COM S 413/513: Homework 4 [written] - Abstract Interpretation

September 14, 2023

Learning Objectives:

In this homework, students will

1. exercise and understand terminologies related to abstract interpretation
2. learn how to construct an abstract intepretation

Instructions:

1. Total points: 19 pt
2. Early Deadline: Sep 20 (Wed) 11:59PM
3. Deadline: Sep 22 (Fri) 11:59PM
4. How to submit: Create a single PDF with answers and upload it to Canvas.

Question:

(19 pt) Construct an abstract interpretation (manually). Given a program that takes two integer inputs x and y. We want to prove that the program always return a non-negative value.

```
1 int func(int x, int y) {
2   int a;
3   if (x < 0) {
4     if (y < 0) {
5       a = x;
6       a = a * y;
7       a = a + 1;
8     } else {
9       a = 2;
10    }
11  } else {
12    a = 2;
13  }
14  return a;
15 }
```

1. (3 pt) Create the abstract domain and explain the mapping between concrete to abstract domains.
2. (8 pt) For the types of statements in the program, construct abstract semantics. You don't need to construct abstract semantics for `if-then-else` statements.
3. (6 pt) Perform computation on the abstract domain using abstract semantics.
4. (2 pt) Is this property hold for all the inputs or violation can occur?