

Indian Institute of Technology Kharagpur  
**CS29003: Algorithms Laboratory, Spring 2021**  
**Assignment 5: Dynamic Programming**

2PM – 5PM

9TH MARCH, 2021

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**General Instructions (to be followed strictly)**

Submit a single C/C++ source file.  
Do not use global variables unless you are explicitly instructed so.  
Do not use Standard Template Library (STL) of C++.  
Use proper indentation in your code and comment.  
Name your file as `<roll_no>_<assignment_no>`.  
Write your name, roll number, and assignment number at the beginning of your program.

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Let  $\{a, b\}^*$  denote the set of all possible finite length strings consisting of the symbols  $a$  and  $b$ , including the empty string. For two strings  $x, y$ , let  $xy$  denote their concatenation.

- (a) Consider the set (also called a *language*)  $L = \{ww : w \in \{a, b\}^*\}$ . Write a function that on input a string  $x$  tests and outputs whether or not  $x \in L$ .
- (b) For any set of strings  $S$ , let  $S^i = \{x_1x_2 \cdots x_i \mid x_1, x_2, \dots, x_i \in S\}$ , the set of all strings obtained by concatenating  $i$  arbitrary strings from  $S$ . Define  $S^*$  as

$$S^* = \cup_{i=0}^{\infty} S^i,$$

that is,  $S^*$  is a set consisting of the empty string and all strings of finite length obtained by concatenating arbitrary elements of  $S$ .

Write a function that takes as input a string  $y$  and determines whether or not  $y \in L^*$  as efficiently as possible. Here,  $L$  is the language defined in Part (a). You will need the function from the previous part here. Try to minimise the number of calls to the function from Part (a).

In the `main()` function,

- Read a string  $y$ .
- Call the function from the second part and output 'Yes' indicating that  $y \in L^*$  or 'No' indicating that  $y \notin L^*$ .

You are not allowed to use any library functions for string manipulation other than `strlen` only.

**Sample Input/Output**

- Enter string: bbbbababbaabbaababaaabaa  
Yes
- Enter string: bbaabbbaaaba  
No
- Enter string: aaabbb  
No
- Enter string: aabb  
Yes