First Midterm  
Philosophy 112  
Winter 2001  

Answer the following questions in the spaces below them.

1. (7 points each) Give the substitution instance using the constant ‘a’ for each of the following sentences of \( PL \):

a. \( (\exists x)(\exists y)((Gxy \land (\forall z)(Gzxy \supset Bya))) \)

\( (\exists y)(Gay \land (\forall z)(Gzay \supset Byaa)) \)

b. \( (\forall y)(\exists x)(\forall z)(Xxz \supset (Gx \equiv Byav)) \)

\( (\exists x)(\forall z)(Xxz \supset (Gx \equiv Baxv)) \)

2. (9 points) Show all the subformulas of the following \( PL \) sentence:

\( (\forall x)[Fxb \supset (\forall z)((\exists y)Gyx \lor (\forall w)(Fwb \land \neg(\forall y)(Gyx \land Fza)))] \)

\( (\forall x)[Fxb \supset (\forall z)((\exists y)Gyx \lor (\forall w)(Fwb \land \neg(\forall y)(Gyx \land Fza)))] \)

\( Fxb \supset (\forall z)((\exists y)Gyx \lor (\forall w)(Fwb \land \neg(\forall y)(Gyx \land Fza))) \)

\( Fxb \)

\( (\forall z)((\exists y)Gyx \lor (\forall w)(Fwb \land \neg(\forall y)(Gyx \land Fza))) \)

\( (\exists y)Gyx \lor (\forall w)(Fwb \land \neg(\forall y)(Gyx \land Fza)) \)

\( (\exists y)Gyx \)

\( Gyx \)

\( (\forall w)(Fwb \land \neg(\forall y)(Gyx \land Fza)) \)

\( Fwb \land \neg(\forall y)(Gyx \land Fza) \)

\( Fwb \land \neg(\forall y)(Gyx \land Fza) \)

\( \neg(\forall y)(Gyx \land Fza) \)

\( (\forall y)(Gyx \land Fza) \)

\( Gyx \land Fza \)

\( Gyx \land Fza \)

\( Fza \)
3. (7 points each) Symbolize the following sentences in PL, using the symbolization key provided.

UD: Everything
   d: Governor Davis   Fxy: x thinks y is a federal problem   Rx x is right
   b: President Bush   Sxy x thinks y is a state problem   Px: x is a person
   e: the energy crisis

a. President Bush thinks the energy crisis is a state problem, while Governor Davis thinks it is a federal problem, and one of them is wrong.

\[(Sbe \land Fde) \land \sim(Rb \land Rd)\]

b. Whoever thinks the energy crisis is a state problem does not think it is a federal problem.

\[\forall x ((Px \land Sxe) \supset \sim Fxe)\]

c. If someone who thinks the energy crisis is a state problem is right, then everyone who thinks it is a federal problem is wrong.

\[\exists x ((Px \land Sxe) \& Rx) \supset (\forall x ((Px \land Fxe) \supset \sim Rx))\]
4. (7 points each) Symbolize the following sentences in PLI, using the symbolization key provided.

UD: Positive integers (1, 2, 3, . . .)

f: four  Gxy: x is greater than y
s: six  Lxy: x is less than y

a. Four, but not six, is less than or equal to four.

(Lff ∨ f = f) & (Lsf ∨ s = f)

b. There is no positive integer which is greater than every positive integer.

∼(∃x)(∀y)Gxy

c. Exactly one positive integer is less than six and greater than four.

(∃x)[(Lxs & Gxf) & (∀y)((Lys & Gyf) ⊃ x = y)]
5. (7 points each) Symbolize the following sentences in PLI, providing your own symbolization key.

Symbolization key

Sx: x is a small bus  
Vx: x is an SUV  
Lx: x is a large car  
Tx: x is a truck  
Bx: x is a bus  
Lxy: x is larger than y  
Uxy: x uses more energy than y

a. A small bus uses more energy than a large car.

\[(\forall x)(Sx \supset (\forall y)(Ly \supset Uxy))\]

b. Only trucks and buses are larger than SUVs.

\[(\forall x)((\forall y)((Sy \& Lxy) \supset (Tx \lor Bx)))\]

c. Every SUV is larger than some truck, but some truck is larger than every SUV.

\[(\forall x)(Vx \supset (\exists y)(Ty \& Lxy)) \& (\exists x)(Tx \& (\forall y)(Vy \supset Lxy))\]
6. (7 points each) Give fluent readings of the following sentences of PLI, using the symbolization key provided.

UD: Everything
f: Florida s: the Supreme Court Wxy: x wins y
g: Al Gore e: the electoral vote Fxyz: x makes y the winner in z
Px: x is a person

a. \((\neg Fgf \supset \neg Wgf) \& (\forall x)(Px \supset (\neg Wxf \supset \neg Wxe))\)

Al Gore does not win Florida unless the Supreme Court makes him a winner there, and anyone who does not win Florida does not win the electoral vote.

b. \((\exists x)[(Px \& Fsxf) \& (\forall y)(Fsf \supset x = y)) \& Wxe]\)

The person the Supreme Court makes the winner in Florida wins the election.