Ethan Le

CS 2341

Prof. Fontenot

6th of October, 2021

Lab Report of Project Assignment 03: “Mystery Sort”

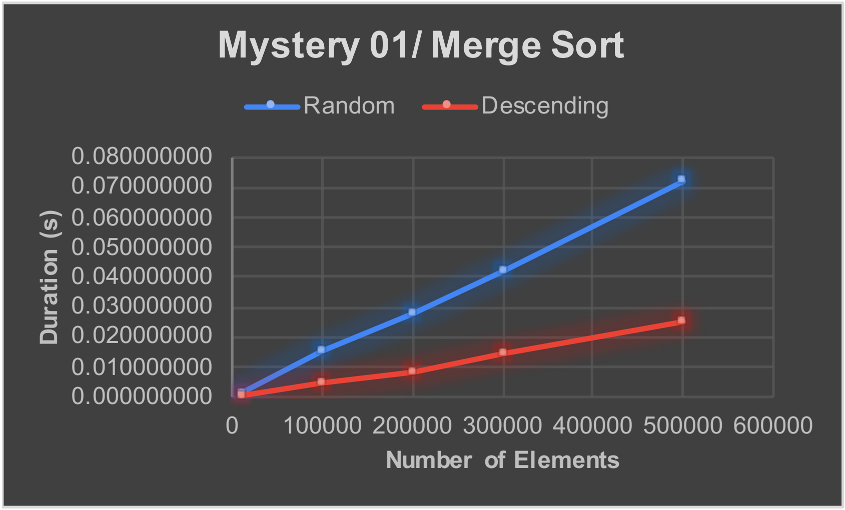
As an introduction, my name is Ethan Le, and I am a student at SMU studying for a bachelor's degree in computer science. My goal is to delve into the field of software engineering, because I want to explore the design and implementation of computer algorithms. This semester I took a course on Data Structure and came across project 3 “Mystery Sort”. The project assignment requires to determine the type of sorting in each mystery sorting that has been implemented. We will do this by determining the group of O(n Log n) and O(n^2) from the data input.

Throughout the solving process, I started to distinguish the mystery function into two groups of running time n Log n and n^2. Merge sort and quicksort would be in place of O(n Log n) due to its worst case time complexities. While, selection sort, bubble sort, and insertion sort would be in place of O(n^2) due to its average and worst case time complexities. For O(n Log n), the two mystery functions that satisfy the criterion are mystery 01 and mystery 04 since the input data of the two functions when sorted in random order had the fastest runtime. The next procedure was to determine the type of sorts between mystery 01 and mystery 04. The Mystery 04 function is recognized as a quick sort because it has the slowest running time when sorting in the reverse order. The data plot graph of Mystery 04 shows that it takes more time to build and run through the number of elements than the Mystery 01. At a size of 200 000, mystery 04 had a significant amount of 13.64 seconds in descending order . While, the mystery 01 function takes about 0.0086 seconds. Therefore, the mystery 01 function is identified as a merge sort because it has the fastest running time when sorted in reverse order. Hence, mystery 01 represents the merge sort and mystery 04 represents the quick sort.

At this point, random orders such as mystery 02, mystery 03, and mystery 05 had the slowest runtime. Each of these sorting algorithms would be in place of O(n^2). For the group O(n^2), there are two procedures to find the sorting algorithms. The first procedure is to determine the selection sort by running the number of elements in a sorted order. Based on the observations of the graph, the ascending column of Mystery 05 shows a higher upward trend than the other two graphs. Consequently, mystery 05 function is the selection sort since it takes more time to run through the number of elements. Within almost sorted data, bubble sort and insertion sort need very few swaps. However, selection sort requires the same amount of search process even in almost sorted data. The second procedure is to determine the bubble sort and insertion sort by running the number of elements in reverse order. The chart of Mystery 02 shows that during the descent process, the running time is longer than that of Mystery 03. In addition, bubble sort performs more swap operations than the insertion sort. The higher number of swaps leads to a higher runtime for the bubble sort algorithm. Thus, the difference in runtime grows as the number of elements to be sorted increases on a random list. Therefore, the mystery 02 function is recognized as a bubble sort because it has the slowest running time when sorted in the reverse order. Moreover, the mysterious 03 function represents insertion sort, because it is still the fastest running time in reverse order.

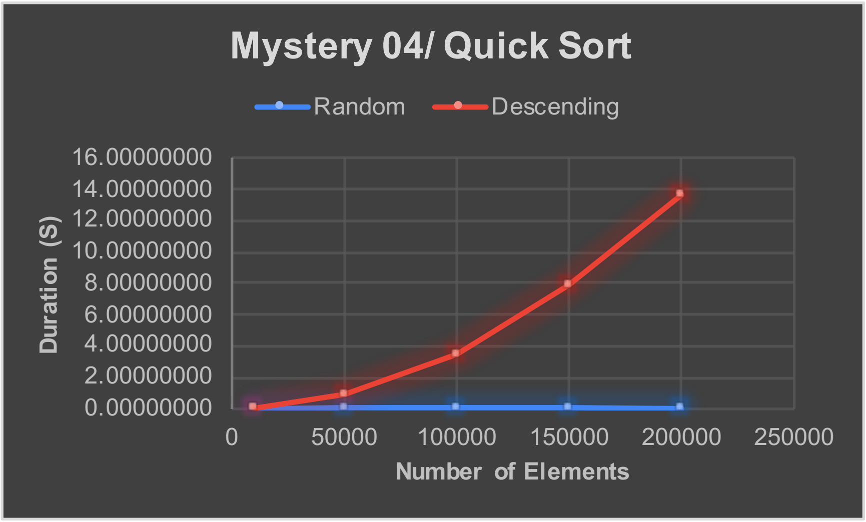
Mystery 01

Sizes	Random	Descending
10000	0.001294315	0.000411183
100000	0.014985683	0.005031366
200000	0.028106890	0.008590262
300000	0.042574468	0.014167441
500000	0.072072206	0.025143856



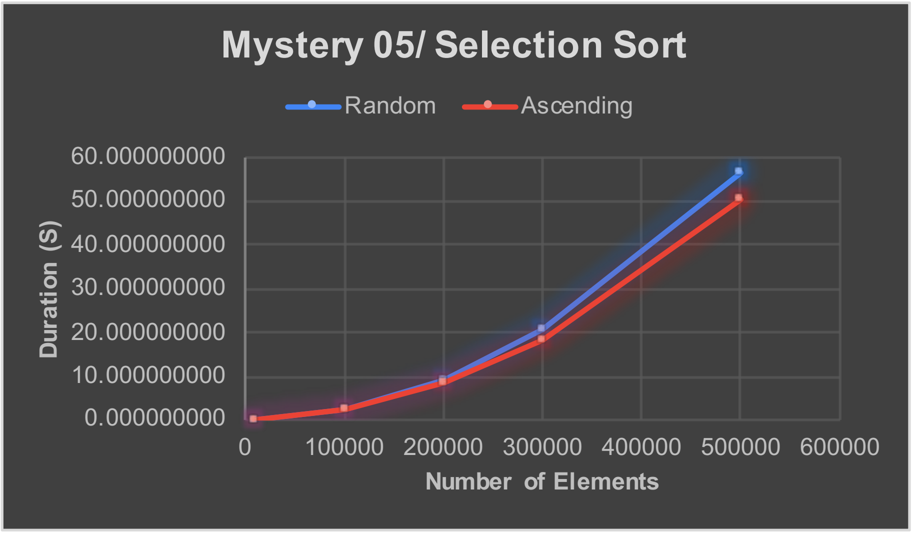
Mystery 04

Sizes	Random	Descending
10000	0.00056808	0.041067020
50000	0.00358493	0.899040658
100000	0.00795571	3.492967303
150000	0.01208633	7.822190262
200000	0.01605936	13.642814743



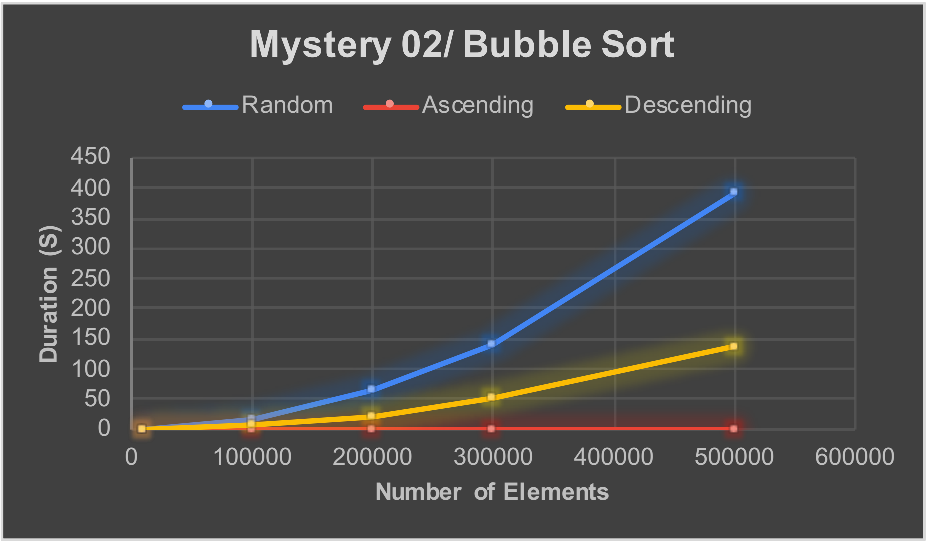
Mystery 05

Sizes	Random	Ascending
10000	0.027999301	0.027691584
100000	2.428134335	2.130611126
200000	9.179784043	8.271582271
300000	20.73234077	18.1733182
500000	56.52622908	50.434989686



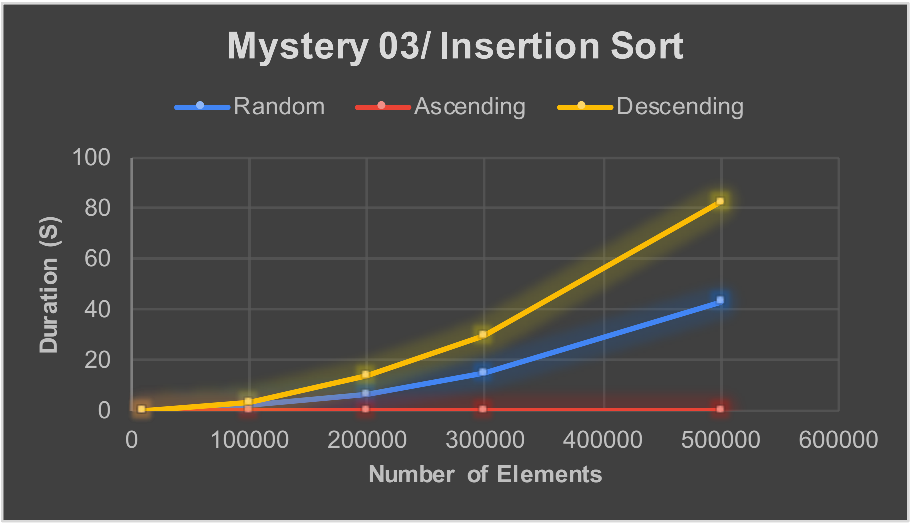
Mystery 02

Sizes	Random	Ascending	Descending
10000	0.12661107	0.000005636	0.063842871
100000	16.37790912	0.000064781	5.812633186
200000	63.517187965	0.000140571	22.47353246
300000	140.1344214	0.000183761	50.92603918
500000	391.106616348	0.000319813	137.9291341



Mystery 03

Sizes	Random	Ascending	Descending
10000	0.021541586	0.000012117	0.058664426
100000	1.79613073	0.000120955	3.512306902
200000	6.958663412	0.000353566	13.409657950
300000	15.0638765	0.000546211	29.633732395
500000	43.015400741	0.000658538	82.749315932


Mystery 03/ Insertion Sort
Random
Ascending
Descending
Duration (S)
Number of Elements