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)

	$kill_B$	gen_B	ITERAZIONE 1		ITERAZIONE 2	
			IN[B]	OUT[B]	IN[B]	OUT[B]
BB1	$\emptyset$	$\emptyset$	u	u	u	u
BB2	$\emptyset$	$\emptyset$	u	u	u	u
BB3	$\emptyset$	*{(b-a)}*	u	u	u	{(a-b)}
BB4	$\emptyset$	*{(a-b)}*	u	$\emptyset$	{(a-b)}	$\emptyset$
BB5	$\emptyset$	*{(b-a)}*	u	u	u	$\emptyset$
BB6	u	$\emptyset$	u	u	$\emptyset$	{(a-b)}
BB7	$\emptyset$	*{(a-b)}*	u	$\emptyset$	{(a-b)}	$\emptyset$
BB8	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

	ITERAZIONE 3		ITERAZIONE 4		ITERAZIONE 5	
	IN[B]	OUT[B]	IN[B]	OUT[B]	IN[B]	OUT[B]
BB1	*u*	*u*	u	{(b-a)}	{(b-a)}	{(b-a)}
BB2	*u*	*{(b-a)}*	{(b-a)}	{(b-a)}	{(b-a)}	{(b-a)}
BB3	*u*	*{(a-b)}*	u	{(a-b)}	u	{(a-b)}
BB4	*{(a-b)}*	$\emptyset$	{(a-b)}	$\emptyset$	{(a-b)}	$\emptyset$
BB5	*{(b-a)}*	$\emptyset$	{(b-a)}	$\emptyset$	{(b-a)}	$\emptyset$
BB6	$\emptyset$	*{(a-b)}*	$\emptyset$	{(a-b)}	$\emptyset$	{(a-b)}
BB7	*{(a-b)}*	$\emptyset$	{(a-b)}	$\emptyset$	{(a-b)}	$\emptyset$
BB8	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

	Dataflow Problem 2
Domain	All subsets of nodes
Direction	Forward $OUT[B] = f_B(IN[B])$ $IN[B] = \displaystyle\bigcap_{p \in Pred(B)} OUT[p]$
Transfer function	$f_B(x) = x \cup \{B\}$
Meet Operation	Intersection ($\cap$)
Boundary Condition	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}	u	{A}	{A,B}	{A}	{A,B}	{A}	{A,B}
C	{A}	u	{A}	{A,C}	{A}	{A,C}	{A}	{A,C}
D	u	u	{A,C}	u	{A,C}	{A,C,D}	{A,C}	{A,C,D}
E	u	u	{A,C}	u	{A,C}	{A,C,E}	{A,C}	{A,C,E}
F	u	u	u	u	{A,C}	u	{A,C}	{A,C,F}
G	u	u	{A,B}	u	{A,B}	{A,B,G}	{A}	{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 = {(a,4),(b,2),(k,2),(k,3),(k,4),(k,5),(x,5),(x,6),(x,8),(y,8)}

	ITERAZIONE 1		ITERAZIONE 2		ITERAZIONE 3	
	IN[B]	OUT[B]	IN[B]	OUT[B]	IN[B]	OUT[B]
entry	∅	∅	∅	∅	∅	∅
k = 2	∅	u	∅	(k,2)	∅	(k,2)
if	U	U	(k,2)	U	(k,2)	(k,2)
a = k + 2	U	U	U	U	(k,2)	U
x = 5	U	U	U	U-(x,6)-(x,8)	U	U-(x,6)-(x,8)
a = k * 2	U	U	U	U	(k,2)	U
x = 8	U	U	U	U-(x,5)-(x,6)	U	U-(x,5)-(x,6)
k = a	U	U	U-(x,_)	U-(k,2)-(k,3)-(k,5)	U-(x,_)	(a,4),(b,2),(k,4),(y,8)
while	U	U	U-(k,_)	U	(a,4),(b,2),(k,4),(y,8)	U-(k,_)
b = 2	U	U	U	U	U-(k,_)	U
x = a + k	U	U	U	U-(x,_)	U	U-(x,_)
y = a * b	U	U	U-(x,_)	U	U-(x,_)	U-(x,_)
k++	U	U	U	U-(k,_)	U-(x,_)	U-(k,_)
print(a + x)	U	U	U-(k,_)	U	U-(k,_)	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	Ø	Ø	Ø	Ø	Ø	Ø
k = 2	Ø	(k,2)	Ø	(k,2)	Ø	(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)	U-(x,6)-(x,8)	(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)	U-(x,5)-(x,6)	(k,2),(a,4)	(k,2),(a,4),(x,8)	(k,2),(a,4)	(k,2),(a,4),(x,8)
k = a	U-(x,_)	(a,4),(b,2),(k,4),(y,8)	(a,4),(b,2),(y,8)	(a,4),(b,2),(y,8)	(a,4)	(a,4),(b,2),(y,8)
while	(a,4),(b,2),(y,8)	(a,4),(b,2),(k,4),(y,8)	(a,4),(b,2),(y,8)	(a,4),(b,2),(y,8)	(a,4)	(a,4),(b,2),(y,8)
b = 2	(a,4),(b,2),(k,4),(y,8)	U-(k,_)	(a,4),(b,2),(y,8)	(a,4),(b,2),(k,4),(y,8)	(a,4),(b,2),(y,8)	(a,4),(b,2),(y,8)
x = a + k	U-(k,_)	U-(x,_)	(a,4),(b,2),(k,4),(y,8)	(a,4),(b,2),(y,8)	(a,4),(b,2),(y,8)	(a,4),(b,2),(k,4),(y,8)
y = a * b	U-(x,_)	U-(x,_)	(a,4),(b,2),(k,4),(y,8)	U-(x,_)	(a,4),(b,2),(k,4),(y,8)	(a,4),(b,2),(k,4),(y,8)
k++	U-(x,_)	(a,4),(b,2),(y,8)	U-(x,_)	(a,4),(b,2),(y,8)	(a,4),(b,2),(k,4),(y,8)	(a,4),(b,2),(y,8)
print(a + x)	(a,4),(b,2),(k,4),(y,8)	U-(k,_)	(a,4),(b,2),(y,8)	(a,4),(b,2),(k,4),(y,8)	(a,4),(b,2),(y,8)	(a,4),(b,2),(k,4),(y,8)
exit	U-(k,_)	U	a,4),(b,2),(k,4),(y,8)	U-(k,_)	(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	Ø	Ø	Ø	Ø	Ø	Ø
k = 2	Ø	(k,2)	Ø	(k,2)	Ø	(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	(a,4)	(a,4)	(a,4)	(a,4)	(a,4)	(a,4)
while	(a,4)	(a,4)	(a,4)	(a,4)	(a,4)	(a,4)
b = 2	(a,4)	(a,4),(b,2),(y,8)	(a,4)	(a,4),(b,2)	(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)	(a,4),(b,2),(y,8)	(a,4),(b,2)	(a,4),(b,2)
y = a * b	(a,4),(b,2),(y,8)	(a,4),(b,2),(k,4),(y,8)	(a,4),(b,2),(y,8)	(a,4),(b,2),(y,8)	(a,4),(b,2)	(a,4),(b,2),(y,8)
k++	(a,4),(b,2),(k,4),(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,4)	(a,4),(b,2),(y,8)	(a,4)	(a,4)	(a,4)	(a,4)

a + x)						
exit	(a,4),(b,2),(y,8)	(a,4),(b,2),(y,8)	(a,4)	(a,4),(b,2),(y, 8)	(a,4)	(a,4)