Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Department of Computer Science & Engineering
Teaching and Evaluation Scheme

B. Tech (Hons.) Computer Science & Engineering with Specialization of Artificial intelligence & Machine learning

Course Code	Course Name	Sem	Teaching Scheme				Evaluation Scheme		
			L	T	P	CR	C	M M	Pass
UCSH0301	Mathematical Foundations for AI and ML	III	3	1	-	4	ESE	100	40
UCSH0401	Data Engineering	IV	3	1		4	ESE	100	40
UCSH0501	Artificial Intelligence and Machine Learning Programming	V	4		2	5	ESE	100	40
UCSH0601	Deep Learning	VI	3	1	-	4	ESE	100	40
UCSH0701	Mini Project	VII	-		2	1	ESE (POE)	100	40
			13	3	4	18		500	

CR: Credit, C; Component, MM: Max. Marks, Pass: Passing Marks

Total Credits - 18, Total Contact hours – 20

Note: Credits allotted to Tutorials may be replaced by Practical (02 Contact hours = 01 Credit) if required without disturbing the Credit Distribution in each semester.

Kolhapur Institute of Technology's College of Engineering (Autonomous) Kolhapur
Computer Sci & Engg. Dept.

1/2/2024

Head
Department of Comp. Sci. & Engg.
Kolhapur Institute of Technology's
College of Engineering (Autonomous)
Kolhapur

Title of the Course: Mathematical Foundations for AI and ML Course Code: UCSH0301	L	T	P	Credit
	3	1		4

Course Pre-Requisite: Linear algebra and a basic background in probability as well as basic experience in programming (e.g. Matlab, Python) will be required. Some basic knowledge in optimization is recommended.

Course Description: This course will cover the mathematical foundations and exact concepts behind some of the most important methods in machine learning and artificial intelligence. The emphasis in this course will be on the rigorous mathematical principles behind how and why methods work.

Course Objectives

1.To understand the mathematical concepts for AI and Machine Learning
2.Learn to implement algorithms in python
3.Understand the how the concepts extend for real world ML problems

Assessments :

Teacher Assessment:

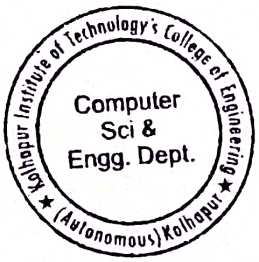
One components of End Semester Examination (ESE) having 100% weight.

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content covered.

Course Contents:

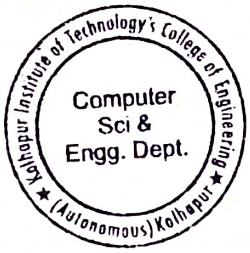
Unit 1. Introduction Introduction to AI& ML ,Why AI & ML , Use Cases in Business and Scope, Scientific Method , Modeling Concepts.	5 Hrs
Unit 2. Linear Algebra Vector and Matrix Norms, Vectors, Matrices, and Tensors in Python, Special Matrices and Vectors, Eigen values and Eigenvectors, Norms and Eigen decomposition.	7 Hrs.
Unit 3. Mathematical Foundations of ML Linear Regression method, Least squares method, Linear algebra solution to least squares problem, Examples of linear regression.	7 Hrs.
Unit 4:Statistical Analysis Initial Data Analysis, Relationship between attributes: Covariance, Correlation Coefficient, Chi Square Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution) and other statistical graphs	8 Hrs.
Unit 5:Multivariate Analysis Introduction to Derivatives, Basics of Integration, Gradients, GradientVisualization, Optimization.	5 Hrs.
Unit 6:Probability Theory Theory, Distributions, Covariance, Probability(Joint, marginal and conditional probabilities), Probability distributions (Continuous and Discrete), Density Functions and Cumulative functions	7 Hrs.



Text Books:

1.Matrix Analysis (2nd ed.). Roger A. Horn, Charles R. Johnson. Cambridge University Press, 2013.

2.Introduction to Probability (2nd ed.). Dimitri P. Bertsekas, John N. Tsitsiklis. Athena Scientific, 2008.



Title of the Course: Data Engineering Course Code: UCSH0401	L	T	P	Credit
	3	1		4

Course Pre-Requisite: Statistics and Linear Algebra.

Course Description: This course will cover the data pre-processing and data preparation for machine learning model.

Course Objectives

To interpret the data properties.
To examine missing data and outliers.
To interpret feature scaling.
To design feature extraction model.

Assessments :

Teacher Assessment:

One components of End Semester Examination (ESE) having 100% weight.

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content covered.

Course Contents:

Unit-I Data Foreseeing Why data engineering?, technical requirements of data during machine learning modeling:- identify numerical and categorical variables, missing data, determine cardinality in categorical variables, identifying linear relationship, identify normal distribution, highlighting outliers.	**6 Hrs**
Unit-II Handling Missing Data and Data Encoding Impute missing data: - remove missing data, impute missing data by mean, mode or median, replacing missing values with value at the end of the distribution, multivariate imputation. Data Encoding:- Why encoding?, one hot encoding, replace categories with ordinal numbers, encoding with integers , encoding with mean of the target.	**7 Hrs.**
Unit-III Variable Discretization and Working with Outliers Variable Discretization:- divide the variables into equal intervals, perform discretization followed by categorical encoding. Working with outliers:- Outliers means?, trimming outliers, capping the variables at arbitrary max and min values, perform zero coding.	**6 Hrs.**
Unit-IV Feature Scaling Standardizing features, mean normalization, scaling to max and min values, scaling with the median and quantiles, scaling to vector unit length, deriving new features with decision tree, carrying out PCA.	**7 Hrs.**
Unit-V Feature Creation with transaction and time series data Aggregating transaction with mathematical operations, aggregating transaction in a time window, determining the number of local maxima and minima, deriving time elapsed between time-stamped events, creating features from transaction.	**6 Hrs.**
Unit-VI Feature Extraction from text and Case study Counting characters, words, vocabulary, estimating text complexity by counting sentences, create features with bag-of-words and n-grams, Case study:- Data preprocessing @given dataset(includes exploratory data analysis(EDA), pipelining)	**6 Hrs.**
Text Books: **Python Feature Engineering Cookbook by Soledad Galli.**	

Title of the Course: Artificial Intelligence and Machine Learning Programming Course Code: UCSH0501	L	T	P	Credit
	4		2	5

Course Pre-Requisite: Python Programming

Course Description: This course aims to develop the basic concepts of **Artificial Intelligence, Machine Learning Programming** using Python Programming language.

Course Objectives

1. The objective of this course is to provide comprehensive knowledge of python programming paradigms required for Artificial Intelligence ,Machine Learning Programming.
2. To provide practical hands-on of Sci-Kit learn Python Machine learning libraries.
3. To demonstrate practical skills of huge data processing and analysis using python.

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Demonstrate the use of built-in objects, libraries and functionalities of programming language	4	Evaluate
CO2	Demonstrate significant experience with program development environment	4	Demonstrate
CO3	Demonstrate numerical programming, data handling and visualization through NumPy, Pandas and MatplotLib modules	4	Evaluate,Demonstrate
CO4	Analyze and Apply appropriate machine learning based data analytics techniques for solving real life problems	2	Apply

CO-PO Mapping:

CO	a	b	c	d	e	f	g	h	i	j	k	PSO 1	PSO 2
CO1	3		2									2	
CO2	3		2									2	
CO3	3		2									2	
CO4		2			3							1	2

Assessments :

Teacher Assessment:

One components of End Semester Examination (ESE) having 100% weight.

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content covered.

Course Contents:

Unit 1 . Introduction To Python - Sequence Data Types Sequences, Tuple, Sets, Mapping and Sets- Dictionaries Introduction to Regular Expressions using "re" module. **Exercises:** 1. Demonstrate Tuples and Sets 2. Demonstrate Dictionaries	**6 Hrs**
Unit 2. Using NumPy Basics of NumPy - Computation on NumPy- Aggregations -Computation on Arrays Comparisons, Masks and Boolean Arrays-Fancy Indexing-Sorting Arrays-Structured Data : NumPy's Structured Array.	**8 Hrs.**

Exercises : 1. Demonstrate Aggregation 2. Demonstrate Indexing and Sorting	
Unit 3. Data Manipulation with Pandas -I Introduction to Pandas Objects-Data indexing and Selection-Operating on Data in Pandas, Handling Missing Data-Hierarchical Indexing - Combining Data Sets, Data Pre-processing, Data Reduction **Exercises :** 1. Demonstrate handling of missing data 2. Demonstrate hierarchical indexing	**6 Hrs.**
Unit 4 : Data Manipulation With Pandas -II Aggregation and Grouping-Pivot Tables-Vectorized String Operations -Working with Time Series-High Performance Pandas- eval() and query() **Exercises :** 1. Demonstrate usage of Pivot table 2. Demonstrate use of eval() and query()	**8 Hrs.**
Unit 5: Machine learning techniques with Sci-kit Learn libraries and Keras, Tensorflow Libraries **Supervised Learning techniques** :Regression, Linear Regression, Logistic Regression ,Classification Trees, Support Vector Machines, Ensemble Methods: Random Forest, Decision trees, K Means Clustering, Artificial Neural Networks, Deep learning,K Nearest Neighbours **Unsupervised Learning techniques:** K-meansClustering, Associative Rule Mining , Big data analysis **Application development using Keras and Tensorflow Libraries** **Exercises:** 1. Students will be deploying various Machine learning based predictive models based on python programming	**8 Hrs.**
Unit 6: Visualization using MatPlotLib Basic functions of matplotlib -Simple Line Plot, Scatter Plot-Density and Contour Plots, Histograms, Binnings and Density-Customizing Plot Legends, Colour Bars-Three Dimensional Plotting in Matplotlib. **Exercises :** 1. Demonstrate Scatter Plot 2. Demonstrate 3Dplotting	**6- Hrs.**

Textbooks:

1.Hands-On Machine Learning with Scikit-Learn and TensorFlow :Concepts, Tools, and Techniques to Build Intelligent Systems by Aurélien Géron ,O'reilly publications .

2. Python for Data Analysis ,First edition , by Wes McKinney

References:

1]Hands-on Deep Learning Algorithms with Python – SudharsanRavichandran.

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Title of the Course: Deep Learning Course Code: UCSH0601	L	T	P	Credit
	3	1		4

Course Pre-Requisite: Machine Learning algorithms

Course Description:
Deep Learning has been widely used to solve problems in Computer Vision and Natural Language Processing. This course covers the building blocks used in the Deep Learning based solutions. Specifically, convolutional neural networks, recurrent neural networks and adversarial networks. The course also focuses on the deep architectures used for solving various Computer Vision tasks.

Course Objectives:
1. To introduce students to Convolutional Neural Network algorithms.
2. To introduce students to Recurrent Neural Network algorithm.
3. To introduce students to Generative Adversarial Network.

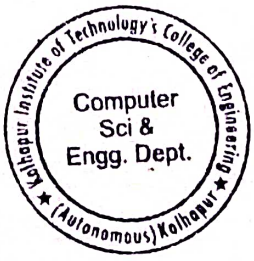
Assessments :
Teacher Assessment:
One components of End Semester Examination (ESE) having 100% weight.

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content covered.

Course Contents:

Unit 1 Introduction to Deep Learning Neural network fundamentals: General Introduction to Deep Learning, Perceptron algorithm, Back propagation and Multi-layer Networks. Image fundamentals: Pixels, Image coordinate, scaling and aspect ratios	**5 Hrs**
Unit 2 Parameterized Learning and Optimization Methods Parameterized Learning: Introduction to linear classification, Four components of parameterized learning, role of loss function. Optimization Methods: Optimization Methods: Gradient descent, stochastic gradient descent (SGD) and extensions to SGD, regularization	**6 Hrs**
Unit 3 Convolutional Neural Networks (CNN) Understanding Convolutions: Convolutions versus Cross-correlation, The "Big Matrix" and "Tiny Matrix" Analogy, Kernels, A Hand Computation Example of Convolution The Role of Convolutions in Deep Learning. CNN Building blocks: Layer Types, Convolutional Layers, Activation Layers, Pooling Layers, Fully-connected Layers, Batch Normalization, Dropout, ShallowNEt, LeNet, MiniVGGNET	**7 Hrs.**



Unit 4 Deep learning-based object detection Deep learning-based object detection Fundamentals of Object detection, Family of R-CNN, Single shot detectors (SSD), Family of You only look once (YOLO)	**6 Hrs.**
Unit 5 Sequence Models Recurrent Neural Networks, Vanishing gradients, Gated Recurrent Units (GRU), Long-short-term-memories (LSTMs), Transformer, Bidirectional Encoder Representations from Transformers (BERT)	**8 Hrs.**
Unit 6 Generative Models Autoencoders, Variational Autoencoders, Generative Adversarial Networks, Application of Generative models	**5 Hrs.**
Text Books: 1. "Learning deep architectures for AI", by Bengio, Yoshua 2. "Deep learning", by Bengio, Yoshua, Goodfellow and Courville, An MIT Press book in preparation. (2015).	

CourseCode:	UCSH0701		L	T	P	Credit
Course Code &Name	Mini Project				2	1

Course Prerequisites

Knowledge of Project Based Learning (PBL)

CourseDescription:

The students shall apply the course knowledge and project-basedlearningskills forsolvingrealworld problems. The students shall use the concepts they have learned during B.Tech program (III-VI) to develop a solution to the considered problem statement.

CourseOutcomes: Student should be able to

CO1	Identify the real-world problems to be solved applied computer science knowledge.
CO2	Explain the proposed solution for problem by carrying survey and analysis.
CO3	Implement the proposed solution using state of art technologies.
CO4	Build a detailed project report.

CO-POMapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1				1		1	3	2	2	3	3	3
CO2	2	2	3		3	1		2	3	2	3	3	3	3
CO3	2	2	3		3	1		2	3	2	3	3	3	3
CO4	2	1	1		3	1		2	3	3	3	3	3	3

AssessmentScheme:

SN	Assessment	Weightage	Remarks
1	ESE(POE)	100%	Practical Performance Oral

CourseContents:

Guidelines for Mini Project

The primary objective of the mini project is to attain multi course project Based learning. Course Instructor shall form a team of 2-3 students. Each team shall apply the knowledge learned in previous semester's to identify the real World problem and consider state of art technologies as part of the solution. The students shall be graded based on the skills demonstrated to identify the problem statement & design a proposed methodology.The students shall be graded based on the project implementation and submission of detailed project report which shall include the technical aspects of the project. It is recommended to consider a common project report format and common evaluation process.Course instructors shall discuss the sample case studies to help them students understand the mini project deliverables.

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