

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 (\cap)
Boundary Condition	$IN[EXIT] = \emptyset$
Initial interior points	$IN[B_i] = u$ (universal set)

[illegible]

	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 (\cap)
Boundary Condition	$IN[START] = \emptyset$ $OUT[START] = \{START\}$
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	\emptyset	{A}	\emptyset	{A}	\emptyset	{A}	\emptyset	{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	\emptyset	{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: $gen_B = \begin{cases} \{(x, k)\}, & \text{if } B: x = k \text{ (k is a constant)} \\ \{(x, val(y))\}, & \text{if } B: x = y \text{ (y is a variable with constant value)} \\ \emptyset, & \text{if } B: x = y \text{ op } z \text{ and either } val(x) \text{ or } val(y) \text{ are not constants} \end{cases}$
Meet Operation	Intersection (\cap)
Boundary Condition	$OUT[START] = \emptyset$
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	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset
k = 2	\emptyset	u	\emptyset	(k,2)	\emptyset	(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	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset
k = 2	\emptyset	(k,2)	\emptyset	(k,2)	\emptyset	(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	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset
k = 2	\emptyset	(k,2)	\emptyset	(k,2)	\emptyset	(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 + x)	(a,4)	(a,4),(b,2),(y,8)	(a,4)	(a,4)	(a,4)	(a,4)
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)