Algorithm and Data Structures - ID 1020
TCOMK2 - Lab 1 Higher grade assignment

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7 september 2020

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Assignment Task:

Implement a program which takes as input a series of parentheses , that is a series of the characters: '(', ')', '[', ']', '{', '}'. The program should check if the parentheses are balanced or not.

Algorithm choice:

The algorithm implements a Stack data structure based on a resizable array with char as type. The input is given either as a String paramether to the function or from command line. The String is then parsed one character at a time. A resizable array data structure was chosen due to its ease

of access, and the state of the Stack was tracked by the use of an index.

Time complexity:

We are going to calculate the time complexity in the worst case scenario, that is when the whole string of characters is being parsed. Let's take the size of the String as N and calculate how many comparisons are being made at each iteration of the while loop. When a character is being pushed

to the stack we will perform 3 comparisons, while in the popping phase we'll have to both check the new coming closing character and the one being removed from the stack, resulting in 6 comparisons. The worst case scenario will therefore happen when the String is balanced, with $\frac{N}{2}$

push sections with 3 comparisons in each and $\frac{N}{2}$ pop sections with 6 comparisons each. There's also going to be a comparison at the beginning of each while loop and one comparisons in the end to check if the stack is empty. If we add them together this will result in:

$$N + 3 * \frac{N}{2} + 6 * \frac{N}{2} = \frac{2N+9N}{2} = \frac{11N}{2} = O(N)$$

Which is linear complexity.

Memory complexity:

When it comes to memory complexity the worst case will happen when the characters given as input are all opening parenthesis. In any other case a closing bracket will result in a pop from the stack and therefore in a release of memory. The worst case will therefore be when all characters are being pushed to the stack and therefore resulting in a memory complexity of $O(N)$, which is also linear.