Structure and Analysis of Algorithm

Assignment-1

Group-2 (**IEC2021005-IEC2021009**)

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Introduction to Programming

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Abstract— **Given an unsorted array of n numbers, find the sum of all the perfect numbers and check whether it is Armstrong number or not.**

I. INTRODUCTION

Given an array arr[] of size n, we will find the sum of all the perfect numbers and further we will check whether the sum is an Armstrong number or not.

A **perfect number** is a positive integer that is equal to the sum of all its proper positive divisors excluding the number itself. For e.g.: 6,28, 256, etc. 6 is a perfect number because the proper divisor of 6 are 1,2,3 (excluding 6) and sum of all its positive divisors (1+2+3) is 6.

An **Armstrong number** of order n is a number in which each digit when multiplied by itself n number of times and finally added together, results the same number. For eg: 371 is a three-digit number. Therefore, order=3. now, here each digit is multiplied by itself three times and finally added together and results in our original number. For e.g.:

(3*3*3+7*7*7+1*1*1) = (27+343+1) = 371

II. ALGORITHM DESIGN

- We initiated the program by declaring "b" as a size of array and specified Boolean perfect=false, this will be useful in calculating whether the number is perfect or not.
- Set max array size as a[100]. Then executing program will ask for first number of elements.
- For loop will be executed, asking user to enter that number of elements as per the choice.
- Sum=0, d=0 are stored in integer type variable. sum will store sum of divisors of array elements and d will store sum of all perfect numbers among those array elements.
- To extract the values from array like a[i], for loop is used and sum=0 is stored by default.
- For checking the perfect numbers, another for loop is used. for (int j = 1; j <= a[i] / 2; j=j+1); Now if statement is used, if a[i] is divided by j and remainder comes as 0 then it will calculate sum of divisors as sum= sum + j.
- if sum of divisors = a[i] itself, then that sum will be considered as a perfect number. And further d will store that sum as d= d + sum.
- Now if perfect stores True then it will further check for Armstrong Number and if not then it will display that there is no perfect number.
- Sum1 and Sum2 are two copies of d and nod will store the number of digits. First while loop will calculate the number of digits in d and store it in the nod.
- Second while loop is to extract each digit of d in e(base) and calculate and store power raised to the digit in digsum.
- If this digsum becomes equal to d then it will be an Armstrong number otherwise it will be not.

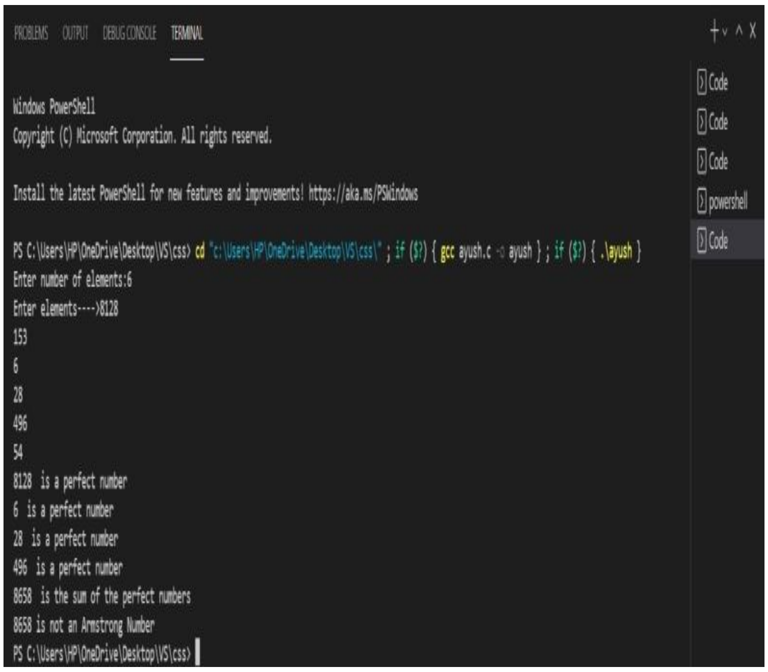
III. ALGORITHM AND ILLUSTRATION

```
  Begin
 int b
Bool Value of perfect=FALSE
Array a[100]
DISPLAY- "Enter number of elements"
INPUT b
DISPLAY- "Enter elements"
for (int i=0; i<b; i=i+1)
INPUT a[i]
EndFor
```

```
            int sum, d;
            for (i=0; i<b; i=i+1)
            sum=0,d=0;
            for (int j=1; j <= a[i] / 2; j=j+1)
            if (a[i]%j==0) then
            sum = sum + j
            EndIf
EndFor
    if (sum==a[i]) then
DISPLAY- "(sum) is a perfect number"
          d=d+sum AND
          Bool Value of perfect=TRUE
    EndIf
EndFor

     if (Bool Value of perfect==TRUE) then
      DISPLAY- "d is the sum of perfect numbers"
      int sum1=d, digsum=0, nod=0
     while (sum1! = 0) then
 nod=nod+1 AND
           sum1=(sum1 /10)
      EndWhile
      Int sum2=d
      while (sum2 != 0) then
           int e=sum%10 AND
           digsum = digsum + pow(e, nod)
      EndWhile
      if (digsum==d) then
            DISPLAY- "d is an Armstrong number"
     EndIf
            else
                 DISPLAY- "d is not an Armstrong number"
            EndElse
 EndIf
      else then
          DISPLAY- "There is no perfect number"
EndElse

     End
```



```
Windows PowerShell
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Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\HP\OneDrive\Desktop\VS\css> cd "c:\Users\HP\OneDrive\Desktop\VS\css\" ; if ($?) { gcc ayush.c -o ayush } ; if ($?) { .\ayush }
Enter number of elements:6
Enter elements---->8128
153
6
28
496
54
8128  is a perfect number
6  is a perfect number
28  is a perfect number
496  is a perfect number
8658  is the sum of the perfect numbers
8658 is not an Armstrong Number
PS C:\Users\HP\OneDrive\Desktop\VS\css>
```
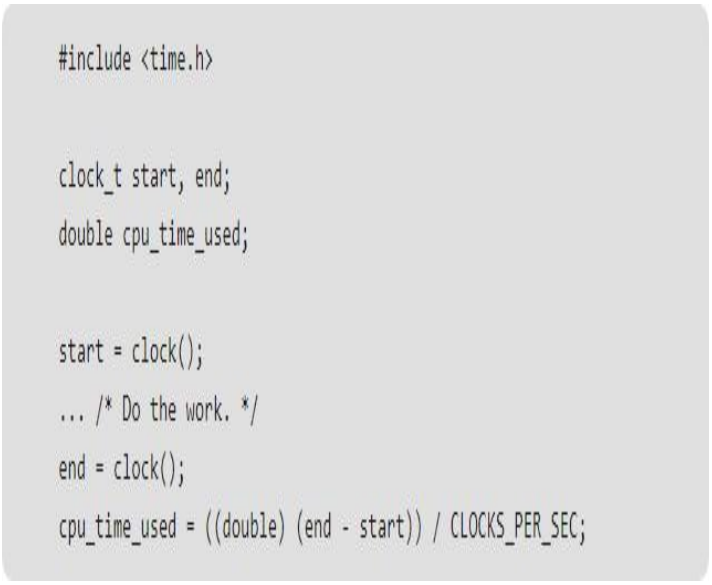

IV. ALGORITHM ANALYSIS

Time complexity:

The average execution time of above algorithm is calculated as **0.00481375 seconds**.
It is calculated using following syntax:



```
#include <time.h>


clock_t start, end;
double cpu_time_used;


start = clock();
... /* Do the work. */
end = clock();
cpu_time_used = ((double) (end - start)) / CLOCKS_PER_SEC;
```

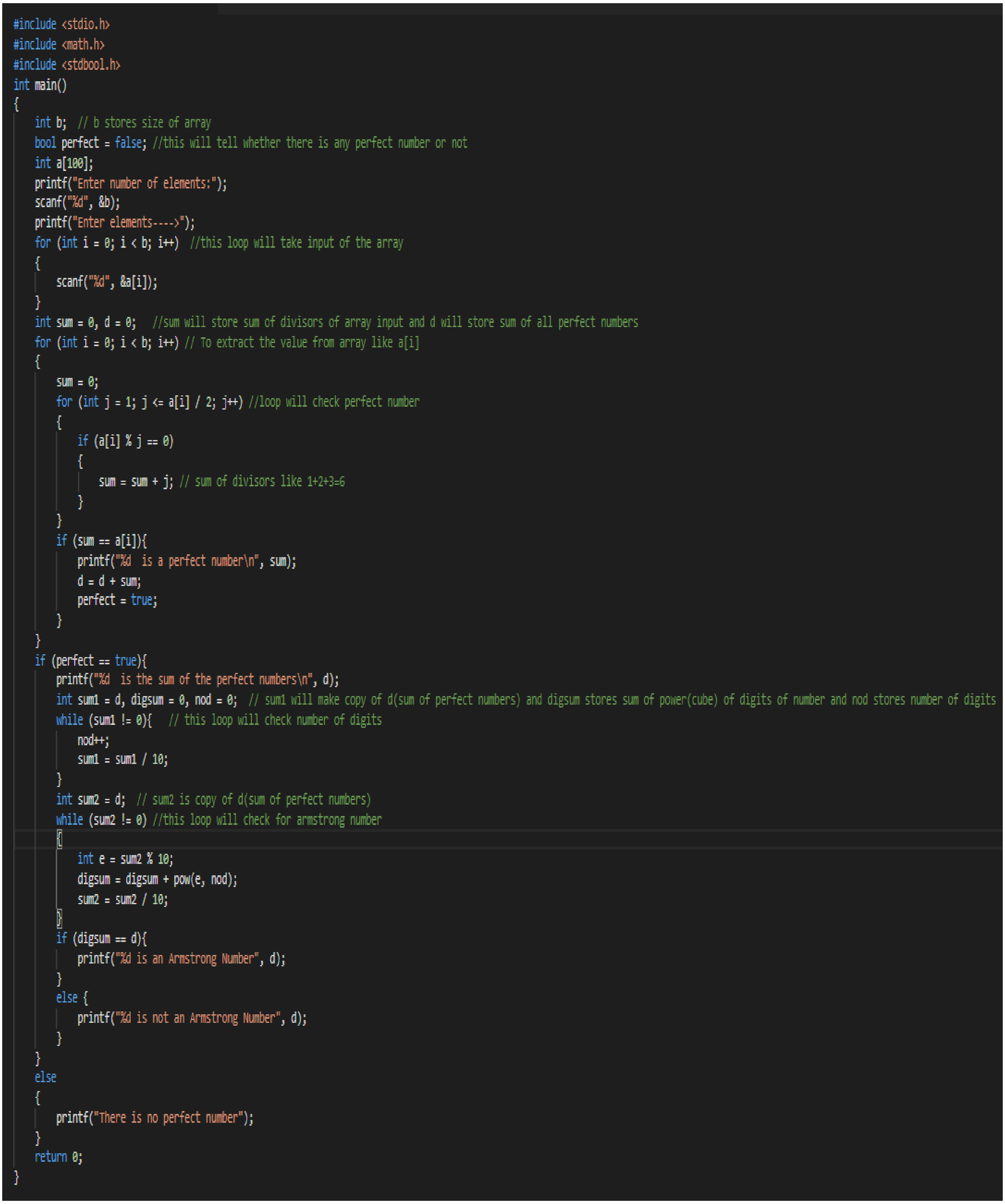
V. CONCLUSION

With the help of this problem we may conclude that it becomes easy to find perfect number and armstrong number using while loop.Instead of re-writing the code again and again we only have to iterate using while loop till the condition is true.
We may also conclude that it becomes easy to store many inputs in a single variable using array. Otherwise for each input value, we may have to assign a new variable.

VI. REFERENCES

- https://www.geeksforgeeks.org/program-for-armstrong-numbers/
- https://www.geeksforgeeks.org/perfect-number/
- https://www.geeksforgeeks.org/sum-factors-number/
- **'Let us C'**-book by Yashwant Kanetkar

Code for Problem Statement



```c
#include <stdio.h>
#include <math.h>
#include <stdbool.h>
int main()
{
    int b;  // b stores size of array
    bool perfect = false; //this will tell whether there is any perfect number or not
    int a[100];
    printf("Enter number of elements:");
    scanf("%d", &b);
    printf("Enter elements---->");
    for (int i = 0; i < b; i++)  //this loop will take input of the array
    {
        scanf("%d", &a[i]);
    }
    int sum = 0, d = 0;   //sum will store sum of divisors of array input and d will store sum of all perfect numbers
    for (int i = 0; i < b; i++) // To extract the value from array like a[i]
    {
        sum = 0;
        for (int j = 1; j <= a[i] / 2; j++) //loop will check perfect number
        {
            if (a[i] % j == 0)
            {
                sum = sum + j; // sum of divisors like 1+2+3=6
            }
        }
        if (sum == a[i]){
            printf("%d  is a perfect number\n", sum);
            d = d + sum;
            perfect = true;
        }
    }
    if (perfect == true){
        printf("%d  is the sum of the perfect numbers\n", d);
        int sum1 = d, digsum = 0, nod = 0;  // sum1 will make copy of d(sum of perfect numbers) and digsum stores sum of power(cube) of digits of number and nod stores number of digits
        while (sum1 != 0){   // this loop will check number of digits
            nod++;
            sum1 = sum1 / 10;
        }
        int sum2 = d;  // sum2 is copy of d(sum of perfect numbers)
        while (sum2 != 0) //this loop will check for armstrong number
        {
            int e = sum2 % 10;
            digsum = digsum + pow(e, nod);
            sum2 = sum2 / 10;
        }
        if (digsum == d){
            printf("%d is an Armstrong Number", d);
        }
        else {
            printf("%d is not an Armstrong Number", d);
        }
    }
    else
    {
        printf("There is no perfect number");
    }
    return 0;
}
```