The Last Battle

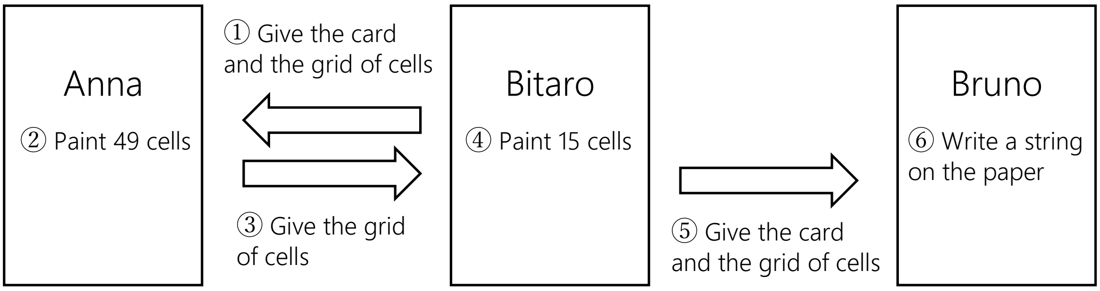
JOICup is a popular television variety program held by JOI broadcast station. Now JOICup becomes the final round. In the final round, the "messenger game" will be played. Only one team which passed the first round will play the game. The team consists of two players, Anna and Bruno,

In the messenger game, the players send information using a grid of 8×8 cells. The rows of the grid are numbered from 0 to 7, and the columns of the grid are numbered from 0 to 7.

In the messenger game, Anna and Bruno are isolated in different rooms. They will play Q **challenges**. The i-th challenge ($1 \leq i \leq Q$) proceeds as follows.

1. Bitaro, the moderator of the game, gives a card and a grid of 8×8 cells to Anna. On the card, three integers X_i, Y_i, N_i ($0 \leq X_i \leq 7,\ 0 \leq Y_i \leq 7,\ 1 \leq N_i \leq 43$) and a string S_i of length N_i consisting of '`A`' and '`B`' are written. All of the cells in the grid are white.
2. Anna paints each of the 49 cells whose row is different from X_i and column is different from Y_i. The color of each cell is either blue or red.
3. Anna gives the grid of cells to Bitaro, the moderator of the game.
4. Bitaro paints each of the 15 cells whose row is equal to X_i or column is equal to Y_i. The color of each cell is either blue or red. This process is done in a room which is not seen by Anna nor Bruno.
5. Bitaro, the moderator of the game, gives a card and the grid of cells to Bruno. Only the integer N_i is written on the card.
6. Bruno writes a string on a paper. If it coincides with S_i, Anna and Bruno win the game.

The challenges proceed as in the following figure.


Anna
② Paint 49 cells
① Give the card and the grid of cells
③ Give the grid of cells
Bitaro
④ Paint 15 cells
⑤ Give the card and the grid of cells
Bruno
⑥ Write a string on the paper

Write programs which implement the strategies of Anna and Bruno to win the "messenger game." For the grading of this task, see Grading.

Implementation Details

You need to submit two files.

The first file is `Anna.cpp`. It should implement Anna's strategy. It should implement the following functions. The program should include `Anna.h` using the preprocessing directive `#include`.

- `void Anna(int X, int Y, int N, std::string S)`

  This function is called Q times. The i-th call ($1 \leq i \leq Q$) corresponds to the procedures 1., 2., 3. of the i-th challenge of the game.

  ◦ The parameter `X` is the integer X_i written on the card given to Anna in the procedure 1. of the i-th challenge.

  ◦ The parameter `Y` is the integer Y_i written on the card given to Anna in the procedure 1. of the i-th challenge.

  ◦ The parameter `N` is the integer N_i written on the card given to Anna in the procedure 1. of the i-th challenge.

  ◦ The parameter `S` is the string S_i written on the card given to Anna in the procedure 1. of the i-th challenge.

  For each function call to `Anna`, the following function should be called 49 times in total. The following function should be called once for each of the 49 cells whose row is different from X_i and column is different from Y_i.

  ★ `void Paint(int a, int b, int c)`

  ◇ The parameters `a, b` mean Anna paints the cell whose row is `a` and column is `b`. Here the conditions $0 \leq$ `a` ≤ 7, $0 \leq$ `b` ≤ 7, `a` $\neq$ `X`, `b` $\neq$ `Y` should be satisfied. If this condition is not satisfied, your program is judged as **Wrong Answer [1]**.

  ◇ The parameter `c` means the color painted by Anna is blue if `c` $= 0$, and red if `c` $= 1$. Here, $0 \leq$ `c` ≤ 1 should be satisfied. If this condition is not satisfied, your program is judged as **Wrong Answer [2]**.

  ◇ If the function `Paint` is called with the same parameters (`a`, `b`) more than once, your program is judged as **Wrong Answer [3]**.

  ◇ When the function `Anna` terminates, if the number of function calls to `Paint` is different from 49, your program is judged as **Wrong Answer [4]**.

The second file is `Bruno.cpp`. It should implement Bruno's strategy. It should implement the following function. The program should include `Bruno.h` using the preprocessing directive `#include`.

- `std::string Bruno(int N, std::vector<std::vector<int>> T)`
  This function is called every time when Anna finishes painting the grid. This function is called Q times in total. The i-th call ($1 \leq i \leq Q$) corresponds to the procedures 5., 6. of the i-th challenge of the game.
  - The parameter `N` is the integer N_i written on the card given to Bruno in the procedure 5. of the i-th challenge.
  - The parameter `T` is a two-dimensional array of size 8×8 corresponding to the grid of cells given to Bruno in the procedure 5. of the i-th challenge. The color of the cell whose row is `a` ($0 \leq$ `a` ≤ 7) and column is `b` ($0 \leq$ `b` ≤ 7) is blue if `T[a][b]` $= 0$, and red if `T[a][b]` $= 1$.
  - The return value is the string written by Bruno on a paper.
  - If the return value is a string of length 44 or more, your program is judged as **Wrong Answer [5]**.
  - Each character of the return value should be either '`A`' or '`B`'. If this condition is not satisfied, your program is judged as **Wrong Answer [6]**.

Important Notices

- Your program can implement other functions for internal use, or use global variables. Submitted files will be compiled with the grader, and become a single executable file. All global variables and internal functions should be declared in an unnamed namespace to avoid confliction with other files. When it is graded, it will be executed as two processes of Anna and Bruno. The process of Anna and the process of Bruno cannot share global variables.
- Your program must not use the standard input and the standard output. Your program must not communicate with other files by any methods. However, your program may output debugging information to the standard error.

Compilation and Test Run

You can download an archive file from the contest webpage which contains the sample grader to test your program. The archive file also contains a sample source file of your program.

The sample grader is the file `grader.cpp`. In order to test your program, put `grader.cpp`, `Anna.cpp`, `Bruno.cpp`, `Anna.h`, `Bruno.h` in the same directory, and run the following command to compile your programs. Instead, you may run `compile.sh` contained in the archive file.

```
g++ -std=gnu++17 -O2 -o grader grader.cpp Anna.cpp Bruno.cpp
```

When the compilation succeeds, the executable file `grader` is generated.

Note that the actual grader is different from the sample grader. **In particular, Bitaro does not necessarily choose the colors to paint the cells randomly**. The sample grader will be executed as a single process, which will read input data from the standard input and write the results to the standard output.

Input for the Sample Grader

The sample grader reads the following data from the standard input.

Q
X_1 Y_1 N_1 S_1
X_2 Y_2 N_2 S_2
$\vdots$
X_Q Y_Q N_Q S_Q

Output of the Sample Grader

The sample grader outputs the following information to the standard output (quotes for clarity).

- If your program is judged as correct, it writes the value of L^* as “`Accepted: 28`”. For the value of L^*, see Grading.
- If your program is judged as any type of Wrong Answer, the sample grader writes its type as “`Wrong Answer [1]`”.

If your program satisfies the conditions of several types of Wrong Answer, the sample grader reports only one of them.

In sample grader, the colors chosen by Bitaro for challenges are randomly determined by pseudorandom numbers whose results do not change for different executions. In order to change the seed of pseudorandom numbers, run the sample grader with the first integer argument as follows.

```
./grader 2023
```

Constraints

- $1 \leq Q \leq 20\,000$.
- $0 \leq X_i \leq 7$ $(1 \leq i \leq Q)$.
- $0 \leq Y_i \leq 7$ $(1 \leq i \leq Q)$.
- $1 \leq N_i \leq 43$ $(1 \leq i \leq Q)$.
- Q, X_i, Y_i, N_i are integers.
- S_i $(1 \leq i \leq Q)$ is a string of length N_i consisting of ‘A’ and ‘B’.

Grading

If your program is judged as any type of Wrong Answer [1]–[6] (see Implementation Details) or any type of runtime errors (TLE (Time Limit Exceeded), MLE (Memory Limit Exceeded), Abnormal End, etc.) in any of the test cases, your score is 0 point regardless of whether your program wins challenges in other test cases.

Otherwise, let L^* be the minimum of the following values for all test cases of this task. Your score is calculated as in the following table.

- The maximum value of L such that Anna and Bruno win all the challenges satisfying $N_i \leq L$. However, if they win all the challenges in the test cases, we set $L = 43$.

L^*	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Score	0	5	8	10	11	13	14	16	18	19	21	22	24	26	27

L^*	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Score	29	30	32	34	35	37	38	40	42	43	45	46	48	50	51

L^*	30	31	32	33	34	35	36	37	38	39	40	41	42	43
Score	53	54	56	57	59	60	62	65	68	71	74	77	84	100

Sample Communication

Here is a sample input for the sample grader and corresponding function calls. The parameters `T` for the function calls to `Bruno` are omitted.

Sample Input 1	Sample Function Calls		
	Function call to Anna	Function call to Bruno	Return value of Bruno

`2`
`0 0 1 B`
`5 7 8 AAAABBBB`
	`Anna(0, 0, 1, "B")`		

	`Paint(1, 1, 0)`		
	`Paint(1, 2, 1)`		
	⋮		
	`Paint(7, 7, 1)`		
		`Bruno(1, ...)`	
			`"B"`
	`Anna(5, 7, 8, "AAAABBBB")`		
	`Paint(0, 0, 1)`		
	`Paint(0, 1, 1)`		
	⋮		
	`Paint(7, 6, 0)`		
		`Bruno(8, ...)`	
			`"AAAABBBB"`

In this sample input, there are Q (= 2) challenges.

- In the first challenge, we have $X_1 = 0$, $Y_1 = 0$, $N_1 = 1$, $S_1 =$ “B”. Anna paints the 49 cells whose row is different from 0 and column is different from 0.
- In the second challenge, we have $X_2 = 5$, $Y_2 = 7$, $N_2 = 8$, $S_2 =$ “`AAAABBBB`”. Anna paints the 49 cells whose row is different from 5 and column is different from 7.

For example, if your program calls `Paint(0, 2, 1)` in the first challenge, it is judged as **Wrong Answer [1]** because it designates a cell whose row is 0.

Here is another sample input for the sample grader.

Sample Input 2

```
30
3 1 1 A
1 4 1 A
6 6 2 AA
1 1 2 BB
3 1 3 BAB
7 4 3 AAB
6 4 4 BAAB
6 7 4 BABA
3 3 5 BABBA
1 5 5 ABBBA
4 3 6 ABBBBB
2 1 6 ABAAAA
6 0 7 AAABABA
6 6 7 BBABBAA
0 4 8 AABAABAB
2 1 8 AABBBBBA
2 0 9 BABABBAAA
1 5 9 BBAAABABB
6 7 10 BAAABAAABB
1 7 10 BBBBBBBABA
2 6 12 AABAABABABAB
3 4 15 BBAABAAAABABAAB
5 6 18 BAAAABBABABBBABBAB
7 0 22 BABBAABAAABBABBBBBBABA
2 0 26 AAAABBABBAAAAABABABBAABAAA
0 7 30 AAABBBAAABAABBBBAABBAAABBBABBB
2 7 34 BABAABBAABABBABAABBABBABAABBBBABBB
2 5 38 BBBBAABAABAABABABBBBBAAABBABAAABAAABBB
5 2 41 AABABBAAABBABAAAABBABABBAAAAAABBABBABBABA
1 0 43 AABBABBBBABABBBABBBBAAAAAABABAAABBBAABBAAAB
```