Tutorial Course 1

General
This course was thought to be done in java, but you are free to do it in any language you find suitable, or are more comfortable with.

Evaluation criteria
Each TP has 5% of the final mark. The code and quality of answers as well as the class activity will be taken into account.

Instruction
Upload a zip file before the deadline (~24h before the next TP) which includes your code (+read me if needed) and a short report. The report should include answers to the TP's questions. Moreover it should include the methods of using the tools, and libraries. They should be explained shortly as well.

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Part 1: Recursion, iteration & Memoization

Fibonacci sequence

Write an algorithm as efficient as possible, which given an integer n outputs its Fibonacci sequence.

Reminder: The Fibonacci sequence is defined as: $\left\{ \begin{array}{c} F_0 = 0 \\ F_1 = 1 \\ F_{n+2} = F_{n+1} + F_n \end{array} \right\}$

Example	
Input = 10	Output = 55

Input format. An integer n.

Output format. The Fibonacci sequence of n.

Questions.

1. What kind of problem (Decision, construction, optimization ...) is it?
2. Create a class called "FibonacciSequence"
   a. Create a method called RecursiveFib(int n) which given a number computes and return its Fibonacci sequence using a recursive algorithm.
   b. What is its complexity?
   c. Create a method called IterativeFib(int n) which given an input number n computes and return its Fibonacci sequence using an iterative algorithm
   d. What is its complexity?

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Part 2: Dynamic programming

Dynamic programming

Permutation of a string of unique characters

How would you compute all the permutations of a string of unique characters?

Example		
n = 3	Input = abc	Output = cab, acb, abc, cba, bca, bac

Input format. A string of unique characters.

Output format. A collection of strings representing all the possible permutations of the input

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Questions.

1. Write a method called "Permutations(String uniqueCharStr)"
2. Write the minimal code required to solve the problem for a string of two characters.
3. What happens if the string is now 3 characters? How do you solve the problem using the previous solution?
4. Write an algorithm which uses the previous solutions and works for the general case where the string is any length.

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Part 3: Greedy algorithm

Maximum Product of Two Sequences Problem

You have n advertisement slots on your popular Internet page and you want to sell them to advertisers.
They expect, respectively; $c_1, c_2, c_3, \ldots, c_n$ clicks per day. You then found n advertisers willing to pay the following prices per click; $p_1, p_2, p_3, \ldots, p_n$

How would you pair the slots and advertisers in order to maximize your revenue?

Example		
n = 3	$c_1 = 10$ clicks$_{/day}$ $c_2 = 20$ clicks$_{/day}$ $c_3 = 30$ clicks$_{/day}$	$p_1 = 2€$ $p_2 = 3€$ $p_3 = 5€$
The following pairing $10 \cdot 5 + 20 \cdot 2 + 30 \cdot 3 = 180$ gives us 180 dollars, while the following one $10 \cdot 3 + 20 \cdot 5 + 30 \cdot 2 = 190$ results in a revenue of 190 dollars.		

Input format. The first line contains an integer *n*, the second one contains a sequence of integers $price_1, \ldots, price_n$, the third one contains a sequence of integers $clicks_1, \ldots, clicks_n$.

Output format. Output the maximum value of $(price_1 \cdot c_1 + price_2 \cdot c_2 + \cdots + price_n \cdot c_n)$

Questions

1. What type of problem is it ?
2. Create a new class "GreedyProblems" and a method "MaxSeqProduct" which intend to solve the previous problem.