

## Permutation Sequence

For this problem the goal is to return the  $k$ -th lexicographical permutation of numbers  $[1 \dots n]$ .

### Key Idea: Factorial Number System:

Instead of generating all permutations ( $O(n!)$ ), we compute the  $k$ -th permutation directly using factorials.

### Steps:

1. Precompute factorials for numbers  $1 \dots n$ .
2. Create a list of numbers  $[1, 2, \dots, n]$ .
3. Convert  $k$  to 0-based index ( $k-1$ ).
4. For each position:
  - Determine which number to pick using  $\text{index} = k / \text{factorial}[n-1]$
  - Append number at index to result.
  - Remove that number from list.
  - Update  $k = k \% \text{factorial}[n-1]$
  - Decrease  $n$  and repeat.

### Complexity:

- Time:  $O(n^2)$  (due to erase from vector; negligible for  $n \leq 9$ )
- Space:  $O(n)$  for factorial and numbers list.