

NATIONAL UNIVERSITY OF SAN MARCOS

FACULTY OF MATHEMATICAL SCIENCES

SYLLABUS

1. GENERAL INFORMATION

1.1 Course name	:	Deep Learning
1.2 Code	:	AI264
1.3 Academic Program	:	Scientific Computing
1.4 Credits	:	5
1.5 Prerrequisites	:	AI263. Introduction to Machine Learning. (8^{th} Sem)
1.6 Type of Course	:	Mandatory
1.7 Area of Studies	:	Estudios Generales
1.8 Number of Weeks	:	16
1.9 Hours per week	:	3 HT; 4 HP;
1.10 Cycle	:	I
1.11 Learning modality	:	Face to face
1.12 Academic Period	:	2026-I
1.13 Semester Start Date	:	
1.14 Semester End Date	:	

2. PROFESSORS

Meetings after coordination with the professor

3. INTRODUCTION TO THE COURSE

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

4. GOALS

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

5. COMPETENCES

ABET-2) An ability to formulate or design a system, process, procedure, or program for the intended purpose. (Usage)

ABET-3) An ability to develop and conduct experiments or test hypotheses, analyze and interpret data, and use scientific judgment to draw conclusions. (Assessment)

6. TOPICS

Unit 1: Neural Network Training and Optimization (10 hours)	
Competences Expected: ABET-2,ABET-3	
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: ABET-2,ABET-3	
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: ABET-2,ABET-3	
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: ABET-2,ABET-3	
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**]	

7. WORKPLAN

7.1 Methodology

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

7.2 Theory Sessions

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

7.3 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.

8. EVALUATION SYSTEM

********* EVALUATION MISSING ********

9. BASIC BIBLIOGRAPHY