Consider the program below: it contains the result of a data-flow analysis that solves constant propagation.

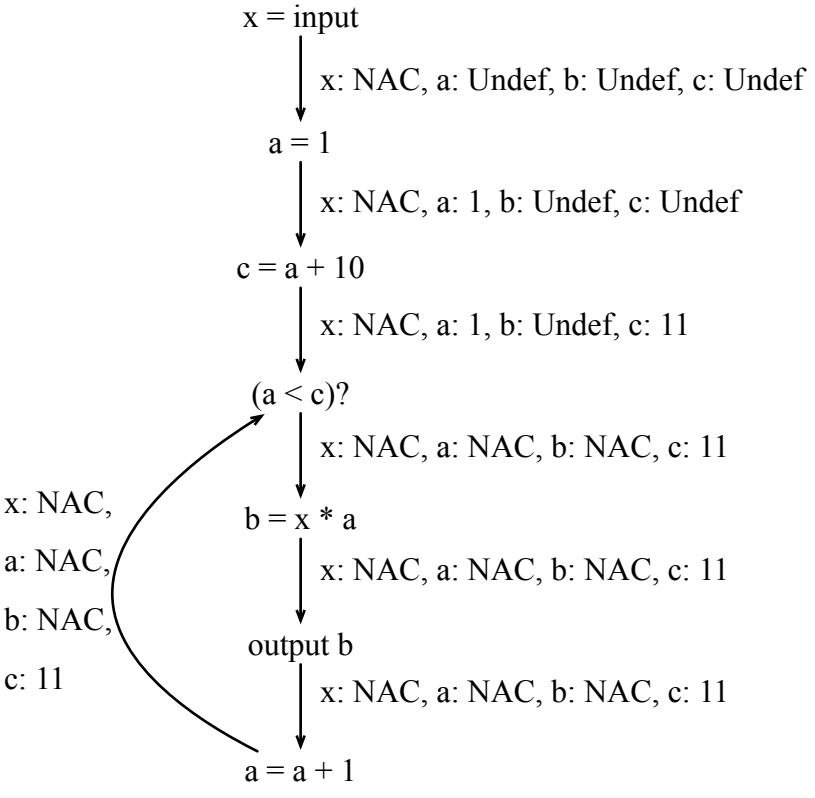

Figure 2: Result of constant propagation on a simple program.

1. What is the computational complexity, in time, to run constant propagation, assuming a program with N instructions? You can assume that the number of variables is proportional to the number of instructions.

2. What is the computational complexity, *in space*, to run constant propagation, assuming the same setting as in question (1)?

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3. Can you come up with a way to run constant propagation in linear-time and space, assuming a program whose control-flow graph is relatively sparse? A sparse CFG is graph whose nodes contain at most a constant number of successors. CFGs produced by programs with while, continue, break and if are sparse.