

Modeling Objects with Polygons

Polygons

A polygon is a closed sequence of edges.

line seg joining
↑
2 vertices

They can only approximate a curved object.



← crude polygonal approximation

A polygon mesh is a collection of polygons connected such that each edge is shared by at most two polygons.

Polygon mesh representation:

- 1) explicit list of pointers
- 2) pointers to vertex list
- 3) pointers to edge list

Rep.#1: Each polygon is rep. by a list of vertex coords

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

↑
stored in order of traversal around polygon

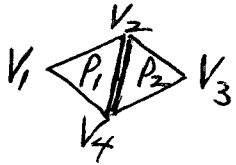
Advantage: space-efficient for a single polygon

Disadvantage: space-inefficient for polygon mesh because coords of shared vertices are duplicated. No explicit rep of shared edges + vertices (to save time in clipping, drawing, interactive manipulation, ...)

Rep. #2: Each polygon is rep. by a list of ptrs to a vertex list.

$V = ((x_1, y_1, z_1), (x_2, y_2, z_2), \dots, (x_n, y_n, z_n))$ ← each vertex is stored once
 $P = (3, 5, 7, 10)$ ← polygon made up of vertices 3, 5, 7, 10

EX: $V = (V_1, V_2, V_3, V_4) = ((x_1, y_1, z_1), \dots, (x_4, y_4, z_4))$
 $P_1 = (1, 2, 4)$ $P_2 = (4, 2, 3)$



Note that V_2 and V_4 are not duplicated

Advantage: vertices are stored once; saves space;
Coords of a vertex can be changed easily (visit vertex list only)

Disadvantage: difficult to find polygons that share edges; shared edges are drawn twice

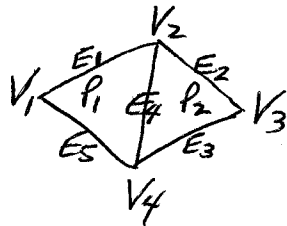
Rep #3: Each polygon is rep. by a list of ptrs to an edge list.

Each edge in the edge list occurs once, points to 2 vertices in vertex list, and also to 1 or 2 polygons to which the edge belongs.

$$P = (E_1, E_2, \dots, E_n)$$

$$E_i = (V_1, V_2, P_1, P_2)$$

EX:



$$V = (V_1, V_2, V_3, V_4) = ((x_1, y_1, z_1) \dots (x_4, y_4, z_4))$$

$$E_1 = (V_1, V_2, P_1, \emptyset)$$

$$E_2 = (V_2, V_3, P_2, \emptyset)$$

$$E_3 = (V_3, V_4, P_2, \emptyset)$$

$$E_4 = (V_4, V_2, P_1, P_2)$$

$$E_5 = (V_4, V_1, P_1, \emptyset)$$

$$P_1 = (E_1, E_4, E_5)$$

$$P_2 = (E_2, E_3, E_4)$$

Advantage: Knowing shared edges lets us avoid redundant clipping, drawing, transformations, + scan conversion.

Disadvantage: still not easy to determine which edges are incident to a vertex.