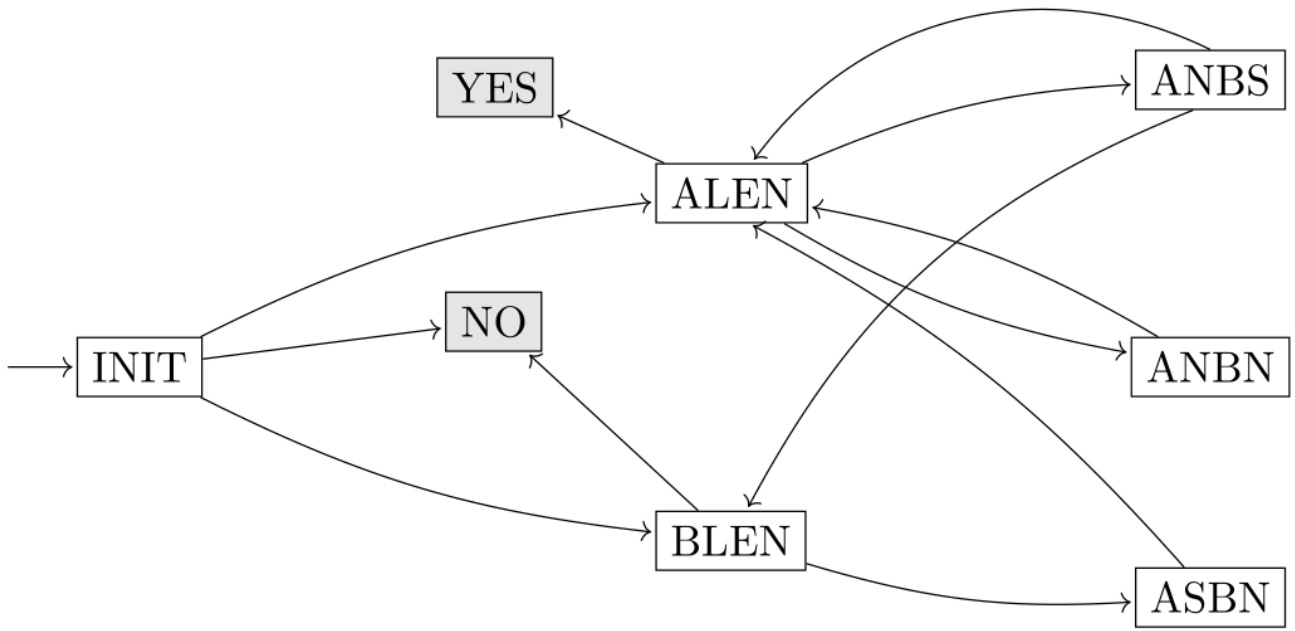
Trace-Based Programming Method



Confidential String Matching

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Example: $A = [\mathrm{ab}, \mathrm{cd}, \mathrm{e}]$, $B = [\mathrm{a}, \mathrm{bcd}, \mathrm{e}]$

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$\rightarrow$ abcde ✓

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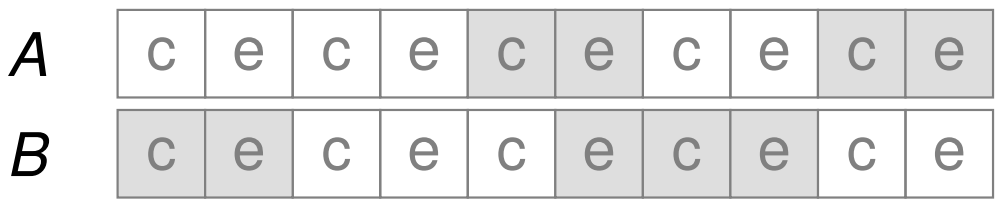

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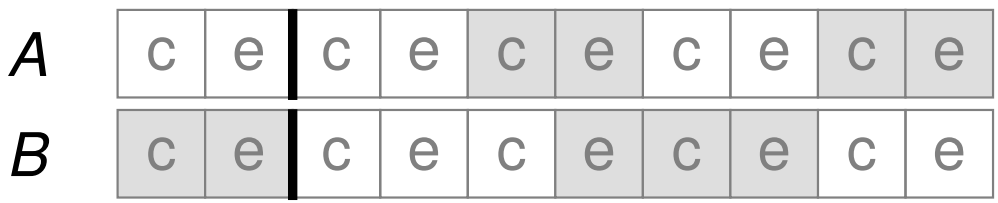

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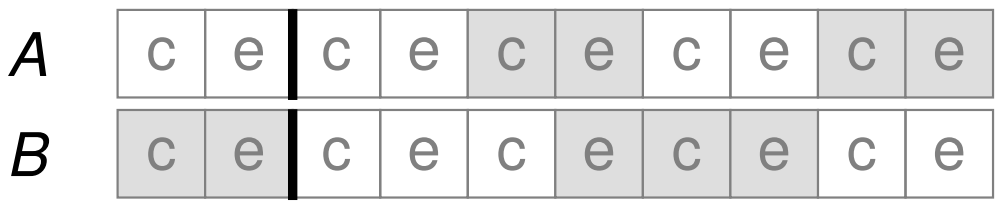

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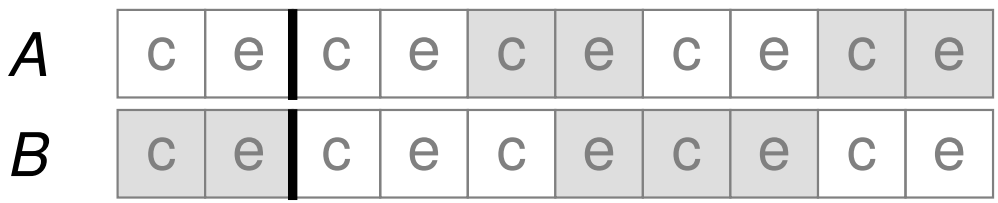

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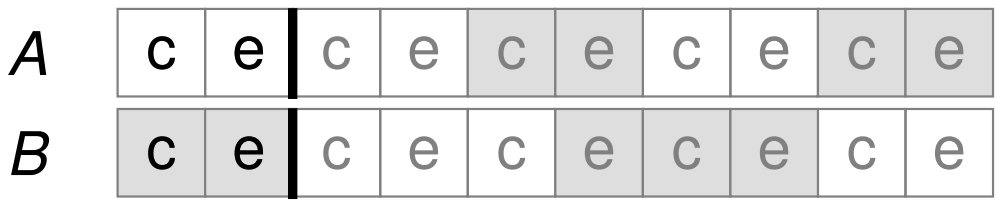

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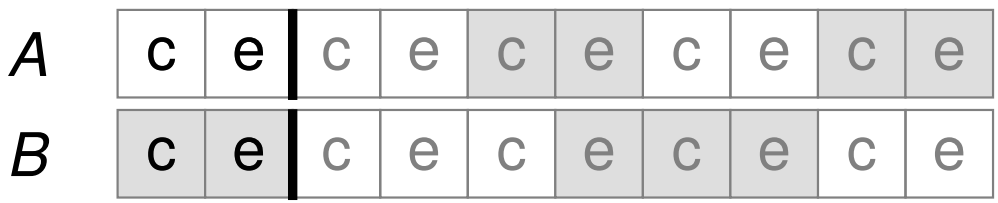

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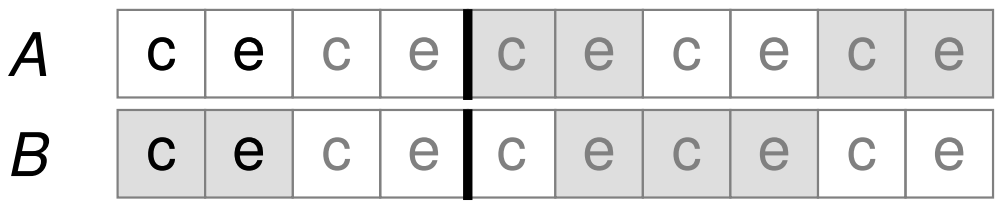

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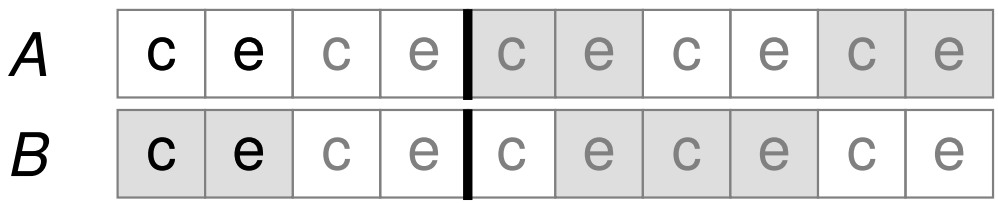

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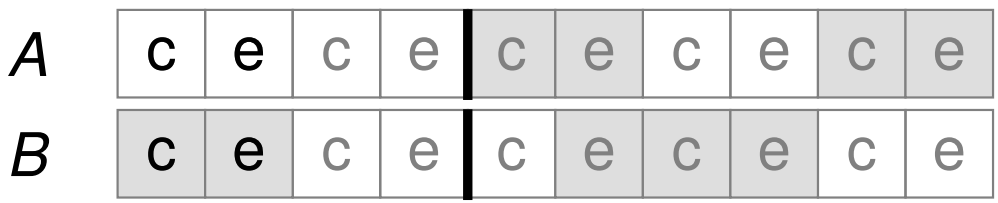

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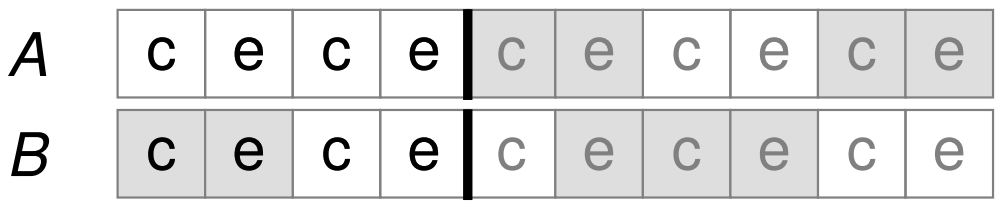

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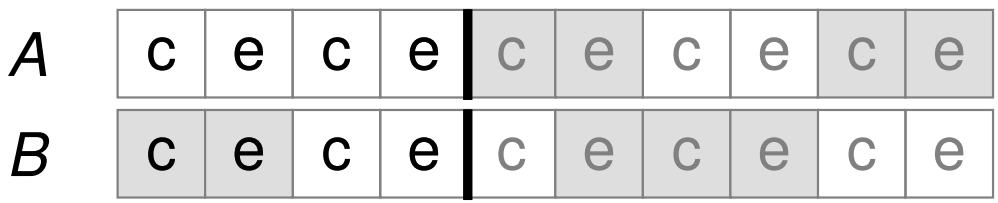

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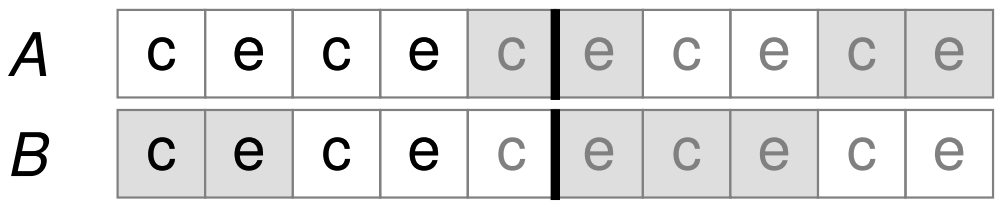

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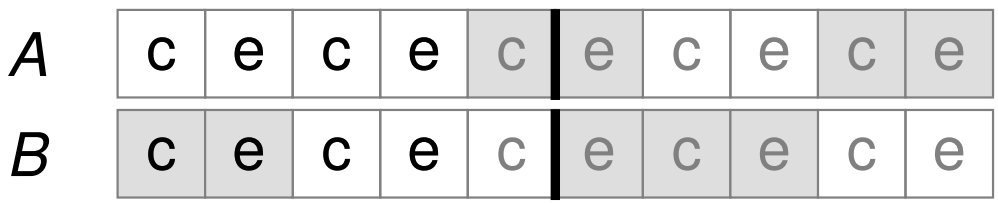

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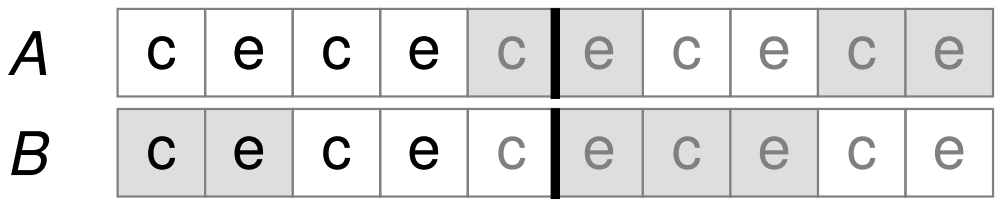

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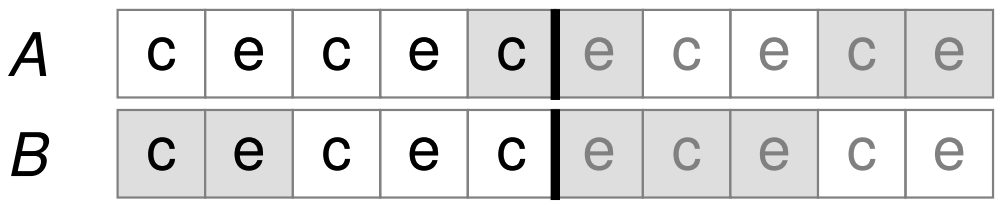

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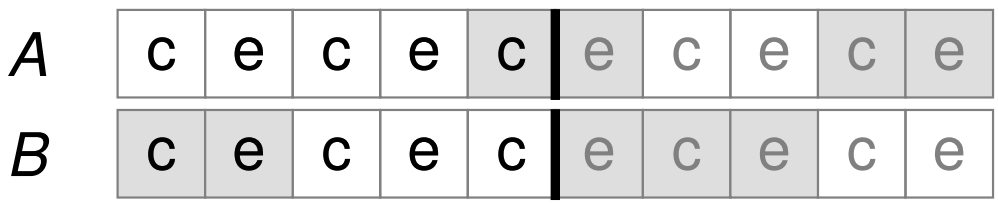

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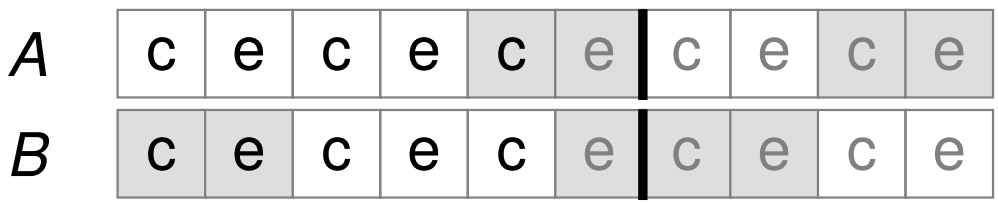

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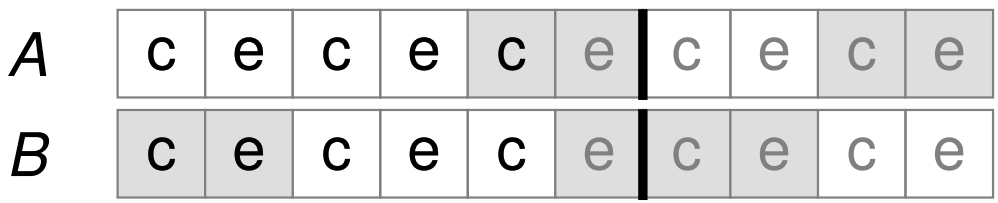

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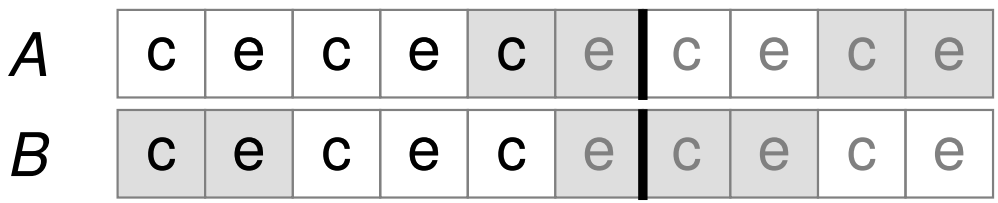

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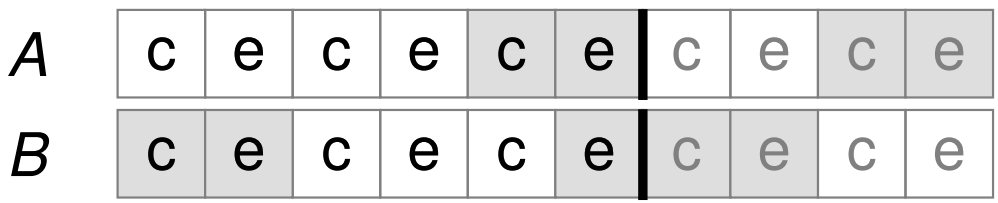

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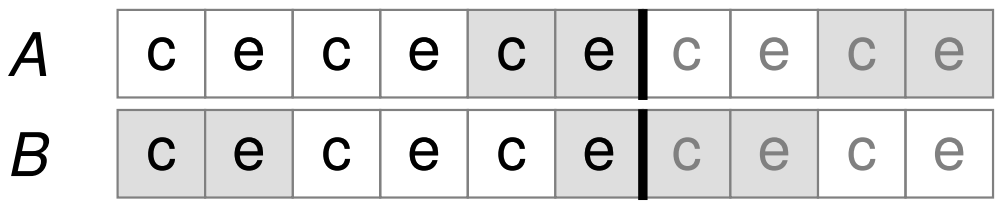

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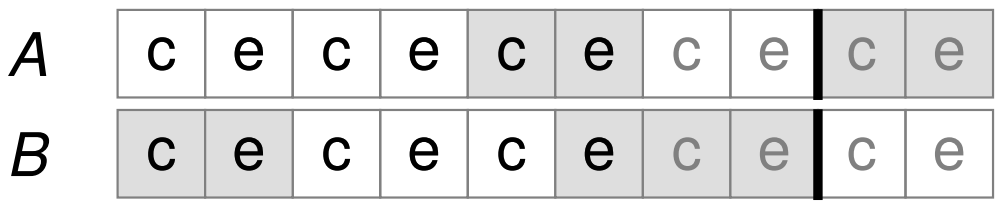

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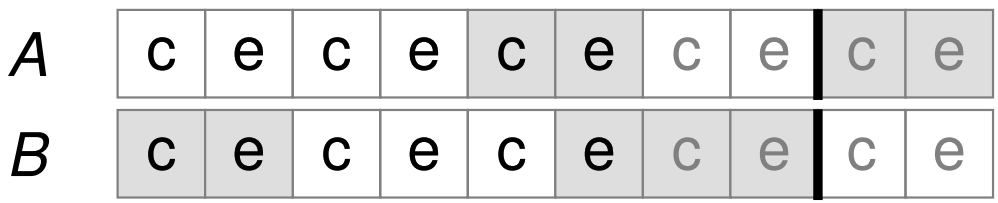

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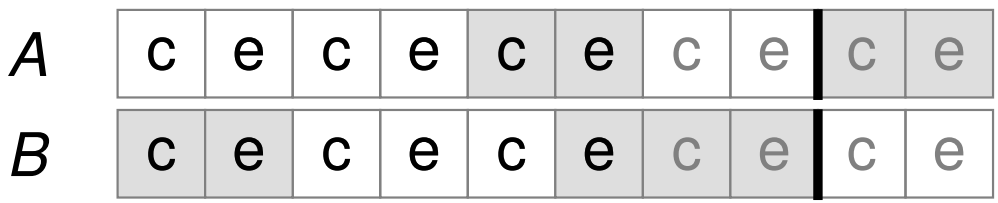

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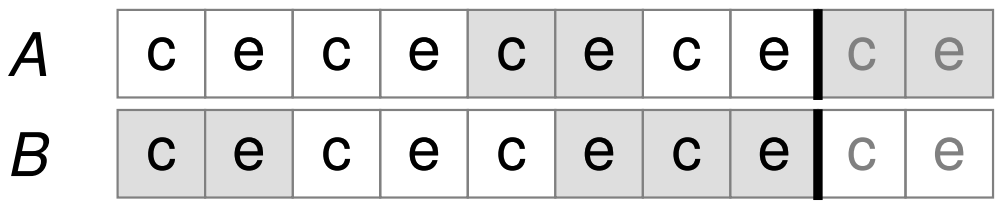
$$\text{substr}(A[1], 0, 2) = \text{substr}(B[2], 1, 2)$$

index offset length

Algorithm:



$$\text{substr}(A[3], 0, 2) = \text{substr}(B[3], 1, 2)$$

Confidential String Matching

Input: $A = [a_1, \ldots, a_n]$, $B = [b_1, \ldots, b_m]$

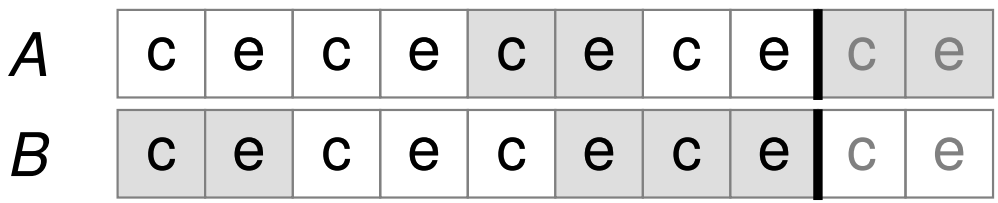
Question: $a_1 \ldots a_n = b_1 \ldots b_m$?

Example: $A = [??, ??, ?]$, $B = [?, ???, ?]$

$$\text{substr}(A[1], 0, 2) = \text{substr}(B[2], 1, 2)$$

index offset length

Algorithm:



Confidential String Matching

Input: $A = [a_1, \ldots, a_n]$, $B = [b_1, \ldots, b_m]$

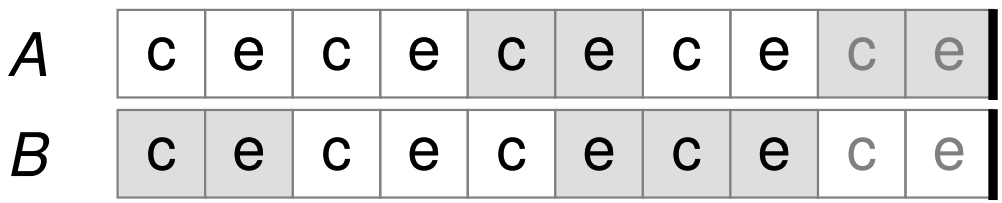
Question: $a_1 \ldots a_n = b_1 \ldots b_m$?

Example: $A = [??, ??, ?]$, $B = [?, ???, ?]$

$$\text{substr}(A[1], 0, 2) = \text{substr}(B[2], 1, 2)$$

index offset length

Algorithm:



Confidential String Matching

Input: $A = [a_1, \ldots, a_n]$, $B = [b_1, \ldots, b_m]$

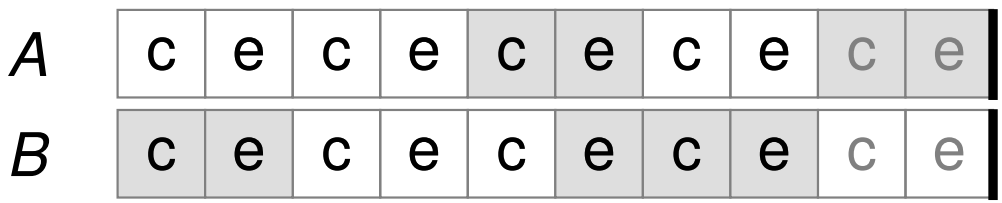
Question: $a_1 \ldots a_n = b_1 \ldots b_m$?

Example: $A = [??, ??, ?]$, $B = [?, ???, ?]$

$$\text{substr}(A[1], 0, 2) = \text{substr}(B[2], 1, 2)$$

index offset length

Algorithm:



$$\text{substr}(A[4], 0, 2) \stackrel{?}{=} \text{substr}(B[4], 0, 2)$$

Confidential String Matching

Input: $A = [a_1, \ldots, a_n]$, $B = [b_1, \ldots, b_m]$

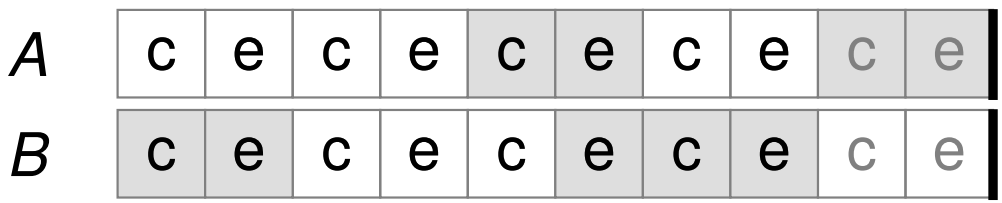
Question: $a_1 \ldots a_n = b_1 \ldots b_m$?

Example: $A = [??, ??, ?]$, $B = [?, ???, ?]$

$$\text{substr}(A[1], 0, 2) = \text{substr}(B[2], 1, 2)$$

index offset length

Algorithm:



$$\text{substr}(A[4], 0, 2) = \text{substr}(B[4], 0, 2)$$

Confidential String Matching

Input: $A = [a_1, \ldots, a_n], B = [b_1, \ldots, b_m]$

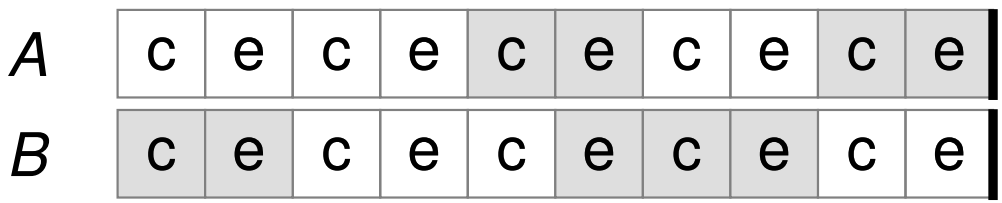
Question: $a_1 \ldots a_n = b_1 \ldots b_m$?

Example: $A = [??, ??, ?], B = [?, ???, ?]$

$$\text{substr}(A[1], 0, 2) = \text{substr}(B[2], 1, 2)$$

index offset length

Algorithm:



$$\text{substr}(A[4], 0, 2) = \text{substr}(B[4], 0, 2)$$

Confidential String Matching

Input: $A = [a_1, \ldots, a_n]$, $B = [b_1, \ldots, b_m]$

Question: $a_1 \ldots a_n = b_1 \ldots b_m$?

Example: $A = [??, ??, ?]$, $B = [?, ???, ?]$

$$\text{substr}(A[1], 0, 2) = \text{substr}(B[2], 1, 2)$$

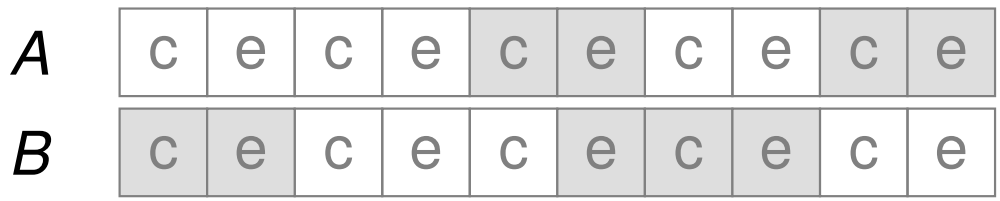
index offset length

Algorithm:

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

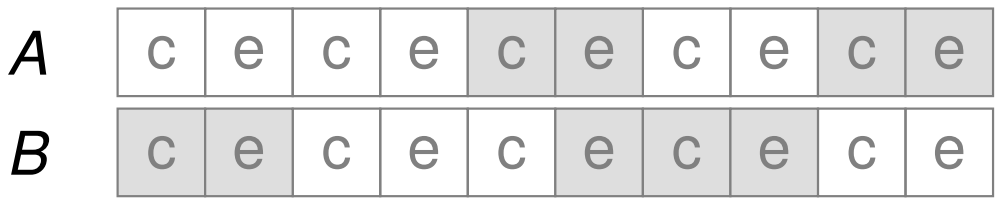
✓

Write Traces



Write Traces

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*

substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		

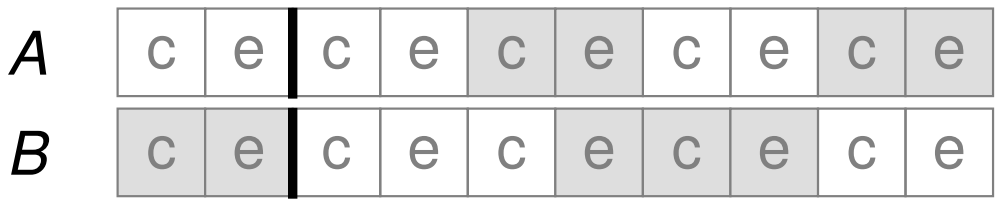
substr($A[ca], oa, l$)=substr($B[cb], ob, l$)

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		

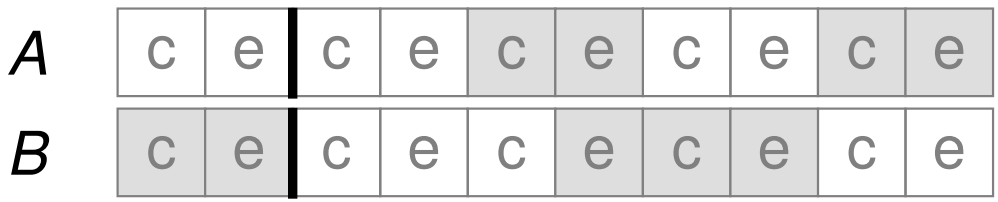
substr($A[ca], oa, l$)=substr($B[cb], ob, l$)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	

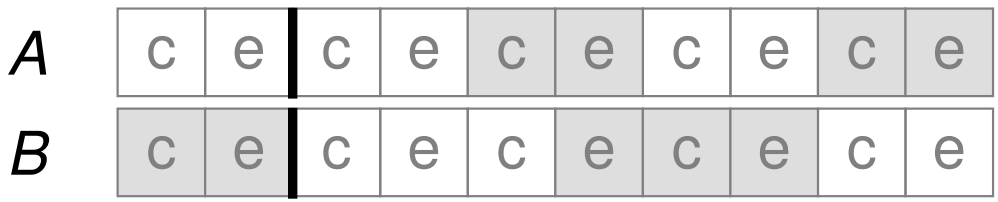
substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$

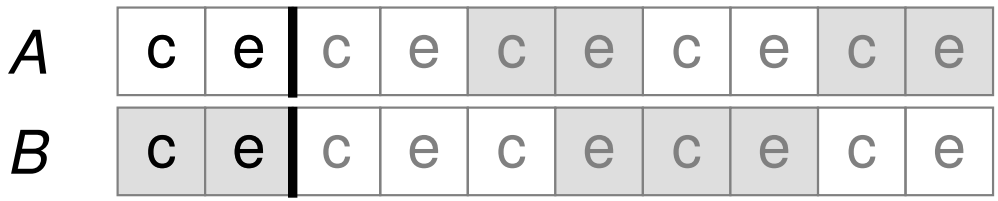


$$\text{substr}(A[1], 0, 2) = \text{substr}(B[1], 0, 2)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$



$$\text{substr}(A[1], 0, 2) = \text{substr}(B[1], 0, 2)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		

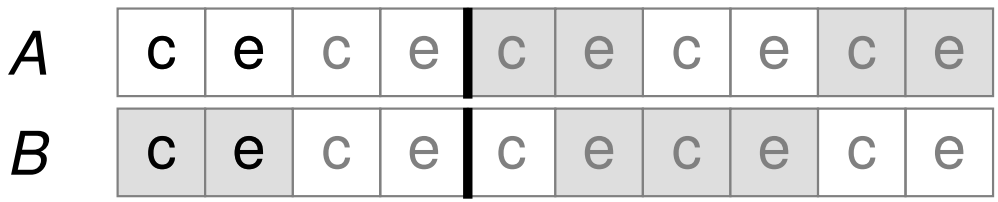
substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		

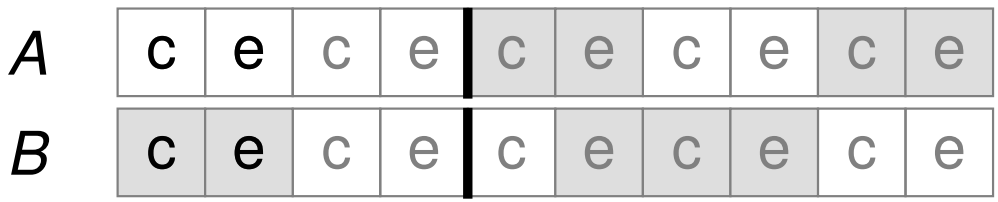
substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	

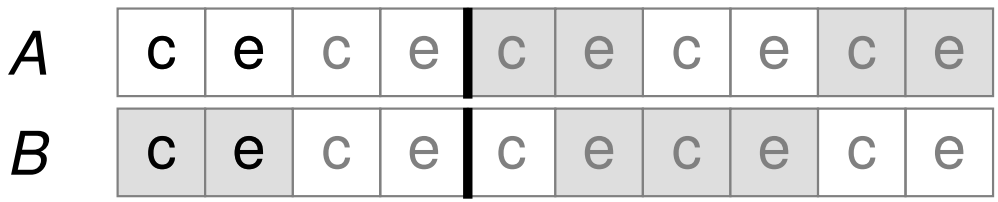
substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$

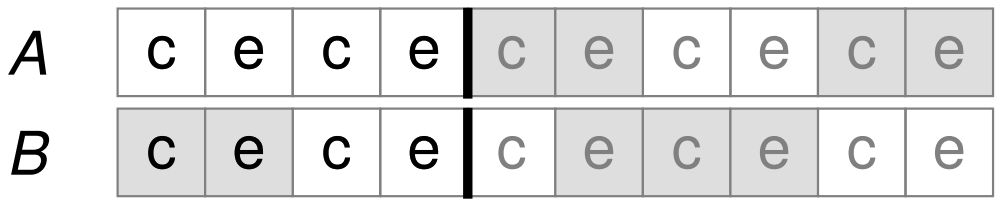


$$\text{substr}(A[1], 2, 2) = \text{substr}(B[2], 0, 2)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$



$$\text{substr}(A[1], 2, 2) = \text{substr}(B[2], 0, 2)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		

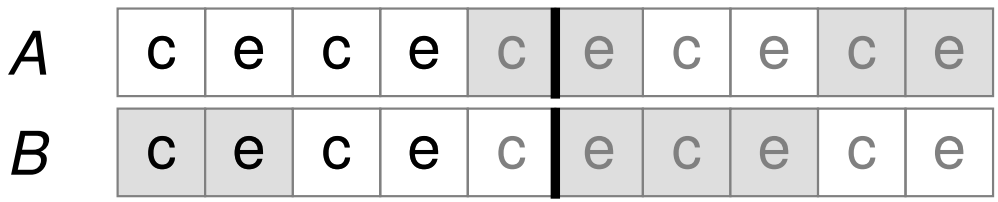
substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		

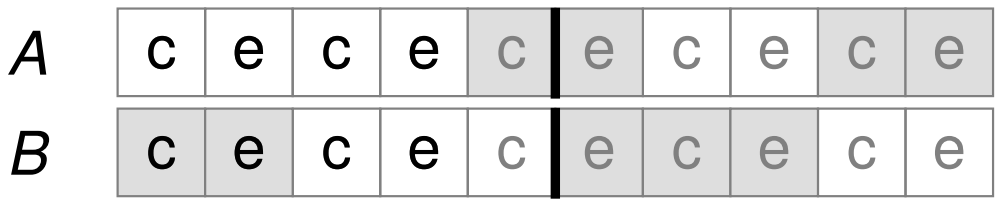
substr($A[ca], oa, l$)=substr($B[cb], ob, l$)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	

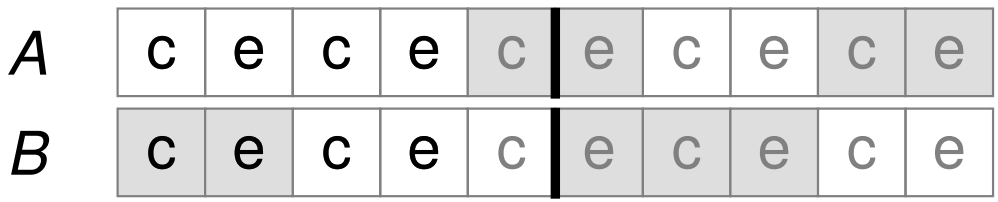
substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$

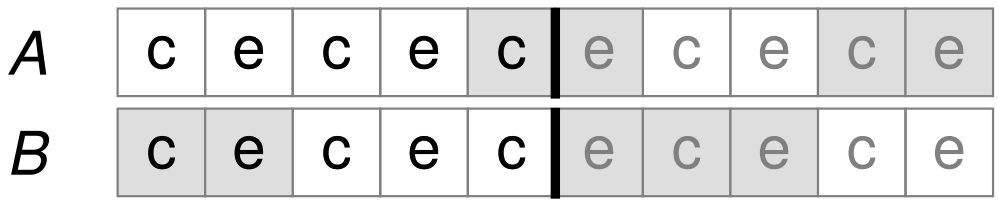


$$\text{substr}(A[2], 0, 1) = \text{substr}(B[2], 2, 1)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$



$$\text{substr}(A[2], 0, 1) = \text{substr}(B[2], 2, 1)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		

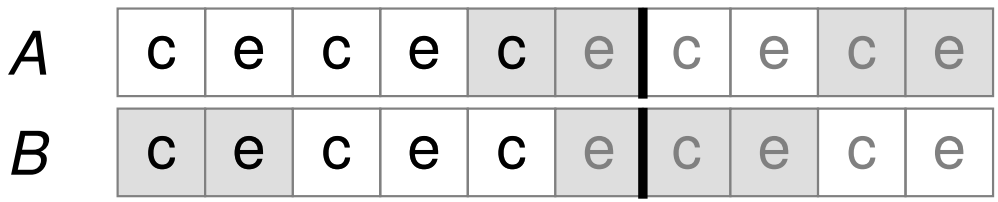
substr($A[ca], oa, l$)=substr($B[cb], ob, l$)

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		

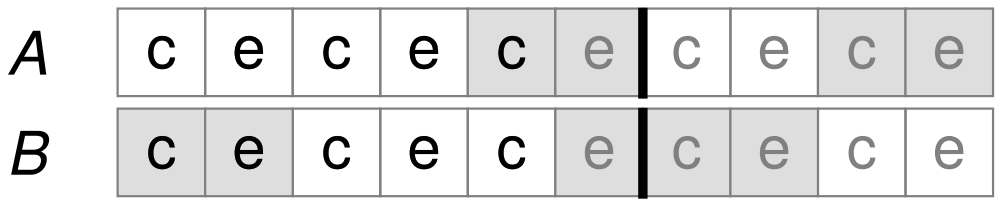
substr($A[ca], oa, l$)=substr($B[cb], ob, l$)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	

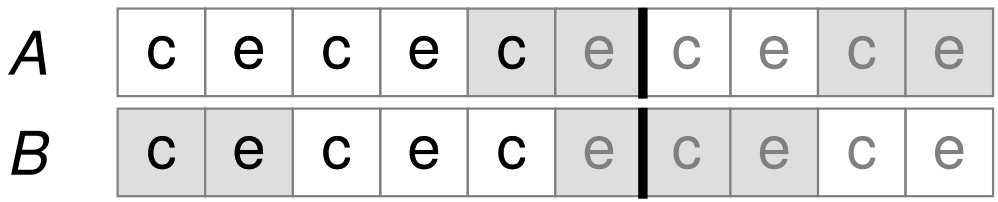
substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$

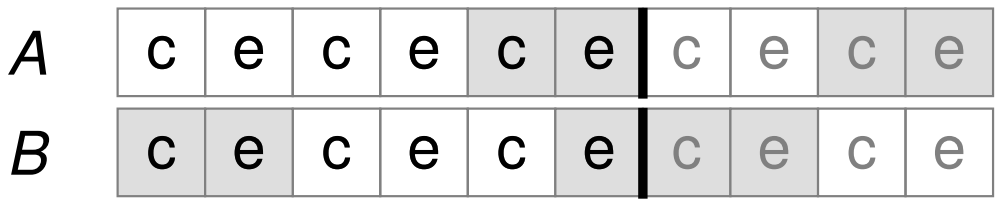


$$\text{substr}(A[2], 1, 1) = \text{substr}(B[3], 0, 1)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$

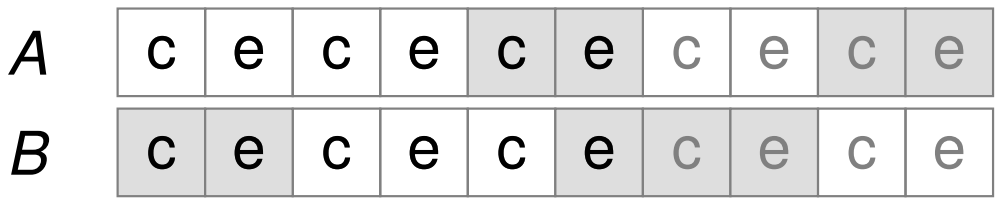


$$\text{substr}(A[2], 1, 1) = \text{substr}(B[3], 0, 1)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		

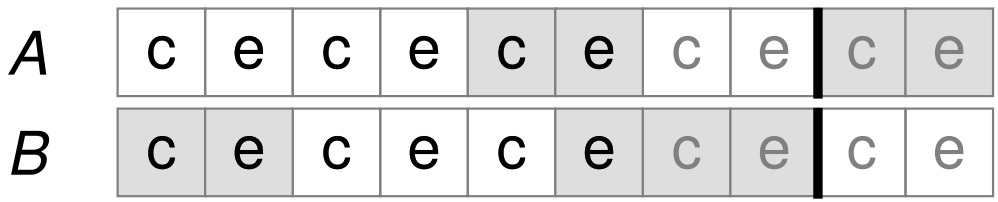
substr($A[ca], oa, l$)=substr($B[cb], ob, l$)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		

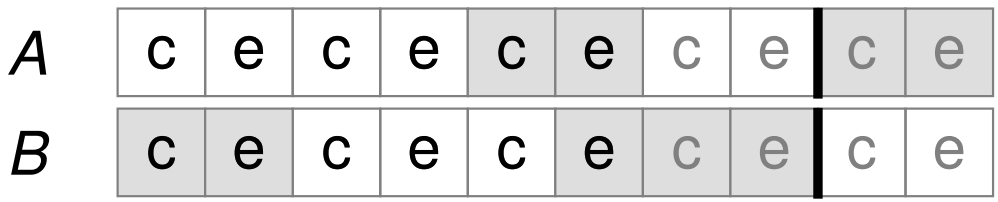
substr($A[ca], oa, l$)=substr($B[cb], ob, l$)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		
				2	

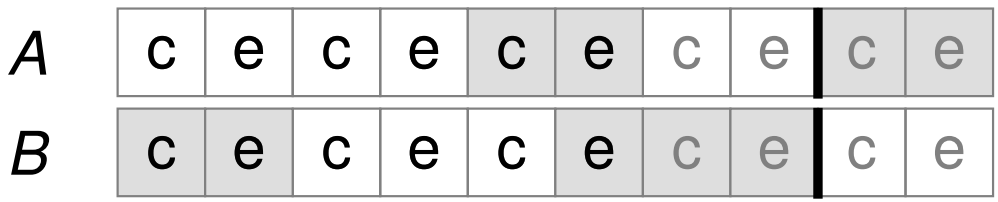
substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		
				2	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$

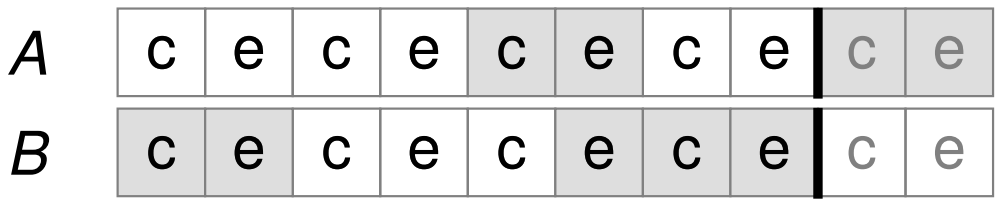


$$\text{substr}(A[3], 0, 2) = \text{substr}(B[3], 1, 2)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		
				2	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$



$$\text{substr}(A[3], 0, 2) = \text{substr}(B[3], 1, 2)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		
				2	
4	4	0	0		

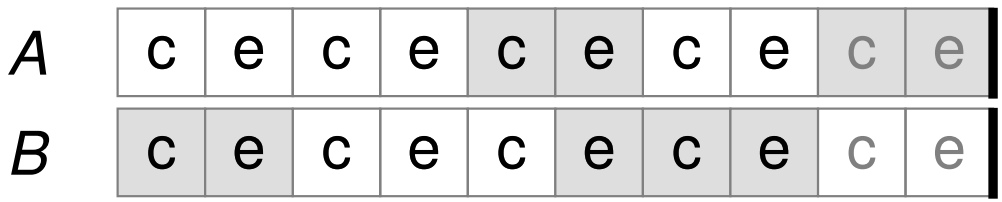
substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		
				2	
4	4	0	0		

substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)



Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		
				2	
4	4	0	0		
				2	

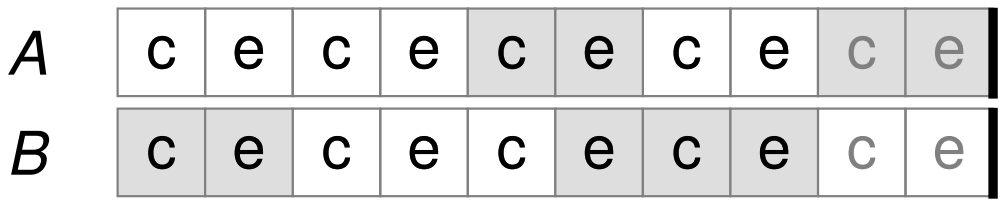
substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		
				2	
4	4	0	0		
				2	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$



$$\text{substr}(A[4], 0, 2) = \text{substr}(B[4], 0, 2)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		
				2	
4	4	0	0		
				2	

$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

$$\text{substr}(A[4], 0, 2) = \text{substr}(B[4], 0, 2)$$

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		
				2	
4	4	0	0		
				2	

substr(A[*ca*], *oa*, *l*)=substr(B[*cb*], *ob*, *l*)

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

✓

Write Traces

ca	*cb*	*oa*	*ob*	*l*	*r*
1	1	0	0		
				2	
	2	2	0		
				2	
2		0	2		
				1	
	3	1	0		
				1	
3		0	1		
				2	
4	4	0	0		
				2	
					✓

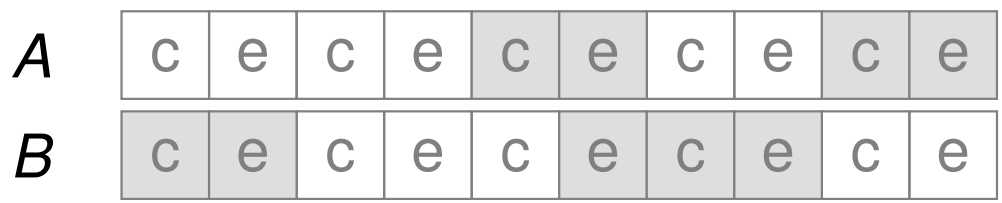
$$\text{substr}(A[ca], oa, l) = \text{substr}(B[cb], ob, l)$$

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

✓

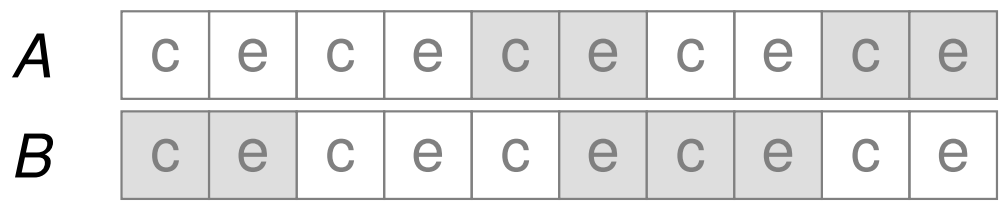
Generalize Traces

ca	*cb*	*oa*	*ob*	*I*



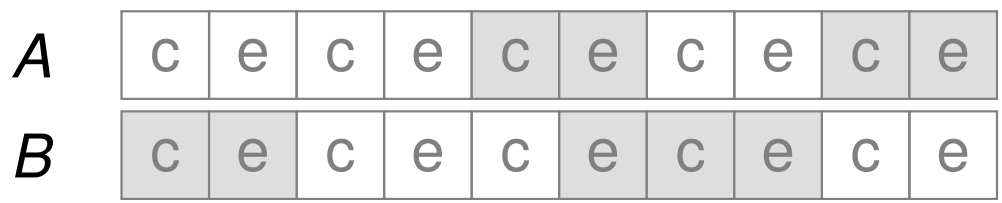
Generalize Traces

ca	*cb*	*oa*	*ob*	*l*
1	1	0	0	



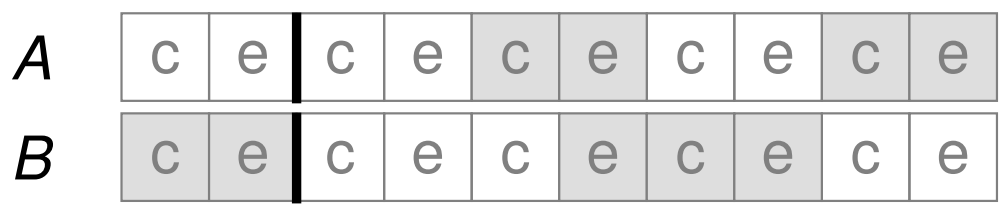
Generalize Traces

ca	*cb*	*oa*	*ob*	*I*
1 = 1	1 = 1	0 = 0	0 = 0	



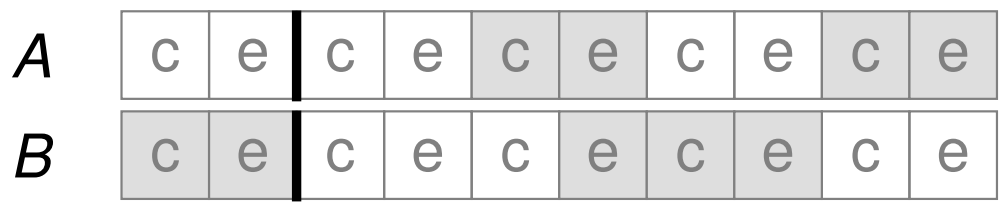
Generalize Traces

ca	*cb*	*oa*	*ob*	*I*
1 = 1	1 = 1	0 = 0	0 = 0	



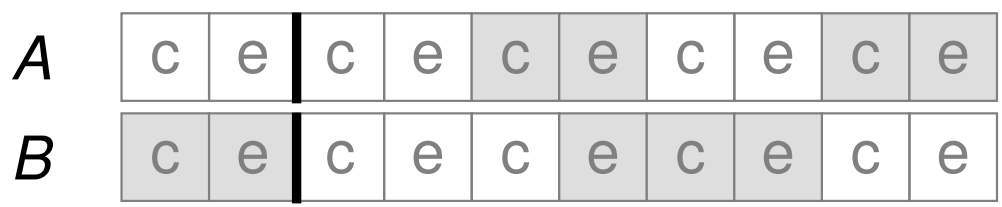
Generalize Traces

ca	*cb*	*oa*	*ob*	*l*
1 = 1	1 = 1	0 = 0	0 = 0	2



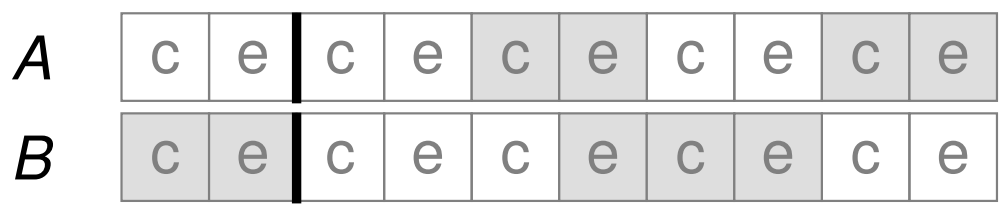
Generalize Traces

ca	*cb*	*oa*	*ob*	*I*
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	$2 = \lvert B[1] \rvert$



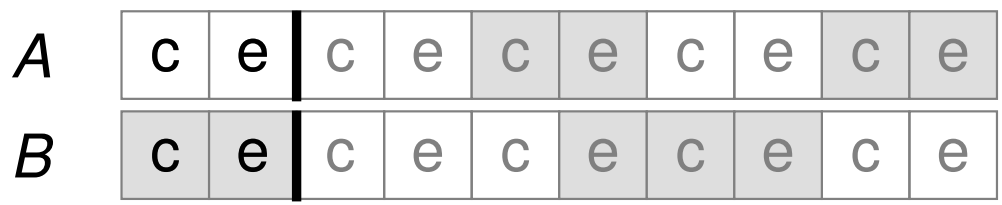
Generalize Traces

ca	*cb*	*oa*	*ob*	*I*
1 = 1	1 = 1	0 = 0	0 = 0	$2 = \lvert B[cb] \rvert$



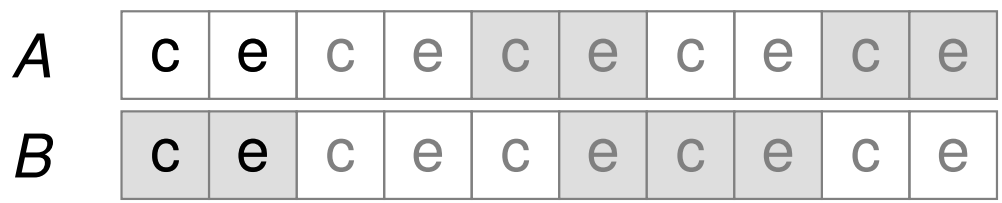
Generalize Traces

ca	*cb*	*oa*	*ob*	*I*
1 = 1	1 = 1	0 = 0	0 = 0	$2 = \lvert B[cb] \rvert$



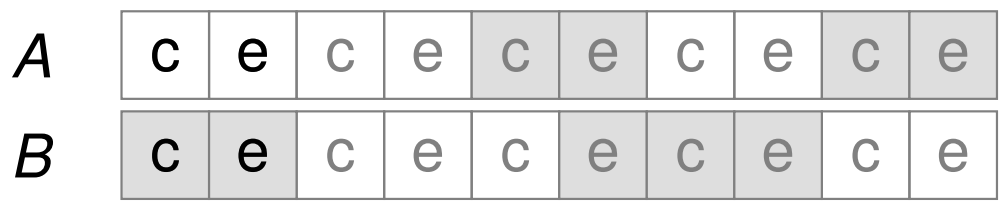
Generalize Traces

ca	*cb*	*oa*	*ob*	*l*
1 = 1	1 = 1	0 = 0	0 = 0	
				2 = $\lvert B[cb] \rvert$
	2	2	0	



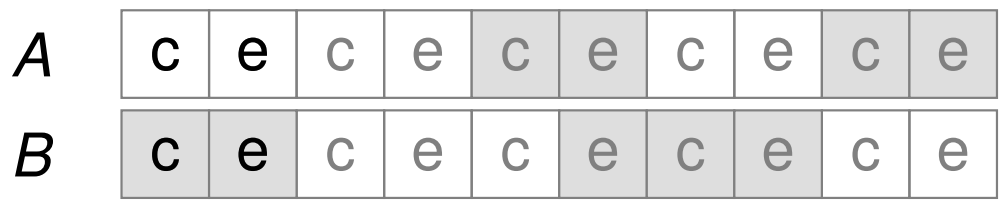
Generalize Traces

ca	cb	oa	ob	I
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	2	$0 = 0$	



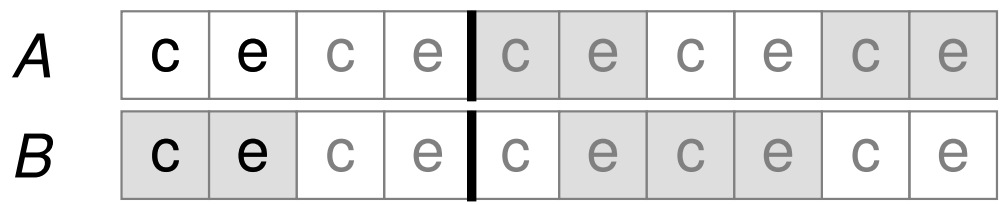
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	



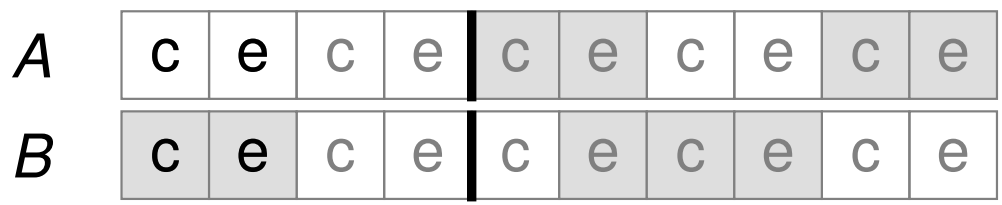
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	



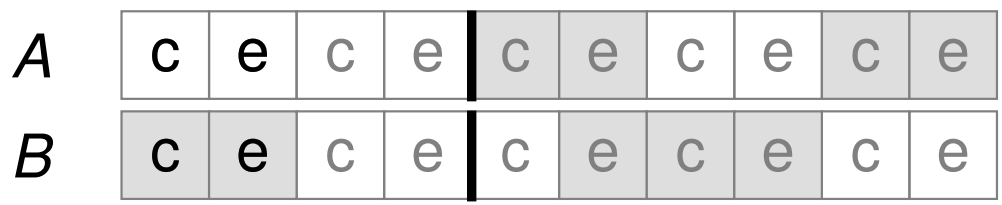
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	2



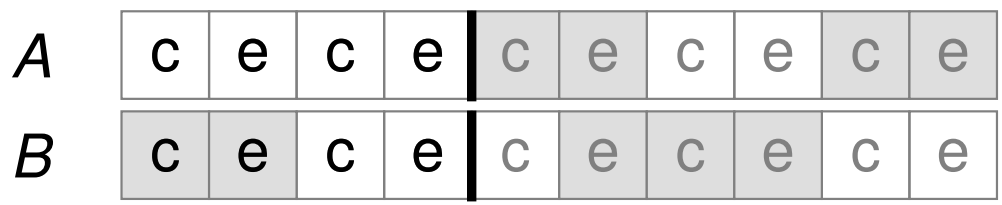
Generalize Traces

ca	cb	oa	ob	I
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + I$	$0 = 0$	$2 = \lvert A[ca] \rvert - oa$



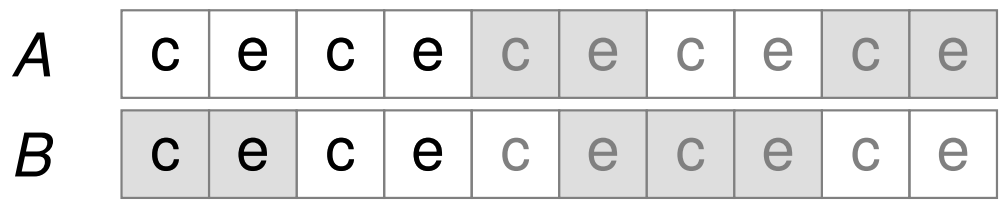
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$



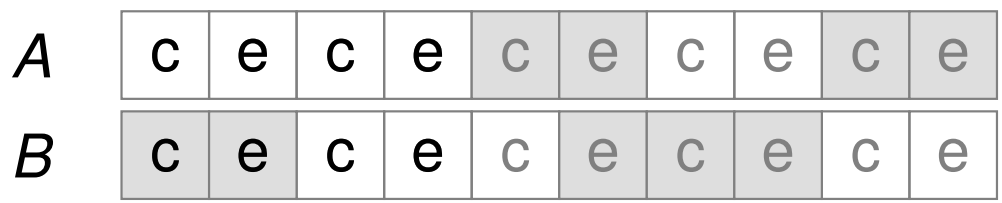
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
2		0	2	



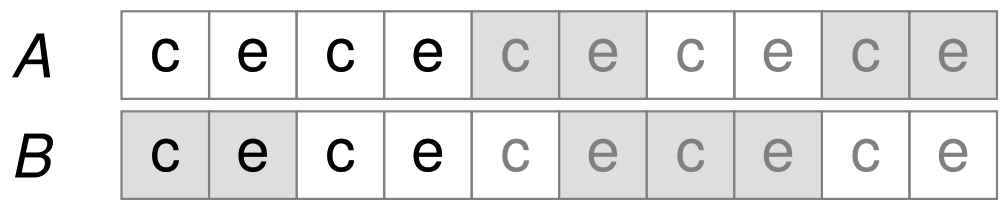
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	2	



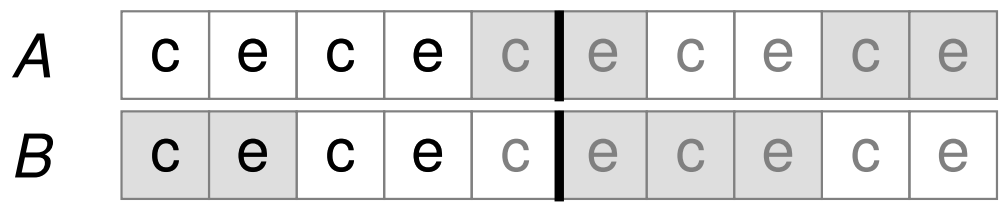
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	



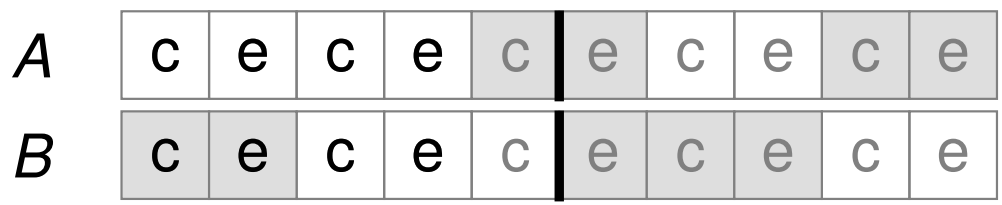
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	



Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				1



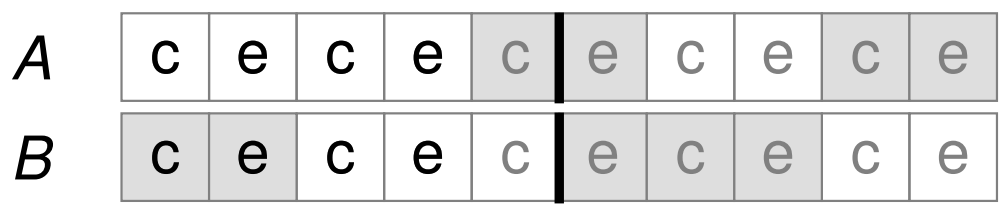
Generalize Traces

ca	cb	oa	ob	I
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert$
	$2 = cb + 1$	$2 = oa + I$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + I$	
				$1 = \lvert B[cb] \rvert - ob$

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

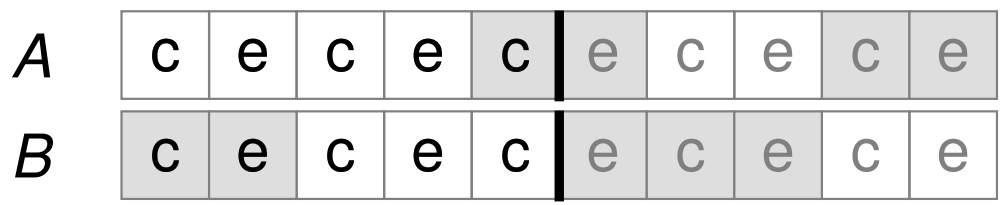
Generalize Traces

ca	cb	oa	ob	I
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert - ob$
	$2 = cb + 1$	$2 = oa + I$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + I$	
				$1 = \lvert B[cb] \rvert - ob$



Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \lvert B[cb] \rvert - ob$



Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \|B[cb]\| - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \|A[ca]\| - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \|B[cb]\| - ob$
	3	1	0	

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

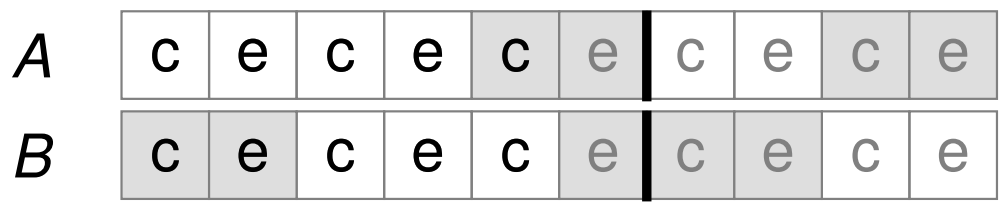
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \lvert B[cb] \rvert - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

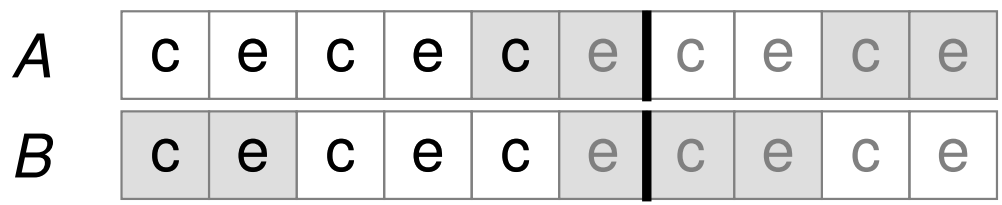
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \lvert B[cb] \rvert - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	



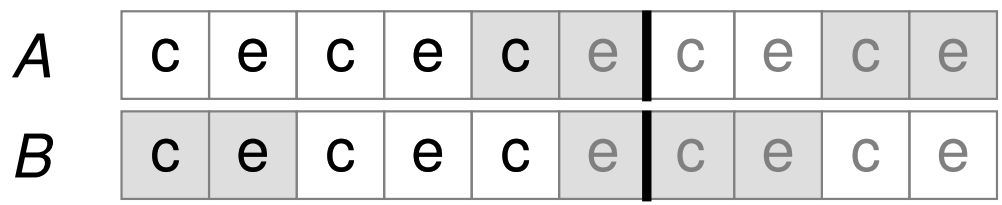
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \lvert B[cb] \rvert - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				1



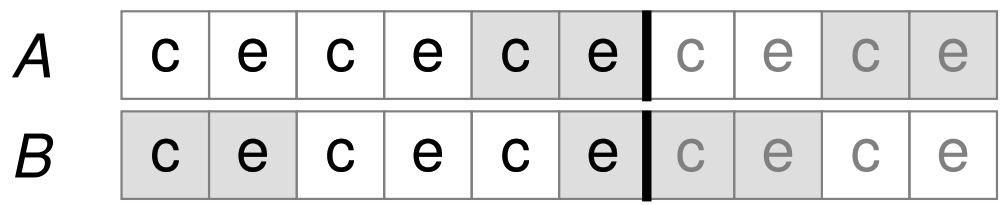
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \lvert B[cb] \rvert - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \lvert A[ca] \rvert - oa$



Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \|B[cb]\| - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \|A[ca]\| - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \|B[cb]\| - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \|A[ca]\| - oa$



Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \|B[cb]\| - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \|A[ca]\| - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \|B[cb]\| - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \|A[ca]\| - oa$
3		0	1	

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

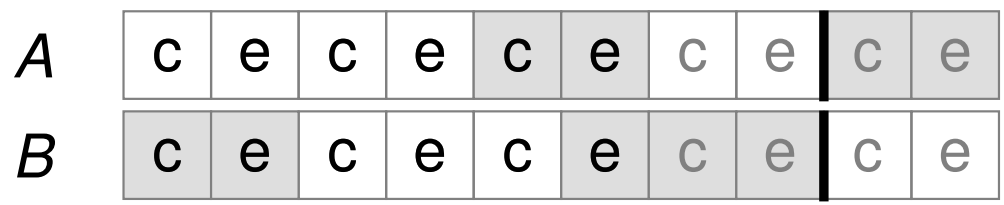
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \lvert B[cb] \rvert - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \lvert A[ca] \rvert - oa$
$3 = ca + 1$		$0 = 0$	$1 = ob + l$	

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

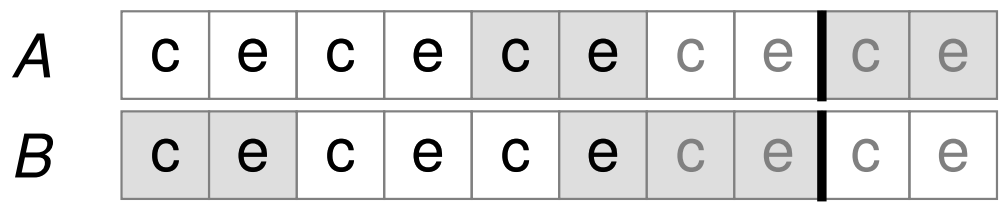
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \|B[cb]\| - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \|A[ca]\| - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \|B[cb]\| - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \|A[ca]\| - oa$
$3 = ca + 1$		$0 = 0$	$1 = ob + l$	



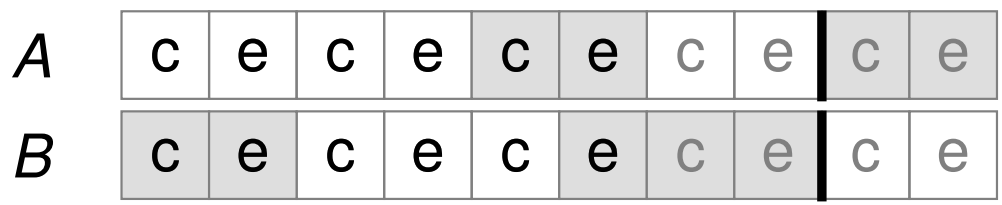
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \lvert B[cb] \rvert - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \lvert A[ca] \rvert - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \lvert B[cb] \rvert - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \lvert A[ca] \rvert - oa$
$3 = ca + 1$		$0 = 0$	$1 = ob + l$	
				2



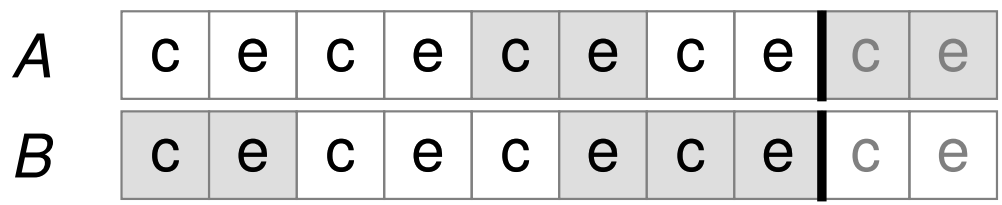
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \|B[cb]\| - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \|A[ca]\| - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \|B[cb]\| - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \|A[ca]\| - oa$
$3 = ca + 1$		$0 = 0$	$1 = ob + l$	
				$2 = \|A[ca]\| - oa$



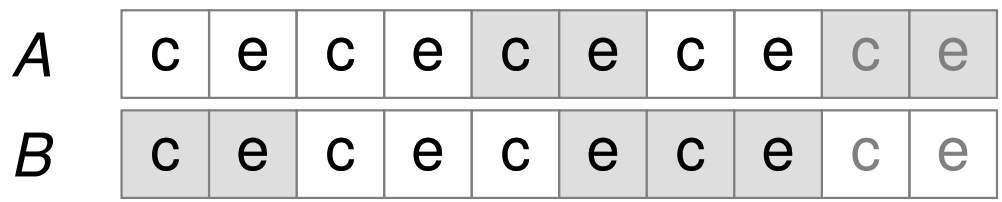
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \|B[cb]\| - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \|A[ca]\| - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \|B[cb]\| - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \|A[ca]\| - oa$
$3 = ca + 1$		$0 = 0$	$1 = ob + l$	
				$2 = \|A[ca]\| - oa$



Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \|B[cb]\| - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \|A[ca]\| - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \|B[cb]\| - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \|A[ca]\| - oa$
$3 = ca + 1$		$0 = 0$	$1 = ob + l$	
				$2 = \|A[ca]\| - oa$
4	4	0	0	



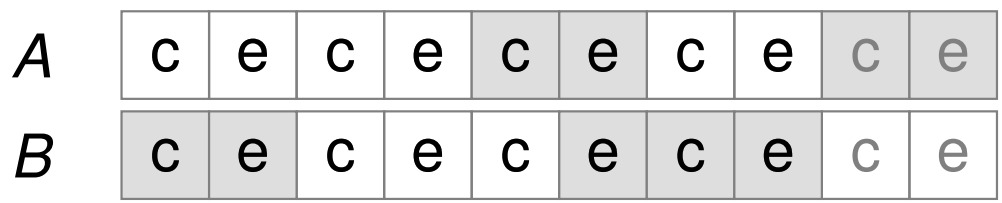
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \|B[cb]\| - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \|A[ca]\| - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \|B[cb]\| - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \|A[ca]\| - oa$
$3 = ca + 1$		$0 = 0$	$1 = ob + l$	
				$2 = \|A[ca]\| - oa$
$4 = ca + 1$	$4 = cb + 1$	$0 = 0$	$0 = 0$	

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

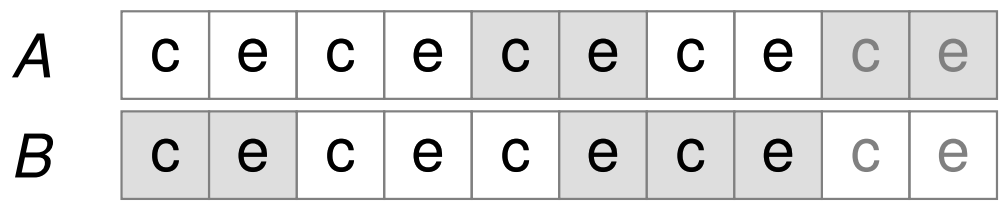
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \|B[cb]\| - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \|A[ca]\| - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \|B[cb]\| - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \|A[ca]\| - oa$
$3 = ca + 1$		$0 = 0$	$1 = ob + l$	
				$2 = \|A[ca]\| - oa$
$4 = ca + 1$	$4 = cb + 1$	$0 = 0$	$0 = 0$	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$



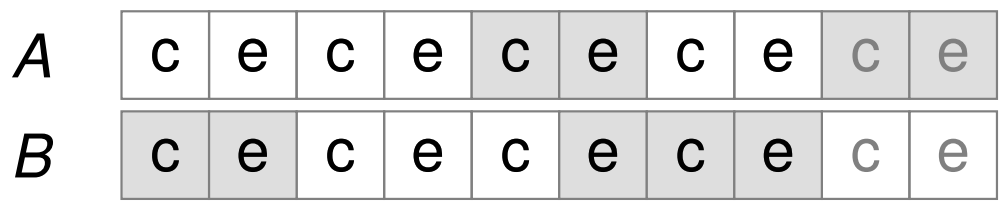
Generalize Traces

ca	cb	oa	ob	l
$1 = 1$	$1 = 1$	$0 = 0$	$0 = 0$	
				$2 = \|B[cb]\| - ob$
	$2 = cb + 1$	$2 = oa + l$	$0 = 0$	
				$2 = \|A[ca]\| - oa$
$2 = ca + 1$		$0 = 0$	$2 = ob + l$	
				$1 = \|B[cb]\| - ob$
	$3 = cb + 1$	$1 = oa + l$	$0 = 0$	
				$1 = \|A[ca]\| - oa$
$3 = ca + 1$		$0 = 0$	$1 = ob + l$	
				$2 = \|A[ca]\| - oa$
$4 = ca + 1$	$4 = cb + 1$	$0 = 0$	$0 = 0$	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$



Generalize Traces

ca	cb	oa	ob	l
1	1	0	0	
				$\lvert B[cb]\rvert - ob$
	$cb+1$	$oa+l$	0	
				$\lvert A[ca]\rvert - oa$
$ca+1$		0	$ob+l$	
				$\lvert B[cb]\rvert - ob$
	$cb+1$	$oa+l$	0	
				$\lvert A[ca]\rvert - oa$
$ca+1$		0	$ob+l$	
				$\lvert A[ca]\rvert - oa$
$ca+1$	$cb+1$	0	0	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$



Generalize Traces

ca	cb	oa	ob	l
1	1	0	0	
				$\lvert B[cb]\rvert - ob$
	$cb+1$	$oa+l$	0	
				$\lvert A[ca]\rvert - oa$
$ca+1$		0	$ob+l$	
				$\lvert B[cb]\rvert - ob$
	$cb+1$	$oa+l$	0	
				$\lvert A[ca]\rvert - oa$
$ca+1$		0	$ob+l$	
				$\lvert A[ca]\rvert - oa$
$ca+1$	$cb+1$	0	0	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

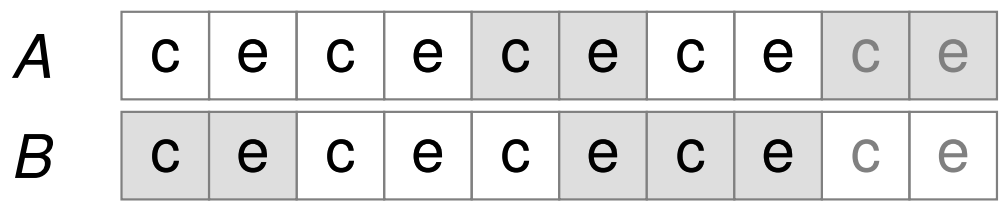
Generalize Traces

Name	ca	cb	oa	ob	l
	1	1	0	0	
					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
					$\lvert A[ca]\rvert - oa$
	$ca+1$	$cb+1$	0	0	
⋮	⋮	⋮	⋮	⋮	⋮

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Generalize Traces

Name	ca	cb	oa	ob	l
INIT	1	1	0	0	
					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
					$\lvert A[ca]\rvert - oa$
	$ca+1$	$cb+1$	0	0	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$



Generalize Traces

Name	ca	cb	oa	ob	l
	1	1	0	0	
BLEN					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
BLEN					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
					$\lvert A[ca]\rvert - oa$
	$ca+1$	$cb+1$	0	0	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Generalize Traces

Name	ca	cb	oa	ob	l
	1	1	0	0	
					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
ALEN					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
ALEN					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
ALEN					$\lvert A[ca]\rvert - oa$
	$ca+1$	$cb+1$	0	0	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Generalize Traces

Name	ca	cb	oa	ob	l
	1	1	0	0	
					$\lvert B[cb]\rvert - ob$
ASBN		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
					$\lvert B[cb]\rvert - ob$
ASBN		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
					$\lvert A[ca]\rvert - oa$
	$ca+1$	$cb+1$	0	0	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Generalize Traces

Name	ca	cb	oa	ob	l
	1	1	0	0	
					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
ANBS	$ca+1$		0	$ob+l$	
					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
ANBS	$ca+1$		0	$ob+l$	
					$\lvert A[ca]\rvert - oa$
	$ca+1$	$cb+1$	0	0	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

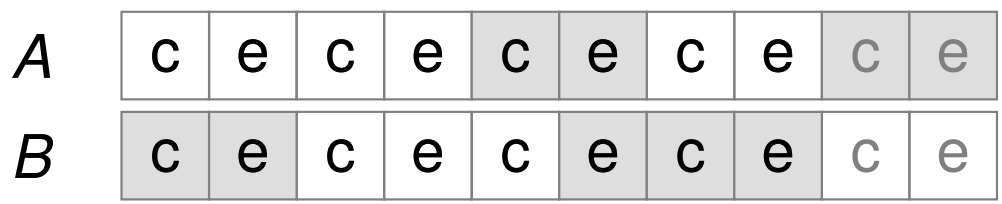
Generalize Traces

Name	ca	cb	oa	ob	l
	1	1	0	0	
					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
					$\lvert B[cb]\rvert - ob$
		$cb+1$	$oa+l$	0	
					$\lvert A[ca]\rvert - oa$
	$ca+1$		0	$ob+l$	
					$\lvert A[ca]\rvert - oa$
ANBN	$ca+1$	$cb+1$	0	0	
⋮	⋮	⋮	⋮	⋮	⋮

A	c	e	c	e	c	e	c	e	c	e
B	c	e	c	e	c	e	c	e	c	e

Generalize Traces

Name	ca	cb	oa	ob	l
INIT	1	1	0	0	
BLEN					$\lvert B[cb]\rvert - ob$
ASBN		$cb+1$	$oa+l$	0	
ALEN					$\lvert A[ca]\rvert - oa$
ANBS	$ca+1$		0	$ob+l$	
BLEN					$\lvert B[cb]\rvert - ob$
ASBN		$cb+1$	$oa+l$	0	
ALEN					$\lvert A[ca]\rvert - oa$
ANBS	$ca+1$		0	$ob+l$	
ALEN					$\lvert A[ca]\rvert - oa$
ANBN	$ca+1$	$cb+1$	0	0	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$



Synthesize Control Flow

$$\text{INIT} \rightarrow \text{BLEN} \rightarrow \text{ASBN} \rightarrow \text{ALEN} \rightarrow \text{ANBS} \rightarrow \text{BLEN} \rightarrow \ldots \rightarrow \text{ALEN} \rightarrow \text{YES}$$

Synthesize Control Flow

INIT $\rightarrow$ BLEN $\rightarrow$ ASBN $\rightarrow$ ALEN $\rightarrow$ ANBS $\rightarrow$ BLEN $\rightarrow \ldots \rightarrow$ ALEN $\rightarrow$ YES

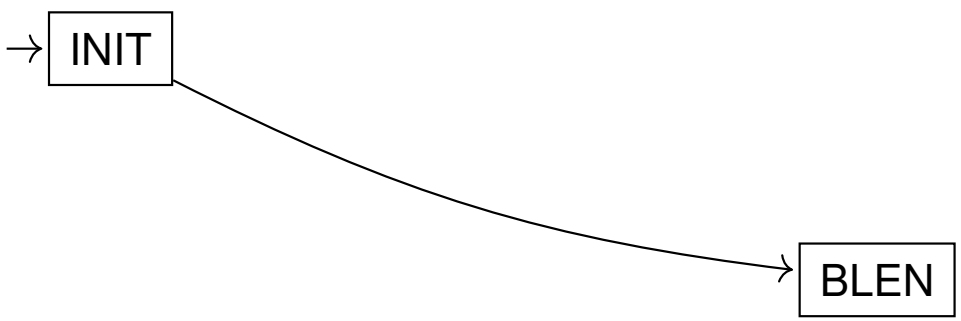
Synthesize Control Flow

INIT $\rightarrow$ BLEN $\rightarrow$ ASBN $\rightarrow$ ALEN $\rightarrow$ ANBS $\rightarrow$ BLEN $\rightarrow \ldots \rightarrow$ ALEN $\rightarrow$ YES

$\rightarrow$ INIT

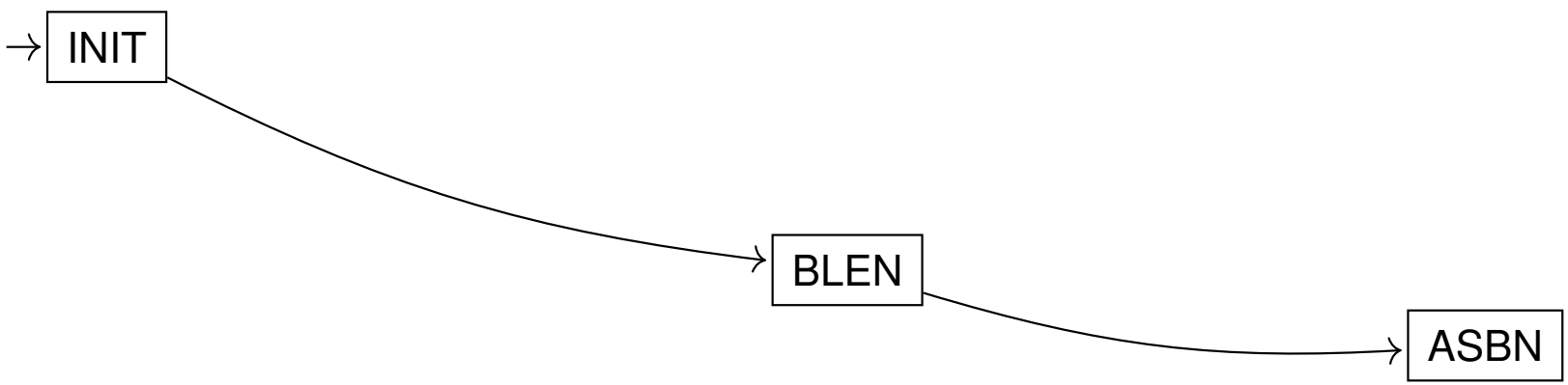
Synthesize Control Flow

INIT $\rightarrow$ BLEN $\rightarrow$ ASBN $\rightarrow$ ALEN $\rightarrow$ ANBS $\rightarrow$ BLEN $\rightarrow \ldots \rightarrow$ ALEN $\rightarrow$ YES



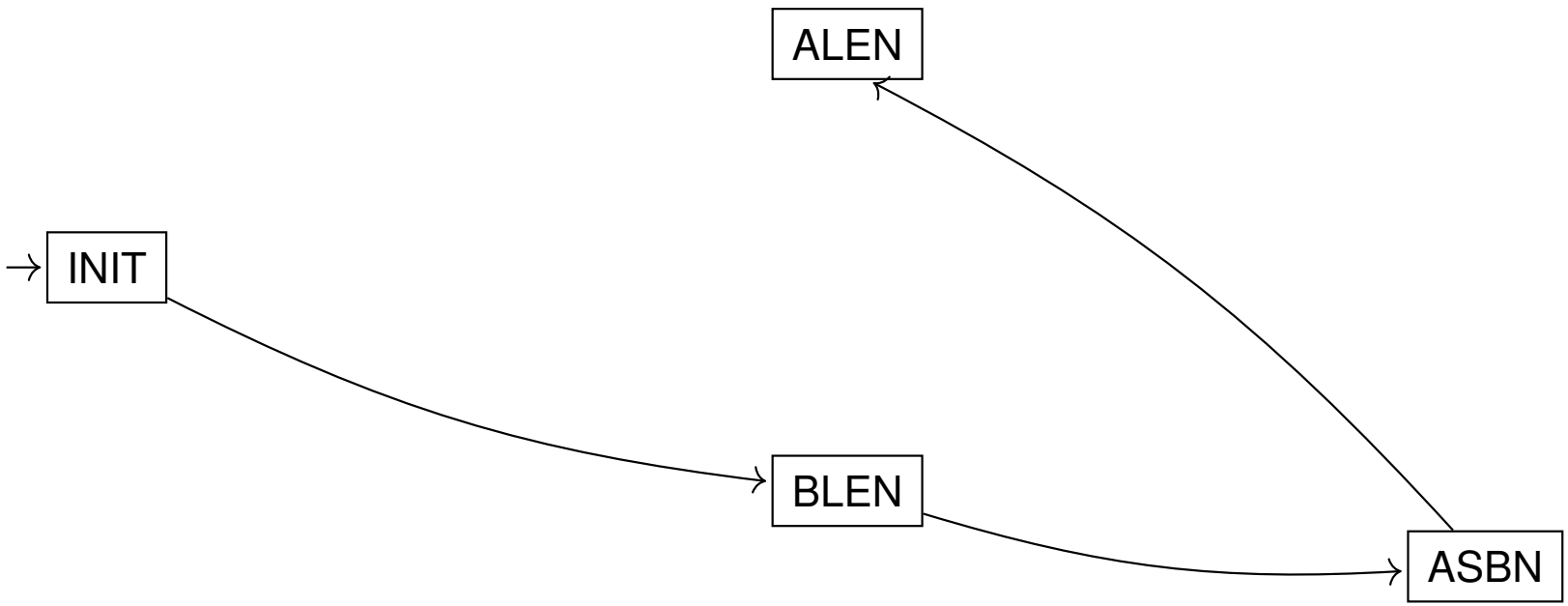
Synthesize Control Flow

INIT → BLEN → ASBN → ALEN → ANBS → BLEN → . . . → ALEN → YES



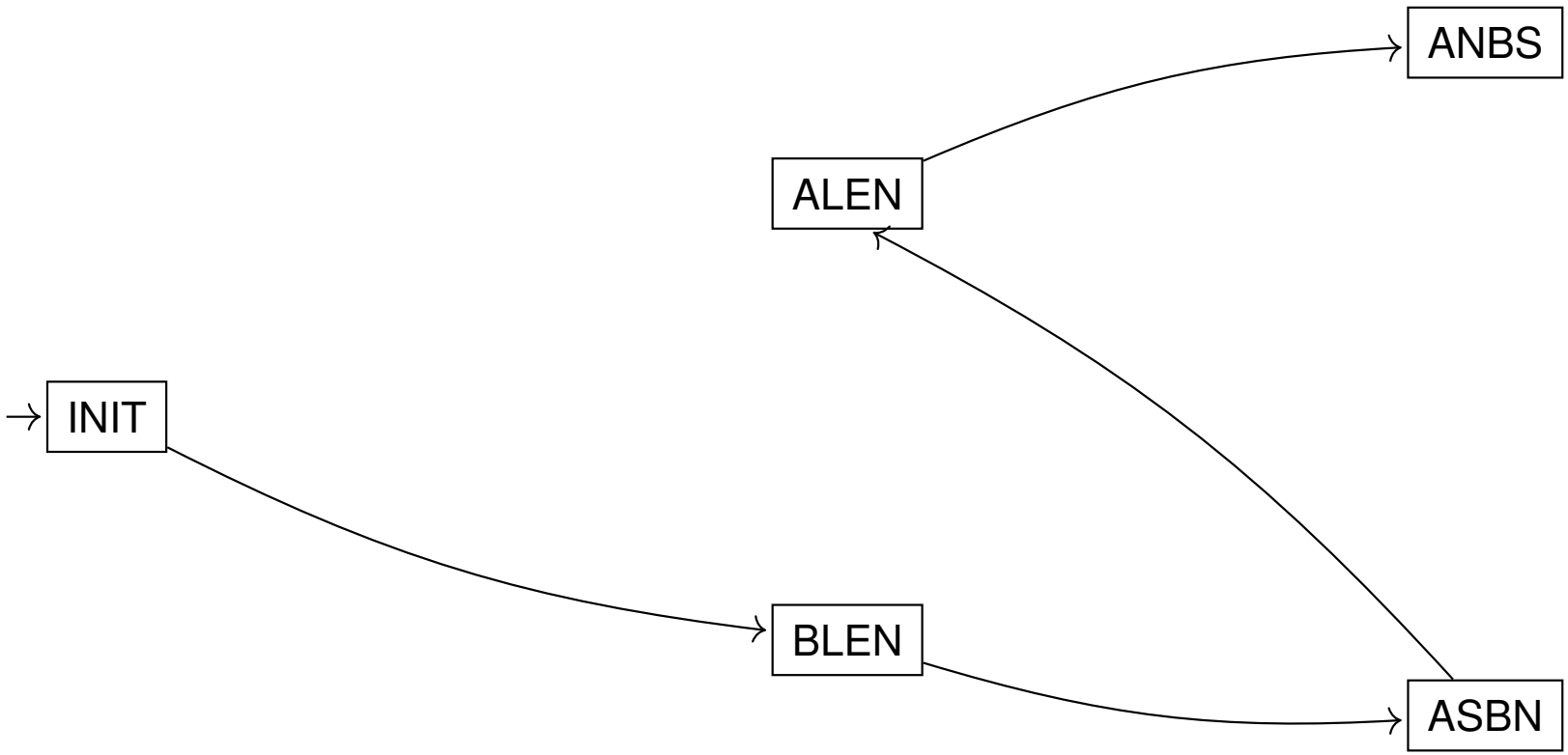
Synthesize Control Flow

INIT → BLEN → ASBN → ALEN → ANBS → BLEN → . . . → ALEN → YES



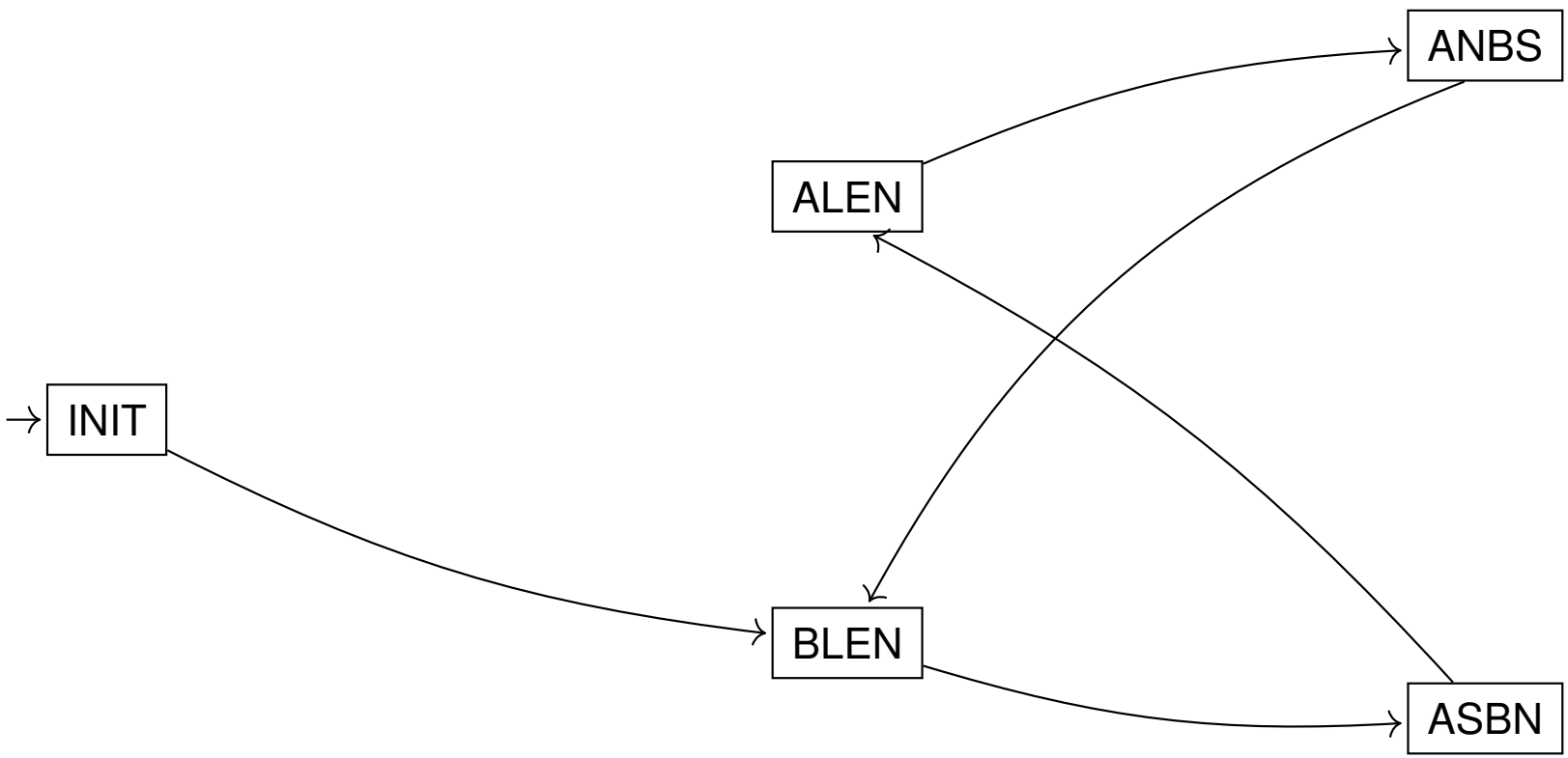
Synthesize Control Flow

INIT → BLEN → ASBN → ALEN → ANBS → BLEN → . . . → ALEN → YES



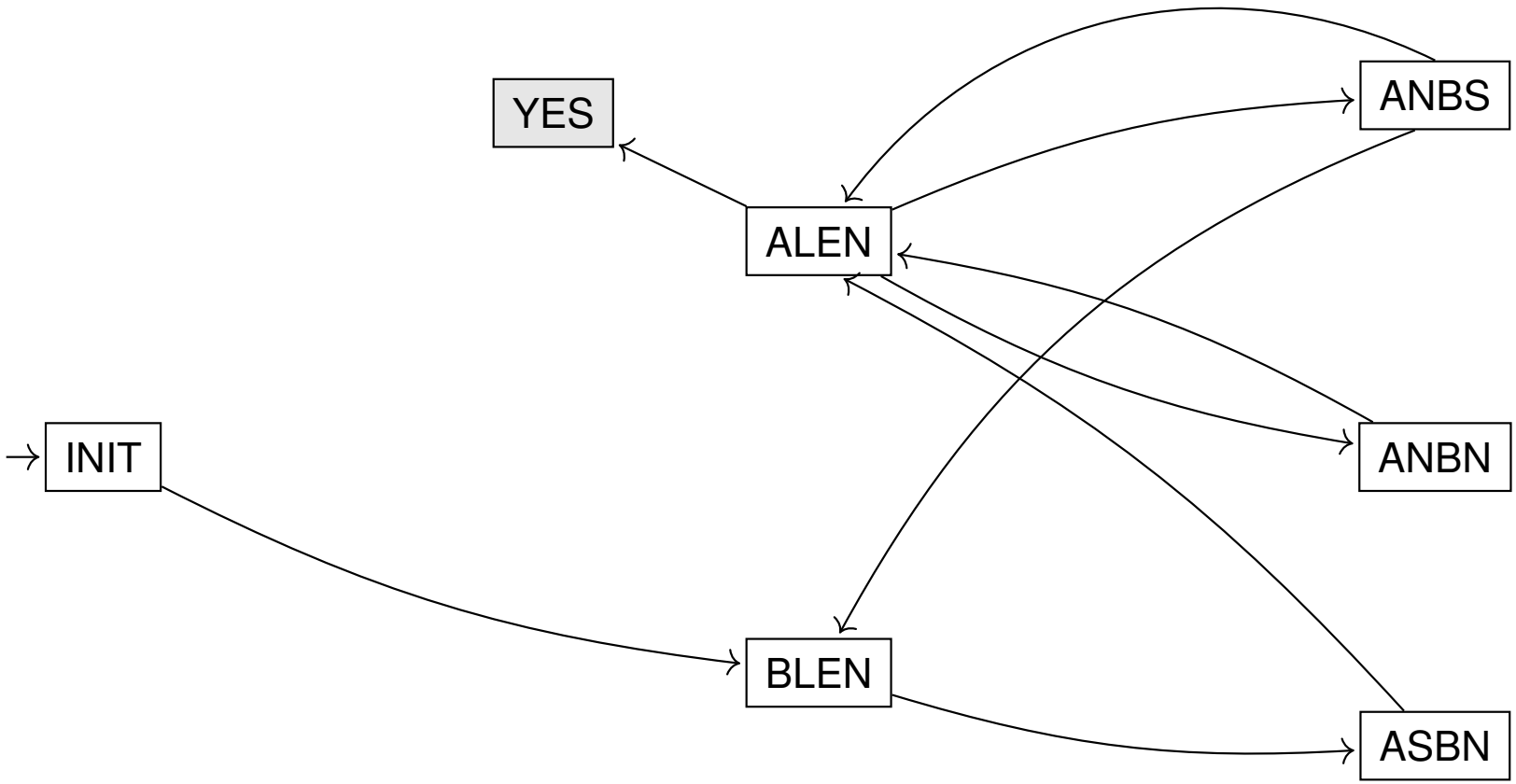
Synthesize Control Flow

INIT → BLEN → ASBN → ALEN → ANBS → BLEN → . . . → ALEN → YES



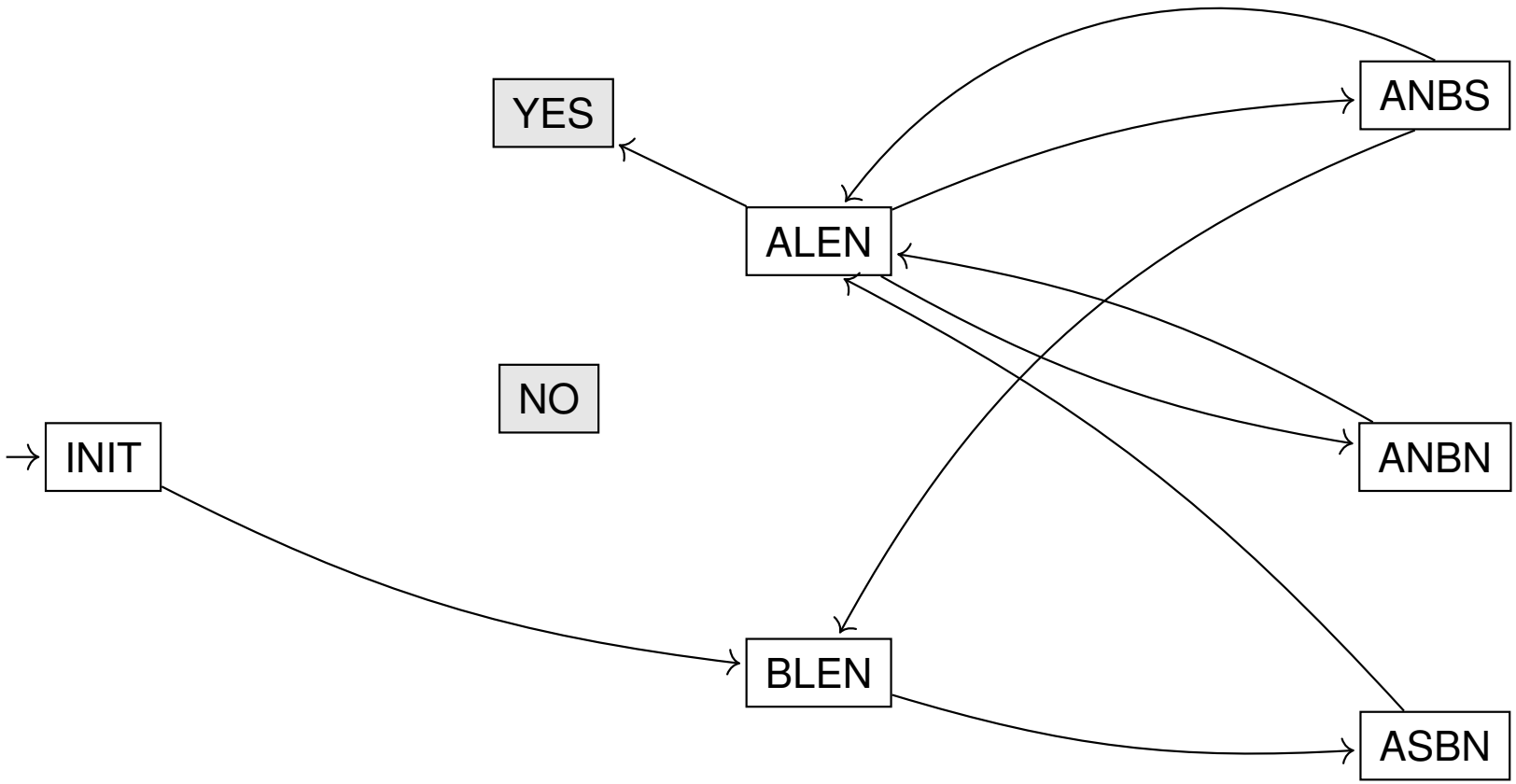
Synthesize Control Flow

INIT $\rightarrow$ BLEN $\rightarrow$ ASBN $\rightarrow$ ALEN $\rightarrow$ ANBS $\rightarrow$ BLEN $\rightarrow \ldots \rightarrow$ ALEN $\rightarrow$ YES



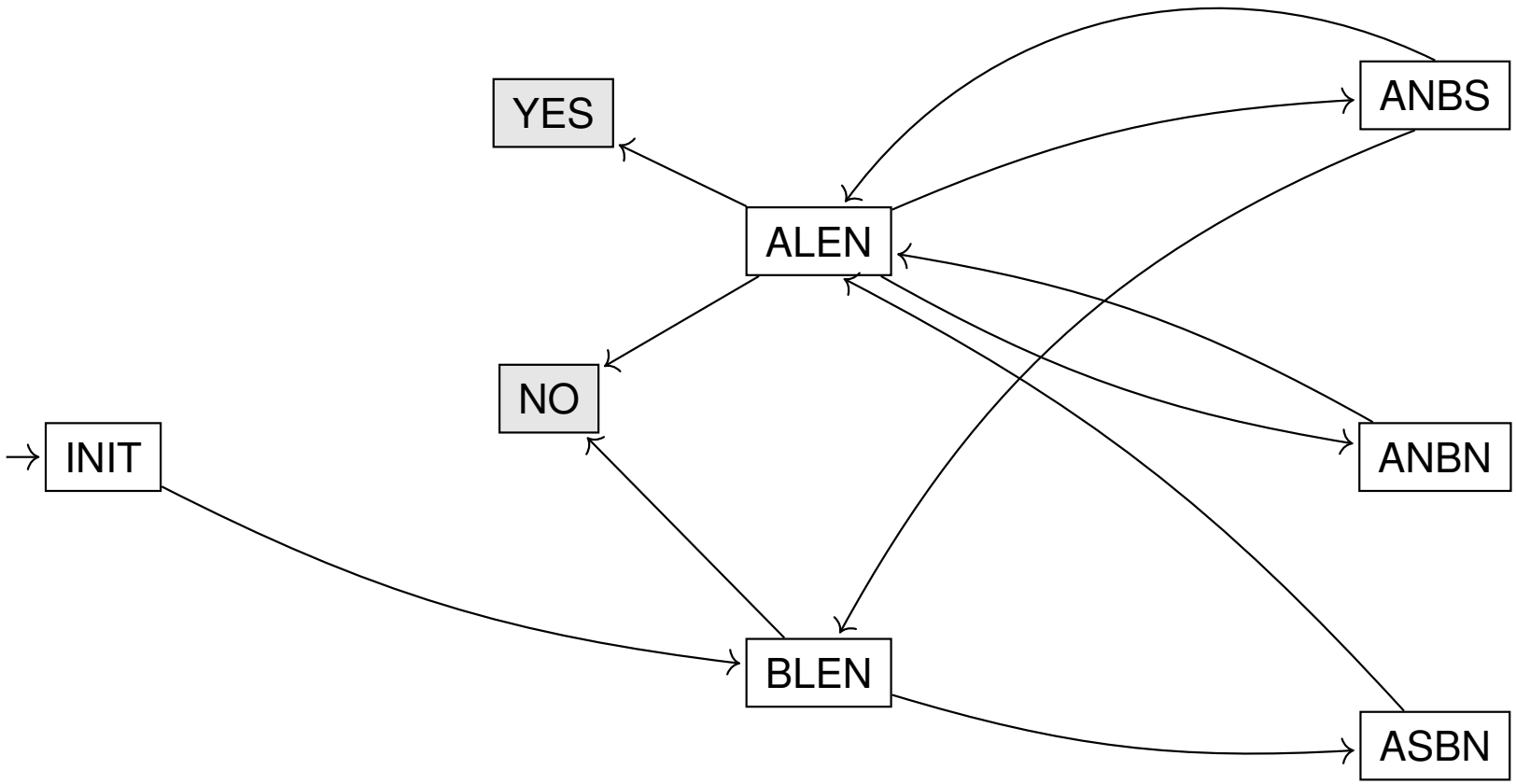
Synthesize Control Flow

INIT $\rightarrow$ BLEN $\rightarrow$ ASBN $\rightarrow$ ALEN $\rightarrow$ ANBS $\rightarrow$ BLEN $\rightarrow \ldots \rightarrow$ ALEN $\rightarrow$ YES



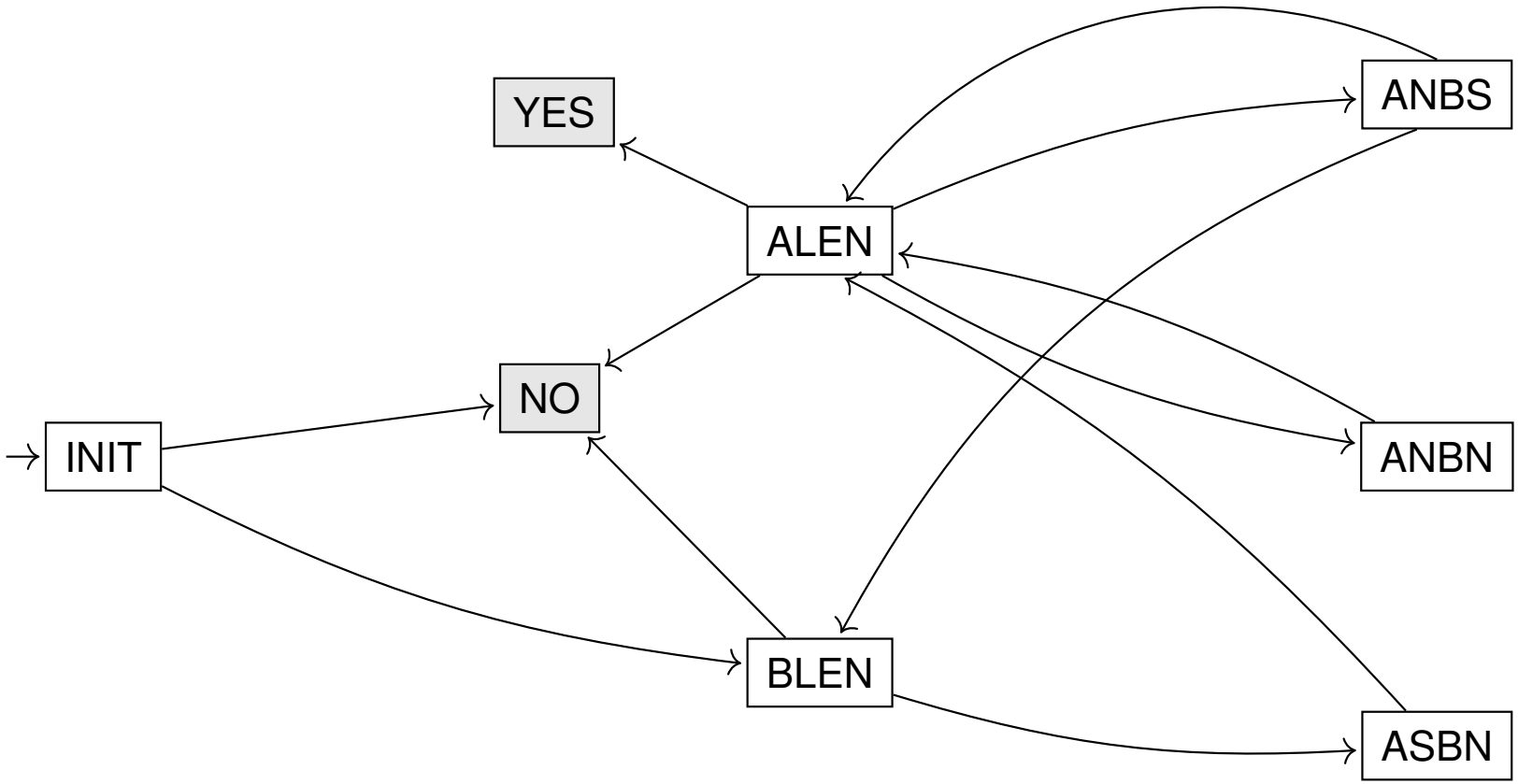
Synthesize Control Flow

INIT $\rightarrow$ BLEN $\rightarrow$ ASBN $\rightarrow$ ALEN $\rightarrow$ ANBS $\rightarrow$ BLEN $\rightarrow \ldots \rightarrow$ ALEN $\rightarrow$ YES



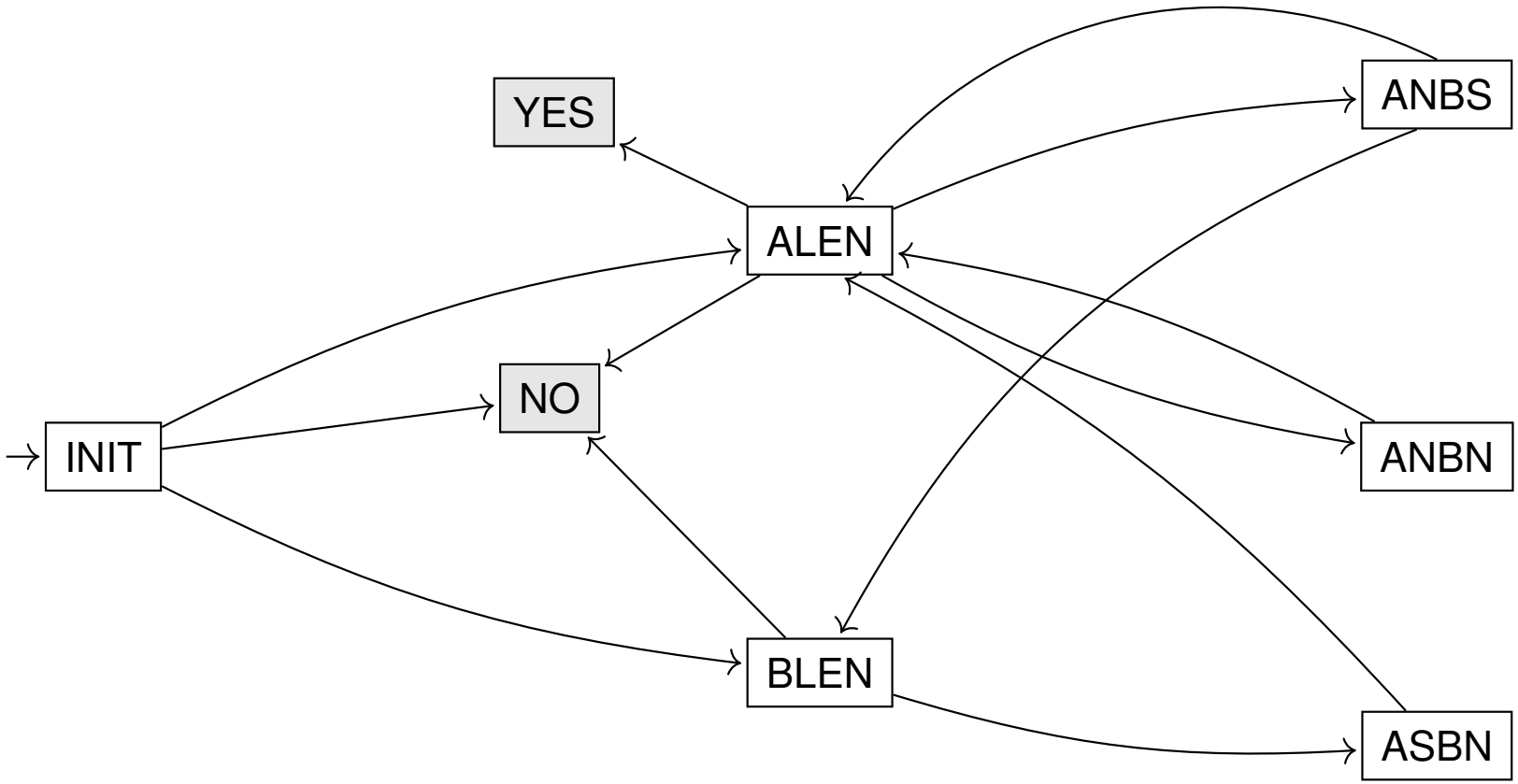
Synthesize Control Flow

$$\text{INIT} \rightarrow \text{BLEN} \rightarrow \text{ASBN} \rightarrow \text{ALEN} \rightarrow \text{ANBS} \rightarrow \text{BLEN} \rightarrow \ldots \rightarrow \text{ALEN} \rightarrow \text{YES}$$



Synthesize Control Flow

$$\text{INIT} \to \text{BLEN} \to \text{ASBN} \to \text{ALEN} \to \text{ANBS} \to \text{BLEN} \to \ldots \to \text{ALEN} \to \text{YES}$$



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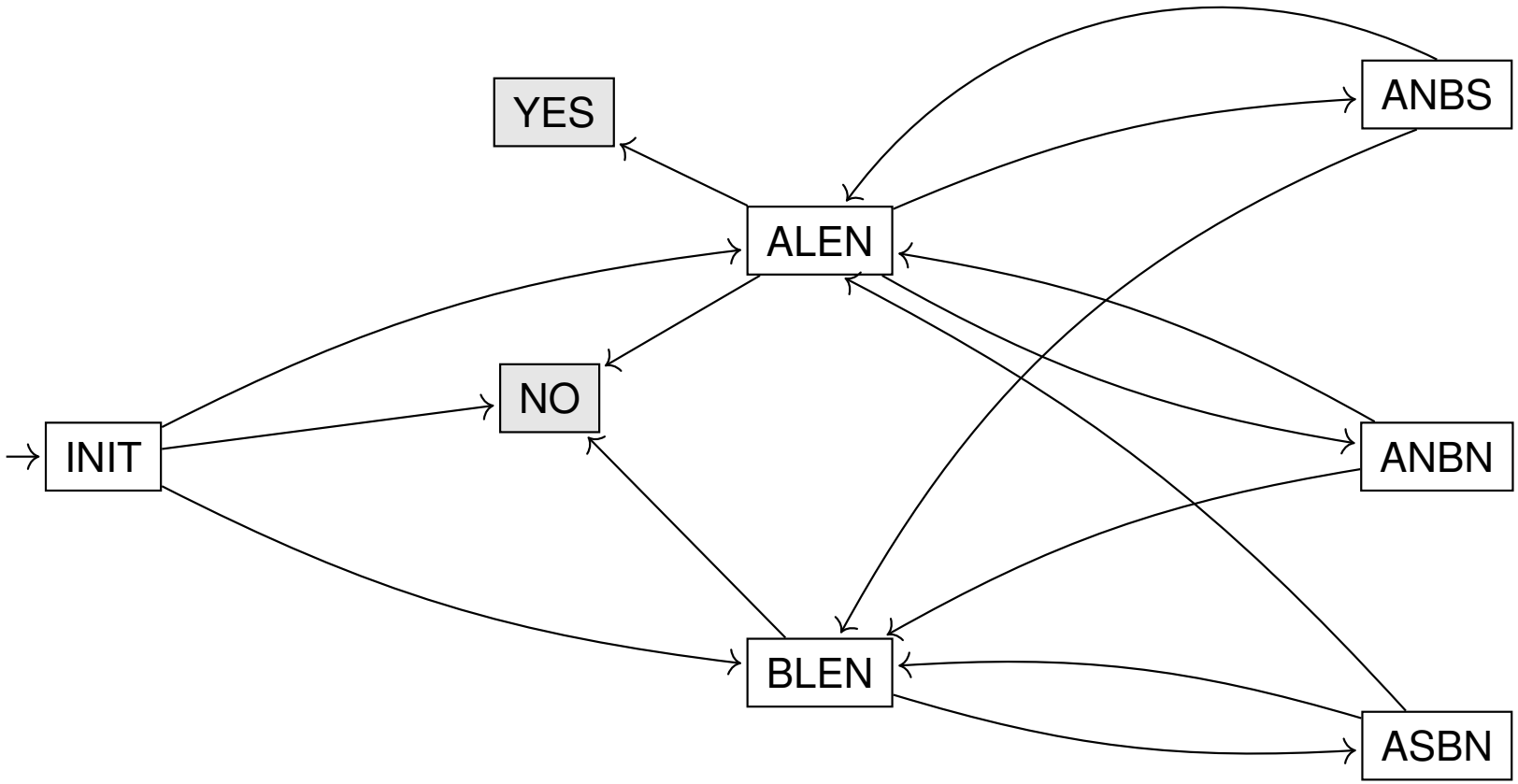

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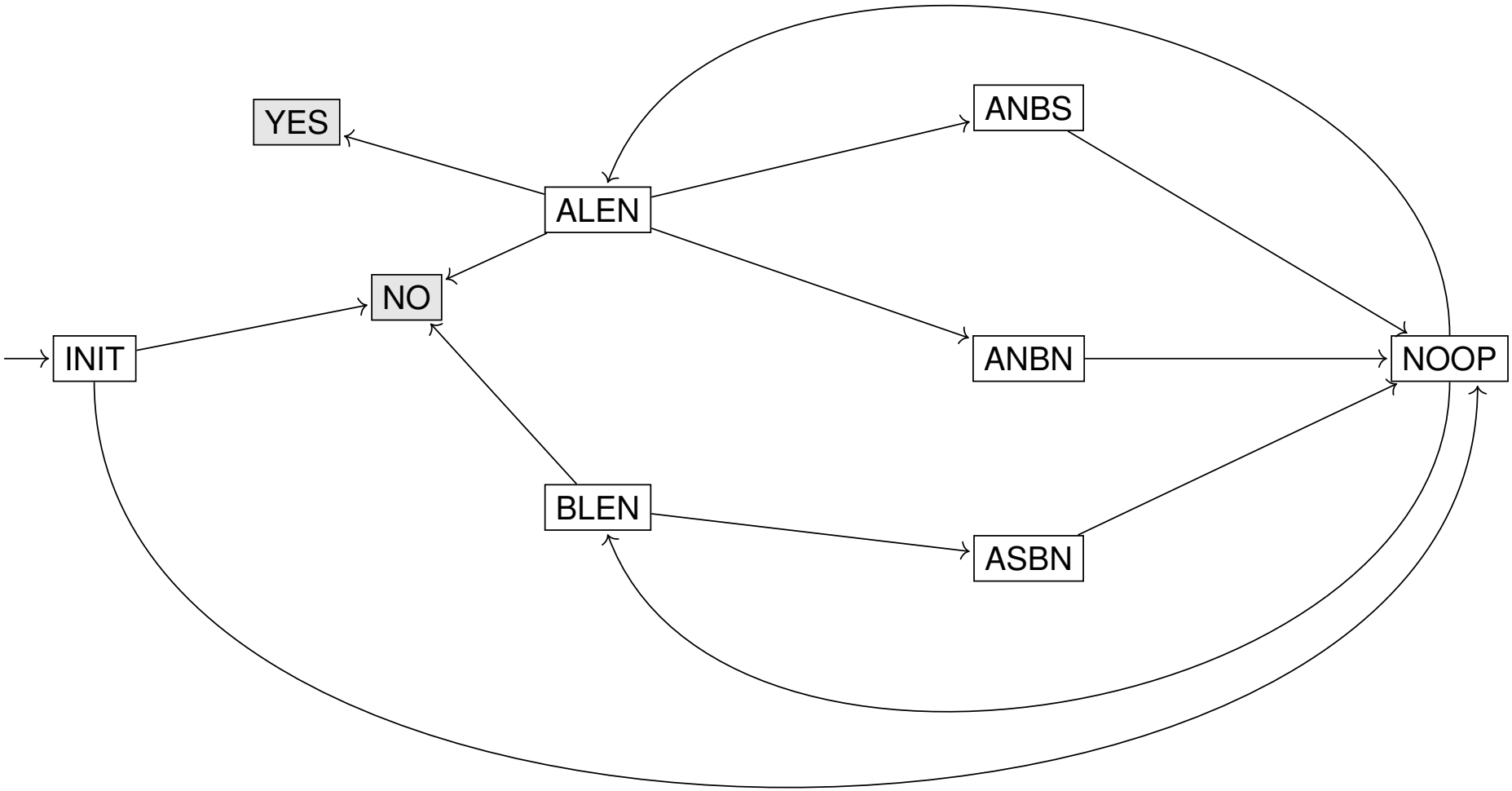

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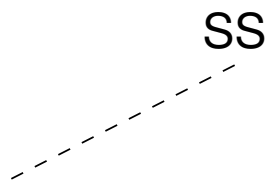

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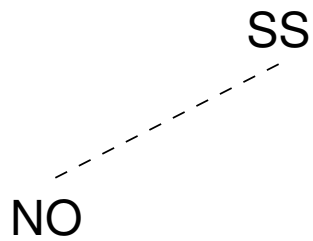

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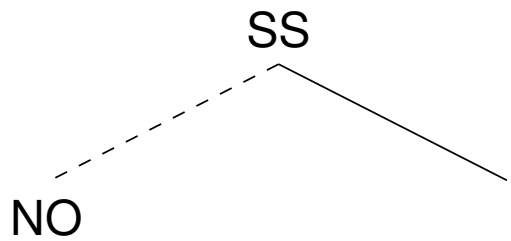

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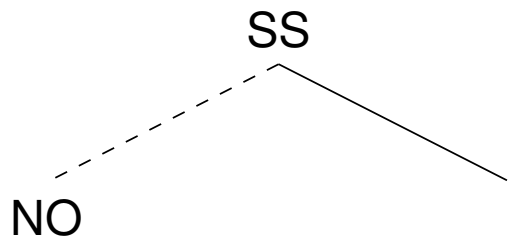

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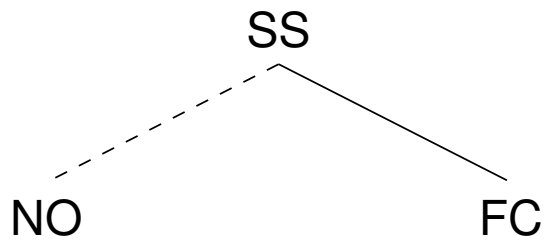

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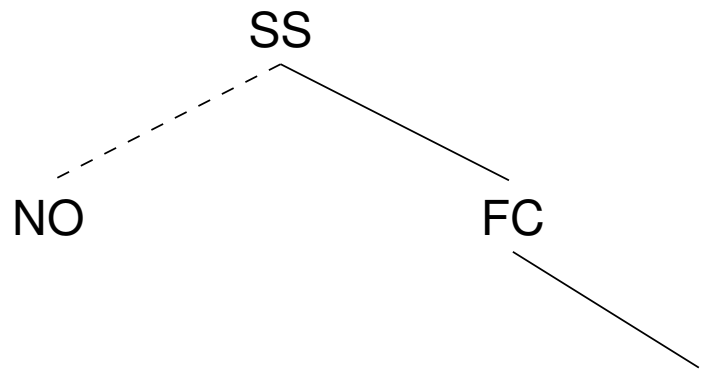

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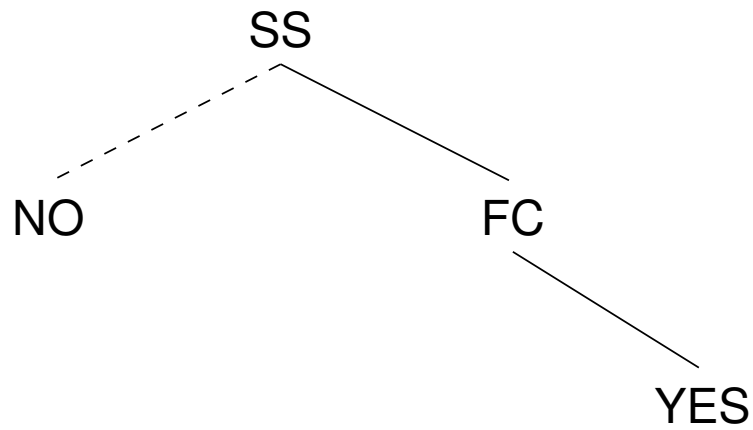

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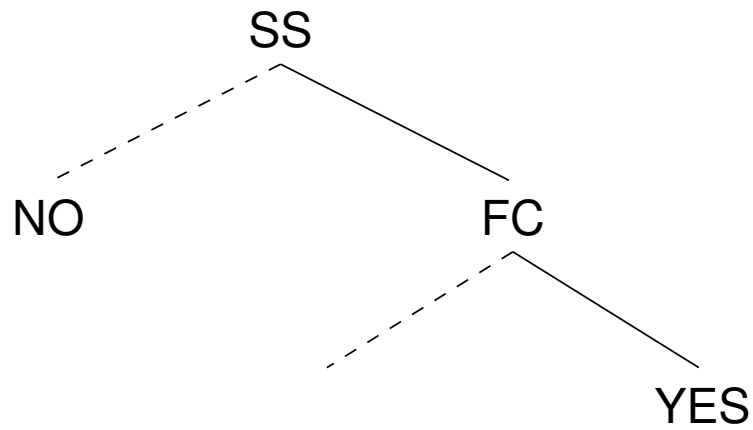

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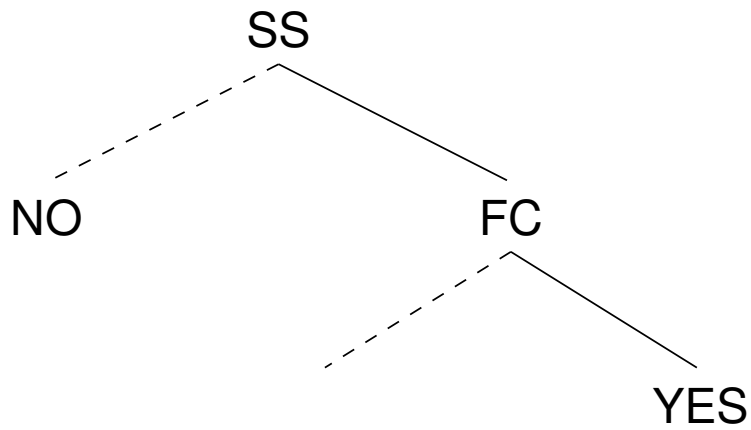

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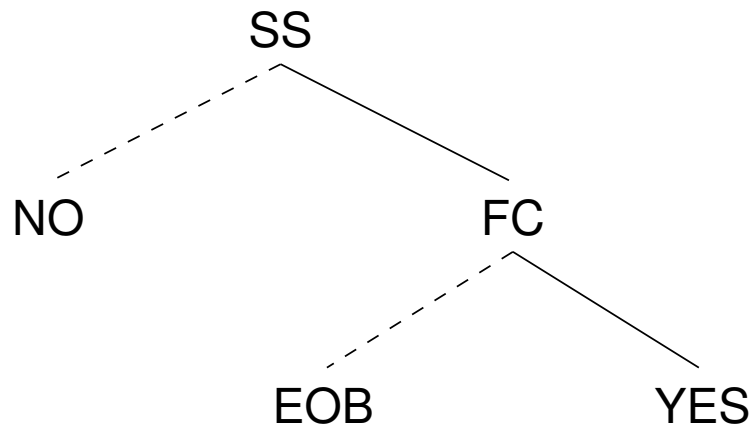

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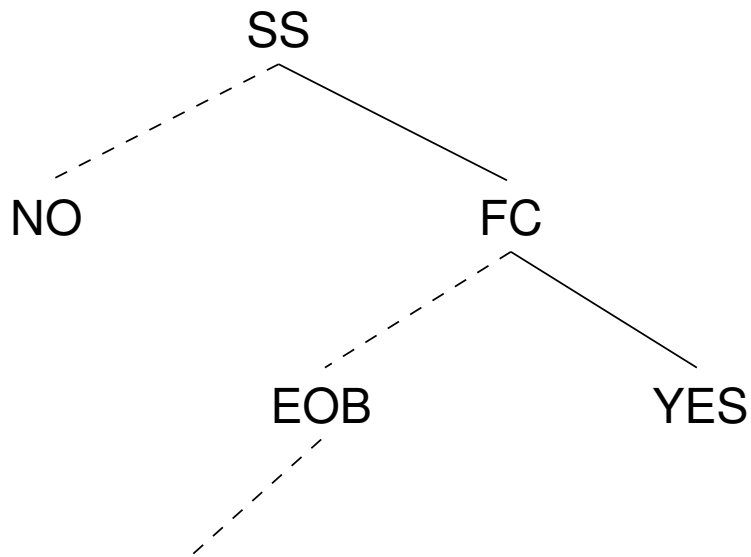

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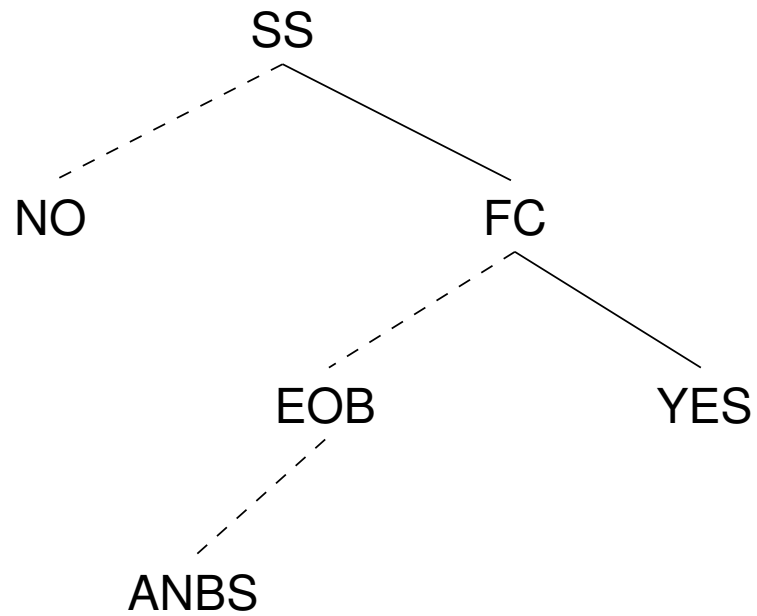

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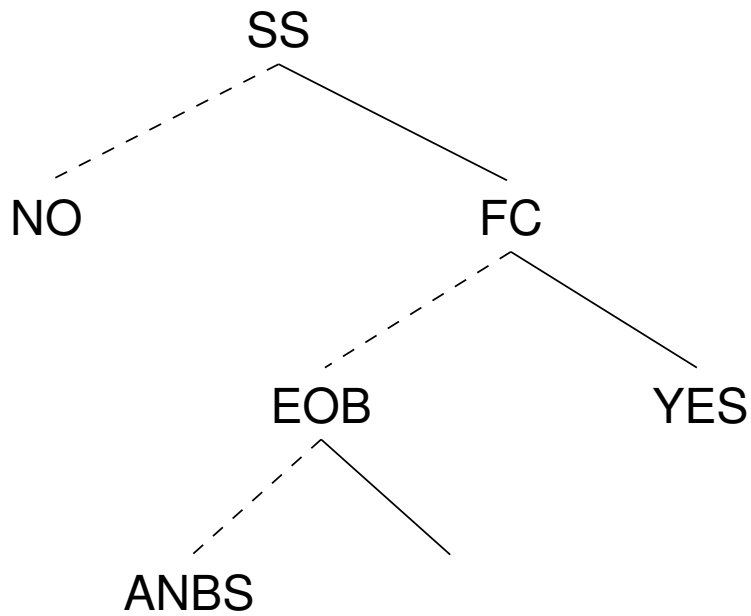

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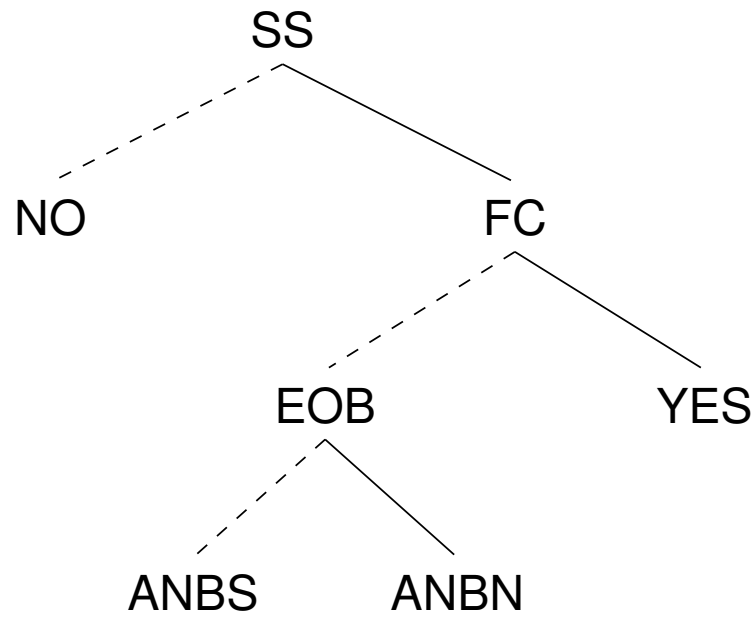

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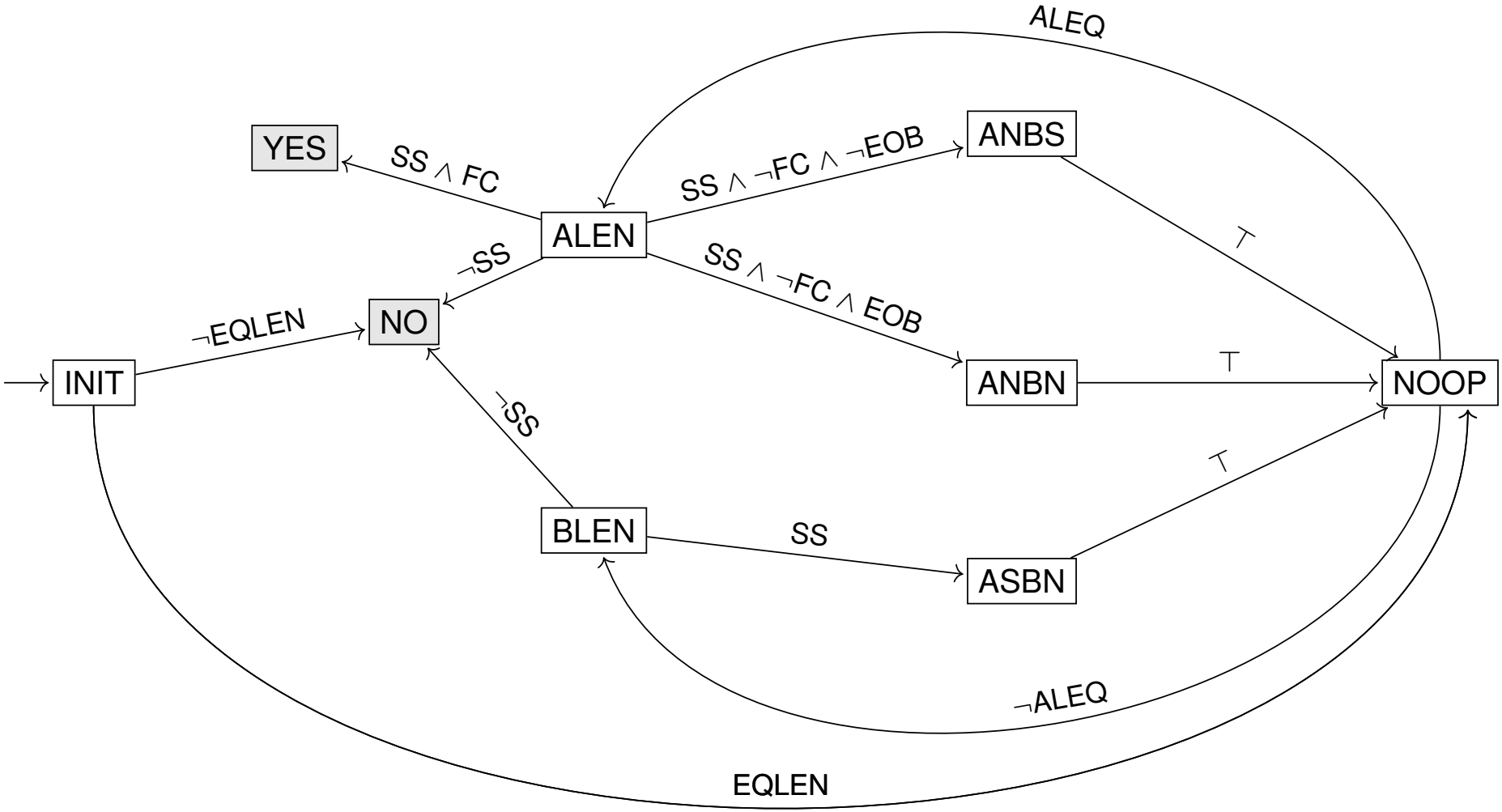
Complete Program



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