Operating Systems

Assignment 3

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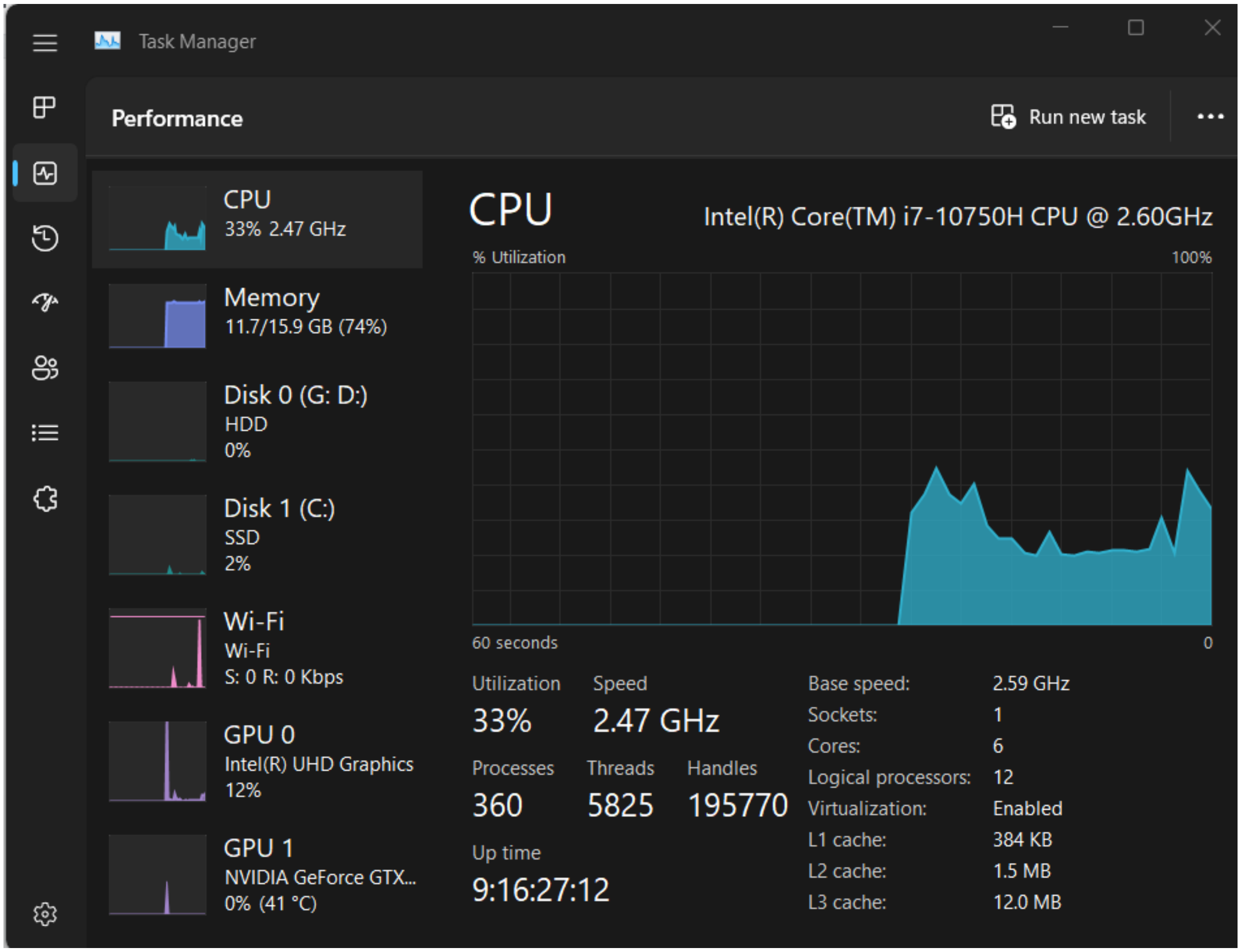
CS-01-A

Check processor cores of system. For n cores create n threads & divide array among these threads, sort them using merge sort. Take the size of array as input.
Submit:

1. multi threaded mergesort cpp file
2. Screenshot of available cores
3. Screenshot of MAC addresses of system
4. Reference link of merge sort code
5. Git hub link

Number of Cores



CPU
33% 2.47 GHz

Memory
11.7/15.9 GB (74%)

Disk 0 (G: D:)
HDD
0%

Disk 1 (C:)
SSD
2%

Wi-Fi
Wi-Fi
S: 0 R: 0 Kbps

GPU 0
Intel(R) UHD Graphics
12%

GPU 1
NVIDIA GeForce GTX...
0% (41 °C)

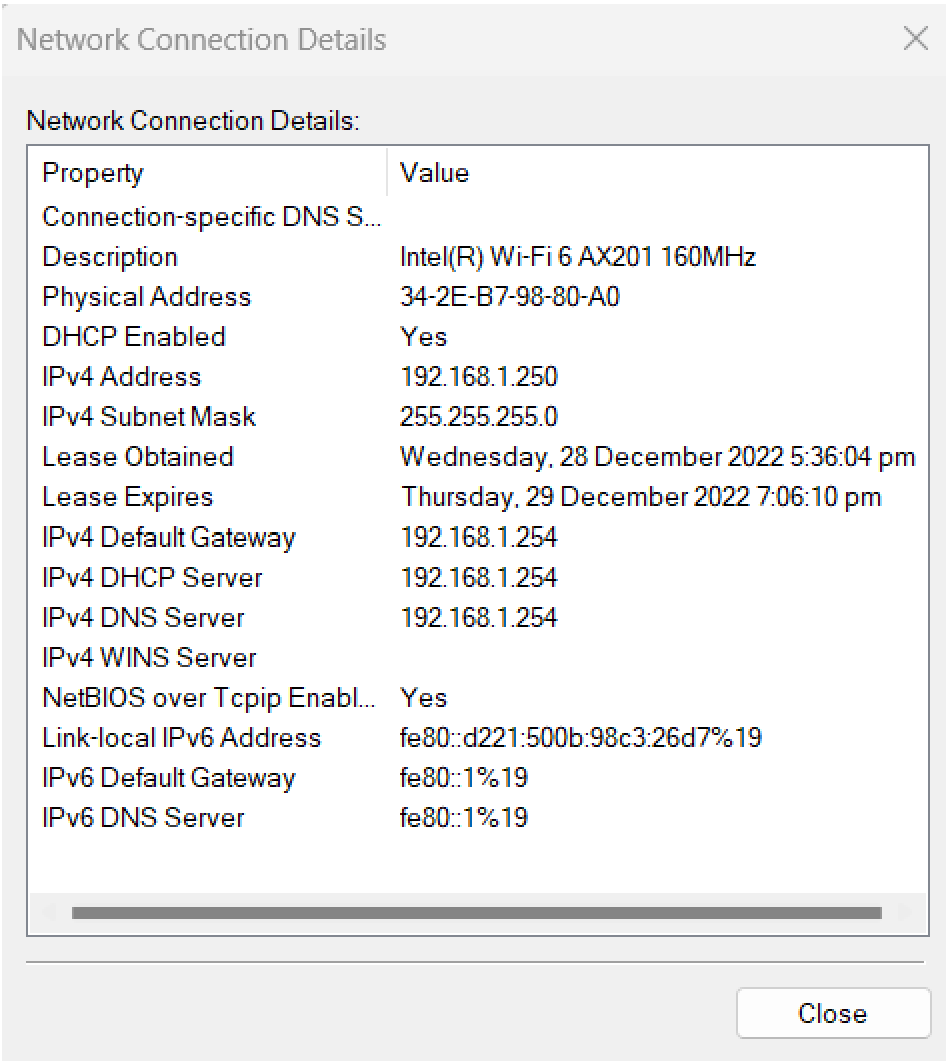
CPU Intel(R) Core(TM) i7-10750H CPU @ 2.60GHz

Utilization 33%
Speed 2.47 GHz
Processes 360
Threads 5825
Handles 195770
Up time 9:16:27:12

Base speed:	2.59 GHz
Sockets:	1
Cores:	6
Logical processors:	12
Virtualization:	Enabled
L1 cache:	384 KB
L2 cache:	1.5 MB
L3 cache:	12.0 MB

Using 6 Cores as shown above.

MAC Address



Network Connection Details:

Property	Value
Connection-specific DNS S...	
Description	Intel(R) Wi-Fi 6 AX201 160MHz
Physical Address	34-2E-B7-98-80-A0
DHCP Enabled	Yes
IPv4 Address	192.168.1.250
IPv4 Subnet Mask	255.255.255.0
Lease Obtained	Wednesday, 28 December 2022 5:36:04 pm
Lease Expires	Thursday, 29 December 2022 7:06:10 pm
IPv4 Default Gateway	192.168.1.254
IPv4 DHCP Server	192.168.1.254
IPv4 DNS Server	192.168.1.254
IPv4 WINS Server	
NetBIOS over Tcpip Enabl...	Yes
Link-local IPv6 Address	fe80::d221:500b:98c3:26d7%19
IPv6 Default Gateway	fe80::1%19
IPv6 DNS Server	fe80::1%19

Physical Address: 34-2E-B7-98-80-A0

References:

- Reference of Merge Sort and Merge functions: https://www.programiz.com/dsa/merge-sort
- Git Hub Link: https://github.com/farwaa-sr/farwaa-sr/tree/main

```
#include <iostream>
#include <thread>
#include <vector>
#include <pthread.h>
```

```
using namespace std;

//                              MERGE  SORTING
// merge two subarrays L and M into arr
void merge(int* arr, int start, int limit, int end)
{
// sizes of the two subarrays to be merged
// create L <- A[start...limit] & M <- A[limit+1...end]
int size1 = limit - start + 1;
int size2 = end  - limit;

// create temp arrays
int* left = new int[size1];
int* right = new int[size2];

// copy data to temp arrays
for (int i = 0; i < size1; i++)
        left[i] = arr[start + i];
for (int i = 0; i < size2; i++)
        right[i] = arr[limit + 1 + i];

// merge the temp arrays back into arr[l..end]
//Maintain current index of sub-arrays and main array
int i, j, k;
i = 0;
j = 0;
k = start;
//until we reach either end of left or right, pick larger and place correct position at A[start...limit]
while (i < size1 && j < size2)
{
        if (left[i] <= right[j])
        {
        arr[k] = left[i];
        i++;
        }
        else
```

```
    {
    arr[k] = right[j];
    j++;
    }
    k++;
}

// copy remaining elements of left[], if any and put in A[start…end]
while (i < size1)
{
    arr[k] = left[i];
    i++;
    k++;
}

// copy remaining elements of right[], if any
while (j < size2)
{
    arr[k] = right[j];
    j++;
    k++;
}
}
// Merge sort
void mergeSort(int* array, int start, int end)
{
 if (start < end)
  //limit is the point where the array is divided into two subarrays
  {
    // find the middle point
    int limit = start + (end - start) / 2;
    // sort the two halves
    mergeSort(array, start, limit);
    mergeSort(array, limit + 1, end);
    // merge the sorted subarrays
    merge(array, start, limit, end);
 }
}
//                              MULTITHREADING
// divides the array into six equal parts & merge sort
void multithreaded(int* array, int total_size)
{
 // to get the size of every part that is used
 int partSize = total_size / 6;
 //six threads created
 thread t1(mergeSort, array, 0, partSize - 1);
 thread t2(mergeSort, array, partSize, 2 * partSize - 1);
 thread t3(mergeSort, array, 2 * partSize, 3 * partSize - 1);
 thread t4(mergeSort, array, 3* partSize, 4 * partSize - 1);
 thread t5(mergeSort, array, 4* partSize, 5 * partSize - 1);
 thread t6(mergeSort, array, 5 * partSize, total_size - 1);

 // waiting time for completion of threads:
 t1.join();
 t2.join();
 t3.join();
 t4.join();
 t5.join();
 t6.join();
// displaying sorted array
cout << "Sorted array: ";
for (int i = 0; i < total_size; i++)
cout << array[i] << " ";

}

//                              MAIN
int main()
{
 // take array size as input from user
 int sizeArray;
 cout << "Enter size of array here:  ";
 cin >> sizeArray;
 int* array = new int;
 for (int i=0;i<sizeArray; i++){
  cout<<" for "<<i<<" enter: ";
  cin>>array[i];
 }
multithreaded(array, sizeArray);

 return 0;
}
```