

## First Missing Positive

This problem is requiring  $O(n)$  time and  $O(1)$  extra space; we will use the index placement (cyclic sort / hashing in-place) approach.

### Key Insight:

The smallest missing positive must lie in range  $[1, \dots, n+1]$  where  $n = \text{nums.length}$ :

- If all numbers  $1 \dots n$  exist, answer is  $n+1$ .

- Otherwise, answer is the smallest missing in  $1 \dots n$ .

### Steps:

1. Place each number  $x$  in its correct index  $x-1$ :

- While  $1 \leq \text{nums}[i] \leq n$  and  $\text{nums}[i] \neq \text{nums}[\text{nums}[i]-1]$ :

- Swap  $\text{nums}[i]$  with  $\text{nums}[\text{nums}[i]-1]$ .

2. Find first missing positive;

- Iterate array; first index  $i$  where  $\text{nums}[i] \neq i+1 \rightarrow$  return  $i+1$ .

3. If all correct  $\rightarrow$  return  $n+1$ .

### Complexity:

- Time:  $O(n)$  (each number placed at most once).

- Space:  $O(1)$  (in place)