ME1 Computing - End of Term test

CID number:	0								
	1st	2nd	3rd	4th	5th	6th	7th	8th	

Comment appropriately all your scripts. Comments are marked too! [3]

STATE YOUR CID into a comment at the beginning of every file

Imported libraries allowed*: random, maths, matplotlib.pyplot*

Define a list of eight elements, each containing a number from your CID.

Example CID = 02345678 (in the script you have to use YOUR CID):
$$cid = [0,2,3,4,5,6,7,8]$$

Task A [20]

Write a script to compute the array D:

$$D = (A + B) \cdot (A - B)$$

Matrices A and B have same dimensions 8 x 8 and of the form below, with values made out of your College CID.
Code the filling of matrices A and B from the list cid, rather than just manually inserting the numbers into A and B.

Example CID = 02345678 (in the script you have to use YOUR CID)

$$A = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 8 \\ 2 & 0 & 0 & 0 & 0 & 0 & 0 & 7 \\ 3 & 0 & 0 & 0 & 0 & 0 & 0 & 6 \\ 4 & 0 & 0 & 0 & 0 & 0 & 0 & 5 \\ 5 & 0 & 0 & 0 & 0 & 0 & 0 & 4 \\ 6 & 0 & 0 & 0 & 0 & 0 & 0 & 3 \\ 7 & 0 & 0 & 0 & 0 & 0 & 0 & 2 \\ 8 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad B = \begin{pmatrix} 0 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 8 & 7 & 6 & 5 & 4 & 3 & 2 & 0 \end{pmatrix}$$
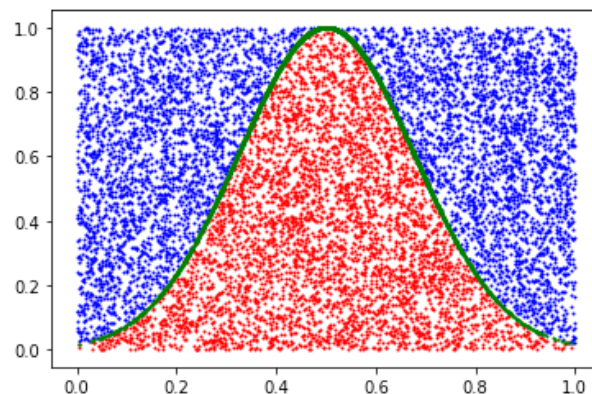
Save your files frequently

Task B [8]

Given the bell function:

$$f(x) = exp\left(-\frac{(x - 0.5)^2}{\sigma^2}\right)$$

Write a code to determine the ratio between the two shadowed areas (underneath and outside the bell) in the picture below.

Set the value $\sigma = 0.1 + a/20$, where a is the 6th digit of your CID.

(The code does not need to plot the graph below, just to determine the numerical value of the areas ratio).

Save your files frequently

Task C [20]

For this task **try to use the least number of loops** (you can achieve all the requests by using only one loop in the entire code).

The file *Vax.txt* contains the statistics of COVID-19 vaccinations in the UK, for the days in the period from 11.01.21 to 23.03.21. The data in the file are organised sequentially as:

Day 1
First dose vaccinations with Pfizer
First dose vaccinations with AstraZeneca
Second dose vaccinations with Pfizer
Second dose vaccinations AstraZeneca
Day 2
First dose vaccinations with Pfizer
First dose vaccinations with AstraZeneca
Second dose vaccinations with Pfizer
Second dose vaccinations AstraZeneca
….

Write a script to determine and print out (in this order) the five values:
1. The overall number of first dose vaccinations inoculated in the given period
2. The overall number of second dose vaccinations inoculated in the given period
3. The day with the largest overall number of vaccinations
4. The overall number of vaccinations done with Pfizer and those with AstraZeneca

Plot graphically, on the same plot:
1. The number of first doses per each day
2. The number of second doses per each day

Save your files frequently

Task D [12]

Write a function *Series(N)* to calculate the sum:

$$P = \sum_{i=1}^{N} \left(\frac{1}{(i-1)!} \sum_{k=1}^{i} (a+10)^{k-3} \right)$$

where $a = 4^{th}$ digit of your CID.

Call the function for all the values $N = 1, 2, \ldots.50$ and plot a graph of P vs N.

Submit on BB either four separate files, one for each task, or one single file with all the tasks.