COM S 413/513: Homework 3 [written] - Dataflow Analysis

September 7, 2023

Learning Objectives:

In this homework, students will

1. exercise and understand terminologies related to dataflow analysis
2. understand the dataflow problems and data analysis algorithms

Instructions:

1. Total points: 29 pt
2. Early Deadline: Sep 13 (Wed) 11:59PM
3. Deadline: Sep 15 (Fri) 11:59PM
4. How to submit: Create a single PDF with answers and upload it to Canvas.

Question:

(29 pt) Perform dataflow analysis (manually) for an instance of dataflow problem, namely the *reaching definition* problem. Answer the questions below:

```
1 int main() {
2   int b = 2;
3   int a = 10;
4   if (a > 2) {
5     a = 2;
6     b = a + 2;
7   } else {
8     b = a * 4;
9   }
10  a = b - 5;
11  while (a > 0) {
12    a = a - 1;
13  }
14 }
```

1. (3 pt) Construct an CFG for this function
2. (3 pt) List all the *definitions* in the function
3. (3 pt) List all the *uses* in the function
4. (4 pt) What are the dataflow equations for the *reaching definition* problem?
5. (4 pt) Initialize dataflow analysis: use *bitvector* representations to show the definitions at each node of CFG (Out[B]) at the beginning of dataflow analysis.

6. (8 pt) At the program point line 12, which *definitions* reach this *use*? Show the steps of dataflow algorithm and mark the dataflow information at each step.

7. (4 pt) Is *reaching definition* problem a *forward* or *backward* dataflow problem? Why? Is *reaching definition* problem a *may* or *must* problem? Why?