

Program Name : Diploma in Artificial Intelligence and Machine Learning
Program Code : AN
Semester : Fifth
Course Title : Fundamental of AI & ML Algorithm
Course Code : 22593

1. RATIONALE

Artificial Intelligence (AI) is a big field; AI is one of the newest fields in science and engineering. This course will cover the basic of AI and ML and its architecture, Life cycle of Machine Learning, different searching techniques. AI as the study of agents that receive percepts from the environment and perform actions.

2. COMPETENCY

The aim of this course is to help the student to attain the following *industry identified* competency through various teaching learning experiences:

- **Classify real world problem and apply knowledge of AI and ML**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Describe the foundations of AI and Study different types of AI agents.
- Analyze and illustrate how search algorithms play vital role in problem solving
- Use different techniques knowledge representation for solving real world problems
- Describe Machine Learning Life Cycle and analyze different forms of data
- Analyze the data using different learning methods.
- Use different classification and regression techniques.

4. TEACHING AND EXAMINATION SCHEME

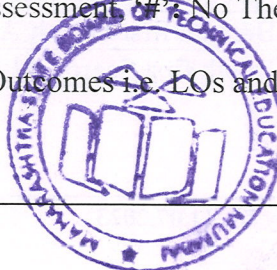
Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(**) marks should be awarded on the basis of internal end semester theory exam of 50 marks based on the specification table given in S. No. 9.

(~²): For the **practical only courses**, the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e. 30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e. 20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.

Legends: L Lecture; T Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit, ESE -End Semester Examination; PA - Progressive Assessment, @ - No Theory Examination

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)



This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

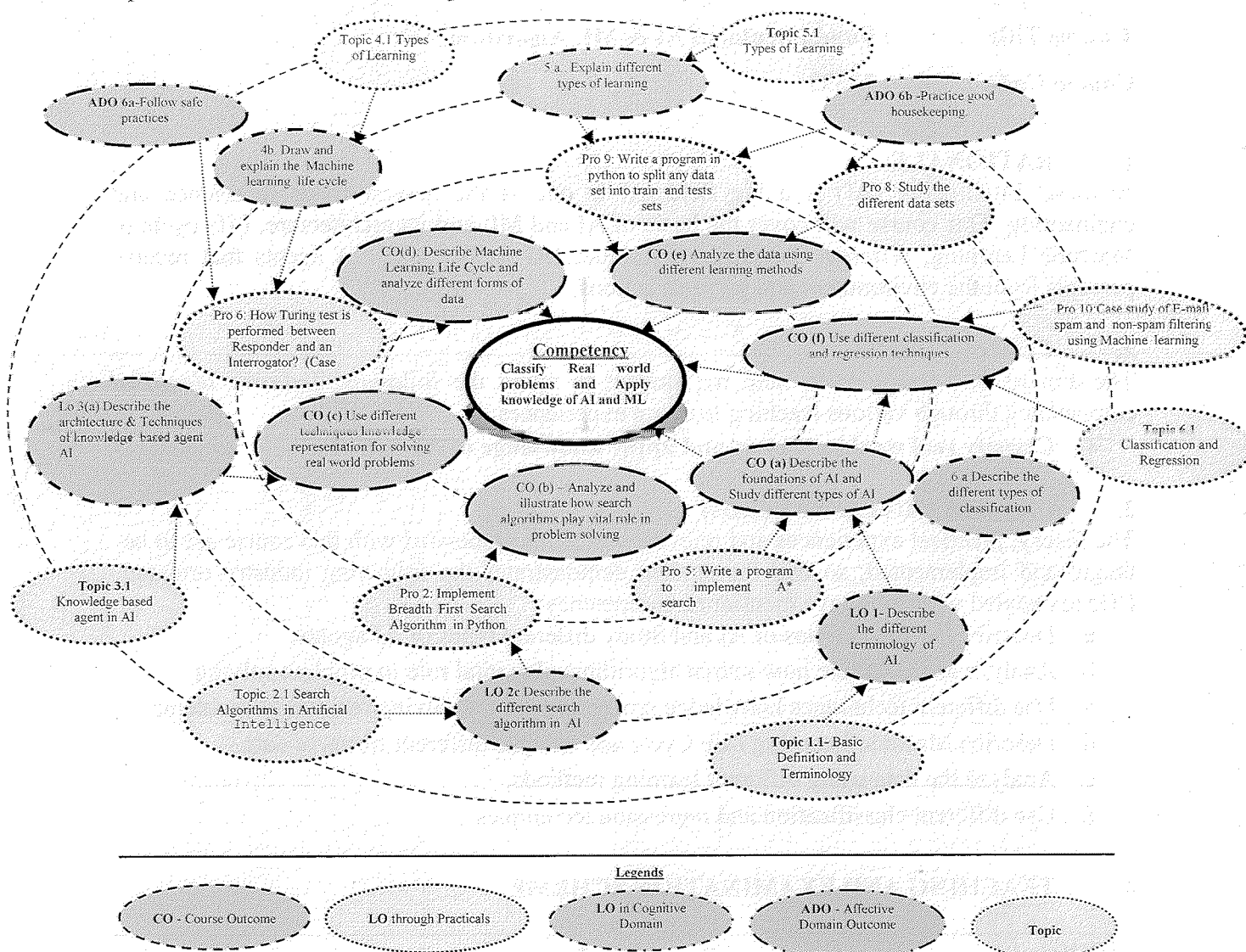


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e. sub-components of the COs) are to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
1	a. Installation of Python (Any IDE) b. Installation of Python scikit learn for ML c. Use of google colab (https://colab.research.google.com/)	I	02*
2	Implement Breadth first Search Algorithm (Uninformed) in Python	II	04*
3	Implement Depth first Search Algorithm (Uninformed) in Python	II	02

S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
4	Write a program to implement Greedy best-first (Informed Type) search algorithm in python	II	04
5	Write a program to implement A* search (Informed Type) algorithm in Python	II	02*
6	Case study on: How Turing test is performed between Responder and an Interrogator?	III	02*
7	Study the different data set finders e.g. Google Dataset Search, Kaggle etc...	IV	02*
8	Build model on following data sets in various domains. a. Machine learning data set: e.g. Credit Card Fraud Detection Dataset b. NLP data Sets: eg. Twitter Dataset ,HotspotQA Dataset	IV	02*
9	Write a program in python to split any data set into train and test sets	IV	04*
10	Case study of E-mail spam and non-spam filtering using Machine learning	V,VI	04*
11	Implementation of Simple Linear Regression using Python	VI	02*
12	Implementation of Multiple Linear Regression using Python	VI	02
Total			32

*: compulsory practicals to be performed.

Note

- Given in above tables is suggestive list of practical exercises. Teachers can design other similar exercises.
- Assessment of the 'Process' and 'Product' related skills in the laboratory/workshop/field work should be done as per suggested sample below:

S.No.	Performance Indicators	Weightage in %
1	Import packages and Libraries of Python.	20
2	Use Python to create, edit, assemble and link the programs.	40
3	Debug, test and execute the programs	20
4	Able to answer oral questions.	10
5	Submission of report in time.	10
Total		100

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

- Handle command prompt environment.
- Experiment with Python
- Plan, develop, assemble, link, debug and test the programs.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

- 'Valuing Level' in 1st year



- 'Organizing Level' in 2nd year and
- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Expt. S.No.
1	Hardware: Personal computer, (i5 preferable), RAM minimum 8 GB onwards.	For all Experiments
2	Operating system: Windows 10 onward	
3	Software: Editor: Python setup	

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop I.Os in cognitive domain for achieving the COs to attain the identified competency.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Introduction to AI	1a. Describe the different terminology of AI. 1b. Differentiate between AI vs ML. 1c. List the different types of AI agent 1d. Describe the structure of agents. 1e. Explain the turning test in AI	1.1 Basic Definition and Terminology: <ol style="list-style-type: none"> Foundation and Evaluation of AI Scope of AI Overview of AI Problems Components of AI Types of AI Application of AI AI vs ML 1.2 Intelligent Agent in AI: <ol style="list-style-type: none"> Types of AI agent Concept of Rationality Nature of environment Structure of agents Turning Test in AI
Unit-II Problem Solving	2a. State the different types of search algorithm 2b. Explain different Heuristic Search Techniques. 2c. Describe the properties of A* algorithm 2d. Describe the Constraint Satisfaction problem	2.1 Search Algorithms in Artificial Intelligence: <ol style="list-style-type: none"> Terminologies Properties of search Algorithms Types of search algorithms: uninformed search and informed search, State Space search 2.2 Heuristic Search Techniques: <ol style="list-style-type: none"> Generate-and-Test; Hill Climbing; Properties of A* algorithm, Best-first Search; Problem Reduction 2.3 Beyond Classical Search:

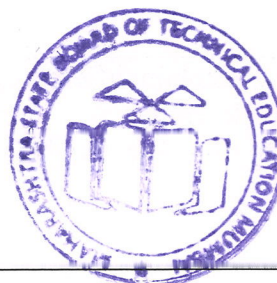


Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		<ul style="list-style-type: none"> a. Local search algorithms and optimization problem, b. Local search in continuous spaces, c. Searching with nondeterministic action and partial observation, d. Online search agent and unknown environments.
Unit-III Knowledge and Reasoning	<ul style="list-style-type: none"> 3a. Describe the architecture and techniques of knowledge based agent in AI 3b. Explain forward and backward chaining in AI 3c. Explain the different types of Reasoning in AI 	<ul style="list-style-type: none"> 3.1 Knowledge-Based Agent in Artificial intelligence: <ul style="list-style-type: none"> a. Architecture, b. Approaches to designing a knowledge-based agent knowledge representation: c. Techniques of knowledge representation, Propositional logic, d. Rules of Inference e. First-Order Logic, f. Forward Chaining, And backward chaining in AI, 3.2 Reasoning in Artificial intelligence: <ul style="list-style-type: none"> a. What is Reasoning? b. Types of Reasoning 3.3 Probabilistic reasoning in AI <ul style="list-style-type: none"> a. Uncertainty b. Causes of Uncertainty c. Need of probabilistic reasoning in AI d. d. Bayes' Theorem.
Unit – IV Introduction to ML	<ul style="list-style-type: none"> 4a. Describe the history and evaluation of ML 4b. Draw and explain the Machine learning life cycle 4c. Explain different forms of data 4d. Explain different data preprocessing methods 	<ul style="list-style-type: none"> 4.1 History and Evaluation of ML 4.2 Machine Learning life Cycle. <ul style="list-style-type: none"> a. Gathering data b. data preparation c. data Wrangling d. Data Analysis e. Train Model f. Test Model g. Deployment 4.3 Different forms of data: <ul style="list-style-type: none"> a. Statistics b. Data Mining c. Data Analytics d. Statistics Data e. Statistics vs. Data Mining vs. f. Data Analytics vs. Data Science 4.4 Dataset for ML 4.5 Data Cleaning : Missing Data, Outliers
Unit– V Types of Learning	<ul style="list-style-type: none"> 5a. Explain different types of learning 5b. Introduce the different 	<ul style="list-style-type: none"> 5.1 Types of Learning: <ul style="list-style-type: none"> a. Supervised b. Unsupervised



Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	types of supervised machine learning algorithm 5c. Introduce the different Unsupervised learning algorithm 5d. Describe the dimensionality reduction.	c. Semi-Supervised Learning 5.2 Supervised Learning: a. Learning a Class from Examples, b. Introduction of different types of supervised Machine Learning Algorithms 5.3 Unsupervised: a. Introduction of different Types of Unsupervised Learning Algorithm, 5.4 Model Evaluation a. Training Vs Testing b. Positive and Negative Class Cross-validation
Unit– VI Classification & Regression	6a. Describe the different types of classification 6b. Describe the assessing performance of Regression 6c. Differentiate between overfitting and under fitting 6d. Describe different types of regression	6.1 Linear Regression: a. Assessing performance of Regression – b. Error measures, c. Overfitting and Under fitting, d. Catalysts for Overfitting, 6.2 Multiple Linear Regression: Multiple Linear regression equation Implementation of multiple linear regression 6.3 Metrics for Regression a. Mean Squared Error (MSE). b. Root Mean Squared Error (RMSE). c. Mean Absolute Error (MAE) 6.4 Logistic Regression a. Binary and Multiclass Classification: b. Assessing c. Classification Performance, d. Handling more than two classes, e. Multiclass Classification- f. One vs One, g. One vs Rest. 6.5 Metrics for Classification: Confusion Matrix, AUC /ROC Curve, F1 Score, Accuracy, Precision, Recall

Note: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.



9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to AI	06	04	04	-	08
II	Problem Solving	10	04	06	06	16
III	Knowledge and Reasoning	10	02	04	06	12
IV	Introduction to ML	08	02	04	04	10
V	Types of Learning	08	02	06	06	14
VI	Classification & Regression	06	02	04	04	10
Total		48	16	28	26	70

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of I.Os. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

This specification table also provides a general guideline for teachers to frame internal end semester practical theory exam paper which students have to undertake.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

- Prepare journals based on practical performed in laboratory.
- Library/E-Books survey regarding assembly language programming used in Computer industries.
- Prepare power point presentation for showing different types of Assembly language Programming Applications.

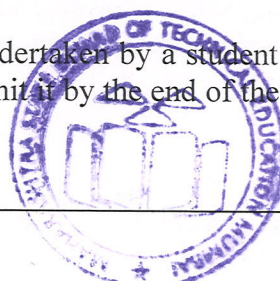
11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- '**L**' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- Guide student(s) in undertaking micro-projects.
- No. of practical's selection to be performed should cover all units.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop



the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practicals, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) studentengagement hours** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **8-Puzzle Problem Solving**-Each group will develop a program to perform following operations

1. Using any Uninformed or informed search algorithm

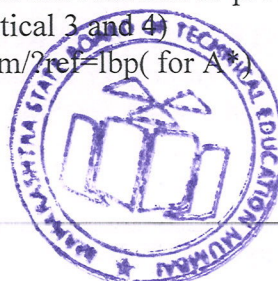
b. **8-queen Problem in python**-Each group will develop a program to perform following operations using Python libraries

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Artificial Intelligence A modern Approach Third edition	Stuart Russell and Peter Norvig, Editors	Pearson Education, Inc ISBN-13: 978-0-13-604259-4 ISBN-10: 0-13-604259-7
2	Machine Learning in Action	Peter Harrington,	DreamTech, First Edition, 2012 13: 978- 161729018
3	Practical Machine Learning with Python A Problem-Solver's Guide to Building Real-World Intelligent Systems	Dipanjan Sarkar Raghav Bali Tushar Sharma	Apress publication ISBN-13 (pbk): 978-1-4842-3206-4 ISBN-13 (electronic): 978-1-4842-3207-1
4	Introduction to Machine Learning with Python	Andreas C. Müller & Sarah Guido	O'Reilly Media, Inc
5	Machine Learning using Python	Manaramjan Pradhan, U Dinesh Kumar	Wiley india ISBN: 978-81-265-7990-7

14. SOFTWARE/LEARNING WEBSITES

- <https://www.pdfdrive.com/machine-learning-for-absolute-beginners-e188007429.html>
- <https://www.geeksforgeeks.org/ml-fuzzy-clustering/>
- <https://www.pdfdrive.com/machine-learning-step-by-step-guide-to-implement-machine-learning-algorithms-with-python-d158324853.html>
- <https://machinelearningmastery.com/classification-as-conditional-probability-and-the-naive-bayes-algorithm/> (for Practical)
- <https://www.geeksforgeeks.org/naive-bayes-classifiers/> (for Practical)
- <https://favtutor.com/blogs/breadth-first-search-python> (for BFS)
- <https://www.analyticsvidhya.com/blog/2021/10/an-introduction-to-problem-solving-using-search-algorithms-for-beginners/> (for practical 3 and 4)
- <https://www.geeksforgeeks.org/a-search-algorithm/> (for A*)



- i. <https://www.geeksforgeeks.org/uniform-cost-search-dijkstra-for-large-graphs/?ref=lbp> (for Uniformed algorithms)
- j. <https://favtutor.com/blogs/depth-first-search-python> (for DFS PR)
- k. <https://pub.towardsai.net/best-datasets-for-machine-learning-data-science-computer-vision-nlp-ai-c9541058cf4f> (for data set)
- l. <https://www.educba.com/turing-test-in-ai/?source=leftnav> (for Practical 9)
- m. <https://machinelearningmastery.com/machine-learning-in-python-step-by-step/> (for Practical 10)
- n. <https://www.geeksforgeeks.org/implementation-of-logistic-regression-from-scratch-using-python/?ref=rp> (for logistic)
- o. <https://www.geeksforgeeks.org/ml-multiple-linear-regression-using-python/> (for Linear)

