Cpts_540 HW 6

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1. Consider the following logic problem: All people who like computers also like coding. All people who like coding and like chess will learn AI. For all people that learn AI, there is at least one company that will hire them. All people who are hired by some company will be rich and famous. a. We will solve this problem using first-order logic. First, show one first-order logic sentence for each of the first four sentences in the above problem. You may only draw from the following first-order predicates.

   • Like (x, Chess)

   • Like (x, Computers)

   • Like (x, Coding)

   • Learn (x, AI)

   • Hire (x, y) – which means company x hires person y

   • Rich (x)

   • Famous (x)

   1. $\forall x$ Like (x, Computers) $\Rightarrow$ $\forall x$ Like (x, Coding)

   2. $\forall x$ Like (x, Coding) $\wedge$ $\forall x$ Like (x, Chess) $\Rightarrow$ $\forall x$ Learn (x, AI)

   3. $\forall x$ Learn (x, AI) $\Rightarrow$ Hire (y, x)

   4. $\forall x$ Hire (y, x) $\Rightarrow$ $\forall x$ Rich (x)

   5. $\forall x$ Hire (y, x) $\Rightarrow$ $\forall x$ Famous (x)

   b. Convert each of the four sentences from part (a) into Conjunctive Normal Form (CNF). You may just show the final result for each sentence; no need to show the intermediate steps. Number each clause. We will refer to these clauses as the knowledge base (KB) below

   C1: ($\neg$ Like (x, Computers) $\vee$ Like (x, Coding)

   C2: ($\neg$ Like (x, Coding) $\vee$ $\neg$Like (x, Chess)) $\vee$ Learn (x, AI)

   C3: $\neg$ Learn (x, AI) $\vee$ Hire (y, x)

   C4: $\neg$ Hire (y, x) $\vee$ Rich (x)

   C5: $\neg$ Hire (y, x) $\vee$ Famous (x)

To the KB from part (b), add the two facts: “Larry likes computers” and “Larry likes chess”. Using this augmented KB, perform a resolution proof by refutation to prove

“Rich(Larry)”. In your proof, be sure to do the following: 2 • For each resolution step, show the numbers of the two clauses used, the resulting clause, any variable substitutions resulting from unifying the complementary literals, and then number the resulting clause. • Be sure to use unique variables (e.g., x1, x2, y1, etc.) for each use of a clause from the KB. • Remember: each resolution step can only be done with two clauses at a time and can eliminate only one literal from each clause.

C6 : Like(Larry, Computers)

C7 : Like(Larry, chess)

To prove Rich(Larry), add C8 :¬ Rich(Larry) to the KB

Resolution proof:

C1 with C6 ⇒ C9 : Like (Larry, Coding)

C9 with C2 ⇒ C10 : Learn (Larry , AI)

C10 with C3 ⇒ C11 : Hire (Larry , x)

C11 with C4 ⇒ C12: Rich (Larry)

C12 with C8 ⇒ empty clause

Therefore, Rich(Larry) is true.

d. To the KB from part (b), add the fact: “There exists someone who learns AI.” Be sure to first convert this fact to CNF. Using this augmented KB, perform a resolution proof by refutation to prove “∃x Famous(x)”, following the guidelines in part (c).

add the C6 to part(b) : ∃x Learn(x, AI)

add the C7 : ¬ x Famous(x) to the KB.

Resolution proof:

C6 with C3 ⇒ C8 : ∃x,Hire (y , x)

C8 with C5 ⇒ C9 : ∃x Famous(x)

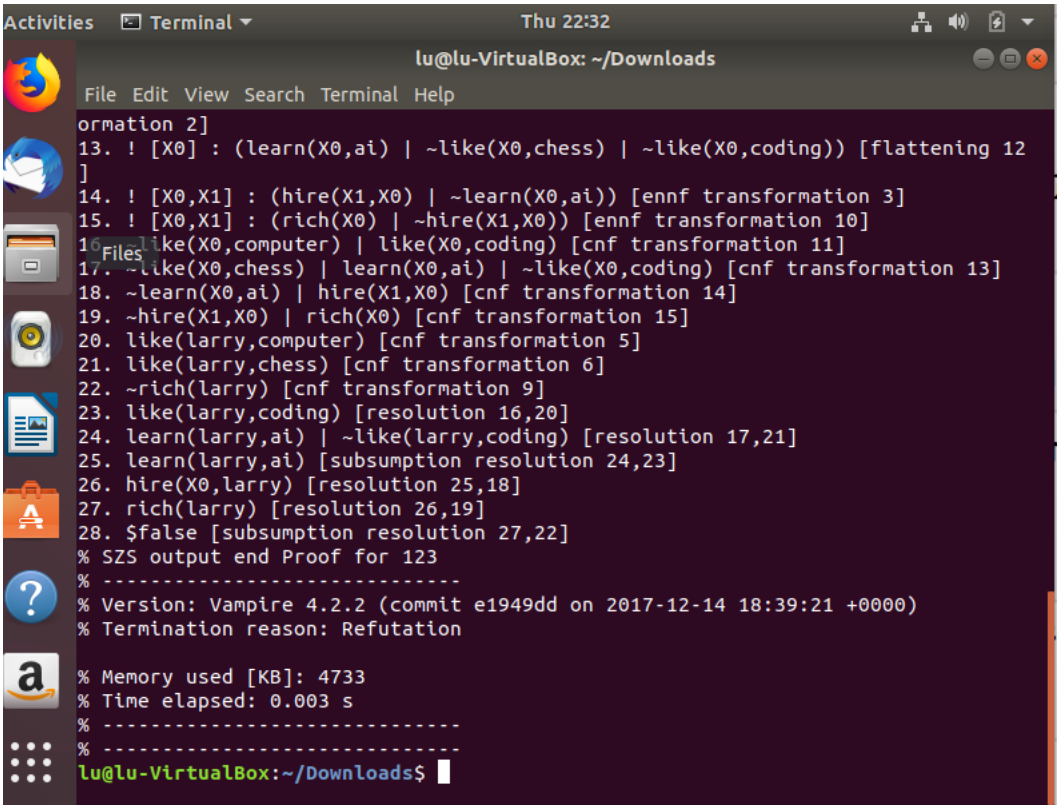
C9 with C7 ⇒ empty clause

Therefore, ∃x Famous(x) is true.

2. input file:

```
fof(a1,axiom,
    ! [X] : (like(X,computer) => like(X,coding))).

fof(a2,axiom,
    ! [X] : (like(X,coding) & like(X,chess) =>learn(X,ai))).

fof(a3,axiom,
    ! [X,Y] : (learn(X,ai)=> hire(Y,X))).

fof(a4,axiom,
    ! [X,Y] : (hire(Y,X)=>rich(X) & famous(X))).

fof(a5,axiom,
    like(larry,computer)).

fof(a6,axiom,
    like(larry,chess)).

fof(c1, conjecture, rich(larry)).
```

Output file:


Activities
Terminal
Thu 22:32
lu@lu-VirtualBox: ~/Downloads
File Edit View Search Terminal Help
Files
ormation 2]
13. ! [X0] : (learn(X0,ai) | ~like(X0,chess) | ~like(X0,coding)) [flattening 12
]
14. ! [X0,X1] : (hire(X1,X0) | ~learn(X0,ai)) [ennf transformation 3]
15. ! [X0,X1] : (rich(X0) | ~hire(X1,X0)) [ennf transformation 10]
16. ~like(X0,computer) | like(X0,coding) [cnf transformation 11]
17. ~like(X0,chess) | learn(X0,ai) | ~like(X0,coding) [cnf transformation 13]
18. ~learn(X0,ai) | hire(X1,X0) [cnf transformation 14]
19. ~hire(X1,X0) | rich(X0) [cnf transformation 15]
20. like(larry,computer) [cnf transformation 5]
21. like(larry,chess) [cnf transformation 6]
22. ~rich(larry) [cnf transformation 9]
23. like(larry,coding) [resolution 16,20]
24. learn(larry,ai) | ~like(larry,coding) [resolution 17,21]
25. learn(larry,ai) [subsumption resolution 24,23]
26. hire(X0,larry) [resolution 25,18]
27. rich(larry) [resolution 26,19]
28. $false [subsumption resolution 27,22]
% SZS output end Proof for 123
% ------------------------------
% Version: Vampire 4.2.2 (commit e1949dd on 2017-12-14 18:39:21 +0000)
% Termination reason: Refutation
% Memory used [KB]: 4733
% Time elapsed: 0.003 s
% ------------------------------
% ------------------------------
lu@lu-VirtualBox:~/Downloads$