



SIE 545: Fundamentals of Optimization Fall 2021

Time and Location: Tuesday and Thursday, 11:00am–12:15pm, ENGR 301

Course format: In-Person

Office Hours: Tuesday and Thursday, 12:30 pm-1:30 pm, and by appointment, In-person & Zoom (<https://arizona.zoom.us/j/82877434924>)

Instructor: Jianqiang Cheng **Office Location:** ENGR 123

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Course Description: This is a graduate level introductory course on optimization, with an emphasis on the classical mathematical concepts, theories and techniques for linear and nonlinear optimization problems. The course will cover fundamental concepts in optimization, modeling nonlinear/linear problems, basic results in convex analysis, and optimality conditions for constrained and unconstrained problems, duality theory, and some algorithms.

Prerequisite(s): SIE 340 – Deterministic Operations Research, or equivalent. Knowledge of elementary calculus and matrix algebra.

Credit Hours: 3

Textbook: M.S. Bazaraa, H.D. Sherali, and C.M. Shetty, *Nonlinear Programming: Theory and Algorithms*, 3rd edition, Wiley & Sons Inc, New Jersey, 2006.

Supplementary: Boyd, Stephen, and Lieven Vandenberghe, *Convex optimization*, Cambridge university press, 2004.

Course Website: We'll be using D2L(<https://d2l.arizona.edu/>). All class materials, including homework assignments, lecture notes, supplementary

readings, etc. will be distributed from D2L. I will also be sending emails to the whole class throughout the semester using the classlist in D2L. You must check the announcements in D2L and your email at least twice a week.

Course Objectives:

At the completion of this course, students will:

1. improve their ability to formulate real-world problems as optimization problems by some modeling and reformulation tricks, and recognize when problems they consider are nonlinear programming problems
2. extend knowledge and understanding of the mathematical foundations of optimization
3. be able to understand optimality conditions for both unconstrained and constrained nonlinear programming problems
4. be able to understand when and how to apply optimality conditions for solving particular problems
5. be able to apply some basic computational algorithms for nonlinear programs.

Course Outline (subject to change):

1. Mathematical modeling (5 lectures)
2. Convex analysis:
Convex sets (3 lectures)
Convex functions and generalizations (4 lectures)
3. Optimality conditions and duality:
Optimality conditions for unconstrained and constrained problems (6 lectures)
Lagrangian duality and saddle point optimality conditions (4 lectures)
4. Algorithms (3 lectures)

Course Requirements:

- **Lectures:** Students are expected to attend and participate in all lectures. Lecture materials will be posted in D2L, and you can print and take them to class to make notes. Some questions left in lectures will require you study by yourself.

- **Reading:** Reading materials from textbook or supplementary posted in D2L will be mentioned in the end of lecture notes. Students are responsible for completing these readings.
- **Homework assignments:** There will be about 5-6 problem sets due approximately every two weeks. The due date will be given in class and shown in D2L. Late homework will not be accepted, and all homework submissions should be electronically through D2L as a PDF-file (preferred: produced by LaTeX).
- **Exams (Closed book, Closed notes) :** There will be one midterm exam (with 75-minute limit) and one final exam (with 2-hour limit).
- **Grading distribution:**
 Homework: About 5-6 sets (30%)
 Midterm exam : (30%)
 Final exam: (40%)
- **Final Grade:** A (90-100), B (80-89), C (70-79), D (60-69), E (< 60)

Class Notes/Materials: Selling/Sharing class notes and/or other course materials to other students or to a third party for resale is **NOT permitted** without the instructor's express written consent. Providing student email addresses to a third party is not permitted. Violations to this and other course rules are subject to **the Code of Academic Integrity** and may result in course sanctions. Additionally, students who use D2L or UA email to **sell or buy** these copyrighted materials are subject to Code of Conduct Violations for misuse of electronic resources provided by The University of Arizona. This conduct may also constitute copyright infringement.

Recordings: This course will be recorded via Panopto. For lecture recordings, which are used at the discretion of the instructor, students must access content in D2L only. Students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using them in a manner inconsistent with UArizona values and educational policies (Code of Academic Integrity and the

Student Code of Conduct) are also subject to civil action.

Academic integrity policy: Students are welcome to discuss class related materials, homework assignments with your classmates. However, students must write solutions individually and cite references, including discussions with classmates.

Specific COVID-19 related information and others:

- **Face coverings are required in our classroom:** Based on UArizona's Face Covering guidance, face coverings that cover the nose, mouth, and chin are required to be worn *in all indoor spaces where it is not possible to adequately and continuously maintain social distance.*
- **Classroom attendance:**
 - If you feel sick, or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel.
 - Notify your instructor if you will be missing a course meeting or an assignment deadline.
 - Non-attendance for any reason does not guarantee an automatic extension of due date or rescheduling of examinations/assessments. Please communicate and coordinate any request directly with your instructor.
 - If you must miss the equivalent of more than one week of class, you should contact the Dean of Students Office
DOS-deanofstudents@email.arizona.edu to share documentation about the challenges you are facing.
 - Voluntary, free, and convenient COVID-19 testing is available for students on Main Campus.
 - COVID-19 vaccine is available for all students at Campus Health.
 - Visit the UArizona COVID-19 page for regular updates.
- **Academic advising:** If you have questions about your academic progress this semester, please reach out to your academic advisor (<https://advising.arizona.edu/advisors/major>). Contact the Advising

Resource Center (<https://advising.arizona.edu/>) for all general advising questions and referral assistance. Call 520-626-8667 or email to advising@.arizona.edu

- **Life challenges:** If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office can be reached at (520) 621-2057 or DOS-deanofstudents@email.arizona.edu.
- **Physical and mental-health challenges:** If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520) 621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.
- **Accessibility and Accommodations:** At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, <https://drc.arizona.edu>) to establish reasonable accommodations.

You are encouraged to make recommendations to improve the class and my teaching skills.

Note: This syllabus is tentative and the instructor reserves the right to make modifications if appropriate.