Assignment- 4.7

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Batch: 23

Problem: Library Book Borrowing Records

Problem Statement:

A university library records the number of books borrowed each day. Due to late returns or corrections, daily records may change. You are required to efficiently support the following operations:

1. Prefix Query – Find the total number of books borrowed from Day 1 to Day *x*
2. Update Operation – Update the number of books borrowed on a given day

Implement a Binary Indexed Tree (Fenwick Tree) to process these operations in O(log n) time.

Input Format:

- The first line contains an integer T, the number of test cases.
- For each test case:
  - o The first line contains an integer N, the number of days
  - o The second line contains N space-separated integers representing the number of books borrowed each day o The third line contains an integer Q, the number of queries o The next Q lines contain queries of the form:
    - SUM x → Find total books borrowed till Day *x*
    - UPDATE i val → Increase books borrowed on Day *i* by *val*

Output Format:

- For each SUM query, print the result on a new line.

Constraints:

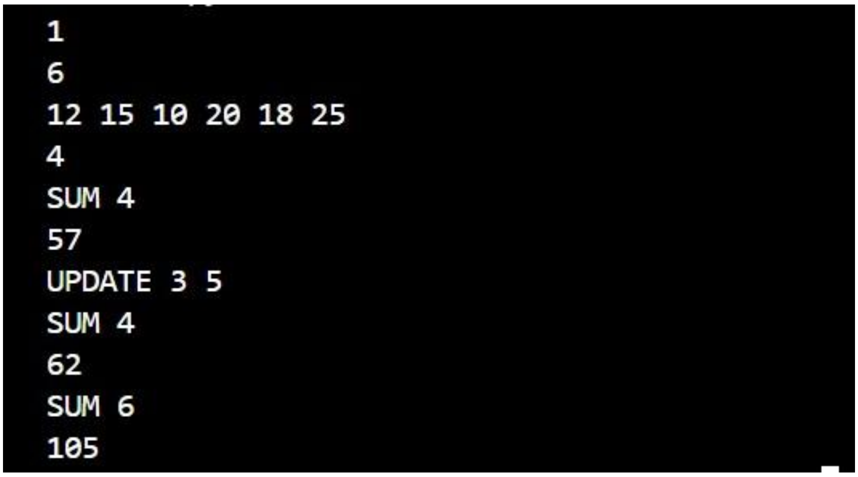
- 1 ≤ T ≤ 20
- 1 ≤ N ≤ 200000

- $-10^9 \le arr[i] \le 10^9$
- $1 \le Q \le 200000$

PYTHON CODE:

```
class   FenwickTree:              def
__init__(self,  n):           self.n  =  n
self.bit  =  [0]  *  (n  +  1)         def
update(self, i, val):        while i <=
self.n:          self.bit[i] += val          i
+= i & -i    def query(self, i):       s =
0       while i > 0:         s += self.bit[i]
i -= i & -i       return s T = int(input())
for _ in range(T):     N = int(input())
arr  =  list(map(int,  input().split()))
ft  =  FenwickTree(N)        for  i  in
range(N):      ft.update(i + 1, arr[i])
Q = int(input())    for _ in range(Q):
q  =  input().split()           if  q[0]  ==
"SUM":                      x  =  int(q[1])
print(ft.query(x))              else:   #
UPDATE
        i = int(q[1])
val = int(q[2])
ft.update(i, val)
```

Output:



```
1
6
12 15 10 20 18 25
4
SUM 4
57
UPDATE 3 5
SUM 4
62
SUM 6
105
```

C CODE:

```
#include <stdio.h>

#include <string.h>

#define MAXN 200005

long long BIT[MAXN];

int N; void update(int i, long

long val) {    while (i <= N) {

BIT[i] += val;        i += i & (-i);

   }

} long long query(int i)

{    long long sum = 0;

while (i > 0) {        sum

+= BIT[i];

       i -= i & (-i);

   }

   return

sum; } int

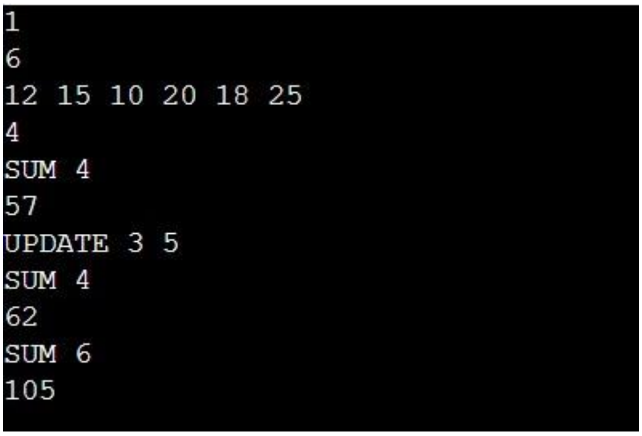
main() {

   int T;
```

```
  scanf("%d", &T);    while (T--) {
scanf("%d", &N);        for (int i = 1; i <=
N; i++)           BIT[i] = 0;        for (int i =
1; i <= N; i++) {           long long x;
scanf("%lld", &x);           update(i, x);
}       int Q;       scanf("%d", &Q);
while (Q--) {           char type[10];
scanf("%s", type);           if
(strcmp(type, "SUM") == 0) {
            int x;              scanf("%d",
&x);              printf("%lld\n",
query(x));
         } else {              int i;
long long val;              scanf("%d
%lld", &i, &val);              update(i,
val);

         }
      }    }
return 0;
}
```

Output:



```
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```

JAVA CODE:

```
import java.io.*;

import java.util.*;


public class Main {

  static int N;

static long[] BIT;


  static void update(int i, long

val){       while(i<=N){

BIT[i]+=val;           i+=i&(-i);

    }

  }


  static long query(int i){

long sum=0;       while(i>0){

sum+=BIT[i];           i-=i&(-i);

    }       return

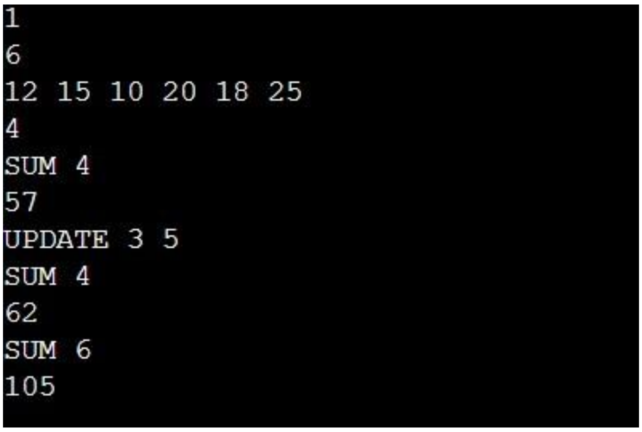
sum;

  }
```

```
 public static void main(String[] args)throws Exception{
  BufferedReader br=new BufferedReader(new
InputStreamReader(System.in));    StringTokenizer st;    int
T=Integer.parseInt(br.readLine());    while(T-->0){
   N=Integer.parseInt(br.readLine());
BIT=new long[N+1];    st=new
StringTokenizer(br.readLine());    for(int
i=1;i<=N;i++){
update(i,Long.parseLong(st.nextToken()));
   }
   int Q=Integer.parseInt(br.readLine());
while(Q-->0){    st=new
StringTokenizer(br.readLine());    String
type=st.nextToken();
if(type.equals("SUM")){    int
x=Integer.parseInt(st.nextToken());
     System.out.println(query(x));
    }else{    int
i=Integer.parseInt(st.nextToken());
long val=Long.parseLong(st.nextToken());

     update(i,val);
    }
   }
  }
 }
}
```

Output:



```
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