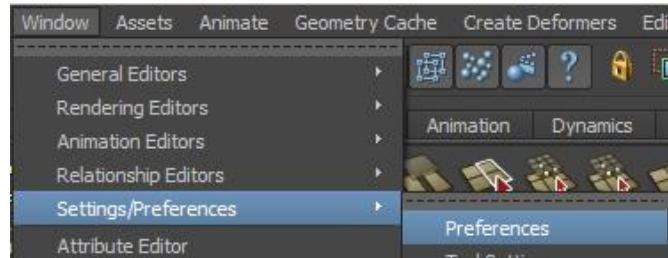


## Introduction to Modelling

This is how your characters and scene objects are created. Anything imaginable can be built within Maya and by using a variety of techniques explained below.

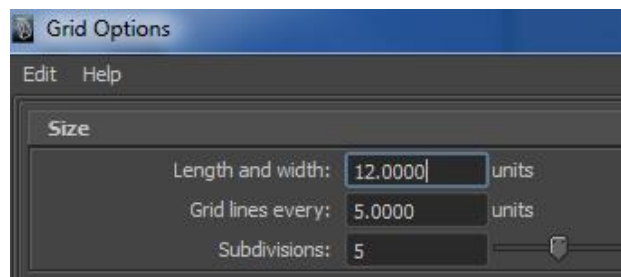
### Modelling to Scale

It is important to model to scale where possible. Especially if you plan to integrate realistic lighting and/or dynamics into your scene – these both rely heavily on accurate physical models. The first step is to decide what



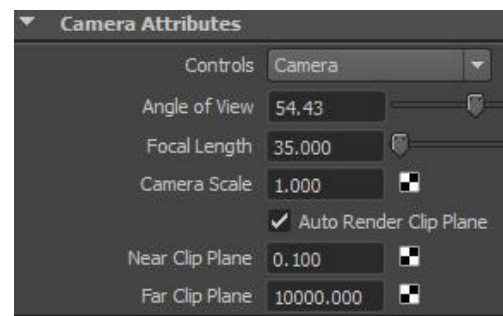
units to work with within Maya – In your *Settings/Preferences > Preferences* window go to the *Settings* category and choose your working units based on what will be most suitable for your current scene.

If the Maya scene is set to metres, then a box that is one metre cubed in real life should be one unit long. Likewise if we are working in cm then a person should be 170 units tall. This may seem outrageously large when we view it in Maya, especially



compared with our grid which is now tiny in comparison. We can easily go and fix this however, by going into our Grid Options box *Display > Grid* and adjusting the Length and Width of our grid, and more importantly (because this will affect your top, front and side panels also) how often you want Maya to display grid lines.

One note to make is that if you are modelling to scale, you are likely to 'outgrow' the camera's range of view. The camera has a limited distance that it can view



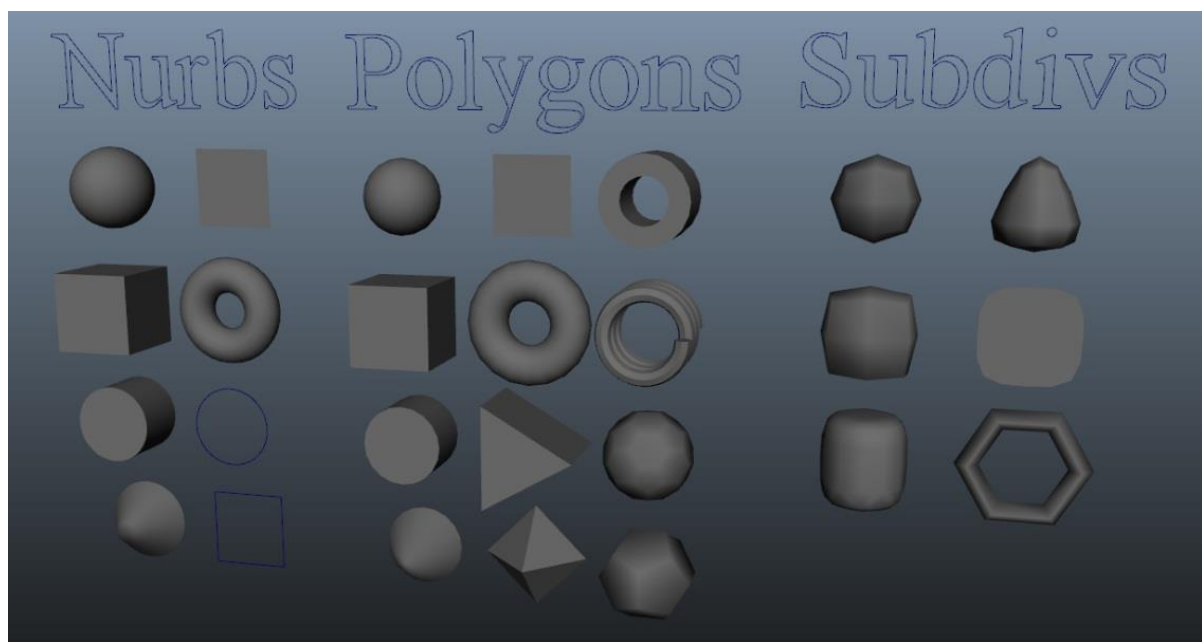
objects which is called the *Far Clip Plane* and can be adjusted in the attribute editor with the



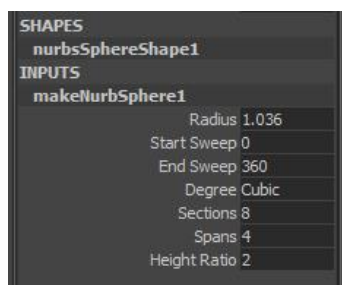
camera selected (remember you can select the current view camera in the viewport menu by selecting *View > Select Camera*).

## Primitives

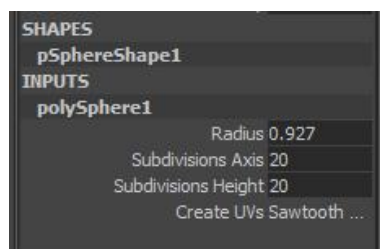
A Primitive is often the starting block of any model and will take a relatively simplistic form to be later sculpted into something more aesthetically appealing. The initial level of detail and starting geometry can be altered offering the modeller a greater level of control. Using the channels box (when initially created) you can edit aspects such as divisions, sections and spans, however once the geometry has been edited this feature cannot be used as you will notice some abnormal behaviour



### NURBS



### Polygons



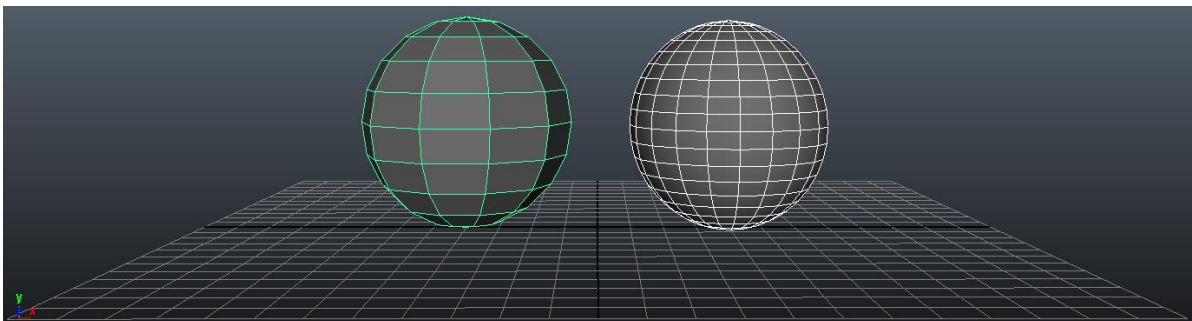
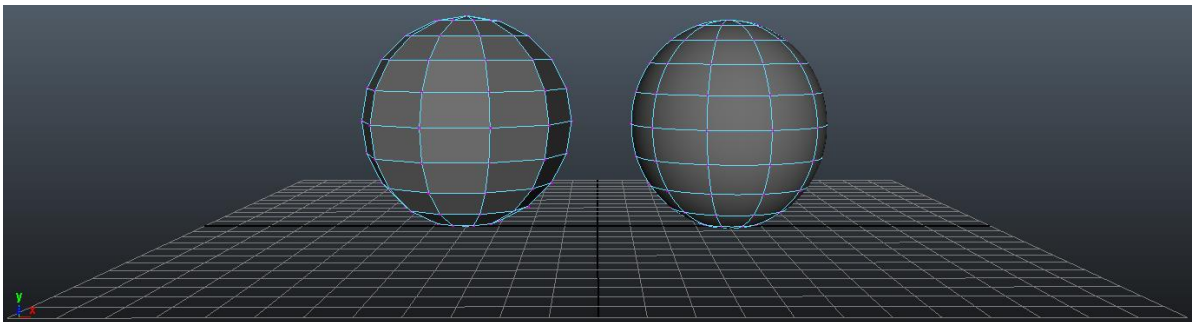
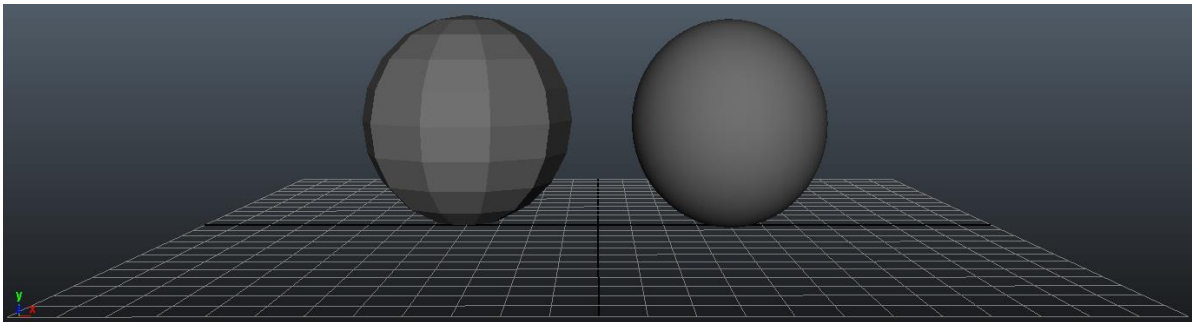
### Subdivs



## The Basics of Modelling

### Polygons

Polygons allow for a simplified overall Modelling process, you can make fantastic looking models with only a handful of key tools. Its universal Modelling form often allows a simple interaction with external packages like Zbrush and Photoshop. Creating “*hard edges*” is relatively effortless and often requires considerably less geometry than other means. Unlike NURBS, polygons will retain their form until rendered where at this point you can create a smoother appearance (first image). The biggest challenge arises when used within an organic model as each individual polygon is independent and just one edge or vertex out of alignment can become noticeable. It makes for good practice to keep polygon models in their lowest possible resolution and only to smooth (last image) in the final stages otherwise your scene can become unnecessarily large.



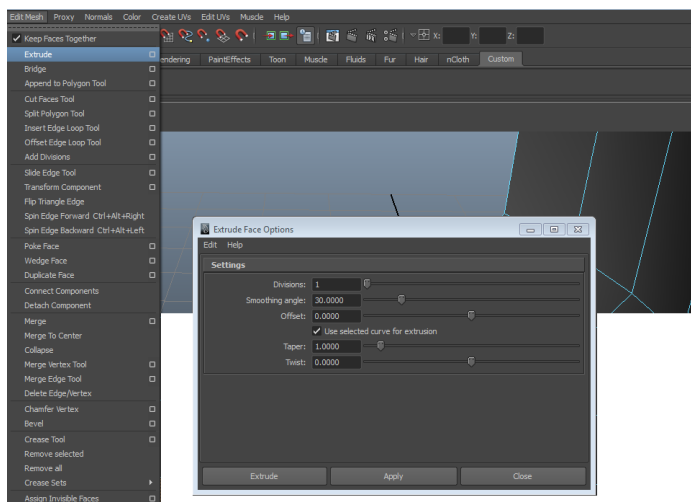
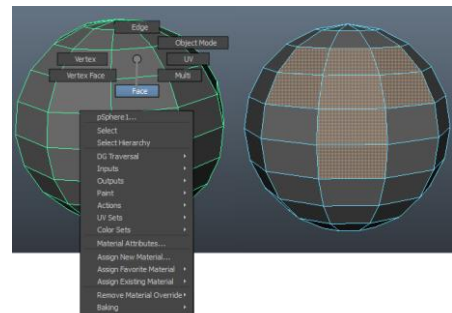
## Common Polygon Modelling Tools and Techniques

### Extrude

Possibly the most commonly used tool within polygon modelling which allows you to create additional faces and manipulate them accordingly.

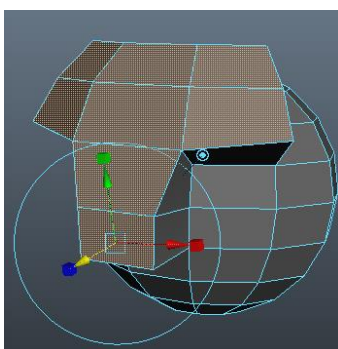
#### Using the Tool:

- **RMB** (hold)
- **Select Faces**
- **Highlight appropriate faces**



- **Navigate to (Polygon Menu set)**  
*Edit Mesh > Extrude* □

You will then be presented with a type of universal manipulator



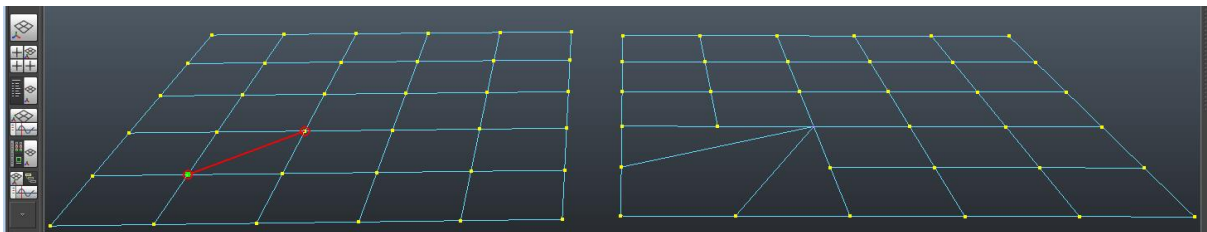
You can use the Translate, Rotate, and Scale attributes of the manipulator to move the extrusion in relation to the object. If however you would like your manipulator to act in accordance to the scene defaults (i.e. be able to extrude perfectly along the Y axis) before you click on the manipulator you will notice a little circular icon just outside the rotation ring. By pressing this you can alternate between the two, we recommend you try this so you have a better understanding before moving forward.

## Merge Vertex / Edges

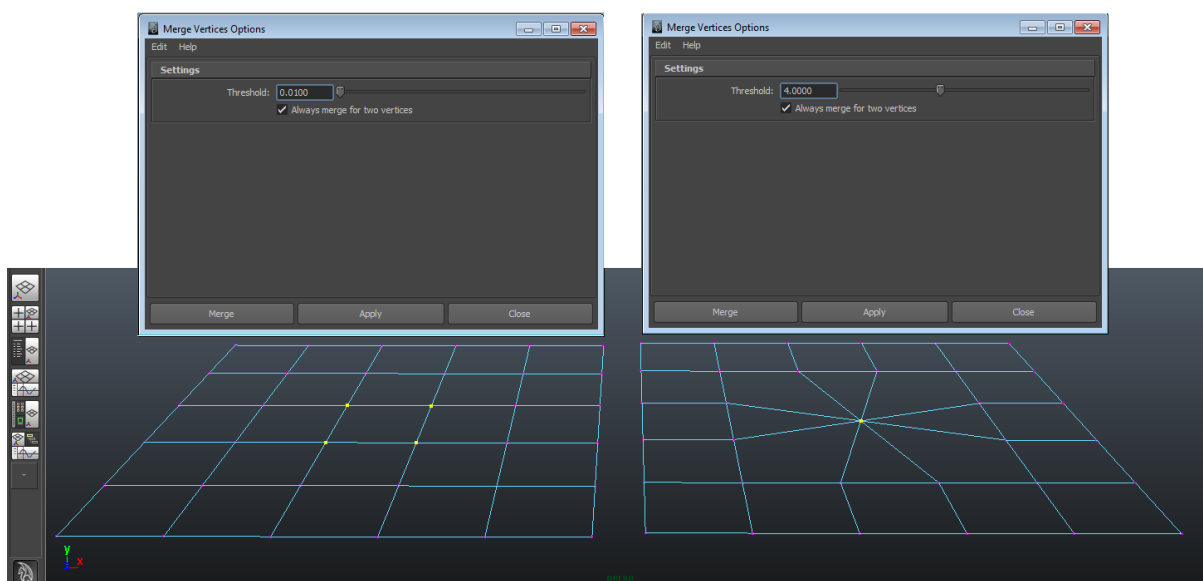
### Vertex

Firstly we'll take a look at merging a vertex as they have two varied ways to get the same desired effect.

1. **Interactive Merge Tool** – As you would assume is allows you to merge them interactively, to do this select your object then navigate to *Edit Mesh > Merge Vertex Tool*. You will notice the selected object will transfer into Vertex mode and you now have a + as a curser. To merge a vertex to another click on the one you want to move initially then select the target vertex illustrated below. If you click on the tools option box you can chose if it merges to the target or the mid-way point between the two vertices...



2. **Merge Vertex Tool** – By default this tool will merge a vertex to a central position amongst those selected prior to the merge. You are also able to merge multiple points at once by shift selecting or highlighting a large section. To perform this action, navigate to *Edit Mesh > Merge* □. The slider represents the tolerated difference where it will actually perform a merge, if a vertex is too far away from the target to nothing will happen, if nothing happens increase the range and merge again.

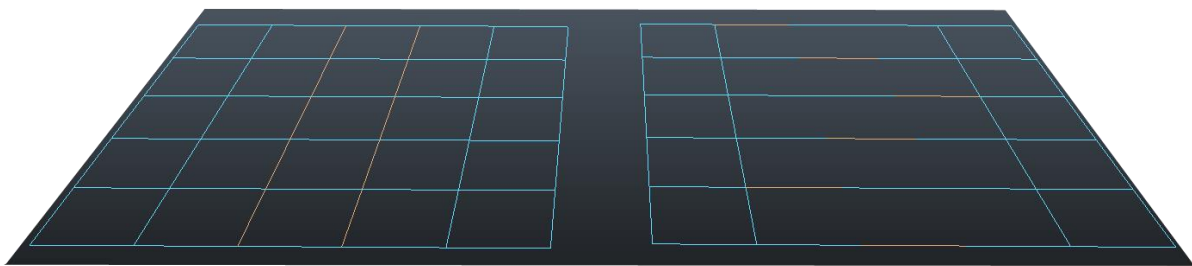


## Edges

Merging an edge is less commonly used and to do so is a very similar technique to that above but instead of selecting a vertex you select an edge *Edit Mesh > Merge Edge Tool* □.

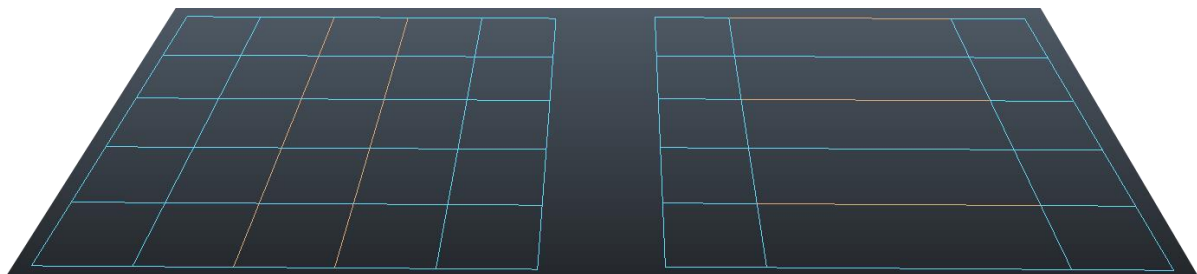
## Deleting a Vertex or an Edge

Polygon geometry is made up of edges, where those edges cross paths you will find vertices and faces make up the gaps in between. By removing a face there are no further implications as the surrounding geometry is untouched. If you remove an edge or vertex there are potentially side effects such as those illustrated below. You can clearly see that if the two long edges are removed along the centre by pressing delete, they leave behind the intersections making one line appear as three.



Broken Lines (Vertex points still)

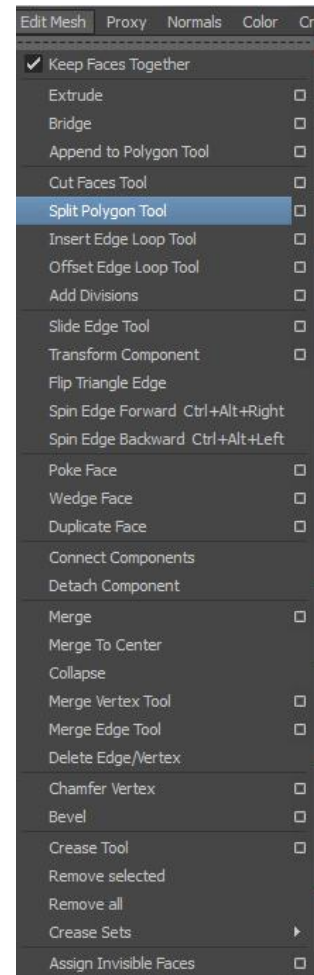
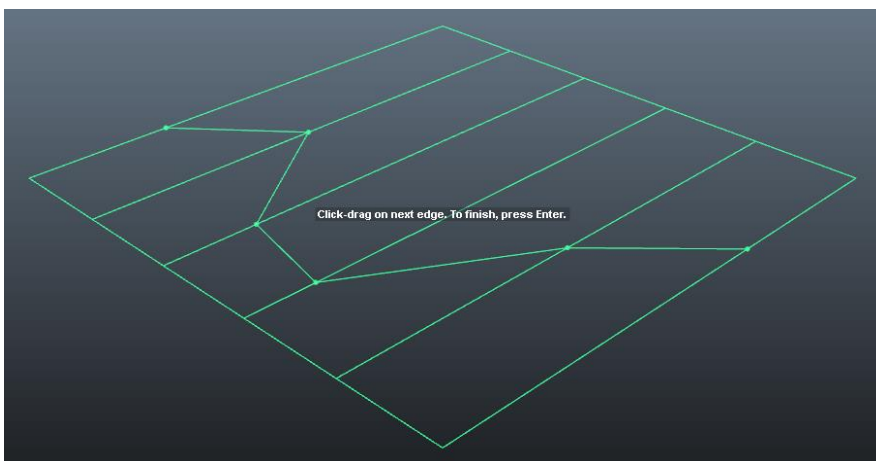
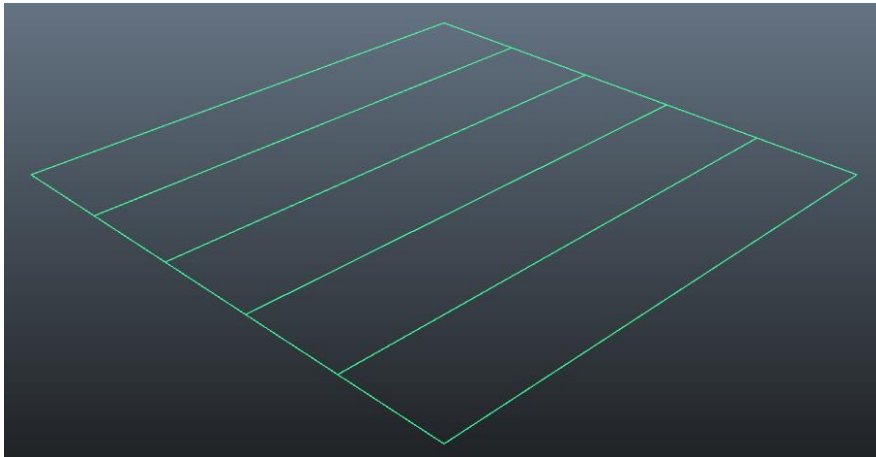
The resolution to the above issue is simple, you select the edges in the same fashion but instead of using the delete key you have to use the *Delete Select Vertex / Edge Tool*. This way you will not leave behind any unwanted geometry, keeping your model as clean as possible.



Complete Lines (Vertex points)

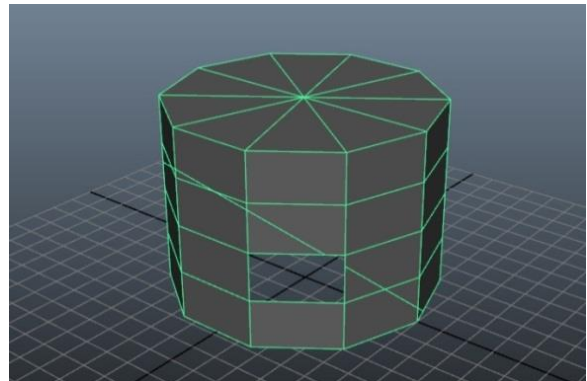
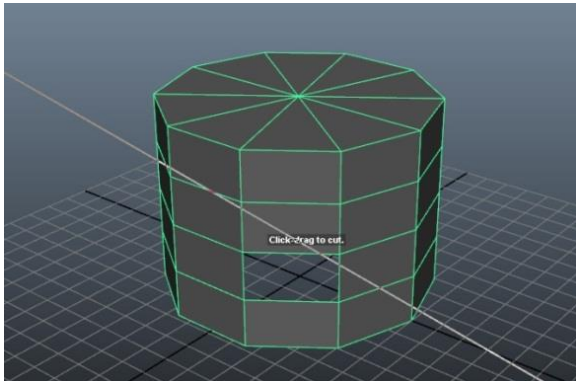
## Split Polygon Tool

This tool is used for splitting individual faces of polygons, often used when altering the topology (edge flow) of any character/model. We will delve further into its uses at a more appropriate time. If you wish to access this tool, navigate to (Polygon Menu Set) *Edit Mesh > Split Polygon Tool*, once you are happy with your split; press the enter key to finalise.



## Cut Faces Tool

This tool quite literally allows you to slice through your geometry paying no particular attention to edge flow, shape sides or holes in geometry:

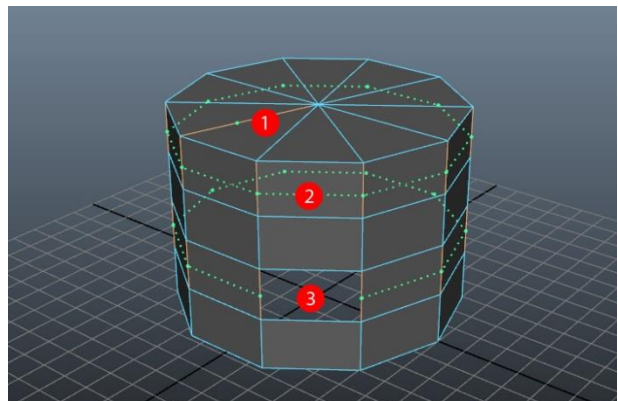


## Edge Loop

An “*Edge Loop Tool*” as the name would suggest adds a complete looping edge around your geometry, whilst taking into account edge flow unlike the “*Cut Faces*” tool. The loop will complete full circle (2) unless it meets one of the following issues:

- Poly face that doesn't equate to having 4 sides (1)
- Geometry ends or vertices/edges may not be joined (3).

**Note:** *If you were expecting it to loop around and it doesn't, investigate the area in which the flow seize to locate your issue.*





## Common NURBS Modelling Tools and Techniques

The initial few techniques (Loft, Revolve and Boundary) involve creating curves then using them to create the required geometry. Therefore before we delve into Nubs familiarize yourself with the functionality of curves and how they need to be constructed.

### *CV Curve Tool*

CV Curves in essence are NURBS Curves with editable *Control Vertices*; each vertex however will not lie directly on the curve, as each of them represents points on a control lattice that encompasses the entire curve. You can however enter Edit Point mode to adjust vertices within the curves *Marking Menu*.

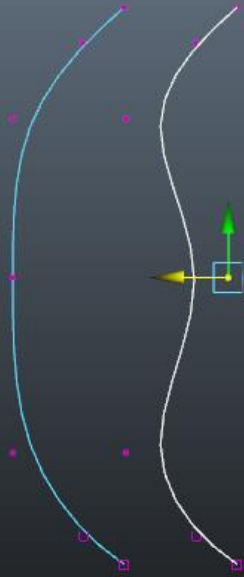
### *EP Curve Tool*

*Edit point* curve tool will create curve points to follow exactly, you can however select CV's within the *Marking Menu* which will then alter the way in which the curve is interact with.

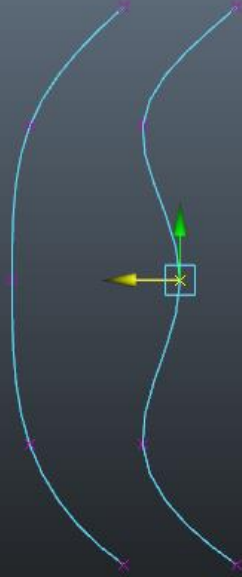
### *Bezier Curves:*

Bezier curves have always been used within Mayas Hypergraph however these have been recently transitioned to the surfaces toolset. Bezier Curves are most commonly used in computer imaging software for smoothing out curves, but gained their notoriety when dealing with vector images as they provide the ability to be scaled indefinitely.

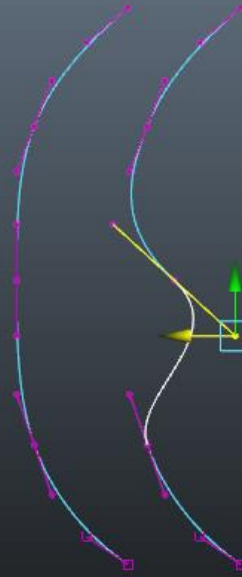
CV



EP



Bezier

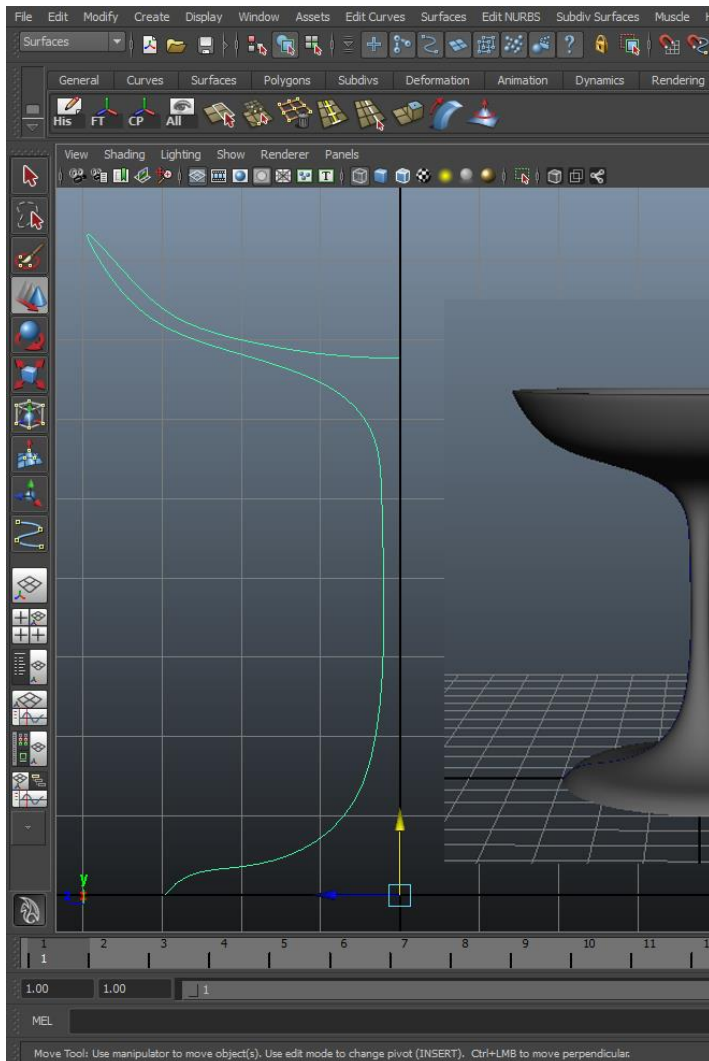


## NURBS & Curves

NURBS (Non-Uniform Rational B-Splines) are very different to your conventional modelling tools; whereas polygons are rigid; NURBS create objects using curves and surfaces allowing for an interactive interpolated surface and are often used to re-create organic objects such as people and detailed mechanical objects. A popular modelling technique using NURBS is patchwork modelling, whereby you create sections of a model separately and joining them at their end (if necessary). They are also used in the early stages of Modelling as they enable

you to achieve a quick and accurate overall representation of your model, to be then converted into polygons where more detailed aspects can be applied. Below you will see a CV curve revolved into a wine glass,

and can hopefully appreciate how quickly some shapes could be achieved using this and similar methods.

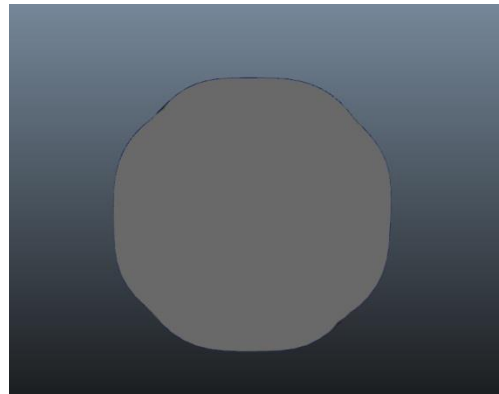
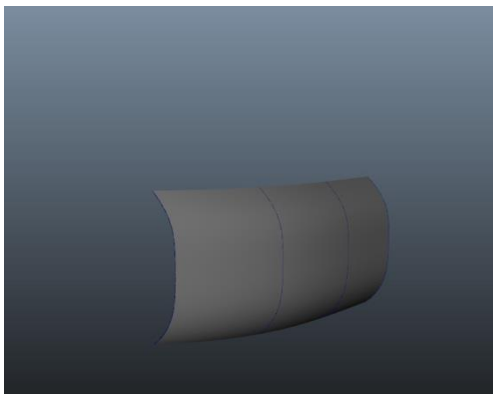
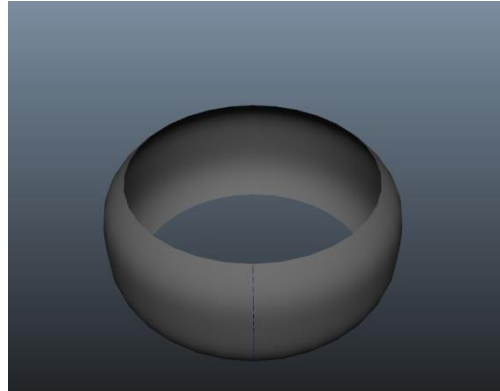


### Creating a Curve

To simply select either (CV or EP) curve, navigate to the Create menu ensuring you are (generally) in an orthographic camera (perspective camera not recommended for drawing curves), and repeatedly click until you have created the shapes outline. It makes for good practice that whenever you have a corner you apply at least 3 curve points to define it.

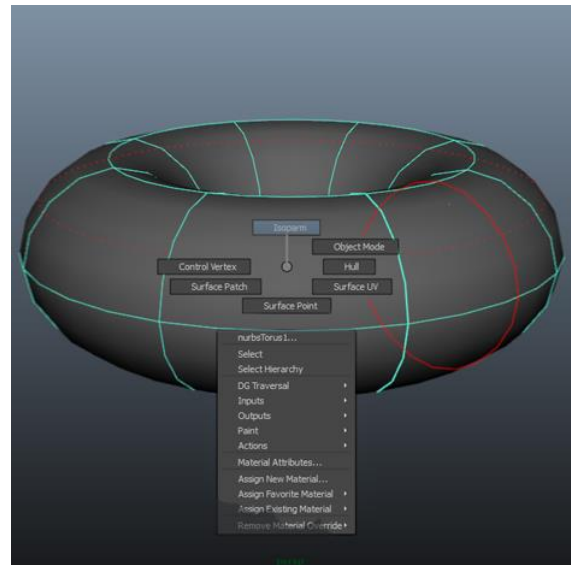
### Loft, Revolve, and Boundaries

These three common techniques all stem from the creation of one or more EP/CV curves with the purpose of creating editable geometry. A revolve will use only 1 curve and in order to create its geometry it will “*revolve*” around its centre pivot (by default this will be the centre of the grid 0,0,0) creating elliptical objects. A loft uses two or more curves to create a surface panel and will subsequently pass through any amount of specified curves which will ultimately define the overall panel shape. The final one is the boundary which requires a closed group of 4 Curves (selected in a clockwise formation), creating geometry within the specified area.



## Isoparms

These allow you to add additional geometric lines providing more control over the specified area. When you have your NURBS shape, hold RMB to enter the marking menu, and “isoparm” (being the top option) will allow you to start placing them. Click on an already existing line to illustrate which curve you would like it to follow (horizontal/vertical) then drag appropriately, holding shift if you would like to enter more than one. To illustrate all pending isoparm placement you will see dotted yellow lines, to finalise the process and insert the isoparms navigate to *Edit NURBS > Insert Isoparms*.



## Control Vertex

The same as a CV point on a single curve, you can manipulate each CV for each curve that makes up a NURBS surface.

## Hull

A Hull is essentially a row or column of CV's that makes up a NURBS surface.

## Surface Point

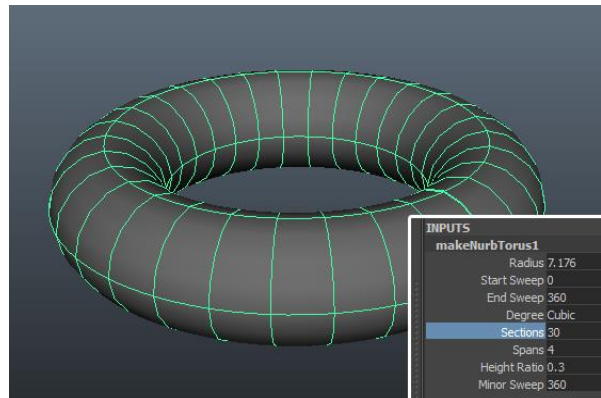
As simple as it sounds, this indicates a specific point on a surface. Although this cannot be manipulated, you can select points on the surface in order to insert isoparm's for example.

### NURBS Primitive Settings

NURBS primitives by default are created with history based on a few common attributes. We will cover the most useful of these below. By creating the object with history, this also means that we can change the settings, such as the radius, even after the objects has been created, moved and modified.

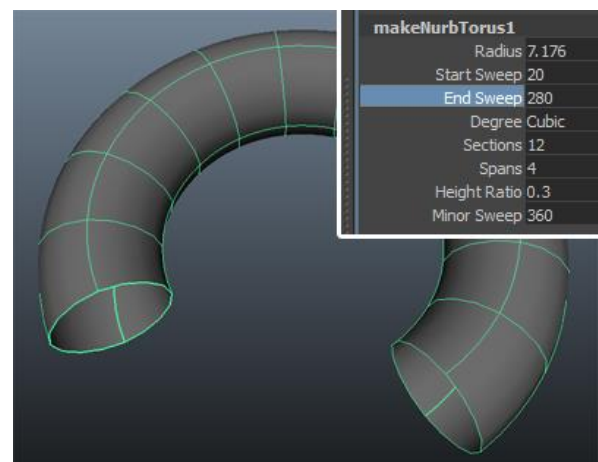
### Sections

Sections are used in spherical objects to control the resolution used; i.e. the number of isoparms to define the shape as demonstrated on the right.



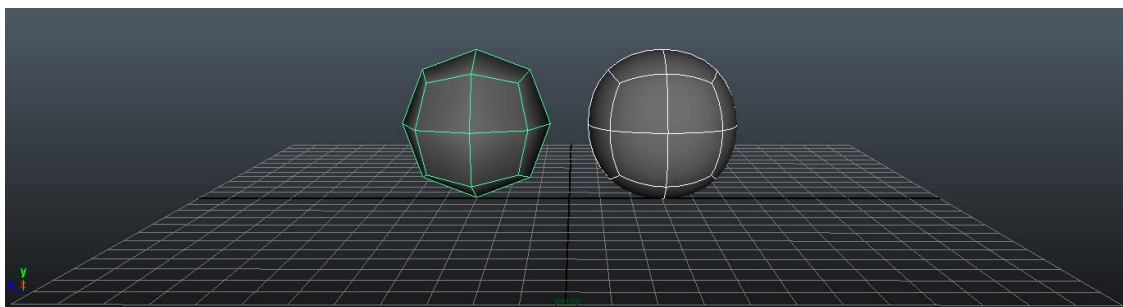
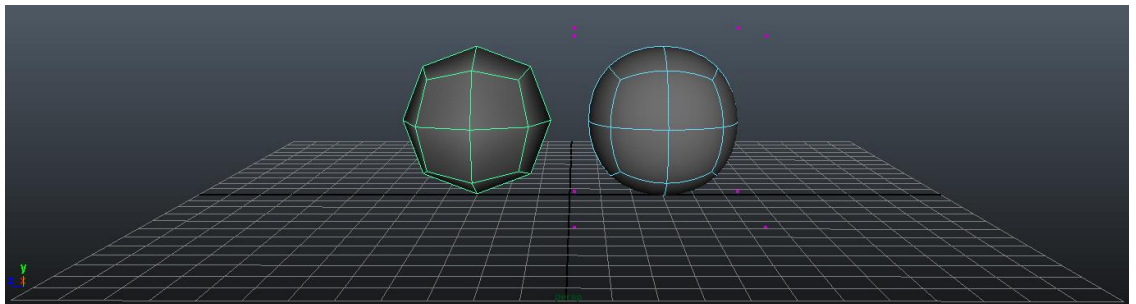
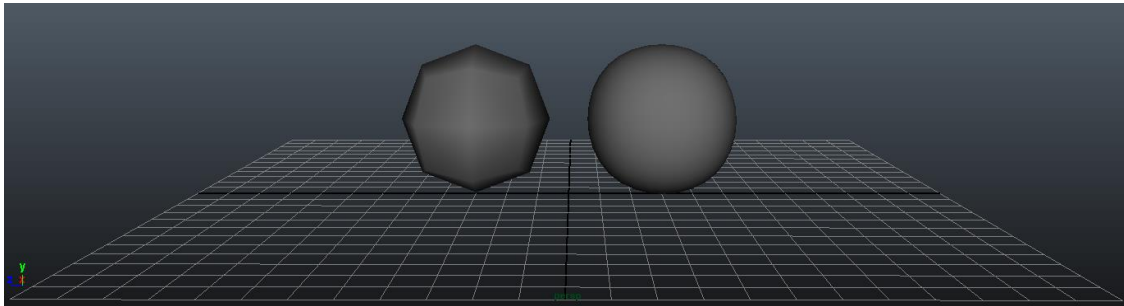
### Start sweep / End sweep

Spherical objects also have start and end sweeps. This is the angle at which the loft that creates these surfaces starts and ends as demonstrated on the right.



## Sub-Divisional Surfaces

At a glance sub-divisional surfaces can often appear to offer the best of both worlds; allowing you access to the simplified polygon modelling form but the manoeuvrability of a NURBS surface, thus making it a popular method for creating organic models. A big advantage is you can work in hierarchies from "0" (Base level) upward, but it's wise not to enter above level 2-3 if you wish to convert to polygons at any point. You have fewer vertices to manipulate the object but the hierarchical structure provides you with the ability to add detail without adding geometry, but they are not without their limitations. You will notice a vast reduction in tool set in comparison to polygons, but the biggest discrepancy of this method is undoubtedly the increase in render time, some results may be worth the increase but if you have a busy scene and limited time it could be worth considering converting them to an alternate form.



## Render Layers

Similar to the above organisational structure this feature allows you to split up your renderable objects onto various layers or what is often referred to as render passes. Rendering in layers is an essential tool especially when it comes to the compositing stage as we will discuss in greater depth

Layers give you a visual hierarchy which is useful in all areas of animation. This can be used to minimise the geometry in the scene, hide the rig etc.

### How to use the outliner:

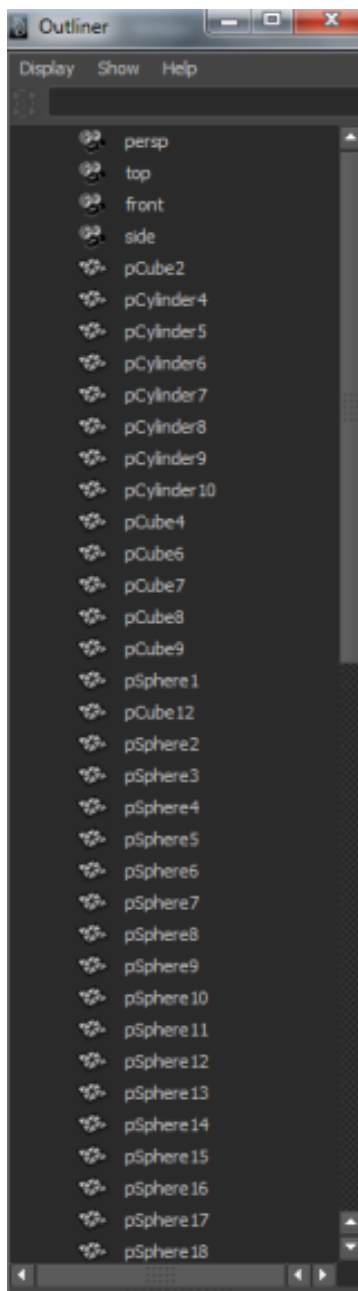
Task	Details
How to access	<i>Window &gt; Outliner</i>
Select a node (object)	LMB click on the node
Select multiple nodes	LMB drag selection or Ctrl/Shift+LMB
Create a group node	Select group contents then press Ctrl+G
Reorganise objects between groups	MMB drag the node to the desired node
Remove a group	Highlight group and Ctrl+Shift+G
Parent a node to another	MMB the child under the parent
Un-parent a node	MMB the child away from the parent
Name / Rename a node	LMB Double Click, then type in new name



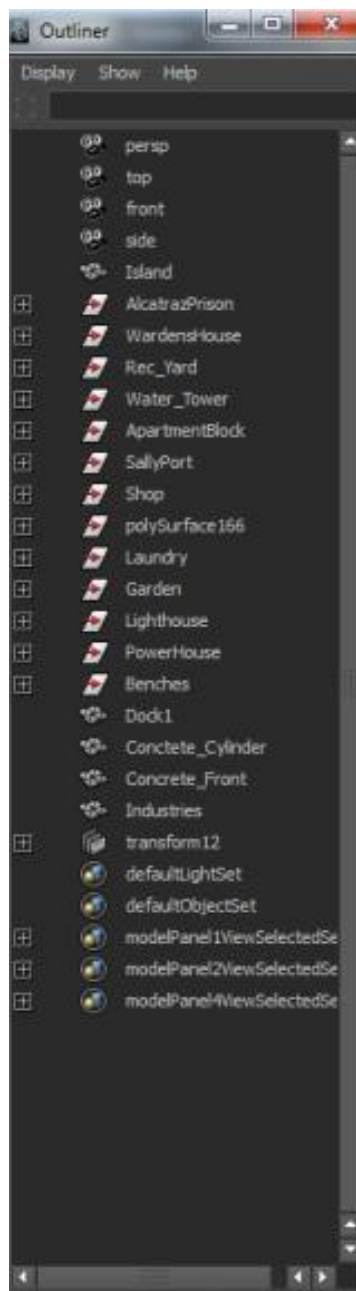
As a continuation from the introduction chapter on page 32, the outliner will help you to ensure you're organised and structured. Initially this may seem pointless and mundane but by using simple naming techniques and hierarchies like those demonstrated below it will prove invaluable to you and colleagues as you progress towards more complex scene files.

The below examples are taken from the same scene, hopefully you will understand why we are stressing the importance of this aspect.

Untouched



Organised



## Image Planes

Image planes can be very useful at the modelling stage; they allow you to keep the model accurate to their original drawings and maintain consistency throughout. An excellent website for acquiring these for free is [www.the-blueprints.com](http://www.the-blueprints.com) here you will be able to download image planes for vehicles, electrical items, weapons, and various other miscellaneous items.

On the other hand if you are solely working on a project as opposed to within a client based production team you may find it easier to have a few reference images of similar models, then use them as well as your creativity to model something truly original.

## Image Plane Setup

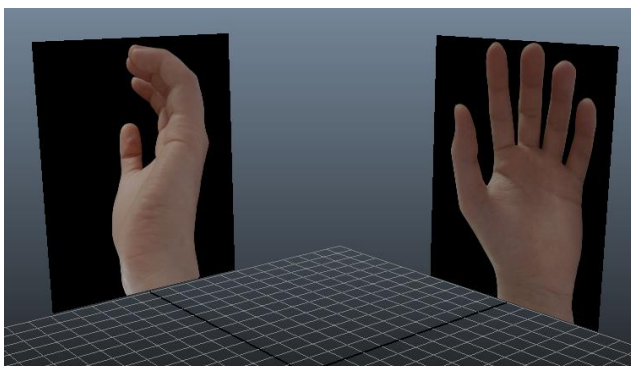
**Note:** *If you need assistance with preparing an image plane in Photoshop for use in Maya please refer to page 109*

Once your image has been prepared we will be looking at two methods of setting up an image plane.

### Importing an image onto a plane

1. Create polygon Plane
2. RMB > Click and drag down to Assign new Material > Lambert
3. *Common Material Attributes > Colour > Chequered box > File > image name* (select file by clicking on the folder icon)

**Note:** *you may need to alter the UV settings (pg 81) or update the size of the image plane (Attribute editor > PolyPlane > PolyPlane History > width/height), to replicate exact dimensions.*



## Importing an image onto a camera

For good practice you can set up new orthographic cameras to hold reference image, however this comes down to personal preferences. To set up new cameras:

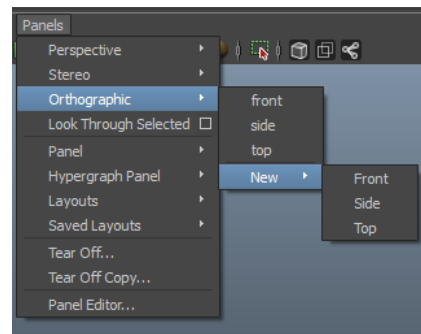
**In view pane:** *Panels > Orthographic > New...*

1 x Top (bottom may be required in some circumstances)

1 x Side (only 1 pane is needed for symmetrical models)

2 x front (you will need to rotate one of these 180° as well

as adopting a suitable naming strategy [Img\_Front, Img\_Rear etc.).

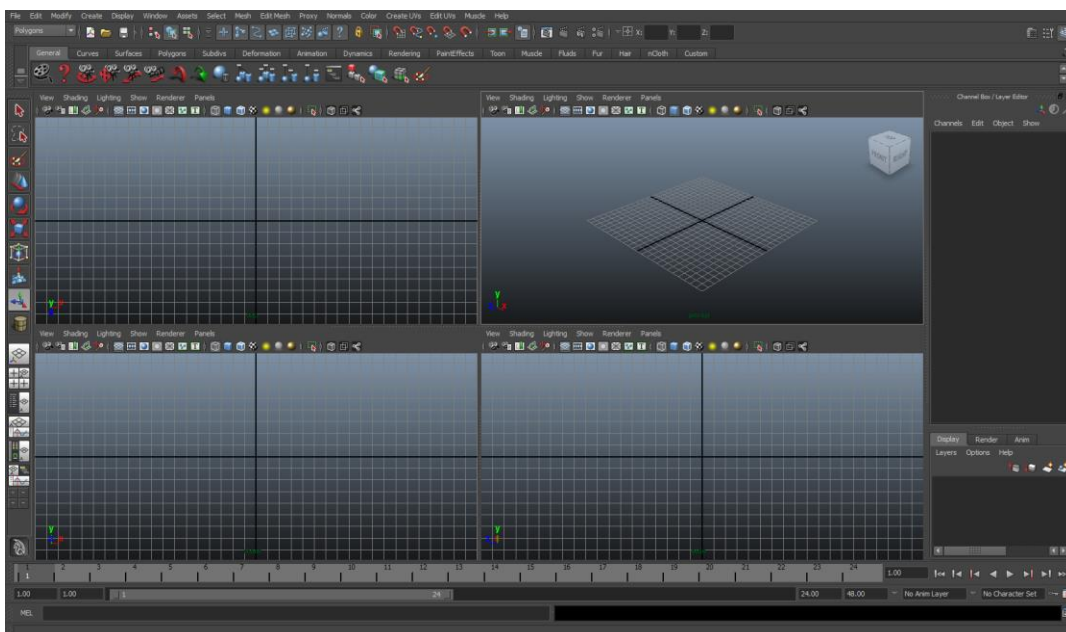


**Import your images onto the camera:** *View > Image Plane > Import Image*

at this point in the attribute editor check the *looking through camera* option as opposed to "all views" (you might want to do this bit last so in the perspective view you can see the theory behind what happens next.

**Change 2 viewpoints to the new front and rear cameras (leaving the persp cam):** *Panels > Orthographic.... (Select Cam):*

By doing this you should have a similar setup to before, only some of your viewpoints are the new cameras



*View > Image Plane > Image Plane Attributes... Placement Extras > Centre...* (Adjust the value in the last box (Z axis) to conflicting values one as 20, and one -20 (this may need to be adjusted depending on your grid size).

### Summary

What this has effectively done is put a camera and image plane on either side of the grid. You will now only see the relevant image planes from the appropriate camera.

### Anatomy and Physiology

Having an understanding of the basics of anatomy and physiology will undoubtedly assist you when it comes to creating your own characters; as allowing your edge flow to mimic human muscle structure is pivotal if you wish to achieve true to life deformations.

You should research anatomy images and pay particular attention to muscle structure if you want to achieve realistic deformations.

### Tips before we begin Modelling Anatomy

- Ensure you feel comfortable with the basics of polygon modelling as terms such as, extrude, merge, combine, and edge flow are used but not explained in this area of the book. Please refer to pages 49 - 59 for more information.
- Familiarise yourself with the physiological makeup of the particular aspect you wish to model, as it will help you pre-visualise edge flow.
- Having the correct edge flow from the outset will reduce the need for the split polygon tool.
- Remember that image references for organic models may not always align perfectly like you can often get with blueprints. Therefore be aware of variances in angles, size and perspective; using them only as a guide to help maintain overall consistency.
- Have real life images at the ready, if you're using dual screens; plaster one side with reference images, as they will all assist you.
- Remember once you have your base humanoid mesh you can manipulate this to adhere to the requirements of your specific model proportions (i.e. gangly arms)
- Remember when using polygons, to use your smooth preview (using numbers 1,2 or 3) to help pre-visualise your model you can model in any mode but we would always suggest referring make to the base mesh to "keep thing tidy".

Finally and possible one of the key points in modelling **Keep the geometry as low as possible for as long as possible.**