**Augmented Red-Black Tree**

**Description:** You are expected to implement a balanced binary search tree (specifically a Red-Black (RB) - -Tree)which performs operations and queries displayed below. Then you are required to improve it by augmenting the tree structure. You must insert each line in “people.txt” to both RB-Tree and Augmented RB-tree. Assignment will be coded in Java.

**Note:** ‘people.txt’ contains*id of a person*,*birthdate of this person*(day/month/year) separated by comma (,).

Trees will be generated by the **age**.

**Task 1: Design and code a RB-­‐‐Tree data structure with the following capabilities:**

-­‐‑INSERT: insert an input item (each line in ‘people.txt’)

-­‐‑GETNUMSMALLER1: get the number of people who are born before a given input date

-­‐GETNUMSMALLER2: get the number of people who are born before a person with a given id

-­‐‑GETMAX: get maximum aged (oldest) person and print the id and birthdate of the person

-­‐‑GETMIN: get minimum aged (youngest) person and print the id and birthdate of the person

----GETNUM: get number of all people in the tree by using **in-­‐‑order tree** walk.

-­‐‑PRINT: display all items of the tree by applying **in-­‐‑order tree** walk.

**Task 2: The program should run the methods in the following order for testing.**

-­‐‑Insert all elements in the input file (people.txt)

-­‐‑Print the result of GETNUMSMALLER1 for the item with value 7/6/1991

-­‐‑Print the result of GETNUMSMALLER2 for the item with value 9988

-­‐‑Print the maximum age (with the birthdate and id)

-­‐‑Print the minimum age (with the birthdate and id)

-­‐‑Print the number of all items (GETNUM)

**Task 3: Improve the RB-­‐‐Tree class by augmenting the structure so that each node holds** an additional field**: the number of all nodes (age) that are smaller than the current node**’s **age.** Note **that you need to update this value on each insert operation.** You must update some of operations for this Augmented RB-tree. Not alloperations will be the same as in the original RB-tree. Consider the additional field and plan which operations should be updated.

An example output of your program should appear as follows (***This is just an example output which may not*** ***be correct output of your code for the ‘poeple.txt’***)

------ RB-Tree ------

All items were inserted.

The result of GETNUMSMALLER1 for the node with birthdate 7/6/1991 is 35 The result of GETNUMSMALLER2 for the node with id 9988 is 35

The maximum age of all people is 98, id : 4434, Birthdate : 1920

The minimum age of all people is 13, id : 6060, Birthdate : 2003

The number of all people is 49

------ Augmented RB-Tree ------

All items were inserted.

The result of GETNUMSMALLER1 for the node with birthdate 7/6/1991 is 35 The result of GETNUMSMALLER2 for the node with id 9988 is 35

The maximum age of all people is 98, id : 4434, Birthdate : 1920

The minimum age of all people is 13, id : 6060, Birthdate : 2003

The number of all people is 49

Menu

1- Insert a new person

2- GETNUMSMALLER

3- GETMAX

4-GETMIN

5-GETNUM

6-PRINT

**Task 4:** Prepare a menu as shown above. After choosing between 1-6, provide other necessary inputs from the user.

**Note:** Your code must work on different kind of inputs (Two input fields, it means that your input data types mustbe **Generic**). *You are expected to* ***change your input*** *with* ***a new file*** *in the* ***code control***.

**Task 5:** Prepare a report that explains which methods / functions are updated in the Augmented RB-Tree.Why did you update these functions? What kind of advantages / disadvantages were obtained by Augmented RB-Tree?

**Grading Policy**

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| --- | --- |
| **Task** | **Percentage** |
| RB-­‐‑Tree | % 20 |
| Augmented RB-­‐‑Tree | % 40 |
| Menu | % 10 |
| Generic + Working on different input files | % 20 |
| Report | % 10 |

