

Written Assignment - Logic and Planning

Max points:

- CSE 4308: 125 (150 with EC)
- CSE 5360: 125 (130 with EC)

The assignment should be submitted via Canvas.

Instructions

- The answers can be typed as a document or handwritten and scanned.
- Name files as assignment4_<net-id>.<format>
- Accepted document format is .pdf.
 - If you are using Word, OpenOffice or LibreOffice, make sure to save as .pdf.
 - If you are using LaTeX, compile into a .pdf file.
 - Please do not submit .txt files.
- If you are scanning handwritten documents make sure to scan it at a minimum of 600dpi and save as a .pdf or .png file. Do not insert images in word document and submit.
- If there are multiple files in your submission, zip them together as assignment6_<net-id>.zip and submit the .zip file.

Task 1 (CSE 4308: 10 Points; CSE 5360: 10 points)

A	B	C	KB	S1
True	True	True	True	True
True	True	False	False	True
True	False	True	True	True
True	False	False	False	True
False	True	True	False	False
False	True	False	False	False
False	False	True	True	True
False	False	False	False	False

KB and S1 are two propositional logic statements, that are constructed using symbols A, B, C, and using various connectives. The above truth table shows, for each combination of values of A, B, C, whether KB and S1 are true or false.

Part a: Given the above information, does KB entail S1? Justify your answer.

Part b: Given the above information, does statement NOT(KB) entail statement NOT(S1)? Justify your answer.

Task 2 (CSE 4308: 10 Points; CSE 5360: 10 points)

Suppose that some knowledge base contains various propositional-logic sentences that utilize symbols A, B, C, D (connected with various connectives). There are only two cases when the knowledge base is **false**:

- First case: when A is true, B is false, C is false, D is true.
- Second case: when A is false, B is false, C is true, D is false.

In all other cases, the knowledge base is true. Write a conjunctive normal form (CNF) for the knowledge base.

Task 3 (CSE 4308: 15 Points; CSE 5360: 15 points)

Consider the KB

A \Leftrightarrow B
B \Rightarrow C
D \Rightarrow A
C AND E \Rightarrow F
E
D

Show that this entails F by

- i. Forward Chaining
 - ii. Backward Chaining
 - iii. Resolution
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Task 4 (CSE 4308: 30 Points (+10 pts EC); CSE 5360: 30 points)

On April 20, 2017, John and Mary sign the following contract:

- If it rains on May 1, 2017, then John must give Mary a check for \$10,000 on May 2, 2017
- If John gives Mary a check for \$10,000 on May 2, 2017, Mary must mow the lawn on May 3, 2017.

What truly happened those days is the following:

- it did not rain on May 1, 2017
- John gave Mary a check for \$10,000 on May 2, 2017
- Mary mowed the lawn on May 3, 2017.

Part a: Write a first order logic statement to express the contract. Make sure that you clearly define what constants and predicates that you use are. (NOTE: DO NOT use functions)

Part b: Write a logical statement to express what truly happened. When possible, use the same predicates and constants as in question 6a. If you need to define any new predicates or constants, clearly define what they stand for.

Part c: Was the contract violated or not, Justify your answer

Part d (10 pts EC for 4308, req for 5360): Define the symbols required to convert any KB involved in the above domanin from FOL to Propositional logic. Use this to convert the answers to part a and b to Propositional Logic.

Task 5 (CSE 4308: 30 Points (+5 Points EC); CSE 5360: 25 points (+5 Points EC))

Three adults and three children are on the left side of the river. Each adult weighs 150 pounds. Each child has half the weight of an adult, so each child weighs 75 pounds. They all want to cross to the right side of the river. However, the only means of transportation they can use is a boat, and the boat can carry a maximum of 225 pounds. Thus, the boat can carry one adult, one adult and one child, one child or two children. Any adult or child can operate the boat, but the boat cannot be operated without having at least one person on the boat. The goal is to come up with a plan for moving everyone from the left side to the right side using multiple boat trips.

Describe the initial state and the goal, using PDDL. Define appropriate actions for this planning problem, in the PDDL language. For each action, provide a name, arguments, preconditions, and effects.

Extra Credit (5 pts): Also, give a complete plan (using the actions described) for getting from the start to the goal state

Task 6 (CSE 4308: 30 Points; CSE 5360: 25 points)

Suppose that we are using PDDL to describe facts and actions in a certain world called JUNGLE. In the JUNGLE world there are 4 predicates, each predicate takes at most 4 arguments, and there are 5 constants. Give a reasonably tight bound on the number of unique states in the JUNGLE world. Justify your answer.

Task 7 (CSE 4308: 10 Points (EC); CSE 5360: 10 points)

Consider the problem in Task 5. Let us say that, if there is only one person in the boat, the boat can be blown off course and end up back on the side it originally started from. How would you modify the actions you described in Task 1 to account for this if you were going to try and handle this scenario by

- Execution Monitoring/Online Replanning
- Conditional Planning

In both cases, show what the modifications are (If no modification is necessary, Justify).