

CMPE 436: Assignment 3
Fall 2017 Instructor: Alper Sen
Due Date: midnight, Nov 3, 2017 Demo Date: TBD

Question 1- (25 points)

- a) Give examples of multithreaded Java programs where the Lockset based race detection algorithm finds a potential race and another one where it does not find the data race (examples should be different than the lecture notes).
- b) Repeat above for Happens-before based data race detection algorithm.
- c) Download and install Road Runner tool. <https://github.com/stephenfreund/RoadRunner>
The tool supports various race detection algorithms including the above two. Use Road Runner to verify races/no races you listed in part a and b.

Question 2- (50 points)

The following is a mutual exclusion algorithm for two processes developed by A. Pnueli. The two processes share a boolean variable s which is initially 1, and each process P_i , $i = 1, 2$, has a local variable y_i , which can be read by the other process. The variable y_i is initially 0, variable i contains the process id 0 or 1.

```
l0: loop forever do
  begin
    l1: Noncritical section
    l2:  $(y_i, s) := (1, i)$ ;
    l3: wait until  $(y_{1-i} = 0) \mid (s \neq i)$ ;
    l4: Critical section
    l5:  $y_i := 0$ ;
  end
```

Here, $(y_i, s) := (1, i)$ is a multiple assignment to variables y_i and s taking place atomically. The variable y_{1-i} denotes the local variable of the other process.

- a) Model this algorithm in Promela and formulate the property of mutual exclusion as LTL formula and check it with Promela. Use never claims in Promela.
- b) Check whether Pnueli's protocol ensures absence of unbounded overtaking, i.e., when a process wants to enter its critical section, it eventually will be able to do so. Provide a counterexample (and an explanation thereof) in case this property is violated.
- c) Express in LTL that each process will occupy its critical section infinitely often. Check the property.

SPIN model checker and its documentation is freely available at <http://spinroot.com>. Use the graphical interface jspin or ispin.

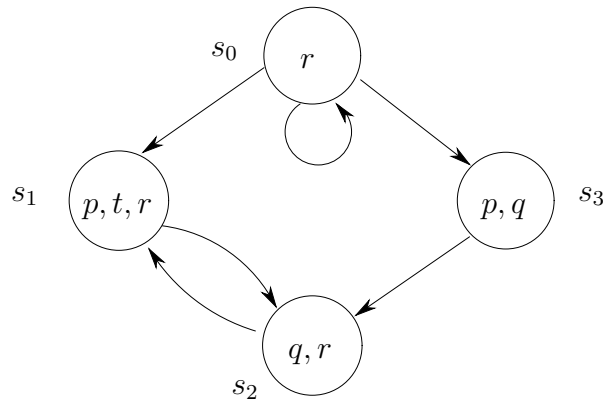
Question 3- (25 points)

Consider the system M represented in the transition system below.

- (a) Beginning from state s_0 , unwind this system into an infinite tree, and draw all computation paths up to length 4 (= the first four layers of that tree).

(b) Determine whether $M, s_0 \models \phi$ and $M, s_2 \models \phi$ hold and justify your answer, where ϕ is the LTL formula:

- (i) $\neg p \rightarrow r$
- (ii) Ft
- (iii) Fq
- (iv) $G(r \vee q)$.



Guidelines:

- 1- Email your assignment solution.
- 2- Add the following to the start of your programs.
 // your name // your student ID // your email address
 // CMPE436-Assignment n - where n is the assignment number (1, 2, ...)
- 3- Add comments to your programs. Program clarity is very important. You get graded on this.
- 4- Also add a README.txt file to explain your programs.
- 5- Demo your homework to the instructor. Bring your laptop.
- 6- DO NOT DISCUSS WITH YOUR CLASSMATES. DO NOT USE SOLUTIONS FROM OTHERS. CHEATING WILL NOT BE TOLERATED.**