

Modelling Shapes with Polygonal Meshes

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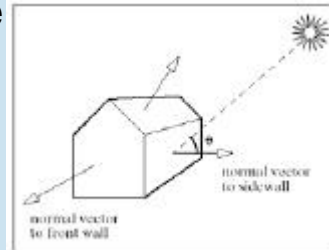
Modelling shapes with Polygonal Meshes

- Goal: describe 3D objects using a polygonal mesh
- A mesh is a collection of polygons
- Data Structure: list of polygons + directional information

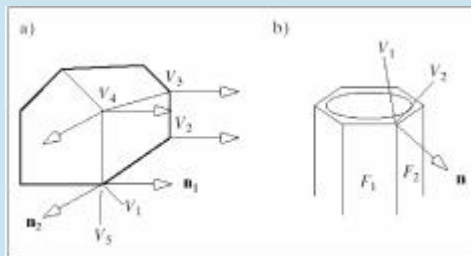


Normal Vectors

- Shading process: determine how much light from a light source is scattered off the face

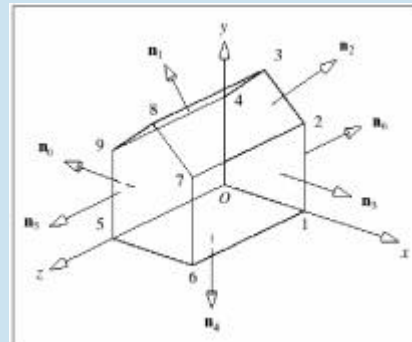


- Vertex normal versus face normal



Example

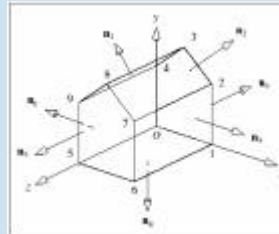
- The basic barn
- Various ways to store the mesh
- Associate locations of vertices to the faces
- This has redundant information & is inflexible
- More efficient approach



Vertex List

- Vertex list: locations of vertices
 - Geometric
- Normal list: direction of normal vectors
 - Orientation
- Face list: indices of the other two
 - Topological

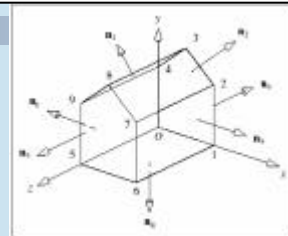
vertex	x	y	z
0	0	0	0
1	1	0	0
2	1	1	0
3	0.5	1.5	0
4	0	1	0
5	0	0	1
6	1	0	1
7	1	1	1
8	0.5	1.5	1
9	0	1	1



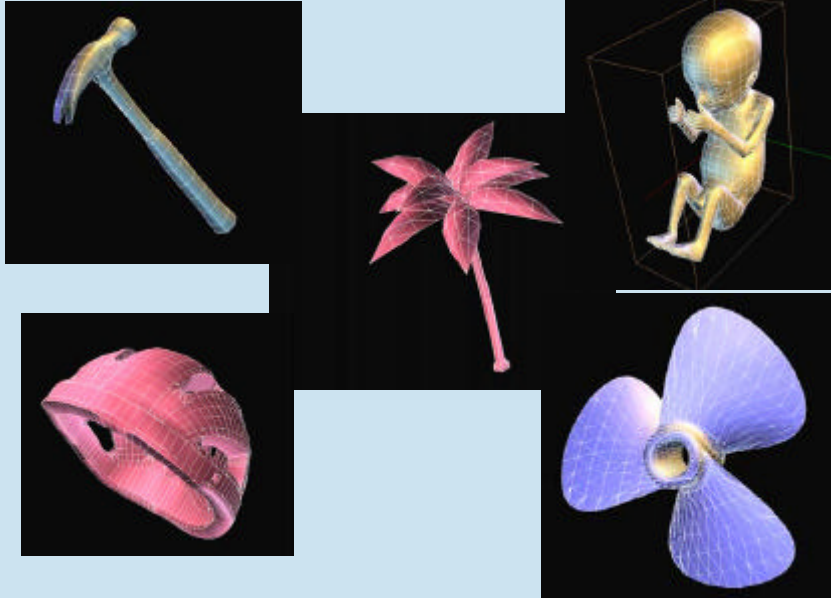
Face List, Normal List

Normal	n_x	n_y	n_z
0	-1	0	0
1	-0.707	0.707	0
2	0.707	0.707	0
3	1	0	0
4	0	-1	0
5	0	0	1
6	0	0	-1

face	vertices	associated normal
0 (left)	0,5,9,4	0,0,0,0
1 (roof left)	3,4,9,8	1,1,1,1
2 (roof right)	2,3,8,7	2,2,2,2
3 (right)	1,2,7,6	3,3,3,3
4 (bottom)	0,1,6,5	4,4,4,4
5 (front)	5,6,7,8,9	5,5,5,5,5
6 (back)	0,4,3,2,1	6,6,6,6,6



Several Examples



.obj Format

- (Face list and Vertex list) is a standard mesh representation technique
- Obj format from Alias|Wavefront
- Maya

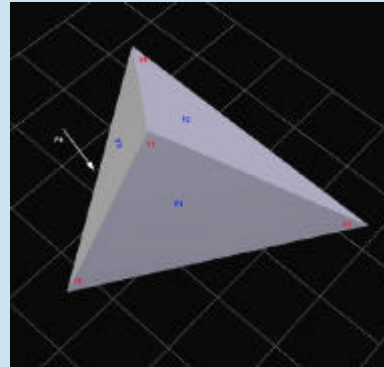


.obj Format

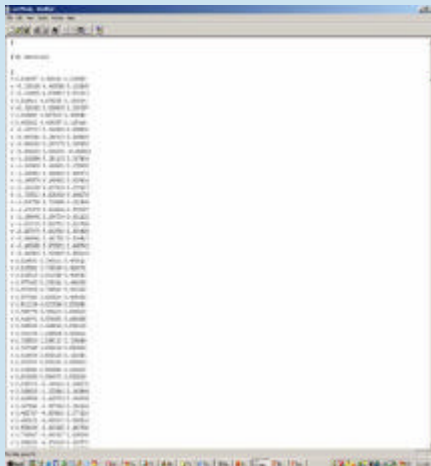
- Tetrahedron

Example .obj listing:

```
v 1.0 1.0 1.0
v 2.0 0.0 0.0
v 0.0 0.0 0.0
v 1.0 1.6 0.0
f 1 2 3
f 1 3 4
f 1 4 2
f 2 4 3
```



Real Example



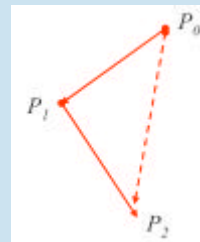
Traversal of Polygons

- Clockwise
- Counter Clockwise
- Convention: travel CCW as seen from the outside.

Computing the Normal Vector

- In the case of flat faces

$$m = (P_1 - P_0) \times (P_2 - P_0)$$
$$n = \frac{m}{|m|}$$



- When does the formula fail?
- Average of normal vertices of the face
 - To avoid the fail case
 - work for non-planar faces too