

Advanced computer programming

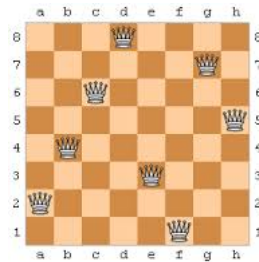
Exercise session 7: Problem solving

Jean-Michel BEGON – <http://www.montefiore.ulg.ac.be/~jmbegon>

December 2014

Exercise 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.

- What category belongs this algorithm in ?
- Write the pseudo-code for this problem.
- 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,

- Propose a brute-force solution for this problem.
- Propose a divide-and-conquer solution. Can you bound the number of weighing.

Exercise 4

Let $P = \{p_1, p_2, \dots, p_n\}$ 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 $1, \dots, N$.”

which was solved with:

```
NBTREE( $B$ )
1  if  $N \leq 1$ 
2      return 1
3   $Nb = 0$ 
4  for  $i = 1$  to  $N$ 
5       $Nb = NBTREE(i - 1) * NBTREE(N - i)$ 
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).