Alternate

Pseudo:

```
swapnums = 0
for i = 0 to n/2 do
          for j = i % 2 to n - 1 step 2 do
                    If disk[j] > disk[j+1]
                              swap disks
                              swapnums++
                    end if
          end for
end for
```

Step Count:

//Decided to count swap as 3 tu as counted from the swap function

when j = i % 2 = 0:

if statement = 1 + max(4, 0)
If statement = 5

inner forloop = $\sum_{j=0}^{n-1} 5$ = 5(n -1 + 1) = 5n
Total = outer * inner * for block
Total = $\sum_{i=0}^{n/2} (5n) = 5 \sum_{i=0}^{n/2} n$ = 5(n/2 + 1)n
= $\frac{5n^2+10n}{2}$

when j = i % 2 = 1:

if statement = 1 + max(4, 0)
If statement = 5

inner for loop = = $\sum_{j=1}^{n-1} 5$ = 5(n - 1 -1 + 1) 5n - 5 total = $\sum_{i=0}^{n/2}$ (5n-5) = 5 $\sum_{i=0}^{n/2}$ n - $\sum_{i=0}^{n/2}$ 5 = 5(n/2 + 1)n - 5(n/2 +1) =

5n(n/2 +1) + 5(n/2 + 1) = $\frac{5n^2}{2} + 5n - \frac{5n}{2} - 5$

= $\frac{5n^2}{2} + \frac{5n}{2} - 5$

Complexity = O(n^2)

Time Complexity Proof

Complexity = O(n^2)

Proof when j = i%2 = 0:

$$\lim_{n \to \infty} \frac{\frac{5n^2+10n}{2}}{n^2} = \frac{(5n^2+10n)'}{(2n^2)'} = \frac{(10n+10)'}{(4n)'} = \frac{10}{4} = \frac{5}{2} >= 0$$

Proof when j = i%2 = 1:

$$\lim_{n \to \infty} \frac{\frac{5n^2-5n-10}{2}}{n^2} = \frac{(5n^2+10n)'}{(2n^2)'} = \frac{(10n-5)'}{(4n)'} = \frac{10}{4} = \frac{5}{2} >= 0$$

Lawnmower

Pseudo:

```
numOfSwap = 0
while !is_sorted
  for i = 0 to (total_count-1) do
    if disk[i] == DARK && disk[i+1] == LIGHT
      swap disks
      numOfSwap++
  for j = (total_count-1) to j > 1 do
    if disk[j] == LIGHT && disk[j-1] == DARK
      swap disks
      numOfSwap++
    end if
  end for
end while
return sorted_disks
```

Step Count:

numOfSwap = 0 -> 1 tu

while !is_sorted -> 3n+4 tu (is_sorted = 3n+3, ! = 1)

for i = 0 to (total_count-1) do -> n times tu

if disk[i] == DARK && disk[i+1] == LIGHT -> 2 tu

swap disks -> 3 tu

numOfSwap++ -> 1 tu

for j = (total_count-1) to j > 1 do -> -n+1 times tu

[([final value - initial value]/step) + 1] * $SC_{\text{for block}}$ -> ((n-1-1)/-1)+1 -> -n+1

if disk[j] == LIGHT && disk[j-1] == DARK -> 2 tu

swap disks -> 3 tu

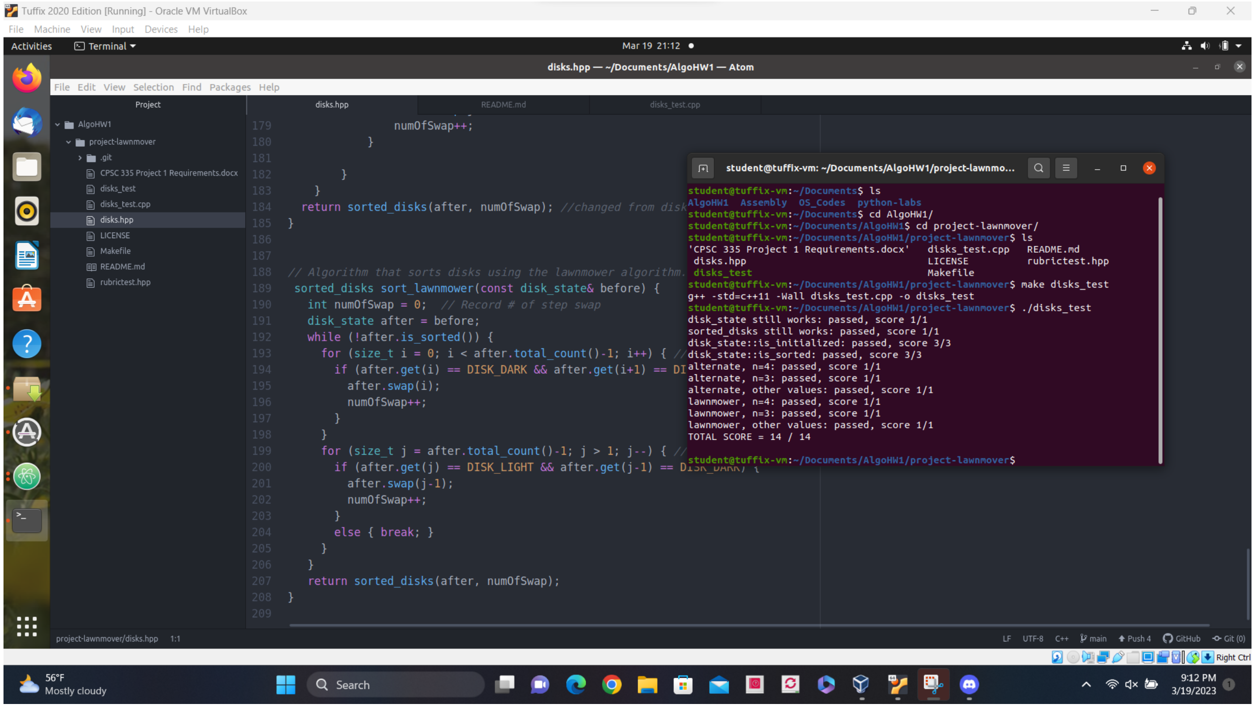
numOfSwap++ -> 1 tu

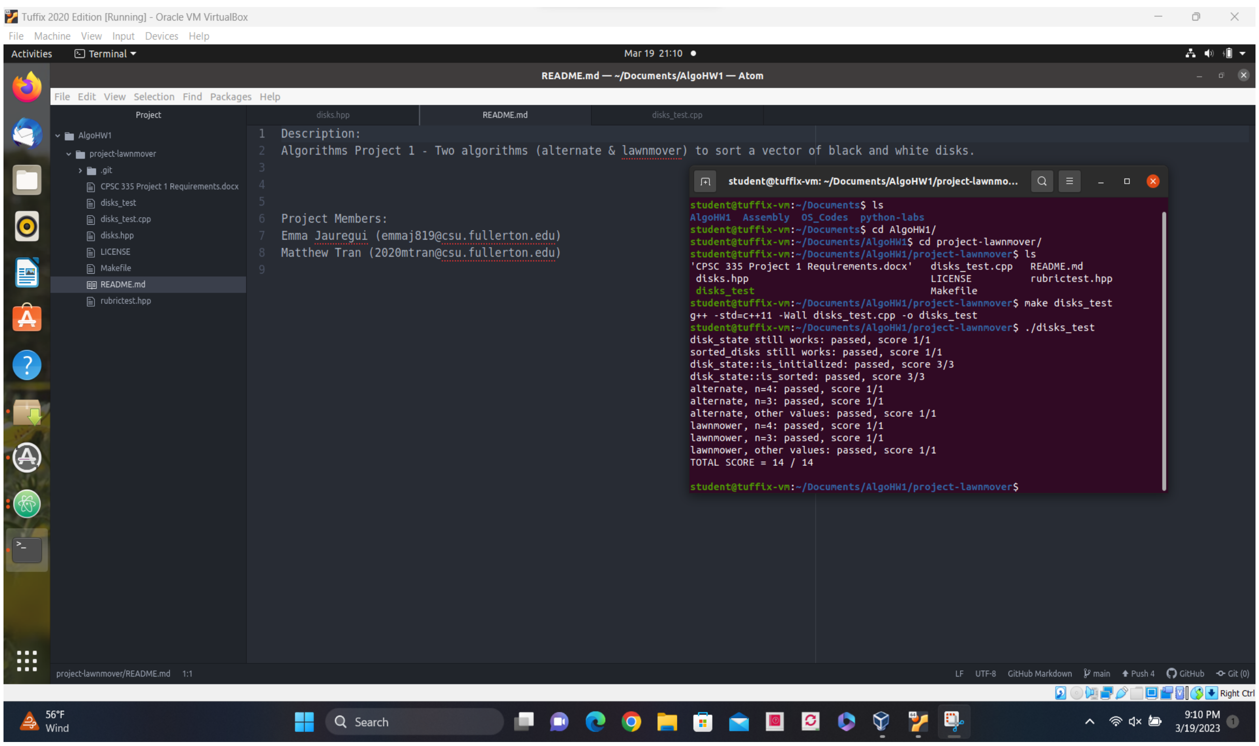
Total Time Complexity: 1 + 3n+4(5n + -5n+5) = 1 + 3n+4(5) = 1 + 15n + 20 = 15n+21 -> O(n)

Time Complexity Proof

$\lim_{n \to \infty} 15n + 21 = \infty$ -> O(n)

Screenshots


Tuffix 2020 Edition [Running] - Oracle VM VirtualBox
disks.hpp — ~/Documents/AlgoHW1 — Atom
numOfSwap++;
}
}
}
return sorted_disks(after, numOfSwap); //changed from disk
}
// Algorithm that sorts disks using the lawnmower algorithm.
sorted_disks sort_lawnmower(const disk_state& before) {
int numOfSwap = 0; // Record # of step swap
disk_state after = before;
while (!after.is_sorted()) {
for (size_t i = 0; i < after.total_count()-1; i++) {
if (after.get(i) == DISK_DARK && after.get(i+1) == DI
after.swap(i);
numOfSwap++;
}
}
for (size_t j = after.total_count()-1; j > 1; j--) {
if (after.get(j) == DISK_LIGHT && after.get(j-1) == DISK_DARK) {
after.swap(j-1);
numOfSwap++;
}
else { break; }
}
}
return sorted_disks(after, numOfSwap);
}
student@tuffix-vm: ~/Documents/AlgoHW1/project-lawnmo...
student@tuffix-vm:~/Documents$ ls
AlgoHW1 Assembly OS_Codes python-labs
student@tuffix-vm:~/Documents$ cd AlgoHW1/
student@tuffix-vm:~/Documents/AlgoHW1$ cd project-lawnmover/
student@tuffix-vm:~/Documents/AlgoHW1/project-lawnmover$ ls
'CPSC 335 Project 1 Requirements.docx' disks_test.cpp README.md
disks.hpp LICENSE rubrictest.hpp
disks_test Makefile
student@tuffix-vm:~/Documents/AlgoHW1/project-lawnmover$ make disks_test
g++ -std=c++11 -Wall disks_test.cpp -o disks_test
student@tuffix-vm:~/Documents/AlgoHW1/project-lawnmover$ ./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
student@tuffix-vm:~/Documents/AlgoHW1/project-lawnmover$
56°F
Mostly cloudy
9:12 PM
3/19/2023


Tuffix 2020 Edition [Running] - Oracle VM VirtualBox
README.md — ~/Documents/AlgoHW1 — Atom
Description:
Algorithms Project 1 - Two algorithms (alternate & lawnmover) to sort a vector of black and white disks.
Project Members:
Emma Jauregui (emmaj819@csu.fullerton.edu)
Matthew Tran (2020mtran@csu.fullerton.edu)
student@tuffix-vm: ~/Documents/AlgoHW1/project-lawnmo...
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AlgoHW1 Assembly OS_Codes python-labs
student@tuffix-vm:~/Documents$ cd AlgoHW1/
student@tuffix-vm:~/Documents/AlgoHW1$ cd project-lawnmover/
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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:~/Documents/AlgoHW1/project-lawnmover$
56°F
Wind
9:10 PM
3/19/2023