T-106.420 Concurrent programming
Example solution for homework assignment 1

1. (a) $(x = 5 \wedge y = 2)$

   (b) Six possible execution orders:
   $S_1;\ S_2;\ S_3;\ \models\ (x = 5 \wedge y = 2)$
   $S_1;\ S_3;\ S_2;\ \models\ (x = 2 \wedge y = -3)$
   $S_2;\ S_1;\ S_3;\ \models\ (x = 2 \wedge y = -3)$
   $S_2;\ S_3;\ S_1;\ \models\ (x = 2 \wedge y = -3)$
   $S_3;\ S_1;\ S_2;\ \models\ (x = 2 \wedge y = -3)$
   $S_3;\ S_2;\ S_1;\ \models\ (x = -11 \wedge y = -8)$

   (c) The await statement never executes. The other statement sets x to -3. The whole co statement deadlocks with $(x = -3 \wedge y = 5)$

2. (a) Yes. The final value of x is zero. The last statement executes first, then the other two (in either order).

   (b) $S_1(fails); S_2(fails); S_3;\ \models\ (x = 5)$
   $S_2(fails); S_1(fails); S_3;\ \models\ (x = 5)$
   $S_1(fails); S_3; S_2;\ \models\ (x = 2)$
   $S_2(fails); S_3; S_1;\ \models\ (x = 3)$
   $S_3; S_1; S_2;\ \models\ (x = 0)$
   $S_3; S_2; S_1;\ \models\ (x = 0)$

3. Initial values that work, and the corresponding final values:
   $x = \{-1, 0, 1\} \quad \models \quad x = \{-1, 0, 1\}$

   Altogether 6 possible histories.

   $\{(x < -1)\} \quad \models\ S_1\ and\ S_3\ deadlocks$
   $\{(x > 1)\} \quad \models\ S_2\ and\ S_3\ deadlocks$