

Operating Systems

Assignment 3

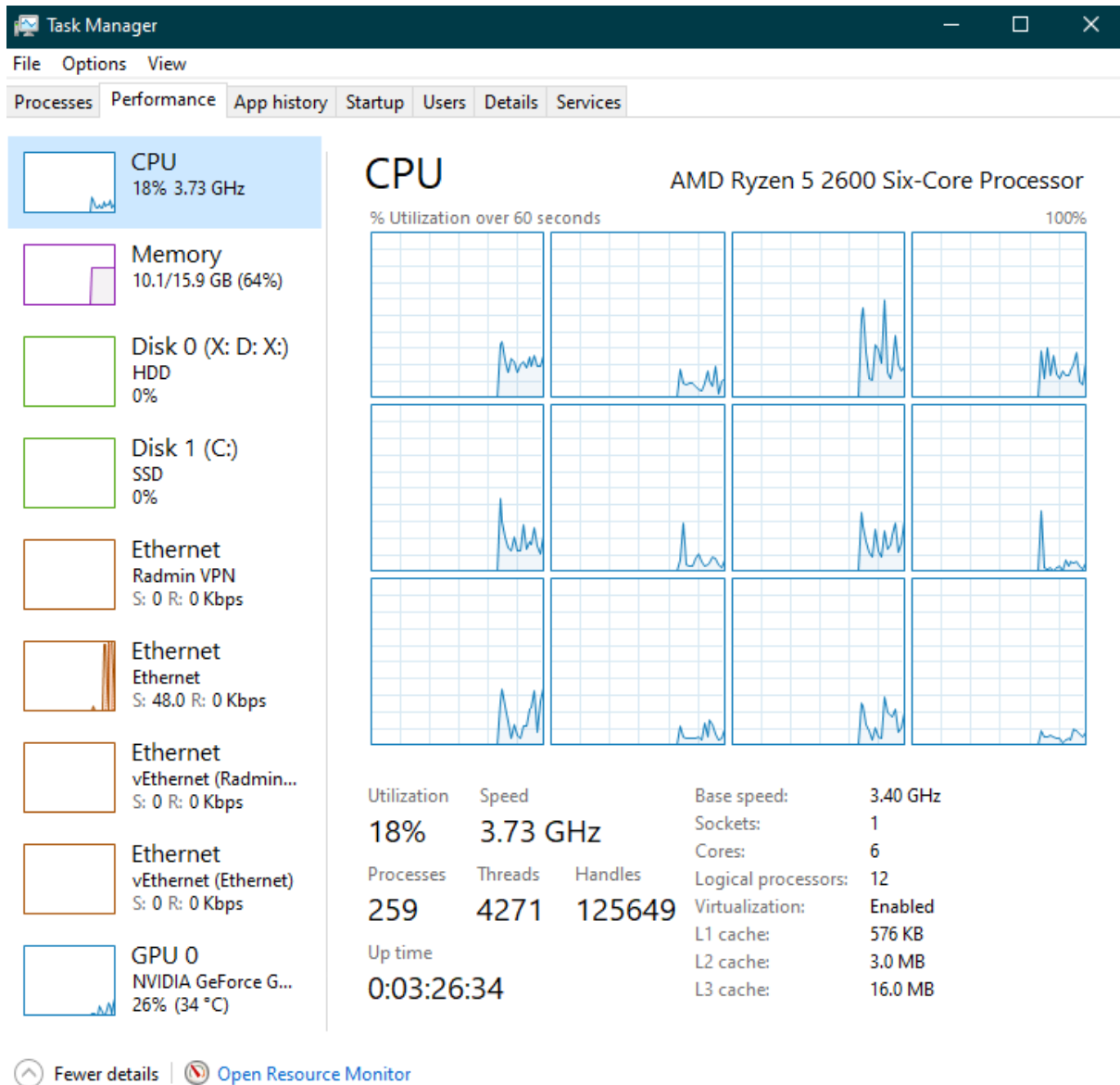


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Merge Sort using Threads

CPU Cores and Threads:

Our processor has 6 cores, and each core is capable of running 2 threads at one time.



Total Threads are 12, we will be utilizing them for our merge sort algorithm.

Merge Sort Code:

```
#include <iostream>
#include <thread>
#include <cstdlib>
#include <conio.h>
```

```

using namespace std;

// merge sort function taken from programiz
https://www.programiz.com/dsa/merge-sort
void merge(int arr[], int left, int middle, int right)
{
    int l, m, r;    //indexes that we use to denote left right and center
    int n1 = middle - left + 1; //name of sub arrays we use for combining
    int n2 = right - middle;

    int* L = new int[n1];
    int* R = new int[n2];    //declaring the sub arrays

    for (l = 0; l < n1; l++)    //copying values of the array from sub
array to the combined array
        L[l] = arr[left + l];
    for (m = 0; m < n2; m++)
        R[m] = arr[middle + 1 + m];

    l = 0;
    m = 0;
    r = left;
    while (l < n1 && m < n2){    //logic to decide whether to combine
the index with left array or right array
        if (L[l] <= R[m]){
            arr[r] = L[l];
            l++;
        }
        else{
            arr[r] = R[m];
            m++;
        }
        r++;
    }

    while (l < n1){
        arr[r] = L[l];
        l++;
        r++;
    }

    while (m < n2){
        arr[r] = R[m];
        m++;
        r++;
    }
}

void mergeSort(int arr[], int left, int right){
    if (left < right){
        int middle = left + (right - left) / 2;

        //assign arrays to separate threads

```

```

        thread leftSorter(mergeSort, arr, left, middle);
        thread rightSorter(mergeSort, arr, middle + 1, right);

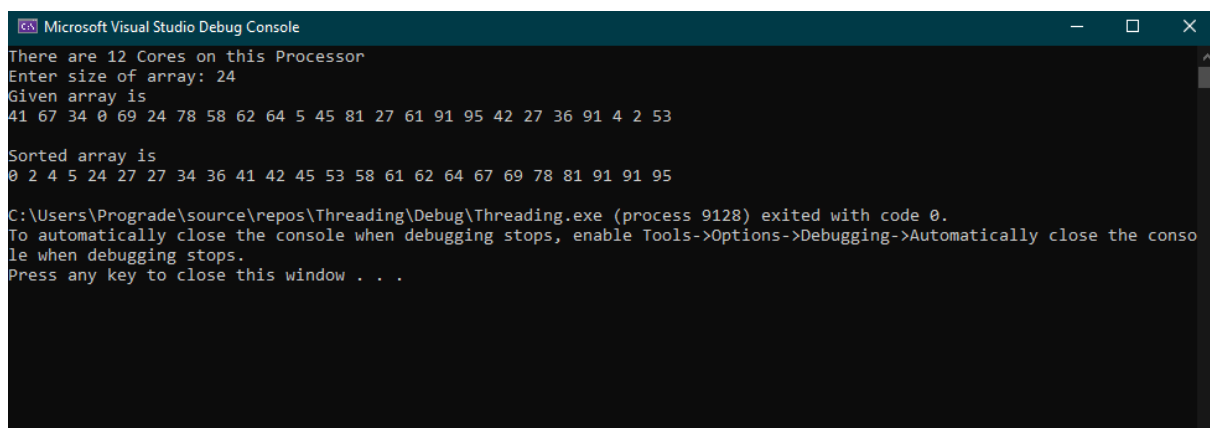
        //merge outputs after join
        leftSorter.join();
        rightSorter.join();
        merge(arr, left, middle, right);
    }
}

int main(){
    int* array1;
    int arr_size;
    cout << "There are 12 Cores on this Processor\n";
    cout << "Enter size of array: ";
    cin >> arr_size;
    array1 = new int[arr_size];
    int element;
    for (int i = 0; i < arr_size; i++){
        cout << "Enter element " << i + 1 << " : "; cin >> element;
        array1[i] = element;
    }
    cout << "Given array is \n";
    for (int i = 0; i < arr_size; i++)
        cout << array1[i] << " ";
    cout << endl;

    mergeSort(array1, 0, arr_size - 1);

    cout << "\nSorted array is \n";
    for (int i = 0; i < arr_size; i++)
        cout << array1[i] << " ";
    cout << endl;
    return 0;
}

```



```

Microsoft Visual Studio Debug Console
There are 12 Cores on this Processor
Enter size of array: 24
Given array is
41 67 34 0 69 24 78 58 62 64 5 45 81 27 61 91 95 42 27 36 91 4 2 53

Sorted array is
0 2 4 5 24 27 27 34 36 41 42 45 53 58 61 62 64 67 69 78 81 91 91 95

C:\Users\Prograde\source\repos\Threading\Debug\Threading.exe (process 9128) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .

```

MAC Address for this System:

The screenshot displays two Windows windows. The left window is a Command Prompt showing the output of the 'ipconfig' command. It lists network adapters: Radmin VPN, Local Area Connection 2, Ethernet, and vEthernet (Radmin VPN) and vEthernet (Ethernet). The right window is the 'Ethernet Status' window, showing connection details for the Ethernet adapter, including IPv4 and IPv6 connectivity, media state, and activity. Below the Ethernet Status window is the 'Network Connection Details' window, which provides a detailed list of network properties and their values.

Command Prompt Output:

```
Microsoft Windows [Version 10.0.19041.1]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\Prograde>ipconfig

Windows IP Configuration

Ethernet adapter Radmin VPN:

    Connection-specific DNS Suffix  . : 
    IPv6 Address. . . . . : fdfd::1a23:98f5
    Link-local IPv6 Address . . . . . : fe80::84dc:f692:ddff:5cd3%9
    IPv4 Address. . . . . : 26.35.152.245
    Subnet Mask . . . . . : 255.0.0.0
    Default Gateway . . . . . : 26.0.0.1

Unknown adapter Local Area Connection 2:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

Ethernet adapter Ethernet:

    Connection-specific DNS Suffix  . : 
    IPv6 Address. . . . . : 2407:d000:f:652a:c5f5:d7d5:aea7:86a0
    Temporary IPv6 Address. . . . . : 2407:d000:f:652a:15bf:7f91:8fce:32c
    Link-local IPv6 Address . . . . . : fe80::c5f5:d7d5:aea7:86a0%8
    IPv4 Address. . . . . : 192.168.18.12
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : fe80::1%8
    . . . . . : 192.168.18.1

Unknown adapter Local Area Connection:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

Ethernet adapter vEthernet (Radmin VPN):

    Connection-specific DNS Suffix  . : 
    Link-local IPv6 Address . . . . . : fe80::6820:1633:806d:90cd%35
    IPv4 Address. . . . . : 172.30.208.1
    Subnet Mask . . . . . : 255.255.240.0
    Default Gateway . . . . . : 

Ethernet adapter vEthernet (Ethernet):

    Connection-specific DNS Suffix  . : 
    Link-local IPv6 Address . . . . . : fe80::1d2c:d954:87f8:b4b3%39
    IPv4 Address. . . . . : 172.29.160.1
    Subnet Mask . . . . . : 255.255.240.0
```

Ethernet Status Window:

General

Connection

IPv4 Connectivity: Internet

IPv6 Connectivity: Internet

Media State: Enabled

Duration: 03:34:17

Speed: 1.0 Gbps

Details...

Activity

Sent — Received

Bytes: 42,716,696 | 328,891,756

Properties Disable Diagnose

Network Connection Details Window:

Property	Value
Connection-specific DN...	
Description	Realtek PCIe GbE Family Controller
Physical Address	A8-A1-59-47-D3-02
DHCP Enabled	Yes
IPv4 Address	192.168.18.12
IPv4 Subnet Mask	255.255.255.0
Lease Obtained	Wednesday, 28 December 2022 7:18
Lease Expires	Wednesday, 28 December 2022 11:4
IPv4 Default Gateway	192.168.18.1
IPv4 DHCP Server	192.168.18.1
IPv4 DNS Server	192.168.18.1
IPv4 WINS Server	
NetBIOS over Tcpip En...	Yes
IPv6 Address	2407:d000:f:652a:c5f5:d7d5:aea7:86
Temporary IPv6 Address	2407:d000:f:652a:15bf:7f91:8fce:32c
Link-local IPv6 Address	fe80::c5f5:d7d5:aea7:86a0%8

Github Profile Link:

<https://github.com/ProgradeX>

Task Link: