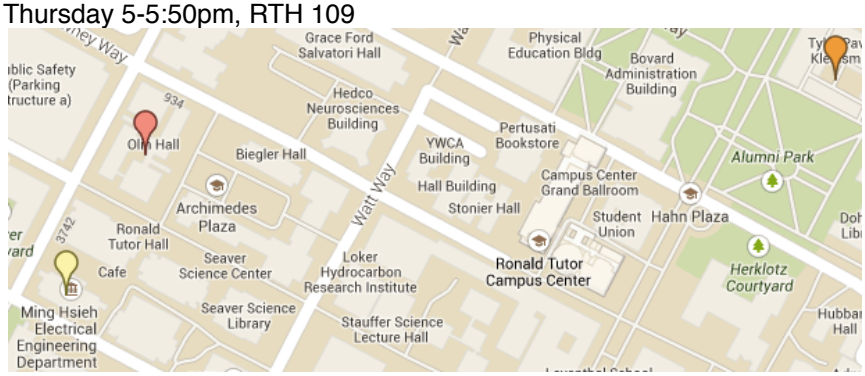
EE 441: Applied Linear Algebra for Engineering (Fall 2013)

Instructor: Ben Reichardt
EEB 528, 213-740-7229, ben.reichardt@usc.edu
office hours: Wednesday 11:30-1pm or by appointment

TA: Saeid Jafari
EEB 322, 213-740-6005, sjafari@usc.edu
office hours: Monday 5-7pm and Thursday 6-7pm

Objectives: To provide a fundamental understanding of concepts and techniques of linear algebra. The emphasis will be on developing the analysis and design tools needed to apply linear algebra to graduate electrical engineering courses and research.

Class website: https://www.uscden.net
Lectures: Tuesday and Thursday 2-3:30pm, OHE 100C
Discussion: Thursday 5-5:50pm, RTH 109



Text: Carl Meyer, "Matrix Analysis and Applied Linear Algebra"
Prerequisites: Math 445 or equivalent (calculus, undegraduate linear algebra and basic matrix theory)

Grading: 20% homework, 35% midterm, 45% final
Your lowest homework score will be thrown out before computing final grades.
No late homework will be accepted. No make-up exams will be given.
You are encouraged to discuss homework problems among yourselves, but each person must do their own work. Copying or turning in identical homework sets is cheating.
You have *one week* from the date that a graded paper is returned to dispute the scoring of a problem, by submitting a request in writing to me.

Outline: (each item roughly corresponds to one week's material)

1. Solving simultaneous linear equations I
(Elementary row operations, Gaussian elimination, matrix algebra)

2. Vector spaces
(Vectors in 2 and 3 dimensions, real vector spaces, abstract vector spaces)

3. Subspaces
(Subspaces in general, subspaces of a linear transformation)

4. Linear independence, bases, and dimension
(All bases for the same vector space have the same cardinality, determinants)

5. Eigenvalues and eigenvectors I
(Definition, significance, calculation of eigenvalues and eigenvectors, Jordan canonical form)

6. Orthogonality
(Orthogonal vectors, orthogonality, normed vector spaces, Gram-Schmidt process)

7. Eigenvalues and eigenvectors II
(Similarity of matrices, simultaneous diagonalization of operators, projections, Jordan's lemma)

8. Special matrices
(Symmetric, skew symmetric, orthogonal, Hermitian, unitary, stochastic, positive definite (and quadratic forms); diagonalization of Hermitian/unitary matrices; applications to quantum mechanics)

9. Singular-value decomposition
(SVDs, pseudo-inverses)

10. Least squares
(Orthogonal projections and least-squares fitting, applications to data analysis)

11. Solving simultaneous linear equations II
(Iterative methods, conjugate gradient; preconditioning; sparse, diagonally-dominant systems; more applications)

12. Vector spaces over finite fields and applications to error-correcting codes
(Counting sizes, numbers of subspaces/subspace bases, Hamming metric, basic coding theory)

13. Linear programming
(Geometry, duality, applications)

14. Clustering and Cheeger's inequality

15. More applications and course review
(Markov chains and Perron-Frobenius theory, Differentiation and integration as linear transformations, infinite-dimensional Hilbert spaces, perturbation theory)

Academic Responsibilities:

Academic Integrity

"The University, as an instrument of learning, is predicated on the existence of an environment of integrity. As members of the academic community, faculty, students, and administrative officials share the responsibility for maintaining this environment. Faculties have the primary responsibility for establishing and maintaining an atmosphere and attitude of academic integrity such that the enterprise may flourish in an open and honest way. Students share this responsibility for maintaining standards of academic performance and classroom behavior conducive to the learning process. Administrative officials are responsible for the establishment and maintenance of procedures to support and enforce those academic standards. Thus, the entire University community bears the responsibility for maintaining an environment of integrity and for taking appropriate action to sanction individuals involved in any violation. When there is a clear indication that such individuals are unwilling or unable to support these standards, they should not be allowed to remain in the University." (Faculty Handbook, 1994:20)

Academic dishonesty includes: (Faculty Handbook, 1994: 21-22)

Examination behavior - any use of external assistance during an examination shall be considered academically dishonest unless expressly permitted by the teacher. Fabrication - any intentional falsification or invention of data or citation in an academic exercise will be considered a violation of academic integrity. Plagiarism - the appropriation and subsequent passing off of another's ideas or words as one's own. If the words or ideas of another are used, acknowledgment of the original source must be made through recognized referencing practices. Other Types of Academic Dishonesty - submitting a paper written by or obtained from another, using a paper or essay in more than one class without the teacher's express permission, obtaining a copy of an examination in advance without the knowledge and consent of the teacher, changing academic records outside of normal procedures and/or petitions, using another person to complete homework assignments or take-home exams without the knowledge or consent of the teacher.

Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. Your letter must be specific as to the nature of any accommodations granted. DSP is located in STU 301 and is open 8:30 am to 5:30 pm, Monday through Friday. The telephone number for DSP is (213) 740-0776.