## Examination Paper

## School of Science and Technology

**MIDDLESEX UNIVERSITY**

**EXAMINATION PAPER**

**Academic Year 2018/2019 May**

**CSD 3939**

###### Developing Artificial Intelligence

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| Time allowed: | 3 hours |
| Total number of questions: | 4 |
| Instructions to candidates: | Answer all 4 questions.  *Each question is worth a maximum 25 marks.* |
| Materials provided: | None |
| Equipment permitted: | None |
| Total number of pages: | 3 (including front cover) |

**EXAM PAPER CAN BE REMOVED FROM THE EXAM ROOM**

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| **No books, paper or electronic devices are permitted to be brought into the examination room.**  **Candidates are warned that credit cannot be given for work that is illegible.** |

1. State Spaces

(a) A case based reasoning system has five input features. Four are integers between 0 and 99, and the fifth is an enumerated type of 8 colours. How many different possible cases are there? What is the size of the search space?

(9 marks)

(b) Give an example similarity metric for this system.

(8 marks)

(c) Describe in terms of state spaces what makes a good similarity metric on this case base.

(8 marks)

2. Knowledge Representation

a) When campaigning, Donald Trump said “I will build a great great wall on our southern border and I’ll have Mexico pay for that wall.". Write a logic formula for this statement. Include variables and how they link to the statement.

(6 marks)

(b) Draw a truth table for the formula from part a.

(5 marks)

(c) At present, is the statement true? You can state your understanding of the current situation. (That is you don’t have to know if there is a wall built, just say what you think.) Draw an arrow to the cell in the truth table (from part b) that represents your understanding of the statement.

(6 marks)

(d) Inheritance conflicts are a problem for semantic nets (and class based languages). Describe an example of an inheritance conflict. (You may use a picture.) How might a knowledge representation system resolve inheritance conflicts?

(8 marks)

3. Machine Learning

(a) A self organising map (SOM) uses a distance measurement to find the distance between two data points. Find the Euclidean distance between the 3D points (5,4,7) and (-5,10,3).

(4 marks)

(b) Draw a three layer multi-layer perceptron (MLP) network with three inputs, one output and 2 nodes in the hidden layer. Set each weight to be unique.

(8 marks)

(c) The nodes in the hidden layer uses a linear transfer function with a slope of 2. The output node is a step function with a threshold of 3. Show the outputs for the inputs (1,2,3) and (-2,5,2).

(6 marks)

(d) Describe the common learning algorithm that is used for MLPs.

(7 marks)

4. Applications

a) What is the standard format of input to vision algorithms, and what are two common first steps for vision processing algorithms.

(9 marks)

(b) The four queens problem is a simple constraint satisfaction problem deriving from chess. There is a 4x4 board. 4 queens need to be placed on the board so they cannot take each other. A queen can take another queen if they are in the same row or column, or if they are on the same diagonal. Show one solution.

(8 marks)

(c) Write pseudo code for a chatbot that responds differently to four different commands, and says I don’t understand for anything else.

(8 marks)