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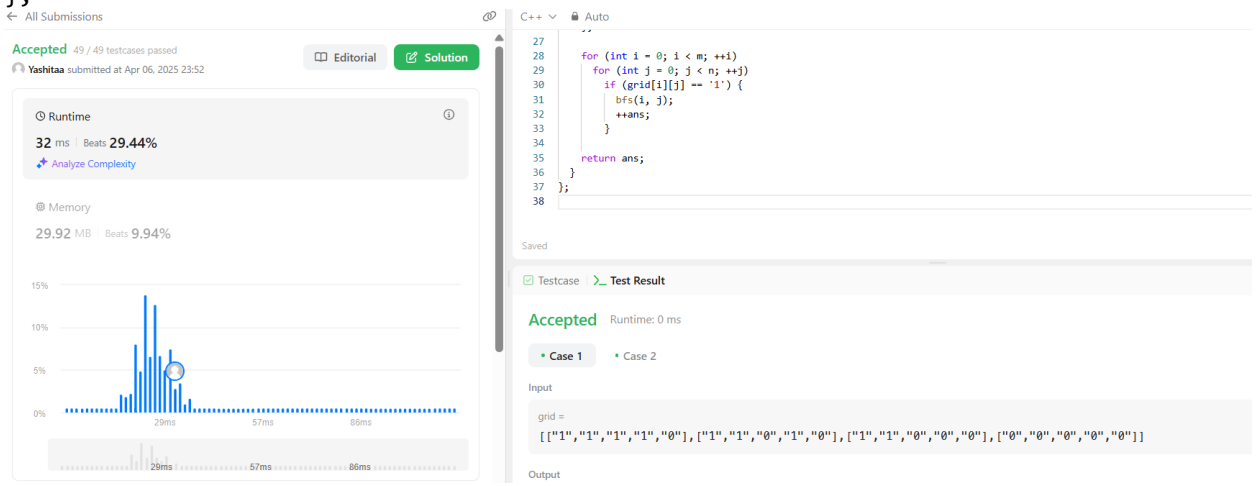
Ap experiment 9

1. Number of Islands

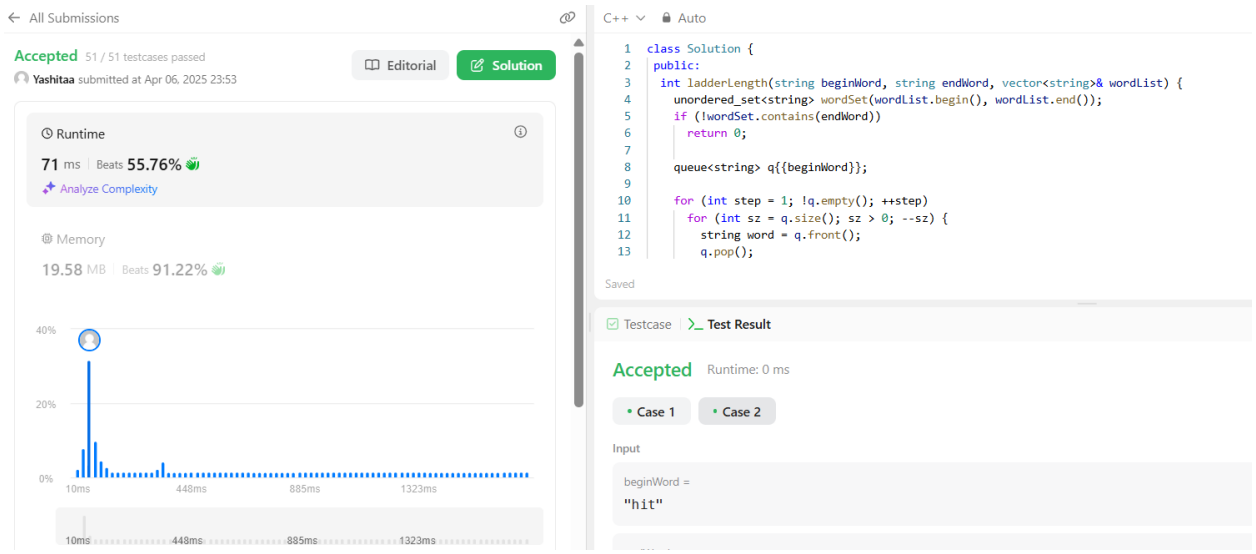
```
class Solution {
 public:
  int numIslands(vector<vector<char>>& grid) {
    constexpr int kDirs[4][2] = {{0, 1}, {1, 0}, {0, -1}, {-1, 0}};
    const int m = grid.size();
    const int n = grid[0].size();
    int ans = 0;

    auto bfs = [&](int r, int c) {
      queue<pair<int, int>> q{{{r, c}}};
      grid[r][c] = '2';
      while (!q.empty()) {
        const auto [i, j] = q.front();
        q.pop();
        for (const auto& [dx, dy] : kDirs) {
          const int x = i + dx;
          const int y = j + dy;
          if (x < 0 || x == m || y < 0 || y == n)
            continue;
          if (grid[x][y] != '1')
            continue;
          q.emplace(x, y);
          grid[x][y] = '2';
        }
      }
    };

    for (int i = 0; i < m; ++i)
      for (int j = 0; j < n; ++j)
        if (grid[i][j] == '1') {
          bfs(i, j);
          ++ans;
        }

    return ans;
  }
```

};



2. [Word Ladder]

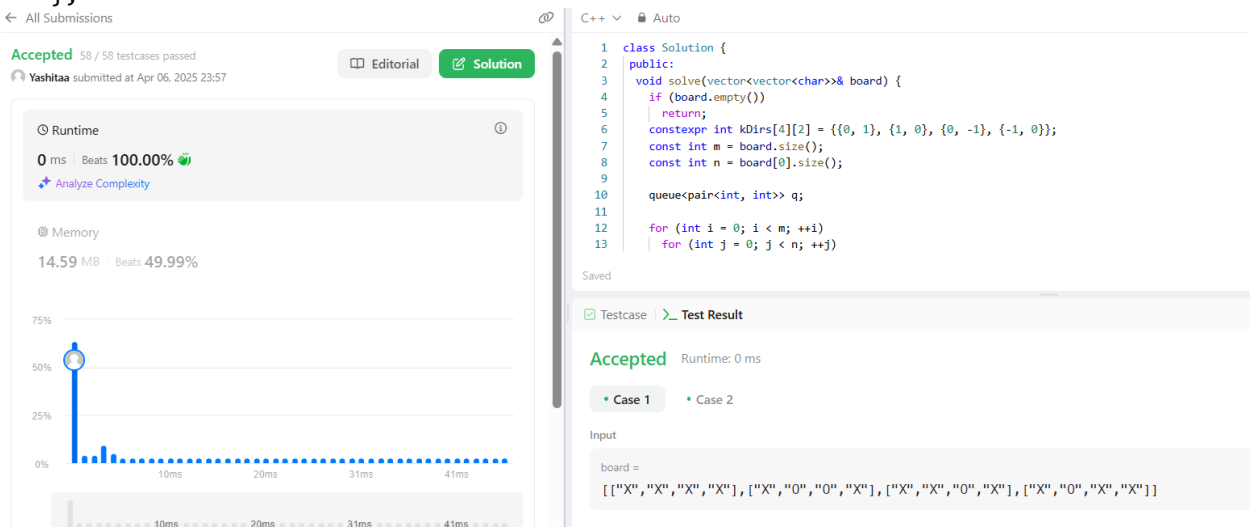
```
class Solution {
 public:
  int ladderLength(string beginWord, string endWord, vector<string>& wordList) {
    unordered_set<string> wordSet(wordList.begin(), wordList.end());
    if (!wordSet.contains(endWord))
      return 0;

    queue<string> q{{beginWord}};

    for (int step = 1; !q.empty(); ++step)
      for (int sz = q.size(); sz > 0; --sz) {
        string word = q.front();
        q.pop();
        for (int i = 0; i < word.length(); ++i) {
          const char cache = word[i];
          for (char c = 'a'; c <= 'z'; ++c) {
            word[i] = c;
            if (word == endWord)
              return step + 1;
            if (wordSet.contains(word)) {
              q.push(word);
              wordSet.erase(word);
            }
          }
          word[i] = cache;
        }
      }

    return 0;
  }
};
```



3. Surrounded Regions

```
class Solution {
 public:
  void solve(vector<vector<char>>& board) {
    if (board.empty())
      return;
    constexpr int kDirs[4][2] = {{0, 1}, {1, 0}, {0, -1}, {-1, 0}};
    const int m = board.size();
    const int n = board[0].size();

    queue<pair<int, int>> q;

    for (int i = 0; i < m; ++i)
      for (int j = 0; j < n; ++j)
        if (i * j == 0 || i == m - 1 || j == n - 1)
          if (board[i][j] == 'O') {
            q.emplace(i, j);
            board[i][j] = '*';
          }
    while (!q.empty()) {
      const auto [i, j] = q.front();
      q.pop();
      for (const auto& [dx, dy] : kDirs) {
        const int x = i + dx;
        const int y = j + dy;
        if (x < 0 || x == m || y < 0 || y == n)
          continue;
        if (board[x][y] != 'O')
          continue;
```

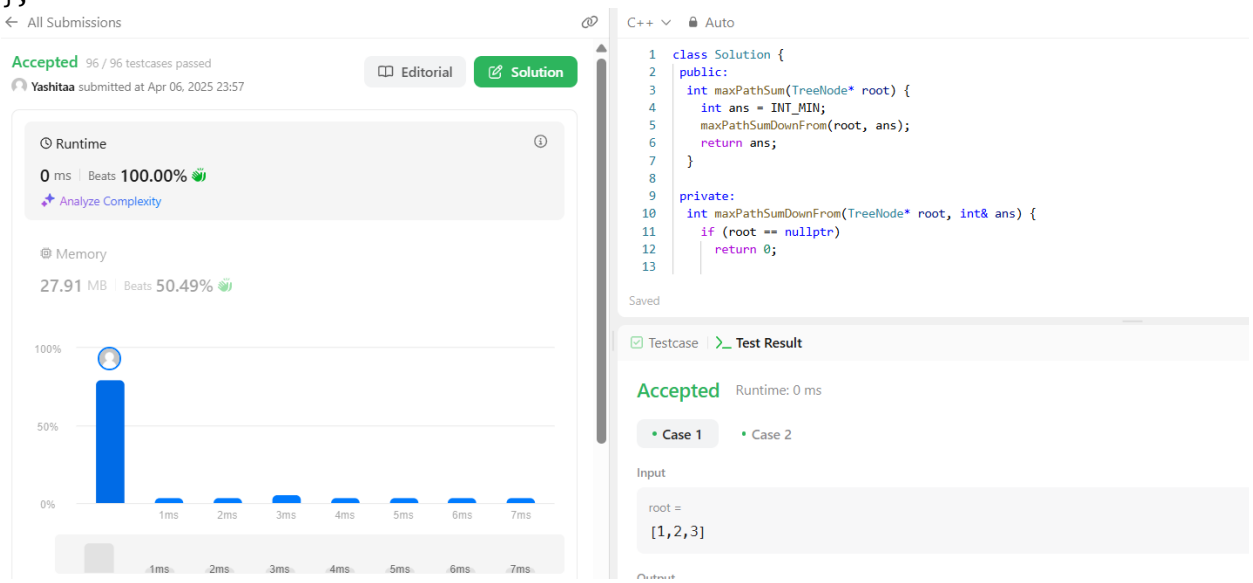
```
        q.emplace(x, y);
        board[x][y] = '*';
      }
    }

    for (vector<char>& row : board)
      for (char& c : row)
        if (c == '*')
          c = 'O';
        else if (c == 'O')
          c = 'X';
  }
};
```



4. [Binary Tree Maximum Path Sum]

```
class Solution {
 public:
  int maxPathSum(TreeNode* root) {
    int ans = INT_MIN;
    maxPathSumDownFrom(root, ans);
    return ans;
  }

 private:
  int maxPathSumDownFrom(TreeNode* root, int& ans) {
    if (root == nullptr)
      return 0;

    const int l = max(0, maxPathSumDownFrom(root->left, ans));
    const int r = max(0, maxPathSumDownFrom(root->right, ans));
    ans = max(ans, root->val + l + r);
    return root->val + max(l, r);
```

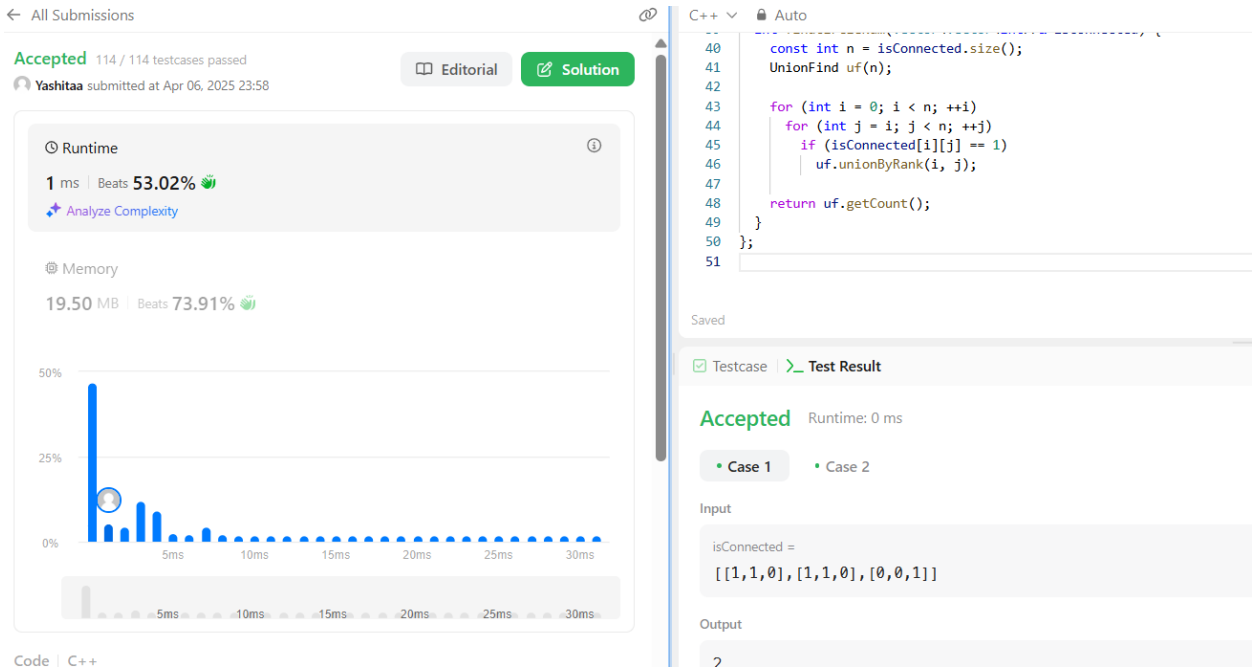
```
    }
};
```



5. [Number of Provinces]

```
class UnionFind {
 public:
 UnionFind(int n) : count(n), id(n), rank(n) {
  iota(id.begin(), id.end(), 0);
 }

 void unionByRank(int u, int v) {
  const int i = find(u);
  const int j = find(v);
  if (i == j)
   return;
  if (rank[i] < rank[j]) {
   id[i] = j;
  } else if (rank[i] > rank[j]) {
   id[j] = i;
  } else {
   id[i] = j;
   ++rank[j];
  }
  --count;
 }

 int getCount() const {
  return count;
 }

private:
 int count;
 vector<int> id;
 vector<int> rank;
```

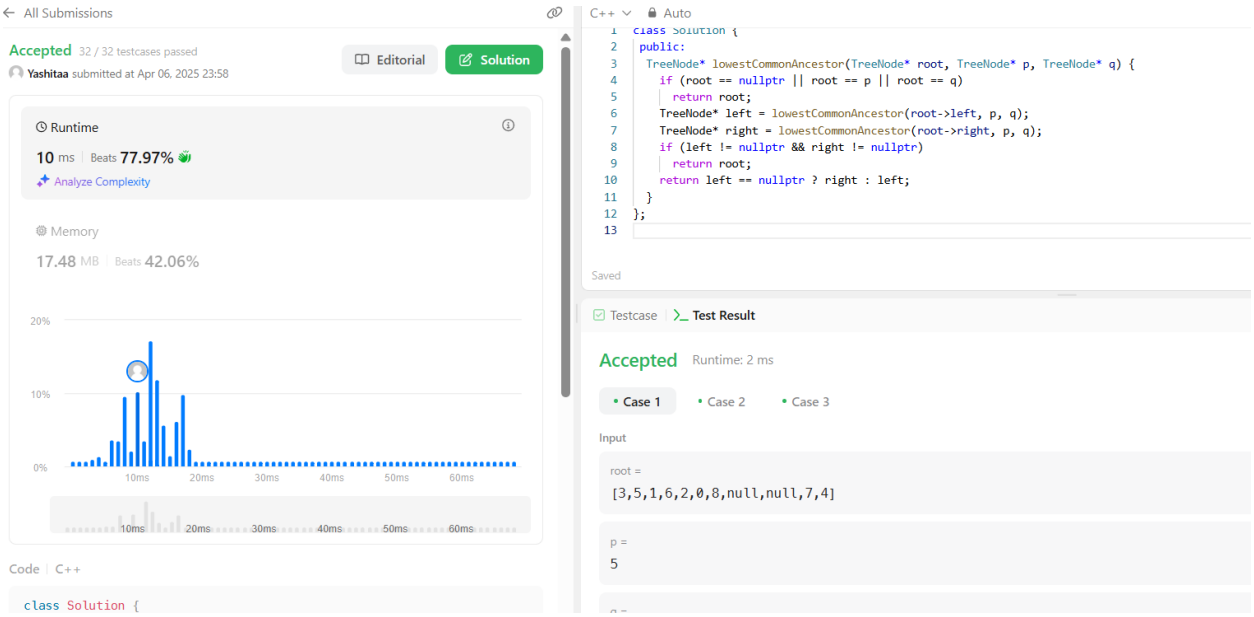
```
  int find(int u) {
    return id[u] == u ? u : id[u] = find(id[u]);
  }
};

class Solution {
 public:
  int findCircleNum(vector<vector<int>>& isConnected) {
    const int n = isConnected.size();
    UnionFind uf(n);

    for (int i = 0; i < n; ++i)
      for (int j = i; j < n; ++j)
        if (isConnected[i][j] == 1)
          uf.unionByRank(i, j);

    return uf.getCount();
  }
};
```



6. [Lowest Common Ancestor of a Binary Tree]

```
class Solution {

 public:

  TreeNode* lowestCommonAncestor(TreeNode* root, TreeNode* p, TreeNode* q) {

    if (root == nullptr || root == p || root == q)
```

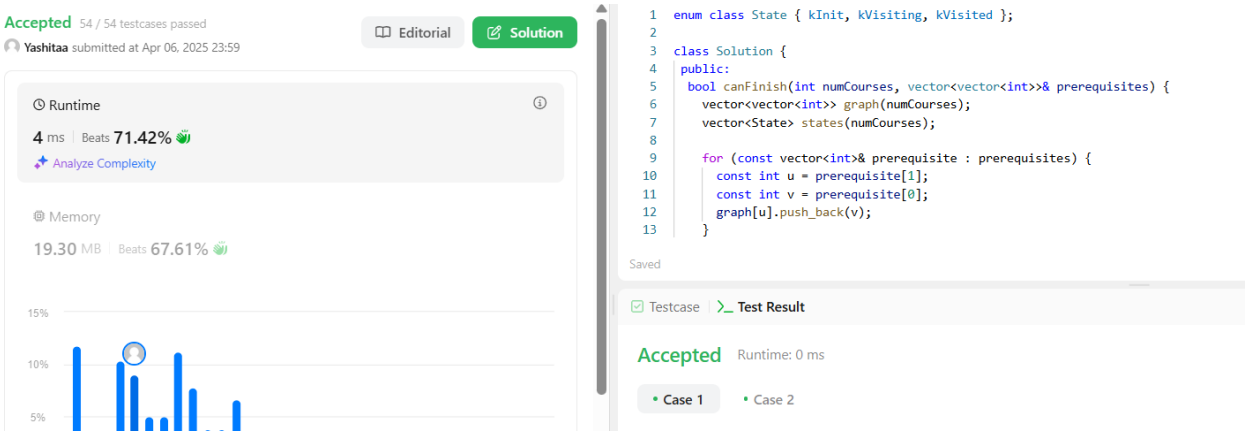
```
    return root;
  TreeNode* left = lowestCommonAncestor(root->left, p, q);
  TreeNode* right = lowestCommonAncestor(root->right, p, q);
  if (left != nullptr && right != nullptr)
    return root;
  return left == nullptr ? right : left;
 }
};
```



7. Course Schedule

```
enum class State { kInit, kVisiting, kVisited };

class Solution {
 public:
  bool canFinish(int numCourses, vector<vector<int>>& prerequisites) {
    vector<vector<int>> graph(numCourses);
    vector<State> states(numCourses);

    for (const vector<int>& prerequisite : prerequisites) {
      const int u = prerequisite[1];
      const int v = prerequisite[0];
      graph[u].push_back(v);
    }
```

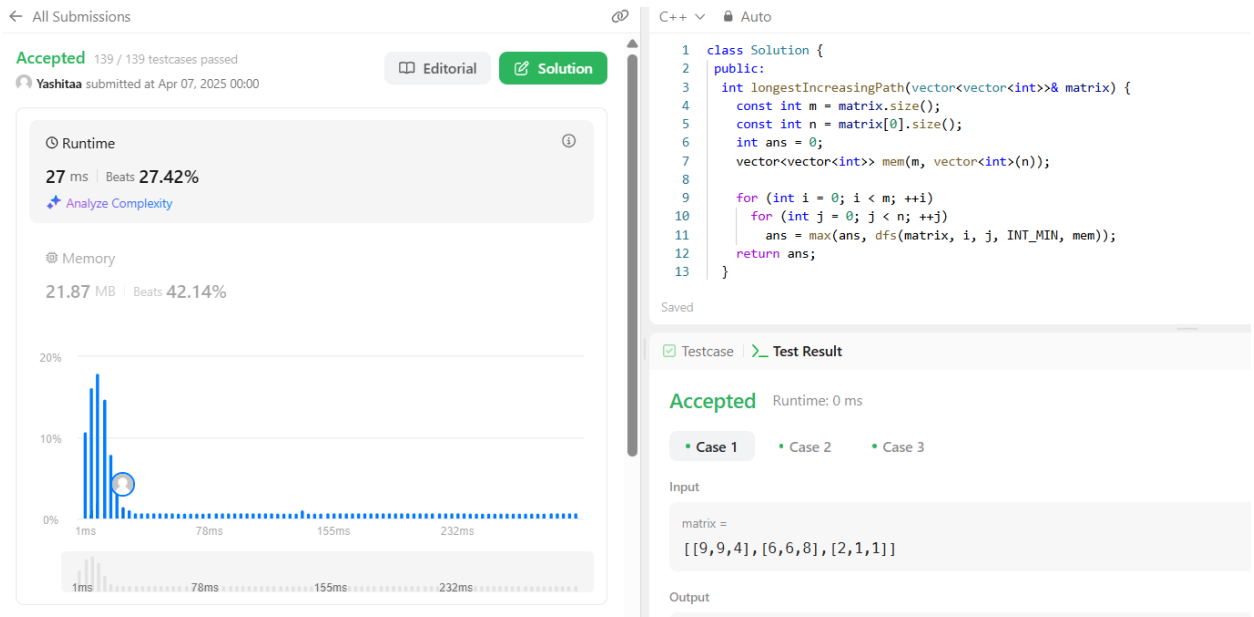
```
  for (int i = 0; i < numCourses; ++i)
    if (hasCycle(graph, i, states))
      return false;

  return true;
 }

private:
 bool hasCycle(const vector<vector<int>>& graph, int u,
               vector<State>& states) {
  if (states[u] == State::kVisiting)
    return true;
  if (states[u] == State::kVisited)
    return false;
  states[u] = State::kVisiting;
  for (const int v : graph[u])
    if (hasCycle(graph, v, states))
      return true;
  states[u] = State::kVisited;
  return false;
 }
};
```



8. [Longest Increasing Path in a Matrix]

```
class Solution {
 public:
  int longestIncreasingPath(vector<vector<int>>& matrix) {
    const int m = matrix.size();
    const int n = matrix[0].size();
    int ans = 0;
    vector<vector<int>> mem(m, vector<int>(n));

    for (int i = 0; i < m; ++i)
      for (int j = 0; j < n; ++j)
```

```
        ans = max(ans, dfs(matrix, i, j, INT_MIN, mem));
    return ans;
  }
 private:
  int dfs(const vector<vector<int>>& matrix, int i, int j, int prev,
          vector<vector<int>>& mem) {
    if (i < 0 || i == matrix.size() || j < 0 || j == matrix[0].size())
      return 0;
    if (matrix[i][j] <= prev)
      return 0;
    int& ans = mem[i][j];
    if (ans > 0)
      return ans;

    const int curr = matrix[i][j];
    return ans = 1 + max({dfs(matrix, i + 1, j, curr, mem),
                          dfs(matrix, i - 1, j, curr, mem),
                          dfs(matrix, i, j + 1, curr, mem),
                          dfs(matrix, i, j - 1, curr, mem)});
  }
};
```



9. Course Schedule II

```
enum class State { kInit, kVisiting, kVisited };

class Solution {
 public:
  vector<int> findOrder(int numCourses, vector<vector<int>>& prerequisites) {
    vector<int> ans;
```

```
  vector<vector<int>> graph(numCourses);
  vector<State> states(numCourses);

  for (const vector<int>& prerequisite : prerequisites) {
    const int u = prerequisite[1];
    const int v = prerequisite[0];
    graph[u].push_back(v);
  }

  for (int i = 0; i < numCourses; ++i)
    if (hasCycle(graph, i, states, ans))
      return {};

  ranges::reverse(ans);
  return ans;
 }

private:
 bool hasCycle(const vector<vector<int>>& graph, int u, vector<State>& states,
               vector<int>& ans) {
  if (states[u] == State::kVisiting)
    return true;
  if (states[u] == State::kVisited)
    return false;
  states[u] = State::kVisiting;
  for (const int v : graph[u])
    if (hasCycle(graph, v, states, ans))
      return true;
  states[u] = State::kVisited;
  ans.push_back(u);
  return false;
 }
};
```