



**Semester 1 2017**

## **Artificial Intelligence, Assignment 1 COMPSCI 3007, 7059**

Instructions and submission guidelines:

- Answer all questions in a report.
- Make sure that your writing is legible and clear, and the mathematical symbols are consistent.
- You must sign an assessment declaration coversheet to submit with your assignment. The assessment declaration coversheet is included in the zip file.
- Submit via myuni.

Questions	Due day	Marks
Answer all 5 questions	See myuni	100 marks
		100 Total

**Overview of Artificial Intelligence****Question 1**

Choose the correct answer(s) from multiple choices.

- (a) Which ones are commonly accepted definitions of artificial intelligence:

- (A) Thinking humanly
- (B) Thinking rationally
- (C) Acting humanly
- (D) Acting rationally

[4 marks]

- (b) Turing test corresponds to :

- (A) Thinking humanly
- (B) Thinking rationally
- (C) Acting humanly
- (D) Acting rationally

[4 marks]

- (c) Which of the following statements is (or are) **False**?

- (A) Rationality is perfection
- (B) Simple reflex agents memorise the environment
- (C) AI problems are often specified by PEAS
- (D) All intelligent agents can be improved using learning

[4 marks]

**[Total for Question 1: 12 marks]**

**Logical Agent****Question 2**

Choose the correct answer(s) from multiple choices.

- (a) Which of the following statements is (or are) **False**?
- (A) Knowledge base and database are the same
  - (B) Propositional logic only has facts
  - (C) First order logic has both facts and rules
  - (D) Propositional logic can not describe rules at all, not even indirectly by enumerating.

[4 marks]

- (b) How many possible models (worlds) for  $(\alpha \iff \beta) \iff \gamma$ ?
- (A) 2
  - (B) 4
  - (C) 6
  - (D) 8

[4 marks]

**[Total for Question 2: 8 marks]**

**Propositional Logic****Question 3**

(a) Prove the following statements

i.  $\neg A \Rightarrow B \equiv \neg B \Rightarrow A$

[5 marks]

ii.  $(\neg A \vee B) \Rightarrow C \equiv \neg C \Rightarrow A \wedge \neg B$

[5 marks]

iii.  $A \vee B \vee C \vee D \vee (B \Rightarrow E) \vee (\neg G \wedge H)$  is valid

[5 marks]

(b) Resolution

i. Explain the concept of Resolution.

[5 marks]

ii. Simply the following rules  $A \vee B$ ,  $\neg B \vee C$ ,  $C \Rightarrow D$  using Resolution, and show the derivation.

[5 marks]

(c) Conjunctive Normal Form (CNF)

i. Turn  $C \Rightarrow (A \Rightarrow B) \wedge \neg D$  to a conjunctive normal form and show derivation

[5 marks]

ii. Prove any sentence in propositional logic can be written in CNF.

[10 marks]

**[Total for Question 3: 40 marks]**

**First Order Logic (FOL)****Question 4**

- (a) Please state the difference between predicates and functions in FOL.

[5 marks]

- (b) Given the predicate  $\text{Friends}(x, y)$ ,  $x, y$  are variables for human, and constants Anna, Bob, and Christ, please list all groundings for the predicate.

[6 marks]

- (c) Prove the following statements

i.  $\forall x (P(x) \wedge Q(x)) \equiv \neg \exists x (\neg P(x) \vee \neg Q(x))$

[5 marks]

ii.  $\forall x (P(x) \Rightarrow Q(x)) \equiv \neg \exists x (P(x) \wedge \neg Q(x))$

[5 marks]

**[Total for Question 4: 21 marks]**

**Inference in First Order Logic (FOL)****Question 5**

- (a) Universal instantiation only applies to statements that have no  $\exists$ , but  $\forall$ . However, all statements involving  $\exists$  can be turned to statements with  $\forall$  instead. Please turn  $\exists x P(x) \Rightarrow Q(x)$  to a statement without  $\exists$ .

[5 marks]

- (b) Given the following rules:

$\forall x \text{ King}(x) \wedge \text{Greedy}(x) \Rightarrow \text{Evil}(x)$   
 $\text{King}(\text{John})$   
 $\text{King}(\text{Richard})$   
 $\text{Greedy}(\text{John})$   
 $\text{Greedy}(\text{Richard})$   
 $\text{Greedy}(\text{Lisa})$   
 $\text{Greedy}(\text{Phil})$

List all Evil people here.

[4 marks]

- (c) Unification makes different logical expressions look identical. Write down the result of the following unification

$\text{UNIFY}(\text{Friends}(\text{Anna}, x), \text{Friends}(y, \text{Bob})).$

[5 marks]

- (d) Write down the result of the following unification

$\text{UNIFY}(\text{Friends}(\text{Anna}, x), \text{Friends}(x, \text{Bob}))$

[5 marks]

**[Total for Question 5: 19 marks]**