

Homework 4  
COMP 3200  
Spring, 2023  
Prof. Stucki

1. Suppose  $\sigma_1 = \{\langle x, 1 \rangle, \langle y, 2 \rangle, \langle z, 3 \rangle\}$ ,  $\sigma_2 = \{\langle y, 5 \rangle\}$ , and  $\sigma_3 = \{\langle w, 1 \rangle\}$ . What are the results of the following operations?
  - (a)  $\sigma_1 \uplus \sigma_2$
  - (b)  $\sigma_1 \uplus \sigma_3$
  - (c)  $\sigma_2 \uplus \sigma_3$
  - (d)  $\emptyset \uplus \sigma_2$
  - (e)  $\sigma_1 \otimes \sigma_3$
  - (f)  $\sigma_1 \otimes \sigma_2$
  - (g)  $(\sigma_1 - (\sigma_1 \otimes \sigma_3)) \cup \sigma_3$
2. Write operational semantics rules for the ‘implies’, ‘not’, and ‘<=’ operators of *NotJava*.
3. Derive the complete operational semantics for the program below, where the initial value of  $n$  is 3. Show all execution rule applications and derive the final state that includes  $\langle \text{fib0}, 2 \rangle$ . Assume that the initial state  $\sigma = \emptyset$ .

```
n = 4;
fib0 = 0;
fib1 = 1;
while (n > 0) {
    temp = fib0;
    fib0 = fib1;
    fib1 = fib0 + temp;
    n = n - 1;
}
```

4. Show how the meaning of each of the following expressions and statements and given states are derived from the function  $M$ . Show your work (all the steps).
  - (a)  $M((z+2)*y, \{\langle x, 2 \rangle, \langle y, -3 \rangle, \langle z, 75 \rangle\})$
  - (b)  $M(z = 2*x + 3/y - 4, \{\langle x, 2 \rangle, \langle y, -3 \rangle, \langle z, 75 \rangle\})$
  - (c)  $M(1, \{\langle x, 2 \rangle, \langle y, -3 \rangle, \langle z, 75 \rangle\})$