**Title (Units):** **COMP3057 Introduction to Artificial Intelligence and Machine Learning (3,2,1)**

**Course Aims:** To introduce the fundamentals, models and techniques commonly found in artificial intelligence applications, and in particular, machine learning. To gain some hands-on experience on developing machine learning solutions.

**Prerequisite:** i) MATH1205 Discrete Mathematics, MATH2005 Calculus, Probability and Statistics for Computer Science (or equivalent)

OR

ii) COMP2865 Fundamental of Data Analysis and Management

**Course Intended Learning Outcomes (CILOs):**
Upon successful completion of this course, students should be able to:

| No. | Course Intended Learning Outcomes (CILOs) |
|---|---|
| | **Knowledge** |
| 1 | Describe the fundamentals of artificial intelligence |
| 2 | Explain classical AI and machine learning algorithms and their applications |
| 3 | Describe machine learning models |
| 4 | Explain the capabilities, strengths and limitations of various AI and machine learning techniques |
| | **Professional Skill** |
| 5 | Apply selected machine learning models |
| 6 | Evaluate available learning methods |

**Calendar Description:** This course aims to introduce the fundamentals, models and techniques of artificial intelligence, and in particular, machine learning. Students will learn the fundamentals and widely-adopted techniques and gain hands-on experiments on developing a solution.

**Teaching and Learning Activities (TLAs):**

| CILOs | Type of TLA |
|---|---|
| 1 - 6 | Students will learn the fundamentals, models and techniques in lectures. Examples of how to solve problems will be demonstrated in tutorials or labs to help students to have an understanding of the teaching materials. |
| 3 - 6 | Students will work on assignments and labs to enhance the understanding of learning principles, and acquire hands-on experience from doing a mini project. |

**Assessment:**

| No. | Assessment Methods | Weighting | CILOs to be addressed | Description of Assessment Tasks |
|---|---|---|---|---|
| 1 | Assignments and Lab Exercises | 30% | 1 - 6 | Assignments, lab exercises, and a mini-project will be used to evaluate students' understanding of the concepts and to assess their ability to apply learning techniques, applications and tools to solve a given problem. |
| 2 | Mini Project | 20% | 1 - 6 | A mini-project will be used to evaluate students' understanding of the concepts and to assess their ability to apply learning techniques, applications and tools to solve a given problem. |
| 3 | Examination | 50% | 1 - 6 | Examination will be used to assess students' overall understanding of various artificial intelligence and machine learning, their applications, as well as their capabilities, strengths and limitations. |

**Assessment Rubrics:**

| | |
|---|---|
| Excellent (A) | • Achieve all CILOs, demonstrating a good mastery of both the theoretical and practical aspects of the knowledge and skills associated with artificial intelligence and machine learning<br>• Able to develop correct solutions to problems<br>• Demonstrate a thorough understanding and solid knowledge of artificial intelligence and machine learning<br>• Able to apply a variety of techniques and relevant knowledge for solving problems in artificial intelligence and machine learning |
| Good (B) | • Achieve most of the CILOs, demonstrating a good understanding of the knowledge and skills associated with artificial intelligence and machine learning<br>• Able to develop correct solutions to problems<br>• Demonstrate a competent level of knowledge of artificial intelligence and machine learning<br>• Ability to make use of appropriate techniques and knowledge and apply them to familiar problems |
| Satisfactory (C) | • Achieve some of the CILOs, demonstrating a basic level of understanding of the knowledge and skills associated with artificial intelligence and machine learning<br>• Able to provide acceptable solutions to problems<br>• Demonstrate an adequate level of knowledge of artificial intelligence and machine learning<br>• Ability to make use of some techniques and knowledge and apply them to familiar situations |
| Marginal Pass (D) | • Achieve few of the CILOs, with minimal understanding of the associated concepts and underlying methodologies<br>• Able to provide solutions to simple problems<br>• Demonstrate a basic level of knowledge of artificial intelligence and machine learning<br>• Ability to apply some techniques and knowledge to a limited number of typical situations |
| Fail (F) | • Achieve none of the CILOs, with little understanding of the associated concepts and underlying methodologies<br>• Unable to provide solutions to simple problems<br>• Knowledge of artificial intelligence and machine learning falling below the basic minimum level<br>• Unable to apply techniques and knowledge to situations or problems |

**Course Content and CILOs Mapping:**

| **Content** | | **CILO No.** |
|---|---|---|
| I | Applied Mathematics | 1 |
| II | Knowledge Representation | 1 |
| III | Learning Tasks | 2, 4, 5 |
| IV | Basic Models | 2, 4, 5, 6 |
| V | Deep Models | 3, 4, 5, 6 |

**References:**

- Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar, Foundations of Machine Learning (Adaptive Computation and Machine Learning series) 2nd Edition, The MIT Press, December 2018.
- Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning (Adaptive Computation and Machine Learning series), The MIT Press, November 2016.
- Francois Chollet, Deep Learning with Pytorch, Manning Publication, 2017.
- Tom M. Mitchell, Machine Learning, McGraw-Hill International Editions, 1997
- Stuart Russell and Peter Norvig, Artificial Intelligence, A Modern Approach, Prentice Hall, 3rd Edition, 2009.

**Course Content:**

**Topic**

I. Applied Mathematics
   1. Linear Algebra
   2. Probability and Information Theory
   3. Convex Optimization
   4. Numerical Computation

II. Knowledge Representation
   1. Problem Solving (A* Search and Constraint Satisfaction)
   2. Knowledge, Reasoning and Planning (First-order Logic and Automated Planning)
   3. Uncertain Knowledge and Reasoning (Probabilistic Reasoning and Programming)

III. Learning Tasks
   1. Supervised Learning (Classification, Regression and Ranking)
   2. Unsupervised Learning (Clustering and Dimensionality Reduction)
   3. Reinforcement Learning (Q-learning and TD learning)

IV. Basic Models
   1. Model Selection and Validation
   2. Decision Trees and Nearest Neighbor
   3. Support Vector Machines and Kernel Methods
   4. Generative and Discriminative Models

V. Deep Models
   1. Deep Forward, Convolutional and Recurrent Networks
   2. Regularization and Optimization for Deep Learning