TEACHING GUIDE

1. BASIC INFORMATION

Subject	**Speech and Natural Language Processing**
Degrees	**Intelligent Systems Engineering (GISI)**
Faculties	**Faculty of Engineering and Business Technology**
ECTS	**6**
Character	**Mandatory**
Language	**English**
Mode	**In-person/Synchronous In-person**
Semester	**Fifth**
Subject Coordinator	**Isaac González**

2. PRESENTATION

The subject Speech and Natural Language Processing focuses on developing and applying computational skills to process and analyze text and speech data effectively. It introduces foundational concepts of Natural Language Processing (NLP), including text preprocessing, representation, statistical methods, and machine learning models. Advanced topics cover deep learning for NLP, such as word embeddings, sequence modeling, attention mechanisms, and fine-tuning. The course also explores transformers, large language models, and their applications. Additionally, speech processing concepts like speech-to-text, text-to-speech, and automatic speech recognition are covered. By the end of the course, students will be equipped to design, develop, and implement practical solutions for medium to complex NLP and speech processing tasks using Python and modern AI tools.

3. COMPETENCIES AND LEARNING OUTCOMES

Competencies	Code	Description
Basic Competencies	**CB02**	Students know how to apply their knowledge to their work or vocation in a professional way and possess the competencies that are usually demonstrated through the laboration and defense of arguments and the problem solving within their area of study.
General Competencies	**CG01**	Resolve complex and unpredictable situations systematically, creatively and with critical judgment, making decisions with incomplete information and assuming risks in the field of engineering.
	CG02	Effectively determine objectives, priorities, methods and controls to perform tasks by organizing activities with the deadlines and means available in the engineering field.
	CG03	Demonstrate the ability to analyze, synthesize and evaluate data and information in the field of engineering.
Transversal Competencies	**CT03**	Demonstrate oral and written communication skills in a foreign language.

Competencies	Code	Description
	CT05	Solve problems and make decisions by applying knowledge, methods and tools in their academic and professional fields.
	CT07	Demonstrate skills and attitudes for independent work and teamwork.
	CT08	Use knowledge, skills, abilities and attitudes to communicate in digital environments.
Specific Competencies	CE22	The graduate will be able to use the fundamentals, methods, techniques and tools for processing written and spoken natural language.

Code	Description
LO01	Identify, select, and use appropriate software tools for the development of intelligent applications that require the processing of natural spoken language.
LO02	Identify, select, and use appropriate software tools for the development of intelligent applications that require the processing of natural written language.
LO03	Use advanced machine learning techniques for language processing.
LO04	Design and build applications for language modeling tasks such as content summarization, classification, speech synthesis, language analysis, and language generation.
LO05	Use software tools in the scope of the subject.

4. CONTENT

Unit I: Natural Language Processing

1.1. Introduction to NLP

1.2. Python for text processing and regular expressions

1.3. Text preprocessing: tokenization, stemming, lemmatization, stopword removal

1.4. Text Representation: Bag-of-Words, TF-IDF, and N-Grams.

1.5 Statistical and Rule-Based Methods: Rule-based systems and statistical techniques.

1.6 NLP with Machine learning models

1.7 Evaluation metrics: Accuracy, precision, recall, F1 score.

Unit II: Deep learning for NLP

2.1 Introduction to Deep Learning for NLP

2.2 Word Embeddings

2.3 Sequence Modeling

2.4 Attention Mechanism and Sequence-to-sequence

2.5 Fine-Tunning

Unit III: Transformers and Large Language Models

3.1. Introduction to Transformers

3.2. Foundation Models

3.3. Large Language Models

3.4 Fine-Tuning Transformers

3.5 Building applications with LLMs

Unit IV: Speech processing

4.1 Introduction to Speech Processing

4.2 Automatic Speech Recognition

4.3 Speech-to-text

4.4 Text-to-speech

4.5 Building applications with speech tools

5. TEACHING AND LEARNING METHODOLOGIES

UIE develops an innovative academic model centered on the learner, combining different philosophical approaches to Teaching-Learning (T-L), a wide variety of learning activities—especially those in which students take an active role in knowledge construction—continuous guidance, and the intensive use of technology as a facilitating tool, creating a unique and innovative learning ecosystem.

The training is conducted in an in-person modality, including synchronous virtual learning, supported by a cutting-edge virtual campus that provides flexibility and personalization within a ubiquitous learning (U-Learning) model.

Additionally, in alignment with its founding and corporate principles of social responsibility, UIE not only encourages the participation of its entire university community in volunteer and social service activities but also incorporates the Service-Learning (ApS) approach as a formal component of its teaching-learning strategies.

Code	Activity	Type	Teaching Modalities	Mode
MD01	First Contact and Motivation	I	Introductory	PR
MD02	Presentation, Course Plan and Commitment	I		
MD03	Lecture	T	Expository and Participatory	PR
MD04	Guest Lectures by Experts	T		
MD05	UIE Methodology	T/P	Guided / Autonomous	PR / NP
MD06	Problem Solving and Exercises	P		
MD07	Activity in the Virtual Campus UIE	T/P		

Code	Activity	Type	Teaching Modalities	Mode
MD08	Content Study	T	Guided / Autonomous	NP
MD09	Project and Assignment Development	T/P		
MD10	Case Study	P	Guided	PR
MD11	Seminars	T/P		
MD12	Debates and Discussions	P		
MD13	Presentation	T/P		
MD14	Games, Contests, and Competitions	P		
MD15	Simulation of a Work Environment	T/P		
MD16	Use of Software Tools	P		
MD17	Laboratory Practices	P		
MD18	External Internships	P		
MD19	Service-Learning	T/P	Service-Learning	PR
MD20	Tutoring	T/P	Personalized (Individual/Group)	PR
MD21	Learning Agreement	I/T/P		
MD22	Portfolio Assessment	T/P	Autonomous	NP
MD23	Discussion Forums	T/P		
MD24	Analysis and Synthesis of Documentary Material	T		
MD25	Monitoring and Completion	C	Continuous Self-Assessment	NP

6. TRAINING ACTIVITIES

The following identifies the types of educational activities that will be carried out:

Code	Name	Modality	Type of activity
AF01	Introductory	IP	Motivational/Informative
AF02	Expository and Participatory	IP	Theoretical
AF03	Guided	IP	Theoretical / Practical
AF04	Personalized (Individual / Group)	IP	Theoretical / Practical
AF05	Autonomous	NP	Theoretical / Practical
AF06	Service-Learning	IP	Service-Learning
AF07	Continuous self-assessment	NP	Quality Assessment

IP: In-person   NP: Non-in-person

7. EVALUATION

The model also includes the continuous assessment process as an essential part of verifying the competencies acquired. For UIE, and in line with the proposed improvement of the teaching-learning process for the European Higher Education Area (EHEA), the assessment system, called Learning Outcomes Review (LOR), is developed as a more humanized process, distancing itself from traditional systems where students risk their fate in exams (sessions), sometimes with high and decisive percentage weights, leading to stress, frustration, and occasionally, dropout.

The UIE LOR system is continuous, shared, and progressive, allowing for the monitoring of learning throughout the entire period, making it a natural process to which students turn without negative emotions and aware of the need to understand their own progress.

Code	Evaluation Activity	Weighting %	Type	Mode
AE01	Partial Tests	40	Discrete	O/E
AE03	Projects	14	Discrete	
AE04	Presentation	5	Discrete	
AE05	Participation in the Virtual Campus	4		
AE06	Participation, Daily Activities and Volunteering	5	Discrete (Pass/ Fail)	O
AE08	Service-Learning			
AE09	Digital Portfolio	32	Discrete	D/E
AE10	Retake Partials	-		W/O
		100		

Mode: O: Oral   W: Written   O/E: Both   DF: Digital Folder

8. BIBLIOGRAPHY

➢ Antić, Z. (2020). *Python natural language processing cookbook: Over 50 recipes to understand, analyze, and generate text for implementing language processing tasks*. Packt Publishing.

➢ Iusztin, P., & Labonne, M. (2024). LLM engineer's handbook: Master the art of engineering large language models from concept to production.

➢ Jurafsky, D., & Martin, J. H. (2025). *Speech and language processing: An introduction to natural language processing, computational linguistics, and speech recognition with language models* (3rd ed.).

➢ Kamath, U., Liu, J., & Whitaker, J. (2019). *Deep learning for NLP and speech recognition* (1st ed.). Springer.

➢ Vajjala, S., Majumder, B., Gupta, A., & Surana, H. (2020). *Practical natural language processing: A comprehensive guide to building real-world NLP systems*. O'Reilly Media.

9. TUTORIALS

MD20 Tutorial (2%): Students must attend at least three personalized tutorials throughout the semester. This is an all-or-nothing activity ("Pass-Fail"), meaning that all three tutorials must be completed.

10. QUALITY SURVEYS

MD25 Quality Management (2%): Students must complete four forms throughout the semester related to UIE's quality management. This is an all-or-nothing activity ("Pass-Fail"), meaning that all four forms must be completed within the deadlines specified in the course activity plan. The activity aims to timely assess the development of the teaching-learning process and the transversal competence related to critical and self-critical thinking.