MATLAB

ME1107
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Reference: MATLAB for Engineers by Holly Moore
(Pearson Prentice Hall)

Introduction

- Matlab: Matrix Laboratory

  MATLAB is a large application program. It was originally written in FORTRAN and later rewritten in C.

  System software runs the computer hardware, e.g. operating systems, device drivers….

  Programming software helps to write computer programs, e.g. Salford Plato IDE.

  Application software helps users to do specific tasks, e.g. Word, Excel…

- Functions: scientific calculator

  computer programming

- Strengths: matrix calculations and graphics

Use MATLAB as a calculator

Basic mathematical operators: +, - , *, /, ^

Build-in functions: pi, sqrt, sin, cos, log, tan, asin, acos, atan…….

Use Matlab to evaluate:

$$\sqrt{4}$$

$$2^5/(2^5-1)$$

$$area = \pi r^2 \ \ with\ r = \pi^{1/3} - 1$$

$$e^3, \ln(e^3)$$

$$\sin(30^0)$$

Variables and keywords

Matlab is case sensitive

Always use lowercase to avoid mistakes

Variables

1. All name must start with a letter
2. The allowable characters are letters, numbers and the underscore

```
>> isvarname time
>> isvarname cool-beans
```

3. Not in the reserved keyword list

```
>> iskeyword
```

4. Variables could reassign built-in or user-defined function names

```
>> sin(pi/2)
>> sin = 1
>> sin
>> sin(pi/2)

>> which sin
```

Clear

1. Workspace Window keeps track of the variables
2. Clear one variable

```
>> clear sin
```

3. Clear all variables

```
>> clear all
```

Use MATLAB help

Format

```
>>format short
>>area = pi*3.7^2
>>format long
>>area = pi*3.7^2
```

Find out the difference between format long / format short.

1) Search for FORMAT in the help window
2) >>help format

Magic Squares - coursework

How to create a magic square?

How to prove the matrix is a magic square?

Matrix and matrix operations - 1

- Create a 1-D matrix (1 row)

  t=linspace(t1,t2,N)
  x=linspace(0,20,100)
  x=linspace(0,2*pi,100)

  t = t1 : dt : t2
  x = 0 : 0.2 : 20
  x = 0 : pi/50 : 2*pi

  x = [1 5 6 9 7 1]
  x = [1, 5, 6, 9, 7, 1]

- Transpose 1 row to 1 column

  x = x'

- Create a 3x3 matrix

  x = [1 1 1; 1 2 3; 1 3 6]

Matrix and matrix operations - 2

- **Matrix multiplication**

Given two matrices A = (a_{ij}) and B = (b_{ij}) we can only find AB if the number of columns of A is the same as the number of rows of B. Suppose that

A is m-by-n and B is n-by-p, then

C = A*B is an m-by-p matrix where the elements of C, c_{ij}, are given by

$$c_{ij} = a_{i1}b_{1j} + a_{i2}b_{2j} + ...+ a_{in}b_{nj} = \sum_{k=1}^{n} a_{i,k}b_{k,j}$$

i.e. To get the ij element of C, multiply the elements of row i from A with the corresponding elements of column j from B and add.

- **Array multiplication**

A.*B denotes element-by-element multiplication. A and B must have the same dimensions unless one is a scalar. Suppose that A and B are two m-by-n matices, then C = A.*B is an m-by-n matrix where the elements of C, cij, are given by

$$c_{ij} = a_{ij}b_{jj}$$

Matrix and matrix operations - 3

- times and mtimes

array multiply: element-by-element multiplication, e.g. times(x, y) or x.*y
matrix multipy: matrix product, e.g. mtimes(x, y) or x*y

```
>> x= [0 30 60 90]
>> x=x*pi/180
>> y=sin (x)
>> z=sqrt(x).*y
```

$$z = \sqrt{x} \cdot \sin(x)$$

- Operator list

```
>> help *
```

- Combine 2 1-D matrices into 1 2-D matrix

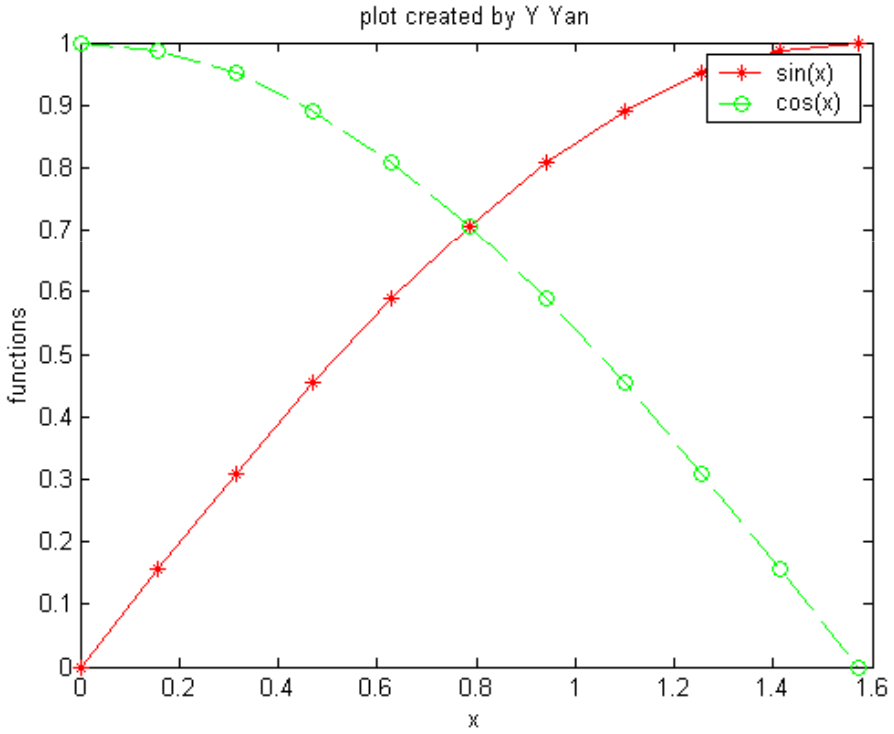
Temperature conversion: C2F

```
>> c=[-100:20:100]
>> f=(9/5)*c +32
>> temperature= [c', f']
```

Plotting Graphs

- Plot y = sin(x) and z = cos(x)

```
x= 0:pi/20:pi/2;
y= sin(x);
z= cos(x);
plot (x, y, 'r-*', x, z,'g--o')
legend ( ‘sin(x)',‘cos(x)')
xlabel ('x'), ylabel('functions')
title ('plot created by Y Yan')
```



Script M-files

A Script M-file is a list of MATLAB statements that are saved in a file

- Comment operator: % (percentage sign)
- Display the comment lines at the beginning

  >> help lecture1
- To list all M-files in the current folder:

  >> what
- To execute, typing the name in the command window or use the ‘save&run’ button or used in another M-file
- When used in another M-file, uses the same workspace

  >> test_lecture1

Coursework Q2: circle.m

Function M-files

Function M-files: user-defined functions

- Function defination line

  function [x, y, z] = lecture1fn(xmin, xmax, N)
- M-file name: lecture1fn.m
- Input argument: xmin, xmax, N
- Output: three arrays - x, y, z
- How to use the function: in the command window or used in another M-file

  >> lecture1fn(0, 0.5, 20);

  >> [u, v, w] = lecture1fn(0, 0.5, 20)
- Variables in a function DO NOT share the same workspace

Coursework Q2: circlefn.m