

Course Title: Artificial Intelligence
Course No: CSC261
Nature of the Course: Theory + Lab
Year: Second, Semester: Fourth

Full Marks: 60+20+20
Pass Marks: 24+8+8
Credit Hours: 3

Course Description: The course introduces the ideas and techniques underlying the principles and design of artificial intelligent systems. The course covers the basics and applications of AI including: design of intelligent agents, problem solving, searching, knowledge representation systems, probabilistic reasoning, neural networks, machine learning and natural language processing.

Course Objectives: The main objective of the course is to introduce concepts of Artificial Intelligence. The general objectives are to learn about computer systems that exhibit intelligent behavior, design intelligent agents, identify AI problems and solve the problems, design knowledge representation and expert systems, design neural networks for solving problems, identify different machine learning paradigms and identify their practical applications.

Detail Syllabus

Chapters / Units	Teaching Methodology	Teaching Hours
Unit I: Introduction 1.1. Intelligence, Artificial Intelligence (AI), AI Perspectives: acting and thinking humanly, acting and thinking rationally 1.2. History of AI 1.3. Foundations of AI: Philosophy, Economics, Psychology, Sociology, Linguistics, Neuroscience, Mathematics, Computer Science, Control Theory 1.4. Applications of AI	Class Lecture	3 Hours
Unit II: Intelligent Agents 2.1. Introduction of agents, Structure of Intelligent agent, Properties of Intelligent Agents 2.2. Configuration of Agents, PEAS description of Agents, PAGE 2.3. Types of Agents: Simple Reflexive, Model Based, Goal Based, Utility Based, Learning Agent 2.4. Environment Types: Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent	Class Lecture + Lab Session	4 Hours

<p>Unit III: Problem Solving by Searching</p> <p>3.1. Definition, State space representaion, Problem as a state space search, Problem formulation, Well-defined problems</p> <p>3.2. Solving Problems by Searching, Search Strategies: Informed, Uninformed, Performance evaluation of search strategies: Time Complexity, Space Complexity, Completeness, Optimality</p> <p>3.3. Uninformed Search: Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bidirectional Search</p> <p>3.4. Informed Search, Heuristic Function, Admissible Heuristic, Informed Search Techniques: Greedy Best First Search, A* Search, Optimality and Admissibility in A*, Hill Climbing Search, Simulated Annealing Search</p> <p>3.5. Game Playing, Adversarial Search Techniques: Mini-max Search, Alpha-Beta Pruning</p> <p>3.6. Constraint Satisfaction Problems, Examples of Constraint Satisfaction Problems</p>	<p>Class Lecture + Lab Session</p>	<p>9 Hours</p>
<p>Unit IV: Knowledge Representation</p> <p>4.1. Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems</p> <p>4.2. Types of Knowledge Representation Systems: Semantic Nets, Frames, Conceptual Dependencies, Scripts, Rule Based Systems (Production System), Propositional Logic, Predicate Logic</p> <p>4.3. Propositional Logic(PL): Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula, Inference using Resolution, Backward Chaining and Forward Chaining</p> <p>4.4. Predicate Logic: FOPL, Syntax, Semantics, Quantification, Inference with FOPL: By converting into PL (existential and universal instantiation), Unification and lifting, Inference using resolution</p>	<p>Class Lecture + Lab Session</p>	<p>14 hours</p>

<p>4.5. Handling Uncertain Knowledge, Radom Variables, Prior and Posterior Probability, Inference using Full Joint Distribution, Bayes' Rule and its use, Bayesian Networks, Reasoning in Belief Networks</p> <p>4.6. Fuzzy Logic: Fuzzy Sets, Membership in Fuzzy Set, Fuzzy Rulebase Systems</p>		
<p>Unit V: Machine Learning</p> <p>5.1. Introduction to Machine Learning , Concepts of Learning, Supervised, Unsupervised and Reinforcement Learning</p> <p>5.2. Statistical-based Learning: Naive Bayes Model</p> <p>5.3. Learning by Genetic Algorithms: Operators in Genetic Algorithm: Selection, Mutation, Crossover, Fitness Function, Genetic Algorithm</p> <p>5.4. Learning with Neural Networks: Introduction, Biological Neural Networks Vs. Artificial Neural Networks (ANN), Mathematical Model of ANN, Activation Functions: Linear, Step Sigmoid, Types of ANN: Feed-forward, Recurrent, Single Layered, Multi-Layered, Application of Artificial Neural Networks, Learning by Training ANN, Supervised vs. Unsupervised Learning, Hebbian Learning, Perceptron Learning, Back-propagation Learning</p>	<p>Class Lecture + Lab Session</p>	<p>9 Hours</p>
<p>Unit VI: Applications of AI (6 Hrs)</p> <p>6.1. Expert Systems, Components of Expert System: Knoledge base, inference engine, user interface, working memory, Development of Expert Systems</p> <p>6.2. Natural Language Processing: Natural Language Understanding and Natural Language Generation, Steps of Natural Language Processing: Lexical Analysis(Segmentation, Morphological Analysis), Syntatic Analysis, Semantic Analysis, Pragmatic Analysis, Machine Translation,</p> <p>6.3. Machine Vision Concepts: Machine vision and its applications, Components of Machine Vision System</p>	<p>Class Lecture + Lab Session</p>	<p>6 Hours</p>

6.4. Robotics: Robot Hardware (Sensors and Effectors) , Robotic Perceptions		

Text Book

1. **Stuart Russel and Peter Norvig**, *Artificial Intelligence A Modern Approach*, Pearson

Reference Books

1. **George F. Luger**, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, Benjamin/Cummings Publication
2. **E. Rich, K. Knight, Shivashankar B. Nair**, *Artificial Intelligence*, Tata McGraw Hill.
3. **D. W. Patterson**, *Artificial Intelligence and Expert Systems*, Prentice Hall.
4. **P. H. Winston**, *Artificial Intelligence*, Addison Wesley.

Laboratory Work Manual

Student should write programs and prepare lab sheet for most of the units in the syllabus. Majorly, students should practice design and implementation of intelligent agents and expert systems, searching techniques, knowledge representation systems and machine learning techniques. Students are also advised to implement Neural Networks for solving practical problems of AI. Students are advised to use LISP, PROLOG, and any other high level language like C, C++, Java, etc. The nature of programming can be decided by the instructor and student as per their comfort. The instructors have to prepare lab sheets for individual units covering the concept of the units as per the requirement. The sample lab sessions can be as following descriptions;

Unit II: Intelligent Agents (4 Hrs)

- Write programs for implementing simple intelligent agents.

Unit III: Problem Solving by Searching (12 Hrs)

- Write programs for illustrating the concepts of
 - o Uninformed Search like DFS, BFS, etc.
 - o Informed Search like Greedy Best First, A*, etc.
 - o Game Search like MiniMax Search
- Write programs for constraint satisfaction problems like water jug, n-queen problem, cryptarithmic problem, etc.

Unit IV: Knowledge Representation (12 Hrs)

- Write programs for illustrating the concepts knowledge representation systems
 - o rule based (program with if then rules)
 - o predicate logic (using predicates like in Prolog)
 - o frames (using concepts of class)
 - o semantic nets (using concepts of graph)

Unit V: Machine Learning (10 Hrs)

- Write program for implementing Naive Bayes.
- Write program for implementing Neural Networks for realization of AND, OR gates.
- Write program for implementing Backpropagation Learning.

Unit VI: Applications of AI (7 Hrs)

- Write program for implementing expert systems like disease prediction, weather forecasting etc.
- Use library tools like NLTK to illustrate concepts of Natural Language Processing.

Model Question
Tribhuvan University
Institute of Science and Technology

Course Title: Artificial Intelligence
Course No: CSC261
Level: B. Sc CSIT Second Year/ Fourth Semester

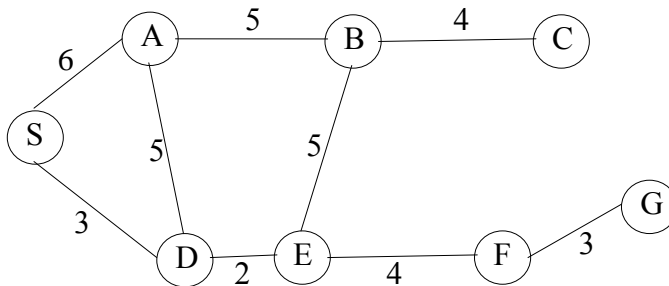
Full Marks: 60
Pass Marks: 24
Time: 3 Hrs

Section A
Long Answer Questions

Attempt any Two questions.

[2*10=20]

1. What do you mean by heuristic search? Given following state space representation, show how greedy best first and A* search is used to find the goal state. [2+8] [Unit 3]



S is the start state and G is the goal state. The heuristics of the states are $h(S)= 12$, $h(A)= 8$, $h(D)= 9$, $h(B)= 7$, $h(D)= 6$, $h(E)= 4$, $h(C)= 5$, $h(F)= 2$, $h(G)= 0$.

2. How resolution algorithm is used as a rule of inference in predicate logic? Convert following sentences into FOPL. [4+6] [Unit 4]
- All over smart person's are stupid
Children's of all stupid persons are naughty
Roney is Children of Harry
Harry is over smart
- Prove that "Roney is naughty" using resolution algorithm.
3. What is Artificial Neural Network? Define its mathematical model. Discuss how back propagation algorithm is used to train ANN? [1+2+6] [Unit 5]

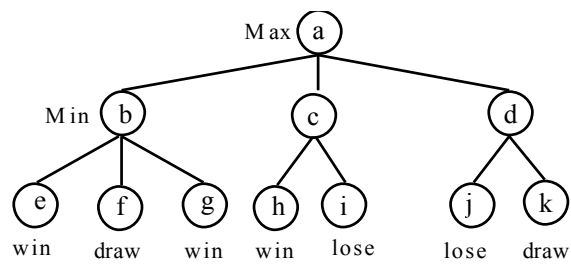
Section B
Short Answer Questions

Attempt any Eight questions.

[8*5=40]

4. Describe how Turing Test is used to define AI as acting humanly? [Unit 1]
5. Differentiate between model based and simple reflex agent with an example. [Unit 2]
6. What is Natural Language Processing? Discuss the steps of natural language processing. [1+4] [Unit 6]
7. How belief networks are constructed? Consider the probability of having cloudy is 50%. The probability that it will rain given the conditions it will be cloudy and if it is winter is 30%. The probability of being winter is 50%. The probability that it will be shiny is 70%. Now construct a belief network for this example. [2+3] [Unit 4]
8. What is expert system? Explain the major components of Expert System? [1+4] [Unit 6]

9. How mini-max algorithm is used in game search. For the following state space, show how mini-max algorithm finds path for the two players. [2.5+2.5][Unit 3]



10. How knowledge is represented using semantic networks? Illustrate with an example. [5]
[Unit 4]
11. What is supervised learning? Discuss how Naïve Bayes model works? [Unit 5]
12. Construct PEAS framework for following intelligent agents. [Unit 2]
- Internet Shopping Assistant
 - English Language Tutor