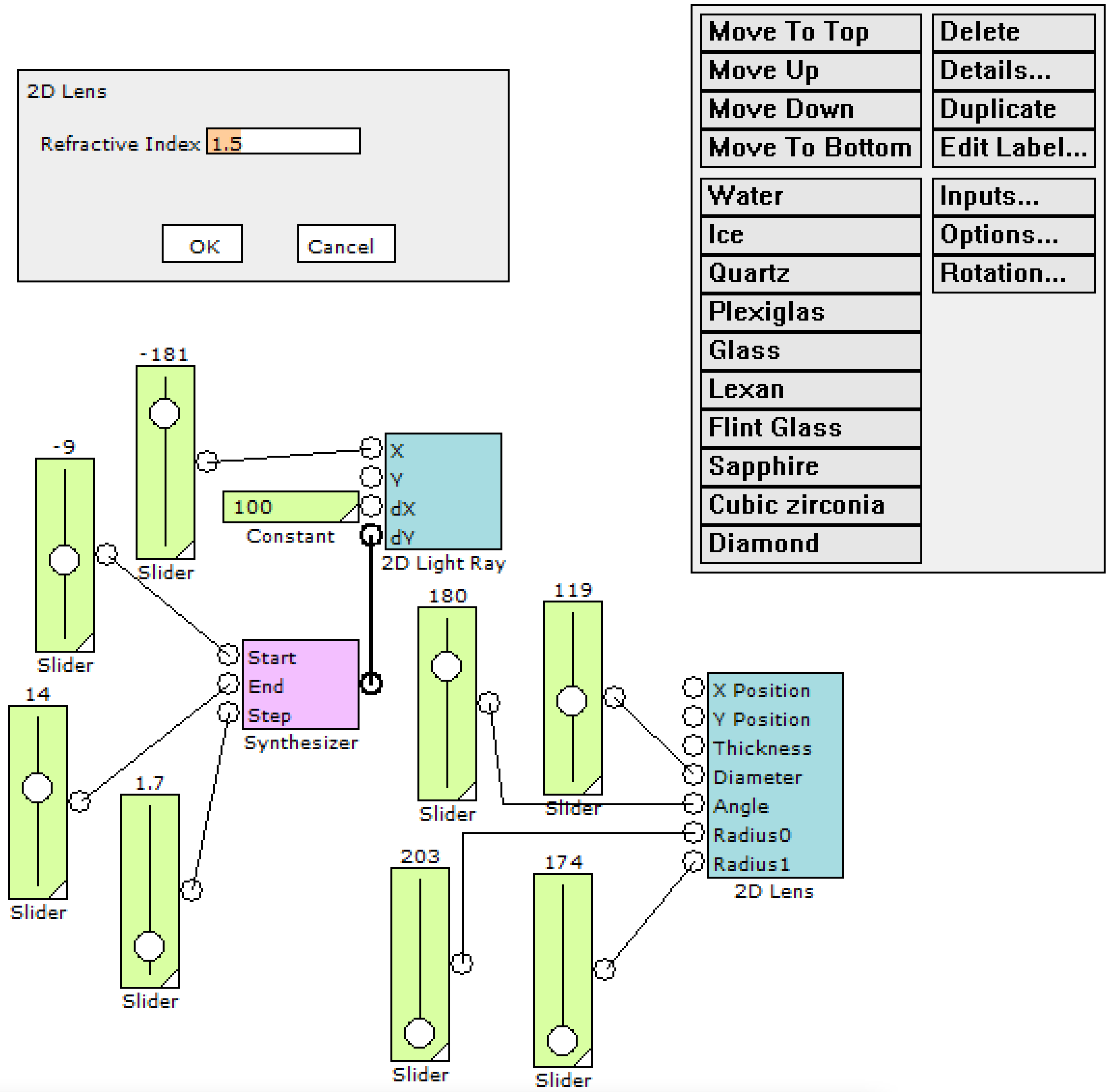
2D Length

The 2D Length component takes a vector begin and end coordinates with a length and outputs vector begin and end coordinates of that length.   2D - column 2



2D Lens

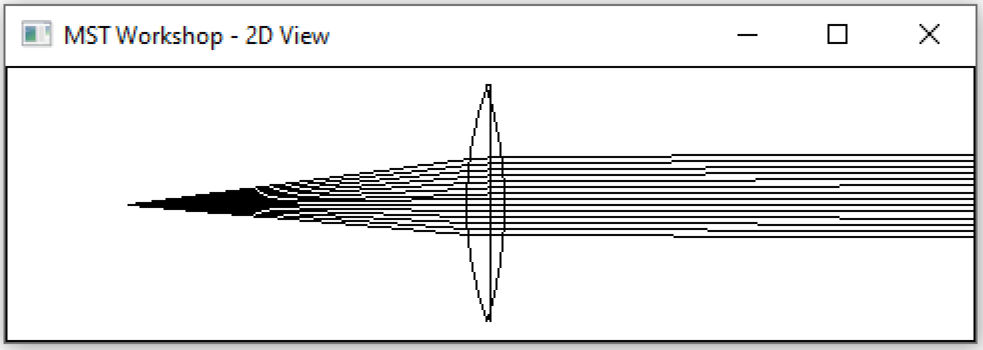
The 2D Lens component bends light rays in the 2D view window. The settings determine how the ray progresses through the lens.   2D - column 3



2D Lens

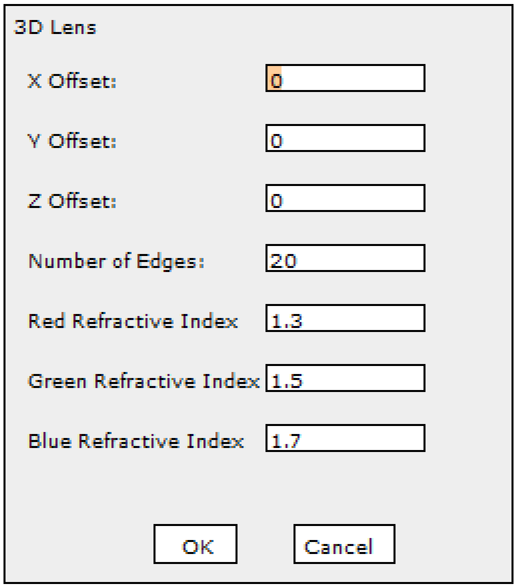
Refractive Index 1.5

OK Cancel



3D Lens

The 3D Lens component bends light rays in the 3D view window. The settings determine how the ray progresses through the lens. The Affine [4x4] array input modifies the size, position and orientation of the lens.   3D - column 5



3D Lens

X Offset: 0

Y Offset: 0

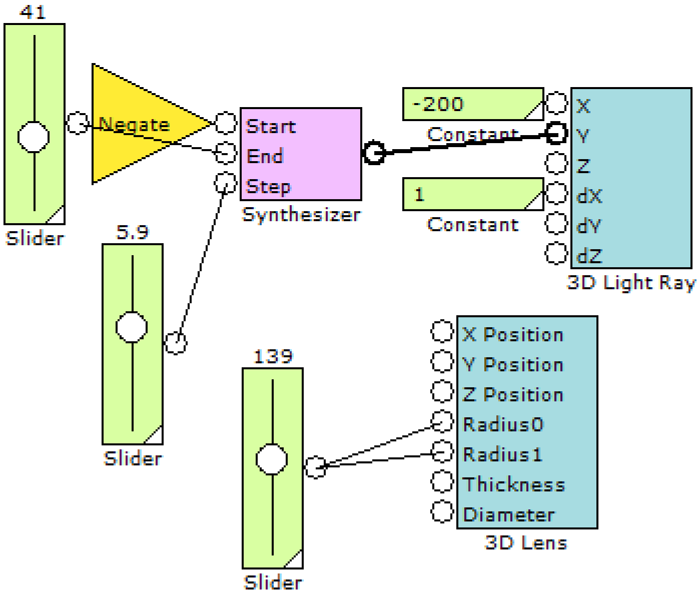
Z Offset: 0

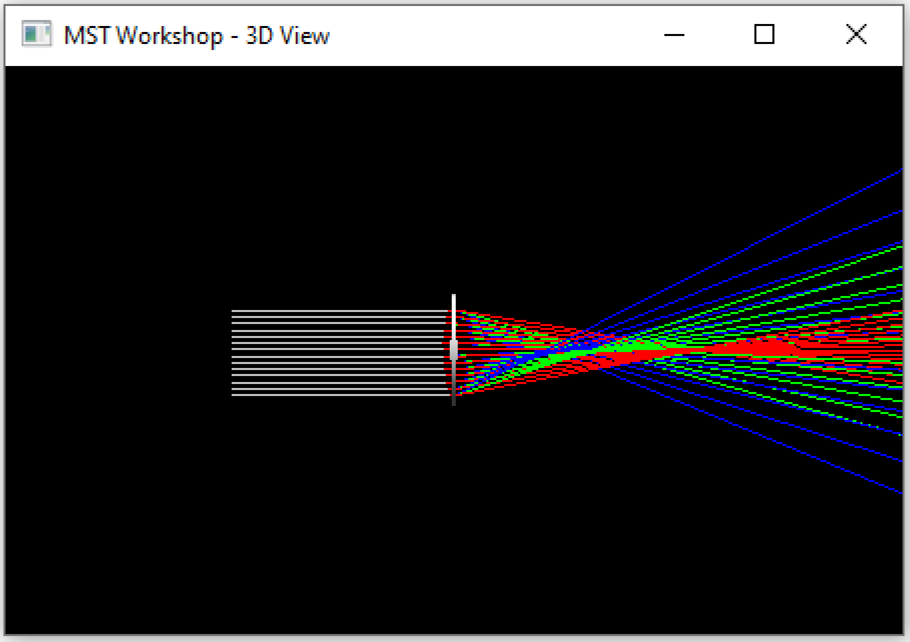
Number of Edges: 20

Red Refractive Index 1.3

Green Refractive Index 1.5

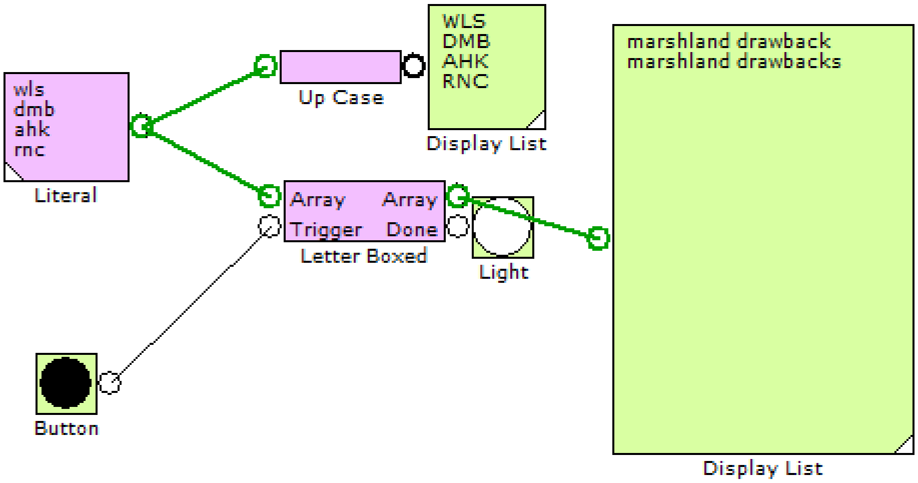
Blue Refractive Index 1.7





Letter Boxed

The Letter Boxed solves the Letter Boxed puzzle. Input a string array of characters for each side of the puzzle. The array can be 4 lines of 3 characters each. Set Trigger to true to solve the puzzle.



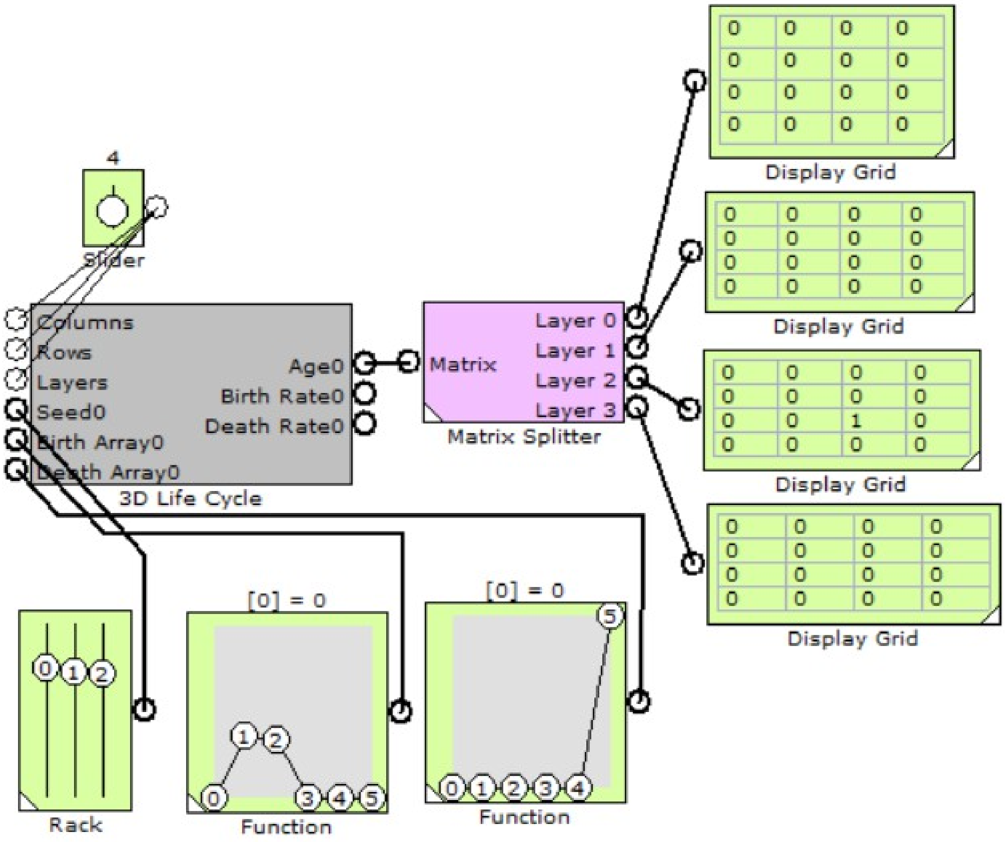
```
wls
dmb
ahk
rnc
```

```
WLS
DMB
AHK
RNC
```

```
marshland drawback
marshland drawbacks
```

3D Life Cycle

The 3D Life Cycle component creates a 3D array of potential life forces. Birth, growth and death proceed based on the input parameters. Arrays – column 2



0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

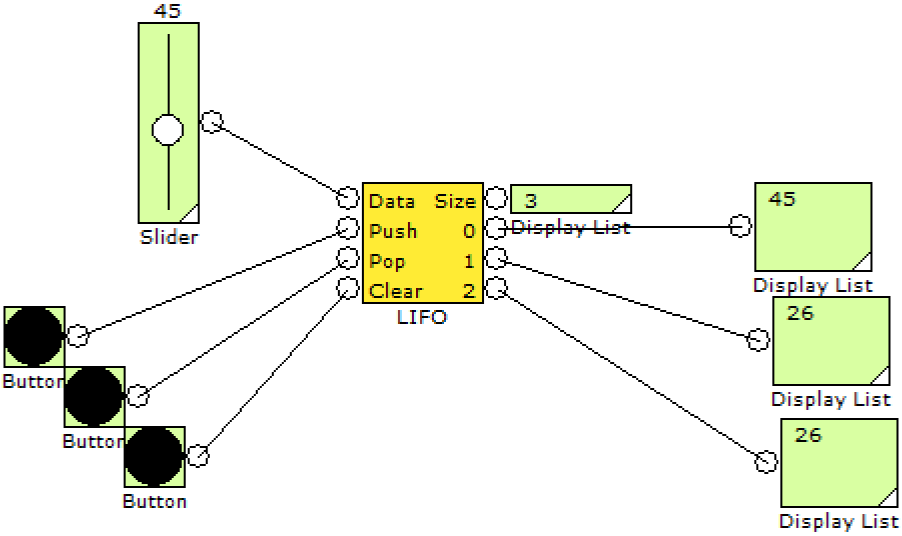
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

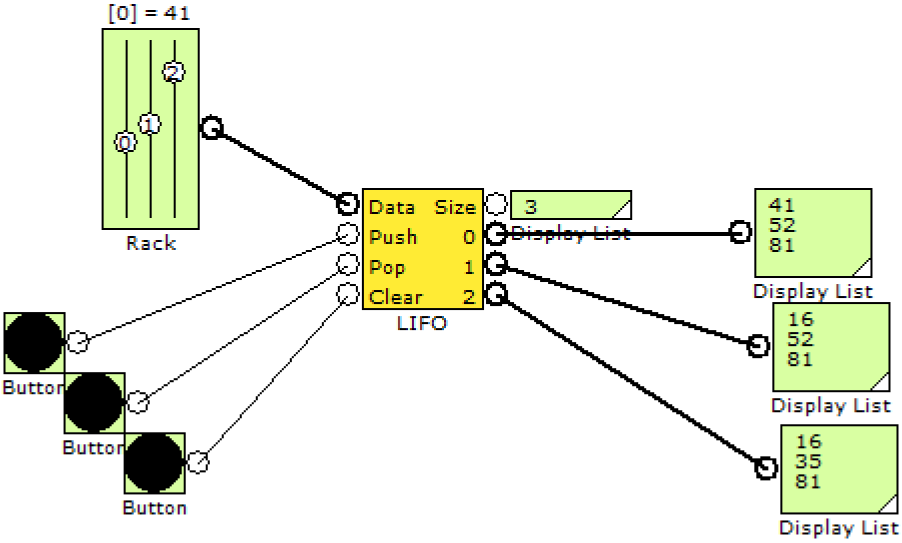
0	0	0	0
0	0	0	0
0	0	1	0
0	0	0	0

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

LIFO

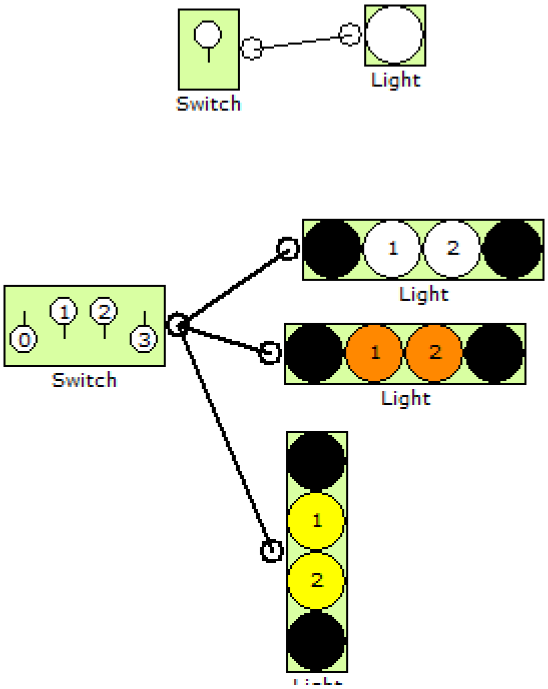
The LIFO component stores data each time the in clock goes true. The output changes when the out clock goes true. Functions - column 4





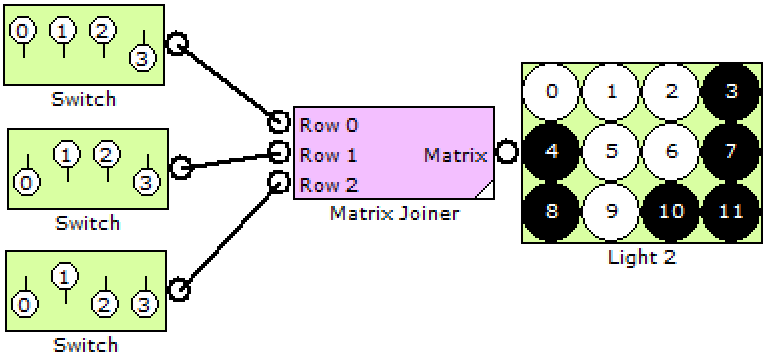
Light

The Light goes on when the input is not zero or logic true. Controls - column 4



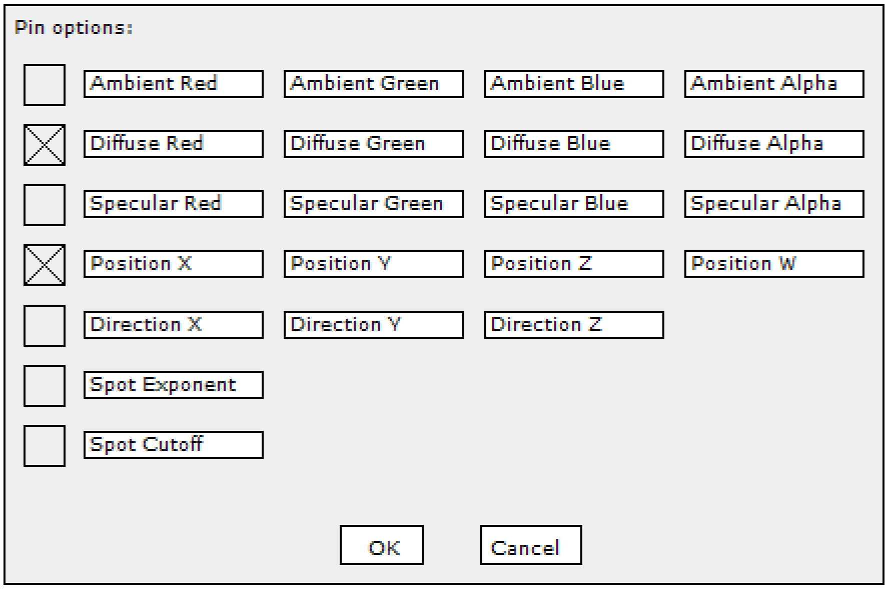
Light 2

The Light 2 goes on when the input is not zero or logic true.   Controls - column 4



3D Light

The 3D Light controls various aspects of lighting in the 3D view window. The X, Y, and Z inputs set the position or direction of various aspects of the light. The Affine [4x4] array input modifies the position.   3D - column 5



Pin options:

□ Ambient Red | Ambient Green | Ambient Blue | Ambient Alpha

☒ Diffuse Red | Diffuse Green | Diffuse Blue | Diffuse Alpha

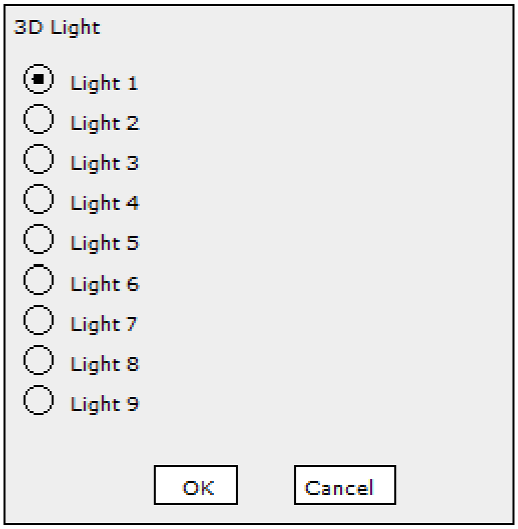
□ Specular Red | Specular Green | Specular Blue | Specular Alpha

☒ Position X | Position Y | Position Z | Position W

□ Direction X | Direction Y | Direction Z

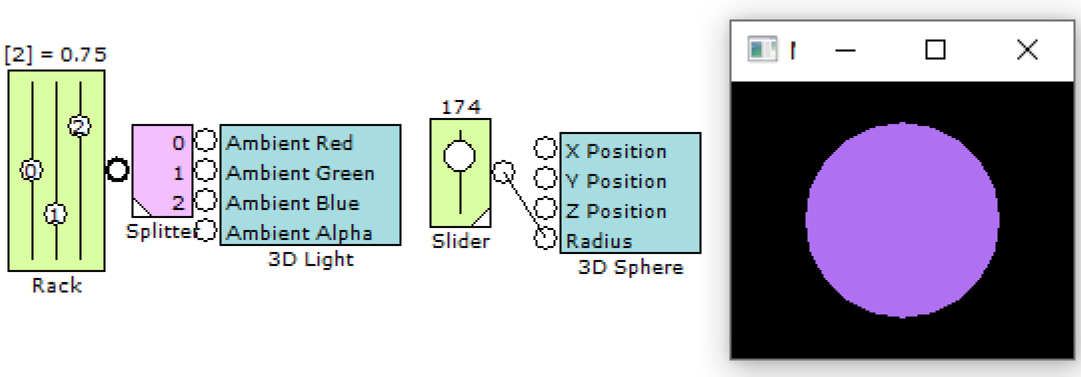
□ Spot Exponent

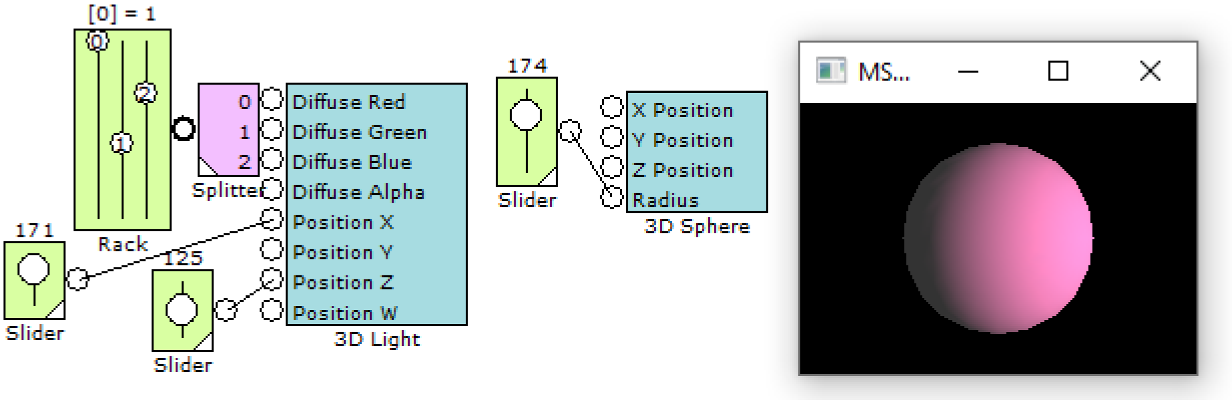
□ Spot Cutoff



3D Light

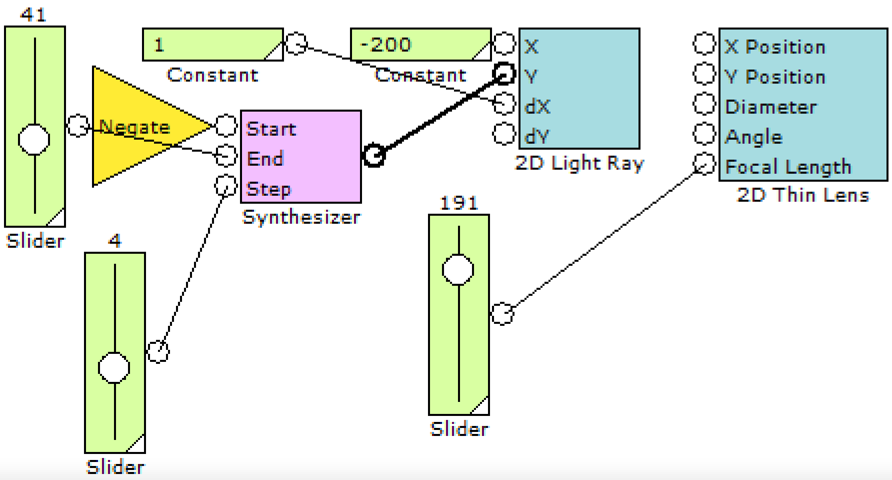
● Light 1
○ Light 2
○ Light 3
○ Light 4
○ Light 5
○ Light 6
○ Light 7
○ Light 8
○ Light 9

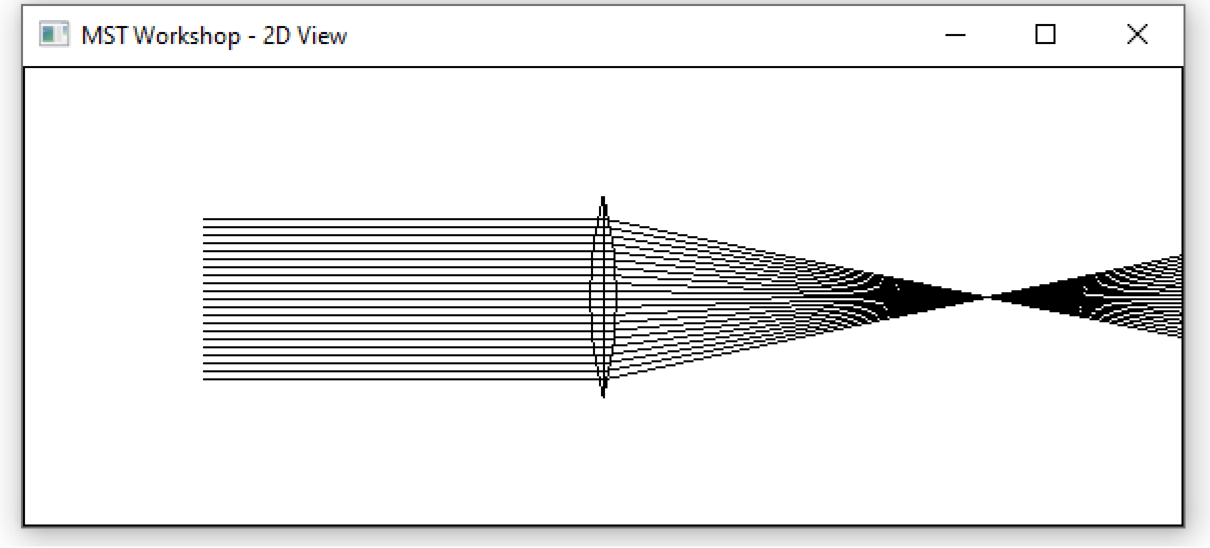

[2] = 0.75
0
1
2
Rack
0
1
2
Splitter
Ambient Red
Ambient Green
Ambient Blue
Ambient Alpha
3D Light
174
Slider
X Position
Y Position
Z Position
Radius
3D Sphere


[0] = 1
0
1
2
Rack
0
1
2
Splitter
Diffuse Red
Diffuse Green
Diffuse Blue
Diffuse Alpha
Position X
Position Y
Position Z
Position W
3D Light
171
Slider
125
Slider
174
Slider
X Position
Y Position
Z Position
Radius
3D Sphere
MS...

2D Light Ray

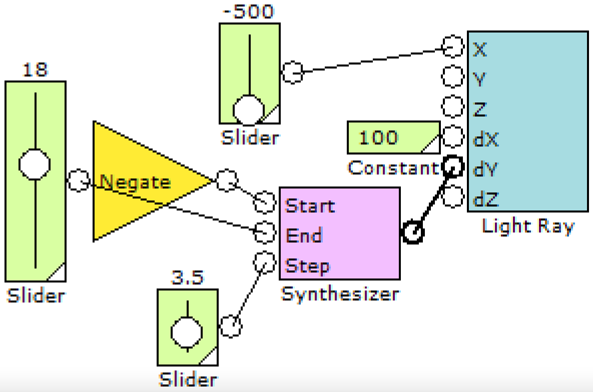
The 2D Light Ray component draws a ray of light in the 3D view window. The origin and direction determine how the ray progresses through the lenses.   2D - column 3

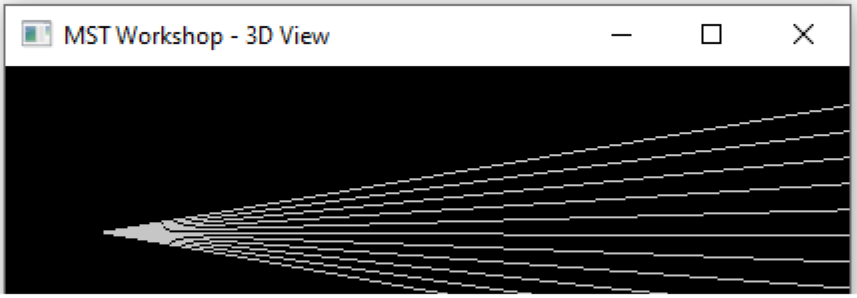


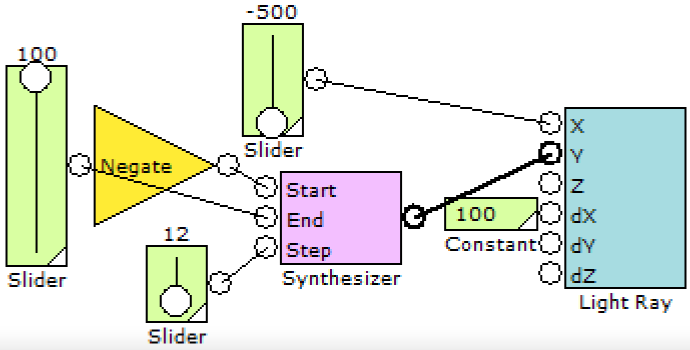


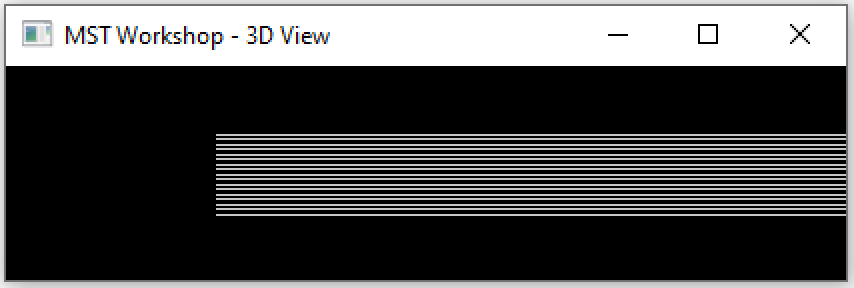
3D Light Ray

The 3D Light Ray component draws a ray of light in the 3D view window. The origin and direction determine how the ray progresses through the lenses. The Affine [4x4] array input modifies the size, position and orientation of the ray.   3D - column 5



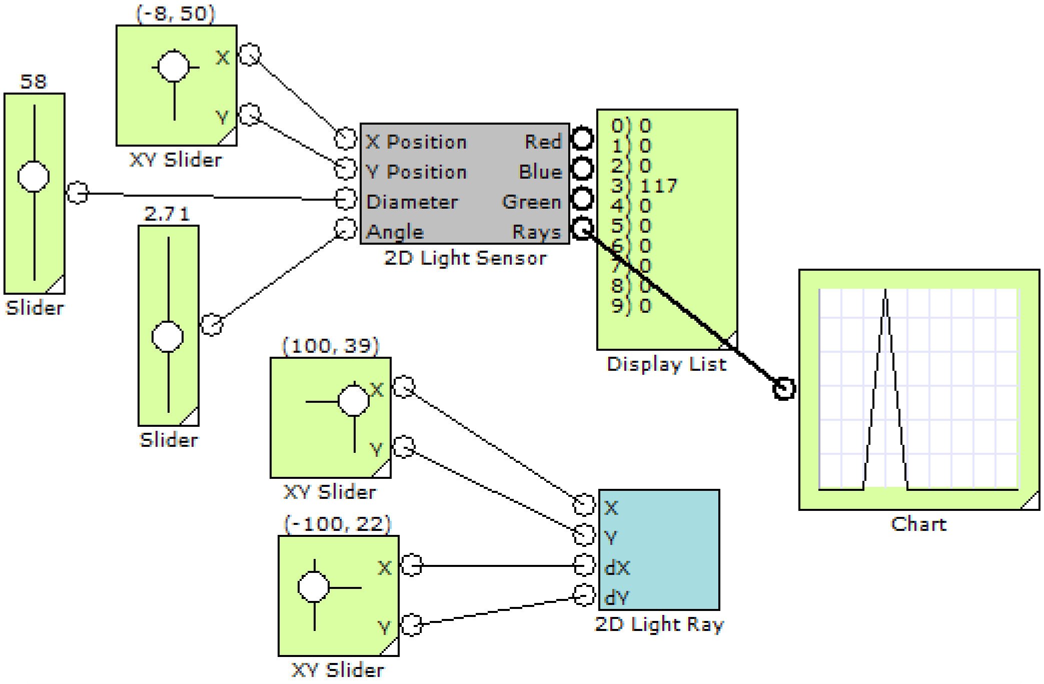


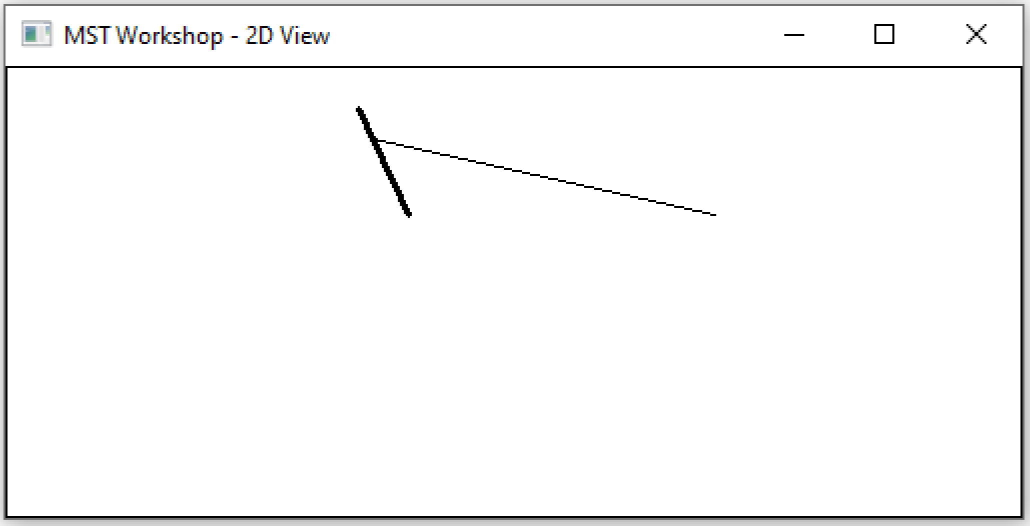




2D Light Sensor

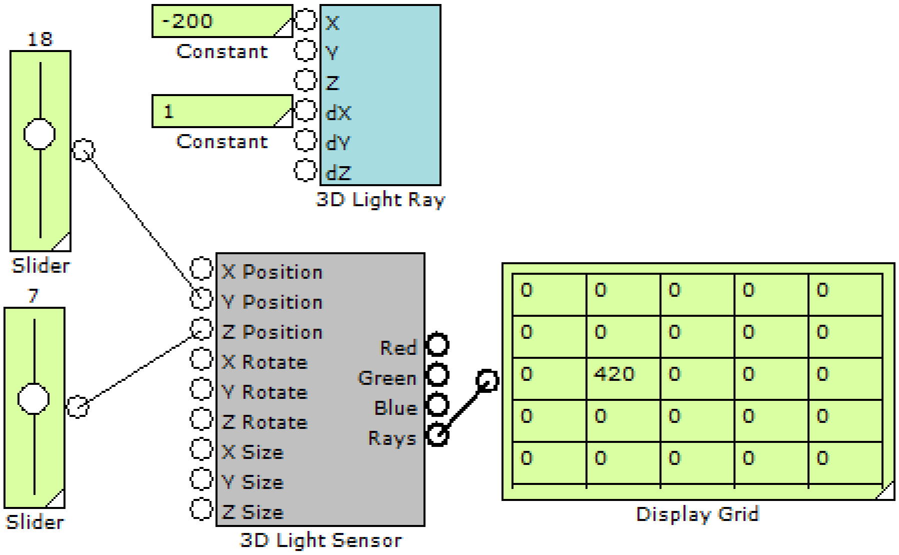
The 2D Light Sensor component collects rays of light in the 2D view window. The origin and direction controls the placement of the sensor. 2D - column 3



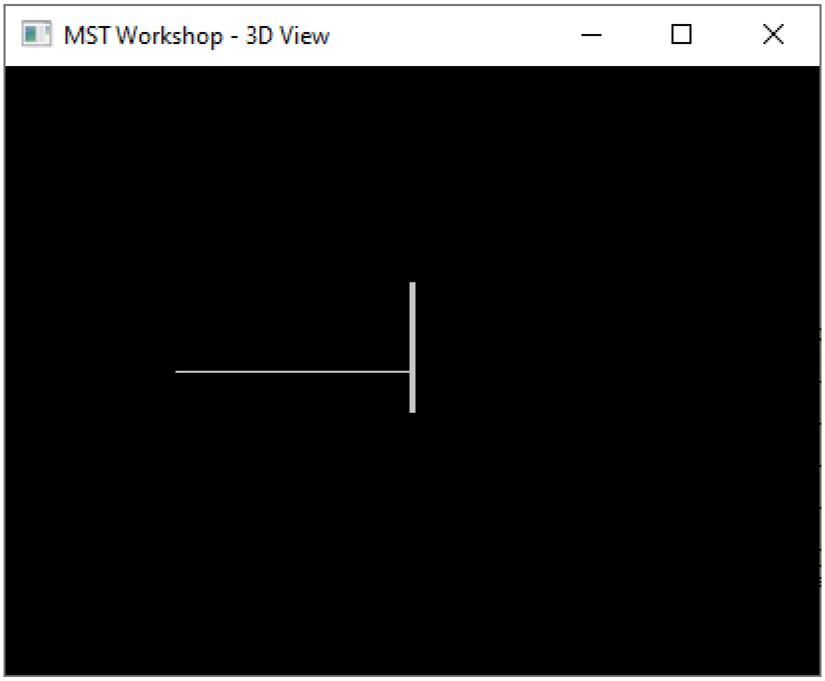


3D Light Sensor

The 3D Light Sensor component collects rays of light in the 3D view window. The origin and direction controls the placement of the sensor. The Affine [4x4] array input modifies the size, position and orientation of the collector. 3D - column 3

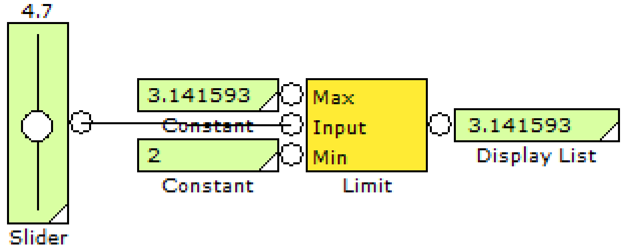


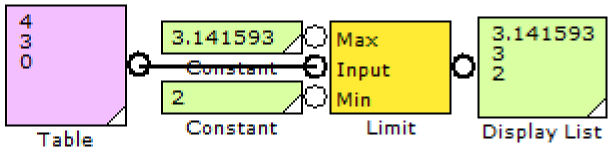
0	0	0	0	0
0	0	0	0	0
0	420	0	0	0
0	0	0	0	0
0	0	0	0	0



Limit

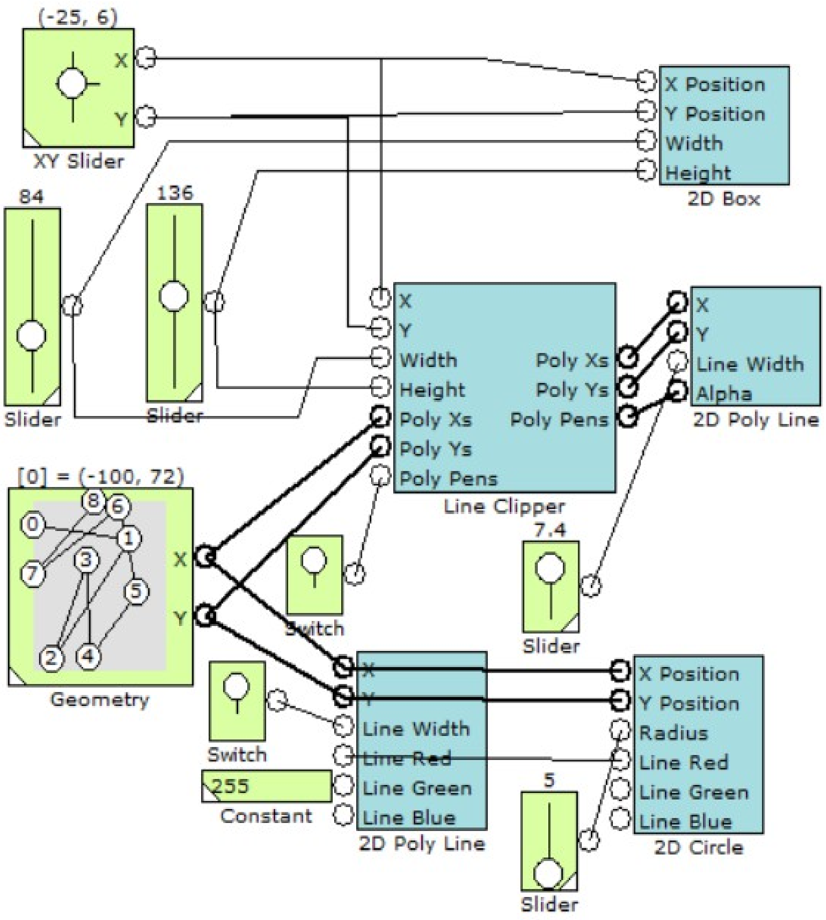
The Limit component limits the output to between the Max and Min values. Functions - column 2

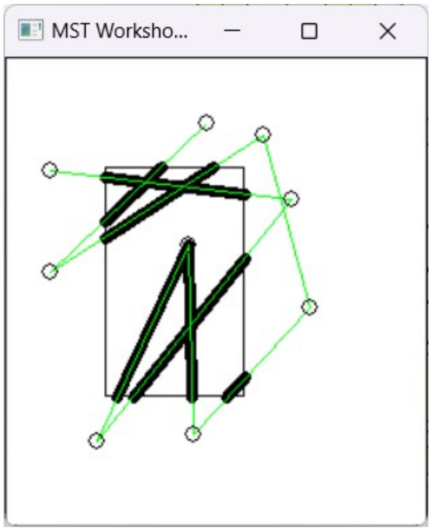




Line Clipper

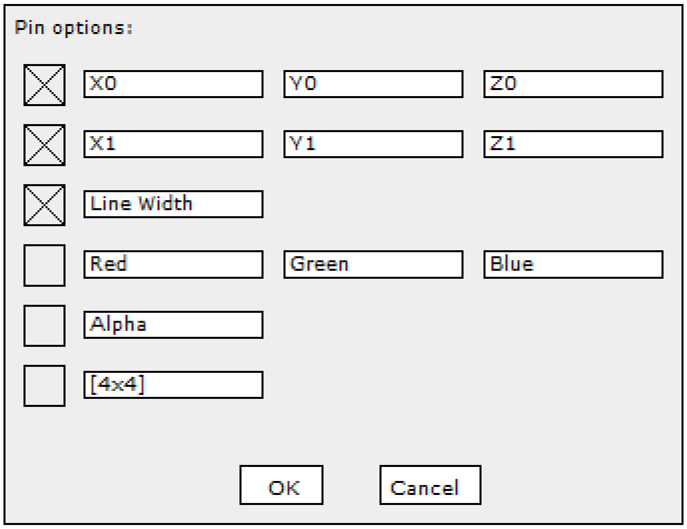
The Line Clipper component clips the input lines to fit exactly in the given rectangle. 2D – column 2





3D Line

The 3D Line Segment component draws multiple lines in the 3D view window. The X, Y, and Z inputs set the start and end points. The Affine [4x4] array input modifies the size, position and orientation.
3D - column 4



Pin options:

☒ X0 Y0 Z0

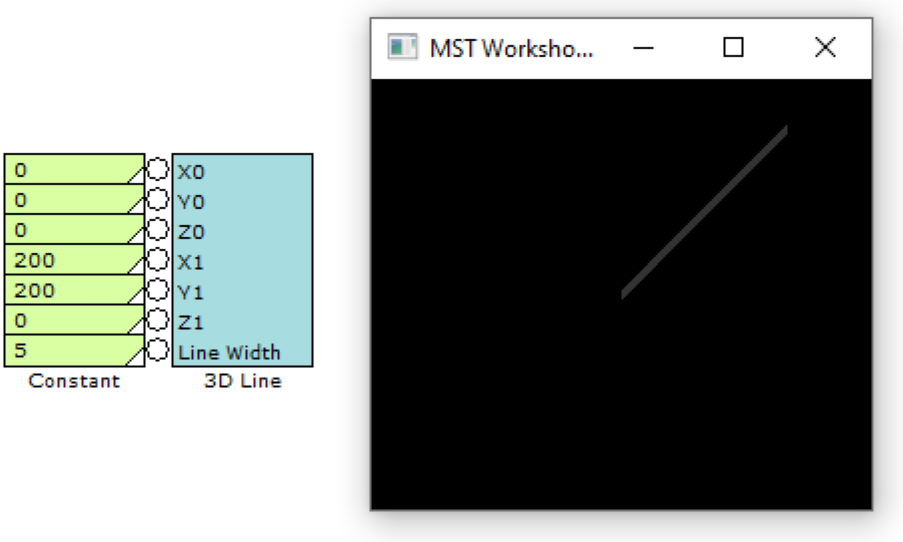
☒ X1 Y1 Z1

☒ Line Width

□ Red Green Blue

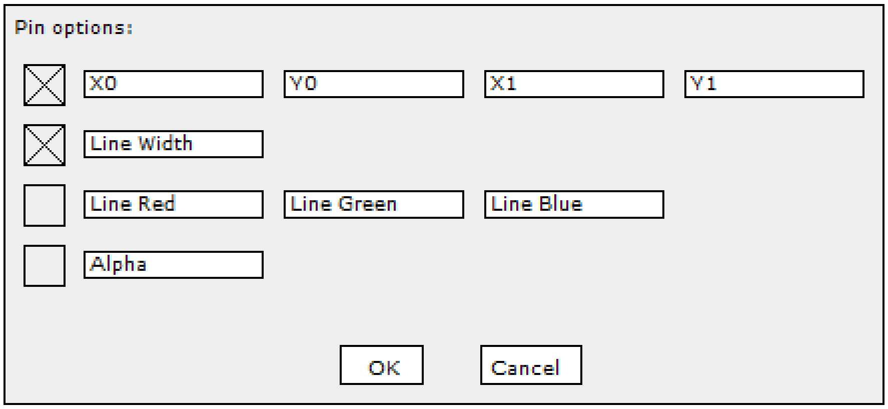
□ Alpha

□ [4x4]



2D Line Segment

The 2D Line Segment component draws one or more line segments on the 2D canvas.   2D - column 1



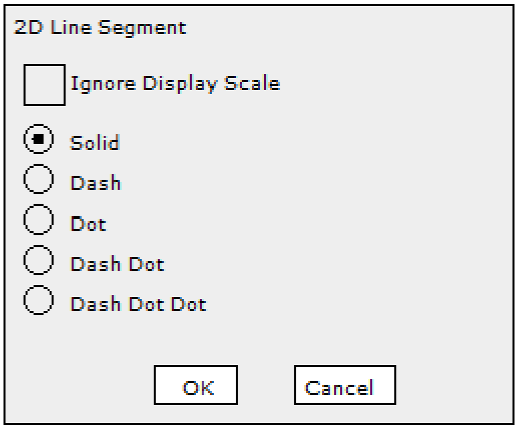
Pin options:

☒ X0 Y0 X1 Y1

☒ Line Width

□ Line Red Line Green Line Blue

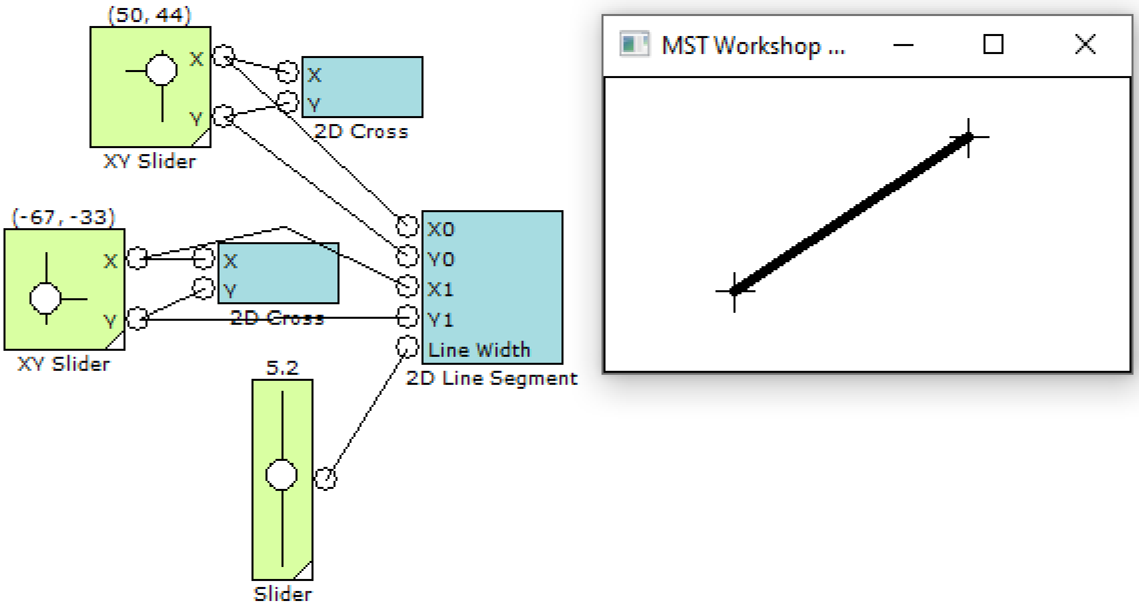
□ Alpha



2D Line Segment

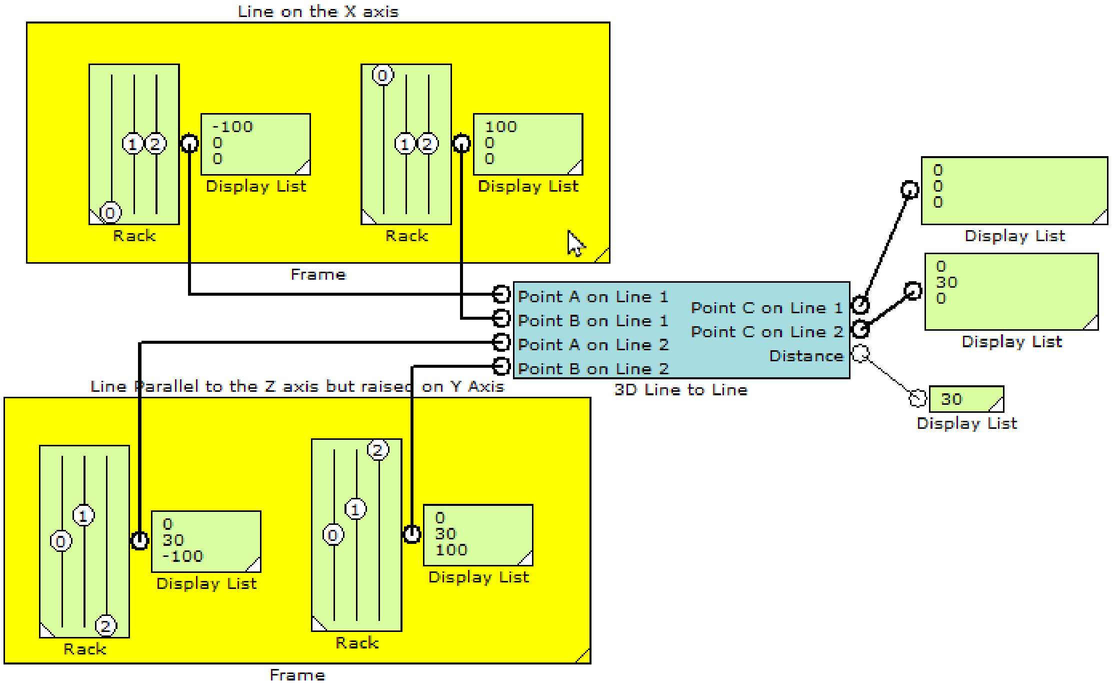
□ Ignore Display Scale

● Solid
○ Dash
○ Dot
○ Dash Dot
○ Dash Dot Dot



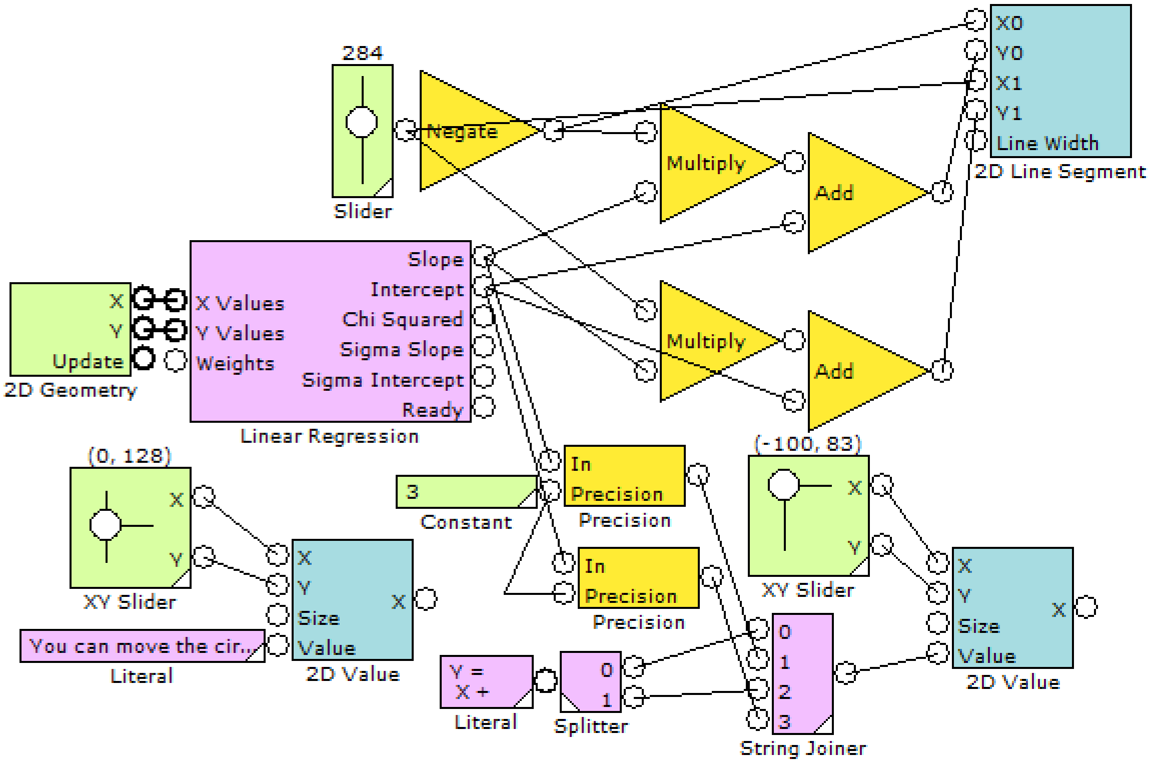
3D Line to Line

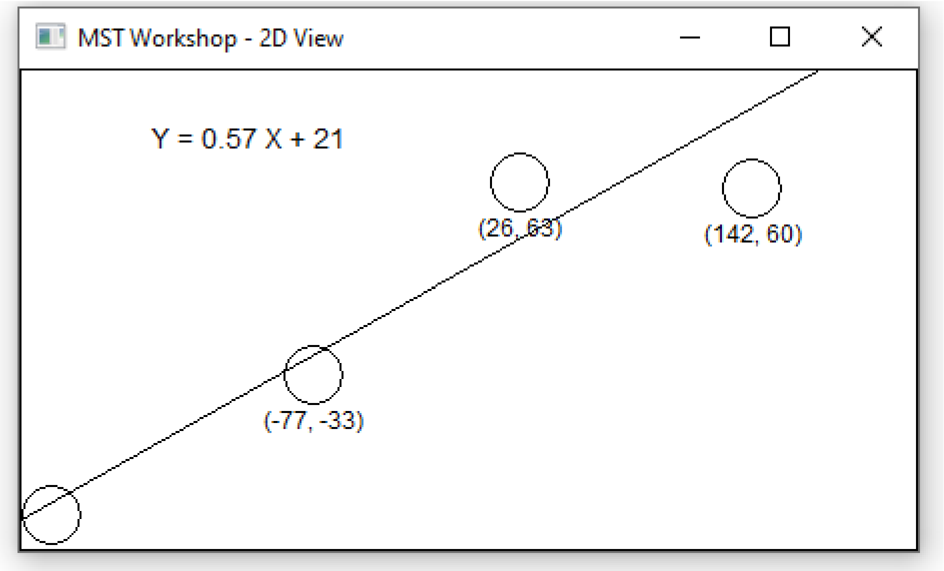
The 3D Line to Line component calculates the distance from a line to another line. It also returns the closest points on each line. 3D - column 2



Linear Regression

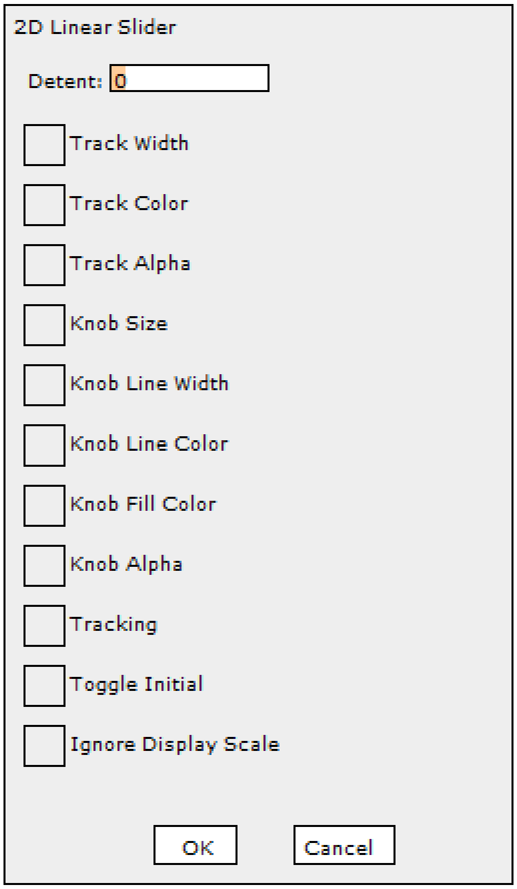
The Linear Regression component calculates a linear fit to the input data. Arrays - column 5





2D Linear Slider

The 2D Linear Slider outputs a number based on its dial(s) position(s). Controls - column 2



2D Linear Slider

Detent: 0

□ Track Width

□ Track Color

□ Track Alpha

□ Knob Size

□ Knob Line Width

□ Knob Line Color

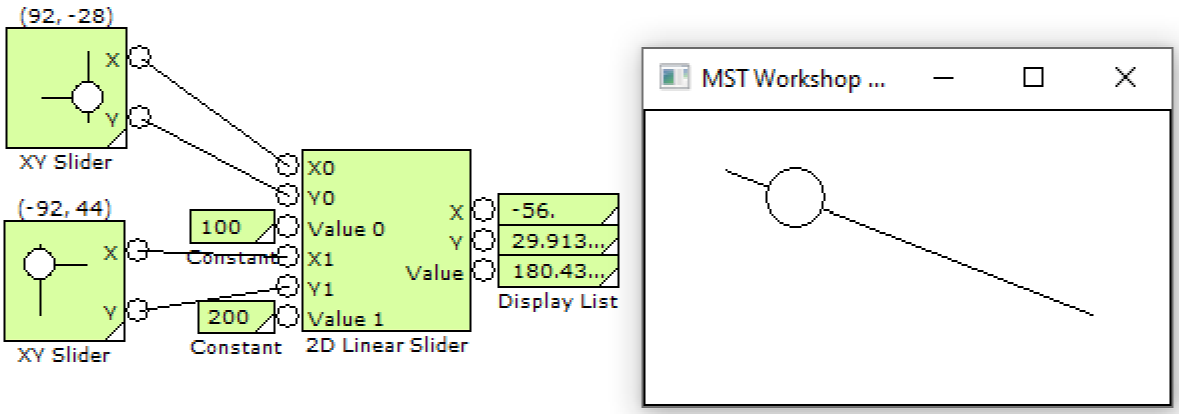
□ Knob Fill Color

□ Knob Alpha

□ Tracking

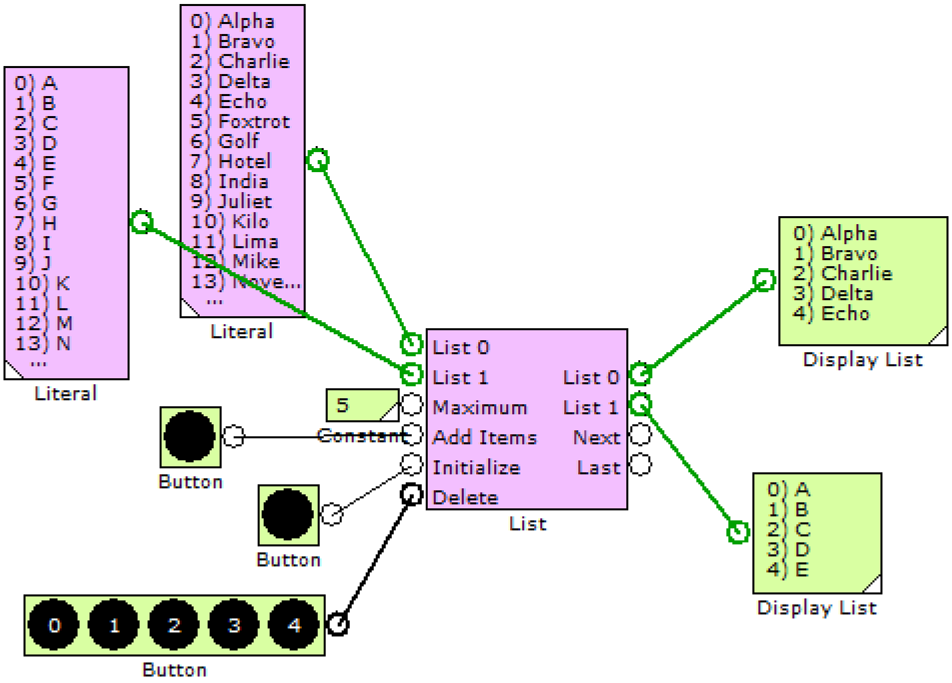
□ Toggle Initial

□ Ignore Display Scale



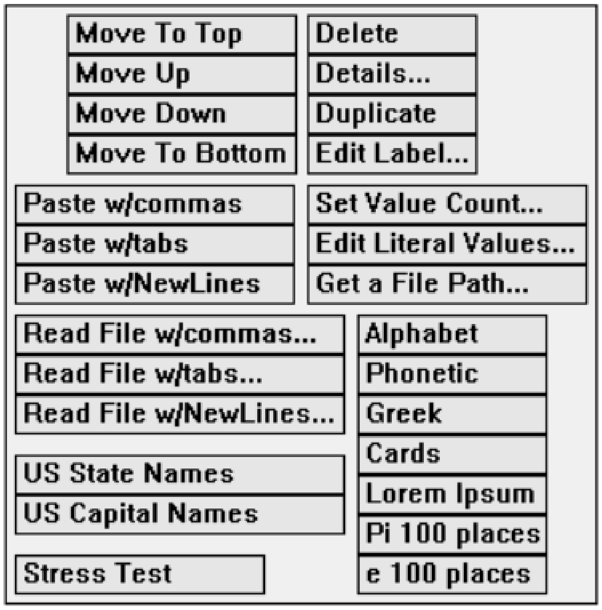
List

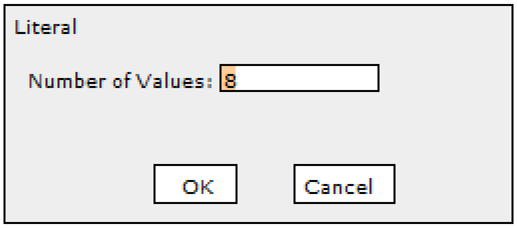
The List component lets you process lists starting at the beginning of the list. Input one or more lists and they will be output when the Initialize input is triggered. You can restrict the number of items output using the Maximum input. Enable the Add Items input to refill the list after some are deleted. The Delete input indicates by a boolean array which items to delete.   Arrays - column 1



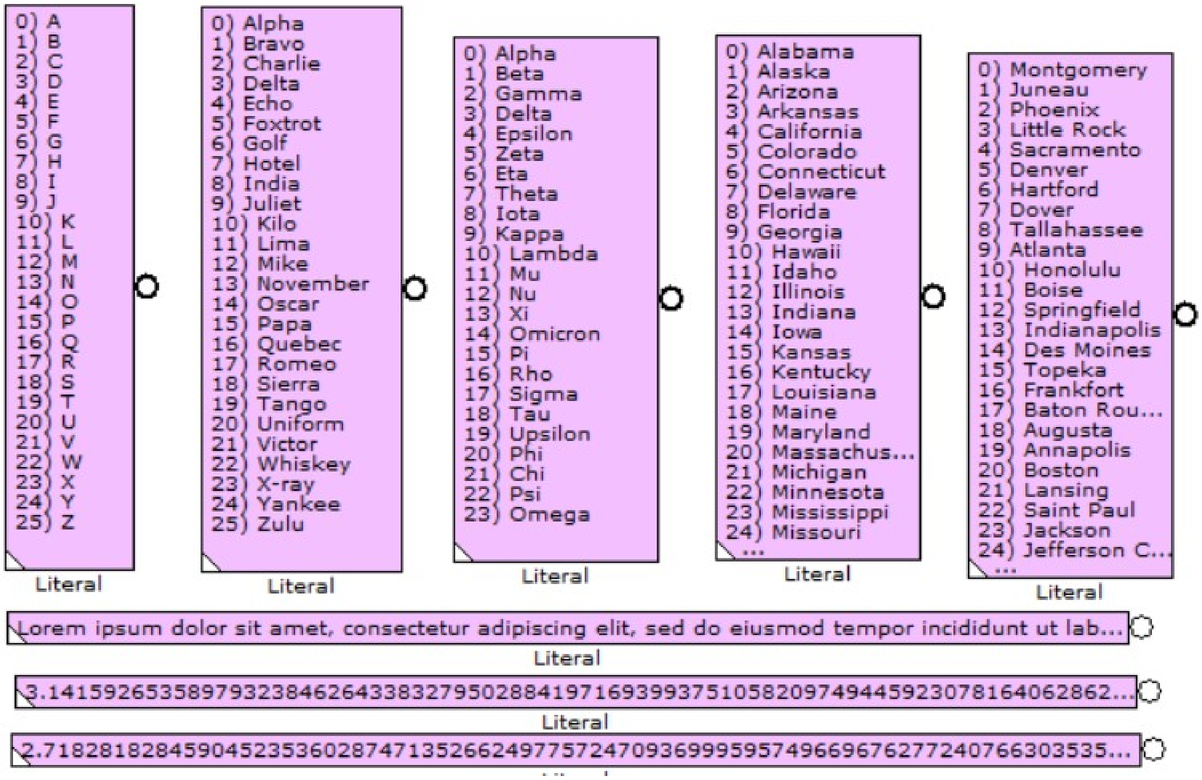
Literal

The Literal component lets you create a list of text strings. Arrays - column 6




Literal

Number of Values: 8


0) A
1) B
2) C
3) D
4) E
5) F
6) G
7) H
8) I
9) J
10) K
11) L
12) M
13) N
14) O
15) P
16) Q
17) R
18) S
19) T
20) U
21) V
22) W
23) X
24) Y
25) Z

Literal

0) Alpha
1) Bravo
2) Charlie
3) Delta
4) Echo
5) Foxtrot
6) Golf
7) Hotel
8) India
9) Juliet
10) Kilo
11) Lima
12) Mike
13) November
14) Oscar
15) Papa
16) Quebec
17) Romeo
18) Sierra
19) Tango
20) Uniform
21) Victor
22) Whiskey
23) X-ray
24) Yankee
25) Zulu

Literal

0) Alpha
1) Beta
2) Gamma
3) Delta
4) Epsilon
5) Zeta
6) Eta
7) Theta
8) Iota
9) Kappa
10) Lambda
11) Mu
12) Nu
13) Xi
14) Omicron
15) Pi
16) Rho
17) Sigma
18) Tau
19) Upsilon
20) Phi
21) Chi
22) Psi
23) Omega

Literal

0) Alabama
1) Alaska
2) Arizona
3) Arkansas
4) California
5) Colorado
6) Connecticut
7) Delaware
8) Florida
9) Georgia
10) Hawaii
11) Idaho
12) Illinois
13) Indiana
14) Iowa
15) Kansas
16) Kentucky
17) Louisiana
18) Maine
19) Maryland
20) Massachus...
21) Michigan
22) Minnesota
23) Mississippi
24) Missouri
...

Literal

0) Montgomery
1) Juneau
2) Phoenix
3) Little Rock
4) Sacramento
5) Denver
6) Hartford
7) Dover
8) Tallahassee
9) Atlanta
10) Honolulu
11) Boise
12) Springfield
13) Indianapolis
14) Des Moines
15) Topeka
16) Frankfort
17) Baton Rou...
18) Augusta
19) Annapolis
20) Boston
21) Lansing
22) Saint Paul
23) Jackson
24) Jefferson C...
...

Literal

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut lab...

Literal

3.14159265358979323846264338327950288419716939937510582097494459230781640628620...

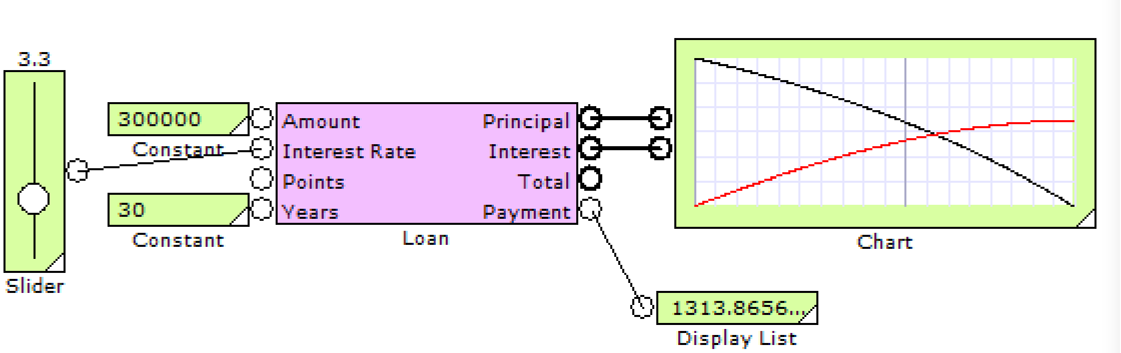
Literal

2.71828182845904523536028747135266249775724709369995957496696762772407663035...

Literal

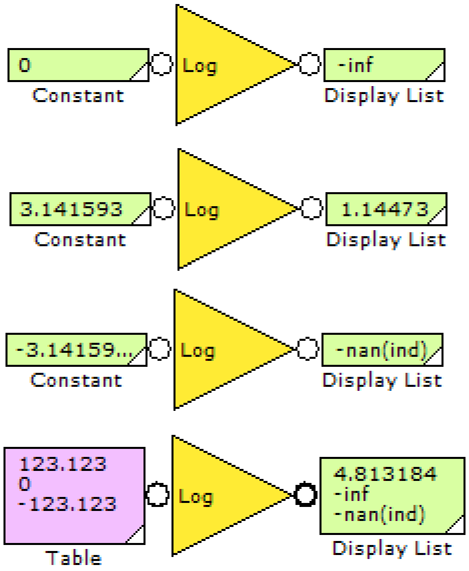
Loan

The Loan component calculate the monthly payment on an loan.   Arrays - column 5



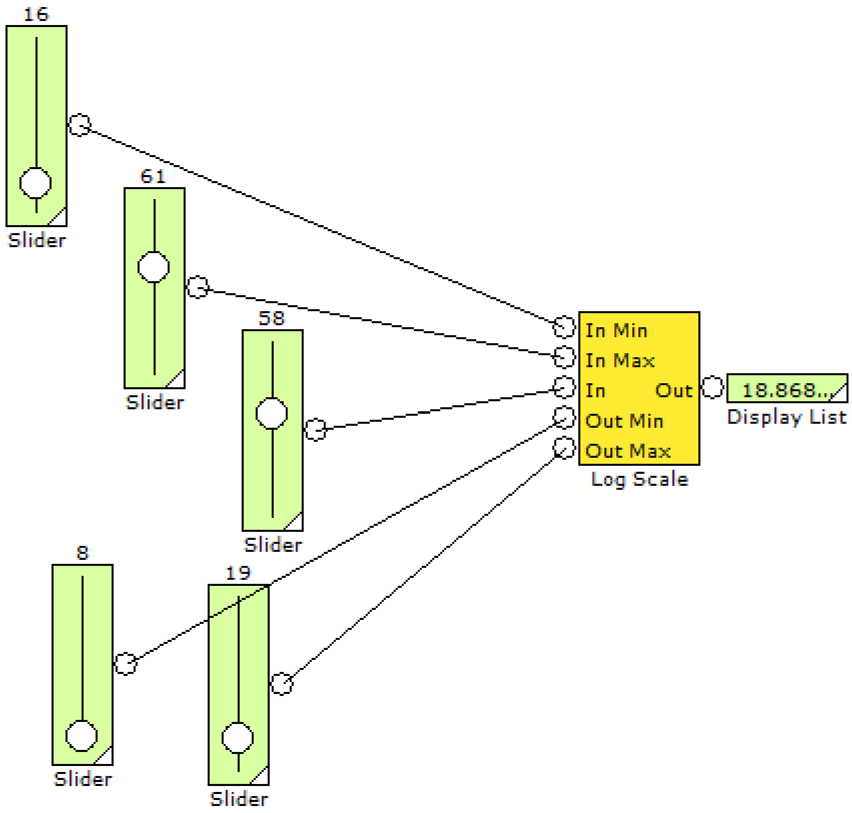
Log

The Log component calculate the logarithm of the input base e. Input can be scalar or an array.
Functions - column 1



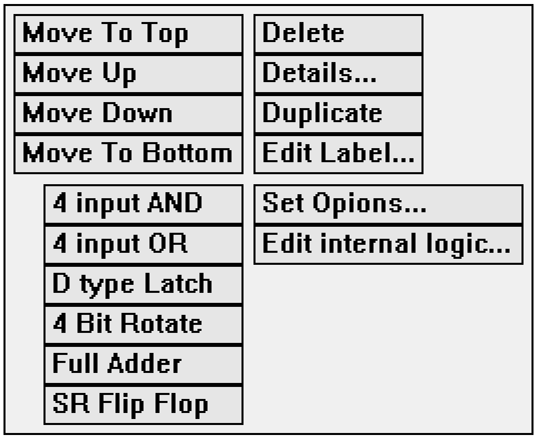
Log Scale

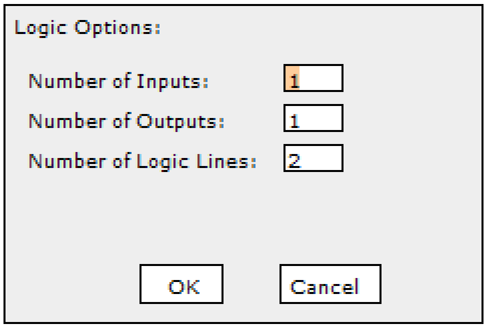
The Log Scale component scales its inputs from a linear range to a logarithmic range. Functions - column 5



Logic

The Logic component lets you create advanced logic in a single component.   Functions - column 3





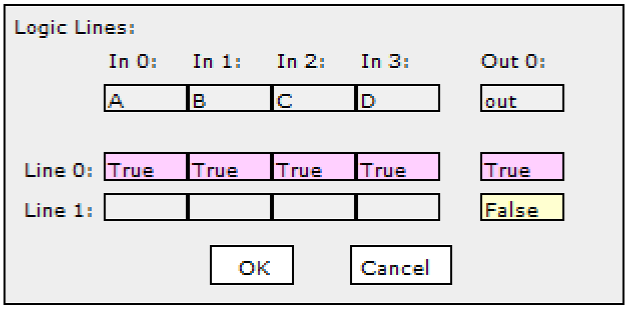
Logic Options:

Number of Inputs: 1

Number of Outputs: 1

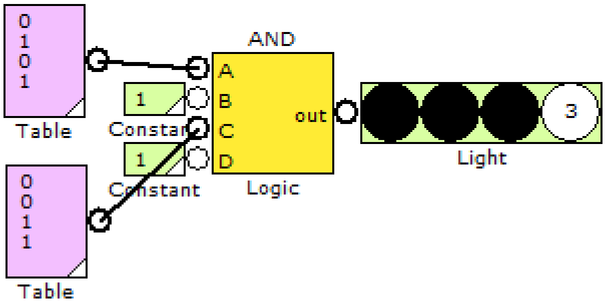
Number of Logic Lines: 2

4 input AND

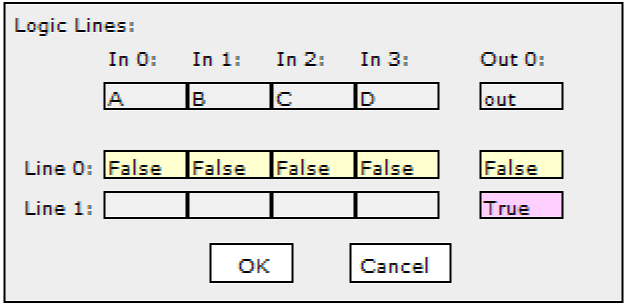


Logic Lines:

	In 0:	In 1:	In 2:	In 3:	Out 0:
	A	B	C	D	out
Line 0:	True	True	True	True	True
Line 1:					False

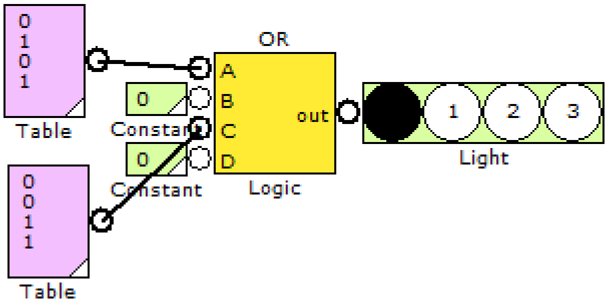


4 input OR

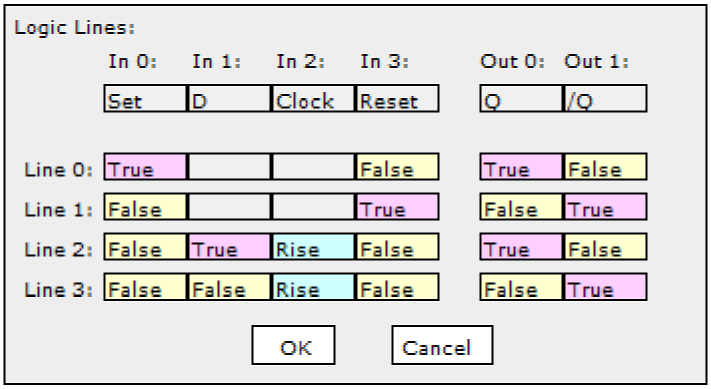


Logic Lines:

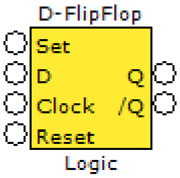
	In 0:	In 1:	In 2:	In 3:	Out 0:
	A	B	C	D	out
Line 0:	False	False	False	False	False
Line 1:					True



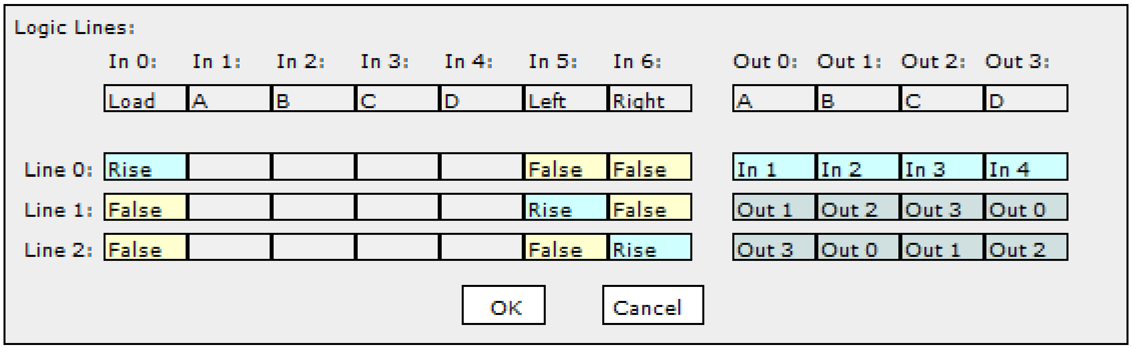
D type Latch


Logic Lines:

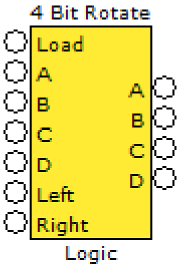
	In 0:	In 1:	In 2:	In 3:	Out 0:	Out 1:
	Set	D	Clock	Reset	Q	/Q
Line 0:	True			False	True	False
Line 1:	False			True	False	True
Line 2:	False	True	Rise	False	True	False
Line 3:	False	False	Rise	False	False	True



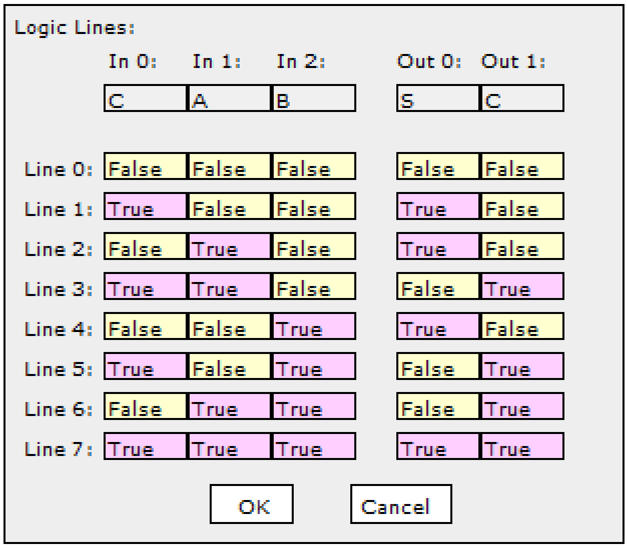
4 Bit Rotate


Logic Lines:

	In 0:	In 1:	In 2:	In 3:	In 4:	In 5:	In 6:	Out 0:	Out 1:	Out 2:	Out 3:
	Load	A	B	C	D	Left	Right	A	B	C	D
Line 0:	Rise					False	False	In 1	In 2	In 3	In 4
Line 1:	False					Rise	False	Out 1	Out 2	Out 3	Out 0
Line 2:	False					False	Rise	Out 3	Out 0	Out 1	Out 2

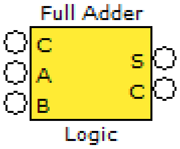


Full Adder

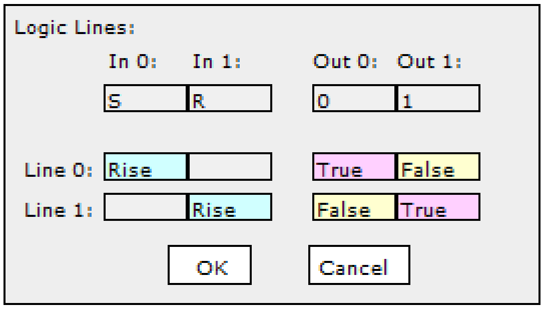


Logic Lines:

	In 0:	In 1:	In 2:	Out 0:	Out 1:
	C	A	B	S	C
Line 0:	False	False	False	False	False
Line 1:	True	False	False	True	False
Line 2:	False	True	False	True	False
Line 3:	True	True	False	False	True
Line 4:	False	False	True	True	False
Line 5:	True	False	True	False	True
Line 6:	False	True	True	False	True
Line 7:	True	True	True	True	True

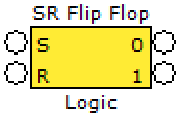


SR Flip Flop



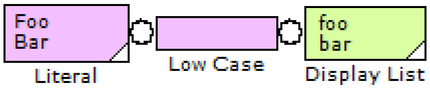
Logic Lines:

	In 0:	In 1:	Out 0:	Out 1:
	S	R	0	1
Line 0:	Rise		True	False
Line 1:		Rise	False	True



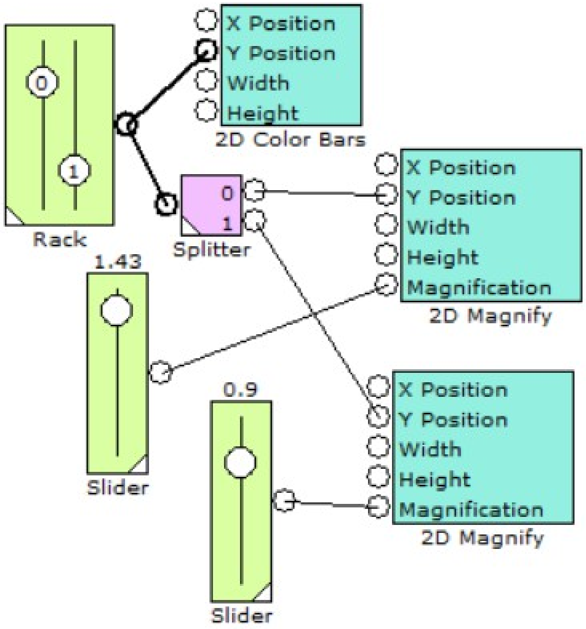
Low Case

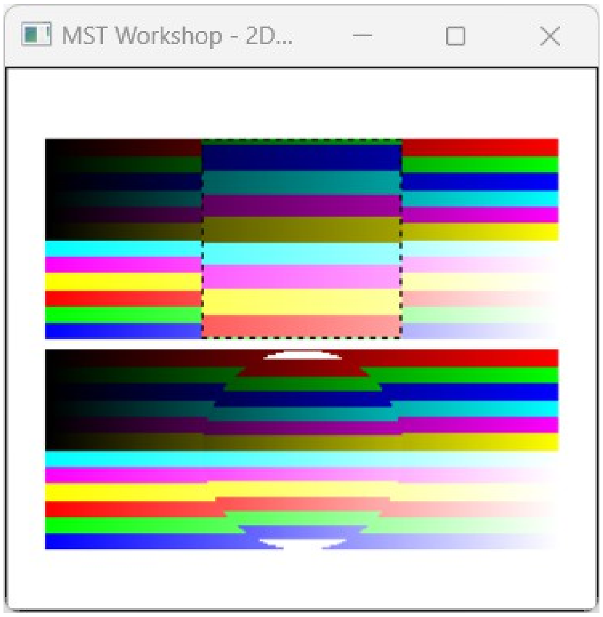
The Low Case component changes the input string to lower case characters.   Arrays - column 6



2D Magnify

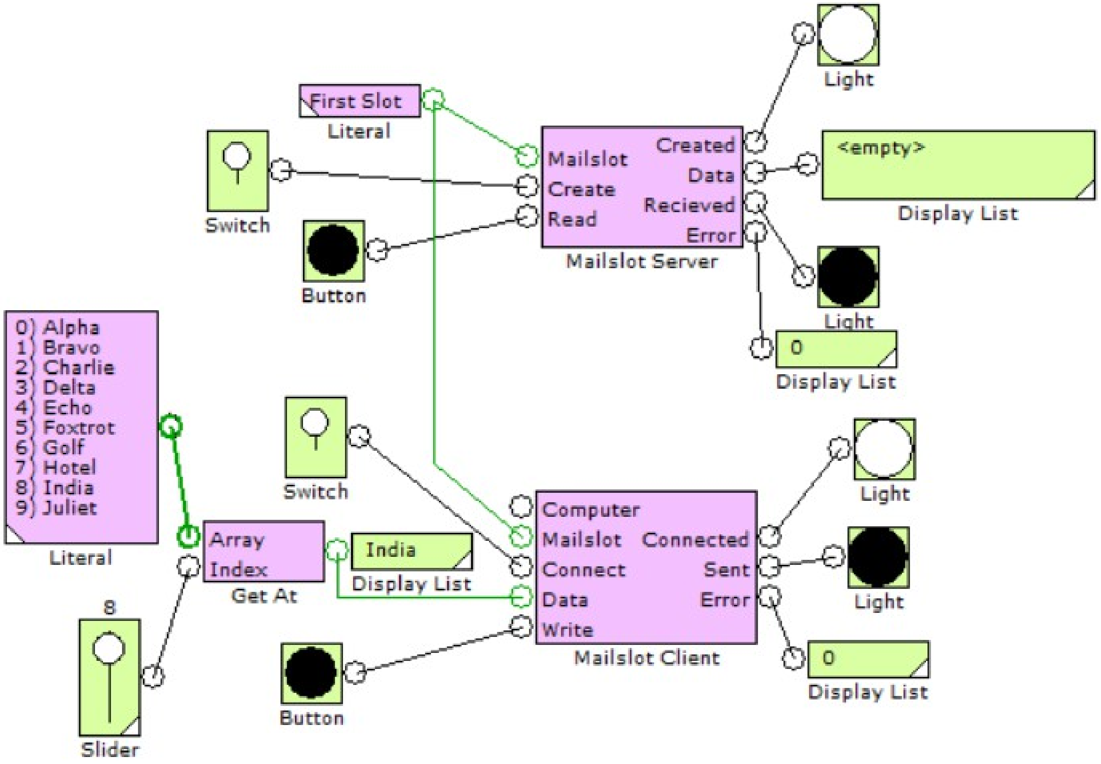
The 2D Magnify magnifies the image in the 2D drawing it covers. 2D – column 1





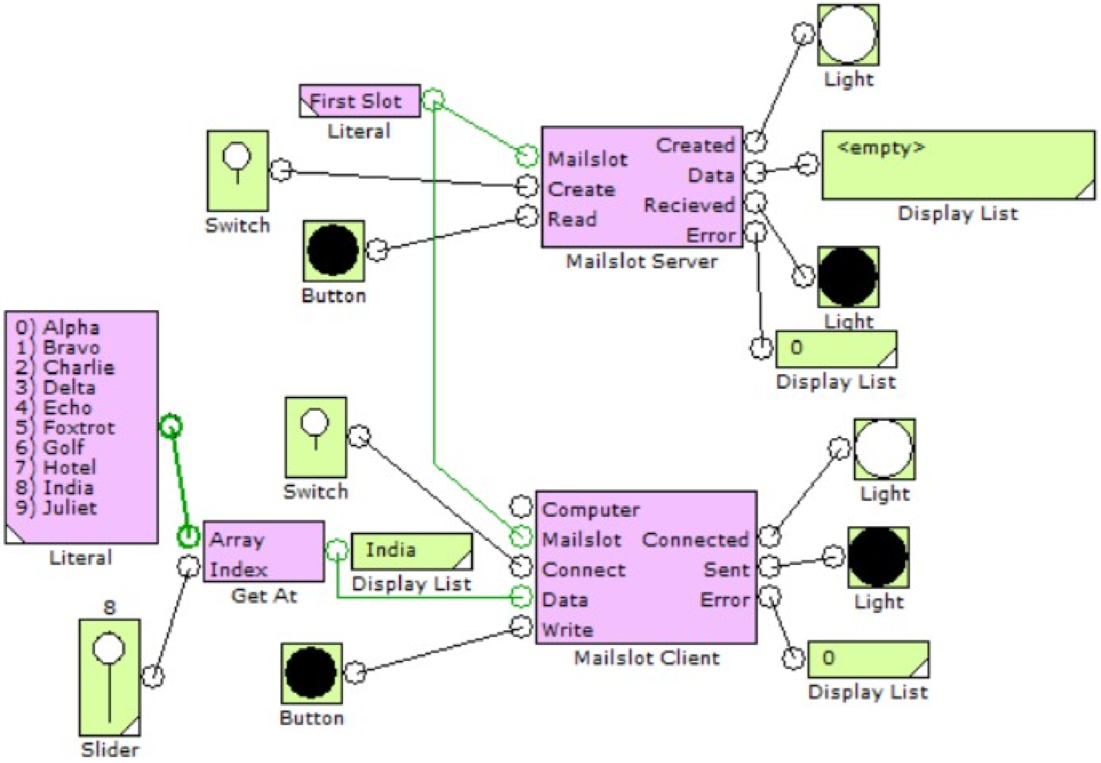
Mailslot Client

The Mailslot Client component can open a Mailslot and write text to it. Mailslots can be on the same computer or other computers on the same local network.   Arrays - column 6



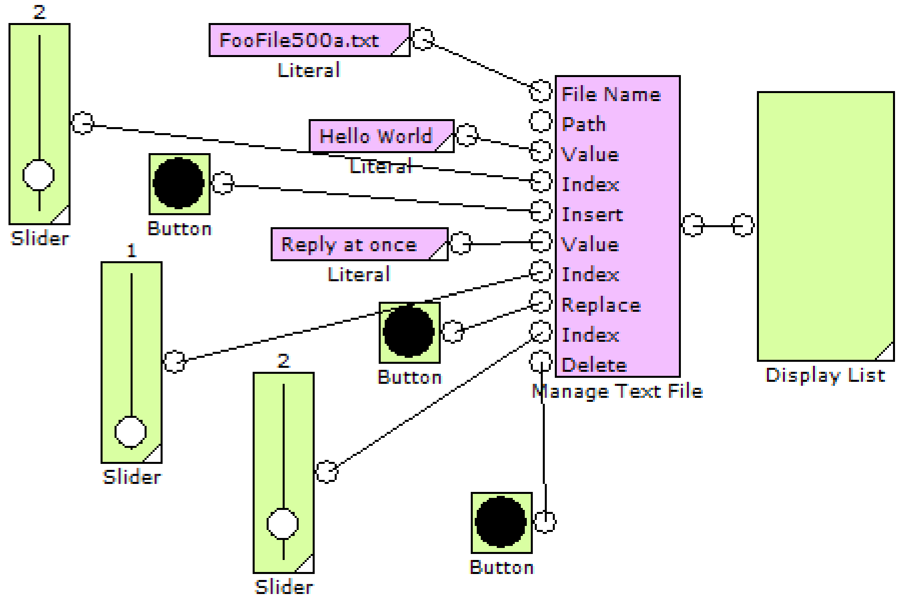
Mailslot Server

The Mailslot Server component can create Mailslots and read from them. Mailslots can be on the same computer or other computers on the same local network.   Arrays - column 6



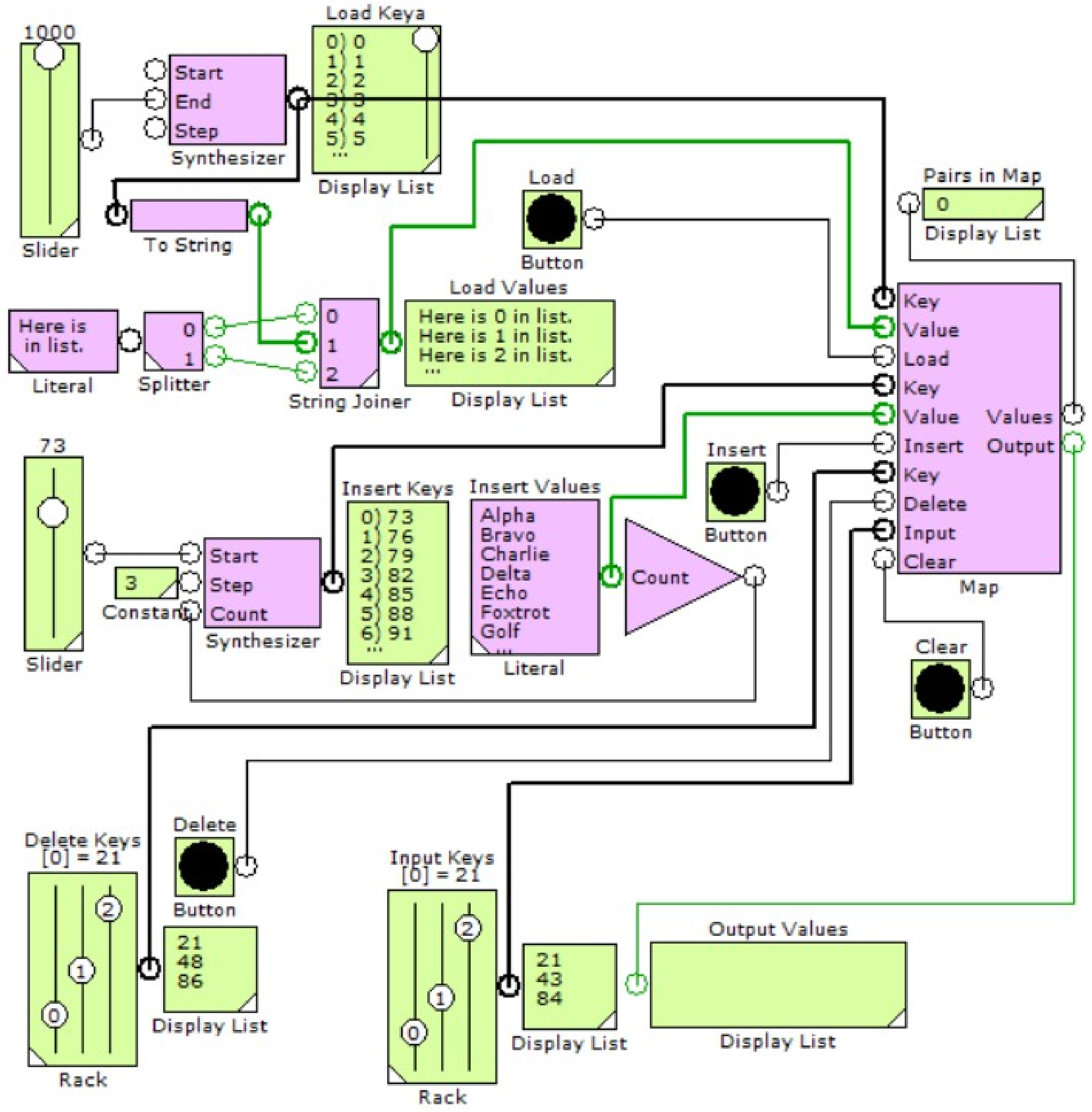
Manage Text File

The Manage Text File component creates a text file. Use the Value, Index and Insert inputs to add new values. Use the Value, Index and Replace inputs to replace a value. Use the Index and Delete inputs to delete a value. Arrays - column 7



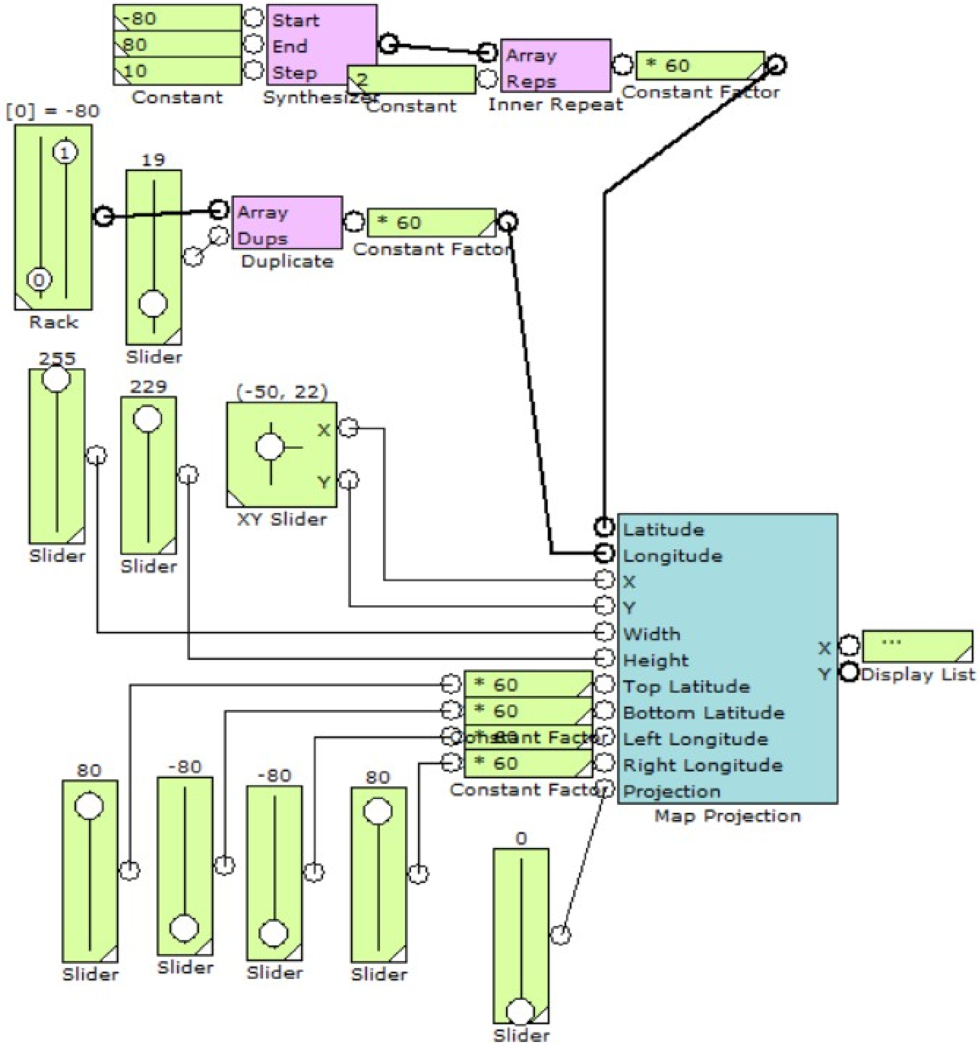
Map

The Map component holds a list of Key Value pairs. Keys are integers and Values are strings. You can load the pairs all at once with the Load command or insert and delete them one at a time or in groups with the Insert and Delete commands. Clear empties the Map completely. A key(s) at theInput will result in the corresponding Value(s) at the Output. Keys are unique, so inserting duplicate keys will be ignored. Arrays – column 1



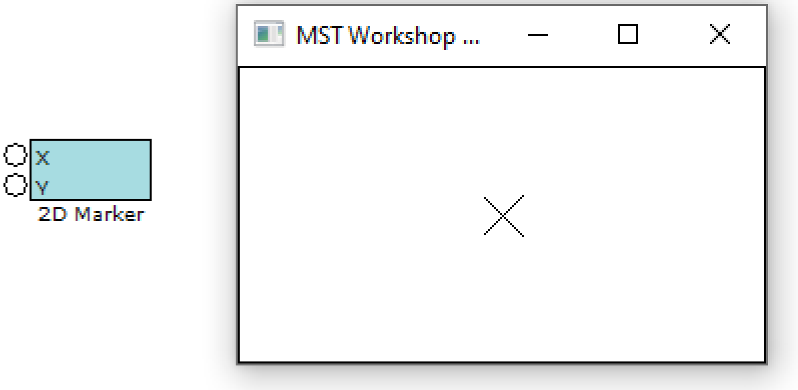
Map Projection

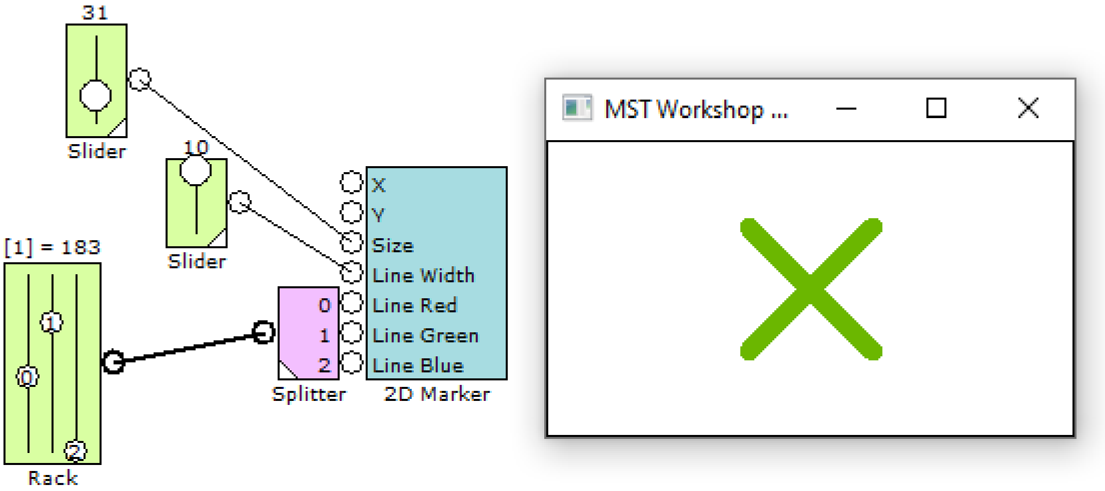
The Map Projection component projects a drawing from Latitude, Longitude coordinates to X, Y coordinates. 2D – column 1



2D Marker

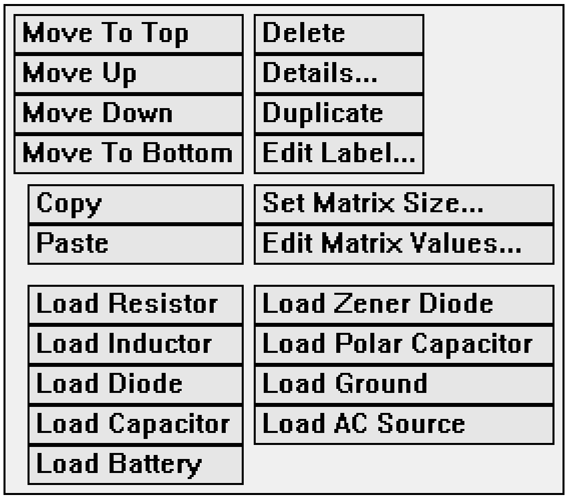
The 2D Marker component draws an X at the X, Y location. 2D - column 1

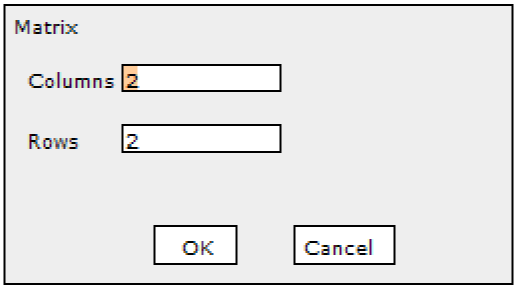




Matrix

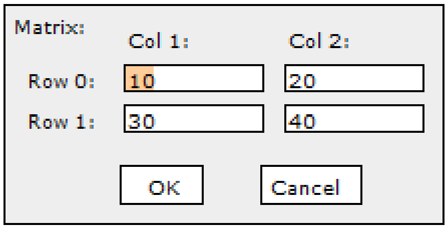
The Matrix component is used to create a two dimensional matrix of numbers.   Arrays - column 1



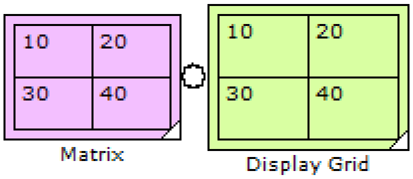


Columns 2

Rows 2



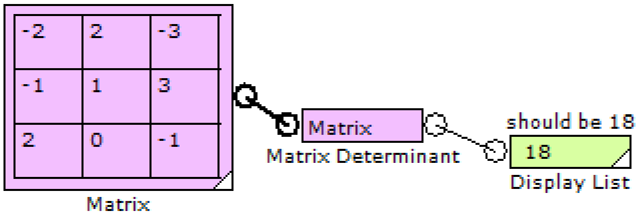
Matrix:	Col 1:	Col 2:
Row 0:	10	20
Row 1:	30	40



Matrix Determinant

The Matrix Determinant component returns the determinant of a matrix. Input matrix must be square.

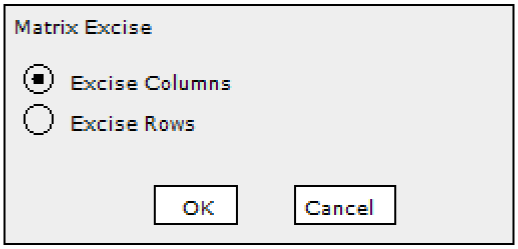
Arrays - column 4



-2	2	-3
-1	1	3
2	0	-1

Matrix Excise

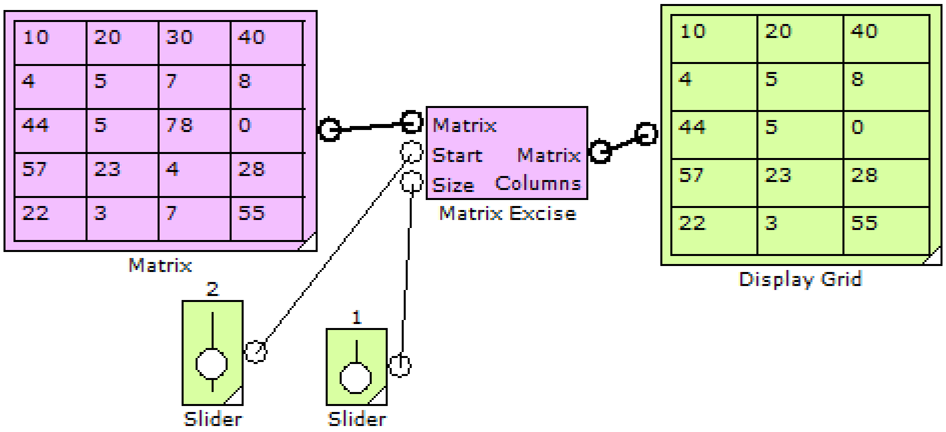
The Matrix Excise component removes a portion of the array. From the menu choose either X or Y direction. Input the number of the first value in X or Y, and the size in X or Y you want to remove.
Arrays - column 4



Matrix Excise

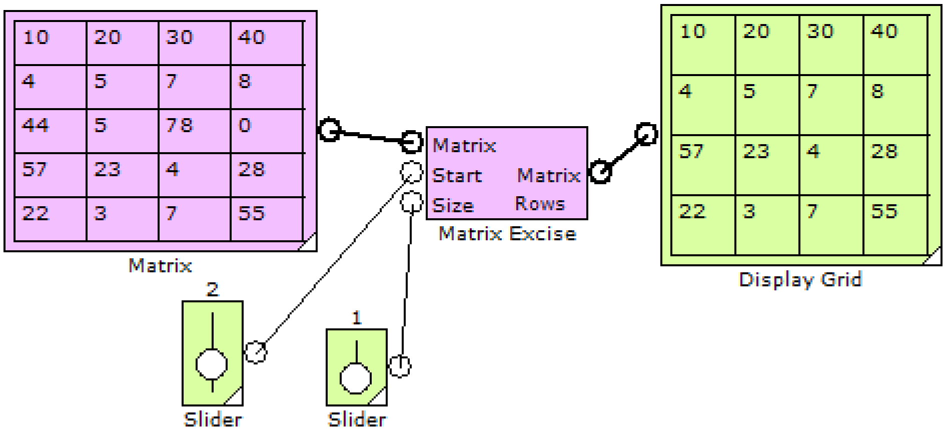
● Excise Columns

○ Excise Rows



10	20	30	40
4	5	7	8
44	5	78	0
57	23	4	28
22	3	7	55

10	20	40
4	5	8
44	5	0
57	23	28
22	3	55

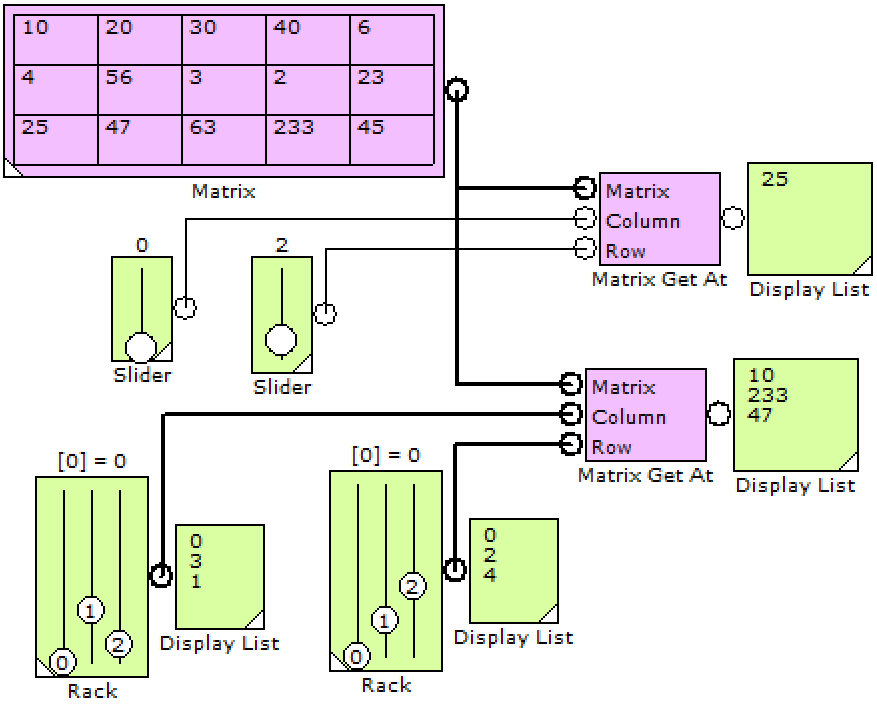


10	20	30	40
4	5	7	8
44	5	78	0
57	23	4	28
22	3	7	55

10	20	30	40
4	5	7	8
57	23	4	28
22	3	7	55

Matrix Get At

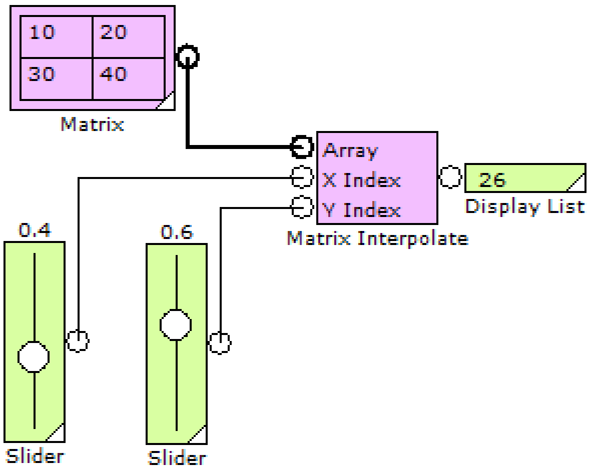
The Matrix Get At component gets the Array value at the X and Y Index inputs. It outputs the value(s) at the positions given by the XY Index(s).   Arrays - column 4

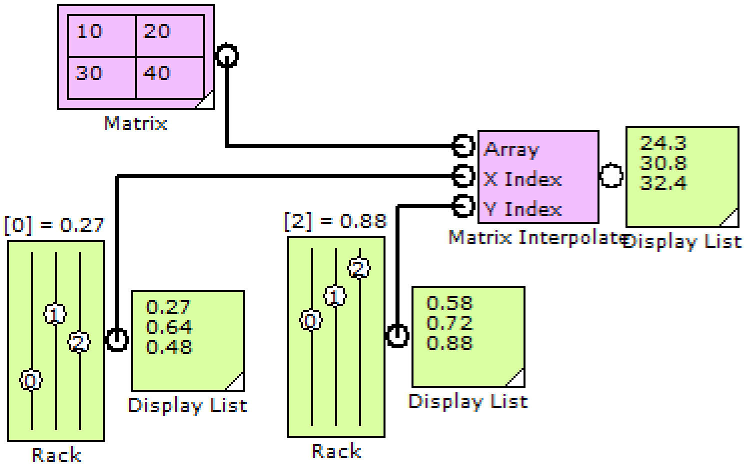


10	20	30	40	6
4	56	3	2	23
25	47	63	233	45

Matrix Interpolate

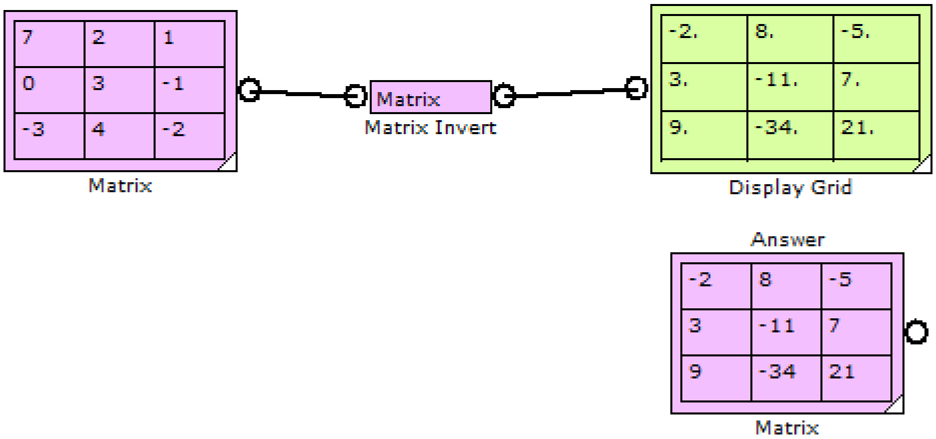
The Matrix Interpolate component gets the Matrix values around the Indexes input and interpolates. It outputs the value(s) at the xy positions given by the Index(s). Arrays - column 4





Matrix Invert

The Matrix Invert component computes the inverse of a square matrix.   Arrays - column 4



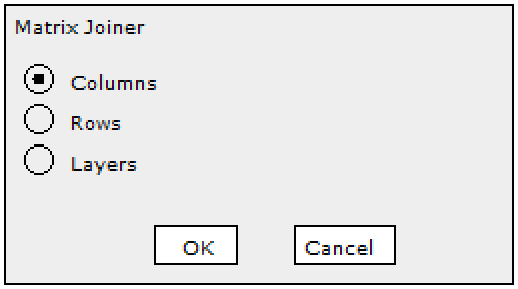
7	2	1
0	3	-1
-3	4	-2

-2.	8.	-5.
3.	-11.	7.
9.	-34.	21.

-2	8	-5
3	-11	7
9	-34	21

Matrix Joiner

The Matrix Joiner component joins matrices in the x direction into a single matrix. Arrays - column 4

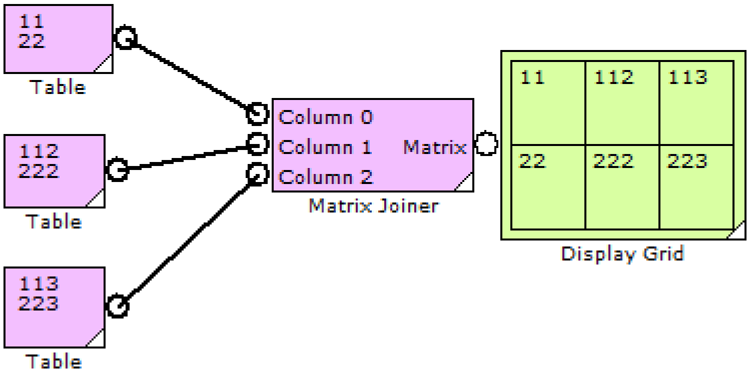


Matrix Joiner

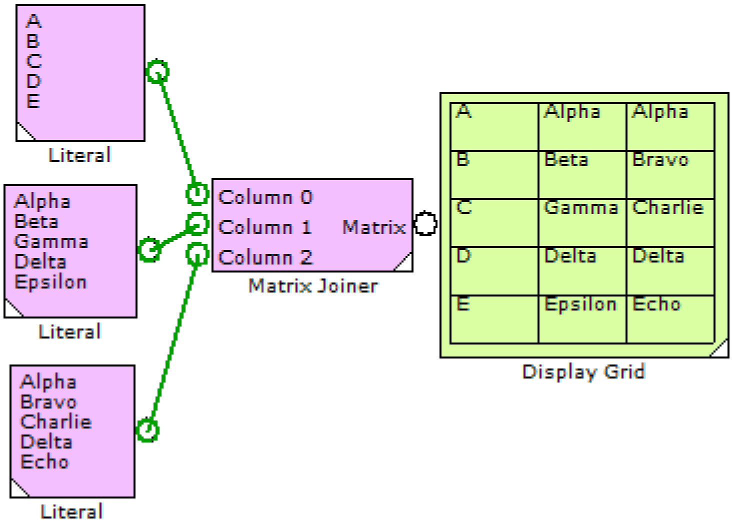
● Columns

○ Rows

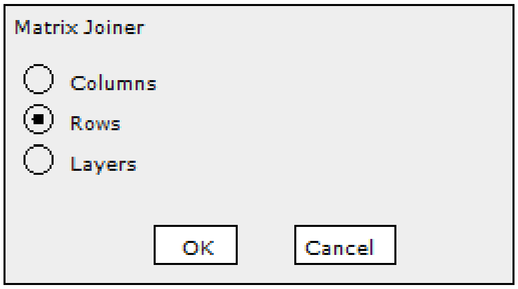
○ Layers



11	112	113
22	222	223



A	Alpha	Alpha
B	Beta	Bravo
C	Gamma	Charlie
D	Delta	Delta
E	Epsilon	Echo

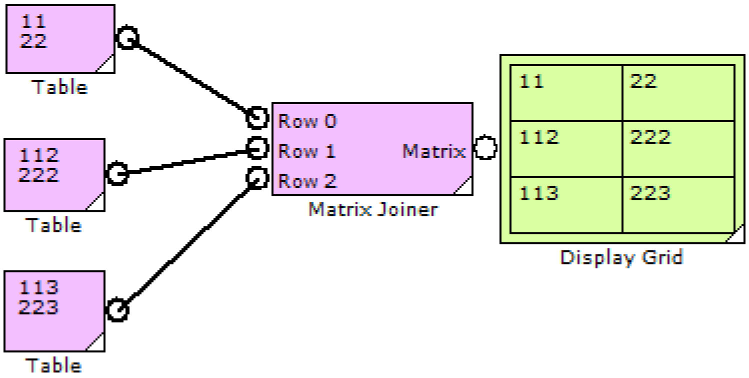


Matrix Joiner

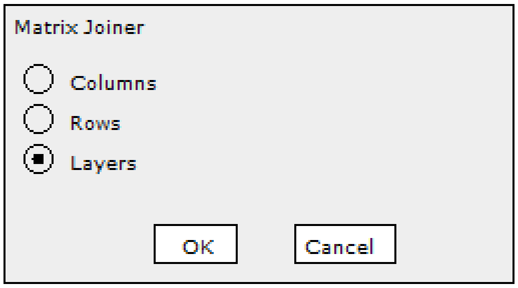
○ Columns

● Rows

○ Layers



11	22
112	222
113	223

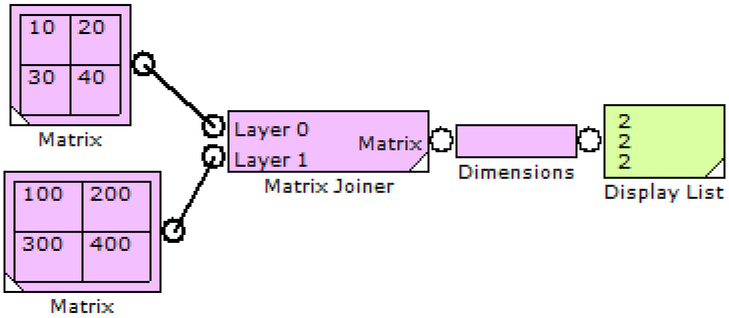


Matrix Joiner

○ Columns

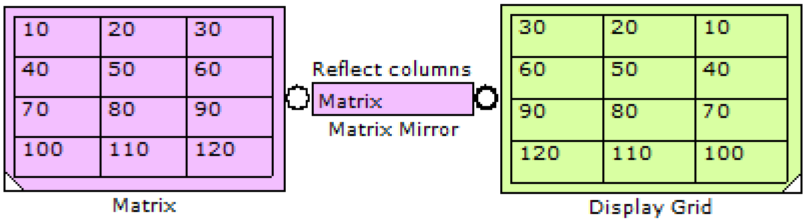
○ Rows

● Layers



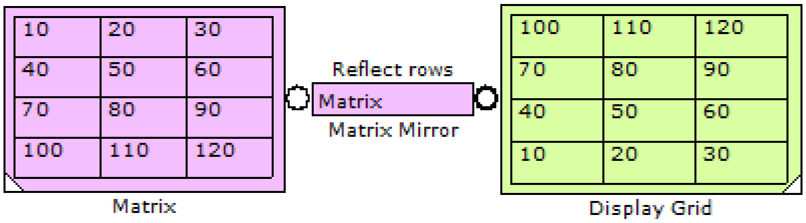
Matrix Mirror

The Matrix Mirror component returns the matrix mirrored in rows, columns, or both. Use the Options menu to decide. Arrays - column 4



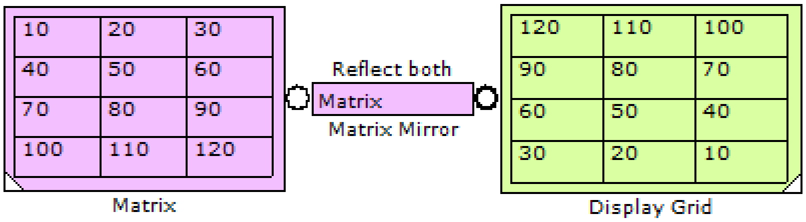
10	20	30
40	50	60
70	80	90
100	110	120

30	20	10
60	50	40
90	80	70
120	110	100



10	20	30
40	50	60
70	80	90
100	110	120

100	110	120
70	80	90
40	50	60
10	20	30

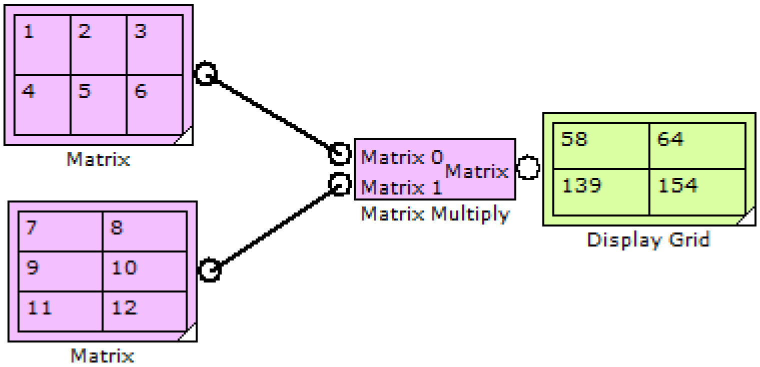


10	20	30
40	50	60
70	80	90
100	110	120

120	110	100
90	80	70
60	50	40
30	20	10

Matrix Multiply

The Matrix Multiply component multiplies two matrices and outputs a matrix and its size. Arrays - column 4



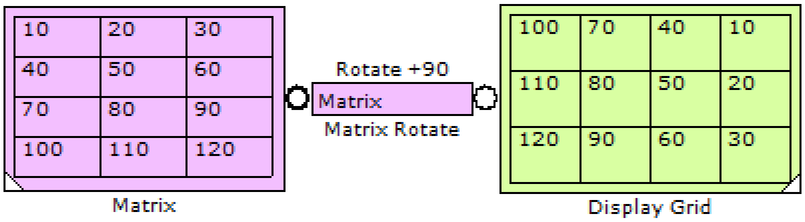
1	2	3
4	5	6

7	8
9	10
11	12

58	64
139	154

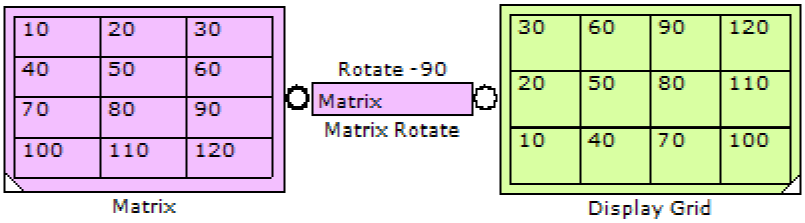
Matrix Rotate

The Matrix Rotate component returns the matrix rotated by +90, -90, or 180 degrees. Use the Options menu to decide.   Arrays - column 4



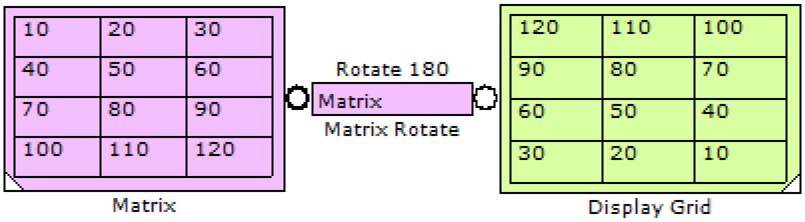
10	20	30
40	50	60
70	80	90
100	110	120

100	70	40	10
110	80	50	20
120	90	60	30



10	20	30
40	50	60
70	80	90
100	110	120

30	60	90	120
20	50	80	110
10	40	70	100

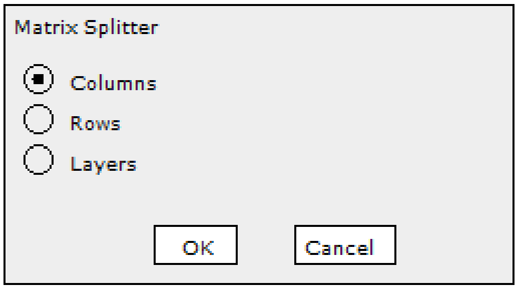


10	20	30
40	50	60
70	80	90
100	110	120

120	110	100
90	80	70
60	50	40
30	20	10

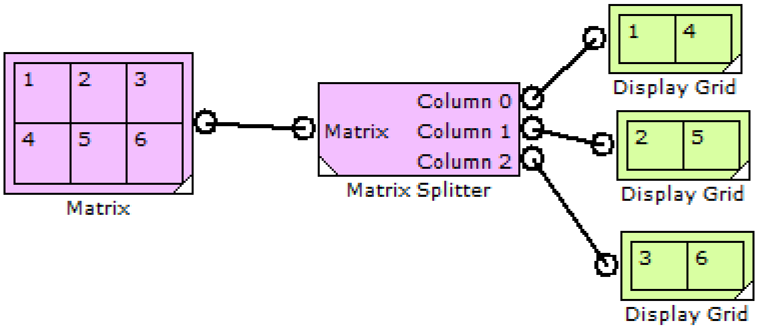
Matrix Splitter

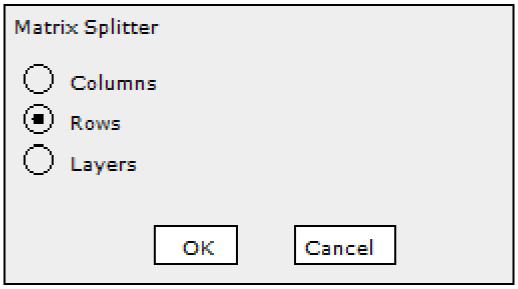
The Matrix Splitter component breaks the input matrix into separate vector arrays. You can set the number of outputs desired.   Arrays - column 4


Matrix Splitter

● Columns
○ Rows
○ Layers

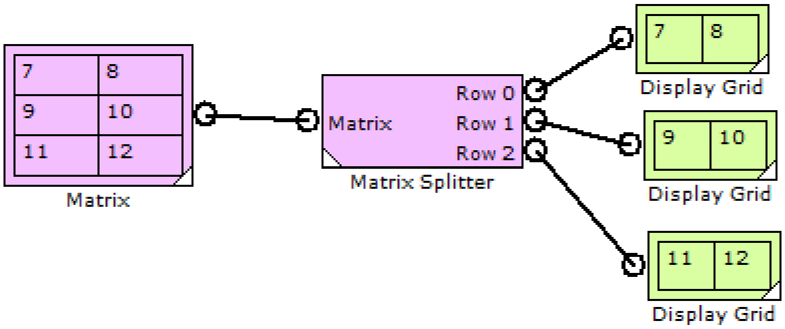
OK   Cancel

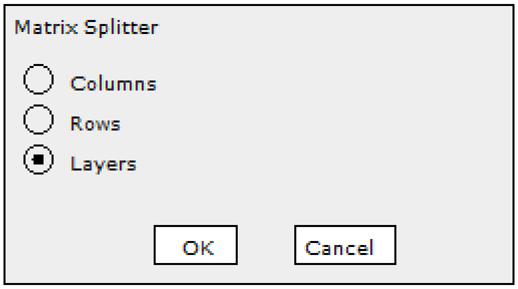



Matrix Splitter

○ Columns
● Rows
○ Layers

OK   Cancel



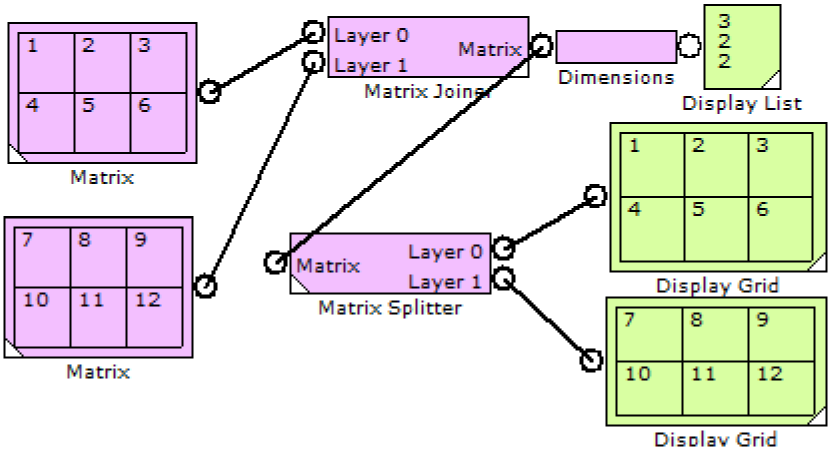


Matrix Splitter

○ Columns

○ Rows

● Layers



1	2	3
4	5	6

7	8	9
10	11	12

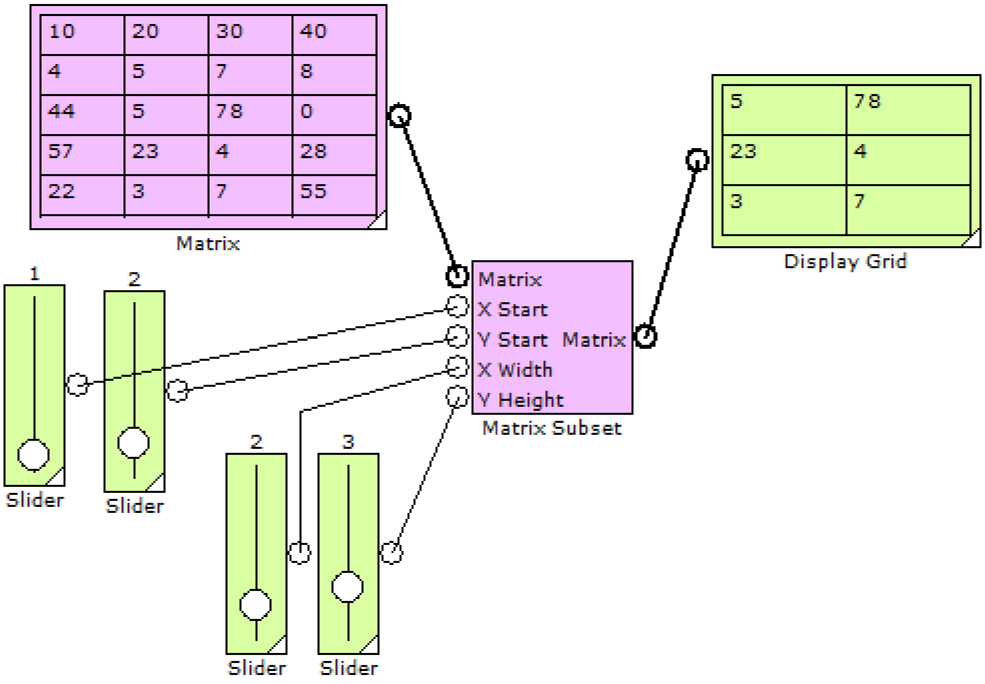
3
2
2

1	2	3
4	5	6

7	8	9
10	11	12

Matrix Subset

The Matrix Subset component outputs a portion of the values in an array. Input the number of the first value in X and Y, and the size in X and Y you want at the output.   Arrays - column 4



Matrix

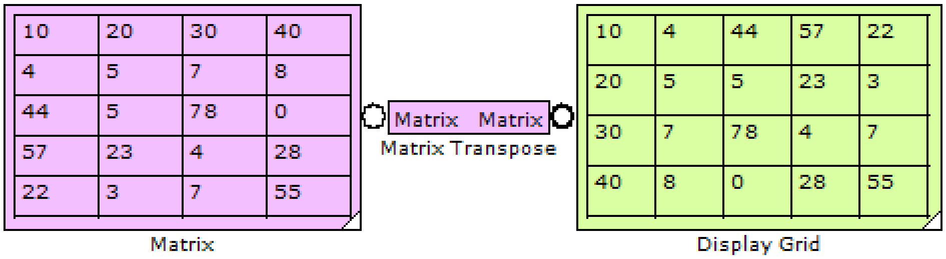
10	20	30	40
4	5	7	8
44	5	78	0
57	23	4	28
22	3	7	55

Display Grid

5	78
23	4
3	7

Matrix Transpose

The Matrix Transpose component returns the transpose of a matrix. Values are shifted along the diagonal.   Arrays - column 4

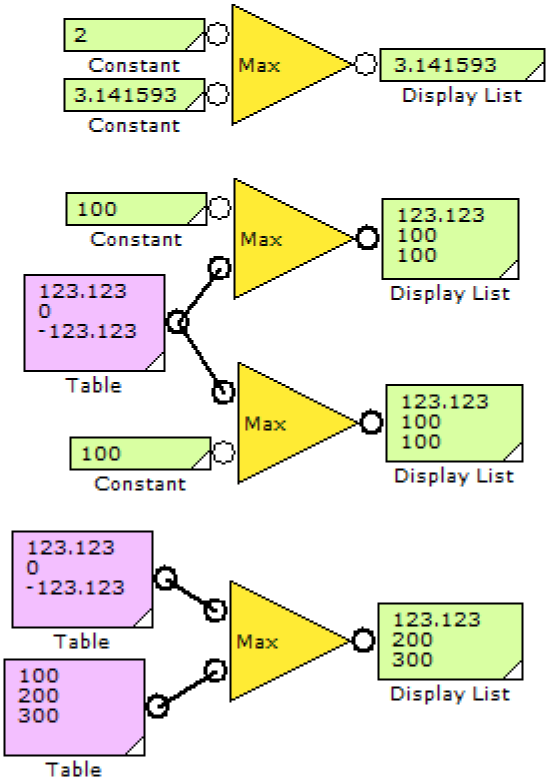


10	20	30	40
4	5	7	8
44	5	78	0
57	23	4	28
22	3	7	55

10	4	44	57	22
20	5	5	23	3
30	7	78	4	7
40	8	0	28	55

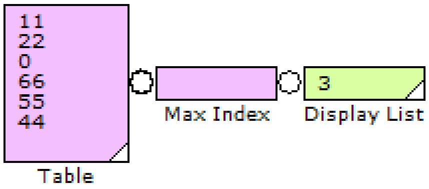
Max

The Max component outputs the larger of the two input values. Inputs can be scalars or arrays.
Functions - column 1



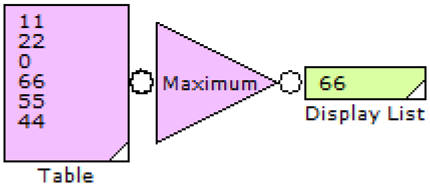
Max Index

The Max Index component scans the input array and outputs the index of the largest value. Arrays - column 3



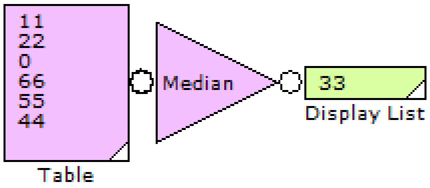
Maximum

The Maximum component scans the input array and outputs the largest value. Arrays - column 3



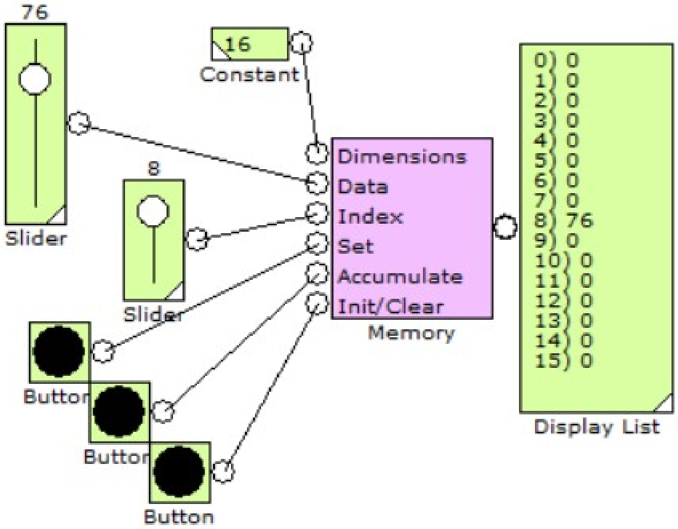
Median

The Median component scans the input array and outputs the middle value. Arrays - column 3



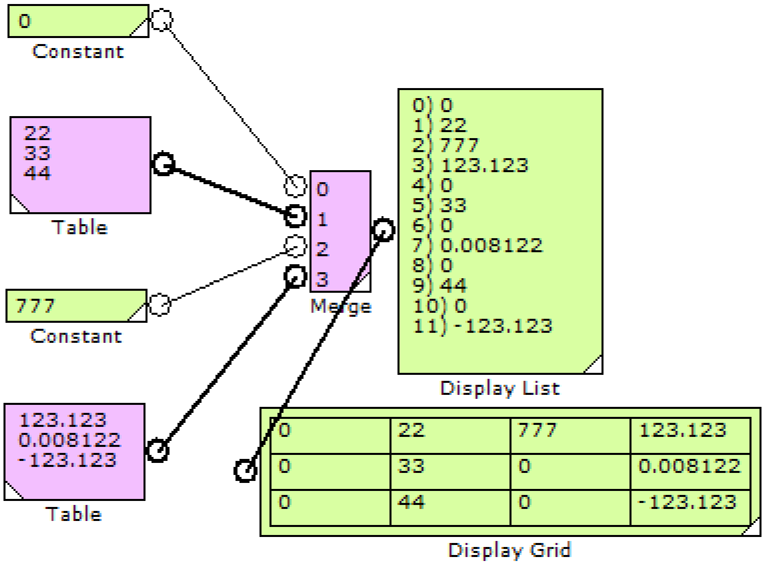
Memory

The Memory component creates a table of the input Dimensions filled with zeros when the Init/Clear input goes true. When the Set input goes true the values at the Data input are put at the positions indicated by the Index input. When the Accumulate input goes true the values at the Data input are added to the values at the positions indicated by the Index input. Arrays - column 1



Merge

The Merge component joins all the values for all its inputs into a single output. The inputs are interlaced one at a time like stacking a deck of cards. You can set the number of inputs.   Arrays - column 1

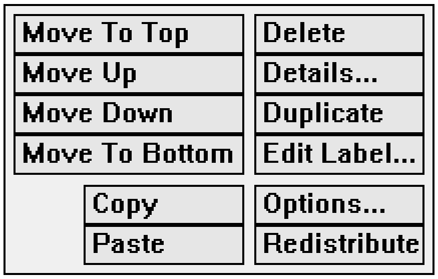


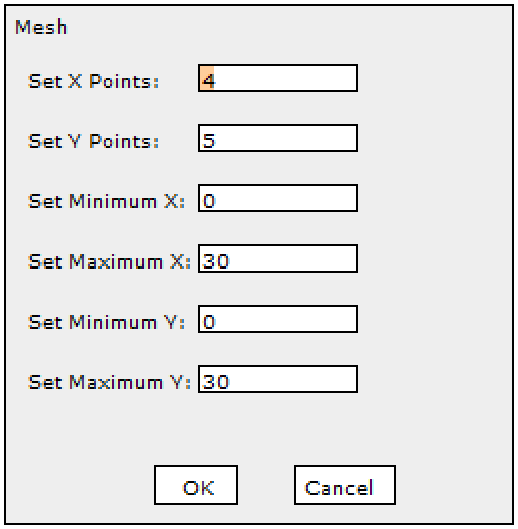
```
0) 0
1) 22
2) 777
3) 123.123
4) 0
5) 33
6) 0
7) 0.008122
8) 0
9) 44
10) 0
11) -123.123
```

0	22	777	123.123
0	33	0	0.008122
0	44	0	-123.123

Mesh

The Mesh component lets you control a number of constants in two dimensions, horizontal (x) and vertical (y).   Controls - column 1




Mesh

Set X Points: 4

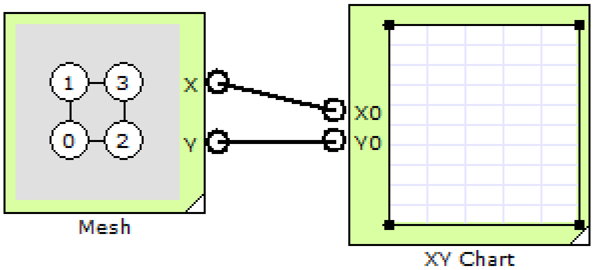
Set Y Points: 5

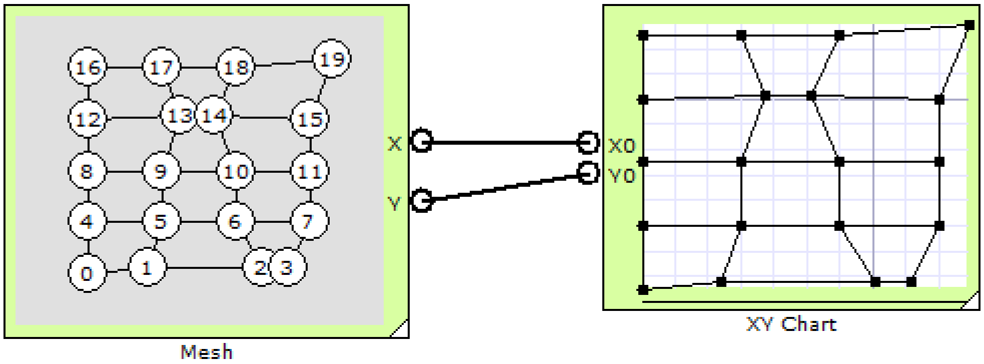
Set Minimum X: 0

Set Maximum X: 30

Set Minimum Y: 0

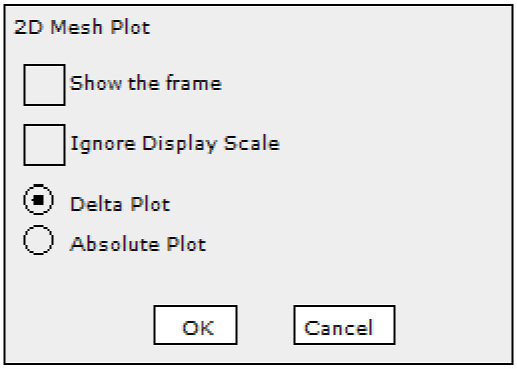
Set Maximum Y: 30





2D Mesh Plot

The 2D Mesh Plot plots 2D data creating a mesh plot of the data in the 2D display window. In the mesh plot, a grid with dots is created from the X, Y points. The component has 2 modes: Absolute and Delta. The inputs to the X Values and Y Values must be two 2 dimensional arrays.   2D - column 2



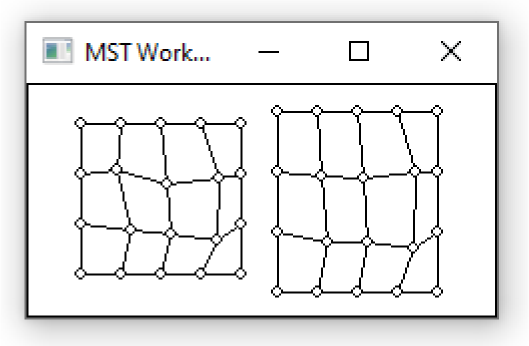
2D Mesh Plot

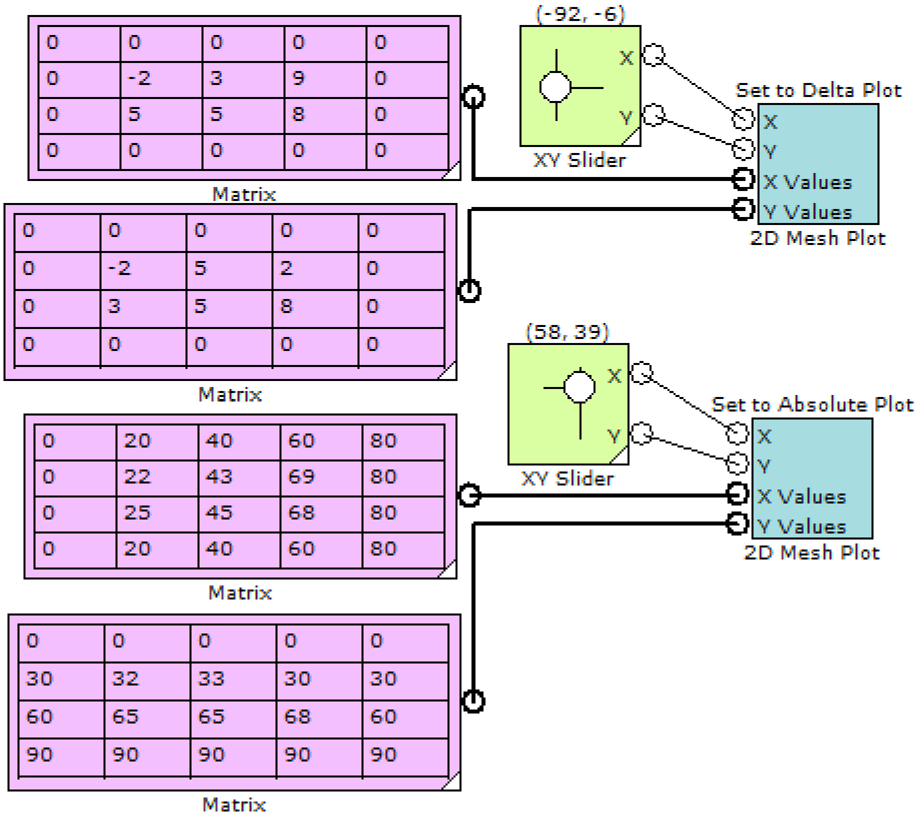
□ Show the frame

□ Ignore Display Scale

● Delta Plot

○ Absolute Plot





0	0	0	0	0
0	-2	3	9	0
0	5	5	8	0
0	0	0	0	0

Matrix

0	0	0	0	0
0	-2	5	2	0
0	3	5	8	0
0	0	0	0	0

Matrix

0	20	40	60	80
0	22	43	69	80
0	25	45	68	80
0	20	40	60	80

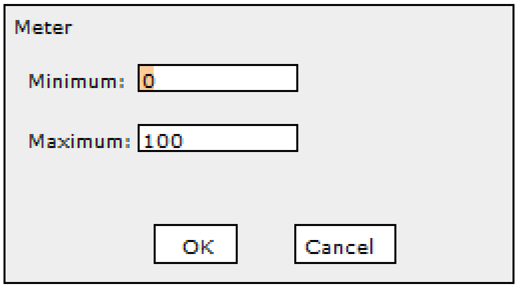
Matrix

0	0	0	0	0
30	32	33	30	30
60	65	65	68	60
90	90	90	90	90

Matrix

Meter

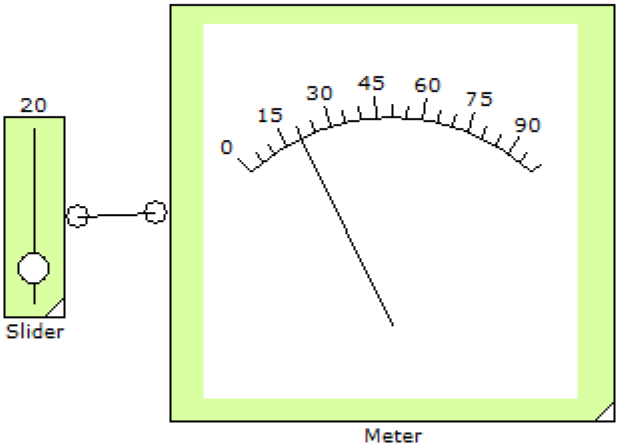
The Meter is used to show the values at any terminal using pointers.   Controls - column 4

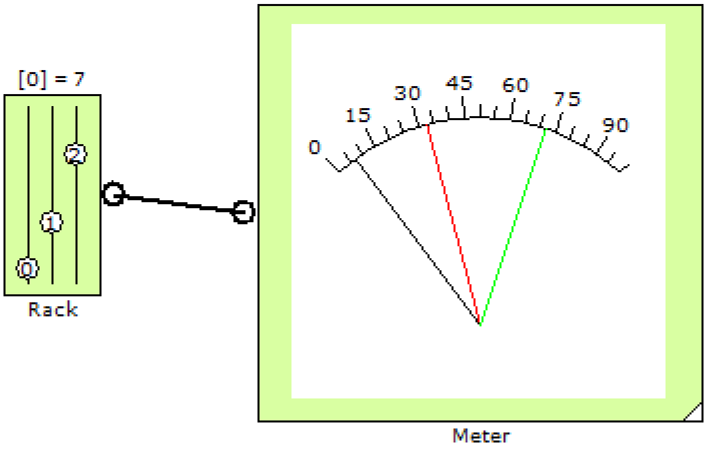


Meter

Minimum: 0

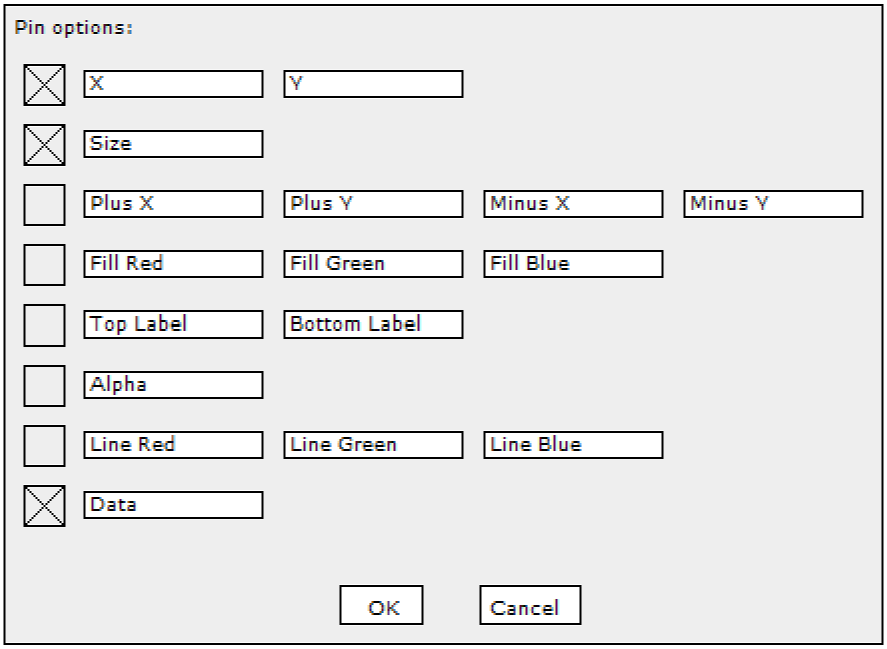
Maximum: 100





2D Meter

The 2D Meter is used to show the values at any terminal using pointers. It draws in the 2D display window. 2D - column 2



Pin options:

☒ X Y

☒ Size

□ Plus X Plus Y Minus X Minus Y

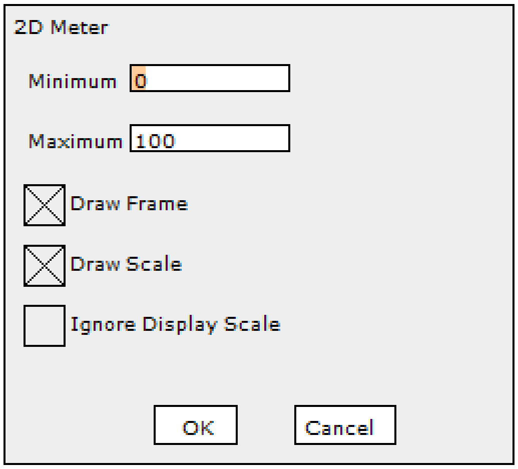
□ Fill Red Fill Green Fill Blue

□ Top Label Bottom Label

□ Alpha

□ Line Red Line Green Line Blue

☒ Data



2D Meter

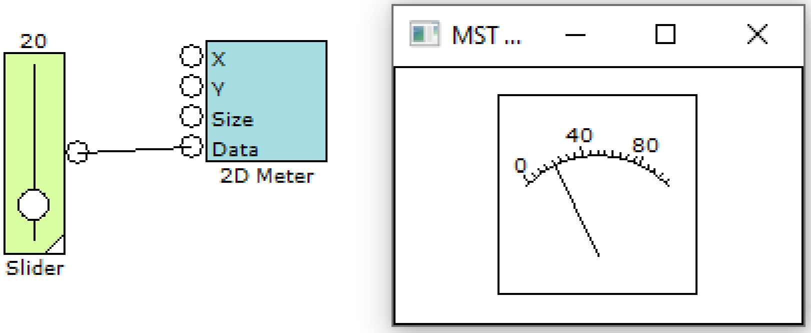
Minimum 0

Maximum 100

☒ Draw Frame

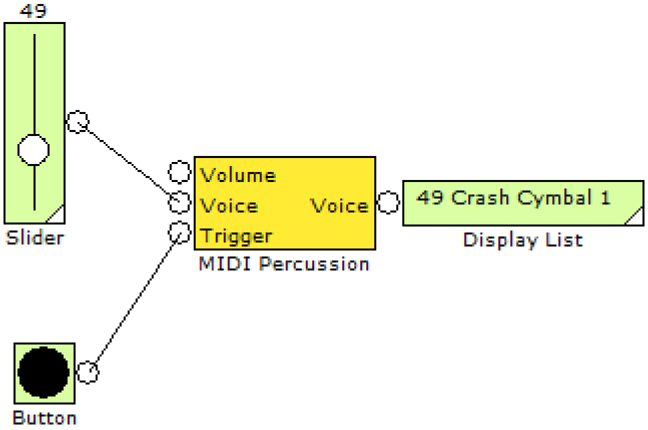
☒ Draw Scale

□ Ignore Display Scale



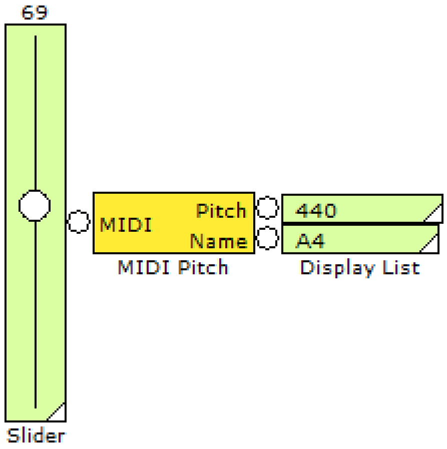
MIDI Percussion

The MIDI Percussion component uses the internal MIDI synthesizer to play a percussive sound. Duration is milliseconds, Volume is 0 to 127. Voice is the instrument to play.   Functions - column 6



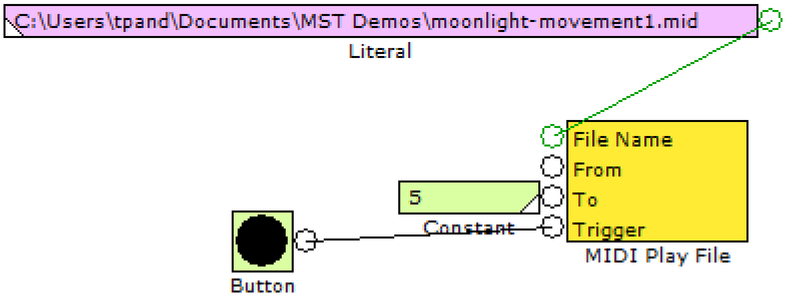
MIDI Pitch

The MIDI Pitch component given the MIDI number of a note, this component outputs the frequency and name of the note. Functions - column 6



MIDI Play File

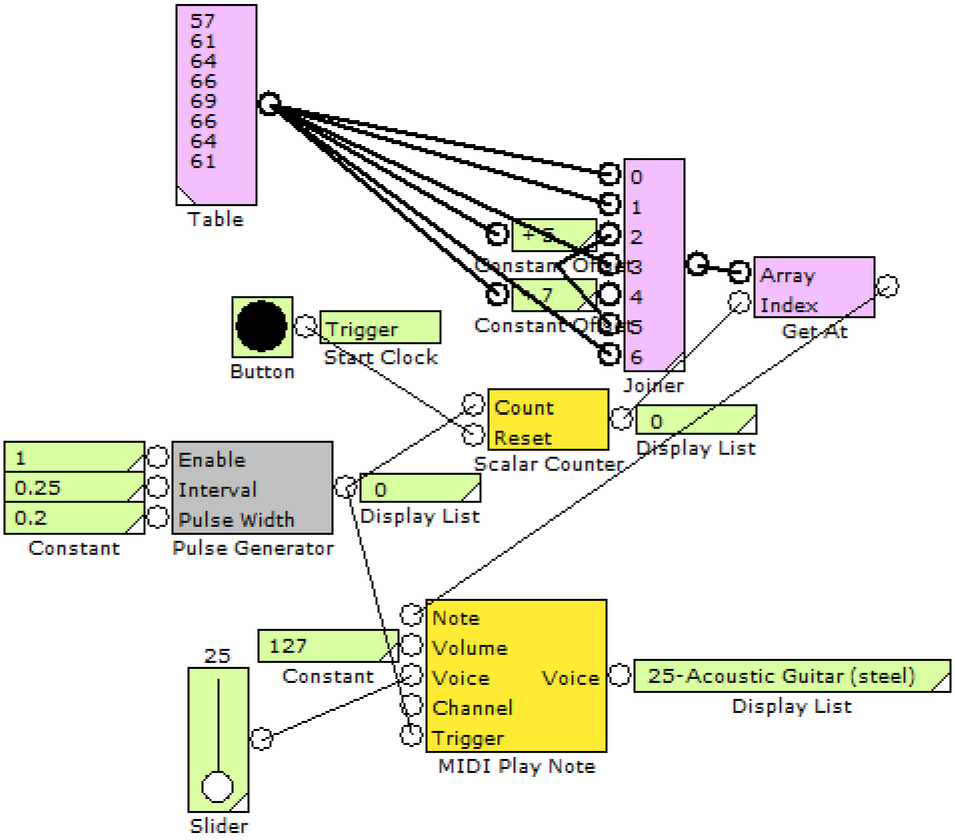
The MIDI Play File component plays the input file with the MIDI synthesizer. Functions – column 6



MIDI Play Note

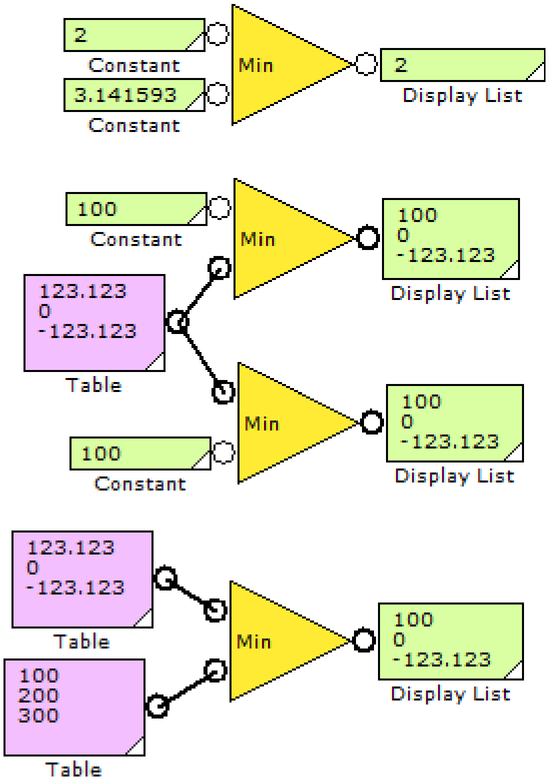
The MIDI Play Note component uses the internal MIDI synthesizer to play a sound. Note is the MIDI note (60 is middle C), Duration is milliseconds, Volume is 0 to 127. Voice is the instrument to play.

Functions - column 6



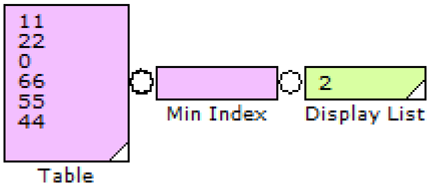
Min

The Min component outputs the smaller of the two input values. Inputs can be scalars and /or arrays.
Functions - column 1



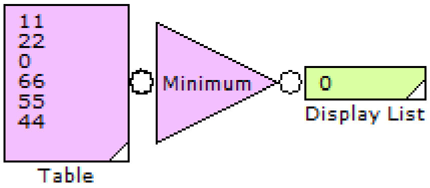
Min Index

The Min Index component scans the input array and outputs the index of the smallest value. Arrays - column 3



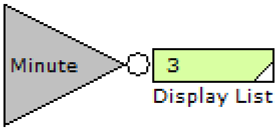
Minimum

The Minimum component scans the input array and outputs the smallest value.   Arrays - column 3



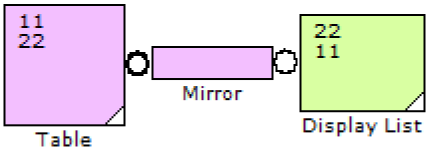
Minute

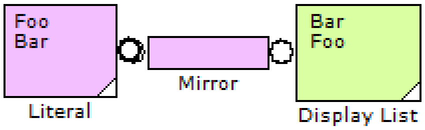
The Minute component outputs the clock minutes from the computers internal clock.   Functions - column 7



Mirror

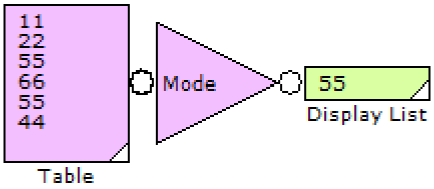
The Mirror component reverses the order of the input array.   Arrays - column 2





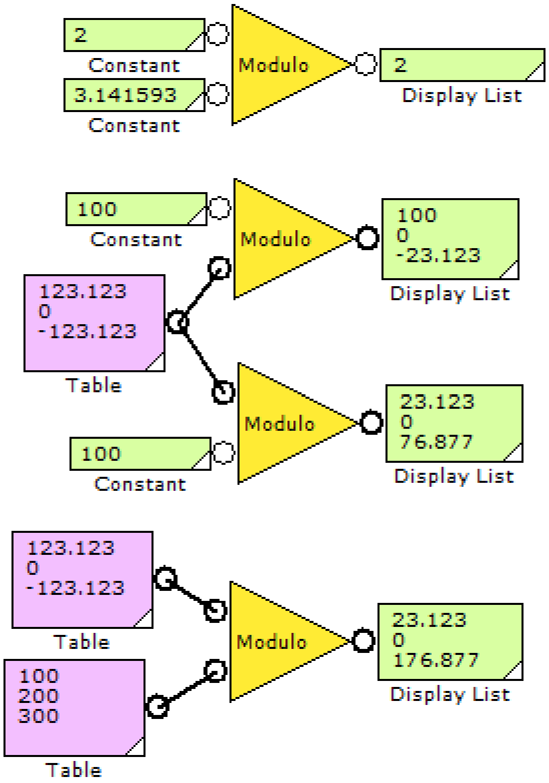
Mode

The Mode component scans the input array and outputs the most common value. Arrays - column 3



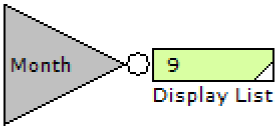
Modulo

The Modulo component divides the inputs and outputs the remainder. Inputs can be scalars or arrays.
Functions - column 1



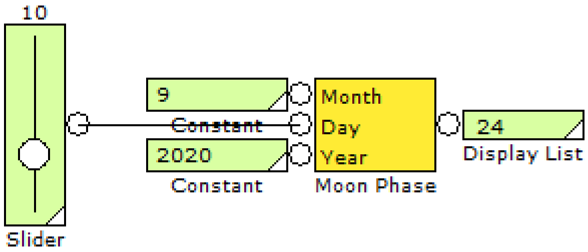
Month

The Month component outputs the current calendar month.Functions - column 7



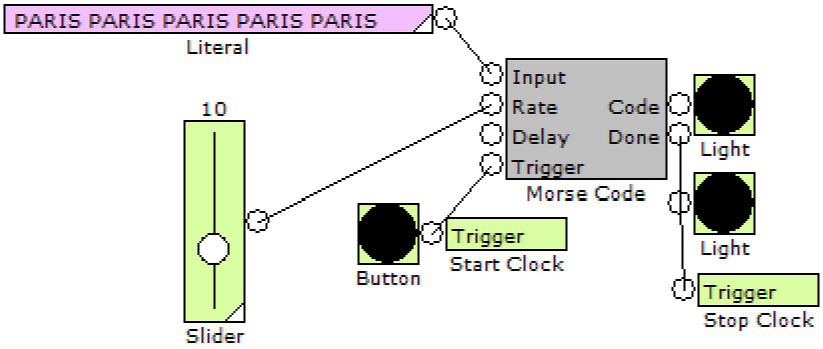
Moon Phase

The Moon Phase component calculates the Phase of the Moon. Output is days since the New Moon (0 to 29, where 0=new moon, 15=full) for the selected date.   Functions - column 9



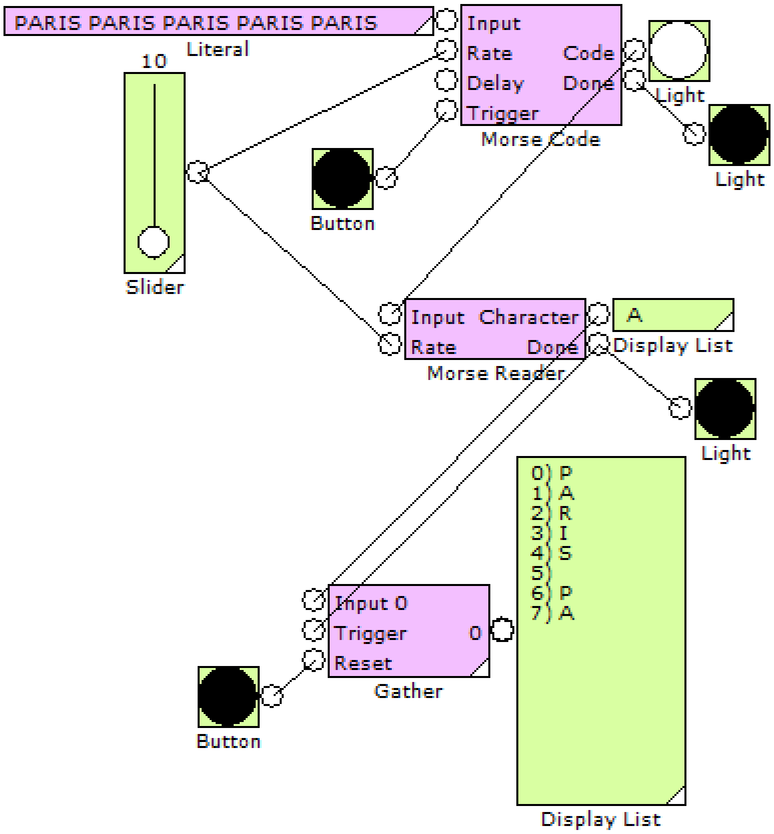
Morse Code

The Morse Code component generates pulses based on the inputs. These pulses can be connected to a light or sound input. You can use the delay to give you time to respond to the Morse code while learning the character sounds at a higher speed. Arrays - column 7



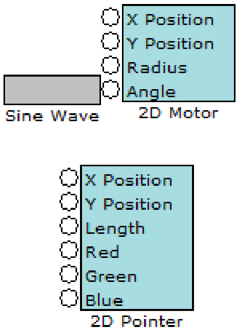
Morse Reader

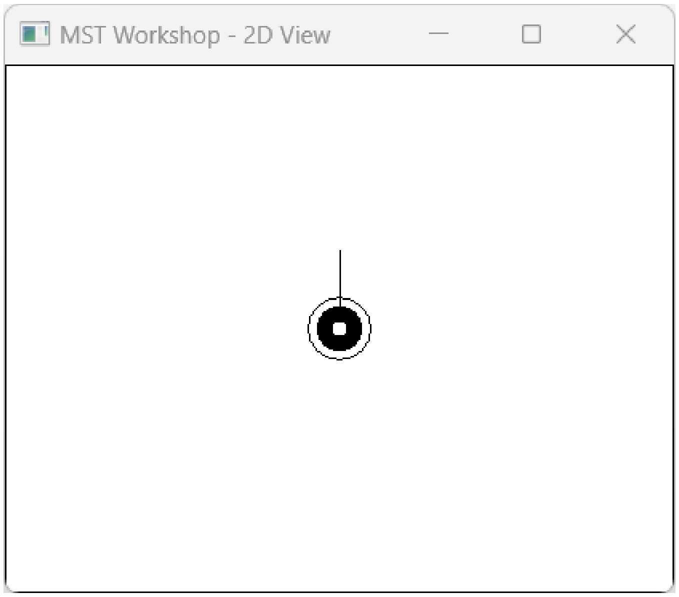
The Morse Reader component receives pulses and converts them to the equivalent Morse Code. Arrays - column 7



2D Motor

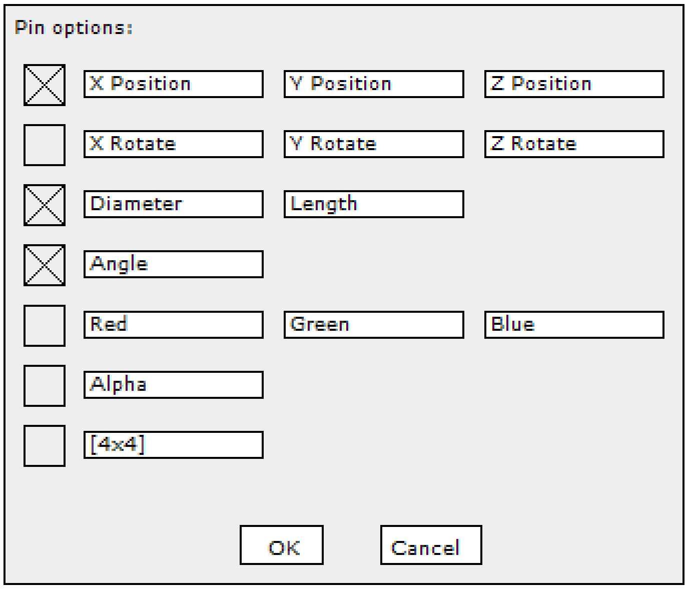
The 2D Motor converts it input directly into shaft rotation. Place a Gear at the same X, Y position to connect the motor to the gear.
2D - column 3





3D Motor

The 3D Motor creates a motor that can drive other 3D simulation objects like 3D Gears. Place a Gear at the same X, Y, Z position and orientation to connect the gear to a motor. You specify the angle of the motor's shaft. 3D - column 4



Pin options:

☒ X Position | Y Position | Z Position

☐ X Rotate | Y Rotate | Z Rotate

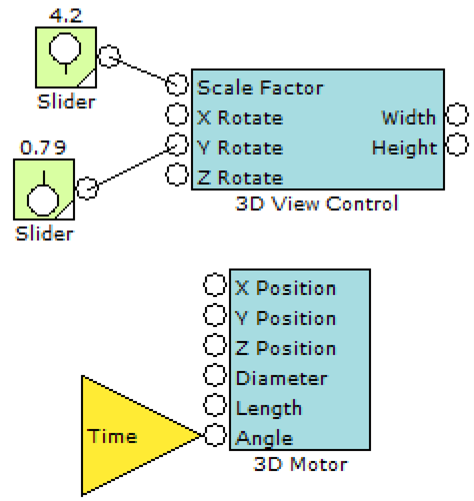
☒ Diameter | Length

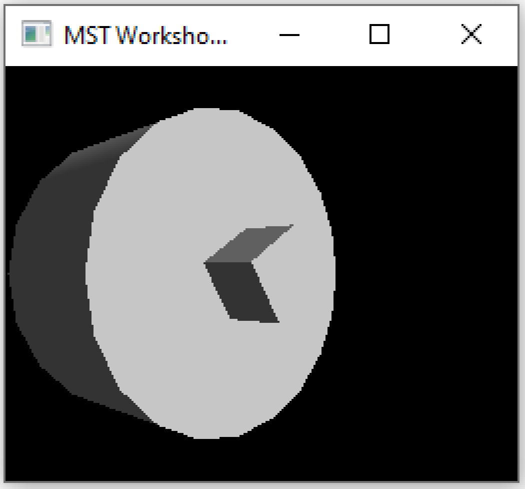
☒ Angle

☐ Red | Green | Blue

☐ Alpha

☐ [4x4]

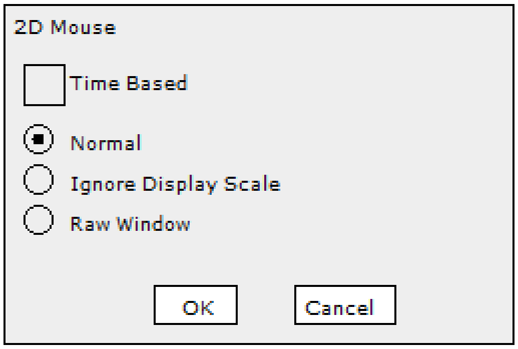




2D Mouse

The 2D Mouse gives you the X and Y position of the cursor in the 2D display window. There are Options for how the X and Y values are measured. The Z output is from the wheel on the mouse. The Button output gives 5 mouse buttons in this order: Left, Middle, Right, Extra Left, Extra Right.

Controls - column 1

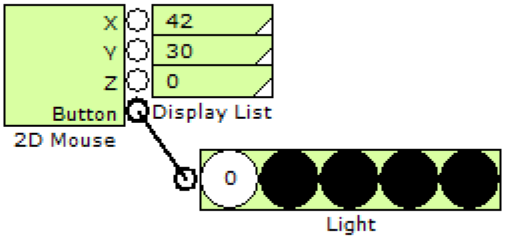

2D Mouse

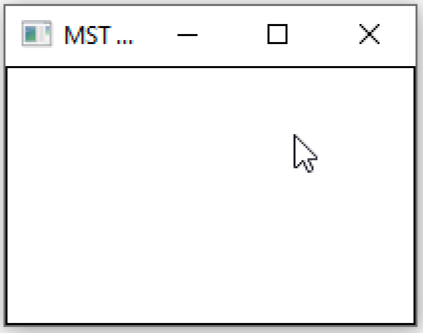
□ Time Based

● Normal

○ Ignore Display Scale

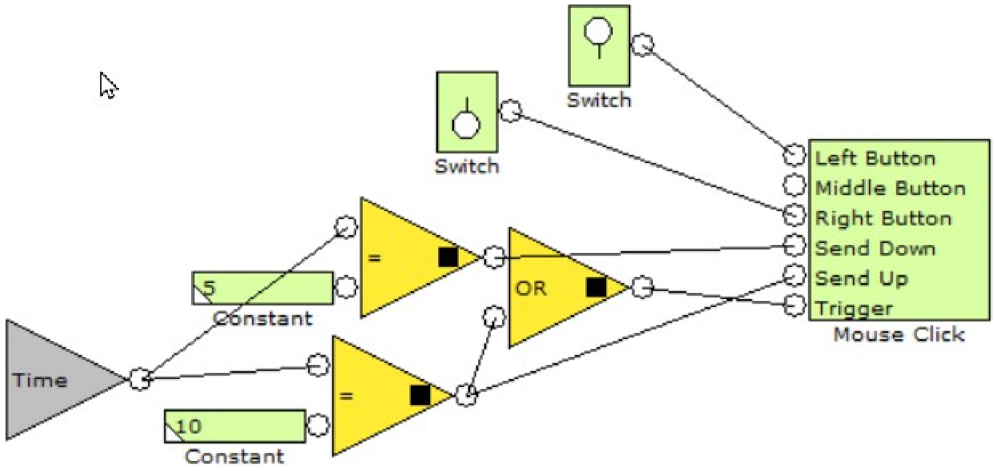
○ Raw Window





Mouse Click

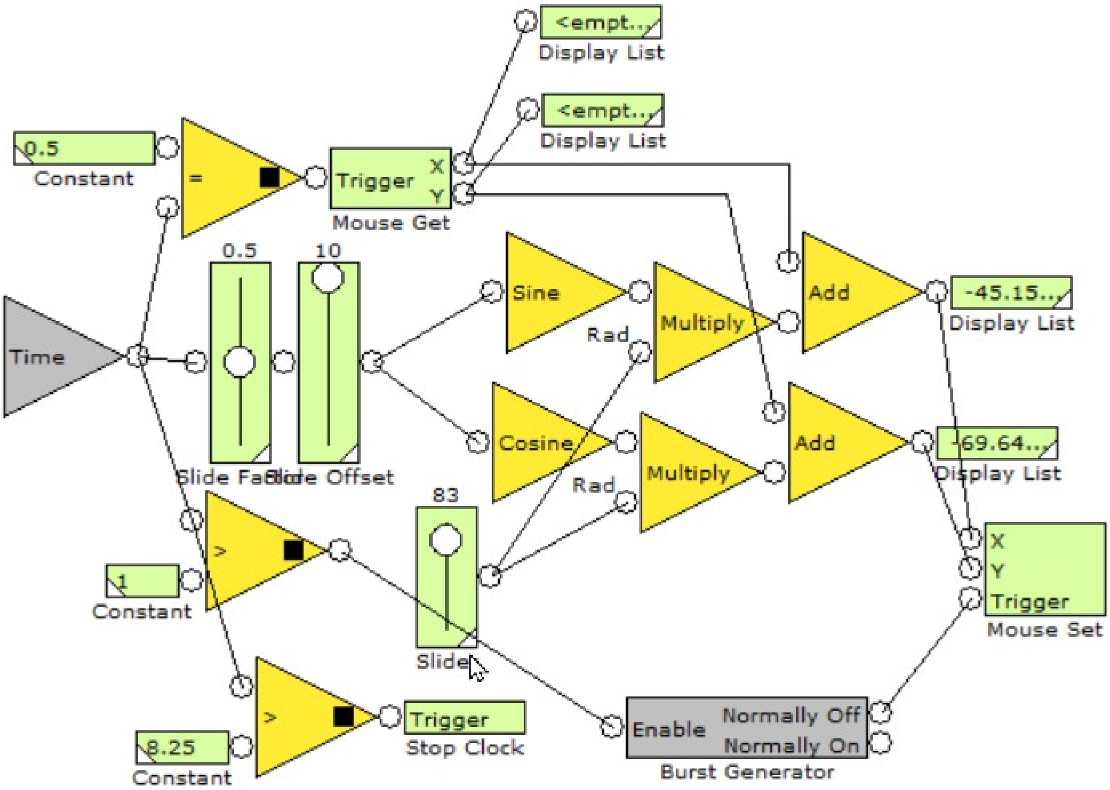
The Mouse Click component simulates a mouse click as if someone is clicking the computer's mouse buttons. Connect True or False for the Left and Right inputs to select which button and True or False for the desired Up and Down action. Controls – column 4



Reset and start this solution and it will click the left button down at 5 seconds and release it at 10 seconds. You can see the effect by opening a word processor and dragging the mouse through the text as this solution runs. A section of the text will be selected.

Mouse Get

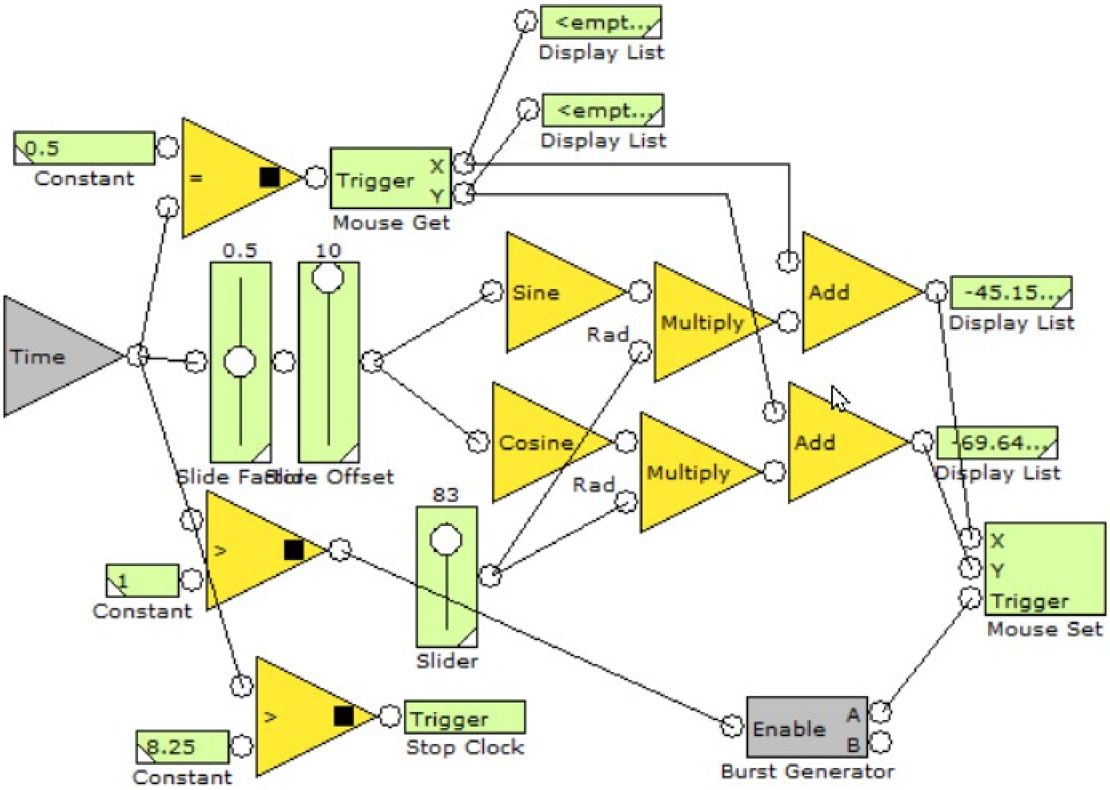
The Mouse Get component gets the x and y coordinates of the computer's mouse. Controls – column 4



This solution gets the current mouse position and drives it in a semicircle around that position when the clock is started.

Mouse Set

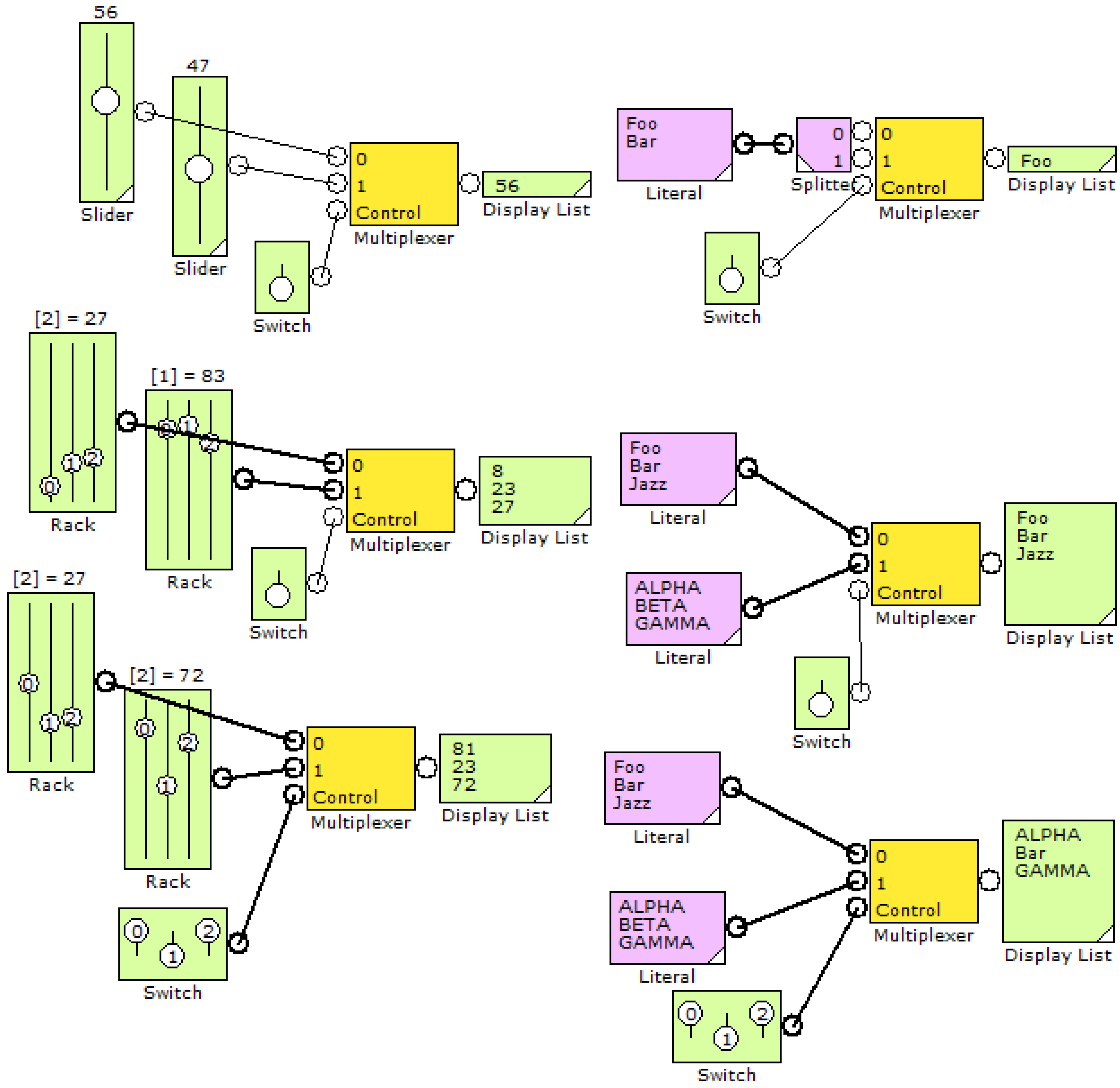
The Mouse Set component sets the x and y coordinates of the mouse as if someone moved the computer's mouse. Controls – column 4



This solution gets the current mouse position and drives it in a semicircle around that position when the clock is started.

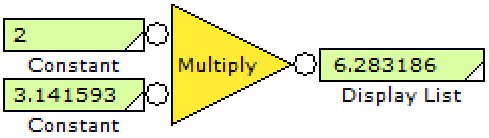
Multiplexer

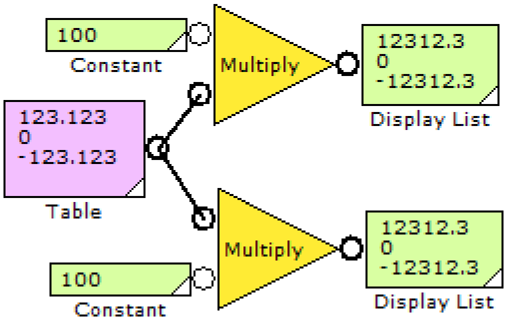
The Multiplexer can switch inputs based on the Control input. Functions - column 6

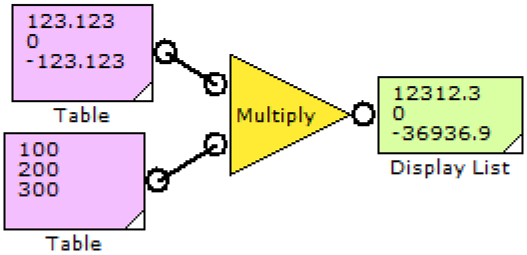


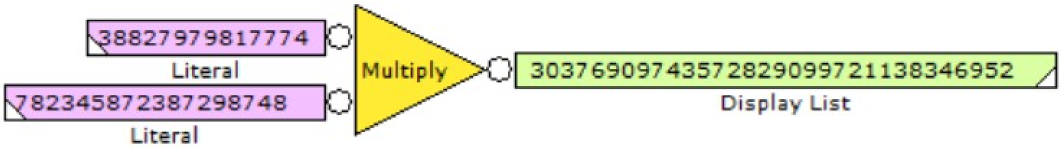
Multiply

The Multiply component multiplies the inputs together. Inputs can be scalar and /or arrays.
Functions - column 1



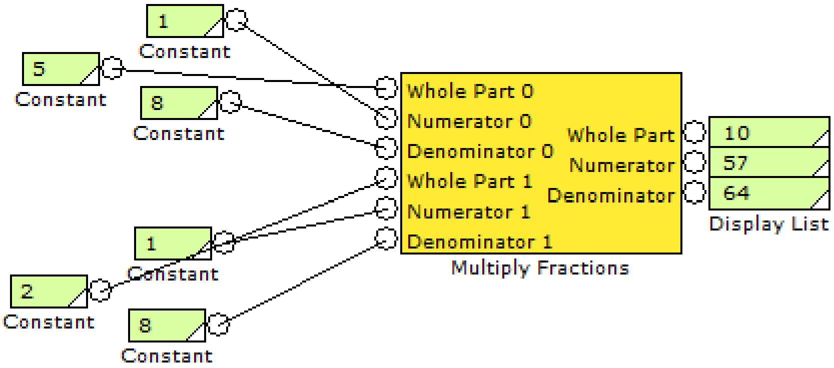






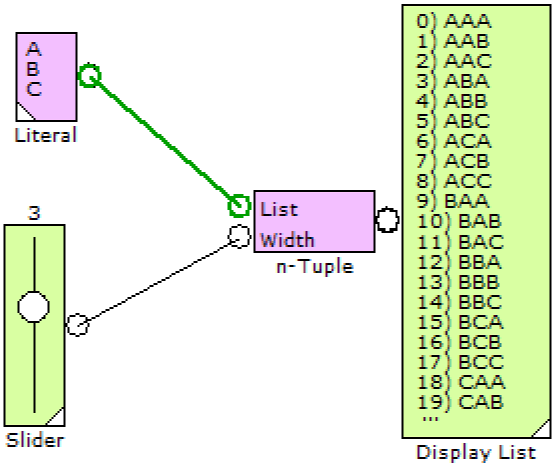
Multiply Fractions

The Multiply Fractions component multiplies two numbers with fractions. The output is a whole number with a fraction as needed.   Functions - column 9

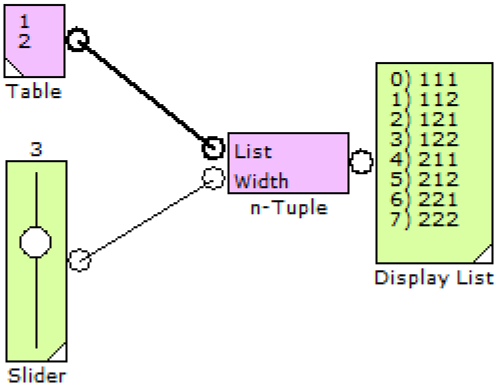


n-Tuple

The n-Tuple component outputs a list of values using the set of inputs with the specified width. Arrays – column 5.



```
0) AAA
1) AAB
2) AAC
3) ABA
4) ABB
5) ABC
6) ACA
7) ACB
8) ACC
9) BAA
10) BAB
11) BAC
12) BBA
13) BBB
14) BBC
15) BCA
16) BCB
17) BCC
18) CAA
19) CAB
...
```

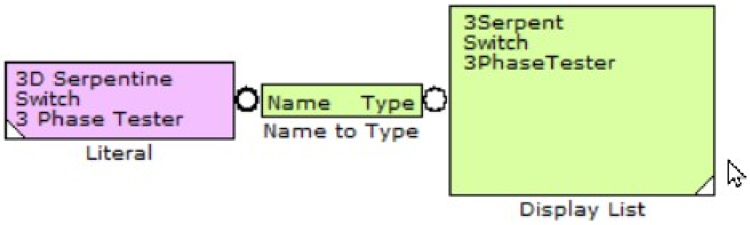


```
0) 111
1) 112
2) 121
3) 122
4) 211
5) 212
6) 221
7) 222
```

Name to Type

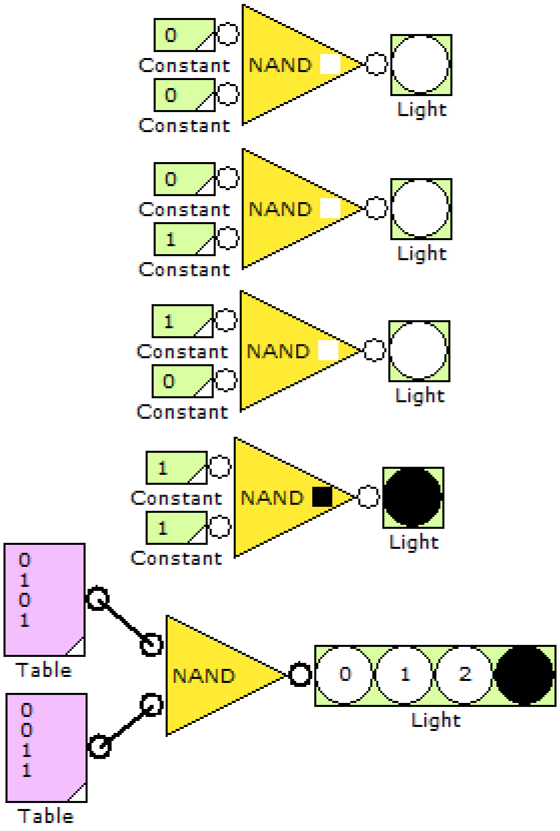
The Name to Type Component returns the internal type for each component name input.

Controls - column 5



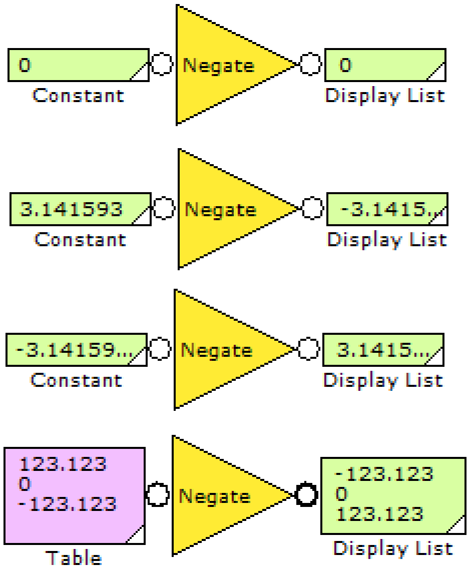
NAND

The NAND component compares the inputs and returns false if both values are true. It's output is the opposite of the AND component. Inputs can be scalars or arrays.   Functions - column 3



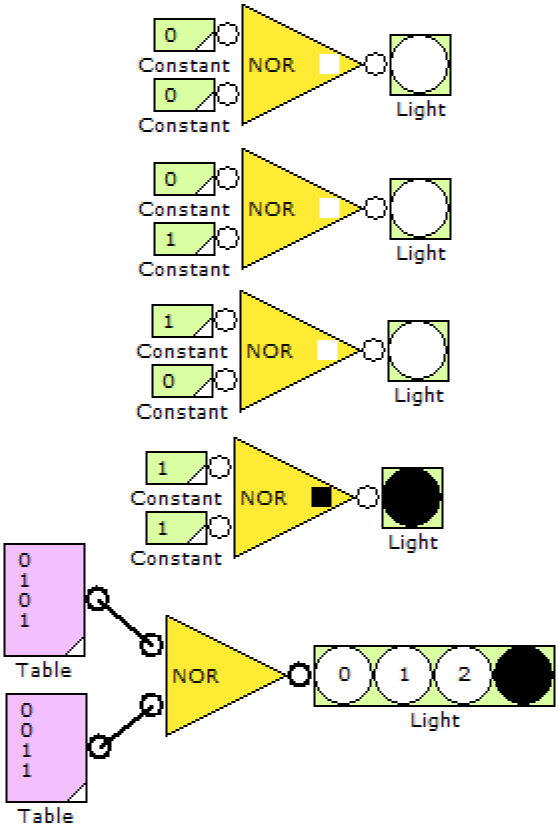
Negate

The Negate component changes the sign of the input. Input can be a scalar or an array. Functions - column 1



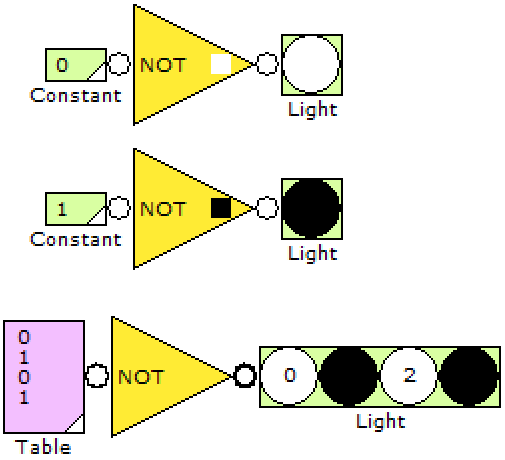
NOR

The NOR component compares the inputs and returns false if either or both values are true. It's output is the opposite of the OR component. Inputs can be scalars or arrays. Functions - column 3



NOT

The NOT component compares the inputs and returns true if the input if false, returns false if the input is true. Inputs can be scalars or arrays. Functions - column 3

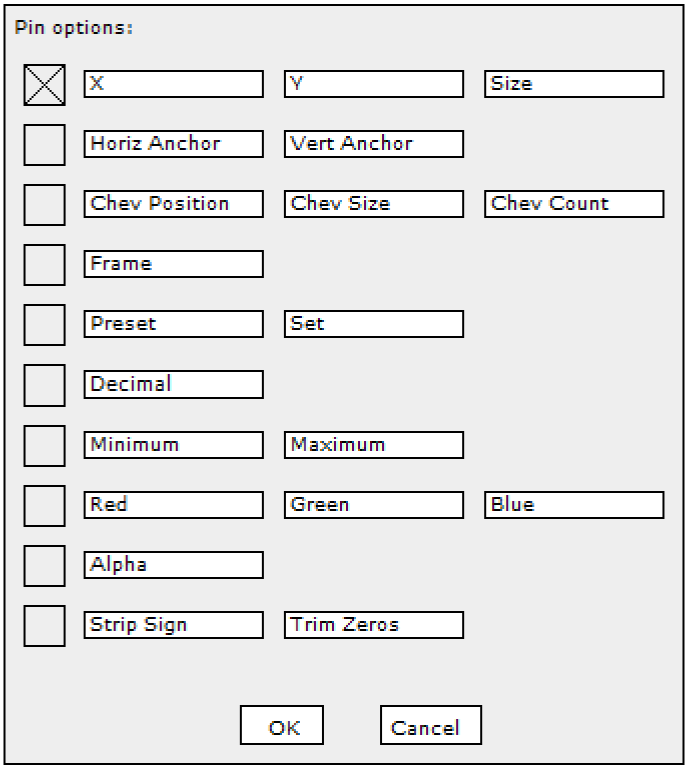


2D Number Spinner

The 2D Number Spinner is used to enter a number on the 2D canvas.

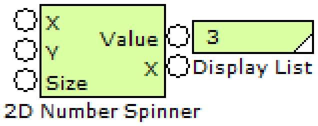
The X, Y and Size inputs control the position and font size of the number.
The Anchor inputs offset the number to left, center or right justify.
The Chevron Position inputs control the horizontal position and size.
The Frame input frames the number.
The Preset inputs allow setting the value externally.
The Decimal input sets the number of decimal places displayed.
The Limit inputs allow setting minimum and maximum values allowed.
The Color inputs color the number.
The Alpha input fades the number.
The Text input takes a list of text options to display.
The Horizontal outputs give the left and right frame coordinates.
The Vertical outputs give the top and bottom frame coordinates.
The Sign output is one when the value is negative AND suppresses the sign on the canvas.

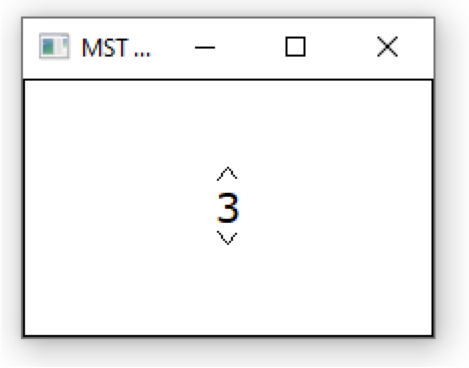
Controls - column 2



Pin options:

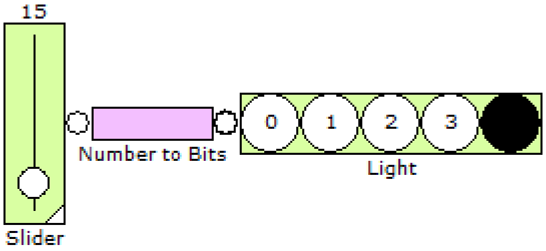
☒	X	Y	Size
□	Horiz Anchor	Vert Anchor	
□	Chev Position	Chev Size	Chev Count
□	Frame		
□	Preset	Set	
□	Decimal		
□	Minimum	Maximum	
□	Red	Green	Blue
□	Alpha		
□	Strip Sign	Trim Zeros	





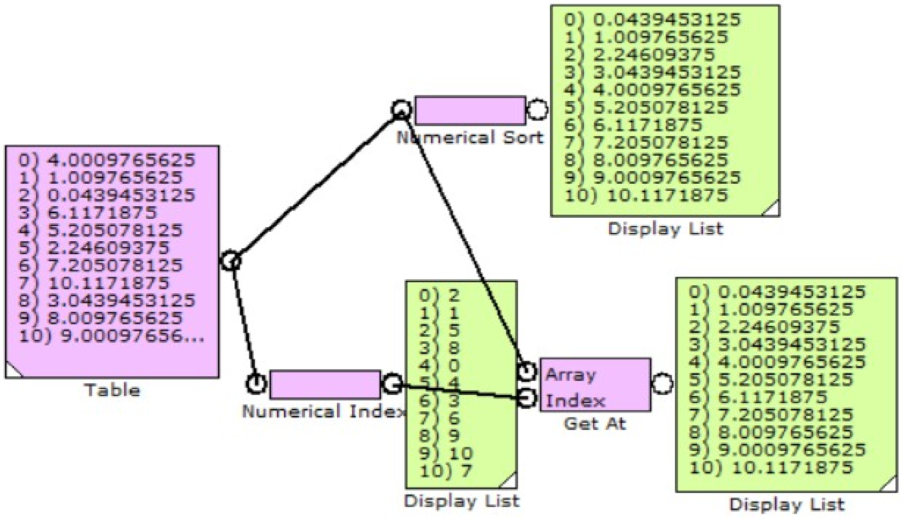
Number to Bits

The Number to Bits component breaks the input into an array of bit values.   Arrays - column 4



Numerical Index

The Numerical Index component outputs a list of numbers in the order of the sorted numerical input.
Arrays – column 4



```
0) 4.0009765625
1) 1.009765625
2) 0.0439453125
3) 6.1171875
4) 5.205078125
5) 2.24609375
6) 7.205078125
7) 10.1171875
8) 3.0439453125
9) 8.009765625
10) 9.00097656...
```

```
0) 0.0439453125
1) 1.009765625
2) 2.24609375
3) 3.0439453125
4) 4.0009765625
5) 5.205078125
6) 6.1171875
7) 7.205078125
8) 8.009765625
9) 9.0009765625
10) 10.1171875
```

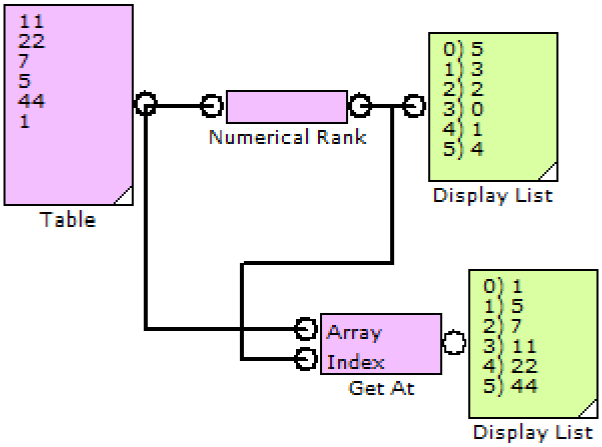
```
0) 2
1) 1
2) 5
3) 8
4) 0
5) 4
6) 3
7) 6
8) 9
9) 10
10) 7
```

```
0) 0.0439453125
1) 1.009765625
2) 2.24609375
3) 3.0439453125
4) 4.0009765625
5) 5.205078125
6) 6.1171875
7) 7.205078125
8) 8.009765625
9) 9.0009765625
10) 10.1171875
```

Numerical Rank

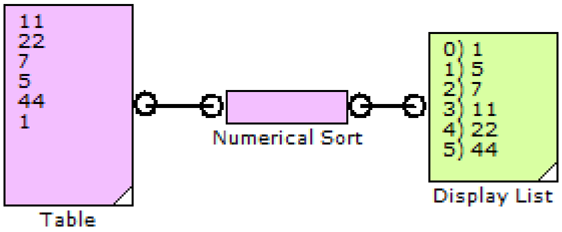
The Numerical Rank component outputs a list of numbers in the order of the sorted numerical input.

Arrays - column 4



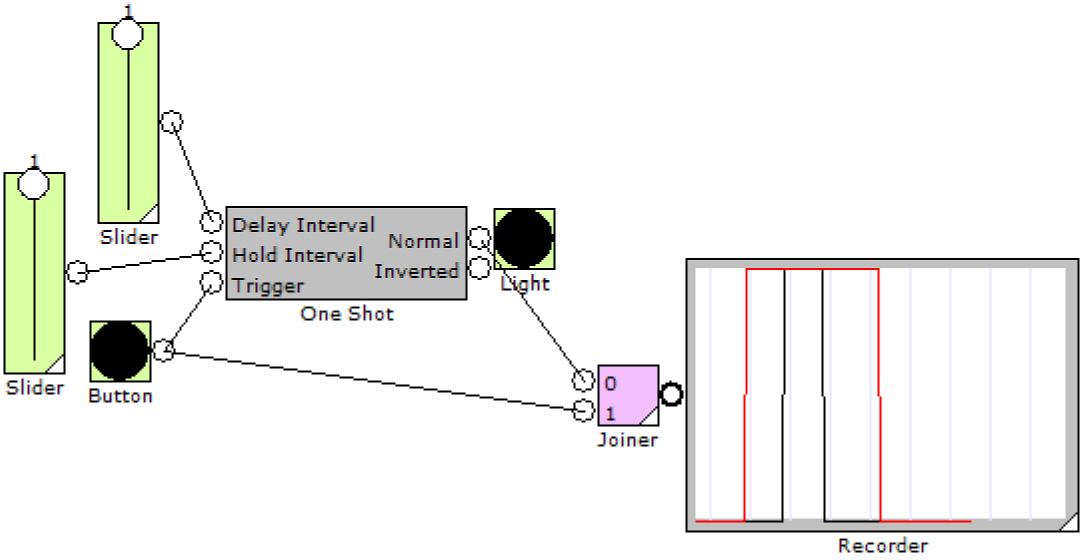
Numerical Sort

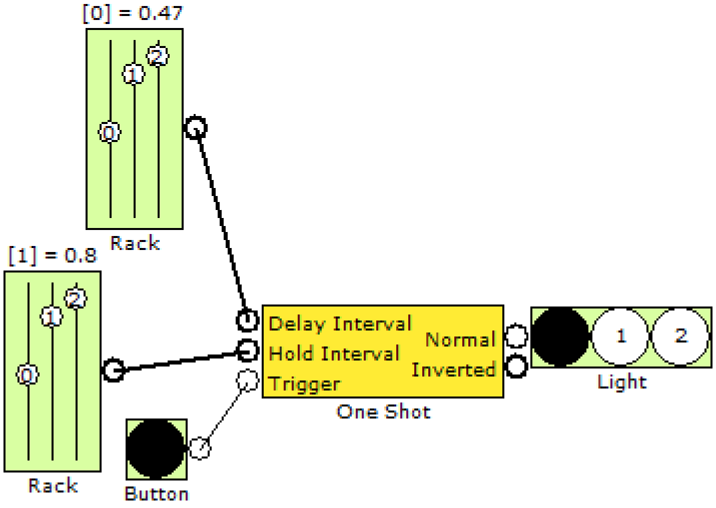
The Numerical Sort component sorts the input values into numerical order. Arrays - column 4



One Shot

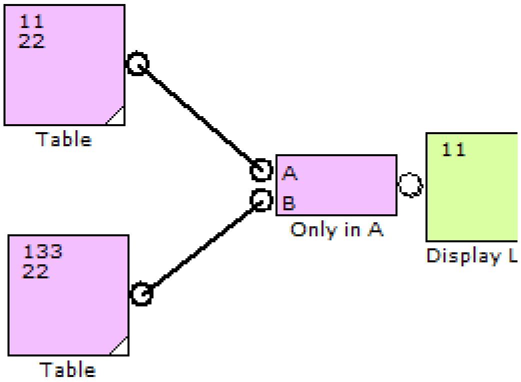
The One Shot component starts when the Trigger input is triggered, then delays for the Delay interval, then goes high for the Hold interval, then resets. Inputs are milliseconds. Functions - column 7

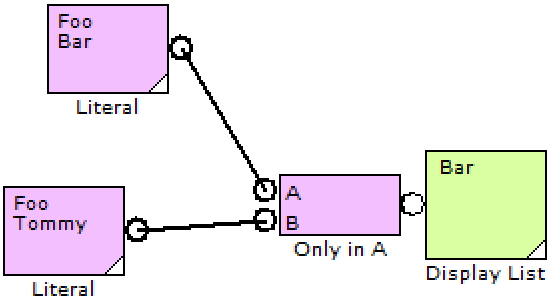




Only in A

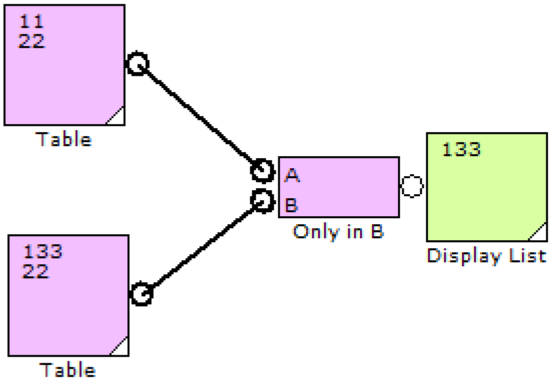
The Only in A component scans the input arrays and outputs the elements that are only found in the top input array.   Arrays - column 5

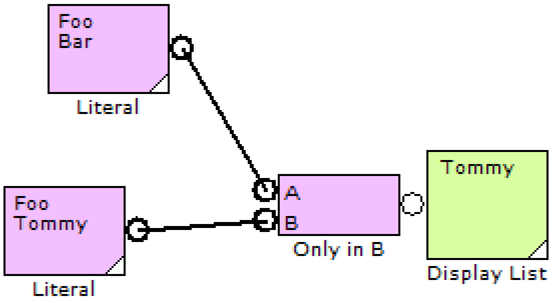




Only in B

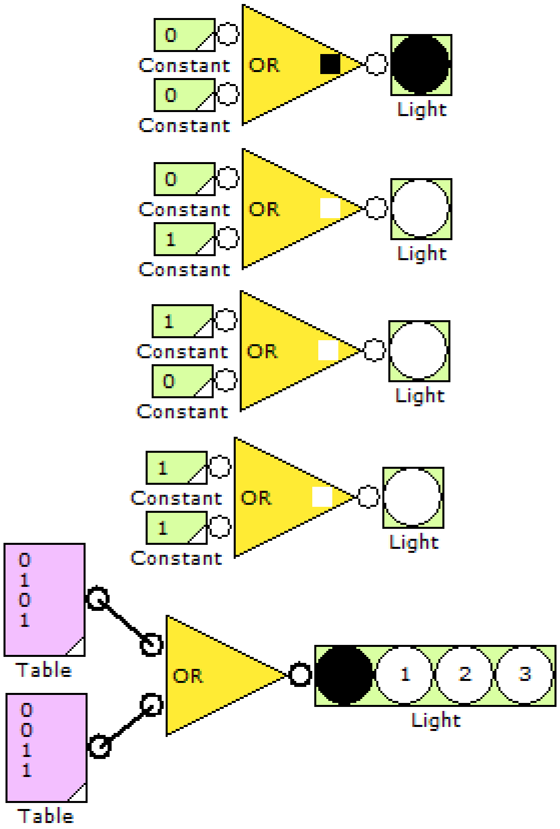
The Only in B component scans the input array and outputs the elements that are only found in the bottom input array.   Arrays - column 5





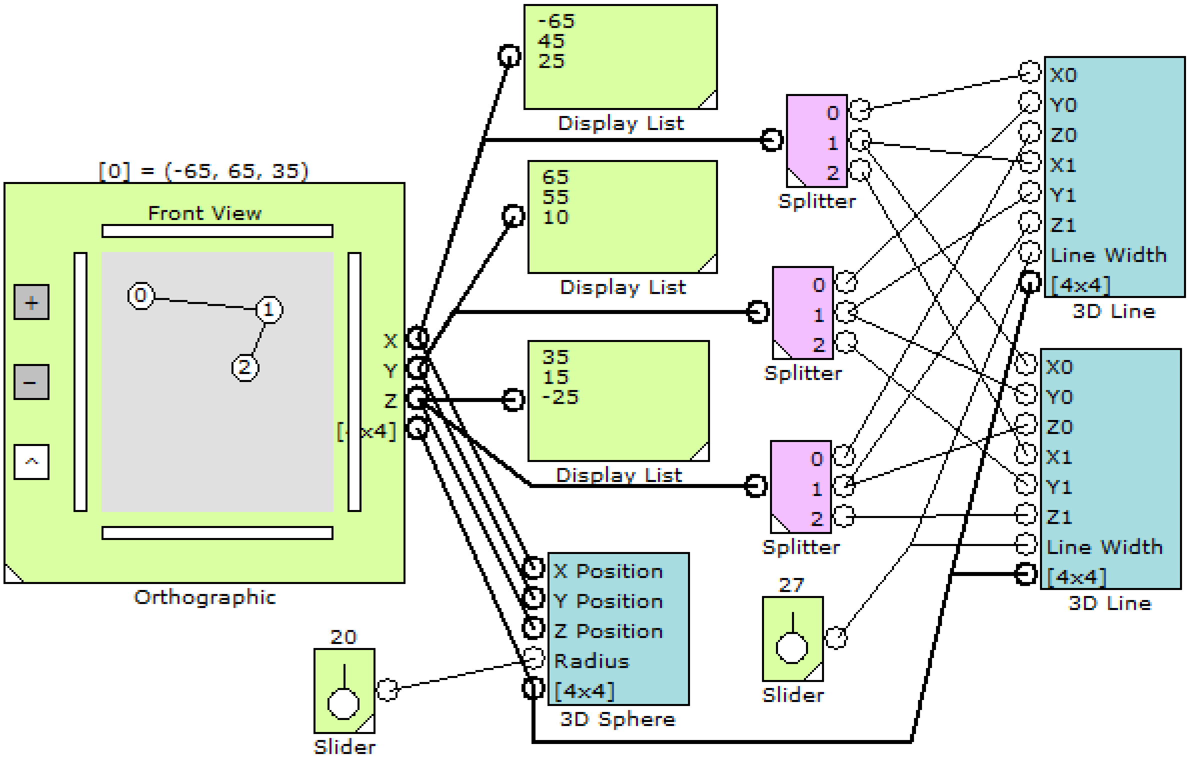
OR

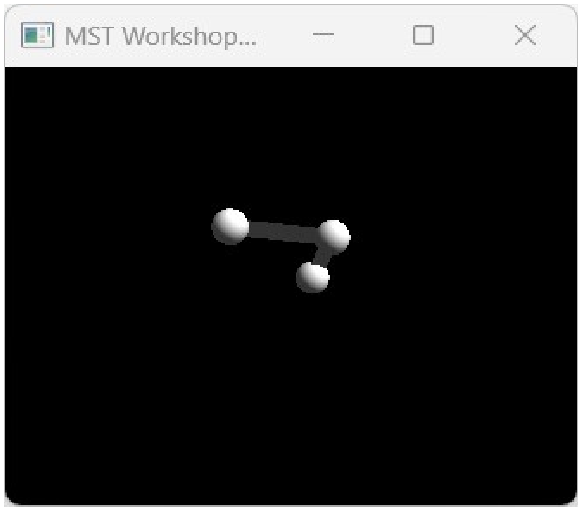
The OR component compares the inputs and returns true if either or both values are true. Inputs can be scalars or arrays.   Functions - column 3



Orthographic

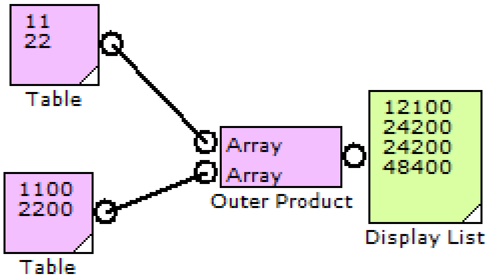
The Orthographic lets you generate a function in 3 dimensions. You can move the points in X and Y at first but then shift from the front view to top, bottom, left, right or back dragging the vertical controls on the edges of the component. Depending on the view, moving the points left/right or up/down changes the X, Y and Z coordinates of the view. If you have a wheel on your mouse, you can use it to move in the in/out direction to allow control of all 3 coordinates in each view. Note: This component can be operated using the wheel on the mouse. Controls - column 2



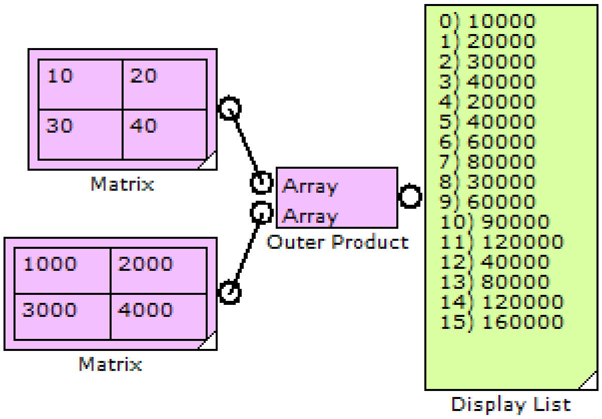


Outer Product

The Outer Product component combines the input arrays multiplying the values from each input into a larger array.   Arrays - column 3



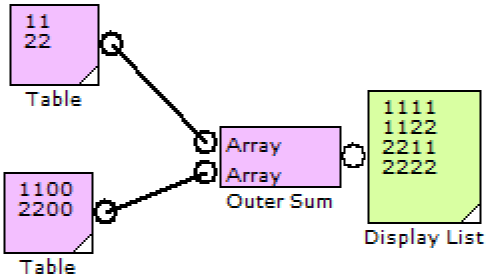
```
12100
24200
24200
48400
```



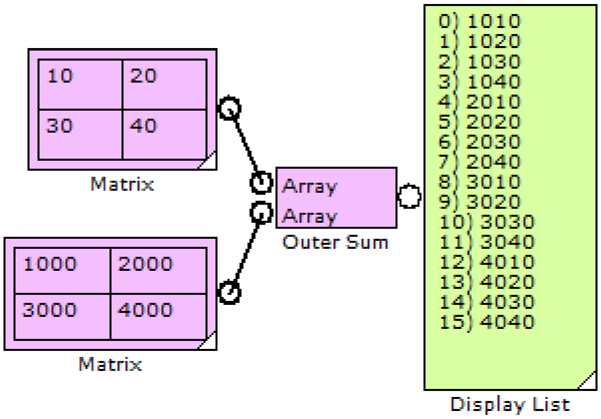
```
0) 10000
1) 20000
2) 30000
3) 40000
4) 20000
5) 40000
6) 60000
7) 80000
8) 30000
9) 60000
10) 90000
11) 120000
12) 40000
13) 80000
14) 120000
15) 160000
```

Outer Sum

The Outer Sum component combines the input arrays summing the values from each input into a larger array.   Arrays - column 3



```
1111
1122
2211
2222
```

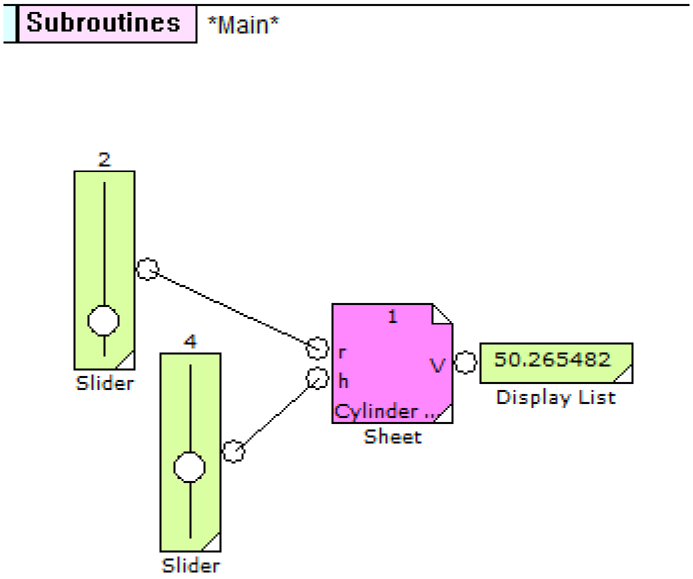


```
0) 1010
1) 1020
2) 1030
3) 1040
4) 2010
5) 2020
6) 2030
7) 2040
8) 3010
9) 3020
10) 3030
11) 3040
12) 4010
13) 4020
14) 4030
15) 4040
```

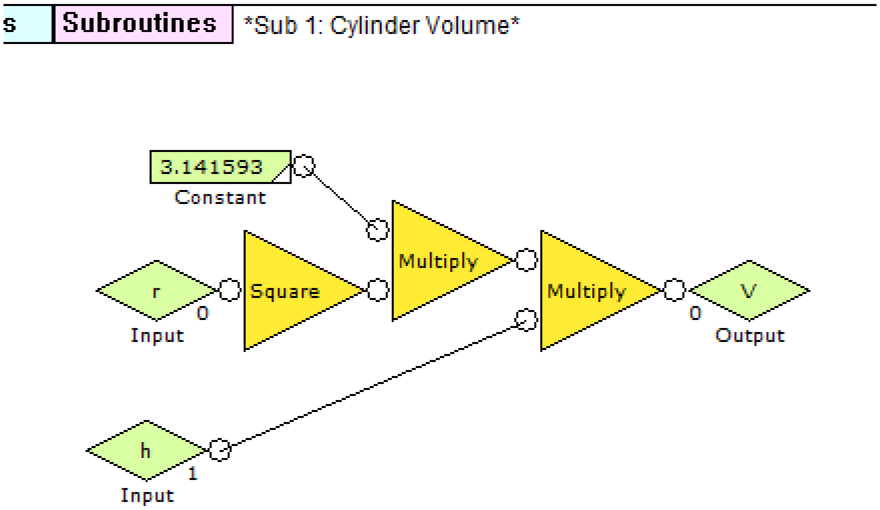
Output

The Output component is used in a subroutine to carry output values out of the subroutine. Each Output shows as an output pin on the subroutine icon. Controls - column 5

In the main workspace:

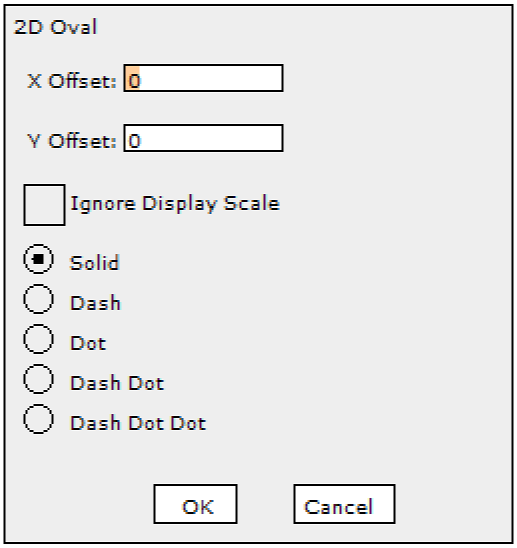


In the subroutine:



2D Oval

The 2D Oval component draws an oval on the 2D canvas. You can control a portion of the oval to make an arc. 2D - column 1



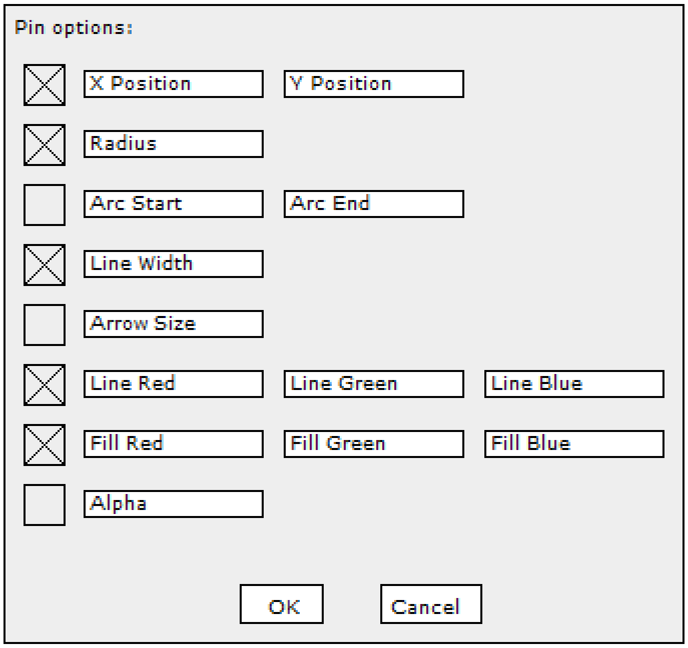
2D Oval

X Offset: 0

Y Offset: 0

☐ Ignore Display Scale

● Solid
○ Dash
○ Dot
○ Dash Dot
○ Dash Dot Dot



Pin options:

☒ X Position | Y Position

☒ Radius

☐ Arc Start | Arc End

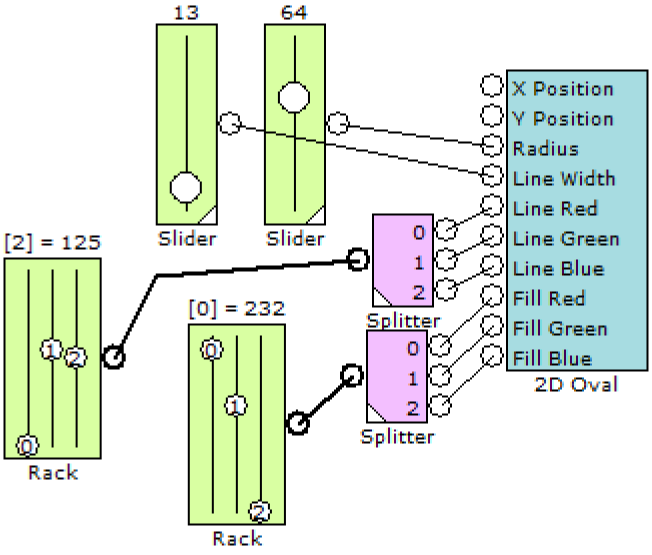
☒ Line Width

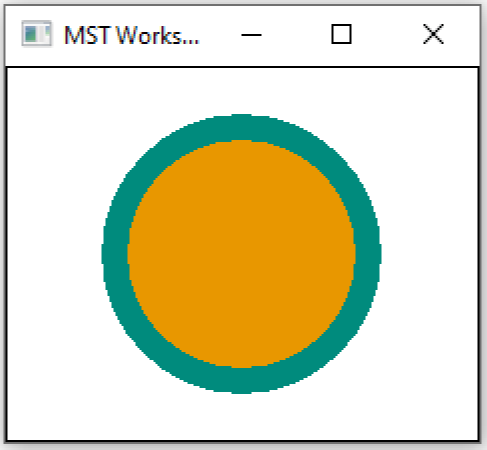
☐ Arrow Size

☒ Line Red | Line Green | Line Blue

☒ Fill Red | Fill Green | Fill Blue

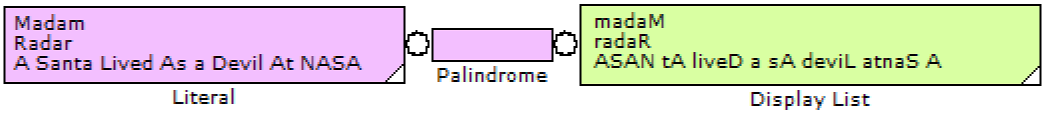
☐ Alpha





Palindrome

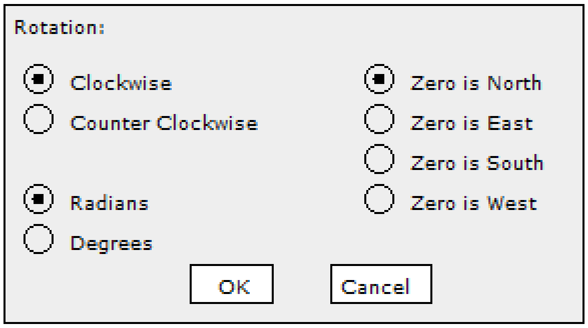
The Palindrome component reverses the characters in a string.   Arrays - column 6



Madam
Radar
A Santa Lived As a Devil At NASA
Literal
Palindrome
madaM
radaR
ASAN tA liveD a sA deviL atnaS A
Display List

2D Parabola

The 2D Parabola component draws a parabola outline using the X and Y points given. You can control the line thickness.   2D - column 1

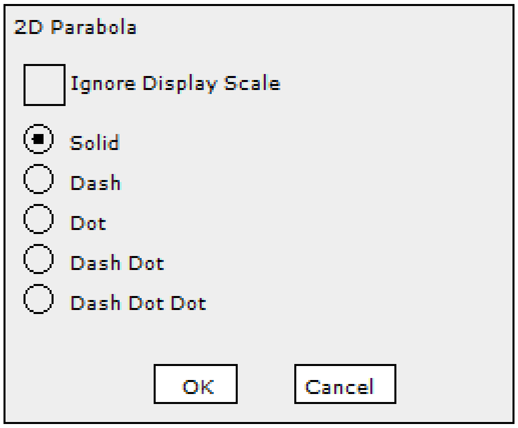


Rotation:

● Clockwise
○ Counter Clockwise

● Radians
○ Degrees

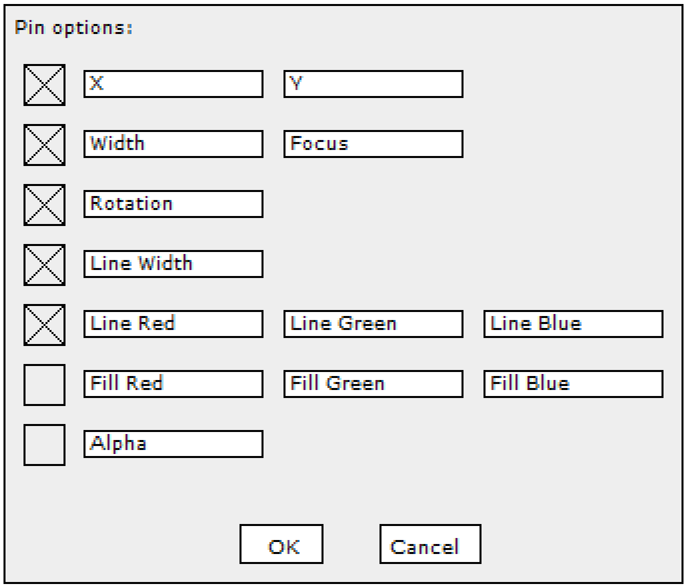
● Zero is North
○ Zero is East
○ Zero is South
○ Zero is West



2D Parabola

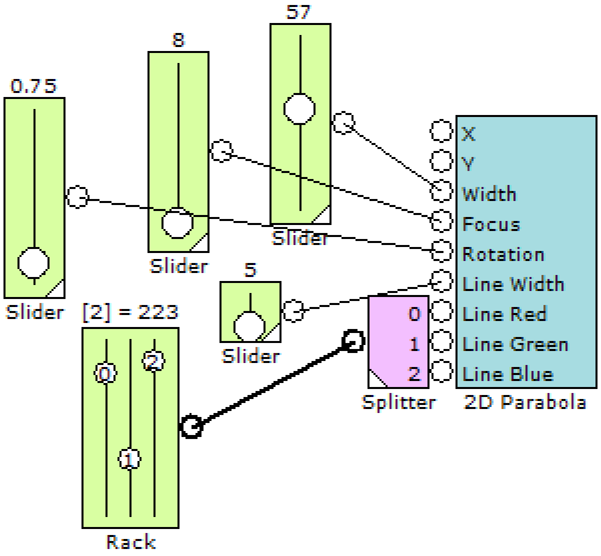
□ Ignore Display Scale

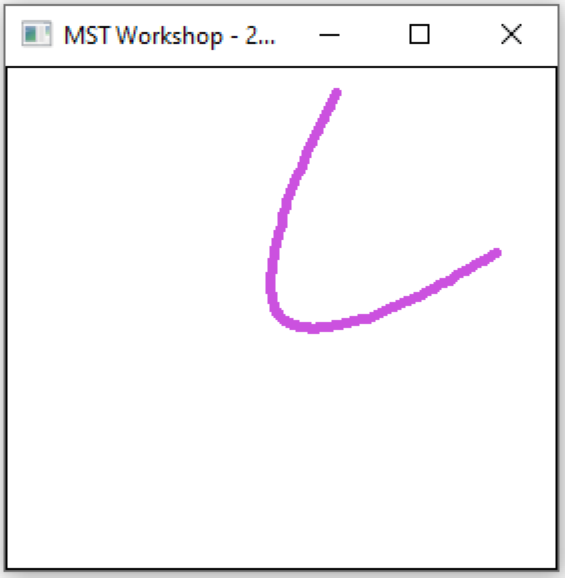
● Solid
○ Dash
○ Dot
○ Dash Dot
○ Dash Dot Dot



Pin options:

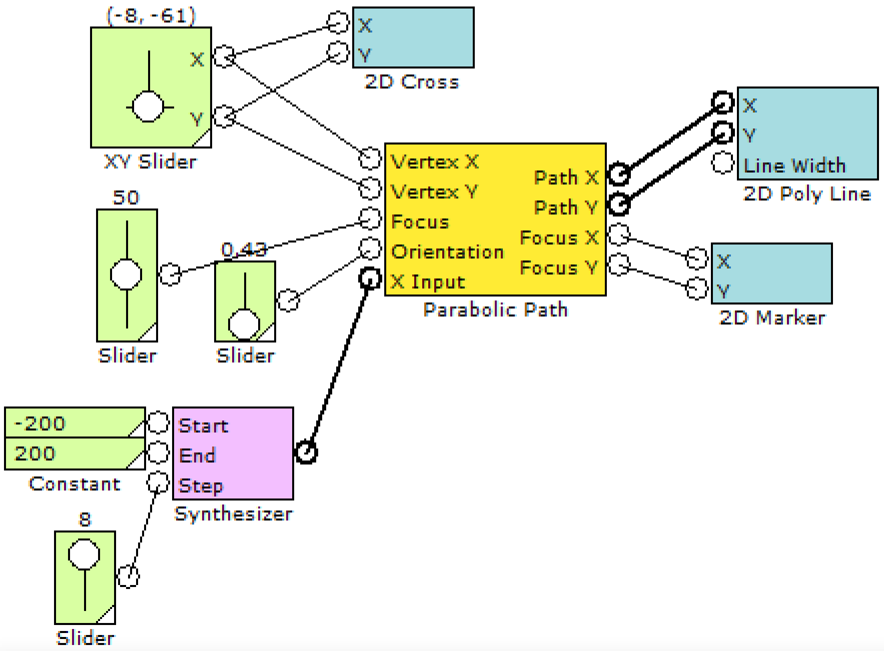
☒ X Y
☒ Width Focus
☒ Rotation
☒ Line Width
☒ Line Red Line Green Line Blue
□ Fill Red Fill Green Fill Blue
□ Alpha

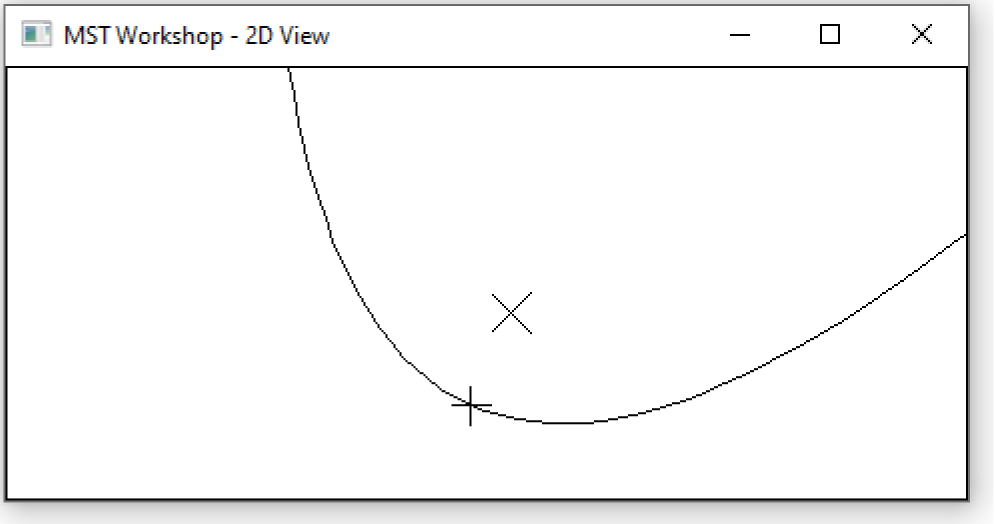




Parabolic Path

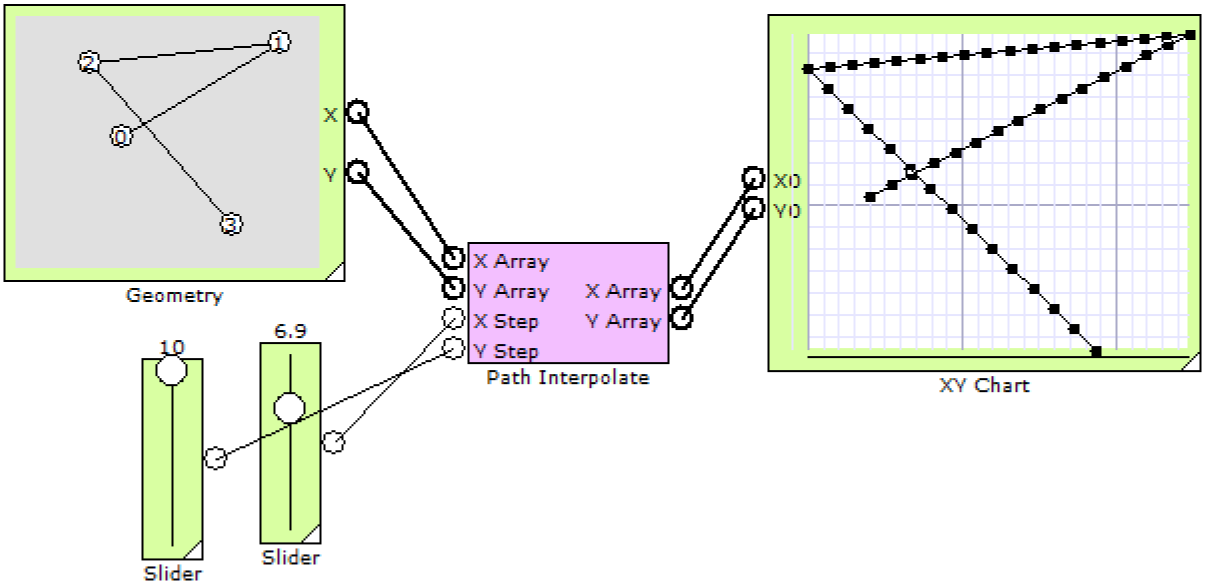
The Parabolic Path component traces the parabola(X, Y) given the inputs and a range of X Inputs.
Functions - column 9





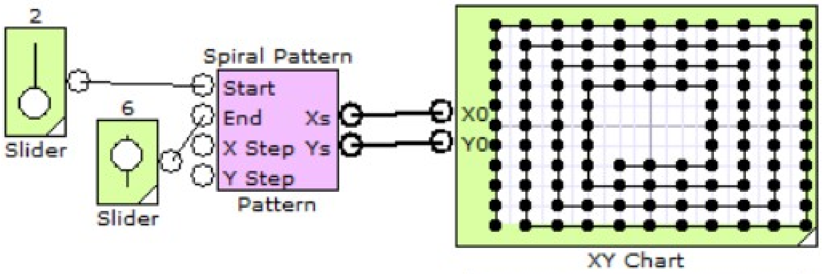
Path Interpolate

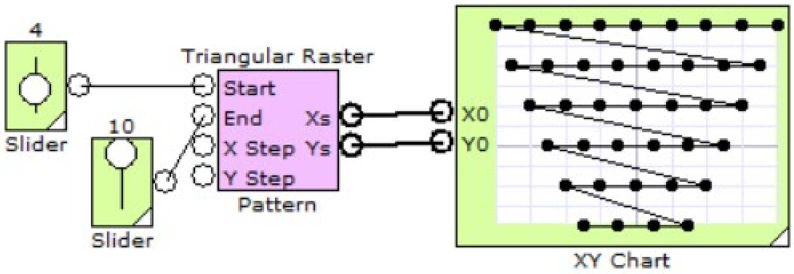
The Path Interpolate component adds intermediate points to an X, Y path. Arrays - column 7

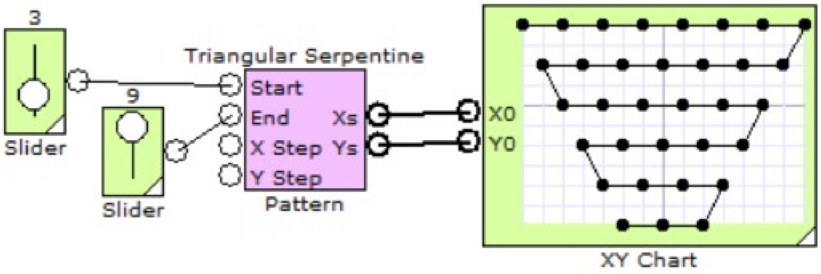


Pattern

The Pattern component creates a set of X and Y coordinates arranged in a triangular or square spiral pattern. Arrays – column 1

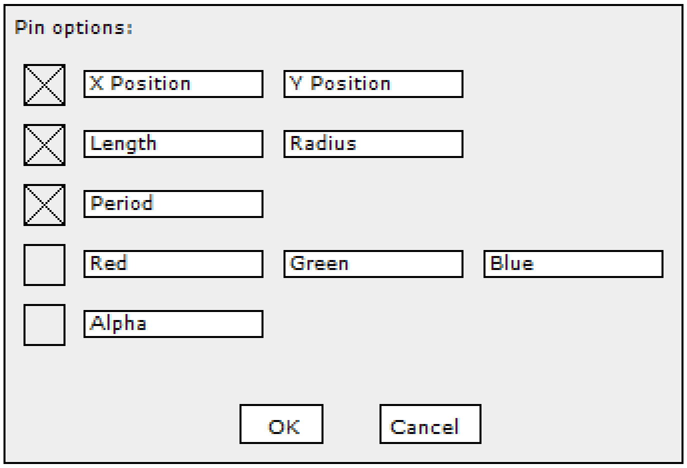






2D Pendulum

The Pendulum component can drive other simulation objects like Gears. Place a Gear at the same X, Y position to connect the pendulum to the gear.   2D - column 3



Pin options:

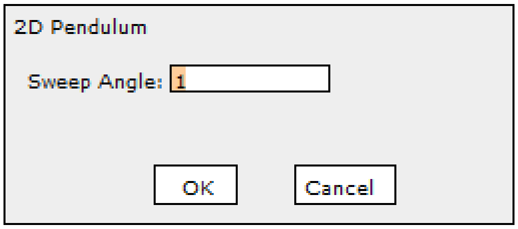
☒ X Position | Y Position

☒ Length | Radius

☒ Period

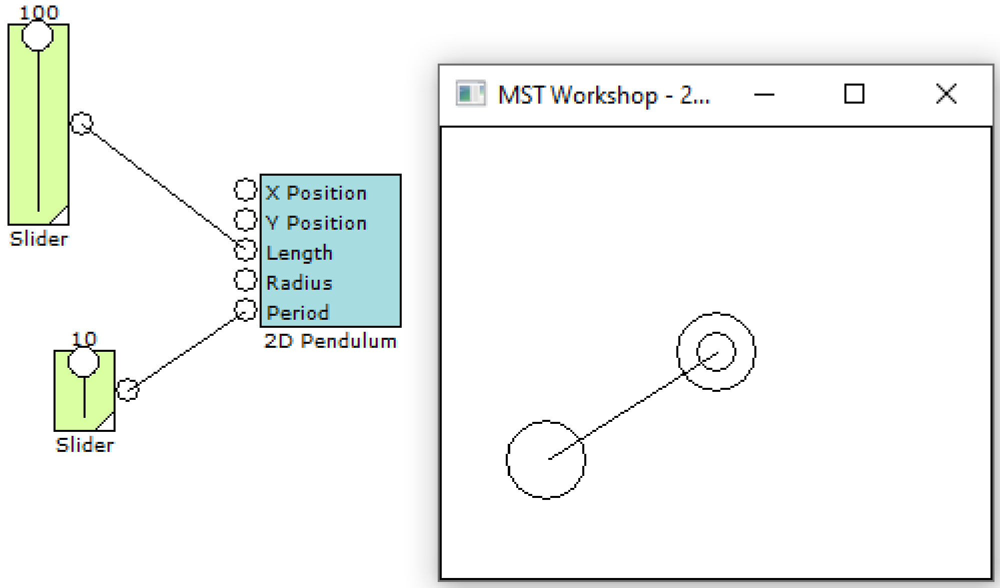
☐ Red | Green | Blue

☐ Alpha



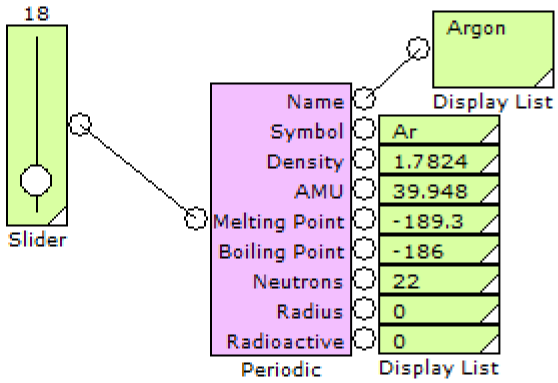
2D Pendulum

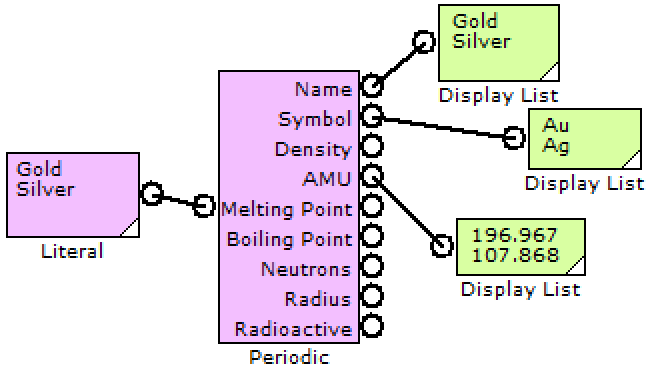
Sweep Angle: 1



Periodic

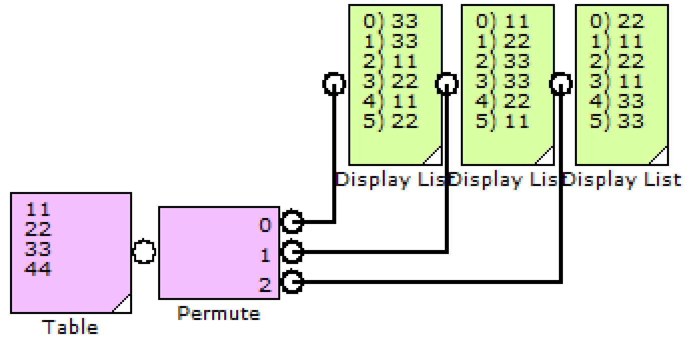
The Periodic component contains important information found in the periodic table of elements. Input the atomic number, the name, or the symbol for the desired element.   Arrays - column 5

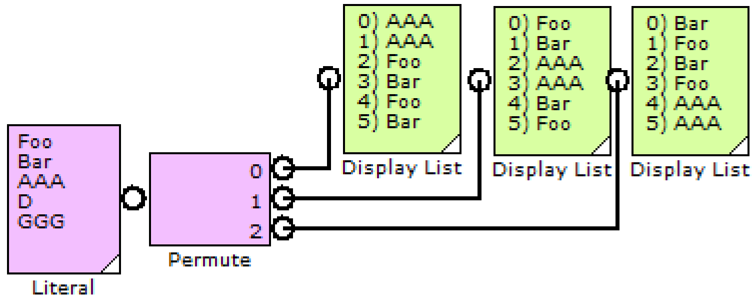




Permute

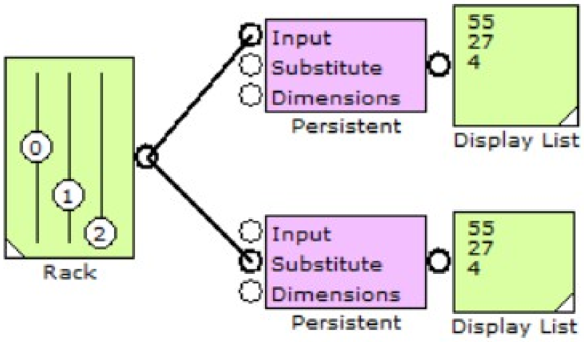
The Permute component outputs a list of all arrangements of the input values.   Arrays - column 5

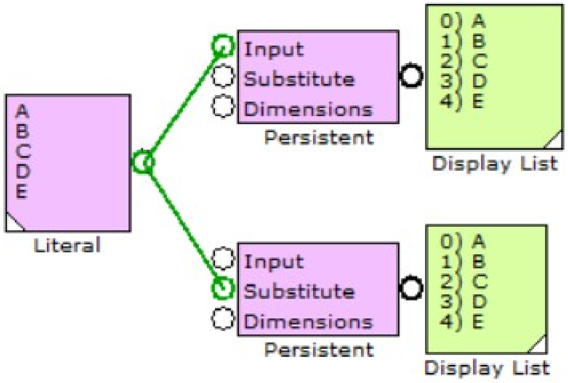




Persistent

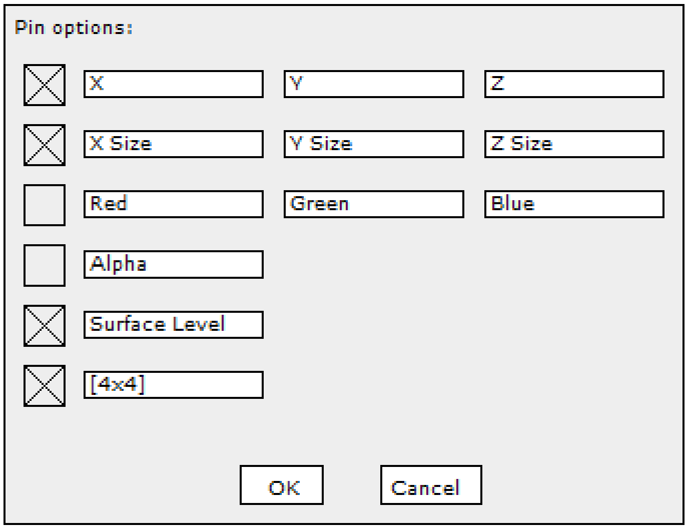
The Persistent component passes the input data when its available. Otherwise it passes the Substitute data. When no Input or Substitute data is present the Dimension input will be used to create an array of zeros with the specified dimensions.   Arrays - column 2





3D Plane Surface

The 3D Plane Surface component draws a plane with an embossed surface in the 3D view window. The Matrix and Mat Row Size inputs set the 2D data to be plotted. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 5



Pin options:

☒ X | Y | Z

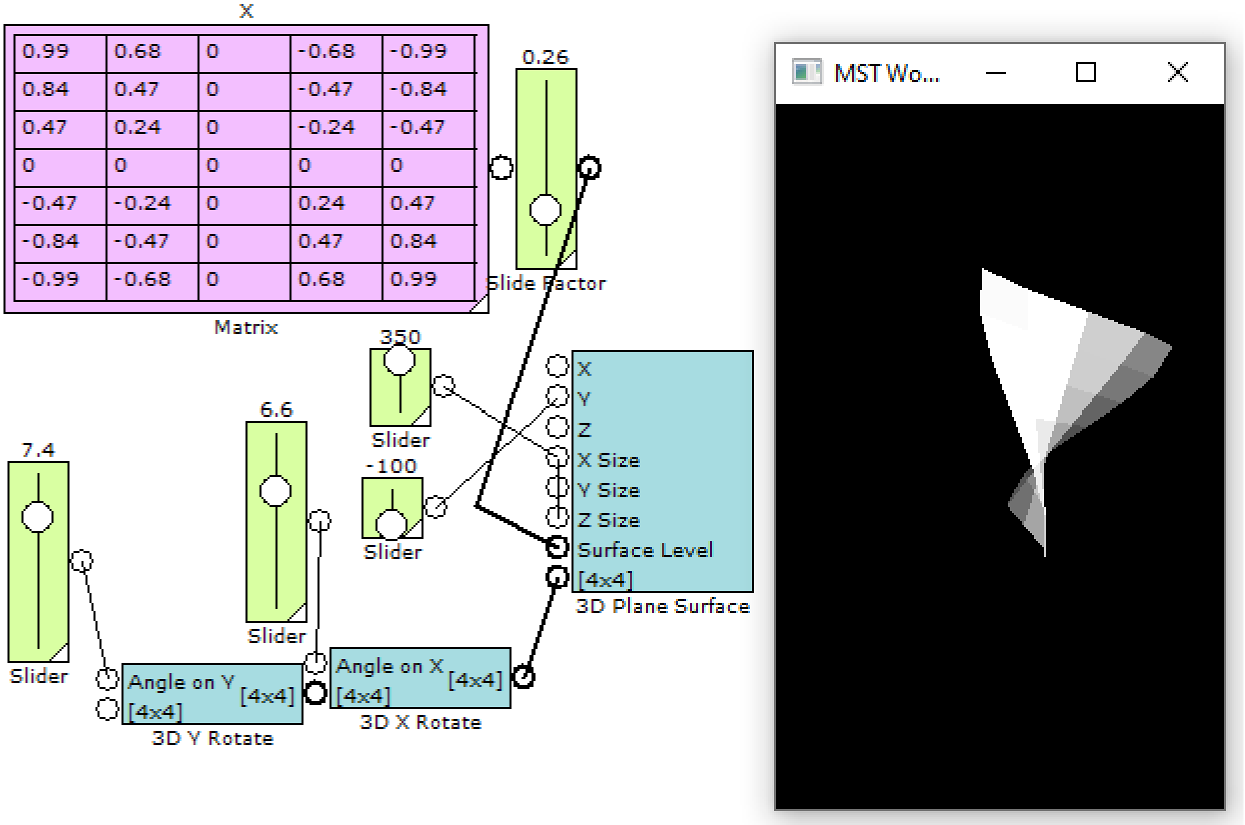
☒ X Size | Y Size | Z Size

□ Red | Green | Blue

□ Alpha

☒ Surface Level

☒ [4x4]



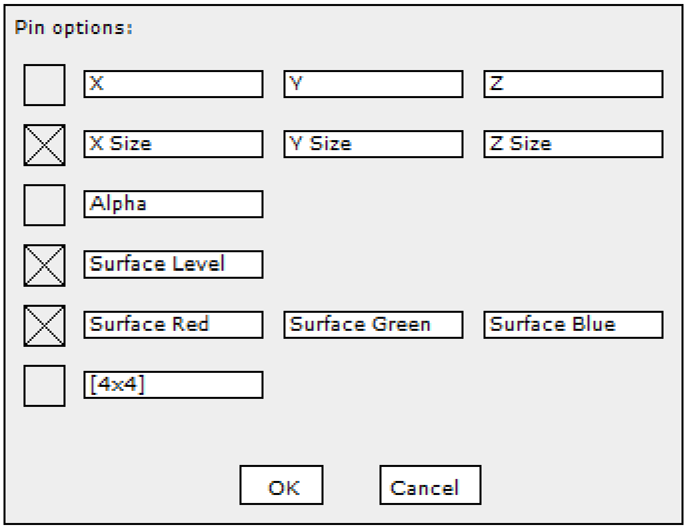
X

0.99	0.68	0	-0.68	-0.99
0.84	0.47	0	-0.47	-0.84
0.47	0.24	0	-0.24	-0.47
0	0	0	0	0
-0.47	-0.24	0	0.24	0.47
-0.84	-0.47	0	0.47	0.84
-0.99	-0.68	0	0.68	0.99

Matrix

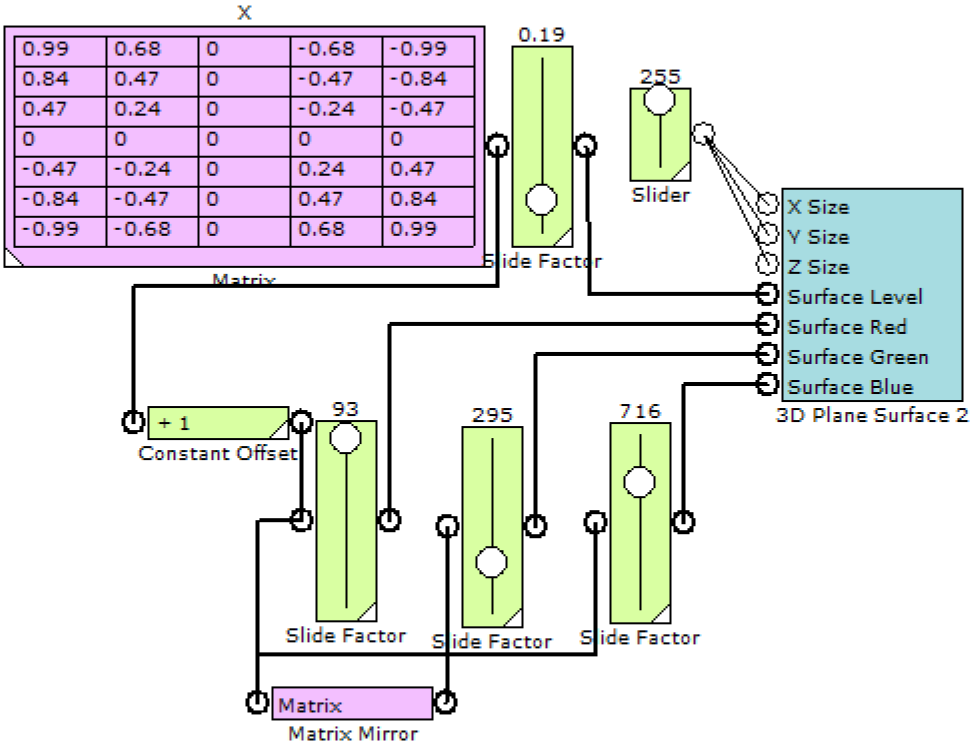
3D Plane Surface 2

The 3D Plane Surface 2 component draws a plane with an embossed and color surface in the 3D view window. The Matrix and Mat Row Size inputs set the 2D data to be plotted. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 5

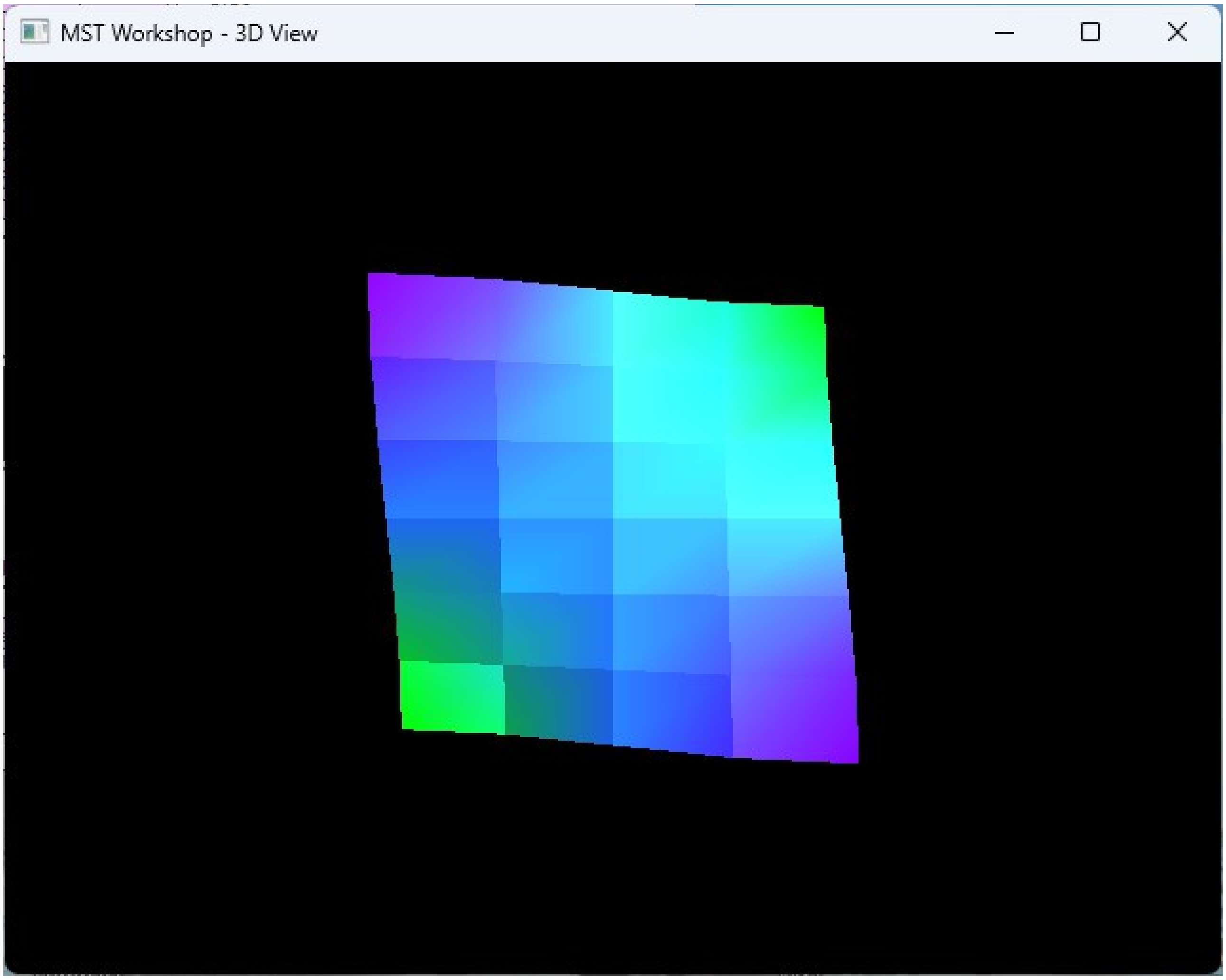


Pin options:

- □ X | Y | Z
- ☒ X Size | Y Size | Z Size
- □ Alpha
- ☒ Surface Level
- ☒ Surface Red | Surface Green | Surface Blue
- □ [4x4]

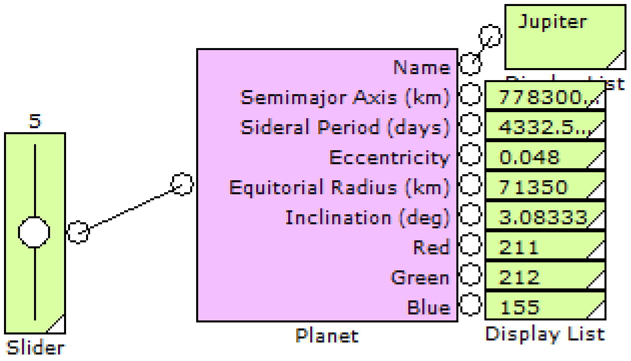


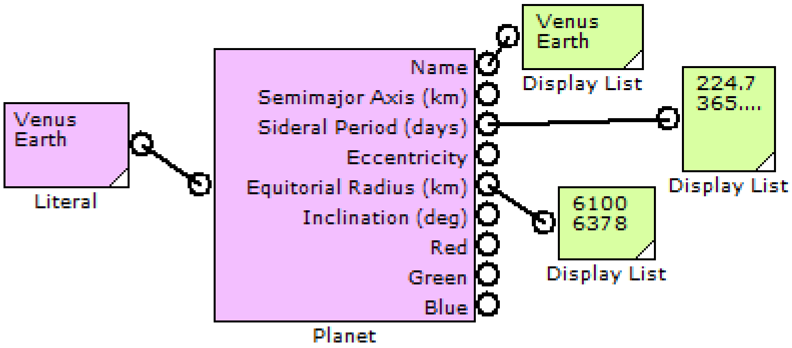
0.99	0.68	0	-0.68	-0.99
0.84	0.47	0	-0.47	-0.84
0.47	0.24	0	-0.24	-0.47
0	0	0	0	0
-0.47	-0.24	0	0.24	0.47
-0.84	-0.47	0	0.47	0.84
-0.99	-0.68	0	0.68	0.99


MST Workshop - 3D View

Planet

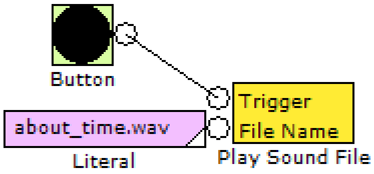
The Planet component contains important information about the planets in our Solar System. Input a number 0 for Sun, 1 and up for planets. Alternatively you can input a string with the name of the planet desired.   Arrays - column 5





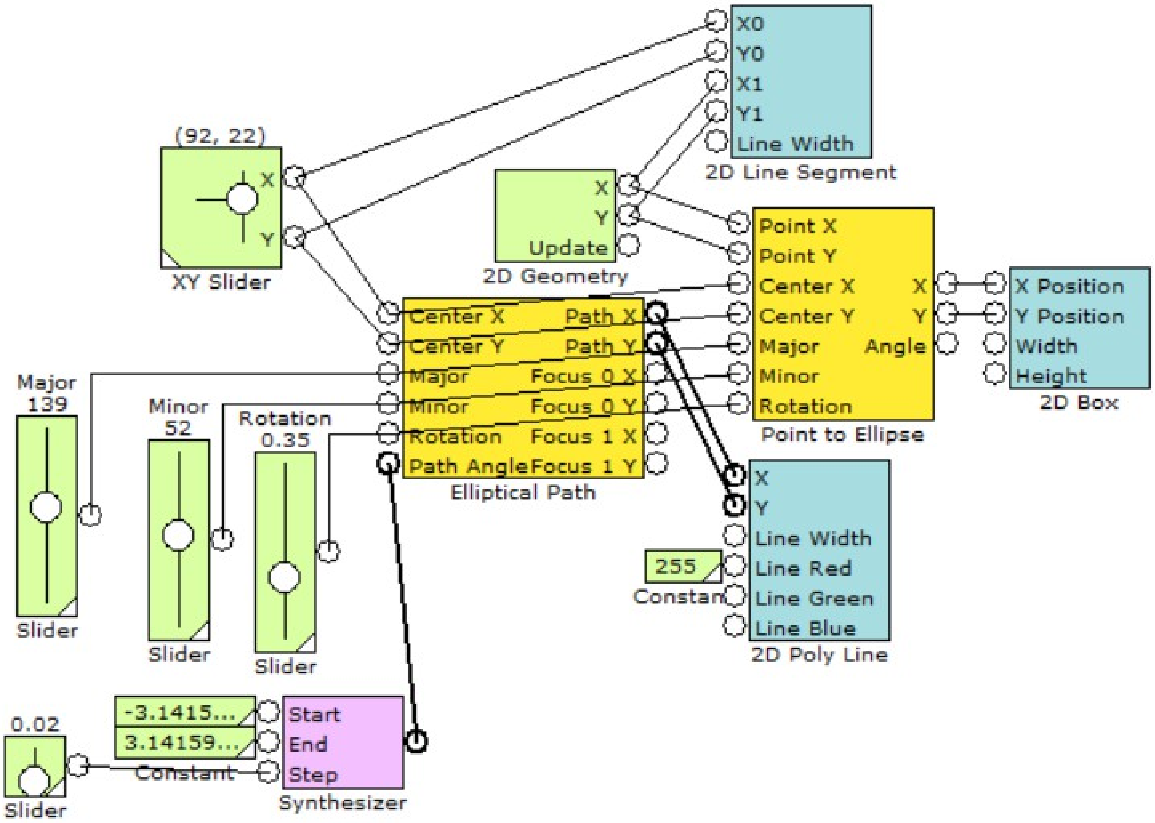
Play Sound File

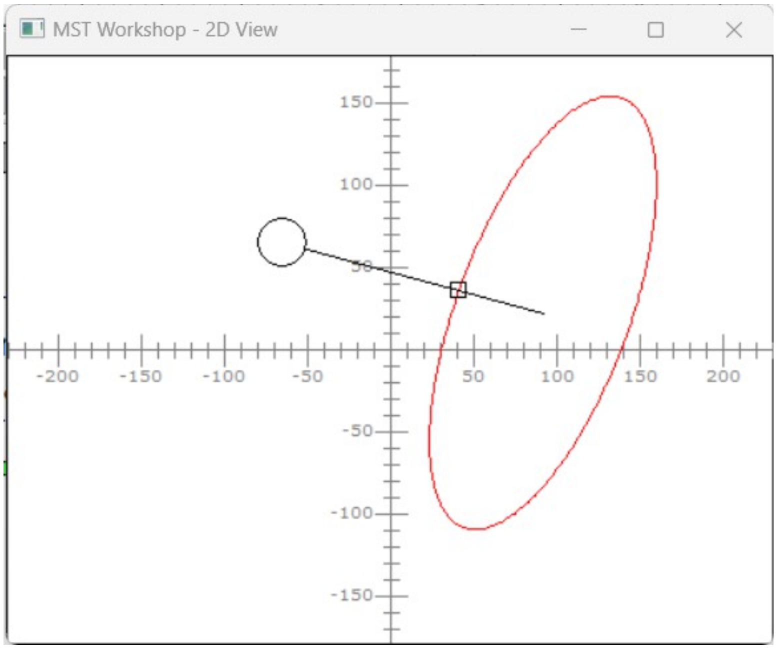
The Play Sound File component reads the given sound file and plays it.



Point to Ellipse

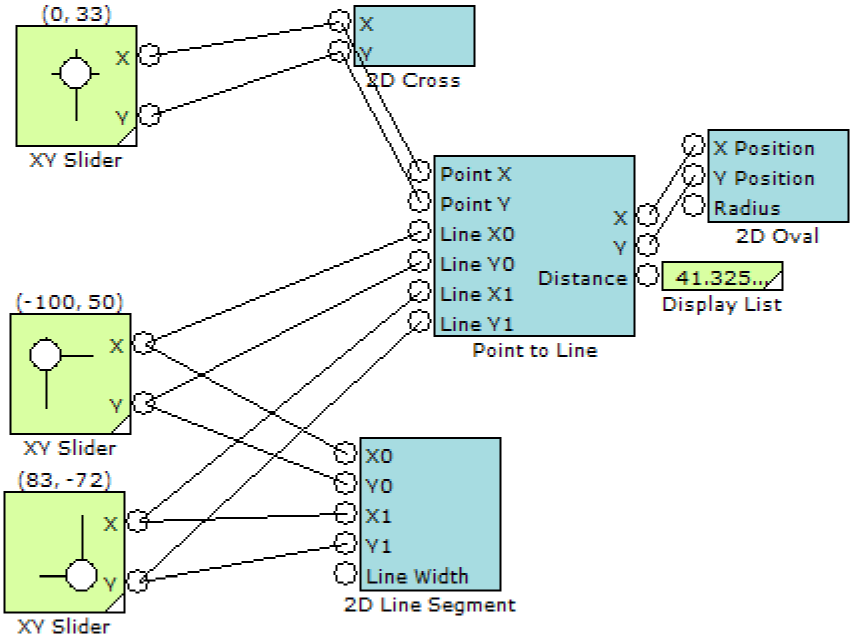
The Point to Ellipse component finds the coordinates and angle of the ellipse that will radiate from the center of the ellipse to the input point.

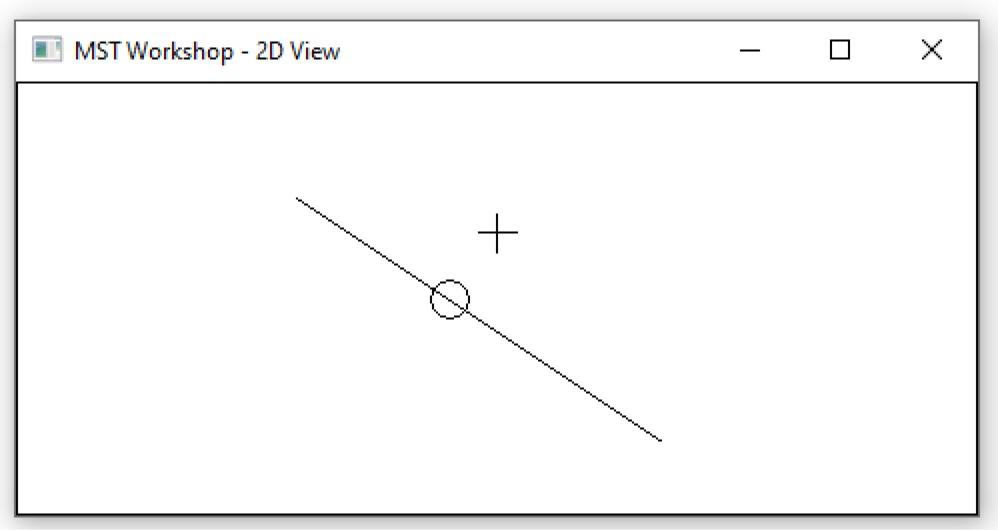




Point to Line

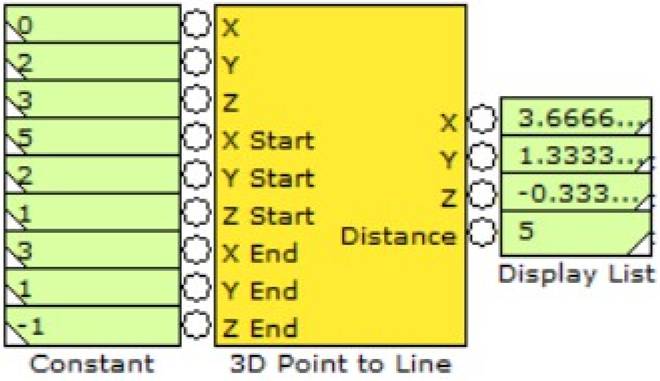
The Point to Line component computes the distance from a point to a line and gives the coordinates of the point on the line.   2D - column 2





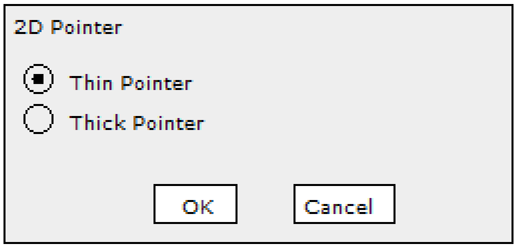
3D Point to Line

The 3D Point to Line component computes the distance from a point to a line and gives the coordinates of the point on the line.   3D - column 2



2D Pointer

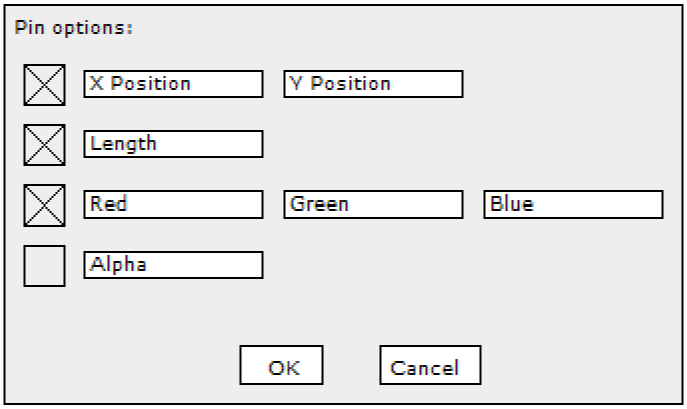
The Pointer creates an indicator that can attach to a shaft on objects like Motors. Place the Pointer at the same X, Y position as a motor to connect the pointer to the motor. 2D - column 3



2D Pointer

● Thin Pointer

○ Thick Pointer



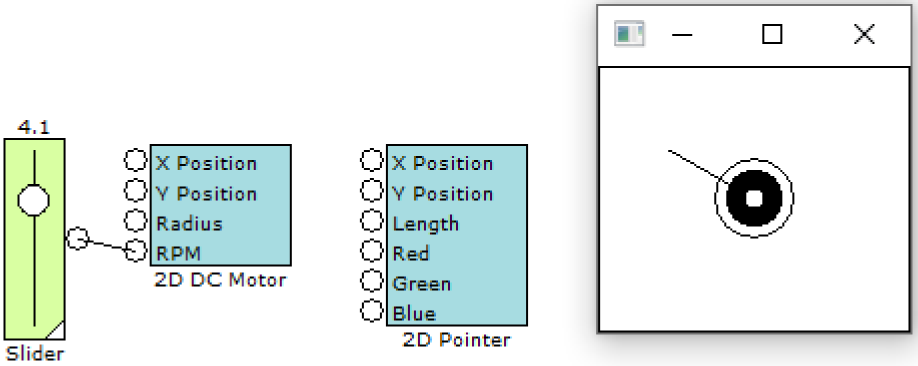
Pin options:

☒ X Position | Y Position

☒ Length

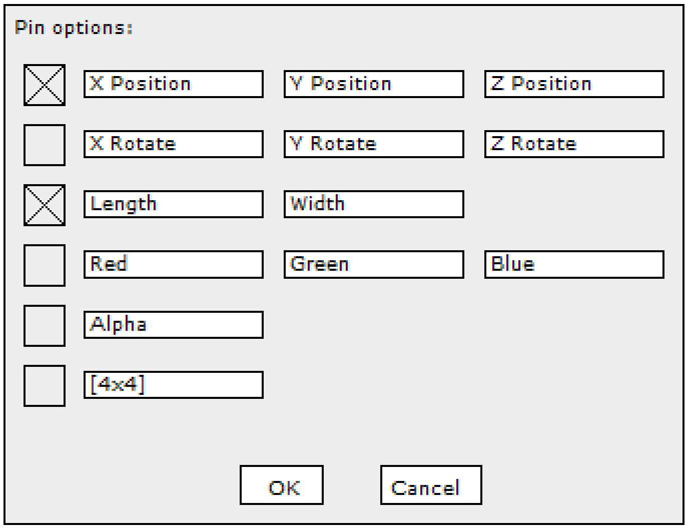
☒ Red | Green | Blue

□ Alpha



3D Pointer

The 3D Pointer component can be used to indicate the position of the motor or gear shaft, for example in a clock or stopwatch. Place the pointer at the X, Y, Z position and orientation of a motor, gear, or shaft.   3D - column 4



Pin options:

☒ X Position Y Position Z Position

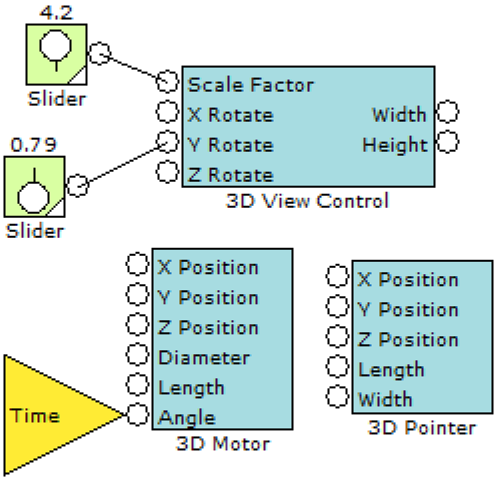
□ X Rotate Y Rotate Z Rotate

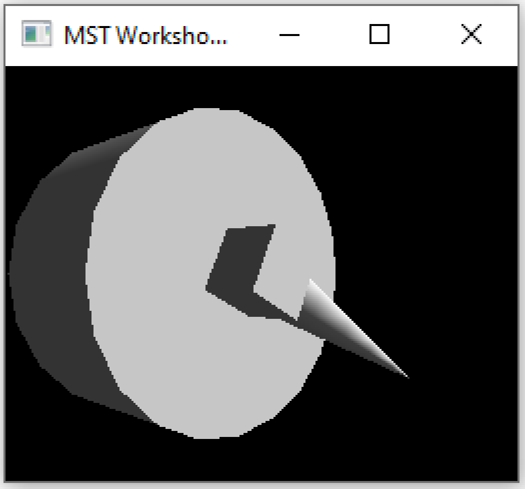
☒ Length Width

□ Red Green Blue

□ Alpha

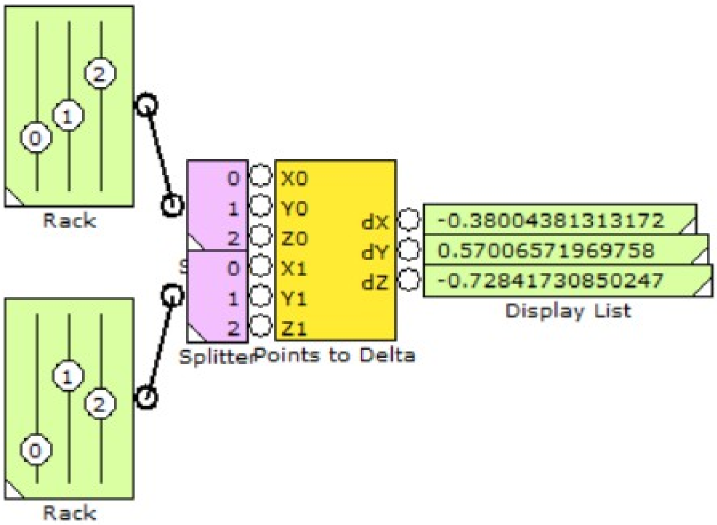
□ [4x4]





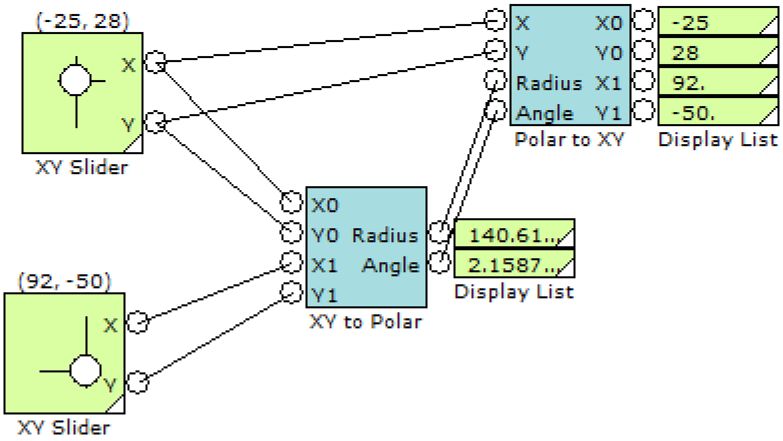
Points to Delta

The Points to Delta component calculates the unit delta between two points. Functions – column 8



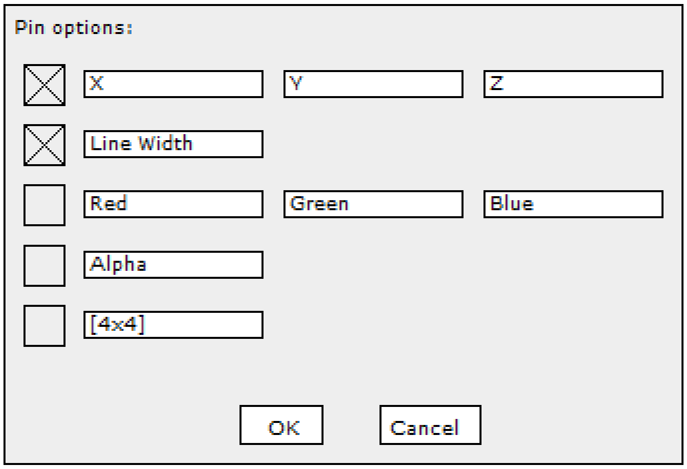
Polar to XY

The Polar to XY component takes a radius and an angle then returns X, Y coordinates.   2D - column 5



3D Poly

The 3D Poly Line component draws a single segmented line in the 3D view window. The X, Y, and Z array inputs set the points along the line. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 4



Pin options:

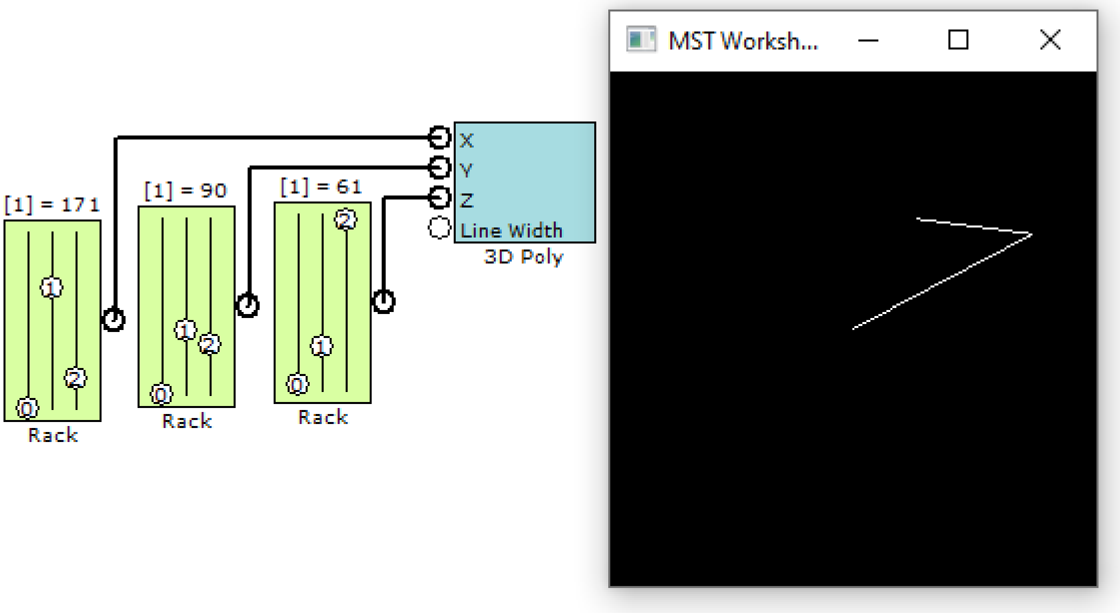
☒ X Y Z

☒ Line Width

□ Red Green Blue

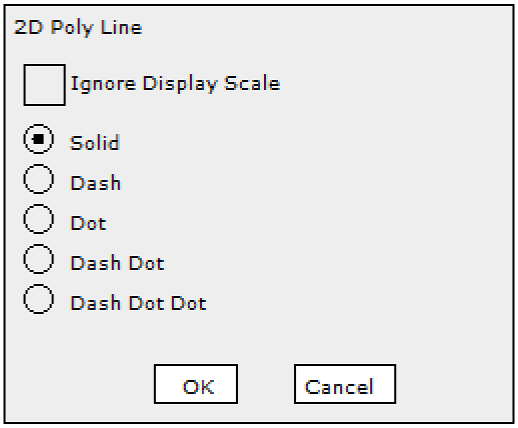
□ Alpha

□ [4x4]



2D Poly Line

The 2D Poly Line component draws a line from point to point. Input a series of X and Y points. 2D - column 1

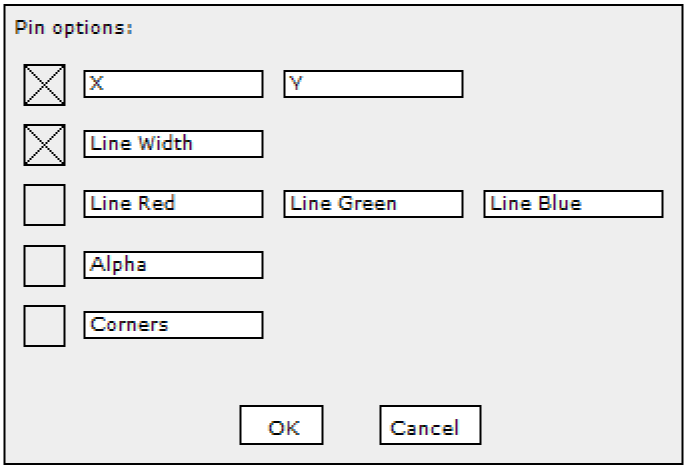


2D Poly Line

□ Ignore Display Scale

● Solid
○ Dash
○ Dot
○ Dash Dot
○ Dash Dot Dot

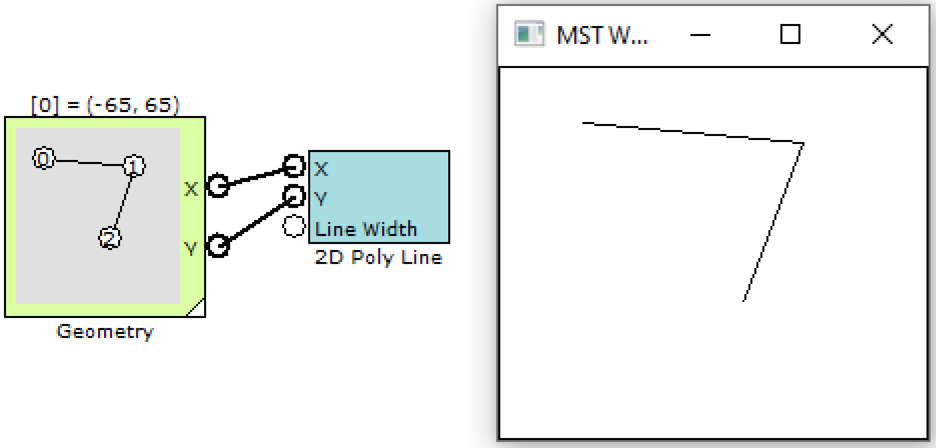
OK Cancel



Pin options:

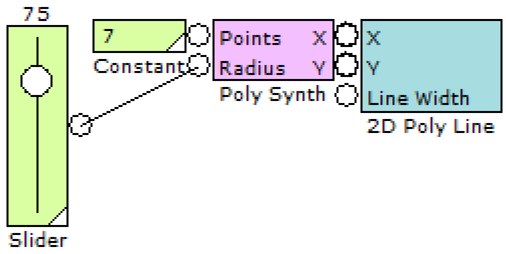
☒ X Y
☒ Line Width
□ Line Red Line Green Line Blue
□ Alpha
□ Corners

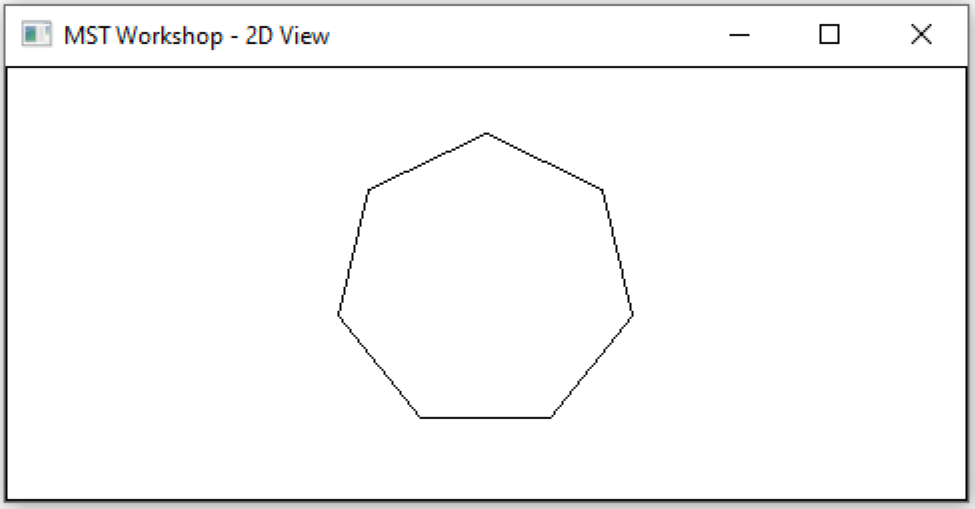
OK Cancel



Poly Synth

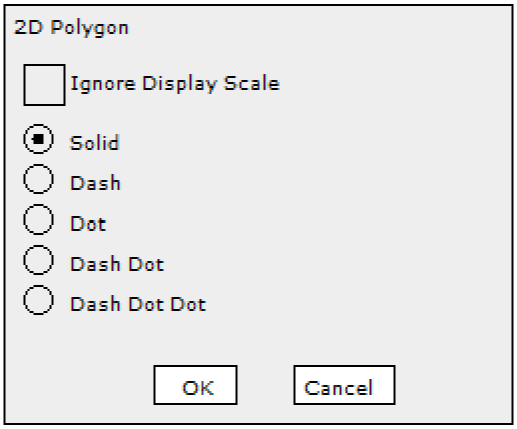
The Poly Synth component creates a regular polygon and outputs its X and Y coordinates. Arrays - column 1





2D Polygon

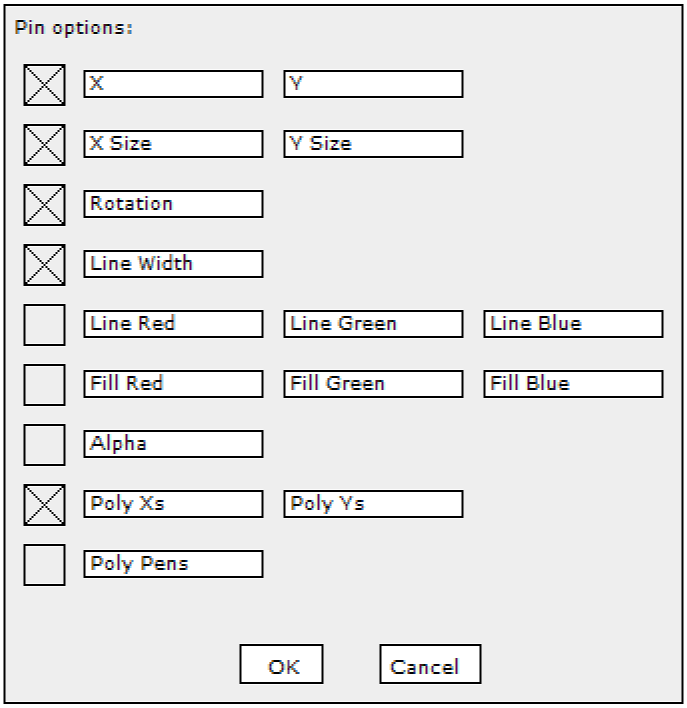
The 2D Polygon component draws a polygon outline using the X and Y points given. You can control the line thickness.   2D - column 1



2D Polygon

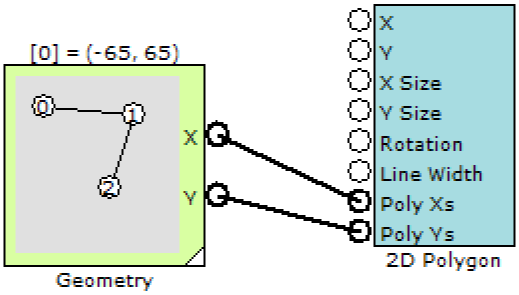
☐ Ignore Display Scale

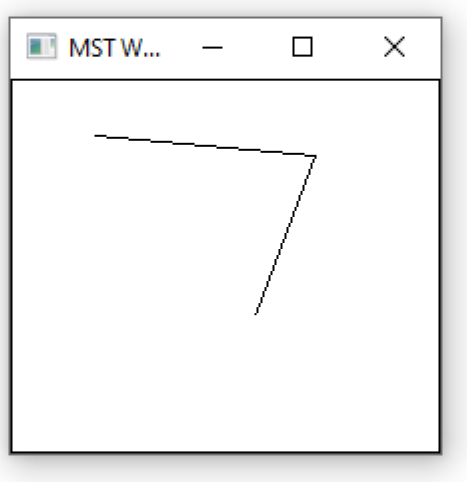
● Solid
○ Dash
○ Dot
○ Dash Dot
○ Dash Dot Dot



Pin options:

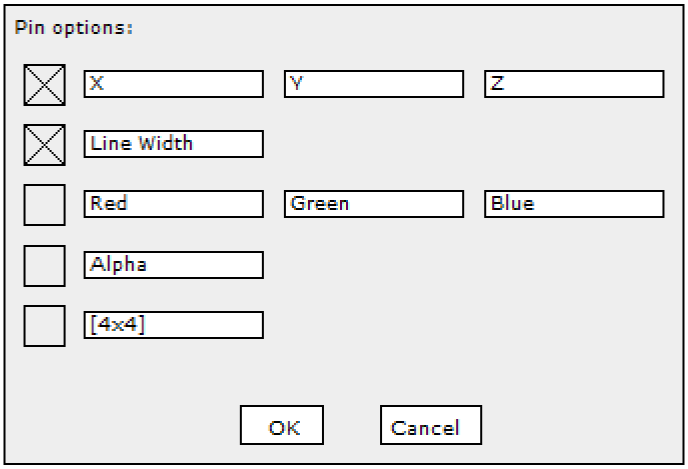
☒ X Y
☒ X Size Y Size
☒ Rotation
☒ Line Width
☐ Line Red Line Green Line Blue
☐ Fill Red Fill Green Fill Blue
☐ Alpha
☒ Poly Xs Poly Ys
☐ Poly Pens





3D Polygon

The 3D Polygon draws a 3D polygon in the 3D view window. The X, Y, and Z inputs set the position and size of the polygon. The Affine [4x4] array input modifies the size, position and orientation.
3D - column 4



Pin options:

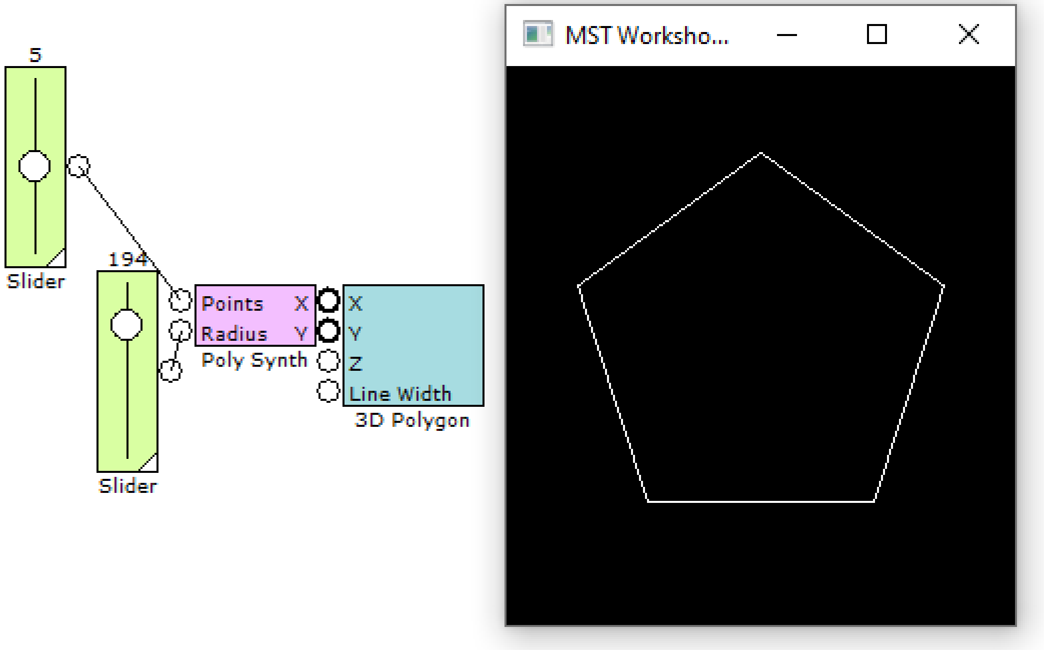
☒ X Y Z

☒ Line Width

□ Red Green Blue

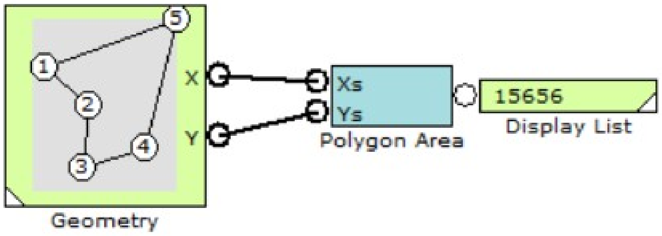
□ Alpha

□ [4x4]



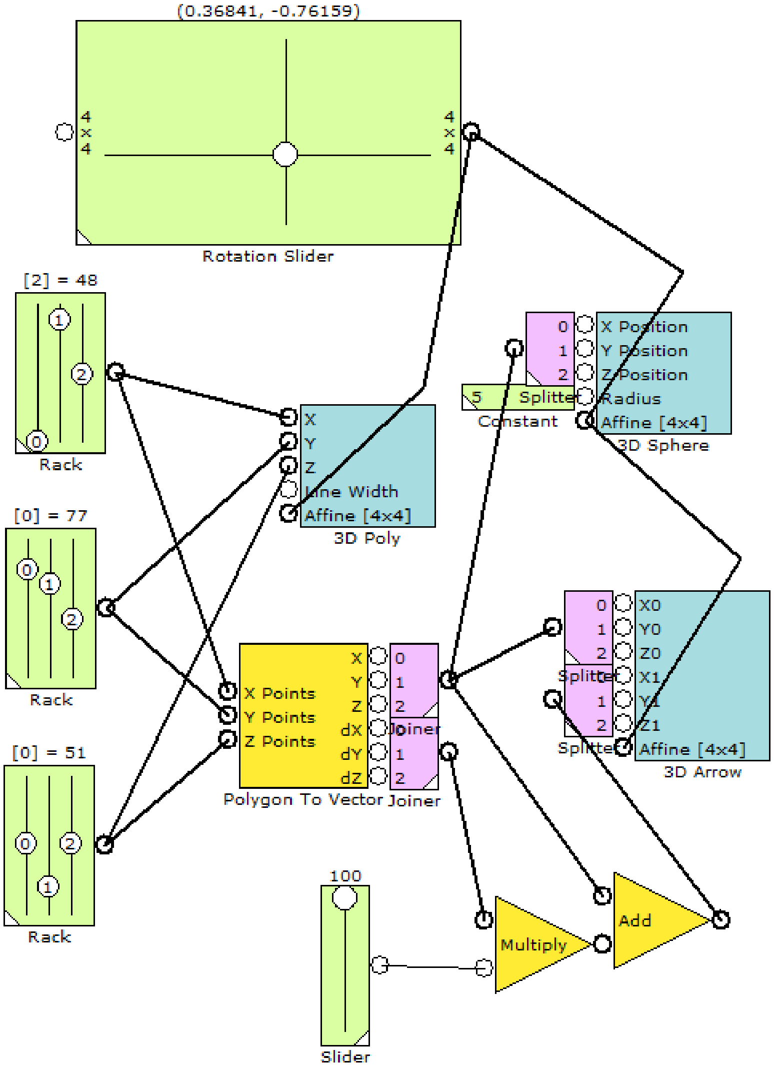
Polygon Area

The Polygon Area component computes the area of a polygon from its XY coordinates. 2D – column 2



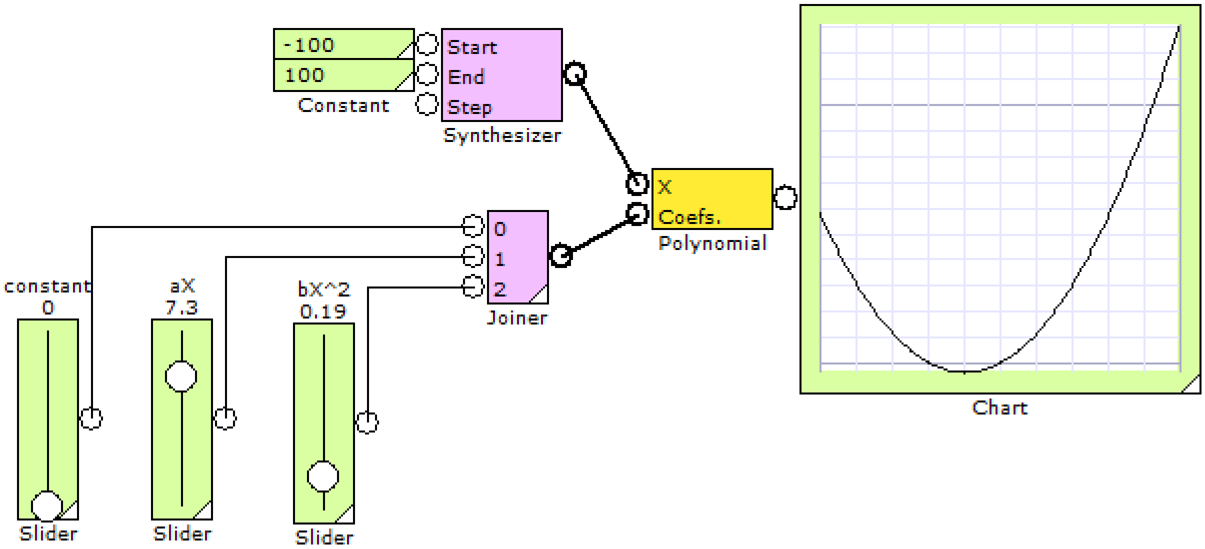
Polygon To Vector

The Polygon To Vector component calculates the origin of a vector from the center of a polygon that is perpendicular to the polygon. Functions – column 8



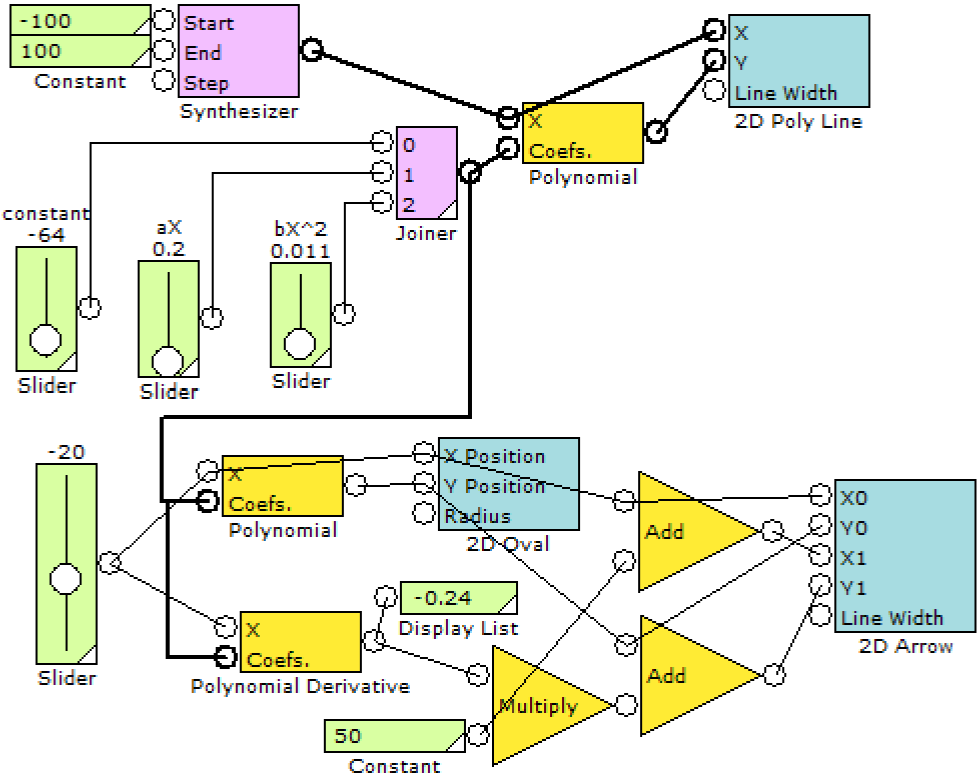
Polynomial

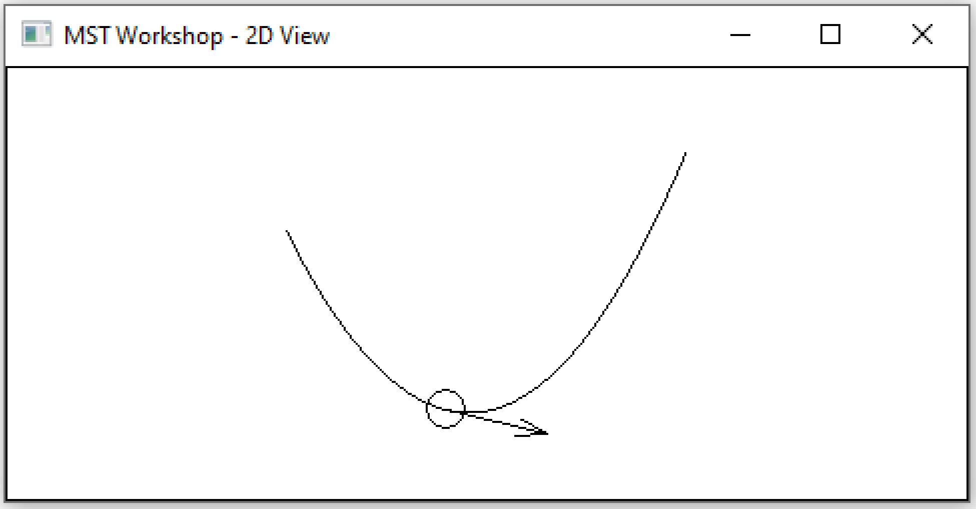
The Polynomial component calculates the polynomial using the coefficients and the X input.
Functions - column 6



Polynomial Derivative

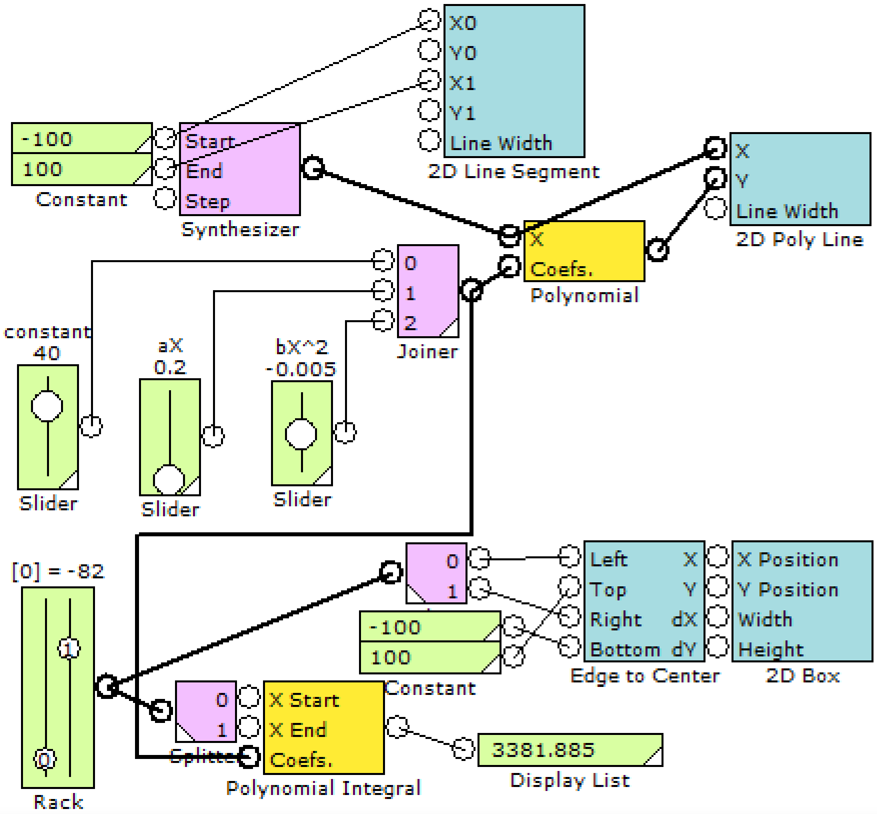
The Polynomial Derivative component calculates the derivative of a polynomial using the coefficients and the X input.   Functions - column 6

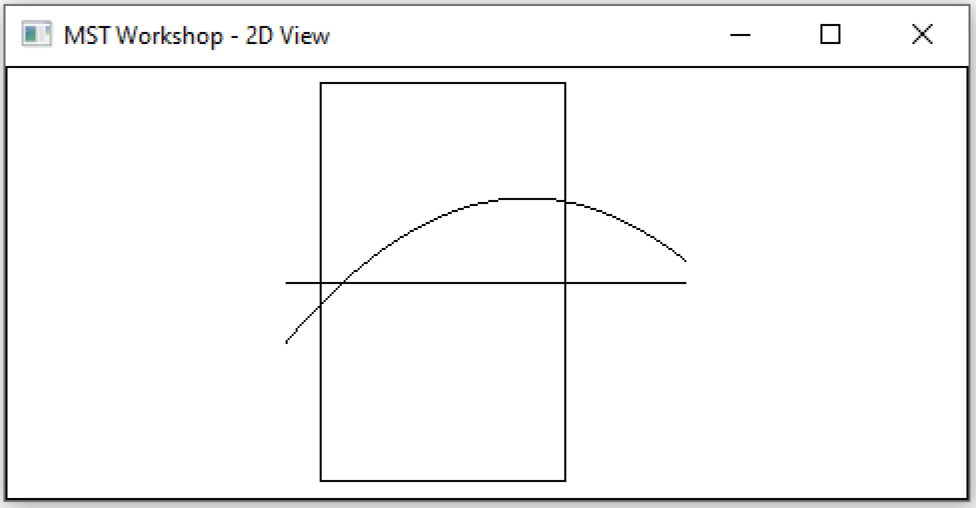




Polynomial Integral

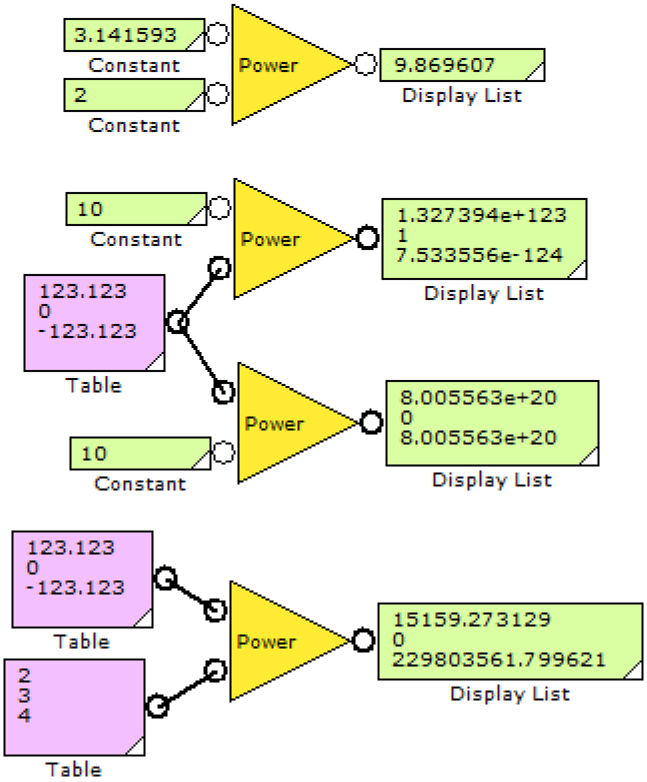
The Polynomial Integral component calculates the integral of a polynomial using the coefficients and the X input from X Start to X End.   Functions - column 6





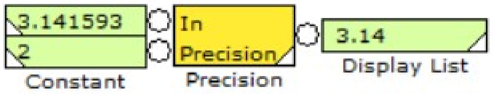
Power

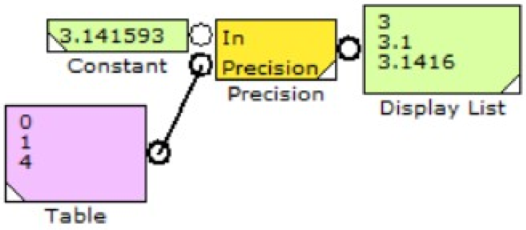
The Power component calculates the top input value raised to the bottom input value. Inputs can be scalar or arrays. Functions - column 1

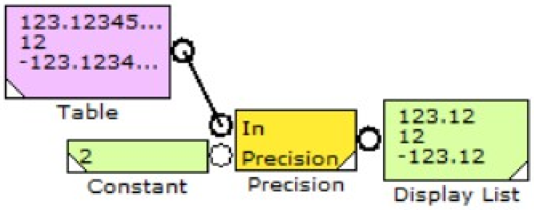


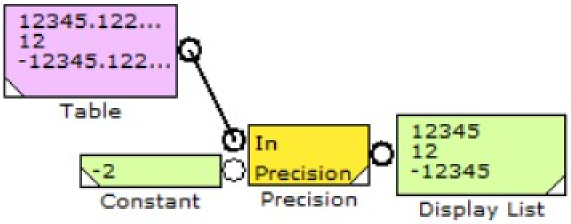
Precision

The Precision component outputs a value with the specified precision. Inputs can be scalar or arrays.
Functions - column 2



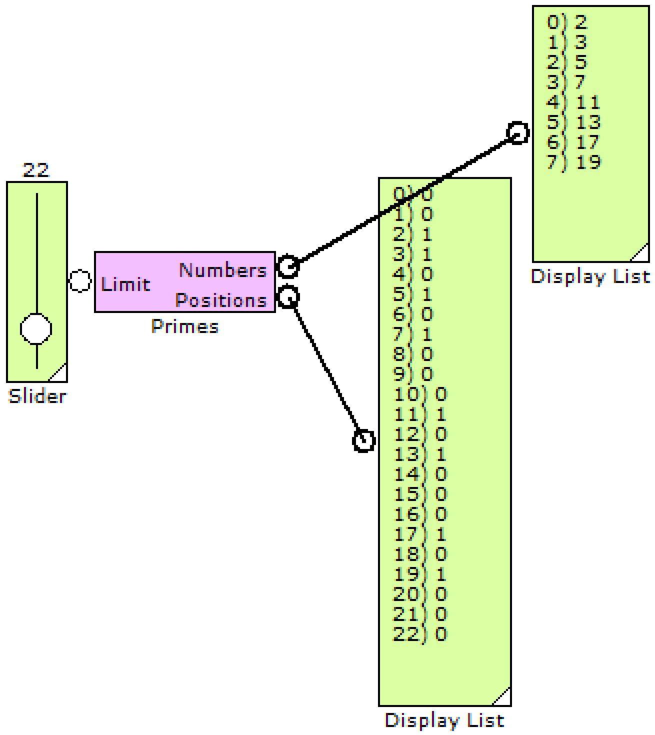






Primes

The Primes component outputs a list of primes less than the input limit.   Arrays - column 5

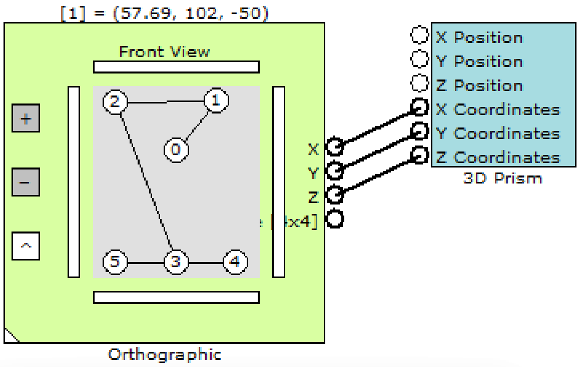


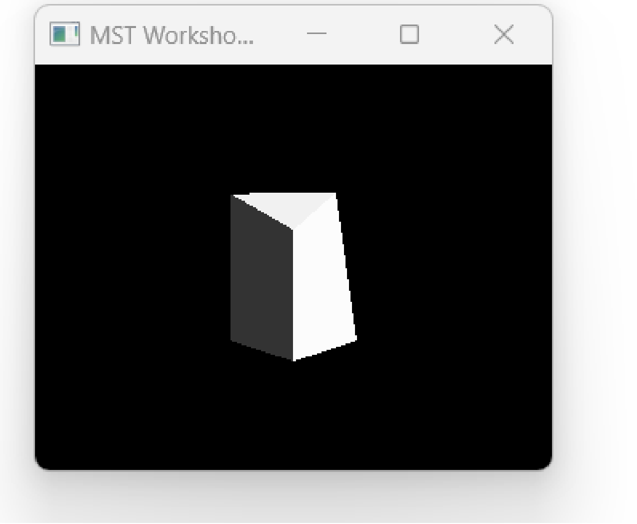
```
0) 2
1) 3
2) 5
3) 7
4) 11
5) 13
6) 17
7) 19
```

```
0) 0
1) 0
2) 1
3) 1
4) 0
5) 1
6) 0
7) 1
8) 0
9) 0
10) 0
11) 1
12) 0
13) 1
14) 0
15) 0
16) 0
17) 1
18) 0
19) 1
20) 0
21) 0
22) 0
```

3D Prism

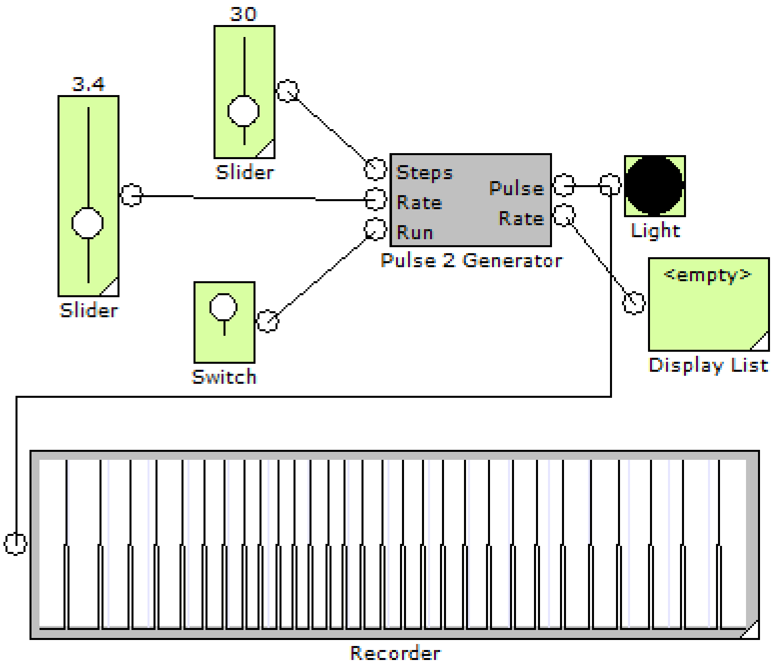
The 3D Prism draws a prism in the 3D view window. The X, Y, and Z inputs set the position and size of the prism. The Affine [4x4] array input modifies the size, position, and orientation of the pyramid. 3D – column 4

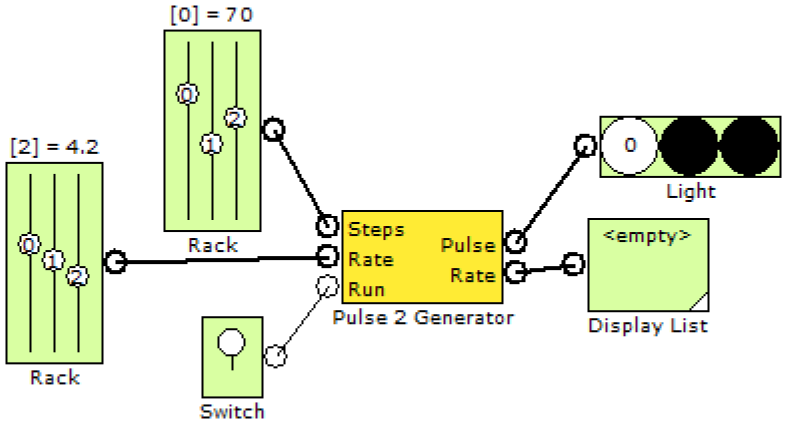




Pulse 2 Generator

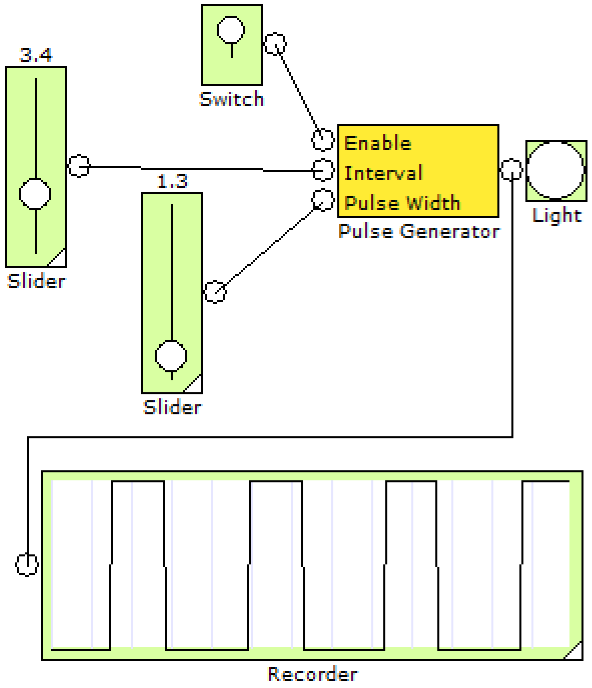
The Pulse 2 Generator component outputs a short pulse at a specified interval. Use this pulse generator to drive a stepper motor. Inputs are seconds. Functions - column 8

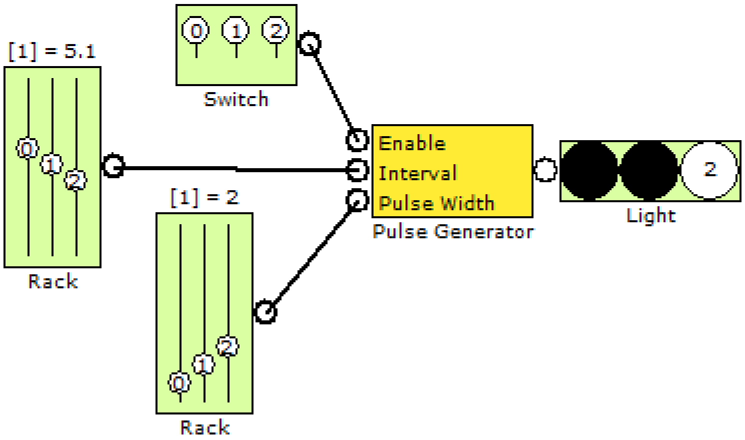




Pulse Generator

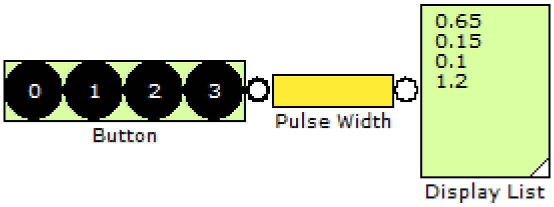
The Pulse Generator component outputs a short pulse at a specified interval. Inputs are seconds.
Functions - column 8

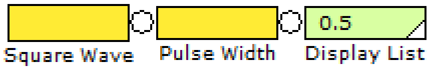




Pulse Width

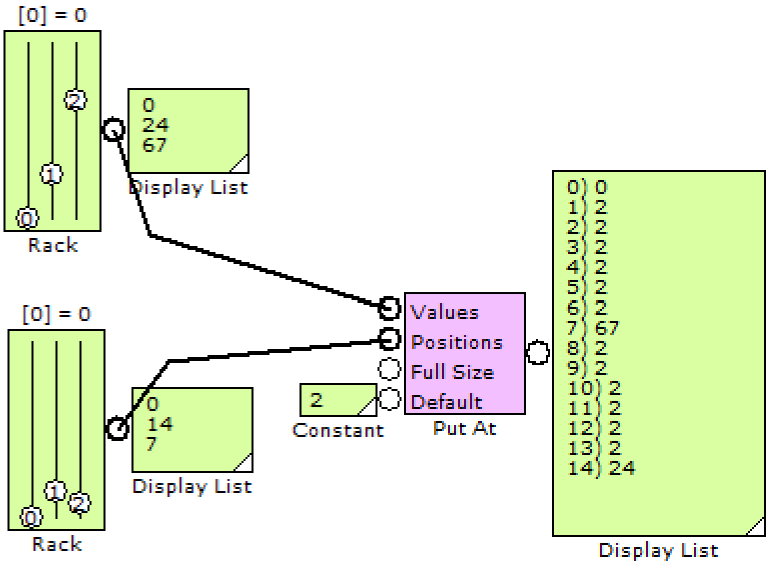
The Pulse Width component measures the width of the input pulse. Functions - column 7





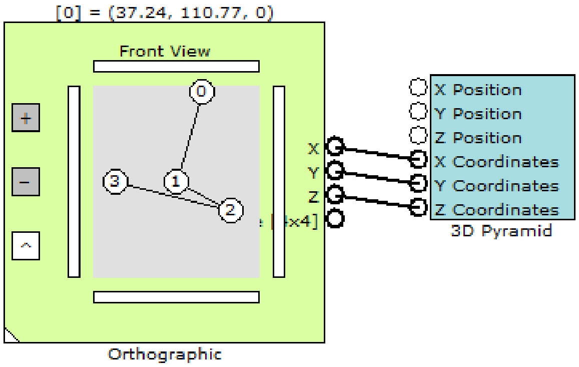
Put At

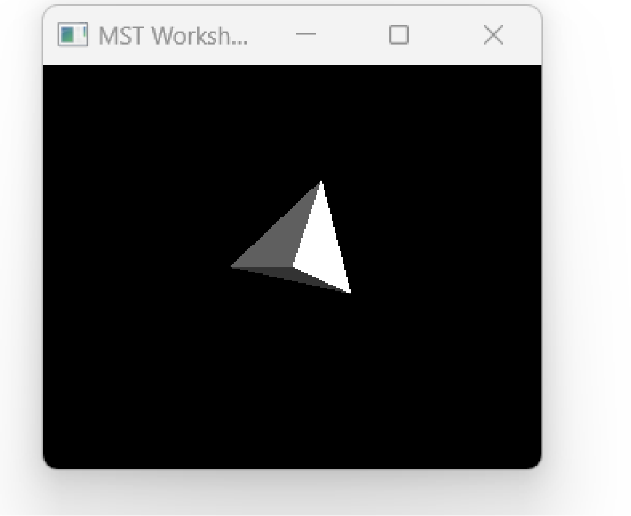
The Put At component outputs a list of values in the specified positions, open positions are filled with the default. Arrays - column 2



3D Pyramid

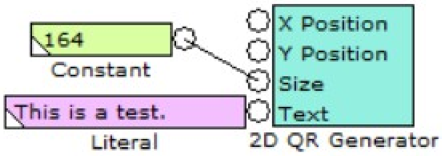
The 3D Pyramid draws a pyramid in the 3D view window. The X, Y, and Z inputs set the position and size of the pyramid. The Affine [4x4] array input modifies the size, position, and orientation of the pyramid. 3D – column 4

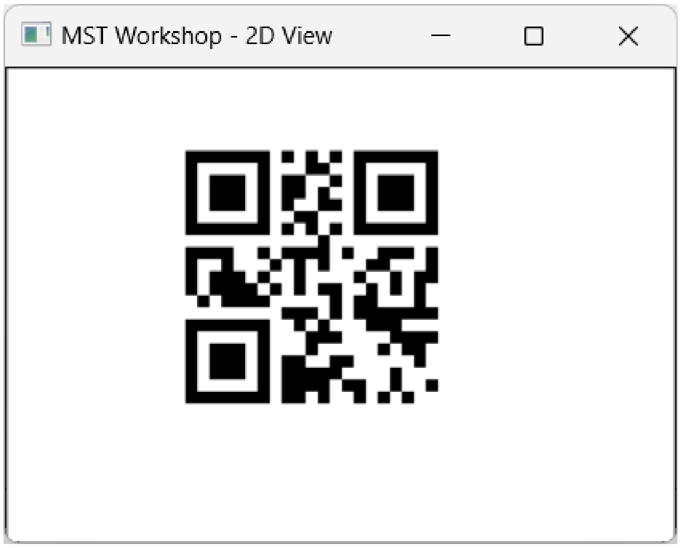




QR Generator

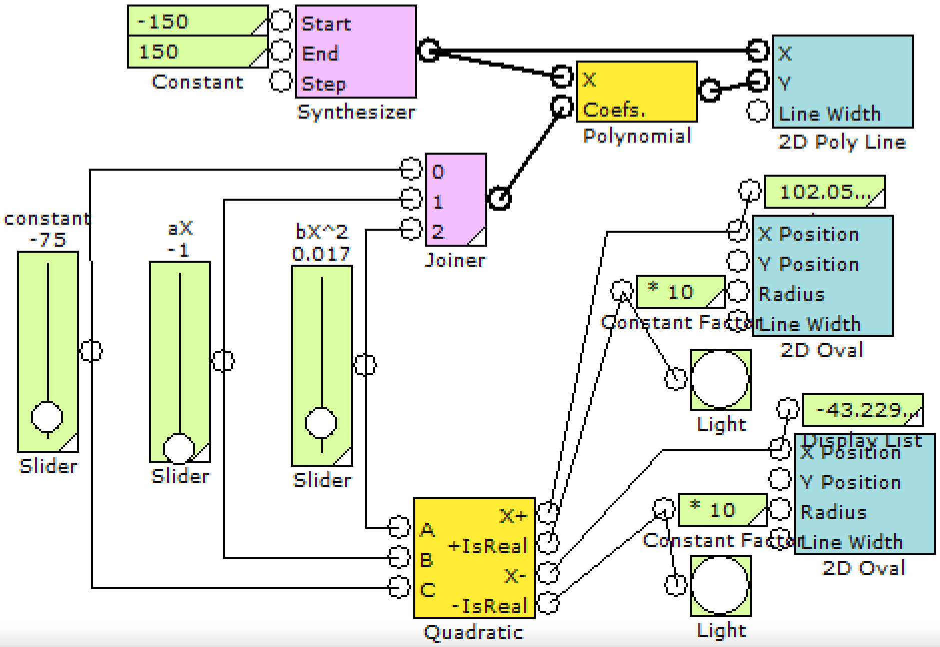
The QR Generator component creates a QR graphic in the 2D View. 2D – column 3

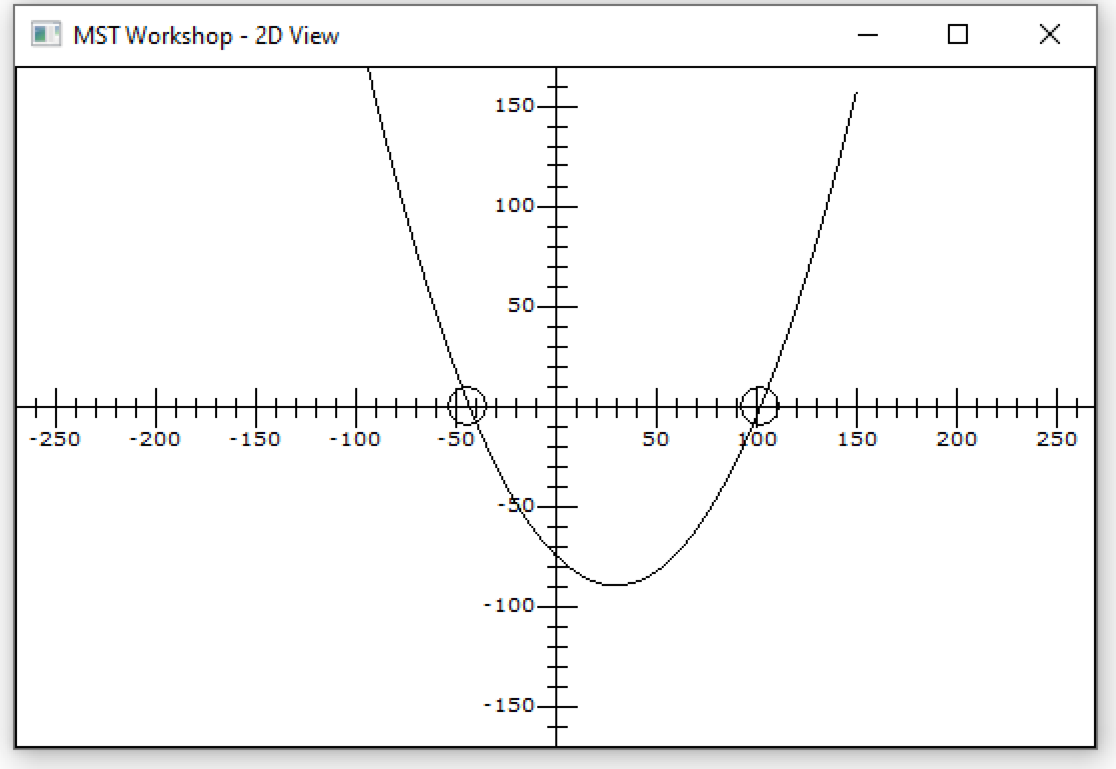




Quadratic

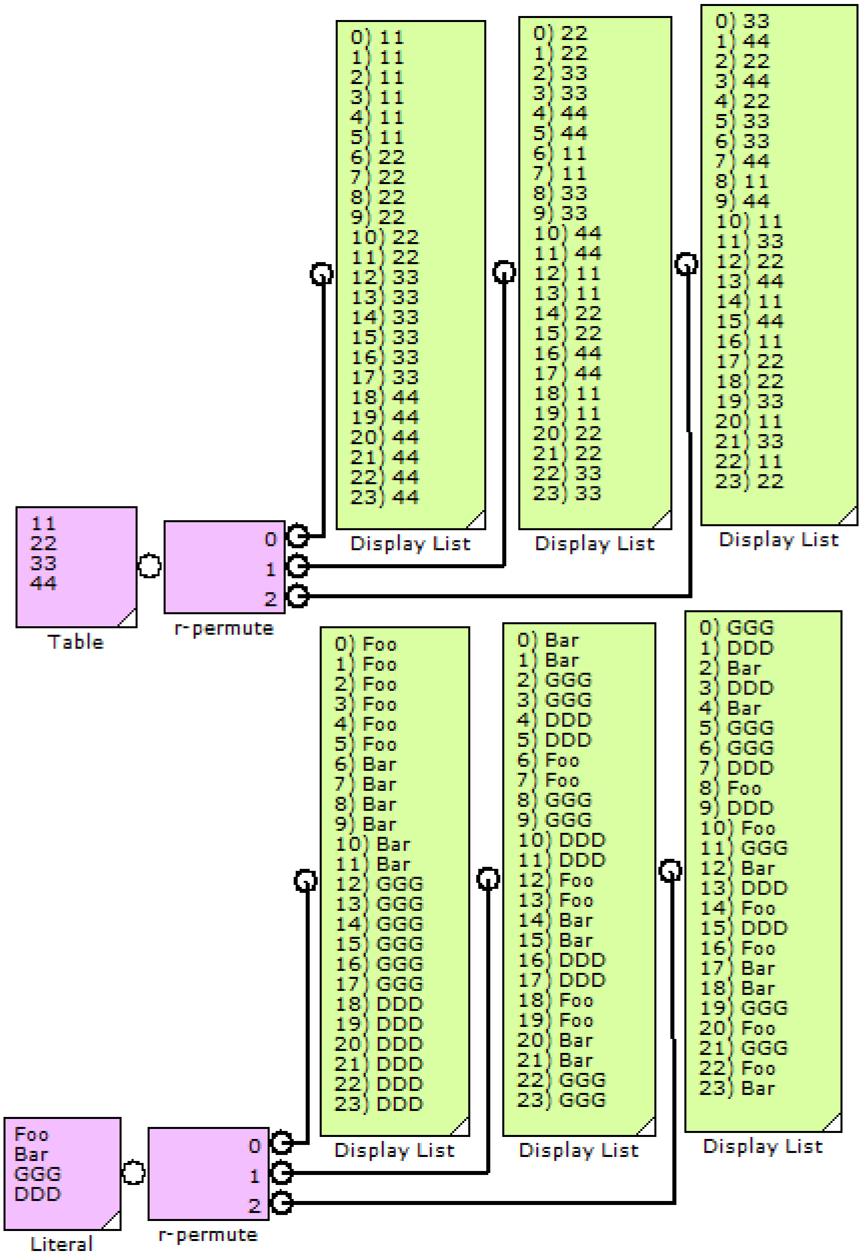
The Quadratic component factors a second degree polynomial. Input can be scalar or an array.
Functions - column 1





r-permute

The r-permute component outputs a list of arrangements of a number of the input values. Arrays - column 5



```
11
22
33
44
```

```
0) 11
1) 11
2) 11
3) 11
4) 11
5) 11
6) 22
7) 22
8) 22
9) 22
10) 22
11) 22
12) 33
13) 33
14) 33
15) 33
16) 33
17) 33
18) 44
19) 44
20) 44
21) 44
22) 44
23) 44
```

```
0) 22
1) 22
2) 33
3) 33
4) 44
5) 44
6) 11
7) 11
8) 33
9) 33
10) 44
11) 44
12) 11
13) 11
14) 22
15) 22
16) 44
17) 44
18) 11
19) 11
20) 22
21) 22
22) 33
23) 33
```

```
0) 33
1) 44
2) 22
3) 44
4) 22
5) 33
6) 33
7) 44
8) 11
9) 44
10) 11
11) 33
12) 22
13) 44
14) 11
15) 44
16) 11
17) 22
18) 22
19) 33
20) 11
21) 33
22) 11
23) 22
```

```
Foo
Bar
GGG
DDD
```

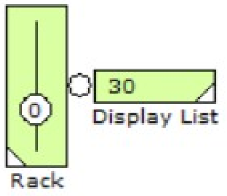
```
0) Foo
1) Foo
2) Foo
3) Foo
4) Foo
5) Foo
6) Bar
7) Bar
8) Bar
9) Bar
10) Bar
11) Bar
12) GGG
13) GGG
14) GGG
15) GGG
16) GGG
17) GGG
18) DDD
19) DDD
20) DDD
21) DDD
22) DDD
23) DDD
```

```
0) Bar
1) Bar
2) GGG
3) GGG
4) DDD
5) DDD
6) Foo
7) Foo
8) GGG
9) GGG
10) DDD
11) DDD
12) Foo
13) Foo
14) Bar
15) Bar
16) DDD
17) DDD
18) Foo
19) Foo
20) Bar
21) Bar
22) GGG
23) GGG
```

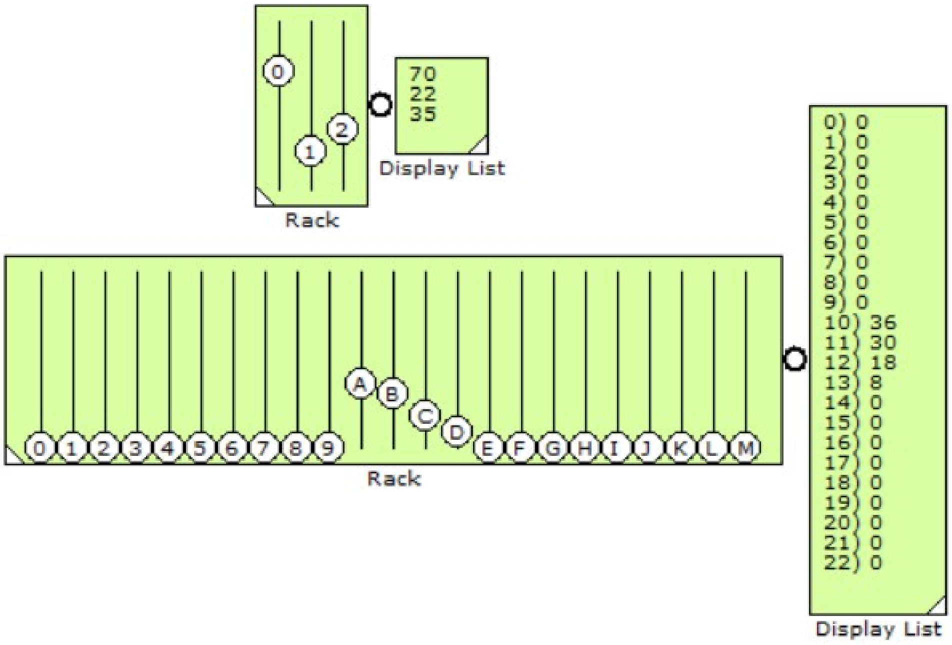
```
0) GGG
1) DDD
2) Bar
3) DDD
4) Bar
5) GGG
6) GGG
7) DDD
8) Foo
9) DDD
10) Foo
11) GGG
12) Bar
13) DDD
14) Foo
15) DDD
16) Foo
17) Bar
18) Bar
19) GGG
20) Foo
21) GGG
22) Foo
23) Bar
```

Rack

The Rack component outputs a bunch of constant numbers based on its dial positions.   Controls - column 1



```
30
```

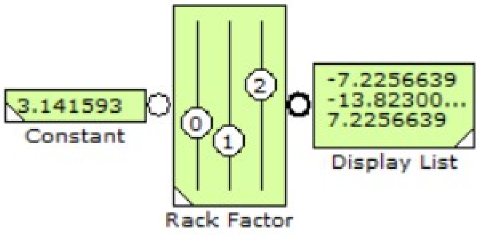


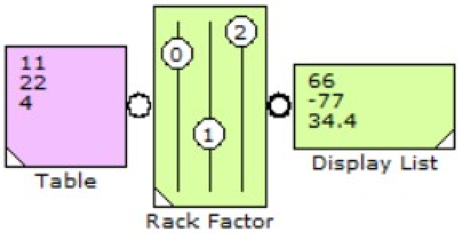
```
70
22
35
```

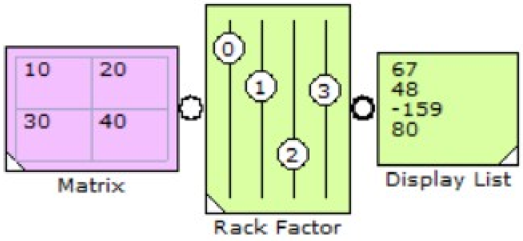
```
0) 0
1) 0
2) 0
3) 0
4) 0
5) 0
6) 0
7) 0
8) 0
9) 0
10) 36
11) 30
12) 18
13) 8
14) 0
15) 0
16) 0
17) 0
18) 0
19) 0
20) 0
21) 0
22) 0
```

Rack Factor

The Rack Factor component multiplies the inputs based on its dial positions. Controls - column 2

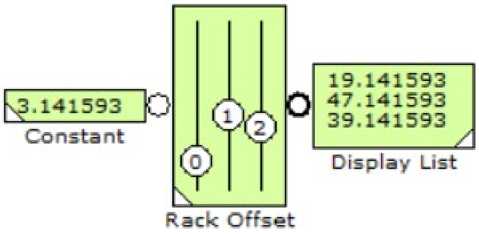


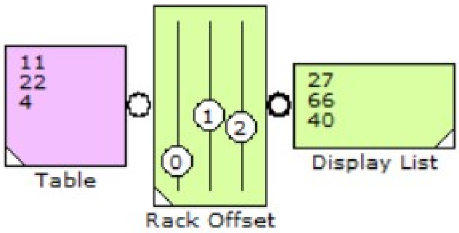


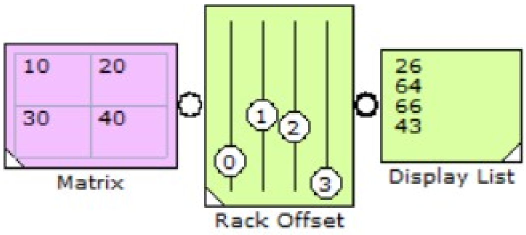


Rack Offset

The Rack Offset component adds constants to the inputs based on its dial positions. Controls - column 3

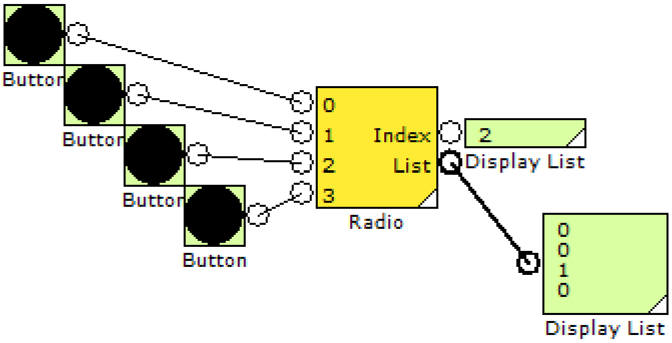






Radio

The Radio component is like the function of a group of radio buttons. It outputs the number of the last input that went high. Functions - column 3



2D Radio Group

The 2D Radio Group is used to choose one of several buttons.

The X, Y and Size inputs control the position and font size of the text.

The Offsets control the position of the text relative to the buttons.

The Preset inputs allow external setting of the selection.

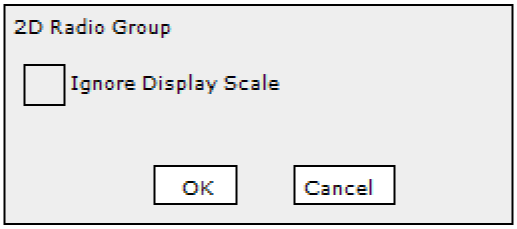
The Color input sets the color of the buttons and text.

The Alpha input fades the buttons and text.

The Index output indicates which item is chosen.

The List output provides an array with a one at the selected position.

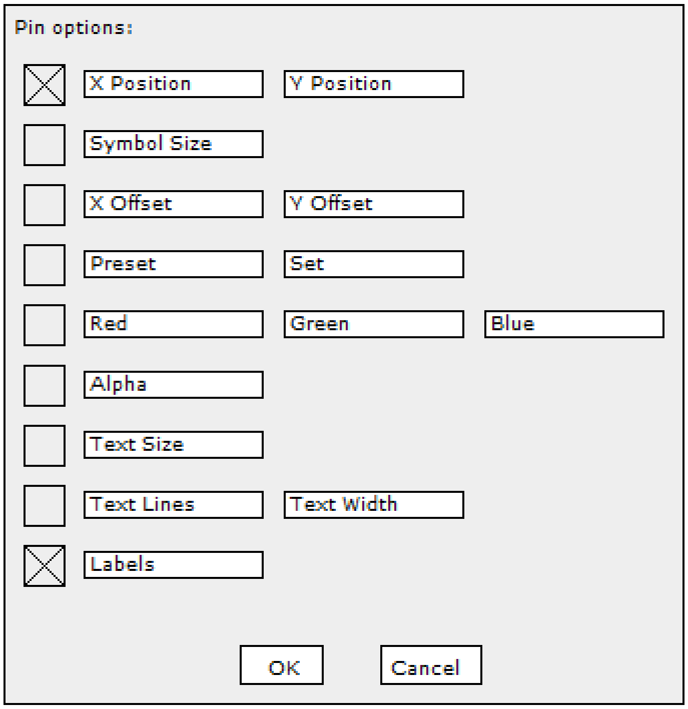
Controls - column 2



2D Radio Group

□ Ignore Display Scale

OK Cancel



Pin options:

☒ X Position | Y Position

□ Symbol Size

□ X Offset | Y Offset

□ Preset | Set

□ Red | Green | Blue

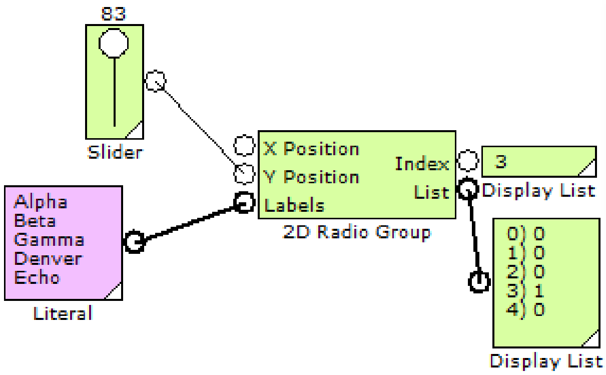
□ Alpha

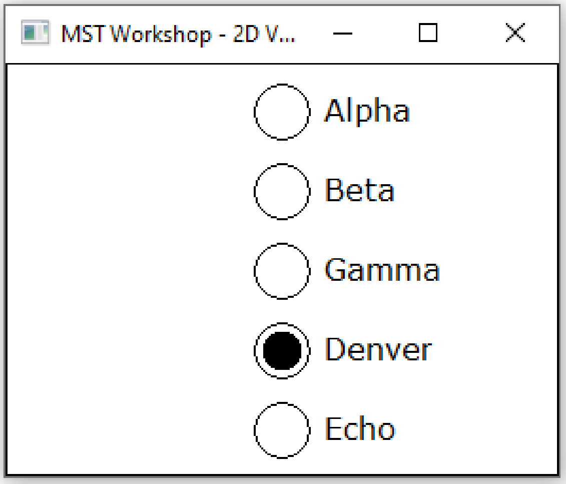
□ Text Size

□ Text Lines | Text Width

☒ Labels

OK Cancel





MST Workshop - 2D V...

○ Alpha

○ Beta

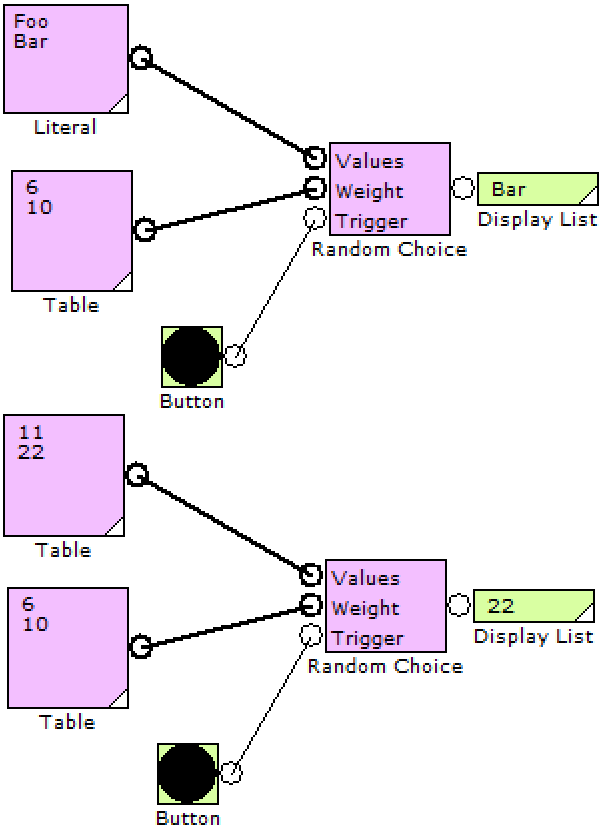
○ Gamma

● Denver

○ Echo

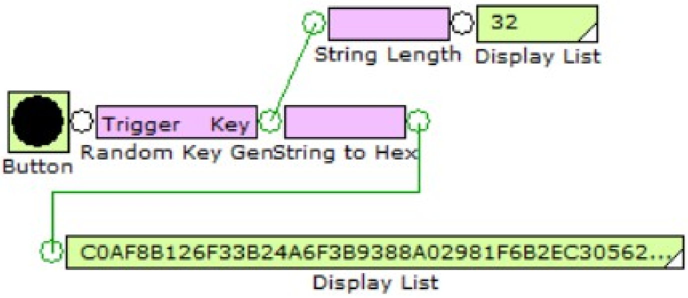
Random Choice

The Random Choice component randomly chooses one of the values at Values input. If the Weights input is used the choice is based on the weights at that input otherwise the choices are evenly weighted.
Arrays - column 3



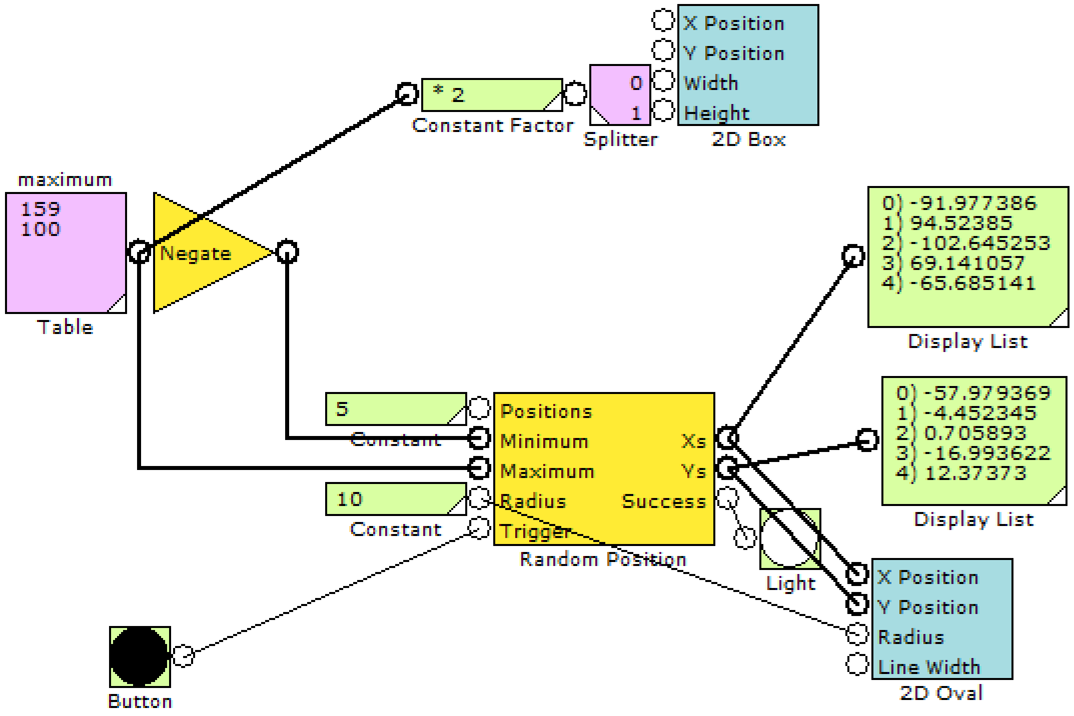
Random Key Gen

The Random Key Gen component creates a key from random numbers. Arrays – column 3



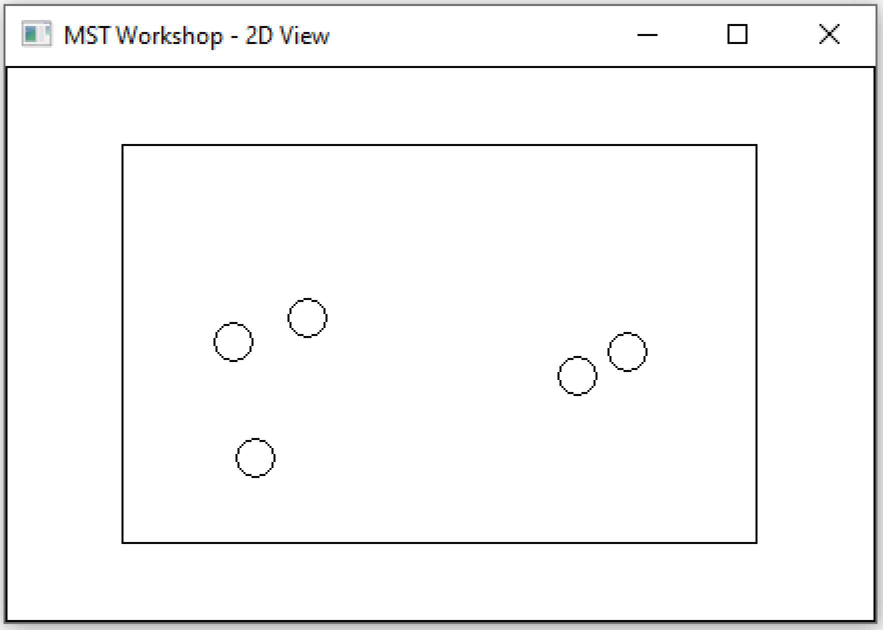
Random Position

The Random Position component outputs random positions between between the minimum and maximum when the trigger goes from between false to true. The positions will be separated using the Radius input. Set the number of dimensions in the menu. Functions - column 6



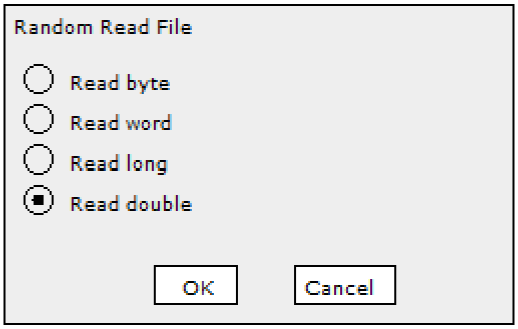
```
0) -91.977386
1) 94.52385
2) -102.645253
3) 69.141057
4) -65.685141
```

```
0) -57.979369
1) -4.452345
2) 0.705893
3) -16.993622
4) 12.37373
```



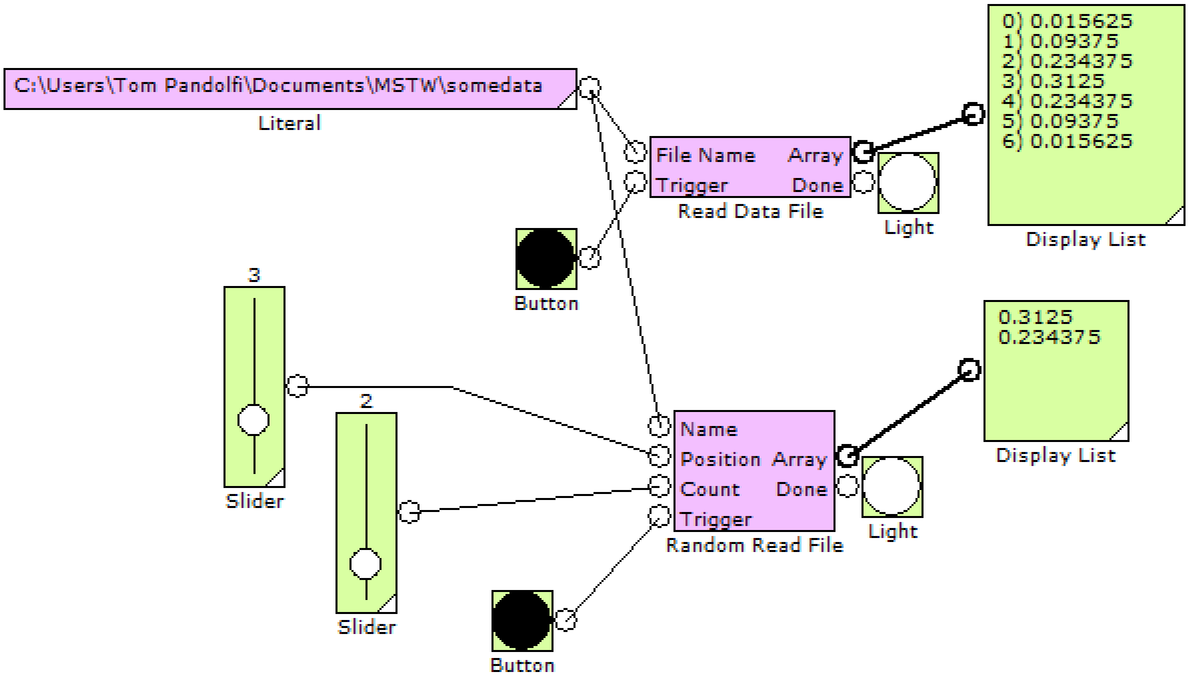
Random Read File

The Random Read File component seeks to the specified position and reads the specified count of data type. The data type can be bytes, words, longs, or doubles, depending on what you specify in the options. Arrays - column 7



Random Read File

○ Read byte
○ Read word
○ Read long
● Read double



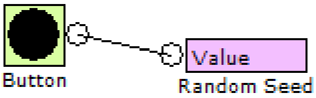
C:\Users\Tom Pandolfi\Documents\MSTW\somedata

```
0) 0.015625
1) 0.09375
2) 0.234375
3) 0.3125
4) 0.234375
5) 0.09375
6) 0.015625
```

```
0.3125
0.234375
```

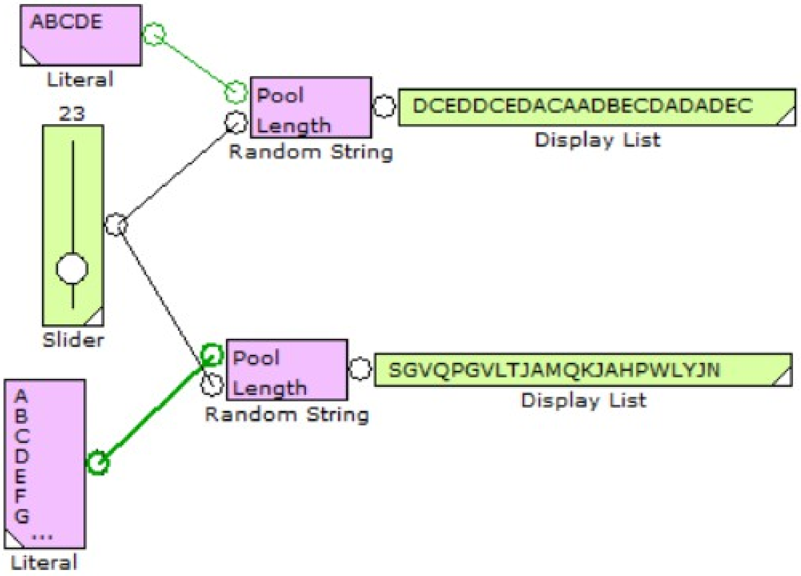
Random Seed

The Seed component sets a new starting point for the random generator. If no input is connected the current time is used to set the random sequence.   Arrays - column 3



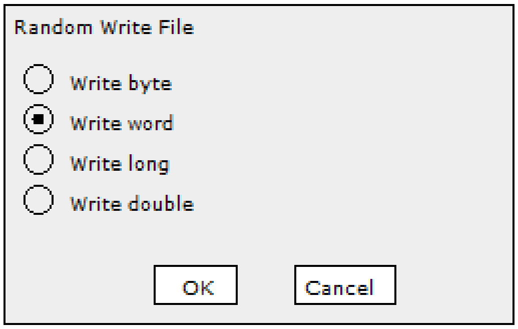
Random String

The Random String component generates a random string from characters in the input Pool.
Arrays – column 5



Random Write File

The Random Write File component seeks to the specified position and writes the array in the specified format. The array data type can be bytes, words, longs, or doubles, depending on what you specify in the options. You can set an option to append the data to an existing file.   Arrays - column 7



Random Write File

○ Write byte

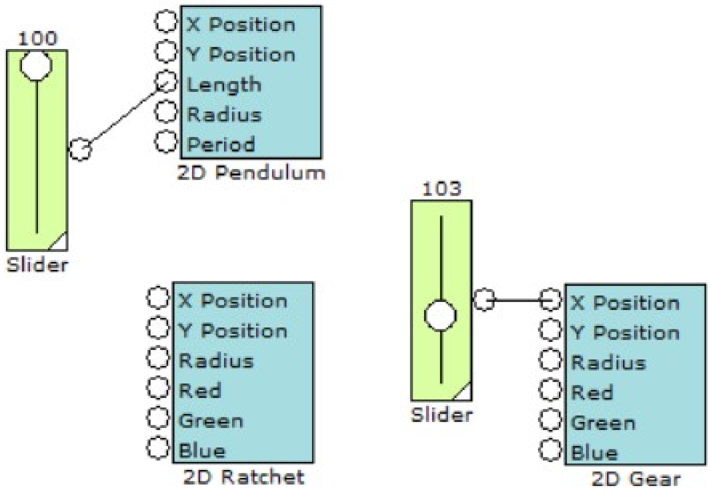
● Write word

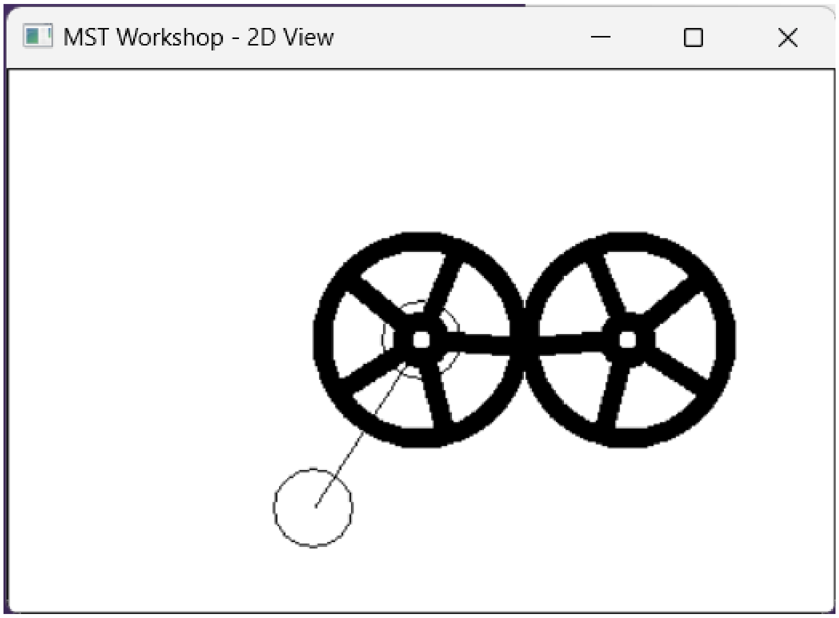
○ Write long

○ Write double

2D Ratchet

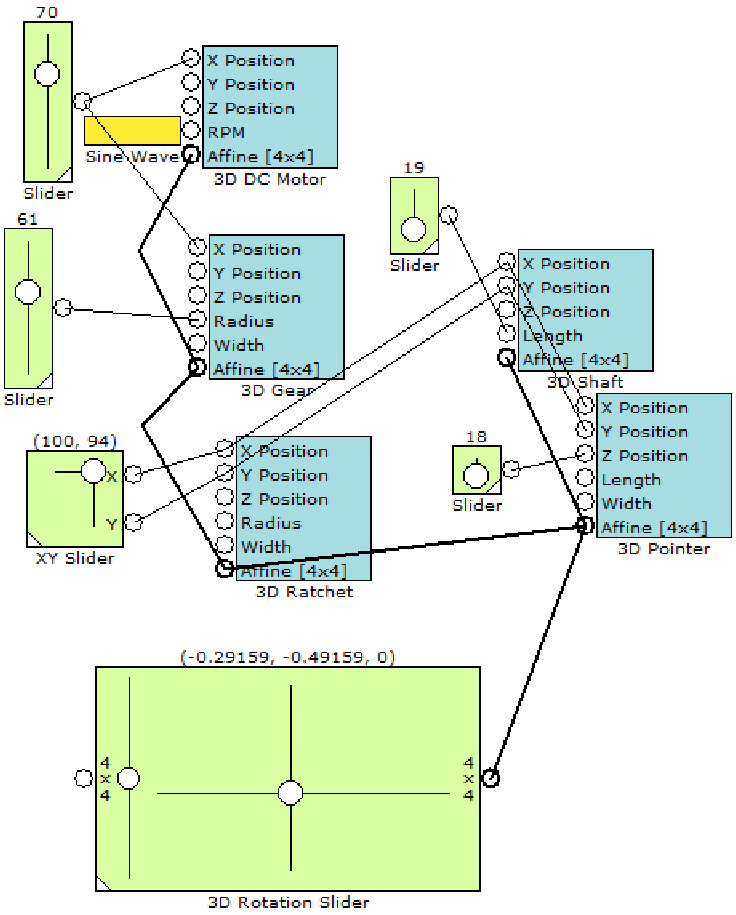
The 2D Ratchet component is like a gear that transmits rotation only in one direction. You can attach a driver to the shaft and drive something from the edge, or vise versa. Options indicate which direction is transmitted from hub to edge or vise versa.
2D – column 3

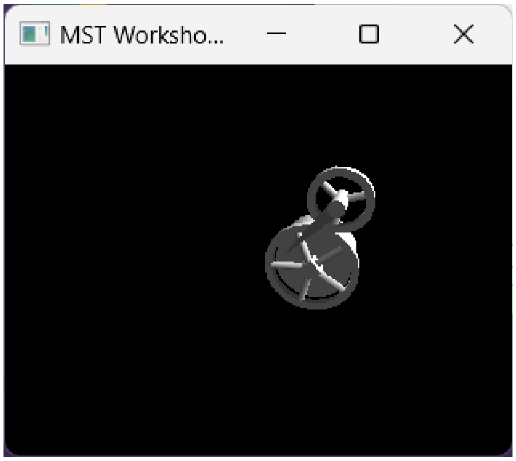




3D Ratchet

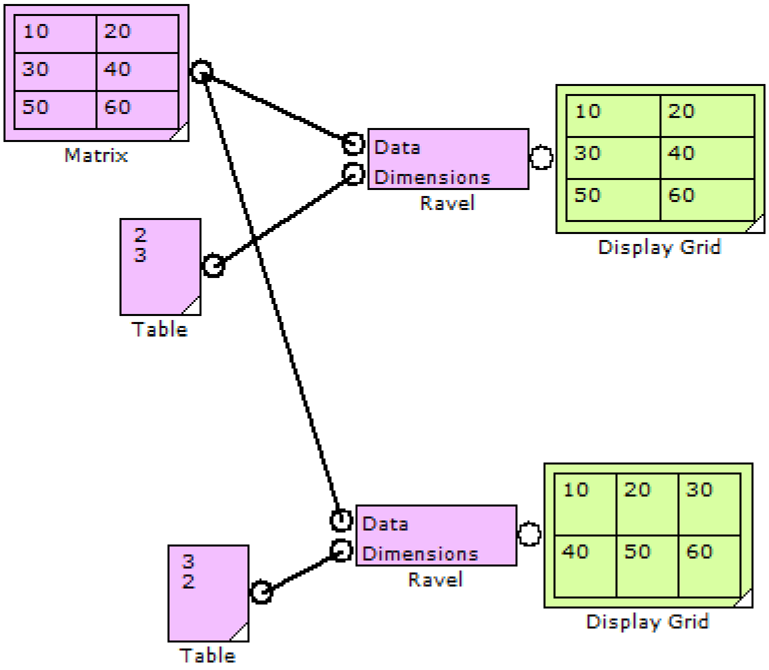
The 3D Ratchet component is like a gear that transmits rotation only in one direction. You can attach a driver to the shaft and drive something from the edge, or vise versa. Options indicate which direction is transmitted from hub to edge or vise versa.
3D – column 4





Ravel

The Ravel component sets the dimensions for the input data. Use it to create a matrix from a vector or to change the dimensions of the input data.   Arrays - column 2



Matrix

10	20
30	40
50	60

Table

2
3

Display Grid

10	20
30	40
50	60

Table

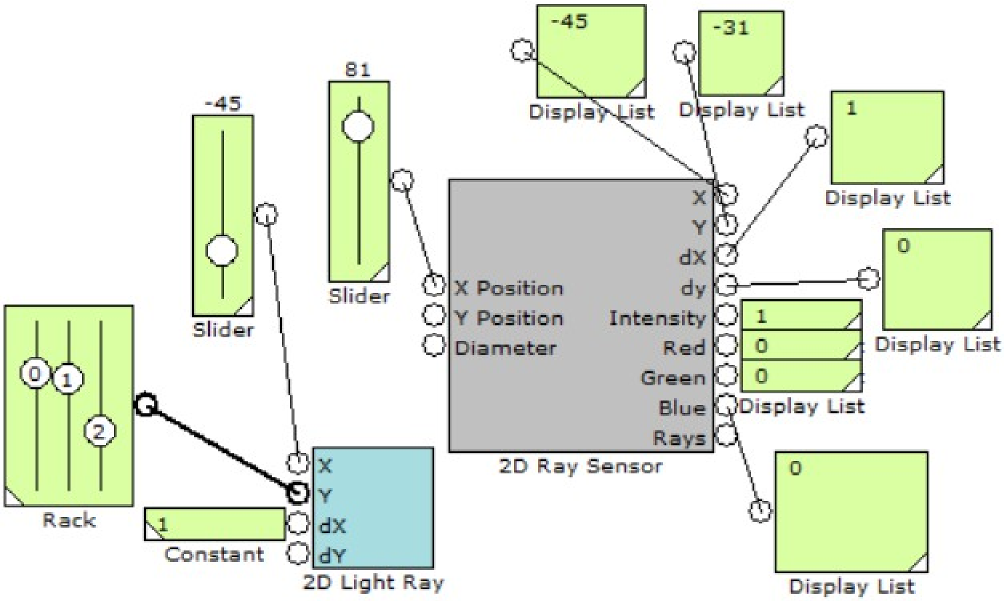
3
2

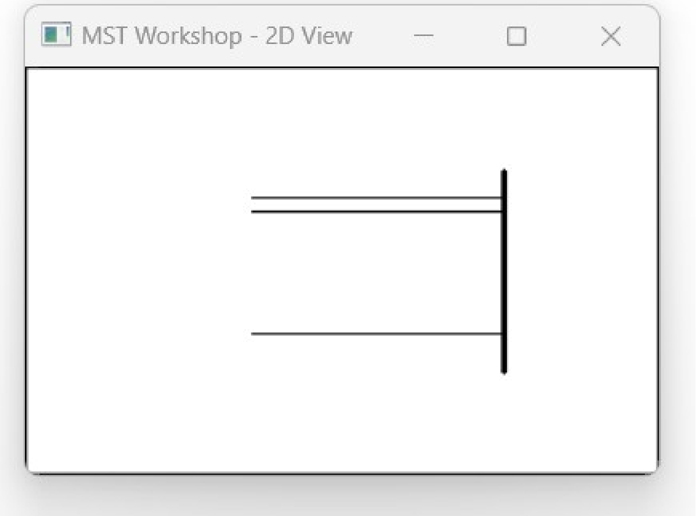
Display Grid

10	20	30
40	50	60

2D Ray Sensor

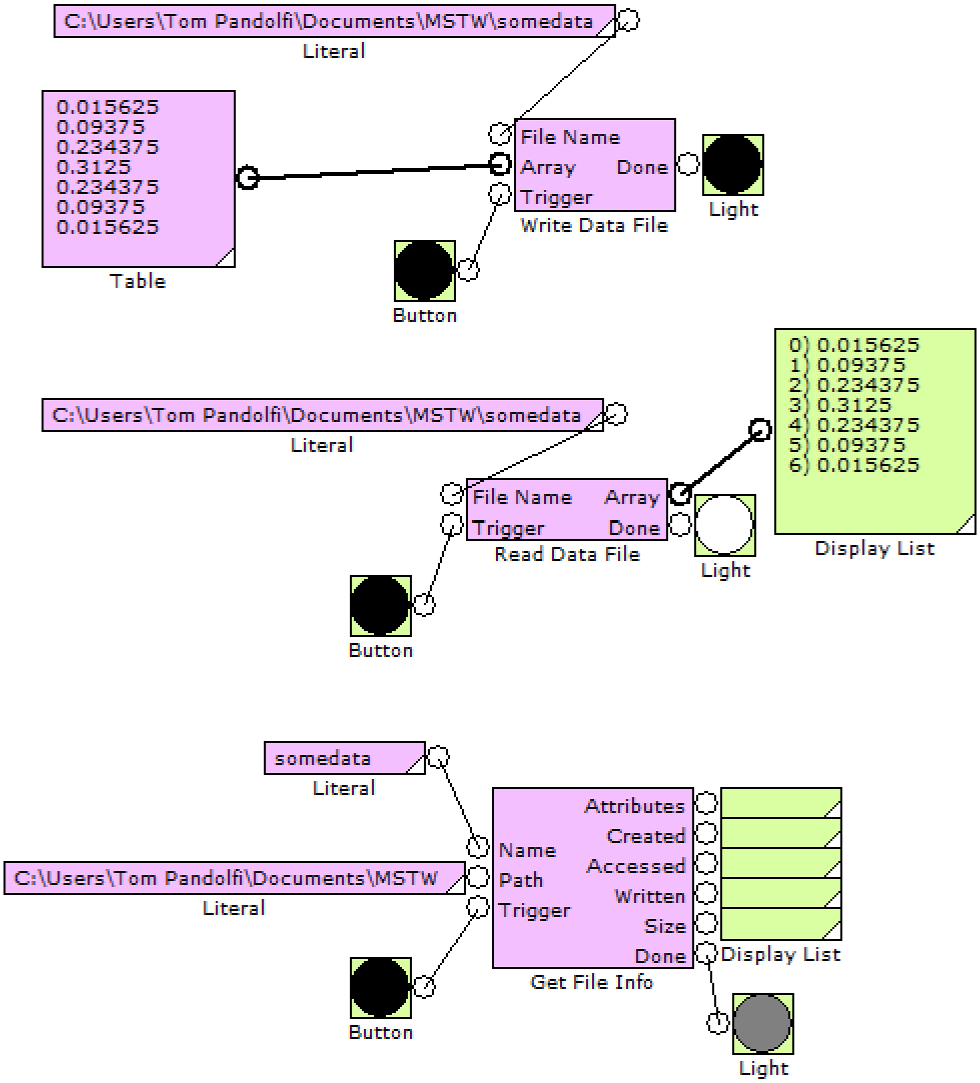
The 2D Ray Sensor component collects rays of light in the 2D view window. The position and diameter control the position and size of the sensor. The outputs give information about where the ray is coming from. 2D – column 3





Read Data File

The Read Data File component reads a binary file. The file can be bytes, words, longs, or doubles, depending on what you specify in the options.   Arrays - column 7

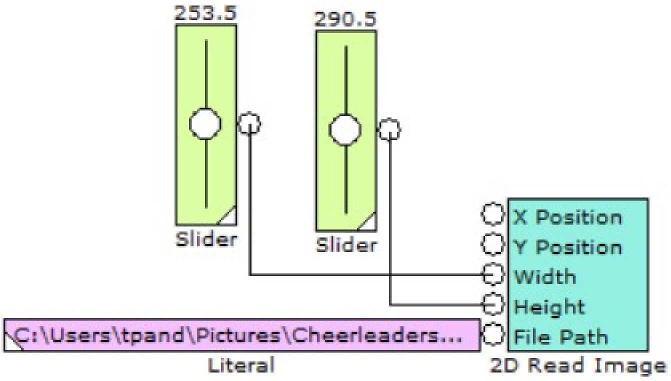


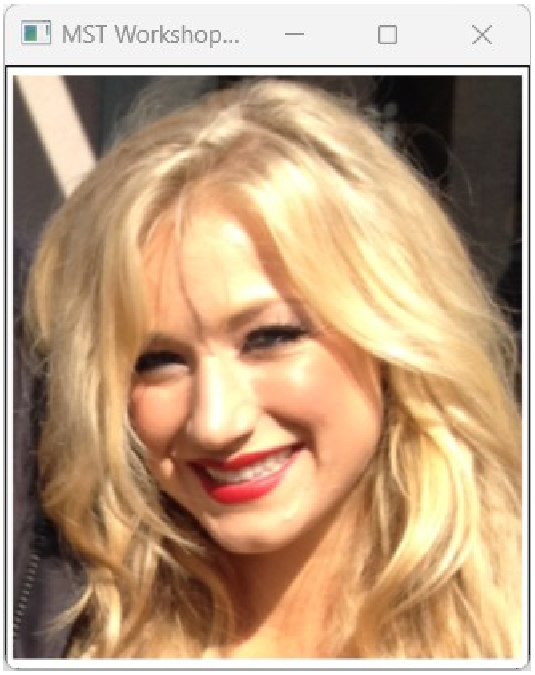
```
0.015625
0.09375
0.234375
0.3125
0.234375
0.09375
0.015625
```

```
0) 0.015625
1) 0.09375
2) 0.234375
3) 0.3125
4) 0.234375
5) 0.09375
6) 0.015625
```

2D Read Image

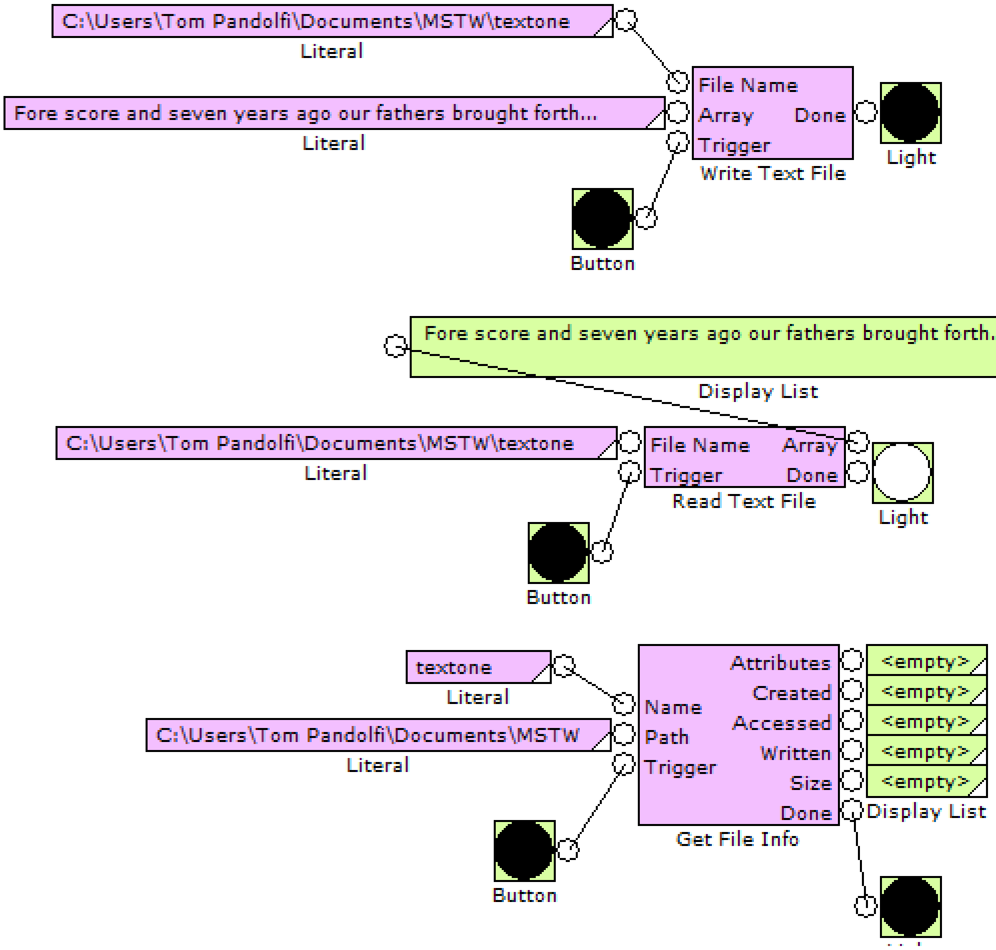
The 2D Read Image component reads an image and draws it in the 2D window. 2D – column 1





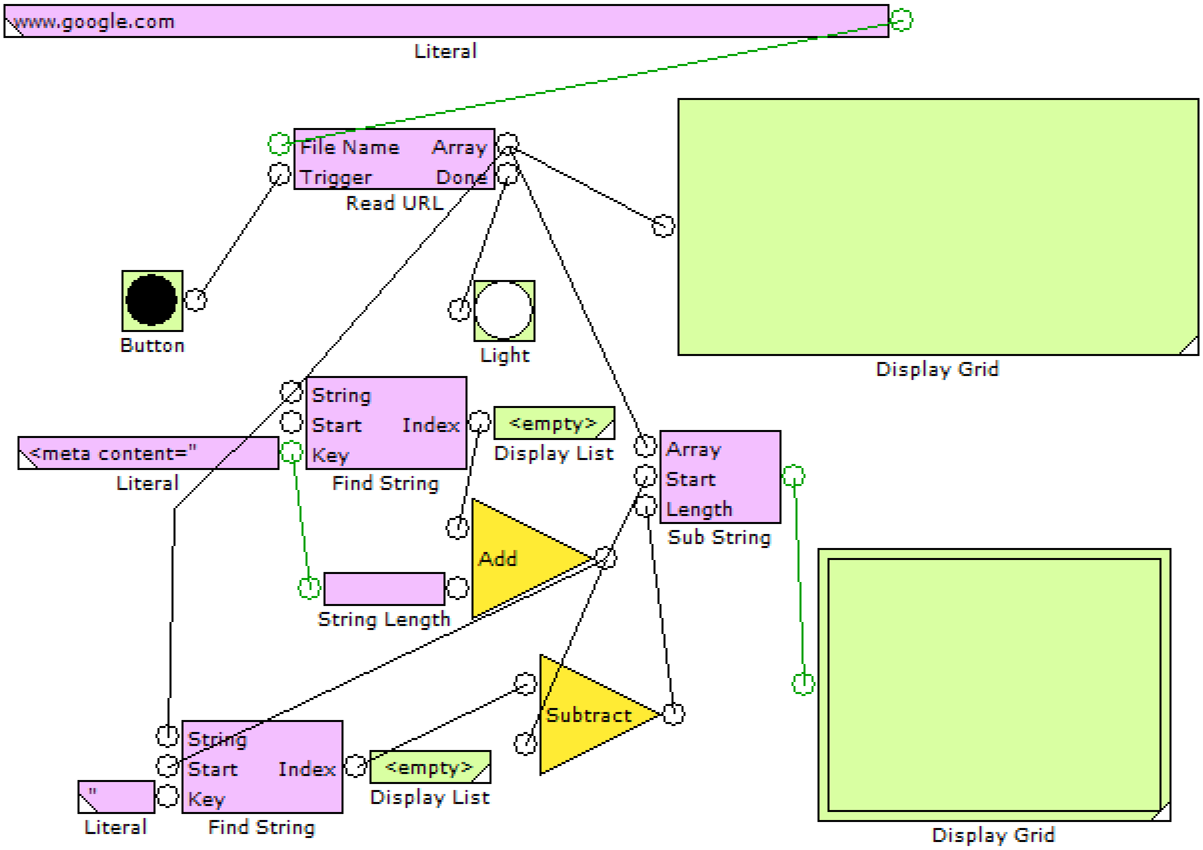
Read Text File

The Read Text File component reads a text file.   Arrays - column 7



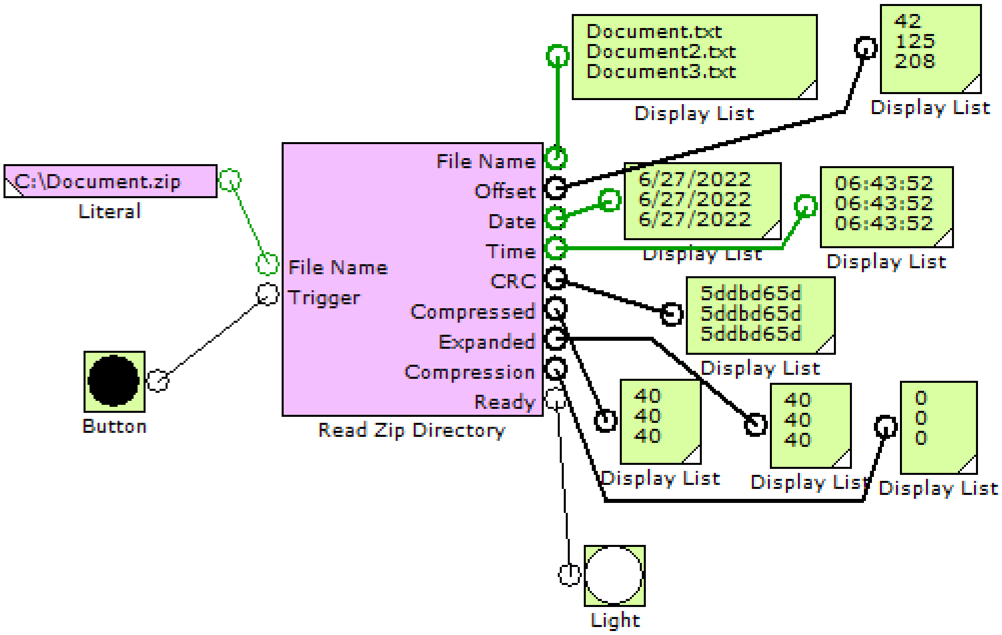
Read URL

The Read URL component reads a file on the internet given the URL of the file. Arrays - column 7



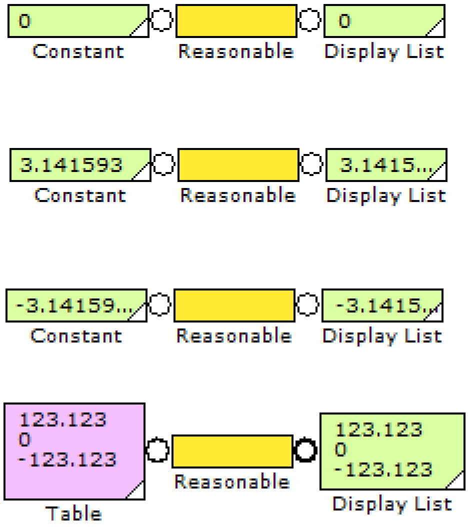
Read Zip Directory

The Read Zip Directory component reads a Zip file and outputs the inner file names, positions and sizes. Use the position and size to read any of the inner files.   Arrays – column 7



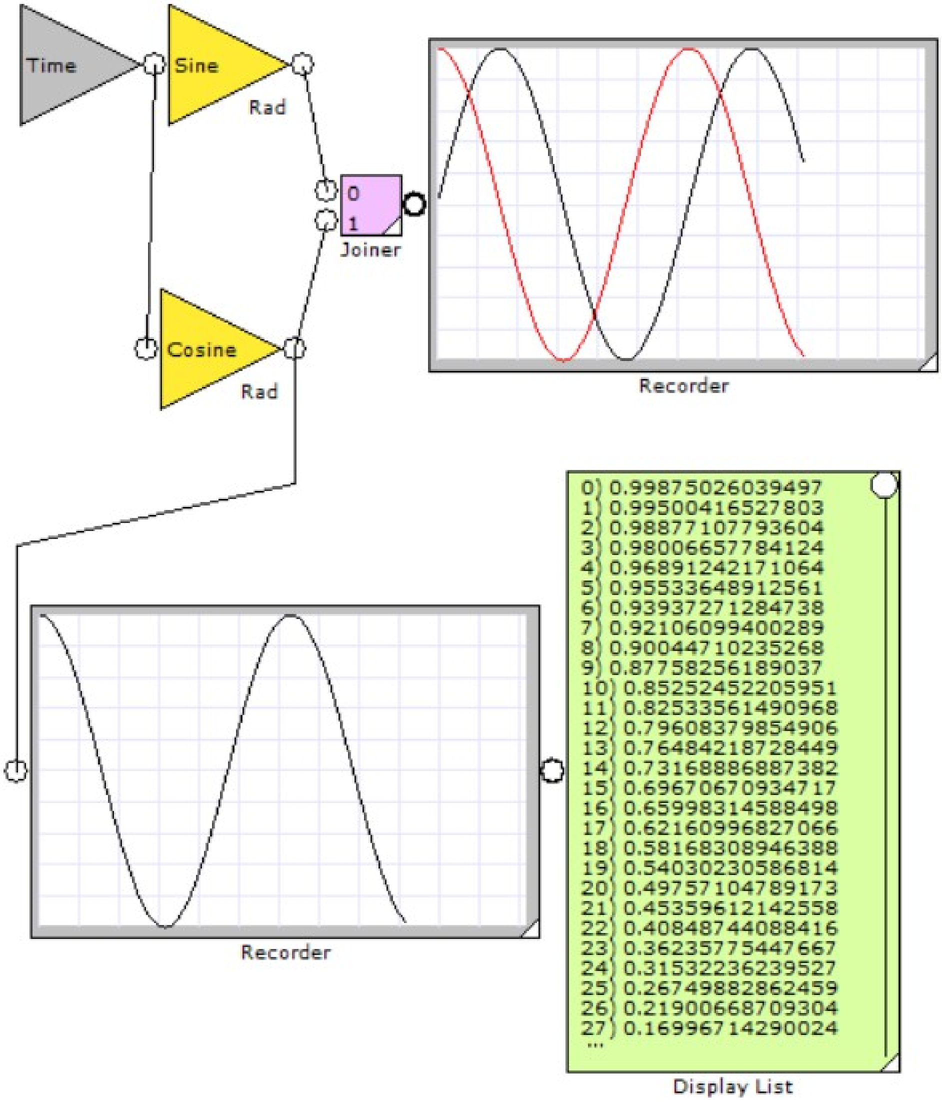
Reasonable

The Reasonable component converts values to a reasonable value. Inputs can be scalar or arrays.
Functions - column 2



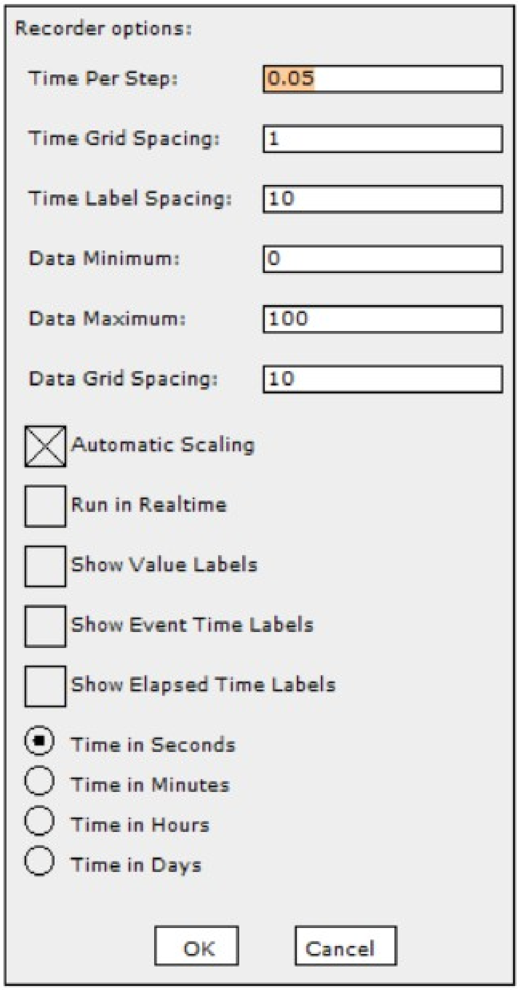
Recorder

The Recorder plots the value of the inputs over time. Hit the Start button to run this recorder. You can access the values shown on the recorder by enabling the Outputs. Controls - column 4



```
0) 0.99875026039497
1) 0.99500416527803
2) 0.98877107793604
3) 0.98006657784124
4) 0.96891242171064
5) 0.95533648912561
6) 0.93937271284738
7) 0.92106099400289
8) 0.90044710235268
9) 0.87758256189037
10) 0.85252452205951
11) 0.82533561490968
12) 0.79608379854906
13) 0.76484218728449
14) 0.73168886887382
15) 0.69670670934717
16) 0.65998314588498
17) 0.62160996827066
18) 0.58168308946388
19) 0.54030230586814
20) 0.49757104789173
21) 0.45359612142558
22) 0.40848744088416
23) 0.36235775447667
24) 0.31532236239527
25) 0.26749882862459
26) 0.21900668709304
27) 0.16996714290024
...
```

You can set the time steps using the Time Per Step input and the radio buttons to select if this time is seconds, minutes, hours or days. As shown below the setting is 0.05 seconds per step. The Time Grid Spacing indicates how many steps before a grid line is drawn. The Time Label Spacing is how many steps before a bold line and label are drawn.
For the vertical grid, you can control the minimum and maximum values allowed in the plot or select Automatic Scaling.
For the horizontal grid, three options are available: Event Time, Elapsed Time, or both. If you select Event Time vertical lines will be drawn and labeled at the bottom to indicate the time of the event starting at the time the Recorder was started. If you select Elapsed Time vertical lines will be drawn and labeled at the top indicating the time elapsed since the Recorder was started. If you select both the labels will show as normally but the vertical lines will be drawn to the mid point of the chart.



Recorder options:

Time Per Step: 0.05

Time Grid Spacing: 1

Time Label Spacing: 10

Data Minimum: 0

Data Maximum: 100

Data Grid Spacing: 10

☒ Automatic Scaling

□ Run in Realtime

□ Show Value Labels

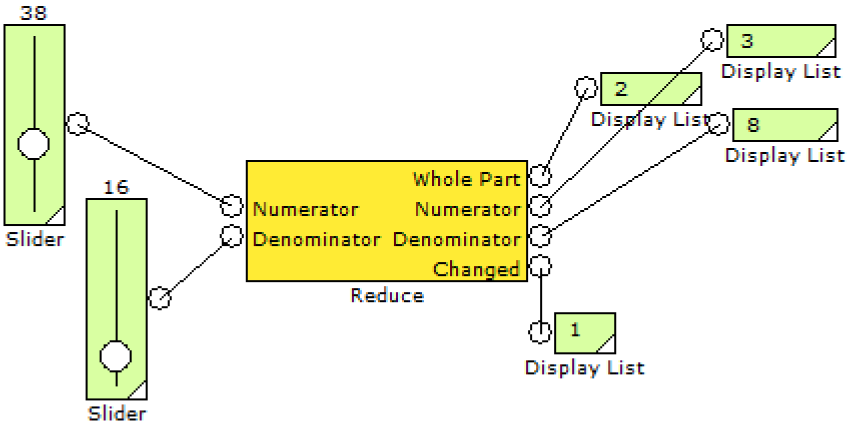
□ Show Event Time Labels

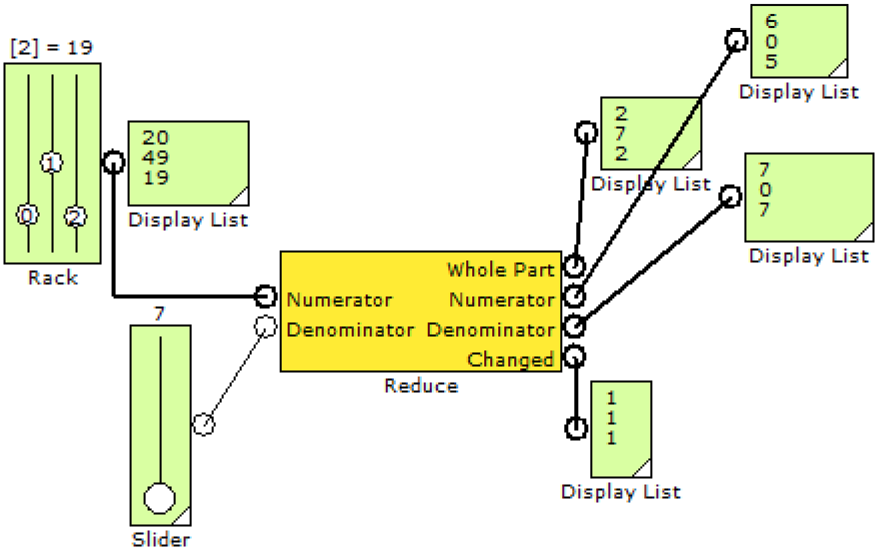
□ Show Elapsed Time Labels

● Time in Seconds
○ Time in Minutes
○ Time in Hours
○ Time in Days

Reduce

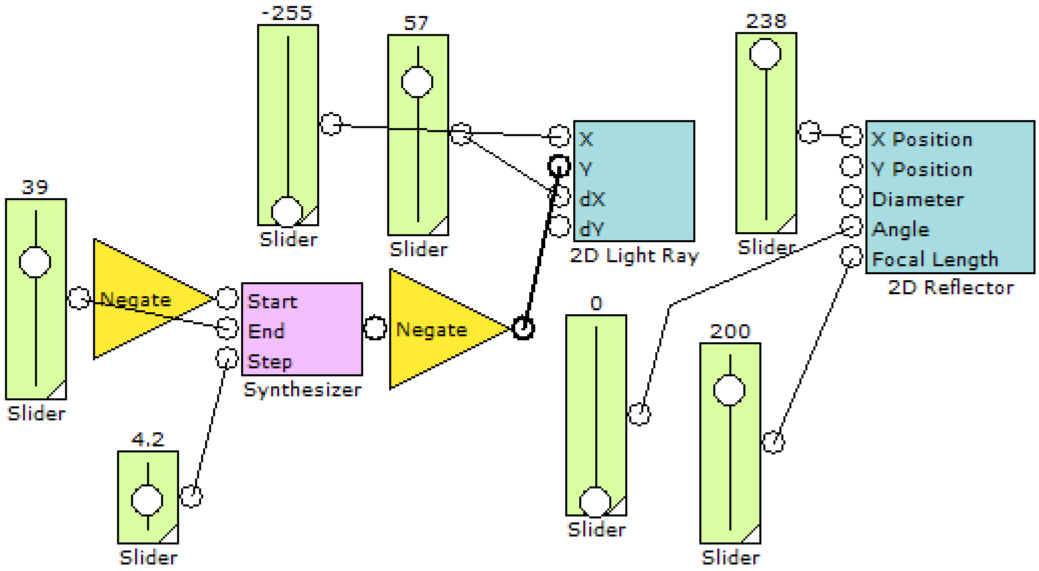
The Reduce component reduces the input fraction to a proper fraction. Possibly with a whole part.
Functions - column 9

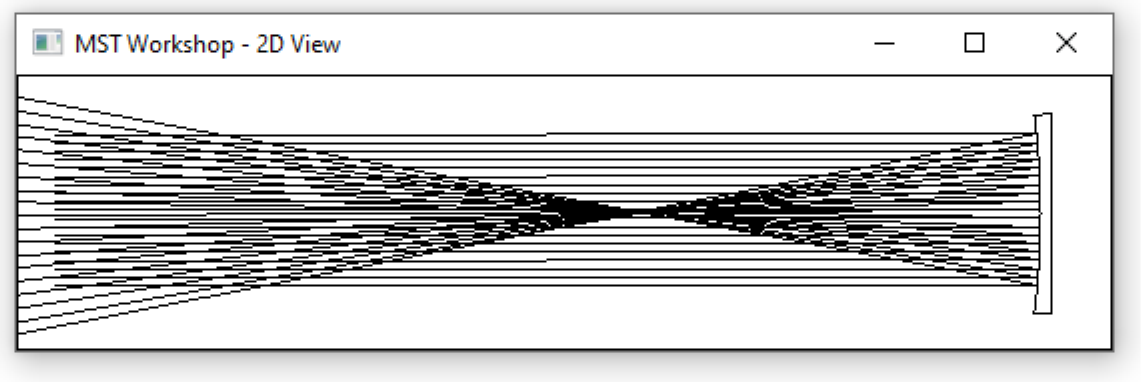




2D Reflector

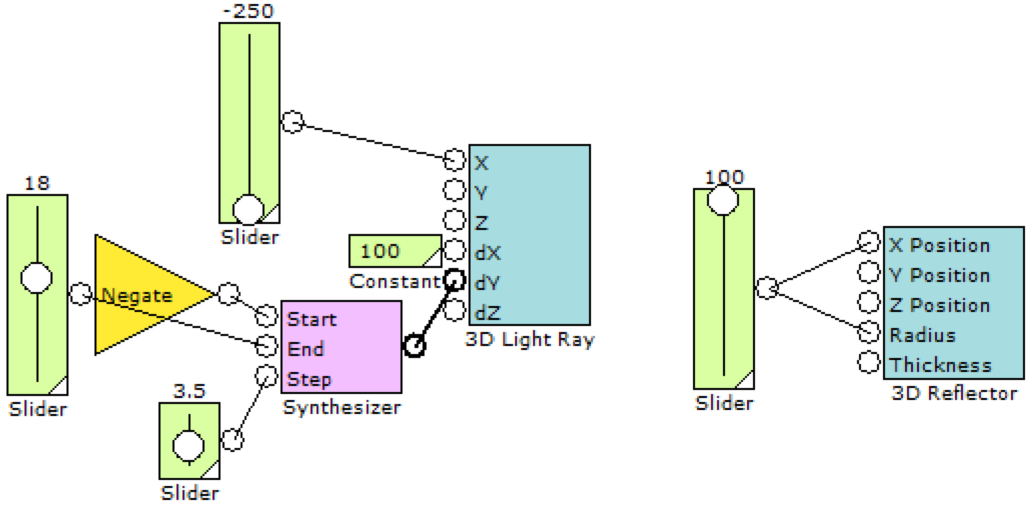
The 2D Reflector component reflects light rays in the 2D view window. The settings determine the fraction of light that reflects and passes through.   2D - column 3

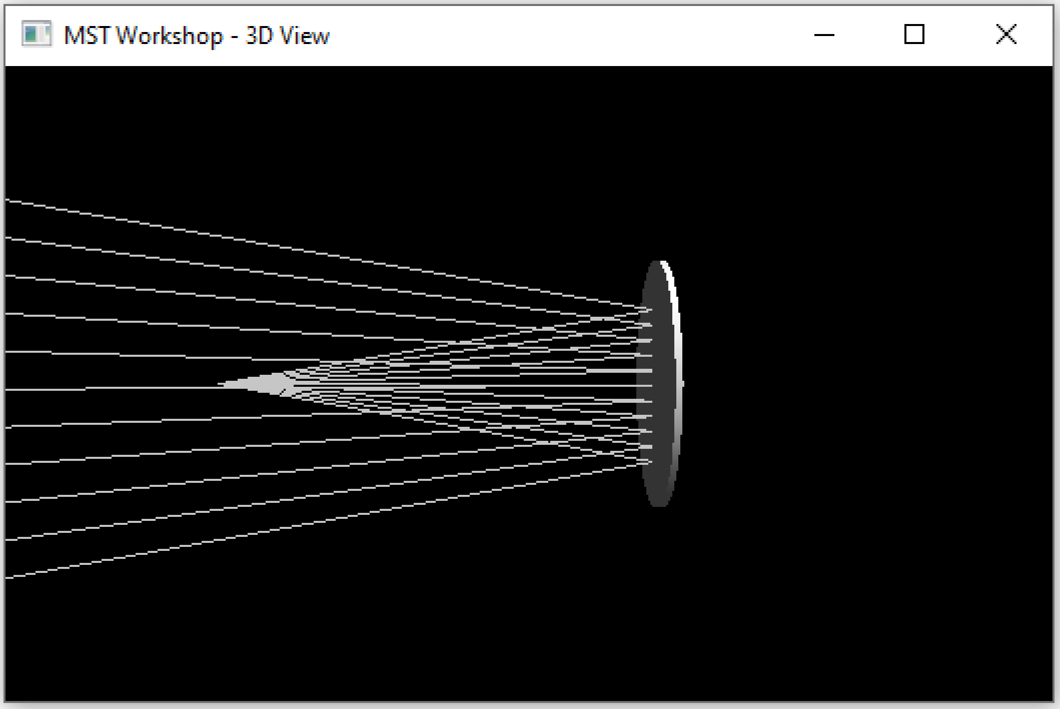




3D Reflector

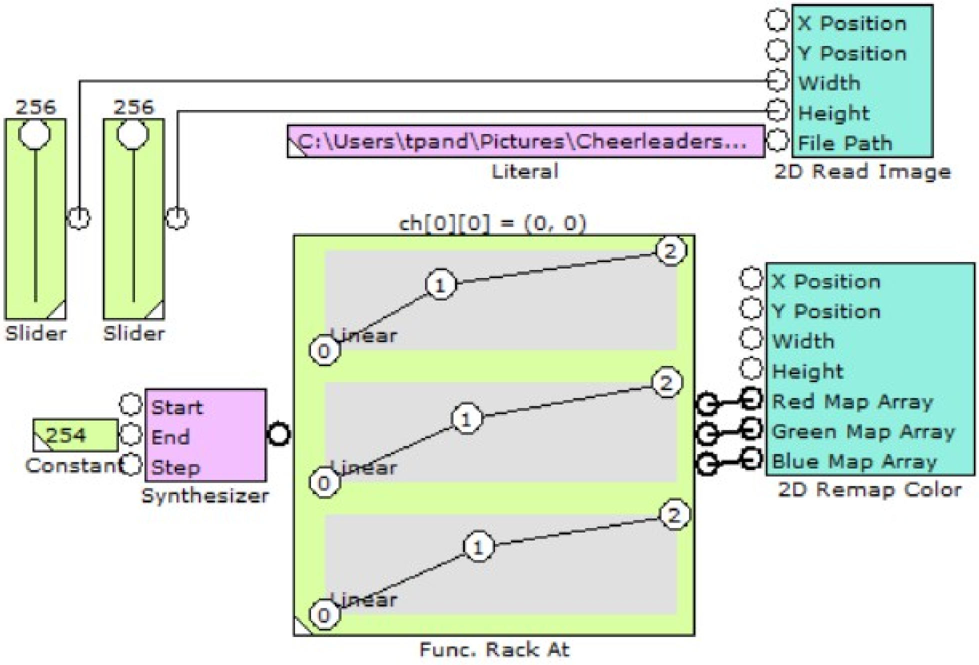
The 3D Reflector component reflects light rays in the 3D view window. The settings determine the fraction of light that reflects and passes through. The Affine [4x4] array input modifies the size, position and orientation of the reflector.   3D - column 5

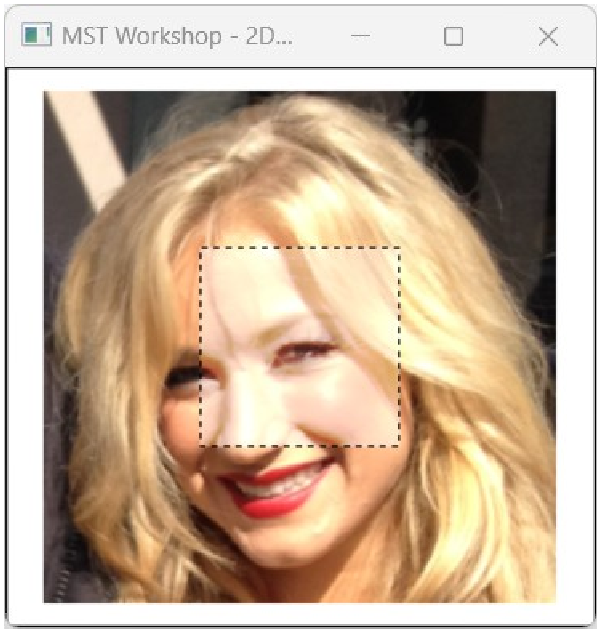




2D Remap Color

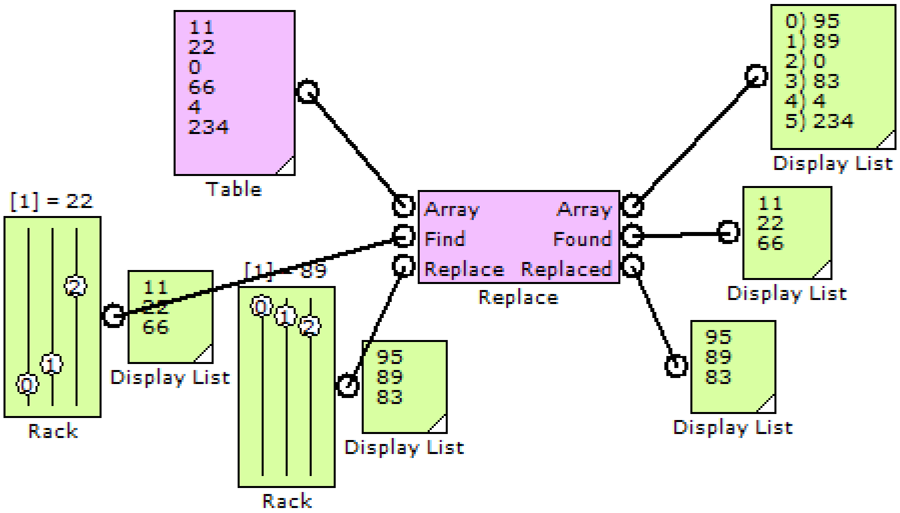
The 2D Remap Color uses the input look-up table to modify the color of each pixel. 2D – column 1

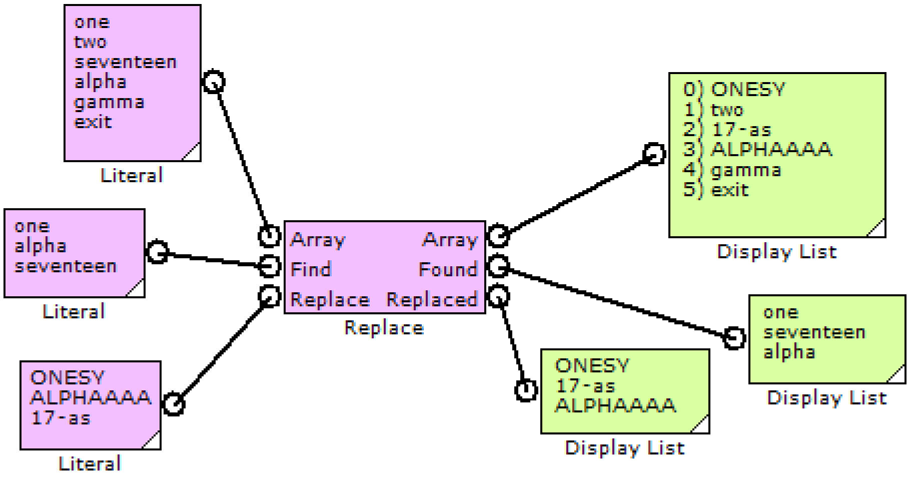




Replace

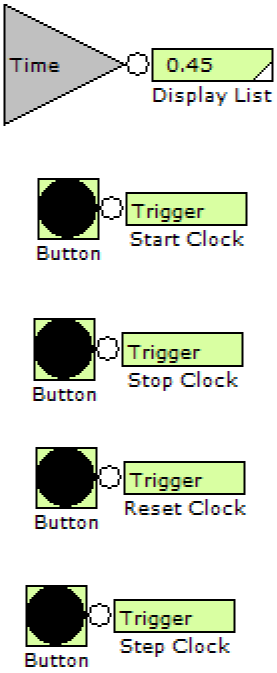
The Replace component scans the input, when it finds the Match input value it replaces it with the Replace input string.   Arrays - column 2





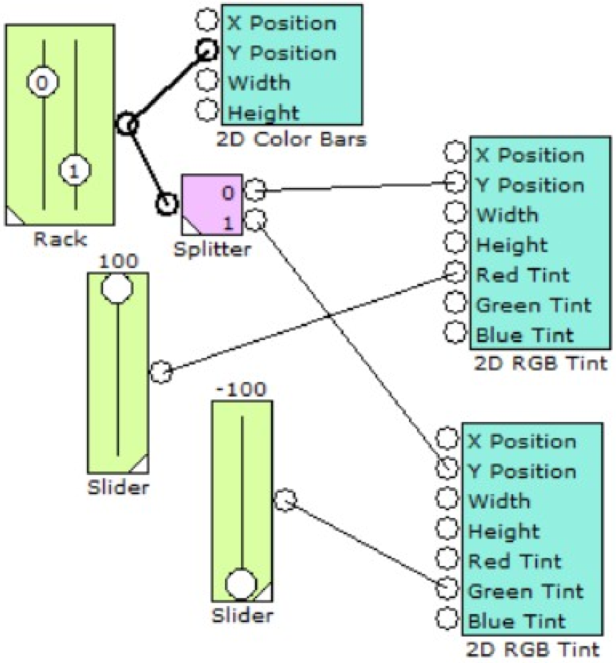
Reset Clock

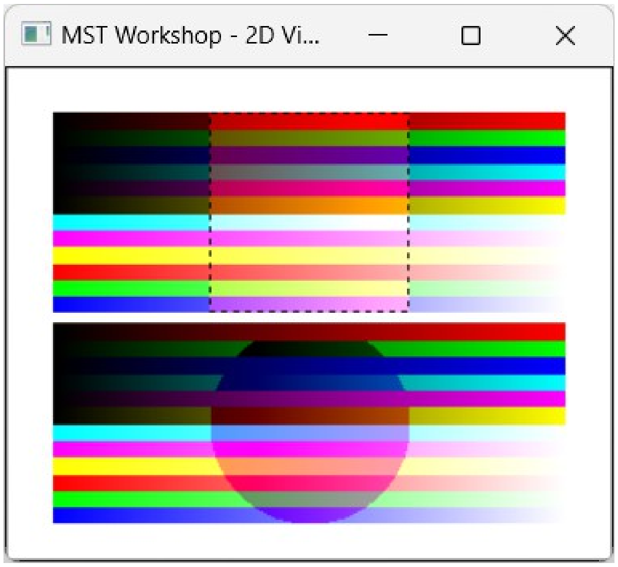
The Reset Clock component sets the solution clock to zero when the trigger goes from false to true.
Controls - column 3



2D RGB Tint

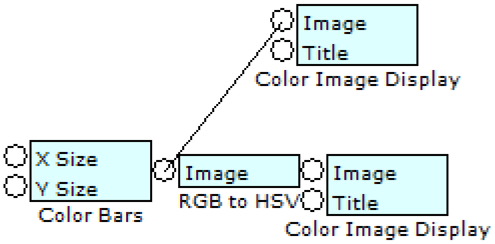
The 2D RGB Tint lightens or darkens each of the Red Green and Blue components in the 2D drawing it covers. 2D – column 1

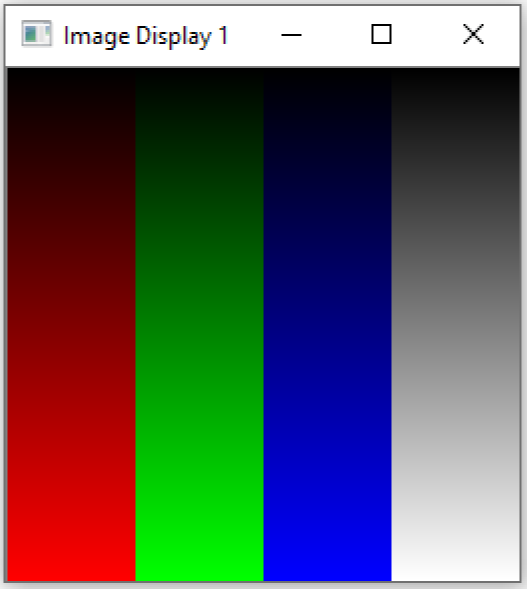


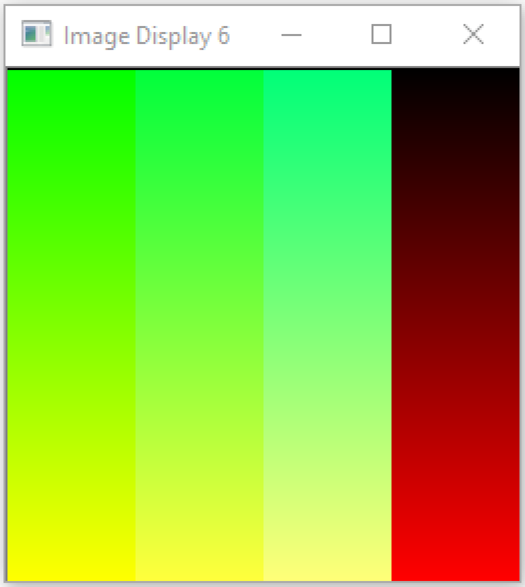


RGB to HSV

The RGB to HSV component converts the image from RGB color to HSV color. Images - column 1

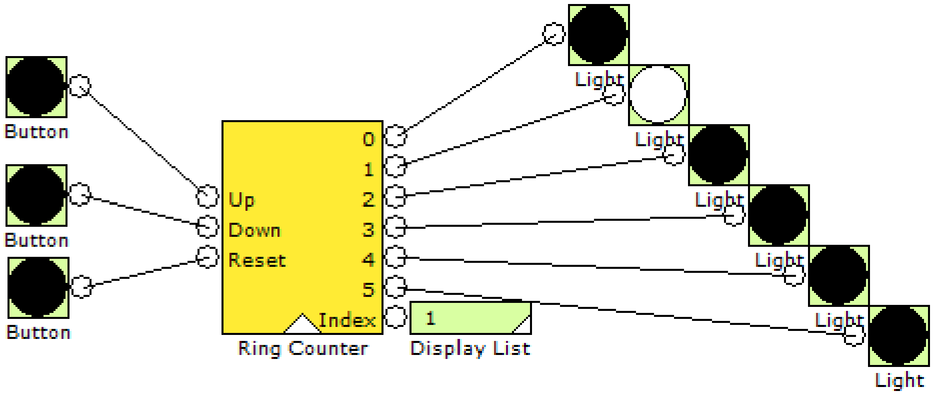






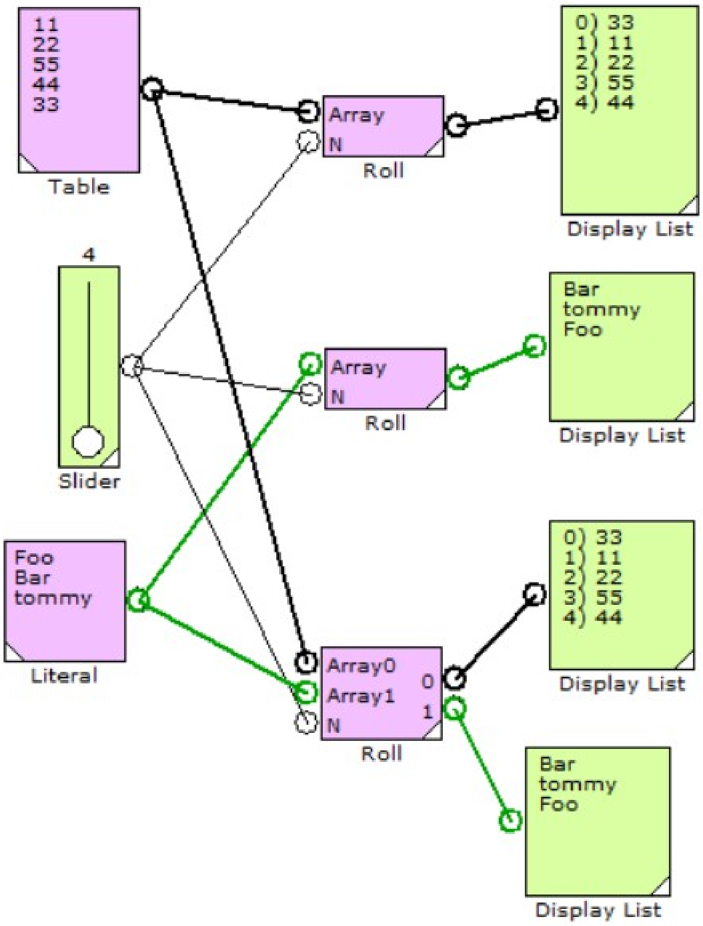
Ring Counter

The Ring Counter component counts up or down and outputs one of n true values and the index of that value. Functions - column 8



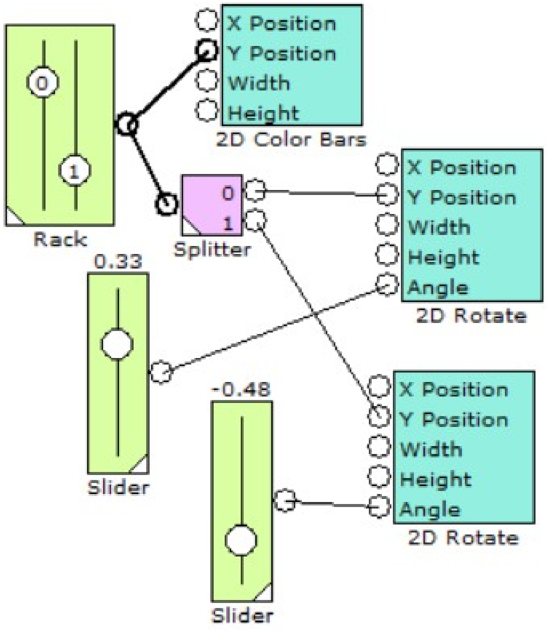
Roll

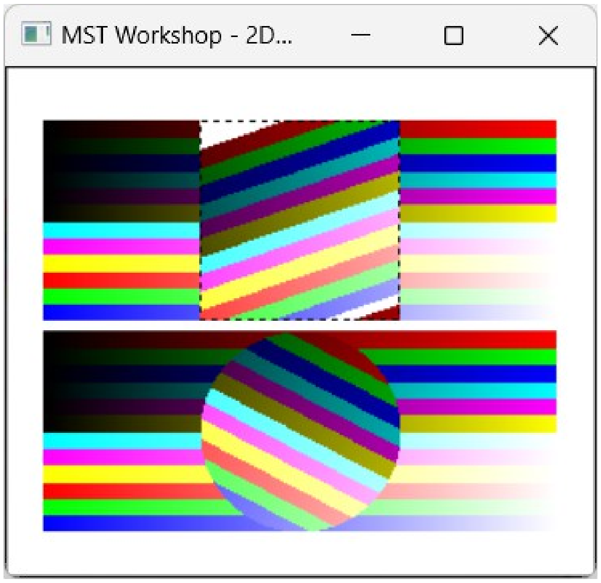
The Roll component rotates the values by the Amount given. Negative numbers rotate backwards.
Arrays - column 1



2D Rotate

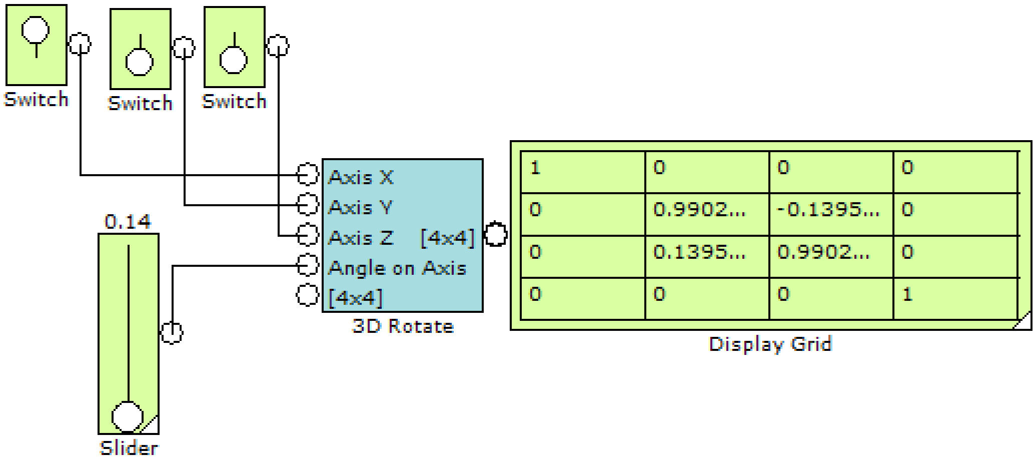
The 2D Rotate rotates the image in the 2D Drawing it covers. 2D – column 1



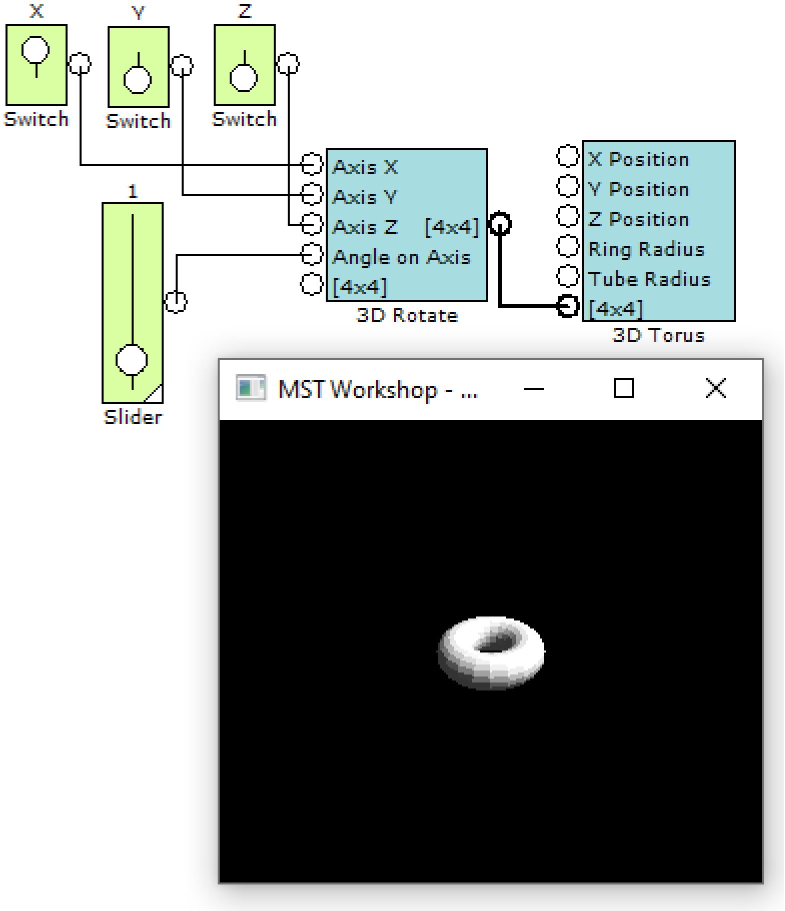


3D Rotate

The 3D Rotate rotates a 4 by 4 matrix on the X, Y, and/or Z axis.   3D - column 3

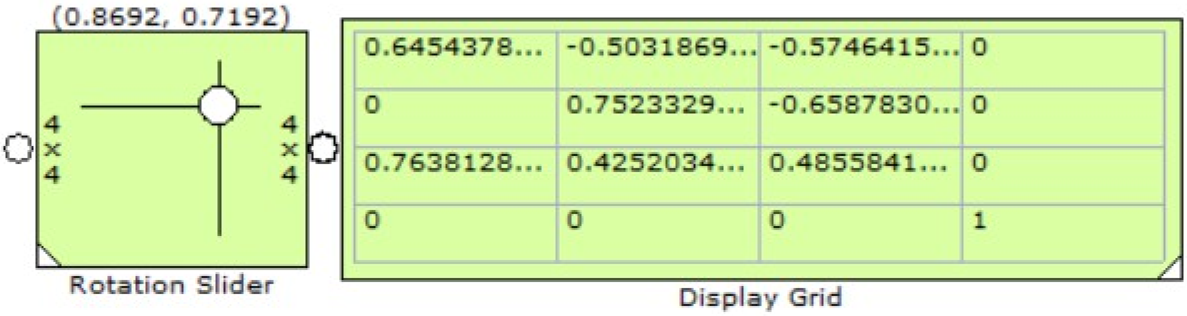


1	0	0	0
0	0.9902...	-0.1395...	0
0	0.1395...	0.9902...	0
0	0	0	1



Rotation Slider

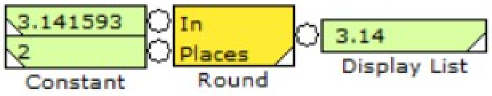
The Rotation Slider component creates a 4x4 rotation matrix from the position of the control knob.
Controls – column 2

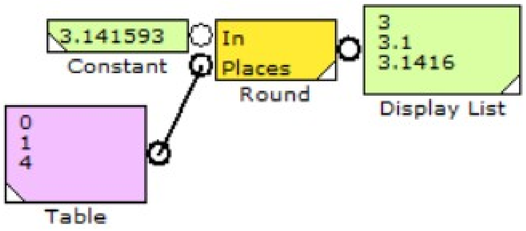


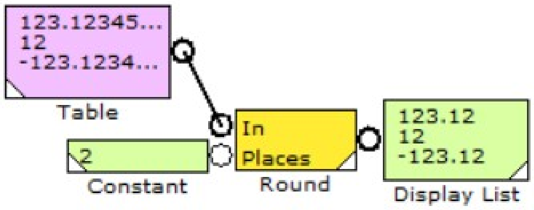
0.6454378...	-0.5031869...	-0.5746415...	0
0	0.7523329...	-0.6587830...	0
0.7638128...	0.4252034...	0.4855841...	0
0	0	0	1

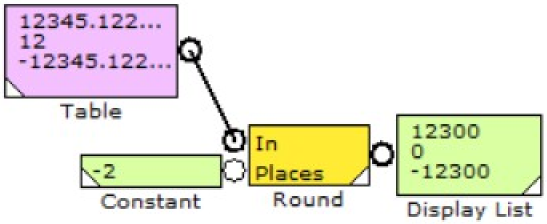
Round

The Round component outputs a value with the specified decimal places. Inputs can be scalar or arrays.
Functions - column 2



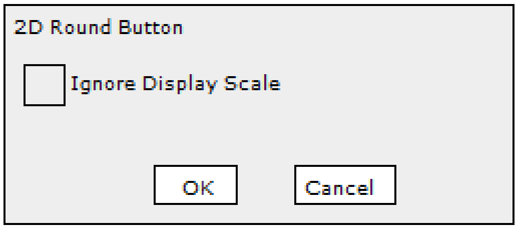






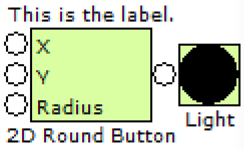
2D Round Button

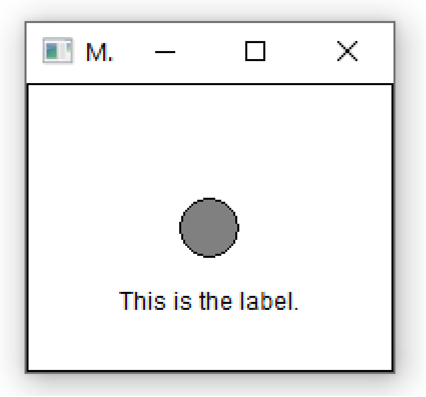
The 2D Round Button is used to trigger an event by clicking on it. Controls - column 1



2D Round Button

□ Ignore Display Scale

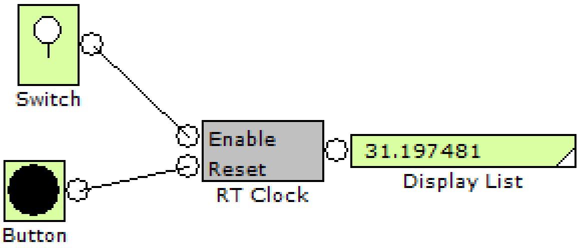


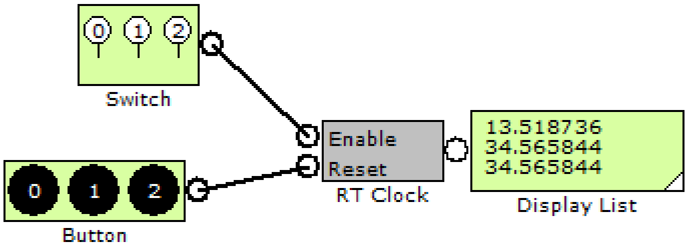


RT Clock

The RT Clock component lets you measure time using the computer's internal clock (not the workspace time). The output is in seconds with microsecond resolution. When the RT Clock is enabled it is running even though it's output is only updated when the workspace clock increments.

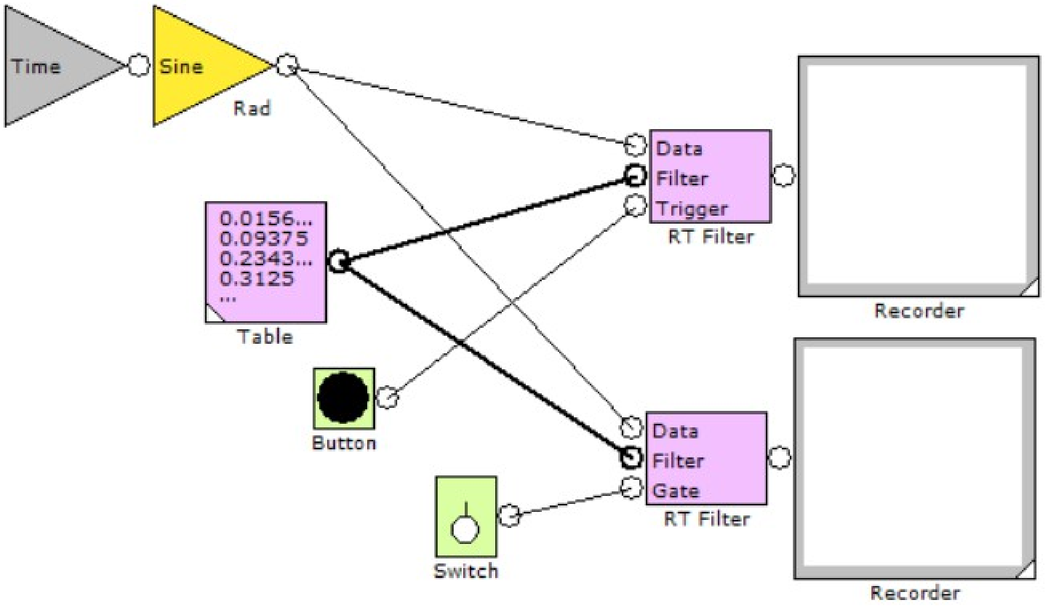
Functions - column 7





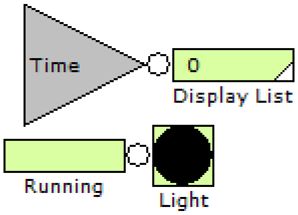
RT Filter

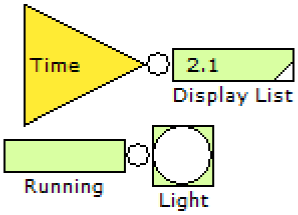
The RT Filter component processes the data as it comes into the filter in realtime. It uses the input from the Filter array. The output is the filtered value.   Arrays – column 2



Running

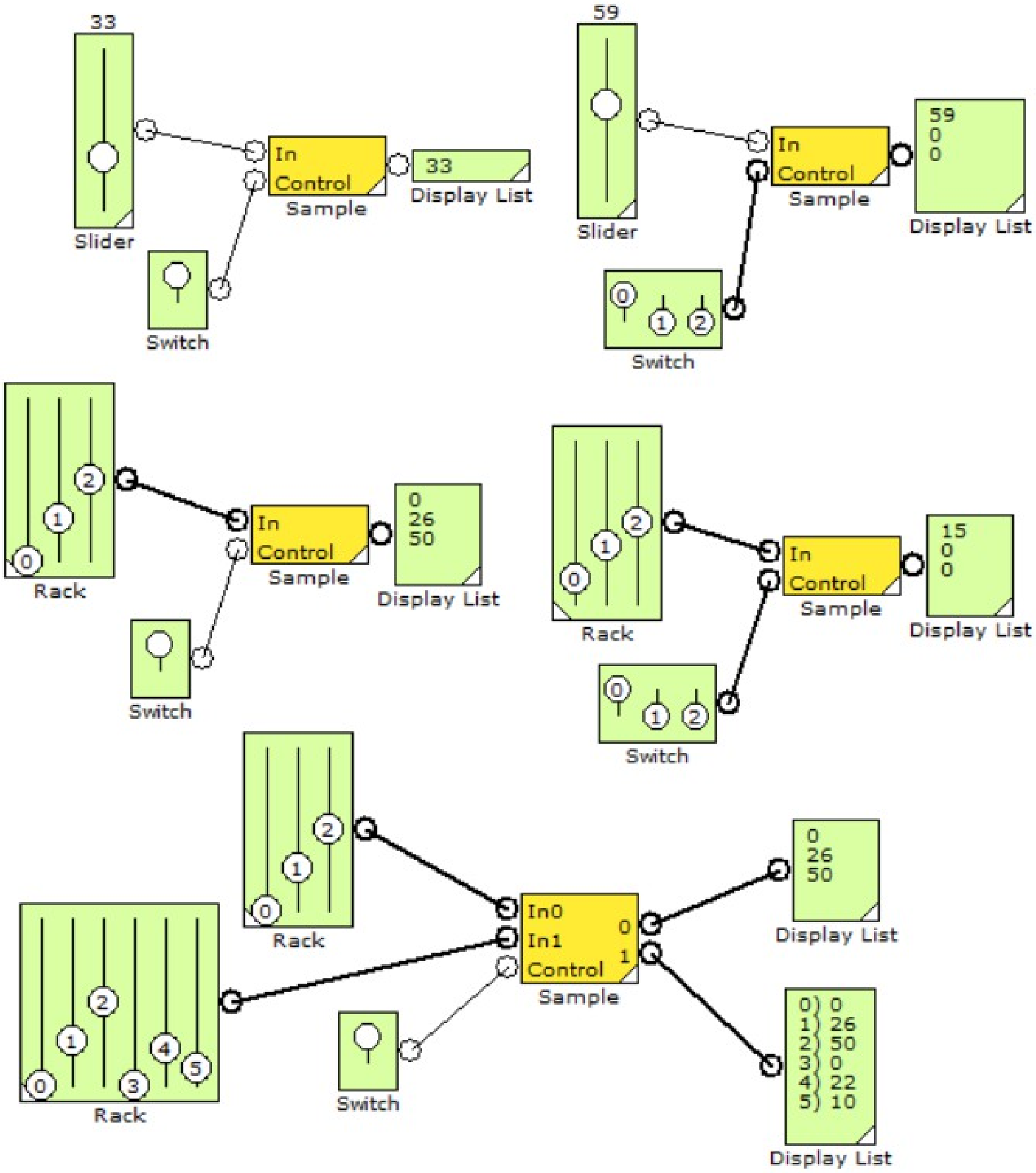
The Running component outputs a 1 when the clock is running or 0 when the clock is stopped.
Controls - column 3





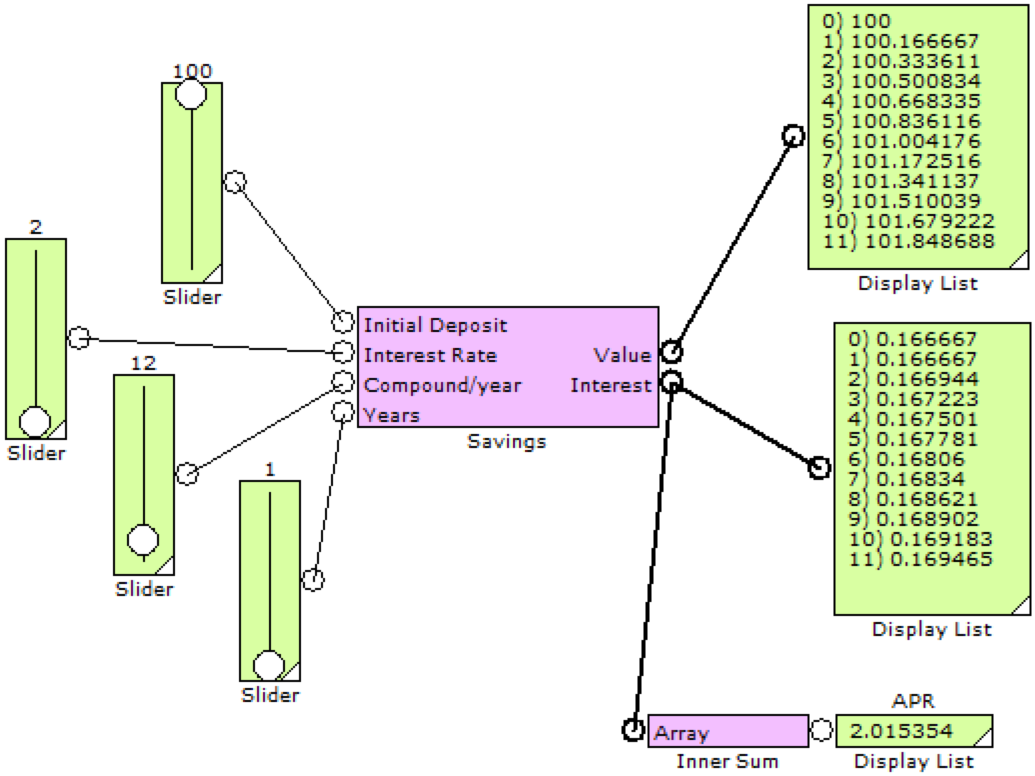
Sample

The Sample will send the input to the output when the control input is true.   Functions - column 2



Savings

The Savings component calculate the interest on an investment.   Arrays - column 5



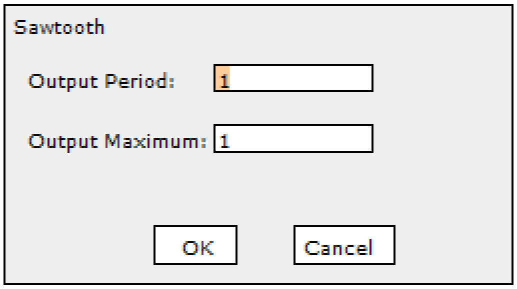
```
0) 100
1) 100.166667
2) 100.333611
3) 100.500834
4) 100.668335
5) 100.836116
6) 101.004176
7) 101.172516
8) 101.341137
9) 101.510039
10) 101.679222
11) 101.848688
```

```
0) 0.166667
1) 0.166667
2) 0.166944
3) 0.167223
4) 0.167501
5) 0.167781
6) 0.16806
7) 0.16834
8) 0.168621
9) 0.168902
10) 0.169183
11) 0.169465
```

```
2.015354
```

Sawtooth

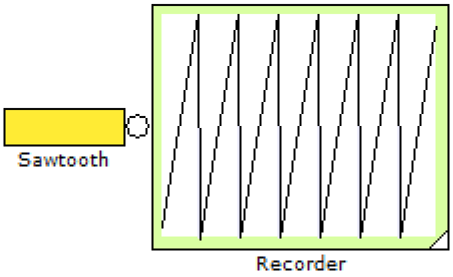
The Sawtooth component outputs a ramp that drops sharply when the clock is running.   Functions - column 8

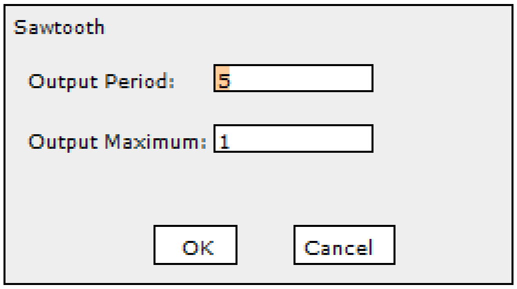


Sawtooth

Output Period: 1

Output Maximum: 1

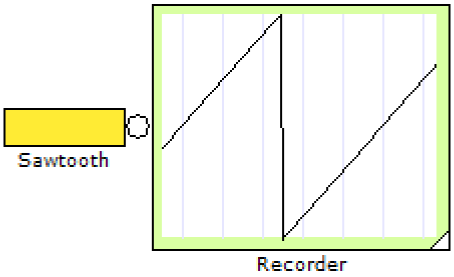




Sawtooth

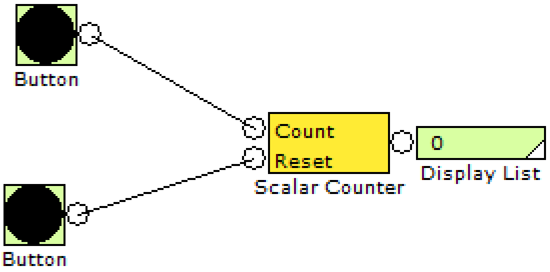
Output Period: 5

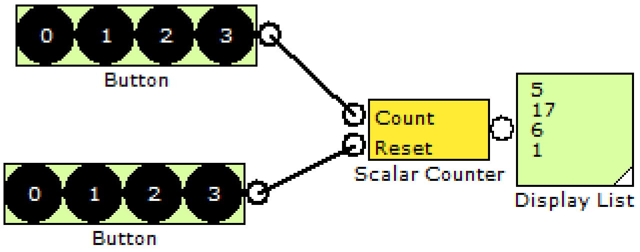
Output Maximum: 1



Scalar Counter

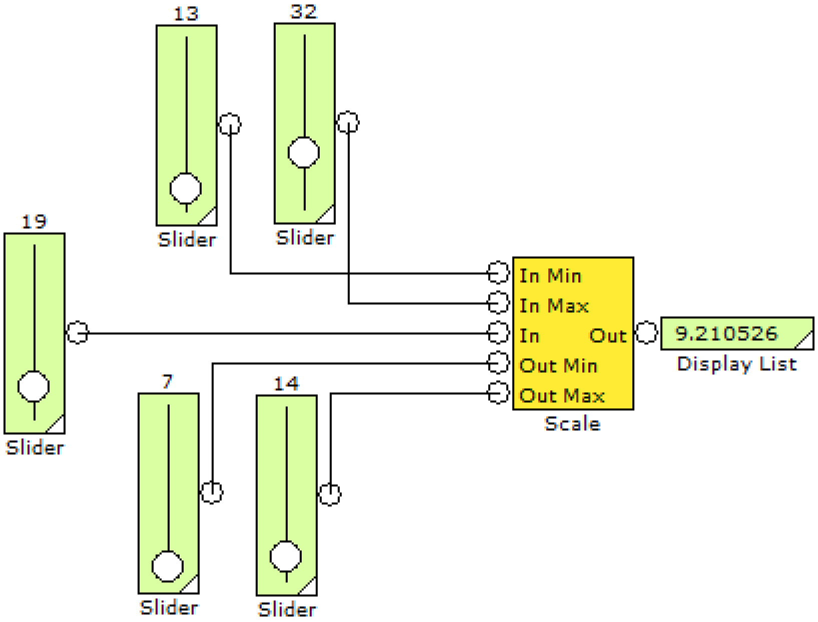
The Scalar Counter component counts up or down and outputs the value. Functions - column 8

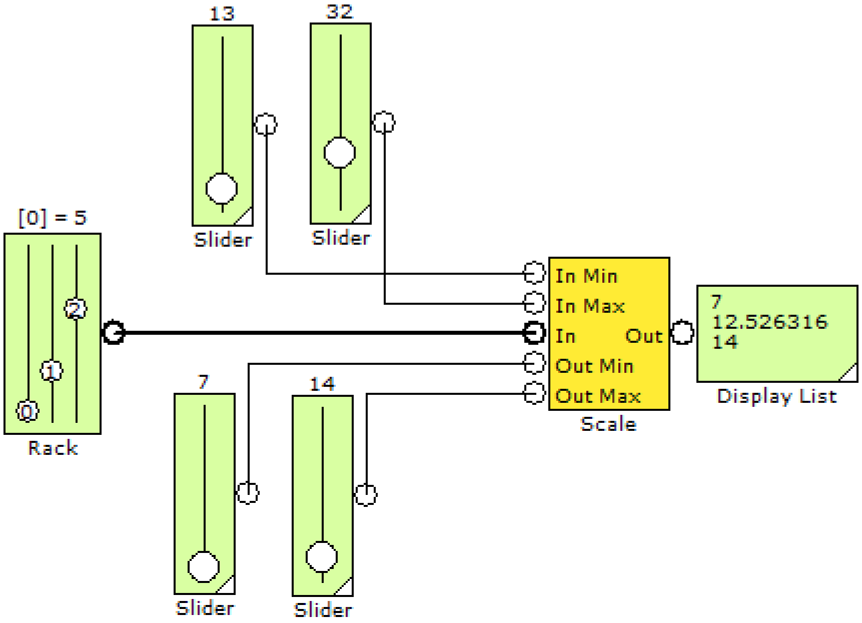




Scale

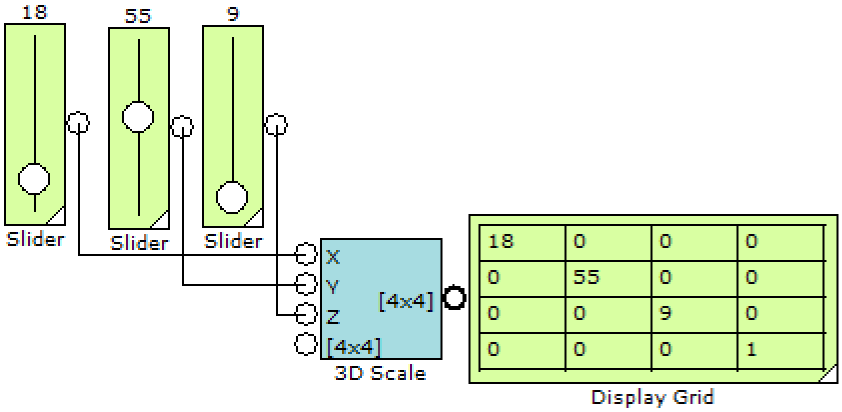
The Scale component linearly scales its inputs from one range to another. Functions - column 5



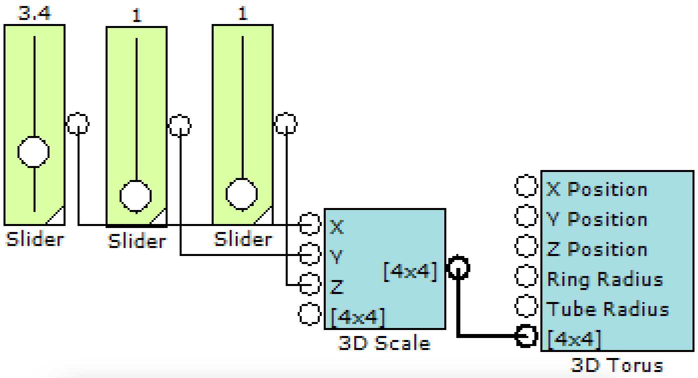


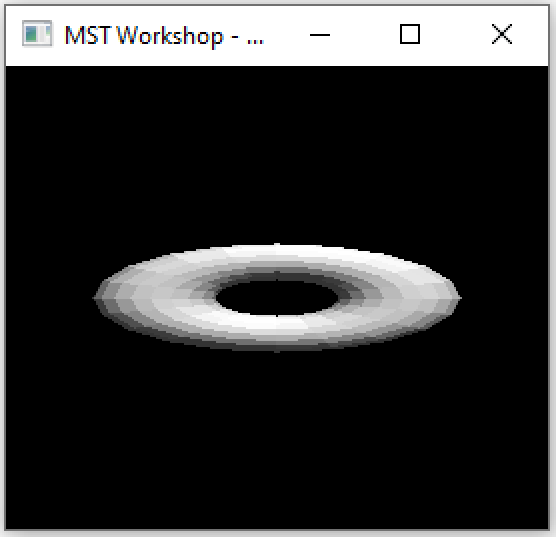
3D Scale

The 3D Scale magnifies a 4 by 4 matrix in the X, Y, and Z directions. 3D - column 3



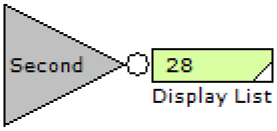
18	0	0	0
0	55	0	0
0	0	9	0
0	0	0	1





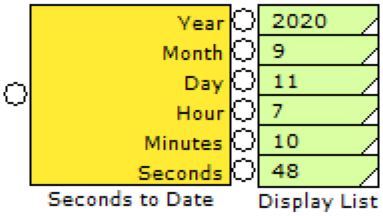
Second

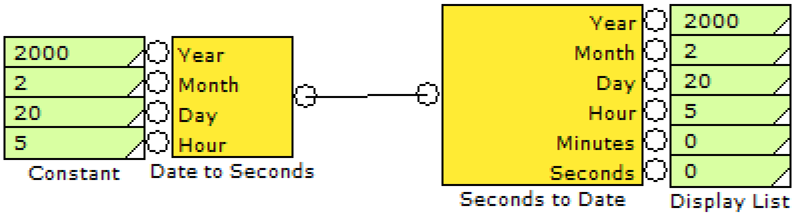
The Second component outputs the clock seconds from the computers internal clock.   Functions - column 7



Seconds to Date

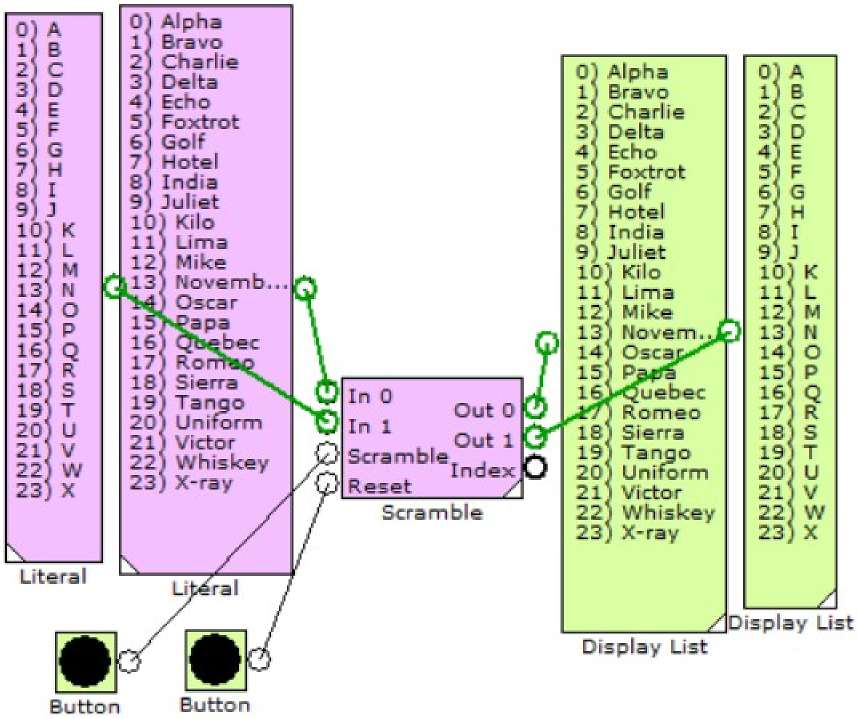
The Seconds to Date component a number of seconds and converts it to a date.   Functions - column 6





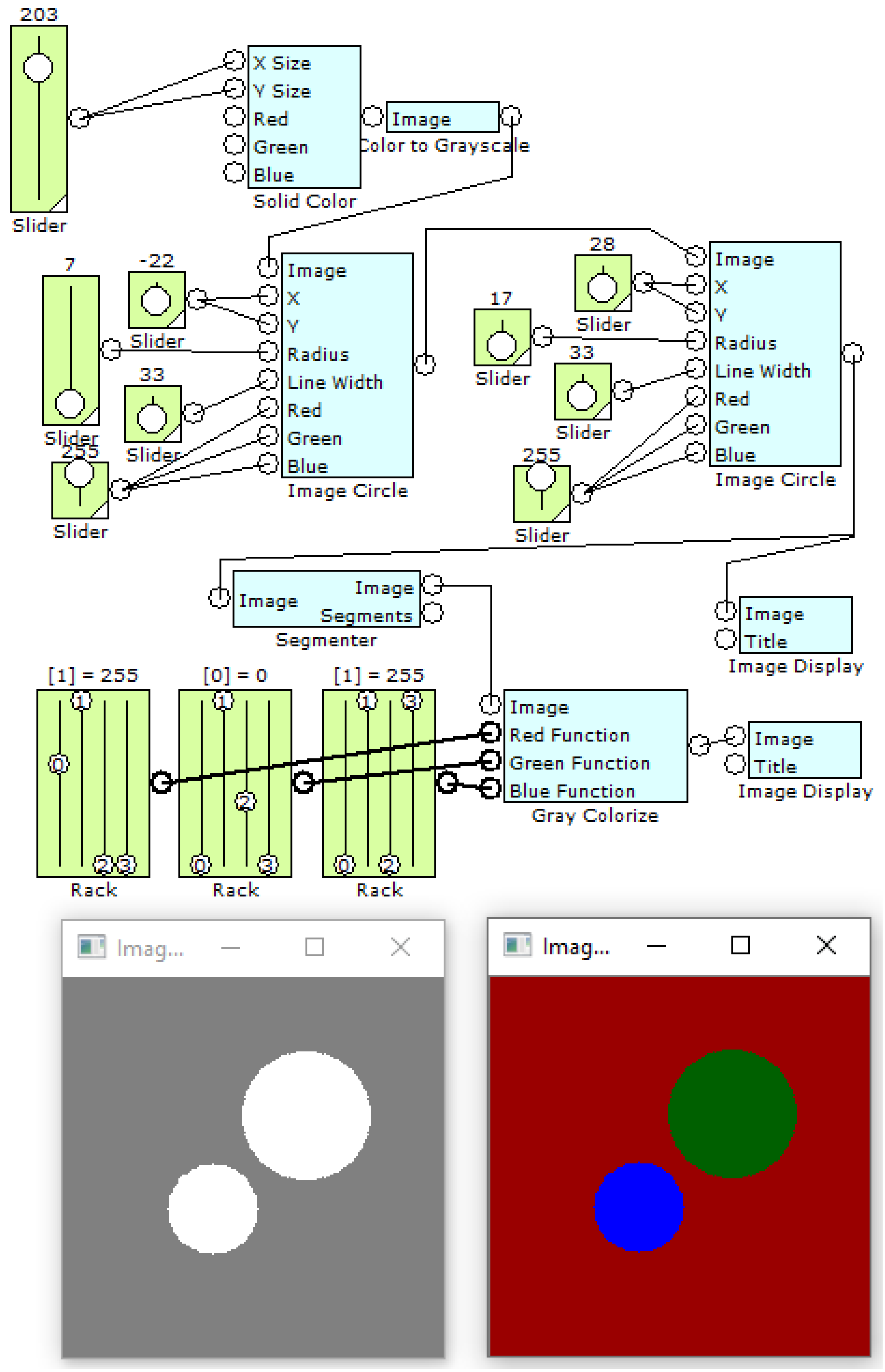
Scramble

The Scramble component randomly rearranges the input(s). If there are multiple inputs they are scrambled with the same random index. Arrays – column 1



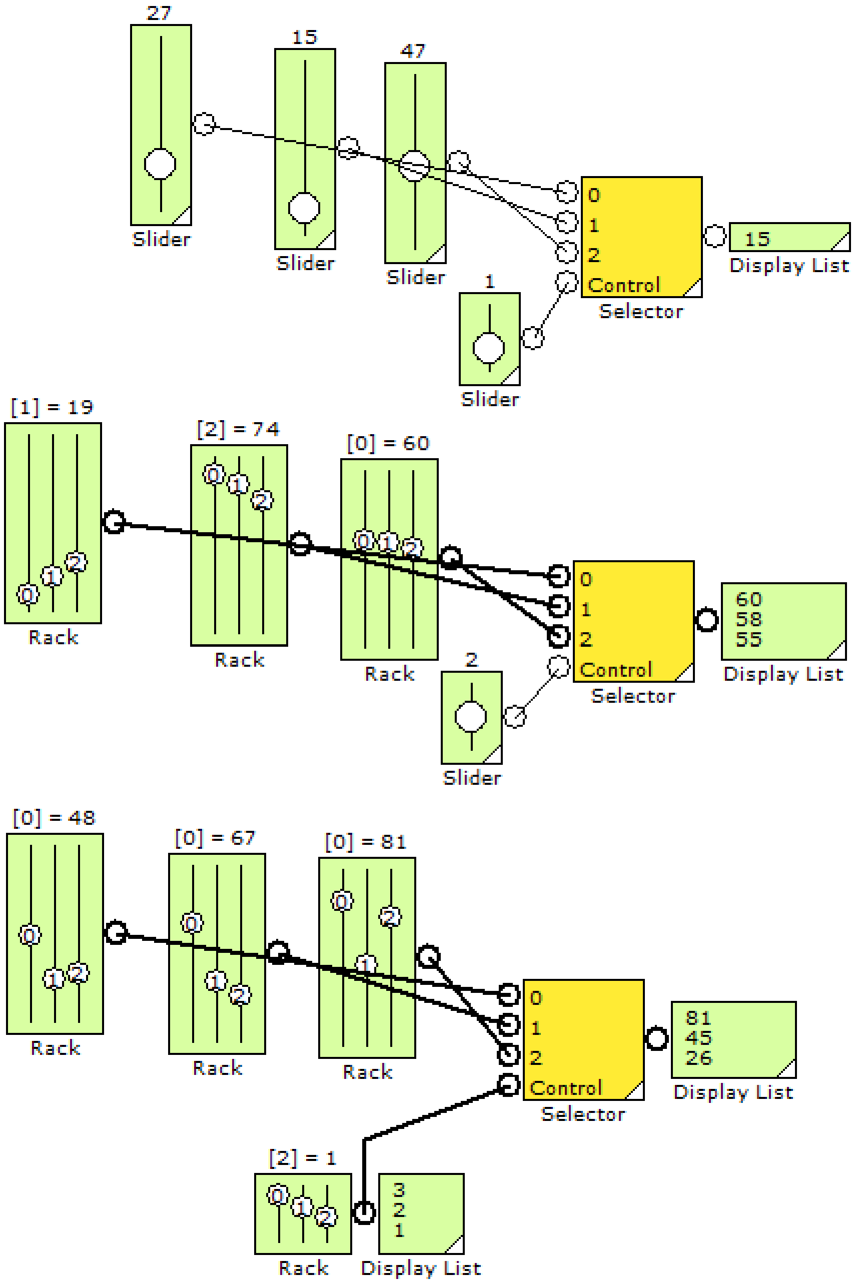
Segmenter

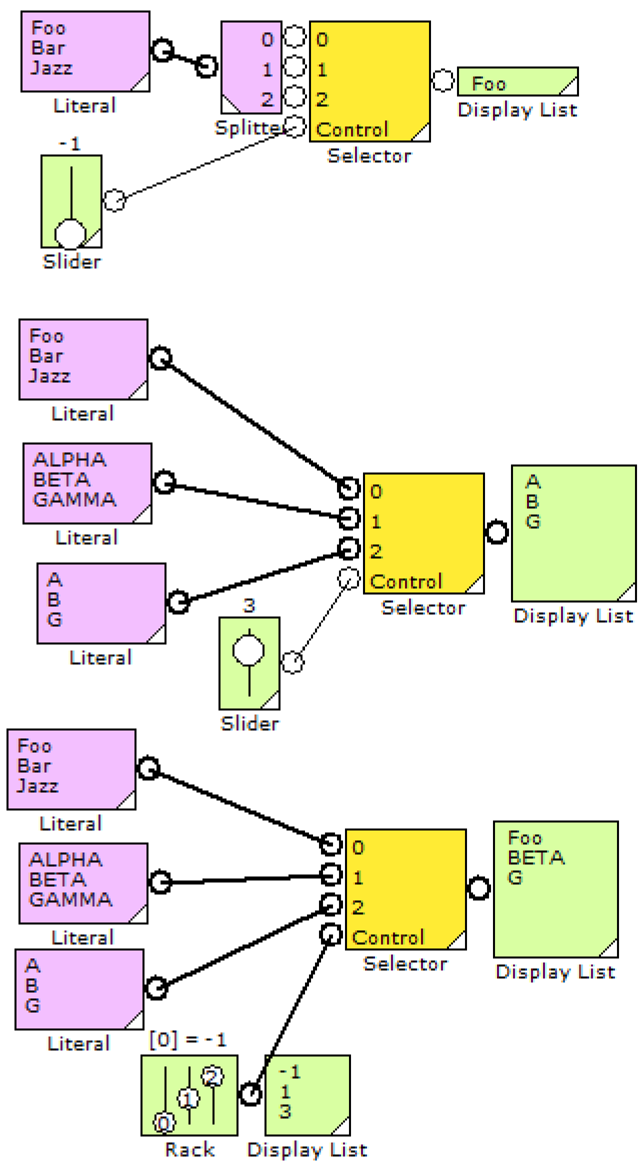
The Segmenter component inputs a grayscale image and outputs a grayscale image that has a different gray level for each segment found.   Images - column 4



Selector

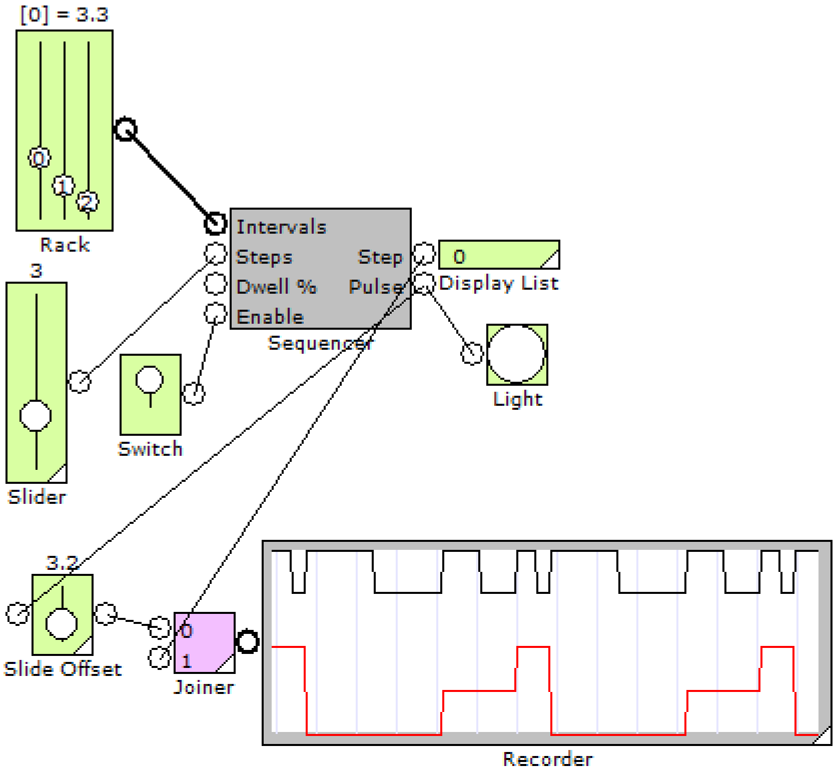
The Selector component picks one of the input values based on the control input. You can set the number of inputs. Functions - column 6




Foo
Bar
Jazz
Literal
0
1
2
Splitter
0
1
2
Control
Selector
Foo
Display List
-1
Slider
Foo
Bar
Jazz
Literal
ALPHA
BETA
GAMMA
Literal
A
B
G
Literal
3
Slider
0
1
2
Control
Selector
A
B
G
Display List
Foo
Bar
Jazz
Literal
ALPHA
BETA
GAMMA
Literal
A
B
G
Literal
[0] = -1
0
1
2
Rack
-1
1
3
Display List
0
1
2
Control
Selector
Foo
BETA
G
Display List

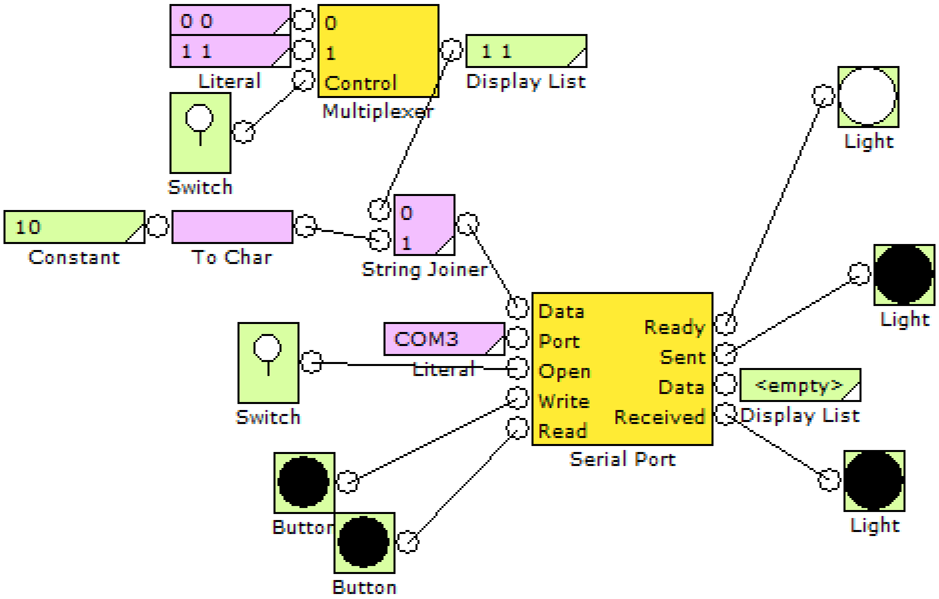
Sequencer

The Sequencer component increments the Step output based on the number of Interval inputs. Each step is timed by the number of seconds in the Interval array. The Pulse output is high for the percent of the interval step specified in the Dwell % input.   Arrays - column 7



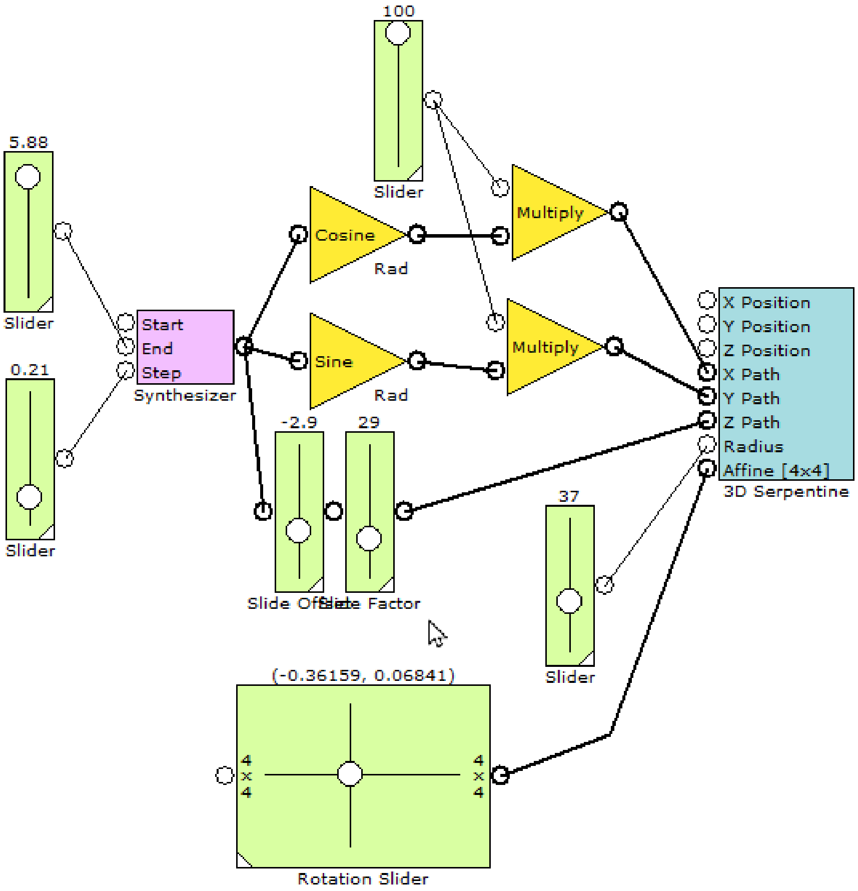
Serial Port

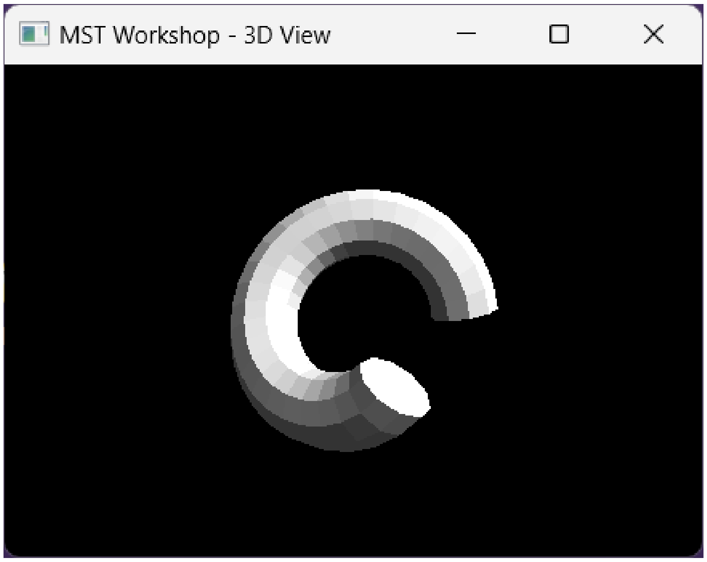
The Serial Port component lets you send and receive messages through the computer's serial ports.
Functions - column 7



3D Serpentine

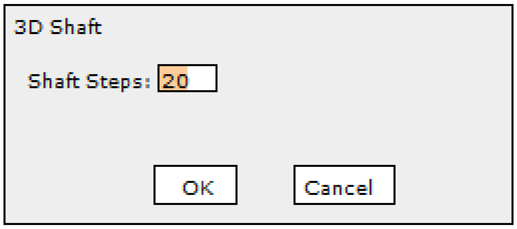
The 3D Serpentine component draws a circular extrusion in the 3D view window. The serpentine follows the given Path in X, Y and Z. The Radius can be constant or an array the same size as the path points. The X, Y, and Z inputs set the position and size of the Serpentine. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 4





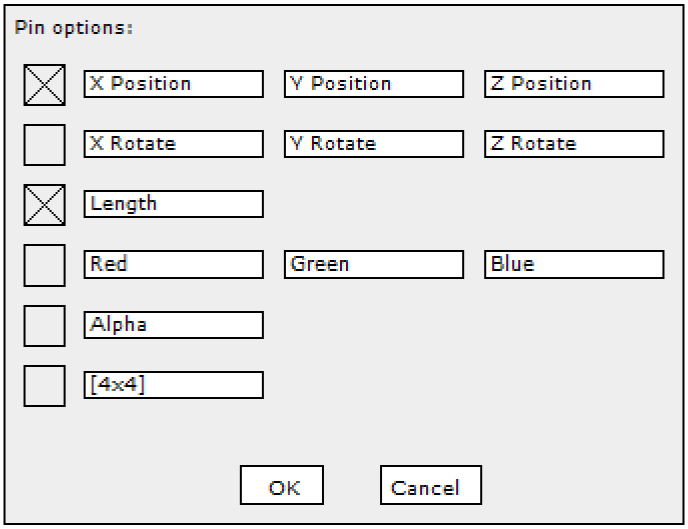
3D Shaft

The 3D Shaft component creates a connection between drivers like motors and driven objects like gears or other simulation objects. Place the Shaft at the same X, Y, Z position and orientation as a motor to connect the gear to the motor.   3D - column 4



3D Shaft

Shaft Steps: 20



Pin options:

☒ X Position   Y Position   Z Position

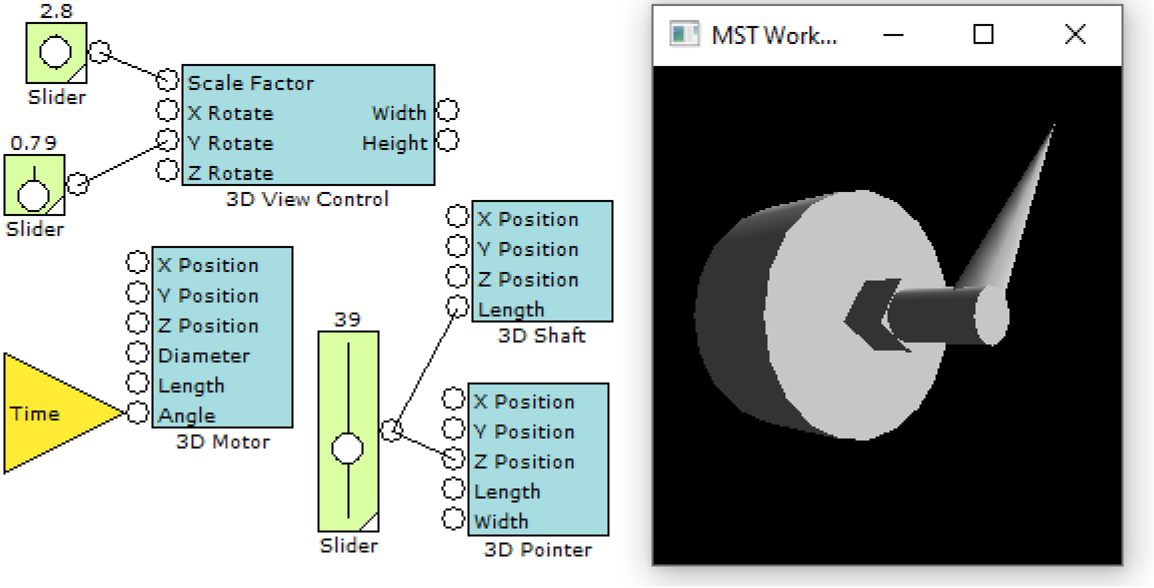
□ X Rotate   Y Rotate   Z Rotate

☒ Length

□ Red   Green   Blue

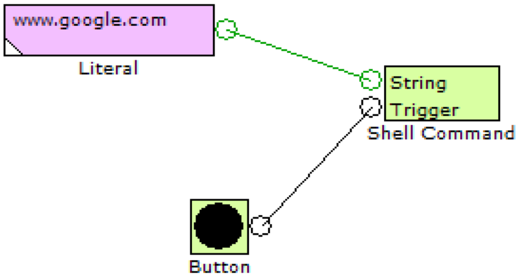
□ Alpha

□ [4x4]



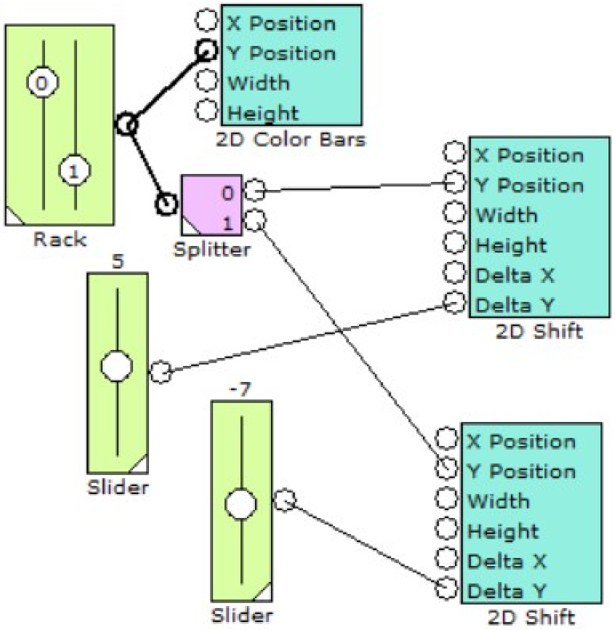
Shell Command

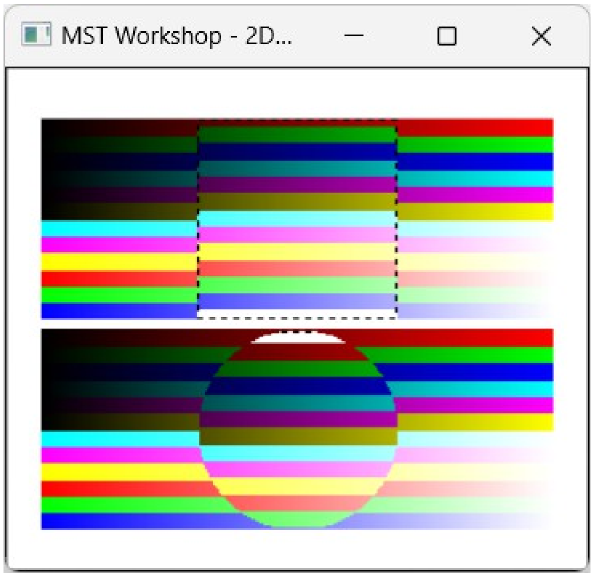
The Shell Command opens a new window using the input shell command. For example the string "www.Google.com" will open Google's web site.   Controls – column 3



2D Shift

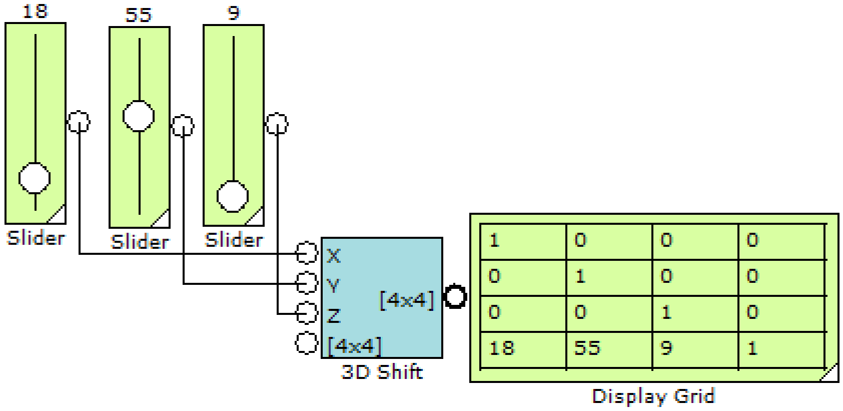
The 2D Shift shifts the image in the 2D drawing it covers. 2D – column 1



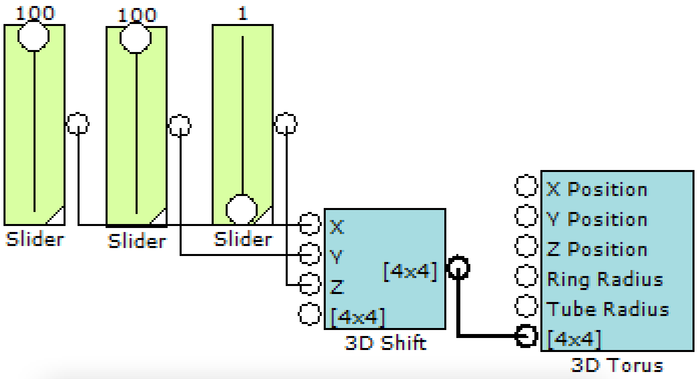


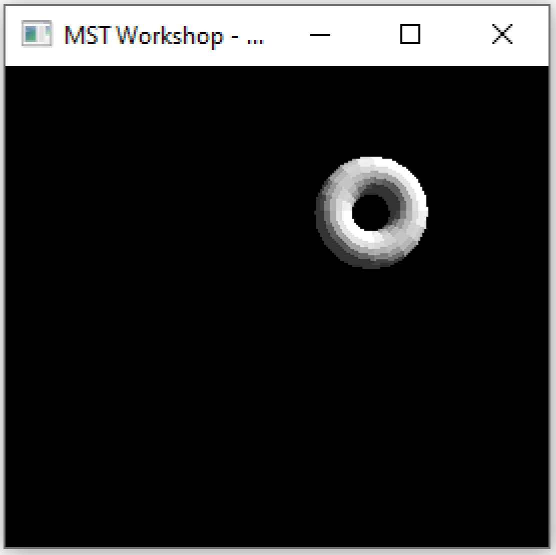
3D Shift

The 3D Shift translates a 4 by 4 matrix in the X, Y, and Z directions. 3D - column 3



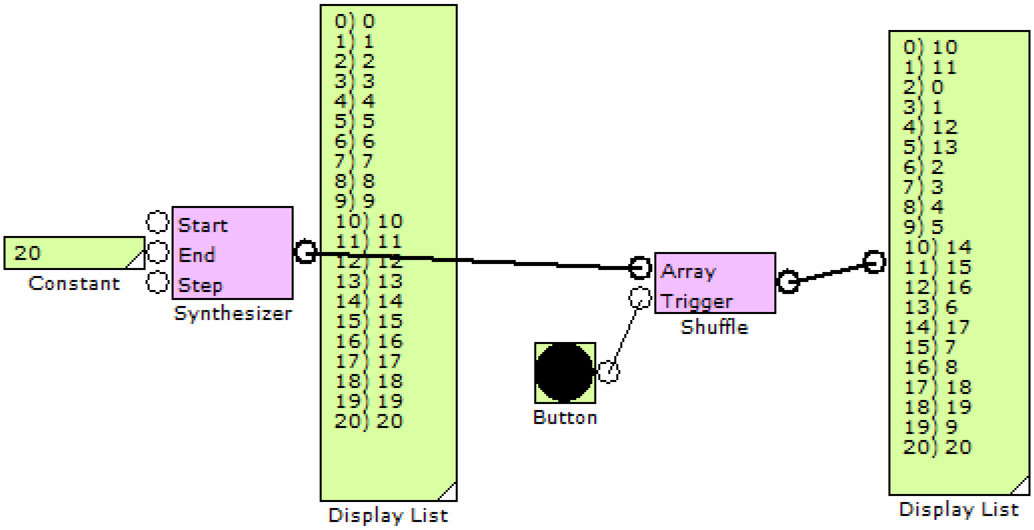
1	0	0	0
0	1	0	0
0	0	1	0
18	55	9	1





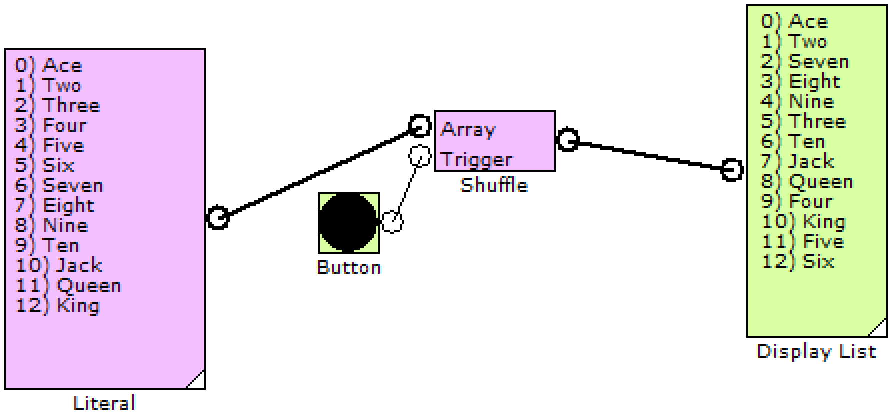
Shuffle

The Shuffle component cuts the input list in two nearly equal groups, then shuffles them back together. Like cutting a deck cards and merging them together.   Arrays - column 1



```
0) 0
1) 1
2) 2
3) 3
4) 4
5) 5
6) 6
7) 7
8) 8
9) 9
10) 10
11) 11
12) 12
13) 13
14) 14
15) 15
16) 16
17) 17
18) 18
19) 19
20) 20
```

```
0) 10
1) 11
2) 0
3) 1
4) 12
5) 13
6) 2
7) 3
8) 4
9) 5
10) 14
11) 15
12) 16
13) 6
14) 17
15) 7
16) 8
17) 18
18) 19
19) 9
20) 20
```

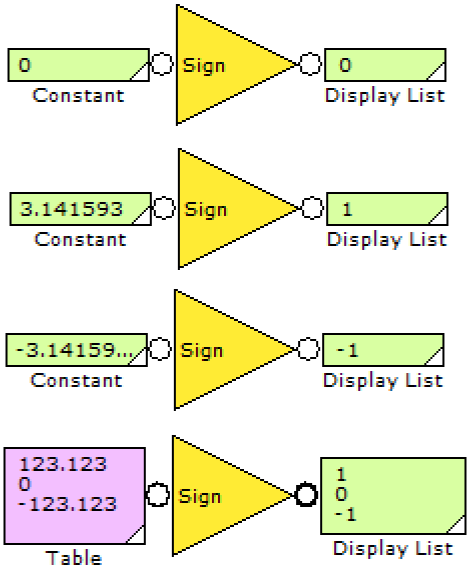


```
0) Ace
1) Two
2) Three
3) Four
4) Five
5) Six
6) Seven
7) Eight
8) Nine
9) Ten
10) Jack
11) Queen
12) King
```

```
0) Ace
1) Two
2) Seven
3) Eight
4) Nine
5) Three
6) Ten
7) Jack
8) Queen
9) Four
10) King
11) Five
12) Six
```

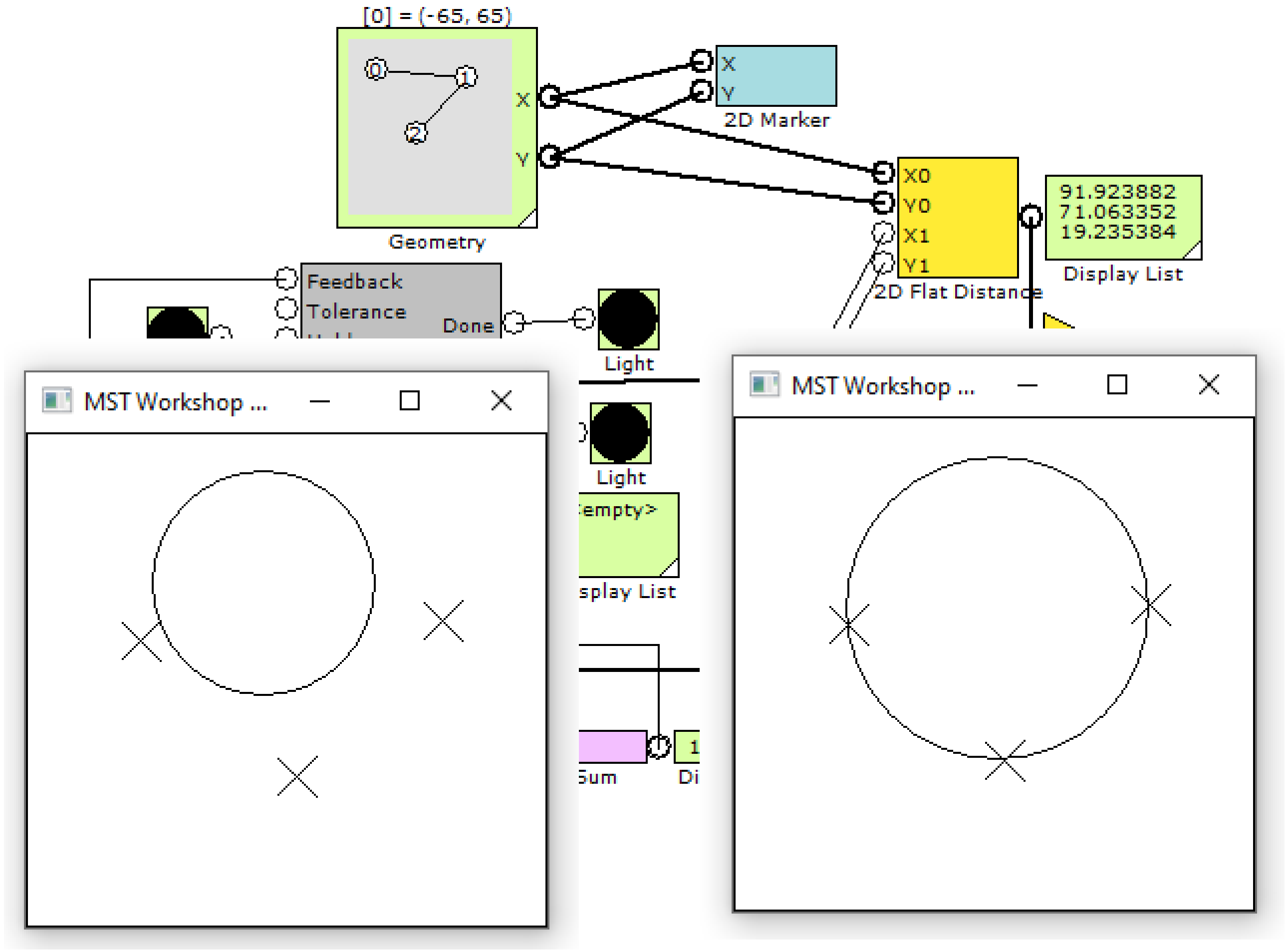
Sign

The Sign component outputs zero if the input is zero, one if the input is positive or minus one if the input is negative. Input can be scalar or an array.   Functions - column 2



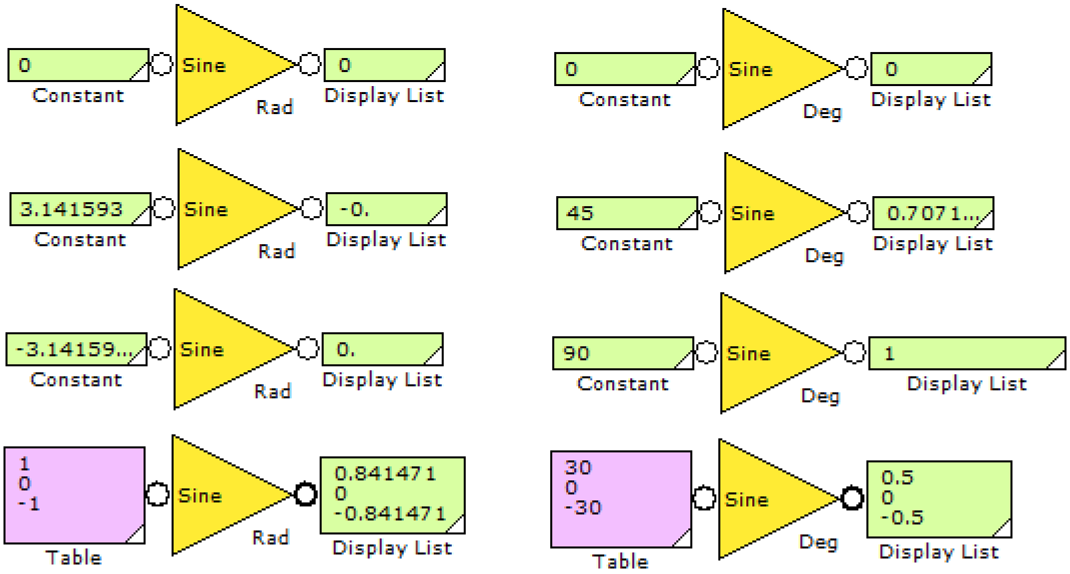
Simplex Solver

The Simplex Solver component finds the best parameters to reduce feedback. Functions - column 6


91.923882
71.063352
19.235384

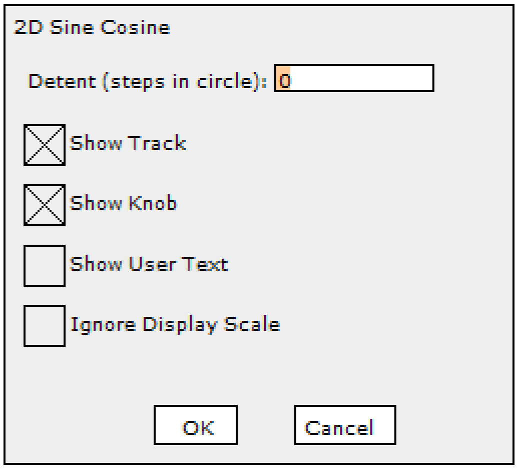
Sine

The Sine component calculates the trigonometric sine of the input (in radians).   Input can be scalar or an array.   Functions - column 5



2D Sine Cosine

The 2D Sin/Cos component outputs sine and cosine based on the angle of the dial.   Controls - column 1



2D Sine Cosine

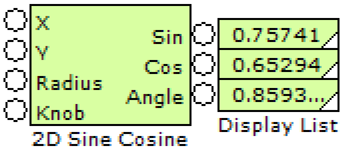
Detent (steps in circle): 0

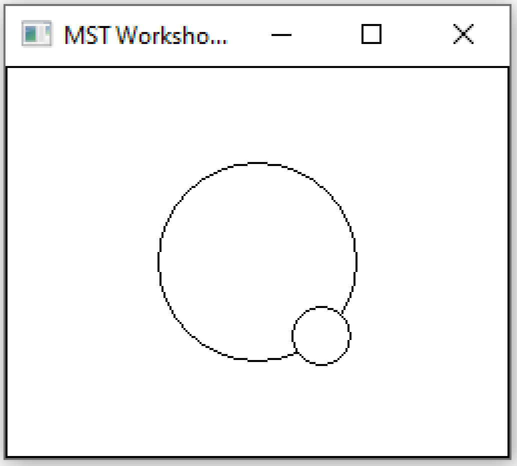
☒ Show Track

☒ Show Knob

☐ Show User Text

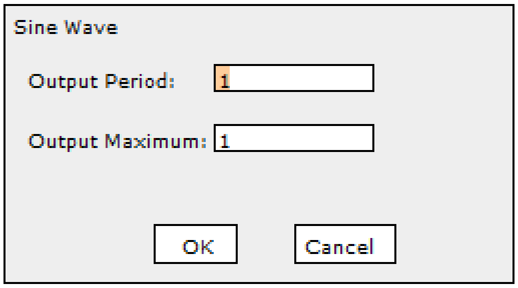
☐ Ignore Display Scale





Sine Wave

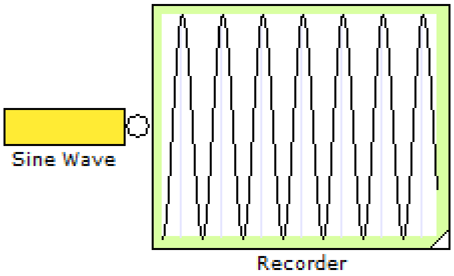
The Sine Wave component outputs a sinusoidal wave when the clock is running. Functions - column 8

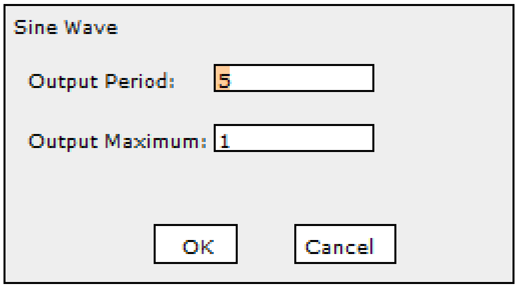


Sine Wave

Output Period: 1

Output Maximum: 1

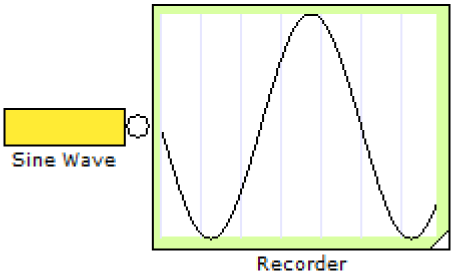




Sine Wave

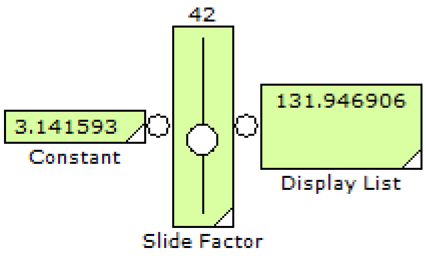
Output Period: 5

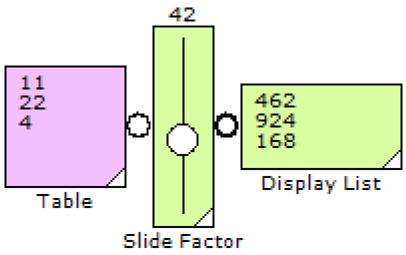
Output Maximum: 1

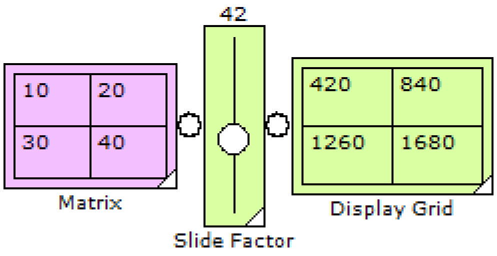


Slide Factor

The Slide Factor component multiplies its inputs by its dial position.   Controls - column 2

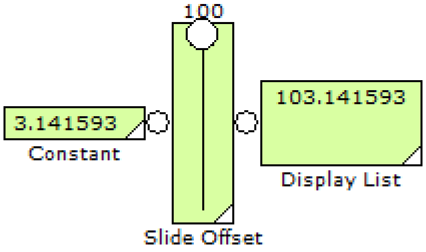


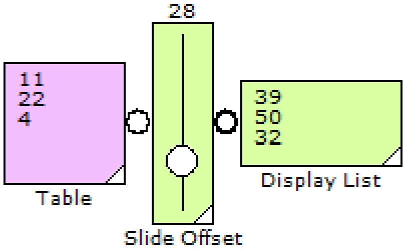


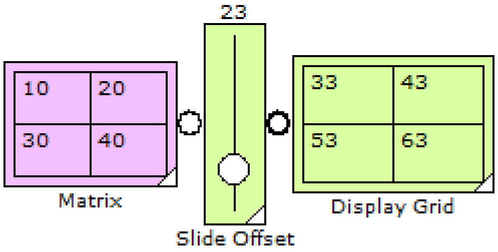


Slide Offset

The Slide Offset component adds its dial position to its inputs. Controls - column 3

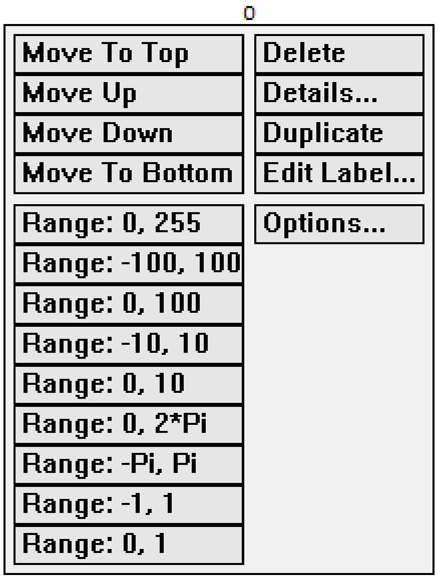


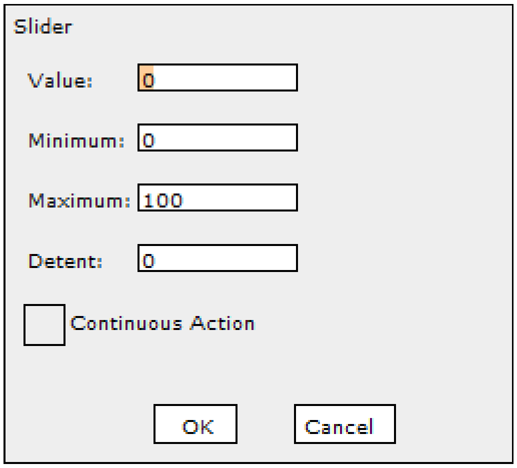




Slider

The Slider component outputs a constant number based on its dial position. Note: This component can be operated using the wheel on the mouse.   Controls - column 1




Slider

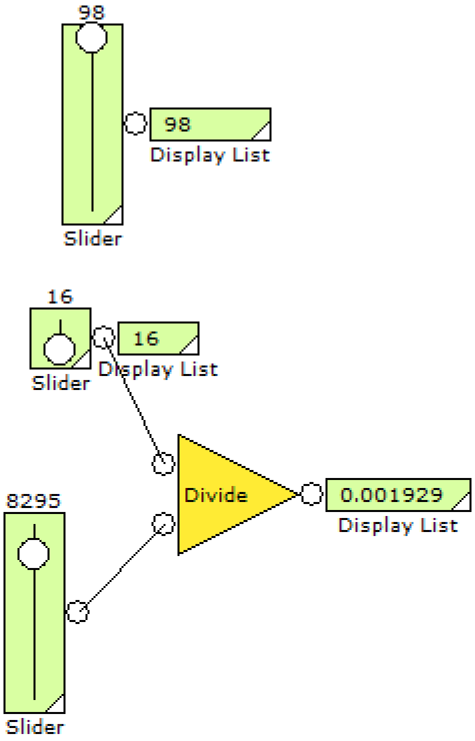
Value: 0

Minimum: 0

Maximum: 100

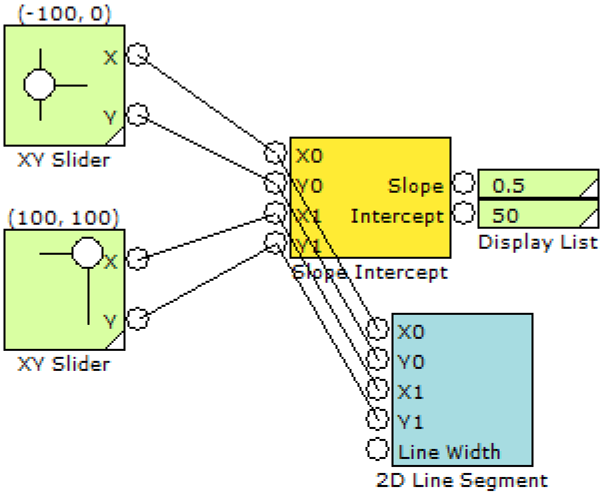
Detent: 0

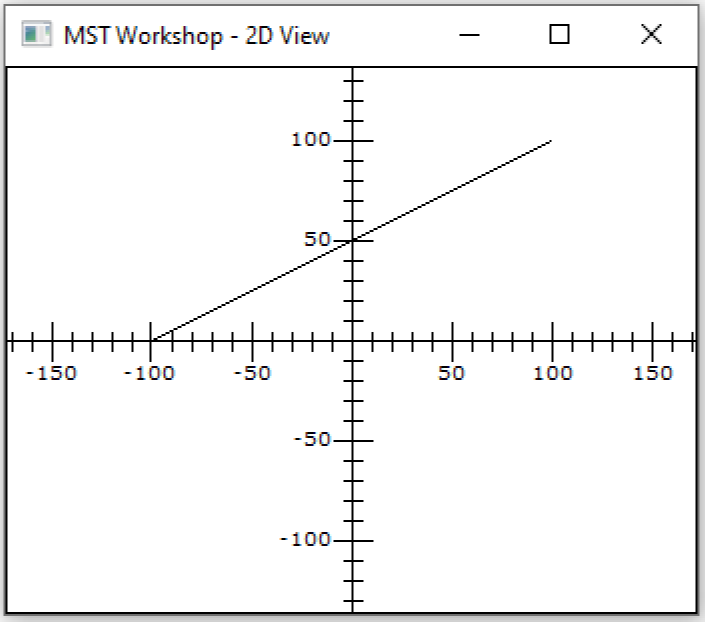
□ Continuous Action



Slope Intercept

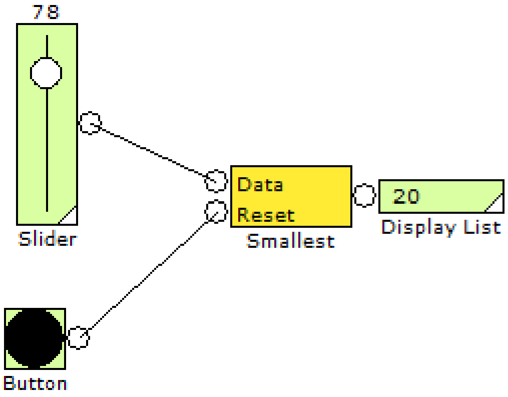
The Slope Intercept component calculates the slope and intercept between two points.   Functions - column 8





Smallest

The Smallest component watches the Data input and outputs the smallest value since it was reset.
Functions - column 2



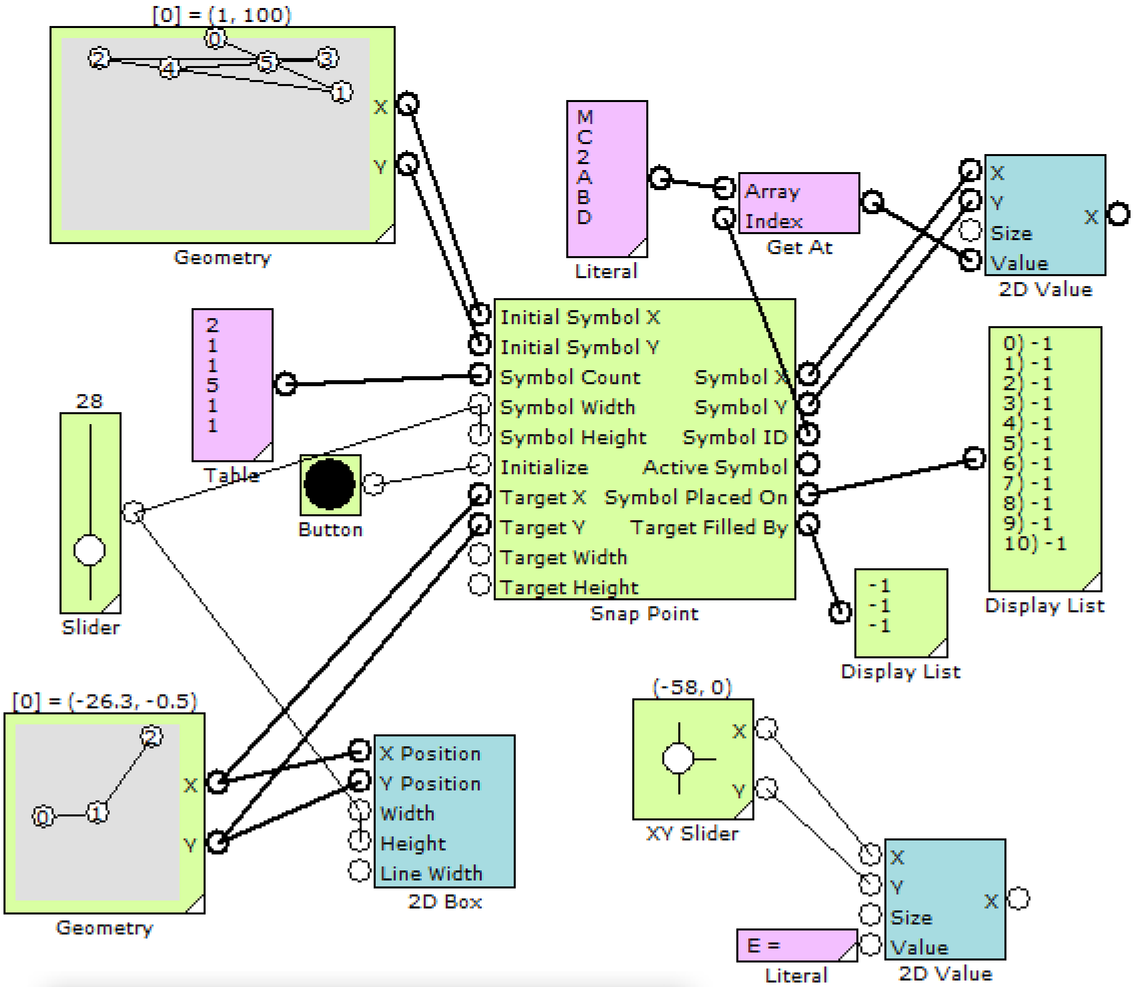
Snap Point

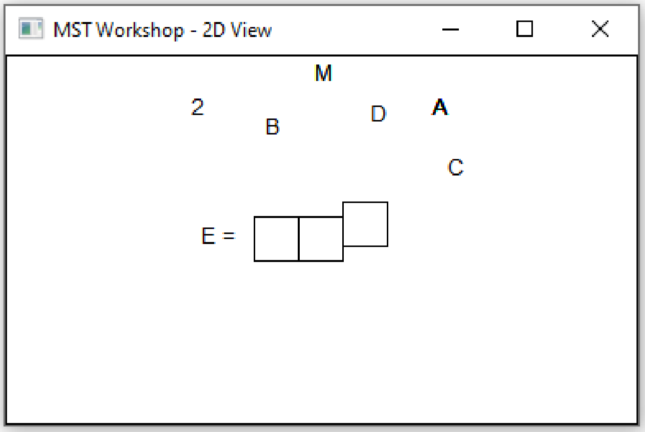
The Snap Point allows you to guide symbols to defined targets.

Initial inputs are the XY coordinates of the 2D symbols at the start.

Target inputs are the XY coordinates of the destinations.

Snapped outputs indicate the part is in place. Filled outputs indicate the target position has been filled. Controls - column 3





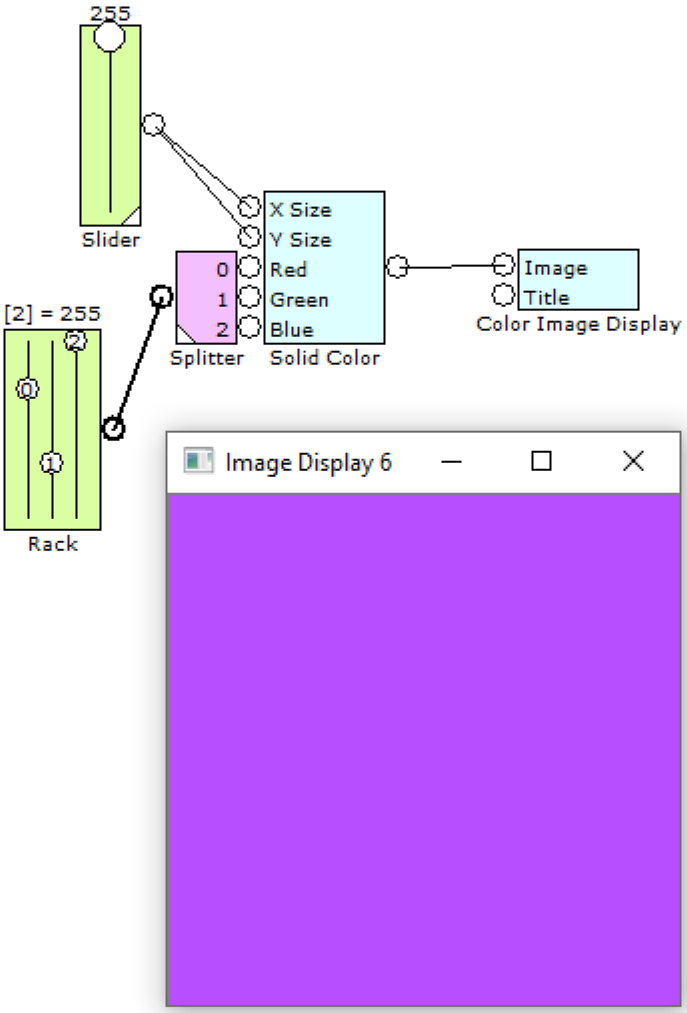
Snap Point+

The Snap Point+ allows you to guide symbols to defined targets. This component has an added Hold input. Everything else is the same as Snap Point.

Initial inputs are the XY coordinates of the 2D symbols at the start.
Target inputs are the XY coordinates of the destinations.
Snapped outputs indicate the part is in place.
Filled outputs indicate the target position has been filled.   Controls - column 3

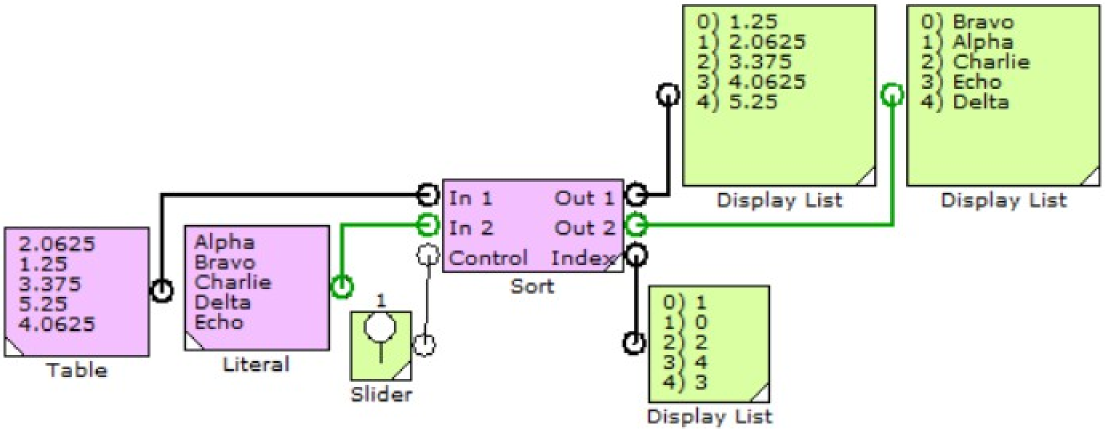
Solid Color

The Solid Color component creates an image with a single color.   Images - column 1



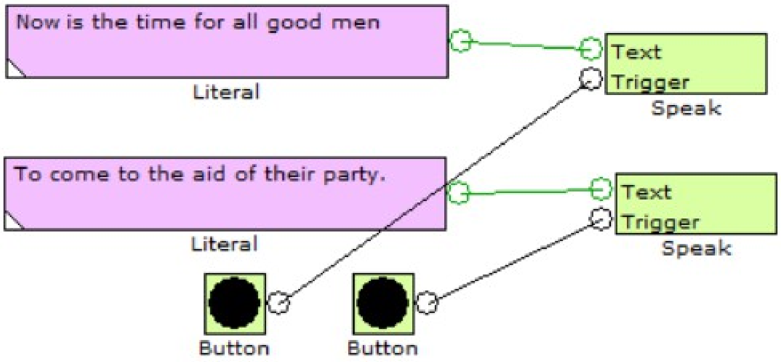
Sort

The Sort component sorts the input data. The input(s) can be arrays of numbers or strings. The Array at the control input indicates how each data input should be sorted. A single number at the control input indicates which input is primary. A negative number indicates sorting in reverse. If an array is at the control input, the second value indicates which data input is used as a secondary sort when primaries are identical.   Arrays – column 1



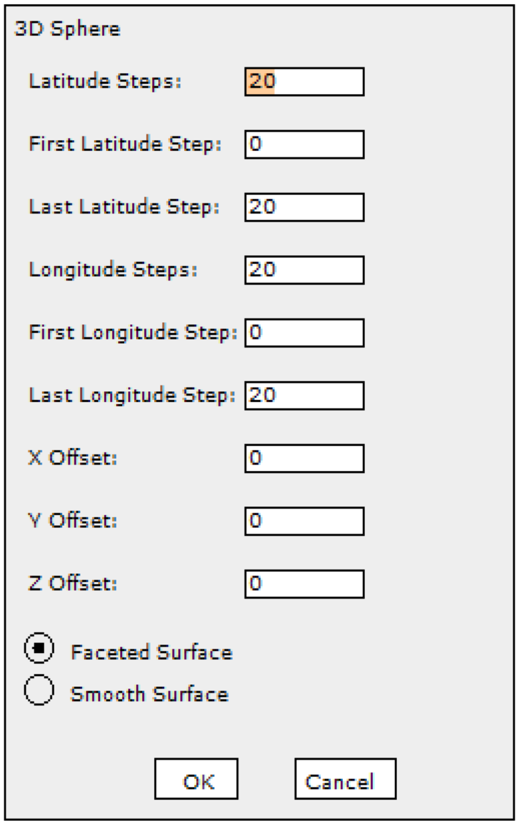
Speak

The Speak component uses text to speech technology to say the string at it's input. Controls – column 4


Now is the time for all good men
Literal
Text
Trigger
Speak
To come to the aid of their party.
Literal
Text
Trigger
Speak
Button
Button

3D Sphere

The 3D Sphere draws a sphere in the 3D view window. The X, Y, and Z inputs set the position and size of the sphere. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 4



3D Sphere

Latitude Steps: 20

First Latitude Step: 0

Last Latitude Step: 20

Longitude Steps: 20

First Longitude Step: 0

Last Longitude Step: 20

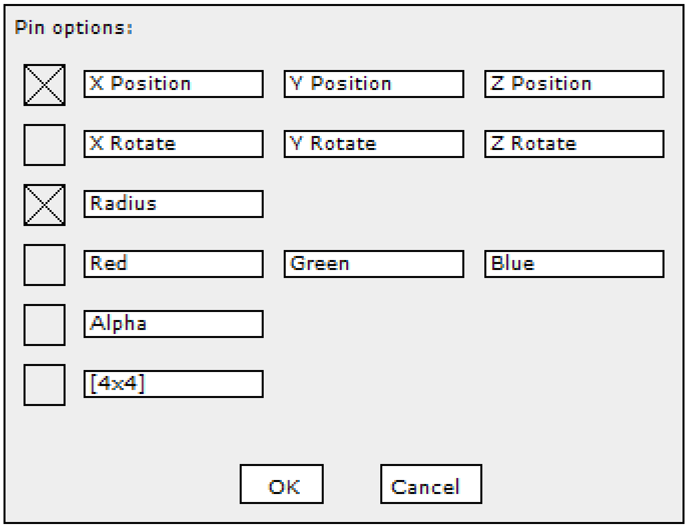
X Offset: 0

Y Offset: 0

Z Offset: 0

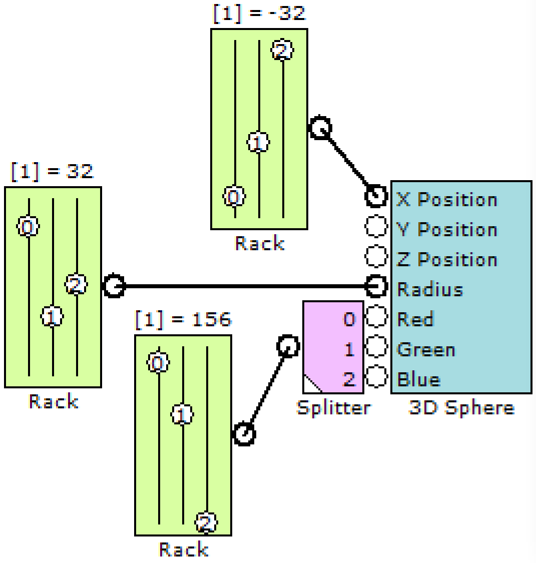
● Faceted Surface

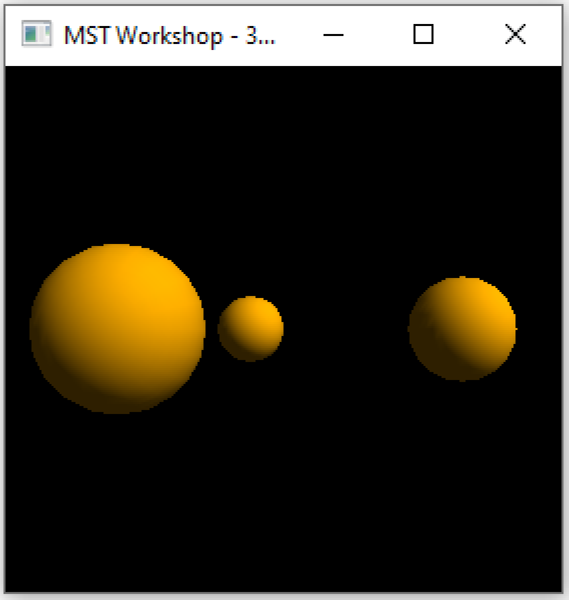
○ Smooth Surface

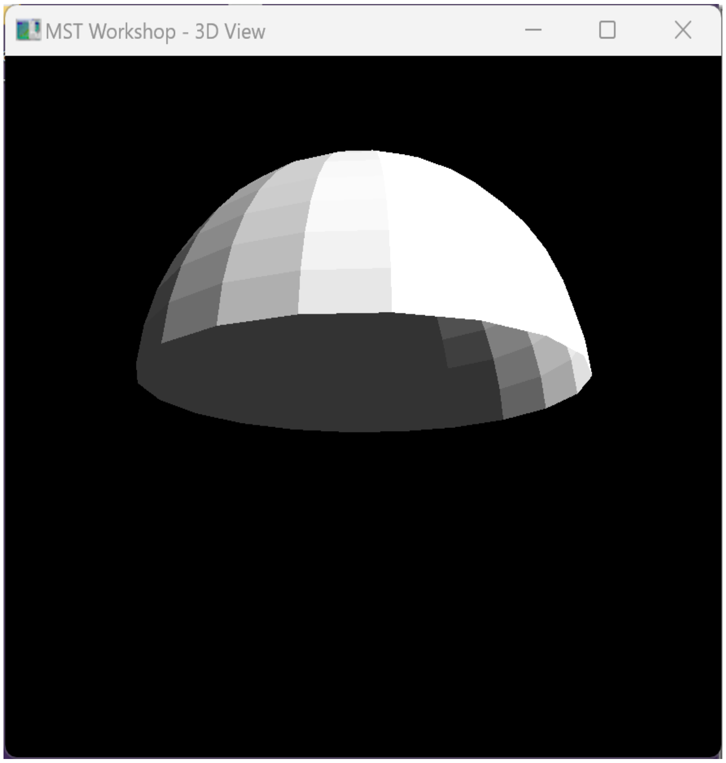


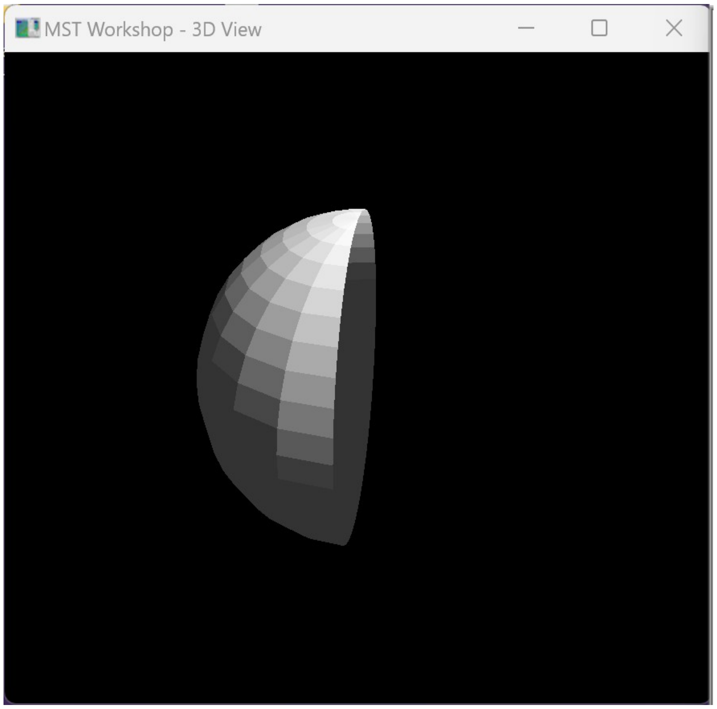
Pin options:

☒	X Position	Y Position	Z Position
□	X Rotate	Y Rotate	Z Rotate
☒	Radius		
□	Red	Green	Blue
□	Alpha		
□	[4x4]		



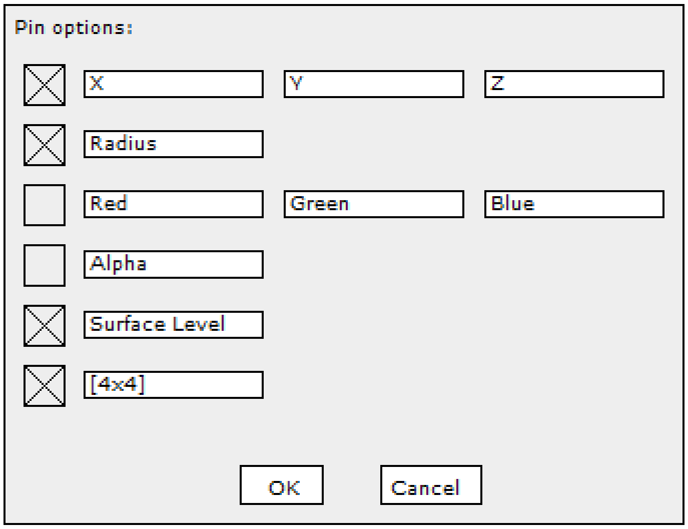



MST Workshop - 3D View


MST Workshop - 3D View

3D Sphere Surface

The 3D Sphere Surface component draws a sphere with an embossed surface in the 3D view window. The Matrix and Mat Row Size inputs set the 2D data to be plotted. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 5



Pin options:

☒ X Y Z

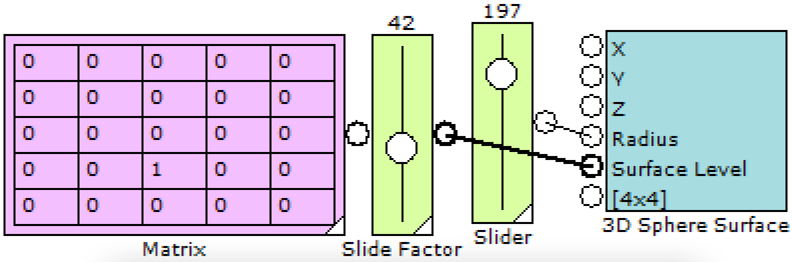
☒ Radius

□ Red Green Blue

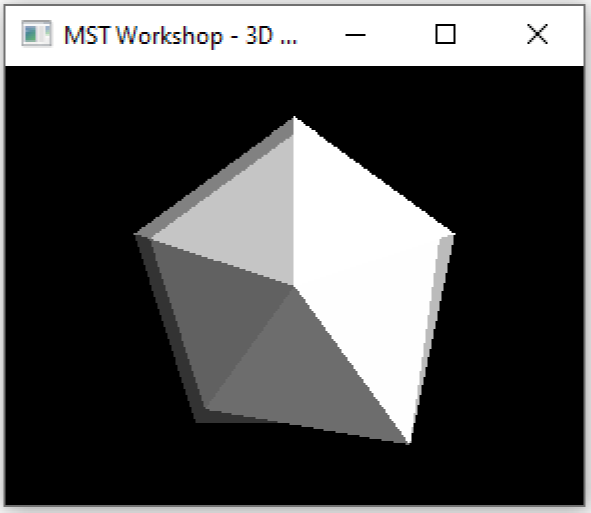
□ Alpha

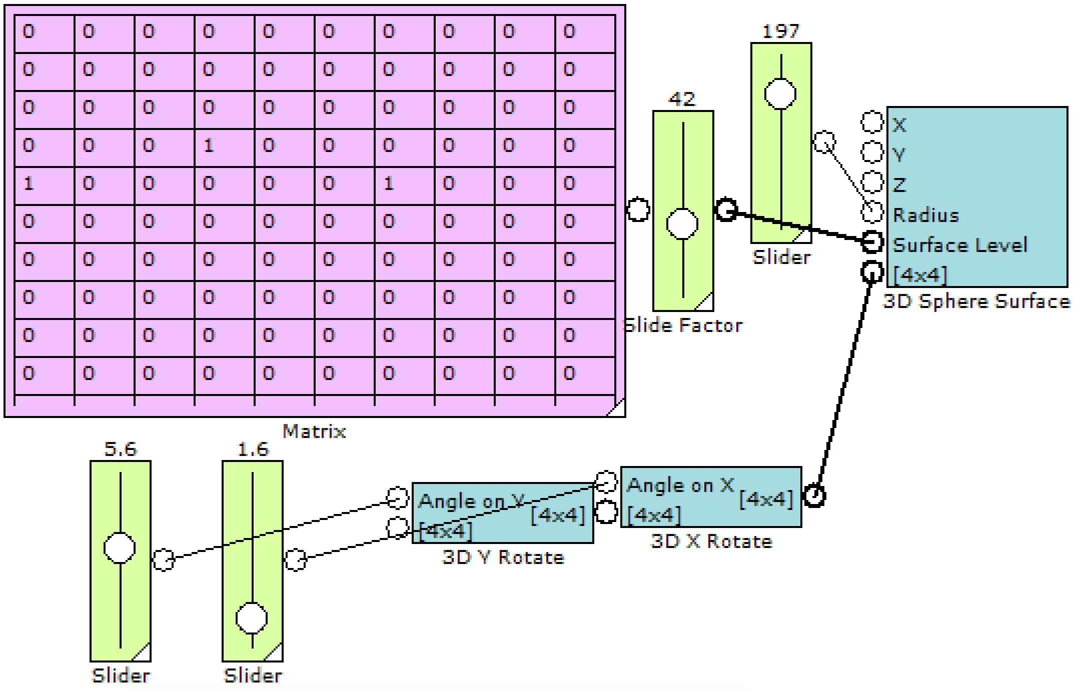
☒ Surface Level

☒ [4x4]

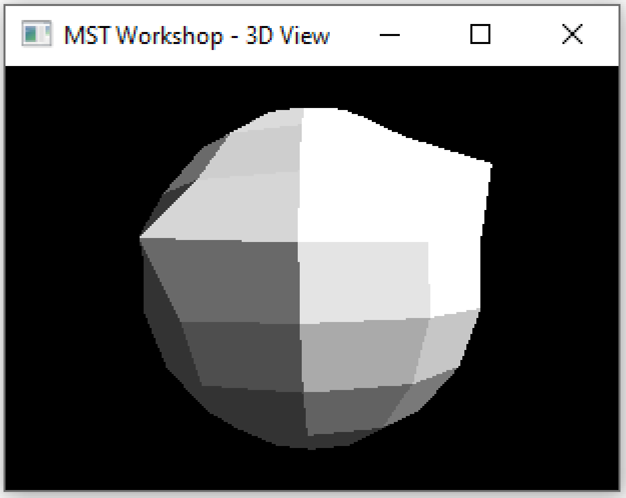


0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	1	0	0
0	0	0	0	0



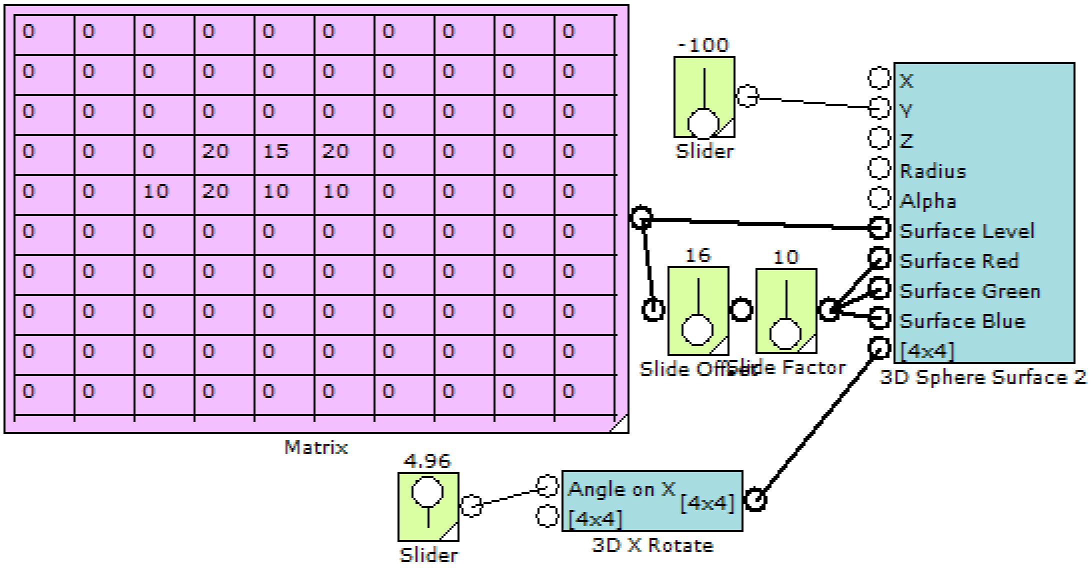


0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

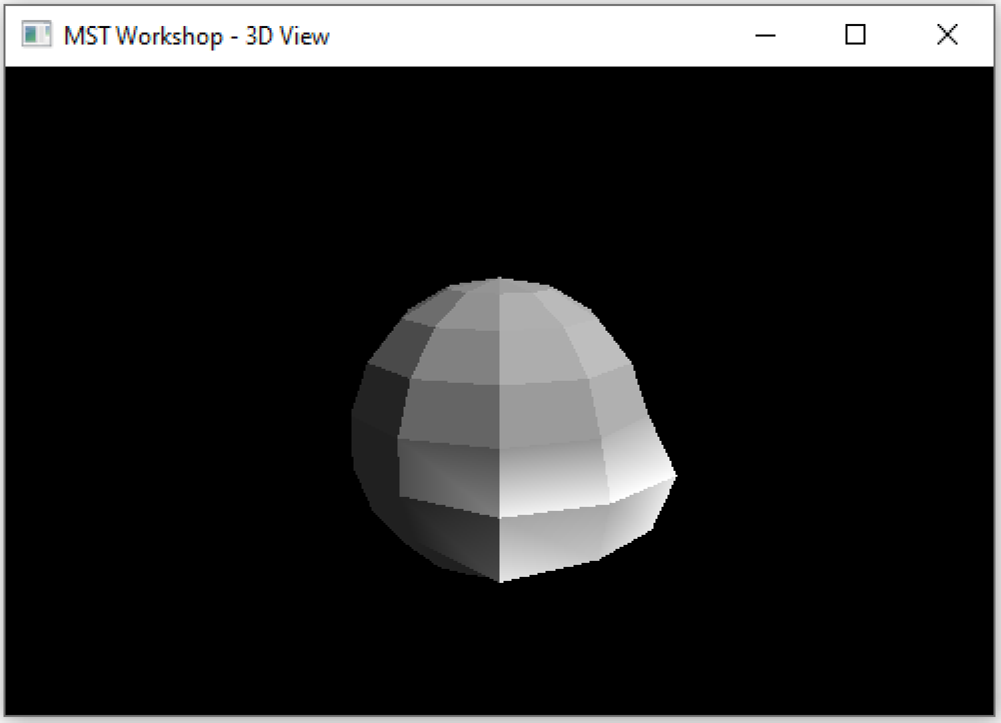


3D Sphere Surface 2

The 3D Sphere Surface 2 component draws a sphere with an embossed and color surface in the 3D view window. The Matrix and Mat Row Size inputs set the 2D data to be plotted. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 5

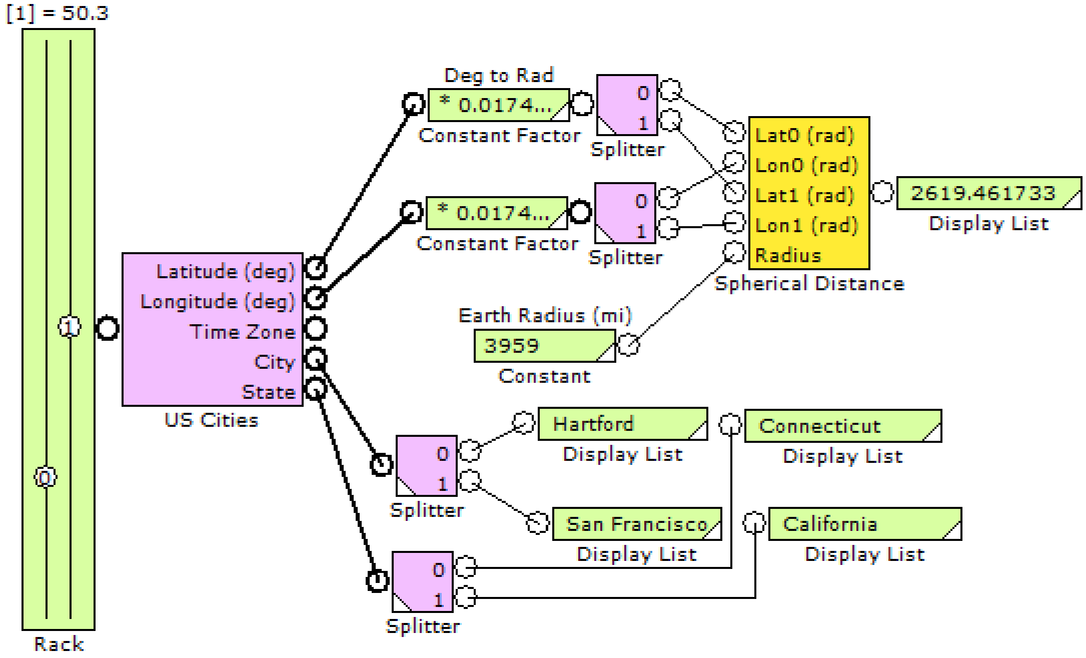


0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	20	15	20	0	0	0	0
0	0	10	20	10	10	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0



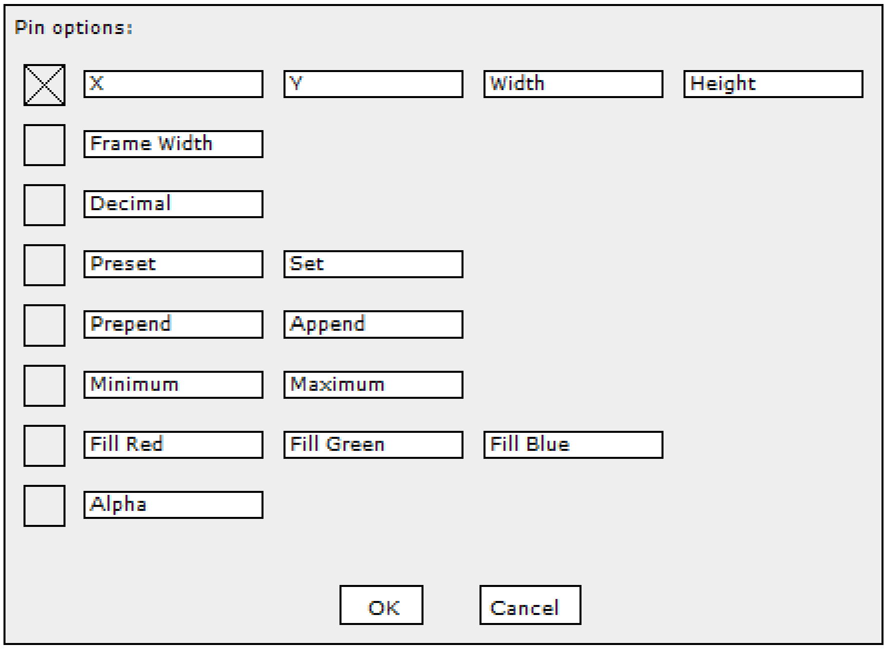
Spherical Distance

The Spherical Distance component calculates the distance between two points on a sphere.
Functions - column 8



2D Spinner

The 2D Spinner is used to enter a number on the 2D canvas. Controls - column 2


Pin options:

☒ X Y Width Height

□ Frame Width

□ Decimal

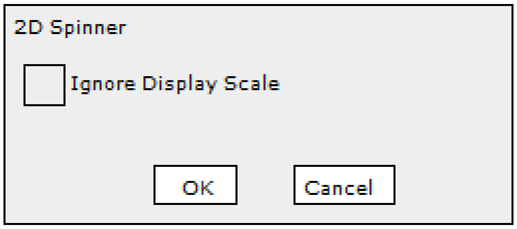
□ Preset Set

□ Prepend Append

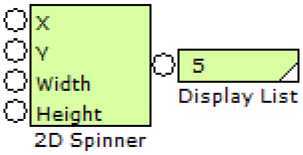
□ Minimum Maximum

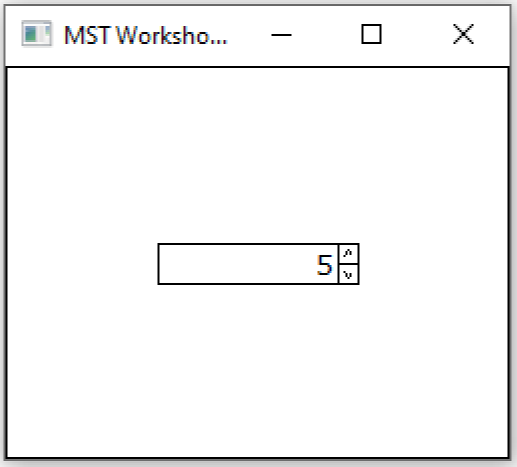
□ Fill Red Fill Green Fill Blue

□ Alpha


2D Spinner

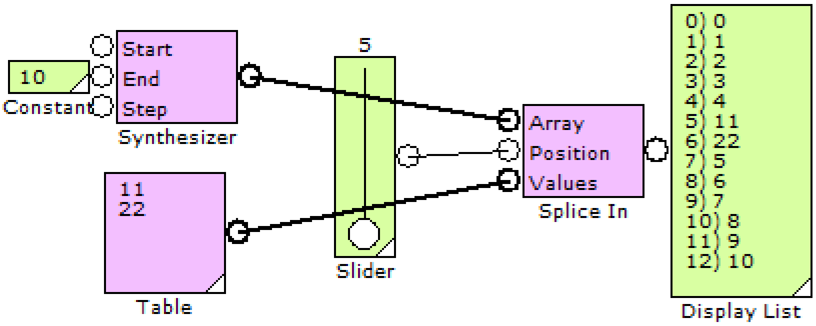
□ Ignore Display Scale

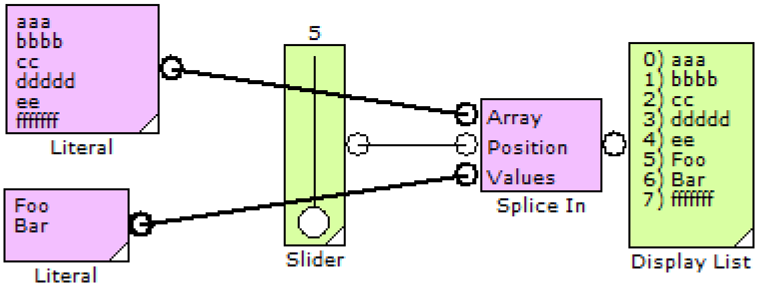




Splice In

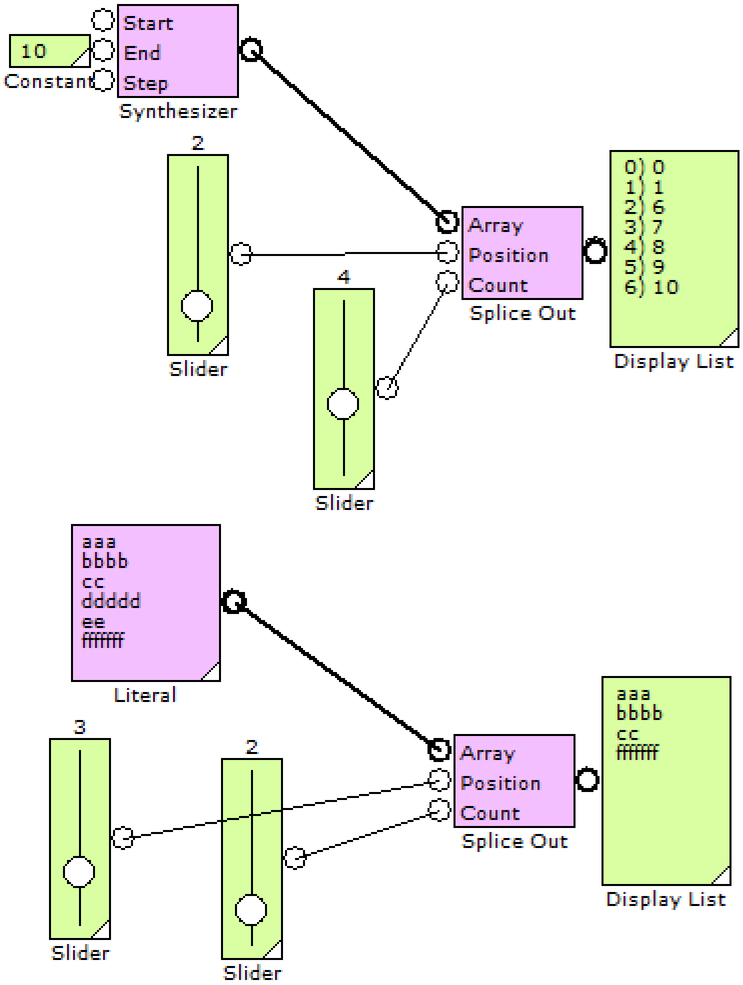
The Splice In component inserts values into an array at the desired position. Arrays - column 1





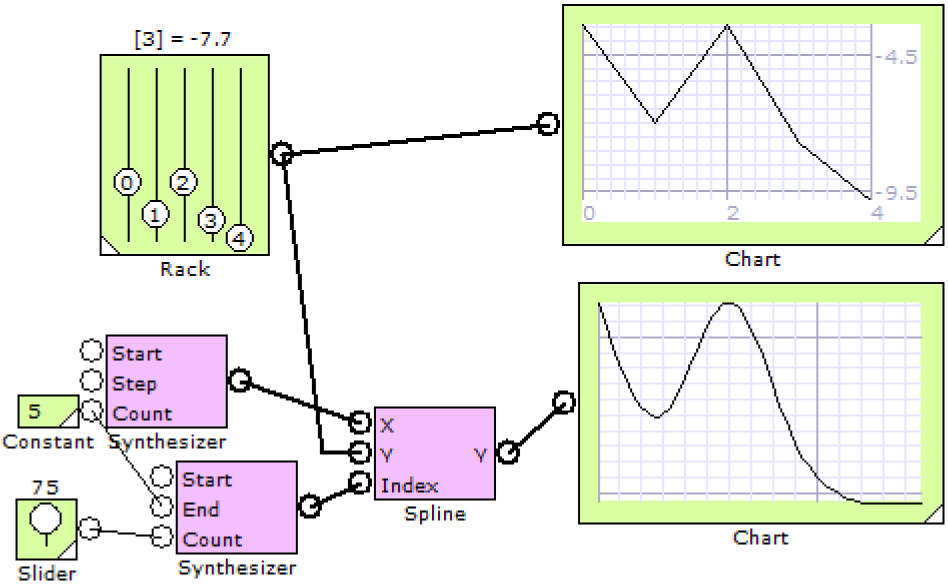
Splice Out

The Splice Out component removes values from the specified position.   Arrays - column 1



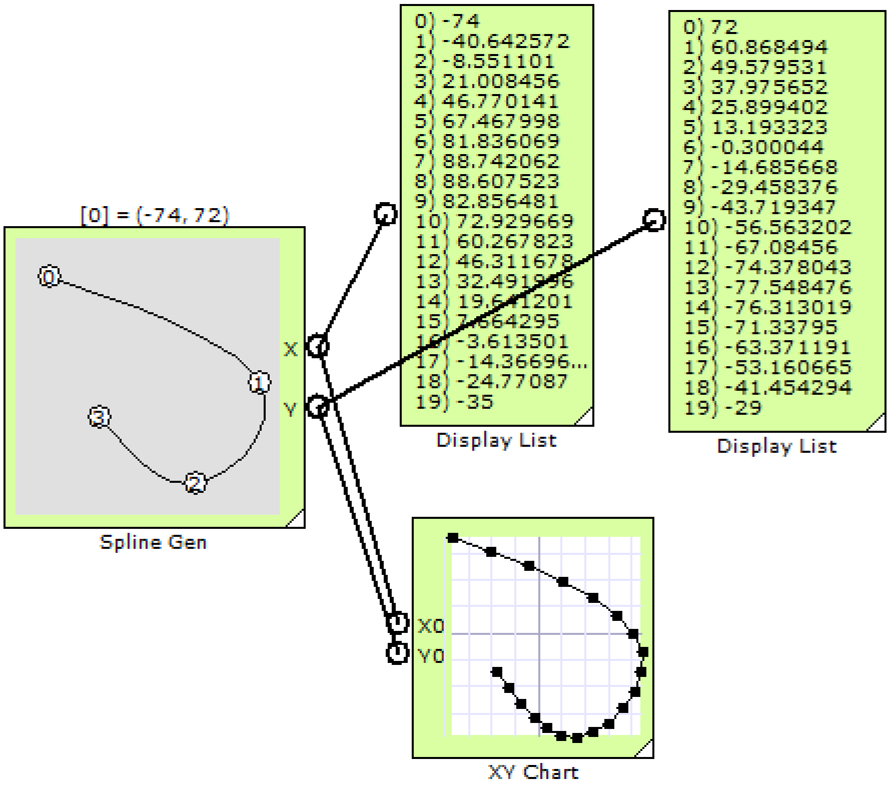
Spline

The Spline component interpolates a spline curve based on the input array. It outputs the Y value(s) at the positions given by the Index(s) Arrays - column 2



Spline Gen

The Spline Gen lets you generate a smooth curve from a small number of control points in X and Y.
Controls - column 1

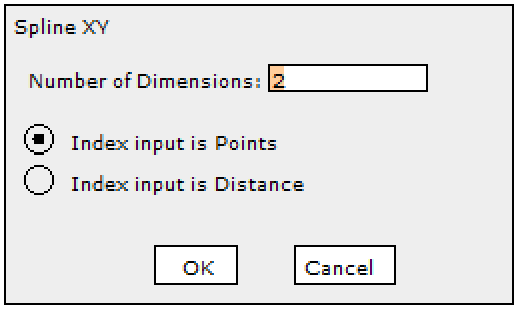


```
0) -74
1) -40.642572
2) -8.551101
3) 21.008456
4) 46.770141
5) 67.467998
6) 81.836069
7) 88.742062
8) 88.607523
9) 82.856481
10) 72.929669
11) 60.267823
12) 46.311678
13) 32.491956
14) 19.641201
15) 7.664295
16) -3.613501
17) -14.36696...
18) -24.77087
19) -35
```

```
0) 72
1) 60.868494
2) 49.579531
3) 37.975652
4) 25.899402
5) 13.193323
6) -0.300044
7) -14.685668
8) -29.458376
9) -43.719347
10) -56.563202
11) -67.08456
12) -74.378043
13) -77.548476
14) -76.313019
15) -71.33795
16) -63.371191
17) -53.160665
18) -41.454294
19) -29
```

Spline XY

The Spline XY component interpolates a spline curve based on the input array. It outputs the X and Y value(s) at the positions given by the Index(s). The number of dimensions can be expanded. Arrays - column 2

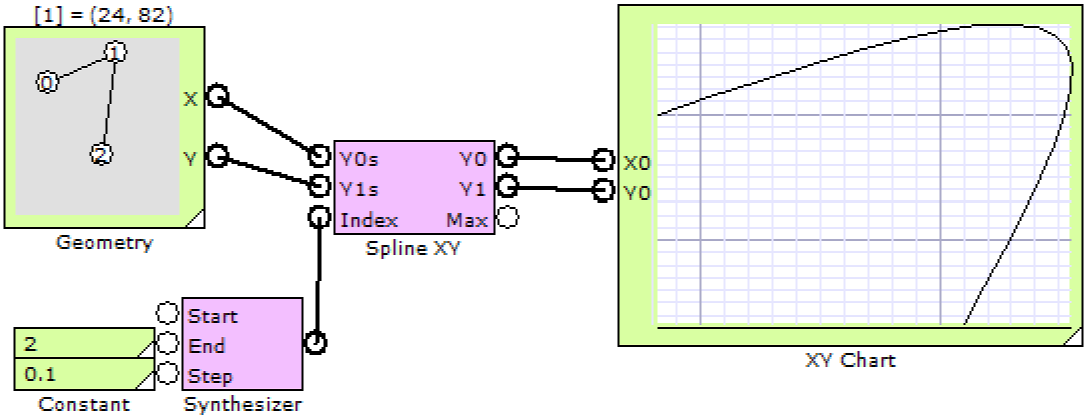


Spline XY

Number of Dimensions: 2

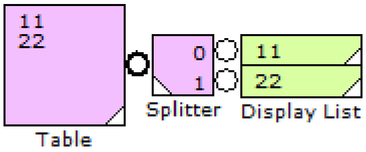
● Index input is Points

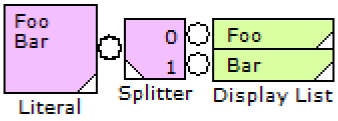
○ Index input is Distance

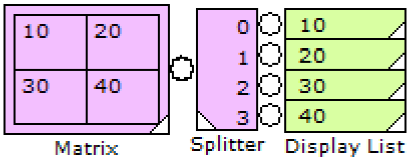


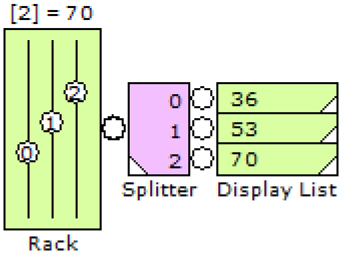
Splitter

The Splitter component breaks the input into separate outputs. You can set the number of outputs desired.   Arrays - column 1



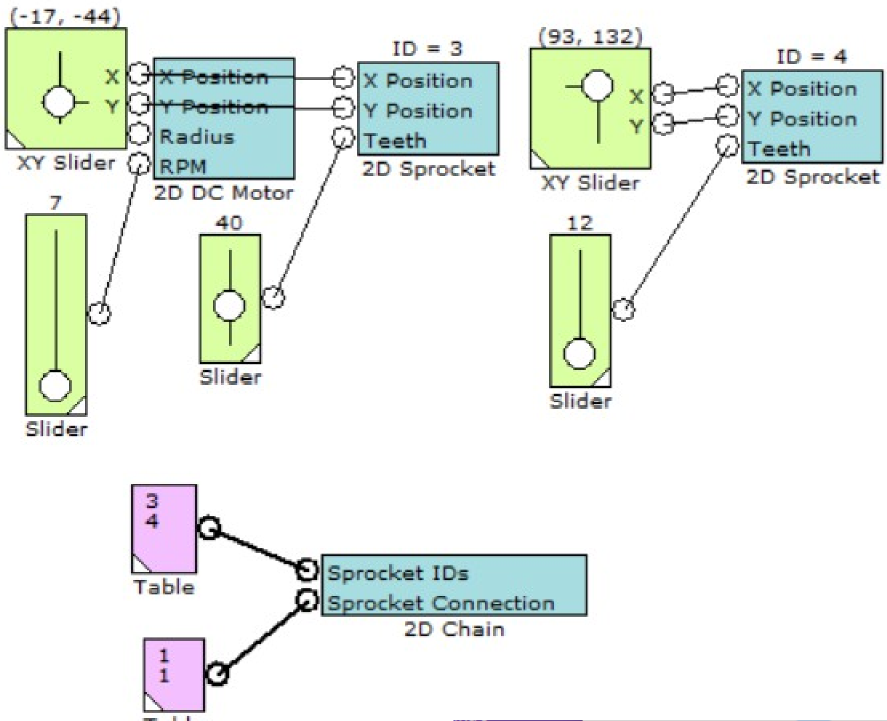


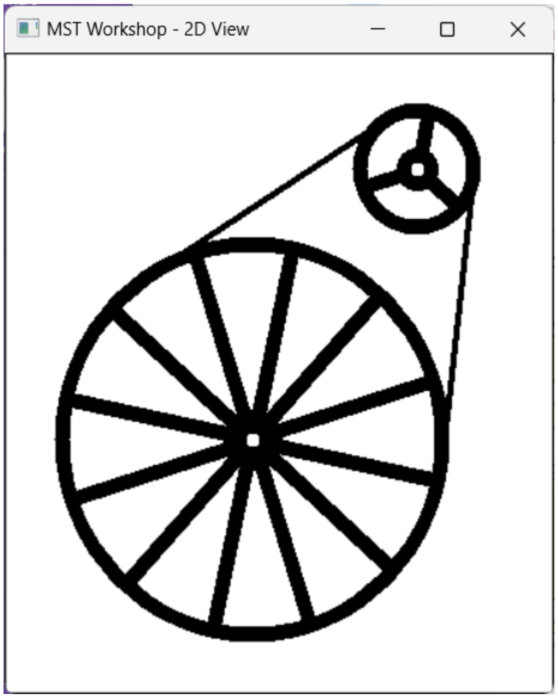




Sprocket

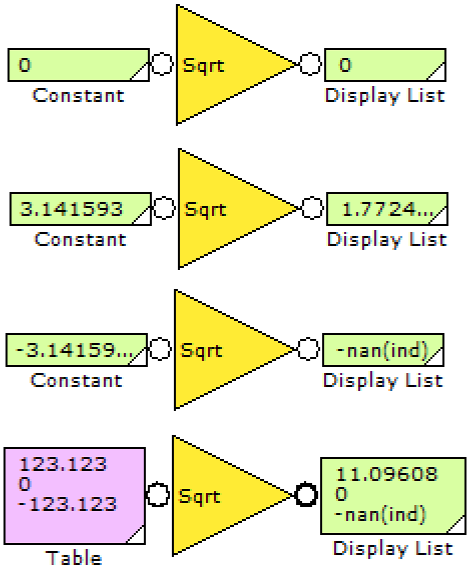
The 2D Sprocket component creates a sprocket that can attach to a Chain or other simulation objects like Motors. Place the Sprocket at the same X, Y position as a motor to connect the Sprocket to the motor. Use the Chain component to hook two or more Sprockets together. 2D - column 3





Sqrt

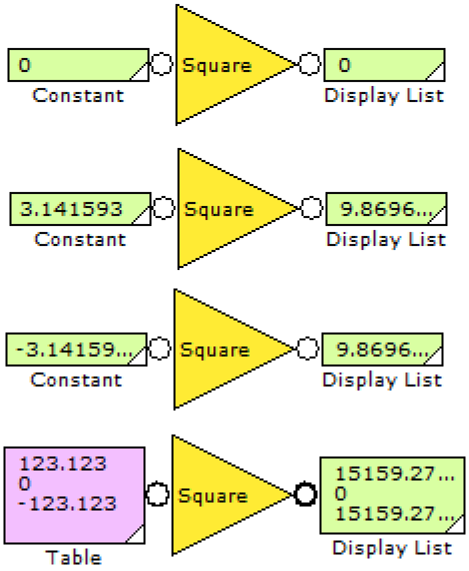
The Sqrt component outputs square root of the input value. Input can be scalar or an array.
Functions - column 1



Square

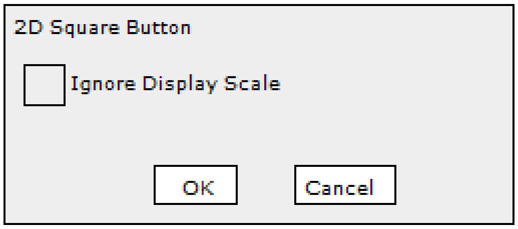
The Square component multiplies the input value times itself. Input can be scalar or an array.

Functions - column 1



2D Square Button

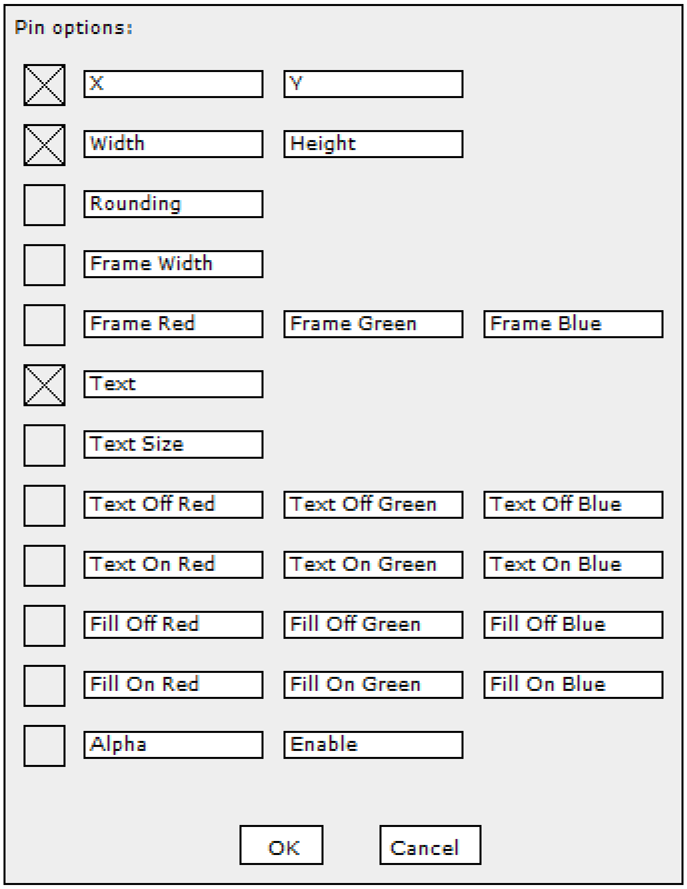
The 2D Square Button is used to trigger an event by clicking on it.   Controls - column 1



2D Square Button

□ Ignore Display Scale

OK   Cancel



Pin options:

☒ X   Y

☒ Width   Height

□ Rounding

□ Frame Width

□ Frame Red   Frame Green   Frame Blue

☒ Text

□ Text Size

□ Text Off Red   Text Off Green   Text Off Blue

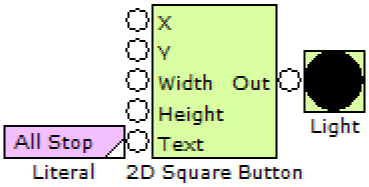
□ Text On Red   Text On Green   Text On Blue

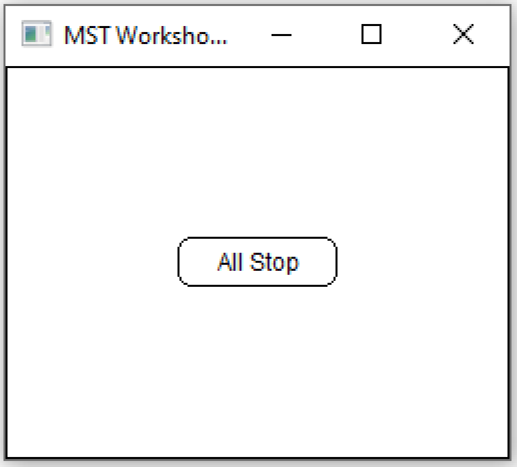
□ Fill Off Red   Fill Off Green   Fill Off Blue

□ Fill On Red   Fill On Green   Fill On Blue

□ Alpha   Enable

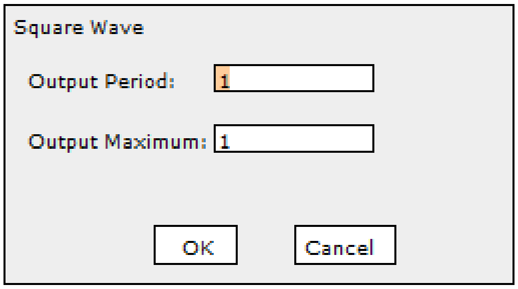
OK   Cancel





Square Wave

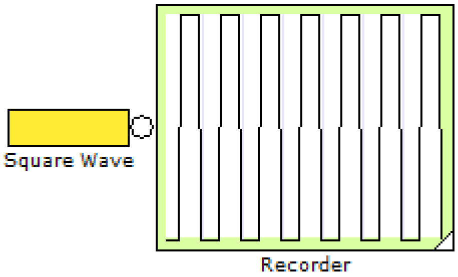
The Square Wave component outputs a square wave when the clock is running.   Functions - column 8

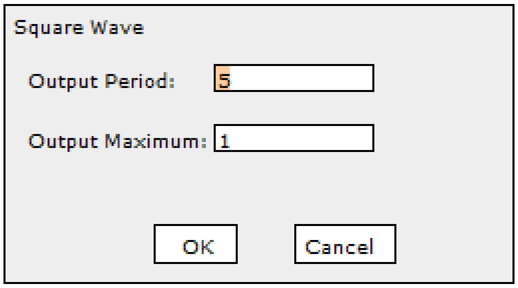


Square Wave

Output Period: 1

Output Maximum: 1

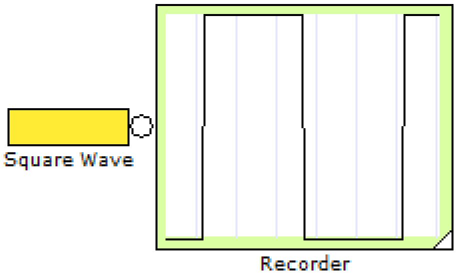




Square Wave

Output Period: 5

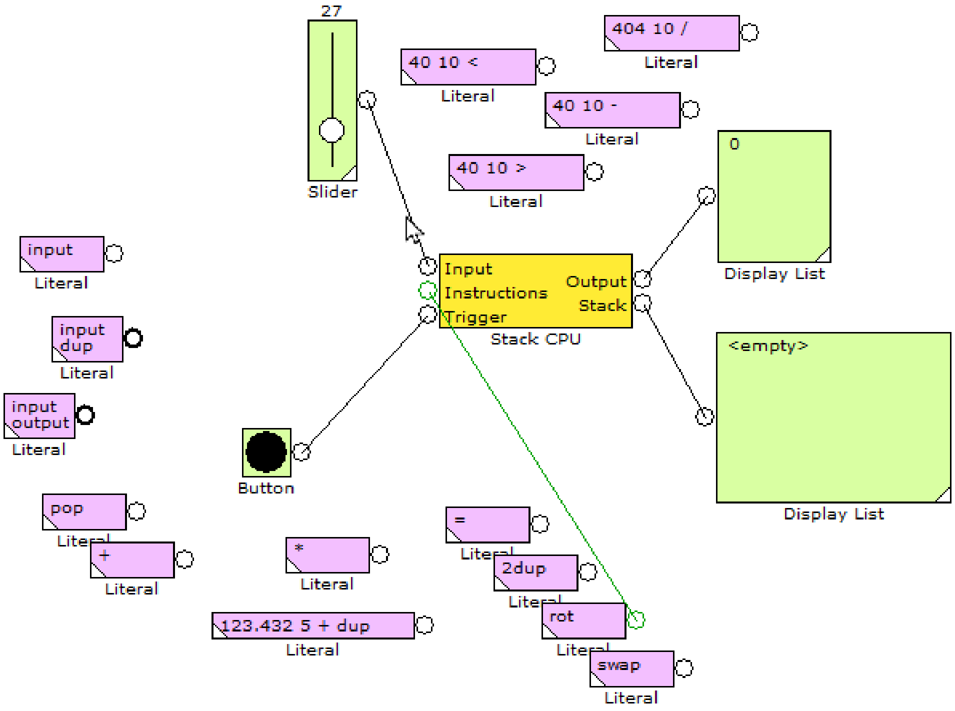
Output Maximum: 1



Stack CPU

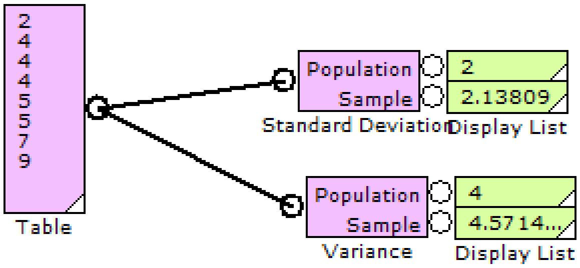
The Stack CPU component is a stack based computer that you can program in a language similar to Forth. Functions - column 3

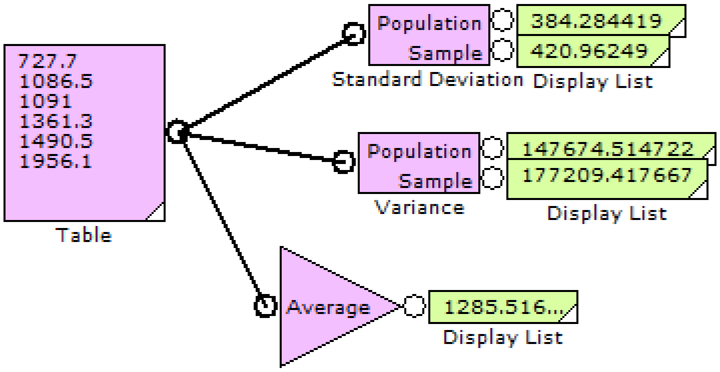
NOTE: Stack CPU is just in its beta phase and only understands a few words.



Standard Deviation

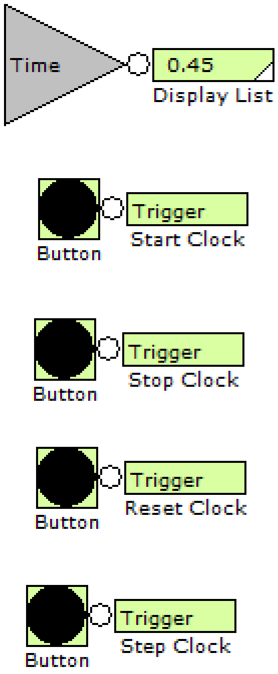
The Standard Deviation component scans the input array and calculates the standard deviation of those values. Arrays - column 3





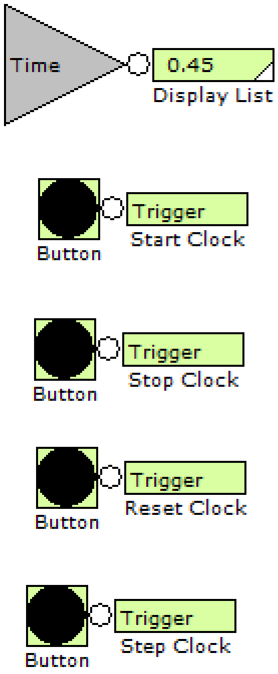
Start Clock

The Start Clock component starts the solution clock when the trigger goes from false to true.
Controls - column 3



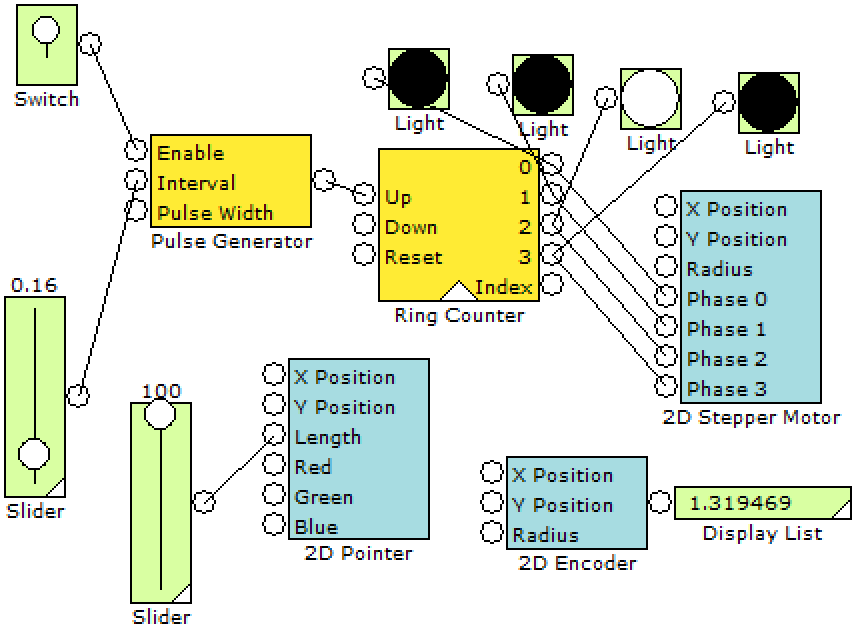
Step Clock

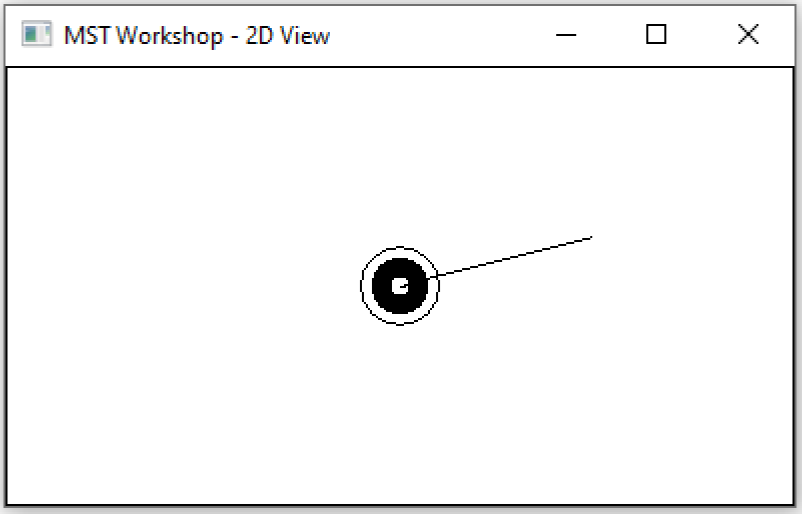
The Step Clock component steps the solution clock one time interval when the trigger goes from false to true.   Controls - column 3



2D Stepper Motor

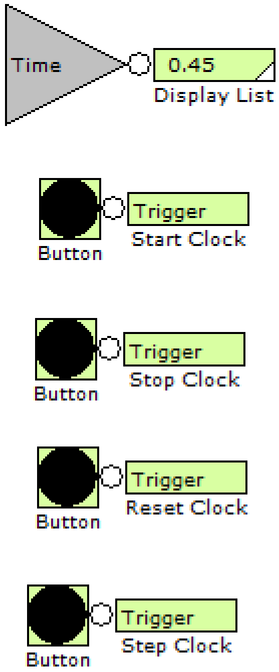
The Stepper Motor creates a motor that can drive other simulation objects like Gears. Place a Gear at the same X, Y position to connect the motor to the gear.   2D - column 3





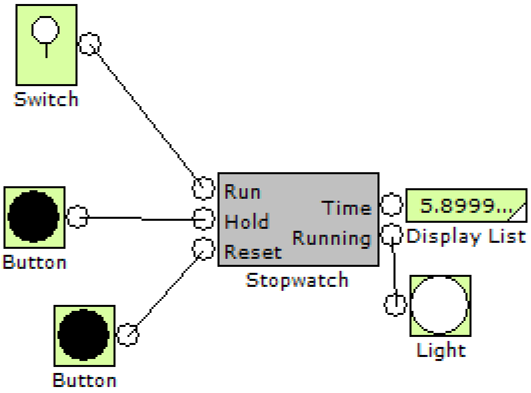
Stop Clock

The Stop Clock component stops the solution clock when the trigger goes from false to true.
Controls - column 3



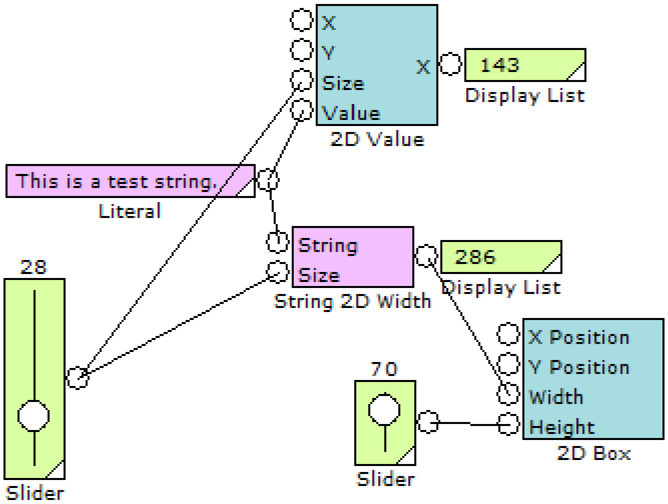
Stopwatch

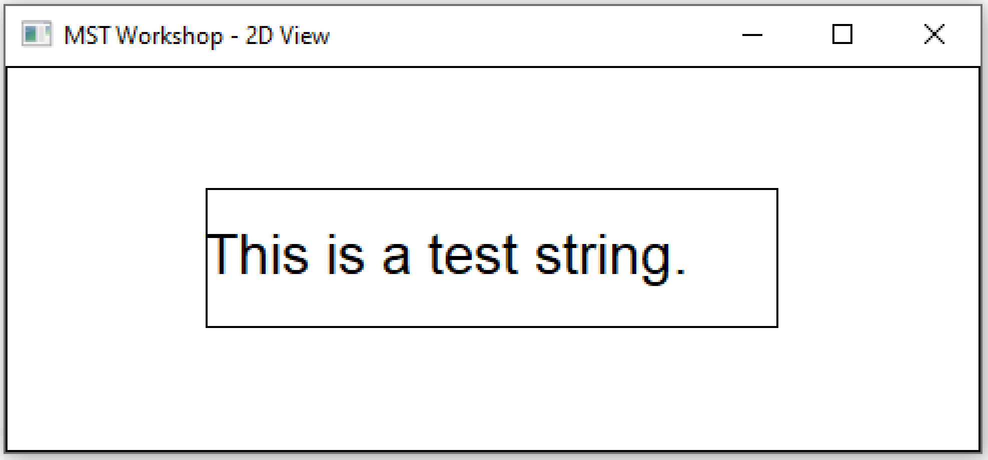
The Stopwatch component starts when the Run input goes high and runs until the Run input goes low. It can hold when the Hold input is high. It runs on the workspace clock.   Functions - column 7



String 2D Width

The String 2D Width component measures the width of the input string in 2D pixels. Arrays - column 6

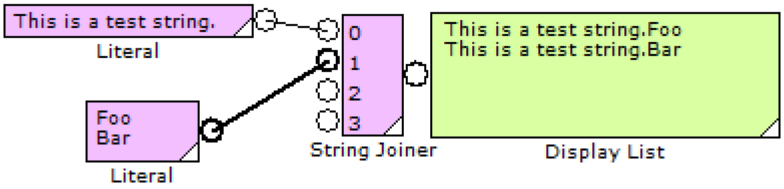




This is a test string.

String Joiner

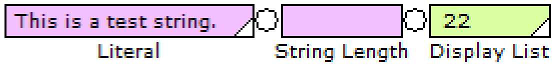
The String Joiner component combines all the values for all its inputs into a single output. You can set the number of inputs. Arrays - column 6

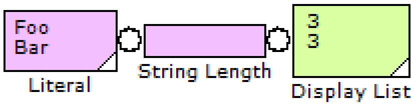


```
This is a test string.Foo
This is a test string.Bar
```

String Length

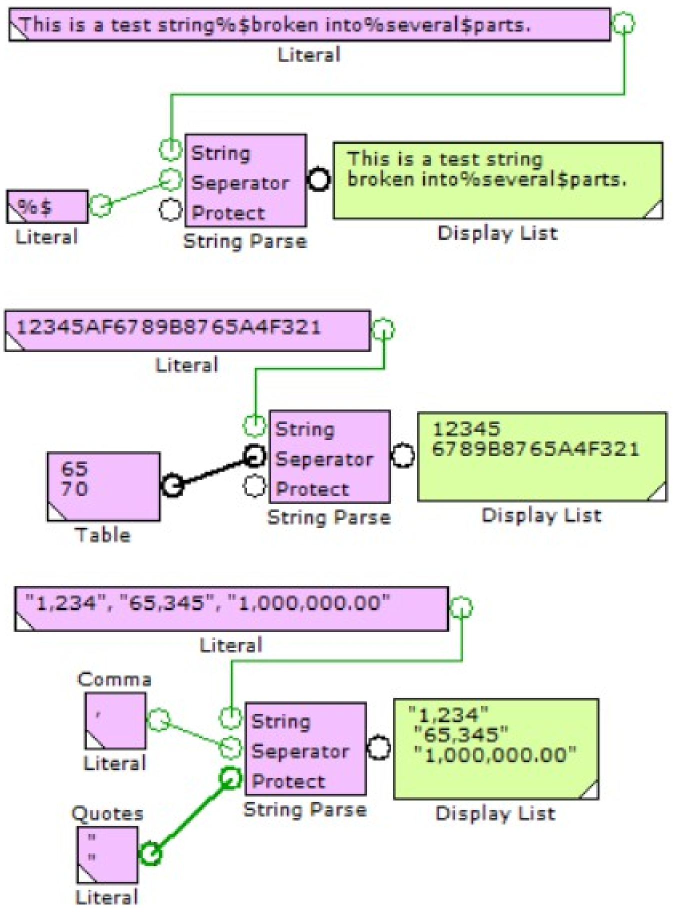
The String Length component outputs the number of characters in the string at the input. Arrays - column 6





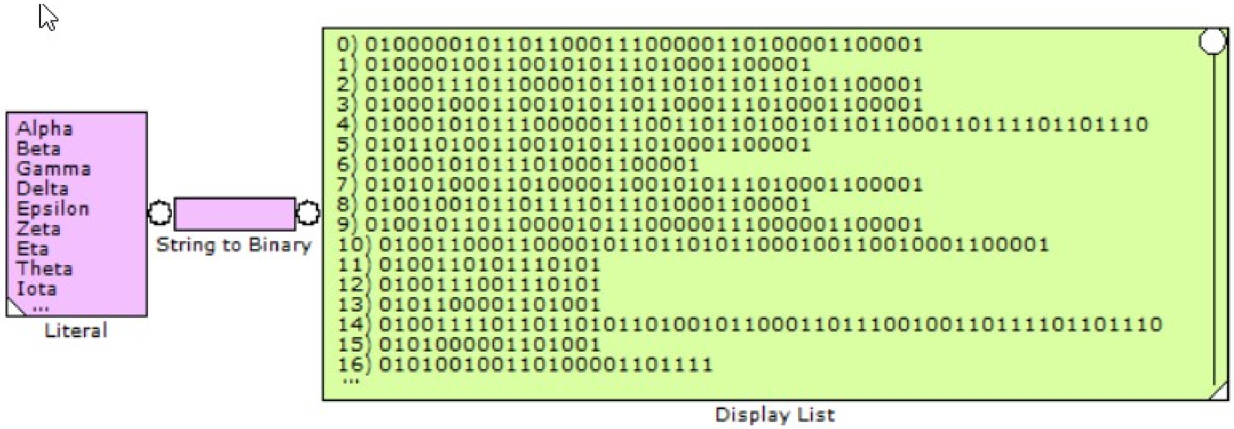
String Parse

The String Parse component takes the string input and breaks it into array elements based on the separator. The separator can be either a string or an array of numerical values of ASCII characters. You can also specify a pair of strings to Protect ranges of characters from being parsed.
Protect examples: " and "; [and]; or (and) .   Arrays - column 6



String to Binary

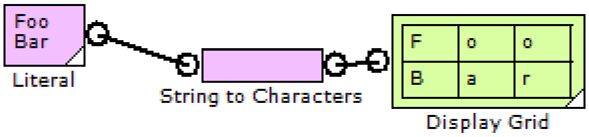
The String to Binary component converts a string to its Binary representation.   Arrays – column 3



```
0) 0100000101101100011100000110100001100001
1) 01000010011001010111010001100001
2) 0100011101100001011011010110110101100001
3) 0100010001100101011011000111010001100001
4) 01000101011100000111001101101001011011000110111101101110
5) 01011010011001010111010001100001
6) 010001010111010001100001
7) 0101010001101000011001010111010001100001
8) 01001001011011110111010001100001
9) 0100101101100001011100000111000001100001
10) 010011000110000101101101011000100110010001100001
11) 0100110101110101
12) 0100111001110101
13) 0101100001101001
14) 01001111011011010110100101100011011100100110111101101110
15) 0101000001101001
16) 010100100110100001101111
...
```

String to Characters

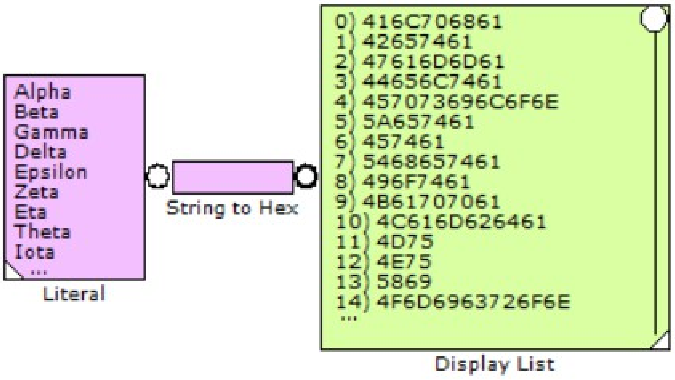
The String to Characters component outputs an array of characters based on the input string.   Arrays - column 7



F	o	o
B	a	r

String to Hex

The String to Hex component converts a string to its Hexadecimal representation. Arrays – column 3

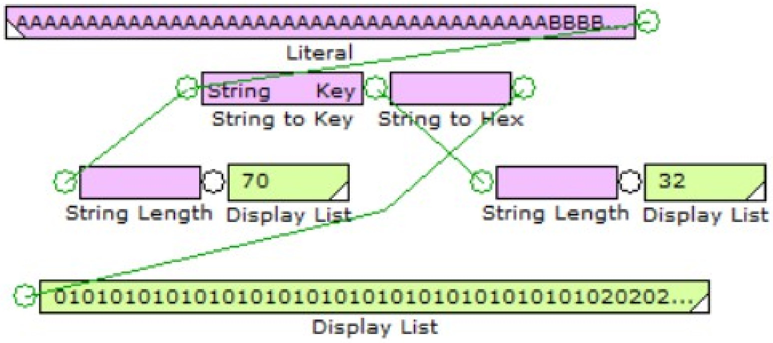


```
Alpha
Beta
Gamma
Delta
Epsilon
Zeta
Eta
Theta
Iota
...
```

```
0) 416C706861
1) 42657461
2) 47616D6D61
3) 44656C7461
4) 457073696C6F6E
5) 5A657461
6) 457461
7) 5468657461
8) 496F7461
9) 4B61707061
10) 4C616D626461
11) 4D75
12) 4E75
13) 5869
14) 4F6D6963726F6E
...
```

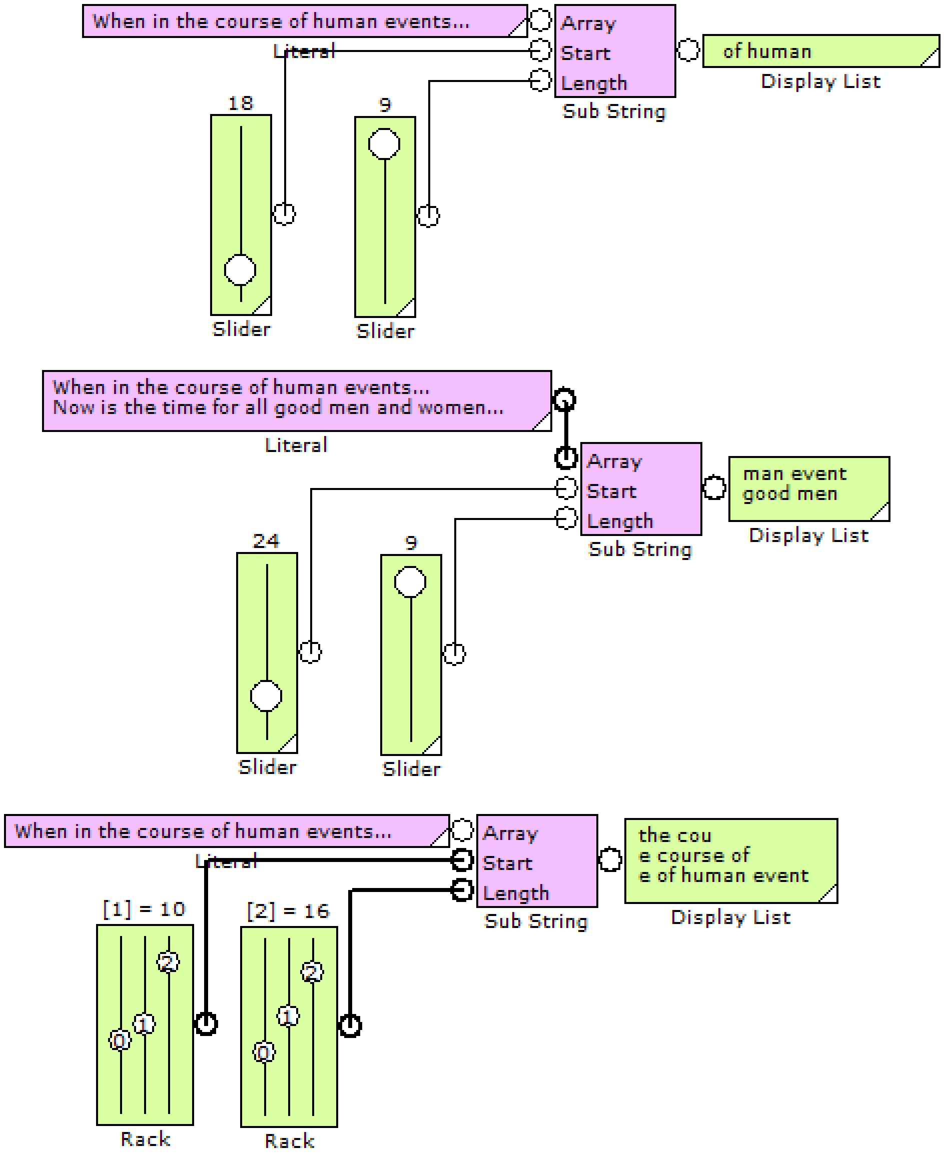
String to Key

The String to Key component takes a string and packs it into a key. Arrays – column 3



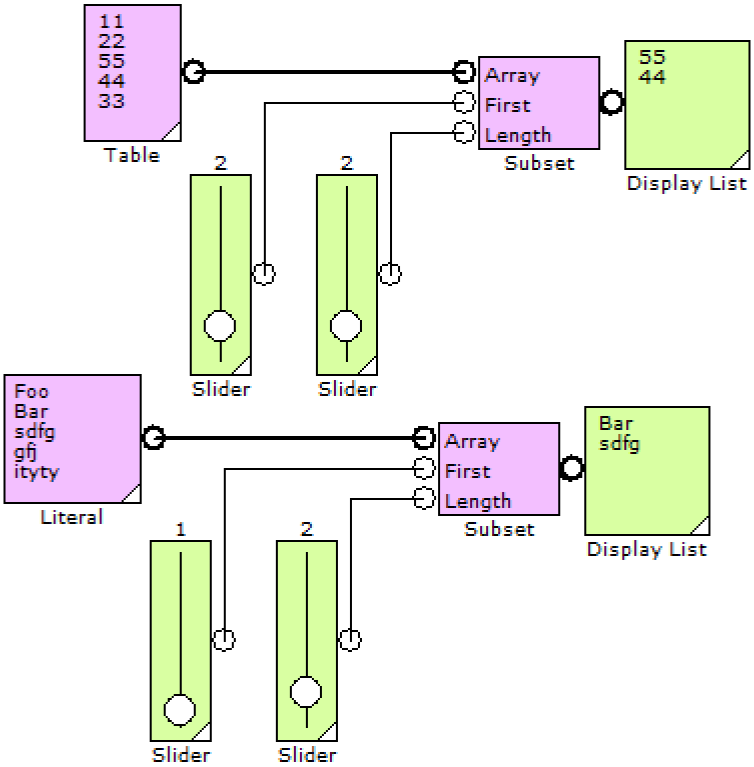
Sub String

The Sub String component outputs a portion of the input string.   Arrays - column 6



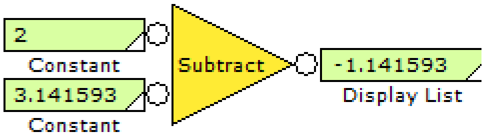
Subset

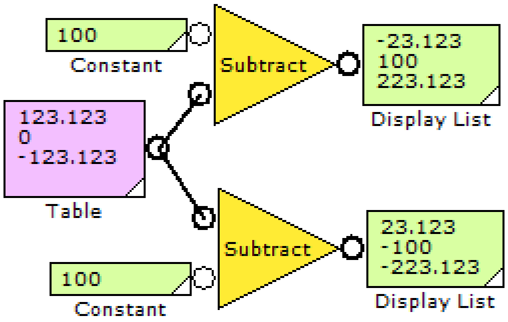
The Subset component outputs a portion of the values in an array. Input the number of the first value and the number of values you want at the output.   Arrays - column 1

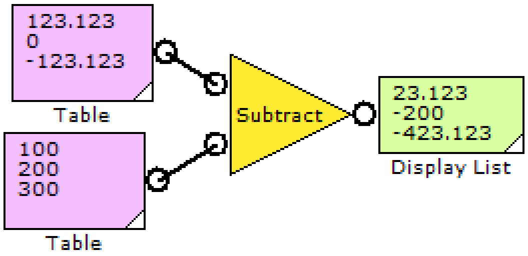


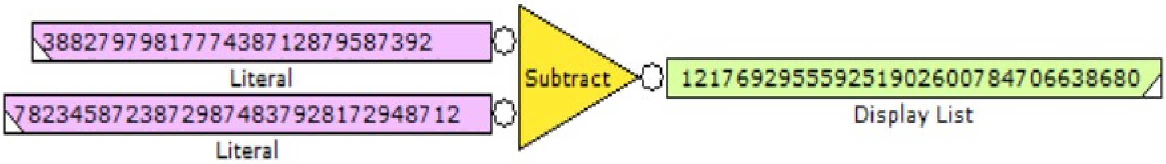
Subtract

The Subtract component subtracts the inputs. Inputs can be scalar and /or arrays. Functions - column 1



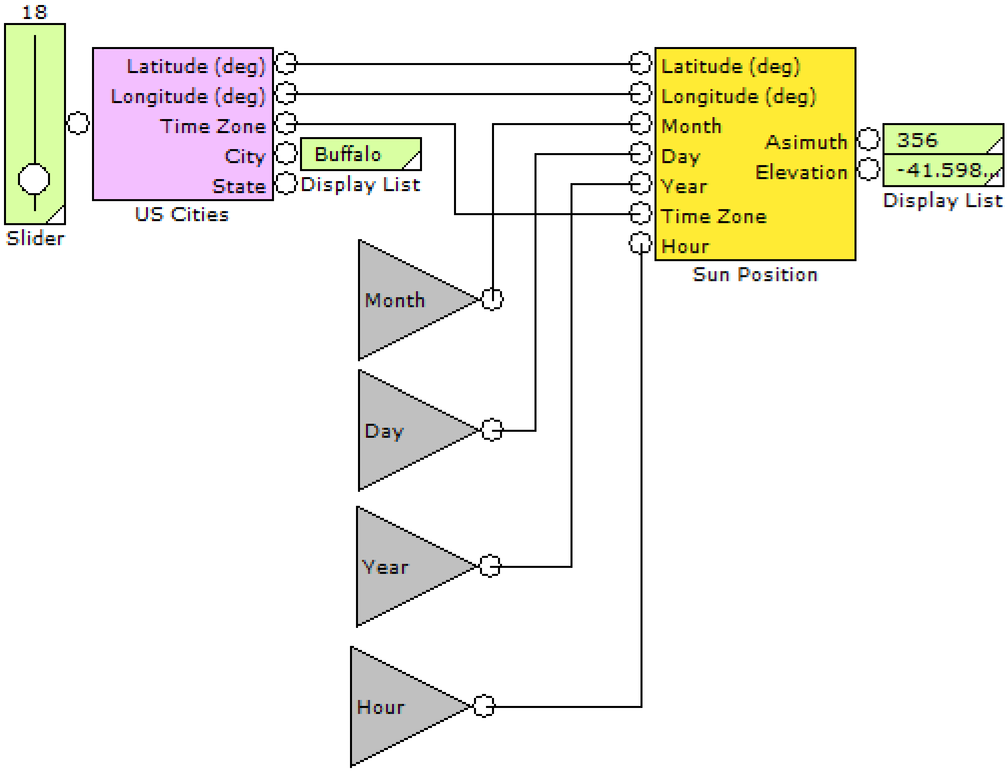






Sun Position

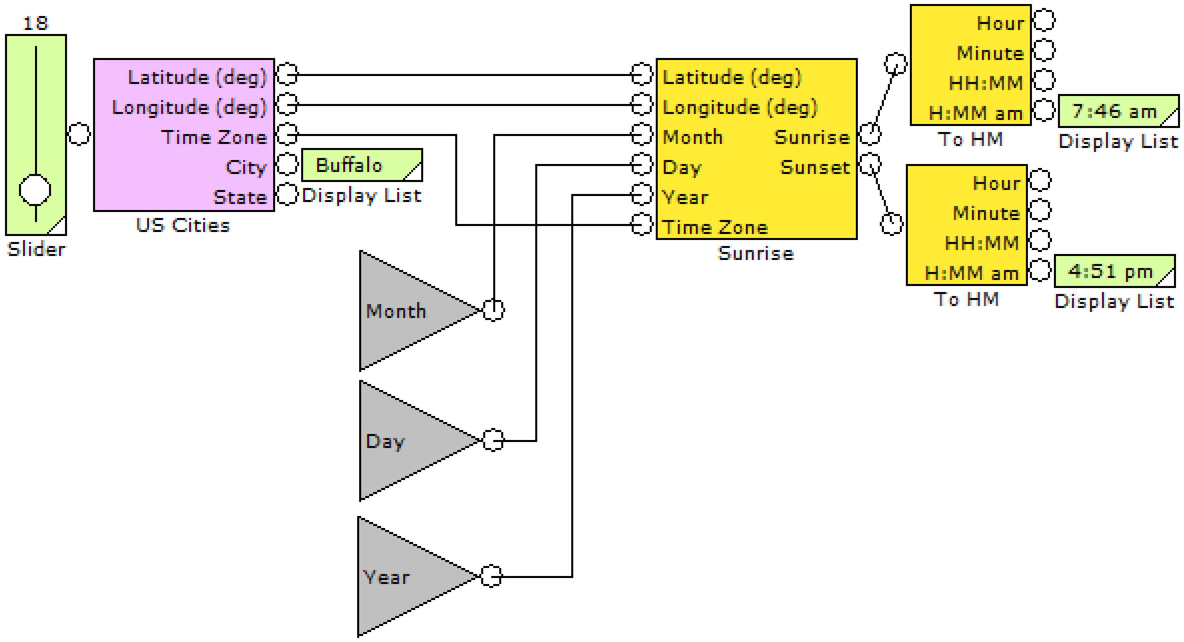
The Sun Position component calculates the Elevation and Azimuth of the Sun. Latitude and Longitude are in degrees. North Latitude is positive. West Longitude is negative. The outputs are in degrees.



Functions - column 9

Sunrise

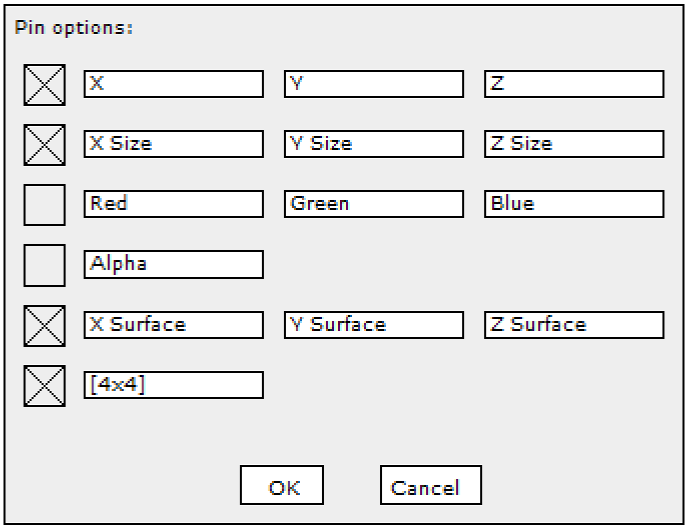
The Sunrise component calculates the time of Sunrise and Sunset. Latitude and Longitude are in degrees. North Latitude is positive. West Longitude is negative. The output is a fraction of a day.
Functions - column 9



\

3D Surface

The 3D Surface component draws a surface in the 3D view window. The X, Y, and Z Matrix and Mat Row Size inputs set the 3D data to be plotted. The Affine [4x4] array input modifies the size, position and orientation.   3D - column 5



Pin options:

☒ X Y Z

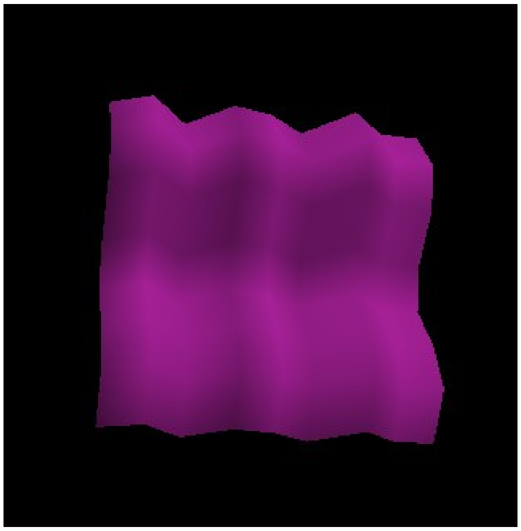
☒ X Size Y Size Z Size

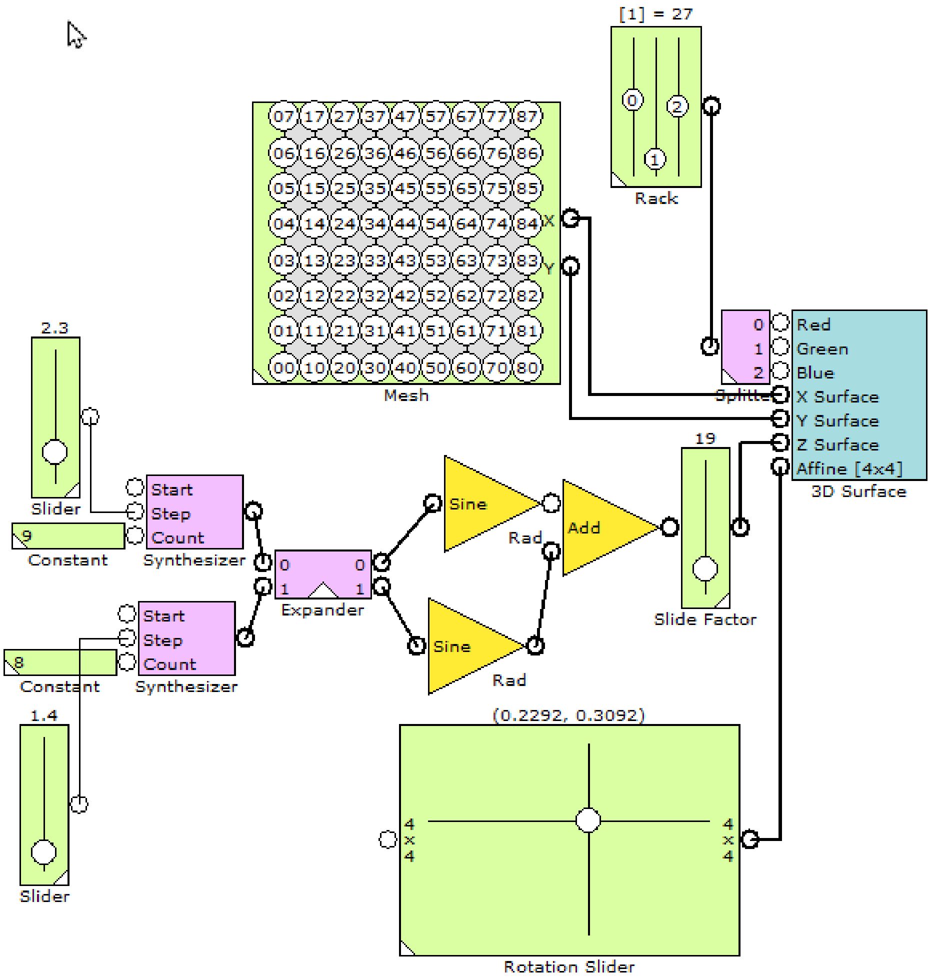
□ Red Green Blue

□ Alpha

☒ X Surface Y Surface Z Surface

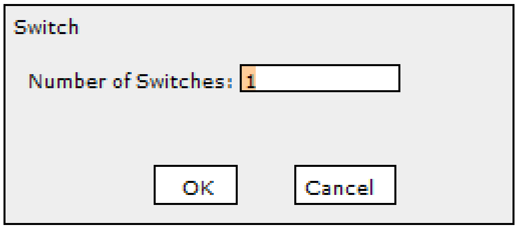
☒ [4x4]




[1] = 27
0
1
2
Rack
07 17 27 37 47 57 67 77 87
06 16 26 36 46 56 66 76 86
05 15 25 35 45 55 65 75 85
04 14 24 34 44 54 64 74 84
03 13 23 33 43 53 63 73 83
02 12 22 32 42 52 62 72 82
01 11 21 31 41 51 61 71 81
00 10 20 30 40 50 60 70 80
X
Y
Mesh
0
1
2
Splitter
Red
Green
Blue
X Surface
Y Surface
Z Surface
Affine [4x4]
3D Surface
2.3
Slider
9
Constant
Start
Step
Count
Synthesizer
0
0
1
1
Expander
Sine
Rad
Add
19
Slide Factor
Sine
Rad
Start
Step
Count
Synthesizer
8
Constant
1.4
Slider
(0.2292, 0.3092)
4
x
4
4
x
4
Rotation Slider

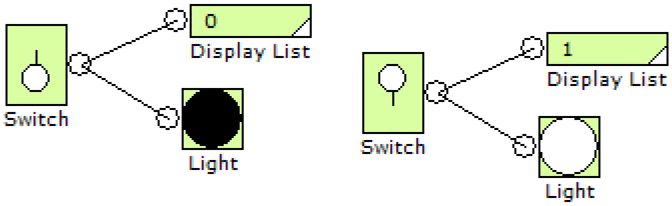
Switch

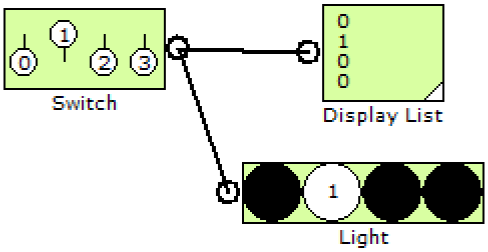
The Switch goes on when mouse moves the knob up, off when it is moved down. Note: This component can be operated using the wheel on the mouse. Controls - column 4



Switch

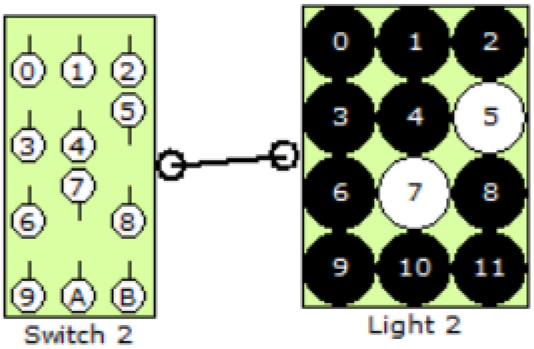
Number of Switches: 1





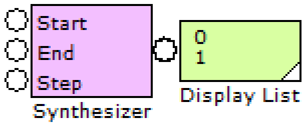
Switch 2

The Switch 2 goes on when the mouse moves the knob up, off when it is moved down. Switch 2's output is 2 dimensional. Note: This component can be operated using the wheel on the mouse. Controls – column 4

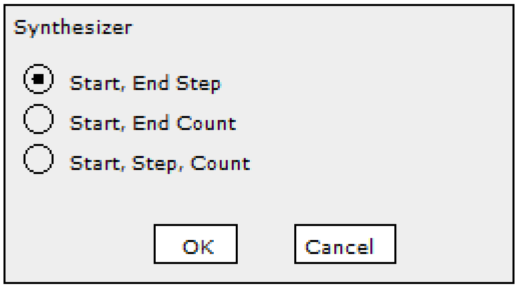


Synthesizer

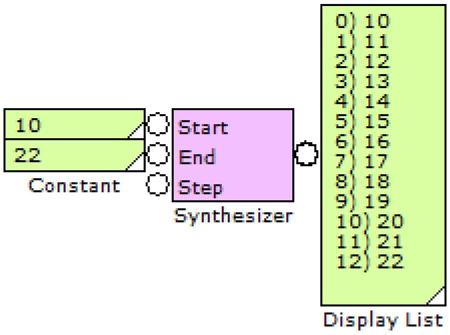
The Synthesizer component creates an array of numbers.   Arrays - column 1



```
0
1
```

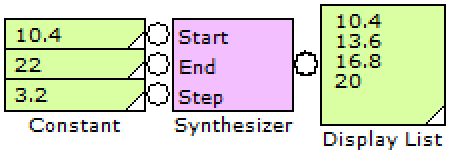

Synthesizer

- ● Start, End Step
- ○ Start, End Count
- ○ Start, Step, Count



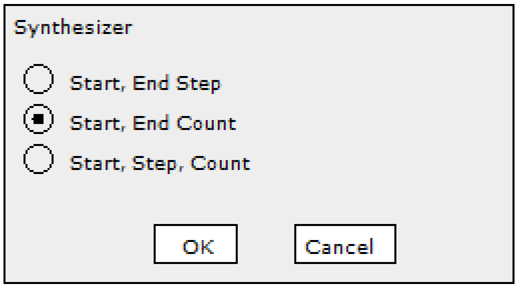
```
10
22
```

```
0) 10
1) 11
2) 12
3) 13
4) 14
5) 15
6) 16
7) 17
8) 18
9) 19
10) 20
11) 21
12) 22
```

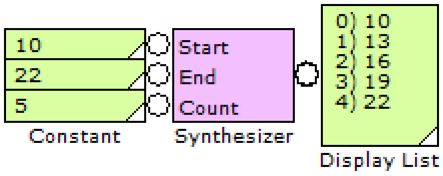


```
10.4
22
3.2
```

```
10.4
13.6
16.8
20
```

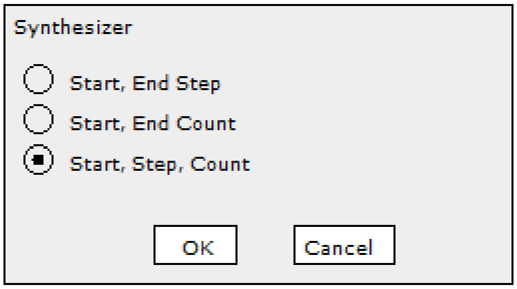

Synthesizer

- ○ Start, End Step
- ● Start, End Count
- ○ Start, Step, Count

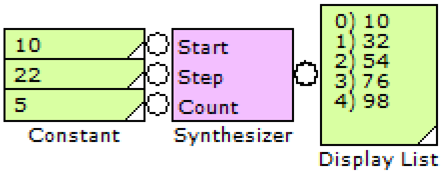


```
10
22
5
```

```
0) 10
1) 13
2) 16
3) 19
4) 22
```


Synthesizer

- ○ Start, End Step
- ○ Start, End Count
- ● Start, Step, Count

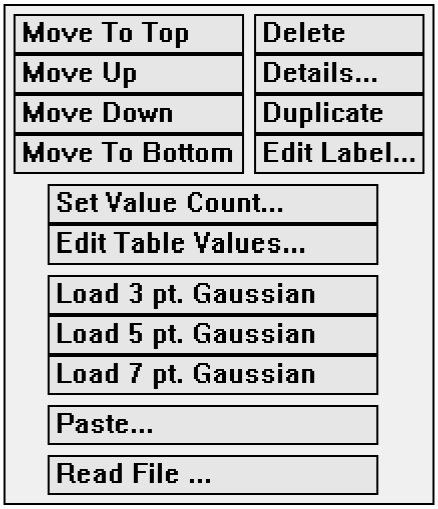


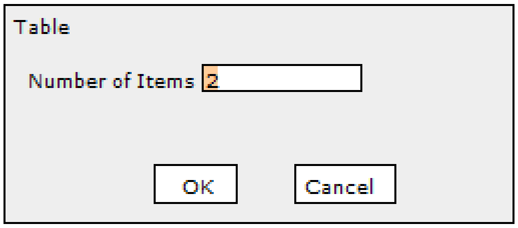
```
10
22
5
```

```
0) 10
1) 32
2) 54
3) 76
4) 98
```

Table

The Table component is used to create a one dimensional table of numbers.   Arrays - column 1





Table

Number of Items 2

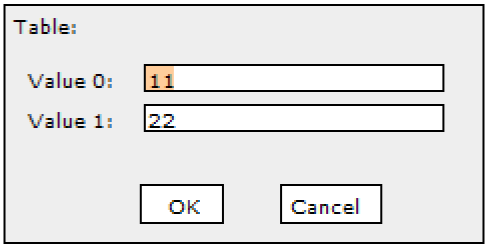
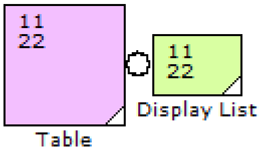


Table:

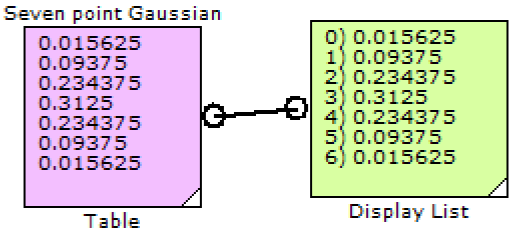
Value 0: 11

Value 1: 22



```
11
22
```

```
11
22
```

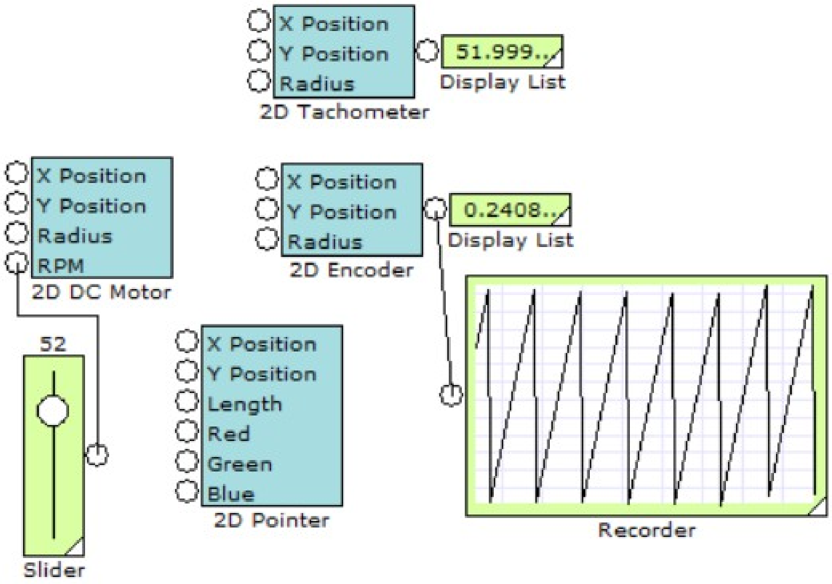


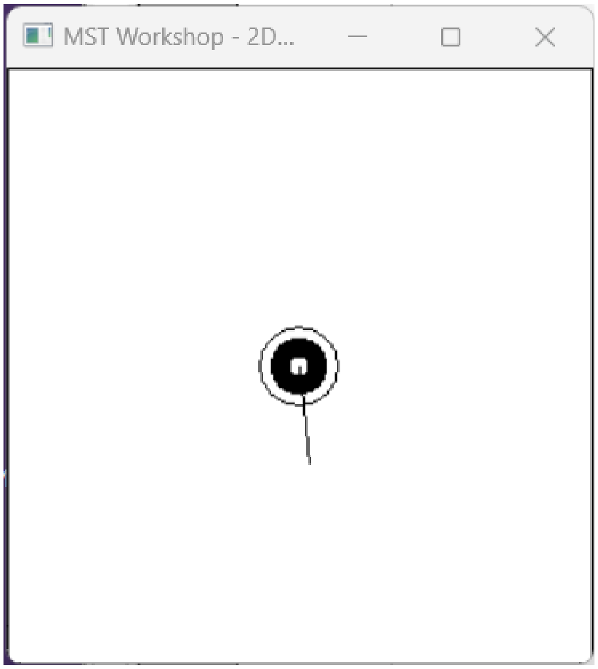
```
0.015625
0.09375
0.234375
0.3125
0.234375
0.09375
0.015625
```

```
0) 0.015625
1) 0.09375
2) 0.234375
3) 0.3125
4) 0.234375
5) 0.09375
6) 0.015625
```

2D Tachometer

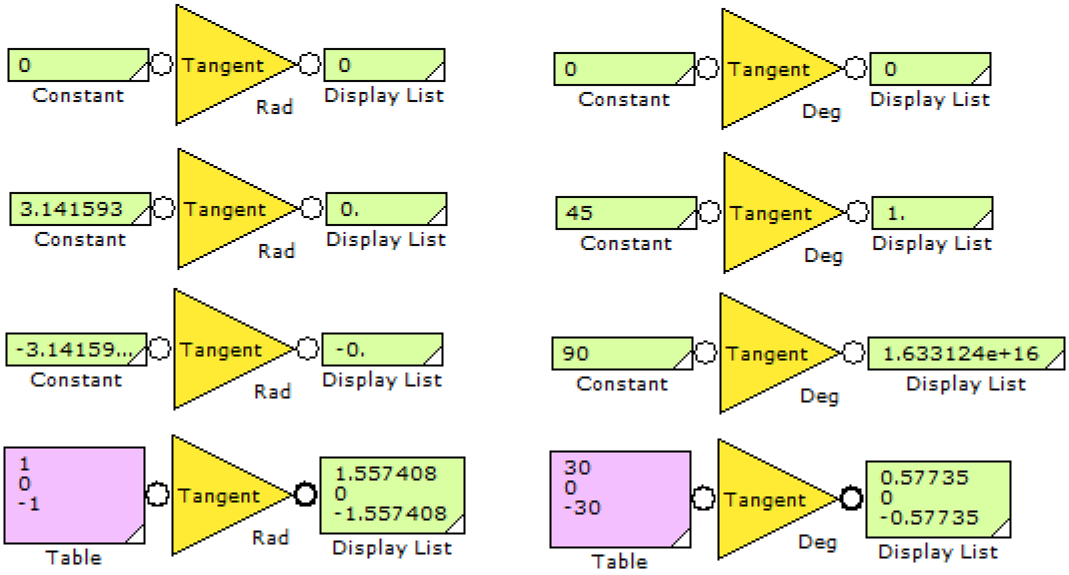
The 2D Tachometer outputs the speed of rotation of the shaft. You can attach it to Gears or other simulation objects like Motors. Place the tachometer at the same X, Y position as a gear to connect them.
2D – column 3





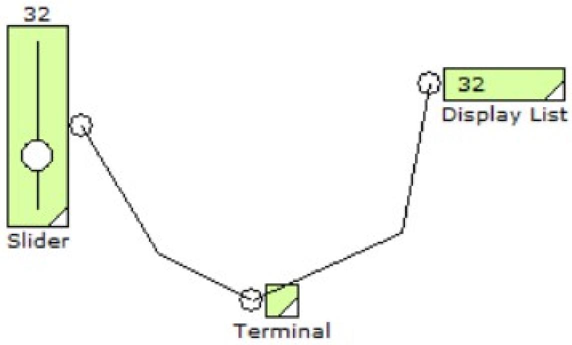
Tangent

The Tangent component calculates the trigonometric tangent of the input (in radians). Input can be scalar or an array.   Functions - column 5



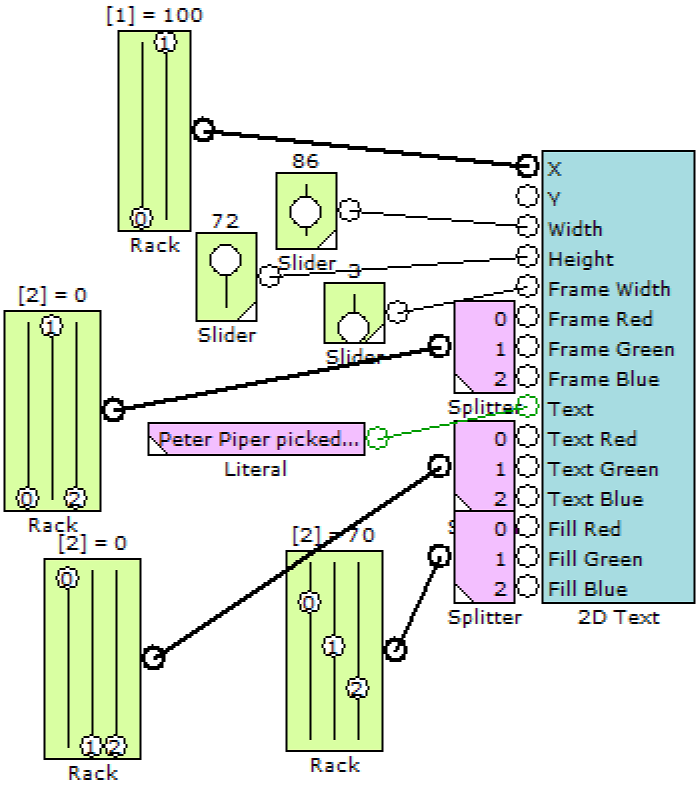
Terminal

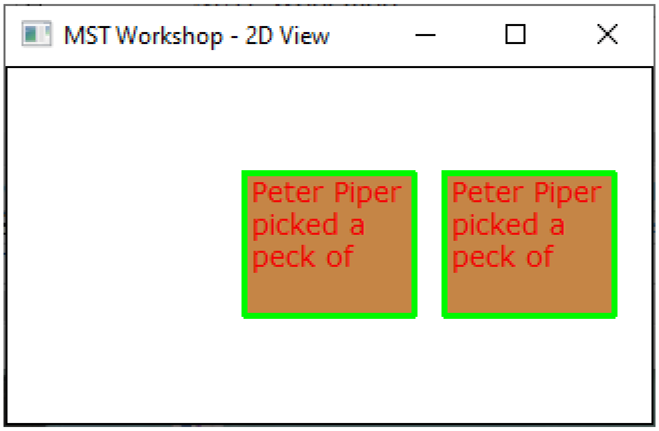
The Terminal is used when you need a mid point to connect two distant components. Controls - column 5



2D Text

The 2D Text is used put formatted text on the 2D canvas.



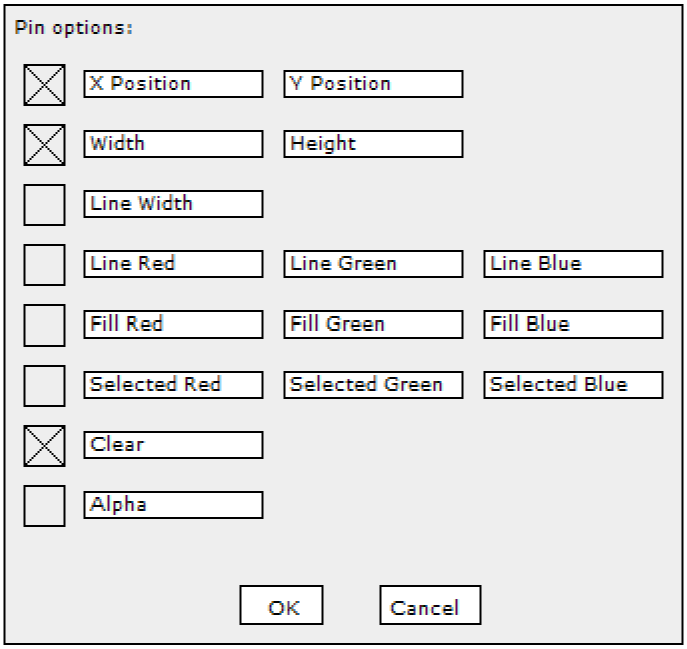


Peter Piper picked a peck of

Peter Piper picked a peck of

2D Text Entry

The 2D Text Entry allows the user to type text in the 2D view at the specified location and with the specified size.   Controls - column 2



Pin options:

☒ X Position   Y Position

☒ Width   Height

☐ Line Width

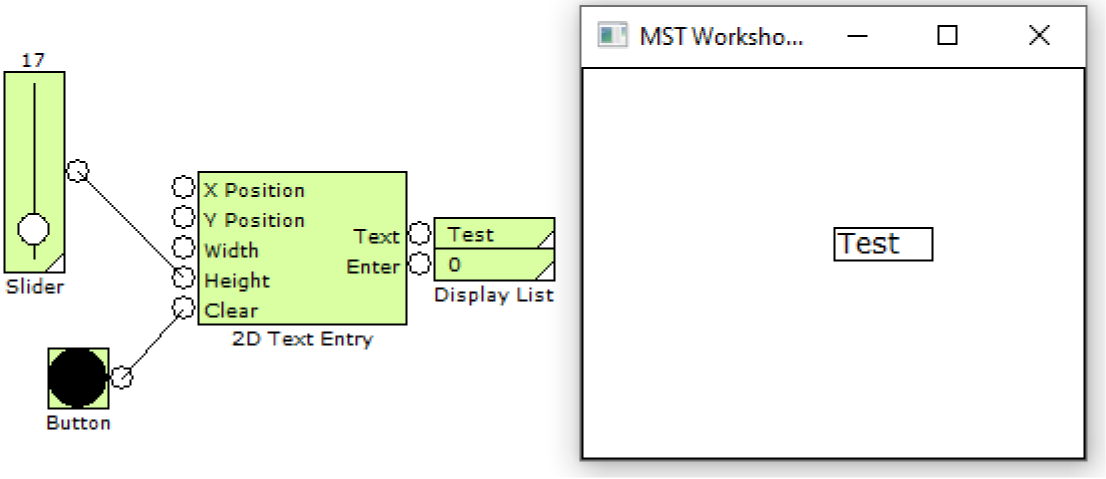
☐ Line Red   Line Green   Line Blue

☐ Fill Red   Fill Green   Fill Blue

☐ Selected Red   Selected Green   Selected Blue

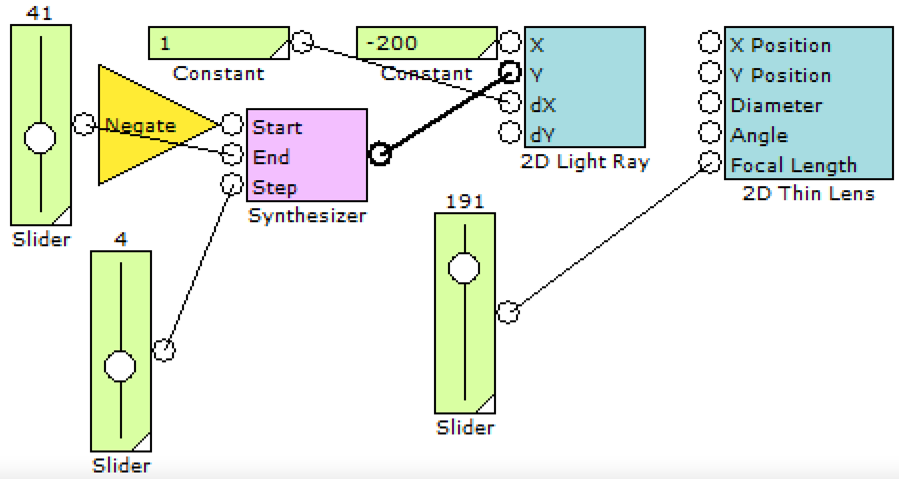
☒ Clear

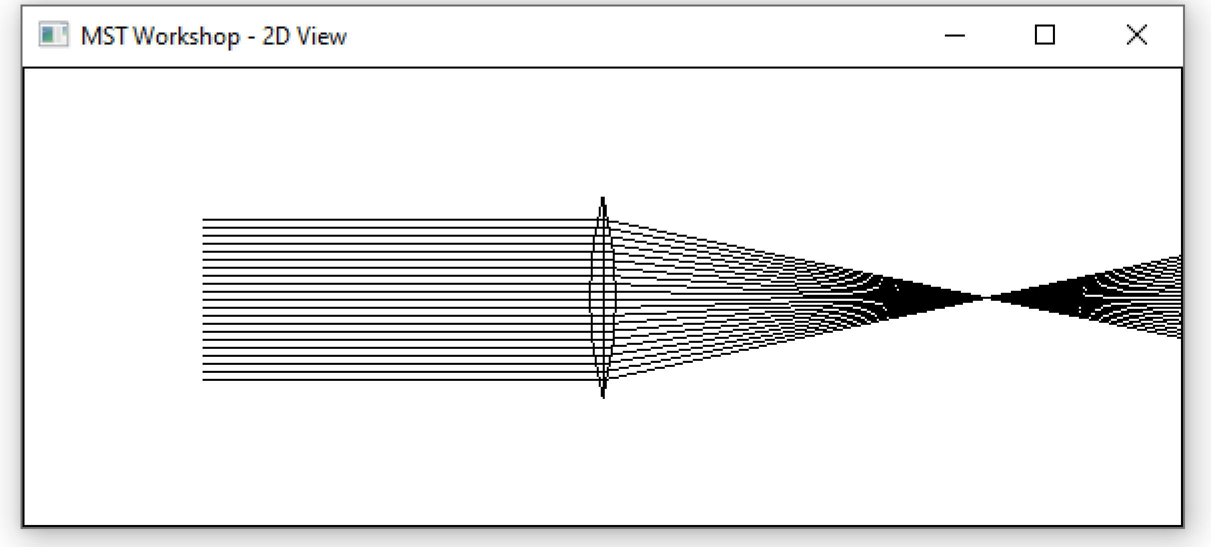
☐ Alpha



2D Thin Lens

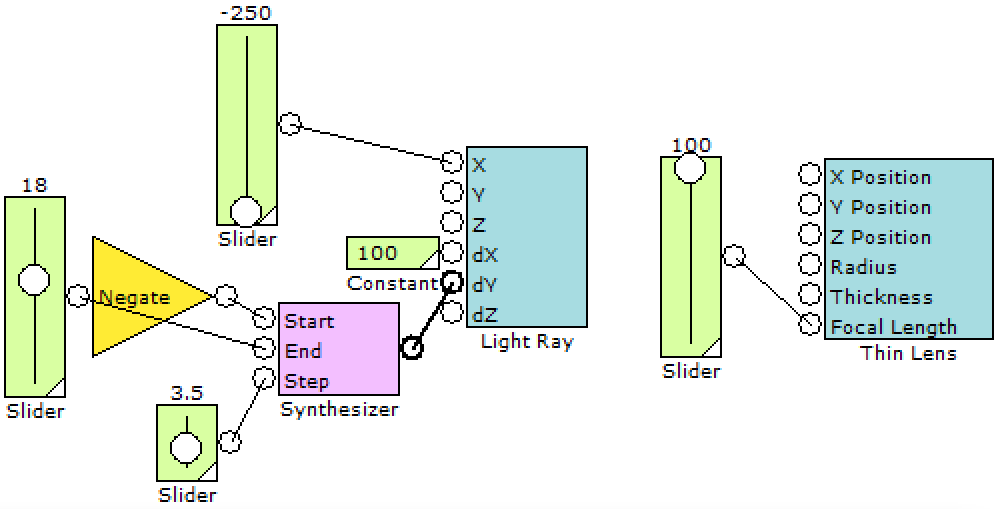
The 2D Thin Lens component bends light rays in the 2D view window. The settings determine how the ray progresses through the lens.   2D - column 3

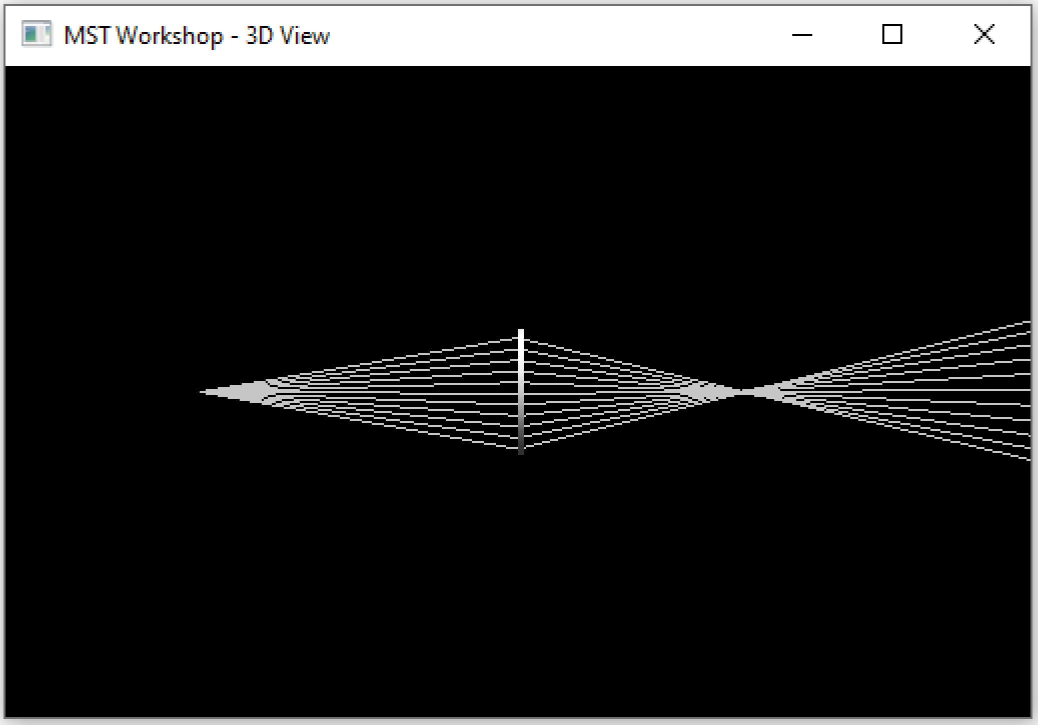




3D Thin Lens

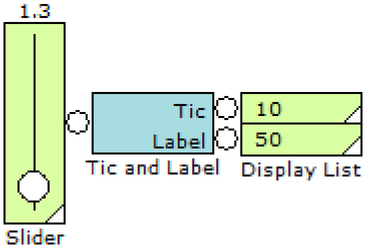
The Thin Lens component bends light rays in the 3D view window. The settings determine how the ray progresses through the lens. The Affine [4x4] array input modifies the size, position and orientation of the lens.   3D - column 5





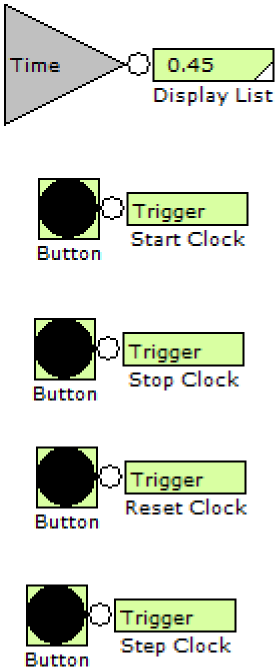
Tic and Label

The Tic and Label component calculates the best separation for tics and labels for the Vertical or Horizontal Axis component. 2D - column 1



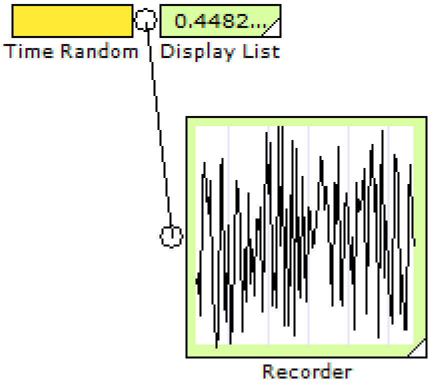
Time

The Time component outputs the number of milliseconds since start was pressed. This time is based on the components in the workspace not real time.   Functions - column 7



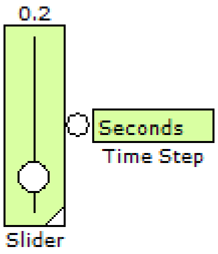
Time Random

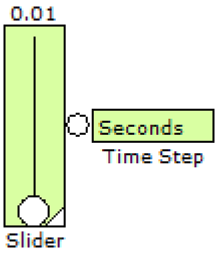
The Time Random component outputs a new random number between 0 and 1 when the clock runs.
Functions - column 6



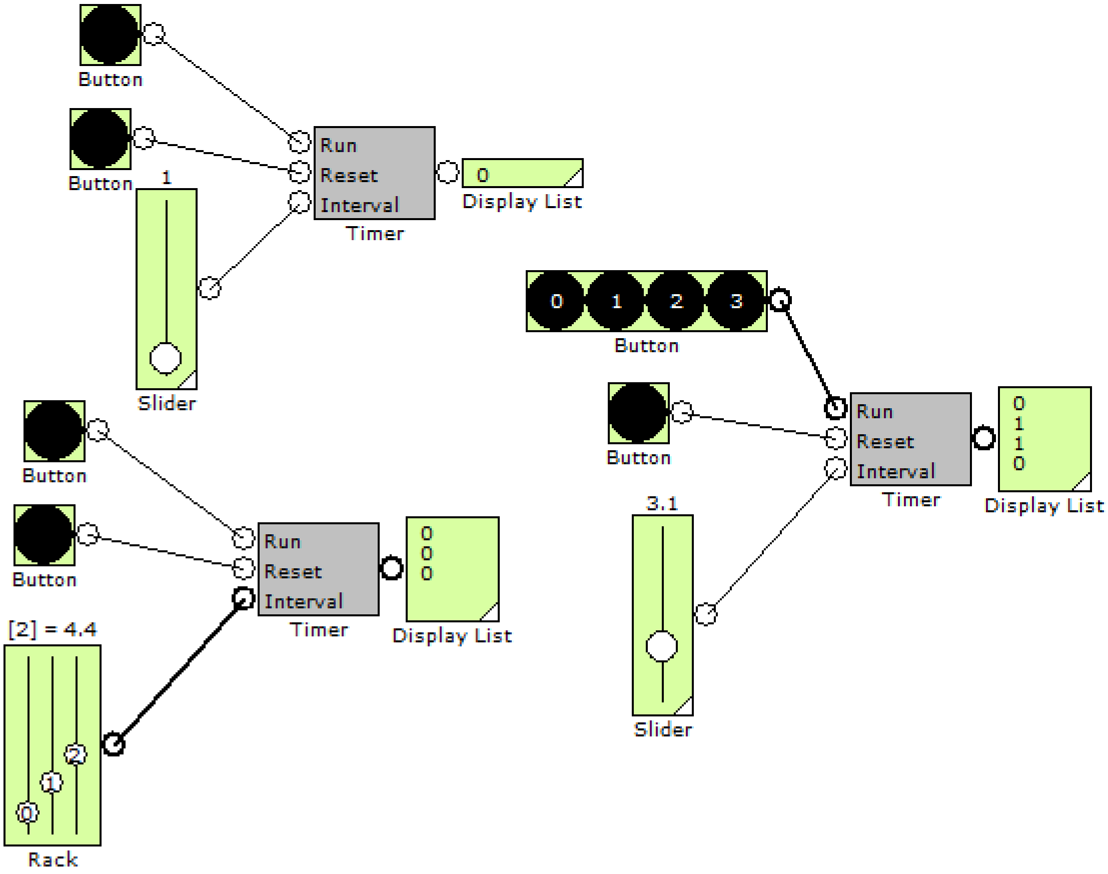
Time Step

The Time Step component changes the time interval between calculations. It does not change the time given to execute, it changes the time interval that the solution will use to advance each time based component. The minimum time step allowed is 0.001 Seconds (1 millisecond)   Controls - column 3





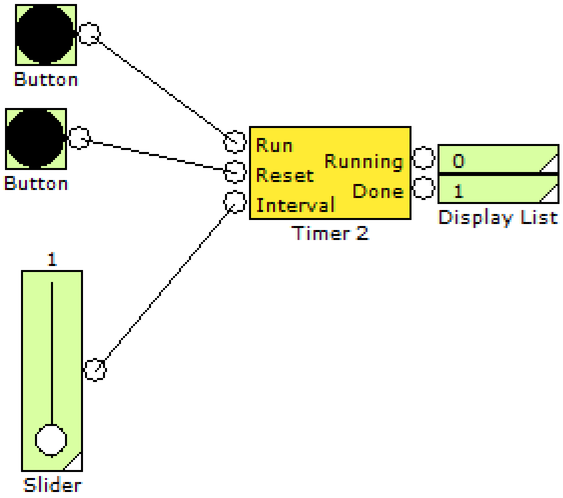
Timer



The Timer component measures time whenever the Run input is true, when the interval is reached the output goes high and remains high until it is reset.   Functions - column 7

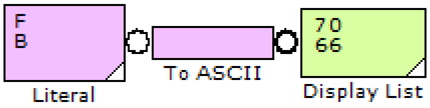
Timer 2

The Timer 2 component starts when the Start input is triggered and runs until the Interval time has elapsed or it is reset.   Functions - column 7



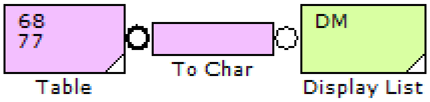
To ASCII

The To ASCII component converts the one letter input to the ASCII number. Arrays - column 6



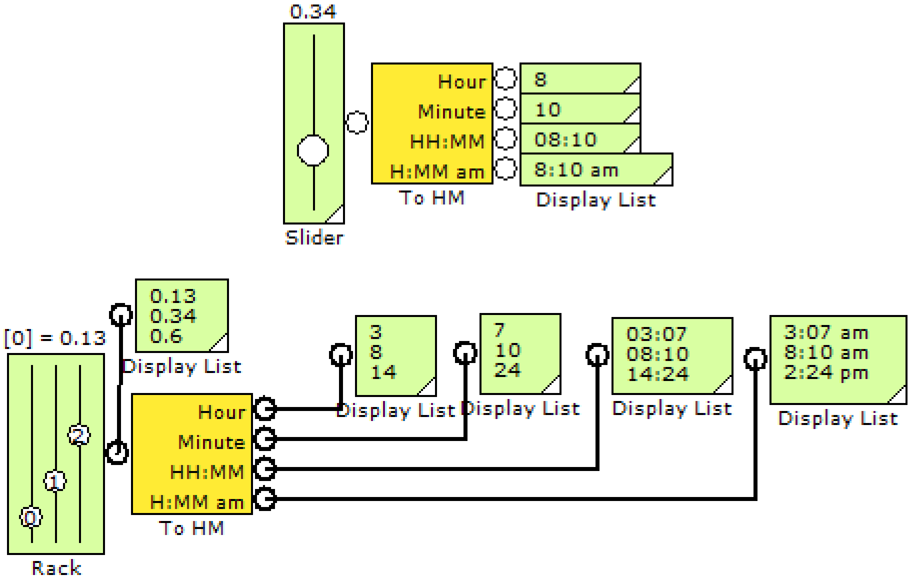
To Char

The To Char component converts the input numbers to characters. Arrays - column 6



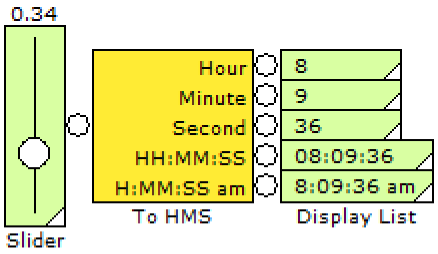
To HM

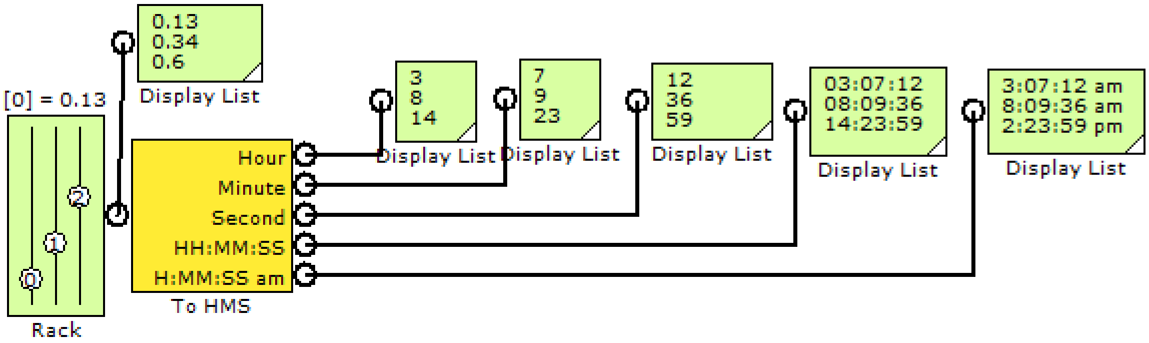
The To HM component converts a day to Hours and Minutes. Also provides 24 and 12 hour time formats.   Functions - column 5



To HMS

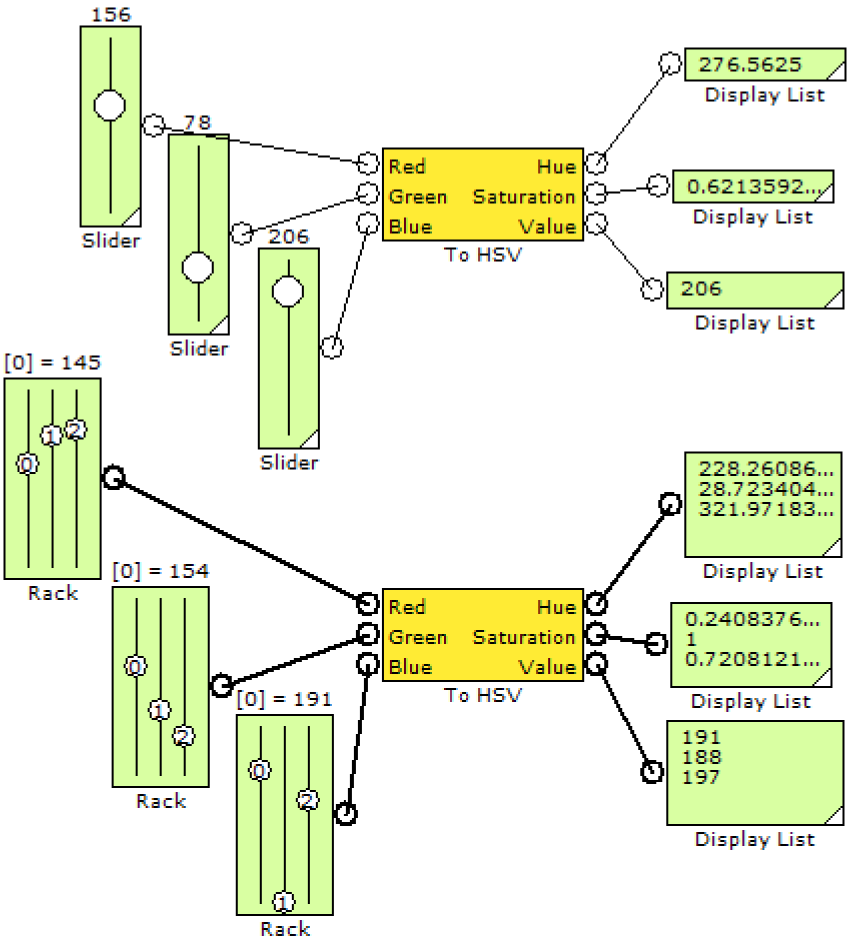
The To HMS component converts a day to Hours, Minutes and Seconds. Also provides 24 and 12 hour time formats. Functions - column 5





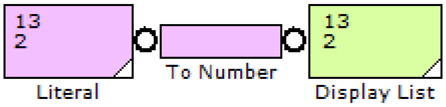
To HSV

The To HSV component outputs a color from Red, Green, Blue to Hue, Saturation, Value.
Functions - column 5



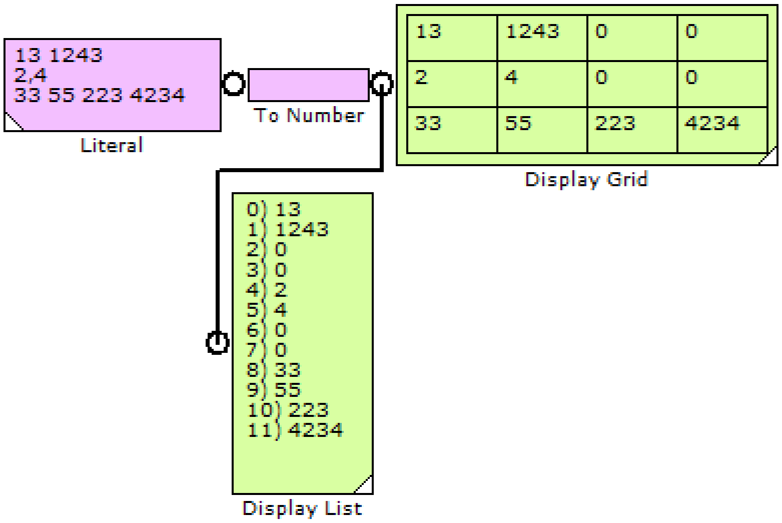
To Number

The To Number component converts the text input to numerical values.   Arrays - column 6



```
13
2
```

```
13
2
```



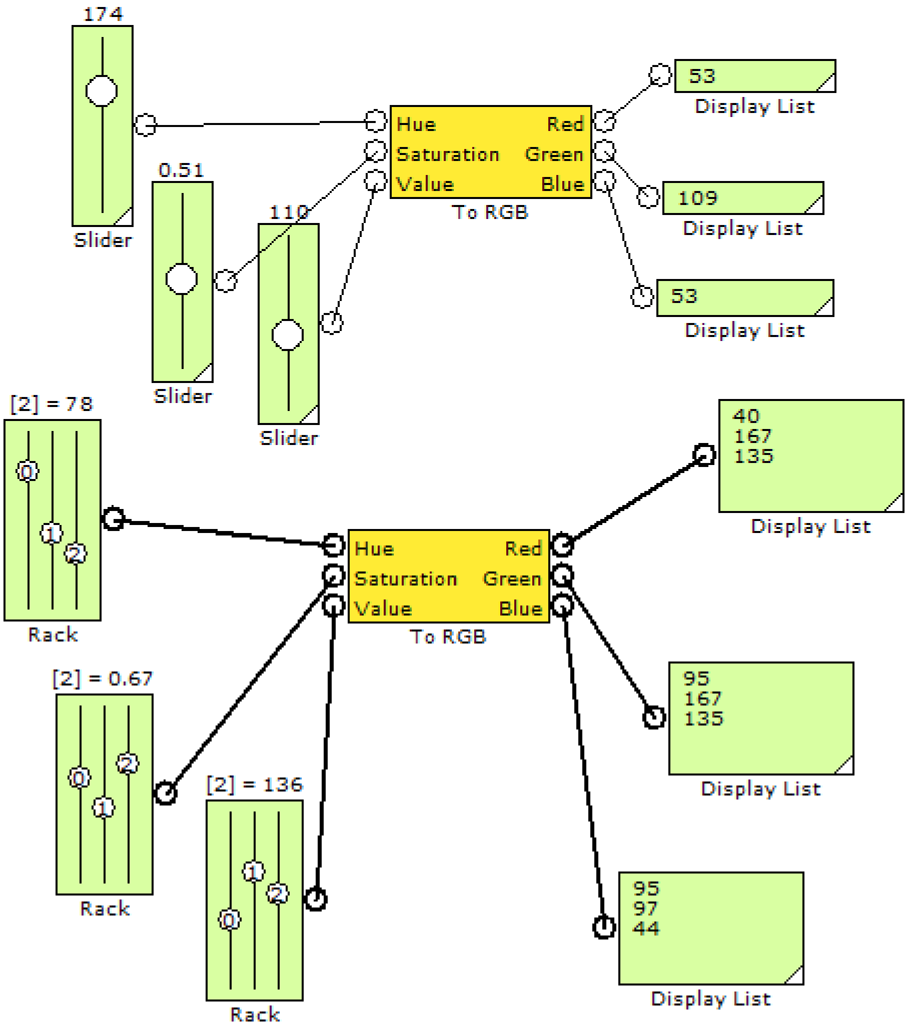
```
13 1243
2,4
33 55 223 4234
```

13	1243	0	0
2	4	0	0
33	55	223	4234

```
0) 13
1) 1243
2) 0
3) 0
4) 2
5) 4
6) 0
7) 0
8) 33
9) 55
10) 223
11) 4234
```

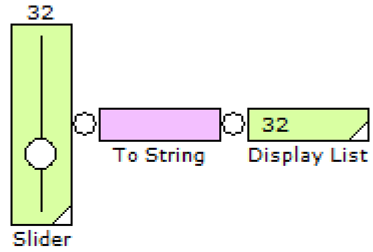
To RGB

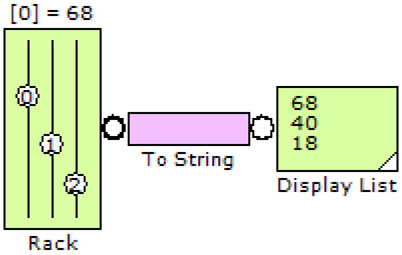
The To RGB component converts a color from Hue, Saturation, Value to Red, Green, Blue.
Functions - column 5



To String

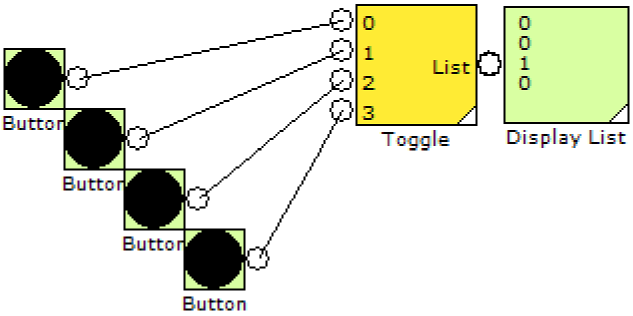
The To String component converts the input numbers to strings.   Arrays - column 6





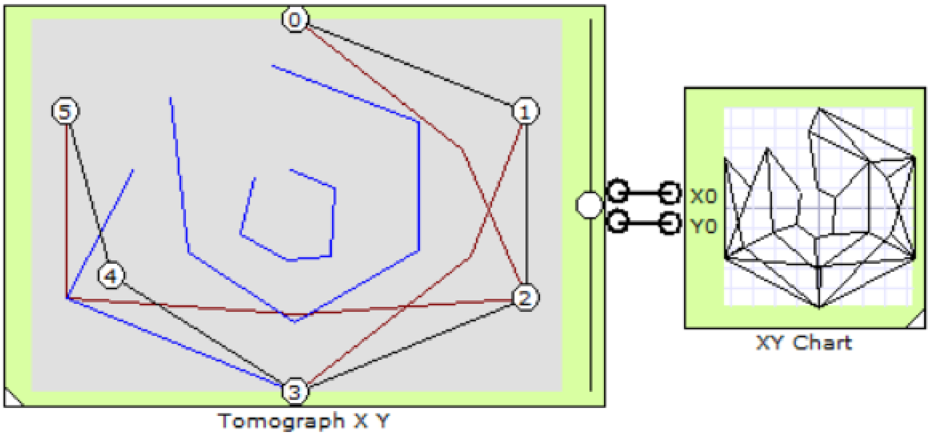
Toggle

The Toggle component is like the function of the checkbox. It toggles values in the output each time the input goes high.   Functions - column 3



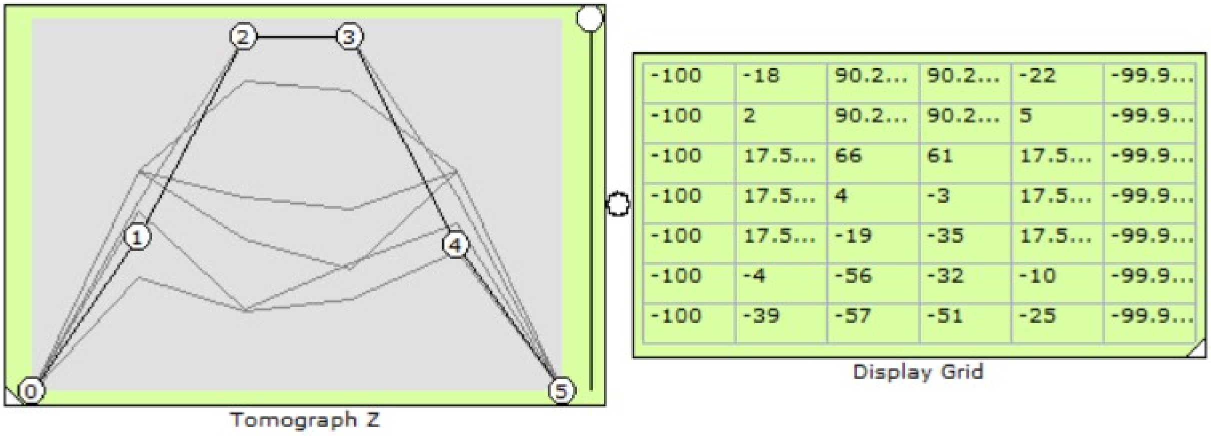
Tomograph X Y

The Tomograph X Y component lets you create 3 dimensional data sets by drawing individual curves.
Controls – column 2



Tomograph Z

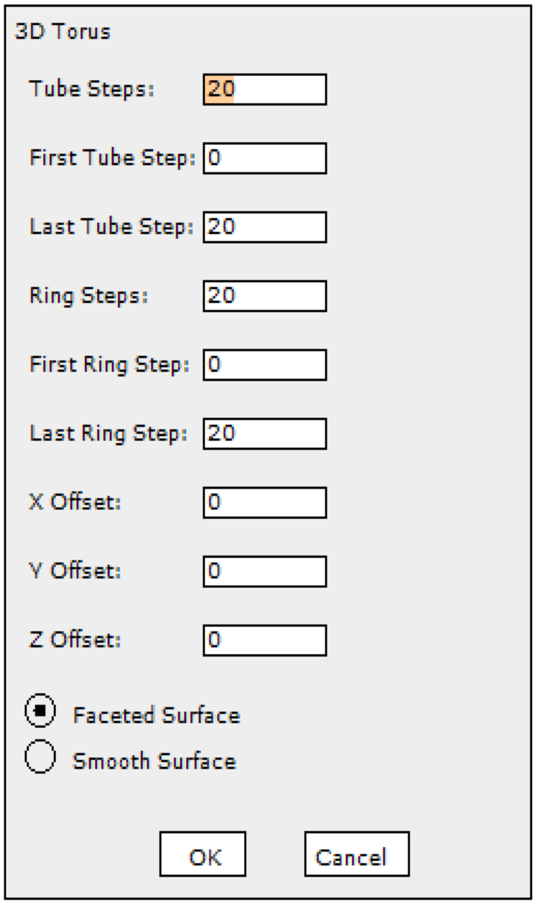
The Tomograph Z component lets you create a 2 dimensional matrix by drawing individual curves. You can adjust the view to front (X vs. Z) or side (Y vs. Z). Controls – column 2



-100	-18	90.2...	90.2...	-22	-99.9...
-100	2	90.2...	90.2...	5	-99.9...
-100	17.5...	66	61	17.5...	-99.9...
-100	17.5...	4	-3	17.5...	-99.9...
-100	17.5...	-19	-35	17.5...	-99.9...
-100	-4	-56	-32	-10	-99.9...
-100	-39	-57	-51	-25	-99.9...

3D Torus

The 3D Torus draws a torus in the 3D view window. The X, Y, and Z inputs set the position and size of the torus. The Affine [4x4] array input modifies the size, position and orientation. 3D - column 4



3D Torus

Tube Steps: 20

First Tube Step: 0

Last Tube Step: 20

Ring Steps: 20

First Ring Step: 0

Last Ring Step: 20

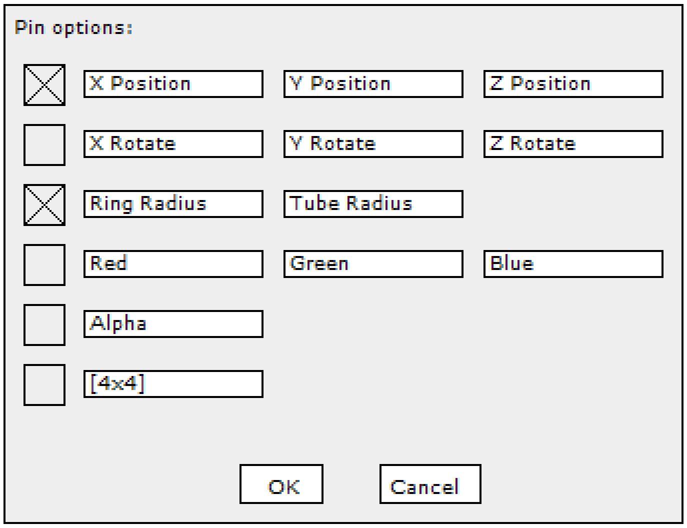
X Offset: 0

Y Offset: 0

Z Offset: 0

● Faceted Surface

○ Smooth Surface



Pin options:

☒ X Position | Y Position | Z Position

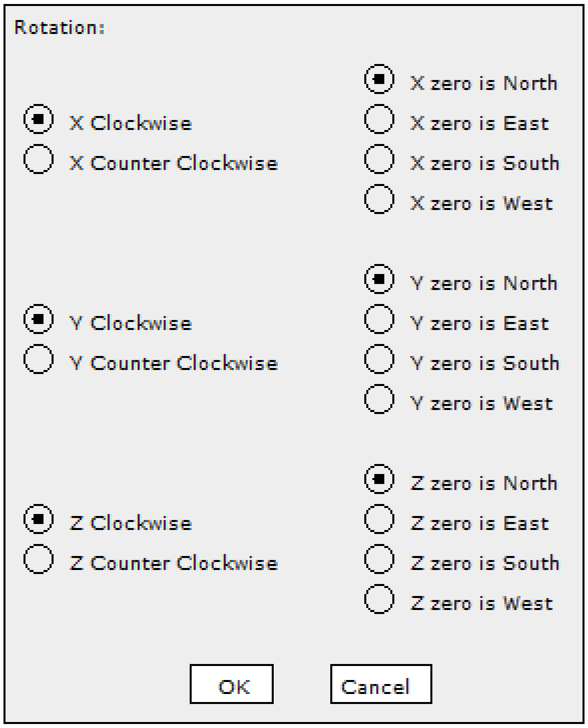
□ X Rotate | Y Rotate | Z Rotate

☒ Ring Radius | Tube Radius

□ Red | Green | Blue

□ Alpha

□ [4x4]



Rotation:

● X Clockwise
○ X Counter Clockwise

● X zero is North
○ X zero is East
○ X zero is South
○ X zero is West

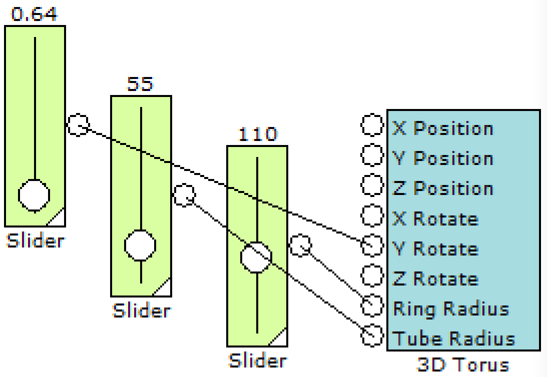
● Y Clockwise
○ Y Counter Clockwise

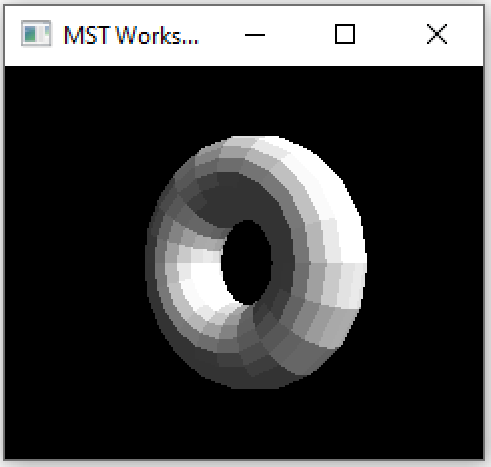
● Y zero is North
○ Y zero is East
○ Y zero is South
○ Y zero is West

● Z Clockwise
○ Z Counter Clockwise

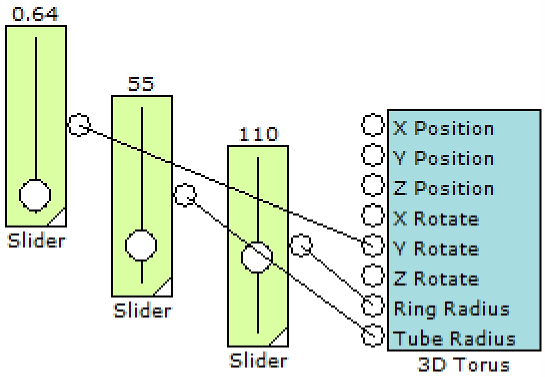
● Z zero is North
○ Z zero is East
○ Z zero is South
○ Z zero is West

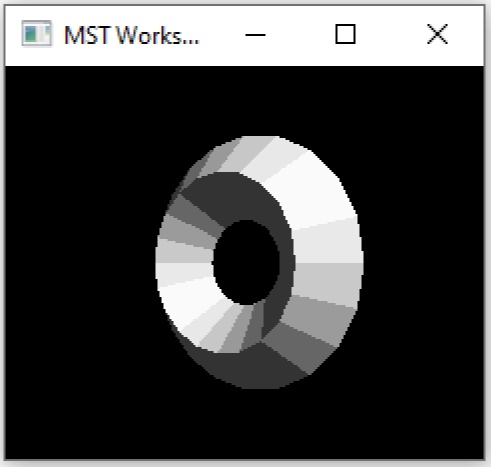
Tube Steps = 20, Ring Steps = 20



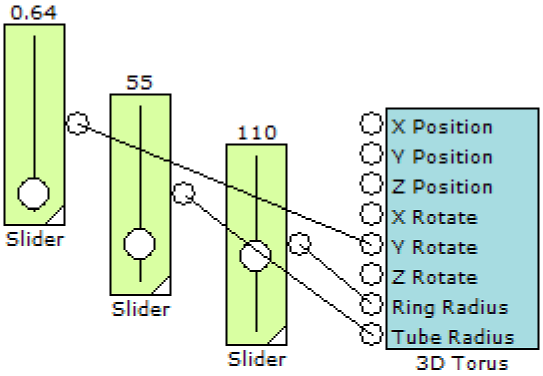


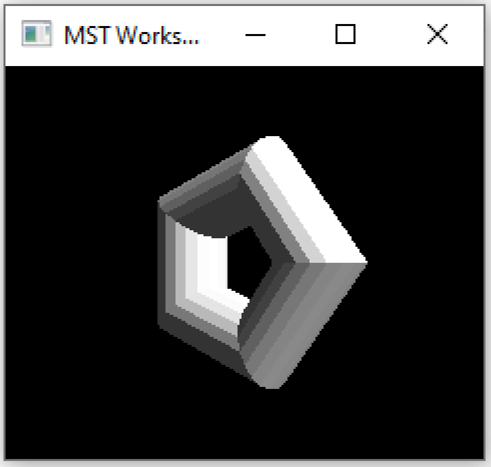
Tube Steps = 4, Ring Steps = 20

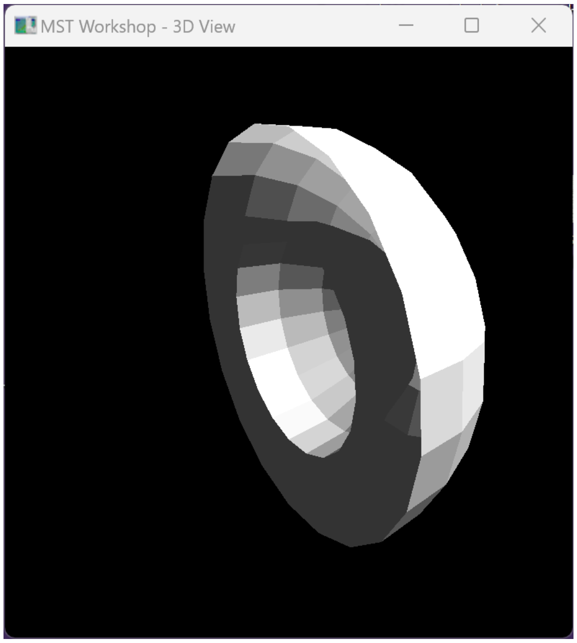


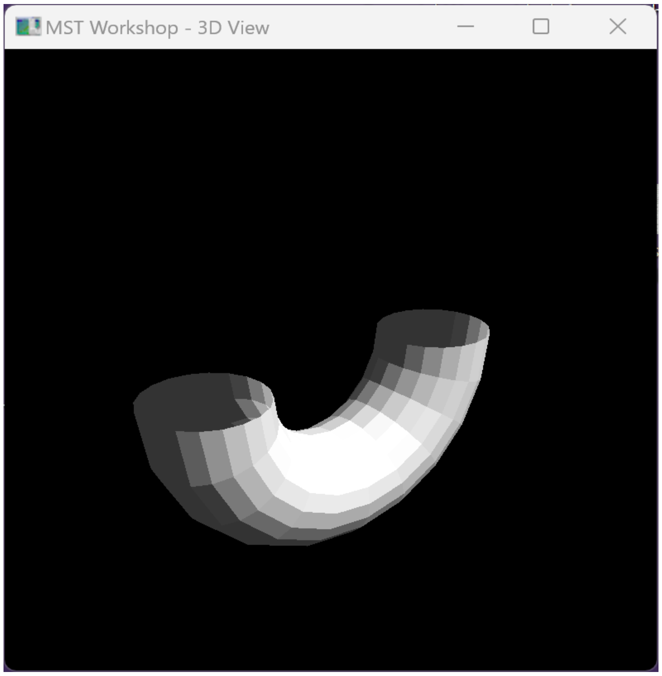


Tube Steps = 20, Ring Steps = 4



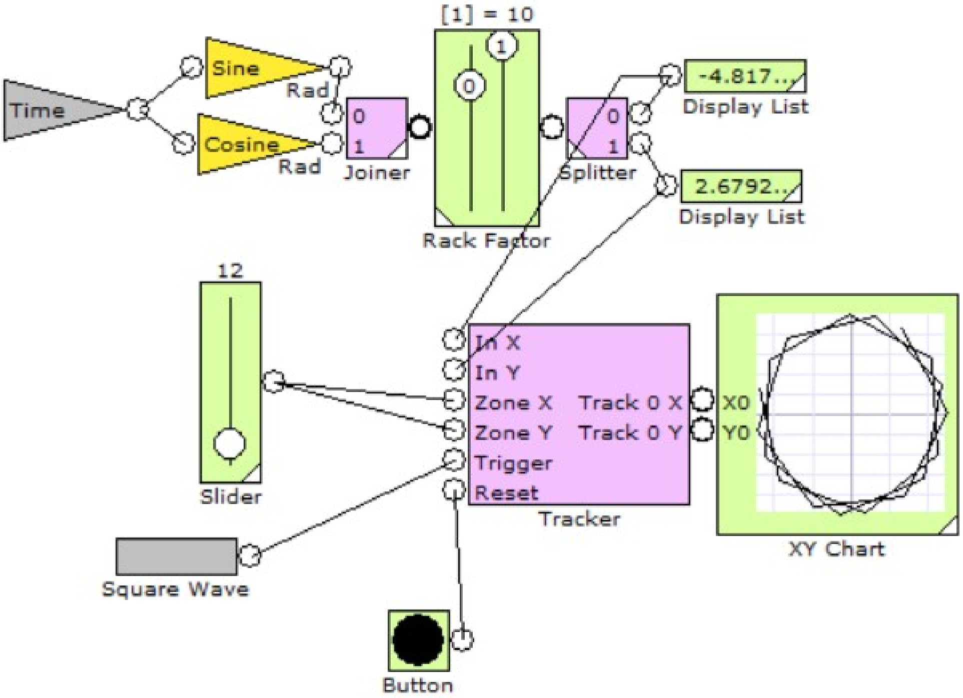



MST Workshop - 3D View


MST Workshop - 3D View

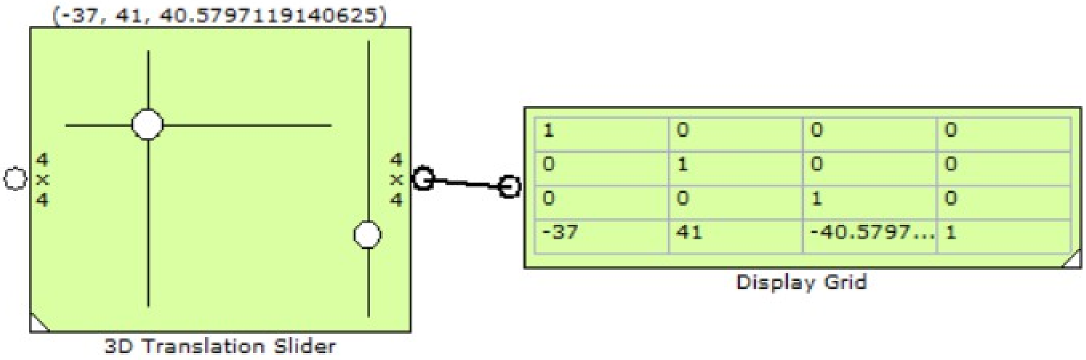
Tracker

The Tracker component creates a path from input points. Array – column 2



3D Translation Slider

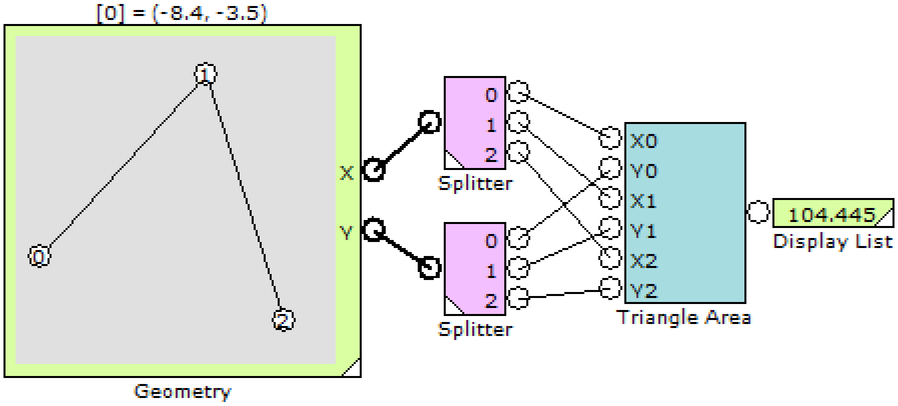
The 3D Translation Slider component creates a 4x4 translation matrix from the position of the control knobs. Controls – column 2



1	0	0	0
0	1	0	0
0	0	1	0
-37	41	-40.5797...	1

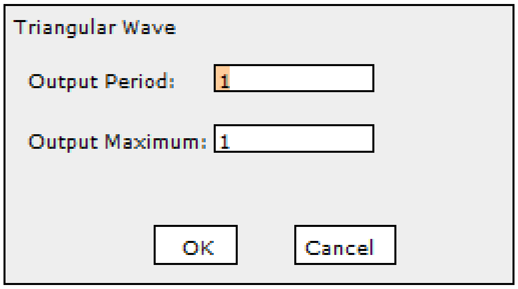
Triangle Area

The Triangle Area component computes the area of a triangle from its 3 XY coordinates.2D - column 2



Triangular Wave

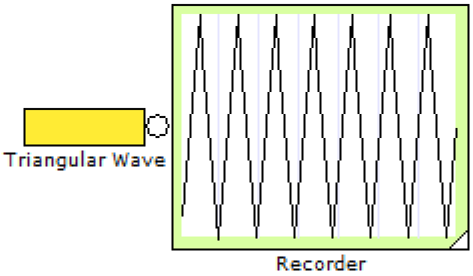
The Triangular Wave component outputs a triangular wave that slopes up then down when the clock is running.   Functions - column 8

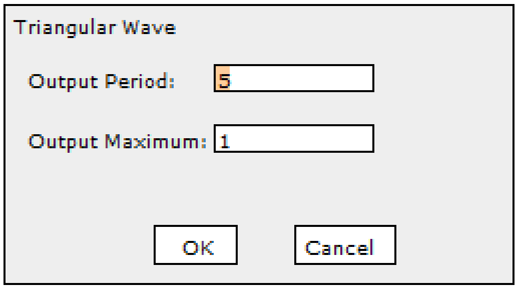


Triangular Wave

Output Period: 1

Output Maximum: 1

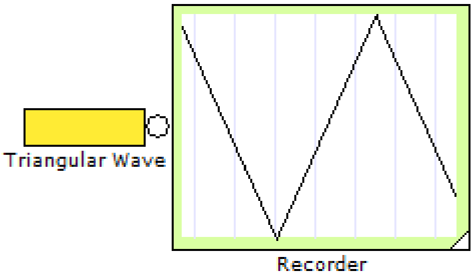




Triangular Wave

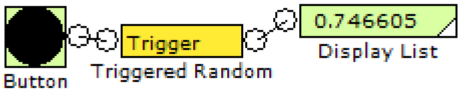
Output Period: 5

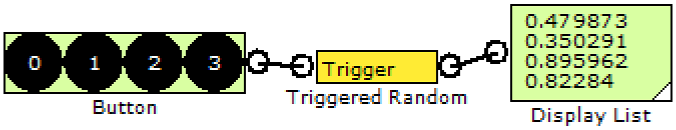
Output Maximum: 1



Triggered Random

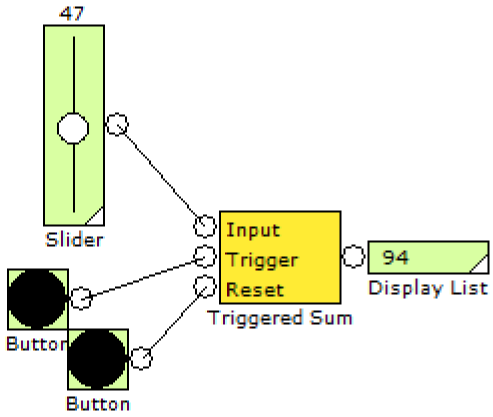
The Triggered Random component delivers random number between 0 and 1 when the trigger goes from between false to true. Functions - column 6

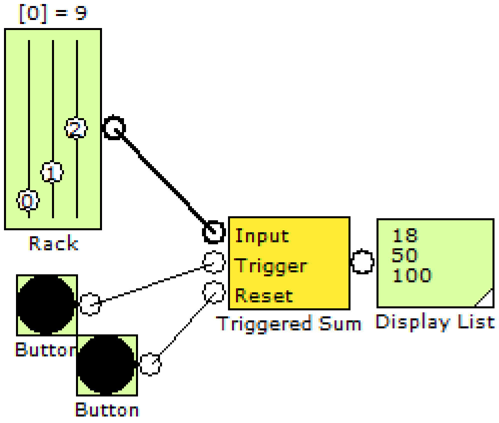


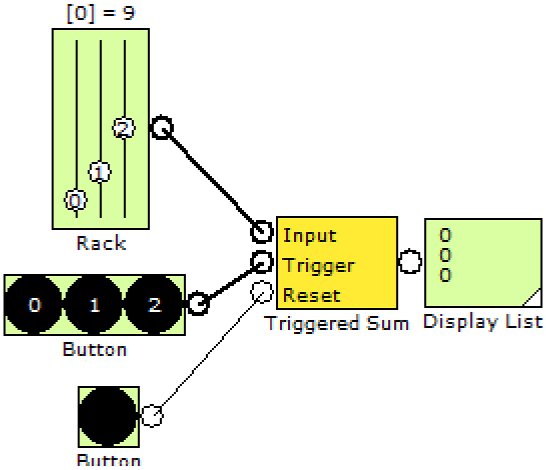


Triggered Sum

The Triggered Sum component sums the input each time the trigger goes true. Functions - column 3

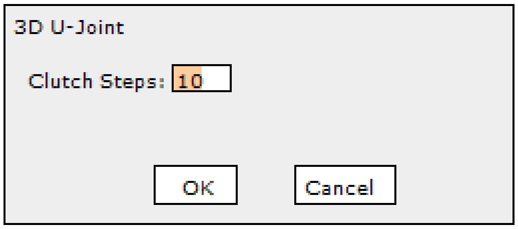






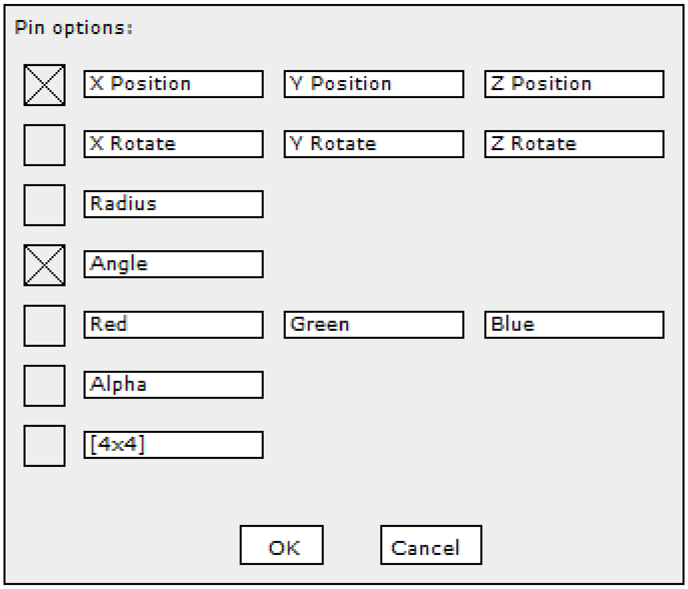
3D U-Joint

The 3D U-Joint component creates a connection between two shafts that can be at an angle. You can attach a driver to the input and drive something at the end of the shaft. Place the U-Joint at the same X, Y, Z position as a motor and place a gear at the X, Y, Z coordinates as the other end.   3D - column 4



3D U-Joint

Clutch Steps: 10



Pin options:

☒ X Position | Y Position | Z Position

☐ X Rotate | Y Rotate | Z Rotate

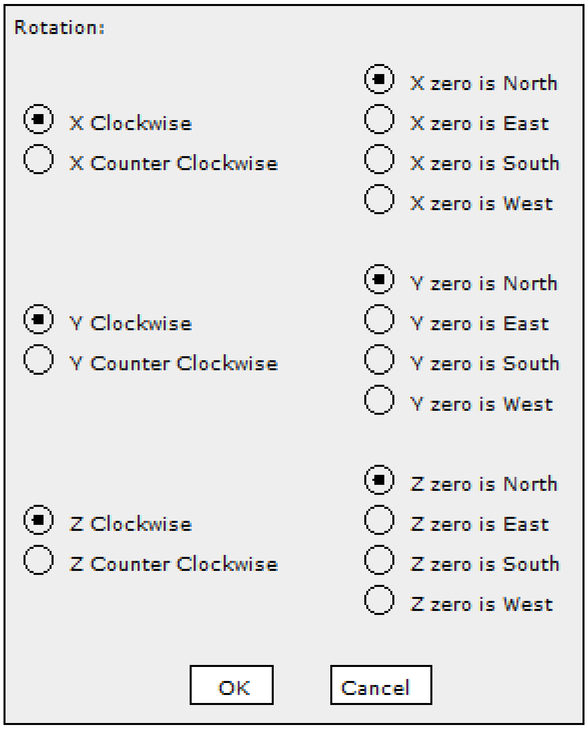
☐ Radius

☒ Angle

☐ Red | Green | Blue

☐ Alpha

☐ [4x4]



Rotation:

● X Clockwise
○ X Counter Clockwise

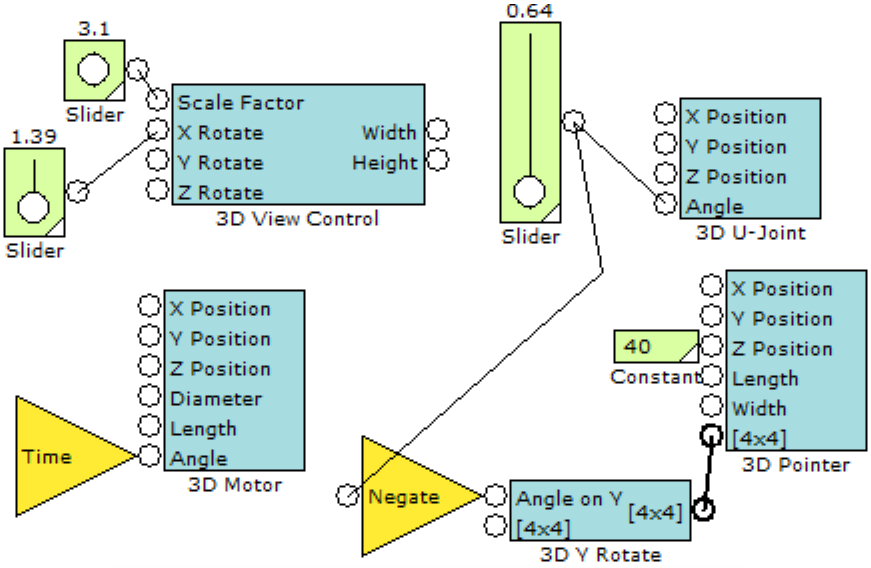
● X zero is North
○ X zero is East
○ X zero is South
○ X zero is West

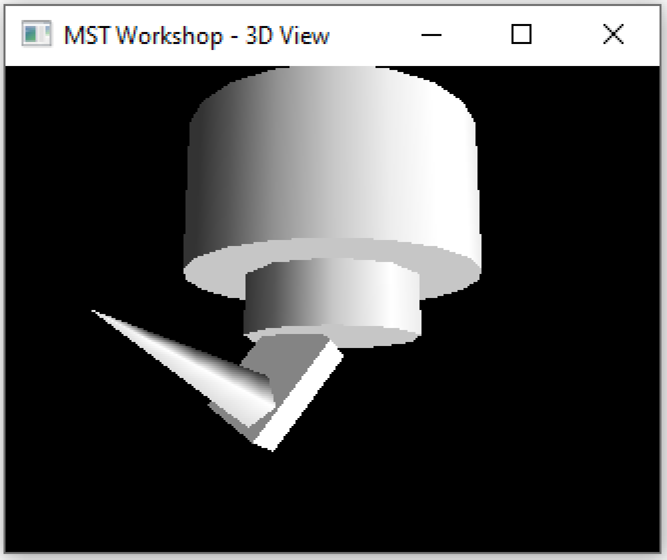
● Y Clockwise
○ Y Counter Clockwise

● Y zero is North
○ Y zero is East
○ Y zero is South
○ Y zero is West

● Z Clockwise
○ Z Counter Clockwise

● Z zero is North
○ Z zero is East
○ Z zero is South
○ Z zero is West

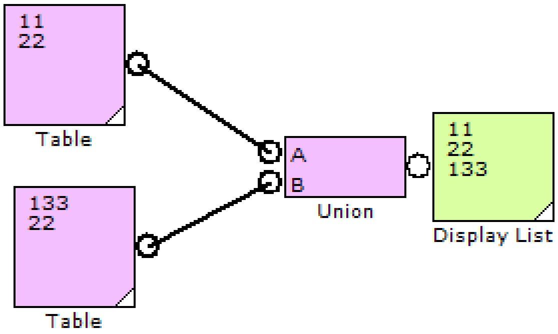

3.1
Slider
1.39
Slider
Scale Factor
X Rotate
Y Rotate
Z Rotate
Width
Height
3D View Control
0.64
Slider
X Position
Y Position
Z Position
Angle
3D U-Joint
X Position
Y Position
Z Position
Length
Width
[4x4]
3D Pointer
40
Constant
X Position
Y Position
Z Position
Diameter
Length
Angle
3D Motor
Time
Negate
Angle on Y
[4x4]
[4x4]
3D Y Rotate

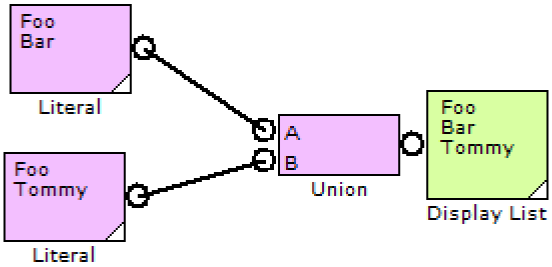

MST Workshop - 3D View

Union

The Union component combines the elements of the two inputs and outputs each value just once.

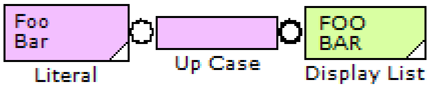
Arrays - column 5





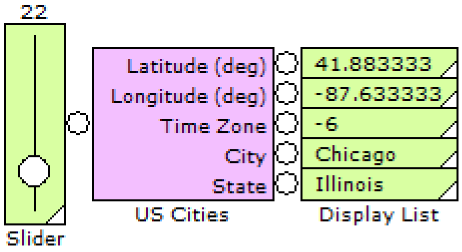
Up Case

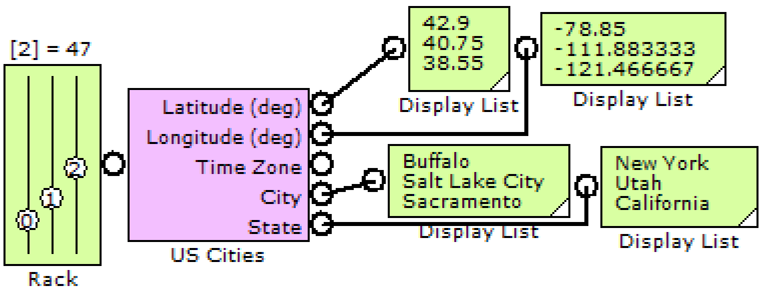
The Up Case component changes the input string to upper case characters. Arrays - column 6

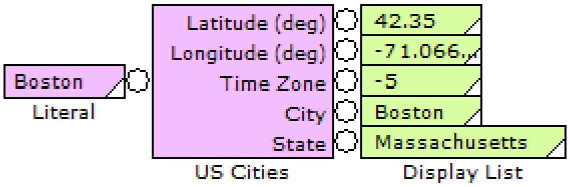


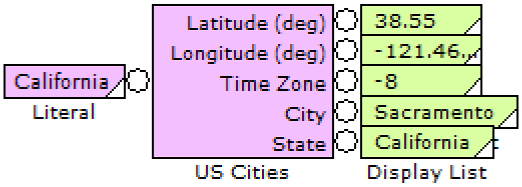
US Cities

The US Cities component contains Latitude, Longitude, and Time Zone for some cities in the US.
Arrays - column 5



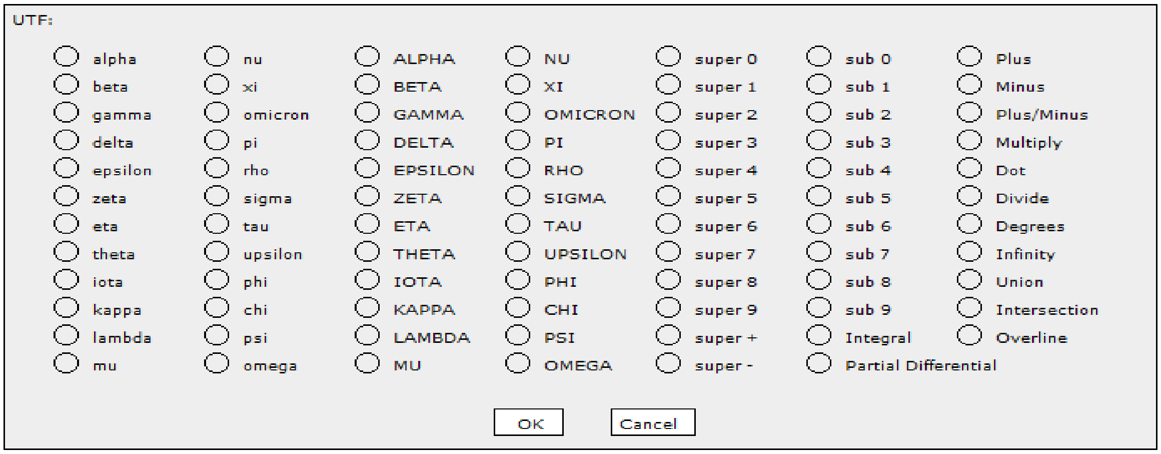




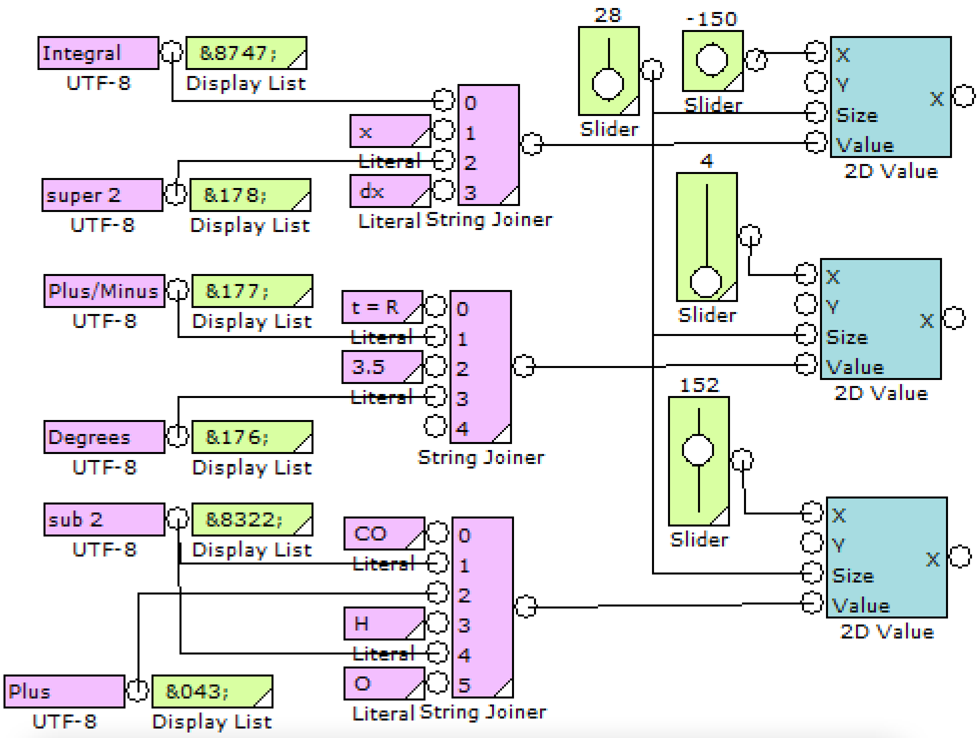


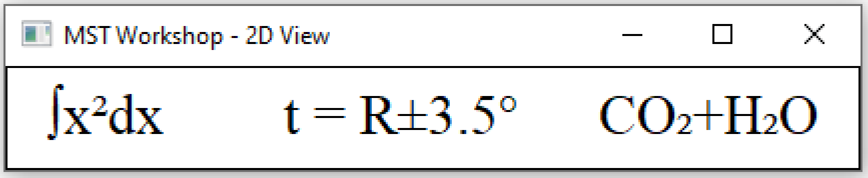
UTF-8

The UTF-8 component outputs a constant string that represents the UTF-8 character chosen in the options dialog. Use it to display special characters in the 2D Value and 2D Text components. Arrays - column 6



Note: The 2D Value is set to Times font.




MST Workshop - 2D View

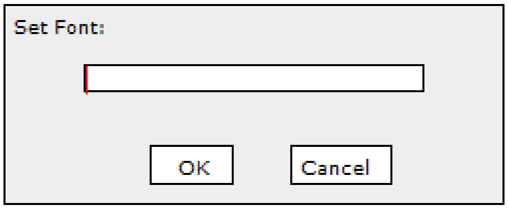
∫x²dx   t = R±3.5° CO_2+H_2O

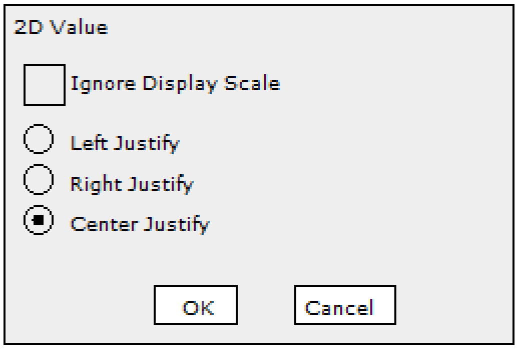
2D Value

The 2D Value component draws a number or text on the 2D canvas.

The Size input sets the font size.
The Background input enables a white background behind the value.
The Color input sets the color of the value.
The Alpha input fades the value on the canvas.
The Gradient inputs override the color and alpha inputs.
The Gradient input needs 2 xy pairs to indicate the start and end points of the gradient on the canvas.
The Stops input takes 2 or more color inputs. Each stop is 4 or 5 values.
Each of them starts with a fraction to indicate where along the line between the 2 xy pairs to place the color.
If each stop is 4 values: first is the fraction of the gradient.
Usually the first stop is at zero and the last stop is at 1.
The next 3 values are the Red, Green, Blue components of the color at that fraction.
You can add a fifth value after color to indicate the alpha value at that point.
The Horizontal outputs are the left and right limits of the text on the canvas.
The Vertical outputs are the top and bottom limits of the text on the canvas.

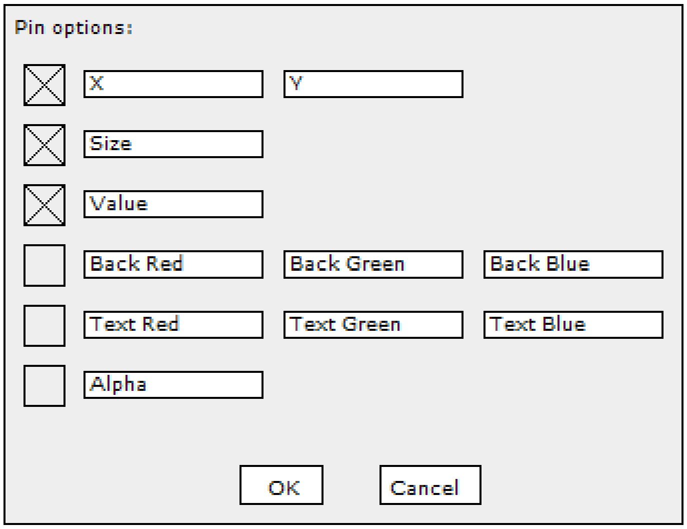
The Center, Left, Right and Decimal Justify control the position of the value on the canvas. 2D - column 1


Set Font:

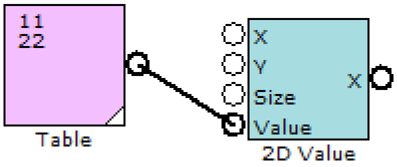

2D Value

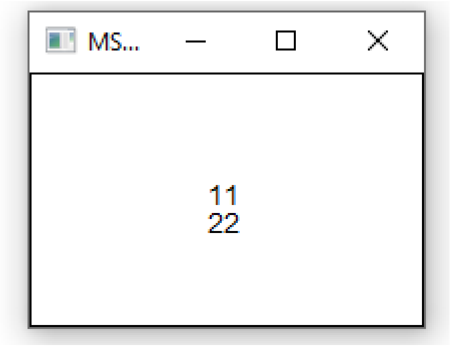
□ Ignore Display Scale

○ Left Justify
○ Right Justify
● Center Justify

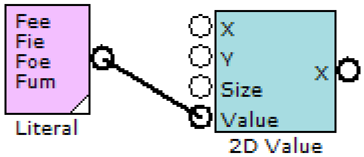

Pin options:

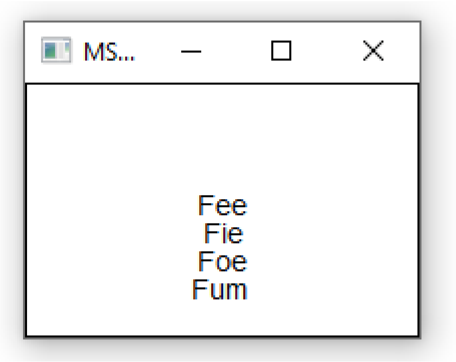
☒ X Y
☒ Size
☒ Value
□ Back Red Back Green Back Blue
□ Text Red Text Green Text Blue
□ Alpha



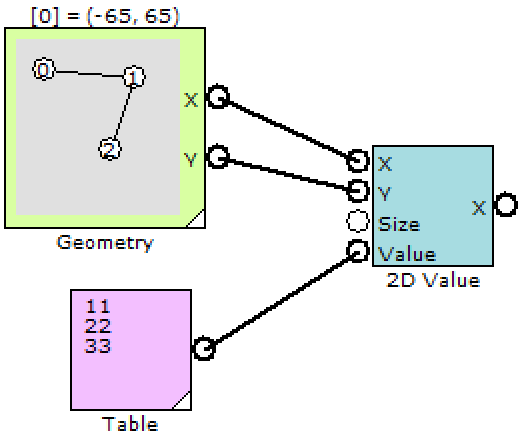


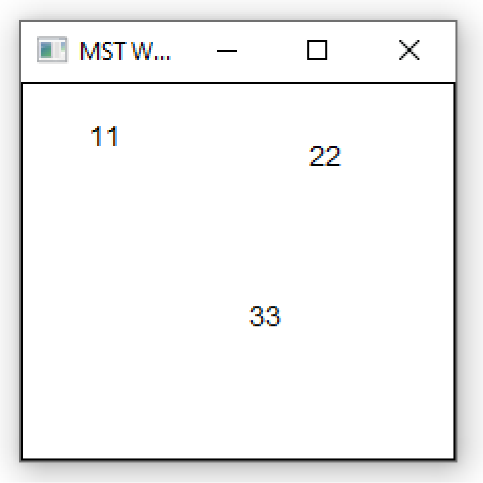
```
11
22
```





```
Fee
Fie
Foe
Fum
```



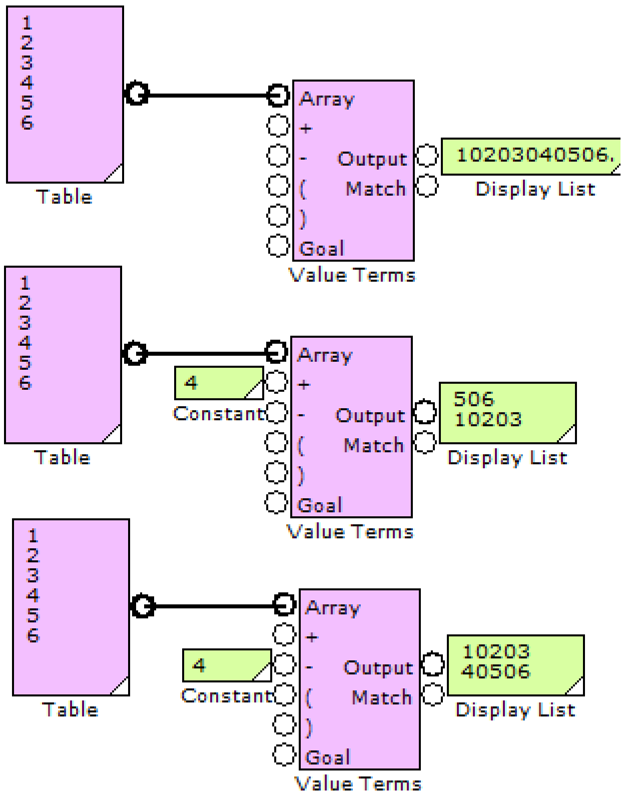


```
11        22

       33
```

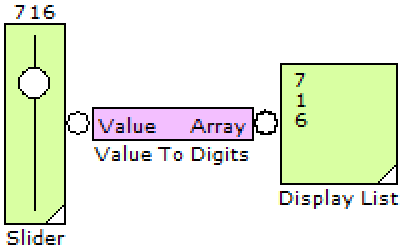
Value Terms

The Value Terms component converts the input to terms using standard rules of addition, subtraction, multiplication, and grouping. Arrays - column 5



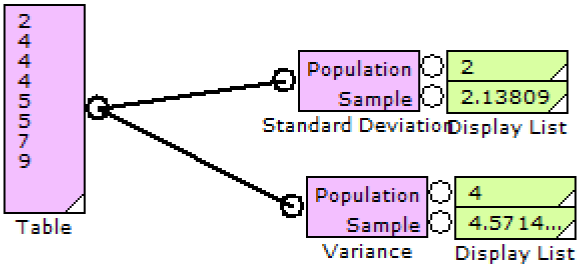
Value To Digits

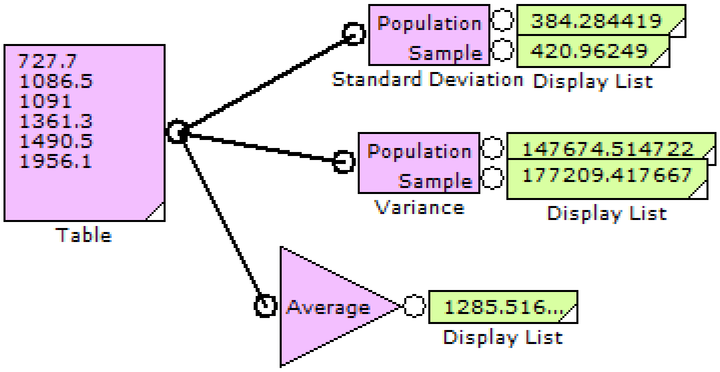
The Value To Digits component converts a value to an array of digits. 10 indicates a negative sign.
Arrays - column 5



Variance

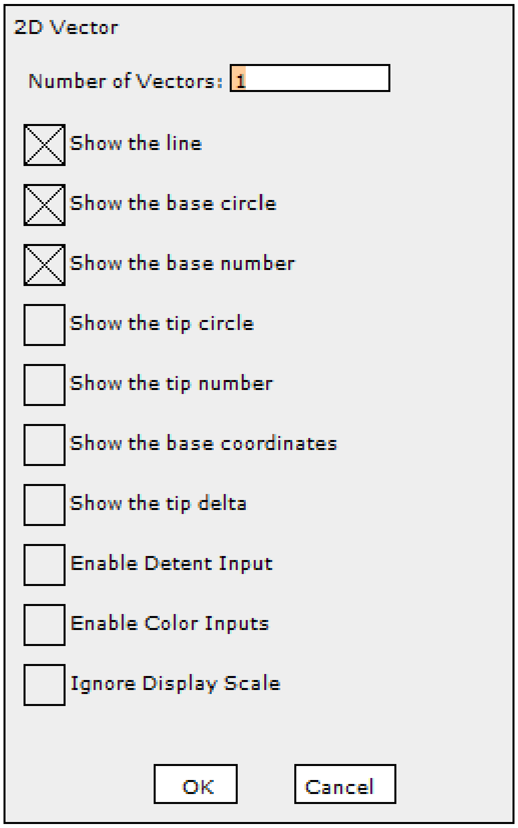
The Variance component scans the input array and calculates the variance of those values. Arrays - column 3





2D Vector

The 2D Vector component outputs the XY coordinates and the dX/dY of the vector. Controls - column 2



2D Vector

Number of Vectors: 1

☒ Show the line

☒ Show the base circle

☒ Show the base number

□ Show the tip circle

□ Show the tip number

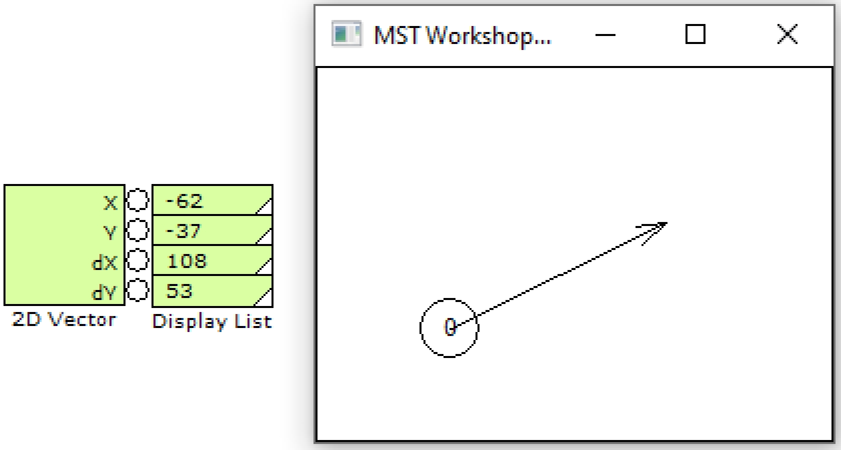
□ Show the base coordinates

□ Show the tip delta

□ Enable Detent Input

□ Enable Color Inputs

□ Ignore Display Scale



X -62

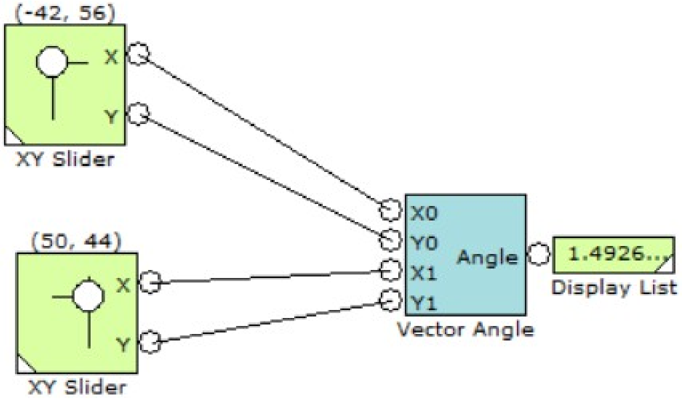
Y -37

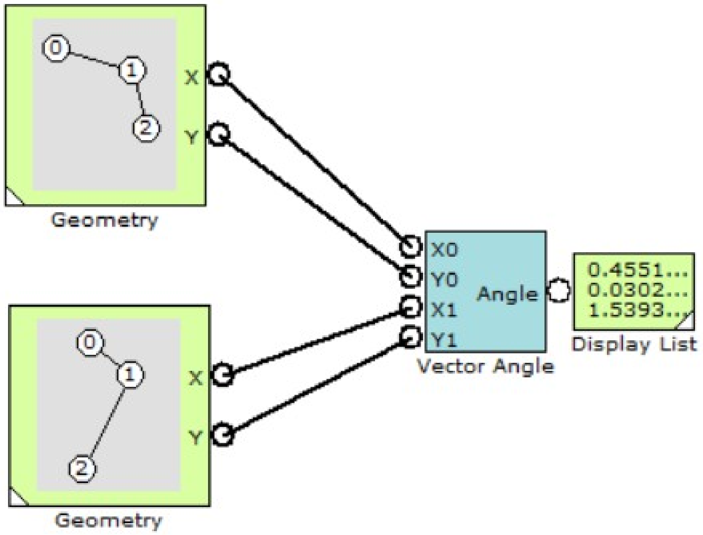
dX 108

dY 53

Vector Angle

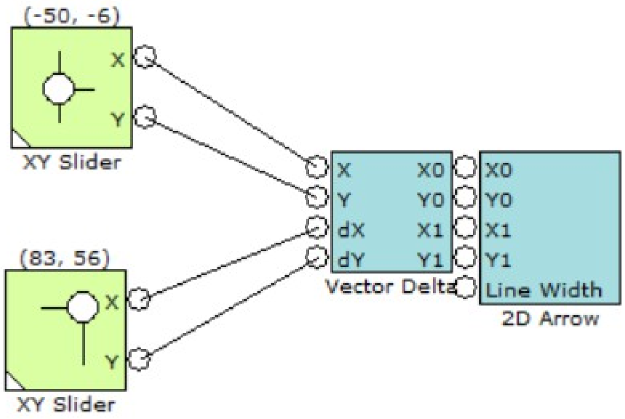
The Vector Angle component calculates the angle between 2 vectors.   2D - column 2

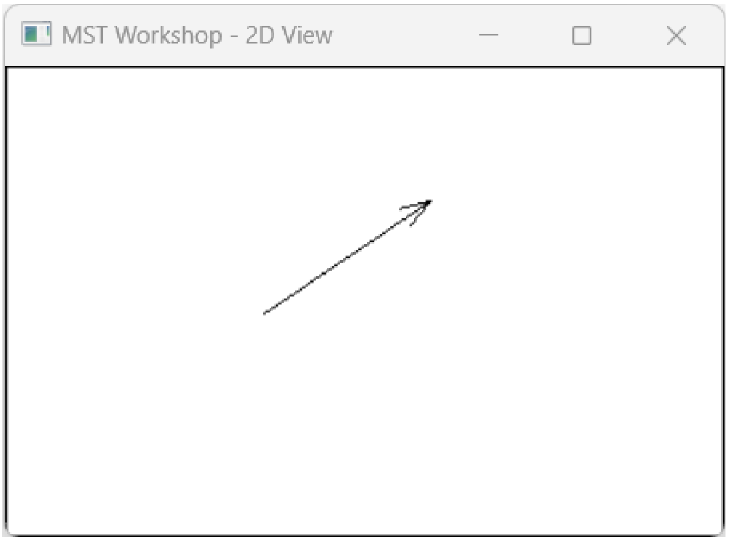




Vector Delta

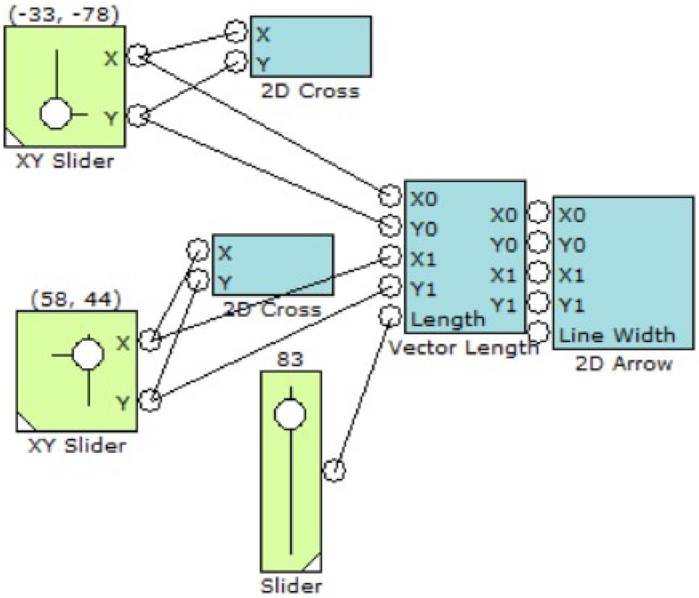
The Vector Delta component takes X Y coordinates and deltas and outputs the resulting vector. 2D - column 2

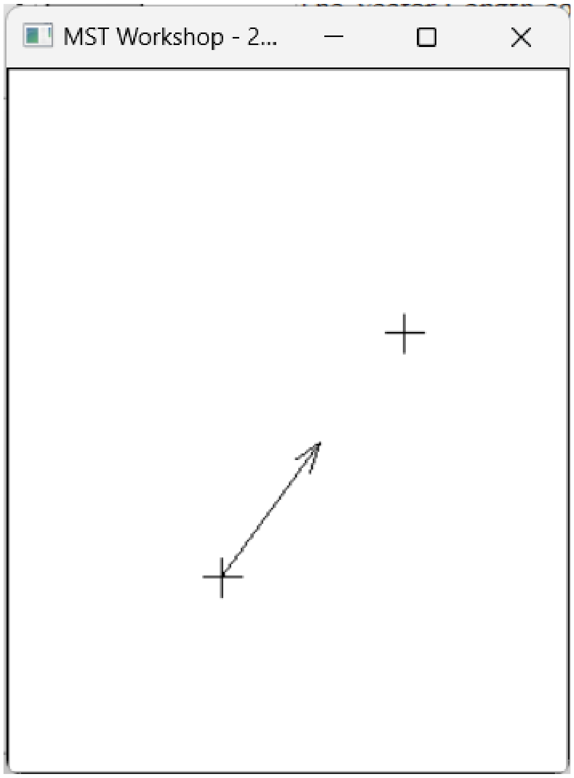




Vector Length

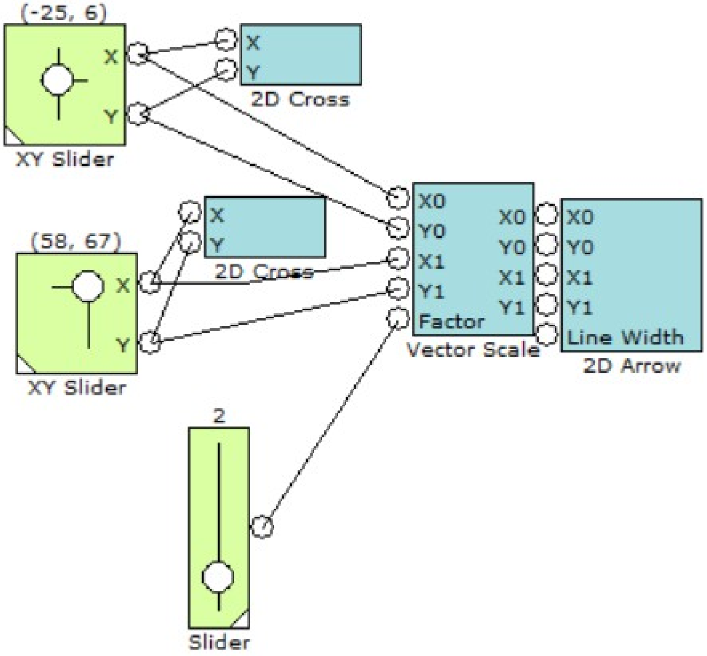
The Vector Length component takes a vector begin and end coordinates with a length and outputs vector begin and end coordinates of that length.   2D - column 2

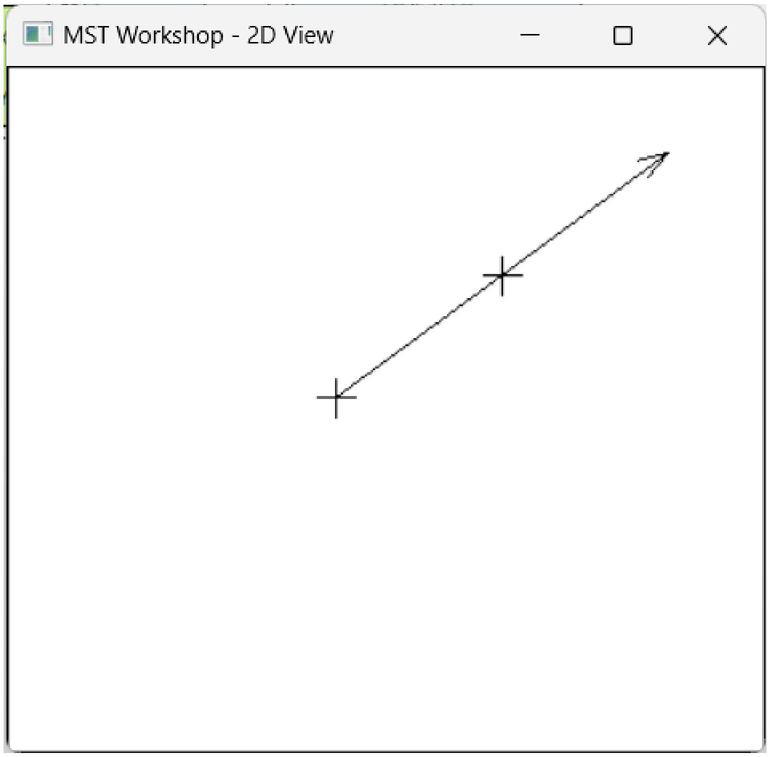




Vector Scale

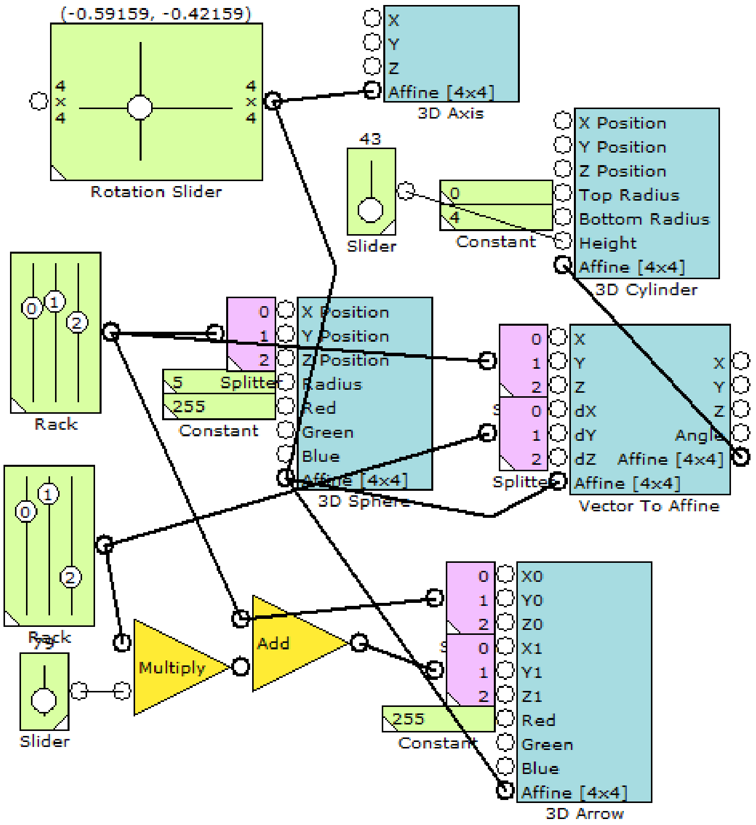
The Vector Scale component takes a vector begin and end coordinates with a factor and outputs vector begin and end coordinates scaled by that factor.   2D - column 2

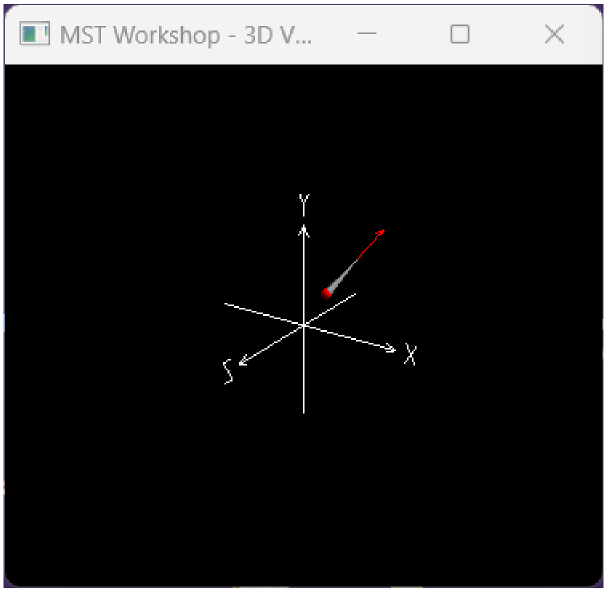




Vector To Affine

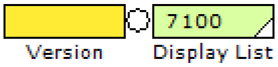
The Vector To Affine component creates an Affine [4x4] matrix that will translate a 3D object to align with the input vector position and direction. Functions – column 8





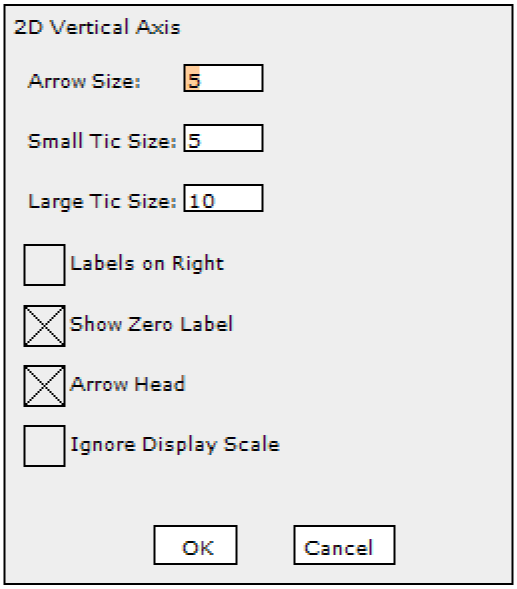
Version

The Version component outputs the current software version. Functions - column 9



2D Vertical Axis

The 2D Vertical Axis component draws labeled axes on the 2D canvas.   2D - column 1



2D Vertical Axis

Arrow Size: 5

Small Tic Size: 5

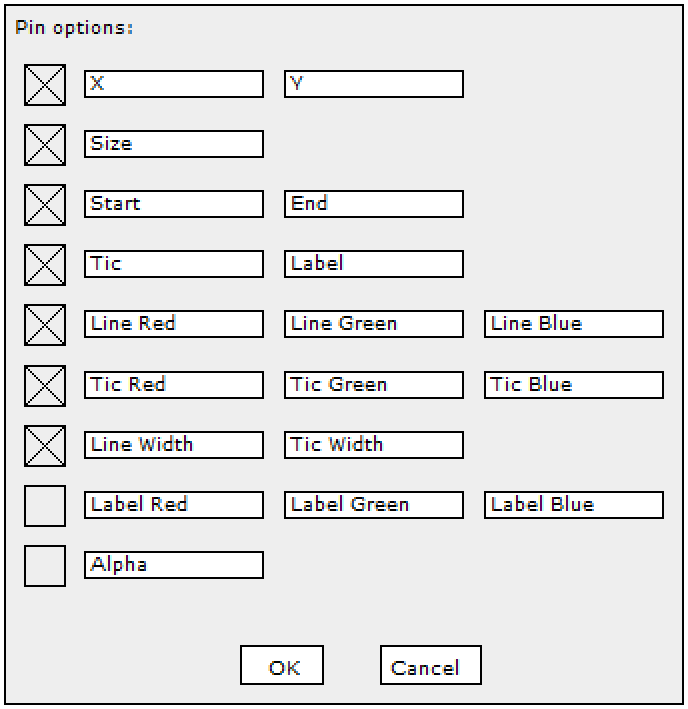
Large Tic Size: 10

□ Labels on Right

☒ Show Zero Label

☒ Arrow Head

□ Ignore Display Scale



Pin options:

☒ X | Y

☒ Size

☒ Start | End

☒ Tic | Label

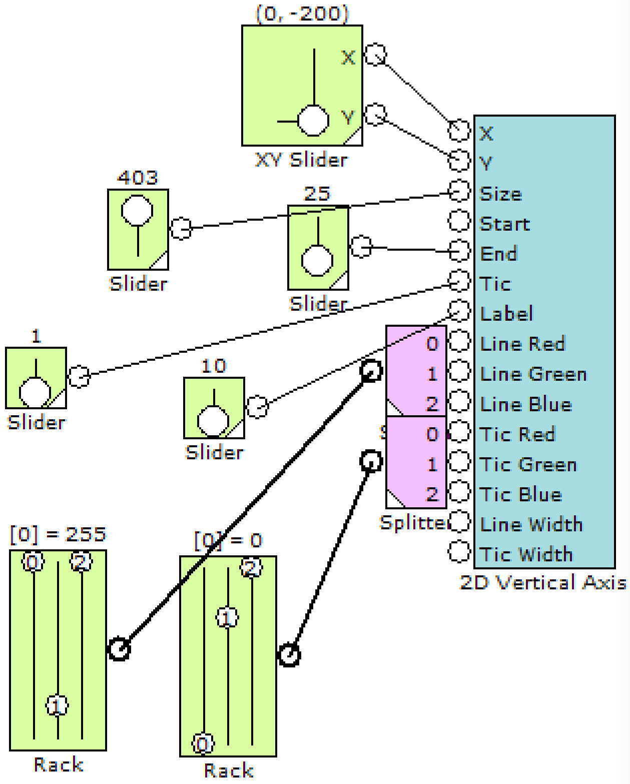
☒ Line Red | Line Green | Line Blue

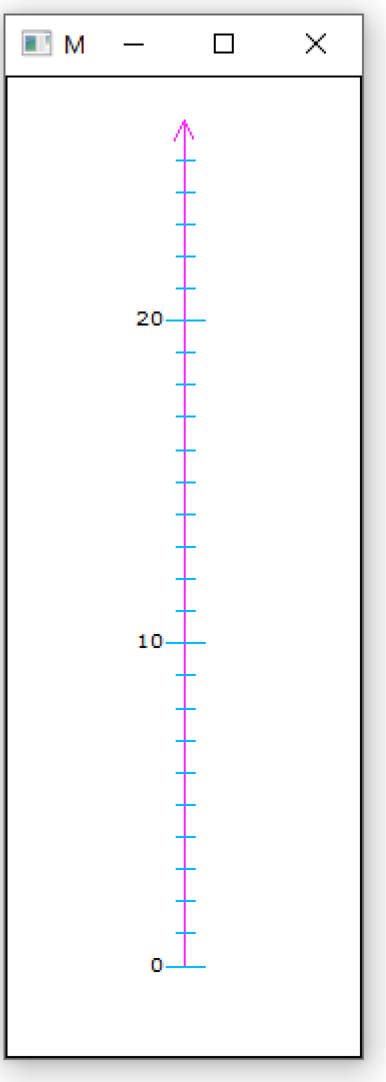
☒ Tic Red | Tic Green | Tic Blue

☒ Line Width | Tic Width

□ Label Red | Label Green | Label Blue

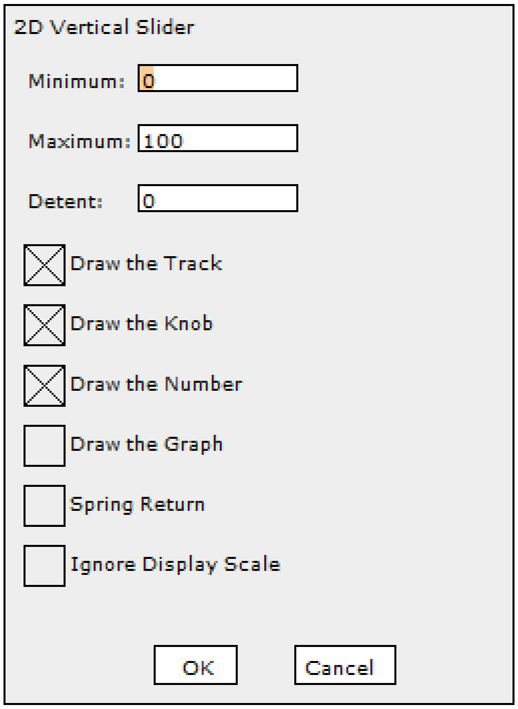
□ Alpha


(0, -200)
X
Y
XY Slider
403
Slider
25
Slider
1
Slider
10
Slider
[0] = 255
Rack
[0] = 0
Rack
0
1
2
0
1
2
Splitter
X
Y
Size
Start
End
Tic
Label
Line Red
Line Green
Line Blue
Tic Red
Tic Green
Tic Blue
Line Width
Tic Width
2D Vertical Axis


M
20
10
0

2D Vertical Slider

The 2D Vertical Slider component outputs a number based on its dial position.   Controls - column 1



2D Vertical Slider

Minimum: 0

Maximum: 100

Detent: 0

☒ Draw the Track

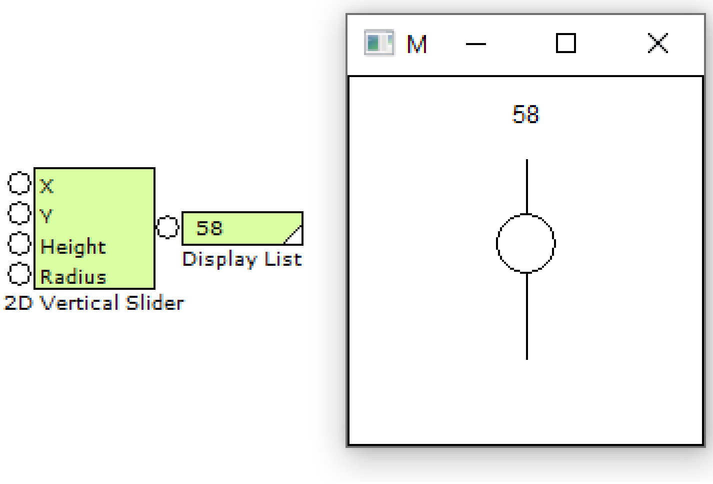
☒ Draw the Knob

☒ Draw the Number

☐ Draw the Graph

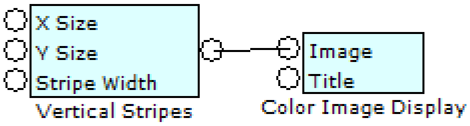
☐ Spring Return

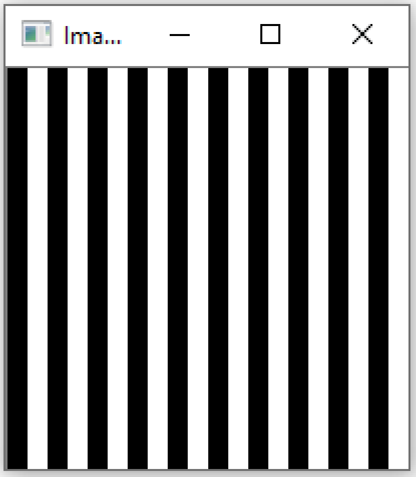
☐ Ignore Display Scale



Vertical Stripes

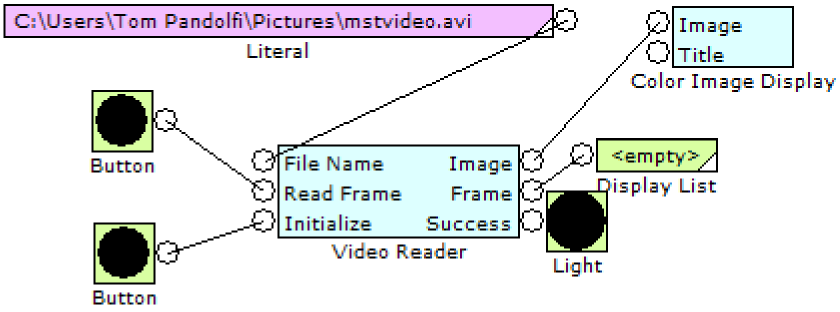
The Vertical Stripes component creates an image with a vertical stripped test pattern. Images - column 1

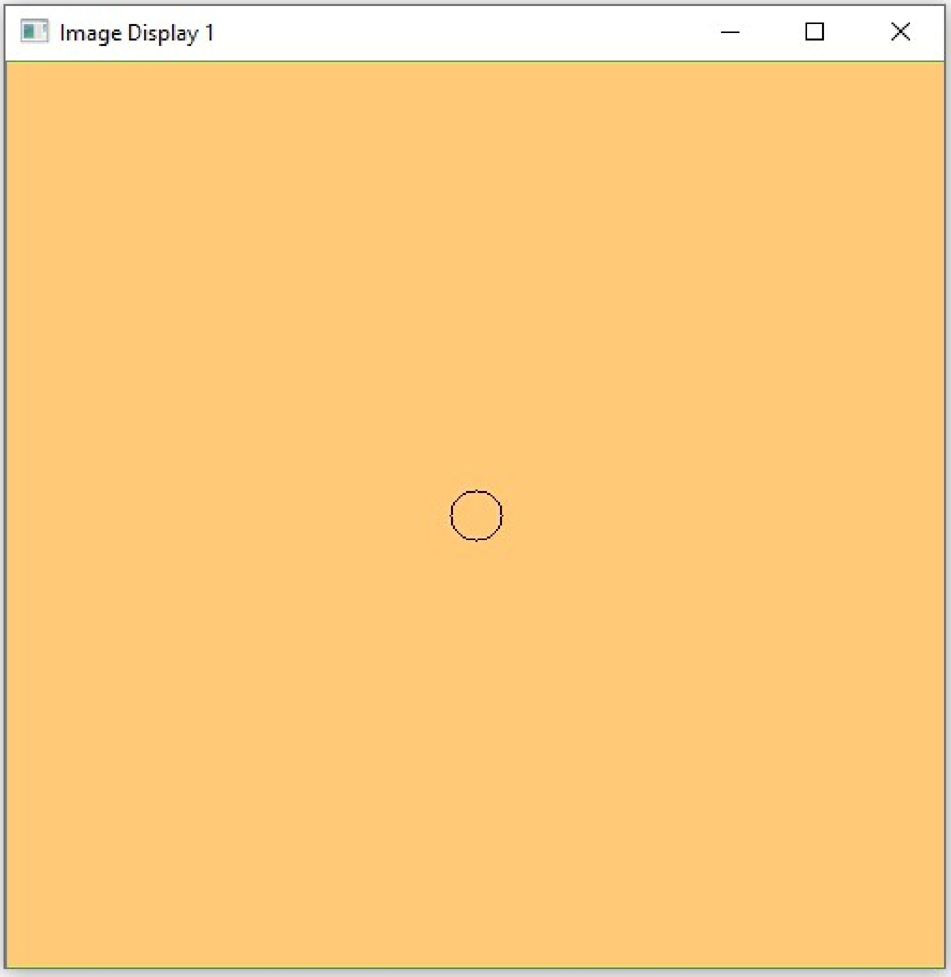




Video Reader

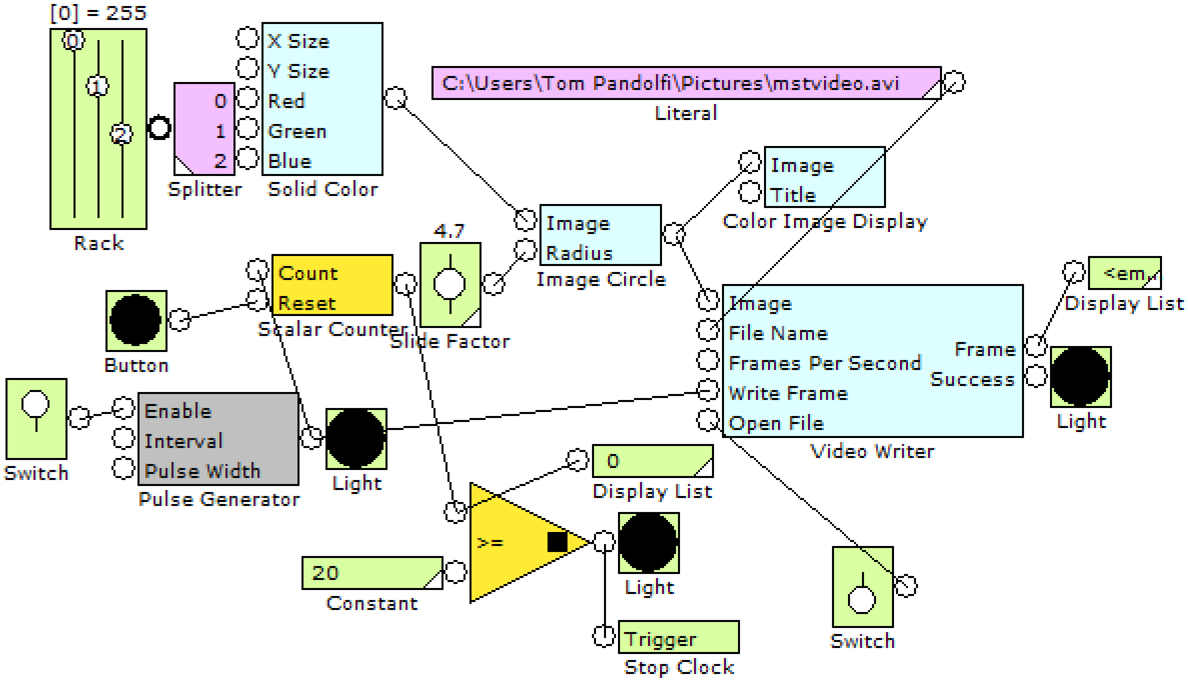
The Video Reader component reads a video file at the path given and outputs it frame by frame. Images - column 5

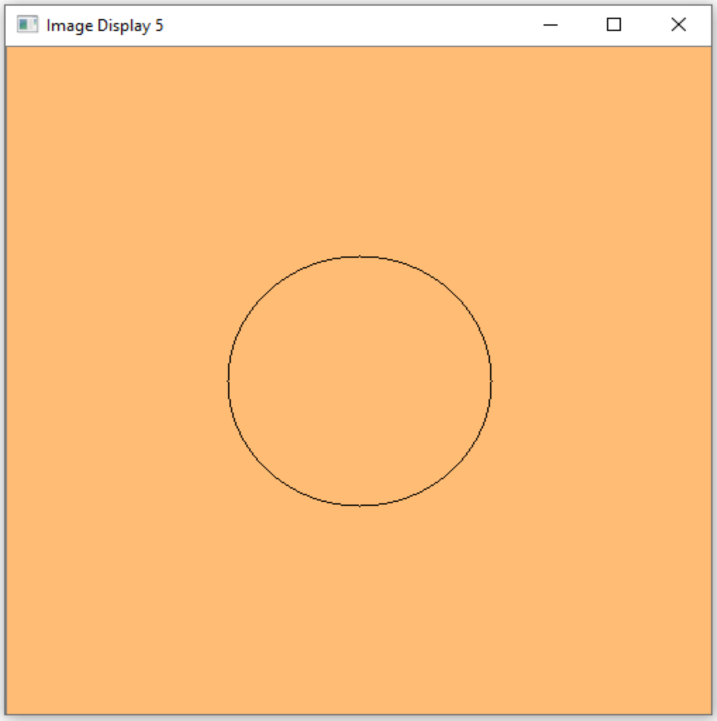




Video Writer

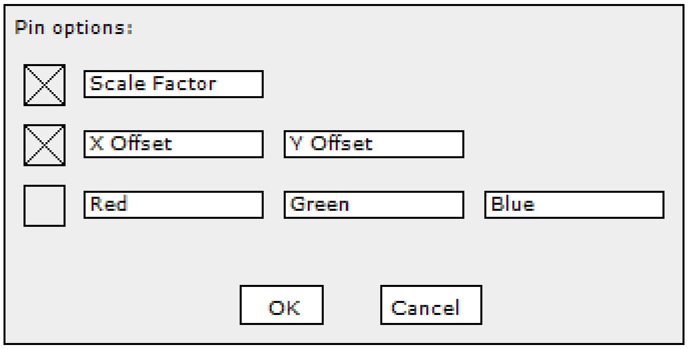
The Video Writer component writes a series of images to a video file at the path given.   Images - column 5





2D View Control

The 2D View Control component lets you set the scale, X and Y offsets and size of the 2D display window.   2D - column 1

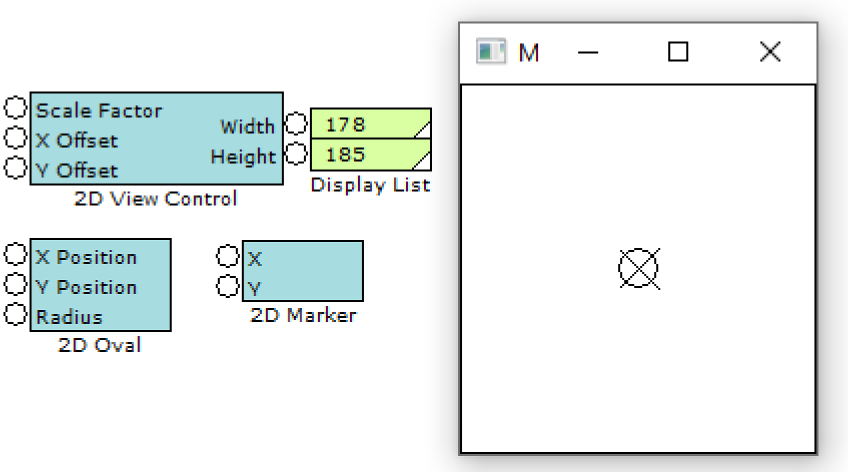


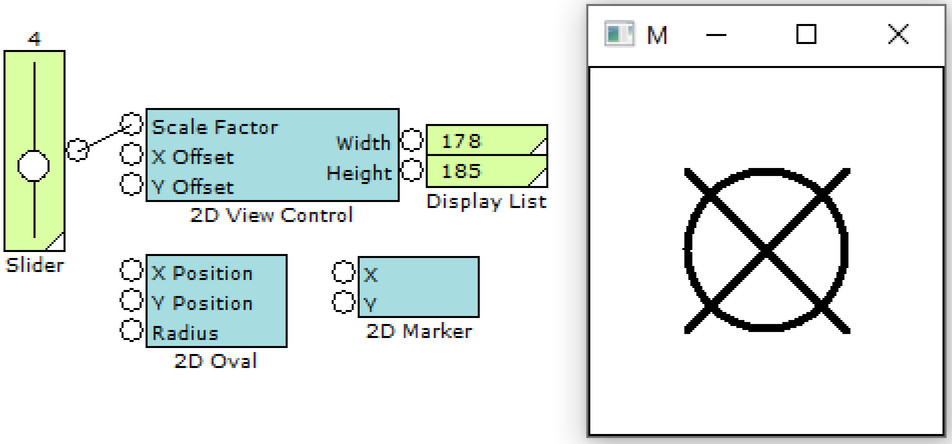
Pin options:

☒ Scale Factor

☒ X Offset   Y Offset

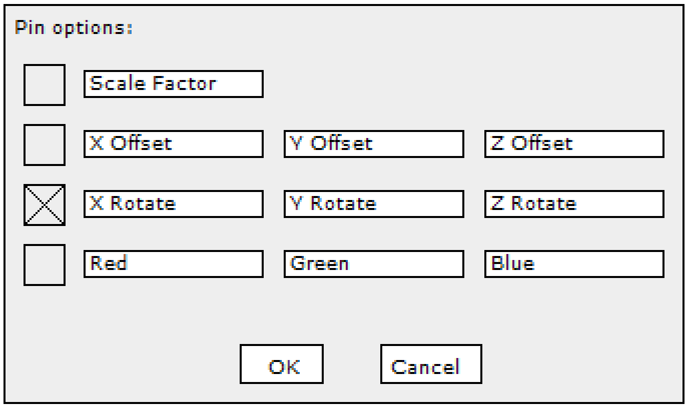
☐ Red   Green   Blue





3D View Control

The 3D View Control sets the scale, offset, rotation, and background color of the 3D View window.
    3D - column 3



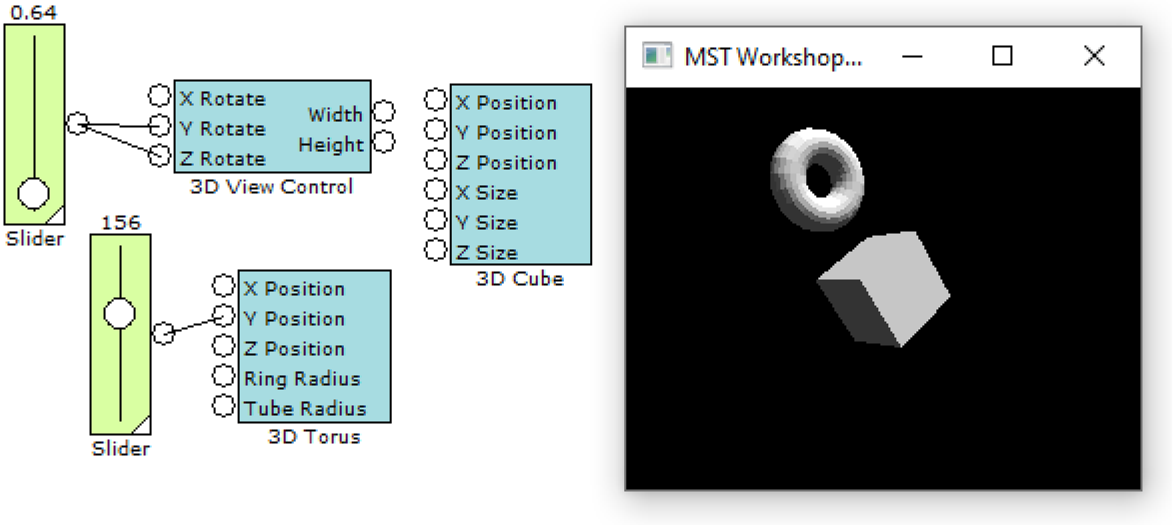
Pin options:

□ Scale Factor

□ X Offset Y Offset Z Offset

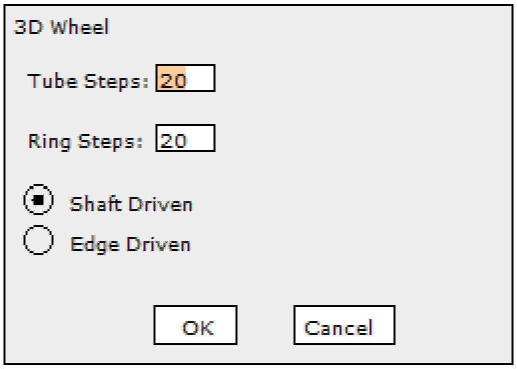
☒ X Rotate Y Rotate Z Rotate

□ Red Green Blue



3D Wheel

The 3D Wheel component creates a wheel that can attach to other simulation objects like 3D Motors. Place the Wheel at the same X, Y, Z position and orientation as a motor to connect the wheel to the motor. 3D - column 4

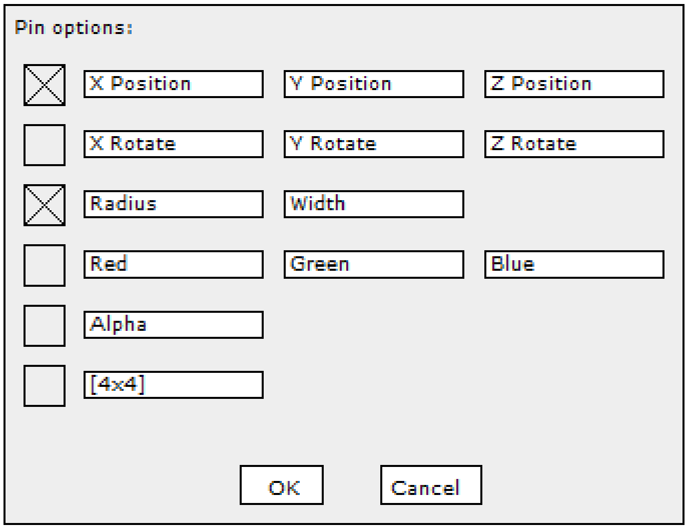


3D Wheel

Tube Steps: 20

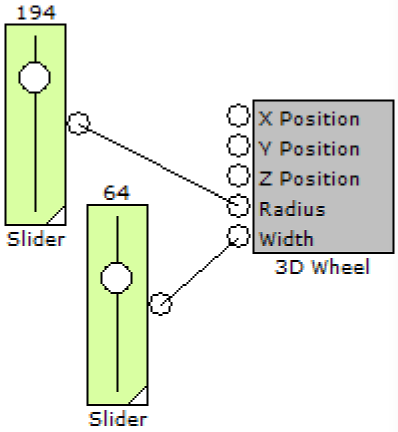
Ring Steps: 20

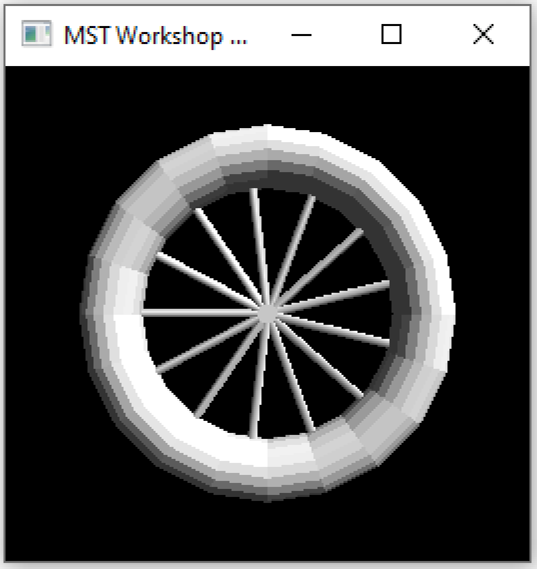
● Shaft Driven
○ Edge Driven



Pin options:

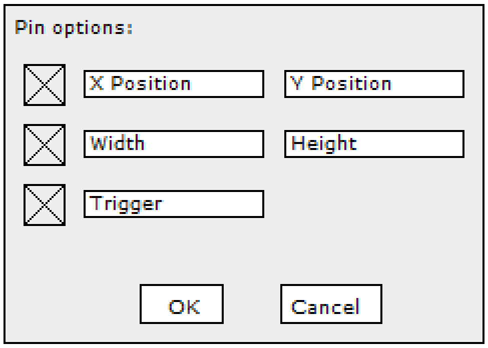
☒ X Position | Y Position | Z Position
□ X Rotate | Y Rotate | Z Rotate
☒ Radius | Width
□ Red | Green | Blue
□ Alpha
□ [4x4]





2D Window Control

The 2D Window Control component lets you set the position and size of the 2D window. 2D - column 1



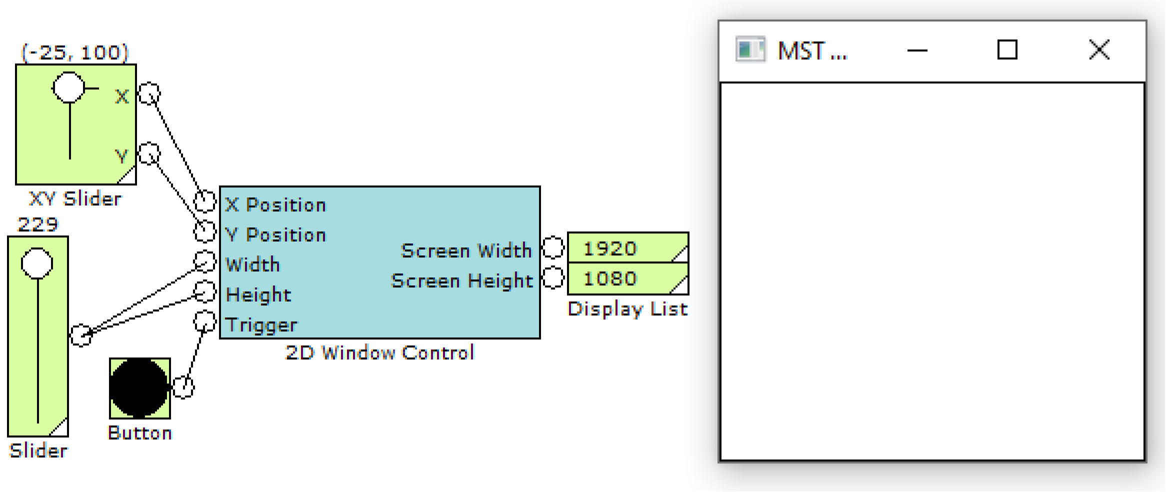
Pin options:

☒ X Position | Y Position

☒ Width | Height

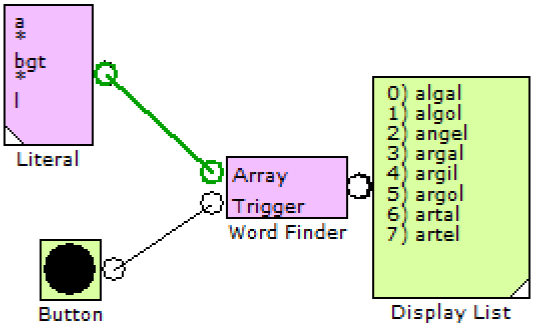
☒ Trigger

OK Cancel



Word Finder

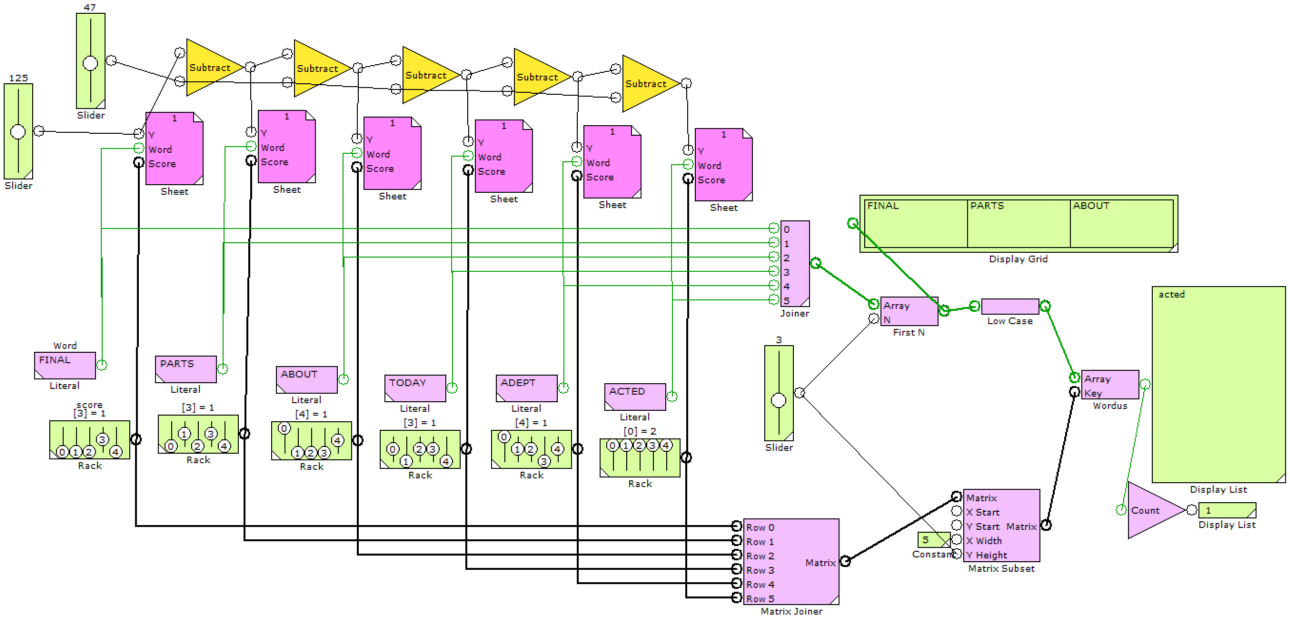
The Word Finder lists words the fit the input specification. Input should be a set of strings that contains the possible letters desired in each position. The number of input strings is the number of letters in the result. Use a single star to indicate any letter is allowed. Set Trigger to true to generate the list.

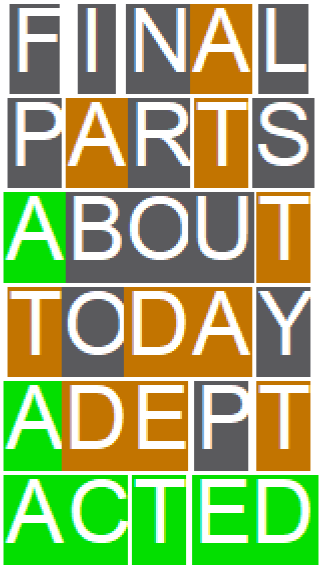


```
0) algal
1) algol
2) angel
3) argal
4) argil
5) argol
6) artal
7) artel
```

Wordus

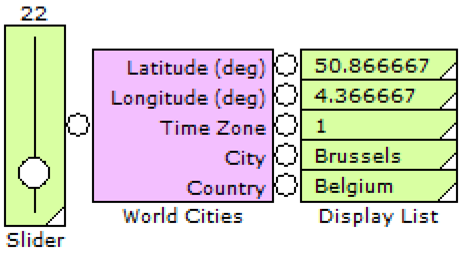
The Wordus recommends words possible in the Wordus game. Connect an array of 6 words in the Array input. Connect 6 switches each of 5 knobs using Join to the Key input. Set the switches to 0 for bad letters, 1 for good letters in wrong position, and 2 for letters in the correct position. Arrays - column 6

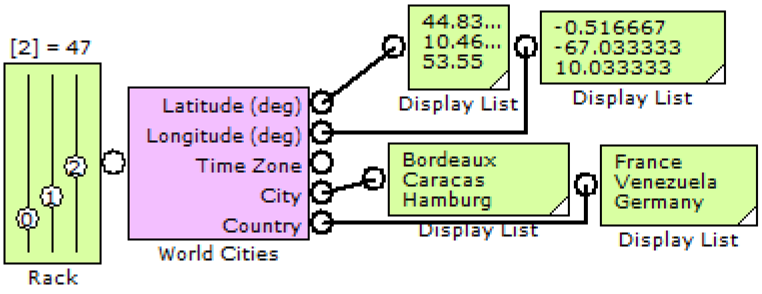


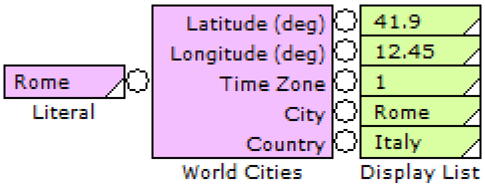


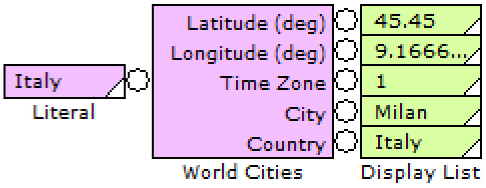
World Cities

The World Cities component contains Latitude, Longitude, and Time Zone for some cities around the World. Arrays - column 5



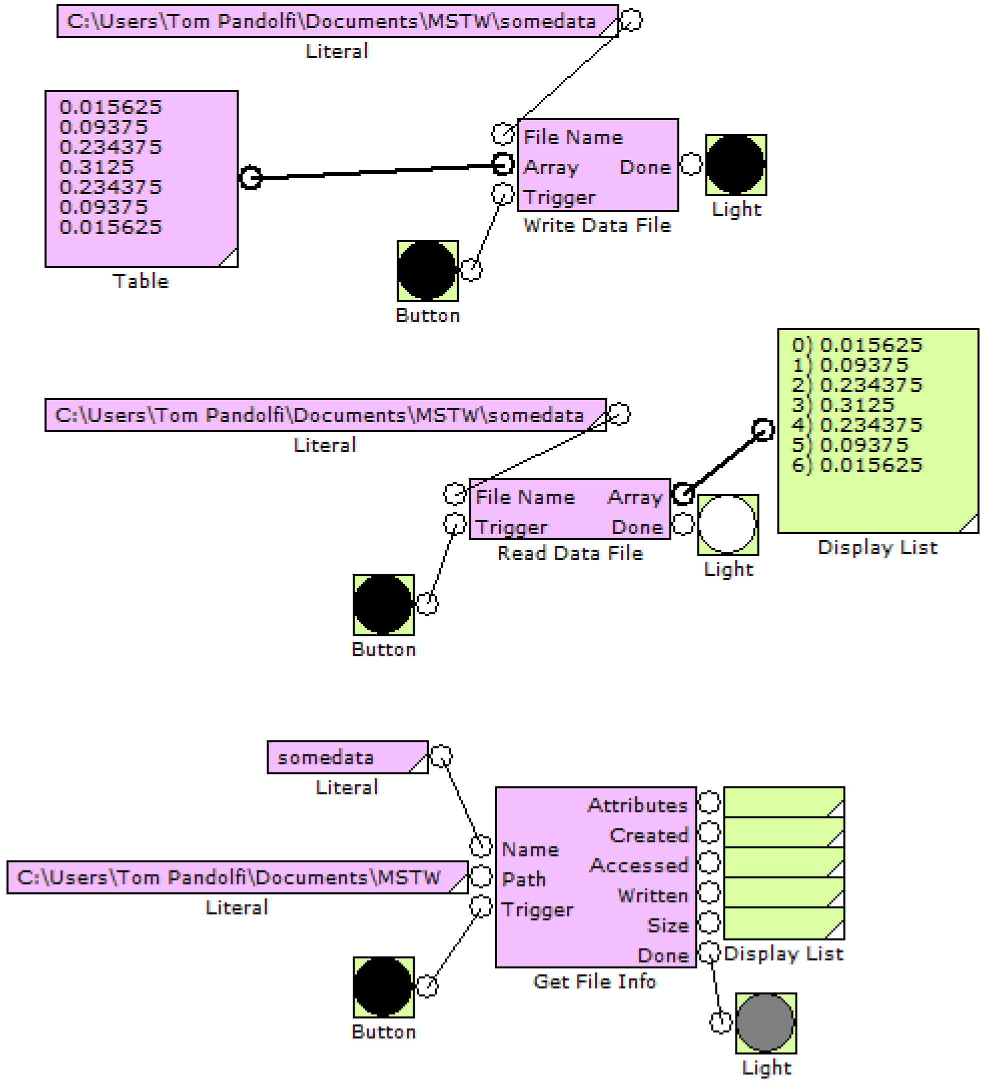






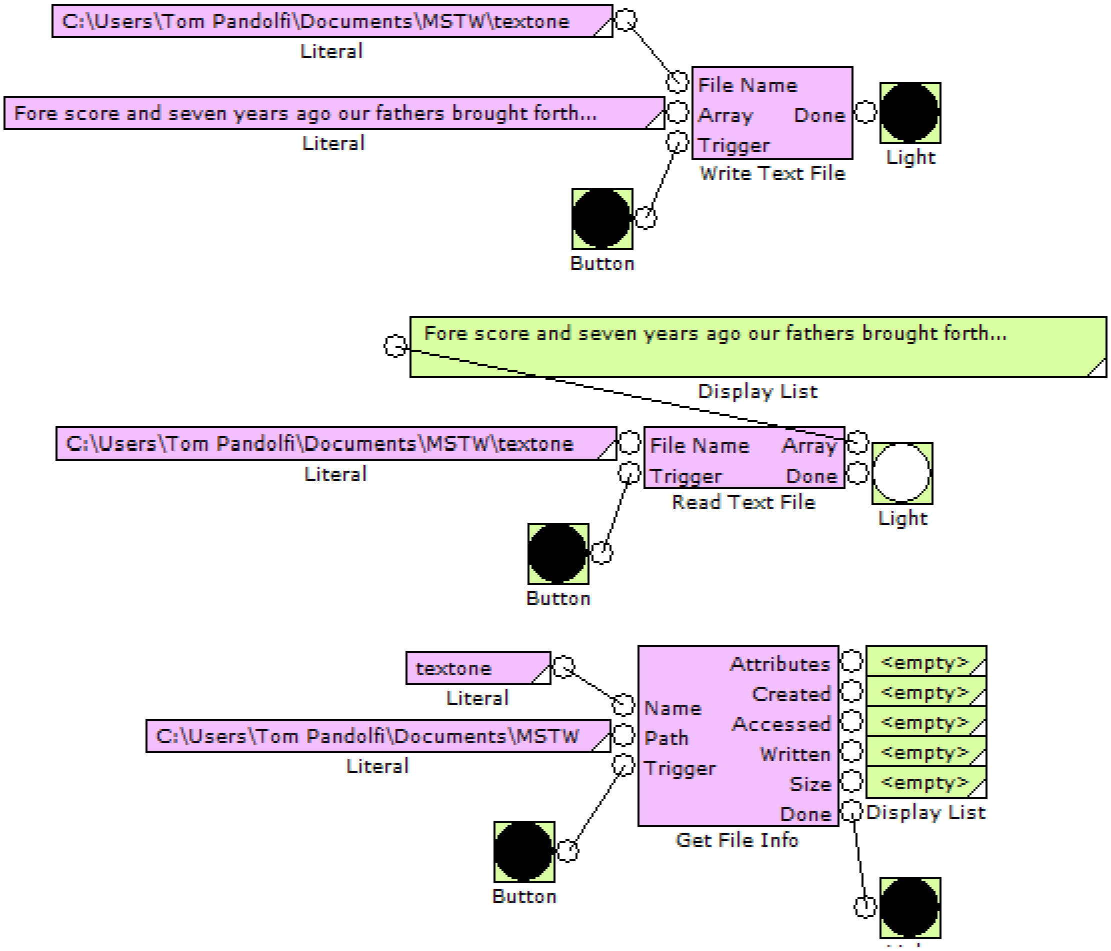
Write Data File

The Write Data File component writes a binary file. The file can be bytes, words, longs, or doubles, depending on what you specify in the options. You can set an option to append the data to an existing file.   Arrays - column 7



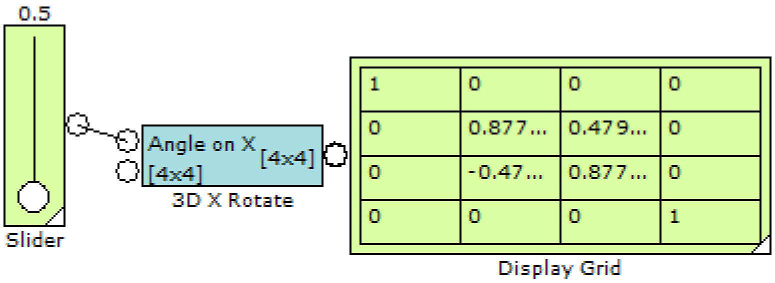
Write Text File

The Write Text File component writes a text file. You can set an option to append the data to an existing file.   Arrays - column 7

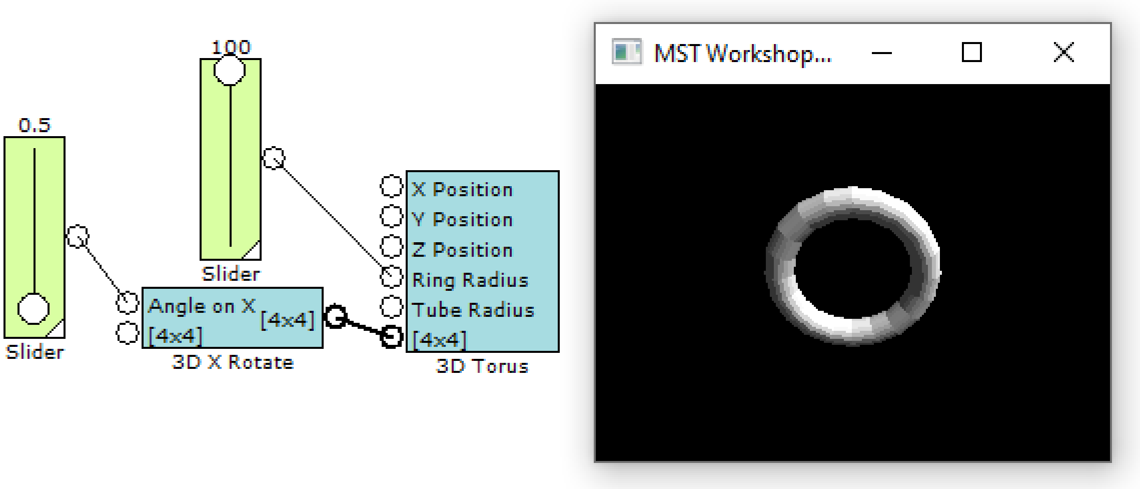


3D X Rotate

The 3D X Rotate rotates a 4 by 4 matrix around the X axis by Radians. 3D - column 3

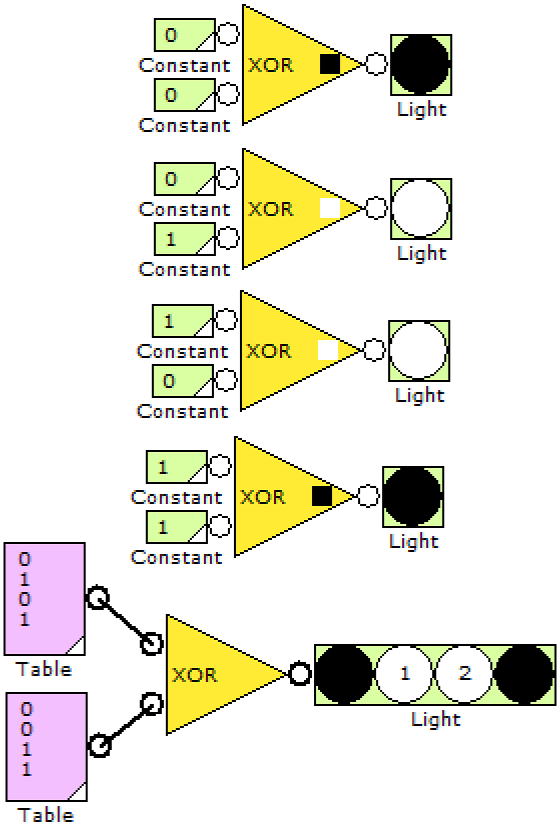


1	0	0	0
0	0.877...	0.479...	0
0	-0.47...	0.877...	0
0	0	0	1



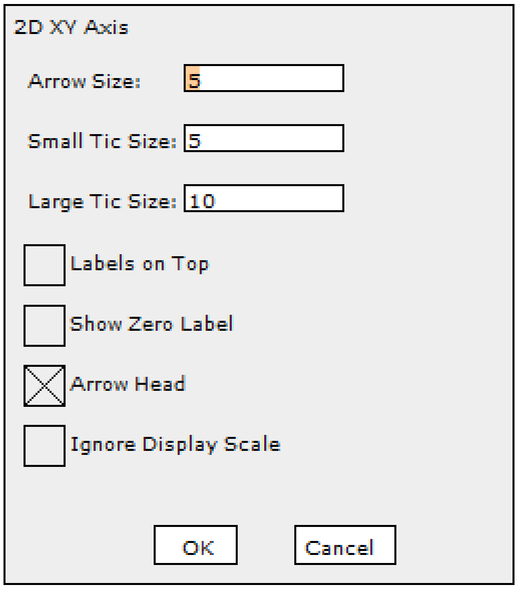
XOR

The XOR component compares the inputs and returns true if one value is true and the other is false. Inputs can be scalars or arrays.   Functions - column 3



2D XY Axis

The 2D XY Axis component draws a pair of labeled axes on the 2D canvas.   2D - column 1



2D XY Axis

Arrow Size: 5

Small Tic Size: 5

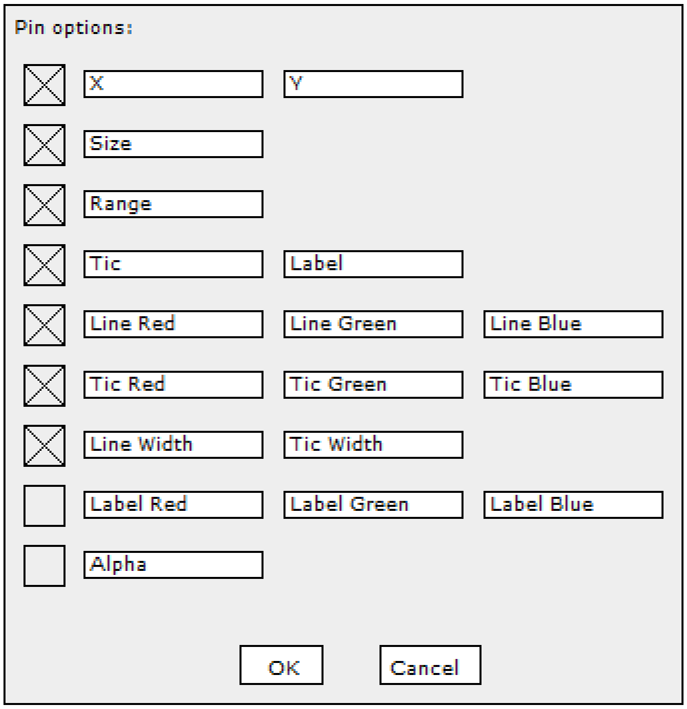
Large Tic Size: 10

☐ Labels on Top

☐ Show Zero Label

☒ Arrow Head

☐ Ignore Display Scale



Pin options:

☒ X | Y

☒ Size

☒ Range

☒ Tic | Label

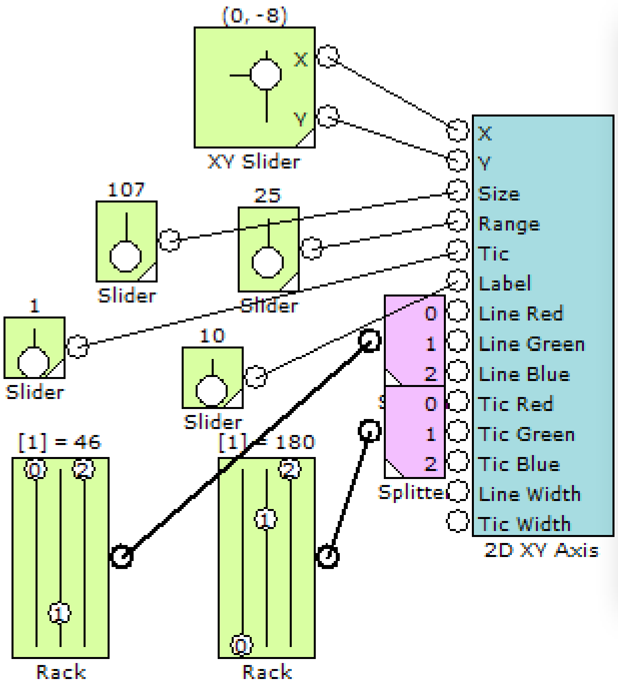
☒ Line Red | Line Green | Line Blue

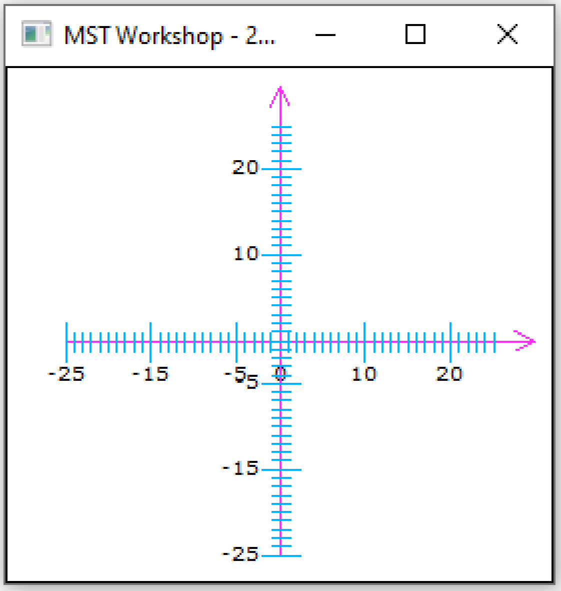
☒ Tic Red | Tic Green | Tic Blue

☒ Line Width | Tic Width

☐ Label Red | Label Green | Label Blue

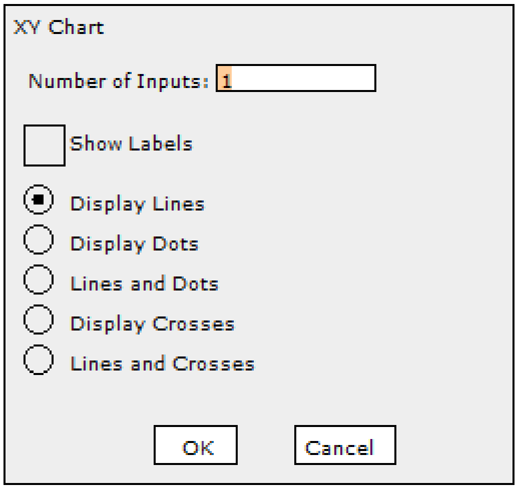
☐ Alpha





XY Chart

The XY Chart shows X vs. Y creating a scatter plot of the data.   Controls - column 4

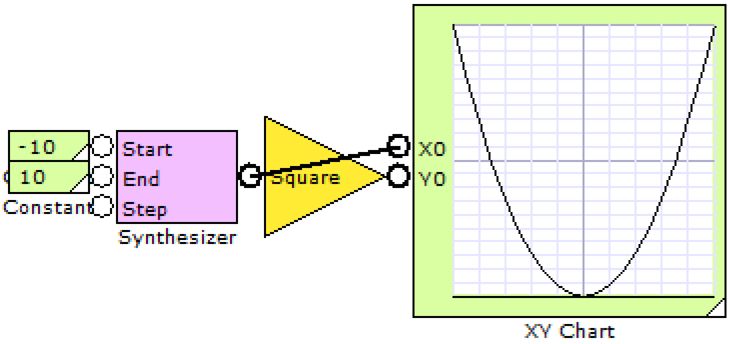


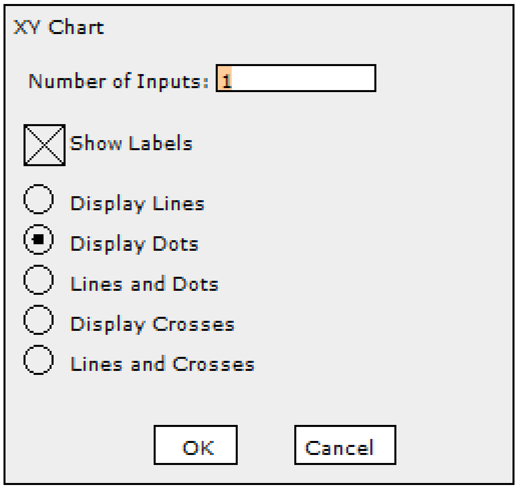
XY Chart

Number of Inputs: 1

□ Show Labels

● Display Lines
○ Display Dots
○ Lines and Dots
○ Display Crosses
○ Lines and Crosses



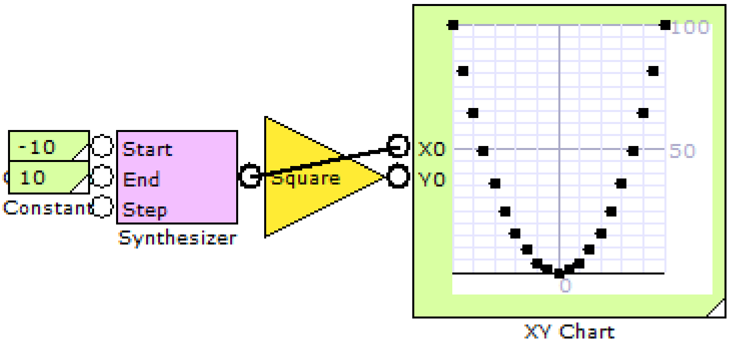


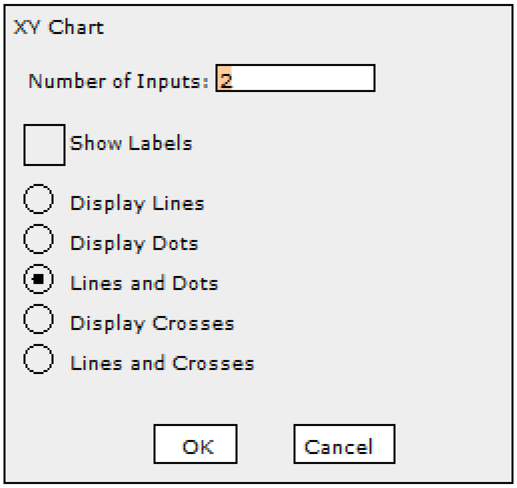
XY Chart

Number of Inputs: 1

☒ Show Labels

○ Display Lines
● Display Dots
○ Lines and Dots
○ Display Crosses
○ Lines and Crosses



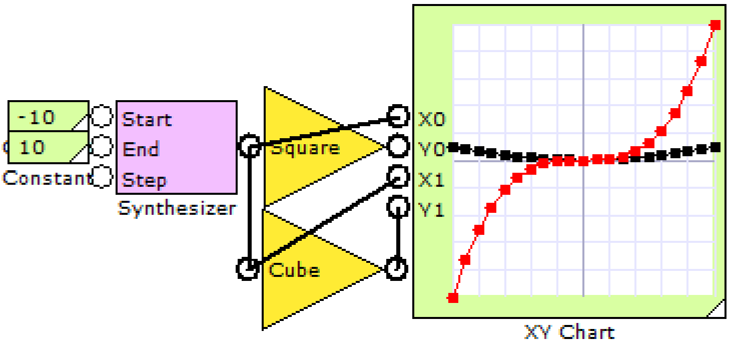


XY Chart

Number of Inputs: 2

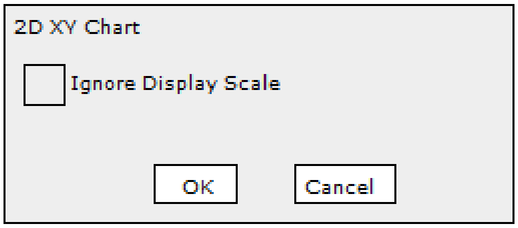
□ Show Labels

○ Display Lines
○ Display Dots
● Lines and Dots
○ Display Crosses
○ Lines and Crosses



2D XY Chart

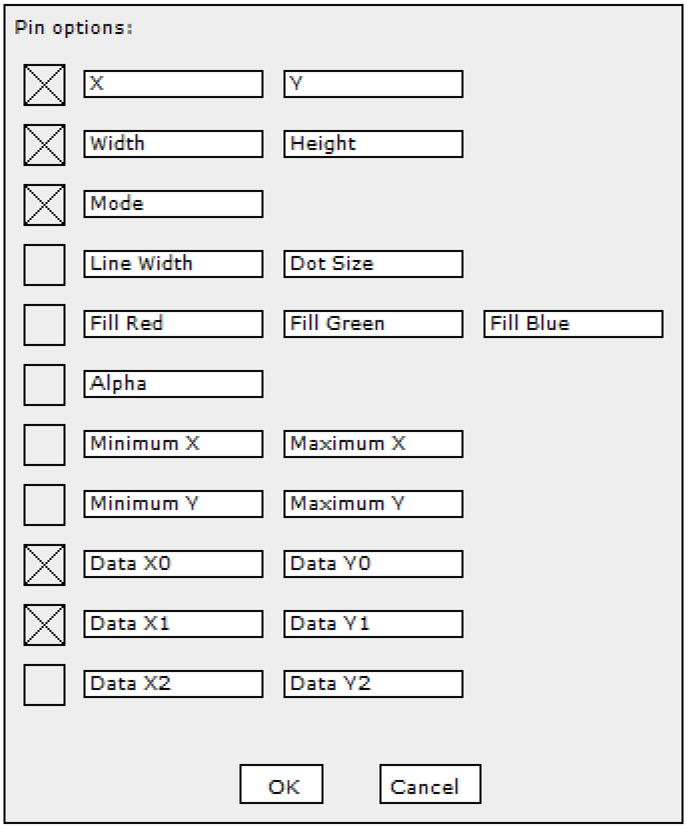
The 2D XY Chart shows X vs. Y creating a scatter plot of the data in the 2D display window.   2D - column 2



2D XY Chart

□ Ignore Display Scale

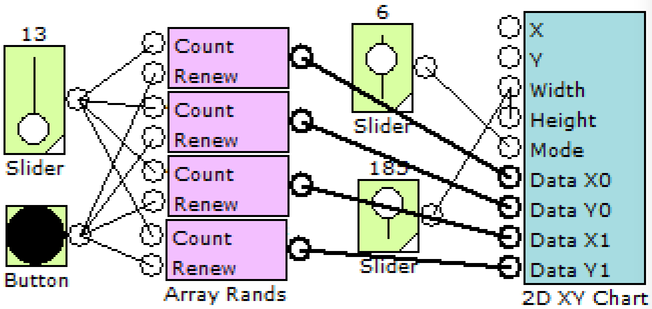
OK   Cancel

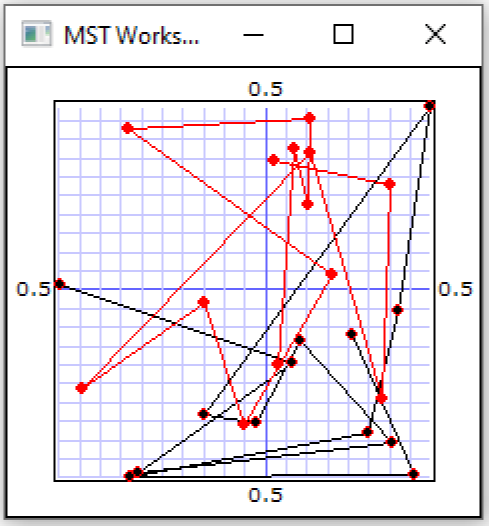


Pin options:

☒	X	Y	
☒	Width	Height	
☒	Mode		
□	Line Width	Dot Size	
□	Fill Red	Fill Green	Fill Blue
□	Alpha		
□	Minimum X	Maximum X	
□	Minimum Y	Maximum Y	
☒	Data X0	Data Y0	
☒	Data X1	Data Y1	
□	Data X2	Data Y2	

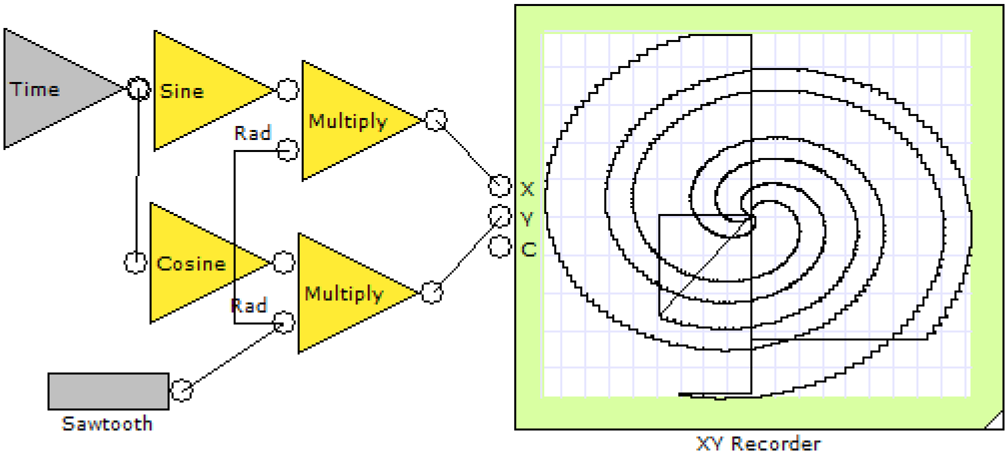
OK   Cancel





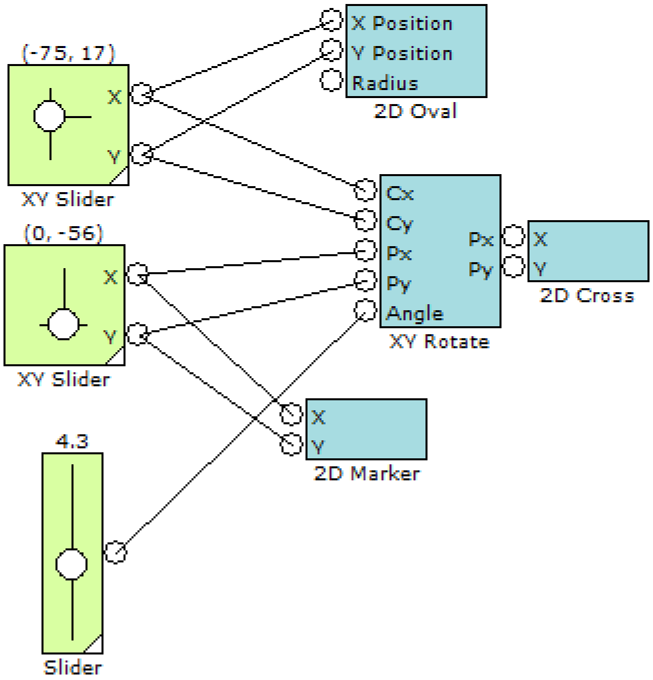
XY Recorder

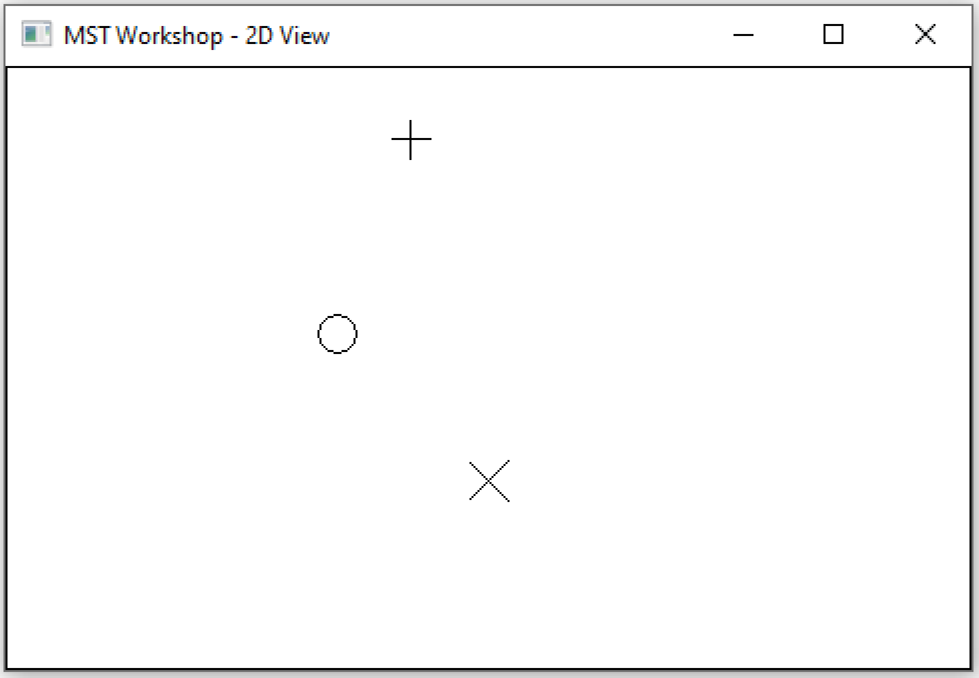
The XY Recorder plots the value of the 2 inputs over time. Controls - column 4



XY Rotate

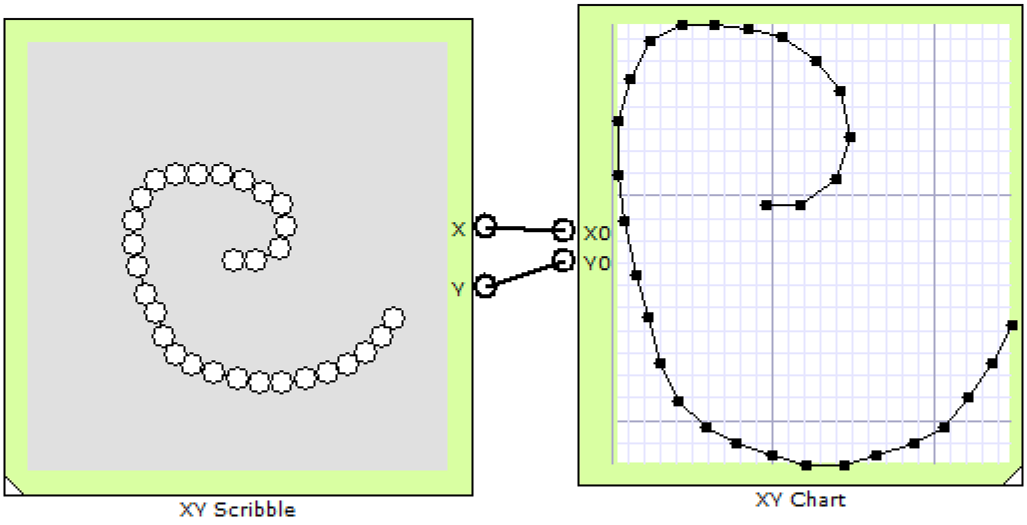
The XY Rotate calculates new XY coordinates after a rotation.   2D - column 5





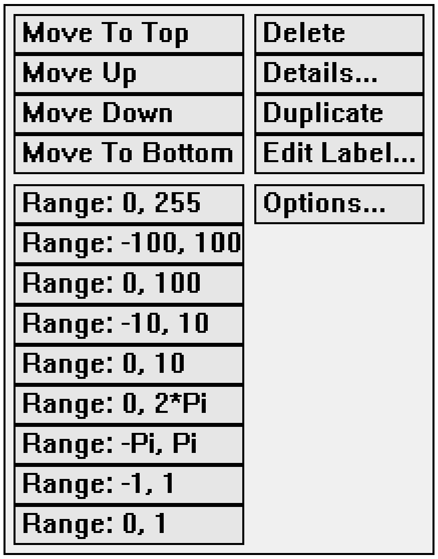
XY Scribble

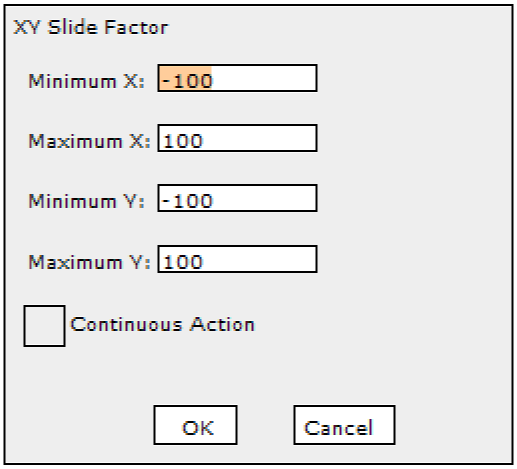
The XY Scribble component lets you draw a curve by moving the mouse inside the control. You can add to either end by dragging the end points. Restart by clicking on an empty space. You can adjust the position of any of the inner points after first drawing.



XY Slide Factor

The XY Slide Factor takes in two inputs and multiplies one by the X position and one by the Y position of the slide.   Controls - column 2




XY Slide Factor

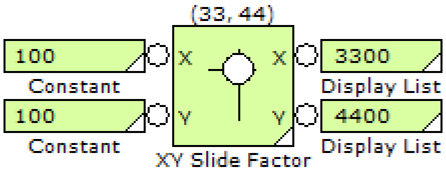
Minimum X: -100

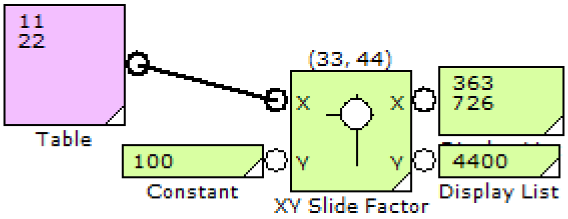
Maximum X: 100

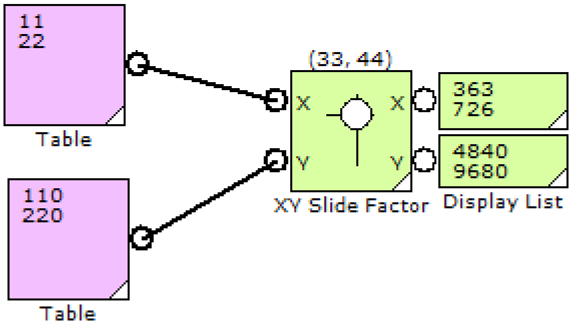
Minimum Y: -100

Maximum Y: 100

□ Continuous Action

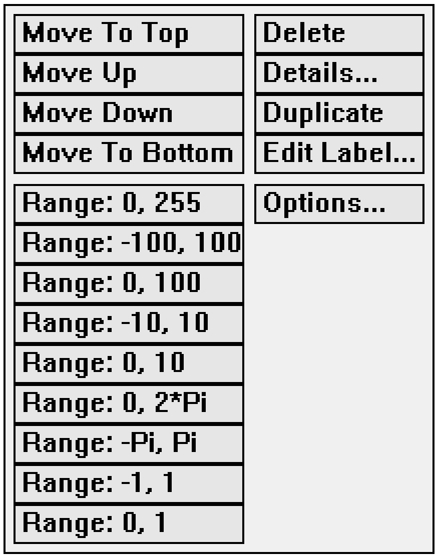


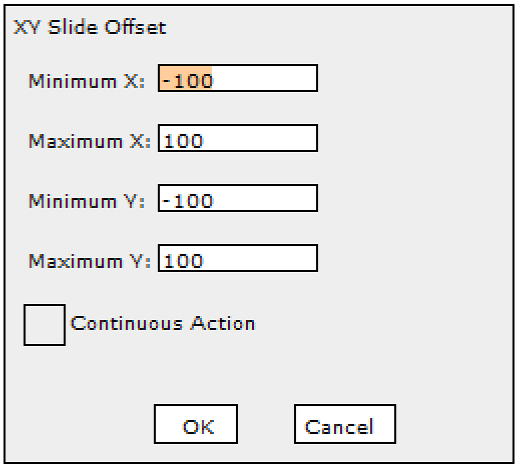




XY Slide Offset

The XY Slide Offset adds the X and Y positions of the slider to the two inputs.   Controls - column 3





XY Slide Offset

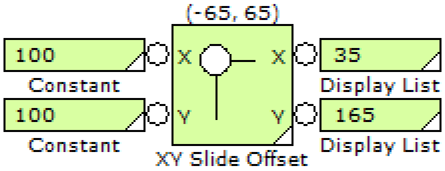
Minimum X: -100

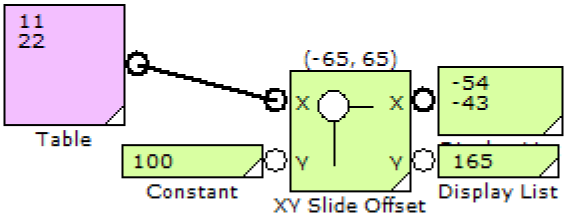
Maximum X: 100

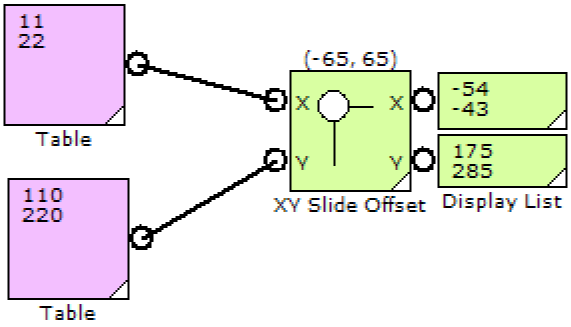
Minimum Y: -100

Maximum Y: 100

□ Continuous Action

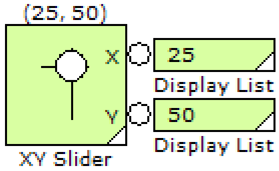


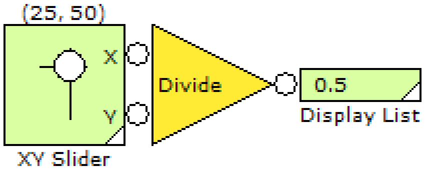


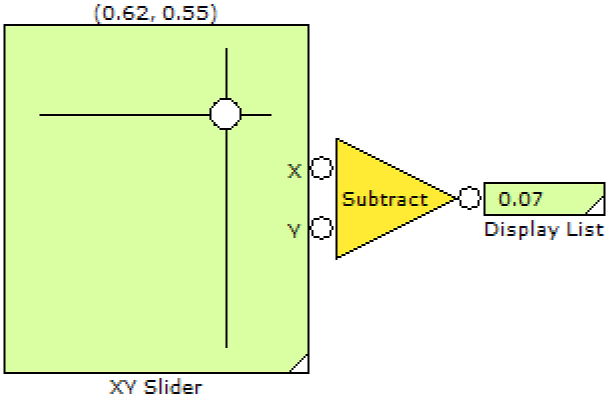


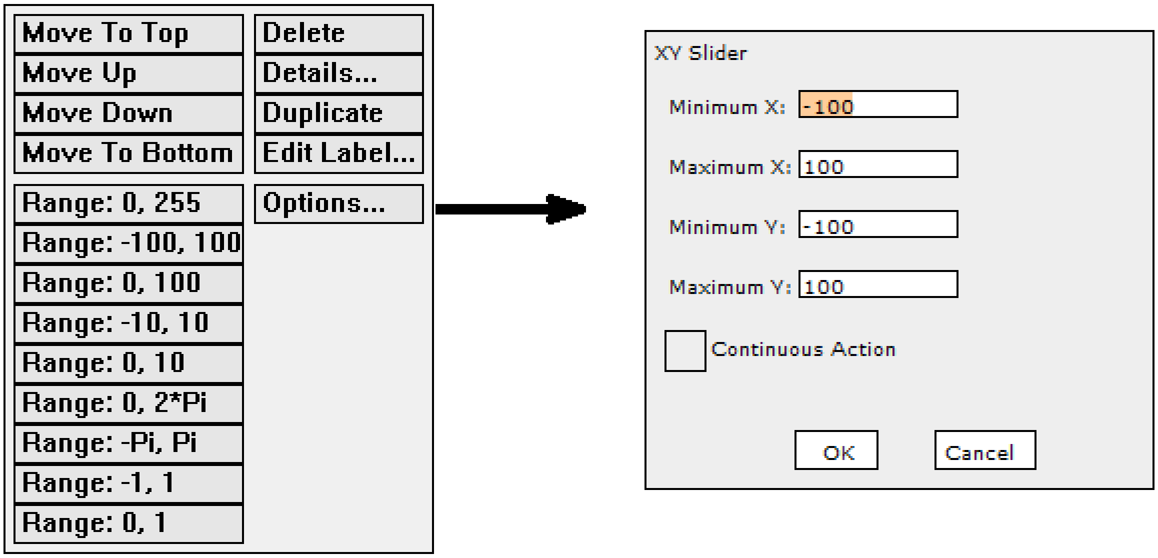
XY Slider

The XY Slider lets you control two constants in two directions, horizontal (x) and vertical (y).
Controls - column 1









XY Slider

Minimum X: -100

Maximum X: 100

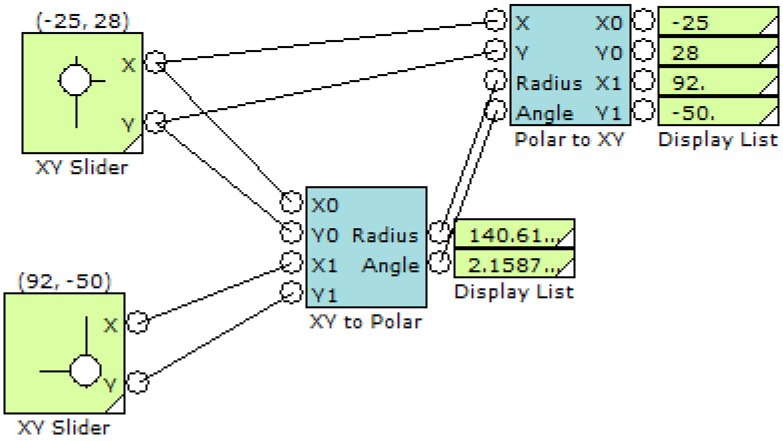
Minimum Y: -100

Maximum Y: 100

□ Continuous Action

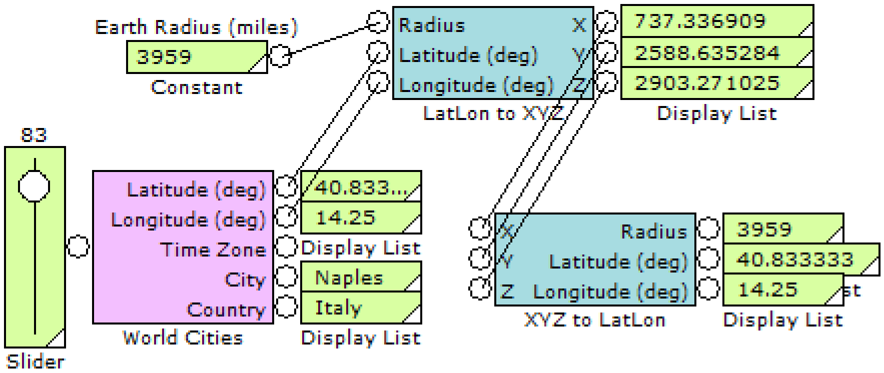
XY to Polar

The XY to Polar component takes an X,Y coordinate and returns a radius and angle. 2D - column 5



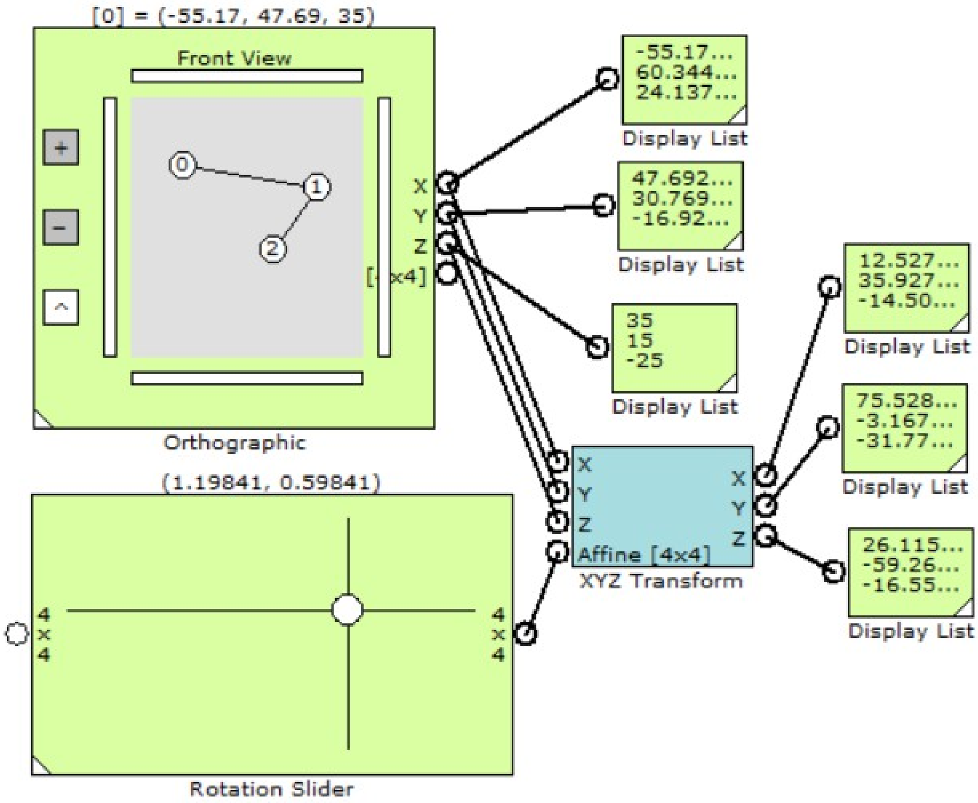
XYZ to LatLon

The XYZ to LatLon component takes an X,Y,Z coordinate and returns a Radius, Latitude and Longitude. 3D - column 6



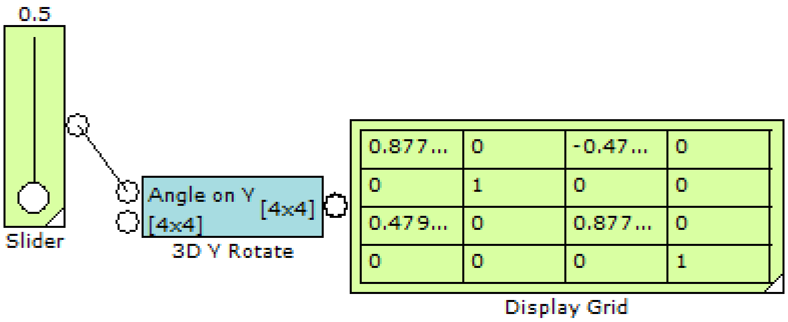
XYZ Transform

The XYZ Transform takes a point's X, Y and Z coordinates, transforms them with the Affine [4x4] input and outputs new X, Y, and Z coordinates. 3D – column 5

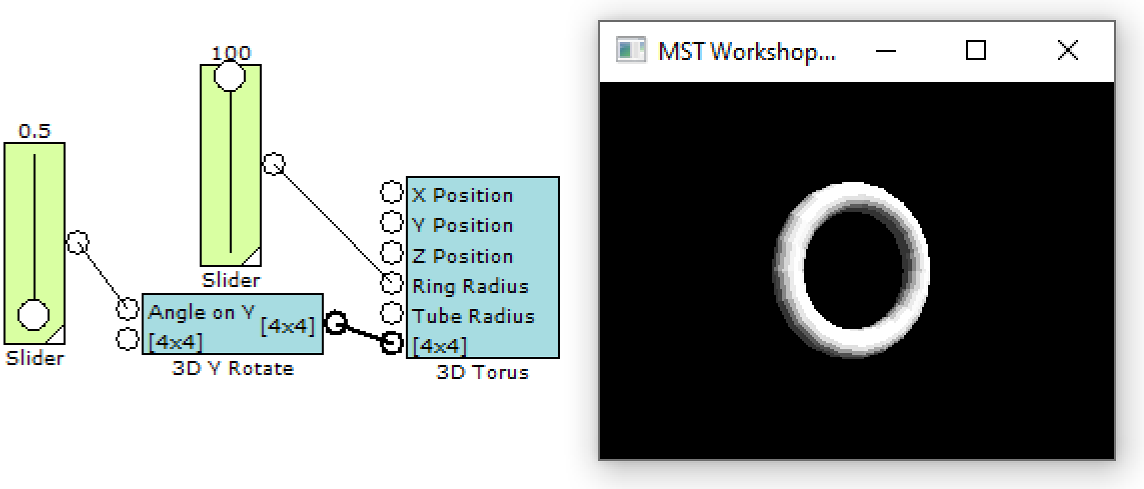


3D Y Rotate

The 3D Y Rotate rotates a 4 by 4 matrix around the Y axis by Radians.   3D - column 3

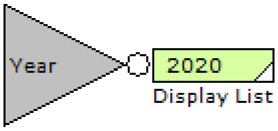


0.877...	0	-0.47...	0
0	1	0	0
0.479...	0	0.877...	0
0	0	0	1



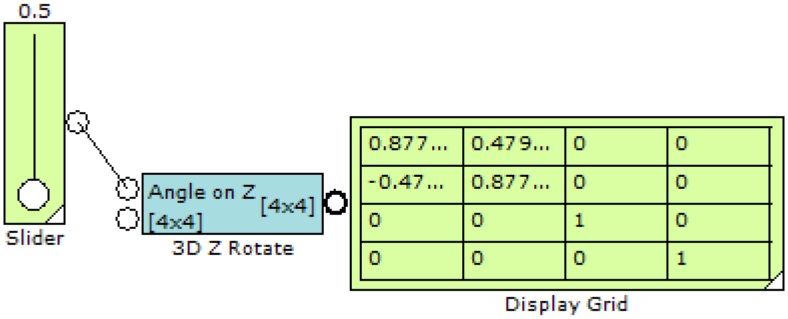
Year

The Year component outputs the current calendar year.   Functions - column 7

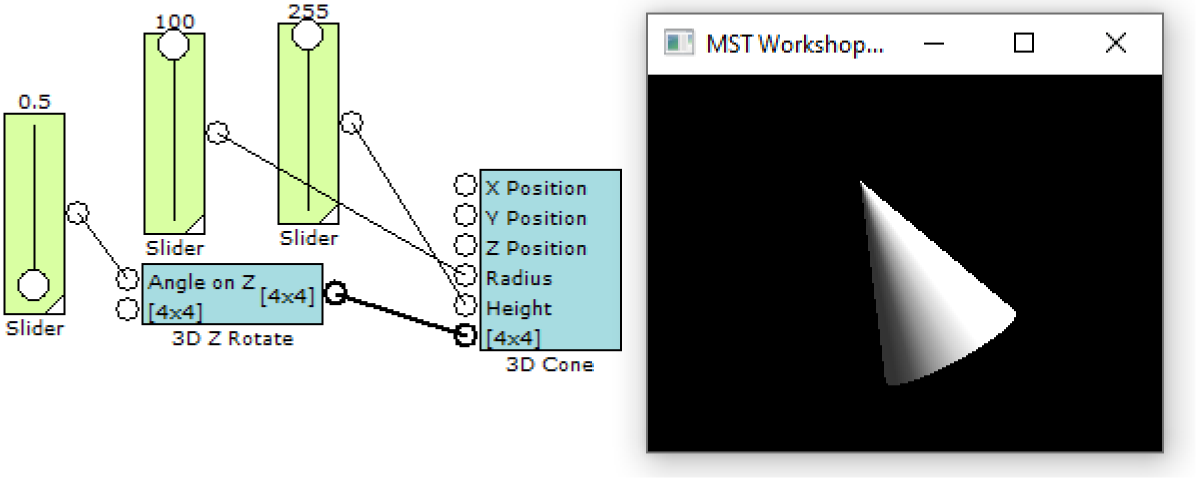


3D Z Rotate

The 3D Z Rotate rotates a 4 by 4 matrix around the Z axis by Radians.   3D - column 3



0.877...	0.479...	0	0
-0.47...	0.877...	0	0
0	0	1	0
0	0	0	1


0.5
100
255
Slider
Slider
Slider
Angle on Z
[4x4]
[4x4]
3D Z Rotate
X Position
Y Position
Z Position
Radius
Height
[4x4]
3D Cone
MST Workshop...