Quiz 1
October 24, 2016

Time: 50 minutes; Total Marks: 45
One double-sided 8.5" x 11" cheat sheet allowed

This test contains 3 questions and 5 pages

NAME: _____

STUDENT NUMBER: _____

Question	Marks	Time budget
1	/24	25 min
2	/12	10 min
3	/9	10 min

1. (24 marks) True or False questions. **Provide a short explanation.**

   (a) True or False. If a parameter μ maximizes the likelihood for a training set $\mathcal{D}$, μ also maximizes the log likelihood for $\mathcal{D}$.

   (b) True or False. The prior probability that a sample is in class k, $P(\mathcal{C}_k)$, must be no greater than 1: i.e. $P(\mathcal{C}_k) \leq 1$.

   (c) True or False. The perceptron criterion for training a classifier is equal to the number of mis-classified training examples.

(d) True or False. For a fixed learning rate η, gradient descent and stochastic gradient descent will always obtain the same solution when training logistic regression.

(e) True or False. A neural network classifier with 1 layer of hidden units can produce non-linear decision boundaries.

(f) True or False. The weight vector $\boldsymbol{w}$ that minimizes error in a neural network is unique.

2. (12 marks) Consider regression with a single training data point: $(x_1 = 4, t_1 = 3)$ and the basis function

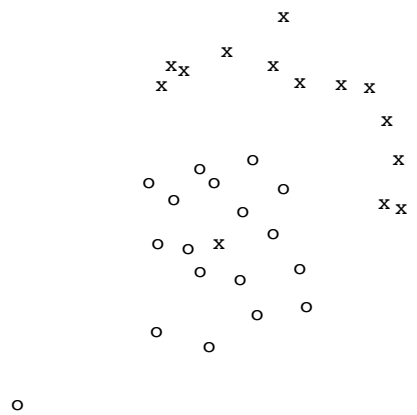
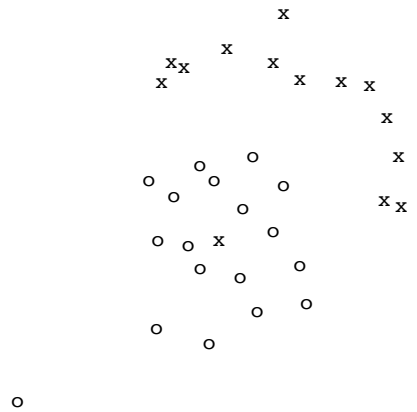
$$\phi_1(x) \quad = \quad \exp\left\{-(x-4)^2\right\}$$

- Suppose we train a model with no regularization using only the basis function $\phi_1(x)$ (no bias term): $y(x) = w_1\phi_1(x)$.
  - Draw the learned function $y(x)$.
  - What would w_1 be?

- Suppose we added a bias term: $y(x) = w_0 + w_1\phi_1(x)$ and trained with no regularization. What would happen?

- Suppose we added a bias term: $y(x) = w_0 + w_1\phi_1(x)$ and trained with regularization only on w_1. What would happen?

3. (9 marks) Consider the training set below for two-class classification. Draw the approximate decision regions when using **1-nearest neighbour**, **3-nearest neighbour**, and **logistic regression**. Please notice the "x" in the middle of the "o" points.

1-nearest neighbour	
3-nearest neighbour	
logistic regression