

Unit 5: Translations in Description Logic

1. EXERCISES

Directions: Using the suggested abbreviations (the capitalized words), translate each of the following statements into the language of description logic. As usual, write down your lexicon.

2. EXERCISE SET A

1. JAY is the FRESHMAN, and KAY is the SOPHOMORE.
2. The FRESHMAN RESPECTS the SOPHOMORE.
3. The FRESHMAN is sitting BETWEEN the JUNIOR and the SENIOR.
4. JAY is the FRESHMAN SITTING in the back row.
5. The FRESHMAN SITTING in the back row is TALL.
6. The square ROOT of 4 is the unique POSITIVE number whose SQUARE is 4.
7. 2 DIVIDED by 3 is the unique number whose PRODUCT with 3 is 2.
8. The person who SHOT JFK WORKED for the CIA.
9. Jack RUBY SHOT the person who SHOT JFK.
10. The person who SHOT JFK is the person whom Jack RUBY SHOT.
11. The person who SHOT JFK is not the person who SHOT KING.
12. RUBY is the person who SHOT the person who SHOT JFK.
13. Kay is the STUDENT whom every STUDENT RESPECTS.
14. The WOMAN that everyone ADMIRES RESPECTS herself.
15. The EXAM that every STUDENT FAILED is HARDER than the EXAM that every STUDENT PASSED.
16. JAY is the one FRESHMAN who ACED every COURSE in which he enrolled.
17. JACK BUILT exactly one HOUSE, the RED HOUSE.
18. THIS is the HOUSE that JACK BUILT.
19. Exactly one MOUSE LIVED in the HOUSE that JACK BUILT.
20. THIS is the MOUSE that LIVED in the HOUSE that JACK BUILT.
21. THIS is the CAT that STALKED the MOUSE that LIVED in the HOUSE that JACK BUILT.
22. THIS is the DOG that CHASED the CAT that STALKED the MOUSE that LIVED in the HOUSE that JACK BUILT.
23. The CAT that LIVED in the HOUSE that JACK BUILT STALKED the MOUSE that LIVED in the HOUSE that JACK BUILT.

3. EXERCISE SET B

24. No one ADMIRES the person who SHOT JFK.
25. Everyone ENVIES the one person whom everyone RESPECTS.
26. The FRESHMAN in class KNOWS every PROFESSOR.
27. The WOMAN whom everyone ADMIRES RESPECTS no one.
28. The square ROOT of a number is the unique POSITIVE number whose SQUARE is that number.
29. A person's MOTHER is the one FEMALE PARENT of that person.
30. Every STUDENT RESPECTS the STUDENT who PASSED every EXAM.
31. Every MAN ENVIES the one MAN ADMIRER by every WOMAN.
32. If at least two people are GREAT, then no one is the one GREAT person.
33. The STUDENT whom everyone RESPECTS is the only STUDENT who PASSED every EXAM. (Use standard IL to symbolize 'is the only'.)
34. The WOMAN that everyone ADMIRES RESPECTS no one but herself.
35. No WOMAN RESPECTS the MAN who HAS everything.
36. JONES is the one PROFESSOR whom the one FRESHMAN RESPECTS.
37. The one FRESHMAN in class RESPECTS exactly one PROFESSOR.

4. EXERCISE SET C

38. KAY is the TALLEST STUDENT.
39. Every STUDENT ENVIES the TALLEST STUDENT.
40. The person who COACHES the BASKETBALL team is LOOKING for the TALLEST STUDENT.
41. Nothing is the GREATEST POSITIVE integer.
42. The SMALLEST POSITIVE integer is the same as the one POSITIVE integer that is equal to its own SQUARE.
43. The TALLEST person is the HEAVIEST person.
44. The TALLEST STUDENT is the HEAVIEST STUDENT.
45. The WOMAN LOVED by a MAN is not the WOMAN who LOVES that man.
46. Every WOMAN ENVIES the WOMAN LOVED by the MAN who LOVES exactly one WOMAN.
47. JAY did not MARRY the WOMAN he HOPED to marry.
48. JAY was not the MAN the WOMAN he HOPED to marry HOPED to marry.
49. JAY's MOTHER was the WOMAN JAY's FATHER HOPED to marry
50. The WOMAN JAY HOPED to marry was not the WOMAN the MAN she HOPED to marry HOPED to marry.
51. For any x , for any y , the QUOTIENT of x and y is the number whose PRODUCT with y is x .
52. Although RUSSELL AUTHORED PM, he is not the one person who AUTHORED PM. (PM = *Principia Mathematica*)
53. If you can't BE with the one you LOVE, LOVE the one you're WITH (Stephen Stills).
54. Something's HAPPENING HERE, what it is ain't exactly CLEAR (Stephen Stills).

5. ANSWERS

The following is the lexicon; note that there are duplicated letters.

b	the basketball team	$R[\alpha, \beta]$	α respects β
c	the CIA	$S[\alpha, \beta]$	α shot β
j	JFK		α is smaller than β
	Jay		α stalked β
	Jack	$T[\alpha, \beta]$	α is taller than β
	Jones	$W[\alpha, \beta]$	α works for β
t	this		α is with β
h	here (this location)	$B[\alpha, \beta, \gamma]$	α is sitting between β and γ
k	Kay	$G[\alpha, \beta, \gamma]$	α gets β at (time) γ
	King	$W[\alpha, \beta, \gamma]$	α wants β at (time) γ
p	Principia Mathematica	$f(\alpha)$	the father of α
r	Jack Ruby	$m(\alpha)$	the mother of α
	Russell	$r(\alpha)$	the square root of α
$A[\alpha, \beta]$	α authored β	$s(\alpha)$	the square of α
	α admires β	$d(\alpha, \beta)$	α divided by β
	α aced β	$m(\alpha, \beta)$	α multiplied by β
$B[\alpha, \beta]$	α can be with β	$p(\alpha, \beta)$	the product of α and β
	α built β	$q(\alpha, \beta)$	the quotient of α and β
$C[\alpha, \beta]$	α chased β	$C[\alpha]$	α is a cat
	α coaches β		α is exactly clear
	α is a course in which β enrolled	$D[\alpha]$	α is a dog
$E[\alpha, \beta]$	α envies β	$E[\alpha]$	α is an exam
$F[\alpha, \beta]$	α fails β	$F[\alpha]$	α is a Freshman
$G[\alpha, \beta]$	α is greater than β		α is female
	α gets β	$G[\alpha]$	α is great
$H[\alpha, \beta]$	α is harder than β	$H[\alpha]$	α is a house
	α hoped to marry β	$M[\alpha]$	α is a mouse
	α is heavier than β	$P[\alpha]$	α is positive
	α is happening at β		α is a professor
$K[\alpha, \beta]$	α knows β	$R[\alpha]$	α is red
$L[\alpha, \beta]$	α loves β	$S[\alpha]$	α is a student
	α lives in β		α is a senior
	α is looking for β		α is a sophomore
$M[\alpha, \beta]$	α married β		α is sitting in the back row
$P[\alpha, \beta]$	α passes β	$T[\alpha]$	α is tall
	α parents β	$W[\alpha]$	α is a woman
		$R[\alpha, \beta]$	α respects β
		$S[\alpha, \beta]$	α shot β
			α is smaller than β

1. $j = \lambda x Fx \ \& \ k = \lambda x Sx$
2. $R[\lambda x Fx, \lambda x Sx]$
3. $B[\lambda x Fx, \lambda x Jx, \lambda x Sx]$
4. $j = \lambda x (Fx \ \& \ Sx)$
5. $T[\lambda x (Fx \ \& \ Sx)]$
6. $r(4) = \lambda x (Px \ \& \ s(x)=4)$
7. $d(2,3) = \lambda x [p(x,3)=2]$
8. $W[\lambda x Sxj, c]$
9. $S[r, \lambda x Sxj]$
10. $\lambda x Sxj = \lambda x Srx$
11. $\lambda x Sxj \neq \lambda x Sxk$
12. $r = \lambda x S[x, \lambda x Sxj]$
13. $k = \lambda x \{Sx \ \& \ \forall y (Sy \rightarrow Ryx)\}$
14. $R[\lambda x \{Wx \ \& \ \forall y Ayx\}, \lambda x \{Wx \ \& \ \forall y Ayx\}]$
15. $H[\lambda x \{Ex \ \& \ \forall y (Sy \rightarrow Fyx)\}, \lambda x \{Ex \ \& \ \forall y (Sy \rightarrow Pyx)\}]$
16. $j = \lambda x \{Fx \ \& \ \forall y (Cyx \rightarrow Axy)\}$
17. $\exists x \{\forall y \{[Hy \ \& \ Bjy] \leftrightarrow y=x\} \ \& \ x = \lambda x \{Rx \ \& \ Hx\}\}$
18. $t = \lambda x \{Hx \ \& \ Bjx\}$
19. $\exists x \forall y \{[My \ \& \ L[y, \lambda x \{Hx \ \& \ Bjx\}]] \leftrightarrow y=x\}$
20. $t = \lambda x \{Mx \ \& \ L[x, \lambda x \{Hx \ \& \ Bjx\}]\}$
21. $t = \lambda x \{Cx \ \& \ S[x, \lambda x \{Mx \ \& \ L[x, \lambda x \{Hx \ \& \ Bjx\}]]]\}$
22. $t = \lambda x \{Dx \ \& \ C[x, \lambda x \{Cx \ \& \ S[x, \lambda x \{Mx \ \& \ L[x, \lambda x \{Hx \ \& \ Bjx\}]]]\}]\}$
23. $S[\lambda x \{Cx \ \& \ L[x, \lambda x \{Hx \ \& \ Bjx\}]], \lambda x \{Mx \ \& \ L[x, \lambda x \{Hx \ \& \ Bjx\}]]]$
24. $\sim \exists x A[x, \lambda x Sxj]$
25. $\forall x E[x, \lambda x \forall y Ryx]$
26. $\forall x \{Px \rightarrow K[\lambda x Fx, x]\}$
27. $\sim \exists x R[\lambda x \{Wx \ \& \ \forall y Ayx\}, x]$
28. $\forall x [r(x) = \lambda y \{Py \ \& \ s(y)=x\}]$
29. $\forall x [m(x) = \lambda y \{Fy \ \& \ Pyx\}]$
30. $\forall x (Sx \rightarrow R[x, \lambda x \{Sx \ \& \ \forall y (Ey \rightarrow Pxy)\}])$
31. $\forall x (Mx \rightarrow E[x, \lambda x \{Mx \ \& \ \forall y (Wy \rightarrow Ayx)\}])$
32. $\exists x \exists y \{x \neq y \ \& \ Gx \ \& \ Gy\} \rightarrow \sim \exists x [x = \lambda x Gx]$
33. $\forall x \{[Sx \ \& \ \forall y (Ey \rightarrow Pxy)] \leftrightarrow x = \lambda x [Sx \ \& \ \forall y Ryx]\}$
34. $\forall z \{R[\lambda x (Wx \ \& \ \forall y Ayx), z] \leftrightarrow z = \lambda x (Wx \ \& \ \forall y Ayx)\}$
35. $\sim \exists x \{Wx \ \& \ R[x, \lambda x \{Mx \ \& \ \forall y Hxy\}]\}$
36. $j = \lambda x \{Px \ \& \ R[\lambda x Fx, x]\}$
37. $\exists x \forall y \{[Py \ \& \ R[\lambda x Fx, y]] \leftrightarrow y=x\}$
38. $k = \lambda x \{Sx \ \& \ \forall y \{[Sy \ \& \ y \neq x] \rightarrow Txy\}\}$
39. $\forall x \{Sx \rightarrow E[x, \lambda x \{Sx \ \& \ \forall y \{[Sy \ \& \ y \neq x] \rightarrow Txy\}]\}]\}$
40. $L[\lambda x Cxb, \lambda x \{Sx \ \& \ \forall y \{[Sy \ \& \ y \neq x] \rightarrow Txy\}\}]\}$
41. $\sim \exists x [x = \lambda x \{Px \ \& \ \forall y ([Py \ \& \ y \neq x] \rightarrow Gxy)]]$
42. $\lambda x \{Px \ \& \ \forall y \{[Py \ \& \ y \neq x] \rightarrow Sxy\}\} = \lambda x \{Px \ \& \ x = s(x)\}$
43. $\lambda x \forall y \{y \neq x \rightarrow Txy\} = \lambda x \forall y \{y \neq x \rightarrow Hxy\}$
44. $\lambda x \{Sx \ \& \ \forall y \{[Sy \ \& \ y \neq x] \rightarrow Txy\}\} = \lambda x \{Sx \ \& \ \forall y \{[Sy \ \& \ y \neq x] \rightarrow Hxy\}\}$
45. $\forall x \{Mx \rightarrow \lambda y \{Wy \ \& \ Lxy\} \neq \lambda y \{Wy \ \& \ Lyx\}\}$
46. $\forall x \{Wx \rightarrow E[x, \lambda x \{Wx \ \& \ L[\lambda x \{Mx \ \& \ \exists y \forall z \{[Wz \ \& \ Lxz] \leftrightarrow z=y\}], x]\}]\}$
47. $\sim M[j, \lambda x \{Wx \ \& \ Hjx\}]$
48. $j \neq \lambda x \{Mx \ \& \ H[\lambda x \{Wx \ \& \ Hjx\}, x]\}$
49. $m(j) = \lambda x \{Wx \ \& \ H[f(j), x]\}$
50. $\lambda x \{Wx \ \& \ Hjx\} \neq \lambda x \{Wx \ \& \ H[\lambda x \{Mx \ \& \ H[\lambda x \{Wx \ \& \ Hjx\}, x]\}, x]\}$
51. $\forall x \forall y \{q(x, y) = \lambda z \{p(z, y)=x\}\}$
52. $Arp \ \& \ r \neq \lambda x Axp$
53. $\forall x \{\sim B[x, \lambda y Lxy] \rightarrow L[x, \lambda y Wxy]\}$
54. $\exists x \{H[x, h] \ \& \ \sim C[\lambda y [x=y]]\}$