COMP3702/COMP7702 Artificial Intelligence
Semester 2, 2020
Tutorial 7

Before you begin, please note:

- Tutorial exercises are provided to help you understand the materials discussed in class, and to improve your skills in solving AI problems.
- Tutorial exercises will not be graded. However, you are highly encouraged to do them for your own learning. Moreover, we hope you get the satisfaction from solving these problems.
- The skills you acquire in completing the tutorial exercises will help you complete the assignments.
- You'll get the best learning outcome when you try to solve these exercises on your own first (before your tutorial session), and use your tutorial session to ask about the difficulties you face when trying to solve this set of exercises.

Exercises

Exercise 7.1. Please use resolution refutation to show

$$(P \wedge \neg P) \models R$$

Exercise 7.2. This question continues from last week's tutorial. UQPark is a theme park with 5 rides: Bumper cars, carousel, haunted class, roller coaster, and ferris wheel, where each ride can be turned on and off independently of the other rides. After performing a cost-benefit analysis, UQPark Management decided that only 3 rides should be open at any given day, and the set of rides that are open/closed must satisfy the following constraints:

1. Either bumper cars or carousel must be open.
2. If bumper cars is closed, then roller coaster must open.
3. If carousel is open, then either bumper cars or haunted class must be open too.
4. If haunted class is open, then ferris wheel must be open too.
5. Bumper cars and ferris wheel cannot both be open at the same day.
6. If roller coaster is open, then ferris wheel must be open too.
7. If roller coaster is closed, then either haunted class or ferris wheel must be open.

UQPark Facilities thinks there is no combination of the rides that can satisfy all of Management's constraints.

Last week we cast this problem as a satisfiability problem with propositional logic representation. Let B represent bumper cars is open, C represent carousel, H represent haunted class, R represent roller coaster, and F represent ferris wheel is open. Then, the constraints are expressed in clauses as:

1. $B \vee C$
2. $\neg B \rightarrow R$ which is $B \vee R$
3. $C \rightarrow (B \vee H)$ which is $\neg C \vee B \vee H$
4. $H \rightarrow F$ which is $\neg H \vee F$
5. $\neg(B \wedge F)$ which is $\neg B \vee \neg F$

6. $R \rightarrow F$ which is $\neg R \vee F$

7. $\neg R \rightarrow (H \vee F)$ which is $R \vee H \vee F$

Final conjunctive normal form (CNF):

$$(B \vee C) \wedge (B \vee R) \wedge (\neg C \vee B \vee H) \wedge (\neg H \vee F) \wedge (\neg B \vee \neg F) \wedge (\neg R \vee F) \wedge (R \vee H \vee F)$$

Question: Which team is correct, UQPark's Facilities or Management?

a) Please solve the problem in using DPLL.

b) If both are correct or both are incorrect, please also explain why using DPLL.

Exercise 7.3. Suppose your friend is developing a navigation agent for Brisbane metro (the starting and end position is within Brisbane CBD area). His goal is for the agent to recommend a path that can reach the goal within a given time duration. To simplify the problem, time duration is discretized into 15-minutes intervals. To account for traffic uncertainty, the agent uses AND-OR tree, with "solved leaf node" being the goal point reached within the given time duration. As discussed in class, the solution is found whenever the root of the tree can be labelled as solved.

Using this approach, if the agent cannot find a solution, will it still be possible for the agent to move to the goal point within the desired time duration? Please explain your answer. To provide a clear explanation, please first define the agent problem for this navigation agent.