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

1. COURSE

AI262. Natural Language Processing (Elective)

2. GENERAL INFORMATION

2.1 Course	:	AI262. Natural Language Processing
2.2 Cycle	:	CS300 Cycle.
2.3 Credits	:	4
2.4 Hours	:	2 HT; 4 HP;
2.5 Duration of the period	:	16 weeks
2.6 Type of course	:	Elective
2.7 Learning modality	:	Face to face
2.8 Prerrequisites	:	STA251. Probability Calculation. (2^{nd} Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

This course introduces the theoretical and practical fundamentals of Natural Language Processing (NLP), covering from classical techniques to modern deep learning models. Students will learn to implement complete NLP pipelines for applications like sentiment analysis, machine translation, and chatbots.

5. GOALS

- Understand computational representation of human language.
- Implement text processing algorithms in Python.
- Apply NLP models to real-world problems using modern frameworks.

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. (Usage)

7. TOPICS

Unit 1: NLP Fundamentals (15 hours)	
Competences Expected: AG-C09,AG-C11	
Topics	**Learning Outcomes**
• Tokenization and text representation • N-gram models and smoothing • Feature extraction (TF-IDF, word embeddings)	• Preprocess text for NLP models [Usar] • Explain limitations of classical statistical models [Familiarizarse]
Readings : [JM21], [MS99]	

Unit 2: Language Modeling (15 hours)	
Competences Expected: AG-C09,AG-C11	
Topics	**Learning Outcomes**
• Word2Vec, GloVe and FastText • Recurrent Neural Networks (RNNs) for NLP • Sequence-to-sequence models (seq2seq)	• Train word embeddings [Usar] • Implement basic RNNs for text generation [Evaluar]
Readings : [Gol17], [Mik+13]	

Unit 3: Transformers and Modern NLP (15 hours)	
Competences Expected: AG-C09,AG-C11	
Topics	**Learning Outcomes**
• Transformer architecture (self-attention) • BERT and pre-trained models • Fine-tuning for specific tasks	• Apply pre-trained models with HuggingFace [Usar] • Evaluate NLP performance metrics [Evaluar]
Readings : [Vas+17], [Dev+19]	

Unit 4: Practical Applications (15 hours)	
Competences Expected: AG-C09,AG-C11	
Topics	**Learning Outcomes**
• Sentiment analysis with transformers • Question-answering systems • Model deployment with Flask/FastAPI	• Build a complete NLP pipeline [Usar] • Optimize models for production [Evaluar]
Readings : [JM21], [Cho21]	

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

[MS99] Christopher D. Manning and Hinrich Schütze. *Foundations of Statistical Natural Language Processing*. MIT Press, 1999.

[Mik+13] Tomas Mikolov et al. "Efficient Estimation of Word Representations in Vector Space". In: *arXiv:1301.3781* (2013).

[Gol17] Yoav Goldberg. *Neural Network Methods for Natural Language Processing*. Morgan & Claypool, 2017.

[Vas+17] Ashish Vaswani et al. "Attention Is All You Need". In: *Advances in Neural Information Processing Systems* 30 (2017).

[Dev+19] Jacob Devlin et al. "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding". In: *arXiv:1810.04805* (2019).

[Cho21] François Chollet. *Deep Learning with Python*. 2nd. Manning, 2021.

[JM21] Daniel Jurafsky and James H. Martin. *Speech and Language Processing*. 3rd. Pearson, 2021.