DUBLIN INSTITUTE OF TECHNOLOGY

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

Year 4

DT228 BSc. (Honours) Degree in Computer Science

Year 4

DT8900/1 International Pre Masters for MSc in Computing

WINTER EXAMINATIONS 2016/2017

ARTIFICIAL INTELLIGENCE 1
[CMPU4010]

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TUESDAY 10TH 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)** Explain what is a **knowledge representation**. Discuss the criteria used for evaluating different knowledge representations.

(10 marks)

(b) Explain the purpose and set up of the **Turing test**. Discuss the advantages of the Turing test as a measure of intelligence

(10 marks)

(c) Prove that **modus ponens** is sound for propositional calculus.

(5 marks)

(d) Briefly distinguish between **declarative** and **procedural** programming

(5 marks)

(e) Explain what is meant by a **Horn clause** and give an example of a propositional logic formula that is a Horn clause.

(5 marks)

(f) Discuss how **inference** works in semantic networks.

(5 marks)

2. **(a)** Prove using **model enumeration** that the knowledge base

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

does **not entail** the statement

$$\alpha = P \wedge Q$$

(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. Table 1 at the end of the exam paper lists logical equivalence rules that you might find useful.)

(15 marks)

(c) Convert the following formula in Conjunctive Normal Form (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.)

$$(p \Rightarrow \neg r) \Rightarrow s$$

(10 marks)

3. (a) *"For many practical problems, a heuristic algorithm may be the only way to get good solutions in a reasonable amount of time."*

Discuss the **role of heuristics** in search algorithms.

(5 marks)

(b) For many problems we can use several **heuristics** – explain how we can **invent** them, and how we can choose the **most suitable** one.

(10 marks)

(c) Discuss the different **heuristics** that can be used in solving a **constraint satisfaction problem**.

(10 marks)

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

(5 marks)

4. (a) Discuss the role of the **inference engine** in a rule-base system.

(10 marks)

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

(10 marks)

(c) Discuss the advantages and disadvantages of the Rule-based systems. Illustrate your answer with examples where appropriate.

(10 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
$(\alpha \Longrightarrow \beta)$	$\equiv$	$(\neg\beta \Longrightarrow \neg\alpha)$	contraposition
$(\alpha \Longrightarrow \beta)$	$\equiv$	$(\neg\alpha \vee \beta)$	implication elimination
$(\alpha \Leftrightarrow \beta)$	$\equiv$	$\big((\alpha \Longrightarrow \beta) \wedge (\beta \Longrightarrow \alpha)\big)$	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
$\big(\alpha \wedge (\beta \vee \gamma)\big)$	$\equiv$	$\big((\alpha \wedge \beta) \vee (\alpha \wedge \gamma)\big)$	distributivity of $\wedge$ over $\vee$
$\big(\alpha \vee (\beta \wedge \gamma)\big)$	$\equiv$	$\big((\alpha \vee \beta) \wedge (\alpha \vee \gamma)\big)$	distributivity of $\vee$ over $\wedge$

Table 1: List of logical equivalences