Assignment #8: 图论：概念、遍历，及 树算

Updated 1919 GMT+8 Apr 8, 2024

2024 spring, Complied by ==同学的姓名、院系==

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：macOS Ventura 13.4.1 (c)

Python编程环境：Spyder IDE 5.2.2, PyCharm 2023.1.4 (Professional Edition)

C/C++编程环境：Mac terminal vi (version 9.0.1424), g++/gcc (Apple clang version 14.0.3, clang-1403.0.22.14.1)

1. 题目

19943: 图的拉普拉斯矩阵

matrices, http://cs101.openjudge.cn/practice/19943/

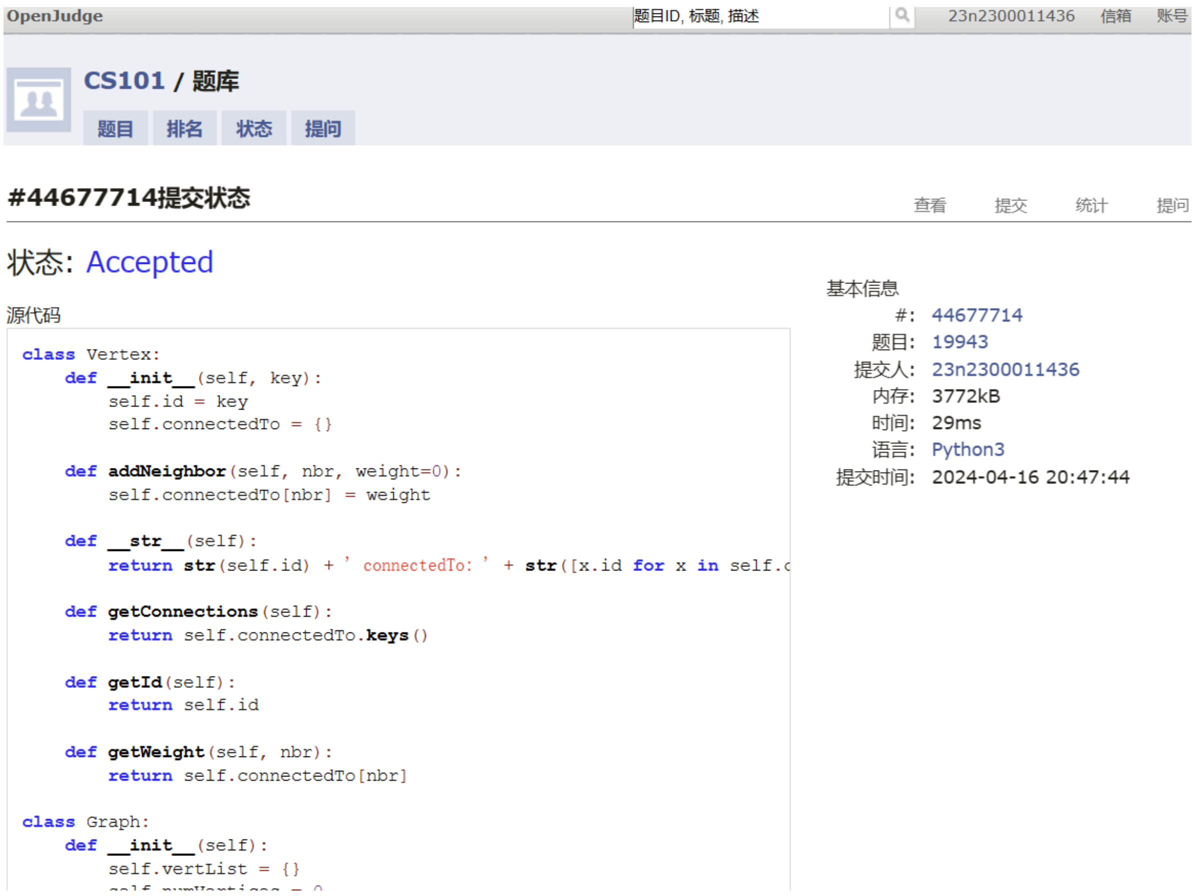
请定义Vertex类，Graph类，然后实现

思路：

代码

```python
class Vertex:
    def __init__(self, key):
        self.id = key
        self.connectedTo = {}

    def addNeighbor(self, nbr, weight=0):
        self.connectedTo[nbr] = weight
    def __str__(self):
        return str(self.id) + ' connectedTo: ' + str([x.id for x in
self.connectedTo])

    def getConnections(self):
        return self.connectedTo.keys()

    def getId(self):
        return self.id

    def getWeight(self, nbr):
        return self.connectedTo[nbr]

class Graph:
    def __init__(self):
        self.vertList = {}
        self.numVertices = 0

    def addVertex(self, key):
        self.numVertices = self.numVertices + 1
        newVertex = Vertex(key)
        self.vertList[key] = newVertex
        return newVertex

    def getVertex(self, n):
        if n in self.vertList:
            return self.vertList[n]
        else:
            return None

    def __contains__(self, n):
        return n in self.vertList

    def addEdge(self, f, t, weight=0):
        if f not in self.vertList:
            nv = self.addVertex(f)
        if t not in self.vertList:
            nv = self.addVertex(t)
        self.vertList[f].addNeighbor(self.vertList[t], weight)

    def getVertices(self):
        return self.vertList.keys()

    def __iter__(self):
        return iter(self.vertList.values())

def constructLaplacianMatrix(n, edges):
    graph = Graph()
    for i in range(n):  # 添加顶点
        graph.addVertex(i)

    for edge in edges:  # 添加边
        a, b = edge
        graph.addEdge(a, b)
        graph.addEdge(b, a)

    laplacianMatrix = []    # 构建拉普拉斯矩阵
    for vertex in graph:
        row = [0] * n
        row[vertex.getId()] = len(vertex.getConnections())
        for neighbor in vertex.getConnections():
            row[neighbor.getId()] = -1
        laplacianMatrix.append(row)

    return laplacianMatrix


n, m = map(int, input().split())    # 解析输入
edges = []
for i in range(m):
    a, b = map(int, input().split())
    edges.append((a, b))

laplacianMatrix = constructLaplacianMatrix(n, edges)    # 构建拉普拉斯矩阵

for row in laplacianMatrix: # 输出结果
    print(' '.join(map(str, row)))
```

代码运行截图 ==（至少包含有"Accepted"）==


OpenJudge　题目ID, 标题, 描述　23n2300011436　信箱　账号

CS101 / 题库

题目　排名　状态　提问

#44677714提交状态　查看　提交　统计　提问

状态: Accepted

源代码

```
class Vertex:
    def __init__(self, key):
        self.id = key
        self.connectedTo = {}

    def addNeighbor(self, nbr, weight=0):
        self.connectedTo[nbr] = weight

    def __str__(self):
        return str(self.id) + ' connectedTo: ' + str([x.id for x in self.c

    def getConnections(self):
        return self.connectedTo.keys()

    def getId(self):
        return self.id

    def getWeight(self, nbr):
        return self.connectedTo[nbr]

class Graph:
    def __init__(self):
        self.vertList = {}
        self.numVertices = 0
```

基本信息

#:	44677714
题目:	19943
提交人:	23n2300011436
内存:	3772kB
时间:	29ms
语言:	Python3
提交时间:	2024-04-16 20:47:44

18160: 最大连通域面积

matrix/dfs similar, http://cs101.openjudge.cn/practice/18160

思路：

代码

```
#
```

代码运行截图 ==（至少包含有"Accepted"）==

sy383: 最大权值连通块

https://sunnywhy.com/sfbj/10/3/383

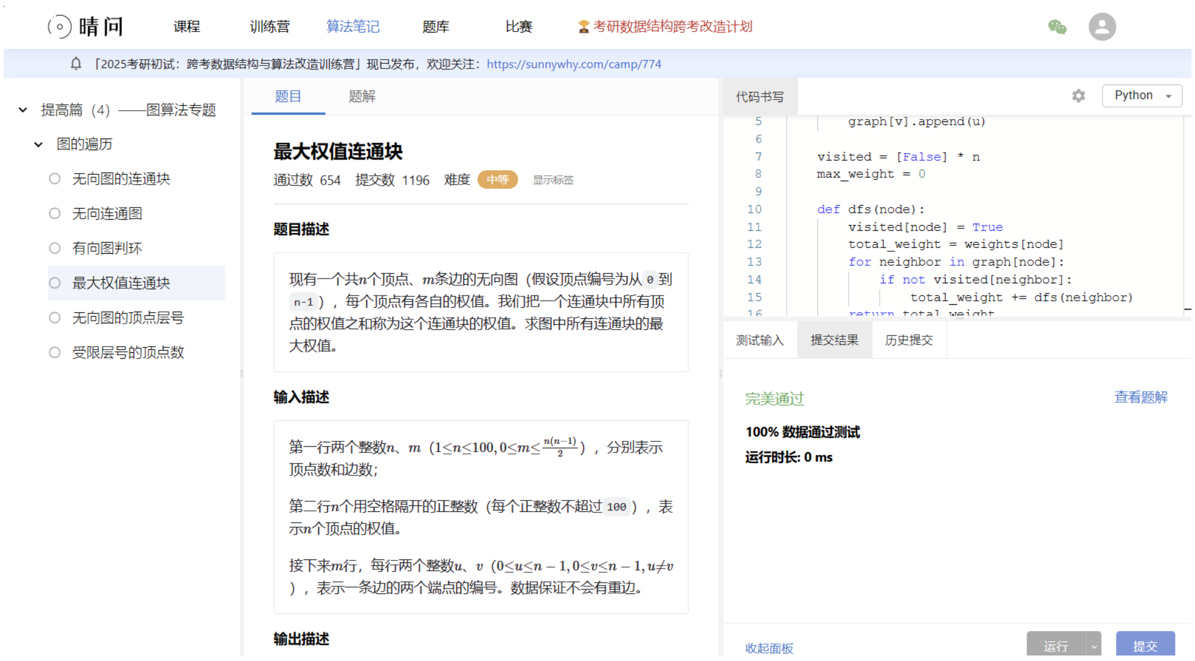
思路：

代码

```
def max_weight(n, m, weights, edges):
    graph = [[] for _ in range(n)]
    for u, v in edges:
        graph[u].append(v)
        graph[v].append(u)

    visited = [False] * n
    max_weight = 0

    def dfs(node):
        visited[node] = True
        total_weight = weights[node]
        for neighbor in graph[node]:
            if not visited[neighbor]:
                total_weight += dfs(neighbor)
        return total_weight

    for i in range(n):
        if not visited[i]:
            max_weight = max(max_weight, dfs(i))

    return max_weight
```

```python
# 接收数据
n, m = map(int, input().split())
weights = list(map(int, input().split()))
edges = []
for _ in range(m):
    u, v = map(int, input().split())
    edges.append((u, v))

# 调用函数
print(max_weight(n, m, weights, edges))
```

代码运行截图 ==（AC代码截图，至少包含有"Accepted"）==



「2025考研初试：跨考数据结构与算法改造训练营」现已发布，欢迎关注：https://sunnywhy.com/camp/774

最大权值连通块

通过数 654　提交数 1196　难度 中等　显示标签

题目描述

现有一个共n个顶点、m条边的无向图（假设顶点编号为从 `0` 到 `n-1`），每个顶点有各自的权值。我们把一个连通块中所有顶点的权值之和称为这个连通块的权值。求图中所有连通块的最大权值。

输入描述

第一行两个整数n、m（$1 \le n \le 100, 0 \le m \le \frac{n(n-1)}{2}$），分别表示顶点数和边数；

第二行n个用空格隔开的正整数（每个正整数不超过 `100`），表示n个顶点的权值。

接下来m行，每行两个整数u、v（$0 \le u \le n-1, 0 \le v \le n-1, u \ne v$），表示一条边的两个端点的编号。数据保证不会有重边。

输出描述

```python
        graph[v].append(u)

    visited = [False] * n
    max_weight = 0

    def dfs(node):
        visited[node] = True
        total_weight = weights[node]
        for neighbor in graph[node]:
            if not visited[neighbor]:
                total_weight += dfs(neighbor)
        return total_weight
```

完美通过　查看题解

100% 数据通过测试

运行时长: 0 ms

03441: 4 Values whose Sum is 0

data structure/binary search, http://cs101.openjudge.cn/practice/03441

思路：

代码

```
#
```

代码运行截图 ==（AC代码截图，至少包含有"Accepted"）==

04089: 电话号码

trie, http://cs101.openjudge.cn/practice/04089/

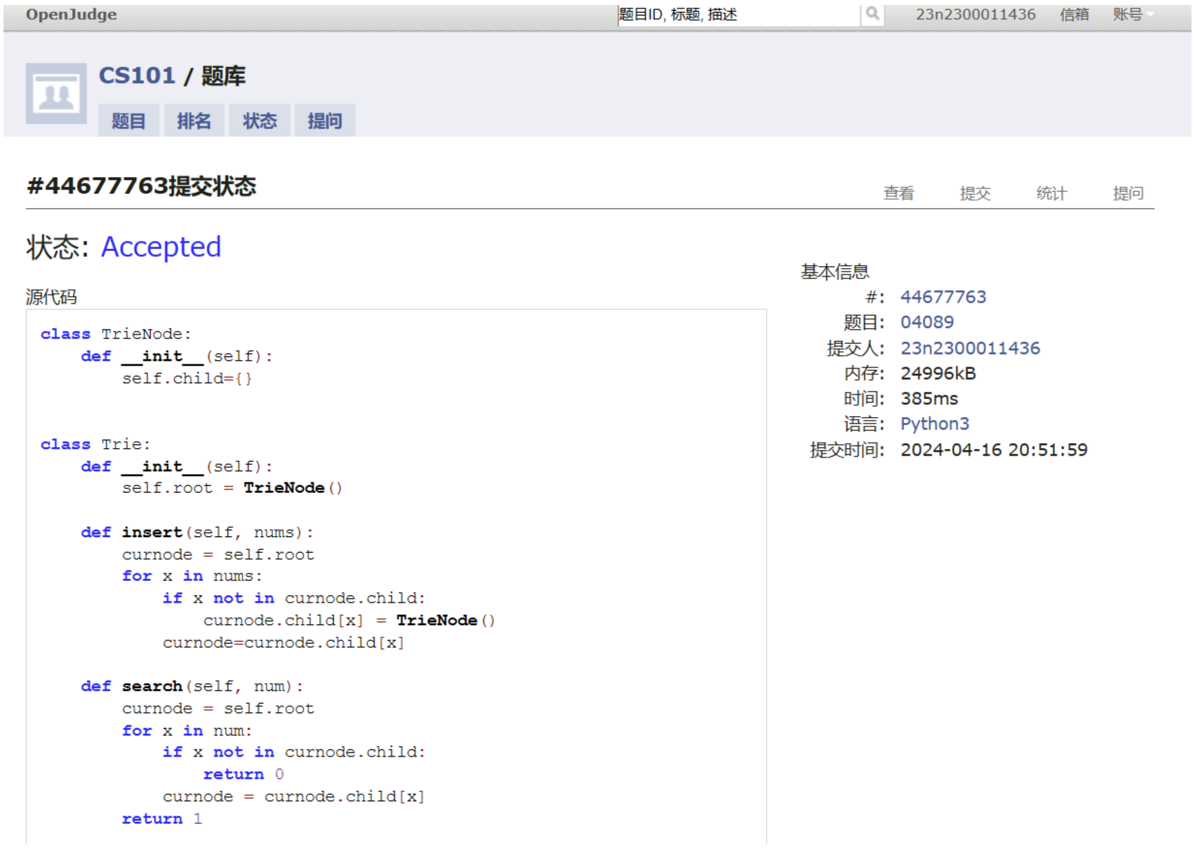
Trie 数据结构可能需要自学下。

思路：

代码

```python
class TrieNode:
    def __init__(self):
        self.child={}


class Trie:
    def __init__(self):
        self.root = TrieNode()

    def insert(self, nums):
        curnode = self.root
        for x in nums:
            if x not in curnode.child:
                curnode.child[x] = TrieNode()
            curnode=curnode.child[x]

    def search(self, num):
        curnode = self.root
        for x in num:
            if x not in curnode.child:
                return 0
            curnode = curnode.child[x]
        return 1


t = int(input())
p = []
for _ in range(t):
    n = int(input())
    nums = []
    for _ in range(n):
        nums.append(str(input()))
    nums.sort(reverse=True)
    s = 0
    trie = Trie()
    for num in nums:
        s += trie.search(num)
        trie.insert(num)
    if s > 0:
        print('NO')
    else:
        print('YES')
```

代码运行截图 ==（AC代码截图，至少包含有"Accepted"）==



#44677763提交状态

状态: Accepted

源代码

```
class TrieNode:
    def __init__(self):
        self.child={}


class Trie:
    def __init__(self):
        self.root = TrieNode()

    def insert(self, nums):
        curnode = self.root
        for x in nums:
            if x not in curnode.child:
                curnode.child[x] = TrieNode()
            curnode=curnode.child[x]

    def search(self, num):
        curnode = self.root
        for x in num:
            if x not in curnode.child:
                return 0
            curnode = curnode.child[x]
        return 1
```

基本信息

#:	44677763
题目:	04089
提交人:	23n2300011436
内存:	24996kB
时间:	385ms
语言:	Python3
提交时间:	2024-04-16 20:51:59

04082: 树的镜面映射

http://cs101.openjudge.cn/practice/04082/

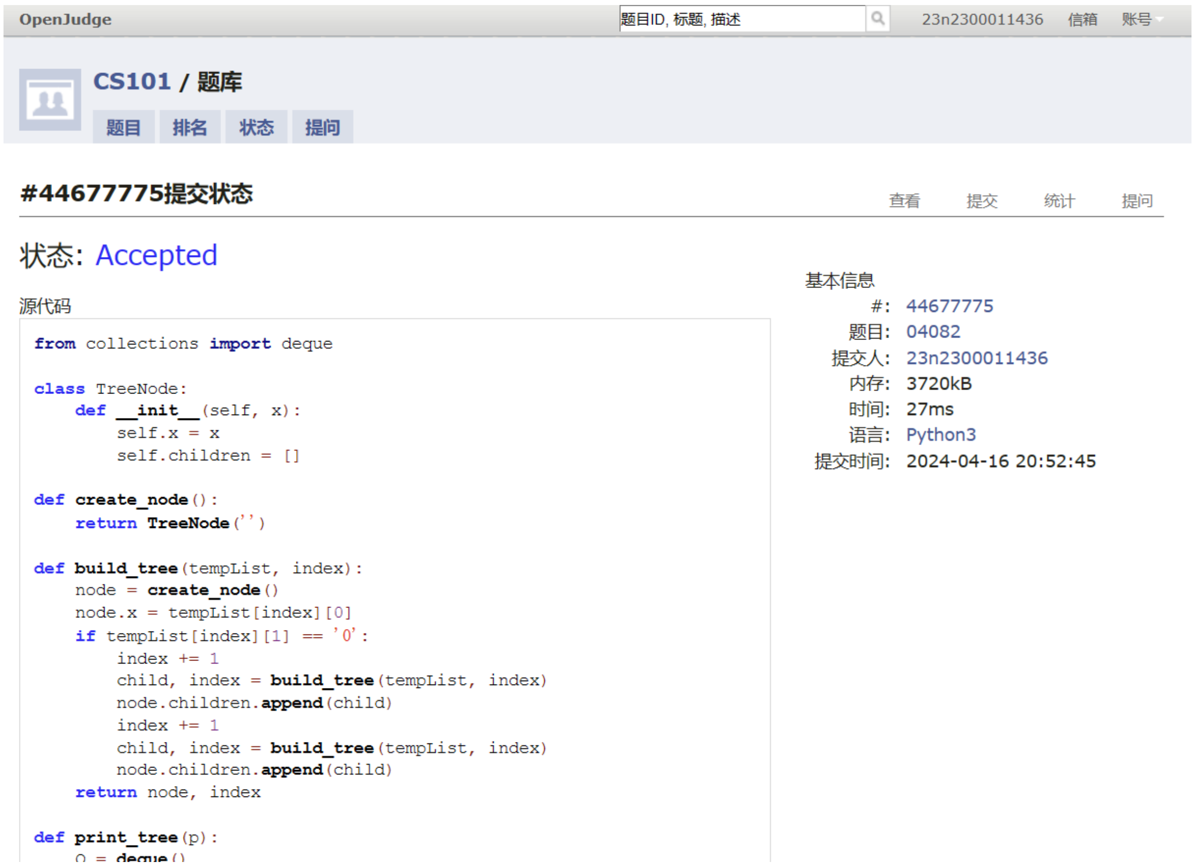
思路：

代码

```
from collections import deque

class TreeNode:
    def __init__(self, x):
        self.x = x
        self.children = []

def create_node():
    return TreeNode('')

def build_tree(tempList, index):
    node = create_node()
    node.x = tempList[index][0]
    if tempList[index][1] == '0':
        index += 1
```

```
            child, index = build_tree(tempList, index)
            node.children.append(child)
            index += 1
            child, index = build_tree(tempList, index)
            node.children.append(child)
        return node, index

def print_tree(p):
    Q = deque()
    s = deque()

    # 遍历右子节点并将非虚节点加入栈s
    while p is not None:
        if p.x != '$':
            s.append(p)
        p = p.children[1] if len(p.children) > 1 else None

    # 将栈s中的节点逆序放入队列Q
    while s:
        Q.append(s.pop())

    # 宽度优先遍历队列Q并打印节点值
    while Q:
        p = Q.popleft()
        print(p.x, end=' ')

        # 如果节点有左子节点，将左子节点及其右子节点加入栈s
        if p.children:
            p = p.children[0]
            while p is not None:
                if p.x != '$':
                    s.append(p)
                p = p.children[1] if len(p.children) > 1 else None

            # 将栈s中的节点逆序放入队列Q
            while s:
                Q.append(s.pop())


n = int(input())
tempList = input().split()

# 构建多叉树
root, _ = build_tree(tempList, 0)

# 执行宽度优先遍历并打印镜像映射序列
print_tree(root)
```

代码运行截图 ==（AC代码截图，至少包含有"Accepted"）==



#44677775提交状态

状态: Accepted

源代码

```
from collections import deque

class TreeNode:
    def __init__(self, x):
        self.x = x
        self.children = []

def create_node():
    return TreeNode('')

def build_tree(tempList, index):
    node = create_node()
    node.x = tempList[index][0]
    if tempList[index][1] == '0':
        index += 1
        child, index = build_tree(tempList, index)
        node.children.append(child)
        index += 1
        child, index = build_tree(tempList, index)
        node.children.append(child)
    return node, index

def print_tree(p):
    Q = deque()
```

基本信息

#:	44677775
题目:	04082
提交人:	23n2300011436
内存:	3720kB
时间:	27ms
语言:	Python3
提交时间:	2024-04-16 20:52:45

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。==

学习了图的dfs bfs算法