**Machine Learning-IS-485**

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| Resource Person: | Ms. Amna Altaf |
| Email: | Amna.altaf@umt.edu.pk |
| Contact Hours: | Monday: 12:00-1:00  Wednesday: 2:00-3:00  Thursday: 12:00-1:00 |
| Office Address: | New faculty hall, Cabin no. 3 |
| Programme: | BBIS(h) |
| Section: |  |
| Semester: | Fall 2022 |
| Course Pre-requisites: |  |
| Credit Hours: | 03 |
| Course Type: | Practical |
| Venue/Day/Time: |  |
| Course URL (if any): |  |

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| **Course Description:** |
| Machine learning studies the design and development of algorithms that can improve their performance at a specific task with experience. Machine learning methods have been applied to a diverse number of problems ranging from learning strategies for game playing to recommending movies to customers. This course covers the key approaches to machine learning, including inductive inference of decision trees, linear models for classification and regression; Bayesian learning methods, support vector machines, and graphical models. The theory discussed in class will be empirically tested in assignments and homework. |

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| **Course Teaching Methodology:** |
| Interactive Classes, Activity Based Learning |

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| **Programme Educational Objectives (POs):** | |
| PO-1 | To provide students with a strong foundation in the principles and applications of machine learning. |
| PO-2 | To enable students to develop practical skills in implementing and evaluating machine learning algorithms. |
| PO-3 | To prepare students for further study and research in machine learning and related fields. |
| PO-4 | To equip students with the ability to apply machine learning to real-world problems. |

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| **Programme Learning Outcomes (PLOs):**  **After completing this degree programme, students shall be able to:** | | |
|  | | **Mapping the PLOs with POs** |
| PLO-1 | Develop a thorough understanding of the principles and techniques of machine learning. | PO-1 |
| PLO-2 | Demonstrate proficiency in implementing and evaluating machine learning algorithms. | PO-2 |
| PLO-3 | Develop the ability to analyze and solve real-world problems using machine learning techniques. | PO-3, PO-4 |
| PLO-4 | Acquire the skills necessary to conduct independent research in machine learning. | PO-3 |

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| **Course Objectives (COs)** | |
| CO-1 | To introduce students to the fundamental concepts and techniques of machine learning. |
| CO-2 | To provide students with a strong mathematical foundation in machine learning. |
| CO-3 | To teach students how to implement and evaluate machine learning algorithms. |
| CO-4 | To provide students with practical experience in applying machine learning to real-world problems. |
| CO-5 | To foster a strong interest in the theory and application of machine learning. |

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| **Course Learning Outcomes (CLOs):**  **After completing this course, students shall be able to:** | | |
|  | | **Mapping the CLOs with PLOs** |
| CLO-1 | Understand the fundamental principles and techniques of machine learning. | PLO-1, PLO-3 |
| CLO-2 | Demonstrate proficiency in applying mathematical concepts to machine learning problems. | PLO-1, PLO-2 |
| CLO-3 | Develop the ability to implement and evaluate machine learning algorithms. | PLO-2, PLO-3 |
| CLO-4 | Acquire practical experience in applying machine learning to real-world problems. | PLO-3 |
| CLO-5 | Develop a strong interest in the theory and application of machine learning. | PLO-4 |

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| **Assurance of Learning and Assessment Items:**  *Specify Assessment Items that will assure student learning through application and achieve objectives of specific PLOs / COs / CLOs* | |
| **Assessment Item** | **Application/ Objectives**  **PLO / CO / CLO** |
| Quizzes | All |
| Assignments | All |
| Mid-term exam | All |
| Final exam | All |
| Project | All |
| Class Participation | All |

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| **Assessment Structure and Grading Policy\*:** | | |
| **Assessment Item** | **Weight (%)** | **Execution Plan** |
| Quizzes | 10 | 04 |
| Assignments | 10 | 04 |
| Mid-term exam | 25 | One-time assessment |
| Final exam | 25 | One-time assessment |
| Project | 25 | One-time assessment |
| Class Participation | 5 |  |
| **Total** | **100** |  |
| **Notes – Norms and Important Class Policies:**  *(such as submission guidelines, academic honesty, make-up policy, code of conduct)*  • Be On Time  You need to be at class at the assigned time. After 10 minutes past the assigned time, you will be marked absent.  • Mobile Policy  TURN OFF YOUR MOBILE PHONE! It is unprofessional to be texting or otherwise.  • Email Policy  READ YOUR EMAILS! You are responsible if you miss a deadline because you did not read your email.  Participants should regularly check their university emails accounts regularly and respond accordingly.  • Class Attendance Policy  A minimum of 80% attendance is required for a participant to be eligible to sit in the final examination. Being sick and going to weddings are absences and will not be counted as present. You have the opportunity to use 6 absences out of 30 classes. Participants with less than 80% of attendance in a course will be given grade ‘F’ (Fail) and will not be allowed to take end term exams. International students who will be leaving for visa during semester should not use any days off except for visa trip. Otherwise they could reach short attendance.  • Withdraw Policy  Students may withdraw from a course till the end of the 12th week of the semester. Consequently, grade W will be awarded to the student which shall have no impact on the calculation of the GPA of the student. A Student withdrawing after the 12th week shall be automatically awarded “F” grade which shall count in the GPA.  • Moodle  UMT –LMS (Moodle) is an Open Source Course Management System (CMS), also known as a learning Management System (LMS). Participants should regularly visit the course website on MOODLE Course Management system, and fully benefit from its capabilities. If you are facing any problem using moodle, visit http://oit.umt.edu.pk/moodle. For further query send your queries to moodle@umt.edu.pk  • Harassment Policy  Sexual or any other harassment is prohibited and is constituted as punishable offence. Sexual or any other harassment of any participant will not be tolerated. All actions categorized as sexual or any other harassment when done physically or verbally would also be considered as sexual harassment when done using electronic media such as computers, mobiles, internet, emails etc.  • Use of Unfair Means/Honesty Policy  Any participant found using unfair means or assisting another participant during a class test/quiz, assignments or examination would be liable to disciplinary action.  • Plagiarism Policy  All students are required to attach a “Turnitin” report on every assignment, big or small. Any student who attempts to bypass “Turnitin” will receive “F” grade which will count towards the CGPA. The participants submit the plagiarism report to the resource person with every assignment, report, project, thesis etc. If student attempts to cheat “Turnitin”, he/she will receive a second “F” that will count towards the CGPA. There are special rules on plagiarism for final reports etc. all outlined in your handbook.  • Communication of Results  The results of quizzes, midterms and assignments are communicated to the participants during the semester and answer books are returned to them. It is the responsibility of the course instructor to keep the participants informed about his/her progress during the semester. The course instructor will inform a participant at least one week before the final examination related to his or her performance in the course. | | |

*\*Rubrics for all assessments (including mid and final exams) will be provided separately to the students.*

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| **Weekly Sessions Plan:** | | | |
| **Week** | **Topics / Contents** | **Activity** | **Application/Objectives**  **PLO / CO / CLO** |
| 1 | **Fundamentals of Machine Learning**   * **G**oal of machine learning, * Applications of machine learning * Inductive and deductive learning * General settings for input output function * Representation of observations for machine learning models, | **Lab work**: Google Collab Tutorial | All |
| 2 | **Fundamentals of Machine Learning**   * Data annotation * Types of machine learning * Training regimes * Phases of machine learning * Balanced data, unbalanced data * Types of input data for machine learning Difference between random split and class balanced split. | **Lab Work**: Basics of Python/ Class Discussion/  Assignment 1 | All |
| 3 | **Concept Learning**   * Inductive bias, * Searching of hypothesis that best fits on data * Instance space * Concept space * Hypothesis space, | **Lab Work**: Basics of Python/Assignment 2 | All |
| 4 | **Probability Based Classifiers**   * Naïve bayes Working * Assumptions of naïve bayes * Bayes theorem (derivation) * dealing with missing values * Laplace smoothing . | **Lab Work**: Pandas Library, Implementation of NB/**Quiz 1** | All |
| 5 | **Linear Regression**   * How to find relationship between dependent and independent variable? * Equation of linear regression * Error estimation * Representation of input and output for linear regression. | **Lab Work**: Implementation of linear regression/Activity | All |
| 6 | **Multiple Linear Regression**   * How to find relationship between dependent and independent variables * Equation of multiple linear regression * Error estimation * Representation of input and output for multiple linear regression. | **Lab Work**: Implementation of multiple linear regression  **Quiz 2** | All |
| 7 | **Logistic Regression**   * Draw backs of linear regression for binary output values, use of sigmoid function, loss function. | **Lab work**: Implementation of logistic regression/ Activity | All |
| 8 | * Mid Term |  | All |
| 9 | **Lazy Learning**  Working of KNN Classifier | **Lab work**: Implementation of KNN/ Discussion on Project |  |
| 10 | **Clustering**   * Working of K-Means Clustering | **Lab Work**: Implementation of K- Means Clustering/  **Assignment 3** | All |
| 11 | **Decision Trees**   * Calculation of entropy and information gain for prediction of output * Overfitting and underfitting of machine learning models. | **Lab Work**: Implementation of tree-based algorithms  **Assignment 4** | All |
| 12 | **Evaluation Measures**   * Precision * Recall * F1-score * Accuracy * Comparison of classifiers * Cross validations. | **Lab work**: Confusion matrix/ **Quiz 3** | All |
| 13 | **Introduction to Artificial Neural Networks**   * General Architecture, biological motivation, types of neural networks, perceptron, unit functions, training of perceptron, learning rate. | **Lab work**: Implementation of Perceptron | All |
| 14 | **Revision** | Quiz 4/Revision | All |
| 15 | **Project Presentation & Viva** |  | All |
| 16 | Final Term Examination |  |  |

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| **Primary Text Book (s):** |
| Machine Learning by Tom M. Mitchell |

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| **Reference / Supplementary Reading (s):** |
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| **Useful Online / Web Resources:** |
| * https://lms.umt.edu.pk/ |