

# TRINITY COLLEGE DUBLIN THE UNIVERSITY OF DUBLIN

**Faculty of Engineering, Mathematics and Science**

**School of Computer Science & Statistics**

**Integrated Computer Science Programme  
B.A. (Mod.) Business & Computing  
B.A. (Mod.) CSLL  
Year 3 Annual Examinations**

**Trinity Term 2015**

## **Artificial Intelligence I**

**Monday 18 May 2015**

**Luce Lower**

**14:00-16:00**

**Dr Tim Fernando**

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### **Instructions to Candidates:**

Attempt **two** questions (out of the three given).

All questions carry equal marks. 50 marks per question.

You may not start this examination until you are instructed to do so by the Invigilator.

### **Materials permitted for this examination:**

Non-programmable calculators are permitted for this examination — please indicate the make and model of your calculator on each answer book used.

1. Consider the basic AI problem of

(†) an agent acting intelligently in its environment.

(a) What is a Turing machine and what does it have to do with (†)?

[15 marks]

(b) What is the Halting Problem and how is it relevant to (†)?

[10 marks]

(c) What is the Satisfiability Problem (SAT) and how is it relevant to (†)?

[15 marks]

(d) What is the P versus NP Problem and how is SAT relevant to it?

[10 marks]

2. A simple way in Prolog to search a graph for a goal is as follows

```
search(Node) :- goal(Node).  
search(Node) :- arc(Node,Next), goal(Next).
```

(a) What is non-determinism, and how does it arise in the code above?

[5 marks]

(b) Modify the code above to do bounded depth-first search (i.e. depth-first search up to a specified depth) and iterative deepening (i.e. bounded depth-first search, with the bounds incremented until the search succeeds).

[10 marks]

(c) What further ingredients do we need for A-star search? Without giving full details of the code, outline how A-star search works.

[15 marks]

(d) What does it mean for A-star be admissible?

[5 marks]

(e) What are the ingredients of a Constraint Satisfaction Problem (CSP)?

Explain your answer, using the example of 3-coloring (coloring each node of a graph with one of 3 colors so that there is no arc between nodes of the same color).

[5 marks]

(f) What is a generate-and-test approach to CSP?

Explain your answer, using the example of 3-coloring.

[10 marks]

## 3. Consider the knowledge base

```

false :- p.
false :- a,b.
p :- b,c.
p :- q.
a :- r.s.
b.

```

- (a) What is an *integrity constraint*, and what is a *Horn clause*? List all integrity constraints and Horn clauses in the knowledge base above. Which are *definite clauses*?

[10 marks]

- (b) Suppose  $q, r, s$  were assumable in the knowledge base above. What are the conflicts? What are the minimal conflicts?

[10 marks]

- (c) What is the *Complete Knowledge Assumption* (CKA)? What can we conclude if we apply CKA to the knowledge base above?

[10 marks]

- (d) Which of these conclusions are logical consequences of the knowledge base? Which are not?

[10 marks]

- (e) What does it mean for an inference system to be *non-monotonic*? State if the following is true or false: CKA leads to non-monotonicity.

[5 marks]

- (f) What does it mean for a knowledge base to be *consistent*? Is the knowledge base above consistent? Explain.

[5 marks]