DUBLIN INSTITUTE OF TECHNOLOGY

DT211C/4 BSc. (Honours) Degree in Computer Science (Infrastructure)

DT228/4 BSc. (Honours) Degree in Computer Science

DT282/4 BSc. (Honours) Degree in Computer Science (International)

DT8900/1 International Pre Masters for MSc in Computing

WINTER EXAMINATIONS 2017/2018

ARTIFICIAL INTELLIGENCE 1
[CMPU4010]

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TUESDAY 9TH JANUARY 9.30 A.M – 11.30 A.M.

TWO HOURS

ANSWER **QUESTION 1 (40 MARKS)**
AND ANY **TWO OTHER** QUESTIONS (30 MARKS EACH)

1. **(a)** Describe, in your own words, what is meant by **Artificial Intelligence**.

(5 marks)

(b) Discuss the advantages of the Turing test as a measure of intelligence.

(5 marks)

(c) For each of the following two pairs of first-order predicate logic sentences, define **the most general unifier** if one exists:

- Pair 1: BossOf(John, X) and BossOf(X, Peter)
- Pair 2: Password(Mary, Pet(Y, Z)) and Password(X, Pet(Jack, Mary))

(5 marks)

(d) Explain the difference between **general** and **domain-specific** knowledge and provide an example of each.

(5 marks)

(e) Show using **model enumeration** whether the knowledge base

$$KB = \{P \wedge Q, P \Leftrightarrow Q\}$$

entails or does **not entail** the statement

$$\alpha = P \vee Q$$

(10 marks)

(f) Briefly explain the **inference mechanism** for **semantic networks**.

In your answer discuss the **potential issues** with inference.

(10 marks)

2. **(a)** Show using truth tables that

$$P \wedge Q \Rightarrow Q \vee R$$

is equivalent to True.

(5 marks)

(b) Prove using **Proof by Contradiction** that the knowledge base

$$KB = \{P \vee Q, P \Rightarrow Q\}$$

does **not entail** the statement

$$\alpha = P \wedge Q$$

(Note: You will need to convert the knowledge base into conjunctive normal form. Figure 1 at the end of the exam paper lists logical equivalence rules that you might find useful.)

(15 marks)

(Question 2 CONT. on next page)

(c) Convert the following formula to Conjunctive Normal Form

$$p \Leftrightarrow (r \wedge q)$$

(Note that Table 1, which is on the last page of the exam paper, lists some logical equivalence rules that you might find useful for this task.)

(10 marks)

3. (a) Briefly compare and contrast the **depth-first** and the **iterative deepening search** algorithms.

(10 marks)

(b) In the context of Artificial Intelligence, explain in your own words what is meant by a **constraint satisfaction problem.**

(5 marks)

(c) Complete the **MIN-MAX values** for each node in the tree in Figure 2 (last page of the paper).

(5 marks)

(d) Perform **left-to-right alpha-beta pruning** for the tree in Figure 2.

(10 marks)

4. (a) You have been given the resources to build any intelligent system of your choice to solve any problem. To which task would you apply your system to and why?

In your answer include why you think the task is suitable for applying AI algorithms to, and describe the benefits of building an intelligent system for this task.

(15 marks)

(b) Explain what it means for rules in an **expert system** to be in **conflict**, and discuss four different **conflict resolution strategies.**

(10 marks)

(c) Discuss the role of **mutation** in **genetic algorithms.**

(5 marks)

$(\alpha \wedge \beta)$	$\equiv$	$(\beta \wedge \alpha)$	commutativity of $\wedge$
$(\alpha \vee \beta)$	$\equiv$	$(\beta \vee \alpha)$	commutativity of $\vee$
$((\alpha \wedge \beta) \wedge \gamma)$	$\equiv$	$(\alpha \wedge (\beta \wedge \gamma))$	associativity of $\wedge$
$((\alpha \vee \beta) \vee \gamma)$	$\equiv$	$(\alpha \vee (\beta \vee \gamma))$	associativity of $\vee$
$\neg(\neg\alpha)$	$\equiv$	α	double − negation elimination
$(\alpha \Rightarrow \beta)$	$\equiv$	$(\neg\beta \Rightarrow \neg\alpha)$	contraposition
$(\alpha \Rightarrow \beta)$	$\equiv$	$(\neg\alpha \vee \beta)$	implication elimination
$(\alpha \Leftrightarrow \beta)$	$\equiv$	$((\alpha \Rightarrow \beta) \wedge (\beta \Rightarrow \alpha))$	biconditional elimination
$\neg(\alpha \wedge \beta)$	$\equiv$	$(\neg\alpha \vee \neg\beta)$	De Morgan
$\neg(\alpha \vee \beta)$	$\equiv$	$(\neg\alpha \wedge \neg\beta)$	De Morgan
$(\alpha \wedge (\beta \vee \gamma))$	$\equiv$	$((\alpha \wedge \beta) \vee (\alpha \wedge \gamma))$	distributivity of $\wedge$ over $\vee$
$(\alpha \vee (\beta \wedge \gamma))$	$\equiv$	$((\alpha \vee \beta) \wedge (\alpha \vee \gamma))$	distributivity of $\vee$ over $\wedge$

Figure 1: List of logical equivalences

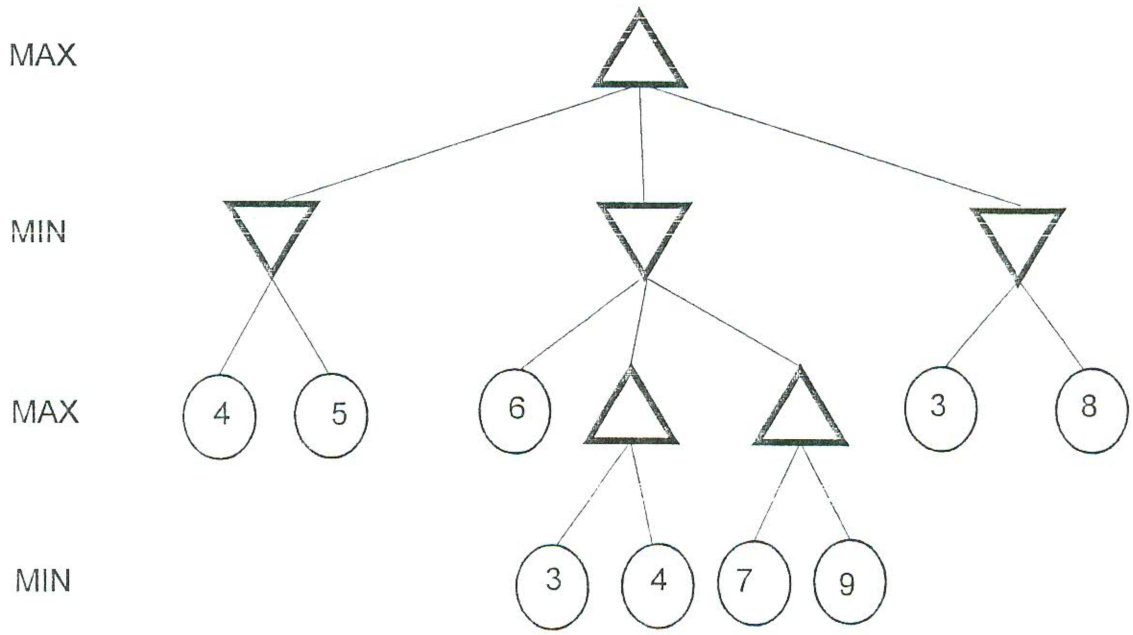

Figure 2: Example game tree for Question 3