# Course Outline

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| **Course title: Machine Learning** | **Instructor name: Jun Albert Pardillo** |
| **Credit units: 3** | **Total hours: 54** |

## Course Description:

Machine Learning is a graduate-level course designed for Masters Degree CSIE students who are interested in exploring the field of artificial intelligence and its applications. This course provides an in-depth understanding of the fundamental concepts, algorithms, and techniques used in machine learning.  
  
The course begins with an introduction to the basics of machine learning, including supervised and unsupervised learning, regression, classification, clustering, and dimensionality reduction. Students will learn how to use various machine learning algorithms such as decision trees, random forests, support vector machines, and neural networks to solve real-world problems.  
  
The course also covers advanced topics such as deep learning, reinforcement learning, and natural language processing. Students will learn how to use deep learning techniques to build complex neural networks for image recognition, speech recognition, and natural language processing.  
  
Throughout the course, students will work on several hands-on projects and assignments to gain practical experience in implementing machine learning algorithms. They will also learn how to evaluate the performance of machine learning models and how to optimize them for better accuracy.  
  
By the end of this course, students will have a solid understanding of the principles and techniques of machine learning and will be able to apply them to solve real-world problems. They will also be well-prepared to pursue further research in the field of artificial intelligence.

## Course Learning Outcomes (CLOs)

* Understand and explain the fundamental concepts, algorithms, and techniques used in machine learning.
* Apply various machine learning algorithms such as decision trees, random forests, support vector machines, and neural networks to solve real-world problems.
* Implement deep learning techniques to build complex neural networks for applications in image recognition, speech recognition, and natural language processing.
* Evaluate the performance of machine learning models and optimize them for better accuracy.
* Conduct research and pursue further studies in the field of artificial intelligence.

## Topics / Modules and Intended Learning Outcomes

1. Introduction to Machine Learning

* Describe the basics of machine learning, including supervised and unsupervised learning.
* Identify the applications and implications of machine learning in real-world scenarios.

1. Supervised and Unsupervised Learning

* Compare and contrast supervised and unsupervised learning techniques.
* Apply supervised and unsupervised learning algorithms to different datasets.

1. Machine Learning Algorithms

* Implement machine learning algorithms such as decision trees and support vector machines in problem-solving.
* Evaluate the effectiveness of various machine learning algorithms on specific tasks.

1. Deep Learning and Reinforcement Learning

* Understand the principles and applications of deep learning and reinforcement learning.
* Develop models using deep learning and reinforcement learning for complex problem-solving.

1. Natural Language Processing with Machine Learning

* Apply machine learning techniques to natural language processing tasks.
* Evaluate the performance of NLP models developed using machine learning techniques.

## Weekly Activities

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| **Week No.** | **Topic** | **Activity Description** | **Expected Output** | **Assessment Tools** |
| Week 1 | **Introduction to Machine Learning** | Lecture on the history and fundamentals of machine learning. Introduction to course structure and assessment methods. | Understanding of course expectations and basic machine learning concepts. | Class participation |
| Week 2 | **Supervised and Unsupervised Learning** | Interactive lecture on supervised vs. unsupervised learning. Group discussion on real-world applications. | Identification of key differences and applications of supervised and unsupervised learning. | Group presentation |
| Week 3-4 | **Machine Learning Algorithms** | Hands-on lab sessions on implementing decision trees and support vector machines using Python. | Implemented machine learning algorithms on provided datasets. | Lab assignments |
| Week 5-7 | **Deep Learning and Reinforcement Learning** | Series of lectures and lab sessions on deep learning principles and reinforcement learning strategies. | Developed deep learning and reinforcement learning models for specified tasks. | Project submission |
| Week 8-9 | **Natural Language Processing with Machine Learning** | Introduction to NLP and its challenges. Lab sessions on applying machine learning techniques to NLP tasks. | Implemented NLP models using machine learning algorithms. | Lab reports and project presentation |
| Week 10 | **Midterm Project** | Students will choose a problem to solve using the machine learning techniques learned so far. | A working machine learning model and a report detailing the problem, approach, and results. | Project report and code review |
| Week 11-16 | **Advanced Topics in Machine Learning** | Exploration of advanced topics including but not limited to anomaly detection, dimensionality reduction, and ensemble methods through lectures and projects. | Deepened understanding of advanced machine learning concepts and techniques. | Weekly quizzes, project updates |
| Week 17 | **Final Project** | Students will finalize their projects, incorporating feedback and learning from the entire course. | A comprehensive final report and presentation of the project. | Final project presentation and report |
| Week 18 | **Course Wrap-up and Feedback** | Review of the course. Feedback session on the course content, teaching methods, and learning experience. | Feedback on the course and reflection on learning outcomes. | Feedback form |

## References

*Vieira, S., Pinaya, W.H.L., & Mechelli, A. (2020). Introduction to machine learning. Machine learning, Elsevier.*  
Link: https://www.elsevier.com/books/introduction-to-machine-learning/vieira/978-0-12-818803-3

*Sindhu Meena, K., & Suriya, S. (2020). A survey on supervised and unsupervised learning techniques. Springer.*  
Link: https://link.springer.com/article/10.1007/s00521-019-04556-0

*Teles, G., Rodrigues, J.J.P.C., Rabelo, R.A.L., & Al-Muhtadi, J. (2021). Comparative study of support vector machines and random forests machine learning algorithms on credit operation. Wiley Online Library.*  
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*Matsuo, Y., LeCun, Y., Sahani, M., Precup, D., & Silver, D. (2022). Deep learning, reinforcement learning, and world models. Neural Networks, Elsevier.*  
Link: https://www.journals.elsevier.com/neural-networks

*Houssein, E.H., Mohamed, R.E., & Ali, A.A. (2021). Machine learning techniques for biomedical natural language processing: a comprehensive review. IEEE Access.*  
Link: https://ieeexplore.ieee.org/document/9372906