

实验二: SPARK 基础编程方法

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1 实验目的

- 理解 SPARK 工作流程;
- 掌握 SPARK 基础编程方法.

2 实验平台

- OS: Linux
- Hadoop v3.1.3
- JDK v1.8
- Spark: 3.4.0

3 实验步骤

3.1 数据去重

3.1.1 Problem Description

描述: 编写独立应用程序实现数据去重, 对于两个输入文件 A 和 B, 编写 Spark 独立应用程序 (推荐使用 Scala 语言), 对两个文件进行合并, 并剔除其中重复的内容, 得到一个新的文件 C。(文件 A, B 如下) .

Input(输入文件 A):

```
20170101 x
20170102 y
20170103 x
20170104 y
20170105 z
20170106 z
```

Input(输入文件 B):

```
20170101 y
20170102 y
20170103 x
20170104 z
20170105 y
```

Expected output:

20170101 x
20170101 y
20170102 y
20170103 x
20170104 y
20170104 z
20170105 y
20170105 z
20170106 z

3.1.2 Code

```
package net.homework

import org.apache.spark.SparkConf
import org.apache.spark.SparkContext
import org.apache.spark.SparkContext._

import java.nio.file.Paths

object App {
  def main(args : Array[String]) : Unit = {
    val cwd = Paths.get("").toAbsolutePath.toString

    val inputPath = "file://" + cwd + "/input"
    val outputPath = "file://" + cwd + "/output"
    val inputFile0 = inputPath + "/A.txt"
    val inputFile1 = inputPath + "/B.txt"

    val conf = new SparkConf().setMaster("local").setAppName("pro1")
    val sc = new SparkContext(conf)

    val input0 = sc.textFile(inputFile0)
    val input1 = sc.textFile(inputFile1)

    val unionRes = input0.union(input1)
```

```

    val res = unionRes.distinct.sortBy(_.split(" ")(0))
    res.saveAsTextFile(outputPath)
  }
}

```

3.1.3 Result

The screenshot shows a Scala IDE with a file named `App.scala` and a terminal window. The Scala code defines a `main` function that reads two input files, unions their contents, removes duplicates, and saves the result to an output file. The terminal window shows the execution of the program, displaying the deduplicated output.

```

App.scala
22 package net.homework;
21
20 import org.apache.spark.SparkConf
19 import org.apache.spark.SparkContext
18 import org.apache.spark.SparkContext._
17
16 import java.nio.file.Paths
15
14 object App {
13   def main(args : Array[String]) : Unit = {
12     val cwd = Paths.get("").toAbsolutePath.toString
11
10     val inputPath = "file://" + cwd + "/input"
9     val outputPath = "file://" + cwd + "/output"
8     val inputFile0 = inputPath + "/A.txt"
7     val inputFile1 = inputPath + "/B.txt"
6
5     val conf = new SparkConf().setMaster("local").setAppName("pro1")
4     val sc = new SparkContext(conf)
3
2     val input0 = sc.textFile(inputFile0)
1     val input1 = sc.textFile(inputFile1)
0
1     val unionRes = input0.union(input1)
2
3     val res = unionRes.distinct.sortBy(_.split(" ")(0))
4     res.saveAsTextFile(outputPath)
5   }
6 }

```

```

HuJiaxin@M102102145:~/workspace/spark/tmp/pro1$ bash run.sh
9 20170101 x
8 20170101 y
7 20170102 y
6 20170103 x
5 20170104 y
4 20170104 z
3 20170105 y
2 20170105 z
1 20170106 z
HuJiaxin@M102102145:~/workspace/spark/tmp/pro1$

```

图 1: 数据去重

3.2 求平均值

3.2.1 Problem Description

描述: 每个输入文件表示班级学生某个学科的成绩, 每行内仅由两个字段组成, 第一个是学生名字, 第二个是学生的成绩; 编写 Spark 独立应用程序 (推荐使用 Scala 语言) 求出所有学生的平均成绩, 并输入到一个新文件中。(各个科目的程序文件如下)

Algorithm 成绩:

小明 92
 小红 87
 小新 82
 小丽 90

Database 成绩:

小明 95
 小红 81

小新 89

小丽 85

Python 成绩:

小明 82

小红 83

小新 94

小丽 91

平均成绩如下:

(小红,83.67)

(小新,88.33)

(小明,89.67)

(小丽,88.67)

3.2.2 Code

```
package net.homework
```

```
import org.apache.spark.SparkConf
```

```
import org.apache.spark.SparkContext
```

```
import org.apache.spark.SparkContext._
```

```
import java.nio.file.Paths
```

```
import java.io.File
```

```
object App {
```

```
  def main(args : Array[String]) : Unit = {
```

```
    val cwd = Paths.get("").toAbsolutePath.toString
```

```
    val inputPath = "file://" + cwd + "/input"
```

```
    val outputPath = "file://" + cwd + "/output"
```

```
    val conf = new SparkConf().setMaster("local").setAppName("pro2")
```

```
    val sc = new SparkContext(conf)
```

```
    val textData = sc.wholeTextFiles(inputPath)
```

```
    val textContent = textData.map(_._2).flatMap(_.split("\n"))
```

```

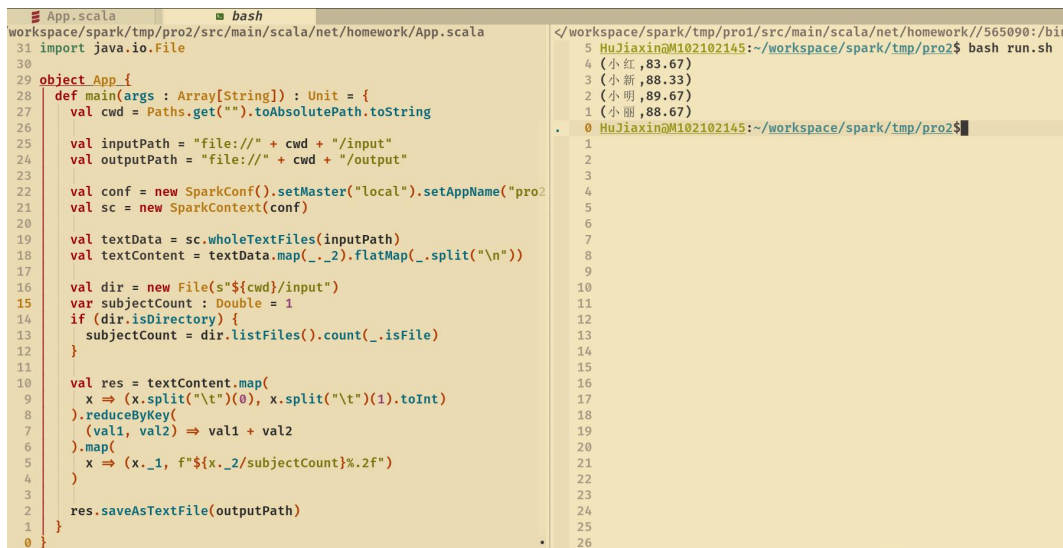
val dir = new File(s"${cwd}/input")
var subjectCount : Double = 1
if (dir.isDirectory) {
    subjectCount = dir.listFiles().count(_.isFile)
}

val res = textContent.map(
    x => (x.split("\t")(0), x.split("\t")(1).toInt)
).reduceByKey(
    (val1, val2) => val1 + val2
).map(
    x => (x._1, f"${x._2/subjectCount}%.2f")
)

res.saveAsTextFile(outputPath)
}
}

```

3.2.3 Result



```

App.scala
import java.io.File
object App {
  def main(args : Array[String]) : Unit = {
    val cwd = Paths.get("").toAbsolutePath.toString
    val inputPath = "file://" + cwd + "/input"
    val outputPath = "file://" + cwd + "/output"
    val conf = new SparkConf().setMaster("local").setAppName("pro2")
    val sc = new SparkContext(conf)
    val textData = sc.wholeTextFiles(inputPath)
    val textContent = textData.map(_._2).flatMap(_.split("\n"))
    val dir = new File(s"${cwd}/input")
    var subjectCount : Double = 1
    if (dir.isDirectory) {
      subjectCount = dir.listFiles().count(_.isFile)
    }
    val res = textContent.map(
      x => (x.split("\t")(0), x.split("\t")(1).toInt)
    ).reduceByKey(
      (val1, val2) => val1 + val2
    ).map(
      x => (x._1, f"${x._2/subjectCount}%.2f")
    )
    res.saveAsTextFile(outputPath)
  }
}

```

```

HuJiaxin@M102102145:~/workspace/spark/tmp/pro2$ bash run.sh
5 HuJiaxin@M102102145:~/workspace/spark/tmp/pro2$ bash run.sh
4 (小红,83.67)
3 (小新,88.33)
2 (小明,89.67)
1 (小丽,88.67)
0 HuJiaxin@M102102145:~/workspace/spark/tmp/pro2$

```

图 2: 求平均值

3.3 人数, 身高统计

3.3.1 Problem Description

描述: 对于文件 people.txt, 该文件包含了序号、性别和身高三个列, 编写 Spark 应用程序, 计算得到男性总数、女性总数、男性最高身高、女性最高身高、男性最低身高、女性最低身高、男性平均升高、女性平均身高。

文件形式如下:

```
0 F 168
1 F 141
2 M 184
3 F 186
```

3.3.2 Code

```
package net.homework

import org.apache.spark.SparkConf
import org.apache.spark.SparkContext
import org.apache.spark.SparkContext._

import java.nio.file.Paths
import java.io.File

object App {
  def main(args : Array[String]) : Unit = {
    val cwd = Paths.get("").toAbsolutePath.toString

    val inputPath = "file://" + cwd + "/input"

    val conf = new SparkConf().setMaster("local").setAppName("pro3")
    val sc = new SparkContext(conf)

    val textData = sc.wholeTextFiles(inputPath)
    val textContent = textData.map(_._2).flatMap(_.split("\n"))

    val people = textContent.map(
      x => {
```

```

        val arr = x.split("\t")
        (arr(2).toDouble, arr(1))
    }
)

val male = people.filter(x => x._2 == "M").map(_._1)
val female = people.filter(x => x._2 == "F").map(_._1)

val numOfMale = male.count
val numOfFemale = female.count

val maxHeightOfMale = male.max
val maxHeightOfFemale = female.max

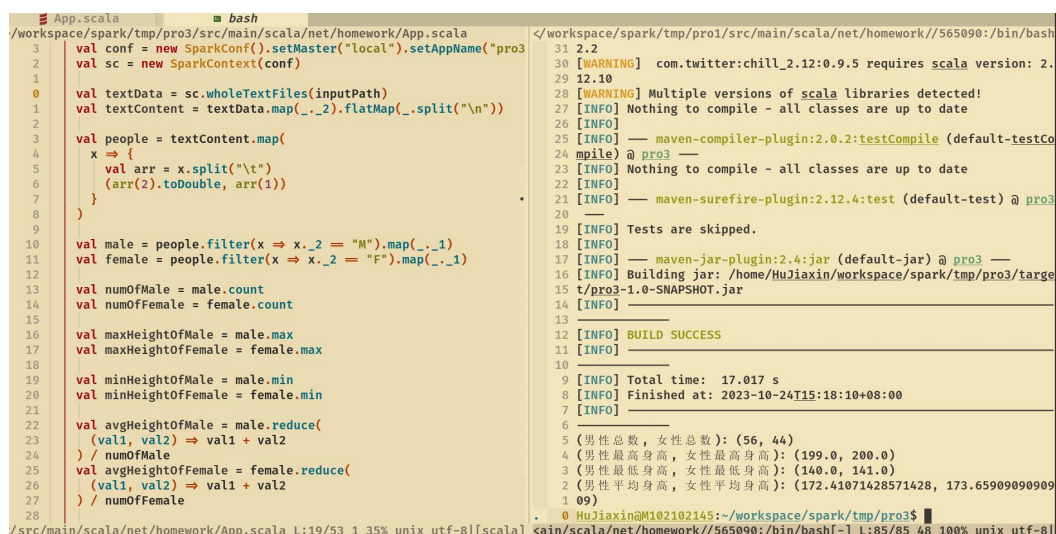
val minHeightOfMale = male.min
val minHeightOfFemale = female.min

val avgHeightOfMale = male.reduce(
    (val1, val2) => val1 + val2
) / numOfMale
val avgHeightOfFemale = female.reduce(
    (val1, val2) => val1 + val2
) / numOfFemale

println(s"(男性总数, 女性总数): ($numOfMale, $numOfFemale)")
println(s"(男性最高身高, 女性最高身高): ($maxHeightOfMale, $maxHeightOfFemale)")
println(s"(男性最低身高, 女性最低身高): ($minHeightOfMale, $minHeightOfFemale)")
println(s"(男性平均身高, 女性平均身高): ($avgHeightOfMale, $avgHeightOfFemale)")
}
}

```


3.3.3 Result



```
App.scala
3 val conf = new SparkConf().setMaster("local").setAppName("pro3")
4 val sc = new SparkContext(conf)
5
6 val textData = sc.wholeTextFiles(inputPath)
7 val textContent = textData.map(_._2).flatMap(_.split("\n"))
8
9 val people = textContent.map(
10   x => {
11     val arr = x.split("\t")
12     (arr(2).toDouble, arr(1))
13   }
14 )
15
16 val male = people.filter(x => x._2 == "M").map(_._1)
17 val female = people.filter(x => x._2 == "F").map(_._1)
18
19 val numOffMale = male.count
20 val numOffFemale = female.count
21
22 val maxHeightOfMale = male.max
23 val maxHeightOfFemale = female.max
24
25 val minHeightOfMale = male.min
26 val minHeightOfFemale = female.min
27
28 val avgHeightOfMale = male.reduce(
29   (val1, val2) => val1 + val2
30 ) / numOffMale
31 val avgHeightOfFemale = female.reduce(
32   (val1, val2) => val1 + val2
33 ) / numOffFemale
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```

val inputPath = "file://" + cwd + "/input"
val outputPath = "file://" + cwd + "/output"

val conf = new SparkConf().setMaster("local").setAppName("pro4")
val sc = new SparkContext(conf)

val textData = sc.wholeTextFiles(inputPath)
val textContent = textData.map(_._2).flatMap(_.split("\n"))

val res = textContent.map(
  x => {
    val arr = x.split("<")
    (arr(0), arr(1).split(","))
  }
).flatMap(
  x => {
    var ret = List((x._1, (x._2.length, 0)))
    for (fan <- x._2) {
      ret = (fan, (0, 1)) +: ret
    }
    ret
  }
).reduceByKey(
  (val1, val2) => (val1._1 + val2._1, val1._2 + val2._2)
).map(
  x => (x._1, x._2._1, x._2._2)
).sortBy(_._1)

res.saveAsTextFile(outputPath)
}
}

```

3.4.3 Result



```
App.scala bash
workspace/spark/tmp/pro4/src/main/scala/net/homework/App.scala </workspace/spark/tmp/pro1/src/main/scala/net/homework//565090:/bin/bash
15 HuJiaxin@M102102145:~/workspace/spark/tmp/pro4$ bash run.sh
31 val cwd = Paths.get("").toAbsolutePath.toString
30
29 val inputPath = "file://" + cwd + "/input"
14 (A,6,9)
28 val outputPath = "file://" + cwd + "/output"
13 (B,4,4)
27
26 val conf = new SparkConf().setMaster("local").setAppName("pro4"
12 (C,4,7)
25 val sc = new SparkContext(conf)
11 (D,4,8)
24
23 val textData = sc.wholeTextFiles(inputPath)
10 (E,5,8)
22 val textContent = textData.map(_._2).flatMap(_.split("\n"))
9 (F,7,6)
21
20 val res = textContent.map(
8 (G,5,1)
19 x => {
7 (H,5,1)
18 val arr = x.split("<"
6 (I,2,2)
17 (arr(0), arr(1).split(","))
5 (J,2,1)
16 }
4 (K,3,2)
15 ).flatMap(
3 (L,3,2)
14 x => {
2 (M,3,2)
13 var ret = List((x._1, (x._2.length, 0)))
1 (O,5,5)
12 for (fan <- x._2) {
0 HuJiaxin@M102102145:~/workspace/spark/tmp/pro4$
11 ret = (fan, (0, 1)) += ret
1
10 }
9
8 ret
7
6 }).reduceByKey(
5 (val1, val2) => (val1._1 + val2._1, val1._2 + val2._2)
4
3 ).map(
2 x => (x._1, x._2._1, x._2._2)
1
0 ).sortBy(_._1)
res.saveAsTextFile(outputPath)
}
}
tc/main/scala/net/homework/App.scala L:42/42 1 100% unix utf-8[[scala] <main/scala/net/homework//565090:/bin/bash[-] L:71/87 48 81% unix utf-8[[
```

图 4: 用户关系统计

4 出现的问题及其解决方案

没有问题.