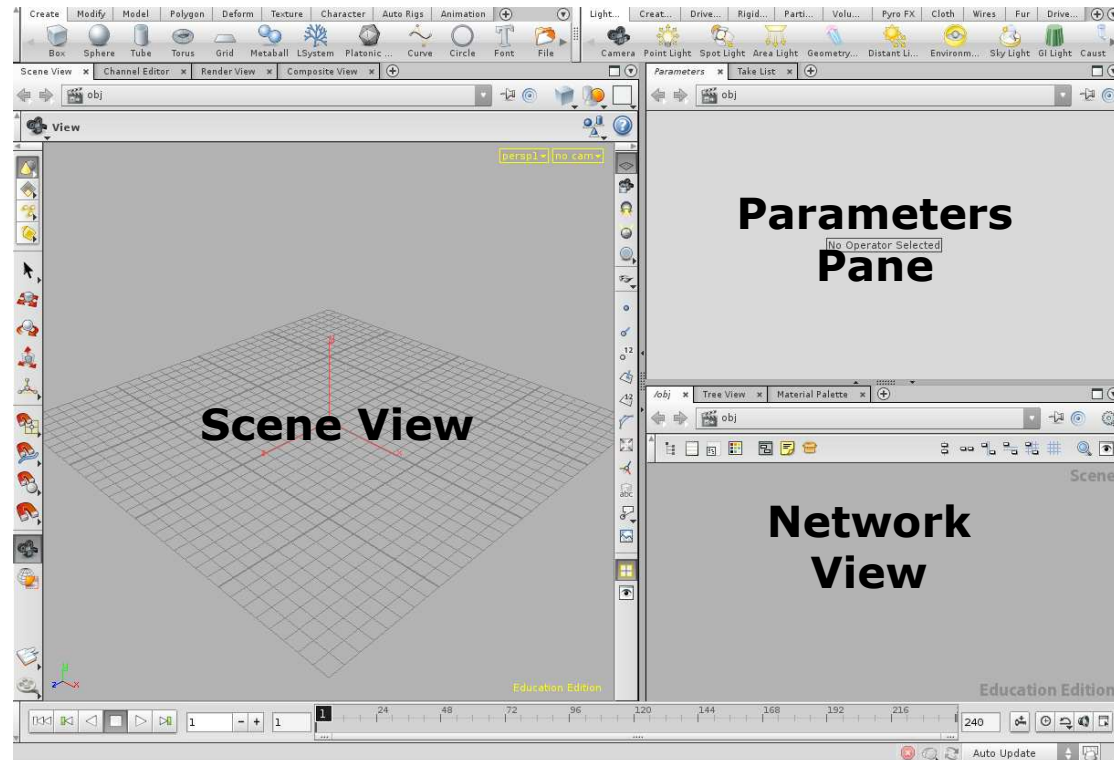


Workshop 01: Getting start with Houdini

The Houdini interface

Once you have launched Houdini, you will see a number of panes and toolbars. We will look at the basic functionality of these panes during this workshop.

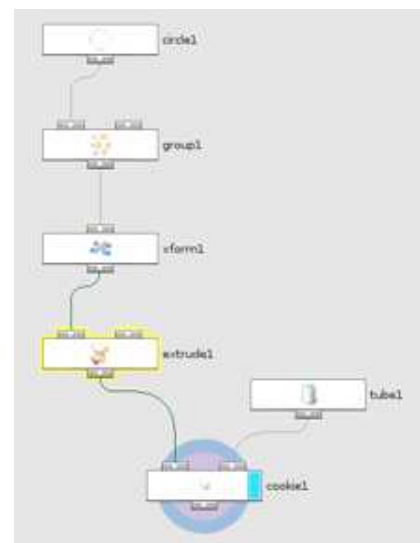


The Houdini workflow

Houdini workflow is based on a simple concept: everything is created and modified through a **"network of operators (OPs)"**. Each operator will do a little bit processing. Each of them will take, or generate, some "contents" (vertices, faces, curves, etc), and the contents will be processed, and then be passed to the next operator for further processing.

Houdini divided "networks of OPs" into different categories:

- Objects (OBJ) – networks of objects (geometry, light, camera, etc).
- Geometry (SOP) – networks to construct a geometry's shape.
- Particle (POP) – networks for particle effect.
- Compositing (COP2) – networks for 2D compositing.
- Dynamic (DOP) – networks for dynamic effect.
- Channel (CHOP) – networks for channel's operation. "Channel" controls how a value changes over time.
- Shaders (SHOP) – networks for creating different shaders.
- Output (ROP) – networks for specifying the rendering settings.
- VEX Builder (VOP) – networks for the Houdini scripting language called "VEX".



Of course, we will not cover all. We will only cover those related to the concept we learned during the class.

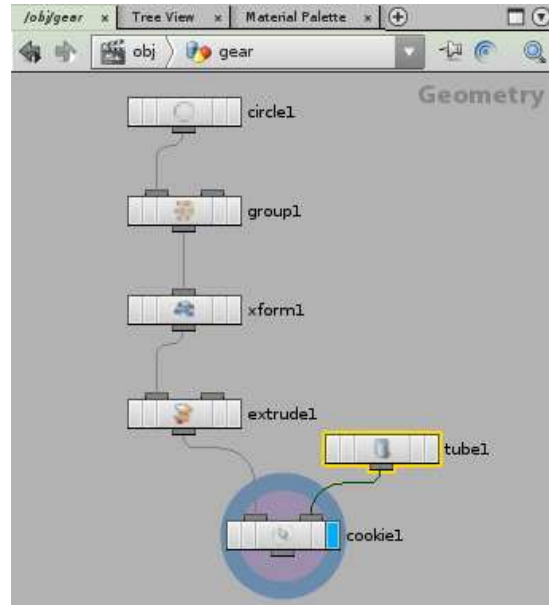
The Network View

The Network View is the most important place inside Houdini: in here we build our network of OPs (i.e. procedures) to perform different tasks.

To create an OP, you can move your mouse inside the Network View, press TAB and choose one of the "OP" available. If you remember the name of the OP, you can directly type the name after you pressed TAB.

The OPs are connected through lines: left-click an output pin (at the bottom) of an OP, and then left-click an input pin (at the top) of another OP you can connect them together.

To disconnect a line, click on the input pin and then click on empty space.



Useful Hot keys for Network View

- 'H' – view all OPs
- 'L' – layout the OPs

Go "in" and "out" an OP:

In most of the time you need to "go into an OP" – to edit the "sub-network" of an OP (if it has). Let's try this simple example:

1. Start from an empty Houdini file.
2. In the Network View of OBJ level, press TAB and create a GEOMETRY.
3. Select the geometry OP, double-click it to "go into the geometry".
4. Now you are "inside" the geometry. Note that you have entered into a SOP network. You can then construct an SOP network for defining the shape of the object.
5. After you have constructed the SOP network, press "u" to go up to the "parent" level – i.e. in this case, the OBJ level.

OBJ level

SOP level

Select and double-click an OP to go into it.

Press "u" to go back to the parent level.

Information about an OP

- Right-click an OP and choose "Help".
- Middle-click an OP – shows the "contents" of this OP.

There are some important terms that you may find in the "contents" of an OP:

Full Name: each OP has a unique name. Of course, you can change its name.

OP type: each OP has a type (i.e. what procedure it does) that you cannot change.

Points: most OP contains points. Points are the basic element of a 3D scene. Points contains a 3D position (x,y,z), and optionally points can also contain color, normal, and other custom attribute (all called *point attributes*). Points are one of the most important elements that we want to manipulate.

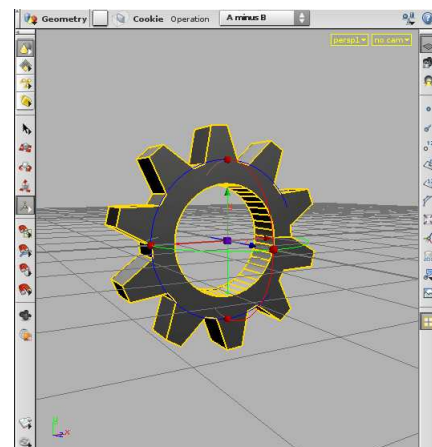
Vertices: vertices can share points, but vertices also contain their own information. For example, if I have a cube with 6 different colored faces, then each corner of the cube contains 3 vertices (each vertex has a different color), but these 3 vertices share the same 3D position (i.e. shared the same point).

Primitives: several points form a "primitive". Points cannot be rendered, but primitive can be. "Primitive" is a general term in Houdini, where it can be polygons, curve surfaces (NURBS), meta-ball, a whole particle system, etc.

The Scene View

The Scene View is a view of your scene. You can navigate this 3D view using your mouse.

Similar to any other 3D software, Houdini allows animator to pick/drag/modify any element (vertices, edges, faces, curves, etc) in the Scene View. Say, you can pick-and-drag vertices there. However, as this course is about the "procedural" approach, we will focus on the Network View more than the Scene View.



Hot key for navigating the scene:	
"space" + left mouse button	Tumble view
"space" + middle mouse button	Pan the view
"space" + right mouse button	Zoom in and out of the scene
"space" + "H"	Reset to the default view
"space" + "G"	Frame all visible objects
"space" + "B"	Toggle between 4 views and single view
"space" + "W"	Toggle between wireframe and shading

Note that the Scene View can have two different modes: "view" mode and "edit" mode. If you are in the "view mode", you can simply drag your mouse buttons without need to press the SPACE BAR. If you are in the "edit mode", you can manipulate the current selected OP through different manipulators.

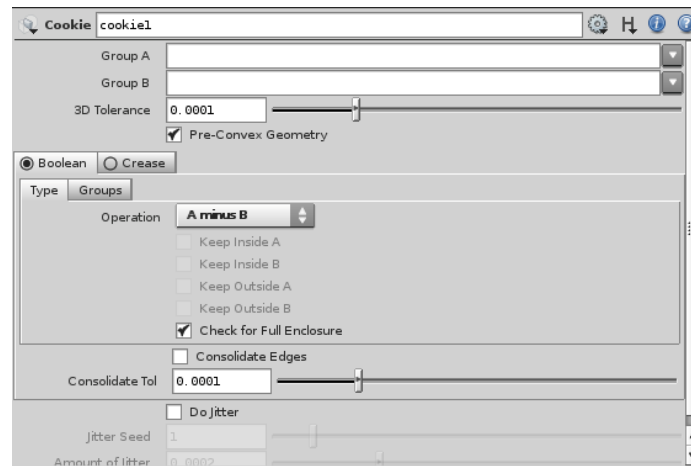
Switch between EDIT and VIEW mode in the Scene View:	
<ul style="list-style-type: none"> ● Select an OP in the Network View. ● Move the mouse to the Scene View. ● Press ENTER to go into "edit mode" of the selected OP. ● Press ESC (when the mouse is in the Scene View) to go back to "view mode". 	

The Parameter pane

When you select an operator in the Network View, the parameters of that operator will be shown in the Parameter pane. You can modify any editable values there.

There are several ways to edit a value:

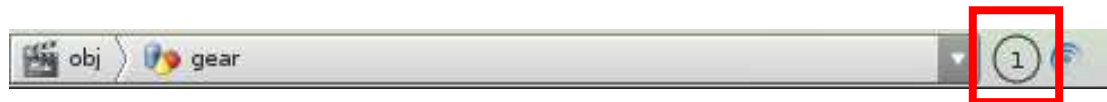
- Type in a new value directly.
- Middle-click-and-drag horizontally on any numerical value in the Parameter pane to adjust its value.
- Type a value and then set a key frame by pressing Alt+LMB.
- Type in an expression (e.g. `sin()`, `cos()`, `rand()`, etc).



(Tips: right-click on a value you can find other operations that can be applied on that value. In some situations, you may want to use the “Delete Channels” to remove the key-frames stored in that value, or “Revert to Defaults” to set the value back to the default value.)

In Houdini, most “procedural animation” can be done through typing expression for a value. In this way, it minimized the effort of writing script line-by-line.

Link pane together



Another interesting feature of Houdini interface is to “link panes together”. For example, if the Parameter pane and the Network View are linked, selecting an operator in the Network View will make the Parameter pane show that selected operator. If they are not linked, the Parameter pane will keep unchanged. You can link/unlink panes to fit your own need.

Desktop

In Houdini, a “Desktop” is just a combination of panes. You can choose a pre-defined desktop (from menu Windows > Desktop) that fits your need, or you can create your own desktop arrangement.

Our first Houdini model

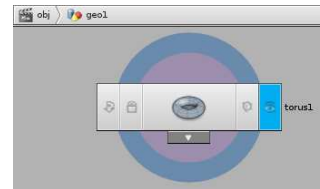
Let's start to "build some model". We are going to create a simple model as our first exercise on Houdini.

We said that Houdini realized the "procedural approach" by connecting operators (OPs) together. In this exercise we will create a "SOP" network to specify the geometry of an object.

Step 1) Create a new Houdini file. In the OBJ level, press TAB and create a GEOMETRY. Double-click the newly created geometry to go into it. In the Network View, select and delete the default FILE OP that was created for you.

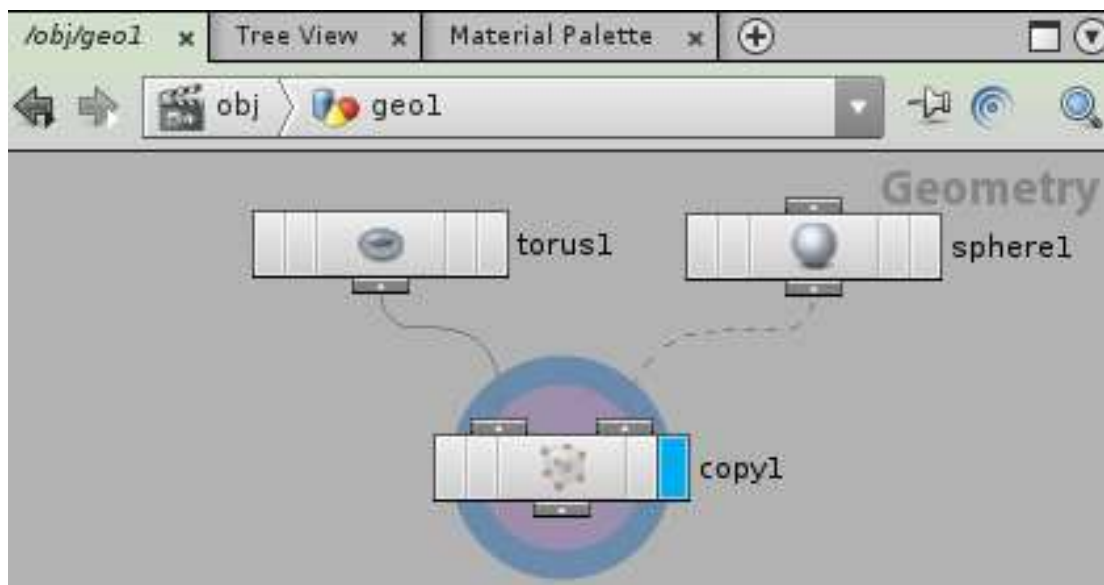
Step 2) In the Network View, press TAB and create a TORUS. Set the orientation of the torus to Z-axis (I will explain this soon). You may like to fine-tune other parameters of the torus, but let's keep them in their default values at this moment. We can go back here anytime we like (this is one of the advantages of procedural approach, right?).

Note the **blue flag** on the rightmost of the OP. It is the display/render flag. You have to turn it on if you want to view the result in the Scene View. One and only one display flag can be turned on inside a SOP network.



Step 3) Create a SPHERE OP. Turn its blue flag on if you want to view it in the Scene View. Increase its radius to 5 (tips: try middle-drag the parameter name "Radius" to see what happen). Also select "Polygon" as its "primitive type". We want the SPHERE to be made up by many points (and those points will be passed to the next OP). A "primitive" sphere will only contain one "point" – its center, and this is not what we want in this exercise.

Step 4) Create a COPY OP and connect the network as shown below, and see what happen.



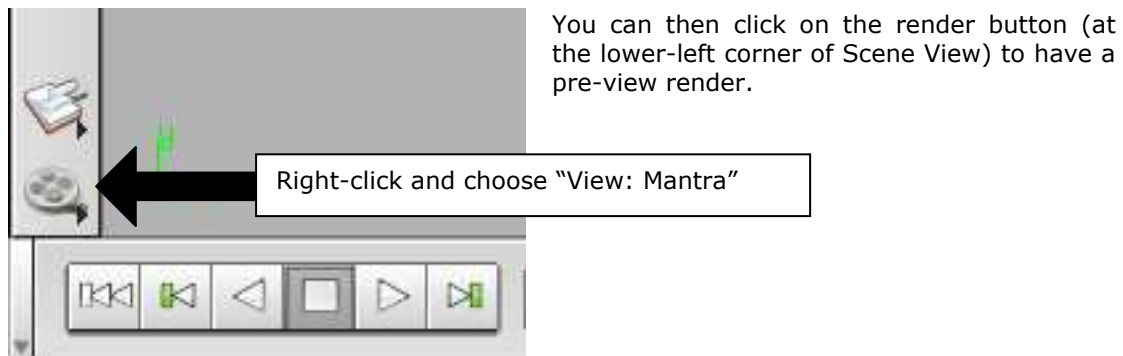
Note that COPY is a "procedure" in Houdini: **it copies the shape on the left input to every point on the right input**. By default, the z-axis of the LHS shape will be oriented to match the *normal* of the points on the RHS (that's why we set the orientation of the torus to "z-axis").

Note that this COPY OP is not restricted to work on Torus and Sphere (of course!). You can connect, say, on the left input a complicated network that generates a shape, and another complicated network on the right input that generates points. The COPY OP will still work in its own way: "copy shape on left input to every point on the right input".

Actually COPY is one of the most important OPs in Houdini. We can create many interesting effects using COPY. We will look at it in the coming weeks.

You should also middle-click on each OP to read the information about its contents. It can help you to understand more on what you have right now in the scene.

Pre-view Render



Create lights

If you don't want to use the default lighting, you can create your own lights. For example, you can click the "Point Light" button on the Shelf at the top of the window, and then press ENTER inside the Scene View.



In the OBJ level you should find a new object (a Point Light) created. After you create the light, you may want to use the "edit" mode of the Scene View to position your light – select your light in the Network View, move your mouse to the Scene View, and press ENTER.

Tips: there is another (faster) way to locate a new light: before you create the light, imagine that the Scene View represent a light's view. Move your Scene View to find a position and direction that you want the light to shine to. Then you can press Ctrl+LMB on the "Point Light" shelf button. The newly created light will be placed at your camera position (and direction).

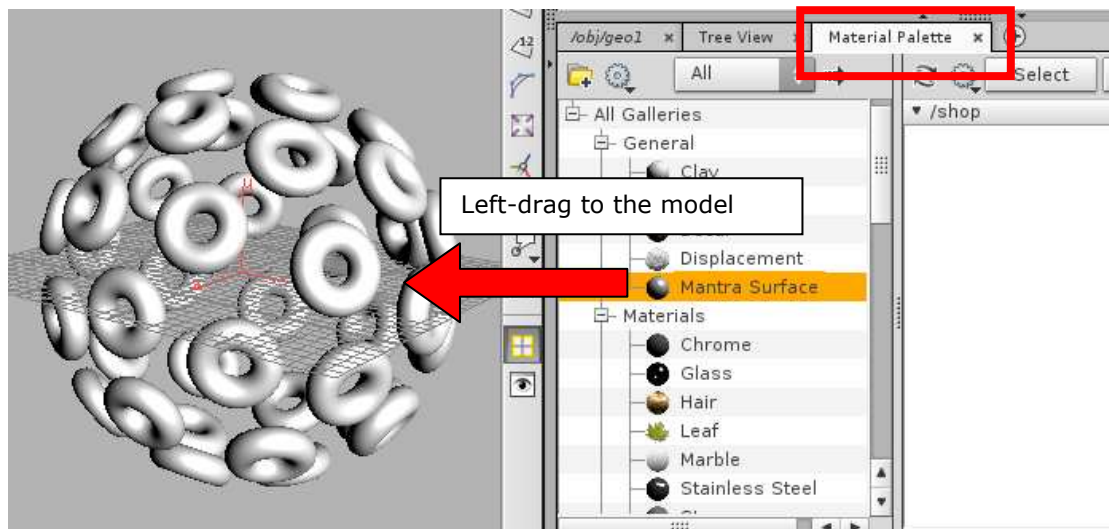
Assigning materials

We will use simple material at this moment. Later on (if we have time) we will try to create our own "procedural shader and texture".

To assign material to an object, you have to do 2 steps:

1. Create one "material" in the SHOP level.
2. Assign a SHOP material to an object in the OBJ level.

Tips: Houdini provides a quicker way to assign a material from a "Material Palette". You can choose a material from the *Material Palette*, left-drag a material onto the model in the Scene View. Houdini will automatically perform the two steps mentioned above.



You can check the result by:

- Go to the SHOP level: you should find a new OP created. You can fine-tune the color here.
- Go to the OBJ level, and select your model. In the Parameter Pane, select "Material". You should find the full name of the SHOP material be put there.

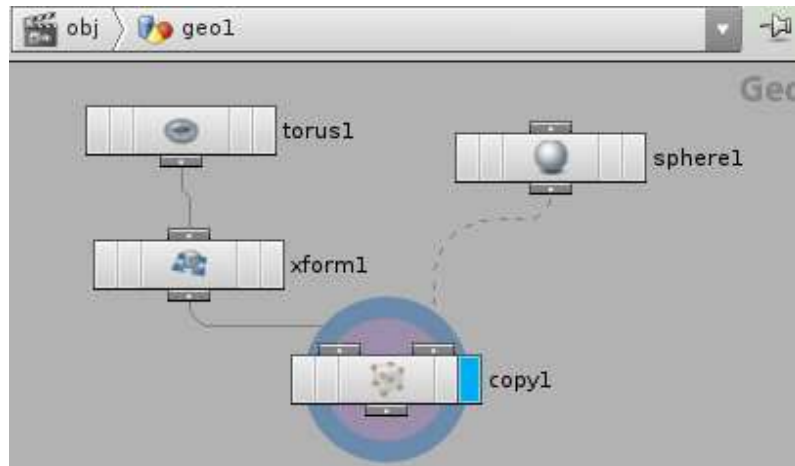
For beginner, I suggest you using the "basic" material called "Mantra Surface". You can also try other materials under the category "General", "Materials" and "Patterns". (The materials under category "Sprite", "Utility" and "Volume" are for other purposes, which we may not have enough time to cover.)

You can also assign material in the SOP level. We will look at this later in this course.

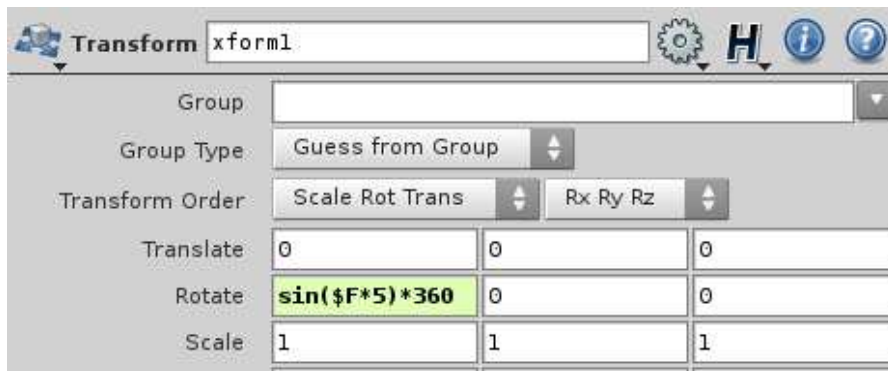
A Simple Animation

Let's setup a simple "procedural" animation in this first exercise: the TORUS rotates according to a cyclic formula – the *sine()* formula.

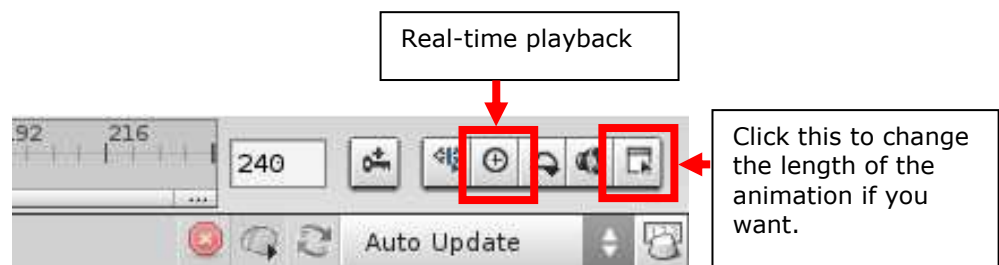
1. Go inside the geometry if you are not there.
2. Select the TORUS. Right-click at its output pin, and then type TRANSFORM. A new TRANSFORM OP should be created and connected between TORUS and COPY.



3. In the Parameter Pane, type the following formula inside the Rotate X attribute of the TRANSFORM OP (I will explain this formula later in this course):
 $\sin(\$F*5)*360$



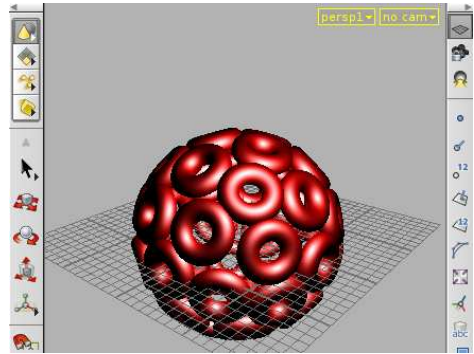

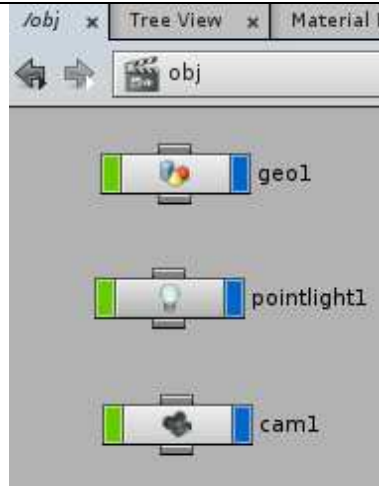
4. Play the scene to see what happen. You may also want to turn on the "real time playback" to have an idea how fast the animation is in the final rendered.



We will look at this kind of "procedural animation" later in this course. You don't need to worry too much about the formula at this moment.

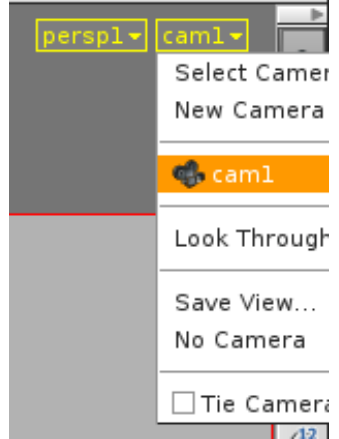

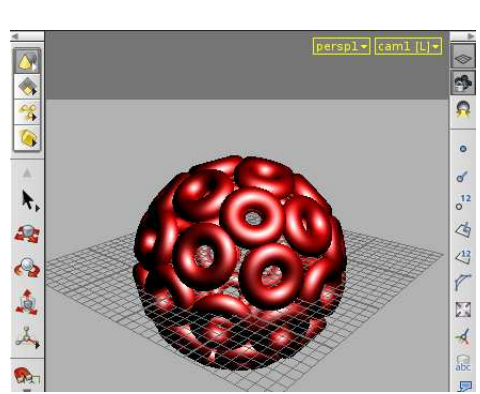
Final Rendering

To have a final rendering, especially you want to render a sequence of images, you have to create at least one camera. Similar to creating a light, you can move your view in the Scene View, and then Ctrl+left click on the camera shelf button. In the OBJ level you should find a new camera object is created:

		
<p>(1) Move the view</p>	<p>(2) Ctrl+left click the camera shelf button</p>	<p>(3) A new camera object will be created</p>

Note that when you navigate in the Scene View again, you are not moving the new camera, but move a default camera called "no camera". If you want to navigate through a particular camera, you have to "lock the camera":

1. Choose the camera from the drop-down menu at the upper-right corner of the Scene View.
2. Press the "Lock camera" button.
3. Now, when you navigate your Scene View, you are actually moving the selected camera.

		
<p>(1) Choose a camera</p>	<p>(2) Lock camera</p>	<p>(3) Navigate through the selected camera</p>

Tips: the "lock camera" idea can also be applied to light, so that you can look through your light, lock the light, and navigate in the Scene View to position your light.

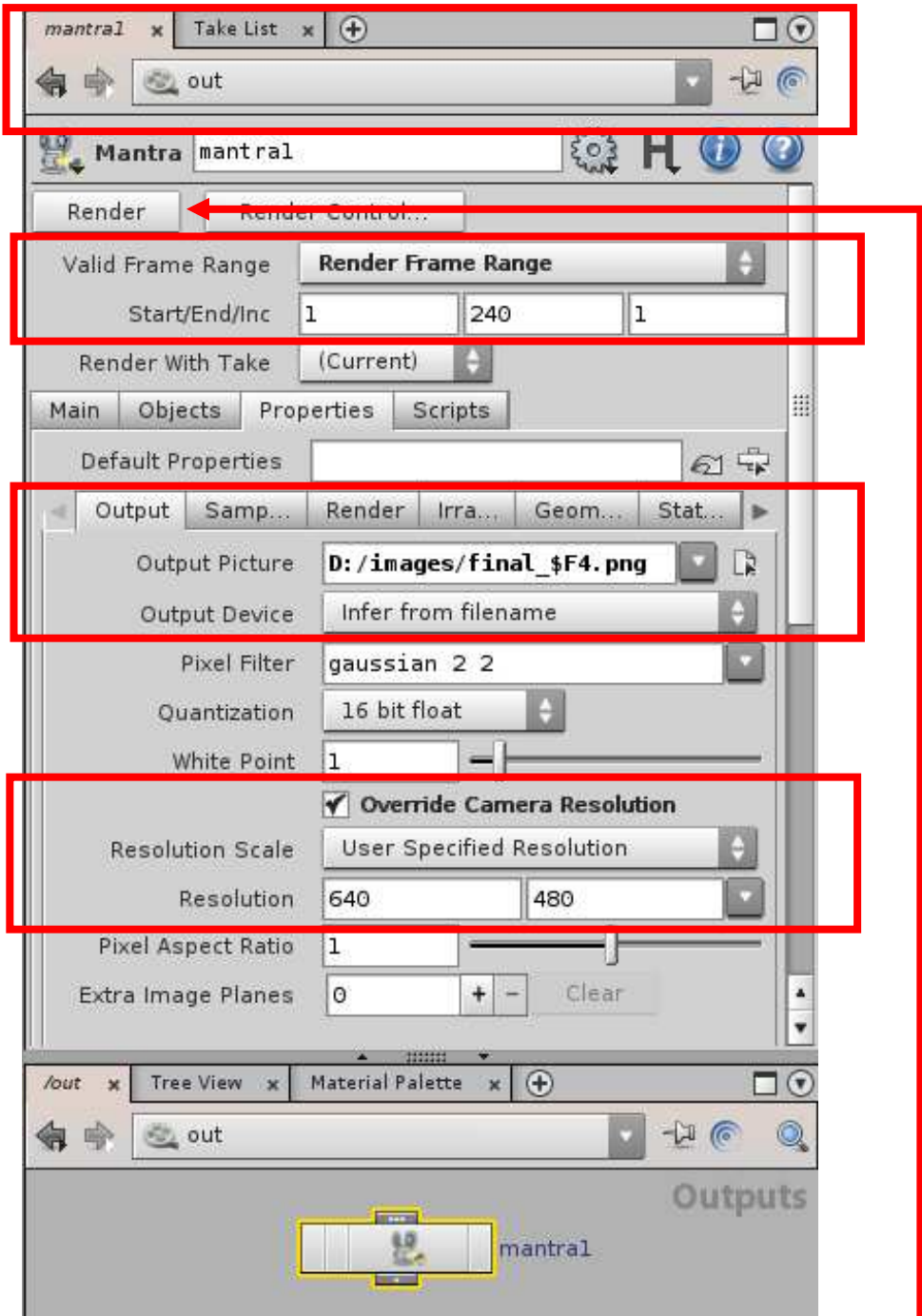
To render a sequence of images, you should create an "Output driver" in the OUT level. Go to the OUT level, press TAB in the Network View and create a MANTRA OP. Tune the rendering settings in the Parameter Pane:

Make sure that you are in the OUT level.

Change this section if you want to render a sequence of images.

Specify the image(s) name and file format. The \$F4 in the file name will be replaced by the frame number, padded with 4 digits.

Change this section if you want to render in a different resolution.



Lastly, you can click the RENDER button on the upper-left corner of the Parameter Pane to start the final rendering.

Tips: Houdini has a tool for viewing the output image sequences:
 Start > Programs > Side Effects Software > Houdini 11.0.XXX > Image Viewer

**** Week 01 END ****