

# Predicates

## Predicate

A function that outputs true or false.

$\text{Cat}(x) := \text{"x is a cat"}$

$\text{Prime}(x) := \text{"x is prime"}$

$\text{LessThan}(x, y) := \text{"x < y"}$

$\text{Sum}(x, y, z) := \text{"x + y = z"}$

$\text{HasNChars}(s, n) := \text{"string s has length n"}$

Numbers and types of inputs can change. Only requirement is output is Boolean.

# Domain of Discourse

$x$  is prime or  $x^2$  is odd or  $x = 2$ .

$\text{Prime}(x) \vee \text{Odd}(x^2) \vee \text{Equals}(x, 2)$

To make sure we **can't** plug in 4.5 for  $x$ , predicate logic requires deciding on the types we'll allow

## Domain of Discourse

The set of all inputs allowed as inputs to our predicates.

Often we give the type(s) of allowed inputs, like "all integers" or "all real numbers."

## Try it...

What's a possible domain of discourse for these lists of predicates?

1. "x is a cat", "x barks", "x likes to take walks"
2. "x is prime", "x=5" "x < 20" "x is a power of two"
3. "x is enrolled in course y", "y is a pre-req for z"

## Translations

Domain of Discourse  
Integers

Predicate Definitions  
Even(x) := x is even  
LessThan(x, y) := x < y  
( )

"For every x, if x is even, then  $x = 2$ ."

"There are x, y such that  $x < y$ ."

$\exists x (\text{Odd}(x) \wedge \text{LessThan}(x, 5))$

$\forall y (\text{Even}(y) \wedge \text{Odd}(y))$