



UNIVERSITY CUP

PRACTICE PROBLEM

SUPPLY OPTIMIZATION

PROBLEM DESCRIPTION

You are given a map with banana crates denoted by an uppercase alphabetical character. Each crate has a destination base where the bananas must be delivered to. The base for each crate is denoted by the corresponding lowercase alphabetical character.

I.e. The banana from crate **A** must be delivered to base **a**.

The **first line** of the input file gives you 5 comma separated numbers. In order these represent the **worm_count**, **num_crates**, **num_bases**, **map_width** and **map_height**.

For example:

4,7,7,10,10

This equates to 4 worms, 7 crates (A-G), 7 bases (a-g), and a map of size 10x10.

The rest of the file contains the map with empty blocks being represented by # characters. Worms can only carry one banana at a time. Worms will always start at position [0, 0] which is at the bottom left of the map.

YOUR GOAL

Write an algorithm to visit each crate and deliver the banana to its associated base whilst minimizing distance travelled.

Distance is calculated using the Manhattan distance formula:

https://en.wikipedia.org/wiki/Taxicab_geometry

$$\text{Given : } A = [x_1, y_1] \text{ and } B = [x_2, y_2]$$

$$\text{Distance } (A, B) = \text{abs}(x_2 - x_1) + \text{abs}(y_2 - y_1)$$

Scores will only be given to solutions where **all** bananas have been delivered to **all** bases. Note: not all worms need to be used to get an optimal solution.

CONSTRAINTS

0 < map_width <= 100
0 < map_height <= 100
0 < worm_count <= 20
0 < num_crates <= 26
0 < num_bases <= 26

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EXAMPLE 1 INPUT

```
1,2,2,5,5
###b#
#####
##A##
a####
##B##
```

The first line indicates there is 1 worm, 2 crates, 2 bases and the map size is 5x5.
The following lines represent the map.
Uppercase characters are crates (A & B).
Lowercase characters are bases (a & b).

EXAMPLE 1 OUTPUT

A,a,B,b

Each line consists of the instructions for a single worm. In this case the 1 worm visited crate **A**, then base **a**, then crate **B**, then base **b**. The total Manhattan distance travelled is 15.
The final score is 15.

EXAMPLE 2 INPUT

```
2,2,2,5,5
###b#
#####
##A##
a####
##B##
```

EXAMPLE 2 OUTPUT

A,a
B,b

Each line consists of the instructions for a single worm. In this case there are 2 worms.
Worm 1 visited crate **A**, then base **a**. Worm 2 visited crate **B**, then base **b**. The combined Manhattan distance travelled by all worms is 14.
The final score is 14.

If you have any questions or comments,
please ask the team via email or the forum:

challenge@entelect.co.za
<https://forum.entelect.co.za>

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