

Maya 2015

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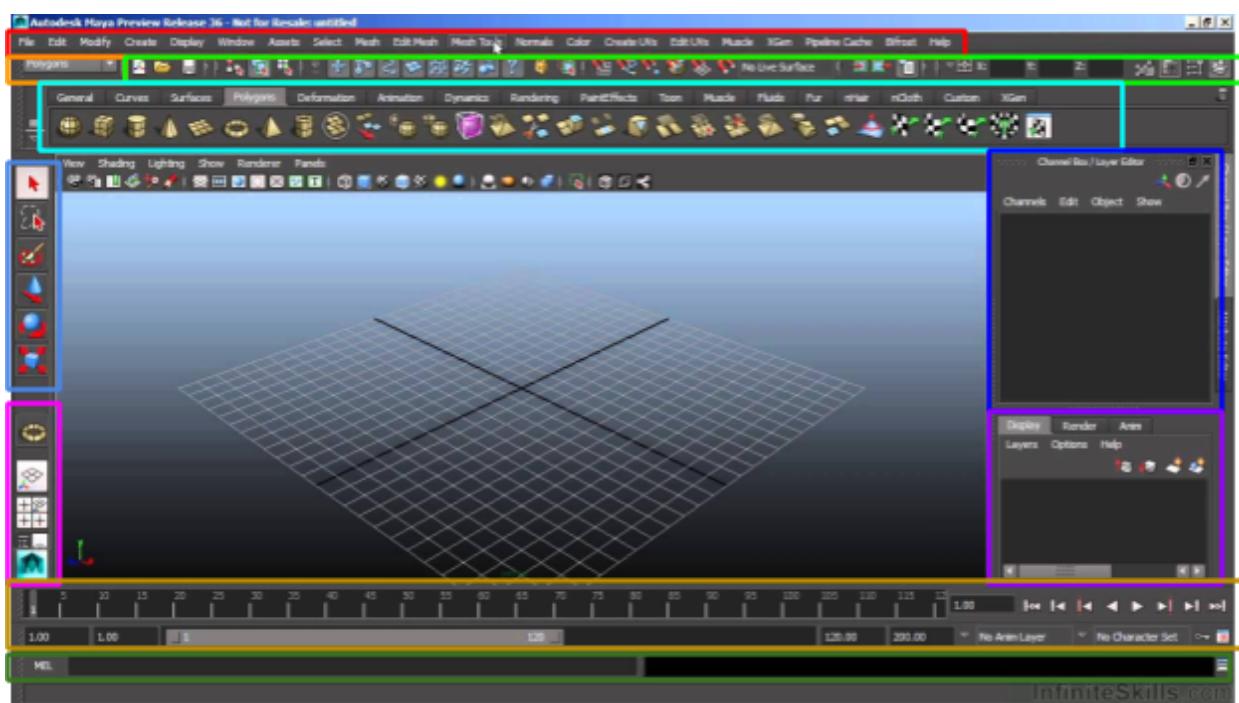
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Interface

Main



Menu Provides access to all of Maya's functionality: everything from object creation to rendering a final image. The first 7 menus and the last menu never change (common functionality). The menus in between change based on the option selected in the menu set.

Menu set Controls which menus show up.

Toolbar Typical toolbar: saving/loading, selection, magnets, etc...

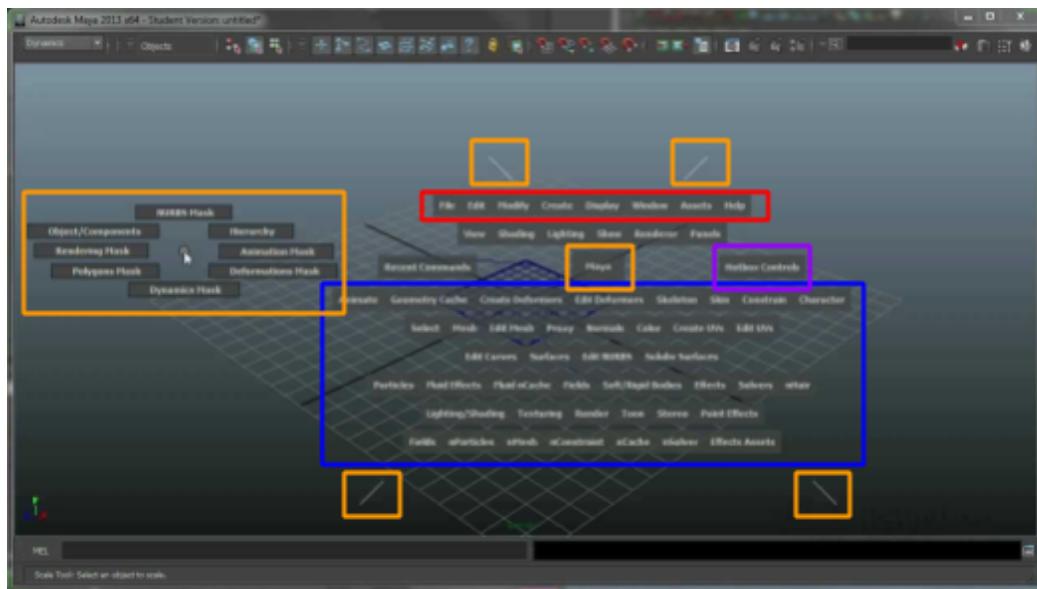
Shelves Commonly used tools: creating objects, deforming objects, etc. You can create custom shelves, but Maya comes with several shelves already setup for you.

Channel box Streamlined access to object attributes for quick edits.

Layer	Organize objects, renders, and animations in layers. Layers are key to managing all of your assets inside of Maya.
Toolbox	Selection + transform tools (move/rotate/scale).
Quick layout	Shortcuts to commonly used viewport configurations.
Timeline	Timeline, playback controls, and range slider. Together, these let you set the length of your animation and playback.
MEL	Maya expression language (programming interface). Gray bar on the left is the input, while black bar on the left is the output.

Hotbox

The hotbox is an action menu that contains every “action” from Maya’s interface. You can access the hotbox by pressing and holding the spacebar.



Across the top of the hotbox, you get each of the **common menus**. On the bottom, you get each of the individual **menu sets**.

NOTE: Remember that common menus are the first 7 + last main menus, while the menu sets are the menus that show up when you choose a specific item in the menu set drop down. Check out the interface section if you can’t remember what common menus / menu sets are.

The 4 white lines represent the **designated marking menus**. Left clicking in the ...

- center region gives you options for switching between different cameras
- top region gives you options for predefined viewport layouts
- left region gives you selection masks

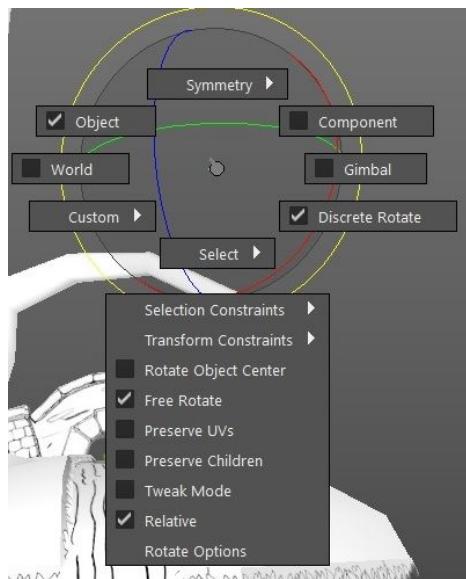
- right region gives you options for turning on/off UI elements (e.g. get rid of timeslider)
- bottom region gives you options to switch to different windows/editors (e.g. graph editor)

You can also customize the hotbox by using [hotbox controls](#).

Tool Marking Menus

Depending on the tool, you can get menus to pop up (similar to the designated marking menus talked about in the previous section) that let you access the configuration options for that tool.

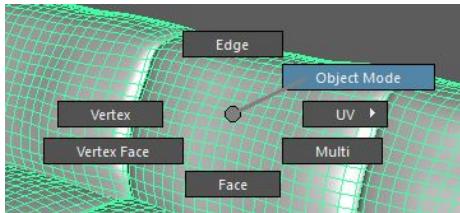
For example, the W key in the hotkey for the move tool. If you press and hold the W key, you can left click anywhere in the viewport to show a pop-up menu similar to a hotbox designated marking menu. This menu will give you access to all of the tool's functionality, similar to if you double click the move tool in the toolbox and have the options show up in the tool settings pane.



This works with all of the transformation tools (E for rotate and R for scale).

Object Marking Menus

Similar to the tool marking menus discussed above, you can right-click on an object to get a marking menu specific to that object.



Camera Controls

Maya has 4 cameras by default...

- perspective
- top
- left
- side

You can toggle back and forth between them by using the space bar. To manipulate the camera, you can use the Alt in combination with any of the mouse buttons...

- Alt + LMB = tumble/rotate (only in perspective view)
- Alt + MMB = pan
- Alt + RMB = zoom (mouse wheel also works for this)

You can also access these tools in the menus just above the viewport's toolbar...

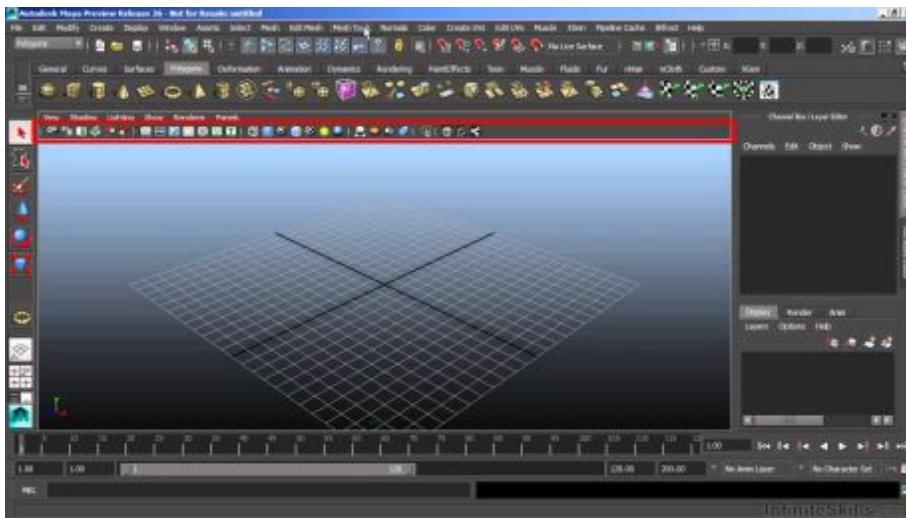
View -> Camera Tools -> (tool)

The history for the camera's position is retained, you can go back and forward using the bracket keys ([and]).

Sometimes you want to frame up objects -- have it take up the entire viewport. To do this...

- Press F to frame up the currently selected objects.
- Press A if you want to frame up all objects.
- Hold Ctrl+Alt and select area (top-left first) in viewport to frame up an area.
- Hold Ctrl+Alt and select area (bottom-right first) in viewport to frame up out of an area.

There are also camera controls in the viewport's toolbar.



1. First icon selects the camera as if it were an object.
2. Second icon selects the camera and open the attribute editor.
Use this to set camera attributes like FOV.
3. Third icon bookmarks the current view.
To go to a bookmark, just above the viewport's toolbar select View -> Bookmarks -> (bookmark here)

Projects

When working inside of Maya, you always want to start by establishing a project directory. Once you have that project directory established, you only need to set it from there on out. Maya will remember that project directory and every time you start Maya it'll directly open up into that project.

NOTE: This is handled by setshot at SPI?

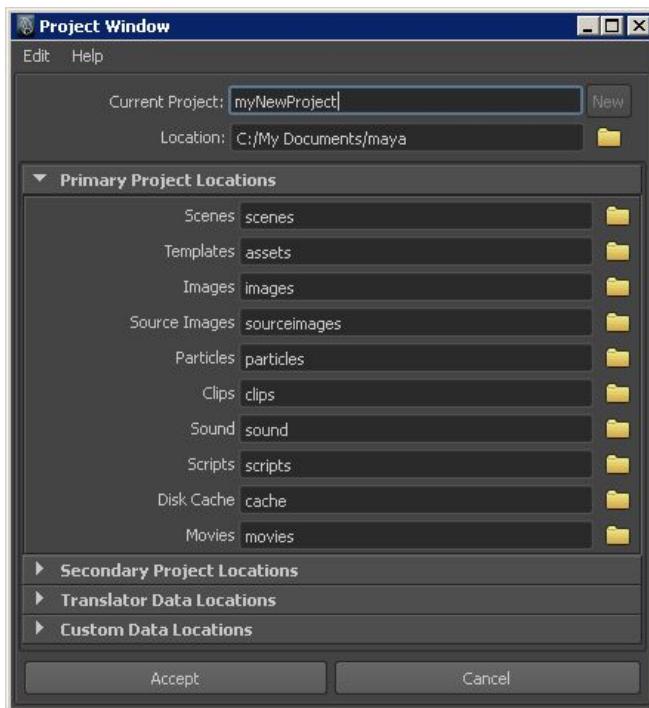
What is the purpose of having a project? It's so that Maya's directory paths are set to your current 'scene'. This makes sure that all of the external assets (e.g. textures) are loaded properly.

NOTE: This is a fancy way of saying that paths are relative, referenced against the project directory.

If an asset can't be found, Maya will use a placeholder. For example, if a texture can't be found you'll get an all black placeholder.

To change the current project... File -> Set Project.

To create a project... File -> Project Window. Press New, filling out the name/location fields, updating the location fields (if you want to), and hit Accept.



- Primary Project Locations -- this is the individual folders Maya will create for us
- Secondary Project Locations -- similar to primary but for lesser used things like fur
- Translate/Custom Data Locations -- other types of directories we want Maya to create

NOTE: At SPI, it looks like you can't do this. The system already sets it up for you when setshot is used and Maya starts. If you try to make a new project folder in that shot, you won't have the permissions to do so?

NOTE: A project's information is kept in the workspace.mel file. You'll find that file in the root project folder. Without that file, Maya won't be able to recognize the project structure.

NOTE: The two really important locations are scenes and source images. These are the ones that you usually access most often.

- Scenes -- scenes
- Source images -- external textures / images

Primitive Objects

There are 3 types of primitive objects in Maya...

- NURBs -- algorithmic curves, you did your gfx project on these algorithms
- Polygons -- basic flat polygon surfaces (triangle, triangle fan, etc..)
- Volumes -- implicit surface (used for fog/lighting effects)

NOTE: What is an implicit surface? It means you can't change any of the components/vertices that make this surface up. You can scale/rotate/move, but you can't modify.

Creation

To create a primitive object...

1. Create -> (type) Primitives -> (object type)
2. Click and drag on viewport

NOTE: You'll notice an checkable menu item called Interactive Creation near the bottom. If you turn this off, objects will be created at origin instead of click-dragging.

Primitive objects all come with a creation node (accessible under INPUTS in channel box). Changing the properties under this creation node modifies the components that make up the object.

For example, a NURBs sphere will have the properties sections and spans. These properties add/remove segments for the NURBs surface.

HINT: If you select an integer item in the channel box like sections/spans, you can hold the middle mouse button down in the viewport and move the mouse left/right to decrease/increase.

NOTE: Between NURBs and Polygon objects, polygons are more versatile and have the greatest amount of tools. NURBs aren't used that often anymore because they're harder to work with. With polygons, you can take any surface and subdivide it to do whatever you have to.

Transforming Objects

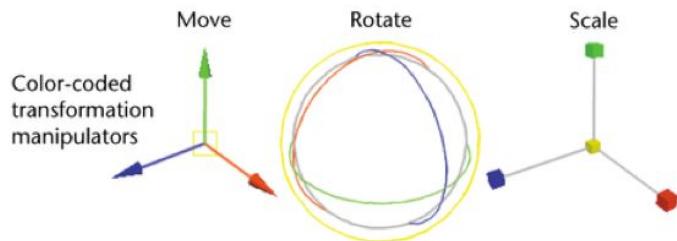
Remember that the basic controls for transforming an object are...

- Move tool (hotkey W)
- Rotate tool (hotkey E)
- Scale tool (hotkey R)

NOTE: You can access all these tools through the toolbox as well as through the hotkeys given.

When one of these tools is selected, you have control markers show up. For example, the move tool will give you arrows and planes that map to the world coordinates.

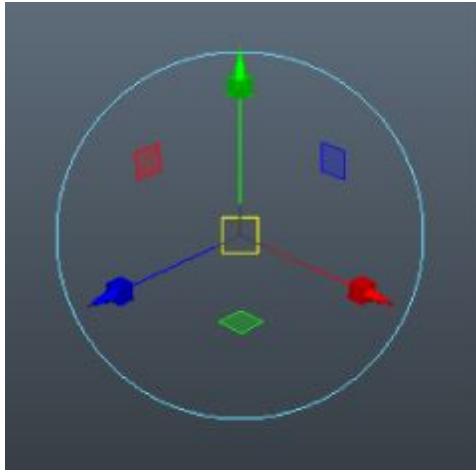
- Pressing + makes the markers bigger
- Pressing - makes the markers smaller
- Pressing INS allows you to move the pivot point in the center
 - You can also hold D and move the pivot point
 - If you want to go back you can go to the main menu and Modify -> Center Pivot



Move Tool

The move tool allows you to move an object. Depending on the marker you choose, you move in a certain axis/plane.

- Selecting arrows makes you move in that arrow's direction
- Selecting planes makes you move in that plane
- Selecting the pivot makes you move in all 3 dimensions (relative to viewport?)

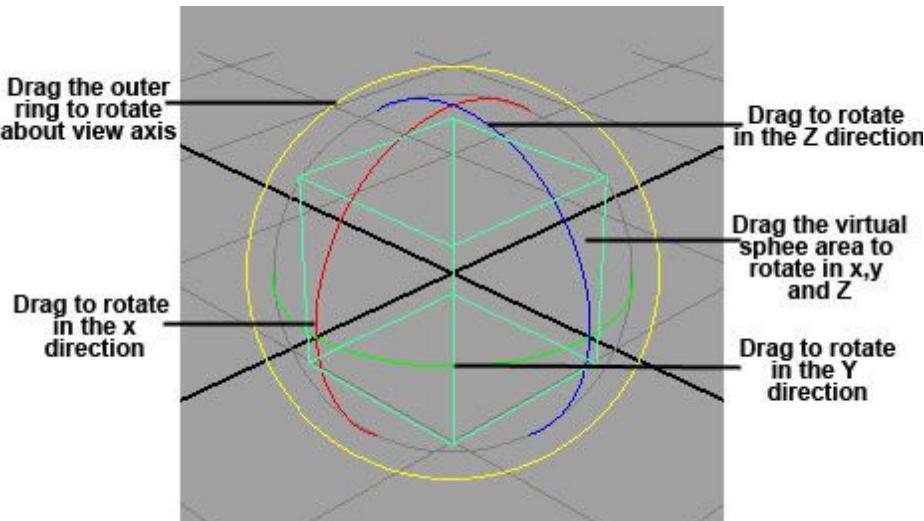


One special thing to note is that you can change the axis to something other than object/local (e.g. local vs world). In the Tool Settings pane (double click the scale tool), you can find the Scale Axis option under the Scale Settings rollout (at the top).

Rotate Tool

The rotate tool is similar to the move tool. You can use the different markers to rotate in the desired.

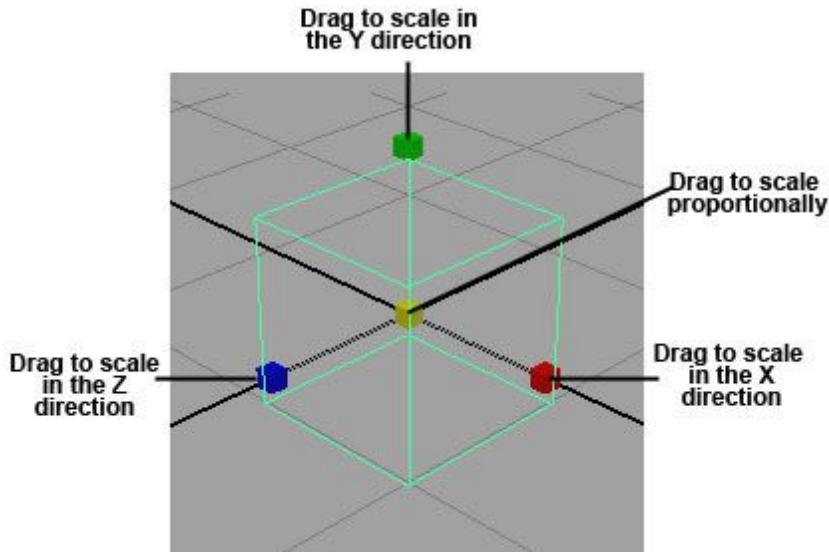
BE AWARE that this rotates your object around the pivot point, so if you moved the pivot point the markers will be off and you'll be rotating around the pivot point instead of around your object's center.



Scale Tool

The scale tool is similar to the move tool. You can use the different markers to scale in the desired direction.

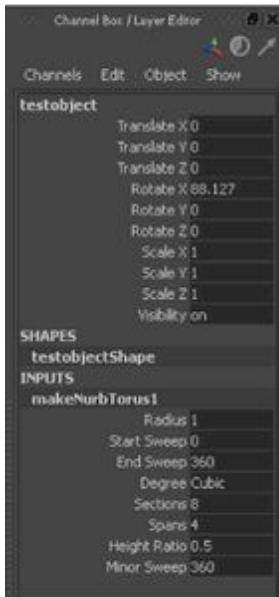
BE AWARE that this scales your object around the pivot point, so if you moved the pivot point the markers will be off and you'll be scaling based on some arbitrary point rather than the local object.



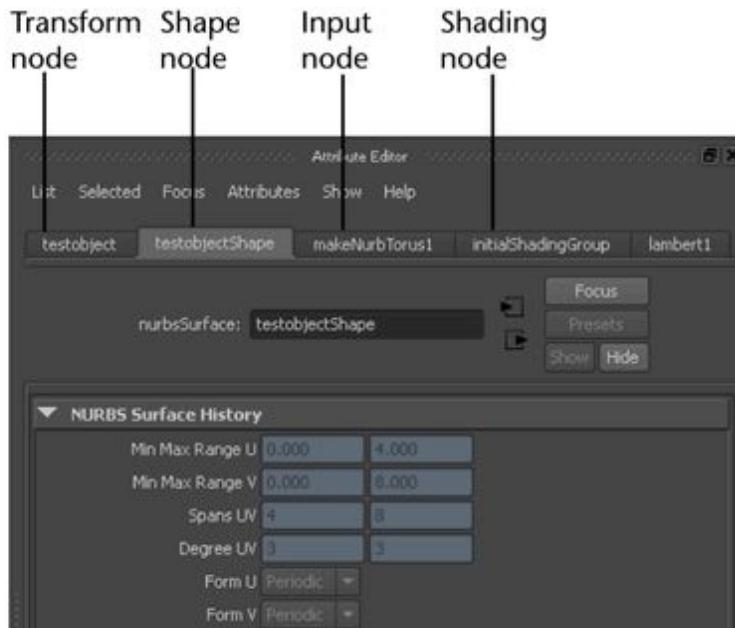
One special thing to note is that you can change the axis to something other than object/local (e.g. world). In the [Tool Settings](#) pane (double click the scale tool), you can find the [Scale Axis](#) option under the [Scale Settings](#) rollout (at the top).

Manual Edits

Manual edits to the translate/rotate/scale can be done via the channel box / attribute editor.



Channel Box



Attribute Editor

For example, if you want to move the object back to (0,0,0), you can change each translate coordinate back to 0.

HINT: You can select all 3 inputs at once and type 0 (channel box only)

HINT: You can select the **field label** (not the input field) and hold+move the middle mouse button in the viewport to increase/decrease numeric values (channel box only)

Transforming Vertices/Faces

To move a vertex:

1. Go into vertex/component selection mode
2. Click vertex
3. Press W for the move tool
4. Move vertex

To move a face:

1. Go into vertex/component selection mode
2. Click vertices that make up face
3. Press W for the move tool
4. Move vertices

You can't really rotate or scale a face?

Snapping

You can snap to different things by using the snapping menu / snapping hotkeys.



Snap to grids - (hold X) will snap to intersection points on the ground grid

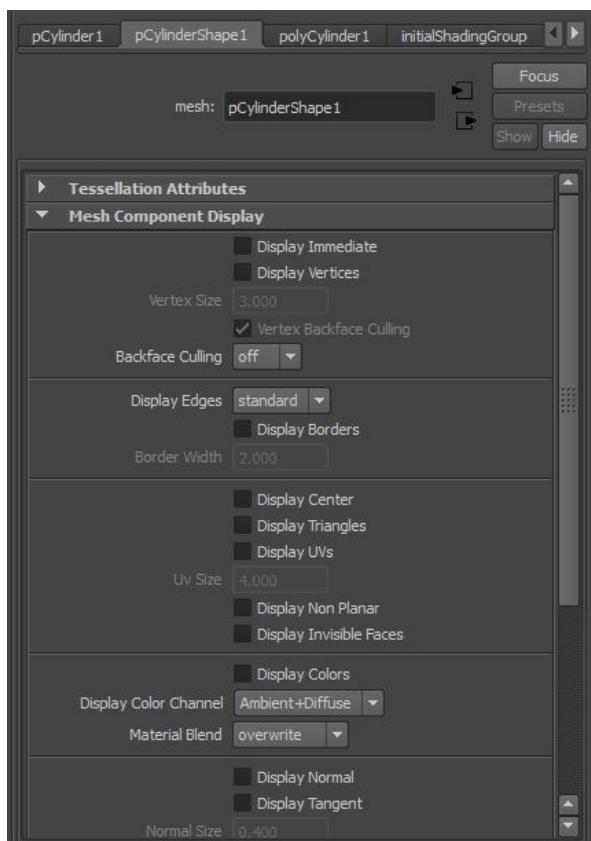
Snap to curves - (hold C) will snap to curves -- you can slide along the curve

Snap to points - (hold V) will snap to points -- this is useful, see note below

Snap to projected center - (no hotkey) unsure what this snaps to

Snap to view plane - (no hotkey) unsure what this snaps to

For snap to points, you can snap to various points on an object. You need to first select the object, go into the attribute editor and select the shape node (e.g. CylinderShape1), expand Mesh Component Display, and select what you want to display.



You can snap other objects to whatever you choose to display. For example, if you choose to display center, you can now snap to the center of each face on that object by using [snap to points](#).

Parenting

Parenting allows you to make objects children of some other object. For example, object C is a child of object P, now whenever object P is selected object C is selected along with it (the opposite doesn't apply).

Moves/rotates/scales applied to the parent will be applied to the child as well. When this happens, the pivot of the parent object is the pivot of the child objects (e.g. children's rotation will be pivoted around parent's pivot).

You can still move/rotate/scale children independently by selecting them individually.

To attach child objects to a parent...

1. Hold Shift
2. Select the child objects
3. Select the parent object (MUST be selected last)
4. Hit P

To detach child objects from a parent...

1. Select the child objects (BUT NOT the parent object)
2. Hit Shift+P

HINT: As you've probably guessed, you can have a hierarchy chain of parents. You can use the arrow keys to traverse the hierarchy. Pressing up will take you to the parent.

Grouping

Grouping is similar to parenting, except that the parent will be a newly created null object.

NOTE: A null object is an object without any geometry (nothing renderable). Its sole purpose in this case is to anchor the other objects.

To group objects together...

1. Hold Shift
2. Select the objects
3. Hit Ctrl+G

To ungroup objects...

1. Hold Shift
2. Select the objects
3. Hit Shift+P

Subdivisions

Subdivisions are like a hybrid between NURBs features and polygon features. For example...

1. Create a polygon cube
2. In the attribute editor, go to Smooth Mesh rollout
3. Enable the Smooth Mesh Preview checkbox (hotkey is 3 to enable / 1 to disable)

You should now see that the cube is smoothed into a sphere. But, if you try to move the vertices of the sphere, you'll notice that the vertices show up where they would be on the original cube.

Directly below the Smooth Mesh rollout is the Subdivision Levels rollout. Enable the Display Subdivisions checkbox to see the subdivisions being created.

Hypergraph

Maya is a node-based editor -- this means that everything we create is a separate node. The hypergraph gives us a schematic view of the nodes in our scene file.

Take a basic polygon sphere as an example. If you create a cylinder and look in the channel box, you'll see multiple headings: pCylinder, pCylinderShape, and polyCylinder. Each one of these is a separate node.



We can look at these specific nodes inside the hypergraph.

HINT: Always keep the hypergraph open and keep an eye on things. It helps identify problems / helps you understand what's going on in your scene / helps identify things that you thought you got rid of but are still there (e.g. null objects?).

You can consider the hypergraph as the "hub of Maya." It's super important that you get use to using it.

Hypergraph: Hierarchy

Open the hypergraph by going to the main menu: Window -> Hypergraph: Hierarchy

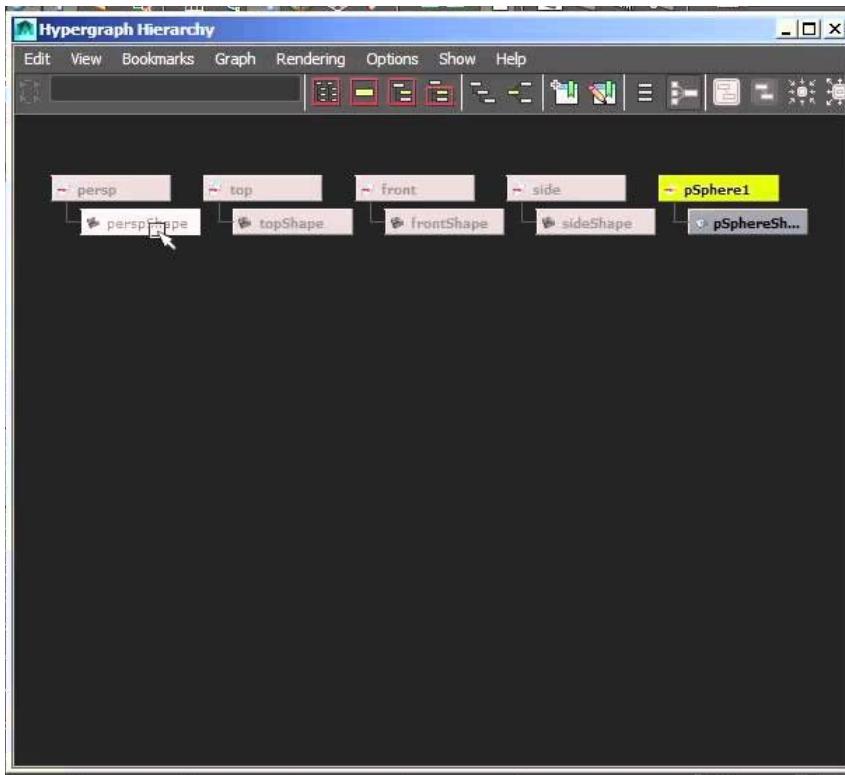
NOTE: Notice that there are 2 different hypergraph options: Hierarchy and Connection. Ultimately, they both lead to the same thing. You can switch between the two via the toolbar in the hypergraph window.

The window that pops-up is the top level hypergraph view. You'll see the objects you created here.

HINT: To maneuver around the hypergraph, you can use the typical camera controls to pan/rotate/zoom (ALT + LMB/MMB/RMB). Hit A to frame all. Hit F to frame the currently selected nodes.

If you want to see all nodes, check the following boxes in the main menu...

1. Options -> Display -> Hidden Nodes (brings up stuff like camera nodes)
2. Options -> Display -> Shape Nodes (brings up the nodes we saw for our cylinder -- pCylinderShape)



Top level nodes (e.g. pSphere or pCylinder) are transform nodes. They contain our transform values like translation and rotation. The node underneath it (e.g. pSphereShape or pCylinderShape) is the node that actually holds the geometry.

HINT: Click and hold the middle mouse button to a transform node and move it under another transform node to automatically create a parent/child relationship. To undo, click and hold middle mouse button and move to empty space.

HINT: Double-click node to hide/expand children. Right-click for further options (e.g. expand all)

The hypergraph shows us everything that makes up our scene. There can sometimes be thousands of nodes in here, so it's best to not show hidden nodes and use the collapse/expand feature. You can also turn off the automatic layout and switch to free-form layout, which lets you move around items and organize them yourself (available in the toolbar of the hypergraph window).

Hypergraph: Connections

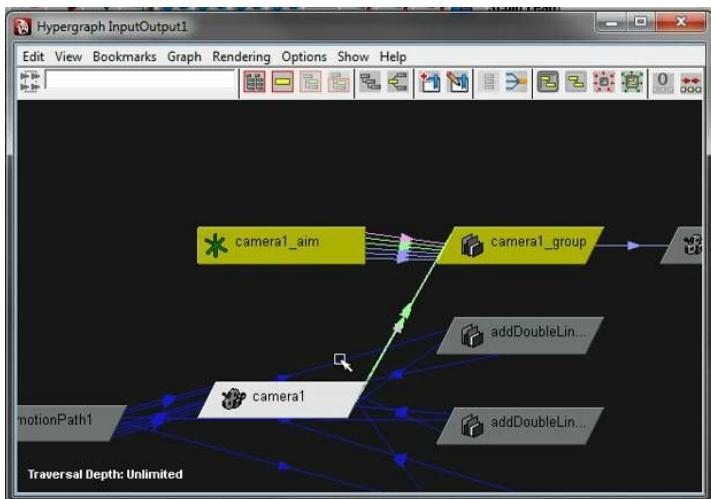
Open the hypergraph by going to the main menu: Window -> Hypergraph: Connections (MAKE SURE YOU HAVE AN OBJECT SELECTED WHEN YOU DO THIS)

NOTE: Notice that there are 2 different hypergraph options: Hierarchy and Connection. Ultimately, they both lead to the same thing. You can switch between the two via the toolbar in the hypergraph window.

The window that pops-up is the connections hypergraph view. You'll see the objects you created here + the connections that make them up.

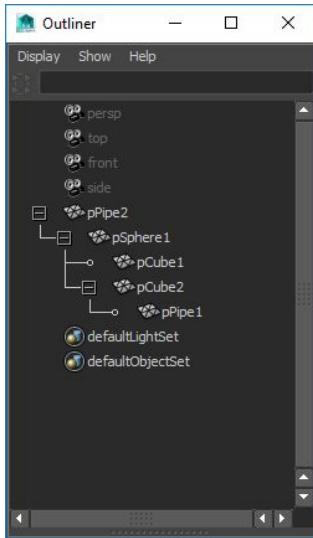
NOTE: A lot of the nodes that are being fed in are construction history nodes? These contain the history of steps that were taken to get the object to its current state??? If you go to Edit -> Delete By Type -> History, it seems to get rid of them but the objects all remain.

HINT: To maneuver around the hypergraph, you can use the typical camera controls to pan/rotate/zoom (ALT + LMB/MMB/RMB). Hit A to frame all. Hit F to frame the currently selected nodes.



Outliner

The outliner is very similar to the hypergraph. It gives you a tree of nodes in your scene.



Just like with the hypergraph, the outliner allows you to see parent child relationships between your nodes. Unlike the hypergraph, the outliner won't allow you to see connections between the nodes.

A lot of what you can do with the hypergraph interface. Here are the important things you can do in the outliner...

1. Click and hold MMB on a node and move it onto another node to make it a child
2. Click and hold MMB on a node and move it in between other nodes to re-order
3. Selecting a node in the outliner selects it in the perspective view (and vice versa)
4. Right-click and choose "Reveal Selected" to have the outliner go to the specific node

If you want to cleanup the outliner a bit, you can hide nodes by

1. Select nodes
2. Right-click -> Hide in Outliner -> Hide

You can unhide nodes by...

1. Display -> Ignore Hidden
2. Select all nodes
3. Right-click -> Hide in Outliner -> Unhide

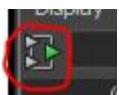
OR

1. Select node in perspective view
2. Go back to outliner and Right-click empty space -> Hide in Outliner -> Unhide

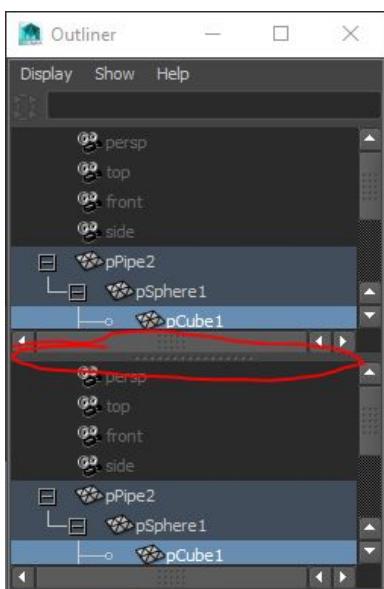
You can limit the type of objects shown in the outliner by ...

1. Show -> Objects -> (object type)

For example, if I choose Cameras, everything that isn't one of my camera nodes will not show in the outliner. Note that when you do this, the icon to the left of the textbox turns green to indicate that some constraint is active. You can click it to clear the constraints.



NOTE: If you look closely, you'll notice a divider at the very bottom of the outliner. Click and drag it to expose a second instance of the outliner. This is useful because it allows you to work on a location but see another location.



NOTE: You can choose to see the individual shape nodes by going to Display -> Shapes. People usually keep this off because it makes things a bit confusing by making the outliner a bit overpopulated.

Node Editor

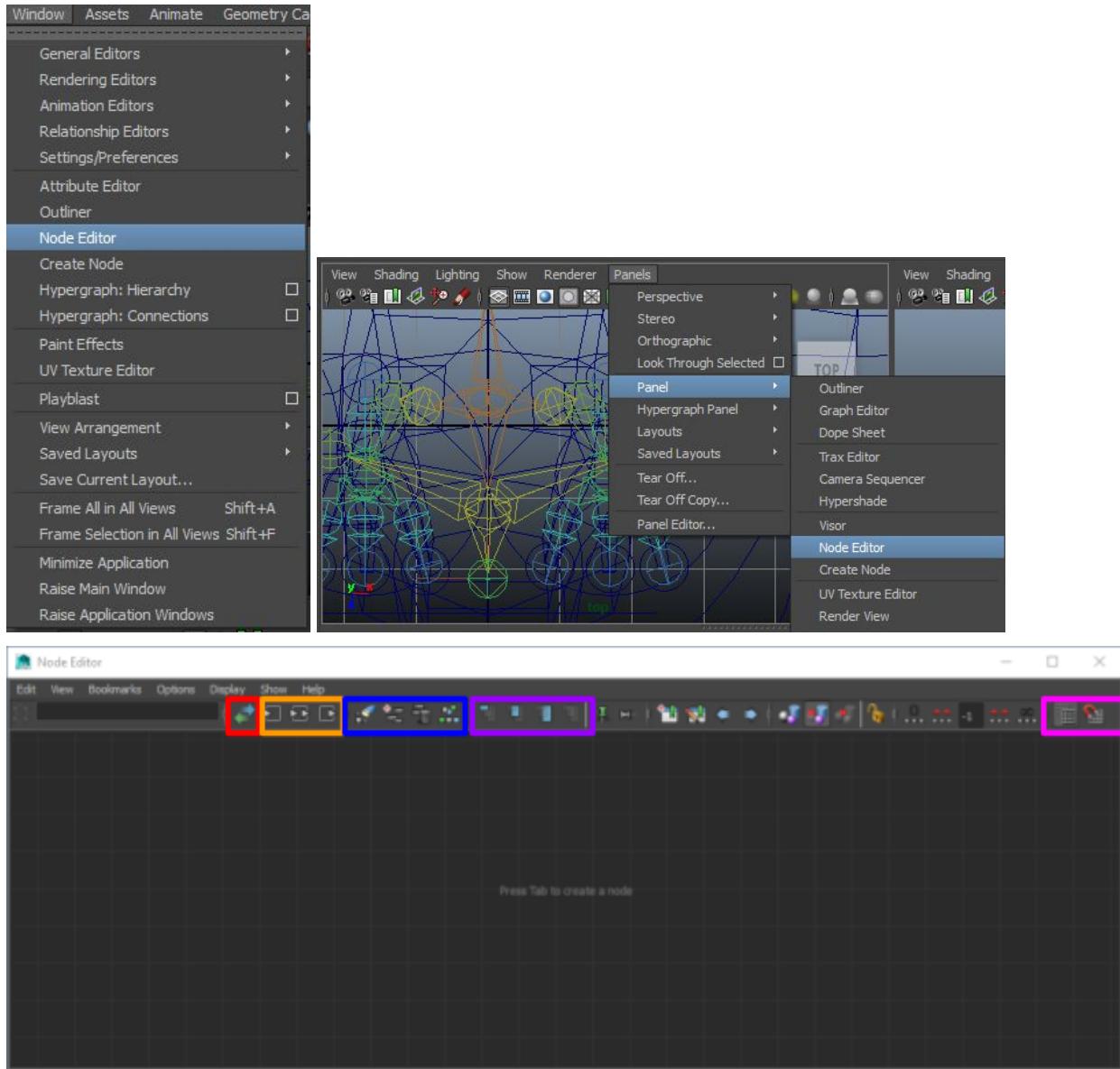
The node editor is a lot like the hypergraph/outliner. You can view the nodes in your scene, expand them out to see their properties, and even link (constrain) certain properties together.

For example, you can make it so that the translation of an object is copied to the translation of another object.

There are 2 ways of opening up the node editor.

1. In a new window: Window -> Node Editor
2. In a panel: Panels -> Panel -> Node Editor

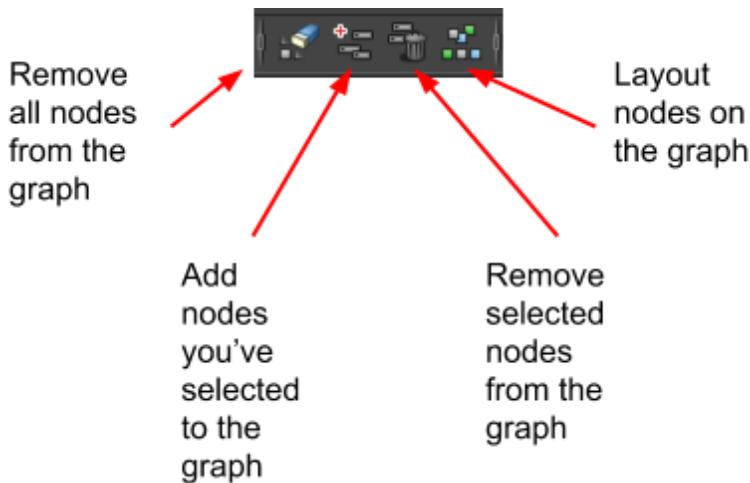
NOTE: You can have multiple node editor instances open at once if you want.



NOTE: You can treat the node editor like a viewport. F to frame up on a node, A to frame up on all, move around like you normally would in the viewport (Alt+MMB), zoom in like you would normally do (Alt+RMB or scroll wheel)

Nodes

Use this to add/remove nodes to the node editor, as well as layout nodes. Buttons should be self-explanatory from the icons / tool tips.

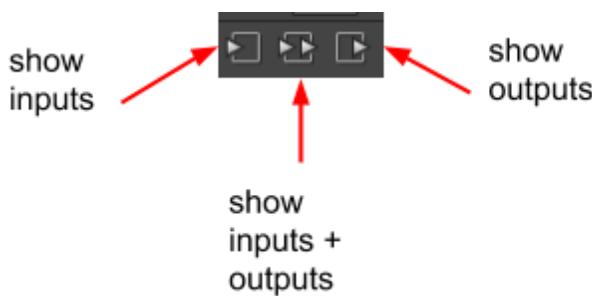


NOTE: To add a node, you have to have that node selected somewhere (e.g. in your viewport/hypergraph/outliner/attribute editor/etc...). If you select it and hit the add button, it'll show up in the node editor.

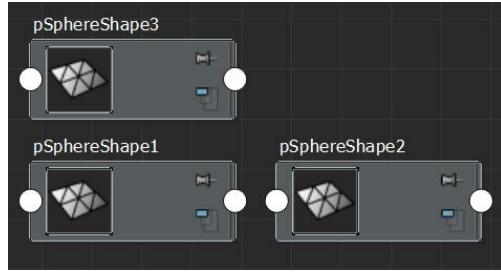
NOTE: When you're removing nodes from the graph, you're not actually deleting them from your scene. You're only removing them from the node editor. The nodes still exist.

Connections

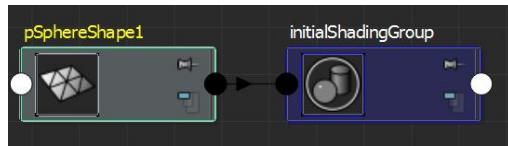
Use this to include the inputs/outputs for the selected node(s) in the node editor.



For example, imagine I had the following objects in my node editor...



When I select pSphereShape1 and click the show outputs button, everything other than pSphereShape1 and its outputs get cleared.



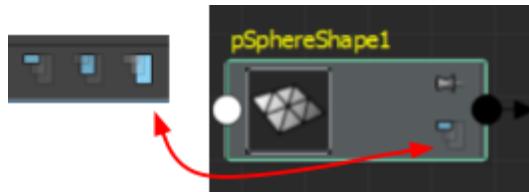
Sync

Synchronizes what's selected in the node editor with what's selected in the outside world. For example, if you select a box in one of your viewports that same box will be selected in the node editor (assuming that the node for the box has been added to the node editor).

You can turn this off if you want to inspect your objects in the viewport without messing up your selections in the node editor.

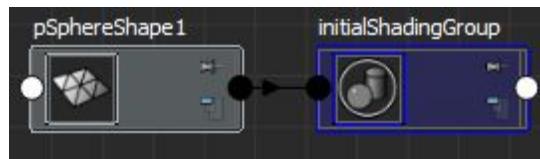
Expand

Use these buttons to expand out nodes in the graph to see their properties/attributes. There are 3 levels available.

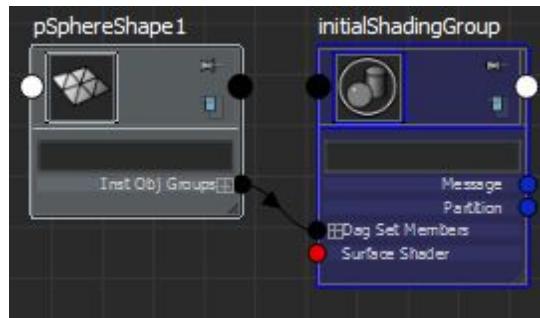


NOTE: Notice how the same button is available on individual nodes. You can expand/collapse by individual node instead of using the toolbar version. The toolbar version will collapse/expand ALL nodes in the node editor.

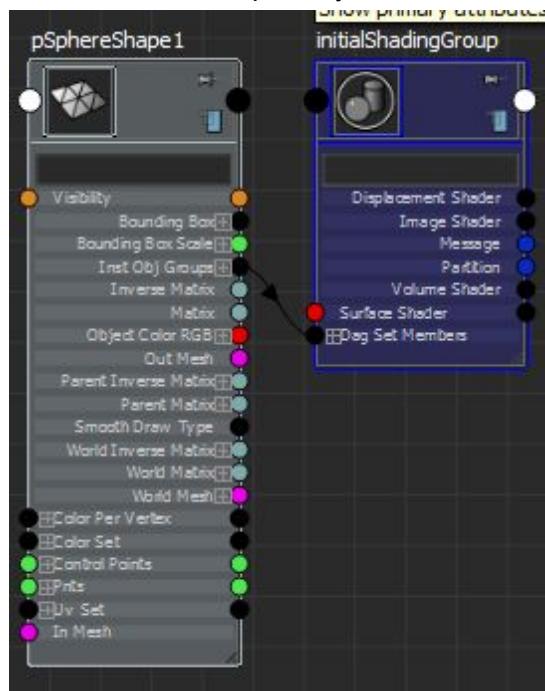
1st level completely collapses the node(s)...



2nd level shows only attributes that are connected to other nodes...



3rd level shows all primary attributes...

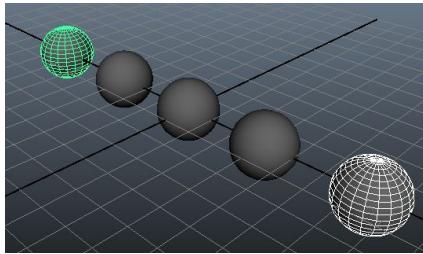


Snap

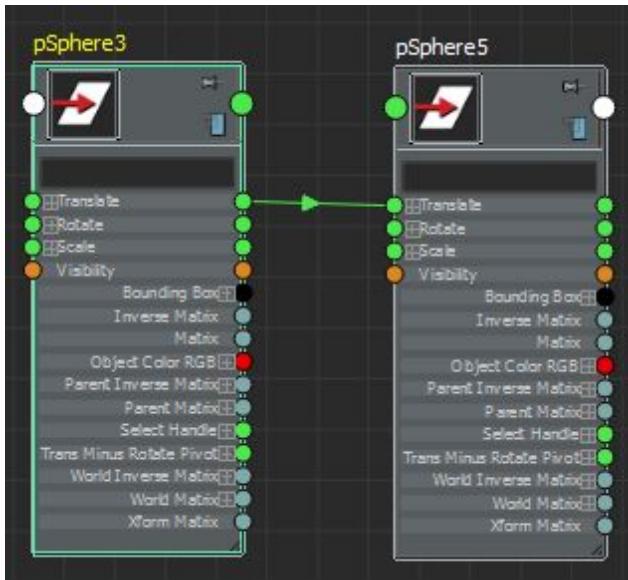
Use these buttons to toggle grid visibility / grid snapping. Pretty self-explanatory.

Linking/Constraining Attributes

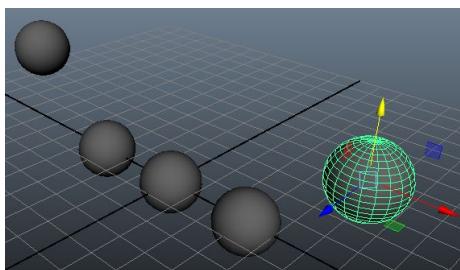
You can link attributes from one node to others, such that the other nodes will take on those values for the linked attribute. For example, imagine I had 2 spheres...



I want to make it so that every time I translate the first sphere, the other sphere picks up those same translation values. I can do this by adding these spheres to my node editor and linking the translate attributes together.



Now when I move the right-most sphere, the left-most sphere moves the same.



NOTE: The spheres here had their transforms freezed. If they didn't have their transforms freezed, the right-most sphere would get superimposed on the left-most sphere.

If you open up the right-most sphere in the channel box and look at the translate attributes, you'll see that they're yellow. Yellow means that the values are coming from elsewhere / you can't directly change them.

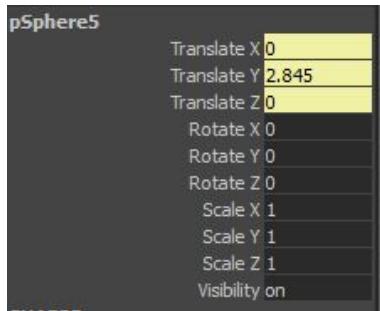
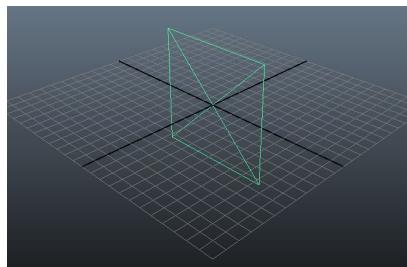


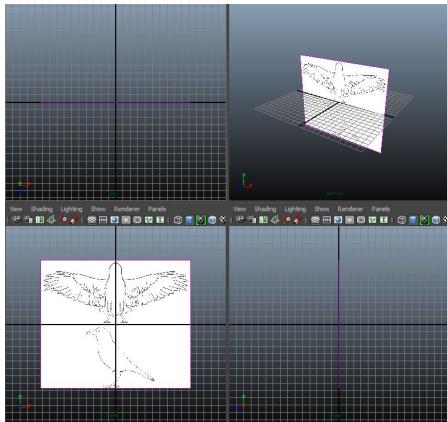
Image Planes

Image planes allow us to bring in a background image to serve as an environment, background, or reference for modelling.

To create an image plane... Create -> Free Image Plane



This generates the image plane node, which we can then assign our texture/image to via the attributes editor (Ctrl+A). In the following example, we assign a reference drawing of a crow, which we can then view in our various cameras and use as a reference to model our crow.



NOTE: Note that this node is transformable -- you can move/rotate/scale it as desired.

NOTE: You can load multiple image planes. For example, it's normal to have a different image plane node for each orthographic projection (top/side/front). In the attributes editor, you can make it so that an image plane node is only visible to a certain camera (Display option).

NOTE: If you're using an image plane as a reference for modelling, note that moving it forward/back won't cause any distortion in the orthographic cameras (remember how orthographic cameras work -- projected objects don't get smaller as they're moved farther back). It's normal to move reference images back because sometimes what you're modelling may intersect with the image plane. Another thing you can try is to let it intersect but change the alpha value of the image plane (in attribute editor).

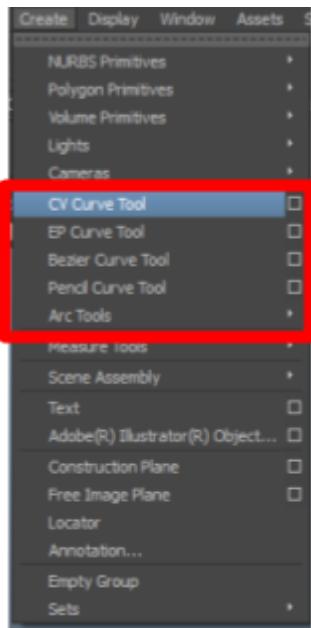
NOTE: In our example, we're using a drawing (of a crow) so the image lines up pretty well. However, if we were using photo instead, we'd get camera distortion due to the lens of the camera that photo was taken in. In that case we kind of just accept it and pick a view that works best for us / improvise with our other views as we model.

Curves

Curves are non-renderable objects used throughout Maya for a number of different applications...

- Hair
- Surfaces
- Guides for other nodes/objects (animation?)

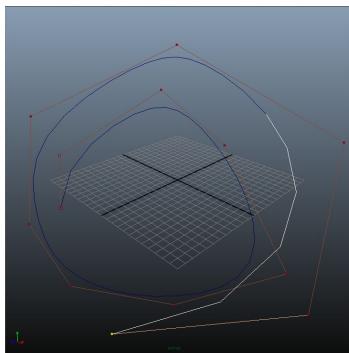
You can find the different types of curves that Maya has under the Create menu



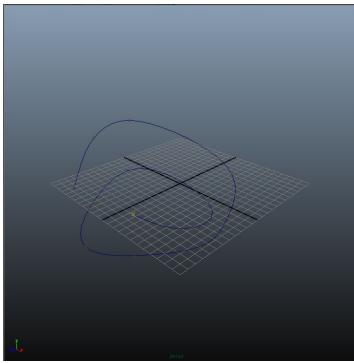
CV/EP Curve Tool

CV/EP Curves are the most commonly used curves. They're essentially the same type of curve, just with a slightly different manipulation mechanic:

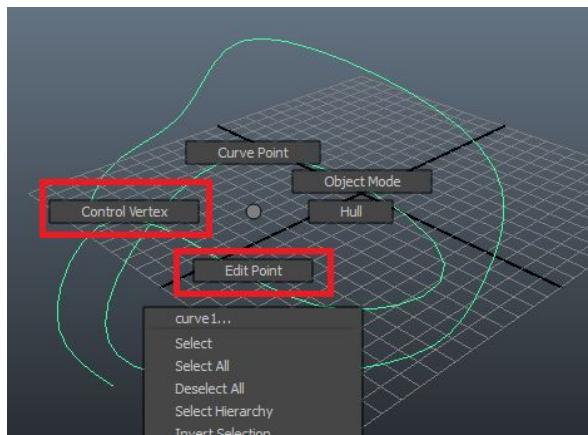
- **CV = Control vertex.** This means that you control how your curve bends using control points (remember how splines/bsplines/nurbs worked from school).



- **EP = Edit point.** This means that you control how your curve bends using edit points -- the nodes that shape the curve are actually on the curve itself.



Once the curve has been created, you can edit the points via EP or CV (regardless of which mode it was initially created in). Just select the curve and right-click to show up a marking menu.



NOTE: Before creating a CV/EP curve, double-click on the curve tool icon in the toolbox (it'll show up as the most recently used tool when you go to Create -> EP/CV Curve) and double-click. In the Tool Settings, you can choose the degree of the curve. YOU CANNOT CHANGE THIS AFTER THE CURVE IS CREATED.

Pencil Curve Tool

The pencil curve tool allows you to freehand a curve and it'll attempt to turn that into a curve (very similar to what inkscape's pencil tool does). Most of the time this isn't really used because of the jaggy nature of drawing by hand -- you end up with a curve with lots of components.

Arc Curve Tool

Sets up a basic 2-point or 3-point arc. Left-click on the viewport to set the points for the arc. For the last point, you can click-and-drag to see how the end result will look before you release.

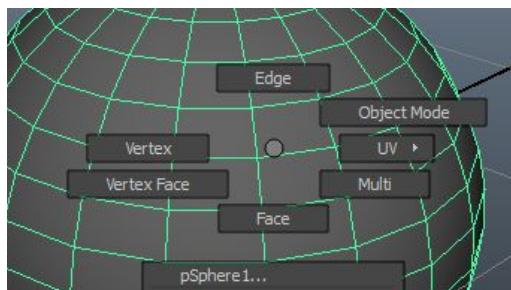
Polygon Selection

Polygons are n-sided faces where $n > 2$ (3=triangle, 4=quad, 5+=n-sided polygon). If you remember from school, there are other properties here as well. For example, for polygons to render properly they have to be convex (maya may implicitly handle this).

There are 2 ways to create polygons.

1. As a primitive shape... Create -> Polygon Primitives -> (primitive type)
2. As a single polygon... Mesh Tools -> Create Polygon Tool, then click around viewport and enter when finished

Once you have your polygon object, you can select it right-click to show a marking menu that allow you to select by...



- Vertex -- obvious
- Face -- obvious
- Edge -- obvious
- Vertex face -- this is an exploded view of the object, which is useful for debugging (e.g. if you have duplicate vertices at the same position)
- UV -- like vertex selection, but this is used for projecting textures on our object (you can't transform the vertex here)

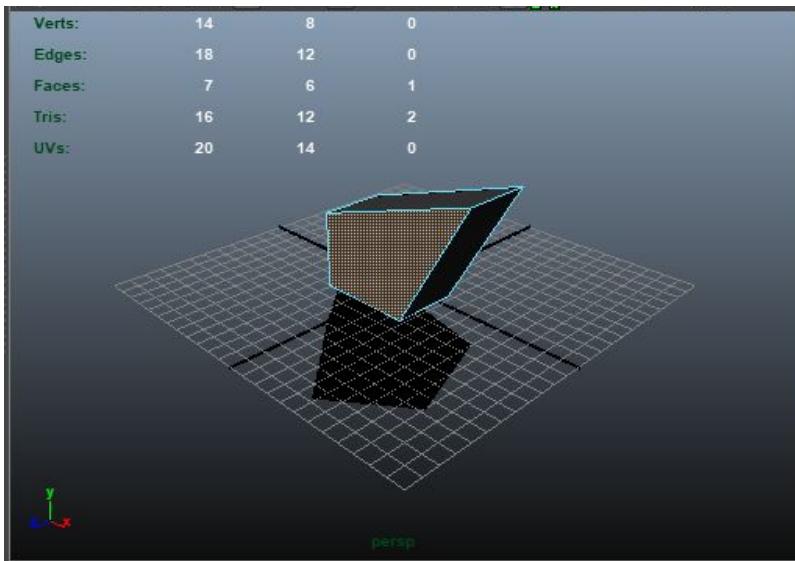
A useful tool to have displayed when working with polygon objects is the Polygon HUD. You can enable this by going to...

Display -> Heads Up Display -> Polycount

Your viewports should now contain information about the scene, selected object, and selected components. Column number ...

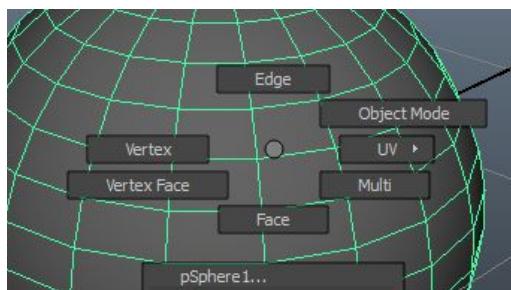
1. contains polygon stats for the entire scene
2. contains polygon stats for the selected object(s)

3. contains polygon stats for the selected component(s)



Selecting Components via Mouse

Right-click on an object to give you the typical polygon marking menu.



From here you can select by the component edge you want.

Edge Selection

Typical text selection rules apply in edge mode. To select ...

- a single edge: Click an edge
- row/ring of edges: Double click edge in that row/ring
- multiple selection: Hold shift and click/double-click one or more edges

Vertex Selection

Vertex mode is like edge mode, but with some caveats. To select ...

- a single vertex: Click a vertex

- row/ring of edges: Click a vertex, then hold shift and double-click a second vertex
- multiple selection: Hold shift and click,double-click one or more edges

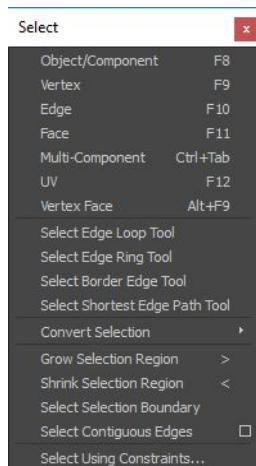
Face Selection

Face mode is like edge mode, but with some caveats. To select ...

- a single face: Click a face
- all faces: Double-click a face
- row/ring of faces: Click a face, then hold shift and double-click a second face
- multiple selection: Hold shift and click,double-click one or more faces

Selecting Components via Select Menu

In the main menu, the select menu provides even more functionality/tools for selecting polygons. Note that you have to be in the polygon menu set or else you won't see this menu!



Edge/Vertex/Face Selection

These are exactly the same as their marking menu counterparts, but be aware that when you select via this menu it's entering you into a global selection mode. Using the marking menu puts you into a local selection mode (local to the selected object).

Selection details have been replicated here from the mouse section...

Edge Selection

Typical text selection rules apply In edge mode. To select ...

- a single edge: Click an edge
- row/ring of edges: Double click edge in that row/ring

- multiple selection: Hold shift and click/double-click one or more edges

Vertex Selection

Vertex mode is like edge mode, but with some caveats. To select ...

- a single vertex: Click a vertex
- row/ring of edges: Click a vertex, then hold shift and double-click a second vertex
- multiple selection: Hold shift and click/double-click one or more edges

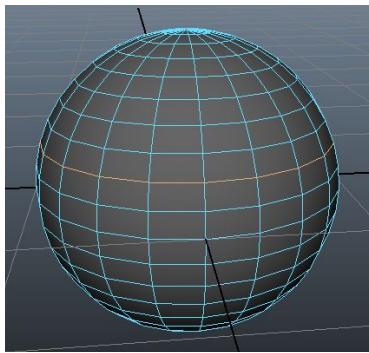
Face Selection

Face mode is like edge mode, but with some caveats. To select ...

- a single face: Click a face
- all faces: Double-click a face
- row/ring of faces: Click a face, then hold shift and double-click a second face
- multiple selection: Hold shift and click/double-click one or more faces

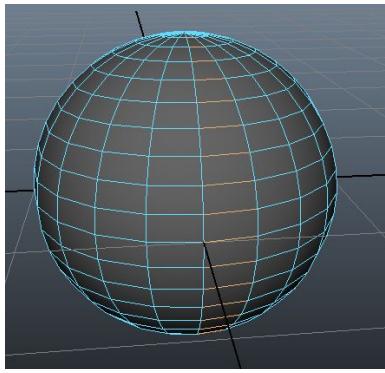
Select Edge Loop Tool

This is similar to how you select rows/rings with the edge selection tool. The difference is that you can now select edge loops even if you aren't in edge selection mode (e.g. you can select an edge loop in vertex mode instead of edge mode).



Select Edge Ring Tool

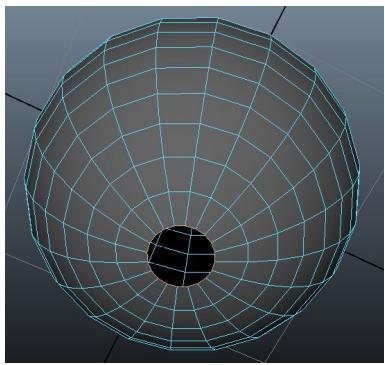
This is similar to the select edge loop tool, but instead it gives you the ring of edges that are adjacent to your loop.



Select Border Edge Tool

This tool allows you to select edges that are on the borders of the object. Border means that the edge isn't shared with another polygon.

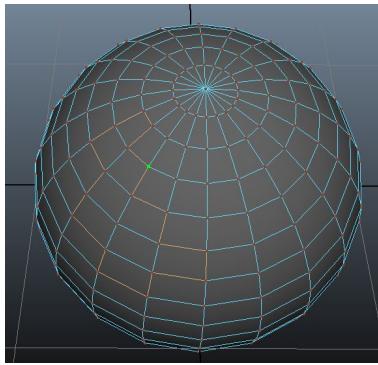
In the example below, we took a sphere and removed the bottom faces. Then we clicked the chose one of the bordering edges with the tool and all the bordering edges got selected.



Select Shortest Edge Path Tool

Selects the shortest path (edges) between two vertices. Really basic. Continually single click vertices to build the shortest path between them.

NOTE: This works in vertex mode and UV mode only.

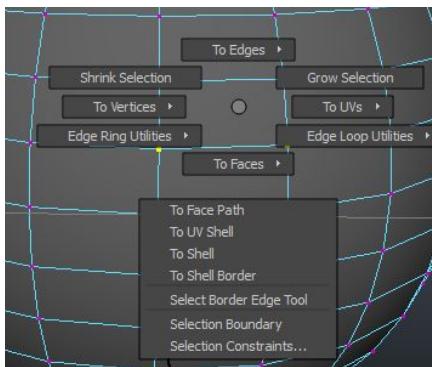


Convert Selection

Convert selection contains a set of really useful tools that allow you to switch your selection between different component types (e.g. faces to vertices).



You can also get this as a marking menu by selecting your components and hitting Ctrl+RMB.

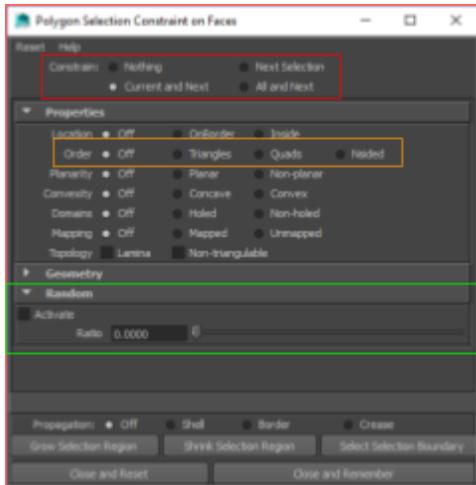


The basic conversions (this are all obvious)...

Vertex -> Edge: selects edges vertex is a part of
 Vertex -> Face: selects faces vertex is a part of
 Vertex -> Contained Face: selects faces when all vertices that are a part of it are also selected
 Edge -> Vertex: selects vertices edge is a part of
 Edge -> Face: selects faces edge is a part of
 Edge -> Contained Face: selects faces when all edges that are a part of it are also selected
 Face -> Vertex: selects face as vertices
 Face -> Vertex Perimeter: selects vertices on the outside (perimeter) of selected faces
 Face -> Edge: selects face as edges
 Face -> Edge Perimeter: selects edges on the outside (perimeter) of selected faces

Select Using Constraints

This tool allows you to constrain what gets selected. It only seems to work on components (not objects).



I'm unsure what all these options do. The main option is called **constrain**. It defines which selection your changes will have an effect on: current selection, current and next selections, next selections, etc... The one you want is probably current and next.

The other 2 options that seem to be somewhat useful...

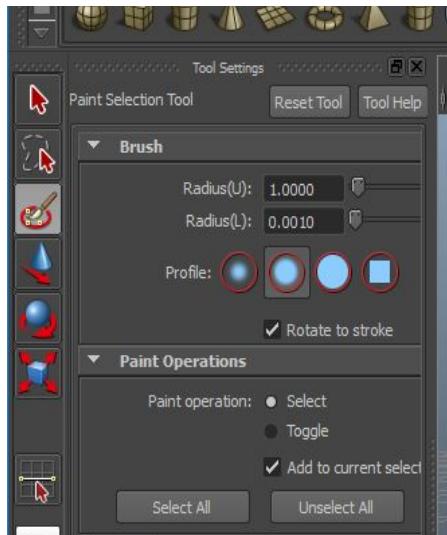
- If you only want to select faces that are triangles (not quads or n-sided), you would set the **order** option to triangles.
- If you want to select faces at random, activate the **random** option and set the ratio. Then, click and drag over the area for randomized selection.

NOTE: This dialog is for faces, but there's an equivalent with somewhat similar options when you're in vertex/edge mode.

NOTE: When closing the dialog, always choose Close and Reset, never Close And Remember. Otherwise your selection constraints will hang around.

Paint Select Tool

The paint select tool can be accessed through the toolbox. It allows you to select wide regions of faces/edges/vertices, as if you're spray painting.



NOTE: A quick way to resize the radius is to hold B, then click and drag to the right or left.

NOTE: Hold CTRL when painting to de-select components.

Polygon Extrude Faces

There are two ways to use the extrude tool

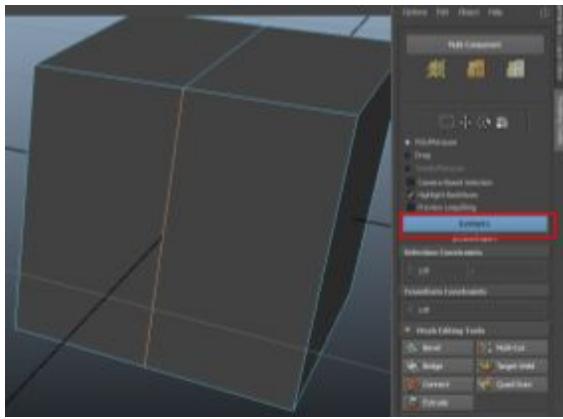
1. Mesh Tools -> Modeling Toolkit -> Extrude (in the popup panel/window)
2. Mesh Tools -> Extrude Tool
3. Edit Mesh -> Extrude

Options #1 and #2 lead to the same thing. Option #3 gives you a few extra features in the UI that you can use to tweak (although these are also available in 1 and 2 in the modeling toolkit).

NOTE: Extrusion is a really powerful tool for box modeling. Box modeling is when you start with a primitive box, apply symmetry/mirroring (explain how to do this in the next

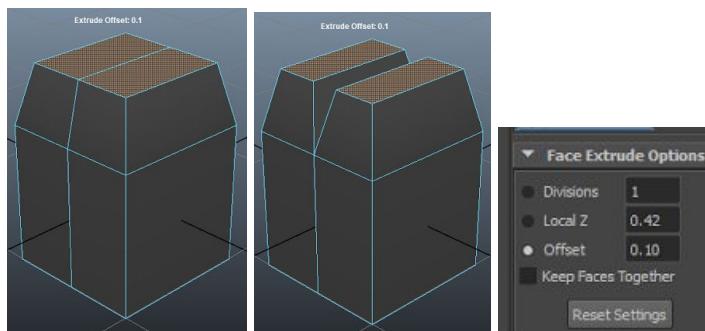
note), and extrude out the quads to get a rough model of what you want. This seems to work really well if you have drawings you want to load up via image planes.

NOTE: To apply symmetry, first open up the modeling toolkit. Then go to your object and select an edge that directly cuts across the object. Once selected, go back to the modeling toolkit and click the big ‘Symmetry’ button. Now every component selection you make will be mirrored.

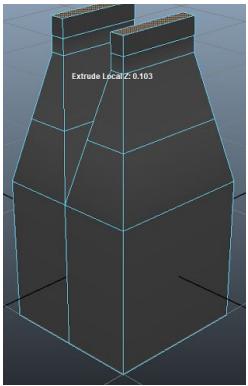


One thing to note when you extrude: if you extrude faces that are direct neighbours, they'll extrude as if they're stuck together.

- If you're using the modeling toolkit, you can turn this off by UNSELECTING the 'Keep Faces Together' option.
- If you're using the basic Edit Mesh -> Extrude option, you can go to the newly created extrude node in the attribute editor and turn off 'Keep Faces Together' option.



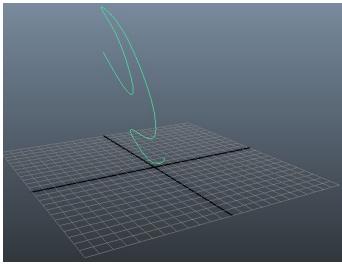
HINT: If you want to keep extruding in the same direction, use Ctrl+Shift+LMB to end the current extrude and start a new extrude from that point



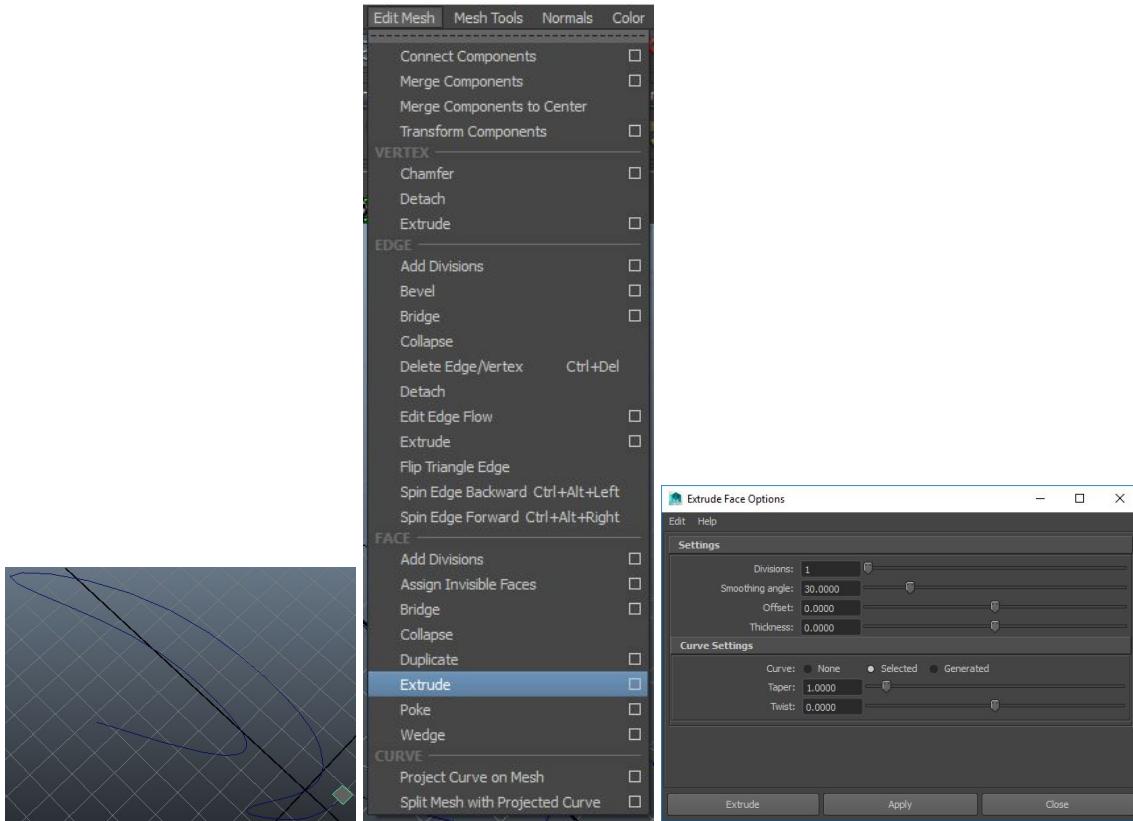
Polygon Extrude Face Along a Curve

If you want, you can choose to extrude along a curve rather than manually orienting and extruding yourself. To do this...

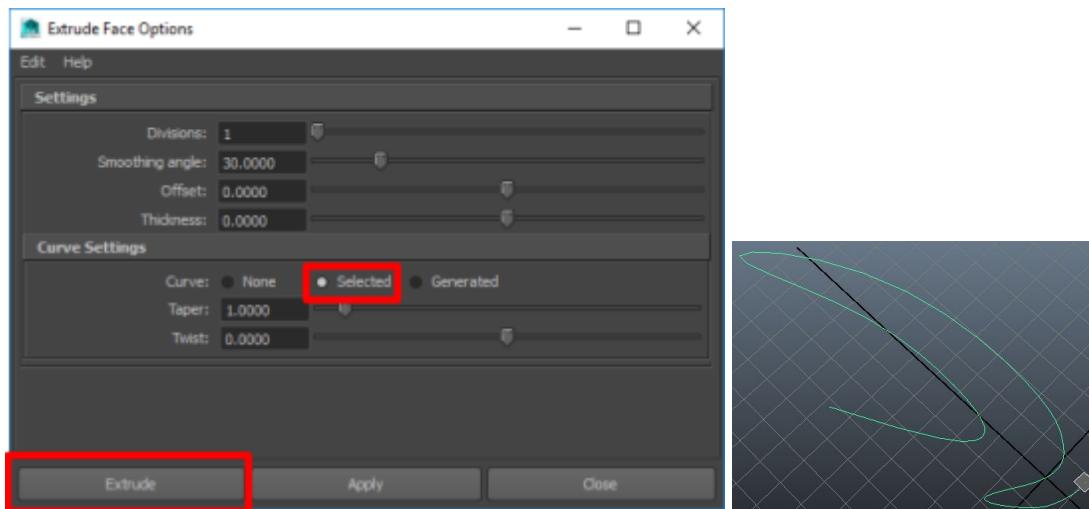
1. Create your curve.



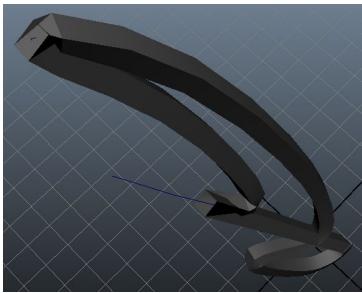
2. Orient the face you'll be extruding on either edge of the curve, then go to Edit Mesh -> Face -> Extrude and choose the square on the right-hand side to open the options.



3. In the extrude face options dialog, set Curve to selected and select the curve you want the extrude to follow in your viewport. Hit Extrude when you're done.

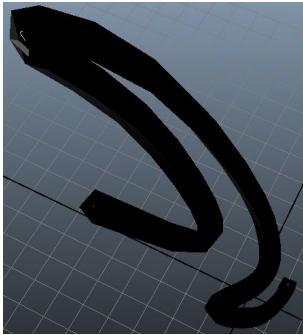


4. In the channel box/attribute editor, adjust the number of divisions.

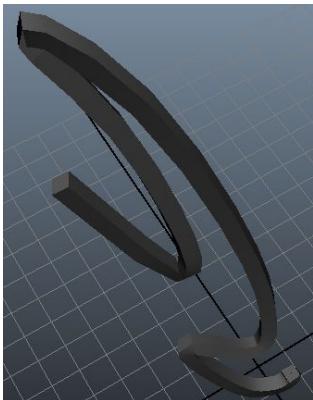


5. If you notice some weird distortion with the extrude near the end of the curve, such as the one shown above, that's likely because you placed the face at the end of your curve rather than the beginning.

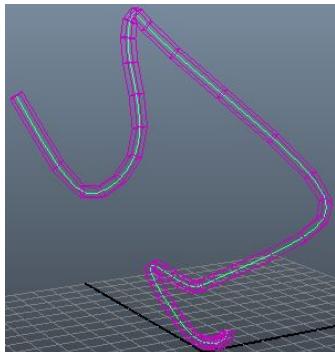
To fix this, simply select the curve, change the menu set to Surfaces, and select Edit Curves -> Reverse Curve Direction.



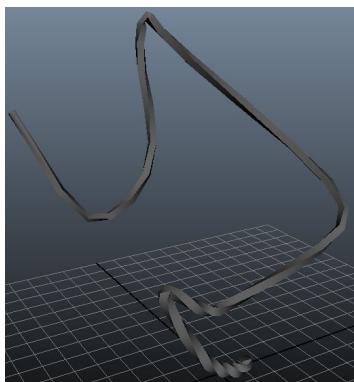
Now the curve looks normal, but all the normals have been flipped. To fix this, go to Normals -> Reverse.



6. Note that edits to the curve after the fact will affect the extrude and everything else you did. That's because the edits to the curve are being made on the history node. As such, everything else you did follows along.



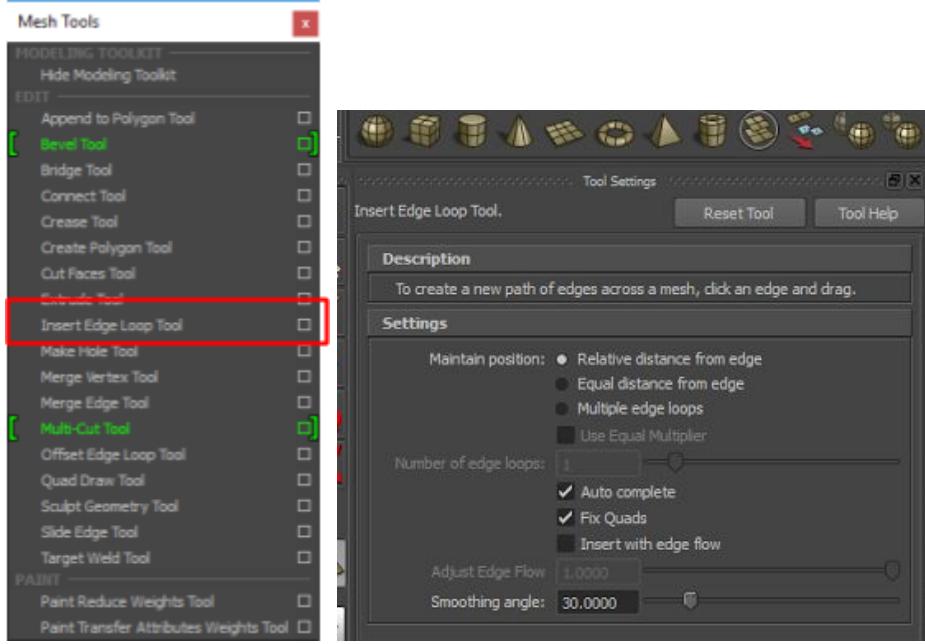
7. Apply twist and taper on the extrude node if you'd like. In this example, taper was set to 0.5, twist to 1440, and the normals were softened + the horizontal edge normals were hardened.



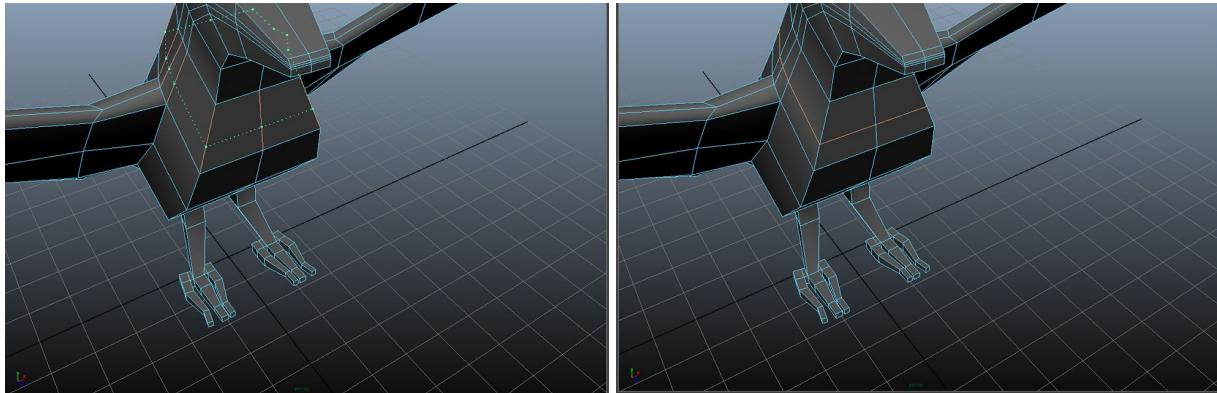
NOTE: Attribute editor will likely have finer graph-based tapering controls.

Polygon Edge Loops

You can create edge loops by going to Mesh Tools -> Insert Edge Loop Tool (click on the box to the right of the menu item text to open up the tool setting panel)

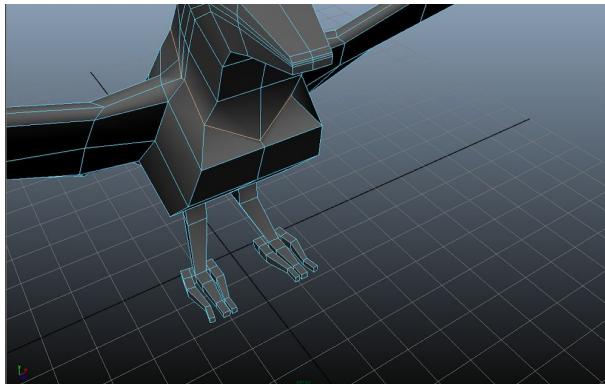


With the tool enabled, left click and hold to on an edge to insert an edge loop



This creates an edge loop that's exactly planar to the faces it's being created on. If you want the edge to be extruded/shrunken a bit to match the shape of whatever it is you're modeling, select the Insert with edgeflow checkbox in the tool settings. You can adjust the edge flow parameter in the slider below (can make it extend past 1.0 by typing in a number).

Here's that same edge with a 5.0 edgeflow.



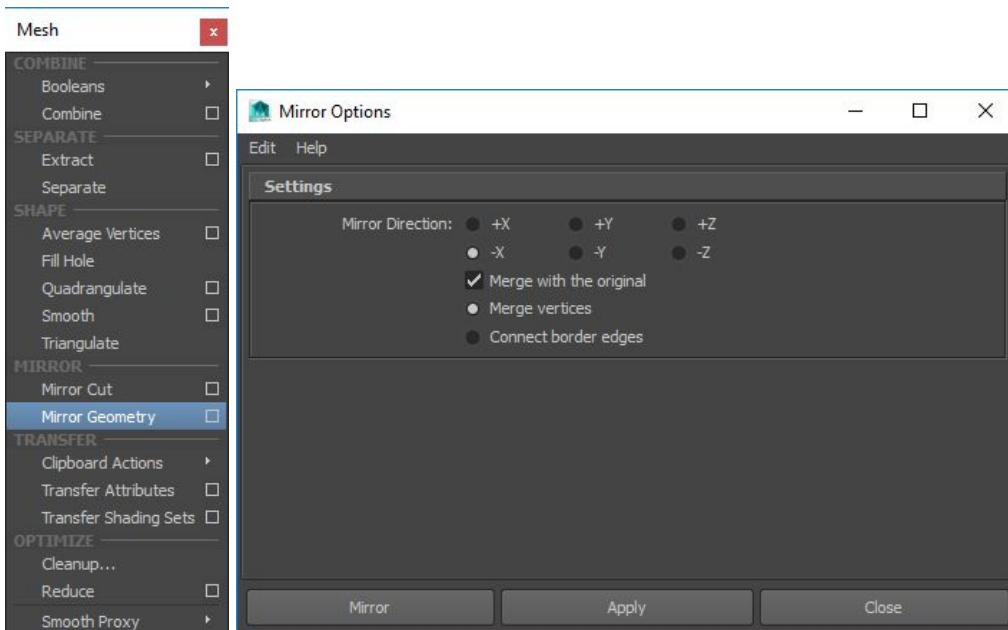
If you want to create an edge loop that is exactly inbetween the exactly in between the edges of the faces it's being created on, here's a neat trick:

In the tool settings, select the Multiple edge loops option, but set the Number of edge loops option to 1. Now when you create an edge loop it'll be created dead center.

NOTE: You can also do this after the fact by going to the history node for the edge loop (named polySplitRing#) and setting the weight to 0.5

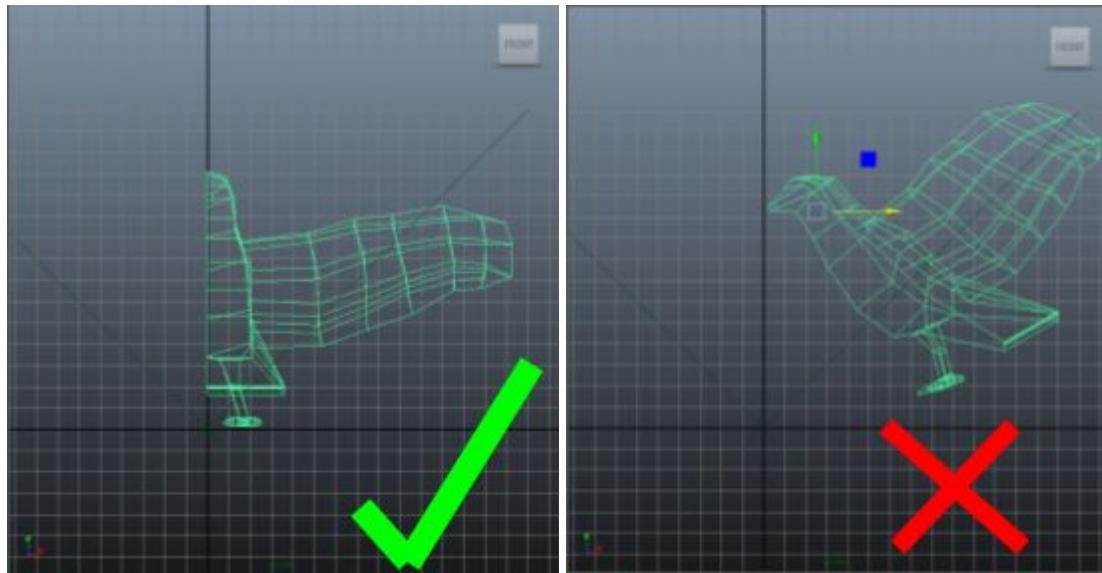
Polygon Mirror Geometry

You can mirror geometry by going to Mesh -> Mirror Geometry (click on the box to the right of the menu item text to open up the tool setting panel)



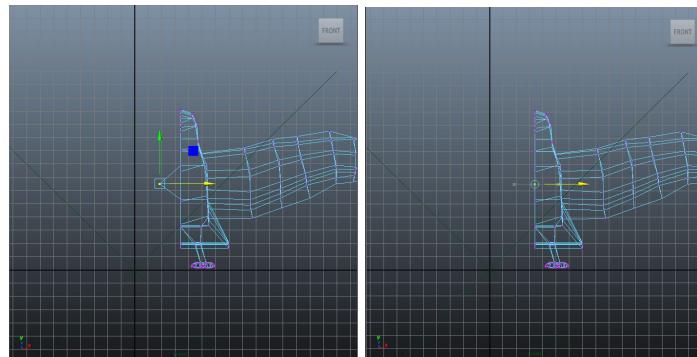
- Mirror Direction defines which axis the mirror should show up on
- Merge with the original will attempt to merge with what's being mirrored

If you're merging with the original, make sure that all the vertices that are going to be merged are sitting on the plane of the direction that you're mirroring on. For example, if we're mirroring on -X, we want the following...

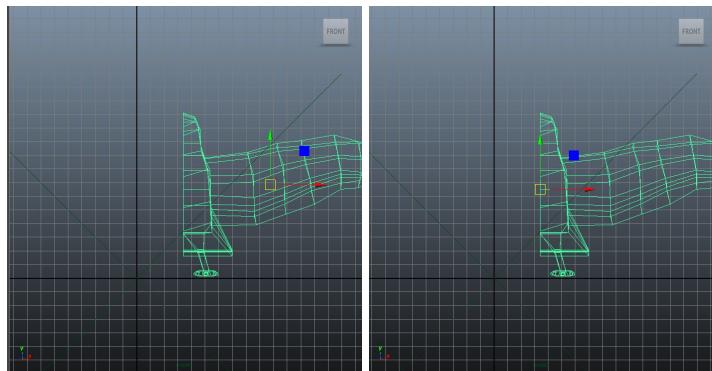


HINT: If you're merging but some of the vertices being merged aren't perfectly aligned to a plane (there's either a gap or a protrusion). Sometimes you can try going to the history node after the merge and fiddling with the Merge Threshold to see if you can get things to work. A lot of the times though, this will result in messed up geometry. If the vertices you're merging aren't properly aligned to a plane, here's what you can do to make sure you merge properly...

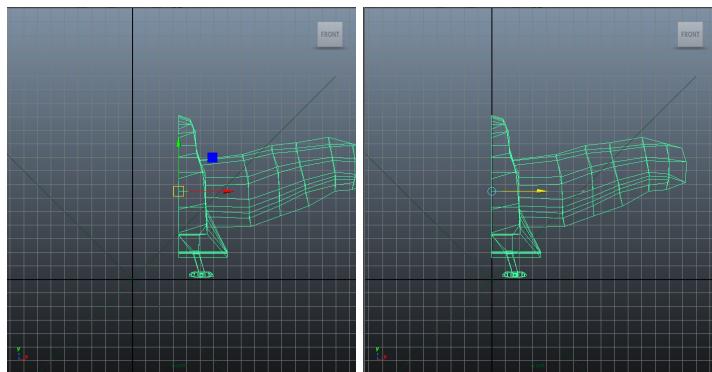
1. Go into vertex mode, select the outlier vertex, then hold V and use the axis mover to mover of the move tool to align that vertex with the rest of the vertices.



2. Go into object mode, hold V and D and move the pivot point to the edge being mirrored.



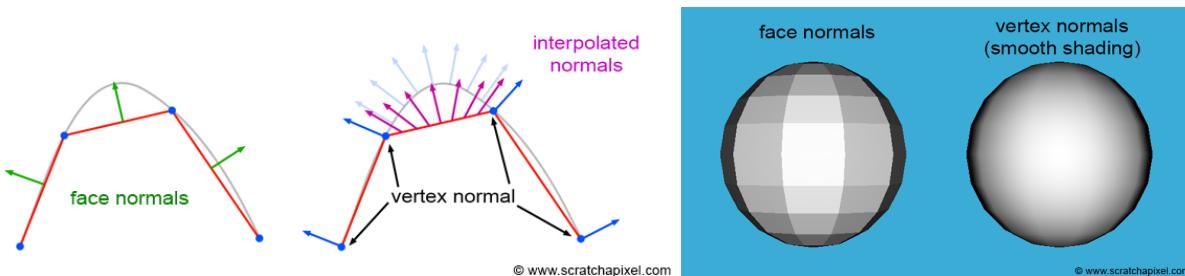
3. Hold X and use the axis mover to move of the move tool to move the object right up to the plane



Polygon Normals

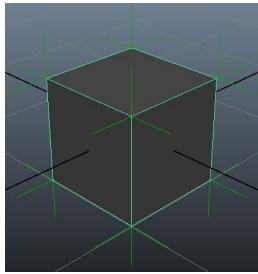
Polygon normals are vectors that determine how light reflects off of a surface. Normals are typically perpendicular to the surface that they're reflecting light off of.

There are 2 types of normals: face normals and vertex normals. A face normal is a single normal that's applied to all the points on a face, while vertex normals are interpolated between the vertices that make up a face. The end result is that face normals make each face look flat while vertex normals (depending on how you orient them) allow you to have a smoother look, a harder look, or a flat look.



NOTE: In Maya, it looks like vertex normals are NOT shared between the faces they're attached to -- meaning that each vertex has 1 normal for each face that it's a part of. As such, face normals are probably just a special case of vertex normals: setting the face normal just orients all the vertex normals for that face the same way.

For example, here's a picture showing the vertex normals of a cube that has flat shading. Note that there are 3 normals for each vertex (each vertex in a cube attaches to 3 different faces)...

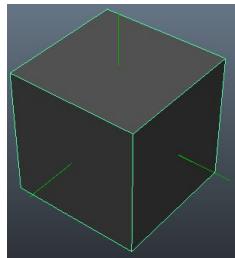


NOTE: You went through the math for all of this during school. Go here for a refresher on the various concepts:

<https://www.scratchapixel.com/lessons/3d-basic-rendering/introduction-to-shading/shading-normals>

Face Normals

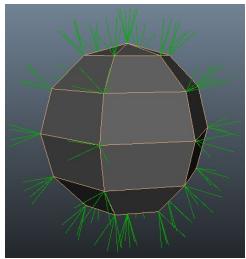
To turn on face normals, go to Display -> Polygon -> Face Normals.



NOTE: Face normals are very likely just the average of the vertex normals. When you manipulate the face normals, it'll manipulate all the vertex normals the same way (probably).

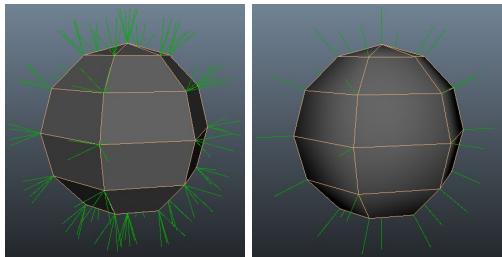
Vertex Normals

To turn on vertex normals, go to Display -> Polygon -> Vertex Normals.



Remember that each vertex has a normal for each face that it's attached to. A vertex normal is interpolated between the other vertex normals of that face in order to give smooth out the look of the face.

Compare the following 2 spheres...



In the first picture, each vertex normal for a face is oriented such that it's normal (perpendicular) to the face. In the second picture, each vertex normal is a blend (average?) of the normals of the faces it's attached to. As such, the second picture looks smoother while in the first picture each surface is hard/flat.

If you want to get a hard look (1st picture), select object and go to Normals -> Harden Edge

If you want to get a soft look (2nd picture), select object and go to Normals -> Soften Edge

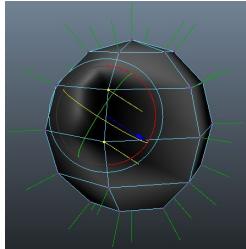
NOTE: You can apply Harden/Soft Edge to vertices, edges, faces, or objects.

NOTE: The history nodes for these (polySoftEdge#) will give you an angle option which you can use to control how hard/soft you want it.

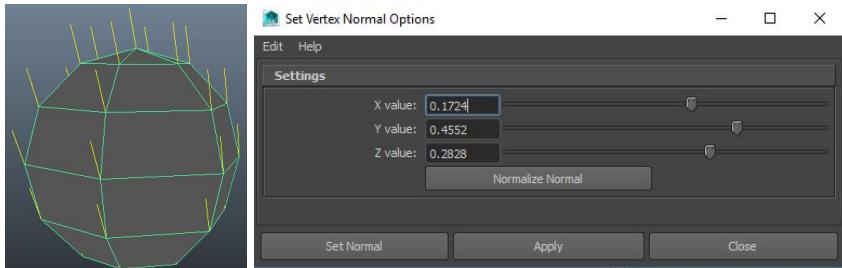
Manually Editing Normals

You can manually edit normals by going to Normals -> Vertex Normal Edit Tool

The tool will give you a rotation tool prompt and you can use it to adjust the vertex normal for vertices, edges, faces, or objects. In the following picture I selected the vertex normals for multiple vertices and rotated them.



If you want to change all the vertex normals to some specific value, you can do that by going to Normals -> Set Vertex Normals (click on the box on the right-hand of the menu to open the options).

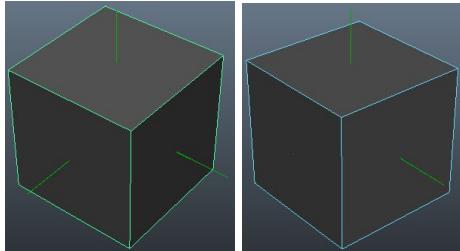


NOTE: When you manipulate a vertex normals like this, you're locking the normal in to some position. To unlock the normals, go to Normals -> Unlock Normals.

Backfacing

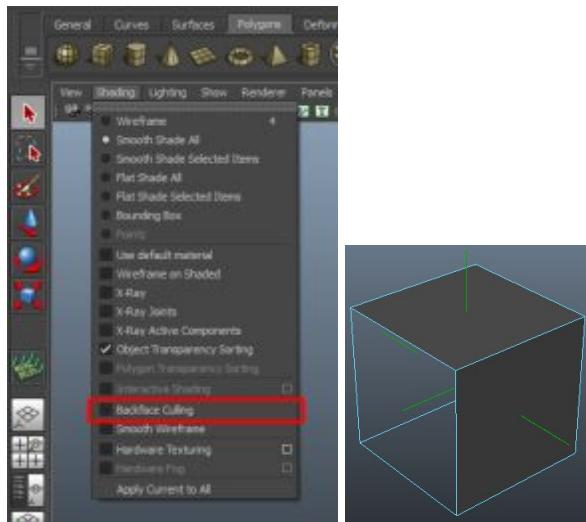
A normal is either facing forward or is backfacing. In the cube example above, the normals are all facing forward. If you wanted to, you could select a face and reverse the normal.

To reverse the normal, select the face and go to Normals -> Reverse.

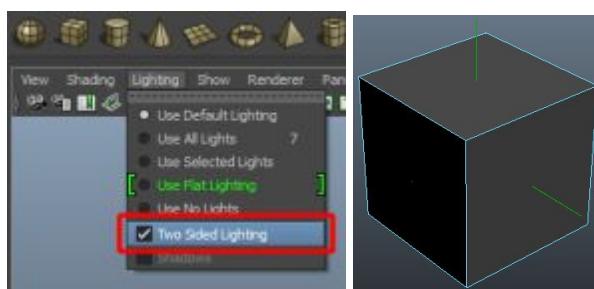


Note that the face on the left has had its normal reversed, and there's now a difference how that face is reflecting light vs the original (subtle).

A good way to find out if a surface is backfacing without having to show normals is to enable backface culling in the viewport. To do this, you can go to the viewport's menu and choose Shading -> Backface Culling. Once you do this, if the normal for a surface is backfacing, it'll be transparent (not shaded).



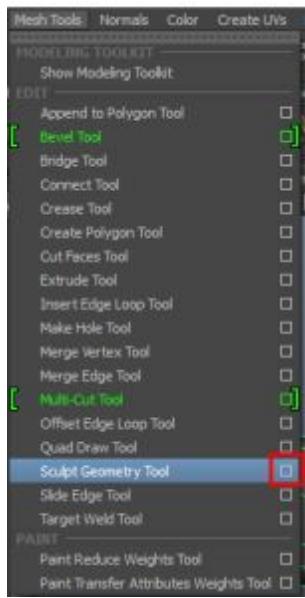
Another good way to find out if a surface is backfacing is by turning off two-sided lighting in the viewport. To do this, you can go to the viewport's menu and go to Lighting -> Two Sided Lighting to turn it off. Once you do this, if the normal for a surface is backfacing, it'll be black (no lighting applied to it).



Polygon Sculpt Geometry

The polygon sculpt geometry tool is a tool that'll let you manipulate geometry with a brush. The brush is something analogous to an Inkscape brush. You get a brush size and brush opacity setting. The size effects how wide an array you can spray and the opacity controls how much of the effect is applied.

To open the polygon sculpting tool, go to Mesh Tools -> Sculpt Geometry Tool (make sure to click the little box on the right hand side so you open up the tool settings).



In the tool settings that open up, the **Brush** and **Stroke** options apply to pretty much all functions of the tool, while the **Sculpt Parameters** define what function is actually performed.



For brush options...

- Radius(U) is the brush size -- typically this is set in the viewport by holding B + dragging the LMB.
- Radius(L) is the minimum size the brush can be when you resize in the viewport.
- Opacity is how strongly the selected function the brush is applied.

For sculpt parameter options...

- Reference vector is the vector in which the sculpt tool is operating against
- Max displacement is the maximum amount of change the sculpt tool will make per application (per application = as long as the mouse button is held down)

NOTE: These options are a bit confusing. As an example, if you're using the push/pull tool with the reference vector of X-axis, it'll only push/pull in the X-axis directions. The units talked about in max displacement are in relation to the grid in your viewport.

For stroke options...

- Reflection lets you mirror whatever you do on one side to the other

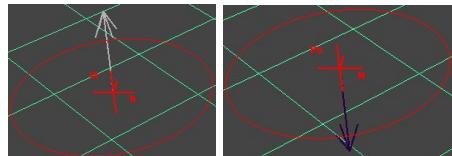
- Invert reference vector is used to define how the effect of the brush is reflected

These options will be described further below in the tools they're important for.

Push/Pull Tool

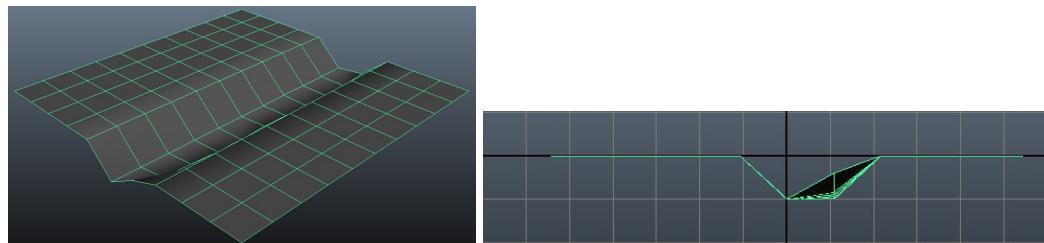


The push and pull tools let you essentially do the same thing. You're either pushing out or pulling in faces. If you select one, you can temporarily switch the functionality to the other by holding down the Ctrl key.



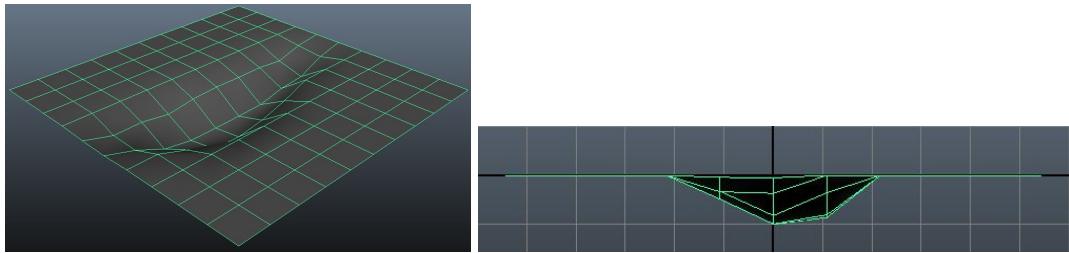
The max displacement setting describes the maximum amount you want the face to go down/up, while the opacity setting describes how much of that max displacement is applied.

For example, this is one stroke with a max displacement of 1 and a opacity of 1.



Note that it only pushed down 1 unit. No matter how many times I go over this groove with the mouse button pressed, it'll only go down to the max displacement (1 unit). If I release the mouse button and do another stroke, then it'll go down another unit.

Here's another example. This time the max displacement is 1 and the opacity is 0.1.



Note that this also only pushed down a max of 1 unit, but it's a more boat-like gouge. It was one continuous stroke, but I went over the outside lightly and went over the inside more heavily.

NOTE: By default this pushes/pulls in relation to the normal vector of the face. If you want to push/pull in a certain direction, try setting the reference vector. However, if you have reflection turned on, you might need to use invert reference vector to get it things to be applied symmetrically.

Smooth/Relax Tool

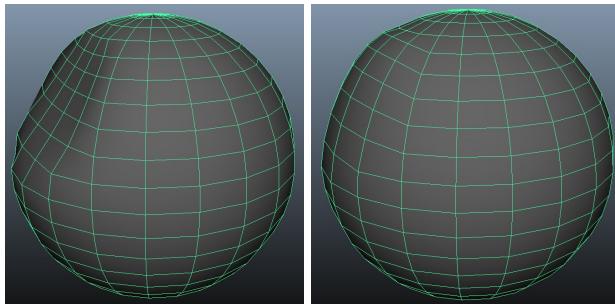


The smooth and relax tool do similar things.

The smooth tool averages the vertices that you're sculpting on, in essence smoothing them out. A problem with the smooth tool is that tends to deflate the volume of the object. Sometimes you want to smooth things out but you don't want the volume to heavily change, which is what the relax tool tries to do.

You would use these tools to try to smooth out jagged edges in your object.

In the example below, the left image has had the smooth tool applied to an area of the sphere while the right image has had the relax tool applied. Note that the left image looks deflated, while the right image is mostly retains the shape.



As with the other tools, max displacements and opacity effect how much of the effect is applied.

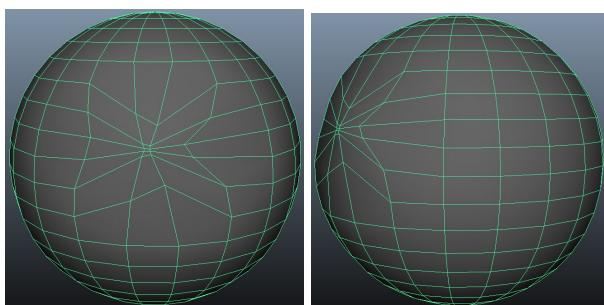
NOTE: Changing the reference vector to something other than normal also seems to have an effect on how the tool operates but I can't think of a usecase where this would actually be needed.

Pinch Tool



The pinch tool allows you to tighten the vertices in a certain area. Note that the pinch tool tries to maintain the shape of the area that it's tightening (it tries not to distort the overall shape).

In the example below, I used the pinch tool to smush the front of the sphere.

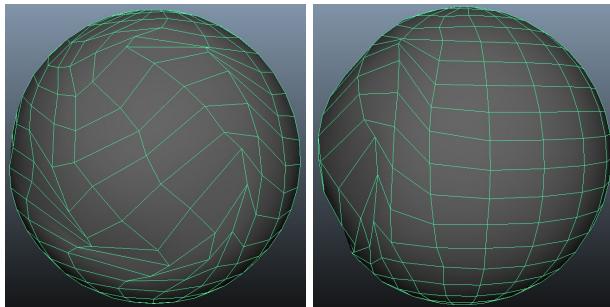


Slide Tool



The slide tool allows you to slide the vertices around in a certain area. The direction you move the mouse is the direction the vertices will slide in. Note that the slide tool tries to maintain the shape of the area that it's tightening (it tries not to distort the overall shape). As such, it's very useful for evening out your geometry.

In the example below, I used the slide tool and continually went in circles to try to create a swirl on the outside of the sphere...

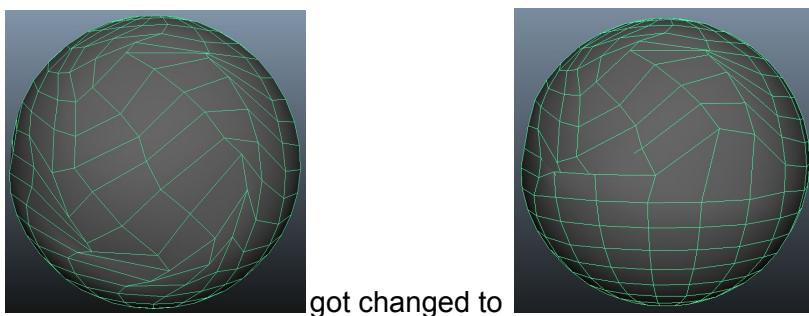


Erase Tool



The erase tool reverses the sculpting changes you made. Why would you use this instead of Ctrl+Z (undo)? Because this lets you target specific areas to undo via the brush.

In the example below, I undid the bottom half of the swirl distortion from the slide tool example...

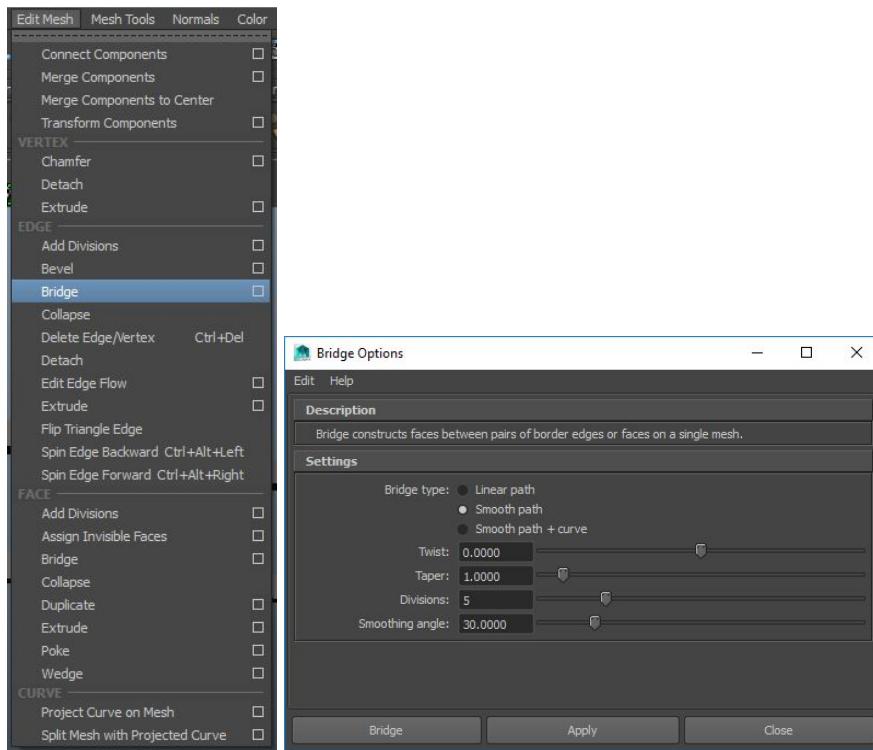


NOTE: This erase tool only works during the particular sculpting session that you're in. So if you navigate away from the sculpting session (e.g. navigate away from the sculpt tool by going to the select tool or to the modelling toolkit or something), you won't be able to use the erase tool to undo the previous sculpting changes you made. The moment you navigate away from the sculpting tool is the moment the erase tool loses its context.

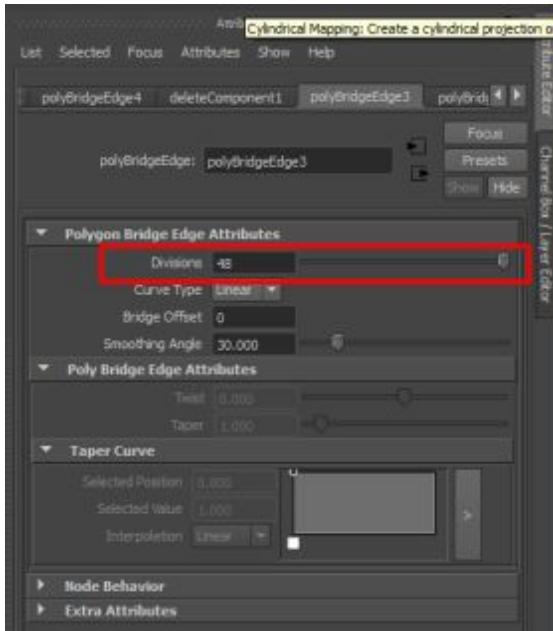
Polygon Bridge

Bridging allows you to connect n open edges from one side of an object to n open edges on another side of the same object. Note that the edges must be open (not connected to a face) and the number of edges being connected must be the same.

To do bridge edges together, first select your edges and then go to Mesh Tools -> Bridge (click the box on the right-hand side of the menu to open up the tool settings).



NOTE: Not all options are exposed in the options dialog. Some options are only available in the attribute editor and channel box. For example... If you want a high number of divisions (more than 25), you need to do it via the channel box / attribute editor.

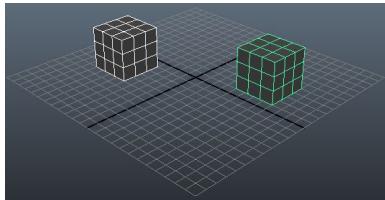


NOTE: Sometimes when you change the number of divisions, you'll notice that the shading won't show up on the newly created faces. This is a bug in Maya, and it resolves itself as you continue to work. If you need to fix it right away, go into object mode + right click on the object + choose Assign Existing Material -> lambert1 (or whatever material you're using).

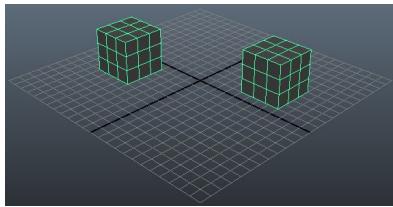
NOTE: At least some of this bridging functionality is exposed through the modeling toolkit.

Basic Bridge

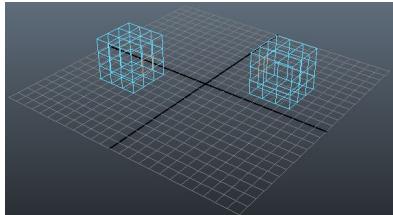
1. Create your cube and duplicate it. Make sure you have 3 subdivisions on each side.



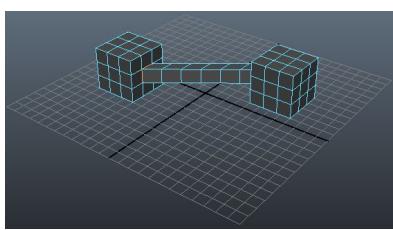
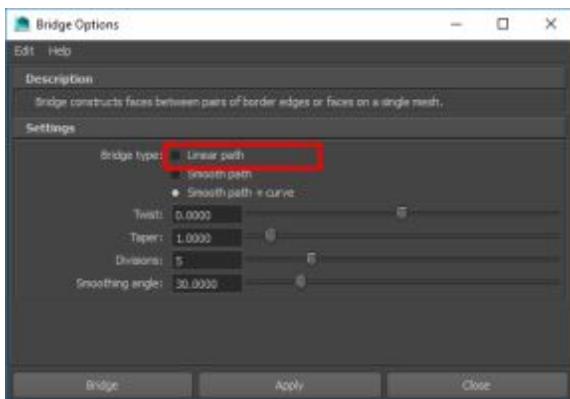
2. Combine these 2 objects by going to Mesh -> Combine.



3. Remove the face attached to the edges you want to connect + select those edges.



4. With the edges selected, go to Edit Mesh -> Bridge (click the box on the right-hand side of the menu item to open up the options). Choose a bridge type of linear.

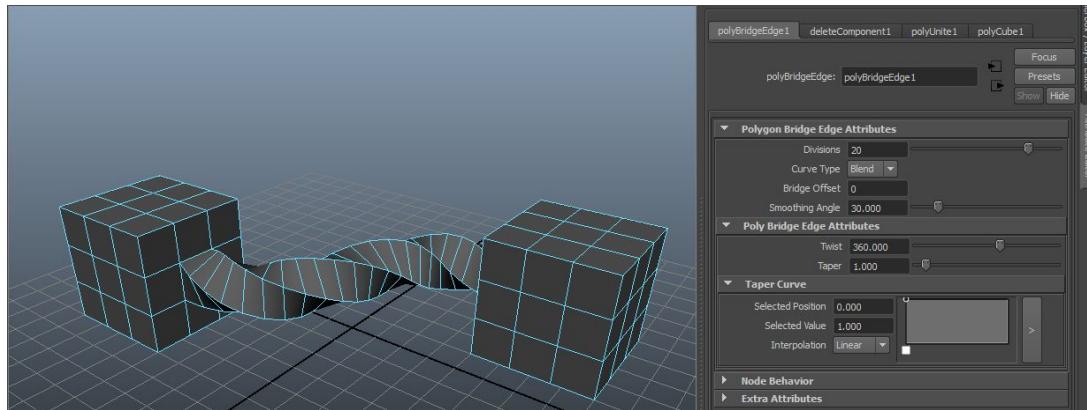


NOTE: In the attribute editor, change the parameters are you see fit. The image below sets the draw type to Blend and the twist to 360. Additional changes you can make include...

1. You can use smoothing angle to adjust the normals (you can always manually set/adjust the normals through other means)

2. You can use taper to bulge/slim the bridge either by setting the taper value or using the taper curve graph.

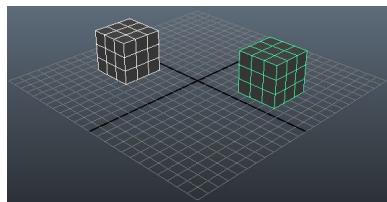
One thing you can't do is set the draw type to Curve. This is explained more in the curved bridge section.



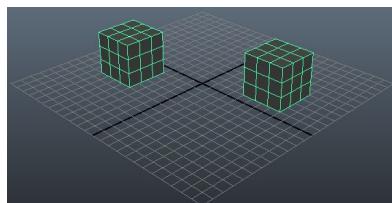
Curved (Smooth + Curve) Bridge

You can create a bridge that has an underlying curve that shapes the bridge. The caveat here is that you need to specify this when creating the bridge. You can't change to a Curve type after the fact via the channel box / attribute editor (because no curve will exist).

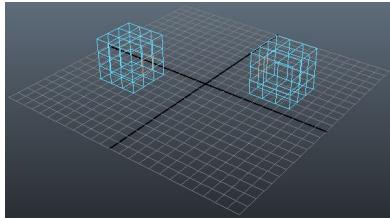
1. Create your cube and duplicate it. Make sure you have 3 subdivisions on each side.



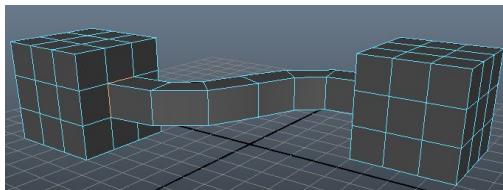
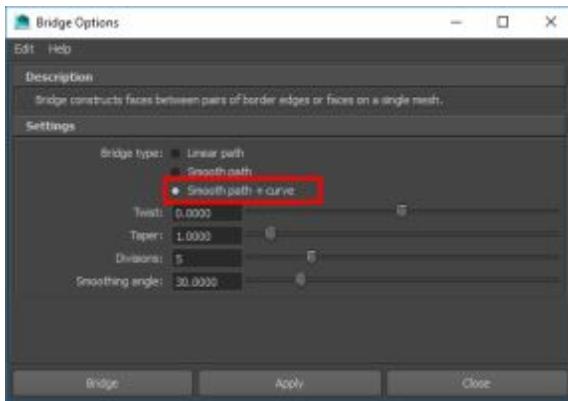
2. Combine these 2 objects by going to Mesh -> Combine.



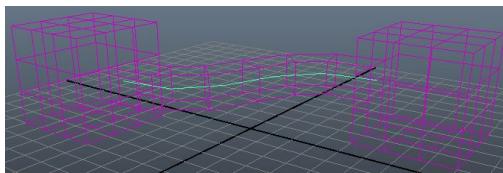
3. Remove the face attached to the edges you want to connect + select those edges.



- With the edges selected, go to Edit Mesh -> Bridge (click the box on the right-hand side of the menu item to open up the options). Choose a bridge type of smooth path + curve.

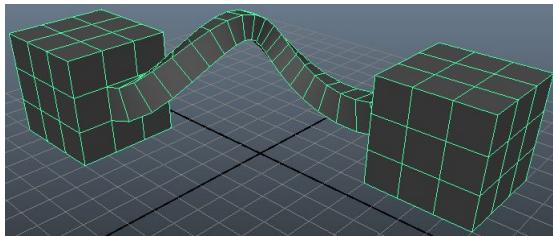


If you switch to wireframe view, you'll now notice that there's a curve running through the bridge. You can adjust the control vertices on this curve to curve the bridge to your liking.

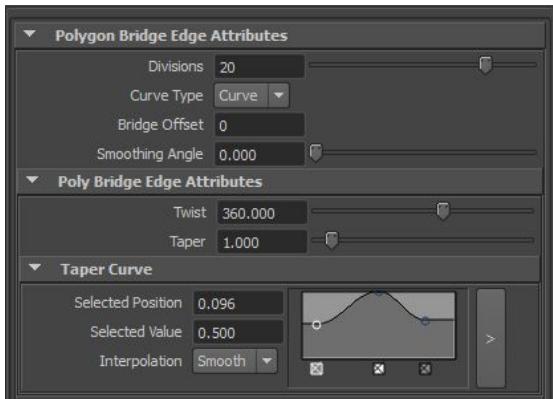
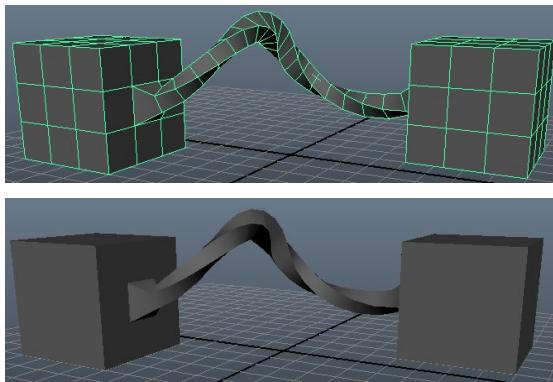


- Just for kicks, I messed with the attributes here a bit here as well.

I increased the divisions to 20 and then curved the bridge up.



I then twisted the bridge and I used the taper to try to get rid of that pinch at the top. I also smoothed the normals but hardened the normals along the horizontal edges.

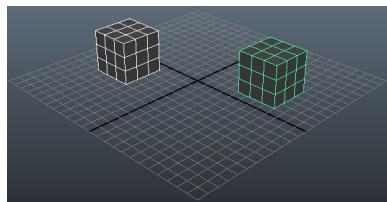


Blended (Smooth) Bridge

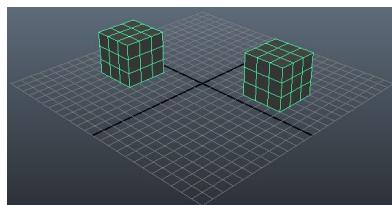
This is pretty much the same thing as a curved (smooth + curve) bridge, but without the underlying curve that lets you manipulate the bridge after the fact. You can think of it the same way except that the underlying curve gets removed after the bridge is created.

Unlike the curve bridge, you CAN switch to a blended bridge after the fact via the channel box / attribute editor.

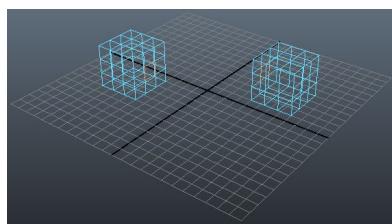
1. Create your cube and duplicate it. Make sure you have 3 subdivisions on each side.



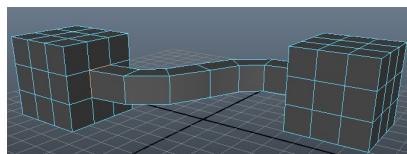
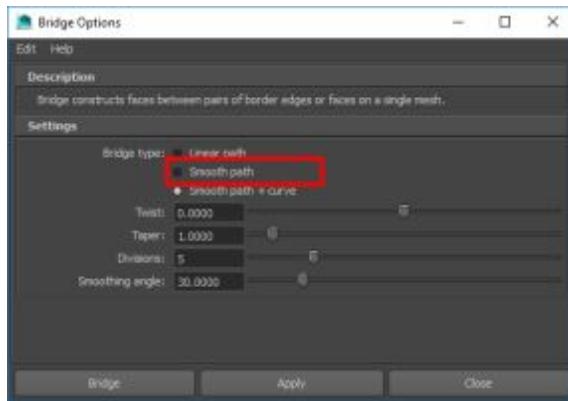
2. Combine these 2 objects by going to Mesh -> Combine.



3. Remove the face attached to the edges you want to connect + select those edges.



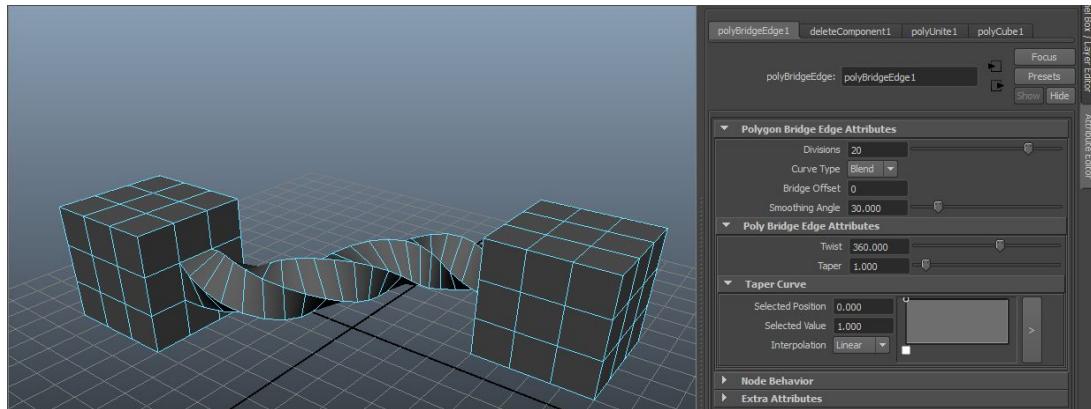
4. With the edges selected, go to Edit Mesh -> Bridge.



NOTE: In the attribute editor, change the parameters are you see fit. I set the twist to 360. Additional changes you can make include...

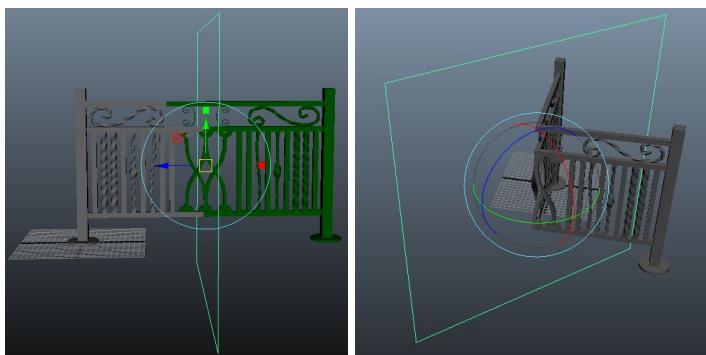
1. You can use smoothing angle to adjust the normals (you can always manually set/adjust the normals through other means)
2. You can use taper to bulge/slim the bridge either by setting the taper value or using the taper curve graph.

One thing you can't do is set the draw type to Curve. This is explained more in the curved bridge section.

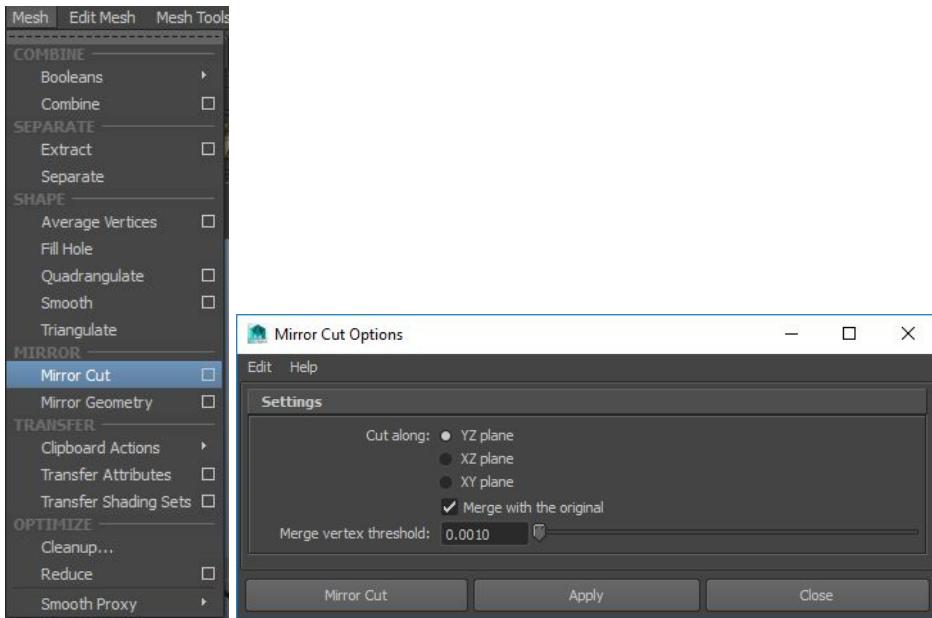


Polygon Mirror Cut

The mirror cut tool allows you to mirror one side of your object across one of the planes that the basis vectors make up (XY, XZ, or YZ). You can use the mirror cut tool to easily extend a repeatable pattern across different orientations. For example, you can use it to extend a model of a fence / give it a 90 degree angle.

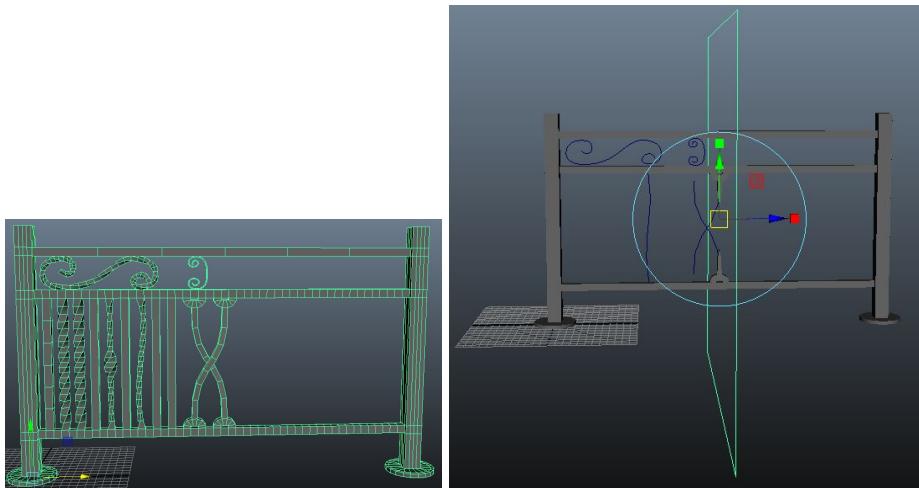


To use the mirror cut tool, first select your object then go to Mesh -> Mirror Cut and select the box on the right-hand side to open up the tool options.

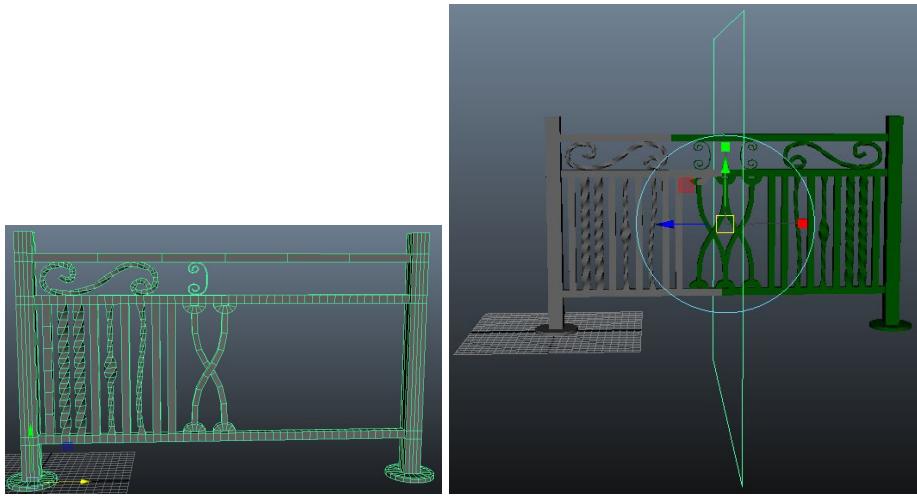


Once you cut, an invisible surface will show up on the axis you specified. This plane is used to cut and/or mirror your geometry, and you can orient it different ways to get different effects.

In the example below, we're mirroring the right-side of the object to the left side.

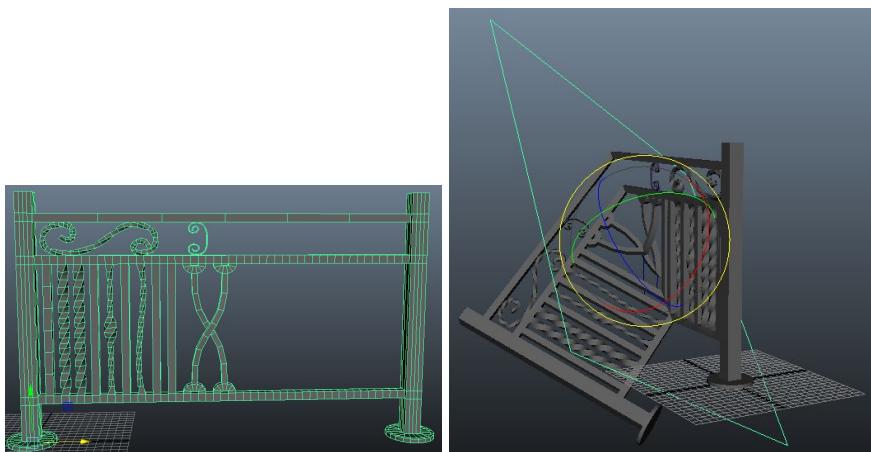


If we wanted to mirror the other way around (from the left-side of the object to the right-side), just rotate the plane 180 degrees.

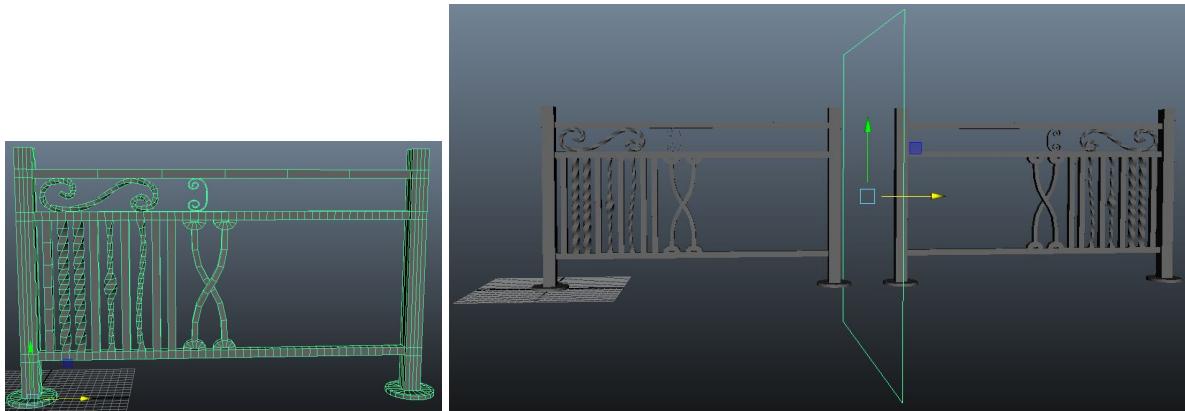


NOTE: If you're wondering why portions are showing up as green, I have zero clue why this is happening. This is how things look in viewport 2.0. In the legacy viewport, things seem to not get shaded at all (although in the legacy viewport this seems to be a temporary thing that eventually resolves itself). To fix this, go into object mode and right-click on the object and choose Apply existing material -> lambert1.

You can orient this image plan however you like. For example, here's a weird rotation setting.

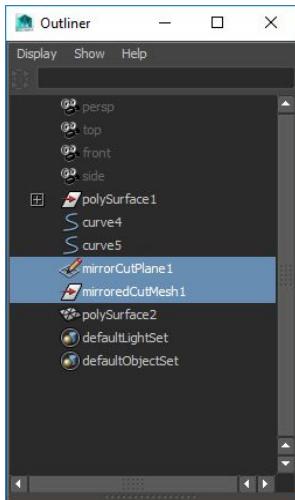


Or, you can even extend the plane past bounds of your object.



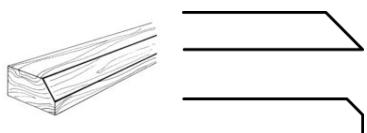
Once you're done with your mirror cutting, you need to delete the history so it can stay this way. To do this, with the object selected go to Edit -> Delete by type -> History.

You'll notice that the mirror plane is still there (transforming will no longer have any effect). That's because it wasn't part of the node history for that object (it's a separate object of its own). To get rid of it, open up the Outliner (or hypergraph) and delete the mirrorCutPlane# and mirroredCutMesh# items.

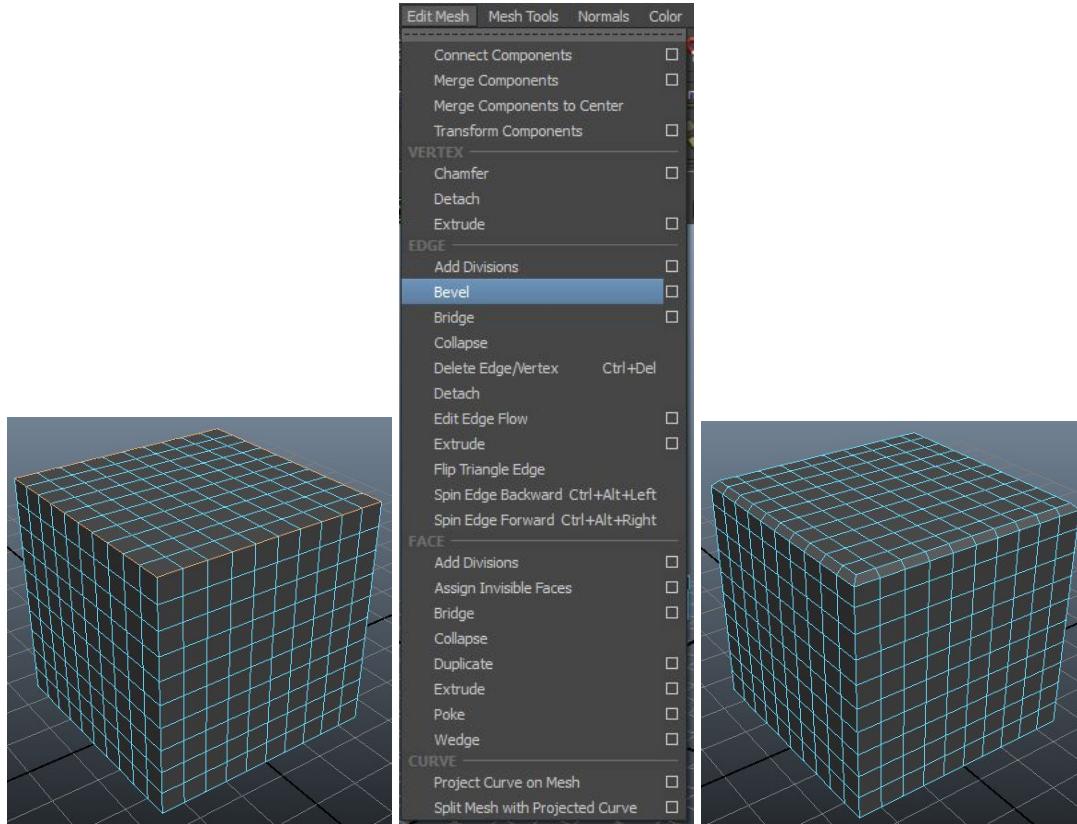


Polygon Bevel

A bevelled edge refers to an edge on a structure that isn't perpendicular to the faces of the faces of that piece.

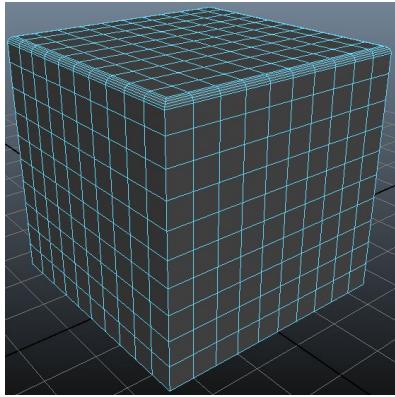


To create a bevelled edge, first select the edge(s) and then go to Edit Mesh -> Edge -> Bevel. Modifications are best made based in the channel box / attribute editor, so you don't need to click the box on the right-hand side to open up the tool options.



Useful options that control how the bevel looks can be found in the channel box / attribute editor.

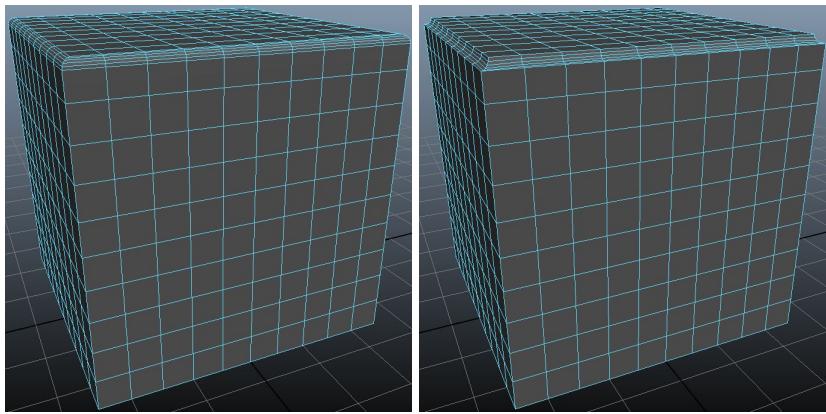
You can increase the number of segments that make up the bevel by changing the segments property. In the example below, segments is set to 5.



If you zoom in and look close at the bevel, you can see that it's rounded.

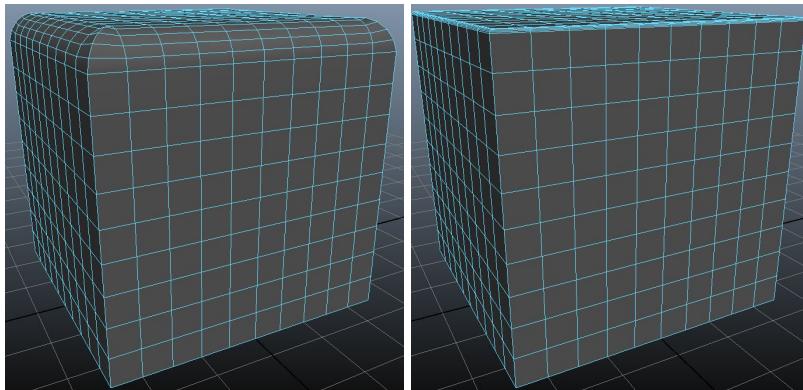
Trying to change the roundness property does nothing. That's because the autofit property is set to on. Turn off the autofit property and you can now set the roundness property. Setting a roundness > 0 will cause the bevel to protrude outward, while setting a roundness of < 0 will cause it to sink inward.

The left picture is a positive roundness while the right is a negative roundness (if the pics below are too small for it to be noticeable, zoom in)



The fraction property controls how large the bevel is. If you use the slider, it'll only extend to 1, which will take up half of each polygon. You can manually set this to 2 to take up the entire polygon. Anything more than that and the object ends up distorting.

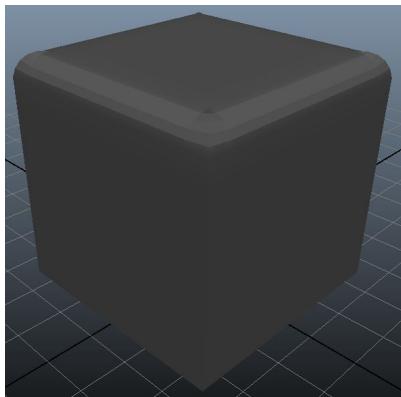
The left picture is a fraction of 0.1 while the right is a fraction of 2.



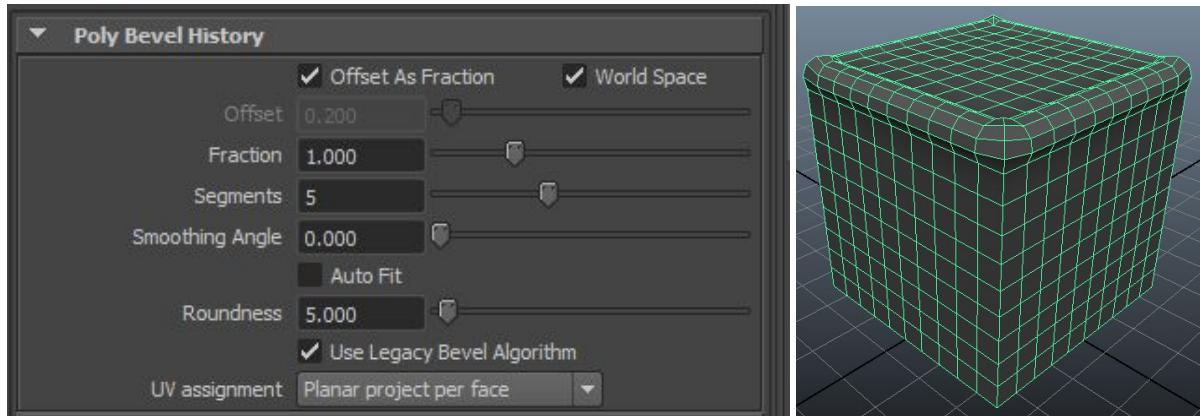
NOTE: It looks like if you set a fraction greater than 1 and a roundness > 0, sharp corners may end up bulging out slightly.

The smoothing angle property controls the normals. Set to 0 for hard edges, set to 180 for soft edges. Or, control the normals manually via hand-editing or the normals menu. Either way works.

In the example below, the smoothing angle has been set to 0 so the faces of the bevel look hard.



If you want the bevel to protrude out, kind of like a pipe. You can go to the attribute editor, choose the use legacy algorithm option, and manually set the roundness to something really high. This causes the bevel to extend out of the object.

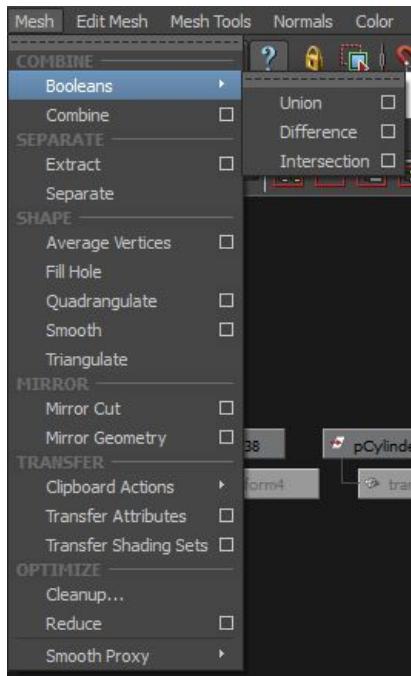


Polygon Booleans

Boolean allow you take 2 objects and ...

- add (combine) them together
- intersect them such that you get a new object that only occupies the space where they collide
- subtract (difference) them such that one object's volume gets carved out from the other

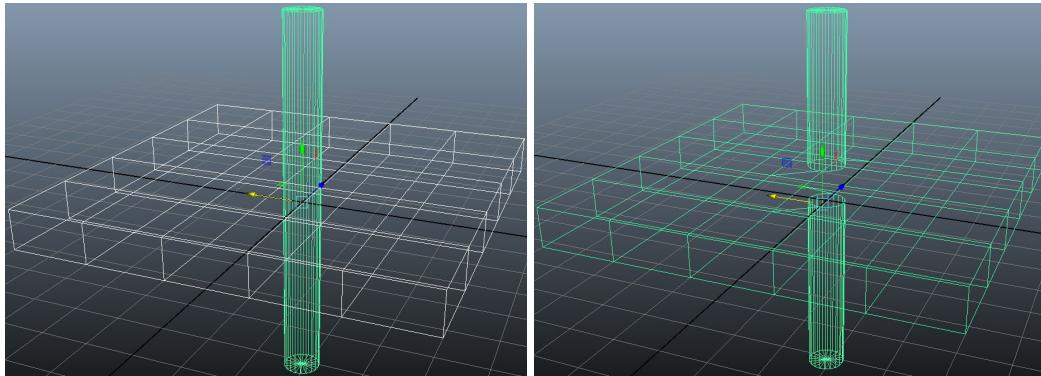
To access these options, go to Mesh -> Combine -> Booleans -> (option)



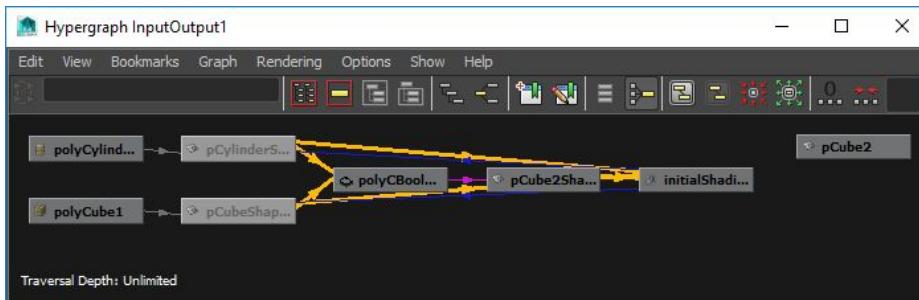
Add / Union

Union combines one or more objects together. For example, this cube and this cylinder are separate objects, but they become the same object once combined (notice how the intersecting portions have merged).

The left image is before the add, the right is after. The 2 shapes become 1.



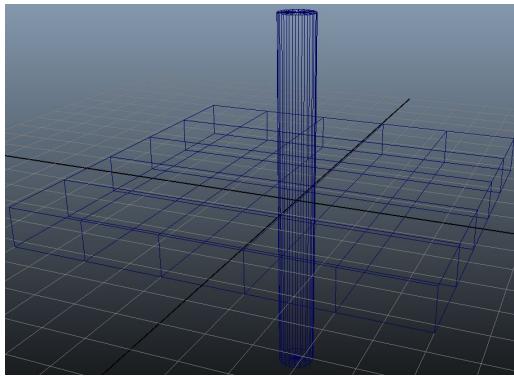
NOTE: Fun fact... if you go to the hypergraph and view the connections for the new object, you can still see and access the previous objects the new object was made of. If you select one of the shape nodes for the previous objects, you can transform it (move it/scale it/rotate it) and the new shape will pick up the changes.



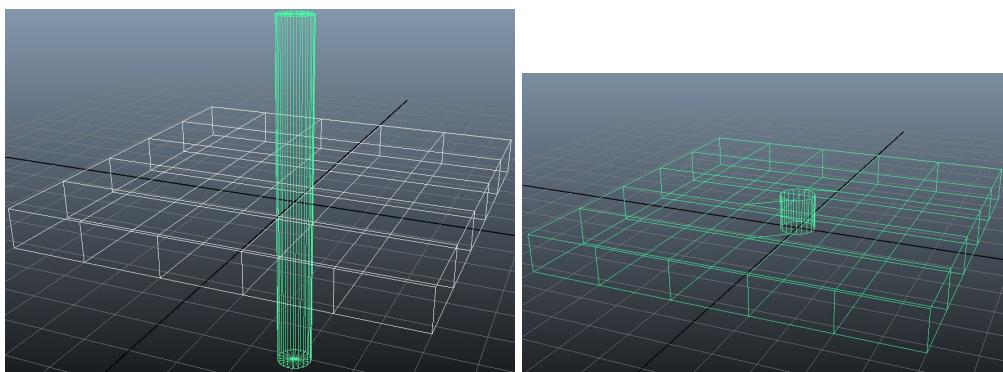
NOTE: I'm unsure how doing this operation (Mesh -> Combine -> Booleans -> Union) is different from doing Mesh -> Combine -> Combine.

Difference / Subtract

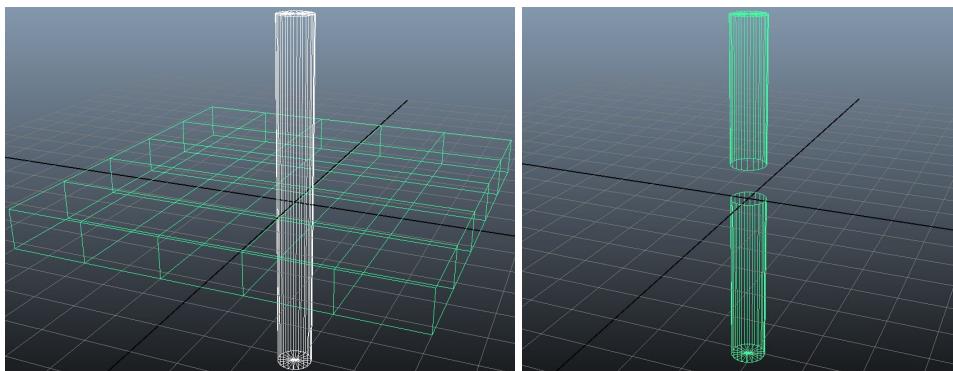
Difference subtracts the intersecting portion of one object from another. The order in which objects are selected is important here. The first selected object is the object that's subtracted from. For example, consider the following two objects.



If I select the cube first and the cylinder second, here's what the difference would look like...

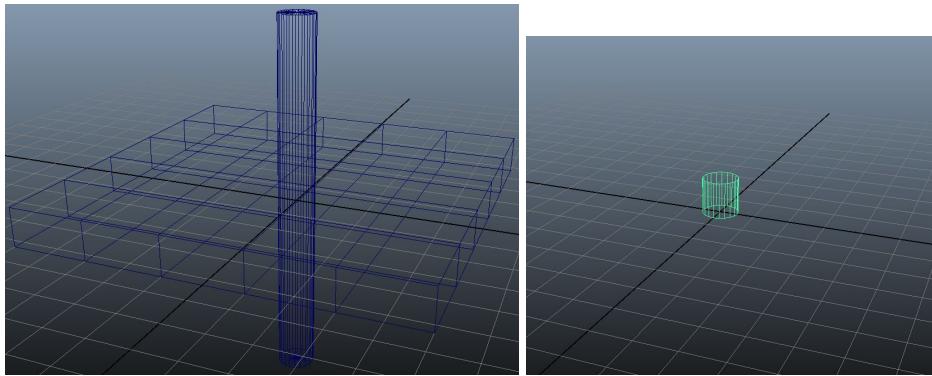


If I select the cylinder first and the cube second, here's what the difference would look like...



Intersect

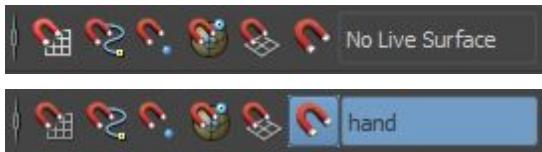
Intersection just keeps the part where all objects meet. Unlike difference, the selection order for intersection doesn't matter. For example, this is the intersection of the following objects.



Polygon Quad Draw (cleanup geometry / scan data)

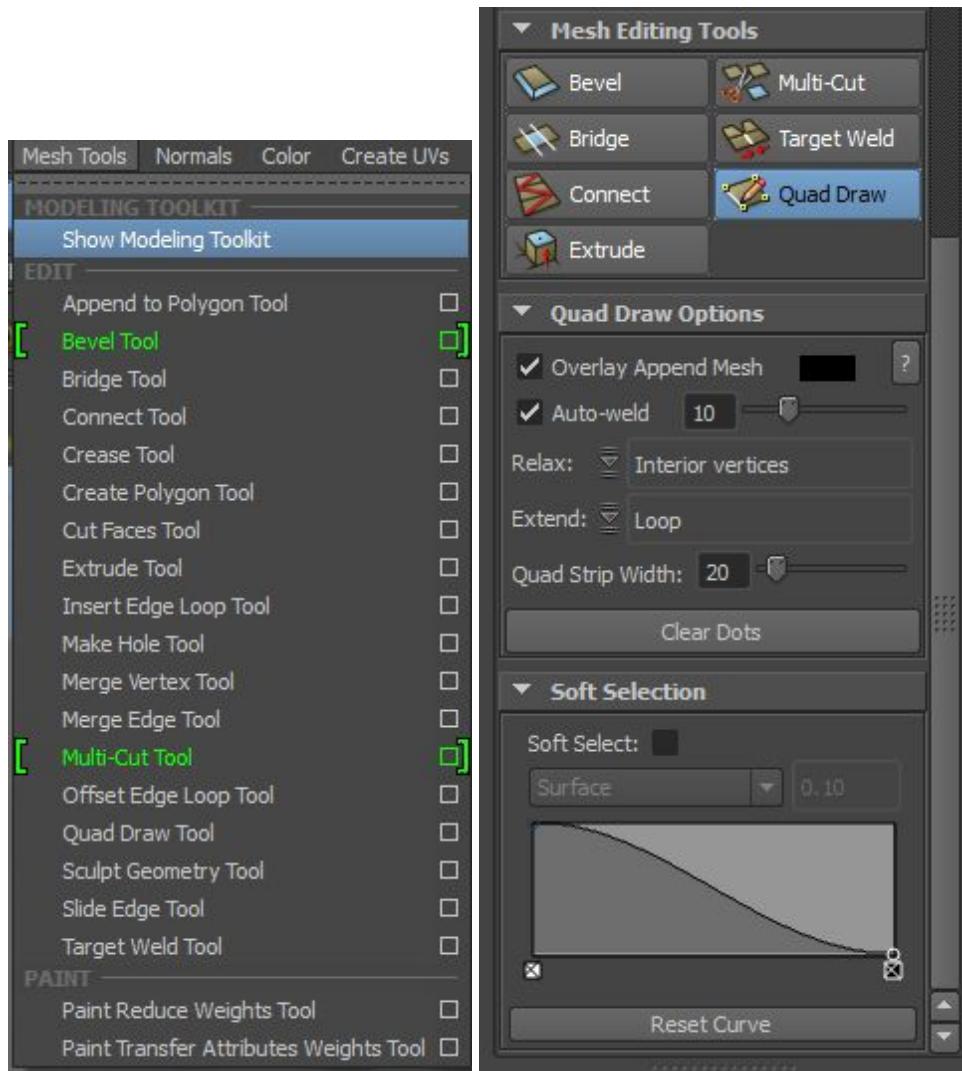
The quad draw tool allows you to draw new geometry on top of old geometry. It's used a lot to re-do geometry or cleanup bad scan data.

To use the quad draw tool, you first need to select an object as the live surface. To do this, select the object and click on the magnet. You should see the name of the object you selected show up next to the magnet.



NOTE: If you go to wireframe, you'll notice that an object that's set to live surface will be represented in green.

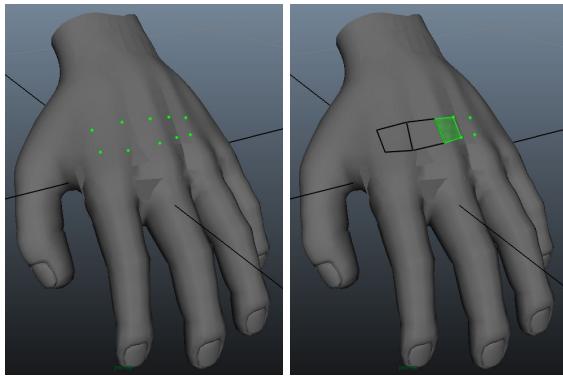
Then, go to Mesh Tools -> Show Modeling Toolkit. The quad draw tool should be available as a button in the panel that opens up.



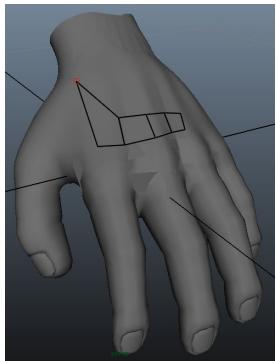
HINT: Handy shortcuts ...

- Context menu = **ctrl + shift + rmb**
- Move = **lmb/mmb**
- Split = **ctrl + lmb**
- Extend = **tab + lmb drag**
- Delete = **ctrl + shift + lmb**
- Soft select = **b** (hold **b** + drag to change selection size)

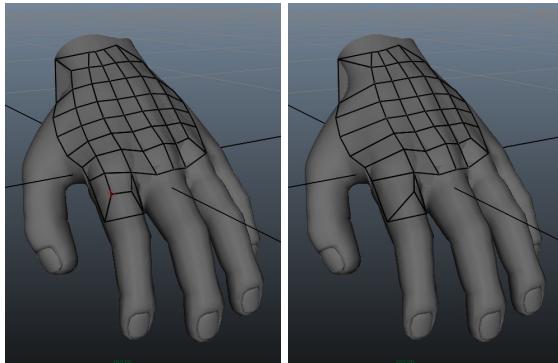
Once you do that, you can click LMB on your object to create points, then shift+LMB to create a polygon based on those points.



If you're unhappy with where the vertices/quads are sitting, you can click+hold MMB to move them around (LMB seems to work as well).



If you want to delete an edge loop/border or a face, hold ctrl+shift and click LMB to delete.



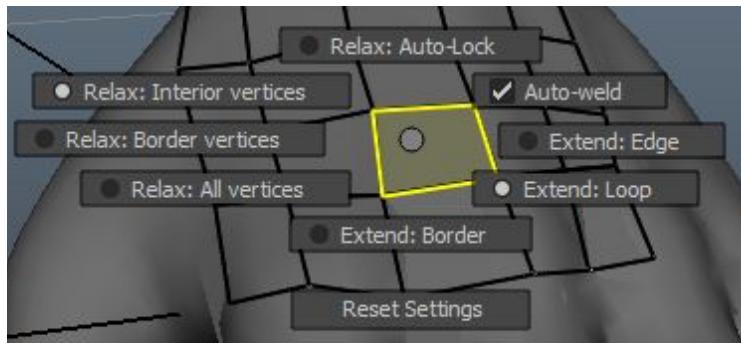
Extending Polygons

If you want to create a new polygons from previous polygons, you can use the extend feature.

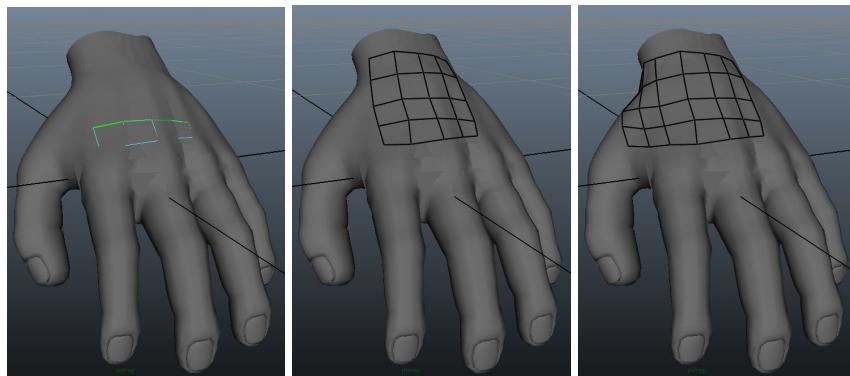
Extensions come in 3 types... single or loop or border...

- Single will only extend a single polygon by an edge.
- Loop will extend the entire row/column of edges.
- Border will extend the border edges (those not going to another polygon)

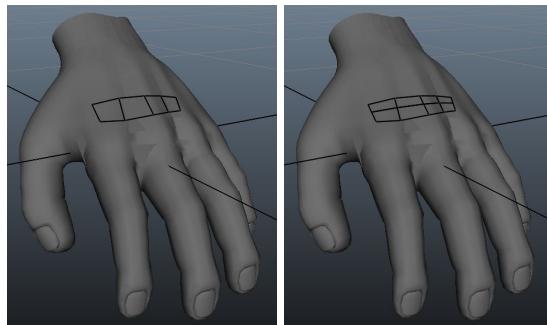
Choose between the three by opening up the marking menu. Open the marking menu by holding Ctrl+Shift and press+hold the RMB. Then choose Extend: ????.



Once you're done that, you can hold Tab then LMB+drag an edge to extend it.

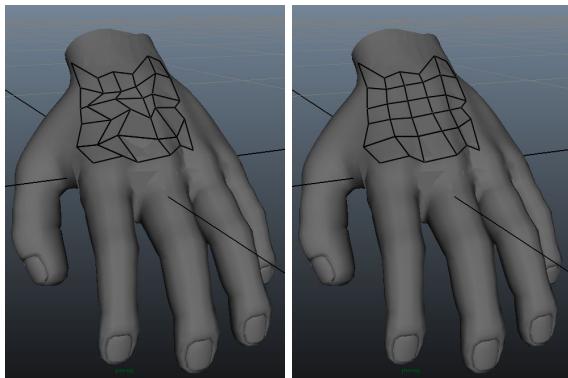


If you want to split your row/column of polygons in 2, you can hold down ctrl and click LMB on where you want the split to be.

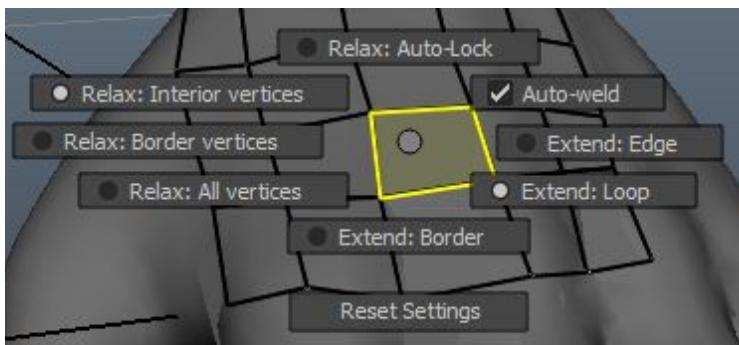


Relaxing Polygons

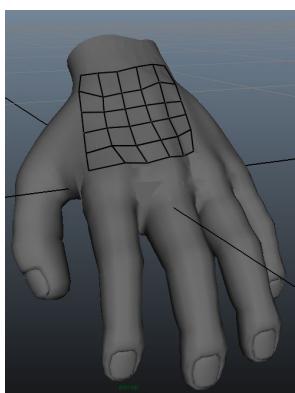
Sometimes the polygons you create may be jacked up. You can relax your polygons by holding shift and click+hold LMB while you go over them with your mouse.



By default the tool only relaxes interior vertices, but you can change to border vertices or all vertices through the marking menu. Open the marking menu by holding Ctrl+Shift and press+hold the RMB. Then choose Relax: ???? vertices.



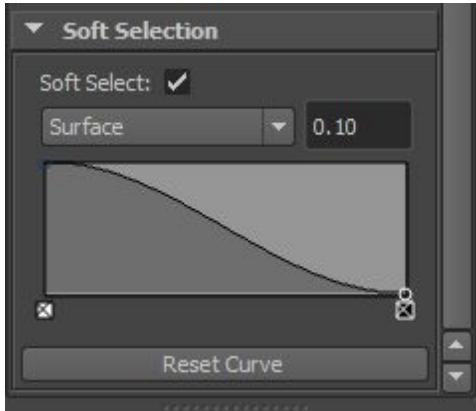
Here is a version with the borders relaxed as well...



Soft Select

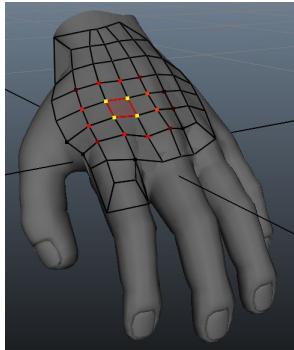
Sometimes you don't want to just work on one edge/face/dot, you want the surrounding components to be affected as well. We can do this by using the soft select tool.

To enable soft select, either press b or enable it in the panel.



NOTE: Surface selection seems to be the one you want.

Now when you go to make a selection, you'll see a heat map. The brighter the dot, the more it'll be impacted by whatever happens.



Notice how the surrounding polygons change when I move this face right a bit. The surrounding vertices got dragged a bit long with it.

