**DAA Assignment**

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Implement Merge Sort (The program should report the number of comparisons)

test run the algorithm on 100 different inputs of sizes varying from 30 to 1000. Count the number of comparisons and draw the graph. Compare it with a graph of nlogn.

Code:

#include<iostream>

#include<fstream>

#include<vector>

using namespace std;

vector<int> merge(vector<int> &array1,vector<int> &array2,int\* &count){

int lengthOfArray1=array1.size();

int lengthOfArray2=array2.size();

vector<int> res(

lengthOfArray1

+

lengthOfArray2

);

int leftPointer = 0;

int rightPointer = 0;

int resPointer = 0;

while ( leftPointer<lengthOfArray1 &&

rightPointer<lengthOfArray2

){

if (array1[leftPointer]<array2[rightPointer]){

res[resPointer] = array1[leftPointer];

resPointer+=1;

leftPointer+=1;

\*count+=1;

}

else{

res[resPointer] = array2[rightPointer];

resPointer+=1;

rightPointer+=1;

\*count+=1;

}

}

while(leftPointer<lengthOfArray1){

res[resPointer] = array1[leftPointer];

resPointer+=1;

leftPointer+=1;

\*count+=1;

}

while(rightPointer<lengthOfArray2){

res[resPointer] = array2[rightPointer];

resPointer+=1;

rightPointer+=1;

\*count+=1;

}

return res;

}

//1 1 2 1 3

vector<int> mergeSort(vector<int> &array,int start,int end,int \* &count){

if (end-start==0){

vector<int> r;

r.push\_back(array[start]);

return r;

}

int mid = (start+end)/2;

vector<int> left = mergeSort(array,start,mid,count);

vector<int> right= mergeSort(array,mid+1,end,count);

return merge(left,right,count);

}

int main(int argc, char const \*argv[]){

ofstream MyFile("Coordinates.txt");

int \* count = new int(0);

cout<<"Size of Array,No. of Comparisons\n";

for(int x=0; x<100; ++x)

{

\*count = 0;

int n = rand() % 971 + 30;

vector<int> vArray;

for(int i=0; i<n; ++i)

{

vArray.push\_back(rand());

}

vector<int> res = mergeSort(vArray,0,n-1,count);

MyFile <<n<<","<<\*count<<"\n";

cout<<n<<","<<\*count<<endl;

}

MyFile.close();

return 0;

}

Output:

Size of Array,No. of Comparisons

330,2788

103,696

589,5455

64,384

920,9096

53,307

653,6159

533,4839

933,9239

288,2368

837,8183

976,9712

243,1931

426,3748

243,1931

143,1031

353,3018

828,8084

58,342

482,4308

617,5763

267,2158

812,7908

127,888

358,3068

679,6445

932,9228

836,8172

312,2608

737,7083

62,370

790,7666

165,1229

881,8667

593,5499

101,680

544,4960

863,8469

836,8172

428,3768

982,9778

534,4850

510,4588

34,174

633,5939

549,5015

792,7688

443,3918

854,8370

980,9756

512,4608

793,7699

157,1157

349,2978

413,3618

686,6522

415,3638

619,5785

923,9129

177,1337

337,2858

649,6115

795,7721

292,2408

277,2258

364,3128

560,5136

569,5235

419,3678

594,5510

615,5741

252,2012

469,4178

431,3798

738,7094

895,8821

546,4982

253,2021

850,8326

330,2788

693,6599

512,4608

920,9096

545,4971

92,608

703,6709

884,8700

957,9503

214,1670

551,5037

573,5279

544,4960

852,8348

971,9657

324,2728

878,8634

118,816

130,914

410,3588

248,1976

Plotting Graph with python:

from pylab import rcParams

import matplotlib.pyplot as plt

import math

file = open("/Users/mac/Documents/Coordinates.txt","r")

data = file.read().split("\n")

array1 = []

array2 = []

for i in data:

v = i.split(",")

value1 = int(v[0])

value2 = int(v[1])

array1.append(value1)

array2.append(value2)

for i in range(len(array1)+1):

for j in range(len(array1)-i-1):

if array1[j]>array1[j+1]:

array1[j],array1[j+1]=array1[j+1],array1[j]

array2[j],array2[j+1]=array2[j+1],array2[j]

a3=[0]\*100

for i in range(100):

a3[i]=array1[i]\*math.log(array1[i],2)

plt.title('Merge Sort')

plt.xlabel('No. of elements')

plt.ylabel('No. of comparisons')

plt.plot(array1,array2,label="My graph")

plt.plot(array1,a3,label="nlogn")

plt.legend(loc='upper left')

plt.show()

Graph and Merge Sort

