Registration No_____ Section_____

National University of Computer and Emerging Sciences, Lahore Campus

Course:	Artificial Intelligence	Course Code:	CS 401
Program:	BS(Computer Science)	Semester:	Fall 2016
Duration:	60 minutes	Total Marks:	25
Date	10-11-2016	Weight	15%
Section:	A and B	Pages:	7

Notes:

This is a closed book exam however students are allowed to possess a hand written A4 size cheat-sheet

Calculators are allowed

Attempt All Questions in the space provided. You might use extra sheets but write your final answer in the provided space to get it marked.

Problem 1: 5 Points

Part a) **[5 Points]**

For a binary classification task the actual labels of 10 instances and the labels predicted by a decision tree are given below.

Actual Labels	Red	Green	Red	Red	Red	Green	Green	Red	Green	Red
Predicted Labels	Red	Red	Red	Green	Red	Red	Green	Red	Green	Green

Compute the confusion matrix and four accuracy measures including Accuracy, Precision, Recall and F-1 score for each of the two classes.

Part b) **[3 Points]**

Give a brief justification of why each of the following statements are true or false.

i) In some cases the accuracy of a classifier might be a misleading measure of its' performance.

ii) It is always a good idea to reserve 50% of the labeled training examples for measuring Test accuracy

iii) A classifier having a high precision and very low recall has a very high false positive rate

Problem 2: Genetic Algorithms:

Part a) **[2+ 1+ 1 Points]**

The famous N-QUEENS problem requires us to place N queens on an N x N chess board such that no queen is attacking the other queen. It has been decided to solve this problem by using the famous genetic algorithm.

I. Suggest a suitable representation of the chromosome(i.e. a possible solution) for this problem.

II. What is the size of search space for the problem when N is 20.

III. How would you measure the fitness of a chromosome for this problem.

Part b) **[4 Points]**

An unknown problem is being solved by using the genetic algorithm. Following table lists the initial population with each chromosome represented as a sequence of nine bits.

Initial Population	Fitness	New Population
100010111	6	
100000001	1	
010101010	0	
010100110	5	
001100111	0	
110110110	8	

For this initial population, determine the next population that results after one iteration. Assume that fitness-proportionate selection is being used to select chromosomes and that a single point cross-over is used by the algorithm. Also assume that the Mutation rate of 0.1. If you need random numbers, choose in order from the following list and repeat from beginning if you need more.

.86, .59, .67, .14, .34, .08, .11, .29, .85, .76, .43, .47, .89, .80, .98, .58, .03, .57, .49, .92

Problem 3: Decision Tree Learning **[3 + 2 Points]**

A Pakistani space ship robot is to be programmed to discriminate aliens from human beings. A student at FAST working at the SPARCO suggest that a identification tree can be learned using some training data. After much hard work the following training data has been prepared by the SPARCO and the world famous ID3 algorithm is to be used to fit a single node decision tree on the training data. It was further decided that the accuracy will be estimated by using six randomly selected as training set and two randomly chosen examples as test set.

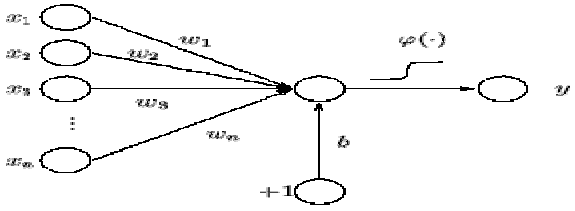
Green	Legs	Height	Smelly	Actual Label
N	3	S	Y	A
Y	2	T	N	A
Y	3	T	N	A
N	2	S	Y	A
Y	3	T	N	A
N	2	T	Y	H
N	2	S	N	H
N	2	T	N	H
Y	2	S	N	H
N	2	T	Y	H

I. Which feature will be placed at the root of the decision tree by the ID3 algorithm. Show all working. Assume that Entropy based Gain measure will be used to select a feature. Also remember that you need to select six randomly chosen examples as training set.

II. Compute test accuracy of the decision tree and also compute training performance by computing accuracy, precision and recall for the human class.

Problem 4: Delta Rule Derivation **[4 Points]**

Consider a single perceptron unit with a bias term $\mathbf{x_0 = b = +1}$ and ***n* inputs** [x_1, ... x_n].



Assume that the perceptron uses weights [w_0, w_1, ... w_n] and the squashing activation function given below to compute the output

$$f(x) = \tanh(x) = \frac{2}{1 + e^{-2x}} - 1 \qquad f'(x) = 1 - f(x)^2$$

Use the MSE (Mean Squared Error) to derive the weight update equation for such a perceptron

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