University of Aberdeen
Foundations of Artificial Intelligence (CS5060)
Assessment C (Various Topics)

Overview

This assessment will give you a chance to show your knowledge and understanding of topics studied in the course, as well as your problem-solving and communication skills.

Practicalities

The **hand-in date** for this assessment is **08.59AM, Monday 30th of September 2019**

Lateness penalties:

- Handing in your submission by 08.59AM Tuesday 1 October (24 hours) will incur in a 10% penalty
- Handing in up to a week late will lead to a 25% penalty. Submissions after a week will get feedback but 0 marks.

Please notice:

- This assessment will contribute towards 60% of your final mark for this course.
- This is an *individual assessment*, not a team-based one; its purpose is to assess *your knowledge*, not your ability to find answers on the Internet.
- *Plagiarism* and *collusion* are serious issues and will not be tolerated. It is your responsibility to familiarise yourself with the University's code of practice[1]. You *must* appropriately cite all material you have used in your work.

You should upload a single ZIP file in MyAberdeen, containing:

- A document with all your answers as a PDF file
- Any program, data and other files

Scenario, Problem and Tasks

1 Scenario

A city has 4 major areas, listed below with their population:

- Area A has 30,000 people
- Area B has 45,000 people
- Area C has 55,000 people
- Area D has 65,000 people

The city council will put in place a smart traffic management system, so as to facilitate the daily commute of people from all areas into the city centre. The traffic lights will change their setup depending on the times of the day, so as to give priority to the areas with most people. There are 4 traffic periods:

- **Period 1** – week days, between 7AM and 10AM
- **Period 2** – week days, between 10.01AM and 4PM
- **Period 3** – week days, between 4.01PM and 7PM
- **Period 4** – all other times, including week-ends

A percentage of the population from each area will commute daily and fewer people will commute over the week-end.

Assume you have access to historical data recording traffic from each area into the city centre, for a month.

[1] `https://tinyurl.com/y92xgkq6`

2 Problem

Your task is to design an intelligent traffic management system which would control the traffic lights, prioritising those areas with more people, during the busy periods (periods 1 and 3). For simplicity, assume that the 4 areas are all suburbs located around the city centre. The traffic management system consists of giving priority to an area for some time (depending on the likelihood of the amount of traffic from the area); however, the priority should change from area to area after a period of time. Assume also that the flow of traffic from/to each area with population Pop is constant, at a rate of $Pop \times 0.05$ per hour.

Your solution should maximise the flow of commuters into the city centre, ensuring the busy periods 1 and 3 prioritise more populated areas.

3 What you should provide

You should submit a technical report (up to 4,000 words) addressing the items below.

3.1 Choice of AI technique to represent/solve the problem

Choose **any 2** of the following AI techniques studied in our course:

- Search
- Logics (propositional or first-order logic) or production rules
- Planning
- Decision trees
- Decision networks

To represent/model the problem and/or provide a solution.

As part of this item, you should

- Provide a technical justification for your choice – explain **why** you think the techniques are adequate to represent/solve the problem.
- Explain how you will use the techniques to represent and solve the problem. This explanation can be in the form of pseudo-code, or a list of steps you will go through to use/adapt the technique to represent and solve the problem.
- If your solution takes into account the historic data on traffic (say, to predict future use) then you should explain what information should be recorded in the data.

Important: Consider **combining** 2 techniques above, instead of using them independently. The combination of techniques is only a suggestion and this is not mandatory; having two techniques used independently will not lower your mark.

This item will contribute with up to 25% of the overall mark.

3.2 Worked out example using techniques

In this item you should

- Provide a worked out example of an instance of the problem and how you represent/model it using the techniques you chose in the previous item.
- Explain how the instance of the problem is solved with each of the techniques you chose in the previous item.

Your example should be *non-trivial*, that is, it should consider all areas and a whole week's traffic.

This item will contribute with up to 25% of the overall mark.

3.3 A comparison of the techniques chosen

In this item you should provide a comparison between the two techniques chosen in terms of

- Guarantees (e.g., correctness, termination, etc.)
- Efficiency, accuracy, ease-of-use,
- Existence of available software/systems, and other technical issues.

If you have combined techniques, then rather than comparing them (which would not make much sense), you should explain/justify why you combined them the way you did, reporting on the same features listed above.

This item will contribute with up to 25% of the overall mark.

3.4 Simple prototype and test cases

In this item you will implement a simple prototype to test out your ideas. Your prototype should make use of existing systems, instead of being implemented from scratch. For instance, depending on the techniques you have chosen, you may use an on-line PDDL editor[2], or one of the many existing implementations of decision trees[3], or existing implementations of search algorithms[4].

Your prototype should implement the techniques you have chosen in item 3.1. (and explored in items 3.2 and 3.3). It should use as input traffic information (e.g., number of cars from each area into town over a period of time); you can either manually create this information or write a simple program to generate it. The prototype may use the knowledge about the periods and the flow of traffic, as presented above. Your prototype should output a sequence of areas to prioritise (and for how long) over a period of time (e.g., a day, a week or a month); however, your sequence of areas cannot neglect/ignore the less populated areas.

For this item you should submit:

- The input (files) required to execute/run your prototype
- Any code you have written and any piece of third party software your prototype needs in order to run – please indicate clearly what code is yours and what code is third-party
- 2 test cases

Your report should contain

- An explanation of how your prototype works
- Instructions to run your prototype (including how to use external Web sites or Web services)
- The results of running your prototype and an explanation of how it solves the 2 test cases
- Issues you encountered (if any) and how you solved these
- A critical evaluation of the technologies you used

This item will contribute with up to 25% of the overall mark.

4 Marking scheme

Marks will be given based on

- Depth and breadth of knowledge
- Technical details of formalisation, worked out examples and pseudo-code
- Communication skills (clear, technical contents and sound reasoning)
- Structure of document

[2] `http://editor.planning.domains/`

[3] For instance `https://www.geeksforgeeks.org/decision-tree-implementation-python/`.

[4] For instance, `https://tutorialedge.net/artificial-intelligence/breadth-first-search-java/`.