SS 2025 28.07.2025

Exercises to the lecture
Semantics
Sheet 10

Prof. Dr. Roland Meyer
Jan Grünke Delivery until 15.08.2025 at 23:59

Bonus Exercise 10.1 (Translating LTL Operators into Modal μ-Calculus)
Translate standard LTL formulas into equivalent formulas in the modal μ-calculus. You may assume an action-labeled transition system with only one label a for simplicity. Provide modal μ-calculus equivalents for the following LTL formulas:

a) $\bigcirc\varphi$ (Next)

b) $\varphi\,\mathcal{U}\,\psi$ (Until)

c) $\Diamond\varphi$ (Eventually)

d) $\Box\varphi$ (Gloablly)

e) $\varphi\,\mathcal{R}\,\psi$ (Release)

Bonus Exercise 10.2 (Does it terminate?)
Consider the following program $P = (W, I, R)$, where every state is an initial state.

```
1: while (x >= 0) {
2:   x := x - y;
3:   y := y + 1;
   }
```

The configuration space is $\Gamma = \{\ell_1, \ell_2, \ell_3\} \times \Sigma$, where the state space is $\Sigma = \mathbb{Z}^2$. The transition relation R is the union of the following transitions:

$$R_1 \equiv pc = \ell_1 \wedge pc' = \ell_2 \wedge x' = x \wedge y' = y \wedge x \geq 0$$
$$R_2 \equiv pc = \ell_2 \wedge pc' = \ell_3 \wedge x' = x - y \wedge y' = y$$
$$R_3 \equiv pc = \ell_3 \wedge pc' = \ell_1 \wedge x' = x \wedge y' = y + 1$$

Question: Is the program terminating? If the program terminates, give a disjunctively well-founded transition relation. If the program does not terminate, describe some infinite program execution.