Total number of printed pages – 8 **B. Tech**

PECS 3301

Sixth Semester Examination – 2008

ARTIFICIAL INTELLIGENCE

Full Marks – 70

Time : 3 Hours

Answer questions from Section – A or B but not from both.

Section – A

Answer Question No. ***1*** *which is compulsory and any* ***five*** *from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2 × 10

   (a) What is the space and time complexity of minimax search with alpha-beta pruning ?

   (b) Define backward chaining with backtracking.

   (c) What are the major components of Expert system ?

   (d) What are the principal risks of hill climbing ?

   (e) Define what it means for a heuristic function to be admissible, and to be monotonic.

   (f) Define what it means for a search algorithm to be complete and to be optimal.

   (g) What is basic difference between A* and AO* algorithm ?

   (h) Define Problem Space or Search Space.

   (i) What is a Horn clause ?

   (j) What is knowledge acquisition ?

2. (a) Use a truth table to prove that Modus Ponens is valid. 5

   (b) What is unification in the context of First-Order Predicate Logic ? Why is it necessary ? 5

3. (a) What is meant by the term 'Unification' when applied to the First-Order Predicate Calculus ? Illustrate your answer by constructing a commented list of the tasks required of a unification algorithm. 5

(b) Describe the Minimax Algorithm for searching game trees. 5

4. (a) Given the following situation :

Jack owns a dog. Every dog owner is an animal lover. No animal lover kills an animal. Either Jack or Curiosity killed the cat, who is named Claude.

We want to know "did Curiosity kill the cat ?" 5

- Express the above situation in first-order predicate logic
- Express the situation in Conjunctive Normal Form
- Use resolution refutation to answer the question.

(b) Describe the operation of the A by heuristic search algorithm. 5

5. (a) Explain how the Alpha-Beta Algorithm is a better way to search game tree. 5

(b) Give a brief description of the basic back-tracking algorithm for finding a solution. 5

6. (a) Use an outline diagram to describe the structure of the main parts of an expert system. What is knowledge acquisition ? What are the most common knowledge acquisition techniques ? 5

(b) Give a brief description of the way in which if-then rules can be used as a basis for knowledge representation and reasoning. What essential elements would you expect to be included in such a system ? 5

7. (a) Why does search in game-playing programs always proceed forward from the current position rather than backward from the goal ? 5

(b) Convert the following sentences into propositional logic and use resolution refutation to prove : you are either too warm or get soaked. 5

If it is raining then put on your raincoat. If it is not raining then you are too warm. If it is raining and you don't put on your raincoat then you will get soaked ! You didn't put on your raincoat !!!

8. (a) Is the following WFF valid ? Justify your answer using a truth table. 5

$$\left(\neg A \vee B\right) \wedge \left(\neg B \vee C\right) \Rightarrow \left(\neg A \vee C\right)$$

(b) Write brief notes describing the various components that may be required of a system of inference in the First-Order Predicate calculus. 5

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Section – B

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10
   (a) Distinguish between search space and state space.
   (b) Write two characteristics of good control strategy.
   (c) Differentiate between knowledge and data.
   (d) What is a heuristic search technique ?
   (e) Differentiate between forward chaining and backward chaining.
   (f) Define AI and agent.
   (g) What basic functions or operations must a program perform in order to access specific chunks of knowledge ?
   (h) What do you mean by syntactic processing ?
   (i) What is inferencing mechanism ?
   (j) What is a non-monotonic reasoning system ?
2. (a) Show that A* algorithm is admissible. 5
   (b) Give the initial state, goal test, successor function and cost function for the following problem :

"Two water jugs, a 7 litre one and a 4 litre one, have no measuring marks on them. There is a pump with continuous flow of water. How can exactly 2 litres of water be stored in the 7 litre jug" ? 5

3. (a) Describe a state space in which iterative deepening search performs much worse than depth-first search. 5

(b) What are the different characteristics that govern the direction of a search procedure ? When is the bidirectional search more fruitful ? 5

4. (a) Differentiate between reflex agent, goal-based agent, utility based agent and learning agent. 5

(b) Show that if a heuristic is consistent, it must be admissible. Construct an admissible heuristic that is not consistent. 5

5. (a) Represent the following sentences in first-order-logic : 5

"Politicians can fool some of the people all of the time, and they can fool all of the people some of the time, but they can't fool all of the people all of the time."

(b) How can resolution be used to show that a sentence is valid ? Unsatisfiable ? 5

6. (a) Describe the differences and similarities between problem solving and planning using an example. 5

(b) Explain the learning techniques in Neural network. 5

7. (a) Explain the learning techniques for each pair of terms (if it exists) : 5

(i) P (A, B, B) ; P (x, y, z)

(ii) (f, Marcus (g, x, y)) ; (f, x (g, Cassar, Marcus))

(b) Translate the following sentence to conjunctive normal form : 5

"Everyone who lover all animals is loved by someone."

8. (a) What is the Chomsky hierarchy ? Explain the limitations of Chomsky's grammars for describing English languages. 5

(b) What is context free language ? Check whether the sentence **"The silly robot moved the red pyramid to the big table"** is context free or not. 5

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