UNIVERSITY OF EDINBURGH

FACULTY OF SCIENCE AND ENGINEERING

ARTIFICIAL INTELLIGENCE 2Bh SAMPLE MCQ QUESTIONS

May 2002

There are 11 sample multiple choice questions in this paper. The AI2Bh exam in June 2002 will have 26 multiple choice questions (part A) plus two further parts B and C. The 26 multiple choice questions on the June paper will be worth 50% of the total mark of the AI2Bh paper.

Part A
ANSWER ALL QUESTIONS IN PART A. Use the special mark sheet.

1. Event A and B are statistically independent given event C if and only if

   (a) $\texttt{Pr}\{A|B\cap C\} = \texttt{Pr}\{A|B\}\texttt{Pr}\{A|C\}$
   (b) $\texttt{Pr}\{A\cap B|C\} = \texttt{Pr}\{A|C\}\texttt{Pr}\{B|C\}$
   (c) $\texttt{Pr}\{A\cap B|C\} = \texttt{Pr}\{A|B\cap C\}$
   (d) $\texttt{Pr}\{A|B\cap C\} = \texttt{Pr}\{A|B\}$
   (e) $\texttt{Pr}\{A\cap B|C\} = \texttt{Pr}\{A\cap B\}$

2. During the construction of a decision tree, a split on an attribute with 2 values yields 2 subsets such that

   - subset 1 has 3 negative examples and 1 positive example
   - subset 2 has 2 positive examples and 2 negative examples

   Before the split, there were 3 positive examples and 5 negative examples. Given that $I(p,n)$ measures the entropy of a set with p positive examples and n negative examples, the *information gain* after the split is given by:

   (a) 1
   (b) 0
   (c) $I(3,5) - (\frac{1}{2}I(1,3) + \frac{1}{2})$
   (d) $(\frac{1}{2}I(1,3) + \frac{1}{2}) - I(3,5)$
   (e) $I(3,5) - (\frac{5}{8}I(1,3) + \frac{3}{8}I(2,2))$

3. Using notation as in Russell and Norvig, the update rule for weights in a multilayer neural network with learning rate η is given by

   (a) $W_{ji} \leftarrow \eta a_j \Delta_i$
   (b) $W_{ji} \leftarrow W_{ji} + \eta a_j \Delta_i$
   (c) $W_i \leftarrow W_i + \eta I_i \Delta_i$
   (d) $W_i \leftarrow W_i + \eta I_i (T - O)$
   (e) $W_{ji} \leftarrow W_{ji} + \eta a_j (T - O)$

4. Which is not a correct expression for $\texttt{Pr}\{M|S\}$?

   (a) $\texttt{Pr}\{M|S\} = \frac{\texttt{Pr}\{S|M\}\texttt{Pr}\{M\}}{\texttt{Pr}\{S|M\}\texttt{Pr}\{M\}+\texttt{Pr}\{S|\neg M\}\texttt{Pr}\{\neg M\}}$

   (b) $\texttt{Pr}\{M|S\} = \frac{\texttt{Pr}\{S|M\}\texttt{Pr}\{S\}}{\texttt{Pr}\{S|M\}\texttt{Pr}\{M\}+\texttt{Pr}\{S|\neg M\}\texttt{Pr}\{\neg M\}}$

   (c) $\texttt{Pr}\{M|S\} = \frac{\texttt{Pr}\{M\cap S\}}{\texttt{Pr}\{S\}}$

   (d) $\texttt{Pr}\{M|S\} = \frac{\texttt{Pr}\{S|M\}\texttt{Pr}\{M\}}{\texttt{Pr}\{S\}}$

5. In Utility theory, if $Result(Act)$ denotes the set of outcomes of an action Act and $U(X)$ denotes the utility of X, then the expected utility of Act given evidence E is defined by

(a) $EU(Act|E) = \sum_{R \in Result(Act)} \texttt{Pr}\{R|E\}U(R)$

(b) $EU(Act|E) = \sum_{R \in Result(Act)} \texttt{Pr}\{R|E, Act\}U(R)$

(c) $EU(Act|E) = \sum_{R \in Result(Act)} \texttt{Pr}\{R|E\}U(E)$

(d) $EU(Act|E) = \sum_{R \in Result(Act)} \texttt{Pr}\{R|Act\}U(Act)$

(e) $EU(Act|E) = \sum_{R \in Result(Act)} \texttt{Pr}\{R|E, Act\}U(Act)$

- **Questions 6–7 concern a propositional logic in which there are only four propositional letters, A, B, C, and D.**

6. How many models are there for the sentence, $A \to (B \wedge C)$?

   (a) 8
   (b) 10
   (c) 12
   (d) 14
   (e) none of the above

7. How many models are there for the sentence, $(A \vee B) \to (C \wedge D)$?

   (a) 10
   (b) 11
   (c) 12
   (d) 13
   (e) none of the above

8. How many *abstract* models with three individuals are there for a predicate logic with one binary relation and three unary predicates?

   (a) $2^{(3+3)} \times 2^{(3\times 3)}$
   (b) $2^{(3^2)} + 3 \times 2^3$
   (c) $2^{(3^3)} \times (2^3)^3$
   (d) $(3^2)^2 + 3 \times 2^3$
   (e) $2^{(3^2)} \times (2^3)^3$

- **Question 9 concerns a predicate calculus with equality, a single binary relation *Parent*(p, c) and unary predicates *Male*(i), *Female*(i), and *Living*(i). The intended interpretation is that variables range over human individuals: *Parent*(p, c) is true if p is a parent of c (equivalently, c is a child of p); the predicates *Male* and *Female* distinguish individuals by gender, and *Living*(i) is true iff i is alive.**

9. Which of the following sentences is *FALSE* in the intended interpretation?

   (a) $\forall x.\forall y.Male(x) \wedge Parent(x, z) \wedge Parent(y, z) \wedge x \neq y \to Female(y)$
   (b) $\forall x.Living(x) \to \exists y.\exists(z)Parent(y, x) \wedge Parent(z, x) \wedge x \neq y$
   (c) $\forall x.\exists y.Living(x) \to Parent(x, y)$

(d) $\exists x.\forall y.Living(x) \rightarrow Parent(y, x)$

- Questions 10–11 concern the formalization of the following simple planning scenario: **A lecturer has a briefcase and computer at home. He prints out lecture notes, puts them in the briefcase, picks up the briefcase, goes to the lecture room, and takes them out of the briefcase.** This plan often works, but it can fail in many, many ways: for example, to name but two, if the printer is out of ink or there is a power cut.

10. Formalizing the fact that the computer stays at home is an example of which problem?

    (a) The qualification problem.
    (b) The ramification problem.
    (c) The frame problem.

11. The briefcase goes to the lecture room, with the lecturer. Formalizing this fact is an example of which problem?

    (a) The qualification problem.
    (b) The ramification problem.
    (c) The frame problem.

Specimen Answers

1. B
2. C
3. B
4. B
5. B
6. b
7. e
8. e
9. c
10. c
11. b