

Course Outline

1. Document Information

Degree Program	Computer Science
Course Number	CS 535
Course Title	Advanced Machine Learning
Semester Hours	3
Course Coordinator	Xiaolan Huang
Revision Term	Fall 2023
Latest Revision	Fall 2023

2. Catalog Description

The purpose of this course is for students to acquire in-depth knowledge of advanced aspects of machine learning. This course will cover topics including classification clustering, the foundation of deep learning, convolutional Neural Networks, recurrent Neural Networks, and some other advanced topics-deep reinforcement learning and deep generative models. Students will learn the foundations of machine learning, deep learning, and develop skills for performing research to advance the state of knowledge in machine learning.

3. Textbooks

4. References

- Deep Learning By Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT press, 2016. Link of the book through the author's website: <http://www.deeplearningbook.org/>
- Michael Nielsen's online book on Neural Networks and Deep Learning <http://neuralnetworksanddeeplearning.com/>

5. Course Learning Outcomes

- Understand and describe the foundational concepts of machine learning, its various algorithms, and its differences from traditional algorithmic approaches.

- Demonstrate proficiency in applying clustering and classification algorithms to organize and categorize data. To learn the computation models and frameworks of Big Data.
- Apply the principles of backpropagation to train deep neural networks and fine-tune model parameters.
- Design and implement Recurrent Neural Networks (RNNs) for sequence data and understand their applications and limitations.
- Design, develop, and optimize Convolutional Neural Networks (CNNs) for image and video data and discern their importance in the world of visual computing.
- Explain the underlying concepts of deep generative models, their significance, and their applications in various domains.
- Implement deep reinforcement learning techniques to optimize decision-making processes in various simulated environments.
- Critically review, evaluate, and analyze current research papers in the domain of machine learning and deep learning, discerning their significance, implications, and potential future impact.
- Develop solutions and models following ethical guidelines, understanding the implications of machine learning models on society, and recognizing biases in data.
- Communicate complex machine learning concepts, findings, and implementations effectively to a diverse range of audiences, both verbally and in written form.
- Engage in collaborative research projects in machine learning, taking on various roles and responsibilities to contribute to the advancement of knowledge in the field.

6. Assessment of the Contribution to Student Outcomes

Outcome	1	2	3	4	5	6	7
Assessed	X	X	X	X	X	X	X

7. Prerequisites by Topic

CS 434 or CS 437 with a grade of C or better. Concurrent enrollment in CS 434 or CS 437 is allowed.

8. Major Topics Covered in the Course

1. Introduction to Machine Learning
2. Clustering and Classification
3. Backpropagation

4. Recurrent Neural Network
5. Convolutional Neural Network
6. Deep generative models
7. Deep reinforcement learning