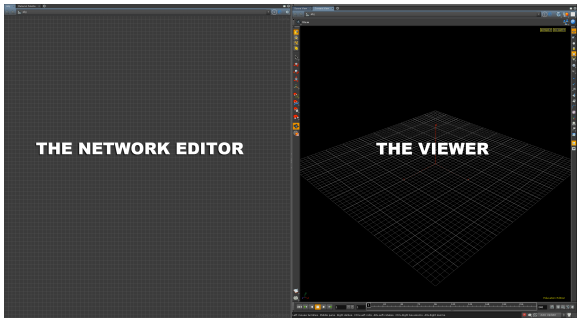
THE CREATION DESK

From the data folder provided for this lecture, **copy** the **houdini14.0** folder into the **$HOME** area of your computer. This will launch Houdini using **The Creation Desk (http://houdinicreationdesk.ipage.com/).** This is a fast, efficient desktop configuration for Houdini, making it simple to understand and learn.

LAUNCHING HOUDINI

Houdini can be launched on the NCCA computer systems by opening a Terminal Shell and typing the command **/public/bin/goHoudini**. If /public/bin has been added to the **$PATH environment variable** using the **.bashrc** or **.profile**, this command can be shortened to **goHoudini**. When Houdini is launched, The Creation Desk will be automatically loaded as the default interface. The primary interface of Houdini is known as **Object Level**. Here a variety of operators can be created including **geometry**, **lights** and **cameras** as well as a host of other higher-level operators.



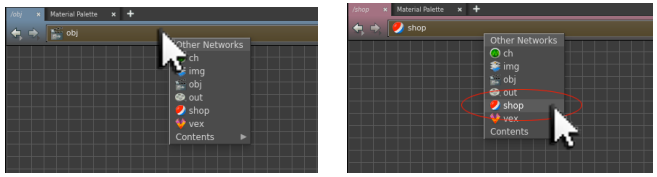
The **Creation Desk** interface consists of **two primary panes**: **The Network Editor** and **The Viewer**. The **Network Editor** allows for the construction of **Node Networks**, with The **Viewer** giving a **visualisation** of any Node Networks created.

MAXIMISING VIEW PANES

Both The Network Editor and The Viewer can be Maximised by moving the mouse over the View Pane to be maximised and pressing CTRL + b (+ b on Apple). Similarly, maximised panes can be minimised using the same keyboard command.

THE OBJECT LEVEL

The **Object Level** of Houdini is visually represented by the colour **blue** along the top of each primary window of The Creation Desk configuration. The **Level Menu** located at the top of either the Network Editor or The Viewer can access **other Levels of Houdini**.

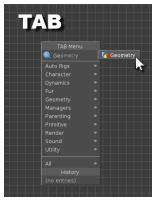


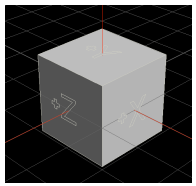
Each Level of Houdini has a different purpose, and when accessed, the **colourisation** of the interface panes **changes accordingly** to denote the level. The **SHOP Level** of Houdini for example has a **pink colourisation** and is used for the storage of shaders and materials.

When **learning Houdini**, it is best to **learn** the **Object Level** and **Geometry Level** (**a hidden level of Houdini that only appears when a piece of geometry is created**). As all Houdini Levels work on the same principles, learning the Object and Geometry Levels will create instant familiarity with all other levels.

CREATING OPERATORS

Operators can be created in either **The Network Editor** or **The Viewer**. When learning Houdini the general rule is that it is better to create everything initially through **The Network Editor**. **Return to Object Level**, and with the **mouse over the Network Editor**, press **TAB** and type the word **geometry**. This will attach a geometry operator called **geo1** to the mouse, which can be placed into The Network Editor by pressing the **Left Mouse Button** (**LMB**).





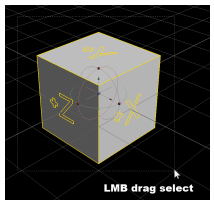
Doing this will also create a default piece of geometry in The Viewer. This XYZ geometry is located inside the geo1 object node. When making objects, a geometry object node is created and then its contents are modified and edited to produce any shape the user wishes.

BASIC VIEWING CONTROLS

The Network Editor and The Viewer can be navigated in comparable ways. In **The Network Editor**, **LMB** will select operators, **MMB** (Middle Mouse Button) will grab and move the entire Network Editor around, and **RMB** (Right Mouse Button) will zoom The Network Editor in and out. Similarly in **The Viewer**, **LMB** will **tumble** The Viewer, **MMB** will **pan** The Viewer and **RMB** will **dolly** The Viewer. The Network Editor and Viewer can also be reset to a default view by pressing **SPACEBAR** + **g** or **h** with the mouse over the required view pane.

TOOL AND VIEW MODES

At present, only The Viewer (and not the XYZ geometry inside The Viewer) can be interacted with. This is known as **View Mode**. To select and move geometry objects around, **press ENTER** with the mouse over **The Viewer**. This is known as **Tool Mode**. **LMB drag-select** the default geometry object to activate its transform handles.



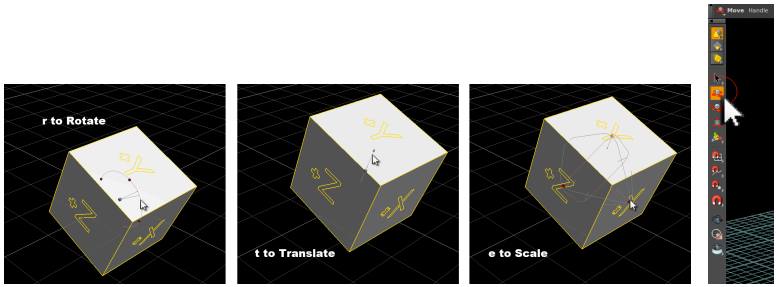
The geometry will be outlined in **yellow** to indicate it has been selected, and an **interactive transform handle** will appear at its centre.

When The Viewer is in **Tool Mode**, only the current tool can be interacted with. To **temporarily restore View Mode**, **press and hold SPACEBAR** with the mouse over The Viewer. When **SPACEBAR** is released **Tool Mode** is reactivated. The **ESC** key can be pressed with the mouse over The Viewer to permanently restore View Mode (until the ENTER key is once again pressed).

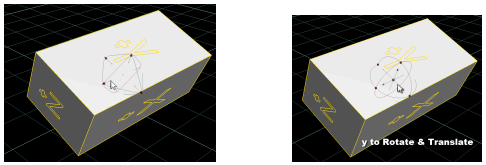
This **SPACEBAR Tool Mode / View Mode mechanism** is the same as the **hand grab spacebar tool** found in **Adobe Photoshop**. A user can quickly enter Tool Mode to move and modify geometry and use **SPACEBAR** to move around The Viewer.

TRANSFORMING OBJECTS

Objects can be translated (positioned), rotated and scaled when in Tool Mode. Keyboard shortcuts can be used to activate each transformation tool. Alternatively, the sidebar Transform Buttons of the Viewer can be activated when at Object Level.



NOTE: The Scale Tool can also be scaled on a per axis basis using the inner scale handles.

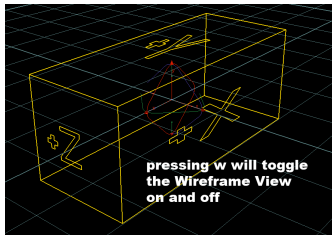


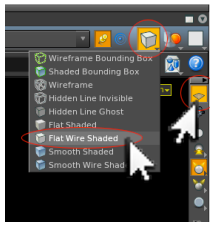
Pressing **y** on the keyboard with the mouse over The Viewer will reactivate the default multi-function transform tool.

Grabbing the very centre of the multi-function or Translate Tool will also allow for movement of the geometry relative to The Viewer's screen space.

WIREFRAME DISPLAY & VIEWER DRAW STYLES

Wireframe Display can be toggled on and off by pressing **w** with the **mouse over The Viewer**. The **Drawing Style** button located at the top right hand side of **The Viewer** can change the default viewer draw style between different draw style shading modes.

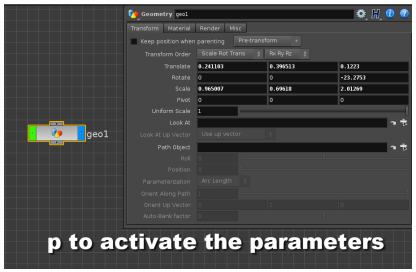




Another feature of **The Viewer** the ability to deactivate is the display of the **Construction/Ortho Plane**. This is the construction grid present in The Viewer. It is utilised simply as a visual placement guide for objects. This is controlled by the **Display Construction Plane / Ortho Grid button** at the top of the **right hand Viewer Options Stow Bar**.

THE PARAMETERS PANE

In order to see the numerical values of a selected object's transforms, **p** can be pressed with either the **mouse over The Network Editor** or **The Viewer**. Pressing **p** will also hide an open Parameters Pane.

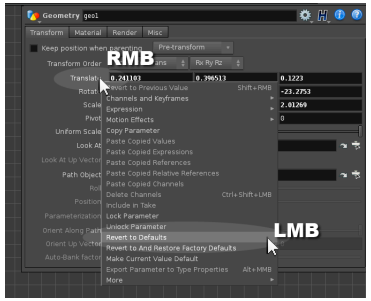


If **Parameters** are activated in **The Viewer**, the **Op Dialog** tab must be activated to see the standard Parameters listing. The Parameters Pane lists many different parameters for controlling an object's behaviour and characteristics.

The Transform Parameters are listed as columns with each column representing each primary axis of the object. This axis convention is also represented in The Viewer where X equals left or right, Y equals up or down, and Z equals forward or backward.

RESTORING PARAMETER VALUES

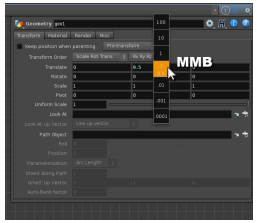
RMB on either the axis **Parameter Name** or **Parameter Value** can also reset parameters. This will result in a **contextual menu** where the option **Revert to Defaults** can be found.



RMB on the **Parameter Name** and choosing **Revert to Defaults** from the contextual menu will result in **all the parameters being reset**. **RMB** on a **single Parameter Value** will result in **only that value being reset**.

THE NUMERIC NUMBER LADDER

A feature of the **Parameters Pane** is the ability to slide numeric values up and down interactively. This is done using the **Interactive Number Ladder,** which can be accessed by **MMB** holding on either the **Parameter Name** (for example **Translate**), or on a specific xyz number value. **MMB hold** on the **Parameter Name** will increase or decrease all three xyz values simultaneously. **MMB hold** on an individual Parameter will increase or decrease that particular value only.



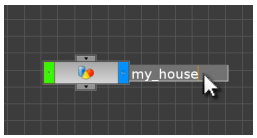
MMB hold on the **Parameter** will display the **Interactive Number Ladder**. The mouse can then be moved left or right to decrease or increase the value. Moving the mouse up or down will increase or decrease the numeric unit being used.

PRIMITIVE MODELLING

Reset all of the **Parameters** for the **geo1** object back to their defaults. This will move the object back to the **World Origin** of The Viewer. At present this object is not defined; and although it exists, it has no function or purpose. The xyz box geometry present in The Viewer is simply a placeholder for other geometry that ultimately will do or represent something.

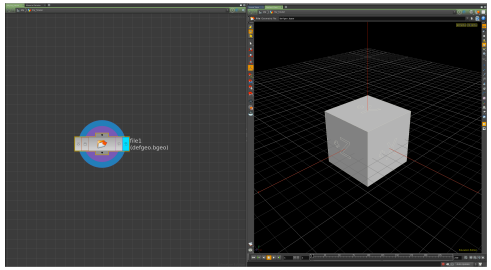
NAMING OBJECTS

The best place to begin defining an object is by renaming it. This can be done by **double LMB** clicking on the **name** in **The Network Editor** and entering in a new name for the object. Rename the object from **geo1** to **my_house**.



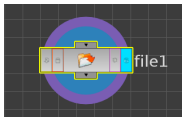
GOING INSIDE OBJECTS

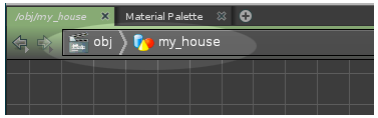
Select the **my_house** object, and with the mouse over the **Network View** double **LMB** on the node; or press **i** (in) on the keyboard to enter **inside** it. The main **interface colour** will change from **blue** to **green** indicating the change from **Object Level** to **Geometry Level**.



INSIDE AN OBJECT

Inside the **my_house** object is a **File S**urface **Op**erator (**File SOP**) called **file1**. This is reading in the default xyz box geometry stored in the install directory of Houdini.

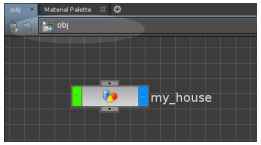




The current location of the interface is also return as a graphical listing along the top of The Network Editor and The Viewer.

COMING BACK OUT OF AN OBJECT

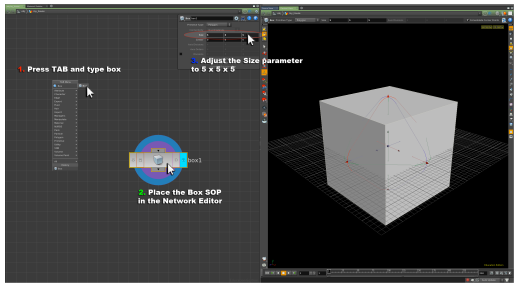
Object Level can be accessed once more by pressing **u** (up) on the keyboard, and the interface colour will return to blue. The current location listing will also have reverted back.



CREATING THE MY_HOUSE GEOMETRY

Return back **inside** the **my_house** object and in the Network View, select the default **File SOP** and press the **DELETE** key **(BACKSPACE on Apple)** to erase it. In its place create a **Box SOP** by pressing **TAB** and typing **box** or by selecting it from the 'Primitive' Sub-List of the TAB Menu System.Place the **Box SOP** in **The Network Editor**, and adjust its **parameters** to:

Size	**5**	**5**	**5**

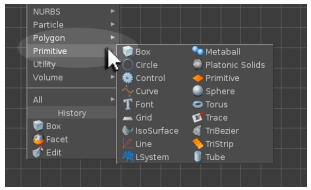


This will create the basis of the house geometry. The Box SOP geometry can be examined in The Viewer by holding down **SPACEBAR** to activate **View Mode**.

SEEING ALL AVAILABLE LEVEL NODES

Each Houdini Level contains their own set of operators' specific to that level. The entire operator list for a Level can be accessed by going to the **All subsection** of the **TAB Menu System**.

The nodes for each Houdini Level are also sub-listed into categories. At **Geometry Level**, the **SOPs** for creating simple geometry are listed under the **Primitive** sub-listing.

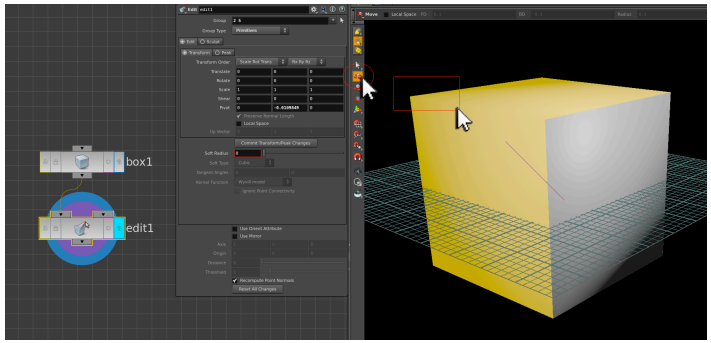


NOTE: If a name of an operator is unknown, the **All** section of the TAB Menu System can be investigated. Typing into the TAB Menu System is also **CAPS LOCK sensitive**. It's internal search for nodes will behave in a different way if CAPS LOCK has been activated on the keyboard.

The TAB Menu system is also intuitive; meaning it will reveal all operators based on what is being typed. For example typing **poly** will reveal a list of operators all starting with poly (for example the **Poly**Wire SOP, as well as an operator called VDB from **Poly**gons).

AUTOMATIC GEOMETRY EDITING IN THE VIEWER

When in **Geometry Level**, the **Viewer sidebar buttons** for **Move**, **Rotate**, and **Scale** will **automatically append** an **Edit SOP** to the current operator. This mechanism can be confusing for new users of Houdini.

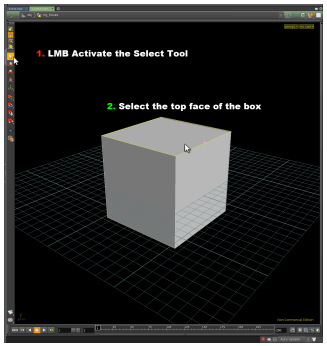


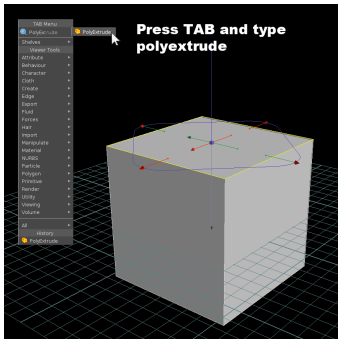
If an Edit SOP is accidently created, it can be deleted by **selecting it** in **The Network Editor** and **pressing** the **DELETE** key (BACKSPACE on Apple). The **Tool Mode** for the **current operator** can then be **restored** by **pressing ESC** and **ENTER** with the mouse over the Viewer.

When learning Houdini, it is better not to use these Transform buttons at Geometry Level until more modeling familiarity is gained. To begin with it is better to **only use** the **Select Arrow button** from the **sidebar** and then **call specific operators individually** using the **TAB Menu** with the mouse over the **Viewer**.

SELECTING GEOMETRY

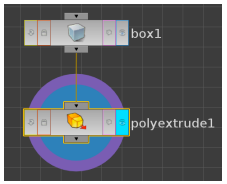
From the **Selector and Handle Controls Stow Bar**, **LMB** activate the **Select Tool** (keyboard shortcut **s**), and **LMB select** the **top face** of the box. This will allow the top face to be edited to create a roof for the house. When selected, the **top face** will have a **yellow outline** in order to indicate it has been selected. The Viewer also allows for selection without invoking the Select Tool.

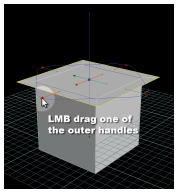




THE POLYEXTRUDE SOP

With the **mouse over The Viewer**, press **TAB** and **type polyextrude**. This will invoke a **Polygon Extrude operation** in **The Viewer** as well as **automatically appending** a **PolyExtrude SOP** to the Box SOP in **The Network Editor**.





Using the **outer interactive Scale Handle**, uniformly scale the extruded box face to form a base for the roof.

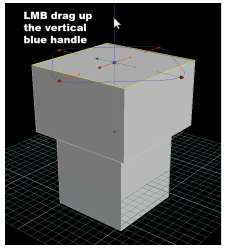
NOTE: The **PolyExtrude SOP** works with polygon based geometry (the default geometry type of the Box SOP). **For extruding other geometry types, please refer to the Extrude SOP**.

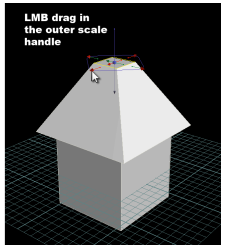
REPEATING OPERATIONS

The PolyExtrude operation can be repeated to further create the roof. Instead of invoking the interactive **TAB Menu system**, the current operation can be reactivated anew by pressing **q** on the keyboard with the mouse over **The Viewer**.

NOTE: the face to be extruded must still be selected in order for this to work correctly.

LMB drag up the **blue vertical bar** of the interactive Transform Handles for the second PolyExtrude SOP. This will define the roof height.



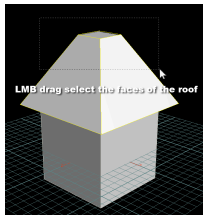


Using one of the **outer scale handle** arrows, uniformly reduce the size of the top face so that it forms the shape of a roof.

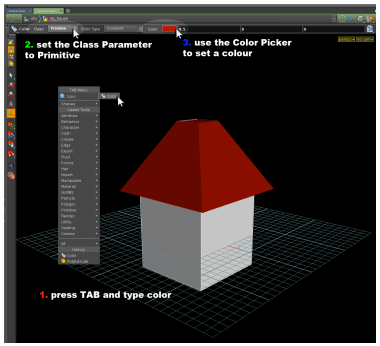
NOTE: If at any point the interactive handles disappear (for example if the user LMB on The Viewer), they can be reactivated by **LMB reselecting** the associated **node** in **The Network View**. If the **Parameters Pane** is **active**, the reselected node's parameters will also appear.

ADDING COLOUR

Using the Select Tool (**s**), select all of the faces that make up the roof. **SHIFT** can be used to select multiple faces individually or a selection marquee can be drawn to select the whole roof area.



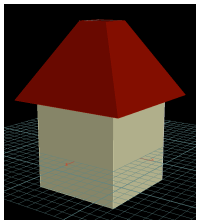
With the mouse over the **View Pane**, press **TAB** and type **Color**. This will automatically generate a Color SOP affecting only the selected faces of the roof. In the **Parameters** for the **Color SOP**, set the **Class Parameter** to **Primitives** (faces) and the **Color Parameter** to a dark red.



NOTE: If the **Operation Controls Stow Bar** is **active**, the **primary parameters** for the current operation will also be listed here. These parameter listings are duplicates of the parameters found on the node itself.

NOTE: On our current version of Redhat Linux, **ALT + F4** can be used to **close a floating dialog window** such as the Color Chooser.

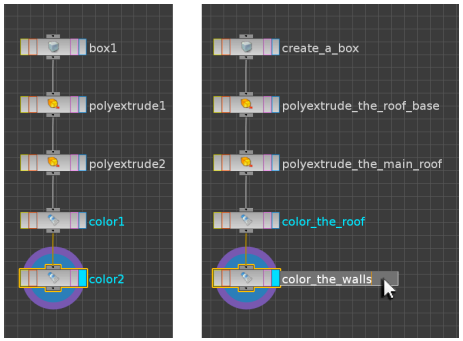
Select the **faces** of the house **walls**, and use **q** with the **mouse over the Viewer** to **repeat** the **Color SOP** operation. This will add colour to the walls of the house.



NOTE: When the **Class Parameter** of the second Color SOP is set to **Primitives**, the red roof will reappear.

ANNOTATING NETWORKS

The Network Editor now has a simple node chain inside it creating and colouring the house. This node chain can be annotated by renaming the nodes, to better describe their function.



Doing this as networks are created helps with document workflow and allows a Houdini scene to be quickly made sense of if ever revisited.

RESELECTING GEOMETRY

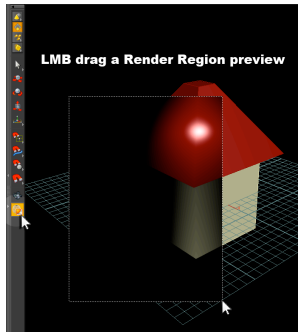
Sometimes after a selection has been made, it becomes clear that a selection needs to be modified (for example if all of the roof geometry has not been selected properly). Reselecting Geometry can be done very simply at any stage of network creation without the need for a new operation.

To **reselect geometry** for an operator, **LMB** select the **problematic node in The Network Editor**, **RMB** on the **Select Tool arrow** and from the resulting menu choose **Reselect for Current Tool**. This will temporarily break the network chain just above the problematic node, allowing for a new selection to be made.

The **Select Tool RMB Menu** also lists **different methods of selection**, such as **Add to Selection**, **Replace Selection**, **Toggle Selection**, **Remove from Selection**. This menu also has other **Selection Tools** such as **Box Picking**, **Brush Picking** and **Lasso Picking**.

RENDER REGION PREVIEWS

In order to gauge what the house will look like at Render Time, a **Render Region** Preview can be drawn in **The Viewer**. To do this, **LMB** the **Render Region** button found in the **Selector and Handle Controls Stow Bar**, and **LMB drag a region** to be previewed.



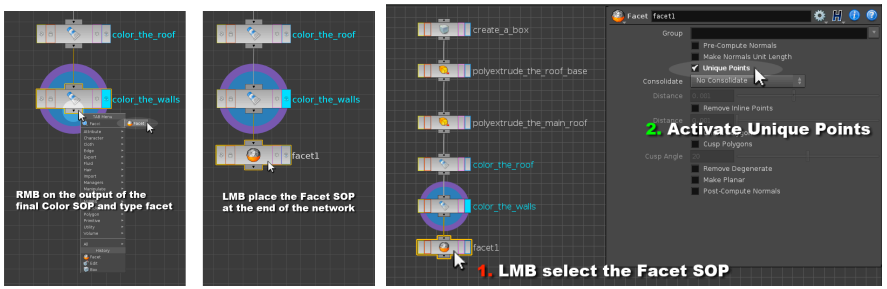
The render preview displays the geometry as a round surface with a light projecting from the camera to illuminate the scene. Pressing **ESC** with the **mouse over the Viewer** will **deactivate** the Render Region Preview if normal Viewer interaction is once again required.

HARD SURFACE MODELLING

By default Houdini will render all surfaces as curved surfaces. For Hard Surface Modelling, the desired surface flatness needs to be explicitly declared. A **Facet SOP** can be utilised to declare geometry as a Hard Surface at Render Time.

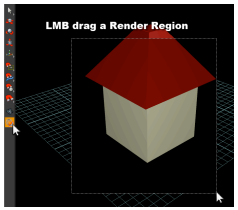
APPENDING NODES IN THE NETWORK EDITOR

RMB on the **output** of the final **Color SOP** to append a **Facet SOP**. In the **Parameters** for the **Facet SOP** activate **Unique Points**. This will cause the house geometry to render as a Hard Surface.



RENDER REGION PREVIEW OF A HARD SURFACE

With the Display & Render Flags of the Facet SOP activated, a Render Region Preview reveals the house rendering as a Hard Surface.



THE NULL SOP

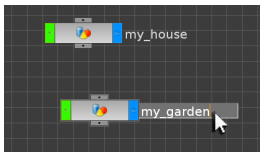
As a final step, a Null SOP can be appended to the end of the network chain creating the house. A Null SOP can be utilised in Houdini to mark the completion of a Network, as it is a deliberate empty node with no function.

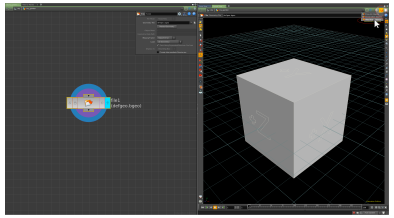
RMB on the output of the **final Color SOP** in the **Network Editor** and type the word **null** into the TAB Menu System. This will append a **Null SOP** to the network chain creating the house. **Rename** the **Null SOP** in the Network Editor from null1 to **FINAL_HOUSE_GEOMETRY**.

See file **Simple_Scene_Stage1.hipnc**

CREATING A GARDEN

Return back up to **Object Level** and create a new piece of geometry by pressing **TAB** and typing **geometry** with the mouse over the Network Editor.Rename this new object from **geo1** to **my_garden** and **double LMB the node** to go inside it.





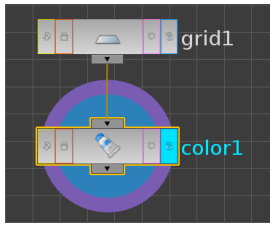
At **Geometry Level**, select the **Hide Other Objects option** from the Context View's **Object Display Options** button located in the top right hand corner of The Viewer. This will make the my_house object disappear from The Viewer.

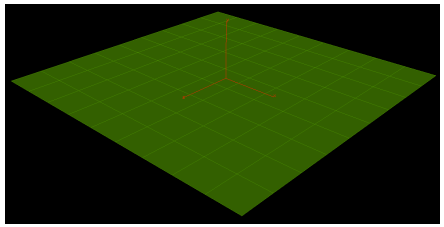
NOTE: The **my_house** object now visible only at **Object Level** and can be seen using the Scene View if required, or by returning to Object Level.

Delete the default **File SOP** and in its place create a **Grid SOP**. In the **Parameters** for the **Grid SOP** specify:

Size	**30**	**30**

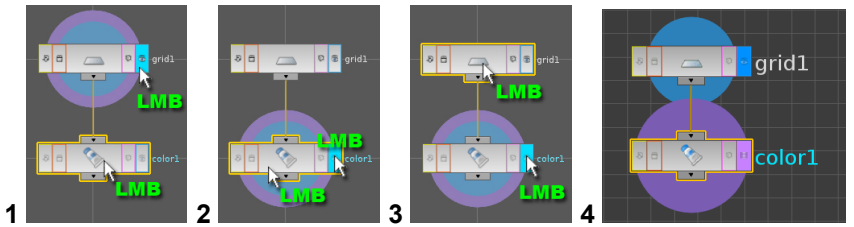
RMB append a **Color SOP** to the Grid SOP in **The Network Editor**. Using the **Parameters** for the **Color SOP**, colour the grid green to help indicate the garden area.





DISPLAY & RENDER FLAGS

At Geometry Level, each node can be independently selected, displayed or rendered depending upon user preference. Different combinations of display, render and selection can be utilised between nodes. This ability to control Display & Render Flags also allows for a network to be stepped through and examined one node at a time. This can help when debugging networks if an error occurs.



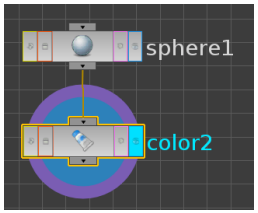
1. If a new node is selected without its Display & Render Flag activated, the Parameters of the new operator will be displayed, but its effect will not be visible in the View Pane or in the render.

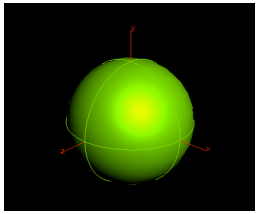
2. If a new node has its Display & Render Flag activated and is selected, the effect of the operator will be seen in the View Pane, the Parameters Pane and the render.
3. If a new node has its Display & Render Flag activated but another node is selected, then the Parameters of the selected node will be displayed.
4. It is also possible to separate the Display and Render Flags onto different SOPs by holding the **CTRL** button. This allows for a non-displayed operator to be rendered at render time.

CREATING A SIMPLE TREE

With the mouse over **The Network Editor**, press **TAB** and from the **Primitive** sub-listing choose **Sphere**. **LMB** drop the Sphere SOP into a new area of the **Network Editor**. Activate the **Display & Render Flag** for this node to see its effect in The Viewer. The green grid will disappear from view. In the **Parameters** for the **Sphere SOP** specify:

Radius	**4**	**4**	**4**

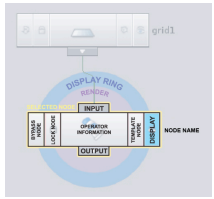


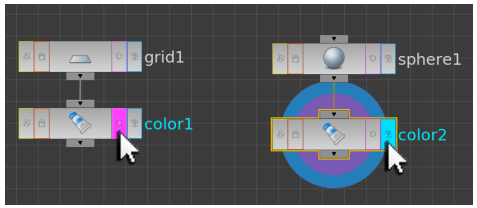


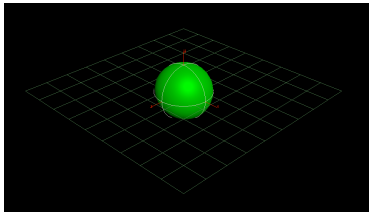
RMB on the output of the **Sphere SOP** to append a second **Color SOP**, and as before set its Color Parameter to green. **NOTE**: Operators that have recently been created also appear in the **History listing** of the **TAB Menu system**.

TEMPLATING OPERATORS

When working in 3D, it is very useful to be able to see more than one operator in the Viewer. One way of achieving this is to activate the **Pink Template Flag** on the secondary operator to be viewed. This will return a faint outline version of the operator that cannot be interacted with. This display type is known as Templated Geometry.







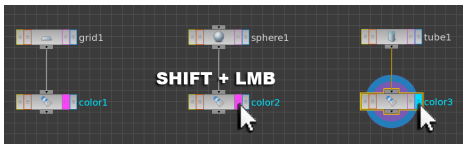
With the **Template Flag activated**, the grid appears as a non-interactive wire-frame in The Viewer. Templating allows for the positioning of SOP nodes relative to each other. Holding down **CTRL** before activating the Template Flag can activate a **Selectable Template Display**. Holding down **SHIFT** will allow **more than one node to be templated**.

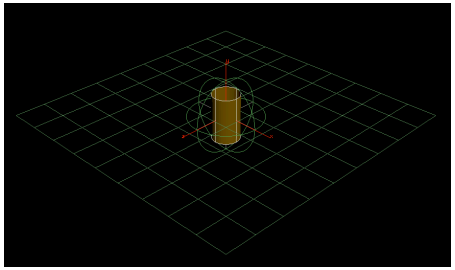
CREATING THE TREE TRUNK

With the mouse over the **Network View**, press **TAB** and from the **Primitive** sub-listing create a **Tube SOP**. In the Parameters for the Tube SOP specify:

Radius	**1.5**	**1.5**
Height	**10**	

Append to the **Tube SOP** a third **Color SOP**, setting the **Color Picker Parameter** to **brown**. This will form the tree trunk. The sphere network chain can also be **SHIFT templated** to see all the developing networks displayed in the Viewer.

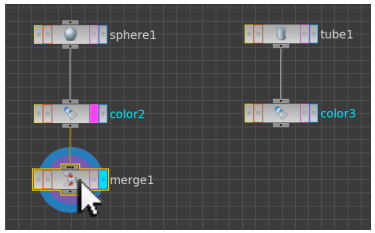




THE MERGE SOP

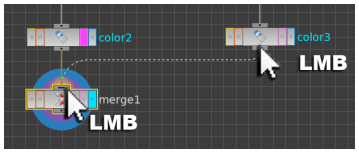
At present, there is geometry representing the ground, geometry representing tree foliage and geometry representing the tree trunk. Each of these node networks is separate from each other. This means that only one of the networks can be displayed and rendered. Creating a Merge SOP can rectify this. This operator can be utilised to combine geometry networks together.

RMB on the output of the **second Color SOP** (affecting the Sphere SOP) and when the **TAB** Menu System appears, **type merge**. This will automatically append a Merge Operator to the foliage network.

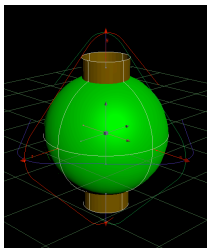


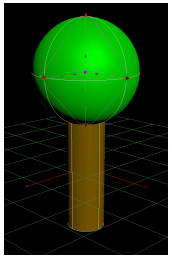
MANUAL NODE WIRING

LMB on the output of the third Color SOP (affecting the Tube SOP) to activate a connection wire. **LMB** click this connection into the input of the Merge SOP.



When the Blue Display Flag is activated on the Merge SOP, the coloured Sphere and the Tube will appear in the View Pane. **Rename** the Merge SOP to **SIMPLE_TREE**.

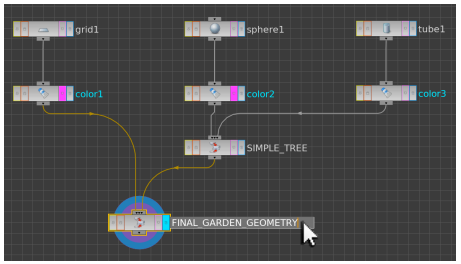


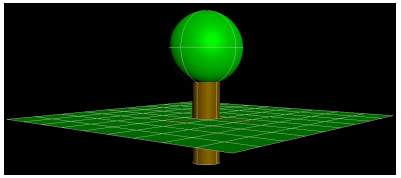


Once more **select** the **Sphere SOP** and **Tube SOP** nodes in turn to **activate their Parameters**, and modify their individual positions and sizes so that their merged output resembles a simple tree.

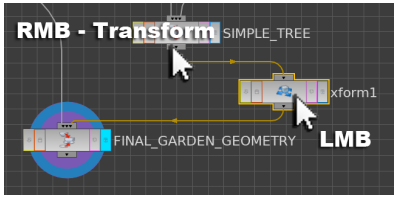
FINISHING THE GARDEN

RMB on the output of the **first Color SOP** (affecting the Grid SOP) and append a **second Merge SOP**. Wire the output of the ground geometry network and the simple tree network together. Rename this Merge SOP to **FINAL_GARDEN_GEOMETRY**.



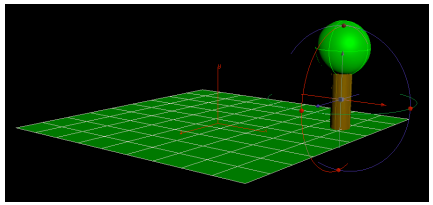


At present the simple_tree geometry and the grid intersect. Modification of the Parameters associated with the simple_tree's geometry components would rectify this; however it would mean adjusting both the Sphere SOP and the Tube SOP individually. A better alternative to this is to move the SIMPLE_TREE as a single unit. Inserting a **Transform SOP** between the **SIMPLE_TREE** network and the **FINAL_GARDEN_GEOMETRY** node can do this.



RMB on the output of the simple_tree node, and when the TAB menu system appears; type **transform**. Select the Transform SOP from the menu and LMB the node onto the Network Editor. This will insert the Transform SOP between the SIMPLE_TREE node and the FINAL_GARDEN_GEOMETRY node.

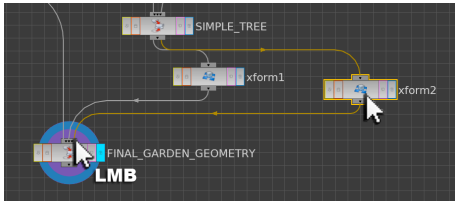
Ensure that the **Transform SOP** (xform1) is selected in the **Network Editor**, and with the mouse over the View Pane press **Enter** to go into **Tool mode**. The SIMPLE_TREE geometry can now be scaled and moved into position.

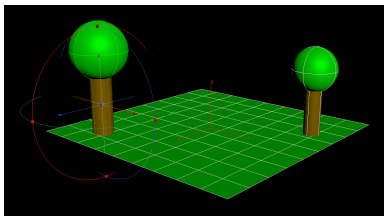


NOTE: Transformations at **Geometry Level** are known as **Object Space Transformations**, where the components of an Object are moved relative to themselves inside the Object. An Object as a unit can moved relative to other objects at the Object Level of Houdini (in **World Space**).

CREATING A SECOND TREE

Nodes in Houdini can be **copied** (**CTRL + c**) and **pasted** (**CTRL + v**) in order to replicate them. Creating a second simple tree can occur by selecting all of the nodes that create the tree, and copying and pasting them into the Network Editor.



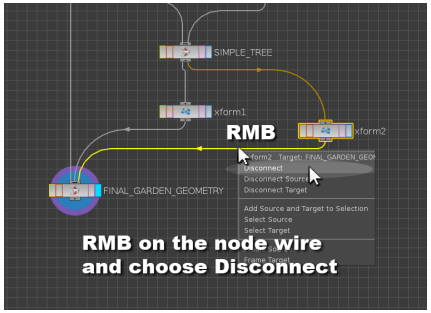


A better and more efficient way to create a second tree is to simply **copy and paste the Transform SOP**. Wiring the output of this second Transform SOP into the **FINAL_GARDEN_GEOMETRY Merge SOP** will then allow the second tree to be both seen, scaled and positioned.

NOTE: any modification to the Sphere SOP or the Tube SOP will be passed down to both instances of the SIMPLE_TREE.

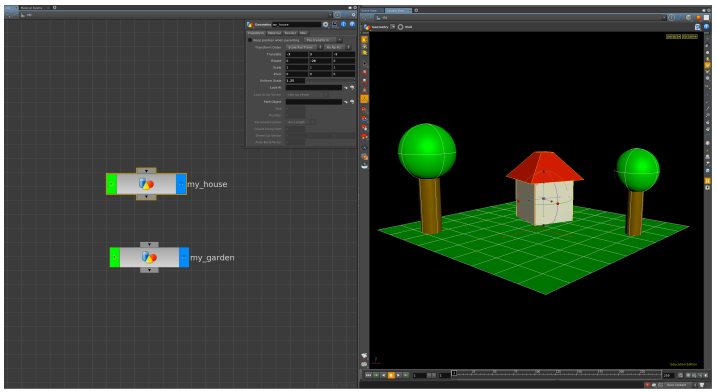
MANUALLY DISCONNECTING NODES

To manually disconnect a node, simply **RMB** on the associated **node wire**, and from the resulting menu choose **Disconnect**.



POSITIONING THE HOUSE AND GARDEN

Press **u** on the keyboard to return back up to **Object Level**. Now that the geometry for the **my_house** object is complete, the function of Object Level and World Space now becomes more apparent.



The two scene objects my_house and my_garden can now be positioned, scaled and rotated relative to each other. This positioning will transform all of the object components stored at Geometry Level as a single unit (or object). These World Space Transformations are stored in the Geometry Object's Parameters.

See Simple_Scene_Stage2.hipnc

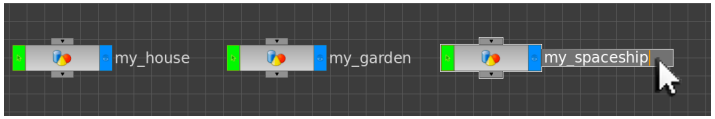
SAVING WORK

Now that the scene has been completed to a provisional level, it can be saved. This can be done by going to the main **File menu** and choosing **Save As…** This will activate the **Save As window**, which can be utilised to specify a location for the saved file.

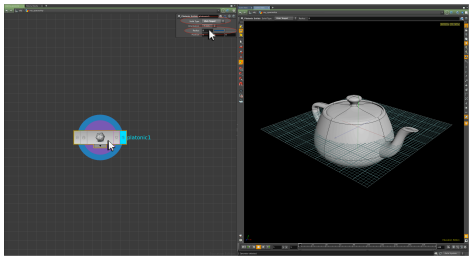
NOTE: The file extension **.hipnc** is specific to Houdini and means **H**oudin**i** **P**roject (**N**on **C**ommercial). Commercial versions of Houdini use the file extension **.hip**. The difference between the Educational version of Houdini and the free Apprentice version is the ability to render without the Houdini watermark. In all other aspects these versions are identical.

ANIMATION PATHS

The simple scene being developed can also be utilised to demonstrate simple animation. At **Object Level**, create a new piece of **Geometry** and rename it to **my_spaceship**.

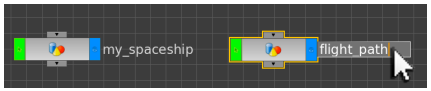


Go **inside this object**, and **delete** the default **File SOP**. In its place create a **Platonic Solids SOP**, setting its **Type parameter** to **Utah Teapot** and its **Radius parameter** to **5**.



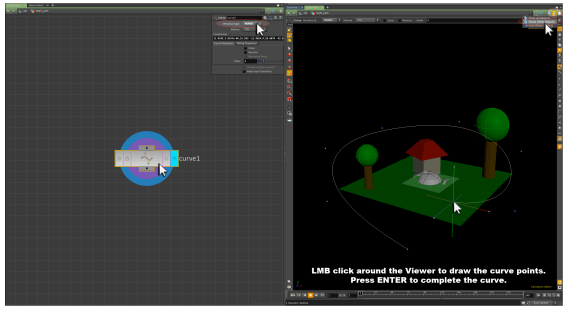
This will create a teapot in the viewer that can act as a **temporary placeholder** whilst more higher-level spaceship geometry is being developed.

Return to **Object Level**, and in the **Network Editor**, create a new piece of geometry, renaming it to **flight_path**.



Go **inside** the **flight_path object** and **delete** the **default File SOP**. In its place, create a **Curve SOP**. This operator can be utilised for drawing any type of curve or line. In this example, the curve will become an animation path for the spaceship rather than a piece of geometry for rendering.

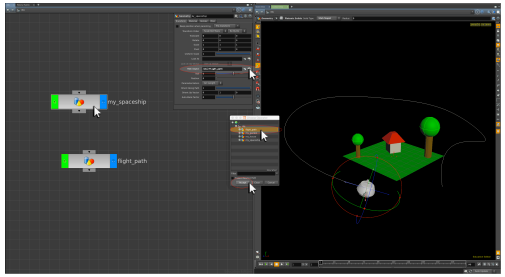
With the **mouse over the Viewer**, press **ENTER** to invoke the **Curve Tool Mode**. The mouse will turn into a cross-hair icon. Use the **Object Display button** to activate **Ghost Other Objects**, and **LMB click approximately 8 points** around the Viewer. The curve will be drawn relative to the Viewer's position. At this stage however it does not matter where in space the curve points are. When all points of the curve have been drawn, press **ENTER** to complete the curve. This will also activate editing handles for each curve-point allowing the curve to be reshaped.



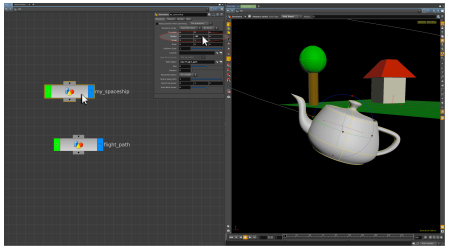
Tumble the view, **selecting each of the curve points in turn** in order to **reshape the curve** appropriately to surround the scene objects. Setting the **Primitive Type parameter** of the **Curve SOP** to **NURBS** will also ensure a smooth curve is drawn between the points.

ASSIGNING THE SPACESHIP TO THE FLIGHT PATH

Return to **Object Level**, and in the **Network Editor**, **select** the **my_spaceship object**. Activate its **parameters** and locate the **Path Object parameter**.



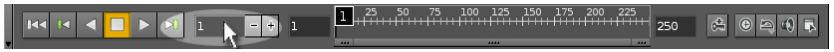
Use the **Operator Chooser button** associated with the Path Object parameter to **choose the flight_path object**. When **Accept** is pressed on the Operator Chooser floating dialog window, the teapot will jump to the start of the flight_path curve.



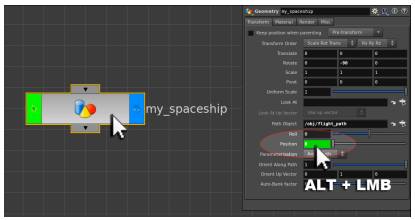
Set the **Rotate Y parameter** of the **spaceship object** to **-90**. This will correctly orient the teapot relative to its direction along the curve.

ANIMATING THE SPACESHIP ALONG THE PATH

The **position** of the **my_spaceship** object on the path can be controlled over time. This is known as setting **keyframes**.



Set the **timeline** to **Frame 1** and the **Position Parameter** of the **my_spaceship object** to **0**.



ALT + LMB on the **Position Parameter**, to set a key frame for the first frame of the animation. This will cause the parameter to appear bright green (indicating that a keyframe or a procedural expression has been set).

Note:	Parameter Colour	Meaning
	Bright Green	Channel has a keyframe or procedural expression set to it, and timeline is currently at that frame.
	Pale Blue	Channel has a keyframe or procedural expression set to it, and timeline is not currently at that frame.
	Yellow	Channel has a keyframe set to it; the timeline is not currently at that frame, and the parameter value has been modified without a new keyframe yet being set.

Set the **timeline** to **Frame 250**, and the **Position Parameter** of the **teapot object** to **1**. This will move the teapot to the far end of the flight_path curve. **Pressing Alt + LMB** on the **Position Parameter** will activate this new Position Parameter value as a second key frame.

When **PLAY** is pressed, the teapot animates along the curve. Ensure that the **Real Time Playback button** is activated. This will cause the timeline to play relative to the current **F**rames **P**er **S**econd setting (this is preconfigured at 25 FPS).

Other Key-Frame-able Parameters to cont the spaceship object along the path include **Roll** (which will cause the object to perform an oriented spin along the path) and **Auto Bank factor** (a multiplier value causing the object to automatically roll relative to tightness and direction of the curve – the higher this value is set, the more the object automatically rolls).

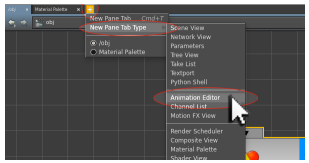
EDITING KEYFRAMES

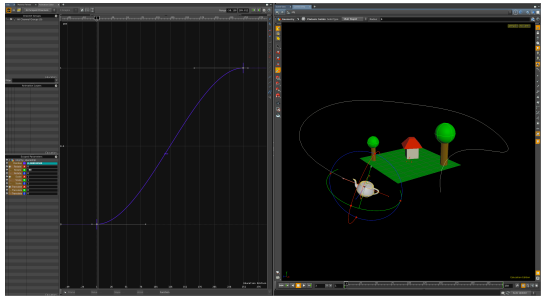
Deleting Keyframes: **RMB hold** on the **Parameter Name**, or its numeric value and choose **Delete Channels** from the resulting menu. This will erase all keyframe or procedural expression references from the parameter's channel, and restore it to a numeric entry field.

Editing Keyframes on Timeline: **SHIFT + LMB Drag** will select a range of keyframes
SHIFT + MMB Drag will move any selected keyframes along the timeline
RMB on timeline will activate a contextual menu for editing keyframes on the timeline.

THE ANIMATION EDITOR

Keyframes can also be viewed in graphical form, allowing for the interpolation between the keyframes to be seen and modified. The **Animation Editor** can be activated by **LMB** the **Pane Tab + button** in the Network Editor, and from the resulting menu choosing **New Pane Tab Type > Animation Editor**.





This will activate the Animation Editor on the left side of Creation Desk split pane book format, allowing for ease of editing keyframes relative to their visible effect in the Viewer.

NOTE: If an animation curve does not immediately appear in the Animation Editor, simply select the object with keyframes assigned in the Viewer and press ENTER to activate it.

When the **Position parameter animation curve** is **LMB selected** into the **Animation Editor**, its interpolation function is revealed as being of type **bezier()**. This interpolation draws a smooth curve between the two keyframes that is rounded at either end. This rounding of the animation curve creates a slower start and finish to the animation of the spaceship known formally as 'ease in' and 'ease out'.

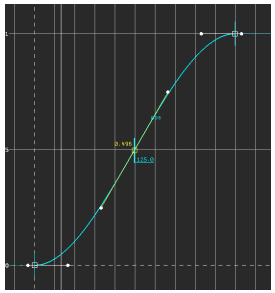
Other types of animation behaviour can be set by **LMB** selecting the existing animation curve and selecting a new interpolation type from the **Function menu** located at the bottom right hand corner of the Animation Editor. Multiple interpolations (separated by keyframes) can also exist on a single animation curve.

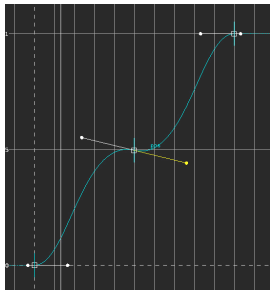
INSERTING & DELETING KEYFRAMES

Alt + LMB clicking on the animation curve at the desired keyframe insert position can add Keyframes. Keyframes can be deleted by **LMB** selecting the keyframe and pressing the **DELETE** key.

MODIFYING KEYFRAME TANGENTS

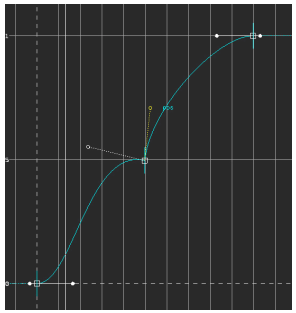
Ensure the interpolation curve between the two keyframes is set to **Bezier()** and add a new keyframe to the middle of the curve using **ALT + LMB**. **LMB drag-select** this new keyframe so that the yellow tangent handles appear.

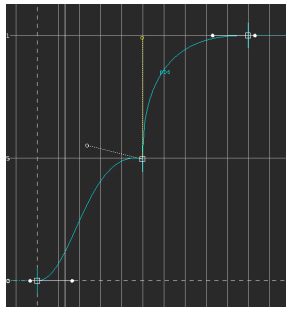




Move the yellow tangent handle so that the shape of the animation curve is altered. Notice that both sides of the new keyframe are affected by modifying one of the tangent handles.

Tangent handles can also be **broken** so that both sides of a keyframe work independently of each other. **Pressing t** on the keyboard with the **mouse over the Animation Editor** can do this.



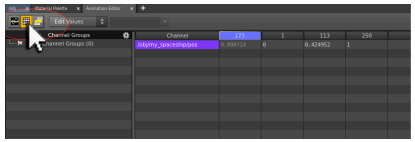


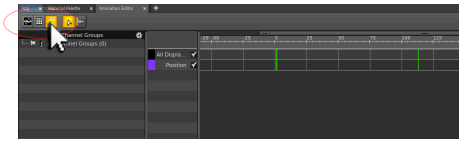
If a curve is set to a bezier() interpolation, the tangent handles can also be scaled to increase the arc of the curve it affects.

NOTE: Some animation curve interpolation functions do not allow for tangent modification

ALTERNATE CHANNEL EDITOR VIEWS

The **Animation Editor** has two **alternate views** for editing keyframes. These are the **Table View** and the **Dopesheet View**.





These views represent the same keyframe information as the graphical view; however can make accessing larger amounts of animation data simpler. Both the Table View and Dopesheet View can also edit and create keyframes.

See **Simple_Scene_Animated.hip**

COMPLETING THE SCENE - HOMEWORK

Continuing with this simple scene, create and develop the following objects using Primitive modeling techniques:

my_boat **my_horse** **my_spaceship**

This will help practice with the Houdini interface.

Primitive Modeling is also a useful Production Technique as it allows for the establishment and successful engineering of a scene long before higher-level geometry is created. Due to this node based construction of scenes, when new higher-level geometry arrives, it can simply be switched for the Primitive Model placeholders. If a Houdini scene is engineered correctly, this switch of geometry will cascade seamlessly down the entire established network.

OTHER USEFUL SOPS FOR PRIMITIVE MODELLING

For the purposes of primitive modeling (or doodling in Houdini), the following **Geometry Level operators** are worth exploring:

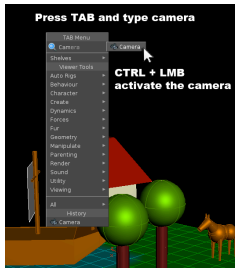
Box SOP, Grid SOP, Sphere SOP, Torus SOP, Tube SOP, Platonic Solids SOP, Color SOP, Copy SOP, Merge SOP, Duplicate SOP, Transform SOP, Mirror SOP, PolyExtrude SOP, Wireframe SOP, Edit SOP.

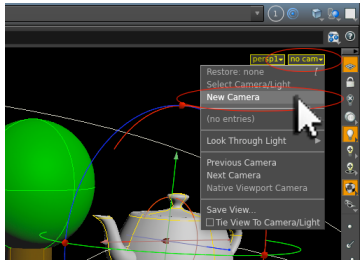
Examine how these modifications to the Position Channel animation curve have affected the movement of the spaceship along the flight path. Experiment further with keyframe animating the other Parameters associated with the my_spaceship object.

Create an animation curve for both the **my_horse** object and the **my_boat** object.

ADDING A CAMERA

A camera can be added to the scene at Object Level by tumbling The Viewer to the desired camera location, and with the mouse over The Viewer pressing TAB and typing camera. Hold down **CTRL** before **LMB** accepting the camera from the menu listing. This will automatically place the camera at The Viewer's current position.

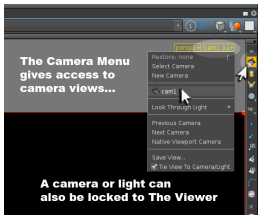




A camera can also be created by going to the **no-cam yellow drop down menu** in the **Viewer** and choosing **New Camera**.

CAMERA BEHAVIOUR

Any created camera will remain in this position unless instructed otherwise. This means any **movement of the Viewer** will **break the camera view**, and restore a standard view for examining the scene. A **camera view can be re-accessed** by going to the **yellow camera menu** of the **Viewer.**



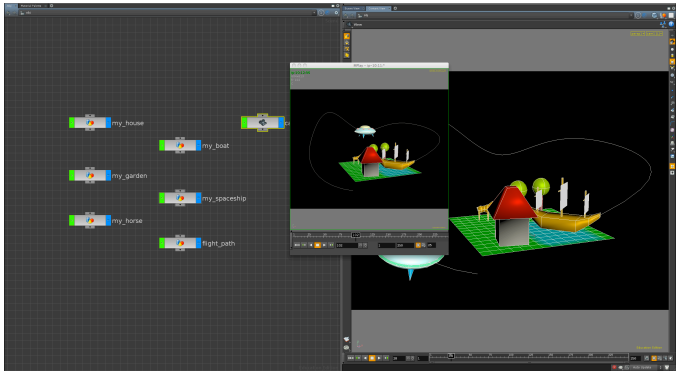
A camera can also be locked to The Viewer by **LMB activating** the **Camera/Light lock button** located on the **right-hand Viewer Stow Bar**. When a camera is locked to The Viewer, any tumbling or interactive positioning of The Viewer will directly affect the camera.

FLIPBOOK RENDERING

A Flip Book render of the scene can be created by **LMB** the **FlipBook Render button** located near the bottom of The Viewer's left-hand Stow Bar. **RMB** the **FlipBook Render button** will give additional flip book render controls.

SAVING A FLIPBOOK RENDER

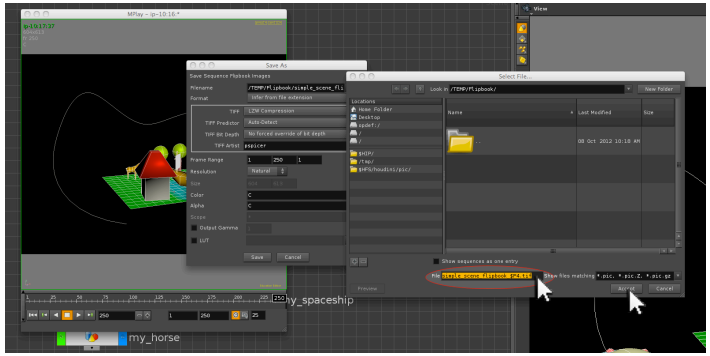
When a flipbook render is activated, Houdini's Image Viewer **MPlay will appear**. The image sequence stored in MPlay are screengrabs of the Viewer, allowing for real time playback to be seen.



This image sequence can be saved to disk for future reference by going to the **MPlay File Menu** and choosing **Save Sequence As**…

In the **Save As Dialog window**, the **Filename browser button** can be activated to choose a destination for the image sequence.

When saving out image sequences from Houdini, **Frame Padding** should be invoked. Frame Padding is the **automated addition of frame numbers** to each saved image, allowing them to be reloaded in the correct order.



In this example, the flipbook render is saved as a tif file sequence with the following naming convention:

simple_scene_flipbook_$F4.tif

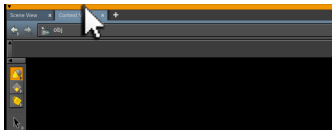
Where **$F4** will append the current frame number (**$F**) padded to **4 digits** (for example **0001.tif**).

$F4 == 0001
$F3 == 001
$F2 == 01
$F == 1

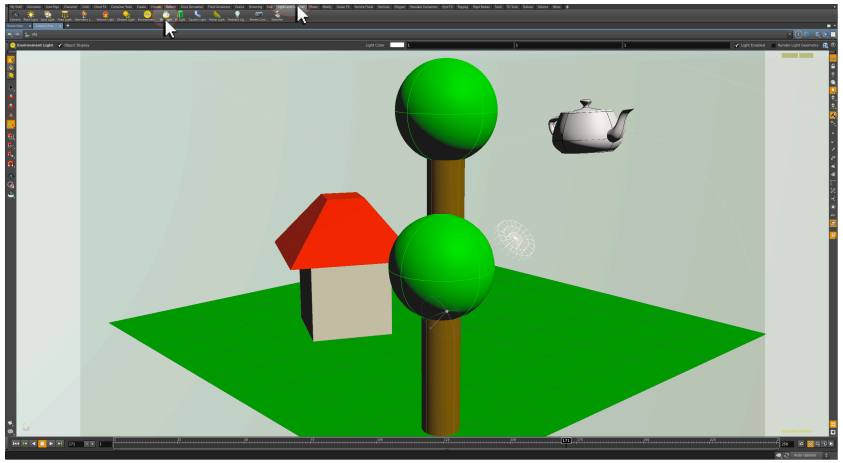
The above listing can be used as a guide to Frame Padding. It is important that Frame Padding has a leading zero above and beyond the total number of frames. In this example for a 250 frame sequence, $F4 was chosen to name the frames 0001 to 0250.

CREATING FORMAL RENDERS OF A SCENE

As well as Flip Book rendering (suitable for animatics), **a scene can be formally rendered**. Before rendering commences, it is a good idea to **add** some **simple lighting to the scene**. This can be done using a **feature of Houdini** known as **the Shelves**. The **Shelves** contain many higher-level Houdini tools that will be explored during the course of Houdini teaching. When learning Houdini, it is a good idea only to use the Shelves for simple tasks such as the creation of cameras, lights and simple modeling tools.

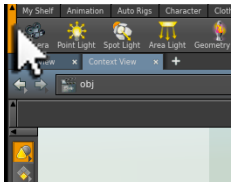


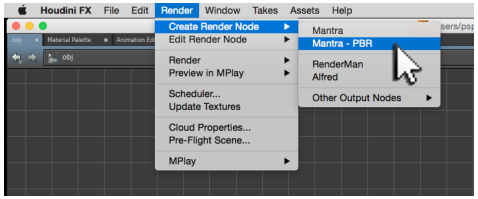
Use **CRTL + B** to **maximize the Viewer**, and at the top of the Viewer **LMB** the **top grey stow-bar** to **activate the Shelves** (it will turn **orange** when it is pressed).



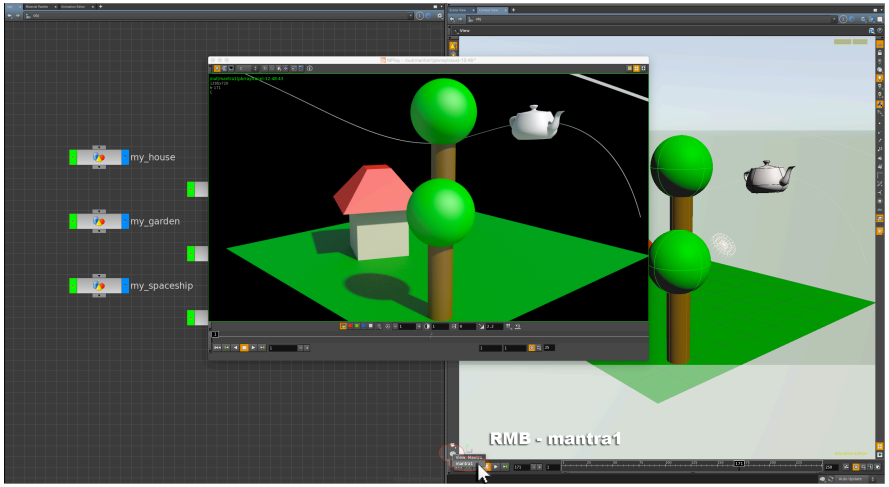
Go to the **Lights and Camera Shelf** and **LMB activate** the **Sky Light button**. This will automatically create the nodes for a daylight scene at Object Level in the Network Editor.

After this step, the **Shelves can be re-hidden** so not to clutter the Viewer interface.





Use **CTRL + B** to **minimize** the **Viewer**, and from the main **Render Menu** choose **Create Render Node > Mantra PBR** (Physically Based Rendering).

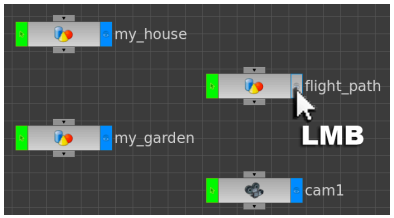


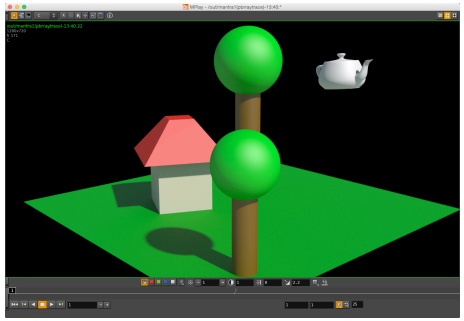
RMB on the **Film Spool Render Button** will reveal the **mantra1** option (the Render Node just created). When this **mantra1** option is **selected**, **a formal render** of the scene will be generated and **displayed** in **MPlay**.

The **flight_path curve** is however **visible in the render**. This is because by default, curves render in Houdini. While this is useful for rendering fur for example, in this context the curve should be invisible.

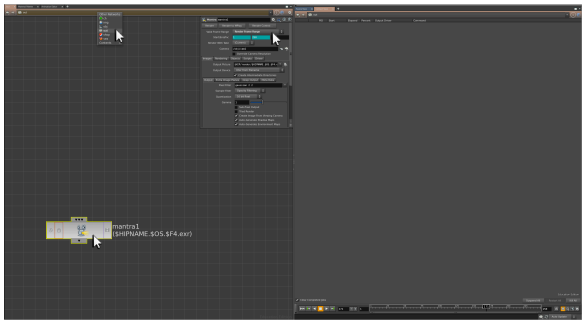
HIDING OBJECTS

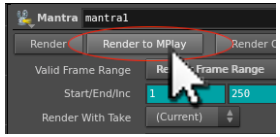
At Object Level, the visibility and select-ability of objects can be controlled using the Network Editor. The blue display flag of the **flight_path object** can be **LMB deactivated** to make it invisible in formal renders and flipbooks. Similarly the green select flag can be deactivated to prevent unwanted interaction with an object in the Viewer.





When the scene is rendered again, the flight_path curve no longer appears.





If required, the **OUT Level** of Houdini can be accessed, where the **parameters** of the **mantra1 ROP node** can be adjusted to **render out an image sequence**. The **Render to MPlay button** will render the sequence to Houdini's image viewer, where it can be saved out to disk as per Flip Book Rendering. More formal instruction about Mantra PBR parameters and rendering sequences will be given in a future Houdini lesson.

WHAT IS HOUDINI?

Houdini allows for the creation of computer-generated objects for film and animation. This generation of objects takes place at Object Level. Each object created is a container for the geometry that describes the object. Inside each object is a Geometry Level, which contains all of the operations for creating geometric shapes. Transforming an object at Object Level is known as a World Space Transformation. Transforming the geometry inside an object at the Geometry Level is known as an Object Space Transformation.

Geometry Networks that describe geometry can either be built by hand in the Network Editor or generated through The Viewer.

Networks can be generated in a very dynamic way. In this example, a network creating a simple tree was utilised twice to create a second tree in the scene by strategically appending a transform node to do this.

Primitive Modeling is a modeling technique utilised for creating a scene quickly and efficiently to a rudimentary level. This allows for all elements within a scene to be developed in parallel, rather than overdeveloping one aspect of a project in favour of others.

Houdini has a total of nine different levels which each have their own set of operators assigned to them. Each Level therefore has its own purpose. As all Houdini levels work on the same interface principle, learning the Object and Geometry Level's will enable a user to quickly adapt to the other levels.