ETHZ D-INFK
Prof. Dr. B. Meyer, Dr. C.A. Furia, Dr. S. Nanz

Software Verification – Problem Sheets
Fall 2014

Problem Sheet 11: Testing
Sample Solutions

Chris Poskitt*
ETH Zürich

1 Branch and Path Coverage

i. (a) 4.
   (b) 6.

ii. (a) Yes, e.g. $\mathtt{function}(4, 6)$ and $\mathtt{function}(6, 4)$.
    (b) Yes, e.g. $\mathtt{x} := 1$, $\mathtt{x} := 0$, and $\mathtt{x} := -1$.

iii. (a) 3.
     (b) 10.

iv. (a) $\mathtt{z} := \mathtt{true} \leadsto \mathtt{result} := \text{"b"}$.
    (b) $\mathtt{y} := \mathtt{x} + \mathtt{x} \; [\leadsto \; \mathtt{y} := \mathtt{y} + 2]^n$ for $0 \leq n \leq 6$.

v. (a) For full path coverage we add the test $\mathtt{function}(1, 2)$.
   (b) For full path coverage we add the tests: $\mathtt{x} := 2$, $\mathtt{x} := 3$, $\ldots \mathtt{x} := 8$.

2 Logic Coverage

i. (a) $\mathtt{x} < \mathtt{y}$ and $\mathtt{z}$ $\mathtt{\&\&}$ $\mathtt{x} + \mathtt{y} == 10$.
   (b) $\mathtt{x} > 0$, $\mathtt{y} < 15$, and $\mathtt{x} = 0$.

ii. Yes: we can use the same tests as we used for branch coverage.

iii. (a) $\mathtt{x} < \mathtt{y}$, $\mathtt{z}$, and $\mathtt{x} + \mathtt{y} == 10$.
     (b) $\mathtt{x} > 0$, $\mathtt{y} < 15$, and $\mathtt{x} = 0$.

iv. Yes in both cases.

   (a) For full clause coverage we can use the tests $\mathtt{function}(4, 6)$ and $\mathtt{function}(1, 2)$.
   (b) For full clause coverage we can use the tests $\mathtt{x} := 1$, $\mathtt{x} := 0$, and $\mathtt{x} := -1$.

v. Predicate coverage implies branch coverage (in fact, the definitions are equivalent). Clause coverage, however, does not imply branch coverage. Take for example the predicate:

$$x > 0 \vee y > 0.$$

With the tests $(x \mapsto 0, y \mapsto 1)$ and $(x \mapsto 1, y \mapsto 0)$ we achieve clause coverage. However, these tests do not achieve predicate coverage (since the compound formula in both cases evaluates to true) and hence do not achieve branch coverage.

---

*Solution sheet adapted from an earlier version by Stephan van Staden.