

INTRODUCTION TO ARTIFICIAL INTELLIGENCE (AML2201)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) A heuristic $h(n)$ is called “admissible” if it:

(a) Overestimates the cost to the goal	(b) Never overestimates the cost to the goal
(c) Equals the actual cost	(d) Is equal to 0.
- (ii) A heuristic h_1 is said to dominate heuristic h_2 , if at any node n

(a) $h_1(n) > h_2(n)$	(b) $h_1(n) < h_2(n)$
(c) $h_1(n) \geq h_2(n)$	(d) $h_1(n) \leq h_2(n)$
- (iii) What is the purpose of Alpha-Beta pruning?

(a) To optimize the Mini-max algorithm by skipping unnecessary evaluations.	(b) To guarantee the shortest path
(c) To find all possible solutions.	(d) To eliminate backtracking.
- (iv) Consider the following PROLOG clauses:
 $p(1).$
 $p(2):-!$
 $p(3).$
 Which of the following is correct if the goal $p(X), !, p(Y)$ is placed

(a) $X=1, Y=1$	(b) $X=1, Y=1; X=1, Y=2$
(c) $X=2, Y=1$	(d) None of these
- (v) Inheritable knowledge is best represented by

(a) Semantic net	(b) Database
(c) FOPL	(d) None of these
- (vi) Lane finding on GPS data can be solved using

(a) Supervised Learning	(b) Unsupervised Learning
(c) Semi Supervised Learning	(d) Reinforcement Learning
- (vii) What is the process of breaking text into individual words or terms called?

(a) Sentence Segmentation	(b) Tokenization
(c) Lemmatization	(d) Parsing
- (viii) Genetic algorithm is a metaheuristics inspired by natural Selection. It has

(a) Large class of Heuristic Algorithm	(b) Approximate algorithm
(c) Fitness function	(d) None of the above
- (ix) When is breadth-first-search optimal?

(a) When there is less number of nodes	(b) When all step costs are equal
(c) When all step costs are unequal	(d) Both (a) & (c)
- (x) Which of the following is the correct FOPL representation of the English sentence “all students are smart”?

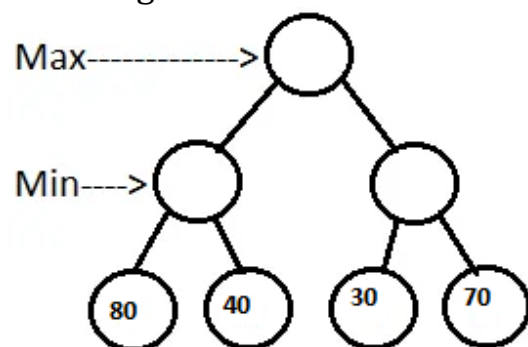
(a) $\forall X: (\text{student}(X) \wedge \text{smart}(X))$	(b) $\exists X: (\text{student}(X) \rightarrow \text{smart}(X))$
(c) $\forall X: (\text{student}(X) \rightarrow \text{smart}(X))$	(d) None of these

Fill in the blanks with the correct word

- (xi) In a decision tree, a homogeneous split should have _____ degree of purity.
- (xii) A rational agent is an autonomous entity that perceives its environment through _____ and acts using _____.
- (xiii) AO* finds optimal solutions in complex, hierarchical problems represented as _____ graph.
- (xiv) _____ is a m/c learning technique which uses feedback to learn behaviour without explicit training data.
- (xv) At MIN nodes of a game tree, the best backed – up values found so far is called _____.

Group - B

2. (a) Name various types of games. Write a pseudo code of the Minmax algorithm in Game Playing. Apply Minmax over the tree to generate value at the root.



- (b) Compare UCS and A* search with respect to completeness, optimality, time and space complexity. [[AML 2201.1) (Apply/IOCQ)]
[[AML 2201.4) (Analyse/IOCQ)]

$$6 + (3 + 3) = 12$$

3. (a) The 8 – puzzle consists of a 3x3 board with 8 numbered tiles & a blank space. Each tile has a number on it. A tile adjacent to the blank space can only slide into that space. The game consists of a starting position & a specified goal position. The goal is to transform the starting position into the goal position by sliding the tiles around.
- (i) Represent this problem as a state space search problem, by mentioning initial state, goal state, allowed set of operators and pre-condition of those operators.
- (ii) Show that your state space representation will work on the following instance of the problem by giving one solution of the problem.

Start			Goal		
2	8	3	1	2	3
1	6	4	8		4
7		5	7	6	5

- (b) Explain Goal Based Agent. Can an online Search agent be designed?

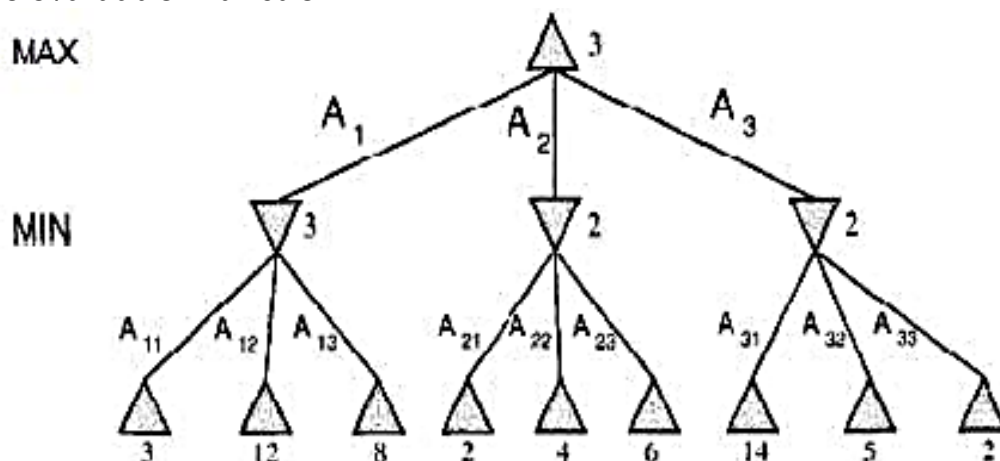
$$[[AML 201.1) (Apply/IOCQ)]$$

$$[[AML 2201.3) (Apply/IOCQ)]$$

$$(6 + 2) + (3 + 1) = 12$$

Group - C

4. (a) In MINIMAX algorithm, evaluation function is always applied only on the leaf nodes of the game tree. Why? [[AML 2201.4) (Analyse/IOCQ)]
- (b) A two-ply game tree generated by MINIMAX algorithm is shown below, where the terminal nodes contain the evaluation score returned by some evaluation function.



Apply alpha-beta pruning algorithm on the above game tree to find which of the nodes in the game tree can be pruned .In each case mention the type of pruning and where pruning is allowed.

- (c) What do you mean by path Consistency in CSP? [[AML 2201.4) (Apply/IOCQ)]

$$4 + (3 + 3) + 2 = 12$$

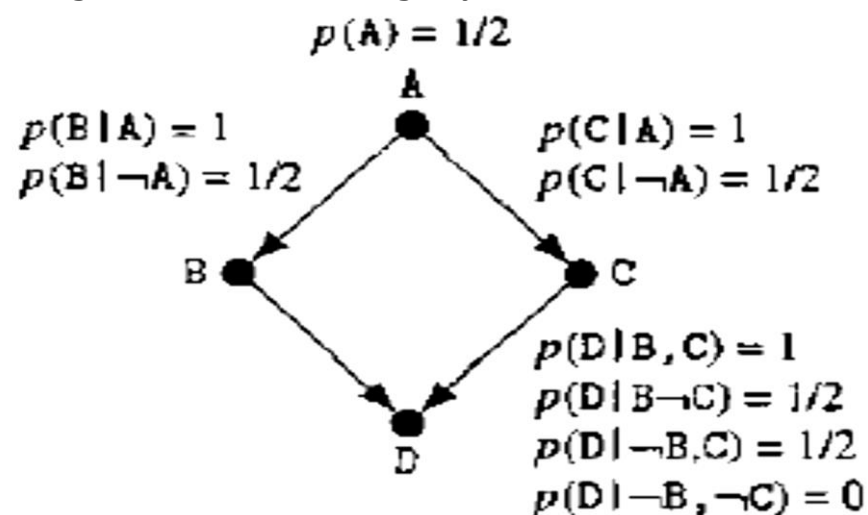
5. (a) Suppose you are in charge of scheduling of 5 classes that meet on Mondays, Wednesdays and Thursdays. Three professors will be taking those classes. You are constrained by the fact that each professor can only take one class at a time.
- Class timings are as follows:
- OS – 8:30 am to 9:30 am
 - AI – 9:30 am to 10:30 am
 - NLP – 10:30 am to 11:30 am
 - IR – 10:30 am to 11:30 am
 - ML – 11:30 am to 12:30 pm
- Details of the 3 professors are as follows:
- Professor A is available to take the classes of NLP and IR
 - Professor B will take the classes of AI, NLP, ML and IR
 - Professor C is available to take the classes of OS, AI, NLP, ML and IR

Now, answer the following questions:

- (i) Formulate the above problem as a CSP problem by mentioning variables, domain of each variable and the constraints. You are also supposed to provide the constraint graph.
- (ii) Apply backtracking method along with 'the most constraining variable' as the heuristic to give one solution of the problem. [[AML 2201.4) (Apply/IOCQ)]
- (b) Prove that the heuristic 'sum of manhattan distances' for the 8-puzzle problem used by A* algorithm is an admissible heuristic. [[AML 2201.6) (Analyze/IOCQ)]
- (3 + 4) + 5 = 12**

Group - D

6. (a) Explain the difference between Fuzzy Sets and Classical Sets. [[CSEN 3104.1) (Understand/LOCQ)]
- (b) Consider two fuzzy subsets of the universal set $X = \{a, b, c, d, e\}$, referred to as A and B, where $A = \{1/a, 0.3/b, 0.2/c, 0.8/d, 0/e\}$, $B = \{0.6/a, 0.9/b, 0.1/c, 0.3/d, 0.2/e\}$. Now find the result of the following operations done on two fuzzy sets A & B: (i) $A \cup B$, (ii) $A \subseteq B$ (iii) $\text{core}(A)$. [[AML 2201.3) (Apply/IOCQ)]
- (3 + 3) + (3 × 2) = 12**
7. (a) Consider the following facts describing block world situation.
 ONTABLE(A), ONTABLE(C), ON(D, C), ON(B, A), ON(E, B), HEAVY(B), HEAVY(D), CLEAR(E), CLEAR(D), WOODEN(B). The following statements provide general knowledge about this block world.
 (i) Every big, blue block is on a green block
 (ii) Each heavy, wooden block is big.
 (iii) All blocks with clear tops are blue
 (iv) All wooden blocks are blue
 Write a PROLOG program to answer the query 'Which block is on green block?' [[AML 2201.5) (Apply/IOCQ)]
- (b) An admission committee for a college is trying to determine the probability that an admitted candidate is really qualified. The relevant probabilities are given in the following Bayesian network. Calculate $p(A|D)$.



A = applicant is qualified
 B = applicant has high grade point average
 C = applicant has excellent recommendations
 D = applicant is admitted

[[AML 2201.3) (Apply/IOCQ)]
5 + 7 = 12

Group - E

8. (a) Discuss the significance of crossover operation in the implementation of genetic algorithm and its convergence. [[AIML 2201.6) (Understand/LOCQ)]
- (b) "Artificial Neural Network can be used as a classifier" – Give proper explanation against this statement. [[AML 2201.3) (Apply/IOCQ)]
- 6 + 6 = 12**
9. (a) Define Information gain as an attribute selection measure of a decision tree. [[AML 2201.4) (Remember/LOCQ)]
- (b) Consider the following table where the attribute 'class' is the class label:

	sex	mask	cape	tie	ears	smokes	class
batman	male	yes	yes	no	yes	no	Good
robin	male	yes	yes	no	no	no	Good
alfred	male	no	no	yes	no	no	Good
penguin	male	no	no	yes	no	yes	Bad
catwoman	female	yes	no	no	yes	no	Bad
joker	male	no	no	no	no	no	Bad

Calculate the information gain corresponding to the attributes sex, mask, cape, tie, ears & smokes in selecting an attribute to construct (induct) a decision tree from the data provided in the above table. Also mention the attribute you will select based on the calculated information gain in each step. (Note: No need to draw the whole decision tree).

[(AML 2201.4) (Apply/IOCQ)]
2 + (7 + 3) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	12.5	87.5	0