ANALYSIS OF BINARY SEARCH TREE – AVL TREE – TREAPS

TEST FILE 1 : TEST_1.txt

Total operrations : 10000

No of insertions: 7325

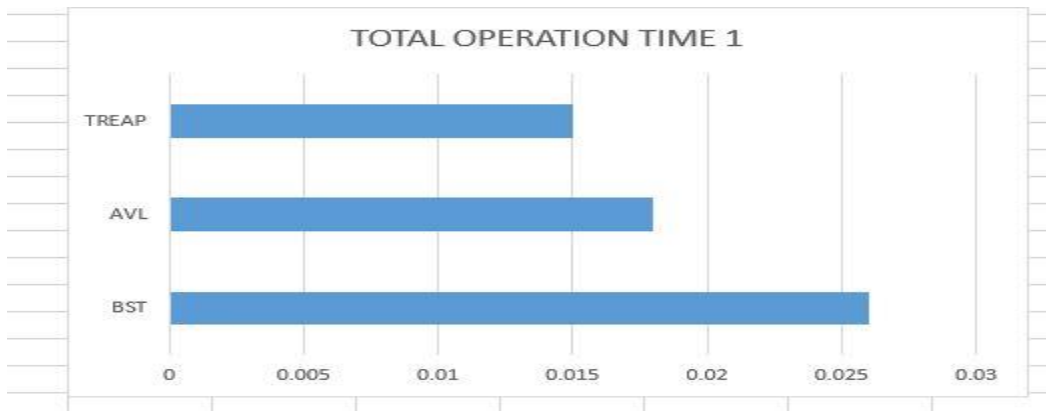**No of deletions: 2675**

PARAMETERS:

---n = number of nodes

---log n is of base 2

1. **TOTAL TIME OF OPERATIONS (MACHINE DEPENDENT)**

TREES	EMPIRICAL VALUE
BST	0.026s
AVL	0.018s
TREAP	0.015s

2. **TREE HEIGHT OF FINAL TREE**

TREES	THEORATICAL VALUE(min – max)	EMPIRICAL VALUE
BST	O(log n) to O(n) =12.18 - 4649	29
AVL	O(log n)=13	15
TREAP	O(log n) to O(n) =12.18 - 4649	30

3. **AVERAGE HEIGHT OF NODES IN FINAL TREE**

TREES	EMPIRICAL VALUE
BST	3.288817
AVL	1.316689
TREAP	3.439785

4. **KEY COMPARISIONS**

TREES	EMPIRICAL VALUE
BST	74228
AVL	106394
TREAP	84453

BST KEY COMPARE

KEY COMPARISIONS
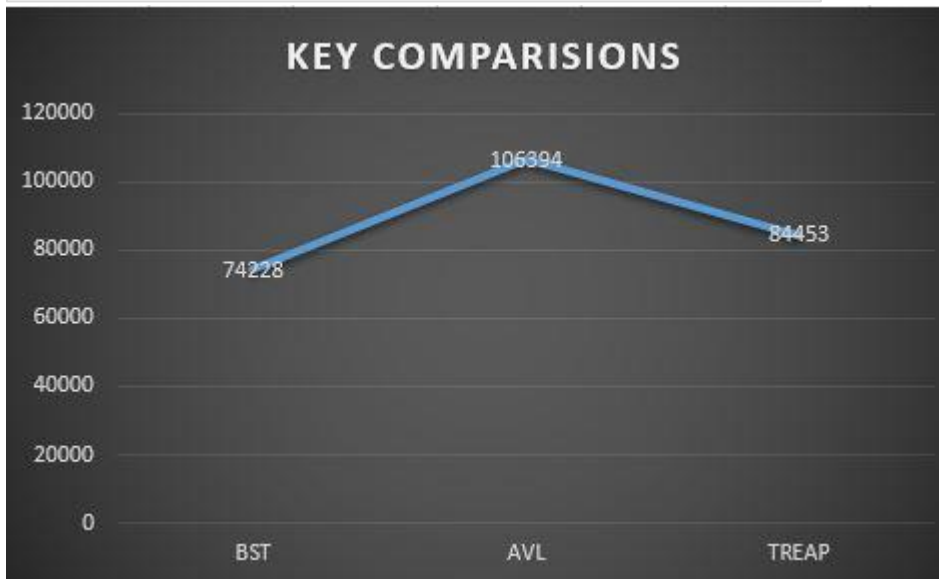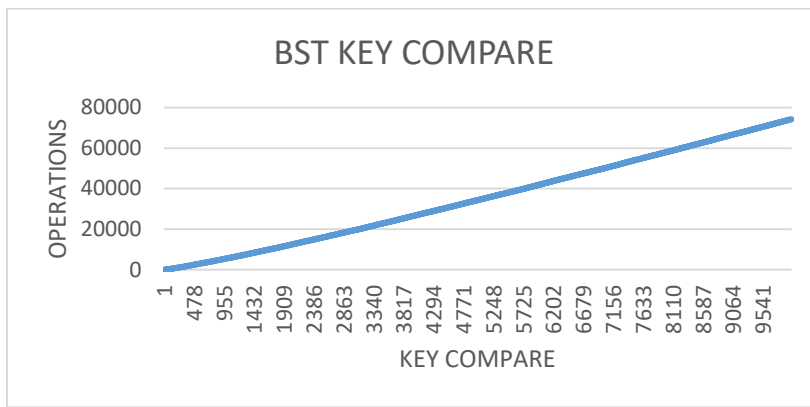
5. **NUMBER OF ROTATIONS**

TREES	EMPIRICAL VALUE
AVL	5853
TREAP	17125

ROTAIONS

AVL   TREAP
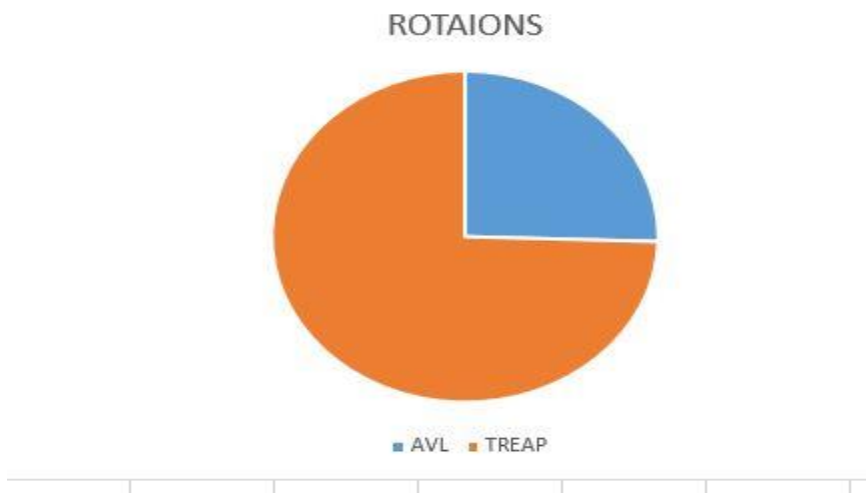
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RESULTS OF TEST_1.txt-------------------------------------------------------------

TOTAL OPERATION TIME BST: 0.026000
TOTAL OPERATION TIME TREAP: 0.015000
TOTAL OPERATION TIME AVL: 0.018000


TOTAL ROTATIONS AVL: 5853
TOTAL ROTATIONS TREAP: 17125


TOTAL KEY COMPARISIONS BST: 74228
TOTAL KEY COMPARISIONS TREAP: 84453
TOTAL KEY COMPARISIONS AVL: 106394


FINAL TREE HEIGHT BST: 29
FINAL TREE HEIGHT TREAP: 30
FINAL TREE HEIGHT AVL: 15


AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE BST: 3.288817
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE TREAP: 3.439785
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE AVL: 1.316689
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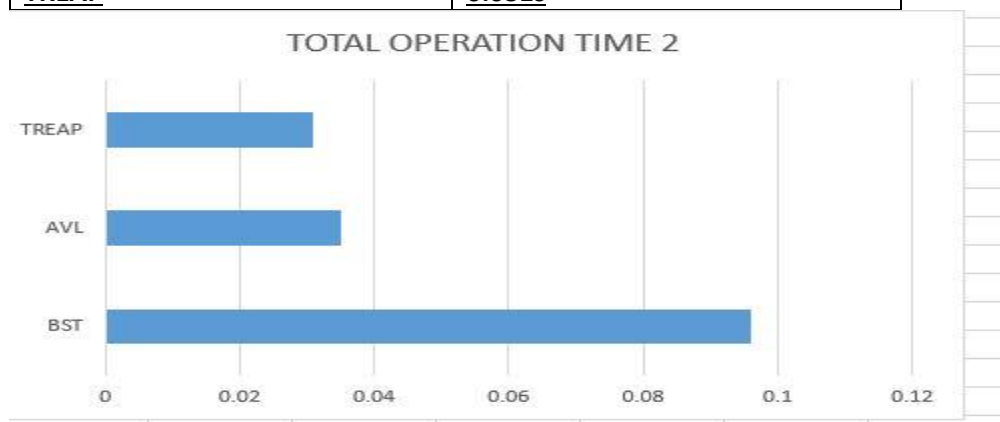**TEST FILE 2 : TEST_2.txt**

Total operrations : 20000

No of insertions: 14270

No of deletions: 5730

PARAMETERS:

1. **TOTAL TIME OF OPERATIONS(MACHINE DEPENDENT)**

TREES	EMPIRICAL VALUE
BST	0.096s
AVL	0.035s
TREAP	0.031s

TOTAL OPERATION TIME 2

2   TREE HEIGHT OF FINAL TREE

TREES	THEORATICAL VALUE	EMPIRICAL VALUE
BST	13.45 – 11192	32
AVL	13	16
TREAP	13.45 - 11192	34

3   TREE HEIGHT OF NODES IN FINAL TREE

TREES	EMPIRICAL VALUE
BST	3.301974
AVL	3.163594
TREAP	3.446976

4   KEY COMPARISIONS

TREES	EMPIRICAL VALUE
BST	176250
AVL	251667
TREAP	203415
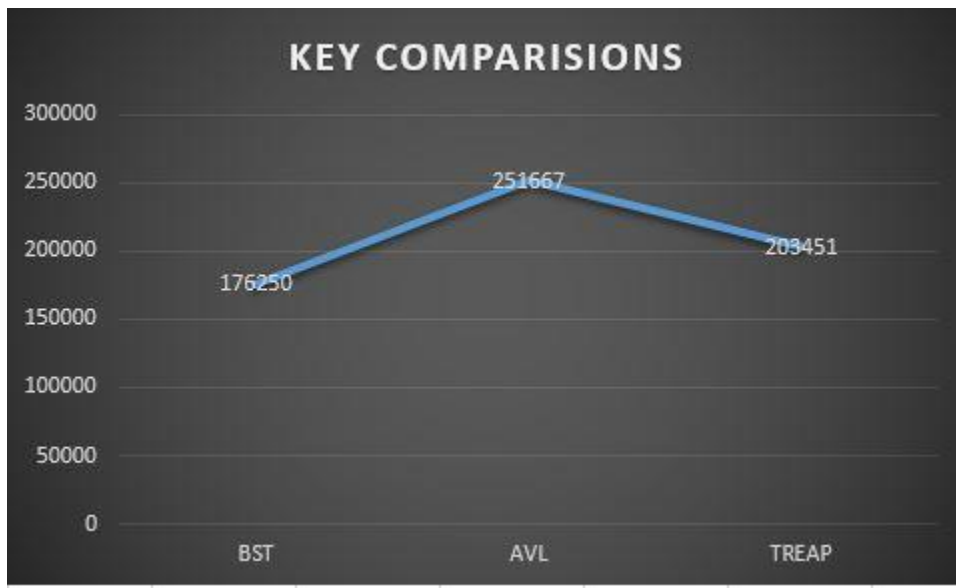
5   NUMBER OF ROTATIONS

TREES	EMPIRICAL VALUE
AVL	9882
TREAP	29725
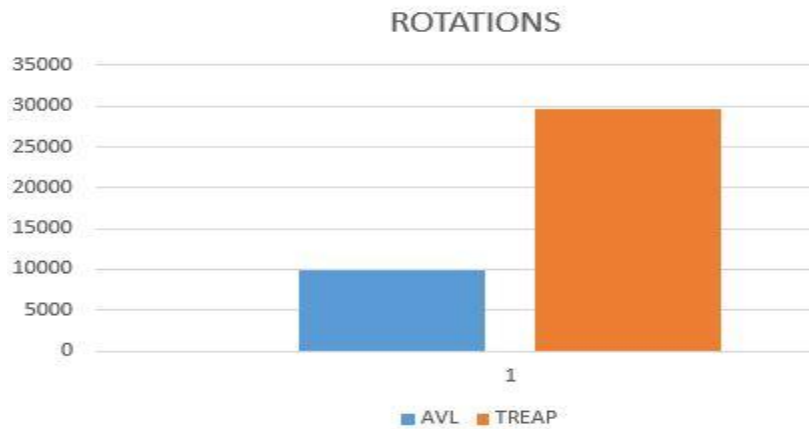
ROTATIONS


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RESULTS OF TEST_2.txt--------------------------------------------------------------

TOTAL OPERATION TIME BST: 0.096000
TOTAL OPERATION TIME TREAP: 0.031000
TOTAL OPERATION TIME AVL: 0.035000


TOTAL ROTATIONS AVL: 9882
TOTAL ROTATIONS TREAP: 29725


TOTAL KEY COMPARISIONS BST: 176250
TOTAL KEY COMPARISIONS TREAP: 203415
TOTAL KEY COMPARISIONS AVL: 251667


FINAL TREE HEIGHT BST: 32
FINAL TREE HEIGHT TREAP: 34
FINAL TREE HEIGHT AVL: 16


AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE BST: 3.301974
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE TREAP: 3.446976
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE AVL: 3.163594
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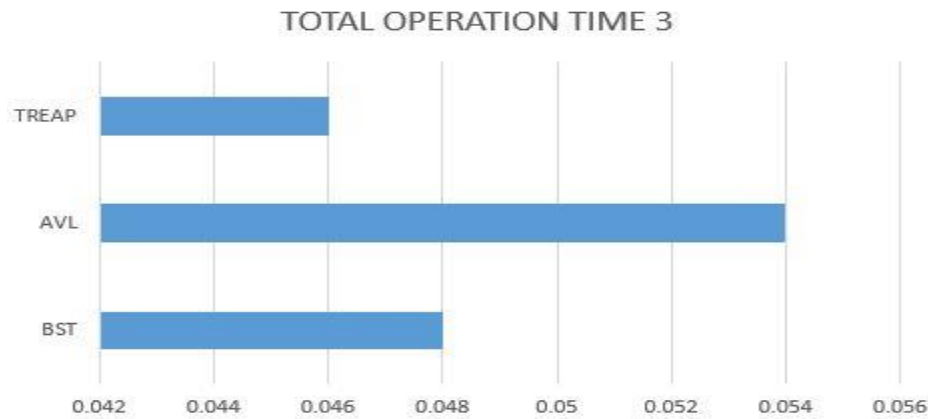**TEST FILE 3 : TEST_3.txt**

Total operrations : 30000

No of insertions: 20556

No of deletions: 9444

PARAMETERS:

1. **TOTAL TIME OF OPERATIONS(MACHINE DEPENDENT)**

TREES	EMPIRICAL VALUE
BST	0.048s
AVL	0.054s
TREAP	0.046s

TOTAL OPERATION TIME 3

2 TREE HEIGHT OF FINAL TREE

TREES	THEORATICAL VALUE	EMPIRICAL VALUE
BST	13.89 -15250	32
AVL	13.99	17
TREAP	13.89 - 15250	35

3 AVERAGE HEIGHT OF NODES IN FINAL TREE

TREES	EMPIRICAL VALUE
BST	3.301029
AVL	2.160227
TREAP	3.453478

4 KEY COMPARISIONS

TREES	EMPIRICAL VALUE
BST	278435
AVL	391194
TREAP	327421

KEY COMPARISIONS
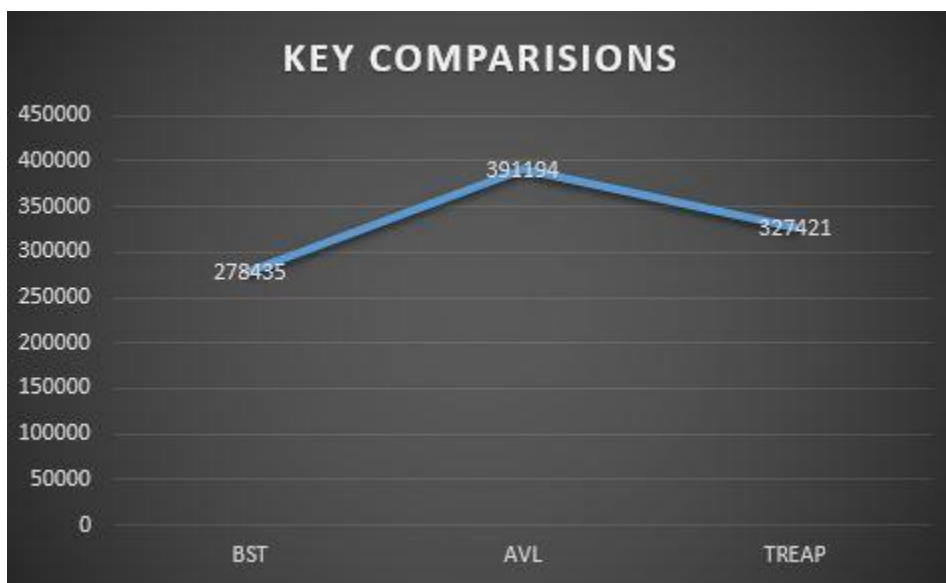
5 NUMBER OF ROTATIONS

TREES	EMPIRICAL VALUE
AVL	11245
TREAP	35885
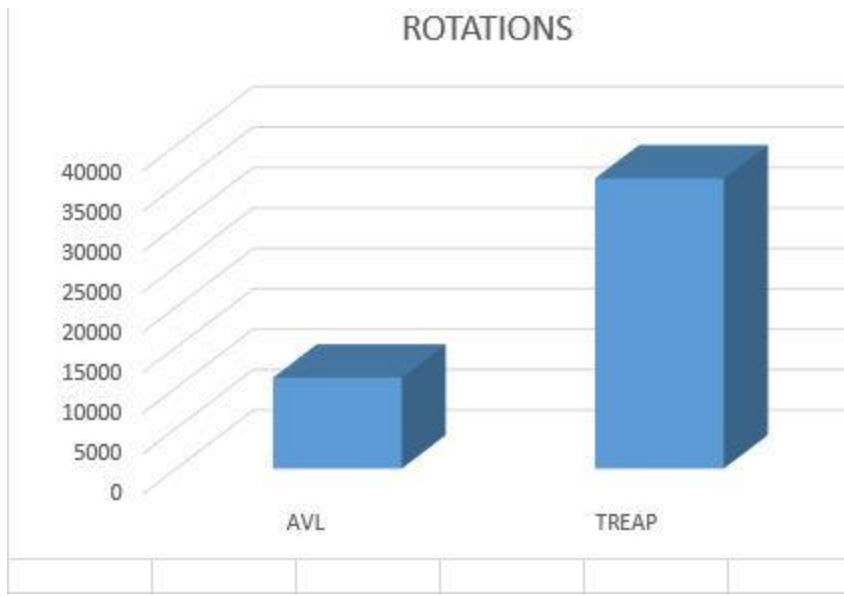
ROTATIONS

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RESULTS OF TEST_3.txt------------------------------------------------------------

TOTAL OPERATION TIME BST: 0.048000
TOTAL OPERATION TIME TREAP: 0.046000
TOTAL OPERATION TIME AVL: 0.054000


TOTAL ROTATIONS AVL: 11245
TOTAL ROTATIONS TREAP: 35885


TOTAL KEY COMPARISIONS BST: 278435
TOTAL KEY COMPARISIONS TREAP: 327421
TOTAL KEY COMPARISIONS AVL: 391194


FINAL TREE HEIGHT BST: 32
FINAL TREE HEIGHT TREAP: 35
FINAL TREE HEIGHT AVL: 17


AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE BST: 3.301029
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE TREAP: 3.453478
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE AVL: 2.160227
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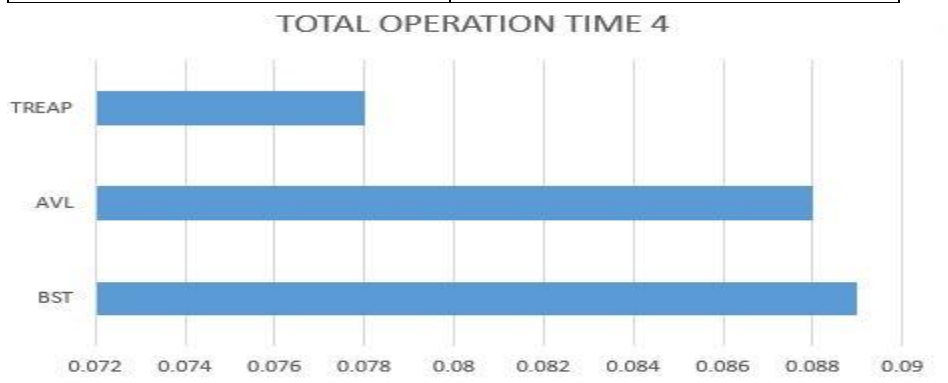**TEST FILE 4 : TEST_4.txt**

Total operrations : 50000

No of insertions: 30299

No of deletions: 19701

PARAMETERS:

    1.   **TOTAL TIME OF OPERATIONS(MACHINE DEPENDENT)**

TREES	EMPIRICAL VALUE
BST	0.089s
AVL	0.088s
TREAP	0.078s

TOTAL OPERATION TIME 4

2 **TREE HEIGHT OF FINAL TREE**

TREES	THEORATICAL VALUE	EMPIRICAL VALUE
BST	13.52 – 11746	30
AVL	13	16
TREAP	13.52 - 11746	34

3 **AVERAGE HEIGHT OF NODES IN FINAL TREE**

TREES	EMPIRICAL VALUE
BST	3.223206
AVL	3.335612
TREAP	3.461139

4 **KEY COMPARISIONS**

TREES	EMPIRICAL VALUE
BST	468061
AVL	650598
TREAP	607567

KEY COMPARISIONS
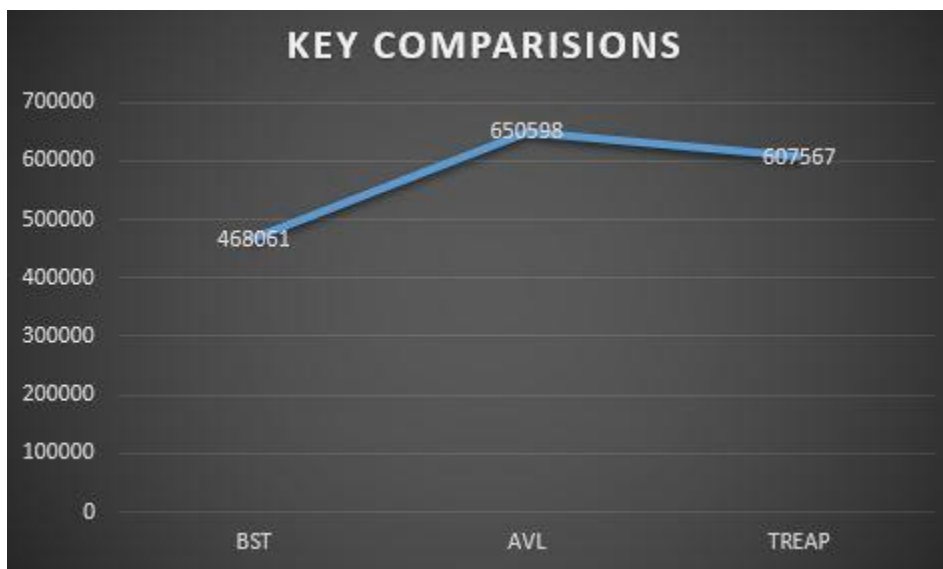
5   NUMBER OF ROTATIONS

TREES	EMPIRICAL VALUE
AVL	16509
TREAP	51530

ROTATIONS

■ AVL   ■ TREAP
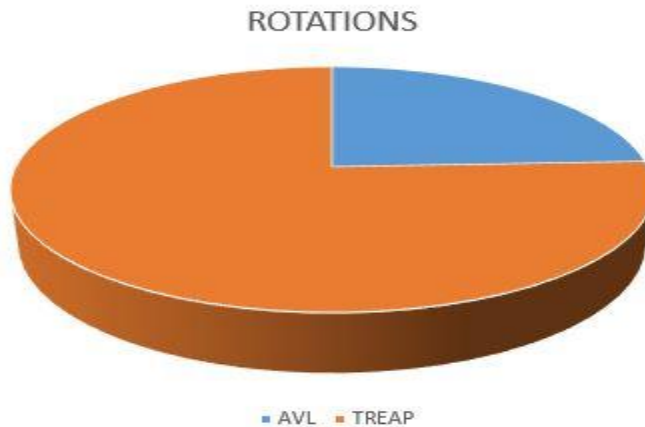
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RESULTS OF TEST_4.txt-----------------------------------------------------------------

TOTAL OPERATION TIME BST: 0.089000
TOTAL OPERATION TIME TREAP: 0.078000
TOTAL OPERATION TIME AVL: 0.088000


TOTAL ROTATIONS AVL: 16509
TOTAL ROTATIONS TREAP: 51530


TOTAL KEY COMPARISIONS BST: 468061
TOTAL KEY COMPARISIONS TREAP: 607567
TOTAL KEY COMPARISIONS AVL: 650598


FINAL TREE HEIGHT BST: 30
FINAL TREE HEIGHT TREAP: 34
FINAL TREE HEIGHT AVL: 16


AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE BST: 3.223206
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE TREAP: 3.461139
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE AVL: 3.335612
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TEST FILE 5 : TEST_5.txt

Total operrations : 65000

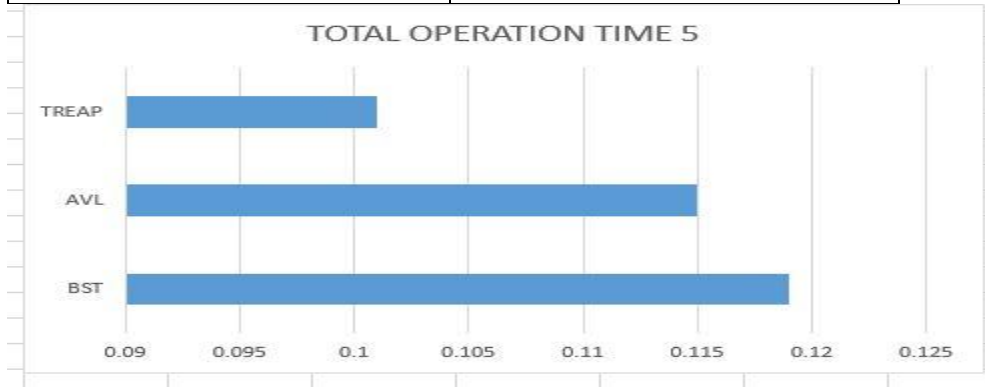**No of insertions: 32760**

No of deletions: 32240

PARAMETERS:

1. **TOTAL TIME OF OPERATIONS(MACHINE DEPENDENT)**

TREES	EMPIRICAL VALUE
BST	0.119s
AVL	0.115s
TREAP	0.101s

2. **TREE HEIGHT OF FINAL TREE**

TREES	THEORATICAL VALUE	EMPIRICAL VALUE
BST	9.03 -522	21
AVL	7.99	11
TREAP	9.030 - 522	17

3. **AVERAGE HEIGHT OF NODES IN FINAL TREE**

TREES	EMPIRICAL VALUE
BST	3.151052
AVL	4.725490
TREAP	3.349904

4. **KEY COMPARISIONS**

TREES	EMPIRICAL VALUE
BST	585416
AVL	816805
TREAP	805076

5. **NUMBER OF ROTATIONS**

TREES	EMPIRICAL VALUE
AVL	23960
TREAP	74575

ROTATION

■ AVL ■ TREAP

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RESULTS OF TEST_5.txt-------------------------------------------------------------

TOTAL OPERATION TIME BST: 0.119000
TOTAL OPERATION TIME TREAP: 0.101000
TOTAL OPERATION TIME AVL: 0.115000


TOTAL ROTATIONS AVL: 23960
TOTAL ROTATIONS TREAP: 74575


TOTAL KEY COMPARISIONS BST: 585416
TOTAL KEY COMPARISIONS TREAP: 805076
TOTAL KEY COMPARISIONS AVL: 816805


FINAL TREE HEIGHT BST: 21
FINAL TREE HEIGHT TREAP: 17
FINAL TREE HEIGHT AVL: 11


AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE BST: 3.151052
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE TREAP: 3.349904
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE AVL: 4.725490
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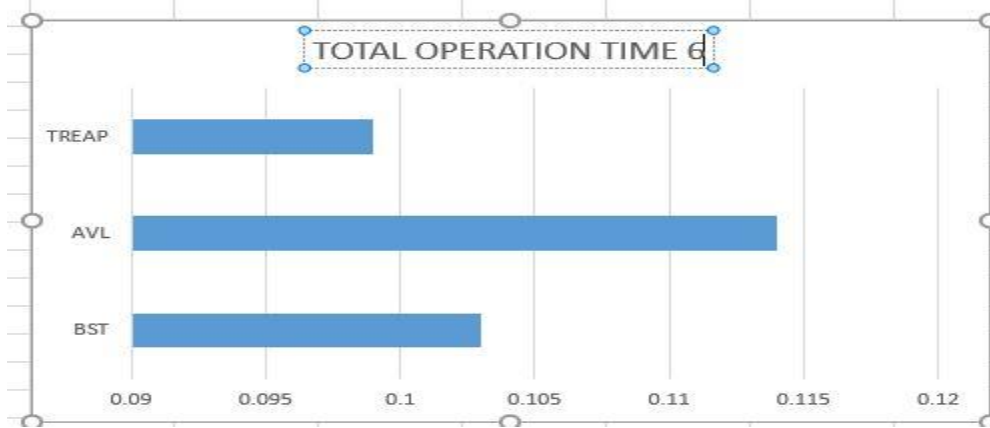**TEST FILE 6 : TEST_6.txt**

Total operrations : 65500

No of insertions:32768

No of deletions: 32732

PARAMETERS:

1. <u>**TOTAL TIME OF OPERATIONS(MACHINE DEPENDENT)**</u>

TREES	EMPIRICAL VALUE
BST	0.103s
AVL	0.114s
TREAP	0.099s

2. <u>**TREE HEIGHT OF FINAL TREE**</u>

TREES	THEORATICAL VALUE	EMPIRICAL VALUE
BST	5.16 – 35	9
AVL	5	6
TREAP	5.16 - 35	8

3. <u>**AVERAGE HEIGHT OF NODES IN FINAL TREE**</u>

TREES	EMPIRICAL VALUE
BST	2.722222
AVL	2.483871
TREAP	2.777778

4. <u>**KEY COMPARISIONS**</u>

TREES	EMPIRICAL VALUE
BST	549300
AVL	798469
TREAP	774954

5. NUMBER OF ROTATIONS

TREES	EMPIRICAL VALUE
AVL	33211
TREAP	97625
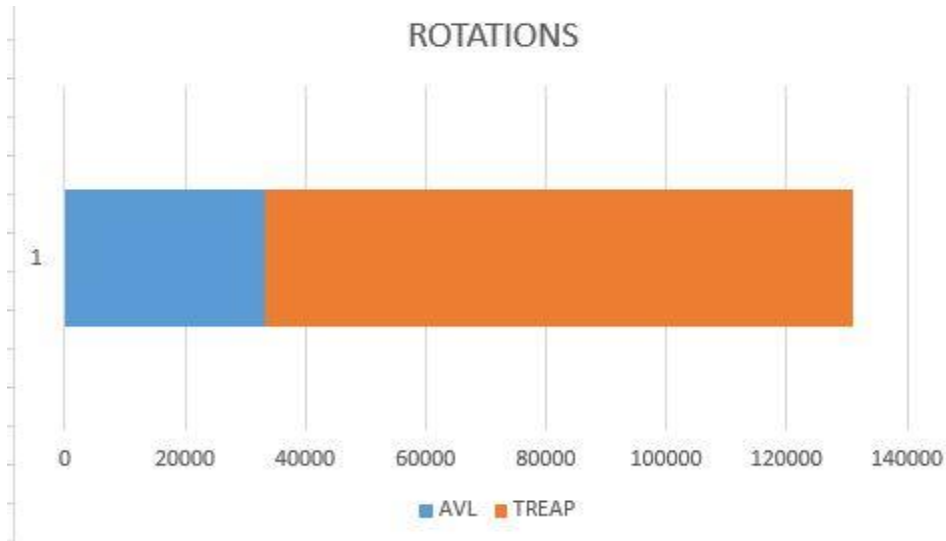

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RESULTS OF TEST_6.txt--------------------------------------------------------

TOTAL OPERATION TIME BST: 0.103000
TOTAL OPERATION TIME TREAP: 0.099000
TOTAL OPERATION TIME AVL: 0.114000


TOTAL ROTATIONS AVL: 33211
TOTAL ROTATIONS TREAP: 97625


TOTAL KEY COMPARISIONS BST: 549300
TOTAL KEY COMPARISIONS TREAP: 774954
TOTAL KEY COMPARISIONS AVL: 798469


FINAL TREE HEIGHT BST: 9
FINAL TREE HEIGHT TREAP: 8
FINAL TREE HEIGHT AVL: 6


AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE BST: 2.722222
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE TREAP: 2.777778
AVERAGE HEIGHT OF EVERY NODE IN FINAL TREE AVL: 2.483871
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FINAL CONCLUSION ON PERFORMANCE OF THESE 3 TREES:

PARAMETERS	EFFICIENT TREE	
TOTAL TIME OF OPERATIONS	TREAP	TREAP TIME IS LESS THAN AVL AND BST
TREE HEIGHT OF FINAL TREE	AVL	AVL VALUE IS LESS THAN BST AND TREAP
AVERAGE HEIGHT OF NODE IN FINAL TREE	BST AND AVL	BST AND AVL VALUES ARE CLOSE AND LESS THAN TREAP
KEY COMPARISIONS	BST	BST < TREAP < AVL
NO OF ROTATIONS	AVL	AVL < TREAP