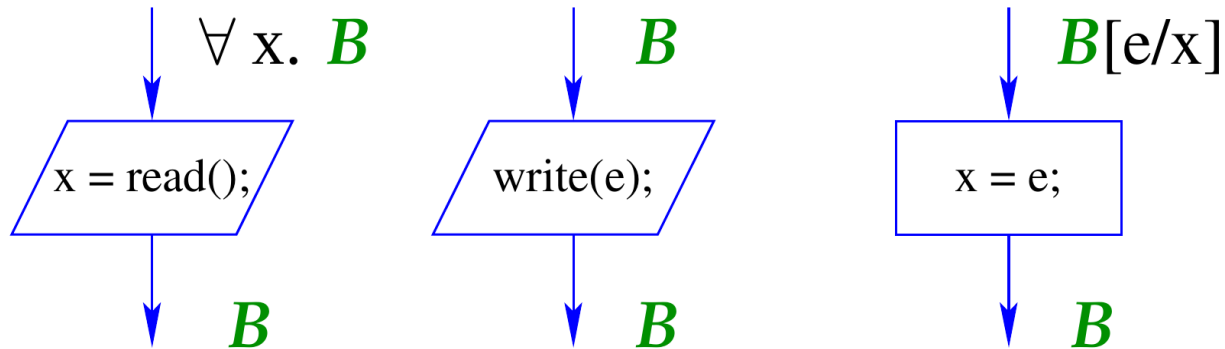


Week 3: Loop Invariants



Week 03 Tutorial 01 — MiniJava 2.0



Week 03 Tutorial 01 — MiniJava 2.0

1. **rand** x :

Assigns a random value to variable x ,

2. $x = \text{either } e_0, \dots, e_k$:

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

3. $x = e \text{ in } a, b$:

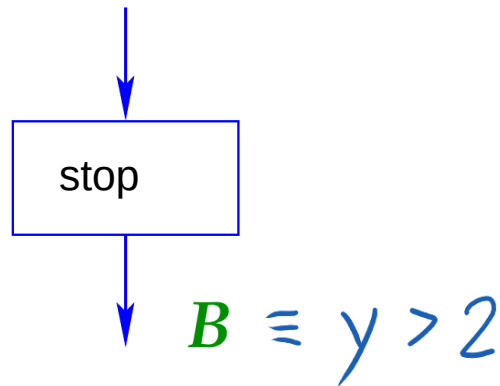
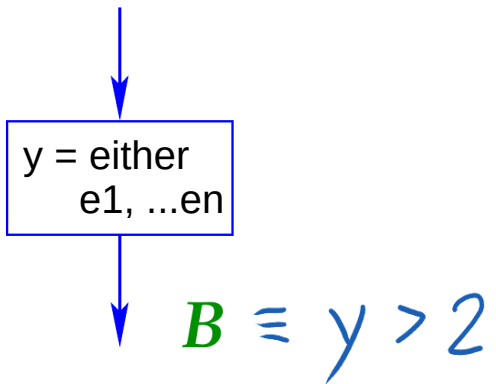
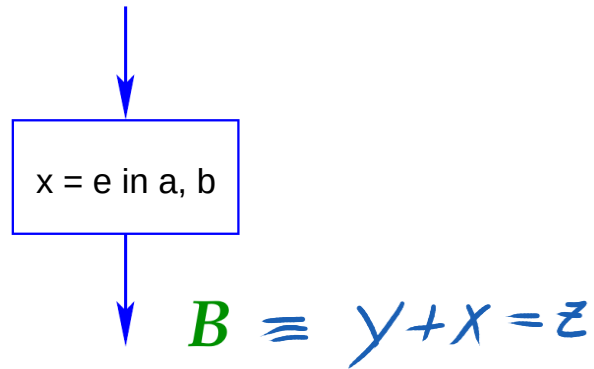
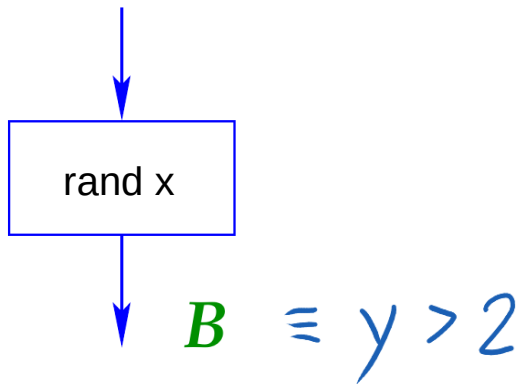
Assigns the value **1** to variable x , if the value of expression e is in the range $[a, b]$ and **0** if e is not in the range or the range is empty ($a > b$),

4. **stop**:

Immediately stops the program.

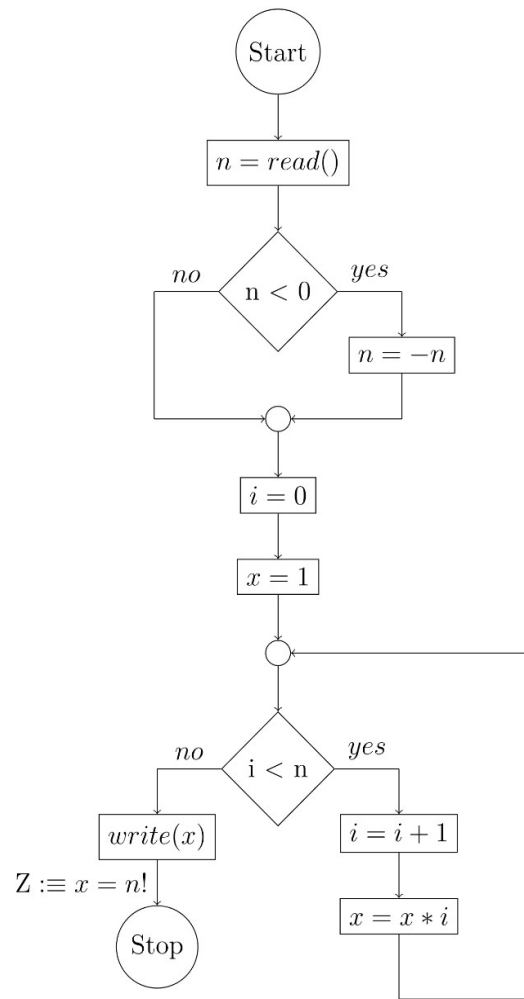
Define the weakest precondition operator $\mathbf{WP}[\![\dots]\!](B)$ for each of these statements.

Week 03 Tutorial 01 — MiniJava 2.0



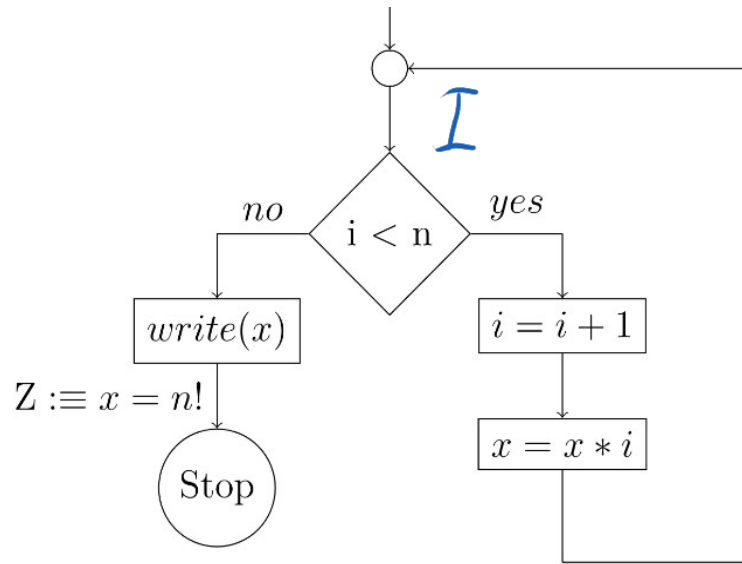
Week 03 Tutorial 02 — Loop Invariants

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



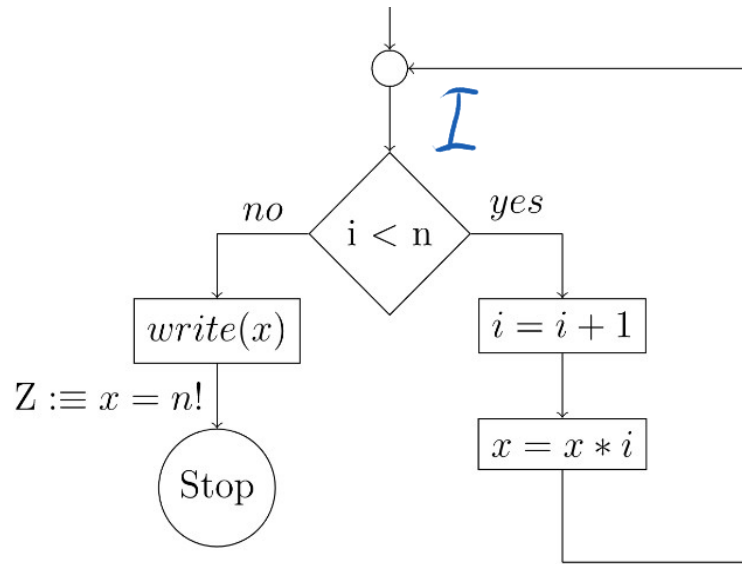
Week 03 Tutorial 02 — Loop Invariants

$$I \equiv x \geq 0$$



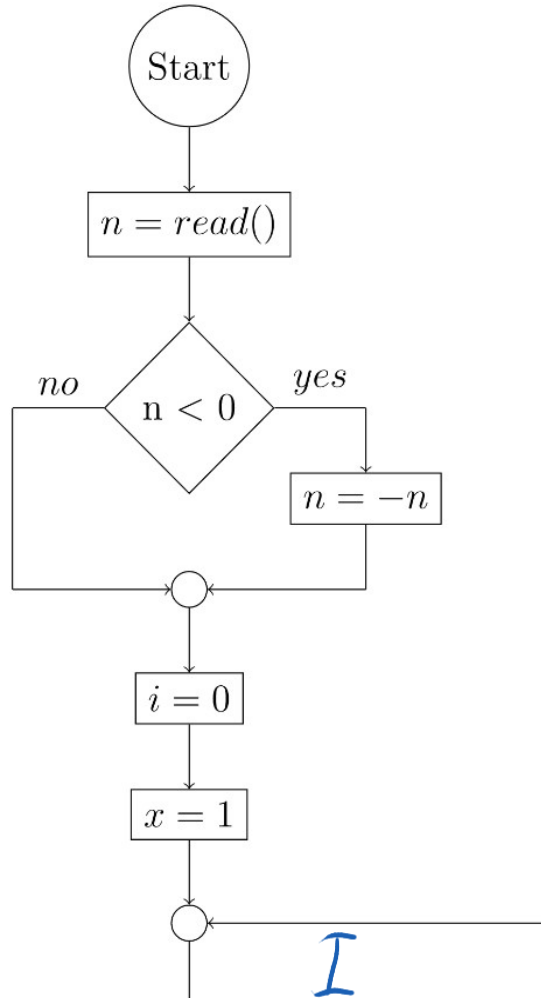
Week 03 Tutorial 02 — Loop Invariants

$$I \equiv i=0 \wedge x=1 \wedge n=0$$



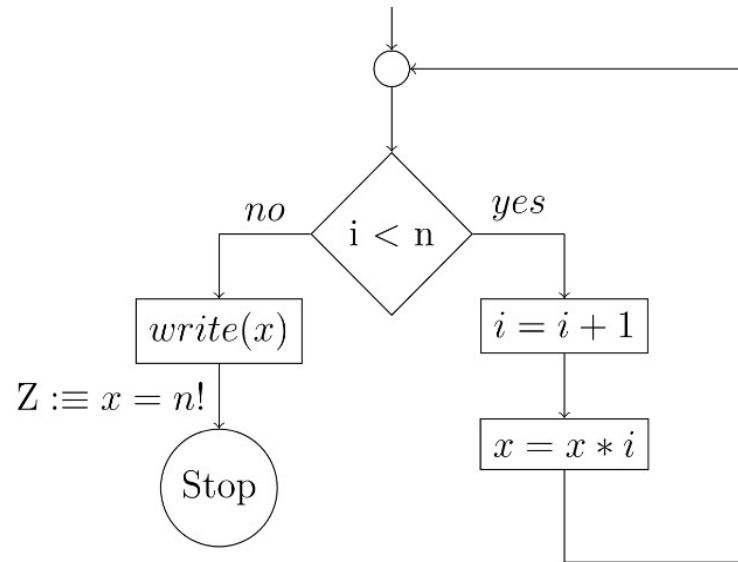
Week 03 Tutorial 02 — Loop Invariants

$$I \triangleq i = 0 \wedge x = 1 \wedge n = 0$$

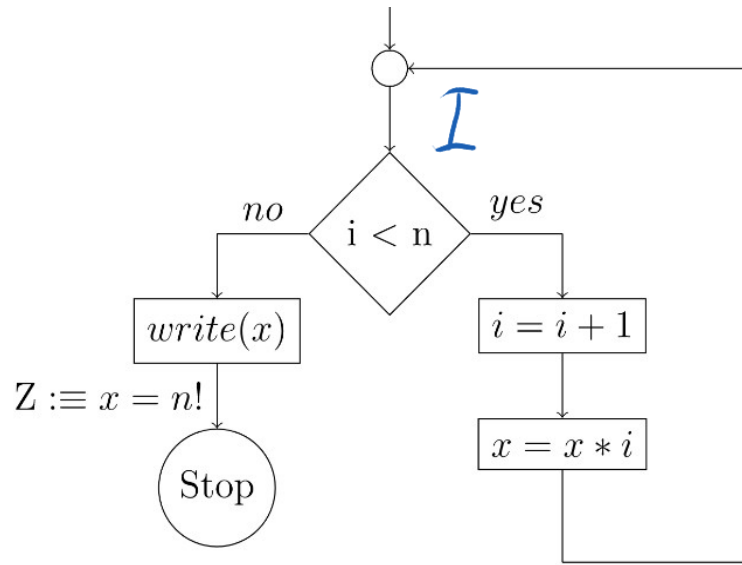


Week 03 Tutorial 02 — Loop Invariants

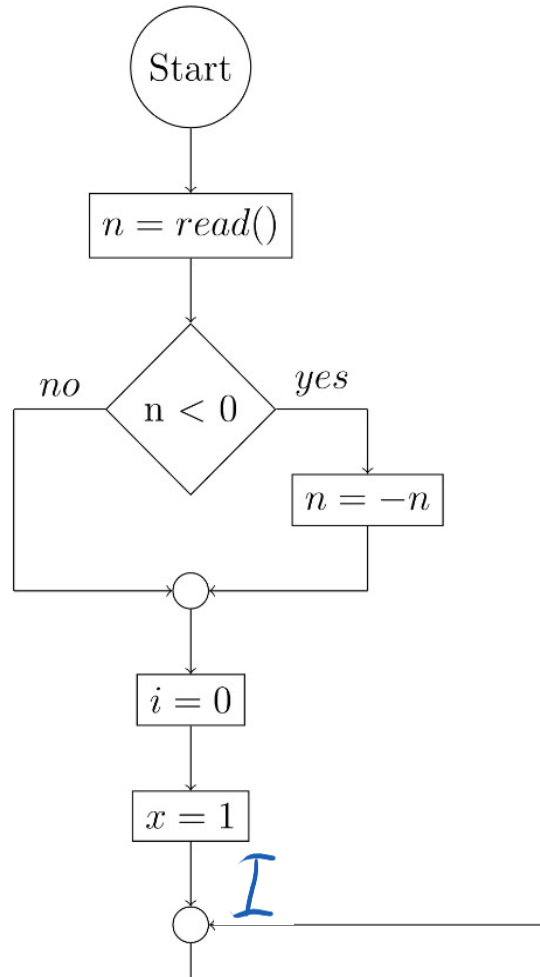
- a) How has a useful loop invariant be related to Z ?
- b) What happens if the loop invariant is chosen too strong?
- c) What happens if the loop invariant is chosen too weak?



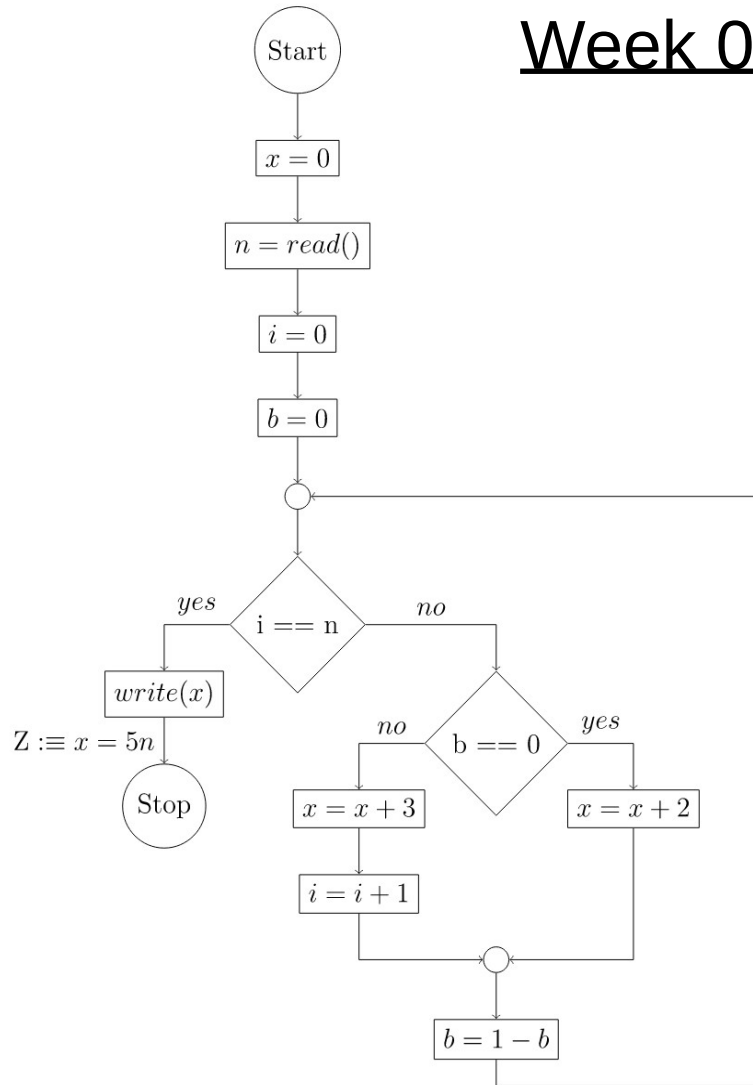
Week 03 Tutorial 02 — Loop Invariants



Week 03 Tutorial 02 — Loop Invariants



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



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

