

CS370 Introduction to Scientific Computing, Fall 2008

Instructor: Mike Thomason

Class Time: 9:05-9:55 MWF

Office Hours 10-11MWF C316 (Often in office other times, but not guaranteed available.)

Lab Time: 2:30-5:30 F C103

Description: Design, analysis, and implementation of numerical algorithms for solving problems in science and engineering. Emphasis on program design, data structures, computational complexity, scientific computing environments, and high performance software packages. 3 hour lab required.

Prereq: CS140, M241, and M251.

Purpose: The course covers some basics of numerical techniques in scientific computing. This section will emphasize MATLAB as a scientific computing environment. You will use MATLAB version 7.2.0 and a couple of its specialized toolboxes in the labs. *All assignments and labs must use MATLAB. See the statement at the end of this handout concerning the latest provisions for MATLAB at UTK.*

One of your first tasks will be to learn some MATLAB. At least one lab will use the Profiler with the `profile` function for performance evaluation. Time permitting, there will be labs using the Parallel Computing Toolbox, high performance packages called from MATLAB, and the `mex` function to compile C code into a MATLAB-external file which MATLAB itself can execute. (Plain-text MATLAB script and function files are called M-files. MATLAB-external files are called MEX-files.)

The text is *Numerical Computing with MATLAB*, Cleve Moler, SIAM Press, 2004. We will cover subsets of the topics below by reordering chapters in the text. There will be additional hard-copy handouts in class. You are responsible for all assignments in the text, all handouts, and all labs.

Tentative Outline (Expect some real-time fine-tuning. We will omit some sections of text chapters.):

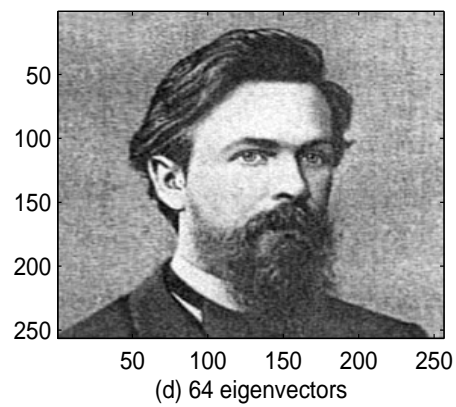
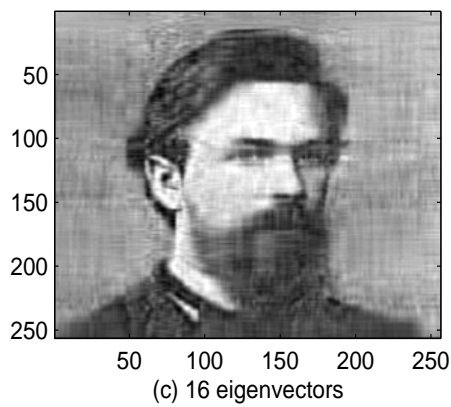
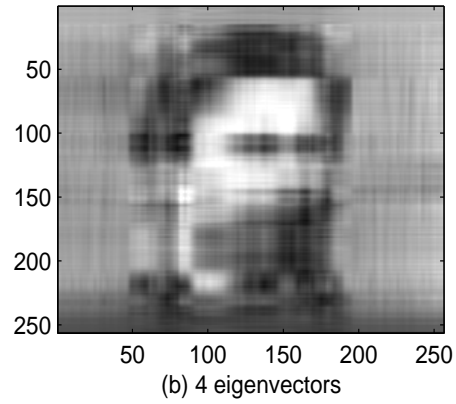
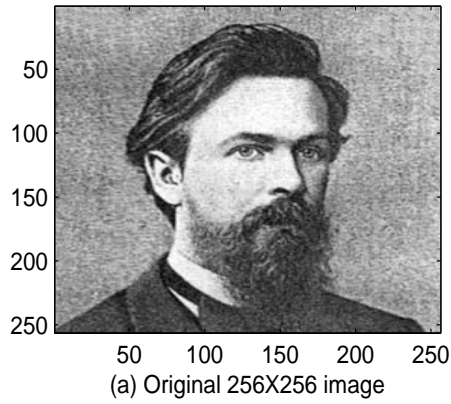
- MATLAB (chap. 1 exercises and on-line documentation) [Labs 1-2]
- Computer arithmetic (chap. 1 (1.7))
- Linear systems and linear least-squares (chaps. 2,4,5) [Labs 3-4-5]
- Quiz 1
- Eigenvalues, eigenvectors, and SVD (chap. 10) [Lab 6]
- Optimization (some relevance in chap. 4) [Lab 7]
- Data Compression (handout: Huffman codes and LZW coding) [Lab 8]
- Quiz 2
- FFT (chap. 8) [Lab 9]
- Random numbers and simulation (chap. 9) [Lab 10]
- Interpolation (as time permits chap. 3) [possible Lab 11 but unlikely]
- Numerical integration and differentiation (as time permits)
- ODEs and PDEs (chaps. 7 and 11 as time permits)
- Quiz 3 in alternatives period

Scientific computing environments these days have good tools for plotting and visualizing data. There are two examples in this handout. The figure at the top is `meshgrid` of a function called *banana* used to test optimization code for multidimensional minimization. The second figure of digital images is a visual example of eigenvectors in image processing. A subset of the eigenvectors can be used to represent the original image with less data at the cost of introducing visual distortion. The upper left (a) is the original image, a 256×256 matrix of 8-bit gray-level pixels; (b) is the image from processing the first 4 eigenvectors in decreasing order of magnitude; (c) is from the first 16 eigenvectors; and (d) is from the first 64 eigenvectors.

Grading: There will be three, 50-minute, closed book, in-class quizzes for 100 points each. If there is overwhelming request from the class, we will discuss making one or two of the quizzes take-homes. The quizzes will be roughly evenly spaced through the semester. Your lab average will be equivalent to a fourth 100-point quiz; however, if you fail to complete three or more labs, your lab average will be assigned a 0 no matter what the other lab grades are. There will be 8 to 10 labs, allowing some flexibility in covering material.

With the instructor's permission, you can carry out your own project in a relevant application or technique *in detail* and give a demo to the class in lieu of the last quiz. If you want to do this, contact the instructor ASAP with your proposal. This could be some feature of MATLAB or some relevant area like a statistical analysis method or an optimization method.

Students who have a disability that requires accomodation(s) should make an appointment with the Office of Disability Services (974-6087) to discuss their specific needs, as well as schedule an appointment with the Administrative Services Assistant, College of Arts and Sciences during office hours.



30 July 2008: UT's System-wide License Agreement with The MathWorks Provides
MATLAB and Other Software Free

The University of Tennessee now has a system-wide license agreement with The MathWorks that makes MATLAB, Simulink and 54 other products available for free to all University of Tennessee faculty, staff and students. The MathWorks MATLAB and Simulink products are computational software environments for use in engineering, mathematics, statistics, science and finance. The other 54 products are optional toolboxes that work within the MATLAB and Simulink environments. When MATLAB is mentioned to below, it refers to this entire software suite.

The system-wide license agreement, called TAH (Total Academic Headcount), began July 1, 2008, and is an annual license. The TAH license replaces all eligible licenses that UT has with The MathWorks. All existing active licenses with current Software Maintenance Services (SMS) were suspended and placed in storage. Should UT decide not to renew the TAH agreement, the stored licenses in the most recent version can be taken from storage after paying a one year maintenance fee.

If people in the university have MATLAB installed and want to continue using their license, they may do so. However, if they want to upgrade to MATLAB 2008, or add any of the 54 other products, they must use the UT system-wide TAH license.

There are four major steps to follow to use the TAH license. 1. Create a MathWorks account. 2. Associate your account with the TAH license using the Activation Key that is included in the UT installation instructions. 3. Download MATLAB products from The MathWorks web site and install MATLAB software. The website is restricted to UT faculty, staff and students. 4. Activate the MATLAB software.

Instructions and activation keys can be downloaded from the Internet Downloads area of <http://oit.utk.edu/software>. A NetID and password are required for access.

The TAH MATLAB license allows installations that use a network license server. Departmental lab administrators can avoid having to activate a MATLAB license on each workstation by directing those workstations to a network license server. College of Engineering departments may email the IT staff of Electrical Engineering and Computer Science at help@eecs.utk.edu for assistance with network

concurrent licenses. UTK departments can also email labs@utk.edu to request access to the OIT Lab Services Matlab license server.

The TAH agreement includes direct support from The MathWorks. Problems with download, installation, and activation should be directed to MathWorks support:

http://www.mathworks.com/support/contact_us/

For new users, MATLAB tutorials are available here:

http://www.mathworks.com/academia/student_center/tutorials/

Students have access to the same software as faculty. The MATLAB & Simulink Student Version is a separate product and is not included in the TAH agreement.