COMP5400: Biological and Bio-Inspired Computation
Coursework 1
Evolution and Co-evolution with BEAST
Due Date: 23-27 March 2020

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Marking

This coursework is summative, will be marked and will count towards your final classification for 15 %. Total coursework counts for 40 %. The exam will count for 60 %.

Assessment

The coursework will be assessed in viva, a discussion of approximately 20-30 minutes that will be arranged with you in the week 23-27 March. You need to prepare by bringing the following:

- Your student ID *with student number*. If you don't bring your ID, the viva cannot take place.
- Printouts of the plots of Q1, Q6. Also, have available the scripts that you used to generate these plots. *Without these scripts, you may be awarded no marks for these questions.*
- The code modifications that you made to answer Q4. *Without being able to inspect these modifications, you may be awarded no marks for Q4.*
- A formal report is not required, but you will be much better prepared if you answer each question briefly in writing. You may bring preparatory notes to the viva, and if you are nervous you may write out your answers in detail beforehand. The rules for plagiarism apply here.

The marking scheme below is indicative. It demonstrates which questions are weighted higher compared to others, but marks are awarded based on the answers in the viva.

Plagiarism

Coding scripts and preparatory notes must be prepared by yourself. It is strictly prohibited to borrow or share code, which is why you must bring your scripts to the viva. You are allowed to discuss ideas, but should not share explicit answers to the questions with your colleagues. You are encouraged to share simulation results for Q6, but still must have run at least one simulation yourself, and bring the script that allowed you to plot the results to the viva.

Questions

Run the *mouse* demo in BEAST.

1. Plot the fitness of the mice as a function of the generation. Be judicious where you break off. Don't stop too early. Briefly motivate why you show the particular range you chose.
   [5 marks]

2. Describe the behaviour of the mice for different generations
   [5 marks]

3. Describe the fitness function used by the mice. It can be found in the file 'mouse.cc'. Experiment with the fitness function: change it and run the simulation again. Judging from the behaviour of the mice, explain whether you believe that the performance of the mice improves or deteriorates with your changes. Look in the code to see what parameters the genetic algorithm uses. Consider the influence of these parameters in your answer.
   [10 marks]

4. How would you define the performance objectively and how would you evaluate the relative performance of the different fitness functions? Implement and evaluate them. Also experiment with different sensor configurations. Explain the reasoning behind your experiments.
   [20 marks]

5. Based on the lecture notes and the literature cited there, discuss what you understand by the term *collective behaviour*. Describe and explain the behaviour of the mice. Do you see evidence of collective behaviour? Explain your answer.
   [15 marks]

   Run the *chase* demo in BEAST. Run three demonstrations for 100 generations. You can do this in parallel. Also record the behaviour of both types of agent after 10, 50 and 100 generations. Also let one simulation run for much longer (several thousands of generations). **It is explicitly allowed and you are encouraged to share the results of the long simulation run with your colleagues.**

6. Make a plot of the fitness of each agent as a function of the generation for both types of agent for all runs. Think of a good way to represent your results in plots so that you can make comparisons easily. Include *at least two of your colleagues'* results from the long simulation.
   [10 marks]

7. Describe the behaviour of the agents. Explain with reasoning whether or not you see evidence for co-evolution after different numbers of generations.
   [10 marks]

8. Judging the fitness plots, do you see evidence for co-evolution? Discuss this
   [10 marks]

9. Consider the predator-prey simulations. Do you consider the behaviour of the agents to be intelligent? Answer extensively, and give your own motivation. Have a look at different definitions of intelligence that are around, for example the paper 'Intelligence without Representation' by Rodney Brooks, which can be found on the 'Reading List' section of the VLE, and incorporate them in your argument.
[15 marks]

[100 marks total]