Competitive Programming

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HTNO: 2303A51876

Batch-14

Date: 04-02-2026

Week-6 ASSIGNMENT (Wednesday Lab)

Assignment 1:

Practical Exercises with Fenwick Trees -Binary Indexed Trees: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:
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:
•The first line contains an integer N, the number of days
•The second line contains N space-separated integers, representing books borrowed each day
•The third line contains an integer Q, the number of queries
•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 ≤ Q ≤ 200000
- 0 ≤ i < N

Sample Input

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

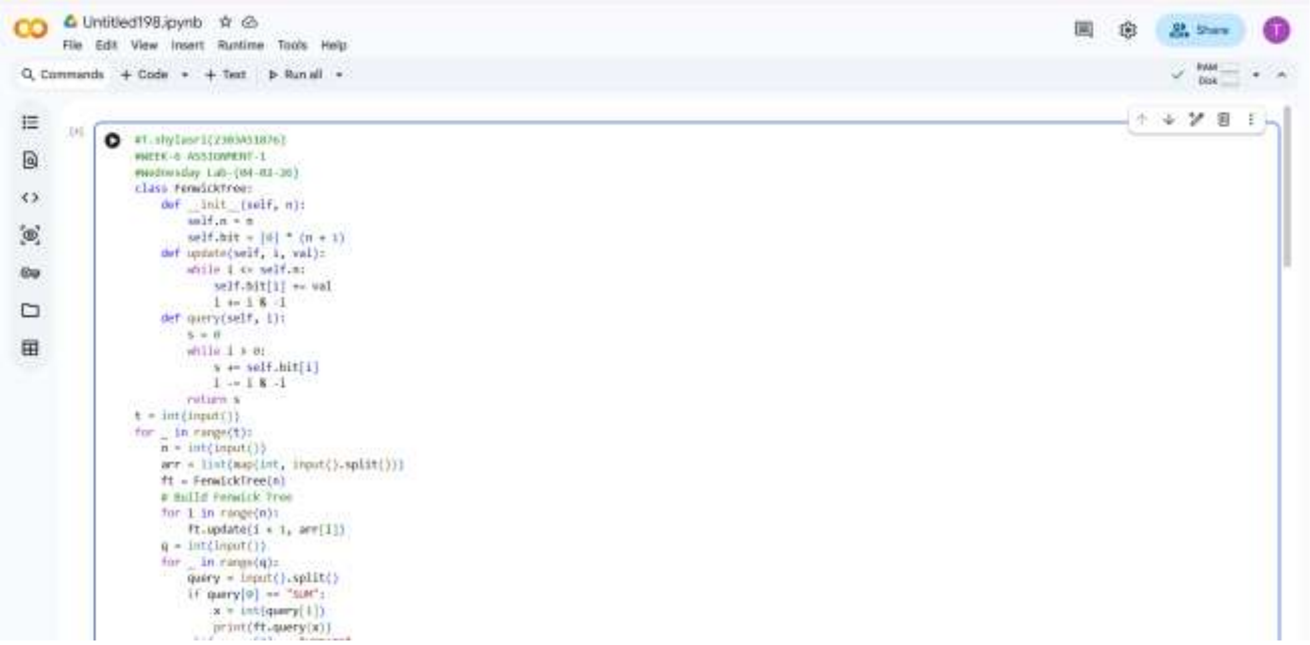
Sample Output

```
57
62
105
```

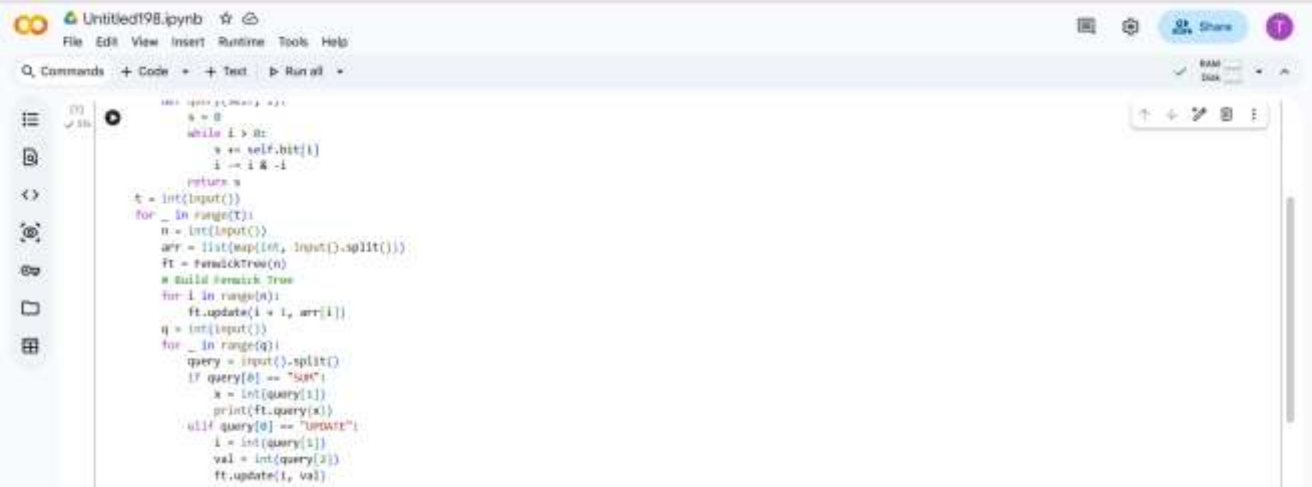
Python Code:

```
#T.shylasri(2303A51876)

#WEEK-6 ASSIGNMENT

#Wednesday Lab-(04-02-26)

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)
    # Build Fenwick Tree
    for i in range(n):
        ft.update(i + 1, arr[i])
    q = int(input())
    for _ in range(q):
        query = input().split()
        if query[0] == "SUM":
            x = int(query[1])
            print(ft.query(x))
        elif query[0] == "UPDATE":
            i = int(query[1])
            val = int(query[2])
            ft.update(i, val)
```

Python Code Screenshot:

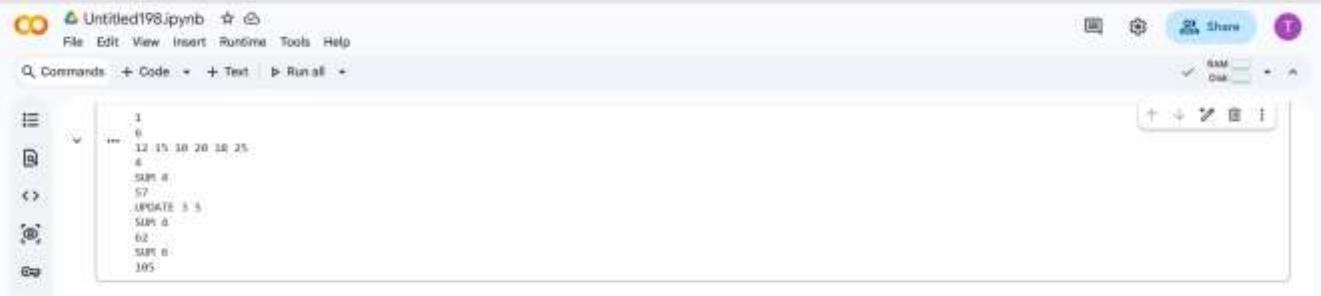

Untitled198.ipynb
File Edit View Insert Runtime Tools Help
Commands + Code + Text ▷ Run all
Share

```
#T.shylasri(2303A51876)
#WEEK-6 ASSIGNMENT-1
#Wednesday Lab-(04-03-26)
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)
    # Build Fenwick Tree
    for i in range(n):
        ft.update(i + 1, arr[i])
    q = int(input())
    for _ in range(q):
        query = input().split()
        if query[0] == "SUM":
            x = int(query[1])
            print(ft.query(x))
```


Untitled198.ipynb
File Edit View Insert Runtime Tools Help
Commands + Code + Text ▷ Run all
Share

```
            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)
        # Build Fenwick Tree
        for i in range(n):
            ft.update(i + 1, arr[i])
        q = int(input())
        for _ in range(q):
            query = input().split()
            if query[0] == "SUM":
                x = int(query[1])
                print(ft.query(x))
            elif query[0] == "UPDATE":
                i = int(query[1])
                val = int(query[2])
                ft.update(i, val)
```

Python Output:

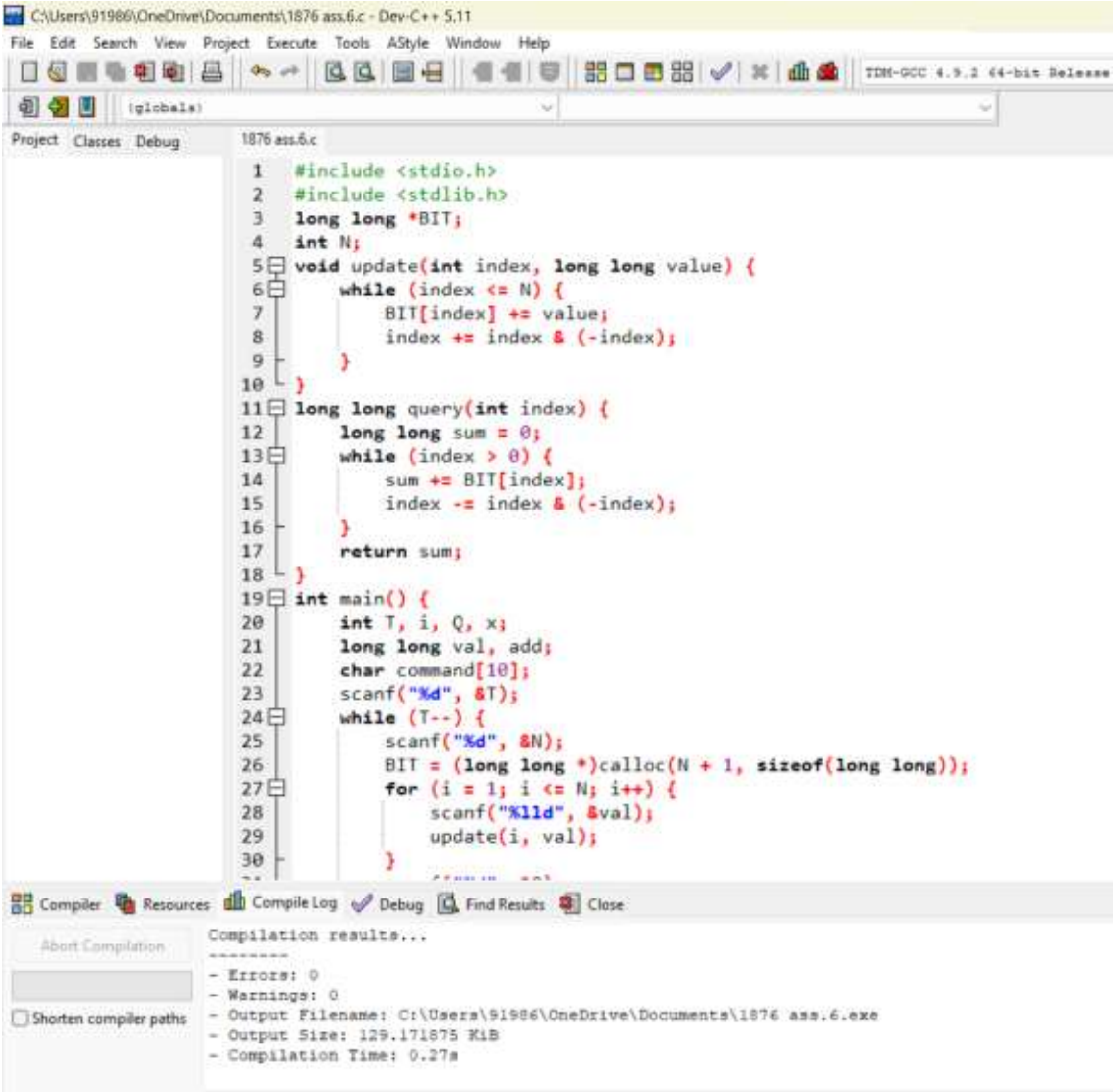

Untitled198.ipynb
File Edit View Insert Runtime Tools Help
Commands + Code + Text ▷ Run all
Share

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

C Program:

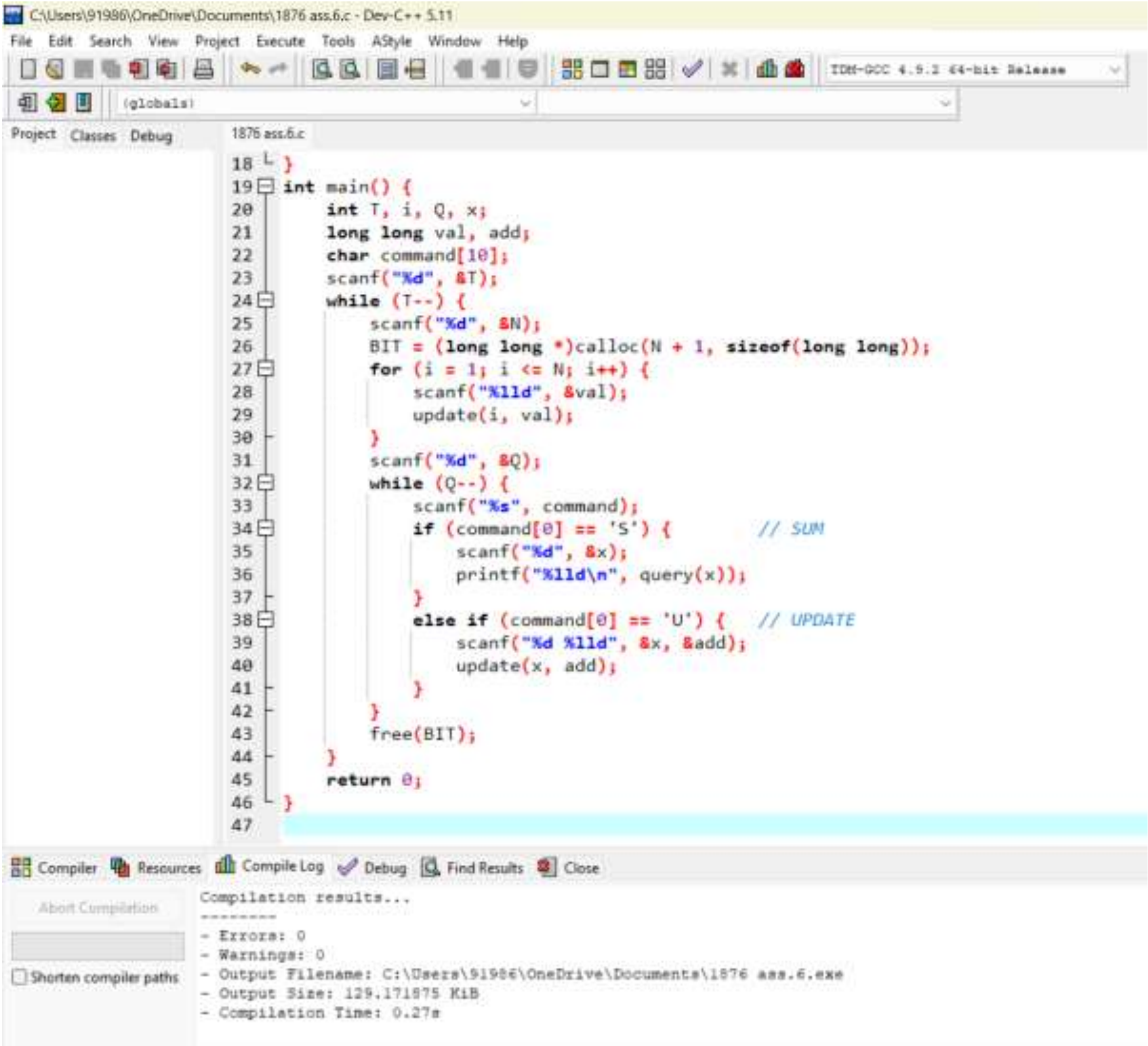
```
#include <stdio.h>
#include <stdlib.h>
long long *BIT;
int N;
void update(int index, long long value) {
    while (index <= N) {
        BIT[index] += value;
        index += index & (-index);
    }
}
long long query(int index) {
    long long sum = 0;
    while (index > 0) {
        sum += BIT[index];
        index -= index & (-index);
    }
    return sum;
}
int main() {
    int T, i, Q, x;
    long long val, add;
    char command[10];
    scanf("%d", &T);
    while (T--) {
        scanf("%d", &N);
        BIT = (long long *)calloc(N + 1, sizeof(long long));
        for (i = 1; i <= N; i++) {
            scanf("%lld", &val);
            update(i, val);
        }
        scanf("%d", &Q);
        while (Q--) {
            scanf("%s", command);
            if (command[0] == 'S') {        // SUM
                scanf("%d", &x);
                printf("%lld\n", query(x));
            }
            else if (command[0] == 'U') {   // UPDATE
                scanf("%d %lld", &x, &add);
                update(x, add);
            }
        }
        free(BIT);
    }
    return 0;
}
```

C Code Screenshot:


C:\Users\91986\OneDrive\Documents\1876 ass.6.c - Dev-C++ 5.11
File Edit Search View Project Execute Tools AStyle Window Help
TDM-GCC 4.9.2 64-bit Release
(globals)
Project Classes Debug
1876 ass.6.c
Compiler Resources Compile Log Debug Find Results Close
Abort Compilation
□ Shorten compiler paths

```c
#include <stdio.h>
#include <stdlib.h>
long long *BIT;
int N;
void update(int index, long long value) {
    while (index <= N) {
        BIT[index] += value;
        index += index & (-index);
    }
}
long long query(int index) {
    long long sum = 0;
    while (index > 0) {
        sum += BIT[index];
        index -= index & (-index);
    }
    return sum;
}
int main() {
    int T, i, Q, x;
    long long val, add;
    char command[10];
    scanf("%d", &T);
    while (T--) {
        scanf("%d", &N);
        BIT = (long long *)calloc(N + 1, sizeof(long long));
        for (i = 1; i <= N; i++) {
            scanf("%lld", &val);
            update(i, val);
        }
```

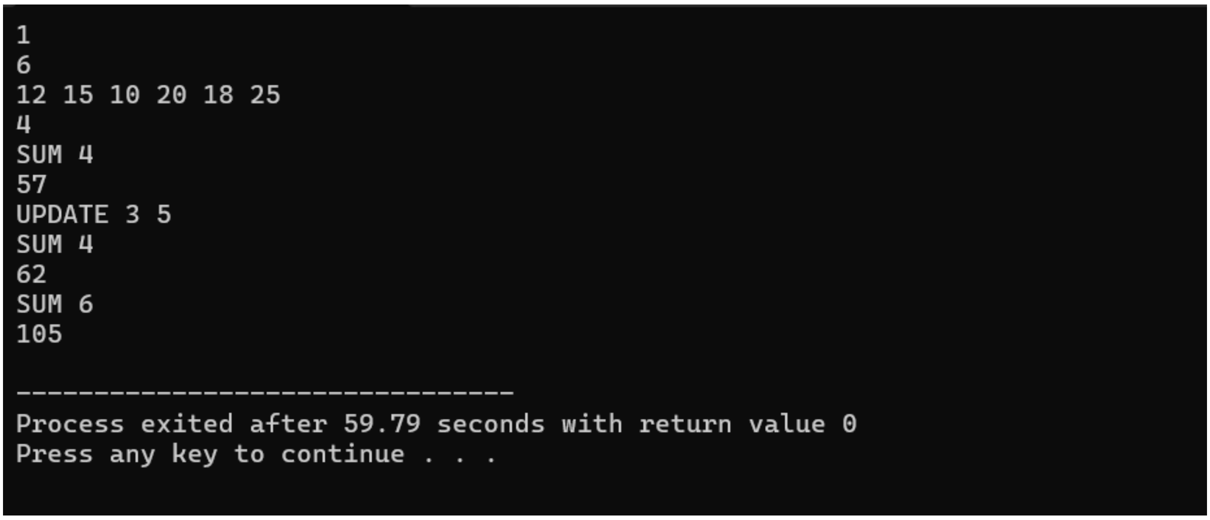
```
Compilation results...
--------
- Errors: 0
- Warnings: 0
- Output Filename: C:\Users\91986\OneDrive\Documents\1876 ass.6.exe
- Output Size: 129.171875 KiB
- Compilation Time: 0.27s
```


C:\Users\91986\OneDrive\Documents\1876 ass.6.c - Dev-C++ 5.11
File Edit Search View Project Execute Tools AStyle Window Help
TDM-GCC 4.9.2 64-bit Release
(globals)
Project Classes Debug
1876 ass.6.c
Compiler Resources Compile Log Debug Find Results Close
Abort Compilation
□ Shorten compiler paths

```c
}
int main() {
    int T, i, Q, x;
    long long val, add;
    char command[10];
    scanf("%d", &T);
    while (T--) {
        scanf("%d", &N);
        BIT = (long long *)calloc(N + 1, sizeof(long long));
        for (i = 1; i <= N; i++) {
            scanf("%lld", &val);
            update(i, val);
        }
        scanf("%d", &Q);
        while (Q--) {
            scanf("%s", command);
            if (command[0] == 'S') {         // SUM
                scanf("%d", &x);
                printf("%lld\n", query(x));
            }
            else if (command[0] == 'U') {   // UPDATE
                scanf("%d %lld", &x, &add);
                update(x, add);
            }
        }
        free(BIT);
    }
    return 0;
}
```

```
Compilation results...
--------
- Errors: 0
- Warnings: 0
- Output Filename: C:\Users\91986\OneDrive\Documents\1876 ass.6.exe
- Output Size: 129.171875 KiB
- Compilation Time: 0.27s
```

C Output:



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

--------------------------------
Process exited after 59.79 seconds with return value 0
Press any key to continue . . .
```

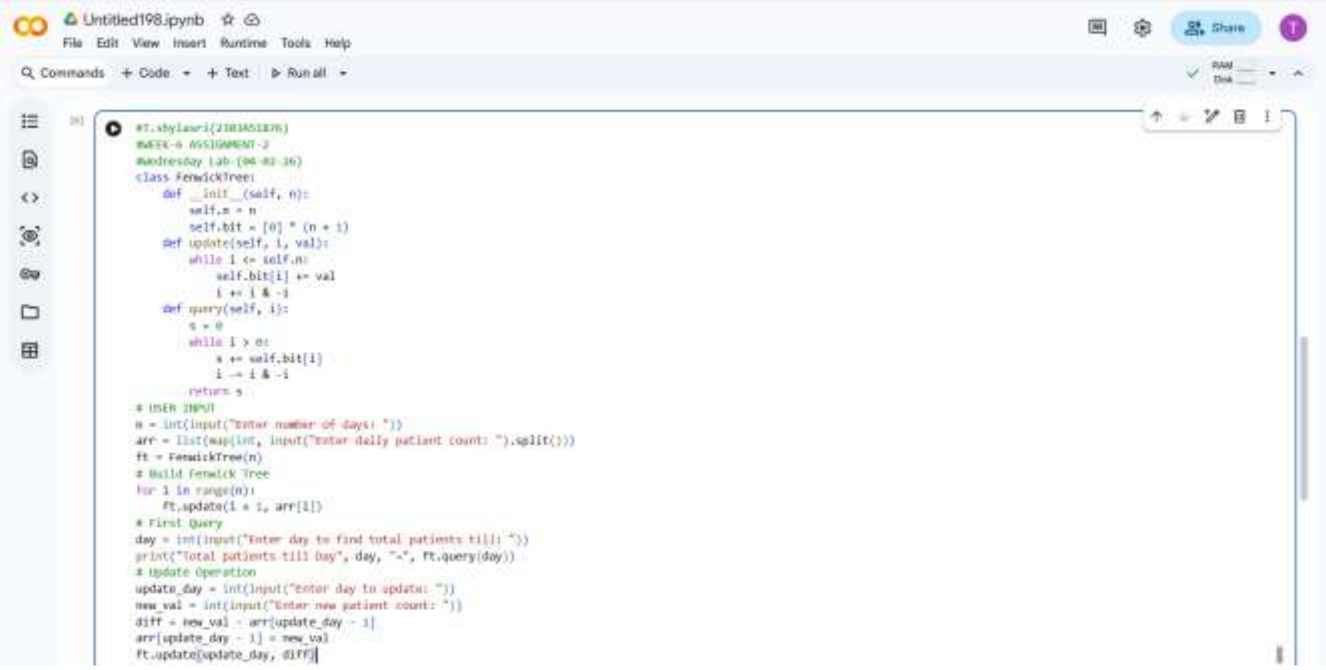
Assignment 2:

Python Code:

```
#T.shylasri(2303A51876)
#WEEK-6 ASSIGNMENT-2
#Wednesday Lab-(04-02-26)
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
# USER INPUT
n = int(input("Enter number of days: "))
arr = list(map(int, input("Enter daily patient count: ").split()))
ft = FenwickTree(n)
# Build Fenwick Tree
for i in range(n):
    ft.update(i + 1, arr[i])
# First Query
day = int(input("Enter day to find total patients till: "))
```

```
print("Total patients till Day", day, "=", ft.query(day))

# Update Operation

update_day = int(input("Enter day to update: "))

new_val = int(input("Enter new patient count: "))

diff = new_val - arr[update_day - 1]

arr[update_day - 1] = new_val

ft.update(update_day, diff)

# Second Query

day = int(input("Enter day to find total patients till after update: "))

print("After update, total patients till Day", day, "=", ft.query(day))
```

Python Code Screenshot:



Untitled198.ipynb
File Edit View Insert Runtime Tools Help
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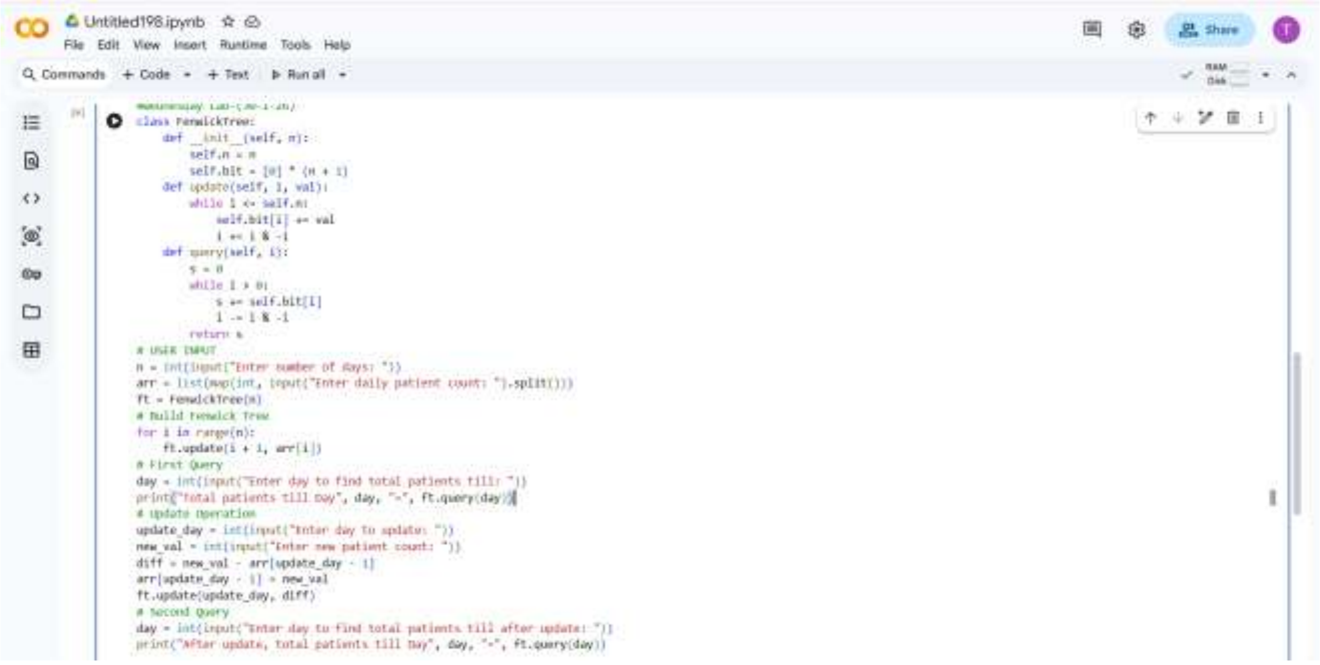
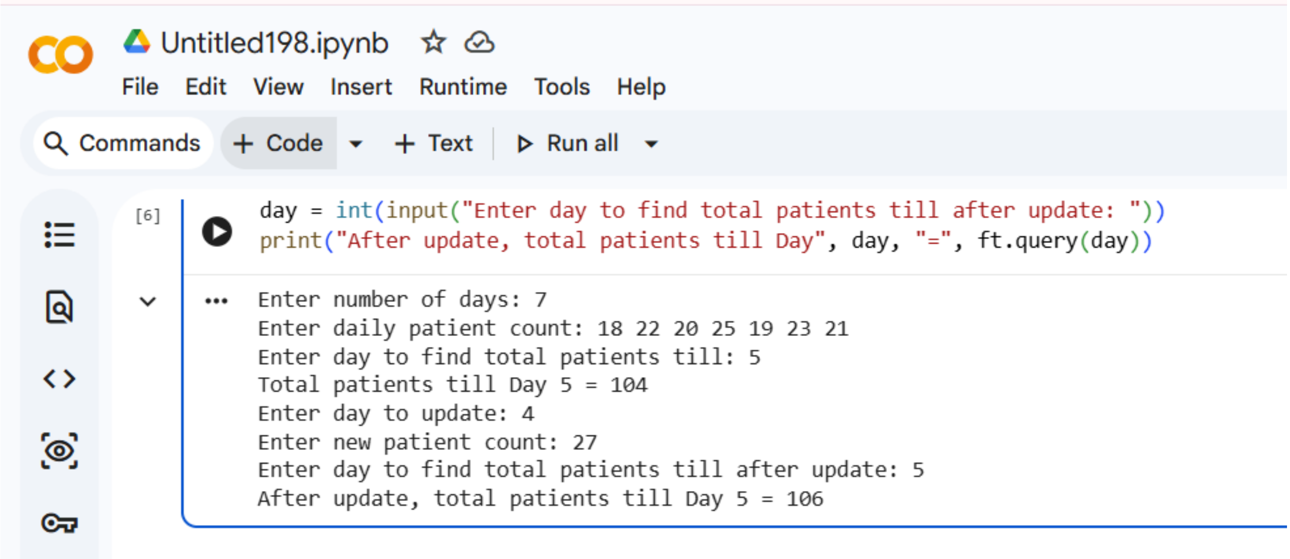
Share
RAM
Disk

```
#T.shylasri(2303A51E76)
#WEEK-6 ASSIGNMENT-2
#Wednesday Lab (04-02-26)
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
# USER INPUT
n = int(input("Enter number of days: "))
arr = list(map(int, input("Enter daily patient count: ").split()))
ft = FenwickTree(n)
# Build Fenwick Tree
for i in range(n):
    ft.update(i + 1, arr[i])
# First Query
day = int(input("Enter day to find total patients till: "))
print("Total patients till Day", day, "=", ft.query(day))
# Update Operation
update_day = int(input("Enter day to update: "))
new_val = int(input("Enter new patient count: "))
diff = new_val - arr[update_day - 1]
arr[update_day - 1] = new_val
ft.update(update_day, diff)
```


Untitled198.ipynb
File Edit View Insert Runtime Tools Help
Commands + Code + Text Run all
Share

```python
Wednesday Lab-(30-1-26)
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
# USER INPUT
n = int(input("Enter number of days: "))
arr = list(map(int, input("Enter daily patient count: ").split()))
ft = FenwickTree(n)
# Build Fenwick Tree
for i in range(n):
    ft.update(i + 1, arr[i])
# First Query
day = int(input("Enter day to find total patients till: "))
print("Total patients till Day", day, "=", ft.query(day))
# Update Operation
update_day = int(input("Enter day to update: "))
new_val = int(input("Enter new patient count: "))
diff = new_val - arr[update_day - 1]
arr[update_day - 1] = new_val
ft.update(update_day, diff)
# Second Query
day = int(input("Enter day to find total patients till after update: "))
print("After update, total patients till Day", day, "=", ft.query(day))
```

Python Output:


Untitled198.ipynb
File Edit View Insert Runtime Tools Help
Commands + Code + Text Run all
[6]

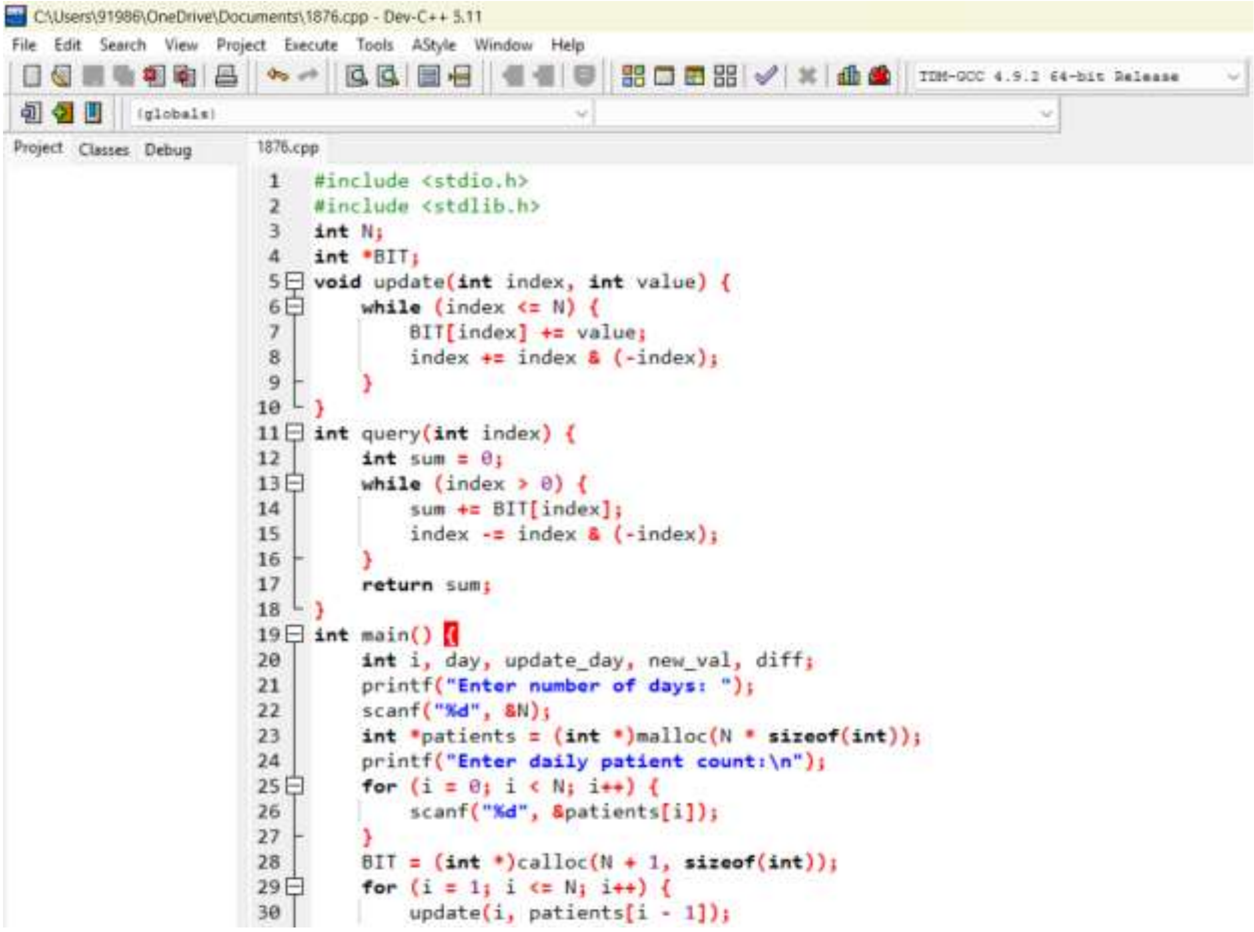
```python
day = int(input("Enter day to find total patients till after update: "))
print("After update, total patients till Day", day, "=", ft.query(day))
```

```
Enter number of days: 7
Enter daily patient count: 18 22 20 25 19 23 21
Enter day to find total patients till: 5
Total patients till Day 5 = 104
Enter day to update: 4
Enter new patient count: 27
Enter day to find total patients till after update: 5
After update, total patients till Day 5 = 106
```

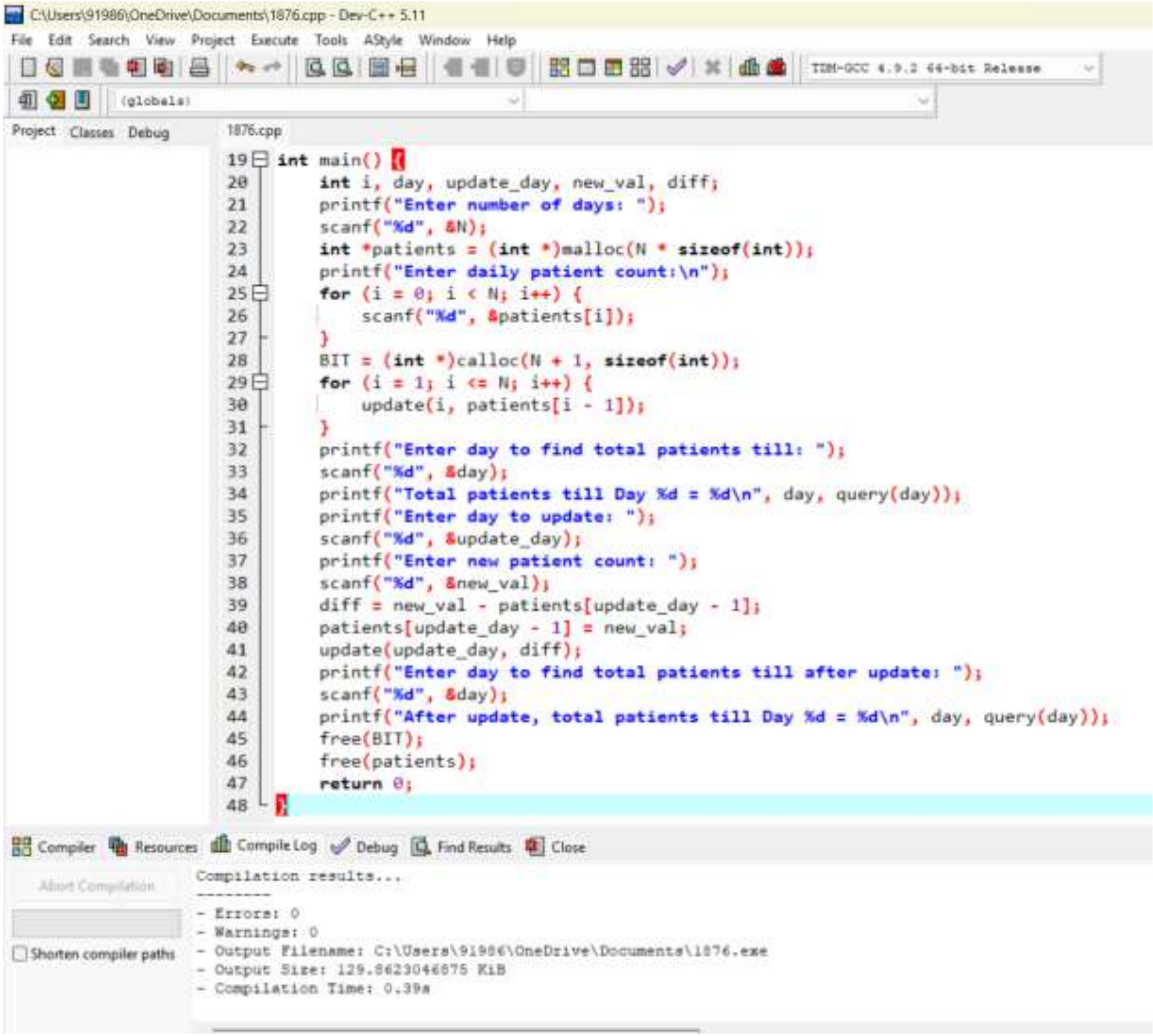
C Program:

```c
#include <stdio.h>

#include <stdlib.h>

int N;

int *BIT;

void update(int index, int value) {

   while (index <= N) {
       BIT[index] += value;
       index += index & (-index);
   }
}
int query(int index) {
   int sum = 0;
   while (index > 0) {
       sum += BIT[index];
       index -= index & (-index);
   }
   return sum;
}
int main() {
   int i, day, update_day, new_val, diff;
   printf("Enter number of days: ");
   scanf("%d", &N);
   int *patients = (int *)malloc(N * sizeof(int));
   printf("Enter daily patient count:\n");
   for (i = 0; i < N; i++) {
       scanf("%d", &patients[i]);
   }
   BIT = (int *)calloc(N + 1, sizeof(int));
   for (i = 1; i <= N; i++) {
       update(i, patients[i - 1]);
   }
   printf("Enter day to find total patients till: ");
   scanf("%d", &day);
   printf("Total patients till Day %d = %d\n", day, query(day));
   printf("Enter day to update: ");
   scanf("%d", &update_day);
   printf("Enter new patient count: ");
   scanf("%d", &new_val);
   diff = new_val - patients[update_day - 1];
   patients[update_day - 1] = new_val;
   update(update_day, diff);
   printf("Enter day to find total patients till after update: ");
   scanf("%d", &day);
   printf("After update, total patients till Day %d = %d\n", day, query(day));
   free(BIT);
   free(patients);
   return 0;
}
```

C Code Screenshot:


C:\Users\91986\OneDrive\Documents\1876.cpp - Dev-C++ 5.11
File Edit Search View Project Execute Tools AStyle Window Help
TDM-GCC 4.9.2 64-bit Release
(globals)
Project Classes Debug
1876.cpp

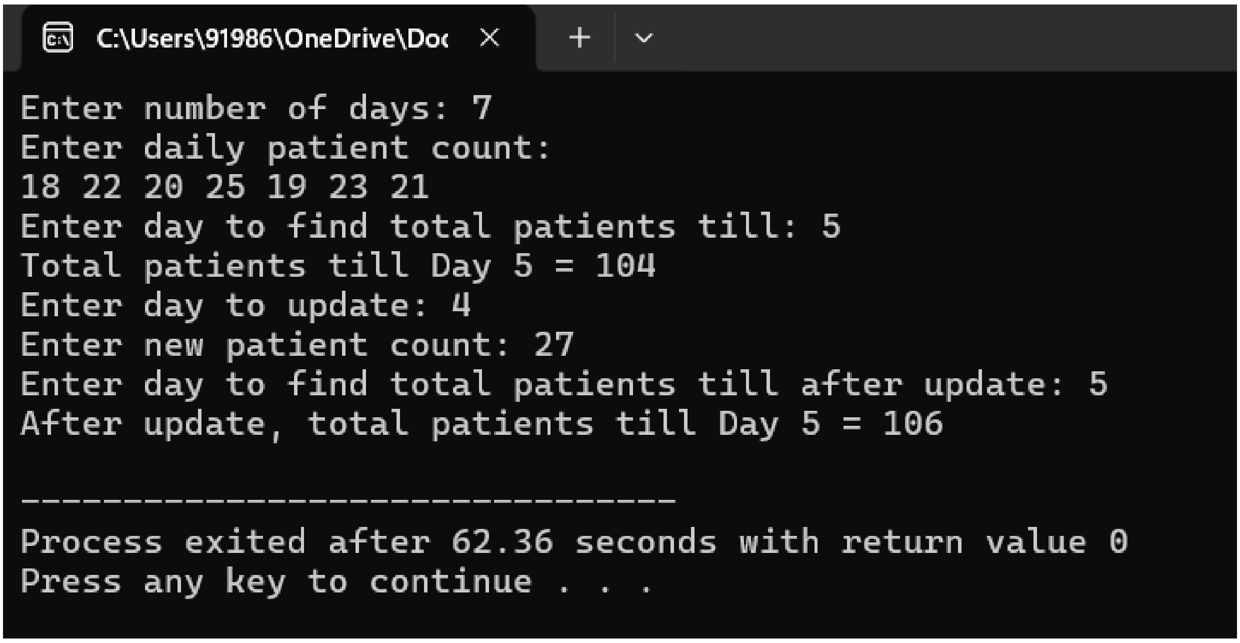
```
#include <stdio.h>
#include <stdlib.h>
int N;
int *BIT;
void update(int index, int value) {
    while (index <= N) {
        BIT[index] += value;
        index += index & (-index);
    }
}
int query(int index) {
    int sum = 0;
    while (index > 0) {
        sum += BIT[index];
        index -= index & (-index);
    }
    return sum;
}
int main() {
    int i, day, update_day, new_val, diff;
    printf("Enter number of days: ");
    scanf("%d", &N);
    int *patients = (int *)malloc(N * sizeof(int));
    printf("Enter daily patient count:\n");
    for (i = 0; i < N; i++) {
        scanf("%d", &patients[i]);
    }
    BIT = (int *)calloc(N + 1, sizeof(int));
    for (i = 1; i <= N; i++) {
        update(i, patients[i - 1]);
```


C:\Users\91986\OneDrive\Documents\1876.cpp - Dev-C++ 5.11
File Edit Search View Project Execute Tools AStyle Window Help
TDM-GCC 4.9.2 64-bit Release
(globals)
Project Classes Debug
1876.cpp
Compiler Resources Compile Log Debug Find Results Close
Abort Compilation
□ Shorten compiler paths

```c
int main() {
    int i, day, update_day, new_val, diff;
    printf("Enter number of days: ");
    scanf("%d", &N);
    int *patients = (int *)malloc(N * sizeof(int));
    printf("Enter daily patient count:\n");
    for (i = 0; i < N; i++) {
        scanf("%d", &patients[i]);
    }
    BIT = (int *)calloc(N + 1, sizeof(int));
    for (i = 1; i <= N; i++) {
        update(i, patients[i - 1]);
    }
    printf("Enter day to find total patients till: ");
    scanf("%d", &day);
    printf("Total patients till Day %d = %d\n", day, query(day));
    printf("Enter day to update: ");
    scanf("%d", &update_day);
    printf("Enter new patient count: ");
    scanf("%d", &new_val);
    diff = new_val - patients[update_day - 1];
    patients[update_day - 1] = new_val;
    update(update_day, diff);
    printf("Enter day to find total patients till after update: ");
    scanf("%d", &day);
    printf("After update, total patients till Day %d = %d\n", day, query(day));
    free(BIT);
    free(patients);
    return 0;
}
```

```
Compilation results...
--------
- Errors: 0
- Warnings: 0
- Output Filename: C:\Users\91986\OneDrive\Documents\1876.exe
- Output Size: 129.8623046875 KiB
- Compilation Time: 0.39s
```

C Output:



```
Enter number of days: 7
Enter daily patient count:
18 22 20 25 19 23 21
Enter day to find total patients till: 5
Total patients till Day 5 = 104
Enter day to update: 4
Enter new patient count: 27
Enter day to find total patients till after update: 5
After update, total patients till Day 5 = 106

--------------------------------
Process exited after 62.36 seconds with return value 0
Press any key to continue . . .
```