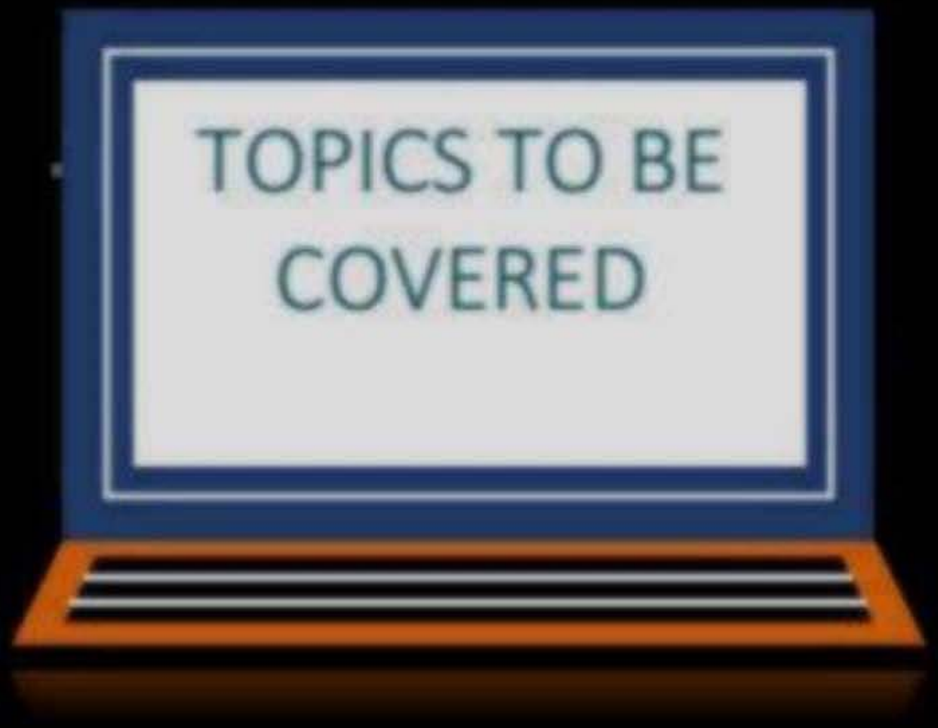
CS & IT ENGINEERING

Compiler Design

Intermediate code and code optimization

Lecture No. 4

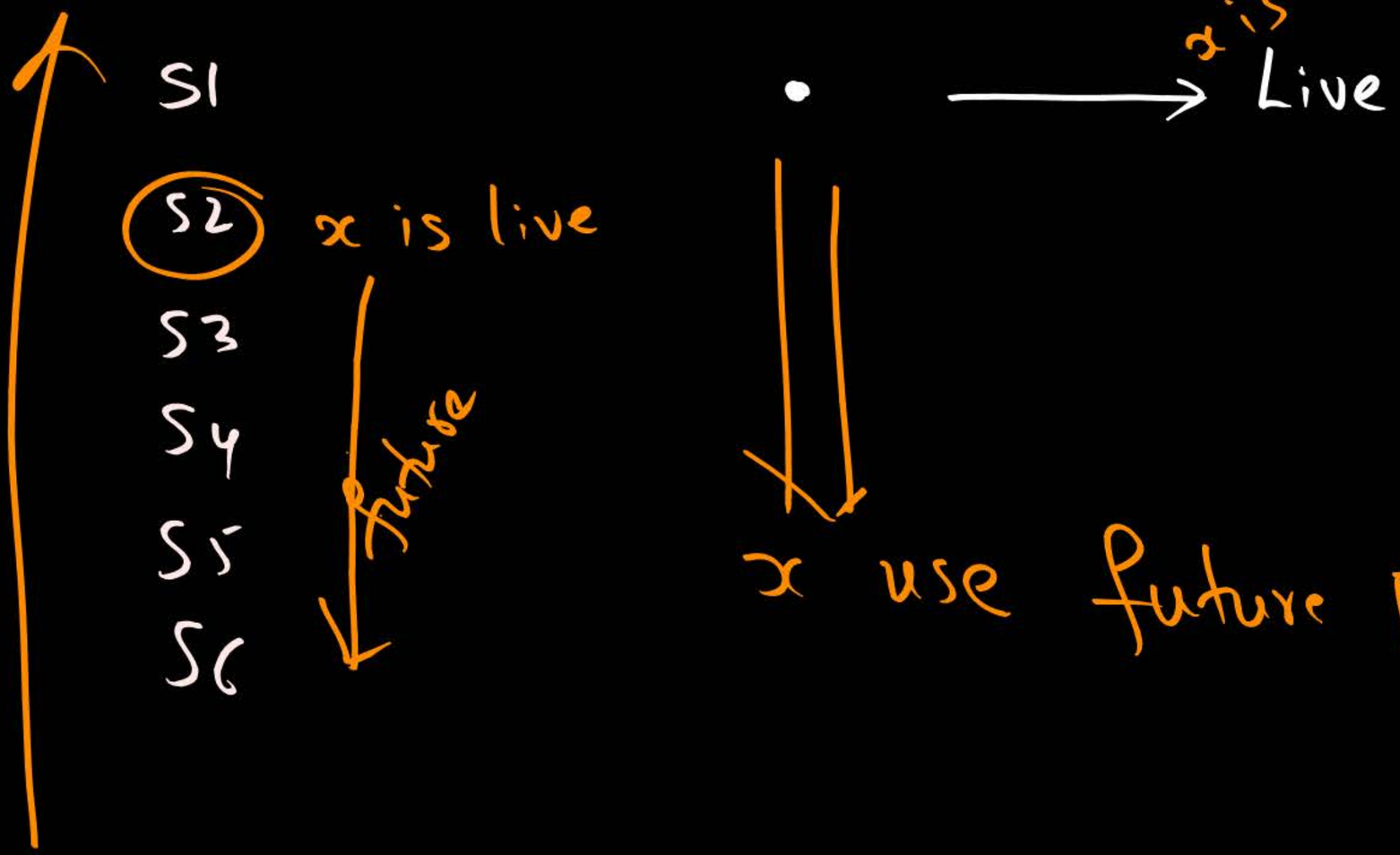
By- DEVA Sir



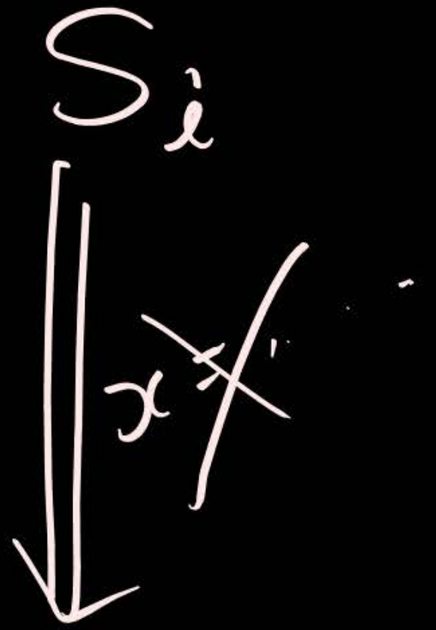
(Liveness)

1. Live Variable Analysis
   - What is Live variable ?
   - GEN set, KILL set } for Basic Block
   - IN Set, OUT Set } for Basic Block using Backward Analysis
   - Live variable Analysis on program using Backward Analysis
2. Reaching Definitions Analysis using Backward Analysis

What is Live variable ?



What is live variable ?



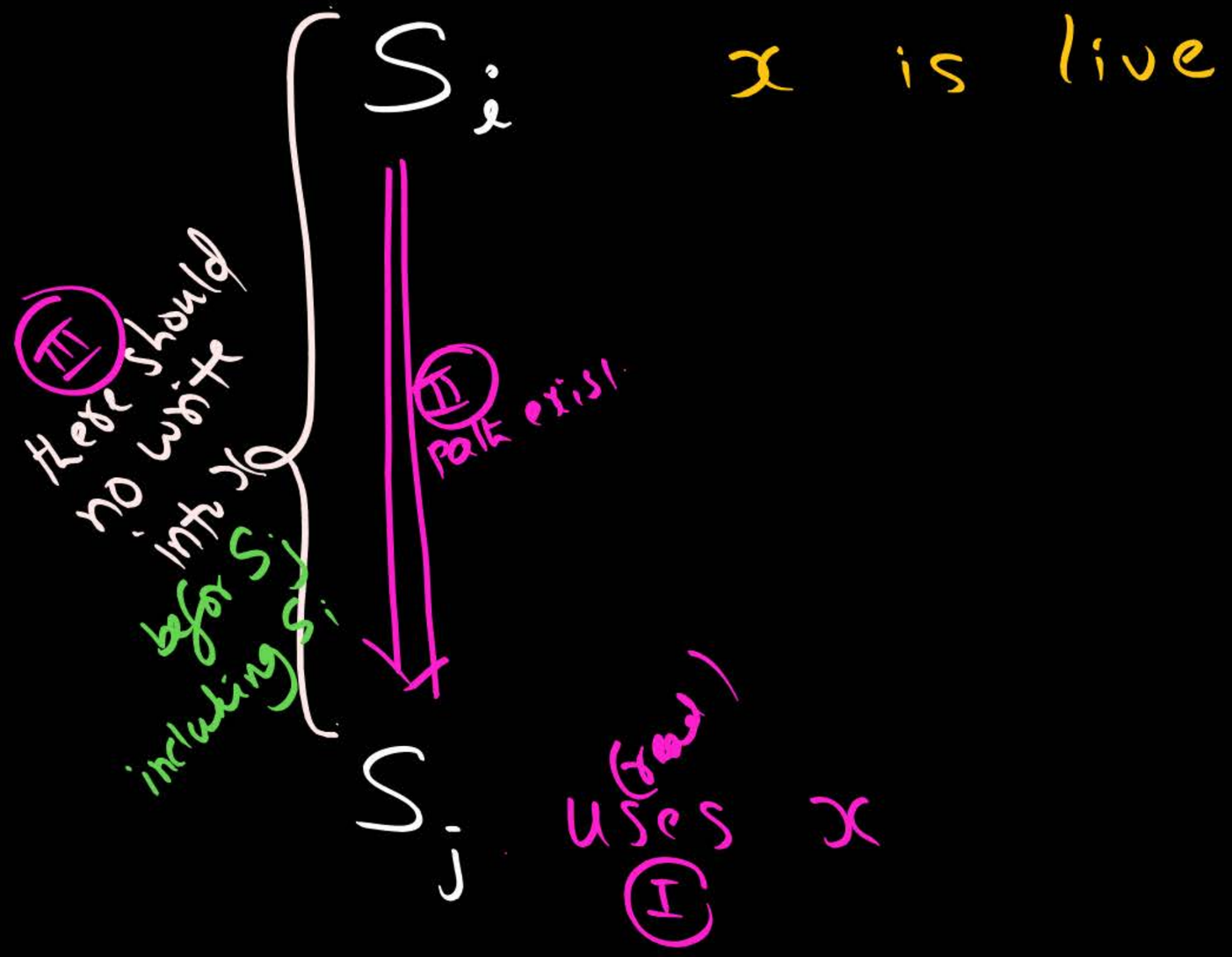
x is live at S_i

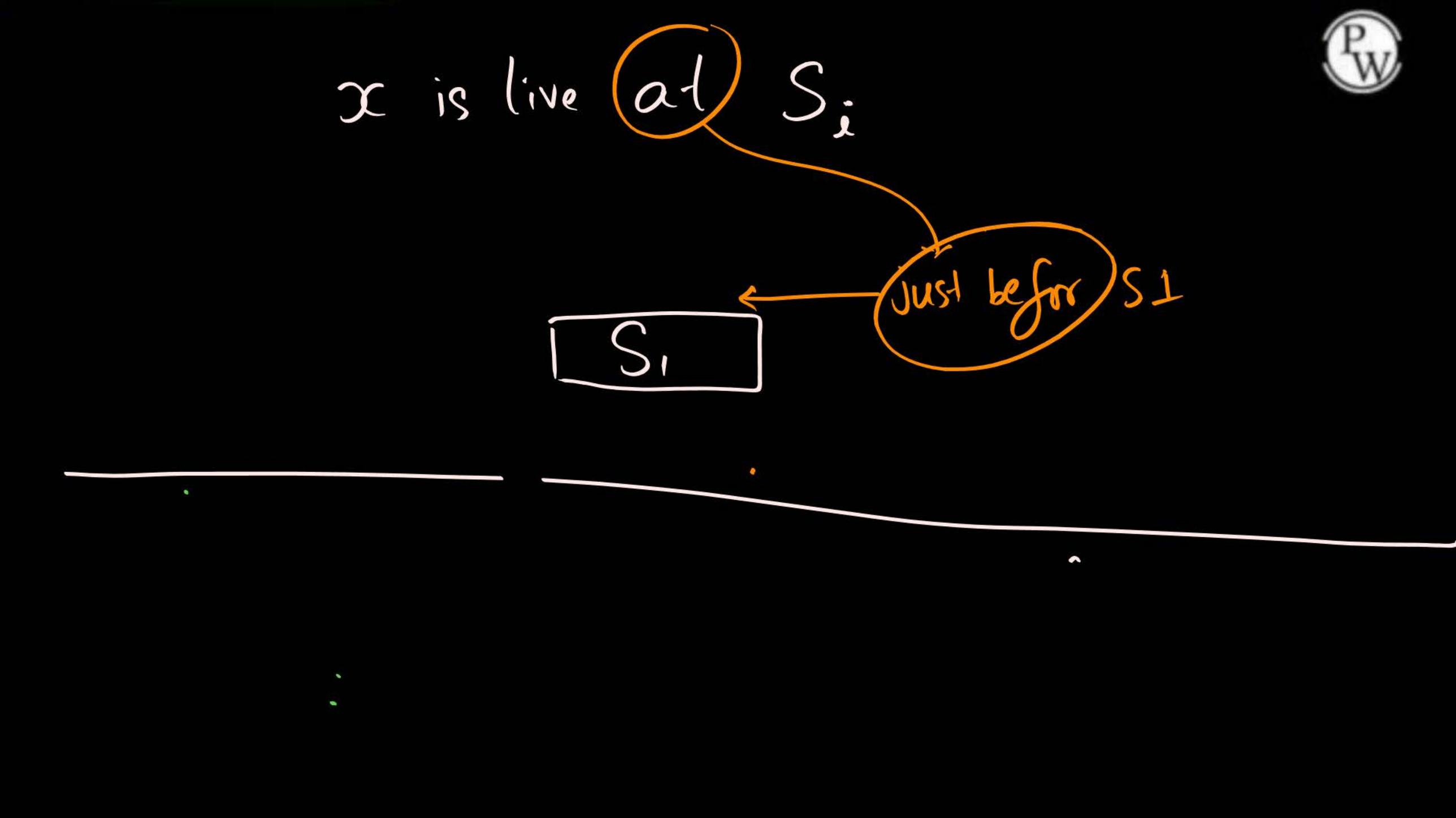
iff

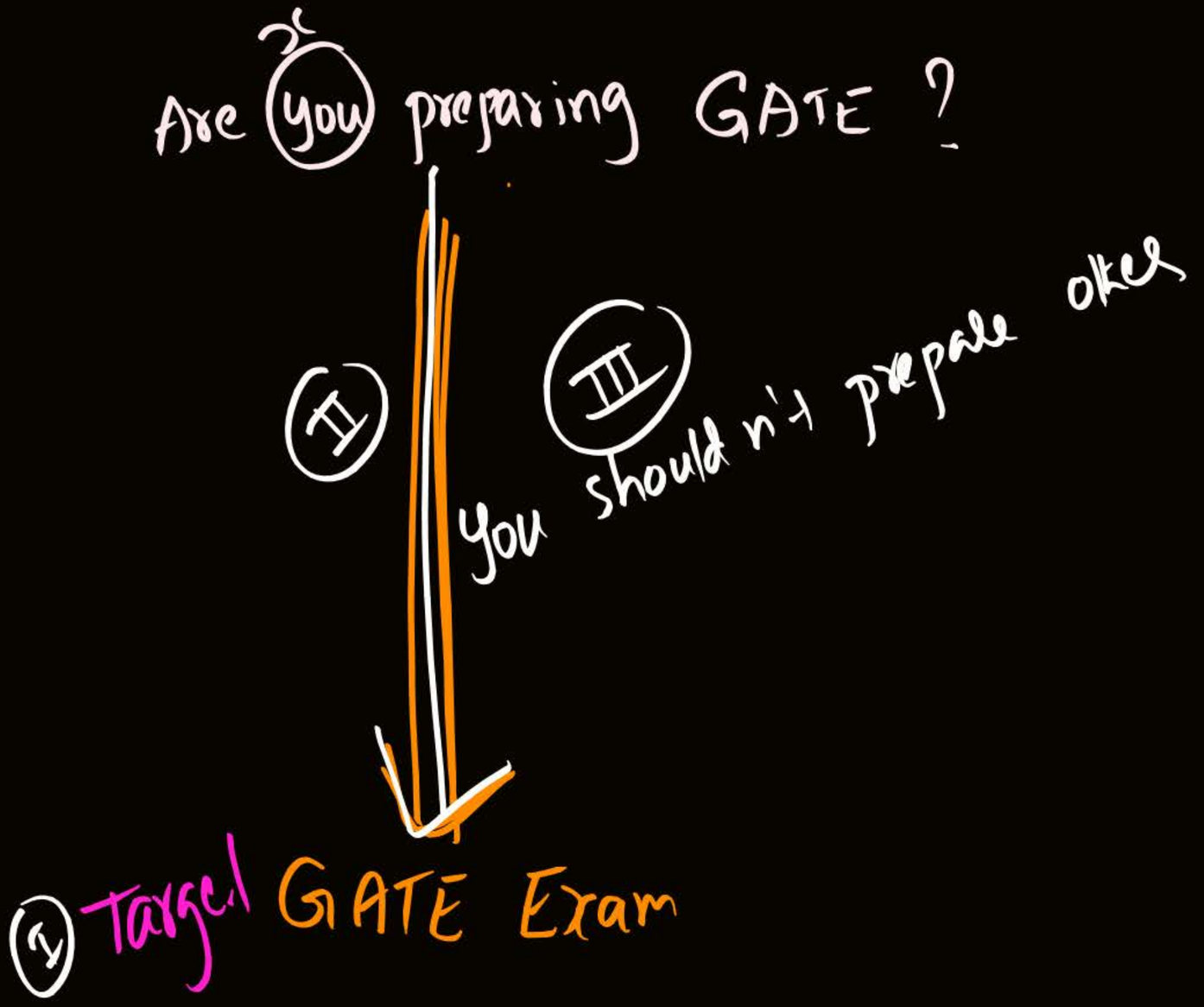
I) S_j uses x

II) Path exist from S_i to S_j

III) x shouldn't be modified in b/w
[x shouldn't have assignment (defined) in b/w S_i & S_j]


S_i
x is live
Here should no write into x before S_i including S_i
Path exist
S_j
uses x


x is live at S_i
Just befor S1
S_1


Are you preparing GATE ?
II
III
You should n't prepare other
1 Target GATE Exam

Q1) What are live variables at statement 1?

1. a = b + c
2. p = a * p
3. q = x + a
4. x = a * p
5. a = x + y

x ✓ is live at S1 → S3 (no work into x)

y ✓ is live → S5 (y = x ...)

a ✗

b ✓ S1 → S1

c ✓

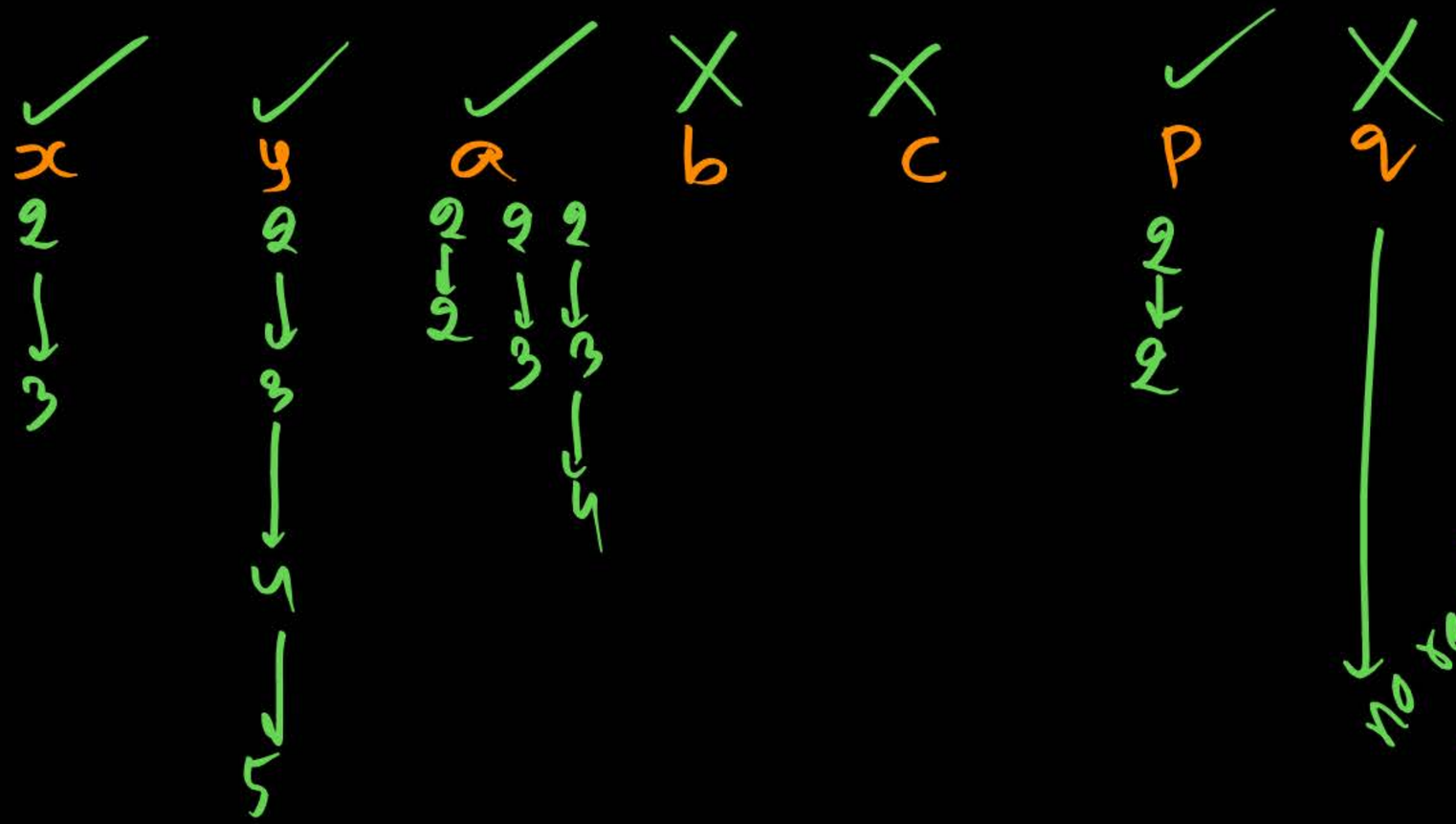
p ✓

q ✗

x, y, b, c, p are live at (1)

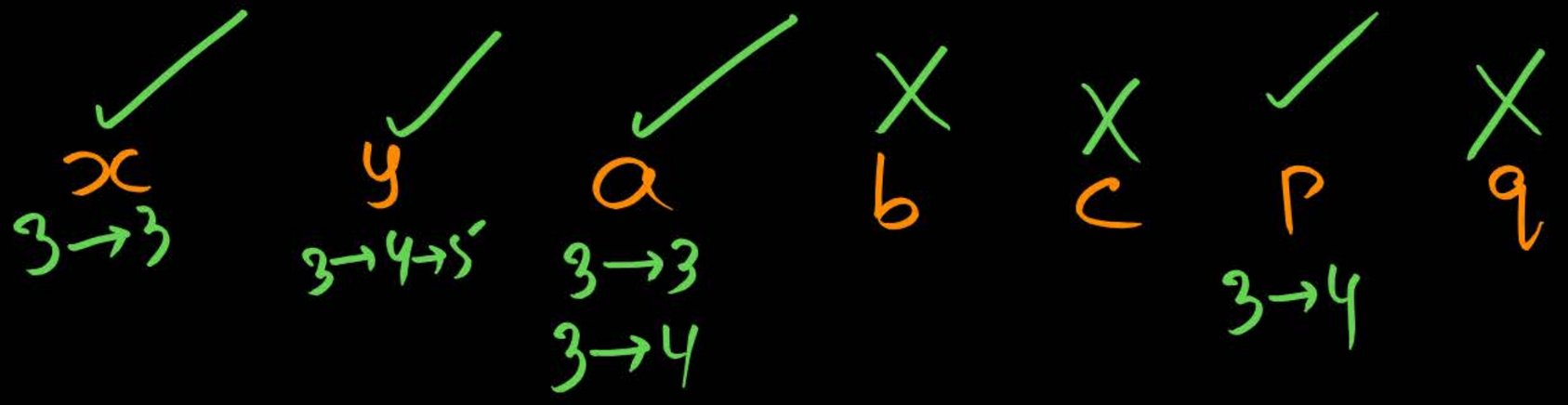
Q2) What are live variables at statement 2?

1. a = b + c
2. p = a * p
3. q = x + a
4. x = a * p
5. a = x + y



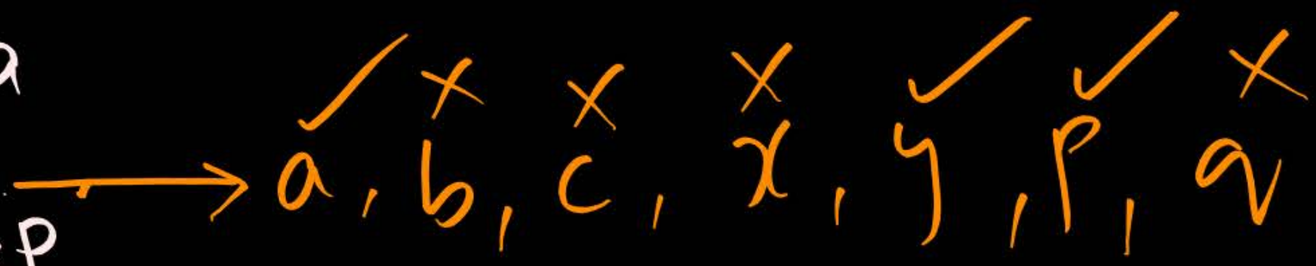
Q3) What are live variables at statement 3?

1. a=b+c
2. p=a*p
3. q=x+a
4. x=a*p
5. a=x+y



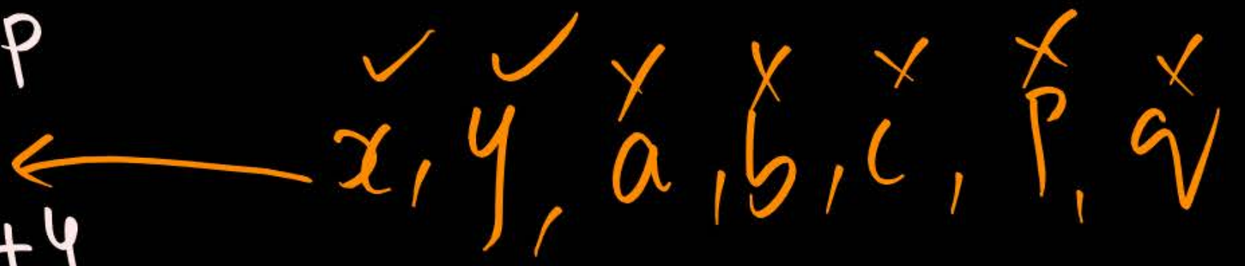
Q4) What are live variables at statement 4 ?

1. a=b+c
2. p=a*p
3. q=x+a
4. x=a*p
5. a=x+y



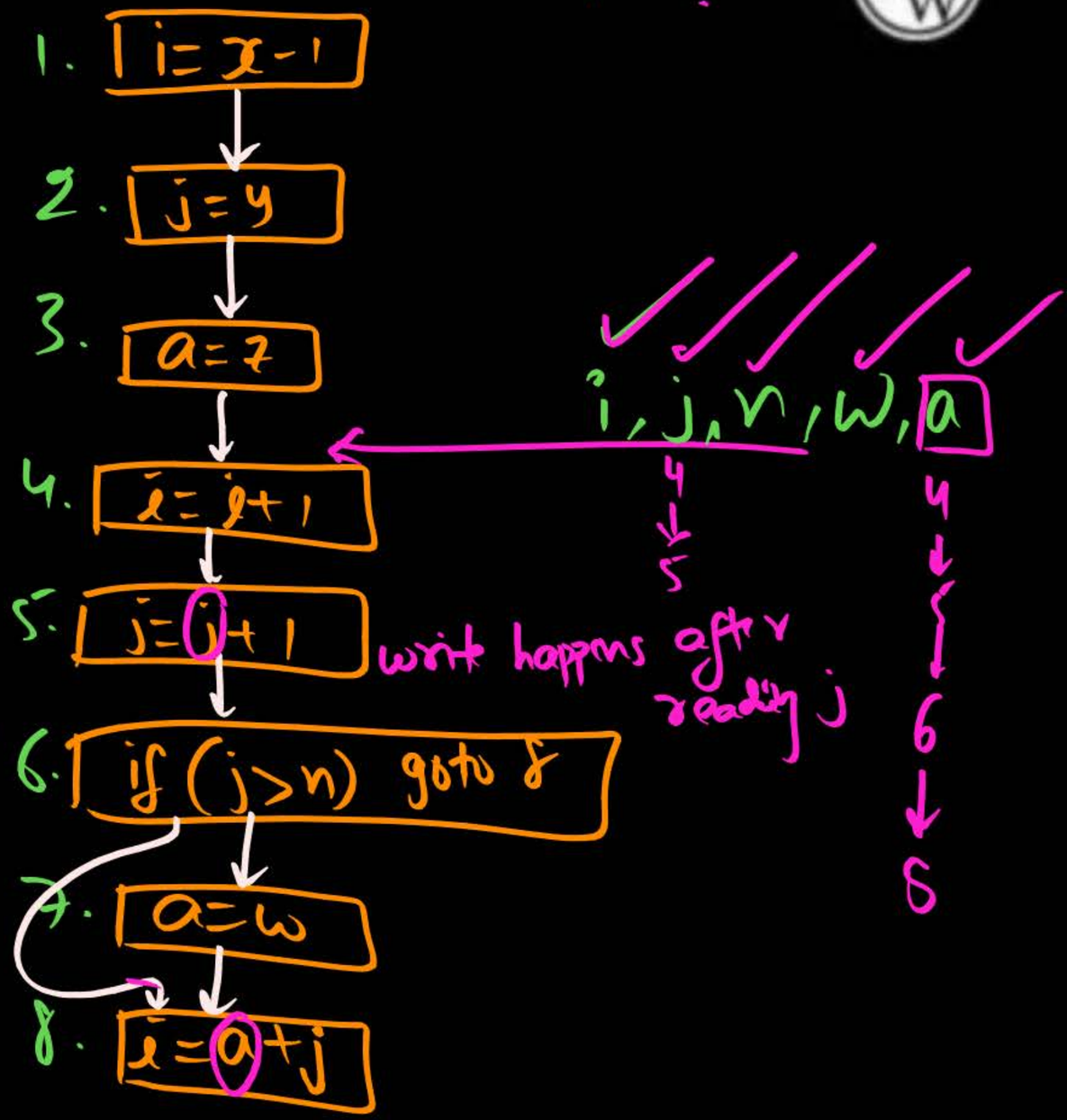
Q5) What are live variables at statement 5?

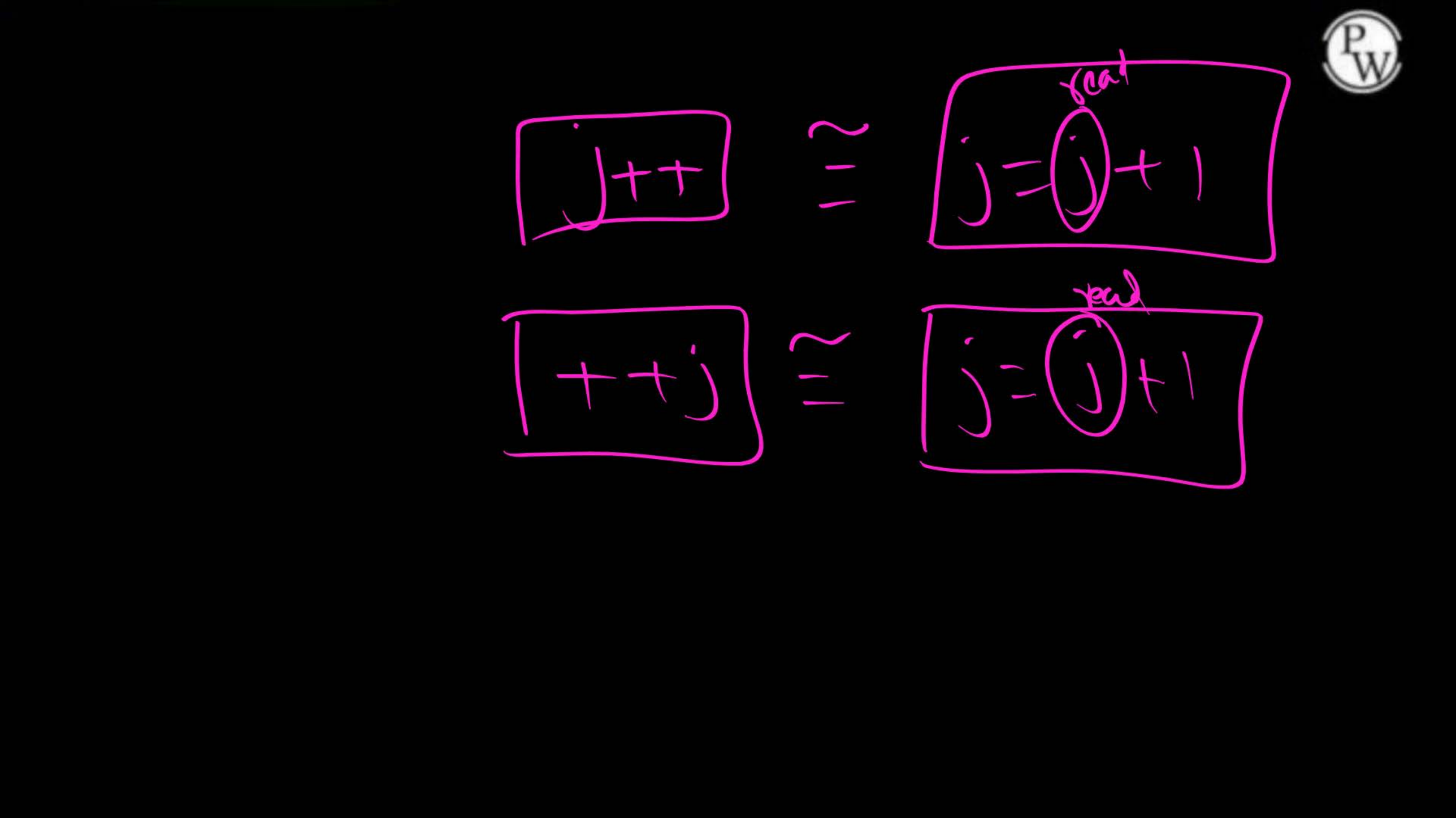
1. a=b+c
2. p=a*p
3. q=x+a
4. x=a*p
5. a=x+y



⑥ What are Live variables at Statement 4 ?

1. i = x - 1
2. j = y
3. a = z
4. i = i + 1
5. j = j + 1
6. if (j > n) goto 8
7. a = w
8. i = a + j



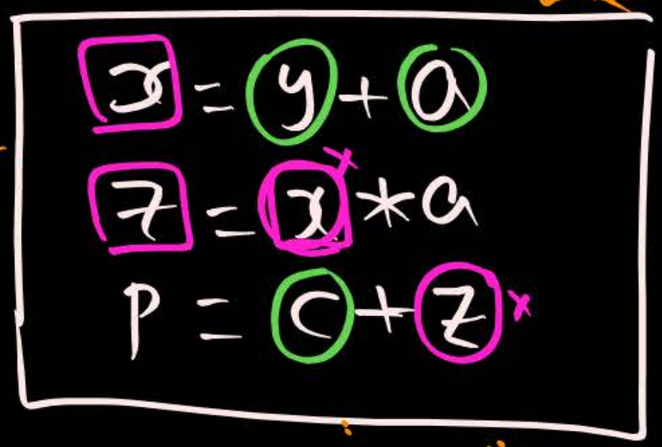

j++
=
j=j+1
++j
=
j=j+1

GEN and KILL Sets for Basic Blocks

$= \{ v \mid$ (LHS of assignment) v is defined $\}$

$KILL_K = \{x, z, p\}$

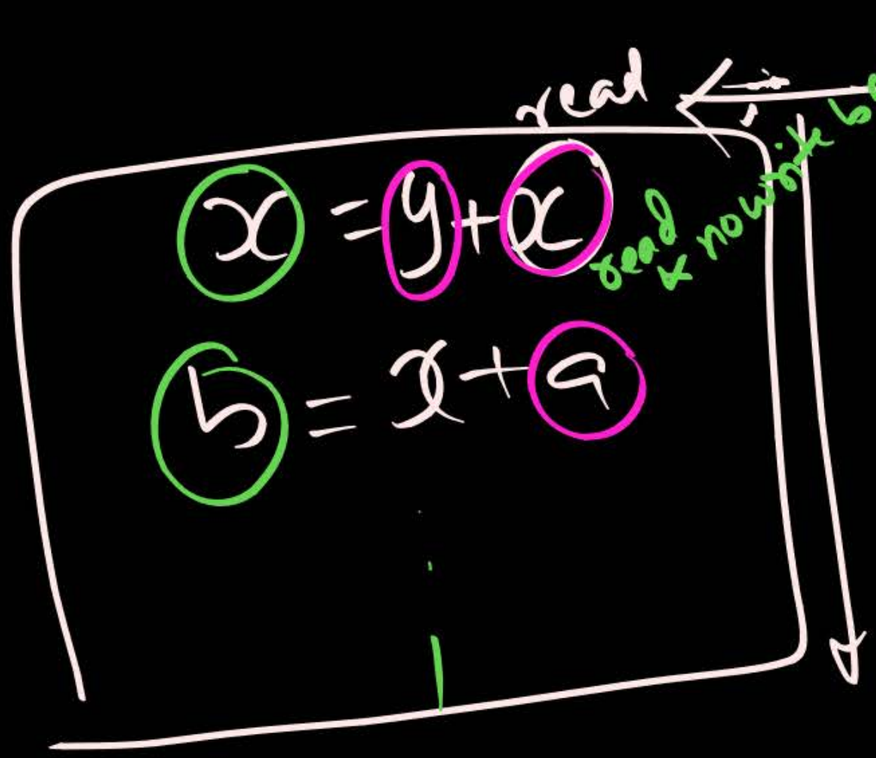
BB$_K$



a, p, x, y, z, c

$GEN_K = \{a, y, c\}$

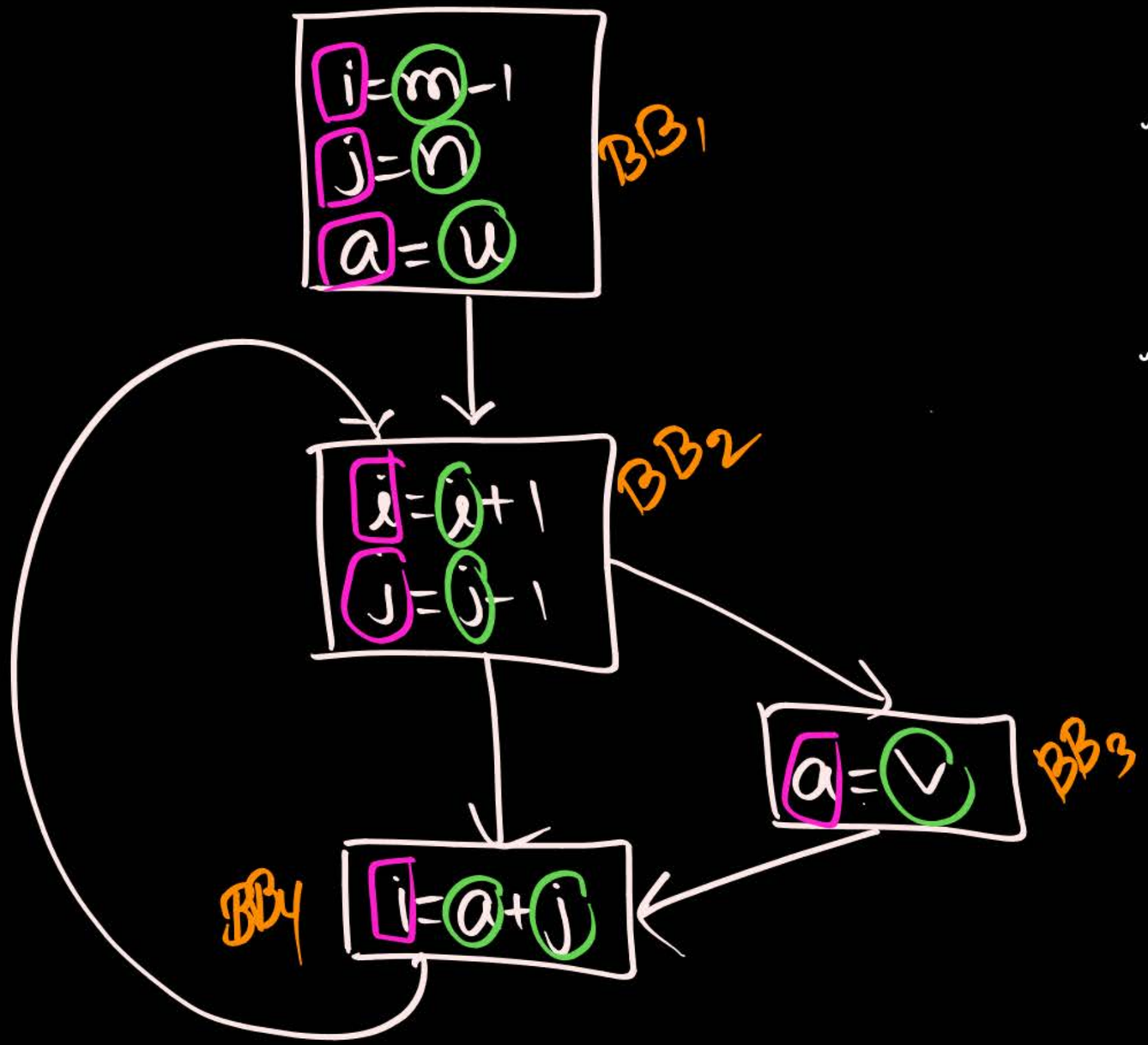
$= \{ v \mid$ v is read at some statement and no write into v before the read $\}$



GEN = { x, y, a, ... }

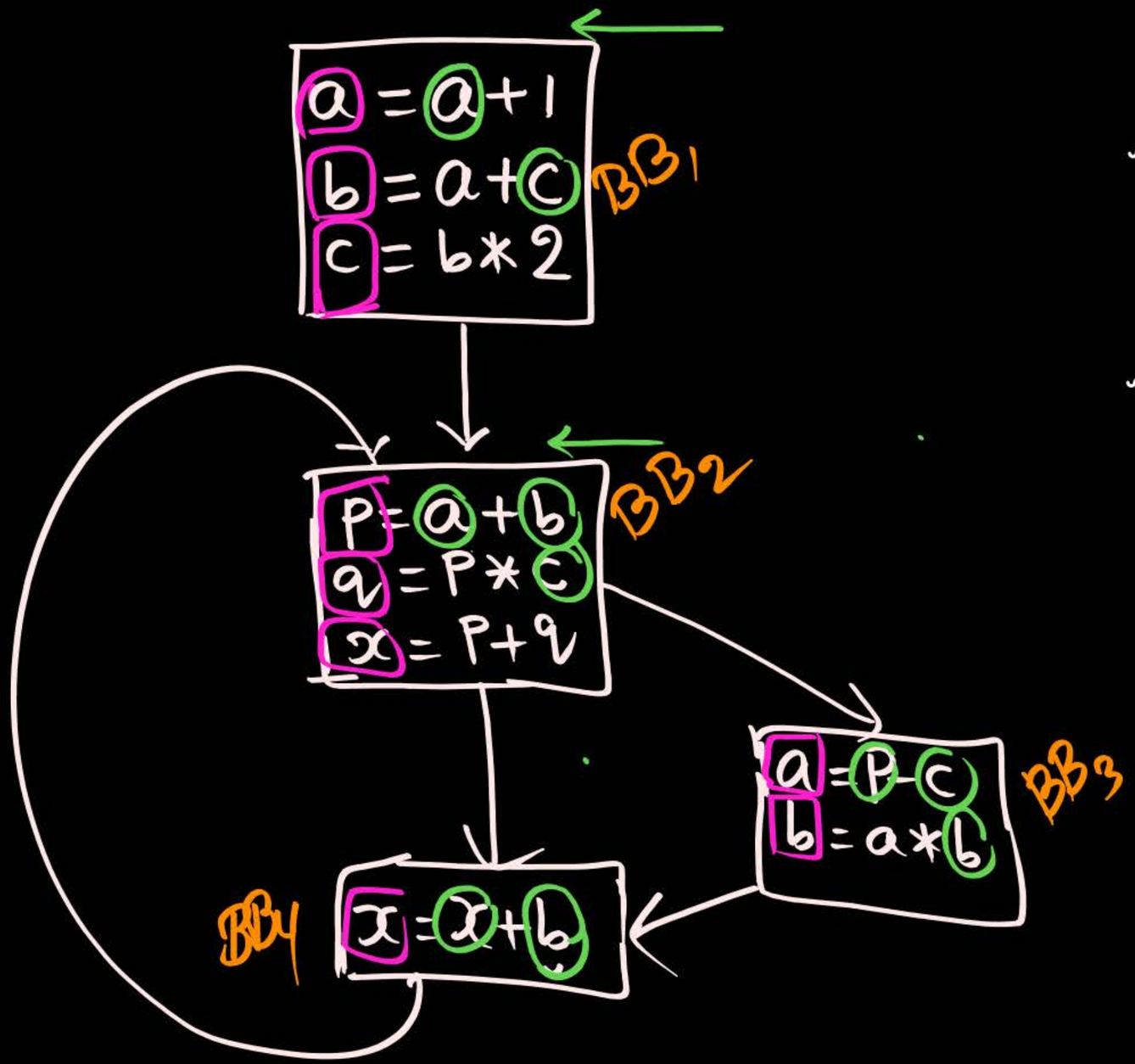
KILL = { x, b, ... }

Find GEN set and KILL Set for every Basic Block.



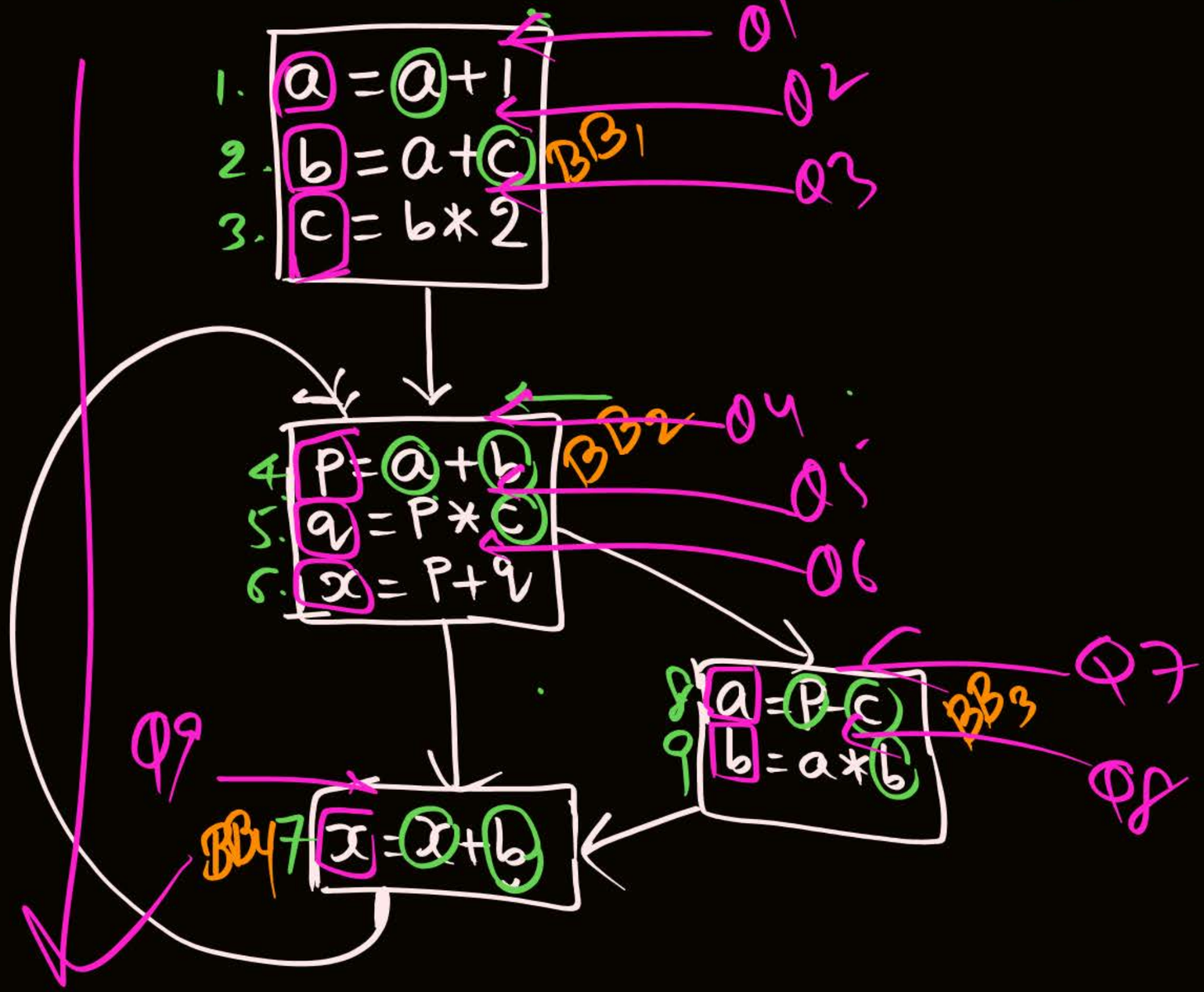
	GEN Set	KILL Set
BB_1	{m, n, u}	{i, j, a}
BB_2	{i, j}	{i, j}
BB_3	{v}	{a}
BB_4	{a, j}	{i}

Find GEN set and KILL Set for every Basic Block.



	GEN set	KILL set
BB_1	{a, c}	{a, b, c}
BB_2	{a, b, c}	{p, q, x}
BB_3	{p, c, b}	{a, b}
BB_4	{x, b}	{x}

Find Live variables at every statement.



Summary

- Live variable ?
- GEN & KILL sets
- Next : IN and OUT sets


THANK YOU
GW
SOLDIERS !