

**Special Problems: Advanced Topics in Continuous Optimization**  
EIN 6905 Section 841D

***Class Periods and Locations:***

Tuesdays: 11:45 am — 1:40 pm @ WEIM 1092  
Thursdays: 11:45 am — 12:35pm @ WEIM 1070

***Academic Term:*** Spring 2023.

***Instructor:***

*Name:* Hongcheng Liu  
*Email Address:* liu.h@ufl.edu  
*Office Phone Number:* 352-294-7728  
*Office Hours:* Wednesday, 10:40 AM – 11:40 AM (The time may be subject to modifications later). Via zoom. Extra and one-on-one meetings are available by appointment.

***Teaching Assistants:***

NA

***Course Description (3 Credits)***

The course is focused on continuous optimization theories. The analyses of several classical techniques under different oracle assumptions will be discussed.

***Course Pre-Requisites / Co-Requisites***

ESI6417 or ESI6420 or permission by Instructor. This course assumes a student to have a reasonable knowledge of linear algebra, linear programming, and optimization models and algorithms.

***Course Objectives***

After the completion of this course, the students are anticipated to be able to (1) explain the basic theoretical underpinnings for the convergence analysis of several mainstream optimization techniques, (2) examine basic complexity of optimization algorithms, and (3) recognize the ongoing research topics and open problems in continuous optimization.

***Required Textbooks and Software***

Materials or lecture notes to be provided by the instructor.

***Recommended Materials***

- A. Ben-Tal, A. and Nemirovski, A., 2001. *Lectures on modern convex optimization: analysis, algorithms, and engineering applications*. Society for industrial and applied mathematics.
- B. Polyak, R., 2021. *Introduction to Continuous Optimization*. Springer. ISBN: 978-3-030-68713-7
- C. Nesterov, Y., 2018. *Lectures on convex optimization* (Vol. 137). Cham: Springer.
- D. Shapiro, D. Dentcheva, A. Ruszczyński, *Lectures on Stochastic Programming: Modeling and Theory*. 2009. ISBN 978-0-898716-87-0
- E. Additional material in lecture notes to be provided.

## Course Schedule

	Topics
Weeks 1-2	Preliminaries; General settings of continuous optimization and complexity analysis; General introductions to continuous optimization algorithms.
Weeks 3-5	Analysis of several first-order methods in deterministic continuous optimization; Nesterov's optimal method; ADAM-type first-order methods in deep learning.
Week 6-9	Analysis of several first-order methods in stochastic continuous optimization: Stochastic gradient descent, Mirror Descent, Spider
Weeks 10-11	Several zeroth-order optimization algorithms and their complexity results; Dimension-insensitive variations of zeroth-order algorithms in data science
Weeks 12-13	Analysis of second-order interior-point methods
Week 14-15	Sample complexity in several data-driven optimization schemes; deep learning from the lens of data-driven optimization
Final week	Final Exam (Take-home)

The course schedule may be subject to change in accordance with the pace of the course and the interest of the students.

### **Attendance Policy, Class Expectations, and Make-Up Policy**

Attendance is encouraged. You are expected to be aware of all announcements made in class and know all previously covered material when you attend the class.

In general, there will be no makeup exams or assignments given. However, a student is permitted to make up a missed exam/quiz without penalty if he/she has a conflict between an exam/quiz and a scheduled University approved activity. A student needing a make-up exam or assignment due to schedule conflicts must notify the instructor at least *one week* before the day the exam or assignment is scheduled. Excused absences are consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

### **Flipped classroom sessions**

"Flipped" classroom sessions will be held throughout the course. For each of the sessions, the instructor will select one proof problem for one student group (assigned by the instructor) to explain to the class. One student (assigned by the instructor) from the group will make a short presentation and address questions, if any, from both the instructor and students. It is recommended that the presentation be made through Zoom virtually to make sure that students using all modes to take this course can take part in the discussions easily. The presentations may be recorded.

The grading rubrics are as below:

- **40% points:** The selected student from the group has made clear effort to understand the assigned problem. The group is able to complete the whole explanation, despite some major mistakes or errors. Efforts are made to answer all the questions raised by the instructor.
- **60% points:** The selected student from the group understand 80% or more of the problem and the proof. The group is able to complete the whole explanation, despite some mistakes or errors caused by common misconceptions. The logic of the explanation should be correct, if misconceptions were assumed correct. Clear efforts are made to answer all the questions raised by the instructor.
- **75% point:** The selected student from the group can fully understand the proof, but some part of the explanation is unclear, despite that efforts are made to meet the time requirement. The students can answer correctly most of the questions raised by the instructor.
- **90% points:** The selected student from the group can explain the assigned mathematical proof successfully. The students can answer correctly all the questions raised by the instructor.
- **100% points:** The selected student from the group can successfully explain the assigned mathematical proof within the given time limit. The students can answer all the questions raised by the instructor.

### **Exams**

There will be a final, take-home exam. The exact date of the midterm will be communicated later.

### **Evaluation of Grades**

<b>Assignment</b>	<b>Total Points</b>	<b>Percentage of Final Grade</b>
Classroom discussions (See the section for “Flipped classroom sessions” for detail)	100	50%
Final Exam (Take-home)	100	50%
Total		100%

### **Grading Policy**

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 – 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 – 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00

60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

Exam/Homework grade disputes/inquiries must be made to the instructor within one week after grades are posted. Any grade dispute/inquiry after the specified period will not be considered.

More information on UF grading policy may be found at:  
<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>  
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### ***Students Requiring Accommodations***

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.ua.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-results/>.

### ***In-Class Recording***

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### **University Honesty Policy**

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### **Commitment to a Safe and Inclusive Learning Environment**

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### **Software Use**

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### **Student Privacy**

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

### **Campus Resources:**

#### **Health and Wellness**

#### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

**Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

**Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

**Career Connections Center**, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

**Writing Studio**, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

**On-Line Students Complaints:** <https://distance.ufl.edu/state-authorization-status/#student-complaint>.