

Assignment 1

1 Find-Union algorithms

Implement the Find-Union algorithms studied in class.

2 Solving Recurrences

solve the following recurrences:

1. $C_N = C_{\frac{N}{2}} + N$ for $N \geq 2$ with $C_1 = 0$.
2. $C_N = 2C_{\frac{N}{2}} + N$ for $N \geq 2$ with $C_1 = 0$.
3. $C_N = 2C_{\frac{N}{2}} + 1$ for $N \geq 2$ with $C_1 = 1$.

3 Some recursive algorithms

1. Write the factorial function (iterative and recursive version) and evaluate its cost.
2. The gcd of two integers is defined to be the largest common divisor of the given integers. An algorithmic solution for computing the gcd of two integers a and b is based on the following remark: $\text{gcd}(a, b) = \text{gcd}(b, a \bmod b)$, where $a \geq b$. Write the recursive and iterative version of the Euclidean algorithm, which is based on the above remark.
3. Given a sorted array of integers, write the sequential and binary search function of an item in the array.
4. Write a recursive program to evaluate prefix expressions.

4 The Abstract Data Structure: List

We define the abstract data type **RList** as a collection of Elements (predefined type) that has the following operations:

- boolean IsEmpty(RList l): returns true if the RList l is empty and false otherwise.
- Element Head(RList l): returns the first Element of the RList. This operation is not defined for empty RLists.
- RList End (RList l): returns the RList after removing the first Element. Again, the argument l should not be the empty RList.

Write the functions Member that checks whether a given Element in a given RList and the function IsSet that tests whether a given RList is a set of Elements.