Course Number: 28657

Course Name: Applied Machine Learning

Course Type: Theoretical course	Type & Max Unit: Fixed-3
Prerequisite: ---	Corequisite: ---
Level: Graduate Course	First Presentation: 14011
Group: Applied Design	Last Edition: 14011

Objectives: This course aims to provide an applied tutorial of machine learning concepts for graduate students. To solve engineering problems without explicit programming, this course covers all main types of machine learning algorithms with an emphasis on practical applications in several branches of mechanical engineering.

Topics:

1- Basic concepts in Machine Learning
1-1- Basic concepts and Definitions
1-2- Type of Machine Learning Systems
1-3- Batch Learning and Online Learning
1-4- Instance-based Learning and Model-based Learning

2- Supervised Learning
2-1-Regression (Problem formulation and Solving)
2-2- Regression (Evaluation and generalization)
2-3-Regression: Probabilistic perspective
2-4- Linear classifiers (Perceptron, Fisher/ LDA), Multi-class classification
2-5- Probabilistic classification (Generative models: Gaussian Bayes classifier, Naïve Bayes)
2-6- Support Vector Machine (SVM)
2-7- Kernel Methods
2-8- Decision Tree
2-9- Instant based Regression
2-10- Ensemble learning: Bagging - Random Forest
2-11- Ensemble learning: Boosting- AdaBoost
2-12- Applications of Supervised Learning and Case studies

3- Unsupervised Learning
3-1- Dimensionality Reduction
3-2- Principal Component Analysis (PCA)
3-3- k-Means Clustering
3-4- Applications of Unsupervised Learning and Case studies

4- Deep Learning
4-1- Introduction of Deep Learning
4-2- Feedforward Neural Network (FNN)
4-3- Recurrent Neural Network (RNN)
4-4- Convolution Neural Network
4-5- Applications of Deep Learning and Case studies

5- Reinforcement learning
5-1- Introduction of Reinforcement Learning Problem
5-2- Formal Framework of Reinforcement Learning Problem
5-3- Dynamic Programing
5-4- Monte Carlo Algorithms
5-5-Temporal-Difference Learning
5-6-Actor-Critic Algorithms

5-7-Applications of Reinforcement Learning and Case studies

References:

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Bishop, Christopher M., and Nasser M. Nasrabadi. *Pattern recognition and machine learning*. Vol. 4. No. 4. New York: springer, 2006.
Mitchell, Tom M., and Tom M. Mitchell. *Machine learning*. Vol. 1. No. 9. New York: McGraw-hill, 1997.
Géron, Aurélien. *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems*. " O'Reilly Media, Inc.", 2019.
Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. *Deep learning*. MIT press, 2016.
Sutton, Richard S., and Andrew G. Barto. *Reinforcement learning: An introduction*. MIT press, 2018.