Prof. Dr. Rüdiger Ehlers TU Clausthal

Model Checking and Games 2019 – Assignment Sheet 4

Due: Thursday, 5th September 2019, before the lecture

Please indicate your **name** and **email address**. You can work in **groups** of up to **three** students. Only one submission per group is necessary. However, in the tutorials every group member must be able to present the solutions to each problem solved by your group.

Please submit your solutions by e-mail to `ruediger.ehlers@tu-clausthal.de` or hand them in in paper form right before the lecture.

Note that you will need 50% of the points on all exercise sheets in order to take the exam. You may be asked to present your solutions in the tutorial, especially if you work in a group. We aim for asking everyone taking part in the course to present at least once during the block course.

Exercise 1: Model checking – Part 1 (20 pts.)

We want to model check a simple process. Consider the following *pseudocode* for a reactive system reading from the input propositions/bits a and b and writing to the output bit/proposition c:

```
x = FALSE
output c=FALSE
while true:
  if a AND b then
    while true:
      output c=FALSE
  else:
    x = x XOR (a OR b)
    output c=x
```

Model this process as a Kripke structure, **where you remove potential intermediate states in which the `output` statement is not executed.**

Exercise 2: Model checking – Part 2 (30 pts.)

We want to check the following property over a process over the atomic propositions a, b, and c:

> Whenever the value of a is 1 infinitely often, then the value of c should be 0 infinitely often.

Build Büchi automata both for this specification and the complement of the specification!

Exercise 3: Model checking – Part 3 (25 pts.)

Build a product automaton from the Büchi automaton for the complement of the specification (from the previous exercise) and the Kripke structure from the first exercise.

Exercise 4: Model checking – Part 4 (25 pts.)

Use the Double-DFS algorithm from the lecture to check the the product automaton from the previous exercise for language emptiness.