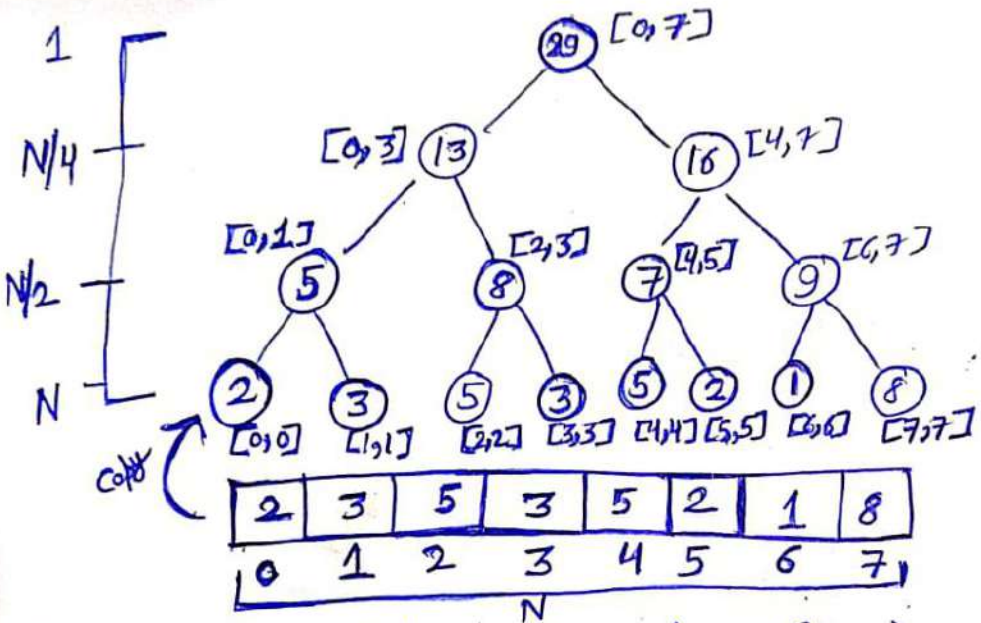
Segment Tree

↳ Range Updates / Queries



$h = \log N$

Total no : $N + \frac{N}{2} + \frac{N}{4} + \cdots 1$

$= \cancel{2(2N)} \; 2N-1$

Query – Range : select & add nodes $(\log N)$

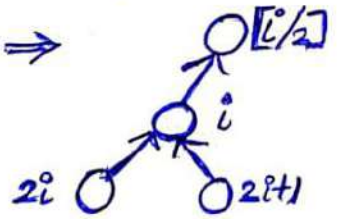
Update – point : path from leaf to root $(\log N)$

* on each range, select two nodes (atmost) for optimal solution per level.

Level $= \log N$

∴ Any range can be written in $2 \log N$ no. of ranges.

- Numbering of binary tree ⇒



```cpp
#include<bits/stdc++.h>
using namespace std;

int n;
int arr[100100];

int t[4*100100];
void build(int id,int l,int r){
    if(l==r){
        t[id] = arr[l];
        return;
    }
    int mid = (l+r)/2;
    build(2*id,l,mid);
    build(2*id+1,mid+1,r);
    t[id] = t[2*id]+t[2*id+1];
}
```

```
void update(int id,int l,int r,int pos,int val){
    if(pos<l||pos>r) return;
    if(l==r){
        arr[pos]=val;
        t[id]=val;
        return;
    }
    update(id<<1,l,mid,pos,val);
    update(id<<1|1,mid+1,r,pos,val);
    t[id] = t[2*id]+t[2*id+1];
}
```

```
int query(int id,int l,int r,int lq,int rq){
    if(lq>r||l>rq)return 0;
    if(lq<=l&&r<=rq) return t[id];
    int mid = (l+r)/2;
    return query(id<<1,l,mid,lq,rq) + query(id<<1|1,mid+1,r,lq,rq);
}
```

```
void solve(){
    cin>>n;
    for(int i=0;i<n;i++)cin>>arr[i];
    build(1,0,n-1);

    int q;
    cin>>q;
    while(q--){
        int type;
        cin>>type;
```

```
int q;
cin>>q;
while(q--){
    int type;
    cin>>type;
    if(type==1){
        int pos, val;
        cin>>pos>>val;
        // update arr[pos]=val;
        update(1,0,n-1,)
    }
    else{
        int l,r;
        cin>>l>>r;
        // find sum(arr[i]) -> i - [l,r]

    }
```

GSS3 - Can you answer these queries III

#tree

You are given a sequence A of N ($N \le 50000$) integers between -10000 and 10000. On this sequence you have to apply M ($M \le 50000$) operations: modify the i-th element in the sequence or for given x y print $\max\{A_i + A_{i+1} + .. + A_j \mid x \le i \le j \le y\}$.

Input

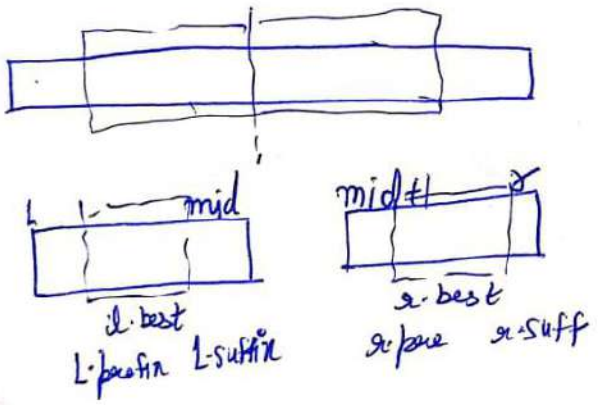
The first line of input contains an integer N. The following line contains N integers, representing the sequence A1..AN. The third line contains an integer M. The next M lines contain the operations in following form:

- 0 x y: modify A_x into y ($|y| \le 10000$).
- 1 x y: print $\max\{A_i + A_{i+1} + .. + A_j \mid x \le i \le j \le y\}$.

Output

For each query, print an integer as the problem required.

Q. Max. subArray within a range (CSSJ: Can you answer these queries III)



Max. sum can be:
1. entirely in left child
2. " " right child
3. the midpoint (partially in left & partially in right.

To create a parent node.

P.ans = max ({L.best, R.best, L.suff + R.pre 3)