

TIME & SPACE COMPLEXITY

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→ Those codes which take less time and need less memory space — **ARE EFFICIENT**

→ Relation of Input size & operations

can be — linear

— square

— cubic

— quadratic

— log_n

TIME COMPLEXITY

— Relation between input size & running time (operations)

For e.g. we input

$n = 2$

and run a for loop for $i \leq 2$ times and print

“Hello world” x 2

— Operation = printing “Hello world” x 2 times

— Input size = 2 (i.e. integer) or say 4 bytes

WAYS TO FIND TIME COMPLEXITY

• BEST CASE = $\Omega = 1$

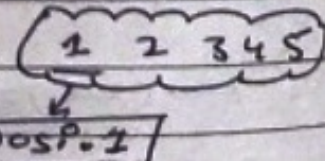
• AVERAGE CASE = $\phi = \frac{n(n+1)}{2}$

• WORST CASE = $O(n)$

Understanding by example

Numbers = [1, 2, 3, 4, 5]

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① Best case 

Hammer ~~cross~~ operation at 1st

Average Case

I can be present at any position

i.e.

$$\text{Average operation} = \frac{1+2+3+4+5}{5}$$

$$= \frac{n(n+1)}{2}$$

3) WORST CASE

I is present at sm position

$$\text{operations} = 5$$

* We usually take worst case in solving question in CP

Question

for $n=5$

```
int n = input.nextInt();
```

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

```
{ for (int j=0; j<n; j++)
```

```
{ print (hello world);
```

```
}
```

```
}
```

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For given loop

We can see

Outer loop
Inner loop

i=0	0, 1, 2, 3, 4, 5
i=1	0, 1, 2
i=2	0, 1, 2

WORST
Time Complexity

$$(n+n) \text{ i.e. } 3+3=6$$

operation

* Small input size are easily processed, but large input size will exponentially increase the time complexity

SPACE COMPLEXITY

- Space Complexity of an algorithm is the total space taken by the algorithm with respect to the input size. Space complexity includes both Auxiliary space and space used by input.

Auxiliary - Space is extra space or temporary space used by an algorithm.

Combining all these will give the space complexity.

eg

```
p.s.v main(String[] args)
```

```
{
```

```
Scanner sc = new Scanner(System.in);
```

```
int n = sc.nextInt();
```

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

```
{
```

```
    print(something)
```

```
}
```

Here

Object take space

+

input take space

+

variables take space