

First Midterm Solutions
Philosophy 112
Winter 2002

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. $(\exists x)(\exists y)(Gxy \ \& \ (\forall z)(Gzxy \supset \ Byxa))$

$(\exists y)(Gay \ \& \ (\forall z)(Gzay \supset \ Byaa))$

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

$(\exists x)(\forall z)(Xxz \supset \ (G \equiv \ Baav))$

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

$(\exists x)[Vcx \ \& \ (\forall y)\sim((\forall z)Xxz \ \vee \ (\exists z)(Rzc \equiv \ Cxza))]$

$(\exists x)[Vcx \ \& \ (\forall y)\sim((\forall z)Xxz \ \vee \ (\exists z)(Rzc \equiv \ Cxza))]$

$Vcx \ \& \ (\forall y)\sim((\forall z)Xxz \ \vee \ (\exists z)(Rzc \equiv \ Cxza))$

Vcx

$(\forall y)\sim((\forall z)Xxz \ \vee \ (\exists z)(Rzc \equiv \ Cxza))$

$\sim((\forall z)Xxz \ \vee \ (\exists z)(Rzc \equiv \ Cxza))$

$(\forall z)Xxz \ \vee \ (\exists z)(Rzc \equiv \ Cxza)$

$(\forall z)Xxz$

Xxz

$(\exists z)(Rzc \equiv \ Cxza)$

$Rzc \equiv \ Cxza$

Rzc

$Cxza$

3. (7 points each) Symbolize the following sentences in *PLI*, using the symbolization key provided.

UD: Everything

b: The Bush administration g: The GAO e: The Enron Corporation

Sxy: x is suing y Axy: x advised y Ixy: x influenced y

Nxy: x is in y Px: x is a person

a. If anyone who advised the Bush administration influenced it, it was Enron.

$(\exists x)(Axb \ \& \ Ixb) \supset (Aeb \ \& \ Ieb)$

b. Only those who were advised by Enron are being sued by the GAO.

$(\forall x)(Sgx \supset Aex)$

c. Whoever in the Bush administration was advised by Enron was influenced by it.

$(\forall x)((Nxb \ \& \ Aex) \supset Iex)$

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

o: one Lxy: x is less than y

a. The positive integer that is less than all others is one.

$(\exists x)[((\forall y)(\sim x = y \supset Lxy) \ \& \ (\forall z)((\forall w)(\sim z = w \supset Lzw) \supset x = z)) \ \& \ x = o]$

b. No positive integer is greater than every positive integer.

$\sim(\exists x)(\forall y)Gxy$

c. Exactly two positive integers are less than four and greater than one.

$(\exists x)(\exists y)[(((Lxf \ \& \ Gxo) \ \& \ (Lyf \ \& \ Gyo)) \ \& \ \sim x = y) \ \& \ (\forall z)((Lzf \ \& \ Gzo) \supset (x = z \vee y = z))]$

5. (7 points each) Symbolize the following sentences in *PLI*, providing your own symbolization key.

Symbolization key

UD: Animals

Ex: x is an elephant Mx: x is a mouse Lx: x is large mouse

Sx: x is a small elephant Lxy: x is larger than y Axy: x is afraid of y

Exy: x eats more than y

a. Small elephants eat more than large mice.

$(\forall x)(Sx \supset (\forall y)(Ly \supset Exy))$

b. Elephants are afraid of mice, but not of themselves.

$(\forall x)(Ex \supset ((\forall y)(My \supset Axy) \& \sim Axx))$

c. Every elephant is larger than some animal, but some animal is larger than every elephant.

$(\forall x)(Ex \supset (\exists y)Lxy) \& (\exists x)(\forall y)(Ey \supset Lxy)$

6. (7 points each) Give fluent readings of the following sentences of *PLI*, using the symbolization key provided.

UD: Everything

d: Grey Davis Rx: x is a Republican Dx: x is a Democrat
r: Richard Riordan Cx: x is conservative Mx: x is a moderate
Px: x is a person Bxy: x can beat y

a. $(\forall x)(\forall y)((Cx \ \& \ Dx) \ \& \ Byx) \supset (My \ \& \ Ry)$

Only a moderate Republican can beat a conservative Democrat.

b. $(\exists x)[([Px \ \& \ (Rx \ \& \ Bxd)] \ \& \ (\forall y)([Py \ \& \ (Ry \ \& \ Byd)] \supset \ x = y)) \ \& \ x = r]$

Richard Riordan is the Republican who can beat Grey Davis.