CptS 540 Artificial Intelligence
hw6
Jinyang Ruan
011696096

Q1:
(¬Stench(x) ∨ Adjacent (x, F(x)) ∧ (¬Stench(x) ∨ At (Wumpus, F(x))

Q2:

a. ∀x (Likes (x, Apples)) => Plays (x, Chess)
b. ∀x (Likes (x, Oranges)) => Plays (x, Go)
c. ∀x ((Likes (x, Oranges) ∧ ¬Likes (x, Apples)) ∨ (Likes (x, Apples) ∧ ¬Likes (x, Oranges)))
d. Likes (John, Apples)
e. ∀y (Likes (John, y) => ¬Likes (Mary, y))

Q3:

a. ¬Likes (x, Apples) ∨ Plays (x, Chess)
b. ¬Likes (x, Oranges) ∨ Plays (x, Go)
c. (Likes (x, Oranges) ∨ Likes (x, Apples)) ∧ (¬Likes (x, Apples) ∨ ¬Likes (x, Oranges))
d. Likes (John, Apples)
e. ¬Likes (John, y) ∨ ¬Likes (Mary, y)

C1: ¬Likes (x, Apples) ∨ Plays (x, Chess)
C2: ¬Likes (x, Oranges) ∨ Plays (x, Go)
C3: Likes (x, Oranges) ∨ Likes (x, Apples)
C4: Likes (x, Apples) ∨ ¬Likes (x, Oranges)
C5: Likes (John, Apples)
C6: ¬Likes (John, y) ∨ ¬Likes (Mary, y)

Q4:

a. C7: ¬Plays (Mary, Go) //Negated query
b. Proof
    i. Resolve: C1 and C3 (no standardizing of variables or substitution needed)
       C1: ¬Likes (x, Apples) ∨ Plays (x, Chess)
       C3: Likes (x, Oranges) ∨ Likes (x, Apples)
       C8: Likes (x, Oranges) ∨ Plays (x, Chess)
    ii. Resolve: C8 and C2 (no standardizing of variables or substitution needed)
       C2: ¬Likes (x, Oranges) ∨ Plays (x, Go)
       C9: Plays (x, Chess) ∨ Plays (x, Go)
    iii. Resolve: C9 and C7
       C7: ¬Plays (Mary, Go)
       Substitute (x/Mary)
       C10: Plays (x, Chess)
       No contradiction can be reached; thus, the original query might not be true.

Or:

i. Resolve: C4 and C6
   C4: Likes (x, Apples) ∨ ¬Likes (x, Oranges)
   C6: ¬Likes (John, y) ∨ ¬Likes (Mary, y)
   Substitute (x/Mary, y/Apples)
   C11: ¬Likes (John, y) ∨¬Likes (x, Oranges)

ii. Resolve: C11 and C5
   C5: Likes (John, Apples)
   Substitute (y/Apples)
   C12: ¬Likes (x, Oranges)
   No contradiction can be reached; thus, the original query might not be true.

Q5:

Input file (hw6.p):

```
fof(a1, axiom,

   ! [X] : (likes(X, apples) => plays(X, chess))).

fof(a2, axiom,

   ! [X] : (likes(X, oranges) => plays(X, go))).

fof(a3, axiom,

   ! [X] : ((likes(X, oranges) & ~likes(X, apples)) | (likes(X, apples) & likes(X, oranges)))).

fof(a4, axiom,

   likes(john, apples)).

fof(a5, axiom,

   ! [X] : (likes(john, Y) => likes(mary, Y))).

fof(c1, conjecture, plays(mary, go)).
```

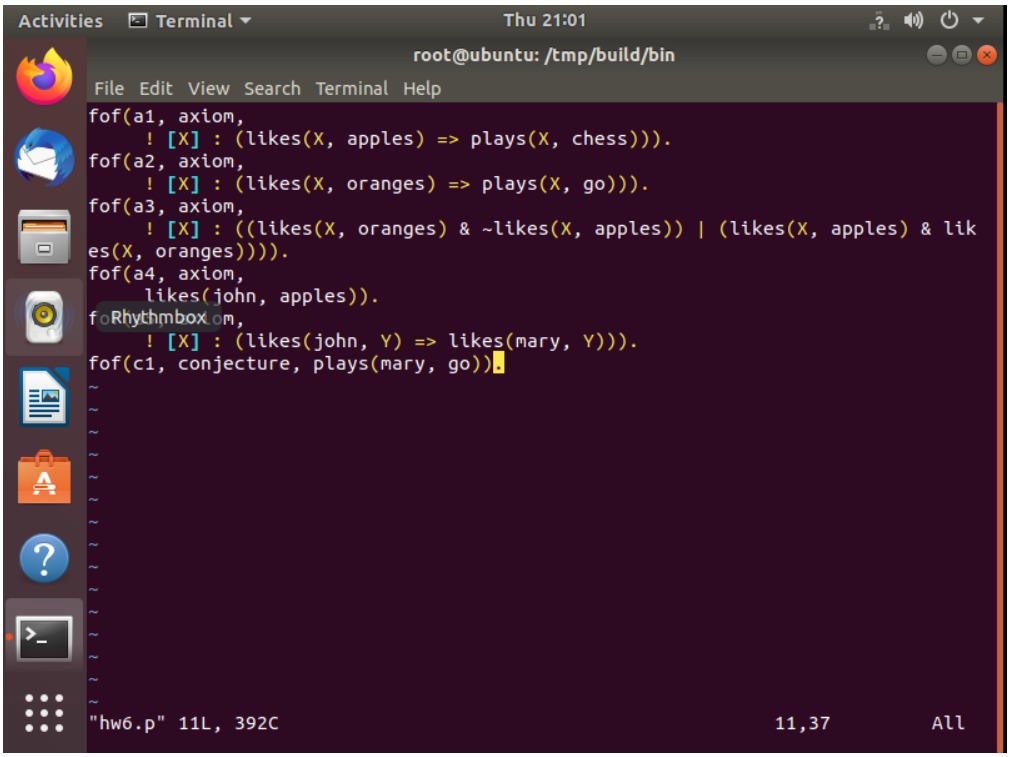
Command:

```
root@ubuntu:/tmp/build/vampire/bin# ./vampire_dbg_static_master_5911 --avatar off hw6.p
```

Output:

```
% Running in auto input_syntax mode. Trying TPTP
% Refutation found. Thanks to Tanya!
% SZS status Theorem for hw6
% SZS output start Proof for hw6
2. ! [X0] : (likes(X0,oranges) => plays(X0,go)) [input]
3. ! [X0] : ((~likes(X0,oranges) & likes(X0,apples)) | (~likes(X0,apples) & likes(X0,oranges)))
[input]
4. likes(john,apples) [input]
5. ! [X0] : (likes(john,X1) => ~likes(mary,X1)) [input]
6. plays(mary,go) [input]
7. ~plays(mary,go) [negated conjecture 6]
8. likes(john,X1) => ~likes(mary,X1) [rectify 5]
9. ! [X1] : (likes(john,X1) => ~likes(mary,X1)) [closure 8]
10. ~plays(mary,go) [flattening 7]
12. ! [X0] : (plays(X0,go) | ~likes(X0,oranges)) [ennf transformation 2]
13. ! [X1] : (~likes(mary,X1) | ~likes(john,X1)) [ennf transformation 9]
14. ! [X0] : (~likes(mary,X0) | ~likes(john,X0)) [rectify 13]
16. ~likes(X0,oranges) | plays(X0,go) [cnf transformation 12]
17. likes(X0,oranges) | likes(X0,apples) [cnf transformation 3]
21. likes(john,apples) [cnf transformation 4]
22. ~likes(mary,X0) | ~likes(john,X0) [cnf transformation 14]
23. ~plays(mary,go) [cnf transformation 10]
25. plays(X0,go) | likes(X0,apples) [resolution 17,16]
28. likes(mary,apples) [resolution 25,23]
30. ~likes(john,apples) [resolution 28,22]
32. $false [subsumption resolution 30,21]
% SZS output end Proof for hw6
% ------------------------------
% Version: Vampire 4.5.1 (commit f34089821 on 2021-10-14 14:32:58 +0200)
% Termination reason: Refutation

% Memory used [KB]: 383
% Time elapsed: 0.015 s
% ------------------------------
----  Runtime statistics ----
clauses created: 18
clauses deleted: 3
------------------------------
% ------------------------------
```

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5. ! [X0] : (likes(john,X1) => ~likes(mary,X1)) [input]
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----------------------------
% ------------------------------
root@ubuntu:/tmp/build/vampire/bin# ^C
root@ubuntu:/tmp/build/vampire/bin#
```