Pattern Classification Homework #1

1. Let the discriminant functions for a three class problem be

   $g_1(\underline{x}) = -x_1 + x_2$

   $g_2(\underline{x}) = x_1 + x_2 - 1$

   $g_3(\underline{x}) = -x_2$

   and the decision rule is the original one described in class:

   Assign $\underline{x}$ to S_k iff $g_k(\underline{x}) > g_j(\underline{x})$ for all $j \neq k$

   (a) Draw the decision boundaries and label classified regions and any indeterminant regions.

   (b) Classify the point $\underline{x}=(1,1)^T$

   (c) Classify the point $\underline{x}=(1/2,1/4)^T$

2. For a multiclass problem, if any class S_k can be separated from all other classes S_j by a single hyperplane, the samples are totally linearly separable and can be separated by S_k vs. not S_k decisions. Let the decision functions for a 3 class problem be

   $g_1 = -x_1 + x_2$

   $g_2 = x_1 + x_2 - 5$

   $g_3 = -x_2 + 1$

   Let

   $g_i(\underline{x}) > 0$ then $\underline{x} \in S_i$

   $g_i(\underline{x}) < 0$ then $\underline{x} \in \overline{S}_i$

   and the decision rule is:

   Assign $\underline{x}$ to class S_i iff $\underline{x} \in S_i$ and $\underline{x} \in \overline{S}_j$ for all $j \neq i$.

   (a) Find the decision boundaries and draw them in the feature space.

   (b) Label the classification of regions and identify any indeterminant (undefined) regions.

   (c) Classify the following samples $\underline{x}^{(1)} = (6,5)$, $\underline{x}^{(2)} = (2.5,2)$, and $\underline{x}^{(3)} = (3,0)$.