Homework 3 - Software Verification

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Textbook problem 5.3 page 151. Write which are T_z-valid and T_r-valid.

1 $@x > 0;\ x := x - k;$ **assume** $k \leq 1;\ @x \geq 0;$

$x > 0 \rightarrow (k \leq 1 \rightarrow x - k \geq 0)$
(assert (not (=> (> x 0)(=> (<= k 1)(>= (- x k) 0)))))

$T_z = valid,$
$T_r = invalid; counterexample : x = \frac{1.0}{2.0}, k = 1.0$

2 $@T;$ **assume** $k \leq x;\ x := x - k;\ @x \geq 0;$

$T \rightarrow (k \leq x \rightarrow (x - k) \geq 0)$
(assert (not (=> true (=> (<= k x)(>= (- x k) 0)))))

$T_z = valid,$
$T_r = valid$

3 $@T;\ x := x - k;$ **assume** $k \leq x;\ @x \geq 0;$

$T \rightarrow ((k \leq x - k) \rightarrow (x - k \geq 0))$
(assert (not (=> true (=> (<= k (- x k))(>= (- x k) 0)))))

$T_z = invalid; counterexample : x = -2, k = -1$
$T_r = invalid; counterexample : x = -1.0, k = \frac{1.0}{2.0}$

4 $@k \geq 0;\ x := x - k;$ **assume** $k \leq x;\ @x \geq 0;$

$k \geq 0 \rightarrow ((k \leq x - k) \rightarrow (x - k \geq 0))$
(assert (not (=> (>= k 0) (=> (<= k (- x k))(>= (- x k) 0)))))

$T_z = valid,$
$T_r = valid$

5 $@y \geq 0;\ x := x - k;$ **assume** $x > 0;\ y := y + x;\ @x + 2y \geq 3;$

$y \geq 0 \rightarrow ((x + 1 > 0) \rightarrow (3x + 2y + 3 \geq 3))$
(assert (not (=> true (=> (>= (- x k) 0)(<= k x)))))

$T_z = valid,$
$T_r = invalid; counterexample : x = -\frac{1.0}{6.0}, y = 0.0$