Problem3

Yihang Wang

March 2020

1 Representation

For my Graph, I utilize a map to implement this graph class. each pair is a string(which represents a node) corresponding to a set of edges(the edges of this nodes, which could be empty set). The advantage is that it is very easy for me to get the iterator by either nodes or edges in alphabetically order. Also, I rewrite the equal, compareTo, hashCode methods for edges to help me implement this. It is absolutely that map is very efficient since it can be sorted automatically. Also, many methods is O(log n). Furthermore, we sometimes need to find the child of certain nodes.

2 The advantage and disadvantages

1. **The collection of edges**

```
The advantages are following:

1. We only need to store edges in a data structure. We do not
need to create new classes to implement graph.
So it could make problems easier

2. The rep invariant would be true, and we require less.

3. Some methods like add nodes or add edges cost very little.
-------------------------------------------------------------
The disadvantages are following:

1. Without new classes to store graph, it is difficult for
us to label this graph.

2. Every time we implement listNodes, we need to get each node
from collection of edges, which has low efficiency.

3. For each node, if we want to find its indegree. We need to
```

go over the whole graph, which has low efficiency.

2. **The adjacency matrix**

The advantages are following:

1. It is very clear for us to find relationship of any two nodes.

2. It is convenient for us to utilize index to find any node's information.

3. It is convenient for us to utilize number to indicate some information between any two nodes.

The disadvantages are following:

1. It is difficult for us to regulate index for each node.

2. It would be misunderstanding for the weights between two nodes.

3. If a graph has many nodes but with little edges. To go over adjacency matrix would be low efficient since most of values are 0.

3. **The adjacency list**

The advantages are following:

1. It is clear to indicate the children of any node

2. It is efficient for us to go over the whole graph.

3. It is also clear to indicate all nodes of graph easily.

The disadvantages are following:

1. We will utilize large space to store this kind of graph.

2. It is difficult for us to implement this kind of graph. More complex means more bugs and more tests needed.

3. The rep invariant will cost much to test if it holds after any producers and mutators