

SYLLABUS

QM414E

Introduction to Deep Learning

ACADEMIC AREA :	OPERATIONS AND ANALYTICS
PROGRAMME :	MASTER DAIS / PGE / UGTC LEVEL 4 PGE
PERIOD :	SPRING
COORDINATOR :	Dr. Ahmed ATIL
INSTRUCTOR(S) :	Dr. Ahmed ATIL
CONTACT HOURS :	24.0 hours
STUDY TIME :	null hours (Class preparation, homework and assessments)
CREDITS :	4.0 ECTS
AOL :	NO

PRE-REQUISITE MODULES :

Introduction to Machine Learning: Basic understanding of machine learning concepts, including supervised and unsupervised learning.

Linear Algebra: Knowledge of linear algebra concepts, particularly matrices and vectors, as they are fundamental to neural networks.

Probability and Statistics: Understanding of probability distributions and statistical methods.

Python Programming: Intermediate Python programming skills, especially familiarity with libraries such as NumPy, TensorFlow, or PyTorch.

MODULE DESCRIPTION :

This course introduces students to the foundational concepts of deep learning, a subset of machine learning that uses neural networks to model complex patterns in data. Students will learn the architecture, principles, and applications of deep neural networks and gain hands-on experience in building and evaluating models. By the end of this course, students will be able to understand, design, and implement deep learning models for various tasks.

CONTRIBUTION TO PROGRAMME LEARNING OBJECTIVES :

- Build and cultivate relationships to Connect people in multicultural & multisituational contexts #ConnectPeople

Connect People: Through group projects and collaborative learning environments, students will learn to build and maintain relationships, connect diverse ideas, and work in multicultural and multi-situational contexts.

The course fosters an environment where students develop a shared understanding of deep learning's potential in diverse, real-world applications.

MODULE INTENDED LEARNING OUTCOMES (ILOs) :

Understand the Foundations of Deep Learning: Comprehend core deep learning concepts, including neural network structures, activation functions, and training processes. Design and Implement Neural Networks: Develop the skills needed to construct and train neural networks using industry-standard tools. Apply Deep Learning to Real-World Problems: Analyze real-world datasets and design models to solve classification, regression, and clustering tasks. Evaluate and Optimize Models: Master techniques for assessing model performance and fine-tuning model parameters for optimal results. Understand the Ethical Implications of Deep Learning: Identify and consider the ethical and social implications of using deep learning technologies in society.

TOPICS COVERED :

Introduction to Deep Learning: Overview of deep learning, its history, and its role within artificial intelligence and machine learning. Neural Networks and Architecture: Detailed exploration of neural network architectures, including feedforward, convolutional, and recurrent networks. Training Deep Networks: Techniques for training deep networks, including backpropagation, gradient descent, and optimization methods. Regularization and Overfitting: Methods to prevent overfitting, such as dropout, batch normalization, and data augmentation. Applications of Deep Learning: Study of applications in image recognition, natural language processing, and recommendation systems.

RESEARCH-LED TEACHING :

The course integrates recent research on neural networks and deep learning, with case studies that focus on current industry applications and academic advancements.

Students will examine research papers and case studies, learning how cutting-edge methods are applied to real-world problems and contribute to advances in deep learning.

CSR AND SUSTAINABLE DEVELOPMENT GOALS :

Corporate Social Responsibility (CSR) and Sustainable Development Goals (SDGs)
Ethics and Bias in AI: Focus on the ethical considerations in deep learning, including data bias, model fairness, and privacy.

Hours concerning CSR and Sustainable Development: 3 hours dedicated to CSR, discussing the environmental impact of deep learning and responsible AI practices.

Sustainable Development Goals Covered:

SDG 9: Industry, Innovation, and Infrastructure.

SDG 10: Reduced Inequalities (with a focus on fairness in AI).

SDG 12: Responsible Consumption and Production (especially regarding the computational resources used in deep learning).

CSR NB HOURS :

3

SUSTAINABLE DEVELOPMENT GOALS COVERED :

- 09 - Industry, innovation and infrastructure
- 10 - Reduced inequalities
- 12 - Responsible consumption and production

TEACHING METHODS :

Concept Presentation: Lectures introducing core concepts and principles of deep learning, supported by visualizations and interactive discussions.

Hands-on Application: Practical labs where students will design and train their neural networks on real datasets, using Python and popular deep learning libraries.

E-learning Platform: Use of an online platform for assignments, self-paced learning modules, quizzes, and continuous assessments, allowing students to track their progress and engage with supplementary material.

METHODS OF ASSESSMENT :

Continuous/Final	Group/Individual	Assessment	Weight	Duration	ILOs assessed
Continuous	Individual	Quiz	10%		1 , 2 , 3 , 4 , 5
Continuous	Group	Written assessment at home	30%		1, 2 , 3, 4, 5

Final	Individual	Final written exam	60%	2 Heures	1,2, 3, 4 ,5
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Assessment 1 details:

Continuous Assessment via E-learning Platform (10%) over 6 sessions

Description:

Students will complete online quizzes, assignments, and interactive exercises through the E-learning platform to reinforce their understanding.

Objective:

Assess and reinforce understanding of foundational concepts and principles as they progress through the course.

Assessment 2 details:

Group Project Evaluation (30%) over 5 sessions

Description:

Students will work in groups to design and implement a deep learning model based on real-world data, with a presentation at the end of the course.

Objective:

Encourage collaboration, practical application of knowledge, and the integration of ethical considerations and sustainability in model development.

Assessment 3 details:

Final Individual Assessment (60%)

Description:

A final examination will assess students' comprehensive understanding of deep learning concepts, architecture, and practical applications.

Content:

Includes theoretical questions, case analysis, and problem-solving, with an emphasis on ethical implications and real-world applications.

Objective:

Measure students' ability to independently apply deep learning skills, demonstrate critical understanding, and engage with advanced deep learning topics.

ACADEMIC INTEGRITY :

Academic misconduct encompasses various behaviors or actions that violate the principles of academic integrity, fairness, and honesty, thereby undermining the credibility of academic work, assessments, or research. Examples of academic misconduct include:

- Cheating
- Plagiarism
- Fabrication
- Gaining an unfair advantage
- Assisting others in committing academic misconduct, such as by utilizing generative AI
- Falsification of records or official documents
- Unauthorized access to restricted information or data
- Unauthorized or unethical use of generative AIS

Academic misconduct is a serious offense and can result in consequences such as module failure, research project failure, or even expulsion from the school. To prevent unintentional academic misconduct, it is essential to consult with your instructor to understand the specific rules and instructions pertaining to the use of AI in learning and assessment.

For more comprehensive information on academic integrity rules, principles, and disciplinary procedures, please refer to the Academic Integrity section of the Student Handbook.

BIBLIOGRAPHY :

Recommended Bibliography

"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

"Neural Networks and Deep Learning" by Michael Nielsen

Additional Reading

MODULE PLAN SESSIONS :

Plan Session 01 :

Introduction to Deep Learning

Overview of deep learning and its applications; review of machine learning concepts as a basis for understanding deep learning.

Plan Session 02 :

Neural Network Architecture

Deep dive into different neural network architectures, focusing on feedforward networks and perceptrons.

Plan Session 03 :

Convolutional Neural Networks (CNNs)

Introduction to CNNs and their application in image processing tasks, including convolution layers, pooling, and feature extraction.

Plan Session 04 :

Deep Learning Applications and Case Studies

Exploration of real-world applications, including hands-on projects in computer vision and natural language processing.

Plan Session 05 :

Group Project Presentation

Students present their group projects, demonstrating their model design, implementation, and application of deep learning principles to a specific problem.

