Instructor: Narendra Goel  
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Office Hours: Mondays 1:45-2:45 PM, State 306; Wednesdays 8:30-9:30 AM, 5057 Woodward Ave., Rm 14109.2;  
other hours by appointment  
Grader: Aseem Ahir  
E-mail: aseem.ahir@wayne.edu  
Lectures: Mondays & Wednesdays 11:45 AM -1:35PM State Hall 306  
Recommended Books:  
(You can freely download chapters from http://www.matrixanalysis.com/DownloadChapters.html)  
Prerequisites: CSC 2110, or equiv.; and MAT 2250 for computer science students, BE 3040 for engineering students.  
The student should have some level of mathematical maturity (calculus, discrete mathematics, elementary algebra) and  
computer science maturity (programming and data structure).  
The course is designed for upper level undergraduate and graduate students (including those pursuing Ph.D.) from a  
variety of backgrounds (computer science, biology, physics, chemistry, and engineering)  
Course Objectives: This course will introduce the methodology of matrix analysis and applied linear algebra using  
computers. Considerable attention will be given to use of matrices to practical problems involving development of  
models and their simulations.  

The course material will be some what custom designed for the class. One key aspect of the course is for the student to  
do a significant project using matrices and present it to the class. It is strongly encouraged for the student to select a  
project of his/her own interest, including those which may become thesis problem. Some of the projects may lead to  
publications in scientific journals. The project could be from physical, chemical, biological, social and computer  
sciences, engineering, and bioinformatics. We hope to cover the following topics:  

Fundamentals (vectors and matrices, norms, inner products, the singular value decompositions), QR factorization and  
least squares (projectors, Gram-Schmidt orthogonalization, Householder triangulation), condition and stability, solving  
systems of equations (iterative methods, Gaussian elimination, Cholesky factorization), eigenvalue problems (principal  
component analysis), stochastic matrices and Markov chains, hidden Markov chains, and various software packages.  

Applications: GPS systems, input-output models, network flow, population growth and population stability, optimal  
allocation of resources, Google search engine, speech recognition, image processing and image compression  
(wavelets, DCT, fractals, SDV), image reconstructions, least square fitting, heat and electrical conduction in complex  
media, mechanical stress and strain, robotics, animation, cluster analysis, principal component and factor analyses,  
manufacturing assembly, and other applications depending upon the class makeup.
Learning Objectives: After completing this course, students should be able to do the following:
1. Develop software to solve matrix equations $ax=b$ for different kind of matrices using various methods.
2. Develop software to determine eigen values and eigen vectors for different kind of matrices using various methods.
3. Know how to formulate different problems in the form of matrices and then solve them.
4. Be proficient in the use of commercial software Matlab to solve various problems involving matrices This includes writing programs in Matlab
5. Define and develop a project on their own where matrices are used, find the relevant literature, write a paper on the project and make a 15 minute presentation on the project and the findings of research.

Outcome Coverage:
(a) An ability to apply math, science and engineering knowledge. The assignments, midterm exam and project require direct application of mathematical, scientific, and engineering knowledge to successfully complete the course. This requires solving problems from different fields.
(b) An ability to identify how matrices are used in a problem, write the software to solve the matrix problem, and analyze the results of the computations.
(c) An ability to understand the errors and instable solutions in matrix analysis and what techniques should be used to get the most accurate and stable solution using least amount of computer time and computer storage.
(d) An ability to identify, formulate and solve engineering and scientific problems. The students achieve this item during the final project where they choose their own problem, analyze the problem, determine the techniques to be used, write a computer program to solve the problem and get results.
(e) An ability to communicate effectively: All students are required to make an oral presentation on their project work. The students are also required to submit a well-written technical report on their project work. The oral presentation and technical report writing process help them in achieving effective communication skills.
(f) An ability to use the techniques and skills of matrix analysis necessary for engineering practice: Students learn to use the Matlab software and learn how to write their own software in C++ or Java

Attendance: Attending all lectures is essential; the assignments, exams, quizzes, etc. will be based primarily (though not exclusively) on the material presented in these lectures. Attendance will be taken and you are allowed to miss at most two lectures. If you miss more than two, the instructor may administratively drop you from the course. Also, assignments due dates, explanation and clarification of assignments, and material outside textbook will be presented during lectures. If you miss a lecture, it is your responsibility to obtain the information covered in the session or notes given from your fellow classmates.

Homework and Examinations: There will be 9-10 homework assignments, due at the beginning of the lecture period of the due date. No late assignment will be accepted. Since each assignment is an integral part of the course, the instructor reserves the right to give a failing grade to anyone who is turning in 50% or less of the homework. The homework is a very important tool for learning the material taught in the lecture. Therefore, it is very important that you do the homework on your own.

There will be held two examinations on or about Feb. 16 and March 21, 2016 (dates are subject to change, but at least one week notice will be given). All the examinations will be held during the regular lecture hours. The examinations will be closed books, closed notes and closed neighbors. In order to pass the course, you must pass all exams. There will be no make-up examinations.

An important part of the course is for you to choose a topic of interest to you and model the system. You must specify the project no later than March 7, 2013. I will help you through the analysis of the problem and formulation of the approach. You will be required to write a report on your findings and make a 10 min presentation (with 5 minutes for questions) to the class. The presentations will be held on Thursday April 21, 2016, 8:00 AM-2:00 PM.
Final grade: For the final grade, home works and exams are weighted as follows:

Homework: 20%
Exam 1: 20%
Exam 2: 20%
Final project*: 40%

The final letter grades will be determined approximately as follows:

A  92-100% ; A-  90-91% ; B+  88-89% ; B  82-87%
B-  80-82% ; C+  78-79% ; C  72-77% ; C- 70-71% D+ 68-69% ; D 62-67% ; D-  60-61% ; E  0-59%

A grade of Incomplete (I) will be not be given.

Students Responsibilities and Academic Honesty: As a college student, who is committed to seek a higher education, we expect you to be a very responsible person. At the least, please:

* Do your best to understand the material covered in the class; ask questions when you do not understand.
* Be aware of the homework assignments and deadlines.
* Obtain notes and handouts from your classmates if you miss a class for unavoidable circumstances. *Turn in your assignments in neat, readable and easily accessible form.* Obtain notes and handouts from your classmates if you miss a class for unavoidable circumstances.

Also we expect all of you to have the highest level of academic honesty. We expect each of you to do your work (assignments, and exams) yourself and strongly encourage you to discuss with the instructor and teaching assistant regarding any problems which you might have in the course work. However, any copying will be severely dealt with including giving zero in the assignment copied and all those submitted before. Repeated incidents will be dealt with severe disciplinary actions.

Course Drops and Withdrawals: In the first two weeks of the (full) term, students can drop this class and receive 100% tuition and course fee cancellation. After the end of the second week there is no tuition or fee cancellation. Students who wish to withdraw from the class can initiate a withdrawal request on Pipeline. You will receive a transcript notation of WP (passing), WF (failing), or WN (no graded work) at the time of withdrawal. No withdrawals can be initiated after the end of the tenth week. Students enrolled in the 10th week and beyond will receive a grade. Because withdrawing from courses may have negative academic and financial consequences, students considering course withdrawal should make sure they fully understand all the consequences before taking this step. More information on this can be found at: http://reg.wayne.edu/pdf-policies/students.pdf

Religious Holidays: Because of the extraordinary variety of religious affiliations of the University student body and staff, the Academic Calendar makes no provisions for religious holidays. However, it is University policy to respect the faith and religious obligations of the individual. Students with classes or examinations that conflict with their religious observances are expected to notify their instructors well in advance so that mutually agreeable alternatives may be worked out.

Students with disabilities: If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TTD only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours or at another agreed upon time to discuss your needs. Student Disability Services mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University.
Student services:

- The Academic Success Center (1600 Undergraduate Library) assists students with content in select courses and in strengthening study skills. Visit [www.success.wayne.edu](http://www.success.wayne.edu) for schedules and information on study skills workshops, tutoring and supplemental instruction (primarily in 1000 and 2000 level courses).

- The Writing Center is located on the 2nd floor of the Undergraduate Library and provides individual tutoring consultations free of charge. Visit [http://clasweb.clas.wayne.edu/](http://clasweb.clas.wayne.edu/) writing to obtain information on tutors, appointments, and the type of help they can provide.

Class recordings:

Students need prior written permission from the instructor before recording any portion of this class. If permission is granted, the audio and/or video recording is to be used only for the student’s personal instructional use. Such recordings are not intended for a wider public audience, such as postings to the internet or sharing with others. Students registered with Student Disabilities Services (SDS) who wish to record class materials must present their specific accommodation to the instructor, who will subsequently comply with the request unless there is some specific reason why s/he cannot, such as discussion of confidential or protected information.