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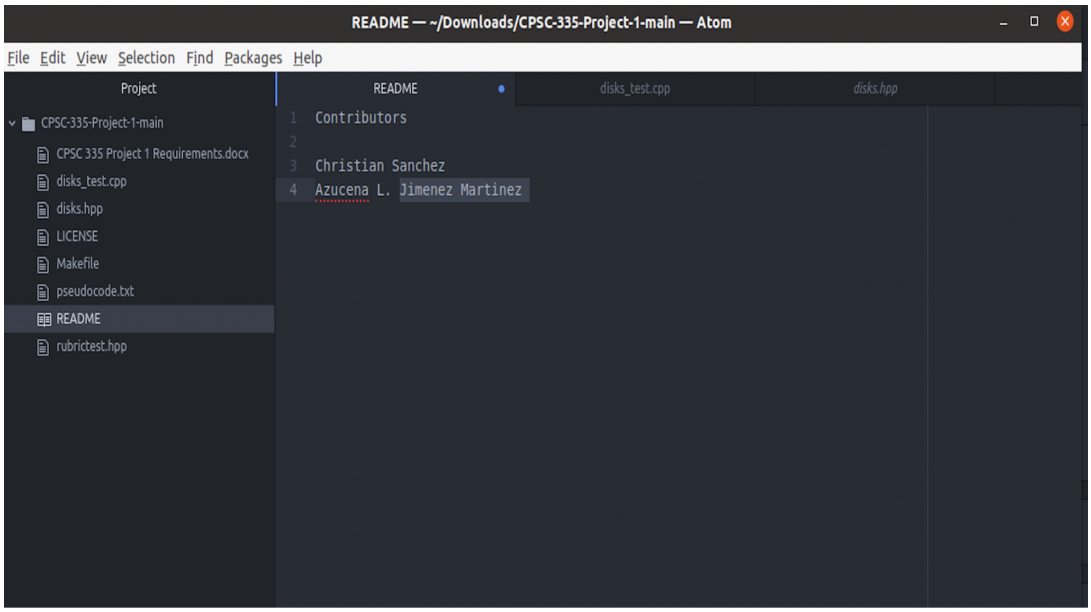
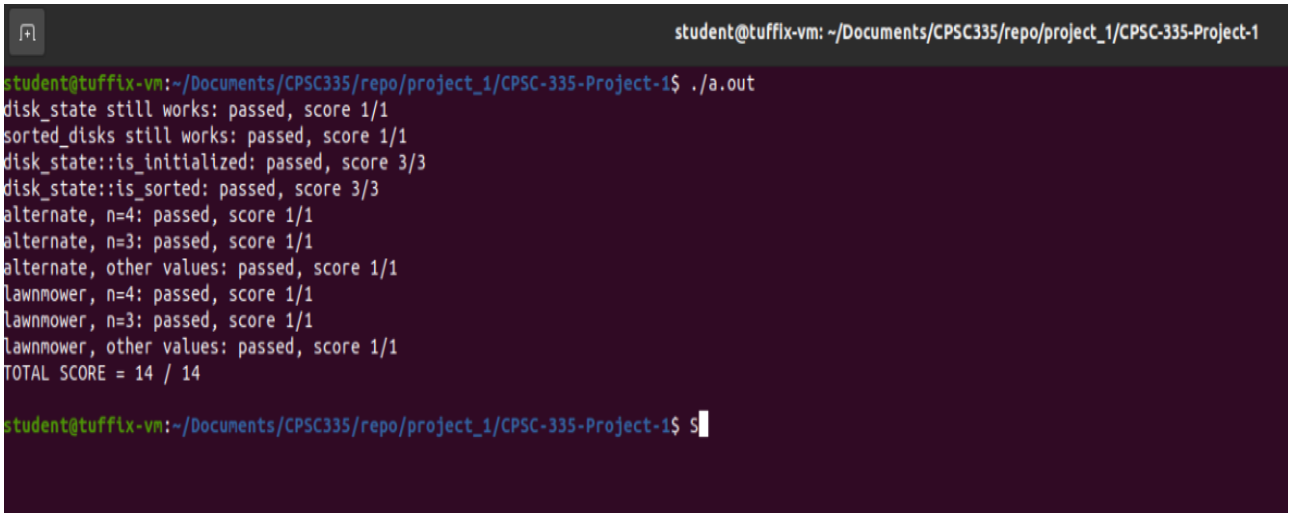
CPSC 335 Project 1 - implementing algorithms Submission

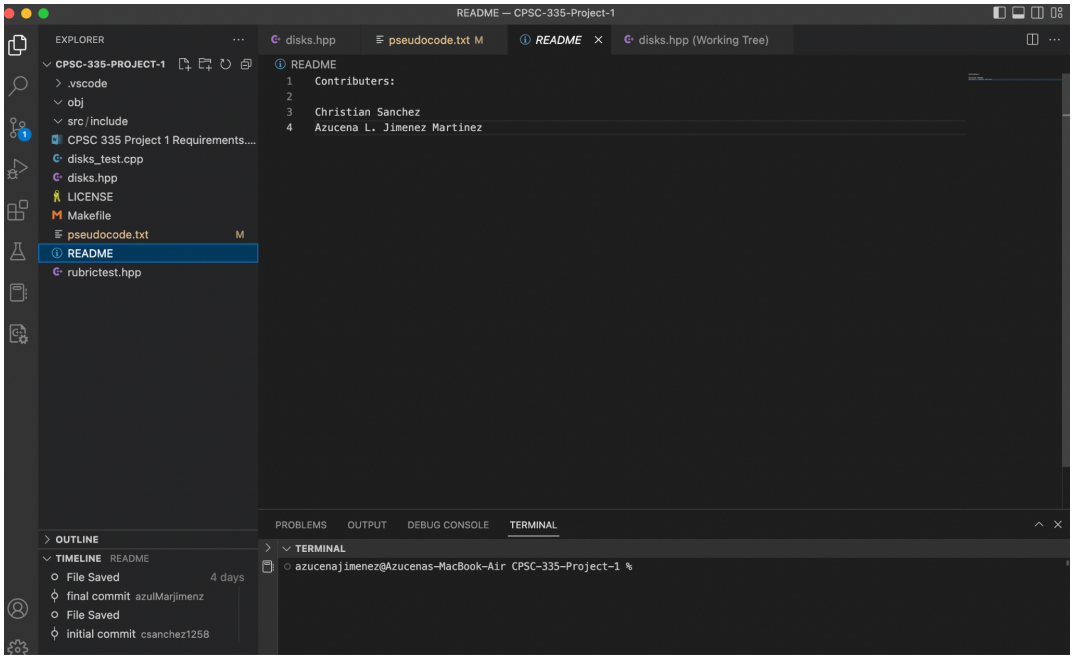
Project 1 was completed using both Tuffix and VS code, therefore screenshot submissions are included for both.

Tuffix





Visual Studio Code:




```
azucenajimenez@Azucenas-MacBook-Air CPSC-335-Project-1 % ./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
```

The alternate algorithm - Pseudocode listing + Step count + Proof

```
------------------------------------------------------------
Algorithm that sorts disks using the Alternate Algorithm
------------------------------------------------------------

Alternate:

int numOfSwap = 0                          // 1tu
disk_state state = before                  // 1tu
for i = 0 to n do                          // n+1 times
  for j = 0 to n-1 do                      // n times
  if (Left == Dark && Right == light)      // 3tu
    swap(Left_Disk, Right_Disk)            // 1tu
    ++numOfSwap                            // 1tu
end
```

```
*****************************************************************************************************
Step Count calculation
*****************************************************************************************************
if statement s.c = 3+1+1+max(2,0) = 7tu
S.C = (n+1)(n) * (3+1+1+max(2,0))
    = n^2 + n * 7
    = 7n^2 + n

*****************************************************************************************************
Proof by limits
*****************************************************************************************************
7n^2 + n ∈ O(n^2)

lim as n -> infinity 7n^2/n^2  -> 7
lim as n -> infinity n/n^2     -> 0

7+0 = 7
7 ≥ 0 so, by the limit theormem 7n^2 + n ∈ O(n^2)
```

The lawnmower algorithm - Pseudocode listing + Step count + Proof

```
 ---------------------------------------------------------
 Algorithm that sorts disks using the Lawnmower Algorithm
 ---------------------------------------------------------

 Lawnmower:

   int numOfSwap = 0                                    //1tu

   for i = 0 in n/2 do:                                 //(n/2)+1 tu
     b_swap = false                                     // 1tu
     for k = 0 in n do:                                 //n+1 tu
       if k+1 != n do:                                  //2tu
         if(k == DISK_DARK && k+1 == DISK_LIGHT)        //4tu
           swap(k,k+1)                                  //1tu
           b_swap = true                                // 1tu
           numOfSwap++                                  //1tu
     for j = n down to 0 do:  (0-n/-1) + 1 =            //n+1tu
       if j != 0    1tu
         if(j == DISK_LIGHT && k-1 == DISK_DARK)        //4tu
           swap(k,k-1)                                  //1tu
           b_swap = true                                //1tu
           numOfSwap++                                  //1tu

     if(!(b_swap))                                      //1tu
       break

     endif
```

```
**********************************************************************************************************
Step Count calculation
**********************************************************************************************************

    1 + (n/2)+1( 1+n+1( 2+max ( 4+max(3,0) ) ,0)) + n+1( 1+max ( ( 4+max(3,0) ),0 )) ) + 1
    1 + n/2 + 1(1+n+1 (2+4+3)+ n+1(1+3+3) + 1)
    1 + n/2 + 1(1+n+1(9) + n+1(7)+ 1)
    1 + n/2 + 1(1+n+9 + n+7 + 1)
    1 + n/2 + 1(n+10 + n+8)
    n/2 + n + n + 19
    n/2 + 2n + 19

**********************************************************************************************************
Proof by limits
**********************************************************************************************************

n/2 + 2n + 19 ∈ O(n^2)

(n/2)/n^2 + 2n/n^2 + 19/n^2

lim as n -> infinity 1/2n + 2/n + 19/n^2

0 + 0 + 0 = 0 ; L >= 0, so n/2 + 2n + 19 ∈ O(n^2)
```