# COSC 1001/1901 Computational Science in MATLAB 2011

## Assignment — due Friday 19th October, 5pm

The assignment consists of two questions, each worth 10 marks. It is worth 20% of your total assessment for this Unit of Study. You will be marked on the correctness and quality of the code, as well as your written responses to the questions. You may submit your solutions independently or as a pair with another student. If you submit as a pair you will both receive the same mark. Both members of the pair must be in the same stream (Advanced or Normal).

Download and unzip the assignment zip file (assignment_code.zip) from the eLearning website. You should write your solutions in these template files. All programs should include a 1 paragraph description of how they work as a comment at the top of the file. Your written solutions can be in .txt, .doc, .docx or .pdf format.

Your code (and any other files) must be submitted as a single zip file to the assignment drop-box on the eLearning website. The zip file should be named using your SID (e.g. 012345678.zip), or both SIDs if you are submitting as a pair (e.g. 012345678_111222333.zip).

The syntax for creating a file in Unix is zip -r <zipfilename> <file1> <file2> <file3> .... To include all files in the current directory, use the wildcard operator *. For example:

```
$ ls
question1.m    question2.m     question1.txt   question2.txt
$ zip -r 012345678_111222333.zip *
  adding: question1a.m (deflated 60%)
  adding: question2a.m (deflated 60%)
...
```

Ensure you have submitted the following

1. All programs (question1a.m etc) with your solutions to Q1 and Q2
2. Any extra functions you have written that are used by these programs.
3. Your saved visualisations (PDF, PNG, or JPG files) for Q1.
4. Any written responses to Q1 and Q2 as .txt, .doc, .docx or .pdf files.

**You must submit your zip file by 5pm on the due date.**

We encourage cooperation between students in completing assignments and allow 1 or 2 students to hand in a single assignment. All students submitting this assignment certify that they have made a fair contribution to the attached assignment and are happy to receive the same mark.

We will NOT accept assignments that are simply copied. Copying the work of another person without acknowledgement is plagiarism and contrary to University policies. By uploading your submission to eLearning you are certifying that you have read and understood the document http://sydney.edu.au/ab/policies/Academic_Honesty_Cwk.pdf

## Question 1

1. Many natural processes can be modelled by random walks. Imagine a single pollen particle floating in water. Write a program that models this as a $100 \times 100$ matrix. The particle starts at the centre of the grid (50, 50).

   In each time step the particle can move a single unit in one of four directions: up, down, left or right (with equal probability). Visualise the path of the particle over $n$ timesteps using **imagesc**. You can represent cells the particle has visited with **1** and other cells with **0**. You should continue to update the value of the pollen if it leaves the boundaries of your grid, but you should only display the $100 \times 100$ grid.

   You should call your program **question1a.m** and save an example of your visualisation after 1000 timesteps as a PDF/PNG/JPG file, e.g. `question1a.pdf`.

2. Extend your program so that any number of particles can start at the initial position. In each timestep they should all behave in a similar manner, randomly moving either up, down, left or right. Visualise the path of all the particles over $n$ timesteps using **imagesc**.

   You should call your program **question1b.m** and save an example of your visualisation for 10 particles after 1000 timesteps as a PDF/PNG/JPG file, e.g. `question1b.pdf`.

3. Use **surf** to plot a two-dimensional histogram of the final position of the particles after 1000 timesteps. This plot should show the number of times a particle has ended its walk on each grid point in the matrix.

   Run your experiment for 10, 100, 1000, and 10 000 initial particles all starting at the centre of the grid. Describe the histogram produced and explain its behaviour as you increase the number of initial particles.

   You should call your program **question1c.m** and save examples of each of your histograms as PDF/PNG/JPG files (e.g. `question1c1.pdf`, etc). Also include your explanation in a text file, PDF or Word document.

4. Simple aggregration models are an example of how random changes on a micro-scale can lead to continuous behaviour on a macro-scale. Write a program that starts with a single black cell in the centre of a $200 \times 200$ grid. In each timestep a single live cell is created in a random position adjacent to one of the existng live cells (not including diagonal positions). Visualise the model using **imagesc**.

   Describe and explain what happens after a large (say 10 000) number of cells have been added to the cluster.

   Save your program as **question1d.m** and an example of your visulisation after a large number of timesteps as a PDF/PNG/JPG file, e.g. `question1d.pdf`.

## Question 2

The file `australia_east.txt` contains altimetry data from the US National Geophysical Data Center. This data file represents the Eastern part of Australia, consisting of Victoria, NSW and Queensland. Read this data file in using:

```
>> alt = load('australia_east.txt'); %Don't forget the semi-colon!
```

You can view the image using **`imagesc(alt)`**.

You will only receive full marks if you vectorize your code when appropriate.

1. The minimum value in the data represents the ocean. What is this value? Write a program to compute the fraction of the map that is covered in ocean.

   Save your program as **`question2a.m`**.

2. Current climate models suggest that global warming will cause Greenland to completely melt in around 1000 years. If this happens, sea levels will rise by 7.2 m. What fraction of the land on the map would become covered by water after such a sea level rise? What fraction would this be if the Antarctic ice sheet melted and sea levels rose by 70 m?

   Save your program as **`question2b.m`**.

3. An explorer is lost at coordinate (500,300) in the middle of Cape York, noting that the coordinates as plotted by **`imagesc`** are South then East from the top left corner of the plot. The explorer has enough food to last for 100 days, and moves 10 map units in a random cardinal direction (North, South, East or West) each day. Write a program **`question2c.m`** that computes the probability that the explorer reaches the ocean before running out of food.