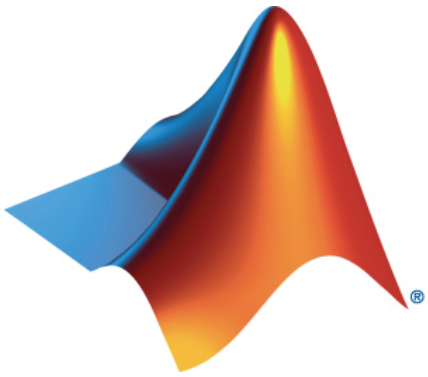
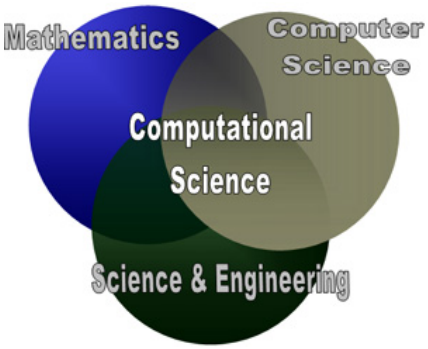
CME 292: Advanced MATLAB for Scientific Computing

Schedule: Autumn 2014, TuTh 3:15p - 4:45p, 60-120 **Units:** 1





Course Description

Short course running first four weeks of the quarter (8 lectures) with interactive lectures and application-based assignments. Students will be introduced to advanced MATLAB features, syntaxes, and toolboxes not traditionally found in introductory courses. Material will be reinforced with in-class examples, demos, and homework assignments involving topics from scientific computing. MATLAB topics will be drawn from: advanced graphics (2D/3D plotting, graphics handles, publication quality graphics, animation), MATLAB tools (debugger, profiler), code optimization (vectorization, memory management), object-oriented programming, compiled MATLAB (MEX files and MATLAB Coder), interfacing with external programs, and toolboxes (optimization, parallel computing, symbolic math, PDEs). Scientific computing topics will include: numerical linear algebra, numerical optimization, ODEs, and PDEs. Prerequisites: basic knowledge of MATLAB (CME 192 or equivalent), basic linear algebra (CME 104 or equivalent).

Students will have the opportunity to design an optional 9th lecture on MATLAB-related topics that were not covered in the first 8 lectures. Students should expect to gain: ◆ exposure to the tools available in the MATLAB software ◆ knowledge of and experience with advanced MATLAB features ◆ independence as a MATLAB user. Successful completion of the course requires satisfactory submission of four homework assignments.

Course Outline

- Lecture 1
  - Fundamental MATLAB features, syntaxes, concepts [**?**]
    - Data types
    - Functions/scripts, publishing
    - Debugger, profiler
    - Memory management
    - Numeric arrays
- Lecture 2
  - Graphics
    - Advanced Plotting Functions
      - Vector fields

            - Contour plots, surfaces, volumes, polygons
        - Graphics handles and objects
        - Publication-quality graphics
        - Animation

- Lecture 3
    - Numerical linear algebra [**?**, **?**]
        - Dense vs. sparse matrices
        - Direct vs. iterative linear system solvers
        - Matrix decompositions
            - LU, Cholesky, QR factorizations
            - Eigenvalue decomposition (EVD)
            - Singular value decomposition (SVD)

- Lecture 4
    - Numerical optimization [**?**, **?**, **?**]
        - Optimization toolbox [**?**]
    - Solution of nonlinear systems of equations

- Lecture 5
    - Object-oriented programming
        - User-defined classes

- Lecture 6
    - File manipulation and system interaction
        - Text/binary file manipulation
        - System calls
        - Interfacing to spreadsheet (Excel)

- Lecture 7
    - MEX interface to low-level coding languages (C/C++/Fortran)
    - Generating standalone C/C++ code from MATLAB code
        - MATLAB Coder

- Lecture 8
    - Symbolic Math Toolbox
    - Parallel Computing Toolbox
    - ODEs/PDEs [**?**, **?**]
        - PDE Toolbox

Prerequisites

- (required) Basic programming skills in MATLAB (CME 192 or equivalent)
- (recommended) Basic knowledge of numerical analysis and numerical linear algebra

Instructor

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