Richard Hayes, rhayes_98@csu.fullerton.edu

CPSC 335 - Project 1 Submission

Input: a positive integer n and a list of 2n disks of alternating colors light-dark, starting with light
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.

Algorithm 1 - Lawnmower Algorithm:

Algorithm Design:

Input: List of length 2n with disks of alternating colors. (Assume light is less than dark)

Pseudocode:

```
first = 0

for j = 0 to n/2 do

    //loop forward, first check
    for i = 0 to (2n - 1) do
        //compare forward
        if list[i] < list[i+1]
            first = list[i]
            list[i] = list[i+1]
            list[i+1] = first
        end if
    end for
    //finished first loop, now to loop backwards from 2n

    for i = (2n - 1) to 0 do
        //compare backwards
        if list[i] > list[i-1]
            first = list[i]
            list[i] = list[i-1]
            list[i-1] = first
        end if
    end for

    //finished second loop, move onto next iteration of master loop, or finish
end for
```

Mathematical Analysis:

Step Count:

Step Count = 2 + [n/2] * (SC1 + SC2)

SC1 = [2n -1 + 1] * (2 + 1 + 2 + 2)

-> = [2n] * (7)

-> = 14n

SC2 = [((0 - (2n-1))/(-1)) + 1] * (2 + 1 + 2 + 2)

-> = [2n] * (7)

-> = 14n

Step Count = 2 + [n/2] * (14n + 14n)

-> = 2 + [n/2] * (28n)

-> = 2 + (14n^2)

-> = $14n^2 + 1$

Final Step Count = = $14n^2 + 1$

Big O Notation:

Suppose $F(n) = 14n^2 + 1$ and $G(n) = n^2$

We want to show that there exists some C and some N_0 such that

$F(n) < C * G(n)$ for $n > N_0$

Let C = 100 and $N_0 = 100$

$F(n) < 100 * G(n)$ for $n > 100$

-> $14n^2 + 1 < 100 * n^2$ for $n > 100$

-> $14 * (100)^2 + 1 < 100 * (100)^2$

-> 14 * (10,000) + 1 < 100 * (10,000)

-> 140,000 + 1 < 1,000,000

-> 140,001 < 1,000,000

Therefore, because $F(n) < 100 * G(n)$ for $n > 100$, we can conclude that by the definition of Big O Notation that $14n^2 + n/2 + 1$ exists within $O(n^2)$.

Algorithm 2 - Alternate Algorithm:

Algorithm Design:

Input: List of length 2n with disks of alternating colors. (Assume light is less than dark)

Pseudocode:

```
for j = 0 to n
    for i = 0 to 2n, step 2 do
        if list[i] < list[i+1]
            first = list[i]
            list[i] = list[i+1]
            list[i+1] = first
        end if
    end for

    for i = 1 to 2n - 1, step 2 do
        if list[i] < list[i+1]
            first = list[i]
            list[i] = list[i+1]
            list[i+1] = first
        end if
    end for
end for
```

Mathematical Analysis:

lmao

Step Count:

Step Count = [n + 1] * (SC1 + SC2)

SC1 = [(2n)/2 + 1] * (2 + 1 + 2 + 2)

-> [n + 1] * (7)

-> 7n + 7

SC2 = [((2n-1) - 1)/2 + 1] * (2 + 1 + 2 + 2)

-> = [(2n-2)/2 + 1] * (7)

-> = [n] * (7)

-> = 7n

Step Count = [n+1] * ((7n + 7) + (7n))

-> = [n+1] * (14n + 7)

-> = $14n^2 + 7n + 14n + 7$

-> = $14n^2 + 21n + 7$

Final Step Count = $14n^2 + 21n + 7$

Big O Notation:

Suppose $F(n) = 14n^2 + 21n + 7$ and $G(n) = n^2$

We want to show that there exists some C and some N_0 such that

$F(n) < C * G(n)$ for $n > N_0$

Let C = 100 and $N_0 = 100$

$F(n) < C * G(n)$ for $n > N_0$

-> F(100) < 100 * G(100)

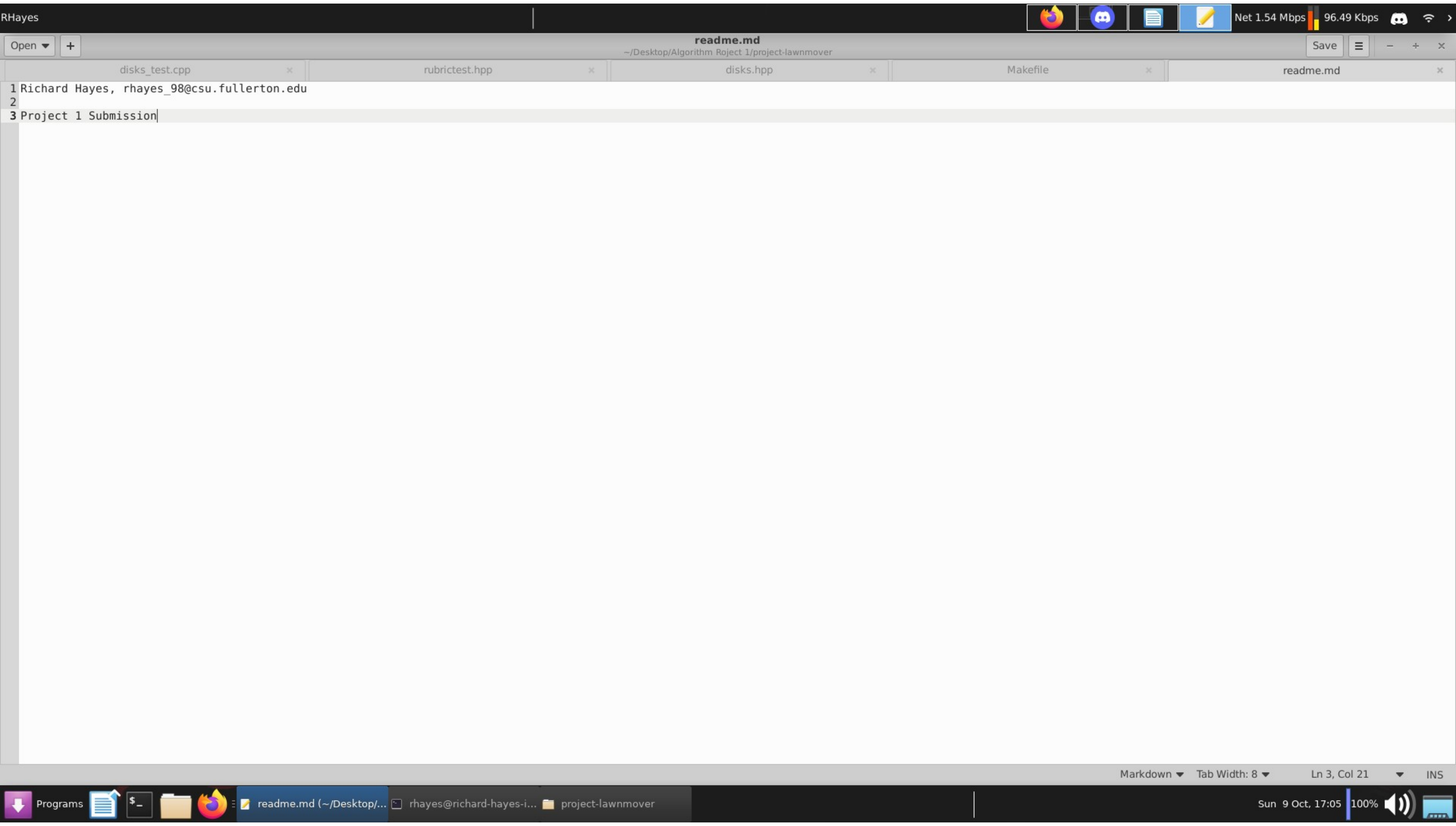
-> $14(100)^2 + 21(100) + 7 < 100\ (100)^2$

-> 140,000 + 2100 + 7 < 1,000,000

-> 142,107 < 1,000,000 is true

Therefore, because F(n) < 100 * G(n) for n > 100, we can conclude that by the definition of Big O Notation that $14n^2 + 21n + 7$ exists within $O(n^2)$.

Readme.md Screenshot:



Code running Screenshot: