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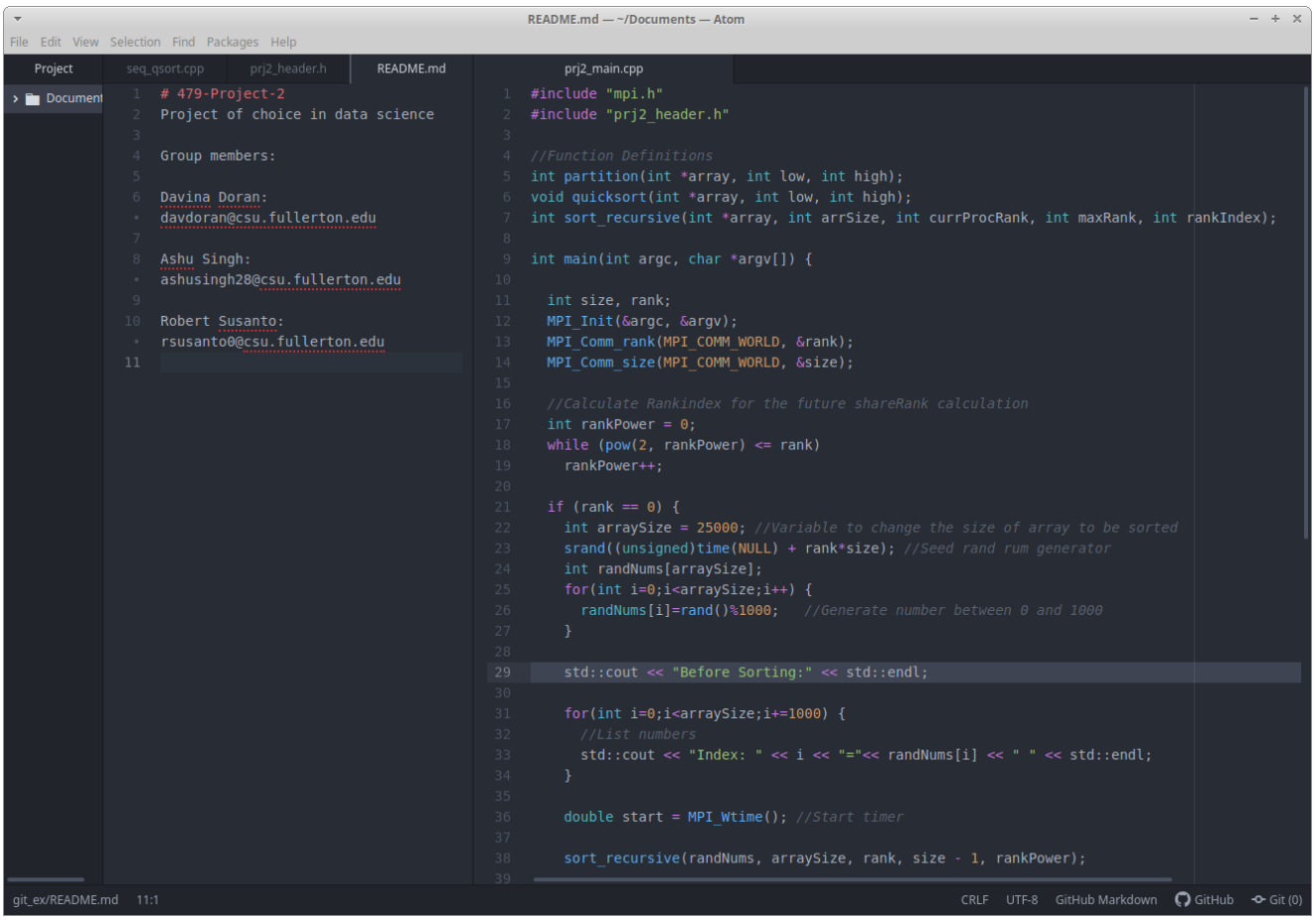
CPSC 479-01

Professor: Doina Bein

05-19-2021

Project 2 Report Document

Full Screen Screenshot (w/ group member names):



How to Run:

Compile: mpiCC pri2_main.cpp

Run: mpirun -np <num of processors> ./a.out (*** sometimes receives seg fault. Just rerun and that solves it***)

Pseudocode:

```
MAIN.CPP
main:
   if (rank == 0): //leader
      - MPI: Init, rank, size: rank, size
      - create & output array or random numbers: A[n]
      - start clock
      - call sort_recursive(A)
index      - end clock
      - output contents of A & end - start times
   else: // rest of the processes
      - MPI: status, Probe, Get_count //get size of array to recv.
      - allocate memory for subarray: SA
      - MPI_Recv(SA, SASize)
      - sort_recursive(SA)
      - MPI_Send(SA, SASize)



HEADER.H
int sort_recursive(A, arraySize, currentProcessRank, maxRank, rankIndex):
   - sharedProcess = currentProcessRank +2^(rankIndex); rankIndex++
   - if (sharedProcess > maxRank): sort chunk sequentially
   - do:
      - pivotIndex = partition(A, j, arraySize - 1); j++
   - while (pivotIndex = j - 1)

   - if(pivotIndex <= arraySize - pivotIndex)
      - MPI_Send(A, pivotIndex - 1)
      - sort_recursive((A + pivotIndex + 1), (arraySize - pivotIndex - 1), currentRank,
                                                maxRank, rankIndex)
      - MPI_Recv((A+ pivotIndex + 1), (arraySize - pivotIndex - 1))


void quicksort(A, low, high):
   - if (low < high):
      - p = partition(A, low, high);
      - quicksort(A, low, p)
      - quicksort(A, p + 1, high)


int partition(A, low, high):
   - pivot = A[low]; i = low - 1; j = high + 1
   - while(true):
      - do: i = i + 1; while(A[i] < pivot)
      - do: j = j - 1; while(A[j] > pivot)
      - if ( i >= j): return j
   - temp = A[i]; A[i] = A[j]; A[j] = temp
```

Execution Snapshots:

5 Processes

```
Terminal - student@tuffix-vm: ~/Documents/git_ex
File  Edit  View  Terminal  Tabs  Help
student@tuffix-vm:~/Documents/git_ex$ mpirun -np 5 -oversubscribe ./a.out
Before Sorting:
Index: 0=189
Index: 1000=952
Index: 2000=227
Index: 3000=89
Index: 4000=280
Index: 5000=288
Index: 6000=605
Index: 7000=117
Index: 8000=394
Index: 9000=917
Index: 10000=43
Index: 11000=859
Index: 12000=17
Index: 13000=992
Index: 14000=856
Index: 15000=203
Index: 16000=18
Index: 17000=248
Index: 18000=278
Index: 19000=201
Index: 20000=449
Index: 21000=293
Index: 22000=798
Index: 23000=304
Index: 24000=792
After Sorting:
Index:0=0
Index:1000=41
Index:2000=81
Index:3000=122
Index:4000=160
Index:5000=199
Index:6000=238
Index:7000=279
Index:8000=317
Index:9000=355
Index:10000=397
Index:11000=435
Index:12000=475
Index:13000=516
Index:14000=556
Index:15000=598
Index:16000=638
Index:17000=679
Index:18000=717
Index:19000=761
Index:20000=802
Index:21000=841
Index:22000=879
Index:23000=918
Index:24000=960
Execution time:0.0432882
student@tuffix-vm:~/Documents/git_ex$
```

20 Processes:

```
Terminal - student@tuffix-vm: ~/Documents/git_ex
File  Edit  View  Terminal  Tabs  Help
student@tuffix-vm:~/Documents/git_ex$ mpirun -np 20 -oversubscribe ./a.out
Before Sorting:
0=363
1000=988
2000=419
3000=732
4000=985
5000=551
6000=707
7000=331
8000=607
9000=641
10000=109
11000=664
12000=329
13000=397
14000=426
15000=863
16000=699
17000=602
18000=623
19000=372
20000=456
21000=972
22000=273
23000=916
24000=870
After Sorting:
0=0
1000=41
2000=82
3000=121
4000=160
5000=200
6000=242
7000=281
8000=322
9000=361
10000=400
11000=438
12000=479
13000=520
14000=559
15000=600
16000=640
17000=680
18000=720
19000=760
20000=798
21000=839
22000=880
23000=920
24000=962
Execution time:0.0871126
student@tuffix-vm:~/Documents/git_ex$
```

Sequential

```
Terminal - student@tuffix-vm: ~/Documents
File  Edit  View  Terminal  Tabs  Help
Before Sorting:
Index: 0=468
Index: 1000=891
Index: 2000=905
Index: 3000=112
Index: 4000=941
Index: 5000=324
Index: 6000=435
Index: 7000=165
Index: 8000=591
Index: 9000=577
Index: 10000=347
Index: 11000=902
Index: 12000=547
Index: 13000=652
Index: 14000=404
Index: 15000=871
Index: 16000=224
Index: 17000=727
Index: 18000=923
Index: 19000=444
Index: 20000=325
Index: 21000=592
Index: 22000=152
Index: 23000=961
Index: 24000=214
After Sorting:
Index:0=0
Index:1000=39
Index:2000=79
Index:3000=118
Index:4000=156
Index:5000=197
Index:6000=239
Index:7000=278
Index:8000=318
Index:9000=358
Index:10000=400
Index:11000=438
Index:12000=477
Index:13000=516
Index:14000=558
Index:15000=600
Index:16000=641
Index:17000=681
Index:18000=721
Index:19000=758
Index:20000=797
Index:21000=839
Index:22000=880
Index:23000=919
Index:24000=959
Time measured: 0.011 seconds.
student@tuffix-vm:~/Documents$
```