Written Assignment - Propositional and First Order Logic

Max points:

- CSE 4308: 100
- CSE 5360: 100

The assignment should be submitted via Canvas.

Instructions

- The answers can be typed as a document or handwritten and scanned.
- Name files as assignment3_<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 assignment3_<net-id>.zip and submit the .zip file.

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

Two logical statements S1 and S2 are logically equivalent if (S1 <=> S2) is valid. We have two knowledge bases, KB1 and KB2.. Write a function CHECK_EQUIVALENCE(KB1, KB2) that:

- returns true if KB1 and KB2 are logically equivalent.
- returns false otherwise.

Your pseudocode can re-use any code from the textbook or slides, and can call any of the functions given in the textbook or slides, as long as such code and functions are used correctly, with correct names for the functions, and with well-specified values for all variables and arguments.

Task 2 (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 3 (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 true, 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 4 (CSE 4308: 20 Points; CSE 5360: 20 points)

Consider the KB

A => B
B <=> C
D => A
E => D
C AND E => F
E

Show that this entails F by

i. Forward Chaining
ii. Backward Chaining
iii. Resolution

Task 5 (CSE 4308: 40 Points; CSE 5360: 40 points)

In April, John and Mary sign the following contract:

- If it rains in May, then John must give Mary a check for $10,000
- If John gives Mary a check for $10,000, Mary must mow the lawn.

What truly happened those days is the following:
- It did not rain in May.
- John gave Mary a check for $10,000
- Mary mowed the lawn.

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: Define the symbols required to convert any KB involved in the above domanin from FOL to Propositional logic (Your symbols must allow me to convert ANY KB that uses the predicates and constants as decribed previously).

Part d: Use the sybols given in part c, to convert the answers to part a and b to Propositional Logic.

Part e: Was the contract violated or not, Justify your answer (Note: if the sequence of events that occured entails the contract then it was not violated)

Task 6 (CSE 4308: 10 Points; CSE 5360: 10 Points)

Unify the following if possible:

- Taller (x, John); Shorter (John, Mary)
- Taller (x, Mother(x)); Taller (Bob, y)
- Shorter (Bob, Mother(Bob)); Shorter (x, Mother(y))
- Shorter (Bob, x); Shorter (John, Mary)
- Taller (x, y); Taller (Mother(Bob), Bob)