

# MATH 3341: Introduction to Scientific Computing Lab

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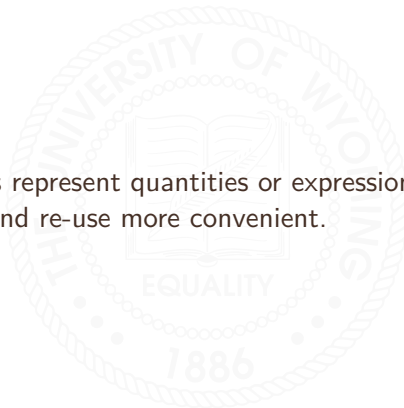
## Lab 02: Variables, Arrays, and Scripts



## Variables



Variables help us represent quantities or expressions in order to make their use and re-use more convenient.



# Naming Variables

- Must start with a letter.
- Followed by letters (a-z, A-Z) or numbers (0-9) or underscores (\_).
- Maximum 63 characters (excluding the .m extension).
- Must not be the same as any MATLAB reserved word.
- Space is not permitted.
- Case sensitive, i.e., `a`  $\neq$  `A`.



# Naming Variables

- Be as descriptive as possible with your variable names.
- Avoid built-in function/variable names (reserved keywords) such as `pi`, `sin`, `exp`, etc.
- Check if a name is already in use: `which variableName` or `exist variableName`.



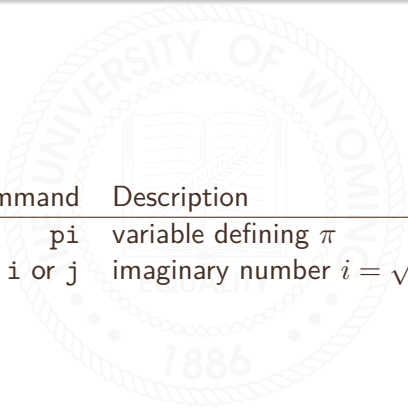
# Naming Conventions

- snake\_case: writing compound words or phrases in which the elements are separated with one underscore character ( \_ ) and no spaces, e.g. “foo\_bar”.
- camelCase: writing compound words or phrases such that each word or abbreviation in the middle of the phrase begins with a capital letter, with no intervening spaces or punctuation, e.g. “fooBar”
- Other conventions: Hungarian notation, positional notation, etc.

Reference: [https://en.wikipedia.org/wiki/Naming\\_convention\\_\(programming\)](https://en.wikipedia.org/wiki/Naming_convention_(programming))



# Default Variable Definitions



Command	Description
<code>pi</code>	variable defining $\pi$
<code>i</code> or <code>j</code>	imaginary number $i = \sqrt{-1}$





## Arrays



# Array, Vectors, and Matrices

- An array is a data form that can hold several values, all of one type.
- A vector is a 1-D array: we can define row vectors, column vectors.
- A matrix is a 2-D array.
- Also, we can define  $N$ -D array.

The general notation for a vector or matrix is a list of values enclosed in square brackets `[]` separated by commas (space) or semi-colons (or the combination).



# Vectors

- Row vector, e.g.,  $x = \begin{bmatrix} 1 & 2 & 3 & 4 \end{bmatrix}$ 
  - $x = [1,2,3,4]$
  - $x = [1 \ 2 \ 3 \ 4]$
- Column vector, e.g.,  $x = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix}$  or  $x = \begin{bmatrix} 1 & 2 & 3 & 4 \end{bmatrix}^T$ 
  - $x = [1;2;3;4]$
  - $x = [1 \ 2 \ 3 \ 4]'$  where  $'$  is the infix notation for transpose operation in MATLAB.



# Matrices

- Define a matrix, e.g.,  $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$   
 $A = [1,2;3,4]$



## Generate a Subarray using Slicing

- `a = [1,2,3;4,5,6;7,8,9]`
- `b = a(1,1)`    % `b = [1]`
- `c = a(:,1)`    % `c = [1;4;7]` same as `c = a(1:3,1)`
- `d = a(2:end,2:end)`    % `d = [5,6;8,9]`  
same as `d = a(2:3,2:3)`



## Generate a 3-D Array using Slicing

- $A = [1, 2; 3, 4]$
- $B = [5, 6; 7, 8]$
- $C(:, :, 1) = A$  or  $C(:, :, 1) = [1, 2; 3, 4]$
- $C(:, :, 2) = B$  or  $C(:, :, 2) = [5, 6; 7, 8]$



# Concatenate Arrays

- `a = [1,2,3]`
- `b = [4,5,6]`
- `c = [a,b] % c = [1,2,3,4,5,6]`
- `d = [a;b] % d = [1,2,3;4,5,6]`
- `e = [d;d] % e = [1,2,3;4,5,6;1,2,3;4,5,6]`
- `f = [d,d] % f = [1,2,3,1,2,3;4,5,6,4,5,6]`



## Functions for Vectors & Matrices





Command	Description
<code>linspace</code>	Linearly spaced vector
<code>logspace</code>	Logarithmically spaced vector
<code>colon</code> or <code>:</code>	Colon
<code>transpose</code> or <code>'</code>	Non-conjugate transpose of a vector
<code>eye</code>	Identity matrix
<code>ones</code>	Ones array
<code>zeros</code>	Zeros array
<code>rand</code>	Uniformly distributed pseudorandom numbers
<code>randn</code>	Normally distributed pseudorandom numbers
<code>magic</code>	Magic square
<code>diag</code>	Diagonal matrices and diagonals of a matrix
<code>reshape</code>	Reshape array
<code>size</code>	Size of array
<code>length</code>	Length of vector



## Script Files



A script file is simply a file that contains a chain of commands that you edit in a separate window, then execute with a single mouse click or command. This is where we can define variables, perform calculations and leave comments to remind us what the file calculates.



# File Naming Conventions

- “The rules are exactly the same as for variable names: start with a letter, followed by letters or numbers or underscore, maximum 63 characters (excluding the .m extension), and must not be the same as any MATLAB reserved word.”
- “None of the conventions matter to MATLAB itself: they only matter to the people writing the code, and the people maintaining the code (usually a much harder task), and to the people paying for the code (you’d be amazed how much gets written into contract specifications.)”

Reference:

<https://www.mathworks.com/matlabcentral/answers/30223-what-are-the-rules-for-naming-script-files>



## Put Comments to Your Script File

```
% MATH 3341, Fall 2019  
% Lab 02: Variables, Arrays, and Scripts  
% Author: first_name last_name  
% Date: 09/11/2019
```



## Additional Functions and Commands



Command	Description
<code>iskeyword</code>	Check if input is a keyword
<code>who</code>	List current variables
<code>whos</code>	List current variables, long form
<code>which</code>	Locate functions and files
<code>clear</code>	Clear variables and functions from memory
<code>clc</code>	Clear command window
<code>clf</code>	Clear current figure
<code>close</code>	Close figure
<code>exist</code>	Check existence of variable/script/function/folder/class
<code>disp</code>	Display array

