



NISTtech Coding Competition - March 2023

| Problems

→ Problem 0: Example Problem

Difficulty: Easy

Points awarded: 0

Scenario

To familiarize yourself with the format of the questions, taking input, the grader, and submission form, complete this problem. Given 2 numbers, return their sum.

Input/output specifications

The input consists of two integers, **a** and **b**, separated by a new line.

The output consists of one integer, the sum of **a** and **b**

Limits

$1 \leq n(\text{input}) \leq 100$

Example input/output

<u>Example Input</u>	<u>Example Output</u>	<u>Explanation</u>
10 20	30	$10 + 20 = 30$

→ Problem 1: Virtual DAC

Difficulty: Easy

Points awarded: 10

Scenario

In electronics, a digital-to-analog converter (DAC) is a system that converts a binary representation of that signal into an analog output. Create a function that takes a number representation of a signal and returns the analog voltage level that would be created by a DAC if it were given the same number in binary.

The value range is 0-1023.

The reference range is 0.00 - 5.00 volts.

This DAC has 10 bits of resolution and the DAC reference is set at 5.00 volts.

Input/output specifications

The input consists of one integer v , $0 \leq v \leq 1023$

The output consists of one float rounded to two decimal places r , $0.00 \leq r \leq 5.00$

Example input/output

<u>Example Input</u>	<u>Example Output</u>	<u>Explanation</u>
0	0.00	0 is 0% of the maximum, which is mapped to 0V on a 0-5V scale.
1023	5.00	1023 is 100% of the maximum, which is mapped to 5V on a 0-5V scale.
400	1.96	400 is 39.1% of the maximum value 1023, which is equal to 1.96V on a 0-5V scale.

→ Problem 2: Luke, I am your...

Difficulty: Easy

Points awarded: 10

Scenario

Luke Skywalker has family and friends. Help him remind them who is who. Given a string with a name, output the relation of that person to Luke.

Person	Relation
Darth Vader	father
Leia	sister
Han	brother in law
R2D2	droid

If the person has no relation to Luke, tell him that!

Input/output specifications

The input consists of the name of the person, a string `s`

The output consists of one string.

Limits

The input is guaranteed to be a valid string, $1 \leq s.length \leq 15$

Example input/output

<u>Example Input</u>	<u>Example Output</u>	<u>Explanation</u>
"Darth Vader"	"Luke, I am your father."	See table above.
"Leia"	"Luke, I am your sister."	
"Josh"	"Luke, you don't know me."	Luke doesn't know Josh.

→ Problem 3: Tournament Selection

Difficulty: Easy

Points awarded: 10

Scenario

Each player in a tournament plays six games. There are no ties.

The tournament director places the players in groups based on the results of games as follows:

- if a player wins 5 or 6 games, they are placed in Group 1
- if a player wins 3 or 4 games, they are placed in Group 2
- if a player wins 1 or 2 games, they are placed in Group 3
- if a player does not win any games, they are eliminated from the tournament.

Write a program to determine which group a player is placed in.

Input/output specifications

The input consists of six strings separated by new lines, each with one of two possible letters: W (to indicate a win) or L (to indicate a loss).

The output will be an integer, either 1, 2, 3 (to indicate which Group the player should be placed in) or -1 (to indicate the player has been eliminated).

Example input/output

<u>Example Input</u>	<u>Example Output</u>	<u>Explanation</u>
W L W W L W	2	The player had 4 wins and 2 losses, placing them in group 2.
L L L L L L	-1	The player lost every game, eliminating them from the tournament.

→ Problem 4: Palindrome Number

Difficulty: Medium

Points awarded: 30

Scenario

Given an integer x , output “true” if x is a palindrome, and “false” otherwise.

Input/output specifications

The input consists of one integer x .

The output consists of a string, either “true” or “false” without any capitals.

Limits

$$0 \leq x \leq 2^{31} - 1$$

Example input/output

<u>Example Input</u>	<u>Example Output</u>	<u>Explanation</u>
121	true	121 reads as 121 from left to right and from right to left.
10	false	Reads as 01 from right to left. Therefore it is not a palindrome.

→ Problem 5: Grade Boundaries

Difficulty: Medium

Points awarded: 30

Scenario

Mr. Joe keeps the grade boundaries for Math in his room, but he wants a program that will allow his students to calculate their grade based on the raw marks they achieved.

Percentage Boundary (%)	Grade
82	7
71	6
59	5
47	4
34	3
17	2
9	1

Table 1. Conversion from the bottom boundary to the 0-7 grade scale

For a certain number of raw marks a student got on the test, calculate the equivalent grade.

Input/output specifications

The first line consists of an integer m , the number of marks that a student achieved on a test.

The second line consists of an integer t , the total number of marks possible for that test.

The output consists of an integer g , the grade the student obtained.

Limits

$$0 \leq m \leq 150$$

$$0 \leq t \leq 150$$

$$0 \leq g \leq 7$$

Example input/output

Example Input	Example Output	Explanation
58 59	7	58/59 = 98.3%, which is a 7. See the above table.
51 80	5	51/80 = 63.8%, which is a 5. See the above table.

→ Problem 6: C*ns*r*d Str*ngs

Difficulty: Medium

Points awarded: 30

Scenario

Someone has attempted to censor Jimin's strings by replacing every vowel with a *, l*k* th*s.

Luckily, he's been able to find the vowels that were removed.

Given a censored string and a string of the censored vowels, return the original uncensored string.

Input/output specifications

The first line of input is a string, the censored string.

The second line of input contains the recovered vowels, separated by nothing.

The output consists of the reconstructed string.

Limits

The vowels are given in the correct order.

The number of vowels will match the number of * characters in the censored string.

Example input/output

<u>Example Input</u>	<u>Example Output</u>	<u>Explanation</u>
Wh*r* d*d my v*w*ls g*? eeioeo	Where did my vowels go?	*'s replaced with the vowel in order, in the correct case. Non-vowels are ignored.
abcd "" [empty string]	abcd	
*PP*RC*S* UEAE	UPPERCASE	

→ Problem 7: Roman Numerals

Difficulty: Hard

Points awarded: 50

Scenario

Roman numerals are represented by seven different symbols: I, V, X, L, C, D and M.

Symbol	Value	Symbol	Value
I	1	C	100
V	5	D	500
X	10	M	1000
L	50		

For example, 2 is written as II in Roman numerals. 12 is written as XII, which is simply X + II. The number 27 is written as XXVII, which is XX + V + II.

Roman numerals are usually written largest to smallest from left to right. However, there are six instances where subtraction is used:

- I can be placed before V (5) and X (10) to make 4 and 9.
- X can be placed before L (50) and C (100) to make 40 and 90.
- C can be placed before D (500) and M (1000) to make 400 and 900.

Given a roman numeral, convert it to an integer.

Input/output specifications

The input consists of one string.

The output consists of one integer.

Limits

$1 \leq s.length \leq 15$

`s` contains only the characters ('I', 'V', 'X', 'L', 'C', 'D', 'M').

It is guaranteed that `s` is a valid roman numeral in the range [1, 3999].

Example input/output

Example Input	Example Output	Explanation
III	3	III = 3
LVIII	58	L = 50, V = 5, III = 3
MCMXCIV	1994	M = 1000, CM = 900, XC = 90 and IV = 4

→ Problem 8: Longest Common Prefix

Difficulty: Hard

Points awarded: 50

Scenario

Write a function to find the longest common prefix string amongst an array of strings.
If there is no common prefix, return an empty string: "".

Input/output specifications

The first line is an integer n .

The next n rows each contain a string s , an English word.

The output consists of a string p , the longest common prefix.

Limits

$1 \leq n \leq 200$

$0 \leq s.length \leq 200$

s consists of only lowercase English letters.

Example input/output

<u>Example Input</u>	<u>Example Output</u>	<u>Explanation</u>
3 flower flow flight	fl	There is a common prefix "fl" in both words.
2 dog racecar	"" [empty string]	There is no common prefix.

→ Problem 9: Am I Ghosting?

Difficulty: Very Hard

Points awarded: 80

Scenario

You want to measure how long your friends have to wait for your replies. Your phone records each received and sent message in order using the following two kinds of entries:

- R X indicates a message was received from a friend numbered X ;
- S X indicates a message was sent to a friend numbered X .

Your message device sends and receives messages instantaneously, and for each consecutive pair of entries described above, either

- a single entry W N is recorded in between them indicating they occur N seconds apart, or
- there is no entry between them and they occur one second apart.

Several rules are always followed:

- the only messages you send are replies to messages that you have received;
- you send at most one reply to any message from any particular friend;
- your friends do not send a subsequent message until you have replied to their previous message.

Your job is to determine the total wait time for each friend.

Input/output specifications

The input consists of the integer M ($1 \leq M \leq 20$), followed by M lines, where each line consists of one character (W, R, or S), followed by a space, followed by an integer ($1 \leq n(\text{integer}) \leq 100$).

Output one line for each friend that sent a message in the form $X \ T$ where X is a friend number and T is the total wait time for friend X .

The wait time for a message is the time that passes between when you receive it and the time you reply to it. If a friend X received a reply to each message they sent, the total wait time for friend X is the sum of all wait times for all messages from friend X . Otherwise, the total wait time for friend X is -1 .

The lines are in increasing order of the friend numbers.

Example input/output

<u>Example Input</u>	<u>Example Output</u>	<u>Explanation</u>
5 R 2 R 3 W 5 S 2 S 3	2 6 3 6	<ul style="list-style-type: none">• Friend 2 sends a message at time 0 and receives a reply at time 6.• Friend 3 sends a message at time 1 and receives a reply at time 7.
14 R 12 W 2 R 23 W 3 R 45 S 45 R 45 S 23 R 23 W 2 S 23 R 34 S 12 S 34	12 13 23 8 34 2 45 -1	<ul style="list-style-type: none">• For Friend 12, a message is received at time 0 and replied to at time 13.• For Friend 23, two messages are exchanged, with the first message having a wait time of 6 seconds and the second message having a wait time of 2 seconds.• For Friend 34, a message is received at time 10 and replied to at time 12.• Friend 45 sends a message which is never replied to.

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