# Lab: Linear Data Structures

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

# I. Arrays and Lists

## 1. Encrypt, Sort and Print Array

Write a program that reads a **sequence of strings** from the console. Encrypt every string by summing:

- The code of **each vowel multiplied by the string length**
- The code of **each consonant divided by the string length**

**Sort** the **number** sequence alphabetically and print it on the console.

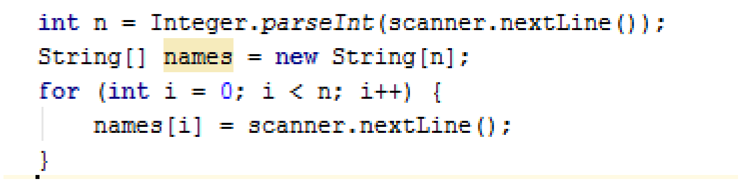
On first line, you will always receive the number of strings you have to read.

### Examples

| Input | Output | Comments |
|---|---|---|
| 4<br>Peter<br>Maria<br>Katya<br>Todor | 1032<br>1071<br>1168<br>1532 | Peter = 1071<br>Maria = 1532<br>Katya = 1032<br>Todor = 1168 |
| 3<br>Sofia<br>London<br>Washington | 1396<br>1601<br>3202 | Sofia = 1601<br>London = 1396<br>Washington = 3202 |

### Hints

- Thinks about the **Arrays** class
- You might help yourself with the **code** below:



```
int n = Integer.parseInt(scanner.nextLine());
String[] names = new String[n];
for (int i = 0; i < n; i++) {
    names[i] = scanner.nextLine();
}
```

## 2. Split by Word Casing

Read a **text**, split it into words and distribute them into **3 lists**.

- **Lower-case words** like “programming”, “at” and “databases” – consist of lowercase letters only.
- **Upper-case words** like “PHP”, “JS” and “SQL” – consist of uppercase letters only.
- **Mixed-case words** like “C#”, “SoftUni” and “Java” – all others.

Use the following **separators** between the words: **, ; : . ! ( ) " ' \ / [ ] space**

Print the 3 lists as shown in the example below.

## Examples

| Input | Output |
|---|---|
| `Learn programming at SoftUni: Java, PHP, JS, HTML 5, CSS, Web, C#, SQL, databases, AJAX, etc.` | `Lower-case: programming, at, databases, etc`<br>`Mixed-case: Learn, SoftUni, Java, 5, Web, C#`<br>`Upper-case: PHP, JS, HTML, CSS, SQL, AJAX` |

## Hints

- **Split** the input text using the above described **separators**.
- **Process** the obtained **list of words** one by one.
- Create 3 lists of words (initially empty): lowercase words, mixed-case words and uppercase words.
- Check each word and append it to one of the above 3 lists:
  - Count the **lowercase letters** and **uppercase letters**.
  - If all letters are **lowercase**, append the word to the lowercase list.
  - If all letters are **uppercase**, append the word to the uppercase list.
  - Otherwise the word is considered mixed-case → append it to the mixed-case list.
- Print the obtained 3 lists as shown in the example above.

# II. Multidimensional Arrays

## 3. Sum Matrix Elements

Write a program that **reads a matrix** from the console and prints:

- The count of **rows**
- The count of **columns**
- The sum of all **matrix's elements**

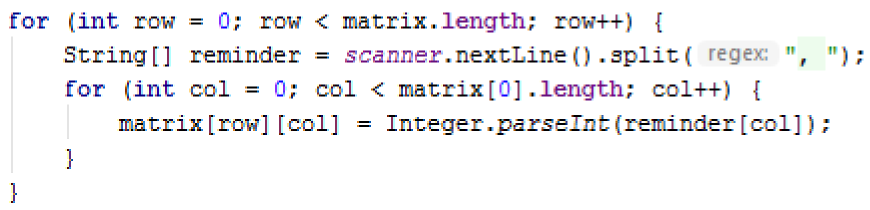
On the first line you will get the dimensions of the matrix in format **{rows, columns}.** On the next lines you will get the elements for each **row** separated with a coma.

## Examples

| Input | Output |
|---|---|
| `3, 6`<br>`7, 1, 3, 3, 2, 1`<br>`1, 3, 9, 8, 5, 6`<br>`4, 6, 7, 9, 1, 0` | `3`<br>`6`<br>`76` |

## Hints

- Help yourself with the code below for reading the matrix
- Try to use a **`foreach`**`-loop`



```
for (int row = 0; row < matrix.length; row++) {
    String[] reminder = scanner.nextLine().split( regex: ", ");
    for (int col = 0; col < matrix[0].length; col++) {
        matrix[row][col] = Integer.parseInt(reminder[col]);
    }
}
```

## 4. Maximum Sum of 2x2 Submatrix

Write a program that **reads a matrix** from the console. Then find the biggest sum of a **2x2 submatrix.** Print the submatrix and its sum.

On the first line you will get the dimensions of the matrix in format **{rows, columns}.** On the next lines you will get the elements for each **row** separated with a coma.

### Examples

| Input | Output |
|---|---|
| 3, 6<br>7, 1, 3, 3, 2, 1<br>1, 3, 9, 8, 5, 6<br>4, 6, 7, 9, 1, 0 | 9 8<br>7 9<br>33 |
| 2, 4<br>10, 11, 12, 13<br>14, 15, 16, 17 | 12 13<br>16 17<br>58 |

### Hints

- Ensure that your program doesn't throw an `IndexOutOfBoundsException()`

# III. Working with Stacks

## 5. Simple Calculator

**Create a simple calculator** that can **evaluate simple expressions** that will not hold any operator different from addition and subtraction. There will not be parentheses or operator precedence.

Solve the problem **using a Stack**.

### Examples

| Input | Output |
|---|---|
| 2 + 5 + 10 - 2 - 1 | 14 |
| 2 - 2 + 5 | 5 |

### Hints

- Use an `ArrayDeque<>`

- Consider using the **add()** method
- You can either
    - add the elements and then pop them out
    - or push them and reverse the stack

## 6. Decimal to Binary Converter

Create a simple program that **can convert a decimal number to its binary representation**. Implement an elegant solution **using a Stack**.

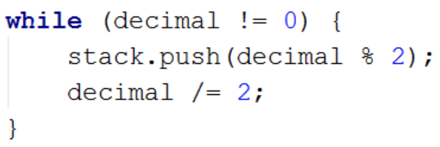
**Print the binary representation** back at the terminal.

### Examples

| Input | Output |
|---|---|
| 10 | 1010 |
| 1024 | 10000000000 |

### Hints

- If the given number is 0, just print 0
- Else, while the number is greater than zero, divide it by 2 and push the reminder into the stack



```
while (decimal != 0) {
    stack.push(decimal % 2);
    decimal /= 2;
}
```

- When you are done dividing, pop all reminders from the stack, that is the binary representation

## 7. Matching Brackets

We are given an arithmetical expression with brackets. Scan through the string and extract each sub-expression.

Print the result back at the terminal.

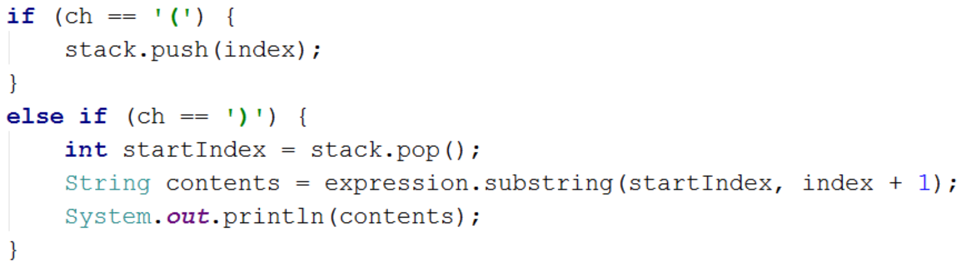
### Examples

| Input | Output |
|---|---|
| 1 + (2 - (2 + 3) * 4 / (3 + 1)) * 5 | (2 + 3)<br>(3 + 1)<br>(2 - (2 + 3) * 4 / (3 + 1)) |
| (2 + 3) - (2 + 3) | (2 + 3)<br>(2 + 3) |

### Hints

- Use a stack, namely an **ArrayDeque()**
- Scan through the expression searching for brackets
    - If you find an opening bracket, push the index into the stack

- If you find a closing bracket pop the topmost element from the stack. This is the index of the opening bracket.
- Use the current and the popped index to extract the sub-expression



```
if (ch == '(') {
    stack.push(index);
}
else if (ch == ')') {
    int startIndex = stack.pop();
    String contents = expression.substring(startIndex, index + 1);
    System.out.println(contents);
}
```

# IV. Working with Queues

## 8. Hot Potato

Hot potato is a game in which **children form a circle and start passing a hot potato**. The counting starts with the fist kid. **Every n^th toss the child left with the potato leaves the game**. When a kid leaves the game, it passes the potato forward. This continues repeating **until there is only one kid left**.

Create a program that simulates the game of Hot Potato. **Print every kid that is removed from the circle**. In the end, **print the kid that is left last**.

### Examples

| Input | Output |
|---|---|
| Mimi Pepi Toshko<br>2 | Removed Pepi<br>Removed Mimi<br>Last is Toshko |
| Gosho Pesho Misho Stefan Krasi<br>10 | Removed Krasi<br>Removed Pesho<br>Removed Misho<br>Removed Gosho<br>Last is Stefan |
| Gosho Pesho Misho Stefan Krasi<br>1 | Removed Gosho<br>Removed Pesho<br>Removed Misho<br>Removed Stefan<br>Last is Krasi |

## 9. Math Potato

Rework the previous problem so that a **child is removed only on a prime cycle** (cycles start from 1)

If a **cycle is not prime**, just **print the child's name.**

As before, print the name of the child that is left last.

### Examples

| Input | Output |
|---|---|
| Mimi Pepi Toshko | Removed Pepi |

| | |
|---|---|
| 2 | Prime Mimi<br>Prime Toshko<br>Removed Mimi<br>Last is Toshko |
| Gosho Pesho Misho Stefan Krasi<br>10 | Removed Krasi<br>Prime Pesho<br>Prime Misho<br>Removed Stefan<br>Prime Gosho<br>Removed Gosho<br>Prime Misho<br>Removed Pesho<br>Last is Misho |