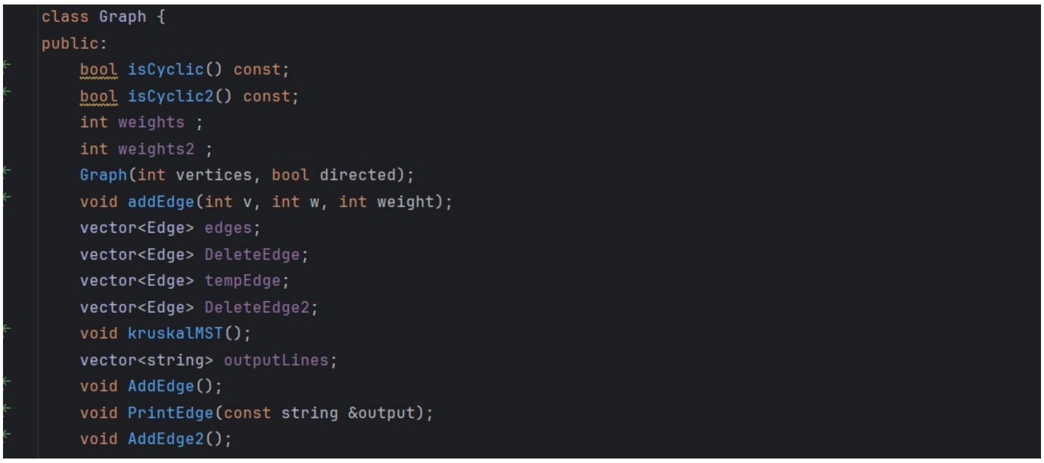
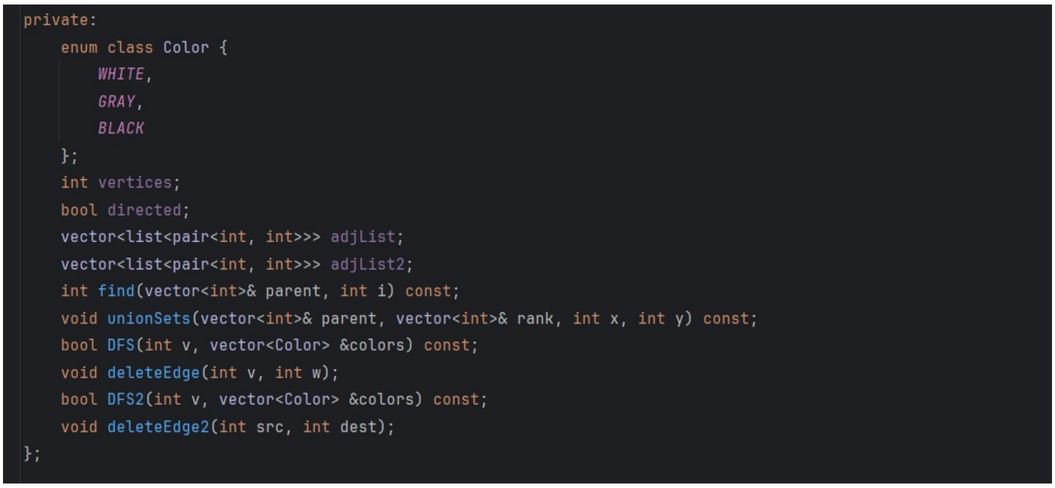
Algorithms-PA3 b10505005 蔣依倢

First illustrated the data structure of the program



```cpp
class Graph {
public:
    bool isCyclic() const;
    bool isCyclic2() const;
    int weights ;
    int weights2 ;
    Graph(int vertices, bool directed);
    void addEdge(int v, int w, int weight);
    vector<Edge> edges;
    vector<Edge> DeleteEdge;
    vector<Edge> tempEdge;
    vector<Edge> DeleteEdge2;
    void kruskalMST();
    vector<string> outputLines;
    void AddEdge();
    void PrintEdge(const string &output);
    void AddEdge2();
```



```cpp
private:
    enum class Color {
        WHITE,
        GRAY,
        BLACK
    };
    int vertices;
    bool directed;
    vector<list<pair<int, int>>> adjList;
    vector<list<pair<int, int>>> adjList2;
    int find(vector<int>& parent, int i) const;
    void unionSets(vector<int>& parent, vector<int>& rank, int x, int y) const;
    bool DFS(int v, vector<Color> &colors) const;
    void deleteEdge(int v, int w);
    bool DFS2(int v, vector<Color> &colors) const;
    void deleteEdge2(int src, int dest);
};
```

I. Reading data, construct a Graph, vertices = vertices number, adding edges into adjList[], which adjList.size() = vertices number, and use weights to record the sum of deleted weights in order to get the min sum of weights.

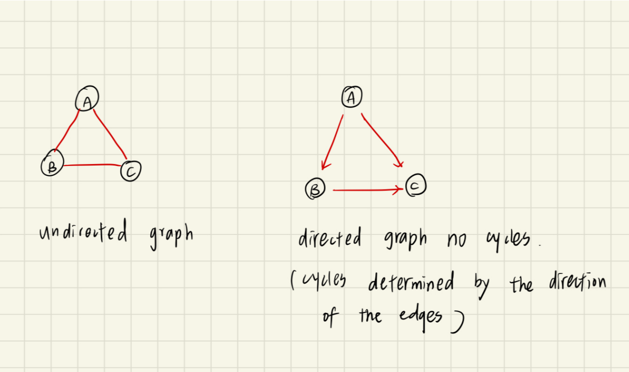
II. Running Kruskal Algorithm with union sets to find MST, which doesn't contain cycles in undirected graph. The program time complexity will be $O(ElogV)$

III. If in directed graph, we have to run for adding Deleted edges back into graph and check if it contains cycles one by one, since cycle in undirected graph have chances not to cause cycle in directed graph.

Findings:

I. I found out that the order of the edges not only influence the Kruskal graph (we sorted the edges in descending order) , but also the AddEdge function, if we change the order of the edges to add back into graph, it comes out to be different results. That is, I think it’s an important part of the program.

II. Another is that the main difference between directed and undirected graph. When in undirected graph, we can simply use Kruskal to find out MST, but in directed graph, three edges between three edges may not cause cycle, as below


A
B
C
undirected graph
A
B
C
directed graph no cycles.
(cycles determined by the direction of the edges)