Problem 186: Take Me Out to the State Machine

Difficulty: Hard

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Problem Background

Baseball is a very popular sport in the United States and several other countries. A long-standing practice amongst baseball enthusiasts is to complete a scorecard as the game progresses. This scorecard records most details of the game so that it can be completely reconstructed afterwards. This is possible because a game of baseball proceeds as a series of states, with a pause in between each action taken by the offensive team. This contrasts with a sport like basketball or soccer where play will progress for minutes without a break, making a full reconstruction of events very difficult.

This play-and-pause behavior makes a baseball game function as a state machine; a construct in which a set of actions result in one of several distinct "states." If these actions are recorded and repeated by another identical state machine, it will end up in the same state as the original machine. Here, the scorecard serves as the record of actions taken within the game.

Problem Description

You will need to read and parse a baseball scorecard in order to reconstruct the events that took place during that game. As part of this process, you will need to determine the final score of the game, as well as show how the field looked at specific points during the game.

First, a quick review of the game of baseball; if you're already familiar with the game, you can skip this paragraph, as it won't provide any information relevant to the problem that you don't already know. Baseball is played by two teams on a field known as a diamond, due to the arrangement of four "bases" around the field. Over the course of nine "innings", teams take turns on offense (or "at bat") and defense (or "in the field"). The away team is always at bat first, in the "top" of the inning; the home team is at bat second, in the "bottom" of the inning. Players on the team currently at bat take turns standing at home base attempting to hit a ball thrown by the pitcher of the team in the field. If the batter misses or doesn't attempt to hit the ball, they are awarded a "strike" or "ball" based on several factors. If the batter hits the ball, they become a "runner" and attempt to run counter-clockwise around the field, to first, second, and third base, then back to home base. Each runner earns one point for his team when he crosses home base without being tagged out by the team in the field. The teams switch roles once three players on the team at bat are out.

(Continue reading here if you skipped the paragraph above.) Baseball scorecards show the events that occurred while a team is at bat. They are presented as a table, with each row representing a different inning and each column showing the actions taken by each player during the inning. These

actions are represented by acronyms for the various plays that can be made during a game. For this problem, we will use a simplified set of acronyms that don't cover all possible plays or all possible outcomes from those plays. These include:

Offensive plays:

- BB - Walk / Base on Balls. The batter has earned four balls and is able to walk to first base unopposed. Other runners already on the field do not advance, except as needed to allow the batter to move to first base. (e.g., a runner on first base would walk to second base, but a runner on second base would not move unless someone was also on first base.)
- S - Single. The batter hits the ball and is able to advance to first base. Other runners will advance one base unless tagged out.
- D - Double. The batter hits the ball and is able to advance to second base. Other runners will advance two bases unless tagged out.
- T - Triple. The batter hits the ball and is able to advance to third base. Any other runners will advance to home base and score unless tagged out.
- HR - Home Run. The batter hits the ball out of the field and is able to cross home plate and score along with any other runners.

Outs:

- B - Bunt. The batter hits the ball a short distance and is tagged out before he can reach first base. Other runners already on base will advance one base.
- FC - Fielder's Choice. A fielder tags out the batter or one of the runners. Other runners (including the batter) will advance one or more bases.
- DP - Double Play. The team in the field tags out two of the runners (one of whom may be the batter). Other runners (including the batter) will advance one or more bases if they are not also tagged out.
- K - Strike Out. The batter has earned three strikes and is out without reaching a base. Any runners already on base do not advance.
- PF - Pop Fly. The batter hits the ball up high, but it is caught before touching the ground, resulting in an out. Any runners already on base do not advance.

Each cell within the scorecard's table indicates the position of that player on the field after each play during the inning; first base is shown at the right of the cell, second base at the top, third base on the left, and home base at the bottom. If the player made it to a base, their initial position will be marked with the acronym for the offensive play they made. As the plays made by teammates allow the player to advance around the bases, a number will be displayed at each of the player's positions representing the number of their teammate that allowed the advance. For example, see the cell below showing Player 1's actions:

```
|   2   |
|      S|
|   4   |
```

In this case, Player 1 hit a single and was able to advance to first base (indicated by the "S" on the right side). Player 2 later came to bat and allowed Player 1 to advance to second base (indicated by the "2" at the top). Player 3 didn't allow Player 1 to advance, and so his number doesn't appear; however, Player 4 allowed Player 1 to advance to home base and score (indicated by the "4" at the bottom). Notice that we don't know what Players 2-4 did on their turns at bat just from this cell; this is documented in their own sections of the scorecard.

When a batter or runner is out, the acronym representing the cause of their out is shown in the center of the diamond. For example:

```
|       |
|  DPBB |
|       |
```

This player was able to reach first base with a walk; however, before he was able to each any other bases, he was tagged out in a double play on a teammate's turn at bat.

Each cell in the scorecard represents multiple states during the course of the game. The second example shows two states; one in which the batter was able to walk to first base, then another when he was tagged out and removed from the field. This doesn't preclude the possibility of other states in between those states; another player may have struck out between the walk and double play, without affecting the position of the runners. As a result, you have to look at the diagrams for other players to get a full understanding of what happens during each inning.

Your program must read in a scorecard for each team in order to reconstruct the events that took place during the game. You will then be asked to show the state of the field at specific points during the game, as well as the final score of the game.

Sample Input

The first line of your program's input, received from the standard input channel, will contain a positive integer representing the number of test cases. Each test case will include:

- A line containing two positive integers separated by spaces; respectively:
  - X, the number of innings played during the game. This number will be between 1 and 9 inclusive.
  - Y, the number of points in the game for which you must show the state of the field.
- Two scorecards laid out over multiple lines. The first scorecard represents the away team and the top of each inning; the second scorecard represents the home team and the bottom of each inning. The format of each scorecard is as follows:
  - A line containing a header for the scorecard, formatted as follows:

        - A space followed by a pipe (|)
        - Nine cells containing information about each player, formatted as follows:
            - A space
            - An integer, 1 through 9 inclusive, representing the player's batting number. Players will be listed in their batting order, from 1 to 9.
            - A space
            - Two uppercase letters representing the player's initials
            - A space followed by a pipe (|)
    - A row divider consisting of 65 dashes (-).
    - X table rows, each consisting of four lines of text and containing ten cells. The first cell in each row contains spaces except for the second line, which will contain a positive integer between 1 and X inclusive. The other cells will contain spaces, numbers, and uppercase letter acronyms, arranged as described in the problem description above. Cells are divided by a column of pipes (|), and every row ends with a divider line consisting of 65 dashes (-).
- Y lines listing the points during the game for which you must display the state of the field. These lines contain the following information, separated by spaces:
    - The phrase "TOP OF" or "BOTTOM OF" if the point during the game is during the away team's at bat or the home team's at bat, respectively.
    - A positive integer from 1 to X inclusive, representing the number of the inning
    - The word "PLAYER"
    - A positive integer from 1 to 9 inclusive, representing the number of the player about to bat. The point in time to represent is just as the indicated player is stepping up to bat, before they have taken the action shown in the scorecard.

To avoid breaking across pages, the sample input begins on the next page.

```
1
3 5
  | 1 CF | 2 FB | 3 LF | 4 SS | 5 CA | 6 TB | 7 RF | 8 SB | 9 PI |
-----------------------------------------------------------------
  |      |   D  |      |      |      |      |      |      |      |
1 | 2  BB| 4    |   K  |  DP S|  DP  |      |      |      |      |
  |   4  |      |      |      |      |      |      |      |      |
-----------------------------------------------------------------
  |      |      |      |      |      |      |      |      |      |
2 |   K  |      |      |      |      |  PF  |    BB|      |  PF  |
  |      |      |      |      |      |      |   8  |  HR  |      |
-----------------------------------------------------------------
  |      |      |      |      |   6  |      |      |      |      |
3 |      |   K  |  PF  | T    |    BB|     S|  PF  |      |      |
  |      |      |      |   6  |      |      |      |      |      |
-----------------------------------------------------------------
  | 1 FB | 2 RF | 3 CA | 4 SB | 5 TB | 6 LF | 7 SS | 8 CF | 9 PI |
-----------------------------------------------------------------
  |      |   D  |      |      |      |      |      |      |      |
1 |   K  |      |    BB|      |  PF  |   K  |      |      |      |
  |      |   4  |   4  |  HR  |      |      |      |      |      |
-----------------------------------------------------------------
  |      |      |      |      |      |      |   8  |   9  |      |
2 |   B  |     S|   K  |      |      |      | 9   S| 1   S|   B  |
  |      |      |      |      |      |      |   1  |   2  |      |
-----------------------------------------------------------------
  |      |      |      |      |      |      |      |      |      |
3 |      |      |      |      |      |      |      |      |      |
  |      |      |      |      |      |      |      |      |      |
-----------------------------------------------------------------
TOP OF 1 PLAYER 4
BOTTOM OF 1 PLAYER 2
TOP OF 2 PLAYER 6
BOTTOM OF 2 PLAYER 3
TOP OF 3 PLAYER 7
```

Sample Output

For each test case, your program must print the following information:

- `Y` diagrams of the baseball field, representing the state of the game as the indicated player comes up to bat during the indicated inning. Each diagram must be formatted as follows:
    - A line containing two spaces followed by the uppercase initials of the player on second base. If second base is unoccupied, print two underscores in place of the initials (__).
    - A line containing a space, a forward slash (/), two spaces, and a back slash (\)

  - A line containing the uppercase initials of the player on third base, two spaces, and the uppercase initials of the player on first base. If either base is unoccupied, print two underscores in place of the respective initials (__)
  - A line containing a space, a back slash (\), two spaces, and a forward slash (/)
  - A line containing two spaces followed by the uppercase initials of the player currently at bat.
  - A line showing the score at that point in the game, including:
    - A number showing the home team's score
    - A dash (-)
    - A number showing the away team's score
  - A line showing the number of outs at that point during the inning, formatted as an integer followed by a space and the word "OUT"
  - Remember that no lines should contain any trailing spaces.
- A line showing the game's final score, formatted as described below. The score after all provided innings is the final score, even if the number of innings played is less than 9.
  - If one team had a higher score than the other:
    - The word "FINAL:" followed by a space
    - The word "HOME" or "AWAY", depending on which team had a higher score
    - A space followed by the phrase "TEAM WINS" and another space
    - The home team's score, printed as an integer
    - A dash (-)
    - The away team's score, printed as an integer
  - If both teams had the same score:
    - The phrase "FINAL: TIE GAME" followed by a space
    - The home team's score, printed as an integer
    - A dash (-)
    - The away team's score, printed as an integer

```
  FB
 /  \
CF  __
 \  /
  SS
0-0
1 OUT

  __
 /  \
__  __
 \  /
  RF
0-1
1 OUT

  __
 /  \
__  __
 \  /
  TB
3-1
0 OUT

  __
 /  \
__   RF
 \  /
  CA
5-3
2 OUT
  CA
 /  \
__   TB
 \  /
  RF
5-4
2 OUT
FINAL: HOME TEAM WINS 5-4
```