

CIS263 Assignment Six

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Programmatically implement a B-Tree data structure based on the methods and pseudocode shown below. Populate the B-tree using all the letters of the alphabet using $T = 2$ and then $T = 3$. Be sure to select an insert sequence that properly demonstrates the full functionality of your B-tree implementation. The B-tree should output the contents of the tree in an easy-to-read format. You may work in a group of two to complete this assignment. Please make sure both students names appear in the comments at the top of the program and only one student submits the work.

Approved programming languages: C, C++, C#, Python, Java.

Hand-in:

1. The output demonstrating the functionality of your program
2. A file containing the implementation source code (no zip files).

Grading Rubric:

B-Tree Implementation  Weight <input type="text" value="60.00"/> %	<div>Percent <input type="text" value="0.00"/></div> <div>Not implemented or not implemented using the supplied pseudocode</div> <div>abc </div>	<div>Percent <input type="text" value="50.00"/></div> <div>Some of the methods follow the supplied pseudocode</div> <div>abc </div>	<div>Percent <input type="text" value="100.00"/></div> <div>Implemented and follows the supplied pseudocode</div> <div>abc </div>
Tree Print Method  Weight <input type="text" value="20.00"/> %	<div>Percent <input type="text" value="0.00"/></div> <div>Not implemented</div> <div>abc </div>	<div>Percent <input type="text" value="50.00"/></div> <div>Tree output, but difficult to understand structure</div> <div>abc </div>	<div>Percent <input type="text" value="100.00"/></div> <div>Tree output and structure is clearly represented visually</div> <div>abc </div>
Functionality demonstrated  Weight <input type="text" value="20.00"/> %	<div>Percent <input type="text" value="0.00"/></div> <div>Not demonstrated clearly</div> <div>abc </div>	<div>Percent <input type="text" value="50.00"/></div> <div>Limited demonstration</div> <div>abc </div>	<div>Percent <input type="text" value="100.00"/></div> <div>Clearly demonstrated</div> <div>abc </div>

See blackboard for point breakdown.

Pseudo-code for B-Tree from the textbook:

B-TREE-CREATE(T)

```
1   $x = \text{ALLOCATE-NODE}()$ 
2   $x.\text{leaf} = \text{TRUE}$ 
3   $x.n = 0$ 
4   $\text{DISK-WRITE}(x)$ 
5   $T.\text{root} = x$ 
```

B-TREE-SPLIT-CHILD(x, i)

```
1   $z = \text{ALLOCATE-NODE}()$ 
2   $y = x.c_i$ 
3   $z.\text{leaf} = y.\text{leaf}$ 
4   $z.n = t - 1$ 
5  for  $j = 1$  to  $t - 1$ 
6       $z.\text{key}_j = y.\text{key}_{j+t}$ 
7  if not  $y.\text{leaf}$ 
8      for  $j = 1$  to  $t$ 
9           $z.c_j = y.c_{j+t}$ 
10  $y.n = t - 1$ 
11 for  $j = x.n + 1$  downto  $i + 1$ 
12      $x.c_{j+1} = x.c_j$ 
13  $x.c_{i+1} = z$ 
14 for  $j = x.n$  downto  $i$ 
15      $x.\text{key}_{j+1} = x.\text{key}_j$ 
16  $x.\text{key}_i = y.\text{key}_t$ 
17  $x.n = x.n + 1$ 
18  $\text{DISK-WRITE}(y)$ 
19  $\text{DISK-WRITE}(z)$ 
20  $\text{DISK-WRITE}(x)$ 
```

B-TREE-INSERT(T, k)

```
1   $r = T.\text{root}$ 
2  if  $r.n == 2t - 1$ 
3       $s = \text{ALLOCATE-NODE}()$ 
4       $T.\text{root} = s$ 
5       $s.\text{leaf} = \text{FALSE}$ 
6       $s.n = 0$ 
7       $s.c_1 = r$ 
8      B-TREE-SPLIT-CHILD( $s, 1$ )
9      B-TREE-INSERT-NONFULL( $s, k$ )
10 else B-TREE-INSERT-NONFULL( $r, k$ )
```

B-TREE-INSERT-NONFULL(x, k)

```
1   $i = x.n$ 
2  if  $x.leaf$ 
3      while  $i \geq 1$  and  $k < x.key_i$ 
4           $x.key_{i+1} = x.key_i$ 
5           $i = i - 1$ 
6       $x.key_{i+1} = k$ 
7       $x.n = x.n + 1$ 
8      DISK-WRITE( $x$ )
9  else while  $i \geq 1$  and  $k < x.key_i$ 
10      $i = i - 1$ 
11      $i = i + 1$ 
12     DISK-READ( $x.c_i$ )
13     if  $x.c_i.n == 2t - 1$ 
14         B-TREE-SPLIT-CHILD( $x, i$ )
15         if  $k > x.key_i$ 
16              $i = i + 1$ 
17     B-TREE-INSERT-NONFULL( $x.c_i, k$ )
```