

Let x and L be LinkedList Nodes.

Analyzing append

```

1 append(x, L) {
2   Node curr = L;
3   while (curr != null && curr.next != null) {
4     curr = curr.next;
5   }
6   curr.next = x;
7 }

```

$O(n)$

LinkedList Reversal

```

1 reverse(L) {
2   if (L == null) {
3     return null;
4   }
5   } else {
6     Node front = L;
7     Node rest = L.next;
8     L.next = null;
9
10    Node restReversed = reverse(rest);
11    append(front, restReversed);
12  }
13 }

```

else if (L.next == null) {
return L;

$$T(n) = \begin{cases} d_0 & \text{if } n=0 \text{ or } 1 \\ c_0 + c_1n + T(n-1) & \text{otherwise} \end{cases}$$

$$\begin{aligned}
 T(n) &= (c_0 + c_1n) + T(n-1) \\
 &= (c_0 + c_1n) + (c_0 + c_1(n-1)) + T(n-2) \\
 &= (c_0 + c_1n) + (c_0 + c_1(n-1)) + (c_0 + c_1(n-2)) + \dots + (c_0 + c_1(1)) + d_0
 \end{aligned}$$

$$= \sum_{i=1}^n (c_0 + c_1i) + d_0$$

$$= n \cdot c_0 + c_1 \sum_{i=1}^n i + d_0$$

$$= n \cdot c_0 + c_1 \left(\frac{n(n+1)}{2} \right) + d_0 = O(n^2)$$

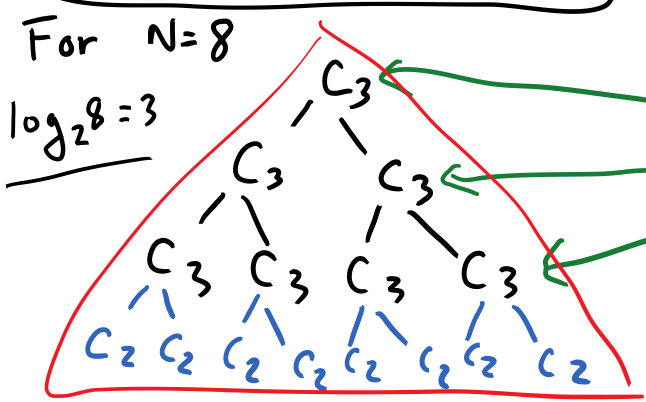
```

int sum(int[] arr){
    return help(arr,0,arr.length);
}
int help(int[] arr, int lo, int hi) {
    if(lo==hi) return 0;
    if(lo==hi-1) return arr[lo];
    int mid = (hi+lo)/2;
    return help(arr,lo,mid) + help(arr,mid,hi);
}

```

$$\begin{aligned}
 T(0) &= C_1 \\
 T(1) &= C_2 \\
 T(N) &= C_3 + 2 \cdot T\left(\frac{N}{2}\right)
 \end{aligned}$$

$$T\left(\frac{N}{2}\right) \quad T\left(\frac{N}{2}\right)$$



level	# nodes at this level	Total Work at this level
0	1	$1 \cdot C_3$
1	2	$2 \cdot C_3$
2	2^2	$4 \cdot C_3$
...
$\log_2 N$	$2^{\log_2 N}$	$2^{\log_2 N} \cdot C_3$

$$\begin{aligned}
 T(N) &= \sum_{i=0}^{\log_2 N - 1} 2^i C_3 + C_2 \cdot N \\
 &= C_3 \sum_{i=0}^{\log_2 N - 1} 2^i + C_2 \cdot N \\
 &= C_3 \cdot (2^{\log_2 N} - 1) + C_2 \cdot N \\
 &= C_3 \cdot (N - 1) + C_2 \cdot N = C_3 \cdot N - C_3 + C_2 \cdot N \\
 &= O(N)
 \end{aligned}$$

$$\sum_{i=0}^k 2^i = 2^{k+1} - 1$$