University of London International Programmes
CO3310 Artificial intelligence
Coursework assignment 1, 2016–2017

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 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), with an appendix including any Prolog code you have written and the results of running your code. Marks may be deducted if your submission is not in the required format.
- Please ensure that you include your full name, student number, course code and assignment number e.g. Zuckerberg_920000000_CO3310cw1.pdf)
    - FamilyName is your family name (also known as last name or surname) 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).

1. This question concerns agent-based computing. [30 marks]

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

(i) Actuators
(ii) Percepts
(iii) Utility
(iv) Rationality
(v) Reflex agent
(vi) Goal-directed agent.

(b) This is a list of the types of tasks that could be assigned to a **teaching assistant** in primary or secondary schools in the UK (teaching assistants may also be called **classroom assistants** or **learning support assistants**).

i. getting the classroom ready for lessons
ii. listening to children read or reading to them
iii. helping children with special educational needs
iv. helping teachers plan lessons and prepare teaching materials
v. helping teachers manage class behaviour

vi. supervising group activities
vii. looking after children who are upset
viii. clearing away materials and equipment
ix. helping with outings and sports' events
x. keeping records on children's progress
xi. leading classes with help from the teacher.

https://nationalcareersservice.direct.gov.uk/job-profiles/teaching-assistant

(Accessed October 31st 2016.)

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 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 words for I and II combined.

2. This question concerns search. [35 marks]

(a) Compare the following search strategies in terms of their **time** and **space complexity**.

i. Breadth-first search
ii. Depth-first search
iii. Depth-first search with iterative deepening
iv. A* search.

(b) Explain in your own words the difference between **tree search** and **graph search**.

(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 3 of AIMA.

Calculate the routes that would be chosen from Mehadia to Bucharest by each of:

i. Greedy search
ii. Uniform-cost search
iii. A* search.

You should explain your answers and show your working.

3. This question concerns formal logic, knowledge representation and reasoning. [35 marks]

Prolog is a declarative programming language that allows you to create a knowledge

base by writing first-order logic sentences, and then to pose queries to that knowledge base. The language itself takes care of performing the necessary inference; your role is primarily that of correctly specifying the problem and the query you need answered. You may use any implementation of Prolog for this question. SWI-Prolog is recommended as it is very straightforward to install and use. A current stable version for your platform can be freely downloaded from http://www.swi-prolog.org/, and a version is also included with your course materials.

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

i. A **model**
ii. **Monotonocity**
iii. **False negative** and **false positive**
iv. **Prior probability** and **posterior probability.**

(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 ∃ and one using the universal ∀.

(i) All leopards are cats and all cats are mammals.
(ii) All elephants are African or Asian.
(iii) No elephants are ungulates.
(iv) Some cats are not nocturnal.
(v) Not all mammals are carnivorous.
(vi) The barber shaves every man who does not shave himself.

(c) Encode the knowledge base (KB) on pp.25–26 of the CO3310 Artificial intelligence subject guide as a series of Prolog clauses. Note that as Prolog does not allow disjunction in the head of a clause, you will have to formulate logically equivalent versions of some of the rules.

Use your Prolog implementation to derive answers to the following queries. You may need to add new clauses to the KB. (Note: the answers should reflect the original 'facts' in the KB, not your own common-sense knowledge.)

(i) What fruits are red?
(ii) Is some onion tasty?
(iii) What things are coloured?
(iv) Is there a tasty vegetable?

You should **explain** your solutions and discuss any cases where the results seem unintuitive.

[TOTAL 100 marks]

[END OF COURSEWORK ASSIGNMENT 1]