Project 2

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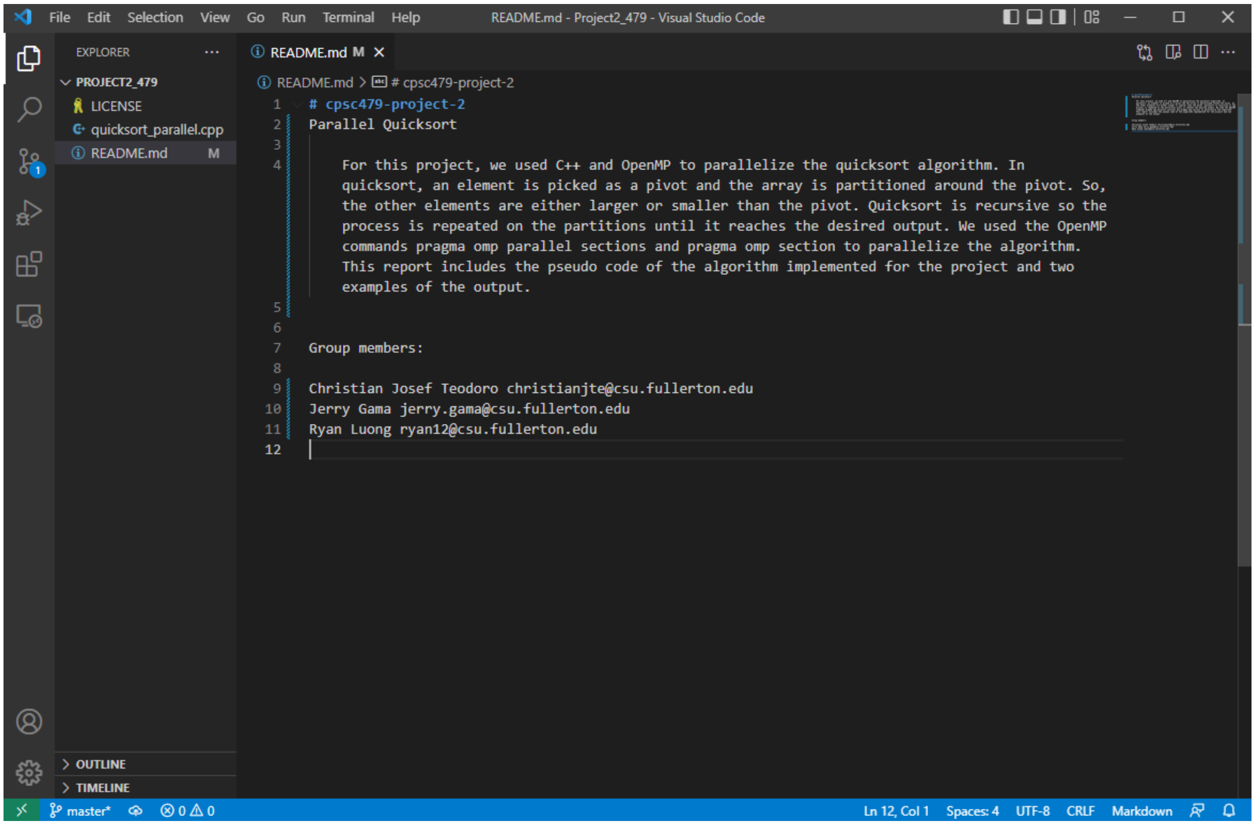

Summary:

For this project, we used C++ and OpenMP to parallelize the quicksort algorithm. In quicksort, an element is picked as a pivot and the array is partitioned around the pivot. So, the other elements are either larger or smaller than the pivot. Quicksort is recursive so the process is repeated on the partitions until it reaches the desired output. We used the OpenMP commands pragma omp parallel sections and pragma omp section to parallelize the algorithm. This report includes the pseudo code of the algorithm implemented for the project and two examples of the output.

Pseudocode:

```
elaspedTime = 0

int partition(array, first, last) {

    pivot = first array element

    count = 0

    for (i = first + 1; i <= last; i++) {
```

```
        if array[i] <= pivot
            add 1 to count
    }
    pivotIndex = first + count
    swap array[pivotIndex] and arr[last]
    i = first, j = last
    while i is less than pivotIndex and j is greater than pivotIndex {
        while array[i] is less than or equal to pivot
            add 1 to i
        while array[j] is greater than pivot
            subtract 1 to j
        if i is less than pivotIndex and j is greater than pivotIndex
            swap array[i] and array[j]
            add 1 to i
            subtract 1 to j
}
    return pivotIndex
}
void quickSort(array, first, last) {
    if first < last {
        p = partition(array, first, last)
        Start parallelizing {
            parallelize this block of code
            begin, end
            start timing (begin)
            quicksort(array, first, p - 1)
            end timing (end)
            elaspedTime += end - begin
}
```

```
      parallelize this block of code {
      begin, end
      start timing (begin)
      quicksort(array, p + 1, last)
      end timing (end)
      elaspedTime += end - begin
}
}
}
}
main function () {
  arraySize = 0
  randomize seed
  ask for arraySize
  initialize array based on arraySize
  for i to arrarySize {
    rando = random number between 1 to arraySize
    array[i] = rando
}
  quickSort(array, 0, n-1)
  if elapsedTime is less than 60 minutes {
    print the array elements
    print the elapsed time
}
  else
    end the program
}
}
```

The code was compiled and run using:

g++ -fopenmp quicksort_parallel.cpp -o quicksort

./quicksort

n = 100,000

```
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99992
99992
99992
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99997
99998
99998
99998
100000
Elapsed time: 1.284895student@tuffix-vm:~/project2$
```

n = 1m

```
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999958
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999959
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999992
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999995
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999999
1000000
Elapsed time: 11.998142student@tuffix-vm:~/project2$
```