Variables and Universes Predicate logic

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Variables and Universes

Autumn 2013 – Session 2/2 (4) 1 / 7

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Propositional logic

If someone enters with a wet raincoat, then it is raining outside.

- Propositional logic
 - s := someone enters with a wet raincoat,
 - t := it is raining outside

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- $s \Rightarrow t$
- Propositional logic does not analyse the statements any deeper
- Who is somebody?

Polynomials $p(x) = x^3 + 2x + 1$ Programming for (i=0 ; i < n ; ++i)

- A variable can take different values
 - each value gives a new result
- Variables varies over some set
- The set of possible values = universe



Definition

The universe of a variable x is the set of possible values that x can take.

- Programming: the universe is the (data) type of x
- Mathematical functions: the universe is the domain

Definition

A variable x is called a free variable if it can take any value (with no universe defined to restrict it).

Predicate logic

Predicate logic introduces variables into the predicates.

- s := someone enters with a wet raincoat
- 2 t := it is raining outside
- *S*(*x*) := *x* enters with a wet raincoat
- $x \in C$ where C is the set of students and teachers in the class
- For each $x \in C$, we get a new predicate S(x)
- Can we rephrase *s* in terms of *S*(*x*)?

• s := there is some $x \in C$, such that P(x)

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Predicate logic

Note the function-like notation for a predicate S(x).



- Propositional logic defines the predicates one by one.
- Predicate logic can define sets of predicates
 - using a variable

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Consider the predicate

$$P(x) := |x| \le 1$$

For what values of x is P(x) true ...

- If the universe of x is the integers?
- If the universe of x is the set of real numbers?

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