Kurdistan Region Government
Ministry of Higher Education
and Scientific Research
Erbil Polytechnic University

زانکۆی پۆلیتەکنیکی هەولێر
ERBIL POLYTECHNIC UNIVERSITY

Module (Course Syllabus) Catalogue

2023-2024

College/ Institute	**Erbil Technical Engineering College**	
Department	**Information System Engineering**	
Module Name	**Machine Learning**	
Module Code	**MAL502**	
Degree	**Technical Diploma** ☐ **Bachelor** ☐ **High Diploma** ☐ **Master** ☐ **PhD** ■	
Semester	**1**	
Qualification	**PhD In Computer Engineering**	
Scientific Title	**Assist. Prof**	
ECTS (Credits)	**6**	
Module type	**Prerequisite** ☐ **Core** ■ **Assist.** ☐	
Weekly hours		
Weekly hours (Theory)	**(3)hr Class**	
Weekly hours (Practical)		
Number of Weeks	**14**	
Lecturer (Theory)	**Shahab Wahhab Kareem**	
E-Mail & Mobile NO.	**Shahab.kareem@epu.edu.iq**	
Lecturer (Practical)		
E-Mail & Mobile NO.		
Websites		

Course Book

1. Course name	**Machine Learning**
2. Lecturer in charge	
3. Department/ College	**Information Systems Engineering**
4. Contact	**e-mail: Shahab.karim@epu.edu.iq** **Tel: (optional)**
5. Time (in hours) per week	**Theory: 3**
6. Office hours	
7. Course code	**MAL502**
8. Teacher's academic profile	Shahab Wahhab Kareem I received my BSc in Control and Computer Engineering from the University of Technology Baghdad in 2001, and MSc in Software Engineering from Salahadeen University in 2009. He is a PhD in Yasar University Izmir, Turkey 2020. My research interests include Machine learning and Big data. I'm an Asist. Prof. at the Information System Eng. (ISE) Department (2011-till now)
9. Keywords	

10. Course overview:

Machine Learning is concerned with computer programs that automatically improve their performance through experience (e.g., programs that learn to recognize human faces, recommend music and movies, and drive autonomous robots). This course covers the theory and practical algorithms for machine learning from a variety of perspectives. We cover topics such as decision tree learning, Support Vector Machines, neural networks, boosting, statistical learning methods, unsupervised learning, active learning, and reinforcement learning. Short programming assignments include hands-on experiments with various learning algorithms.

11. Course objective:

The course aims to provide an introduction to the basic principles, techniques, and applications of Machine Learning. Programming assignments are used to help clarify basic concepts.

The course covers the principles, design and implementation of learning programs that improve their performance on some set of tasks with experience. Upon successful completion of the course, students will have a broad understanding of machine learning algorithms and their use in data-driven knowledge discovery and program synthesis. Students will

have designed and implemented several machine-learning algorithms in Java. Students will also be able to identify, formulate and solve machine learning problems that arise in practical applications. Students will have a knowledge of the strengths and weaknesses of different machine learning algorithms (relative to the characteristics of the application domain) and be able to adapt or combine some of the key elements of existing machine learning algorithms to design new algorithms as needed. You will have an understanding of the current state of the art in machine learning and be able to begin to conduct original research in machine learning.

12. Student's obligation

Homework assignments will be a mix of paperwork and machine problems. Written homework should be finished individually, discussions with peers or instructor is allowed, but copying or any other type of cheating is strictly prohibited. You will be given one week to finish the written homework. Some of the machine problems are designed for teamwork and due day may vary. Any late submission will incur a 15% penalty for that assignment.

13. Forms of teaching

داتاشۆ و پاوەرپۆینت، سەر تەختەڕەش، تەختەی سپی، هتد

14. Assessment scheme

Both article review and final exams will be closed-book written exams. The coverage of the exam will be discussed before the exam. A review session will be given one week before the exam. The format of exam questions include True/False question, short answer questions, and short essay questions. The length of the exams will between 120-180 minutes in class.

15. Student learning outcome:

By the end of this course the student should:

- Analyse and identify significant characteristics of data sets.
- Develop an understanding of training a learning algorithm including over-fitting, noise, convergence and stopping criteria.
- Match a data set with the most promising inductive learning algorithms.
- Understand and implement the training, testing, and validation phases of learning algorithms development and deployment.
- Determine the computational complexity associated with development and execution of learning algorithms for a given data set.
- Develop hands on experience with the leading set of inductive learning algorithms.
- Apply machine learning algorithms for classification and functional approximation or regression.

16. Course Reading List and References:

1- Introduction to Machine Learning with Python: A Guide for Data Scientists
Andreas C. Müller, *Sarah Guido*

2- Machine Learning with Python Cookbook: Practical Solutions from Preprocessing to Deep Learning
Chris Albon

2- Machine Learning
Tom M. Mitchell

17. The Topics:	**Lecturer's name**

	Lecture	Topics	Readings and useful links
1	Course Overview	Intro, Admin	
		Machine Learning Examples	
		Decision Tree Learning	
	Decision Tree Learning	Decision Tree Learning	Mitchell Chapters 1,2,6.1-6.3
		The Big Picture	Murphy Chapter 2
		Overfitting	Bishop Chapter 1,2
2	Learning Linear Separators	Learning Linear Separators	Mitchell Chapters 4.1.2 and 4.4.1
		The Perceptron Algorithm	Bishop Chapter 4.1.7
		Margins	Daume
	Estimating Probabilities from Data	Bayes Rule	Mitchell: Estimating Probabilities
		MLE	
		MAP	
3	Naive Bayes	Conditional Independence	Mitchell: Naive Bayes and Logistic Regression
		Naive Bayes: Why and How	
	Naive Bayes	Naive Bayes: Why and How	Mitchell: Naive Bayes and Logistic Regression
		Bag of Words	

4	Logistic Regression	Logistic Regression: Maximizing Conditional Likelihood	Weinberger: Gradient Descent
		Gradient Descent	Mitchell: Naive Bayes and Logistic Regression
	Kernels	Kernels	Bishop 6.1 and 6.2
		Kernelizing Algorithms	Notes
		Kernelizing Perceptron	
5	Application Area: Computer Vision	Problems and Challenges in Computer Vision	
		Deep Learning in Computer Vision	
	Kernels cont'd	Kernels	Bishop 6.1 and 6.2
		Kernelizing Algorithms	Notes
		Kernelizing Perceptron	
6	Support Vector Machines	Geometric Margins	Notes on SVM by Andrew NG
		SVM: Primal and Dual Forms	
		Kernelizing SVM	
	Generalization and Overfitting	Sample Complexity	Mitchell: Ch 7
		Finite Hypothesis Classes	Notes on Generalization

7	Generalization and Overfitting	Sample Complexity	Mitchell: Ch 7
		VC Dimension Based Bounds	Notes on Generalization
	Generalization and Overfitting	Sample Complexity	Mitchell: Ch 7
		VC Dimension Based Bounds	Notes on Generalization
8	Model Selection, Regularization	Sturctural Risk Minimization	
		Regularization	
		k-Fold Cross Validation	
	Linear Regression	Linear Regression	Murphy: Ch 7.1 - 7.3
		Minimizing squared error and maximizing data likelihood	
9	Neural Networks	Neural Networks	Mitchell: Chapter 4
		Backpropagation	
	Deep Networks	Convolution	Goodfellow: Chapter 9
		Convoluational Neural Networks	
		LeNet-5 Architecture	

10	Boosting	Boosting Accuracy	Schapire's NIPS Tutorial
		Adaboost	Schapire's Survery
	Unsupervised Learning	Objective Based Clustering	Hastie, Tibshirani and Friedman, Chapter 14.3
		Hierarchical Clustering	Center Based Clustering: A Foundational Perspective (Sections 1-3)
11	Learning Representations, Dimensionality Reduction	Hierarchical Clustering	Bishop 12.1, 12.3
		PCA	
		Dimensionality Reduction	
	Interactive Learning	Active Learning	Two Faces of Active Learning by by Sanjoy Dasgupta
		Common heuristics, Sampling bias	
		Safe Disagreement Based Active Learning Schemes	
12	Semi-Supervised Learning	Semi-supervised Learning	Semi-Supervised Learning in Encyclopedia of Machine Learning, Jerry Zhu
		Transductive SVM	
		Co-training	

13	Reinforcement Learning	Markov Decision Processes	Mitchell, Chapter 13	
14		Value Iteration	Kaelbling, et al., Reinforcement Learning: A Survey	
		Q-Learning		
15	Online Learning	Online Learning. Recap.	Avrim Blum survey	

18. Practical Topics (If there is any)

19. Examinations:

20. Extra notes:

21. Peer review: Dr.Roojwan Sc. Hawezi