实验3： MapReduce和Spark编程实验

1. 实验任务

1. MapReduce：
    - 统计各省的双十一前十热门关注产品（“点击+添加购物车+购买+关注”总量最多前10的产品）
    - 统计各省的双十一前十热门销售产品（购买最多前10的产品）
2. Hive
    - 把精简数据集导入到数据仓库Hive中，并对数据仓库Hive中的数据进行查询分析
    - 查询双11那天有多少人购买了商品
    - 查询双11那天男女买家购买商品的比例
    - 查询双11那天浏览次数前十的品牌
3. Spark：
    - 统计各省销售最好的产品类别前十（销售最多前10的产品类别）
    - 统计各省的双十一前十热门销售产品（购买最多前10的产品）-- 和MapReduce作业对比结果
    - 查询双11那天浏览次数前十的品牌 -- 和Hive作业对比结果
4. 数据挖掘：
    - 针对预处理后的训练集和测试集，基于MapReduce或Spark MLlib编写程序预测回头客
    - 评估预测准确率

2. 实验环境

- Java 1.8+
- Hadoop 3.2.x
- Spark 2.4.x
- Hive 2.3.x

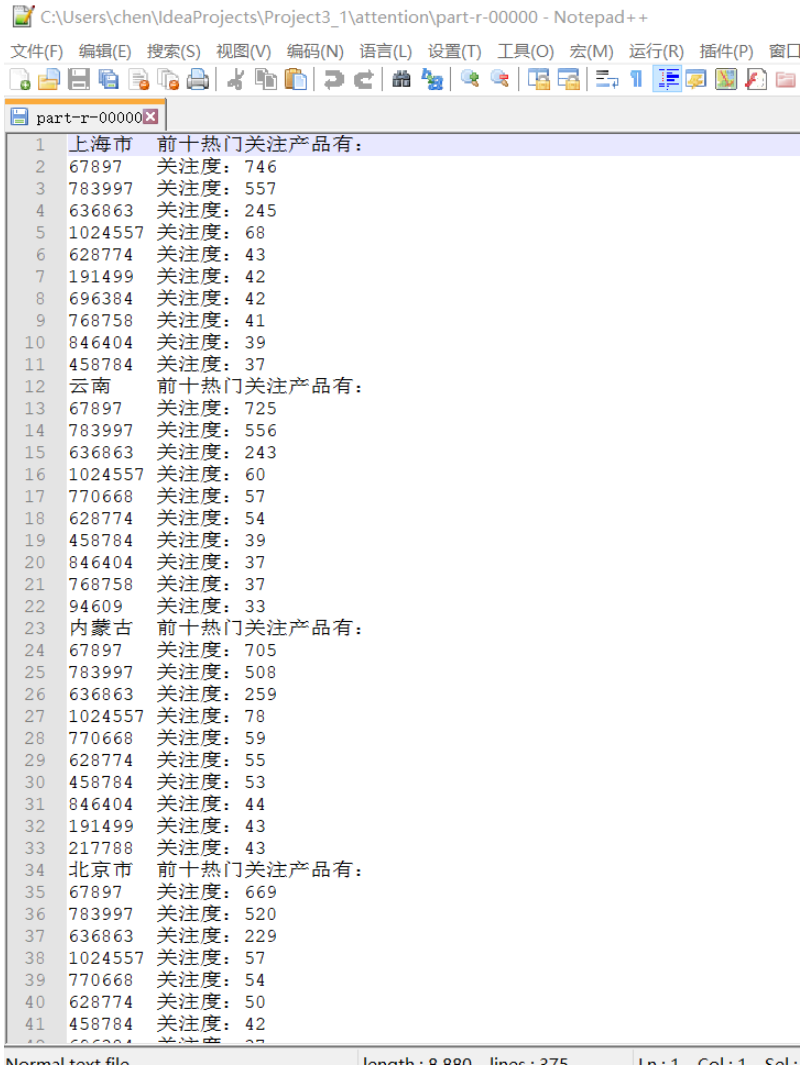
3. 实验过程

3.1 MapReduce（代码分别见Attention.java和Sell.java）

- 统计各省的双十一前十热门关注产品

命令行参数：<输入文件路径>

- 统计各省的双十一前十热门销售产品



命令行参数：<输入文件路径>

3.2 Hive：

- 把精简数据集导入到数据仓库Hive中

```
hive> DESCRIBE test;
OK
userid                  string                  USERID
brandid                 string                  BRANDID
action                  string                  ACTION
gender                  string                  GENDER
Time taken: 0.033 seconds, Fetched: 4 row(s)
hive> SELECT count(*) FROM test;
-chgrp: 'DESKTOP-OUAET50\chen' does not match expected pattern for group
Usage: hadoop fs [generic options] -chgrp [-R] GROUP PATH...
Query ID = chen_20191123154835_b3803dab-5f9e-423f-886d-c34859bb0926
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Job running in-process (local Hadoop)
2019-11-23 15:48:37,218 Stage-1 map = 100%,  reduce = 100%
Ended Job = job_local2073606011_0018
MapReduce Jobs Launched:
Stage-Stage-1:  HDFS Read: 299291708 HDFS Write: 33254784 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
999999
Time taken: 1.44 seconds, Fetched: 1 row(s)
```

- 查询双11那天有多少人购买了商品

```
SELECT count(DISTINCT userid) as num FROM test
WHERE action = '2';
```

输出37202

```
hive> SELECT count(DISTINCT userid) as num FROM test WHERE action = '2';
-chgrp: 'DESKTOP-OUAET50\chen' does not match expected pattern for group
Usage: hadoop fs [generic options] -chgrp [-R] GROUP PATH...
Query ID = chen_20191123154612_d7c8511c-c21b-44cc-b1bf-9edc9e12d80c
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Job running in-process (local Hadoop)
2019-11-23 15:46:14,312 Stage-1 map = 100%,  reduce = 100%
Ended Job = job_local1497605306_0015
MapReduce Jobs Launched:
Stage-Stage-1:  HDFS Read: 199529378 HDFS Write: 33254784 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
37202
Time taken: 1.466 seconds, Fetched: 1 row(s)
```

- 查询双11那天男女买家购买商品的比例

```
SELECT count(gender) as num FROM test WHERE
action = '2' and gender = '0';
SELECT count(gender) as num FROM test WHERE
action = '2' and gender = '1';
```

分别输出38932和39058

```
hive> SELECT count(gender) as num FROM test WHERE action = '2' and gender = '1';
-chgrp: 'DESKTOP-OUAET50\chen' does not match expected pattern for group
Usage: hadoop fs [generic options] -chgrp [-R] GROUP PATH...
Query ID = chen_20191123154722_d2871755-634d-4125-9583-da0f051377d9
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Job running in-process (local Hadoop)
2019-11-23 15:47:23,558 Stage-1 map = 100%,  reduce = 100%
Ended Job = job_local1650853851_0017
MapReduce Jobs Launched:
Stage-Stage-1:  HDFS Read: 266037598 HDFS Write: 33254784 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
38932
Time taken: 1.447 seconds, Fetched: 1 row(s)
```

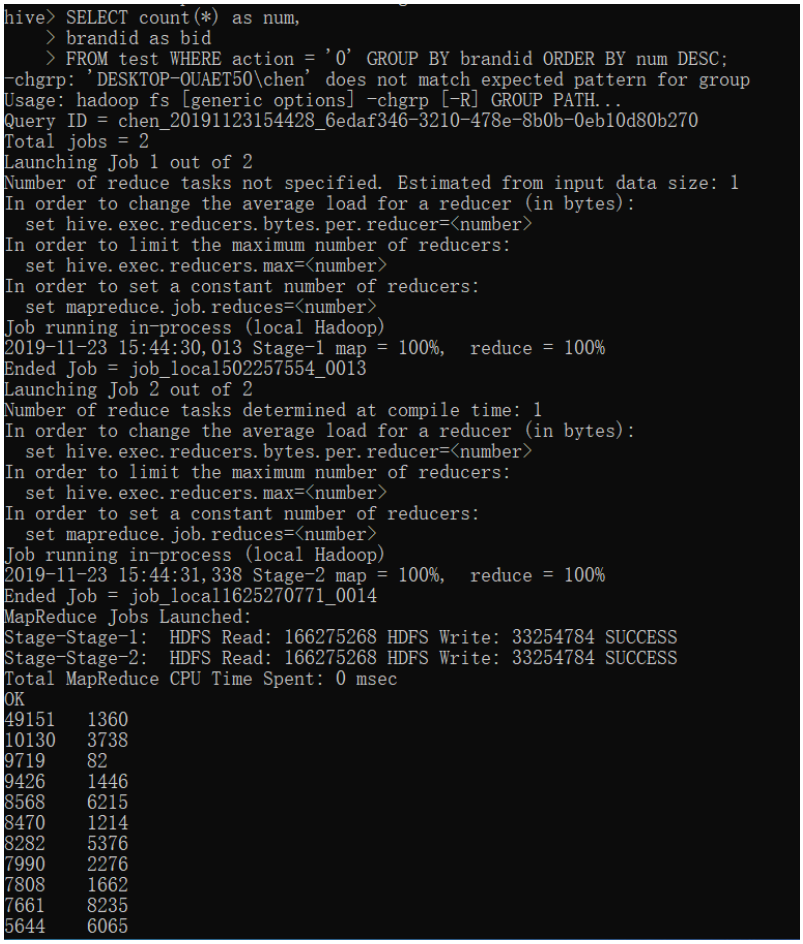
```
hive> SELECT count(gender) as num FROM test WHERE action = '2' and gender = '0';
-chgrp: 'DESKTOP-OUAET50\chen' does not match expected pattern for group
Usage: hadoop fs [generic options] -chgrp [-R] GROUP PATH...
Query ID = chen_20191123154642_6ee90c78-79f3-4415-82cc-efbf09c695b2
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Job running in-process (local Hadoop)
2019-11-23 15:46:43,596 Stage-1 map = 100%,  reduce = 100%
Ended Job = job_local1071604233_0016
MapReduce Jobs Launched:
Stage-Stage-1:  HDFS Read: 232783488 HDFS Write: 33254784 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
39058
Time taken: 1.492 seconds, Fetched: 1 row(s)
```

- 查询双11那天浏览次数前十的品牌

```
SELECT count(*) as num brandid as bid FROM test
WHERE action = '0' GROUP BY brandid ORDER BY num
DESC;
```

数量	品牌

数量	品牌
49151	1360
10130	3738
9719	82
9426	1446
8568	6215
8470	1214
8282	5376
7990	2276
7808	1662
7661	8235



3.3 Spark（代码见task3.py）

- 统计各省销售最好的产品类别前十（销售最多前10的产品类别）

```
[('青海', [656, 1208, 1142, 1401, 737, 602, 1213, 662, 177, 389]),
 ('黑龙江', [656, 1208, 177, 1213, 1401, 602, 662, 1142, 737, 389]),
 ('澳门', [656, 1208, 1213, 602, 662, 177, 1142, 737, 1401, 1438]),
 ('台湾', [656, 602, 1208, 1213, 662, 389, 1438, 1142, 177, 1401]),
 ('湖南', [656, 1213, 737, 1208, 602, 177, 1142, 662, 389, 1401]),
 ('香港', [656, 1208, 602, 1213, 389, 662, 737, 1401, 1142, 420]),
 ('江苏', [656, 1208, 662, 602, 1213, 737, 177, 1438, 1401, 1142]),
 ('宁夏', [656, 1208, 602, 737, 662, 177, 1213, 1438, 1401, 1142]),
 ('内蒙古', [1208, 656, 662, 602, 177, 737, 1142, 1401, 389, 1611]),
 ('湖北', [656, 1208, 1213, 602, 737, 662, 1401, 1142, 177, 389]),
 ('江西', [656, 1208, 602, 737, 177, 662, 1213, 1142, 1401, 389]),
 ('新疆', [1208, 656, 737, 662, 1213, 177, 1401, 602, 1438, 389]),
 ('广东', [656, 1208, 602, 1401, 420, 1213, 1142, 737, 389, 662]),
 ('云南', [1208, 656, 177, 1142, 737, 662, 602, 1401, 1611, 1553]),
 ('河北', [1208, 656, 602, 662, 737, 1142, 1213, 1401, 1553, 389]),
 ('上海市', [656, 602, 1208, 1142, 177, 1213, 1401, 662, 737, 389]),
 ('山西', [656, 1208, 1401, 602, 177, 1213, 1142, 664, 420, 737]),
 ('天津市', [1208, 656, 1213, 602, 662, 1142, 389, 737, 177, 664]),
 ('陕西', [1208, 656, 602, 1213, 177, 1142, 662, 389, 737, 1401]),
 ('海南', [1208, 656, 177, 1213, 1401, 389, 602, 662, 1553, 1438]),
 ('安徽', [656, 1208, 602, 737, 1213, 1401, 662, 664, 420, 1142]),
 ('河南', [656, 1208, 1401, 602, 737, 177, 1213, 389, 898, 662]),
 ('福建', [1208, 656, 662, 177, 602, 389, 1213, 1142, 1401, 737]),
 ('甘肃', [1208, 656, 602, 177, 737, 1213, 662, 1553, 389, 1142]),
 ('贵州', [1208, 656, 602, 1213, 1142, 737, 1553, 389, 662, 1401]),
 ('广西', [656, 1208, 602, 737, 662, 389, 1401, 1142, 1213, 1611]),
 ('西藏', [656, 1208, 662, 177, 389, 602, 1142, 737, 1213, 1438]),
 ('浙江', [1208, 656, 602, 177, 662, 737, 664, 1142, 1213, 1401]),
 ('辽宁', [1208, 656, 177, 602, 662, 1401, 1213, 1438, 1142, 737]),
 ('吉林', [656, 1208, 602, 177, 389, 737, 662, 1438, 1213, 664]),
 ('山东', [656, 1208, 602, 662, 389, 1142, 177, 737, 1401, 420]),
 ('重庆市', [1208, 656, 1213, 177, 602, 662, 737, 1401, 389, 1553]),
 ('北京市', [656, 602, 1208, 177, 1213, 737, 1142, 1438, 662, 1401]),
 ('四川', [656, 1208, 602, 737, 662, 420, 1401, 1553, 177, 1213])]
```

- 统计各省的双十一前十热门销售产品（购买最多前10的产品）-- 和MapReduce作业对比结果

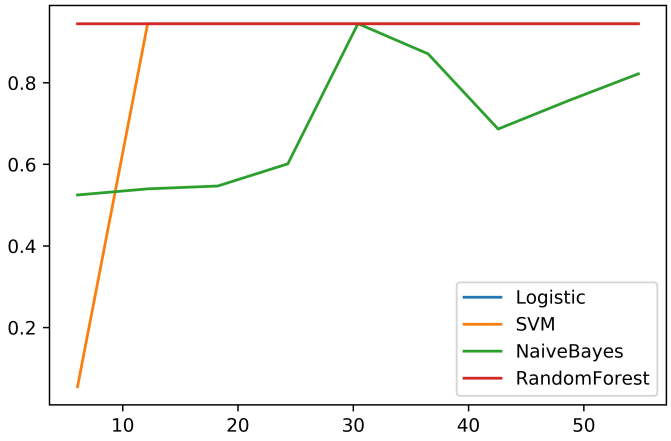
```
[('江西',
  [191499,
   349999,
   107407,
   698879,
   181387,
   229233,
   676215,
   783997,
   713695,
   514725]),
 ('河南',
  [191499,
   1059899,
   713695,
   353560,
   203050,
   48664,
   735931,
   316514,
   758374,
   783997]),
 ('贵州',
  [936203,
   179830,
   783997,
   713695,
   823766,
   343432,
   353560,
   28895,
   191499,
   89953]),
 ('湖北',
```

- 查询双11那天浏览次数前十的品牌 -- 和Hive作业对比结果

```
+-----+-----+
|brand|count|
+-----+-----+
| 1360|49151|
| 3738|10130|
|   82| 9719|
| 1446| 9426|
| 6215| 8568|
| 1214| 8470|
| 5376| 8282|
| 2276| 7990|
| 1662| 7808|
| 8235| 7661|
+-----+-----+
only showing top 10 rows
```

3.4 数据挖掘（代码见task4.py）：

- 使用MLlib中Logistic、SVM、NaiveBayes和RandomForest编写程序
- 使用 age_range 和 gender 进行预测
- 将train_after按照70%:30%划分成训练集和测试集
- 使用accuracy_score对预测的准确率进行评估
- 通过**改变训练集中正反例的比例**，每个算法训练十个模型，绘出训练集中正反例比例与预测的准确率的图像



- data.txt是对test_after的预测