# **Big O Notation**

Used to quantify the performance of various algorithms as input size grows.

### Constant time (O(1)) complexity

An algorithm that takes the same amount of time to run independent of the size of the input data

```
1 def getFirst(my_list):
2 return my_list[0]
```

The function getFirst will always take the same amount of time to retrieve the first element in a passed list

#### Linear Time (O(n)) complexity

An algorithm whose execution time is directly proportional to the size of the input

```
1 def getSum(my_list):
2    sum = 0
3    for item in list:
4        sum += item
5    return sum
```

Notice that in the main loop of the function getSum the number of iterations it performs increases linearly with an increasing value of n resulting in O(n) complexity

## Quadratic Time ( $O(n^2)$ ) complexity

An algorithm whose execution time is proportional to the square of the input size

```
1 def getSum(my_list):
2    sum = 0
3    for row in my_list:
4        for item in row:
5        sum += 0
6    return sum
```

Note that the nested inner loop within the other main loop gives this code a complexity of  $O(n^2)$ 

## Logarithmic Time ( $O(\log n)$ ) complexity

An algorithm whose execution time is proportional to the logarithm of the input size, i.e.with each iteration the input size decreases by a constant multiple factor.

```
def searchBinary(my_list, item):
2
       first = 0
       last = len(my_list) - 1
3
       foundFlag = False
4
       while first <= last and not foundFlag:</pre>
6
            mid = (first + last) // 2
7
            if my_list[mid] == item:
                foundFlag = True
8
9
            else:
10
                if item < my_list[mid]:</pre>
                    last = mid - 1
11
                    first = mid + 1
13
14
       return foundFlag
```