MATH1101: An Introduction to Optimization

FALL, 2024

INSTRUCTOR: 武岳 WU, Yue Ivan
OFFICE: 望江校区基础教学楼B座 Room #609
EMAIL: ivan.wuyue@scu.edu.cn
OFFICE HOURS: Tuesday 9:00 AM – 11:00 AM
LECTURES: Thursday 8:15—11:00/13:50—16:25
RECITATION: None
TEXTBOOK: *Mathematical Programming: An Introduction to Optimization, by Melvyn W. Jeter*
TEACHING ASSISTANT: YAN Jiajun, LIAO Sijia

PREREQUISITE: Fundamental knowledge of linear algebra and calculus is recommended.

DESCRIPTION: Optimization techniques are central to solving a wide array of problems in modern mathematics, engineering, economics, and computer science. This course introduces you to the foundational principles and methodologies of mathematical programming, including linear and nonlinear programming. Through a combination of theoretical exploration and practical application, you will learn how to formulate, analyze, and solve optimization problems using mathematical techniques. The course is designed for those with a background in linear algebra and calculus, and it emphasizes both conceptual understanding and computational skills, equipping students with the tools to tackle optimization challenges across diverse disciplines.

COURSE OBJECTIVES:
Upon completion of this course, students will:
1) Understand the fundamentals of mathematical programming, including both linear and nonlinear optimization problems.
2) Identify and apply convex analysis techniques to optimization challenges.
3) Learn the simplex method, duality theory, and post-optimal analysis.
4) Recognize and solve convex optimization problems and understand the significance of KKT conditions in constrained problems.
5) Work on practical optimization problems and computational techniques to deepen their understanding.

LEARNING OUTCOMES FOR THIS COURSE:
1) Master the theoretical principles behind the optimization problems.
2) Learn to solve the mathematical programming problems using computational methods.
3) Understand duality theory and its practical applications.

GRADE DETERMINATION:
1. Assignments: 40%
2. Attendance: 10%
3. Final Exam: 50%

EXAMS:
A comprehensive final exam will be conducted in Week 20, covering all course material.

QUIZZES:
None

GRADE REBUTTAL:
If you have concerns or disagreements regarding your grade, please follow the steps below:

1. **Timeframe**: Submit your grade appeal within one week of the grade being published.
2. **Prepare Materials**: Gather all relevant documents, including your assignment, original submission, and any supporting materials.
3. **Submit to the Teaching Assistant**:
   Thursday Morning: Contact Liao Sijia at lsj19923818672@163.com.
   Thursday Afternoon: Contact Yan Jiajun at jiajunscu@163.com.
4. **Await Response**: The teaching assistant will review your submission. If additional materials are needed, they will reach out to you for further information.
5. **TA's Decision**: The teaching assistant will provide a decision based on their review.
6. **Escalation (if needed)**: If you disagree with the TA's decision, your materials will be forwarded to the course instructor for further review.
7. **Final Decision**: The course instructor's decision will be final.
8.

HOMEWORK:
Homework will be assigned after each chapter and will collectively contribute 40% to the final grade.

ATTENDANCE:
Attendance will be recorded electronically at least twice a month and will account for 10% of the final grade.

MAKE-UP POLICY:
Students are expected to submit their homework on time. In case of a valid reason, the homework must be submitted before the next class session (not the next week).

MATERIAL COVERED: The sequence of the sections covered in this class is:

Week	Contents	Descriptions
1 (09/05)	1.1 – 1.2	Overview of mathematical programming and optimization. Linear vs. nonlinear programming.
2 (09/12)	1.3 – 1.5	Examples of optimization problems, Global vs. local solutions.
3 (09/19)	2.1 – 2.3	A review of Linear Algebra
4 (09/26)	3.1 – 3.2	Introduction to Convex Sets and Affine Sets, and exercise 01
5 (10/03)	3.2 – 3.3	Introduction to Convex Sets and Affine Sets, and exercise 02
6 (10/10)	4.1 – 4.3	Linear programing problems, and some Geometric interpretation 01
7 (10/17)	4.4 – 4.7	Linear programing problems, and some Geometric interpretation 02
8 (10/24)	5.1 – 5.2	Introduction to the primal simplex method and its steps in solving linear programming problems.
9 (10/31)	5.3 – 5.4	Duality and the linear complementarity problems 01: Dual linear programming problems
10 (11/07)	5.5 – 5.6	Duality and the linear complementarity problems 02: Dual Simplex Method

11 (11/14)	5.7 – 5.9	Duality and the linear complementarity problems 03: Linear complementarity problem.
12 (11/21)	6.1 – 6.5	Network Programming: Linear Network Flow Problems, Some Basic Graph Theory, The Network Simplex Procedure for the Transshipment Problem. The Maximal Primal Dual Flow Problem. Procedures for Network Flow Problems.
13 (11/28)	7.1 – 7.3	Convex Functions 01
14 (12/05)	7.4 – 7.6	Convex Functions 02
15 (12/12)	8.1 – 8.6	KKT Conditions
16 (12/19)	TA Special	Review and Q/A
17 (12/26)		Final Exam Week