Design and Analysis of Algorithms - Exam 2

Instructions

For each of the following questions:

1. Write an algorithm that solves the given problem.
2. Define the basic operation.
3. Derive the expression for the number of operations.
4. Define the time complexity of the presented algorithm.

Questions

1. Given a square matrix, write an algorithm to check if the sum of the values of each column is equal to the sum of the values of each row. That is, the algorithm should return True if the sum of the values of column i is equal to the sum of the values of row i for all i in $[0, 1, 2, ..., n-1]$ and False, otherwise.

2. Write a recursive function to calculate the sum of the first n natural numbers.

3. Present an exhaustive search algorithm for the Binary Knapsack Problem. You should present and analyze both the search algorithm and the method that calculates the cost of a solution.

4. For each of the following operations, indicate the time complexity $\Theta(\cdot)$:

   (a) Adding an element at the beginning of an array.

   (b) Removing an element from the beginning of an array.

   (c) Adding an element at the end of an array.

   (d) Removing an element from the end of an array.

   (e) Searching for an element in an array.

   (f) Adding an element to a stack (implemented in an array).

   (g) Removing an element from a stack (implemented in an array).

   (h) Adding an element to a queue (implemented in an array).

   (i) Removing an element from a queue (implemented in an array).