

COMP 681 Formal Methods Spring 2008 Recitation 9—Solutions

1. Translate the following argument into the language of predicate logic and use a Venn diagram to show that it is valid. Be sure to indicate the meanings of the predicate symbols you use.

All cats and dogs are pets. Some cats eat birds. Anything that eats birds should be shot. Therefore, some pets should be shot.

Answer

Let

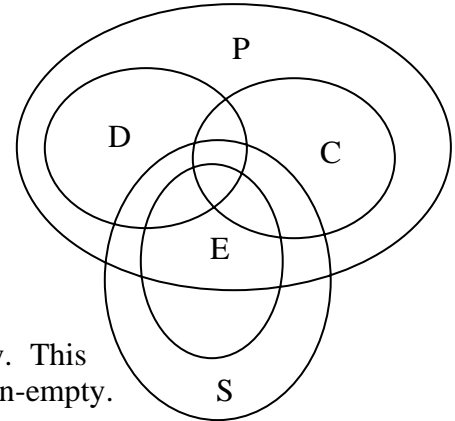
$D(x)$: x is a dog.

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

$P(x)$: x is a pet.

$E(x)$: x eats birds.

$S(x)$: x should be shot.



We are guaranteed that the overlap of C and E is non-empty. This must be within both P and S , so the overlap of P and S is non-empty.

2. Translate the following statements into the language of predicate logic. Be sure to indicate the meanings of the predicate symbols you use.

- a. *Cats purr when they're happy.*

Answer

Let

$cat(x)$ mean x is a cat

$purrs(x)$ mean x purrs

$happy(x)$ mean x is happy

Then

$$\forall x \bullet cat(x) \Rightarrow (happy(x) \Rightarrow purrs(x))$$

Equivalently,

$$\forall x \bullet cat(x) \wedge happy(x) \Rightarrow purrs(x)$$

- b. *Black ducks and white geese both fly and swim.*

Answer

Let

$black(x)$ mean x is black

$duck(x)$ mean x is a duck

$white(x)$ mean x is white

$goose(x)$ mean x is a goose

$flies(x)$ mean x flies

$swims(x)$ mean x swims

Then:

$$\forall x \bullet black(x) \wedge duck(x) \vee white(x) \wedge goose(x) \Rightarrow flies(x) \wedge swims(x)$$

c. *Milk is healthy and sometimes tasty.*

Answer

Let

milk(x) mean *x is milk*

healthy(x) mean *x is healthy*

tasty(x) mean *x is tasty*

Then:

$$(\forall x \bullet \text{milk}(x) \Rightarrow \text{healthy}(x)) \wedge (\exists x \bullet \text{milk}(x) \wedge \text{tasty}(x))$$

d. *Some dogs bark when they run.*

Answer

Let

dog(x) mean *x is a dog*

barks(x) mean *x barks*

runs(x) mean *x runs*

Then

$$\exists x \bullet \text{dog}(x) \wedge (\text{runs}(x) \Rightarrow \text{barks}(x))$$