# MATH:8100:001 Mathematical Programming

Fall 2019

**Instructor:** Boshi Yang (boshiy@clemson.edu)

**Class Times:** MW 2:30pm–3:45pm
**Classroom:** Martin M-301
**Office:** Martin O-204
**Office Phone:** (864) 656-5198
**Office Hours:** Mondays 10:00am – 11:30am and Thursdays 8:30am–10:00am

**Textbooks:**

- [BT] D. Bertsimas and J. Tsitsiklis, *Introduction to Linear Optimization*, Athena Scientific, 1997.
- [BV] S. Boyd and L. Vandenberghe, *Convex Optimization*, Cambridge University Press, 2004 (available online at http://stanford.edu/~boyd/cvxbook/).

**Objectives:** The course covers the fundamentals of mathematical programming, including brief introductions to convexity, optimality conditions, linear optimization theory and algorithms, and network optimization. Upon successful completion of the course, students should be able to recognize classical optimization models, solve basic linear and nonlinear optimization problems, and conduct theoretical analysis using duality theory. The course serves as an introductory course to the field of optimization and lays the foundation for further studies on linear optimization (MATH:8130), nonlinear optimization (MATH:8110), discrete optimization (MATH:8120), network optimization (MATH:8140), multi-criteria optimization (MATH:8170), and other advanced optimization topics.

**Materials covered:** The core materials of the course are Chapters 1-5 of [BT] and Chapters 2, 3, and 5 of [BV]. The tentative schedule of topics is

- Review of prerequisites and introduction to mathematical optimization (1 week)
- Nonlinear optimization theory (5 weeks)
  - convex sets and convex functions
  - optimality conditions (unconstrained)
  - steepest descent and Newton's method
  - Lagrange duality and KKT conditions
- Linear optimization theory and the simplex method (6 weeks)
  - geometry of linear programming
  - simplex method
  - linear program duality theory
  - sensitivity analysis
- Network flow optimization (2 weeks)
  - network flow problem
  - network simplex method

It should be noted that the above schedule does not necessarily follow the chapter sequences of the textbooks. Extra materials out of the textbooks may be covered during the course.

**Course evaluation:** Homework and mid-term exams will be given throughout the semester. A comprehensive project, in which students need to perform necessary theoretical analysis and algorithm implementation, will be due at the end of the semester.

| | Homeworks | Midterm Exams | Project | Final Exam |
|---|---|---|---|---|
| Points | 20 | $20 \times 2$ | 10 | 30 |

**Class cancellation:** The class will be dismissed in the case when the instructor or the invited lecturer is not present within 15 minutes of the scheduled start time.

**Final grade:**

| $[90, 100]$ | $[85, 90)$ | $[80, 85)$ | $[75, 80)$ | $[70, 75)$ | $[65, 70)$ | $[60, 65)$ | $[55, 60)$ | $[0, 55)$ |
|---|---|---|---|---|---|---|---|---|
| A | A− | B+ | B | B− | C+ | C | C− | F |

**Accommodation:** It is university policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. Students with disabilities requesting accommodations should make an appointment with Accessibility Services (656-6848), to discuss specific needs within the first month of classes. Students should present a Faculty Accommodation Letter from Student Accessibility Services when they meet with instructors. Accommodations are not retroactive and new Faculty Accommodation Letters must be presented each semester..

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