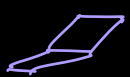
Mr. XOR

Mr. Kaif

10s

15s

Hardware



Mac book Pro

Samsung

10s

7s

Language

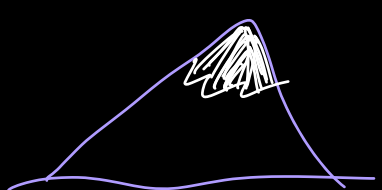
Python

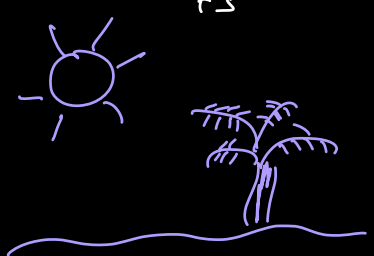
C/C++

6.5s

7s

Physical Facts

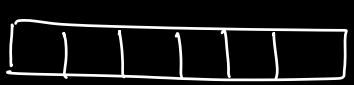




7.1s

6.9s

Selection of Input



5.3s

11s

```
int fn(N){
    s=0;
    for(i=0; i<N; i++){
        s= s+i;
    }
    ret s;
}
```

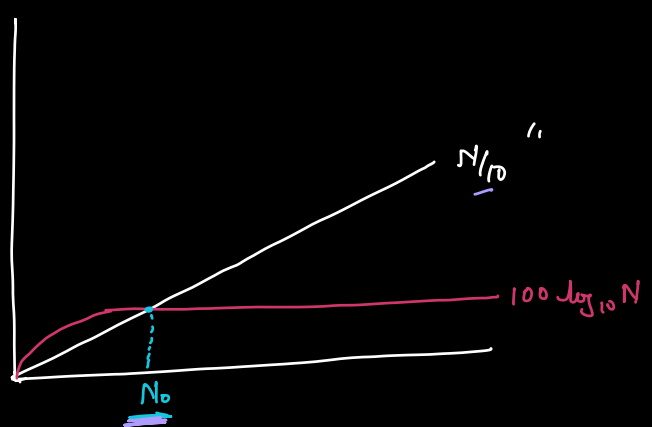
# of iterations = N

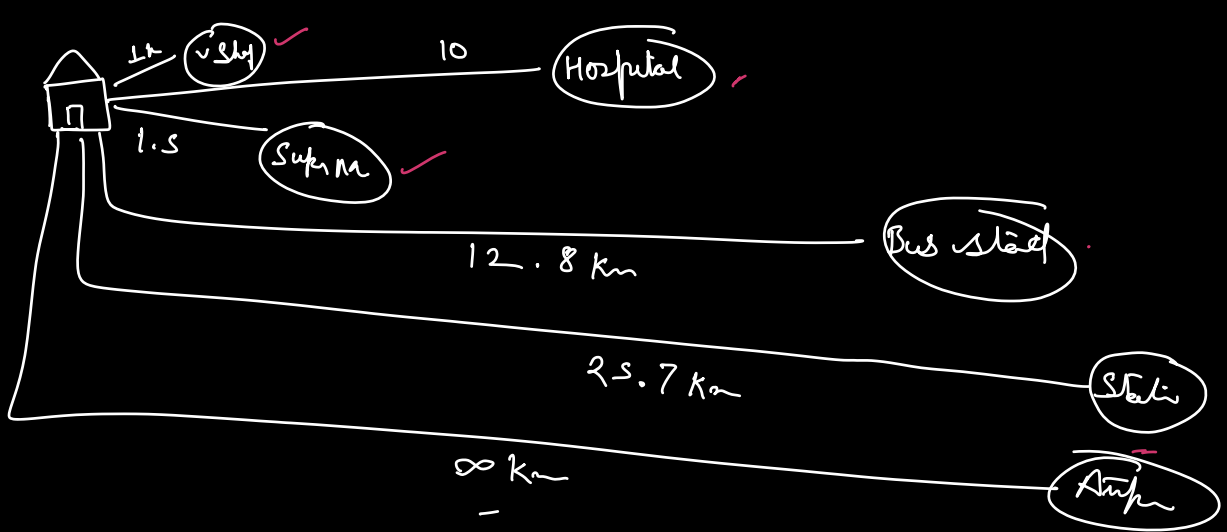
XOR

$100 \log_{10} N$

Kaif

$\frac{N}{10}$





Veg Shop
Super Market.
] Walking dist

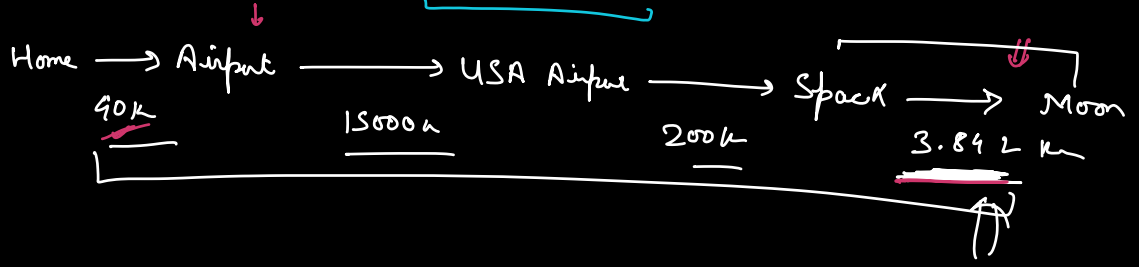
Hospital
Bus stand
] Bike

Airport
] Cab

USA
Canada
UK
] Flight

The moon — Rocket

Home → Moon ≈ 3, 84, 000 km



f(N)	Growth Rate (g(N))
N + 10 2N 10 N	O(N)
$2N^2$ $3N^2 + 2N + 1$ $4N^2 + N$	$O(N^2)$
$5N^3 + N$ $6N^3 + 2N^2 + N$	$O(N^3)$

Asymtotic Analysis ⇒ for very large values.

N	N^3	N^2
N = -10	-1000	100

↳ Size of input

Big O
(just for knowledge)

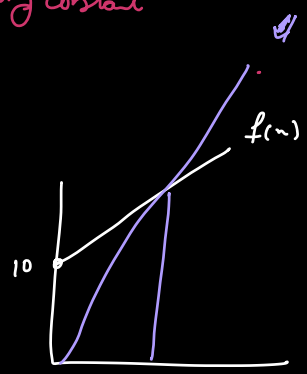
a function f(n) will be O(g(n))

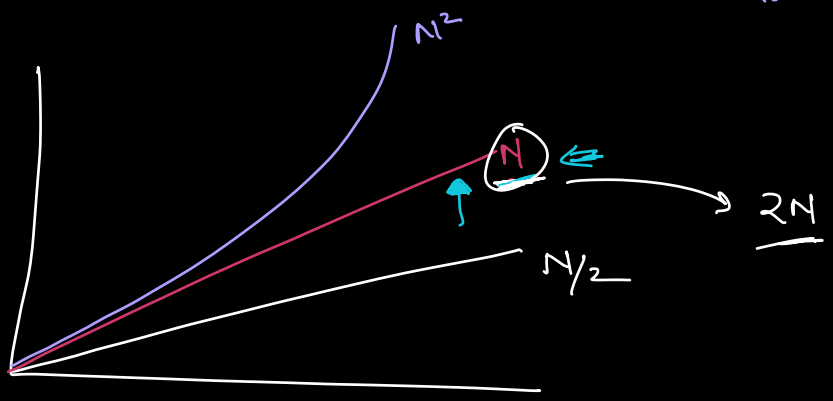
if $f(n) <= c\ g(n)$ $\forall\ n >= n_0$

c → any constant

$f(N) = N + 10$

$N + 10 <= 2N$





$f(n) = \frac{N}{2}$

N , N^2 , N^3 , N^4

Limitations of Big-O

Algo 1	Algo 2
$O(N^2)$	$O(N^3)$

Time taken by Algo 1 is ALWAYS is lesser than that of Algo 2.

- $100N^2 + 10N + 36 \Rightarrow O(N^2)$
- $N^3 \Rightarrow O(N^3)$

Algo 1

$O(N^2)$

$100N^2$

Algo 2

$O(N^3)$

N^3

	Algo 1	Algo 2
$N = 1$	100	1
$N = 10$	10,000	1000
$N = 100$	$(100)^3$	$(100)^3$

Algo 1

$O(N^2)$

$4N^2 + 3N + 1$

Algo 2

$O(N^2)$

N^2

Break till 10:42 p

Why $O(\log N)$ & not $O(\log_2 N)$

$$\log_2 N = \frac{\log_3 N}{\log_3 2}$$

$b \to c$

$$\log_b x = \frac{\log_c x}{\log_c b}$$

$$\log_2 N = C \log_3 N$$

$\log_{10} N \leq \log_2 N$

Space Complexity

int : 4B
long : 8B
double : 8B

```
void fn (N) {
    int a, b, c;
    long d;
    double e;
    Print (a*b*e);
}
```

Space created in fn =
3×4 + 8 + 8
= 28B

Space Complexity : O(1)
↑ constant space

```
void fn (N) {
    int a, b, c;
    long d;
    double e;
    int arr[N];
}
```

Space created :
3×4 + 16 + 4N
28
28 + 4N
Space Complexity : O(N)

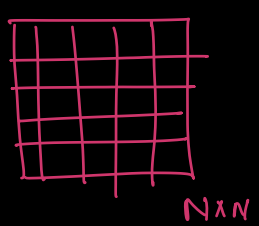
Space Complexity = Input Space* + Extra Space / Auxiliary Space

```
void fn (N) {
    int a, b, c;
    long d;
    double e;
    int arr[N];
    int arr[N][N];
}
```

Extra Space being created :

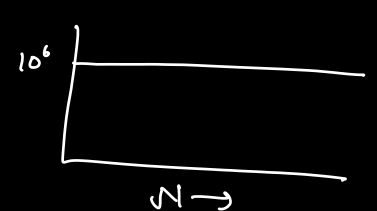
$28 + 4N + 4N^2$

Space Complexity : $O(N^2)$



Quiz 1 $f(N) = 10^6$

$O(1)$



Quiz 2 $N \log N$ vs $N\sqrt{N}$

N	$\log N$		$\sqrt{N}$
$N = 2^{32}$	32	<	2^{16}

$f(N)$: $4N + 3N \log N + 10^6$

Quiz

```
void f(N) {
    int arr1[N];   ⟹ 4NB
    int arr2[2N];  ⟹ 8NB
}
```

> 12NB ⇓ O(N)

Quiz

```
int add(a, b) {
    ret a+b;
}
```

⇒ TC : O(1)
SC : O(1)