

## 477. Total Hamming Distance

The [Hamming distance](#) between two integers is the number of positions at which the corresponding bits are different.

Now your job is to find the total Hamming distance between all pairs of the given numbers.

### Example:

**Input:** 4, 14, 2

**Output:** 6

**Explanation:** In binary representation, the 4 is 0100, 14 is 1110, and 2 is 0010 (just showing the four bits relevant in this case). So the answer will be:  
 $\text{HammingDistance}(4, 14) + \text{HammingDistance}(4, 2) + \text{HammingDistance}(14, 2) = 2 + 2 + 2 = 6.$

### Note:

1. Elements of the given array are in the range of 0 to  $10^9$
2. Length of the array will not exceed  $10^4$ .

---

### Algorithm :

2. check LSB of all numbers every time
3. count no of elements with zero LSB and number of elements with 1 LSB, total hamming distance will be then product of these values
4. after this shift all numbers to right by 1 and repeat

---

### CODE:

```
int totalHammingDistance(vector<int>& nums) {
    int ans = 0;
    while(1){
        int ones = 0;
        bool allZero = true;
        for(int i=0;i<nums.size();i++){
            if(nums[i]) allZero = false;
            ones += (nums[i] & 1);
            nums[i] = nums[i] >> 1;
        }
        if(allZero) break;
        ans += ones*(nums.size() - ones);
    }
    return ans;
}
```