Lec-11

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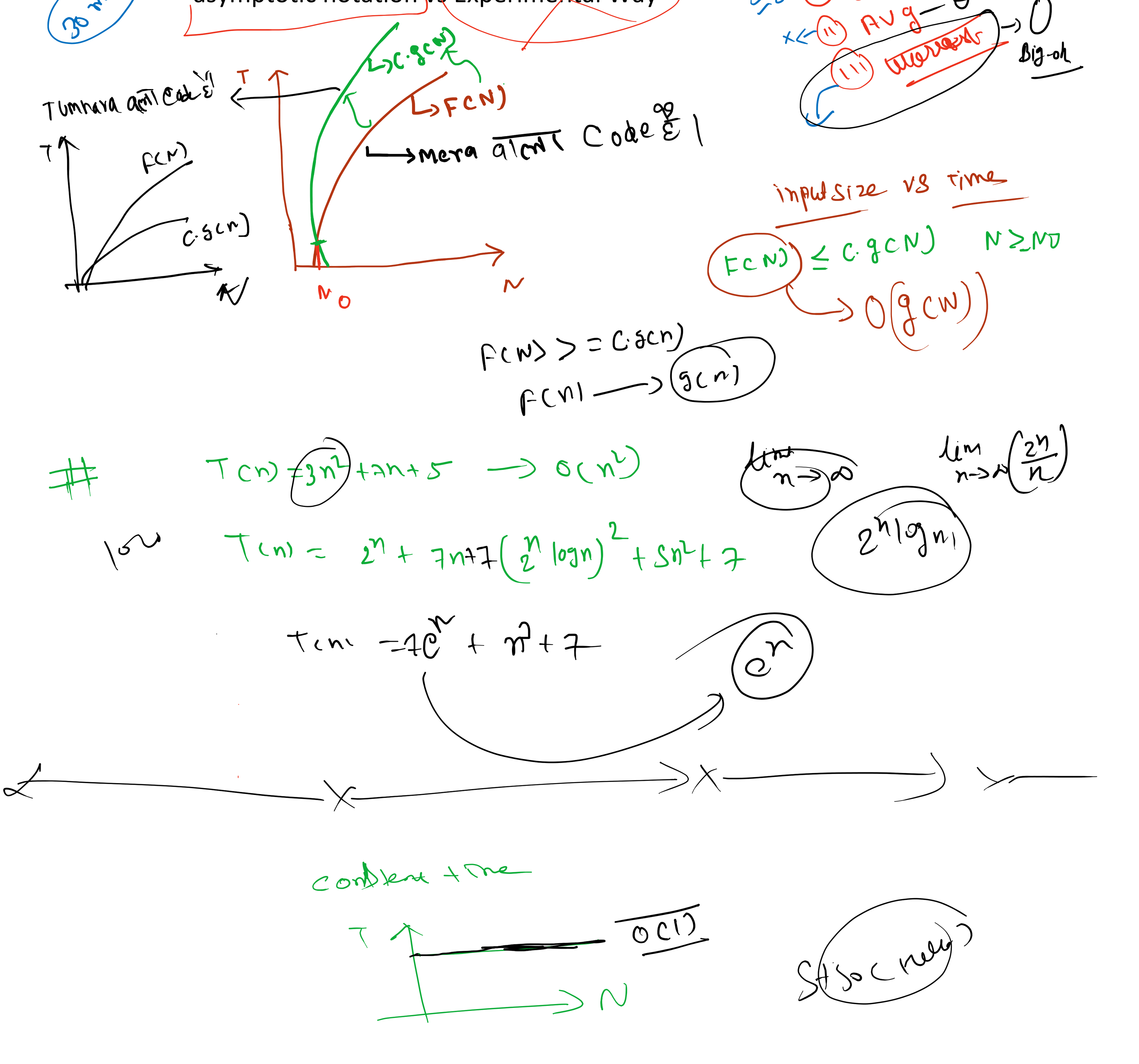
Time & Space Complexity

asymptotic notation vs Experimental Way



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

T(n) = N

O(n)

```
public static int Maximum(int[] arr) {
        int max = arr[0];
        for (int i = 1; i < arr.length; i++) {
            if (arr[i] > max) {
                max = arr[i];
            }
        }
        return max;
    }
```

T(n) = (n-1) + 1

O(n)

```
public static int Search(int[] arr, int item) {
        int lo=0;
        int hi=arr.length-1;
        while(lo<=hi) {
            int mid=(lo+hi)/2;
            if(arr[mid]==item) {
                return mid;
            }
            else if(arr[mid]>item) {
                hi=mid-1;
            }
            else {
                lo=mid+1;
            }
        }
        return -1;
    }
```

$K = \log_2 N$

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

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

$n \times n = n^2$

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

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

$\frac{N}{2}[1 + 2^2 + 3^2 + 4^2 + \dots + N^2]$

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

$N(1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots + \frac{1}{N})$

N(log(n))

```
public static int Maximum(int[] arr) {
        int ans = Integer.MIN_VALUE;
        for (int i = 0; i < arr.length; i++) {
            int sum = 0;
            for (int j = i; j < arr.length; j++) {
                sum += arr[j];
                ans = Math.max(ans, sum);
            }
        }
        return ans;
    }
```