



C++ Assignments | Time and space complexity analysis - 2 | Week 8 ¹.

Calculate the time complexity for the following code snippet.

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

21) Calculate the time complexity for the following snippet.

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

$\rightarrow O(n)$

$j < \sqrt{n}$

let $n=10$

$i=0$

$i=1$

$i=2$

$i=3$

$i=4$

$i=5$

$j=0, 1, 2, 3, 4 \dots \sqrt{n}$

$j=0, 1, 2, 3, 4 \dots \sqrt{n}$

$j=0, 1, 2, 3, 4 \dots \sqrt{n}$

$j=0, 1, 2, 3, 4 \dots \sqrt{n}$

$j=0, 1, 2, 3, 4 \dots \sqrt{n}$

$j = 0$ to \sqrt{n}

j loop ~~now~~ work s till \sqrt{n}
times always

$$T.C = O(n * \sqrt{n})$$

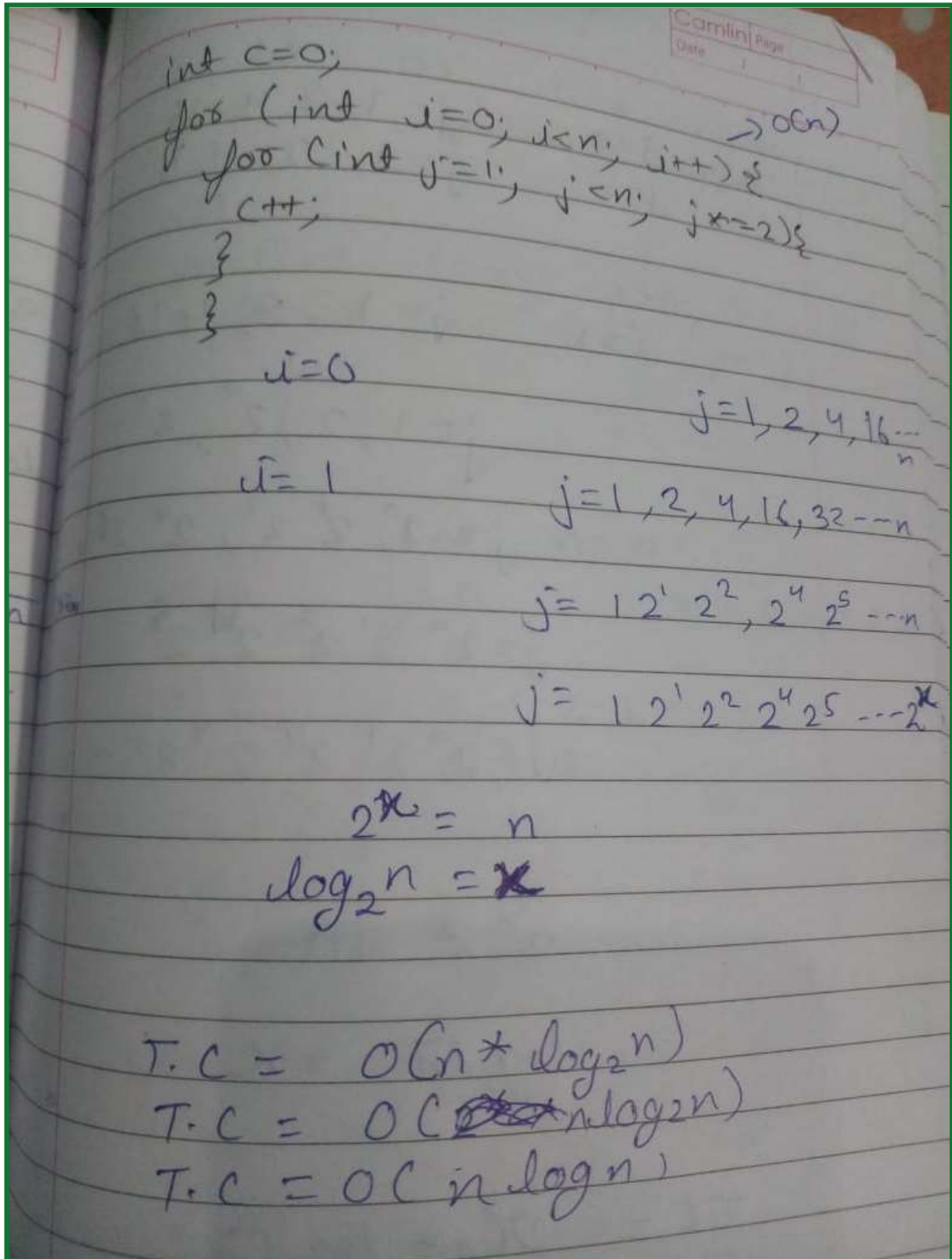
$$= O(n * n^{1/2})$$

$$= O(n^{3/2})$$

Ans.

2. Calculate the time complexity for the following code snippet.

```
int c = 0;  
for(int i = 0; i < n; i++) {  
  for(int j = 1; j < n; j *= 2) {  
    c++;  
  }  
}
```



3. Calculate the time complexity for the following code snippet.

```
int c = 0;
for(int i = 0; i < n; i++) {
  for(int j = 1; j * j < n; j *= 2) {
    c++;
  }
}
```

$$\begin{array}{ll}
 i=0 & j=1, 2, 4, 16 \dots \\
 i=1 & j=1, 2, 4, 16 \dots \\
 \vdots & \vdots \\
 i=n & j=1, 2, 4, 16, 32 \dots
 \end{array}$$

$$j = 1, 2, 2^2, 2^4, 32 \dots \sqrt{n}$$

$$j = 2^0, 2^1, 2^2, 2^4, 2^5 \dots \sqrt{n}$$

$$j = 2^0, 2^1, 2^2, 2^4, 2^5 \dots \sqrt{n}$$

$$j = 2^0, 2^1, 2^2, 2^4, 2^5 \dots 2^x$$

$$2^x = \sqrt{n}$$

$$\log_2 \sqrt{n} = x$$

$$\begin{aligned}
 T.C &= O(n \times \log_2 \sqrt{n}) \\
 T.C &= O(n \log \sqrt{n}) \\
 T.C &= O\left(n \frac{1}{2} \log n\right) \\
 T.C &= O\left(n \log n\right) \quad \text{Ans}
 \end{aligned}$$

4. Calculate the time complexity for the following code snippet.

```

int c = 0;
for(int i = n; i > 0; i /= 2) {
    for(int j = 0; j < i; j++) {
        c++;
    }
}

```

sum of $i = n + \frac{n}{2} + \frac{n}{4} + \frac{n}{8} + \dots$

$$ST = a \cdot \frac{1 - r^n}{1 - r}$$

$$ST = \frac{n \left[1 - \left(\frac{1}{2}\right)^{\log_2 n} \right]}{1 - \frac{1}{2}}$$

$$ST = 2n \left[1 - \left(\frac{1}{2}\right)^{\log_2 n} \right]$$

$$ST = \left[2n - 2n \left(\frac{1}{2}\right)^{\log_2 n} \right]$$

$$ST = \left[2n - 2n \frac{1}{2^{\log_2 n}} \right]$$

$$ST = \left[2n - \frac{2n}{2n} \right]$$

$$ST = 2(n-1)$$

$$ST = 2(n-1)$$

T.C = $O(n)$ Ans.

5. Calculate the time complexity for the following code snippet.

```

int c = 0;
for(int i = 1; i < n; i *= 2) {
    for(int j = n; j > i; j--) {
        c++;
    }
}

```


Total no. of operations = $(n-2) + (n-2) + \dots + (n-4) + (n-6) + \dots$

$n = \log_2 n$

$= n \cdot n$

$= (n + n + \dots) - [1 + 2 + 4 + \dots]$

$= \log n \quad \log_2 n$

$= n \cdot \log n - \left[\frac{2^{\log_2 n} - 1}{2 - 1} \right]$

$= n \log n - [n - 1]$

$= n \log n - n + 1$

T.C = $O(n \log n)$

Note:- Please try to invest time doing the assignments which are necessary to build a strong foundation. Do not directly Copy Paste using Google or ChatGPT. Please use your brain 😊.