



FACOLTÀ DI INGEGNERIA DELL'INFORMAZIONE
Artificial Intelligence 2008–09
Test 1 – 29th January 2009

RULES: You have 2 hours to complete the test
You can use no texts, written notes, computers, calculators, mobile phones
Please write your name and student ID on all sheets
Please answer Question 3 on a separate sheet to speed up the marking process

1. State Space (10 points)

- 1.1 Specify the general Tree Search Algorithm (in pseudo-code or in a programming language of your choice).
Then explain how the algorithm must be adapted to generate the following search strategies: depth first, breadth first, uniform cost, A*.
- 1.2 Explain what it means for a search strategy to be optimal.
Then, again with respect to Tree Search, specify the conditions under which the A* strategy is optimal.

2. Planning (10 points)

- 2.1 Define the frame problem, then say whether STRIPS planners suffer from it, and explain why.
- 2.2 Specify a STRIPS representation for the planning problem stated below (please read it carefully): define a set of predicates (and possibly constants) with their intuitive meanings, specify a set of action schemes, and represent the initial state and the goal (you are not required to find a plan).

The “Monkey and Banana” problem.

In a room there is a box, a monkey (the agent), and a bunch of bananas hanging from the ceiling. The monkey can grasp a banana from the bunch only if it stands on the box when the box is right below the bunch of bananas.

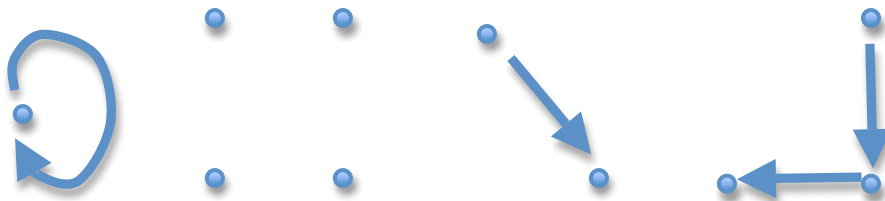
Initially, the box and the monkey are at different places in the room, and the box is not under the bunch of bananas.

The monkey can pull the box to move it, can climb the box, and can grasp a banana (in the previously specified conditions).

The goal is that the monkey has a banana.

3. Logic (12 points)

- 3.1 Formalize the following sentence into a first order logic formula:
if a person likes someone, then there is someone who likes this person.
Do not forget that *someone* does not necessarily mean *someone else*.
- 3.2 What is the truth-value of the previous formula in the following four domains?



- 3.3 Modify the previous formula by writing \exists instead of \forall (and vice versa) and by writing \wedge instead of \rightarrow (and vice versa). For instance, $\forall x L(x,x) \rightarrow \exists y L(y,y)$ becomes $\exists x L(x,x) \wedge \forall y L(y,y)$.
Write an English sentence that expresses its meaning.
- 3.4 What is the truth-value of the new formula in the four domains above?

Logic solutions:

3.1

$$\forall x (\exists y L(x,y) \rightarrow \exists z L(z,x))$$

3.2

True, true, false, false

3.3

$\exists x (\forall y L(x,y) \wedge \forall z L(z,x))$ = There is someone who likes everybody and whom everybody likes.

3.4

True, false, false, false