Birla Institute of Technology & Science, Pilani
Second Semester 2017-2018, DSA (CS F211)
Lab Assignment #1

1.

A magic **square** palindrome is a string whose characters can be divided in a K × K square table with the property that the original sentence can be read from the table in four different ways:

• Start from the (0, 0) cell, move right until the end of the line and then proceed to the next line from (1, 0) cell, move right until the end of line and so on.

• Start from the (0, 0) cell, move down until the end of the column and then proceed to the next column from (0, 1) cell, move down until the end of the column and so on.

• Start from the (K-1, K-1) cell, move left until the beginning of the line and then proceed to the previous line from (K-2, K-1) cell, move left until the beginning of the line and so on.

• Start from the (K-1, K-1) cell, move up until the beginning of the column and then proceed to the previous column from (K-1, K-2) cell, move up until the beginning of the column and so on.

"satorarepotenetoperarotas" is the most famous magic square palindrome. We can arrange it in a K = 5 (5 × 5) table in the following way as shown in figure below (string has 25 characters and the way characters are stored is first 5 character in 0^{th} row and next 5 character in next row and so on…)

s	a	t	o	r
a	r	e	p	o
t	e	n	e	t
o	p	e	r	a
r	o	t	a	s

Notice that the original sentence can be read from the table in the four different ways described above.
Write a program to solve the problem.

Input format: The first line of input gives the number the input strings (without spaces and of maximum 100 length and in lowercase). Then there is following n lines, each containing a string.

Output format: N lines of output, each line has either YES or NO following by newline. (YES if string is a magic square palindrome otherwise NO)

2. Write a program to find the number of times that a given word (i.e. a short string) occurs in a sentence (i.e. a long string!). Read data from standard input. The first line is a single word, which is followed by general text on the second line.

Sample Input
the
the cat sat on the mat

Sample Output
2

3. Given a string (it can have any printable letter), you have to count the frequency of occurrence of each character in a newline terminated string by using an array of structures. Initially no memory is allocated for any of the letters.

   Sample Input
   ccbbbbaaccaaz (
   Sample Output
   c 4
   b 4
   a 4
   z 1
   1
   (1
   Notice that space character has occurred once in the input above (look at the outline line with bold **1**).

4. Write a program to encode a given message. The encoding algorithm first performs reverse operation on each word and then transforms each character into its third successor in the series. (considers series of characters arranged in a circle so last characters like **x** will have **a** as third successor) For an example, the message "have a good day" will be encoded as "hydk d grrj bdg". Your program should also be able to decode a given coded message into its original form i.e. if I give an encoded message it should decode the original message.

5. Write a program that reads n and finds the last 10 digits of 2^n where 0 <= n <= 100. You have to take care of how to handle large numbers. Hint: Use long long type. Last 10 digits of 2^n is same as 2^n modulo 10^{10}. So, you basically need to create your own power function that computes everything modulo 10^{10}.

   Sample Input
   10
   Sample Output
   1024

6. You have infinitely many balls and each of them is colored with one of the C colors. You decided to fill each of the N boxes (B_1, B_2, B_3, ..., B_N) with exactly one ball. In how many ways can you do that? Two *ways* are considered different if there is at least one box in one *way* that has different colored ball than in the other *way*. The answer can get really huge, so just output the (answer % P), where % is the modulus operator. Input contains one line containing integers C N P

   Sample Input
   2 4 10
   Sample Output
   6\n

   Explanation: We have 4 boxes and 2 colors. Each box has 2 options, so answer is just 2 x 2 x 2 x 2 = 16 and 16 % 10 = 6

7. Given an integer N ($0 \leq N \leq 10^{18}$) (use long long), count the number of 1s in the binary representation of N

Sample Input
5
Sample Output
2

8. Scientists are making a chimpanzee C learn chat on Facebook. C wants to say “goodbye” (*no space between good and bye*) to his Gorilla friend G. C typed a word **W**. It is assumed that C has said “goodbye” if **W** is the string “goodbye” or if a few letters can be deleted from the typed word **W** so that it results in the word "goodbye". For example, if C types the word “bagpotodbqyeeje", it will be considered that he said “goodbye”, and if he types "pngodtbeyz", it will be considered that he didn't manage to say goodbye. Given **W**, determine whether C managed to say “goodbye” to G by printing Yes or No.

   Sample Input-1
   bagpotodbqyeeje
   Sample Output-1
   Yes

   Explanation: b,a,p,t,q,e,j,e can be deleted to get goodbye

   Sample Input-2
   pngodtbeyz
   Sample Output-2
   No

9. You are given two matrices $A_{m \times p}$ and $B_{p \times n}$
   Find $AB_{m \times n}$ and only print the sum of all elements in AB . You will read first m and p and then elements of matrix A then p and n and then elements of matrix B.

   Sample Input
   2 3
   9 2 1
   4 5 6
   3 1
   1
   2
   3
   Sample Output
   48\n

10. Write a program to read n and find the value of n! where $0 \leq n \leq 200$. You have to take care of how to handle large numbers. Use an array to store individual digits of the factorial, since factorial of large numbers such as 100 cannot fit within any native datatype.

    Sample Input
    5
    Sample Output
    120