



Verifikation nebenläufiger Programme

Sommersemester 2004

Serie 10

28. Juni 2004

Thema: Endsemestertest – Bitte einzeln bearbeiten und abgeben!

Ausgabetermin: 28. Juni 2004

Abgabe: Freitag 9. Juli 2004 um 12:00 (im Schreiben)

Aufgabe 1 (3 Punkte) Attempt to write LTL-formulas that specify the following properties. Note that not every property mentioned can be described in LTL. Please identify explicitly the properties that are not LTL-expressible (in your opinion).

1. Propositions p , q , and r are pairwise exclusive. That is, when one of them holds, the other two cannot. For the rest of the property list, you may assume this to hold.
2. Every two occurrences of p are separated by at least one q .
3. Every p is followed by a q with no intermediate r .
4. We say that an occurrence of p is *even* if it is the n 'th occurrence, where n is an even natural number (i.e., evenly divisible by 2).

The property: q may occur only in the interval between an odd and an even occurrence of p .

5. There are only finitely many occurrences of q that are immediately preceded by an occurrence of p .
6. Let $\#p$ denote the number of occurrences of p from the beginning of the sequence.

The property: At all points $\#p \geq \#q$.

Aufgabe 2 (6 Punkte) Consider the following mutual exclusion algorithm (Dekker):

	$t := 1$		
l_1 :	$in1 := \text{true}$	m_1 :	$in2 := \text{true}$
l_2 :	if $\neg in2$ then goto l_7	m_2 :	if $\neg in1$ then goto m_7
l_3 :	if $t = 1$ then goto l_2	m_3 :	if $t = 2$ then goto m_2
l_4 :	$in1 := \text{false}$	m_4 :	$in2 := \text{false}$
l_5 :	loop until $t = 1$	m_5 :	loop until $t = 2$
l_6 :	goto l_1	m_6 :	goto m_1
l_7 :	$t := 2$	m_7 :	$t := 1$
l_8 :	$in1 := \text{false}$	m_8 :	$in2 := \text{false}$
l_9 :	goto l_1	m_9 :	goto m_1

Prove the liveness property $at_L_1 \Rightarrow \diamond at_L_7$ by displaying the proof diagram using the chain reasoning proof principle (mention the invariances used). See handout: “14. Axiomatization of program dependent properties”.

Aufgabe 3 (3 Punkte) Verify the correctness of the following two rules:

$$\frac{B, \Gamma \vdash \Delta \quad \Gamma \vdash A, \Delta}{A \supset B, \Gamma \vdash \Delta} \quad \frac{\Gamma, A \vdash B, \Delta}{\Gamma \vdash A \supset B, \Delta}$$

Aufgabe 4 (6 Punkte) 1. Specify the following function f in PVS:

$$f : \text{nat} \rightarrow \{y : \text{int} \mid y \neq 0\}$$

$$x \mapsto \begin{cases} 2 & \text{if } x = 0 \\ (-1)^x \cdot 3 \cdot (f(x-1) - 1) & \text{otherwise} \end{cases}$$

2. Prove in PVS the TCCs of your specification. Change your specification if necessary, but take care that the type of f is kept as above.

Send your specification file (.pvs) and your automatically generated proof file (.prf) by email to bls+serie10@informatik.uni-kiel.de before the deadline.