# Introduction to MATLAB Programming with Applications

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MATLAB 335
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>> Lecture 0
>>
>>              -- Introduction
>>
```

# Class Information

- Instructor: 盧政良 (Zheng-Liang Lu)
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- The course website is

  http://www.csie.ntu.edu.tw/~d00922011/matlab.html.
- All lecture slides are organized in English and will be modified if necessary.

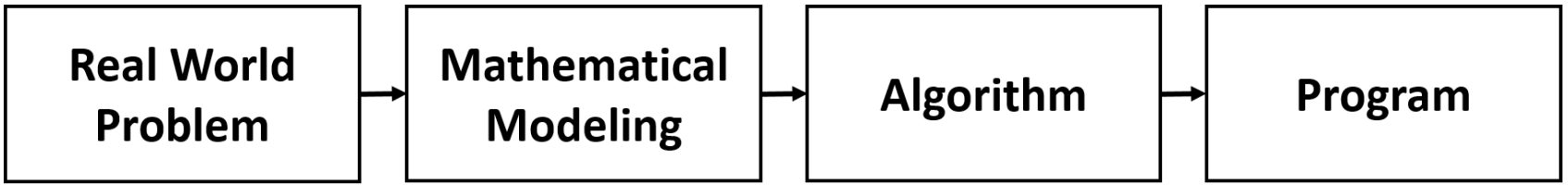
# Teaching Philosophy

- I try to lower the barriers to entry.
- I provide resources as many as possible.
- I answer your questions.

# Roll Call

# What Can A Program Do?

- A program is an implementation of an algorithm expressed in a specific programming language.



# Algorithms In A Nutshell[1]

- An algorithm is a well-defined computational procedure that takes necessary information as input and produces an correct answer as output.
- Simply put, an algorithm is a procedure that solves a specific class of problems, like a recipe or a cookbook.


[1] Also see `http://ed.ted.com/lessons/your-brain-can-solve-algorithms-david-j-malan`.

- An algorithm has properties as follows:
  - Definiteness: all steps are precisely defined.
  - Finiteness: for any input, the algorithm must terminate after a finite number of steps (time).
  - Effectiveness: operations are basic enough (e.g. $+ - \times \div$) to be able to done exactly and in a finite number of steps.
- Note that an algorithm could be expressed not only in programming languages, but also in human languages, flow charts, and pseudo codes.

# Example: Greatest Number

- Let $A$ be a list of numbers.
- For example, consider $A = \{1, 7, 9, -2, 4\}$.
- Then it is clear that the answer is 9.
- Now propose an algorithm which finds the greatest element in for any list of numbers.

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**Input**: $A$.
**Output**: the greatest element in $A$.

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- Try a top-down approach in your native language?

# Optimal Solution

- Let $A(1)$ be the first element of $A$ and so on.
- The symbol $\leftarrow$ is a copy operator from right to left.

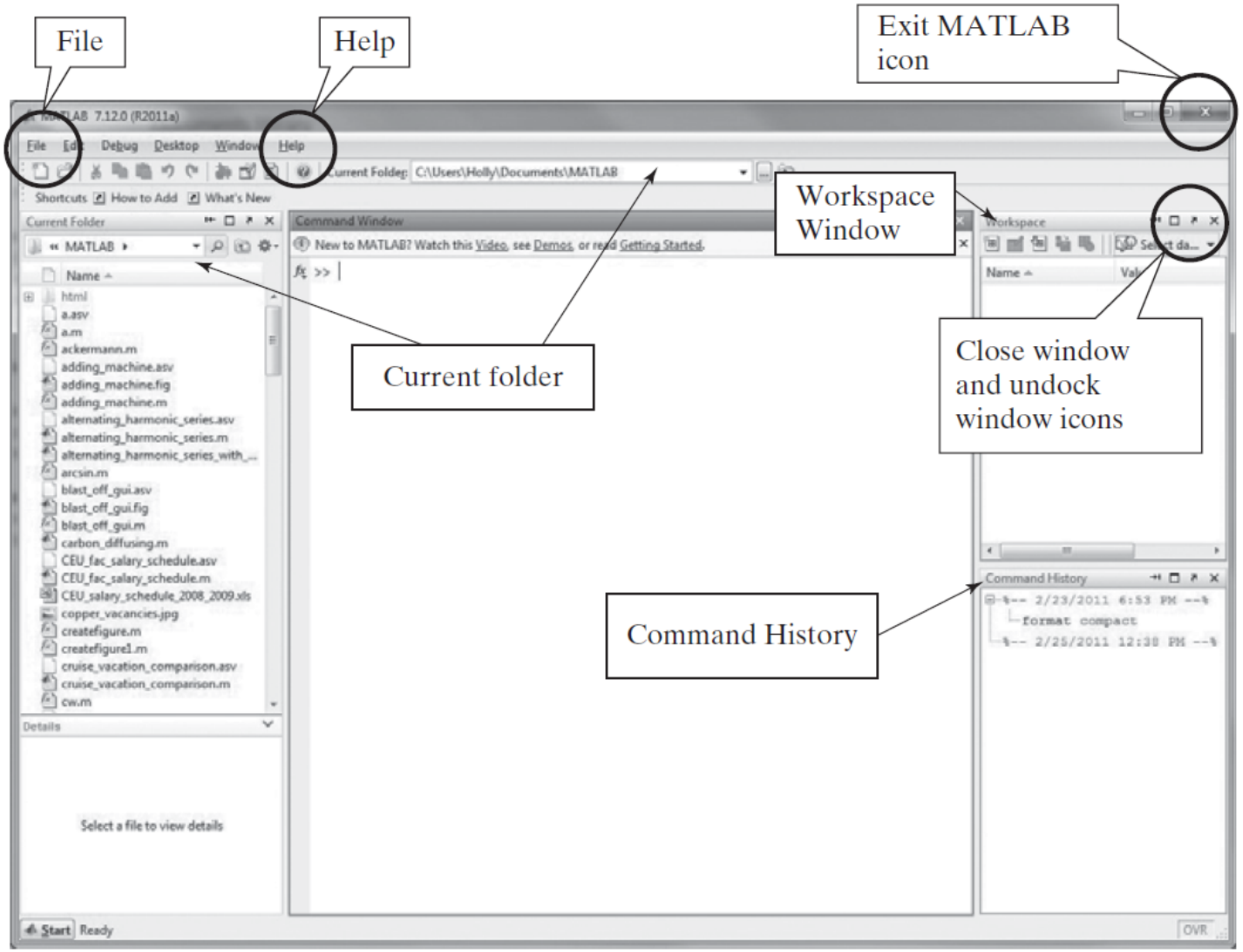
```
1 max <- A(1)
2 for i <- 2 ~ n
3     if A(i) > max
4         max <- A(i)
5     end
6 end
7 return max
```

- In Line 1, why not $\boxed{\text{max} \leftarrow 0}$ but $\boxed{\text{max} \leftarrow A(1)}$?
- You may extend this solution to more questions:
  - Smallest element?
  - Location of the greatest element?

# Remarks

- Program design $\approx$ data structures + algorithms
  - Data structures: organize your data in an efficient way
  - Algorithms: process your data so that you can derive the solution
- In some sense, we can say that programming languages are less important than the two above.
- Here we will learn programming concepts and classical algorithms in MATLAB.

# MATLAB: An Overview



# Command Window

- Let's try a greeting, "Hello, MATLAB."

```
>> disp("Hello, MATLAB.");
```

  - **disp** takes the string as input and outputs it on the screen.
  - A string is double-quoted in MATLAB.
- The convention in the slides is as follows:
  - Boxes show the listings for sample programs.
  - Important words and sentences are highlighted in red.
  - Words in blue are reserved words.
  - Bold words in black are functions.

# Errors

- MATLAB interrupts your program if an error occurs.
- Don't be frustrated by these red lines.
- Most of these errors detected by MATLAB are syntax errors and runtime errors, which can be avoided by more practices.
- Logic errors cannot be found by the machine itself!

*"Why do we fall sir? So that we can learn to pick ourselves up."*

– Alfred Pennyworth, *Batman Begins* (2005)

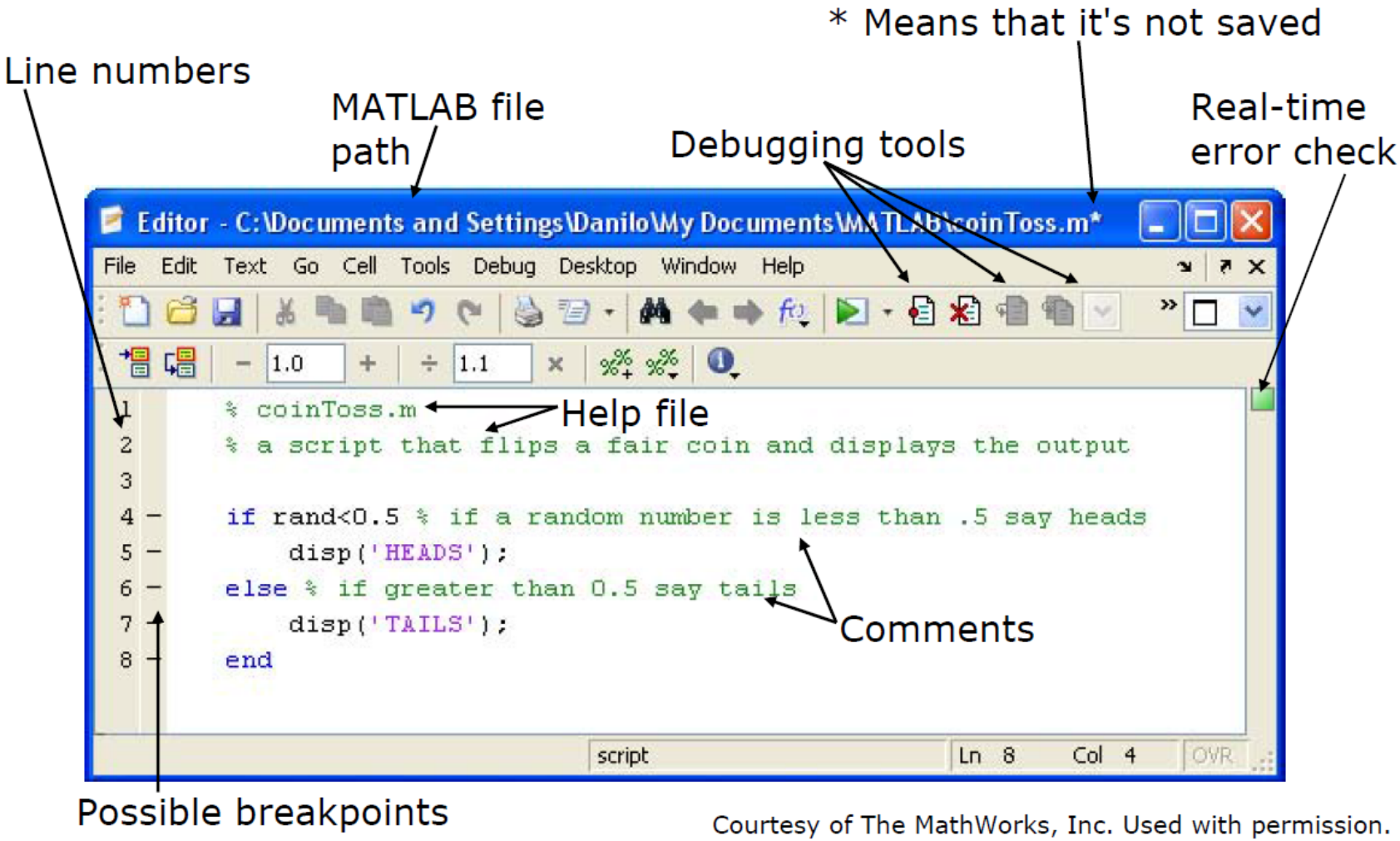
# Help Yourself

- **help** followed by the command name shows the usage of that command, for example,

```
>> help disp
...
```

- The reference page also provides the detail of commands with fruitful examples.
- Google is your best friend (when you learn by yourself).

# Scripts: the Editor




Courtesy of The MathWorks, Inc. Used with permission.

# Debut: Your First MATLAB Program

```
% This is my first MATLAB program.

clear; % Clear all variables stored in the workspace.
clc; % Clear the screen.
% Main program
disp("Hello, Matlab.");
```

- The lines which begin with % are treated as comments which won't be executed.
- The command **clear** is used to release all the variables in the workspace[2].
- Use **clc** to clean the command window.

[2] You may delete the variable $x$ by calling **clear** $x$.

- To run this program, we need to save to a file, for example, helloworld.m.
- Click the *Run* button.[3]
- Alternatively, press F5 for saving the file and executing the program.

```
>> helloworld

Hello, world.
```

[3] If this script is not at the current folder when you execute it, MATLAB will offer two options: (1) change folder, or (2) add to path pool. We often choose (1).

# Block Comments

- Press ctrl + r to comment lines.
- Press ctrl + t to de-comment lines. (Useful!)
- The contiguous comment lines starting from the top of file are regarded as the program document.

```
>> help helloworld

This is my first MATLAB program.
```

- We can easily organize the program by these two hot keys during the trial-and-error stage.