

# THE BRITISH COMPUTER SOCIETY

## THE BCS PROFESSIONAL EXAMINATIONS Professional Graduate Diploma

### KNOWLEDGE BASED SYSTEMS

19th April 2006, 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. KBS are developed from an understanding of how people solve problems in particular application domains.
  - a) Describe the process of case-based reasoning. **(8 marks)**
  - b) Explain the process of analogical reasoning. **(5 marks)**
  - c) Consider the characteristics of problems, and specify three features that warrant the application of knowledge-based technologies. Illustrate the discussion with one example of a task that demonstrates the need for KBS, and one task for which KBS are unnecessary. **(12 marks)**
  
2. Problem solving involves both inference and searching for a solution.
  - a) Explain the principle of rule inference and describe both forward and backward chaining using illustrative examples. **(10 marks)**
  - b) Explain the difference between inductive and deductive reasoning. **(5 marks)**
  - c) Explain both brute-force and heuristic search methods and discuss their relative merits. **(10 marks)**
  
3. Development of any software system requires careful management in order to ensure that a quality product is produced. Produce a project management framework that is suitable for the construction of an interactive rule based advisory system by addressing the following tasks:
  - a) Identify all the main stakeholders involved in the project, and explain their respective roles and responsibilities in the construction of an intelligent knowledge based system. **(8 marks)**
  - b) Identify a suitable project management and software development methodology, and describe the main phases in the development process as they relate to knowledge engineering in particular. **(10 marks)**
  - c) Describe the measures that should be taken to ensure quality throughout the entire development process. **(7 marks)**

**Turn over]**

4. Suppose a genetic algorithm uses chromosomes of the form  $x = abcdefgh$  with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual  $x$  be calculated as:  $f(x) = (a + b) - (c + d) + (e + f) - (g + h)$ , and let the initial population consist of four individuals with the following chromosomes:

- $x_1 = 6\ 5\ 4\ 1\ 3\ 5\ 3\ 2$
- $x_2 = 8\ 7\ 1\ 2\ 6\ 6\ 0\ 1$
- $x_3 = 2\ 3\ 9\ 2\ 1\ 2\ 8\ 5$
- $x_4 = 4\ 1\ 8\ 5\ 2\ 0\ 9\ 4$

- a) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last. **(8 marks)**
- b) Perform the following crossover operations:
  - i) Cross the fittest two individuals using one-point crossover at the middle point. **(4 marks)**
  - ii) Cross the second and third fittest individuals using a two-point crossover (points b and f). **(4 marks)**
  - iii) Cross the first and third fittest individuals (ranked 1st and 3rd) using a uniform crossover. **(4 marks)**
- c) Suppose the new population consists of the six offspring individuals received by the crossover operations in the above question. Evaluate the fitness of the new population, showing all your workings. Has the overall fitness improved? **(5 marks)**

5. Suppose that you have a small kiosk database of purchased items. The available food items in the kiosk are: Coca-cola, Pepsi, Sprite, Budweiser beer, Guinness beer, Estrella chips, Pringles chips and Taffel chips

The database contains the following purchase transactions:

TID	Items bought
1	Coca-cola, Budweiser beer, Pringles chips
2	Coca-cola, Taffel chips
3	Budweiser beer, Pringles chips
4	Pepsi, Budweiser beer, Guinness beer, Estrella chips
5	Sprite, Estrella chips
6	Pepsi, Budweiser beer, Estrella chips
7	Sprite
8	Budweiser beer, Guinness beer, Estrella chips
9	Pepsi, Estrella chips
10	Coca-cola, Pringles chips

- a) What kind of rules do you get with confidence threshold 0.0 and support threshold 0.2? **(8 marks)**
- b) Create a hierarchy for the food items in the kiosk **(5 marks)**
- c) Figure out if you could get more meaningful information using multi-level association rules. **(12 marks)**