```
0
1       1
2       3       5
8       13      21  34
..
```

Structure ||

```
*
*   *
*   *   *
*   *   *   *
*   *   *   *
```

Number to print →

0 1 1 2 3 5 8 13 21 ..

fibonacci

0 1 1 2 3 5 8 13 ..... nth

a b c

c = a+b;

syso(c);

→ print a;

→ Move a & b pointer ahead;

syso;
c = a+b;
a = b;
b = c;

variable pattern →

Structure

c=0 c<=r

r=0 *

* *

* * *

* * * *

* * * * *

convert var →

a → var

fibbonaci

b=1;

1

1 1

1 1 1

1 1 1 1

1 1 1 1 1

change variable according to be qus

```
int a = 0;
int b = 1;

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

Shifting of variable

n=4.

calling ??

r = 0   c=0: 0   1st

r = 1   c=0: 1   c=1: 1   3rd

r = 2   c=0: 2   c=1: 3   c=2: 5

r = 3   c=0: 8   c=1: 13   c=2: 21   c=3: 34

0
1 1
2 3 5
8 13 21 34

a = ~~0~~ ~~1~~ ~~1~~ ~~2~~ ~~3~~ ~~5~~ ~~8~~ ~~13~~ ~~21~~ ~~34~~ 55

b = ~~1~~ ~~1~~ ~~2~~ ~~3~~ ~~5~~ ~~8~~ ~~13~~ ~~21~~ ~~34~~ ~~55~~ 89

temp = ~~1~~ ~~2~~ ~~3~~ ~~5~~ ~~8~~ ~~13~~ ~~21~~ ~~34~~ ~~55~~ 89

	0	1	2	3	4	5
0	1					
1	1	1				
2	1	2	1			
3	1	3	3	1		
4	1	4	6	4	1	
5	1	5	10	10	5	1
	..					

$\longrightarrow$

$^0C_0 = 1$

$^1C_0 = 1 \quad ^1C_1 = 1$

$^2C_0 = 1 \quad ^2C_1 \quad ^2C_2 = 1$

$^3C_0 = 1 \quad ^3C_1 \quad ^3C_2 \quad ^3C_3 = 1$

$^4C_0 = 1 \quad ^4C_1 \quad \boxed{^4C_2} \quad ^4C_3 \quad ^4C_4 = 1$

$^5C_0 = 1 \quad ^5C_1 \quad ^5C_2 \quad ^5C_3 \quad ^5C_4 \quad ^5C_5 = 1$

Relation ??

$^nC_r \longleftrightarrow {}^nC_{r+1}$

$^nC_r \quad ^nC_{r+1}$

Pascal triangle. $\longrightarrow$

$^nC_0 = 1$

$^nC_n = 1$

$= {}^nC_0 = 1$

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

Relation ??

$$^4C_2 = \frac{4!}{2!\,2!}$$

${}^nC_{r+1} \, f$

${}^nC_r \cdot F = {}^nC_{r+1}$ ${}^nC_r$ find f ??

$$\frac{\cancel{n!}}{(n-r)!\,r!} \cdot F = \frac{\cancel{n!}}{[n-(r+1)]!\,(r+1)!}$$

$(r+1)! = (r+1)\,r!$

$(n-r)! = (n-r)\,(n-r-1)!$

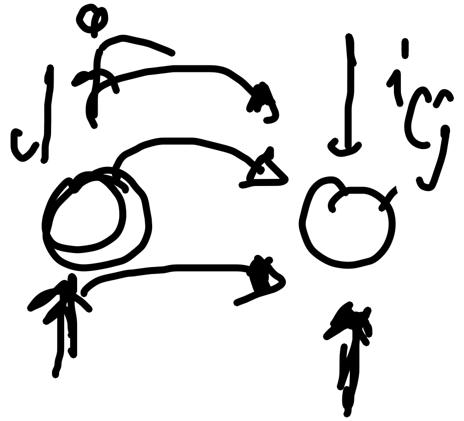
$4! = 4 \times 3!$

$${}^nC_r \times F = {}^nC_{r+1}$$

$$F = \frac{(n-r)!\,r!}{(n-r-1)!\,(r+1)!}$$

$$= \frac{(n-r)!\,\cancel{r!}}{(n-r-1)!\,(r+1)\cancel{r!}} = \frac{(n-r)!}{(n-r-1)!\,(r+1)}$$

$$\boxed{F = \frac{n-r}{r+1}}$$



$$f = \frac{(n-r)\,\cancel{(n-r-1)!}}{\cancel{(n-r-1)!}\,(r+1)} = \frac{n-r}{r+1}$$

${}^iC_{j+1}$

$val = 1$

$j = 0$

${}^{0}C_0 = 1$

$j = 0 \qquad j = 1$

${}^{1}C_0 = 1 \qquad {}^{1}C_1$

${}^{n}C_r * F = {}^{n}C_{r+1}$

${}^{i}C_j * F = {}^{i}C_{j+1}$

$$F = \frac{i - j}{j + 1}$$

$j = 0 \qquad j = 1 \qquad j = 2$

${}^{2}C_0 = 1$

$j = 0 \qquad j = 1 \qquad j = 2 \qquad j = 3$

${}^{3}C_0 = 1$

$j = 0 \qquad j = 1 \qquad j = 2 \qquad j = 3 \qquad j = 4,$

${}^{4}C_0 = 1$

${}^{1}C_0 \qquad {}^{1}C_1$

$$F = \frac{1 - 0}{0 + 1} = 1$$

$1 \qquad 1$

$j = 0 \qquad j = 1 \qquad j = 2$

$i = 2 \qquad 1 \qquad 2$

$$va \quad \frac{val * (i - j)}{j + 1}$$

```java
public static void main(String[] args) {
    Scanner scn = new Scanner(System.in);
    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();
    }
}
```

$^nC_0 = 0$

$^iC_0 = 1$

$$F = \frac{(i-j)}{j+1}$$

$3 \quad 3$

1

$i=0$ $j=0$: 1

$i=1$ $j=0$: 1, $i=1, j=0$: $\frac{C_0 * 1}{1} = 1$; $j=1$: 1

$i=2$ $j=0$: $\boxed{1}$; $j=1$: 2; $j=2$: $(2, 2)$ 1

$j=1$, $i=2$, $val = 2$

$$val = \frac{2 * (1)}{1+1} = \frac{2}{2} = 1$$

$i=3$ $j=0$: 1; $j=1$: 3; $j=2$: 3; $j=3$: 1

$i=4$ $j=0$: 1; $j=1$; $j=2$; $j=3$; $j=4$

$j=0 \quad j=1 \quad j=2 \quad j=3 \quad j=4$

$i=0$: ${}^0C_0 = 1$

$i=1$: ${}^1C_0 = 1 \quad {}^1C_1$

$i=2$: ${}^2C_0 = 1 \quad {}^2C_1 \quad {}^2C_2$

$i=3$: ${}^3C_0 = 1 \quad {}^3C_1 \quad {}^3C_2 \quad {}^3C_3$

$i=4$: ${}^4C_0 = 1 \quad {}^4C_1 \quad {}^4C_2 \quad {}^4C_3 \quad {}^4C_4$

$val = {}^iC_j$

O/P Required $\underbrace{{}^iC_{j+1}}$??

Factor f ??

Pattern - I4 ||

H.W.

$${}^iC_j * f = {}^iC_{j+1}$$

$$\frac{\cancel{i!}}{(i-j)!\,j!} * F = \frac{\cancel{i!}}{(i-j-1)!\,(j+1)!}$$

$$f = \frac{(i-j)\cancel{(i-j-1)!}\,\cancel{j!}}{\cancel{(i-j-1)!}\,(j+1)\cancel{j!}}$$

$$F = \frac{i-j}{j+1}$$

$$\boxed{\frac{val * (i-j)}{j+1}} \qquad {}^iC_j * \frac{i-j}{j+1} = {}^iC_{j+1}$$

$val = 1, \quad \frac{i-j}{j+1} = \frac{1}{2}$

overall res: 1

$val * \left(\frac{i-j}{j+1}\right) \Rightarrow 0$

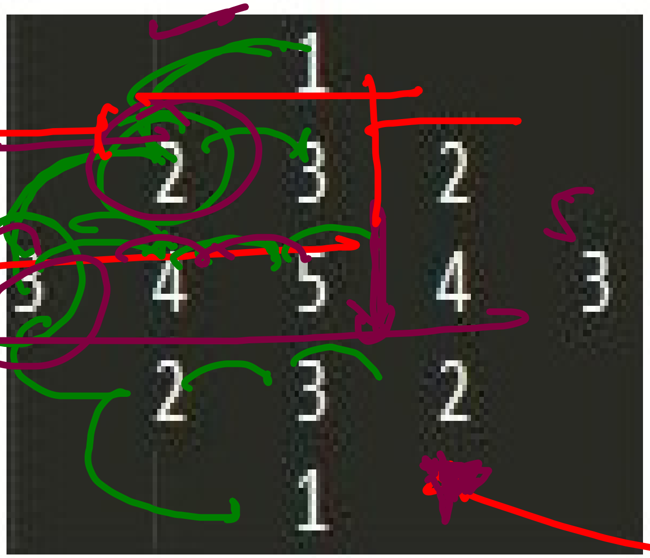
$val * 0 = 0$

End

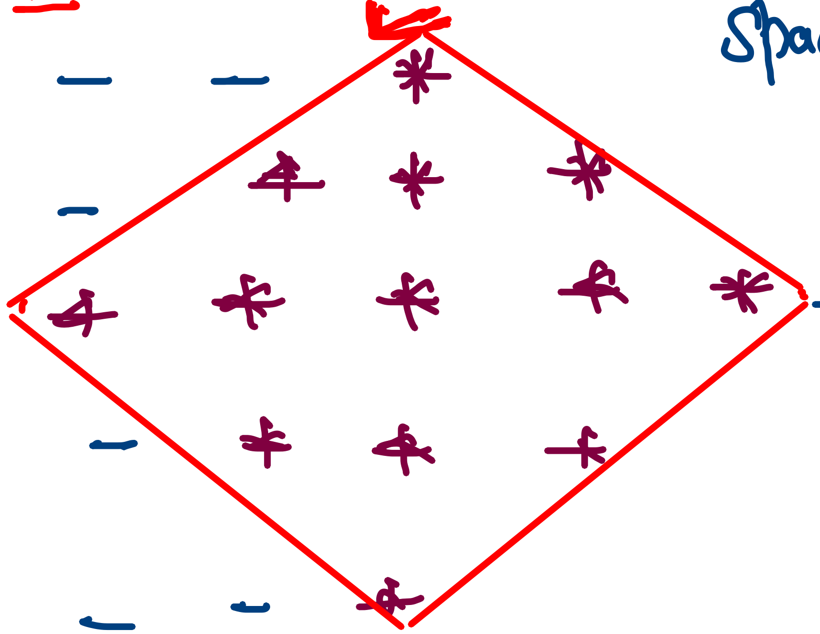
doubt]+ support

Structure:

var++;



var--;



Space: n/2   Star: 1

space--   Star += 2

space++   Star -= 2

1
1 1 1
1 1 1 1 1
1 1 1
1

1 → convert into var

→

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

var++;

→

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

End

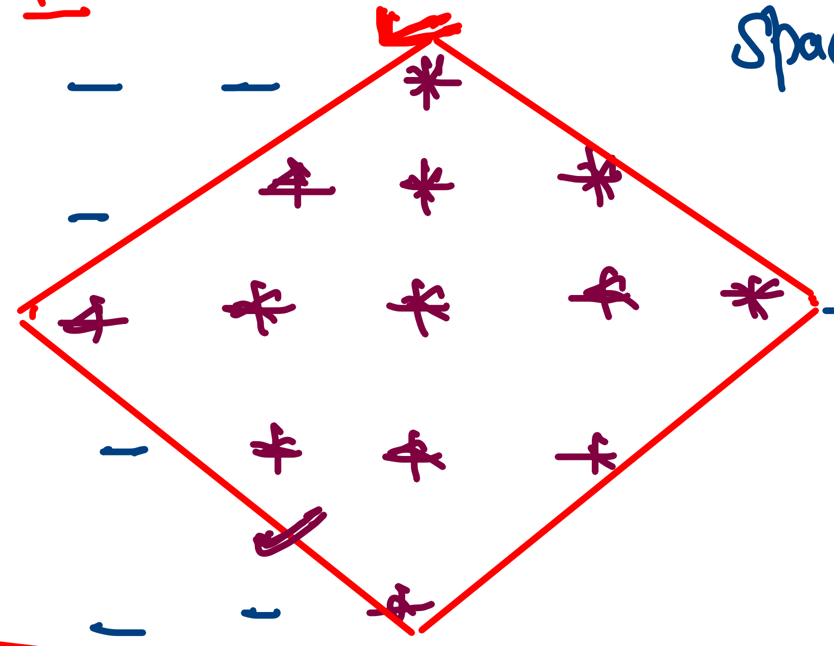
doubt + support

Structure:

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

var++;

var--;



Space: $n/2$ Star: 1

space--   Star += 2

space++   Star -= 2

```
    1
  1 1 1
1 1 1 1 1
  1 1 1
    1
```

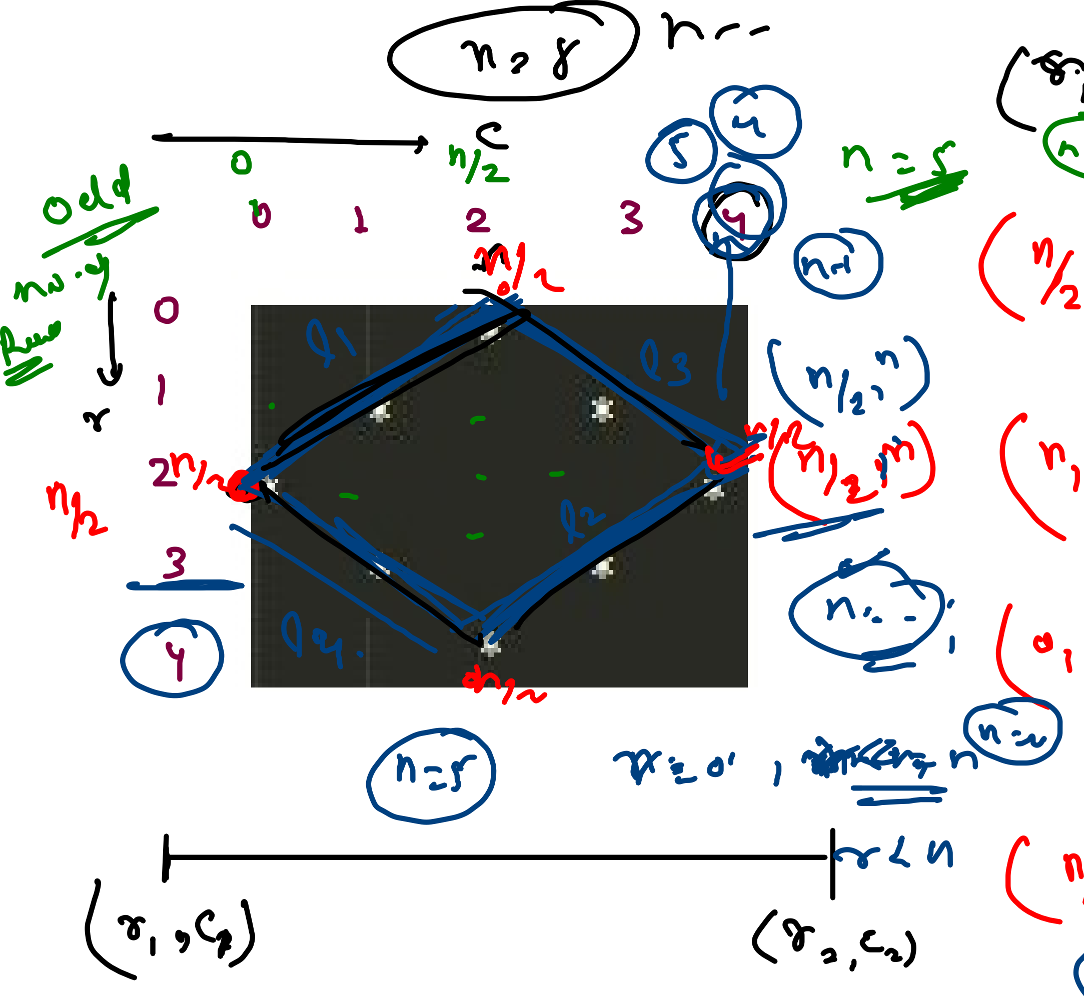
1 → convert into var

var++

var++;

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

```
    1
  2 2 2
3 3 3 3 3
  2 2 2
    1
```



(r_1, c_1) $\qquad$ (r_2, c_2)

$l1$: $(n/2, 0)$ — $(0, n/2)$

$$m = \frac{n/2 - 0}{0 - n/2} = -1$$

$l2$: $(n, n/2)$ — $(n/2, n)$

$$m = \frac{n - n/2}{n/2 - n} = -1$$

$l3$: $(0, n/2)$ — $(n/2, n)$

$$m = 1$$

$l4$: $(n/2, 0)$ — $(n, n/2)$

$$m = 1$$

$l_1 \rightarrow$

$$c - 0 = -1\left(r - n/2\right)$$

$$\boxed{c + r = n/2}$$

$l_2 =$

$$c - n/2 = -1\left(r - n\right)$$

$$\boxed{c + r = n + n/2}$$

l_4

$$c - 0 = 1\left(r - n/2\right)$$

$$\boxed{r - c = n/2}$$

$l_3 \rightarrow$

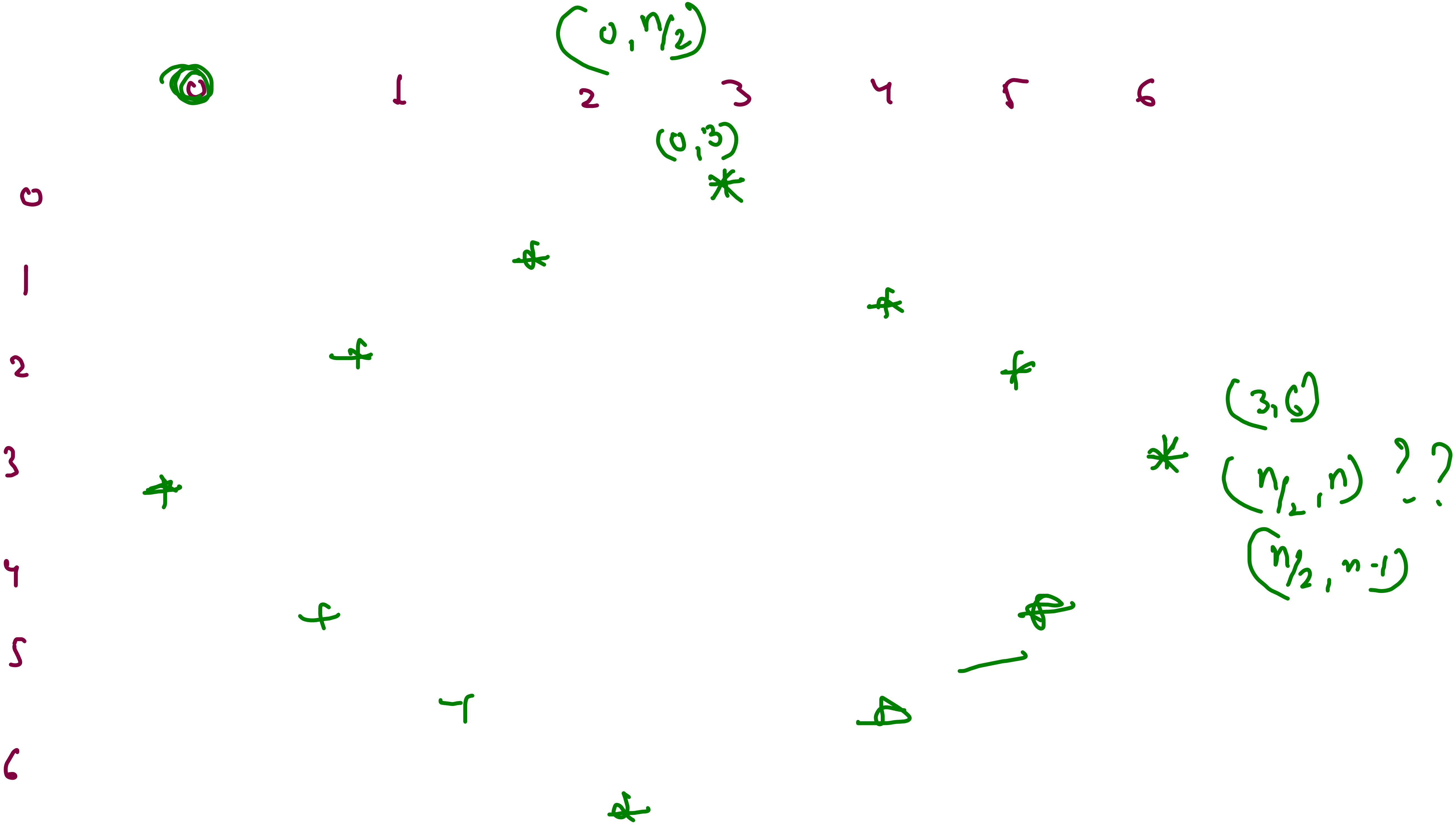
$$c - n/2 = 1\left(r - 0\right)$$

$$\boxed{c - r = n/2}$$

$$\frac{c - c_1}{r - r_1} = \frac{c_2 - c_1}{r_2 - r_1}$$

$$\text{Slope} = \frac{c_2 - c_1}{r_2 - r_1} = m$$

$$c - c_1 = m\left(r - r_1\right)$$

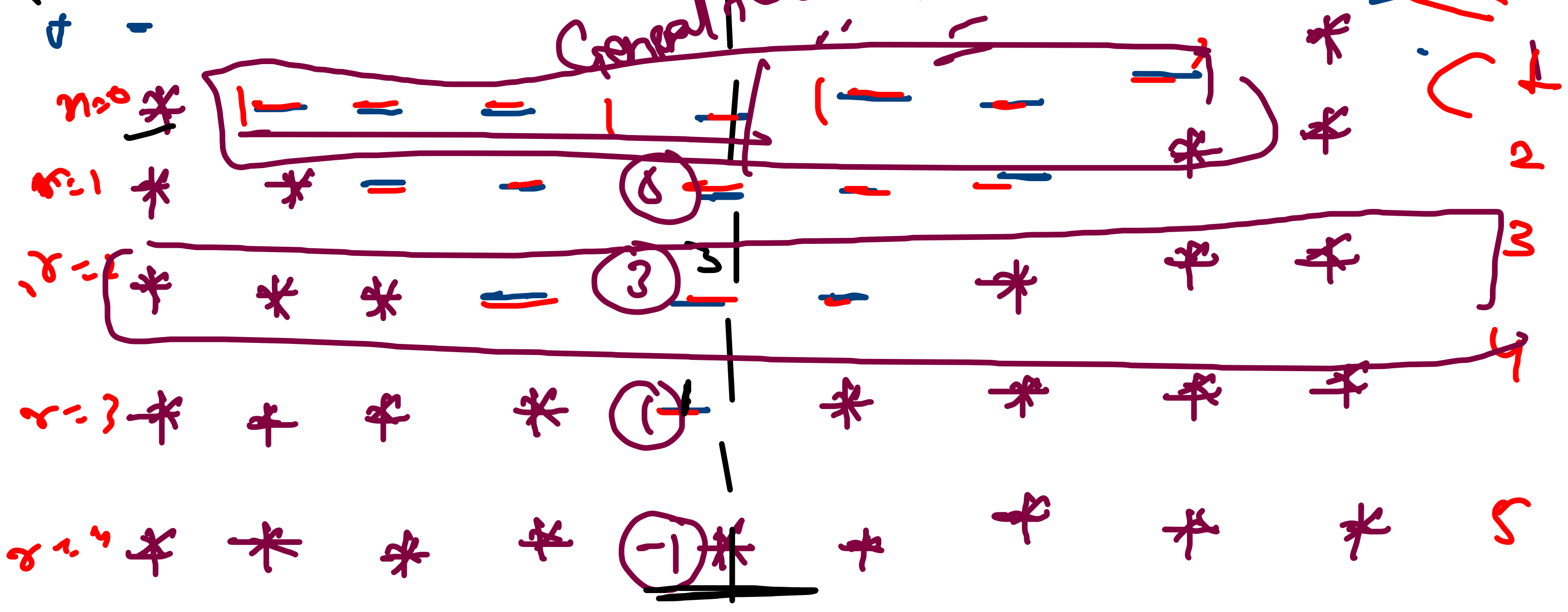


$(0, n/2)$
0 1 2 3 4 5 6
$(0,3)$
0
1
2
3
4
5
6
$(3,6)$
$(n/2, n)$??
$(n/2, n-1)$

```
1           1
1 2       2 1
1 2 3   3 2 1
1 2 3 4 3 2 1
```

n = 4

General term??



star = 1

star++

Star

Space

n = 5

$2n-3$

7

5

3

1

-1

2 less

n = 5

$2n-3$

$2 \times 5 - 3$

$= 10 - 3 = 7$

-1   1   3   5   7 . . . .

a_n → in terms of n

General term of A.P

$$\boxed{a_n = a + (n-1)d}$$

$a = -1$, $d = 2$

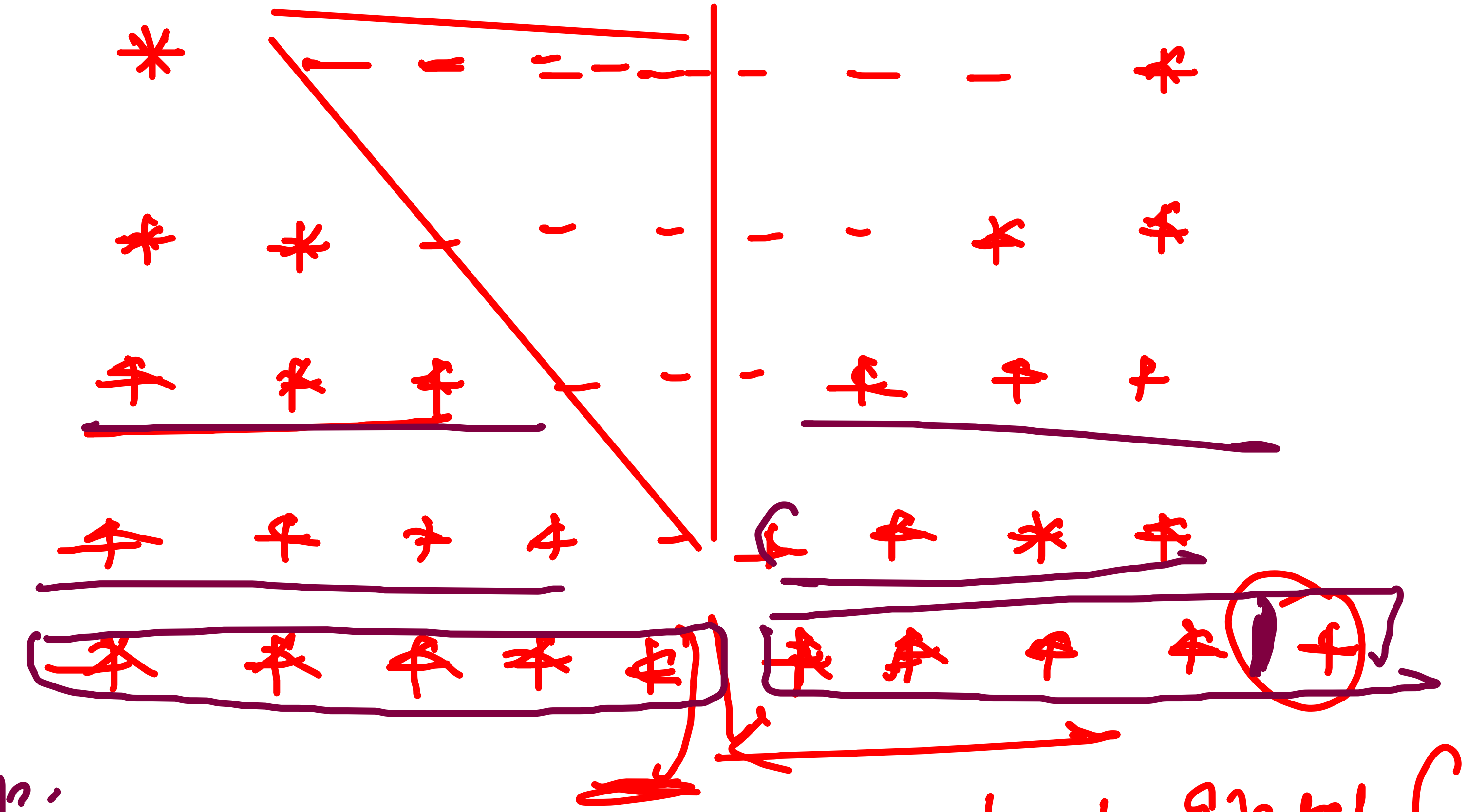
$a_n = -1 + (n-1)2$

$$\boxed{a_n = 2n-3}$$

print star   print space   print star → hit Enter

$2n-3=7$

Star	Space	Star	
1	7	1	\n
2	5	2	\n
3	3	3	\n
4	1	4	\n
5	-1	4	\n



last iteration (star --

st	sp.	
4	3	1
2	1	2
3	-1	3

$n=3$

$2n-3$

$2\times3-3=3$