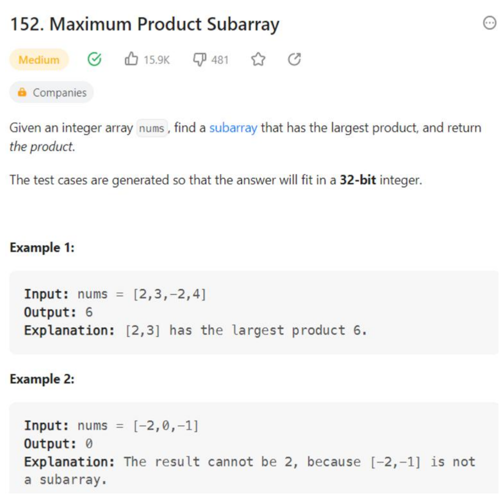
42. Maximum Product Subarray

Wednesday, May 24, 2023 11:06 AM



152. Maximum Product Subarray

Medium 15.9K 481

Companies

Given an integer array `nums`, find a subarray that has the largest product, and return *the product*.

The test cases are generated so that the answer will fit in a **32-bit** integer.

Example 1:

```
Input: nums = [2,3,-2,4]
Output: 6
Explanation: [2,3] has the largest product 6.
```

Example 2:

```
Input: nums = [-2,0,-1]
Output: 0
Explanation: The result cannot be 2, because [-2,-1] is not
a subarray.
```

Maximum Product Subarray

$\hookrightarrow$ contigous part of array.

arr [] = [2, 3, -2, 4]   [2, -2] X (Subsequences)

ans = 6

1) Brute Force

- Generate all sub array.

```
maxi = INT_MIN
for (i = 0 ; i < n ; i ++)
{
  for (j = i ; j < n ; j ++)
  {  product = 1
     for ( k = i → j )   // this will give subarray
     {
        product = product * arr [k] ;
```

```
            }
            maxi = max(maxi, product)
        }
    }
```

TC ⇒ $O(n^3)$ S.C ⇒ $O(1)$

2) Better Solution :

```
for(i=0; i<n; i++)
{   product = 1
    for(j=i; j<n; j++)
    {   prod = prod * arr[j];
        maxi = max(maxi, prod)
    }
}
```

TC ⇒ $O(n^2)$ S.C ⇒ $O(1)$

3) Optimal Approach

$$\begin{tikzcd} & \text{Optimal Approach} \arrow[dl] \arrow[dr] & \\ \text{Observation} & & \text{Kadane's Algo} \end{tikzcd}$$

Observation → use this always in interview

arr[] = [2, 3, -2, 4]

ans = 6

1. +ve ⇒ multiple everyone

2. even -ve, rest +ve ⇒ multiple everyone

3. odd -ve rest +ve ⇒ will give -ve.

2. even -ve, rest +ve → multiple everyone

3. odd -ve, rest +ve ⇒ will give -ve.

we need max product, so you can do remove one -ve nos of odd nos of -ves will leave we with even nos of -ves.

4. if it has '0', multiplication will be '0'.

e.g. $\boxed{-2\ 3\ 4\ -1}$ 0 $\boxed{-2\ 3\ 1\ 4}$ 0 $\boxed{4\ 6\ 7}$

i ll take this array and check

{ 2 3 -2 4 }

max = ~~INT_MIN~~ ~~2~~ $\boxed{6}$ → this is max of {2 3}

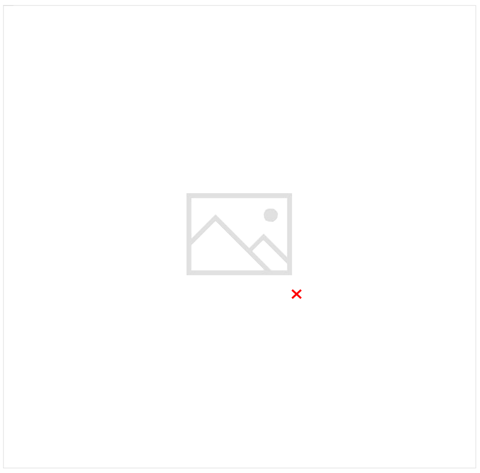
prex = ~~1~~ ~~2~~ ~~6~~ ~~-12~~ -48

suff = ~~1~~ ~~4~~ ~~-8~~ ~~-24~~ ~~-48~~

Now if there is '0' in the array and if you encounter '0' while multiplying then change the prefix to '1' again. (starting up new).

<u>Pseudo</u>

```
pref = 1 , suff = 1
for( i = 0 → n-1)
{
    if ( pre == 0) pre = 1      } //handling '0' in
    if (suff == 0) suff = 1     }  the array.
    pref = pref x arr[i]
    suff = suff * arr[n-i-1]; //as suff is from back.
    maxi = max(maxi, max(pref, suff))
}
return maxi;
```



T.C $\Rightarrow$ $O(n)$ S.C $\Rightarrow$ $O(1)$