SAARLAND UNIVERSITY
COMPUTER SCIENCE

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Development of Safety-Critical Embedded Systems
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Exercise Sheet 6

Please hand in the solutions to the theoretical exercises until the beginning of the next lecture, Fri. 2012-12-21, 10:00. Please write your name, the number of your tutorial group, and/or the date/time slot on the first sheet of your solution.

Exercise 6.1: Life, Death, and In-Between (Points: 8)

Modify the live variables analysis from the lecture to perform a *faint variables analysis*! We call a variable a *faint variable* if it is dead or if it is only used to calculate new values for faint variables.
As an example, consider the program fragment
`x = 23; x = x - 1; x = 42;`
with the assumption that `x` is dead at the end of the fragment. Then `x` will be faint after each of the three assignments, dead after the second and after the third assignment, and live after the first assignment due to the usage in the second assignment. `x` will never be truly (strongly) live in this example.

Formally define the complete lattice for your analysis, the edge effects for all possible edge labels of our toy language, the MOP, and how to construct the set of constraints your analysis has to solve in order to produce safe and sound results.

Exercise 6.2: More On Widening (Bonus Points: 3+3+2+1)

Reconsider the example on slide 149. Compare the result to that of the analysis without widening on slide 141. As you can see, when applying widening, we do not find out that program point 7 is unreachable and derive less precise information for program point 8. Maybe we overdid it with widening? Try applying widening only (!) at program point 1. Furthermore, try applying widening only (!) at program point 2. Compare these results (the two you just produced and the two from the slides). Try to explain the differences in your results/findings! Can we still guarantee termination when applying widening only at selected program points?