HOUDINI FOUNDATIONS

MODEL A REVOLVER

Learn how to use Houdini's modeling tools to create an old west revolver. A lot of this work will be accomplished in the viewport where you will model interactively. Houdini's node network will be used for some modeling tasks and to organize your work. The revolver will be created using primarily **Polygon Modeling Tools** with a focus on models that can be subdivided at render time. You will therefore learn how to clean up models that have topology that won't subdivide properly.

To finish up, learn how to move the revolver into the Solaris context for lookdev and lighting. Here you will assign materials for the body and handle of the revolver. You will then render out an image of the final model using the Karma XPU renderer.

LESSON GOAL

Model an old west revolver using subdivision surfaces then render it using Karma XPU.

WHAT YOU WILL LEARN

- How to set up **reference images** in the background of the viewport panels.
- How to model the **Revolver** geometry in the viewport
- How to use tools such as Boolean, PolyExtrude and PolyDraw
- How to work with **Polygons** and **Subdivision** surfaces
- How to set up **Texture UVs** for the handle
- How to move your model into the Solaris context for lighting and rendering
- How to assign **Metal** and **Wood** materials for the revolver
- How to **render** the final image with **Karma XPU**

LESSON COMPATIBILITY

Written for the features in Houdini 20.5

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

Houdini Core	✔
Houdini FX	✔
Houdini Indie	✔
Houdini Apprentice	✔
Houdini Education	✔

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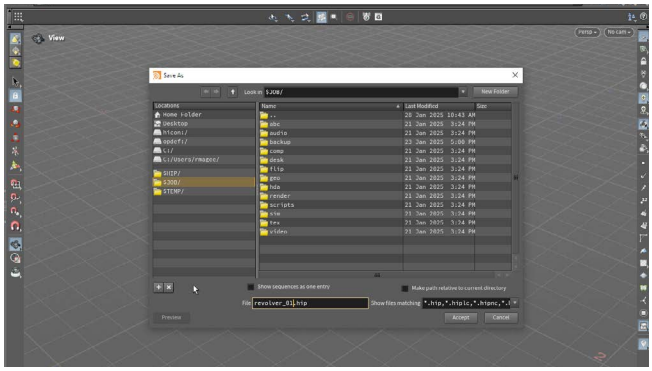
PART ONE: Model the Cylinder

To start, you will learn how to set up reference images for three of the views to assist with the modeling process. You will focus on one section then use reflection and rotational symmetry to build up the cylinder geometry.

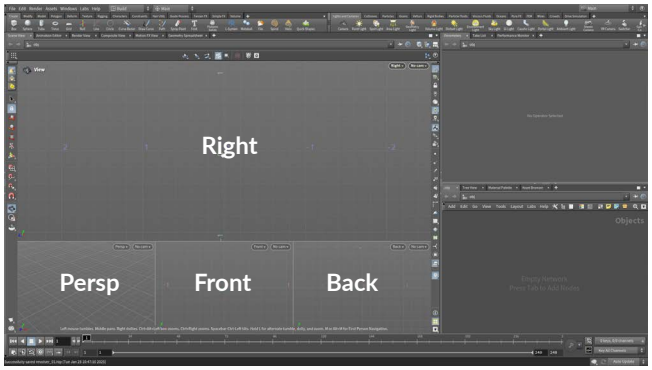
PROJECT FILES

Go to the **Foundations tutorial** page on **SideFX.com**, where you likely got this document, to download the *revolver_lesson_start* directory. Put a copy it into the **Houdini Projects** directory and rename it *revolver_lesson*.



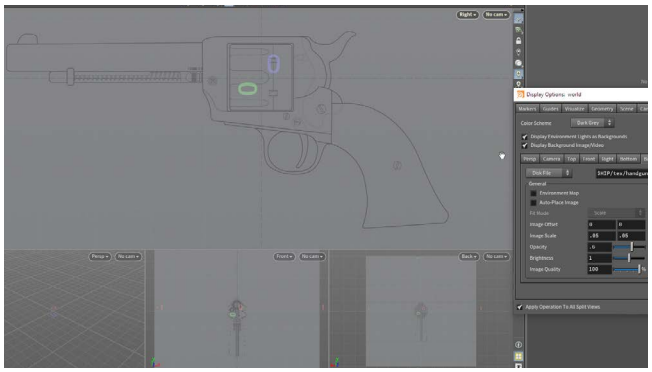
01 Select **File > Set Project.** Find the *revolver_lesson* directory that you downloaded earlier and press **Accept**. This makes this directory and its sub directories the place for you to put all the files associated with this project. Most of these directories are empty. There are reference images and textures in the *tex* directory.

Select **File > Save As...** You should be looking into the new *revolver_lesson* directory. Set the file name to *revolver_01.hip* and click **Accept** to save. Now you will be able to access the reference images in the *Textures* folder.



02 **Press v** to bring up a radial menu and choose **Viewport Layout > Four Views (Bottom)**. Using the view menu in the top left of the **Right view**, change this view to a **Back View**.

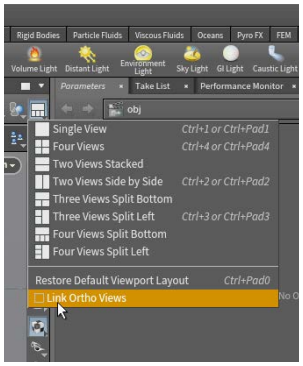
Use the same method to change the large **Persp View** to a **Right View** and the **Top View** to a **Persp View**.

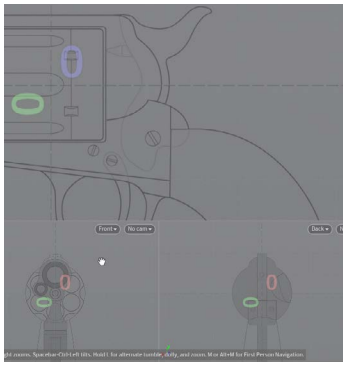


03 Hit **D** with the mouse in the viewport. Click on the **Background** tab and set **Color Scheme** to **Dark Grey**.

On the **Right** tab, use the file picker to navigate to *$HIP* then *tex>revolver_side.png*. Make sure **Auto-Place** Image is turned off and set **Image Scale** to **0.05, 0.05** and **Brightness** to **0.6**. Now if you dolly in the right view the image will zoom in and out.

Then go to the **Front** tab and repeat using the *revolver_front.png* image and the **Back** tab and using the *revolver_back.png* image. For both of these, make sure **Auto-Place** Image is turned off and set **Image Scale** to **0.05, 0.05** and **Brightness** to **0.6**.

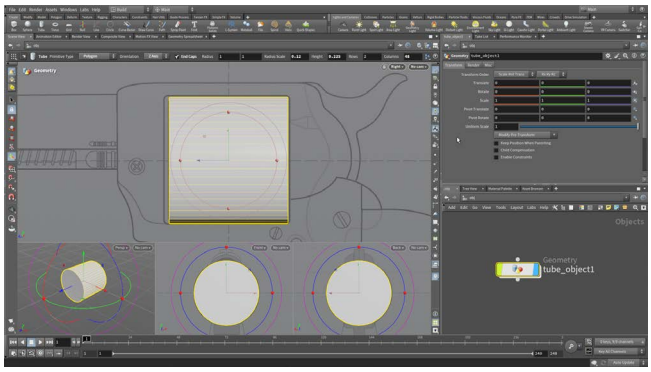




04 To bring any of these views forward you can mouse over it and then press **Spacebar b**. Using **Spacebar b** on the expanded view will bring you back to the four views.

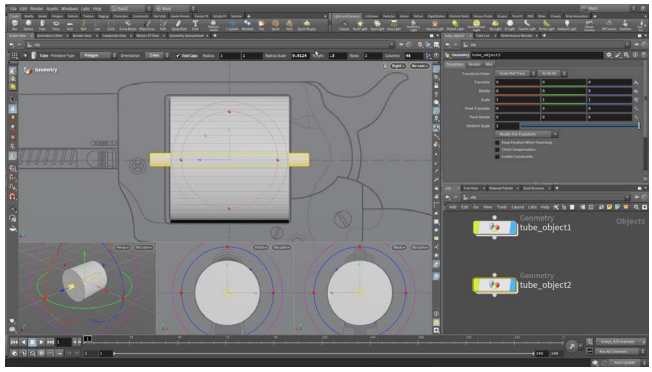
From the menu at the top right of the Scene view, you can turn on **Lock Ortho Views**. This will sync view changes in the different orthographic views.

In the viewport, **press v** to bring up another radial menu. From this menu, choose **Shading >Smooth Wire Shaded**. Now when you start creating geometry you will see the wire lines.



05 **Press c** and from the radial menu, choose **Create > Geometry > Tube** . Press **Enter** to place it at the origin. On the **Operation Controls** bar at the top of the viewport, set:

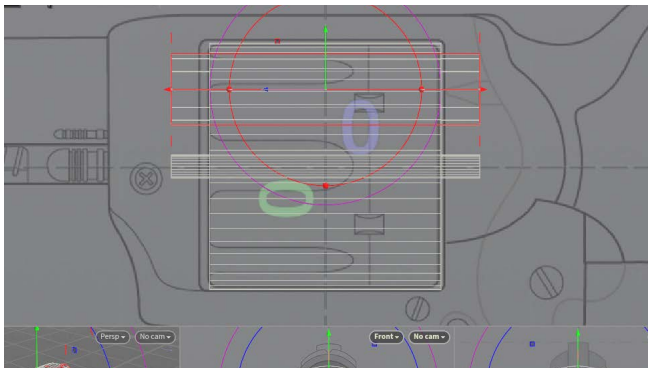
- **Orientation** to **Z Axis**
- **End Caps** to **ON**
- **Radius** to **1, 1**
- **Radius Scale** to **0.12**
- **Height** to **0.225**
- **Rows** to **2**
- **Columns** to **48**



06 **Alt-drag** in the network view to create another version of the same tube. On the **Operation Controls** bar, set the following:

- **Radius Scale** to **0.0114**
- **Height** to **0.3**
- **Columns** to **24**

This tube will be used to cut a hole in the center of the cylinder.



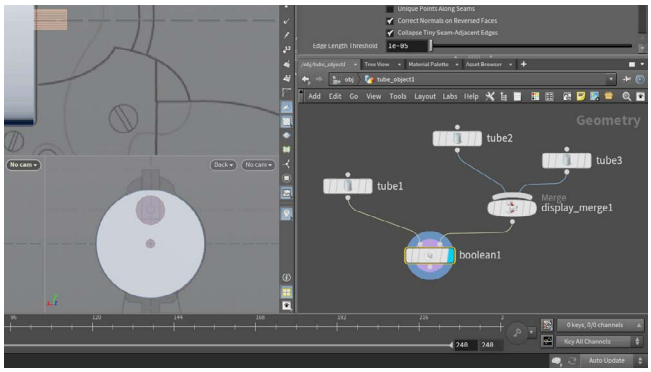
07 **Alt-drag** in the network view to create another version of the same cylinder. On the **Operation Controls** bar, set the following:

- **Radius Scale** to **0.0345**
- **Columns** to **12**

With the node selected **press i** to dive into it then set:

- **Center** to **0, 0.075, 0**

This tube will be used to cut a hole for the bullet for the cylinder. Later when you set up radial symmetry, you will turn this one hole into 6 holes.



08 In the Network pane, **Press u** to go back up to the object level. Select the main tube. From the **Model** shelf, click on the **Boolean** tool. This accepts the main tube as **set A** for the Boolean. Select the two longer tubes and press **Enter** to create **set B**. This combines the three tubes into a new network.

Press L to organize the nodes. Select the *boolean* node and from the **Output Geometry** section, set **Operation** to **Subtract**.

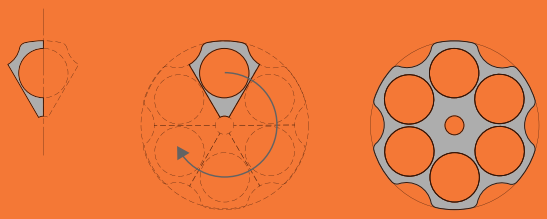
BOOLEAN

The boolean tool combines shapes to create more complex geometry. You can union, intersect or subtract to get the shape you need. You create a Set A and a Set B then apply the appropriate operation. The shelf tool set up these groups using the two inputs on the node. You could also feed geometry into the two sides to get the node to function properly.

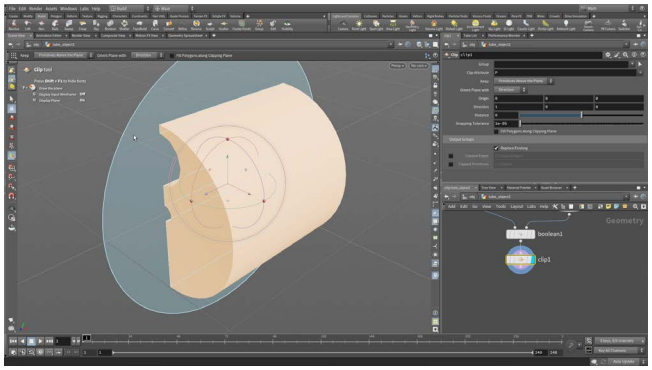
Union Subtract Intersect

USING SYMMETRY

In nature, you will find repetitions and symmetry that can help you when modeling a shape. The revolver's cylinder is made up of a shape that can be flipped to create one wedge then rotated 6 times to get a complete shape. The use of both reflective and radial symmetry will make it easier to build this shape. You will use the clip node to create the base shape that can then be refined.

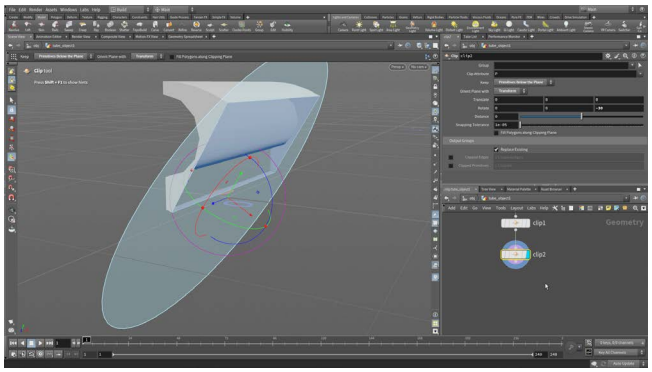


Reflect Radial Symmetry



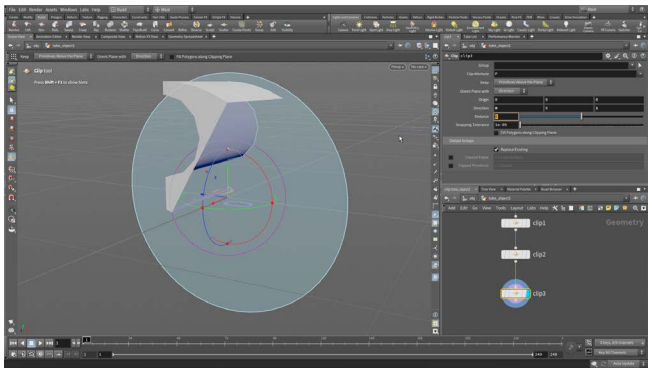
09 Press **spacebar-b** in the perspective view. **Select all [n]** then **press tab** > **Clip.** In the parameter pane, make sure the following are set:

- **Origin** to **0, 0, 0**
- **Direction** to **1, 0, 0**.



10 In the Network view, press **tab > clip** and add a **Clip** node to the end of the chain and set its Display Flag. In the parameter pane, set:

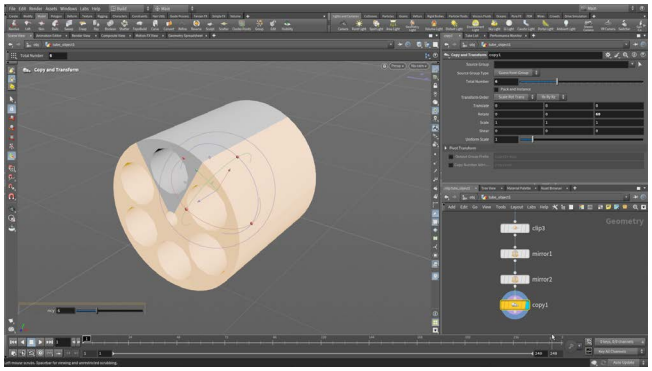
- Keep to **Primitives Below the Plane**
- **Orient Plane with** to **Transform**
- **Origin** to **0, 0, 0**
- **Rotate Z** to **-30**



11 In the Network view, press **tab > clip** and add a **Clip** node to the end of the chain and set its Display Flag. In the parameter pane, set:

- **Origin** to **0, 0, 0**
- **Direction** to **0, 0, 1**

Now you can work on this one part of the model and copy it later using symmetry to get back to the complete shape. This is a great way to work efficiently when you are creating geometry which are symmetrical.



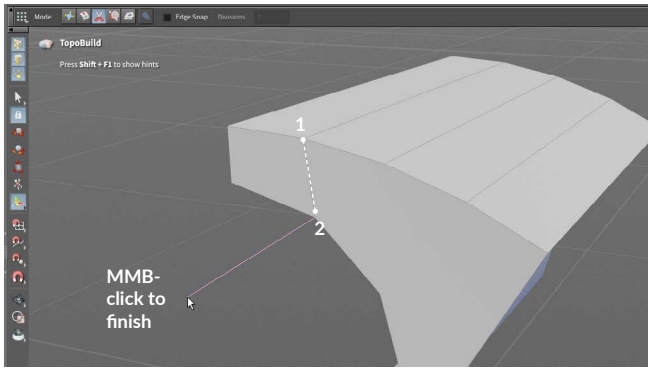
12 Press **tab** > **Mirror** tool and set the following:

- **Origin** to **0, 0, 0**
- **Direction** to **0, 0, 1**

Select all [n] then **press q** to repeat the Mirror. Leave this on at its defaults. Press **s** to select then **n to Select All.** Press **tab** > **Copy and Transform**. Set the following:

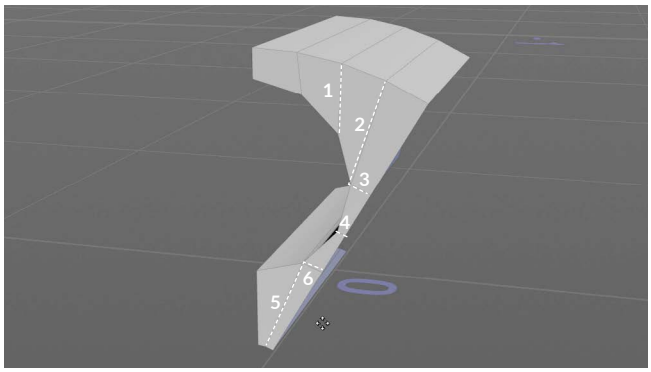
- **Rotate Z** to **60**
- **Total Number** to **6**

Now you can see the six bullet holes.



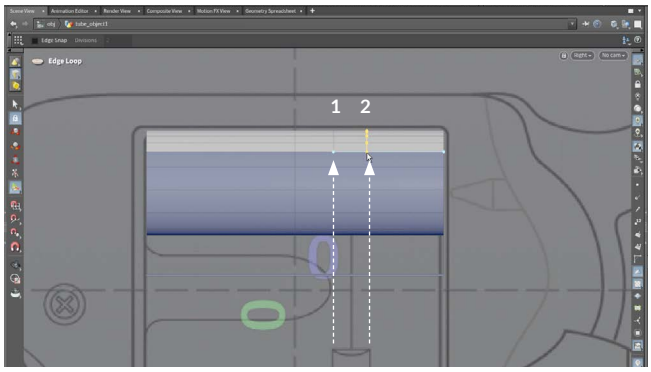
13 Set the **Display Flag** on the third *clip* node. **Press n** to select all the geometry. **Press tab** and from the menu, start typing **Polydraw**. Choose the **Polydraw** tool which adds a *topobuild* node to your network. This will get placed between the *clip* and the *mirror* nodes.

Click on the **Split tool [Shift-3]** in the Operation Control bar and on the front face of the cylinder, click on the **first point** and then the **second point** and shown here. **MMB-click** to finish.



14 Continue using **Polydraw/topobuild** to split up the face as shown in the image on the left. You want to split the faces to make sure there are only **quad [4-sided]** polygons.

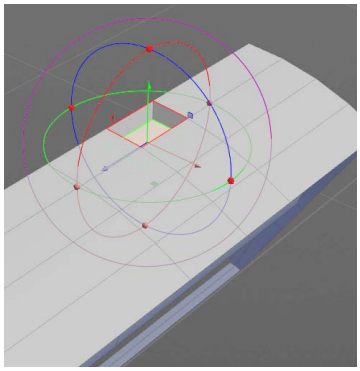
When you finish, press **Shift - Delete** to remove any unused points. It is possible that you clicked somewhere and added a reference point which you don't want when you continue modeling.

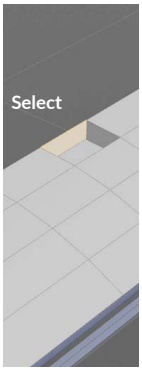


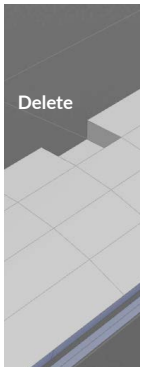
15 Set the **Display Flag** on the first *mirror* node that creates the back end for the cylinder. Make sure to select this node so that it highlights yellow.

Press **spacebar-b** to go back to a four view layout. In the Right view you can see a squarish notch in the cylinder. You want to add some edge loops to help you create this detail.

From the **Polygon** shelf, get the **Edge Loop** tool and add a loop to the top of the cylinder geometry that aligns with the notch in the cylinder. **Press q** to repeat this and add a second loop next to it that aligns with the end of the notch.







16 Go back to a perspective view. **Press 4** to get face selection and select the face shown. Press **tab > Polyextrude.** Under **Extrusion**, set the following:

- **Transform Extruded Front** to **ON**
- **Transform Space** to **Global**
- **Translate Y** to **-0.008**

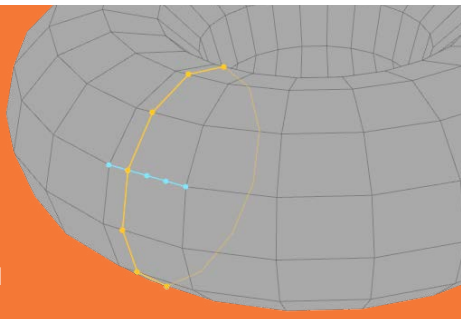
This keeps the edges of the face aligned with the ZY plane.

After the extrude, use the **Select** tool to select the primitive that is on the line of symmetry and press the **delete** key to remove it. A *blast* node will be added to the network.

EDGE LOOPS

Edge loops run around a piece of geometry to add topology to your model. The **Edge Loop** tool, found on the **Shelf** and the **Tab** menu, creates a **Poly-Split** node. It allows you to create the loop with a single click whereas using **PolySplit** directly would require more than one click. The **MMB** scroll wheel can add snap points to create a more accurate split.

You could also create a loop with the **Split** mode in the **PolyDraw/Topobuild** tool by using a **Shift click**.

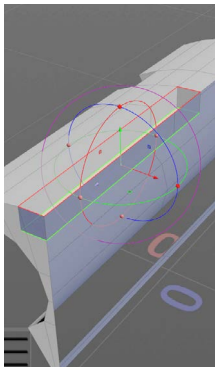


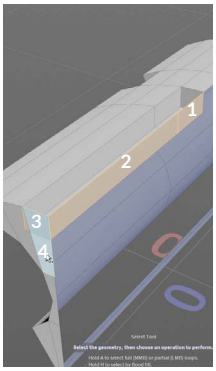
POLYDRAW

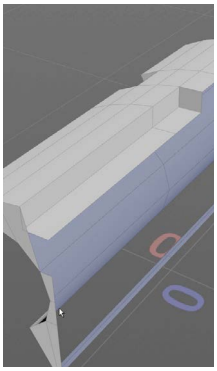
Polydraw is a node that lets you create and edit geometry using a single node without worrying about construction history. You can build from scratch, use it to edit existing geometry or use it to trace an existing topology. This shelf tool creates a **topobuild** node.

This tool has several different modes. **Build** and **Split** will be the main ones you use the most but others may come into play. Sometimes PolyDraw adds points you don't need. Always press **Shift-Delete** to clean them up.

Build Shift-1 | Slide Shift-2 | Split Shift-3 | Brush Shift-4 | Smooth Shift-5







17

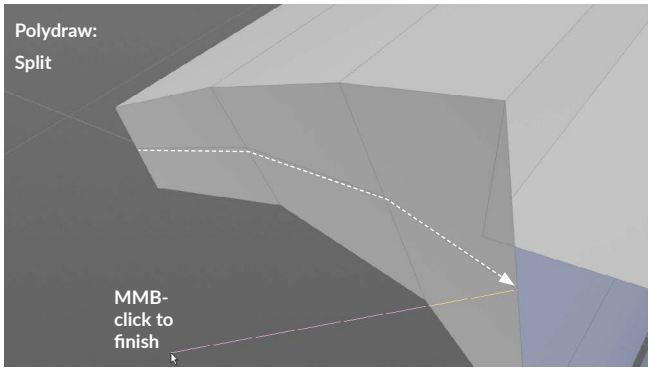
Select all [n] then **press tab > Transform** and set the following:

- **Rotate X** to **30**
- Under **Pivot Transform** set **Pivot Translate** to **0, 0, 0**

Select the top two faces shown and **press tab > Polyextrude.** Under **Extrusion**, set the following:

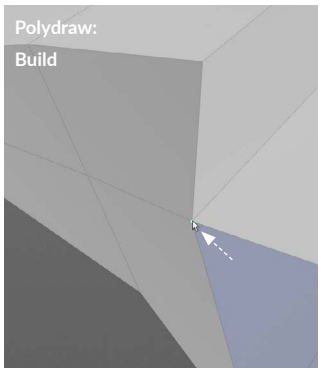
- **Transform Extruded Front** to **ON**
- **Transform Space** to **Global**
- **Translate Y** to **-0.014**

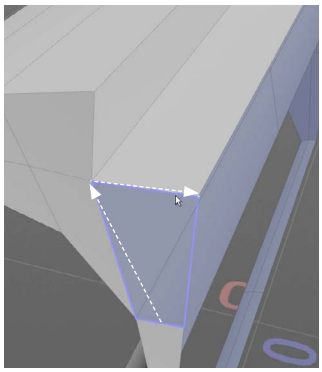
Delete the four extra faces.



18

Select all [n] then **press tab > Polydraw**. Choose the **Split** mode then use the **Scroll Wheel** on your mouse to create three guide points. Use the middle point to snap as you split the three polygons on the left side of the shape. When you finish, **MMB-click** to stop splitting.



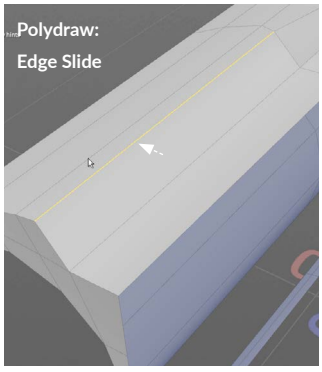


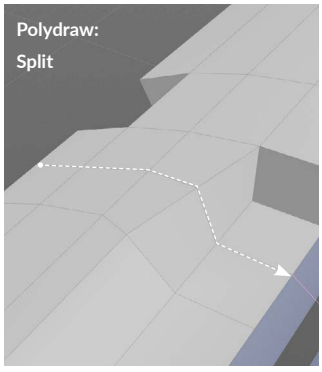
19

Now go to **Build** mode and select the middle point at the end of the split you just made. Drag it to snap to the corner of the *polybevel*.

Next select the top edge of the polygon under the extrusion and drag it up. Move first to the point on the left and then to the right and **MMB-click** to stop. This adds a new polygon and fuses all the parts together.

Move the corner point around a bit to make sure that they are connected. Undo once you are sure they are connected.

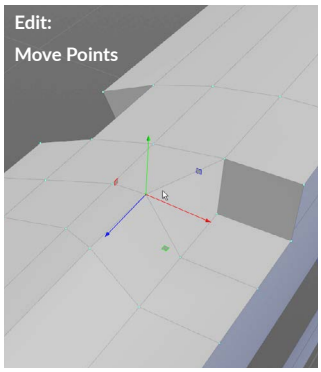


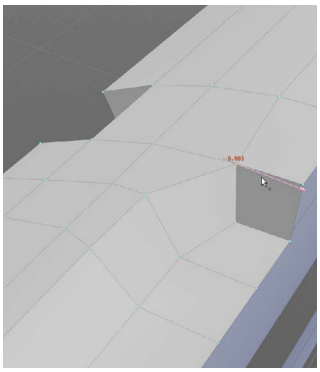


20

Now go to **Edge Slide** mode and select the left edge of the polyextrude. Move it to the left next to the neighboring edge.

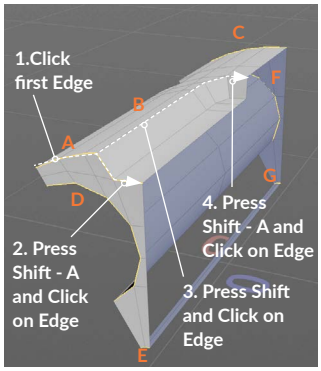
Choose **Split** mode then use the **Scroll Wheel** on your mouse to create three guide points. Use the middle point to snap as you create an edge loop at the end of the extruded section.

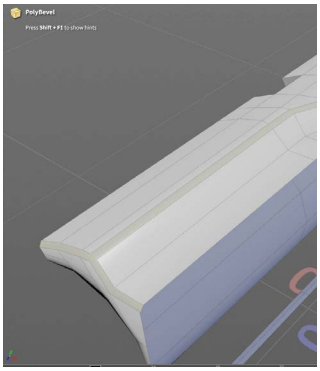




21 Now go to the top end of the extruded shape. **Press S** to go to the **Select** tool then **2** to go to **Point** selection. Select one of the points belonging to the highlighted polygon and press the **Move** tool. This adds an *edit* node to the network. **RMB-click** on the handle and choose **Align Handle > World**. Tweak the point. Turn off **Secure Selection** then tweak the two middle points to round out the end of the inset. Do not to edit any of the points on the shape's profile.

The goal is to make the shape a bit a rounder.

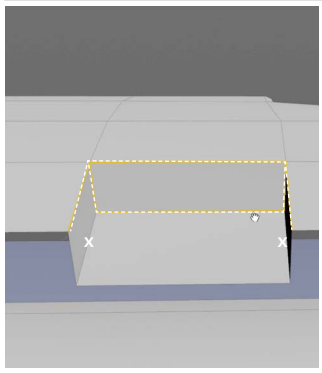




22 Go to the **Select** tool. **Press 3** to go to **Edge** selection. Click on the first edge of segment A. **Press Shift - A** and click on the second edge to select all the edges for segment A. **Press Shift** then click on the first edge of segment B then **press Shift** and **A** and click the second edge. Use this method to select the other segments indicated in the diagram. Be sure to use **Shift** to select a new edge and **Shift A** to select a whole segment.

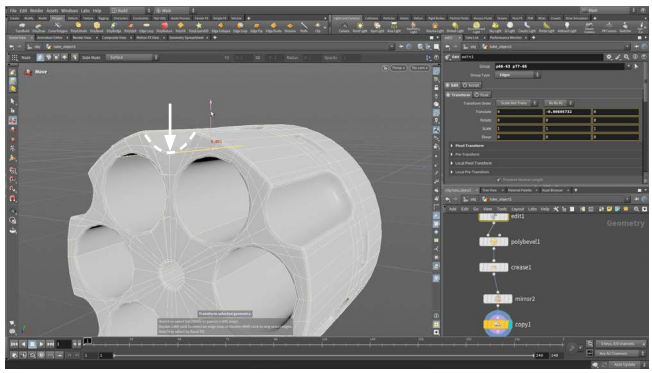
Press tab > PolyBevel to bevel these edges then set the following:.

- **Distance** to **0.002**
- **Divisions** to **2**



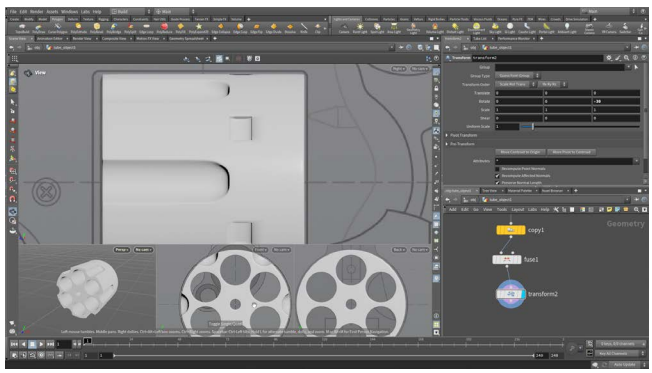
23 Select the edges at the back of the notch and the top edges on the sides. Don't choose the lower edges. Press **tab > Crease** and set **Crease** to **2**. This will sharpen the shape when you subdivide the shape.

Press **Shift +** to turn **ON** Subdivision display. You can see how some edges are sharp and some soft. In the viewport, **press v** to bring up another radial menu. From this menu, choose **Shading >Smooth Shaded**. Now you can see the model without the wire lines.



24 The shape isn't smooth where the parts meet. Set Display Flag on the *copy* node. Go to the **Select** tool. **Press 2** to go to **Point** selection. **Press n** to select all the points then press **tab > Fuse** to connect all the parts.

The grooves are a bit flat. Set the Display flag on the *edit* node just before the *polybevel*. **Press 3** to go to **Edge selection**. Select the 2 edges in the middle of the groove. While the *edit* node is still selected, set the Display flag on the *fuse* node. Now you can move the edge up and down to get the right curvature. You are able to visualize one node while editing another one up the chain.

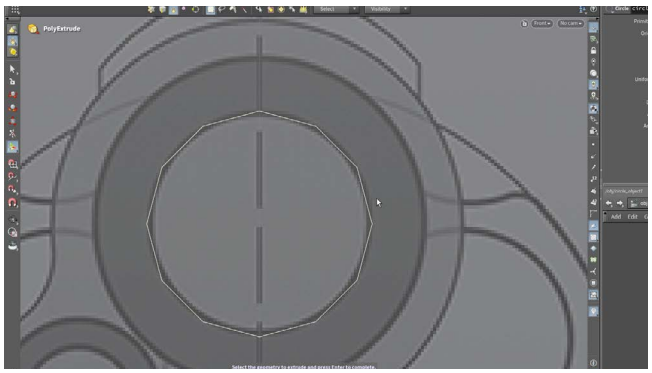


25 At the end of the chain, add a **Transform** node and set **Rotate Z** to **30**. This rotates the cylinder to align with the reference images. Add a **Null** node and name it *CYLINDER_OUT*.

Go to Object level and name this object to *cylinder*. Turn off its **Display Flag** to hide this object for now.

PART TWO:
Create the Front of the Revolver Body

The front of the Revolver requires a bit of planning to make sure there are polygons where you will need them down the line. Learn how to create and combine shapes then use Polydraw to fuse everything together with good topology. PolyExtrude will then be used to build out the shape.

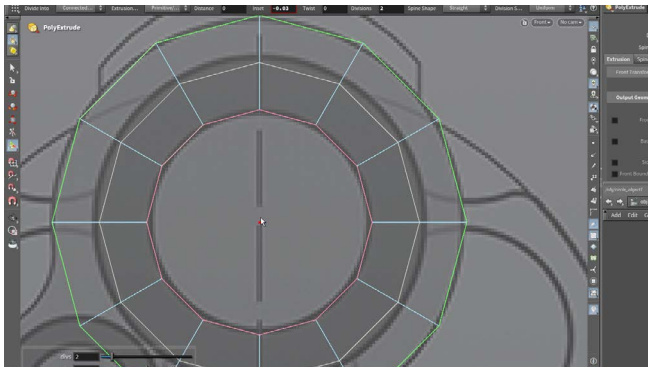


01 Press **Spacebar-b** to go out to a four view layout. Move your cursor over the *Front* view and press **Spacebar-b** again. Dolly in until you are focused on the cylinder area.

From the **Create** shelf, click on the **Circle** tool and press **Enter** to place it at the origin. In the Network View, **Double-click** on the *circle_object* node to dive into it. Select the *circle* node and set:

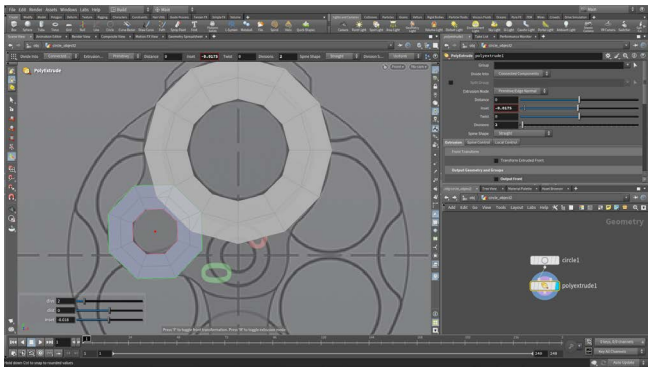
- **Uniform Scale** to **0.037**
- **Center Y** to **0.076**
- **Divisions** to **12**

Press v and select **Shading > Wire frame Ghost**.



02 **Press c** and select **Model > Polygons > Polyextrude**. Under **Extrusion**, set:

- **Inset** to **-0.03**
- **Divisions** to **2**
- **Turn off Output Front**

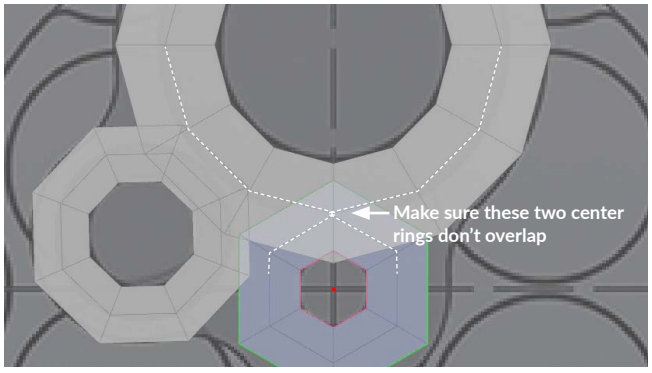


03 In the Network View, **press u** to go to the object level. **Alt-drag** on the *circle_object* node and move it to the side. **Press i** to dive into the new object.

Select the circle node and, set:

- **Uniform Scale** to **0.0175**
- **Center** to **-0.06, 0.017, 0**
- **Divisions** to **8**
- **Rotate Z** to **24**

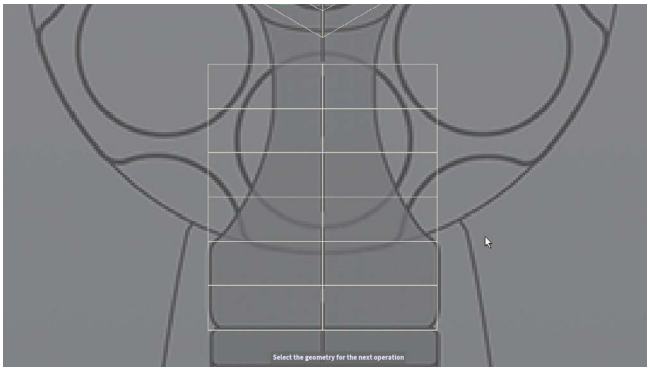
Select the *polyextrude* node and set **Inset** to **-0.0175.** This will create some overlap which will be dealt with in a later step.



04 In the Network View, **press u** to go to the object level. **Alt-drag** on the first *circle_object* node and move it to the side. Press i to dive into the new object. Use the **Transform** handle to center it over the lower circle. Select the *circle* node and, set:

- **Uniform Scale** to **0.012**
- **Center** to **0, -0.0001, 0**
- **Divisions** to **6**
- **Rotate Z** to **30**

Select the *polyextrude* and set **Inset** to **-0.019.** The center ring of this shape shouldn't overlap the center ring of the top shape.

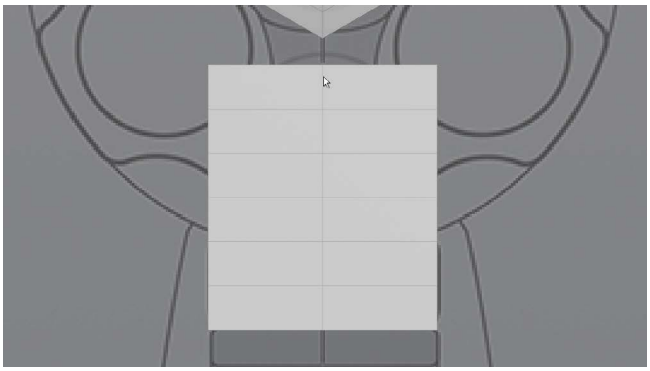


05

Press c and from the radial menu, choose **Create > Geometry > Grid** . Press **Enter** to place it at the origin. **Press i** to dive into the new object. Select the grid node and, set:

- **Orientation** to **XY Plane**
- **Size** to **0.095, 0.11**
- **Center Y** to **-0.1**
- **Rows** to **7**
- **Columns** to **3**

This creates a grid that you can use to shape the lower part of the revolver's body.

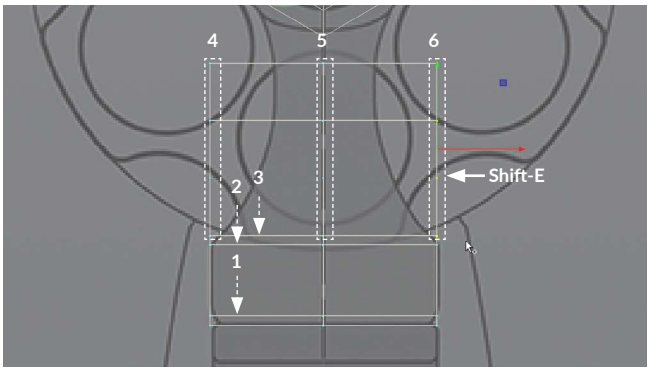


06

Press v and from the Radial menu, select **Shading > Smooth Wired Shaded**. You can see that the polygons are blue which indicates that they are facing away from our current view. In the Scene View, press **tab > Reverse**.

Press n to select all the primitives and **Enter** to accept. Now they are facing the right way.

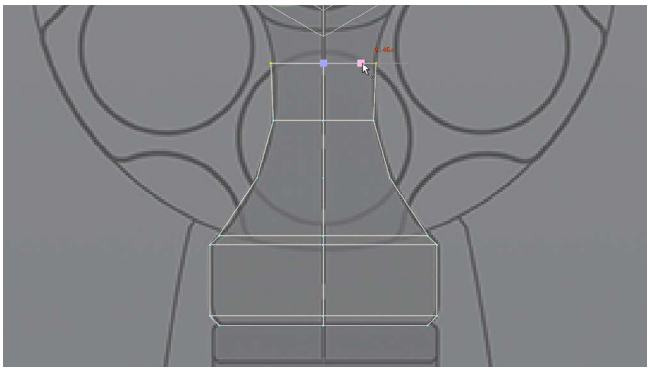
Press w to toggle to **Wireframe Ghost**. This will make it easier to create the shape that is needed.



07

Press 2 to go to **Point** selection.. Select the three points on the top of the bottom two primitives. **Press t** to go to the move tool which adds an *edit* node to the Network. Move the points down near the bottom of the shape. Now do the same for the next two edges points to align with the background.

Now Select the top four points on the left side of the shape. **RMB-click** and choose **Evenly Space Selection [Shift-E]**. Repeat this for the four points in the middle and the four on the right.



08

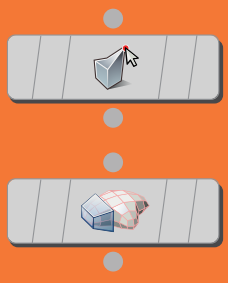
Select the three points at the bottom of the grid and **press e** to bring up the scale handle. Scale along the X Axis to match the background image. Now do the same for the other points as shown so they match the background.

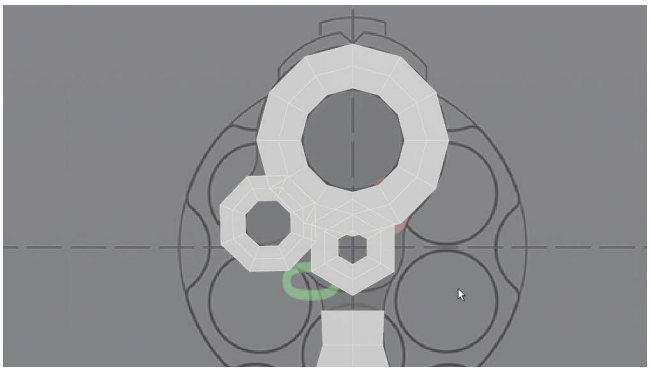
All of these edits are accomplished by the *edit* node. While many geometry nodes have a single selection/action, the edit node allows for different kinds of edits with the final shape stored in the node.

TO BE PROCEDURAL OR NOT TO BE PROCEDURAL

One of the benefits of the node-based approach in Houdini is that you can make changes to a node higher up on the chain and watch the changes will cascade to the final output. That is not always the case. **PolyDraw/Topobuild** caches its output and ignores its input once you start making edits. Changes to nodes above a **PolyDraw** do not carry through.

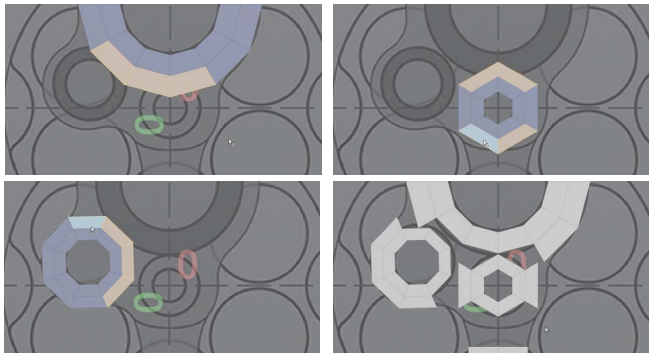
The **Edit** node also has limitations. If you change the topology of the model before the Edit then the point numbers change and Edit make changes to the wrong points. The revolver model is not meant to be completely procedural therefore it is fine to use these nodes.





09 Go to the object level and select the three *circle_object* nodes and the *grid_object* node. On the **Modify** shelf, select **Combine**. Now you have the four objects inside one object with a **Merge** node tying the four chains together.

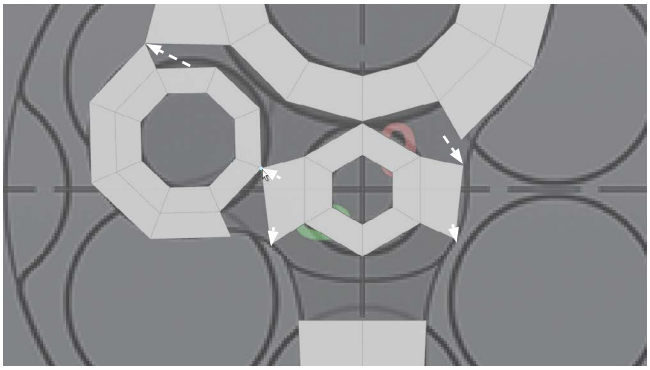
Press w to go back to **Smooth Wired Shaded** to make sure that all the polygons are facing the right way. If the other shapes need to be reversed then you can move the *reverse* node to the end of the chain after the *merge*.



10 Set the Display flag on the *polyextrude* node belonging to the biggest circle. With the **Select** tool, **press 4** then **Shift** and select three of the polygons at the lower left of the outer ring. Press the **Delete** key to blast those polygons

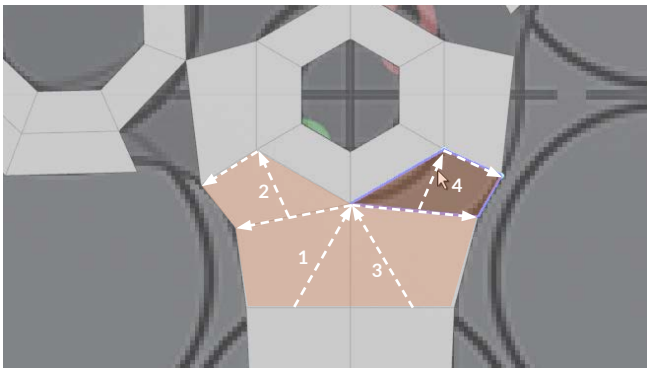
Set the Display flag on the *polyextrude* node belonging to the circle at the bottom. **Select** two polygons from the top and bottom of the outer ring and **Delete** them.

Set the Display flag on the *polyextrude* node belonging to the circle at the side. **Select** three polygons from the top right of the circle then **Delete** them. Set the Display flag back to the *reverse* node.



11 Press **tab > Polydraw**. This gives you a topobuild node but doesn't ask you for a surface to work from. Make sure you have the **Handle tool** selected and in the top bar the **Build mode** is active. Select and move the points shown in this diagram. You can click-drag on them to move them.

In some cases, do not let them connect with any other points. You will connect them in the next step. Make sure that you don't edit any of the points on the inner rings on the three main circles If you click in empty space and a yellow point is added to the model, you can press **Shift-Delete** to remove it.

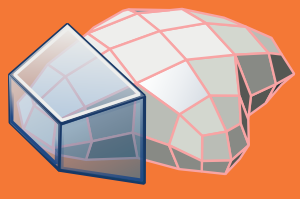


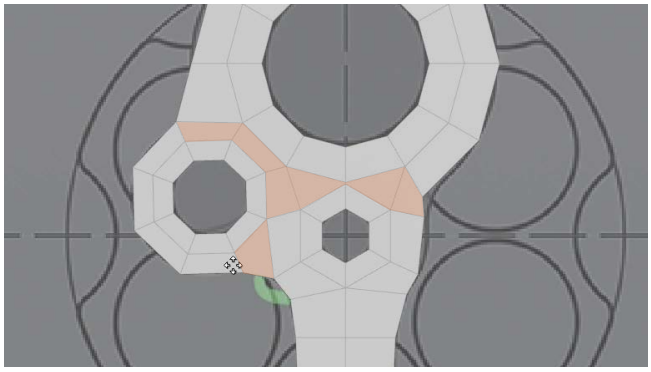
12 Select an edge at the top of the grid. Move the outline up and snap to the bottom point on the lower circle. You will see it snap into place. Press and drag to move the other point to the edge. Use the background image to guide you. Now take the new guides and snap to the next two polygons shown here. Continue doing this right to the edge of the shape. **MMB-click** to stop.

CLEANING UP WITH POLYDRAW/TOPOBUILD

When you need to clean up a model, PolyDraw offers you a toolset that can split, delete and build polygons. You can do many actions all in one node which is convenient. This node caches your work and prevents edits up the chain which is generally fine because you do your cleanup once you have things all worked out.

The Topobuild tool was designed to take an existing piece of high resolution geometry and retopologize it. PolyDraw uses the same node but has a different Tool name to let you know that it can be a creation and cleanup tool for any polygon model.

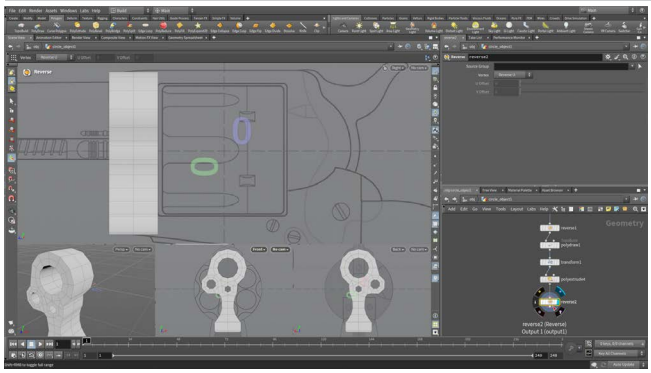




13 Use the same technique to connect the other open spaces as shown. There are the two polygons at the top of the bottom circle and a few on the right side.

In the end, all of the polygons should be connected into a single shape with three holes in the middle.

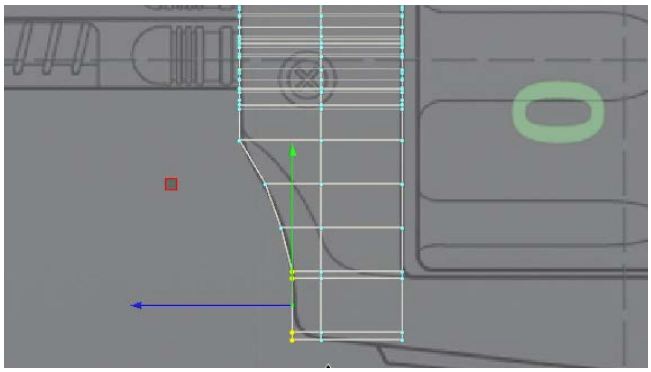
Press **Shift-Delete** to remove any unused points.



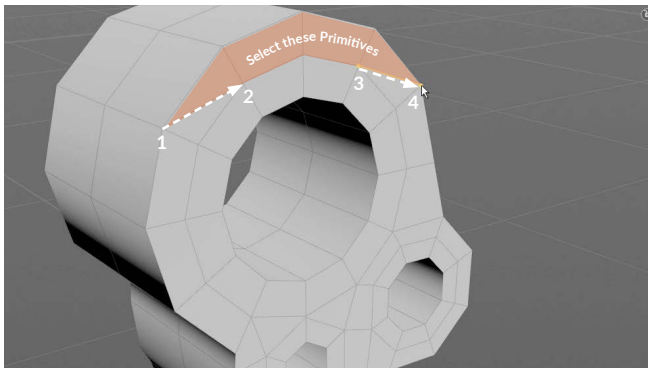
14 Press **Spacebar-B** to change to a four view layout. Press **tab > Transform** and **press n** to select all the geometry. Use the transform handle to move the profile in front of the cylinder. It is hard to see the geometry in the Right view but you can use the handle to position it. Press **tab > Polyextrude**. Pull on the handle to extrude the shape to the end of the body. In the Parameter pane, set:

- **Divisions** to **2**

Under **Output Geometry and Groups**, turn on **Output Back**. If the shape is blue then add another **Reverse** node to the end of the chain.

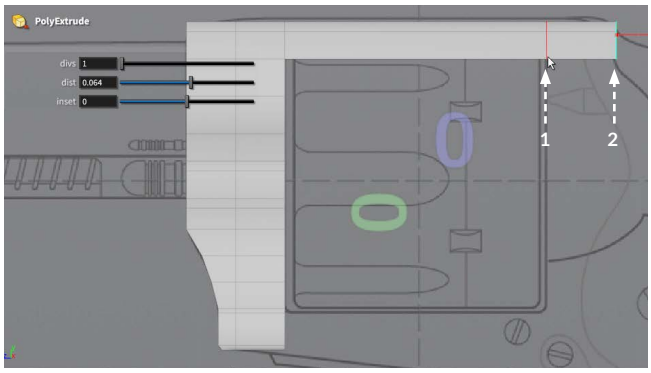


15 **Press 2** to get **Point** selection and from the Front view, select and Move the points to match the background image underneath. Select the 6 points at the top right of the shape and drag them up to align with the background. All of these edits will get put into an *edit* node.

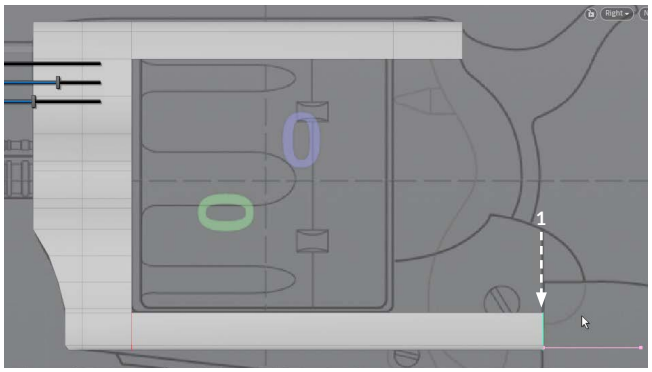


16 In the Perspective view, tumble around to the front of the geometry. **Press c** then choose **Model > Polygons > PolySplit**. Click the two corner points labelled 1 and 2 in the screengrab then press **Enter**. **Press Q** to repeat and click on the other two corner points labelled 3 and 4 then press **Enter**.

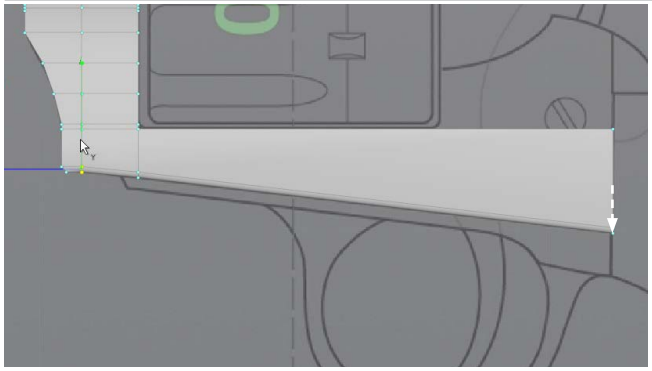
Press S to get the **Select** tool then **press 4** to get **Primitive** selection and in the perspective view, select the four faces at the top of the shape.



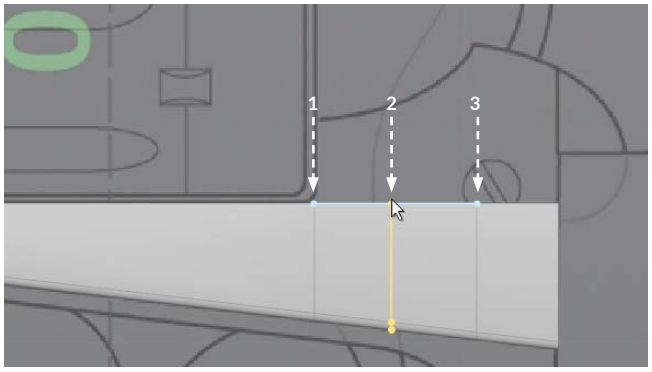
17 **Press c** then choose **Model > Polygons > PolyExtrude**. Drag the handle in the Right view until the shape aligns with the end of the cylinder. **Press q** to repeat and drag the handle to the end of the shape.



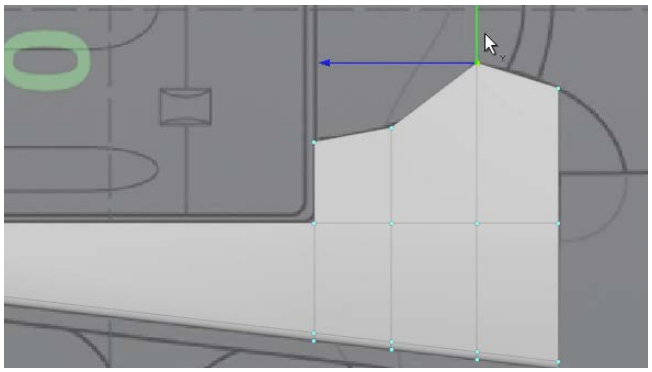
18 **Select** the four faces at the bottom of the original shape. **Press c** then choose **Model > Polygons > PolyExtrude**. Use the Handle to drag it out to the beginning of the grip.



19 **Press 2** switch to **Point** selection and in the Right view, box select the points at the bottom of this extruded shape. **Press M** to get the **Move** tool and drag these points down to align with the Background image.

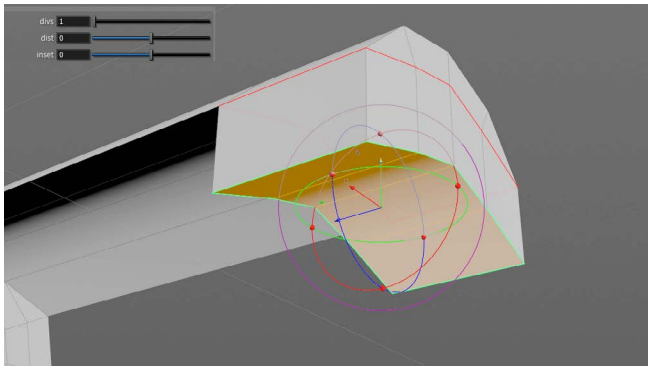


20 From the **Polygon Shelf**, select the **Edge Loop** tool. In the Right view, add a loop that lines up with the end of the cylinder then press Enter. **Press q** to add a second one a little to the right and a third one to the right of that one.



21 **Select** the six faces at the top of the area you just created with the edge loops. **Press c** then choose **Model > Polygons > PolyExtrude**. Use the Handle to drag it up.

Press 2 switch to **Point** selection and in the Right view, box select the points on the left side of the extruded shape. **Press m** to get the **Move** tool and drag these points up to align with the Background image.



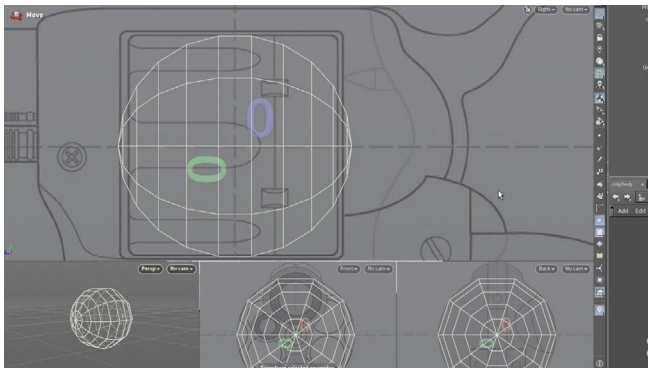
22 **Select** the four faces at the bottom of the top area. **Press c** then choose **Model > Polygons > PolyExtrude**.

Use the **Transform Extruded Front** to drag it down. Set **Transform Space** to **Global** and set **Translate Y** to **-0.035**.

Add a **Null** node and name it BODY_FRONT.

PART THREE:
Create the Back of the Revolver Body

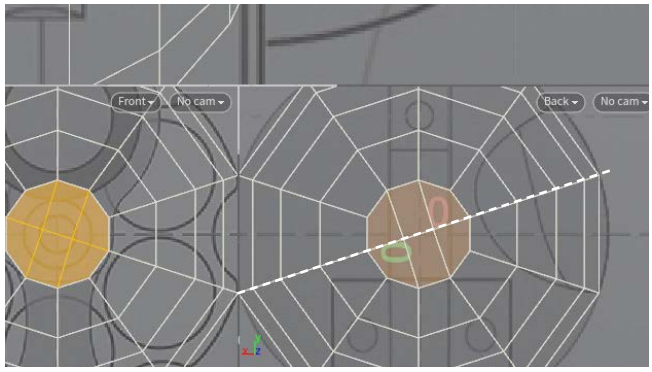
To finish up the revolver body, you will create a half sphere and boolean it into the main shape. You will also carve out the revolver's gate which will also require another boolean and some tweaks to the points. This will complete the main body of the revolver which you will use to build out parts such as the barrel and the handle.



01

In the Network view press **tab > Sphere**. Place the node down and set its Display Flag. Set the following:

- **Orientation** to **Z axis**
- **Rotate Z** to **18**
- **Uniform Scale** to **0.25**
- **Rows** to **12**
- **Columns** to **10**



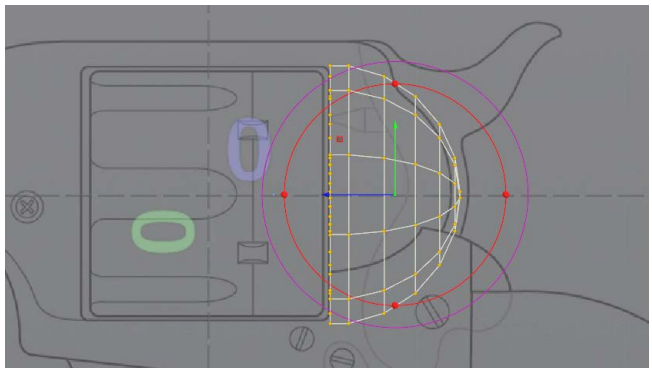
02

Go to the **Select** tool. **Press 4** to get Primitive selection. In either the Front or Back views, box select the polygons in the center. Press **Delete** to put a hole in both ends of the sphere.

Press 3 to go to Edge selection and in the perspective view double click on the edge of one of the holes. Press **tab > PolyFill** then set:

- **Fill Mode** to **Quadrilateral Grid**
- **Tangent Strength** to 2
- **Corner Offset** to get the orientation shown here.

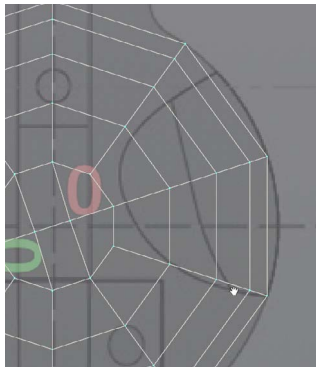
Select the edge of the other hole and repeat. Make sure you set Corner Offset to match the same as the first one.

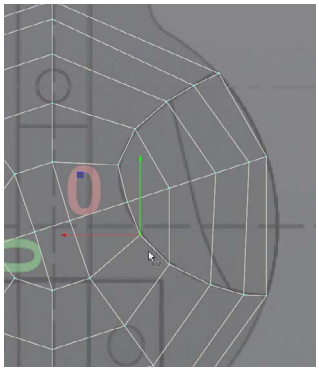


03

Press n to select all the geometry. Press **tab > Flatten** to add a *flatten* node. Set **Direction** to **0, 0, -1**.

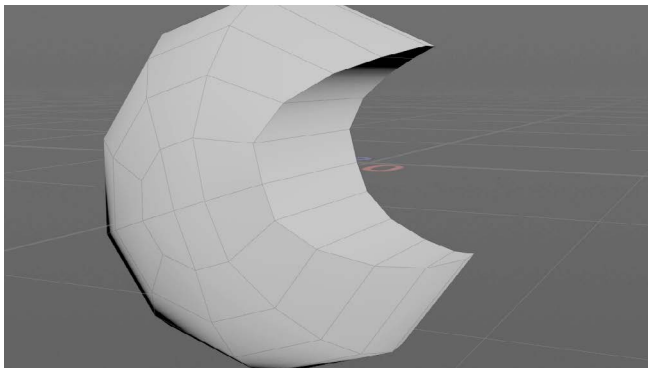
In the Network view, add a **Transform** node and in the Right view move the sphere to the back of the cylinder.





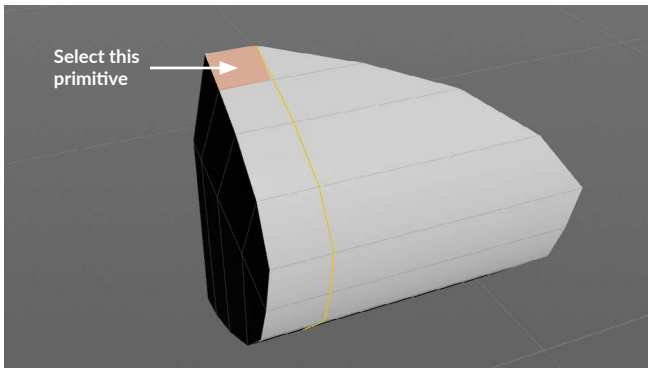
04

Press 2 to get **Point** selection and from the Back view, box select, so you get the points at the back, then move the points shown to match the background image underneath.



05 **Press s** to get the **Select** tool then **press 4** to get **Primitive** selection and in the perspective view, box select the primitives inside the shape you just set up. Press **tab > Split** to add a *split* node and turn on **Invert Selection**.

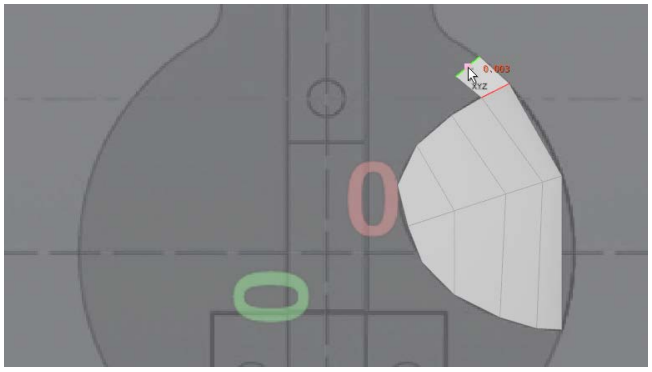
RMB-click on the first output of the *split* node and find the **PolyFill** tool. Click to place down the node and set its **Display Flag**. Set **Fill Mode** to **Quadrilateral Grid**. This fills the empty area with polygons.



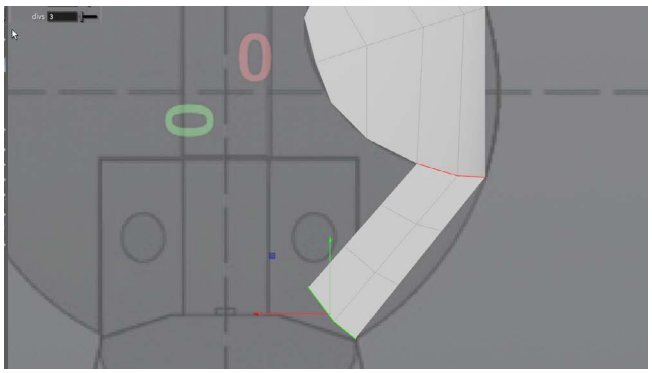
06 **Alt drag** the *polyfill* node over to the right. Wire the second output of the *split* node into this polyfill.

Get the **PolySplit** tool and click on the second point at the top then click about the same distance in on an edge in the middle of the shape and then tumble around and click on the second point at the bottom. Press **Enter** to accept.

Press s to get the **Select** tool then **press 4** to get **Primitive** selection and in the perspective view, select the primitive at the top of the shape

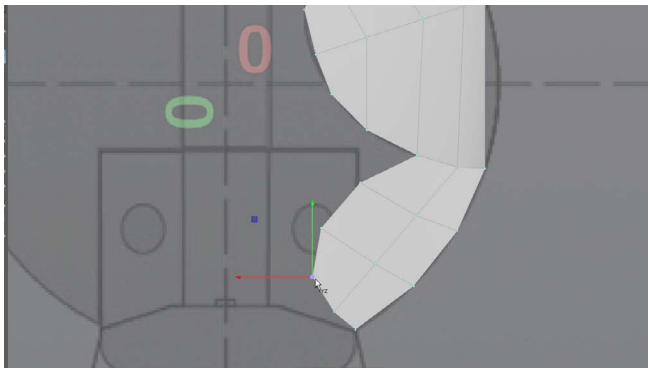


07 **G**et the **PolyExtrude** tool. Under **Extrusion > Front Transform**, turn on **Transform Extruded Front** and use the handle to position the extruded front as shown. You can **Translate [T]**, **Rotate [R]** around Y and **Scale [E]** along X as you position it.



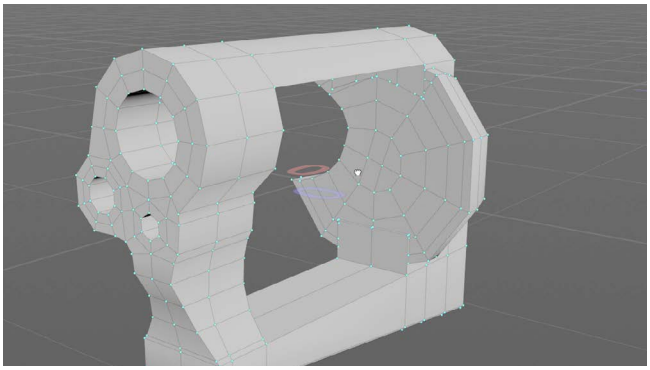
08 **Press s** to get the **Select** tool and in the perspective view, select the opposite two primitives at the bottom of the shape on. **Press Q** to get the **PolyExtrude** tool. Set **Divisions** to **3**.

Under **Extrusion > Front Transform**, turn on **Transform Extruded Front** and use the handle to position the extruded front as shown. You can **Translate [T]**, **Rotate [R]** around Y and **Scale [E]** along X as you position it.



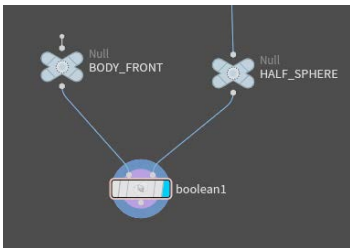
09 **Press 2** to get **Point** selection and from the Back view, box select and move the points shown to create the shapes shown in this screenshot.

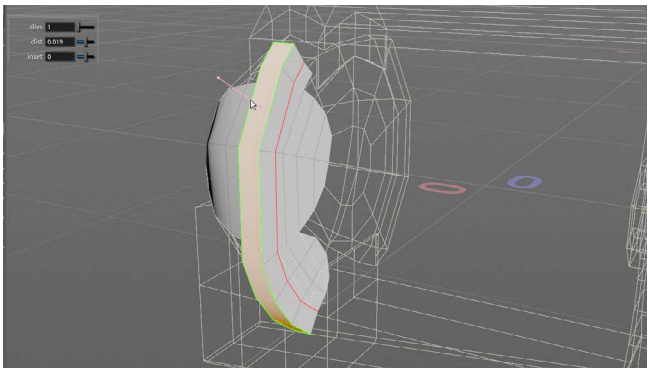
Add a **Null** node after the edit and name it *GATE*. Add another **Null** node after the *polyfill* on the other side of the *split* and call it *HALF_SPHERE*.



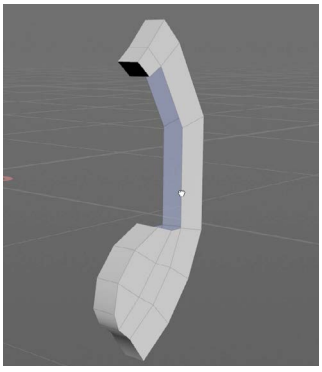
10 Add a **Boolean** node in the Network View. Wire the *BODY_FRONT* Null node into the first input of the boolean node. Wire the *HALF_SPHERE* node into the second input.

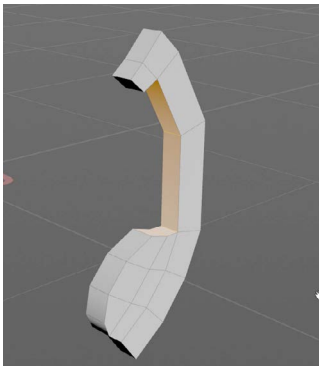
Set **Operation** to **Union** to bring the shapes together.





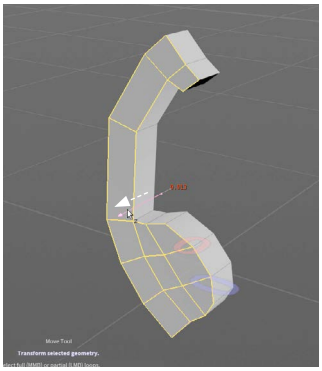
11 Set the Display Flag on the *GATE* node. Tumble around and select the primitives at the edge. Polyextrude a little bit to create an overlap on this edge.





12 Tumble around and select the primitives from the original half sphere so only the outer edge remains. Press **Delete** these remove these faces.

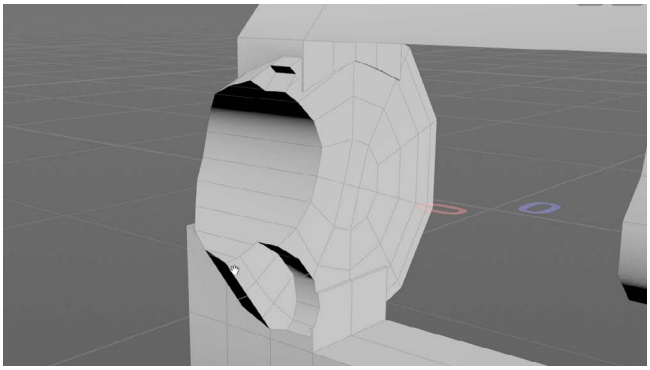
Add a **PolyFill** node to the end of the chain. Set **Fill Mode** to **Quadrilateral Grid.** This will close up the open area.



13 Get the **Select** tool and click on the **Select by Normal** button on the Operation Control bar. Click on one of the primitives on the flat area of the shape to select the whole area. **Press T** to get the **Move tool and use the handle to move** these faces out along x to add some depth to the shape.

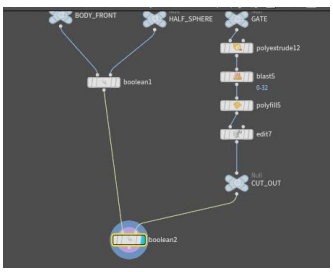
Turn off Select by Normal then move the inner faces shown to ensure that there is a bit of an overlap

Add a Null node and call it *CUT_OUT*.



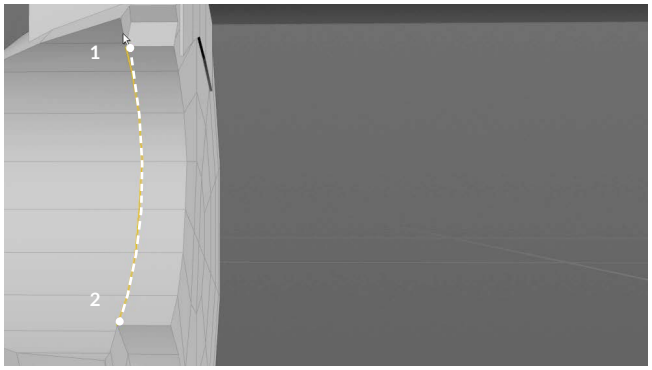
14 Add a Boolean node in the Node View. Wire the first *boolean* node into the first input of the new *boolean* node. Wire the *CUT_OUT* node into the second input.

Set **Operation** to **Subtract**. Now there is a cutout shape from the main body of the revolver for the gate to sit.

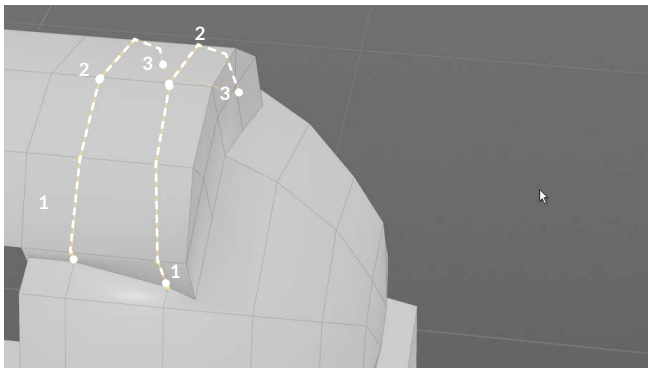


PART FOUR:
Cleanup Topology

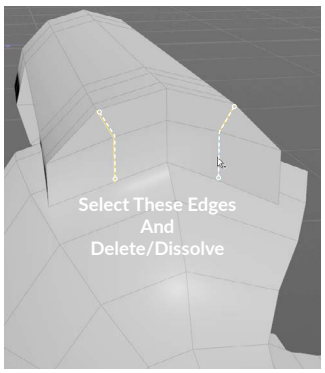
The booleans created a lot of n-side polygons which makes for a messy topology. Learn how to clean up the model using tools such as PolyDraw and PolySplit. The goal will be to create quad polygons that will subdivide properly down the line. This lesson will tackle a number of topology issues. You may find more that you can fix using these techniques.

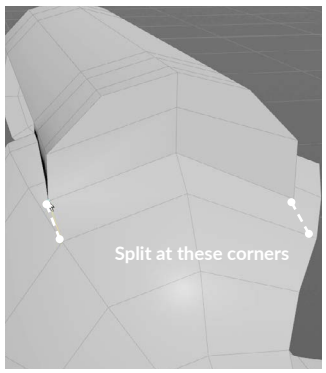


01 Looking at the new cutout shape, press **tab > PolySplit** then click on once at the top and then at the bottom. Press **Enter** to accept and the model will be split from top to the bottom.



02 Tumble around to the revolver's back looking down at the model. **Press q** to do another Polysplit and add a split from the intersection of the circle with the top. Add a second click at the centerline then tumble around to add a point on the other side. Repeat for the second intersection point.





03 On the back face, select the 4 edges that run from the top to the circle. Press **Delete** to dissolve those edges. The back faces are all quads so these lines weren't needed.

Now press **tab > Polydraw** and **Press N** to select the whole model then press **Enter**. Press **Shift-3** to get the **Split** mode and add two edges at the corners to connect the circle to the main shape. At each corner click once on each point then **MMB-click** to complete the split.

QUAD GEOMETRY

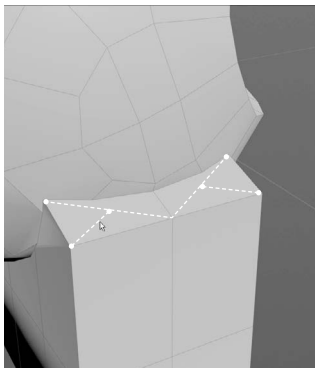
A clean, quad-based model creates topology that is easy to work with that provides the best outcome for subdivisions. In Houdini, these subdivision render at a micropolygon level which looks great when rendered properly.

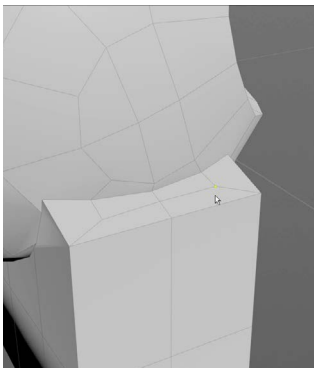
However, if you have n-sided polygons there can be kinks and bad smoothing that ruins your model. In the case of the revolver, creasing also assists in controlling the subdivision of the model. Bevels can also help with this.

POLYDRAW: DELETE EXTRA POINTS

When using the PolyDraw node's **Build** mode, you are able to place points in space as snapping guides to assist as you draw shapes. Any un-used points, or points made by accidentaly by clicking in empty space will become part of you model's topology. This has been said a few times already...

It is **important** that you press **Shift-Delete** when you are finished using the node in order to remove these extra points. Even if you are not sure you made any of these points it is safer to just use **Shift-Delete** as often as possible.

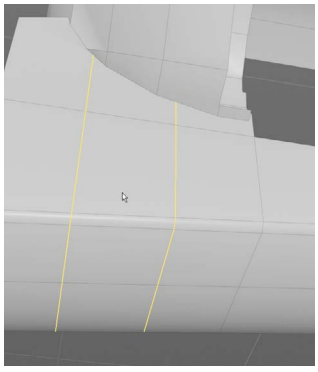


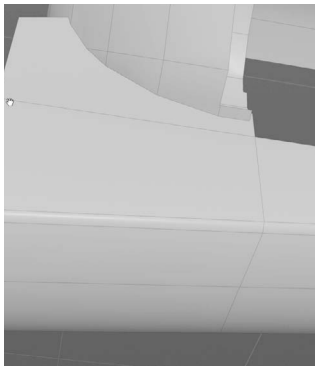


04 Go to the back of the revolver. Split from the corner to the line from the half sphere. Repeat for the other side.

Now split the center of these two lines.

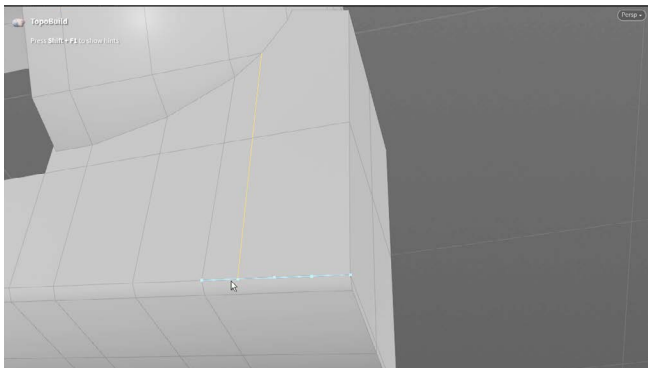
Press **Shift-2** to get the **Edge Slide** mode. Select and move the points to square off the primitives. Edge slide will keep the points on the same plane.



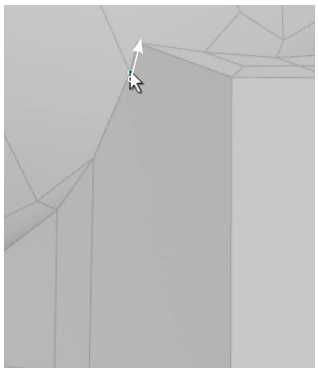


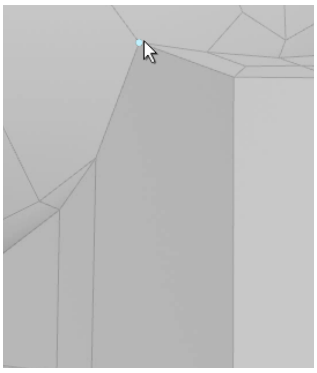
05 Press **Shift-1** to go to **Build** mode then select the edges at the bottom of the circle that don't connect with the circle. You will need to tumble to get the edges on both sides and the bottom. Press **Delete** to dissolve them.

Earlier when you selected the edges and deleted them you got a *dissolve* node. This time the dissolve is part of the *polydraw* node therefore no extra node is created.



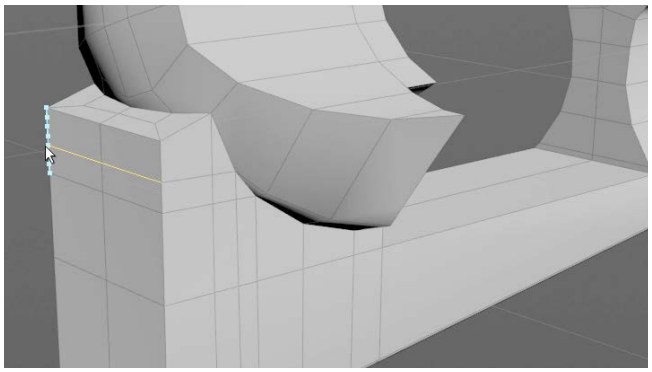
06 Press **Shift-3** to go to **Split** mode Split the bottom area from the points on the circle down. You can use the Right and Left views to split them straight down. If you drag the line from the intersection point down past the base of the shape, you will create all the points on one side. Repeat for the other side then connect them on the bottom.



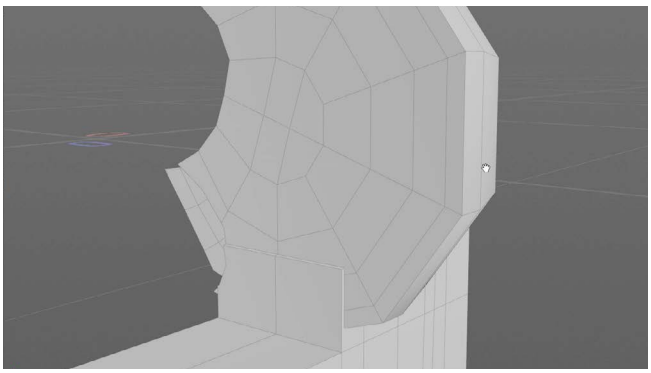


07 There is one oddly shaped polygon at the corner where the two shapes meet. Press **Shift-1** to go to **Build** mode then drag the lower point up until it snaps to the top point and joins everything together.

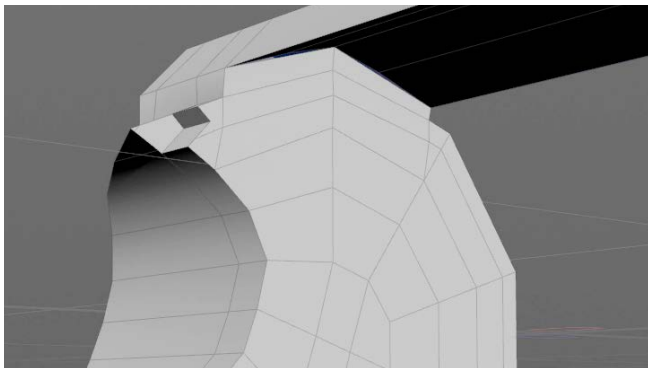
If you are unsure if it joined then you can jiggle the point to see if everything moves properly. Just press **Ctrl-Z** to undo after this edit to move things back.



08 Press **Shift-3** to go to **Split** mode Split from the intersection points to the back of the shape. You can again use the Right and Left views to split them straight to the back then reconnect them on the back face.

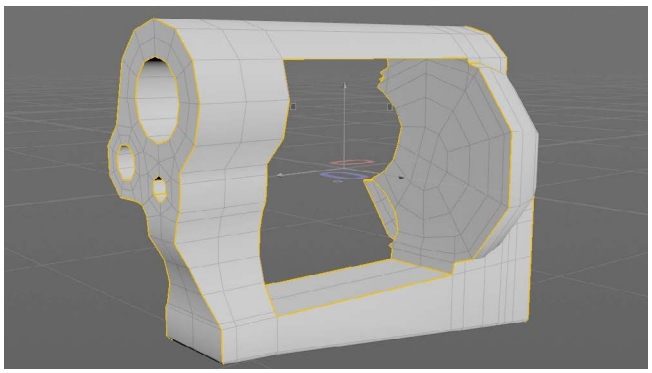


09 Inside the revolver, you created a small overlap between the half cylinder and the body. This needs to be cleaned up. Continue using PolyDraw to remove primitives then add new ones. The video that comes with this lesson goes into more detail about this cleanup process.



10 When you are finished, the polygons should be mostly quads and all flush to the same plane. The odd triangle is fine in the middle of the shape because that area is all flat.

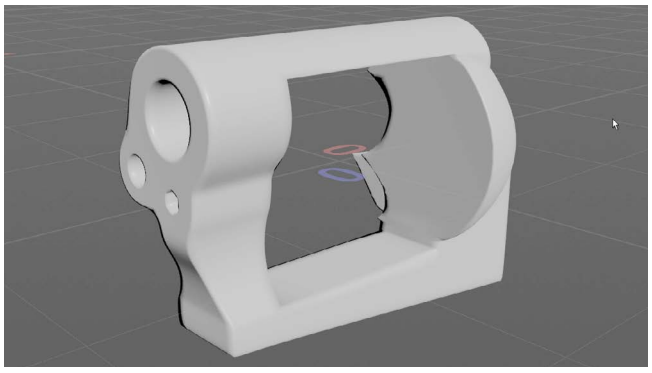
At this point there are still some non-quad polygons and a few other areas that could be cleaned up but there is more modeling to do and the cleanup can happen at the end.



11 **RMB-click** on the output of the *polydraw* node and choose **Group**. Place the node down and set:

- **Group Name** to **crease_edges**
- **Group Type** to **Edges**
- **Enable Base Group** to **OFF**
- **Enable Include by Edges** to **ON**
- Turn on **Min Edge Angle** and set it to **55**
- Turn on **Max Edge Angle** and set it to **180**

This will find all the edges between the main shapes.



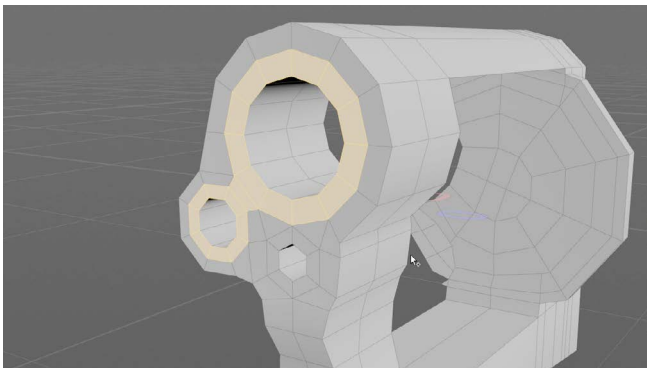
12 **RMB-click** on the output of the *group* node and choose **Crease**. Place the node down and set **Crease** to **10**.

Add a **Null** node at the end of the chain and call it *BODY_OUT*.

Press **Shift +** to turn **ON** Subdivision display. In the viewport, **press v** to bring up another radial menu. From this menu, choose **Shading >Smooth Shaded**. Now you can see the model without the wire lines. The creasing is doing its job to harden up the edges.

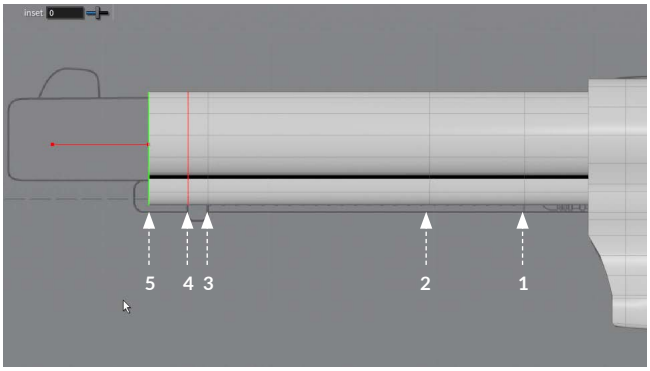
PART FIVE:
Create the Barrel

When you modeled the front plate of the revolver body, you used three rings that will now be used to create the barrel. PolyExtrude will bring out this shape and add enough detail to accommodate some of the smaller parts such as the sight. Because this is being extruded from the main body, the barrel will be well connected to the overall shape.

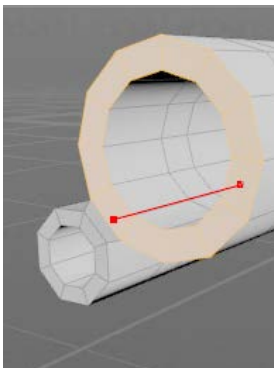


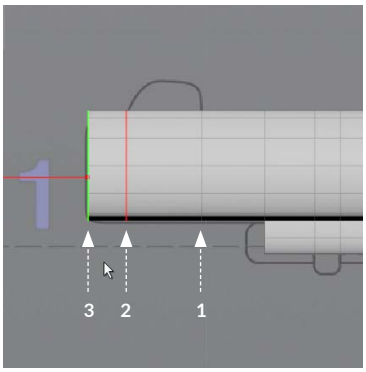
01 On the front face of the shape, get the Select tool and press **4** to get primitive selection. Select one primitive on the inner ring then press **Shift-A** and **MMB-click** on a second to select the whole ring. Press **Shift** and select a primitive on the smaller ring then press **Shift-A** and **MMB-click** on another primitive to select the second ring.

Press **Shift** and select the primitive that connects the two rings to complete the selection.

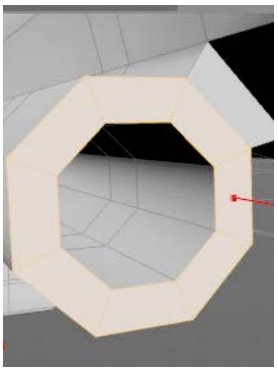


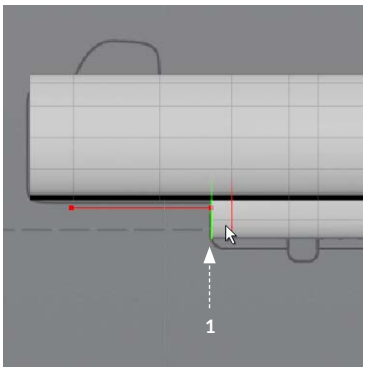
02 Press **tab > Polyextrude.** In the Right view drag the handle out to the to the first line shown here. Now **press q** to repeat and add four more extrusions to the lines shown here.



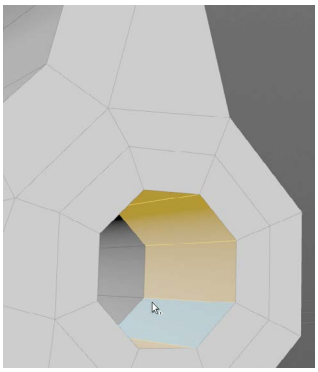


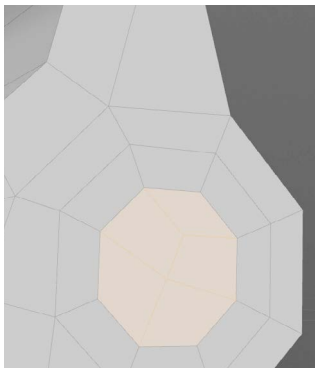
03 Select just the end of the main barrel and **Polyextrude** three times as shown here.





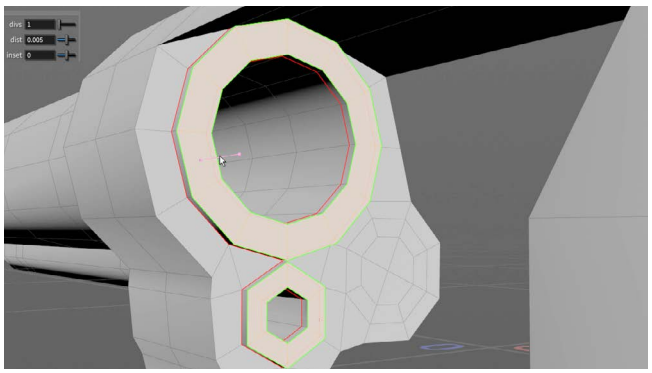
04 Select the end of the small part of the barrel and **Polyextrude** once.



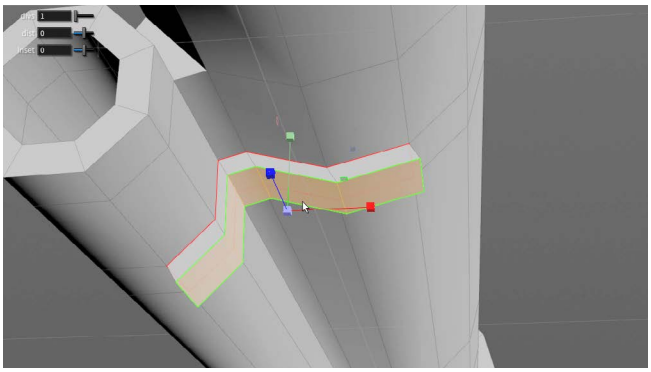


05 **Press 4** to get **Primitive** selection. Select one of the primitives inside the hole shown here. Press **Shift-A** and **MMB-click** on the next primitive. This will select the whole ring. Press **Delete** to remove these faces.

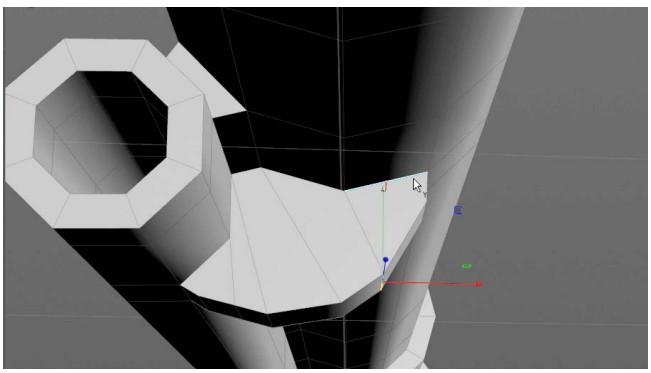
Press 3 to get Edge selection. Double click on the edge of the circle and press **tab > Polyfill**. Set **Fill Mode** to **Quadrilateral Grid**.



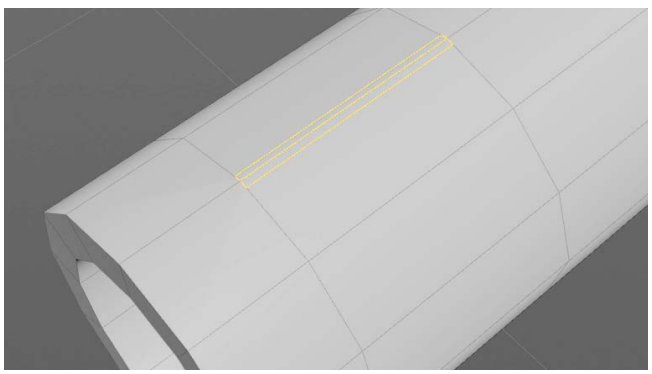
06 Select the rings that surround the two remaining holes using the **Shift** and **A** keys. **PolyExtrude** them a little bit to add detail.



07 Near the end of the barrel, select the following five primitives that cross over the two cylinders. **PolyExtrude** using **Transform Extruded Front** to use the handle to pull all of the parts out the same amount.

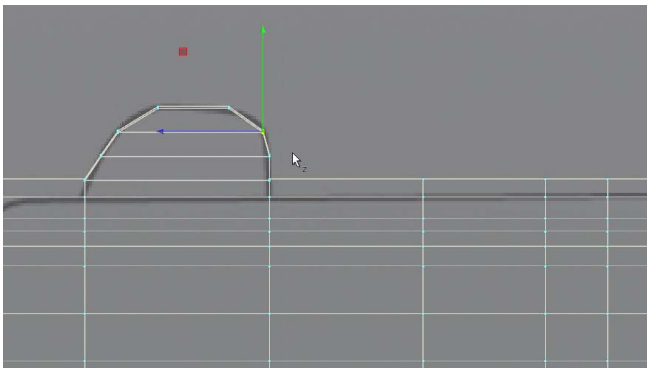


08 **Press 3** to get **Edge** selection and select one of the edges on the extruded shape. Press t to **Move** it. **Select** and **Move** edges until you get the shape shown here. You may want to confirm these edits in a Front view.



09 **Select** the second edge from the end of the barrel. **PolyBevel** to create the revolver's sight. Set the following:

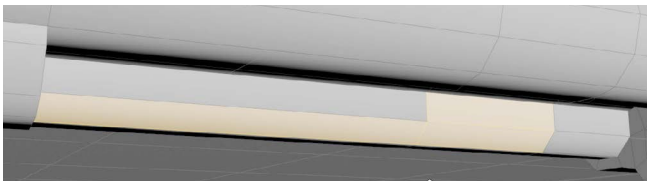
- **Offset** to **0.0025**
- **Shape** to **Solid**
- **Divisions** to **2**

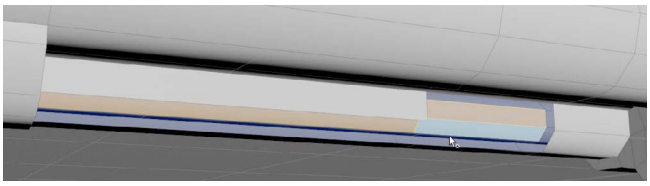


10 **Press 4** to go to primitive selection and select the newly created shape. **PolyExtrude** the sight with the following settings:

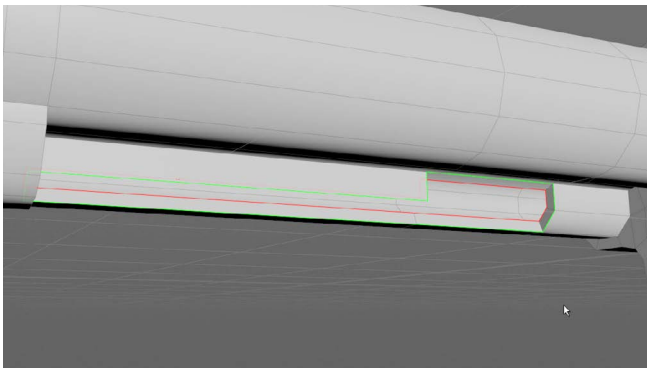
- **Divisions** to **3**

Press 2 to get point selection and in the Right view, edit the points to reshape the sight as shown here.



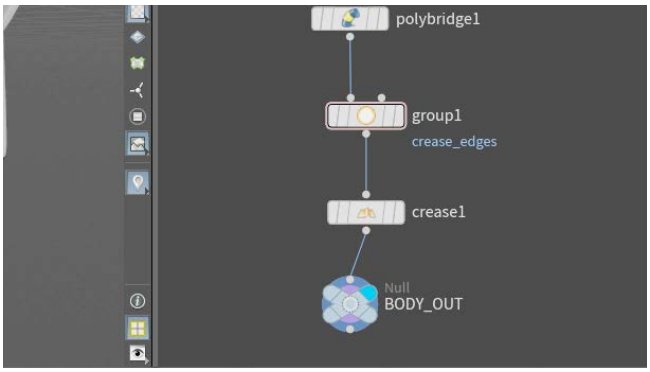


11 **Press 4** to go to primitive selection and select the 3 faces that create the opening in the ejector rod casing. Press **Delete** to remove the outer faces then select the 3 inner faces and **Delete** them too.



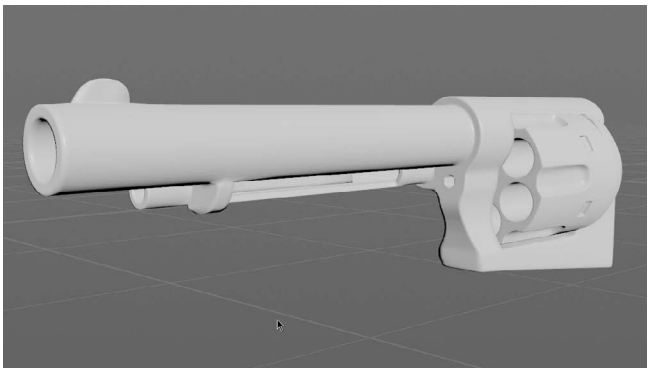
12 **Press 3** to get edge selection. Get the **PolyBridge** tool. **Double-click** on the outer edge of opening of the ejector rod casing for the first profile. **Double-click** on the inner edge of the opening for the second profile and press **Enter**.

Set **Divisions** to **1**.



13 In the Network view, move the *group* and *crease* nodes to the end of the chain, just before the BODY_OUT null node. This makes sure that all of your new changes are being creased properly.

Because the group node selects edges based on angles, it can be moved and still function properly.

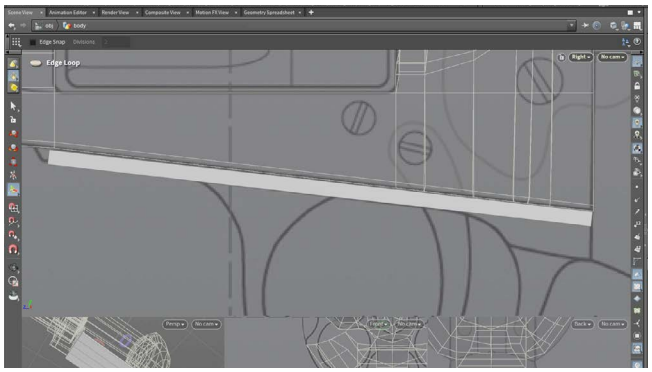


14 Set the Display Flag on the *BODY_OUT* null node. Go back to object level. Turn on the display of the *cylinder* and now you can see both shapes together. Make sure **Subdivision** display is set for both of them.

Save your work.

PART SIX:
Model the Trigger Guard and Handle

To create the Trigger guard and the handle, you will learn how to use tools such as PolyBridge. There will also be various edge loops, polydraws and tweaked polygons along the way. Some of these steps will be repeated from earlier in the lesson but practice makes perfect and each of these parts of the model come with their own challenges.



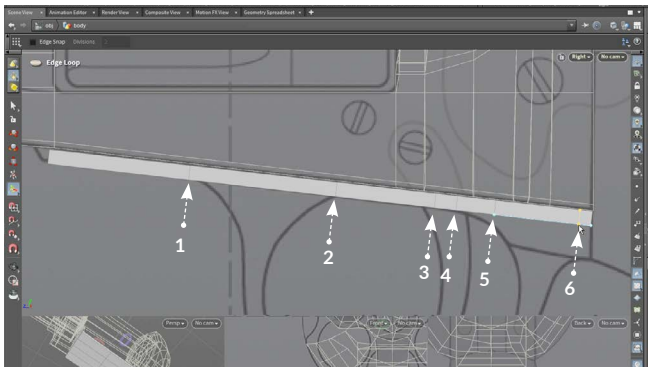
01

Turn off the *cylinder* then dive into the *body* object. Turn off **Subdivision** display and set display to **Smooth Wired Shaded**.

Add a **Box** node to the network and set its Display Flag. Set the Template flag on *BODY_OUT* so you can see the existing model.

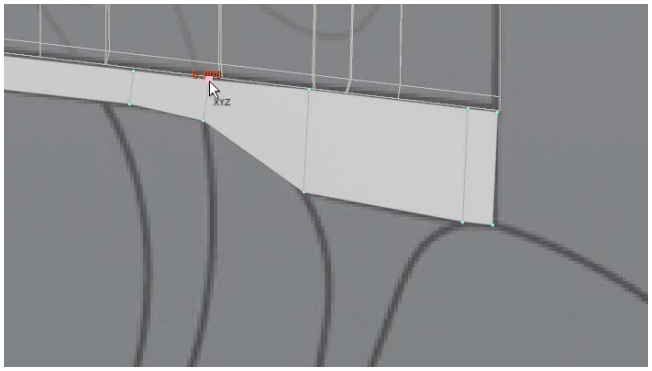
On the new *box* node, set the following:

- **Size** to **0.1, 0.01, 0.38**
- **Center** to **0, -0.187, -0.0625**
- **Rotate X** to **-6.5**
- **Axis Divisions** to **5, 2, 2**



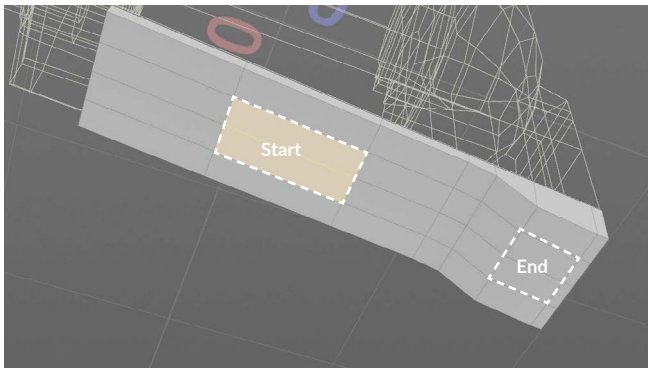
02

In the Scene view, press **tab > Edge Loop**. **Press Q** to repeat it 5 more times to add the edges shown here. These edges are needed to make edits and to create the trigger guard using a PolyBridge.



03

Press 2 to go to Point selection. In the Right view, select and edit Points to match background image as shown. Be sure to box select each of the points before moving them to ensure that you select all five points.



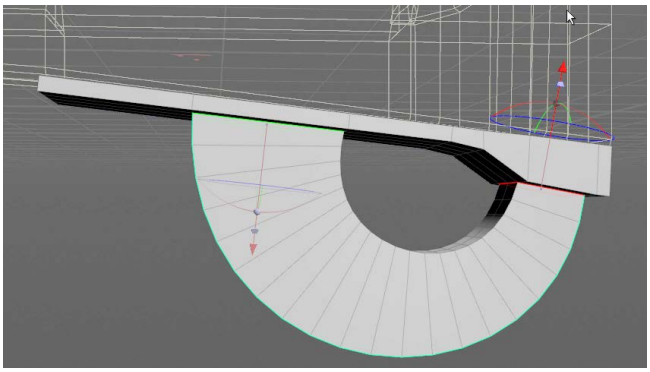
04

Press s to get the **Select** tool. Click in empty space to make sure that nothing is selected. **Press c** and choose **Model > Polygons > PolyBridge**.

Tumble to show the bottom of the shape, select the 2 primitives labeled as start. Press **Enter**. Now select the 2 primitives labelled as end. Press **Enter**.

In the Parameter pane, set the following:

- **Divisions** to **20**
- **Spine Shape** to **Curved**

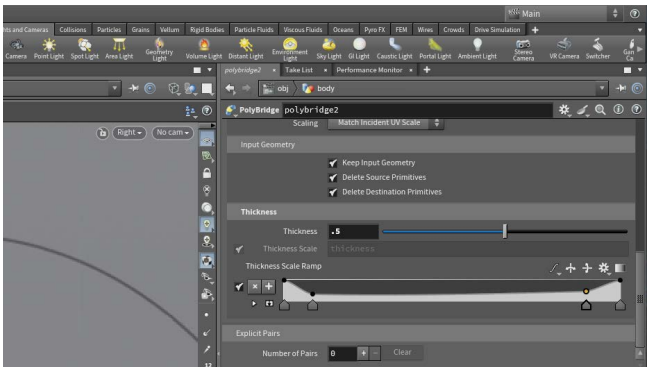


05 On **Pairing** tab, set: **Implicit Pairing** to **Use Edge Counts**

On **Footings** tab, set:

- Under **Depart** set **Depart** to **Along Explicit Direction**
- Under **Destination** set **Arrive** to **Along Explicit Direction.**

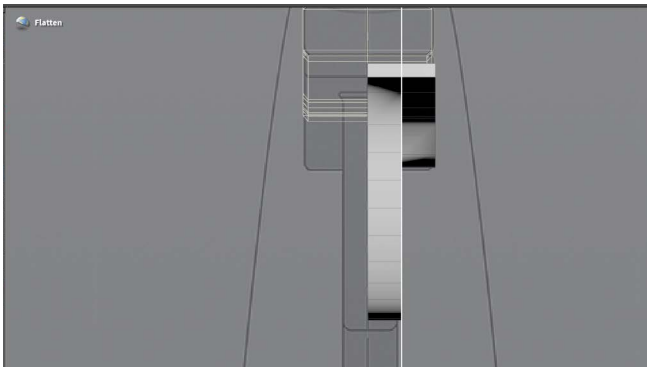
This will orient the bridge properly. You may need to tinker with **handles** to get the exact shape you need.



06 Go to the **Bridge** tab and scroll down the to set up **Thickness** section. Set **Thickness** to **0.5** then use the **Scale Ramp** to pinch the start and end of the bridge. You can use this Ramp to shape the trigger guard .

This makes the guard skinny in all directions which isn't quite what you are looking for. You need to thicken the guard along the x direction.

07 If your guard is not matching the reference image properly then use the handles on the **Bridge** tool to tweak the shape until it matches. As a result, you may want to further tweak the **Thickness Scale Ramp**.

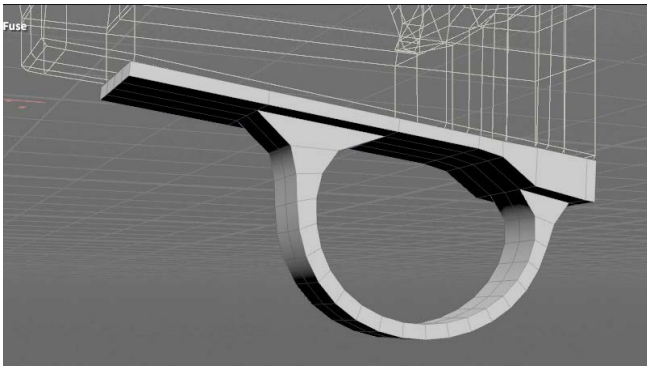


08 **Press 4** to get **Primitive** selection then **press n** to select all the geometry. Press **tab > Clip** to cut the model in half. Leave the **Direction** set to **1, 0, 0.**

Press 2 to get **Point** selection. In the *Front* view, select all the middle points on this shape. Press **tab>Flatten**. Now set the following:

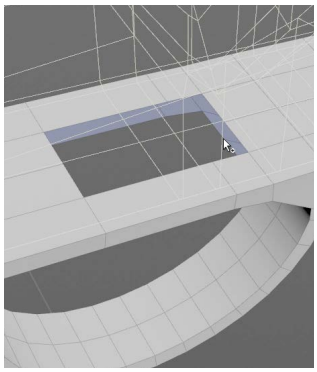
- **Direction** to **1, 0, 0**
- **Origin** to **0.025, 0, 0**.

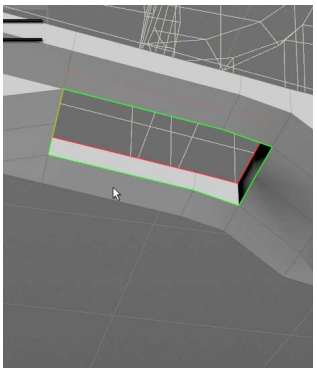
This gives the guard a bit more thickness in the x direction.



09 Press **tab>Mirror** and then **press n** to select all the primitives then press **Enter**.

The polybridge process placed some extra polygons along the seam that aren't needed. Press **tab>Fuse**. **Press n** to select all the points then press **Enter**. Set **Snap Distance** to **0.1** and the points along the seam will be fused together.

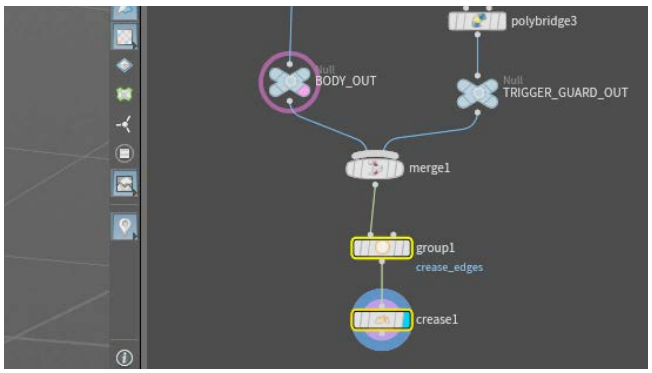




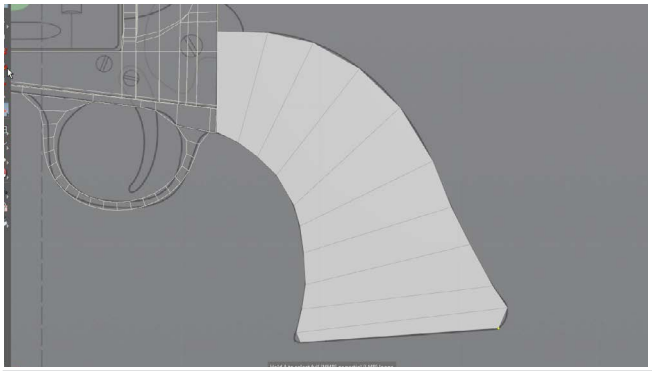
10 **Press 4** to go to Primitive selection. Select four primitives from the bottom as shown then tumble around and select the same four from the top. Delete all the to create an opening.

Press 3 to get Edge selection. Get the **PolyBridge** tool. **Double-click** on the lower edge of opening then press **Enter**. **Double-click** on the upper edge of the opening for the second profile and press **Enter**.

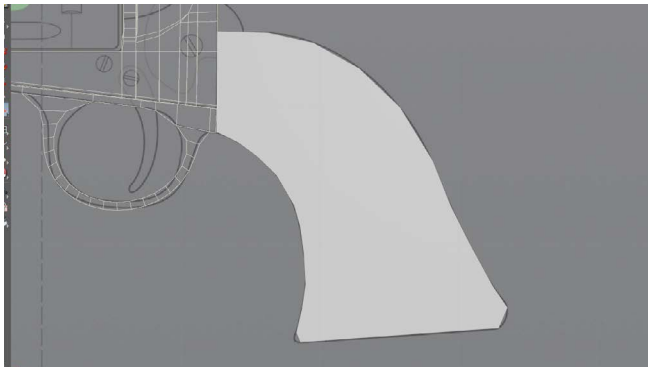
Set **Divisions** to **1**. This creates the hole for trigger which you will build later.



11 Move the *Group* and *crease* nodes again. Add a **Null** node to the end of the chain and call it *TRIGGER_GUARD_OUT*. Add a Merge node and feed the BODY_OUT and *TRIGGER_GUARD_OUT* nodes into it. Set the Display Flag on the *crease* node.



12 In the Network view, press **tab > Polydraw** and place it into the network off to the side. Set its Display Flag and set the Template Flag on the *merge* node. Make sure the **Handle** tool is active and using **Build** mode draw out the handle to trace the revolver's handle.



13 **Press 3** to get Edge selection. Double-click on part of the outer edge to select the shape's profile.

Press **tab > Dissolve** node. Set the following:

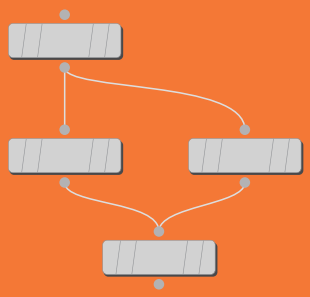
- **Operation** to **Dissolve Non-Selected**
- **Collinearity Tolerance** to **0**

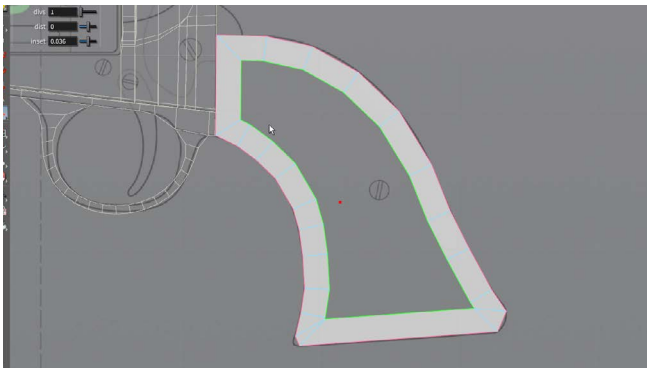
This leaves you with just a filled in profile shape.

BRANCHING NODES

One benefit of working with nodes is that you can branch off in one direction to create the handle frame and then in another for the handle itself. Both sides are working off the same source but you can apply unique operations that are appropriate for each side.

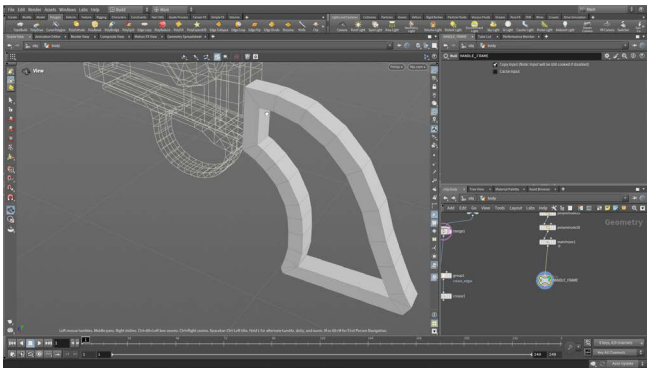
In many cases, an edit to the original shape can cascade to change both sides of the chain. With Houdini you always have the option to model straight ahead or plan things out and using nodes to your advantage.





14 **Press 4** to get Primitive selection. **Press n** to select all the faces. Press **tab >PolyExtrude**. Set the following:

- **Inset** to **0.036**
- Under **Extrusion > Output Geometry and Groups**, turn off **Output Front**.



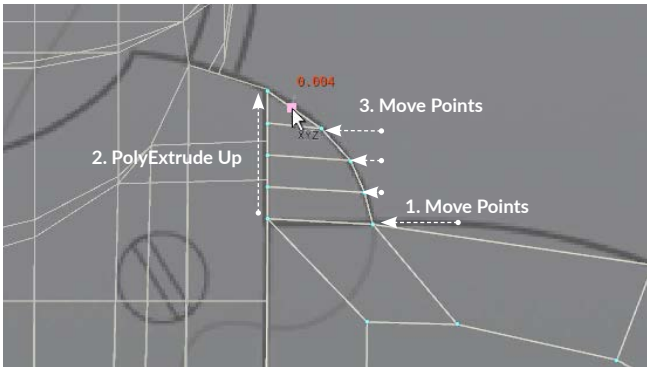
15 **Press n** to select all the faces. Press **tab>PolyExtrude**. Set the following:

- **Distance** to **0.05**

Press n to select all the faces. Press **tab>Match Size**. Set the following:

- **Justify Y** to **None**
- **Justify Z** to **None**

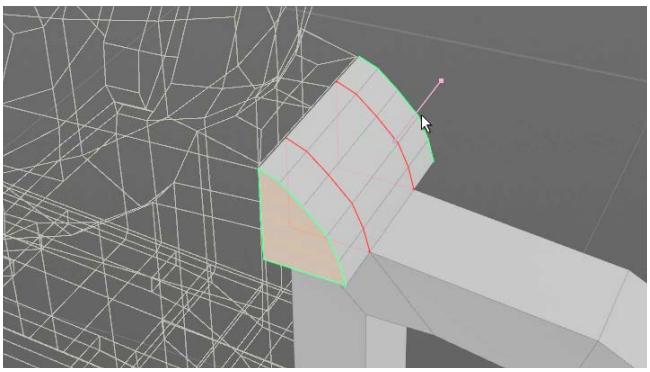
This centers the shape along X. Add a **Null** node and name it *HANDLE_FRAME*.



16 **Press 2** to get Point selection. **Select** the three points at the top of the handle and use the **Move** tool to them to align with the reference image.

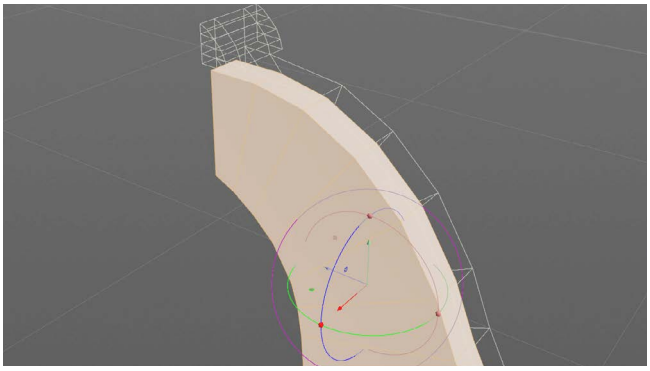
Press 4 to get Primitive selection. Go to the **Select** tool and select the two primitives at the top of the handle shape. Press **tab > Polyextrude** and drag the profile up and set **Divisions** to **2**.

Press 2 to get Point selection. **Select** the points on the right side of the shape and move them to align with the reference image. **Shift-select** this node's Template flag to add it to the templated shapes.



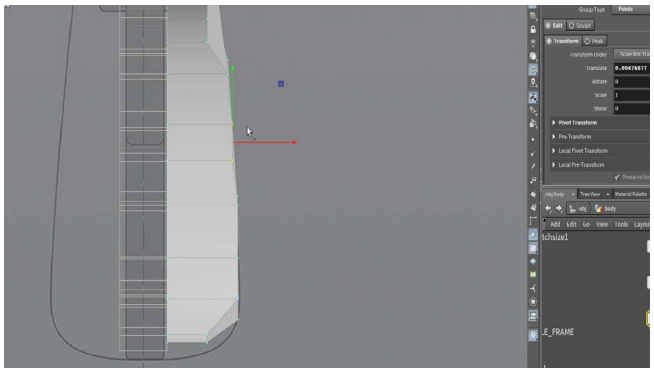
17 **Press 4** to get Primitive selection. Go to the **Select** tool and select the primitives on the side of the handle's top shape then tumble around and shift-select the primitives on the opposite side.

Press **tab > Polyextrude** and drag the profile out to match the back of the revolver body. This would set the **Distance** to around **0.023**.

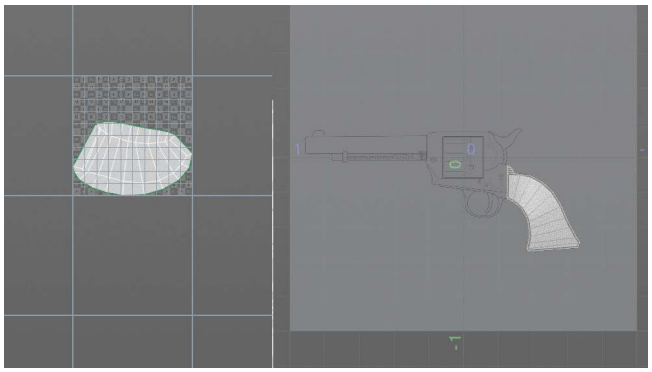


18 Branch off another *polyextrude* from **Polydraw** node and set its Display Flag. **Press n** to select all the primitives and press **tab > Polyextrude.** Set **Distance** to **0.05**. **Press q** to repeat and set **Inset** to **-0.0075**.

Press n to select all the primitives and press **tab > Transform.** Set **Translate X** to **0.025**. This moves this part of the handle to just outside the handle frame.



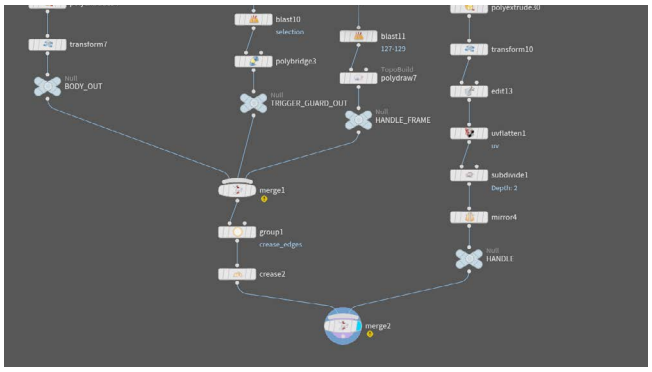
19 Go to a **Front** view. **Press 2** to get Point selection. **Select** the points at the side of the handle and use the **Move** tool to them to tweak them to match the reference image.



20 Add a **UV Flatten** node after mirror then add a **Subdivide** node to smooth the shape of the handle.

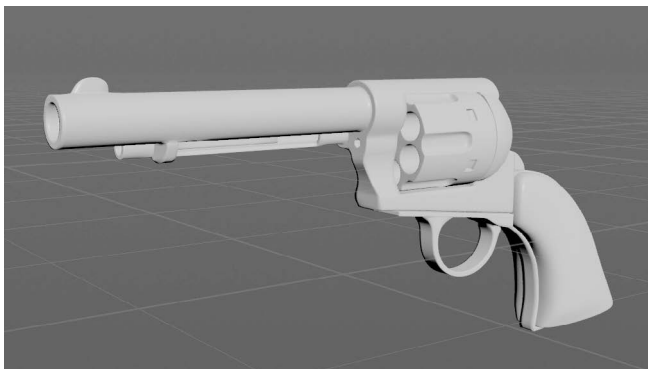
Add a **Mirror** node and mirror along the X axis.

Add a **Null** node and name it *HANDLE*.



21 Add a **Merge** node in the Network view just before the *crease_edge* **Group** node. Feed the *BODY*, *TRIGGER_GUARD*, and *HANDLE_FRAME* null nodes into it.

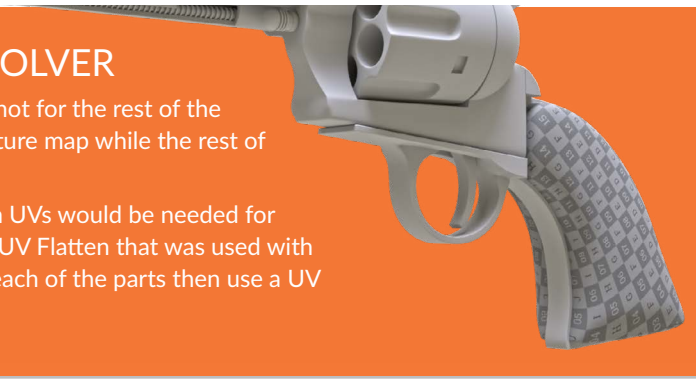
Add a **Merge** node in the Network view just before the *REVOLVER* **Null** node. Feed the HANDLE null nodes into this new null node.



22 Go back to the Object level, display the *Cylinder* and set up **Subdivision** display to review the model so far.

There are a few details to add such as the trigger and the hammer. For the hammer, you will need to boolean the back of the revolver to create space for it.

SETTING UP UVS FOR THE REVOLVER

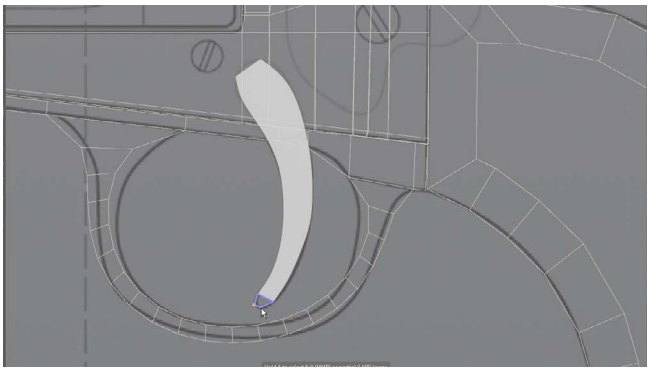


Right now you have set up UVS for the handle but not for the rest of the revolver. This is because only the handle uses a texture map while the rest of the model will use a reflective metal material.

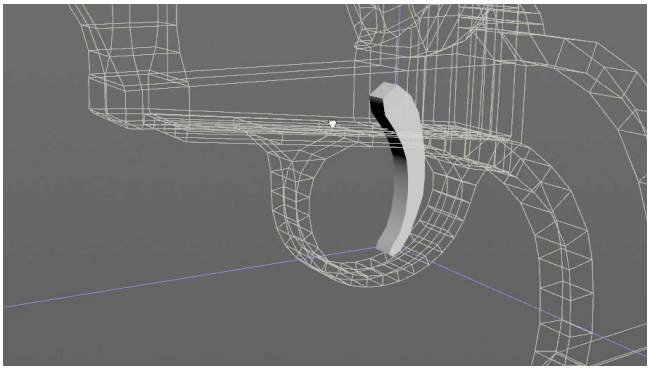
If you wanted to add dirt maps or other details then UVs would be needed for the whole model. This can be done using the same UV Flatten that was used with the handle. It would make sense to set up UVs for each of the parts then use a UV Layout tool to organize the parts in the end.

PART SEVEN:
Model the Trigger and Hammer

You will start building both of these shapes using polydraw then extrude and center the shapes. Transform nodes will be set up to create rotation points for the shapes. The hammer requires that you cut a box out the back of the revolver which will again require cleanup. The revolver is getting very close to being ready.



01 In the Network view, press **tab > Polydraw** and place it into the network off to the side. Set the Template flag on the *Revolver* null node. Make sure the **Handle** tool is active and using **Build** mode draw out the polygons to trace the revolver's trigger. Press **Enter** to complete the shape.



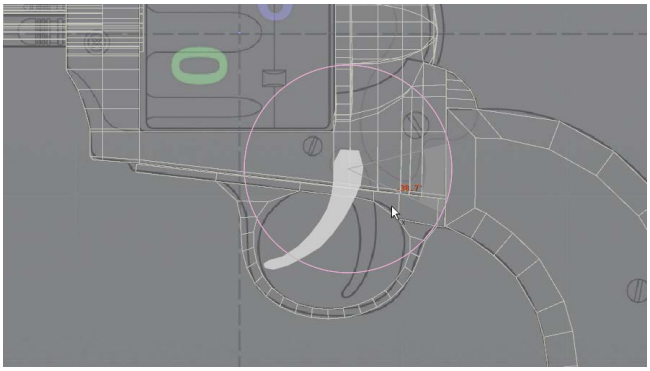
02 **Press 4** to get Primitive selection. **Press n** to select all the primitives. Press **tab>PolyExtrude**. Set the following:

- **Distance** to **0.025**
- **Divisions** to **2**

Press n to select all the faces. Press **tab>Match Size**. Set the following:

- **Justify Y** to **None**
- **Justify Z** to **None**

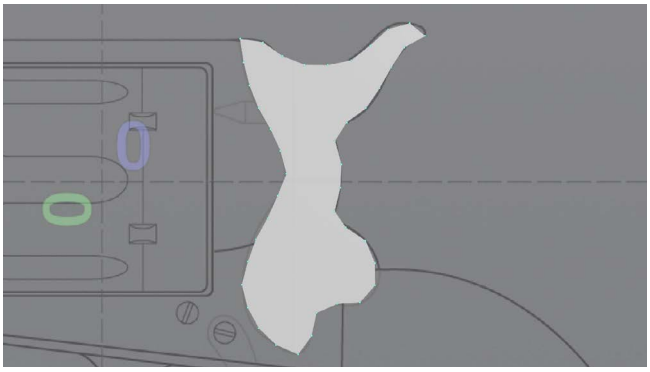
This centers the shape along X.



03 Add a **Transform** node. Press the **Insert** key to turn on **Pivot Mode**. In the Right view move the pivot to the top of the trigger where the screw is in the reference image. Press the **Insert** key again to go back to transform. Make sure the **Pivot Rotate** is **0, 0, 0**.

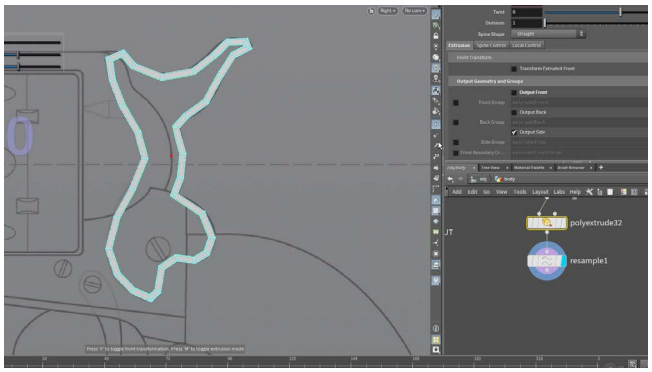
RMB-click on **Rotate Y** and **Rotate Z** and from the menu choose **Lock Parameter**. Now you can rotate around X to test the trigger. Undo to rotate it back. This could be animated later.

Add Null and name it TRIGGER_OUT.



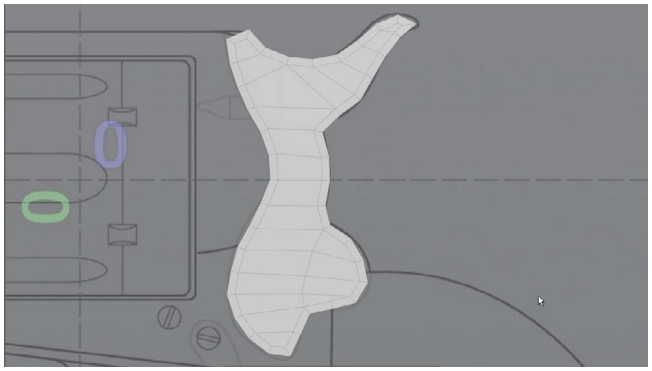
04 In the Network view, press **tab > Curve** and place it into the network off to the side. Set **Primitive Type** to **Polygon**. Make sure the **Handle** tool is active and using **Draw** mode trace the revolver's hammer. Click on the first point at the end to close the shape. Press **Enter** to complete the shape.

In the Network view, add a **Resample** node after the curve node. Turn off **Maximum Segment Length** and turn on **Maximum Segments**. Set **Segments** to **42**. This creates evenly spaced segments which will be better for defining this shape.



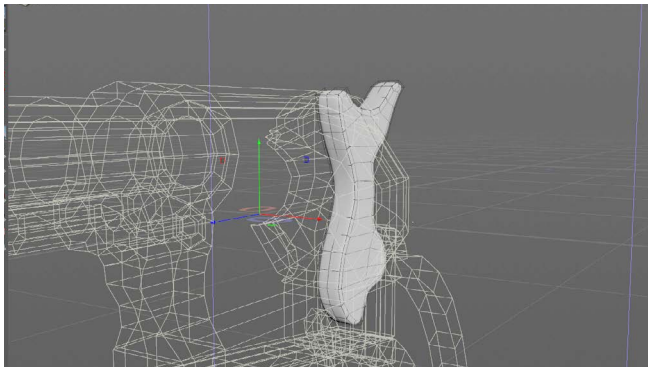
05 **Press n** to select the new shape. Press **tab > Polyextrude**. Set **Inset** to **0.008**. Select the curve node and turn on Select/Edit mode.

Press **Shift +** to subdivide the shape then adjust points on the original curve node to create a shape that matches the reference image. You may want to untemplate the Revolver null node to get a clearer picture.



06 Select the *polyextrude* node. In the Scene view, press **tab > PolyDraw**. Make sure the **Handle** tool is active and using **Build** mode to fill in the center.

When you finish, press **Shift-Delete** to remove any stray points.

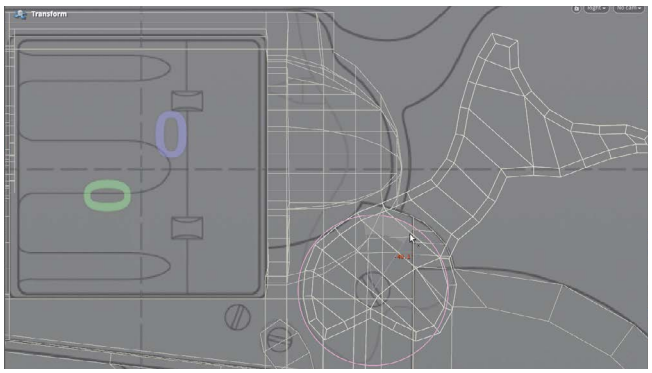


07 **Press 4** to get Primitive selection. **Press n** to select all the primitives. Press **tab>PolyExtrude**. Set the following:

- **Distance** to **0.035**
- **Divisions** to **2**

Go to the **Select** tool. **Press n** to select all the faces. Press **tab>Match Size**. Set the following:

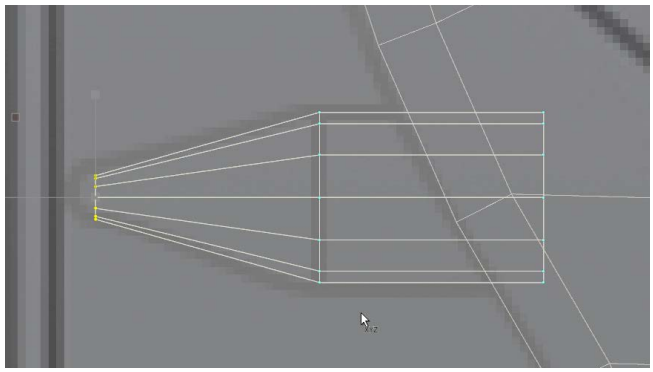
- **Justify Y** to **None**
- **Justify Z** to **None**



08 Add a **Transform** node. Press the **Insert** key to turn on **Pivot Mode**. In the Right view move the pivot to the bottom of the hammer where the screw is in the reference image. Press the **Insert** key again to go back to transform. Make sure the **Pivot Rotate** is **0, 0, 0**.

RMB-click on **Rotate Y** and **Rotate Z** and from the menu choose **Lock Parameter**. Now you can rotate around X to test the hammer. Undo to rotate it back. This can be animated later.

Add Null and name it HAMMER_OUT.

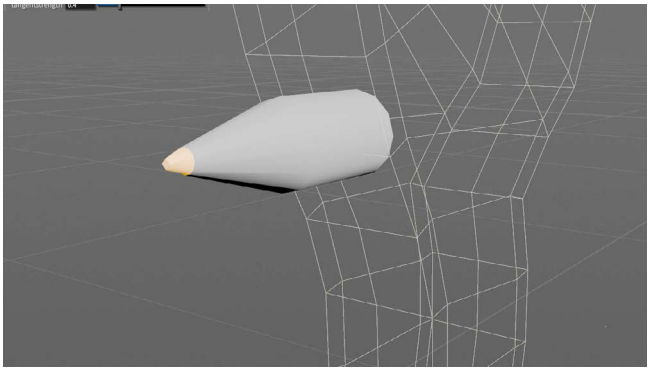


09 In the Network view, press **tab > Tube** and place the new node next to the hammer nodes. Set the following:

- **Radius** to **0.011, 0.011**
- **Height** to **0.058**
- **Rows** to 2

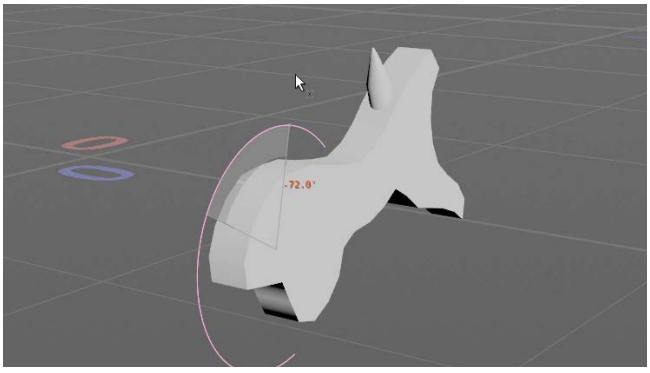
Use the translate handles to move the part until it aligns with the shape next to the hammer.

Go to the **Select** tool. **Press 2** to get Point selection. Box select the points at the end of the tube. **Press e** to get the **Scale** tool and scale the top down around **0.25**.



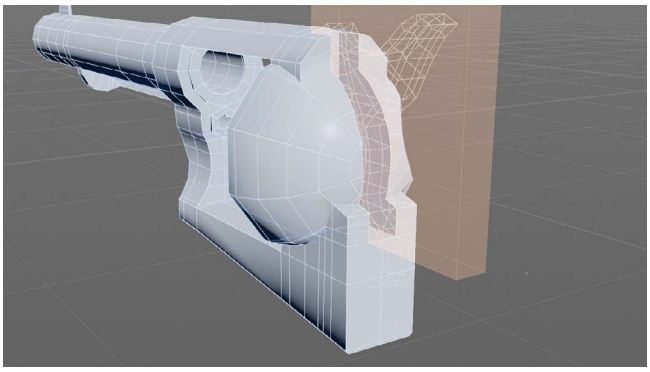
10 Go to the **Select** tool. **Press 3** to get Edge selection. Select the edges at the end of the shape. Press **tab > Polyfill**. Set the following:

- **Fill Mode** to **Quadrilateral Grid**
- **Tangent Strength** to **0.1**



11 Add a **Merge** node in between the *matchsize* and *transform* nodes in the hammer network chain. Feed the *polyfill* node into the merge node to bring the two shapes together. Set the Display flag on the *HAMMER_OUT* node.

Select the *transform* node and rotate around X to test the combined shape. Undo to rotate it back. This can be animated later.

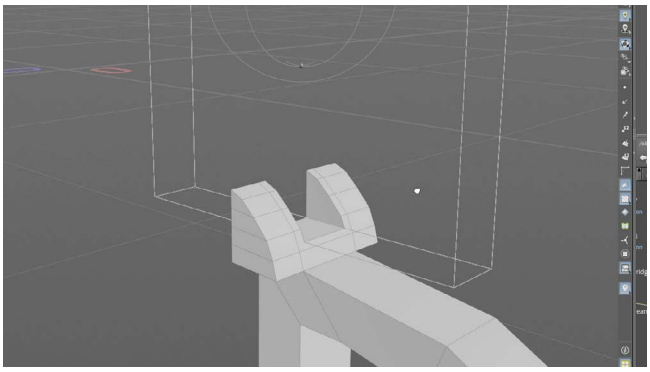


12 In the Network view, press **tab > Box** and place the box node down. Set the following:

- **Size** to **0.038, 0.3, 0.25**
- **Center** to **0, 0.72, 0.265**

Now add a **Boolean** node into the Network view just before the *BODY_OUT* node. Feed the new *box* node into the second input and under **Output Geometry**, set **Operation** to **Subtract**.

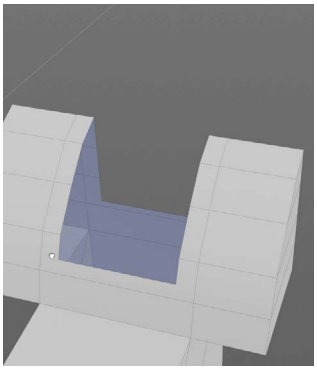
You have now cut out a shape from the main body.

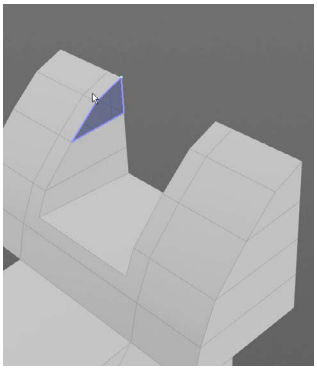


13 Now add a **Boolean** node into the Network view just before the *HANDLE_FRAME_OUT* node. Feed the new *box* node into the second input and under **Output Geometry**, set **Operation** to **Subtract**.

This cuts out a small notch from the top of the frame.

These cuts create some topology issues which you can easily fix in future steps.





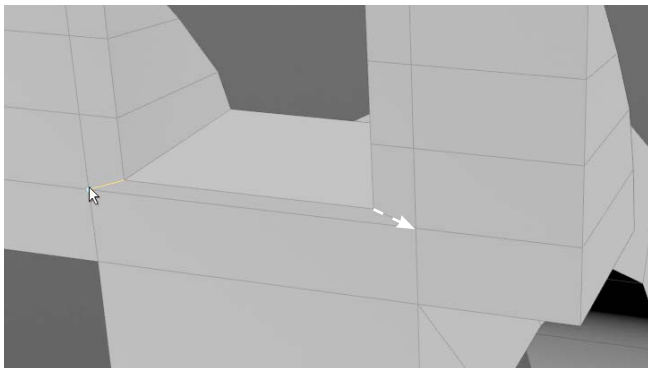
14 Get the **Select** tool and **press 4** to get **Primitive** selection. **Double-click** on the shape to select it all and then press **tab > Polydraw** and use **Build** mode to remove the primitives inside the shape then build up the proper quad topology one polygon at a time.

SUBDIVIDE NODE VS SUBDIVIDE DISPLAY

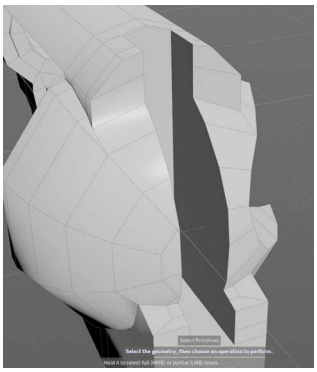
When modeling in Houdini, there are different ways to subdivide your model. The **Subdivide** node adds topology and smooths out the surface a bit but it still leaves you with polygons. You used this node on the handle.

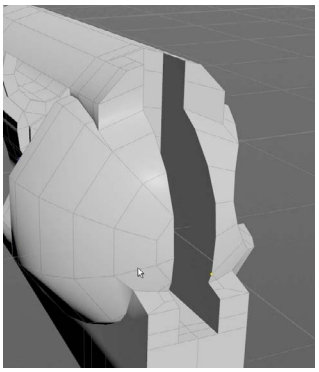
Subdivision display that you get with **Shift +** shows what would happen if the model stayed the same but the polygons were subdivided taking creases into account. This lets you test out a surface before rendering.

To subdivide at render time you need to check off **Render Polygons as Subdivision** when you move the model over to Solaris. This will allow Karma to render the surface as a subdivision with micropolygon level accuracy.



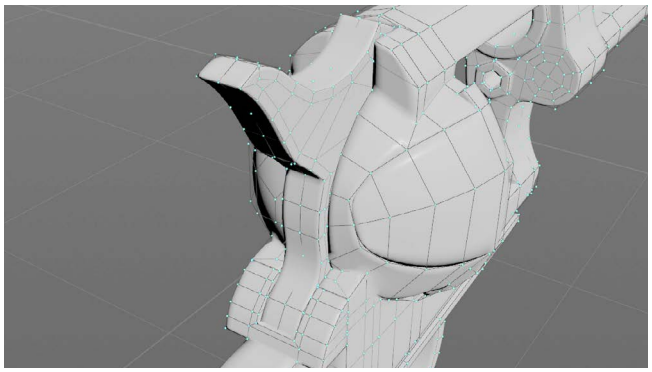
15 Use **Split** mode to connect all the lines on the corner of the booleaned shape. This will extend the topology and create quad primitives. Repeat for the other side.





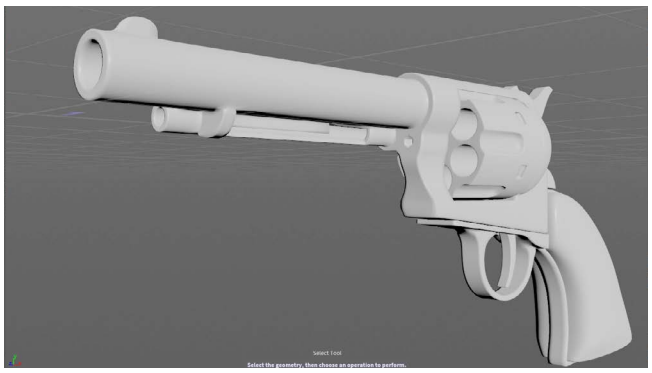
16 Go to the *Boolean* node that is part of the Handle frame and set its Display Flag. Get the Select tool and **press 4** to get **Primitive** selection. **Double-click** on the shape to select it all and then press **tab > Polydraw** and use **Split** mode to connect all the lines inside the cut out area.

This will take a number of steps with lots of tumbling around. In some cases you may need to go to the select tool then back to the Handle tool to get things to work properly. Check out the video too see all the steps.



17 Set the Display flag on the *Revolver* null node. You will see that the **Gate** is missing. In the Network view, find the *gate* null node and Tumble around to show the other side of the model. Connect this node to the merge node in front of the crease node. This way the *gate* will be creased as well.

If you want to you can add a **Transform** node for the *gate* similar to the one used for the trigger and hammer. If you do then be sure to move the pivot to the rotation point for the *gate*.

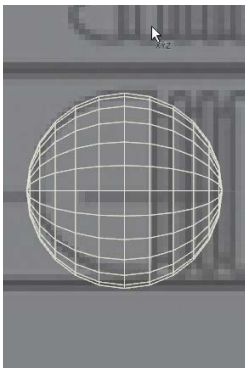


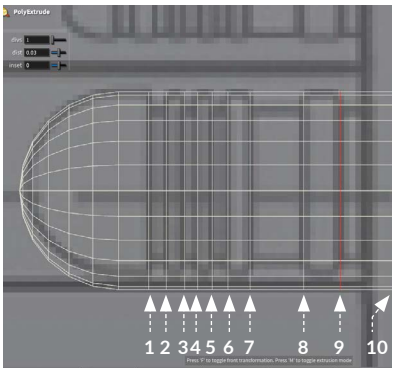
18 Go back to the Object level, display the *Cylinder* and set up **Subdivision** display to review the model so far.

There are a few details such as the *Base Pin* and *Ejector Rod* needed to complete the model.

PART EIGHT:
Add Details

There are a couple of finishing touches to finish up the model. The base pin will be built out of a half sphere and the ejector rod will use a Helix to create the spring and PolyWire to surface it. These small details add to the look of the revolver and are worth taking the extra time to create.



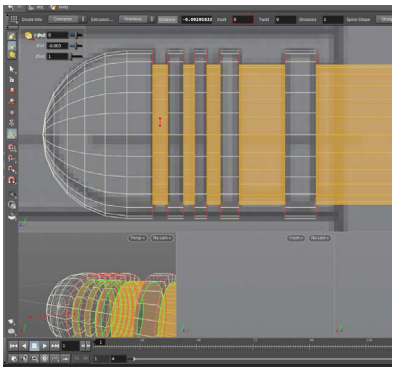


01

In the Right view, **pan** over to the Base pin. In the Network view press **tab > Sphere** and place the node. Set the following:

- **Orientation** to **Z Axis**
- **Radius** to **0.5, 0.5, 0.5**
- **Center** to **0, 0, 0.25**
- **Uniform Scale** to **0.035**

In the Scene View, select the sphere. Press **Tab > Clip**. Turn on **Fill Polygons along Clipping Plane**. Select the flat primitive and press **Tab > PolyExtrude**. Pull the face out. **Press q** and repeat 10 times.

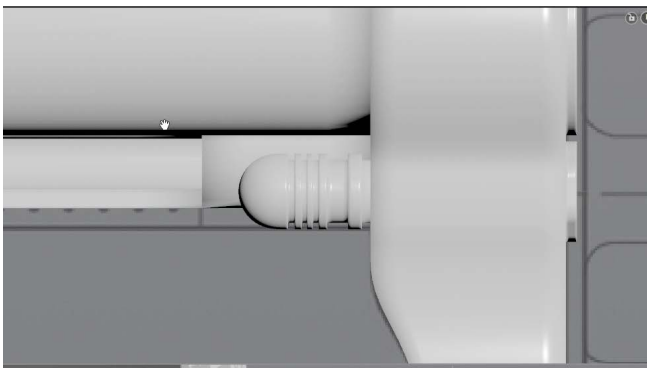


02

Go to the **Select** tool box select all the polygons in the areas where there are notches. Press **tab > PolyExtrude** and set a **Distance** of around **-0.0031**.

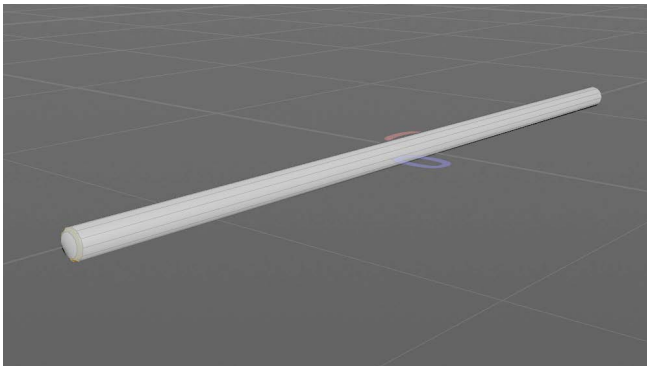
When you finish tumble around to the back of this shape and select the inner primitive and use **Shift-A** and **MMB** to get the ring of primitives at the end. Press **Delete** to blast them away.

Add a **Null** node and name it *BASE_PIN*.



03

In the Network view, feed the *BASE_PIN* node into the *merge* node just before the *crease*. This way this shape will be creased before any subdivision.



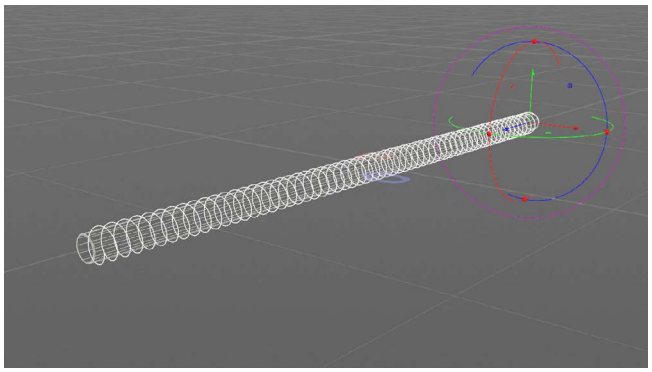
04

In the Network view, press **tab > Tube**. Place the node down and set its Display flag. Set the following:

- **Radius** to **1, 1**
- **Radius Scale** to **0.009**
- **Height** to **0.55**
- Turn on **End Caps**.

Go to Edge selection and double click the edges on both ends. Press **tab > Polybevel** and set:

- **Distance** to **0.002**
- **Divisions** to **2**

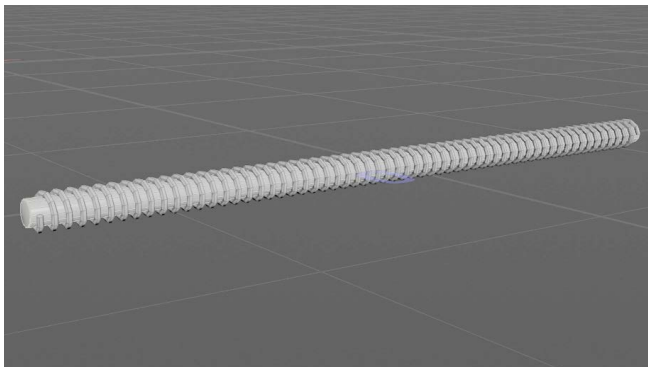


05

In the Network view, press **tab > Helix**. Place the node down and set its Display flag. Set the following:

- **Transform > Rotate X** to **90**
- **Transform > Translate Z** to **-0.27**
- **Height** to **0.54**
- **Start Radius** to **0.011.**
- **Turns** to **60**
- **Divisions per turn** to **10.**

This creates a helix that wraps around the tube you just created.



06

Go to the **Select** tool and **double-click** on the curve to select it. Press **tab > PolyWire** and set:

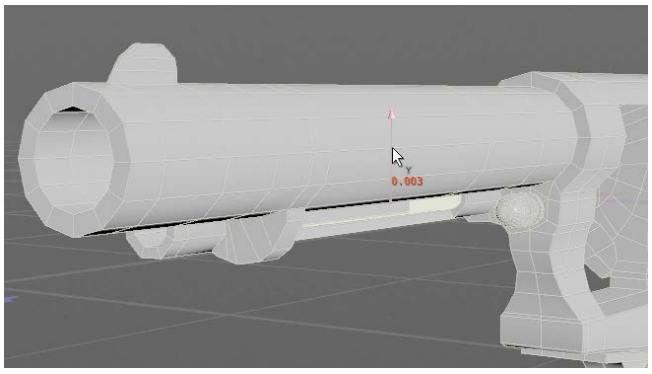
- **Wire Radius** to **0.002**
- **Divisions** to **6**

Add a **Merge** node in the Network and wire in the **Helix's** *polywire* node and the **Tube's** *polybevel* node.

Next add a **Transform** node and set:

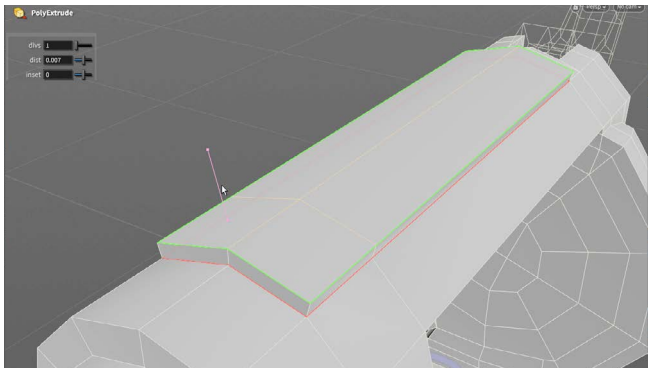
- **Translate** to around **-0.6, 0.01, 0.475**

Add a **Null** node and name it *EJECTOR_ROD*.



07

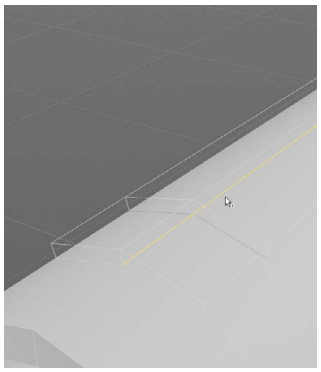
Feed the EJECTOR_ROD into the *merge* node near the end of the chain. This geometry doesn't need to be creased. If it doesn't seem to be positioned in the opening properly then play with the **Transform** node to make sure it fits

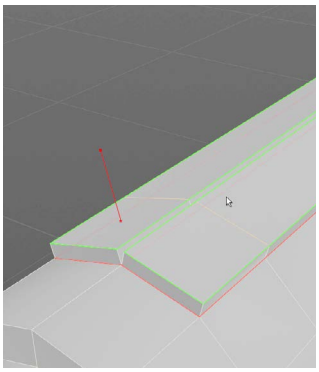


08

Go back to BODY_OUT part of the network and set its Display Flag on the *polydraw* node. With the **Select** tool, select the four primitives at the top of the body just above the Cylinder opening.

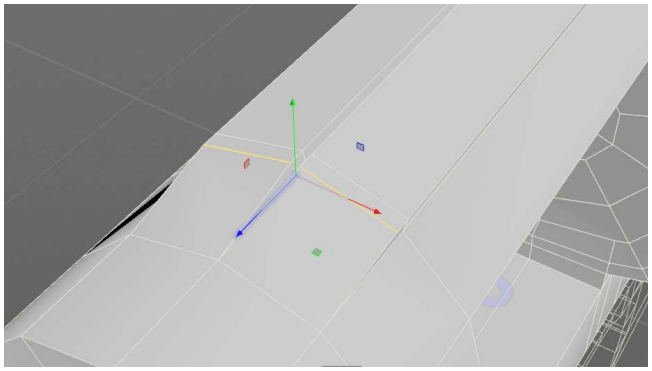
Press **tab > PolyExtrude** and set a **Distance** of **0.0065**. Now all the primitives are connected. What is needed is one for the right and one for the left. This is where you can use the **Split Group** option.



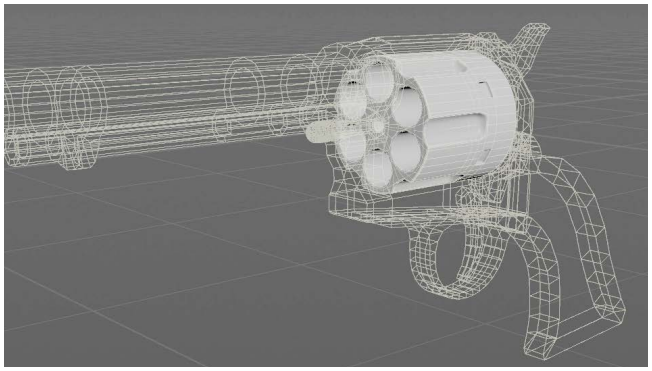


09

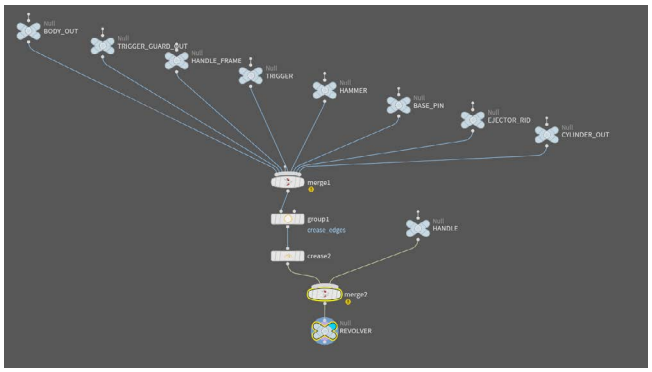
Turn on the **Split Group** option then click on the **Select Geometry** arrow icon. **Press 3** to get **Edge** selection and then **Shift-select** the two edges separating the two halves. Press **Enter** to accept and now there are two extrusions.



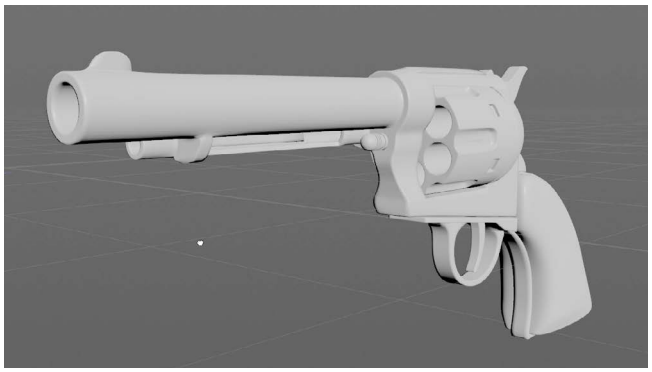
10 Use the **Select** tool to select the two edges at the front end of this extruded shape. Press **tab > transform**. **RMB-click** on the transform handle and select **Align Handle > World**. Push these two edges backwards to reshape the front of the sight.



11 Go to the Object level and select the select the *body* object and then **Shift-click** on the *cylinder* node. On the **Modify** shelf, click on the **Combine** tool. Now all the modeling nodes are in one network.



12 Delete the *display_merge* node. **Hide Inputs** on the *Cylinder* null node and move it next to the other parts of the revolver's body. Feed it into the *merge* node before the *group* and *crease* nodes. If you want to, you can **RMB > Inputs > Hide Inputs** on the null nodes to make it easier to visualize the network.



13 Go back to the Object level, There is only one object called *body*. Rename it *revolver*. Press **Shift-+** to turn on Subdivision display. The model is complete.

Now you can set up the model for rendering.

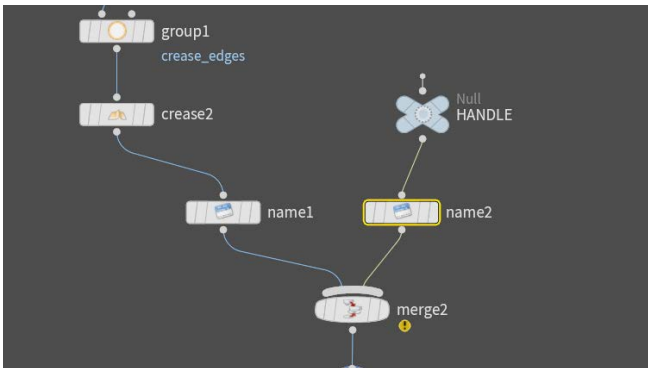
NODE TYPE | LOPS

You have used object nodes and dived into them to create geometry using Surface Operators or SOPS. You are now going to move your work to Solaris which is the Lighting Operator or LOP context in Houdini. The Solaris environment can be found in the */stage* network.

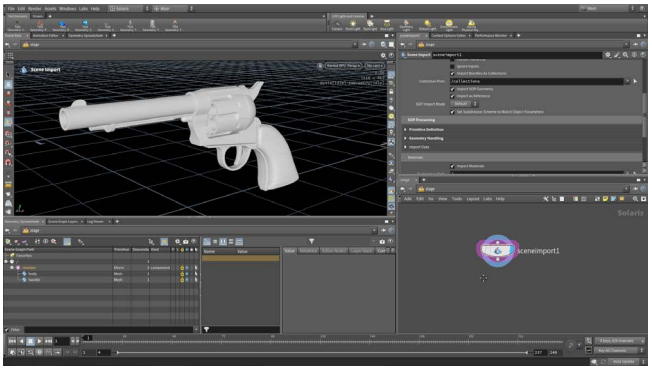
Here you will place nodes for bringing in geometry, assigning materials and adding lights and cameras. The Solaris environment converts everything into USD [**Universal Scene Description**] which is an open source format created by PIXAR. The Solaris/LOPS context allows you to work with USD which is needed to render to the Karma XPU renderer.

PART NINE:
Render the Revolver

To render the revolver, you will learn how to bring the geometry into the Solaris context to add materials and lights. This will involve adding a name attribute to separate handle from the body for rendering purposes. You will then build a background shape and add a textured material. You will then render using the fast Karma XPU renderer.



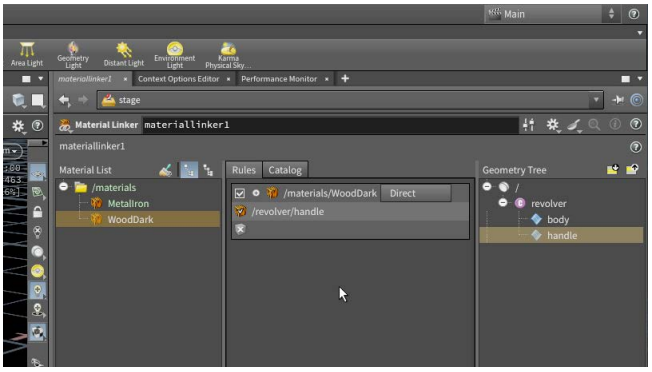
01 Dive into the new *revolver* object. In the Network view, add a **Name** node after the *crease* node and set its **Name** to *body*. **Alt-drag** on that node and place it just after the *HANDLE* node and set its **Name** to *body*. These *name* nodes will help define the geometry for use when you bring it over to Solaris.



02 Change the desktop to **Solaris**. Make sure you are looking at the **Stage** in the path bar.

In the Network view, press **tab > Scene Import** and click to place the node down. Name this node *revolver*. Click on the node selector button next to **Objects** and choose the *revolver* object. In the Scene Graph you can see the *revolver* and under it the *body* and *handle* primitives. In the Parameter pane, scroll down to **Geometry Handling** and turn on **Treat Polygons as Subdivision Surfaces**.

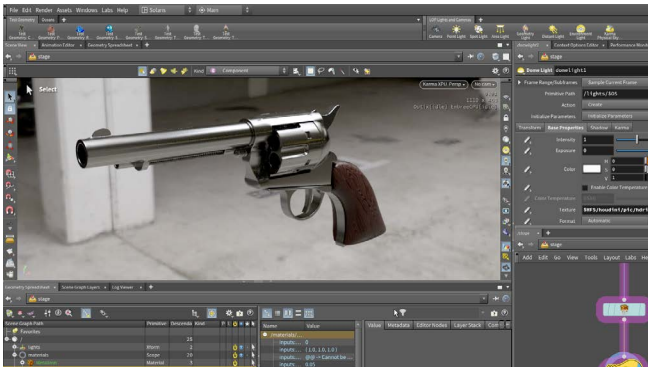
Click on the *Persp* menu and set it to **Karma XPU**. You can tumble around to see how XPU works interactively.



03 Add a **Material Linker** node to the end of the chain. Click on the **Catalog** tab in the Parameter pane and drag the *MetalIron* and *WoodDark* materials to the **Material List** section.

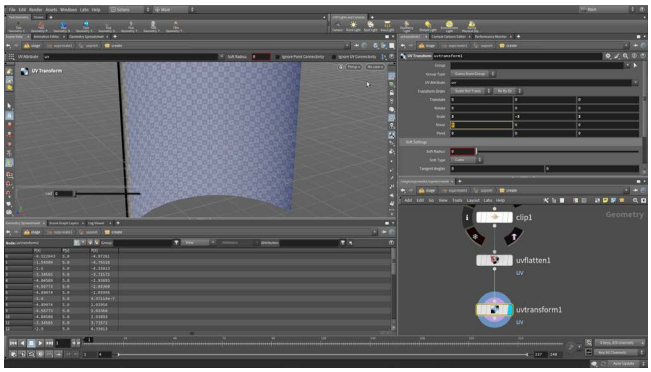
Click on the **Rules** tab and drag the *MetalIron* material over. Now from the **Geometry Tree** on the right, drag the */revolver/body* primitive to the material section of the rule. Now use the same technique to assign the *WoodDark* to the */revolver/handle* primitive.

Right now the revolver looks very dark because there is nothing for it to reflect. You will use a **Dome** light to add an *hdri* image.



04 Add a **Dome Light** node to the end of the chain and set its Display Flag. Click on the **File selector** button and from the sidebar select the *$HFS/houdini/pic/hdri/* to go to that folder. Select the *HDRIHaven_skylit_garage_2K.rat* and press **Accept**.

Now you can see reflections in the metal and a garage in the background. Lets cover up the garage with some background geometry.

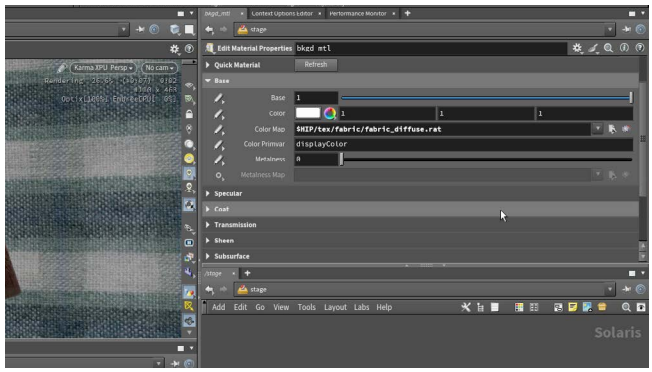


05

Add a **SOP Create** node and feed this node into the *revolver* node. Rename it *background* and double click to dive into it. Add a tube node and set:

- **Radius** to **5, 5** & **Height** to **10**
- **Columns** to **30**.
- Under **Geometry Handling** turn on **Treat Polygons as Subdivision Surfaces**.

Add a **Clip** node and set **Direction** to **-1, 0, 0**. Add a **UV Flatten** node then add a **UV Transform** node and set **Scale** to **3, -3, 3**. Set the Display flag on *uvtransform* and go back to the *stage* level.

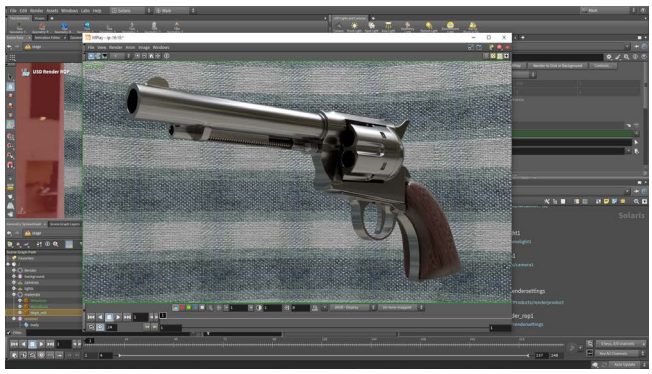


06

Add **Quick Surface Material** node and name it *bkgd_mtl*. Feed it into the *background* node then go to the *materiallinker* node and link the *bkgd_mtl* to the */background* primitive. Keep the Display flag on the end of the chain.

In the **Base** section, click on the icon on the left of the **Color Map** field and choose **Set or Create**. Next to **Color Map** click on the **File Chooser** button. Go to the $HIP/*tex/fabric/* directory and get the *fabric_diffuse.rat* file. Go to the Bump section and set the Bump Height Map to $HIP/*tex/fabric/fabric_bump.rat*

Now there is a fabric pattern on the background object.



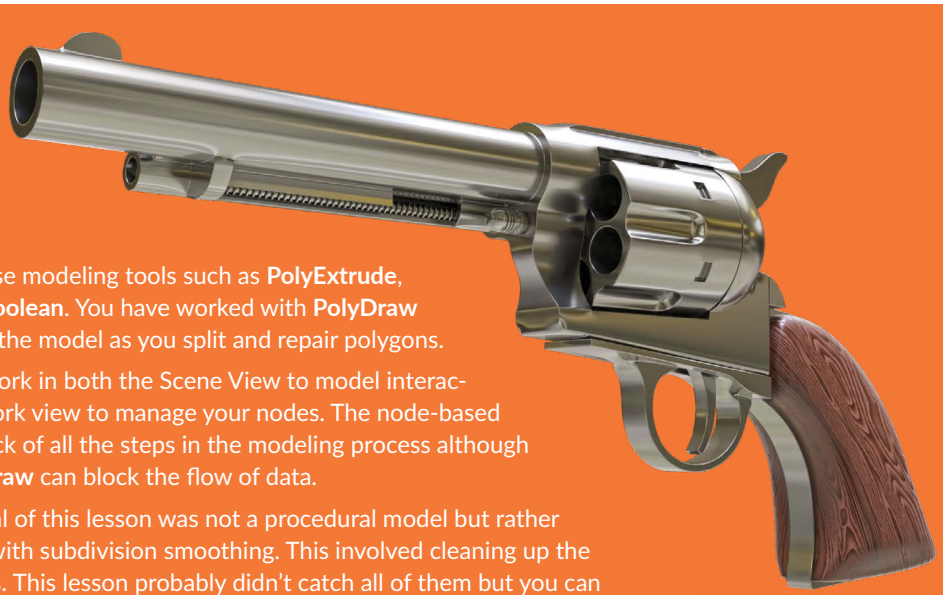
07

From the **No Cam** menu in the top right corner, choose **New Camera**. Click on the **Lock camera to view** button. Use the **View tools** to tweak the position the camera.

In the **Network View**, press **tab > Karma** to add a **Karma Render Settings** and **USD Render ROP** node. Add them into the end of the chain. Set the Display Flag on *karmarendersettings* and set **Engine Settings** to **XPU parameters**. On the **Image Output > Filters** tab set **Denoiser** to **nvidia Optix Denoiser** to turn the denoiser back on.

Select the *usdrender_rop* node and press **Render to Mplay** to render the revolver.

CONCLUSION



Congratulations! You have built this revolver model from scratch using background images to guide you on your way.

You have learned how to use modeling tools such as **PolyExtrude**, **PolyBevel**, **PolySplit** and **Boolean**. You have worked with **PolyDraw** to manage the topology of the model as you split and repair polygons.

You have learned how to work in both the Scene View to model interactively and to use the Network view to manage your nodes. The node-based workflow lets you keep track of all the steps in the modeling process although some nodes such as **PolyDraw** can block the flow of data.

This is fine because the goal of this lesson was not a procedural model but rather one that renders properly with subdivision smoothing. This involved cleaning up the polygons to focus on quads. This lesson probably didn't catch all of them but you can always go back and tinker if you see any kinks in the model.

To complete the model, you brought it into the Solaris context to add materials, lights and a camera and render. You then created and textured a background shape and rendered with Karma XPU.