

CS 497 (Fall 2007) Assignment: Program Analysis

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1. Consider a programming language with integer variables and the following kinds of instructions:

- $v_1 := v_2 + v_3$
- $v_1 := v_2 - v_3$
- $v_1 := v_2 * v_3$
- $v_1 := v_2 / v_3$
- $v := \textit{integer constant}$
- *label*:
- $\text{if}(v_1 < v_2) \text{ goto } \textit{label}$
- $\text{read}(v)$
- $\text{write}(v)$

Define a dataflow analysis that will determine, at each program point and for each integer variable, whether the values that it may hold may be positive, negative, zero, or some combination of these three. Follow the steps presented in class, on the slide titled “Designing a Dataflow Analysis”. State any assumptions that you make.

2. (a) Is there a program for which your analysis reports that a given variable may be negative, yet the variable never takes on a negative value in any execution of the program? If yes, give an example of such a program.
(b) Is there a program for which your analysis reports that a given variable may not be negative, yet there is some execution of the program in which the variable takes on a negative value? If yes, give an example of such a program and execution trace.