Problem Solving 1

Agenda :

- log(n) complexity
- Prime number (optimize)
- Euclidean distance
- Assignment questions

★ Time Complexity in Binary Search

```
                0  1  2  3  4  5  6  7
# li = [2, 5, 6, 8, 10, 13, 16, 17]
       s           m              e
```

mid = (s+e) // 2 ⇒ 3

★ Best case :

target = 8

Time Complexity = O(1)

Worst Case Time Complexity :

128 → 2^7

128 ↓ 64 ↓ 32 ↓ 16 ↓ 8 ↓ 4 ↓ 2 ↓ 1

2^{10} ↓ $\log_2^{2^{10}} = 10$

How many times you divide a number by 2 to get 1.

$b^y = x$

$$\log_b^x = y$$

$\log_2^{128} = 7$

$\log_2^n = y$

$\log_2^n \rightarrow \boxed{\log n}$

In here base is 2 because in Binary Search we always divide our search space into 2 parts.

Q.1)

```
n = 50
a = 0
i = n

while i > 1 :
    a += 1
    i //= 2
```

$i = 50 \xrightarrow{1/2} 25 \xrightarrow{1/2} 12 \xrightarrow{1/2} 6 \cdots 1$

$(\log n)$ Ans:

Question

```
for i in range (1, n):          => n times
    for j in range (1, n//4):   => n/4
        for k in range (1, n):  => 1
            break
```

$T(C) \approx n \times \frac{n}{4} \times 1 \Rightarrow \frac{n^2}{4}$

$T(C) = O(n^2)$ Ans

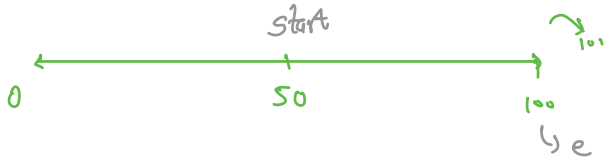
$n = 10^8$
$n/2 = 5 \times 10^7$

$n = 10^{16}$
$n/4 = 2.5 \times 10^{15}$

Question :

```
C = 0
for i in range(1, n+1):          ≈ n
    for j in range(1, n+1):      ≈ n
        for k in range(n//2, n+1, n//2):
            C += 1               ≈ O(1)
```

n = 100



After 1st jump there will be no range left for you to jump.

$TC = n \times n \times 1 \Rightarrow n^2$

TC = O(n²)

★ Prime Number :

i) A number divisible by 1 & itself
ii) A number having exactly 2 different factors.

n = 11

11 : 1 11 yes

n = 10

10 : 1 , 2, 5 , 10 No

If a number has any factors between 2 – (n-1) : Not prime. else prime.

n = 20

20 : 1, 2, 4, 5, 10, 20

40 : 1, 2, 4, 5, 8, 10, 20, 40

We can check till n//2 numbers

★ Improvised :

n = 100

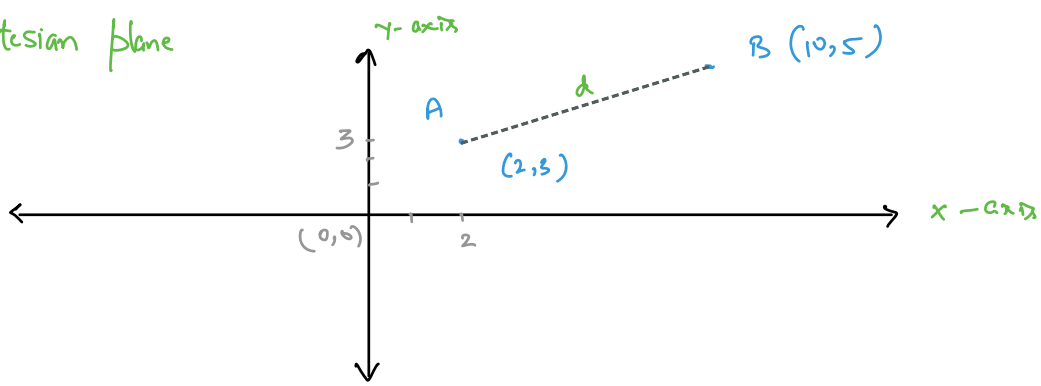
sqrt(100) => 10

10 → 2, 3, 4, 5, 6, 7, 8, 9, 10

77 → 7 not prime
76 → 2 not prime
99 → 3 not prime
48 → 2 not prime
73 → --- Prime

★ Euclidean distance :

Cartesian plane



$P_A(x, y)$

A (2,3) → $x_1 = 2$, $y_1 = 3$

B (10,5) → $x_2 = 10$, $y_2 = 5$

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$d = \sqrt{(10-2)^2 + (5-3)^2}$

$d = \sqrt{(8)^2 + (2)^2}$

$d = \sqrt{64 + 4}$

$d = \sqrt{68}$ Ans

★ KNN : k- nearest neighbors