Exercises: Multidimensional Arrays

This document defines the exercises for ["Java Advanced" course @ Software University](). Please submit your solutions (source code) of all below described problems in [Judge]().

1. Fill the Matrix

Filling a matrix in the regular way (**top to bottom** and **left to right**) is boring. Write two **methods** that **fill** a **matrix** of size **N x N** in **two** different **patterns.** Both patterns are described below:

Pattern A

1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

Pattern B

1	8	9	16
2	7	10	15
3	6	11	14
4	5	12	13

Examples

Input	Output

`3, A`	`1 4 7`
	`2 5 8`
	`3 6 9`

`3, B`	`1 6 7`
	`2 5 8`
	`3 4 9`

Hints

- Make a different method for each pattern
- Make a method for printing the matrix

2. Matrix of Palindromes

Write a program to generate the following **matrix of palindromes** of **3** letters with **r** rows and **c** columns like the one in the examples below.

- **Rows** define the first and the last letter: row 0 → ‘a’, row 1 → ‘b’, row 2 → ‘c’, …
- **Columns + rows** define the middle letter:
  - column 0, row 0 → ‘a’, column 1, row 0 → ‘b’, column 2, row 0 → ‘c’, …
  - column 0, row 1 → ‘b’, column 1, row 1 → ‘c’, column 2, row 1 → ‘d’, …

Input

- The numbers **r** and **c** stay at the first line at the input.
- **r** and **c** are integers in the range [1…26].

- **r + c** ≤ 27

Examples

Input	Output

`4 6`	`aaa aba aca ada aea afa`
	`bbb bcb bdb beb bfb bgb`
	`ccc cdc cec cfc cgc chc`
	`ddd ded dfd dgd dhd did`

`3 2`	`aaa aba`
	`bbb bcb`
	`ccc cdc`

Hints

- Use two nested loops to generate the matrix.
- Print the matrix row by row in a loop.
- Don't forget to pack everything in methods.

3. Diagonal Difference

Write a program that finds the **difference between the sums of the square matrix diagonals** (absolute value).

	0	1	2
0	11	2	4
1	4	5	6
2	10	8	-12

primary diagonal
sum = 11 + 5 -12 = 4

	0	1	2
0	11	2	4
1	4	5	6
2	10	8	-12

secondary diagonal
sum = 4 + 5 + 10 = 19

Input

- The **first line** holds a number **n** – the size of matrix.
- The next **n lines** hold the **values for every row** – **n** numbers separated by a space.

Examples

Input	Output	Comments

`3`
`11 2 4`
`4 5 6`
`10 8 -12`
	`15`	**Primary diagonal:** sum = 11 + 5 + (-12) = 4
		Secondary diagonal: sum = 4 + 5 + 10 = 19
		Difference: |4 - 19| = 15

Hints

- Use a **single** loop **`i`** = **`[1 … n]`** to sum the diagonals.
- The **primary diagonal** holds all cells {**`row`**, **`col`**} where **`row`** == **`col`** == **`i`**.

- The **secondary diagonal** holds all cells {`row`, `col`} where `row` == `i` and `col` == `n-1-i`.

4. Maximal Sum

Write a program that reads a rectangular integer matrix of size **N x M** and finds in it the square **3 x 3** that **has maximal sum of its elements**.

Input

- On the first line, you will receive the rows **N** and columns **M**.
- On the next **N lines** you will receive **each row with its elements**.

Print the **elements** of the 3 x 3 square as a matrix, along with their **sum**. See the format of the output below:

Examples

<table>
<tr><th>Input</th><th>Output</th><th>Comments</th></tr>
<tr>
<td>4 5
1 5 5 2 4
2 1 4 14 3
3 7 11 2 8
4 8 12 16 4</td>
<td>Sum = 75
1 4 14
7 11 2
8 12 16</td>
<td>
<table>
<tr><td>1</td><td>5</td><td>5</td><td>2</td><td>4</td></tr>
<tr><td>2</td><td>1</td><td>4</td><td>14</td><td>3</td></tr>
<tr><td>3</td><td>7</td><td>11</td><td>2</td><td>8</td></tr>
<tr><td>4</td><td>8</td><td>12</td><td>16</td><td>4</td></tr>
</table>
</td>
</tr>
</table>

5. Matrix Shuffling

Write a program which reads a string matrix from the console and performs certain operations with its elements. User input is provided in a similar way like in the problems above – first you read the **dimensions** and then the **data**.

Your program should then receive commands in format: "**swap row1 col1 row2c col2**" where row1, row2, col1, col2 are **coordinates** in the matrix. In order for a command to be valid, it should start with the "**swap**" keyword along with **four valid coordinates** (no more, no less). You should **swap the values** at the given coordinates (cell [row1, col1] with cell [row2, col2]) **and print the matrix at each step** (thus you'll be able to check if the operation was performed correctly).

If the **command is not valid** (doesn't contain the keyword "swap", has fewer or more coordinates entered or the given coordinates do not exist), print "**Invalid input!**" and move on to the next command. Your program should finish when the string "**END**" is entered.

Examples

Input	Output
2 3 1 2 3 4 5 6 swap 0 0 1 1 swap 10 9 8 7 swap 0 1 1 0 END	5 2 3 4 1 6 Invalid input! 5 4 3 2 1 6

1 2 Hello World 0 0 0 1 swap 0 0 0 1 swap 0 1 0 0 END	Invalid input! World Hello Hello World

Hints

- Think about `Exception Handling`

6. String Matrix Rotation

You are given a **sequence of text lines**. Assume these text lines form a **matrix of characters** (pad the missing positions with spaces to build a rectangular matrix). Write a program to **rotate the matrix** by 90, 180, 270, 360, … degrees. Print the result at the console as sequence of strings after receiving the “**END**” command.

Examples

<table>
<tr><th>Input</th><th>Rotate(90)</th><th>Rotate(180)</th><th>Rotate(270)</th></tr>
<tr>
<td>hello
softuni
exam
END
<table>
<tr><td>h</td><td>e</td><td>l</td><td>l</td><td>o</td><td></td><td></td></tr>
<tr><td>s</td><td>o</td><td>f</td><td>t</td><td>u</td><td>n</td><td>i</td></tr>
<tr><td>e</td><td>x</td><td>a</td><td>m</td><td></td><td></td><td></td></tr>
</table>
</td>
<td>
<table>
<tr><td>e</td><td>s</td><td>h</td></tr>
<tr><td>x</td><td>o</td><td>e</td></tr>
<tr><td>a</td><td>f</td><td>l</td></tr>
<tr><td>m</td><td>t</td><td>l</td></tr>
<tr><td></td><td>u</td><td>o</td></tr>
<tr><td></td><td>n</td><td></td></tr>
<tr><td></td><td>i</td><td></td></tr>
</table>
</td>
<td>
<table>
<tr><td></td><td></td><td></td><td>m</td><td>a</td><td>x</td><td>e</td></tr>
<tr><td>i</td><td>n</td><td>u</td><td>t</td><td>f</td><td>o</td><td>s</td></tr>
<tr><td></td><td></td><td>o</td><td>l</td><td>l</td><td>e</td><td>h</td></tr>
</table>
</td>
<td>
<table>
<tr><td></td><td>i</td><td></td></tr>
<tr><td></td><td>n</td><td></td></tr>
<tr><td>o</td><td>u</td><td></td></tr>
<tr><td>l</td><td>t</td><td>m</td></tr>
<tr><td>l</td><td>f</td><td>a</td></tr>
<tr><td>e</td><td>o</td><td>x</td></tr>
<tr><td>h</td><td>s</td><td>e</td></tr>
</table>
</td>
</tr>
</table>

Input

The input is read from the console:

- The first line holds a command in format "**Rotate(X)**" where **X** are the degrees of the requested rotation.
- The next lines contain the **lines of the matrix** for rotation.
- The input ends with the command "**END**".

The input data will always be valid and in the format described. There is no need to check it explicitly.

Output

Print at the console the **rotated matrix** as a sequence of text lines.

Constraints

- The rotation **degrees** is positive integer in the range [0…90000], where **degrees** is **multiple of 90**.
- The number of matrix lines is in the range [1…**1 000**].
- The matrix lines are **strings** of length 1 … 1 000.
- Allowed working time: 0.2 seconds. Allowed memory: 16 MB.

Examples

Input	Output
Rotate(90)	esh
hello	xoe
softuni	afl
exam	mtl
END	uo
	n
	i

Input	Output
Rotate(180)	maxe
hello	inutfos
softuni	olleh
exam	
END	

Input	Output
Rotate(270)	i
hello	n
softuni	ou
exam	ltm
END	lfa
	eox
	hse

Input	Output
Rotate(720)	js
js	exam
exam	
END	

Input	Output
Rotate(810)	ej
js	xs
exam	a
END	m

Input	Output
Rotate(0)	js
js	exam
exam	
END	

7. Crossfire

You will receive **two integers** which represent the **dimensions** of a **matrix**. Then, you must **fill the matrix** with **increasing integers** starting from 1, and continuing on every row, like this:
first row: 1, 2, 3, …, n
second row: n + 1, n + 2, n + 3, …, n + n
third row: 2 * n + 1, 2 * n + 2, …, 2 * n + n

You will also receive several commands in the form of **3 integers** separated by a space. Those 3 integers will represent a **row** in the matrix, a **column** and a **radius**. You must then **destroy** the cells which correspond to those arguments **cross-like.**

Destroying a cell means that, **that cell** becomes completely **nonexistent** in the matrix. Destroying cells **cross-like** means that you form a **cross figure** with center point - equal to the cell with coordinates – the **given row** and **column**, and **lines** with length equal to the **given radius**. See the examples for more info.

The **input ends** when you receive the command “Nuke it from orbit”. When that happens, you must print what has remained from the initial matrix.

Input

- On the first line you will receive the dimensions of the matrix. You must then fill the matrix according to those dimensions
- On the next several lines you will begin receiving 3 integers separated by a single **space**, which represent the row, col and radius. You must then destroy cells according to those coordinates
- When you receive the command “**Nuke it from orbit**” the input ends

Output

- The output is simple. You must print what is left from the matrix
- Every row must be printed on a new line and every column of a row - separated by a space

Constraints

- The dimensions of the matrix will be integers in the range [2, 100]
- The given rows and columns will be valid integers in the range [$-2^{31} + 1$, $2^{31} - 1$]
- The radius will be in range [0, $2^{31} - 1$]
- Allowed time/memory: 250ms/16MB

Examples

Input	Output	Comment
5 5 3 3 2 4 3 2 Nuke it from orbit	1 2 3 4 5 6 7 8 10 11 12 13 16 21	Initial matrix: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 Result from first destruction: 1 2 3 4 5 6 7 8 10 11 12 13 15 16 21 22 23 25 Result from second destruction: 1 2 3 4 5 6 7 8 10 11 12 13 16 21
5 5 4 4 4 Nuke it from orbit	1 2 3 4 6 7 8 9 11 12 13 14 16 7 18 19	

8. The Heigan Dance

At last, level 80. And what do level eighties do? Go raiding. This is where you are now – trying not to be wiped by the famous dance boss, Heigan the Unclean. The fight is pretty straightforward - dance around the Plague Clouds and Eruptions, and you'll be just fine.

Heigan's chamber is a 15-by-15 two-dimensional array. The player always starts at the **exact center.** For each turn, Heigan uses a spell that hits a certain cell and the neighboring **rows/columns**. For example, if he hits (1,1), he also hits (0,0, 0,1, 0,2, 1,0 … 2,2). If the player's current position is within the area of damage, the player tries to move. First, he tries to move **up**, if there's **damage/wall**, he tries to move **right**, then **down**, then **left**. If he **cannot move** in any direction, because **the cell is damaged** or there is **a wall**, the player **stays** in place and takes the damage.

Plague cloud does 3500 damage **when it hits**, and 3500 damage **the next turn**. Then it **expires. Eruption** does 6000 damage **when it hits.** If a spell hits a player that also has an active Plague Cloud from the previous turn, the **cloud** damage is applied **first**. **Both** Heigan and the player **may** die in the same turn. If Heigan is **dead**, the spell he **would** have casted is **ignored**.

The player always starts at **18500** hit points; Heigan starts at **3,000,000** hit points. **Each** turn, the player does damage to Heigan. The fight is over either when the player is **killed**, or Heigan is **defeated**.

Input

- On the first line you receive a floating-point number **D –** the damage done to Heigan each turn
- On the next several lines – you receive input in format **{spell} {row} {col}** – **{spell}** is either **Cloud** or **Eruption**

Output

- On the first line
  - If Heigan is defeated: "**Heigan: Defeated!**"
  - Else: "**Heigan: {remaining}**", where remaining is rounded to two digits after the decimal separator
- On the second line:
  - If the player is killed: "**Player: Killed by {spell}**"
  - Else "**Player: {remaining}"**
- On the third line: "**Final position: {row, col}**" -> the last coordinates of the player

Constraints

- **D** is a floating-point number in range [0 … 500000]
- A damaging spell will always affect at least one cell
- Allowed memory: 16 MB
- Allowed working time: 0.25s

Examples

Input	**Output**

`10000`
`Cloud 7 7`
`Eruption 6 7`
`Eruption 8 7`
`Eruption 8 7`
	`Heigan: 2960000.00`
	`Player: Killed by Eruption`
	`Final position: 8, 7`

`500000`
`Cloud 7 6`
`Eruption 7 8`
`Eruption 7 7`
`Cloud 7 8`
`Eruption 7 9`
`Eruption 6 14`
`Eruption 7 11`
	`Heigan: Defeated!`
	`Player: 12500`
	`Final position: 7, 11`

`12500.66` `Cloud 7 7`	`Heigan: 2949997.36` `Player: Killed by Plague Cloud`

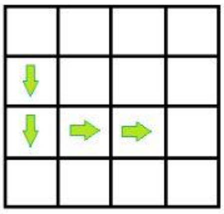
Cloud 7 7 Cloud 7 7 Cloud 7 7	Final position: 7, 7

9. *Parking System

The parking lot in front of SoftUni is one of the busiest in the country, and it's a common cause for conflicts between the doorkeeper Bai Tzetzo and the students. The SoftUni team wants to proactively resolve all conflicts, so an automated parking system should be implemented. They are organizing a competition – Parkoniada – and the author of the best parking system will win a romantic dinner with RoYaL. That's **exactly** what you've been dreaming of, so you decide to join in.

The parking lot is a **rectangular** matrix where the **first** column is **always** free and all other cells are parking spots. A car can enter from **any cell** of the **first column** and then decides to go to a specific spot. If that spot is **not** free, the car searches for the **closest** free spot on the **same** row. If **all** the cells on that specific row are used, the car cannot park and leaves. If **two** free cells are located at the **same** distance from the **initial** parking spot, the cell which is **closer** to the entrance is preferred. A car can **pass** through a used parking spot.

Your task is to calculate the distance travelled by each car to its parking spot.



Example: A car enters the parking at row 1. It wants to go to cell 2, 2 so it moves through **exactly four** cells to reach its parking spot.

Input

- On the first line of input, you are given the integers **R** and **C**, defining the dimensions of the parking lot
- On the next several lines, you are given the integers **Z, X, Y** where **Z** is the entry row and **X, Y** are the coordinates of the desired parking spot
- The input stops with the command '**stop**'. All integers are separated by a **single** space

Output

- For each car, print the distance travelled to the desired spot or the first free spot
- If a car cannot park on its desired row, print the message '**Row {row number} full**'

Constraints

- 2 ≤ R,C ≤ 10000
- Z, X, Y are inside the dimensions of the matrix. Y is never on the first column
- There are no more than 1000 input lines
- Allowed time/space: 0.1s (C#) /16MB

Examples

Input	Output

4 4 1 2 2 2 2 2 2 2 2 3 2 2 stop	4 2 4 Row 2 full

10. *Radioactive Mutant Vampire Bunnies

Browsing through GitHub, you come across an old JS Basics teamwork game. It is about very nasty bunnies that multiply extremely fast. There's also a player that has to escape from their lair. You really like the game so you decide to port it to Java because that's your language of choice. The last thing that is left is the algorithm that decides if the player will escape the lair or not.

First, you will receive a line holding integers **N** and **M**, which represent the rows and columns in the lair. Then you receive **N** strings that can **only** consist of **"."**, **"B"**, **"P"**. The **bunnies** are marked with "**B",** the **player** is marked with "**P**", and **everything** else is free space, marked with a dot **"."**. They represent the initial state of the lair. There will be **only** one player. Then you will receive a string with **commands** such as **LLRRUUDD** – where each letter represents the next **move** of the player (Left, Right, Up, Down).

After each step of the player, each of the bunnies spread to the up, down, left and right (neighboring cells marked as "." **changes** their value to B). If the player **moves** to a bunny cell or a bunny **reaches** the player, the player has died. If the player goes **out** of the lair **without** encountering a bunny, the player has won.

When the player **dies** or **wins**, the game ends. All the activities for **this** turn continue (e.g. all the bunnies spread normally), but there are no more turns. There will be **no** stalemates where the moves of the player end before he dies or escapes.

Finally, print the final state of the lair with every row on a separate line. On the last line, print either **"dead: {row} {col}"** or **"won: {row} {col}"**. Row and col are the coordinates of the cell where the player has died or the last cell he has been in before escaping the lair.

Input

- On the first line of input, the numbers **N** and **M** are received – the number of **rows** and **columns** in the lair
- On the next N lines, each row is received in the form of a string. The string will contain only ".", "B", "P". All strings will be the same length. There will be only one "P" for all the input
- On the last line, the directions are received in the form of a string, containing "R", "L", "U", "D"

Output

- On the first N lines, print the final state of the bunny lair
- On the last line, print the outcome – "won:" or "dead:" + {row} {col}

Constraints

- The dimensions of the lair are in range [3…20]
- The directions string length is in range [1…20]

Examples

Input	Output

5 8 ....B ...B.... ....B..B ....P..... ULLL	BBBBBBBB BBBBBBBB BBBBBBBB .BBBBBBB ..BBBBBB won: 3 0
4 5 .... .B... ...P. LLLLLLLL	.B... BBB.. BBBB. BBB.. dead: 3 1

11. Reverse Matrix Diagonals

You are given a matrix (2D array) of integers. You have to print the matrix diagonal but in reversed order. Print each diagonal on new line.

Input

On the first line, single integer the number **R** of rows in the matrix. On each of the next **R** lines, **C** numbers separated by single spaces. Note that **R** and **C** may have different values.

Output

The output should consist of R lines, each consisting of exactly C characters, separated by spaces, representing the matrix diagonals reversed.

Constraints

All the integers will be in the range **[1….1000]**

Examples

Input	Output
3 4 21 20 18 15 19 17 14 12 16 13 11 10	10 11 12 13 14 15 16 17 18 19 20 21
1 3 3 2 1	1 2 3
3 3	10

18 17 15 16 14 12 13 11 10	11 12 13 14 15 16 17 18

12.*** the Matrix

You are given a matrix (2D array) of lowercase alphanumeric characters (**`a-z`**, **`0-9`**), a starting position – defined by a start row **`startRow`** and a start column **`startCol`** – and a filling symbol **`fillChar`**. Let's call the symbol originally at **`startRow`** and **`startCol`** the **`startChar`**. Write a program, which, starting from the symbol at **`startRow`** and **`startCol`**, changes to **`fillChar`** every symbol in the matrix which:

- is equal to **`startChar`** AND
- can be reached from **`startChar`** by going up (**`row - 1`**), down (**`row + 1`**), left (**`col - 1`**) and right (**`col + 1`**) and "stepping" ONLY on symbols equal **`startChar`**

So, you basically start from **`startRow`** and **`startCol`** and can move either by changing the row OR column (not both at once, i.e. you can't go diagonally) by **`1`**, and can only go to positions which have the **`startChar`** written on them. Once you find all those positions, you change them to **`fillChar`**.

In other words, you need to implement something like the Fill tool in MS Paint, but for a 2D char array instead of a bitmap.

Input

On the first line, two integers will be entered – the number **R** of rows and number **C** of columns.

On each of the next **R** lines, **C** characters separated by single spaces will be entered – the symbols of the **R**th row of the matrix, starting from the **`0`**th column and ending at the **`C-1`** column.

On the next line, a single character – the **`fillChar`** – will be entered.

On the last line, two integers – **`startRow`** and **`startCol`** – separated by a single space, will be entered.

Output

The output should consist of R lines, each consisting of exactly C characters, **NOT SEPARATED** by spaces, representing the matrix after the fill operation has been finished.

Constraints

`0 < R, C < 20`
`0 <= startRow < R`
`0 <= startCol < C`

All symbols in the input matrix will be lowercase alphanumerics (**`a-z`**, **`0-9`**). The **`fillChar`** will also be alphanumeric and lowercase.

The total running time of your program should be no more than **`0.1s`**

The total memory allowed for use by your program is **`5MB`**

Examples

Input	Output
5 3 a a a a a a a b a a b a a b a x 0 0	xxx xxx xbx xbx xbx
5 3 a a a a a a a b a a b a a b a x 2 1	aaa aaa axa axa axa
5 6 o o 1 1 o o o 1 o o 1 o 1 o o o o 1 o 1 o o 1 o o o 1 1 o o 3 2 1	oo11oo o1331o 133331 o1331o oo11oo
5 6 o o o o o o o o o 1 o o o o 1 o 1 1 o 1 1 w 1 o 1 o o o o o z 4 1	oooooo ooo1oo oo1o11 o11w1z 1zzzzz
5 6 o 1 o o 1 o o 1 o o 1 o	z1oo1z z1oo1z z1111z

o 1 1 1 1 o o 1 o w 1 o o o o o o o z 4 0	z1zw1z zzzzzz

Hints

For some of the tests you can solve the problem with naive approach, however complete solution can be obtained by using **Stack**, **Queue**, **DFS** or **BFS** – go search on the internet.