# MATH 100 – Introduction to the Profession
## Introduction to MATLAB

Greg Fasshauer

Department of Applied Mathematics
Illinois Institute of Technology

Fall 2012

# MATLAB Guides

Quite a bit of introductory material is posted online at
http://math.iit.edu/~fass/100.html.

# MATLAB Guides

Quite a bit of introductory material is posted online at
http://math.iit.edu/~fass/100.html.

This includes

- Getting Started in MATLAB (Some very basic info to get you off the ground — similar to the following slides)

# MATLAB Guides

Quite a bit of introductory material is posted online at
http://math.iit.edu/~fass/100.html.

This includes

- Getting Started in MATLAB (Some very basic info to get you off the ground — similar to the following slides)
- MATLAB's built-in help: *Video*, *Demos*, or *Getting Started*

# MATLAB Guides

Quite a bit of introductory material is posted online at
http://math.iit.edu/~fass/100.html.

This includes

- Getting Started in MATLAB (Some very basic info to get you off the ground — similar to the following slides)
- MATLAB's built-in help: *Video*, *Demos*, or *Getting Started*
- A MATLAB introduction basic_definitions.m along with all the other scripts that are called by this.

# MATLAB Guides

Quite a bit of introductory material is posted online at
http://math.iit.edu/∼fass/100.html.

This includes

- Getting Started in MATLAB (Some very basic info to get you off the ground — similar to the following slides)
- MATLAB's built-in help: *Video*, *Demos*, or *Getting Started*
- A MATLAB introduction basic_definitions.m along with all the other scripts that are called by this.

A *Very Elementary MATLAB Tutorial* is available directly from The MathWorks.

- MATLAB is widely used in many areas of applied mathematics and engineering.

- MATLAB is widely used in many areas of applied mathematics and engineering.
- MATLAB stands for MATrix LABoratory and the software uses vectors and matrices as basic building blocks.

- MATLAB is widely used in many areas of applied mathematics and engineering.
- MATLAB stands for MATrix LABoratory and the software uses vectors and matrices as basic building blocks.
- We have to learn to think "the MATLAB way" if we want to take full advantage.

- MATLAB is widely used in many areas of applied mathematics and engineering.
- MATLAB stands for MATrix LABoratory and the software uses vectors and matrices as basic building blocks.
- We have to learn to think "the MATLAB way" if we want to take full advantage.
- In addition to its computational engine MATLAB provides a powerful graphical interface that allows us to produce both 2D and 3D plots.

- MATLAB is widely used in many areas of applied mathematics and engineering.
- MATLAB stands for MATrix LABoratory and the software uses vectors and matrices as basic building blocks.
- We have to learn to think "the MATLAB way" if we want to take full advantage.
- In addition to its computational engine MATLAB provides a powerful graphical interface that allows us to produce both 2D and 3D plots.
- In addition to its interactive mode, MATLAB is also one of the easiest programming languages for solving mathematical problems.

- MATLAB is widely used in many areas of applied mathematics and engineering.
- MATLAB stands for MATrix LABoratory and the software uses vectors and matrices as basic building blocks.
- We have to learn to think "the MATLAB way" if we want to take full advantage.
- In addition to its computational engine MATLAB provides a powerful graphical interface that allows us to produce both 2D and 3D plots.
- In addition to its interactive mode, MATLAB is also one of the easiest programming languages for solving mathematical problems.
- MATLAB's basic capabilities can be extended by calling functions defined in additional *toolboxes*.

- All IIT computer labs should have MATLAB installed. You can also purchase the Student Version for about $100.

- All IIT computer labs should have MATLAB installed. You can also purchase the Student Version for about $100.
- Usually we use MATLAB via its windows-based interface, and start it like any other program.

- All IIT computer labs should have MATLAB installed. You can also purchase the Student Version for about $100.
- Usually we use MATLAB via its windows-based interface, and start it like any other program.
- Important MATLAB windows:
    - Command window: where you work in interactive mode (at the » command prompt), or run programs (M-files)

- All IIT computer labs should have MATLAB installed. You can also purchase the Student Version for about $100.
- Usually we use MATLAB via its windows-based interface, and start it like any other program.
- Important MATLAB windows:
    - Command window: where you work in interactive mode (at the » command prompt), or run programs (M-files)
    - Editor window: where you write your program code, and then save it to your hard drive (other text editors are also allowed)

- All IIT computer labs should have MATLAB installed. You can also purchase the Student Version for about $100.
- Usually we use MATLAB via its windows-based interface, and start it like any other program.
- Important MATLAB windows:
    - Command window: where you work in interactive mode (at the » command prompt), or run programs (M-files)
    - Editor window: where you write your program code, and then save it to your hard drive (other text editors are also allowed)
    - Help window: where you can get online help (can also type `help` or `help <command name>` at the command prompt)

- All IIT computer labs should have MATLAB installed. You can also purchase the Student Version for about $100.
- Usually we use MATLAB via its windows-based interface, and start it like any other program.
- Important MATLAB windows:
    - Command window: where you work in interactive mode (at the » command prompt), or run programs (M-files)
    - Editor window: where you write your program code, and then save it to your hard drive (other text editors are also allowed)
    - Help window: where you can get online help (can also type `help` or `help <command name>` at the command prompt)
- Other MATLAB windows:
    - Command History window
    - Current Directory window
    - Workspace window (provides information about all the variables in use)

Other important things

- In an emergency (such as a run-away loop) you can interrupt MATLAB by typing Ctrl-C (note that sometimes it may take MATLAB a while to "come back" from heavy calculations).

Other important things

- In an emergency (such as a run-away loop) you can interrupt MATLAB by typing Ctrl-C (note that sometimes it may take MATLAB a while to "come back" from heavy calculations).
- Once you have finished your work you can exit MATLAB by either typing `quit` at the prompt (») in the Command window, by going to the File→Exit menu, or by closing the Command window in the usual way.

Other important things

- In an emergency (such as a run-away loop) you can interrupt MATLAB by typing Ctrl-C (note that sometimes it may take MATLAB a while to "come back" from heavy calculations).
- Once you have finished your work you can exit MATLAB by either typing `quit` at the prompt (») in the Command window, by going to the File→Exit menu, or by closing the Command window in the usual way.
- In addition to the windows-based interface with all its bells and whistles MATLAB also has a command-line interface that can be invoked by using additional switches such as `matlab -nodesktop`.

- While you can enter individual MATLAB commands interactively in the Command window, you will often want to combine a sequence of commands into a program (also called a script file or function file).

- While you can enter individual MATLAB commands interactively in the Command window, you will often want to combine a sequence of commands into a program (also called a script file or function file).
- You need to write such programs in a separate editor (see above).

- While you can enter individual MATLAB commands interactively in the Command window, you will often want to combine a sequence of commands into a program (also called a script file or function file).
- You need to write such programs in a separate editor (see above).
- If the Editor does not open by itself when you start MATLAB you can invoke it via the File→New→M-File menu (for a new file) or File→Open menu (for an existing file).

- While you can enter individual MATLAB commands interactively in the Command window, you will often want to combine a sequence of commands into a program (also called a script file or function file).
- You need to write such programs in a separate editor (see above).
- If the Editor does not open by itself when you start MATLAB you can invoke it via the File→New→M-File menu (for a new file) or File→Open menu (for an existing file).
- Basic use of the editor is straightforward.

- While you can enter individual MATLAB commands interactively in the Command window, you will often want to combine a sequence of commands into a program (also called a script file or function file).
- You need to write such programs in a separate editor (see above).
- If the Editor does not open by itself when you start MATLAB you can invoke it via the File→New→M-File menu (for a new file) or File→Open menu (for an existing file).
- Basic use of the editor is straightforward.
- Many advanced features are also available (such as adding breakpoints to your code for debugging purposes).

# How to save and run a MATLAB program — M-file

While typing your code in the editor, no commands will be performed!
In order to run a program do the following:

# How to save and run a MATLAB program — M-file

While typing your code in the editor, no commands will be performed!
In order to run a program do the following:

- In the Editor save your code as an M-file with some filename you pick. (MATLAB should automatically add the .m extension that is required for the file to be recognized as a MATLAB program file).

# How to save and run a MATLAB program — M-file

While typing your code in the editor, no commands will be performed!
In order to run a program do the following:

- In the Editor save your code as an M-file with some filename you pick. (MATLAB should automatically add the `.m` extension that is required for the file to be recognized as a MATLAB program file).

- Go to the Command window. Make sure the folder your Command window is looking at is the same one you saved your program in!

# How to save and run a MATLAB program — M-file

While typing your code in the editor, no commands will be performed!
In order to run a program do the following:

- In the Editor save your code as an M-file with some filename you pick. (MATLAB should automatically add the `.m` extension that is required for the file to be recognized as a MATLAB program file).
- Go to the Command window. Make sure the folder your Command window is looking at is the same one you saved your program in!
- Run the program by entering its name (without the `.m` extension) at the command prompt.

# How to save and run a MATLAB program — M-file

While typing your code in the editor, no commands will be performed!
In order to run a program do the following:

- In the Editor save your code as an M-file with some filename you pick. (MATLAB should automatically add the .m extension that is required for the file to be recognized as a MATLAB program file).
- Go to the Command window. Make sure the folder your Command window is looking at is the same one you saved your program in!
- Run the program by entering its name (without the .m extension) at the command prompt.
- If your code contained an error, MATLAB will interrupt execution of the program and provide you with an error message. You can click on the error message, and will be taken to the corresponding place in the code in the Editor.

# A first script file

Example (Assigning Mystery Terms for Scavenger Hunt)

We now use our first MATLAB script.

It will create a scrambled list of your names assigned to a list of mathematical "mystery terms" you need to research for our mathematical scavenger hunt.

Run `scavenger_assign.m`

# Diary files

It is also possible to record the work you perform interactively in the Command window[1].
To do this one uses a so-called **diary file** (a simple text file that you can view with any text editor, such as the MATLAB Editor).

---

[1]Most people—once they're used to MATLAB—will write M-files.

## Diary files

It is also possible to record the work you perform interactively in the Command window[1].

To do this one uses a so-called **diary file** (a simple text file that you can view with any text editor, such as the MATLAB Editor).

- Make sure you are in the folder you want to be in. If needed, change MATLAB's "Current Folder".
- **To start recording and open the diary file**, type `diary filename.txt` at the command prompt.
- **To stop recording and close the diary file**, type `diary off`.
- Frequently, you will want to open the diary file in the editor and clean up your session.

---

[1]Most people—once they're used to MATLAB—will write M-files.

## Diary files

It is also possible to record the work you perform interactively in the Command window[1].

To do this one uses a so-called **diary file** (a simple text file that you can view with any text editor, such as the MATLAB Editor).

- Make sure you are in the folder you want to be in. If needed, change MATLAB's "Current Folder".
- **To start recording and open the diary file**, type `diary filename.txt` at the command prompt.
- **To stop recording and close the diary file**, type `diary off`.
- Frequently, you will want to open the diary file in the editor and clean up your session.

Note that everything displayed in the Command window is stored in the diary file. Graphical output, however, does not get preserved in the diary. Typing `help diary` provides more details.

[1] Most people—once they're used to MATLAB—will write M-files.

To illustrate the use of diaries we type at the command prompt

```
diary math100_0830.txt, scavenger_assign, diary off
```

which results in the following content of `math100_0830.txt`:

```
ans =
    'John'        'Bayesian experimental design'
    'Felipe'      'boundary integral method'
    'Martha'      'Boussinesq equation'
    'Joanna'      'counter party risk assessment'
    'Jessica L'   'dynamic coherent acceptability index'
    'Roxanne'     'generalized hill climbing algorithm'
    'Carlo'       'Gibbs-Thomson effect'
    'Jessica M'   'graph knapsack problem'
    'Hongwei'     'Hele-Shaw flow'
    'Beatriz'     'isometric operator'
    'Miriam'      'kernel approximation'
    'Yibin'       'large eddy simulation'
    'Zhizhen'     'liar game'
    'Jason'       'Monte-Carlo method'
    'Timothy'     'multidimensional quadrature'
    'Imran'       'native space'
    'Lingfeng'    'nonparametric modeling'
    'Ashley'      'orthogonal art gallery'
    'James'       'random variable'
    'Todor'       'stochastic partial differential equation'
    'Yangge'      'Stokes flow'
    'Magni'       'tractability'
    'Ryne'        'two repairmen problem'
    'Martin'      'vortex sheet'
    'Intan'       'Wiener-Hopf operator'
    'Danielle'    'stochastic regression model'
    'Machao'      'graph packing'
```
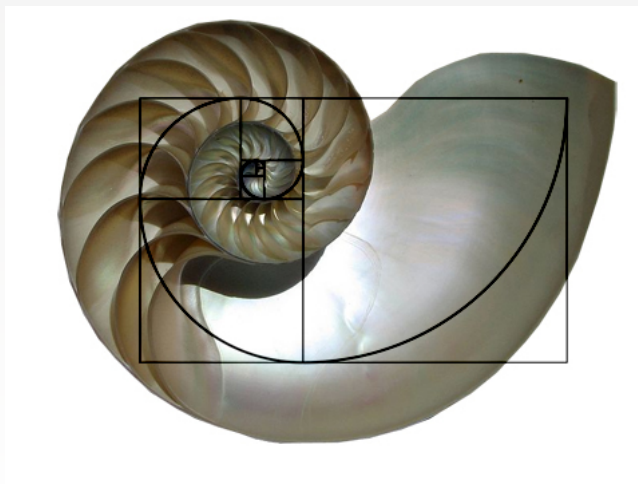
# Supplements to [ExM, Chapter 1]



Figure : The golden ratio in nature: a nautilus shell.

# Greek Temples



Figure : The Concordia Temple in Agrigento, Sicily.
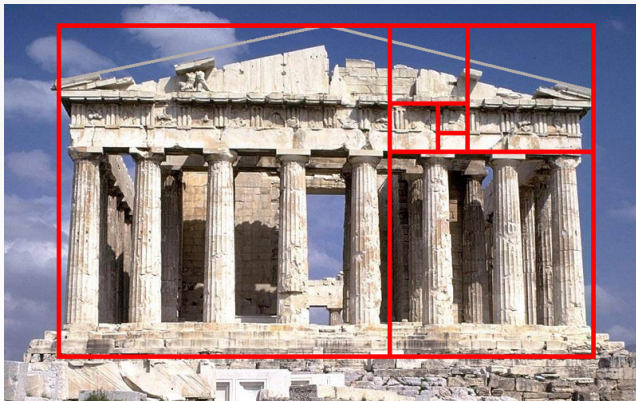
# Greek Temples



Figure : The Parthenon with golden rectangle superimposed.

## Example (Calculation of golden ratio, from Ch .1 [ExM])

```
x = 3
while x ~= sqrt(1+x)
x = sqrt(1+x)
end
```

## Example (Calculation of golden ratio, from Ch .1 [ExM])

```
x = 3
while x ~= sqrt(1+x)
x = sqrt(1+x)
end
```

BUT, it is dangerous to compare floating point numbers for equality.
They are not evenly spaced!

```
eps(0), eps(1), eps(2)
```

Example (Calculation of golden ratio, from Ch .1 [ExM])

```
x = 3
while x ~= sqrt(1+x)
x = sqrt(1+x)
end
```

BUT, it is dangerous to compare floating point numbers for equality.
They are not evenly spaced!

```
eps(0), eps(1), eps(2)
```

Therefore, since `eps = eps(1)`,

```
eps == 0
1 + eps == 1
2 + eps == 2
```

Look through `chapter1_recap.m`.

# References I

📕 T. A. Driscoll.
Learning MATLAB.
SIAM, Philadelphia, 2009.
http://epubs.siam.org/ebooks/siam/other_titles_in_applied_
mathematics/ot115

📕 D. J. Higham and N. J. Higham.
MATLAB Guide.
SIAM (2nd ed.), Philadelphia, 2005.
http://epubs.siam.org/ebooks/siam/other_titles_in_applied_
mathematics/ot92

📕 C. Moler.
Numerical Computing with MATLAB.
SIAM, Philadelphia, 2004.
http://www.mathworks.com/moler/index_ncm.html

# References II

C. Moler.
Experiments with MATLAB.
Free download at
http://www.mathworks.com/moler/exm/chapters.html

The MathWorks.
MATLAB 7: Getting Started Guide.
http://www.mathworks.com/access/helpdesk/help/pdf_doc/
matlab/getstart.pdf