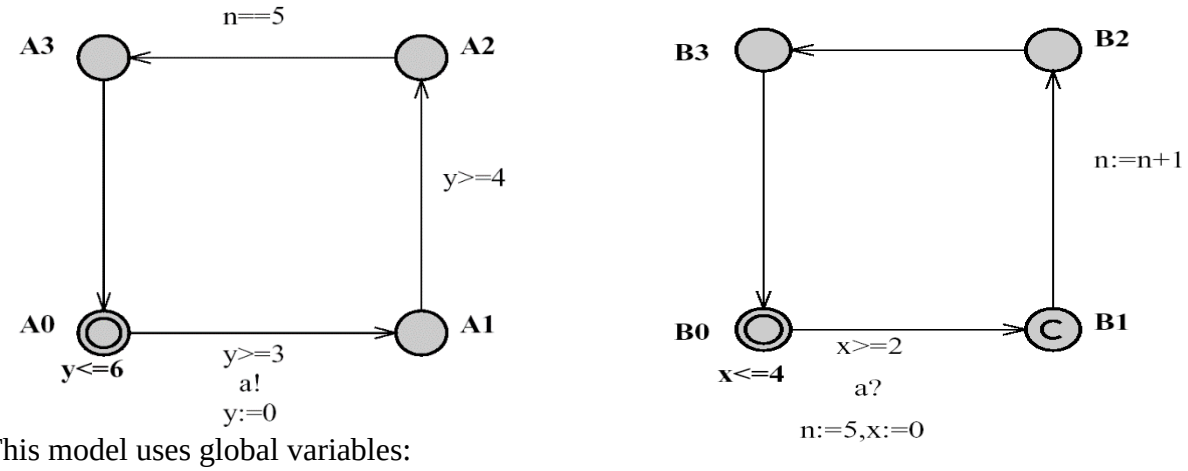
BCS2213 – Formal methods

Teaching assignment 7. Learning UPPAAL. Modelling systems using timed automata.

1. Run UPPAAL Toolbox.

2. Specification and checking properties of timed automata.

2.1. Create new model and draw the automata depicted on Figure below.



This model uses global variables:
clock x, y;
int n;
chan a;

Make screenshots from the model and add them into lab_7_<your_ID>.doc(x) file.

2.2. Specify the property to check the delayed transition.
If none of the invariants of the nodes in the current state are violated, time *may* progress without making a transition. E.g., from $((A_0,B_0),x=0,y=0,n=0)$, time may elapse 3.5 units to $((A_0,B_0),x=3.5,y=3.5,n=0)$, but time cannot be more 4 time units because that would violate the invariant on B_0.

2.3. Specify the property to check the synchronised transition.
If two complementary edges of two different processes are enabled in a state, then they can synchronize; e.g., from $((A_0,B_0),x=0,y=0,n=0)$ the two processes can synchronize to $((A_1,B_1),x=0,y=0,n=5)$.

2.4. Redefine **chan a** as an urgent channel.
Check the property, when two processes can synchronize on an urgent channel, no further delay is allowed. I.e. in the state $((A_0,B_0),x=3,y=3,n=0)$ synchronization on the channel a is enabled and time could not elapse beyond 3.

2.5.Check the property, if one of the components is in a committed node, no delay is allowed and any transition must involve the committed node to continue. E.g., in the state $((A_1,B_1),x=0,y=0,n=5)$, B_1 is committed, so the next state of the automata should be $((A_1,B_2),x=0,y=0,n=6)$.

Add these formulated with temporal logic properties and your comments into lab_7_<your_ID>.doc(x) file.

3. Develop UPPAAL model of simplified Mutual Exclusion Program

```
P0 :: while True do
        while(turn==1); // Wait
             Critical_section;
        turn:=1;
       endwhile
||
P1 :: while True do
        while(turn==0); // Wait
        Critical_section;
        turn:=0;
       endwhile
```

Make one-two screenshots from your model and add them into file lab_7_<your_ID>.doc(x) file.

Formulate with temporal logic a possible property of this model and add it with your comments into lab_7_<your_ID>.doc(x) file.

4. Modify developed simplified UPPAAL model correspondingly to Peterson's Mutual Exclusion Algorithm

```
flag[0]   = 0
flag[1]   = 0
turn      = 0

P0: flag[0] = 1                          P1: flag[1] = 1
    turn = 1                                 turn = 0
    while( flag[1] && turn == 1 );           while( flag[0] && turn == 0 );
            // do nothing                            // do nothing
    // critical section                      // critical section
    ...                                      ...
    // end of critical section               // end of critical section
    flag[0] = 0                              flag[1] = 0
```

Make one-two screenshots from this enhanced model and add them into the file lab_7_<your_ID>.doc(x). Add comments, why this model is better than previous (simplified) one.

5. Upload lab_7_<your_ID>.doc(x) into Kalam for evaluation.