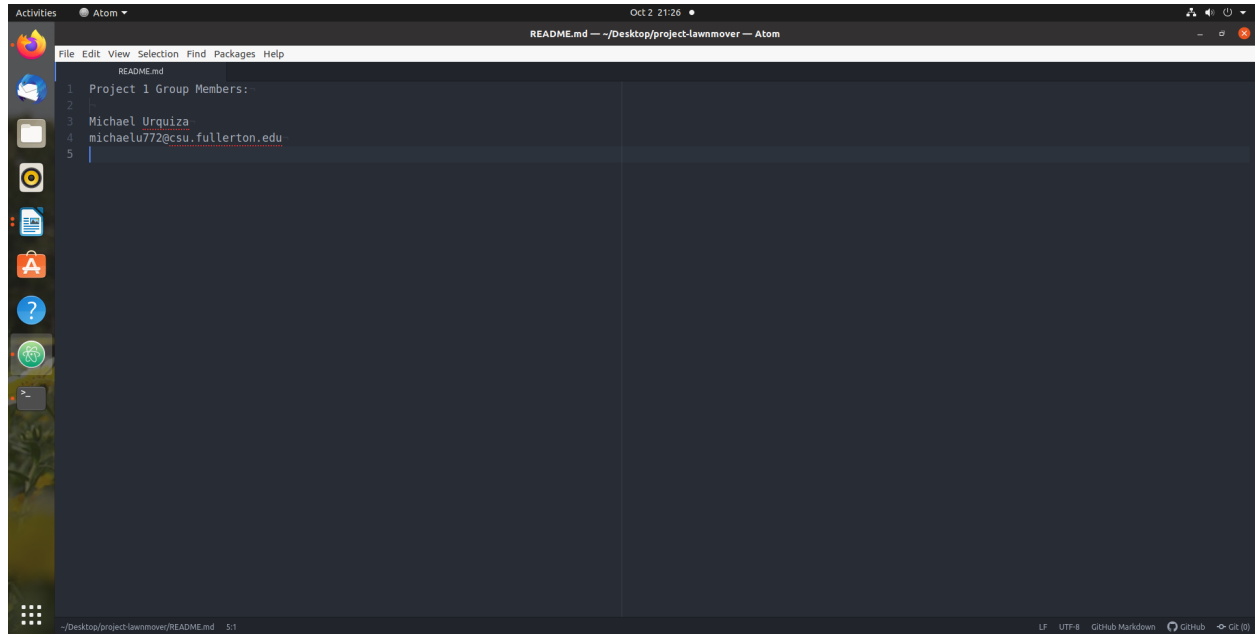


Project 1 Report

Group Members:

Michael Urquiza

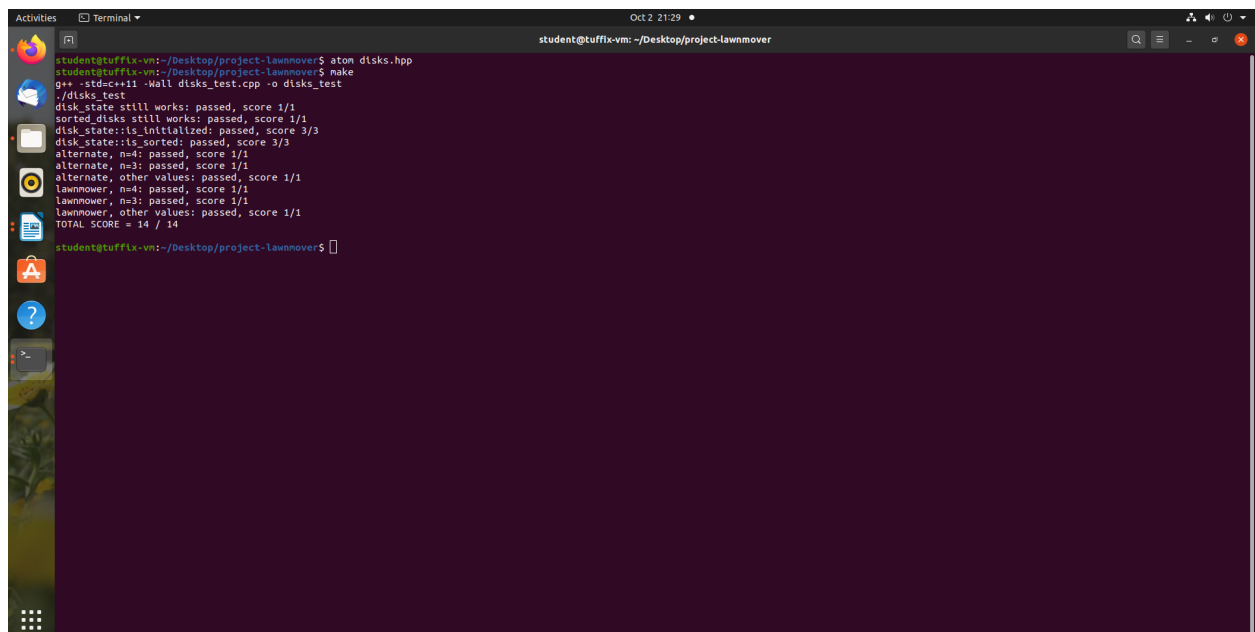
michaelu772@csu.fullerton.edu



A screenshot of the Atom text editor interface. The title bar shows 'Oct 2 21:26' and the file path 'README.md -- ~/Desktop/project-lawnmover -- Atom'. The menu bar includes 'File', 'Edit', 'View', 'Selection', 'Find', 'Packages', and 'Help'. The left sidebar shows a file explorer with 'README.md' selected. The main editor area displays the following text:

```
1 Project 1 Group Members:
2
3 Michael Urquiza
4 michaelu772@csu.fullerton.edu
5
```

The status bar at the bottom shows the file path '~/Desktop/project-lawnmover/README.md' and the line/character count '5/1'.



A screenshot of a terminal window titled 'student@tuffix-vm: ~/Desktop/project-lawnmover'. The terminal shows the following commands and output:

```
student@tuffix-vm:~/Desktop/project-lawnmover$ atom disks.hpp
student@tuffix-vm:~/Desktop/project-lawnmover$ make
g++ -std=c++11 -Wall disks_test.cpp -o disks_test
./disks_test
disk_state still works: passed, score 1/1
sorted disks still works: passed, score 1/1
disk_state::its_initialized: passed, score 3/3
disk_state::its_sorted: passed, score 3/3
alternate, n=4: passed, score 1/1
alternate, n=3: passed, score 1/1
alternate, other values: passed, score 1/1
lawnmower, n=4: passed, score 1/1
lawnmower, n=3: passed, score 1/1
lawnmower, other values: passed, score 1/1
TOTAL SCORE = 14 / 14
student@tuffix-vm:~/Desktop/project-lawnmover$
```

Alternative Pseudocode

```
swapCount = 0; - 1
For int x = 0 to n - 1: - n
    For int i = 0 to 2n - 2; step 2: - n + 2
        If vector[i + 1] is dark AND vector[i + 2] is dark: - 3
            vector.swap(i + 1); - 3
            ++swapCount; - 1
        endif
    //endFor
    For int j = 1 to 2n - 2: - 2n - 1
        If vector[j + 1] is dark AND vector[j + 2] is NOT dark: - 3
            vector.swap(j + 1); - 3
            ++swapCount; - 1
        //endif
    //endif
//endFor

return vector;
```

Step Count

$$S.c = 1 + n [(3 + 3 + 1) * (n + 2) + (3 + 3 + 1) * (2n - 1)]$$

$$S.c = 1 + n [7 * (n + 2) + 7 * (2n - 1)]$$

$$S.c = 1 + n [7n + 14 + 14n - 7]$$

$$S.c = 1 + n [21n - 7]$$

$$S.c = 1 + 21n^2 - 7n$$

$$S.c = 21n^2 - 7n + 1$$

Time Complexity Proof

$$\lim_{n \rightarrow \infty} \frac{21n^2 - 7n + 1}{n^3}$$

$$\lim_{n \rightarrow \infty} \frac{21}{n} - \frac{7}{n^2} + \frac{1}{n^3}$$

$$= 0 - 0 - 0$$

Therefore, the time complexity of this algorithm is $O(n^3)$

Lawnmower Pseudocode

```
swapCount = 0; - 1
For int x = 0 to n / 2: - n/2 + 1
    For int i = 0 to 2n: - 2n + 1
        If vector[i] is dark AND vector[i + 1] is NOT dark: - 3
            vector.swap(i); - 3
            ++swapCount; - 1
        //endif
    //endFor
For int j = 2n - 1 to 0: - 2n
    If vector[j] is dark AND vector[j + 1] is NOT dark: - 3
        vector.swap(j); - 3
        ++swapCount; - 1
    //endif
//endFor
//endFor

return vector;
```

Step Count

$$S.c = 1 + \left(\frac{n}{2} + 1\right) * [(3 + 3 + 1) * (2n + 1) + (3 + 3 + 1) * (2n)]$$

$$S.c = 1 + \left(\frac{n}{2} + 1\right) * [(7) * (2n + 1) + (7) * (2n)]$$

$$S.c = 1 + \left(\frac{n}{2} + 1\right) * [(14n + 7) + (14n)]$$

$$S.c = 1 + \left(\frac{n}{2} + 1\right) * [(28n + 7)]$$

$$S.c = 1 + \left(14n^2 + \frac{63n}{2} + 7\right)$$

$$S.c = 14n^2 + \frac{63n}{2} + 8$$

Time Complexity Proof

$$\lim_{n \rightarrow \infty} \frac{14n^2 + \frac{63n}{2} + 8}{n^3}$$

$$\lim_{n \rightarrow \infty} \frac{14}{n} - \frac{63}{2n^2} + \frac{8}{n^3}$$

$$= 0 - 0 - 0$$

Therefore, the time complexity of this algorithm is $O(n^3)$