Exercises werkcollege 6, FMSE

Exercise 1

Consider the following FSP definitions:

```
BUFFER    = (in -> out -> BUFFER).

||SYNC_IN = (a:BUFFER || b:BUFFER)/{in/{a.in,b.in}}.
||SYNC_OUT= (c:BUFFER || d:BUFFER)/{out/{c.out,d.out}}.

||SYSTEM  = ( SYNC_IN/{sync.ac/a.out,sync.bd/b.out}
              ||SYNC_OUT/{sync.ac/c.in,sync.bd/d.in})
             @{in,out}.
```

a) Give a structured graph of the labelled transition system of `SYSTEM`. Label the states with tuples (*i*,*j*,*k*,*l*), where *i*,*j*,*k*,*l* are the respective local states of the processes `a:BUFFER`, `b:BUFFER`, `c:BUFFER` and `d:BUFFER`, who collectively determine the global state of `SYSTEM` (so you can't just copy the the LTSA output).
b) Give a minimal automaton that is observation equivalent to `SYSTEM`. Give a sequential FSP process (i.e. without parallel composition or hiding) that is observation equivalent to `SYSTEM`.

Exercise 2

Complete the MAZE example given in lecture 6 (slide 13). A path out of the maze is called *balanced* if and only if the number of north/south steps differs equals the number of east/west actions in the path. Modify your model such that for each initial square a shortest balanced path out of the maze, if it exists, is produced as a deadlock trace of the model. Determine the squares for which a balanced exit path exists.

Exercise 3

One solution to the dining philosophers problem permits only 4 philosophers to sit down at the table at the same time. Specify a BUTLER process that, when composed with the model presented in lecture 6 (slide 9), permits a maximum of 4 philosophers to be seated concurrently at the table. Show that this system is deadlock-free.

Exercise 4

What action trace violates the following safety property?

```
property PS = (a->(b->PS|a->PS)|b->a->PS).
```

Exercise 5

A lift has a maximum capacity of ten people. In the model of the lift control system, passengers entering a lift are signalled by an `enter` action and passengers leaving the lift are signalled by and `exit` action. Specify a safety property in FSP that when composed with the lift will check that the system never allows the lift to have more than 10 occupants.