SYLLABUS

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COURSE OVERVIEW

COURSE DESCRIPTION

Math 210 introduces students to the tools of linear algebra and optimization, including solving linear systems, matrices as linear transformations, eigenvalues and eigenvectors, approximations, derivatives, and optimization in multiple dimensions. This course emphasizes multidimensional thinking and applications to data science. Python will be used as a computational tool.

TARGET AUDIENCE

This course is intended for data science minors and for students who want to learn linear algebra and optimization techniques for application to economics or other quantitative fields. Students who have already taken Math 347 or
Math 577 should not take this class due to the substantial overlap.

PREREQUISITES

Students are expected to be proficient working with functions and their graphs, manipulating variable expressions, and solving equations using algebra, as demonstrated by Math 110 or Math 110P credit.

COURSE GOALS

Content specific

This course will enable students to:

1. Perform operations on matrices
2. Use matrices to solve problems
3. Describe how matrices are used to simplify data and compress images
4. Calculate and interpret derivatives
5. Use derivatives to maximize or minimize quantities and to train neural networks

General Education Quantitative Reasoning Learning Outcomes

As part of the General Education curriculum Quantitative Reasoning focus capacity, this course will enable students to comprehend and apply mathematical concepts in authentic contexts, developing tools for reasoning with data, logic, and quantitative methods.

Questions for Students

1. What is the role of mathematics in organizing and interpreting measurements of the world?
2. How can mathematical models and quantitative analysis be used to summarize or synthesize data into knowledge and predictions?
3. What methodology can we apply to validate or reject mathematical models or to express our degree of confidence in them?

Quantitative Reasoning Learning Outcomes

1. Summarize, interpret, and present quantitative data in mathematical forms, such as graphs, diagrams, tables, or
mathematical text.

2. Develop or compute representations of data using mathematical forms or equations as models, and use statistical methods to assess their validity.

3. Make and evaluate important assumptions in the estimation, modeling, and analysis of data, and recognize the limitations of the results.

4. Apply mathematical concepts, data, procedures, and solutions to make judgments and draw conclusions.

5. Synthesize and present quantitative data to others to explain findings or to provide quantitative evidence in support of a position.

Recurring Capacities

Math 210 will sustain the recurring capacities of inquiry that guide the general education mission as follows:

1. Pose problems and questions that require systematic thinking about evidence, argument and uncertainty

2. Consider its content in the context of human difference between and within societies; the full range of legitimate debate in its field; and/or change over time

3. Require
   a. Writing totaling at least 10 pages in length, or the intellectual equivalent.
   b. Presenting material to the class, small groups, or the public through oral presentations, webpages, or other means that enable corroboration of fact and argument.
   c. Collaborating in pairs or groups to learn, design, solve, create, build, research or similar.

COURSE TOPICS

This list is tentative and may be changed. Any changes will be announced in class and posted on Sakai.

1. Systems of linear equations and matrices
2. Elementary row operations and Gaussian elimination
3. Existence and uniqueness of solutions
4. Matrix operations (addition, scalar multiplication, multiplication)
5. Vectors
6. Solving matrix equations
7. Inverses of matrices
8. Transpose, trace, and determinant
9. Eigenvalues and eigenvectors
10. Diagonalizing matrices
11. Dot product and orthogonality
12. Symmetric matrices
13. Linear independence
14. Gram-Schmidt orthogonalization
15. Singular value decomposition
16. Derivatives
17. Optimization
18. Partial derivatives
19. Gradient and gradient descent
20. Neural networks

**COURSE STRUCTURE**

Class meets three hours per week MWF 11:15 - 12:05 in Phillips 385. Class activities will include interactive lecture and problem solving in small groups.

Students are expected to prepare for each class by watching short video(s) and completing before class assignments. Homework assignments will be due three times a week. There will be three midterms and a final exam.

**INSTRUCTOR**

Linda Green, greenl@email.unc.edu
MATERIALS

TEXTBOOKS

We will use the following textbooks:


PIAZZA

Instead of emailing the instructor with questions about homework problems or logistics, please post your questions on Piazza. Other students, instructors, and TAs can answer them there for the benefit of all students. If you were not automatically added to Piazza, you can register yourself here: piazza.com/unc/fall2021/math210. There is no charge for using Piazza.

EDFINITY

Most homework and before class assignments will be on Edfinity. Please make an account as follows:

1. If you already have an Edfinity account from a previous course, please sign into it. Otherwise, go to step 2.
2. Go to the following registration link: https://edfinity.com/join/PC8YHULV
3. You will be prompted to pay~$30 and enroll in our section.

GRADESCOPE

Tests and possibly some homework assignments will be graded via Gradescope. If you were not automatically added, you can enroll yourself at gradescope.com using the entry code ER2GBY. Please use your UNC email. There is no charge for using Gradescope.

https://sakai.unc.edu/portal/tool/b4dfe117-3baa-499e-a692-1031fdcabf33
We will use Google Colab notebooks with Python to supplement by-hand computations. Colab is free and integrated with Google docs. You may need a gmail account to use it. No prior experience with Colab, Python, or any other programming language is expected.

Colab documents from class will be available at tinyurl.com/math210unc

In the event that we need to hold class via Zoom, the following Zoom meeting id will be used: 978 7642 5285 (or go to https://unc.zoom.us/j/97876425285). Please log in via SSO to avoid the waiting room.

The following components of this course will contribute to your grade.

Before Class Assignments
For most classes, there is a before class assignment on Edfinity, due at the start of class on Mondays, Wednesdays, and Fridays. Instructions on what to do before class are posted on Sakai under that class date. Your lowest two before class assignment grades will be dropped.

Homework
Most homework assignments will be on Edfinity. There may be additional "written" homework assignments on Gradescope. Homework will be due three times a week: on Sundays, Tuesdays and Thursdays at 11:59 pm. Normally, assignments on topics discussed in class on Monday will be due on Thursdays, topics discussed on Wednesday will be due on Sundays, and topics discussed on Fridays will be due on Tuesdays. Occasionally, more than one assignment may be due on the same day. Due dates can be found on Edfinity and on Gradescope.

Your lowest homework score will be dropped if at least 80% of students complete the mid-semester survey and a second lowest homework will be dropped if at least 80% complete the end of semester course evaluation.
There will be three tests given in class. Your lowest test grade will be replaced by your final exam grade, if your final exam grade is higher.

Tentative test dates are as follows:

- Test 1: 9/17/2021
- Test 2: 10/13/2021
- Test 3: 11/08/2021

**PARTICIPATION**

Participation in class will be graded as follows: 2 points if you came to class and participated, 1 point if you came but did not participate or only came part of the time. Your lowest 6 scores will be dropped.

**FINAL EXAM**

The cumulative final exam will be on Friday, Dec 10 from 12:00 - 3:00 pm in accordance with UNC's final exam schedule. The final exam is given in compliance with UNC’s final exam regulations and calendar, and will not be given prior to this exam date. In order to take the make-up exam after this date, you must have an official examination excuse from the Dean or authorized agent of the Dean (in Steele Building).

**GRADING**

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<thead>
<tr>
<th>Assignment</th>
<th>Percentage of Final Grade</th>
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<tbody>
<tr>
<td>Homework</td>
<td>12%</td>
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<tr>
<td>Before Class Assignments</td>
<td>3%</td>
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<tr>
<td>Participation</td>
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</tr>
<tr>
<td>Tests Assignment</td>
<td>45%</td>
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https://sakai.unc.edu/portal/tool/b4dfe117-3baa-499e-a692-1031f0ca6b33
## Final Exam
<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93–100%</td>
</tr>
<tr>
<td>A-</td>
<td>90–92%</td>
</tr>
<tr>
<td>B+</td>
<td>87–89%</td>
</tr>
<tr>
<td>B</td>
<td>83–86%</td>
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<tr>
<td>B-</td>
<td>80–82%</td>
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<tr>
<td>C+</td>
<td>77–79%</td>
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<tr>
<td>C</td>
<td>73–76%</td>
</tr>
<tr>
<td>C-</td>
<td>70–72%</td>
</tr>
<tr>
<td>D+</td>
<td>67–69%</td>
</tr>
<tr>
<td>D</td>
<td>60–66%</td>
</tr>
<tr>
<td>F</td>
<td>0–59%</td>
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</tbody>
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COURSE POLICIES

COMMUNICATION

Please post questions about homework and class logistics on Piazza.

If you have a private question, specific to your individual circumstances, you can post privately on Piazza or send the instructor an email. If the instructor does not respond to an email or private message within 48 hours, please send a second message.

If you need to have a private conversation, not appropriate for a public office hours setting, please book an appointment via lindagreenunc.youcanbook.me.

ILLNESS

Please do not attend class in person if you are sick, think you might be sick, or have been in contact with someone who is sick. On request, the instructor will broadcast the class over zoom so that you can attend remotely and/or record it so that you can see what you missed.

The following are University Approved Absences:

- Authorized University activities
- Disability/religious observance/pregnancy, as required by law and approved by Accessibility Resources and Service and/or the Equal Opportunity and Compliance Office (EOC)
- Significant health condition and/or personal/family emergency as approved by the Office of the Dean of Students, Gender Violence Service Coordinators, and/or the Equal Opportunity and Compliance Office (EOC).

LATE WORK AND MAKE-UP WORK

No make-up tests will be given. Tests can be given early if the student will be absent for university athletics, an academic field trip, or a religious holiday and makes prior arrangements with written documentation at least a week in advance. Exceptions may be made in extreme circumstances with intervention from the Dean of Students. The lowest test score will be replaced by the final exam score, so one missed test will not affect your grade.

Homework on Edfinity will be accepted up to a week late for a 25% penalty. Homework assignments on Gradescope...
may be accepted late for a 25% penalty, but only if solutions have not yet been posted.

Attendance points cannot be made up but the lowest 6 attendance scores will be dropped.

HONOR CODE

It is expected that each student in this class will conduct themself within the guidelines of the UNC Honor System, described at http://studentconduct.unc.edu/students.

On homework, before class assignments, and in-class worksheets, students are encouraged to work together in pairs or small groups, provided that all participants are contributing and the collaboration benefits the learning of all involved. Simply copying or trading answers is an instance of cheating. Homework are open book and open notes, and calculators and computer apps are permitted.

Tests and the final exam are closed book and closed notes unless otherwise specified. Calculators are permitted unless otherwise specified. It is an instance of cheating to give or receive help on a test or exam, except from the instructor. In particular, it is a violation of the honor code to post test questions on the internet or access questions that others have posted, or to get help from online problem solving services, whether computerized (e.g. Wolfram Alpha) or staffed by live humans (e.g. Chegg).

If you are not sure what is permitted on any assignment, please ask!

In addition to avoiding actual academic dishonesty, please avoid appearances of academic dishonesty. In particular, please silence and put away cell phones before any exams are handed out, please avoid the appearance of looking at other students’ papers, please avoid accessing any internet sites that are not specifically permitted during online assessments. In order to maintain a proper testing atmosphere, the instructor may ask students to switch seats before or during an in-person exam and the instructor will proctor students taking online assessments via Zoom or using other online proctoring tools.

Students who take assessments online are responsible for establishing a proper testing environment in their location. This includes silencing and putting away all cell phones and other devices not permitted for the assessment, closing all laptop apps and browser windows that are not required for the assessment, putting away all books and notes, and securing a quiet space free from interruptions.

Students who observe a violation of the honor code should report it to the instructor. The instructor will report any
suspected honor code violations to the Honor Court.

CAMPUS-WIDE POLICIES AND RESOURCES

Additional information on campus-wide policies and resources are available [here](https://sakai.unc.edu/portal/tool/b4dfe117-3baa-499e-a692-1031fdcabf33), including info on

- Attendance Policy
- Honor Code
- Mask use
- Acceptable use (ITS and technology)
- Accessibility Resources
- Counseling and Psychological Services (CAPS)
- Title IX
- Non-discrimination
- Diversity
- Undergraduate Testing Center
- Learning Center
- Writing Center
- Grade Appeals

HELP

There are several ways to get help for this class.

OFFICE HOURS

- Linda Green's office hours:
  - Priority office hours for Math 210 students: F 12:15 - 1:15 (in Phillips 338)
  - Priority office hours for Math 233 or Math 115 students, but Math 210 students are welcome:
    - M, Tu 4:00 – 5:00 (online at [https://unc.zoom.us/my/lindagreenunc or Zoom meeting number 349 299 9188](https://unc.zoom.us/my/lindagreenunc or Zoom meeting number 349 299 9188))
    - W, Th 3:00 – 4:00 (in Phillips 338)
- Check Piazza for updates.
TUTORING

- The math department offers free tutoring at the Math Help Center, at least 5 days a week.
- The Learning Center sponsors free drop-in Peer Tutoring on Tuesday, Wednesday, and Thursday evenings from 6 - 8 pm. Additional information is here: https://learningcenter.unc.edu/drop-in-peer-tutoring/.
- The Learning Center also has tutoring by appointment, Sunday through Friday. Students can make peer tutoring appointments by going to https://success.oasis.unc.edu.
- The math department maintains a tutor list of math grad students offering paid private tutoring.

ACADEMIC COACHES

- The Learning Center has two math coaches, Gonzalo and Jackie, who can give you tips on how to study for and succeed in a math class. Students can make academic coaching appointments by going to https://success.oasis.unc.edu

QUESTIONS ABOUT THE COURSE?

Post on Piazza! Please make it public so that other students can benefit. Anonymous posts are fine.

If you have a private concern, please make a private post on Piazza to the instructor only, or email the instructor directly: greenl@email.unc.edu.

QUESTIONS ABOUT TECHNOLOGY?

Contact the ITS Service Desk:

- Phone (919) 962-HELP (4357)
- Chat: https://help.unc.edu/
- Online Help Request