B.E. (CST) Part-IV 8th Semester Examination, 2007

# Symbolic Logic & Artificial Intelligence

## (CST-802)

Time : 3 hours                                                    Full Marks : 100

*Answer any FIVE questions.*

1. a) Explain the diference between inductive learning and deductive learning giving suitable examples.

   b) Write ID3 algorithm for induction of decision tree, given a set of attributes and a set of training examples.

   c) Consider the following set of training examples.

   | Attribute | | | Class |
   |---|---|---|---|
   | Furry? | Age? | Size? | |
   | furry | old | large | lion |
   | not furry | young | large | not lion |
   | furry | young | medium | lion |
   | furry | old | small | not lion |
   | furry | young | small | not lion |
   | furry | young | large | lion |
   | not furry | young | small | not lion |
   | not furry | old | large | not lion |

   Work out the root attribute of the output decision tree, taking ID3 decision tree induction algorithm.                                    (4+7+9)

2. a) Explain why do the ensemble methods of combining multiple models generally perform better than single classifier model? Under what condition the ensemble methods will give degraded performance than single classifier model?

   b) What is bias? What is variance? How can you explain the performance improvement through ensemble methods of combining multiple classifier using a theoretical device called bias-variance decomposition?

   c) How do you generate multiple models in bagging? How do we combine output decisions in bagging in cases of classification and numeric prediction?

   d) What are the basic differences between bagging and boosting?   (5+6+5+4)

3. a) Write both model generation and classification algorithms for Ada Boost. MI and explain its underlying principles. What action would you take if the error rate becomes zero before prespecified number of iterations are over in case of boosting?

   b) Define : accuracy of a classifier.
   How would you estimate the accuracy of a classifier using :
   (i) Hold-out method  (ii) k-fold cross-validation?     (11+9)

4. a) Define :
   i)    unification
   ii)   substitution
   iii)  answer extraction in FOPL.

   b) Victor has been murdered and Arthur, Bertram, and Carleton are suspects. Arthur says he did not do it. He says that Bertram was the victim's friend but Carleton hated the victim. Bertram says he was out of town on the day of murder and besides this he did not even know the victim. Carleton says he is innocent and he saw Arthur and Bertram with the victim just before the murder. Assuming that everyone, except possibly the murder, is telling the truth – use answer extraction to solve the crime.     (6+4)

5. a) Define : Resolution in PL.
   Write an algorithm to perform resolution in PL.

   b) Suppose we can perform the following chemical reactions :
   $$MgO + H_2 \rightarrow Mg + H_2O$$
   $$C + O_2 \rightarrow CO_2$$
   $$CO_2 + H_2O \rightarrow H_2CO_3.$$
   Suppose we have some quantities of $MgO$, $H_2$, $O_2$ and $C$. Use resolution to show that we can make $H_2CO_3$.     (8+12)

6. Write PROLOG programs for :     (4×5)
   i)    Permutation Sort
   ii)   Insertion Sort
   iii)  Quick Sort
   iv)   Merge Sort.

7. a) What is the purpose of CUT (!) in a PROLOG program? What is a Green Cut? Red Cut? Give examples of Green and Red Cuts with suitable PROLOG programs.

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    b)    Write PROLOG programs to implement set membership, set union, set intersection and set difference operations.

    c)    The eight queen problem states that eight queens should be placed in an $8 \times 8$ chessboard such that no queen attack each other. Describe a suitable data structure to implement the problem in PROLOG and hence develop a PROLOG program for its solution.        (7+8+5)

8.    a)    Explain how does the rule-based expert system architecture can be understood in terms of production system model of problem solving.

    b)    Draw the architecture of an expert system and explain its components.

    c)    Discuss control of search
        i)    through conflict resolution
        ii)    through forward chaining and backward chaining
    in a production system model.        (5+8+7)

9.    a)    Write Iterative Deepening search algorithm. Illustrate the algorithm, marking the order of the nodes searched, for a complete tree with branching factor 3 and depth 2.

    b)    Obtain the space and time complexities of
    (i) BFS, (ii) DFS, (iii) Iterative Deepening
    Search algorithms and explain which one would you choose as a blind search algorithm and why?        (8+12)

10.    a)    Write Hill climbing search algorithm.

        What are the different problems obtained in case of Hill climbing search strategy? How can those be tackled to search out a solution?

    b)    Write $A^*$ algorithm and explain how does it work by taking a suitable example.        (12+8)

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