MATLAB Tutorials

Aeronautics & Astronautics - 16.01/16.02 Unified Engineering - Fall 2007

web.mit.edu/acmath/matlab/unified/fall07

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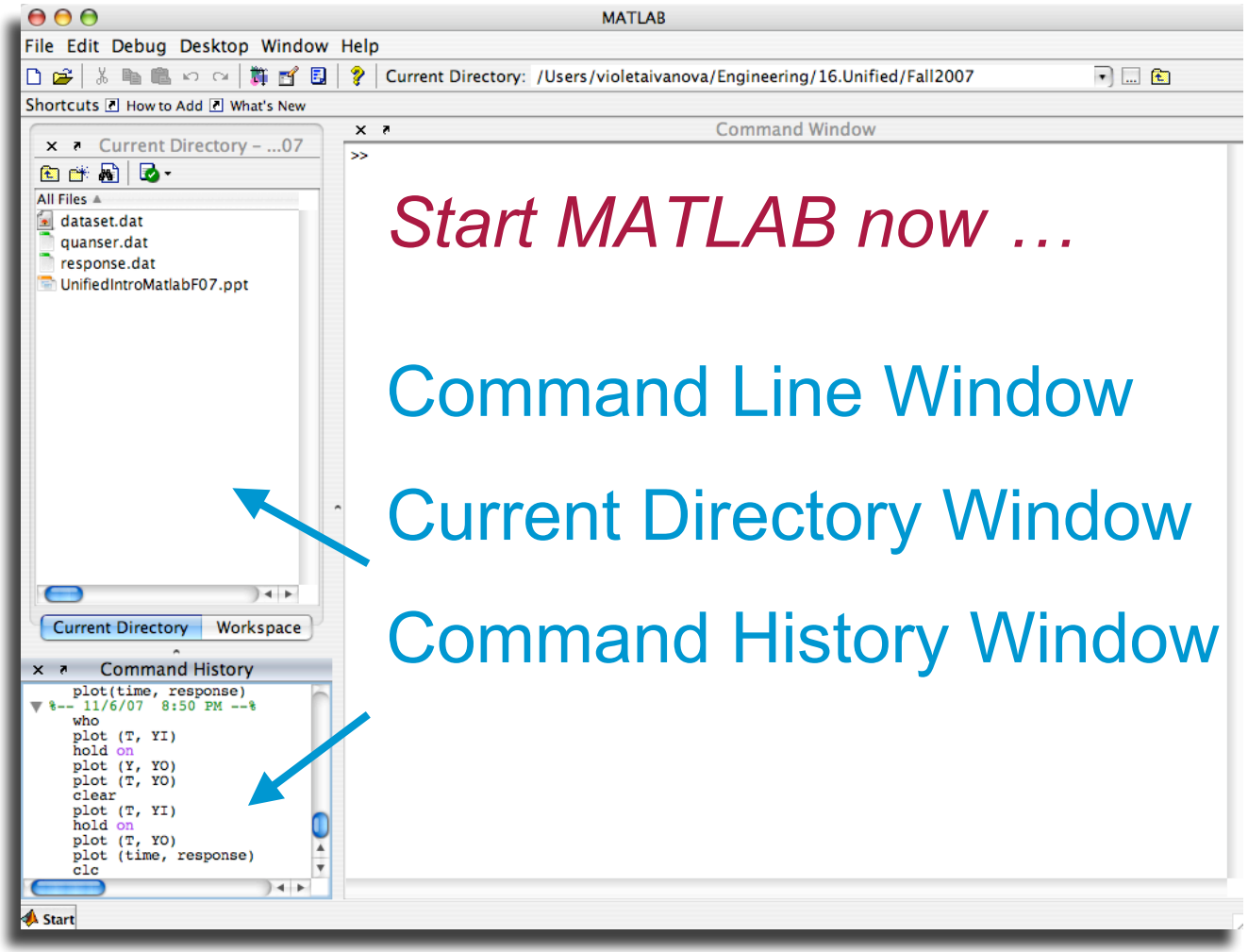
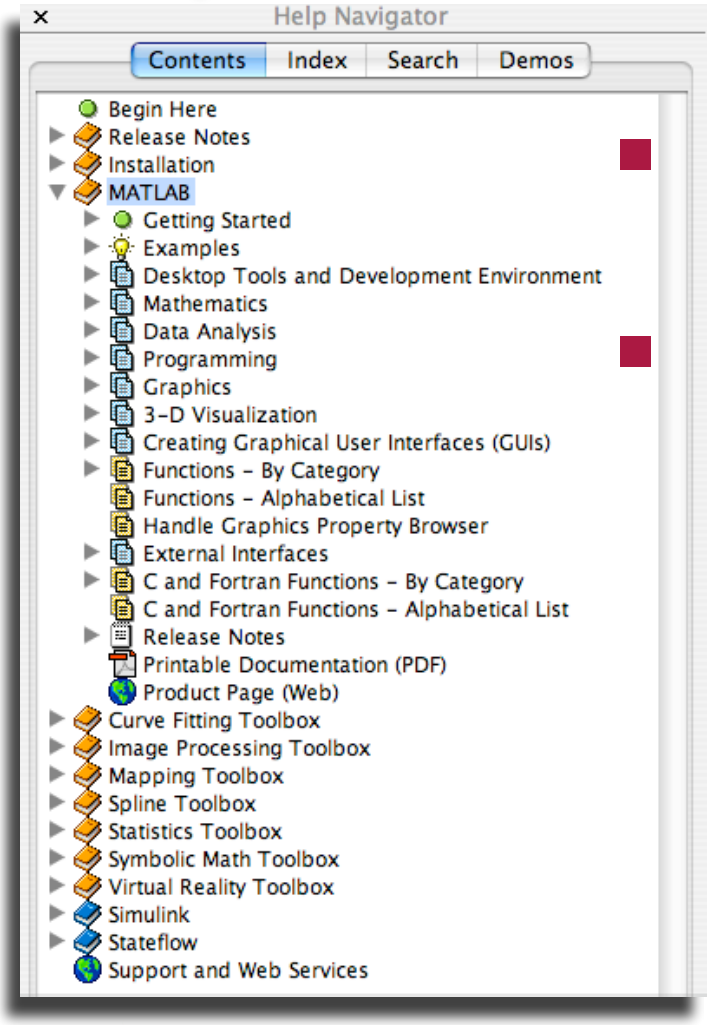
MATLAB Desktop Interface



Help in MATLAB



Help Browser

Help->MATLAB Help

Command line help

```
>> help <command>
```

e.g. `help cos`

```
>> lookfor <keyword>
```

e.g. `lookfor cosine`

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`
- Built-in constants: **`pi i j Inf`**
- **`clear`** removes variables
- **`who`** lists variables
- Special characters

  `[] () {} ; % : = . ... @`

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)
```

Matrix Operations

- Operators + and –

```
>> X = [x1 x2 x3]
>> Y = [y1 y2 y3]
>> A = X + Y
   A =
      x1+y1   x2+y2   x3+y3
```

- Operators *, /, and ^

```
>> Ainv = A^-1
```

Matrix math is default!

Element-Wise Operations

- Operators `.*`, `./`, and `.^`

```
>> Z = [z1 z2 z3]'
>> B = [Z.^2   Z   Z.^0]
B =
```

$$\begin{bmatrix} z_1^2 & z_1 & 1 \\ z_2^2 & z_2 & 1 \\ z_3^2 & z_3 & 1 \end{bmatrix}$$

File Input / Output

- Import Wizard for data import

  `File->Import Data …`

- File input with `load`

```
B = load('datain.txt')
```

- File output with `save`

```
save('dataout', 'A', '-ascii')
```

Graphics

- 2D linear plots

```
>> plot (X, Y, 'ro')
>> plot (X, Y, 'Color', [0.5 0 0], …
          'Marker', 'o', …
          'LineStyle', 'none')
```

- Colors: b r g y m c k w
- Markers: o * . + x d
- Line styles: - -- -. :

Customizing Graphs

- Annotating graphs

```
>> plot (X, Y)
>> legend ('Points')
>> title ('Coordinates')
>> xlabel ('X')
>> ylabel ('Y')
```

- Plot Edit mode: icon  in Figure editor
- Property Editor: `View->Property Editor`
- Saving figures: `File->Save As`

Plotting Multiple Datasets

- Built-in function `hold`

```
>> g1 = plot(X, Y, 'ro')
>> hold on
>> g2 = plot(x, y1, 'b-')
>> hold on
>> g2 = plot(x, y2, 'g--')
>> hold off
```

M-File Programming

- Script M-Files
  - Automate a series of steps.
  - Share workspace with other scripts and the command line interface.
- Function M-Files
  - Extend the MATLAB language.
  - Can accept input arguments and return output arguments.
  - Store variables in internal workspace.

Function M-Files

Example: amodel.m

```
function Y = amodel(t, A, B, a, w, p)
% H1 line: AMODEL computes step response.
% Help text: appears when you type
% "help amodel" in command line window.

% Comment: function body is below.
Y = A * exp(-a.*t).*cos(w.*t + p) + B;
```

Script M-Files

Example: model.m

```
% Define time interval & other input.
T = [0 : 0.01 : 30]; A = 10; B = -A;
alpha = -0.2; phi = 2; omega = -2;
% Compute Y as a function of time.
Y = amodel(T, A, B, alpha, omega, phi)
% Plot model as a function of time.
plot (T, Y);
```

MATLAB Program

- Always has one script M-File
- Uses built-in functions as well as new functions defined in function M-files
- Created in MATLAB Editor / Debugger

```
>> edit model.m
```

- Run from Command Line Window

```
>> model
```

Exercises

- **Step response**: `modelfit.m`

  Follow instructions in m-file …

  - Import data: *time*, *response*
  - Plot data: *response* v. *time*
  - Write function: $y(t) = A(1 - e^{-\alpha t}\cos(\omega t + \varphi))$
  - Fit graphically *y(t)* to measured data
- **Frequency response**: `response.dat`
  - Import data: t, y_{input}, y_{output}
  - Plot data (on one graph): $y_{input}(t)$, $y_{output}(t)$
  - Define graphically *amplitude* & *phase change*

References

- Mathematical Tools at MIT

  web.mit.edu/ist/topics/math

  - MATLAB for student computers (free)

    http://matlab.mit.edu

- Course 16 MATLAB materials

  web.mit.edu/acmath/matlab/course16/

  web.mit.edu/acmath/matlab/unified/

QUESTIONS?