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COURSE CODE: CSA0386

SUB.NAME: DESIGN AND ANALYSIS OF ALGORITHM

1. You are a professional robber planning to rob houses along a street. Each house has a certain amount of money stashed. All houses at this place are arranged in a circle. That means the first house is the neighbour of the last one. Meanwhile, adjacent houses have security systems connected, and it will automatically contact the police if two adjacent houses were broken into on the same night.

Examples: (i) Input: nums = [2, 3, 2] Output: The maximum money you can rob without alerting the police is 3 (robbing house 1). (ii) Input: nums = [1, 2, 3, 1] Output: The maximum money you can rob without alerting the police is 4 (robbing house 1 and house 3)

main.py	Output
<pre>1 def rob(nums): 2 if len(nums) == 1: 3 return nums[0] 4 5 def rob_linear(houses): 6 prev = curr = 0 7 for amount in houses: 8 prev, curr = curr, max(curr, prev + amount) 9 return curr 10 11 return max(rob_linear(nums[:-1]), rob_linear(nums[1:])) 12 13 nums1 = [2, 3, 2] 14 print("Example 1:", rob(nums1)) 15 16 nums2 = [1, 2, 3, 1] 17 print("Example 2:", rob(nums2)) 18</pre>	<pre>Example 1: 3 Example 2: 4 === Code Execution Successful ===</pre>

2. You are climbing a staircase. It takes n steps to reach the top. Each time you can either climb 1 or 2 steps. In how many distinct ways can you climb to the top? Examples: (i) Input: n=4 Output: 5

ain.py	Run	Output
<pre> def climbStairs(n): if n == 1: return 1 if n == 2: return 2 prev2, prev1 = 1, 2 for i in range(3, n + 1): current = prev1 + prev2 prev2, prev1 = prev1, current return prev1 n = 4 print("Example Output:", climbStairs(n)) </pre>		<p>Example Output: 5</p> <p>=== Code Execution Successful ===</p>

3. A robot is located at the top-left corner of a $m \times n$ grid. The robot can only move either down or right at any point in time. The robot is trying to reach the bottom-right corner of the grid. How many possible unique paths are there?

Examples: (i) Input: $m=7, n=3$ Output: 28 (ii) Input: $m=3, n=2$ Output: 3

main.py	Run	Output
<pre> def uniquePaths(m, n): dp = [[1]*n for _ in range(m)] for i in range(1, m): for j in range(1, n): dp[i][j] = dp[i-1][j] + dp[i][j-1] return dp[-1][-1] m1, n1 = 7, 3 print("Example 1:", uniquePaths(m1, n1)) m2, n2 = 3, 2 print("Example 2:", uniquePaths(m2, n2)) </pre>		<p>Example 1: 28</p> <p>Example 2: 3</p> <p>=== Code Execution Successful ===</p>

4. In a string S of lowercase letters, these letters form consecutive groups of the same character. For example, a string like $s =$

"abbxxxxzy" has the groups "a", "bb", "xxxx", "z", and "yy". A group is identified by an interval [start, end], where start and end denote the start and end indices (inclusive) of the group. In the above example, "xxxx" has the interval [3,6]. A group is considered large if it has 3 or more characters. Return the intervals of every large group sorted in increasing order by start index.

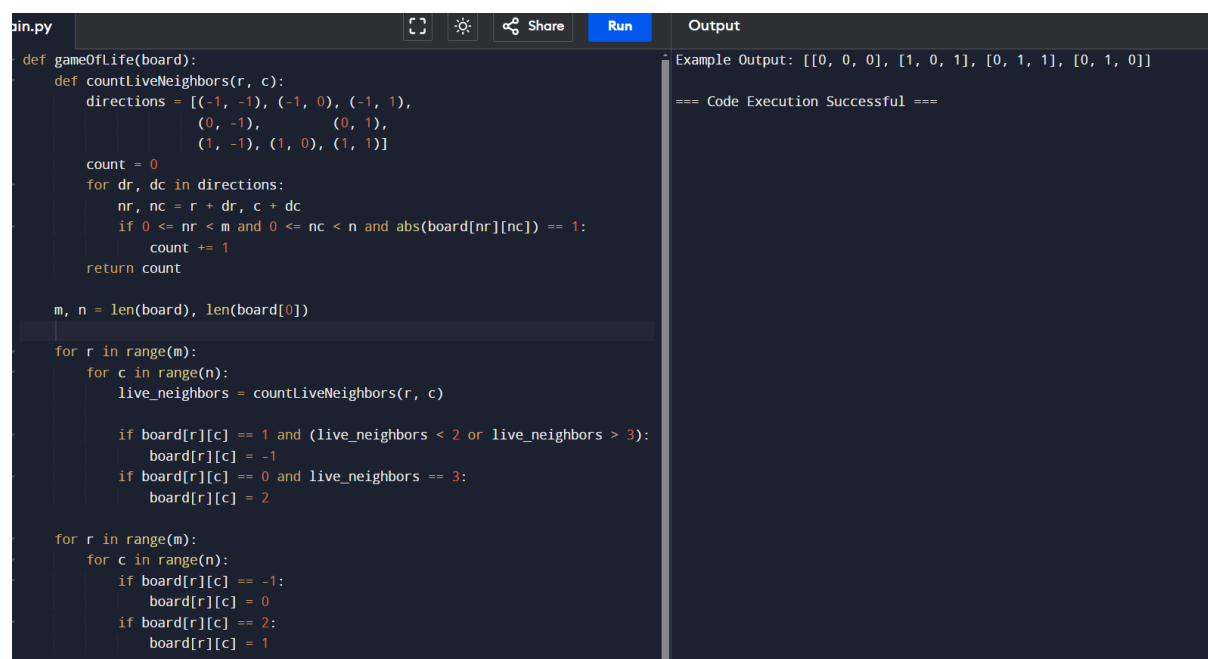
Example 1: Input: s = "abbxxxxzy" Output: [[3,6]] Explanation: "xxxx" is the only large group with start index 3 and end index 6.

main.py	Output
<pre>1 def largeGroupPositions(s): 2 result = [] 3 i = 0 4 n = len(s) 5 6 while i < n: 7 j = i 8 while j < n and s[j] == s[i]: 9 j += 1 10 11 if j - i >= 3: 12 result.append([i, j - 1]) 13 14 i = j 15 16 return result 17 s1 = "abbxxxxzy" 18 print("Example 1 Output:", largeGroupPositions(s1)) 19</pre>	<p>Example 1 Output: [[3, 6]]</p> <p>=== Code Execution Successful ===</p>

5. "The Game of Life, also known simply as Life, is a cellular automaton devised by the British mathematician John Horton Conway in 1970." The board is made up of an m x n grid of cells, where each cell has an initial state: live (represented by a 1) or dead (represented by a 0). Each cell interacts with its eight neighbours (horizontal, vertical, diagonal) using the following four rules Any live cell with fewer than two live neighbours dies as if caused by underpopulation. 1. Any live cell with two or three live neighbors lives on to the next generation. 2. Any live cell with more than three live neighbors dies, as if by overpopulation. 3. Any dead cell with

exactly three live neighbors becomes a live cell, as if by reproduction. The next state is created by applying the above rules simultaneously to every cell in the current state, where births and deaths occur simultaneously. Given the current state of the $m \times n$ grid board, return the next state.

Example 1: Input: board = [[0,1,0],[0,0,1],[1,1,1],[0,0,0]] Output: [[0,0,0],[1,0,1],[0,1,1],[0,1,0]]



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bin.py  [Icons]  Share  Run  Output
def gameOfLife(board):
    def countLiveNeighbors(r, c):
        directions = [(-1, -1), (-1, 0), (-1, 1),
                      (0, -1),           (0, 1),
                      (1, -1), (1, 0), (1, 1)]
        count = 0
        for dr, dc in directions:
            nr, nc = r + dr, c + dc
            if 0 <= nr < m and 0 <= nc < n and abs(board[nr][nc]) == 1:
                count += 1
        return count

    m, n = len(board), len(board[0])

    for r in range(m):
        for c in range(n):
            live_neighbors = countLiveNeighbors(r, c)

            if board[r][c] == 1 and (live_neighbors < 2 or live_neighbors > 3):
                board[r][c] = -1
            if board[r][c] == 0 and live_neighbors == 3:
                board[r][c] = 2

    for r in range(m):
        for c in range(n):
            if board[r][c] == -1:
                board[r][c] = 0
            if board[r][c] == 2:
                board[r][c] = 1

Example Output: [[0, 0, 0], [1, 0, 1], [0, 1, 1], [0, 1, 0]]
=== Code Execution Successful ===
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7. We stack glasses in a pyramid, where the first row has 1 glass, the second row has 2 glasses, and so on until the 100th row. Each glass holds one cup of champagne. Then, some champagne is poured into the first glass at the top. When the topmost glass is full, any excess liquid poured will fall equally to the glass immediately to the left and right of it. When those glasses become full, any excess champagne will fall equally to the left and right of those glasses, and so on. (A glass at the bottom row has its excess champagne fall on the floor.) For example, after one cup of champagne is poured, the top most glass is full. After two cups of champagne are poured, the two glasses

on the second row are half full. After three cups of champagne are poured, those two cups become full - there are 3 full glasses total now. After four cups of champagne are poured, the third row has the middle glass half full, and the two outside glasses are a quarter full, as pictured below. Now after pouring some non-negative integer cups of champagne, return how full the j th glass in the i th row is (both i and j are 0-indexed.)

Example 1: Input: poured = 1, query_row = 1, query_glass = 1
Output: 0.00000 Explanation: We poured 1 cup of champagne to the top glass of the tower (which is indexed as (0, 0)). There will be no excess liquid so all the glasses under the top glass will remain empty.

main.py	Output
<pre>1 def champagneTower(poured, query_row, query_glass): 2 dp = [[0] * k for k in range(1, 102)] 3 dp[0][0] = poured 4 5 for i in range(100): 6 for j in range(i + 1): 7 if dp[i][j] > 1: 8 excess = (dp[i][j] - 1) / 2 9 dp[i][j] = 1 10 dp[i + 1][j] += excess 11 dp[i + 1][j + 1] += excess 12 13 return min(1, dp[query_row][query_glass]) 14 15 poured = 1 16 query_row = 1 17 query_glass = 1 18 print("Example 1 Output:", champagneTower(poured, query_row, query_glass)) 19</pre>	<p>Example 1 Output: 0</p> <p>=== Code Execution Successful ===</p>