Math 221Q - Linear Algebra

Course Information

Instructor and Course Information

Instructor: Nicolas Petit, Pierce Hall 126
E-mail: nicolas.petit@emory.edu
Meeting times: MWThF 1:00-1:50 AM, Seney 208
Tentative Office Hours:
Mo 4-6 PM (in the math center), W 10-11:30 AM
Th 3-5 PM (in the math center), F 2-3 PM
and by appointment.

Course Goals

Math 221 is centered around linear algebra, a basic tool needed to understand the world that surrounds us. We will balance two approaches in the course, one that focuses on computations in the matrix algebra and its applications to real life (e.g. Google's Pagerank algorithm or Principal Component Analysis) and one that centers around the mathematical theory of vector spaces and clear, concise proofwriting.

Textbook

H. Anton and C. Rorres, *Elementary Linear Algebra, Applications Version*, 11th edition.

Grades

The grades in the course will be calculated as follows

Class Participation	75 points
Homework	75 points
Quizzes	150 points
In-class midterms (2×75)	150 points
Take-home midterms (2×75)	150 points
End-of-term Project	200 points
In-class Final Exam	200 points
TOTAL	1000 points

Letter grades will be determined based on the total points each student earns: A: at least 900 points; B: 800-899 points; C: 700-799 points; D: 600-699 points; F: fewer than 600 points. Plus and minus grades will be assigned for sums of points near cut-off values.

Participation

The class is student-based and inquiry-driven (essentially, flipped), so your attendance and active participation are essential. Being absent, inattentive or inactive in the classroom will hurt your participation grade. For clarity's sake, "being inattentive" also covers excessive phone use/reviewing other material during class time/not engaging in group work/etc. Two latenesses make one absence; note that class starts at $1:00$ PM exactly, with the Seney bell being the cutoff. Every students gets two "freebies", so you will not lose participation points for the first two absences/inattentive days.

The amount of effort and participation you put in the course is the most important factor in achieving the success you desire in the class; never forget that.

Homework Assignments

Homework will be assigned daily. The main part of your homework will be to read the material we'll cover in the next class, including examples and proofs, with the help of reading guides that highlight the most important definitions to remember, what examples to focus on, and so forth. You are required to do so ahead of class, so we can use class time to answer any questions you might have and help you develop your computational and proofwriting skills, rather than have you mindlessly copy statements from the board without reflecting on them. Every section will have a discussion page associated to it on Canvas, where you're free to post any questions you might have, or any useful resources you found online; besides helping to guide the in-class discussion, consistent participation in the discussion pages by asking or answering questions will grant you up to four extra "freebies" for your participation grade.

The remaining homework consists of a list of exercises from the book, split between computations and proofs. While the reading is typically to be done before class, homework should be done AFTER class; you're free to start working on it as you're doing the reading (and it can be really helpful), but we'll use class time to explore some of the more complicated ideas of the topic, and the homework will typically reflect those. Unless otherwise stated, homework sets should be done before the next class meeting; you are expected to keep a somewhat neat version of the homework solutions in your notebook.

Randomly throughout the term homework sets will be collected, your solutions will be skimmed through and feedback will be given, especially on the structure and language of the proofs. If you attempted almost all the assigned problems and you put effort in the solutions, your work will be considered "satisfactory"; if most of the homework is missing, or you have an unexcused absence the day that homework is collected, your grade will be marked "unsatisfactory". You can make up an "unsatisfactory" grade by fixing it by the next time the homework is collected; every "unsatisfactory" grade you get will cost you a fixed percentage of the 75 available points. A "complete" (i.e. without the proofs) homework solutions manual is available in the library reserves, and solutions to the proof questions will be regularly posted on Canvas. You are strongly discouraged from checking the solutions manual for homework you haven't attempted yet.

Quizzes

To test whether you're keeping up with the readings, there will be regular 5-minute reading quizzes at the beginning of class. These will typically focus on simple, quick computations, or a definition or two; you should expect these to happen basically every day, so you typically will not be warned ahead of time. The amount of points each quiz has might slightly vary, depending on length and difficulty; your total quiz score will be scaled to 150 points at the end of the term.

Exams

There will be two exams during the term. Both of these will include an in-class portion (during regular class time) as well as a take-home portion. The in-class portions will mostly focus on computations, while the take-home portions will have more long-winded, in-depth problems, and a focus on proofs. Please note that you will be expected to keep up with regular work while the take-home exam is assigned (reading, homework, etc). We will also have an in-class final exam, which the registrar set for December 17, 9 AM-12 PM. The in-class exams will be closed book, while the take-home exams will (likely) be open book, and in all of them collaboration is not allowed; read carefully the instructions when taking an exam, and if you have any questions don't hesitate to ask.

Final project

As part of your final grade you will be asked to work on a final project in small groups (3-5 people). The list of possible topics will be posted after the first few weeks of class; these cover a wide range of applications, so there should be something of interest for everyone. Note that every group must pick a different topic. You will be required to pick your group by fall break, and let me know your choice of topic; you are free to

form the groups however you want, but there should be no less than five groups and no more than seven or eight, and I reserve the right to rearrange the groups in the early stages. The topic can be changed in the early stages, but should be finalized by the second midterm (end of October). The goal is for each group to give a 10-15 minute presentation at the end of the term, presenting the topic concisely to the rest of the class. You should favor big ideas, examples and important theorem statements over proofs and minutiae. You will also be required to submit an individual contribution to the project (which we'll have agreed upon ahead of time) as well as a short essay reflecting on your experience on the project and the group dynamic.

The final project grade will split into a team grade (80 points) and an individual grade (120 points). The team grade will focus on the presentation, where you'll be evaluated for overall presentation, ability to summarize the project and ability to answer questions from the audience. The individual grade will be based off of your individual contribution (code you wrote for the project/homework problems on the topic/summary of results/other), the reflection on your experience and the group dynamic.

Inclusivity

Students with a documented disability who anticipate barriers related to the format or requirements of this course, or presume to have a disability (e.g. mental health, attention, learning, vision, hearing, physical or systemic) and are in need of accommodations this semester should contact the Office of Accessibility Services (OAS) as soon as possible to learn more about the registration process and steps for requesting accommodations.

Students who are currently registered with OAS who do not receive an accommodation notification letter within the first week of class must notify OAS immediately by emailing `adsroxford@emory.edu`. Students who have accommodations in place are encouraged to coordinate a face to face meetings with the instructor to communicate specific needs for the course as it relates to approved accommodations. All discussions with OAS and faculty members concerning the nature of a student's disability remain confidential. For additional information regarding OAS and how to register, please visit the website: `equityandinclusion.emory.edu/access`.

Religious Observances

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please meet with me as soon as possible to discuss appropriate accommodations.

Academic Honesty

In-class exams will be closed book, take-home exams will (likely) be open book. More details on what resources you can access for the take-home exams will be detailed on the exam itself. Calculators will generally not be allowed in the course. You are allowed (encouraged, in fact) to collaborate on homework, but the solutions you turn in must be written in your own words. We have a complete solutions manual on reserve in the library; naturally you can only consult the problems that have already been graded. In particular, this means you are not allowed to copy proofs from the internet.

THE HONOR CODE OF OXFORD COLLEGE APPLIES TO ALL WORK SUBMITTED FOR CREDIT IN THIS COURSE. BY SUBMITTING SUCH WORK, YOU PLEDGE THAT WORK WAS DONE IN ACCORDANCE WITH THE RULES STIPULATED ON THE ASSIGNMENT AND IN THIS SYLLABUS.

TENTATIVE SYLLABUS BY DAY
Math 221Q, Fall 2018

Monday	Tuesday	Wednesday	Thursday	Friday
Aug 27th	28th	29th **1** Introduction to the course	30th **2** Linear Systems (1.1)	31st **3** Gaussian Elimination I (1.2)
Sep 3rd No Class (Labor Day Holiday) *Drop/Add Ends on Sep 5*	4th	5th **4** Matrix Operations (1.3)	6th **5** Gaussian Elimination II (1.2)	7th **6** Algebraic Properties of matrices (1.4)
10th **7** Inverses and elementary matrices (1.4, 1.5)	11th	12th **8** Properties of inverses; special matrix shapes (1.6, 1.7)	13th **9** Matrix transformations (1.8)	14th **10** Application: the Leontief I/O model (1.10)
17th **11** Determinants via cofactors and row-reduction(2.1, 2.2)	18th	19th **12** Properties of determinants and Cramer's rule (2.3)	20th **13** Vectors (3.1, 3.2)	21st **14** The geometry of linear systems (3.4)
24th **15** General vector spaces I (4.1)	25th	26th **16** General vector spaces II (4.1)	27th **17** Review session	28th **18** In-class midterm, take-home assigned
Oct 1st **19** Subspaces I (4.2)	2nd	3rd **20** Subspaces II (4.2); Take-home due	4th **21** Linear Independence (4.3)	5th **22** Bases and coordinates (4.4)
8th No Class (Fall Break)	9th	10th **23** Dimension (4.5)	11th **24** Change of basis (4.6)	12th **25** Fundamental spaces of a matrix (4.7)
15th **26** Rank and Nullity (4.8)	16th	17th **27** Transformations in $\mathbb{R}^2, \mathbb{R}^3$ (4.9)	18th **28** Properties of transformations (4.10)	19th **29** Application: geometry of transformations (4.11)

Monday	Tuesday	Wednesday	Thursday	Friday
22nd **30** Eigenvalues and eigenvectors (5.1)	23rd	24th **31** Diagonalization I (5.2)	25th **32** Diagonalization II (5.2)	26th **33** Application: Markov chains (5.5)
29th **34** Review session; TAKE-HOME ASSIGNED	30th	31st **35** IN-CLASS MIDTERM	Nov 1st **36** General linear transformations (8.1); TAKE-HOME DUE	2nd **37** General linear transformations II (8.1)
5th **38** Composition and inverses (8.2)	6th	7th **39** Isomorphisms (8.3)	8th **40** Matrices for linear transformations (8.4)	9th **41** Similarity (8.5)
12th **42** Inner products (6.1)	13th	14th **43** Orthogonality (6.2)	15th **44** Gram-Schmidt I (6.3)	16th **45** Gram-Schmidt II (6.3)
19th **46** Orthogonal matrices and orthogonal diagonalization (7.1, 7.2)	20th	21st NO CLASS (Thanksgiving Recess)	22nd NO CLASS (Thanksgiving Recess)	23rd NO CLASS (Thanksgiving Recess)
26th **47** Extra topics	27th	28th **48** Extra topics	29th **49** Extra topics	30th **50** Extra topics
Dec 3rd **51** Extra topics	4th	5th **52** Extra topics	6th **53** Presentations	7th **54** Presentations
10th **55** Final review	11th	12th Reading Day	13th	14th