Polygonal Geometry

A model is anything in your 3D software package that is constructed of geometry. Shapes are what rule the world of modeling, from the most detailed Pixar characters to the most basic of iPhone games. The one single important shape that is the building block for all others, the atom of the 3D geometrical world, is the triangle.

A triangle is a shape with with three sides. In 3D graphics, we call this a polygon. A polygon is any multisided object that consists of triangles, which is the basic building block of all 3D shapes. The components of the polygon are:

1. Vertex: The most important aspect of a polygon, the vertex is a point in space that has coordinates. These points in space are connected and create the objects you see.
2. Edge: An edge connects two vertices together.
3. Face: The face is all of the space in between the connected vertices. This is what is turned into pixels and displayed on your sreen
4. Normal: the normal is the perpendicular, or 90-degree angle to the face. The normal is a derived value, or something that changes because of the positions of the of the other sub-objects.

The polygon could not exist without all of them. We can transform them each using translate, rotate, and scale. Only the vertex, however, will move independently; the rest are dependent upon their connected vertices. This is why a good modeler or digital sculptor, will mostly do transformations at the vertex level . An edge requires two vertices, a face requires at least three vertices. A vertex however requires nothing but itself.

Triangulation and Polygons

Everything you see that has been created in 3D at one point is broken down into triangles. The reason for this is that the computer does not understand anything else in terms of 3D graphics. In order for any object to be displayed on your screen, it must be broken down into the simplest element possible, which is a triangle. Even when you have quads, which are four-sided polygons, they are being broken down into triangles. Triangles ruin visual directional flow. It is very hard to work with only triangles, so modeling is generally done in quads when possible. We prefer to keep all geometry in 3D to three or four sides per polygon. This is known as good topology. Although we want to work strictly in quads if we can, sometimes we have to use triangles to close off shapes properly. However, we never want to have polygons with more than four sides it we can help it. The only time where it is essentially OK to do so is in case where the polygon is completely flat, in which case it will have little effect. Regardless, even in these cases it is best to convert them to four- and three-sided polygons.

How do I create Polygon Models

Polygon Primitives

There are many ways to create polygonal models. The first and most common way to do so is by using primitives. Every 3D software program has primitives. Primitives are common shapes such as planes, cubes, spheres, and cylinders that save time by providing a starting point for various 3D models. The nice thing about primitives is that they have parameters, or values, that can be changed, edited, and tweaked before the geometry itself is touched. All primitives have the ability to be subdivided in various ways to increase the amount of detail available for editing the shape. We could definitely model all of this stuff ourselves if we wanted to waste the time and energy, but there is no reason to keep reinventing the wheel.

Point-to-point creation is another way to create your initial polygon model. Point-to-point isn’t as nearly as quick or easy as creating primitives and editing them, but it is useful in various places. The point-to-point operation leaves a vertex every place you click the mouse, connecting the current vertex to the previous vertex with an edge and filling in the space between the first three points with a triangle.

Chamfer and Bevel: take sharp corners and make them rounded. Chamfer uses a vertex and bevel uses an edge.

Extrude

Extrude can be done on a vertex, an edge, or a face, but primarily this operation is done on faces. Extrude “pulls out” the vertex, edge or face of a polygon while creating connecting faces that create a 3D shell around your component. Extrusion also let you take simple shapes, such as our 2D staircase and pull them out to 3D shells. This is the best way to make simple 3D Extrusions are very important in modeling because it is the only way to create branching geometry. Branching geometry is essential in creating organic shapes, like a human torso or a piece of coral.

Smoothing

Smoothing faces or entire models is a very common polygon-editing tool. Smoothing works by increasing the number of faces in a polygon model and rounding those resulting faces out.