Worksheet 1 – MATLAB fundamentals.

Basic mathematics

Find MATLAB in the start menu and open it. If it has not previously been used on the computer it may take a moment to install. Once it has loaded, solve the following questions by typing commands into the command window. Remember to refer to your notes to help you (digital copies are available on moodle).

Q1: Multiplication using the * operator:
a) $10*10$ b) $20*10*10$ **c)** $7*7*7*7*7*1000$ d**)** $z=1000*80$

Q2: Raising numbers to the power using the ^ operator:
a) $x=2^2$ b) $y=2^4$ **c)** $z=1000^2$ d**)** $z=1000^{1.6}$

Q3: Using brackets (hint you will also have to use the *):
a) $y=1000(1+3)$ b) $y=(1+3)(20+1)$ c) $y=(1+2+3+4)(1+4)(7+9)$

Q4: Dividing using the / operator:
a) $v=\frac{1}{20}$ b) $v=\frac{1}{100}$ c) $v=\frac{1}{4}$ d) $v=\frac{1000}{20}$

Q5: Using brackets, multiplication and division together.
a) $v=\frac{1}{4}*\frac{7}{2}$ b) $v=\frac{1}{4}*\frac{7}{2}$ c) $v=\frac{5}{4}*\frac{7}{2}*\frac{7}{2}$ **d)** $v=\frac{5}{4}*\frac{7}{2}*\frac{7}{2}*\frac{7}{7}*\frac{3}{7}$

Q6: Use of mixed operators
a) $x=(2^2+2^2)\frac{(4+1)}{7^2}$ b) $x=2*(2^2+2^2)\frac{(4+1)}{7^2}$ c) $x=(7^2+2^2+2^2)^2(4+1)^3$

Commands and functions

Q7: Type 'who' into the command line. What does the who command do?

Q8: Type 'clear' command into the command line then type the who command. What does the 'clear' command do? Hint – the answer is in the notes.

Q9: On the top right hand side of the screen you will see a question mark in a white circle. Click the question mark. This brings up the help. Using the help find out what the 'dir', 'date', 'pwd', and 'sqrt' commands do?

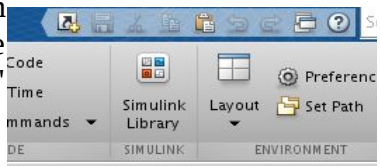

Figure 1: Accessing the help

Hint: The MATLAB help is very good!

Simple mathematical series

Q10a: Initialize the variables a=10 b=20, then type 'who' to check that the variables are initialized. Now evaluate the equation
b: Evaluate z=a+b using MATLAB. What is the answer?

c: 'Evaluate z=z+1/z, what is the new value of z?
d: If you press the 'up arrow', the last command you typed will appear on the command line. Press the up arrow once to get z=z+1/z back on the command line, then hit enter. What is the new value of z? Do this ten times, what happens to the value of z? Can you think of a name for this type of series?

Q11: The area of a sphere is given by the formula $A = 4\pi r^2$.
a: Type 'pi' into the command line, to how many decimal places does MATLAB know pi?
b: Evaluate the area of a sphere at r=1, r=4, r=10, r=20, r=40

Using the built in functions
Q12: Clear the work space with the 'clear' command. Then evaluate the following equations with at x=1.5.

a) $x = \sin(x)$
b) $y = \sin(x)\cos(x)$
c) $z = \sin^2(x)$
d) $v = (\cos(2x) + 10\sin(x))100$
e) $t = 10x^3 + 20x^2 + 10x^1 + 10x^0$
f) $z = \exp(x)$
f) $z = \exp(\sin(x))$

Use the who command to see which variables you have defined in the work space. Can you remember the definition of a variable? Re-evaluate these functions at x=2.5 by using the up-arrow. Hint on the right hand side of the screen there is a history of past commands – by double clicking on them you can also recall them.

Scientific notation
Q13: MATLAB uses 'e^z' to represent x10^z. So for example the seeped of light (3x10^8) would be written as 3e8. Or the charge on an electron (1.6x10^{-19}) would be written as 1.6e-19. Enter the following numbers into MATLAB in scientific notation:
a) a=6.37x10^6 (Radius of earth in meters)
b) b=6.02214x10^{26} (Avogardo's number)
c) c=1.01325x10^5 (Standard pressure)
d) d=1.00464x10^3 (Specific heat of dry air at constant pressure)

Q14a: The speed of light can be derived from the electric permittivity of free space and the magnetic permeability of free space using the equation $c = \frac{1}{\sqrt{\epsilon\mu}}$, where $\epsilon = 8.85418782x10^{-12}, \mu = 1.25663706 \times 10^{-6}$. Calculate the speed of light using this formula and the sqrt function. Hint: use words instead of the Greek symbols.

Q14b: The speed of sound in water is given by the equation $c = \sqrt{\frac{C}{\rho}}$ where C is the coefficient pf stiffness and ρ is the density of the material. Calculate the speed of sound when C=400x10^9 N/m2 and ρ = 8000 kg/m^3.

MATLAB Easter eggs

Q15: 'Easter eggs' is used in computing to describe amusing hidden bonus features included in a program. MATLAB has quite a few hidden functions. They are interesting at the moment in as far as they show you some of the more complex things you can do with MATLAB without having to program it your self. Try typing the commands:

a) 'image' – this is an example of a 2D color heat plot we will cover these later

b) 'penny' – this is an example of 3D plotting. Can you rotate the image?

c) why

d) 'life' – this is a simulation of Conways's game of life. It is a cell simulator which simulates the evolution of biological cells. A cell can either be alive (black) or dead (white) It uses the following rules to run. 1. Any live cell with fewer than two live neighbours dies. 2. Any live cell with two or three live neighbouring cells lives on to the next generation. 3. Any live cell with more than three live neighbours dies, as if by overcrowding. 4. Any dead cell with exactly three live neighbours becomes a live cell, as if by reproduction.

Program flow:

Remembering computer commands and writing computer code is in general quite easy. The hard part (and the part which will get you lots of money!) is figuring out how to break real world problems down into a program which a computer can follow. In this question your task is to break real world problems down into a flow diagram.

Q16: Imagine you have a robot in your kitchen. Your job is to write a flow diagram to tell the robot how to cook an egg. Use the example of 'making a cup of tea' covered in the lecture to help you.

Q17 (hard): Imagine you are trying to program a computer to solve the quadratic equation, write a flow diagram to describe this program. If the number in the square root is negative the program should give an error and exit. Finally use MATLAB and the quadratic formula to solve the quadratic equation $x^2+3x-4=0$.

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