Assignment #B: 图论和树算

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2024 spring, Complied by 刘子暄 环境科学与工程学院

说明：

1）请把每个题目解题思路（可选），源码Python, 或者C++（已经在Codeforces/Openjudge上AC），截图（包含Accepted），填写到下面作业模版中（推荐使用 typora https://typoraio.cn ，或者用word）。AC 或者没有AC，都请标上每个题目大致花费时间。

2）提交时候先提交pdf文件，再把md或者doc文件上传到右侧“作业评论”。Canvas需要有同学清晰头像、提交文件有pdf、"作业评论"区有上传的md或者doc附件。

3）如果不能在截止前提交作业，请写明原因。

编程环境

（请改为同学的操作系统、编程环境等）

操作系统：Windows 11

Python编程环境: PyCharm Community Edition 2023.3

1. 题目

28170: 算鹰

dfs, http://cs101.openjudge.cn/practice/28170/

思路：

代码

```python
def dfs(x,y):
    graph[x][y] = "-"
    for dx,dy in [(1,0),(-1,0),(0,1),(0,-1)]:
        if 0<=x+dx<10 and 0<=y+dy<10 and graph[x+dx][y+dy] == ".":
            dfs(x+dx,y+dy)
graph = []
result = 0
for i in range(10):
    graph.append(list(input()))
for i in range(10):
    for j in range(10):
        if graph[i][j] == ".":
            result += 1
            dfs(i,j)
print(result)
```

代码运行截图 （至少包含有"Accepted"）
alt text

02754: 八皇后

dfs, http://cs101.openjudge.cn/practice/02754/

思路：
因为计概时对dfs水了，现在八皇后做不动，之后会再理解一遍

代码

```python
def solve_n_queens(n):
    solutions = []  # 存储所有解决方案的列表
    queens = [-1] * n  # 存储每一行皇后所在的列数

    def backtrack(row):
        if row == n:  # 找到一个合法解决方案
            solutions.append(queens.copy())
        else:
            for col in range(n):
                if is_valid(row, col):  # 检查当前位置是否合法
                    queens[row] = col  # 在当前行放置皇后
                    backtrack(row + 1)  # 递归处理下一行
                    queens[row] = -1  # 回溯，撤销当前行的选择

    def is_valid(row, col):
        for r in range(row):
            if queens[r] == col or abs(row - r) == abs(col - queens[r]):
                return False
        return True

    backtrack(0)  # 从第一行开始回溯

    return solutions


# 获取第 b 个皇后串
def get_queen_string(b):
    solutions = solve_n_queens(8)
    if b > len(solutions):
        return None
    queen_string = ''.join(str(col + 1) for col in solutions[b - 1])
    return queen_string


test_cases = int(input())  # 输入的测试数据组数
for _ in range(test_cases):
    b = int(input())  # 输入的 b 值
    queen_string = get_queen_string(b)
    print(queen_string)
```

```

```

代码运行截图 （至少包含有"Accepted"）
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03151: Pots

bfs, http://cs101.openjudge.cn/practice/03151/

思路：

代码

```python
def bfs(A, B, C):
    start = (0, 0)
    visited = set()
    visited.add(start)
    queue = [(start, [])]

    while queue:
        (a, b), actions = queue.pop(0)

        if a == C or b == C:
            return actions

        next_states = [(A, b), (a, B), (0, b), (a, 0), (min(a + b, A),\
                max(0, a + b - A)), (max(0, a + b - B), min(a + b, B))]

        for i in next_states:
            if i not in visited:
                visited.add(i)
                new_actions = actions + [get_action(a, b, i)]
                queue.append((i, new_actions))

    return ["impossible"]


def get_action(a, b, next_state):
    if next_state == (A, b):
        return "FILL(1)"
    elif next_state == (a, B):
        return "FILL(2)"
    elif next_state == (0, b):
        return "DROP(1)"
    elif next_state == (a, 0):
        return "DROP(2)"
    elif next_state == (min(a + b, A), max(0, a + b - A)):
        return "POUR(2,1)"
    else:
        return "POUR(1,2)"
```

```python
A, B, C = map(int, input().split())
solution = bfs(A, B, C)

if solution == ["impossible"]:
    print(solution[0])
else:
    print(len(solution))
    for i in solution:
        print(i)
```

代码运行截图 （AC代码截图，至少包含有"Accepted"）
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05907: 二叉树的操作

http://cs101.openjudge.cn/practice/05907/

思路：
想到用字典做，因为每个节点的信息都是充足的，但是没有想清楚父子节点交换咋写，而且自己写的非常不简洁，还是参考了别人的算法。发现用列表辅助记录节点信息会更简洁，就不用在字典上来回访问了

代码

```python
def swap(x, y):
    tree[loc[x][0]][loc[x][1]] = y
    tree[loc[y][0]][loc[y][1]] = x
    loc[x], loc[y] = loc[y], loc[x]


for _ in range(int(input())):
    n, m = map(int, input().split())
    tree = {}
    loc = [[] for _ in range(n)]
    for _ in range(n):
        a, b, c = map(int, input().split())
        tree[a] = [b, c]
        loc[b], loc[c] = [a, 0], [a, 1]
    for _ in range(m):
        op = list(map(int, input().split()))
        if op[0] == 1:
            swap(op[1], op[2])
        else:
            cur = op[1]
            while tree[cur][0] != -1:
                cur = tree[cur][0]
            print(cur)
```

代码运行截图 （AC代码截图，至少包含有"Accepted"）
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18250: 冰阔落 I

Disjoint set, http://cs101.openjudge.cn/practice/18250/

思路：

代码

```python
def find(x):
    if parent[x] != x:
        parent[x] = find(parent[x])
    return parent[x]

def union(x, y):
    root_x = find(x)
    root_y = find(y)
    if root_x != root_y:
        parent[root_y] = root_x

while True:
    try:
        n, m = map(int, input().split())
        parent = list(range(n + 1))

        for _ in range(m):
            a, b = map(int, input().split())
            if find(a) == find(b):
                print('Yes')
            else:
                print('No')
                union(a, b)

        unique_parents = set(find(x) for x in range(1, n + 1))  # 获取不同集合的根节点
        ans = sorted(unique_parents)  # 输出有冰阔落的杯子编号
        print(len(ans))
        print(*ans)

    except EOFError:
        break
```

代码运行截图 （AC代码截图，至少包含有"Accepted"）
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05443: 兔子与樱花

http://cs101.openjudge.cn/practice/05443/

思路：

dijkstra

代码

```python
import heapq

def dijkstra(adjacency, start):
    distances = {vertex: float('infinity') for vertex in adjacency}
    previous = {vertex: None for vertex in adjacency}
    distances[start] = 0
    pq = [(0, start)]

    while pq:
        current_distance, current_vertex = heapq.heappop(pq)
        if current_distance > distances[current_vertex]:
            continue

        for neighbor, weight in adjacency[current_vertex].items():
            distance = current_distance + weight
            if distance < distances[neighbor]:
                distances[neighbor] = distance
                previous[neighbor] = current_vertex
                heapq.heappush(pq, (distance, neighbor))

    return distances, previous

def shortest_path_to(adjacency, start, end):
    distances, previous = dijkstra(adjacency, start)
    path = []
    current = end
    while previous[current] is not None:
        path.insert(0, current)
        current = previous[current]
    path.insert(0, start)
    return path, distances[end]

# Read the input data
P = int(input())
places = {input().strip() for _ in range(P)}

Q = int(input())
graph = {place: {} for place in places}
for _ in range(Q):
        src, dest, dist = input().split()
        dist = int(dist)
        graph[src][dest] = dist
        graph[dest][src] = dist  # Assuming the graph is bidirectional

R = int(input())
requests = [input().split() for _ in range(R)]

# Process each request
for start, end in requests:
    if start == end:
        print(start)
        continue

    path, total_dist = shortest_path_to(graph, start, end)
    output = ""
    for i in range(len(path) - 1):
        output += f"{path[i]}->({graph[path[i]][path[i+1]]})->"
    output += f"{end}"
    print(output)
```

代码运行截图 （AC代码截图，至少包含有"Accepted"）
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2. 学习总结和收获

如果作业题目简单，有否额外练习题目，比如：OJ“2024spring每日选做”、CF、LeetCode、洛谷等网站题目。
概念和做题是两回事，细节的地方有很多的变化，应该开始刷题了