Project Lawnmower (Project 1 for CPSC 335 course at CSUF – Spring 2023)
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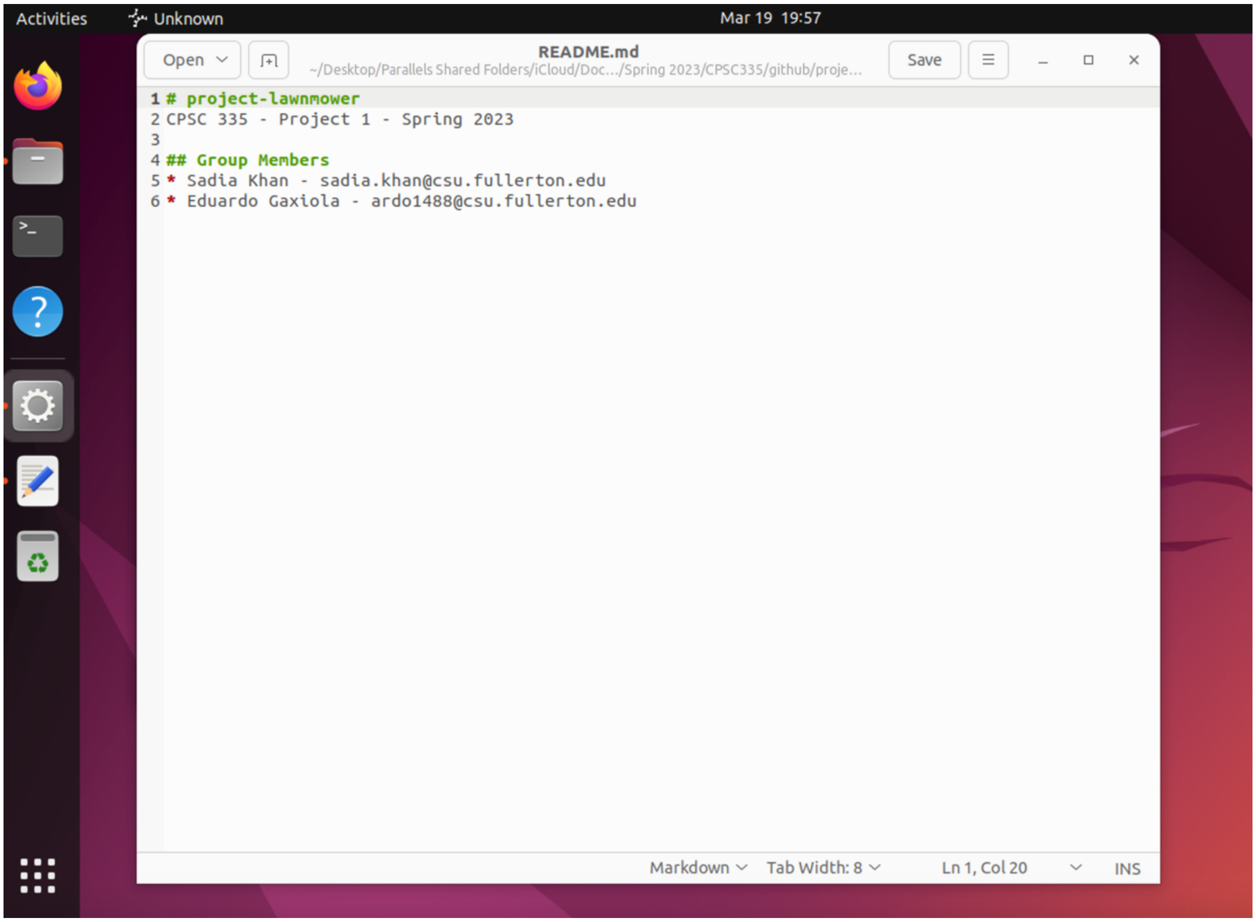
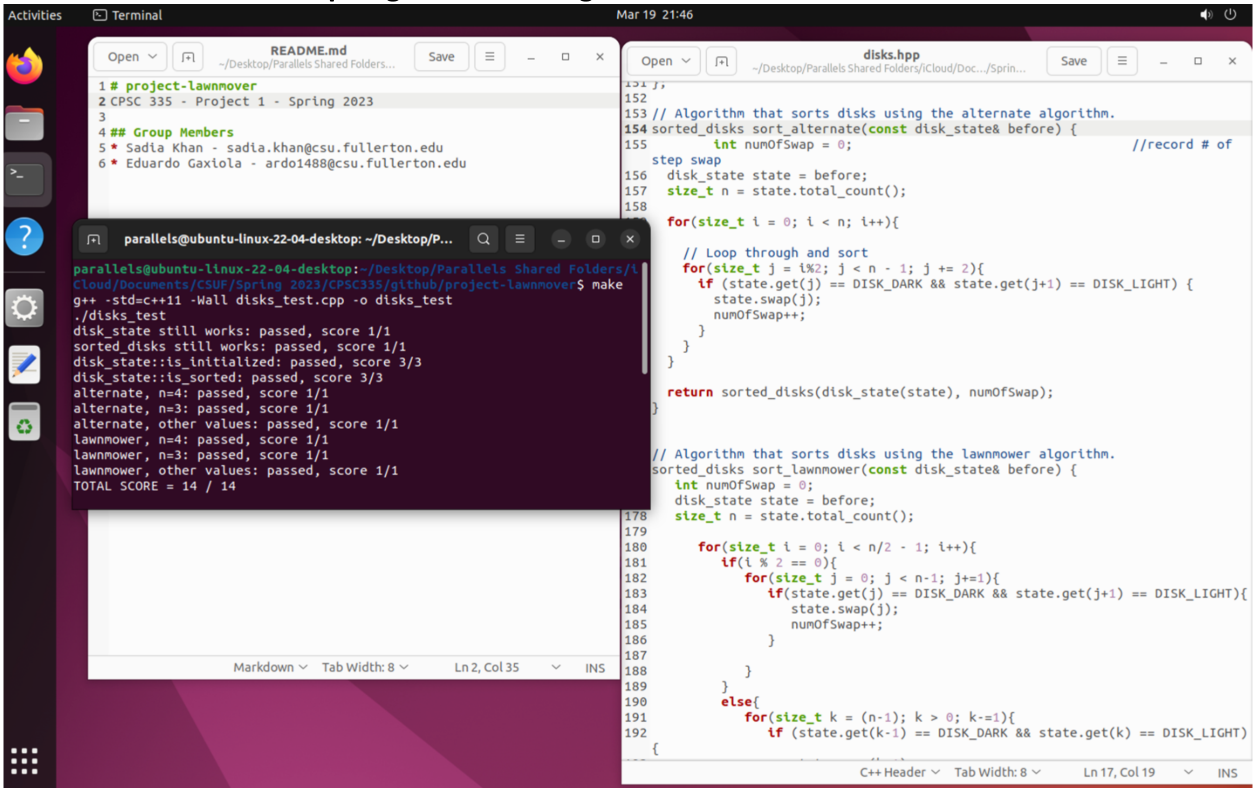
Readme screenshot



Screenshot of Code Compiling and Executing



Pseudocode listings, step count, and proof for time complexity:

Alternate Algorithm:

<u>PseudoCode for Alternate Algorithm with step counts – Time Complexity: O(n^2):</u>

Input: alternating disks of size 2n

numOfSwap = 0 // 1 tu

```
for (i = 0 to 2n, i++) do // 2n-0+1 = 2n+1 times
   for (j = i%2 to 2n-1, j+=2) do // ((2n-1)-0)/2 + 1 = n + 1/2 or ((2n-1)-1))/2 + 1 = n
      if(disks[j] == dark and disks[j+1] == light)  // 4 tu
         swap(disks[j], disks[j+1])  // 3 tu
         numOfSwap++ // 1 tu
```

return state, numOfSwap

/* Step Count (SC) for the Alternate Algorithm */

s.c. for if inside inner for = 4 + 4 = 8
s.c. for inner for = max((n + 1/2)*8 , 8n) = 8n + 4

s.c. for outer for = (2n + 1)*(8n + 4) = 16n^2 + 16n + 4

Total for Alternate Algorithm:
s.c. = 1 + 16n^2 + 16n + 4 = 16n^2 + 16n + 5
===> This leads to O(n^2)

<u>Proof</u>:

Alternate algorithm:

$$\lim_{n\to\infty} \frac{f(n)}{g(n)}$$

$$= \lim_{n\to\infty} \frac{16n^2+16n+5}{n^2} = \lim_{n\to\infty} 16 + \lim_{n\to\infty} \frac{16}{n} + \lim_{n\to\infty} \frac{5}{n^2}$$

$$= 16 \geq 0 \text{ and a constant}$$

$$\therefore \boxed{16n^2+16n+5 \in O(n^2)}$$

Lawnmower Algorithm:

<u>PseudoCode for Lawnmower Algorithm with step counts – Time Complexity: O(n^2):</u>

Input: alternating disks of size 2n

```
numOfSwap = 0  // 1 tu

for( i = 0 to n – 1) do   // n-1-0+1 = n times
     if( i % 2 == 0) then do        // 2 tu
       for( j = 0 to 2n -2) do      //2n-2-0+1 = 2n-1 times
            if(disks[j] == dark and disks[j+1] == light) then do   // 3 tu
               swap(disks[j], disks[j+1])   // 3 tu
               numOfSwap++       // 1 tu
    else
          for(k = 2n-1 to 1) do   // 2n-1 + 1 = 2n
               if(disks[k-1] == dark and disks[k] == light) then do          // 3 tu
```

swap(disks[k-1], disks[k])   // 3 tu
numOfSwap++   // 1 tu

return state, numOfSwap

Step Count for Lawnmower:

s.c inside the outer for loop: 2 + max(max(6n-3, 14n-7), max(6n, 14n)) = (14n + 2)
sc. Outer loop : n(14n+2) = 14n^2 + 2n // O(n^2)

$$\lim_{n\to\infty} \frac{f(n)}{g(n)}$$

$$= \lim_{n\to\infty} \frac{14n^2 + 2n}{n^2} = \lim_{n\to\infty} 14 + \lim_{n\to\infty} \frac{2}{n}$$

$$= 14 + 0 = 14 \geq 0 \text{ and a constant}$$

$$\boxed{14n^2 + 2n \in O(n^2)}$$