Verification

Please write the names of all group members on the solutions you hand in.

Problem 1: Weakest precondition

Compute the following formulae:

1. $\mathsf{wp}(x \geq 0,\ x := x - k; \mathtt{assume}\ k \leq 1)$

2. $\mathsf{wp}(x \geq 0,\ \mathtt{assume}\ k \leq x; x := x - k)$

3. $\mathsf{wp}(x \geq 0,\ x := x - k; \mathtt{assume}\ k \leq x)$

Problem 2: Absolute values

Prove the total correctness of abs. Annotate the function with an inductive loop invariant; visualize the basic paths in a diagram; list the basic paths and corresponding verification conditions and prove that all verification conditions are valid. Furthermore, give a ranking function to prove termination.
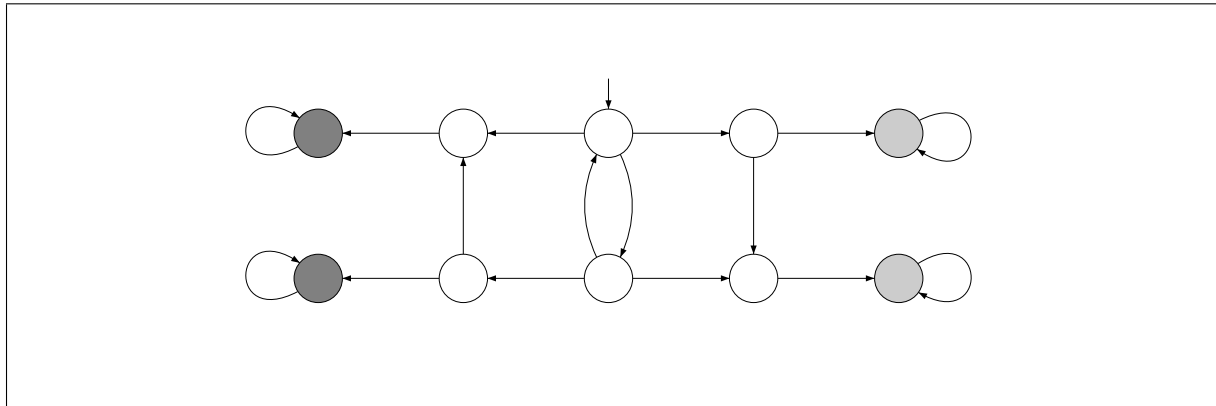
```
@pre ⊤
@post ∀i.0 ≤ i < |rv|  →  rv[i] ≥ 0
int[] abs(int[] a₀) {
  int[] a := a₀;
  for
    @ ⊤
    (int i := 0;  i < |a|;  i := i + 1) {
    if (a[i] < 0)  {
       a[i] :=  − a[i];
    }
  }
  return a;
}
```
Figure 1: Computing the absolute values of an array

Problem 3: Stuttering

Consider the transition system TS shown in the following figure.

(a) Give the smallest transition system that is stutter-trace equivalent to TS.

(b) Is the resulting transition system from (a) stutter bisimilar to TS? Justify your answer.

Figure 2: Transition system TS