2017 CS PROGRAMMING GURU COMPETITION

P1. Obstacle Avoidance Using a LIDAR Scanner (submitted by Prof. AJ)

A robot has been equipped with a LIDAR scanner for avoiding obstacles. A LIDAR scanner is a one-dimensional (planar) rotational laser scanner that measures distances from objects around the robot. It returns an array of 360 integers that correspond to all degrees in a full circle. An index in the array corresponds to the angle at which the measurement was made.

You are to write a software module that calculates minimal distances to objects surrounding the robot in each of several equal zones. For example, for 12 zones, your software must calculate a minimum and the corresponding index for every zone. In this case, 12 minima along with 12 indices should be calculated and printed as the output.

The first zone start with angle zero. Please note that a single global minimum in a zone is required, and not multiple local minima. If there are multiple equal minimal values in a zone, then the smallest index should be reported. For example, for a sequence:

```
3 2 1 1 2 3 1 2 1 1 3 4 5
```

`1` would be reported as the minimum, and `2` would be the index of the minimum.

Your program should accept two parameters: the number of zones followed by a sequence of 360 integers.

The output should consist of the minima for each zone separated by a single space in the first line followed by their corresponding indices also separated by a single space in the second line.

SAMPLE INPUT

```
12
255 256 256 256 256 257 257 258 259 259 260 261 255 237 221 208 196 18
5 176 167 160 153 146 141 135 130 126 122 118 114 111 108 105 102 100
97 95 93 91 89 87 85 84 82 81 79 78 77 76 74 73 72 71 70 70 69 68 67 6
6 66 65 64 64 63 63 62 62 61 61 61 60 60 59 59 59 59 58 58 58 58 58 57
57 57 57 57 57 57 57 57 57 57 57 57 57 57 57 57 58 58 58 58 58 430 402
377 355 344 346 348 350 353 355 255 246 237 229 221 214 208 202 196 19
1 186 181 177 172 169 165 161 158 155 152 149 147 144 142 140 137 135
133 132 130 128 127 125 124 122 121 120 118 122 126 130 135 141 146 15
3 160 167 176 185 196 208 221 237 255 275 289 288 287 286 286 285 285
284 284 284 284 284 284 284 284 284 285 285 267 234 208 187 170 156 14
5 134 126 118 111 105 100 95 91 87 83 80 77 74 71 69 67 65 63 61 59 58
56 55 54 52 51 50 49 48 47 46 46 45 44 43 43 42 41 41 40 40 39 39 38 3
8 38 37 37 36 36 36 36 35 35 35 34 34 34 34 34 33 33 33 33 33 33 33 33
32 32 32 32 32 32 32 32 32 32 32 32 32 32 32 32 33 33 33 33 33 33 3
```

3 33 34 34 34 34 34 35 35 35 36 36 36 36 37 37 38 38 38 39 39 40 40 41
41 42 43 43 44 45 46 46 47 48 49 50 51 52 54 55 56 58 59 61 63 65 67 6
9 71 74 77 80 83 87 91 95 100 105 111 118 126 134 145 156 260 259 259
258 257 257 256 256 256 256 255 255

SAMPLE OUTPUT

118 66 57 57 121 118 67 38 32 32 38 67
28 58 81 90 148 150 208 236 261 270 300 330

P2. Smith Numbers (submitted by Prof. Claveau)

A Smith number is a number for which the sum of its digits is equal to the sum of the digits in its prime factorization.

For example, $378 = 2 \times 3 \times 3 \times 3 \times 7$ is a Smith number since $3 + 7 + 8 = 2 + 3 + 3 + 3 + 7$.

Write a program to output the first Smith number that has a sum of 42.

P3. Problem: Robot Angles (submitted by Prof. Isaacs)

You are designing an algorithm to control the heading for one of three rover robots. You know the heading of the other two rovers and you want to pick your heading to be the average of the other two.

For example, if one rover is heading East (0 degrees) and the other is heading North (90 degrees) you want to pick the heading for the third rover to be NorthEast (45 degrees).

Write a program that takes in two integers between 0 and 359 degrees that represent headings and returns a String formatted to two decimal places which is the average of those two headings in units of degrees.

If there is more than one valid answer, please pick the smallest. Example: inputs of 0 and 180 should produce the output 90.

Other examples:

INPUT:

90
0

OUTPUT:

45.00

P4. Numbering of Words (submitted by Prof. Pawel Pilarcyzk)

For a course in languages and automata, an instructor is generating lists of all the possible nonempty words (strings) that can be built using m first letters of the English alphabet. In the lists, the words are sorted by the length of the string, and then alphabetically within the words of the same length. For example, if the number of chosen letters is 3 then the words would be: “a”, “b”, “c”, “aa”, “ab”, “ac”, “ba”, “bb”, “bc”, “ca”, “cb”, “cc”, “aaa”, “aab”, “aac”, “aba”, “abb”, etc. The instructor would like to determine what the n-th word in this sequence would be, without generating all the previous words one-by-one, because that would be too much time consuming. Write a program that can quickly determine this, and could work with any number m of letters between 1 and 26 (inclusive), and be suitable for relatively large numbers n (up to some 1,000,000,000,000,000).

The input consists of a few cases. The first number on the input is the number of cases to process. Then each case to consider is defined by two numbers: The number m of letters chosen (1-26), and the index of the string to compute. The program should output the computed strings line by line.

Sample input:

5
3 13
15 27229
21 1715936269
25 910209956620
26 51498792311443

Corresponding output:

aaa
good
success
excellent
ilovecsuci

P5. Hungry but Picky Worm (submitted by Prof. Scrivnor)

Imagine a sequence of numbers written on a sheet a paper, say 1-9999.

A worm who likes to eat the number 0 comes by and eats all the 0's on the paper. What is the sum of all those numbers? Note that 1200 becomes a single number 12 and 1206 becomes *two* numbers, 12 and 6.

Write a program to receive two inputs:

- The single digit the worm eats and,
- The maximum number in the sequence.

And then print the sum.

Input

0,9999

Output

37359000

P6. Truthiness (submitted by Prof. Thoms)

Since the last election cycle, Facebook has been tasked with, "doing more" to combat fake news. Since then, they have integrated a triangulated approach to identifying fake news, which relies on experts, crowdsourcing and machine learning algorithms. For this problem you will rely only on crowdsourcing to flag 'potential' fake news. Your program will read transactional data from standard input (as one line) and calculate the percentages of 'real' and 'fake' news digested by users. While a number of generalizations are made for this problem, please assume the following:

1. Initial news items are assigned the status 0 (meaning true).
2. News reads are assigned the status -1.
3. News items are flagged 'fake' with the status 1.
4. News is labeled 'fake' when 75% or more of reports identify it as 'fake'.
5. News labels may move from 'real' to 'fake' or 'fake' to 'true'.
6. Output will use whole numbers.
7. Records are separated by pipes.
8. Fields are separated by commas.
9. You may assume that a news item has not been read until it is first initialized (see 1.)

Sample input where -1 indicates a read, 0 flags a statement as 'valid', and 1 flags a statement as 'fake'.

1,Humans use 10 percent of their brain.,0|2,Humans use 10 percent of their brain.,-1|3,Humans use 10 percent of their brain.,1|4,Humans use 10 percent of their brain.,-1|5,Humans use 10 percent of their brain.,1|6,Humans use 10 percent of their brain.,-1|7,Humans use 10 percent of their brain.,1|8,Humans use 10 percent of their brain.,-1|9,Humans use 10 percent of their brain.,1|10,Humans use 10 percent of their brain.,-1

Properly formatted output will look like:

Total User Reads:5
True Reads:40%
Fake Reads:60%

Analysis: "Humans use 10 percent of their brain." was read as 'valid' 4 times until the threshold was met and the statement was flagged as 'fake' in sequence 7. Hindsight being 20/20, 60% of all content digested by users was consumed under false pretenses.

More realistic input requires your program to continually receive many different news items for validation. This sample input is shown below and should be used for validating your program:

1,Humans use 10 percent of their brain.,0|2,There are 24 hours in a day.,0|3,Humans use 10 percent of their brain.,-1|4,Humans use 10 percent of their brain.,1|5,The memory span of a goldfish is 3 seconds,0|6,Humans use 10 percent of their brain.,-1|7,Humans use 10 percent of their brain.,1|8,The memory span of a goldfish is 3 seconds,-1|9,The memory span of a goldfish is 3 seconds,-1|10,Humans use 10 percent of their brain.,-1|11,The memory span of a goldfish is 3 seconds,1|12,Humans use 10 percent of their brain.,1|13,Humans use 10 percent of their brain.,-1|14,The memory span of a goldfish is 3 seconds,-1|15,The memory span of a goldfish is 3

seconds,1|16,Humans use 10 percent of their brain.,1|17,Humans use 10 percent of their brain.,-1|18,There are 24 hours in a day.,-1|19,The memory span of a goldfish is 3 seconds,1|20,The memory span of a goldfish is 3 seconds,-1|21,The memory span of a goldfish is 3 seconds,-1|22,There are 24 hours in a day.,-1|23,The memory span of a goldfish is 3 seconds,0|24,The memory span of a goldfish is 3 seconds,1|25,The memory span of a goldfish is 3 seconds,-1|26,The memory span of a goldfish is 3 seconds,1|27,The memory span of a goldfish is 3 seconds,1|28,The memory span of a goldfish is 3 seconds,-1

Properly formatted output for the above would be:

Total User Reads:14
True Reads:50%
Fake Reads:50%

Input data, where output is hidden, will be used for validation:

1,Humans use 10 percent of their brain.,0|2,There are 24 hours in a day.,0|3,Humans use 10 percent of their brain.,-1|4,Humans use 10 percent of their brain.,1|5,A guinea pig is a real pig.,0|6,A guinea pig is a real pig.,-1|7,A guinea pig is a real pig.,0|8,The memory span of a goldfish is 3 seconds.,0|9,Humans use 10 percent of their brain.,-1|10,Humans use 10 percent of their brain.,1|11,The memory span of a goldfish is 3 seconds.,-1|12,A guinea pig is a real pig.,-1|13,A guinea pig is a real pig.,1|14,Only humans can work more than 100 percent.,0|15,The memory span of a goldfish is 3 seconds.,-1|16,Humans use 10 percent of their brain.,-1|17,The memory span of a goldfish is 3 seconds.,1|18,Humans use 10 percent of their brain.,1|19,Only humans can work more than 100 percent.,-1|20,Humans use 10 percent of their brain.,-1|21,The memory span of a goldfish is 3 seconds.,-1|22,The memory span of a goldfish is 3 seconds.,1|23,Humans use 10 percent of their brain.,1|24,Humans use 10 percent of their brain.,-1|25,A guinea pig is a real pig.,1|26,There are 24 hours in a day.,-1|27,Only humans can work more than 100 percent.,1|28,Only humans can work more than 100 percent.,1|29,The memory span of a goldfish is 3 seconds.,1|30,The memory span of a goldfish is 3 seconds.,-1|31,A guinea pig is a real pig.,1|32,The memory span of a goldfish is 3 seconds.,-1|33,Only humans can work more than 100 percent.,0|34,Only humans can work more than 100 percent.,1|35,Only humans can work more than 100 percent.,-1|36,There are 24 hours in a day.,-1|37,A guinea pig is a real pig.,1|38,The memory span of a goldfish is 3 seconds.,0|39,The memory span of a goldfish is 3 seconds.,1|40,The memory span of a goldfish is 3 seconds.,-1|41,The memory span of a goldfish is 3 seconds.,1|42,The memory span of a goldfish is 3 seconds.,1|43,The memory span of a goldfish is 3 seconds.,-1|44,Only humans can work more than 100 percent.,-1|45,There are 24 hours in a day.,0|46,A guinea pig is a real pig.,-1|47,Only humans can work more than 100 percent.,0|48,There are 24 hours in a day.,-1|49,A guinea pig is a real pig.,-1|50,Only humans can work more than 100 percent.,-1

If you solved this problem or are interested in other crowdsourcing problems, see Prof. Thoms.

P7. Number Sequence (backup problem submitted by Prof. Thoms)

Problem: Construct a program that for standard input x=6, the following output is generated:

0,1,1,2,3,5

INPUT

6

OUTPUT:

0,1,1,2,3,5