Exercises to the lecture
Concurrency Theory
Sheet 8

Roland Meyer, Viktor Vafeiadis Delivery until 17.06.2014 at 12h

Exercise 8.1
A *data race* is defined by the following predicate:

$$\begin{aligned}\text{race}(a,b) \Leftrightarrow\ & (\mathit{type}(a) = \text{NA} \vee \mathit{type}(b) = \text{NA}) \\ & \wedge\ (\mathit{write}(a) \vee \mathit{write}(b)) \\ & \wedge\ \mathit{loc}(a) = \mathit{loc}(b) \\ & \wedge\ \neg \mathit{hb}(a,b) \wedge \neg \mathit{hb}(b,a) \\ & \wedge\ a \neq b\end{aligned}$$

A program is called *data race free* if no valid execution contains a data race.
Now consider the following program:

$$\begin{array}{c|c|l} & x = y = 0 & \\ X_{\text{NA}} = 1 & \| & \textbf{if } (Y_{\text{ACQ}} == 1) \\ Y_{\text{REL}} = 1 & \| & \quad \text{print}(X_{\text{NA}}) \end{array}$$

a) Prove or disprove that the program is data race free.

b) Change the $Y_{\text{REL}} = 1$ command to $Y_{\text{RLX}} = 1$. Is the program now data race free?

Exercise 8.2
Consider the following program:

$$\begin{array}{l|l|l|l} & a = x = y = 0 & & \\ \textbf{if } (X_{\text{ACQ}} == 1) & \textbf{if } (Y_{\text{RLX}} == 1) & & a_{\text{NA}} = 1 \\ \quad Y_{\text{REL}} = 1 & \quad \textbf{if } (a_{\text{NA}} == 1) & & \\ & \quad\quad X_{\text{RLX}} = 1 & & \end{array}$$

Prove or disprove that this program is data race free.

Exercise 8.3
Prove the lemma from the lecture:

$$\text{consistent}_{\text{TSO}}(A, \mathit{lab}, \mathit{po}, \mathit{rf}, \mathit{mo}_{\text{TSO}}) \Rightarrow \exists \mathit{mo} : \text{consistent}_{\text{Rel-Acq}}(A, \mathit{lab}, \mathit{po}, \mathit{rf}, \mathit{mo})$$

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