University of London International Programmes

Computing and Information Systems/Creative Computing

CO3310 Artificial intelligence

Coursework assignment 1 2017-18

Notes

- In what follows, 'AIMA' refers to *Artificial Intelligence: A Modern Approach* (3rd Edition, 2010) by Stuart Russell and Peter Norvig.
- You should list all references at the end of your work, and they should be properly cited whenever referred to. Note that any answers that consist entirely or mostly of quoted material are unlikely to gain high marks, even if properly referenced.
- Where you are asked to 'explain' or 'justify' your answer, unless otherwise stated, you should write no more than one or two sentences.

*Please submit your work as a single PDF file (**not** a zip file), using the following file-naming conventions:*

YourName_SRN_COxxxxcw#.pdf (e.g. MarkZuckerberg_920000000_CO3310cw1.pdf)

- ***YourName** is your full name as it appears in your student record (check your student portal);*
- ***SRN** is your Student Reference Number, for example 920000000;*
- ***COXXXX** is the course number, for example CO3310; and*
- ***cw#** is either cw1 (coursework 1) or cw2 (coursework 2).*

There are 100 marks available for this assignment.

Marks may be deducted if your submission is not in the required format.

REMINDER: It is important that your submitted assignment is your own individual work and, for the most part, written in your own words. You must provide appropriate in-text citation for both paraphrase and quotation, with a detailed reference section at the end of your assignment (this should not be included in any word count). Copying, plagiarism and unaccredited and wholesale reproduction of material from books or from any online source is unacceptable, and will be penalised (see our guide on how to avoid plagiarism on the VLE).

1. Agent-based computing [30 marks]

(a) Explain the following terms **in your own words**, in the context of agent-based computing.

i. Reflex agent
ii. Reflex agent with state
iii. Goal-based agent
iv. Utility-based agent

(b) A recent report by PwC UK estimates that workers in Transportation and Storage are at the highest risk of having their jobs displaced by automation. The research behind this report specifically focused on the types of tasks involved in a variety of occupations, and whether these tasks were at risk of being automated. See 'Will robots steal our jobs?', March 2017 https://www.pwc.co.uk/services/economics-policy/insights/uk-economic-outlook/march-2017.html

This is a list of the types of tasks that could be assigned to **warehouse workers** in the UK.

Warehouse workers: warehouse operative, warehouse picker or packer

1. taking delivery of goods and storing them
2. checking for damaged or missing items
3. moving stock by hand or with machines
4. packing and wrapping goods
5. loading goods for sending out
6. keeping stock records
7. cleaning the warehouse.

https://nationalcareersservice.direct.gov.uk/job-profiles/warehouse-worker

i. Which of these tasks do you think could be carried out by robots or other AI systems, given the current state of knowledge or advances that can reasonably be expected within the next 5-10 years?
ii. Describe the characteristics of **four** of these tasks with reference to the 'dimensions' listed in Section 2.3 of the subject guide and Chapter 2 of AIMA.

You should write no more than about 600-800 words for (i) and (ii) combined.

2. Search [30 marks]

(a) Compare the following search strategies according to whether or not they are complete, optimal and informed. Justify your answers.

i. Breadth-first search
ii. Depth-first search
iii. Greedy best-first search

iv. Uniform-cost search.

(b) This question concerns heuristics in search.

i. Explain what is meant by a heuristic, and how heuristics can be useful in efficiently finding solutions.
ii. Describe two heuristics for the 8-puzzle.

(c) For this question, you will need to use the simplified map of Romania and the table of straight-line distances to Bucharest from Chapter 4 of AIMA.

Suppose you are travelling from Sibiu to Bucharest. The possible routes on the map include:

- Sibiu-Fagaras-Bucharest
- Sibiu-Rimnicu Vilcea-Pitesti-Bucharest
- Sibiu-Rimnicu Vilcea-Craiova-Pitesti-Bucharest.

i. If you use the A* algorithm to calculate the route, which of these paths will be explored and which will be selected as the optimal route?
ii. What solution would be returned if you use the greedy best-first algorithm?

You should explain your answers and show your working.

3. Formal logic, knowledge representation and reasoning [40 marks]

(a) Explain in your own words what is meant by the following terms, in the context of logical reasoning:

i. Validity
ii. Soundness
iii. Completeness.

(b) Represent the following statements as formulas of Predicate Calculus, stating the intended interpretation of any predicates and constants that you use. You should give two versions of each formula, one using the existential quantifier $\exists$ and one using the universal $\forall$.

i. All sharks are fish and all fish are cold-blooded.
ii. All rhinos are Black Rhinos or White Rhinos.
iii. No rhinos are fish.
iv. Some fish are not striped.
v. Not all cold-blooded animals are fish.

(c) The subject guide (Konidaris, 2013: p18) states:

'Propositional logic is a simple logic that deals with symbols and their relationships with each other. This allows us to create agents that deal with known facts…'

There is an assumption here that symbols can be reliably associated with (or 'represent') facts about the world, and that logical expressions can faithfully capture the properties of, and relations between objects (or at least, those properties and relations which are relevant to a particular problem). This assumption has been challenged since the early days of AI, in terms of what became known as the 'Symbol Grounding Problem'.

Read through the paper by Harnad cited below and **either** the paper by Steels **or** the one by Taddeo and Floridi, as well as any other relevant sources you may identify through independent reading or the references in these papers, and write an essay (no more than 1,000 – 1,200 words) which addresses these points:

- What is the Symbol Grounding Problem, and why is it a problem?
- Evaluate **one** of the proposed solutions to the problem described by Taddeo and Floridi or Steels.

Stevan Harnad *The Symbol Grounding Problem* (2003):
http://cogprints.org/3018/1/symgro.htm

Luc Steels *The Symbol Grounding Problem has been solved. So what's next?* (2007):
https://pdfs.semanticscholar.org/539e/dbdab51943e5ba273048f8bec4e888976cfb.pdf

Mariarosaria Taddeo and Luciano Floridi *Solving the Symbol Grounding Problem: a Critical Review of Fifteen Years of Research* (2005):
http://philsci-archive.pitt.edu/2542/1/sgpcrfyr.pdf

[Total 100 marks]

[END OF COURSEWORK ASSIGNMENT 1]