Introduction to Machine Learning

Machine Learning: Jordan Boyd-Graber
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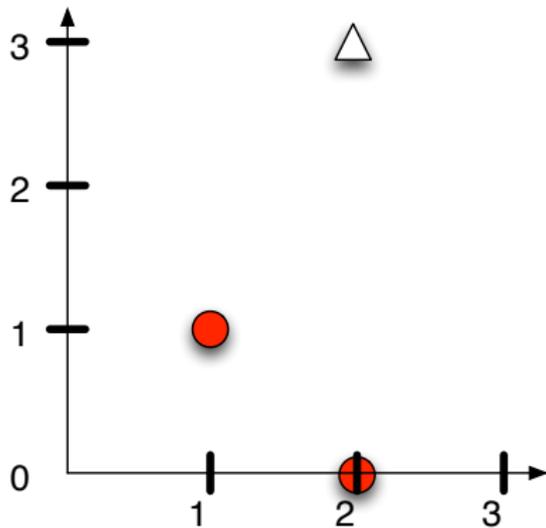SLACK SVMS

Slides adapted from Tom Mitchell, Eric Xing, and Lauren Hannah
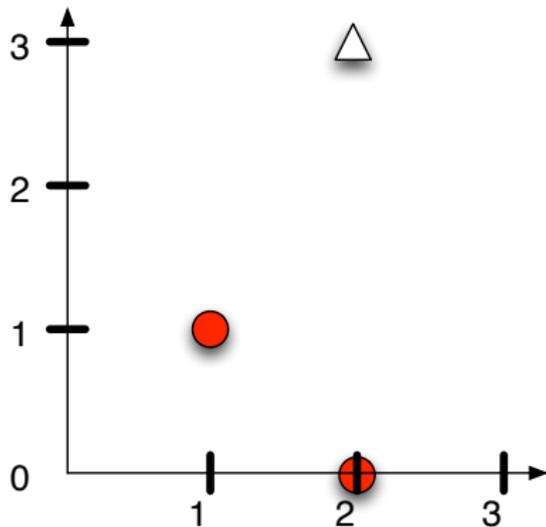
Content Questions

Administrative Questions

Find the maximum margin hyperplane

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Which are the support vectors?

Walkthrough example: building an SVM over the data shown

Working geometrically:

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- If you got $0 = .5x + y - 2.75$, close!

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Working geometrically:

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- Set up system of equations

$$w_1 + w_2 + b = -1 \qquad (1)$$

$$\frac{3}{2}w_1 + 2w_2 + b = 0 \qquad (2)$$

$$2w_1 + 3w_2 + b = +1 \qquad (3)$$

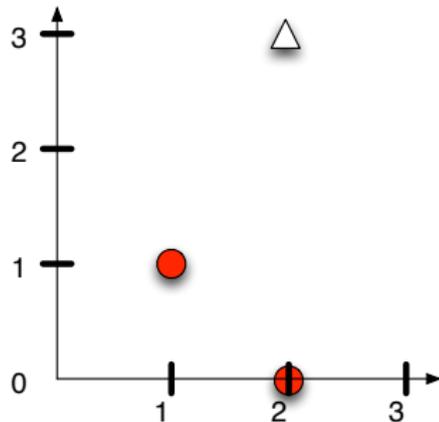**Walkthrough example: building an SVM over the data shown**

Working geometrically:

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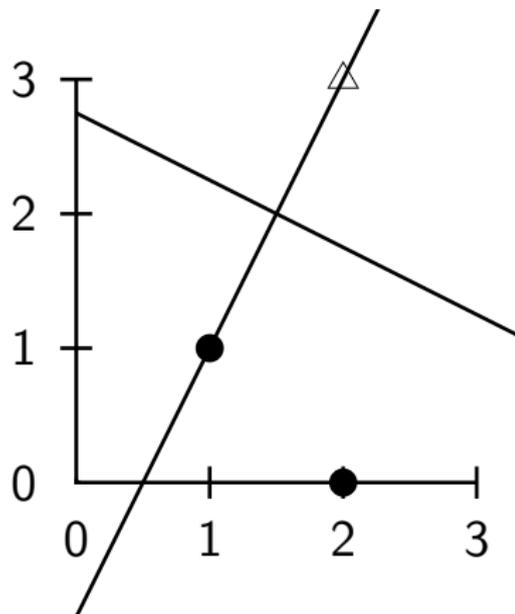$$\frac{3}{2}w_1 + 2w_2 + b = 0 \qquad (2)$$

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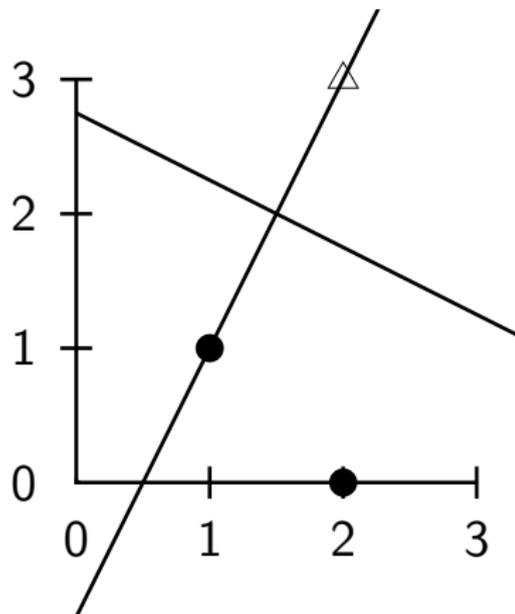
The SVM decision boundary is:

$$0 = \frac{2}{5}x + \frac{4}{5}y - \frac{11}{5}$$
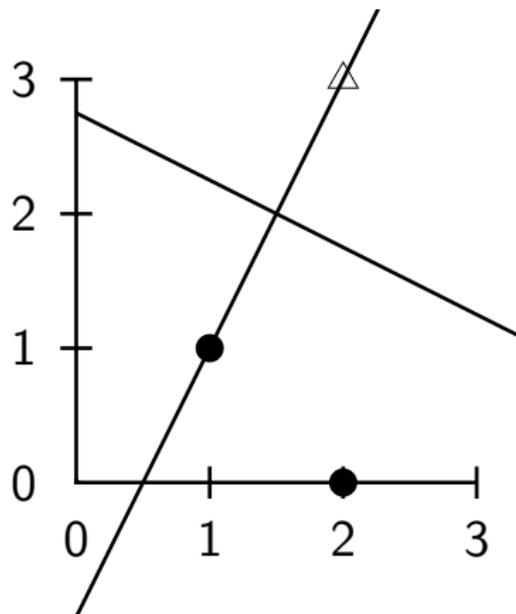
Cannonical Form

$w_1 x_1 + w_2 x_2 + b$

$$.4x_1 + .8x_2 - 2.2$$

Cannonical Form

$.4x_1 + .8x_2 - 2.2$

- $.4 \cdot 1 + .8 \cdot 1 - 2.2 = -1$
- $.4 \cdot \frac{3}{2} + .8 \cdot 2 = 0$
- $.4 \cdot 2 + .8 \cdot 3 - 2.2 = +1$

What's the margin?

- Distance to closest point

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- Weight vector

$$\frac{1}{\|w\|} = \frac{1}{\sqrt{\left(\frac{2}{5}\right)^2 + \left(\frac{4}{5}\right)^2}} = \frac{1}{\sqrt{\frac{20}{25}}} = \frac{5}{\sqrt{5}\sqrt{4}} = \frac{\sqrt{5}}{2} \tag{5}$$