

# Logic and Symbolic Robotics

## Exercise Week 1

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1. Can the logical agent in the Wumpus world in principle determine the whole map on Page 198 of the book, without running any risk?
2. Give a possible Wumpus world (4x4) where it is impossible to find the gold.
3. Give a possible Wumpus world (4x4) where it is possible to find the gold, but not without running any risk.
4. Is it easy to decide whether it is possible for an agent to get the gold (with or without running any risk) in a given Wumpus world. If so, describe an algorithm.
5. The same question, but now demanding that the agent does not run any risk.
6. Calculate the chance that a (4x4) Wumpus world contains
  - (a) no pit,
  - (b) precisely one pit,
  - (c) precisely two pits.
7. In the realm of real arithmetic, which of the following are proper entailments. Motivate your answers.
  - (a)  $x = 2 \models x^2 = 4$
  - (b)  $x^2 = 4 \models x = 2$
  - (c)  $x^2 - x = 0 \models x = 1$
  - (d)  $x = 1 \models x^2 - x = 0$
  - (e)  $x + a = b \models x = b - a$
  - (f)  $x = b - a \models x + a = b$
8. When is model checking applicable?

9. Plea that model checking is indeed a sound inference algorithm (whenever applicable).
10. Is *true* a positive literal? Is *false* a positive literal?
11. Calculate in a truth table the values of  $A \wedge (B \wedge C)$ ,  $(A \wedge B) \wedge C$  and of  $A \wedge (B \wedge C) \Leftrightarrow (A \wedge B) \wedge C$ .
12. Calculate in a truth table the values of  $A \Leftrightarrow (B \Leftrightarrow C)$ ,  $(A \Leftrightarrow B) \Leftrightarrow C$  and of  $(A \Leftrightarrow (B \Leftrightarrow C)) \Leftrightarrow ((A \Leftrightarrow B) \Leftrightarrow C)$ .
13. Calculate in a truth table the values of  $A \Rightarrow (B \Rightarrow C)$ ,  $(A \Rightarrow B) \Rightarrow C$ ,  $(A \Rightarrow (B \Rightarrow C)) \Rightarrow ((A \Rightarrow B) \Rightarrow C)$  and of  $((A \Rightarrow B) \Rightarrow C) \Rightarrow (A \Rightarrow (B \Rightarrow C))$ .
14. Is the notion of propositional variable somewhere defined in Chapter 7?
15. Give an example of a run of TT-entails? that is initialised by  $symbols = \{ true, false \}$  that returns *true*.
16. Give an example of a run of TT-entails? that is initialised by  $symbols = \{ true, false \}$  that returns *false*.
17. In Figure 7.10 on Page 209, there are two closing brackets missing. Point out where.
18. Describe the run of TT-entails?( $Q \wedge R, Q \vee R$ ).
19. We use the notation of  $O(f(n))$  from the book (A1).
  - (a) Show that if an algorithm runs in  $O(n)$  time, it runs in  $O(n^2)$  time.
  - (b) Show that  $O(n^2) = O(n^2 + 20n)$ .
20. What does it mean for an inference algorithm to be sound?
21. What does it mean for an inference algorithm to be complete?