

# Assignment 3: Dataflow Analysis

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## 1 Intro

## **2 Discussion Point 1**

### **2.1 Implementation**

### **2.2 Results**

### **2.3 Analysis Precision**

Question(s): What would be the most precise result? Why does the analysis lose precision on this program?

**TODO: Most precise result**

## **3 Discussion Point 2**

### **3.1 Implementation**

### **3.2 Results**

## 4 Discussion Point 3

### 4.1 Context

**Question:** Which variables would you include in the context for functional loop unrolling?

Since the bases of functional sensitivity is on the abstract state, it would atleast start of with the variable(s) defined in the predicate of the while loop. The more variables added to the context that are defined/used inside of the loop the more precision is gained. Increasing the size of the state to be stored in the context, comes with the drawback that performance might be reduced.

Continuining from the context with atleast variable  $i$ , variable  $x$ , defined in the loop may also be added.

### 4.2 Question 2

**Question:** Write a TIP program where functional loop unrolling improves precision compared to callstring loop unrolling, and explain the difference.

**TODO: Add**

#### 4.2.1 Program

```
1 x = 1;
2 y = input
3
4 while (i > 0) {
5   assert i > 0;
6   if (i % 2 == 0) {
7     x = x + 1;
8   } else {
9     if (x > 0) {
10       assert x > 0;
11       x = x - 1;
12     }
13   }
14 }
```

Listing 1: Example program - functional loop unrolling.

**TODO: Add**

#### 4.2.2 Difference

**TODO: Add**

### 4.3 Finite

**Question:** Does interval analysis with functional loop unrolling terminate for every program? Explain why or why not (give an example).

Applying the practice of loop unrolling to functional sensitivity does not change the fact that for some given

programs the analysis will **not** terminate. An example for sucha program can be seen in Listing 2.

```
1 x = 0;
2
3 // First iteration
4 x = x + 1;
5
6 // While iteration
7 while (true) {
8   x = x + 1;
9 }
```

Listing 2: Example program - functional loop unrolling.

As with functional sensitivity for each abstract state of the program, in this the while loop a new context is generated [1], [2]. Unrolling the first iteration of the loop as displayed in the above program, does not terminate for the given program, since the size of the state (on which functional sensitivity based itself) is not finite in this case. Therefore when considering functional sensitivity, the chosen state is to be considered carefully [1].

## Bibliography

- [1] [Online]. Available: <https://cs.au.dk/~amoeller/spa/7-procedural-analysis.pdf>
- [2] [Online]. Available: <https://dl.acm.org/doi/fullHtml/10.1145/3230624>