Homework 6
SNU 4541.664A Program Analysis
Spring 2006

Prof. Kwangkeun Yi

due: 5/30 13:00 & 24:00

During this semester, I will give you two homeworks each of which can evolve into your project if you choose so. This homework is one of the two.[1]

Exercise 1 "Interval Abstract Interpreter"

Consider our imperative language C--:

$$
\begin{array}{rcl}
C & \to & \texttt{skip} \\
 & | & x \texttt{ := } E \mid \texttt{*}x \texttt{ := } E \\
 & | & C \texttt{ ; } C \\
 & | & \texttt{if } B\ C\ C \\
 & | & \texttt{while } B\ C \\
E & \to & \texttt{readint} \mid n \quad (n \in \mathbb{Z}) \\
 & | & E \texttt{ + } E \mid \texttt{ - } E \\
 & | & x \mid \texttt{*}x \mid \texttt{\&}x \\
B & \to & E \texttt{ < } E \mid E \texttt{ = } E \mid E \texttt{ \&\& } E
\end{array}
$$

Design and implement an abstract interpreter that analyzes input C-- program P and returns a table that has collected all the *abstract* memories occurring right before executing each command inside P (a table from each command inside P to the set of *abstract* memories that has occurred right before executing the command).

- Analysis goal: to *safely* estimate the range of integer values that each variable can have at each program point.
- Performance goal: we will measure your analysis accuracy for a set of benchmark C-- programs. This benchmark set will not be available to you. However, TAs will provide another set of similar benchmarks beforehand, against which you can test your analyzer while you develop it.

You have to submit two things:

[1] For this homework to become a project, the language will be extended to have at least the dynamic memory allocation.

- the design of your analyzer: the definitions of the concrete and abstract domains, Galois connections, abstract semantic definitions, and, if any, widening and narrowing operators. You don't have to include the correctness proof.
- and the implementation of your analyzer `ai`:

$$\texttt{ai} : \mathrm{PGM}_C \to (\mathrm{PGM}_C \to \hat{Mem})$$

  You must also include a pretty printer of your analysis result.

Submit your design document in class 13:00 5/30 and the implementation via email to TAs 24:00 5/30. □