

**University of London**  
**Computing and Information Systems/Creative Computing**  
**CO3310 Artificial intelligence**  
**Coursework assignment 1 2018-19**

**Introduction**

- 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 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 on 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).

**Preparatory reading**

Before tackling the questions in this coursework assignment you are recommended to study the following resources:

- "Will robots steal our jobs?" – chapter from PWC report, UK Economic Outlook, March 2017: [www.pwc.co.uk/economic-services/ukeo/pwcukeo-section-4-automation-march-2017-v2.pdf](http://www.pwc.co.uk/economic-services/ukeo/pwcukeo-section-4-automation-march-2017-v2.pdf)
- "Granny and the robots: ethical issues in robot care for the elderly", Sharkey, A. & Sharkey, N. Ethics Inf Technol (2012) 14: 27. doi: <https://doi.org/10.1007/s10676-010-9234-6>, PDF: <https://link.springer.com/content/pdf/10.1007%2Fs10676-010-9234-6.pdf>

- Introduction to Logic, a series of tutorials from Oxford University's Philosophy Department: <http://logic.philosophy.ox.ac.uk/>

### Question 1: Intelligent agents, social and ethical issues

A combination of ageing populations, dispersed families, time pressures and increasing restrictions on migration have been predicted to lead to severe shortages of carers for the elderly, particularly in the more industrialised nations, and there has been speculation that robots, humanoid or otherwise, will be deployed to fulfil this need.

The UK's National Career Service lists the following typical duties of carers who help older people in their own homes or in day centres, residential or nursing homes:

- getting to know clients and their interests and needs
- helping with personal care like washing, using the toilet and dressing
- food preparation, feeding and giving out medication
- carrying out general tasks like housework, laundry and shopping
- helping clients manage their budget, pay bills and write letters
- supporting families to get used to new caring responsibilities
- giving emotional and practical support to children and young people
- working with other health and social care professionals to provide individual care and development plans
- helping to organise leisure activities
- going with clients to and from a residential home

<https://nationalcareersservice.direct.gov.uk/job-profiles/care-worker>

- Pick **THREE** of the above tasks and describe their characteristics in terms of the task dimensions listed in the subject guide (p7) and in chapter 2 of AIMA. Justify your answers.
- Describe actually implemented or proposed systems which carry out the same three tasks you selected for part (a), with reference to the Sharkey and Sharkey (2011) paper, the PWC report and/or your own independent reading.
- Write an essay of up to 1,200 words addressing the question: "*Are [assistive robots] actually designed to help the elderly person, or to cut costs and reduce the workload of their carers?*" (Sharkey and Sharkey 2011, p30).

**[50 marks]**

## Question 2: Logic and reasoning

Suppose your fridge contains:

- Three green apples
- Two red apples
- Six red tomatoes
- Four yellow tomatoes
- Two green peppers (capsicum)
- One green cucumber
- One green cabbage
- Nothing else

- a. Explain the following terms **in your own words**, in the context of logic and reasoning. Give examples where appropriate:
- i. Knowledge base
  - ii. Entailment
  - iii. Soundness
  - iv. Completeness
  - v. Literal
  - vi. Random variable
  - vii. Probability distribution
  - viii. Marginalising
  - ix. Conditioning
  - x. Posterior probability
- b. Which of the following Predicate Calculus statements are true, applied solely to the contents of the fridge as listed above? Express each statement as precisely as you can in English before deciding on your answer, and give your reasons for each answer.
- i.  $\exists x(\text{Red}(x) \ \& \ \text{Apple}(x))$
  - ii.  $\forall x(\text{Apple}(x) \rightarrow \text{Red}(x))$
  - iii.  $\forall x(\text{Yellow}(x) \ \& \ \text{Tomato}(x))$
  - iv.  $\forall x(\text{Cucumber}(x) \rightarrow \text{Green}(x))$
  - v.  $\exists x(\text{Cucumber}(x) \rightarrow \text{Yellow}(x))$
  - vi.  $\forall x(\text{Red}(x) \rightarrow (\text{Apple}(x) \vee \text{Tomato}(x) \vee \text{Pepper}(x)))$
- c. Calculate the percentage of items in the fridge that are apples, the percentage of items that are green, and the percentage of apples that are green. Explain how you can use Bayes' formula to calculate the probability that a green item is an apple. Give your answer and interim calculations to two significant figures.

- d. For this question you should use reasoning patterns which are either explicitly listed in the subject guide, pp.20-22, or can be produced using the logical equivalences in Figure 4.1.

Show which literals can be inferred from the following knowledge bases, using both reasoning patterns **and** truth tables. Show **all** steps in your reasoning and **explain** your answers.

i.  $P \& Q$   
 $Q \rightarrow R \vee S$   
 $P \rightarrow \sim R$

ii.  $\sim(P \vee Q)$   
 $R \rightarrow Q$   
 $R \vee S$

iii.  $(A \& (B \vee C))$   
 $\sim(B \& A)$

[50 marks]

[Total: 100 marks]

[END OF COURSEWORK ASSIGNMENT 1]