电子科技大学
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Lord Kelvin Programming Competition

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Lord Kelvin's Atlantic Cable Quest

Background

Imagine a time when sending a message across the ocean was as challenging as exploring the depths of space today. In the 19th century, Lord Kelvin (William Thomson), a brilliant Scottish scientist and engineer, revolutionised global communication by solving the technical challenges of the transatlantic telegraph cable, the world's first communication link between North America and Europe. His ingenious designs, especially the relay systems, ensured that signals could travel across the vast Atlantic seabed without losing strength.

This year marks the 200th anniversary of Lord Kelvin's birth, a celebration of his legacy in science and engineering. In honour of this milestone, the University of Glasgow and Glasgow College UESTC have joined hands to put together a thrilling programming competition. Inspired by Kelvin's groundbreaking work, we have designed a simulation game that lets you step into his shoes, applying your creativity and problem-solving skills to optimise underwater communication.

As China shapes the world's future through technological innovations, this competition is a chance to connect Kelvin's pioneering spirit with the ingenuity of modern engineering. Show off your coding talents, embrace the challenge, and see how far your strategy can take you—just as Kelvin bridged continents, you will bridge history and innovation!

In this game, you step into the boots of Lord Kelvin and embark on an exciting quest to supercharge the Atlantic cable network! Your mission is to collect relay devices scattered across the ocean floor to boost the network's efficiency.

Each relay holds a unique power level — the stronger the relay, the bigger the impact. But watch out! The ocean is alive with currents, and these devices won't last long. Relays appear and disappear unpredictably, hence you will need a sharp strategy and quick thinking to stay ahead of the game.

Can you navigate the challenges of the deep and ensure Lord Kelvin's legacy shines brighter than ever? Dive in and prove your skills!

Objective

Write a program to control Lord Kelvin's movement to maximise his network score by collecting as many high-powered relays as possible before they disappear. The game is played over a fixed number of steps (time limit = 1000 in this assignment). At each step, Lord Kelvin must decide

his next move, aiming to collect relay devices that are still active and maximize the total score by the end of the time limit.

Code

We only provide the base code in C language. The main file contains the following structures which are important in the assignment.

```c
#define WIDTH 160
#define HEIGHT 40
#define MOVES 1000
#define MAX_RELAYS 5000

char map[HEIGHT][WIDTH]; // The map. E.g. map[2][3] represents the
    position at the third line and forth column.

struct Player {
    int x, y; // The start position of the player.
    int score; // The current score of the player.
} Kelvin;

int numRelays;

struct Relay{
    int x, y; // The position of the realy.
    int score; // The increased score of the relay if picked.
    int st, ed; // The existing time window of the relay.
} relays[MAX_RELAYS];
```

Visualizer

You are given a 40×160 grid map representing a section of the Atlantic Ocean floor:

- `.` represents an open ocean where Lord Kelvin can move.
- `#` represents obstacles (e.g., rocky formations or debris) that block movement.
- **L** represents the starting position of Lord Kelvin.
- Various relay devices are scattered throughout the map, represented by `*`. Each relay has a different power level and appears and disappears at specific times based on ocean currents. The power level of a relay adds to the network score once it is collected.

The left top point is labeled by $(0, 0)$, while the right bottom one is represented by $(139, 39)$. An example pattern when running the visualizer is shown in Figure 1.

Input

The input is given by two files.

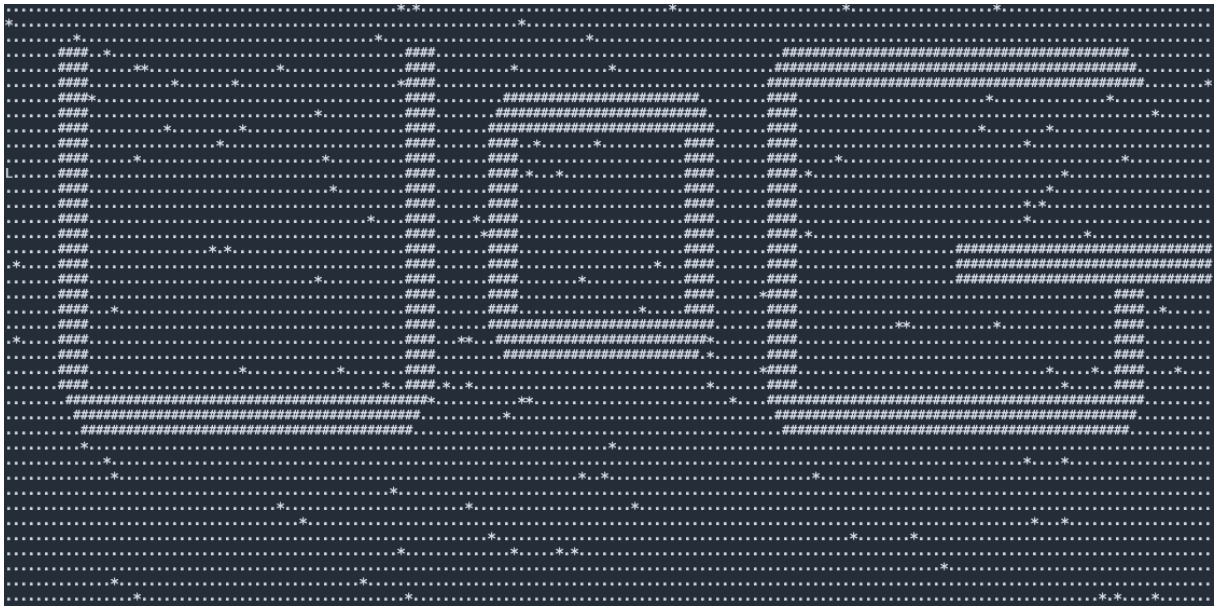

Figure 1: Example Pattern

- "mapSample.txt": An 40×160 grid map (matrix).
- "relaySample.txt": The first line contains 3 integers x, y, n, in which (x, y) is the start position of Kelvin, and n is the number of relays. The following n lines contains the information of relay devices, each specified by its coordinates, appearance time, disappearance time, and power level.

Output

A step-by-step representation of Lord Kelvin's movement, i.e. a sequence of 'L', 'R', 'U', 'D', in which

- 'L': Move from (x, y) to $(x - 1, y)$.
- 'R': Move from (x, y) to $(x + 1, y)$.
- 'U': Move from (x, y) to $(x, y - 1)$.
- 'R': Move from (x, y) to $(x, y + 1)$.

In this example, Lord Kelvin starts at a given position on the grid. The relays are scattered across the ocean floor, each with its own active period. Lord Kelvin must navigate obstacles and make decisions based on the remaining active relays within the allotted moves. Your program should optimize Lord Kelvin's strategy to collect the highest possible score by the end of the time limit.

Rubric

There are 5 test cases in total, each contains one map file and 20 relay files. Your final score should be the sum of the minimum scores Kelvin got in all 5 test cases.