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| IQRA University (IU) | | |
| Faculty of Engineering Sciences and Technology (FEST) | | |
| Computer Science Department (CS) | | |
| Course Code | Course Name | Credit Hr |
| AIC221 | INTRODUCTION TO MACHINE LEARNING | 2+1 |

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| 1. Basic Information | | | |
| Instructor | -- | Designation | Assistant professor |
| Prerequisite(s) | AIC211 | Semester | Fall 2024 |
| Email | example@iqra.edu.pk | Phone | NA |
| Consulting Hours | Friday(12:00 – 14:00) | Office Location | First Floor Faculty offices |

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| 1. **Course Objective(s)** |
| Develop a comprehensive understanding of machine learning techniques, including supervised, unsupervised, and reinforcement learning, while effectively applying algorithms such as decision trees, Naive Bayes, SVMs, clustering methods, and ensemble models. Demonstrate the ability to evaluate model performance, mitigate overfitting, and design adaptive solutions for real-world problems through the integration of advanced methods like Markov Decision Processes, bagging, boosting, and EM algorithms for semi-supervised learning. |

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| 1. **Course Contents** |
| Introduction to machine learning; concept learning: General-to-specific ordering of hypotheses, Version spaces Algorithm, Candidate elimination algorithm; Supervised Learning: decision trees, Naive Bayes, Artificial Neural Networks, Support Vector Machines, Overfitting, noisy data, and pruning, Measuring Classifier Accuracy; Linear and Logistic regression; Unsupervised Learning: Hierarchical Agglomerative Clustering. k-means partitional clustering; Self-Organizing Maps (SOM) k-Nearest-neighbor algorithm; Semi supervised learning with EM using labeled and unlabeled data; Reinforcement Learning: Hidden Markov models, Monte Carlo inference Exploration vs. Exploitation Trade-off, Markov Decision Processes; Ensemble Learning: Using committees of multiple hypotheses. Bagging, boosting.sy data, and pruning, Measuring Classifier Accuracy; Linear and Logistic regression; Unsupervised Learning: Hierarchical Agglomerative Clustering. k-means partitional clustering; Self-Organizing Maps (SOM) k-Nearest-neighbor algorithm; Semi supervised learning with EM using labeled and unlabeled data; Reinforcement Learning: Hidden Markov models, Monte Carlo inference Exploration vs. Exploitation Trade-off, Markov Decision Processes; Ensemble Learning: Using committees of multiple hypotheses. Bagging, boosting. |

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| 1. **Course Learning Outcomes** | | | | | | |
| **CLOs** | **CLO Statement** | **BT Level** | **Mapping** | | | **% Weight** |
| **GAs** | **ACM KA** | **SGDs** |
| CLO1 | **Describe** basic machine learning concepts, theories and applications. | C2 | GA2 | #9  IS | 4 & 9 | 30% |
| CLO2 | **Apply** and evaluate foundational machine learning algorithms to solve problems**.** | C3 - Apply | GA5 | 30% |
| CLO3 | **Analyze** and synthesize advanced machine learning concepts to address complex scenarios**.** | C4 - Analyze | GA3 | 40% |
| ***Note: On successful completion of course GA 1 (Academic Education) will automatically attain.*** | | | | | | |

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| 1. **Course Textbook / Reference Books and Supplementary Reading Material** | | | |
| **S No** | **Book Title** | **Author(s)** | **Edition/ publication year/publisher** |
| 1 | Python Machine Learning | Sebastian Raschka and Vahid Mirjalili | Edition: 4th (2023) |
| 2 | Machine Learning with TensorFlow | Nishant Shukla | Edition: Latest (2022) |

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| 1. **kaCLO Outcome Based Assessment (OBA) Tentative** | | | | | | |
| **Assessment Tool** | | **CLO Mapped** | **CLO Marks** | **% Weight** | **Total Marks** | **Assessment Date** |
| **Quizzes**  **10** | Quiz #1 | *CLO1* | 10 | 30% | 3 | TBD |
| Quiz #2 | *CLO2* | 10 | 30% | 3 |  |
| Quiz #3 | *CLO3* | 10 | 40% | 4 |  |
| **Total Quizzes %** | | | **100%** | **10** |  |
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| **Assignments**  **15** | Assignment #1 | *CLO1* | 10 | 33.3% | 5 |  |
| Assignment #2 | *CLO2* | 10 | 33.3% | 5 |  |
| Assignment #3 | *CLO3* | 10 | 33.3% | 5 |  |
|  |  | | | **100%** | **15** |  |
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| **Midterm**  **25** | Midterm Q1 | *CLO1* | **5** | **20%** | 5 |  |
| Midterm Q2 | *CLO1* | **5** | **20%** | 5 |  |
| Midterm Q3 | *CLO2* | 5 | **20%** | 5 |  |
| Midterm Q4 | *CLO2* | 5 | **20%** | 5 |  |
| Midterm Q5 | *CLO3* | 5 | **20%** | 5 |  |
|  | **Total Midterm %** | | | **100%** | **25** |  |
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| **Project/CCP**  **10** | Project/CCP | *CLO3* | 10 |  |  |  |
|  | **Total Project /CCP %** | | | **100%** | **10** |  |
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| **Final Exam**  **40** | Final Exam Q1 | *CLO1* | 10 | **25%** | 10 |  |
| Final Exam Q2 | *CLO2* | 10 | **25%** | 10 |  |
| Final Exam Q3 | *CLO3* | 10 | **25%** | 10 |  |
| Final Exam Q4 | *CLO3* | 10 | **25%** | 10 |  |
|  | **Total Final Exam %** | | | **100%** | **40** |  |
| **100** | **Total Marls** | | | | **100** |  |
| ***Note: Please make sure every CLO must be assessed at least 3 time.*** | | | | | | |

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| 1. **Weekly Plan** | | | | |
| **Week** | **Lecture No** | **Topic Covered** | **CLO/1/2/3** | **Assessment Tool (Quiz#, Mid, Final)** |
| 1 | 1 | Introduction to machine learning; | CLO1 |  |
| 2 | concept learning: General-to-specific ordering of hypotheses, Version spaces Algorithm, Candidate elimination algorithm; | CLO1 |  |
| 2 | 3 | Supervised Learning: decision trees, Naive Bayes, | CLO1 |  |
| 4 | Artificial Neural Networks, Support Vector Machines, | CLO1 |  |
| 3 | 5 | Overfitting, noisy data, and pruning, Measuring Classifier Accuracy; Linear and Logistic regression; | CLO1 |  |
| 6 | Unsupervised Learning: Hierarchical Agglomerative Clustering. | CLO1 | Quiz1/ Assignment 1 |
| 4 | 7 | k-means partitional clustering; Self-Organizing Maps (SOM) k-Nearest-neighbor algorithm; Semi supervised learning with EM using labeled and unlabeled data; | CLO2 |  |
| 8 | Reinforcement Learning: Hidden Markov models, | CLO2 |  |
| 5 | 9 | Monte Carlo inference Exploration vs. Exploitation Trade-off, |  |  |
| 10 | Markov Decision Processes; |  |  |
| 6 | 11 | Ensemble Learning: Using committees of multiple hypotheses |  | Quiz2 |
| 12 | Bagging, |  | Assignment 2 |
| 7 | 13 | boosting. | CLO2 |  |
| 14 | data, and pruning, | CLO2 |  |
| 15 | **CCP/ Assignment and Discussion** |  |  |
| 8 | **Midterm Exam** | | | |
| 9 | 16 | Measuring Classifier Accuracy. | CLO2 |  |
| 17 | Linear Regression |  |  |
| 10 | 18 | Logistic Regression |  |  |
| 19 | Unsupervised Learning: Hierarchical Agglomerative Clustering |  | Assignment 3 |
| 11 | 20 | k-means partitional clustering; |  |  |
| 21 | Self-Organizing Maps (SOM) |  |  |
| 12 | 22 | k-Nearest-neighbor algorithm |  |  |
| 23 | Semi supervised learning with EM using labeled and unlabeled data; | CLO2 |  |
| 13 | 24 | Reinforcement Learning: Hidden Markov models |  | Quiz3 |
| 25 | Monte Carlo inference Exploration vs. Exploitation Trade-off, | CLO3 |  |
| 14 | 26 | Markov Decision Processes; | CLO1 |  |
| 27 | Ensemble Learning: Using committees of multiple hypotheses. Bagging, boosting | CLO2 |  |
| 15 | 28 | Revision |  |  |
| 29 | Revision |  |  |
| 16 | 30 | **Submission of CCP / Project** |  |  |
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| **17** | **Final Exam** | | | |

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| 1. **IU Assessment / grading Policy** | **Instructor grading for course \*** |
| Quizzes 10-15%  Assignments 10-15%  Projects/Presentation/CCP 0-10%  Mid Semester Examination/ 20-30%  End Semester Examination 40-50% | 10  15  10  25  40 |