

1.5 Nested Quantifiers

1.5 pg. 65 # 9

Let $L(x, y)$ be the statement “ x loves y ,” where the domain for both x and y consists of all people in the world. Use quantifiers to express each of these statements.

- a) Everybody loves Jerry.
- b) Everybody loves somebody.
- c) There is somebody whom everybody loves.
- d) Nobody loves everybody.
 - i Everyone loves himself or herself

1.5 pg. 64 # 5

Let $W(x, y)$ mean that student x has visited website y , where the domain for x consists of all students in your school and the domain for y consists of all websites. Express each of these statements by a simple English sentence.

- d $\exists y(W(\text{Ashok Puri}, y) \wedge W(\text{Cindy Yoon}, y))$
- e $\exists y \forall z (y \neq (\text{David Belcher}) \wedge (W(\text{David Belcher}, z) \rightarrow W(y, z)))$
- f $\exists x \exists y \forall z (((x \neq y) \wedge (W(x, z) \leftrightarrow W(y, z))))$

1.5 pg. 66 # 13

Let $M(x, y)$ be “ x has sent y an e-mail message” and $T(x, y)$ be “ x has telephoned y ,” where the domain consists for all students in your class. Use quantifiers to express each of these statements.

- k There is a student in your class who has not received an e-mail message from anyone else in the class and who has not been called by any other student in the class.
- l Every student in the class has either received an e-mail message or received a telephone call from another student in the class.
- m There are at least two students in your class such that one student has sent the other e-mail and the second student has telephoned the first student

1.5 pg. 67 # 33

Rewrite each of these statements so that negations appear only within predicates (that is, so that no negation is outside a quantifier or an expression involving logical connectives).

- a) $\neg \forall x \forall y P(x, y)$
- d $\neg (\exists x \exists y \neg P(x, y) \wedge \forall x \forall y (Q(x, y)))$