Dataflow Analysis

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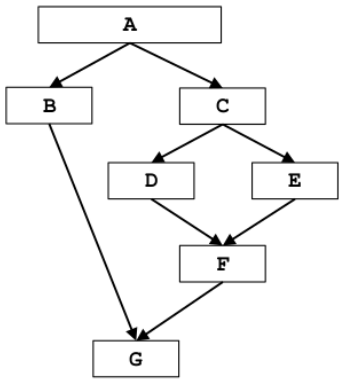
Dominator Analysis

Example 1

Table 1: $Gen_b = \{b\}$, $Kill_b = \emptyset$

	Dominator Analysis
Domain	Basic Blocks
Direction	Forward
Framework	$out[b] = f_b(in[b])$ $in[b] = \cap\ out[pred(b)]$
Transfer function	$f_b(x) = Gen_b \cup (x\text{-}kill_b)$
Meet operation	$\cap$
Boundary Condition	in[entry] = entry
Initial interior points	out[b] = U

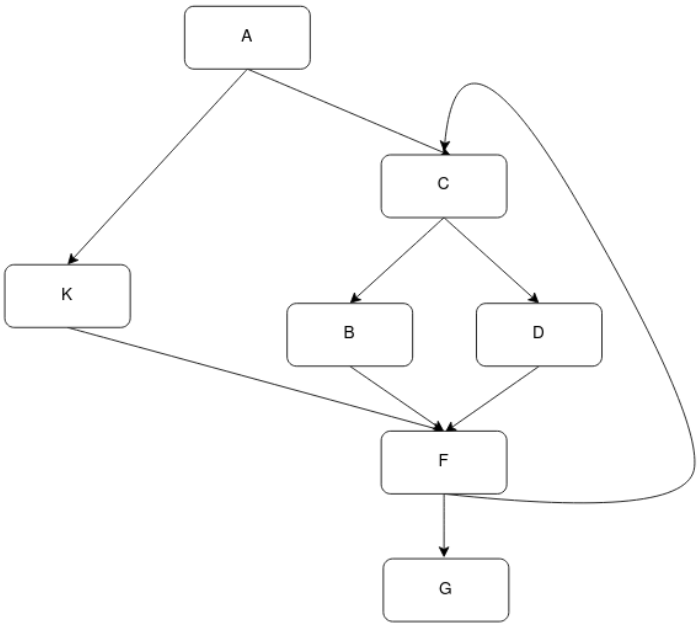


Iter 1[1]

	In	Out
A	<0000000>	<1000000>
B	<1000000>	<1100000>
C	<1000000>	<1010000>
D	<1010000>	<1011000>
E	<1010000>	<1010100>
F	<1010000>	<1010010>
G	<1000000>	<1000001>

[1] initialization is not considered as an iteration.

Example 2



Iteration 1 [2]

	In	Out
A	{∅}	{A}
C	{A}	{C,A}
B	{C,A}	{C,A,B}
D	{C,A}	{C,A,D}
F	{A}	{F,A}
G	{F,A}	{F,A,G}
K	{A}	{A,K}

[2] initialization is not considered as an iteration.

Very busy expression analysis

Example 1

In this example, we assume that each BB contains just 1 expression, as showed in the graph.

	Very busy expression
Domain	Expressions
Direction	Backwards
Framework	$in[b] = f_b(out[b])$
	$out[b] = \cap\ in[succ[(b)]$
Direction	Backwards
Transfer function	$f_b(x) = Gen_b \cup (x\text{-}Kill_b)$
Meet Operation	$\cap$
Boundary condition	$in[exit] = \emptyset$
Initial interior points	$in[b] = U$

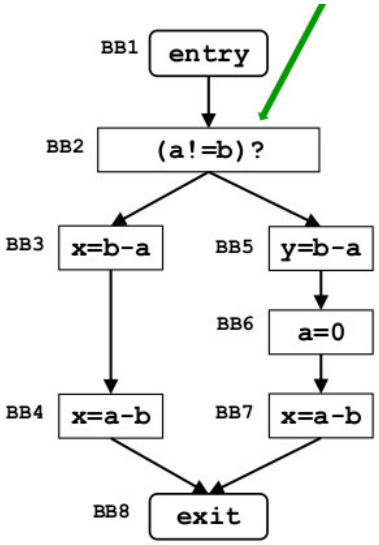


Figure 1: Gen_b = expressions evaluated in b before the definition of one of their operands, $Kill_b$ = every expression that contains a operand that is defined in b

Iteration 1 [3]

Expressions:

1. a!=b
2. b-a
3. a-b

BB	OUT	IN
8	000	000
7	000	001
4	000	001
6	001	000[4]
5	000	010
3	001	011
2	010	110
1	110	110

[3] initialization is not considered as an iteration.

[4] a-b gets killed

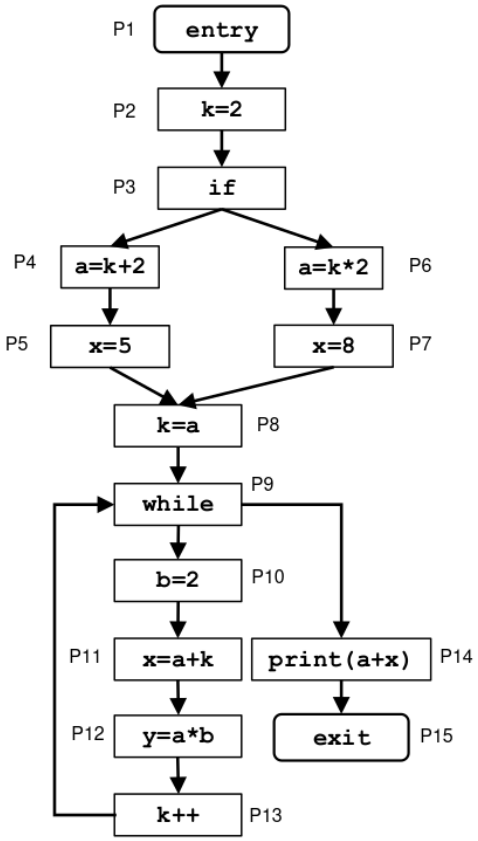
Costant propagation analysis

Example 1

In this example, we assume that each BB contains only 1 expression, as showed in the graph.

Table 2: Gen_b = (lhs, c) if operand is costant for each operand in rhs, $Kill_b$ = (lhs, *)

	Constant Propagation
Domain	couples (val, costant)
Direction	Forward
Framework	out[b] = f_b(in[b])
	in[b] = $\cap$ out[pred(b)]
Transfer function	$f_b(x) = Gen_b \cup (x\text{-}kill_b)$
Meet operation	$\cap$
Boundary Condition	in[entry] = $\emptyset$
Initial interior points	out[b] = U



Iteration 1 [5]

Point	IN	OUT
P1	∅	∅
P2	∅	(k:2)
P3	(k:2)	(k:2)
P4	(k:2)	(k:2),(a:4)
P5	(k:2),(a:4)	(k:2),(a:4),(x:5)
P6	(k:2)	(k:2),(a:4)
P7	(k:2),(a:4)	(k:2),(a:4),(x:8)
P8	(k:2),(a:4)	(k:4),(a:4)
P9	(k:4),(a:4)	(k:4),(a:4)
P10	(k:4),(a:4)	(k:4),(a:4),(b:2)
P11	(k:4),(a:4),(b:2)	(k:4),(a:4),(b:2),(x:8)
P12	(k:4),(a:4),(b:2),(x:8)	(k:4),(a:4),(b:2),(x:8),(y:8)
P13	(k:4),(a:4),(b:2),(x:8), (y:8)	~~(k:4)~~ **(k:5),(a:4),(b:2),(x:8),(y:8)**
P14	(k:4),(a:4)	(k:4),(a:4)
P15	(k:4),(a:4)	(k:4),(a:4)

Iteration 2

Point	IN	OUT
P1	∅	∅
P2	∅	(k:2)
P3	(k:2)	(k:2)
P4	(k:2)	(k:2),(a:4)
P5	(k:2),(a:4)	(k:2),(a:4),(x:5)
P6	(k:2)	(k:2),(a:4)
P7	(k:2),(a:4)	(k:2),(a:4),(x:8)
P8	(k:2),(a:4)	(k:4),(a:4)
P9	**(a:4)**	(a:4)
P10	(a:4)	(a:4),(b:2)
P11	(a:4),(b:2)	(a:4),(b:2)
P12	(a:4),(b:2)	(a:4),(b:2),(y:8)
P13	(a:4),(b:2),(y:8)	(a:4),(b:2),(y:8)
P14	(a:4)	(a:4)
P15	(a:4)	(a:4)

[5] a → 10000, b → 01000, k → 00100, x → 00010, y → 00001, initialization is not considered as a iteration.