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 \( \exists y(W(\text{Ashok Puri}, y) \land W(\text{Cindy Yoon}, y)) \)

e \( \exists y \forall z (y \neq (\text{David Belcher}) \land (W(\text{David Belcher}, z) \rightarrow W(y, z))) \)

f \( \exists x \exists y \forall z (((x \neq y) \land (W(x, z) \leftrightarrow W(y, z)))) \)

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 \( \neg (\exists x \exists y \neg P(x, y) \land \forall x \forall y (Q(x, y))) \)