COURSE OUTLINE

Department:	Faculty of Computing	**Knowledge Group:**	Vision and Machine Learning	
Programme:	MSCS	**Class:**	MSCS-2k23	
Course code:	CS-871	**Academic Session/Semester:**		Spring 2024
Course name:	Machine Learning	**Pre/co requisite (course name and code, if applicable):**		None
Credit hours:	3+0			

Course Synopsis	This course is designed to provide students with a comprehensive and in-depth understanding of the core principles, techniques, and applications of machine learning. This course explores the foundations of supervised, unsupervised, and reinforcement learning, delving into topics such as classification, regression, clustering, and neural networks. The knowledge gained in this course will enable the students to build and evaluate predictive models, extract meaningful insights from data, and make informed decisions in various domains, from business analytics to healthcare. Through a combination of theoretical knowledge and practical application, this course equips students with the skills and expertise needed to excel in the dynamic and rapidly evolving field of machine learning.			
Course Learning Outcomes (CLOs)	At the end of the course, the students will be able to: 1. **Understand** machine learning algorithms, tools, and techniques. 2. **Analyse** supervised and unsupervised learning techniques for classification, regression, and dimensionality reduction tasks. 3. **Develop** solutions for practical challenges by employing machine learning algorithms. 4. **Implement** various machine learning algorithms for real-world applications using standard tools and applications.			
Course Schedule	Tuesday (CR-16 IAEC) Thursday (CR-16 IAEC)			
Course lecturer	**Name**	**Office**	**Contact no.**	**E-mail**
	Dr Hashir Moheed Kiani	A-104		hashir.moheed@seecs.edu.pk

Details on Innovative Teaching & Learning practices that will be used during the course:

No.	Type	Implementation
1.	Active learning	Conducted through in-class or hands-on activity.
2.	Cooperative learning	Conducted through design project. Students in a team of two to three will be given a design project that requires the application of Machine Learning algorithms to a real-world problem in domains like healthcare, environment, business analytics etc.
3.	Blended learning	Conducted through Learning Management System (LMS) of NUST. All information as well as materials related to teaching and learning activities will

		be shared with class through this system. Some for formative assessments will be also conducted using this system.

Weekly Schedule:

Week	Topics	Assessment Plan
Week 1	Introduction to course Machine Learning as function approximation Linear Regression	
Week 2	Gradient Descent Stochastic Gradient Descent Logistic Regression	
Week 3	Decision Trees Gini Impurity and Information Gain Decision Tree Pruning	Quiz 1
Week 4	K Nearest Neighbours Parzen Windows	Assignment 1
Week 5	Kernel Methods	Quiz 2
Week 6	Support Vector Machines Linearly separable case Non-Linear cases and kernel trick	Assignment 2
Week 7	Bayesian Analysis Bayes Theorem Naïve Bayes Classifier	Quiz 3, Project Floated
Week 8	Bayesian Networks Forward Backward Algorithm	Project Proposal Submission
Week 9	**Mid-Semester Exam**	
Week 10	Model Selection Feature Engineering Regularization Experimental Design	
Week 11	Principal Component Analysis Linear Discriminant Analysis	
Week 12	Perceptron Backpropagation	Assignment 3, Project Update 1
Week 13	Clustering Techniques	Quiz 4
Week 14	Reinforcement Learning	Project Update 2
Week 15	ML in Healthcare Prediction of Heart Disease (Case Study 1)	Quiz 5

	Prediction of Covid (Case Study 2)	
Week 16	ML in Environment Monitoring Prediction of pollutant levels using satellite data (Case Study 1) Prediction of AQI (Case Study 2)	Project Report Submission
Week 17	Project Presentations	Project Presentations
Week 18	**End Semester Exam**	

Assessment Methods:

Assessment		**Percentage**
1	Quizzes	10%
2	Assignments	5%
3	Mid-Term Exam	25%
4	End-Semester Exam	45%
5	Project	15%
Total:		**100%**

Learning resources:

Textbook:

1. RS Michalski, JG Carbonell, TM Mitchell, "Machine Learning: An Artificial Intelligence Approach", Springer, 2014
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 2007

Reference Book:

1. Richard Duda, Peter Hart and David Stork, Pattern Classification, 2nd ed. John Wiley & Sons, 2001.
2. Richard Sutton and Andrew Barto, Reinforcement Learning: An introduction. MIT Press, 1998

Grading Policy:

Quiz Policy:

The quizzes will be unannounced / announced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures. Number of quizzes that will be used for evaluation is at the instructor's discretion.

Project Policy:

Students will be required to develop a project during the course which should be completed towards the end of the semester. They will be graded based on project deliverables and presentation at the end. Students will work in a group/team for projects. A group of 3 students is recommended.

Assignment Policy:

In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No 'best-of' policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee.

Plagiarism:

SEECS maintains a zero-tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the SEECS plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action.