CSI 635 Assignment #2: Unsupervised & Reinforcement Learning

Due: 04/08/02 at the start of class
One half grade will be deducted per week (including partial weeks) delay

Marks: 17% of final grade

Choose either option a) or option b).

Option a): Reinforcement Learning

Provide solutions for exercises 13.2, 13.3 on page 388 of the Mitchell book and two additional questions. Show detailed working and reasoning for all solutions. The points for each question are as follow:

Q1. Exercise 13.2 a) 10, b) 10, c) 20. Note introduce notation that describe the states, actions and reward.

Q2. For the grid world problem, write the psuedo code that implements an agent that performs Q learning while navigating this world. 15 points

Q3. Exercise 13.3 a) 20  b) 10

Q4. Describe the limitations of Q learning. Sustain your argument with examples. 15 points.

Total 100 points

Option b): Clustering

Implement either the K-Means or SOM algorithm for clustering.

Question 1): Provide the psuedo code for your algorithm. 30 points

Question 2): Discuss the convergence properties and sensitivity to initial conditions of the algorithm. 15 points

Try the algorithms on the following problem.

Segmentation and Prediction

Cluster the training data for the pen-based digit recognition problem provided for assignment #1 into ten classes (note you must not consider the dependent attribute). If you wish, you can experiment with more than ten classes.

Question 3): List the centroids of each cluster and the proportion of the cluster’s instances by digit. For each cluster determine the “majority” digit. For each cluster, plot the centroid values onto a grid. Remember (0,0), (100,0), (0,100), (100,100) are the bottom left hand, bottom right hand, top left hand and top right hand corners respectively. 20 points

Question 4): Using the second test set classify each instance into a cluster and make a prediction of its digit. Describe how you make your predictions. Send predictions in machine readable format with one prediction per line. 20 points

Question 5): Rank the instances in the training set according to their distance to their respective cluster centers. Isolate the 10 percent most distant instances. What interesting insights can you can find amongst
these outliers? For example are they all the same digit? You may refer to the pictures of the training digits on the web site. 15 points.

Bonus Question

Submit another set of predictions for the test set, but this time you do not need to make predictions for all instances. Incorporate the notion of confidence in your predictions and describe how you make predictions for only your 75% most confident predictions. Mark an absent prediction with a blank line. 10 points.