

COMP572–Combinatorial Optimization

- Instructor: **Mordecai Golin** (golin@cse.ust.hk)
- TA: **Zhang Qin** (qinzhang@cse.ust.hk)
- Meeting Times: **Tuesday/Thursday 13:30-14:50**
- Marking Scheme:
3/4 Homework Assignments + a programming project
- Textbook:
Combinatorial optimization : algorithms and complexity
Christos H. Papadimitriou, Kenneth Steiglitz
Englewood Cliffs, N.J. : Prentice Hall, c1982
- Reference Book:
Introduction to algorithms (2nd ed)
Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest , Clifford Stein
Imprint Cambridge, Mass. : MIT Press ; Boston : McGraw-Hill, c2001
and many others

Course Requirements

- Linear Algebra
Vector spaces, bases, matrices, determinants
- A class in the
Design and Analysis of Algorithms (COMP271)
Graph Algorithms, Data Structure Analysis,
 $O()$ Notation, Dynamic programming,
NP Completeness, etc..

In particular, for new students:

If you were told that you have to take COMP271 and have not been waived out of the requirement then you should **NOT** take this class.

What is this course?

- **How to solve optimization problems *exactly***
as opposed to heuristically, e.g, simulated annealing, genetic algorithms
- **Algorithmically Oriented**
Some of this material is taught in optimization departments from a different perspective.
- **The types of problems we will look at arise *everywhere*,**
e.g., database, networking, chip design, logistics, graphics, etc.
- **This is a basic technique course.**
We will specifically **NOT** look at individual applications.
- **This is an introductory PG course.**
It is **NOT** intended to teach cutting edge research techniques.
It is designed to teach the old techniques upon which cutting-edge techniques are based.

Tentative Syllabus

- Network Flow (CLRS book)
- Binomial Heaps (CLRS book)
- Linear Programming and related topics (PS book)
(50% of the class)
- Matchings (PS book)
- Matroids (PS book)
- Dynamic Programming Speedups (possible advanced topic)
- Introduction to Approximation Algorithms (possible advanced topic)

Two Typical Problems

Let $G = (V, E)$ be a **weighted** graph

V are the vertices; E are the edges

For $e \in E$, $w(e)$ is the **weight** of e .

The weight of edge-set $E' \subseteq E$ is $w(E') = \sum_{e \in E'} w(e)$.

A **tree** is an acyclic connected graph containing all V .

A **Hamiltonian Cycle** is a simple cycle containing all V .

- **Minimum Spanning Tree:**

Find minimum-weight tree among all trees in G .

Polynomially time solvable ($|E| \log |V|$)

e.g., Kruskal's Algorithm and Prim's algorithm.

- **The Travelling Salesman problem:**

Find minimum-weight H.C. among all H.C. in G

NP-Hard, so polynomial-time solution is unlikely.