

Introduction to MATLAB

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[Topics]

- ✓ MATLAB Interface and Basics
- ✓ Linear Algebra and Calculus
- ✓ Graphics
- ✓ Programming
- MATLAB Practice
- Math On the Web (optional)
 - MATLAB Web Server

[Class Materials]

- On laptops download from:

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

- On Athena copy from locker **acmath**

```
athena% add acmath
```

```
athena% cp
```

```
    /mit/acmath/matlab/IntroMATLAB/Practice.tar .
```

[Help in MATLAB]

- Command line help

 - >> `help command`

 - e.g. `help guide`

 - >> `lookfor keyword`

 - e.g. `lookfor GUI`

- Desktop menu

 - Help->Help MATLAB

[MATLAB Help Browser]

- MATLAB

- + Programming

- + M-File Programming

- + Programming Tips

- + Creating Graphical User Interfaces

- + Getting Started with GUIDE

- + Creating a GUI

- + Laying Out GUIs and Setting Properties

- + Programming GUIs

- + GUI Applications

- + Working with Callbacks

- + Functions - Categorical List

MATLAB GUI Programming

Graphical User Interface
Widgets and Callbacks
GUIDE, FIG-Files and M-Files

[Graphical User Interface]

■ Widgets

- Text fields: static text, edit text
- Buttons: toggle, push, and radio buttons
- Popup menus
- Check boxes
- Sliders
- Axes
- Panels

■ Callbacks

Functions called by widgets.

[MATLAB Programs with GUI]

- FIG-File(s)
 - Created with GUIDE
 - GUI graphical layout (widgets)
- M-Files
 - Created in Editor/Debugger
 - The code behind a GUI
 - Function M-file to open the GUI
 - Function M-files with callbacks
 - Other function M-files

Built-In Functions

- GUIDE Editor

```
>> guide
```

```
>> guide filename
```

- Code behind a GUI

```
openfig
```

```
figure
```

```
findobj
```

```
set
```

```
get
```

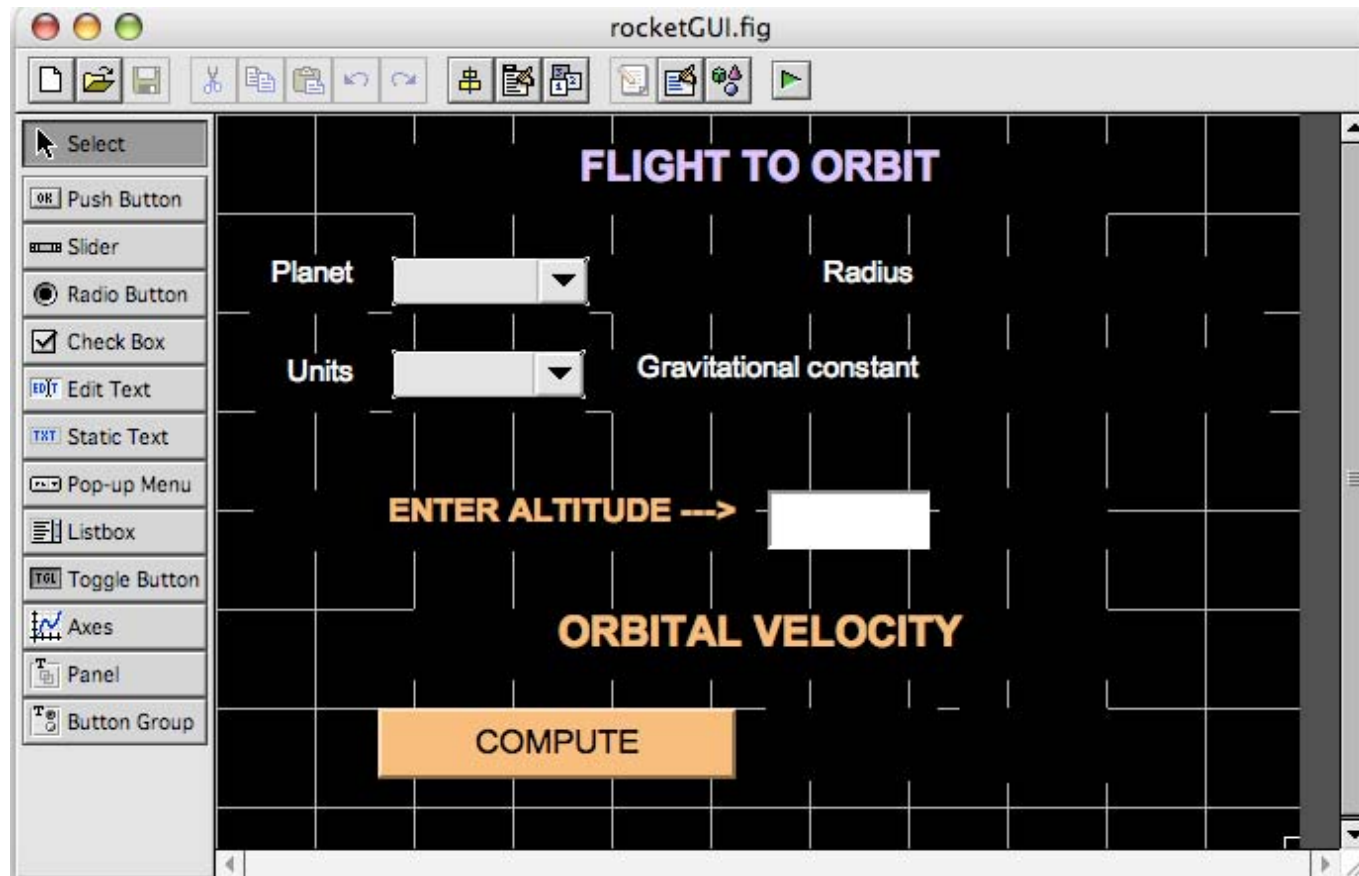
- Strings and numbers

```
str2num
```

```
num2str
```

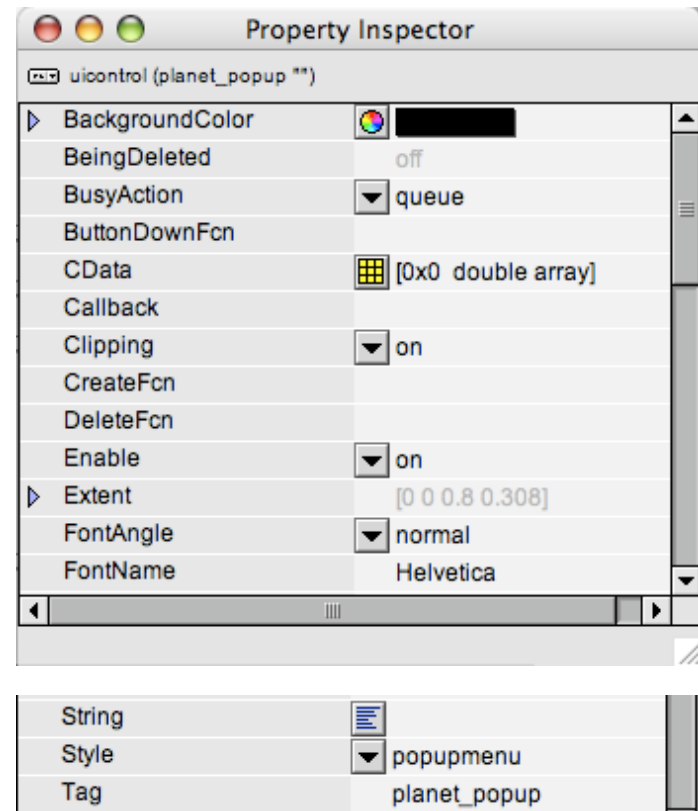
[GUIDE Editor: Layout Design]

```
>> guide GUIfilename
```



GUIDE: Property Inspector

- Double click on a widget to open the Property Inspector
- Set widget attributes
 - Tag
 - String
 - Fonts (optional)
 - Colors (optional)
- Do NOT set **Callback** function here



[GUI FIG-Files and M-Files]

- In GUIDE, save the graphical layout to a **FIG file**
 - Note: you may ignore the generated M-file.
- In Editor/Debugger, create **M-Files**
 - One M-File for every GUI Window
 - One M-File for every **Callback** function that is executed when the user interacts with widgets
 - Note: different widgets may call the same callback function.

[GUI M-Files]

- Functions:
 - To open the GUI: `openfig`, `figure`
 - To get access to widgets: `findobj`
 - To set attributes to widgets: `set`
 - To get attributes of widgets: `get`
- Widget attributes:
 - Widgets work with **STRINGS**, not numbers
 - `'String'` and `'Value'`
 - `'Tag'`
 - `'Callback'`

[GUI M-Files: Example]

```
function rocketprogram
% -----
fig1 = openfig('rocketGUI.fig', 'reuse')
figure(fig1)
% -----
R_units_txt = findobj( fig1, 'Tag', 'R_units_txt' );
units_popup = findobj( fig1, 'Tag', 'units_popup' );
% -----
set( R_units_txt, 'String', 'km' );
set( units_popup, 'String', { 'Metric', 'English' } );
set( units_popup, 'Value', 1);
set( units_popup, 'Callback', computevelocity);
```

[GUI M-Files: Example (continued)]

```
function computevelocity
% -----
units_popup = findobj( fig1, 'Tag', 'units_popup' );
H_input_txt = findobj( fig1, 'Tag', 'H_input_txt' );
% -----
units = get( units_popup, 'Value' );
strH   = get( H_input_txt, 'String' );
numH   = str2num( strH );
% -----
if units == 1
    V = orbitalvelocity( R, g0, numH, 'm' )
```

[Cleaning Up a Program]

■ MATLAB Editor's debugging mode

- Click next to line numbers to set stops

```
22  
23 ● elseif nargin == 3  
24
```

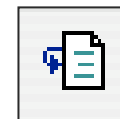
- Run program in Command Window

- The program runs in Debug Mode

⌘>> and stops at the set stops

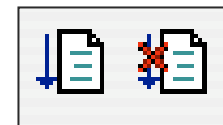
```
22  
23 ● → elseif nargin == 3  
24
```

- Click Step icon to proceed line by line



- Hold the cursor over a variable to see its current value

- Click Run icon to complete program's run or Exit Debug Mode icon to stop debugging



MATLAB Demos and Practice

MIT MATLAB Programs
MATLAB File Exchange
Questions & Answers

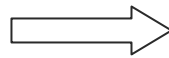
MIT MATLAB Demos

- **1.010 Uncertainty in Engineering**
 - Three programs for Monte Carlo simulations.
 - CC Andreas Langousis and Daniele Veneziano
- **6.013 Electromagnetics**
 - Several demos with graphical user interface
 - © 2004 Xiaowei He and Markus Zahn
- Download from:
<http://web.mit.edu/acmath/matlab/IntroMATLAB>
 - 1_010_statistics (.tar, .zip)
 - 6_013_electromagnetics (.tar, .zip)

[MATLAB File Exchange]

<http://www.mathworks.com/support>

User Community



File Exchange

... or go directly to ...

<http://www.mathworks.com/matlabcentral/fileexchange/>

- Various File Exchange Categories
- Download examples from:

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

MATLAB_File_Exchange_Downloads (.tar, .zip)

units.m, sun_position.m, sudoku.m

[Additional Training (Free)]

- Online MATLAB tutorial
https://web.mit.edu/tm/matlab_mastery_I/setup/Start.htm
- IAP 2006 advanced MATLAB seminars
 - Two sessions by Mathworks' instructors
 - Using MATLAB for Test and Measurement Applications
 - Advanced Programming Tips and Techniques for MATLAB 7
 - Math On the Web seminar
 - Including the MATLAB Web Server
 - Sponsored by Information Services & Technology
 - <http://web.mit.edu/violeta/www/IAP2006>

[Additional Training (For Fee)]

- From The Mathworks Inc.
 - Ongoing off campus
 - <http://www.mathworks.com/services/training>
 - 50% discount for MIT community
 - By request on MIT campus
 - Call The Mathworks directly, or ...
 - Call MIT Academic Computing to organize training sessions with Mathworks' instructors.
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Educational Technology Help

- Free help for educational technology needs on math tools at MIT
 - If you teach or TA an undergraduate course that needs teaching materials in MATLAB, or ...
 - If students in your department are required to know MATLAB in order to do their theses' research ...
- Contact the Educational Technology Consultants at MIT Academic Computing
 - et-consult@mit.edu or directly:
 - violeta@mit.edu

[IT Resources at MIT]

- MIT Information Services and Technology
<http://web.mit.edu/ist>
- Educational Technology services at MIT
(Academic Computing)
<http://web.mit.edu/ist/topics/educomp>
- Ed Tech Times (online journal)
<http://edtech.mit.edu/times>
- Teaching with Technology
<http://web.mit.edu/teachtech>

[MATLAB Practice Exercises]

- Exercise One: `rocketGUI.fig` and `rocketprogram.m`
 - Graphical User Interface: creating widgets with the `GUIDE` Editor
 - Callbacks: writing code behind a GUI
 - Cleaning up code with the Editor/Debugger
- Demos
 - MIT MATLAB programs
 - MATLAB File Exchange
- Questions & Answers