Homework 4
COMP 3200
Spring, 2025
Prof. Stucki

1. Suppose $\sigma_1 = \{<x, 1>, <y, 2>, <z, 3>\}$, $\sigma_2 = \{<y, 5>\}$, and $\sigma_3 = \{<w, 1>\}$. 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 <fib0, 2>. Assume that the initial state $\sigma = \emptyset$.

   ```
   n = 3;
   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) $M((z+2)*y, \{<x, 2>, <y, -3>, <z, 75>\})$

   (b) $M(z = 2*x + 3/y - 4, \{<x, 2>, <y, -3>, <z, 75>\})$

   (c) $M(1, \{<x, 2>, <y, -3>, <z, 75>\})$