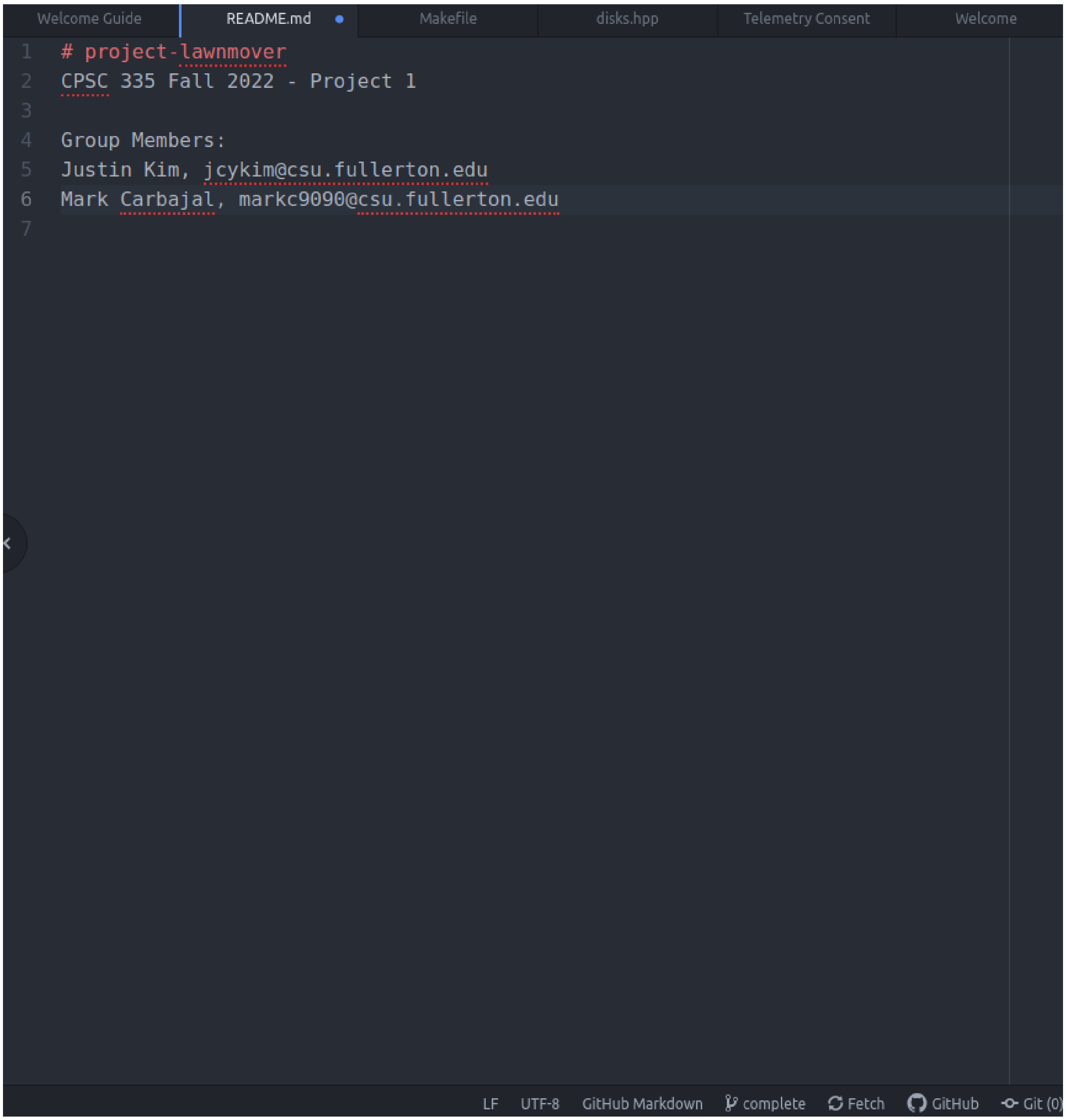
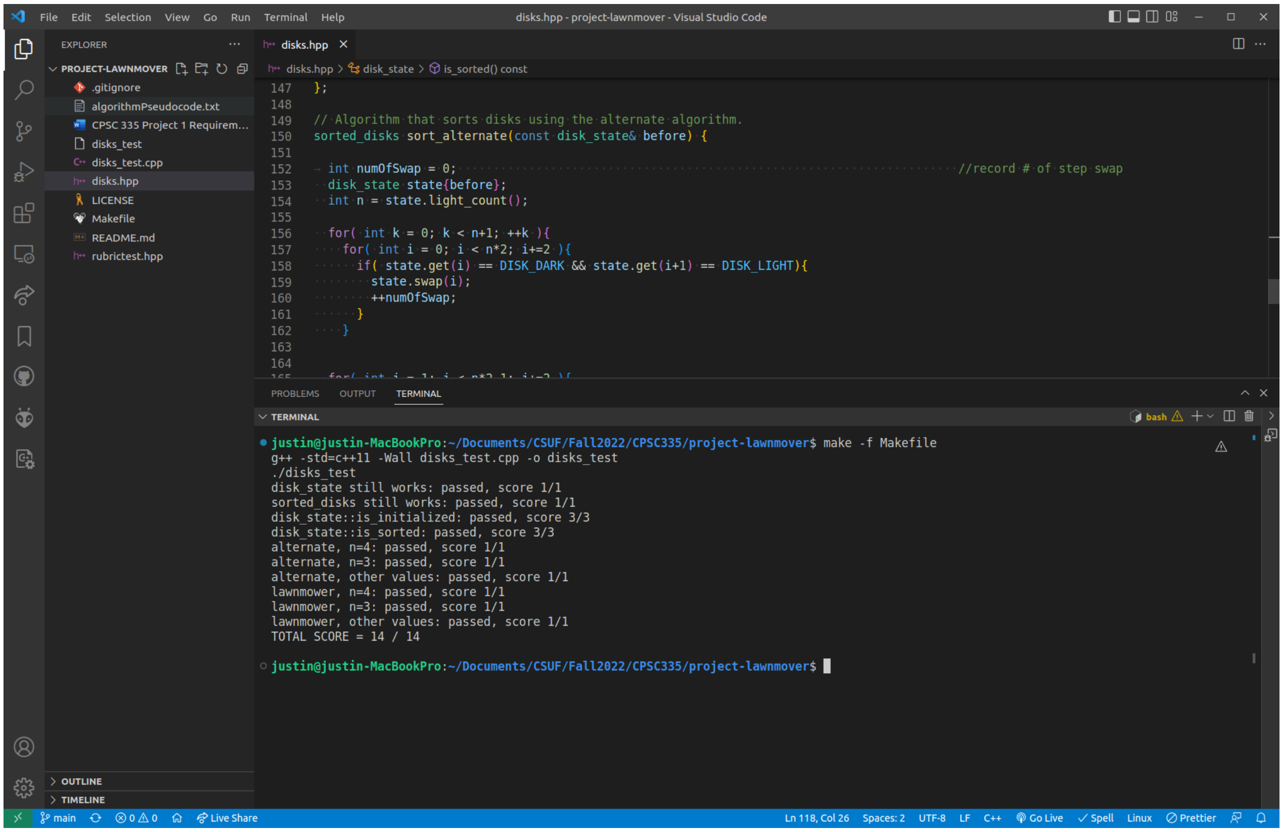
Justin Kim - jcykim@csu.fullerton.edu
Mark Carbajal - markc9090@csu.fullerton.edu

CPSC 335 Project 1
Due: 10/9/2022





Input: a positive integer n and a list of 2n disks of alternating colors light-dark, starting with light

Output: a list of 2n disks, the first n disks are light, the next n disks are dark, and an integer m representing the number of swaps to move the dark ones after the light ones.

Lawnmower Algorithm -

```
numberOfSwaps = 0 // 1tu

for k = 0 to ((n+1)/2)-1 do // (((n+1)/2) - 1 +1 ) = (n+1)/2 times
   //left to right
   for i = 0 to 2*n-2 do: // ((2*n-2)-0)/1 + 1 = 2*n-1 times
      if (disk[i] == D && disk[i+1] == L) // 4 tu
         swap disk[i] and disk[i+1] // 3tu
         numberOfSwaps++ // 1tu
         // 4+max(4,0) = 8tu
      endif
   endfor


   //right to left
   for j = 2*n-1 to 1 do: // (1 - (2*n-1))/(-1) + 1 = 2*n-2+1 = 2*n-1 times
      if (disk[j] == L && disk[j-1] == D) // 4tu
         swap disk[j] and disk[j-1] // 3tu
         numberOfSwaps++ //1tu
         // 4+max(4,0) = 8tu
      endif
   endfor
endfor
```

S.C = ((n+1)/2) * (8(2*n-1)+8(2*n-1)) + 1 tu
= ((n+1)/2) * (32n - 16) + 1
= 16n^2 + 8n - 7

We want to prove that: 16n^2 + 8n -7 ∈ O(n^2)
So, according to limits theorem,
Lim n-> ∞(16n^2 + 8n -7)'/(n^2)' -> (32n+8)'/(2n)' -> (32)/(2) = 16.

Since 16 ≥ 0, and 16 is a constant, the limits theorem tell us that 16n^2 + 8n -7 ∈ O(n^2).

Alternate Algorithm:

```
numberOfSwaps = 0 // 1tu

for k = 0 to n+1-1 do: // (n/1) + 1 times
  for i = 0 to 2*n-1 step 2 // (2*n-1)/2 + 1 times
    if (disk[i] == 'D' && disk[i+1] == 'L') // 4tu
      swap disk[i] and disk[i+1] // 3tu
      numberOfSwaps++ // 1tu
      // 4+max(4,0) = 8tu
    endif
  endfor

  // 1 3 5 ... n-2
  for j = 1 to 2*n-2 step 2 // ((2n-3)/2 + 1) * 8 times
    if (disk[j] == 'D' && disk[j+1] == 'L') //4 tu
      swap disk[j] and disk[j+1] // 3tu
      numberOfSwaps++ // 1tu
      // 4+max(4,0) = 8tu
    endif
  endfor
Endfor
```

Sc = (n/1 +1) * (((2n-1)/2 +1)*8 + ((2n-3)/2 + 1) * 8) + 1
= (n+1) * ((n + ½)* 8 + (n - ½)* 8) + 1
= (n+1) * (8*n + 4 + 8*n - 4)
= (n+1)(16n) + 1
= 16n^2 + 16n + 1 tu

We want to prove that: 16n^2 + 16n + 1 ∈ O(n^2)
So, according to limits theorem,
Lim n-> ∞(16n^2 + 16n + 1)'/(n^2)' -> (32n+16)'/(2n)' -> (32)/(2) = 16.

Since 16 ≥ 0, and 16 is a constant, the limits theorem tell us that
16n^2 + 16n + 1 ∈ O(n^2).