

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)****ORGANISATION OF ISLAMIC COOPERATION (OIC)****Department of Computer Science and Engineering (CSE)****MID SEMESTER EXAMINATION****WINTER SEMESTER, 2012-2013****DURATION: 1 Hour 30 Minutes****FULL MARKS: 75****CSE 4541: Machine Learning****Programmable calculators are not allowed. Do not write anything on the question paper.**There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

1. a) Define Learning with suitable example. 5
  - b) State the Task (T), Performance Measure (P) and Training Experience (E) of the following learning tasks: 10
    - i. Autonomous Driving Program
    - ii. Computer Chess Program
    - iii. Face Recognition System
    - iv. Handwriting Recognition System
  - c) You are asked to design a program which can play Checkers with human opponents. One of the tasks that you will need to address is the choice of the Target Function. Which one will you use from the following target functions? Justify your answer. 10
    - i. Lookup table
    - ii. Collection of rules
    - iii. Neural Networks
    - iv. Polynomial Functions
2. a) With an example explain the Inductive Learning Hypothesis. 5
  - b) What is Inductive Bias? State the bias of Find-S and Candidate Elimination Algorithm. 5
  - c) Consider the following set of training examples given in Table 1 to train a robot janitor to predict whether or not an office contains a recycling bin. 15

Table 1: Set of training examples

	STATUS	FLOOR	DEPT.	OFFICE	RECYCLING BIN?
1	Faculty	Four	CSE	Medium	Yes
2	Faculty	Four	EEE	Medium	Yes
3	Student	Four	CSE	Small	No
4	Faculty	Five	CSE	Medium	yes

Run the Candidate Elimination Algorithm on the above training examples and generate the sequence of S and G boundaries.

3. a) Consider the Table 2 containing Student Exam Performance Data.

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Table 2: Student exam performance data

	Student Name	Was First last year?	Male?	Works hard?	Drinks?	First this year?
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From this data

- i. Find the entropy of this data collection.
  - ii. Step by step show the construction of a minimal decision tree for this dataset.
- b) Use the decision tree obtained in question 3.a) ii. to classify the instances of Table 3.

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Table 3: Instances

	Student Name	Was First last year?	Male?	Works hard?	Drinks?	First this year?
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- c) Briefly discuss on Reduced Error Pruning.

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4. a) What are Perceptron Units in Artificial Neural Networks (ANN)?

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b) Consider the following Boolean function shown in Table 4. Answer the followings:

4+6

- i. Can this function be represented by a perceptron? Explain with appropriate figure.
- ii. Construct a perceptron that represents the function of Table 4.

Table 4: Boolean function

A	B	$\sim A \vee B$
1	1	1
1	0	0
0	1	1
0	0	1

- c) Gradient Descent algorithm finds the steepest descent along the error surface. This is calculated by computing the derivative of error  $E$  with respect to each component of the weight vector  $w$  according to the following equation:

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$$\nabla E(\vec{w}) \equiv \left[ \frac{\partial E}{\partial w_0}, \frac{\partial E}{\partial w_1}, \dots, \frac{\partial E}{\partial w_n} \right]$$

From the above expression derive an expression of  $\Delta w_i$  in terms of  $t_d, o_d, x_{id}$ .