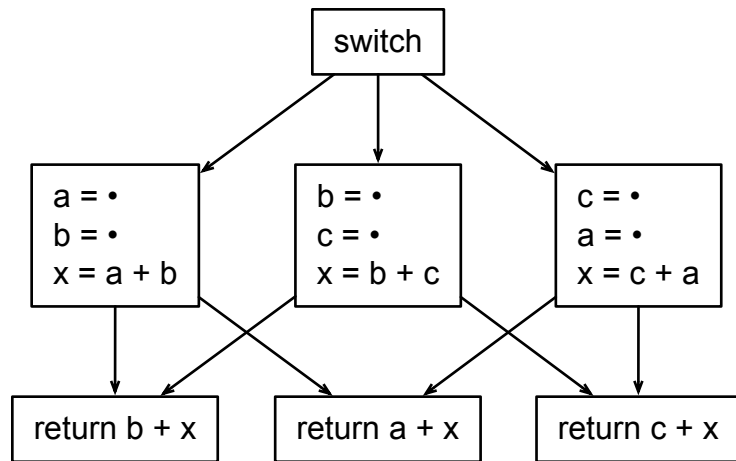Register assigment is a well-known example of an NP-complete problem in compilers. One of the first demonstrations that register allocation is NP-complete was published by Chaitin et al. in 1981. Chaitin reduction used a variety of programs that we shall call "Chaitin-Programs".

Figure 1: A "Chaitin-program"

1. How would you state the register assignment problem as a decision problem?

2. How does a demonstration that a problem is NP-complete work? What would be the basic steps?

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3. In their demonstration, Chaitin et al. showed that if there was a polynomial time solution to *register allocation**, then this solution could be used to solve graph coloring (i.e., is it possible to color this graph with K colors, so that no adjacent nodes get the same color?) in polynomial time. Can you show how that would be possible? Use the program above as an example.

*: nomenclature varies a bit. Chaitin would say "Register allocation", whereas we say "Register assignment". Many people would call register allocation the problem of not only assigning registers, but also doing coalescing and spilling.

To know more: Gregory J. Chaitin, Marc A. Auslander, Ashok K. Chandra, John Cocke, Martin E. Hopkins, Peter W. Markstein: *Register Allocation Via Coloring*. Comput. Lang. 6(1): 47-57 (1981)