Degree Examinations 2017-2018
Department of Computer Science
Adaptive and Learning Agents (ALAS) Part B Open Assessment (100 marks)

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Issued: Wednesday, 14th March, 2018
Submission due: 12 noon, Wednesday 18th April, 2018
Feedback and marks due: Wednesday 9th May, 2018

Submission Guidelines

All students should submit all deliverables through the electronic submission system: `http://www.cs.york.ac.uk/student/assessment/submit/`, by **12 noon, Wednesday 18th April, 2018**.

An assessment (or part of an assessment) submitted after this deadline will be marked initially as if it had been handed in on time, but the Board of Examiners will normally apply a lateness penalty to the whole assessment.

The feedback and marks date is guided by departmental policy but, in exceptional cases, there may be a delay. In these cases, all students expecting feedback will be emailed by the module owner with a revised feedback date. The date by which students can expect to see their feedback is published on the module descriptor: `http://www.cs.york.ac.uk/modules/`

Your attention is drawn to the section about Academic Misconduct in the Departmental Statement on Assessment:
`http://www.cs.york.ac.uk/student/assessment/policies/`

Any queries on this assessment should be addressed to Dimitar Kazakov, `dimitar.kazakov@york.ac.uk`. Answers that apply to all students will be posted on the ALAS VLE site: `http://vle.york.ac.uk/`

Your exam number should be on the front cover of your assessment, and each subsequent page. You should not be otherwise identified anywhere on your submission.

Dynamics of Society-based Cooperation

1 Setup

A population of agents exist in an environment in which the location of an agent is unknown and irrelevant; the only possible event in this environment is for a pair of agents chosen at random to play a game. The game is very simple: each agent chooses one of two possible actions, 'cooperate' or 'be selfish'. The game payoffs to both agents are described by the following table:

	Agent 2	
Agent 1	Cooperate	Be selfish
Cooperate	(3, 3)	(0, 5)
Be selfish	(5, 0)	(1, 1)

Table 1: Payoffs: (Agent1, Agent2)

Neither agent knows in advance what action the other one has chosen. However, the agents know whether they both belong to the same *society* or not, as it is through this knowledge that their strategy is chosen when playing a game. Every agent is a member of exactly one society, and there are four societies with different rules of conduct to choose from. Members of the *Green Society* cooperate with everyone. Members of the *Red Society* cooperate with each other, but not with anyone else. Members of the *Blue Society* do not cooperate with each other, but cooperate with everyone else. Members of the *Brown Society* never cooperate with anyone. When an agent is selected to play a game, it must follow the strategy prescribed by the society it is a member of. Once each of the two players has chosen its move, the appropriate payoffs are handed out as listed in Table 1. After each played game, each player is shown the total wealth of the other player, and is allowed to leave its current society and join another one. (An agent must always remain a member of exactly one of the four societies.) Each agent's personal objective is to maximise its total payoff over the course of the whole simulation, which consists of repeating the above 'event' N times, where the agents do not know that number in advance.

2 To Do

Your main objective is to use machine learning and/or evolutionary algorithms in order to develop a strategy that will allow an agent to maximise its total payoff by changing its society membership over time as appropriate.

1. For **10 marks**, choose a simple and efficient representation of your agents' behaviour. Describe the chosen representation in your report.

2. For **20 marks**, write the necessary code and describe how consecutive runs of the environment are going to provide the basis for estimating the fitness of your adaptive behaviour and/or generate training examples for your learning algorithm.

3. For **40 marks**, design, implement and describe a procedure that uses adaptation and/or learning to produce viable behaviour for your agents.

4. For **20 marks**, design and describe an evaluation procedure that allows you to compare the behaviour obtained through adaptation and/or learning to the default, and draw conclusions that are supported by results that are statistically significant (where applicable). Consider each of the two cases: (a) only one agent is capable of changing (learning/adaptating) its behaviour at a time, and (b) all agents in the environment are doing that.

5. For **10 marks**, collect experimental evidence, carry out, and show the results of the evaluation procedure described above.

You can implement the environment and the solutions to all questions in any programming language or environment of your choice. (Do however consider NetLogo when making this choice.) A full set of source files along with instructions how to compile (if necessary) and run the code need to be submitted. (Omitting your source code will mean any results based on the missing part of the code will be disregarded!)

You can use any third party code provided that (1) its compilation and use do not require additional software to be installed (beyond the contents of your submission), (2) it does not require the user to have administrative rights, and (3) it has not been commissioned explicitly for the purposes of this assessment.

3 Deliverables

1. A single archive containing

   - all data, configuration, source code and binary files that were written by you or produced by your code/experiments.
   - all data produced by your code that was used in the report;
   - a README.txt file describing each of the files in the archive;
   - *either* an executable script implementing all experiments (with a name of your choice), *or* a text file `log.txt` containing a list of instructions which, when followed to the letter (e.g. commands copied and pasted onto a CSE/066 Linux terminal), replicate all your results;

2. A report (as PDF) describing your approach and briefly summarising the specifics of your code as well as your tests, results and evaluation. The report with all tables, figures and appendices should not exceed 6 pages

(A4, 12 pt font) (anything beyond that limit will be ignored), and the main body of text would be expected to represent at most half of this limit.

Criteria to be used in the marking include clarity, simplicity, generality and rigour of the methods chosen, as well as the ability to describe, analyse and visualise experimental results in an effective way.