

MATH 6366-07 (Fall 2024)

Optimization Theory

Instructor: Dr. Nicolas Charon, ✉ ncharon@central.uh.edu

Office: PGH 669.

Semester dates: 08/19/2024-12/11/2024.

Class time & location: Tu-Th 4:00pm-5:30pm in F154.

Office hours: M 3pm-4pm and Thu 11am-12pm, in PGH 669.

Information contained in this syllabus is provisional and subject to future changes. Students are expected to check Canvas regularly for updates.

1 Prerequisites

- Calculus 3 (MATH 2415 or equivalent)
- Linear Algebra (MATH 2318 or equivalent)
- Real Analysis (MATH 4331 or equivalent)
- Some (even limited) prior experience with MATLAB (or similar scientific computing language such as Python...).

2 Textbook

The course mainly follows the textbook *Convex Optimization* by S. Boyd and L. Vandenberghe (Cambridge University Press 2004) which can be downloaded at:

https://stanford.edu/~boyd/cvxbook/bv_cvxbook.pdf

For reference, other textbooks relevant to this course include:

- *Numerical Optimization*. J. Nocedal and S. Wright. Springer 2006.
- *Lectures on Convex Optimization*. Y. Nesterov. Springer 2018.

3 Course Description

This course will introduce the theoretical foundations of optimization and numerical schemes to approximate solutions of continuous optimization problems. Starting from the central concepts and properties around convexity, we will discuss how to design and analyze simple iterative methods for efficiently solving a broad class of optimization problems. While the field of optimization is vast, there exists a small set of methods that achieve optimal performance. We will assess the efficiency of these techniques on prototypical optimization problems, with a particular focus on convex problems. This class will walk through classical results and provide a gateway to cutting edge research in the field.

In addition to the theoretical aspects, some parts of the course will be illustrated via numerical simulations in MATLAB and simple examples of the many applications of optimization in various areas of science.

4 Delivery format and attendance policy

This course will be delivered face-to-face (in person). In between class meetings, there may also be asynchronous activities to complete (e.g., homework assignments).

Attendance is not required, but strongly encouraged. Regular class attendance, participation, and engagement in coursework are important contributors to student success. Absences may be excused as provided in the University of Houston Graduate Excused Absence Policy for reasons including: medical illness of student or close relative, death of a close family member, legal or government proceeding that a student is obligated to attend, recognized professional and educational activities where the student is presenting, and University-sponsored activity or athletic competition. Under these policies, students with excused absences will be provided with an opportunity to make up any quiz, exam or other work that contributes to the course grade or a satisfactory alternative. Please read the full policy for details regarding reasons for excused absences, the approval process, and extended absences. Additional policies address absences related to military service, religious holy days (see paragraph 14), pregnancy and related conditions, and disability.

5 Technical equipment needed

Students will need the following equipment to be able to follow classes: • internet connection, • ability to log in to Canvas for online assignments, • ability to access MS Teams for communications relevant for this class, and • scanner or certain smartphone apps so that you can submit your homework as a PDF file. For technical problems, please contact UH IT Help Desk; your instructor might not be able to help with technical issues. Students that do not have access to the required equipment can find the needed computer equipment in the library. Additional information and technical support is available at <https://www.uh.edu/infotech>.

6 Course evaluation

Evaluation for this course will consist in homework assignments, one midterm and one final exam which modalities are described below. Note that the following information is only provisional and subject to future changes.

Assignments. Assignments will be given on a roughly bi-weekly basis. There should be a total of approximately 5 or 6 homeworks by the end of the semester, each of which will primarily consist of

mathematical problems. In addition to the theoretical part, there will be optional computational assignments that can be done in Matlab or Python. Digital copies of your completed homework assignments have to be uploaded on Canvas at the specified deadline. In fairness to fellow students and graders, late homework will not be accepted without a specific and valid excuse. The final assignment grade will be computed as the average over all the semester's assignments.

Exams. During the semester, there will be one midterm exam (of around 1 hour and 30 mins) and one (cumulative) final exam (~ 3 hours). Exams shall be worked on independently and without the use of your textbook, homework, and class notes (closed book). There will be no makeup exams. Exceptions are possible only in the case of extreme circumstances, such as a documented, serious illness. In the event that a student cannot take an exam on the day it is held, the student needs to contact the instructor in advance.

Final grade. The final grade for the course will be calculated as a weighted average of the assignment and exam grades with the following relative weights: homework (40%), midterm (20%) and final exam (40%).

7 Dissemination of Course Material

The materials provided by the instructor in this course are for **the use of the students enrolled in the course only**. Course materials and course recordings (if permission was warranted) may not be further disseminated without instructor permission. This includes sharing content to commercial course material suppliers or public domain platforms. Students are also prohibited from sharing materials derived from the instructor's content (e.g., a student's lecture notes).

8 Recording of Class

Students may not record all or part of class, livestream all or part of class, or make/distribute screen captures, without advanced written consent of the instructor. If you have or think you may have a disability such that you need to record class-related activities, please contact the Justin Dart, Jr. Student Accessibility Center. If you have an accommodation to record class-related activities, those recordings may not be shared with any other student, whether in this course or not, or with any other person or on any other platform. Classes may be recorded by the instructor. Students may use instructor's recordings for their own studying and notetaking. Instructor's recordings are not authorized to be shared with anyone without the prior written approval of the instructor. Failure to comply with requirements regarding recordings will result in a disciplinary referral to the Dean of Students Office and may result in disciplinary action.

9 Academic Honesty/Honor Code

High ethical standards are critical to the integrity of any institution, and bear directly on the ultimate value of conferred degrees. All UH community members are expected to contribute to an atmosphere of the highest possible ethical standards. Maintaining such an atmosphere requires that any instances of academic dishonesty be recognized and addressed. The UH Academic Honesty Policy is designed to handle those instances with fairness to all parties involved: the students, the instructors, and the University itself. All students and faculty of the University of Houston are responsible for being familiar with this policy.

10 Excused Absence Policy

Regular class attendance, participation, and engagement in coursework are important contributors to student success. Absences may be excused as provided in the University of Houston Undergraduate Excused Absence Policy and Graduate Excused Absence Policy for reasons including: medical illness of student or close relative, death of a close family member, legal or government proceeding that a student is obligated to attend, recognized professional and educational activities where the student is presenting, and University-sponsored activity or athletic competition. Under these policies, students with excused absences will be provided with an opportunity to make up any quiz, exam or other work that contributes to the course grade or a satisfactory alternative. Please read the full policy for details regarding reasons for excused absences, the approval process, and extended absences. Additional policies address absences related to military service, religious holy days, pregnancy and related conditions, and disability.

11 Reasonable Academic Adjustments/Auxiliary Aids

The University of Houston is committed to providing an academic environment and educational programs that are accessible for its students. Any student with a disability who is experiencing barriers to learning, assessment or participation is encouraged to contact the Justin Dart, Jr. Student Accessibility Center (Dart Center) to learn more about academic accommodations and support that may be available to them. Students seeking academic accommodations will need to register with the Dart Center as soon as possible to ensure timely implementation of approved accommodations. Please contact the Dart Center by visiting the website: <https://uh.edu/accessibility/calling> (713) 743-5400, or emailing jdcen@central.uh.edu.

The Student Health Center offers a Psychiatry Clinic for enrolled UH students. Call 713-743-5149 during clinic hours, Monday through Friday 8 a.m. - 4:30 p.m. to schedule an appointment.

The A.D. Bruce Religion Center offers spiritual support and a variety of programs centered on well-being.

The Center for Student Advocacy and Community (CSAC) is where you can go if you need help but don't know where to start. CSAC is a "home away from home" and serves as a resource hub to help you get the resources needed to support academic and personal success. Through our Cougar Cupboard, all students can get up to 30 lbs of FREE groceries a week. Additionally, we provide 1:1 appointments to get you connected to on- and off-campus resources related to essential needs, safety and advocacy, and more. The Cougar Closet is a registered student organization advised by our office and offers free clothes to students so that all Coogs can feel good in their fit. We also host a series of cultural and community-based events that fosters social connection and helps the cougar community come closer together. Visit the CSAC homepage or follow us on Instagram: @uh\$_\$CSAC and @uhcupbrd. YOU belong here.

12 Women and Gender Resource Center

The mission of the WGRC is to advance the University of Houston and promote the success of all students, faculty, and staff through educating, empowering, and supporting the UH community. The WGRC suite is open to you. Stop by the office for a study space, to take a break, grab a snack, or check out one of the WGRC programs or resources. Stop by Student Center South room B12 (Basement floor near Starbucks and down the hall from Creation Station) from 9 am to 5 pm Monday through Friday.

13 Mental Health and Wellness Resources

The University of Houston has a number of resources to support students' mental health and overall wellness, including CoogsCARE and the UH Go App. UH Counseling and Psychological Services (CAPS) offers 24/7 mental health support for all students, addressing various concerns like stress, college adjustment and sadness. CAPS provides individual and couples counseling, group therapy, workshops and connections to other support services on and off-campus. For assistance visit uh.edu/caps, call 713-743-5454, or visit a Let's Talk location in-person or virtually. Let's Talk are daily, informal confidential consultations with CAPS therapists where no appointment or paperwork is needed.

Need Support Now?

If you or someone you know is struggling or in crisis, help is available. Call CAPS crisis support 24/7 at 713-743-5454, or the National Suicide and Crisis Lifeline: call or text 988, or chat 988lifeline.org.

14 Religious holidays

Students whose religious beliefs prohibit class attendance or the completion of specific assignments on designated dates may obtain an excused absence. To do so, please make a written request for an excused absence and submit it to your instructor as soon as possible, to allow the instructor to make arrangements. For more information, see the Student Handbook (<http://catalog.uh.edu/index.php>).

15 Title IX/Sexual Misconduct

Per the UHS Sexual Misconduct Policy, your instructor is a "responsible employee" for reporting purposes under Title IX regulations and state law and must report incidents of sexual misconduct (sexual harassment, non-consensual sexual contact, sexual assault, sexual exploitation, sexual intimidation, intimate partner violence, or stalking) about which they become aware to the Title IX office. Please know there are places on campus where you can make a report in confidence. You can find more information about resources on the Title IX website at <https://uh.edu/equal-opportunity/title-ix-sexual-misconduct/resources/>.

16 Security Escorts and Cougar Ride

UHPD continually works with the University community to make the campus a safe place to learn, work, and live. The security escort service is designed for the community members who have safety concerns and would like to have a Security Officer walk with them, for their safety, as they make their way across campus. Based on availability either a UHPD Security Officer or Police Officer will escort students, faculty, and staff to locations beginning and ending on campus. If you feel that you need a Security Officer to walk with you for your safety, please call 713-743-3333. Arrangements may be made for special needs

Parking and Transportation Services also offers a late-night, on-demand shuttle service called Cougar Ride that provides rides to and from all on-campus shuttle stops, as well as the MD Anderson Library, Cougar Village/Moody Towers and the UH Technology Bridge. Rides can be requested through the UH Go app. Days and hours of operation can be found at <https://uh.edu/parking/cougar-ride/>.