

CSCI 5535: Homework Assignment 6

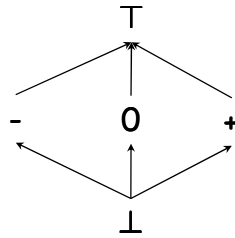
Due Monday, March 9, 2009

Meta-comment: Beginning with this homework assignment, the assignments will have at most 1 or 2 short exercises just to help you test your understanding. For the rest of the semester, your focus should be on the course project.

Exercise 1: Indicate in a sentence or two how much time you spent on this homework, how difficult you found it subjectively, and what you found to be the hardest part. If you would like, tell me something about yourself that I do not already know. Any non-empty answer will receive full credit.

Also, if your opinions have changed since the last assignment, indicate one thing you like about the class so far and one thing you would change about it.

Exercise 2: We consider the abstract interpretation that was set up in class to perform sign analysis on flowchart programs. Let S be the following complete lattice of signs:



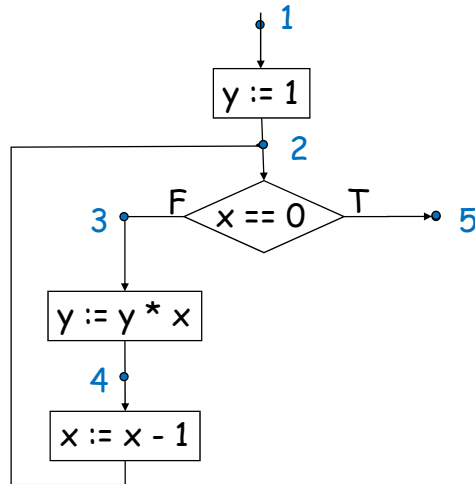
Construct the complete lattice A as mappings from the set of program variables $\{\mathbf{x}, \mathbf{y}\}$ to signs with point-wise ordering. In other words,

$$\begin{aligned} A &\stackrel{\text{def}}{=} \{\mathbf{x}, \mathbf{y}\} \rightarrow S \\ a_1 \sqsubseteq_A a_2 &\text{ iff } a_1(x) \sqsubseteq_S a_2(x) \text{ and } a_1(y) \sqsubseteq_S a_2(y) \\ \perp_A &= \lambda v: \{\mathbf{x}, \mathbf{y}\}. \perp_S \\ \top_A &= \lambda v: \{\mathbf{x}, \mathbf{y}\}. \top_S \end{aligned}$$

For clarity, we subscript operators with the lattice name when appropriate (e.g., \sqsubseteq_A , \perp_S). The sign analysis on a flowchart program with program

variables x, y is then the abstract interpretation that computes an abstract state from the abstract domain A for each program point (i.e., label).

Consider the following flowchart program for computing factorial (from class):



The sign analysis on this program is rather imprecise (i.e., \top appears often in the result).

1. Explain in a few sentences how the analysis is imprecise. You might give an example where at a particular program point, there is a sound abstraction in our abstract domain A that is more precise than what is computed by the sign analysis.
2. Explain in a few sentences how you can improve the analysis result by changing the factorial program but **without** changing the analysis.
3. Explain in a few sentences how you can improve the analysis result by changing the abstract interpretation setup but **without** changing the factorial program given above.