COMP SCI 3EA3 — Software Specification and Correctness

April 03, 2017

Name

Special Instructions:

Student Number

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• This examination paper includes 3 pages (including this cover page) and 2 questions. You are responsible for ensuring that your copy of the paper is complete. Bring any discrepancy to the attention of your

invigilator.

- \bullet Read each question completely and carefully before answering it.
- Answer all questions.
- In doubt, document!

Contents

- 1 Chop-away the hard stuff! 5 marks —
- 2 Replace the difficulties in your life! 10 marks —

This quiz consists of two main questions to solve one problem: Computing the integer logarithm base-7 of a given integer.

 $\{ 1 \le N \} ? \{ 7^x \le N < 7^{x+1} \}$

You are asked to do so using the heuristic (\star) "Programming is a *goal-oriented* activity"; where the first question requires the use of the technique of "Deleting a Conjunct" to find the invariant, and the second approach requires you to use the technique of "Replacing Constants/Expressions by Variables" to solve the problem.

Code without an explicit derivation *following* the outline of the ambient heuristic (*) receives **zero** marks. You may not use any of the search schemas on the Theorem Sheet.

Besides the usual arithmetical results used in-class, you may need some of the following properties: for any *natural numbers* a, b, c and d,

"Exponentiation at zero"

Exponentiation at zero	<i>u</i> – 1		
"Strict-isotonicity of exponentiation"	b < d $a < c$	≡	$a^b < a^d$ $a^b < c^b$
"Exponentiation is strictly expansive"	1 < d 1 < a	=	$a < a^d$ $d < a^d$
"Naturals are discrete"	a < b	≡	$a+1 \leq b$

 $a^0 - 1$

1 Chop-away the hard stuff! — 5 marks —

Solve the integer log base-7 problem by using the technique of "Deleting a Conjunct" to find the invariant —ambiently using the heuristic of "programming is a *goal-directed* activity" to guide your **derivation**!

 $\{ 1 \le N \} ? \{ 7^x \le N < 7^{x+1} \}$

Solve the integer log base-7 problem by using the technique of "Replacing Constants/Expressions by Variables" to find the invariant —ambiently using the heuristic of "programming is a *goal-directed* activity" to guide your **derivation**!

 $\{ 1 \le N \} ? \{ 7^x \le N < 7^{x+1} \}$