Worksheet – 7 Solution

From lecture given on 1/30/2019

Q1. Identify which of the uses in the four print statements (S1, S2, S3, S4) can be identified as constant via constant propagation, using only reaching definitions analysis.

Q2. Identify any additional constants that you can identify in the print statements using insights beyond the use of reaching definitions.

```
1   x =10;
2   y = 2;
3   if (y > 1) y = 3;
4   print(x);              // S1
5   do {
6       z = 4;
7       x = x-1;
8   } while (x > 0);
9   print(z);              // S2
10  print(y);              // S3
11  print(x);              // S4
```

Q1

- **def1 (x=10)** is the only def of **x** to reach **S1**

→ **x** can be identified as constant, 10, in **S1**
(model uses of unitialized variables by adding a dummy def at start)

- **def4 (z=4)** is the only def of **z** to reach **S2**

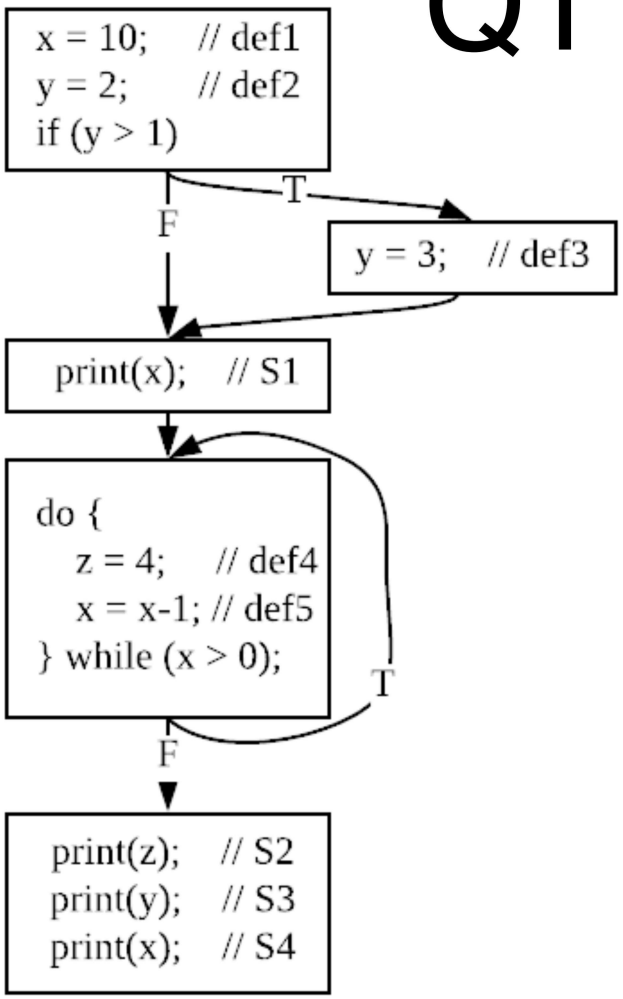
→ **z** can be identified as constant, 4, in **S2**

- Both **def2 (y=2)** and **def3 (y=3)** reach S3

→ we cannot conclude that y is constant in S3 by just using reaching definitions

- **def5** is the only def to reach **S5**, but its rval is not constant.

Uses in S1 & S2 can be identified as constant, using only reaching definitions analysis.



Q2

- **def2** reaches the if-condition expression at line 3.
- By propagating **def2** to **the if-condition**, we can conclude that the if-condition always evaluates to TRUE, thereby ensuring that **def3 (y=3)** is the only def to reach S3
  → **we can conclude that y=3 at S3 by removing unreachable control flow edges**
- Since x starts with a value > 0, and is decremented by 1 in each iteration of the **do-while loop**

→ **we can conclude that x=0 when the loop exits, and that S4 will print x=0**

(This analysis is beyond the scope of the data flow analyses that we will learn in this course)

```
1   x = 10;          // def1
2   y = 2;           // def2
3   if (y > 1) y = 3;  // def3
4   print(x);        // S1
5   do {
6       z = 4;       // def4
7       x = x-1;     // def5
8   } while (x > 0);
9   print(z);        // S2
10  print(y);        // S3
11  print(x);        // S4
```