Laboratory practice 4: Trees

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1) Project questions Simulation

1.a. Can a genealogical tree be implemented more efficiently so that the search and insertion can be done in logarithmic time? Or not? Why?

To implement more efficient trees in terms of search and insertion, the information would need to be balanced using some parameter. For example, if we use the names of the people in the family tree, the tree would not be displayed as a family tree. But we can solve this adding to each node its ancestors, but this would involve changing the tree and respective algorithms that we worked on. Making the tree balanced by adding the male members of the family in the right and the female members to the left would make it a binary search tree. This data structure has the characteristic of having logarithmic time for these tasks (log n)

1.b. Explain the implementation of Exercise 2.1

This is responsible for recursively traversing each node of the tree both left and right and each time this process ends, print the data stored in the corresponding node. First, it is responsible for printing the data that is on the left at the lowest level and going up until reaching the root.

1.c. Exercise 2.1's complexity

i.

```
private void posOrderTreeAux(Node node){

    if(node!=null){ //C1

        posOrderTreeAux(node.left); // T(n/2) + C2

        posOrderTreeAux(node.right); // T(n/2) + C3

        System.out.println(node.data); //C4
```

```
}
```

$$T(n) = C1 + C2 + C3 + C4 + T(n/2) + T(n/2)$$
$$T(n) = O(C1 + C2 + C3 + C4 + T(n/2) + T(n/2))$$
$$T(n) = O(C1 + C2 + C3 + C4 + 2T(n/2))$$
$$T(n) = O(C * (n-1) + (C * n)/2)$$
$$T(n) = O((n-1) + (n/2))$$
$$T(n) = O(n + (n/2))$$
$$T(n) = O(n + n)$$
$$T(n) = O(2n)$$
$$T(n) = O(n)$$

The complexity of this algorithm is O(n)

1.d. Explain what the variables means in the previous exercises

The variable n means the number of nodes entered, in particular the node that is being visited.

2) Midterm Simulation

2.a. Exercise 1

2.1.1 Complete line 04

altura(raiz.izq)+1

2.1.2 Complete line 05

altura(raiz.der)+1

2.b. Exercise 2

c) 3

2.c. Exercise 3

2.3.1 Complete line 03

false

2.3.2 Complete line 05

a.data

2.3.3 Complete line 07

a.izq, suma-a.data

2.3.4 Complete line 08

a.der, suma-a.data

2.d. Exercise 4

2.4.1 Which recurrence equation describes the number of instructions executed by the print algorithm in the worst case?

c) $T(n) = 2T(n/2) + C$

2.4.2 What is the asymptotic complexity in the worst case-scenario?

a) O(n)

2.4.3 What does the algorithm prints?

d) Wilkenson, Joaquina, Eustaquia, Florinda, Eustaquio, Jovín, Sufranio, Piolina, Wilberta, Piolín, Usnavy

2.4.4 What modification should be done to the print algorithm so that it throws the following answer for the previous tree?

a)Changing the lines order 03, 04 and 05 to 05, 04, 03

2.e. Exercise 5

2.5.1 Complete line 04

p.data==toInsert

2.5.2 Complete line 06

toInsert>p.data

2.f. Exercise 6

2.6.1 How many simple paths are in the previous tree?

d) 4

2.6.2 Complete line 04

return 0

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2.6.3 Complete line 06

==0

2.g. Exercise 7

2.7.1 Which is the pos-order print?

1. 0, 2, 1, 7, 5, 10, 13, 11, 9, 4

2.7.2 How many elements appear in the same position?

2. 2

2.h. Exercise 8

b) 2

2.i. Exercise 9

2.9.1 What is the output of the in-order path of the previous binary tree?

a) 5, 3, 6, 1, 7, 4, 8, 0, 2

2.j. Exercise 10

2.10.1 Is the previous tree a binary search tree?

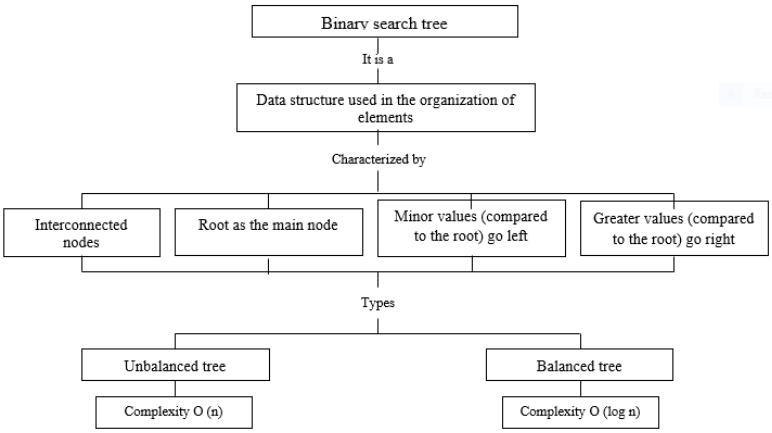
b) No

3) Recommended reading

3.a. Summary

A binary search tree is a data structure used in the organization of elements in a hierarchical way, in which the elements that are greater than the root (first element) go to the right side of the root and the minor elements go to the left side. In this order, every element at the respective sides of the root has a child node with whom they share the same properties. This structure is useful to save elements because it is done in a balanced way, where the level (tree 's subdivisions) is equal or its difference is not greater than one, we can access, insert, search and remove an element with a complexity of O(log n)

3.b. Chart



4) Team work and progress

4.a. Meetings

Team work (meetings)		
Date	time	Description
10.10.18	1 hour	work distribution
12.10.18	1 hours	mutual work in the library
13.10.18	3 hours	construction of the report part 1
14.10.18		construction of the report part 2

4.b. History of changes in the code

History of changes in the code		
version	includes	status
1.0	Preorder and posorder problem	unfinished
2.0	Preorder and posorder problem	finished
	Genealogical tree	
	maternal grandmother problem	

4.c. *History of changes in the report*

History of changes in the report		
version	includes	status
1.0	project questions simulation (3.1-3.3-3.4) midterm simulation	unfinished
2.0	project questions simulation (3.1-3.2-3.3-3.4) midterm simulation recomended reading Team work and gradual progress	finished

4.d. *Team Work*

Member	part of the laboratory	Description
Hamilton	1	1.1 Genealogical tree 1.2 maternal grandmother problem
	2	Preorder and posorder method
	6	team work and gradual progress
	5	recommended reading
Santiago	3	3.1 genealogical tree implementation question 3.2 how exercise 2.1 works 3.3 exercise 2.1 complexity 3.4 meaning of 'n' and 'm' in the complexity
	4	midterm simulation
	6	team work and gradual progress
	7	translate lab

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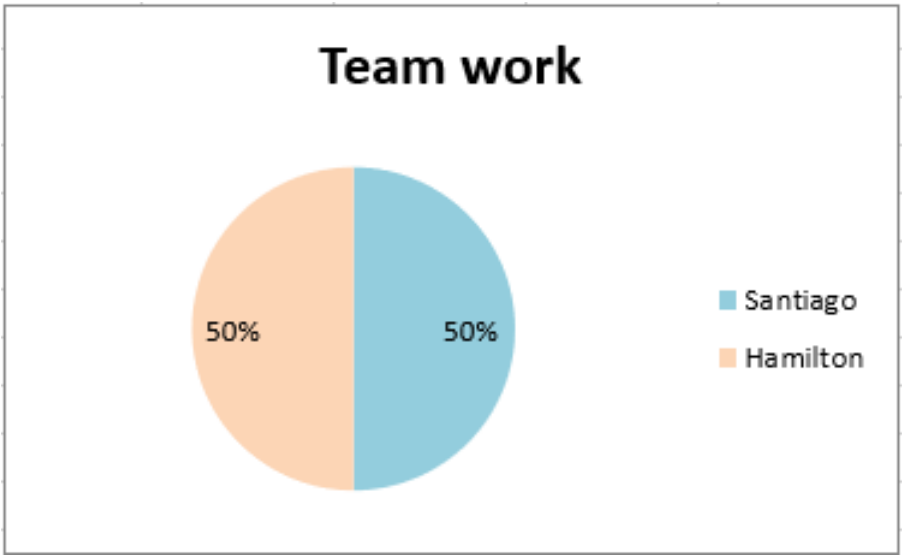

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