Problem Sheet 10: Testing
Sample Solutions

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1 Branch and Path Coverage

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

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

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

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

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

2 Logic Coverage

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

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

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

iv. Yes in both cases.

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

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:

\[ x > 0 \lor y > 0. \]

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.