CM3020 Artificial Intelligence Mid-term coursework specification

Introduction

This document contains information about the mid-term coursework. You need to complete Part A and Part B. Part A is worth 30%. Part B is worth 70%.

Part A

Write an essay about game playing AI. Your essay should answer the following questions. I recommend starting with these as section headings, but you might want to re-structure it later as you see fit.

1) Why do researchers create AI systems that play games?

To answer this question, explain how researchers justify the development of AIs that play games.

2) What are THREE possible application areas for AI systems that play games?

To answer this question, describe three possible application areas for game-playing AI systems.

3) What do researchers think are the ethical problems with game-playing AIs?

To answer this question, discuss the ethical aspects presented by researchers about game playing AIs.

4) Are neural networks the best game players?

Based on what you have read, discuss this question, using evidence from the literature.

5) How reliable are my references?

Choose three of the references you used and evaluate the reliability of the reference.

You should answer each of the questions using information that you have found in the literature. To find relevant papers, you can start with the list provided in the AI game-player case study. To dig deeper you can search for your own references and/ or you can follow up the references at the end of other papers. Provide direct quotes from the research papers you have read to show how the researchers answer those questions and add your own commentary.

For example, 'Smith et al. evaluated game playing AIs based on their ability to consume pizza at 5am after staying up all night. They found that current generation systems in 2021 were not human-competitive. They said: "since

the removal of CD-ROM drives from tower systems, the computers just have nowhere to put the pizza'' [6]. I find that the pizza eating metric is flawed as it does not account for people who are lactose intolerant and computers do not eat pizza.'

Add an appropriately formatted list of references at the end of your essay.

Part A Deliverables:

- Essay in PDF format up to 1,500 words.

Part A Marking criteria

Part A is worth 30% of your final mark.

- All questions answered
- Clear and logical writing using evidence from the literature
- Proper citations and quotes
- Reference list at the end of the essay

Part B

Introduction

This section describes what you have to do and what you have to deliver for Part B of the mid-term CM3020 AI coursework.

For this part of the coursework, you need to build on top of the codebase from the Genetic Algorithm/ Creatures case study. Your objective is to adapt the evolutionary algorithm so that the creatures evolve to complete a new task. The new task involves climbing a mountain. We have created a special new environment for the creatures to operate in. You need to integrate the genetic algorithm code to that new environment such that it evolves creatures that can climb the mountain.

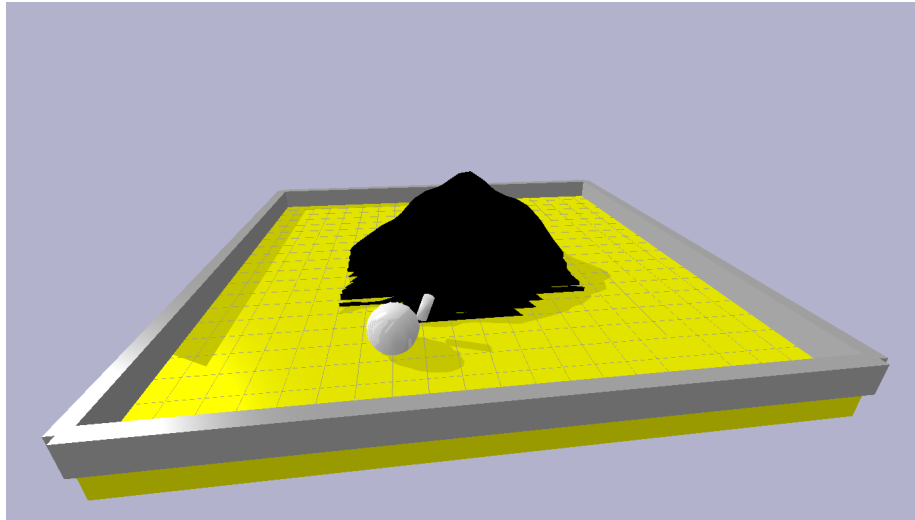The following image illustrates the new environment:

Figure 1: Mountain climbing environment

You can see that there is a kind of sandbox with a mountain in the middle. The idea is for the creature to get as high as possible up the mountain, without cheating and flying into the air. Your job is to integrate that new environment into the simulation code and to adapt the fitness function so it measures maximum closeness to the top of the mountain.

How to complete the coursework

Download the code for the new environment, linked below. You will see that I have included the code as it stood at the end of my development work. There are also some new scripts in there:

- cw-envt.py: run this to see the environment in action. You can see that a random creature is generated and dropped into the arena.
- prepare_shapes.py: This is the script I used to generate the mountain. You will need to experiment with this script to generate some different shapes of mountains.

Step-by-step process you should follow to complete the basic part of the coursework:

- Download the example code
- Set up a virtual environment with the appropriate packages to run the code in cw-envt.py
- Verify that you can run cw-envt.py and that you see the image shown above
- Make a copy of cw-envt.py and integrate the full genetic algorithm system you should have developed during the course so that the simulation loads up the sandbox + mountain environment and tests the creatures in there
- Change the fitness function so that fitness is based on ability to climb the mountain. It is up to you how to do this
- Carry out a series of experiments where you test different GA and genome settings, e.g. different population size and other high-level settings
- Produce graphs and tables describing how the different settings you tried affect the mountain climbing

Advanced coursework steps: experimenting with the encoding scheme

Once you have succeeded in integrating the new environment into your genetic algorithm, you have defined a new fitness function and you have tested it out with various settings, you are ready for the advanced part of the coursework.

The advanced part involves experimenting with the genetic decoding scheme in order to explore a different space of possible creatures. Things you can experiment with are as follows:

- the motor controls
- the shape of the parts of the robot
- having different parts of the robot be evolvable, e.g. you do not evolve every part of the robot, just some of it

There are lots of things you can try out here, for example, can you start with a fixed design robot, and just evolve the motor control parameters? Can you fix some parts of the robot so they cannot evolve, and other parts do, e.g. evolving just leg designs? Can you try some different shapes and connection settings?

You should carry out further experiments wherein you try out your ideas and summarise them in graphs and tables.

How to achieve an exceptional grade (>80%)

There are many possible extensions you can work on to achieve an exceptional grade. Here are some ideas to get you started:

- Experiment with different landscapes: have a look at prepare_shapes.py. Can you use the code there to generate some different landscapes and experiment with those?
- Experiment with sensory input: the creatures cannot receive information about their environment at the moment. Can you have some sort of motor control that responds to a stimulus from the outside world? E.g. can the robot have motors that only turn on or off when it is facing the top of the mountain?

The suggestions above are only some possible things you can do here. It is up to you to choose an area to explore here.

Preparing your code

You need to follow these instructions to prepare and submit your code:

- Concatenate all the code for your project into a single file (e.g. on macos/linux cat *.py > mycode.txt)
- Load the code file into a word processor and add clear colour highlights showing the main blocks of code that you wrote on your own without assistance
- Convert to a PDF and submit

Preparing a video demo

Please make a 5 minute video wherein you present examples of the creatures you were able to evolve. A really good video will contain slides explaining clearly what we are looking at. e.g. state what the experiment was that led to a given creature. If you completed the advanced criteria, make a section in the video for this. If you completed the exceptional criteria, make a section for this. The video should not just be a montage of creatures - there should be explanation and narrative there too.

Part B Deliverables

- Report: 1,500 - 2,000 words long, PDF format
- All code in PDF format as specified above
- Video: around 5 minutes long, MP4 format
- Why my work is exceptional' statement, if you have completed all other other requirements and attempted extensions

Part B Marking criteria

Part B is worth 70% of your mark.

Report:

- Clearly explains the basic experiments you carried out
- Presents the important results of your experiments in the form of graphs and tables
- Has a section explaining the experiments you did with the encoding scheme
- Presents the important results of your experiments with the encoding scheme in the form of graphs and tables
- If you attempted the exceptional criteria, explain and present results of what you did
- You can include code fragments in the report if it helps you to explain what the experiment was
- the report should be 1,500 - 2,000 words long. Please state the word count on the first page
- Is PDF format

Code

- Code is presented as a single file in PDF format with clearly highlighted sections indicating the code you personally wrote without assistance
- Code complexity and quality, beyond the template code provided
- Code quality: formatting, comments

Video

- Video is in MP4 format
- Video is around 5 minutes long
- Video is structured, with appropriate information given about what we are seeing
- Video shows examples of the creatures that evolved under different conditions