

# Modeling Concurrent and Probabilistic Systems

Summer Term 09

---

## – Series 5 –

Hand in until June 17 before the exercise class.

### Exercise 1

(4 points)

Show that for processes  $P, Q \in Proc$ , the chain of inclusions

$$P \sim Q \implies P \simeq Q \implies P \approx Q$$

between strong bisimilarity, observational congruence and weak bisimilarity are proper. To this aim, give examples for processes  $P, Q \in Proc$  such that

- a)  $P \simeq Q$  and  $P \not\sim Q$ ,
- b)  $P \approx Q$  and  $P \not\simeq Q$ .

### Exercise 2

(4 points)

Use the partitioning algorithm as introduced in the lecture to show that the two specifications of the two place buffer are both weakly bisimilar and observationally congruent!

### Exercise 3

(4 points)

Prove the following characterization of weak bisimilarity in terms of observational congruence:  
For every  $P, Q \in Proc$ ,

$$P \approx Q \iff P \simeq Q \text{ or } P \simeq \tau.Q \text{ or } \tau.P \simeq Q.$$

### Exercise 4

(4 points)

Prove or disprove the following propositions:

- a)  $P \parallel \tau.Q \approx P \parallel Q$ ,
- b)  $P \parallel \tau.Q \simeq P \parallel Q$  and
- c)  $P \parallel \tau.Q \simeq \tau.(P \parallel Q)$ .