Assignment 2 – Alessandro Franceschini

	Dataflow Problem 1
Domain	All expressions
Direction	Backward $IN[B] = f_B(OUT[B])$ $OUT[B] = \bigcap_{s \in Succ(B)} IN[s]$
Transfer function	$f_B(x) = (x - kill_B) \cup gen_B$
Meet Operation	Intersection (∩)
Boundary Condition	$IN[EXIT] = \emptyset$
Initial interior points	$IN[B_i] = U$ (universal set)

	ITERAZIONE 1		ITERAZIONE 2		ITERAZIONE 3	
	IN[B]	OUT[B]	IN[B]	OUT[B]	IN[B]	OUT[B]
BB1	{a-b, b-a}	{a-b, b-a}	{a-b, b-a}	{a-b, b-a}	{a-b, b-a}	{a-b, b-a}
BB2	{a-b, b-a}	{a-b, b-a}	{a-b, b-a}	{a-b, b-a}	{a-b, b-a}	{b-a}
BB3	{a-b, b-a}	{a-b, b-a}	{a-b, b-a}	{a-b}	{a-b, b-a}	{a-b}
BB4	{a-b, b-a}	∅	{a-b}	∅	{a-b}	∅
BB5	{a-b, b-a}	{a-b, b-a}	{a-b, b-a}	{b-a}	{b-a}	∅
BB6	{a-b, b-a}	{a-b, b-a}	{b-a}	{a-b}	∅	{a-b}
BB7	{a-b, b-a}	∅	{a-b}	∅	{a-b}	∅
BB8	∅	∅	∅	∅	∅	∅

	ITERAZIONE 4	
	IN[B]	OUT[B]
BB1	{a-b, b-a}	{b-a}
BB2	{b-a}	{b-a}
BB3	{a-b, b-a}	{a-b}
BB4	{a-b}	∅
BB5	{b-a}	∅
BB6	∅	{a-b}
BB7	{a-b}	∅
BB8	∅	∅

	Dataflow Problem 2
Domain	All subsets of nodes
Direction	Forward $OUT[B] = f_B(IN[B]) \cup \{B\}$ $IN[B] = \bigcap_{p \in Pred(B)} OUT[p]$
Transfer function	$f_B(x) = IN[x]$
Meet Operation	Intersection (∩)
Boundary Condition	IN[START] = ∅ OUT[START] = {START}
Initial interior points	OUT$[B_i] = U$ (universal set)

	ITERAZIONE 1		ITERAZIONE 2		ITERAZIONE 3		ITERAZIONE 4	
	IN[X]	OUT[X]	IN[X]	OUT[X]	IN[X]	OUT[X]	IN[X]	OUT[X]
A	∅	{A}	∅	{A}	∅	{A}	∅	{A}
B	{A}	{A,B,C,D,E,F,G}	{A}	{A,B}	{A}	{A,B}	{A}	{A,B}
C	{A}	{A,B,C,D,E,F,G}	{A}	{A,C}	{A}	{A,C}	{A}	{A,C}
D	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,C}	{A,C,D}	{A,C}	{A,C,D}
E	{A,B,C,D,E,F,G	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,C}	{A,C,E}	{A,C}	{A,C,E}
F	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,C}	{A,C,F}
G	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,B,C,D,E,F,G}	{A,B}	{A,B,G}	{A,B}	{A,B,G}

	ITERAZIONE 5	
	IN[X]	OUT[X]
A	∅	{A}
B	{A}	{A,B}
C	{A}	{A,C}
D	{A,C}	{A,C,D}
E	{A,C}	{A,C,E}
F	{A,C}	{A,C,F}
G	{A}	{A,G}

	Dataflow Problem 3
Domain	All possible pairs (x,c)
Direction	Forward $OUT[B] = f_B(IN[B])$ $IN[B] = \bigcap_{p \in Pred(B)} OUT[p]$
Transfer function	$f_B(IN[B]) = (IN[B] - \{(x, \_)\}) \cup gen_B$ Where: $gen_B = \begin{cases} \{(x,k)\}, if\ B: x = k\ (k\ is\ a\ constant) \\ \{(x, val(y)\}, if\ B: x = y\ (y\ is\ a\ variable\ with\ constant\ value) \\ \emptyset, if\ B: x = y\ op\ z\ and\ either\ val(x)\ or\ val(y)\ are\ not\ constants \end{cases}$
Meet Operation	Intersection (∩)
Boundary Condition	OUT[START] = ∅
Initial interior points	OUT[B_i] = U (universal set)

U = {(k,2), (a,4), (x,5), (x,8), (k,4), (b,2), (x,6), (y,8), (k,3), (k,5)}

	ITERAZIONE 1		ITERAZIONE 2		ITERAZIONE 3	
	IN[B]	OUT[B]	IN[B]	OUT[B]	IN[B]	OUT[B]
entry	∅	∅	∅	∅	∅	∅
k = 2	∅	U	∅	{(k,2), (a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	∅	{(k,2)}
if	U	U	{(k,2), (a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	U	{(k,2)}	{(k,2), (a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}
a = k + 2	U	U	U	U	{(k,2), (a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	U
x = 5	U	U	U	{(k,2), (a,4), (x,5), (k,4), (b,2), (y,8), (k,3), (k,5)}	U	{(k,2), (a,4), (x,5), (k,4), (b,2), (y,8), (k,3), (k,5)}
a = k * 2	U	U	U	U	{(k,2), (a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	U
x = 8	U	U	U	{(k,2), (a,4), (x,8), (k,4), (b,2), (y,8), (k,3), (k,5)}	U	{(k,2), (a,4), (x,8), (k,4), (b,2), (y,8), (k,3), (k,5)}
k = a	U	U	{(k,2), (a,4), (k,4), (b,2), (y,8), (k,3), (k,5)}	{(a,4), (x,5), (x,8), (k,4), (b,2), (x,6), (y,8)}	{(k,2), (a,4),(k,4), (b,2), (y,8), (k,3), (k,5)}	{(a,4), (k,4), (b,2), (y,8)}
while	U	U	{(a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	U	{(a,4), (b,2), (y,8)}	{(a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}
b = 2	U	U	U	U	{(a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	U
x = a + k	U	U	U	{(k,2), (a,4), (k,4), (b,2), (y,8), (k,3), (k,5)}	U	{(k,2), (a,4), (k,4), (b,2), (y,8), (k,3), (k,5)}
y = a * b	U	U	{(k,2), (a,4), (k,4), (b,2), (y,8), (k,3), (k,5)}	U	{(k,2), (a,4), (k,4), (b,2), (y,8), (k,3), (k,5)}	U
k++	U	U	U	{(a,4), (x,5), (x,8), (b,2),	U	{(a,4), (x,5), (x,8), (b,2),

				(x,6), (y,8)}		(x,6), (y,8)}
print(a + x)	U	U	U	U	{(a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	U
exit	U	U	U	U	U	U

	ITERAZIONE 4		ITERAZIONE 5		ITERAZIONE 6	
	IN[B]	OUT[B]	IN[B]	OUT[B]	IN[B]	OUT[B]
entry	∅	∅	∅	∅	∅	∅
k = 2	∅	{(k,2)}	∅	{(k,2)}	∅	{(k,2)}
if	{(k,2)}	{(k,2)}	{(k,2)}	{(k,2)}	{(k,2)}	{(k,2)}
a = k + 2	{(k,2)}	{(k,2), (a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	{(k,2)}	{(k,2), (a,4)}	{(k,2)}	{(k,2), (a,4)}
x = 5	{(k,2), (a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	{(k,2), (a,4), (x,5), (k,4), (b,2), (y,8), (k,3), (k,5)}	{(k,2), (a,4)}	{(k,2), (a,4), (x,5), (b,2), (y,8)}	{(k,2), (a,4)}	{(k,2), (a,4), (x,5)}
a = k * 2	{(k,2)}	{(k,2), (a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	{(k,2)}	{(k,2), (a,4)}	{(k,2)}	{(k,2), (a,4)}
x = 8	{(k,2), (a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	{(k,2), (a,4), (x,8), (k,4), (b,2), (y,8), (k,3), (k,5)}	{(k,2), (a,4)}	{(k,2), (a,4), (x,8), (b,2), (y,8)}	{(k,2), (a,4)}	{(k,2), (a,4), (x,8)}
k = a	{(k,2), (a,4), (k,4), (b,2), (y,8), (k,3), (k,5)}	{(a,4),(k,4), (b,2), (y,8)}	{(k,2), (a,4), (b,2), (y,8)}	{(k,4), (a,4), (b,2), (y,8)}	{(k,2), (a,4)}	{(k,4), (a,4), (b,2), (y,8)}
while	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}
b = 2	{(a,4), (b,2), (y,8)}	{(a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}
x = a + k	{(a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	{(k,2), (a,4), (k,4), (b,2),(y,8), (k,3), (k,5)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}
y = a * b	{(k,2), (a,4), (k,4), (b,2),(y,8), (k,3), (k,5)}	{(k,2), (a,4), (k,4), (b,2), (y,8), (k,3), (k,5)}	{(a,4), (b,2), (y,8)}	{(k,2), (a,4), (k,4), (b,2),(y,8), (k,3), (k,5)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}
k++	{(k,2), (a,4), (k,4), (b,2), (y,8), (k,3), (k,5)}	{ (a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	{(k,2), (a,4), (k,4), (b,2),(y,8), (k,3), (k,5)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2),(y,8)}
print(a + x)	{(a,4), (b,2), (y,8)}	{(a,4), (x,5), (x,8), (b,2),	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}

		(x,6), (y,8)}				
exit	{(a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	U	{(a,4), (b,2), (y,8)}	{(a,4), (x,5), (x,8), (b,2), (x,6), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}

	ITERAZIONE 7		ITERAZIONE 8		ITERAZIONE 9	
	IN[B]	OUT[B]	IN[B]	OUT[B]	IN[B]	OUT[B]
entry	∅	∅	∅	∅	∅	∅
k = 2	∅	{(k,2)}	∅	{(k,2)}	∅	{(k,2)}
if	{(k,2)}	{(k,2)}	{(k,2)}	{(k,2)}	{(k,2)}	{(k,2)}
a = k + 2	{(k,2)}	{(k,2), (a,4)}	{(k,2)}	{(k,2), (a,4)}	{(k,2)}	{(k,2), (a,4)}
x = 5	{(k,2), (a,4)}	{(k,2), (a,4), (x,5)}	{(k,2), (a,4)}	{(k,2), (a,4), (x,5)}	{(k,2), (a,4)}	{(k,2), (a,4), (x,5)}
a = k * 2	{(k,2)}	{(k,2), (a,4)}	{(k,2)}	{(k,2), (a,4)}	{(k,2)}	{(k,2), (a,4)}
x = 8	{(k,2), (a,4)}	{(k,2), (a,4), (x,8)}	{(k,2), (a,4)}	{(k,2), (a,4), (x,8)}	{(k,2), (a,4)}	{(k,2), (a,4), (x,8)}
k = a	{(k,2), (a,4)}	{(k,4), (a,4)}	{(k,2), (a,4)}	{(k,4), (a,4)}	{(k,2), (a,4)}	{(k,4), (a,4)}
while	{(a,4)}	{(a,4), (b,2), (y,8)}	{(a,4)}	{(a,4)}	{(a,4)}	{(a,4)}
b = 2	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4)}	{(a,4), (b,2), (y,8)}	{(a,4)}	{(a,4), (b,2)}
x = a + k	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2)}	{(a,4), (b,2), (y,8)}
y = a * b	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}
k++	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}
print(a + x)	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4)}	{(a,4), (b,2), (y,8)}	{(a,4)}	{(a,4)}
exit	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}	{(a,4)}	{(a,4), (b,2), (y,8)}

	ITERAZIONE 10	
	IN[B]	OUT[B]
entry	∅	∅
k = 2	∅	{(k,2)}
if	{(k,2)}	{(k,2)}
a = k + 2	{(k,2)}	{(k,2), (a,4)}
x = 5	{(k,2), (a,4)}	{(k,2), (a,4), (x,5)}
a = k * 2	{(k,2)}	{(k,2), (a,4)}
x = 8	{(k,2), (a,4)}	{(k,2), (a,4), (x,8)}
k = a	{(k,2), (a,4)}	{(k,4), (a,4)}
while	{(a,4)}	{(a,4)}
b = 2	{(a,4)}	{(a,4), (b,2)}
x = a + k	{(a,4), (b,2)}	{(a,4), (b,2)}

y = a * b	{(a,4), (b,2)}	{(a,4), (b,2), (y,8)}
k++	{(a,4), (b,2), (y,8)}	{(a,4), (b,2), (y,8)}
print(a + x)	{(a,4)}	{(a,4)}
exit	{(a,4)}	{(a,4)}