ENGR 0012 – Engineering Problem Solving

Goals for this week:

- Introduce MATLAB and some basic commands
  - Create variables and arrays

MATLAB, or Matrix Laboratory, is “a technical computing environment for high-performance numeric computation and visualization”[1]

1. From course textbook

Some facts about MATLAB:

- It is user friendly
- You can do calculations, programming, and graphical analyses
- Treats all variables as matrices

You will learn MATLAB, though you may not yet be familiar with many of its applications

- MATLAB can be used for matrix theory, linear algebra, curve fitting, statistics, etc.

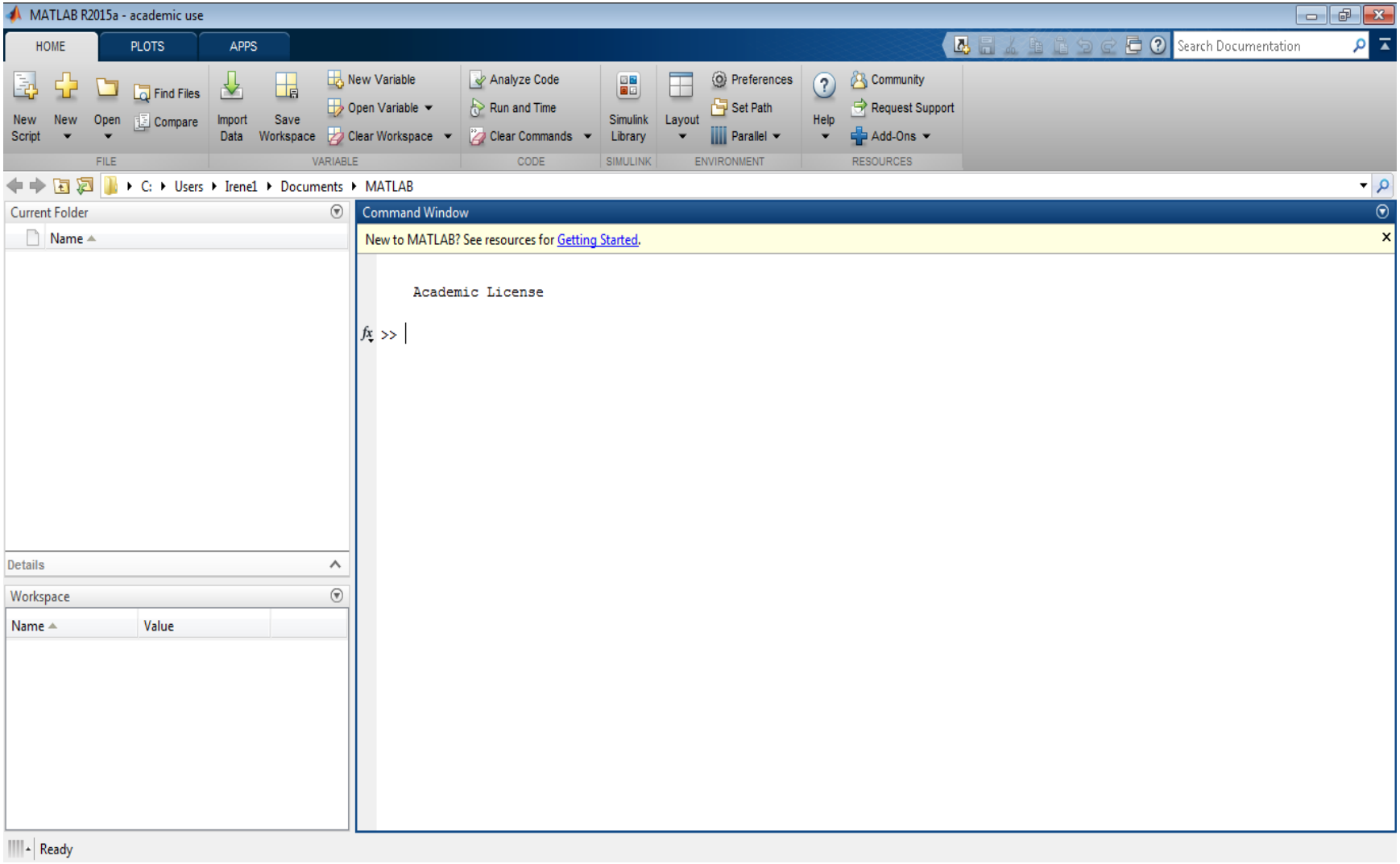
You can find MATLAB in all campus computing labs

- More information in Pitt's technology website

Try it!

- Click on the MATLAB icon or find it in the Start Menu
- You may see a registration window first, then the start up display

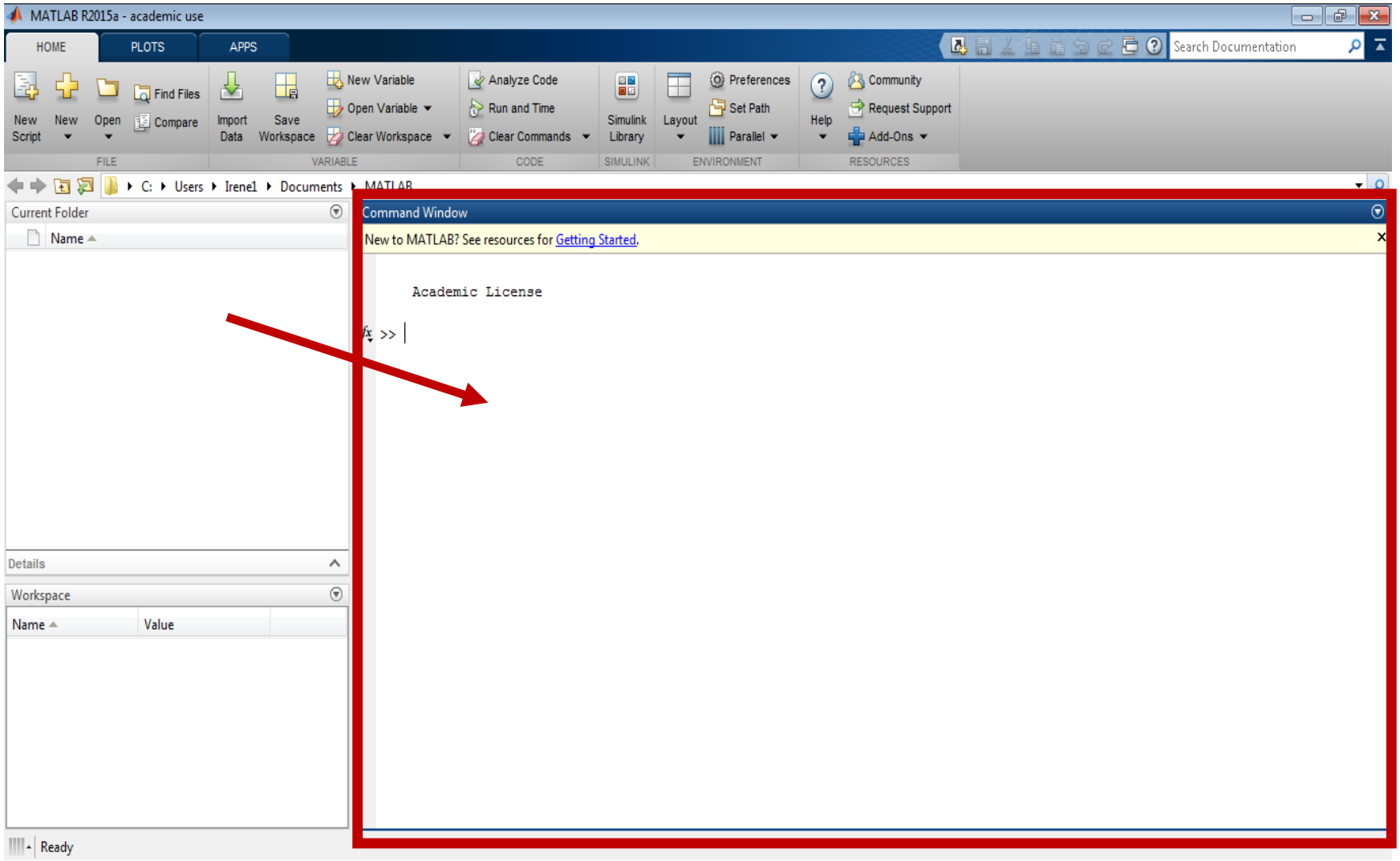
You will see certain things:



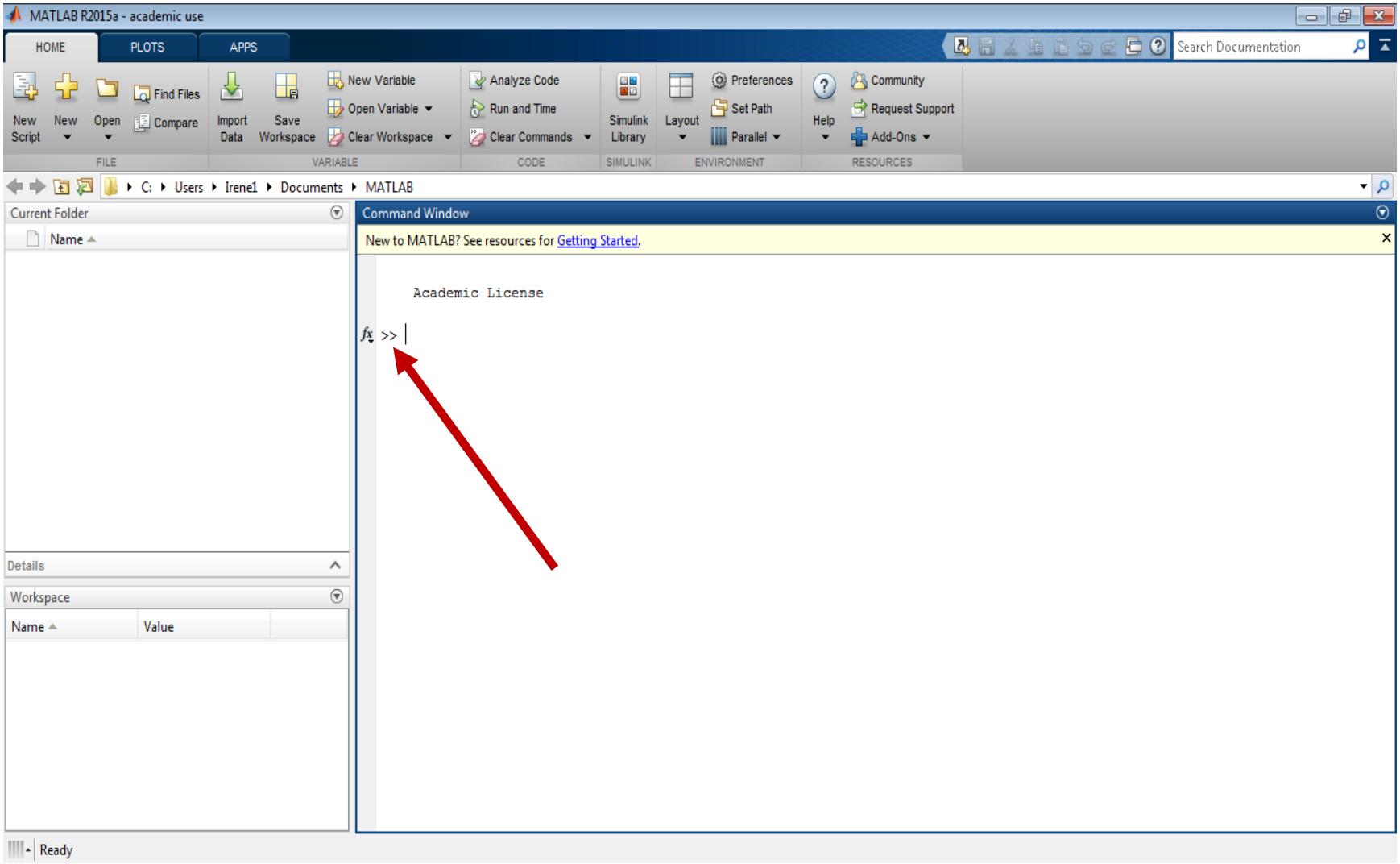
You can close or adjust sizes of the windows!

From slides by N. Vidic

The command window is used to enter commands and see the text output

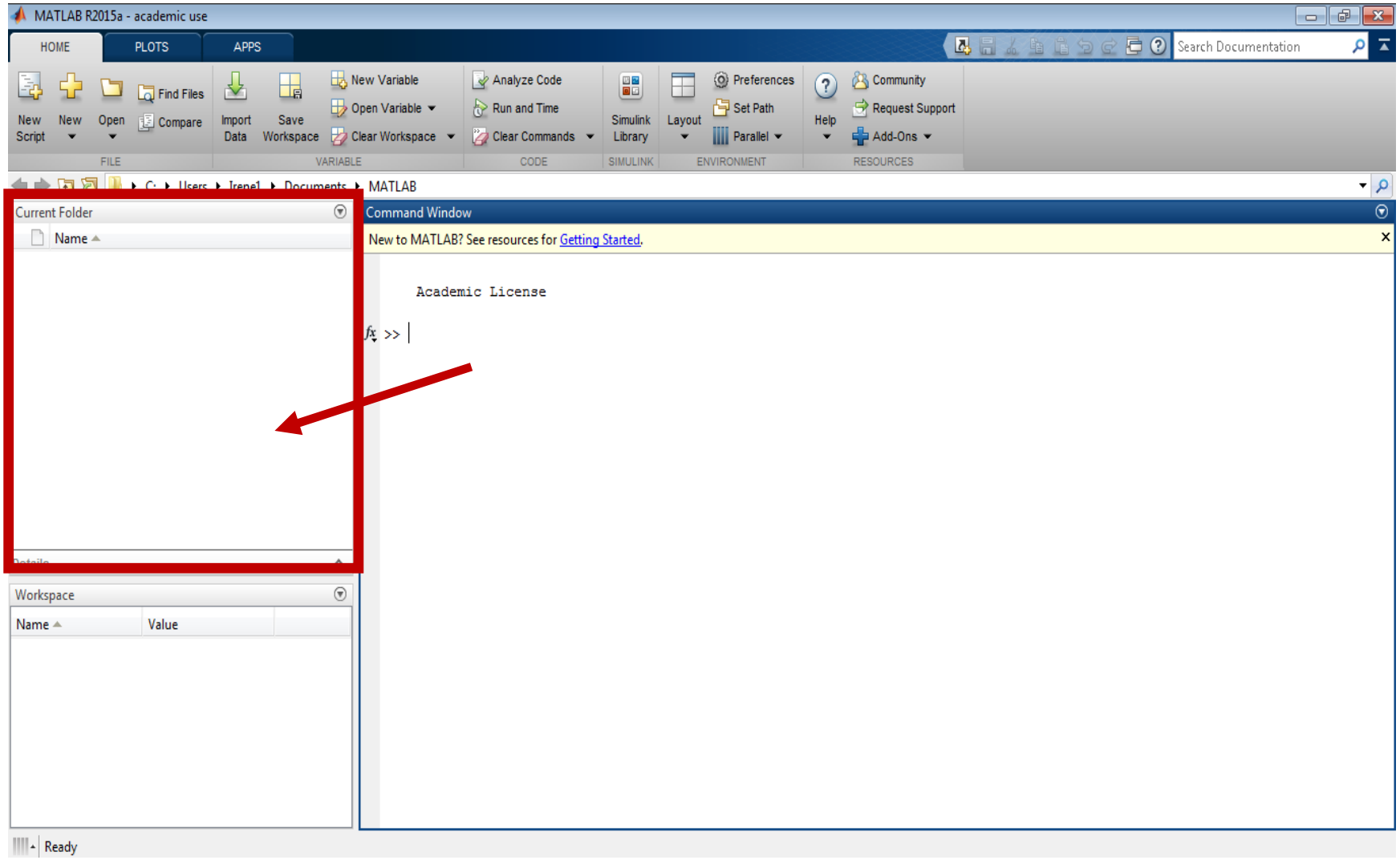


The prompt indicates that MATLAB “is ready to receive your commands”[1]

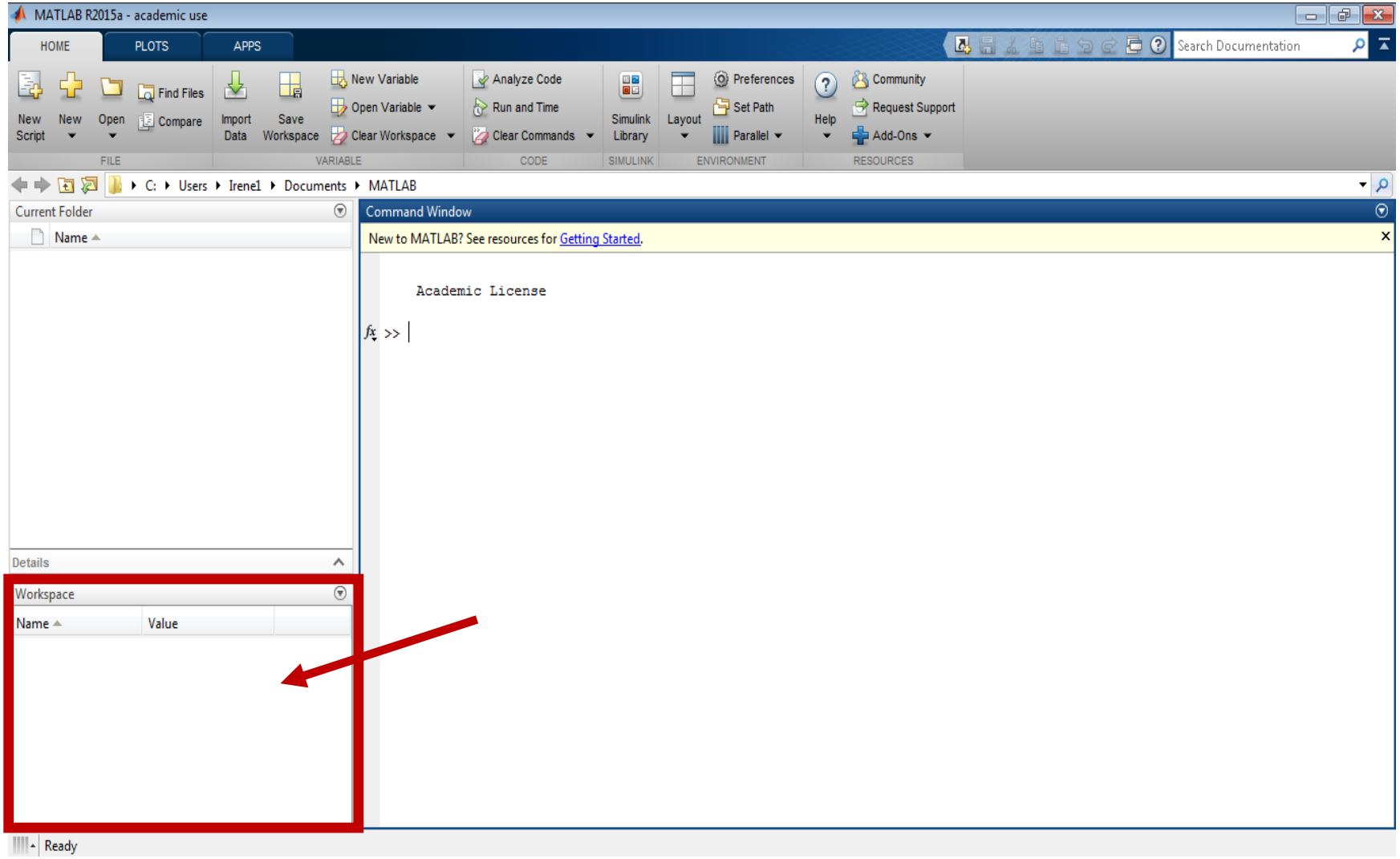


1. From course textbook

The current folder window will display folders, files, functions, etc.



The workspace window shows the defined variables



From slides by N. Vidic

See examples of what MATLAB can do!

- >>demo

You can use MATLAB for basic mathematical functions – as you would a calculator

- +
- -
- *
- / or \ → they mean different things!
- ^

Did you see the variable “ans”?

Scalar right division (/) and scalar left division (\) are different: the denominator is the 2nd number in / and the 1st number in \

```
>> 4/2
ans =
     2
```

```
>> 4\2
ans =
    0.5000
```

The order of the operations follows the standard rules of precedence

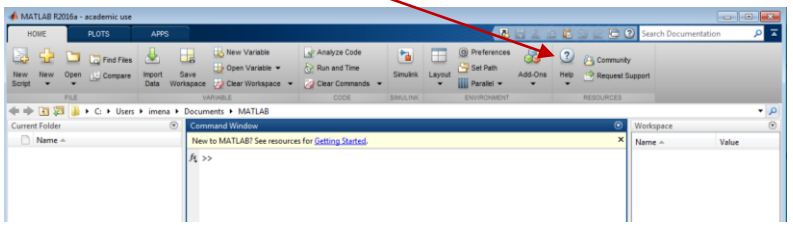
- Left to right
- Exponentiation, then multiplication or division, then addition or subtraction
- Parentheses affect the order as well

Let’s try this!
What results do you get?

- 4^2-3*4+2/4
- 4^2-(3*4+2)/4
- (4^2-(3*4+2))/4
- 4^(2-3)*(4+2/4)

You can ask MATLAB for help in different ways

- Through the command window (>>help) or (>>help *command*)
- Through the help button
- Through your browser



You can use MATLAB for basic mathematical functions – as you would a calculator

- +
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- / or \ → they mean different things!
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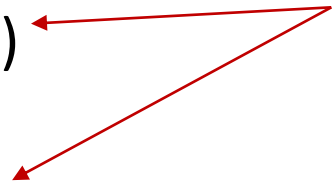
In addition to these basic functions, MATLAB has other standard functions

- Trigonometric functions
- Logarithmic functions
- sqrt and abs
- Many more – see textbook

These basic functions have these function calls:

- sqrt(number) → sqrt(9)
- sqrt(variable) → sqrt(books)
- sqrt(operation) → sqrt(books*3)



Some things to keep in mind:

- Trigonometric functions are in radians – there are separate functions if you are using degrees
  - sin(30) versus sind(30)
- The natural log (usually “ln”) is log and the base 10 log (usually “log”) is log10
- e^n is exp(n)

There are some rules and suggestions to follow when naming variables:

YES

- UPPER and lower case letters, numbers, underscores
- Must begin with a letter
- ≤ 63 characters (but depends on version)
- Case sensitive
- Be descriptive!

NO

- Spaces between characters in a name
- Names that differ by one letter
- Same name for different variables
- Existing function names

See more information in the textbook

Your turn!

- Create at least three different variables
- Perform math operations on them (including trig functions, exponents, and square roots)

- Check out some existing variables:

```
calendar
date
clock
```

- If you want more information, use help:

```
help calendar
```

MATLAB stores data as matrices and arrays

- A scalar is a 1x1 matrix
- A row vector or column vector (these are one-dimensional arrays) have a single row or column
- A matrix has various rows and columns

Example

The colon method and linspace methods are useful in creating arrays

- Colon method

  startValue:stepSize:endValue

- Linspace method

  linspace(startValue, endValue, numberOfValues)

Use the linspace method to specify number of points and the colon method to specify step size

Other useful commands:

- ones
- zeros
- size
- length

Your turn!

1. Create a row vector called A with elements 1 2 3 4. Use commas to separate the data.

2. Create a row vector called B with elements 5 6 7 8. Use spaces to separate the data.

3. Create matrix D with the arrays A and B as the rows

4. Create matrix E, a 4x4 matrix of all ones

5. Create an array F of 6 numbers, equally spaced from 1 to 10 (use linspace)

6. Create an array G of numbers from 1 to 5, with a step size of 0.5 (use the colon method)

Commands used to concatenate:

- cat

  cat(Dim, M1, M2) →

  Dim is either 1 (add rows) or 2 (add columns)

- vertcat

- horzcat

- strcat

- num2str

cat(Dim, M1, M2)

vertcat

horzcat

strcat

num2str

Your turn!

1. Create MatrixA= $\begin{matrix} 1 & 3 & 5 \\ 2 & 4 & 6 \end{matrix}$

2. Create MatrixB= $\begin{matrix} 11 & 13 & 15 \\ 12 & 14 & 16 \end{matrix}$

3. Use one of the concatenation commands to create the equivalent of MatrixC=[MatrixA , MatrixB]

4. Use one of the concatenation commands to create the equivalent of MatrixC=[MatrixA ; MatrixB]

5. Create variable MyName that has your name, and variable MyAge that has your age. Have MATLAB display this sentence: “My name is *MyName* and I am *MyAge* years old.”