

PROGRAM 9 / CSC1310

AVL (BALANCED) TREES



Image credit: <https://www.quora.com/What-is-the-Krabby-Patty-secret-formula> (modified by me on memgenerator.net)

IMPORTANT DATES

Assignment Date: Monday, April 16, 2018

Due Date: Monday, April 23, 2018

PROGRAM ASSIGNMENT DESCRIPTION

Take program 8 and make sure the Binary Search Tree is always balanced (is an AVL Tree). You basically will be adding several private functions to your BinaryTree class. Also, display the tree horizontally.

FILES THAT SHOULD BE INCLUDED IN YOUR SUBMISSION

- BinaryTree.h
- BinaryTree.cpp
- KrustyKrab.cpp (driver)
- Makefile
- runProgram.bat
- TEST_CASE.txt

PROGRAM SPECIFICATIONS (DIRECTIONS ON HOW TO WRITE THE PROGRAM)

BINARY TREE CLASS

ADD THE FOLLOWING FUNCTIONS TO THE BINARYTREE CLASS:

- **balance()** – balance the tree into an avl tree
- **height()** – find the height of a BST node and return it from this function
- **diff()** – find the height difference between the left & right subtrees of a given node and return it from this function
- Create a function for each possible rotation:
 - **rr_rotation** – perform right-right rotation on a given parent node
 - **ll_rotation** – performs left-left rotation on a given parent node
 - **lr_rotation** – performs left-right rotation on a given parent node
 - **rl_rotation** – performs right-left rotation on a given parent node
- **display()** – this function will display a HORIZONTAL view of the tree's customer names (this must be a public function). Notice that it isn't the full name – it is just the first two characters of the names.

Here is the Current BST in horizontal format:

```

                Sq
              Sp
            Sa  Sh
          Pe
    ROOT-> Mr  Pa
              Me
            La  Ma
          Ga
        Eu    Fl
      Ba     Di
```

MODIFY THE FOLLOWING FUNCTIONS IN THE BINARYTREE CLASS:

- **insert()** – the insert function should call the balance function

REMOVE THE FOLLOWING FUNCTIONS

- **delete()**
- **deleteNode()**
- **makeDeletion()**

KRUSTYKRAB.CPP (DRIVER)

CHANGE #2 in the menu (which was to remove a customer's data) to read, "Display the Balanced BST horizontally." Then, call the **display()** binary search tree function if the user chooses this option.

```
Welcome to the Krusty Krab!  
Choose one of the following options:  
1. Enter customer data.  
2. Display the Balanced BST horizontally.  
3. Get statistics on Krabby Patties.  
4. Search for a customer's data.  
5. End Program.  
ENTER 1-5:
```

READABILITY OF OUTPUT & CODE DOCUMENTATION

- Make sure that your output looks similar to my sample output (below). When I run your program, it shouldn't make me want to scream. It should be extremely readable and user-friendly.
- **For this program, don't worry about comments except put your NAME at the top of all files that you modify!!!**

WHAT TO TURN IN

Zip ALL the files required to compile & run the program, in a single zipped file named whatever you want.

Then, upload this zip file to the assignment folder in ilearn. I will **remove one point** if you turn in unzipped files. Programs that do not include all the files listed in the "FILES" section above **will not be graded**.



Image credit: <https://funnyjunk.com/Well+technology+has+reached+its+peak/funny-pictures/5353506/23>

SAMPLE OUTPUT

```
C:\Windows\System32\cmd.exe
C:\Users\acrockett\Desktop\CSC1310 Spring 2018\PROGRAMS\PROGRAM 9\solution>KrustyKrab

      / \   / \   / \   / \   / \   / \   / \   / \   / \   / \
     /___\/___\/___\/___\/___\/___\/___\/___\/___\/___\/___\
    /_____\_____\_____\_____\_____\_____\_____\_____\_____
   /_____\_____\_____\_____\_____\_____\_____\_____\_____
  /_____\_____\_____\_____\_____\_____\_____\_____\_____
 /_____\_____\_____\_____\_____\_____\_____\_____\_____
/_____\_____\_____\_____\_____\_____\_____\_____\_____

Welcome to the Krusty Krab!
Choose one of the following options:
1. Enter customer data.
2. Display the Balanced BST horizontally.
3. Get statistics on Krabby Patties.
4. Search for a customer's data.
5. End Program.
ENTER 1-5: 1
Enter a customer's name or -1 to quit entering data.
NAME: SpongeBob Squarepants
NUMBER KRABBY PATTIES EATEN: 52
Enter a customer's name or -1 to quit entering data.
NAME: Eugene H. Krabs
NUMBER KRABBY PATTIES EATEN: 2
Enter a customer's name or -1 to quit entering data.
NAME: Patrick Star
NUMBER KRABBY PATTIES EATEN: 182
Enter a customer's name or -1 to quit entering data.
NAME: Squidward Tentacles
NUMBER KRABBY PATTIES EATEN: 18
```

```
C:\Windows\System32\cmd.exe
Enter a customer's name or -1 to quit entering data.
NAME: Sandy Cheeks
NUMBER KRABBY PATTIES EATEN: 12
Enter a customer's name or -1 to quit entering data.
NAME: Mrs. Puff
NUMBER KRABBY PATTIES EATEN: 34
Enter a customer's name or -1 to quit entering data.
NAME: Pearl Krabs
NUMBER KRABBY PATTIES EATEN: 3
Enter a customer's name or -1 to quit entering data.
NAME: Gary the Snail
NUMBER KRABBY PATTIES EATEN: 1
Enter a customer's name or -1 to quit entering data.
NAME: Sheldon J. Plankton
NUMBER KRABBY PATTIES EATEN: 5
Enter a customer's name or -1 to quit entering data.
NAME: Mermaid Man
NUMBER KRABBY PATTIES EATEN: 89
Enter a customer's name or -1 to quit entering data.
NAME: Barnacle Boy
NUMBER KRABBY PATTIES EATEN: 19
Enter a customer's name or -1 to quit entering data.
NAME: Flying Dutchman
NUMBER KRABBY PATTIES EATEN: 93
Enter a customer's name or -1 to quit entering data.
NAME: Larry the Lobster
NUMBER KRABBY PATTIES EATEN: 8
Enter a customer's name or -1 to quit entering data.
NAME: Man Ray
```

C:\Windows\System32\cmd.exe

```
NUMBER KRABBY PATTIES EATEN: 6
Enter a customer's name or -1 to quit entering data.
NAME: Dirty Bubble
NUMBER KRABBY PATTIES EATEN: 14
Enter a customer's name or -1 to quit entering data.
NAME: -1
```

```
Welcome to the Krusty Krab!
Choose one of the following options:
1. Enter customer data.
2. Display the Balanced BST horizontally.
3. Get statistics on Krabby Patties.
4. Search for a customer's data.
5. End Program.
ENTER 1-5: 2
```

Here is the Current BST in horizontal format:

Sa

Select C:\Windows\System32\cmd.exe

Here is the Current BST in horizontal format:

```
                Sq
              Sp
            Sa    Sh
            Pe
Pa
ROOT-> Mr
      Me
    La    Ma
  Ga
Eu    Fl
      Di
    Ba
```

```
Welcome to the Krusty Krab!
Choose one of the following options:
1. Enter customer data.
2. Display the Balanced BST horizontally.
```



```
Select C:\Windows\System32\cmd.exe
3. Get statistics on Krabby Patties.
4. Search for a customer's data.
5. End Program.
ENTER 1-5: 3

LEAST NUMBER OF KRABBY PATTIES EATEN: Gary the Snail, 1 Krabby Patties
LARGEST NUMBER OF KRABBY PATTIES EATEN: Patrick Star, 182 Krabby Patties
TOTAL NUMBER OF KRABBY PATTIES EATEN: 538

Welcome to the Krusty Krab!
Choose one of the following options:
1. Enter customer data.
2. Display the Balanced BST horizontally.
3. Get statistics on Krabby Patties.
4. Search for a customer's data.
5. End Program.
ENTER 1-5: 4

Which customer are you looking for?
Barnacle Boy
Dirty Bubble
Eugene H. Krabs
Flying Dutchman
Gary the Snail
Larry the Lobster
Man Ray
```

```
Select C:\Windows\System32\cmd.exe
Man Ray
Mermaid Man
Mrs. Puff
Patrick Star
Pearl Krabs
Sandy Cheeks
Sheldon J. Plankton
SpongeBob Squarepants
Squidward Tentacles
Enter the name of the customer.
NAME: Sandy Cheeks

Sandy Cheeks ate 12 Krabby Patties

Welcome to the Krusty Krab!
Choose one of the following options:
1. Enter customer data.
2. Display the Balanced BST horizontally.
3. Get statistics on Krabby Patties.
4. Search for a customer's data.
5. End Program.
ENTER 1-5: 4

Which customer are you looking for?
Barnacle Boy
Dirty Bubble
Eugene H. Krabs
```

Select C:\Windows\System32\cmd.exe

Flying Dutchman
Gary the Snail
Larry the Lobster
Man Ray
Mermaid Man
Mrs. Puff
Patrick Star
Pearl Krabs
Sandy Cheeks
Sheldon J. Plankton
SpongeBob Squarepants
Squidward Tentacles
Enter the name of the customer.
NAME: Bob Ross

Bob Ross is not a customer of the Krusty Krab.

Welcome to the Krusty Krab!
Choose one of the following options:
1. Enter customer data.
2. Display the Balanced BST horizontally.
3. Get statistics on Krabby Patties.
4. Search for a customer's data.
5. End Program.
ENTER 1-5: 5

Goodbye!