

# CM3020 Artificial Intelligence mid term coursework

This coursework consists of two parts:

PART A: Reviewing research papers about robotic science

PART B: Experimenting with genetic algorithms and evolved creatures

There are three deliverables:

PART A: Written report up to **2000** words in **PDF** format

PART B: Written report up to **1500** words in **PDF** format

PART B: Video showing evolved creatures (1-2 minutes)

## PART A: Reviewing research papers about robotic science

In this part of the assignment, we would like you to carry out a small scale literature review about robotic science.

The output of your work is a document, written in your own words, containing the following elements:

### Introduction to the field of robotic science

What is robotic science? What is it aiming to achieve? What kind of techniques does it use?

### Descriptions of three papers about robotic science

Find three research papers about robotic science. For each paper, write a paragraph answering the following questions:

- \* What are the researchers trying to achieve?
- \* Which techniques did they use to address the problem?
- \* Which techniques did they use to evaluate their research?
- \* How successfully do you think they were in achieving their goals?
- \* Did they provide any source code or open data?

### Creating a timeline of developments in robotic science

Place the papers you read on a timeline. Identify the key techniques used in the papers you read. Find out when those techniques became available. For example, if one of the papers uses LSTM neural networks, find out when those networks became generally available and put that date on the timeline as well.

### Discussion of ethics of robotic science

For each paper, state if the researchers explicitly discussed ethics in the paper. State your own opinion about the ethics of the research. Explain and justify your opinion as clearly as you can.

### Statement on the reliability of the references chosen

How reliable do you think the papers you read were? Do you think this work should be taken seriously? Why?

### Reference list

Provide a list of references. Be sure to number your references and to cite them in the text, e.g. [1]. MLA format is acceptable, e.g.:

[1] Yee-King, Matthew, Mick Grierson, and Mark d'Inverno. "STEAM WORKS: Student coders experiment more and experimenters gain higher grades." *2017 IEEE Global Engineering Education Conference (EDUCON)*. IEEE, 2017.

## PART A Grading criteria:

Criterion	Points
Introduction to the field of robotic science	2
Descriptions of three papers about robotic science	9
Creating a timeline of developments in robotic science	3
Discussion of ethics of robotic science	3
Statement on the reliability of the references chosen	2
Correct formatting of references	1
Originality, quality and overall effort	5
Total	25

## PART B: Experimenting with genetic algorithms and evolved creatures

In this part of the coursework, we would like you to conduct some experiments with the genetic algorithm creatures system.

### Hyper-parameter exploration

First, you need to investigate the impact of various parameter settings on the evolution. This work aims to understand how different settings affect the speed and quality of the evolution. The output of this work should be tables and graphs showing the effect of different parameter settings on the evolution speed and reliability.

Here are some settings you can adjust, but you should also come up with your own ideas:

- \* Mutation rate and range

- \* Population size

Carry out multiple evolution runs with each setting. Calculate the evolution speed (increase in mean fitness of the population over time). Think about how you measure time – is it the number of individuals evaluated? Is it the number of generations? Can you think of any other ways to evaluate the performance of the genetic algorithm with these different settings?

You will have to do some programming to ensure that you can effectively carry out the work.

Explain your evaluation metric, tabulate and graph the results of your experiments and write up a rationale for how you did it.

### Experiment with the encoding scheme

Next, it is time to experiment with the encoding scheme. The encoding scheme describes how to convert the genome into a functional creature. The encoding scheme described in the AI course is based loosely on the scheme specified by Sims in the original creatures research papers. Some details are either not present in the original paper or differ in the AI course implementation.

Look at the gene spec you have in the genome.py file. The gene spec defines the ranges of the various genome parameters.

Think about which parameters you can adjust and what the effect might be. For example, can you make the pieces of the creature longer and thinner or more spaced out?

Run the evolution with different settings and document the results in images showing the different types of creatures that evolve. There will also be a submission point for a video. If you can create a video including examples of various interesting creatures and information about how they evolved (i.e. what the settings were, which generation etc.), that would certainly contribute to the mark for documentation.

## **PART B Grading criteria:**

<b>Criterion</b>	<b>Points</b>
Hyper-parameters: explaining the process you carried out and how you evaluated the evolution runs	5
Hyper-parameters: explain the metrics you used to evaluate the evolution	2
Hyper-parameters: visual presentation of the results in tables and graphs	5
Encoding scheme: process carried out when experimenting with genome parameters	3
Encoding scheme: presentation and discussion of results	5
Originality, quality and overall effort	5
Total	25