THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION
Professional Graduate Diploma

KNOWLEDGE BASED SYSTEMS

18th April 2005, 10.00 a.m.-1.00 p.m.
Answer THREE questions out of FIVE. All questions carry equal marks.
Time: THREE hours.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

1. Knowledge based Systems (KBSs) are developed to deal with particular application domains in which alternative techniques are unable to produce reliable and manageable solutions.

    a) Identify and discuss five aspects of human intelligence that could be used to characterise intelligent knowledge-based systems.   **(10 marks)**

    b) Consider the requirements of different tasks, and specify features that warrant the application of knowledge-based technologies in only some tasks. Illustrate the discussion with one example of a task that demonstrates the need for a KBS, and one task for which KBSs are unnecessary.   **(10 marks)**

    c) Comment briefly on the reasons for an apparent disproportionately low use of KBSs compared to conventional systems in solving business problems.   **(5 marks)**

2. Knowledge elicitation involves modelling the knowledge used by an expert to solve problems. Consider an example application domain (different from that of Question 3) and construct a knowledge base for the domain by completing the following tasks:

    a) Describe briefly general methods that could be applied to elicit the knowledge needed to solve a small complex problem.   **(5 marks)**

    b) Identify a suitable task, and produce a decision tree of five levels to represent the decision process.

                                                                                   (5 marks)

    c) Illustrate the consistency of the decision tree with a worked example using sample data for the task (specify any assumptions made).   **(5 marks)**

    d) Describe how an implemented knowledge base could be tested.   **(5 marks)**

    e) Comment on how machine learning could be utilised to make subsequent decision making with the knowledge base more efficient.   **(5 marks)**

3. Consider the following logical argument.
   "Every KBS is intelligent; CYC is a KBS, therefore, CYC is intelligent".

   a) Explain why the argument could not be validly symbolised using propositional logic and present the predicate logic form for the argument. **(5 marks)**

   b) Construct a rule model for deciding on the choice of a new car. Include the following features:
      i)   at least ten rules (no more than 15) represented in both natural language and predicate logic form, which must be capable of being data driven to make a decision, with at least five assertions made. (You should make use of quantifiers, binary relations, and Boolean operators). **(15 marks)**
      ii) a worked example showing the decision making process with sample data. **(5 marks)**

4. Describe how the following data mining operations are applied and provide typical examples for each:
   i)   Predictive modelling   **(6 marks)**
   ii) Database segmentation   **(6 marks)**
   iii) Link analysis   **(7 marks)**
   iv) Deviation detection   **(6 marks)**

5. A bus company has to set the optimal route for its bus, which has to go through four cities and return to its city of origin. Each city has to be visited exactly once, and the cost of the journey between each pair of cities is known. The problem is to do the tour at minimum total cost or distance.

From/To	A	B	C	D
A	-	4	6	12
B	3	-	6	8
C	7	10	-	10
D	11	7	9	-

Table 1: Distance (or cost) between Cities

   a) Illustrate your description by explicitly finding the shortest tour given the distances (or costs) between cities shown in **Table 1** above. **(8 marks)**

   b) Describe briefly how a solution to the Bus Journey Problem might be obtained using a genetic algorithm, indicating how features of the problem map to the elements needed to use a genetic algorithm. **(12 marks)**

   c) Describe briefly how a solution to the Bus Journey Problem might be obtained using simulated annealing, again indicating how you would obtain the necessary features for *this* problem. **(5 marks)**