Tik-79.146 Logic in Computer Science: Special Topics I **Spring 2000**
Homework assignment 3
6.4.2000

Deadline 5.5.2000.

The home assignment can be returned at the lecture or to the box by the room TB336.

CTL Model Checking

The aim of this assignment is to specify and model check some properties of a small mutual exclusion algorithm which has been initially modeled using a Pr/T -net. However, the starting point of model checking in this assignment is the reachability graph (possible world model) of the Pr/T -net model which is created with the `PROD` Pr/T -Net reachability analysis tool. Model checking is done using the `probe` checker available in the `PROD` system. All the necessary software has been installed to the computing center HP and Alpha workstations (e.g., the "tree" -series of workstations).

The modeled system is a three process mutual exclusion system using the ticket algorithm. The algorithm has a pair of atomically accessed global variables *next* and *granted*. They are modeled by a token in the place `next_granted`. In model checking you can use atomic propositions of the form `(next_granted >= <.N,G.>)` where `N, G` are integers. For example, a proposition

```
(next_granted >= <.2,1.>)
```

is true in all states in which *next* has value 2 and *granted* has value 1.

The program counters are modeled by 3 tuples in the place `pc` and the tuples are of the form `<.pid, state.>` where $0 \leq$ `pid` ≤ 2 and `state` $\in$ {`rem, enter, test, leave_try, crit, reset, leave_exit`}.

In model checking you can use atomic propositions of the form `(pc >= <.P,S.>)` where `P` is an integer and `S` is a state. For instance, `(pc >= <.2,crit.>)` is true in all states in which process 2 is in the critical section.

The local ticket variables are modeled by 3 tuples in the place `vars`. The tuples are of the form `<.pid, value.>` where $0 \leq$ `pid` ≤ 2 and $0 \leq$ `value` ≤ 3, where 3 is a null value. In model checking you can use atomic propositions of the form `(vars >= <.P,V.>)` where `P, V` are integers. For example, `(vars >= <.0,0.>)` is true in all states in which process 0 has ticket value 0.

The assignment is to specify the following properties in CTL and present the model checking results for the formulas in the initial state of the system (`Node 0`):

1. Any two processes are never at the same time in the critical section.
2. When process 0 gets into the enter section, it will always eventually get to the critical section.
3. The system can from all system states return to a state in which all processes are in the remainder section.
4. Process 1 cannot enter the critical section without visiting the enter state first.
5. Process 0 can from all system states eventually reach the critical section.
6. In all system states if the process 2 is in the critical section then it will always eventually get into the remainder section.

Did any of the properties have unexpected outcomes? Which ones did and why do you think they did?

Please see the course web page for detailed instructions on how to use the model checker. Include in your answer the properties above specified in CTL, and answers to the questions above. Also include output of a CTL model checking session checking all the properties. (You can obtain this, for example, by using the "script" -command.)