

DOMAIN WINTER WINNING CAMP

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Day 9 : BackTracking

Very Easy:

1. Generate Numbers with a Given Sum

Generate all numbers of length n whose digits sum up to a target value sum , The digits of the number will be between 0 and 9, and we will generate combinations of digits such that their sum equals the target.

Example 1:

Input: $n = 2$ and $sum = 5$

Output: 14 23 32 41 50

Example 2:

Input: $n = 3$ and $sum = 5$

Output: 104 113 122 131 140 203 212 221 230 302 311 320 401 410 500

Constraints:

$1 \leq n \leq 9$: The number of digits must be between 1 and 9.

$1 \leq sum \leq 100$: The sum of the digits must be between 1 and 100.

The first digit cannot be zero if $n > 1$.

CODE:

```
#include <iostream> #include <vector> using namespace std; void
generateNumbers(int n, int sum, string current, vector<string> &result) {
if (n == 0 && sum == 0) {      result.push_back(current);
return;
}    if (n == 0 || sum < 0) return;
int start = current.empty() ? 1 : 0;
```

```
for (int i = start; i <= 9; ++i) {    generateNumbers(n - 1, sum -
i, current + to_string(i), result);    } }
```

```
int main() {    int n = 2, sum = 5;
vector<string> result;
generateNumbers(n, sum, "", result);    for
(const string &num : result) {        cout
<< num << " ";
    }
return 0;
}
```

Output

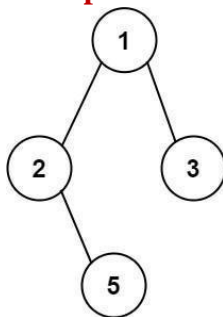
14 23 32 41 50

Easy:

2. Binary Tree Paths

Given the root of a binary tree, return all root-to-leaf paths in any order. A leaf is a node with no children.

Example 1:



Input: root = [1,2,3,null,5] **Output:** ["1->2->5", "1->3"] **Example**

2:

Input: root = [1] **Output:** ["1"]

Constraints:

The number of nodes in the tree is in the range [1, 100]. -100

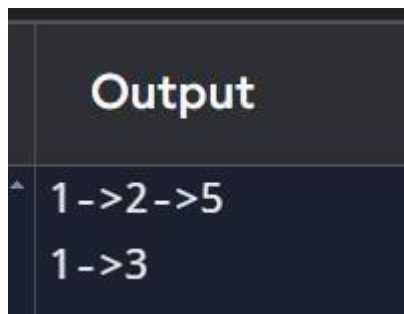
<= Node.val <= 100 CODE:

```
#include <iostream>
#include <vector>
#include <string> using
namespace std; struct
TreeNode {
    int val;
    TreeNode *left, *right;
    TreeNode(int x) : val(x), left(nullptr), right(nullptr) {}
};

void dfs(TreeNode *root, string path, vector<string> &paths) {
    if (!root) return;    path += to_string(root->val);    if (!root-
>left && !root->right) {
        paths.push_back(path);
        return;
    }
    path += "->";    dfs(root->left,
path, paths);    dfs(root-
>right, path, paths);
}

vector<string> binaryTreePaths(TreeNode *root) {
    vector<string> paths;
    dfs(root, "", paths);    return
paths; } int main() {
    TreeNode *root = new TreeNode(1);    root-
>left = new TreeNode(2);    root->right
= new TreeNode(3);
    root->left->right = new TreeNode(5);

    vector<string> result = binaryTreePaths(root);
    for (const string &path : result) {
        cout << path << endl;
    }
    return 0;
}
```



Medium:

3. Combinations

Given two integers n and k , return all possible combinations of k numbers chosen from the range $[1, n]$.

You may return the answer in any order.

Example 1:

Input: $n = 4, k = 2$

Output: $[[1,2],[1,3],[1,4],[2,3],[2,4],[3,4]]$

Explanation: There are 4 choose 2 = 6 total combinations.

Note that combinations are unordered, i.e., $[1,2]$ and $[2,1]$ are considered to be the same combination. **Example 2:**

Input: $n = 1, k = 1$

Output: $[[1]]$

Explanation: There is 1 choose 1 = 1 total combination.

Constraints:

$1 \leq n \leq 20$

$1 \leq k \leq n$ **CODE:**

```
#include <iostream> #include <vector> using namespace std; void combineHelper(int
start, int n, int k, vector<int> &current, vector<vector<int>> &result) {    if (k == 0)
{        result.push_back(current);        return;
}
    for (int i = start; i <= n; ++i) {
        current.push_back(i);
```

```
        combineHelper(i + 1, n, k - 1, current, result);  
current.pop_back();  
    } }
```

```
vector<vector<int>> combine(int n, int k) {  
    vector<vector<int>> result;    vector<int>  
current;    combineHelper(1, n, k, current, result);  
    return result; }
```

```
int main() {
```

```
    int n = 4, k = 2;
```

```
        vector<vector<int>> result = combine(n, k);  
for (const auto &comb : result) {  
    cout << "[";    for (int num : comb)  
cout << num << " ";    cout << "]" <<  
endl;  
    }  
return 0; }
```

Output

```
[1 2 ]
```

```
[1 3 ]
```

```
[1 4 ]
```

```
[2 3 ]
```

```
[2 4 ]
```

```
[3 4 ]
```

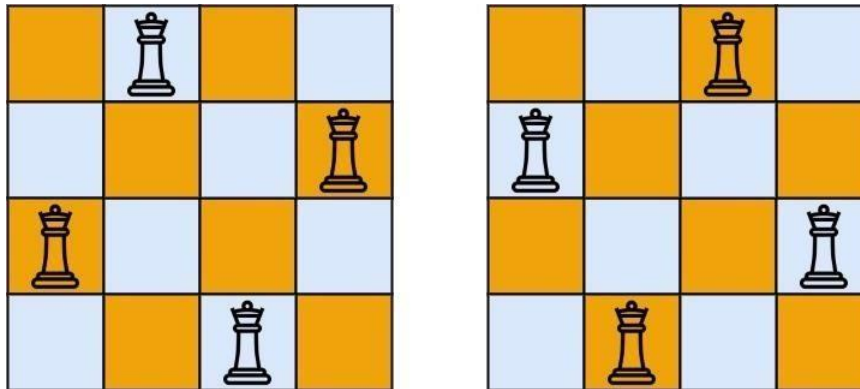
Hard:

4. N-Queens II

The n-queens puzzle is the problem of placing n queens on an n x n chessboard such that no two queens attack each other.

Given an integer n, return the number of distinct solutions to the n-queens puzzle.

Example 1:



Input: $n = 4$

Output: 2

Explanation: There are two distinct solutions to the 4-queens puzzle as shown.

Example 2:

Input: $n = 1$

Output: 1

Constraints: 1

$1 \leq n \leq 9$

CODE:

```
#include <iostream> #include <vector> using namespace std; void solve(int
row, int n, vector<int> &cols, vector<int> &diags1, vector<int>
&diags2, int &count) {    if
(row == n) {
++count;        return;
    }    for (int col = 0; col < n; ++col) {        if (cols[col] || diags1[row -
col + n - 1] || diags2[row + col]) continue;
cols[col] = diags1[row - col + n - 1] = diags2[row + col] = 1;        solve(row
+ 1, n, cols, diags1, diags2, count);        cols[col] = diags1[row -
col + n - 1] = diags2[row + col] = 0;
    } } int
totalNQueens(int n) {
    vector<int> cols(n, 0), diags1(2 * n - 1, 0), diags2(2 * n - 1, 0);
int count = 0;
    solve(0, n, cols, diags1, diags2, count);
```

```
return count;
} int

main() {

int n = 4;
    cout << "Number of solutions for " << n << "-Queens: " << totalNQueens(n) <<
endl;    return 0; }
```

Output

Clear

Number of solutions for 4-Queens: 2

Very Hard:

5. Word Ladder II

A transformation sequence from word `beginWord` to word `endWord` using a dictionary `wordList` is a sequence of words `beginWord` -> `s1` -> `s2` -> ... -> `sk` such that:

Every adjacent pair of words differs by a single letter.

Every `si` for $1 \leq i \leq k$ is in `wordList`. Note that `beginWord` does not need to be in `wordList`. `sk == endWord`

Given two words, `beginWord` and `endWord`, and a dictionary `wordList`, return all the shortest transformation sequences from `beginWord` to `endWord`, or an empty list if no such sequence exists. Each sequence should be returned as a list of the words `[beginWord, s1, s2, ..., sk]`.

Example 1:

Input: `beginWord = "hit", endWord = "cog", wordList =`

`["hot","dot","dog","lot","log","cog"]`

Output: `[["hit","hot","dot","dog","cog"],["hit","hot","lot","log","cog"]]`

Explanation: There are 2 shortest transformation sequences:

`"hit" -> "hot" -> "dot" -> "dog" -> "cog"` `"hit"`

`-> "hot" -> "lot" -> "log" -> "cog"`

Example 2:

Input: `beginWord = "hit", endWord = "cog", wordList =`

`["hot","dot","dog","lot","log"]`

Output: []

Explanation: The endWord "cog" is not in wordList, therefore there is no valid transformation sequence.

Constraints:

1 <= beginWord.length <= 5 endWord.length == beginWord.length 1 <= wordList.length <= 500 wordList[i].length == beginWord.length beginWord, endWord, and wordList[i] consist of lowercase English letters.

beginWord != endWord

All the words in wordList are unique.

The sum of all shortest transformation sequences does not exceed 105.

CODE:

```
#include <iostream>
#include <vector>
#include <unordered_set> #include <queue> using namespace std;
vector<vector<string>> findLadders(string beginWord, string
endWord,
vector<string> &wordList) {
    unordered_set<string> dict(wordList.begin(), wordList.end());
    vector<vector<string>> result;
    if (dict.find(endWord) == dict.end()) return result;

    queue<vector<string>> paths;
    paths.push({beginWord});    int level =
1, minLevel = INT_MAX;
    unordered_set<string> visited;
    while (!paths.empty()) {
        vector<string> path = paths.front();
        paths.pop();    if (path.size() > level) {        for
(const string &word : visited) dict.erase(word);
        visited.clear();        level = path.size();
        if (level > minLevel) break;
    }

    string last = path.back();    for
(int i = 0; i < last.size(); ++i) {
        string next = last;
        for (char c = 'a'; c <= 'z'; ++c) {
            next[i] = c;
```



```
        if (!dict.count(next)) continue;
visited.insert(next);
vector<string> newPath = path;
newPath.push_back(next);          if (next
== endWord) {
result.push_back(newPath);

        minLevel = level;
    } else {
paths.push(newPath);
    }
}
} }
return result;
} int

main() {

    string beginWord = "hit", endWord = "cog";    vector<string>
wordList = {"hot", "dot", "dog", "lot", "log", "cog"};
vector<vector<string>> result = findLadders(beginWord, endWord, wordList);
for (const auto &path : result) {    for (const string &word : path) {        cout
<< word << " ";
    }
    cout << endl;
}
return 0;
}
```

COMPUTER SCIENCE & ENGINEERING

Output

```
hit hot dot dog cog  
hit hot lot log cog
```