

## General Remarks

- Please hand in your solutions in groups of 3. Either hand in your solutions at the beginning of the exercise class or put them into the box at the chair.
- If you have questions regarding the exercises and/or lecture, feel free to write us an email or visit us at our office.

### Exercise 1 (LUB and GLB of Predicate Abstraction):

(3 Points)

Given the set of predicates  $P = \{p_1, \dots, p_4\}$  with

- $p_1 := x > y$
- $p_2 := x > 3$
- $p_3 := y \leq 2$
- $p_4 := x = 2$

Provide the LUB  $\sqcup$  and GLB  $\sqcap$  of the following subsets of  $P$

- $Q_1 = \{p_1\}$  and  $Q_2 = \{p_3\}$
- $Q_1 = \{p_1, p_2\}$  and  $Q_2 = \{p_2, p_4\}$
- $Q_1 = \{p_1, \neg p_2\}$  and  $Q_2 = \{\neg p_3\}$

### Exercise 2 (Predicate Abstraction and CEGAR):

(7 Points)

Consider the following program fragment  $c$ .

```
[y := b]1;  
if [b > 0]2 then [y := y - 1]3;  
if ([y < 0]4) then [skip]5 else [skip]6end;  
else [skip]7end;
```

Show that label 5 is not reachable.

- Give the abstract transition system of  $c$  for the set of predicates  $P = \emptyset$ .
- Provide a spurious counterexample for your initial abstraction from (a).
- Compute the strongest postconditions  $P'$  for your counterexample from (b).
- Execute one abstraction refinement step with the help of your counterexample from (b).
- Is this refinement step sufficing to show that label 5 is not reachable?