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CPSC 335 Project 1: Empirical Analysis
Due 09/19/06

The Alternating Disk Problem:
Input: An even positive integer n and a list of 2n disks of alternating color light-dark disks starting with light
Output: A list of 2n disks sorted with dark on left and light disks on right, and m represents the number of swaps

Lest to right algorithm Pseudocode:

```
Int k = 0 , m = 0
For i = 0 to n step 1
        For k = i to 2n-i  step 1
                //if disk on the left is light and the disk on the right is dark , switch
                If disk[k] > disk [k+1]
                        //swap
                        Temp = disk[k + 1]
                        Disk[k+1] = disk [k]
                        Disk[k] = temp
                        m++
Output m
```

$$\sum_{k=i}^{2n-i} 3$$

$$\sum_{i=0}^{n}\left(\sum_{k=i}^{2n-1} 3\right)$$

Running time

$$\sum_{i=0}^{n}(2n-1-i+1)*3 \Rightarrow 3\sum_{i=0} 2n-i \Rightarrow 3\left(\sum_{i=0}^{n} 2n - \sum_{i=1}^{n} i\right)$$

$$\Rightarrow 3\left(2n(n-0+1) - \left[\frac{n(n+1)}{2}\right]\right) \Rightarrow 3\left(2n^2+2n-\frac{n^2}{2}-\frac{n}{2}\right)$$

$$\Rightarrow 3\left(\frac{3}{2}n^2+\frac{3}{2}n\right) \Rightarrow \text{Runtime} = \frac{9}{2}n^2+\frac{9}{2}n$$

$O(n^2)$

$$\frac{9}{2}n^2+\frac{9}{2}n \in O(n^2) \qquad \lim_{n\to\infty}\frac{\frac{9n^2}{2}+\frac{9}{2}n}{n^2} \Rightarrow \lim_{n\to\infty}\frac{9}{2}+\cancel{\frac{9}{2n}}^{\,0}$$

$$\lim_{n\to\infty}\frac{9}{2}+\frac{9}{2n} = \frac{9}{2} > 0 \text{ and a constant}$$

Lawn Mower Algorithm Pseudocode:

```
 int index
For j = 0 to n step 1
        //start from left or right depending on the index
        If j % 2 == 0
                Index = 0                1
        Else
                Index = 2n-1             1
        For k = 0 to 2n-1 step 1
                If j % 2 == 0
                        Index++          1
                Else
                        Index--          1
                If disk[k] > disk [k+1]
                        //swap
                        Temp = disk[k+1]     1
                        Disk[k+1] = disk[k]  1
                        Disk[k] = temp       1
                        m++                  1
        End for
End for
```

$\max(1,1) = 1$

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$\sum_{k=0}^{2n-1} 4$

$\sum_{j=0}^{n}\left(1+1+\sum_{k=0}^{2n-1}4\right)$

$$\sum_{j=0}^{n}\left(1+1+4(2n-1+0+1)\right) \Rightarrow \sum_{j=0}^{n}(1+1+8n) \Rightarrow \sum_{j=0}^{n}2+\sum_{j=0}^{n}8n$$

$$\Rightarrow 2(n-0+1)+8n(n-0+1) \Rightarrow 2n+2+8n^2+8n \Rightarrow 8n^2+10n+2$$

Running time: $8n^2+10n+2$

$O(n^2)$

$8n^2+10n+2 \in O(n^2)$

$\lim_{n\to\infty}\frac{8n^2+10n+2}{n^2} > 0$ and constant

$\lim_{n\to\infty} 8+\cancel{\frac{10}{n}}^{0}+\cancel{\frac{2}{n^2}}^{0} = 8 > 0$ and Constant