Name: Samuel Sovi

Assignment: 10

Complete & Correct:	48 / 48
Tests:	0 / 0
Format and Comments:	6 / 6
Writeup:	6 / 6
Total Score:	60 / 60

Comments:

1. good job!

Unit test output:

```
==783520== Memcheck, a memory error detector
==783520== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==783520== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==783520== Command: ./hw10_test
==783520==
[======] Running 28 tests from 1 test suite.
[-----] Global test environment set-up.
[-----] 28 tests from BasicBTreeMapTests
[ RUN
          ] BasicBTreeMapTests.EmptyCheck
        OK ] BasicBTreeMapTests.EmptyCheck (11 ms)
Γ
[ RUN
           ] BasicBTreeMapTests.InOrderInsertAndContainsCheck
Γ
        OK ] BasicBTreeMapTests.InOrderInsertAndContainsCheck (21 ms)
[ RUN
           ] \ \ Basic B Tree Map Tests. Reverse Order Insert And Contains Check
Γ
        OK ] BasicBTreeMapTests.ReverseOrderInsertAndContainsCheck (5 ms)
[ RUN
           ] BasicBTreeMapTests.OutOfOrderInsertAndContainsCheck
Γ
        OK ] BasicBTreeMapTests.OutOfOrderInsertAndContainsCheck (4 ms)
[ RUN
           ] BasicBTreeMapTests.RValueAccessCheck
Γ
        OK ] BasicBTreeMapTests.RValueAccessCheck (5 ms)
[ RUN
           ] BasicBTreeMapTests.LValueAccessCheck
Γ
        OK ] BasicBTreeMapTests.LValueAccessCheck (3 ms)
[ RUN
          ] BasicBTreeMapTests.RootEraseTest
Γ
       OK ] BasicBTreeMapTests.RootEraseTest (4 ms)
[ RUN
           ] BasicBTreeMapTests.Case1EraseTest
        OK ] BasicBTreeMapTests.Case1EraseTest (10 ms)
[ RUN
           ] BasicBTreeMapTests.Case3ALeftHas2BothLeavesEraseTest
Γ
        OK ] BasicBTreeMapTests.Case3ALeftHas2BothLeavesEraseTest (6 ms)
[ RUN
          Γ
        OK ] BasicBTreeMapTests.Case3ALeftHas2BothInternalNodesEraseTest (5 ms)
[ RUN
           ] BasicBTreeMapTests.Case3ARightHas2BothLeavesEraseTest
        OK ] BasicBTreeMapTests.Case3ARightHas2BothLeavesEraseTest (5 ms)
Ε
[ RUN
           ] BasicBTreeMapTests.Case3ARightHas2BothInternalNodesEraseTest
        OK ] BasicBTreeMapTests.Case3ARightHas2BothInternalNodesEraseTest (5 ms)
Γ
[ RUN
           ] \ Basic B Tree Map Tests. Case 3 B Right Has 1 Both Leaves Erase Test
        OK ] BasicBTreeMapTests.Case3BRightHas1BothLeavesEraseTest (5 ms)
Γ
[ RUN
           ] BasicBTreeMapTests.Case3BRightHas1BothInternalNodesEraseTest
Г
        OK ] BasicBTreeMapTests.Case3BRightHas1BothInternalNodesEraseTest (5 ms)
[ RUN
           ] BasicBTreeMapTests.Case3BLeftHas1BothLeavesEraseTest
          ] BasicBTreeMapTests.Case3BLeftHas1BothLeavesEraseTest (5 ms)
Γ
[ RUN
           ] BasicBTreeMapTests.Case3BLeftHas1BothInternalNodesEraseTest
```

```
OK ] BasicBTreeMapTests.Case3BLeftHas1BothInternalNodesEraseTest (5 ms)
Γ
[ RUN
          ] BasicBTreeMapTests.Case2AEraseTest
Ε
        OK ] BasicBTreeMapTests.Case2AEraseTest (5 ms)
          ] BasicBTreeMapTests.Case2BEraseTest
[ RUN
        OK ] BasicBTreeMapTests.Case2BEraseTest (4 ms)
Γ
[ RUN
          ] BasicBTreeMapTests.CaseTwoCEraseTest
        OK ] BasicBTreeMapTests.CaseTwoCEraseTest (4 ms)
Γ
[ RUN
          ] BasicBTreeMapTests.ExtendedEraseCheck
OK ] BasicBTreeMapTests.ExtendedEraseCheck (7 ms)
[ RUN
           ] BasicBTreeMapTests.FindKeysTests
Γ
        OK ] BasicBTreeMapTests.FindKeysTests (14 ms)
[ RUN
           ] BasicBTreeMapTests.SortedKeyCheck
Γ
        OK ] BasicBTreeMapTests.SortedKeyCheck (5 ms)
[ RUN
           ] BasicBTreeMapTests.InvalidKeyCheck
        OK ] BasicBTreeMapTests.InvalidKeyCheck (30 ms)
Γ
[ RUN
           ] BasicBTreeMapTests.DestructorCheck
        OK ] BasicBTreeMapTests.DestructorCheck (4 ms)
Γ
[ RUN
           ] BasicBTreeMapTests.CopyConstructorCheck
        OK ] BasicBTreeMapTests.CopyConstructorCheck (6 ms)
Γ
[ RUN
          ] BasicBTreeMapTests.CopyAssignmentCheck
        OK ] BasicBTreeMapTests.CopyAssignmentCheck (9 ms)
Γ
[ RUN
          ] BasicBTreeMapTests.MoveConstructorCheck
Γ
        OK ] BasicBTreeMapTests.MoveConstructorCheck (6 ms)
[ RUN
          ] BasicBTreeMapTests.MoveAssignmentCheck
Γ
        OK ] BasicBTreeMapTests.MoveAssignmentCheck (8 ms)
[-----] 28 tests from BasicBTreeMapTests (229 ms total)
[-----] Global test environment tear-down
[======] 28 tests from 1 test suite ran. (269 ms total)
[ PASSED ] 28 tests.
==783520==
==783520== HEAP SUMMARY:
==783520==
              in use at exit: 0 bytes in 0 blocks
==783520== total heap usage: 1,507 allocs, 1,507 frees, 180,538 bytes allocated
==783520==
==783520== All heap blocks were freed -- no leaks are possible
==783520== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```

Performance test output:

```
# All times in milliseconds (msec)
# Column 1 = input data size
# Column 2 = avl map insert
# Column 3 = 2-3-4 tree map insert
# Column 4 = avl map erase
# Column 5 = 2-3-4 tree map erase
# Column 6 = avl map contains
# Column 7 = 2-3-4 tree map contains
# Column 8 = avl map find range
# Column 9 = 2-3-4 tree map find range
# Column 10 = avl map next key
# Column 11 = 2-3-4 tree map next key
# Column 12 = avl map sorted keys
# Column 13 = 2-3-4 tree map sorted keys
# Column 14 = avl map height
# Column 15 = 2-3-4 tree map height
# Column 16 = log base 2 of input size
 \begin{smallmatrix} 0 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 &
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