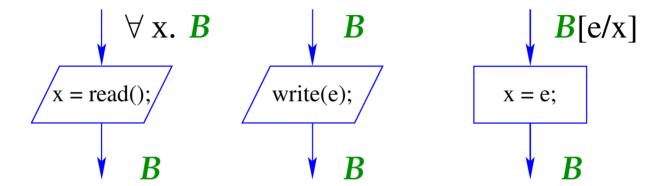
# Week 3: Loop Invariants



#### Week 03 Tutorial 01 — MiniJava 2.0



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```
1. rand x:
```

Assigns a random value to variable x,

2.  $x = either e_0, \ldots, e_k$ :

Assigns one of the values of the expressions  $e_0, \ldots, e_k$  to variable x non-deterministically,

3. x = e in a, b:

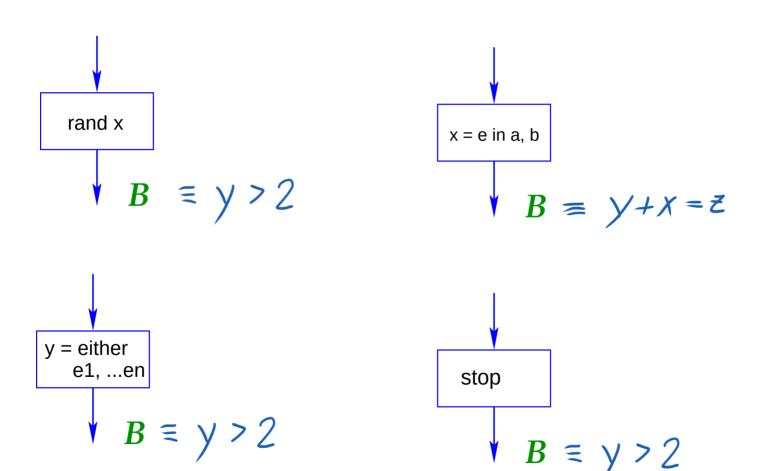
Assigns the value 1 to variable x, if the value of expression e is in the range [a,b] and 0 if e is not in the range or the range is empty (a>b),

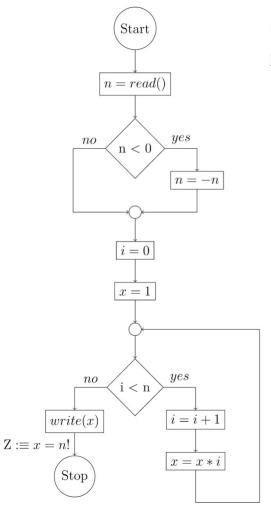
4. stop:

Immediately stops the program.

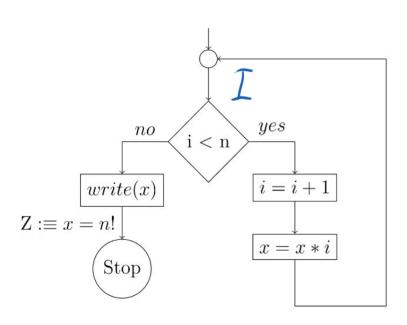
Define the weakest precondition operator  $\mathbf{WP}[\![\ldots]\!](B)$  for each of these statements.

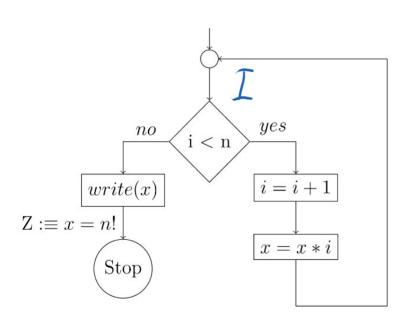
#### Week 03 Tutorial 01 — MiniJava 2.0



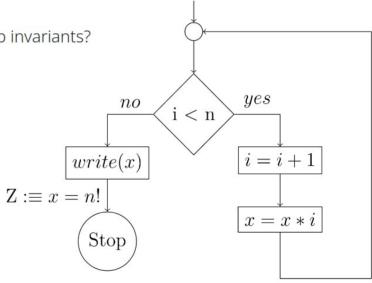


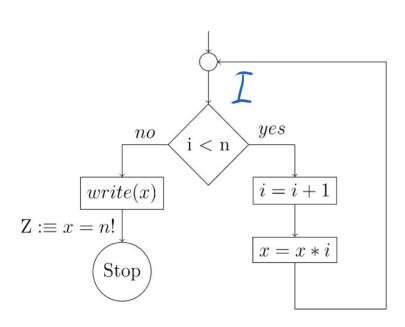
- 1. Discuss the problem that arises when computing weakest preconditions to prove Z.
- 2. How can you use weakest preconditions to prove  $oldsymbol{Z}$  anyway?

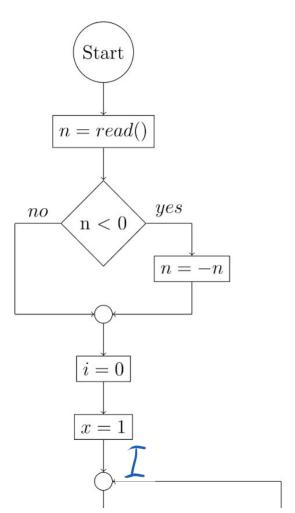


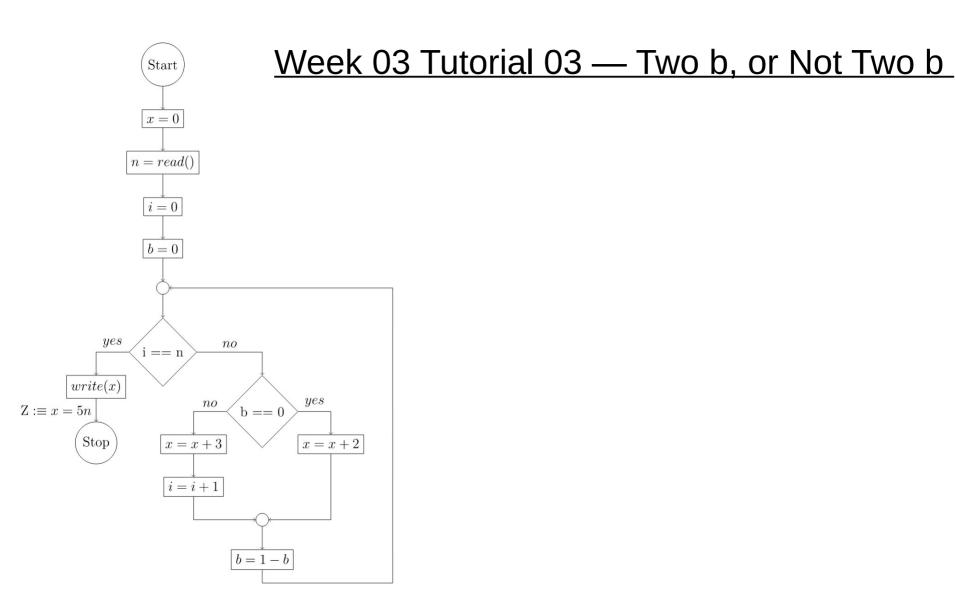


- $\circ$  a) How has a useful loop invariant be related to Z?
- o b) What happens if the loop invariant is chosen too strong?
- o c) What happens if the loop invariant is chosen too weak?
- o d) Can you give a meaningful lower and upper bound for useful loop invariants?









#### Week 03 Tutorial 03 — Two b, or Not Two b

