Thomas Ngo
Van Do
CPSC335-04
Professor Avery
Project 1

1. Pseudocode:

a. Left to right algorithm

//input: a positive integer n and a list of 2n disks of alternating colors dark-light, starting with dark
//output: a list of 2n disks, the first n disks are light, the next n disks are dark, and an integer m representing the number of swaps to move the dark ones after the light ones

```
m←0                                          //number of swaps
for k←0 to k<n do
    for i←0 to i<2n-1 do
        if disks[i] is dark and disks[i+1] is light
            swap disks[i] and disks[i+1]
            m++
```

b. lawnmover algorithm

//input: a positive integer n and a list of 2n disks of alternating colors dark-light, starting with dark
//output: a list of 2n disks, the first n disks are light, the next n disks are dark, and an integer m representing the number of swaps to move the dark ones after the light ones

```
m←0                                          //number of swaps
for k←0 to k<n/2 + 1 do
    //Loop for going from left to right
    for i←0 to i<2n-1 do
        if disks[i] is dark and disks[i+1] is light
            swap disks[i] and disks[i+1]
            m++
    //Loop for going from right to left
    for i←2n-2 to i>0 do
        if disks[i] is light and disks[i-1] is dark
            swap disks[i] and disks[i-1]
            m++
```

2. Analysis:

a. Left to right algorithm

$$T(n)=\sum_{k=0}^{n-1}\sum_{i=0}^{2n-2}1=\sum_{k=0}^{n-1}(2n-2-0+1)=\sum_{k=0}^{n-1}(2n-1)=(2n-1)\sum_{k=0}^{n-1}1$$

$$= \quad (2n-1)(n-1-0+1)=n(2n-1)=2n^2-1\in O(n^2)$$

Proof:

$$2n^2-1\leq 2n^2 \forall n\in R$$

Therefore, c = 2 and n_0 is all real numbers

b. Lawnmover

$$T(n)=\sum_{k=0}^{n/2}\left(\sum_{i=0}^{2n-2}1+\sum_{i=1}^{2n-2}1\right)=\sum_{k=0}^{n/2}[(2n-2-0+1)+(2n-2-1+1)]$$

$$=\quad\sum_{k=0}^{n/2}(2n-1+2n-2)=\sum_{k=0}^{n/2}(4n-3)=4n\sum_{k=0}^{n/2}1-3\sum_{k=0}^{n/2}1$$

$$=\quad 4n\left(\frac{n}{2}-0+1\right)-3\left(\frac{n}{2}-0+1\right)=2n^2+4n-\frac{3}{2}n-3=2n^2+\frac{5}{2}n-3\in O(n^2)$$

Proof:

$$2n^2+\frac{5}{2}n-3\leq 2n^2+\frac{5}{2}n\leq 2n^2+\frac{5}{2}n^2\leq\frac{9}{2}n^2\,\forall\, n\geq 1$$

Therefore, c = 9/2 and n_0 = 1