Advanced computer programming

Exercise session 7: Problem solving

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Exercice 1

In the 8-queens problem, the goal is to place 8 queens on a 8x8 board such that no queen can attack any other. In other words, there never are two queens on the same row, column or diagonal.

Give a brute-force algorithm for this problem.

Exercise 2

Let us consider the following sorting algorithm: one generates all the permutation of the array to sort. Each sequence is tested up till the correct one is found.

(a) What category belongs this algorithm in ?

(b) Write the pseudo-code for this problem.

(c) What is the complexity of this algorithm ?

Exercise 3

The twelve coins problem has many variants. Let us consider the following one:

> *"You have 12 coins, one of which is fake. They are all identical except for the fake one whose weight is a little lighter. How can you find the counterfeit with as few as possible weighing ?"*

In the general case where there are N coins,

(a) Propose a brute-force solution for this problem.

(b) Propose a divide-and-conquer solution. Can you bound the number of weighing.

Exercise 4

Let $P = \{p_1, p_2, ..., p_n\}$ be a set of 2D points such that $p_i = (x_i, y_i)$. Propose an algorithm which determines the (euclidian) distance between the two closest points.

Exercise 5

In exercise session 5, we have encountered the following problem:

> *"Write an algorithm which computes the number of distinct BST one can build with the set 1, .., N ."*

which was solved with:

```
NbTree(B)
1  if N ≤ 1
2        return 1
3  Nb = 0
4  for i = 1 to N
5        NbTree(i − 1) ∗ NbTree(N − i)
6  return Nb
```

whose complexity was huge.

(a) Draw the subproblem graph for $N = 4$.

(b) Apply memoization to reduce the complexity (give a top-down and a bottom-up implementation).