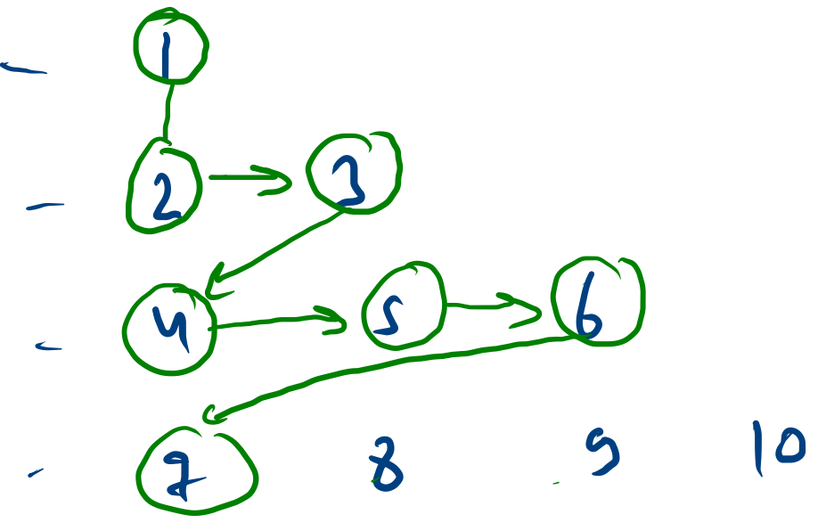
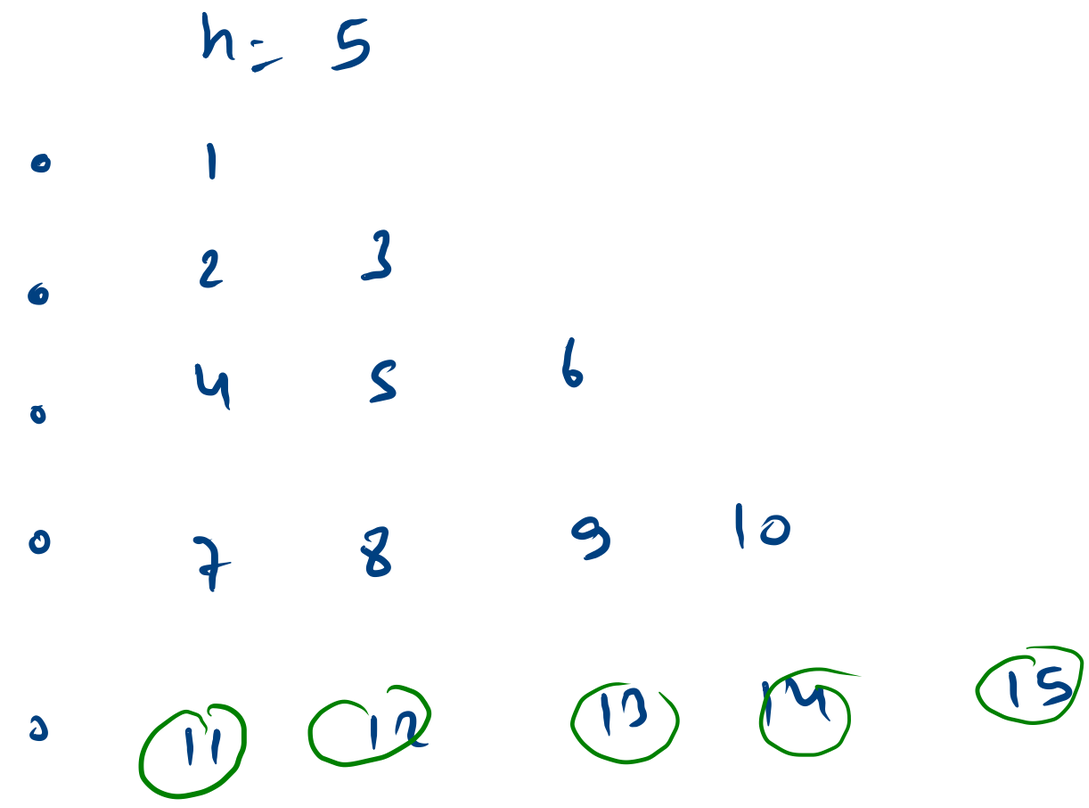
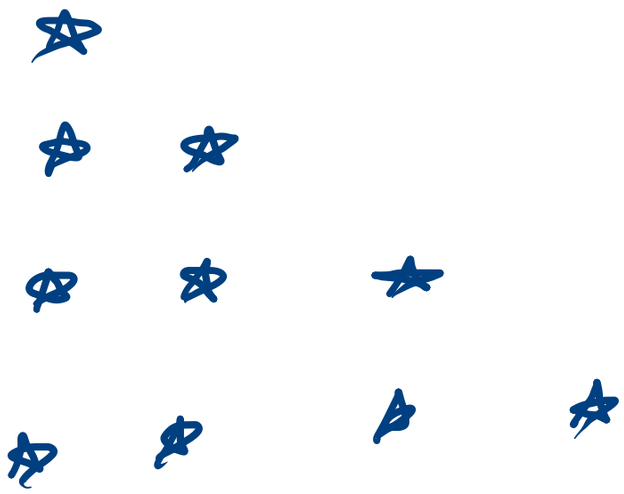
h = 4



h = 5



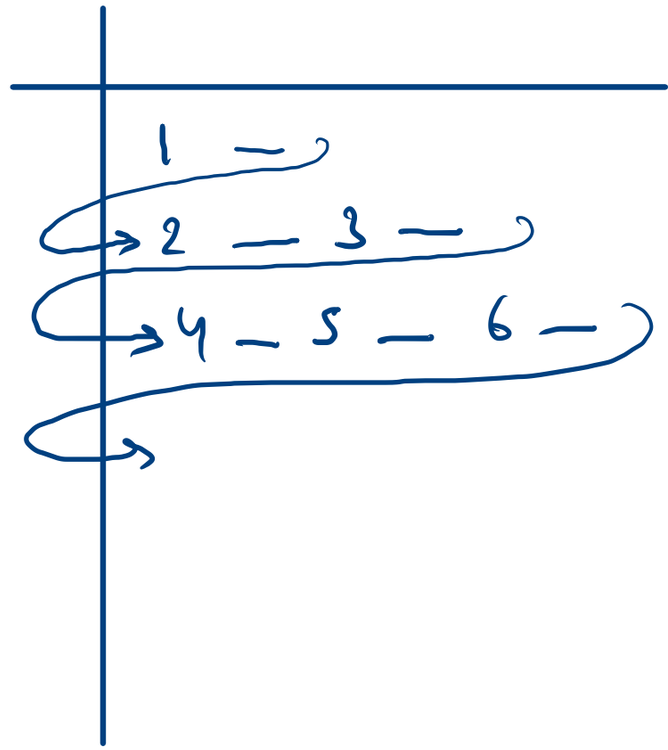


```java
int n = scn.nextInt();

int val=1;
for(int i=1;i<=n;i++){

    for(int j=1;j<=i;j++){
        System.out.print(val + "\t");
        val++;
    }
    System.out.println();
}
```

n = 4

val = 1 2 3 4 5 6 7

i = 1 2 3 4



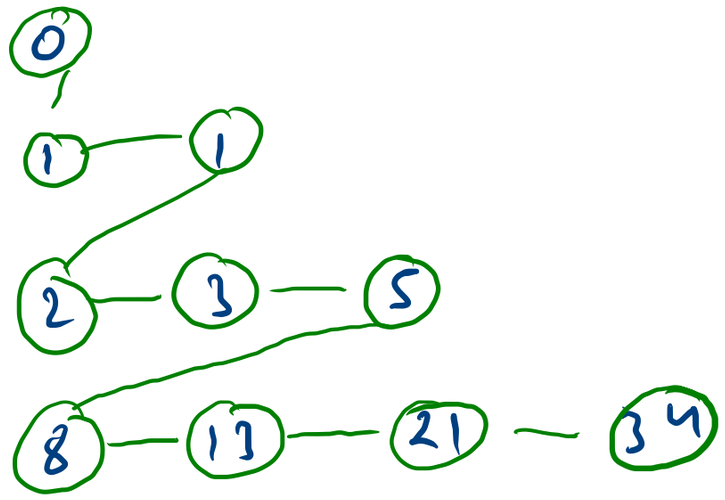
h = 3

0

1 1

2 3 5

h = 4



a = 0
b = 1

loop

```
print (a)
int c = a+b;
a = b;
b = c;
```

0 1 1 2 3 5

a b

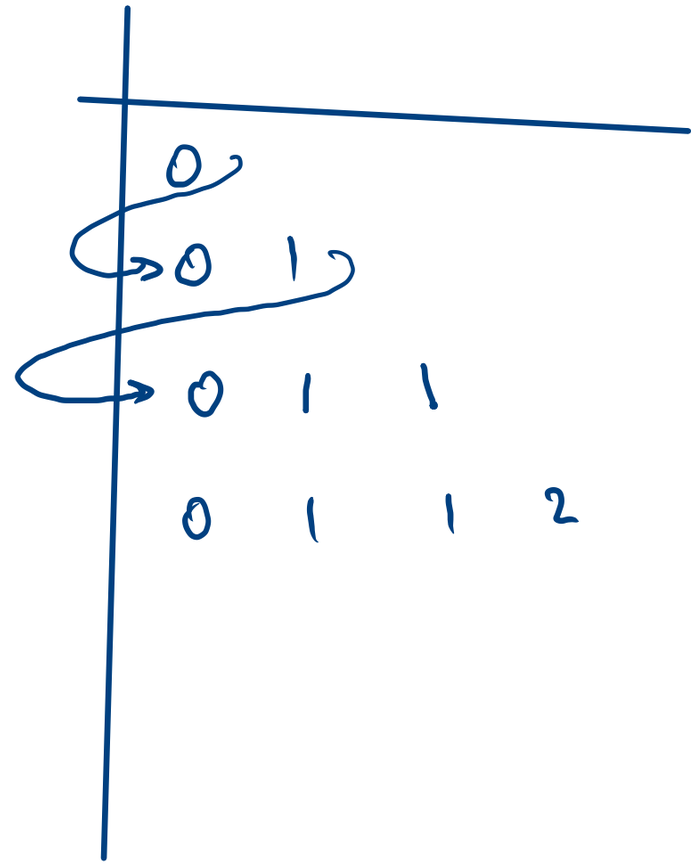
```java
for(int i=1;i<=n;i++){
    int a =0;
    int b=1;

    for(int j=1;j<=i;j++){
        System.out.print(a+"\t");
        int c=a+b;
        a=b;
        b=c;
    }
    System.out.println();
}
```

n = 3

i = 1 2

a = 0

b = 1



0 1 1 2 3 5

a b

```
int a =0;
int b=1;
for(int i=1;i<=n;i++){
    for(int j=1;j<=i;j++){
        System.out.print(a+"\t");
    }
    int c=a+b;
    a=b;
    b=c;
    System.out.println();
}
```

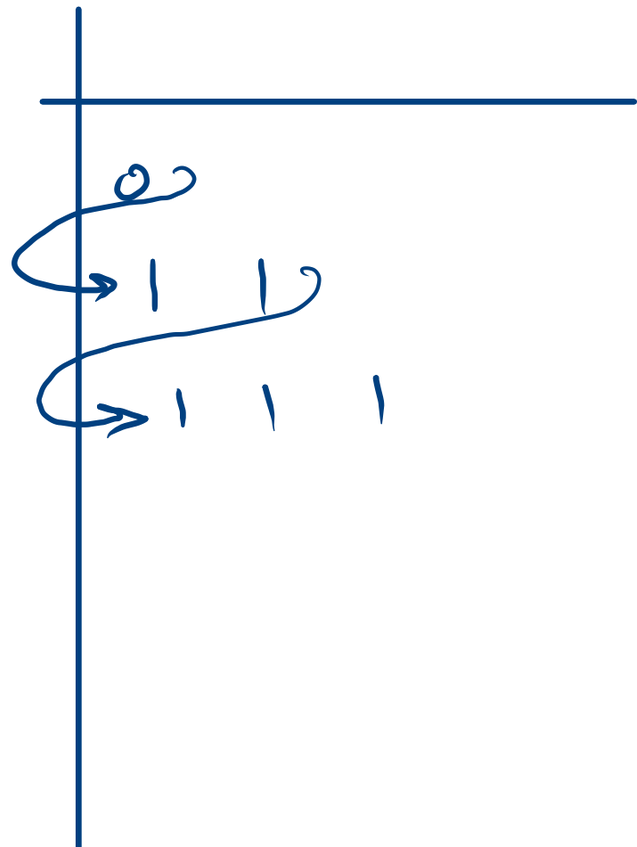
n = 3

a = 0 + 1

b = 1 + 2

i = 1 2 3

j = 1 2 3



0 1 1 2 3 5 8

a b

```
int a =0;
int b=1;
for(int i=1;i<=n;i++){

    for(int j=1;j<=i;j++){
        System.out.print(a+"\t");
        int c=a+b;
        a=b;
        b=c;
    }
    System.out.println();
}
```

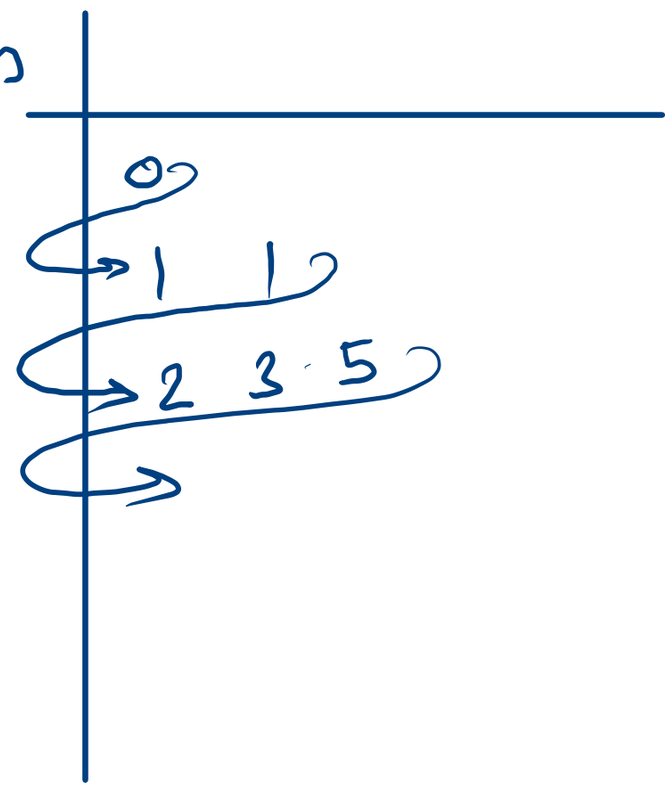
n = 3

a = 0 + 1 + 2 + 3 + 5 + 8

b = 1 + 2 + 3 + 5 + 8 + 13

i = 1 2 3

j = 1 2 3



$^3C_0 \rightarrow {}^3C_1$

$^nC_r \rightarrow \frac{!n}{!r \;\; !(n-r)}$ =

1

1 1

1 2 1

1 3 3 1

1 4 6 4 1

1 5 10 10 5 1

$n = 5$

i

j

i	$^iC_0$	$^iC_1$	$^iC_2$	$^iC_3$	$^iC_4$
0	$^0C_0$				
1	$^1C_0$	$^1C_1$			
2	$^2C_0$	$^2C_1$	$^2C_2$		
3	$^3C_0$	$^3C_1$	$^3C_2$	$^3C_3$	
4	$^4C_0$	$^4C_1$	$^4C_2$	$^4C_3$	$^4C_4$

^iC_j =

0 ... 0

0 ... 1

0 ... 2

0 ... 3

0 ... 4

$i \leftarrow [0 \ldots n-1]$

$j \leftarrow [0 \ldots i]$

$^4C_2 \rightarrow \frac{!4}{!2 \;\; !2} = \frac{4 \times 3 \times 2 \times 1}{2 \times 2}$

$$^{n}C_{r} \longrightarrow {}^{n}C_{r+1}$$

$$\lfloor 4+1 = 5 \times 4 \times 3 \times 2 \times 1$$

$$\frac{\lfloor 4}{5} = 5 \times 4 \times 3 \times 2 \times 1$$

$$\lfloor 4 = 4 \times 3 \times 2 \times 1$$

$$\lfloor 5 = 5 \times \lfloor 4$$

$$\boxed{\lfloor 5 = 5 \times \lfloor 4}$$

$$^{n}C_{r+1} = \frac{\lfloor n}{\lfloor r+1 \;\; \lfloor n-(r+1)} \Rightarrow \frac{\lfloor n}{\lfloor r+1 \;\; \lfloor n-r-1}$$

$$\boxed{^{i}C_{j+1} = {}^{i}C_{j} \times \frac{(i-j)}{(j+1)}}$$

$$= \frac{\lfloor n \quad \times \; n-r}{(r+1) \lfloor r \qquad \lfloor n-r}$$

$n \to i$

$r \to j$

$$= \frac{\lfloor n}{\lfloor r \; \lfloor n-r} \times \boxed{\frac{n-r}{r+1}}$$

$$^{n}C_{r+1} = {}^{n}C_{r} \times \frac{n-r}{r+1}$$

proof

$$\frac{\lfloor n-r}{n-r} \quad \boxed{(n-r)-1 \;\; \frac{\lfloor 5}{5} \;\; \frac{\lfloor 5-1}{5}}$$

$$\lfloor 5-1 = 4 \times 3 \times 2 \times 1$$

$$\frac{\lfloor 5}{5} = \frac{5 \times 4 \times 3 \times 2 \times 1}{5}$$

$$= \lfloor 4$$

```java
//Write your code here
int n = scn.nextInt();

for(int i=0;i<n;i++){

    int val=1;
    for(int j=0;j<=i;j++){
        System.out.print(val+"\t");
        val = val*(i-j)/(j+1);
    }
    System.out.println();
}
```

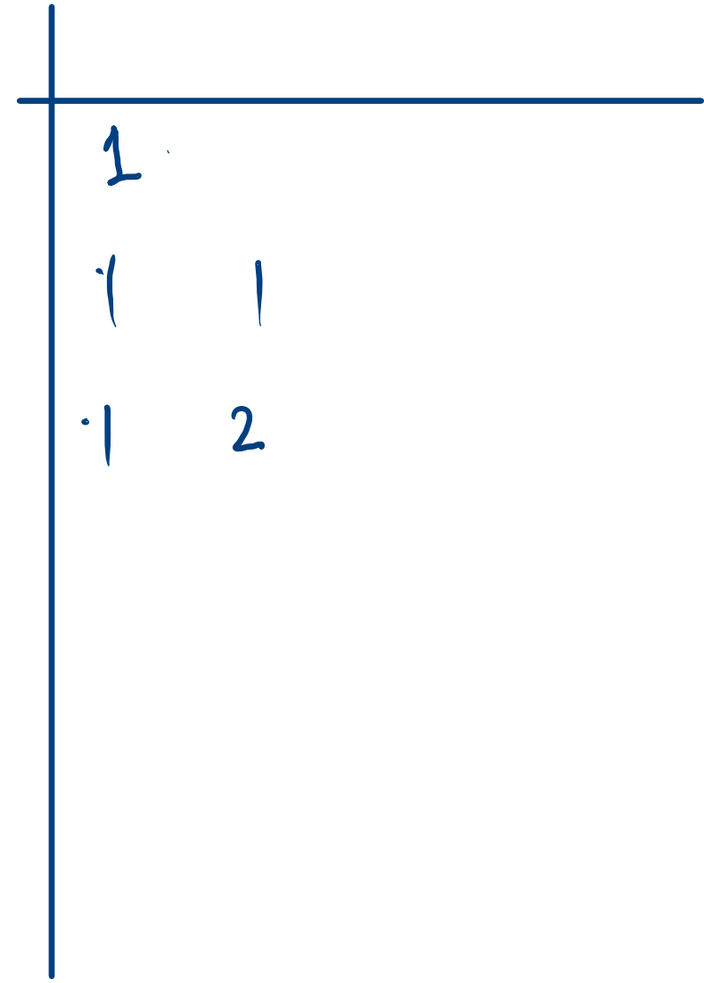
0 <= 1

n = 3

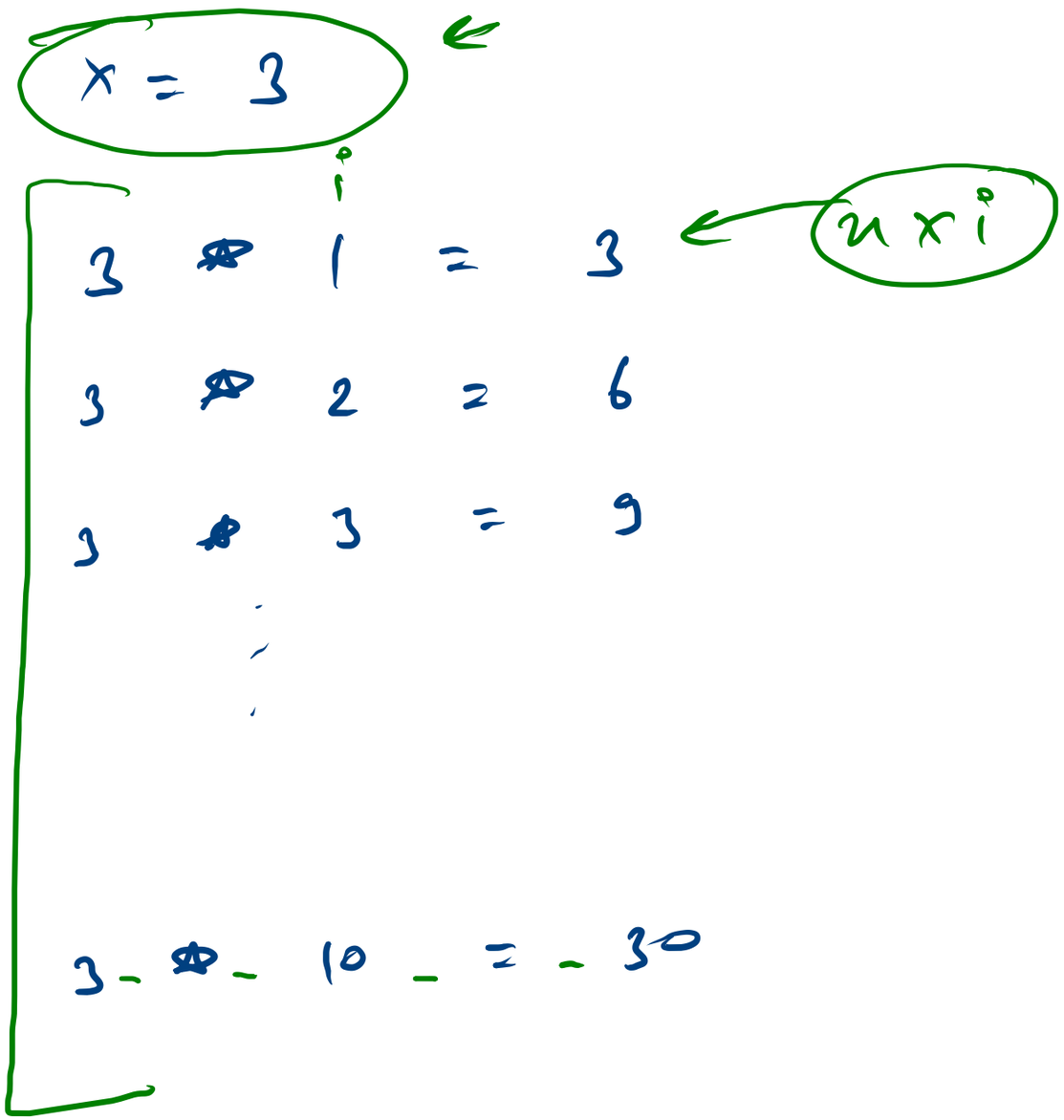
i = 0 to 2

val = 1 * 1

j = 0 to 1



```
x * 1 = x
x * 2 = 2x
..
x * 10 = 10x
```



h = 5

1 1
2 2 3 2
3 3 4 5 4 3
4 2 3 2
5 1

i <= n

h = 7

1 1
2 2 3 2
3 3 4 5 4 3
4 4 5 6 7 6 5 4
5 3 4 5 4 3
6 2 3 2
7 1

ival 3 4 5 4 3
star 5
j = 1 2 3 4
+1 +1 -1

3 4 5 4

ival = 3 4 5 6 7 8
star = 5
j = 1 2 3 4 5
1 2 3 --- star
+1 +1 -1 -1
3 4 5 6 7

j <= star/2
j <= 5/2 2

i <=

h = 5

space -1
star +2

space +1
star -2

i <= n/2

oval

+1 -1

1
2 2 2
3 3 3 3
2 2 2
1

+f

1
2 3 4
3 4 5 6 7
2 3 4
1

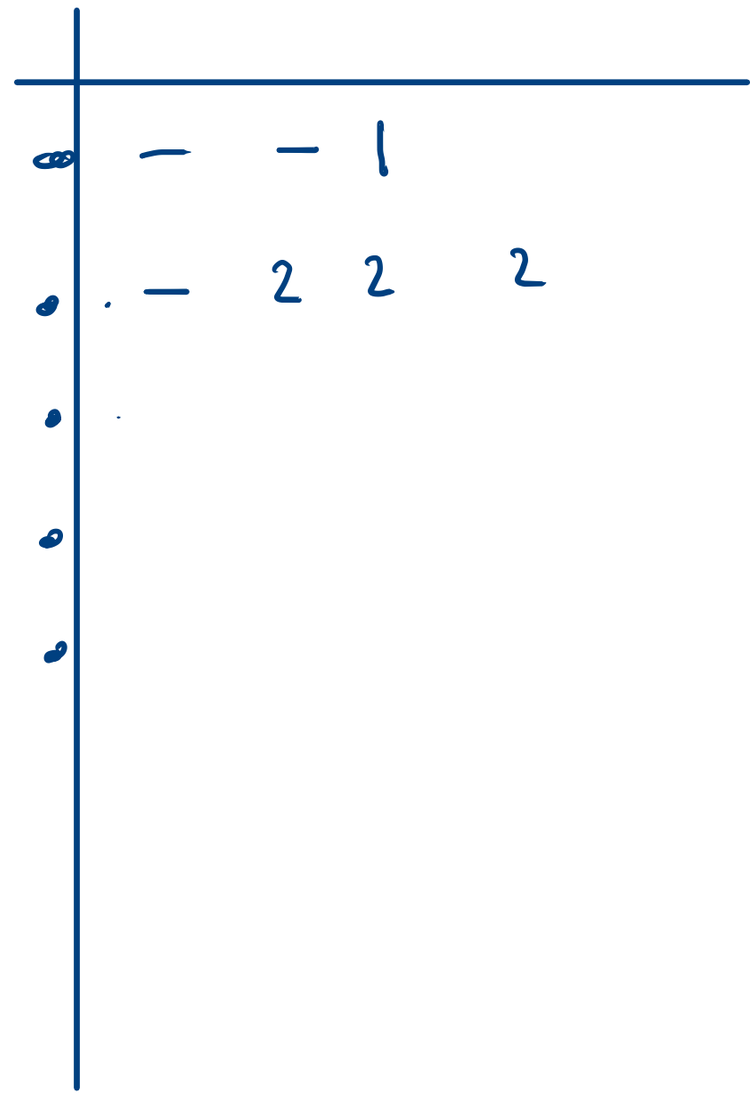
1
2 3 2
3 4 5 4 3
2 3 2
1

```java
int oval=1;
for(int i=1;i<=n;i++){
    int ival=oval;

    for(int j=1;j<=space;j++){
        System.out.print("\t");
    }
    for(int j=1;j<=star;j++){
        System.out.print(ival+"\t");
    }

    if(i<=n/2){
        space--;
        star += 2;
        oval++;
    }else{
        space++;
        star -= 2;
        oval--;
    }
    System.out.println();
}
```

n=5

oval + 2 3

ival = 3

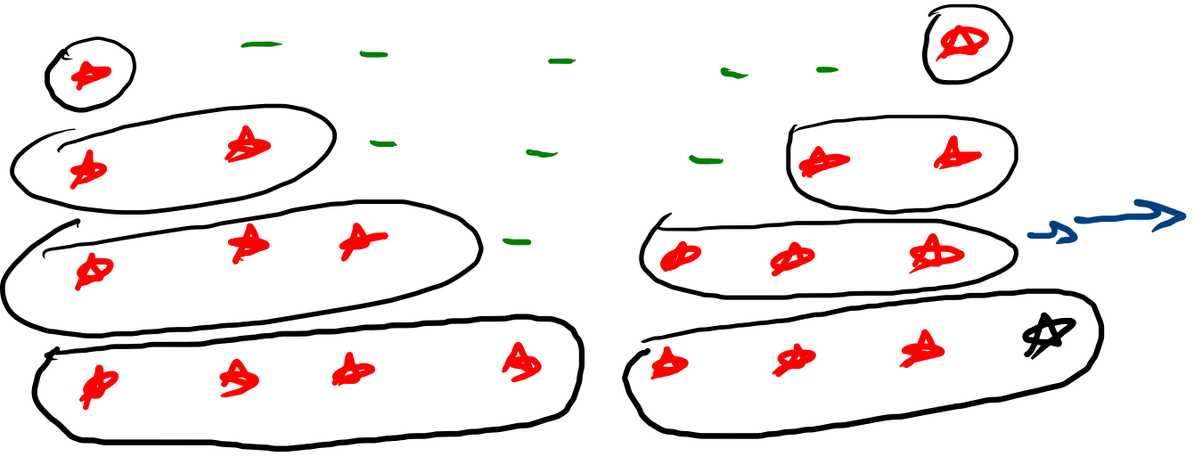


n = 4

1	1	-	-	-	-	-	1
2	1	2	-	-	-	2	1
3	1	2	3	-	3	2	1
4	1	2	3	4	3	2	1

1	-	-	-	-	-	1
1	2	-	-	-	2	1
1	2	3	-	3	2	1
1	2	3	4	4	3	2

Space star



1	-	-	-	-	-	1
1	2	-	-	-	2	3
1	2	3	-	3	4	5
1	2	3	4	4	3	2

```java
for(int i=1;i<=n;i++){
    int ival=1;
    for(int j=1;j<=star;j++){
        System.out.print(ival+"\t");
        ival++;
    }
    for(int j=1;j<=space;j++){
        System.out.print("\t");
    }

    if(i==n){
        star--;
    }
    ival--;
    for(int j=1;j<=star;j++){
        System.out.print(ival+"\t");
        ival--;
    }
    star++;
    space -= 2;
    System.out.println();
}
```

ival--;

star = 4 3

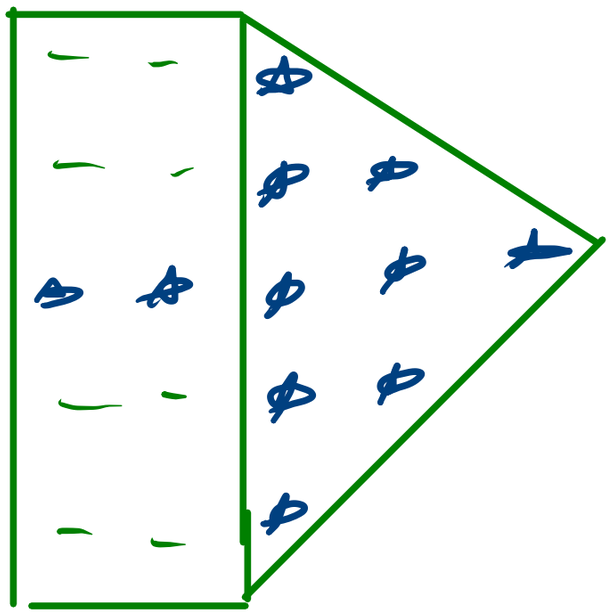
ival = 1 2 3 4 5 4 3 2 1 0

i								
1								
2								
3								
4	1	2	3	4	3	2	1	

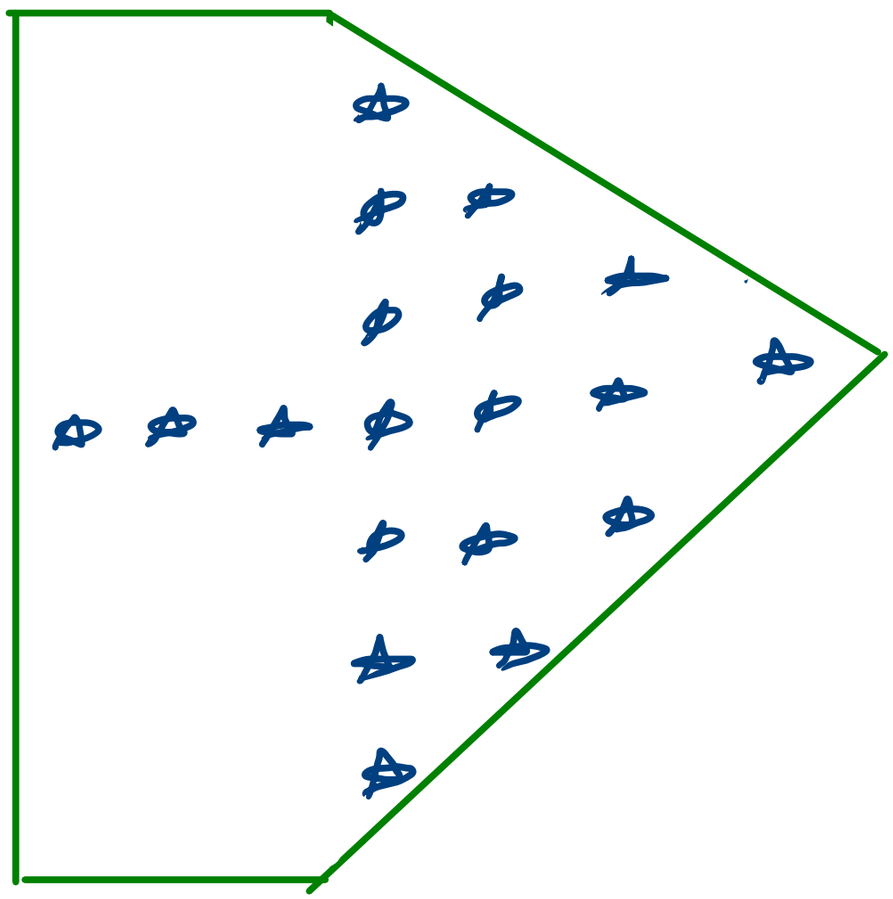
H.W.

Pattern 17

h = 5

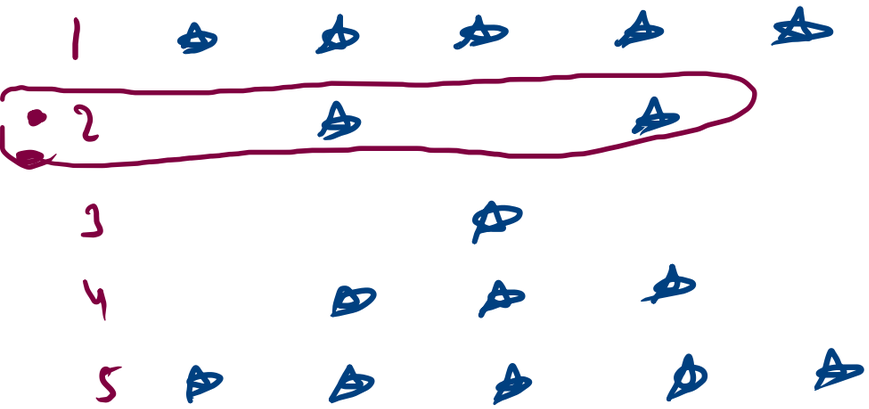


h = 7

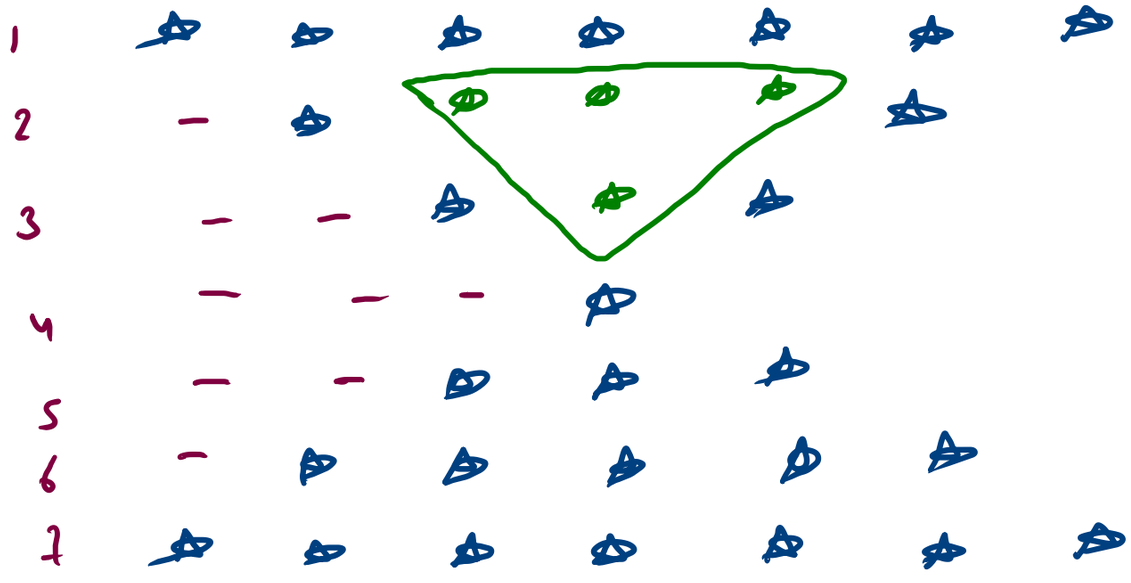


slr = 2

h = 5



h = 7



slur	space
h, 7	0
5	1
3	2
1	3
3	2
5	1
7	0

-2

+2

```java
for (int i = 1; i <= n; i++) {

    for(int j=1;j<=space;j++){
        System.out.print("\t");
    }
    for(int j=1;j<=star;j++){
        System.out.print("*\t");
    }
    System.out.println();

    if(i<=n/2){
        star -= 2;
        space++;
    }else{
        star += 2;
        space--;
    }
}
```

n = 7

7/2 = 3

1 ..... star

last last

start → 2

end n/2 → 3

4

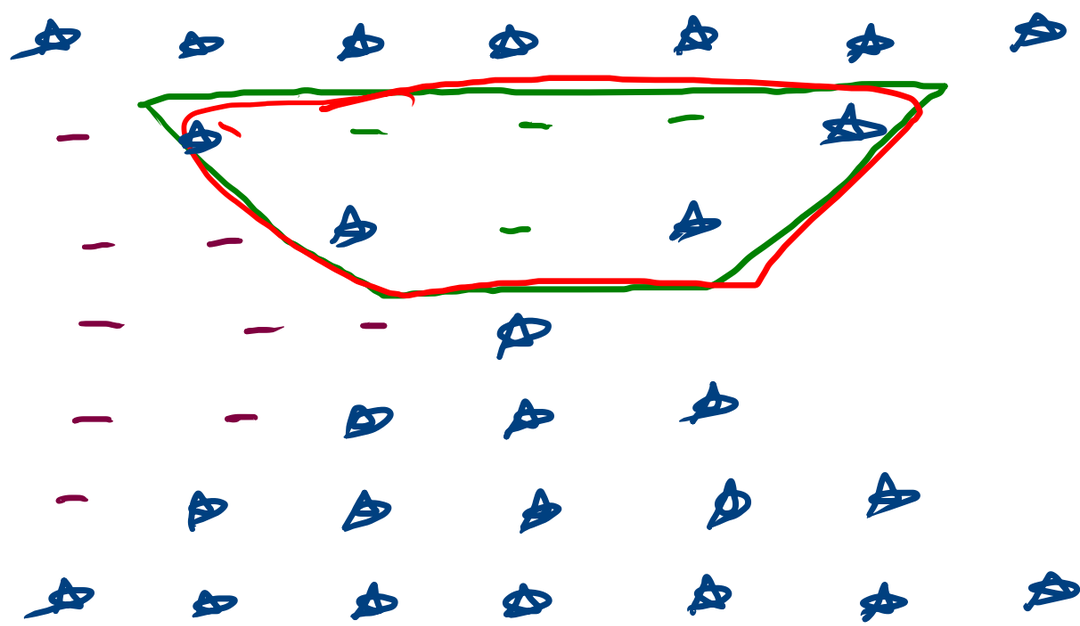
5

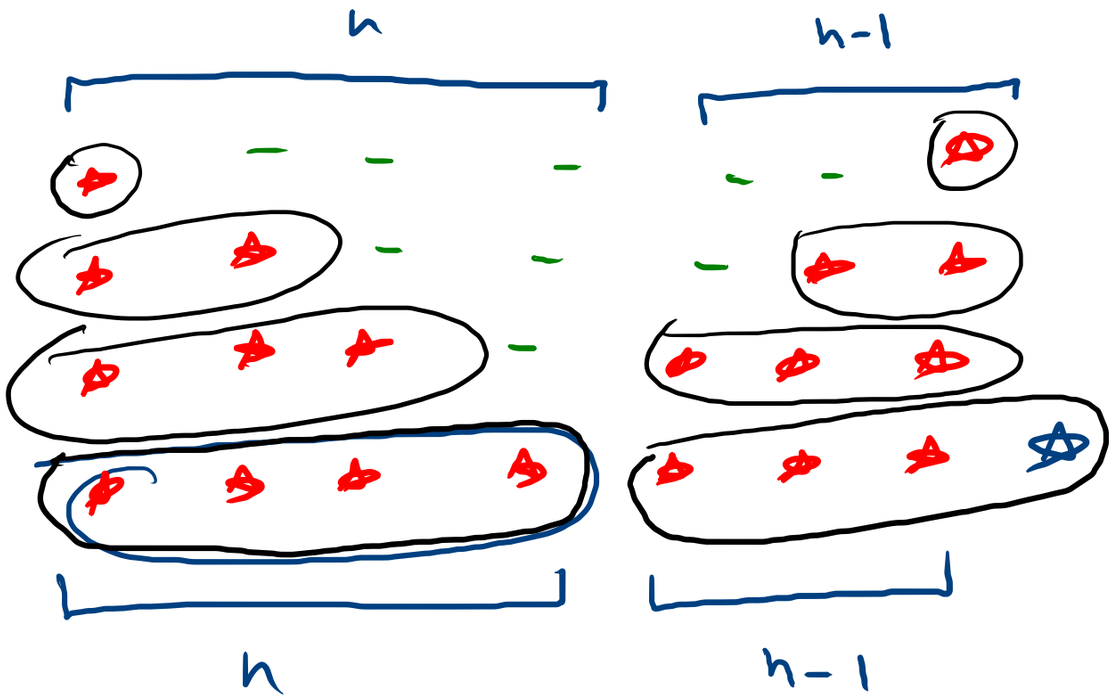
6

7

if (i >= 2 && i <= n/2) {

#





star	space
1	5
2	3
3	1
4	-1

2n-3

n=4

$n + n-1 - 2 \rightarrow 2n - 3$

$4 + 4 - 1 - 2 \rightarrow 8 - 3$

5

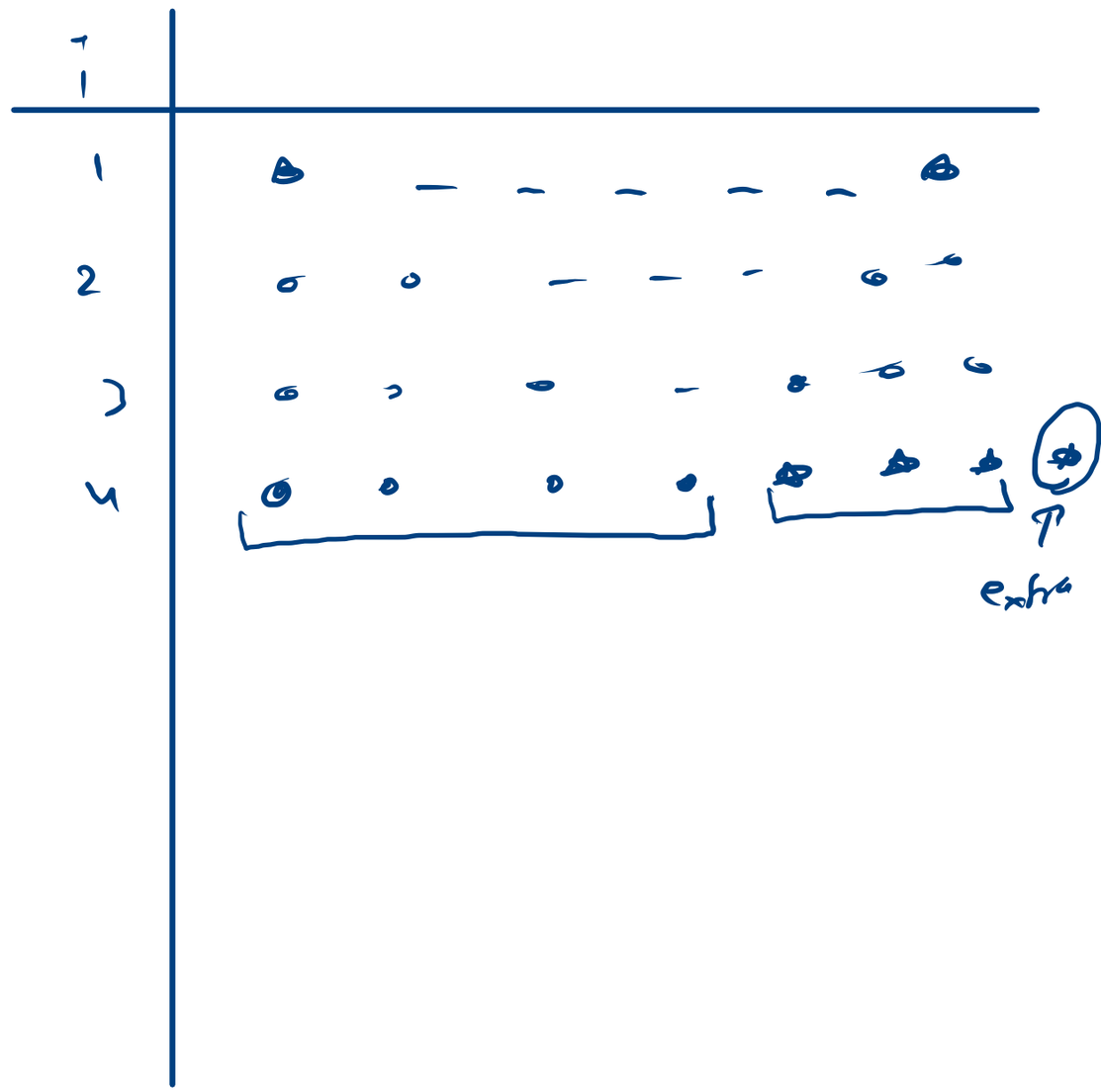
```java
int star = 1;
int space = 2*n-3;

for(int i=1;i<=n;i++){

    for(int j=1;j<=star;j++){
        System.out.print("*\t");
    }
    for(int j=1;j<=space;j++){
        System.out.print("\t");
    }
    for(int j=1;j<=star;j++){
        System.out.print("*\t");
    }
    star++;
    space -= 2;
    System.out.println();
}
```

n=4

star=4

i==n-1

i==n



```java
for(int i=1;i<=n;i++){
    int ival=1;
    for(int j=1;j<=star;j++){
        System.out.print(ival+"\t");
        ival++;
    }
    for(int j=1;j<=space;j++){
        System.out.print("\t");
    }

    if(i==n){
        star--;
    }
    for(int j=1;j<=star;j++){
        System.out.print(ival+"\t");
        ival++;
    }
    star++;
    space -= 2;
    System.out.println();
}
```

ival--;

n=4

star=3

ival=1 2 3 4

ival=1 2 3 4 3 4 5 6