

Time and Space

Time Complexity asymptotic notation vs Experimental notation

① worst case

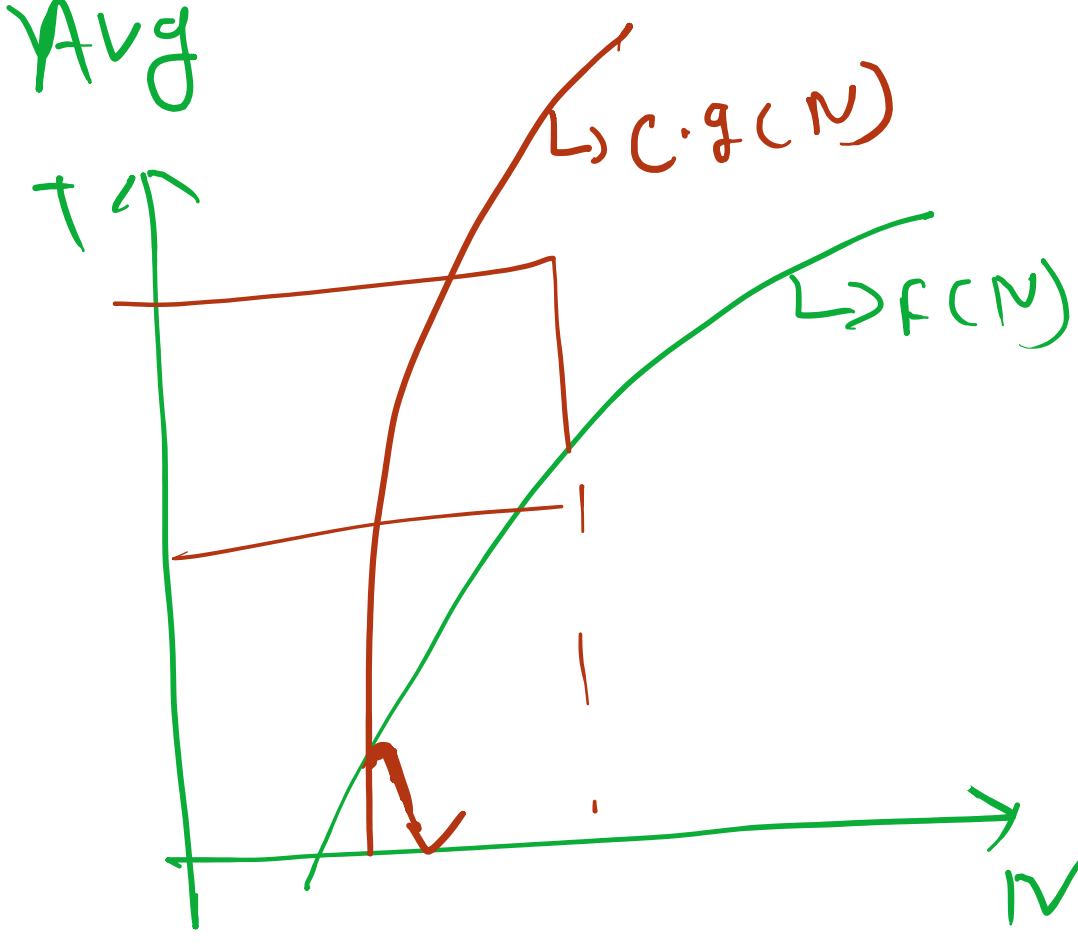
② best case

③ Avg

$f(N) \leq C \cdot g(N)$

$N \geq N_0$

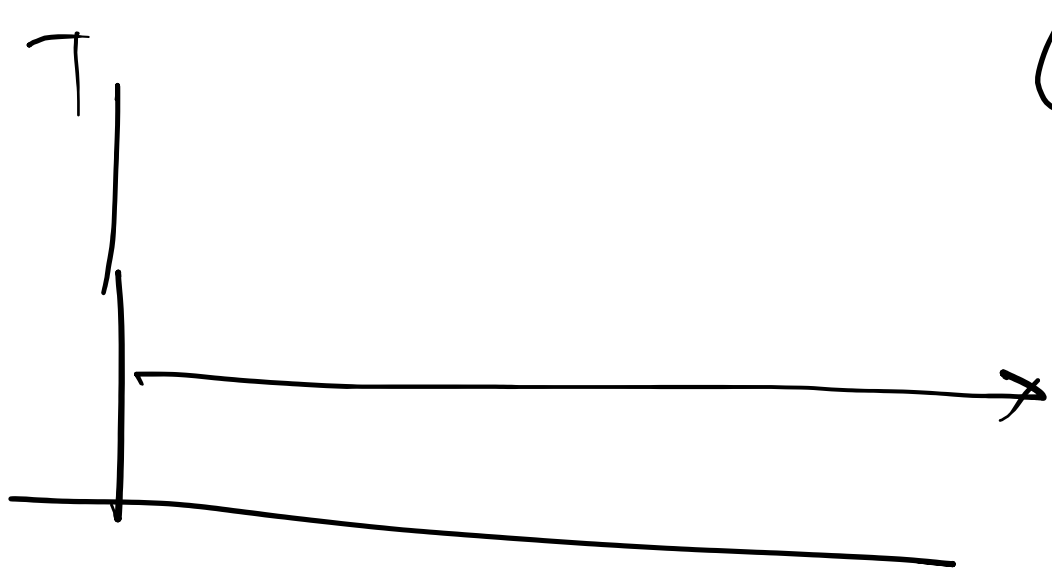
$f(N) = O(g(N))$
Big Oh



Now

$f(N) = 2^{n^2+5n} + 7$ T.C

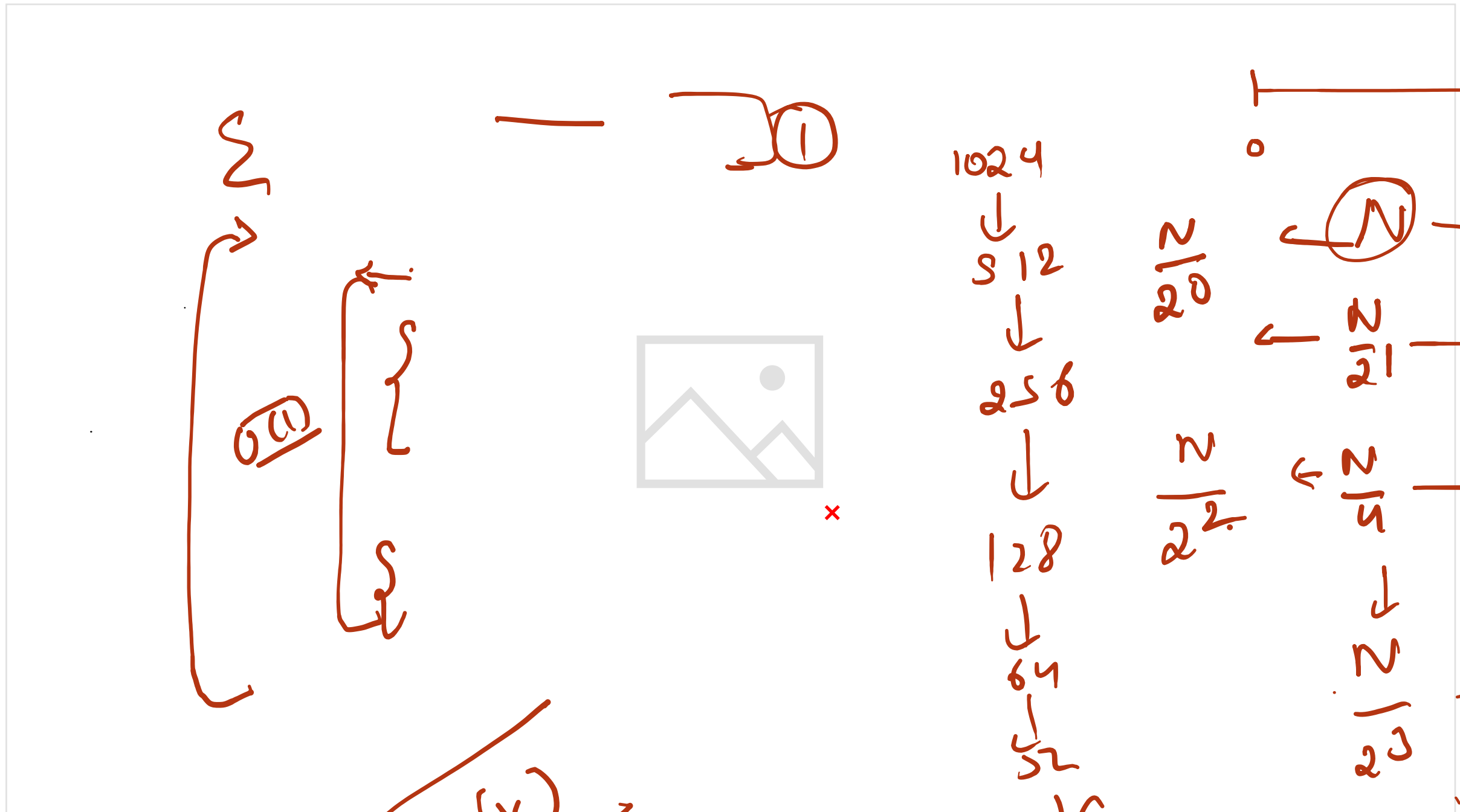
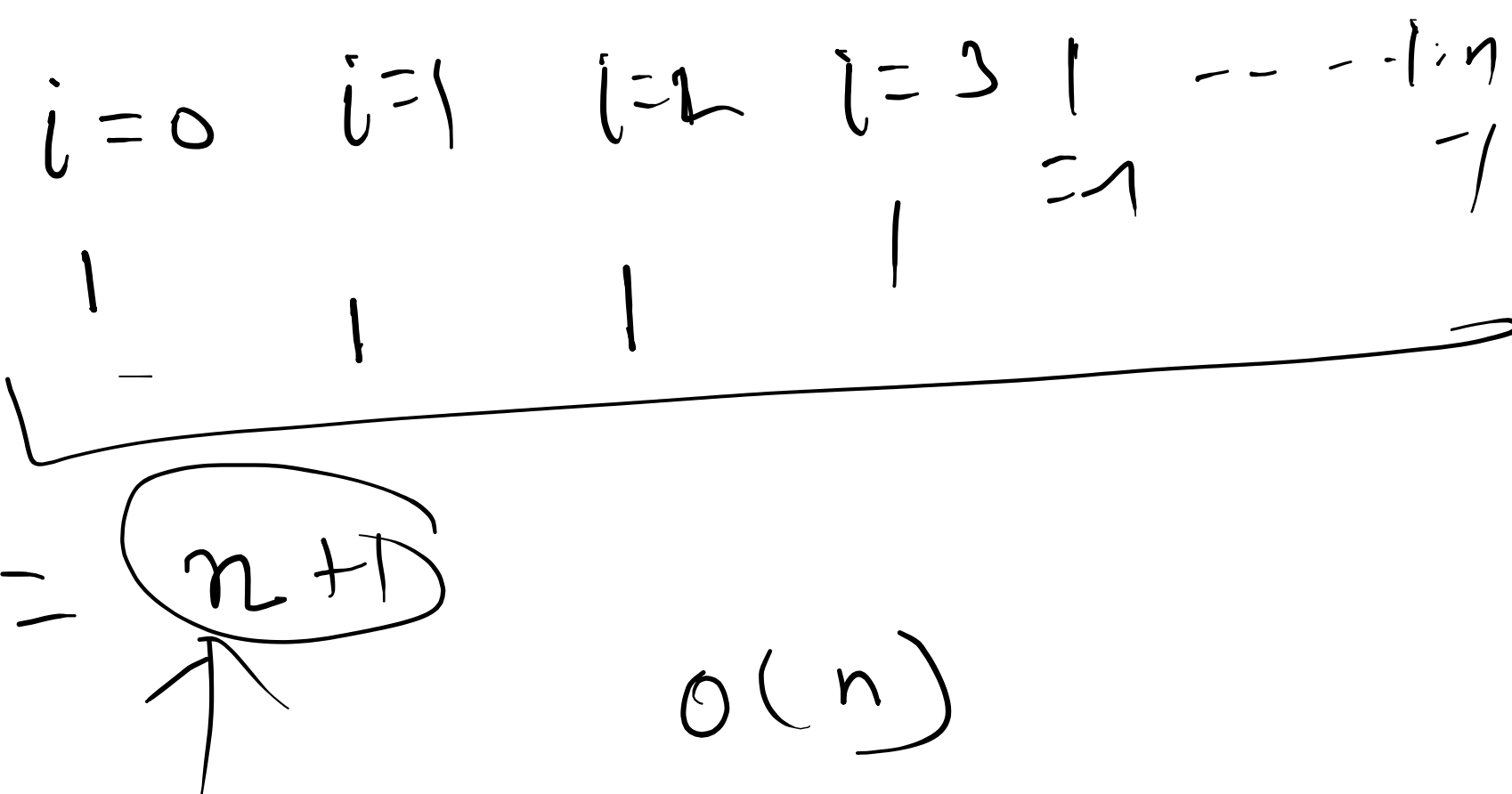
$f(N) = 3n^2 + 2^n \log(n) + 7n^2 + 5$



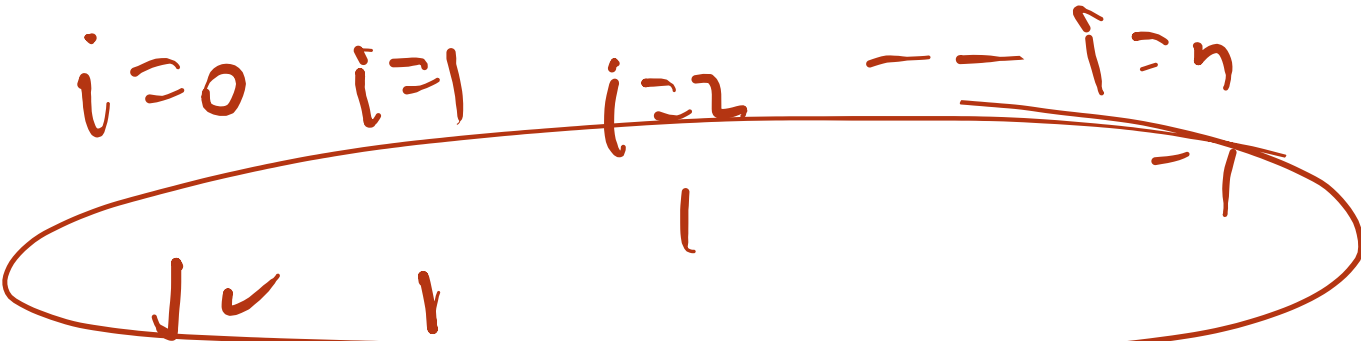
$O(2^n \log(n))$

$O(1)$

```
public static int Search(int[] arr, int item) {  
    for (int i = 0; i < arr.length; i++) {  
        if (arr[i] == item) {  
            return i;  
        }  
    }  
    return -1;  
}
```



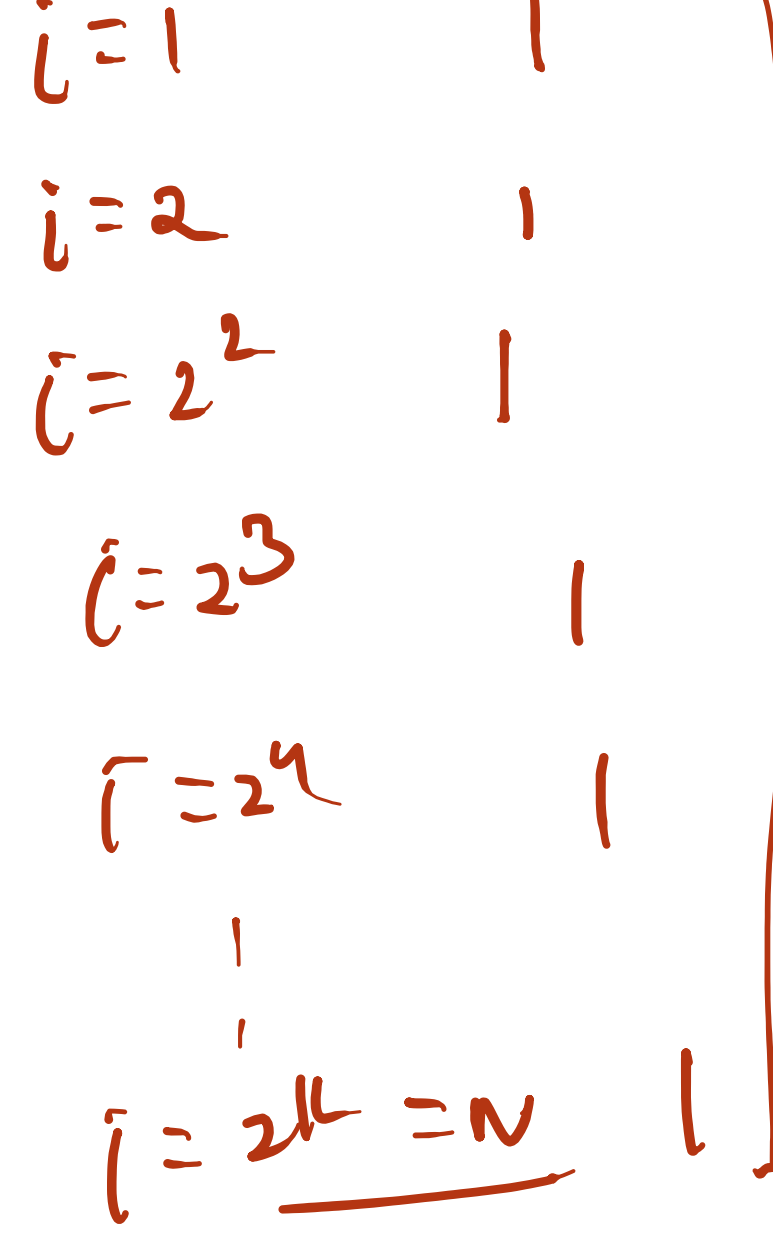
```
while (i < n) {  
    System.out.println("Hey");  
    i++;  
}
```



while (n > 0) {
 n = n/2;
}

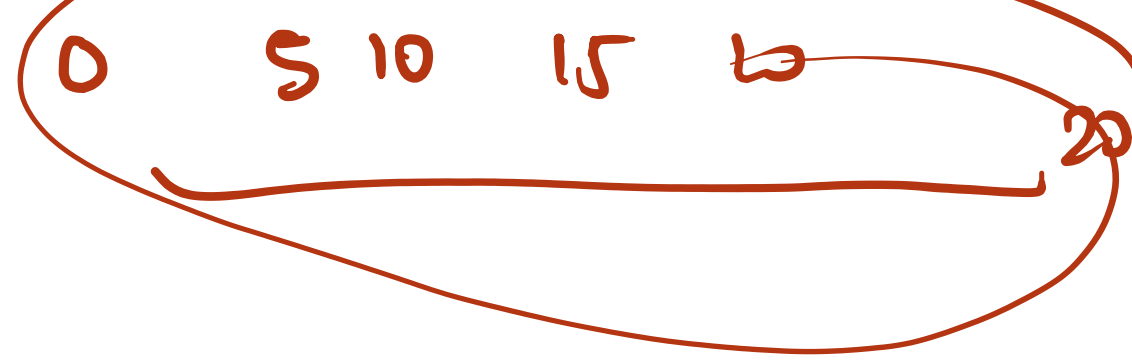
```
while (i < n) {  
    System.out.println("Hey");  
    i *= 2;  
}
```

$2^k = n$
 $k = \log_2 n$



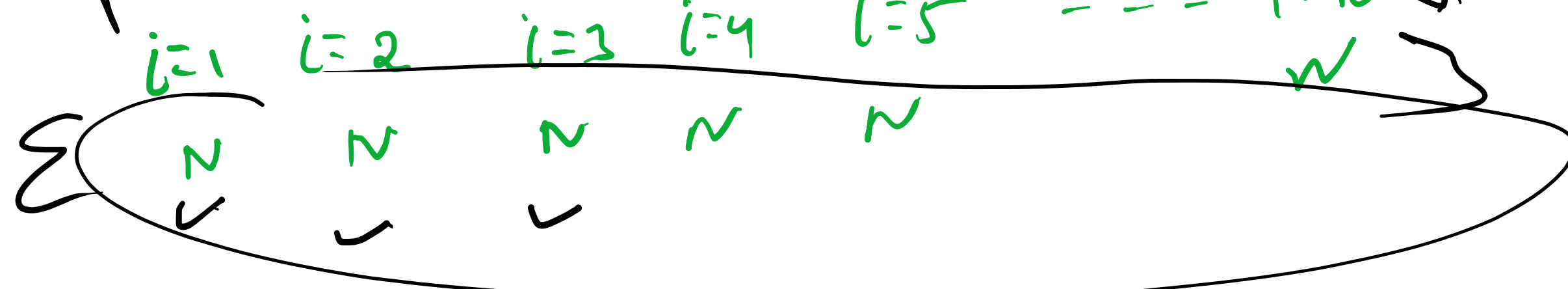
$\frac{n}{3}$

n=0



```
while (i <= n) {  
    System.out.println("Hey");  
    i += 2;  
    i += 3;  
}
```

```
for (i = 1; i <= n; i++) {  
    for (int j = 1; j <= n; j++) {  
        System.out.println("hey");  
    }  
}
```

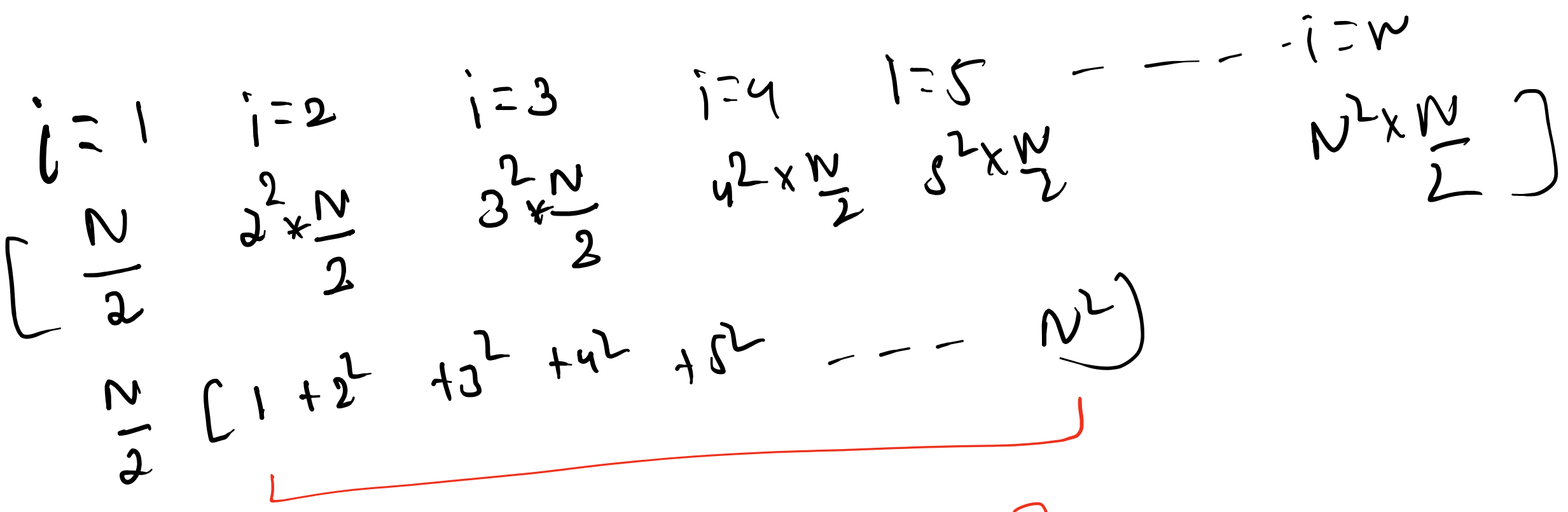
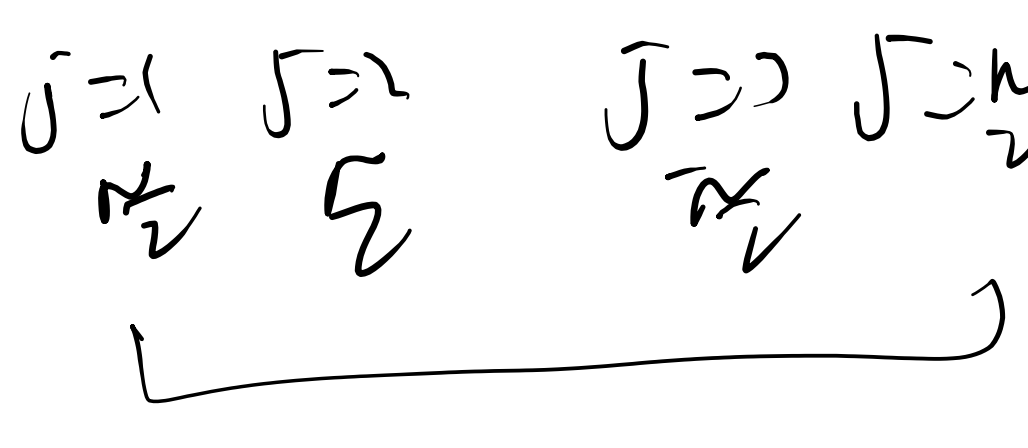


```
for (i = 1; i * i <= n; i++) {  
    System.out.println("hey");  
}
```

$i^2 \leq n$
 $i \leq \sqrt{n}$

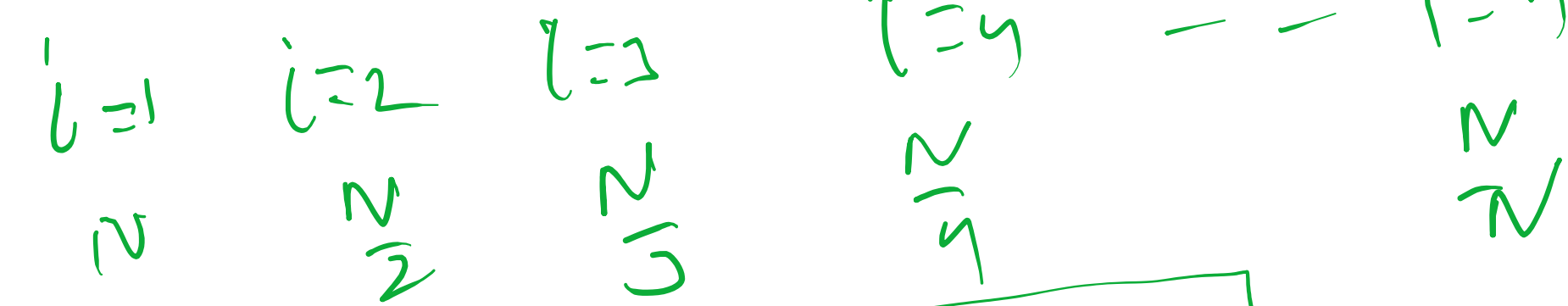
$O(\sqrt{n})$

```
for (i = 1; i <= n; i++) {  
    for (int j = 1; j <= i; j++) {  
        for (k = 1; k <= n/2; k++) {  
            System.out.println("hey");  
        }  
    }  
}
```



$\frac{n}{2} \left(\frac{n(n+1)(2n+1)}{6} \right)$

```
for (i = 1; i <= n; i++) {  
    for (int j = 1; j <= n; j++) {  
        System.out.println("hey");  
    }  
}
```



$N \left(1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n} \right) = O(\log(n))$

