A1

Knowledge elicitation consists of a set of techniques for collecting the knowledge of domain experts. There are many different techniques which can be used for knowledge elicitation.

a. Select one application domain for which a knowledge base might be created. Outline three techniques which could be used for knowledge elicitation in your chosen application domain, highlighting the advantages and disadvantages of each technique.

   (10 marks)

b. Use a knowledge representation scheme to present the knowledge base for your chosen domain. Discuss how your knowledge base could be used to solve problems within the domain, giving examples of the impact that the system might have.

   (15 marks)

Answer Pointer

1. a. One mark awarded for choice of a suitable domain. For each technique selected, one mark awarded for choice of an appropriate technique, one mark for listing a valid advantage and one mark for listing a valid disadvantage to a total of 3 marks for each technique. Possible techniques include: Role Playing, Simulation; Prototyping; Teach back; Observation; Sorting; Laddering; 20 Questions

Marks available for other valid answers. The distribution of the marks within the 10 marks is to be used as a guide only.
1.b. One mark awarded for choice of a valid knowledge representation scheme. Up to 5 marks awarded for a sensible presentation of the knowledge base. Up to 5 marks for discussion of how the knowledge base could be used to solve problems. Marks awarded for sensible choice of problem, and for discussing how the knowledge base and representation scheme help solve problems in that domain. Up to 4 marks awarded for a discussion of the impact that the system might have. Valid representation schemes include: Symbolic schemes; Graphs, trees or networks; Procedural schemes; Neural Networks.

Marks awarded for other valid answers. The distribution of the marks within the 15 marks is to be used as a guide only.

Examiner's Comments

Of the candidates who attempted this question, 61% received a pass. The answers were wide ranging from poor to very good.

Some of the weaker answers were not structured in accordance with the question; the candidates just wrote a selection of paragraphs with no clear separation of the different sections and in some cases the number of techniques in Q1i were often more than the required three. This not only made the answers difficult to follow, but demonstrates that candidates do not always read the questions correctly or believe that by including extra sections, they might be awarded extra marks. In addition only parts of the question were addressed in some cases.

Candidates did not always provide model answers but nevertheless in most cases demonstrated a reasonable understanding of the subject and were therefore credited with a relevant mark.

A2

“The possibility of creating thinking machines raises a host of ethical issues.” (Bostrom & Yudkowsky, The ethics of artificial intelligence, 2013)

a. Identify and discuss three ethical issues which are raised by artificial intelligence and knowledge based systems.

(15 marks)

b. Outline two approaches by which artificial intelligence or knowledge based systems attempt to model human intelligence. Discuss the advantages and disadvantages of each approach you choose.

(10 marks)

Answer Pointer

2.a Marks awarded for:
An understanding of the meaning of ethics and how it relates to IT and KBS/AI in particular. (up to 3 marks)
Identifying valid ethical issues (up to 2 Marks for each valid issue)
Discussing those issues in a sensible way (up to 2 marks for the discussion of each issue)
Up to a maximum of 15 Marks.
Possible ethical issues include:
- Roboethics
- Weaponisation
- Machine morality
- Legal issues
- Impact on people and society

Marks may be awarded for other valid answers. The distribution of the marks within the 15 marks is to be used as a guide only.

2.b One mark awarded for each appropriate approach selected, and 2 marks for an outline of the approach, One mark awarded for a valid advantage and one mark for a valid disadvantage to a total of 5 marks for each approach.

Possible approaches include:
- Symbolic logical systems which try and model the logic we follow
- Neuron-based systems which model how the brain works.

Marks are available for other valid answers. The distribution of the marks within the 10 possible marks is to be used as a guide only.

**Examiner's Comments**

Of the candidates who attempted this question, 50% achieved a pass which is a disappointing result. A number of candidates appeared to be unaware of what ethical issues actually are, or were able to demonstrate only a basic understanding of the term with equally basic answers. In the second part of the question candidates were asked to outline three approaches and discuss advantages and disadvantages. These were not always addressed. Again, candidates did not always give model answers but where they demonstrated some reasonable understanding of the subject, they were credited with a relevant mark.

**A3**

Knowledge based systems and artificial intelligence are receiving renewed interest and are being deployed in new application areas.

a. There is currently much concern about data security and the emergence of cybercrime. Some researchers believe that knowledge based systems and artificial intelligence may offer possible cybersecurity solutions and help us to combat cybercrime. Discuss which knowledge based systems techniques might be applied to combat cybercrime, explaining why these techniques might be applicable and how they might be used in the development of systems for cybersecurity.

(15 marks)

b. Recent advances in cloud technology have opened up new possibilities for the application of knowledge based systems. Describe two knowledge based systems applications which have been made possible by the availability of big data and/or cloud technology. For each knowledge based systems application you choose make it clear how new technology has enabled the development of that application.

(10 marks)
Answer Pointer

3.a. One mark awarded for:
   - Identification of suitable KBS/AI techniques, which might be used to help combat cybercrime (up to 3 marks)
   - Discussion of why these techniques are applicable, explaining why each particular technique is particularly suited to the solution of cybercrime issues (up to 6 marks)
   - Discussion of how these techniques might be used, giving examples of how they would be applied and potential application areas. Possible mention of examples such as IBM's Watson (up to 6 marks)

Potential techniques might include: Expert systems, Neural Network Systems, Intelligent Agents, Genetic Algorithms, Hybrid approaches.

Marks may be awarded for other valid answers. The distribution of the marks within the 15 possible marks is to be used as a guide only.

3.b. For each application selected up to 2 marks awarded for choice of a valid application, and up to 3 marks for discussing how big data/ the cloud have made it possible; up to a maximum of 10 marks.

Possible applications include Big Data Analytics; Health Care applications; Intelligent robots; Aids to decision making.

Marks are available for other valid answers. The distribution of the marks within the 10 possible marks is to be used as a guide only.

Examiner's Comments

Few candidates attempted this question. The results were very disappointing.

Of the candidates that attempted this question, very few demonstrated a clear understanding of what was required and the answers were extremely basic and lacked depth of content and explanation. In part b of the question, once again there was a lack of detail and in most cases the question was not adequately addressed. In both sections of the question, it appears that many candidates did not read the question properly and therefore did not provide the necessary detail as outlined in the question. Again, candidates did not always provide model answers but nevertheless in most cases demonstrated a reasonable understanding of the subject and were therefore credited with appropriate marks.
Section B

B4

Neural network systems offer powerful approaches which can be applied to the solution of problems in many different application domains.

a. Explain the basis on which neural networks operate, illustrating your answer by reference to common neural network algorithms and/or techniques.  

   (10 marks)

b. Outline and discuss three examples of real-world applications of neural network systems. You can use examples from business, industry or everyday life. For each example you choose, discuss the benefits offered by the system and the potential impact that it makes.

   (15 marks)

Answer Pointer

4.a. Marks awarded as follows:
   • Demonstration of a basic understanding of the principles of neural networks, and how they work, including mention of layers, inspiration from biology, neurons and connections, with use of a diagram (up to 5 marks)
   • Demonstration of knowledge of different algorithms and techniques such as, for example, Radial Basis Function, Feedforward, Learning algorithms, and training (up to 5 marks)

   Marks are available for other valid answers. The distribution of the marks within the 10 possible marks is to be used as a guide only.

4.b. For each example given Award 1 Mark for choice of an appropriate example, up to 2 Marks for benefits and up to 2 Marks for impact to a total of 5 Marks for each example.

   Marks may be awarded for other valid answers. The distribution of the marks within the 15 marks is to be used as a guide only.

Examiner’s Comments

Candidates scored reasonably well on this question with 67% achieving a pass. Part 4a of the question tended to be addressed to a higher standard than part 4b where once again there were more examples given than the three that were asked for, with little discussion in some cases. Nevertheless, this question achieved a reasonable result.
Knowledge based systems can be applied to problem solving, and there are several different approaches which they may use to do so.

a. Explain the difference between ill-defined and well-defined problems and briefly discuss how knowledge based systems techniques might be applied to each type of problem.

   (5 marks)

b. Distinguish between brute-force and heuristic methods for problem solving. Discuss the advantages and disadvantages of each of the two approaches, using examples to illustrate your answer.

   (10 marks)

c. Explain the difference between inductive and deductive reasoning. Use examples to illustrate your answer.

   (10 marks)

**Answer Pointer**

5.a. An ill-defined problem is a “wicked” complex problem with no obvious solution, or goals (1 mark).
One mark awarded for discussing how KBS techniques can be applied to an ill-defined problem.
A well-defined problem is constrained, clear goals and a clear solution path (1 mark).
One mark awarded for discussing how KBS techniques can be applied to an ill-defined problem.
One additional mark for a particularly insightful and detailed answer.
Additional marks awarded for other valid answers.

5.b. Brute force involves trying every solution. Also known as exhaustive search or generate and test (up to 2 marks available). One mark awarded for stating the advantages and 1 mark for stating the disadvantages of brute force. One mark awarded for giving a valid example.
Heuristic methods involve finding a good enough solution in a reasonable timeframe using an optimisation algorithm (up to 2 marks). One mark awarded for stating the advantages and 1 mark for stating the disadvantages of heuristic methods. One mark awarded for giving a valid example.
Marks may be awarded for other valid answers. The distribution of the marks within the 10 possible marks is to be used as a guide only.

5.c. Deductive reasoning works from the more general to the more specific. Sometimes this is called the “top-down” approach because it starts at the top with a very broad spectrum of information and works down to a specific conclusion (up to 3 marks).
Inductive reasoning works the opposite way, moving from specific observations to broader generalizations and theories. This is sometimes called a “bottom up” approach. It begins with specific observations and measures, begins to then detect patterns and regularities, formulate some tentative hypotheses to explore, and finally ends up developing some general conclusion (up to 3 marks).
Examples: 2 marks awarded for each valid and sensible example.
Marks may be awarded for other valid answers. The distribution of the marks within the 10 possible marks is to be used as a guide only.
Examiner's Comments

Of the 52 candidates who attempted this question, 79% achieved a pass, many with very good attempts.

This was the most popular question which received the best results.

Examiners' General Comments

The performance overall is varied. Some candidates demonstrated limited knowledge in the subject and a lack of structure, clarity and problem solving ability in the answers given.

The following points need to be made in relation to the overall performance of candidates:

- A reasonable set of results with some good answers but in a significant number of cases there tends to be some quite poor answers.
- Candidates have a tendency not to read the questions adequately, or they may misunderstand the question.
- Not all candidates attempted all the sections in the questions.
- The standard of English was in danger of obscuring the meaning of the candidate's answer.
- Candidates seem to want to write out the question before giving their answer.
- Candidates tend to write about what they know rather than address the actual question.