DDA-6010 [CIE-6010 / MDS-6118] (Fall 2018)

Optimization Theory and Algorithms

CLASSES: MON./WED. 10:30–12NOON, ZHI XIN 110(M)/109(W)

- **Instructor**

  Prof. Yin Zhang (张寅) yinzhang@cuhk.edu.cn
  Institute for Data and Decision Analytics (iDDA)
  Office hours: Tue. 4:30–6:00pm or by appointment, Dao Yuan #503

- **Teaching Assistants**

  Yuchen Yang (杨雨宸) yy42@rice.edu
  Office Hours: Wednesday: 4:00-6:00pm, Dao Yuan #510

  Hualie Jiang (蒋华烈) 217019005@link.cuhk.edu.cn
  Office hour: Tuesday 7:00-8:00pm at Zhi Ren #503

  Yueyao Yu (俞跃耀) 217012009@link.cuhk.edu.cn
  Office hour: Monday 7:00-8:00pm at Dao Yuan #224

- **Course Materials**

  — Textbook: *Nonlinear Programming* by D. Bertsekas (3rd Ed.)
  — Reference: *Numerical Optimization* by J. Nocedal and S. Wright (2nd Ed.)
  — Reference: *Iterative Methods for Optimization* by T. Kelly

  Selected chapters will be made available online along with lecture notes.

- **Objectives and outcomes**

  Students are to learn basic theory and to develop algorithmic understanding about optimization so they will be able to recognize, formulate, and solve optimization problems in their fields. CIE 6010 students are expected to gain a deeper understanding on theoretic issues than MDS 6118 students.

- **Prerequisites**

  Linear algebra (matrix analysis), multi-variable calculus, Matlab programming. No prior knowledge on optimization is required, but a level of mathematical maturity is expected.

- **Grading**

  Assignments (40%). In-class Midterm Exam (30%). Final Project (30%),

  There will be differences in assignments, exam and final project between CIE 6010 (PhD) and MDS 6118 (Masters) students. The two groups will be graded with different criteria.

- **Academic Honesty**

  Students are expected to strictly follow assignment instructions and maintain a high standard of academic honesty.

- **Assignments**

  Assignments will be posted online at the course website. Assignments (weekly to biweekly) may be theoretical questions and/or computer projects. Some theoretical questions may be ungraded, in that case their solutions will be made available to students. All assigned problems, graded or ungraded, will be counted towards the course grades. Late submissions are not accepted unless approved by the instructor under special circumstances.

  Students can discuss the assignments with others on ideas, understandings, and approaches, but must eventually write out solutions or programs on an individual basis as their own effort; that is, no sharing of identically written solutions or copying codes from each others (even with come changes).

- **Tutorials**

  Weekly tutorial sessions are held on Thursdays, 7:00-8:00pm in the evenings. The classroom is Cheng Dao Building Room 208.

- **Topics**

  We plan to cover most of the topics in the following list:

  – Mathematical Review (mostly self-reading)
  – Introduction to Optimization and Linear Programming
  – Unconstrained Optimization - Optimality Conditions
  – Gradient Methods. Line Search and BB steps
  – Nesterov's Method. Incremental Gradient Methods
  – Convergence Analysis of Gradient Methods. Rate of Convergence
  – Newton, quasi-Newton and Gauss-Newton Methods
  – Optimization Over A Convex Set; Optimality Conditions
  – Feasible Direction Methods. Approximate Gradient Projection Methods
  – Constrained Optimization; Lagrange Multipliers. Introduction to Duality
  – Penalty Methods. Augmented Lagrangian Methods
  – Alternating Directions Method of Multipliers
  – Proximity Operator, Bregman Distance, Proximal Gradient (PG) Method
  – Stochastic Approximation Methods
  – Conic Programming (LP, SDP, SOCP) and Duality
  – Interior Point Methods for Conic Programming