Worksheet 9

(The rest of the) Answers

Exercise 9.1 *The answers to exercises D.0.1 were given in their entirety on the first answer sheet.*

Exercise 9.2 *CFL and refutation tree*

1. a. $\neg M_g O \vee \neg H_2 \vee M_g$,
1. b. $\neg M_g O \vee \neg H_2 \vee H_2 O$
2. $\neg C \vee \neg O_2 \vee CO_2$
3. $\neg CO_2 \vee \neg H_2 O \vee H_2 CO_3$
4. $M_g O$
5. H_2
6. O_2
7. C
8. *Negated goal:* $\neg H_2 CO_3$ *becomes* $\neg H_2 CO_3$ *in CFL*

Exercise 9.3 *CFL and refutation tree*

1. $\neg r(X_1) \vee l(X_1)$
2. $\neg d(X_2) \vee \neg l(X_2)$
3. a. *d(flipper)*
3. b. *i(flipper)*
4. *Negated goal:* $\neg \exists X\,(i(X) \wedge \neg r(X))$ *becomes:* $\neg i(X_3) \vee r(X_3)$ *in CFL*

Exercise 9.4 *CFL and refutation tree*

1. $\neg j(X) \vee mta(X)$
2. $\neg aop(Y) \vee \neg j(Y)$
3. *Negated goal:* $\neg \forall X\,(aop(X) \rightarrow \neg mta(X))$ *which in CFL becomes:*
3. a. $aop(a)$
3. b. $mta(a)$

Exercise 9.5 *CFL and refutation tree*

1. $\neg r(X_2) \vee \neg lp(Y_2) \vee \neg s(X_2, Y_2) \vee i(X_2)$
2. $\neg j(X_1) \vee \neg r(X_1) \vee \neg lp(Y_1) \vee s(X_1, Y_1)$
3. $lp(sk)$
4. a. $j(a)$
4. b. $r(a)$
5. *Negated goal:* $\neg\exists X \; i(X)$ *becomes* $\neg \; i(X_3)$ *in CFL which itself becomes* $\neg i(X_3) \vee ans(X_3)$

Exercise 9.6 *CFL and refutation tree*

1. a. $\neg t(X_1) \vee p(f(X_1))$
1. b. $\neg t(X_2) \vee o(f(X_2), X_2)$
2. a. $n(sk)$
2. b. $\neg p(Y_2) \vee \neg o(Y_2, sk)$
3. $\neg b(Z_1) \vee n(Z_1)$
4. $\neg t(Z_2) \vee n(Z_2)$
5. a. $\neg n(Z_3) \vee b(Z_3) \vee t(Z_3)$
5. b. $\neg n(Z_4) \vee \neg b(Z_4) \vee \neg t(Z_4)$
6. *Negated goal:* $\neg \exists X \, (b(X) \wedge \forall Y \, (p(Y) \rightarrow \neg o(Y, X)))$ *which in CFL becomes:*
6. a. $\neg b(X_3) \vee p(g(X_3))$
6. b. $\neg b(X_4) \vee o(g(X_4), X_4)$

Exercise 9.7 *CFL and refutation tree*

1. $\neg paid(smf)$
2. $paid(smf)$
3. *Negated goal:* $\neg spy(pm)$ *which becomes* $\neg spy(pm)$ *in CFL.*

Exercise 9.8 *CFL and refutation tree*

1\. a. $i(a) \vee i(b)$
1\. b. $i(a) \vee i(c)$
1\. c. $i(b) \vee i(c)$
2\. $\neg i(a) \vee friend(b, v)$
3\. $\neg i(a) \vee \neg friend(c, v)$
4\. $\neg i(b) \vee \neg in\text{-}town(b)$
5\. $\neg i(b) \vee \neg know(b, v)$
6\. $\neg i(c) \vee saw\text{-}with(a, v)$
7\. $\neg i(c) \vee saw\text{-}with(b, v)$
8\. *Negated goal:* $\neg \exists X \neg i(X)$ *becomes* $i(X_3)$ *in CFL which itself becomes* $i(X_3) \vee ans(X_3)$
9\. $\neg saw\text{-}with(X_1, v) \vee in\text{-}town(X_1)$
10\. $\neg friend(X_2, Y_2) \vee know(X_2, Y_2)$