EMT 101 – Engineering Programming

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What is Matlab?

- C++ is a programming language but Matlab is software which are used for many engineering applications

- Matlab also has its own programming language

- Matlab has its own interpreter, no need to compile or link source codes

- Data types are not declared–MATLAB: automatically assigns the appropriate type when you *initialize a variable*

Matrix Laboratory?

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- MATLAB performs matrix (or vector) manipulations and computations

- Output to screens are automatic (no need cout)

- Input to code-use *input*

- Type help input to learn more

Vectors and Matrices

- Elements in an array can be assessed using indices

- Example: b = [2 5 6 9 10 12 15 22]

- Type b(2) in MATLAB will give you 5

- b(4) gives you 9

- Type b(2:4) is an array [5 6 9]

- b(3:end) gives you [6 9 10 12 15 22]

Matrices (2D Array)

- Given a 3 x 3 matrix A = [3 4 5;

  8 6 2;

  7 9 11]

- A(1,1) is 3
- A(1,3) is 5
- A(2,:) is a 1D (1 by 3) array of [8 6 2]
- A(:,2) is a 1D (3 by 1) array of [4; 6; 9]

Operators

- sum(x); max(x), min(x), mean(x)

- sum of matrices or vectors

- vector multiplication:dot product vs. vector product
- always be careful with the operators * and .*
- a*b is totally different than a.*b

- matrix multiplication; matrix products

- transpose of a matrix: use '

Linear Algebra Example

- Solving a system of linear equations:

$$Ax = b$$

- matrix vector multiplications

- two ways of solving a system of equations:

- (i) x=inv(A)*b or

  (ii) x=A\b

See Tutorial exercise 2

Control Structures

- If-else statements (similar to C++)

- The format for switch case: Note that <value> cannot be a range like in the if branch. This is a limitation of case

- switch <variableName>

case <value1>

statement

...

case <value2>

statement

...

otherwise

statement

end

For Loop in Matlab

- Example with the dot product operations of vectors **a and b** of sizes *n = 1000*

  sum = 0

  for i = 1:1:1000

  sum = sum + a(i)*b(i)

  end

Tutorial

Construct a vector of with range $-1 \leq x \leq 1$ with increment of 0.1.

Solution:

In Matlab, this can be done by setting X= [-1:0.1:1]

Do-It-Yourself-Exercise $Y_1 = X^2$

1. Determine another array
2. Next, determine the derivative $Y_2 = \dfrac{dY_1}{dX}$

3. Plot the functions using plot(X,Y1,XY2)

%There is no initial Declaration or any include required for Matlab programing. Any variables used will be automatically declared by Matlab

X=[-1:0.1:1];   %by including a "semicolon", the output will
                       %not be shown in the Command Window

Y1=X.^2;   %notice the used of ".^" instead of only "^"

Y2=gradient(Y1);   %command to find the gradient

plot(X,Y1,X,Y2)   %command to plot a graph
legend('Y1','Y2')   %command for the graph's label

Exercise 1

■ Find the slope of a function F=cos x * exp(2x)* x^3 and plot the slope between [0, 3].

■ Plot both the slope and the function F on the same plot.

Exercise 2

■ Write a MATLAB program to solve

(i)   an arbitrary matrix problem A= M*N where M and N are matrices in which you need to input the numbers on your screen. Note M and N has a size mxm.

(ii)   Finding an inverse of the matrix