ALGORITHM-NOTES

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August 10, 2024

1 INTRODUCTION

1.1 What is an Algorithm

In mathematics and computer science, an algorithm is a finite sequence of well-defined, computer-implementable instructions, typically to solve a class of problems or to perform a computation. Algorithms are always unambiguous and are used as specifications for performing calculations, data processing, automated reasoning, and other tasks.

Definition 1.1 – Algorithm An algorithm is a finite sequence of well-defined, computer-implementable instructions, typically to solve a class of problems

Hence ther are some key points of an algorithm:

- An alogrithm need an **input** and an **output**.
- An algorithm is a sequence of conputational steps transfer input to output.

Example 1.1 Sorting problem
INPUT: A sequence of n numbers $< a_1, a_2, \cdots, a_n >$
OUTPUT: A permutation (recordering) $< a'_1, a'_2, \cdots, a'_n >$ of the input sequence such that $a'_1 \leq a'_2 \leq \cdots \leq a'_n$.

Therefore this algorithm provides a way to reorder the sequence in a descending order. The input sequence is called an **instance** of the sorting problem, and the output sequence is called a **solution** to the instance. We say an algorithm is **correct** if, for every input instance, it halts with the correct output. We use **halts** to mean that the algorithm terminates in a finite amount of time. And one shall note that the correctness of an algorithm is independent of the language in which it is implemented.

1.2 Data structure

Definition 1.2 – data strcuture A data structure is a way to store and organize data in order to facilitate access and modifications.

It is curcial to choose the satisfactory data sctructure for the algorithm No single data structure works well for all purposes, so it is important to know the strengths and weaknesses of the various data structures.

2 ALGORITHM

2.1 EFFICIENCY

Everyone wants to save their time for their family and friends. That is why we need to consider the efficiency of the algorithm.

Example 2.1 For insertion sort it takes times around $c_1 \cdot n^2$ to solve the problem
For merge sort takes around $c_2 \times n \times \log_2 n$ c_n stands for constants that independent of n.

```
1  int forloop(int n){
2    res = 0;
3    for(i=1, i<=n, i=++i){
4      res =+i
5    }
6    return res
7  }
```