Coursework commentary 2017–18

CO3310 Artificial intelligence

Coursework assignment 1

Introduction

- In what follows, 'AIMA' refers to Artificial Intelligence: A Modern Approach (3rd Edition, 2010) by Stuart Russell and Peter Norvig.
- Students were advised to list all references at the end of their work, and that they should be properly cited whenever referred to. Note that any answers which consisted entirely or mostly of quoted material were unlikely to get high marks, even if properly referenced
- When asked to "explain your answer", unless otherwise stated you should have written no more than one or two sentences.
- Students were advised to submit work as a single PDF file (**not** a zip file). Marks may be deducted if submissions are not in the required format.

Comments on specific questions

Question 1

Agent-based computing

Part (a) required students to explain terminology; these can all be answered by looking up relevant sections of the subject guide or AIMA, but students should make some effort to express answers in their own words. NB: few or no marks were given for uninformative, circular or dictionary answers such as "Utility is the quality of being useful" or "rationality is a measure of rational behaviour", "a goal-based agent is designed to achieve goals", "a utility-based agent selects actions using a measure of utility", and so on. Most students did reasonably well on this question.

Part (b) dealt with agent technology and types of jobs at risk of being displaced by automation. Good answers might begin by considering what the relevant types of percepts and actions would be to carry out the specified tasks, and the implications for a robot agent's sensors and actuators. The word limit does not allow for all duties to be discussed in depth, but students should have picked a representative selection and given well-motivated classifications along the listed dimensions. A tabular answer may be appropriate as long as there is some justification for the classification. Many large companies have already automated many warehousing tasks, so students may well have referred to published studies as long as these were appropriately cited, e.g. https://www.forbes.com/sites/stevebanker/2016/01/11/robots-in-the-warehouse-its-not-just-amazon/2/#74607557352d

Marks were awarded for well-motivated selections of tasks, for reasonable, well-motivated classifications, and for clarity of expression and scholarly practice. Answers were quite variable in quality: many were thoroughly

researched and well-motivated, though others were lacking in explanation, motivation or proper referencing.

Question 2

Search

Parts (a) and (b) were essentially bookwork. Students were expected to gain good marks by referring to the relevant sections of the subject guide and the recommended readings, and indeed most did quite well and there were few if any serious problems with these questions.

Part (c) involves working through different search algorithms using the simplified map of Romania and the table of straight-line distances to Bucharest from Chapter 4 of AIMA.

Marks were awarded for correct answers, for clear and correct working, and for narrative explanations. Students would get some credit if their working showed good understanding of the algorithms but the calculations went wrong at some point. For full marks, it was necessary to show all paths that would be explored, not just the final solution. NB: different editions of AIMA seem to have some slightly different values for the SLDs: this was taken into account when marking.

Students could obtain good marks for this question by working carefully and meticulously through the problems and submitting a properly documented answer, and indeed quite a few did get full marks. Some students lost marks through not showing all the working or explaining their answer, while others did not attempt this question or submitted incomplete answers. A few answers showed poor understanding of the problem.

Question 3

Formal logic, knowledge representation and reasoning

Here Part (a) was bookwork; students should have been able to get good marks by looking up the relevant sections in the subject guide or other resources. In fact, while a few got high or even full marks, the general standard of answers was disappointing. One thing to keep in mind is that "completeness" has a different meaning in this context than it does when applied to formal logic – some students were confused about this.

Part (b) required students to represent English language statements as formulas of Predicate Calculus, giving two versions of each formula, one using the existential quantifier $\exists$and one using the universal $\forall$. This is a topic that many students find challenging, and students would be well advised to revise it thoroughly for the exams. Some good sources are Wilfred Hodges' *Logic* (Penguin paperback) and the Oxford University Philosophy department's online tutorial at:

http://logic.philosophy.ox.ac.uk/main.htm

A few students got excellent or even full marks, though many were flawed in some way. A common failing is confusing the use of $\rightarrow$and &, e.g. encoding "All As are B" as "$\forall$x(A(x)&B(x))" which actually says that everything that exists is both an A and a B. Some gave away marks by not fully answering the question as specified, e.g. not giving answers using both existential and universal quantifiers.

Part (c) dealt with the Symbol Grounding Problem, a fundamental question in AI concerning whether logical expressions can faithfully represent entities and relations in the "real world". There was scope for various different kinds of

answers, as students were able to choose which papers to work from (including sources identified through independent study) and which proposed solutions to critique.

Marks were awarded for showing understanding of the readings and relevant specialist knowledge, for quality of argumentation, and for clarity, structure, and quality of written expression. This question required students to evaluate proposed solutions, not just to explain them.

Harnad's paper is an encyclopedia entry which gives a very concise statement of the issues and a comprehensive reading list (as of 2003). As he frames it, the SGP is the problem of explaining how an agent/system reliably hooks up symbols in a representation language with entities and events in the real world.

For Steels, solving the SGP for AI/robotics would require agents to have the capacity to autonomously generate "the semiotic networks that it is going to use to relate symbols with the world" rather than executing conceptual frameworks already implemented by their designers, or by supervised learning of concepts within an environment set up by the designer. He notes that much confusion has arisen from the interdisciplinary nature of this debate, as philosophers, linguists and the like may be ignorant of the precise meaning of "symbol" in the context of symbolic programming languages. He also observes that the use of "representation" in the context of database systems misses out much of what is involved in the way humans create and deploy meanings. The main part of his paper describes work which is claimed to satisfy the prerequisites for a solution to the SGP: he argues that these mechanisms provide an effective solution to the SGP, which is evaluated by increasing levels of success in language games.

Taddeo and Floridi (T&F) survey a variety of proposed solutions to the SGP. NB: students are only required to discuss one of these, if they choose to work from this paper. They classify the "solutions" into three types: "representationalist", "semi-representationalist" and "non-representational". Good answers would show an awareness and understanding of this distinction.

A few students gave excellent answers combining clear, well-referenced exposition with critical evaluation but many either did not attempt this question, perhaps through time pressure, or submitted answers that were rather short, uncritical, or showed limited understanding of the problem.