



## PRACTICE PROBLEM

### MINING OPTIMIZATION

#### PROBLEM DESCRIPTION

You are given a map with resource mines denoted by an uppercase alphabetical character. Each mine has an associated depo where resources must be delivered to – these are denoted by the corresponding lowercase alphabetical character.

The first line of the input file gives the **worker\_count**, where each worker unit can collect and carry only one resource at a time from a mine and must deliver it to a depo. A worker unit can carry only one resource at a time. Workers start at position [0, 0] which is the bottom left of the map.

The rest of the input file contains the map, where the number of mines, depots and the size of the map is defined by the map given and must be derived from the input file.

#### YOUR GOAL

Write an algorithm to visit each mine and deliver the resource to its associated depo whilst minimizing distance travelled.

Distance is calculated using the Manhattan distance formula:

[https://en.wikipedia.org/wiki/Taxicab\\_geometry](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 resources have been delivered to all depots, not all workers need to be used to get an optimal solution.

#### CONSTRAINTS

```
0 < map_width <= 100
0 < map_height <= 100
0 < worker_count <= 20
0 < num_mines <= 26
0 < num_depots <= 26
```

### EXAMPLE 1 INPUT

```
1
###b#
#####
##A##
a####
##B##
```

The first line indicates the number of worker units.  
The following lines represent the map.  
Uppercase characters are mines.  
Lowercase characters are depots for the associated mines.

### EXAMPLE 1 OUTPUT

A,a,B,b

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

### EXAMPLE 2 INPUT

```
2
###b#
#####
##A##
a####
##B##
```

### EXAMPLE 2 OUTPUT

A,a  
B,b

Each line consists of the instructions for a single worker. In this case there are 2 workers. Worker 1 visited mine **A**, then depot **a**. Worker 2 visited mine **B**, then depot **b**. The combined Manhattan distance travelled by all workers 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](mailto:challenge@entelect.co.za)  
<https://forum.entelect.co.za>