$\hookrightarrow$ **loops**

1) Single loop $\longrightarrow$ 1D

2) Nested loop

$\quad\quad\quad\quad\quad\quad\hookrightarrow$ 2 loops $\longrightarrow$ 2D

$\quad\quad\quad\quad\quad\quad\hookrightarrow$ 3 loops $\longrightarrow$ 3D

Pattern 1 - Print Stars in same line

```java
public class Solution {

    public static void main(String[] args) {
        Scanner scn = new Scanner(System.in);
        int n = scn.nextInt();

        for (int i = 0; i < n; i++) {
            System.out.print("*");
        }
    }
}
```

Duel — Pattern Printing

input n

n = 5

	0	1	2	3	4
i=0 → 0	✳	✳	✳	✳	✳
i=1 → 1	✳	✳	✳	✳	✳
i=2 → 2	✳	✳	✳	✳	✳
i=3 → 3	✳	✳	✳	✳	✳
i=4 → 4	✳	✳	✳	✳	✳

rows (n)

↑ j=0 ↑ j=1 ↑ j=2 ↑ j=3 ↑ j=4

Cols (n)

5 × 5

n = 5

rows

cols

```
for (int i=0 ; i<n ; i++ ){
    for (int j=0 ; j<n; j++ ){
        // Statement
        (Kaam)
    }
}
```

$i=0, j=0$ ✓
$j=1$ ✓
$j=2$ ✓
$j=3$ ✓
$j=4$ ✓
$j=5<5$ ✗

$i=1, j=0$ ✓
$j=1$ ✓
$j=2$ ✓
$j=3$ ✓
$j=4$ ✓
$j=5<5$ ✗

$i=2, j=0$ ✓
$j=1$ ✓
$j=2$ ✓
$j=3$ ✓
$j=4$ ✓
$j=5<5$ ✗

$i=3, j=0$ ✓
$j=1$ ✓
$j=2$ ✓
$j=3$ ✓
$j=4$ ✓
$j=5<5$ ✗

$i=4, j=0$ ✓
$j=1$ ✓
$j=2$ ✓
$j=3$ ✓
$j=4$ ✓
$j=5<5$ ✗

$\left\{\begin{array}{l} \text{25 times} \\ \text{in total} \\ \text{for input} \\ n=5 \end{array}\right.$

Pattern 2 - Print n x 12 star rectangle

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

    for (int i = 0; i < 12; i++) {     // rows
        for (int j = 0; j < n; j++) {     // cols
            System.out.print("*");
        }
        System.out.println();
    }
}
```

observation

	stars
$i = 0$	1
$i = 1$	2
$i = 2$	3
$i = 3$	4
$i = 4$	5

n

```
for ( int i=0; i<n; i++) {
    for ( int j=0; j<=i; j++) {
        Syso("*");
    }
    Sysoln();
}
```

$i = 0,$
$j = 0 <= 0$ ✓
~~$j = 1 <= 0$~~

$i = 1$
$j = 0 <= 1$ ✓
$j = 1 <= 1$ ✓
~~$j = 2 <= 1$~~ ✗

$i = 2$
$j = 0 <= 2$ ✓
$j = 1 <= 2$ ✓
$j = 2 <= 2$ ✓
~~$j = 3 <= 2$~~ ✗

$i = 3$
$j = 0 <= 3$ ✓
$j = 1 <= 3$ ✓
$j = 2 <= 3$ ✓
$j = 3 <= 3$ ✓
~~$j = 4 <= 3$~~ ✗

n = 4

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

    for (int i = 0; i < n; i++) {     // rows
        for (int j = 0; j <= i; j++) {     // cols
            System.out.print("* ");
        }
        System.out.println();
    }
}
```

$i = 4 < 4$ ✗

output

$i = 0$
$j = 0$

$i = 1$
$j = 0, 1$

$i = 2$
$j = 0, 1, 2$

$i = 3, \quad j = 0, 1, 2, 3$

*
* *
* * *
* * * *