IE 552 Heuristic Methods for Optimization (3 0 3)
(ECTS: 7.5)

Spring 2023 Tentative Course Syllabus

Catalog Description
Introduction, simulated annealing, tabu search, genetic algorithm, ant colony optimization, ant colony, variable neighborhood search, and particle swarm optimization.

Course Objective
To cover various (meta)heuristic search approaches for solving difficult combinatorial optimization problems.

Lecturer & Lecture's Detail
S. Shah Sultan M. QADRI, Ph.D. in Industrial Engineering
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Office hour: To be announced.
Lecture Hours: Wednesday 18:00-21:00 at Balgat Campus

Course Outline: A tentative outline is given below and the instructor reserves the right to make changes as she sees necessary.

Week	Topics
1.	Introduction
2.	Categorization of heuristics
3.	Construction heuristics
4.	Classical improving search
5.	Simulated annealing
6.	Tabu search
7 .	Genetic algorithms
8.	Swarm intelligence and ant colonies
9.	Scatter search
10.	Constraint handling
11.	Genetic Algorithms for multiobjective optimization
12.	Variable neighborhood search
13.	Evaluation of heuristic performance
14.	Computational complexity of heuristics

Textbook
- El-Ghazali Talbi: Metaheuristics - From Design to Implementation, Wiley, 2009 .
- J. Dr´eo, A. P´etrowski, P. Siarry, E. Taillard, Metaheuristics for Hard Optimization, simulated Annealing, Tabu Search, Evolutionary and Genetic Algorithms, Ant Colonies, Springer, 2003.

Reference Books
- Sean Luke, 2013, Essentials of Metaheuristics, Lulu, second edition.

- Gendreau, Michel and Jean-Yves Potvin (eds) (2012) Handbook of Metaheuristics. Springer.
- Talbi, El-Ghazali (2009) Metaheuristics; From Design to Implementation. Wiley.
- Stefan Edelkamp, Peter Norvig: Heuristic Search: Theory and Applications, Elsevier, 2011.
- Fred Glover, Gary A. Kochenberger: Handbook of Metaheuristics, Springer, 2010.
- Zbigniew Michalewicz, David B. Fogel: How to Solve It: Modern Heuristics, Springer, 2004.
- Holger H. Hoos ,Thomas Stützle: Stochastic Local Search, Morgan Kaufmann, 2005.
- Sadiq M. Sait, Habib Youssef: Iterative Computer Algorithms with Applications in Engineering: Solving Combinatorial Optimization Problems, Wiley, 2000.
- Christos H. Papadimitiou, Kenneth Steiglitz: Combinatorial Optimization., Dover Publications, 2nd edition, 1998.
- K. Deb: Multiobjective optimization using Evolutionary Algorithms, Wiley, 2001

Computer Usage

The students must have a working knowledge of Python (preferably) or any other programming language.

Grading :

Evaluation of the students will be based on

- 10% Attendance*
- 30 % Project & Presentation,
- 30% Mid-Term Exam,
- 30% Final exam.

**Conditional*

$$\begin{cases} 10 \text{ points}, & \text{if 10 out of 14 Presents} \\ 0, & \text{otherwise} \end{cases}$$

Project

Students will choose an industrial engineering problem (or from their own field of study) and develop a meta-heuristic algorithm to solve this problem. Students can use any programming language (preferably Python) they want. Students have to prepare a report in a form of a research paper (including an Abstract, Introduction, Literature Review, Methodology, Results, and Conclusion) and give an oral presentation of their work. Further details of the report will be announced later. <u>Students who submit their report on time but do not make a presentation cannot get any points from the assignment</u>.

Attendance:

Attendance may be taken during class sessions. It is best if you fully attend every hour. If you miss even a single hour, you will find it hard to understand the following course material since the topics are interrelated. Furthermore, you will also be marked either Late or Absent.