$$\max_{\alpha} \sum_{i=1}^{n} \alpha_i - \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{1} \alpha_i \alpha_j y_i y_j \langle x_i, x_j \rangle$$

$$\sum_{i} \alpha_i y_i = 0$$

$$C \geq a_i \geq 0$$

want form:

$$\min_{x} \frac{1}{2} x^T P x + Q^T x$$

s.t. $Gx \leq h$

$Ax = b$

let $H = \sum_{i=1}^{n}\sum_{j=1}^{n} y_i y_j \langle x_i, x_j \rangle$

then:

$$\max_{\alpha} \sum_{i=1}^{n} a_i - \frac{1}{2}\alpha^T H \alpha$$

$$\sum_{i=1}^{n} \alpha_i y_i = 0$$

$$\alpha_i \leq C$$

$$\alpha_i \geq 0$$

some simplification of sums gives:

$$\max_{\alpha} 1^T \alpha - \frac{1}{2}\alpha^T H \alpha$$

$$\alpha^T y = 0$$

$$\alpha_i \leq C$$

$$\alpha_i \geq 0$$

multiply all by -1 for max $\to$ min conversion

$$\min_{\alpha} \frac{1}{2}\alpha^T H \alpha - 1^T \alpha$$

$$-\alpha_i \leq 0$$

$$\alpha_i \leq C$$

$$\alpha^T y = 0$$

$$\min_{x} \frac{1}{2} x^T P x + Q^T x$$

s.t. $Gx \leq h$

$Ax = b$

to give intuition into
now we combine these:

$-\alpha_i \leq 0 \qquad G = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} \quad \wedge \quad h = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

$\alpha_i \leq C \qquad G = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad \wedge \quad h = \begin{bmatrix} C \\ C \end{bmatrix}$

then combined becomes

$$G = \begin{bmatrix} -1 & 0 \\ 0 & -1 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} \quad \wedge \quad h = \begin{bmatrix} 0 \\ 0 \\ C \\ C \end{bmatrix}$$

then

$$\min_{\alpha} \tfrac{1}{2} \alpha^T H \alpha - 1^T \alpha$$

$-\alpha_i \leq 0$

$\alpha_i \leq C$

$\alpha^T y = 0$

$$\min_{x} \tfrac{1}{2} x^T P x + Q^T x$$

s.t. $Gx \leq h$

$Ax = b$

becomes:

$x = \alpha$

$P = H = \sum_{i=1}^{n} \sum_{j=1}^{n} y_i y_j \langle x_i, x_j \rangle$

$Q = -1$

G = stack(identity-neg ^ identity)

h = stack(0 ^ c)

A = y

b = 0

make sure correct dims of each