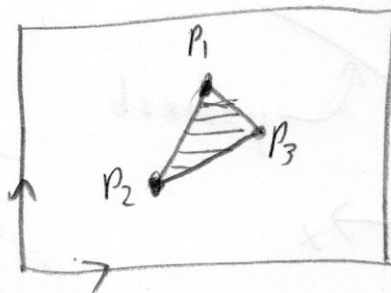




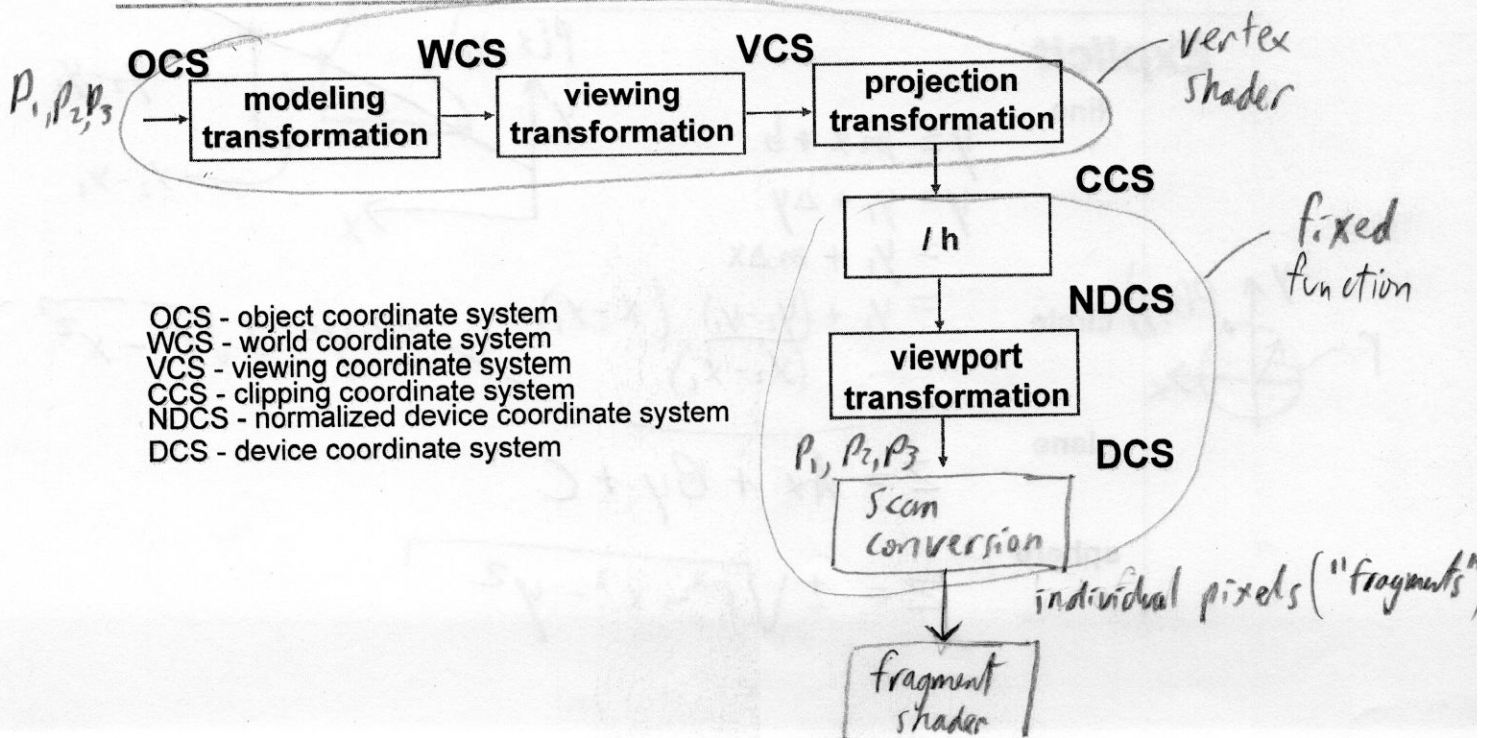
Scan Conversion

The process of drawing all the pixels ("fragments") that form a polygon. (In practice, we nearly always use triangles)



DCS
device coordinate system

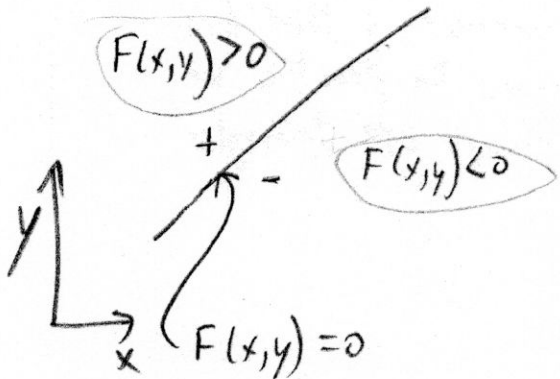
Scan Conversion



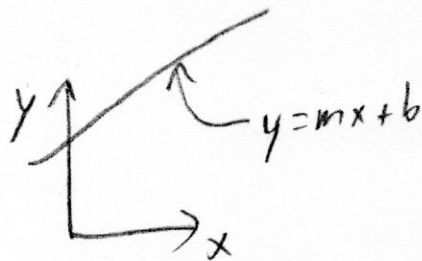
Implicit, Explicit, and Parametric equations for defining geometry

Three ways to write a line equation:

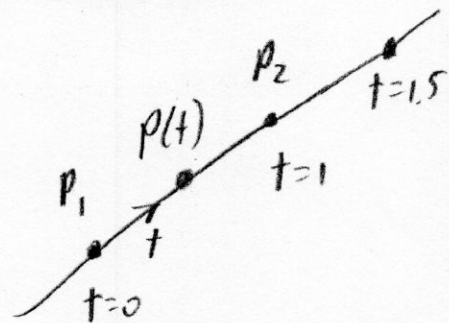
① Implicit



② Explicit



③ Parametric



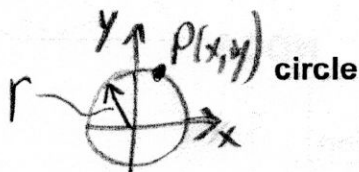
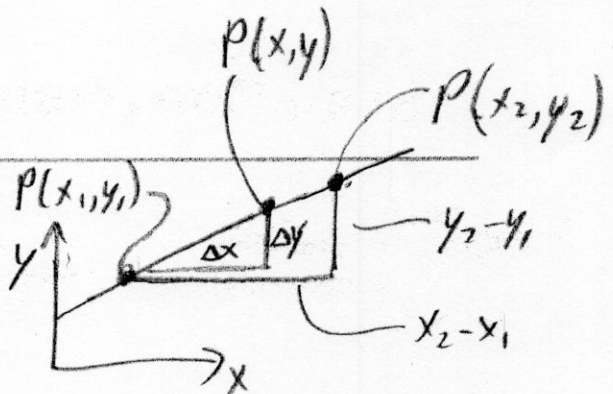
The point is a function of some underlying parameter, t .

Lines and Curves

Explicit

line

$$\begin{aligned}
 y &= mx + b \\
 y &= y_1 + \Delta y \\
 &= y_1 + m \Delta x \\
 &= y_1 + \frac{(y_2 - y_1)}{(x_2 - x_1)} (x - x_1)
 \end{aligned}$$



circle

$$y = \pm \sqrt{r^2 - x^2}$$

plane

$$z = Ax + By + C$$

sphere

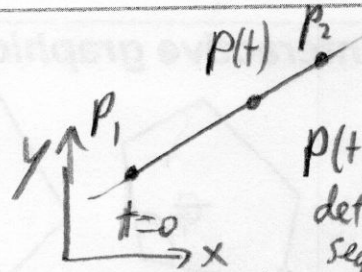
$$z = \pm \sqrt{r^2 - x^2 - y^2}$$

Lines and Curves

Parametric

line

$$P(t) = P_1 + t(P_2 - P_1) \\ = (1-t)P_1 + tP_2$$

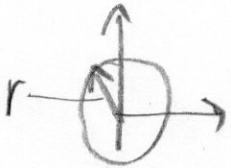


$P(t), t \in [0, 1]$ defines the line segment P_1, P_2 .

"basis functions"

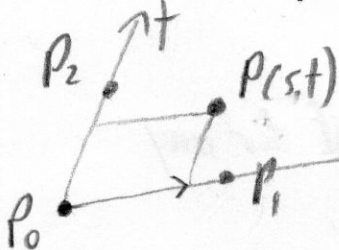
circle

$$x(t) = r \cos(t) \\ y(t) = r \sin(t) \quad t \in [0, 2\pi]$$



plane

$$P(s, t) = P_0 + s(P_1 - P_0) + t(P_2 - P_0)$$



$$\begin{bmatrix} x(s, t) \\ y(s, t) \\ z(s, t) \end{bmatrix} = \begin{bmatrix} x_0 \\ y_0 \\ z_0 \end{bmatrix} + s \begin{bmatrix} x_1 - x_0 \\ y_1 - y_0 \\ z_1 - z_0 \end{bmatrix} + t \begin{bmatrix} x_2 - x_0 \\ y_2 - y_0 \\ z_2 - z_0 \end{bmatrix}$$

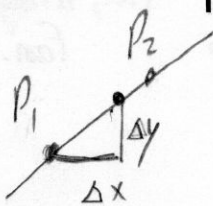
Three points uniquely define a 3D-plane.

Lines and Curves

Implicit

$$F(x, y) = 0, \quad F(x, y, z) = 0$$

line



$$y = y_1 + \Delta y$$

$$= y_1 + m \Delta x$$

$$y = y_1 + \left(\frac{y_2 - y_1}{x_2 - x_1} \right) (x - x_1)$$

$$0 = (y_1 - y) + \left(\frac{y_2 - y_1}{x_2 - x_1} \right) (x - x_1)$$

$$0 = (y_1 - y)(x_2 - x_1) + (y_2 - y_1)(x - x_1)$$

$$0 = x(y_2 - y_1) + y(x_1 - x_2)$$

$$+ y_1 x_2 - y_1 x_1 - y_2 x_1 + y_1 x_1$$

$$0 = x(y_2 - y_1) + y(x_1 - x_2) + y_1 x_2 - y_2 x_1$$

$$0 = Ax + By + C$$

circle

$$r^2 = x^2 + y^2$$

$$0 = x^2 + y^2 - r^2$$

$F(x, y) = 0$: on circle
 < 0 : inside
 > 0 : outside

