

CSCI 2110
Data Structures and Algorithms
Extra Practice on O Notation

1. Arrange the following in increasing orders of complexity

$n, n^2, n^3, 2^n, \sqrt{n}, \underline{n \log n}$

$\overset{n}{\curvearrowright} n \log n = n^2 \log n$
 $\sqrt{n} < n < n^2 < n^2 \log n < n^3 < 2^n$

2. An algorithm with complexity $O(n^2)$ takes 5 ms to process 50 data items.

a) Estimate how long it will take to process 5000 data items.

<u># Steps</u>	<u>Time</u>	
50×50	5	$x = \frac{5 \times 5000 \times 5000}{50 \times 50}$ $= 50,000 \text{ ms}$
5000×5000	$x ?$	

Answer: 50,000 ms

b) Estimate how much data can be processed in 500 ms.

<u>Time</u>	<u># Steps</u>	
5	50×50	$x^2 = \frac{50 \times 50 \times 500}{5}$ $= 250000$ $\therefore x = \sqrt{250000}$ $= 500$
500	$x * x$	

Answer: 500

3. Derive the big O complexity of each of the following code segments:

Code Segment 1:

```
for (int i = 1; i <= n; i++)
    for (int j = 1; j <= n; j++)
        sum++;
```

$\xrightarrow{\text{n iterations}} \quad \xrightarrow{\text{n iterations}} \quad \left. \vphantom{\begin{matrix} \text{n iterations} \\ \text{n iterations} \end{matrix}} \right\} n^2 \text{ iterations}$
 $O(n^2)$

Code Segment 2:

```
for (int i = 1; i <= n; i++)
    for (int j = 1; j <= n; j++)
        sum++;
```

$\xrightarrow{\text{n iterations}} \quad \xrightarrow{\text{n iterations}} \quad \left. \vphantom{\begin{matrix} \text{n iterations} \\ \text{n iterations} \end{matrix}} \right\} n^3 \text{ iterations}$
 $O(n^3)$

$n * n$

Code Segment 3:

```
if (x==10)
```

```
    for (int i = 1; i <= n; i++)  
        sum++;
```

```
else  
{
```

```
    for(int i=1;i<=n;i++)  
        for(int j=1; j<=n;j=2*j)  
            for(int k=1;k<=1000;k++)  
                sum++;
```

```
}
```

1

} n iterations

$\left. \begin{matrix} n \\ \log_2 n \\ 1000 \end{matrix} \right\} 1000 n \log_2 n$

$$1 + \text{MAX}(n, 1000 n \log_2 n)$$

$$= 1 + 1000 n \log_2 n$$

$$\rightarrow O(n \log_2 n)$$