(A)
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5

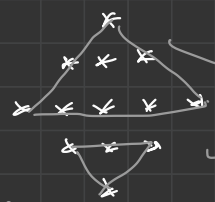
(B)
1
0 1
1 0 1
0 1 0 1
1 0 1 0

(C)

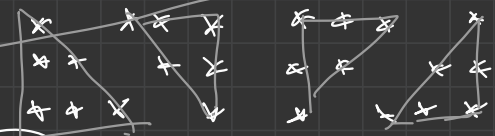
(D)
A
A B A
A B C B A
A B C D C B A
A B C D E D C B A

N = 5

(E)



(F)



N = 3

(G)
1 2 3 4 5
2 5
3 5
4 5
5

(E) ??

(G) ?!

row-wise repetition

(A) and column-wise repitition

i	j-1	2	3	4	5
1 →	1				
2 →	1	2			
3 →	1	2	3		
4 →	1	2	3	4	
5 →	1	2	3	4	5

no of elements in a row = i

values are same as the col-mn (j).

```
for(int i= 1; i<= n; i++) {
    for(int j=1; j<=i; j++) {
        cout<< j<<' ';
    }
    cout<<endl;
}
```

n = row = col.

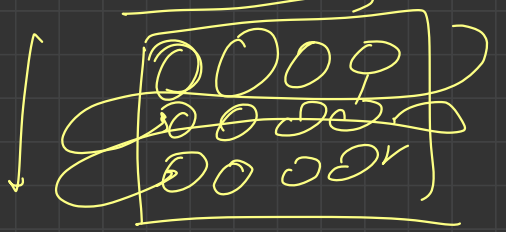
```
for(int i=1; i<=n; i++){
    for(int j=1; j<=n; j++) {
        if( j<= i){
            cout<< j<<' ';
        }
```

Square

A ←

→ left to right

↓ top to bottom

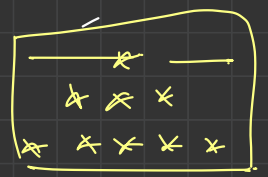


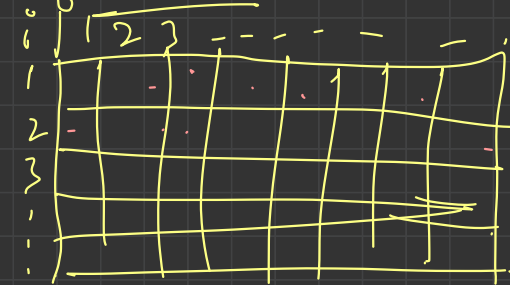
```
else {
    cout<<' ' ,
    }
}
cout<<endl;
}
```

col = 2 × row − 1

n = 3 = row

row-wise





row = n

col = ??

1

n = row

col ??

row, col

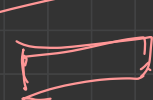
(i, j)

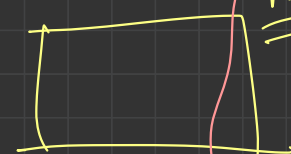
i \ j	1	2	3	4
1	1			
2	1	2		
3	1	2	3	
4	1	2	3	4

col = row

n = 4 =

4 × 4 → 16





row for (i → n) {

col for (i → m) {

}

}

(i, j)

(1, 1) → 1 (2, 1) → 1 (3, 1) → 1 (4, 1) → 1

(1, 2) → ' ' 1 (2, 2) → 2 (3, 2) → 2 (4, 2) → 2

(1, 3) → ' ' 1 (2, 3) → ' ' 1 (3, 3) → 3 (4, 3) → 3

(1,4) → ' ' (2,4) → ' ' (3,4) → ' ' (4,4) → 4

row by row handle → outer loop

↳ inner loop → col.

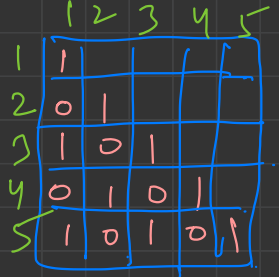
j > i → ' '

logic ?

```
for( i : 1 → N ) {
    for( j : 1 → N ) {
        if( j > i ) { cout << ' ' ; }
        else { cout << j ; }
    }
    cout << endl ;
}
```

??

③



n = row

↳ col.

Space ?? :-

i+j → even

1 → (1,1), (2,2), (3,1), (3,3), (4,2), (4,4), (5,1), (5,3), (5,5)

(i,j)

i+j → odd

0 → (2,1), (3,2), (4,1), (4,3), (5,2), (5,4)

my observations

odd + odd → e

even + even → e

o + e → o

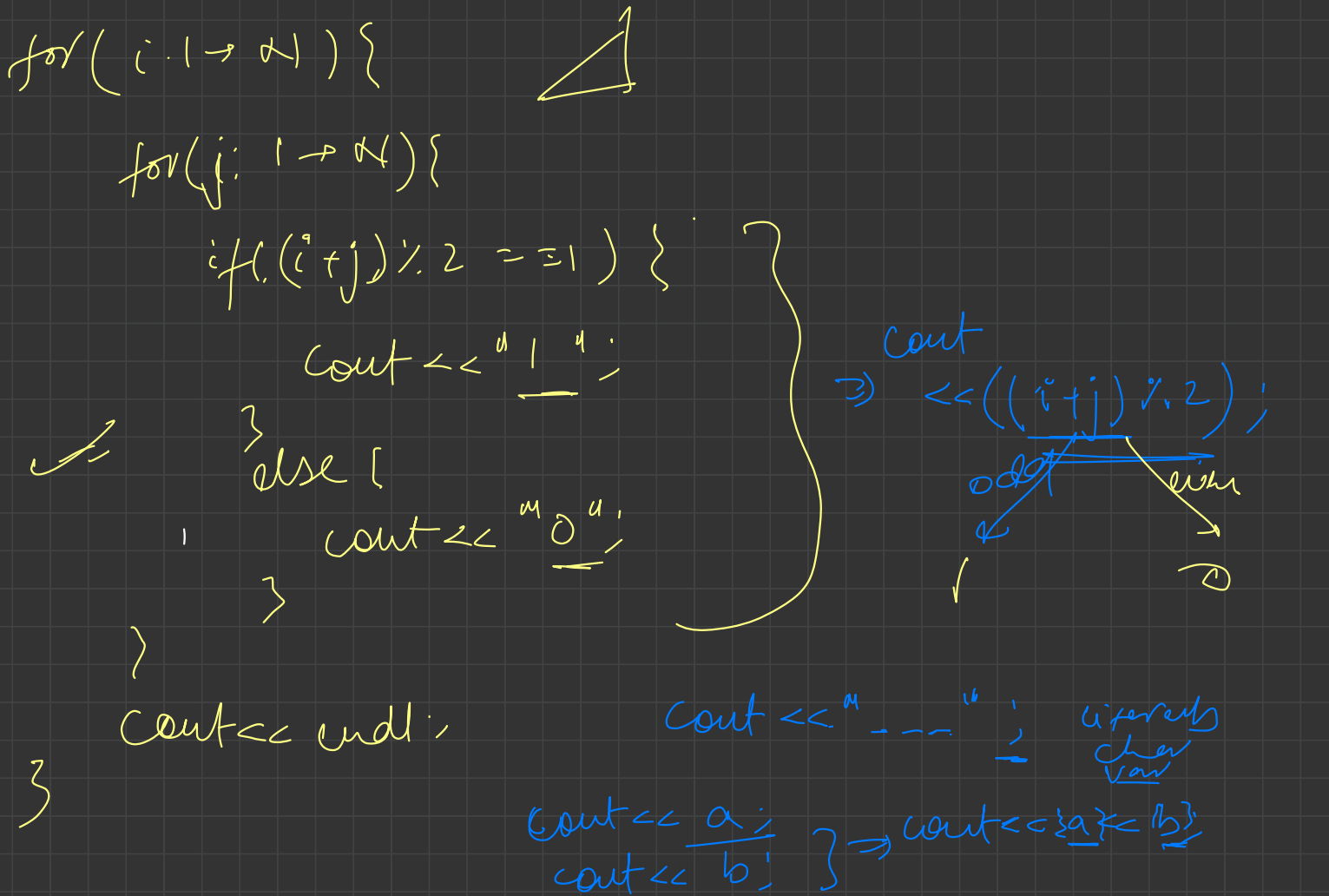
e + o → o

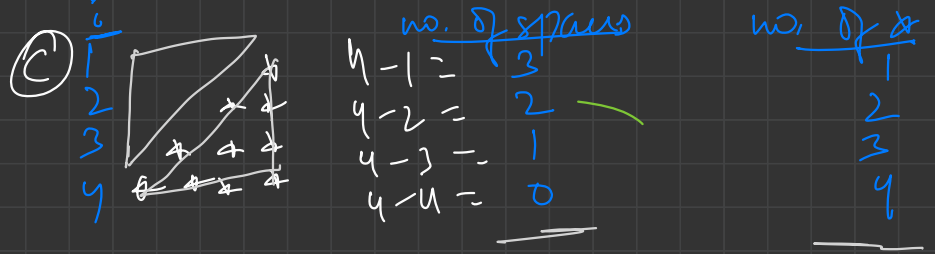
→ if (i and j) both odd → 1 } i+j → e.

both even → 1 }

⇒ if (i and j) have one odd & one even → o

i+j → o =


for(i : 1 → n) {
for(j : 1 → n) {
if((i+j) % 2 == 1) {
cout << " " ;
} else {
cout << "0" ;
}
}
cout << endl ;
}
cout
<< ((i+j) % 2) ;
odd
even
1
0
cout << " ... " ;
literals
char
var
cout << a ;
cout << b ;
} ⇒ cout << a << b ;



(2) no. of stars = i

(1) no. of spaces = n - i

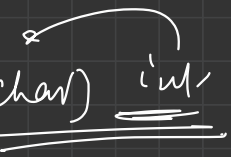
agenda ??

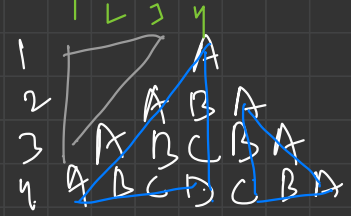
space → star

```
for(i: 1 → N) {
    // print spaces → use a loop, which iterates n-i times
    for(j: 1 → N-i) {
        cout<<' ';
    }
    // print * → i times.
    for(k: 1 → i) {
        cout<<'*';
    }
    cout<<endl;
}
```

??

(char) int





no. of spaces

3
2
1
0

Chars in left

A
A B
A B C
A B C D

Chars in right

A
B A
C B A

T2

(e) 64

A → 65

B → 66

C → 67

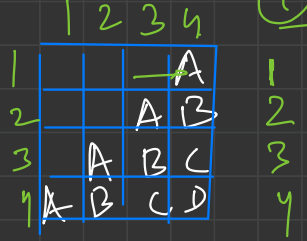
D → 68

a → 97

b → 98

c → 99

(i)



A+1 → B

(char)(65+1) → (66)

T1

A+1 → D

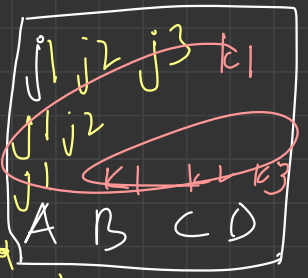
A+2 → C

A+2 → C

A+3 → D

67-3 = 64

C-3 → _



```
for( i : 1 → N ) {
    for( j : 1 → N - i ) {
        cout << ' ';
    }
    for(int k = 1; k <= i; k++) {
        cout << (char) (64+k);
    }
```

spaces

j1	j2	j3	k1
j1	j2		
j1	k1	k2	k3
A	B	C	D

65+k-1

A+k-1

A → 65 = 64+1 = 64+k

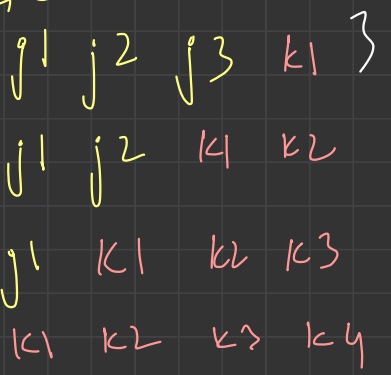
B → 66 = 64+2 = 64+k

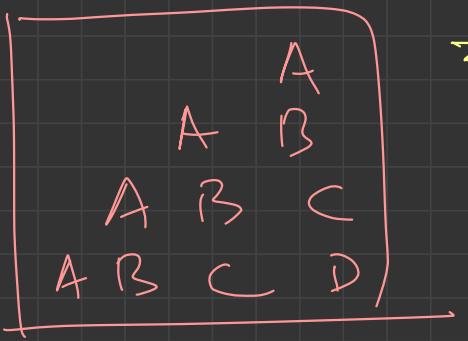
C → 67 = 64+3 = 64+k

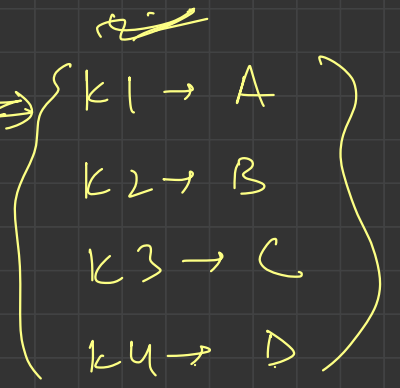
j1	j2	j3	k1
j1	j2	k1	k2
j1	k1	k2	k3
k1	k2	k3	k4

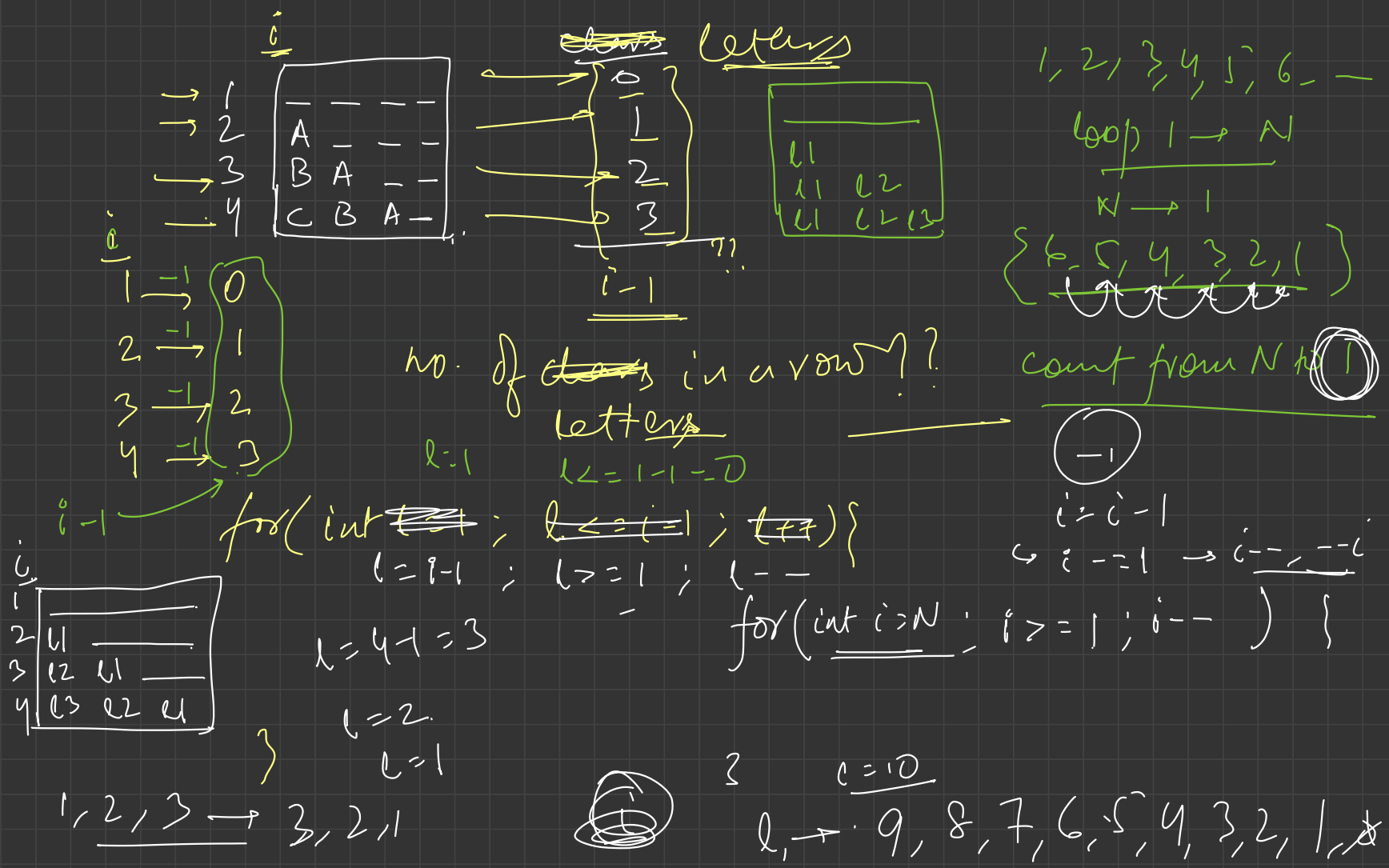
			A
		A	B
	A	B	C
A	B	C	D

⇒ { k1 → A, k2 → B, k3 → C, k4 → D }









i				
1	_	_	_	_
2	A	_	_	_
3	B	A	_	_
4	C	B	A	_

~~chars~~ letters

0
1
2
3

??

i-1

l1		
l1	l2	
l1	l2	l3

1, 2, 3, 4, 5, 6 ...

loop 1 → N

N → 1

{6, 5, 4, 3, 2, 1}

count from N to 1

i		
1	$\xrightarrow{-1}$	0
2	$\xrightarrow{-1}$	1
3	$\xrightarrow{-1}$	2
4	$\xrightarrow{-1}$	3

i-1

no. of ~~chars~~ letters in a row??

l=1

l<=1-1=0

for(int ~~l=1~~ ; ~~l<=i-1~~ ; ~~l++~~){

l=i-1 ; l>=1 ; l--

l=4-1=3

l=2

l=1

}

i			
1			
2	l1		
3	l2	l1	
4	l3	l2	l1

1, 2, 3 → 3, 2, 1

-1

i=i-1

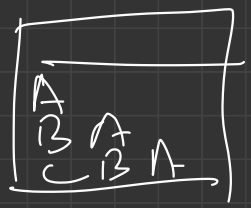
↳ i-=1 → i--, --i

for(int i=N ; i>=1 ; i--){

3

i=10

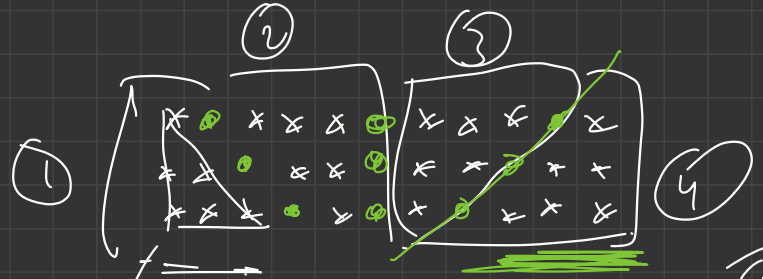
l1 → 9, 8, 7, 6, 5, 4, 3, 2, 1, 0

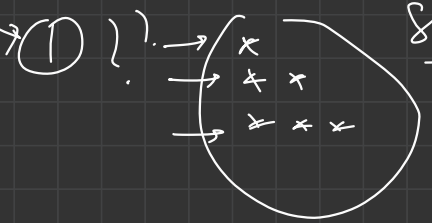


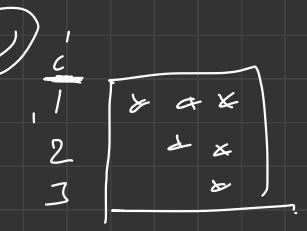

```
for(int i=i-1 ; i>=1 ; i--) {
    cout<<(char)(64+i);
}
```

T2 ✓

i=1 → A
i=2 → B
i=3 → C



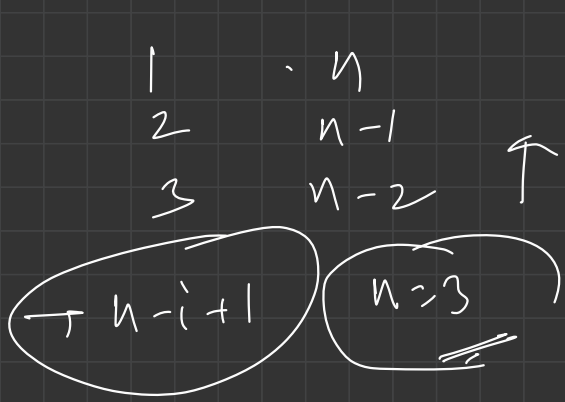


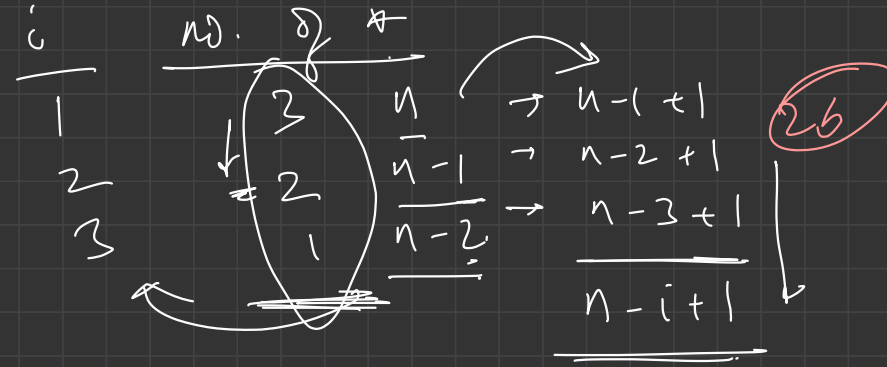


no. of spaces
0
1
2
i-1

2a

no. of *
3
2
1





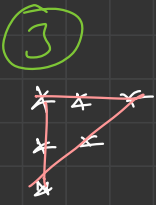
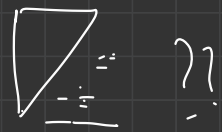

```
for( int i=1 ; i<=n ; i++) {
    // 1
    for(int j=1 ; j<=i ; j++) {
        cout<<i*i;
    }
    cout<<" ";
    for( int k=1; k<=i-1 ; k++) {
        cout<<" ";
```

① ②

```
}
for( int k=1; k<= n-i+1; k++) {
    cout<<'*';
}
cout<<'\n';
for(int m=1; m<=n-i+1; m++) {
    cout<<'*';
}
cout<<'\n';
for( int p=1; p<=i; p++) {
    cout<<'*';
}
```

n=3

i
1
2
3



*	' '
3	0
2	1
1	2
n-i+1	i-1
n-i+1	i-1