Google Code Jam '21 Qualification Round Problem E - Cheating Detection

Time limit: 60.0s **Memory limit:** 1G

100 players are competing in a 10000-question trivia tournament; the players are numbered from 1 to 100. Player i has a skill level of S_i and question j has a difficulty level of Q_j. Each skill level and each question difficulty are chosen uniformly at random from the range $[-3.00, 3.00]$, and independently of all other choices. For example, a player can have a skill level of 2.47853 and a question can have a difficulty level of -1.4172.

When player i tries to answer question j, the probability that they answer it correctly is $f(S_i - Q_j)$, where f is the sigmoid function:

$$f(x) = \frac{1}{1 + e^{-x}}$$

where e is Euler's number) (approximately 2.718...), the mathematical constant. Notice that $0 < f(x) < 1$ for all x, so $f(S_i - Q_j)$ is always a valid probability. Each of these answer attempts is chosen at random independently of all other choices.

There is one exception: exactly one of the players is a cheater! The cheater is chosen uniformly at random from among all players, and independently of all other choices. The cheater behaves as follows: before answering each question, they flip a fair coin. If it comes up heads, they do not cheat and the rules work as normal. If it comes up tails, they secretly look up the answer on the Internet and answer the question correctly. Formally, they decide whether to cheat at random with 0.5 probability for each question, independently of all other choices.

The results of a tournament consist of only the per-question results (correct or incorrect) for each player. Apart from the general description above, you do not know anything about the skill levels of the players or the difficulties of the questions.

You must correctly identify the cheater in at least P percent of the test cases. That is, you must succeed in at least $\frac{P \cdot T}{100}$ out of T cases.

Input Specification

The first line of the input gives the number of test cases, T. The second line of the input gives the percentage of test cases, P, that you must answer correctly for your solution to be considered correct. T test cases follow. Each case consists of 100 lines of 10000 characters each. The j^{th} character on the i^{th} line is `1` if the i^{th} player answered the j^{th} question correctly, or `0` if they answered it incorrectly.

Output Specification

For each test case, output one line containing `Case #x: y`, where x is the test case number (starting from 1) and y is the number of the cheater (with player numbers starting from 1).

Limits

Time limit: 60 seconds.

Memory limit: 1 GB.

$T = 50$.

Test Set 1

$P = 10$.

Test Set 2

$P = 86$.

Sample Input

```
1
0
00111010001010100000100000010001010100000000110001101010001000011001010100000110000100100010000
01100001001000000000001001000000000000011100011000101000000001111001000001100111100010101100 11
00010000010000000010000100100000000000001000011010000101010000000000010001001111000100010001 00
0000010011010001001100110000100010001000010100000001001100010000010000011110010000000110000001
001100100001000110000001000000100000001011000100010001101000000000000000000000011100100000010
1001010110100001100000000000000100010000101100000011010010000000001110000001000000011110000100
0010000000000000110111101100110000111100100000100000011011010110000011000000001000100101000010
000110010010010001000000110101001000001000100000010001010010001000100000000110110001000000 1100
01000000000000000011010000100010000000110100010001001010110000000001000000010000000011100000 00
10101010000000100000110000001000011001100010001111010100101010000000000100000100100000000011101
00000000010010110000100000000010100011010000000101000111110000100000010000111100001110000 10000
0110000000001101100000100010011011000000000111100010000000100001101101000000000000101110000000
0110000011001010000000101000001100010000100000101000001000000000110001000000110000000000000 1001
0000100100000000000100001100000001100000001000001000100001000000110100100010000100000011000110
01001101110010010110000101111110000000110000110110000000100000101011011001000100000001000000 10110
0000010000101000000100010000000001000001110100000000110010110110011000100010000000011110001001 00
001000000001000000010000010100000000000000110000011110010001000101000011000000101010001010001 10
1001000000100001000000100000010010010000110000111100100111110000000100010000000000100000100000000
00001100011000100000000110100001000010011001110010000000100000000000001000000100001000000000101000
11001000101100000010001001110000101010010000111000000010011100000100100111100100000000000000110010
0011000000000000000101101000100010000000000100000100010100001000010000001010100000111100011000001
0011100000000000000000101000000000100000000011010100001100010001000000000111000001100000000010101
0100000000110010000001010000110110000111010001100000100000000111000000000000000010010000000000100
0100000000000000011000100011000000100000000000000000101000000000000000010001011000000101001100010 0
001001000101110011000100010010000000100000010011010100001010001100001010000000100100000000100110
0000010000000100010000000110100100110001000000001001100011000100000000100100001010010000001000000 10
000000000000000010000000011100100100001011100011000100101000001110010000000000001101001101010 1
01000000001010000000011000000000101110010001010100000000001010000000000101000000000010000000000
0101001011100101000000011010000101001000100000000101000000100110000101011000000100001100010001000
0000001001000100001101110000000010011001000000000111001000100010000011100100000011010000101001000
10001100010011001000010000000110111010000000000100000000010001010000000110100100000000100111000000
0000000000000101011000110000111010000000000001001000100100010111110100010011011101010001000 10000
0000001101100001000000110000000000101000000010010001100010110001000000000110100100001001111011 1
00000111000000110100001000110000100101010100001100010010100000000001000100000000010011100000100 00
00011000010001001000011110010000000000000001010000100100010010001100100010011010000001001001 0000
000001000000010001101000000001010101000101000111001010000000000101010000110010011000000100101000 01
0000101000000110111110010001100000000000000101100001100100000001000010000100000000000100000010001 1001
0011100100100001111000100000010001000000110001000000010001010000100100100000011001101010110001 0000
01001000101110010010100000000000000110001000000010100001010001100000010011100101010000000100000000
000000000100010010000100100000010001001000000000000110001100000010000011110000000000000000001000101100
00100000001000101010011110110001000000100000100001110101001000100000000010001001101001000000000 0
00100110000000100101010100111001111000000000100011000001010000000000111100000000000110010100100000
00000000000000000010100001011000011000100010110000000000000000000000100000000000101100001100 1000
00000000011001111001000000000100001100000110001110000000000000111100000000100000000100011001000000
```

0100001000000101000110001000010000100101110100010010000000001101000010000001100100001110101000
0010010010100100011000100001000110001110000100100010100100010010110111010001100000100010000000
0010101111000110010100000000000000100001001011000000100010001111000010000010100001010100001010 0
1010100001010000000100011000100000101010000100101000111111011100001001000001000000000000001010
0110001000100010000101100100100010001000001000100010000010000101010011000100110000011010000010
1100000110000000101000100101011000100100000100011010000000000000100011010000000000000001010010
0000000101100000000000000101010110001000100000011000000100010000000001101011000000100100000000
1010000010010010000101000001100001100100110000000100010001010100000011000000001010000000000110
0101010110000100000000000001000110000000101010110000010110000110000000100000100010100000111000
1010000000111000000000000110010100000110011000001100000010100010100100000101100010010000010001
0100000011100110101000000011010011001100011100011010100010100111100000000010111101000011000010
0000000011010101000000110000000000001010000000010010000000001000011000011010100010000100010000
0100010000000000101010000100100001110000100000000000010000000111100110000100100000000000101100 00
0100010001101000000000010110100010100111001000000100000000001100010010000011010110000010100101
0010000001101000000110000110101000010001001110100000000110010000010001010100000000000110000000 01
0000010001010101001000000001000101000010001000000101000010110000100000000100010000010010110100
0100111000000000000010011000010100100001000011010100001010100011000001010000100001110111100000 0
1100100001101101000000000100000010100010110001000000000000110100000110110010110000100101000000 00
0000000100110001010100000000100000000100001100010000000001010001000000010100001001001010110110000
0001001001001110010001111011000000100000100010000100010111001000000000100010000000110111001001
1000000001000111001000000000100100010001100101011010110000001000001010110011000000001010000000
0001010010110000001001101000010000110100100000000000000111010010001110000000000010100010010000 0
0001000000001000000001100000010000011001100000110010001000000010000000001000010000000001010101 01
0000001001000011000000101011100000001110110101111000001000000000000110000000001000100001100000000
1000110001100110000011000000001000000000101001100001101001100001000110000000001000110010000100 0
0010010000110100010011000000000000100101000000001011100000000000100000100100101000000010000000 00
0000100100000010010010011000101010000000110100100010001000000000100001111000100110000100100000 1
0100010000100000100001000000100110000000000100100100010000110000000010100100001010000000100001010 1
0000000000101011000000010000000010000000010100001100000000000111000000101110100100100011000010 0
0000100000100001000000000100111010001100000100110001001100001000000000000001001000101110100100
1001000000011100000000100010111001010100011010011100000000101000010001000000000100010000010100 0
0110000100001010011101010010100000000000001010000001000011000000100010000010000110000100100000 00
0111001111010110001000100000000000010000000000000100000000100010001110101101010111000000101101 1
0000011100101000000001101011010000000000100000000011000000000100001010010001001000001110000110
0110100000001010001010000000000000101000100010100001100010000000001000010100011000000010000001 1000
1000000001000001100000010001010000000110010010100000000101000000000100010001001000010001110000 10
1000000110001000000001000000100101100101000000000000100010000000111100110000101100000011000000010001
0000001001001010000001110000110010011000000110000100000000110101101101000010000010000010011000 0100
1010000100000010100000001001000000010001100000001100110011000000010000001001010001000100001000 0000
0010000001000010000000010010010010110010100111001000010001010110010011011001100000000000000000 00
0000010000000001000100010001000010110100001000100100111100000000100000111000000000100000000000 11
0000110000000000000110000000000001100000000010011010000000100000001000001100010010010000010000 0
0001010001001000000110010010100100000000000000000000001100111011000000001010111100000000000000 10
1001010000100100000011000000111100001000100000110001000101100000001001100001000000101000000001 001
0000000000101110001001000000100010000000000000001010000010001000000000101101011001010100000100 00
0000000000101101100110000000100000000000000000000001010000010011101000000000000100000011110100 110

```
0000000010011000100010001000001100100100001100100010001100001010101010001010001001000010100000
0000000000000000000000010100100101000110000001001000001001111011000100000100100000001000011100011
1100101000110101011100001001000110100100010010110000011000000001001001000010010000000001100100
1011000001000001110010011000000110000000001010000100001000010010001010111001000001010000001111
0001001001000001100100001011000001101000000000100000001001000100000100001011100010000000000001
0010100000000011001100101110011100000110000000100011100001100000010010100000101001011000000000
0000110010001010001010110100000001101100111011111000000010000001100001001110001001101011000000
0001000000100010000001010010010000010000000000001110001000100000000100010000000010000000000000
0010100000000000011001010001000100100100000110001000000010110000000000011001000010001000000000
0010111101110001011100000001011000101011010001100001100101000000000100000000000100000010000100
0000010000000100010001001000011101000101011000001000100010000010110000000000000101000000000010
0100000011100100001101101010111001010000000011110000100000110010000000010011110001011010000000
0000100011001000000010000010011000000001011000000000000011010001000101000010111000001001001001
0110000000000000100110000001010000101001000000010111100001000011000101100000110010100010101000
0001001110110001000000010010000000010110100010010000100000001000100000000000010100110000000010
0010110000000000000100001011010001111100000010000011000000110000000001000001000010001000000001
0011001001010101010100001010001001l0
```

Sample Output

```
Case #1: 59
```

Notice that the sample input uses $T = 1$ and $P = 0$ and therefore does not meet the limits of any test set. The sample output for it is the actual cheater.