Analysis and Design of Algorithms

Semester III, Year **2021-22**

Lab - 1 Date : 08-09-2021

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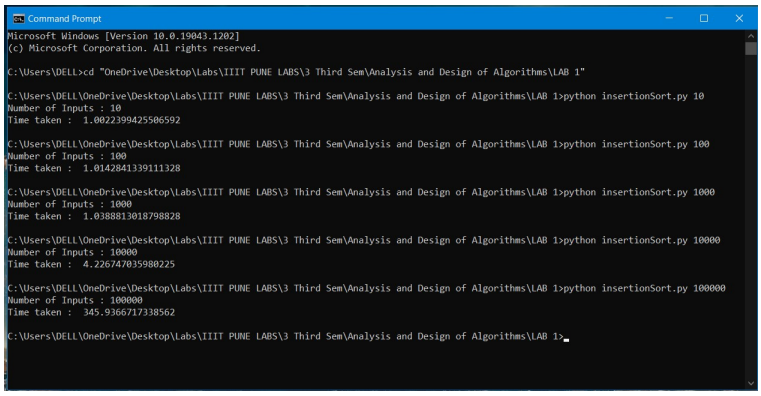
AIM: Implement insertion sort, selection sort bubble sort and merge sort. The number of inputs elements has to be passed from command line arguments. The elements has to be generated randomly within the code.
Compute:

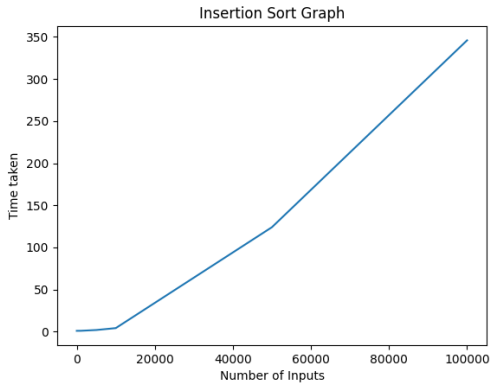
a. Check the performance of program by varying the number of elements.
b. Compute the time taken by each case (for particular number of inputs) n = 10, 100, 1000, 10000, 100000.
c. Plot a graph with number of inputs Vs time taken in seconds.
d. Compare the graphical plots for each sorting algorithms with its theoretical time complexity.
e. Also compute the time taken for sorted array (worst case) and compare with different number of elements.

Insertion Sort:

Output:

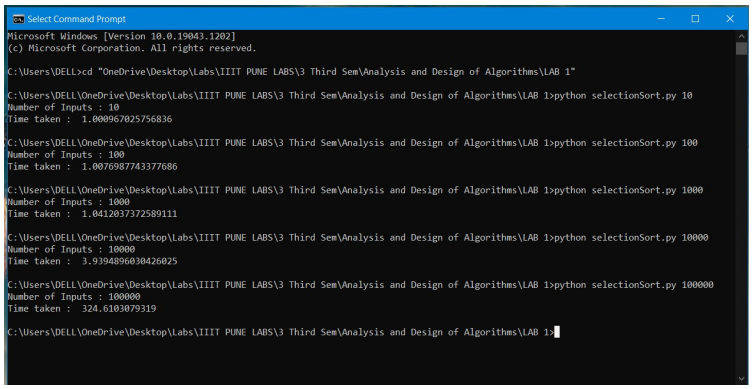


Graph:

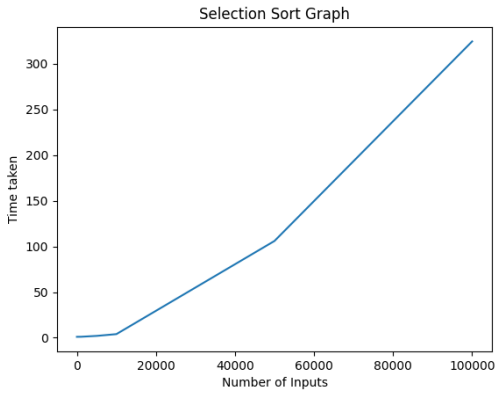


Selection Sort:

Output:

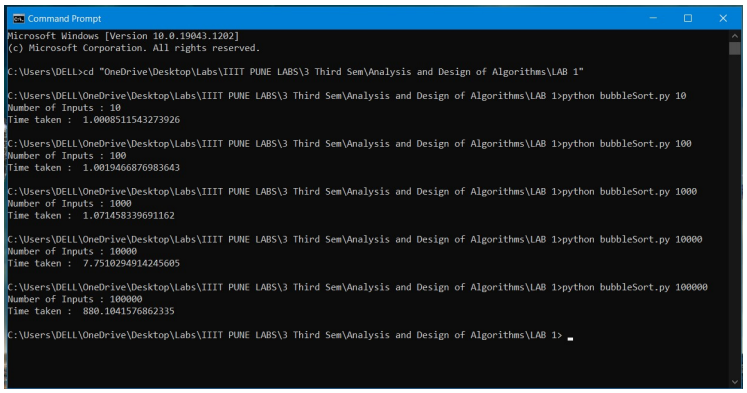


Graph:

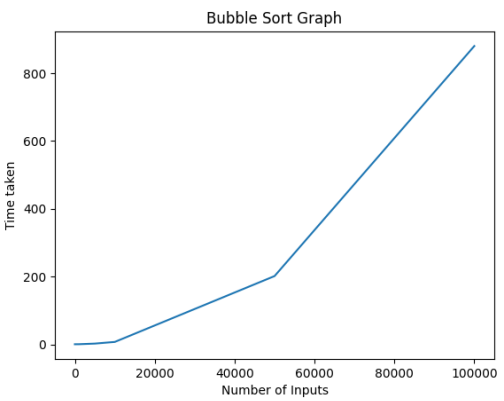


Bubble Sort:

Output:



Graph:



Merge Sort:

Output:

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Command Prompt
Microsoft Windows [Version 10.0.19043.1202]
(c) Microsoft Corporation. All rights reserved.

C:\Users\DELL>cd "OneDrive\Desktop\Labs\IIIT PUNE LABS\3 Third Sem\Analysis and Design of Algorithms\LAB 1"

C:\Users\DELL\OneDrive\Desktop\Labs\IIIT PUNE LABS\3 Third Sem\Analysis and Design of Algorithms\LAB 1>python mergeSort.py 10
Number of Inputs : 10
Time taken :  1.0069692134857178

C:\Users\DELL\OneDrive\Desktop\Labs\IIIT PUNE LABS\3 Third Sem\Analysis and Design of Algorithms\LAB 1>python mergeSort.py 100
Number of Inputs : 100
Time taken :  1.0052106380462646

C:\Users\DELL\OneDrive\Desktop\Labs\IIIT PUNE LABS\3 Third Sem\Analysis and Design of Algorithms\LAB 1>python mergeSort.py 1000
Number of Inputs : 1000
Time taken :  1.0149176120758057

C:\Users\DELL\OneDrive\Desktop\Labs\IIIT PUNE LABS\3 Third Sem\Analysis and Design of Algorithms\LAB 1>python mergeSort.py 10000
Number of Inputs : 10000
Time taken :  1.0160174369812012

C:\Users\DELL\OneDrive\Desktop\Labs\IIIT PUNE LABS\3 Third Sem\Analysis and Design of Algorithms\LAB 1>python mergeSort.py 100000
Number of Inputs : 100000
Time taken :  1.318859577178955

C:\Users\DELL\OneDrive\Desktop\Labs\IIIT PUNE LABS\3 Third Sem\Analysis and Design of Algorithms\LAB 1>
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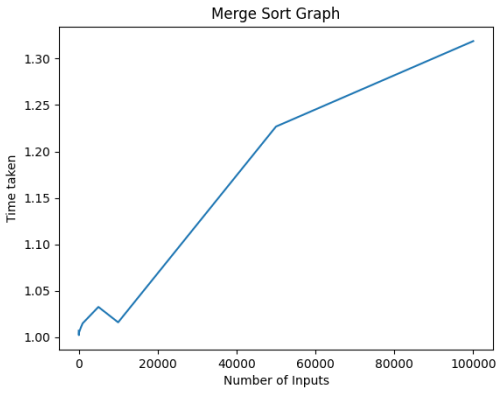
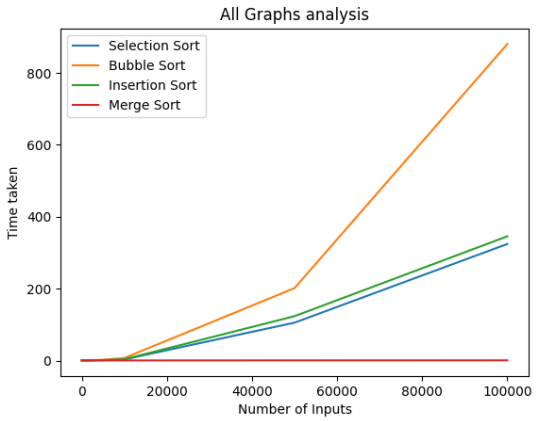
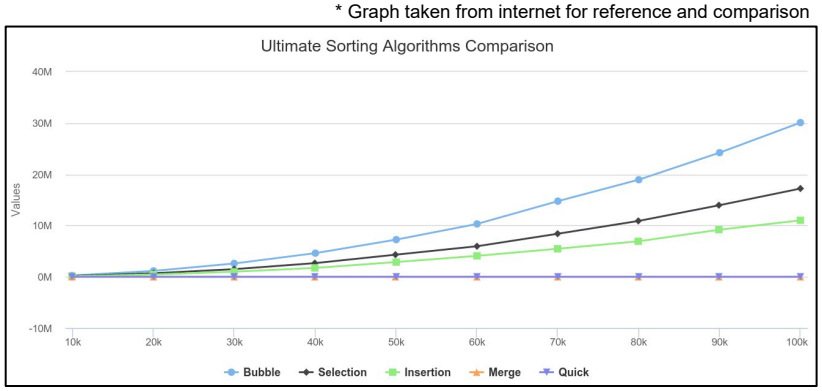
Graph:



Comparison Graph:



* Graph taken from internet for reference and comparison



The graph which I obtained is the same as the theoretical time complexities graph, bubble sort with highest growth and merge sort with least. Selection sort and Insertion sort were almost similar and would be precise if more number of inputs were taken also the graphs would have become curved to represent precise growth of algorithms.

Result:

Here are the results obtained showing the time taken for different sorting algorithms to run different number of inputs.

* All times obtained were added with one second using time.sleep(1)

Number of Inputs (To right)	10	100	1000	10000	100000
Insertion Sort	1.0022399425506592	1.0142841339111328	1.0388813018798828	4.226747035980225	345.9366717338562
Selection Sort	1.000967025756836	1.0076987743377686	1.0412037372589111	3.9394896030426025	324.6103079319
Bubble Sort	1.0008511543273926	1.0019466876983643	1.071458339691162	7.7510294914245605	880.1041576862335
Merge Sort	1.0069692134857178	1.0052106380462646	1.0149176120758057	1.0160174369812012	1.318859577178955

Worst case time complexities:

* All times obtained were added with one second using time.sleep(1)

Number of Inputs (To right)	10	100	1000	10000	100000
Insertion Sort	1.0095903873443604	1.015418062210083	1.1003468036651611	8.794252872467041	759.9043262004852
Selection Sort	1.0060904026031494	1.0086463012695312	1.0807583332061768	4.893258333206177	429.09446573257446
Bubble Sort	1.0025291442871094	1.0156090259552002	1.1648099422454834	12.424667358398438	1159.5737493038177
Merge Sort	1.0050386447906494	1.0106956958770752	1.015178804397583	1.040414571762085	1.3664815425872803

Conclusion:

After analysing the results obtained, I observed that in case of small number of inputs the time taken by the sorting algorithms were as Bubble sort < Selection sort < Insertion sort < Merge Sort whereas when it comes to large number of inputs there are noteworthy changes the time taken were as Merge sort << Selection sort < Insertion sort < Bubble sort. In case of small number of inputs there is little difference between time taken by sorting algorithms. But coming to large number of inputs merge sort gave the input in very much less time compared to remaining sorting algorithms. This comparison shows how efficiency of an algorithm plays an important role in designing of algorithms.

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* All graphs were plotted taking some extra inputs for better precision.