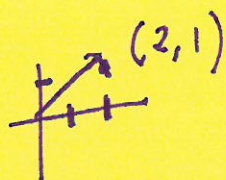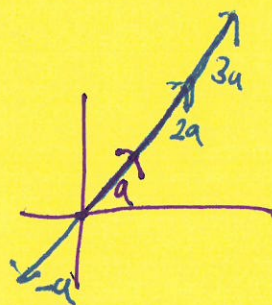# Math

Vector

Addition $a + b = \begin{bmatrix} a_x \\ a_y \end{bmatrix} + \begin{bmatrix} b_x \\ b_y \end{bmatrix} = \begin{bmatrix} a_x + b_x \\ a_y + b_y \end{bmatrix}$
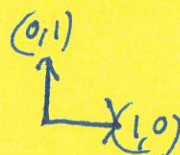
Scaling

$$\alpha a = \alpha \begin{bmatrix} a_x \\ a_y \end{bmatrix} = \begin{bmatrix} \alpha a_x \\ \alpha a_y \end{bmatrix}$$
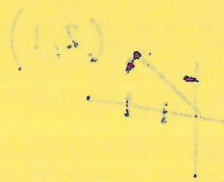
Cartesian coordinates

$$a = \begin{bmatrix} a_x \\ a_y \end{bmatrix} = a_x \begin{bmatrix} 1 \\ 0 \end{bmatrix} + a_y \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Vector

Addition $a + b = \begin{bmatrix} a_x \\ a_y \end{bmatrix} + \begin{bmatrix} b_x \\ b_y \end{bmatrix} = \begin{bmatrix} a_x + b_x \\ a_y + b_y \end{bmatrix}$

Scaling

$\lambda a = \lambda \begin{bmatrix} a_x \\ a_y \end{bmatrix} = \begin{bmatrix} \lambda a_x \\ \lambda a_y \end{bmatrix}$

Cartesian coordinates

$a = \begin{bmatrix} a_x \\ a_y \end{bmatrix} = a_x \begin{bmatrix} 1 \\ 0 \end{bmatrix} + a_y \begin{bmatrix} 0 \\ 1 \end{bmatrix}$
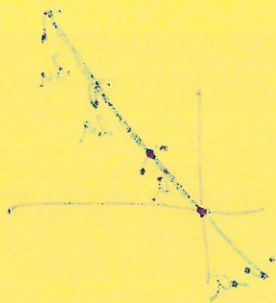
Lines

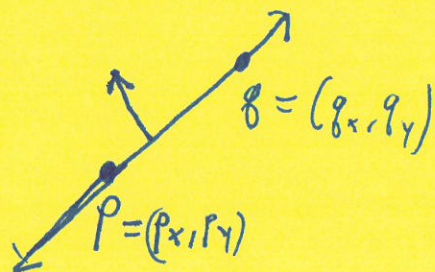→ Std form $A_x + B_y + C = 0$

~~Slope int~~ $y = mx + b$

Given 2 points P, q what is line through p, q

form ⊥ vector to $\vec{PQ}$

$\boxed{P_y - q_y}$

$\boxed{q_x - P_x}$

$f(x,y) = A_x + B_y + C$

$\nabla f(x,y) = [A, B]$

$P = (P_x, P_y)$

$q = (q_x, q_y)$

$(P_y - q_y) x + (q_x - P_x) y + C = 0$

plug in p and solve for c

$C = P_x q_y - q_x P_y$

→ Std form $Ax + by + C = 0$

Slope int $y = mx + b$

Given 2 points P, Q what is line through P, Q

Form $\perp$ vector to $\vec{PQ}$

$$\begin{bmatrix} x - x_1 \\ y - y_1 \end{bmatrix}$$

$f(x,y) = Ax + By + C$

$\vec{f(x,y)} = [A, B]$

$(B, -A)$

$(B, -A) x + (x_2 - x_1) y + C = 0$

plug in P and solve for C

$C = Bx_2 - Ax_1$
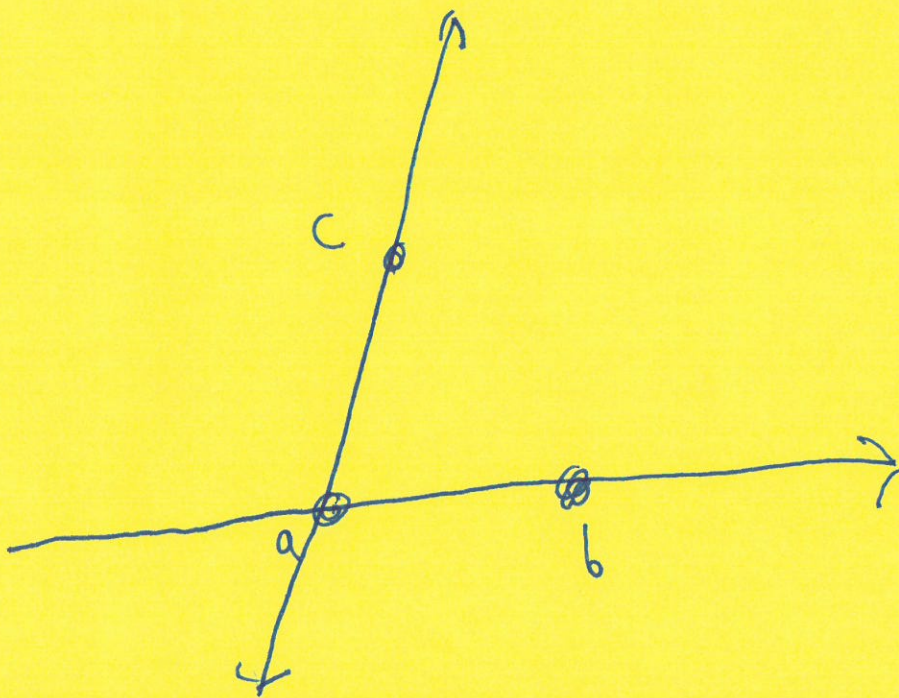
Line through p & q has formula

$$(P_y - q_y)x + (q_x - P_x)y + P_x q_y - q_x P_y = 0$$

$$\begin{vmatrix} P_x & P_y & 1 \\ q_x & q_y & 1 \\ x & y & 1 \end{vmatrix} = 0 = f_{pq}(x, y)$$

Barycentric coordinates
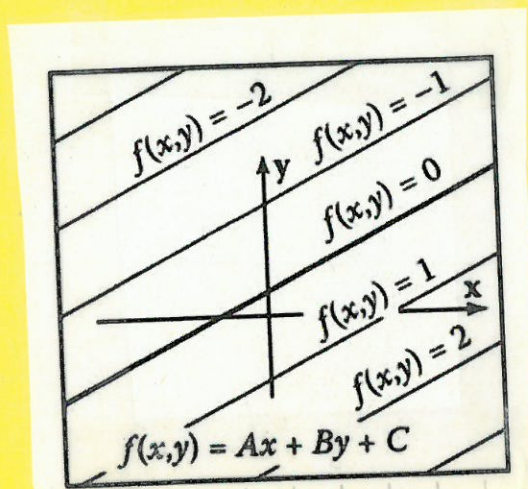
$$f(x,y) = Ax + By + C$$

f(x,y) = -2 f(x,y) = -1
f(x,y) = 0
f(x,y) = 1
f(x,y) = 2
f(x,y) = Ax + By + C

$$p = a + \beta(b-a) + \gamma(c-a) \quad \Leftrightarrow$$

$$p = (1-\beta-\gamma)a + \beta b + \gamma c$$

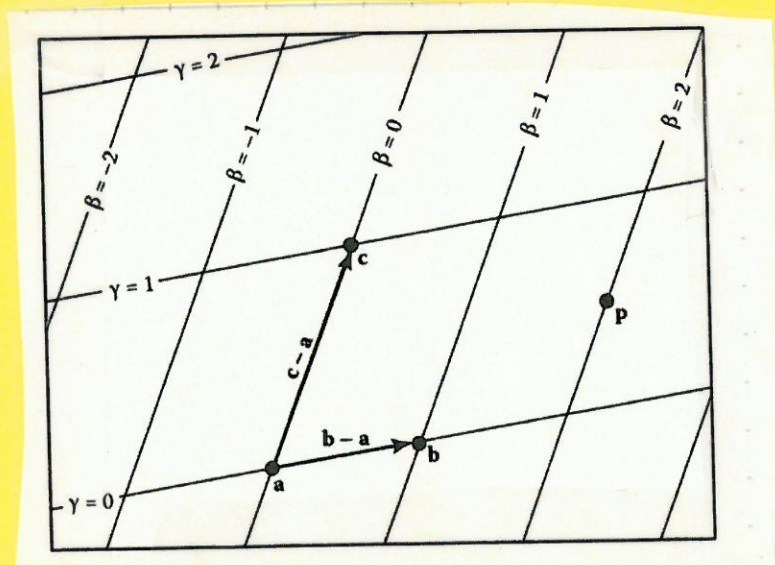$$\text{def} \quad \alpha = 1 - \beta - \gamma$$

$$p = \alpha a + \beta b + \gamma c$$

Barycentic coordinate of P
w/ $\triangle abc$
is (α, β, γ)

$\gamma = 2$
$\beta = -2$ $\beta = -1$ $\beta = 0$ $\beta = 1$ $\beta = 2$
$\gamma = 1$
c
c - a
p
b - a
a b
$\gamma = 0$

Barycentric coordinates

$$f(x,y) = Ax + by + c$$

$$p = \alpha + \beta(b-\alpha) + \gamma(c-\alpha) \quad \text{①}$$

$$p = (1-\beta-\gamma)\alpha + \beta b + \gamma c$$

let $\alpha = 1 - \beta - \gamma$

$$p = \alpha a + \beta b + \gamma c$$

Barycentric coordinate of p

$\triangle abc$

is (α, β, γ)