Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(ECE-NEW)/SEM-7/EC-704E/2009-10

2009

PATTERN RECOGNITION & MACHINE INTELLIGENCE

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives of the following : 10 × 1 = 10

   i) "The computer passes the test if a human interrogator, after posing some written questions, cannot tell whether the response come from a human being or machine."

   Above definition belongs to which one of the following tests ?

   a) Searle's test b) Turing test

   c) Shannon's test d) Weizenbaum test.

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ii) Simulation of intelligence is

a) Strong AI b) Average AI

c) Weak AI d) Very strong AI.

iii) Depth first search is

a) optimal b) complete

c) all of these d) none of these.

iv) The space complexity of depth first search is which one of the following when b is a branching factor and m is a maximum depth ?

a) $O(bm)$ b) $O(mb)$

c) $O(b + m)$ d) none of these.

v) Alpha beta pruning achieves same optimal moves a minimax but achieves improved efficiency by eliminating sub-trees which are

a) at higher cost b) at lower cost

c) provably irrelevant d) none of these.

vi) For any two events x_1 , x_2 and a background evidence E, $P(x_1, x_2 / E) = P(x_2 / E)$, $P(x_1 / E)$ holds good when

a) x_1 and x_2 are independent

b) x_1 is independent of E, but x_2 is dependent of E

c) x_1 , x_2 and E are independent

d) x_1 and x_2 are dependent on E.

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vii) In k-means chestering

a) a point may be mapped into more than one classes

b) all points are mapped on to a single class

c) each point is mapped to its nearest class

d) no more than one point is mapped on to a class.

viii) Non-linearity in a neuron maps is

a) an infinite domain to a finite range

b) a finite domain to an infinite range

c) a finite domain to a finite range

d) an infinite domain to an infinite range.

ix) The belief Bel $\{A, B\}$ is defined by

a) algebraic sum of Bel $\{A\}$ and Bel $\{B\}$

b) orthogonal sum of Bel $\{A\}$ and Bel $\{B\}$

c) logical minimum of Bel $\{A\}$ and Bel $\{B\}$

d) logical product of Bel $\{A\}$ and Bel $\{B\}$.

x) Bayes' classifier employs

a) Maholanobis distance

b) Euclidean distance

c) city-block distance

d) any non-Euclidean distance metric.

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GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Define in your own words the following terms :

   a) State

   b) State space

   c) Search tree

   d) Search node

   e) Goal

   f) Branching factor.

3. Discuss the steps of depth first search algorithm using stacks.

4. What is forward reasoning ? Explain with a suitable example.

5. Given an axiomatic theory $T = \{ \square P \square Q, \quad \neg Q \}$. Prove that $\neg P$ follows from T using non-monotonic resasoning.

6. Construct the weight matrix for a discrete Hopfield net for the following desired stable states :

   $X_1 = [\ 1 \quad -1 \quad 1\ ]$

   $X_2 = [\ -1 \quad 1 \quad -1\ ]$

   and $X_3 = [\ -1 \quad -1 \quad 1\ ]$.

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GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. The missionaries and cannibals probem is usually stated as follows : Five missionaries and four cannibals are on one side of a river, along with a boat that can hold at a time one or two people find a way to get everyone to the other side, without everleaving a group of missionaries with excess cannibals.

   a) Construct a set of production rules for the missionaries-cannibals problem.

   b) Show the solution to the problem by the space search. 8 + 7

8. a) Discuss the steps of breadth first search algorithm. Also explain the order of traversal using tree of depth three.

   b) What is Hill-climbing ? Explain its procedure using stack. 6 + 6 + 3

9. a) Consider the following set of data points :

   $(x_1, x_2) \in \{(1, 1), (2, 2), (2, 1), (5, 1), (6, 2), (7, 1)\}$.

   Initialize $c_1 \in (x_1, x_2) = (1, 2)$ and $c_2 \in (x_1, x_2) = (7, 2)$ as two random chester centres.

   Show one step of execution of the *k*-means dustering and hence determine the updated cluster centres.

   b) What condition do you set to check convergence of the algorithm ?

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c) State the objective function for the k-means chestering and evaluate its value after the first step.

d) How does fuzzy C-means chestering differ from the k-means algorithm ? 6 + 2 + 4 + 3

10. a) Find the eigenvalues of the following matrix :

$$A = \begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$$

and hence determine the principal eigenvector.

b) How can principal component analysis be used for face recognition ? (6 + 2) + 7

11. Consider the following piece of knowledge :

a) Tony, Mike and John are members of Himalaya Club ($H - C$)

b) Every Himalaya Club member who is not a skier is a mountain climber.

c) Mountain climbers do not like rains.

d) Anyone who does not lie snow is not a skier.

e) Mike dislikes whatever Tony likes and likes whatever Toney dislikes.

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f) Tony likes rain and

Represent this knowledge as a predicate statements appropriate for a backward rule based deduction system. Show how such a system would answer the query "Is there a member of Himalaya Club who is not a mountain climber but a skier" by using resolution principle. 15

12. Write short notes on any *three* of the following : 3 × 5

a) Application of pattern recognition and machine intelligence

b) Genetic Algorithm (GA)

c) Abductive reasoning using Fuzzy logic

d) Application of back-propagation neural network in pattern classification problem

e) Bayes' classifier.

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