Homework #1 Answers,
Information Integration, CSCI 6967-01
Due January 31, 2008 at 2pm

Question 1.

$F^0 = \{p(1), p(2), p(3), p(4), p(5), p(6), p(7), p(8), q(1,3), q(2,3), q(4,1), q(5,1), q(7,4), q(8,7)\}$

$F^1 = F^0 \cup \{r(1,1,1), r(2,2,1), r(3,3,1), r(4,4,1), r(5,5,1), r(6,6,1), r(7,7,1), r(8,8,1)\}$

$F^2 = F^1 \cup \{r(1,3,g(1)), r(2,3,g(1)), r(4,1,g(1)), r(5,1,g(1)), r(7,4,g(1)), r(8,7,g(1))\}$

$F^3 = F^2 \cup \{r(4,3,g(g(1))), r(5,3,g(g(1))), r(7,1,g(g(1))), r(8,4,g(g(1)))\}$

$F^4 = F^3 \cup \{r(7,3,g(g(g(1)))), r(8,1,g(g(g(1))))\}$

$F^5 = F^4 \cup \{r(8,3,g(g(g(g(1)))))\}$

$F^6 = F^5$

Question 2.

a.

(1) $: -r(4,3,g(g(1)))$
  (rule 2, $X = 4, Z = 3, T = g(1)$)
(2) $: -r(4,Y,g(1)), q(Y,3)$
  (fact $q(1,3), Y = 1$)
(3) $: -r(4,1,g(1))$
  (rule 2, $X' = 4, Z' = 1, T' = 1$)
(4) $: -r(4,Y',1), q(Y',1)$
  (fact $q(4,1)$, $Y' = 4$)
(5) $: -r(4,4,1)$
  (rule 1, $X = 4$)
(6) $: -p(4).$
  (fact $p(4)$)
(7) $: -$

b.

$(1) :-r(7, 3, g(g(1)))$
(rule 2, $X = 7, Z = 3, T = g(1)$)
$(2) :-r(7, Z, g(1)), q(Z, 3)$
(fact $q(1, 3)$, $Z = 1$)
$(3) :-r(7, 1, g(1))$
(rule 2, $X' = 7, Z' = 1, T' = 1$)
$(4) :-r(7, Y', 1), q(Y', 1)$
(fact $q(4, 1)$, $Y' = 4$)
$(5) :-r(7, 4, 1)$

(fail, backtrack to (4))
$(4) :-r(7, Y', 1), q(Y', 1)$
(fact $q(5, 1)$, $Y' = 5$)
$(5) :-r(7, 5, 1)$
(fail, backtrack to (2))
$(2) :-r(7, Z, g(1)), q(Z, 3)$
(fact $q(2, 3)$, $Z = 2$)
$(3) :-r(7, 2, g(1))$
(rule 2, $X' = 7, Z' = 2, T' = 1$)
$(4) :-r(7, Y', 1), q(Y', 2)$
(fail, no fact to unify with $q(Y', 2)$)
(all paths fail, this fact is not provable)

c.

(1) $:- r(X, 3, g(g(T)))$
(rule 2, $X' = X, Z' = 3, T' = g(T)$)
(2) $:- r(X, Y', g(T)), q(Y', 3)$
(fact $q(1, 3), Y' = 1$)
(3) $:- r(X, 1, g(T))$
(rule 2, $X' = X, Z' = 1, T' = T$)
(4) $:- r(X, Y', T), q(Y', 1)$
(fact $q(4, 1), Y' = 4$)
(5) $:- r(X, 4, T)$
(rule 1, $X' = 4, T = 1$)
(6) $:- p(4)$ (fact $p(4)$)
(7) $:-$ (proves $r(4, 3, g(g(1)))$)

(backtrack to (4))
(4) $:- r(X, Y', T), q(Y', 1)$
(fact $q(5, 1), Y' = 5$)
(5) $:- r(X, 5, T)$
(rule 1, $X' = 5, T = 1$)
(6) $:- p(5)$ (fact $p(5)$)
(7) $:-$ (proves $r(5, 3, g(g(1)))$)

(backtrack to (5))
(5) $:- r(X, 4, T)$
(rule 2, $X' = X, Z' = 4, T = g(T')$)
(6) $:- r(X, Y', T'), q(Y', 4)$
(fact $q(7, 4), Y' = 7$)
(7) $:- r(X, 7, T')$
(rule 1, $X = 7, T = 1$)
(8) $:- p(7)$ (fact $p(7)$)
(9) $:-$ (proves $r(7, 3, g(g(g(1))))$)

(backtrack to (7))
(7) $:- r(X, 7, T')$
(rule 2, $X'' = X, Z'' = 7, T'' = g(T')$)
(8) $:- r(X, Y'', T''), q(Y'', 7)$
(fact $q(8, 7), Y'' = 8$)
(9) $:- r(X, 8, T')$
(rule 1, $X = 8, T = 1$)
(10) $:- p(8)$ (fact $p(8)$)
(11) $:-$ (proves $r(8, 3, g(g(g(g(1)))))$)

d.

(1) : $-r(5, Y, T), r(Z, Y, T), 5 <> Y$
(rule 2, $X' = 5, Z' = Y, T = g(T')$)
(2) : $-r(5, Y', T'), q(Y', Y), r(Z, Y, T), 5 <> Y$
(fact $q(5, 1)$, $Y' = 5, Y = 1$)
(3) : $-r(5, 5, T'), r(Z, 1, T), 5 <> 1$
($5 <> 1$ is true)
(4) : $-r(5, 5, T'), r(Z, 1, T)$
(rule 1, $T' = 1$)
(5) : $-p(5), r(Z, 1, T)$
(fact $p(5)$)
(6) : $-r(Z, 1, T)$
(rule 2, $X'' = Z, Z'' = 1, T'' = g(T)$)
(7) : $-r(Z, Y'', T''), q(Y'', 1)$
(fact $q(5, 1)$, $Y'' = 5$)
(8) : $-r(Z, 5, T'')$
(rule 1, $Z = 5, T'' = 1$)
(9) : $-p(5)$
(fact $p(5)$)
(10) : $-$
(proves $r(5, 1, g(1)), r(5, 1, g(1)), 5 <> 1$)

(backtrack to (7))
(7) : $-r(Z, Y'', T''), q(Y'', 1)$
(fact $q(4, 1)$, $Y'' = 4$)
(8) : $-r(Z, 4, T'')$
(rule 1, $Z = 4, T'' = 1$)
(9) : $-p(4)$
(fact $p(4)$)
(10) : $-$
(proves $r(5, 1, g(1)), r(4, 1, g(1)), 5 <> 1$)

(backtrack to (2))
(2) : $-r(5, Y', T'), q(Y', Y), r(Z, Y, T), 5 <> Y$
(rule 2, $X'' = 5, Z'' = Y', T'' = g(T')$)
(3) : $-r(5, Y'', T''), q(Y'', Y'), q(Y', Y), r(Z, Y, T), 5 <> Y$
(fact $q(1, 3)$, $Y' = 1, Y = 3$)
(4) : $-r(5, Y'', T''), q(Y'', 1), r(Z, 3, T), 5 <> 3$
(5) : $-r(5, Y'', T''), q(Y'', 1), r(Z, 3, T)$
(fact $q(5, 1)$, $Y'' = 5$)
(6) : $-r(5, 5, T''), r(Z, 3, T)$
(rule 1, $T'' = 1$)
(7) : $-r(Z, 3, T)$
(rule 2, $X''' = Z, Z''' = 3, T''' = g(T)$)
(8) : $-r(Z, Y''', T'''), q(Y''', 3)$
(rule 2, $X* = Z, Z* = Y''', T* = g(T''')$)

$(9) : -r(Z, Y*, T*), q(Y*, Y'''), q(Y''', 3)$

(fact $q(1, 3)$, $Y''' = 1$)

$(10) : -r(Z, Y*, T*), q(Y*, 1)$

(fact $q(5, 1)$, $Y* = 5$)

$(11) : -r(Z, 5, T*)$

(rule 1, $Z = 5, T* = 1$)

$(12) : -p(5)$

(fact $p(5)$)

$(10) : -$

(proves $r(5, 3, g(g(1))), r(5, 3, g(g(1))), 5 <> 3$)

(backtrack to (10))

$(10) : -r(Z, Y*, T*), q(Y*, 1)$

(fact $q(4, 1)$, $Y* = 4$)

$(11) : -r(Z, 4, T*)$

(rule 1, $Z = 4, T* = 1$)

$(12) : -p(4)$

(fact $p(4)$)

$(10) : -$

(proves $r(5, 3, g(g(1))), r(4, 3, g(g(1))), 5 <> 3$)

Question 3.

$WorksUnder(L, U) : -Proj(I, N, L), ProjMember(I, U), L <> U$

$WorksTogether(P1, P2) : -WorksUnder(P1, P2)$
$WorksTogether(P1, P2) : -WorksUnder(P2, P1)$
$WorksTogether(P1, P2) : -ProjMember(I, P1), ProjMember(I, P2), P1 <> P2$

(Assuming the leader is not considered a project member. Otherwise, the first two statements are not necessary.)

$DifferentProjects(P1, P2) : -Emp(P1, N1, M1), Emp(P2, N2, M2), P1 <> P2, not\ WorksTogether(P1, P2)$