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Greedy Algorithm

3.a. 1-G-Coin Problem

Aim: Write a program to take value V and we want to make change for V Rs, and we have infinite supply of each of the denominations in Indian currency, i.e., we have infinite supply of { 1, 2, 5, 10, 20, 50, 100, 500, 1000} valued coins/notes, what is the minimum number of coins and/or notes needed to make the change.

Input Format:

Take an integer from stdin.

Output Format:

print the integer which is change of the number.

Example Input :

64

Output:

4

Explanaton:

We need a 50 Rs note and a 10 Rs note and two 2 rupee coins.

Algorithm:

Int main() {

initialize amt

initialize count to 0

read amt from user

// array of currency denominations

```
    initialize arr as {1, 2, 5, 10, 20, 50, 100, 500, 1000}

    // loop through currency denominations from highest to lowest
    for i from 8 down to 0 {
        count = count + (amt divided by arr[i])  // calculate number of notes of current
denomination
        amt = amt modulo arr[i]  // update amt to the remaining amount
    }

    print count  // output the total count of notes
}
```

Program:

```
#include <stdio.h>


int main()
{
    int amt,count=0;
    scanf("%d",&amt);
    int arr[]={ 1, 2, 5, 10, 20, 50, 100, 500, 1000} ;
    for (int i=8;i>=0;i--)
    {
        count+=amt/arr[i];
        amt%=arr[i];
    }
    printf("%d",count);
}
```

Output:

	Input	Expected	Got	
✔	49	5	5	✔

3.b. 2-G-Cookies Problem

Aim:

Assume you are an awesome parent and want to give your children some cookies. But, you should give each child at most one cookie.

Each child i has a greed factor g[i], which is the minimum size of a cookie that the child will be content with; and each cookie j has a size s[j]. If s[j] >= g[i], we can assign the cookie j to the child i, and the child i will be content. Your goal is to maximize the number of your content children and output the maximum number.

Example 1:

Input:

3

1 2 3

2

1 1

Output:

1

Explanation: You have 3 children and 2 cookies. The greed factors of 3 children are 1, 2, 3.

And even though you have 2 cookies, since their size is both 1, you could only make the child whose greed factor is 1 content.

You need to output 1.

Constraints:

1 <= g.length <= 3 * 10^4

0 <= s.length <= 3 * 10^4

1 <= g[i], s[j] <= 2^31 - 1

Algorithm:

```
function main() {
    initialize n  // number of children
```

```
read n

initialize greed array of size n  // array to hold children's greed factors

// read greed factors for each child
for i from 0 to n-1 {
    read greed[i] from user
}

initialize c  // number of cookie sizes
read c from user

initialize csize array of size c  // array to hold cookie sizes

// read cookie sizes
for j from 0 to c-1 {
    read csize[j] from user
}

initialize count to 0  // counter for satisfied children

// check each child's greed against available cookie sizes
for i from 0 to n-1 {
    for j from 0 to c-1 {
        if csize[j] is greater than or equal to greed[i] {
            increment count by 1  // child is satisfied
            break  // exit inner loop after satisfying this child
        }
    }
}

print count  // output the total count of satisfied children
```

}

Program:

```
#include<stdio.h>
#include<string.h>

int main(){
    int n;
    scanf("%d",&n);
    int greed[n];
    for(int i=0;i<n;i++){
        scanf("%d ",&greed[i]);
    }

    int c;
    scanf("%d",&c);
    int csize[c];
    for(int i=0;i<c;i++){
        scanf("%d ",&csize[i]);
    }

    int count=0;
    for(int i=0;i<n;i++){
        for(int j=0;j<c;j++){
            if (csize[j]>=greed[i]){
                count++;
                break;
            }
```

```
        }
    }
    printf("%d",count);


}
```

Output:

	Input	Expected	Got	
✔	2 1 2 3 1 2 3	2	2	✔

3.c. 3-G-Burger Problem

Aim:

A person needs to eat burgers. Each burger contains a count of calorie. After eating the burger, the person needs to run a distance to burn out his calories.
If he has eaten i burgers with c calories each, then he has to run at least $3^i * c$ kilometers to burn out the calories. For example, if he ate 3 burgers with the count of calorie in the order: [1, 3, 2], the kilometers he needs to run are $(3^0 * 1) + (3^1 * 3) + (3^2 * 2) = 1 + 9 + 18 = 28$.
But this is not the minimum, so need to try out other orders of consumption and choose the minimum value. Determine the minimum distance he needs to run. Note: He can eat burger in any order and use an efficient sorting algorithm.Apply greedy approach to solve the problem.

Input Format

First Line contains the number of burgers
Second line contains calories of each burger which is n space-separate integers

Output Format

Print: Minimum number of kilometers needed to run to burn out the calories

Sample Input

```
3
5 10 7
```

Sample Output

```
76
```

Algorithm:

```
int main() {
    initialize n  // number of elements
    read n from user

    initialize cal array of size n  // array to hold integers

    // read values into the cal array
    for i from 0 to n-1 {
        read cal[i] from user
    }
```

```
    // sorting the array using bubble sort
    for i from 0 to n-2 {
        for j from 0 to n-i-2 {
            if cal[j] is greater than cal[j+1] {
                // swap cal[j] and cal[j+1]
                initialize temp as cal[j]
                cal[j] = cal[j+1]
                cal[j+1] = temp
            }
        }
    }

    initialize mulfact  // variable to hold power value
    initialize sum to 0  // variable to hold the final sum
    initialize h to n-1  // index for the last element

    // compute the weighted sum
    for i from 0 to n-1 {
        mulfact = n raised to the power of i  // compute n^i
        sum = sum + (mulfact * cal[h])  // accumulate the weighted sum
        h = h - 1  // move to the next element
    }

    print sum  // output the final result
}
```

Program:

```
#include<stdio.h>
#include<math.h>
```

```
int main(){
    int n;
    scanf("%d",&n);
    int cal[n];
    for(int i=0;i<n;i++){
        scanf("%d ",&cal[i]);
    }
    //sorting the array
    int i, j, temp;
    for (i = 0; i < n-1; i++) {
        for (j = 0; j < n-i-1; j++) {
            if (cal[j] > cal[j+1]) {
                temp = cal[j];
                cal[j] = cal[j+1];
                cal[j+1] = temp;
            }
        }
    }
    int mulfact;
    int sum=0;
    int h=n-1;
    for(int i=0;i<n;i++)
    {
        mulfact=pow(n,i);
        sum+=mulfact*cal[h];
        h--;
    }
    printf("%d",sum);
```

}

Output:

	Test	Input	Expected	Got	
✔	Test Case 1	3 1 3 2	18	18	✔
✔	Test Case 2	4 7 4 9 6	389	389	✔
✔	Test Case 3	3 5 10 7	76	76	✔

3.d. 4-G-Array Sum Max Problem

Aim:

Given an array of N integer, we have to maximize the sum of arr[i] * i, where i is the index of the element (i = 0, 1, 2, ..., N).Write an algorithm based on Greedy technique with a Complexity O(nlogn).

Input Format:

First line specifies the number of elements-n

The next n lines contain the array elements.

Output Format:

Maximum Array Sum to be printed.

Sample Input:

5

2 5 3 4 0

Sample output:

40

Algorithm:

```
function main() {
    initialize n  // number of elements
    read n from user

    initialize arr array of size n  // array to hold integers

    // read values into the arr array
    for i from 0 to n-1 {
        read arr[i] from user
    }

    // sorting the array using bubble sort
    for i from 0 to n-2 {
```

```
        for j from 0 to n-i-2 {
            if arr[j] is greater than arr[j+1] {
                // swap arr[j] and arr[j+1]
                initialize temp as arr[j]
                arr[j] = arr[j+1]
                arr[j+1] = temp
            }
        }
    }

    initialize prod to 0  // variable to hold the weighted sum

    // compute the weighted sum
    for i from 0 to n-1 {
        prod = prod + (arr[i] * i)  // accumulate the weighted sum
    }

    print prod  // output the final result
}
```

Program:

```
#include<stdio.h>
int main(){
    int n;
    scanf("%d",&n);
    int arr[n];
    for(int i=0;i<n;i++){
        scanf("%d",&arr[i]);
    }
```

```
    for(int i=0;i<n-1;i++){
        for(int j=0;j<n-i-1;j++){
            if(arr[j]>arr[j+1]){
                int temp=arr[j];
                arr[j]=arr[j+1];
                arr[j+1]=temp;
            }
        }
    }
    int prod=0;
    for(int i=0;i<n;i++){
        prod+=(arr[i]*i);
    }
    printf("%d",prod);
}
```

Output:

	Input	Expected	Got	
✔	5 2 5 3 4 0	40	40	✔
✔	10 2 2 2 4 4 3 3 5 5 5	191	191	✔
✔	2 45 3	45	45	✔

3.e. 5-G-Product of Array Elements-Minimum

Aim:

Given two arrays array_One[] and array_Two[] of same size N. We need to first rearrange the arrays such that the sum of the product of pairs(1 element from each) is minimum. That is SUM (A[i] * B[i]) for all i is minimum.

Algorithm:

```
function main() {
    initialize n  // number of elements
    read n from user

    initialize array_One of size n  // first array
    initialize array_Two of size n  // second array

    // read values into array_One
    for i from 0 to n-1 {
        read array_One[i] from user
    }

    // read values into array_Two
    for i from 0 to n-1 {
        read array_Two[i] from user
    }

    // sorting both arrays
    for i from 0 to n-2 {
        for j from 0 to n-i-2 {
            // sort array_One in ascending order
```

```
            if array_One[j+1] is less than array_One[j] {
                // swap array_One[j] and array_One[j+1]
                initialize temp as array_One[j]
                array_One[j] = array_One[j+1]
                array_One[j+1] = temp
            }

            // sort array_Two in descending order
            if array_Two[j+1] is greater than array_Two[j] {
                // swap array_Two[j] and array_Two[j+1]
                initialize temp as array_Two[j]
                array_Two[j] = array_Two[j+1]
                array_Two[j+1] = temp
            }
        }
    }

    initialize sum to 0  // variable to hold the final sum

    // calculate the sum of products of corresponding elements
    for i from 0 to n-1 {
        sum = sum + (array_One[i] * array_Two[i])  // accumulate the product
    }

    print sum  // output the final result
}
```

Program:

```
#include<stdio.h>
int main(){
    int n;
    scanf("%d",&n);

    int array_One[n];
    int array_Two[n];

    for(int i=0;i<n;i++){
        scanf("%d ",&array_One[i]);
    }
    for(int i=0;i<n;i++){
        scanf("%d ",&array_Two[i]);
    }
    for(int i=0;i<n-1;i++){
        for(int j=0;j<n-i-1;j++){
            if(array_One[j+1]<array_One[j]){
                int temp=array_One[j];
                array_One[j]=array_One[j+1];
                array_One[j+1]=temp;
            }
            if(array_Two[j+1]>array_Two[j]){
                int temp=array_Two[j];
                array_Two[j]=array_Two[j+1];
                array_Two[j+1]=temp;
            }

        }
    }
    int sum=0;
    for(int i=0;i<n;i++){
```

```
        sum+=(array_One[i]*array_Two[i]);
    }
    printf("%d",sum);
}
```

Output:

	Input	Expected	Got	
✔	3 1 2 3 4 5 6	28	28	✔
✔	4 7 5 1 2 1 3 4 1	22	22	✔
✔	5 20 10 30 10 40 8 9 4 3 10	590	590	✔