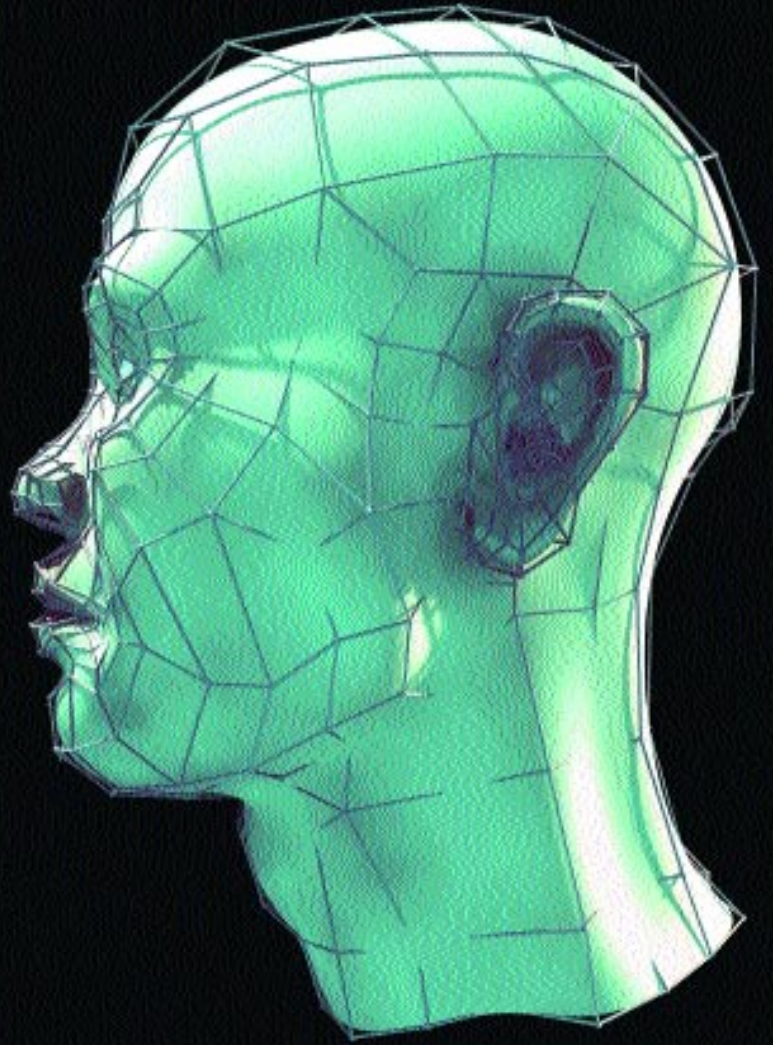
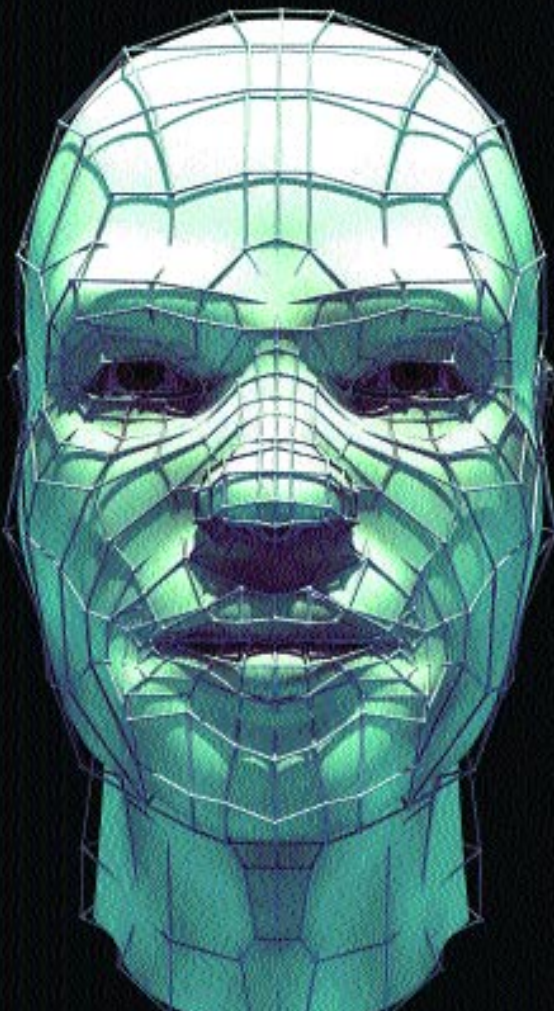
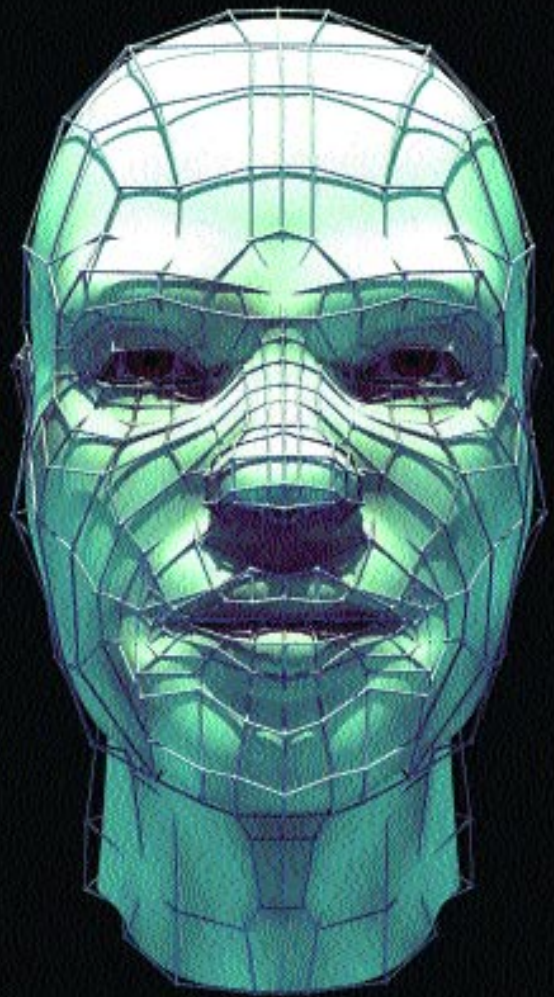
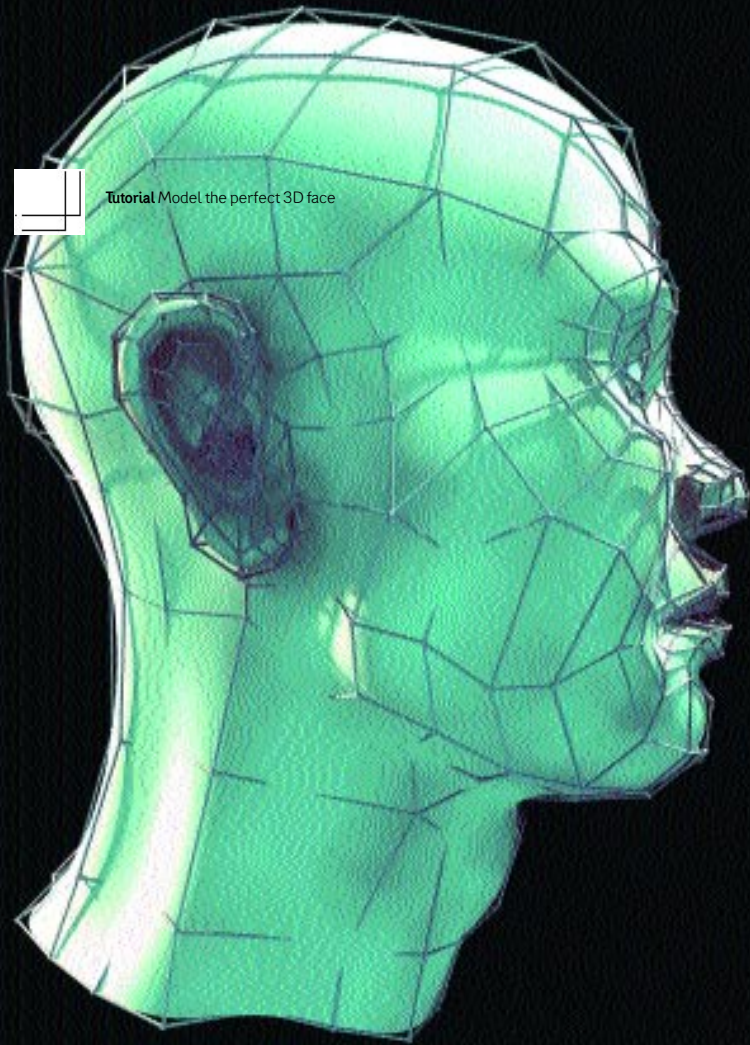


Tutorial Model the perfect 3D face



Model the perfect 3D face

Want to get your head around 3D modelling? We use *Maya* to show you how to build an animatable face feature by feature...

There are many ways in which to model a head in 3D. In this tutorial, we'll look at polygon modelling with subdivision smoothing for mesh refinement. This approach enables you to create the topology of the face mesh in a very direct and hands-on manner. With NURBS modelling, creating a human head can be problematic, and the best method involves stitching multiple surfaces together. This takes an awful lot of planning and isn't a method you can jump straight into. Polygon modelling enables you to correct mistakes more easily.

Correct topology (the way a surface is structured) is the single most important aspect of head modelling. We'll be creating special topological structures, known as 'edge loops', which outline areas of the face and mimic the rings of muscle under the skin. Without proper loops, a head will be difficult to animate. We'll also be making sure all the polygons have four vertices (called quads). A mesh of all quads is less likely to pinch when smoothed and animated.

Although this tutorial uses *Maya*, the principles employed are applicable whatever app you use.



DOWNLOAD
Click here to download the files you need to complete this tutorial



Expertise provided by Simon Danaher. Simon is an acclaimed 3D artist and writer. He has worked in 3D for over seven years and has written several books on 3D and 2D graphics, and is currently working on another. You can contact him at [\[e\] simon.danaher@ntlworld.com](mailto:simon.danaher@ntlworld.com)

Part 1: Initial features

Create a cage mesh in *Maya* and begin modelling the mouth...

Material changes

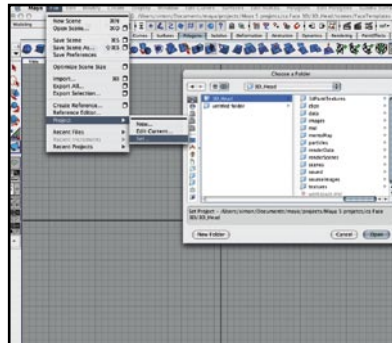
You can change the material to green so it's easier to see. Set the material properties and apply materials to objects using the Hypergraph in *Maya*.

Writing scripts

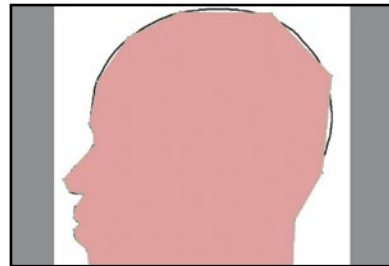
You can also create two scripts to change the visibility of the layers on which the proxy and smooth meshes appear as well as the transparency of the surface of the proxy mesh. This enables you to switch between the low-res cage and smoothed versions of the model as you work with a single click.

Using outlines

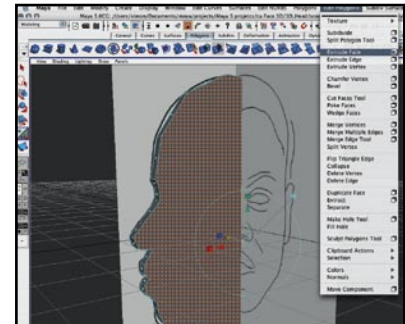
The main reason for the outline is to provide some sort of guide. Without experience, it can be hard to model a head in 3D from scratch. Starting with an outline can help, but it's not essential.



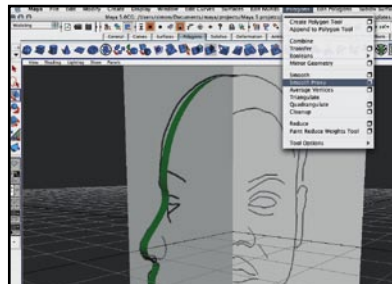
1 Copy the directory called 3D_Head from the download to your hard drive. Set this as your current project (File>Project>Set...) then open the scene file FaceTemplates.mb.



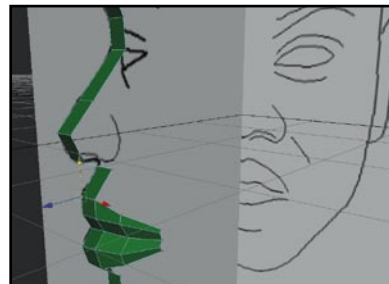
2 Switch to side view and enable textured display (key 6). Now trace the outline of the head using a single polygon. In *Maya*, use the Create Polygon tool (Modelling>Polygons>Create Polygon Tool). Click around the outline to make the polygon, and hit Return to finish. Don't place too many points yet – just make a rough outline. Remember that this will be a cage not the smoothed surface.



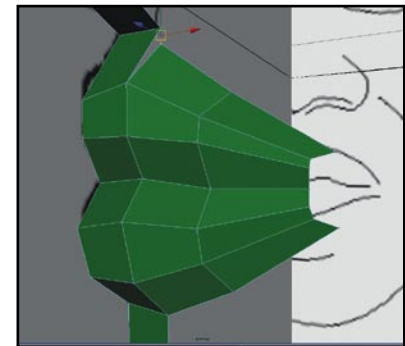
3 The face that's created is selected and extruded slightly to make a band of quad polygons right around the face. In *Maya*, use the Edit Polygons>Extrude Face command and drag the z handle to the desired distance.



4 With the face still selected, press Delete to clear it. Repeat for the face on the opposite side. Switch to object mode (right-click>hold or press F8 until the polygons turn green) and then use Polygons>Smooth Proxy. This generates a subdivided version of the cage – if you're using another app, apply its own subdivision surface option. The cage mesh is saved as Outline.obj.



5 Begin with the mouth. First, adjust the positions of the vertices so they match the template better, then select four edges that define the lips and extrude and adjust them to also follow the template. Repeat this to form two extra polygon segments for the lips. Since not all 3D apps handle edges in the same way, use whatever tools you see fit – it's the mesh topology that's important here.



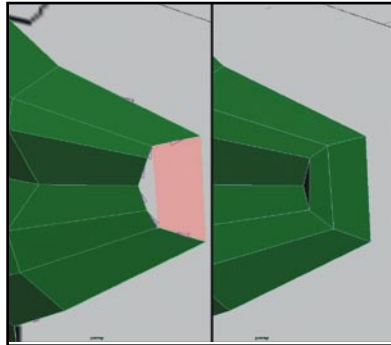
6 It's now time to create the first loop. You need an extra row of polygons above and below the lips, so add these by using Extrude Edge in *Maya*. Join any hanging points to the rest of the mesh using Weld or Merge Vertices.

Part 2: Creating loops

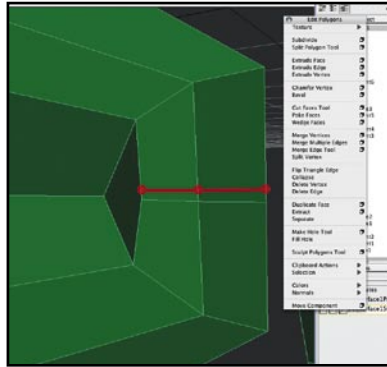
You'll need to use edge loops to mimic muscles under the skin. Without these, the head will be hard to animate...

Workflow considerations

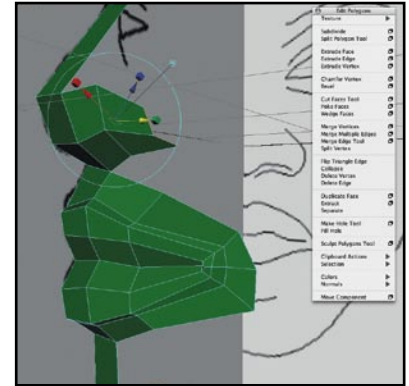
In reality, you might be better off fixing the lone triangle in steps 1 and 2 later when you add more detail to the lips. The reason we've suggested you do it here is to show you the workflow sooner rather than later.



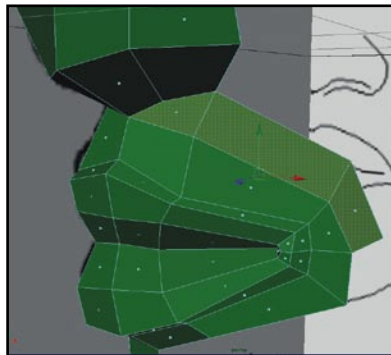
1 Create the first loop at the corner of the mouth. Here, the outer row of polygons is connected to the lower row by a single quad polygon to create a ring. Another ring is formed for the lips themselves. Finally, you're left with a triangle, which you'll have to fill in.



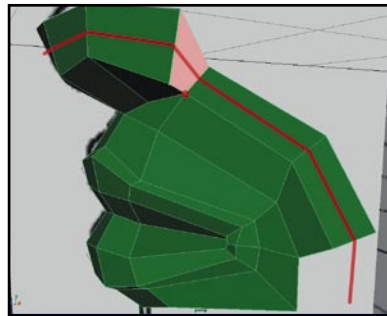
2 This isn't a problem. Use the Split Polygon tool in Maya to draw a cut through the polygons you've just created up to the triangle, converting it into a quad. You simply need to move the point so you can see it better.



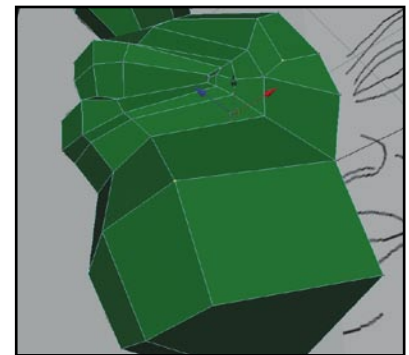
3 Next, work on the nose area. This is often a tricky part, especially in the area where the nose and cheek meet. Two of the nose edges are extruded twice here.



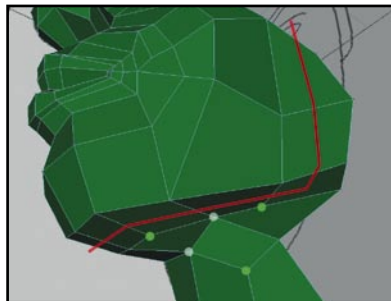
4 Join the nose edges to the upper lip by creating three extra polygons in between, and then join them to the upper lip. Notice that refinement is also continuing on the mesh – an extra loop around the lips has been added to define the edge. As long as you have closed loops, it's easy to add extra detail like this without creating triangles or n-gons.



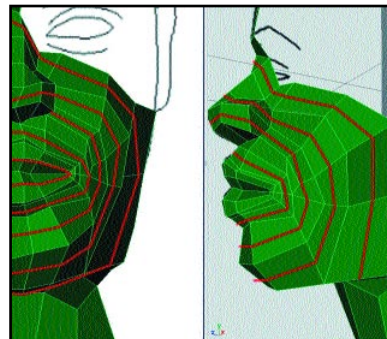
5 Extrude the edges up again creating two more polygons. Join these to the nose junction using the Append to Polygon tool in Maya. This is an important joint in the topology because it marks a change. Note that the highlighted point has five quads connected to it. This enables a loop (highlighted in red) to continue up over the nose while accommodating the extra polygons for the nostril area. The cage object is called FaceNose.obj in the download.



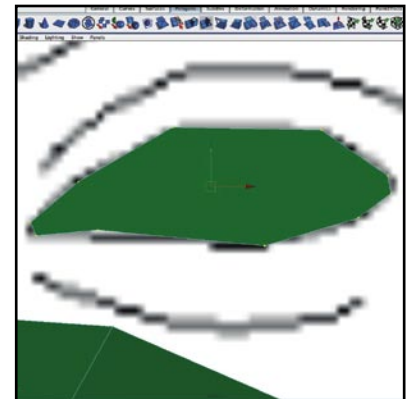
6 Fill in the chin and cheek area economically with polygons. There are ways to stop a loop or redirect it to help keep the mesh optimised. The red dots indicate vertices that are connected to only three polygons. This is another kind of junction, one that enables you to reduce the mesh – its topology is like the corner of a cube and helps to fold the mesh around corners.



7 To create a strong jawline you need to concentrate on the mesh and begin a nice one-shaped loop that runs beneath the chin and up the side of the jawline. This will eventually connect to the eyebrow region, closing the loop. Note the path of the polygons in the loop and also the five (white) and three (green) quad junctions in the mesh which have been created in the process. This is saved as ChinJaw.obj – you'll find the file in the download.



8 Take a minute to examine the mesh. As you can see, there's a nice array of loops following the features and muscles of the face. However, there are one or two problem areas. The corner of the mouth will need looking at later, as will the radial edges perpendicular to the loops. These can be dealt with when we add more detail.



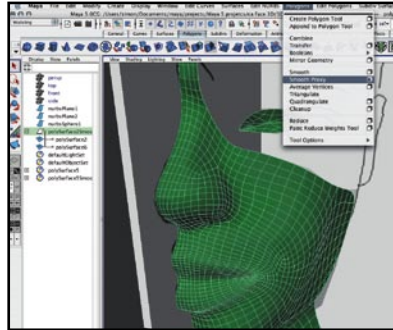
9 Use the Create Polygon tool to trace the outline of the eye opening. We've used ten points in total – notice that the corners both have two points not one.

Part 3: Adding the eye

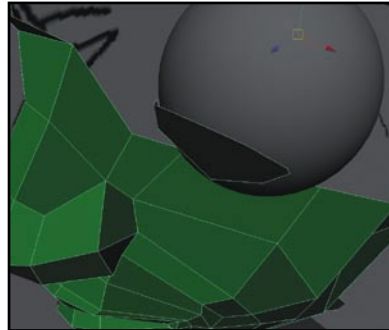
Position an eye socket, create some loops and weld it to the mesh...

Strange shading

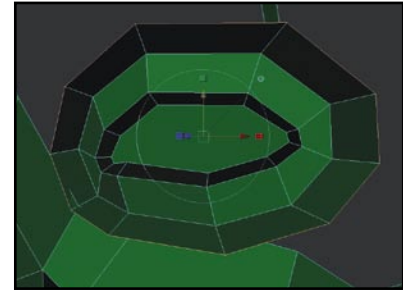
Occasionally, you might have to align the normals of the mesh if its shading suddenly looks odd. Use Edit Polygons>Normals>Set To Face to fix most problems. You can also run the Polygons>Cleanup command to fix problem geometry.



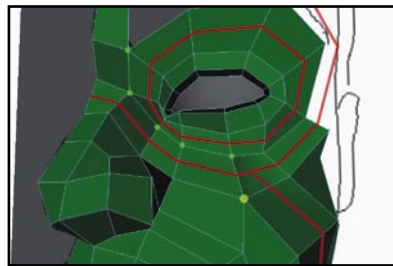
1 Before you start to combine the eye with the rest of the face, first select and delete the smoothed surface, leaving just the cage. Select the face and the eye objects then use Polygons>Combine. Reapply Smooth Proxy to the resulting mesh.



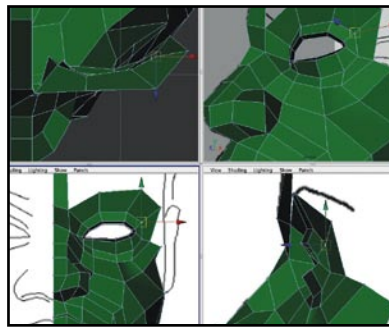
2 Add and position a sphere for the eye. This is just a stand-in to enable you to move the points of the eye polygon to the correct location – a better eyeball can be modelled later if you wish. Select and move the vertices of the flat eye polygon so they just touch the sphere.



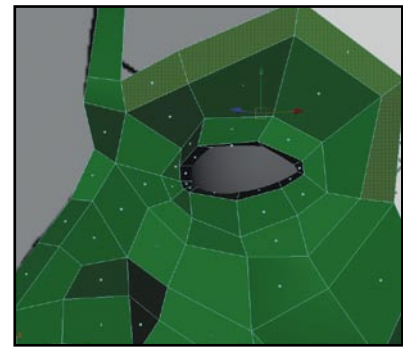
3 You then need to extrude this polygon outwards to make a ring of polygons around the eye. In some apps, such as Maya, you can just extrude the edges instead – both methods work well. Repeat the extrusion process until you get three loops around the eye. If using the polygon extrude method, you can now delete the central n-gons, leaving just the loops.



4 The eye socket is connected to the rest of the mesh by selecting and welding the vertices (green dots). Notice that we're creating concentric loops around the eye, plus one loop that goes over the bridge of the nose and up over the brow. In order to join these smoothly with the rest of the face, a five-point vertex junction is used (yellow dot). This creates a branching loop, which continues down around the mouth and jaw area.



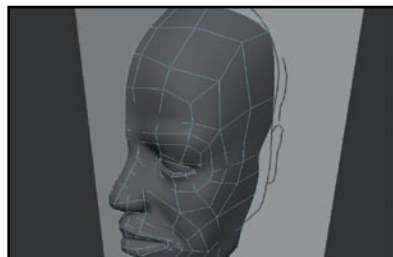
5 Hiding the sphere and activating all four views, move the vertices to match the template. There are no real rules for this – you just need to practise working with a mesh and try to build up the volume of the face in 3D. Using photo references or a mirror will help with this process.



6 The nose-eye loop is finished by extruding the edges above the eye socket and welding the end points back into the rest of the face. The large thin forehead polygon has been split to supply a vertex for welding the brow polygons to.

Part 4: Building the skull

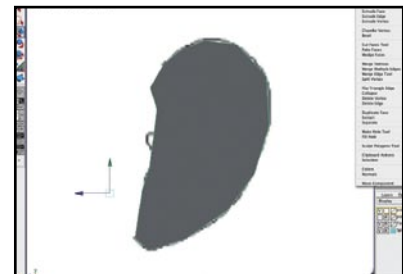
You won't need many polygons for the skull, but creating the ear is an intricate process...



1 Now you need to extend the brow to create the skull, where the polygon density is thinned out. You need few polygons here because the skull is not as detailed as the face. The vertices are edited and the smoothed mesh is previewed. Note we've cut in an extra set of edges running from the inner edge of the eye around the temple to help sculpt this area. Maya's Split Polygon tool is ideal for this. The cage is called Brow.obj in the download.

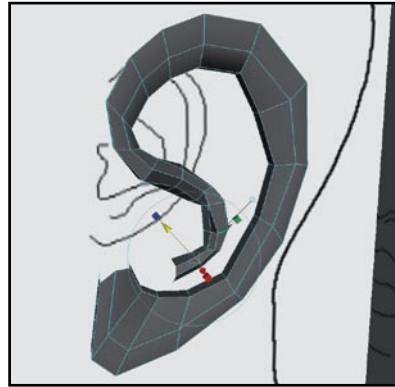


2 The rest of the skull should be completed using similar techniques. Again, pay attention to the bones, tendons and muscles under the skin, though if the character is going to have hair, you won't need to be too particular with the topology of the skull itself. As you can see here, it's by no means perfect, but should be fine for most situations.

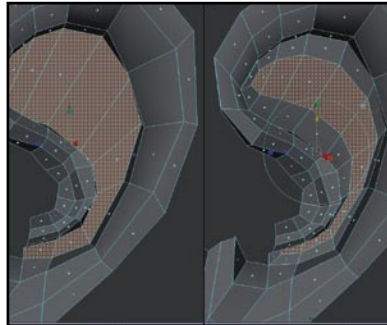


3 Model the ears as a separate object. Begin by tracing the outline of the ear in the template using the Create Polygon tool (or similar) to make a single n-gon. This is moved to the side of the head and then the polygon is extruded outwards, inset twice and then extruded back in again to create a section of polygons for the edge of the ear. The centre n-gons can then be deleted.

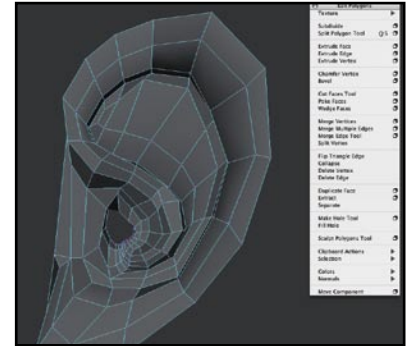
Part 4: Building the skull continued...



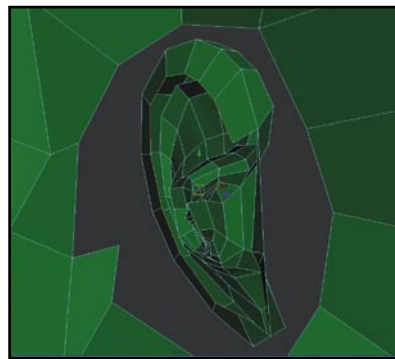
4 Delete a few of the polygons at the front of the ear, then extrude the free edge a number of times, moving and rotating it at each step. This creates the curled inner portion of the ear.



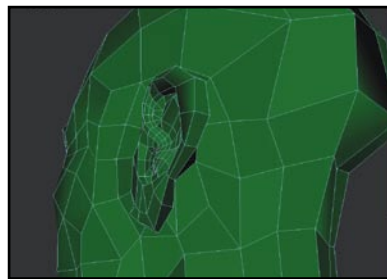
5 Close the open section inside by creating polygons between the edges, making sure they're all quads. In Maya, use the Append Polygon tool and click on opposite edges to create each quad – hit [y] to reactivate the tool. Select the quads and extrude them inward, then move them slightly to create the hump inside the ear.



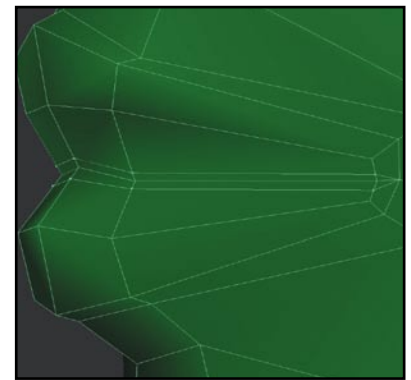
6 Using the same technique with which you began the ear, create an n-gon where you want the ear-hole to be then extrude it inwards a few times moving and rotating as you go. Next, sculpt the ear some more and create the remaining border polygons.



7 Around the back of the ear, select the outer edge and extrude inwards ready to connect it to the head. Some junctions will need to be created for this. A combination of Split Polygon tool, Append Polygon and Merge Vertices is good for constructing this part of the model.



8 By connecting one edge on the ear perimeter to the next-but-one edge, you create a quad that has the effect of reducing the resolution around the perimeter of the ear. Two or three of these should do the trick. This enables you to connect the ear to the head with less of a chance of encountering triangles. You'll probably spend quite a while on this part, because it requires perseverance. If triangles are unavoidable, that's fine – this section of the head hardly moves if animated.



9 The final steps involve cutting in some details. Maya's Split Polygon tool can be used here to add geometry to the lips. A loop is created around the centre edge – triangles are created at the corners but we'll get rid of these soon.

Part 5: Final steps

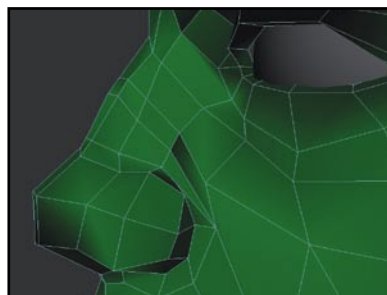
Refine the model and duplicate it to see the full effect of what you've created...

Reading meshes

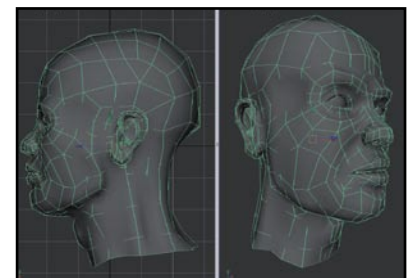
The ability to read a mesh is a skill that you'll acquire as you create more 3D models. You'll soon begin to recognise common topological patterns and gain an instinct of how to cut them or clean them up. As with most things, this skill comes only with practice.



1 Delete the centre edge, leaving a single row of quads. These can then be extruded inwards twice to create the inside of the mouth. The corners of the mouth need a bit of work to remove the triangles and create a cleaner loop of quads. Edges can be cut in under the lower lip to facilitate this and make the result much cleaner.



2 Detail can be added to the nose so that you can create the tight folds around the nostrils and cheek. As you cut in extra edges, you'll find triangles unavoidable. One trick is, if you create a triangle by slicing a quad, create another triangle straight away after it. By removing the edge between the two triangles, you leave a quad.



3 Refining the rest of the model is really just a matter of time, patience and experience. The more you do it, the better you'll become. As we've modelled only half of the face, all we need to do is select the whole model and run Polygons>Mirror, to duplicate this side of the face. Increase the Poly Merge History attribute in the polyMergeVert node to weld the seam. **ca 7**