Introduction to MATLAB

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What is MATLAB?

- Computational Software

  From The MathWorks: www.mathworks.com
- Algorithm Development Environment
- MATrix LABoratory

MATLAB @ MIT

- On Athena
  - 250 floating licenses (free)
- For personal computers
  - Students
    - 300 floating licenses (free)
    - http://matlab.mit.edu
  - Faculty and staff
    - Individual licenses for purchase
    - https://web.mit.edu/is/products/vsls/matlab/matlab-license.html

This Class

- Two series, same topics, hands-on training
  - Introduction to MATLAB I on Athena (morning)
  - Introduction to MATLAB II on laptops (afternoon)
- Web site
  - http://web.mit.edu/violeta/www/IAP2006

Topics

- MATLAB Interface and Basics
- Linear Algebra and Calculus
- Graphics
- Programming
- Graphical User Interface
- Math On the Web (optional)

Class Materials

- On laptops download from:

  http://web.mit.edu/acmath/matlab/IntroMATLAB
- On Athena copy from locker acmath

```
athena% add acmath
athena% cp
   /afs/athena.mit.edu/astaff/project/acmath/
   matlab/IntroMATLAB/Interface_Basics.tar .
```

Additional Training

- Online MATLAB tutorial

  https://web.mit.edu/tm/matlab_mastery_I/setup/Start.htm
- MATLAB for advanced users during IAP 2006
  - Two sessions by MathWorks' instructors
    - Using MATLAB for Test and Measurement Applications
    - Advanced Programming Tips and Techniques for MATLAB 7
  - Sponsored by IS&T and scheduled to follow Introduction to MATLAB

MATLAB Interface

Desktop Interface

Help Browser

Toolboxes

Starting MATLAB on Athena

- Athena default version:
  ```
  athena% add matlab
  athena% matlab &
  ```
- Other Athena versions:
  ```
  athena% add matlab –verX.X
  ```
- MATLAB prompt: >>
- Desktop interface
  ```
  >> desktop
  ```

Starting MATLAB on Laptops

- MATLAB desktop interface is the default
- Supported operating systems by IS&T
  - Windows XP
  - Mac OS X

MATLAB Desktop

You must be running MATLAB now …

- Default desktop
  - Command Window
    - Type MATLAB commands
    - Can also use some UNIX commands
  - Current Directory Window
  - Command History Window
  - Menu Toolbar

Help in MATLAB

- Command line help

  `>> help` *`command`*

  e.g. `help polyval`

  `>> lookfor` *`keyword`*

  e.g. `lookfor integrate`

  `>> helpwin or helpdesk or doc`

- Desktop menu
  - Help->Help MATLAB

MATLAB Help Browser

- MATLAB
  - + Getting Started
    - + Desktop Tools and Development Environment
  - + Mathematics
    - + Matrices and Linear Algebra
    - + Differential Equations
  - + Data Analysis
  - + Programming
  - + Graphics
  - + 3-d Visualization
  - + Creating Graphical User Interfaces
- Other Toolboxes

MATLAB Basics

Matrices and Vectors

Operators and Built-In Functions

Data I/O and M-Files

Variables

- Begin with an alphabetic character: `a`
- Case sensitive: `a, A`
- No data typing: `a=5; a='ok'; a=1.3`
- Default output variable: `ans`
- `who` shows all active variables: `a, A`
- `whos` shows info on variables

```
Name    Size Bytes     Class
a       1x1  8         double array
```

Operators

- +, -, *, /, \, ^
- Examples:

```
>> a = 5; (1+a)^2
ans =
     36
>> a \ 35
ans =
     7
```

Vectors

- Row vector

```
>> R1 = [1 6 3 8 5]
>> R2 = [1 : 5]
>> R3 = [-pi : pi/3 : pi]
```

- Column vector

```
>> C1 = [1; 2; 3; 4; 5]
>> C2 = R2'
```

Matrices

- Creating a matrix

```
>> A = [1 2.5 5 0; 1 1.3 pi 4]
>> A = [R1; R2]
```

- Accessing elements

```
>> A(1,1); A(1:2, 2:4); A(:,2)
```

Scalar-Vector Math

- A + 2: element-wise addition
- A * 2: element-wise multiplication
- A + A: element-wise addition
- A ^ 2: error
- A .^2: element-wise exponentiation

Built-In Functions

- Data I/O
  ```
  >> load
  >> save
  ```
- Data Analysis
  ```
  >> sum
  >> mean
  >> std
  >> min, max
  ```
- Polynomials
  ```
  >> sqrt
  >> roots
  >> polyval
  ```

Built-In Functions (continued)

- Graphics:

```
>> plot
>> plot3
>> surf
>> xlabel, ylabel, title
>> hold on, hold off
```

- Interpolation:

```
>> meshgrid
>> griddata
```

- And many others …

Editors

- Import Wizard
  `File->Import Data …`
- Figure editor
  `>> figure`
- M-File editor
  `>> edit`

M-Files

- Create or open M-file in editor

  `>> edit filename.m`
- Type or copy commands
- Use `%` for comments
- Use `;` to suppress output at runtime
- Save as *`filename.m`*
- Run: filename only (no `.m` extension)

  `>> filename`

Interface and Basics Exercises

- Exercise One: `example1.m`
  - Data input and output
  - Matrices, vectors, and matrix operators
  - Data analysis using built-in functions
- Exercise Two: `example2.m`
  - Matrices and vectors
  - Polynomials
- Exercise Three: `example3.m`
  - Interpolation and plotting
  - Figure and data export