

Roll Number:

**Thapar Institute of Engineering and Technology, Patiala**  
Department of Computer Science

**BE: Semester IV**  
**11 March 2023**

**MST**

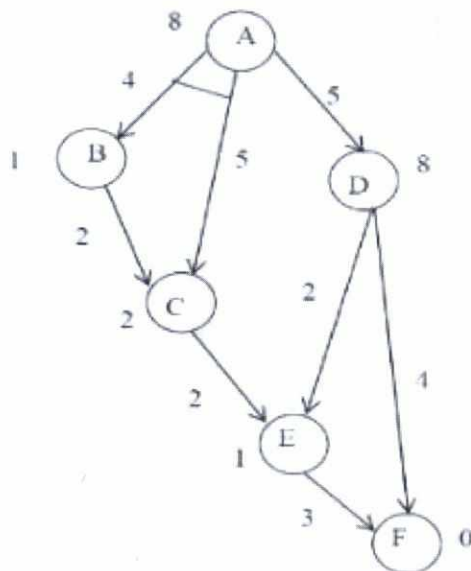
**UCS411: Artificial Intelligence**

Time: 2 Hours; M. Marks: 40

Name of Faculties: Dr. Swati, Dr. Jyoti, Dr. Anu Bajaj, Dr. Payal

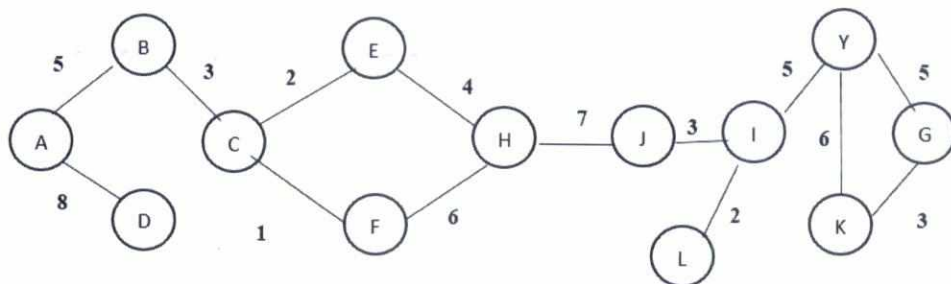
*Note: All questions are compulsory*

- Q1 (a) Solve the following graph using AO star algorithm. The numbers written on edges represent the distance between the nodes and numbers written on nodes represent the heuristic value. (4)

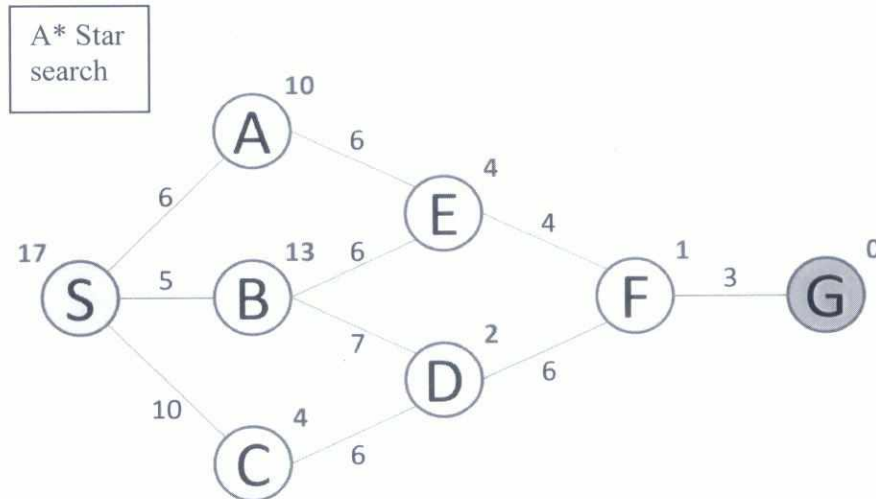


- Q1 (b) Consider a sequence starting from 1 and every state  $k$  has two successors: numbers  $2k$  and  $2k+1$ :
- Draw the state space search for states 1 to 15. (1)
  - For goal state 11, List the order in which nodes will be visited for breadth first search, depth-limited search with limit 3, and iterative deepening search. (3)

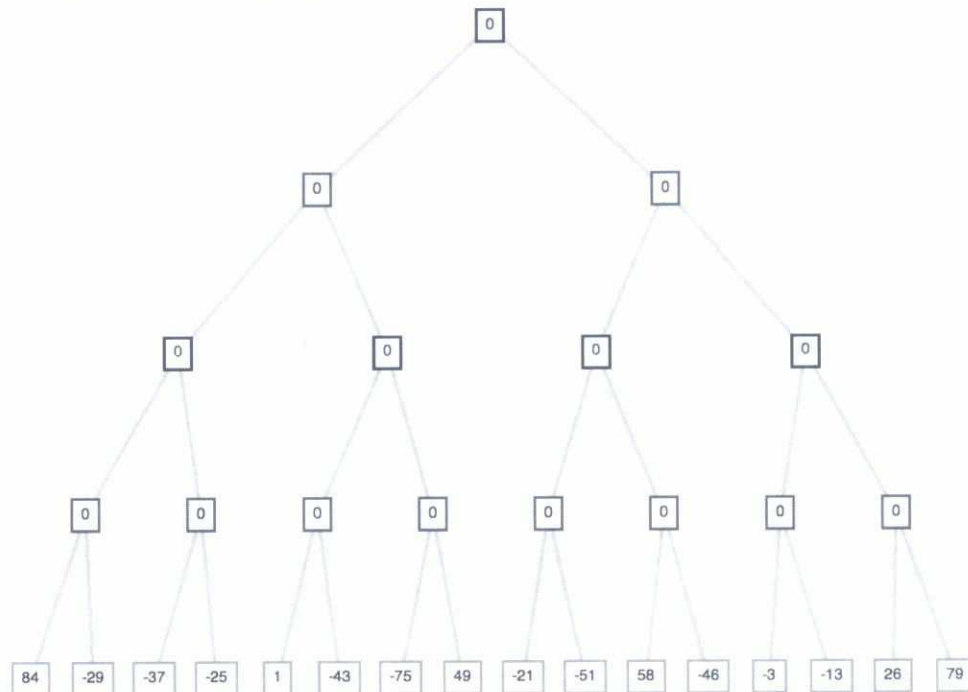
- Q1 (c) Perform bi-directional traversal with starting nodes as A and G. Show each step of the traversal. Find the intersecting node. (2)



- Q2 (a) Perform the A\* Algorithm on the following figure. The numbers written on edges represent the distance between the nodes and numbers written on nodes represent the heuristic value. Start node is S and Final node is G. Explicitly write down the queue at each step. (5)



- Q2 (b) Apply alpha beta pruning on the following tree by showing all intermediate values. Consider root node as max node. Draw a cross on the pruned branches. (5)



- Q3 (a) Explain the following intelligent agents with example. Provide the block diagram to justify your explanation. (1)
- i. Model-based agents (1)
  - ii. Goal-based agents (1)
  - iii. Utility-based agents (1)
  - iv. Learning agents (1)

- Q3 (b) Suppose a genetic algorithm uses chromosomes of the form  $x = abcdefgh$  with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual  $x$  be calculated as:  $f(x) = (a + b) - (c + d) + (e + f) - (g + h)$ , and let the initial population consist of four individuals with the following chromosomes:

$x_1 = 6\ 5\ 4\ 1\ 3\ 5\ 3\ 2$

$x_2 = 8\ 7\ 1\ 2\ 6\ 6\ 0\ 1$

$x_3 = 2\ 3\ 9\ 2\ 1\ 2\ 8\ 5$

$x_4 = 4\ 1\ 8\ 5\ 2\ 0\ 9\ 4$

- i. Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last. (2)
- ii. Perform the following crossover operations: i) Cross the fittest two individuals using one-point crossover at the middle point. ii) Cross the second and third fittest individuals using a two-point crossover (points b and f). (2)
- iii. Suppose the new population consists of the four offspring individuals received by the crossover operations in the above question. Evaluate the fitness of the new population, showing all your workings. Has the overall fitness improved? (2)

- Q4 (a) Consider the following confusion matrix for some model on some dataset

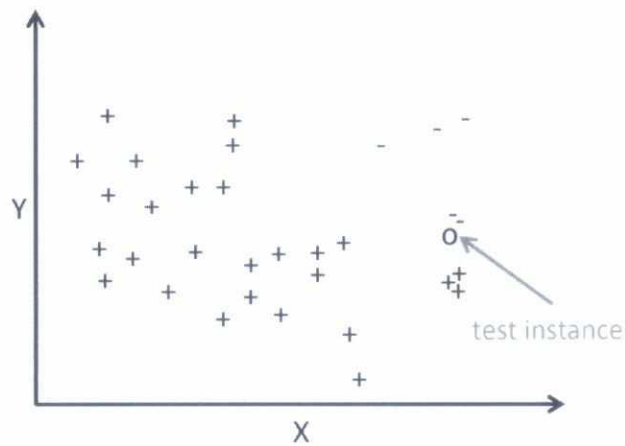
	Predicted+	Predicted-
True+	200	10
True-	20	5

- i. What is the macro precision of the model? Provide its formula and value. (2)
- ii. What is the macro recall of the model? Provide its formula and value. (2)
- iii. What is macro F1-score of the model? Provide its formula and value. (2)

- Q4 (b) Suppose we have the following training set of positive (+) and negative (-) instances and a single test instance (o). All instances are projected onto a vector space of two real-valued features (X and Y). Answer the following questions. Assume “unweighted” KNN (every nearest neighbor contributes equally to the final vote). Distance between instances is measured using Euclidean distance.

- i. What class would be assigned to this test instance for  $K=1$ ?
- ii. What class would be assigned to this test instance for  $K=3$ ? (1)

- iii. What class would be assigned to this test instance for  $K=5$ ? (1)
- iv. Setting  $K$  to a large value seems like a good idea. We get more votes! Given this particular training set, would you recommend setting  $K = 11$ ? Why or why not? (1)



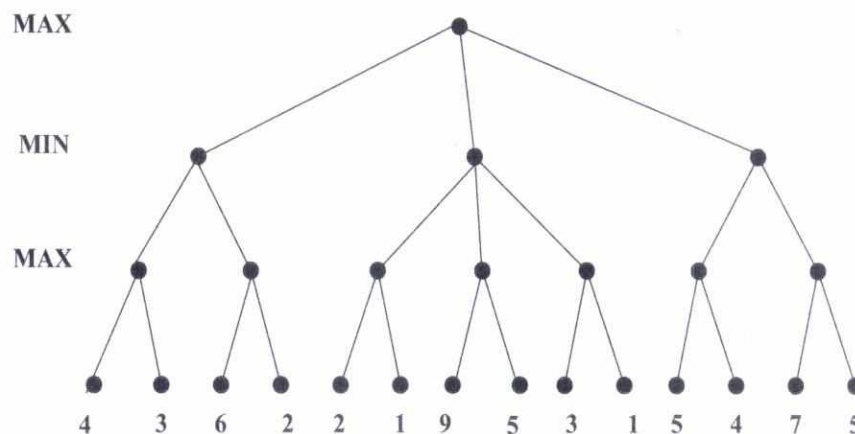


Roll Number:	
<b>Thapar Institute of Engineering &amp; Technology, Patiala</b> <b>Department of Electrical and Instrumentation Engineering</b> <b>MID SEMESTER EXAMINATION</b>	
B. E. (Third Year -EIC): Semester-II (2022-23)	Course Code: UCS411
	Course Name: <b>Artificial Intelligence</b>
Time: 2 Hours, Marks: 25	Name of Faculty: <b>Prof. Mukesh Singh</b>

- Note
1. Attempt all questions. Assume missing data, if any, suitably.
  2. All questions carry equal marks.

1. Design the PEAS information for Taxi drivers and Soccer games. After designing the PEAS information, explain them with different Task Environments. Make sure that Task Environments should be mentioned in a tabular form only.

2. Solve the following graph using alpha-beta pruning. Ensure that there has to be a separate graph at each iteration with a suitable explanation.



3. Given here is the map of Romania with cities and the distance between them. We need to find the shortest route from **Arad** to **Bucharest**. The heuristic that we are using here is the **straight-line distance** from the city to the goal (Here, Bucharest). Note that, this straight-line distance is obtained only by knowing the map coordinates of the 2 cities. Solve using the greedy best search method.



4. Match list (B) with (A) by writing the number from (A) into (C).

(A)	(B)	(C)
1. Search Strategy	Any path with minimum cost.	
2. Turing Test	Program's inputs/output and timing behavior matched with the human behavior.	
3. Intelligence	Possible states of a system.	
4. Neural Networks	Agent acts upon a purely computational environment.	
5. Optical Character Recognition (OCR)	Software applications to become more accurate in predicting outcomes without being explicitly programmed.	
6. Optimal solution	Produce by human art or effort.	
7. State Space Graph	System that converts the knowledge of an expert in a specific subject into a software code.	
8. State Space Tree	Agent's sensors give it full access to the complete state.	
9. Software Agent	Brain Modeling.	
10. Fully observable environment	Modeling how the world changes, how it's actions change the world.	
11. Expert Systems	The inability to distinguish computer response from human response.	
12. Thinking Humanly	Tree is a special case of a graph.	
13. Artificial	Software reads the text written on paper by a pen or on screen by a stylus and recognize the shapes of the letters and convert it into editable text.	
14. Machine Learning	systematic examination of states to find path from the start/root state to the goal state.	
15. Model-based Reflex Agents	Is the ability to acquire knowledge and use it.	

5. Answer the following questions about the search problem shown below. Break any ties alphabetically. For the questions that ask for a path, please give your answers in the form – A – D – G.'

- What path would the breadth-first graph search return for this search problem?
- What path would uniform cost graph search return for this search problem?
- What path would the depth-first graph search return for this search problem?
- What path would A\* graph search, using a consistent heuristic, return for this search problem?

