

Code: AC20/AT21

Subject: ARTIFICIAL INTELLIGENCE

NEURAL NETWORKS

Time: 3 Hours

**JUNE 2011**

Max. Marks: 100

**NOTE:** There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.
- The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

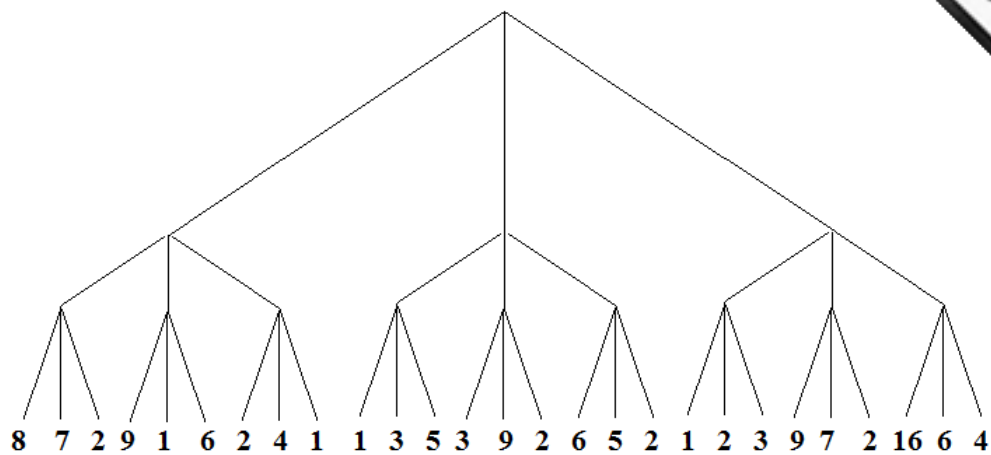
**Q.1 Choose the correct or the best alternative in the following: (2×10)**

- a. Which of the following statements is true for a search graph?
- (A) Only A\* can find the optimal path to the goal, while simple Depth first search cannot find the optimal path.  
(B) Depth first search can find the optimal path but the Breadth first search cannot.  
(C) Both Breadth first search and A\* will find the optimal path.  
(D) Breadth first search will find the optimal path faster than A\*.
- b. A backpropagation network has 6 neurons in the input layer and 3 neurons in the output layer. The number of neurons in the hidden layer must be
- (A) 0 (B) 3  
(C) 6 (D) Could be anything
- c. \_\_\_\_\_ is a linear separable problem.
- (A) NOR (B) NAND  
(C) XOR (D) OR
- d. In First Order Logic, skolemization stands for
- (A) removing a pair of literals which are complimentary to each other  
(B) substitution to make occurrences of literals identical  
(C) elimination of all existential quantifiers  
(D) elimination of universal quantifiers
- e. Identify the STRIPS style planning operator in the Blocks world for which  
precondition:  $CLEAR(X) \wedge ONTABLE(X) \wedge ARMEMPTY$   
Delete:  $ONTABLE(X) \wedge ARMEMPTY$   
Add:  $HOLDING(X)$
- (A) STACK (B) PICKUP  
(C) UNSTACK (D) PUTDOWN

- f. Which one of the following does not relate to predicate logic?
- (A) resolution (B) unification  
(C) activation (D) substitution
- g. In a game tree, node A has 3 children B, C and D. B has 3 children E(9), F(-6), G(0). The numbers in parentheses indicate the goodness of the node for winning. C has two children H(0) and I(-2). D has two children J(-4) and K(-3). If A is at maximizing ply level, what value is backed up to A?
- (A) 0 (B) 9  
(C) -3 (D) -2
- h. Consider the fuzzy rule: *If a person is tall and can run fast, he is suitable for the job.* If fuzzy membership values for Arun being tall is 0.8, and for running fast is 0.6, then the membership value for his suitability for the job would be
- (A) 0.48 (B) 0.6  
(C) 0.7 (D) 0.8
- i. Pick out the incorrect statement from the following statements pertaining to backpropagation networks (BPN)
- (A) A BPN can be trained to learn any nonlinear function.  
(B) A BPN can have linear activation units.  
(C) A BPN produces a real value between 0 and 1 as output.  
(D) A BPN can start with randomly specified set of weights
- j. In the predicate logic formula  $(\forall x)(\exists y)L(y,x)$ ,  $L(y,x)$  stands for  $y$  loves  $x$ . The correct interpretation of the formula is
- (A) Nobody loves anybody. (B) Someone loves someone.  
(C) Everyone is loved by someone. (D) Someone is loved by everyone.

**Answer any FIVE Questions out of EIGHT Questions.**  
**Each question carries 16 marks.**

- Q.2** a. Consider the following Prolog segment  
 $p(\text{ram})$   
 $p(\text{sita}) :- !$   
 $p(\text{lakshman}).$   
 What will be the answer to the query  
 $?- p(X), !, p(Y).$  (8)
- b. Indicate how Bayesian networks are useful in handling uncertainty. Illustrate with an example. (8)
- Q.3** a. Using alpha Beta pruning, indicate the branches that will be pruned from the minmax tree given below. The top most node is at MAX level. Also indicate the value that will be backed up to the root. (8)



- b. Let  $L$  represent a list of objects, and let  $X$  represent an object. The membership relation of  $X$  being present in  $L$  can be expressed in Prolog as  $member(X, [X | Tail])$ .  
 $member(X, [Head | Tail]) :- member(X, Tail)$ .  
 Suppose concatenation of two lists  $L1$  and  $L2$  to result in list  $L3$  is expressed as  $conc(L1, L2, L3)$ . Show how the membership relation can be expressed using  $conc$ .  
 Define the relation  $last(Item, List)$  so that  $Item$  is the last element of list  $List$  using  $conc$ . (8)

- Q.4** a. Find the most general unifier for the following set. Show the complete steps as you use the unification algorithm.  
 $S = \{ A(x, z, g(x, y, f(z))), A(y, f(x), w) \}$  (8)
- b. Discuss the significance of state space search in solving an AI problem. Discuss in brief Water-Jug problem and show how it can be solved using search tree. (8)

- Q.5** a. Express the following statements using well formed formulae in Predicate Logic. Using resolution refutation answer the query whether the party was held at Madhu's house.  
*Harish, Madhu, Manoj, Jai, Sunil are teachers of DAV school. Manoj is married to Madhu. Jai is married to Sunita. Divya may be or may not be a teacher of that school. A dinner party of the teachers was held at Manoj's house on Sunday. Married people live in the same house. Spouse (husband/wife) of a teacher also happens to be a teacher in that school.* (12)
- b. List 4 major benefits of developing expert systems. Name two successful expert systems. (4)

- Q.6** a. Train a perceptron to learn the following input-output pattern

X1	X2	output
0	0	0
1	0	1
0	1	1
1	1	1

(8)

- b. What is the role of backpropagation in a multilayered neural network? Why is it called backpropagation? (4)
- c. Why is a sigmoidal activation preferred in multilayered neural network, over a step function type of activation unit? (4)

**Q.7** a. What do you understand by constraint satisfaction? Solve the following crypto-arithmetic problem using constraint satisfaction: (8)

$$\begin{array}{r} \text{C R O S S} \\ \text{R O A D S} \\ \hline \text{D A N G E R} \end{array}$$

- b. How Recursive Transition Nets (RTN) are different from Augmented Transition Nets (ATN)? Which one is better? (4)
- c. Write a brief note on context-free grammar. (4)

**Q.8** a. The following Prolog relation classifies numbers into three classes: positive, zero and negative:  
 class(Number, positive) :- Number>0.  
 class(0, zero).  
 class(Number, negative) :- Number<0.  
 Define this procedure in a more efficient way using cuts. (6)

- b. Between the two search methods, Depth first and Breadth first, which one is more likely to generate an optimal path? Justify your answer. (4)
- c. Draw a concise semantic net for the following facts: *Pigeons lay eggs. Parrots can fly. Pigeon is a bird. Owl is a bird. Parrots lay eggs. Owl sleeps during daytime. Pigeons and parrots sleep during night. Owls lay eggs. Pigeons and Owls can fly. Parrots are green. Parrots are birds.* (6)

**Q.9** a. Consider a blocks world planning problem. Two blocks F and D are lying on table. Block H is lying on top of block F. Using the STRIPS style operators (stack, putdown, etc.) and goal stack planning, generate a plan such that H and F are on table, and D lies on top of H. Show each entry on the stack. (10)

- b. What is the basic difference between the Best-First search and A\* search methods? (3)
- c. Is A\* always guaranteed to generate the optimal path when both start node and goal node are present in the search graph? Justify your answer. (3)