Polygon Meshes

- A collection of edges, vertices, and polygons connected such that each edge is shared by at most two polygons
- A polygon mesh can be represented in several different ways, each with advantages and disadvantages

Typical operations on a polygon mesh are:

- finding all the edges incident to a vertex
- finding the polygons sharing an edge or a vertex
- finding the vertices connected by an edge
- finding the edges of a polygon
- displaying the mesh
- identifying errors in representation

In general, the more explicitly the relations among polygons, vertices, and edges are represented, the faster the operations are and the more space the representation requires

Explicit Representation

- each polygon is represented by a list of vertex coordinates:

  $P = ((x_1,y_1,z_1), (x_2,y_2,z_2), \ldots, (x_n,y_n,z_n))$

- the vertices are stored in the order in which we would encounter them were we travelling around the polygon
- there are edges between the successive vertices in the list and between the last and the first vertices.

- For a single polygon, this representation is space-efficient
- For a polygon mesh, space is lost because the coordinates of shared vertices are duplicated
- Plus, there is no explicit representation of shared edges and vertices

Pointers to a vertex list

- Each vertex in the polygon mesh is stored just once, in the vertex list

  $V = (V_1, V_2, V_3, V_4) = ((x_1,y_1,z_1), (x_2,y_2,z_2), \ldots, (x_n,y_n,z_n))$

- A polygon is defined by a list of indices (or pointers) into the vertex list

Pointers to an edge list

- We again have a vertex list V, and we also have an edge list which points to two vertices in the vertex list and to one or two polygons
- Polygons are represented as a list of edges list

Parametric Bicubic Surfaces

- a generalization of parametric cubic curves:
  $Q(t) = G \cdot M \cdot T$
  G is geometry matrix
- For notation convenience, replace t with s giving
  $Q(s) = G \cdot M \cdot S$
- If we allow the points in G to vary in 3D along some path parameterized on t, we have:

$$Q(s,t) = \left[\begin{array}{cccc} G_1(t) & G_2(t) & G_3(t) & G_4(t) \end{array}\right] \cdot M \cdot S$$

For a fixed t_1, $Q(s,t_1)$ is a curve because $G(t_1)$ is constant
For t_2, $Q(s,t_2)$ is a slightly different curve
If this is repeated for values of t between 0 and 1, we define an entire family of curves which defines a surface

A family of curves Q(s,t) is defined as t is varied: