SIR C R REDDY COLLEGE OF ENGINEERING, ELURU

DEPARTMENT OF INFORMATION TECHNOLOGY

COURSE HANDOUT

SUBJECT: MACHINE LEARNING

CLASS: IV/IV B.TECH SEMESTER-I, A.Y.2022-23

INSTRUCTOR: SRI G. PAVAN

Course Handout Index

S. No	Description
1	College Vision & Mission
2	Department Vision & Mission
3	Program Educational Objectives (PEOs)
4	Program Outcomes (POs)
5	Program Specific Outcomes (PSOs)
6	JNTUK Academic Calendar
7	Department Academic Calendar
8	Course Description
9	Course Objectives
10	Course Outcomes
11	Lesson Plan
12	Evaluation Pattern
13	Timetable
14	Syllabus
15	Unit wise Questions

College Vision & Mission

Vision: To emerge as a premier institution in the field of technical education and research in the state and as a home for holistic development of the students and contribute to the advancement of society and the region.

Mission: To provide high quality technical education through a creative balance of academic and industry oriented learning; to create an inspiring environment of scholarship and research; to instill high levels of academic and professional discipline; and to establish standards that inculcate ethical and moral values that contribute to growth in career and development of society in general.

Department Vision & Mission

Vision: To be a premier department in the region in the field of Information Technology through academic excellence and research that enable graduates to meet the challenges of industry and society.

Mission: To Provide dynamic teaching-learning environment to make the students industry ready and advancement in career; to inculcate professional and leadership quality for better employability and entrepreneurship; to make high quality professional with moral and ethical values suitable for industry and society.

Program Educational Objectives (PEOs)

PEO1: Solve real world problems through effective professional skills in Information Technology industry and academic research.

PEO2: Analyze and develop applications in Information Technology domain and adapt to changing technology trends with continuous learning.

PEO3: Practice the profession in society with ethical and moral values.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, society, and environmental considerations.

PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in society and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1: Design Skill: Design and develop softwares in the area of relevance under realistic constraints.

PSO2: New Technology: Adapt new and fast emerging technologies in the field of Information Technology.

JNTUK Academic Calendar

Website: www.jntuk.edu.in
Email: dap@jntuk.edu.in

Phone: 0884-2300991

Directorate of Academic Planning
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA-533003, Andhra Pradesh, INDIA
(Established by AP Government Act No. 30 of 2008)

Lr. No. DAP/AC/IV Year /B. Tech/B. Pharmacy/2022 *Date 25.06.2022*

Dr. KVSG Murali Krishna,
M.E, Ph.D.,
Director, Academic Planning
JNTUK, Kakinada

To
All the Principals of Affiliated Colleges,
JNTUK, Kakinada.

Academic Calendar for IV Year - B. Tech/B. Pharmacy for the AY 2022-23

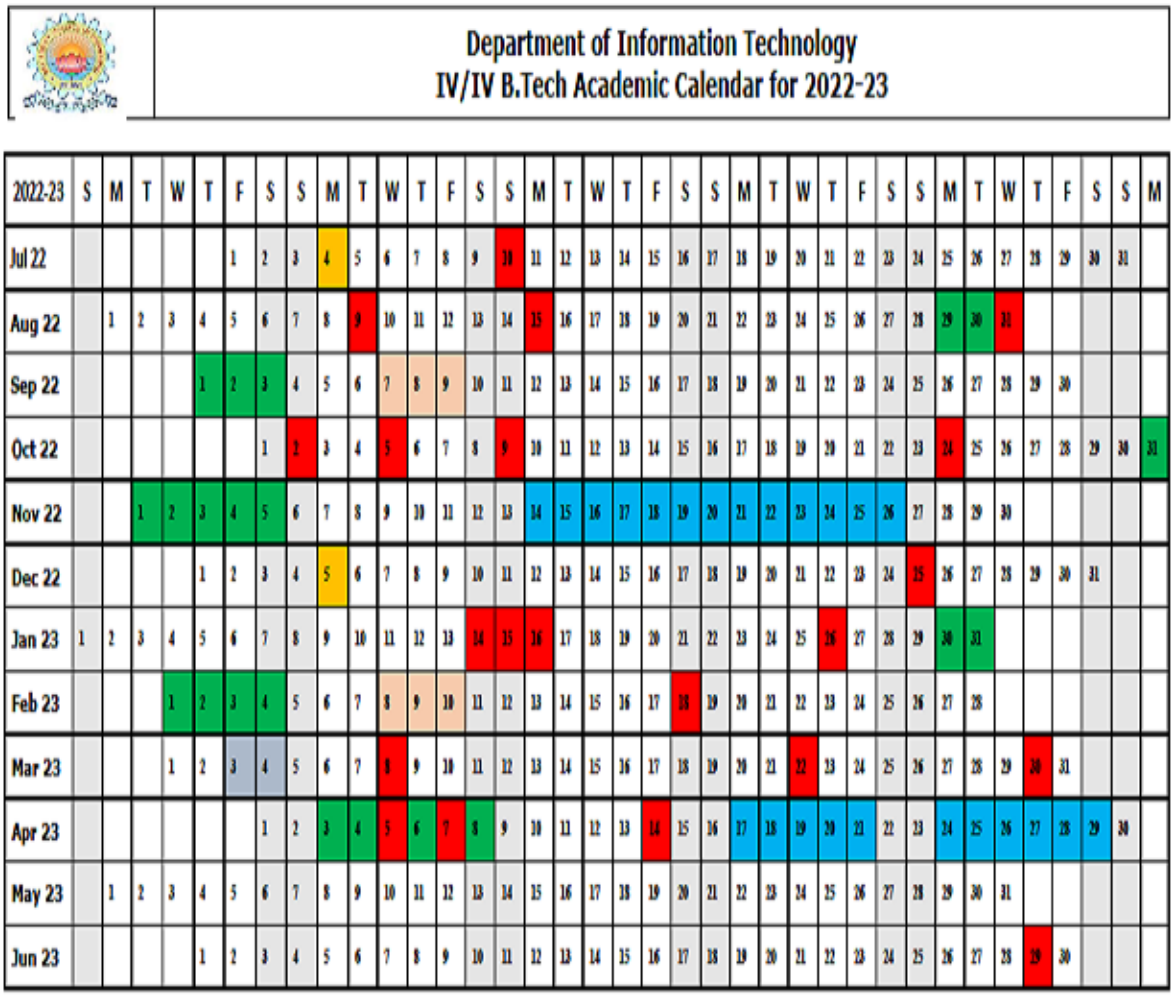
I SEMESTER			
Description	**From**	**To**	**Weeks**
Commencement of Class Work	**04.07.2022**		
I Unit of Instruction	04.07.2022	27.08.2022	8W
I Mid Examinations	29.08.2022	03.09.2022	1W
II Unit of Instructions	05.09.2022	29.10.2022	8W
II Mid Examinations	31.10.2022	05.11.2022	1W
Preparation & Practicals	07.11.2022	12.11.2022	1W
End Examinations	14.11.2022	26.11.2022	2W
Commencement of II Semester Class Work	**05.12.2022**		
II SEMESTER			
I Unit of Instructions	**05.12.2022**	28.01.2023	8W
I Mid Examinations	30.01.2023	04.01.2023	1W
II Unit of Instructions	06.01.2023	01.04.2023	8W
II Mid Examinations	03.04.2023	08.04.2023	1W
Preparation & Practicals	10.04.2023	15.04.2023	1W
End Examinations	17.04.2023	29.04.2023	2W

Director,
Academics & Planning,
JNTUK.
25/6/22

Director
Academic Planning
JNTUK Kakinada

Copy to the Secretary to the Hon'ble Vice Chancellor, JNTUK
Copy to Rector, Registrar, JNTUK
Copy to Director Academic Audit, JNTUK
Copy to Director of Evaluation, JNTUK

Department Academic Calendar



Department of Information Technology
IV/IV B.Tech Academic Calendar for 2022-23

2022-23	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M
Jul 22						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Aug 22		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					
Sep 22					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
Oct 22							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Nov 22			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30					
Dec 22					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
Jan 23	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
Feb 23				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28						
Mar 23				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31			
Apr 23							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
May 23		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					
Jun 23					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			

List of Holidays				
July 10: Bakrid	Oct 9: Mauhd Nabi	Mar 22 : Ugadhi	Mid exams	
Aug 9:Moharum	Oct 24 : Diwali	Mar 30: Sriram navami	End Examinations	
Aug 15:Independence day	Dec 25 :Christmas	Apr 5: Babu Jagjivan Ram Jayanti	Commencement of Class work	
Aug 31:Ganesh Chaturdi	Jan 14-16: sankranti	Apr 7: Good friday	Workshops	
Oct 2: Gandhi jayanthi	Jan 26:Republic Day	Apr 14:Ambedkar Jayanthi	Department fest/Elite	
Oct 5: Vijayadasami	Feb 18 :Sivaratri	Jun 29: Bakrid		HoD
	Mar 8 : holi			Department of IT

Course Description

This course will introduce some of the principles and foundations of Machine Learning algorithms along with their real -world applications. The course will cover the major approaches to learning namely, supervised, unsupervised, and reinforcement leaning. The topics covered in the course include regression, decision trees, support vector machines, artificial neural networks, Bayesian techniques etc.

Course Objectives

The course is introduced for students to

- Gain knowledge about basic concepts of Machine Learning
- Study about different learning algorithms
- Learn about of evaluation of learning algorithms
- Learn about artificial neural networks

Course Outcomes

On completion of this subject/course the students shall be able to:

CO	CO Description	Level
CO1	Understand learning concept and identify problems relevant to machine learning	L2
CO2	Describe issues in decision tree learning and Experimental Evaluation of Learning Algorithms, the theory of Artificial intelligence and Support Vector Machine	L2
CO3	Apply Dimensionality reduction techniques and Rule Learning in Machine Learning	L3
CO4	Implement the concepts of Bayesian Learning and Instance based Learning	L3

Lesson Plan

S.No	Unit	Topics	Teaching Aids	CO
1	I	Introduction: Definition of learning systems	BB/PPT	1
2		Goals and applications of machine learning	BB/PPT	1
3		Aspects of developing a learning system: training data, concept representation, Concept representation	BB/PPT	1
4		Function approximation	BB/PPT	1
5		Inductive Classification: The concept learning task	BB/PPT	1
6		Concept learning as search through a hypothesis space	BB/PPT	1
7		General-to-specific ordering of hypotheses	BB/PPT	1
8		Finding maximally specific hypotheses	BB/PPT	1
9		Version spaces	BB/PPT	1
10		Candidate elimination algorithm	BB/PPT	1
11		Learning conjunctive concepts	BB/PPT	1
12		The importance of inductive bias	BB/PPT	1
13	II	Introduction to Decision Tree Learning	BB/PPT	2
14		Representing concepts as decision trees	BB/PPT	2
15		Recursive induction of decision trees	BB/PPT	2
16		Picking the best splitting attribute: entropy and information gain	BB/PPT	2
17		Picking the best splitting attribute: entropy and information gain	BB/PPT	2
18		Searching for simple trees and Computational complexity	BB/PPT	2

19		Occam's razor	BB/PPT	2
20		Overfitting, noisy data, and pruning	BB/PPT	2
21		Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses	BB/PPT	2
22		Comparing learning algorithms: cross-validation	BB/PPT	2
23		Learning curves	BB/PPT	2
24		Statistical hypothesis testing	BB/PPT	2
25	III	Introduction to Computational Learning & Rule Learning	BB/PPT	3
26		Models of learnability	BB/PPT	3
27		Learning in the limit	BB/PPT	3
28		Probably Approximately Correct (PAC) learning	BB/PPT	3
29		Sample complexity for infinite hypothesis spaces	BB/PPT	3
30		Vapnik-Chervonenkis dimension	BB/PPT	3
31		Rule Learning: Propositional and First-Order	BB/PPT	3
32		Translating decision trees into rules	BB/PPT	3
33		Heuristic rule induction using separate and conquer and information gain	BB/PPT	3
34		First-order Horn-clause induction (Inductive Logic Programming) and Foil	BB/PPT	3
35		Learning recursive rules	BB/PPT	3
36		Inverse resolution, Golem, and Progol	BB/PPT	3
37		Introduction to Artificial Neural Networks	BB/PPT	4
38		Neurons and biological motivation	BB/PPT	4
39		Linear threshold units	BB/PPT	4

40	IV	Introduction to Perceptrons	BB/PPT	4
41		Representational limitation and gradient descent training	BB/PPT	4
42		Multilayer networks and backpropagation	BB/PPT	4
43		Hidden layers and constructing intermediate, distributed representations.	BB/PPT	4
44		Overfitting, learning network structure	BB/PPT	4
45		Recurrent network	BB/PPT	4
46		Support Vector Machines: Maximum margin linear separators	BB/PPT	4
47		Quadratic programming solution to finding maximum margin separators	BB/PPT	4
48		Kernels for learning non-linear function	BB/PPT	4
49	V	Bayesian Learning	BB/PPT	5
50		Probability theory and Bayes rule	BB/PPT	5
51		Naive Bayes learning algorithm	BB/PPT	5
52		Parameter smoothing	BB/PPT	5
53		Generative vs. discriminative training	BB/PPT	5
54		Logisitic regression	BB/PPT	5
55		Bayes nets and Markov nets for representing dependencies	BB/PPT	5
56		Introduction to Instance-Based Learning	BB/PPT	5
57		Constructing explicit generalizations versus comparing to past specific examples	BB/PPT	5
58		k-Nearest-neighbor algorithm	BB/PPT	5
59		k-Nearest-neighbor algorithm	BB/PPT	5
60		Case-based learning	BB/PPT	5

Evaluation Pattern

S. No	Components	Internal	External	Total
1	Theory	25	75	100
2	Engineering Graphics/Design/Drawing	25	75	100
3	Practical	20	30	50
4	Mini Project/Internship/Industrial Training/ Skill Development programmes/Research Project	-	50	50
5	Project Work – Part I	20	30	50
5	Project Work – Part II	60	90	150

Marks Range Theory (Max – 100)	Marks Range Lab (Max – 75)	Letter Grade	Level	Grade Point
≥ 90	≥ 67	O	Outstanding	10
≥80 to <90	≥60 to <67	S	Excellent	9
≥70 to <80	≥52 to <60	A	Very Good	8
≥60 to <70	≥45 to <52	B	Good	7
≥50 to <60	≥37 to <45	C	Fair	6
≥40 to <50	≥30 to <37	D	Satisfactory	5
<40	<30	F	Fail	0
			Absent	0

Timetable

Day/Time	**09.00-09.50**	**09.50-10.40**	**11.00-11.50**	**11.50-12.40**	**01.40-02.30**	**02.30-03.20**	**03.20-04.10**	**04.10-05.00**
Mon	ML-A		ML-B					
Tue			ML-A			ML-B		
Wed	ML-B		ML-A		ML-A			
Thu			ML-B					
Fri					ML-B		ML-A	
Sat					*********			

Syllabus

UNIT I

Introduction: Definition of learning systems, Goals and applications of machine learning, Aspects of developing a learning system: training data, concept representation, function approximation.

Inductive Classification: The concept learning task, Concept learning as search through a hypothesis space, General-to-specific ordering of hypotheses, Finding maximally specific hypotheses, Version spaces and the candidate elimination algorithm, Learning conjunctive concepts, The importance of inductive bias.

UNIT II

Decision Tree Learning: Representing concepts as decision trees, Recursive induction of decision trees, Picking the best splitting attribute: entropy and information gain, Searching for simple trees and computational complexity, Occam's razor, Overfitting, noisy data, and pruning.

Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.

UNIT III

Computational Learning Theory: Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity for infinite hypothesis spaces, Vapnik-Chervonenkis dimension.

Rule Learning: Propositional and First-Order, Translating decision trees into rules, Heuristic rule induction using separate and conquer and information gain, First-order Horn-clause induction (Inductive Logic Programming) and Foil, Learning recursive rules, Inverse resolution, Golem, and Progol.

UNIT IV

Artificial Neural Networks: Neurons and biological motivation, Linear threshold units. Perceptrons: representational limitation and gradient descent training, Multilayer networks and backpropagation, Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks.

Support Vector Machines: Maximum margin linear separators. Quadractic programming solution to finding maximum margin separators. Kernels for learning non-linear functions.

UNIT V

Bayesian Learning: Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logisitic regression. Bayes nets and Markov nets for representing dependencies.

Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific examples. k-Nearest-neighbor algorithm. Case-based learning.

Text Books:

1) T.M. Mitchell, "Machine Learning", McGraw-Hill, 1997.
2) Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2019.

Reference Books:

1) Ethern Alpaydin, "Introduction to Machine Learning", MIT Press, 2004.
2) Stephen Marsland, "Machine Learning -An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3) Andreas C. Müller and Sarah Guido "Introduction to Machine Learning with Python: A Guide for Data Scientists", Oreilly.

e-Resources:

1) Andrew Ng, "Machine Learning Yearning" https://www.deeplearning.ai/machine-learning-yearning/

2) Shai Shalev-Shwartz , Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms" , Cambridge University Press https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html

Unit wise Questions

Unit-1

1. Define Machine Learning. List & Explain types, goals and applications of Machine Learning.
2. Define learning system with an example. List & Explain the aspects of developing a Learning system.
3. Define Version Space. Explain Find-S Algorithm & Implement the Algorithm on a dataset.
4. What is Candidate Elimination Algorithm? Explain the Algorithm & Implement the Algorithm on a dataset.
5. Define Concept Learning. Explain concept learning as search through hypothesis space.
6. Discuss about the importance of inductive bias.

Unit-2

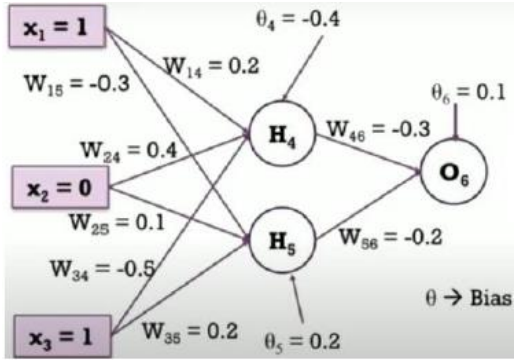
1. Define Decision Tree. Explain ID3 Algorithm & implement it on a dataset. (or) Explain entropy and information gain in Decision Tree using a Dataset.
2. What is Cross-validation? List & explain the methods used for cross-validation.
3. Explain the following:
    - Occam's Razor
    - Over fitting
    - Noisy data
    - Pruning
4. Explain the Computational complexity on searching for simple trees.
5. Discuss about the following
    - Measuring the accuracy of learned hypotheses
    - Learning curves
    - Statistical Hypothesis Testing

Unit-3

1. Define Computational Learning. Explain Probably Approximately Correct (PAC) Learning?
2. What is Vapnik-Chervonenkis dimension? Explain it in detail.
3. Explain Propositional Logic in Rule Learning.
4. Discuss about translating decision trees into rules along with its advantages.
5. What is First Order Inductive Learner? Explain FOIL Algorithm.
6. Explain the following
    - Inverse resolution
    - Golem
    - Progol

Unit-4

1. Define Artificial Neural Network (ANN). Explain the architecture, types & working of ANN along with biological motivation.
2. Explain about the linear threshold units.
3. Define Perceptron. Explain the types, component & working of a perceptron.
4. Discuss how to learn Multilayer networks using gradient descent training algorithm.
5. Explain & Apply Back Propagation Algorithm on the below network. Assume that the neurons have a sigmoid activation function; perform a forward pass and a backward pass on the network. Assume that the actual output of y is 1 and the learning rate is 0.9. Perform another forward pass.



6. Explain the following
    - Overfitting in ANN
    - Recurrent Networks (Types, Working, Applications)

7. Explain Quadratic programming solution in finding maximum margin separators in Support Vector Machines (SVM).

Unit-5

1. Explain Probability theory and Bayes rule. Explain & Apply Naive Bayes learning algorithm on any dataset.
2. Describe Logisitic regression in Machine Learning.
3. Identify the below
   - Parameter smoothing & its methods
   - Generative & discriminative training
   - Bayes nets and Markov nets for representing dependencies
   - Constructing Explicit Generalizations Versus Comparing to past specific examples
4. Explain & Apply KNN Algorithm on any dataset.
5. Explain in detail about Case-Based Learning & its working.