HUST

ĐẠI HỌC BÁCH KHOA HÀ NỘI

HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

ONE LOVE. ONE FUTURE.

FUNDAMENTALS OF OPTIMIZATION

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FUNDAMENTALS OF OPTIMIZATION

Week 1: Introduction to course

ONE LOVE. ONE FUTURE.

Outline

1. **Description**
2. Goal and output requirement
3. References
4. Evaluation
5. Schedule

Description

- Optimization has many effective and ***widespread applications in all areas of life***, including machine learning, resource planning, machine design, automation, business administration, finance, transportation, manufacturing, and urban architecture.

- This course provides students with a theoretical foundation in *linear programming*, *branch-and-bound*, *integer programming*, *constraint programming* for exact algorithms; the *greedy algorithm*, *local search* as heuristics algorithm; and some metaheuristics such as *Iterated local search*, *Tabu search*.

Description

- It also provides optimization software and libraries used to develop programs for solving these kinds of problems.

- The course provides simplified versions of real-life applications as exercises and mini-projects.

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Goal and output requirements

- Modelling the simple real-life applications as combinatorial optimizations
  - Set of decision variables
  - Set of constraints
  - Objective function
- Demonstrate the fundamental knowledges about exact and heuristic algorithms
  - Demonstrate the background theory about optimization
  - Identify, compare and categorize algorithms
  - Use libraries to implement the algorithms

Goal and output requirements

- Apply models, algorithms and libraries for solving various real-life problem efficiently
  - Propose mathematical models for the optimization with easy to medium level of complexity
  - Analyze the business requirement of the application to select appropriately the solution approaches for the problem at hand
  - Implement algorithms for the problems within or without the libraries
- Demonstrate a serious attitude towards learning, respect for peers and society
- Demonstrate a continuous commitment to updating knowledge in the field of optimization

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References

- Slide deck provided for the course
- Nguyễn Đức Nghĩa (1996). Tối ưu hóa (Quy hoạch tuyến tính và rời rạc). NXB Giáo dục.
- George B. Dantzig and Mukund N. Thapa (1997) Linear Programming 1: Introduction, Springer Series in Operations Research and Financial Engineering
- Bertsimas, Dimitris, and Robert Weismantel (2005) Optimization over Integers. Belmont, MA: Dynamic Ideas.
- F. S. Hillier, G. J. Lieberman (2005) Introduction to Operations Research, eighth edition, McGraw Hill.
- De Jong K. A (2006). Evolutionary Computation. A Unified Approach. The MIT Press.
- Glover F (1998). Tabu Search. Kluwer Acad. Publish.

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Evaluation

- Mid-term evaluation (40%)
  - Programming contest: 20%
  - Individual mini-project: 20%
  - Bonus: Up to 2 points added to the mid-term grade for contributions in lectures, such as answering questions or solving exercises on the board.
  - Bonus points are added to the mid-term grade. For example, if a student scores 7 in the programming contest, 7 in the individual mini-project, and earns 2 bonus points, their mid-term grade will be 9.
- Final term (60%)
  - Final exam consists of two parts: Quiz and programming contest.

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Tentative schedule

- Part 1: Foundation
  - Week 1: Introduction
  - Week 2: Convex Optimization
  - Week 3: Divide and conquer and Dynamic programming algorithms for optimization
  - Week 4&5: Introduction to Linear Programming
- Part 2: Exact approaches
  - Week 6: Branch-and-Bound algorithm
  - Week 7: Integer programming
  - Week 8: Constraint programming
  - Week 9: Practicing IP and CP with real-life problems
- Week 10: Mid-term exam
- Part 3: Heuristic approaches
  - Week 11: Greedy algorithm
  - Week 12: Local search
  - Week 13: Metaheuristics
  - Week 14: Practicing heuristic and metaheurist with real-life problems
- Week 15: Tutoring for the individual mini-project
- Week 16: Mini-project presentation – Randomly selected presenter

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THANK YOU !