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, so we would be sacrificing memory for efficiency.

1.b. Explain the implementation of Exercise 2.1

1.c. Exercise 2.1's complexity

   i.

```
private void posOrderTreeAux(Node node){

    if(node!=null){

        posOrderTreeAux(node.left);

        posOrderTreeAux(node.right);

        System.out.println(node.data);

    }
```

$$T(n) = C1 + C2 + C3 + C4 + C5 * n + C6 * (n - 1)$$
$$C7 * (n - 1) + C8 * (n - 1) + C9 * (n - 1) + C10 * (n - 1) + C11 * (n - 1)+$$
$$C12 * (n - 1) + C13 * (n - 1) + C14 * (n - 1) * 1 + C15 * (n - 1) + C16 * (n - 1)+$$
$$C17 * (n - 1) + C18 * n + C19 * (n - 1) * n + C20$$

$$T(n) = O(C1 + C2 + C3 + C4 + C5 * n + C6 * (n - 1)$$
$$C7 * (n - 1) + C8 * (n - 1) + C9 * (n - 1) + C10 * (n - 1) + C11 * (n - 1)+$$
$$C12 * (n - 1) + C13 * (n - 1) + C14 * (n - 1) * 1 + C15 * (n - 1) + C16 * (n - 1)+$$
$$C17 * (n - 1) + C18 * n + C19 * (n - 1) * n + C20)$$

$$T(n) = C1 + C2 + C3 + C4 + C5 * n + C6 * (n - 1) + C7 * (n - 1)+$$
$$C7 * (n - 1) + C8 * (n - 1) + C9 * (n - 1) + C10 * (n - 1) + C11 * (n - 1)+$$
$$C12 * (n - 1) + C13 * (n - 1) + C14 * (n - 1) * 1 + C15 * (n - 1) + C16 * (n - 1)+$$
$$C17 * (n - 1) + C18 * n + C19 * (n - 1) * n + C20$$

$$T(n) = O(C1 + C2 + C3 + C4 + C5 * n + C6 * (n - 1) + C7 * (n - 1)+)$$
$$C7 * (n - 1) + C8 * (n - 1) + C9 * (n - 1) + C10 * (n - 1) + C11 * (n - 1)+$$
$$C12 * (n - 1) + C13 * (n - 1) + C14 * (n - 1) * 1 + C15 * (n - 1) + C16 * (n - 1)+$$
$$C17 * (n - 1) + C18 * n + C19 * (n - 1) + C20$$
$$T(n) = O(14 * (n - 1) + n + n^2)$$
$$T(n) = O(n^2 + 15n - 14)$$
$$T(n) = O(n^2 + 15n)$$
$$T(n) = O(n^2)$$

The complexity of this algorithm is $O(n^2)$

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

- **LinkedList list:** the list, data structure, where the strings are going to be stored, in order to the status of the variable start.

- **Boolean start:** determines if the substrings are going to be added at the end of the list or at the beginning.

- **Integer index:** does the function of a counter, determines the current position at the list.

- **String newString:** is the string in which the substrings stored in the list are going to be added, according to the their position in the list.

2) Midterm Simulation

2.a. Exercise 1

2.1.1 Complete line 04

altura(raiz.left)+1

2.1.2 Complete line 05

altura(raiz.right)+1

2.b. Exercise 2

a) 2

2.c. Exercise 3

2.3.1 Complete line 03

suma==0

2.3.2 Complete line 05

a.data

2.3.3 Complete line 07

a.left, suma-a.data

2.3.4 Complete line 08

a.right, 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)

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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 y 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?

a) 1

2.6.2   Complete line 04

2.6.3   Complete line 06

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

d) 0

2.i. Exercise 9

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

2.j. Exercise 10

2.10.1 Is the previous tree a binary search tree?

a) Yes

3) Recommended reading

3.a. Summary

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