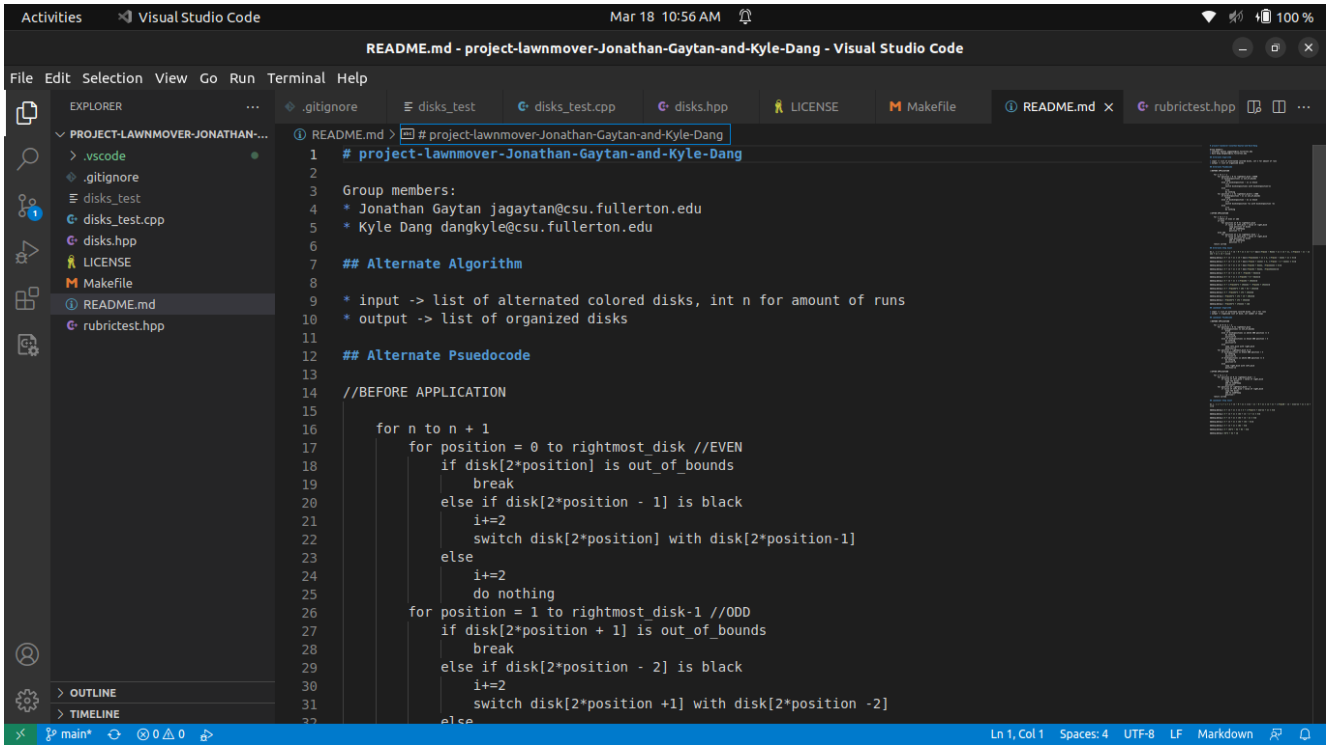
Submission for Project 1

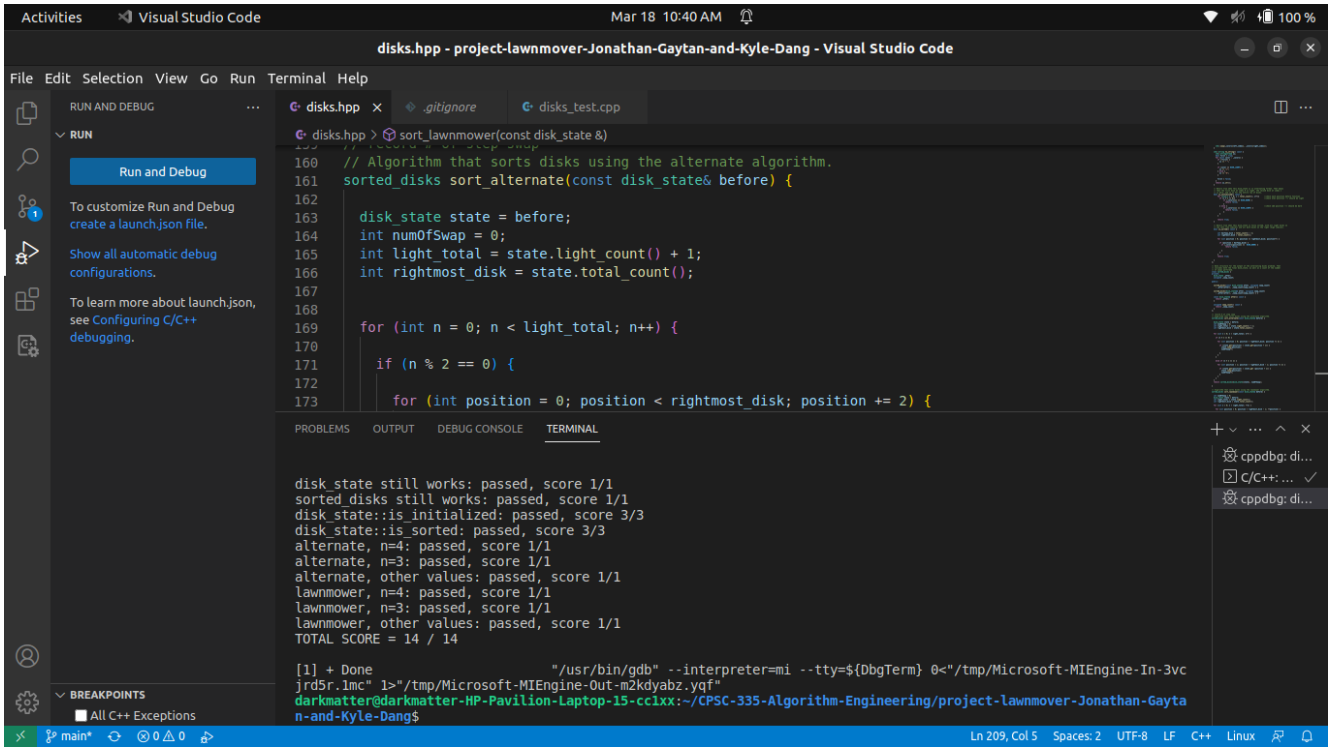
Group members:

Jonathan Gaytan jagaytan@csu.fullerton.edu

Kyle Dang dangkyle@csu.fullerton.edu

Screenshots of Editor and Code Compiling and Executing:





Alternate Algorithm:

Alternate Psuedocode

```
for n to n + 1

    //check if even or odd
    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
```

Alternate Step Count

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Alternate Algorithm 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:

Lawnmower Psuedocode

```
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
```

Lawnmower Step Count

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

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

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

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

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

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

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

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

Lawmower Algorithm 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 $O(n^2)$