Performance Plan

I intend to use the following tests to analyze the performance of the various sorts implemented:

1. Pre-sorted List of size 10
2. Reverse-sorted List of size 10
3. Pre-sorted list of size 10 with the first value at the end
4. Random list of size 50
5. Random list of size 100
6. Random list of size 250
7. Random list of size 500
8. Random list of size 1,000

/\*

//Bruce Conrad

//This is the Client Program for analyzing the various sorting algorithms

//CSCI 385 TR Class

//Hillman

\*/

#include <iostream>

#include <fstream>

#include <string>

#include <algorithm>

#include <cmath>

using namespace std;

void RandomizeNumbers(int\* ary, int listSize);

//Narrative: Randomizes numbers for the arrays to use for the sorts

//Pre-condition: user input indicates this function will be run, all list sizes

//are the same when this function is called

//Post-condition: numbers have been randomized for use in the arrays

void RunSelectionSort(int\* ary, int listSize, int& comparisons, int& swaps);

//Narrative: Runs the selection sort on the selection array

//Pre-condition: selection array has been populated with values

//Post-condition: selection sort has been performed on selection array

void RunHeapSort(int\* ary, int listSize, int& comparisons, int& swaps);

//Narrative: Runs the heap sort on the heap array

//Pre-condition: heap array has been populated with values

//Post-condition: heap sort has been performed on the heap array

void RunQuickSort(int\* ary, int listSize, int low, int high,

int& comparisons, int& swaps);

//Narrative: Runs the quick sort on the quick array

//Pre-condition: quick array has been populated with values

//Post-condition: quick sort has been performed on the quick array

void RunAlgorithmSort(int\* ary, int listSize);

//Narrative: Runs the built-in C++ sort for comparison

//Pre-condition: All other sorts have been run

//Post-condition: The built-in C++ sort has been run for comparison

void PopulateArrays(int\* ary1, int listSize1, int\* ary2, int listSize2,

int\* ary3, int listSize3, int\* ary4, int listSize4,

ifstream& inFile);

//Narrative: reads in data from a file and populates all arrays with this data

//Pre-condition: RandomizeNumbers not called, all list sizes are the same when

//this function is called

//Post-condition: all arrays have been populated with values

void Swap(int\* ary, int listSize, int index1, int index2);

//Narrative: swaps two numbers in terms of their index within that array

//Pre-condition: Selection Sort is being performed, indices are valid

//within the array

//Post-condition: two numbers have been swapped within the array passed in

void HeapifyDown(int\* ary, int listSize, int index, int& comparisons, int& swaps);

//Narrative: Readjusts the heap array properly to maintain heap property

//Pre-condition: Heap Sort is being performed

//Post-condition: Heap is properly sorted as a max heap, heap property

//is maintained

int Partition(int\* ary, int listSize, int low, int high, int& comparisons, int& swaps);

//Narrative: Partitions the list into subsections

//Pre-condition: Quick Sort is being performed

//Post-condition: Partition has been created

void PrintArraysDawg(int\* ary, int listSize);

//Narrative: Prints the arrays in the current order

//Pre-condition: none

//Post-condition: Array has been printed in the current order

int main()

{

int\* selectionArray = NULL;

int\* heapArray = NULL;

int\* quickArray = NULL;

int\* compArray = NULL;

int selectionComp = 0;

int heapComp = 0;

int quickComp = 0;

int selectionSwap = 0;

int heapSwap = 0;

int quickSwap = 0;

ifstream inputFile;

string fileName;

int listSize1;

int listSize2;

int listSize3;

int listSize4;

int commonListSize;

char response;

string inputFileNumString;

int inputFileNumInt;

int i = 0;

int low;

int high;

cout << "Enter the common list size: ";

cin >> commonListSize;

listSize1 = commonListSize;

listSize2 = commonListSize;

listSize3 = commonListSize;

listSize4 = commonListSize;

selectionArray = new int [listSize1];

heapArray = new int [listSize2];

quickArray = new int [listSize3];

compArray = new int [listSize4];

low = 0;

high = listSize3 - 1;

cout << "Would you like to randomize the numbers to sort? (Y or N)";

cin >> response;

if(response == 'Y')

{

RandomizeNumbers(selectionArray, listSize1);

RandomizeNumbers(heapArray, listSize2);

RandomizeNumbers(quickArray, listSize3);

RandomizeNumbers(compArray, listSize4);

}

else

{

cout << "Enter the input file name: ";

cin >> fileName;

inputFile.open(fileName.c\_str());

PopulateArrays(selectionArray, listSize1, heapArray, listSize2,

quickArray, listSize3, compArray, listSize4, inputFile);

}

PrintArraysDawg(selectionArray, listSize1);

PrintArraysDawg(heapArray, listSize2);

PrintArraysDawg(quickArray, listSize3);

PrintArraysDawg(compArray, listSize4);

cout << "Running the Selection Sort!" << endl;

RunSelectionSort(selectionArray, listSize1, selectionComp, selectionSwap);

cout << "Running the Heap Sort!" << endl;

RunHeapSort(heapArray, listSize2, heapComp, heapSwap);

cout << "Running the Quick Sort!" << endl;

RunQuickSort(quickArray, listSize3, low, high, quickComp, quickSwap);

cout << "Running the Built-in Sort" << endl;

RunAlgorithmSort(compArray, listSize4);

inputFile.close();

cout << "Printing Sorted Selection Array and Stats!" << endl;

PrintArraysDawg(selectionArray, listSize1);

cout << "Comparisons: " << selectionComp << endl;

cout << "Swaps: " << selectionSwap << endl;

cout << "Printing Sorted Heap Array and Stats!" << endl;

PrintArraysDawg(heapArray, listSize2);

cout << "Comparisons: " << heapComp << endl;

cout << "Swaps: " << heapSwap << endl;

cout << "Printing Sorted Quick Array and Stats!" << endl;

PrintArraysDawg(quickArray, listSize3);

cout << "Comparisons: " << quickComp << endl;

cout << "Swaps: " << quickSwap << endl;

cout << "Printing Sorted Comp Array!" << endl;

PrintArraysDawg(compArray, listSize4);

delete[] selectionArray;

selectionArray = NULL;

delete[] heapArray;

heapArray = NULL;

delete[] quickArray;

quickArray = NULL;

delete[] compArray;

compArray = NULL;

return 0;

}

void RandomizeNumbers(int\* ary, int listSize)

{

int randomNumber;

srand(time(NULL));

for(int i = 0; i < listSize; i++)

{

randomNumber = rand()%listSize + 1;

ary[i] = randomNumber;

}

}

void RunSelectionSort(int\* ary, int listSize, int& comparisons, int& swaps)

{

int minIndex;

for(int i = 0; i <= listSize - 2; i++)

{

minIndex = i;

for(int j = i + 1; j <= listSize - 1; j++)

{

comparisons++;

if(ary[j] < ary[minIndex])

{

minIndex = j;

}

}

if(minIndex != i)

{

Swap(ary, listSize, i, minIndex);

swaps++;

}

}

}

void RunHeapSort(int\* ary, int listSize, int& comparisons, int& swaps)

{

for(int i = listSize/2 - 1; i >= 0; i--)

{

HeapifyDown(ary,listSize, i, comparisons, swaps);

}

for(int i = listSize -1; i >= 0; i--)

{

Swap(ary, listSize, 0, i);

swaps++;

HeapifyDown(ary, i, 0, comparisons, swaps);

}

}

void RunQuickSort(int\* ary, int listSize, int low, int high,

int& comparisons, int& swaps)

{

int partitionIndex;

if(low < high)

{

comparisons++;

partitionIndex = Partition(ary, listSize, low, high, comparisons, swaps);

RunQuickSort(ary, listSize, low, partitionIndex-1, comparisons, swaps);

RunQuickSort(ary, listSize, partitionIndex+1, high, comparisons, swaps);

}

}

void RunAlgorithmSort(int\* ary, int listSize)

{

sort(ary, ary + listSize);

}

void PopulateArrays(int\* ary1, int listSize1, int\* ary2, int listSize2,

int\* ary3, int listSize3, int\* ary4, int listSize4, ifstream& inFile)

{

string numFromFileString;

int numFromFileInt;

int i = 0;

getline(inFile, numFromFileString);

while(!inFile.eof())

{

numFromFileInt = stoi(numFromFileString, nullptr);

ary1[i] = numFromFileInt;

ary2[i] = numFromFileInt;

ary3[i] = numFromFileInt;

ary4[i] = numFromFileInt;

i++;

getline(inFile, numFromFileString);

}

}

void Swap(int\* ary, int listSize, int index1, int index2)

{

int temp = ary[index2];

ary[index2] = ary[index1];

ary[index1] = temp;

}

void HeapifyDown(int\* ary, int listSize, int index, int& comparisons, int& swaps)

{

int largestValue = index;

int leftChild = 2\*index + 1;

int rightChild = 2\*index + 2;

comparisons++;

if(leftChild < listSize && ary[leftChild] > ary[largestValue])

{

largestValue = leftChild;

}

comparisons++;

if(rightChild < listSize && ary[rightChild] > ary[largestValue])

{

largestValue = rightChild;

}

comparisons++;

if(largestValue != index)

{

Swap(ary, listSize, index, largestValue);

swaps++;

HeapifyDown(ary, listSize, largestValue, comparisons, swaps);

}

}

int Partition(int\* ary, int listSize, int low, int high, int& comparisons, int& swaps)

{

int pivot = ary[low];

do

{

while(low < high && ary[high] >= pivot)

{

high = high - 1;

comparisons++;

}

if(low < high)

{

ary[low] = ary[high];

swaps++;

while(low < high && ary[low] <= pivot)

{

low = low + 1;

comparisons++;

}

if(low < high)

{

ary[high] = ary[low];

swaps++;

}

}

}

while(low < high);

if(pivot != ary[low])

{

ary[low] = pivot;

swaps++;

}

return(low);

}

void PrintArraysDawg(int\* ary, int listSize)

{

for(int i = 0; i < listSize; i++)

{

cout << ary[i] << ", ";

}

cout << endl;

}

Program Output

**(Verified sorting algorithms work properly on smaller lists; included all scripts I ran for clarity)**

Script started on 2019-11-14 16:42:11-0500

]777;notify;Command completed;exit]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:42] s789220c@cslab177:~/CSCI385/Prog5 $ c++ Client.cpp -o Client

]777;notify;Command completed;c++ Client.cpp -o Client]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:42] s789220c@cslab177:~/CSCI385/Prog5 $ ./Client

Enter the common list size: 10

Would you like to randomize the numbers to sort? (Y or N)N

Enter the input file name: tester.dat

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

Running the Selection Sort!

Running the Heap Sort!

Running the Quick Sort!

Running the Built-in Sort

Printing Sorted Selection Array and Stats!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

Comparisons: 45

Swaps: 0

Printing Sorted Heap Array and Stats!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

Comparisons: 108

Swaps: 31

Printing Sorted Quick Array and Stats!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

Comparisons: 54

Swaps: 0

Printing Sorted Comp Array!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

]777;notify;Command completed;./Client]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:42] s789220c@cslab177:~/CSCI385/Prog5 $ exit

exit

Script done on 2019-11-14 16:42:38-0500

Script started on 2019-11-14 16:45:02-0500

]777;notify;Command completed;exit]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:45] s789220c@cslab177:~/CSCI385/Prog5 $ ./Client

Enter the common list size: 10

Would you like to randomize the numbers to sort? (Y or N)N

Enter the input file name: tester2.dat

10, 9, 8, 7, 6, 5, 4, 3, 2, 1,

10, 9, 8, 7, 6, 5, 4, 3, 2, 1,

10, 9, 8, 7, 6, 5, 4, 3, 2, 1,

10, 9, 8, 7, 6, 5, 4, 3, 2, 1,

Running the Selection Sort!

Running the Heap Sort!

Running the Quick Sort!

Running the Built-in Sort

Printing Sorted Selection Array and Stats!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

Comparisons: 45

Swaps: 5

Printing Sorted Heap Array and Stats!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

Comparisons: 81

Swaps: 22

Printing Sorted Quick Array and Stats!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

Comparisons: 54

Swaps: 10

Printing Sorted Comp Array!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

]777;notify;Command completed;./Client]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:45] s789220c@cslab177:~/CSCI385/Prog5 $ exit

exit

Script done on 2019-11-14 16:45:20-0500

Script started on 2019-11-14 16:45:34-0500

]777;notify;Command completed;exit]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:45] s789220c@cslab177:~/CSCI385/Prog5 $ ./Client

Enter the common list size: 10

Would you like to randomize the numbers to sort? (Y or N)N

Enter the input file name: tester3.dat

2, 3, 4, 5, 6, 7, 8, 9, 10, 1,

2, 3, 4, 5, 6, 7, 8, 9, 10, 1,

2, 3, 4, 5, 6, 7, 8, 9, 10, 1,

2, 3, 4, 5, 6, 7, 8, 9, 10, 1,

Running the Selection Sort!

Running the Heap Sort!

Running the Quick Sort!

Running the Built-in Sort

Printing Sorted Selection Array and Stats!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

Comparisons: 45

Swaps: 9

Printing Sorted Heap Array and Stats!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

Comparisons: 105

Swaps: 30

Printing Sorted Quick Array and Stats!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

Comparisons: 30

Swaps: 14

Printing Sorted Comp Array!

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

]777;notify;Command completed;./Client]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:45] s789220c@cslab177:~/CSCI385/Prog5 $ exit

exit

Script done on 2019-11-14 16:45:50-0500

Script started on 2019-11-14 16:46:35-0500

]777;notify;Command completed;exit]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:46] s789220c@cslab177:~/CSCI385/Prog5 $ ./Client

Enter the common list size: 50

Would you like to randomize the numbers to sort? (Y or N)Y

28, 6, 6, 29, 38, 35, 16, 2, 28, 1, 45, 20, 33, 26, 4, 38, 2, 8, 9, 44, 35, 19, 21, 18, 25, 29, 34, 27, 40, 2, 44, 19, 10, 49, 47, 49, 33, 12, 50, 13, 14, 44, 34, 47, 22, 37, 36, 23, 47, 46,

28, 6, 6, 29, 38, 35, 16, 2, 28, 1, 45, 20, 33, 26, 4, 38, 2, 8, 9, 44, 35, 19, 21, 18, 25, 29, 34, 27, 40, 2, 44, 19, 10, 49, 47, 49, 33, 12, 50, 13, 14, 44, 34, 47, 22, 37, 36, 23, 47, 46,

28, 6, 6, 29, 38, 35, 16, 2, 28, 1, 45, 20, 33, 26, 4, 38, 2, 8, 9, 44, 35, 19, 21, 18, 25, 29, 34, 27, 40, 2, 44, 19, 10, 49, 47, 49, 33, 12, 50, 13, 14, 44, 34, 47, 22, 37, 36, 23, 47, 46,

28, 6, 6, 29, 38, 35, 16, 2, 28, 1, 45, 20, 33, 26, 4, 38, 2, 8, 9, 44, 35, 19, 21, 18, 25, 29, 34, 27, 40, 2, 44, 19, 10, 49, 47, 49, 33, 12, 50, 13, 14, 44, 34, 47, 22, 37, 36, 23, 47, 46,

Running the Selection Sort!

Running the Heap Sort!

Running the Quick Sort!

Running the Built-in Sort

Printing Sorted Selection Array and Stats!

1, 2, 2, 2, 4, 6, 6, 8, 9, 10, 12, 13, 14, 16, 18, 19, 19, 20, 21, 22, 23, 25, 26, 27, 28, 28, 29, 29, 33, 33, 34, 34, 35, 35, 36, 37, 38, 38, 40, 44, 44, 44, 45, 46, 47, 47, 47, 49, 49, 50,

Comparisons: 1225

Swaps: 46

Printing Sorted Heap Array and Stats!

1, 2, 2, 2, 4, 6, 6, 8, 9, 10, 12, 13, 14, 16, 18, 19, 19, 20, 21, 22, 23, 25, 26, 27, 28, 28, 29, 29, 33, 33, 34, 34, 35, 35, 36, 37, 38, 38, 40, 44, 44, 44, 45, 46, 47, 47, 47, 49, 49, 50,

Comparisons: 807

Swaps: 244

Printing Sorted Quick Array and Stats!

1, 2, 2, 2, 4, 6, 6, 8, 9, 10, 12, 13, 14, 16, 18, 19, 19, 20, 21, 22, 23, 25, 26, 27, 28, 28, 29, 29, 33, 33, 34, 34, 35, 35, 36, 37, 38, 38, 40, 44, 44, 44, 45, 46, 47, 47, 47, 49, 49, 50,

Comparisons: 281

Swaps: 96

Printing Sorted Comp Array!

1, 2, 2, 2, 4, 6, 6, 8, 9, 10, 12, 13, 14, 16, 18, 19, 19, 20, 21, 22, 23, 25, 26, 27, 28, 28, 29, 29, 33, 33, 34, 34, 35, 35, 36, 37, 38, 38, 40, 44, 44, 44, 45, 46, 47, 47, 47, 49, 49, 50,

]777;notify;Command completed;./Client]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:46] s789220c@cslab177:~/CSCI385/Prog5 $ exit

exit

Script done on 2019-11-14 16:46:44-0500

Script started on 2019-11-14 16:46:53-0500

]777;notify;Command completed;exit]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:46] s789220c@cslab177:~/CSCI385/Prog5 $ ./Client

Enter the common list size: 100

Would you like to randomize the numbers to sort? (Y or N)Y

99, 80, 45, 74, 39, 74, 70, 88, 57, 74, 17, 41, 68, 79, 63, 52, 47, 52, 27, 37, 52, 98, 85, 74, 19, 17, 88, 51, 78, 25, 24, 28, 4, 68, 2, 42, 41, 71, 82, 97, 97, 50, 89, 16, 28, 51, 67, 26, 55, 45, 62, 6, 95, 46, 31, 65, 15, 18, 67, 92, 95, 90, 20, 98, 57, 73, 92, 49, 95, 73, 98, 91, 22, 86, 6, 49, 89, 25, 74, 95, 21, 87, 100, 67, 33, 82, 31, 47, 51, 98, 90, 45, 87, 61, 43, 96, 85, 86, 96, 80,

99, 80, 45, 74, 39, 74, 70, 88, 57, 74, 17, 41, 68, 79, 63, 52, 47, 52, 27, 37, 52, 98, 85, 74, 19, 17, 88, 51, 78, 25, 24, 28, 4, 68, 2, 42, 41, 71, 82, 97, 97, 50, 89, 16, 28, 51, 67, 26, 55, 45, 62, 6, 95, 46, 31, 65, 15, 18, 67, 92, 95, 90, 20, 98, 57, 73, 92, 49, 95, 73, 98, 91, 22, 86, 6, 49, 89, 25, 74, 95, 21, 87, 100, 67, 33, 82, 31, 47, 51, 98, 90, 45, 87, 61, 43, 96, 85, 86, 96, 80,

99, 80, 45, 74, 39, 74, 70, 88, 57, 74, 17, 41, 68, 79, 63, 52, 47, 52, 27, 37, 52, 98, 85, 74, 19, 17, 88, 51, 78, 25, 24, 28, 4, 68, 2, 42, 41, 71, 82, 97, 97, 50, 89, 16, 28, 51, 67, 26, 55, 45, 62, 6, 95, 46, 31, 65, 15, 18, 67, 92, 95, 90, 20, 98, 57, 73, 92, 49, 95, 73, 98, 91, 22, 86, 6, 49, 89, 25, 74, 95, 21, 87, 100, 67, 33, 82, 31, 47, 51, 98, 90, 45, 87, 61, 43, 96, 85, 86, 96, 80,

99, 80, 45, 74, 39, 74, 70, 88, 57, 74, 17, 41, 68, 79, 63, 52, 47, 52, 27, 37, 52, 98, 85, 74, 19, 17, 88, 51, 78, 25, 24, 28, 4, 68, 2, 42, 41, 71, 82, 97, 97, 50, 89, 16, 28, 51, 67, 26, 55, 45, 62, 6, 95, 46, 31, 65, 15, 18, 67, 92, 95, 90, 20, 98, 57, 73, 92, 49, 95, 73, 98, 91, 22, 86, 6, 49, 89, 25, 74, 95, 21, 87, 100, 67, 33, 82, 31, 47, 51, 98, 90, 45, 87, 61, 43, 96, 85, 86, 96, 80,

Running the Selection Sort!

Running the Heap Sort!

Running the Quick Sort!

Running the Built-in Sort

Printing Sorted Selection Array and Stats!

2, 4, 6, 6, 15, 16, 17, 17, 18, 19, 20, 21, 22, 24, 25, 25, 26, 27, 28, 28, 31, 31, 33, 37, 39, 41, 41, 42, 43, 45, 45, 45, 46, 47, 47, 49, 49, 50, 51, 51, 51, 52, 52, 52, 55, 57, 57, 61, 62, 63, 65, 67, 67, 67, 68, 68, 70, 71, 73, 73, 74, 74, 74, 74, 74, 78, 79, 80, 80, 82, 82, 85, 85, 86, 86, 87, 87, 88, 88, 89, 89, 90, 90, 91, 92, 92, 95, 95, 95, 95, 96, 96, 97, 97, 98, 98, 98, 98, 99, 100,

Comparisons: 4950

Swaps: 96

Printing Sorted Heap Array and Stats!

2, 4, 6, 6, 15, 16, 17, 17, 18, 19, 20, 21, 22, 24, 25, 25, 26, 27, 28, 28, 31, 31, 33, 37, 39, 41, 41, 42, 43, 45, 45, 45, 46, 47, 47, 49, 49, 50, 51, 51, 51, 52, 52, 52, 55, 57, 57, 61, 62, 63, 65, 67, 67, 67, 68, 68, 70, 71, 73, 73, 74, 74, 74, 74, 74, 78, 79, 80, 80, 82, 82, 85, 85, 86, 86, 87, 87, 88, 88, 89, 89, 90, 90, 91, 92, 92, 95, 95, 95, 95, 96, 96, 97, 97, 98, 98, 98, 98, 99, 100,

Comparisons: 1917

Swaps: 589

Printing Sorted Quick Array and Stats!

2, 4, 6, 6, 15, 16, 17, 17, 18, 19, 20, 21, 22, 24, 25, 25, 26, 27, 28, 28, 31, 31, 33, 37, 39, 41, 41, 42, 43, 45, 45, 45, 46, 47, 47, 49, 49, 50, 51, 51, 51, 52, 52, 52, 55, 57, 57, 61, 62, 63, 65, 67, 67, 67, 68, 68, 70, 71, 73, 73, 74, 74, 74, 74, 74, 78, 79, 80, 80, 82, 82, 85, 85, 86, 86, 87, 87, 88, 88, 89, 89, 90, 90, 91, 92, 92, 95, 95, 95, 95, 96, 96, 97, 97, 98, 98, 98, 98, 99, 100,

Comparisons: 739

Swaps: 248

Printing Sorted Comp Array!

2, 4, 6, 6, 15, 16, 17, 17, 18, 19, 20, 21, 22, 24, 25, 25, 26, 27, 28, 28, 31, 31, 33, 37, 39, 41, 41, 42, 43, 45, 45, 45, 46, 47, 47, 49, 49, 50, 51, 51, 51, 52, 52, 52, 55, 57, 57, 61, 62, 63, 65, 67, 67, 67, 68, 68, 70, 71, 73, 73, 74, 74, 74, 74, 74, 78, 79, 80, 80, 82, 82, 85, 85, 86, 86, 87, 87, 88, 88, 89, 89, 90, 90, 91, 92, 92, 95, 95, 95, 95, 96, 96, 97, 97, 98, 98, 98, 98, 99, 100,

]777;notify;Command completed;./Client]0;s789220c@cslab177:~/CSCI385/Prog5]7;file://cslab177/home/CS/s789220c/CSCI385/Prog5[16:47] s789220c@cslab177:~/CSCI385/Prog5 $ exit

exit

Script done on 2019-11-14 16:47:07-0500

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Running the Selection Sort!

Running the Heap Sort!

Running the Quick Sort!

Running the Built-in Sort

Printing Sorted Selection Array and Stats!

2, 2, 3, 5, 6, 7, 9, 10, 12, 13, 13, 17, 17, 17, 18, 19, 20, 20, 20, 20, 22, 23, 23, 24, 24, 26, 29, 33, 34, 35, 36, 37, 41, 41, 42, 42, 43, 44, 45, 46, 46, 48, 49, 50, 52, 53, 53, 54, 58, 60, 60, 62, 62, 64, 65, 66, 68, 69, 70, 73, 73, 74, 74, 75, 76, 76, 78, 79, 79, 79, 79, 80, 81, 83, 83, 84, 84, 85, 85, 86, 86, 91, 92, 93, 93, 93, 97, 98, 98, 101, 103, 104, 105, 105, 105, 106, 107, 108, 109, 110, 111, 112, 113, 113, 115, 116, 117, 117, 117, 119, 120, 120, 121, 122, 124, 124, 125, 126, 126, 126, 126, 127, 128, 130, 131, 132, 134, 135, 137, 140, 141, 143, 144, 145, 146, 146, 147, 147, 151, 151, 152, 152, 157, 157, 158, 158, 159, 161, 161, 162, 163, 166, 166, 167, 168, 169, 169, 172, 172, 172, 173, 174, 174, 175, 176, 177, 178, 178, 179, 179, 180, 180, 180, 183, 183, 183, 184, 184, 185, 186, 187, 187, 187, 188, 189, 189, 190, 190, 191, 191, 191, 193, 193, 194, 195, 197, 197, 197, 198, 199, 199, 203, 203, 204, 204, 205, 206, 210, 211, 211, 212, 213, 214, 218, 219, 220, 221, 221, 222, 222, 222, 222, 223, 223, 224, 226, 227, 227, 229, 230, 230, 231, 233, 233, 234, 237, 238, 239, 239, 240, 241, 241, 242, 244, 246, 246, 247, 247, 248, 248, 248, 249, 249, 250, 250, 252, 256, 257, 259, 259, 260, 261, 264, 266, 266, 267, 267, 270, 270, 270, 270, 270, 271, 272, 272, 273, 274, 275, 275, 276, 279, 279, 279, 280, 280, 280, 281, 281, 282, 282, 282, 287, 287, 287, 290, 290, 291, 292, 294, 296, 297, 297, 297, 299, 299, 299, 300, 300, 300, 300, 301, 302, 304, 307, 309, 309, 310, 310, 310, 311, 311, 311, 313, 314, 315, 315, 315, 316, 318, 319, 320, 321, 322, 323, 323, 323, 325, 327, 327, 328, 328, 329, 330, 332, 337, 339, 339, 341, 341, 342, 346, 346, 348, 348, 349, 350, 351, 351, 352, 356, 357, 357, 360, 362, 367, 368, 369, 369, 370, 371, 371, 371, 373, 375, 375, 378, 378, 379, 380, 381, 384, 384, 386, 388, 389, 390, 392, 395, 395, 396, 398, 399, 400, 400, 400, 401, 401, 401, 403, 403, 404, 405, 406, 407, 409, 410, 413, 413, 413, 414, 418, 420, 420, 421, 422, 422, 423, 424, 427, 429, 430, 430, 430, 431, 432, 433, 433, 435, 435, 436, 437, 440, 440, 443, 444, 445, 447, 448, 450, 451, 451, 452, 452, 454, 454, 455, 456, 456, 456, 456, 456, 458, 459, 459, 460, 460, 461, 462, 462, 463, 464, 464, 465, 466, 469, 469, 469, 469, 470, 470, 470, 472, 472, 476, 477, 477, 478, 479, 479, 479, 480, 483, 483, 484, 484, 486, 487, 487, 488, 488, 488, 489, 491, 492, 494, 495, 496, 497, 499, 500,

Comparisons: 124750

Swaps: 490

Printing Sorted Heap Array and Stats!

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Comparisons: 12867

Swaps: 4039

Printing Sorted Quick Array and Stats!

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Comparisons: 4778

Swaps: 1836

Printing Sorted Comp Array!

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Comparisons: 499500

Swaps: 995

Printing Sorted Heap Array and Stats!

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Comparisons: 28611

Swaps: 9037

Printing Sorted Quick Array and Stats!

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Comparisons: 11544

Swaps: 4083

Printing Sorted Comp Array!

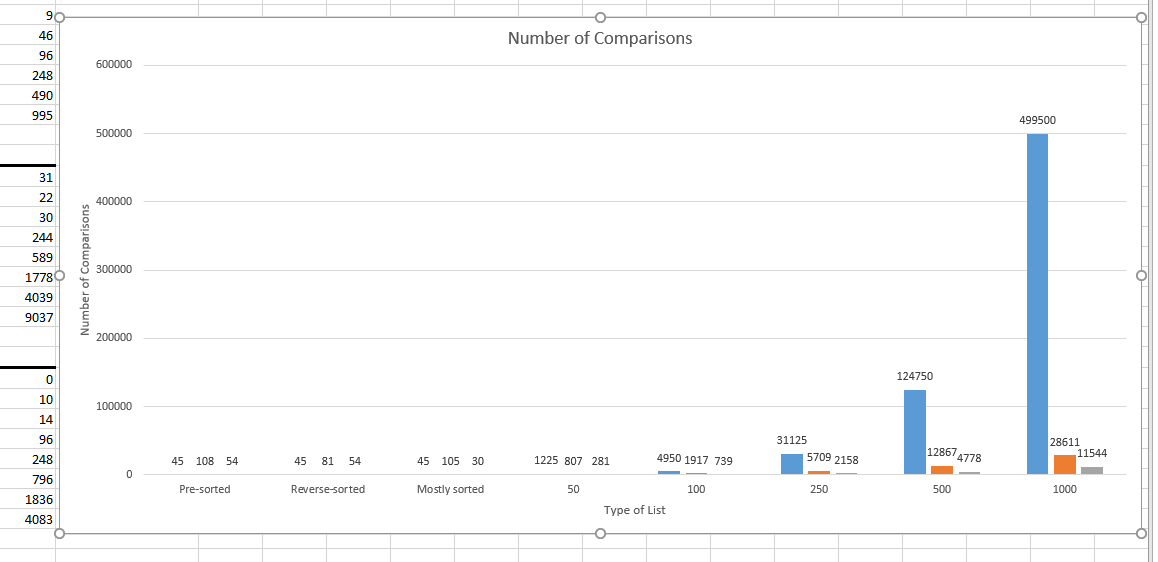
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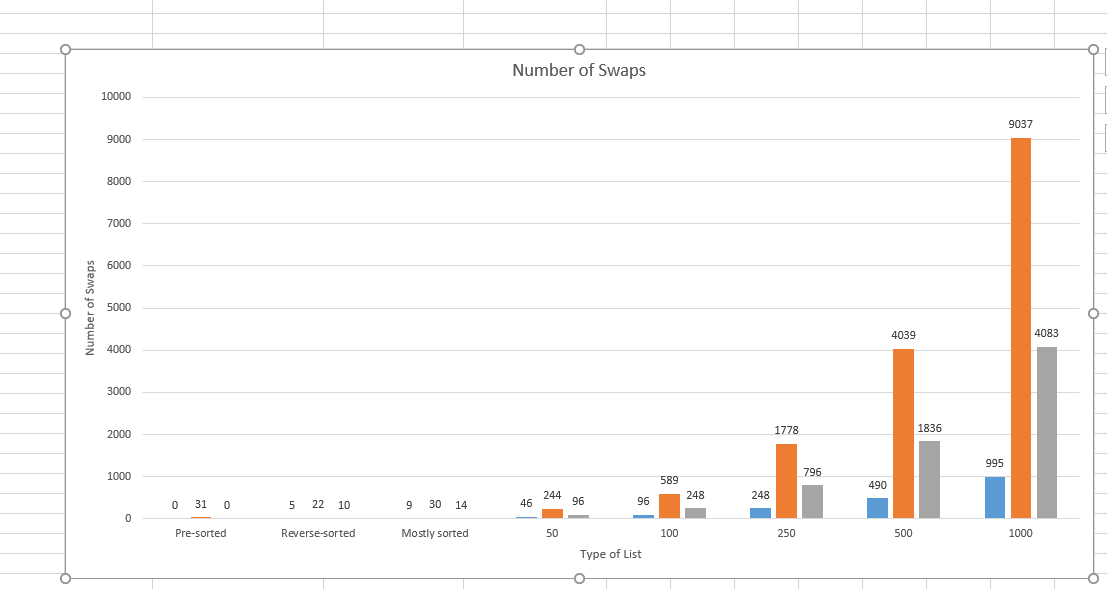
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Script done on 2019-11-14 16:48:48-0500

2)





After reviewing the results of the various sorts, based on the comparisons and swaps, the following is the order of swap efficiency from least to most efficient: Selection Sort, Heap Sort, and Quick Sort. The Selection Sort has significantly more comparisons as the list size increases, but the swaps still stay low in comparison to the other two sorts. The Heap Sort has less comparisons than the Selection Sort, but it has a lot more swaps, which are cost inefficient due to the fact it must maintain the heap property as well. Finally, the Quick Sort has a smaller amount of comparisons than the Selection Sort as the list size increases, but more swaps in comparison to the Selection Sort as well.

For the special lists (pre-sorted, reverse-sorted, and “mostly sorted”), the comparisons and swaps were significantly lower than the randomized lists. Then, for the randomized lists, as the size increased, the comparisons and swaps increased as previously described. I believe based on the collected data that the Quick Sort is the most efficient sort out of the three performed in this program. While it has more swaps than the selection sort, it also has far less comparisons than the other two sorts. Furthermore, the swaps and comparisons are numerically closer to each other, which means it is less computationally expensive overall in comparison. The results of the testing show that my hypothesis about the efficiency of the sorts do match what was discussed in class.