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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
```

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```
// 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:

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	Input	Expected	Got	
✓	49	5	5	✓

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### 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  $s[j] \geq g[i]$ , 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:

$1 \leq g.length \leq 3 \cdot 10^4$

$0 \leq s.length \leq 3 \cdot 10^4$

$1 \leq g[i], s[j] \leq 2^{31} - 1$

#### Algorithm:

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

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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

}

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**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;  
            }  
        }  
    }  
}
```

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

}

Output:

	Input	Expected	Got	
✓	2	2	2	✓
	1 2			
	3			
	1 2 3			

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### 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
```

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```
}
```

```
// 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>
```

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```
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);
}
```

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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	✓

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### 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 ( $i = 0, 1, 2, \dots, N$ ). Write an algorithm based on Greedy technique with a Complexity  $O(n \log n)$ .

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
```

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```

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]);
    }
}

```

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```
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:**

--	--	--

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	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	✓

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### 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
```

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```
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:**

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```
#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	✓

--	--	--