

## HOUDINI FOUNDATIONS

# MODEL, RENDER, ANIMATE

Welcome to Houdini. In this lesson you will start from scratch to model, render, animate, and simulate a soccer ball (also known as a football in many parts of the world). You will create a classic bouncing ball animation using the principles of squash and stretch, apply textures and materials, add lights and cameras, and explore the use of dynamics to simulate a group of soccer balls.

These tasks will introduce you to many different parts of Houdini as you create your first Houdini scene, explore the interface and discover some of its most important tools. You will learn how to work interactively in the **Scene View** and how to use the **Network View** to manage your nodes as you refine your model and build your animation rig. You will also set up materials and textures on the **Solaris Stage** then you will render using Houdini's built-in renderer **Karma**, and finally create a **Rigid Body Simulation**.

### LESSON GOAL

*Model, Render, Animate and Simulate a soccer ball using Houdini's procedural node-based workflow*

### WHAT YOU WILL LEARN

- How to work with the **View Tools**
- How to use **Shelves**, **Radial Menus** and the **Tab** key
- How to create **Geometry**
- How to work with **Nodes and Networks**
- How to set up **Custom Attributes** and a **For-Each Loop**
- How to set up **Materials** and **Texture UVs**
- How to **Layout** a shot and render with **Karma**
- How to **Set Keyframes** and add **Motion FX**
- How to use **Rigid Body Dynamics**

### LESSON COMPATIBILITY

Written for the features in Houdini 19.5+

The steps in this lesson can be completed using the following Houdini Products:

Houdini Core	✓
Houdini FX	✓
Houdini Indie	✓
Houdini Apprentice	✓
Houdini Education	✓

Document Version 4.0 | July 2022  
© SideFX Software



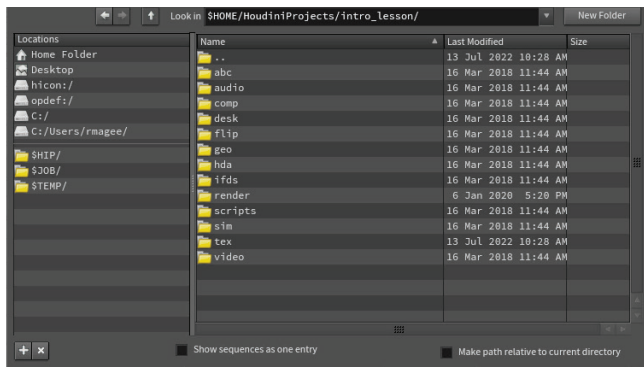
# PART ONE

## Explore the Houdini UI

To get started, it is important to learn how to work with the Houdini workspace and the three panes you will use the most. The **Viewport** lets you create objects interactively, the **Parameter Pane** lets you edit node properties and the **Network Editor** lets you work directly with the node networks.

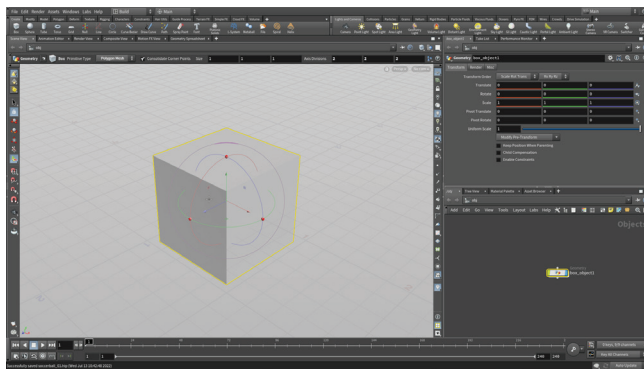
### PROJECT FILES

Go to the **soccerball tutorial** page on **SideFX.com**, where you likely got this document, to download the *intro\_lesson* directory. Put it into the **Houdini Projects** directory which you can find in either the **home** directory or the **documents** directory.



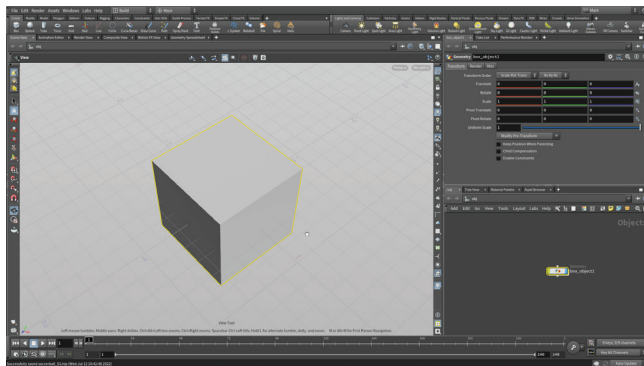
**01** Select **File > Set Project**. Find the *intro\_lesson* directory that you downloaded earlier and press **Accept**. This makes this project directory and its sub folders the place for all the files associated with this shot.

Select **File > Save As...** You should be looking into the new *intro\_lesson* directory. Set the file name to *soccerball\_01.hip* (or *football\_01.hip* if you would prefer) and click **Accept** to save.



**02** In the viewport, **press c** to bring up a radial menu. From this menu, choose **Create > Geometry > Box**. Your cursor now shows the outline of a box waiting to be placed in the scene. **Press Enter** to place it at the origin.

This creates a box in the Scene view, adds a node in the Network editor and shows the object parameters in the Parameter pane. As you work through this project, you will touch on all of these interface elements.



**03** You can now explore the **View** tool in Houdini. Press the following hotkeys:

- **Tumble** Spacebar or Alt[Opt] - LMB click-drag
- **Pan** Spacebar or Alt[Opt] - MMB click-drag
- **Dolly** Spacebar or Alt[Opt] - RMB click-drag

In some cases, you will want to home in to get your bearings. There are some hotkeys for that as well:

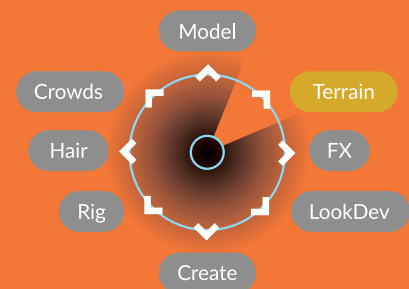
- **Home Grid** Spacebar - H
- **Home All** Spacebar - A
- **Home Selected** Spacebar - G



### RADIAL MENUS

One way to access tools in Houdini is radial menus which you can access using the **X**, **C** and **V** hotkeys. Each of these brings up a radial menu with lots of options for you to choose from. The main focus of each menu is as follows:

- |                  |   |
|------------------|---|
| Snapping         | X |
| Main (or Custom) | C |
| View             | V |

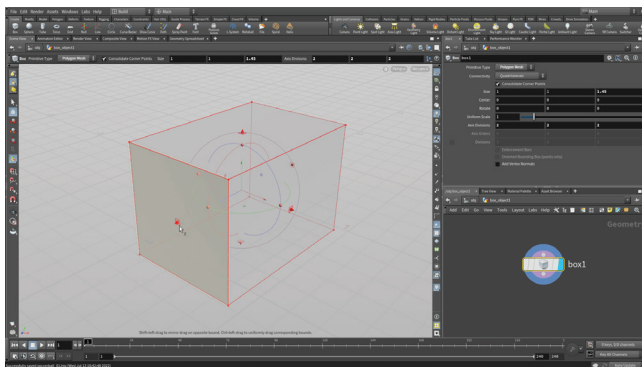
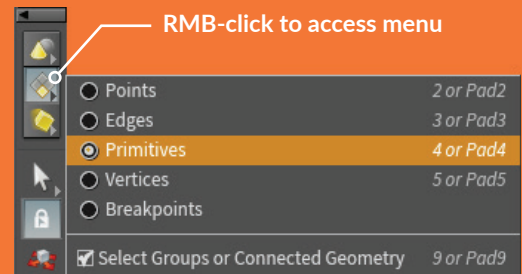




## SELECTION HOTKEYS

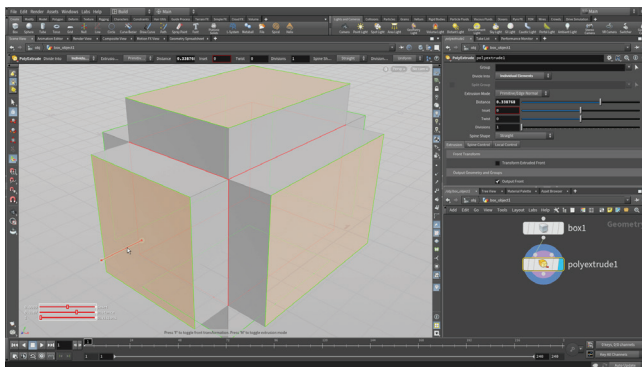
If you are using the **Select, Move, Rotate, Scale** or **Handles** tools, the following hotkeys will determine your selection mode as well as which level you will be working at.

Objects	Object Level	1
Points	Geometry Level	2
Edges	Geometry Level	3
Primitives/Faces	Geometry Level	4
Vertices	Geometry Level	5



**04** With the object selected, **press i** to go to its geometry level. Use the **Shift** key to drag on handles to make it longer along z axis around the origin.

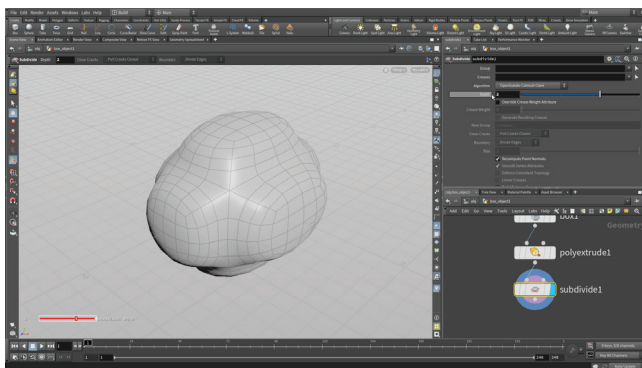
When an object is created in Houdini, there is an **Object level** which is where you manage the transformations of the object and a **Geometry level** where you define its shape. Pressing **i** brought you down into the geometry level of this object. You can also get there by double-clicking on the object node in the Network editor. Later, to get back to the Object level, you will **press U**.



**05** Press **S** to go to the **Select tool** then **4** to access Primitive selection. Press **n** to select all then **press c** to bring up the radial menu and choose **Model > Polygons > Poly Extrude**.

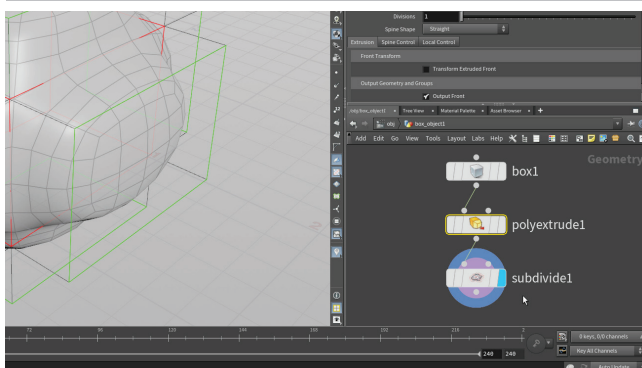
In either the **Operation Control Bar** at the top of the Scene view or the **Parameters** pane, set **Divide Into** to **Individual Elements** and use the handle to set the **Distance** to around **0.4**. This extrudes the faces along the normals of each primitive.

You can see that there are now two nodes in the Network view. Each step you take in Houdini creates a node that you can work with to refine your scene.



**06** Press **n** to select all of the new faces and press **Tab** and begin typing **sub...** then select **Subdivide** from the list. The **Tab** key is another way to access tools in Houdini. Typing the tool name lets you focus the list making it easier to find what you want without navigating the submenus.

In the Parameter pane, set **Depth** to **2**. This subdivides the geometry to create more polygons. Houdini also has a subdivision display option at the Object level which you can use to see subdivisions without actually adding any geometry, but in this case you do want to create more polygons.



**07** Select the different nodes in the chain. The handles for each of the nodes appear as you select them but the display remains on the final shape. Set the **Display Flag** on each of the nodes to change which node is the display node. You can also try some of the other flags such as **Bypass** or **Template**. **Wiggle** the **polyextrude** node out of the network then drop it back in.

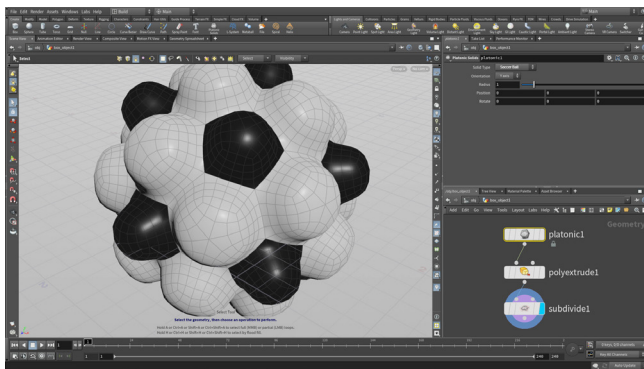
At the end, return everything to normal and set the **Display flag** on the **subdivide** node. This is very important. The Display flag determines what you will see at the object level. **Always check to make sure you have the right display flag set!**



## PART TWO

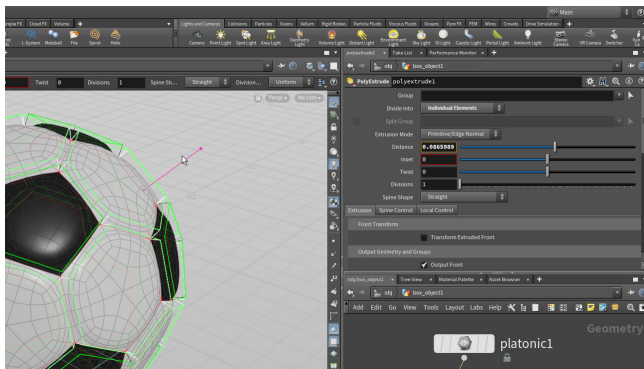
# Create a Soccerball

You are now going to replace the box with a soccerball shaped platonic shape. Using Houdini's procedural approach, you can replace the box node with a platonic solid node. From there you will adjust the other nodes to make it look like a soccerball. This ability to swap out input nodes lets you prototype networks with simple geometry for added flexibility.



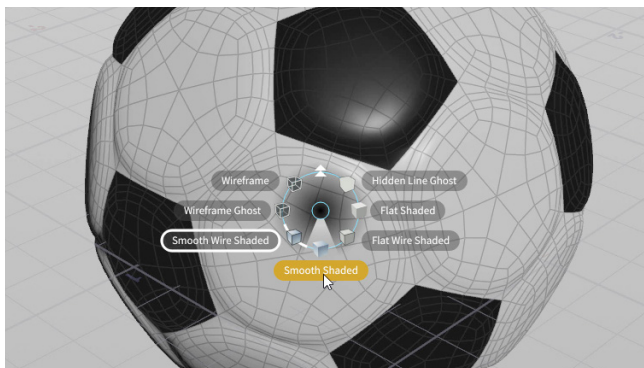
**01** In the **Network editor**, use the **Tab** key to add a **Platonic Solids** node to the network. Click to place it down near the top of the chain. Wire the *platonic* node into the *polyextrude* node. In the parameter pane, set **Solid Type** to **Soccer Ball**. Select and delete the *box* node.

Because of Houdini's procedural nature, it is often possible to replace an input node and have the whole network function properly. This gives you flexibility as you work and if you don't like the results after the change then you can always wire back the original shape.



**02** Select the *polyextrude* node. Make sure the **Handle** tool is active then use the handle in the viewport to set a smaller **Distance**. You can also set the parameter value in the Parameter pane. This creates a better look for the soccerball. Remember that even though you are viewing the *subdivide* node, selecting the *polyextrude* node gives you access to its handles and parameters.

You might think that with this primitive type you are all set but it is really just a truncated icosahedron with flat faces. You need a round soccerball so you will have to put a little more work into it.



**03** Press **V** in the viewport and from the **Radial Menu**, select **Shading > Smooth Shaded**. You can also use the menu in the top right of the viewport to change your shading.

This soccerball looks like a cheap plastic ball rather than a proper leathery soccerball. You are now going to branch off and add more nodes to get a better look.

After analyzing it, set the shading back to **Smooth Wire Shaded**.

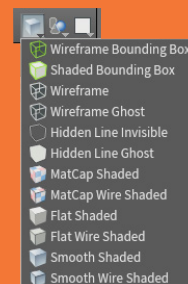


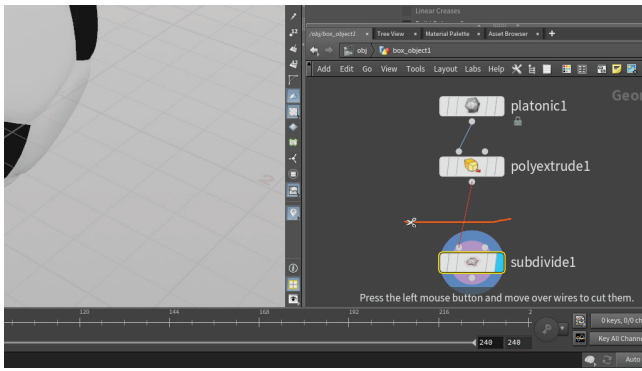
## SHADING OPTIONS

There are a number of **Shading Options** available from either the **View** radial menu or the **Shading** menu in the top right of the Viewport.

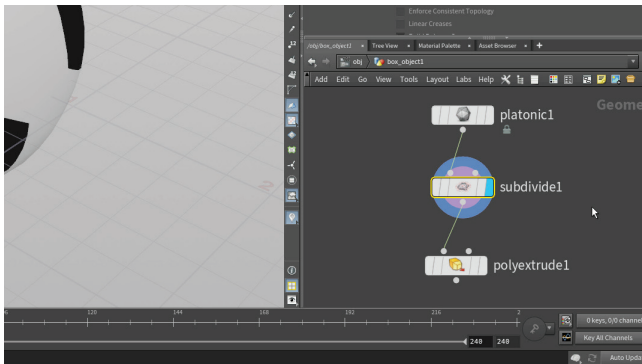
For the shading of your objects, the lighting is determined by the **Display Options** on the right edge of the Viewport. You can choose from a headlight, normal lighting or high quality lighting with shadows.

To quickly toggle from your shaded view to wireframe press the **W** key.

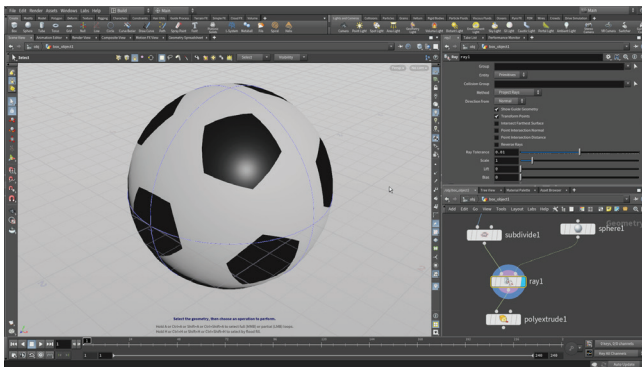




**04** In the Network view, **press Y** and drag across the line connecting the *subdivide* node and the *polyextrude* node to break the connection. You are now going to move the *subdivide* in between the other two nodes so that you get a rounder soccerball.

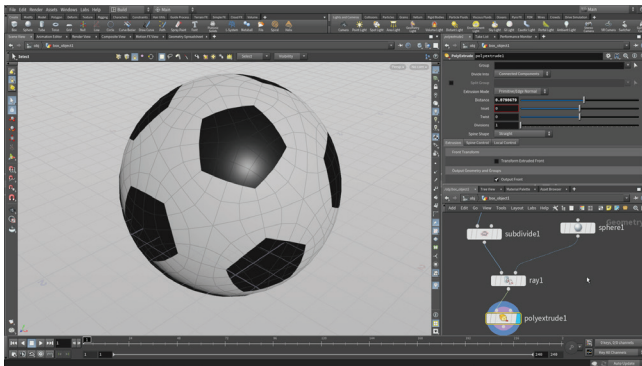


**05** Drag the *subdivide* node in between the *platonic* solid node and the *polyextrude* node. You can drop it on the connecting wire and it will insert itself automatically. If not then jiggle it a little until it finds the connection. This will give more detail to the sphere before it is extruded.



**06** Use the **tab** key in the network editor to add a **Ray** node and wire it in after the *subdivide*. Now add a **sphere** node to the network and set its **Radius** to **1, 1, 1** and the **Primitive Type** to **Primitive**. Now wire the sphere into the second input on the *ray* node. This will project the subdivided ball onto a perfect sphere.

This is a very powerful node in Houdini that lets you project points from one piece of geometry onto another. It is the perfect solution to our problem of a subdivided soccer ball that wasn't truly round.



**07** Set the **Display** flag back on the *polyextrude* node. With **Divide Into** set to **Individual Elements** all the small polygons are extruded but you don't want that. Set it to **Connected Components** then all the polygons are extruded.

You need a way for this network to extrude the original patches of the soccer ball but after the ball has been subdivided. You can do this using the primitive numbers on the original geometry.



## THE RAY NODE

The ray node is a tool that projects points out to another piece of geometry. This is similar to the pinboard toy you played with as a kid. In fact, this is the node you would use to set up a pinboard in Houdini.

**GETTING HELP** | To learn more about each node, you can click on the **?** help button in the top right of the Parameter pane to open up the node's online documentation. You can also hover over the tool in the shelf and **press F1**. In many cases, there are sample files that you can open in Houdini to learn what the node can do.

