6COM2012 Practical Assignment:

Semester A 2022/2023

There are 35 marks to achieve, each translating to 1% of your overall module grade.

Submission requirements

You may discuss your general ideas and thoughts with peers but the work handed in must be distinctly yours and your own. The following sets of documents must be submitted through canvas as individual files, not a directory.
(If you have many Python files please merge this down into 3 or less.)

(a) Your code that runs the different simulations

(b) The csv-files for each simulation

(c) A report to support the simulations

Task 1: Implementing the flocking model by Craig Reynolds in 2 dimensions [10 marks]

Create a "boid" class which has both a position and velocity. Implement the three behaviours (Separation, Cohesion, Alignment) in different functions. [2 marks per behaviour]
Add the inner and outer radius variables to your boid class and implement the decision-making using vector calculations. You can implement the vector calculation yourself or use a library [4 marks].

There is no need to create a visualisation for the simulation but you can use the scatter function of the Matplotlib library to evaluate what is happening. You can find an example of how to use it linked on Canvas.

Task 2: Testing the flocking model [5 marks]

Write a program simulating a group of boids. Intialise the starting positions and velocities randomly, within reasonable ranges. You can choose whether you

use a normal distribution or a uniform one for seeding. For simplicity, boids are allowed to be in the same position and fly through one another (no collision detection) [2 marks].

Run the simulation with 10 and 100 boids for 200 steps each. Save the positions and velocities of the individual boids for each step. Save each run in its own csv-file. (You can find the link to example code of how to save data in a csv-file on canvas.)
Write down your observations of each simulation run (roughly 50 words each) [3 marks].

Task 3: Breaking the Model [10 marks]

Adapt the decision-making to only include two of the behaviours at a time. Run your simulation with each possible combination of behaviours (Separation& Cohesion, Separation & Alignment, Cohesion & Alignment) with 100 boids for 200 steps. Save the positions and velocities of the individual boids for each of these runs in separate csv-files. [2 marks per combination]

Write down your observations of each simulation and compare these individually to the original swarm behaviour (50-100 words each) [4 marks].

Task 4: Exploring the Model [10 marks]

Expand or change the model to further explore swarm behaviour. Choose at least two modifications to the original model. These can be some mentioned during the lecture or some of your own ideas. You can implement these two modifications at the same time or in two separate simulations.

In your report, explain in detail how you modified the model. This should resemble a methodology section and someone else should be able to re-implement your model using this explanation (for the most part). Explain what you expect from these changes [3 marks].

Run the simulation(s) and save the positions and velocities of the individual boids for each of these runs in separate csv-files [4 marks].

Evaluate what your modifications changed in the behaviour of the swarm. How does this match your expectations? [3 marks]

Submission checklist

Python files that show all your simulations
(If you have many Python files please merge this down into 3 or less.):

- Original with 10 boids
- Original with 100 boids

- Separation& Cohesion, with 100 boids
- Separation & Alignment, with 100 boids
- Cohesion & Alignment, with 100 boids
- 1 or 2 modified simulations

csv-files for each simulation (you can create a zip archive):

- Original with 10 boids
- Original with 100 boids
- Separation & Cohesion, with 100 boids
- Separation & Alignment, with 100 boids
- Cohesion & Alignment, with 100 boids
- 1 or 2 modified simulations

Report with the following paragraphs (as pdf):

- Observations of 10 boids
- Observations ofh 100 boids
- Observations and comparison of Separation & Cohesion, with 100 boids
- Observations and comparison of Separation & Alignment, with 100 boids
- Observations and comparison of Cohesion & Alignment, with 100 boids
- Explanation and expectation of your modifications
- Observations and comparison of your modifications