MapReduce 实验五报告

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一、 实验内容

在给定的社交网络图中，统计图中所有三角形的数量。

一个社交网络可以看做是一张图。社交网络中的人对应于图的顶点；社交网络中的人际关系对应于图中的边。在本次实验任务中，只考虑一种关系，即用户之间的关注关系。

在统计前，需要先进行有向边到无向边的转换，依据如下逻辑转换：

IF (A→B) **OR** (B→A) **THEN** A-B

二、 设计思路

1. OR 逻辑：共有 3 个 MapReduce

第一趟 去重

两个邻接点 idA 和 idB 之间的关系为 link

Mapper1 <key,value>=<"idA-idB","link">

Reducer1 <key,value>=<"idA-idB",""">

第二趟 建立搜索关系

Map 将单独一个顶点作为 key，value 为所有与这个 key 邻接的点；Reduce 遍历某个 key 的 value 中的所有点，设 key 和 value 中每个点的关系为 link，再寻找 value 中邻接的两个点，设为 search。

Mapper2 <key,value>=<"idA","idB">

Reducer2 <key,value>=<"idA-idB","link"> <key,value>=<"idA-idB","search">

第三趟 统计三角形个数

Mapper3 <key,value>=<"idA-idB","link"> <key,value>=<"idA-idB","search">

Reducer3 <key,value>=<"The sum of triangle in social networks is", result+"">

2. AND 逻辑：共有 5 个 MapReduce

第一趟 去重

Mapper1 <key,value>=<"idA-idB",""">

Reducer1 <key,value>=<"idA-idB",""">

第二趟 建立搜索关系：寻找存在双向邻接关系的点 idA 和 idB

Mapper2 <key,value>=<"idA","idB">

Reducer2 <key,value>=<"idA-idB","link"> <key,value>=<"idB-idA","search">

第三趟 变成无向图

Mapper3 <key,value>=<"idA-idB","link"> <key,value>=<"idB-idA","search">

Reducer3 <key,value>=<"idA","idB">

第四趟 建立搜索关系

Mapper4 <key,value>=<"idA","idB">

Reducer4 <key,value>=<"idA-idB","link"> <key,value>=<"idA-idB","search">

第五趟 统计三角形个数

Mapper5 <key,value>=<"idA-idB","link"> <key,value>=<"idA-idB","search">

Reducer5 <key,value>=<"The sum of triangle in social networks is", result+"">

三、 程序代码

1、 OR 逻辑

Mapper1 ：

```
@Override
protected void map(LongWritable key, Text value, Context context) throws IOException,
    InterruptedException {
        String[] lines = value.toString().split("\\s+");
        String idA = lines[0];
        String idB = lines[1];
        if(idA.compareTo(idB)>0){
            String tmp = idA;
```

```
                idA = idB;
                idB = tmp;
                context.write(new Text(idA+"-"+idB),new Text("link"));
            }else if(idA.compareTo(idB)<0){
                context.write(new Text(idA+"-"+idB),new Text("link"));
            }

        }
```

Reducer1:

```
private Text value = new Text();
@Override
protected void reduce(Text key, Iterable<Text> values, Context context) throws IOException,
    InterruptedException {
        value.set("");
        context.write(key,value);
    }
```

Mapper2:

```
@Override
protected void map(LongWritable key, Text value, Context context) throws IOException,
    InterruptedException {
        Text idA = new Text() ;
        idA.set(value.toString().split("-")[0]);
        Text idB = new Text(value.toString().split("-")[1].trim());
        context.write(idA,idB);
    }
```

Reducer2:

```
  @Override
  protected void reduce(Text key, Iterable<Text> values, Context context) throws
IOException, InterruptedException {
      ArrayList<String> endList = new ArrayList<String>();
      Text edge = new Text();
      Text rel = new Text();
      rel.set("link");
      for(Text value:values){
         endList.add(value.toString());
         edge.set(key.toString()+"-"+value.toString());
         context.write(edge,rel);
      }
```

```
            rel.set("search");
            for(int i = 0; i<endList.size();i++){
                for(int j = i+1; j<endList.size();j++){
                    String a = endList.get(i);
                    String b = endList.get(j);
                    if(a.compareTo(b)<0){
                        edge.set(a+"-"+b);

                    }else{
                        edge.set(b+"-"+a);
                    }
                    context.write(edge,rel);
                }
            }
        }
```

Mapper3:

```
@Override
protected void map(LongWritable key, Text value, Context context) throws IOException,
    InterruptedException {
        if(value.toString().trim().length()>0){
            String[] line = value.toString().split("\t");
            if(line.length >=2)
            context.write(new Text(line[0].trim()),new Text(line[1].trim()));
        }
    }
```

Reducer3:

```
private static long   result = 0;
@Override
protected void reduce(Text key, Iterable<Text> values, Context context) throws IOException,
    InterruptedException {
        long count = 0;
        boolean flag = false;
        for (Text value:values){
            if(value.toString().trim().equals("link")){
                flag = true;
            }
            else{
                count++;
            }
        }
        if(flag)result += count;
```

```
    }

@Override
protected void cleanup(Context context) throws IOException, InterruptedException {
        context.write(new Text("The sum of triangle in social networks is"),new Text(result+""));
    }
```

2、 AND 逻辑

Mapper1:

```
@Override
protected void map(LongWritable key, Text value, Context context) throws IOException,
    InterruptedException {
            String[] lines = value.toString().split("\\s+");
            String idA = lines[0];
            String idB = lines[1];
            context.write(new Text(idA+"-"+idB),new Text(""));
 }
```

Reducer1:

```
private Text value = new Text();
@Override
protected void reduce(Text key, Iterable<Text> values, Context context) throws IOException,
    InterruptedException {
            value.set("");
            context.write(key,value);
    }
```

Mapper2:

```
@Override
protected void map(LongWritable key, Text value, Context context) throws IOException,
InterruptedException {
            Text idA = new Text() ;
            String[] tmp = value.toString().split("-");
            idA.set(tmp[0].trim());
            Text idB = new Text(tmp[1].trim());
            context.write(idA,idB);
            }
```

Reducer2:

```
@Override
protected void reduce(Text key, Iterable<Text> values, Context context) throws IOException,
    InterruptedException {
```

```
        Text edge = new Text();
        Text rel = new Text();
        for(Text value:values){
            edge.set(key.toString()+"-"+value.toString());
            rel.set("link");
            context.write(edge,rel);
            edge.set(value.toString()+"-"+key.toString());
            rel.set("search");
            context.write(edge,rel);
            context.progress();
        }
    }
```

Mapper3:

```
@Override
protected void map(LongWritable key, Text value, Context context) throws IOException,
    InterruptedException {

        String[] line = value.toString().split("\t");
        if(line.length >=2)
            context.write(new Text(line[0].trim()),new Text(line[1].trim()));

    }
```

Reducer3:

```
@Override
protected void reduce(Text key, Iterable<Text> values, Context context) throws IOException,
    InterruptedException {
     boolean isLink = false;
     boolean isSearch = false;
     for(Text value:values){
        String rel = value.toString();
        if(rel.equals("link")){
            isLink = true;
        }else if(rel.equals("search")){
            isSearch = true;
        }
     }
     if(isLink&&isSearch){
        String[] edge = key.toString().split("-");
        if(edge[0].compareTo(edge[1])<0){
```

```
                    context.write(new Text(edge[0]),new Text(edge[1]));
                }
            }
        }
```

其他 map、reduce 代码和 OR 逻辑一样

四、 运行结果

OR 结果统计：

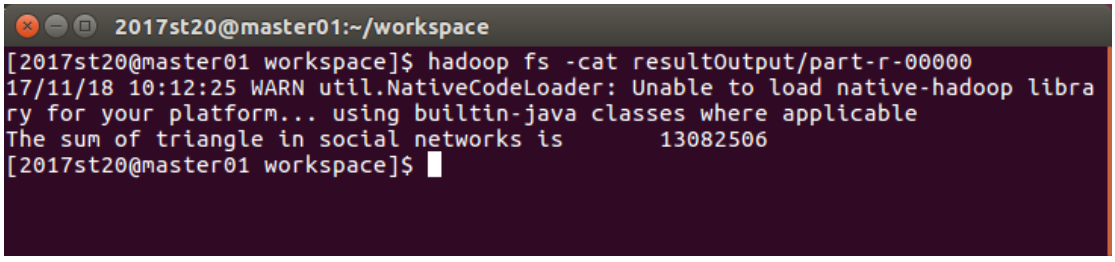
数据集	三角形个数	集群运行时间
Twitter	13082506	21min37sec
Google+	没有运行成功	没有运行成功

AND 结果统计：

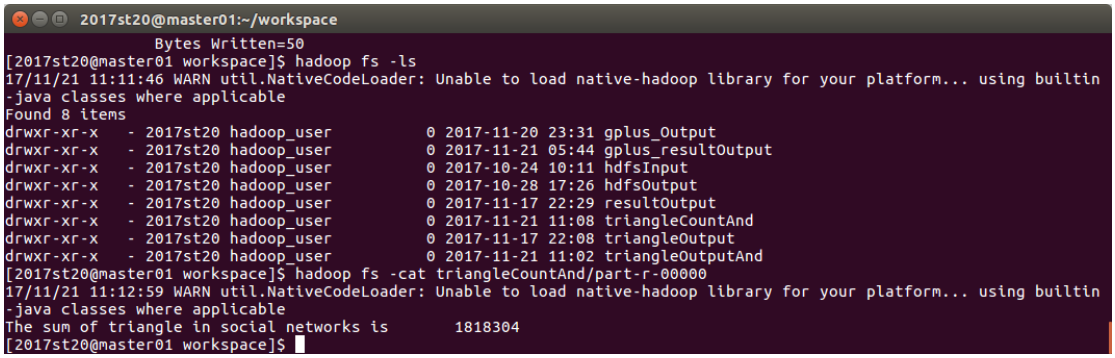
数据集	三角形个数	集群运行时间
Twitter	1818304	2min9sec
Google+	27018510	40min56sec

运行结果截图：

Twitter OR：resultOutput/part-r-00000



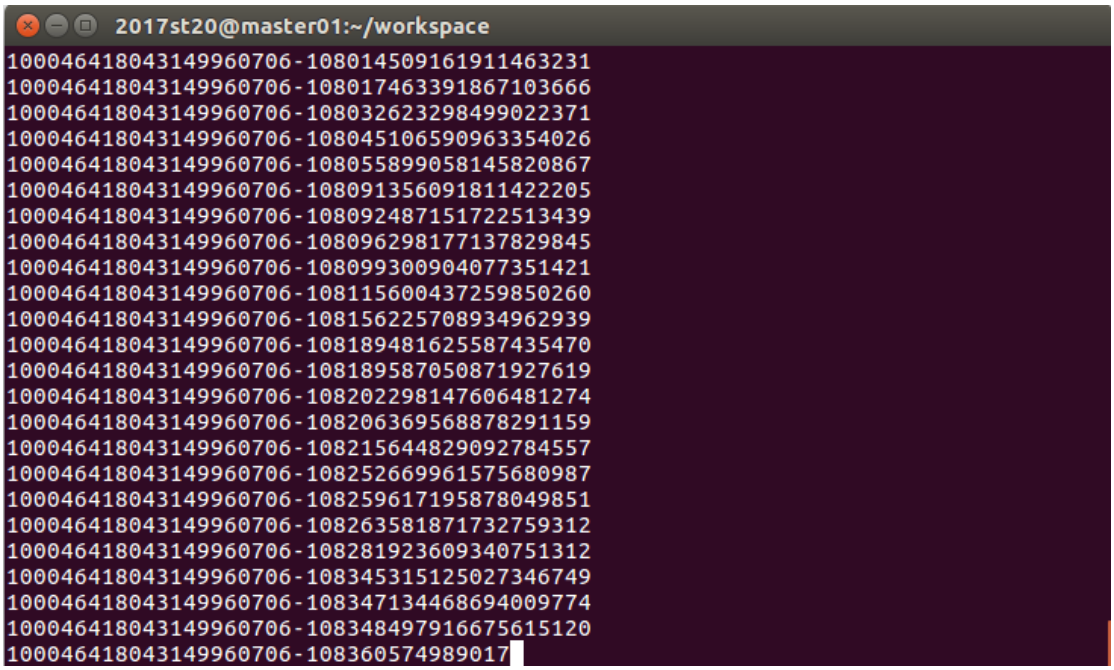
Twitter AND：triangleCountAnd/part-r-00000

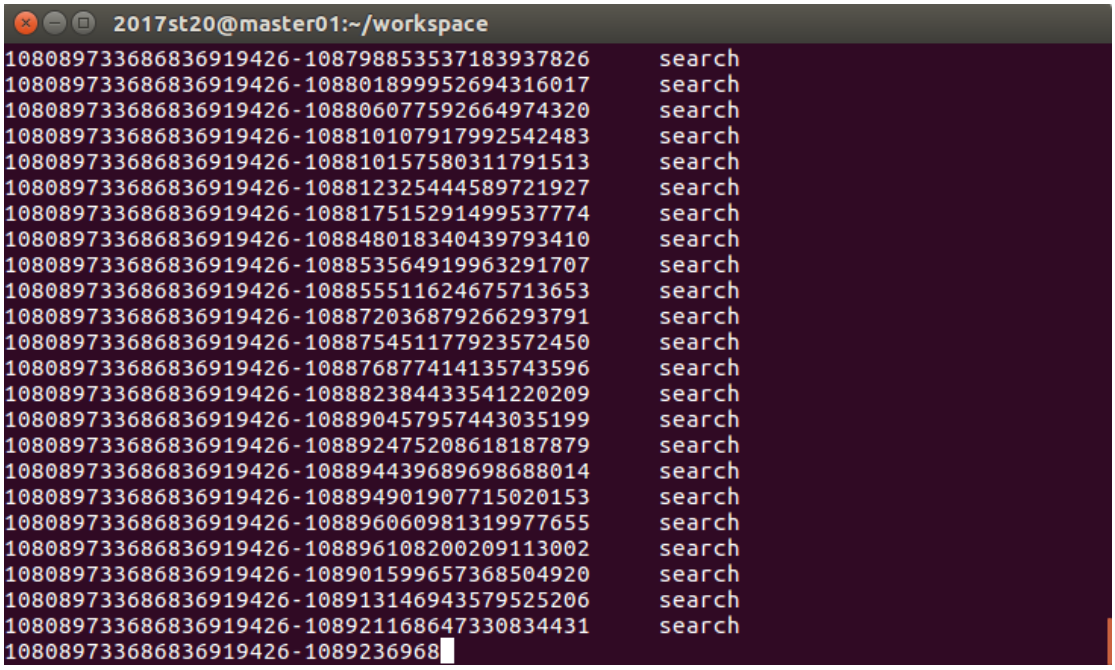


Google+ OR：gplus_resultOutput/part-r-00000

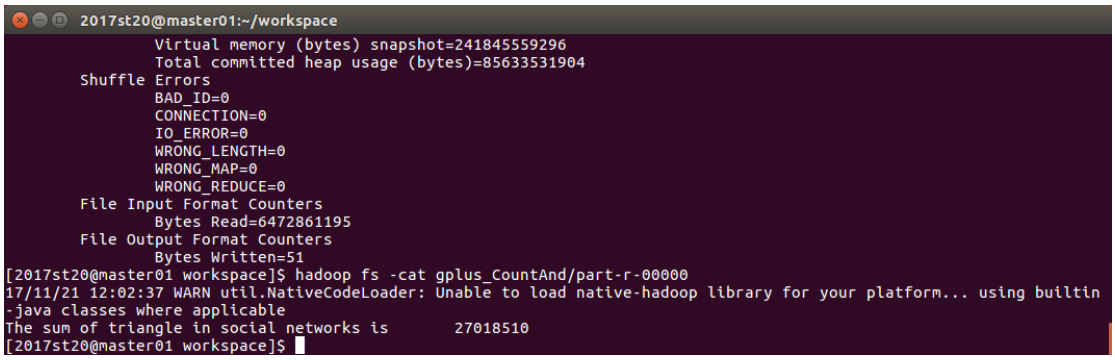
第三趟没有运行成功，前两趟运行成功，前两趟结果分别在

gplus_Output/tmp/step1/part-r-00000　　gplus_Output/tmp/step2/part-r-00000





Google+ AND：gplus_CountAnd/part-r-00000



WebUI 执行报告：

Twitter OR：

application_1508726229114_1534	2017st20	graphTriangleCount.jar	MAPREDUCE	root.2017st20	Fri Nov 17 22:20:04 +0800 2017	Fri Nov 17 22:29:58 +0800 2017	FINISHED	SUCCEEDED	History
application_1508726229114_1531	2017st20	graphTriangleCount.jar	MAPREDUCE	root.2017st20	Fri Nov 17 22:10:01 +0800 2017	Fri Nov 17 22:19:52 +0800 2017	FINISHED	SUCCEEDED	History
application_1508726229114_1530	2017st20	graphTriangleCount.jar	MAPREDUCE	root.2017st20	Fri Nov 17 22:08:21 +0800 2017	Fri Nov 17 22:09:55 +0800 2017	FINISHED	SUCCEEDED	History

Twitter AND：

application_1508726229114_2075	2017st20	Job5	MAPREDUCE	root.2017st20	Tue Nov 21 11:06:25 +0800 2017	Tue Nov 21 11:08:26 +0800 2017	FINISHED	SUCCEEDED	History
application_1508726229114_2074	2017st20	Job4	MAPREDUCE	root.2017st20	Tue Nov 21 11:05:32 +0800 2017	Tue Nov 21 11:06:22 +0800 2017	FINISHED	SUCCEEDED	History
application_1508726229114_2073	2017st20	Job3	MAPREDUCE	root.2017st20	Tue Nov 21 11:03:51 +0800 2017	Tue Nov 21 11:05:24 +0800 2017	FINISHED	SUCCEEDED	History
application_1508726229114_2072	2017st20	Job2	MAPREDUCE	root.2017st20	Tue Nov 21 11:03:04 +0800 2017	Tue Nov 21 11:03:48 +0800 2017	FINISHED	SUCCEEDED	History
application_1508726229114_2071	2017st20	Job1	MAPREDUCE	root.2017st20	Tue Nov 21 11:02:17 +0800 2017	Tue Nov 21 11:03:01 +0800 2017	FINISHED	SUCCEEDED	History

Google+ OR：

application_1508726229114_2048	2017st20	graphTriangleCount.jar	MAPREDUCE	root.2017st20	Tue Nov 21 05:44:06 +0800 2017	N/A	RUNNING	UNDEFINED	ApplicationMaster
application_1508726229114_2034	2017st20	graphTriangleCount.jar	MAPREDUCE	root.2017st20	Mon Nov 20 23:34:43 +0800 2017	Tue Nov 21 05:44:03 +0800 2017	FINISHED	SUCCEEDED	History
application_1508726229114_2033	2017st20	graphTriangleCount.jar	MAPREDUCE	root.2017st20	Mon Nov 20 23:30:47 +0800 2017	Mon Nov 20 23:34:30 +0800 2017	FINISHED	SUCCEEDED	History

Google+ AND

application_1508726229114_2082	2017st20	Job5	MAPREDUCE	root.2017st20	Tue Nov 21 11:47:05 +0800 2017	Tue Nov 21 12:01:45 +0800 2017	FINISHED	SUCCEEDED		History
application_1508726229114_2079	2017st20	Job4	MAPREDUCE	root.2017st20	Tue Nov 21 11:38:10 +0800 2017	Tue Nov 21 11:47:00 +0800 2017	FINISHED	SUCCEEDED		History
application_1508726229114_2078	2017st20	Job3	MAPREDUCE	root.2017st20	Tue Nov 21 11:30:36 +0800 2017	Tue Nov 21 11:38:06 +0800 2017	FINISHED	SUCCEEDED		History
application_1508726229114_2077	2017st20	Job2	MAPREDUCE	root.2017st20	Tue Nov 21 11:25:21 +0800 2017	Tue Nov 21 11:30:29 +0800 2017	FINISHED	SUCCEEDED		History
application_1508726229114_2076	2017st20	Job1	MAPREDUCE	root.2017st20	Tue Nov 21 11:20:49 +0800 2017	Tue Nov 21 11:25:18 +0800 2017	FINISHED	SUCCEEDED		History

五、 性能分析、不足和改进

由于此次实验数据量较大，运行过程比较慢，中间结果的数据量应该尽量简化。此次实验运行速度较慢，还会出现运行到某一趟 MapReduce 时失败的情况，中途失败可以不用重新运行，直接从失败的那一趟 MapReduce 开始运行，读取之前已经写好中间结果。

六、 实验感想

这次实验是实现社交网络图的三角形计数，在实验过程中， 学会了使用多趟 MapReduce 程序串行进行处理数据，逐渐熟悉了 MapReduce 处理数据的框架和过程，对以后的使用大有益处。