CS164 Programming Languages and Compilers **Spring 2024**

Discussion Worksheet 11: Register Allocation

1 Liveness Analysis

Before we can compute the register interference graph for a program, we need to run liveness analysis.

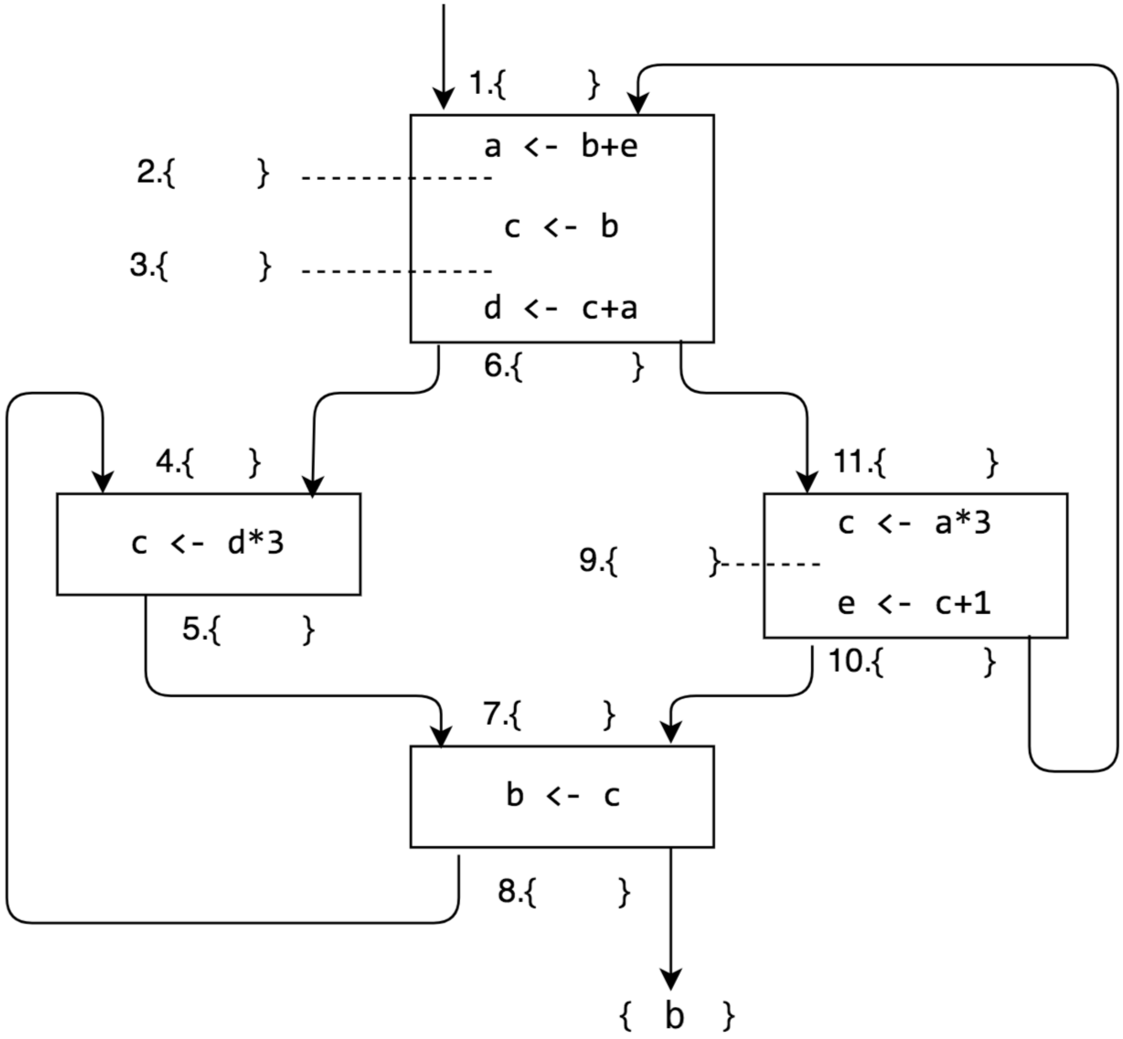
Recall the generalized dataflow transfer functions for liveness analysis. For a given statement s, the variables that are live before ($In(s)$) and after ($Out(s)$) the statement is executed are given by

$$Out(s) = \cup_{s' \in succ(s)} In(s')$$

$$In(s) = Gen(s) \cup (Out(s) - Kill(s))$$

Where $Gen(s)$ is the set of variables that are used before an assignment in s, and $Kill(s)$ is the set of variables that are assigned to in s.

Exercise 1. Run liveness analysis on the following CFG. Assume `b` is live at exit. Here `<-` means `:=`.



2 Register Allocation

Exercise 2 Recall that a Register Interference Graph has as nodes each register in the program, and edges between registers that are live at the same program point.

2.1 Construct a Register Interference Graph (RIG) for the program from Exercise 1.

2.2 We can claim that if the RIG is k-colorable then we only need k registers to store all the variables. Why is this true?

2.3 Color the graph using optimistic coloring with 4 colors. Is this the minimum number of colors we need such that no two nodes of the same color have a connecting edge?

2.4 Suppose we only have 3 registers to allocate, thus we must spill a temporary. Which temporary would you suggest to spill? What are some heuristics you can think of to help decide which temporaries to spill?

2.5 Suppose we chose to spill **b**. Annotate the CFG so that we can store **b** on the stack, and re-compute register allocation.