Date : 13th May
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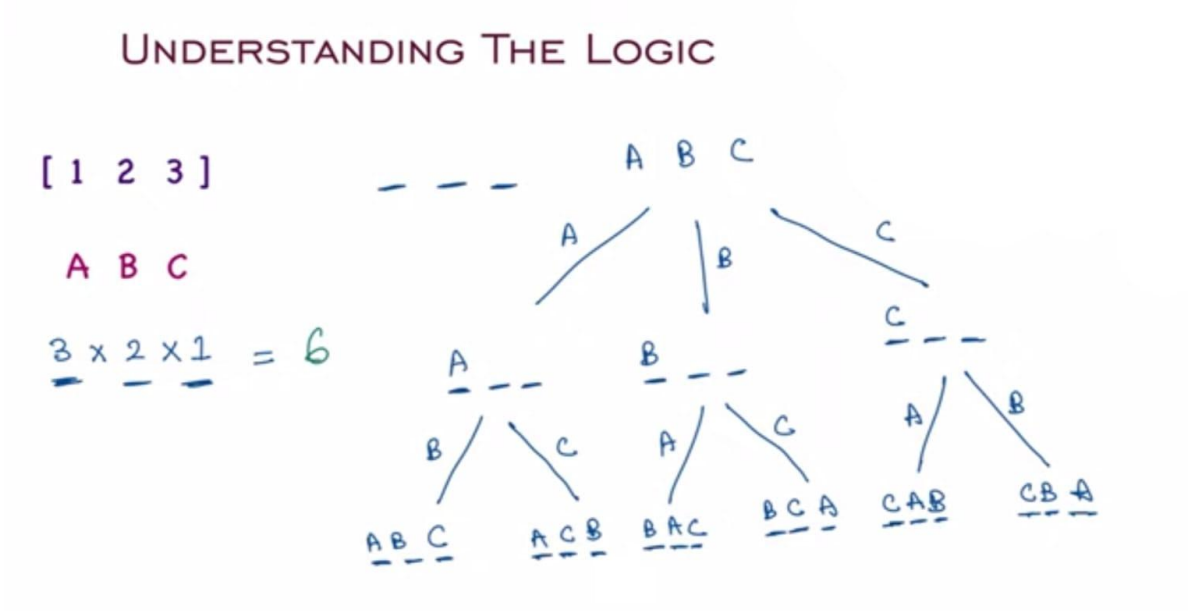
Topic : Backtracking

Q1. Given an array nums of distinct integers, return all the possible permutations. You can return the answer in any order.

Problem Link : https://leetcode.com/problems/permutations/

Approach :

- We use backtracking to generate all permutations
  backtrack function generates all permutations starting from index first
- In each recursive call, we place the i-th integer first in the permutation and use the next integers to complete the permutation
- Finally, we backtrack to get the next permutation
- We keep track of all permutations in the output list and return it in the end



Solution :

```
class Solution {
    public void backtrack(List<List<Integer>> result ,
List<Integer> temp ,int[] nums){
        if(temp.size()==nums.length){
            result.add(new ArrayList<>(temp));
            return;
        }
        for(int i=0 ; i<nums.length ; i++){
            if(temp.contains(nums[i]))
                continue;
            temp.add(nums[i]);
            backtrack(result,temp,nums);
            temp.remove(temp.size()-1);
        }
    }
    public List<List<Integer>> permute(int[] nums) {
        List<List<Integer>> result = new ArrayList<>();
        backtrack(result,new ArrayList<Integer>(),nums);
        return result;
    }

}
```

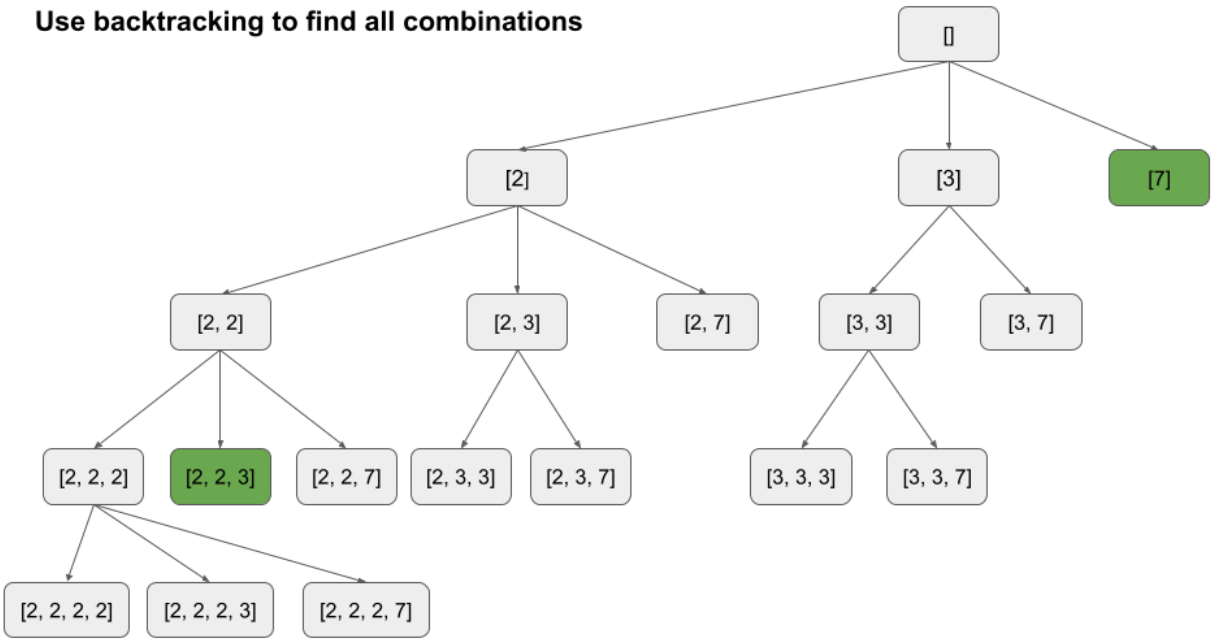
Q2. Given an array of distinct integers candidates and a target integer target, return a list of all unique combinations of candidates where the chosen numbers sum to target. You may return the combinations in any order.

Problem Link : https://leetcode.com/problems/combination-sum/

Approach :

- Initially, the index will be 0, target as given and the list will be empty.
- Now there are 2 options viz to pick or not pick the current index element.
- If you pick the element, again come back at the same index as multiple occurrences of the same element is possible so the target reduces to target – arr[index] (where target -arr[index]>=0) .
- If you decide not to pick the current element, move on to the next index and the target value stays as it is.
- While backtracking makes sure to remove the last element.
- Keep on repeating this process while index < size of the array for a particular recursion call.
- When the target value becomes 0 , you have found a valid combination. Add it to your result list.
- If the target < 0 , that means your combination sum has exceeded the target, and the combination is invalid , so you return.

Example :
Input: candidates = [2,3,6,7], target = 7
Output: [[2,2,3],[7]]
Explanation:
2 and 3 are candidates, and 2 + 2 + 3 = 7. Note that 2 can be used multiple times.
7 is a candidate, and 7 = 7.
These are the only two combinations.



Solution :

```
class Solution {
    public void backtrack(List<List<Integer>> result,List<Integer> temp ,int[]
candidates , int target , int start){
        if(target < 0)
            return;
        else if(target==0){
            result.add(new ArrayList<>(temp));
        }
        for(int i=start ; i<candidates.length ; i++){
            temp.add(candidates[i]);
            backtrack(result,temp,candidates,target-candidates[i],i);
            temp.remove(temp.size()-1);
        }


    }
    public List<List<Integer>> combinationSum(int[] candidates, int target){
        List<List<Integer>> result = new ArrayList<>();
        backtrack(result,new ArrayList<Integer>(),candidates ,target ,0);
        return result;
    }
}
```