Aror University of Art, Architecture, Design & Heritage Sukkur.

BS(Artificial Intelligence)
Fall-2025
Machine Learning (CSC-000)

Course Code	CSC-000	Faculty	Dr. Wazir Ali
Course Title	Machine Learning	Room# & Phone/Ext	
Credit Hours	2+1	Consultation Hours	9-4 PM
Pre-Requisite		E-Mail	wazir.faculty@aror.edu.pk
Program	BS (Artificial Intelligence)	Semester	5th

1. Course Objective

Gain a comprehensive understanding of core machine learning concepts and algorithms, including supervised and unsupervised learning. Develop practical skills in data preprocessing, model evaluation, and application of machine learning techniques to real-world datasets.

2. Course Description

Machine Learning is the field of study that gives computers the ability to learn without being explicitly programmed. It learns adaptive computational systems with respect to some problem that improve their performance with experience. Machine learning methods are applied to wide variety of problems ranging from learning to drive an autonomous vehicle to speech recognition and personality detection at microblogs. This course covers the majority of machine learning methods, complete life cycle of machine learning systems such as: data engineering, system design, implementation, evaluation, and improvements.

3. Course Outcomes

CLO No.	Course Learning Outcomes (CLOs)	Graduate Attributes	Bloom's Taxonomy
1	**Describe** the majority of machine learning methods, mathematical and statistical foundations of machine learning.	GA_2 (Knowledge for solving computing problems)	C2 (Understand)
2	**Analyze** the problem and have experience in the implementation and evaluation of machine learning systems.	GA_3 (Problem Analysis)	C4 (Analyzing)
3	**Apply** the knowledge to solve the real life problems	GA_4 (Design of Solutions)	C3 (Applying)

4. Complex Computing Problem

Complex Computing Problem Details	**Included: Yes** Nature and details of Complex Computing Problem (CCP): It will be given in Assignment # 03. CCP will be based on CLO-2 "Demonstrate ML algorithms and **analyze** their implementation over provided dataset." **Attributes could be: CCP2, CCP3** CCP2: Depth of knowledge required CCP3: Depth of knowledge required Assessment in: Assignment # 02

5. Recommended Books

TEXT BOOK:

Hands-on machine learning with Scikit-Learn and TensorFlow: concepts, tools, and techniques to build intelligent systems. By Géron, Aurélien. " O'Reilly Media, Inc. 2023"

REFERENCE BOOKS:

1. Understanding machine learning: From theory to algorithms. By Shalev-Shwartz, S., & Ben-David, S. Cambridge university press, 2023.
2. Machine Learning, Tom Mitchell, McGraw-Hill International Edition.

3. Teaching Plan

Week No.	Week Dates	Topics	Required Reading	Key Date
1	20-01-2024 to 26-01-2024	Introduction: Basic Concepts, Applications, Learning types, ML Categories, Regression vs Classification, etc.	**Chap 1**	
2	27-01-2024 to 02-02-2024	Linear Regression: Least Squares, Mathematical Foundations, Single Feature, Multi-Features, Cost Functions, Cost Function Curves, Gradient Decent & Ascend, Identification of Bias, Variance, Just-Fit, Degrees, GD: Stochastic, Online, Batch learning, Optimization Techniques, Global and Local Optima, Role of learning rate (alpha), etc.	**Chap 2**	

3	03-02-2024 to 09-02-2024	Polynomial Regression and adding non-linearity in features Over fitting and Regularization, L1 & L2 (Lasso & Ridge) Regularization, Feature scaling/normalization (min-max, zero mean, etc.) and Regularization and Gradient Decent/Learning	**Chap 3**	**Assignment # 1**
4	10-02-2024 to 16-02-2024	Data Translation: Text Processing, Picture Processing, etc. Data Exploration and Feature Engineering, Feature Selection	**Chap 4**	
5	17-02-2024 to 23-02-2024	K-Mean Clustering: Distance measures, stop conditions, limitations, etc. EM Clustering (Multivariate Guasian Model) & Hierarchal Clustering (Agglomerative vs Divisive, Cluster Dist. Measures, Dendrogram)	**Chap 5**	**Quiz # 1**
6	24-02-2024 to 01-03-2024	Anomaly Detection: Gaussian Distribution, Multi-Variate Gaussian Distribution, etc.	**Chap 6**	
7.	**Midterm Examination (02-03-2024 to 08-03-2024)**			
8.	09-03-2024 to 15-03-2024	Logistic Regression: Different Types of Derivations and Example, Sigmoid Function. Neural Networks: MLPs, Non-Linearity, Activation Functions, Back propagation Algorithm, Exploding and Diminishing problems	**Chap 7**	
9.	16-03-2024 to 22-03-2024	Confusion Matrices and Evaluation Metrics, Decision Threshold, Evaluation for binomial problems, regression problems (mean absolute error, mean squared error, median absolute error), multi-class problems, and Un-supervised problems, etc.	**Chap 08**	
10	24-03-2024 to 29-03-2024	Train, Test, Cross-Validation splits and K-Folds, Stratified Sampling etc. Advices for ML debugging Tools for Machine Learning – Python sklearn Tutorial , other python libraries	**Chap 09**	**Quiz # 2**
11	30-03-2024 to 05-04-2024	Dimensionality Reduction: Data Compression, PCA and LSI, Singular Value Decomposition (SVD)	**Chap 10**	**Assignment # 2**

12	06-04-2024 to 12-04-2024	Decision Trees and Modern Trees (Gradient Boosted Decision Trees, Random Forest, etc.)	**Chap 11**	
13	13-04-2024 to 19-04-2024	Bagging, Boosting, Blending and Staking Models, Entropy and Information Gain vs Gini Index, Algo.: ID3, CART, Pruning, Rule Extraction, Over fitting	**Chap 12**	**Assignment # 3**
14	20-04-2024 to 26-04-2024	Naïve Bayes algorithm (Generative models) : Generalization and Derivation, Specialized NLP implementations, Types: Gaussian, Multinomial, Bernoulli	**Chap 13**	**Quiz # 3**
15	27-04-2024 to 03-05-2024	Association Rule Mining: Appriori and FP Growth, role of measures: support, confidence, lift, etc.	**Chap 14**	
16	04-05-2024 to 10-05-2024	Large Margin Classifier - Support Vector Machine: Derivation, Lagrange Multiplier and Convex Hull, Types: Linear and Non-Linear, Radial Basis Function Kernel, Gamma parameter in RBF, Kernel Tricks and Types of non-linear Kernels, C parameter, etc.	**Chap 15**	
Final Examination (11-05-2024 to 23-05-2024)				

4. Relationship between Assessment Tools and COs

Assessment Tools	CLO-1 (38 Marks)	CLO-2 (31 Marks)	CLO-3 (31 Marks)
Quizzes	7.8% (3)	19.3% (6)	19.3% (6)
Assignments	13.1% (5)	16.1% (5)	16.1% (5)
Midterm Exam	52.6% (20)	32.3% (10)	-
Final Exam	26.3% (10)	32.3% (10)	64.5% (20)

5. Grading Policy:

Assessment Tools	Percentage
Quizzes	15%

Assignments	15%
Midterm Exam	30%
Final Exam	40%
TOTAL	**100%**