Big O Notation

Checking Your Understanding

Objective: To understand runtime complexity (algorithm efficiency).

Topics	Exercises
Complexity Classes	Order of N, O(?)

Useful mathematical summations:

$$1+2+3+....+(n-1)+n=\frac{n(n+1)}{2}$$

$$a^0+a^1+a^2+a^3+....+a^{(n-1)}+a^n=\frac{a^{n+1}-1}{a-1}$$

$$2^0+2^1+2^2+2^3+....+2^{(n-1)}+2^n=\frac{2^{n+1}-1}{2-1}$$

NB: DO NOT JUST WRITE THE ANSWER. You must explain in some way by (a) a diagram, (b) showing the order of each line of code in braces and finding the dominant term, (c) a graphical representation or (d) a few sentences. **Failure to do so, will result in a reduced score.**

Run Time Complexity/Algorithm Efficiency

1. What is the order of n, O(f(n)) for the following nested loop?

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

2. What is the order of n, O(f(n)) for the following nested loop?

```
for (i = 1; i <= n; i++)
  for (j = 1; j <= 20; j++)
     k = k + i + j;
```

3. What is the order of n, O(f(n)) of the following function?

$$n^3 + 50n^2 + n$$

4. What is the order, O(f(n)) of the following function?

$$2^n + 2n^3 + 5n$$

5. Suppose an algorithm takes exactly the given number of statements for each value below, in terms of the size of n, i.e., the order of n, O(f(n)). Explain.

$$n \log n + \log n + n$$

6. Suppose an algorithm takes exactly the given number of statements for each value below, in terms of the size of n, i.e., the order of n, O(f(n)). Explain.

$$n^2 \log n + 2n$$