Complex Engineering Problem

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Complex Engineering Problem

Submitted to the faculty of the Electrical Engineering Department
of the University of Engineering and Technology Lahore
in partial fulfillment of the requirements for the Degree of

Bachelor of Science

in

Electrical Engineering.

Internal Examiner

External Examiner

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Declaration

I declare that the work contained in this thesis is my own, except where explicitly stated otherwise. In addition this work has not been submitted to obtain another degree or professional qualification.

Signed: _____

Date: _____

Acknowledgments

Dedicated to ....

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Chapter 1

Problem Statement

The main objectives of this Complex Engineering Problem are:

- To develop programs that store and manage the given data by using four different data structures, that are:
  1. Hash Table (Quadratic Probing)
  2. Array
  3. Linked List
  4. Binary Tree
- Implement the following operations on the given data:
  1. Insert all of the given data in a data structure.
  2. Print data of data structure in sorted order (traverse in sorted order) (numerically or alphabetically).
  3. Find records.
  4. Delete half of the data from the data structure.
- To measure execution time and memory consumption for each operation.
- To compare operations on different data structures depending on their execution time and memory consumption and conclude which data structure is the best for each operation.

Chapter 2

File Input

The workflow for file input routines is follows:

- File is opened in reading mode with **fopen()**
- Reading the data file using **fscanf()** from the first line. Ignore the first string read as it is needed. Next line contains the number of records read and it store as an integer. From the next line we have the data of employees.
- Creating a structure which has fields of "ID"(Integer), "Name"(String), "City"(String) and "Service"(String).
- Allocating memory for an array of "pointers to structures".
- Records are read from the file and are stored in the allocated structures and then pointers to these structures are linked to the array.
- File is closed after storing the data with **fclose**

So after these processes we have *an array of pointers to structures* containing the data of the files.

Chapter 3

Hash Table Implementation

```
Number of Records: 1000
Insert              Execution Time:     0.000054 s      Memory Consumption:     36280 bytes
Find                Execution Time:     0.000015 s      Memory Consumption:     36280 bytes
Sorted Traversal 101 Execution Time:    0.000120 s      Memory Consumption:     40280 bytes
Sorted Traversal    Execution Time:     0.008748 s      Memory Consumption:     40280 bytes
Delete              Execution Time:     0.000039 s      Memory Consumption:     40280 bytes

--------------------------------
Process exited after 0.02986 seconds with return value 0
Press any key to continue . . .
```

FIGURE 3.1: Results for hash implementation with data size 1000.

```
Number of Records: 10000
Insert              Execution Time:     0.000785 s      Memory Consumption:     360328 bytes
Find                Execution Time:     0.000317 s      Memory Consumption:     360328 bytes
Sorted Traversal 101 Execution Time:    0.002094 s      Memory Consumption:     400328 bytes
Sorted Traversal    Execution Time:     0.864026 s      Memory Consumption:     400328 bytes
Delete              Execution Time:     0.000342 s      Memory Consumption:     400328 bytes

--------------------------------
Process exited after 0.8982 seconds with return value 0
Press any key to continue . . .
```

FIGURE 3.2: Results for hash implementation with data size 10000.

```
Number of Records: 100000
Insert              Execution Time:     0.006306 s      Memory Consumption:     3600040 bytes
Find                Execution Time:     0.002778 s      Memory Consumption:     3600040 bytes
Sorted Traversal 101 Execution Time:    0.018601 s      Memory Consumption:     4000040 bytes
Sorted Traversal    Execution Time:     90.938276 s     Memory Consumption:     4000040 bytes
Delete              Execution Time:     0.003380 s      Memory Consumption:     4000040 bytes

--------------------------------
Process exited after 91.73 seconds with return value 0
Press any key to continue . . .
```

FIGURE 3.3: Results for hash implementation with data size 100000.

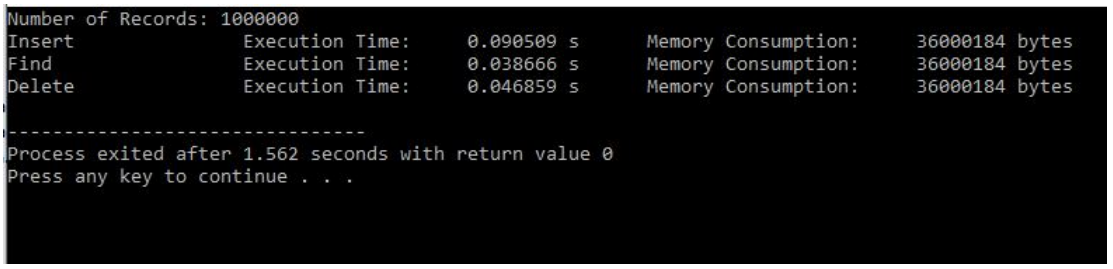

FIGURE 3.4: Results for hash implementation with data size 1000000.

Chapter 4

Array Implementation

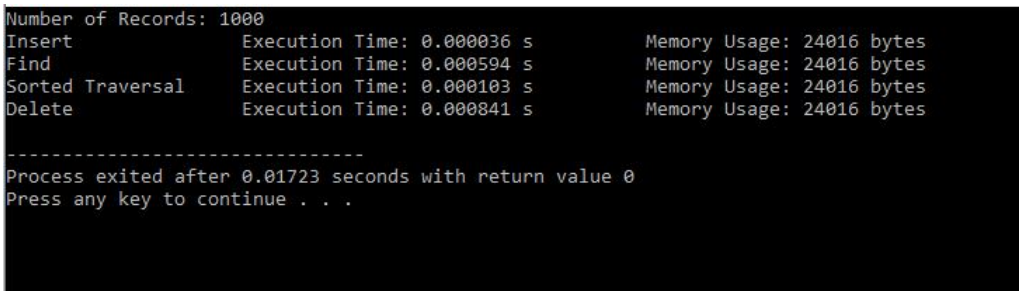

FIGURE 4.1: Results for array implementation with data size 1000.

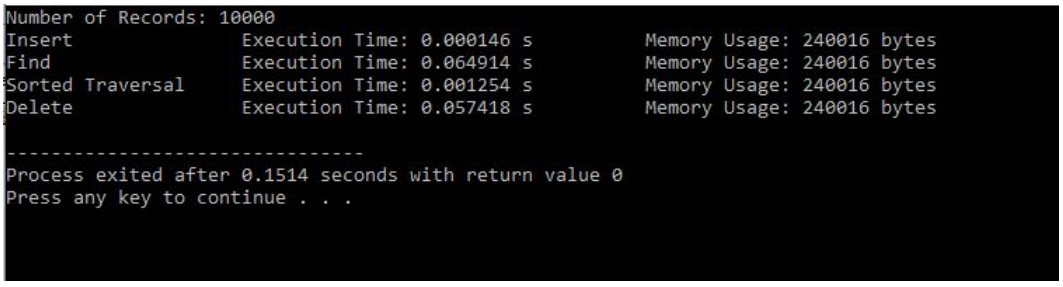

FIGURE 4.2: Results for array implementation with data size 10000.

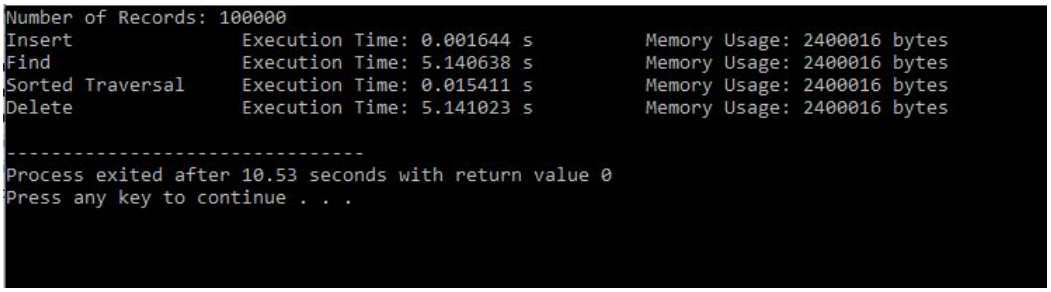

FIGURE 4.3: Results for array implementation with data size 100000.

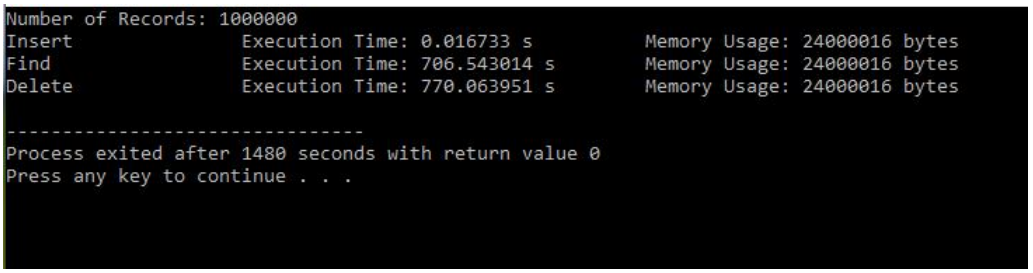

FIGURE 4.4: Results for array implementation with data size 1000000.

Chapter 5

Linked List Implementation

Chapter 6

Tree Implementation

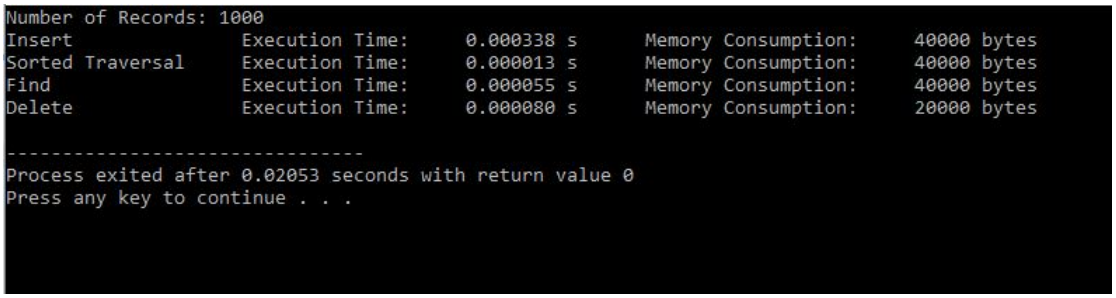

FIGURE 6.1: Results for tree implementation with data size 1000.

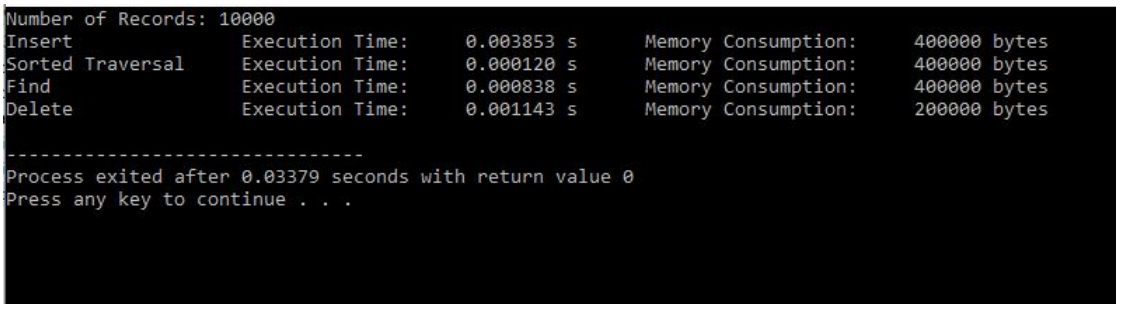

FIGURE 6.2: Results for tree implementation with data size 10000.

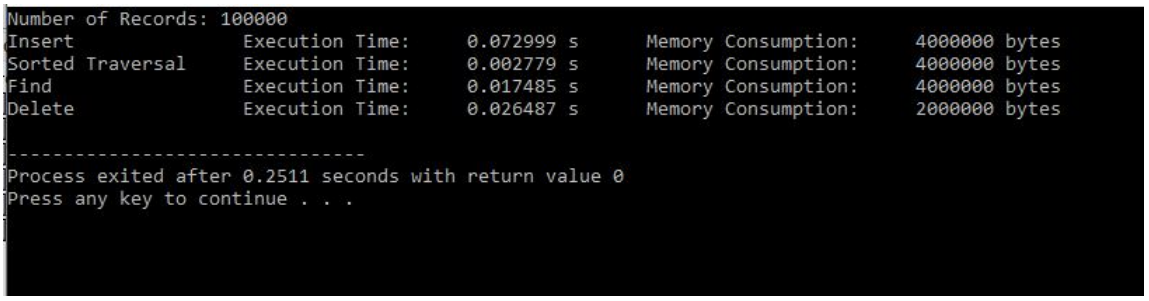

FIGURE 6.3: Results for tree implementation with data size 100000.

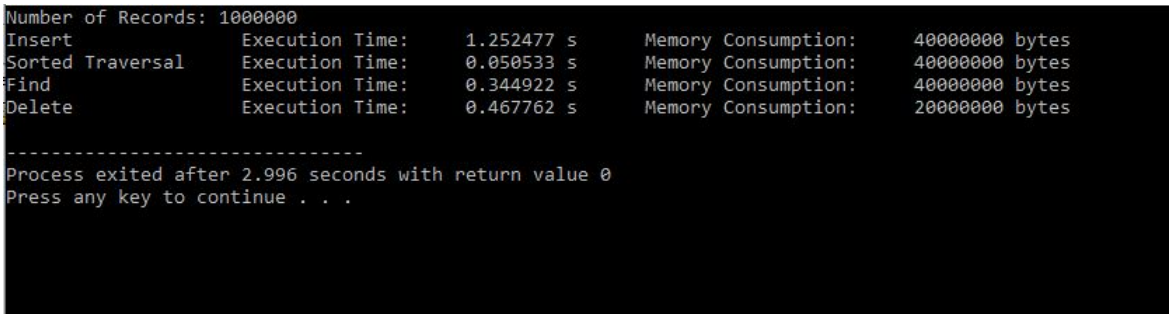

FIGURE 6.4: Results for tree implementation with data size 1000000.

Chapter 7

Results

No. of Records	Data Structure	Execution Time (s)					Memory Consumption (bytes)				
		Insert	Find	Sorted		Delete	Insert	Find	Sorted		Delete
1000	Hash Table	0.000054	0.000015	0.000120	0.008748	0.000039	36280	36280	40280	36280	36280
	Array	0.000036	0.000594	0.000103		0.000841	24016	24016	24016		24016
	Linked List										
	Tree	0.000338	0.000055	0.000013		0.000080	40000	40000	40000		20000
10000	Hash Table	0.000785	0.000317	0.002094	0.864086	0.000342	360328	360328	400328	360328	360328
	Array	0.000146	0.064914	0.001254		0.057418	240016	240016	240016		240016
	Linked List										
	Tree	0.003853	0.000838	0.000120		0.001143	400000	400000	400000		200000
100000	Hash Table	0.006306	0.002778	0.018601	90.938276	0.003380	3600040	3600040	4000040	3600040	3600040
	Array	0.001644	5.140638	0.015411		5.141023	2400016	2400016	2400016		2400016
	Linked List										
	Tree	0.072999	0.017485	0.002779		0.026487	4000000	4000000	4000000		2000000
1000000	Hash Table	0.090509	0.038666	-	-	0.046859	36000184	36000184	-	-	36000184
	Array	0.016733	706.543014	-		770.063951	24000016	24000016	-		24000016
	Linked List			-					-		
	Tree	1.252477	0.344922	0.050533		0.467762	40000000	40000000	40000000		20000000

FIGURE 7.1: Combined results for all data structures and operations.

References

[1]