Math 532 – Linear Algebra

Time and Location: 3:05pm–4:30pm MW, Location E1 119
Instructor: Greg Fasshauer
Office: 208A E1
Phone: 567-3149
Email: fasshauer@iit.edu
WWW: http://math.iit.edu/~fass/
Office hours: M 2:00pm–3:00pm, W 12:00pm–1:00pm, also by appointment

Textbook(s): Carl D. Meyer, *Matrix Analysis and Applied Linear Algebra*, SIAM (2000), ISBN 0-89871-454-0.

Other required material: none

Prerequisites: Undergraduate linear algebra as in MATH 332, or instructor's consent.

Objectives:

1. Students will reinforce their understanding of matrix algebra in the context of the LU factorization.
2. Students will understand the fundamental concepts of vector spaces.
3. Students will understand vector and matrix norms along with the concept of an inner-product space, and learn how these concepts are applied in the context of orthogonal factorization algorithms such as Gram-Schmidt, QR and SVD.
4. Students will understand eigenvalues and eigenvectors and how these concepts apply to matrix diagonalization and algorithms for computing eigenvalues and solving linear systems iteratively.

Course Outline: Hours

1. Matrix Algebra 4
   a. Inverse matrices and Sherman-Morrison formula
   b. Elementary matrices
   c. LU factorization
2. Vector Spaces 10
   a. (Fundamental) subspaces
   b. Linear independence
   c. Basis and dimension, rank
   d. Classical least squares
   e. Linear transformations
3. Norms, Inner Products and Orthogonality 16
   a. Vector and matrix norms
   b. Inner-product spaces
   c. Gram-Schmidt orthogonalization, QR factorization
   d. Unitary and orthogonal matrices
   e. Complementary subspaces
   f. Orthogonal decomposition
   g. Singular value decomposition
   h. Orthogonal projections

4. Determinants 4
5. Eigenvalues and Eigenvectors 12
    a. Elementary properties
    b. Diagonalization, similarity transforms, Cayley-Hamilton theorem
    c. Functions of diagonalizable matrices
    d. Normal matrices
    e. Positive definite matrices
    f. Neumann series and iterative solvers
    g. Krylov methods

Assessment:	Homework	30%
	Midterm Exam (Mon., Mar.23)	30%
	Final Exam (Mon., May 4, 8am-10am)	40%

Homework: There will be frequent homework assignments in the form of written reports. While I do encourage study groups and team learning, I expect that homework solutions are written up by each person **individually**. **Duplicate solutions** will be considered evidence of academic dishonesty.

Academic Integrity: Unless otherwise indicated by the instructor, this course follows the Academic Integrity Policy of IIT's College of Science. This implies that

- students are aware of and follow the IIT Code of Academic Honesty http://www.iit.edu/student_affairs/handbook/information_and_regulations/code_of_academic_honesty.shtml
- a violation of academic integrity will result in a reduced course grade,
- any violation of academic integrity will be reported to the Office of the Vice Provost for Academic Affairs (academichonesty@iit.edu).

Students with Disabilities: Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, students must obtain a letter of accommodation from the Center for Disability Resources and make an appointment to speak with me as soon as possible. The Center for Disability Resources is located at 3424 S. State Street - 1C3-2, 312-567-5744 or disabilities@iit.edu.