

# Daily Coding Problem #96

## Problem

This problem was asked by Microsoft.

Given a number in the form of a list of digits, return all possible permutations.

For example, given `[1,2,3]`, return `[[1,2,3],[1,3,2],[2,1,3],[2,3,1],[3,1,2],[3,2,1]]`.

## Solution

There are a few ways to do this, and most solutions will have the same run-time. We will need to generate all  $N!$  permutations, so our algorithm will have  $O(N!)$  run time.

The most straightforward method is to use recursion. We can think of the problem in terms of subproblems, where we can generate permutations of a sublist. A permutation of a single digit (e.g. `[1]`) would return simply the single digit. To get permutations of size  $n$ , we get all permutations of size  $n-1$  and add the next character within each position (index 0 to  $n$ ). For example, one permutation of the sublist `[2,3]` is `[2,3]`. We add 1 to three positions to obtain `[1,2,3]`, `[2,1,3]`, and `[2,3,1]`.

```
def permute(nums):
    if (len(nums) == 1):
        return [nums]

    output = []
    for l in permute(nums[1:]):
        for idx in range(len(nums)):
            output.append(l[:idx] + [nums[0]] + l[idx:])
    return output
```

`return output`

An alternative way we can formulate the recursion is by generating all permutations of length  $n-1$ , but with all digits allowed. The permutations of size 1 would return the input array (e.g. `[[1],[2],[3]]`). Then, we append the  $n$ th digit to the front of the permutations.

```
def permute(nums):
    def helper(nums, index, output):
        if index == len(nums) - 1:
            output.append(nums.copy())
        for i in range(index, len(nums)):
            nums[index], nums[i] = nums[i], nums[index]
            helper(nums, index + 1, output)
            nums[index], nums[i] = nums[i], nums[index]

    output = []
    helper(nums, 0, output)
    return output
```

Both solutions run in  $O(N!)$  time and space, where  $N$  is the size of the input list.

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