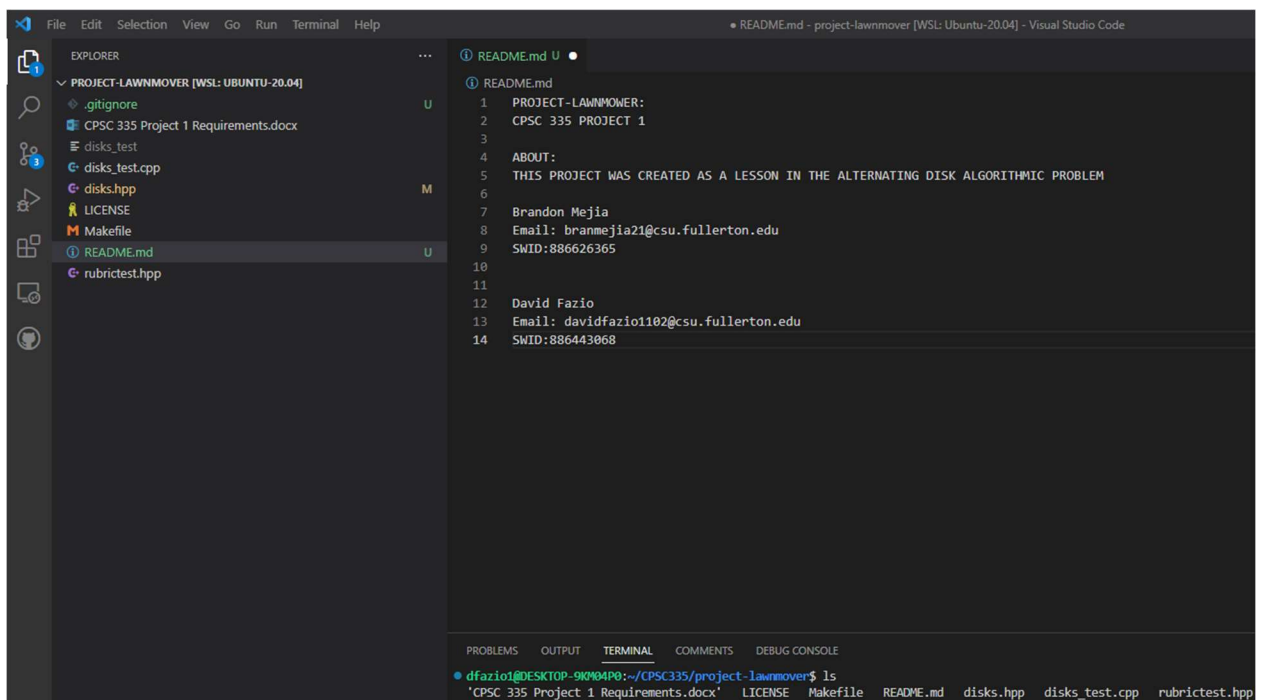


Project 1 Lawnmower

```
1  PROJECT-LAWNMOWER:
2  CPSC 335 PROJECT 1
3
4  ABOUT:
5  THIS PROJECT WAS CREATED AS A LESSON IN THE ALTERNATING DISK ALGORITHMIC PROBLEM
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```



Pseudo Code:

sort alternate

```
int numberOfSwaps = 0
disk_state newDisk = originalDisk
for i = 1 to newDisk.size() / 2 do
    for j = i to newDisk.size() - 1 do
        if (currentDisk == dark and nextDisk == light)
            swapDisk
            numberOfSwaps++
        else
            continue
```

sort lawnmower

```
int numberOfSwaps = 0
disk_state newDisk = originalDisk
for i = 0 to newDisk.size() - 1 do
    for j = 1 to newDisk.size() - 1 do
        if (currentDisk == dark and nextDisk == light
            swapDisk()
            numberOfSwaps++
        else
            continue
```

Limit Theorem/Step Count:

Alternate Algorithm

$$\begin{aligned} & 1 + 1 + \left(\frac{n}{2}\right) \cdot (n-1) \cdot (4+1+1) \\ &= 2 + \left(\frac{n}{2}\right) \cdot (n-1) \cdot 6 \\ &= 2 + \left(\frac{n}{2}\right) \cdot (6n-6) \\ &= 2 + \left(\frac{6n^2}{2} - \frac{6n}{2}\right) \end{aligned}$$

Limit theorem

$$\begin{aligned} f(n) &= \frac{6n^2}{2} - \frac{6n}{2} + 2 \in O(n^2) \quad g(n) = n^2 \\ \lim_{n \rightarrow \infty} \frac{\frac{6n^2}{2} - \frac{6n}{2} + 2}{n^2} &= \frac{f(n)}{g(n)} \\ &= \boxed{3} - \frac{3}{n} + \frac{2}{n^2} \\ &= 3 \neq \infty \end{aligned}$$

$$\text{Therefore } \frac{6n^2}{2} - \frac{6n}{2} + 2 \in O(n^2)$$

Lawnmower Algorithm

$$\begin{aligned} & 1 + 1 + (n-1) \cdot (n-1) \cdot (4+1+1) \\ &= 2 + (n^2 - 2n + 1) \cdot (6) \\ &= 6n^2 - 12n + 8 \end{aligned}$$

Limit theorem

$$\begin{aligned} f(n) &= 6n^2 - 12n + 8 \in O(n^2) \quad g(n) = n^2 \\ \frac{f(n)}{g(n)} &= \frac{6n^2}{n^2} - \frac{12n}{n^2} + \frac{8}{n^2} \\ &= \boxed{6} - \frac{12}{n} + \frac{8}{n^2} \\ &= 6 \neq \infty \end{aligned}$$

$$\text{Therefore } 6n^2 - 12n + 8 \in O(n^2)$$

Compilation:

The screenshot shows the Visual Studio Code interface with the 'disks.hpp' file open in the editor. The file contains a C++ implementation of the lawn mower algorithm. The Explorer sidebar on the left shows the project structure, including files like 'disks_test.cpp', 'disks.hpp', 'LICENSE', 'Makefile', 'README.md', and 'rubrictest.hpp'. The Terminal panel at the bottom shows the output of the compilation process, including the command 'g++ -std=c++11 -Wall disks_test.cpp -o disks_test' and the resulting test results.

```
159 sort_lawnmower(const disk_state& before) {
160     // dark(1) and light(0) swap if dark then light
161     if (after.get(j) > after.get(j + 1)) {
162         after.swap(j);
163         numOfSwap++;
164     }
165 }
166
167 }
168
169 return sorted_disks(disk_state(after), numOfSwap);
170 }
171
172
173 // Algorithm that sorts disks using the lawn timer algorithm.
174 sorted_disks sort_lawnmower(const disk_state& before) {
175     int numOfSwap = 0;
176     disk_state after = before;
177
178     // Loop over the entire list
179     for (size_t i = 0; i < after.total_count() - 1; i++) {
180         // Loop left-to-right and right-to-left over the list at O(n) complexity
181         for (size_t j = 1; j < after.total_count() - 1; j++) {
182             // dark(1) and light(0) swap if dark then light
183             if (after.get(j) > after.get(j + 1)) {
184                 after.swap(j);
185                 numOfSwap++;
186             }
187         }
188     }
```

PROBLEMS OUTPUT TERMINAL COMMENTS DEBUG CONSOLE

```
dfazio1@DESKTOP-9K04P0:~/CPSC335/project-lawnmower$ ls
'CPSC 335 Project 1 Requirements.docx' LICENSE Makefile README.md disks.hpp disks_test.cpp rubrictest.hpp
dfazio1@DESKTOP-9K04P0:~/CPSC335/project-lawnmower$ 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::is_initialized: passed, score 3/3
disk_state::is_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
dfazio1@DESKTOP-9K04P0:~/CPSC335/project-lawnmower$
```

This screenshot shows the terminal output of the compilation and execution of the project-lawnmower program. The output includes the command 'g++ -std=c++11 -Wall disks_test.cpp -o disks_test' and the resulting test results, which show that all tests passed with a total score of 14 out of 14.

```
PROBLEMS OUTPUT TERMINAL COMMENTS DEBUG CONSOLE
dfazio1@DESKTOP-9K04P0:~/CPSC335/project-lawnmower$ ls
'CPSC 335 Project 1 Requirements.docx' LICENSE Makefile README.md disks.hpp disks_test.cpp rubrictest.hpp
dfazio1@DESKTOP-9K04P0:~/CPSC335/project-lawnmower$ 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::is_initialized: passed, score 3/3
disk_state::is_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
dfazio1@DESKTOP-9K04P0:~/CPSC335/project-lawnmower$
```