UNIVERSITY of NICOSIA

Course Syllabus

Course Code	Course Title	ECTS Credits
COMP-447	Neural Networks and Deep Learning	6
Prerequisites MATH-280 COMP-211	**Department** Computer Science	**Semester** Fall
Type of Course Elective for BSc Computer Science Required for BSc Data Science	**Field** Computer Science/Data Science	**Language of Instruction** English
Level of Course 1st Cycle	**Lecturer(s)** Athena Stassopoulou and Michalis Agathocleous	**Year of Study** 4th
Mode of Delivery Face to Face	**Work Placement** N/A	**Corequisites** None

Course Objectives:

To provide an introduction to the fundamental principles of neural networks and Deep Learning. It is designed to develop an understanding of the basic issues associated with the field such as: main neural network architectures, learning algorithms, neural network applications and deep learning models.

Learning Outcomes:

After completion of the course students are expected to be able to:

1. describe the relation between biological and artificial neural networks and discuss current applications of artificial neural networks
2. explain the structure of single-layer perceptrons, learning algorithms, and their limitations
3. explain and contrast back-propagation networks (multi-layer perceptrons) to single-layer perceptrons
4. discuss applications of multi-layer perceptrons

5. explain how we handle temporality with neural networks, recurrent neural networks and back-propagation through time
6. explain the architecture of Radial Basis Function Networks, their learning algorithms and contrast to back-propagation networks
7. explain the architecture of the Hopfield model, its learning algorithm and its applications to pattern recognition
8. explain the structure of the Kohonen self-organizing map, its learning algorithm and its applications to machine vision and speech recognition
9. compare and contrast the various Artificial Neural Network architectures and learning algorithms presented throughout the course
10. explain the fundamentals of deep learning and convolutional neural networks
11. explain how we handle deep sequence models and the importance of long-short term memory (LSTM) networks
12. explain why we need deep generative models and the application of auto-encoders

Course Content:

1. What is a neural network? Biological neural networks and artificial neural networks, their similarities and differences. History of neural networks and current applications.
2. Fundamentals of learning and training samples, supervised and unsupervised learning.
3. Single Layer Perceptrons: architecture, activation function, learning rule, convergence theorem, limitations.
4. Multi-layer Perceptrons: hidden units, Back-propagation (generalized delta) learning rule, applications.
5. Temporality and recurrent neural networks, learning algorithms and applications.
6. Radial Basis Function Networks: architecture, learning, differences with multi-layer perceptrons.
7. The Hopfield model: architecture, learning algorithm, applications to character recognition.
8. Self-Organizing Maps (SOMs): structure of the Kohonen self-organizing map, learning algorithm, applications.
9. Deep Learning and Convolutional Neural Networks, learning algorithm, applications.
10. Deep Sequence modelling and LSTM networks, learning algorithm, applications.
11. Deep generative models and Auto-encoders, learning algorithm, applications.

Learning Activities and Teaching Methods:

Lectures, Practical Exercises and Assignments

Assessment Methods:

Mid-term, Projects, Homework, Final Examination

Required Textbooks / Readings:

Title	Authors	Publisher	Year	ISBN
Neural Networks and Learning Machines (3rd ed.)	Simon O. Haykin	Prentice Hall	2008	0131471392
Deep Learning	Aaron Courville, Ian Goodfellow and Yoshua Bengio	MIT Press	2015	9780262035613

Recommended Textbooks/Reading:

Title	Authors	Publisher	Year	ISBN
An Introduction to Neural Networks	Kevin Gurney	CRC press	1997	1857285034
Neural Networks for Pattern Recognition	Christopher M. Bishop	Oxford University Press	1995	9780125264204
Fundamentals of Neural Networks: Architectures, Algorithms And Applications	Laurene V. Fausett	Prentice Hall	1994	0133341860