

## Exercises werkcollege 4, FMSE

### Exercise 1

Model the elevator for a building with 5 floors, using the actions: up, down, open, en close, where up and down model going up and down one floor.

- Draw the labelled transition system of the elevator.
- Give the traces with length  $\leq 3$ , choosing a suitable initial state.

At a certain day the elevator is slightly defect: the doors will not open on floor 3 if the lift is coming from above.

- Give the labelled transition system of this defect elevator.
- Are the models from (a) and (c) trace equivalent?

### Exercise 2

Draw for the next pairs of FSP processes the corresponding labelled transition systems and check whether they are observation equivalent (we use here directly the tau label; this is not allowed in FSP). Draw the weak bisimulation relations between the states if possible,

- $T1 = (a \rightarrow \tau a \rightarrow C), C = (c \rightarrow C)$ .  
 $T2 = (a \rightarrow C), C = (c \rightarrow C)$ .
- $T1 = (a \rightarrow (b \rightarrow B \mid \tau a \rightarrow C)), B = (b \rightarrow B), C = (c \rightarrow C)$ .  
 $T2 = (a \rightarrow (b \rightarrow B \mid c \rightarrow C)), B = (b \rightarrow B), C = (c \rightarrow C)$ .
- $T1 = (a \rightarrow (b \rightarrow B \mid \tau a \rightarrow C)), B = (b \rightarrow B), C = (c \rightarrow C)$ .  
 $T2 = (a \rightarrow (b \rightarrow B \mid c \rightarrow C) \mid a \rightarrow C), B = (b \rightarrow B), C = (c \rightarrow C)$ .
- $T1 = (a \rightarrow A \mid b \rightarrow B \mid \tau a \rightarrow B), A = (a \rightarrow A), B = (b \rightarrow B)$ .  
 $T2 = (a \rightarrow A \mid \tau a \rightarrow B), A = (a \rightarrow A), B = (b \rightarrow B)$ .
- $T1 = (a \rightarrow A \mid b \rightarrow B \mid \tau a \rightarrow B), A = (a \rightarrow A), B = (b \rightarrow B)$ .  
 $T2 = (a \rightarrow A \mid b \rightarrow \rightarrow B), A = (a \rightarrow A), B = (b \rightarrow B)$ .
- $T1 = (a \rightarrow (b \rightarrow B \mid \tau a \rightarrow B)), B = (b \rightarrow B)$ .  
 $T2 = (a \rightarrow B), B = (b \rightarrow B)$ .

### Exercise 3

Consider the next process definitions:

```
COPY = (get -> copy -> COPY).  
DCOPY = (get -> a.copy -> b.copy -> DCOPY).
```

```
||SYSTEM = (a:COPY || b:COPY) {get/a.get, get/b.get}.
```

Show or refute that SYSTEM is observation equivalent to DCOPY.

#### **Exercise 4**

- a) Adapt the specification of the Alternating Bit system (see slides lecture) such that the medium buffers may duplicate data. Check with LTSA whether the AB-protocol is resistant to this.
- b) Adapt the specification of the Alternating Bit system such that the medium buffers can contain data in two directions. Show the correct functioning of the AB protocol. Until which buffer capacity can you verify this??