

Dataflow Analysis

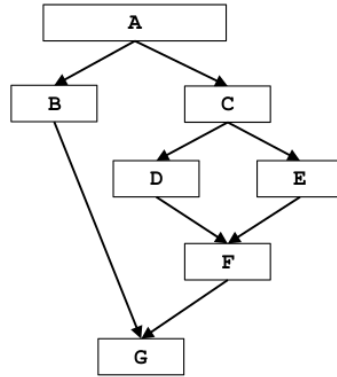
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Dominator Analysis

Example 1

Table 1: $\text{Gen}_b = \{b\}$, $\text{Kill}_b = \emptyset$

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

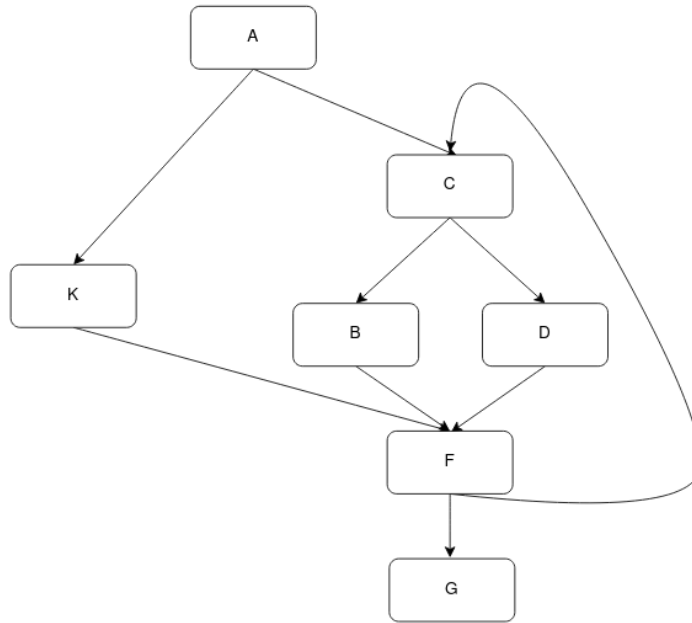


Iter 1¹

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

¹initialization is not considered as an iteration.

Example 2



Iteration 1 ²

	In	Out
A	$\{\emptyset\}$	$\{A\}$
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	$\{A\}$	$\{A,K\}$

²initialization 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	$\text{in}[b] = f_b(\text{out}[b])$ $\text{out}[b] = \cap \text{in}[\text{succ}[(b)]$
Direction	Backwards
Transfer function	$f_b(x) = \text{Gen}_b \cup (x - \text{Kill}_b)$
Meet Operation	\cap
Boundary condition	$\text{in}[\text{exit}] = \emptyset$
Initial interior points	$\text{in}[b] = U$

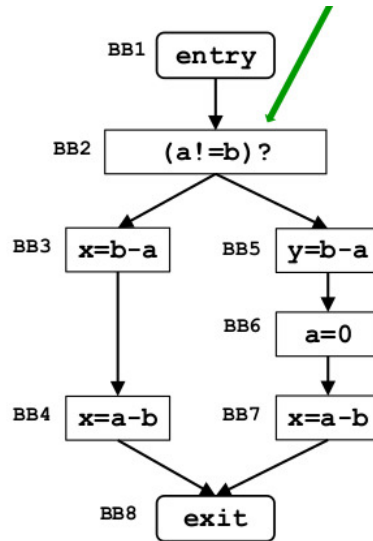


Figure 1: Gen_b = expressions evaluated in b , Kill_b = every expression that contains a operand that is defined in b

Iteration 1 ³

Expressions:

1. $a \neq b$
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

³initialization is not considered as an iteration.

⁴ $a - b$ gets killed

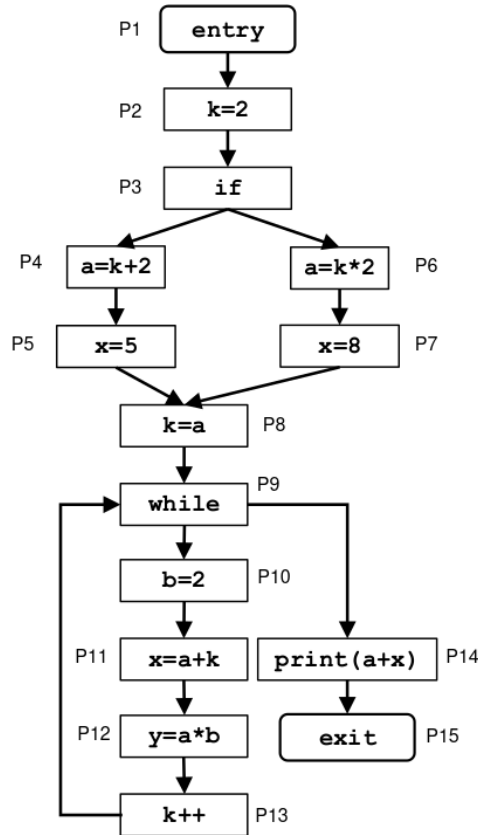
Costant propagation analysis

Example 1

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

Table 2: $\text{Gen}_b = (\text{lhs}, c)$ if operand is costant for each operand in rhs, $\text{Kill}_b = (\text{lhs}, *)$

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



Iteration 1 ⁵

Point	IN	OUT
P1	\emptyset	\emptyset
P2	\emptyset	(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	\emptyset	\emptyset
P2	\emptyset	(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)

⁵a \rightarrow 10000, b \rightarrow 01000, k \rightarrow 00100, x \rightarrow 00010, y \rightarrow 00001, initialization is not considered as a iteration.