National University of Engineering (UNI)
School of Computer Science
Syllabus 2024-II

1. COURSE

CS365. Evolutionary Computing (Mandatory)

2. GENERAL INFORMATION

2.1 Course	:	CS365. Evolutionary Computing
2.2 Semester	:	10^{th} Semester.
2.3 Credits	:	4
2.4 Horas	:	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 Prerrequisites	:	CS262. Machine learning. (7^{th} Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

This course introduces biologically-inspired algorithms for solving complex optimization and design problems. It covers genetic algorithms, evolutionary strategies, and genetic programming, with applications in engineering, logistics, and machine learning. Students will implement solutions using modern frameworks like DEAP.

5. GOALS

- Model complex problems using evolutionary paradigms.
- Implement bio-inspired algorithms in Python.
- Analyze performance of different evolutionary techniques.

6. COMPETENCES

1) Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions. (Usage)

2) Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline. (Usage)

6) Apply computer science theory and software development fundamentals to produce computing-based solutions. (Assessment)

AG-C08) Problem Analysis: Identifies, formulates, and analyzes complex computing problems. (Usage)

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

AG-C11) Tool Usage: Applies modern computing tools in problem-solving. (Assessment)

7. TOPICS

Unit 1: Genetic Algorithms (16 hours)	
Competences Expected: 1,AG-C08	
Topics	**Learning Outcomes**
• Chromosomal representation (binary, real-valued) • Selection operators (roulette, tournament) • Crossover and mutation	• Design representations for discrete problems [Usar] • Compare selection operators [Evaluar]
Readings : [Gol18], [Tea23]	

Unit 2: Evolutionary Strategies (16 hours)	
Competences Expected: 2,AG-C09	
Topics	**Learning Outcomes**
• $(\mu + \lambda)$ and (μ, λ) algorithms • Parameter self-adaptation • Continuous optimization applications	• Implement strategies for real-world problems [Usar] • Tune self-adaptation parameters [Evaluar]
Readings : [Bey01], [**PythonEC**]	

Unit 3: Advanced Applications (16 hours)	
Competences Expected: 6,AG-C11	
Topics	**Learning Outcomes**
• Genetic programming • Co-evolution • Multi-objective optimization (NSGA-II)	• Develop multi-objective solutions [Usar] • Evaluate Pareto front trade-offs [Evaluar]
Readings : [ES15], [Aut22]	

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

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

10. BASIC BIBLIOGRAPHY

[Bey01] Hans-Georg Beyer. *The Theory of Evolution Strategies*. Fundamentos matemáticos. Springer, 2001.

[ES15] A.E. Eiben and J.E. Smith. *Introduction to Evolutionary Computing*. Visión general actualizada. Springer, 2015.

[Gol18] David E. Goldberg. *Algoritmos Genéticos*. Clásico en algoritmos genéticos. Addison-Wesley, 2018.

[Aut22] Various Authors. "Evolutionary Computation in Industry". In: *Nature Reviews* 3 (2022). Aplicaciones industriales modernas. URL: `https://www.nature.com/articles/s42254-022-00490-y`.

[Tea23] DEAP Team. *Documentación de DEAP*. Framework para computación evolutiva en Python. 2023. URL: `https://deap.readthedocs.io`.