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# Equilibrium index of an array

Difficulty Level: Easy • Last Updated: 27 May, 2021

Equilibrium index of an array is an index such that the sum of elements at lower indexes is equal to the sum of elements at higher indexes. For example, in an array A:

#### Example:

**Input**: A[] = {-7, 1, 5, 2, -4, 3, 0}

Output: 3

3 is an equilibrium index, because:

A[0] + A[1] + A[2] = A[4] + A[5] + A[6]

**Input**: A[] = {1, 2, 3}

Output: -1

Write a function *int equilibrium(int[] arr, int n)*; that given a sequence arr[] of size n, returns an equilibrium index (if any) or -1 if no equilibrium indexes exist.

Recommended: Please solve it on "PRACTICE" first, before moving on to the solution.

# Method 1 (Simple but inefficient)

e two loops. Outer loop iterates through all the element and inner loop finds out



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#### C++

```
// C++ program to find equilibrium
// index of an array
#include <bits/stdc++.h>
using namespace std;
int equilibrium(int arr[], int n)
    int i, j;
    int leftsum, rightsum;
    /* Check for indexes one by one until
    an equilibrium index is found */
    for (i = 0; i < n; ++i)
    {
        /* get left sum */
        leftsum = 0;
        for (j = 0; j < i; j++)
            leftsum += arr[j];
        /* get right sum */
        rightsum = 0;
        for (j = i + 1; j < n; j++)
            rightsum += arr[j];
        /* if leftsum and rightsum
        are same, then we are done */
        if (leftsum == rightsum)
            return i;
    /* return -1 if no equilibrium
    index is found */
    return -1;
}
// Driver code
int main()
    int arr[] = \{ -7, 1, 5, 2, -4, 3, 0 \};
    int arr_size = sizeof(arr) / sizeof(arr[0]);
    cout << equilibrium(arr. arr size):
```





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C

```
// C program to find equilibrium
// index of an array
#include <stdio.h>
int equilibrium(int arr[], int n)
    int i, j;
    int leftsum, rightsum;
    /* Check for indexes one by one until
      an equilibrium index is found */
    for (i = 0; i < n; ++i) {</pre>
        /* get left sum */
        leftsum = 0;
        for (j = 0; j < i; j++)
            leftsum += arr[j];
        /* get right sum */
        rightsum = 0;
        for (j = i + 1; j < n; j++)
            rightsum += arr[j];
        /* if leftsum and rightsum are same,
           then we are done */
        if (leftsum == rightsum)
            return i;
    }
    /* return -1 if no equilibrium index is found */
    return -1;
// Driver code
int main()
    int arr[] = { -7, 1, 5, 2, -4, 3, 0 };
    int arr_size = sizeof(arr) / sizeof(arr[0]);
    printf("%d", equilibrium(arr, arr_size));
    getchar();
    return 0;
```



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```
// Java program to find equilibrium
// index of an array
class EquilibriumIndex {
    int equilibrium(int arr[], int n)
        int i, j;
        int leftsum, rightsum;
        /* Check for indexes one by one until
           an equilibrium index is found */
        for (i = 0; i < n; ++i) {</pre>
            /* get left sum */
            leftsum = 0;
            for (j = 0; j < i; j++)
                leftsum += arr[j];
            /* get right sum */
            rightsum = 0;
            for (j = i + 1; j < n; j++)
                rightsum += arr[j];
            /* if leftsum and rightsum are same,
               then we are done */
            if (leftsum == rightsum)
                return i;
        }
        /* return -1 if no equilibrium index is found */
        return -1;
    // Driver code
    public static void main(String[] args)
        EquilibriumIndex equi = new EquilibriumIndex();
        int arr[] = { -7, 1, 5, 2, -4, 3, 0 };
        int arr_size = arr.length;
        System.out.println(equi.equilibrium(arr, arr_size));
}
// This code has been contributed by Mayank Jaiswal
```

Python3





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```
def equilibrium(arr):
    leftsum = 0
    rightsum = 0
    n = len(arr)
    # Check for indexes one by one
    # until an equilibrium index is found
    for i in range(n):
        leftsum = 0
        rightsum = 0
        # get left sum
        for j in range(i):
            leftsum += arr[j]
        # get right sum
        for j in range(i + 1, n):
            rightsum += arr[j]
        # if leftsum and rightsum are same,
        # then we are done
        if leftsum == rightsum:
            return i
    # return -1 if no equilibrium index is found
    return -1
# driver code
arr = [-7, 1, 5, 2, -4, 3, 0]
print (equilibrium(arr))
# This code is contributed by Abhishek Sharama
```

#### C#

```
// C# program to find equilibrium
// index of an array

using System;

class GFG {
    static int equilibrium(int[] arr, int n)
    {
        int i, j;
        int leftsum, rightsum;
    }
}
```

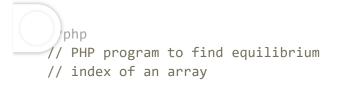


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```
// initialize left sum
            // for current index i
            leftsum = 0;
            // initialize right sum
            // for current index i
            rightsum = 0;
            /* get left sum */
            for (j = 0; j < i; j++)
                leftsum += arr[j];
            /* get right sum */
            for (j = i + 1; j < n; j++)
                rightsum += arr[j];
            /* if leftsum and rightsum are
             same, then we are done */
            if (leftsum == rightsum)
                return i;
        }
        /* return -1 if no equilibrium
         index is found */
        return -1;
    }
    // driver code
    public static void Main()
        int[] arr = { -7, 1, 5, 2, -4, 3, 0 };
        int arr size = arr.Length;
        Console.Write(equilibrium(arr, arr_size));
// This code is contributed by Sam007
```

#### **PHP**







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```
$rightsum;
    /* Check for indexes one by one until
    an equilibrium index is found */
    for (\$i = 0; \$i < \$n; ++\$i)
        /* get left sum */
        $leftsum = 0;
        for (\$j = 0; \$j < \$i; \$j++)
            $leftsum += $arr[$j];
        /* get right sum */
        $rightsum = 0;
        for (\$j = \$i + 1; \$j < \$n; \$j++)
            $rightsum += $arr[$j];
        /* if leftsum and rightsum
        are same, then we are done */
        if ($leftsum == $rightsum)
            return $i;
    /* return -1 if no equilibrium
       index is found */
    return -1;
// Driver code
\arr = array(-7, 1, 5, 2, -4, 3, 0);
$arr size = sizeof($arr);
echo equilibrium($arr, $arr_size);
// This code is contributed
// by akt_mit
?>
```

# **Javascript**

}

```
<script>
// JavaScript Program to find equilibrium

√ index of an array

 inction equilibrium(arr, n)
         var i, j;
         var leftsum, rightsum;
```





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```
/*get left sum*/
             leftsum = 0;
              for(let j = 0; j < i; j++)
              leftsum += arr[j];
              /*get right sum*/
              rightsum = 0;
              for(let j = i + 1; j < n; j++)</pre>
              rightsum += arr[j];
              /*if leftsum and rightsum are same,
              then we are done*/
              if(leftsum == rightsum)
                 return i;
         }
         /* return -1 if no equilibrium index is found*/
            return -1;
}
     // Driver code
    var arr = new Array(-7,1,5,2,-4,3,0);
     n = arr.length;
      document.write(equilibrium(arr,n));
// This code is contributed by simranarora5sos
</script>
```

#### Output

3

# **Time Complexity:** O(n^2)

# Method 2 (Tricky and Efficient)

The idea is to get the total sum of the array first. Then Iterate through the array and keep updating the left sum which is initialized as zero. In the loop, we can get the right sum by obtracting the elements one by one. Thanks to Sambasiva for suggesting this solution d providing code for this.



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- o) iterate through the array and for each index i, do following.
  - a) Update sum to get the right sum.

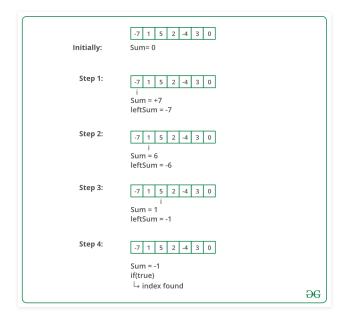
```
sum = sum - arr[i]
// sum is now right sum
b) If leftsum is equal to sum, then return current index.
// update leftsum for next iteration.
c) leftsum = leftsum + arr[i]
```

4) return -1

// If we come out of loop without returning then

// there is no equilibrium index

The image below shows the dry run of the above approach:



Below is the implementation of the above approach:

### C++

```
// C++ program to find equilibrium
// index of an array
#include <bits/stdc++.h>
using namespace std;

it equilibrium(int arr[], int n)

int sum = 0; // initialize sum of work
int leftsum = 0; // initialize left;
```



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```
for (int i = 0; i < n; ++i)</pre>
        sum -= arr[i]; // sum is now right sum for index i
        if (leftsum == sum)
            return i;
        leftsum += arr[i];
    }
    /* If no equilibrium index found, then return 0 */
    return -1;
}
// Driver code
int main()
    int arr[] = { -7, 1, 5, 2, -4, 3, 0 };
    int arr_size = sizeof(arr) / sizeof(arr[0]);
    cout << "First equilibrium index is " << equilibrium(arr, arr_size);</pre>
    return 0;
}
// This is code is contributed by rathbhupendra
```

C

```
// C program to find equilibrium
// index of an array

#include <stdio.h>
int equilibrium(int arr[], int n)
{
   int sum = 0; // initialize sum of whole array
   int leftsum = 0; // initialize leftsum

/* Find sum of the whole array */
   for (int i = 0; i < n; ++i)
        sum += arr[i];

for (int i = 0; i < n; ++i) {
        sum -= arr[i]; // sum is now right sum for index i
        if (leftsum == sum)</pre>
```



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Java

```
// Java program to find equilibrium
// index of an array
class EquilibriumIndex {
    int equilibrium(int arr[], int n)
        int sum = 0; // initialize sum of whole array
        int leftsum = 0; // initialize leftsum
        /* Find sum of the whole array */
        for (int i = 0; i < n; ++i)</pre>
            sum += arr[i];
        for (int i = 0; i < n; ++i) {</pre>
            sum -= arr[i]; // sum is now right sum for index i
            if (leftsum == sum)
                return i;
            leftsum += arr[i];
        /* If no equilibrium index found, then return 0 */
        return -1;
   // Driver code
```



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# Python3

```
# Python program to find the equilibrium
# index of an array
# function to find the equilibrium index
def equilibrium(arr):
    # finding the sum of whole array
    total_sum = sum(arr)
    leftsum = 0
    for i, num in enumerate(arr):
        # total sum is now right sum
        # for index i
        total sum -= num
        if leftsum == total sum:
            return i
        leftsum += num
      # If no equilibrium index found,
      # then return -1
    return -1
# Driver code
arr = [-7, 1, 5, 2, -4, 3, 0]
print ('First equilibrium index is ',
       equilibrium(arr))
# This code is contributed by Abhishek Sharma
```

**)** 

// C# program to find the equilibrium





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```
class GFG {
    static int equilibrium(int[] arr, int n)
        // initialize sum of whole array
        int sum = 0;
        // initialize leftsum
        int leftsum = 0;
        /* Find sum of the whole array */
        for (int i = 0; i < n; ++i)</pre>
            sum += arr[i];
        for (int i = 0; i < n; ++i) {</pre>
            // sum is now right sum
            // for index i
            sum -= arr[i];
            if (leftsum == sum)
                return i;
            leftsum += arr[i];
        /* If no equilibrium index found,
        then return 0 */
        return -1;
    }
    // Driver code
    public static void Main()
        int[] arr = { -7, 1, 5, 2, -4, 3, 0 };
        int arr_size = arr.Length;
        Console.Write("First equilibrium index is " +
                        equilibrium(arr, arr_size));
// This code is contributed by Sam007
```



<?php
// PHP program to find equilibrium</pre>





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```
$sum = 0; // initialize sum of
              // whole array
    $leftsum = 0; // initialize leftsum
    /* Find sum of the whole array */
    for (\$i = 0; \$i < \$n; ++\$i)
        $sum += $arr[$i];
    for (\$i = 0; \$i < \$n; ++\$i)
        // sum is now right sum
        // for index i
        $sum -= $arr[$i];
        if ($leftsum == $sum)
            return $i;
        $leftsum += $arr[$i];
    }
    /* If no equilibrium index
    found, then return 0 */
    return -1;
}
// Driver code
\$arr = array(-7, 1, 5, 2, -4, 3, 0);
$arr_size = sizeof($arr);
echo "First equilibrium index is ",
      equilibrium($arr, $arr size);
// This code is contributed by ajit
?>
```

# **Javascript**

```
<script>
// program to find equilibrium
// index of an array
function equilibrium(arr, n)
    sum = 0; // initialize sum of whole array
    leftsum = 0; // initialize leftsum
    /* Find sum of the whole array */
    for (let i = 0; i < n; ++i)</pre>
```



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### Output

First equilibrium index is 3

#### Output:

First equilibrium index is 3

Time Complexity: O(n)

#### Method 3:

This is a quite simple and straightforward method. The idea is to take the prefix sum of the array twice. Once from the front end of array and another from the back end of array.

After taking both prefix sums run a loop and check for some i if both the prefix sum from one array is equal to prefix sum from the second array then that point can be considered as the Equilibrium point.





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```
int equilibrium(int a[], int n)
    if (n == 1)
        return (0);
    int forward[n] = { 0 };
    int rev[n] = { 0 };
    // Taking the prefixsum from front end array
    for (int i = 0; i < n; i++) {</pre>
        if (i) {
            forward[i] = forward[i - 1] + a[i];
        else {
            forward[i] = a[i];
    }
    // Taking the prefixsum from back end of array
    for (int i = n - 1; i > 0; i--) {
        if (i <= n - 2) {
            rev[i] = rev[i + 1] + a[i];
        else {
            rev[i] = a[i];
    }
    // Checking if forward prefix sum
    // is equal to rev prefix
    // sum
    for (int i = 0; i < n; i++) {</pre>
        if (forward[i] == rev[i]) {
            return i;
    return -1;
    // If You want all the points
    // of equilibrium create
    // vector and push all equilibrium
    // points in it and
    // return the vector
   Driver code
∡nt main()
    int arr[] = { -7, 1, 5, 2, -4, 3, 0 ▲
```



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Java

```
// Java program to find equilibrium
// index of an array
class GFG{
static int equilibrium(int a[], int n)
    if (n == 1)
        return (0);
    int[] front = new int[n];
    int[] back = new int[n];
    // Taking the prefixsum from front end array
    for (int i = 0; i < n; i++)</pre>
        if (i != 0)
            front[i] = front[i - 1] + a[i];
        else
            front[i] = a[i];
    // Taking the prefixsum from back end of array
    for (int i = n - 1; i > 0; i--)
        if (i <= n - 2)
            back[i] = back[i + 1] + a[i];
        else
            back[i] = a[i];
    }
    // Checking for equilibrium index by
    //compairing front and back sums
    for(int i = 0; i < n; i++)</pre>
```



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# Python3

```
# Python program to find the equilibrium
# index of an array
# Function to find the equilibrium index
def equilibrium(arr):
    left sum = []
    right_sum = []
    # Iterate from 0 to len(arr)
    for i in range(len(arr)):
        # If i is not 0
        if(i):
            left_sum.append(left_sum[i-1]+arr[i])
            right_sum.append(right_sum[i-1]+arr[len(arr)-1-i])
        else:
            left sum.append(arr[i])
            right_sum.append(arr[len(arr)-1])
    # Iterate from 0 to len(arr)
    for i in range(len(arr)):
        if(left_sum[i] == right_sum[len(arr) - 1 - i ]):
            return(i)
```

 $\triangle$ 



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### C#

```
// C# program to find equilibrium
// index of an array
using System;
class GFG{
static int equilibrium(int[] a, int n)
    if (n == 1)
        return (0);
    int[] front = new int[n];
    int[] back = new int[n];
    // Taking the prefixsum from front end array
    for(int i = 0; i < n; i++)</pre>
        if (i != 0)
            front[i] = front[i - 1] + a[i];
        else
            front[i] = a[i];
    }
    // Taking the prefixsum from back end of array
    for(int i = n - 1; i > 0; i--)
        if (i <= n - 2)
            back[i] = back[i + 1] + a[i];
        else
            back[i] = a[i];
```



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# **Javascript**

```
// Program to find equilibrium index of an array
function equilibrium(a, n)
{
   if (n == 1)
        return (0);
   var forward = new Array(0);
   var rev = new Array(0);

   // Taking the prefixsum from front end array
   for (let i = 0; i < n; i++) {
        if (i) {
            forward[i] = forward[i - 1] + a[i];
        }
        else {
            forward[i] = a[i];
        }
}</pre>
```



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```
if (i <= n - 2) {
            rev[i] = rev[i + 1] + a[i];
        else {
            rev[i] = a[i];
    }
   // Checking if forward prefix sum
   // is equal to rev prefix
   // sum
   for (let i = 0; i < n; i++) {</pre>
       if (forward[i] == rev[i]) {
            return i;
   return -1;
   // If You want all the points
   // of equilibrium create
   // vector and push all equilibrium
   // points in it and
   // return the vector
}
// Driver code
   arr = new Array(-7, 1, 5, 2, -4, 3, 0);
   n = arr.length;
   document.write("First Point of equilibrium is at index "
         + equilibrium(arr, n) + "\n");
// This code is contributed by simranarora5sos
</script>
```

### Output

First Point of equilibrium is at index 3

**Time Complexity:** O(N)

**Space Complexity:** O(N)

by Sameer, we can remove the return statement and add a print statement to print all equilibrium indexes instead of r ing only one.



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