第五次上机实验报告

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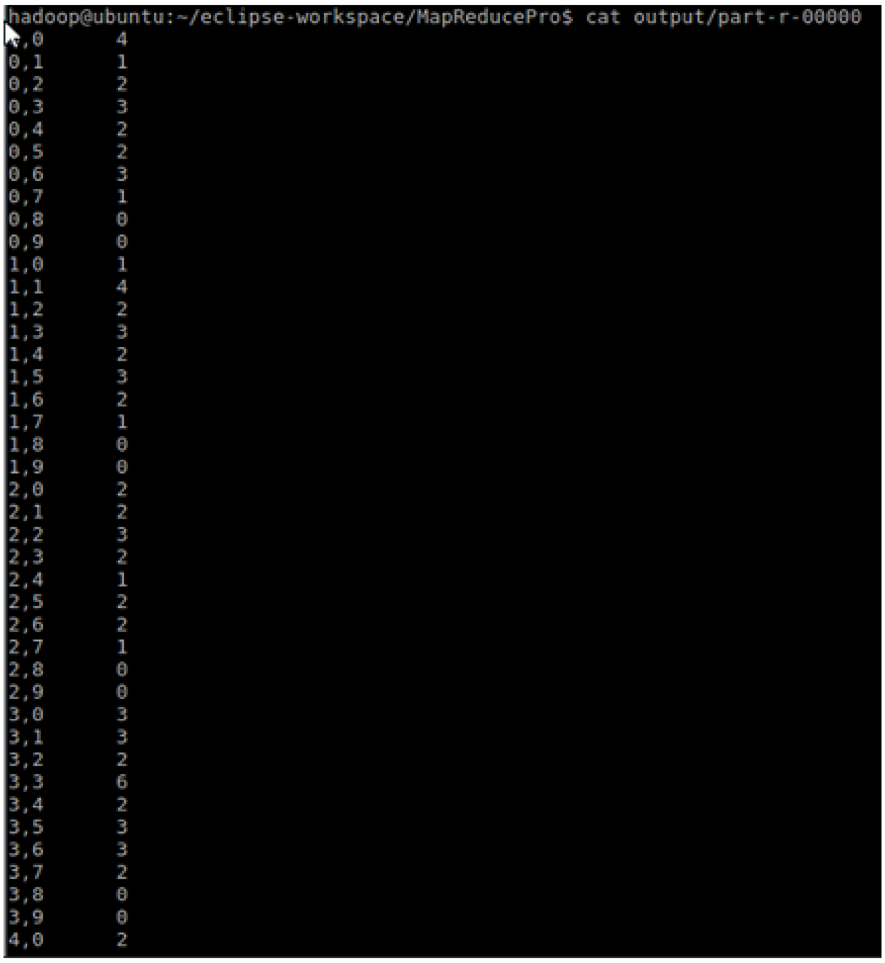
矩阵乘法

1. 用 `mapreduce` 实现矩阵乘法的关键在于分析乘积矩阵C中的每个元素是由A和B中的哪些元素相乘然后相加得到的。
2. 在 `map` 阶段根据文件名是A还是B。把来自矩阵A的元素aij，标识成p条 `<key, value>` 的形式，`key="i,k",（k=1,2,...,p）, value="a,j,aij”`
3. 把来自矩阵B的元素bij，标识成m条 `<key, value>` 形式，`key="k,j"（k=1,2,...,m）, value="b,i,bij"`
4. 这样一来，计算cij需要的A和B中的元素就转变为有相同 `key（"i,j"）` 的数据对，其 `value` 被分到同一个 `Iterable` 中，把其中来自A的和来自B的对应的元素对相乘，然后相加得到cij的值。



```
hadoop@ubuntu:~/eclipse-workspace/MapReducePro$ cat output/part-r-00000
0,0	4
0,1	1
0,2	2
0,3	3
0,4	2
0,5	2
0,6	3
0,7	1
0,8	0
0,9	0
1,0	1
1,1	4
1,2	2
1,3	3
1,4	2
1,5	3
1,6	2
1,7	1
1,8	0
1,9	0
2,0	2
2,1	2
2,2	3
2,3	2
2,4	1
2,5	2
2,6	2
2,7	1
2,8	0
2,9	0
3,0	3
3,1	3
3,2	2
3,3	6
3,4	2
3,5	3
3,6	3
3,7	2
3,8	0
3,9	0
4,0	2
```

```
public void map(LongWritable key, Text value, Context context) throws IOException, Inte
            String fileName = ((FileSplit) context.getInputSplit()).getPath().getName()
            String[] tokens = value.toString().split(",");
            if (tokens.length != 3) {
                System.out.println("len error");
                return;
            }
            int i, j, e;
            try {
                i = Integer.parseInt(tokens[0]);
                j = Integer.parseInt(tokens[1]);
                e = Integer.parseInt(tokens[2]);
            } catch (NumberFormatException e_) {
                System.out.println("Integer cast error");
                return;
            }
            if (e == 0)
                return;
            if (fileName.equals("A")) {
                String va = "a," + j + "," + e;
                for (int k = 0; k < p; k++) {
                    String ke = i + "," + k;
                    context.write(new Text(ke), new Text(va));
                }
            } else if (fileName.equals("B")) {
                String va = "b," + i + "," + e;
                for (int k = 0; k < m; k++) {
                    String ke = k + "," + j;
                    context.write(new Text(ke), new Text(va));
                }
            } else {
                System.out.println("fileName error");
            }
        }
    public void reduce(Text key, Iterable<Text> values, Context context) throws IOExcep
        Map<Integer,Integer> map = new HashMap<Integer, Integer>();
        int sum = 0;
        for (Text val : values) {
            String[] tokens = val.toString().split(",");
            if (tokens.length != 3) {
                System.out.println("len error");
                break;
            }
            int ij, e;
            try {
                ij = Integer.parseInt(tokens[1]);
                e = Integer.parseInt(tokens[2]);
            } catch (NumberFormatException e_) {
                System.out.println("Integer cast error");
                return;
            }
            if(map.containsKey(ij)) {
                sum+=e*map.get(ij);
                map.remove(ij);
            }else {
                map.put(ij, e);
            }
        }

        context.write(key, new Text(" " + sum));
    }
```

PageRank

PageRank一次迭代

利用预处理之后的文件，并应用MapReduce乘法算法，进行一次迭代。 其中 `PageRank` 的 `Mappper` 部分如下：

```
public static class TokenizerMapper extends Mapper<LongWritable, Text, Text, Text> {
  public void map(LongWritable key, Text value, Context context) throws IOException, In
      System.out.println(value.toString());
      String[] tokens = value.toString().split("\t");
      int firstComma = tokens[1].indexOf(',');
      if (firstComma <= 0) {
          return;
      }
      String rankStr = tokens[1].substring(0, firstComma);
      String linksStr = tokens[1].substring(firstComma + 1);
      String[] linksto = linksStr.split(",");
      String url = tokens[0].trim();
      float rank;
      try {
          rank = Float.parseFloat(rankStr);
      } catch (NumberFormatException e_) {
          System.out.println("Float cast error" + rankStr);
          return;
      }
      rank /= linksto.length;
```

```
        for (String u:linksto) {
            context.write(new Text(u), new Text("" + rank));
        }
        context.write(new Text(url), new Text("," + linksStr));
    }
}
```

Reducer 部分代码如下

```
public static class MmSumReducer extends Reducer {
  public void reduce(Text key, Iterable<Text> values, Context context) throws IOExcepti
        String linksStr = "";
        float sum = 0;
        for (Text val : values) {
            String valStr = val.toString();
            if (valStr.charAt(0) == ',') {
                linksStr = valStr;
            } else {
                float valFloat;
                try {
                    valFloat = Float.parseFloat(valStr);
                } catch (NumberFormatException e_) {
                    System.out.println("Float cast error" + valStr);
                    continue;
                }
                sum += valFloat;
            }
        }
        float newRank = sum * d + (1 - d) / N;
        context.write(key, new Text(newRank + linksStr));
    }
}
```

PageRank反复迭代

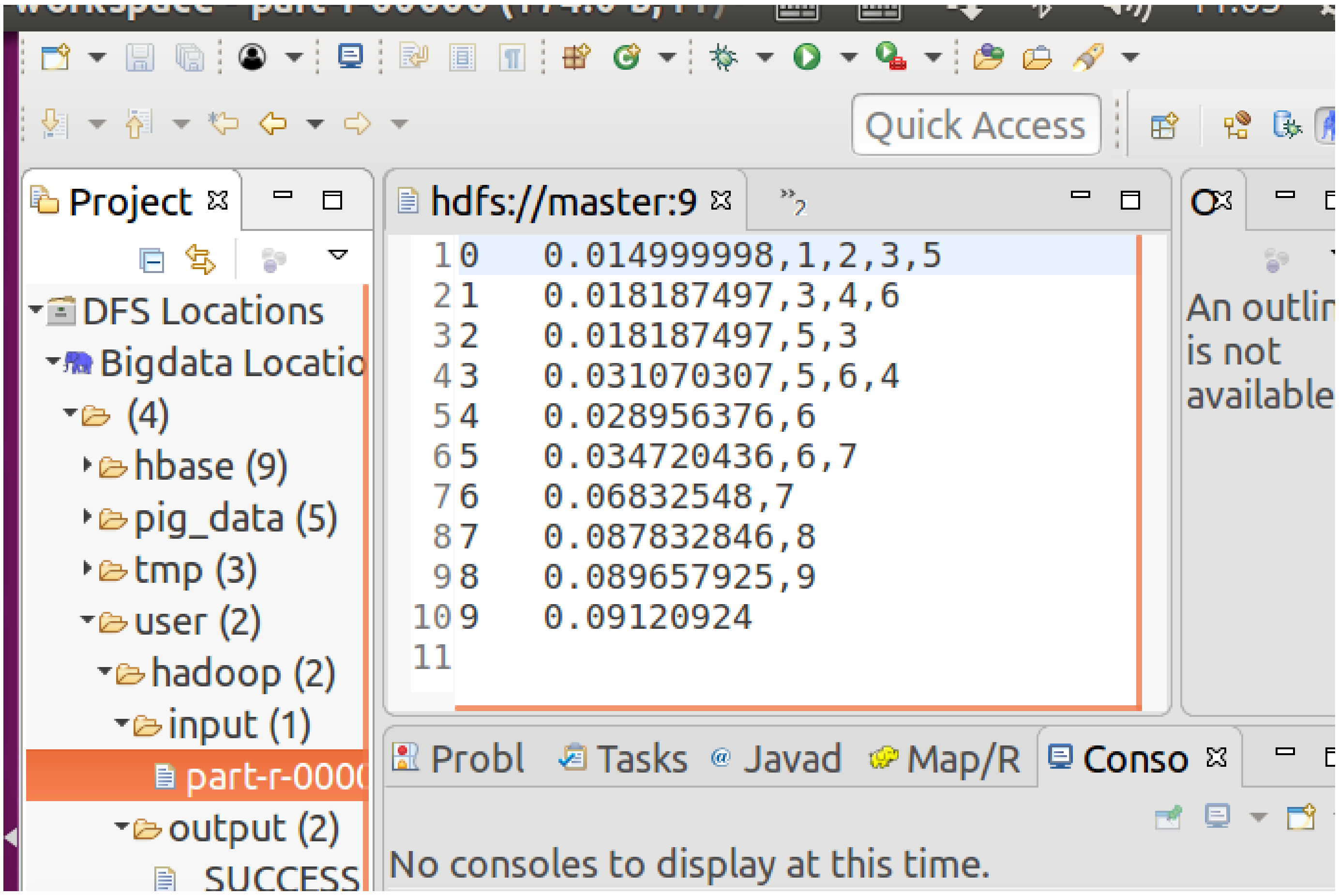
由于一次 mapreduce 只能运算一次，为了实现反复迭代，采用迭代式的 mapreduce。将前一次 mapreduce 产生的 output 文件作为后一次 mapreduce 的 intput 文件。并每次计算两个文件的差别，在差别达到目标精度 precision 时或达到最大迭代次数时停止迭代。 比较两个文件的代码如下：

```
public static ArrayList readList(FileSystem fs, Path p) throws Exception{
    BufferedReader file = new BufferedReader(new InputStreamReader(fs.open(p)));
    ArrayList l = new ArrayList<>();
    String line = file.readLine();
    while(line != null) {
        line = line.split("\t")[1];
        Float f = Float.parseFloat(line.split(",")[0]);
        l.add(f);
        line = file.readLine();
    }
    return l;
}
public static float distance(ArrayList l1, ArrayList l2) {
    float f = 0;
    for(int i=0; i<l1.size();++i) {
        f += (l1.get(i) - l2.get(i)) * (l1.get(i) - l2.get(i));
    }
    return f;
}
public static boolean compare(FileSystem fs, Path p1, Path p2, float precision) throws
    ArrayList l1 = readList(fs, p1);
    ArrayList l2 = readList(fs, p2);
    float f = distance(l1, l2);
    return f < precision;
}
```

迭代的主循环代码如下:

```

for(int i=0; i<7; i++) {
    System.out.println("task:" + Integer.toString(i));
    Job job = new Job(conf, "word count");
    job.setJarByClass(PageRank.class);
    job.setMapperClass(TokenizerMapper.class);
    job.setReducerClass(MmSumReducer.class);
    job.setMapOutputKeyClass(Text.class);
    job.setMapOutputValueClass(Text.class);
    job.setOutputKeyClass(Text.class);
    job.setOutputValueClass(Text.class);
    // input, output
    FileInputFormat.addInputPath(job, input);
    FileOutputFormat.setOutputPath(job, output);

    job.submit();
    while(!job.isComplete()) continue;
    job.killJob();

    boolean b = compare(fs, pi, po, 0.01f);
    System.out.println(b);
    if(b)
```

```
        break;

    // move file
    FileUtil.copy(fs, po, fs, pi, true,true,conf);
    fs.delete(output, true);
```



```
0	0.014999998,1,2,3,5
1	0.018187497,3,4,6
2	0.018187497,5,3
3	0.031070307,5,6,4
4	0.028956376,6
5	0.034720436,6,7
6	0.06832548,7
7	0.087832846,8
8	0.089657925,9
9	0.09120924
```

No consoles to display at this time.