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M.S. Ramaiah Institute of Technology
(Autonomous Institute, Affiliated to VTU)
Department of Computer Science and Engineering

Course Name: Artificial Intelligence
Course Code: CSE551
Credits: 3:0:0:0

Term: September – December 2020

Faculty:
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References

1. Stuart Russel, Peter Norvig: Artificial Intelligence - A Modern Approach, 2nd Edition, Pearson Education, 2012.
2. Elaine Rich, Kevin Knight, Shivashankar B Nair: Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2011.
3. Nils J. Nilsson: Principles of Artificial Intelligence, First Edition, Elsevier, 2002.
4. Luger, G. F., & Stubblefield, W. A., Artificial Intelligence - Structures and Strategies for Complex Problem Solving. New York, NY: Addison Wesley, 5th edition (2005).
5. http://aima.cs.Berkeley.edu

Acknowledgement:
We acknowledge the authors listed above and all the course materials available on the Internet in the area of Artificial Intelligence and Machine Learning.

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CIE- 1 : Syllabus and Possible Questions

Introduction: What is AI? Foundation and History of Artificial Intelligence. **Intelligent Agents:** Agents and Environments, Rationality, The Nature of Environments, The Structure of Agents. **Problem-solving by search:** Problem-Solving Agents, Example Problems, Searching for Solution, Uniformed Search Strategies, Informed Search Strategies, Heuristic Functions. (Chapter 1, 2, 3 of Text Book 1)

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CIE- 1 : Syllabus and Possible Questions

Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Reasoning patterns in propositional Logic, Effective Propositional Model Checking, Agents Based on Propositional Logic. **First-Order Logic**: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic. **Interference in First-order Logic**: Propositional vs. First-Order Inference, Unification and Lifting, Forward chaining, Backward chaining, Resolution. (Chapter 7, 8, 9 of Text Book 1)

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Blooms Cognitive Level

Remember

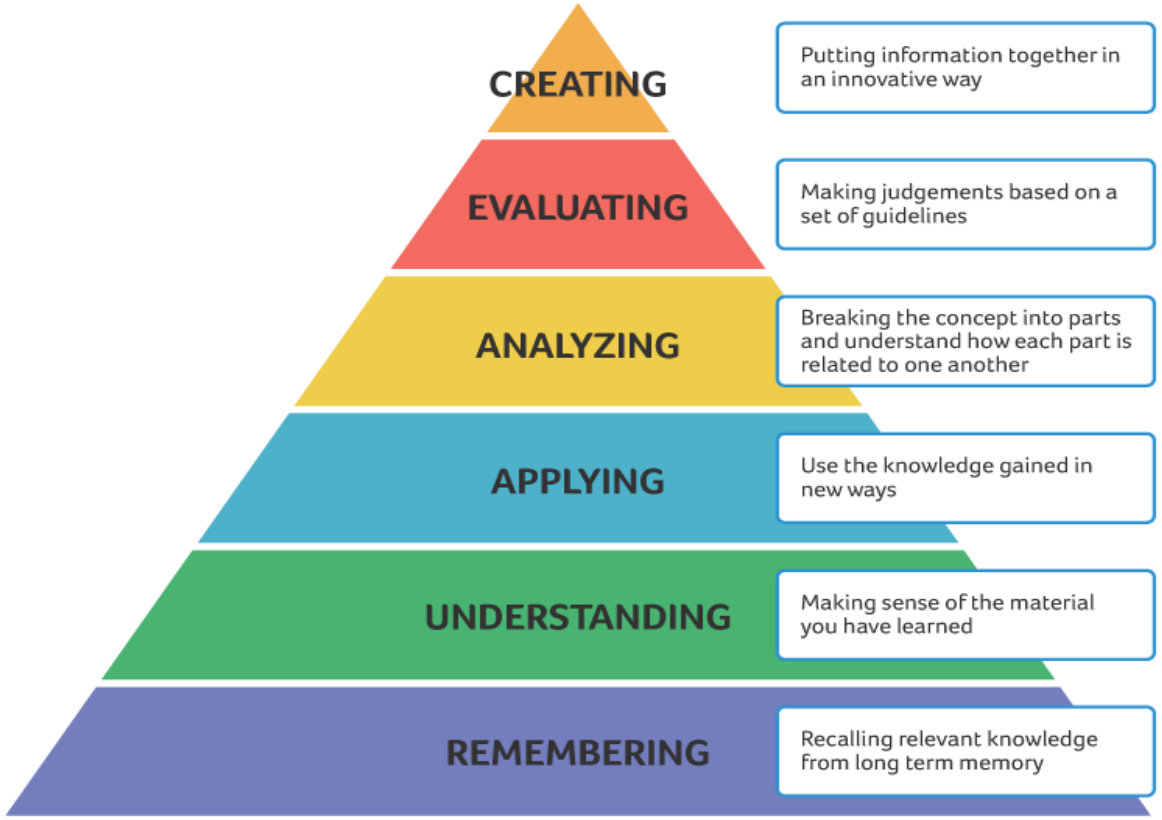
Understand

Apply

Analyze

Evaluate

Create



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Chapter 1: Introduction

- Defining Agents, AI, Rationality, Intelligence, Reasoning and other key words.
- Foundations of AI (Mathematics, Physiological, Commerce..etc)
- History of AI (just a short recollection).
- Acting humanly: The Turing Test approach.
- AI systems block diagram, Knowledge Base (KB).
- Present State of Art of AI and naming certain successful applications of AI.

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Chapter 1: Introduction

- Various definitions of AI as in Literature, also defining AI in your own words including the keywords mimicking human intelligence.
- Where AI is required, and where it does not fit in.
- Ethical Practices of building AI Systems.
- Cannibal and Missionary problem: to understand Logical Thinking
- What are Production Systems? With an example explain the same.

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Chapter 2: Intelligent Agents

- Agents and Environments, Block Diagram, Components
- All types of Agents and their Block Diagram representation with explanation.
- Concept of Rationality, Omniscience, learning, and autonomy
- Specifying Task Environments : PEAS for a case study ; Properties
- Different environment of Agents (Static / Dynamic)
- Structure of Agents , Pseudocode and definitions of Agent Programs and Function, Architecture
- How the components of agent programs work

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Chapter 3: Problem-solving by search

- Algorithms writing, Applications, Performance Comparison.
- Metric for Comparison.
- Tabular representation of the performance of all the search algorithms.
- N Queen, Tile Problem, Water Jug Problem representation, TSP problem.
- Problem reduction by applying constraints/reduction of the complexity of the problems.
- Graph Search and Tree Search Algorithm (diff and Pseudocode).
- Performance measures to be expressed on Completeness and on Optimality of all these listed uniformed and informed search techniques.

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Chapter 4: Logical Agents

- Logical Agents: Knowledge-Based Agents,
- The Wumpus World, Logic case study
- Propositional Logic : Syntax and Semantics
- Reasoning patterns in propositional Logic: Rules and mathematic formulations to be applied.
- Effective Propositional Model Checking : Various definitions of Models and other properties of Inference rules and sentences.
- Agents Based on Propositional Logic.

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Chapter 5: First-Order Logic

- Representation Revisited : Why FOPL
- Syntax and Semantics of First-Order Logic
- Unification Algorithm, Lifting
- Using First-Order Logic : examples
- Knowledge Engineering in First-Order Logic. 7 steps.

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Chapter 6: Interference in First-order Logic

- Interference in First-order Logic: Propositional vs. First-Order Inference
- Unification and Lifting,
- Forward chaining, Backward chaining,
- Resolution.

Sample questions

Note: Do not use the internet to find the answers. Reason out yourself and try to solve the problems.

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Sample questions:

1. Write axioms describing the predicated GrandChild, GreatGrandparent, Brother, Sister, Daughter, Son, Aunt, Uncle, Brother-In-Law, Sister-In-Law and First Cousin. Find out the proper definition of the mth cousin n times removed and write the definition in first-order logic. Using a suitable logical reasoning system TELL it all the sentences you have written down, and ASK it who are Elizabeth's grandchildren, Diana's brothers-in-law, and Zara's great-grandparents.
2. Represent the followings sentences in first-order logic, using consistent vocabulary, which must be defined:
    a. No person buys an expensive policy.
    b. There is an agent who sells policies only to people who are not insured.
    c. Every person who buys a policy is smart.
    d. A person born in the UK, each of whose parents are a UK citizen or a UK resident, is a UK citizen by birth.
    e. There is a barber who shaves all men in the town who do not shave themselves.
    f. The best score in AI is always higher than the best score in DM.
    g. Only one student took AI in spring 2017.
    h. Every student who takes AI passes it.

Sample questions:

3. Given the statements:" Everyone who loves all animals is loved by someone. Anyone who kills an animal is loved by no one. Jack loves all animals. Either Jack or Curiosity killed the cat, who is named Tuna". Answer the question "Did Curiosity kill the cat"? Using the resolution process. (All the intermediate steps are to be written down correctly).

4. Given the statements: "Anyone passing his history exams and winning the lottery is happy. Anyone who studies or is lucky can pass all his exams. John did not study but he is lucky. Anyone who is lucky wins the lottery. Prove by resolution process the statement "John is happy".

5. The law says that it is a crime for an American to sell weapons to hostile nations. The country Nono, an enemy of America, has some missiles, and all of its missiles were sold to it by Colonel West, who is American.

   Prove that Col. West is a criminal. (Use forward and Backward Engineering Technique)

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Sample questions:

7. Explain the steps involved in Resolution Refutation proof. Discuss an algorithm to convert predicate formula to clausal form.
8. List any four knowledge representation techniques. Give an example in each case.
9. Which are the most powerful artificial intelligence companies?
10. What are some common benefits of artificial intelligence technology.
11. Explain why problem formulation must follow goal formulation.
12. Define in your own words the following terms: state, state space, search tree, search node, goal, action, transition model, and branching factor.
13. What's the difference between a world state, a state description, and a search node? Why is this distinction useful?

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Sample questions:

14. Which of the following are true and which are false? Explain your answers.

a. Depth-first search always expands at least as many nodes as A∗ search with an admissible heuristic.

b. h(n) = 0 is an admissible heuristic for the 8-puzzle.

c. A∗ is of no use in robotics because percepts, states, and actions are continuous.

d. Breadth-first search is complete even if zero step costs are allowed.

e. Assume that a rook can move on a chessboard any number of squares in a straight line, vertically or horizontally, but cannot jump over other pieces. Manhattan distance is an admissible heuristic for the problem of moving the rook from square A to square B in the smallest number of moves.

Sample questions:

15. Consider a state space where the start state is number 1 and each state k has two successors: numbers 2k and 2k + 1.
    a. Draw the portion of the state space for states 1 to 15.
    b. Suppose the goal state is 11. List the order in which nodes will be visited for breadth first search, depth-limited search with limit 3, and iterative deepening search.
    c. How well would bidirectional search work on this problem? What is the branching factor in each direction of the bidirectional search?

16. Write a program that will take as input two Web page URLs and find a path of links from one to the other. What is an appropriate search strategy? Is bidirectional search a good idea? Could a search engine be used to implement a predecessor function?

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Sample questions:

17. Prove each of the following statements, or give a counterexample:
    a. Breadth-first search is a special case of uniform-cost search.
    b. Depth-first search is a special case of best-first tree search.
    c. Uniform-cost search is a special case of A∗ search

18. Prove that if a heuristic is consistent, it must be admissible. Construct an admissible heuristic that is not consistent.

19. Trace the operation of A∗ search for any given case study and comment on the performance of the same.

20. Implement all the search algorithms you have studied as a part of the course using any programming language and demonstrate the complexity of the same. (use any data sets to show the comparison of the complexity of the algorithms).

Thank you