

Practice Problems – Data Flow Analysis

Sample Solution

1.

```

dx=x1-x0
dy=y1-y0
t0=2*dy
d=t0-dx
y=y0
x=x0+1
L1 if not (x<x1) then goto L4
   if d>0 then goto L2
   t4=2*dy
   d = d+t4
   goto L3
L2 y=y+1
   t1=2*dy
   t2=2*dx
   t3=t1-t2
   d=d+t3
L3 x=x+1
   goto L1
L4

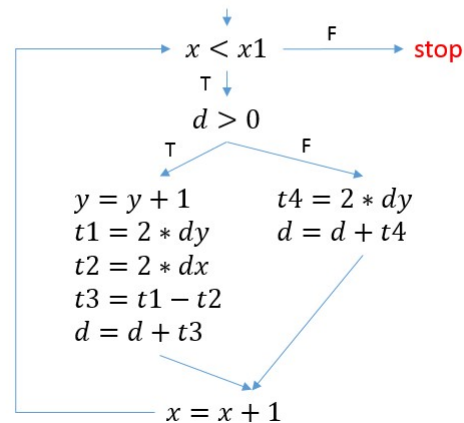
```

Three-address code

```

dx = x1 - x0
dy = y1 - y0
t0 = 2 * dy
d = t0 - dx
y = y0
x = x0 + 1

```



Control-flow graph

2.

```

1 : 1
2 : 1, 2
3 : 1, 2, 3, 4, 5, 6, 9
4 : 1, 2, 3, 4, 5, 6
5 : 1, 3, 4, 5, 6, 9, 11
6 : 1, 3, 4, 5, 6, 9
7 : 3, 4, 5, 6, 7, 9
8 : 3, 4, 6, 7, 8, 9
9 : 1, 2, 3, 5, 6, 9, 11
10: 1, 2, 3, 5, 6, 10, 11
11: 1, 2, 3, 5, 10, 11

```

Reaching Definitions

```

1 : e
2 : a, e
3 : a, b, e
4 : a, b, c, e
5 : a, b, c, d
6 : a, b, c, d
7 : b, d
8 : a, d
9 : a, b, c, d, e
10: a, b, c, e
11: a, b, c, d, e
Live variables

```

```

1 :
2 :
3 : a+b
4 : a+b, c-a
5 : c-a
6 : c-a
7 : b*d
8 : a-d
9 : a+b, c-a
10: a+b, c-a
11: a+b, c-a

```

Available Expressions

```

1 :
2 :
3 : a+b
4 : c-a, a+b
5 : c-a, a+b
6 : c-a
7 : b*d
8 : a-d
9 : b*d, a+b, c-a
10: a+b, e+1, c-a
11: b*d, a+b, e+1, c-a
Very Busy Expressions

```