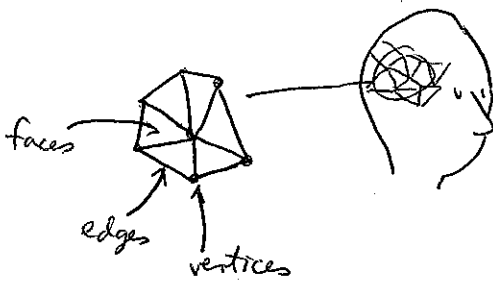


3D Polygonal mesh

9/18/07 (1)



3D Points

• defined by 3 x, y, z coordinates

typedef struct {

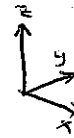
float x;

float y;

float z;

} Point;

• Assumes same common origin



(x, y, z)

3D Vector

Again defined by 3 values

typedef struct {

float i;

float j;

float k;

} vector;



$$\text{length} = \sqrt{i^2 + j^2 + k^2}$$

Operations defined with 3D Vector

X product (cross)

• product (dot)

$$A \times B = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ a & b & c \\ d & e & f \end{vmatrix}$$

$$= (bf - ec)\vec{i} + (dc - af)\vec{j} + (ae - db)\vec{k}$$

↑
vector \perp to both A and B

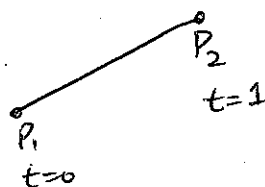
$$A \cdot B = \underbrace{ad + be + cf}_{\text{scalar result}}$$

$$= \|A\| \|B\| \cos \theta$$

$$\|A \times B\| = \|A\| \|B\| \sin(\theta)$$

3D Parametric line segment

$$P = P_1 + t(P_2 - P_1)$$



3D Ray

$$P = P_1 + tV$$

$$(0 \leq t < \infty)$$

typedef struct {

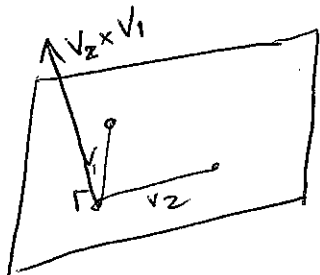
Point P;

Vector V;

} Ray;



3D Plane



implicit representation

unit-length normal of plane

$$N = (N_x, N_y, N_z)$$

$$P \cdot N + d = 0$$

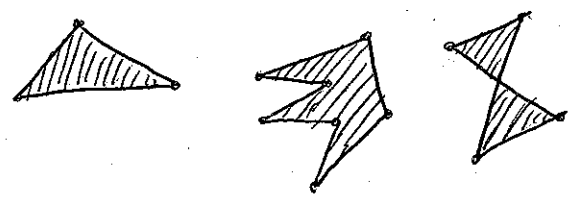
$$N_x x + N_y y + N_z z + d = 0$$

3D Polygons

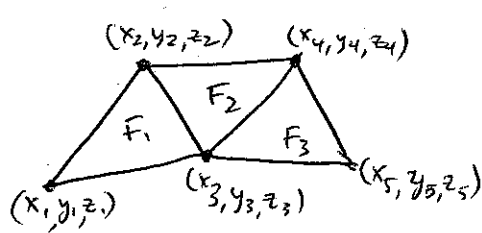
The "interior" points inside a set of coplanar points

typed struct {
Point * points;
int num-pt;

3 Polygon;



Independent Faces



Face Table

F1	(x1, y1, z1) (x3, y3, z3) (x2, y2, z2) duplicates
F2	(x2, y2, z2) (x3, y3, z3) (x4, y4, z4)
F3	(x3, y3, z3) (x5, y5, z5) (x4, y4, z4)

Duplicate vertices!
No adjacency information.

Vertex and Face Tables

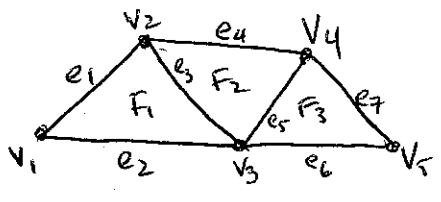
Vertex Table

V_1	(x_1, y_1, z_1)
V_2	(x_2, y_2, z_2)
V_3	(x_3, y_3, z_3)
\vdots	\vdots
V_5	(x_5, y_5, z_5)

Face Table

F_1	V_1, V_3, V_2
F_2	V_2, V_3, V_4
F_3	V_3, V_4, V_5

Adjacency lists

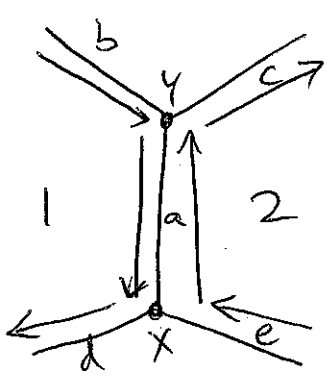


$$e_3 = \begin{cases} F_1, F_2 \\ V_2, V_3 \\ e_1, e_4, e_2, e_5, e_6 \end{cases}$$

$$F_1 = \begin{cases} e_1, e_2, e_3 \\ F_2 \\ V_1, V_2, V_3 \end{cases}$$

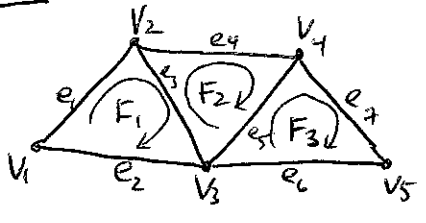
$$V_3 = \begin{cases} V_1, V_2, V_4, V_5 \\ e_2, e_3, e_5, e_6 \\ F_3, F_2, F_1 \end{cases}$$

HINGED EDGE DATA STRUCTURE



Edge	Vertices		Faces		Edges			
	start	end	Left	Right	Left face		Right face	
					pred	succ	pred	succ
a	x	y	1	2	b	d	e	c

EX:



Edge	Vertices		Faces		Edges			
	start	end	Left	Right	Left Face		Right Face	
					pred	succ	pred	succ
e_1	V_1	V_2	-	F_2	e_1	e_2	e_2	e_3
e_2	V_3	V_1	-	F_1	-	-	e_3	e_1
e_3	V_2	V_3	F_2	F_1	e_5	e_4	e_1	e_2
e_4	V_2	V_4	-	F_2	-	-	e_3	e_5
e_5	V_3	V_4	F_2	F_3	e_4	e_3	e_6	e_7
e_6	V_3	V_5	F_3	-	e_7	e_5	-	-
e_7	V_4	V_5	F_3	-	e_5	e_6	-	-