

1.

a) Some dogs have been in a movie.

First,

Let the domain consist of all dogs.

$P(x)$: "x has been in a movie".

$\exists x P(x)$

Second,

Let the domain consist of all living creatures.

$Q(x)$: "x has been in a movie".

$D(x)$: "x is a dog".

$\exists x (Q(x) \wedge D(x))$

b) All dogs have fur.

First,

Let the domain consist of all dogs.

$P(x)$: "x has fur".

$\forall x P(x)$

Second,

Let the domain consist of all living creatures.

$Q(x)$: "x has fur".

$D(x)$: "x is a dog".

$\forall x (D(x) \rightarrow Q(x))$

c) No dog can fly.

First,

Let the domain consist of all dogs.

$P(x)$: "x can fly".

$$\forall x \neg P(x)$$

Second,

Let the domain consist of all living creatures.

$Q(x)$: "x can fly".

$D(x)$: "x is a dog".

$$\forall x \neg (D(x) \wedge Q(x))$$

2.

a) Every Ashesi student is hardworking.

$S(x)$: "x is an Ashesi student"

$H(x)$: "x is hardworking".

U = all people

$$\forall x (S(x) \rightarrow H(x))$$

Negation: $\exists x (S(x) \wedge \neg H(x))$

Negation in English: There is a person that is an Ashesi student and is not hardworking.

b) There is a pig that knows logic programming.

$P(x)$: "x is a pig"

$K(x)$: "x knows logic programming".

U = all animals

$\exists x(P(x) \wedge K(x))$

Negation: $\forall x \neg(P(x) \wedge K(x))$

Negation in English: There is no animal that is a pig and knows logic programming.

c) No cat enjoys being on camera.

$C(x)$: "x is a cat"

$E(x)$: "x enjoys being on camera".

U = all animals

$\forall x \neg(C(x) \wedge E(x))$

Negation: $\exists x(C(x) \wedge E(x))$

Negation in English: There is an animal that is a cat and enjoys being on camera.

3.

a) $\exists x \exists y P(x, y)$ –

Some faculty member from my university has taught some student from my class.

b) $\exists x \forall y P(x, y)$ –

There is a faculty member from my university that has taught all students from my class.

c) $\forall x \exists y P(x, y) -$

Every faculty member from my university has taught at least one student from my class.

d) $\exists y \forall x P(x, y) -$

Some student from my class has been taught by all faculty members from my university.

e) $\forall y \exists x P(x, y) -$

Every student from my class has been taught by some faculty member from my university.

f) $\forall x \forall y P(x, y) -$

All faculty members from my university have taught all students from my class.