



INSTITUTE OF INFORMATION TECHNOLOGY  
JAHANGIRNAGAR UNIVERSITY  
PROFESSIONAL MASTERS IN INFORMATION TECHNOLOGY  
2ND TRIMESTER FINAL EXAMINATION 2023 (SPRING 2023)

Course Code: PMIT 6107  
Course Title: Artificial Intelligence and Neural Networks

Time Allowed: 3 Hours  
Full Marks: 60

Do not write anything in the question script.  
There are seven questions. Answer any five of them.  
Figures in the right margin indicate marks.  
**The question no. 1 is compulsory.**

1. (a) Define Artificial Intelligence (AI) and explain its role in solving complex problems and tasks. [3]  
(b) Breadth-First Search and Depth-First Search are two common graph traversal algorithms used to explore or search through a graph. Compare these two algorithms. [3]  
(c) Suppose we have a temperature control system with a fuzzy membership function for the "coolness" level. The input to the system is the temperature in degrees Celsius, and the fuzzy membership function assigns a degree of membership to the "coolness" level. Define the linguistic variables and their membership function. Plot the membership functions on a graph. [3]  
(d) Create an artificial neural network diagram and contrast it with the structure of a single neuron. [3]
2. (a) Distinguish between supervised and unsupervised learning algorithms. [4]  
(b) Draw a functional block diagram of an Agent and explain its all component using a real-life example. A company is planning to design an agent for room cleaning robot. How can you design a model? Discuss the environment. [8]
3. (a) Consider a scenario involving a group of friends attending a party. Represent the following statements using both First-Order Predicate Logic and Propositional Logic: [4]  
(i) All the friends at the party are having a good time.  
(ii) If John is at the party, then Mary is also at the party.  
(iii) There is a friend at the party who is dancing.  
(iv) None of the friends at the party are leaving early.  
For each statement, provide the translations using First-Order Predicate Logic, including appropriate predicates, variables, quantifiers, and logical connectives. Additionally, provide the translations using Propositional Logic, using appropriate propositional variables and logical connectives.  
(b) Find the optimal path for the example in Figure 1 (on page 2) using Best First Search. [8]
4. Design a fuzzy logic controller for a rice cooker system to achieve optimal cooking results. Consider the cooking time and water level as inputs and the heat intensity as the output. The linguistic variables, membership functions, and fuzzy sets for the input variables: cooking time and water level.

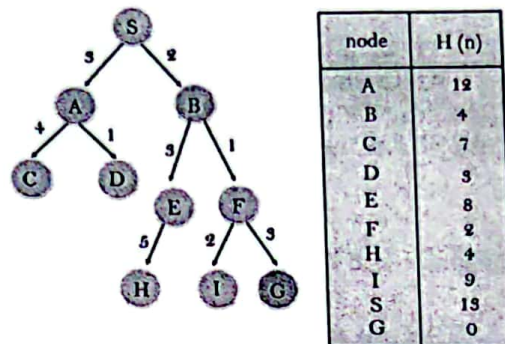


Figure 1: Question 3(b)

- (a) Determine the fuzzy rules that govern the control actions based on the inputs. Specify the antecedents, consequents, and linguistic terms for each rule. Consider the relationships between the cooking time, water level, and heat intensity. [4]
- (b) Explain the process of fuzzification, inference, and defuzzification in the context of the rice cooker system. How are the fuzzy rules applied to determine the appropriate heat intensity based on the cooking time and water level inputs? [4]
- (c) Provide an example scenario where the cooking time is measured as 20 minutes and the water level is medium. Apply the fuzzy logic controller to determine the appropriate heat intensity based on the fuzzy rules and membership functions defined. [4]
5. (a) Explain the key components and operations involved in a Convolutional Neural Network (CNN) architecture. Discuss the importance of convolutional layers, pooling layers, and fully connected layers in a CNN. [6]
- (b) Using a suitable explain, explain the step-by-step operation of a CNN. [6]
6. (a) What is the function of learning rate and bias? [2]
- (b) Write the perceptron learning rule for two input and one output system [5]
- (c) Design a two input NAND gate using Neural Network mod [5]
7. (a) Describe the steps involved in a standard Genetic Algorithm. Discuss the importance of selection, crossover, and mutation in the Genetic Algorithm process. [6]
- (b) Consider a Knapsack problem with the following items: [6]
  - Item 1: Weight = 3, Value = 8
  - Item 2: Weight = 4, Value = 10
  - Item 3: Weight = 2, Value = 5
  - Item 4: Weight = 5, Value = 12
  - Item 5: Weight = 1, Value = 3

The knapsack has a weight capacity of 10. Using a Genetic Algorithm, determine the optimal combination of items to maximize the total value in the knapsack without exceeding its weight capacity.

Please provide the initial population size, number of generations, selection method, crossover method, mutation probability, and any other relevant parameters or considerations you would like to include in the solution.