# Matlab Tutorial

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# Matlab

- Matlab (derived from "matrix laboratory") is a numerical programming language and environment which allows you to easily operate on data, in particular matrices.

- Very widely used (~1M users). Highly useful.

- Although it does some symbolic manipulations (such as integration or equation solving), it is mostly used for operating directly on numerical data.

- Alternatives for scientific computing:
  - Octave (open source implementation of Matlab)
  - python
  - R
  - Mathematica

# 3 Kinds of Matlab Files

- Scripts
  - Have .m file extension
  - Just a collection of matlab commands
  - Can run them just by typing the script name (without the .m)
- Functions (must begin with a specially formatted line)
  - function [out1 out2 out3] = myFunctionName(in1,in2,in3)
  - Have .m file extension
  - Has multiple input and multiple output arguments
- Data files
  - Have .mat file extension
  - Can be loaded in two ways:
    - mydata = load('myfile.mat')
      - This creates a single 'struct' variable mydata, with 'fields' such as mydata.x and mydata.y
    - load('mydata.mat')
      - This will result in variables being introduced in the local environment. (for instance, the variables 'x' and 'y' will now exist)

# Variables

- Matrices (includes scalars as 1x1, vectors as 1xN or Nx1, and general NxM matrices)
  - All elements must be of the same type and size
    - Typical types would be double, uint8, logical, or char.
  - Index (access only some elements) with parentheses. Index is 1-based, not 0-based.
  - E.g.
    - A = [ 2 3 ]; % declares a matrix
    - A(2); % this is the number 3.
- Cell Arrays
  - Elements can be of mixed type and size
  - Index with curly braces.
  - E.g.
    - A{1} = 'hello';
    - A{2} = 12.3;
- Structures
  - Elements can be of mixed types and size
  - Index with names of 'fields'
  - E.g.
    - A.one = 'hello';
    - A.two = 12;

# Now go to:

http://www.klab.caltech.edu/~harel/share/matlab/

And read through all the example .m files

# Exercises

1. Using this equation, write one line of matlab to approximate pi:

$$\frac{\pi^2 - 8}{16} = \sum_{n=1}^{\infty} \frac{1}{(2n-1)^2(2n+1)^2}$$

2. Let x = [2 5 1 6].

   a. Add 16 to each element
   b. Add 3 to just the odd-index elements
   c. Compute the square root of each element
   d. Compute the square of each element

3.

Plot the functions x, $x^3$, $e^x$ and $e^{x^2}$ over the interval 0 < x < 4 ...

# Answers

http://www.klab.caltech.edu/~harel/share/matlab/answers.m