

Time: Three Hours

Full Marks: 100

**Answer any Five Questions**

1. (a) What is AI? Discuss on classifications of AI. What is an agent? How can we visualize an agent as a search process? 3+4+3+5  
  
(b) Describe the criteria for evaluating search strategies. 5
  
2. (a) Prove each of the following statements:  
(i) Breadth first search and depth first search are special cases of best first search.  
(ii) Uniform cost search is a special case of A\* search. 4+4  
  
(b) Justify: "No search method that makes use of heuristic functions can guarantee to find the shortest path from start to goal". 4  
  
(c) Derive the time complexity of Iterative Deepening Search. Why is it called an "optimal" search strategy? 4+4
  
3. Assume you are designing a compiler for a machine with one register and the following instructions:  
  
ONE – Set the value of the register to 1  
DOUBLE – Double the content of the register  
ADD – Add one to the content of the register  
SUB – Subtract one from the content of the register  
DIVIDE – Divide the value of the register by 3.  
  
The first four instructions can only be executed when the register's content is not divisible by 3. When the register's content is divisible by 3, the only instruction available is DIVIDE.  
  
The problem is how to put a constant into the register.  
  
a) State this problem as a formal search process. What is a node? What is an arc? What are neighbours of an arbitrary node?  
b) Given the goal of having 27 in the register and the heuristic function  $h(n) = |27-n|$ , draw the portion of the search tree generated using greedy search. What is the solution found?  
c) Suppose the cost of the operators on the register containing the number  $n$  are:  
ONE -1; Double -  $n$ ; ADD - 1; SUB - 1; DIVIDE -  $2n/3$   
(i.e., each operator has a cost equivalent to the difference they make to the register's value)  
-- Using the same heuristic function as stated in (b), draw the A\* search tree. What is the path actually found? 20

4. Consider the game tree as shown in Fig. A.

(a) In a game tree, which nodes are designated as 'AND' nodes? Why?

3

(b) Define  $\alpha$  cut-off and  $\beta$  cut-off. In the tree (Fig. A), which nodes will be pruned using  $\alpha$ - $\beta$  search?

3+5

(c) What ordering of the leaf nodes (from left to right) results in the most nodes being pruned with  $\alpha$ - $\beta$ ? Maintain the children-parent relationships. Show your reordering.

6

(d) Justify – “ $\alpha$ - $\beta$  can slow game tree search”.

3

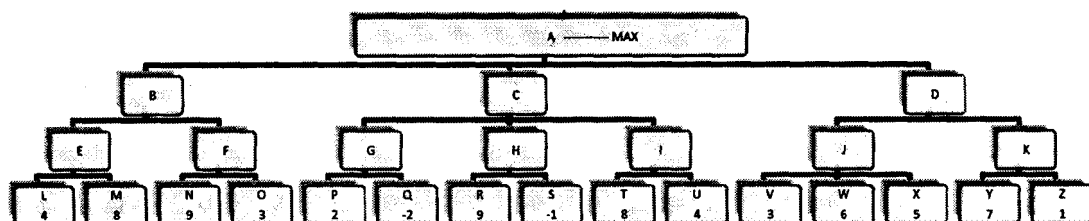


Fig. A

5. (a) What happens when the temperature is lowered too quickly in simulated annealing algorithm? What happens if it is lowered too slowly?

5

(b) Describe a situation where use of Linear Normalization selection is better than Roulette Wheel selection process. Give suitable examples in support of your answer.

4

(c) Why the crossover operator is called a 'primary' operator in Genetic Algorithm? What will happen if mutation is not used in GA?

4 + 3

(d) State the difference(s) between best first search process and hill climbing methods.

4

6. (a) Why do we require 'unification'?

Find the *mg* of the following:

$\{P(f(x,x), A), P(f(y,f(y, A)), A)\}$ .

2+4

(b) State the differences between propositional logic and first order predicate logic.

2

(c) Prove – “Resolution is a sound rule of inference”.

4

(d) Consider the following sentences.

Every child loves Santa.

Everyone who loves Santa loves any reindeer.

Rudolph is a reindeer, Rudolph has a red nose.

Anything which has a red nose is weird or is a clown.

No reindeer is a clown.

John does not love anything that is weird.

---Prove that “John is not a child” using resolution.

8

7. (a) What is the task of TMS? What kind of information does a TMS use for its information? 2+3

(b) Define fuzzy set. Write down the differences between crisp set and fuzzy set. 3+4

(d) Discuss on 'support' and 'concentration' of a fuzzy set. 4

(d) Discuss on 'fuzziness measure' of a fuzzy set. 4

8. (a) Discuss on A\*, its drawbacks, and IDA\*.

(b) Write short notes on: Bidirectional search, its formalization, and island driven search.

(c) Write down the usage of AND-OR tree. 8+8+4

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