Lab #2: Recursion

The main aim of the lab is to solve some common problems using recursive approach.

(Deadline 23:59, 02/10/2023)

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Task 1: Basic Problems

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Task 1.1: Using recursive approach to implement the following **Algebra problems:**

1. **$S(n)=1-2+3-4+\ldots+((-1)^{(n+1)}).n$,** **n>0**
2. **$S(n)=1+1.2+1.2.3+\ldots+1.2.3\ldots n$,** **n>0**
3. **$S(n)=1^2+2^2+3^2+....+n^2$,** **n>0**
4. **$S(n)=1+1/2+1/(2.4)+1/(2.4.6)+\ldots+1/(2.4.6...2n)$,** **n>=0**

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Suggestion:

```
public class Task1_1 {
// S(n)=1-2+3-4+…+ ((-1)^(n+1) ).n ,     n>0
     public static int getSn1(int n) {
          // TODO
          return 0;
     }
// S(n)=1+1.2+1.2.3+…+1.2.3…n,      n>0
     public static int getSn2(int n) {
          // TODO
          return 0;
     }
// S(n)=1^2+2^2+3^2+....+n^2 ,      n>0
     public static int getSn3(int n) {
          // TODO
          return 0;
     }
// S(n)=1+1/2+1/(2.4)+1/(2.4.6)+…+1/(2.4.6.2n),    n>=0
     public static double getSn4(int n) {
          // TODO
          return 0.0;
     }
```

```
}
```

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Task 1.2: Using recursive approach to implement **Fibonacci** problem. Note, Fibonacci - next number is the sum of previous two numbers.

Example: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, …

Suggestion:

```
public class Fibonacci {
	//get the nth value of the Fibonacci series
	public static int getFibonacci(int n) {
		//TODO
		return 0;
	}
// This method is used to display a Fibonaccci series based on the parameter n. Ex. n=10 ==> 0 1 1 2 3 5 8 13 21 34
	public static void printFibonacci(int n) {
		//TODO
	}

}
```

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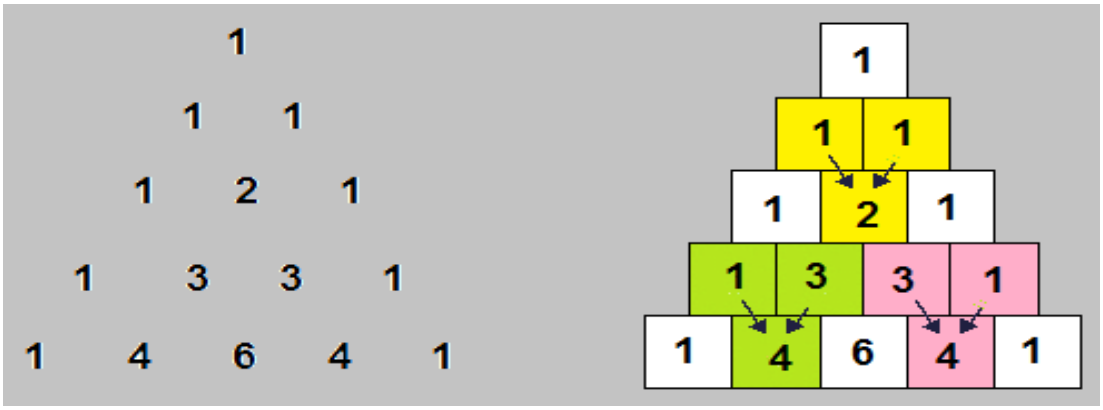
Task 1.3: Using recursive approach to implement **Pascal's triangle problem:**



Suggestion:

```
public class PascalTriangle {
	// This method is used to display a Pascal triangle based on the parameter n.
	// Where n represents the number of rows
	public static void printPascalTriangle(int row) {
		//TODO
	}
```

```
	// get the nth row.
	//For example: n=1 ==> {1}, n=2 ==> {1, 1}, ...
	public static int[] getPascalTriangle(int n) {
		//TODO
		return null;
	}
	// generate the next row based on the previous row
//Ex. prevRow = {1} ==> nextRow = {1, 1}
//Ex. prevRow = {1, 1} ==> nextRow = {1, 2, 1}
	public static int[] generateNextRow(int[] prevRow) {
		//TODO
		return null;
	}

}
```

Optional: How to implements these problems by using iterative approach?

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Task 1.4: Using recursive approach to implement **Towers of Hanoi problem.**

Suggestion: Use the pseudo-code described in the following figure:

```
FUNCTION MoveTower(disk, source, dest, spare):
IF disk == 0, THEN:
    move disk from source to dest
ELSE:
    MoveTower(disk - 1, source, spare, dest)   // Step 1 above
    move disk from source to dest              // Step 2 above
    MoveTower(disk - 1, spare, dest, source)   // Step 3 above
END IF
```

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Task 2: Advanced Problems

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Task 2.1: Implement **drawPyramid(int n) -** This method takes as an input one integer value n and then output on console a pyramid as on figure below for example for n=4:

```
//       X
//      XXX
//     XXXXX
//    XXXXXXX
```

```
public static void drawPyramid(int n) {
    //TODO
}
```

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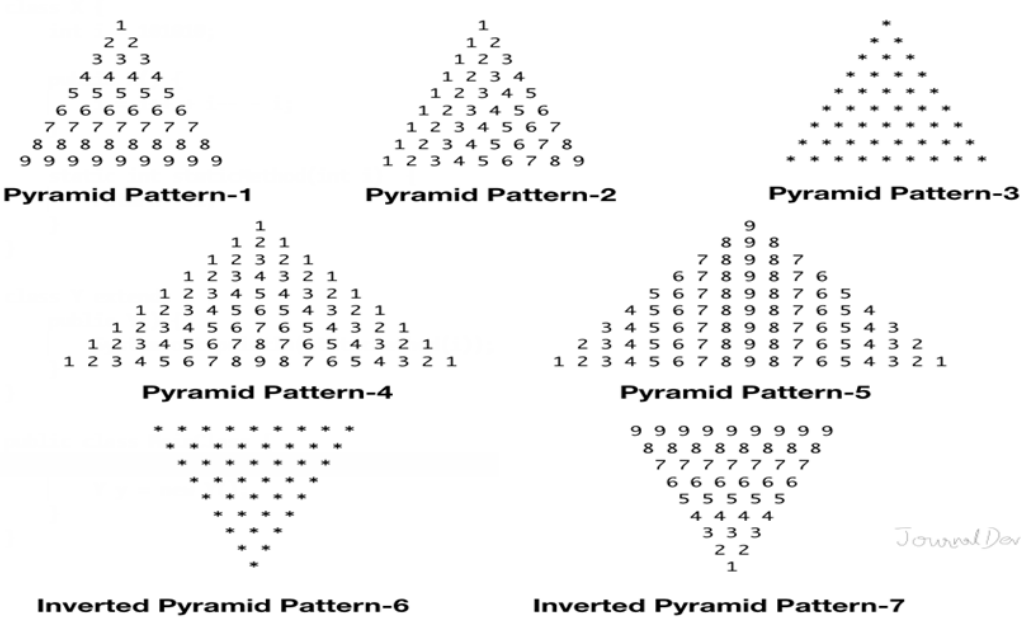
Task 2.2 (Optional): Using other patterns for the **drawPyramid** method defined in the previous task.



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Task 2.3 (Optional): Implement **drawChristmasTree(int n) -** This method takes as an input one integer value n and then output on console a Christmas tree in which last part height equals n.

The tree consists of pyramids of heights from 1 to n.

The shape have to be as presented below (for n=4):

```
//       X
//       X
//      XXX
//       X
//      XXX
//     XXXXX
//       X
//      XXX
//     XXXXX
//    XXXXXXX
```

```
public static void drawChristmasTree(int n) {
    // TODO
}
```