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 Kronecker tensor product 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:

  fopen
  fprintf – with/without using loop
  fclose

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