**Input:**

$C$: regularization parameter
$tol$: numerical tolerance
$max\_passes$: max # of times to iterate over $\alpha$'s without changing
$(x^{(1)}, y^{(1)}), \ldots, (x^{(m)}, y^{(m)})$: training data

**Output:**

$\alpha \in \mathbb{R}^m$: Lagrange multipliers for solution
$b \in \mathbb{R}$ : threshold for solution

$$f(x) = \langle \omega, x \rangle + b$$

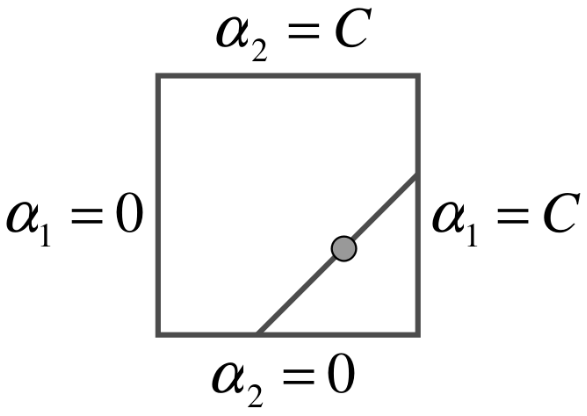
$$\omega = \sum_{i=1}^{m} \alpha_i y^{(i)} x^{(i)}$$

- Initialize $\alpha_i = 0, \forall i, \quad b = 0.$
- Initialize $passes = 0.$

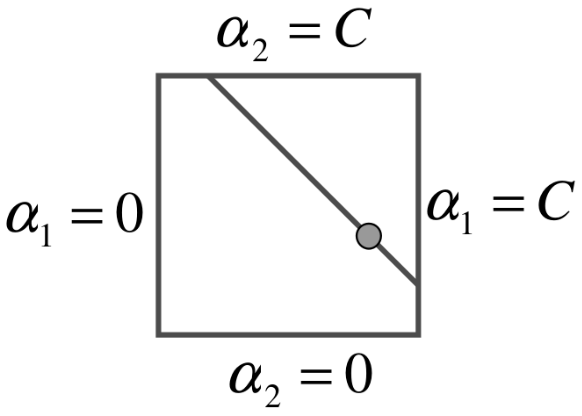
- **for** $i = 1, \ldots m,$
  - Calculate $E_i = f(x^{(i)}) - y^{(i)}$ using (2).
  - **if** $((y^{(i)} E_i < -tol \quad \&\& \quad \alpha_i < C) \,||\, (y^{(i)} E_i > tol \quad \&\& \quad \alpha_i > 0))$
    - Select $j \neq i$ randomly.
    - Calculate $E_j = f(x^{(j)}) - y^{(j)}$ using (2).
    - Save old $\alpha$'s: $\alpha_i^{(\text{old})} = \alpha_i$, $\alpha_j^{(\text{old})} = \alpha_j$.
    - Compute $L$ and $H$ by (10) or (11).
    - **if** $(L == H)$

      **continue** to next $i$.

$$\sum_{i=1}^{m} \alpha_i y^{(i)} = 0$$




$$y_1 \neq y_2 \Rightarrow \alpha_1 - \alpha_2 = \gamma$$




$$y_1 = y_2 \Rightarrow \alpha_1 + \alpha_2 = \gamma$$