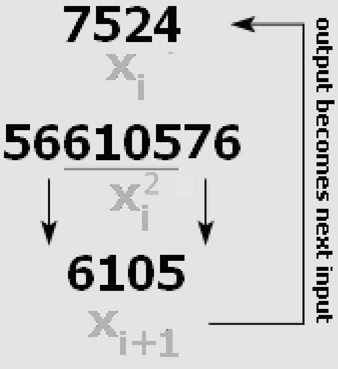
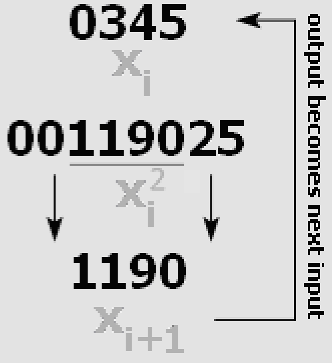
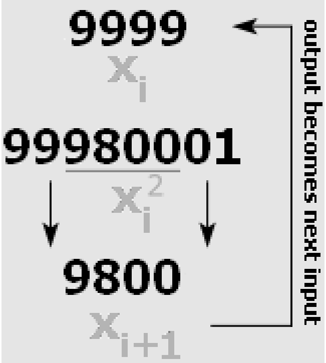
Problem P1 Pay it Forward

The *middle-square method* can be used to generate pseudo-random numbers. The method was first suggested by John Von Neumann in 1946. In practice it is not a good method, since its period is usually very short and it occasionally fails miserably. In this problem, we apply the method to four-digit numbers.

Given a four-digit number $0 \leq x_i \leq 9999$, compute $x_i * x_i$ and extract the middle four digits to compute x_{i+1}. The middle digits are determined by including leading zeros until the product $x_i * x_i$ has eight digits; then extract the middle four digits. Here are several examples when x_i = 7524, 345, or 9999.







Your task is to read from standard input a four-digit number x_0 and then print the next 10 terms (x_1 through x_{10}) using the middle-square method.

Input Format

Your program will read from standard input. You will receive a single line of input which will contain a single positive integer x_0 whose value will be $1000 \leq x_0 \leq 9999$.

Output Format

Your program will write to standard output. Your program should produce ten lines of output. Each line should contain a single number by itself with no spaces and no leading zeros. The first line will be the value of x_1 and the 10th line will be the value of x_{10}.

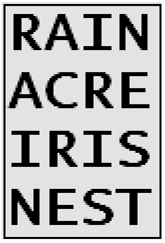
Sample Input and Corresponding Sample Output

Sample Input	Sample Output
7524	6105 2710 3441 8404 6272 3379 4176 4389 2633 9326

Sample Input	Sample Output
9999	9800 400 1600 5600 3600 9600 1600 5600 3600 9600

Problem P2 Spider-Man

The block of letters on the right is an example of a “Word Web”. You will note that the words reading across (RAIN, ACRE, etc…) from top to bottom are the same as the words reading down, from left to right, when considering the 1st letter of each row, then the 2nd letter of each row, etc…



RAIN
ACRE
IRIS
NEST

You are to write a program that receives a value N, where 3 ≤ N ≤ 10 and a block of letters of size N x N. You must determine if the block contains a valid word web.

Input Format

Your program will read from standard input. The first line of input will contain a number N on a line by itself, where 3 ≤ N ≤ 10. The next N lines will each contain a single word of N characters on a line by itself. All characters will be in uppercase and there will be no spaces in the input.

Output Format

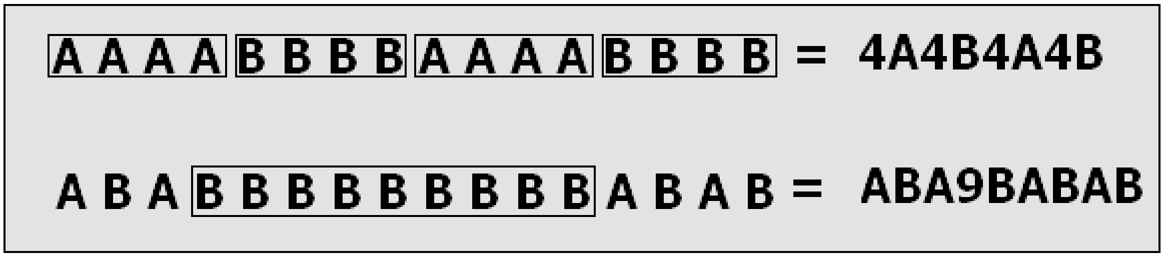
Your program will write to standard output. The output will consist of a single word on one line by itself. You should output TRUE if the input is a valid Word Web, otherwise output FALSE. The output must all be in capital letters.

Sample Input and Corresponding Sample Output

Sample Input	Sample Output
4 RAIN ACRE IRIS NEST	TRUE
3 ACE CAT ERA	FALSE
4 OPEN PARE EROS NEST	TRUE

Problem P3 Marathon Man

You are given a string of 16 letters using As and Bs. You must output a compressed Run Length Encoding (RLE) of the string. Using RLE, two or more consecutive letters of the same value represented by a count followed by the letter, otherwise the letter is unchanged. For example, the string AAAABBBBAAAABBBB is encoded as the RLE string 4A4B4A4B because it contains 4 As, followed by 4Bs, followed by 4As, followed by 4Bs. And the string ABABBBBBBBBBABAB is encoded as the RLE string ABA9BABAB because the nine Bs are the only time two or more consecutive letters of the same value appears in that string. The figure below shows the results graphically.


A A A A B B B B A A A A B B B B = 4A4B4A4B
A B A B B B B B B B B B A B A B = ABA9BABAB

Input Format

Your program will read from standard input. You will receive only one line of input which will contain a string on a line by itself. The string will be composed of only A and B characters and will be 16 characters in length.

Output Format

Your program will write to standard output. Your program should produce a single line of output on a line by itself containing the RLE of the input string.

Sample Input and Corresponding Sample Output

Sample Input	Sample Output
AAAAAAAAAAAAAAAA	16A
AAAABBBBAAAABBBB	4A4B4A4B
ABABBBBBBBBBABAB	ABA9BABAB
ABABABABABABABAB	ABABABABABABABAB
BBBBBBBBBBBBBBBA	15BA
ABBBBBBBBBBBBBBB	A15B

Problem P4 My Big Fat Greek Wedding

You are given three points in the plane using integer coordinates. These three points define a triangle. Your job is to classify the triangle by considering the length of its sides. The three choices are:

- EQUILATERAL (all sides are equal),
- ISOSCELES (only two sides are equal to each other)
- SCALAR (three sides are different)

Input Format

Your program will read from standard input. The input will consist of three lines. Each line will contain two integers “x y” separated by a single space that represents a point in the plane. The first number x represents the x coordinate of that point; the second number y represents the y coordinate of that point. You can assume all x- and y-coordinates of points are positive numbers in the range 0 < x < 100 and 0 < y < 100. You can assume that the three points are all different points.

Output Format

Your program must write to standard output. Your program shall produce a single word on a line by itself. The word must be in all upper case and must either be EQUILATERAL or ISOSCELES or SCALAR depending on the type of triangle.

Sample Input and Corresponding Sample Output

Sample Input	Sample Output

`2 2`
`2 5`
`6 2`
	`SCALAR`

`2 2`
`6 6`
`10 2`
	`ISOSCELES`

`1 1`
`2 9`
`5 5`
	`SCALAR`

Problem P5 The Nutty Professor

You are asked to report on the number of atoms given a chemical compound, that is, a substance consisting of two or more different elements chemically bonded together. A compound is described using a molecular formula, which is a string that supplies information about the types and spatial arrangement of the elements.

While it is well known that elements in the periodic table may have more than one letter symbol (such as **Au** for gold), for this problem you may assume that the elements require only a single character.

Each molecular formula is represented by a series of element *groupings* consisting of element symbols of a single letter followed by a number describing the number of atoms of that element present; the number 1 is omitted when only one atom of that element is present in the grouping. Here are some examples:

Molecule	**Molecular Formula**	**Element Groupings**	**Number of Atoms**
Methane	CH4	C, H4	5
Ammonium Nitrate	NH4NO3	N, H4, N, O3	9
Dibutyl Phthalate	C6H4COOC4H9COOC4H9	C6, H4, C, O, O, C4, H9, C, O, O, C4, H9	42

Your goal is to output the total number of atoms (regardless of element) in a molecular formula.

Input Format

Your program will read from standard input. You will receive a single line containing a string representing a molecular formula. The string will be 64 characters or less. Each element is represented by a single capital letter. No element appears more than 99 times in a single compound.

Output Format

Your program will write to standard output. Your program will produce a single line of output containing an integer on a line by itself.

Sample Input and Corresponding Sample Output

Sample Input	**Sample Output**
`CH4`	`5`
`NH4NO3`	`9`
`H2O`	`3`
`CH3CH2CH2CH2OH`	`15`
`C16H22O4`	`42`

Problem P6 The Gambler

You are given two dice from the popular word game "Boggle"™ . Each die has six sides, with a letter from A to Z on each side (there may be duplicates on the same die).You will be told the letters that appear on the first die and the letters that appear on the second die. Your goal is to state the odds that when you roll the pair of dice, the top two letters will be identical.

Given that the dice are six sided, the odds will be a rational fraction of the form $\frac{X}{6}$

You are to compute the value of the numerator X and report "X OUT OF 36" for each set of dice.

Input Format

Your program will read from standard input. There will be two lines of input. Each line contains six capital letters on a line by itself. The letters will be from A to Z.

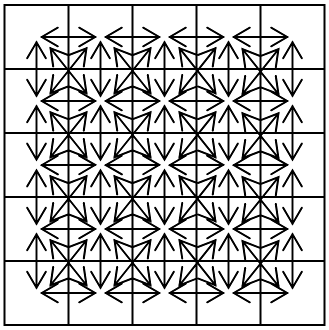
Output Format

Your program will write to standard output. Your output will be a single string of the form "X OUT OF 36" on a line by itself where X is the computed numerator in the fraction $\frac{X}{6}$

Sample Input and Corresponding Sample Output

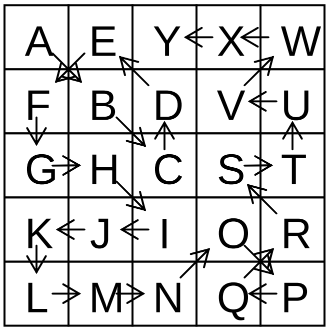
Sample Input	Sample Output
ABCDEF FEDCBA	6 OUT OF 36
AABBCC ABCDEF	6 OUT OF 36
ABCDEA DCBCAE	7 OUT OF 36
ABCDEF GHIHJK	0 OUT OF 36
AAAAAA ABABAB	18 OUT OF 36

Problem P7 Pan’s Labyrinth



You are given a puzzle to solve consisting of a 5x5 square of 25 different capital letters from A-Z. You must determine if there is an unbroken path from the letter A to the letter Y only by moving between neighboring squares. No letter appears twice.

The neighbor of a square can be reached horizontally, vertically or diagonally. The diagram on the right shows the valid neighbors in the 5x5 square. You can’t “wrap around” edges from top to bottom, or from left to right. For example, each corner has exactly three neighbors.



An unbroken path starts where the letter A appears in the square and progresses, by neighboring squares, to B, then to C and so on until Y is found. The solution on the right is a sample successful path through a square. Note that the path can cross over itself. A path breaks either when (i) letter A doesn’t exist in the square; or (ii) no neighboring square of the last letter in the unbroken path contains the next letter in the alphabet.

If a path exists output the string “SUCCESS” on a line by itself; otherwise, output the string “FAILS ON *” where “*” represents the letter at which the path breaks.

Input Format

Your program will read five lines from standard input. Each line contains five capital letters on the line by itself. No letter is duplicated in the square.

Output Format

Your program must write to standard output. The output will consist of a single line. If there is a path, the output will contain “SUCCESS” on a line by itself. Otherwise, the line will contain the string “FAILS ON *” where * is the letter at which the path breaks.

Sample Input and Corresponding Sample Output

Sample Input	Sample Output
AEYXW FBDVU GHCST KJIOR LMNQP	SUCCESS
MLKJX NCBIY ODAHW PEFGV QRSTU	FAILS ON X
BCDEF KJIHG LMNOP UTSRQ VWXYZ	FAILS ON A

Problem P8 Election

You are responsible for determining election results for a mayoral race with up to 50 precincts and no more than 10 candidates running for office. Each precinct reports on a single line its results by listing each candidate’s last name with the votes received; candidates are listed in decreasing order of votes received and candidates receiving no votes are not listed. You can assume there are at least 2 candidates running!

Given the election results, your program must produce a report showing the total votes received by each candidate, in decreasing order. You can assume there will be no ties when all votes are accounted for.

You can assume that all candidates have different last names and that each name is no longer than 16 characters long. You can assume that less than 10,000 people are voting.

Input Format

Your program will read from standard input. The input consists of a number N on a line by itself representing the number of precincts. Each of the remaining N lines contains the results of a single precinct and will contain no more than 256 characters. The format of a single line contains a set of pairs of results “Name Votes” where “Name” is the candidate name and “Votes” is an integer greater than 0 but less than 10,000. Single spaces separate the information on the line and no commas appear in the input. You can assume that each precinct reports only a single vote total for each candidate (i.e., there are no duplicates within a precinct); you can assume that all precincts have at least one candidate that received votes.

Output Format

Your program will write to standard output. The output consists of a number of lines, one per candidate, listing each candidate together with the total number of votes received. The output must list the candidates in decreasing number of votes; that is, the winner appears on the first line. The number of lines output must be the same as the total number of different candidates from the input.

Sample Input and Corresponding Sample Output

Sample Input	**Sample Output**

`5`
`Wilkinson 1933 Murray 1711 Hendricks 1103 Patrick 331`
`Wilkinson 772 Hendricks 743 Patrick 95`
`Patrick 755 Hendricks 673 Patrick 373 Wilkinson 323`
`Hendricks 1299 Wilkinson 1140 Patrick 799 Dennis 93`
`Hendricks 975 Patrick 732 Dennis 137`
	`Hendricks 4793`
	`Wilkinson 4168`
	`Patrick 3085`
	`Murray 1711`
	`Dennis 230`

`3`
`Curly 97 Moe 19 Larry 7`
`Moe 11 Curly 10`
`Larry 6`
	`Curly 107`
	`Moe 30`
	`Larry 13`