Exercise Sheet 9

1 Strongly Live Variables 10 Points

A variable is live at the exit from a label if there is a path from the label to a use of the variable that does not re-define the variable (Slide 31, Program Analysis). This definition, however, also includes variables that are only used in assignment of non-live variables. Such a variable is not live in a more rigorous sense. Define in a formal way a so-called strongly live variables analysis that computes the set of live variables excluding those that are only used for dead variables.

2 MOP versus MFP 3+3+4 Points

There are two solutions to an equation system of a program analysis: the merge over all path (MOP) and maximal fixed point (MFP) (see page 73). In the first solution, the data flow information of all possible paths is merged once at the end of the program and in the latter one, the information is merged as soon as program flow converges.

   a) Which one is more precise? MOP or MFP? Shortly explain your answer.
   a) Under which circumstances are both solutions equal?
   b) Provide an example (i.e. a data flow analysis and a corresponding program), where one is less precise than the other.

3 Code Scheduling 6+4 Points

Carry out the algorithm DDG as presented in the lecture for the basic block example from the lecture (Slide 31, Scheduling) for the instructions 5-9. For each instruction:

   • give all conflicts between instructions checked by the function conflict, no matter if they result in an edge or not Determine conflicting instructions, type of conflict and the ressource.\(^1\)
   • provide the updated sets firstDefs and expUses.

\(^1\) Note that in an instructions of the type \(R_x = \Theta R_x\) for some \(\Theta\), \(R_x\) is used before it is defined.