

CS341 Artificial Intelligence – Spring 2015
Homework 4 – 130 points
Due: Mar. 18

1. (10 points) Problem 7.1, pg. 279
2. (15 points) Problem 7.4, pg. 280
3. (10 points) Problem 7.7, pg. 281
4. (10 points) Problem 7.10, pg. 281
5. (5 points) Problem 7.16, pg. 282. Replace 3-SAT with 3-CNF in the problem.
6. (15 points) Problem 7.17, pg. 282.
7. (20 points)
 - (a) Problem 7.22, pg. 284 part a). Your answer should be a CNF sentence. HINT: your solution should contain only 4 disjunctive clauses.
 - (b) Problem 7.22, part b). Note that you do not have to write out a CNF sentence explicitly, just describe how you would construct one. In your description, be sure to indicate how many disjunctive clauses would be involved. HINT: For given values of n and k , what is the minimum number of squares in which you are guaranteed that at least one contains a mine? This will give you half of your answer.
 - (c) Consider the following situation in Minesweeper:

E	F	
1 C	D	
1 A	B	

For simplicity, we will identify squares using the letters in the lower left of each square. Use resolution so show that there cannot be a mine in square E.

- (d) Show how the DPLL algorithm would prove that there is no mine in square E. Indicate in which order symbols would be assigned values and for what reason (either through the pure symbol heuristic or the unit clause heuristic).
8. (10 points) Develop successor-state axioms for the fluents $East^t$ and $WumpusAlive^t$.

(over)

9. (25 points) The blocks world domain is used to describe a set of blocks sitting on a table, where some blocks may lie on top of other blocks. The objects in this world are blocks and tables. The fluents and atemporal variables are

- $On(x, y)^t$ – block x is directly atop object y at time t . The object y may be either a table or another block.
- $ClearTop(x)^t$ – x is a block with nothing on top of at time t , or x is a table.
- $Block(x)$ – x is a block.
- $Table(x)$ – x is a table.

The only action is $PutOn(x, y)^t$ which moves x onto y , where x is a block with a clear top and y can be either a table or another block with a clear top.

- (a) Define $Under(x, y)^t$ which is true when x is directly below block y at time t .
- (b) Define $SomewhereUnder(x, y)^t$ which is true when x is somewhere below block y at time t .
- (c) Describe the initial state S_0 in which blocks B and C are on the table T and block A is on block B.
- (d) What series of actions would be needed to get to a point where block A is on block B which is on block C which is on the table?
- (e) What conditions must be true in order to be able to perform action $PutOn(x, y)$ at time t ? Write your answer in CNF form.
- (f) Write successor-state axioms for $On(x, y)^t$ and $ClearTop(x)^t$.

10. (10 points) Consider the following simple Wumpus World configuration:

P	W	
		G
A		P

- (a) What is the probability that the Hybrid-Wumpus-Agent in Fig. 7.20 would successfully find the gold? Explain your answer. You may assume that the Agent is initially facing east and that whenever choosing between *not_unsafe* squares, the closest one is always chosen first. If there is a group of squares tied for closest, then a random one is chosen from that group.
- (b) Repeat the above analysis if the uppermost pit is removed.