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Knowledge Management

Reg Date: 19 MAY 2023

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Type: Implementation

Topic: HackerRank Problem Solving Certificate  
(Intermediate)

Question 2 - Bitwise AND

Discipline of Learning:

- Computer Science
- Data Structure
  - Data Structure and Algorithms
  - Data Structure (Array)
- Searching
- Data Type (Operation)
  - Algorithms Application
- Bitwise AND
- Programming Language (Python 3.x)

Content:

\* This kind of "Knowledge" registrations will merge into the sub-directory.

Question: Given an array of non-negative integer ( $\mathbb{Z}^+$ ), participant should count the number of unordered pair of elements such as that their bitwise AND is a power of 2.

arr =

Given the example of following arrays  $\Rightarrow [10, 7, 2, 8, 3]$

AND Symbol "&" denote as Bitwise AND operator.

Step 0 - Listing out the all of groups.

(0,1) (0,2) (0,3) (0,4)  
~~(1,0)~~ (1,2) (1,3) (1,4)  
~~(2,0)~~ (2,1) (2,3) (2,4)  
~~(3,0)~~ (3,1) (3,2) (3,4)  
~~(4,0)~~ (4,1) (4,2) (4,3)

Index	0	1	2	3	4
Value	10	7	2	8	3

Step 1 - Pop-out repeated pair (with red indicated)

- You will soon found so kind of pattern is reveal there.
- When  $J$  is increased by 1, there will have  $J$ -amount of group would Pop-Out from group list. The starting value of Internal loop would be  $I+1$ .

Step 2 - Here's the Pseudo Code of Selecting item from arg.

(grouping)  
 $i \rightarrow 0$  to  $(n-1)$   
 $j \rightarrow (i+1)$  to  $(n-1)$



8 4 2 1  
X X X X

服務市民  
SERVING THE COMMUNITY  
4 Bits

0 1 2 3 4  
[ 10, 7, 2, 8, 3 ]

### Step 3 - Bitwise Operation

There should be only 6 groups (unordered pairs) that have result of fullfill.

	(0,1)	(0,2)	(0,3)	(0,4)	(1,2)	(2,4)
DEC i,j	0,7	0,2	0,8	0,3	7,2	2,3
Bin i	1010	1010	1010	1010	0111	0010
Bin j	0111	0010	1000	0011	0010	0011
Convert to DEC	2	2	8	2	2	2
Is Power of 2?	Yes (True)	TRUE	TRUE (2 <sup>3</sup> )	TRUE	TRUE	TRUE

### Step 4

Step 5 → Return 6

\* Since there are 6 groups of element can form the result that fullfill the requirement.

\* Loop to next test case and repeat from Step 1.



For the second Problem: Find all the pairs whose bit wise AND is a power of 2

## 2. Bitwise AND

Given an array of non-negative integers, count the number of unordered pairs of array elements such that their bitwise AND is a power of 2.

For example, let's say the array is  $arr = [10, 7, 2, 8, 3]$ , and let '&' denote the bitwise AND operator. There are 6 unordered pairs of its elements that have a bitwise AND that is a power of two:

- For indices (0,1),  $10 \& 7 = 2$ , which is a power of 2.
- For indices (0,2),  $10 \& 2 = 2$ , which is a power of 2.
- For indices (0,3),  $10 \& 8 = 8$ , which is a power of 2.
- For indices (0,4),  $10 \& 3 = 2$ , which is a power of 2.
- For indices (1,2),  $7 \& 2 = 2$ , which is a power of 2.
- For indices (2,4),  $2 \& 3 = 2$ , which is a power of 2.

Therefore, the answer is 6.

### Function Description

Complete the function `countPairs` in the editor below.

`countPairs` has the following parameter:

`int arr[n]`: an array of integers

Returns:

int: the number of unordered pairs of elements of `arr` such that their bitwise AND is a power of 2

### Constraints

- $1 \leq n \leq 2 \cdot 10^5$
- $0 \leq arr[i] < 2^{12}$

Returns:

int: the number of unordered pairs of elements of `arr` such that their bitwise AND is a power of 2

### Constraints

- $1 \leq n \leq 2 \cdot 10^5$
- $0 \leq arr[i] < 2^{12}$

### ▼ Input Format For Custom Testing

The first line contains an integer,  $n$ , denoting the number of elements in `arr`.  
Each line  $i$  of the  $n$  subsequent lines (where  $0 \leq i < n$ ) contains an integer describing `arr[i]`.

### ▼ Sample Case 0

#### Sample Input For Custom Testing

```
STDIN      Function
-----
4          => n = 4
1          => arr = [1, 2, 1, 3]
2
1
1
3
```

#### Sample Output

4

#### Explanation

All unordered pair of elements whose bitwise AND is a power of 2 are:

- For indices (0,2),  $1 \& 1 = 1$ , which is a power of 2.
- For indices (0,3),  $1 \& 3 = 1$ , which is a power of 2.
- For indices (1,3),  $2 \& 3 = 2$ , which is a power of 2.
- For indices (2,3),  $1 \& 3 = 1$ , which is a power of 2.

Therefore, the answer is 4.



### Sample Input For Custom Testing

STDIN	Function
4	=> n = 4
1	=> arr = [1, 2, 1, 3]
2	
1	
3	

### Sample Output

4

### Explanation

All unordered pair of elements whose bitwise AND is a power of 2 are:

- For indices (0,2), 1 & 1 = 1, which is a power of 2.
- For indices (0,3), 1 & 3 = 1, which is a power of 2.
- For indices (1,3), 2 & 3 = 2, which is a power of 2.
- For indices (2,3), 1 & 3 = 1, which is a power of 2.

Therefore, the answer is 4.

### Sample Case 1

### Sample Input For Custom Testing

3  
0  
2  
4

### Sample Output

0

### Explanation

There are no pairs of array elements such that their bitwise AND is a power of 2. Therefore, the answer is 0.