RPZ January 8, 2010

Name:

1. (2 points) Define the Neyman-Pearson recognition task.
   (3 points) Find the optimal strategy according to Neyman-Pearson in a problem, where classified objects are from two classes $k \in \{1, 2\}$. The observations are real number $x \in (0, 1)$. Conditional probability densities $p(x|k)$ have the following form: $p(x|1) = 2x, p(x|2) = 3x^2$. Acceptable false negative rate (missed dangerous object) is 0.1 (10%), class 1 is considered dangerous.

2. (5 points) A training set T is given: $T = \{(\mathbf{x_i}; k_i)\}, i = 1, \dots, 5, \mathbf{x_i} \in R^2, k \in \{1, -1\}$,
   $T = \{(-2, 1; 1), (0, 0; -1), (0, 2; -1), (0, -3; 1), (2, 2, -1)\}$.

   Use perceptron algoritm to find a linear classifier,i.e. a vector $\mathbf{w} \in R^2$ and a shift $b \in R$ such that $y = \mathbf{w}\mathbf{x} + b$ is positive for objects from class $k = 1$ and negative for $k = -1$.

   What are the weights $\mathbf{w}$ and shift b after ten iterations of the perceptron algorithm?

3. (5 points) Describe the Support Vector Machine, its learning method and its properties.

4. (5 points) Find the decision function minimizing classification error in a two-class recognition problem where both classes have equal apriori probabilities and normal (Gaussian) conditional probababilities $N(\mu_1, \mathbf{C}_1)$ and $N(\mu_2, \mathbf{C}_2)$ respectively, where: $\mu_1 = \begin{bmatrix} 3 \\ -2 \end{bmatrix} \mathbf{C}_1 = \begin{bmatrix} 1/2 & 0 \\ 0 & 2 \end{bmatrix} \mu_2 = \begin{bmatrix} 3 \\ -2 \end{bmatrix} \mathbf{C}_2 = \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$