Project 1: implementing algorithms

CPSC 335 - Algorithm Engineering
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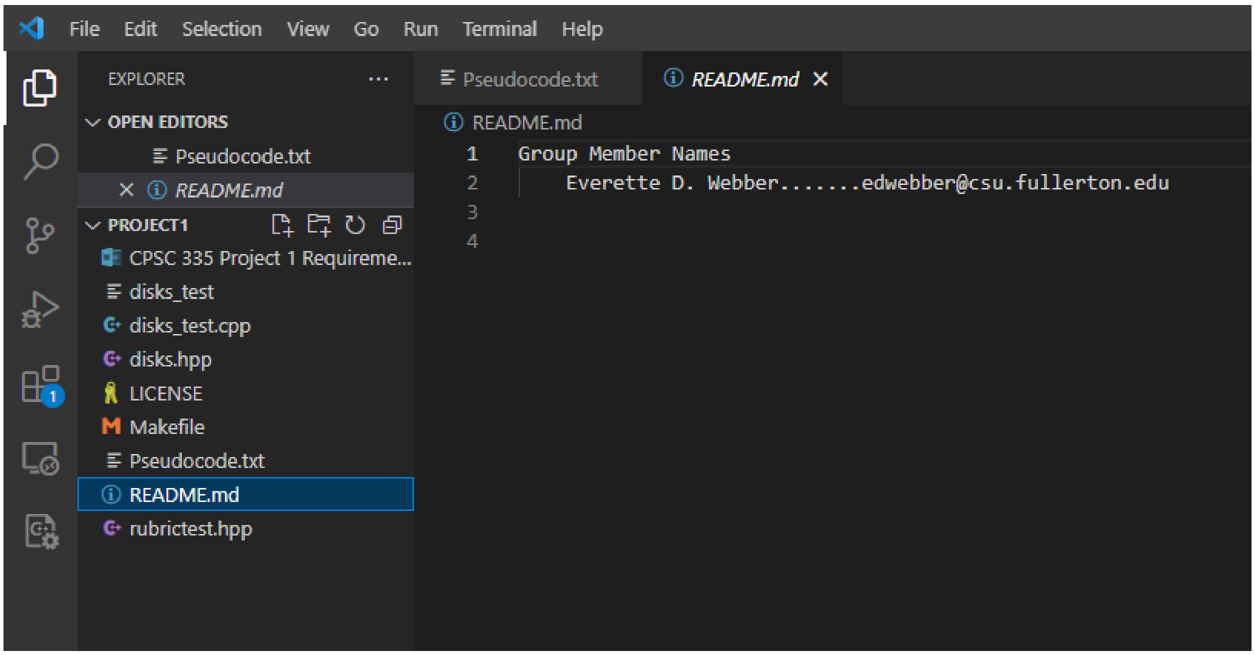
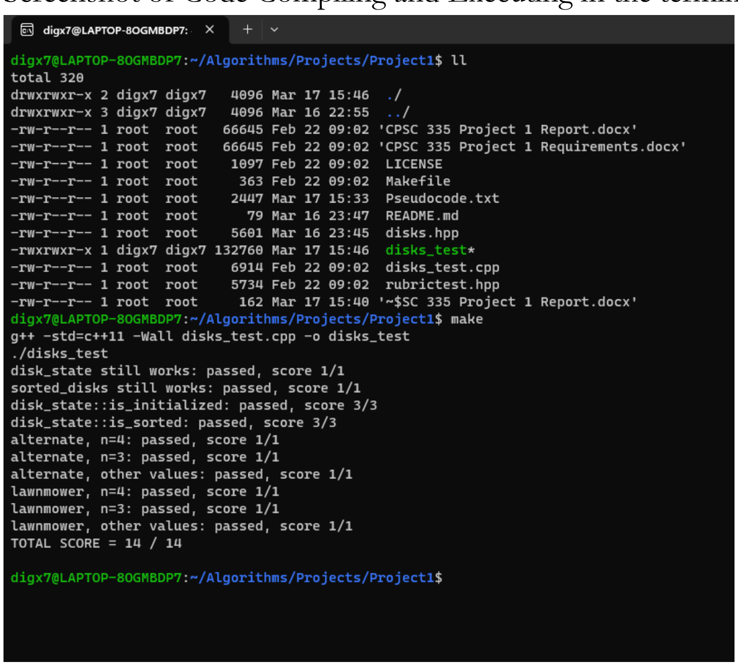
Screenshot of README.md



Screenshot of Code Compiling and Executing in the terminal



Pseudocode

Lawnmower algorithm

// Inputs
Given n
Given DiskList[2n]

// Performance
Step Count = (26n^2 + 14n - 12)
Given that n^2 is the largest variable than this algorithm has O(n^2)

// Algorithm

```
While the numberOfSwitches > 0 do:

    // resets the number of switches for each run
    numberOfSwitches = 0

    // moves from left to right
    for i = 0, i to 2n-1 do:
        if DiskList[i] == D && DiskList[i + 1] == L do:
            DiskList.swap(i)
            numberOfSwitches += 1

    // moves from right to left
    for i = (2n-1), i to 0 do:
        if DiskList[i] == L && DiskList[i - 1] == D do:
            DiskList.swap(i-1)
            numberOfSwitches += 1
```

Alternate algorithm

// Inputs
Given n
Given DiskList[n]

// Performance
Step Count = (12n^2 + 22n - 4)
Given that n^2 is the largest variable than this algorithm has O(n^2)

```
// Algorithm
While the numberOfSwitches > 0 do:

        // resets the number of switches for each run
        numberOfSwitches = 0

        // does the first run starting at the left most position
        for i = 0, i to 2n at i+2 do:
                if DiskList[i] == D && DiskList[i + 1] == L do:
                        DiskList.swap(i)
                        numberOfSwitches += 1

        // does the second run starting at the second left most position
        for i = 1, i to (2n-1) at i+2 do:
                if DiskList[i] == D && DiskList[i + 1] == L do:
                        DiskList.swap(i)
                        numberOfSwitches += 1
```

Proof For Time Complexity's

Lawnmower Algorithm

Step Count = countInsideWhileLoop * numberOfWhileLoops
numberOfWhileLoops = n + 1
countInsideWhileLoop = 1 + firstForLoop + secondForLoop

firstForLoop = countInsideFirstForLoop * numberOfFirstForLoops
countInsideFirstForLoop = 6
numberOfFirstForLoops = 2n – 1
firstForLoop = 6(2n-1)

secondForLoop = countInsideSecondForLoop * numberOfSecondForLoops
countInsideSecondForLoop = 7
numberOfSecondForLoops = (2n-1)
secondForLoop = 7(2n-1)

countInsideWhileLoop = 1 + 6(2n-1) + 7(2n-1) => (26n-12)
Step Count = (26n – 12)(n + 1) => (26n^2 + 14n - 12)

As n approaches infinity (26n^2 + 14n – 12) will approach (26n^2) meaning the Lawnmower Algorithm as a time complexity of O(n^2)

Alternate Algorithm

Step Count = countInsideWhileLoop * numberOfWhileLoops
numberOfWhileLoops = n + 2
countInsideWhileLoop = 1 + firstForLoop + secondForLoop

firstForLoop = countInsideFirstForLoop * numberOfFirstForLoops
countInsideFirstForLoop = 6
numberOfFirstForLoops = 2n/2
firstForLoop = 6(2n/2)

secondForLoop = countInsideSecondForLoop * numberOfSecondForLoops
countInsideSecondForLoop = 6
numberOfSecondForLoops = (2n-1)/2
secondForLoop = 6((2n-1)/2)

countInsideWhileLoop = 1 + 6(2n/2)+ 6((2n-1)/2)=> (12n-2)
Step Count = (12n-2)(n+2) => (12n^2 + 22n -4)

As n approaches infinity (12n^2 + 22n -4) will approach (12n^2) meaning the Lawnmower Algorithm as a time complexity of O(n^2)