Yale University Department of Mathematics  
Math 225 Linear Algebra and Matrix Theory Fall 2017  
Course Syllabus  

Hours: Tuesday and Thursday 09:00 - 10:15 am  
Location: LOM 200  

Instructor  
Prof. Arie Levit  
Email: arie.levit@yale.edu  
Office: LOM 211C, Office hours: Tuesday and Thursday 10:15 - 11:15 am  

Teaching Assistant  
Pratyush Sarkar  
Email: pratyush.sarkar@yale.edu  
Discussion sessions hours: Tue 17:00-18:00 pm LOM 201 and Thu 17:00-18:00 pm LOM 202  
Office hours: Wednesday 12 noon, location: DL 415  

Peer Tutor  
Charles Kenny  
Email: charles.kenney@yale.edu  
Office hours and location: Sunday 19:00 - 21:00 in DL 432 and Monday 16:00 - 18:00 pm in Math common room  

Prerequisites  
The formal prerequisite is Math 120, taken either earlier or concurrently. In practice, there are very little actual prerequisites, and we will do our best to introduce all of the necessary material either in class or in the discussion session.  

Goal  
Math 225 has two main goals. The first is the acquire a theoretic understanding of the notions and ideas of linear algebra, aimed towards mathematics and applications in other sciences. The second is to become acquainted with mathematical rigorous thinking, language, writing style and proof techniques.  

Course material  
Linear algebra is one of the most fundamental and classical disciplines of mathematics. It studies abstract objects called vector spaces. A vector space consists of vectors organized in a linear structure. Other important objects in this discipline are the linear transformations. These describe a certain mapping or relationship between two different vector spaces.  
It is hard to overestimate the importance of this theory in almost all other fields of mathematics, science and engineering. Vector spaces and linear transformations are used to state
laws of physics (e.g. in quantum mechanics), model various natural processes, solve systems of linear equations and design computer algorithms.

Towards the end of the course we will also encounter eigenvalues and eigenvectors as well as inner-product spaces. This will lead toward some basic spectral theory which is extremely useful in exact sciences and engineering.

Mathematical notions that will be discussed in this course include:

- Vector spaces, subspaces.
- Span, linear dependence, basis, dimension.
- Linear transformations, image and kernel, isomorphisms.
- Coordinate representation of a vector, matrix representation of a transformation.
- Determinant, singular and regular matrices.
- Systems of linear equations, homogenous vs. inhomogenous equations.
- Eigenvalues and eigenvectors, diagonalization, the characteristic polynomial.
- Inner product spaces, orthonormal basis, Gram-Schmidt process.
- Orthogonal transformations, the Spectral Theorem.
- If time permits: Quadratic forms over the real and complex numbers.
- If time permits: Theory of affine spaces.

Textbook

There are plenty of good textbooks in linear algebra. Our course is loosely based on the following book


Reading material and exercises will be assigned from this book (referred to as FIS).

Assignments

Problem sets will be assigned each Tuesday, and due in class on Tuesday the week after. *Late submission will not be accepted.*

You may work with other students and consult books and the course instructors to understand and think about the home assignments. However, once you know how to solve a given problem, *you must write down the solution on your own.* Please be honest about it and *indicate your collaborators names.* Working with friends is entirely acceptable, fun and a great way to learn, as long as you remember to write down your own solution.

Please submit your solutions in a well organized and tidy manner. Use clean pages, staple your work and clearly indicate your name.
Grading

The final grade has four components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Final</td>
<td>40%</td>
</tr>
<tr>
<td>Midterm</td>
<td>25%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Weekly assignments</td>
<td>25%</td>
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</tbody>
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The lowest scoring weekly assignment will not be counted towards the grade.

There will be two 20-minute quizzes during the semester, announced a few days in advance.

Midterm and Final

Midterm exam — will take place in class — Tuesday, October 17th at 9am.

Final exam - December 14th, 7:00pm - 10:30pm.

Some general advice on studying mathematics (and 225 in particular)

To understand a new mathematical theory requires a lot of effort (this is true for all of us). It is important that you take plenty of time to read and think about the class material. Make sure you understand — at least the main ideas and arguments at first, if not all of the fine points.

Mathematics courses are structured so that each new notion builds on the previous ones. Therefore it is very important to address difficulties as soon as they arise. You should come to the instructor, teaching assistant and peer tutor office hours to seek assistance if you are having particular questions — but please do so after making an effort to resolve the difficulty on your own or with your friends.

*Home assignments are crucial to your success in mathematics.* Dealing with problems on your own is the "lab" of mathematics. This is where you improve your skills, and the best way to make sure you understand the material and well-prepared for the exams.

Electronic devices

Please do not use your cellular phones during class and discussion sessions. Laptops may be used only for the purpose of taking notes. Students who need to use their laptop during class are requested to speak with the instructor first.

*The use of electronic devices of any kind during quizzes and exams is strictly forbidden.*