CptS 540 Artificial Intelligence

hw6

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Q1:

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

Q2:

1. ∀x (Likes (x, Apples)) => Plays (x, Chess)
2. ∀x (Likes (x, Oranges)) => Plays (x, Go)
3. ∀x ((Likes (x, Oranges) ∧ ¬Likes (x, Apples)) ∨ (Likes (x, Apples) ∧ ¬Likes (x, Oranges)))
4. Likes (John, Apples)
5. ∀y (Likes (John, y) => ¬Likes (Mary, y))

Q3:

1. ¬Likes (x, Apples) ∨ Plays (x, Chess)
2. ¬Likes (x, Oranges) ∨ Plays (x, Go)
3. (Likes (x, Oranges) ∨ Likes (x, Apples)) ∧ (¬Likes (x, Apples) ∨ ¬Likes (x, Oranges))
4. Likes (John, Apples)
5. ¬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:

1. C7: ¬Plays (Mary, Go) //Negated query
2. Proof
3. 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)

1. 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)

1. 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:

1. 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)

1. 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):

Command:

root@ubuntu:/tmp/build/vampire/bin# ./vampire\_dbg\_static\_master\_5911 --avatar off 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)).

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

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% 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

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---- Runtime statistics ----

clauses created: 18

clauses deleted: 3

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Description automatically generated

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