Math 128 Tufts University Spring 2015
Numerical Linear Algebra Department of Mathematics

Sections: 01 (Block J+TR) Xiaozhe Hu

Office Hours: TR 9:30am-11:30am, or by appointment

Required Materials: *Numerical Linear Algebra and Applications, Second Edition,* by Biswa Nath Datta, published by SIAM Philadelphia.

In addition, there will be programming assignments that require the implementation of some computer language. The programming for this course can be done in any language that you choose. MATLAB is recommended and is probably the easiest to pick up if you are not familiar with any other. All Tufts students have access to MATLAB in the ITS Computing Center at Eaton Hall. Tufts University also provides Student License for MATLAB, you can follow the instruction on `https://it.tufts.edu/sw-matlabstudent` and install MATLAB on your own computers. An alternative to MATLAB is Octave. An possibility is Python with numpy/scipy/matplotlib. If you would like to use another option, please discuss this with me.

Recommended Reading Materials: *Matrix Computations, Fourth Edition,* by Gene H. Golub and Charles F. Van Loan, JHU Press and *Numerical Linear Algebra,* by Lloyd N. Trefethen and David Bau, III, SIAM Philadelphia.

Exams and Grading: The full department policy on exams and grading can be found on the department website `http://math.tufts.edu/courses/examPolicy.htm`, as well as the university's `http://uss.tufts.edu/studentAffairs/documents/HandbookAcademicIntegrity.pdf`. Students found violating these policies will receive an F in the course and be reported to the Dean of Students.

Student Accessibility Services: If you are requesting an accommodation due to a documented disability, you must register with the Student Accessibility Services Office at the beginning of the semester. To do so, call the Student Accessibility Services office at 617-627-4539 to arrange an appointment with Linda Sullivan, Program Director of Student Accessibility Services.

Homework: There will be about 10 homework assignments during the semester. Some portions will involve programming. All codes should be printed and turned in with the resulting outputs. In addition, you should write up the answers based on the programming portion of the assignment in a report style, using figures and tables to justify your answers.

You are encouraged to collaborate with other students and to check your solutions. However, you must submit your own solutions in your own writing for the assignments.

Grades: Let M be your score on the midterm exam, F be your score on the final exam, and H be your total homework score. These are scores out of 100. Your total course score will be the larger of the following two numbers:

$$.3\ H + .3\ M + .4\ F \quad \text{or} \quad .35\ H + .1\ M + .55\ F.$$

This score will be translated into a grade following a conversion table that you can find on the mathematics department web page, at `http://math.tufts.edu/courses/gradingSchemes.htm`.

Learning Objectives: This course satisfies Learning Objectives 1.b, 1.e, and 6.a as listed at `http://ase.tufts.edu/faculty/committees/objectives/math.htm`.

	Tentative Schedule		
Lec.	**Date**	**Book Sections**	**Topics**
1	01/15	Sec 2.1-2.5	Introduction and Review of Linear Algebra
2	01/20	Sec 3.1-3.8	Floating Point Systems
3	01/22	Sec. 4.1-4.5	Conditioning, Stability, and Accuracy
Homework 1			
4	01/27	Sec. 5.2-5.4	LU Factorization
5	01/29	Sec. 7.1,7.5	QR Factorization and Gram-Schmidt Process
6	02/03	Sec. 7.2,7.4	Householder Transform and Givens Transform
Homework 2			
7	02/05	Sec. 9.1-9.5	Eigenvalue Decomposition
8	02/10	Sec. 7.8-7.9	Singular Value Decomposition (SVD)
Homework 3			
9	02/12	Sec. 6.4-6.7	Solving Linear Systems, Direct Methods
10	02/17	Sec. 4.6, 6.8-6.9	Perturbation Analysis and Condition Number
Homework 4			
11	02/19	Sec. 12.1-12.2	Linear Iterative Methods
12	02/24	Sec. 12.3	Krylov Methods
13	02/26	Sec. 12.4-12.5	Preconditioning, Comparison
Homework 5			
Midterm (take-home)			
14	03/03	Sec. 8.3, 8.5-8.6	Least-Square Problems
15	03/05	Sec. 8.7.1-8.7.2	Normal Equation, QR for Full-Rank Problems
16	03/10	Sec. 8.7.3-8.7.4	QR for Rank-Deficient Problems, Using SVD
Homework 6			
17	03/12	Sec. 8.8	Underdetermined Systems
18	03/24	Sec. 8.9	Iterative Methods for Least-Square Problems
Homework 7			
19	03/26	Sec. 9.4, 9.6-9.7	Eigenvalue Problems and Iterative Methods
20	03/31	Sec. 9.8-9.9	The Real Schur Form and QR Iterations
Homework 8			
21	04/02	Sec. 10.2	Symmetric Eigenvalue Problems
22	04/07	Sec. 12.6.1-12.6.2	The Rayleigh-Ritz Procedure, Arnoldi Methods
23	04/09	Sec. 12.6.3	Lanczos Methods
Homework 9			
24	04/14	Sec. 10.3.1-10.3.4	SVD and Sensitivity
25	04/16	Sec. 10.3.5-10.3.7	Computing SVD
Homework 10			
26	04/21	Sec. 10.4, 12.7-12.8	Generalized Eigenvalue and SVD Problems
27	04/23		Review
Final Exam			