CPSC 390: Artificial Intelligence
Spring 2020
Exam 2 Prep

1. Consider a world with only four propositions: A, B, C, and D. How many models are there for the following sentences?

a. $(A \wedge B) \vee (C \wedge D)$

b. $A \vee B$

c. $A \Rightarrow B$

2. Consider the problem of constructing crossword puzzles: fitting words into a rectangular grid. The grid, which is given as part of the problem, specifies which squares are blank and which are shaded. Assume a list of words is provided and the task is to fill the blank squares using any subset of the list. Formulate the problem as a CSP. Should the variables be words or letters? Would it be better to formulate this as a search problem? Why or why not?

3.

Given: $(P \wedge Q \wedge R) \Rightarrow S$

$\neg Q \Rightarrow \neg R$

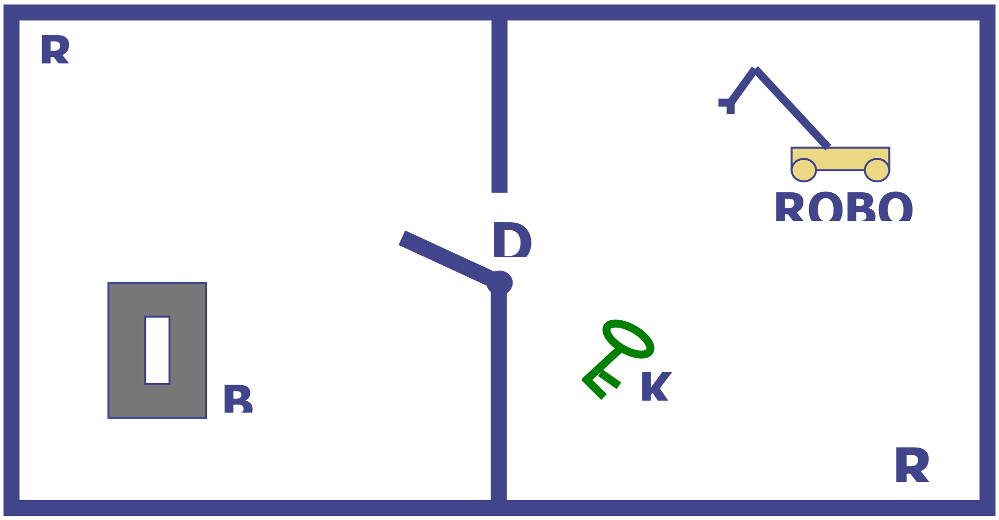
$\neg S \Rightarrow P$

R

Prove: S **<u>using resolution refutation</u>**

[You will first have to convert certain sentences in clause form. Present the proof with one clause per line. Number the lines consecutively, i.e., 1, 2, … On each line, indicate first its number, then the clause, and finally either “given” (if the clause comes form one of the four given sentences), “negation of goal” (if it comes from the negation of the sentence to prove), or “resolve i and j on X” (if it is obtained by resolving the clauses in lines i and j on predicate X).)

4. A robot ROBOT operates in an environment made of two rooms R1 and R2 connected by a door D. A box B is located in R1 and the door's key is initially in R2. The door can be open or closed (and locked). Figure 1 illustrates the initial state described by:
IN(ROBOT,R2), IN(K,R2), OPEN(D)



The only actions available to the robot are:

Grasp-Key-In-R2
Lock-Door
Go-From-R2-To-R1-With-Key
Put-Key-In-Box

They are represented as follows, where P stands for "precondition" and E for "effect":

Grasp-Key-In-R_2
P: IN(ROBOT,R_2), IN(K,R_2)
E: HOLDING(ROBOT,K)

Lock-Door
P: HOLDING(ROBOT,K)
E: ¬OPEN(D), LOCKED(D)

Go-From-R_2-To-R_1-With-Key
P: IN(ROBOT,R_2), HOLDING(ROBOT,K), OPEN(D)
E: ¬IN(ROBOT,R_2), ¬IN(K,R_2), IN(ROBOT,R_1), IN(K,R_1)

Put-Key-In-Box
P: IN(ROBOT,R_1), HOLDING(ROBOT,K)
E: ¬HOLDING(ROBOT,K), ¬IN(K,R_1), IN(K,B)

The goal is:
IN(K,BOX), LOCKED(D)

a. What is the state, S, that results from taking the regression of the goal through Put-Key-In-Box?
b. What is the state, S', that results from taking the regression of S through Lock-Door?
c. Are both of these regressions consistent?