GM04: MATLAB Exercise 2
Introduction—loops, sorting and saving data

Autumn 2015

1. Use loops to create a 5×7 matrix in which the value of each element is the sum of its indices, e.g. $A(3,5) = 8$.

2. Take the vector $x = [-15, -6, 1, 0, 8, -2, 5, 4, -10, 0.5, 6]$ and using conditional statements and loops write a program that determines the sum of positive elements and the sum of negative elements in the vector.

3. Write a user-defined function called $[\text{R},\text{THETA}]=\text{CARTTOPOLAR}(\text{X},\text{Y})$ which converts the xy-coordinates of a point in the plane to the radial distance and argument in the range $-\pi < \theta < \pi$. Use conditional statements to assess the correct quadrant.

4. Given a matrix

$$\mathcal{A} = \begin{pmatrix} 5 & 3 & 1 & 10 & 22 & 7 \\ 2 & 3 & 6 & 1 & 13 & 5 \\ 6 & 14 & 1 & 30 & 28 & 10 \end{pmatrix}$$

   write a code that will find all the numbers in the matrix larger than 10 and all the numbers that differ from the mean value by more than 7. Now find all the numbers in the matrix between the values 10 and 20 or within 5 of the mean value first using conditional statements, then using logical indexing.

5. Using the matrix $\mathcal{A}$ given above, write a function that will sort out its elements into separate arrays defined by the ranges $0 \le x \le 5$, $6 \le x \le 10$, $11 \le x \le 15$, $16 \le x \le 20$, $x > 20$. Can you do this using SWITCH-CASE?

6. Using the matrix $\mathcal{A}$ given above and loops, print to a file a list of elements, giving its row position, its column position and its value in three separate columns. The format should look like

$$\text{Row: 1 \quad Column: 1 \quad Value: 5}$$
$$\text{Row: 1 \quad Column: 2 \quad Value: 3}$$
$$\dots \qquad \dots \qquad \dots$$

7. Write a function that separates elements of an integer input matrix into numbers divisible by 2, 3 and by neither **without** using loops. *Hint: use logical indexing.*

8. Write a function that calculates the 2D Gauss function

$$z = \mathrm{e}^{-\frac{x^2+y^2}{2}\sigma^2}$$

by accepting three arguments - the x, y and σ values. Use loops to calculate the value of this function over the range $-2 \leq x, y \leq 2$ in steps of $0 \cdot 1$ in both directions. Try to write a separate code to do this using vectorised operations instead of loops.

Using two nested loops, dump the output into a file called 'twoDgauss.txt' with three columns containing the corresponding x, y and z values at every point in the array. The three columns should be suitably labelled on the first line of the data file.