



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech VII SEMESTER END EXAMINATIONS (REGULAR) - DECEMBER 2023

Regulation: UG-20

MATHEMATICAL LOGIC IN ARTIFICIAL INTELLIGENCE

Time: 3 Hours

CSE (DATA SCIENCE)

Max Marks: 70

Answer ALL questions in Module I and II

Answer ONE out of two questions in Modules III, IV and V

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

MODULE – I

1. (a) What is artificial intelligence (AI)? Explain how an AI system is different from a conventional computing system? [BL: Understand| CO: 1|Marks: 7]
- (b) You have a table with a 4-glass pitcher $\frac{3}{4}$ full of water and an empty glass of water. You can fill the pitcher at the sink and you can pour water from the pitcher into the glass. You want a full pitcher and a full glass of water. What do you do? Draw the plan you would need for this situation. Use nodes for the start and finish virtual actions and any actions in the plan; you can label the actions informally, in English. Use solid lines to show causal dependence among actions (again, label them, in informal English, with the condition that the lines represent). Use dotted lines to show other constraints in the plan. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) How to combine forward and backward reasoning? Explain. Differentiate procedural knowledge and declarative knowledge. [BL: Understand| CO: 2|Marks: 7]
- (b) List the steps associated with the knowledge engineering process. Write a short note on approaches to knowledge representation. [BL: Understand| CO: 2|Marks: 7]

MODULE – III

3. (a) Describe in detail about propositional logic with an example. Distinguish between predicate logic and propositional logic. [BL: Understand| CO: 3|Marks: 7]
- (b) Translate the following sentences from natural language to FOL. Use the following vocabulary to express the assertions in the sentences to follow.
 - Male(x) means that x is male.
 - Female (x) means that x is female.
 - Loves (x, y) means that x loves y.
 - Married (x, y) means that x is married to y.
 - Respect (x, y) means that x respects y.
 - i) If Sam loves everybody then Sam loves himself.
 - ii) All women love the man that they are married to.
 - iii) No woman loves a man who does not respect all women

[BL: Understand| CO: 3|Marks: 7]

4. (a) Provide an example of a compound proposition and use truth tables to determine its truth values for all possible combinations of truth values of its atomic propositions.
[BL: Understand| CO: 4|Marks: 7]
- (b) Illustrate the representation of the following in predicate logic with an example
- 'instance' and 'isa' relationship
 - Adding exception
 - Computable functions
- [BL: Understand| CO: 4|Marks: 7]

MODULE – IV

5. (a) Show that $(c)\neg[p \vee \neg(\neg q \vee \neg r)]$ is logically equivalent to $(p \vee q) \rightarrow \neg(p \vee r)$.
[BL: Understand| CO: 4|Marks: 7]
- (b) Consider the following future scenario, where vacuum cleaner agents exhibit effective states of happiness or sadness. Here is a typical agent, Jan.
- If Jan is humming, then Jan is happy.
 - If there is no dirt in the house then Jan is happy.
 - Jan is not happy.
- Given the following, use propositional resolution to prove that there is dirt in the house and Jan is not humming. First create the propositions and rules from the sentences above, convert them to CNF and then use resolution to prove the assertion that there is dirt in the house and Jan is not humming.
[BL: Apply| CO: 4|Marks: 7]
6. (a) For the given sentences below, convert the sentences into predicate logic, convert to clausal form and reduce the scope of negation.
- All people who are graduating are happy.
 - All happy people smile.
 - Someone is graduating.
 - Conclusion: Is someone smiling?
- [BL: Understand| CO: 4|Marks: 7]
- (b) Explain the unification algorithm used for reasoning under predicate logic with an example. Consider the following facts
- Team India
 - Team Australia
 - Final match between India and Australia
 - India scored 350 runs, Australia scored 350 runs, India lost 5 wickets, Australia lost 7 wickets.
 - If the scores are same the team which lost minimum wickets wins the match.
- Represent the facts in predicate, convert to clause form and prove by resolution "India wins the match".
[BL: Apply| CO: 4|Marks: 7]

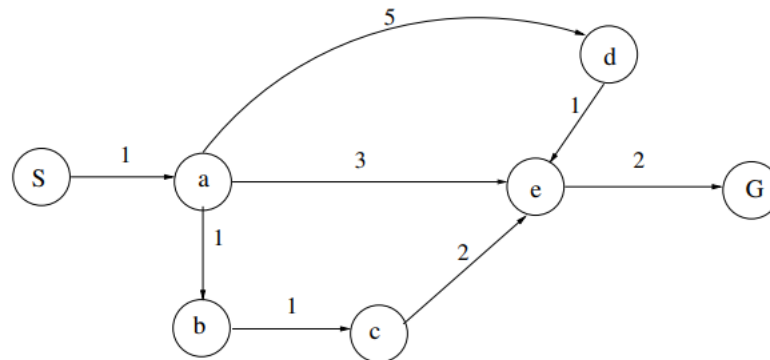
MODULE – V

7. (a) List some key characteristics and components of a problem-solving agent and explain.
[BL: Understand| CO: 4|Marks: 7]
- (b) Consider the graph shown in Figure 1, return a possible order of node expansion with the following search algorithms for the search graph.
- Depth first search

- ii) Breadth first search.
- iii) Uniform cost search.

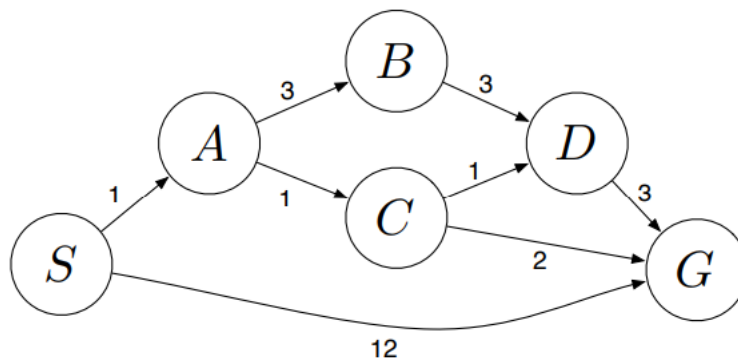
[BL: Apply| CO: 4|Marks: 7]

Figure 1



8. (a) Write a note on Generate-and-test approach. Describe potential advantages and disadvantages of using hill climbing to solve a state search problem. [BL: Understand| CO: 4|Marks: 7]
- (b) Answer the following questions about the search problem shown in Figure 2. Break any ties alphabetically. For the questions that ask for a path, please give your answers in the form ‘S – A – D – G.’

Figure 2



- i) What path would breadth-first graph search return for this search problem?
- ii) What path would uniform cost graph search return for this search problem?
- iii) What path would depth-first graph search return for this search problem?
- iv) What path would A* graph search, using a consistent heuristic, return for this search problem?

[BL: Apply| CO: 4|Marks: 7]

