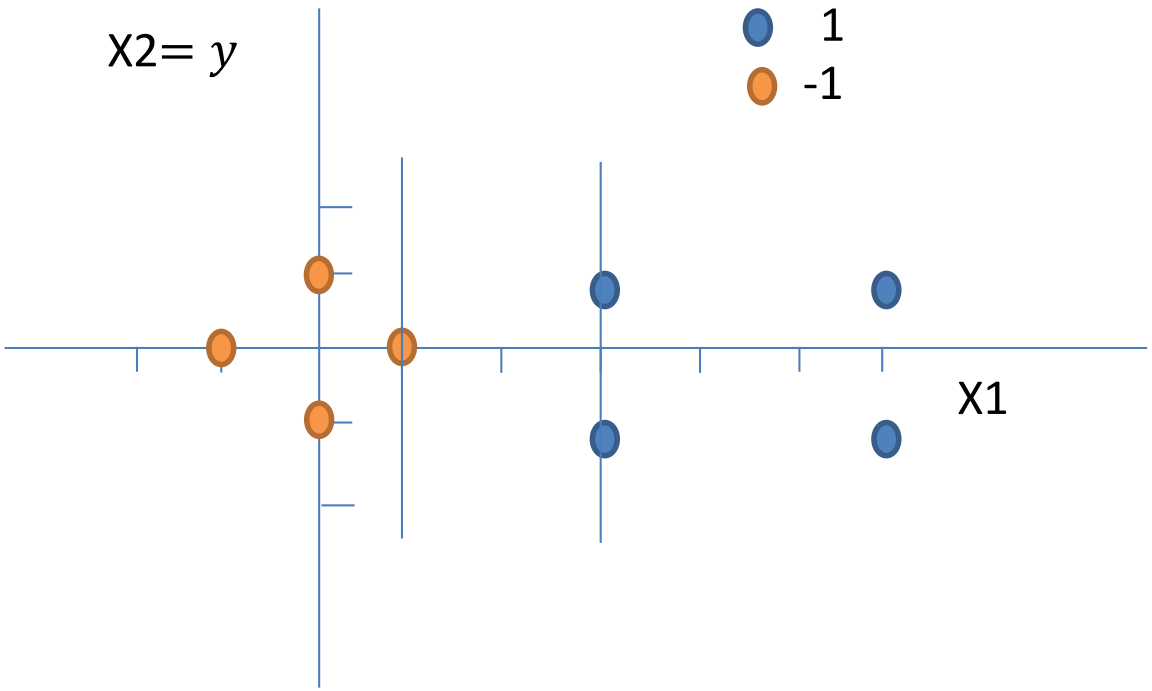
# Numeric Example




| Patter n no | X1 | X2 | class |
|---|---|---|---|
| 1 | 3 | 1 | 1 |
| 2 | 3 | -1 | 1 |
| 3 | 6 | 1 | 1 |
| 4 | 6 | -1 | 1 |
| 5 | 1 | 0 | -1 |
| 6 | 0 | 1 | -1 |
| 7 | 0 | -1 | -1 |
| 8 | -1 | 0 | -1 |

Three support vectors:

S1 = (1, 0)
S2 = (3, 1)
S3 = (3, -1)

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S1 = (1, 0)
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S3 = (3, -1)

Vectors are augmented from d dimension to (d+1)th dimension
(d+1)th dimension is bias and is represented as 1 (This is called data transformation)

S1’ = (1, 0, 1)
S2’ = (3, 1, 1)
S3’ = (3, -1, 1)

To calculate three weights following equations are established:

$$\alpha_1 S1'.S1' + \alpha_2 S1'.S2' + \alpha_3 S1'.S3' = -1$$

$$\alpha_1 S2'.S1' + \alpha_2 S2'.S2' + \alpha_3 S2'.S3' = 1$$

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$\alpha_1(1, 0, 1).(1, 0, 1) + \alpha_2 (1, 0, 1).(3, 1, 1) + \alpha_3(1, 0, 1).(3, -1, 1) = -1$
$\alpha_1(1+0+1) + \alpha_2 (3+0+1) + \alpha_3(3-0+1) = -1$
$2\alpha_1 + 4\alpha_2 + 4\alpha_3 = -1$

$\alpha_1(3, 1, 1).(1, 0, 1) + \alpha_2 (3, 1, 1).(3, 1, 1) + \alpha_3(3, 1, 1).(3, -1, 1) = 1$
$\alpha_1(3+0+1) + \alpha_2 (9+1+1) + \alpha_3(9-1+1) = 1$
$4\alpha_1 + 11\alpha_2 + 9\alpha_3 = 1$

$\alpha_1(3, -1, 1).(1, 0, 1) + \alpha_2 (3, -1, 1).(3, 1, 1) + \alpha_3(3, -1, 1).(3, -1, 1) = 1$
$\alpha_1(3-0+1) + \alpha_2 (9-1+1) + \alpha_3(9+1+1) = 1$
$4\alpha_1 + 9\alpha_2 + 11\alpha_3 = 1$

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$2\alpha_1 + 4\alpha_2 + 4\alpha_3 = -1$

$4\alpha_1 + 11\alpha_2 + 9\alpha_3 = 1$

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$\alpha_1$= -3.5 ; $\alpha_2$ = 0.75 ; $\alpha_3$= 0.75

$$w' = \sum_i \alpha_i S'_i$$

= -3.5 $(1\ 0\ 1)^t$ + 0.75 $(3\ 1\ 1)^t$ + 0.75 $(3\ -1\ 1)^t$

= $(-3.5\ 0\ -3.5)^t$ + $(2.25\ 0.75\ 0.75)^t$ + $(2.25\ -0.75\ 0.75)^t$

= $(1\ 0\ -2)^t$

$$w = (1\ 0)^t$$

$$b = -2$$

$$(c_0 + c_1 X_1 + c_2 X_2 + \cdots \ldots + c_N X_N = 0)$$

w1x1+ w2x2 + c = 0;

1. x1 + 0. x2 + (-2) = 0 ;

x1 = 2