University of London International Programmes

CO3310 Artificial Intelligence: Coursework assignment 2 2016–2017

Due date: 8th April 2017

IMPORTANT

Your Coursework assignment should be submitted using the following file-naming conventions:

FamilyName_SRN_COxxxxcw#.pdf (*e.g.* Zuckerberg_920000000_CO3310cw2.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 CO3354, and
- **cw#** is either cw1 (coursework 1) or cw2 (coursework 2).

Notes

- Any websites cited below were last visited on 31st January 2017.
- The essential textbook for this module is *Artificial Intelligence: A Modern Approach.* (3rd edition) by Stuart Russell and Peter Norvig, and it is referred to in the coursework assignment as AIMA.
    - You should list all references at the end of your work, and they should be properly cited whenever referred to (see link to Harvard referencing guide: http://guides.lib.monash.edu/citing-referencing/harvard)
    - References to websites should include the title, author (if available) and the date last visited.
- Answers should be expressed **in your own words**: an answer consisting entirely or mostly of quotes is unlikely to get good marks, whether or not the sources are 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). Any additional files will be disregarded.
- There are 100 marks available for this coursework assignment.

Question 1: Machine learning [30 marks]

(a) You may have noticed that Facebook now attempts to generate 'alt text' descriptions of user-posted images, which can be surprisingly accurate and detailed: for example, '*Image may contain: 2 people, people smiling, tree, crowd, sky, outdoor and close-up*'. For this question you should read the article 'Learning to Segment' by Piotr Dollar at https://research.fb.com/learning-to-segment/ and answer the following:

i. Based on the above article and your own independent reading, write a summary account of object recognition as a machine learning problem (max 500 words).
ii. Propose three possible applications for this kind of technology. Justify your answers.

(b) Suppose that when you have completed your degree programme, you get a new job that requires you to move to another city. Make a list of the factors you would consider in deciding whether to buy or rent somewhere to live in your new place of residence, and discuss how machine learning techniques could be used to construct a **decision tree** to assist people faced with this choice.

Question 2: Planning [30 marks]

(a) Explain the following terms in the context of AI Planning:

i. Progressive planning
ii. Regressive planning
iii. Partial-order planning
iv. Serialisable subgoals
v. Subgoal independence.

(b) This question is adapted from Exercise 10.5 in Russell and Norvig. Read through this exercise and study Figure 10.14, and then do the following:

i. Write PDDL sentences for Shakey's six actions and the initial state shown in Figure 10.14. Explain the intended meanings of any predicates and constants you use.

ii. Construct a plan for Shakey to:

- Go to Room 1.
- Switch on the light.
- Move Box 4 to the door.
- Switch off the light.
- Take Box 4 back to Room 3.

(We can assume there is enough light from the corridor for Shakey to clearly see Boxes 1 and 2 without the light on but not to see Box 4.)

Question 3: Natural Language Processing and philosophical issues [40 marks]

(a) Study the phrase structure grammar shown on p.42 of the subject guide. Which of the following sentences are generated by this grammar? Justify your answer, and create a parse tree for each sentence that matches the grammar.

i. John smells the wumpus in the pit that stinks.
ii. Boston is right ahead.
iii. Mary and John see Boston.
iv. Mary feels the breeze in Boston.
v. The wumpus that Mary smells is nearby.
vi. John is in Boston and a smelly dead wumpus is nearby.

(b) Explain how the grammar can be modified so that it will generate the following sentences:

i. Miriam sees a wumpus or a small aardvark and walks away.
ii. The wumpus and the pit stink.
iii. Pedro saw 1345 wumpuses in Boston.
iv. Maya very often sees a wumpus in the nearby park.

Are any of the sentences (a) i–vi) or (b) i–iv) ambiguous according to the original grammar or your modified version? Justify your answer by giving alternate parse trees.

(c) Read the article 'Jumping NLP Curves: A Review of Natural Language Processing Research' by Erik Cambria and Bebo White (2014) at http://www.sentic.net/jumping-nlp-curves.pdf, and answer the following questions.

i. Explain what the authors mean by the following in the context of NLP:

- 'bag-of-words'
- 'bag-of-concepts'
- 'bag-of-narratives'
- Compositional semantics
- Taxonomic NLP.

ii. Explain the difference between Natural Language Processing (NLP) and Natural Language Understanding (NLU). Why do the authors claim that current NLP systems are not capable of NLU?

iii. Do the authors make a convincing case that NLP will eventually evolve into NLU? Evaluate their claims in the light of John Searle's arguments for the impossibility of machine understanding of natural language: see *e.g.* 'The Chinese Room Argument' (2004) by David Cole at https://plato.stanford.edu/entries/chinese-room/

[TOTAL 100 MARKS]

[END OF COURSEWORK ASSIGNMENT 2]