Exercises

Program Analysis (CO70020)

Sheet 1

**Exercise 1** Give a labelling of the following program and the (intuitive) flow ‘flow’ and the reverse flow ‘flowR’:

```
x := 1;
while y>0 do (  
  if y<=0 then  
    x := x+3  
  else skip  
  x := x-1;  
  z := z+x;
)
x := 2;
```

What “simplifications” could you think of with regard to the guard y > 0? What happens if you generalise your approach to any guard/test predicate p(y) (and not p(y), respectively)?

**Exercise 2** Consider the following While program:

```
x:=1;
if (x>0)
  then x:=x-1
  else y:=y-1
```

Construct the flow formally.

**Exercise 3** Guess the RD solutions for the following three While programs:

```
x := 4;
z := 2;
if y > x then
  x := 3;
else
  x := 4;
z := x;
x := 4;
z := 2;
if y > x then
  x := 3;
else
  x := 4;
z := x;
x := 4;
y := 2;
if y > x then
  x := 3;
else
  x := 5;
z := x;
```

What kind of optimisation could you suggest.
Exercise 4 Construct the RD equations for the following program:

```plaintext
x := 4;
z := 2;
if y > x then
  x := 3;
else
  x := 4;
z := x;
```

Exercise 5 Is there a program such that:

1. \{ (x, 1), (x, 4), (x, 8) \} \subseteq \text{RD}_{\text{entry}}(9), or a program such that:

2. \{ (x, 1), (x, 4), (y, 4) \} \subseteq \text{RD}_{\text{entry}}(9)

Give example(s) or argument(s).