Eastern Mediterranean University
Doğu Akdeniz Üniversitesi

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Faculty of Engineering
Computer Engineering Department

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CMPE536 METAHEURISTICS
COURSE OUTLINE
2024-2025 SPRING SEMESTERS

COURSE CODE   *CMPE536*
COURSE TITLE   METAHEURISTICS
LECTURERS   Assist. Prof. Dr. Ahmet ÜNVEREN.
PREREQUISITES   Consent of the Instructor

CATALOGUE DESCRIPTION

Heuristics and metaheuristics, neighborhood search, local and global optimization, simulated annealing, greedy randomized adaptive search, tabu search, evolutionary algorithms,Genetic Algorithms, ant-colony optimization, Particle Swarm Optimization, Differential Evolution, hybrid methods, performance evaluation of metaheuristics.

AIMS & OBJECTIVES

Heuristics, popularly known as rules of thumb, stand for strategies that improve the average-case performance of problem solving task. An efficient heuristic discovers good solutions for hard problems relatively quickly. Metaheuristics means heuristics for managing heuristics. Metaheuristics control the application and interaction of one or more heuristics searching for a better solution than any single heuristic would find on its own. The aim of this course is to present the nature and the power of widely used metaheuristic methods, primarily those used in artificial intelligence and operations research. The methods to be covered are used to solve search, reasoning, planning and general engineering optimization problems. . The graduate students who will take this course may use many of the algorithms introduced in this course in their graduate research studies.

ASSIGNMENTS & PRESESENTATION

There will be several assignments throughout the semester. They will greatly help the participants to understand the presented topics from their practical implementation point of view.

METHOD OF ASSESSMENT
Midterm 1 30 %
Assignments (2) + Presentation (1) 30 %
Final 40 %

TEXTBOOK
1. Colin Reeves, "Modern Heuristic Techniques for Combinatorial Optimization", John Wiley & Sons, 1993.
2. Judea Pearl, "Heuristics: Intelligent Search Strategies for Computer Problem Solving", Addison-Wesley, 1985.

3. Jason Brownlee, "Clever Algorithms: Nature-Inspired Programming", 2011.

4. Thomas Back, "Evolutionary Algorithms in Theory and Practice", Oxford University Press, 1996.

5. Lecture Notes.

TENTATTIVE CONTENTS & SCHEDULE

Heuristics, Metaheuristics and Problem Representation: Typical uses of Heuristics in problem solving, search space and problem representations: optimizing, satisfying, and semi-optimizing tasks. Evaluation of heuristics. (3 hours)

Tabu Search: The tabu search algorithm, tabu search characteristics, tabu search memory, reactive tabu search algorithm, intensification and diversification, tabu search applications. (6 hours)

Simulated Annealing: The basic method, the annealing algorithm, problem specific decisions, adaptive simulated annealing, cooperative simulated annealing, applications(6 hours)

Local search & Variable Neighborhood Search to Guided Local Search (3 hours)

Greedy Randomized Adaptive Search: Multi start greedy algorithms, the GRASP approach, construction and local search phases, applications. (3 hours)

Evolutionary Algorithms: Basic concepts, types of evolutionary algorithms: evolution strategies, evolutionary programming, genetic algorithms, genetic programming, problem and method specific decisions, applications. (3 hours)

Ant Colony Optimization, PSO & DE: Cooperative multi-agent problem solving, problem representation, ant colony optimization, PSO & DE, problem specific decisions, applications. (6 hours)

Hybrid Methods : Connections between tabu search, simulated annealing and evolutionary algorithms, applications involving cooperative work of different metaheuristics. (3 hours)

Performance evaluation of metaheuristics: Analytical methods, worst-case and average-case performance analysis, empirical testing, statistical inference. (3 hours)

ADDITIONAL NOTES:

PLAGIARISM
This is intentionally failing to give credit to sources used in writing regardless of whether they are published or unpublished. Plagiarism (which also includes any kind of cheating in exams) is a disciplinary offence and will be dealt with accordingly.

ATTENDANCE
Students ACCEPT to take the responsibility of all inconsistencies and failures due to not attending the lectures. All announcements made and all assignments distributed in class will be assumed to be known by all students. No excuse related to absence in class will be accepted. No attendance score will be added to your total average.

MAKEUP EXAMS
If a midterm and/or final is missed, an **OFFICIAL** document (such as a medical report), clearly stating the LEGAL and ACCEPTABLE reasons preventing you to take the exam, should be submitted to the instructor **within 3 days** following the date of the exam. Otherwise, no makeup exam can be organized.

Assist. Prof. Dr. Ahmet ÜNVEREN