



National University of Engineering (UNI)
School of Computer Science
Syllabus 2027-I

1. COURSE

AI264. Deep Learning (Mandatory)

2. GENERAL INFORMATION

2.1 Course	: AI264. Deep Learning
2.2 Semester	: 7 th Semester.
2.3 Credits	: 4
2.4 Hours	: 2 HT; 4 HP;
2.5 Duration of the period	: 16 weeks
2.6 Type of course	: Mandatory
2.7 Learning modality	: Face to face
2.8 Prerequisites	: AI263. Introduction to Machine Learning. (6 th Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

This course covers modern deep learning fundamentals, including convolutional networks, transformer architectures, and training techniques for advanced AI systems.

5. GOALS

- Implement deep neural networks using modern frameworks (PyTorch/TensorFlow)
- Design architectures for specific domains (vision, language, etc.)
- Analyze ethical limitations of deep models

6. COMPETENCES

AG-C09) Design and Development of Solutions: Designs, implements, and evaluates solutions for complex computing problems. (Usage)

AG-C11) Use of Tools: Applies modern computing tools in problem solving. (Assessment)

7. TOPICS

Unit 1: Neural Network Training and Optimization (10 hours)	
Competences Expected: AG-C09,AG-C11	
Topics	Learning Outcomes
• Modern backpropagation: computational graphs and automatic differentiation • Advanced optimizers: momentum, RMSProp, Adam, and learning-rate schedules	• Implement a deep neural network from scratch, including its backpropagation pass [Apply] • Select and tune an optimizer and its learning-rate schedule for training stability [Apply]
Readings : [goodfellow2016dl]	

Unit 2: Regularization Techniques for Deep Networks (5 hours)	
Competences Expected: AG-C09,AG-C11	
Topics	Learning Outcomes
• Dropout regularization • Batch normalization	• Diagnose overfitting in a training run using regularization diagnostics [Analyze] • Apply dropout and batch normalization to improve a model's generalization [Apply]
Readings : [goodfellow2016dl]	

Unit 3: Convolutional and Residual Network Architectures (9 hours)	
Competences Expected: AG-C09,AG-C11	
Topics	Learning Outcomes
• Deep convolutional neural network architectures • Residual connections and ResNets	• Design a deep CNN architecture for a given vision task [Apply] • Adapt a residual architecture to a specific vision domain [Apply]
Readings : [he2016resnet]	

Unit 4: Transformer Architectures and Generative Models (16 hours)	
Competences Expected: AG-C09,AG-C11	
Topics	Learning Outcomes
• Transformers and the attention mechanism • Generative models: variational autoencoders (VAEs) and generative adversarial networks (GANs)	• Train a transformer model on a real dataset [Apply] • Analyze and contrast VAE and GAN generative-model architectures [Analyze]
Readings : [vaswani2017attention]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

Theory Sessions:

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

Lab Sessions:

In order to verify their competences, several activities including active learning and roleplay will be developed during lab sessions.

Oral Presentations:

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

Reading:

Throughout the course different readings are provided, which are evaluated. The average of the notes in the readings is

considered as the mark of a qualified practice. The use of our virtual campus allows each student to access the course information, and interact outside the classroom with the teacher and with the other students.

The final grade NF depends on the following grades:

- PE : Partial Exam.
- FE : Final Exam.
- P : Permanent Evaluation (Average of practical work and graded assignments).

The final grade NF is calculated as follows:

$$NF = \frac{PE + FE + P}{3}$$

10. BASIC BIBLIOGRAPHY