CAIRO UNIVERSITY
FACULTY OF ENGINEERING
Pattern Classification

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1) Plot the decision regions and the decision boundary for the two-dimensional linear classifier with $w = (1, 0.5)^T$ and $w_0 = -0.5$.

2) Consider the two-dimensional two-class classification problem, given by the following vectors:

Class 1 : $x(1) = (0 \;\; 1.5)^T$, $x(2) = (1 \;\; 0)^T$, $x(3) = (0.5 \;\; 0)^T$.

Class 2 : $x(4) = (1 \;\; 1)^T$, $x(5) = (1.5 \;\; 0.5)^T$,

Find the weights of a linear classifier, that classifies these points correctly.
If that classifier is given a new point $(1, 1.5)^T$ to classify, what would be the classification?

3) Plot the decision regions and the decision boundary for the two-dimensional nonlinear classifier

$$0.25x_1^2 + x_2^2 = 1$$

Plot the decision regions for the three classes and decision boundary.

4) Consider the two-dimensional three-class classification problem, where the class centers are given by the vectors $(-1 \;\; 0)^T$, $(1 \;\; 0)^T$, $(0 \;\; \sqrt{3})^T$. Plot the decision regions and the decision boundaries for the minimum distance classifier.

5) Consider the two-dimensional four-class classification problem, where the class centers are given by the vectors $(0 \;\; 2)^T$, $(1 \;\; 0)^T$, $(1 \;\; 4)^T$, $(2 \;\; 2)^T$. Plot the decision regions and the decision boundaries for the minimum distance classifier. Find the classification of the vector $(0 \;\; 3)^T$.

6) Consider the following problem:

Class 1 patterns: $(0 \;\; 0)^T$, $(0.5 \;\; -0.1)^T$, $(0.5 \;\; 0.25)^T$, $(1 \;\; 0)^T$, $(0 \;\; 0.5)^T$, $(0 \;\; 1)^T$.
Class 2 patterns: $(2 \;\; 2)^T$, $(2 \;\; 2.5)^T$ $(2.5 \;\; 2)^T$, $(2.25 \;\; 2.25)^T$, $(2.1 \;\; 2.5)^T$, $(3.5 \;\; 1.5)^T$

Assume that we would like to use the nearest neighbor classifier. What would be the classification of each the following two patterns: $(1.2 \;\; 1.2)^T$, $(1 \;\; 0.5)^T$? What would be the classification of these two points using the K-nearest neighbor rule where $K = 3$?