Exercise 8

Exercise 8.1
Two philosophers sit at a table and think about philosophical problems. In front of each is a bowl of spaghetti. Only two forks are available on the table, and each philosopher needs both forks in order to eat. However, a philosopher cannot take both forks from the table at the same time. He must first take one fork (if available), then take the second one (again, if available). If a philosopher holds both forks, he is eating; he may then become satisfied, in which case he puts down both forks on the table at the same time and starts thinking again. It is assumed that a philosopher can only return both forks together. The desired situations are the ones in which each philosopher is either eating or thinking (i.e., either holding both forks or none).

a) Define an alphabet $\Sigma$ of events for the described system and determine its closed and marked languages ($L$ and $L_m$, respectively).

b) Is the plant model $(\Sigma, L, L_m)$ obtained in a) blocking?

c) Consider the following specification: the two philosophers must eat alternately, i.e., the same philosopher is not allowed to eat twice in a row. Determine a language $L_{\text{spec}}$ that represents this specification. Assuming that the only controllable events are the ones of a philosopher taking a fork from the table, find the least restrictive nonblocking and implementable controller that enforces the specified behavior.

d) Consider now another specification: the second philosopher is not allowed to return the forks to the table at any time. Determine a language $L_{\text{spec}2}$ that represents this specification. Assuming the same controllable events from item c), is the language $\hat{K}_2 = L_{\text{spec}2} \cap L_m$ controllable? Does an implementable controller (with closed language $L_c$) exist such that $L_c \cap L_m = \hat{K}_2$ and $L_c \cap L = \hat{K}_2$?