

Activity: Simple Programs

A. Why?

To understand how programs work, we must understand their syntax and semantics.

B. Outcomes

By the end of the activity you should

- Translate programs in our simple language to/from similar programs in standard languages like C, C++, or Java.
- Have practice determining the state changes that occur during execution of a simple program.

C. Questions

As usual, form groups of 5, assign roles, and answer the following questions.

1. Translate the C/C++/Java program fragment `++x; if (x < y) { p = q = 4; }` into our simple programming language.

`x := x+1; if x < y then p := 4; q := 4 fi`

2. Consider the C/C++/Java program `while (--x >= 0) z*=2;` and the program (in our language) `while x ≥ 0 do x := x-1; z := z*2 od`. Do these programs behave the same way if we run them in state σ_0 , where $\sigma_0(x) = 0$ and $\sigma_0(z) = \text{some value}$ (let's call it α)?

No because the first doesn't loop but the second does.

Probably the second one should be `x := x-1; while x ≥ 0 do z := z*2; x := x-1 od`

3. Say state τ_0 maps n , x , and y to **2**, **3**, 0, and 1 respectively. If we execute the program $S \equiv \text{while } x \leq n \text{ do } x := x+1; y := y+y \text{ od}$ starting in state τ_0 , then we start by evaluating the test $x \leq n$ in state τ_0 (and get the result **true false**). Then we evaluate the body of the loop $x := x+1; y := y+y$ and get some state $\tau_1 = \tau_0[x := 1][y := 2]$. Complete the following statements:

- In state τ_1 , the test $x \leq n$ is ??? **true**
- So we execute the body and get a state $\tau_2 = \tau_1[x := ???][y := ???]$ **2 4**
- In state τ_2 , the test $x \leq n$ is ??? **true**
- So we execute the body and get a state $\tau_3 = ???$ **$\tau_2[x := 3][y := 8]$**
- In state τ_3 , the test $x \leq n$ is ??? **false**
- So we halt the loop and end up with state τ_3 .