SESSION 1: MATLAB BASICS

htp://uiuc-cse.github.io/matlab-sp17/

OUTLINE

- Introduction - MATLAB, programming, GUI
- Variables - scalar, vector, matrices & Operators
- Replicating vectors & Reshaping matrices
- Functions
  - Area of a circle & volume of a sphere
  - Fahrenheit/Celsius & plotting
- Matrix Definition
  - Falling ballistic object example
- Element-wise & matrix operators : Truss forces example
- Control Flow – Loop, If Else

INTRODUCTION

- MATLAB Introduction
  - Tool for Linear Algebra
  - Functionality – tool box
- What is programming
  - Commands
  - Data or variables
  - Logic
- MATLAB GUI
  - Workspace
  - Command window
    - Command line
    - Script file - .m file

VARIABLES - SCALAR, VECTOR

- Variable
  - Scalar:

    x=2   y=3   x+y   x*y   x/y   x^y
  - Vector:
    V1 = [0 2 4 6 8] V2 = 0:2:8
    1:2:7 % row vector   (1:2:7)' % column vector
    1:6
    linspace(0,10,5) % row vector   linspace(0,10,5).' % column vector
- Accessing element
  Index in MATLAB starts from 1 (not 0).
  V1(3) M1(2,3) M1(:,2) M1(1,:)

VARIABLES - MATRICES

- Matrices

  - A=[1 2 3 ; 4 5 6 ; 7 8 9]   B= [7 8 ; 9 10 ; 11 12]
  - A*B   A'   A*A   A.*A
  - V=[1 3 4 2]   V'   V*V'   V.*V   eye(3) zeros(3)
  - C=ones(3)   D=rand(3)   C*D   C.*D   C^2   C.^2
  - A(2,2) = 100;   V(5) = 1;   B(1:2) =1;
    B(:,2) = 3;   B(4,4) = 4;   B(2,:) = 5;

REPLICATING & RESHAPING

- Replicating elements in vectors

  - Example : *N = 3; A = [4 5]*
    Create N copies of each element in A, so B = [4 4 4 5 5 5]
        Use **kron**: K = kron(X,Y) returns the <u>Kronecker tensor product</u> of X and Y
    >> kron(A,[1 1 1])

- Reshaping arrays:

  - Example:
    Reshape a 3-by-4 matrix into a 2-by-6 matrix.
    A = [1 4 7 10 ; 2 5 8 11; 3 6 9 12]
    B = reshape(A,2,6) or B = reshape(A,2,[])

EXAMPLE: AREA OF A CIRCLE & VOLUME OF A SPHERE (FUNCTIONS)

- $A(r) = \pi\, r^2$ 			r : radius

- To make it reproducible, use a function

- Try it on 1:1:5

- Create a new function, volOfSphere, and make it work:
  function [V] = volOfSphere(r)

  …..

EXAMPLE: FAHRENHEIT/CELSIUS (FUNCTIONS)

- $T_F(T_C) = T_C \frac{180}{100} + 32$

- Write a function that performs this conversion:
  function Tf = TempC2F(Tc)

  …

- Take Tc as vector:
  - 1:2:200
  - linspace(0, 200, 101)

- Save the results in a file:
  fileName = fopen ('filne name.txt',w)
  fprintf (fileName, 'header1 header2\n');
  fprintf(fileName, %f   %f\n', row vector)
  fclose(fileName)

EXAMPLE: FALLING BALLISTIC OBJECT (VECTORIZATION, FUNCTIONS)

- $y(t) = \frac{1}{2}at^2 + v_0 t + y_0$

  $a = g = -9.81$ $v_0 = 2520$ $y_0 = 0$ $t = 1$

- Vectorize:
  t =linspace(0,5,101);
  Try: y=a*t^2+v*t+x0;
  Not working? Why?

- Plot the t and y - plot(t,y)

- Create a function: function [y] = a_fall(t,v,x0)

- Modify the function to not yield y-values less than zero.

EXAMPLE: TRUSS FORCES (ELEMENT-WISE & MATRIX OPERATORS)

- T*x=f   => x=T^{-1} *f

- Let f_1 =10 and f_2 = 20

- Define T and f using MATLAB new variable or load it from truss-matrix.mat.

- Solve the matrix using function 'inv' & using '\'

- Compare the speed of two method using tic and toc

CONTROL FLOW(LOOP, IF ELSE) & MATRIX DEFINITION

- for loop :
  for i=1:n or linspace(1,n,n)

  do something
  end

- Conditional statement:
  if condition 1

  do something
  elseif condition 2

  do something different
  else

  do this rest of time
  end

- Example: define matrix using for loop and if-elseif-else