CMPS 142: Homework Assignment 3

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1. We want to find the minimum of the geometric margin,

$$min_{w,b}\frac{y(w \cdot x_i + b)}{||w||^2}$$

Our decision boundary will be of the form $w \cdot x_i + b > 0$, which can also be expressed as $w_1 x + w_2 y + b > 0$. After graphing the data and evaluating them visually, we can find a good candidate for a decision boundary at $y > -x + \frac{3}{2}$, or $x + y - \frac{3}{2} > 0$. Our w_1 and w_2 are both 1 and we have a margin of $\frac{2}{||w||} = \sqrt{2}$. The support vectors, then, are (1,1), (1,0), and (0,1).

2. In executing grid search with the specified bounds on parameters, we determined the following costs and gammas for SMO:

C_{min}	C_{max}	C_{step}	γ_{min}	γ_{max}	γ_{step}	Sample Size	C	γ	Accuracy
1	16	1	-5	2	1	25%	16	0	93.6318 %
1	16	1	-5	2	1	50%	14	1	93.6101 %
15	32	1	0	2	0.25	10%	31	0	93.6536 %
15	32	1	0	2	0.25	25%	25	0	93.697 %
23	27	0.25	0.7	1.3	0.1	10%	27	0.7	93.3275 %
23	27	0.25	0.7	1.3	0.1	25%	25.75	0.7	93.371 %
23	27	0.25	0.7	1.3	0.1	50%	24.75	0.7	93.371 %

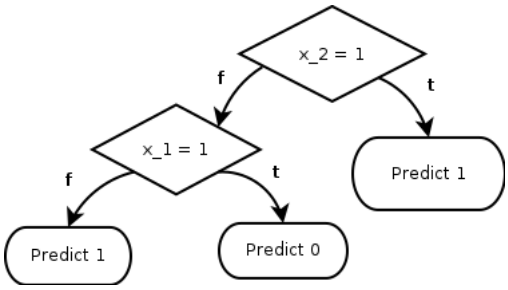
Where the expression for c was i and the expression for γ was 10^i.

3. We can demonstrate the construction of a decision tree on a simple binary dataset such as:

x_1	x_2	y
0	1	1
1	1	1
1	0	0
0	0	1
1	0	0

In calculating the decision tree, we first decide the attribute to split on for the first node by finding the sum the incorrect predictions. Should we split on x_1, when $x_1 = 0$ there are no errors, and when $x_1 = 1$ there are two errors. Should we split on x_2, if $x_2 = 0$ we have one error, and if $x_2 = 1$ we have no errors. This makes a split on x_2 the better choice. Then for the second node, should $x_2 = 0$, we split on the remaining attribute, x_1. By following decision tree algorithm, we find a representation in

the following tree:



However, there exists a simpler tree to classify this miniscule dataset, should we allow compound conditionals on the nodes: