

1. Prove that $5n^2 + 3n + 20$ is in $O(n^2)$
2. Prove that $2n^3 - 7n + 1 = \Omega(n^3)$
3. $2n^3 - 7n + 1 = \Theta(n^3)$

3. Find the worst-case Time complexity of the following snippets:

```

for( int bound = 1; bound <= n; bound *= 2 ) {
    for( int i = 0; i < bound; i++ ) {
        for( int j = 0; j < n; j += 2 ) {
            ... // constant number of operations
        }
        for( int j = 1; j < n; j *= 2 ) {
            ... // constant number of operations
        }
    }
}

```

first loop $\rightarrow \lg n$

Explain the time complexity of the following code snippet?

```

j = 0
for (i = 0; i < n; i++):  $\rightarrow n$ 
    while j > n:
        j = j + 1

```

Explain the time complexity of the following code :

```

sum = 0
for (i = 0; i < n; i++):  $\rightarrow n$ 
    for (j = n; j > i; j--):  $\rightarrow n$ 
        sum = i + j  $\rightarrow 1$ 

```

- 2) Express each of the functions in column B as an asymptotic bound (upper, lower or tight) of the functions in column A. (for example : if $A = 3n^2$, $B = n^2$ you should write, $A = \Theta(B)$. It is a must to mention tight bound here so that the answer is more appropriate.) — 4

A	B	Big - Oh / Big - Omega / Big - Theta ($O / \Omega / \Theta$)
$\ln n$	$n^{\ln(n)}$	$A = O(B)$
$e^{\ln(n)}$	n^2	$A = O(B)$ $A = O(B)$ ✓
$n!$	$n + 1^n$	$A = \Omega(B)$ ✓
$5n \log(n)$	$2 \ln(e^n)$	$A = \Omega(B)$ ✓

- 1) Calculate the running time ($f(n)$ or $T(n)$) of the code snippets in (a) and (b). (Keep your elaboration as brief and short as possible) — 2+3 = 5

(a) 2	(b) 3
<p>Pseudo code:</p> <pre> (n << input) sum = 0 for (k = 1 ; k <= n ; k = k+1){ for (i = 0 ; i < n ; i *= 2){ sum += i*n } } print(f"The code ran {sum} times") </pre>	<p>Pseudo code:</p> <pre> (n << input) handshakes = 0 X = [] for (k = n ; k >= 1 ; k = k-1){ for (i = k-1 ; i >= 1 ; i = i-1){ X.append(i) handshakes = handshakes + 1 } } print(f"Total number of handshakes are {handshakes}") </pre>

Determine the worst case time complexity for the following code,

```

count = 0;
for (x=1; x<=n; x++){
  for (y=1; y<=x; y++){
    count++;
  }
}

for (z=0; z<n; z++){
  arr[z] = z;
}

```

$n+1$

$n+1$

n

Verify which one of the following relations is correct for $f(n) = 100$ and $g(n) = \log 100$,

- I. $f(n) = O(g(n))$ or
- II. $f(n) = \Theta(g(n))$ or
- III. $f(n) = \Omega(g(n))$