A Novel Sorting Method for Real and Integer Numbers: An Extension of Counting Sort

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Abstract: Sorting is an essential concept in the study of data structures. There are many sorting algorithms that can sort elements in a given array or list. Counting sort is a sorting algorithm that has the best time complexity. However, the counting sort algorithm only works for positive integers. In this paper, an extension of the counting sort algorithm is proposed that can sort real numbers and integers (both positive and negative).

Index Terms: Counting Sort, Sorting, Algorithm.

I. INTRODUCTION

In the field of computer science, **sorting** denotes the process of arranging items in a sequence ordered by a given criterion. A sorting procedure is a procedure that places elements of a list or array in a certain order. A capable sorting algorithm helps optimize the competence of other procedures, such as search and merge algorithms, which require input data in the form of sorted lists. In fact, **search preprocessing** is perhaps the single most important application of sorting algorithms. Sorting is also useful for **canonicalizing** data (i.e converting it into a standard representation) and for producing human-readable output. Sorting algorithms function as a basic building block for a wide variety of applications, including problems of closest pair finding, element uniqueness, frequency distribution and selection. Commonly used sorting algorithms include **quick sort, counting sort, heap sort, bubble sort, selection sort, insertion sort, merge sort** and **radix sort.**

The efficiency of an algorithm is measured as a function of the computational cost it exacts on the system, in relations of its space and time complexity. **Time complexity** is a measure of the time it takes for an expression to be executed, as a function of the input size. It is generally expressed in **big O notation (O(n))**, a mathematical notation that is used to describe the limiting manners of a function when its argument tends towards a given value or infinity (asymptotic complexity). This representation describes functions according to their **growth rate**, or the rate at which the time taken to execute a function increases with increase in input size.

Space complexity is a measure of the volume of memory space mandatory to solve an instance of a problem, as a function of input size.

It is also often expressed asymptotically in big O notation O(n), where n is the input size in bytes.

Given below is a comparison of the space and time complexity of various popular sorting algorithms:

Fig. 1.

In this paper, we will focus on a discussion of counting sort, a unique sorting algorithm. Unlike other sorting algorithms, it does not compare elements to arrange them in a particular order. We will test the working of the proposed extension of the counting sort algorithm with large data sets, and compare its space and time complexity with that of other popular sorting algorithms.

II. WORKING OF COUNTING SORT ALGORITHM

Let us assume that an array A of size N is to be sorted.
Algorithm: CountingSort(A, N , SortedA, Count, S)
// A is the array to be sorted
// The result is stored in SortedA
// N is the size of arrays A and SortedA
// Count is an array whose size is equal to the value of maximum element of A
// S is the maximum element of array A.
// Each element of Count is initialized to 0

Step 1: Set i ← 0
Step 2: Repeat this step while i< N
    a.   Set Count[A[i]] ← Count[A[i]] + 1
    b.   Set i ← i + 1
    End of Loop
Step 3: Set i ← 0
Step 4: Set j ← 0
Step 5: Repeat this step while i< S:
    a. Repeat while Count[A[i]] > 0:
        a.   Set SortedA[j] ← A[i]
        b.   Set j ← j + 1
        c.   Set Count[A[i]] ← Count[A[i]] − 1
    End of Loop

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Table of Contents Novel Numbers Counting

1. Understanding the eBook Novel Numbers Counting
    - The Rise of Digital Reading Novel Numbers Counting
    - Advantages of eBooks Over Traditional Books
2. Identifying Novel Numbers Counting
    - Exploring Different Genres
    - Considering Fiction vs. Non-Fiction
    - Determining Your Reading Goals
3. Choosing the Right eBook Platform
    - Popular eBook Platforms
    - Features to Look for in an Novel Numbers Counting
    - User-Friendly Interface

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