CSCI 390, Artificial Intelligence

Assignment 8

Question 1 (Linear regression)

The following is a table of data to be used for linear regression. This table describes the expenditure (in dollars) on recreation per month by employees at a certain company, and their corresponding monthly incomes. We treat the left-hand column as the input and the right-hand column as the output. Considering the bias parameter in your computation.

Expenditure ($)	Income ($)
2400	41200
2650	50100
2350	52000
4950	66000
3100	44500
2500	37700
5106	73500
3100	37500
2900	56700
1750	35600

Answer the following questions:

a. Find the equation of the linear regression line for the data
b. What is the slope? What is the y-intercept?
c. Using the equation for the linear regression that you calculated, estimate the monthly income of an employee at this company who spends 5000 dollars per month on recreation.

Question 2 (Binary perceptron)

Apply the binary perceptron algorithm for the following data set. The training samples (i.e., 3D data points with the corresponding labels) are given as the following table.

#	Features (x_1, x_2, x_3)	Class label
1	(4,3,6)	-
2	(2,-2,3)	+
3	(1,0,-3)	+
4	(4,2,3)	-

Start with weight vector $w = (w_0, w_1, w_2, w_3) = (1,0,0,0)$, where w_0 is the bias parameter. Then, you need to use the bias feature together with given features during your computation.

a. Will the perceptron algorithm converge? Write "never" if it will never converge and prove.

b. If the perceptron algorithm converges, fill out the table below. After how many steps will the perceptron algorithm converge? Note: one step means processing one data point. Data points are processed in order and then repeated, until convergence.

Step	Weights	Score	Correct?
1	(1,0,0,0)		

Final weights:

Question 3 (Multi-class perceptron)

Consider a multi-class perceptron with current weight vectors $w_A = (1, 2, 3)$, $w_B = (-1, 0, 2)$, $w_C = (0, -2, 1)$. A new training sample is provided, which has feature vector $x = (x_0, x_1, x_2) = (1, -3, 1)$ and label $y^* = B$. Here, x_0 is the bias feature.

a. Which class y would be predicted by the current weight vectors?

b. Would the perceptron update the weight vectors after having seen this training example? If yes, write the resulting weight vectors below:

$w_A =$

$w_B =$

$w_C =$