The University of Jordan
School of Engineering
Department of Computer Engineering
Summer Term – A.Y. 2022-2023

Course:	Advanced Topics in Machine Learning – 0907552 (3 Credit Hours)
Catalog Data:	Introduction to Machine Learning. Basics of Artificial Neural Networks (ANNs). Supervised Learning Algorithms (Perceptron, Perceptron Learning Rule, Multi-Layer Perceptron, Hebbian Learning Algorithm, Variations on Hebbian Learning, Widrow-Hoff Learning Algorithm, Back Propagation Learning Algorithm). Unsupervised Learning Algorithms (Unsupervised Hebb Rule, Instar Rule, Outstar Rule). Recurrent ANNs. Additional ANN Topics (Convolutional Neural Networks, Deep Learning). ANN Applications (Adaptive Filters, Echo Cancellation, Noise Cancellation). Basic Concepts in Fuzzy Logic. Fuzzy Membership Functions. Fuzzy Implications. Fuzzification and Defuzzification. Fuzzy Rule Base. Fuzzy Inference Engine. Fuzzy Logic Applications. Further ML Topics include Genetic Algorithms and Programming, Neuro-Fuzzy Systems, and Additional Directions in Contemporary ML.
Prerequisites by Course:	CPE 0907451
Prerequisites by Topic:	Students are assumed to have had sufficient knowledge in programming using Matlab, Digital Logic, and background in Artificial Intelligence and Machine Learning.
Textbook:	J.-S. R. Jang, C.-T. Sun, and E. Mizutani, *Neuro-Fuzzy and Soft Computing*, Pearson.
References:	• J. Yen and R. Langari, *Fuzzy Logic*, Prentice-Hall. • B. Kosko, *Neural Networks and Fuzzy Systems*, Prentice-Hall. • L. Fausett, *Fundamentals of Neural Networks*, Prentice-Hall.
Website:	MS Teams
Schedule & Duration:	8 weeks, 40 lectures, 75 minutes each (including exams).
Minimum Student Material:	Text book, class handouts, instructor keynotes, calculator, access to a personal computer and internet.
Minimum College Facilities:	E-Learning platform, classroom with whiteboard and projection display facilities, library and computational facilities.
Course Objectives:	The objectives of this course are: 1. Introducing students to the various concepts, techniques and tools used in modern ML. Tools include neural, fuzzy, neuro-fuzzy, and genetic systems analysis and design. Concepts also include several aspects of Supervised and Unsupervised Learning Algorithms. 2. Introducing students to neuro and fuzzy systems for real-world applications such as in adaptive filtering, echo cancellation, noise cancellation, control design, robotics, artificial intelligence, machine vision, image processing and signal processing.

Course Outcomes (ILOs):

Upon successful completion of the course, a student should be able to:

1. Carry out basic neural – based learning computations.
2. Apply various learning rules for practical applications.
3. Implement fuzzy – based computations.
4. Apply fuzzy-based rules for engineering applications.

Course Topics:

1. Introduction to Artificial Neural Networks (ANNs)
2. The Biological Neuron
3. NN Paradigm: Architectures, Nodes and Learning Algorithms
4. Learning Algorithms: Supervised vs. Unsupervised
5. NN Learning Representations
6. Perceptron, Perceptron Learning Rule and Perceptron Variations
7. Hebbian Learning Algorithm and its Variations
8. Widrow-Hoff Learning Algorithm and its Applications
9. The Back Propagation (BP) Learning Algorithm
10. Unsupervised Learning
11. Associative Learning: Unsup. Hebb, Instar and Outstar Rules
12. Recurrent Neural Networks (RNNs)
13. ANN Engineering and Real-World Applications
14. Introduction to Fuzzy Logic and Systems
15. Fuzzy Sets and Membership Functions
16. Fuzzy Rule Base and Fuzzy Inference Engines
17. Fuzzy – Based Engineering and Real-World Applications
18. Additional Various Contemporary Topics in ML and Applications

Computer Usage:

Practical aspects are covered using Matlab simulations and examples.

Attendance:

Class attendance will be taken every class and all of the university's polices and regulations will be enforced in this regard.

Assessments:

Coursework and Exams.

Grading policy:

Course Work	20%
Midterm Exam	30%
Final Exam	50%

Instructors:

Prof. Dr. Anas N. Al-Rabadi
E-mail: an321dy@yahoo.com
Office Hours: S. T. Th. 11:00 – 12:00
Arrangement with Instructor

Class Time and Location:

S. M. T. W. Th. 16:00 – 17:15 (online)