Computer Science Competition
District 2022
Programming Problem Set

I. General Notes

1. Do the problems in any order you like. They do not have to be done in order from 1 to 12.

2. All problems have a value of 60 points.

3. There is no extraneous input. All input is exactly as specified in the problem. Unless specified by the problem, integer inputs will not have leading zeros. Unless otherwise specified, your program should read to the end of file.

4. Your program should not print extraneous output. Follow the form exactly as given in the problem.

5. A penalty of 5 points will be assessed each time that an incorrect solution is submitted. This penalty will only be assessed if a solution is ultimately judged as correct.

II. Names of Problems

	Number	Name
✓	Problem 1	Adrian
✓	Problem 2	Arusha
✓	Problem 3	Catherine
	Problem 4	Diane
✓	Problem 5	Facundo
	Problem 6	Haru
✓	Problem 7	Kristina
✓	Problem 8	Lavanya
	Problem 9	Manos
✓	Problem 10	Michaela
✓	Problem 11	Pankaj
	Problem 12	Shirley

1. Adrian

Program Name: Adrian.java **Input File: None**

Adrian is always amused when he sees the classic “Hello World” program! He wonders how many different programming languages have used that program as the first program for students learning the language. From his research he has come up with an initial list of programming languages as shown below. Believe it or not, he even found a COBOL example!

Input: None

Output: Display the following exactly as shown below.

Sample input: None

Sample output:
```
JAVA
PYTHON
SWIFT
ADA
C
C++
COBOL
FORTRAN
ALGOL
BASIC
DELPHI
PASCAL
PL1
JAVASCRIPT
```

2. Arusha

Program Name: Arusha.java **Input File: arusha.dat**

Given a string s, the right rotation of s is the last letter of s, followed by every other letter of s. The left rotation is the first letter of s, preceded by every other letter of s.

For example, with the string "ABCDE", the right rotation is "EABCD", and the left rotation is "BCDEA".

Given a starting string and a sequence of rotations, Arusha wants to know the resulting string. Write a program to help Arusha calculate this.

Input:
The first line of input will contain a single integer T, the number of test cases to follow (1 <= T <= 10)
Each test case will consist of two strings S and I, denoting the string to manipulate, and the instruction sequence.
1 <= |S| <= 100
1 <= |I| <= 100
I will consist of only characters 'L' and 'R', denoting a left and right rotation instruction.

Output:
For each test case on its own line, output the resultant string after completing all rotations.

Sample input:
```
3
ABCDE L
ABCDE R
AB LLL
```

Sample output:
```
BCDEA
EABCD
BA
```

3. Catherine

Program Name: Catherine.java **Input File: catherine.dat**

Catherine, like the rest of the word, is intrigued by the game of Wordle. She needs a program that will allow her to compare a target word and an attempted guess. Write a program that inputs first, the target word, then the guess. Compare the two words and provide the indicated output.

Note: Each word will be a 5-letter word consisting of lower-case letters only. For this program, neither word will contain any repeated letters. That is each word will contain five unique lower-case letters.

The program should compare the two words letter-by-letter.

(1) If the letter in position N of the guess matches the letter in position N of the target, the upper-case form of the letter will be printed in position N of the output.
(2) If the letter in position N of the guess is not anywhere in the target, an asterisk will be printed in position N of the output.
(3) If the letter in position N of the guess is in the target, but not in position N, the lower-case form of that letter in guess will be printed in position N of the output.

Input: The first line consists of a number N, representing the number of lines of data to follow. N will be in the range of [1,50]. The next N lines of data consist of two five-character strings each consisting only of lower-case letters. One space will separate those words.

Output: Each output will be five characters consisting of uppercase letters, lowercase letters, and asterisks.

Sample input:
```
5
logic texas
purse purse
china cloth
shore ascot
abcde edcba
```

Sample output:
```
*****
PURSE
C***h
*s*o*
edCba
```

4. Diane

Program Name: Diane.java **Input File: diane.dat**

Diane simply wants to add two values that may be integers, proper fractions, or mixed numbers.

Write a program to take two values and find the sum in simplified format.

Input: The first line consists of a number N, representing the number of lines of data to follow. N will be in the range of [1,50]. The next N lines of data consist of two numeric values A and B, separated by the lower-case word "and". One space separates value A from "and". Another space separates "and" from value B.

If A or B are proper fractions, the format will be numerator, slash ("/"), then denominator with no spaces.

If A or B are mixed numbers, the format will be integer followed by one space then the proper fraction as mentioned above.

If a proper fraction is negative, the negative will be in the numerator. If a mixed number is negative, the negative will be attached to the integer.

All values will be in the range [-1000,1000].

Output: Each output will be either an integer, a fraction, or a mixed number representing the sum of the two values.
If the sum is an integer, it will be written in integer form.
If the sum is a proper fraction, it shall be written in lowest terms in numerator/denominator form with no spaces separating the numerator from the "/", and no spaces separating the"/" from the denominator.

Output should be simplified and in lowest terms.

Sample input:
```
7
12 and 20
30 and 20
22 and 27
1/7 and 2/5
0 and -21
5 1/3 and 7 5/7
10 1/4 and -11 2/3
```

Sample output:
```
32
50
49
19/35
-21
13 1/21
-1 5/12
```

5. Facundo

Program Name: Facundo.java **Input File: facundo.dat**

Facundo needs a program that will emulate what in his eyes is a perfect shuffle. Your job is to create this program.

The deck of cards will be represented by a string of uppercase letters. The first letter in the string is the top of the deck.

First, the deck will be split into an upper deck and a lower deck. The upper deck will consist of the half of the deck containing the top card. The top card will be the top card of the upper deck. The lower deck will consist of the rest of the cards with the bottom card of the original deck being the bottom card on the lower deck.

If there is an even number of cards, the upper and lower decks will have the same number of cards. If there is an odd number of cards, the upper deck will have one more card than the lower deck.

Then, the decks will be shuffled. The bottom card of the upper deck always goes first to the bottom position in the shuffled deck. The bottom card of the lower deck will go on top of that card. The upper and lower decks continue to alternate being placed on the stack until there are no more cards.

This process is executed as many times as is indicated by the data. For `ABCDEFG 3,` the cards are shuffled three times.

Input: The first line consists of a number N, representing the number of lines of data to follow. N will be in the range of [1,50]. The next N lines of data will consist of a string of uppercase letters followed by an integer in the range of [0,100]. The string will be of length in the range of [2,26].

Output: Each output will be a string of uppercase letters.

Sample input:
```
8
ABCDEFG 0
ABCDEFG 1
ABCDEFG 2
ABCDEFG 3
ABCDEFGHIJ 0
ABCDEFGHIJ 1
ABCDEFGHIJ 2
ABCDEFGHIJ 3
```

Sample output:
```
ABCDEFG
AEBFCGD
ACEGBDF
ABCDEFG
ABCDEFGHIJ
FAGBHCIDJE
CFIADGJBEH
GCJFBIEAHD
```

6. Haru

Program Name: Haru.java **Input File: haru.dat**

Haru and his friend are playing a game called Spikebikes. In this game, each player programs their bike with a set of directions. The bikes will then follow these movement instructions, leaving spikes behind them.
Bikes will crash if they run into a spike or another bike. Given each bike's starting location and instruction set, determine the outcome of the game!

Input:
The first line of input will consist of a single integer T (1 <= T <= 10), the number of test cases to follow.
Each test case will begin with a single integer N, denoting the length of the instruction sequences.
The next two lines will be of the format X Y S and will denote the starting location and instruction sequences of players one and two, respectively. X and Y will be integers (0 <= X, Y <= 100) and S will be a string of length N containing characters {U, D, L, R} denoting movement in the {+Y, -Y, -X, +X} directions, respectively.

Coordinates are a standard X-Y system, and locations less than zero and greater than 100 contain spikes and will crash a bike.

No test case will contain a head on collision at a spike location.

Output:
For each test case, report one of the following outcomes:

1) DRAW (if no bike crashes)
2) DOUBLE SPIKE (if both bikes hit a spike at the same time)
3) HEAD ON (if the bikes crash into each other)
4) P1 WIN (if player 2 runs into a spike first)
5) P2 WIN (if player 1 runs into a spike first)

Sample input:
```
5
1
5 6 R
6 6 L
3
3 3 RRR
5 4 DDD
1
0 0 U
1 1 L
2
0 0 UR
1 1 DL
2
0 0 UU
1 1 UU
```

Sample output:
```
HEAD ON
P2 WIN
HEAD ON
DOUBLE SPIKE
DRAW
```

7. Kristina

Program Name: Kristina.java **Input File: kristina.dat**

Kristina has been studying prefix and postfix notation for arithmetic expressions and has asked you to create a combination prefix/postfix calculator program that will check her manual evaluation of expressions of those forms.

Prefix notation places operators before their operands and operations have to be delayed until two operands are available. Consider the prefix example: **`+ - * 7 5 - 9 6 -5`**

`* 7 5` is 7 * 5 = 35
`- 9 6` is 9 − 6 = 3
`- 35 3` is 35 − 3 = 32
`+ 32 -5` is 32 + -5 = 27

Postfix places operators after their operands which means the needed operands are available as soon as an operator is encountered. Consider the postfix example: **`7 5 * 9 6 - - -5 +`**

`7 5 *` is 7 * 5 = 35
`9 6 -` is 9 − 6 = 3
`35 3 -` is 35 − 3 = 32
`32 -5 +` is 32 + -5 = 27

Kristina wants to work with only integers and wants to use **`^`** as an exponent operator. For example, 2 **`^`** 5 is 32.

Can you create the program for Kristina?

Input: First line of data file contains a positive integer T, the number of test cases that follow with $1 \leq T \leq 25$. The following T lines will start with either "PRE" for a prefix expression or "POST" for a postfix expression. Those will be followed by a single space and a properly formed expression of the indicated notation. The combination of operators (^, *, /, +, and −) and integers, N, will be separated by single spaces with $-100 \leq N \leq 100$. However, exponent and other operations are guaranteed to not result in values that exceed a standard Java integer. Expressions are also guaranteed to not result in division by 0. Length of lines will not exceed 200 characters.

Output: For each test case, display the resulting integer value.

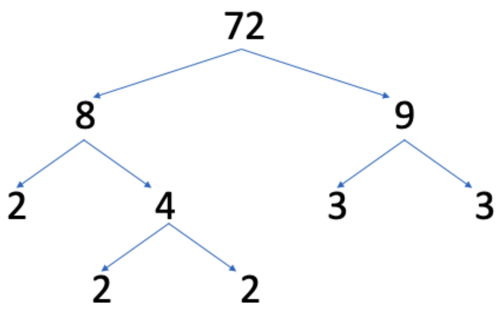
Sample input:
```
6
PRE + - * 7 5 - 9 6 -5
POST 7 5 * 9 6 - - -5 +
POST 2 8 3 4 2 * / + -
PRE - 2 + 8 / 3 * 4 2
POST -39 9 + -35 -44 * -100 / -
PRE + + -97 - * 47 29 / ^ 3 5 100 ^ 2 10
```

Sample output:
```
27
27
-6
-6
-15
2288
```

8. Lavanya

Program Name: Lavanya.java **Input File: lavanya.dat**

Lavanya just learned how to take the prime factorization of a number in her Algebra class. Recall, prime factorization is a way of expressing a number as a product of its prime factors. Remember, a prime number is a number that is divisible by 1 and itself only. For example, the prime factorization of 72 is: 2 * 2 * 2 * 3 * 3. A visual representation of this is:



In order to double check her homework problems, Lavanya has decided to write a program to tell her the prime factorization of any whole number. Can you help her write such a program?

Input: Input will begin with an integer T, the number of test cases. T will be in the range of [1,50]. The following T lines will each contain a single integer I. I will be in the range of [2,2147483647]

Output: For each integer I, you are to output: "`I = primefactor1 * primefactor2 * … * primefactorN`". There is one space between all numbers and operators. NOTE: in the output format, the prime factors are in ascending order, ie, smallest to largest. Your output must match this ascending order.

Sample input:
```
10
72
13
23
100
512
27
28
1000
1001
42
```

Sample output:
```
72 = 2 * 2 * 2 * 3 * 3
13 = 13
23 = 23
100 = 2 * 2 * 5 * 5
512 = 2 * 2 * 2 * 2 * 2 * 2 * 2 * 2 * 2
27 = 3 * 3 * 3
28 = 2 * 2 * 7
1000 = 2 * 2 * 2 * 5 * 5 * 5
1001 = 7 * 11 * 13
42 = 2 * 3 * 7
```

9. Manos

Program Name: Manos.java **Input File: manos.dat**

Manos is playing a 2-player game called Two Towers. In this game, there are two stacks of blocks. During each turn, a player can take as many blocks as they wish from a single stack but must take at least one. The player who removes the last block wins the game! Given the number of blocks in each stack and assuming each player plays optimally, determine which player will win.

Input:
The first line of input will consist of a single integer T, the number of test cases to follow. (1 <= T <= 10)
The next T lines will be of the form A B, denoting the height of the towers for each test case. (0 <= A, B <= 100)
There will be at least one block.

Output:
For each test case on a separate line, print P1 if the first player to go will win, and P2 if the second player will win.

Sample input:
```
3
0 1
1 1
1 2
```

Sample output:
```
P1
P2
P1
```

10. Michaela

Program Name: Michaela.java **Input File: michaela.dat**

Michaela and her friends have created a new way to communicate with each other that utilizes a series of dots (.) and dashes (-) to make sentences or phrases. They've done this so that they can communicate with each other without their nosy teacher, Miss Dolores Umbridge, from eavesdropping on their conversations. They've utilized the ASCII values of the capital letters 'A'-'Z' as well as the ASCII value for the ' ' (space) to create the representations as seen below. Now that their language is created, they need your help in writing a program that can translate an English phrase or sentence into their new language. Can you help them write such a program?

Character	ASCII Value	Representation
(space)	32	`-.....`
A	65	`-.....-`
B	66	`-....-.`
C	67	`-....--`
D	68	`-...-..`
E	69	`-...-.-`
F	70	`-...--.`
G	71	`-...---`
H	72	`-..-...`
I	73	`-..-..-`
J	74	`-..-.-.`
K	75	`-..-.--`
L	76	`-..--..`
M	77	`-..--.-`

Character	ASCII Value	Representation
N	78	`-..---.`
O	79	`-..----`
P	80	`-.-....`
Q	81	`-.-...-`
R	82	`-.-..-.`
S	83	`-.-..--`
T	84	`-.-.-..`
U	85	`-.-.-.-`
V	86	`-.-.--.`
W	87	`-.-.---`
X	88	`-.--...`
Y	89	`-.--..-`
Z	90	`-.--.-.`

Input: Input will begin with an integer M, the number of messages to convert. M will be in range of [1,20]. The following M lines will contain a single message made up of one or more words. Valid messages will be made up of both upper and lower case letters and spaces only. NOTE: even though input can be lower case, all the output will match that of the table above, i.e. upper case letters only.

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Michaela continued…

Output: For each message you are to output: “Message #: series_of_dots_or_dashes series_of_dots_or_dashes …”. There should be a space between each series_of_dots_or_dashes to denote the beginning and end of a letter. Each message is to be output on its own, individual line.

Sample input:
```
6
Hello World
MORSE CODE
UiL cOmPuTeR sCiEnCe
catch the hp reference
SHE WILL NEVER FIGURE THIS OUT
the quick brown fox jumps over the lazy dog
```

Sample output:
```
Message #1: -..-... -...-.- -..--.. -..--.. -..---- -..... -.-.--- -..---- -.-..-. -..--.. -...-..
Message #2: -..--.- -..---- -.-..-. -.-..-- -...-.- -..... -...--- -..---- -...-.. -...-.-
Message #3: -.-.-.- -..-..- -..--.. -..... -...--- -..---- -..--.- -.-.... -.-.-.- -.-.-.. -...-.- -
.-..-. -..... -.-..-- -...--- -..-..- -...-.- -..---. -...--- -...-.-
Message #4: -...--- -....-- -.-.-.. -...--- -..-... -..... -.-.-.. -..-... -...-.- -..... -..-... -.-
.... -..... -.-..-. -...-.- -...--. -...-.- -.-..-. -...-.- -..---. -...--- -...-.-
Message #5: -.-..-- -..-... -...-.- -..... -.-.--- -..-..- -..--.. -..--.. -..... -..---. -...-.- -.-
.--. -...-.- -.-..-. -..... -...--. -..-..- -...--- -.-.-.- -.-..-. -...-.- -..... -.-.-.. -..-... -
..-..- -.-..-- -..... -..---- -.-.-.- -.-.-..
Message #6: -.-.-.. -..-... -...-.- -..... -.-...- -.-.-.- -..-..- -...--- -..-.-- -..... -....-. -.-
..-. -..---- -.-.--- -..---. -..... -...--. -..---- -.--... -..... -..-.-. -.-.-.- -..--.- -.-.... -
.-..-- -..... -..---- -.-.--. -...-.- -.-..-. -..... -.-.-.. -..-... -...-.- -..... -..--.. -....-- -
.--.-. -.--..- -..... -...-.. -..---- -...---
```

11. Pankaj

Program Name: Pankaj.java **Input File: pankaj.dat**

Pankaj will be working for the Ultimate Intelligent Learners Summer camp in the summer of 2022. This camp is geared towards getting the campers to make new friends within their own community and the surrounding areas. This means there is the potential for a camper to know zero, one, or more than one of the other campers attending any given session.

The camp counselors have asked Pankaj to take a list of campers as well as a list of known relationships, and determine if the campers can be broken into two distinct groups such that no two campers in a group have a relationship with anyone else in the group. Remember, the focus of this camp is to get the campers to make new friends, and how can you make new friends with people you already know?

Can you help Pankaj write a program to determine whether it is possible or impossible to break a group of campers up into two distinct groups such that no two campers know anyone else in their group?

Input: The input will consist of an integer *I*, the number of test cases. *I* will be in the range of *[1,20]*. For each test case, input will consist of two lines. Line 1 will contain the name of all the campers attending a given session. Names will be limited to first names only, and only one word first names. It will be guaranteed that no two campers have the same exact first name. Names in the list will be separated by a comma "," and there will be no spaces in the list. Line 2 will consist of the known relationships between the campers. The relationships will be given in the form: "`camper1<->camper2`" this means that `camper1` knows `camper2` and `camper2` knows `camper1`. A relationship in this problem is always two-way, each camper will know the other camper if a relationship is present. Relationships will be separated by a comma "," and there will be no spaces in the list. There will be at least one relationship present between two campers, but potentially more.

Output: For each test case, you are to output "Test Case #: possible" if the campers can be broken into two distinct groups such that know two campers know each other or "Test Case#: impossible" if the campers can not be broken into two such groups.

Sample input:
```
5
Alex,Brent,Chris,Dave,Eric,Fred
Alex<->Chris,Alex<->Eric,Brent<->Dave,Brent<->Fred,Chris<->Eric,Dave<->Fred
Alex,Brent,Chris,Dave,Eric,Fred
Alex<->Chris,Alex<->Eric
Alex,Brent,Chris,Dave,Eric,Fred
Alex<->Brent,Brent<->Chris,Chris<->Dave,Dave<->Eric,Eric<->Fred,Fred<->Alex
Alex,Brent,Chris,Dave,Eric,Fred
Alex<->Brent,Alex<->Chris,Alex<->Dave,Alex<->Eric,Alex<->Fred
Alex,Brent,Chris,Dave,Eric,Fred
Alex<->Brent,Alex<->Chris,Alex<->Dave,Alex<->Eric,Alex<->Fred,Brent<->Chris
```

Sample output:
```
Test case 1: impossible
Test case 2: possible
Test case 3: possible
Test case 4: possible
Test case 5: impossible
```

12. Shirley

Program Name: Shirley.java **Input File: shirley.dat**

After the reposts about shortages of Christmas trees this past year, Shirley thought it might be interesting to analyze aerial data from Christmas tree farms. Current generation mapping drones have amazing resolution capabilities and artificial intelligence (AI) processing of photographs have become astounding!

Shirley found some data but needs help from the UIL programming team to reduce the data into something she can work with. The data she was able to obtain consists of grids of 1-acre (4,840 square yards) square plots with an estimate of the number of trees in that plot. A typical tree farm can vary in their density but seem to hover around 1500 trees per acre. Annual harvesting is usually limited to about 12.5% of the trees to support regeneration on an 8-year cycle with annual harvesting for Christmas. Shirley is an aspiring environmentalist not a computer scientist studying programming and does not view a grid as a zero-base array like most programmers.

Grid Columns ↘ Grid ↓ Rows	1	2	3	4	5	6	7
1	1859	739	0	1101	1569	312	635
2	1069	1789	164	678	568	1282	1633
3	1399	1780	56	0	183	234	1835
4	0	0	973	1155	1157	0	490
5	1750	1523	1714	388	670	0	1256
6	1926	1342	1342	1397	689	0	965

A cluster is 2 or more adjacent plots that each contain 250 or more estimated trees. Adjacent cells are those that have a common edge, not a just a corner. However, a cluster can wrap around a plot or group of plots that contain low numbers. For each grid, Shirley would like a list of the 3 largest clusters in the grid with the total estimated number of trees in the cluster and the percentage of the grid it covers. For the 6 x 7 grid above, the cluster that includes the plot (1, 1) contains 8635 trees and covers 6 plots which is 14.3% of the total grid.

Let's help Shirley with her analysis of Christmas tree data!

Input: The first line is a positive integer 1 ≤ T ≤ 10, the number of test cases in the data file. That will then be followed by T sets of data. For each dataset, the first line will contain 2 integers: the number of rows (R) and the number of columns (C) with 2 ≤ R, C ≤ 15. The dataset continues with R rows, each containing C integers (N) to populate the individual array cells with 0 ≤ N ≤ 2000. All items are whitespace delimited.

Output: For each test case, the first line contains a case number, formatted as shown in sample. The next three lines contain the tree counts and grid percentages, separated by one space, for the largest three clusters from largest count to smallest count. If there are less than three clusters, the later lines will display NONE instead of a count and percentage. The final line for each test case will contain 12 carats "^^^^^^^^^^^^". There are no blank lines.

Sample input:
```
2
6 7
1859 739  0    1101 1569 312  635
1069 1789 164  678  568  1282 1633
1399 1780 56   0    183  234  1835
0    0    973  1155 1157 0    490
1750 1523 1714 388  670  0    1256
1926 1342 1342 1397 689  0    965
3 5
1865 201  1164 1265 248
164  1933 971  1030 166
1828 1624 1654 1136 1693
```

Sample output:
```
Case #1:
16026 31.0
12324 28.6
8635 14.3
^^^^^^^^^^^^
Case #2:
14298 66.7
NONE
NONE
^^^^^^^^^^^^
```