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Question

Given an integer array of size `n`, find all elements that appear more than `⌊ n/3 ⌋` times.

Example

Input: nums = [3,2,3]
Output: [3]

Example

Input: nums = [1]
Output: [1]

Example

Input: nums = [1,2]
Output: [1,2]

Definition

- `⌊ n/3 ⌋` times means → 2/3 = 0
- The floor of n divided by 3
- Floor of n over 3

First Code : 10 min

```
class Solution(object):
    def majorityElement(self, nums):
        flag = int(len(nums)/3)
        counter = {}
```

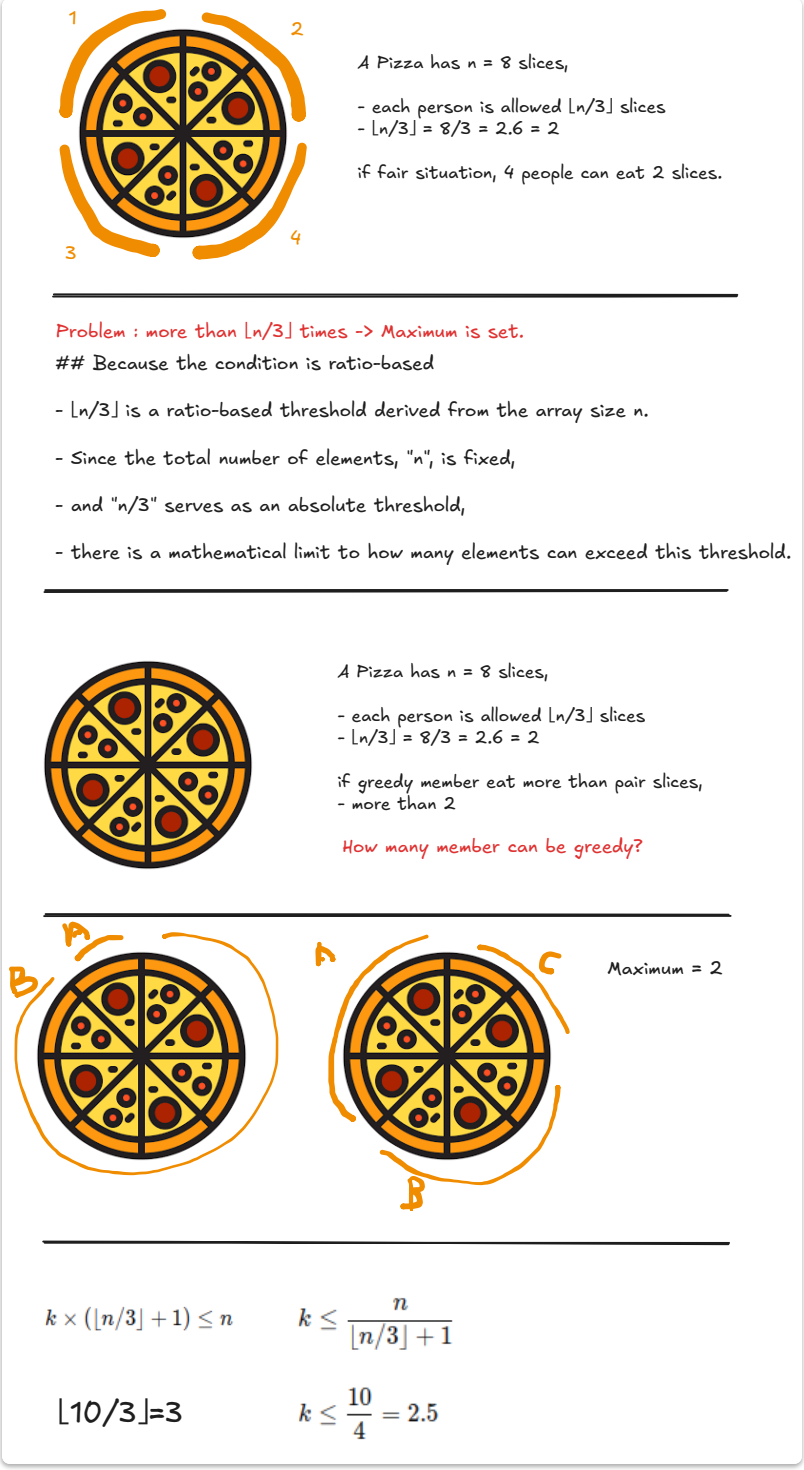
```
        arr = []
        for num in nums:
            if num in arr:
                continue
            if num in counter:
                counter[num] += 1
            else:
                counter[num] = 1
            if counter[num] > flag:
                arr.append(num)
        return arr
# O(n) / O(n) - Dict
```

Solution

```
class Solution:
    def majorityElement(self, nums: list[int]) -> list[int]:
        # Counters for the potential majority elements
        count1 = 0
        count2 = 0
        # Potential majority element candidates
        candidate1 = 0
        candidate2 = 0

        # First pass to find potential majority elements.
        for num in nums:
            # If count1 is 0 and the current number is not equal to
candidate2, update candidate1.
            if count1 == 0 and num != candidate2:
                count1 = 1
                candidate1 = num

            # If count2 is 0 and the current number is not equal to
candidate1, update candidate2.
            elif count2 == 0 and num != candidate1:
                count2 = 1
                candidate2 = num

            # Update counts for candidate1 and candidate2.
            elif candidate1 == num:
                count1 += 1
            elif candidate2 == num:
                count2 += 1

            # If the current number is different from both candidates,
```

```
decrement their counts.
            else:
                count1 -= 1
                count2 -= 1

        result = []
        threshold = len(nums) // 3  # Threshold for majority element

        # Second pass to count occurrences of the potential majority
elements.
        count1 = count2 = 0
        for num in nums:
            if candidate1 == num:
                count1 += 1
            elif candidate2 == num:
                count2 += 1

        # Check if the counts of potential majority elements are greater
than n/3 and add them to the result.
        if count1 > threshold:
            result.append(candidate1)
        if count2 > threshold:
            result.append(candidate2)

        return result
```

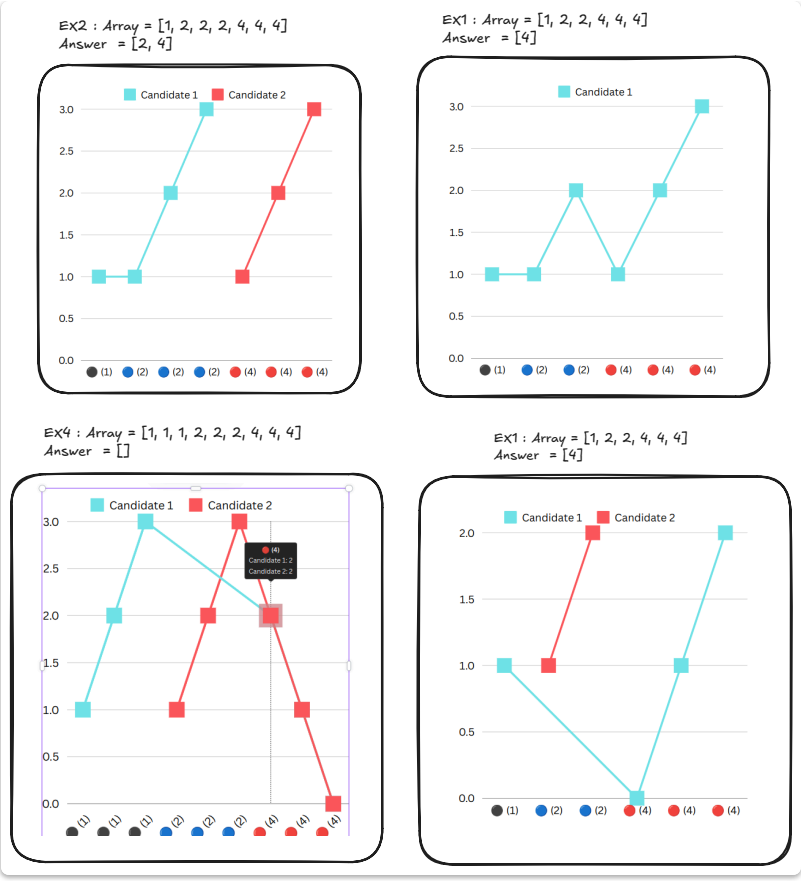
pigeonhole principle majority



📌 결론:

- **비둘기집 원리**를 확장해서, 배열 내 특정 기준 이상으로 등장할 수 있는 원소의 개수를 논리적으로 제한할 수 있습니다.
- **n/(k+1)**보다 많이 등장할 수 있는 원소는 **최대 k개**입니다.
- 이 논리를 기반으로 효율적인 알고리즘(예: Boyer-Moore Voting Algorithm 확장형)을 설계할 수 있습니다. 🚀

Boyer-Moore Majority Voting



📌 결론:

- Although both have a time complexity of O(n),
- Boyer-Moore is more efficient in terms of space complexity with O(1).
- The second pass might make it seem more complex, but in the end, it uses less memory compared to the hash map approach.