Approximation are used to build models and information representations to compute properties of programs without actually executing these programs. The challenge is to determine the right level of data/model approximations to answer a specific question about a program’s behavior, i.e., properties of program executions. For this homework, assume the following program/procedure and its control flow graph (CFG):

1. Problem – Reaching Definitions (RD) data flow framework

Give the definition of the RD = (F, InfoRD, ∅) data flow problem for the CFG above. Explicitly specify the set InfoRD. There are 8 basic blocks in the procedure foo. Each basic block is assigned a transfer/propagation function. List each of the 8 functions explicitly. Give the final MFP solution of the RD data flow problem (IN set for each basic block).

2. Problem – Defined Variables (MUST-DEF) data flow framework

Design a data flow framework MUST-DEF = (F, InfoMUST-DEF, ∧) that determines all program variables defined when an execution reaches the entry of a basic block. A variable is “defined” at a basic block if on every path from the (single) entry of the procedure to the entry of the basic block the variable will have a program defined value, i.e., the execution path includes an assignment statement to the variable. This data flow framework can identify variables that are not initialized, i.e., flag variables as potentially
undefined during program execution. Explicitly specify the set $\text{Info}_{\text{MUST-DEF}}$ and the $\land$ operator. There are 8 basic blocks in the procedure foo. Each basic block is assigned a transfer/propagation function. List each of the 8 functions explicitly. Give the final MFP solution of the MUST-DEF data flow problem (IN set for each basic block).

3. Problem – Procedure summary information

a) You want to compute two types of summary information for procedure foo, called the MAY-USE and MAY-DEF sets. MAY-USE(p) / MAY-DEF(p) are the sets of variables that may be read / written during a call of procedure p. Describe in words (no formal definitions are needed) how you would compute these sets. Give the sets MAY-USE(foo) and MAY-DEF(foo).

b) How would your answer change if you had to compute MUST-USE(p) and MUST-DEF(p)?

Homework Questions

All homework related questions should be posted on piazza. Thanks!