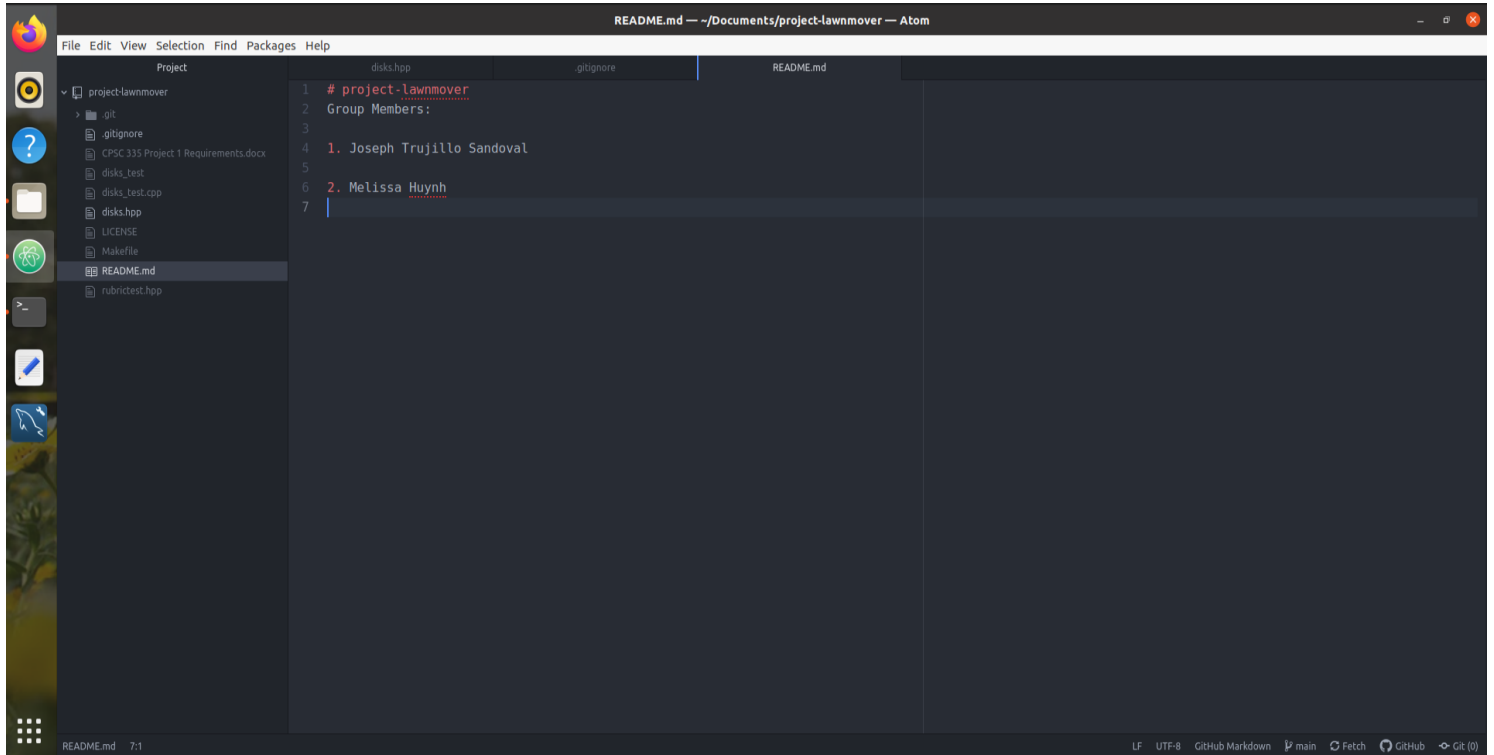# Algorithm Project 1

Description: Analysis for Lawnmower and Alternate algorithms. Submission for project 1>

Group Members:
Joseph Trujillo Sandoval (joeysandoval@csu.fullerton.edu)
Melissa Huynh (melissahuynh26@csu.fullerton.edu)

Sort Alternate Disk Pseudocode:

```
def sort_alternate(const &<input obj>)
        numOfSwap = 0
        n = <count of input obj> / 2
        new obj after = <input obj> // create copy of obj

        for i = 1 to n do
                for j = i to 2n-1 step 2
                        if (<after[j] equals disk_dark AND after[j+1] equals disk_light>)
                                swap(after[j])
                                numOfSwap++

        return <sorted disk after>
```

Sort Alternate Disk Step-count:

Alternate

```
num of swap = 0          // 1 tu
n =   count/2            // 2 tu
new obj                  // 1 tu

for  i=1 to  n  d                // n tu
     for  j=1 to 2n-1 step 2     // n n tu
          if after[j]== disk_dark AND after[j+1] == disk light  // 3 tu
               swap ++                                           // 1 tu
               swap                                              // 1 tu

return  disk after
```

$$\sum_{i=1}^{n} \sum_{j=1}^{2n-1} \cdot 5$$

$$\left(\sum_{j=1}^{2n-1} - \sum_{j=1}^{i-1} \right) \cdot 5$$

$$\sum_{j=1}^{2n-1} \cdot 5 \quad - \quad \sum_{j=1}^{i-1} 5 \quad = \quad 10n - 5 - 5i - 5$$

$$\sum_{i=1}^{n} \cdot 10n - 5i$$

$$\sum_{i=1}^{n} 10n - \sum_{i=1}^{n} 5i$$

$$10n^2 - 5 \sum_{i=1}^{n} i$$

$$5\left(\frac{n \cdot n+1}{2} \right) \Rightarrow 5\left(\frac{n^2 + n}{2} \right) \Rightarrow \frac{5n^2 + 5n}{2}$$

$$10n^2 - \frac{5n^2}{2} - \frac{5n}{2} + 4$$

$$\boxed{\frac{15n^2}{2} - \frac{5n}{2} + 4}$$

S.C $= (15n^2)/2 - 5n/2 + 4$

Sort Alternate Disk Mathematical Analysis (Proof by Definition):

$$\frac{15n^2}{2} - \frac{5n}{2} + 4 \in O(n^2)$$

$$c = 14 \quad n_0 =$$

$$\frac{15n^2}{2} - \frac{5n}{2} + 4 \in 14n^2$$

$$n_0 = 1$$

$$\frac{15}{2} - \frac{5}{2} + 4 \leq 14$$

$$10/2 \Rightarrow 5 + 4 \leq 14$$

$$9 \leq 14 \quad \text{true by def}$$

$$\frac{15n^2}{2} - \frac{5n}{2} + 4 \in O(n^2)$$

Sort Lawnmower Pseudocode:

```
def sort_lawnmower(const &<input obj>)
      numOfSwap = 0
      n = <count of input obj> / 2
      new obj after = <input obj> //create copy of obj

      for i = 0 to ((n+1)/2) do
              for j = i to (2n-1) do
                      if (<after[j] equals disk_dark AND after[j+1] equals disk_light>)
                              swap(after[j])
                              numOfSwap++
              for z = 2n-1 to i
```

```
                    if (<after[z] equals disk_light AND after[z+1] equals disk_dark>)
                         swap(after[z-1])
                         numOfSwap++
        return <sorted disk after>
```

Sort Lawnmower Step-count:

Lawn mower

numof Swap = 0   // 1 tu
n = count /2   // 2 tu
newobj after = before   // 1 tu
for i= 0   to $\left(\frac{n+1}{2}\right)$ do // n tu
   for j=i to (2n-1) do // n tu
      if (j == disk_dark AND j+1 == disk_light) // 3 tu
         Swap   // 1 tu
         count++   // 1 tu
   for z= 2n-1 to i   do // n tu
      if (j == disk_dark AND j+1 == disk_light) // 3 tu
         Swap   // 1 tu
         count++   // 1 tu

$$\sum_{i=0}^{(n+1/2)} \sum_{j=i}^{2n-1} \cdot 5 + \sum_{i=0}^{n+1/2} \sum_{z=2n-1}^{i} \cdot 5$$

$\downarrow$

$$\sum_{j=1}^{2n-1} - \sum_{j=1}^{i-1}$$

$\downarrow$ $(n+1/2)$

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

$\downarrow$

$$\sum_{z=1}^{2n-2} - \sum_{z=1}^{2n-2} \cdot 5$$

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

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

$$\frac{\left(\frac{n+1}{2}\right)\left(\frac{n+1}{2} + \frac{1}{2}\right)}{2}$$

$$n+1 \frac{(n+1)\left(n+1+1/2\right)}{2}$$

$$n+1\left(n + 3/2\right)$$

$$n^2 + n + 3/2 n + 3/2$$

$$5(n^2 + 5/2n + 3/2)$$

$$10n^2 + 5n - 5n^2 + 25/2n + 15/2$$

$$5n^2 - 15/2n - 15/2$$

$$5\left(n^2 + 5/2 n + 3/2\right)$$

$$\sum_{i=0}^{n+1/2} 2n$$

$$10n^2 + 5n$$

$$\sum_{i=0}^{n+1/2} 2$$ $10n + 5$

$$5n^2 + 25/2n + 15/2 - 10n^2 + 5n + 10n + 5$$

$$-5n^2 + 15/2n + 10n + 25/2$$

$$5n^2 - 15/2n - 15/2 + \left(-5n^2 + 15/2n + 10n + 25/2\right)$$

$$10n + 10/2$$

$$10n + 5 + 4$$

$$\boxed{10n + 9}$$

S.C = 10n + 9

Sort Lawnmowe Mathematical Analysis (Proof by Definition):

$$10n + 9 \in O(n^2)$$

$$c = 19 \quad n_0 =$$

$$10n + 9 \leq 19n^2$$

$$n_0 = 1$$

$$10 + 9 \leq 19$$

$$19 \leq 19 \quad \text{true by def}$$

$$10n + 9 \in O(n^2)$$