Software Maintenance SS 19/20, Assignment 1

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GROUP <12>

Assignment			max. points	received points	max. points	received points
Theory	2.2.1	a	2,5		3,5	
		b	1,0			
	2.2.2	a	0,5		1,5	
		b	1,0			
	2.2.3	a	0,5		2,0	
		b	0,75			
		c	0,75			
	2.2.4	a	2,0		3,0	
		b	1,0			
Programming	Static slicer		9,0		10	
	Bug database		1,0			
Total points					20	

1 Theoretical Part

1.1 Static Slicing

(a) i. Slice using table algorithm `(20,{a})`

n	$PRE(n)$	$REF(n)$	$DEF(n)$	$R_{(20,\{a\})}(n)$	$S^0_{(20,\{a\})}(n)$	$INFL(n)$	B	$S^1_{(20,\{a\})}(n)$
2	-	b	a	b	x			x
3	2	a,d	c	a,b				
4	3,7	a,c	-	a,b		6,7	x	x
6	4	a,b	a	a,b	x			x
7	6	a,c	d	a,b				
10	4	a,c	-	a		12		
12	10	a	b	a				
14	10,12	-	-	a		16		
16	14	c	c	a				
19	14,16	a,c	d	a				
20	19	a	-	a				x

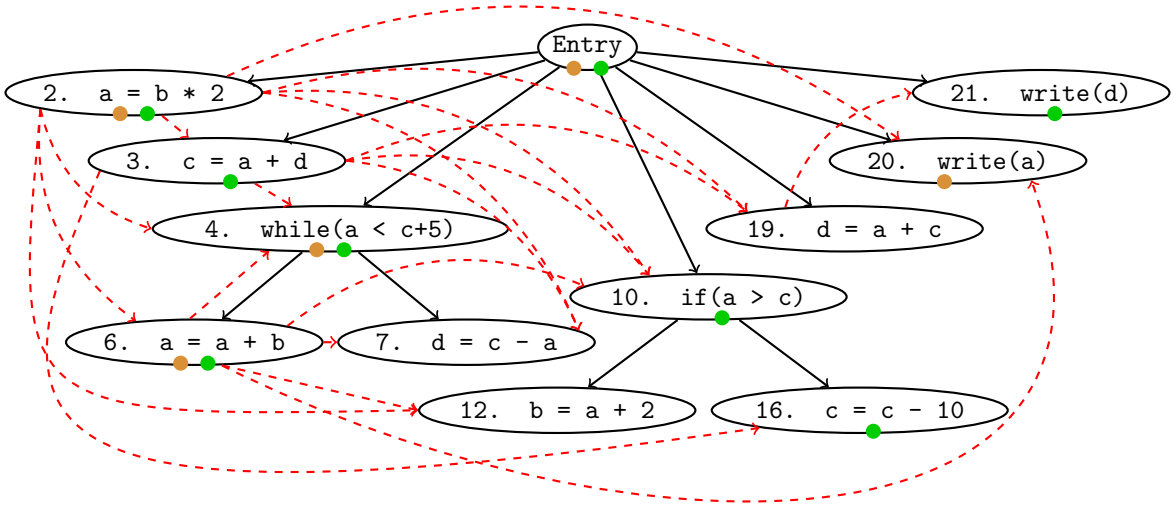
s = {2,4,6,20}

(a) ii. Slice using table algorithm `(21,{d})`

n	$PRE(n)$	$REF(n)$	$DEF(n)$	$R_{(21,\{d\})}(n)$	$S^0_{(21,\{d\})}(n)$	$INFL(n)$	B	$S^1_{(21,\{d\})}(n)$
2	-	b	a	b,d	x			x
3	2	a,d	c	a,d	x			x
4	3,7	a,c	-	a,c		6,7		x
6	4	a,b	a	a,c	x			x
7	6	a,c	d	a,c				
10	4	a,c	-	a,c		12		
12	10	a	b	a,c				
14	10,12	-	-	a,c		16		x
16	14	c	c	a,c	x			x
19	14,16	a,c	d	a,c	x			x
20	19	a	-	d				
21	20	d	-	d				x

s = {2,3,4,6,14,16,19,21}

(b) Slice using Program Dependence Graph

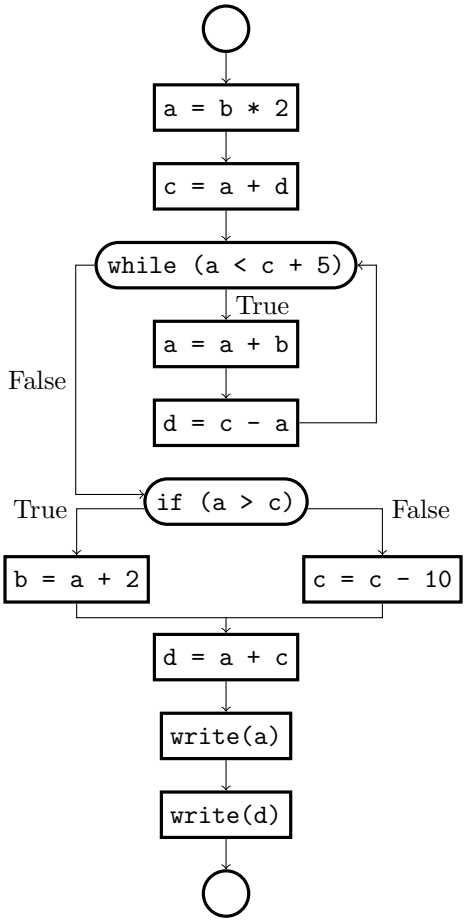


i. (20, {a}) s = {2,4,6,20}

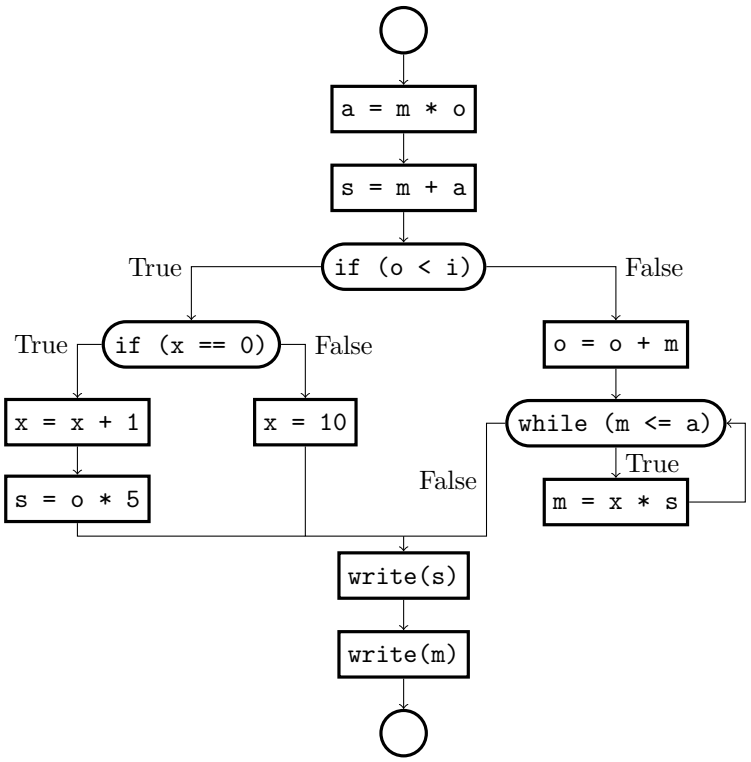
ii. (21, {d}) s = {2,3,4,6,10,14,16,19,21}

1.2 Control Flow Graph

(a)



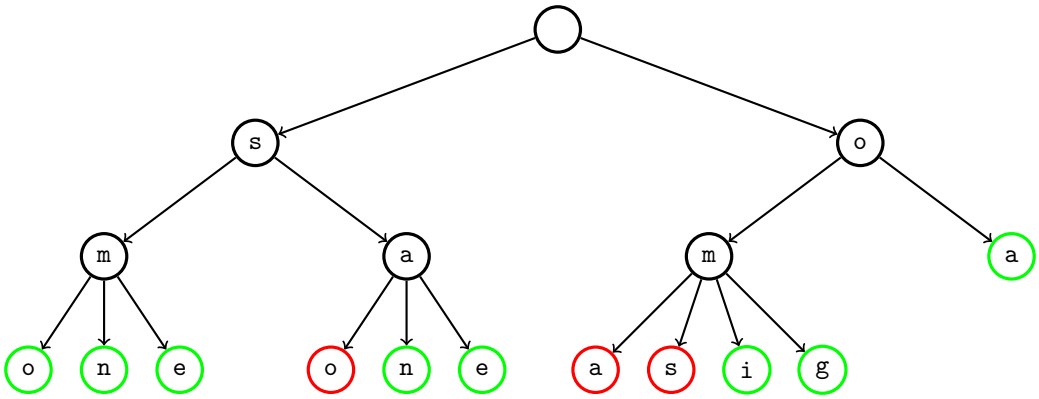
(b)


a = m * o
s = m + a
if (o < i)
True
False
if (x == 0)
True
False
o = o + m
x = x + 1
x = 10
while (m <= a)
True
False
s = o * 5
m = x * s
write(s)
write(m)

1.3 Minimal Hitting Sets

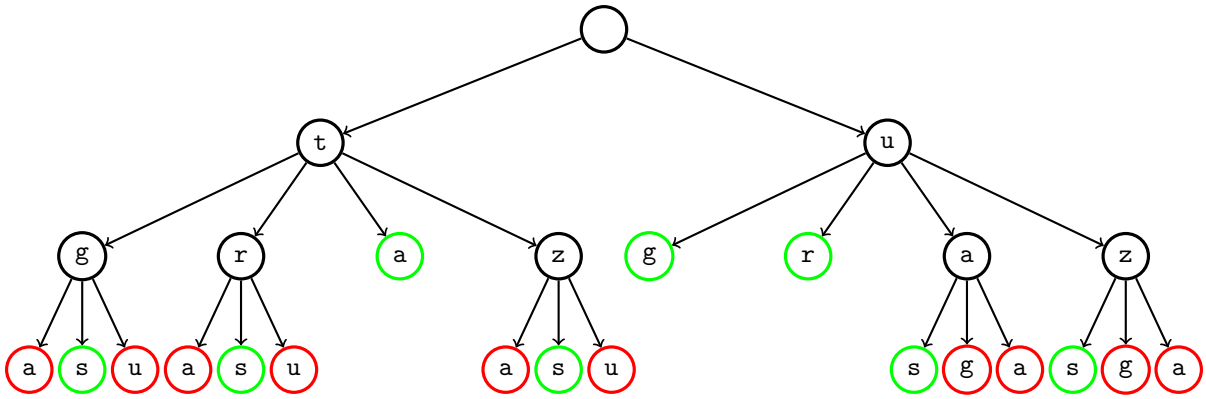
Discarded sets: red, Minimal hitting sets: green

(a) {s,o},{m,a},{a,s,i,g},{o,n,e}



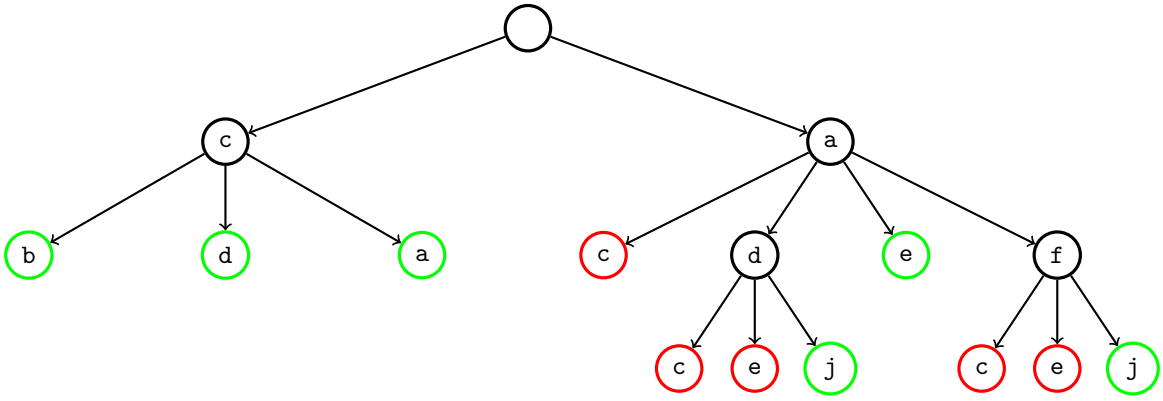
Minimal hitting sets: {o,a},{s,m,o},{s,m,n},{s,m,e},{s,a,n},{s,a,e},{o,m,i},{o,m,g}

(b) {t,u},{g,r,a,z},{a,s,u},{s,g,a}



Minimal hitting sets: {t,a},{u,g},{u,r},{t,g,s},{t,r,s},{t,z,s},{u,a,s},{u,z,s}

(c) {c,a},{b,d,a},{c,d,e,f},{c,e,j}



Minimal hitting sets: {c,b},{c,d},{c,a},{a,e},{a,d,j},{a,f,j}

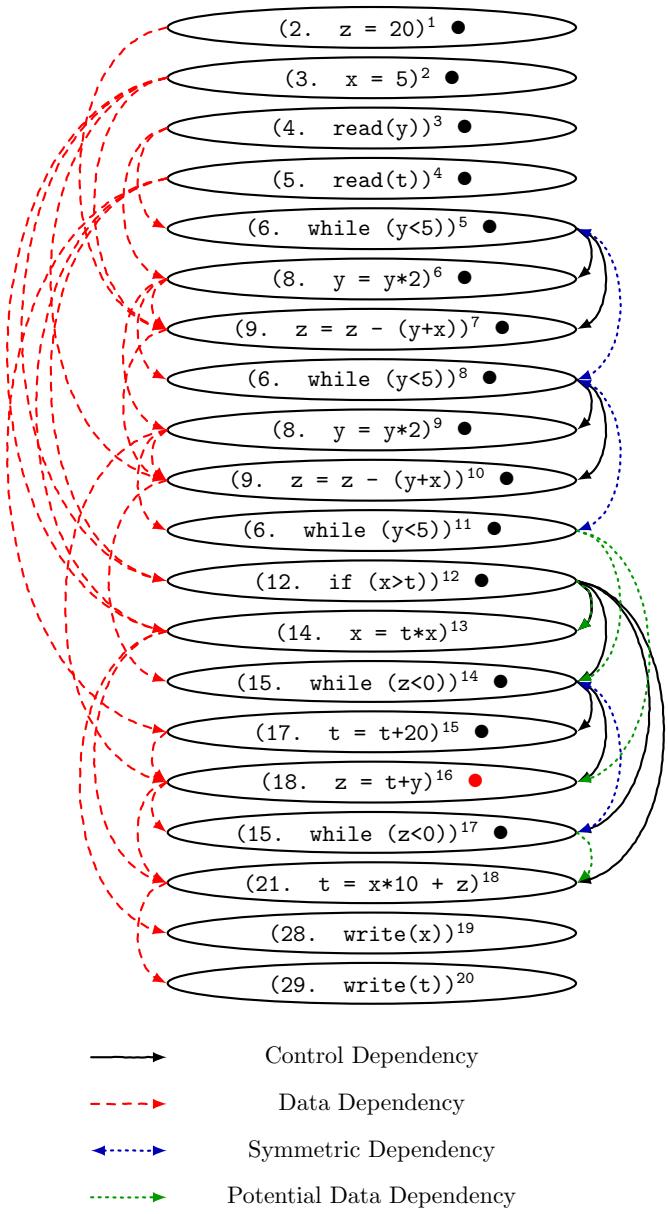
1.4 Dynamic Slicing

Slicing criterion: `({y=2,t=1}, 29`^{20}`, {z})`

(2. `z = 20)`^{1},
(3. `x = 5)`^{2},
(4. `read(y))`^{3},
(5. `read(t))`^{4},
(6. `while (y<5))`^{5},
(8. `y = y*2)`^{6},
(9. `z = z - (y+x))`^{7},
(6. `while (y<5))`^{8},
(8. `y = y*2)`^{9},
(9. `z = z - (y+x))`^{10},
(6. `while (y<5))`^{11}, *PR(6,F)* = $\{y,z\}$
(12. `if (x>t))`^{12}, *PR(12,T)* = $\{x\}$
(14. `x = t*x)`^{13},
(15. `while (z<0))`^{14},
(17. `t = t+20)`^{15},
(18. `z = t+y)`^{16},
(15. `while (z<0))`^{17}, *PR(15,F)* = $\{t,z\}$
(21. `t = x*10 + z)`^{18},
(28. `write(x))`^{19},
(29. `write(t))`^{20},

Extended Execution Trace with Potentially Relevant Variables (PR)

Initial statement marked with red dot, rest of slice with black dot.



Extended Execution Trace Graph with Slice marked

Note: Dynamic (Terminal) and Relevant Slice are the same in this example

Extended Execution Trace	Potential Relations	Data Dependencies	Control Dependencies	Symmetric Dependencies	Potential Dependencies	Terminal Slice	Relevant Slice
2^{1} `z = 20`						x	x
3^{2} `x = 5`						x	x
4^{3} `read(y)`						x	x
5^{4} `read(t)`						x	x
6^{5} `while(y<5)`						x	x
8^{6} `y = y*2`						x	x
9^{7} `z = z-(y+x)`						x	x
6^{8} `while(y<5)`						x	x
8^{9} `y = y*2`						x	x
9^{10} `z = z-(y+x)`						x	x
6^{11} `while(y<5)`	PR(6,F) = {y,z}					x	x
12^{12} `if (x>t)`	PR(12,T) = {x}					x	x
14^{13} `x = t*x`							
15^{14} `while(z<0)`						x	x
17^{15} `t = t+20`						x	x
18^{16} `z = t+y`						x	x
15^{17} `while(z<0)`	PR(15,F) = {t,z}					x	x
21^{18} `t = x*10+z`							
28^{19} `write(x)`							
29^{20} `write(t)`							

Dynamic (Terminal) and Relevant Slice

```
1   begin
2     z = 20;
3     x = 5;
4     read( y );
5     read( t );
6     while( y < 5 ) do
7       begin
8         y = y * 2;
9         z = z - (y + x);
10      end;
11    od;
12    if( x < t ) then
13      begin
14        while( z < 0 ) do
15          begin
16            t = t + 20;
17            z = t + y;
18          end;
19        od;
20      end;
21    fi;
22  end
```

Example reduced to Slice

2 Practical Part

Repo: `https://git-students.ist.tugraz.at/soma20/group-12`
Slicer Project (for IntelliJ IDEA): `submission1/Slicer`
Executable File: `submission1/Slicer/staticslicer_12.jar`
Built using `openjdk version "1.8.0_242"`