राष्ट्रीय प्रौद्योगिकी संस्थान पटना / NATIONAL INSTITUE OF TECHNOLOGY PATNA
संगणक विज्ञान एंव अभियांत्रिकी विभाग / DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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No:- Date:

CS040601: Artificial Intelligence

L-T-P-Cr: 3-0-2-4

Pre-requisites: The student should have conceptual and implementation knowledge of the data structure and algorithms course.

Objectives/Overview:

- To introduce an overview of artificial intelligence (AI) principles and approaches
- To develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning.
- To introduce the concepts of decision-making theories.
- To introduce the role of machine learning in AI.

Course Outcomes – After completing this course, students should be able to:

CO-1. *Recall* problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.

CO-2. *Define* and *formulate* a given problem in the language/framework of different AI production rule methods and knowledge-based system designing.

CO-3. *Design* and *develop* basic AI algorithms (e.g., standard search algorithms or dynamic programming) and performance *comparison* of the searching techniques.

CO-4. *Analyze* and design an empirical evaluation of different planning strategies on a problem formalization, and state the conclusions that the evaluation supports.

CO-5. *Distinguish* between the supervised, and unsupervised Machine learning techniques, uncertain knowledge and decision-making problems.

CO-6. *Determine* an expert system with learning logical programming skills.

Course Outcomes–Cognitive Levels–Program Outcomes Matrix –

[H: High relation (3); M: Moderate relation (2); L: Low relation (1)]

Course Outcomes	Program Outcomes											
	PO-1 (Engineering knowledge)	PO-2 (Problem analysis)	PO-3 (Design/development of solutions)	PO-4 (Conduct investigations of complex problems)	PO-5 (Modern tool usage)	PO-6 (The engineer and society)	PO-7 (Environment and sustainability)	PO-8 (Ethics)	PO-9 (Individual and team work)	PO-10 (Communication)	PO-11 (Project management and finance)	PO-12 (Life-long learning)

CO-1	3	3	3	3	2	3			3	3	1	3
CO-2	3	3	3	3	2	3		1	3	3	1	3
CO-3	3	3	3	3	3	3			3	3	1	3
CO-4	3	3	3	3	2	3			3	3	1	3
CO-5	3	3	3	3	3	3	2	1	3	3	1	3
CO-6	3	3	2	1	3	1	1	1	3	3	2	2

UNIT I: Intelligent agents **Lectures: 5**

Reactive, deliberative, goal-driven, utility-driven, and learning agents. Artificial Intelligence programming techniques.

UNIT II: Problem-solving through Search **Lectures: 5**

Forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.

UNIT III: Knowledge Representation and Reasoning **Lectures: 7**

ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications

UNIT IV: Planning **Lectures: 4**

Planning as search, partial order planning, construction and use of planning graphs

UNIT V: Representing and Reasoning with Uncertain Knowledge **Lectures: 5**

Probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications.

UNIT VI: Decision-Making **Lectures: 5**

Basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.

UNIT VII: Machine Learning and Knowledge Acquisition **Lectures: 10**

Learning from memorization, examples, explanation, and exploration learning nearest neighbour, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications. Sample Applications of AI, student project presentations.

UNIT VIII: Brief Survey of selected additional topics **Lectures: 3**

Perception, communication, interaction, and action; multi-agent systems.

Text/Reference Book:

1) *Artificial intelligence and intelligent systems* by N. P. Padhy, Published 2005 by Oxford University Press, Tom Mitchell, McGraw Hill, 1997
2) *Artificial Intelligence: A Modern Approach*, 3rd Edition, by Stuart Russell and Peter Norvig.
3) *Machine Learning*, Tom Mitchell, McGraw Hill, 1997.

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No:- **Date:**

CS44112 Artificial Intelligence Lab

L-T-P-Cr: 0-0-3-1

Pre-requisites: Design and implementation knowledge of data structure and algorithm course experience in the python programming language.

Objectives/Overview:

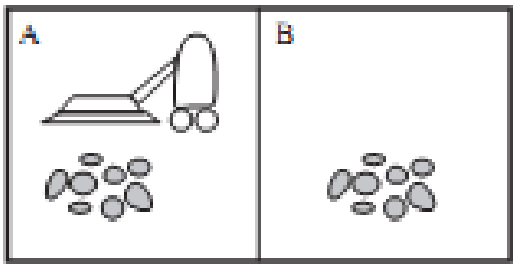
- To implement common pre-processing steps in machine learning on real-world datasets.
- To implement/use common unsupervised, unsupervised, reinforcement learning methods on real-world datasets.
- To implement/use common dimensionality reduction techniques and ensemble learning methods on real-world datasets.

Course Outcomes:
At the end of the course, a student should:

Sl. No.	Outcome	Mapping to POs
1.	Be able to write basic program in Python and implement some basic tasks.	PO1, PO2, PO3, PO4, PO5
2.	Be able to explore the knowledge of AI Agent and its types.	PO1, PO2, PO3, PO4
3.	Be able to write some program on Python using List, Tuple, and Dictionary.	PO1, PO2, PO3, PO9, PO12
4.	Be able to interface a database with Python.	PO3, PO9, PO10, PO12
5.	Be able to preprocess real life datasets using Python.	PO1, PO3, PO4
6.	Be able to implement some AI base production system rule problems	PO1, PO2, PO3, PO4
7.	Be able to implement/use Naïve Bayes and Logistic regression classifier on simple real world datasets.	PO2, PO3, PO4, PO12
8.	Be able to implement/use linear regression and K-means algorithm on simple real world datasets.	PO1, PO2, PO3, PO4
9.	Be able to implement/use LDA and PCA dimensionality reduction techniques for classifying simple real world dataset.	PO1, PO3, PO9, PO10, PO12

List of Experiments:

Experimental lists	Lab session
1. WAP to implement a simple calculator. The output should be something like:	Session 1

Select operation. 1.Add 2.Subtract 3.Multiply 4.Divide Enter choice(1/2/3/4): 3 Enter first number: 15 Enter second number: 14 15 * 14 = 210 2. A leap year is exactly divisible by 4 except for century years (years ending with 00). The century year is a leap year only if it is perfectly divisible by 400. For example, 2017 is not a leap year 1900 is a not leap year 2012 is a leap year 2000 is a leap year WAP to check if a year is leap. Use % operator	
1. (a) WAP to implement a performance-measuring environment simulator for the following vacuum-cleaner world diagram. Your implementation should be modular so that the sensors, actuators, and environment characteristics (size, shape, dirt placement etc.) can be changed easily.  (b) In the addition of the above program (i.e., in 1(a)), WAP to implement a simple reflex agent for the vacuum environment. Run the environment with this agent for all possible initial dirt configurations and agent locations. 2. WAP to implement a model-based reflex agent for the automatic taxi driver environment. Run the environment with this agent for all possible assumptions made by you which makes it model-based. 3. WAP to implement a goal-based reflex agent for the automatic taxi driver in a road map environment. Run the environment with this agent for all possible assumptions made by you which makes it goal-based agent.	Session 2
1. WAP to find factorial of a number. Use range() function. 2. WAP to shuffle a deck of cards. The output should be like: You got: 5 of Heart 1 of Heart 8 of Spade 2 of Spade 4 of Spade	Session 3

3. Accept a string from user consisting of multiple English language words. Now split the words and print them in alphabetical order. You can use string split() method (look up online). **4.** Generate 1000 random numbers in the range 10-100. Write them to a csv file with 10 comma separated numbers in each line resulting in 100 such lines. This can be treated as values of 10 random variables each sampled 100 times. Close the file and open it again in read mode. Read the values. Find maximum and minimum value of each random variable. Find the variance of each random variable. Print the co-variance matrix of all 10 random variables.	
1. Perform the following pre-processing steps for the given dataset (Q1_titanic.csv). Survived/ Not-Survived is represented by 1/0 respectively. **Pre-processing steps:** ***a.*** *Drop the following columns from the dataset:* *b. 'PassengerId','Name','Ticket','Cabin','Embarked','Parch'* *c. Convert 'sex' column information in numeric form:* **i. Replace 'male' with 1 and 'female' with 0** *d. Replace the missing values in 'Age' column as follows:* **i. If Passenger class is 1: Age=37** **ii. If Passenger class is 2: Age=30** **iii. If Passenger class id 3: Age=24** e. Replace missing values by the average value of that column. After the pre-processing steps train Logistic Regression classifier (use test split = 0.30, and random state = 42). Use confusion matrix, accuracy score and classification report to measure the performance of the classifiers. 2. Perform the following pre-processing steps on the given text dataset (Q2_hate_speech.csv). a. Convert the text into lowercase. b. Remove all the punctuations c. Remove the stopwords d. Perform stemming e. Perform lemmatization After all the pre-processing write the pre-processed text with label information into a CSV file with the name of *Pre-processed_text.csv*	Session 4
1. John is an engineering student of CS/IT and right now he is in the home during the lockdown period in the COVID-19 situation. John is playing mobile games all the time, therefore his mother requests him to perform a task with justification (proof of procedure followed to solve the following problem) for her. According to that task, she told: *"I am giving you two buckets, a 4-liter one, and a 3-liter one. Neither have any measuring markers on it. There is a pump that can be used to fill the buckets with water. How can you get exactly 2-liter water into the 4-liter bucket?"* John is an engineering student, and he knows searching algorithms. So, he is ready to solve the above task virtually (for justification purposes) by using the BFS algorithm.	Session 5

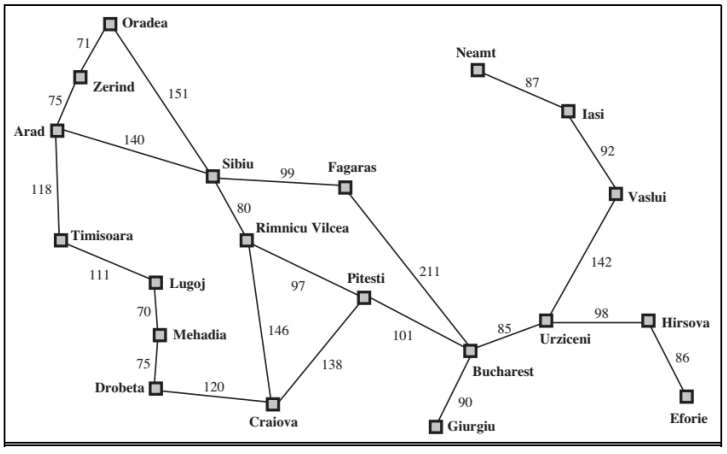
Write a Python program to implement production rule systems of the above task for preparing the justification for his mother. 2. Now, John is working for a Water supply company. He has to present the solution to a given problem in front of his boss. He needs to make a presentation for that problem which is as follows: *"The task is to set up a connection for water supply. Set the water supply in one city and water gets transported from it to other cities using road transport. Certain cities are blocked which means that water cannot pass through that particular city. Determine the maximum number of cities to which water can be supplied."* During his presentation, he is using one of the uninformed search algorithms to solve the above problem with some raw data as: given N cities which are connected using N-1 roads. Between Cities [i, i+1], there exists an edge for all i from 1 to N-1. The following information has been used in the presentation: ● The first line contains an integer >strong>N denoting the number of cities. ● The next N-1 lines contain two space-separated integers **u v** denoting a road between city u and v. ● The next line contains N space-separated integers where it is 1 if the **ith** city is blocked, else it is 0. Write a Python program to implement production rule systems for the water supply problem. 3. One employee Mike is also working with John for the same company. Mike is doing field work-related tasks just like a salesman. He is doing a task and traveling a city for their company. But he has a problem, which is as follows: *"A salesman has a list of cities, each of which he must visit exactly once. There are direct roads between each pair of cities on the list. Find the route the salesman should follow for the shortest possible round trip that both starts and finishes at any one of the cities. And also he has to estimate path cost for each route so that he will not suffer in the future."* Now, John has to implement a python program for the above Travelling Salesman Problem using one of the uninformed search strategies.	
1. Write a program to implement the Tic Tac Toe problem with the help of Minimax algorithm. **2.** Write a program to implement the 8-puzzle problem using DFS. **3.** Write a program to implement the 8-queens problem using hill climbing algorithm.	Session 6
1. WAP to use linear regression model on "Different share market" dataset to find out which market is most dependent on other market fluctuation. 2. WAP to use logistic regression model on "candy-data.csv" dataset to find out the win percentage of chocolates based on different parameters given? The content of dataset is below:	Session 7

candy-data.csv includes attributes for each candy along with its ranking. For binary variables, 1 means yes, 0 means no. The data contains the following fields: ● chocolate: Does it contain chocolate? ● fruity: Is it fruit flavored? ● caramel: Is there caramel in the candy? ● peanutalmondy: Does it contain peanuts, peanut butter or almonds? ● nougat: Does it contain nougat? ● crispedricewafer: Does it contain crisped rice, wafers, or a cookie component? ● hard: Is it a hard candy? ● bar: Is it a candy bar? ● pluribus: Is it one of many candies in a bag or box? ● sugarpercent: The percentile of sugar it falls under within the data set. ● pricepercent: The unit price percentile compared to the rest of the set. winpercent: The overall win percentage according to 269,000 matchups.	
1. WAP to perform clustering on "IPL data" upto 2 cluster. Identify the count of batsman who are actually clustered in different cluster? 2. WAP to use naive bayes classifier to classify the salary of people based on their different attributes (features in adult.csv).	Session 8

List of project:

1. Write a program for representing a goal-based and utility-based agents for a route-finding production system rule problem with its PEAS descriptions. Also compare performance measuring environment simulator for this problem.

2. Suppose two friends live in different cities on a map, such as the Romania map shown in following figure. On every turn, we can simultaneously move each friend to a neighboring city on the map. The amount of time needed to move from city i to neighbor j is equal to the road distance d(i, j) between the cities, but on each turn the friend that arrives first must wait until the other one arrives (and calls the first on his/her cell phone) before the next turn can begin. We want the two friends to meet as quickly as possible.



a. Write a detailed formulation for this search problem. (You will find it helpful to define some formal notation here.)

b. Let D(I, j) be the straight-line distance between cities I and j. Which of the following heuristic functions are admissible? (i) D(I, j); (ii) 2 · D(I, j); (iii) D(I, j)/2.

c. Are there completely connected maps for which no solution exists?

d. Are there maps in which all solutions require one friend to visit the same city twice?

3. Implement the expectiminimax algorithm and the *-alpha–beta algorithm, for pruning game trees with chance nodes. Try them on a game such as backgammon and measure the pruning effectiveness of *-alpha–beta.

4. Write a program for the iris flowers have different species on the .csv dataset and your task is to distinguish them based on the length of petals and sepals using machine learning classifier techniques.

5. The dataset has house prices of the Boston residual areas based on the .csv dataset. The expense of the house varies according to various factors like crime rate, number of rooms, etc. It is a good ML project for beginners to predict prices on the basis of new data.