MATLAB Tutorial II

EEE116 Experimental, Computer Skills and Sustainability
For Group B on Apr. 17th, 2018, HS102 and HS103
For Group A on Apr. 24th, 2018, HS102 and HS103

1 Basic Maths Functions in MATLAB

Problem 1.1. *Given* $x = 4.5$ *and* $y = 8$*, confirm that* $\ln(xy) = \ln x + \ln y$.

Problem 1.2. *Given* $x = 5 + 4i$ *and* $y = 6 - 8i$,

a) Find the product z *of* x *and* y,

b) Fine the real part and imaginary part of z,

c) Show that the magnitude of z *is equal to the product of their magnitudes:* $|z| = |x||y|$,

d) Show that the angle of z *is the sum of the angles:* $\angle z = \angle x + \angle y$.

Problem 1.3. *With* $x = 0°, 45°, 90°, 180°, 270°$ *and* $360°$*, confirm that* $e^{ix} = \cos x + i \sin x$.

Problem 1.4. *For* $x = 0, 0.5$ *and* 1*, confirm that* $\sin^{-1} x + \cos^{-1} x = \pi/2$.

2 Plotting and Programming with MATLAB

Problem 2.1.

a) Write a script file named **`t02plot01.m`** *which plots the functions* $y1 = e^{-x/2}\cos(2\pi x + \pi/4)$ *and* $y2 = e^{-x/2}$ *on the same graph for* $0 \leqslant x \leqslant 5$ *with an increment of* 0.05*, and saves* $x, y1$ *and* $y2$ *into a MAT file named* **`t02plot01data.mat`**. *In the graph, plot* $y1$ *with a solid blue line with a star at each data point, and* $y2$ *with a dashed red line; Use a legend for* $y1$ *and* $y2$*; Set labels for* x*-axis and* y*-axis; Turn on the grid; Give a title to the graph,*

b) Run **`t02plot01.m`** *in the command window and save the obtained graph as* **`t02plot01.fig`**.

Problem 2.2.

a) Write a function named **`FCconvert.m`** *that accepts temperature* T *in degree* F *and computes the corresponding value in degrees* C*. The relation between the two is* T *(in* $°C$*)* $= 5[T\,(\text{in } °F) - 32]/9$. ,

b) Test your function for $T = -100 \sim 100°F$ with an increment of $20°F$. Save the results into a MAT file named **`FCconvert.mat`**,

c) Plot an $X-Y$ graph whose x-axis denotes the temperature in degree F and y-axis denotes the temperature in degree C, using the results in b). Set labels for x-axis and y-axis. Turn on the grid. Use a title. Save the graph as **`FCconvert.fig`**.

3 Relational and Logical Operators

Problem 3.1. *Assume that a, b, c and d are as defined, and evaluate the following expressions.*
$a = 20; b = -2; c = 0; d = 1;$

a) $a > b$,

b) $b > d$,

c) $(a > b)\&(c > d)$,

d) $a\&(b > c)$,

e) $(a\&b) > c$,

f) $a == b$,

g) $a|(b\&d)$.

Problem 3.2. *Use* MATLAB *to fill in the following truth table (Hint: You can use array operation by taking x and y as vectors):*

Inputs		and	or	xor	not
x	y	$x\&y$	$x\|y$	$\text{xor}(x, y)$	$\sim x$
0	0				
0	1				
1	0				
1	1				

4 Branch Statements

Problem 4.1. *Use function* **`cal_roots.m`** *on ICE to solve the following quadratic equations:*

a) $x^2 + 5x + 6 = 0$,

b) $x^2 + 4x + 4 = 0$,

c) $x^2 + 2x + 5 = 0$,

d) $2x + 5 = 0$.

Problem 4.2. *Write a* MATLAB *program to evaluate the function* $y(x) = \ln \dfrac{1}{1-x}$. *Test your program for* $x = -2, 0, 1,$ *and* 2.

Problem 4.3. *Write a* MATLAB *program* ***`funxy.m`*** *which evaluates the value of the following function.*

$$f(x,y) = \begin{cases} x + y, & x \geqslant 0 \text{ and } y \geqslant 0, \\ x + y^2, & x \geqslant 0 \text{ and } y < 0, \\ x^2 + y, & x < 0 \text{ and } y \geqslant 0, \\ x^2 + y^2, & x < 0 \text{ and } y < 0. \end{cases}$$

5 Additional Plotting Features

Problem 5.1. *Assume that the complex function* $f(t)$ *is defined by the equation* $f(t) = (0.5 - 0.25i)t - 1$. *Write a program which plots the amplitude and phase of function* f *for* $0 \leqslant t \leqslant 4$. *Place the two sets of axes on the same figure. Use graph titles,* x*-label,* y*-label. Turn on the grids.*

6 Loops and Program Debugging

Problem 6.1. *Write an M-file to evaluate the function* $y = x^2 + 3x - 2$ *for all values of* x *between* 0.1 *and* 3 *with a step of* 0.1. *Do this twice, once with a* ***`for`*** *loop and once with array operation. Plot the resulting function using a dashed red line.*

Problem 6.2. *Write a program using* ***`for`*** *loops to generate a* 5×5 *matrix* $\mathbf{A}$ *whose* $(m,n)^{th}$ *element is equal to* $m + n$.

Problem 6.3. *Write a program with a* ***`while`*** *loop which allows the user to input a number at each iteration until a negative value is input. Calculate the average of all the input values between* 40 *and* 80 *(inclusive). Test your program with the following inputs:* $29, 35, 65, 49, 38, 79, 93, 80, 28, 29, 58, -7$, *and the output should be* 66.2.

Problem 6.4. *Use a* ***`while`*** *loop to determine how many years it will take to accumulate* $£900,000$ *in a bank account if you deposit* $£10,000$ *initially and* $£10,000$ *at the start of each following year; the account pays* 5.3% *annual interest at the end of each year. Set a breakpoint inside the while loop to trace every iteration. What is the resulting balance in the account? (Answer:* 33 *years;* $£948,458.33$*).*