Computational Science – Task Plan

Part 1

**Report**

Definitions of 2 distributions: uniform(all equal), normal(points around the mean are more likely to occur), reference

State under which circumstances you would use these distributions

Comment on choice of distribution selected for random numbers

Screenshot the movement of the grid

Generate data to show that the directions are uniformly selected. If you find that they are not sufficiently uniform, suggest how you would do it and show that this happens. Provide reasoning

Comment on the computational complexity of each method (You have been asked to locate common-points which both methods reach)

Task 1.1

**Code**

Visualise 100x100 grid?

Create a 2D array for all positions in grid that the cell has access to move to

For loop 100 times

Plot movements

Use uniform distribution

4 possible directions up, down, left, right, binary 0,0-1,1

Use numpy.random.unifrom

Task 1.2

**Code**

Visualise 100x100 grid

Create a 2D array for all positions in grid that the cell has access to move to

For loop 100 times and 1000 times

Plot movements

Use uniform distribution

8 directions, binary 000 – 111

Use numpy.random.unifrom

Part 2

**Report**

Integrating a process for change of state of the cells

Gompertz model: growth of cancer tumours

A white background with black and white clouds

Description automatically generated

N is the number of cells

K is the growth rate of cells and K>0

M is the capacity

Assume K=0.006; M=10^13; and N(0)=10^9

Does the growth reach a steady state?

If not, experiment with the final time and determine the Time required to reach a steady state.

What will happen if the value of M is changed. Pick 2 values either side (10^12 and 10^14)

Consider the issues associated with the numerical strategy you are using.

If the numerical methods are changed. What will be there change in the complexity of the simulation.

Note: this is a simulation of a non-linear function. So use small value of h (order 0.001). Normal differential

Task 2.1

**Code**

Simulate at t=1200

Using formula and figures above

No grid, line graph

Task 2.2

**Code**

In a grid

Start at centre of grid

Grid 100x100

When it reaches steady state from formula, the tumour can move in any direction, the choice to move is random. (Carry out formula at max randomly move)

When it moves to a second cell, an initial population of tumour cell is reset to its initial conditions.

Carry on growth simulating the growth till stead state is reached for 2 cells of the grid. Then the cell growth has to move to another cell in the grid, choice of locations increases.

Plot the movement through the grid