The Walking Dead

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1. Game Rules

For reasons still unknown, the zombie apocalypse has taken over the Earth. The few humans left are trying to survive and seize the scarce resources still available.

This is a game for four players, identified with numbers from 0 to 3. Each player controls a clan of living units. However, two other types of units coexist in the game: dead units and zombies.

The game lasts for 200 rounds, numbered from 1 to 200. Each unit can move a maximum of once per round. Dead units, as expected, cannot move. During these rounds, clans accumulate points, and the game is won by the clan with the most points at the end of round 200.

The game board has dimensions of 60×60. Units cannot move outside of it under any circumstances. A position on the board is determined by a pair of integers (f, c) where $0 \leq f < 60$ and $0 \leq c < 60$. The top-left position is $(0, 0)$, while the bottom-right is $(59, 59)$. Therefore, the first coordinate (f for row) indicates the position on the vertical axis, and the second (c for column) on the horizontal axis. Each cell on the board is either part of a street or filled with debris. Units cannot step on debris and must necessarily move along the streets.

Clans start the game with a certain amount of strength points. A clan's strength is defined as:

$$\left\lfloor \frac{\text{strength points}}{\text{living units}} \right\rfloor$$

and will be key in determining the winner of the battles that will take place during the game. At the end of each round, a clan's strength points are decreased by an amount equal to the number of living units in that clan. However, this amount will never become negative. To increase strength points, living units can gather food found on the board. It is easy to see that a clan with many living units needs to gather a lot of food to maintain considerable strength. This is why some units decide to switch clans: each round, with a 20% probability, a unit from the clan with the most living units will join the clan with the fewest living units. If there are multiple clans with these properties, one of them is selected randomly.

Movement of Living Units

A living unit from a clan can move around the board as follows:

- It can only move to horizontally and vertically adjacent cells, never diagonally.
- If it moves to a cell occupied by debris, a unit of its own clan, or a dead unit, the movement is ignored.
- If it moves to a cell occupied by food, the clan's strength points increase, the unit occupies the cell, making the food disappear, and the clan owns the cell. At the end of the round, a unit of food will reappear in another position. Note that a cell will never be occupied by both food and a unit.
- If it moves to an empty cell (without food or any unit), the movement is executed, and the clan will own the cell.
- If it moves to a cell occupied by a zombie, the zombie dies, but the unit does not move. As a result, the clan receives a certain number of points, and at the end of the round, a living unit from this clan will reappear in another position, replacing the zombie, which will disappear.
- If it moves to a cell occupied by a living unit from another clan, a fight occurs. The losing unit becomes a dead unit and starts its conversion process: after a certain number of rounds, it will become a zombie. If it was already in the process of converting due to a previous zombie bite, the process starts over. The clan of the unit winning the attack receives a certain number of points but does not move from its position. The winner of the fight is determined as follows:

  With a 30% probability, the unit initiating the attack surprises the other and wins without a fight. Otherwise, if the strengths of the two clans involved are N and M, respectively, the first will win with a probability of N/(N + M) and the second with a probability of M/(N + M). If N = M = 0, both units have an equal chance of winning.

Movement of Zombies

Zombies do not belong to any clan and therefore cannot be controlled by any player. Zombies always move toward the nearest living unit, considering obstacles. If there are several at the minimum distance, they will choose one at random. The movements of a zombie are governed by the following rules:

- It can move to horizontally, vertically, and diagonally adjacent cells.
- It will never move to a cell occupied by debris, a dead unit, or another zombie.
- If it moves to a cell occupied by food, the food disappears. At the end of the round, a unit of food will reappear in a random position. If a clan owned this cell, it will no longer do so.
- If it moves to an empty cell (without food or any unit) owned by a clan, the clan loses ownership.
- If it tries to move to a cell occupied by a living unit, the movement does not occur. However, it bites the unit, which begins its conversion process to a zombie, which will occur after a certain number of rounds. If this process had already started due to a previous bite, the conversion process does not restart but continues. During the conversion to a zombie, the unit behaves like a living unit.

As a result of the above rules, the total number of units remains constant throughout the game.

Regeneration of Objects

Whenever a unit of food or a living unit needs to be regenerated, it always reappears in an empty cell C such that there are no units or food in the surrounding positions (marked with an x in the table):

```
x x x x x
x x x x x
x x C x x
x x x x x
x x x x x
```

If at the time of reappearing there is no safe cell in this sense, the object reappears in an empty cell that does not have any unit or food.

It is important to note that units have an identifier that never changes, not even during the regeneration process. That is, if a unit with a certain initial identifier becomes a zombie, it continues with the same identifier. If later the zombie dies and reappears as a living unit from another clan, the identifier remains.

Scoring

A clan's score in a round is determined by two components. First, for each zombie the clan has killed up to that point, they receive 10 points. For each unit killed, they receive 50 points.

Second, for each cell owned by the clan in that round, they receive 1 point. The clan's score is the sum of these amounts. Thus, the score can decrease if the possession of some cells is lost. The constants 10, 50, and 1, as well as others that specify the initial game parameters, are defined in the input file `default.cnf`. All games will be played with exactly the values given in this file.

Execution of Orders

Each round, more than one order can be given to the same unit, although only the first one will be selected (if any). Any program attempting to give more than 1000 commands during the same round will be aborted.

Each round, the selected orders of the four players are executed in random order, but respecting the relative order between the units of the same clan.

As a result of the previous rule, consider giving orders to your units each round from most urgent to least urgent.

Keep in mind that each movement is applied to the board resulting from the previous movements. For example, consider the board:

```
x x x x
x M U x
x V x x
x x x x
```

where M represents food and U and V are two living units from different clans. Imagine that the player controlling U has decided for it to move left, and the player controlling V has decided for it to move up. If V's movement is executed first, then U will miss the food because V has already consumed it, and additionally, U's subsequent movement will be an attack on V, from which it could be harmed. If U dies during this attack, in the game's visualization we will see a transition from the previous matrix to a situation where U has disappeared. Obviously, there could not have been an attack between U and V from the initial configuration because living units cannot move diagonally, but the execution order of the commands made it possible. Keep this in mind when you do not understand certain situations during the visualization of the games.

After executing all player movements, zombie movements proceed. Upon completion, the following processes are executed in this order: units that have completed their conversion process become zombies, dead zombies become living units, a unit from the clan with the most living units may join the clan with the fewest living units, consumed food units are regenerated, and scores are updated.

2. The Viewer

The game viewer is described as follows:

- At the top, there are buttons to play or pause the game, go to the beginning or the end of the game, enable or disable animation mode, or get a help window with more ways to control how the game is played. The current round and a button to close the viewer are also displayed. A horizontal scroll bar visually shows the current round of the game.
- In the left column, each player is displayed with their corresponding name and color. Below it, the current score, the number of living units, and the strength of the corresponding player are shown. In games played on Jutge.org, the percentage of CPU time used by each player is also shown.
- The main part of the window shows the game board. Here, units of each player are displayed with their corresponding color, the dead with a D, and the zombies with a Z. The food units are displayed with an M and the debris with an X. The cells owned by each player are represented with a dot in the same color as the player.

The game viewer allows you to load a game for a detailed study. We highly recommend that you become familiar with its operation.

3. The Interface

Each game player is a program that is compiled and executed according to the rules defined in the Minions standard. The programs only communicate with the judge through the standard input and output.

Each game is played with the same initial parameters, which are defined in the `default.cnf` file. However, different games will have different initial situations of the units.

During the first round, the player must be aware of the initial situation of the game. For each subsequent round, the player must be aware of the movements made by the other players during the previous round and the state of the game resulting from those movements.

Initial Round

During the first round, the player receives from the judge a string in JSON format that informs them about the initial state of the game. This string describes the board and the initial state of the units and food. Here is an example of a game with a 3 × 3 board:

```
{ "board" : [ "X...M...." ],
  "units" : [
    {"id" : 0, "type" : "living", "clan" : 0, "pos" : [0,0]},
    {"id" : 1, "type" : "living", "clan" : 1, "pos" : [0,1]},
    {"id" : 2, "type" : "zombie", "pos" : [0,2]}
  ],
  "food" : [{"pos" : [1,1]}]
}
```

The board is a list of strings, where each string represents a row. The X indicates debris, . indicates an empty cell, and M indicates a cell with food. The units list contains objects representing the living and zombie units, each with an id, a type (either "living" or "zombie"), and a position specified by a list with two integers. The living units also have a clan attribute indicating the clan to which they belong.

Subsequent Rounds

For each round after the first one, the player receives a string in JSON format describing the state of the game after the movements of the previous round. Here is an example for the second round of a game:

```
{ "board" : [ "X...M...." ],
  "units" : [
    {"id" : 0, "type" : "living", "clan" : 0, "pos" : [0,0]},
    {"id" : 1, "type" : "living", "clan" : 1, "pos" : [0,1]},
    {"id" : 2, "type" : "zombie", "pos" : [0,2]}
  ],
  "food" : [{"pos" : [1,1]}]
}
```

As can be seen, the format of the JSON string is the same as that of the initial round.