

Homework 1 Problem 2

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1 Pseudo-Code

Consider the following Pseudo-Code:

Algorithm 1 Main Function

```
function MAIN
  var  $x \leftarrow 1$ 
  while  $x > 0$  do
    if  $x == 1$  then
      return
    end if
     $x \leftarrow x - 1$ 
  end while
  return
end function
```

2 Derivations

1	$\{\text{while } x > 0 \text{ do } \{\text{if } x == 1 \text{ then return; } x = x - 1\} \text{return; } \} \vdash_p \{x \mapsto 1\} \Rightarrow \text{Error}$
2	$x > 0 \vdash_p \{x \mapsto 1\} \Downarrow \text{true}; \{\} :: \{x \mapsto 1\}$
3	$x \vdash_p \{x \mapsto 1\} \Downarrow 1; \{x \mapsto 1\}$
4	$0 \vdash_p \{x \mapsto 1\} \Downarrow 0; \{x \mapsto 1\}$
5	$1 > 0$
6	$\{\text{if } x == 1 \text{ then return; } \} \vdash_p \{\} :: \{x \mapsto 1\} \Rightarrow [\text{None}]$
7	$x == 1 \vdash_p \{\} :: \{x \mapsto 1\} \Downarrow \text{true}; \{\} :: \{\} :: \{x \mapsto 1\};$
8	$x \vdash_p \{\} :: \{x \mapsto 1\} \Downarrow 1; \{\} :: \{x \mapsto 1\}$
9	$1 \vdash_p \{\} :: \{x \mapsto 1\} \Downarrow 1; \{\} :: \{x \mapsto 1\}$
10	$1 == 1$
11	$\text{return; } \vdash_p \{\} :: \{\} :: \{x \mapsto 1\} \Rightarrow [\text{None}]$
12	$\text{return} \vdash_p \{\} :: \{\} :: \{x \mapsto 1\} \Downarrow [\text{None}];$
13	$x = x - 1 \vdash_p [\text{None}] \Rightarrow \text{Error}$
14	$x - 1 \vdash_p [\text{None}] \Downarrow \text{Error};$
15	$x \vdash_p \text{None} \Downarrow \text{Error};$

3 Inference Rule

To fix this issue, we can conclude the following inference rule.

$$\frac{\Sigma \vdash_p e \Downarrow \text{true}; \Sigma' \quad s \vdash_p \Sigma' \Rightarrow [v]}{\text{while } e \text{ do } s \vdash_p \Sigma \Rightarrow [v]}$$