

Sixth Semester Examination – 2007

ARTIFICIAL INTELLIGENCE

Full Marks – 70

Time : 3 Hours

IWL

*Answer the questions either from Set – A or  
Set – B but not from both.*

P.T.O.

## Set – 'A'

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

The figures in the right-hand margin indicate full marks for the questions.

1. Answer the following questions : 2 × 10

- (a) List two properties of environment.
- (b) Distinguish between Search space and State space.
- (c) Differentiate between Knowledge and Data.
- (d) In what kind of a problem space would a depth-first search be better than a breadth first one ?
- (e) Write a grammar to parse the following sentence :  
"The child runs."
- (f) List two examples of informed and uninformed search.
- (g) Define constraint satisfaction problem.

- (h) Differentiate between a predicate and a function.
- (i) Write four different application areas of Artificial Intelligence.
- (j) What is planning ? List one example of a partial-order planning.

2. (a) How can resolution be used to show that a sentence is valid ? Explain with an example. 5

(b) How the choice between situation space and plan space affects the efficiency of a planner ? Explain. 5

3. (a) What are the characteristics that govern the direction of a search procedure ? 4

(b) Algorithm A\* does not terminate until a goal node is selected for expansion. However, a path to a goal node might be reached long before that node is selected for expansion. Why is it not terminated as soon as a goal

- node has been found ? Illustrate your answer with an example. 6
4. (a) Discuss and compare hill climbing and best-first search techniques. 5
- (b) Consider a finite tree of depth  $d$  and branching factor  $b$ . Suppose the shallowest node is at depth  $g \leq d$ . What is the minimum and maximum numbers of nodes that might be generated by a depth first-iterative deepening search ? 5
5. (a) Explain the learning algorithm used in Neutral Networks. Illustrate the procedure with suitable example. 6
- (b) What is the difference between a performance measure and a utility function ? Explain. 4
6. (a) Propose a grammar to handle pronoun case in natural language processing. 6
- (b) Why is the phase structure grammar is inadequate for natural language syntax analysis ? Discuss. 4

7. (a) Show that the final state of the knowledge base after a series of calls to forward-chain is independent of the order of the calls. Does the number of inference steps required depend on the order in which sentences are added ? Suggest a useful heuristic for choosing an order. 6
- (b) Head, I win ; tails you lose. Express these statements (plus orther statements you might need) in the propositional calculus and then use resolution to prove that I win. 4
8. (a) What are the properties of a good system for representation of knowledge ? Discuss with example, the use of declarative and procedural methods to accomplish the objectives of these properties. 5
- (b) Discuss the type of ambiguity in natural language processing and how to resolve it ? 5

## Set – 'B'

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

The figures in the right-hand margin indicate full  
marks for the questions.

[Assume standard formalism wherever necessary]

1. Answer the following questions : 2×10
- (a) What is an admissible heuristic ?
  - (b) What is meant by "first order predicate calculus" or "first order logic" ?
  - (c) State one problem with knowledge acquisition.
  - (d) Define and differentiate between forward chaining and backward chaining.
  - (e) What do you mean by inference mechanism ?

- (f) Define and differentiate between knowledge base and data base.
  - (g) Is A\* search with an admissible heuristic complete ? Is it optimal ?
  - (h) Why is resolution implemented as proof by contradiction ?
  - (i) Define satisfiability of a sentence.
  - (j) What is basic difference between A\* and AO\* algorithm ?
2. (a) Define the term knowledge representation and show how rules qualify to be knowledge representation formalism. 5
- (b) Prove using resolution refutation that from the following sentence

$$\neg A \wedge (C \rightarrow A) \wedge (B \rightarrow (A \vee C))$$

You can deduce to  $(\neg A \wedge \neg B \wedge \neg C)$ . 5

3. (a) What are some ways of handling imprecision and uncertainty in an expert system? What are the pros and cons of each? 5

(b) Translate the following into predicate calculus ( first order logic ) using the predicates provided.

"Every person is loved by some other person"

Predicates : Person (x) loves (x, y)

"A bus took all the PECS 3301 students to one of the stations in New Delhi"

Predicates : Bus (x), Course (x), Station (x), New Delhi (x), course\_name (x, y), in (x, y)

"All birds have at least two wings and exactly two legs"

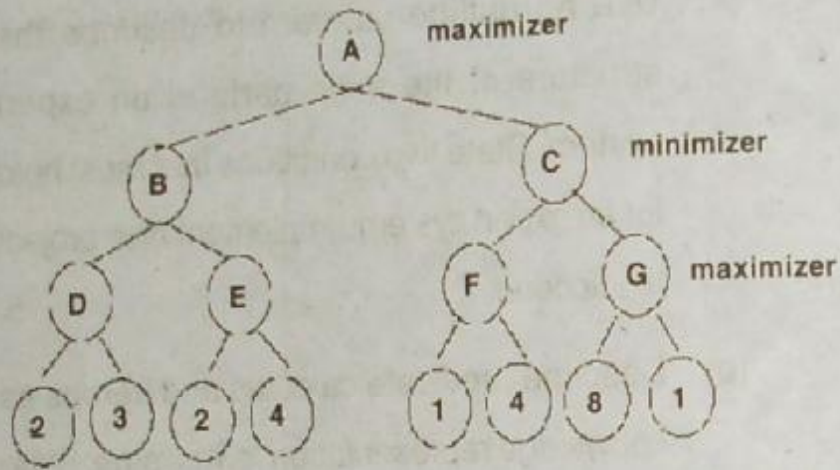
Predicates : Bird (x), Wing(x), Leg(x), has(x,y)

**Note : Do not use the  $\exists$  notation.** 5

4. (a) Use an outline diagram to describe the structure of the main parts of an expert system. State two conditions that must hold for an expert systems implementation project to succeed. 5

(b) Describe predicate calculus and frames as knowledge representation formalisms. State one advantage and one limitation of each of these knowledge representation formalisms. 5

5. (a) Apply the minimax algorithm to the game tree below, where it is the maximizer's turn to play. The values estimated by the evaluation function are indicated at the leaf nodes. Write the estimated values of the intermediate nodes beside their circles, and indicate the proper move of the maximizer by circling one of the root's outgoing arcs. 5



(b) What is knowledge acquisition? Describe the knowledge acquisition process. Discuss, why you think the rule induction and protocol analysis, knowledge elicitation techniques are different. 5

6. (a) Use propositional logic to represent the following sentences. 5

- (i) Fido is always either sleeping or barking.
- (ii) When Fido is hungry Fido barks, but Fido barking does not necessarily mean that Fido is hungry.

(b) What is a heuristic? Give an example of a heuristic that may be used in finding paths between cities. Discuss generation, evaluation and pruning in the context of game playing. 5

7. (a) Discuss Machine Vision and, Natural language & understanding considering in each case the main objective or activities, challenges and potential applications. 5

(b) Define hill climbing as a generalized search technique. What are the principal risks of hill climbing? 5

8. (a) Pruning a game tree is possible with the alpha-beta heuristic. Define and illustrate this heuristic. Give a clear example on a simplified game search tree. 5

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

$$[(P \vee Q) \wedge (Q \vee R)] \Rightarrow (P \vee R).$$

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