Macao Polytechnic Institute

School of Applied Sciences

Master of Science in Big Data and Internet of Things

Module Outline

Academic Year 2021 / 2022 Semester 1

Learning Module	Machine Learning			**Class Code**	COMP6101
Pre-requisite(s)	Nil				
Language of Instruction	English			**Credit**	3
Lecture Hours	45 hrs	**Lab/Practice Hours**	0 hrs	**Total Hours**	45 hrs
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Description

Artificial Intelligence (AI) is so pervasive today that possibly you are using it in one way or the other and you don't even know about it. One of the popular applications of AI is Machine Learning (ML), which is the science of getting computers to learn without being explicitly programmed. In the past decade, machine learning has given us many amazing applications such as self-driving cars, speech recognition, image recognition, financial trading, machine translation, AlphaGo etc. This module covers some of the most important methods for machine learning including deep neural networks, reinforcement learning, etc. The aim of the module is to give students the theoretical underpinnings of machine learning techniques, and to allow them to apply such methods in a range of areas such as image recognition, classification, automatic control etc. by practice.

Learning Outcomes

After completing the learning module, students will be able to:

1. Understand the theoretical underpinning, the complexity and the limitations of machine learning algorithms. (SM1fl, SM2fl)

2. Design neural network architectures and training procedures. (D2fl)
3. Have a working knowledge of one or more neural network simulation packages and be able to use them to perform a range of computational tasks. (EP3fl)
4. Examine multiple criteria for analyzing Different Learning algorithms, and evaluate algorithms on these metrics: e.g. empirical performance, convergence, etc. (EA1fl)

Content

1. Introduction to Machine Learning (3 hours)
   - 1.1 ML applications
   - 1.2 What constitutes an ML algorithm?
   - 1.3 Supervised learning & unsupervised learning
2. Linear regression and logistic regression (9 hours)
   - 2.1 Linear regression with one variable
   - 2.2 Linear regression with multiple variables
   - 2.3 Classification
   - 2.4 Logistic regression
   - 2.5 Advanced optimization
3. Neural network (3 hours)
   - 3.1 What are neural networks?
   - 3.2 Activation functions and error functions
   - 3.3 Back propagation networks
4. Deep learning (21 hours)
   - 4.1 Back propagation
   - 4.2 Convolutional neural networks
   - 4.3 Training deep models
   - 4.4 Special training technologies
   - 4.5 Application domain
   - 4.6 Recurrent neural networks
   - 4.7 LSTM
   - 4.8 Application domain

4.9 Why deep

5. Anomaly detection (3 hours)

5.1 Problem Formation

5.2 Anomaly detection with labels

5.3 Anomaly detection without labels

6. Attack and Defense (3 hours)

6.1 Attacking Deep Neural Network

6.2 Defense methods

6.3 Explainable AI

7. Other Deep Learning methods (3 hours)

7.1 Semi-supervised learning

7.2 Transfer Learning

7.3 Reinforcement Learning

Teaching Method

Lectures /lab practice and assignments

Attendance

Attendance requirements are governed by the "Academic Regulations Governing Master's Degree Programmes of Macao Polytechnic Institute". Students who do not meet the attendance requirements for the module shall be awarded an 'F' grade.

Assessment

The learning module is graded on a 100 point scale, with 100 being the highest possible score and 50 being the pass score.

	Item	Description	AHEP3 LO	Percentage
1.	Assignments	Home based exercises and small projects	EP3fl, EA1fl	40%
2.	Tests	Knowledge assessment	SM1fl, SM2fl	20%
3.	Project	Individual comprehensive project with full report	D2fl, EA1fl	40%
			Total Percentage:	100%

Teaching Material(s)

Textbook(s)

NA

Reference

Reference book(s)

1. Shai Shalev-Shwartz and Shai Ben-David (2014). *Understanding Machine Learning: From Theory to Algorithms.* Cambridge University Press.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville (2016). *Deep Learning.* An MIT Press book, http://www.deeplearningbook.org.
3. Richard S. Sutton and Andrew G. Barto (2018). *Reinforcement Learning: An Introduction (2rd ed).* MIT Press, Cambridge, MA, 2018. http://incompleteideas.net/book/the-book-2nd.html