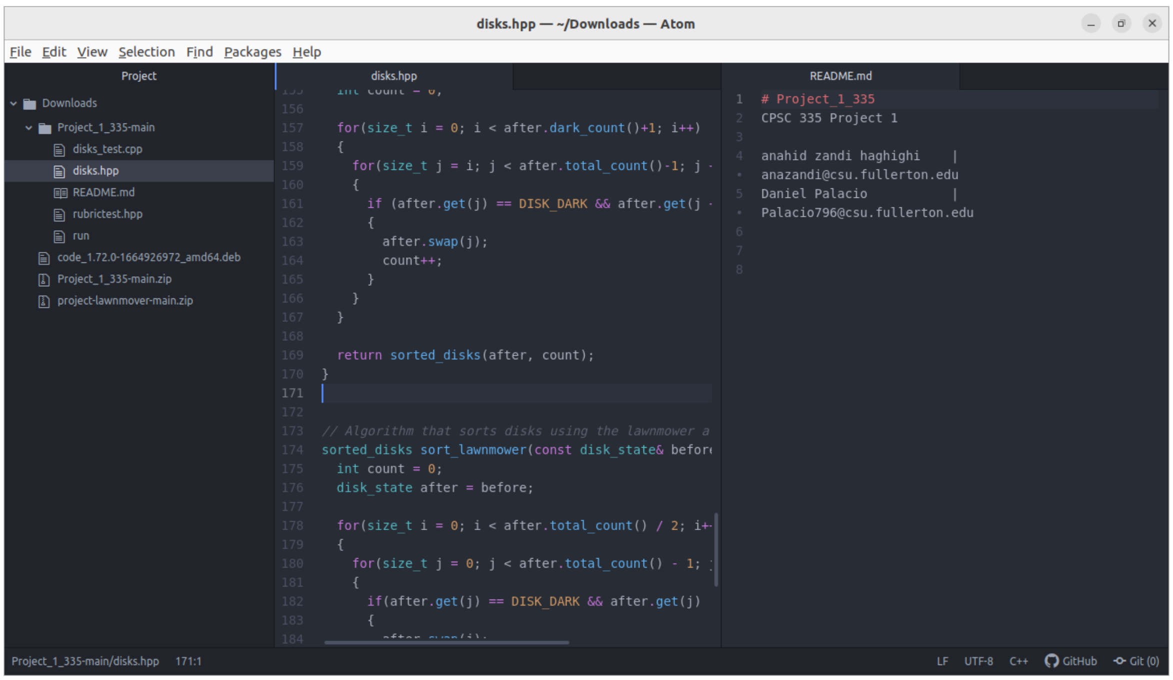
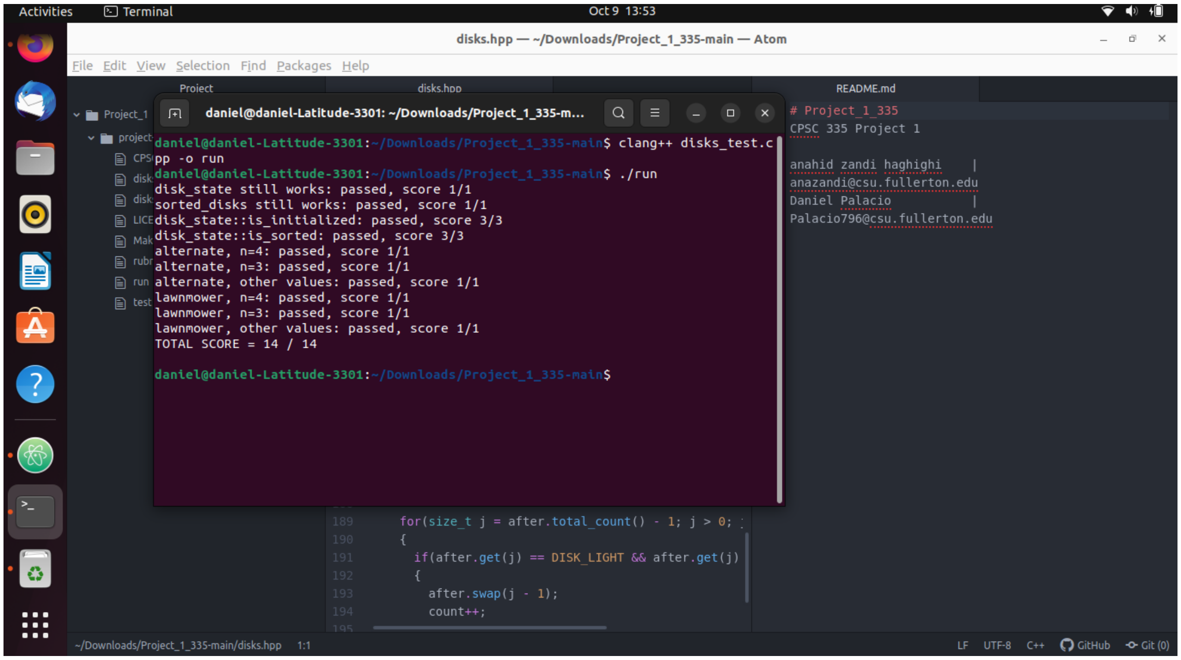
anahid zandi haghighi | anazandi@csu.fullerton.edu
Daniel Palacio | Palacio796@csu.fullerton.edu
CPSC 335 | Project 1

In this Project we were given an alternating disk problem to which we had to use two different algorithms to arange the disk colors in the right location. Light disks on the left and right disks on the right. We wrote psudocode which we turned into real code which let us compile and pass the tests. We later made a mathematical analysis to proof our time efficiency.

Screenshot Atom editor



Screenshot Code Running



Alternating Algortihm Pseudocode:

```
Count = 0
For i = 0 to (n/2) +1 do
        For j = i to n-1 step 2
                if Disk [j] == Dark && Disk[j+1] == Light
                        swap(Disk[j], DIsk[j+1])
                        Count++
                End if
        End for
End for
```

Mathmatical analysis

Alternating algorithm math analysis

count = 0 → 1 tu

for $i=0$ to $(\frac{n}{2})+1$ do

for $j=i$ to $n-1$ step 2

if disk[j]==Dark && disk[j+1]==Light → 4 tu

Swap(disk[j], disk[j+1]) → 5 tu → taken from Swap function

count ++ → 1 tu

end if

end for

end for

$\hookrightarrow 4 + \max(5,1) = 9$ tu

$$\sum_{i=0}^{(\frac{n}{2})+1} \underbrace{\sum_{j=i}^{(\frac{n-1}{2})} \times 9} \rightarrow \sum_{j=i}^{(\frac{n-1}{2})} 9 \rightarrow \sum_{j=1}^{(\frac{n-1}{2})} 9 - \sum^{j=i-1} 9 = \frac{9(n-1)}{2} - 9(i-1)$$

$$= \frac{9n - 18i + 9}{2}$$

$$\underbrace{\sum_{i=0}^{\frac{n}{2}+1} \frac{9n}{2}}_{\text{constant}} - \underbrace{\sum_{i=0}^{\frac{n}{2}+1} \frac{18i}{2}}_{\text{series}} + \sum_{i=0}^{\frac{n}{2}+1} \frac{9}{2} \Rightarrow \left(\frac{n}{2}+1\right) \times \left(\frac{9n}{2}\right) = \frac{9n(2+n)}{4}$$

$$\sum_{i=0}^{\frac{n}{2}+1} 9i = 9\left(\frac{(\frac{n}{2}+1)((\frac{n}{2}+1)+1)}{2}\right) = \frac{9(2+n)(4+n)}{8}$$

$$\sum_{i=0}^{\frac{n}{2}+1} \frac{9}{2} = \left(\frac{n}{2}+1\right)\left(\frac{9}{2}\right) = \frac{9(2+n)}{4} \Rightarrow \left(\frac{9n(2+n)}{4}\right) - \left(\frac{9(2+n)(4+n)}{8}\right) + \left(\frac{9(2+n)}{4}\right)$$

$$\left(\frac{9n^2 + 27n + 18}{4}\right) - \left(\frac{9(2+n)(4+n)}{8}\right) = \frac{9n^2 - 36}{8} \underset{}{\overset{\text{count}=0}{+1}} = \boxed{\frac{9n^2 - 28}{8}\text{ tu}}$$

$$f(n) = \frac{9n^2 - 28}{2}$$

$$\frac{9n^2 - 28}{2} \in O(n)$$

$$\lim_{n \to \infty} \frac{9n^2 - 28}{2n} \overset{\text{l'hopital}}{\Rightarrow} \lim_{n \to \infty} \frac{18n}{2} = \infty = f(n) \notin O(n)$$

$$\frac{9n^2 - 28}{2} \in O(n^2)$$

$$\lim_{n \to \infty} \frac{9n^2 - 28}{2n^2} = \lim_{n \to \infty} \frac{18n}{4n} = \lim_{n \to \infty} \frac{18}{4} = \frac{9}{2} = f(n) \in O(n^2)$$

We can conclude that the Alternate Algorithm efficiency class is O(n^2)

<u>Lawnmower Algorithm PseudoCode:</u>

```
Int count = 0
For i = 0 to n/2 do
        For j = 0 to n-1 do
                If Disk[j] == dark && Disk[j] != Disk[j+1]
                swap ( Disk[j] , Disk[j+1]
                count ++
                End if
        End for
        For j = n -1  to 0 step -1
                If Disk[j] == dark && Disk[j] != Disk[j-1]
                swap ( Disk[j-1], Disk[j]
                Count ++
                End it
        End for
End for
```

<u>Mathmatical Analysis:</u>

$S \cdot C = \text{for} \times (\text{for}(\text{block})) \times \text{For}(\text{block})$

indipendent

```
count = 0    -> 1TU
for i=0 to n/2 do -> (n/2)-0+1 = (n/2+1) times
   for j=0 to n-1 do -> (n-1)-0+1 = n times
      if disk[j]==Dark && disk[j] != disk[j+1] -> 4TU
         Swap (disk[j], Disk[j+1]) -> 5tu
         count ++ -> 1TU
      end if
   end for
   for j=n-1 to 0 step -1 -> (0-(n-1))/(-1) +1 = n times
      if disk[j]=Light && disk[j] != disk[j-1] -> 4tu
         Swap(disk[j-1], disk[j]) -> 5tu
         count ++ -> 1tu
      end if
   end for
end for
```

$$S \cdot C = \left(\frac{n}{2}+1\right)\left(n \cdot (4+\max(5,1))\right)\left(n \cdot (4+\max(5,1))\right)$$

$$= \left(\frac{n}{2}+1\right)(9n)(9n) = 81n^2\left(\frac{n}{2}+1\right) = \frac{81n^2(2+n)}{2}$$

$$f(n) = \frac{81n^2(2+n)}{2}$$

$$\frac{81n^2(2+n)}{2n} \in O(n)$$

$$\lim_{n\to\infty} \frac{81n^2(2+n)}{2n} \Rightarrow \lim_{n\to\infty} \frac{81n^2}{2n} + \lim_{n\to\infty} \frac{(2+n)}{2n} \therefore \frac{81n^2(2+n)}{2} \notin O(n)$$

$$\infty + \infty = \infty$$

$$\frac{81n^2(2+n)}{2} \in O(n^2)$$

$$\lim_{n\to\infty} \frac{81n^2(2+n)}{2n^2} \Rightarrow \lim_{n\to\infty} \frac{81\cancel{n^2}}{2\cancel{n^2}} + \lim_{n\to\infty} \frac{(2+n)}{2n^2}$$

$$\frac{81}{2} \qquad 0$$

$$\Rightarrow \therefore \frac{81n^2(2+n)}{2} \in O(n^2)$$

We can conclude that the lawnmower Algorithm efficiency class is O(n^2)