Submission for Project 1

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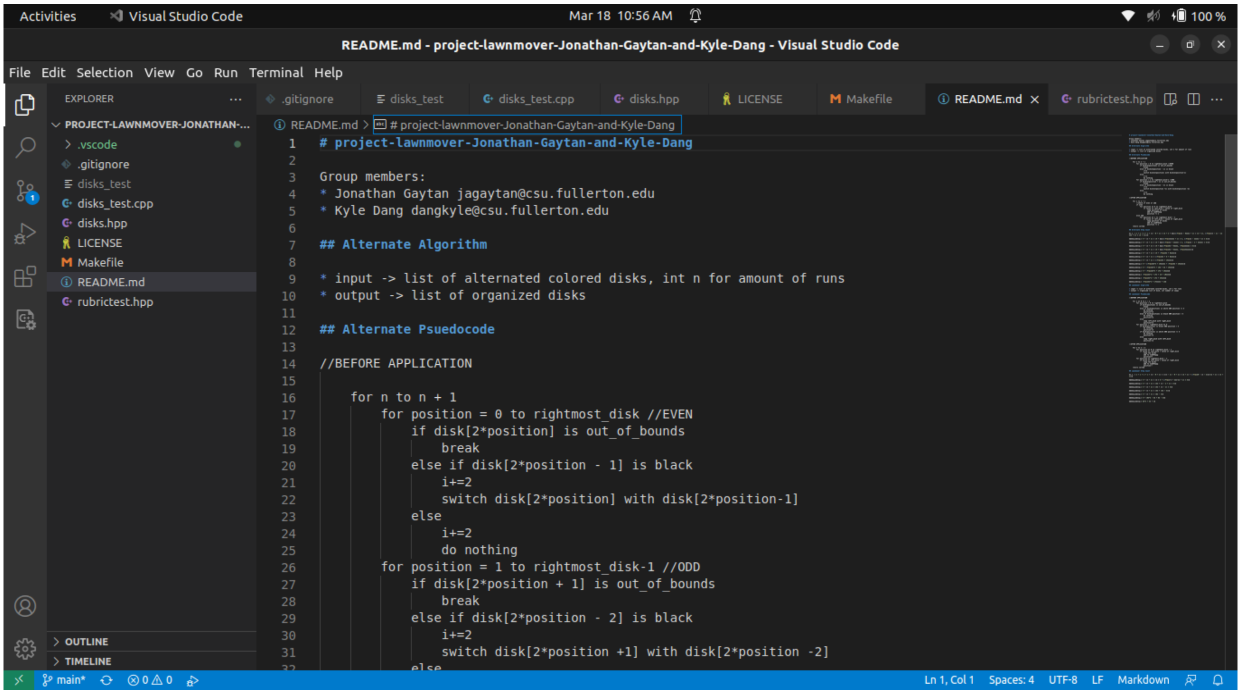
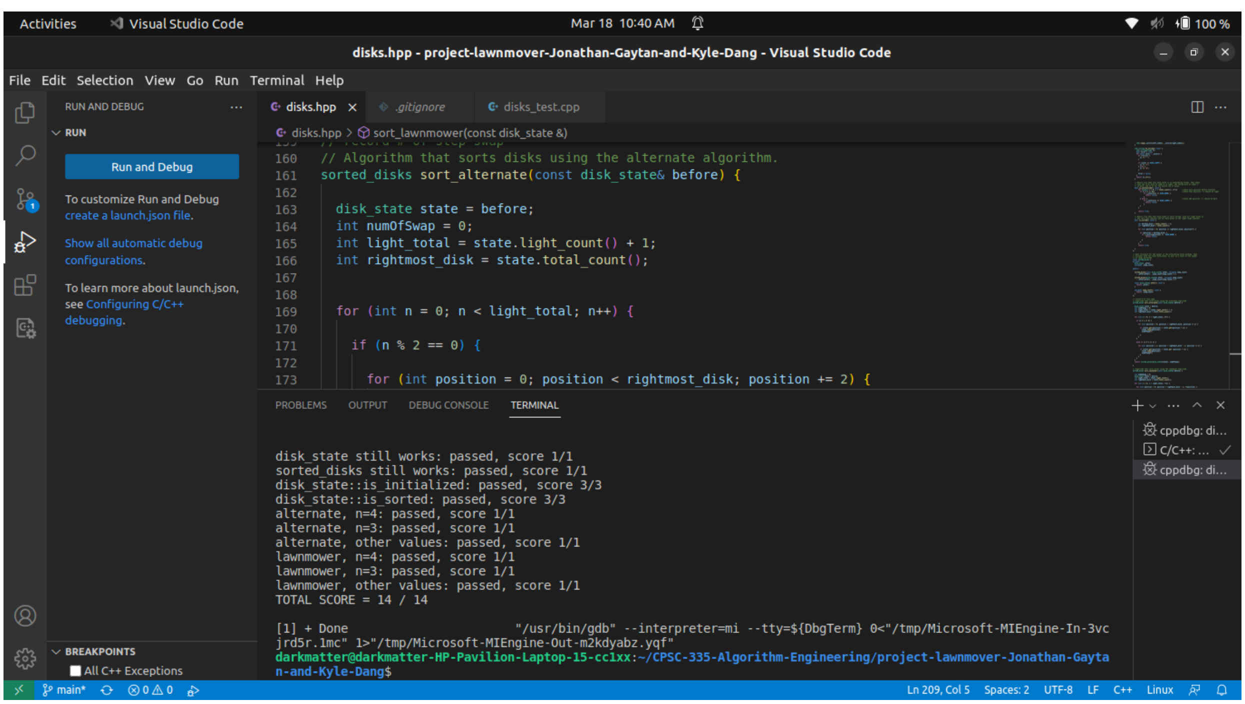
<u>Screenshots of Editor and Code Compiling and Executing:</u>

Editor:



Code Compiling and Executing:



Alternate Algorithm:

Pseudocode:

```
for n to n + 1
    if even
        for position at 0 to rightmost_disk
            if value of left_disk > value of right_disk
                swap position of disks
                add to numOfSwap
                position += 2
    else odd
        for position at 1 to rightmost disk - 1
            if value of left_disk > value of right_disk
                swap position of disks
                add to numOfSwap
                position += 2
return sorted
```

Step Count:

$s.c. = 1 + 1 + 2 + 1 + (n - 0 + 1) * (2 + 2 + max((\frac{n-0}{2} + 1) * (2 + 1), ((\frac{(n-1)-1}{2} + 1) * (2 + 1)))$

$= 5 + (n + 1) * (4 + max((\frac{n}{2} + 1) * 3, (\frac{n-2}{2} + 1) * 3)$

$= 5 + (n + 1) * (4 + max((\frac{n+2}{2}) * 3, (\frac{n-2+2}{2}) * 3))$

$= 5 + (n + 1) * (4 + max(\frac{3n+6}{2}, \frac{n}{2} * 3))$

$= 5 + (n + 1) * (4 + max(\frac{3n+6}{2}, \frac{3n}{2}))$

$= 5 + (n + 1) * (4 + \frac{3n+6}{2})$

$= 5 + (n + 1) * (\frac{3n+6+8}{2})$

$= 5 + (n + 1) * (\frac{3n+14}{2})$

$= 5 + (\frac{3n^2+14n}{2} + \frac{3n+14}{2})$

$= 5 + (\frac{3n^2+14n+3n+14}{2})$

$= 5 + (\frac{3n^2+17n+14}{2})$

$= \frac{3n^2+17n+14+10}{2}$

$= \frac{3n^2+17n+24}{2}$

$= \frac{3n^2+17n}{2} + 12$

Efficiency Class with Limit Theorem:

$$\lim_{n \to \infty} \frac{\frac{3}{2}n^2+\frac{17}{2}n+12}{n^2} = \frac{3}{2}$$

Due to $\frac{3}{2} \geq 0$ and $\frac{3}{2}$ being a constant, the Limit Theorem states that $\frac{3n^2+17n}{2} + 12 \in O(n^2)$.

That means this algorithm has a time complexity of $O(n^2)$.

Lawnmower Algorithm:

Pseudocode:

```
for n to n / 2
    for position at 0 to rightmost_disk - 1
        if value of left_disk > value of right_disk
            swap the disks
            add to numOfSwap
            position++
    for position at rightmost_disk - 2
        if value of left_disk > value of right_disk
            swap the disks
            add to numOfSwap
            position--
return sorted
```

Step Count:

$$s.c. = 1 + 1 + 1 + 1 + (n - 0 + 1) * (((n - 1) - 0 + 1) * (2 + 1) + (\frac{0-(n-2)}{-1} + 1) * (2 + 1))$$

$$= 4 + (n + 1) * (n * 3 + (\frac{-n+2}{-1} + 1) * 3)$$

$$= 4 + (n + 1) * (3n + (n - 2 + 1) * 3)$$

$$= 4 + (n + 1) * (3n + (n - 1) * 3)$$

$$= 4 + (n + 1) * (3n + (3n - 3))$$

$$= 4 + (n + 1) * (6n - 3)$$

$$= 4 + (6n^2 - 3n + 6n - 3)$$

$= 6n^2 + 3n + 1$

Efficiency Class with Limit Theorem:

$$\lim_{n \to \infty} \frac{6n^2+3n+1}{n^2} = 6$$

Due to $6 \geq 0$ and 6 being a constant, the Limit Theorem states that $6n^2 + 3n + 1 \in O(n^2)$.

That means this algorithm has a time complexity of $O(n^2)$.