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CSCI 402
Homework 1

1. $\forall x\,(F^1(x)\ \wedge\ (\forall y(G^1(y)\ \wedge\ J^2(x,y)\ \wedge\ L^4(x,x,x,y)))\ \rightarrow$
   $H^2(x,x)\ \wedge\ \forall y\,(J^2(y,x)\rightarrow\ \neg\,H^2(y,x)))$

2. $\forall x\,(F^1(x)\ \wedge\ \neg\,\exists y\,(H^2(y,x))\ \wedge\ \neg\,G^1(x)\ \rightarrow\ \forall y\,(H^2(y,x)\ \rightarrow\ \neg\,J^2(x,y)))$

3. **System**
   M = person telling the story.

   father(F, M)
   married(M, W)
   daughter(D, W)
   married(D, F)
   son(S1, W)
   son(S2, D)
   brother-in-law(S1, W)
   uncle(S1, M)
   mother(D, M)
   step-daughter(D, M)
   son-in-law(F, M)
   Expressions

   1. $daughter(x,y)\wedge\neg daughter(x,z)\wedge married(y,z)\wedge male(z)\rightarrow step{-}father(z,x)$
   2. $(father(x,y)\vee step-father(x,y))\wedge married(y,z)\rightarrow father-in-law(x,z)$
   3. $(father(x,y)\vee father{-}in{-}law(x,y))\wedge(father(y,z)\vee father{-}in{-}law(y,z))\rightarrow grandfather(x,z)$

   Own Grandfather Proof
   Using modus ponens on expression 1 with x = D, y = W, and z = M we get step-father(M, D).

   Modus ponens on expression 2 with x = M, y = D, and z = F gives us father-in-law(M, F).

   Finally using modus ponens on expression 3 with x = M, y = F, and z = M gives the result grandfather(M, M).

4. (a) {X/a,Z/Y}
   (b) No possible unification because two different ground instances cannot be substituted by the same variable.
   (c) {X/bill, Y/father(bill)}
   (d) This can't be unified because after substituting david for X the result is (father david), george). At this point we have two different constants and they cannot unified.
   (e) This cannot be unified because the first two terms are different constants.