

# CS1023 Lab 3: Quantifiers

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1.  $U = \mathbb{R}$

$G(x, y)$  represents  $x < y$

$F(x)$  represents  $x$  is even

(a)  $\forall x \exists y G(x, y)$

(b)  $\exists x \forall y G(x, y)$

(c)  $\exists x F(x)$

2.  $U$  = set of all people

$L(x, y)$ : “ $x$  likes  $y$ ,”

$g$ : George

(a) Everyone likes everyone.

(b) Everyone likes someone.

(c) Someone does not like anyone.

(d) Everyone likes George.

(e) There is someone whom everyone likes.

(f) There is no one whom everyone likes.

(g) Everyone does not like someone.

3.  $U$  = animals

$Mx$ :  $x$  is a monkey

$Sx$ :  $x$  knows sign language

(a) Every monkey knows sign language

(b) Some monkey knows sign language

4.  $U$ : People and dogs

$Dx$ :  $x$  is a dog

$Fxy$ :  $x$  is a friend of  $y$

$Oxy$ :  $x$  owns  $y$

$f$ : fifi

$g$ : Gerald

(a) Fifi is a dog

(b) Gerald is a dog owner

(c) Someone is a dog owner

(d) All of Gerald's friends are dog owners

## Solution

1. (a) For every  $x$  there is a greater number. (there is an infinite number of values in  $\mathbb{R}$ )  
(b) There exists an  $x$  that is smaller than all  $y$ . (there is a minimum)  
(c) There is an  $x$  such that  $x$  is even.
2. (a)  $\forall x \forall y L(x, y)$   
(b)  $\forall x \exists y L(x, y)$   
(c)  $\exists x \forall y \neg L(x, y)$   
(d)  $\forall x L(x, g)$   
(e)  $\exists x \forall y L(y, x)$   
(f)  $\neg \exists x \forall y L(y, x)$   
(g)  $\forall x \exists y \neg L(x, y)$
3. (a)  $\forall x (Mx \rightarrow Sx)$   
(b)  $\exists x (Mx \wedge Sx)$
4. (a)  $Df$   
(b)  $\exists x (Dx \wedge Ogx)$   
(c)  $\exists x \exists y (Dx \wedge Oyx)$   
(d)  $\forall x [Fxx \rightarrow \exists z (Dz \wedge Oxz)]$