Nirma University

Institute of Technology

Computer Science and Engineering Department

Course Policy Template

2CS501 **Machine Learning** **[3 2 - 4]**

B.Tech. (CSE)

Semester: V, Academic Year: 2020-21, Term: Odd

Course Code & Name	:	**2CS501 – Machine Learning**
Credit Details	:	4
Course Faculty	:	Dr. Priyank Thakkar (Course Coordinator) Prof. Rupal Kapdi
Contact No. & Email	:	Ext: 9564, priyank.thakkar@nirmauni.ac.in
Office	:	Beside N506
Visiting Hours	:	Monday to Friday - 8:45 to 4:00, Saturday (Odd) - 8:45 to 4:45
Course Blog	:	https://ce623rak.wordpress.com/
Course Site	:	https://lms.nirmauni.ac.in/course/view.php?id=1031

Introduction to Course:

Machine learning is the science of getting computers to act without being explicitly programmed. In the past decade, machine learning has given us self-driving cars, practical speech recognition, effective web search, and a vastly improved understanding of the human genome.

Course Learning Outcomes:

At the end of the course, students will be able to –

1. comprehend statistical methods as basis of machine learning domain
2. apply and evaluate variety of learning algorithms for appropriate applications
3. implement machine learning techniques to solve problems in applicable domains

Program Outcomes:

PO1 : an ability to apply knowledge of mathematics, science and engineering in practice

PO2 : an ability to identify, critically analyze, formulate and solve engineering problems with comprehensive knowledge in the area of specialization

PO3 : an ability to select modern engineering tools and techniques and use them with appropriate skills

PO4 : an ability to design a system and process to meet desired needs within realistic constraints such as health, safety, security and manufacturability

PO5 : an ability to contribute by research and innovation to solve engineering problems

PO6 : an ability to understand the impact of engineering solutions in a contemporary, global, economical, environmental, and societal context for sustainable development

PO7 : an ability to function professionally with ethical responsibility as an individual as well as in multidisciplinary teams with positive attitude

PO8 : an ability to communicate effectively

PO9 : an ability to appreciate the importance of goal setting and to recognize the need for life-long reflective learning

Program Specific Outcomes:

PSO 1: To apply the theoretical concepts of computer engineering and practical knowledge in analysis, design and development of computing systems and interdisciplinary applications

PSO 2: To work as a socially responsible professional by applying computer engineering principles and management practices

Program Educational Objectives:

PEO I: To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms.

PEO II: To prepare graduates who will contribute to society as broadly educated, expressive, ethical and responsible citizens with proven expertise.

PEO III: To prepare graduates who will achieve peer-recognition; as an individual or in a team; through demonstration of good analytical, design and implementation skills.

PEO IV: To prepare graduates who will thrive to pursue life-long learning to fulfill their goals.

Mapping of COs to POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	0	0	0	0	0	0	0	0	0	3	0
CO2	2	0	0	3	0	0	0	0	0	0	1	0	3	0
CO3	0	3	0	0	2	0	0	0	1	0	0	1	3	2

Syllabus

Syllabus:	Teaching Hours
Unit I	**3**
Introduction: Motivation and Applications, importance of Data Visualization, Basics of Supervised and Unsupervised Learning	
Unit II	**14**
Regression Techniques: Basic concepts and applications of Regression, Simple Linear Regression – Gradient Descent and Normal Equation Method, Multiple Linear Regression, Non-Linear Regression, Linear Regression with Regularization, Hyper-parameters tuning, Loss Functions, Evaluation Measures for Regression Techniques	
Unit III	**10**
Classification Techniques: Naïve Bayes Classification, Fitting Multivariate Bernoulli Distribution, Gaussian Distribution and Multinomial Distribution, K-Nearest Neighbours, Decision trees.	
Support Vector Machines: Hard Margin and Soft Margin, Kernels and Kernel Trick, Evaluation Measures for Classification Techniques	
Unit IV	**9**
Artificial Neural Networks: Biological Neurons and Biological Neural Networks, Perceptron Learning, Activation Functions, Multilayer Perceptrons, Back-propagation Neural Networks, Competitive Neural Networks	
Unit V	**4**
Clustering: Hierarchical Agglomerative Clustering, k-means Algorithm, Self-Organizing Maps	
Unit VI	**5**
Advanced Concepts: Basics of Semi-Supervised and Reinforcement Learning, Linear Discriminant Analysis, Introduction to Deep Learning	

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on applications of above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings:

1. Tom Mitchell, Machine Learning, TMH
2. C. Bishop, Pattern Recognition and Machine Learning, Springer
3. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification and Scene Analysis, Wiley
4. KishanMehrotra, Chilukuri Mohan and Sanjay Ranka, Elements of Artificial Neural Networks, Penram International
5. RajjanShinghal, Pattern Recognition, Techniques and Applications, OXFORD
6. AthemEalpaydin, Introduction to Machine Learning, PHI

Component wise Continuous Evaluation & Semester End Examination weightage:

Course Code	**2CS501**	**Semester**	**5**	**Year**	**2020**	**Credit**	**4**
Lectures/week	**3**	**Practicals/ week**	**2**	**Tutorials /week**	**0**		

Exam Weightage			**Exam Hours**	
CE	**LPW**	**SEE**	**SEE**	**Practical**
0.4	**0.2**	**0.4**	**3**	**-**

Breakup of CE

	Unit 1	**Unit 2**	**Unit 3**
	Quiz	**Exhaustive Evaluation**	**Assignment**
Inter Component Weightage	0.3	0.4	0.3

Lesson Plan

Sr. No.	**Topics**	**Hours**	**CLOs**
1	**Introduction:** • Theory and practices in machine learning • Overview of machine learning along with its definition and its application area • Types of machine learning techniques • Significance of Model Training • Importance of Data Visualization	**[03]** [01] [01] [01]	CLO 1

2	**Supervised learning for Prediction** • Basic concepts and applications of Regression, Simple Linear Regression – Gradient Descent and Normal Equation Method • Multiple Linear Regression, Non-Linear Regression • Linear Regression with Regularization, Hyper-parameters tuning • Importance of feature scaling • Loss Functions • Evaluation Measures for Regression Techniques	**[14]** [05] [03] [02] [01] [02] [01]	CLO1, CLO2
2	**Unsupervised Learning : Clustering** • K-nearest Neighbor Classification • K-means Clustering • Fuzzy - C means Clustering • Density Based Clustering	**[05]** [01] [02] [02]	CLO 1, CLO 2
3	**Classification Techniques** • Naïve Bayes Classification • Fitting Multivariate Bernoulli Distribution, • Gaussian Distribution and Multinomial Distribution • K-Nearest Neighbours • Decision trees: ID3,C4.5, CART • Support Vector Machines: Hard Margin and Soft Margin, Kernels and Kernel Trick, Evaluation Measures for Classification Techniques	**[10]** [01] [02] [02] [01] [02] [02]	CLO1, CLO2
4	**Artificial Neural Networks** • Biological Neurons and Networks • Artificial Neuron Model • Activation Functions (Linear, step, ramp, log sigmoid and tan sigmoid, ReLU, Leaky ReLU) • Architectures of ANN • Linear Separability • Feed Forward ANN • Back Propagation • Various Loss Functions (Binary and Categorical cross-entropy)	**[09]** [01] [01] [01] [01] [01] [01] [02] [01]	CLO1, CLO2
5	**Unsupervised Learning : Clustering** • K-means Clustering • Fuzzy - C means Clustering • Expectation Maximization	**[04]** [01] [02] [01]	CLO1,CLO2
6	**Advanced Concepts** • Basics of Semi-Supervised and Reinforcement Learning • Linear Discriminant Analysis • Introduction to Deep Learning	**[05]** [02] [01] [02]	CLO1,CLO2
	Total	**45**	

List of Practical

Sr. NO.	Week No.	List of Experiments	Mapped with CO
1	**1**	Introduction to Python and Numpy (2 Hrs) *	**3**
2	**2**	Introduction to Pandas, Matplotlib and Sklearn (2 Hrs) *	**3**
3	**3,4**	Simple and Multiple Linear Regression using Gradient Descent & Normal Equation Method (without using sklearn or equivalent library for both) (4 Hrs)	**3**
4	**5**	Linear Regression with Regularization (without using sklearn or equivalent library) and Simple and Multiple Linear Regression with and without regularization using Sklearn (2 Hrs)	**3**
5	**6**	Naïve-Bayes – Multivariate Bernoulli, Multinomial and Gaussian using sklearn (2 Hrs)	**3**
6	**7**	Decision Trees – ID3, C4.5 using sklearn (2 Hrs)	**3**
7	**8**	Support Vector Classification and Regression with Grid Search for Hyper-parameter tuning using sklearn (2 Hrs)	**3**
8	**9**	AND gate using Perceptron Learning (self-implementation) (2 Hrs)	**3**
9	**10,11**	Ex-OR Gate/any other problem using Backpropagation Neural Networks (self-implementation) (4 Hrs)	**3**
10	**12**	Backpropagation Neural Network and K-means using sklearn (2 Hrs)	**3**
11	**13,14,15**	Reinforcement Learning for some game. (self-implementation) (6 Hrs)	**3**
		Total	**30**

Note: Practical 1 and 2 are of 5 marks, each of the rest is of 10 marks.

* Those who are already good at Python, Numpy, Pandas, Matplotlib and Sklearn, they can perform following 2 practical instead:

1. Use pytesseract library in Python for optical character recognition from (i) an image file (ii) a multi-page pdf file

2. Download financial report of some company in a pdf format. Using Tabula library in Python extract multiple tables from the financial report and save each table in a separate csv file. Repeat the entire task using Camelot library.

1. Course Assessment Schemes

(Course with Laboratory component)

Assessment scheme	**CE**			**SEE**
Component weightage	0.6			0.4
	Quiz 30%	Exhaustive Evaluation 40%	Assignment 30%	

Teaching-learning methodology: (Proposed)

- Lectures: Use of Black board, PPT, Discussion, Case Studies
- Practical: Use of python for implementing and doing

Active learning techniques:(Proposed)

- Flipped classroom
- Active discussions

Types of Special/Innovative Assignments, Term Papers, mini Projects etc.

- Satellite image classification using feature extraction
- Deep feature Based image classification
- Reinforcement learning for robotic arm.

Course Material: (In the website)

- Course Policy
- PPTs, Notes, other Material
- Assignments, Tutorials, Lab Manuals
- Question bank
- Web-links, Blogs, Video Lectures, Journals
- Animations /Simulations, Software
- Advanced topics
- Industries/Organizations

Course Outcome Attainment:

- Use of formal evaluation components of continuous evaluation, laboratory work, semester end examination.
- Informal feedback during course conduction.