Polygonal modeling in Maya

Introduction
Polygonal modeling is the simplest method of representing solids and surfaces on a computer. The fundamental element is a vertex, which is a defined point in 3D space, represented by three rational numbers (x, y, z). Two vertices can define an edge, which is a straight line between them. Edges are vectors – in other words, they have direction from one vertex to the other. Three edges define the simplest kind of face, which is called a polygon. A three-sided polygon is always flat, faces one way (defined by its normal), and is called a tri. Faces can also be made of four edges (called quads) or have more than four sides (called n-gons). There is a basic video review of polygons at https://youtu.be/-bZ7gstlWyl.

However, polygonal models are faceted – that is, they’re made up of flat surfaces. They don’t have a real curvature and so are not suitable for defining smooth curved surfaces. For that you have to use another type of computer model called a NURBS surface; we’ll look at those later. Maya is unusual because it can make polygonal and NURBS models; most 3D programs do one or the other.

Setting up the scene
We’re going to model accurately in inches, so the grid must be set up in these units. Go to Display – Grid and click on the square. Make the Length and Width 1 unit, with grid lines also every 1 unit. These will be feet. Make the subdivisions 12 (inches) and choose colors that work for you for the Axes and Grid lines/numbers. Finally click on the radio button at the foot of the dialog box to put grid numbers along the edges of the orthographic grid (keep the perspective grid numbers hidden).

The polygonal model
Define your project, then make a Maya scene. Use Create – Polygon Primitives – Cube in the menu, and click on the square to the right of the option so that you open the options for the cube. Define the width (X) as 8.00, the height (Y) as 0.25, and the depth (Z) as 4.00, then define the width divisions as 5, height as 3, and depth as 5. Then click on Create. The table top will be made at the center of the scene – that is, its origin point will be located at 0,0,0. You should get something like this:

Note that X axis symmetry will probably be enabled. You can tell by looking at the menu bar; if it’s active then Object X will be shown in a blue box. Click on the arrow left of the name and choose Off.
Instead of making separate objects for the legs, we're going to extrude them from the underside of the table, but first we need to name it. With the table selected – it'll be outlined in green as above – click on the Attribute Editor tab on the right side of the screen. This shows the properties and the history of the object. Choose the polyCube1 tab (on the left) and in the box next to Transform change the name to a_table. The pCube1 tab name will change to a_table and the pCubeShape1 tab next to it will change to a_tableShape. Note that you can't begin an object name with a number, though the name can include or end with one. The initial letter is to allow more important objects in the scene to be at the top of alphabetically sorted lists.

**Extruding the legs**
Go to a perspective view, right click over the table, and go to Edge mode in the Marking Menu. We're going to move the edgeloops to make better proportioned and positioned leg bases. An **edgeloop** is a series of edges that flow end to end into one another; often these will go around a polygonal model.

First go to a top ortho view and then double-click on an edge that is second from one end or side of the table (single clicking selects the single edge) Double clicking selects the entire edgeloop which will turn red. Next enable Grid Snapping as left.

Zoom in to the end of the table and move the edgeloop to 2” from the end of the table. Move the next one 4” from the first, or 6” from the edge of the table. Now move the four horizontal loops (as seen in top view) to also be two and six inches from the edges of the table. Your table top should look like this:

Go back to a perspective view and look at the underside of the table. Change to Face mode. Shift-select the four 4” square faces like this:
These will form the tops of the legs. **Extruding the legs**

Hit Ctrl+E to extrude the legs; enter 2.5 in the Local Translate Z value box in the small polyExtrudeFace1 options panel – 2.5’ is 30”. You will have a simple table shape like the one below:

We’re viewing this table in polygonal mode, which is chosen by hitting the 1 key. Now hit 2 to see the table in subdivided mode but still showing the polygonal cage.
This looks very different! The polygonal model we just made is now the control cage of a subdivision surface. If we want to see just the subdivision surface without the cage, hit 3. Go back to viewing it in Object mode (right click over the table) and use 1 to see it with the control cage. Then go to the a_tableShape tab in the Attribute Editor. Open the Smooth Mesh panel and increase the Preview Division Levels to 4.

Look at the table from an oblique side view so that you can see all four legs, like the view at left. We need to sharpen the transitions between the legs and the top. You’ll notice that the top already has subtle rounding, though we may refine that later.

Adding Edgeloops to sharpen the legs
Take the model to Edge mode. Go to Mesh Tools – Insert Edgeloop. Add two edgeloops to each leg, one close to the base and one close to the top; don’t worry about their exact location for now. You can see that these sharpen up the transitions between top and legs.

Now go to a side view and hit 4 to see the table in wireframe, then 1 to see just the control cage. Double-click and then Shift-double-click on the four edgeloops at the top of the legs so that they’re all selected, then use R to scale them to zero on the vertical Y axis. Then use W (the Move tool) to move them close to the top (you may want to turn off Grid Snapping for this).

Do the same for the four edgeloops at the bottom of the legs to give them a slight radius into the base. When you’re back in Object mode and the table is deselected, it should look like this:
Now try making a chair using the same techniques.

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