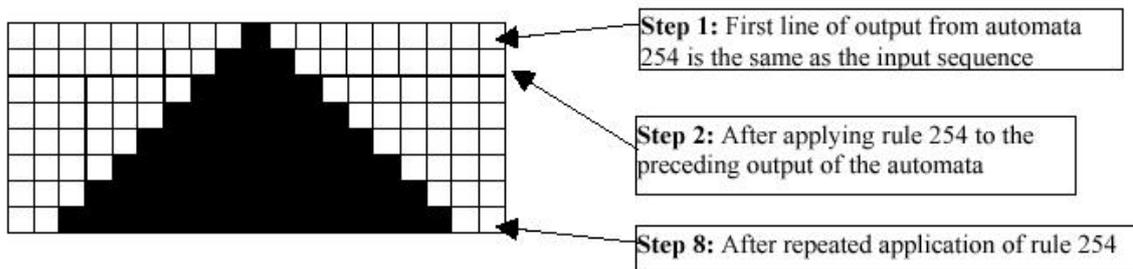


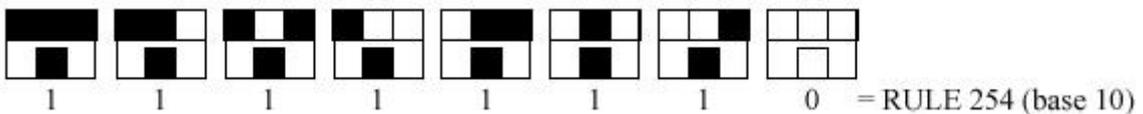
3201 Boundaries on “A New Kind of Science”

Stephen Wolfram in a “New Kind of Science” describes a special kind of cellular automata. Regardless of what you think about the book, the automata he describes are rather interesting. They consist of rows of blocks, where blocks are either filled or not filled depending on the previous row. To generate a new row of blocks, the automata looks at the preceding row and then follows a pre-set “rule” to either color or not color a square on the output row.

For example the following diagram illustrates the “output” from one of these special kind of cellular automata:

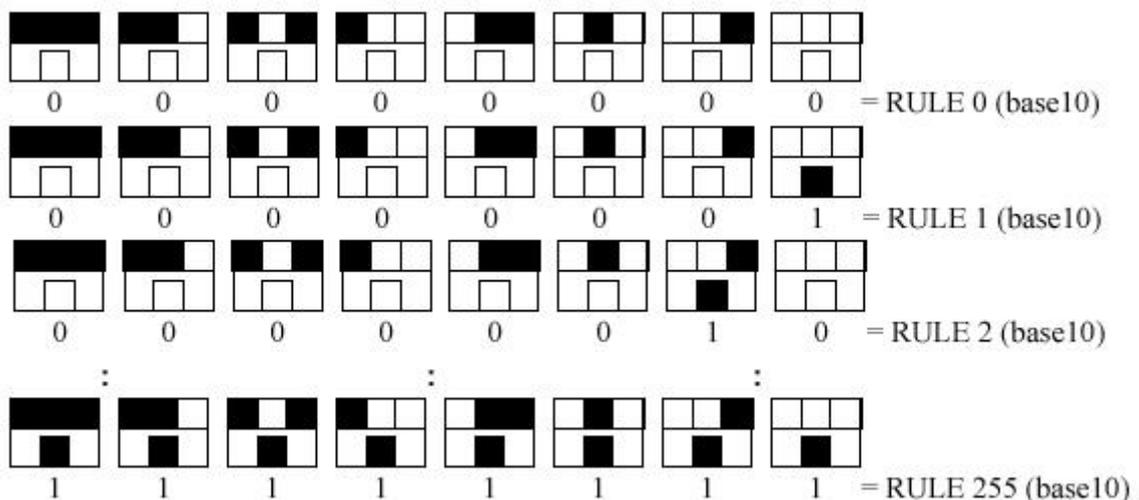


was generated by repeated application of “Rule 254”. The automaton was initialized with an input line that consisted of a single black square. Repeated application of rule 254 to the output line from the preceding step generated the black triangle shown above.



For this rule, the top row in each box gives one of eight possible color combinations for a cell (the middle cell) and its two neighbors (the left and right neighbors of the cell). The bottom row in a box specifies the color that the center cell should have on the next step for each of the 8 possible cases.

Given this arrangement, there are 256 different generating rules or automata numbered as follows:



The “Bounded” Automata

Unlike the automata in “A New Kind of Science”, the automata for this problem operate in a “bounded space”. In other words, each line output by an automaton consists of exactly n squares, and, the first square, and the last square of the output from a bounded automaton are always white no matter what the rule for the automata. This means that while an automaton can examine the first and last square of its input line when computing the new second and second to last characters, it cannot change the first or last square when it outputs a line. These two squares must always remain white.

Bounded automata will always start life on a line with an odd number of squares, and all of the squares (except the middle square) are white. The middle square for step 1 is always black.

The Program

For every line in the input file, your program must determine which (if any) of the 256 possible automata could have generated that particular line. If none of the automata generate the sequence by the given step number, output ‘NONE’. If more than one automata generated that line, then, you must output all of the automata that generate the line as described below in the output section.

Input

- The first field on a line of input consists of a **maximum step number** for the automata to run. This number can be up to 32 bits. Values are chosen such that the problem is solvable within the given time limits given the input specifications.
- The second field on a line of input consists of an **odd-length string of characters** which represent the “squares” on the line.
- The character ‘W’ represents a **white square** and a ‘B’ represents a **black square**.
- If an input string **contains characters other than ‘W’ or ‘B’, or if the input string is an invalid string (not a properly bounded string as described previously)**, then obviously the string cannot be found by any of the automata, and the output will be ‘LINE # NONE’ as illustrated below.
- Each line in the input file will have a terminating newline character.
- Input is terminated by a single line with the characters ‘END OF INPUT’ as illustrated below. The ‘END OF INPUT’ line should not be processed by your search algorithm.

Output

- The output consists of ‘LINE #’ followed by pairs of numbers ‘(*rule*, *step*)’ where *rule* is the rule number of the automata (1 through 255) that generated a particular output and *step* is the **first step in the sequence of outputs at which the automata generated the desired output sequence**.
- If more than one rule generated the desired output sequence **before or on the maximum step number**, list a pair for each rule number that generated the desired output, in order, from lowest automata number to highest automata number with a space between each output pair.
- If none of the automata generate the particular line from the input file **before or on the maximum step number**, output ‘LINE # NONE’ (where # represents the number of the input line with the search string).

Sample Input

```
3 WBWBWBWBW
1000 WBWBWBWBBBW
5235 WBWBWBWBBBWWBBWWWWWWBBWWWWWWBBWWBBBWWBWBWBW
5 WBWBDCWBW
END OF INPUT
```

Sample Output

```
LINE 1 (91,3)
LINE 2 (15,8) (158,11) (159,14) (243,8)
LINE 3 (129,84) (161,84)
LINE 4 NONE
```