数据结构与算法
实验报告

第四次

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实验 1

1. 题目

背景

“Six Degrees of separation”是六度分割理论，也被称为小世界理论，其描述为:”你和任何一个陌生人之间所间隔的人不会超过五个，也就是说，最多通过五个人你就能够认识任何一个陌生人。”根据这个理论，你和世界上的任何一个人之间只隔着五个人，不管对方在哪个国家，属哪类人种，是哪种肤色。

基于上面的理论,有一款以好莱坞影星 Kevin Bacon 为主线的游戏,其名称为“Six Degrees of Kevin Bacon”。本次综合训练的主要任务就是实现这个游戏。

这款游戏以 Kevin Bacon 为中心，对于任何一个给定的演员，给出该演员和 Kevin Bacon 之间进行联系的“Bacon Number “。Bacon Number 的定义规则为:

1. Kevin Bacon 的 Bacon Number 值为 0;
2. 和 Kevin Bacon 在一个电影里出现的所有演员的 Bacon Number 值为 1;
3. 任何演员的 Bacon Number 值为与该演员在同一个电影里的 Bacon Number 值最小的那个演员的 Bacon Number 值加 1。

实践证明，几乎好莱坞的每一个演员都拥有一个小于 6 的 Bacon Number。对于好莱坞明星来说, Bacon Number 值一般最多到 3, 也就是最多通过三部电影就能找到和 Kevin Bacon 的联系。

关于该游戏的更详细的介绍，可以参看维基百科:

http://en.wikipedia.org/wiki/Six_Degrees_of_Kevin_Bacon 。

你也可以尝试通过在线方式玩该游戏，网址为：http://oracleofbacon.org/

任务 1

建立为实现该游戏的图的抽象描述结构，包括图中顶点的意义以及存储的信息、边的意义以及存储的信息。并给出该图的逻辑示意图。

任务 2

在任务 1 的基础上，并结合教材中图的抽象数据类型的定义，设计并实现一个为该游戏而使用的具体的 Graph Class。

任务 3

通过给定的数据文件 simple.txt 构建图。Simple.txt 中的格式为：每一行代表一个电影，每行中的信息都用’ /’进行分割，其中第一个信息为电影名称，其后所有的信息都是出现在该电影的演员名。利用图和相应的算法，你可以根据用户输入的演员名，给出该演员的 Bacon Number，并且列出该数计算的依据，也就是通过哪些电影建立了和 Kevin Bacon 的联系。运行的样例模式如下：

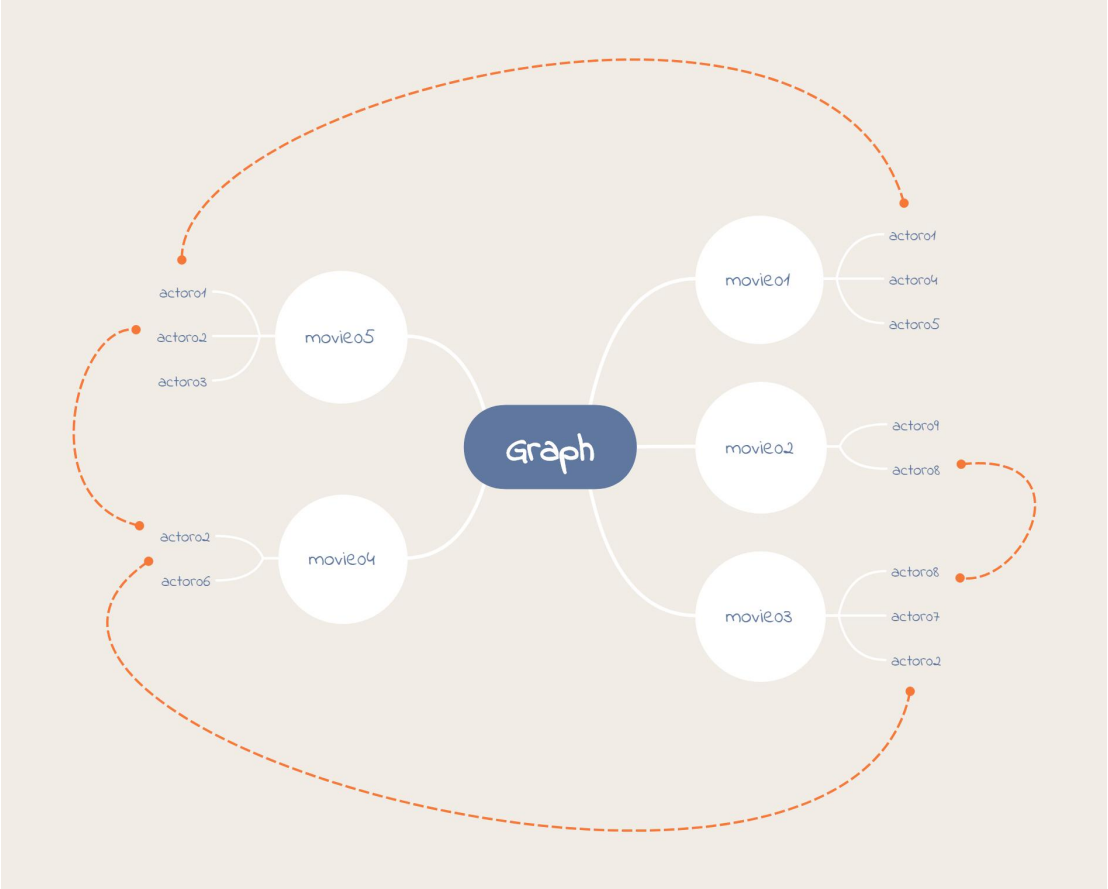
```
Welcome to the Six Degrees of Kevin Bacon.
If you tell me an actor's name, I'll connect them to Kevin Bacon through
the movies they've appeared in.  I bet your actor has a Kevin Bacon number
of less than six!

Actor's name (or ALL for everyone)? Brad Pitt

Path from Brad Pitt to Kevin Bacon:
Brad Pitt was in Ocean's Eleven (2001) with Julia Roberts
Julia Roberts was in Flatliners (1990) with Kevin Bacon
Brad Pitt's Bacon number is 2
```

任务 4（选做）

Complex.txt 是一个数据规模远超 Simple.txt 的文件，两者的格式是一样的。尝试使用任务 3 的解决方案执行 Complex.txt。如果运行效果不理想，请分析问题的原因，并尝试进行改变。

2. 数据结构设计

Vertex: movies
Edge: actors

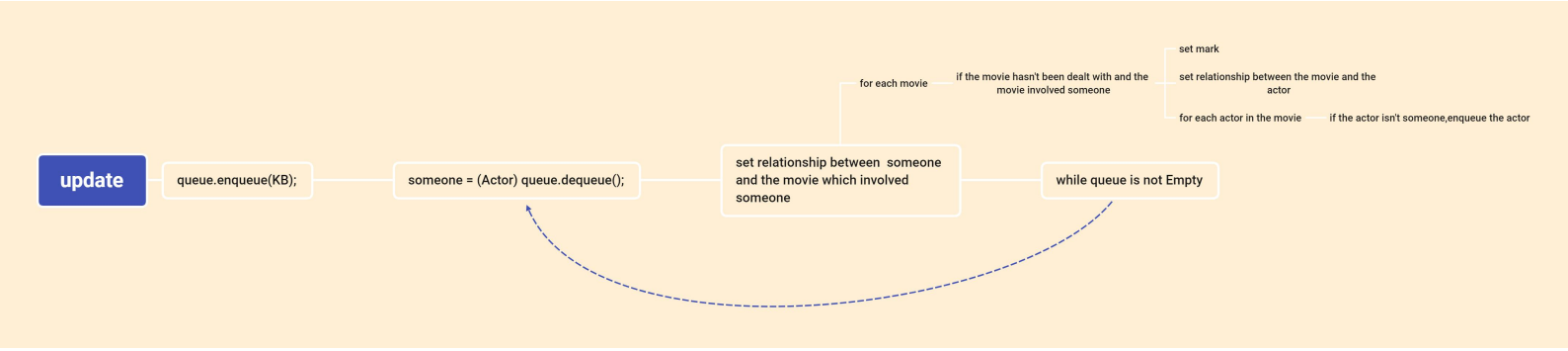



```
public class Graph implements GraphInterface{
    public Actor KB = new Actor("Kevin Bacon");
    public Movie[] movies = new Movie[100000];          //An array that stores all movies
    public MyHash allActors = new MyHash();             //A hash table that stores all actors
    public int moviesNum;                               //The number of movies
    public MyQueue01 queue = new MyQueue01();           //Queue
```

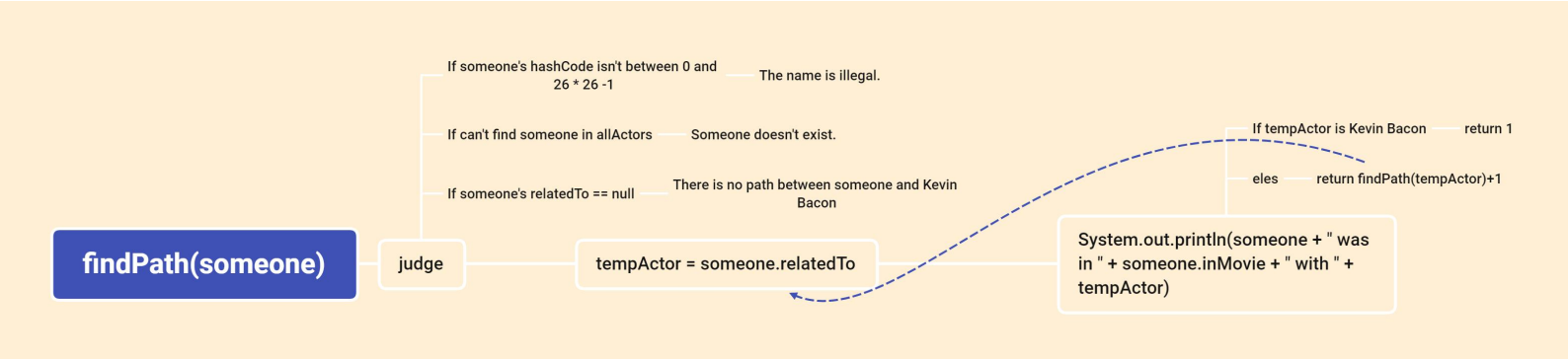
```
    public boolean[] isout = new boolean[100000];     //If movies[i] is processed, isout[i] is true
}

public class Actor {
    public Movie inMovie;       //In the final path, which movie the actor was in.
    public Actor relatedTo;     //In the final path, who the actor was with.
    public String name;         //The actor's name
}

public class Movie {
    public Actor[] actors = new Actor[1000];   //Actors who were in the movie
    public int sumOfActor;                     //the number of actors in the movie
    public String movieName;                   //the name of the movie
}
```

3. 算法设计

Update method



Find path method



4. 主干代码说明

Update method

```
public void update(){
    queue.enqueue(KB);
    Actor someone = (Actor) queue.dequeue();
    for (int i = 0; i < moviesNum; i++) {
        if (!isout[i]&&movies[i].hasSomeone(someone)){
            movies[i].setRelation(someone);          //set relationship between the
                                                     movie and the actor
            isout[i] = true;                         //set mark
            for (int j = 0; j < movies[i].sumOfActor; j++) {
                if (!movies[i].actors[j].equals(someone)){
                    queue.enqueue(movies[i].actors[j]);
                }
            }
        }
    }
    while (!queue.isEmpty()){
        update01();
    }
}

public void update01(){
    Actor someone = (Actor) queue.dequeue();
    for (int i = 0; i < moviesNum; i++) {
        if (!isout[i]&&movies[i].hasSomeone(someone)){
            movies[i].setRelation(someone);      //set relationship between the movie and
                                                 the actor
            isout[i] = true;                     //set mark
            for (int j = 0; j < movies[i].sumOfActor; j++) {
                if (!movies[i].actors[j].equals(someone)){
                    queue.enqueue(movies[i].actors[j]);
                }
            }
        }
    }
}

public void setRelation(Actor someone) {
    for (int i = 0; i < sumOfActor; i++) {
        if (!actors[i].equals(someone)){
```

```
                actors[i].setRalationIn(this,someone);      //set relationship between someone
                                                            and everyone in the movie
            }
        }
}

public void setRalationIn(Movie movie, Actor someone) {
        inMovie = movie;
        relatedTo = someone;
}
```

Find path method

```
public void findPath(String someone){
        Actor temp = new Actor(someone);
        if (temp.hashCode()<0||temp.hashCode()>26*26-1) {
            System.out.println("The name is illegal.");
        }
        if (temp.equals(allActors.find(temp))){        //someone exists
            temp = allActors.find(temp);
            if (temp.relatedTo!=null) {
                System.out.println(someone + "'s Bacon number is "+findPath(temp));
            }else {
                System.out.println("No path");
            }
        } else {
            System.out.println(someone+" doesn't exist.");
        }
}

//return the Bacon Number
public int findPath(Actor someone) {
        Actor tempActor = someone.relatedTo;
        if (KB.equals(tempActor)) {
            System.out.println(someone + " was in " + someone.inMovie + " with " +
            tempActor);
            return 1;
        }else {
            System.out.println(someone + " was in " + someone.inMovie + " with " +
            tempActor);
            return   findPath(tempActor)+1;
        }
}
```

5. 运行结果展示

过程性结果

```
Too small
Too small
Too small
Too small
Too small
Too small
Too small
Too small
Too small
Too small
Wlecome to the Six Degree of Kevin Bacon.
if you tell me an actor's name, I'll connect them to Kevin Bacon through the movies they've appeared in.

Actor's name (or All for everyone) ?
```

刚开始的哈希表用数组实现，在处理了相同的哈希值的情况后，依然容量不够，改用链表实现哈希表之后问题得以解决。

最终结果

Simple:

```
Wlecome to the Six Degree of Kevin Bacon.
if you tell me an actor's name, I'll connect them to Kevin Bacon through the movies they've appeared in.

Actor's name (or All for everyone) ? William Devane
William Devane was in Hollow Man (2000) with Kevin Bacon
William Devane's Bacon number is 1

Actor's name (or All for everyone) ? Richard Gere
Richard Gere was in Pretty Woman (1990) with Julia Roberts
Julia Roberts was in Flatliners (1990) with Kevin Bacon
Richard Gere's Bacon number is 2

Actor's name (or All for everyone) ? Diane Lane
Diane Lane was in My Dog Skip (2000) with Kevin Bacon
Diane Lane's Bacon number is 1

Actor's name (or All for everyone) ? Kathleen Byron
Kathleen Byron was in Saving Private Ryan (1998) with Tom Hanks
Tom Hanks was in Apollo 13 (1995) with Kevin Bacon
Kathleen Byron's Bacon number is 2
```

Complex:

```
Wlecome to the Six Degree of Kevin Bacon.
if you tell me an actor's name, I'll connect them to Kevin Bacon through the movies they've appeared in.

Actor's name (or All for everyone) ? Berthillot, Ludovic
Berthillot, Ludovic was in Transit (2004 II) with Levantal, François
Levantal, François was in Sirène rouge, La (2002) with Bettenfeld, Dominique
Bettenfeld, Dominique was in Rivières pourpres, Les (2000) with Cassel, Vincent
Cassel, Vincent was in Birthday Girl (2001) with Kidman, Nicole
Kidman, Nicole was in Hours, The (2002) with Streep, Meryl
Streep, Meryl was in Lemony Snicket's A Series of Unfortunate Events (2004) with Hoffman, Dustin
Hoffman, Dustin was in Freedom2speak v2.0 (2004) with Clooney, George
Clooney, George was in Ocean's Twelve (2004) with Willis, Bruce
Willis, Bruce was in Fast Food Nation (2006) with Valderrama, Wilmer
Valderrama, Wilmer was in Beauty Shop (2005) with Bacon, Kevin
Berthillot, Ludovic's Bacon number is 10
```

```
Actor's name (or All for everyone) ? Silén, Johan
Silén, Johan was in Transport (2006) with Lemström, Sue
Lemström, Sue was in Aleksis Kiven elämä (2002) with Wiklund, Gustav
Wiklund, Gustav was in Äideistä parhain (2005) with Nyqvist, Michael
Nyqvist, Michael was in Skuggvärld (2005) with Forsberg, Jessica
Forsberg, Jessica was in Harrys döttrar (2005) with Langhelle, Jørgen
Langhelle, Jørgen was in Uno (2004) with Floberg, Bjørn
Floberg, Bjørn was in Dykkerne (2000) with Asholt, Jesper
Asholt, Jesper was in Når lysterne tændes (2001) with Thorn, Niels Anders
Thorn, Niels Anders was in Bertram & Co (2002) with Bue, Claus
Bue, Claus was in Kærlighed ved første hik 3 - Anja efter Viktor (2003) with Wanting, Mira
Wanting, Mira was in Auberge espagnole, L' (2002) with Tautou, Audrey
Tautou, Audrey was in Da Vinci Code, The (2006) with Hanks, Tom
Hanks, Tom was in Magnificent Desolation: Walking on the Moon 3D (2005) with Travolta, John
Travolta, John was in Be Cool (2005) with DeVito, Danny
DeVito, Danny was in Marilyn Hotchkiss Ballroom Dancing & Charm School (2005) with Spencer, Octavia
Spencer, Octavia was in Beauty Shop (2005) with Bacon, Kevin
Silén, Johan's Bacon number is 16
```

6. 总结和收获

通过此次实验，对于图的编写更加熟悉。

之前几次实验一开始就写结果写了很久之后发现有问题，于是这次先构思了很久才开始写。但是只想不写也缺乏感觉，下次可以以写接口的方式来构思，不具体实现方法，而是以抽象的方式进行架构。

在实验中，之前用到了用数组实现的循环队列，发现掌握有一点问题，太久没有写有些生疏，在运用不太熟练的类时，因先充分测试。

7. 参考文献

无。