Computer Olympiad
South African Computer Olympiad: a project of the Computer Society of South Africa.

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SECOND ROUND 2010

This paper is for **ALL** candidates.

Each correct answer earns 5 marks.

Problem 1: Palin

Alice really enjoys word games. At the moment she is looking at Palindromes. Palindromes are words which read the same forwards and backwards like "madam", "racecar" and "anna".

Help Alice by writing a program which will read in a single word (only lower case letters) and output "`Is a Palindrome`" if it is a Palindrome, or otherwise output "`Is Not a Palindrome`"

Example

```
Enter a word: madamimadam

Is a Palindrome
```

Test your program with:

(a) abcdeeedcba
(b) notapalinanot
(c) amanaplanacanalpanama

Problem 2: Fizzbuzz

Alice's maths class has been playing a game called Fizzbuzz. In this game, players count from 1 up to some number *N*, but when they get to a number that is a multiple of three, they say "fizz" instead of the number; similarly, multiples of five are replaced by "buzz". Numbers that are multiples of five and three are replaced with "fizzbuzz".

Alice wants to practice on her own, so she wants you to write a program to check that she is getting it right. It will ask the user for the number *N* and then output all the numbers from 1 to *N*, replacing multiples of three and five as described.

Example

```
Count to what number? 7

1
2
fizz
4
buzz
fizz
7
```

Test your program with:

(a) 10
(b) 15
(c) 32

Problem 3: 133t

Alice has sent an SMS to her friend Bob using a secret code. Knowing that Alice replaced "E" with "3", "L" with "1", "O" with "0", "G" with "9" and "B" with "8", help Bob (or "808") decrypt the message. Given a sentence of only upper case characters (and spaces), display the decrypted sentence for Bob to read.

Example

```
Enter message: H3110 808 ITS A1IC3
H3R3

HELLO BOB ITS ALICE HERE
```

Test your program with:

(a) H0W IS Y0UR H0M3W0RK 90IN9
(b) 90T T0 90 MY M0M IS CA11IN9 M3
(c) I H3ARD TH3 N3XT QU3STI0N IS A80UT MANSI0NS

Problem 4: Mansion

You are in a creepy, unlit mansion. The mansion can be represented as an NxM grid, with lights in some of the grid cells. A light illuminates the cell it's in and its (up to eight) neighbouring cells. There is a light in the cell where you start that is switched on; all other lights are switched off. Your task is to light up as much of the mansion as possible,

however you are scared of the dark and cannot take more than two steps (= two cells) in the dark before entering a lit cell. You cannot step diagonally.

In the diagram **S** represents where you start, * represents a light switch **o** a dark cell and **$** a lit cell.

```
*oo*ooo     *oo*ooo     $$o*ooo     $$$$$oo
ooooooo -> $$ooooo -> $$ooooo -> $$$$$oo
Sooooo*     $$oooo*     $$oooo*     $$oooo*
  (1)         (2)         (3)         (4)
```

(1) You begin in the bottom left corner
(2) The starting cell has a light switched on, so the surrounding cells are lit
(3) You walk to the top left light switch (but not the top middle one yet). You light the surrounding cells.
(4) You walk to the top middle switch and light it. You cannot reach the bottom right light switch and there are no more switches to light so this is the most you can light up.

So in the example you can switch on 2 lights (this excludes the light in your starting cell).

Example

```
How many rows and columns are there? 3 7
Enter the grid for the mansion one row
per line:
*oo*ooo
ooooooo
Sooooo*

I can switch on 2 lights.
```

Test your program with:

```
(a) 3   5
ooooo
oo*oo
*oooS

(b) 3   11
*oooo*oooo*
ooooooooooo
ooo*oooSooo

(c)  4   16
Sooooo****oo*ooo
*ooooo*oo*oo*ooo
*ooooo*oo*oo*ooo
****oo****oo****
```

[Problems set by Max Rabkin, Keegan Carruthers-Smith and Ben Steenhuisen.]

Problem 5: Messages

Scientists have recently discovered intelligent life on the planet Unarus. The Unaran language has two unusual properties: its alphabet only has a single letter, %, and the meaning of a sentence does not depend on the order of the words (so, for example, % %% % and % % %% mean the same thing). Because of this, some words are very long, with hundreds of letters.

Having made these fascinating discoveries, some scientists would like to send a probe to Unarus to find out more. They want to engrave a message on the probe. They know how many letters are in the Unaran translation of this message but they don't know where to put the spaces, so they have decided to engrave *all* possible Unaran messages with that many letters. To ensure that they do not miss any, they want you to write a program to calculate how many different messages there are with a certain number of letters. The program should not count different ways of writing the same message.

Since there may be many messages, ***your program should output the remainder after the number is divided by 10007.***

For example, five messages can be written with four letters:
% % % %
%% % %
%% %%
%%% %
%%%%

In the example, % %% % and % % %% do not appear on the list because they mean the same as %% % %.

Example

```
How many letters in the message? 4

There are 5 messages.
```

Test your program with:

```
(a) 7
(b) 102
(c) 2010
```


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