

Graph Comprehensive Experiment Report

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One、 Experimental purpose

1. Familiar with the basic operation of the graph.
2. Master the storage and travel operation of the graph.
3. Deepen the understanding of the graph algorithms, and to develop the ability to solve practical problems gradually.

Two、 Experimental environment

A computer with visual studio 2019.

This experiment has 4 class hours in all.

Three、 Experimental content

Location problem

【Basic requirement】

There is a traffic map of n villages. If there is a road between village i and village j , connect them with an edge and W_{ij} stands for the weight of this edge. Now we plan to choose one village and build a hospital. You are required to write following algorithms:

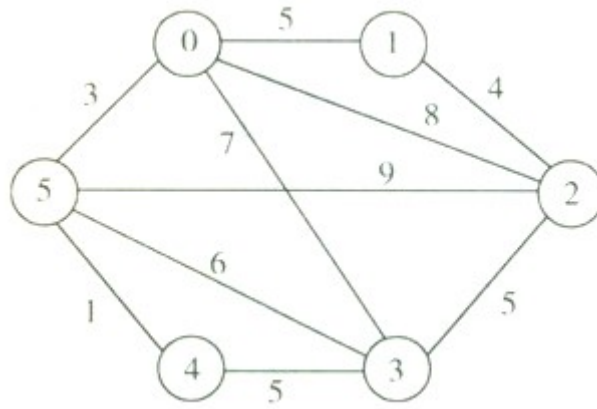
- (1) Find out the village in which we should build the hospital, making the distance of the farthest village from the hospital is shortest.
- (2) Find out the village in which we should build the hospital, making the sum distance of all villages to the hospital is shortest.

【Tips】

For question (1), you can find out the shortest path of every village to all other villages, then store the max value(stands for the distance of the farthest village from hospital if hospital is built in this village); Then find a max value in those min value.

For question (2), you can find out the shortest distance of every village to all other villages, then store the sum of all distance(stands for the sum distance of all villages from the hospital); Then find a min value from these sums.

You can also draw a traffic map of n villages. Here is an example below:



Four、 Important data structures

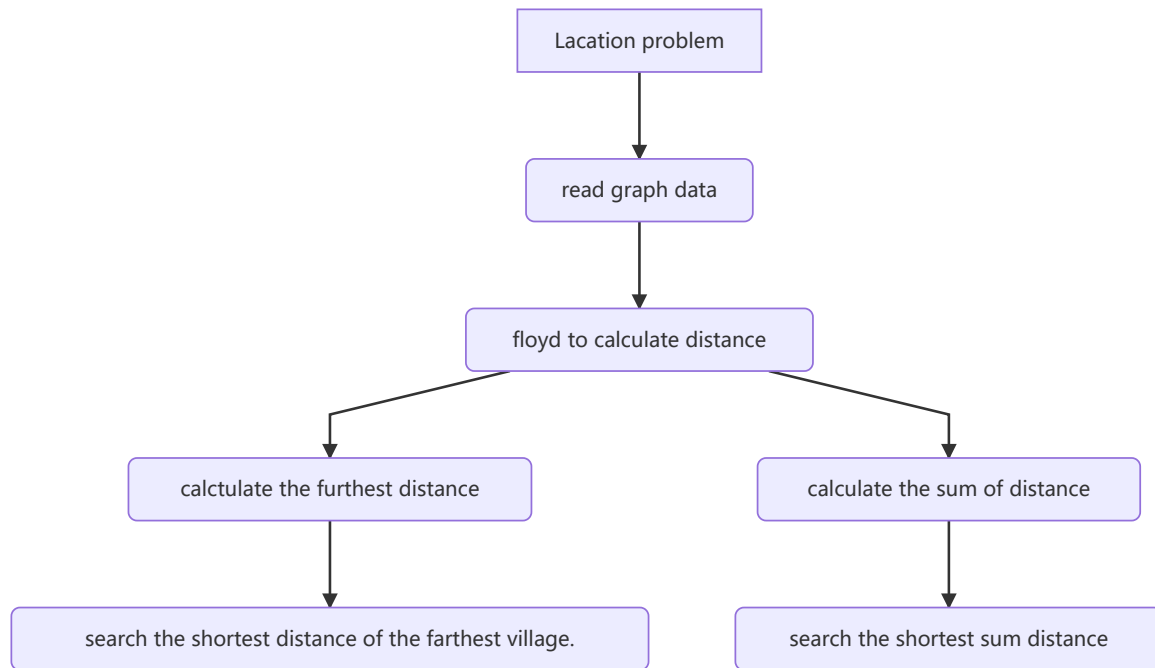
Struct introduce:

```
class Graph {
private:
    int dis[N]; // distance with i
    priority_queue<int> Q; // get the furthest
    int sum; // sum of distance with other villages
    int furthest; // the furthest distance from other villages
public:
    int tot; // village numbers
};
```

Function introduce:

```
void getData(); // read graph data from file
void floyd(int&, int&); // floyd algorithm calculate the distance
void printDistance(); // print distance
void init(); // initialize tot with i
```

Five、Implementation analysis



1.floyd function

Let $d[k, i, j]$ denote the shortest path length from i to j through several nodes with no more than k . The problem can be divided into two subproblems, one is from i to j through nodes no more than $k - 1$, the other is from i to k and then to j . therefore:

$$D[k, i, j] = \min(D[k - 1, i, j], D[k - 1, i, k] + D[k - 1, k, j])$$

code show below.

```
void floyd(int &furthestvill, int &allvill) {
    //-----floyd algorithm-----
    for (int k = 0; k < villagen; k++) {
        for (int i = 0; i < villagen; i++) {
            for (int j = 0; j < villagen; j++) {
                graph[i].dis[j] = min(graph[i].dis[j], graph[i].dis[k] +
graph[k].dis[j]);
            }
        }
    }
    //---get furthest distance and sum distance ---
    for (int i = 0; i < villagen; i++) {
        graph[i].dis[i] = 0x3f3f3f3f;
        for (int j = 0; j < villagen; j++) {
            if (i == j || graph[i].dis[j] > 0x3f3f3f3f)continue;
            graph[i].Q.push(graph[i].dis[j]); //get the furthest distance
            graph[i].sum += graph[i].dis[j]; //maintain the sum of distance
        }
        graph[i].furthest = graph[i].Q.top();
        if (graph[furthestvill].furthest > graph[i].furthest)
            furthestvill = i;
        if (graph[allvill].sum > graph[i].sum)
            allvill = i;
    }
}
```

```
}
```

Six、 Debugging problem analysis

Bug 1

Variable variables are declared in the. H file contained in the header file, resulting in display redefinition errors

Sovle

Move variable variable out and use external variable instead

Bug 2

No extern when using global variables compile errors between multiple files

Sovle:

Add extern to bulid connection in multiple files

Bug 3

After sorting, the subscript is regarded as the number of the graph, which makes it disordered

Sovle:

Add tot to the structure as the number of the graph

Seven、 Summary

In graph theory, if there is a path from one vertex to another vertex in a graph without authority, the path length is the number of edges that pass through the path, equal to the tree of vertices on the path minus 1. There may be multiple paths from one vertex to another, and the number of edges on each path may be different, that is, the path length may be different. The path with the shortest path length is called the shortest path, and its path length is called the shortest path length. If the edge is weighted, the edge weights are added for comparison.

And applying these theories to the actual problem is the minimum cost of building a road or a base station. The real problem is abstracted into edge weights and solved by graph theory.

Eight、 Crew Divison

	Group division	
Member name	work done	Comletion situation
曹鹏霄	Location problem	100%