

Introduction to MATLAB

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[Topics]

- MATLAB Interface and Basics
- Calculus, Linear Algebra, ODEs
- Graphics and Visualization
- Basic Programming
- Programming Practice
- Statistics and Data Analysis

[Resources]

- Class materials

<http://web.mit.edu/acmath/matlab/IAP2007>

- Previous session: [InterfaceBasics](#) <.zip, .tar>
- This session: [Graphics](#) <.zip, .tar>

- Mathematical Tools at MIT web site

<http://web.mit.edu/ist/topics/math>

[MATLAB Help Browser]

- MATLAB

- + Graphics

- + MATLAB Plotting Tools

- + Annotating Graphs

- + Basic Plotting Commands

- + Figure Properties

- + Axes Properties

- + 3D Visualization

- + Creating 3D Graphs

MATLAB Graphics

2D and 3D Plotting
Figure Property Editing
Animation

[Figure Editor]

- To open a new figure window:
`>> figure`
- To plot in the current figure window:
`>> plot (X, Y, 'ro')`
`>> surf (x, y, z)`
`>> contour (x, y, z, N)`
- Plotting commands create a figure window if none is open.

[Creating 2D Graphs]

■ 2D linear plots: `plot`

```
>> plot (t, z, 'r-')
```

```
>> plot (X, Y, 'Color', [1 0 1], ...  
        'Marker', 'o', ...  
        'LineStyle', 'none')
```

■ Graph annotation

```
>> legend ('z = f(t)')
```

```
>> title ('Position vs. Time')
```

```
>> xlabel ('Time')
```

```
>> ylabel ('Position')
```

[Multiple Plots]

- Multiple datasets on a plot

```
>> p1 = plot(xcurve, ycurve)
>> hold on
>> p2 = plot(Xpoints, Ypoints, 'ro')
>> hold off
```

- Subplots on a figure

```
>> s1 = subplot(1, 2, 1)
>> p1 = plot(time, velocity)
>> s2 = subplot(1, 2, 2)
>> p2 = plot(time, acceleration)
```

[Graphics Exercises]

- Exercise One: `subplots.m`
 - 2D plotting
 - Subplots
 - Property Editor

Follow instructions in m-file ...

[Other 2D Graphs]

■ Contour plots

```
>> contour (x, y, z, N)
```

Note: **x**, **y**, and **z** are matrices, not vectors.

■ Polar coordinates

```
>> polar(theta, rho)
```

e.g. >> **t** = [0 : 0.01 : 2*pi]

```
>> polar(sin(t), cos(t))
```

[Creating 3D Graphs]

- Linear plots

```
>> plot3 (x, y, z, 'ro')
```

Note: **x**, **y**, and **z** are **vectors**.

- Surface and mesh plots

```
>> surf (x, y, z)
```

```
>> mesh (x, y, z)
```

Note: **x**, **y**, and **z** are **matrices**, not vectors.

- 3D contour plots

```
>> contour3 (x, y, z, N)
```

[3D Graph Example]

■ Domain Generation

```
>> [x, y] = meshgrid([-3 : 0.25 : 3], ...  
                    -3 : 0.25 : 3]);
```

```
>> z = x .* exp(-(x.^2 + y.^2));
```

■ Plot generation

```
>> s1 = surf(x, y, z)
```

[Figure and Axes Handles]

■ Get current figure and axes:

```
>> p1 = plot3(X, Y, 'ro')
```

```
>> fig1 = gcf
```

```
>> ax1 = gca
```

```
% Alternatively:
```

```
>> ax1 = get(fig1, 'CurrentAxes')
```

■ Set figure and axes' properties:

```
>> set(fig1, 'Color', [0.9 0.8 0.7])
```

```
>> axes(ax1)
```

```
>> axis([Xmin Xmax Ymin Ymax])
```

[Property Editor]

- Start Plot Edit mode

>> **ploteedit on**

... or click on  in the Figure window.

- Open Property Editor

View->Property Editor

- Select element to edit

e.g. Property Editor - Axes

- Edit element-specific properties

[Saving Figures]

- From the Figure window

File->Save As

- MATLAB format: *figurename.fig*
- Other formats: TIFF, JPEG, etc.

- From the command line

```
>> saveas(fig1, 'figurename.tif') 
```

[Graphics Exercises]

- Exercise Two: `surfacepoints.m`
 - 3D plotting
 - Multiple datasets
 - Figure and graphics handles
 - Graphics customizations
 - Graphics export

Follow instructions in m-file ...

[Animation]

- Create animated plot of $y(x)$

```
set(gcf, 'DoubleBuffer', 'on')
for i = 1 : length(x)
    p1 = plot(x(i), y(i), 'bo')
    hold on
    % Enforce the same axes
    set(gca, 'XLim', [xmin xmax], ...
            'YLim', [ymin ymax])

    drawnow
end
```

- Export animation: `getframe`, `movie2avi`

[Graphics Exercises]

- Animation Example: `helix.m`
- Exercise Three: `cubic.m`
 - Animations

Follow instructions in m-file ...