Knowledge Representation Workshop 1

CITS3005

August 4, 2023

First Order Logic

This workshop will allow you to practice the use of first order logic for expressing concepts and knowledge, abd formalising reasoning.

1. Express some simple arithmetic properties using arithmetic logic:

   - Every even number is followed by an odd number.
   - For every number there is always a prime larger than it
   - Every number is the square of some different number.

2. Express the following concepts of data structures using first order logic, where the language consists of:

   - the domain consisting of the natural numbers, and array types, and the constant `null`.
   - predicates `number(x)` (x is a natural number), `array(x)` (x is an array), `x<y` (x and y are both numbers and x is less than y), `elementAt(a,x,y)` (the element ot `a` at index x is y).

   (a) the array `a` is not empty.
   (b) the array `a` has length `n`.
   (c) all the elements of array `a` are arrays.
   (d) the array `a` is sorted.
   (e) the array `a` is the same as the array `b` after it has been sorted?

3. When applying resolution we need to unify terms

   (a) Show that if a unifier exists, a most general unifier exists.
   (b) Give an algorithm for finding the most general unifier.
   (c) Can you find a most general unifier for $p(X, f(X))$ and $p(f(Y), Y)$.

4. Given the statements:

   - Cris is a student in CITS3005.
   - All students who study hard will pass if a unit is easy.
   - CITS3005 is easy.
   - Cris studies hard.

   Formalise these statements in first order logic, reduce to CNF, and apply resolution to show Cris passes CITS3005.