



Staffordshire
UNIVERSITY

SCHOOL OF COMPUTING

ARTIFICIAL INTELLIGENCE

CM3331 - 3

SEMESTER 1

Date: Tuesday 22nd January 2002

Time: 2.00pm - 3.30pm

Time Allowed: 1½ hours

This paper consists of five questions. You must answer ALL questions from Section A and TWO questions from Section B.

The marks allocated for each question, or for its parts, are shown on the right.

Begin the answer to each question in a separate Answer Booklet.

All personal details must be completed at the top of every Answer Booklet. Please ensure that the corner of the booklet is folded down and sealed. Every question attempted should be clearly marked in the space provided on the front of the Answer Booklet.

Section A.

Answer ALL questions from this section (40 marks)

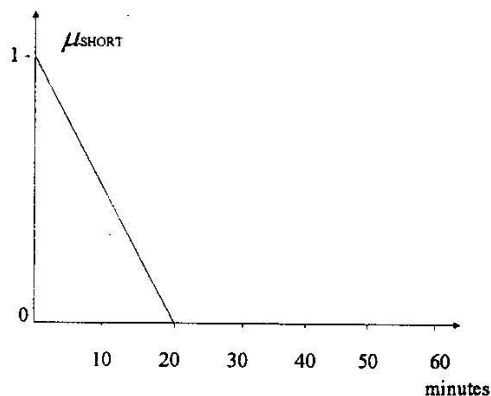
A1.

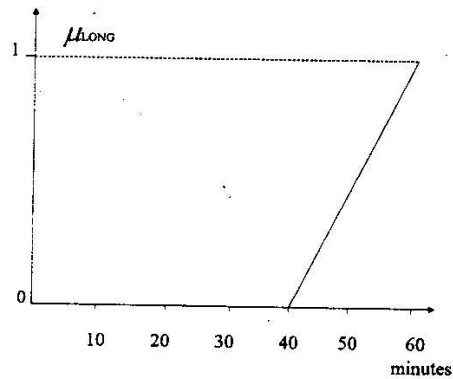
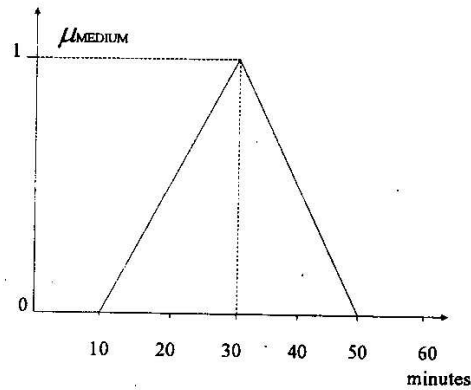
Case Based Reasoning (CBR) systems are based upon Schank & Abelson's understanding of the way in which humans learn to associate problems with their solutions and also how people apply previous problem solving experience to new problem situations.

- (i) With the aid of a diagram show how each of the four parts of the CBR Cycle relate to one another.
(5 marks)
- (ii) Write a clear explanation of what each part of the CBR Cycle is required to do.
(5 marks)
- (iii) One of the techniques frequently used in the first stage of the CBR Cycle is Nearest Neighbour matching. Describe how a 2-dimensional Nearest Neighbour matching process works in a CBR system
(10 marks)

A2.

- (i) Explain why classical set theory is unable to model adequately imprecise notions and describe how such notions can be modelled using fuzzy sets.
(10 marks)
- (ii) A washing machine contains sensors which measure the pH and the temperature of the suds in the drum. The output of these sensors is used by a fuzzy control mechanism to determine the duration of the wash. Two fuzzy sets LOW and HIGH are used to describe the pH and two fuzzy sets COLD and HOT are used to describe the temperature. The duration which ranges between 0 and 60 minutes is described by three fuzzy sets : SHORT , MEDIUM and LONG illustrated below:





The rule base of the fuzzy controller contains the following rules:

1. IF pH is HIGH THEN duration is SHORT
2. IF pH is LOW AND temperature is COLD THEN duration is LONG
3. IF pH is LOW AND temperature is HOT THEN duration is MEDIUM

Given that

$$\mu_{LOW}(pH) = 0.6, \mu_{HIGH}(pH) = 0.3, \mu_{COLD}(temperature) = 0.3 \text{ and } \mu_{HOT}(temperature) = 0.7$$

calculate the exact duration determined by the controller.

(10 marks)

Section B

Answer TWO questions only from this section (60 marks)

B1.

- (i) Suppose that the knowledge base include the following rules and the following true facts A, D, and E:

Rule 1: if A is true AND D is true then W is true.

Rule 2: if A is true AND E is true then W is true.

Rule 3: if C is true AND E is true then X is true.

Rule 4: if X is true OR B is true then Y is true.

Rule 5: if W is true OR Y is true then Z is true.

Draw an AND/OR graph to represent the chaining of the rules given above.

- (ii) Explain the following terms using the rules and facts given above: (8 marks)
- Backward chaining,
 - Forward chaining,
 - Conflict resolution.

(15 marks)

- (iii) Explain what is meant by default reasoning by means of an example and explain when it is appropriate to use it.

(7 marks)

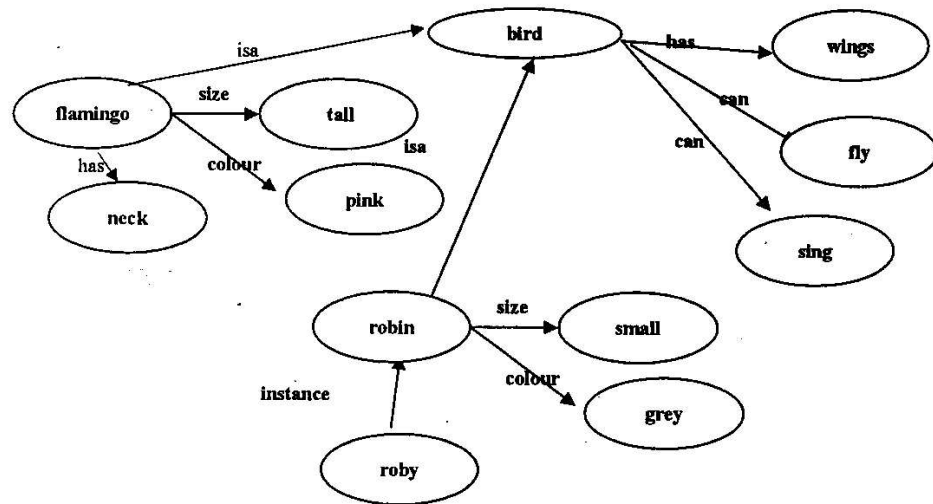
B2

(i) Describe the knowledge representation called frames.

(10 marks)

(ii) Transform the knowledge encoded below as a semantic network into a frame based representation using the appropriate notation.

(12 marks)



(iii) Explain with reference to 2 examples how frames handle exceptions and modify your frame based representation above to illustrate this point.

(8 marks)

B3.

(i) Briefly describe the main features of a 3 layer Multi Layer Perceptron (MLP) which was featured in the course. Ensure that your answer contains a correctly labelled diagram of the MLP's main features.

(10 marks)

(ii) Describe the differences between Supervised and Unsupervised training strategies when applied to Neural Networks.

(5 marks)

(iii) Produce a list of the advantages and disadvantages of Neural Networks when compared to other Symbolic Knowledge Representation Systems, provide a brief explanation of each point in your list.

(15 marks)