

Dataflow Analysis

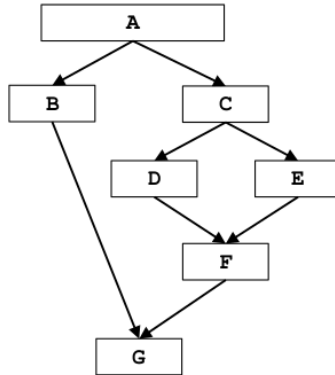
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Dominator Analysis

Example 1

Table 1: $\text{Gen}_b = \{b\}$, $\text{Kill}_b = \text{successors}(b)$

	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	$\text{in}[\text{entry}] = \emptyset$
Initial interior points	$\text{out}[b] = U$

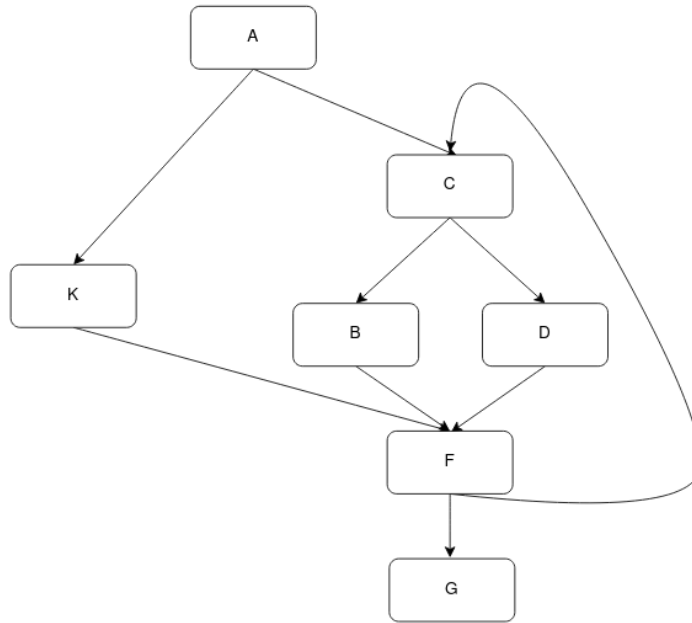


Iter 1¹

	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	$\{C, A\}$	$\{F, A\}$ ³
G	$\{F, A\}$	$\{F, A, G\}$
K	$\{A\}$	$\{A, K\}$

²initialization is not considered as an iteration.

³C gets killed

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	$\text{in}[b] = U$

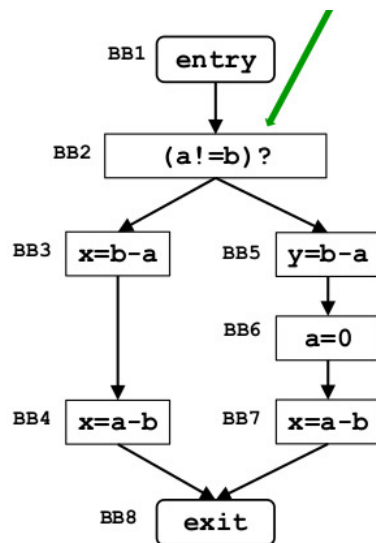


Figure 1: Gen_b = expressions evaluated in b , Kill_b = every expression that contains a operand that is defined in b

Iteration 1 ⁴

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 ⁵
5	000	010
3	001	011
2	010	110
1	110	110

⁴initialization is not considered as an iteration.

⁵ $a - b$ gets killed

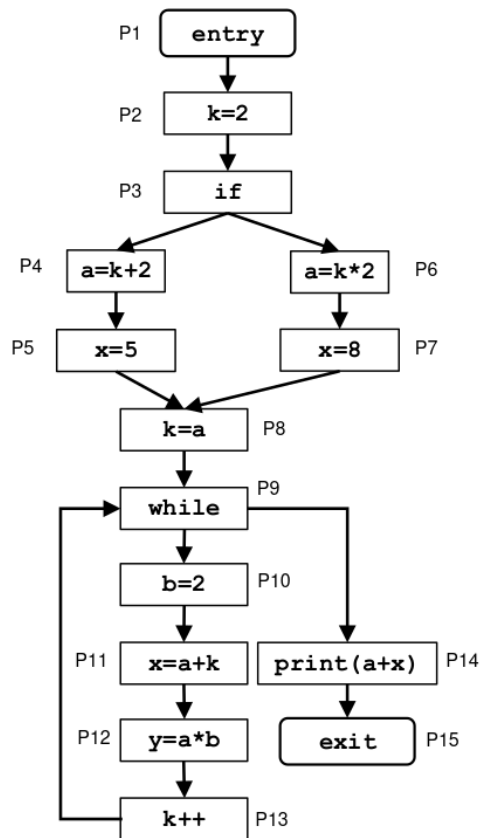
Costant propagation analysis

Example 1

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

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

	Dominator Analysis
Domain	Variables
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	$\text{out}[b] = U$



We assume that values are stored in a symbol table (hash map).

Iteration 1 ⁶

Point	IN	OUT
P1	00000	00000
P2	00000	00100 {k:2}
P3	00100 {k:2}	00100 {k:2}
P4	00100 {k:2}	10100 {k:2, a:4}
P5	10100 {k:2, a:4}	10110 {k:2, a:4, x:5}
P6	00100 {k:2}	10100 {k:2, a:4}
P7	10100 {k:2, a:4}	10110 {k:2, a:4, x:8}
P8	10100 {k:2, a:4}	10100 {k:4, a:4}
P9	10100 {k:4, a:4}	10100 {k:4, a:4}
P10	10100 {k:4, a:4}	11100 {k:4, a:4, b:2}
P11	11100 {k:4, a:4, b:2}	11110 {k:4, a:4, b:2, x:8}
P12	11110 {k:4, a:4, b:2, x:8}	11111 {k:4, a:4, b:2, x:8, y:8}
P13	11111 {k:4, a:4, b:2, x:8, y:8}	11111 {k:5, a:4, b:2, x:8, y:8}
P14	10100 {k:4, a:4}	10100 {k:4, a:4}
P15	10100 {k:4, a:4}	10100 {k:4, a:4}

Iteration 2

Point	IN	OUT
P1	00000	00000
P2	00000	00100 {k:2}
P3	00100 {{k:2}}	00100 {k:2}
P4	00100 {k:2}	10100 {k:2, a:4}
P5	10100 {k:2, a:4}	10110 {k:2, a:4, x:5}
P6	00100 {k:2}	10100 {k:2, a:4}
P7	10100 {k:2, a:4}	10110 {k:2, a:4, x:8}
P8	10100 {k:2, a:4}	10100 {k:4, a:4}
P9	10000 {a:4}	10000 {a:4}
P10	10000 {a:4}	11000 {a:4, b:2}
P11	11000 {a:4, b:2}	11000 {a:4, b:2}
P12	11000 {a:4, b:2}	11001 {a:4, b:2, y:8}
P13	11001 {a:4, b:2, y:8}	11001 {a:4, b:2, y:8}
P14	10000 {a:4}	10000 {a:4}
P15	10000 {a:4}	10000 {a:4}

⁶a → 10000, b → 01000, k → 00100, x → 00010, y → 00001, initialization is not considered as a iteration.