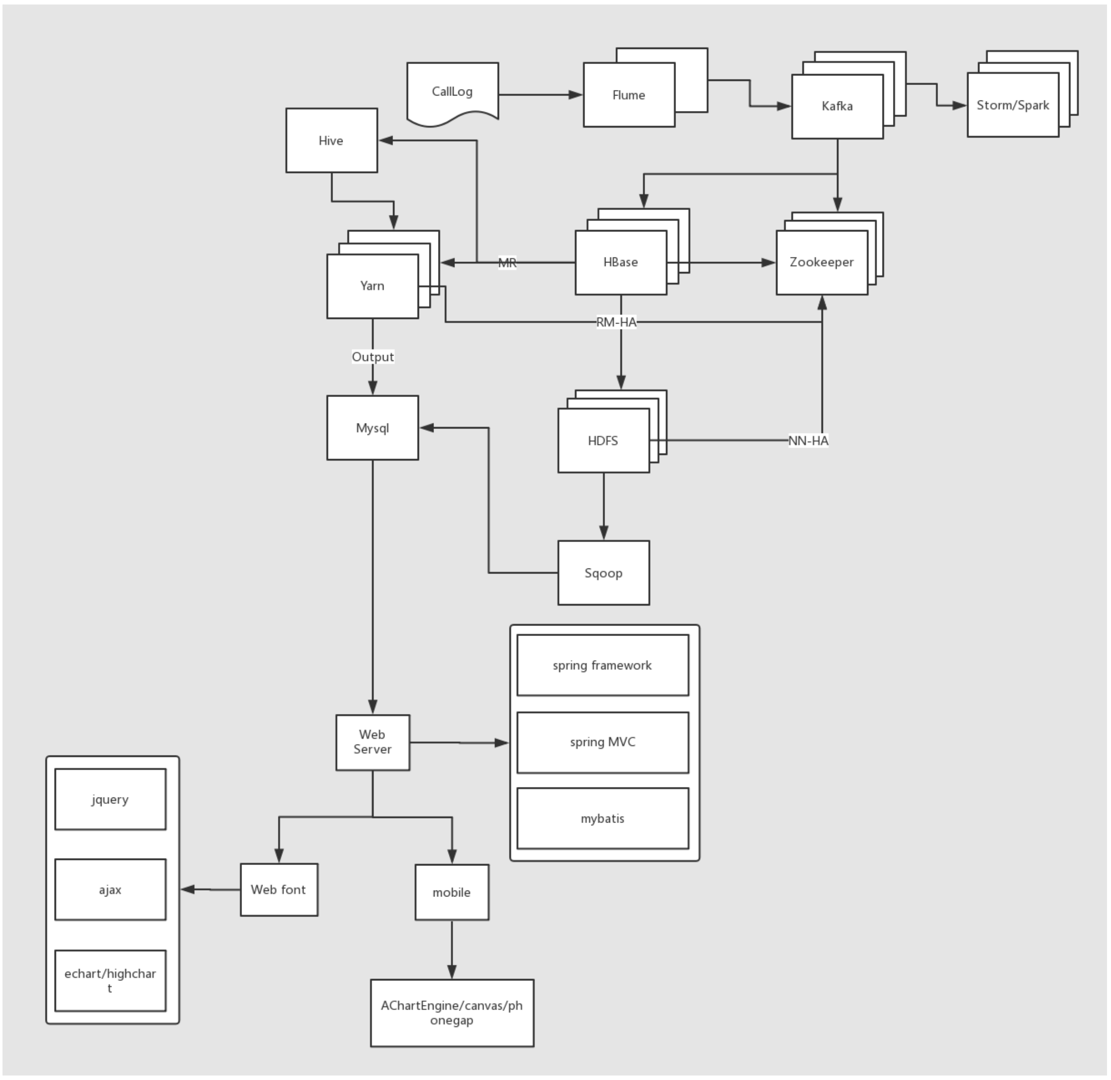
尚硅谷大数据技术之电信客服（想认真写写）

目录

一、项目背景

通信运营商每时每刻会产生大量的通信数据，例如通话记录，短信记录，彩信记录，第三方服务资费等等繁多信息。数据量如此巨大，除了要满足用户的实时查询和展示之外，还需要定时定期的对已有数据进行离线的分析处理。例如，当日话单，月度话单，季度话单，年度话单，通话详情，通话记录等等+。我们以此为背景，寻找一个切入点，学习其中的方法论。

二、项目架构



三、项目实现

系统环境：

系统	版本
windows	**10 专业版**
linux	**CentOS 6.8 or CentOS7.2 1611 内核**

开发工具：

工具	版本
idea	2017.2.5 旗舰版
maven	3.3.9
JDK	1.8+

尖叫提示：idea2017.2.5 必须使用 maven3.3.9，不要使用 maven3.5，有部分兼容性问题

集群环境：

框架	版本
hadoop	cdh5.3.6-2.5.0
zookeeper	cdh5.3.6-3.4.5
hbase	cdh5.3.6-0.98
hive	cdh5.3.6-0.13
flume	cdh5.3.6-1.5.0
kafka	2.10-0.8.2.1

硬件环境：

	linux01	linux02	linux03
内存	4G	2G	2G
CPU	2 核	1 核	1 核
硬盘	50G	50G	50G

3.1、数据生产

此情此景，对于该模块的业务，即数据生产过程，一般并不会让你来进行操作，数据生产是一套完整且严密的体系，这样可以保证数据的鲁棒性。但是如果涉及到项目的一体化方案的设计（数据的产生、存储、分析、展示），则必须清楚每一个环节是如何处理的，包括其中每个环境可能隐藏的问题；数据结构，数据内容可能出现的问题。

3.1.2、数据结构

我们将在 HBase 中存储两个电话号码，以及通话建立的时间和通话持续时间，最后再加上一个 flag 作为判断第一个电话号码是否为主叫。姓名字段的存储我们可以放置于另外一张表做关联查询，当然也可以插入到当前表中。

列名	解释	举例
call1	第一个手机号码	15369468720
call1_name	第一个手机号码人姓名(非必须)	李雁
call2	第二个手机号码	19920860202
call2_name	第二个手机号码人姓名(非必须)	卫艺
date_time	建立通话的时间	20171017081520
date_time_ts	建立通话的时间（时间戳形式）	
duration	通话持续时间（秒）	0600
flag	用于标记本次通话第一个字段(call1)是主叫还是被叫	1 为主叫，0 为被叫

3.1.3、编写代码

思路：

a) 创建 Java 集合类存放模拟的电话号码和联系人；

b) 随机选取两个手机号码当做“主叫”与“被叫”（注意判断两个手机号不能重复），产出 call1 与 call2 字段数据；

c) 创建随机生成通话建立时间的方法，可指定随机范围，最后生成通话建立时间，产出 date_time 字段数据；

d) 随机一个通话时长，单位：秒，产出 duration 字段数据；

e)、将产出的一条数据拼接封装到一个字符串中；

f)、使用 IO 操作将产出的一条通话数据写入到本地文件中；

新建 **module** 项目：**ct_producer**

pom.xml 文件配置：

```
<project xmlns="http://maven.apache.org/POM/4.0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
http://maven.apache.org/xsd/maven-4.0.0.xsd">
        <modelVersion>4.0.0</modelVersion>

        <groupId>com.china</groupId>
        <artifactId>ct_producer</artifactId>
        <version>1.0-SNAPSHOT</version>
        <packaging>jar</packaging>

        <name>ct_producer</name>
        <url>http://maven.apache.org</url>

        <properties>
                <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
        </properties>

        <dependencies>
                <!-- https://mvnrepository.com/artifact/junit/junit -->
                <dependency>
                        <groupId>junit</groupId>
                        <artifactId>junit</artifactId>
                        <version>4.12</version>
                        <scope>test</scope>
                </dependency>
```

```
    </dependencies>


    <build>
        <plugins>
            <plugin>
                <groupId>org.apache.maven.plugins</groupId>
                <artifactId>maven-surefire-plugin</artifactId>
                <version>2.12.4</version>
                <configuration>
                    <skipTests>true</skipTests>
                </configuration>
            </plugin>
        </plugins>
    </build>
</project>
```

1) 随机输入一些手机号码以及联系人，保存于 Java 的集合中。

新建类：ProductLog

```
//存放联系人电话与姓名的映射
public Map<String, String> contacts = null;
//存放联系人电话号码
public List<String> phoneList = null;
public void initContacts() {
    contacts = new HashMap<String, String>();
    phoneList = new ArrayList<String>();


    phoneList.add("15369468720");
```

```
        phoneList.add("19920860202");
        phoneList.add("18411925860");
        phoneList.add("14473548449");
        phoneList.add("18749966182");
        phoneList.add("19379884788");
        phoneList.add("19335715448");
        phoneList.add("18503558939");
        phoneList.add("13407209608");
        phoneList.add("15596505995");
        phoneList.add("17519874292");
        phoneList.add("15178485516");
        phoneList.add("19877232369");
        phoneList.add("18706287692");
        phoneList.add("18944239644");
        phoneList.add("17325302007");
        phoneList.add("18839074540");
        phoneList.add("19879419704");
        phoneList.add("16480981069");
        phoneList.add("18674257265");
        phoneList.add("18302820904");
        phoneList.add("15133295266");
        phoneList.add("17868457605");
        phoneList.add("15490732767");
        phoneList.add("15064972307");

        contacts.put("15369468720", "李雁");
        contacts.put("19920860202", "卫艺");
        contacts.put("18411925860", "仰莉");
        contacts.put("14473548449", "陶欣悦");
        contacts.put("18749966182", "施梅梅");
        contacts.put("19379884788", "金虹霖");
        contacts.put("19335715448", "魏明艳");
        contacts.put("18503558939", "华贞");
        contacts.put("13407209608", "华啟倩");
        contacts.put("15596505995", "仲采绿");
        contacts.put("17519874292", "卫丹");
        contacts.put("15178485516", "戚丽红");
        contacts.put("19877232369", "何翠柔");
        contacts.put("18706287692", "钱溶艳");
        contacts.put("18944239644", "钱琳");
        contacts.put("17325302007", "缪静欣");
        contacts.put("18839074540", "焦秋菊");
        contacts.put("19879419704", "吕访琴");
        contacts.put("16480981069", "沈丹");
        contacts.put("18674257265", "褚美丽");
        contacts.put("18302820904", "孙怡");
        contacts.put("15133295266", "许婵");
        contacts.put("17868457605", "曹红恋");
        contacts.put("15490732767", "吕柔");
        contacts.put("15064972307", "冯怜云");
}
```

2) 创建随机生成通话时间的方法：randomDate

该时间生成后的格式为 yyyy-MM-dd HH:mm:ss，并使之可以根据传入的起始时间和结束时间来随机生成。

```
/**
```

```
  * @Description: 随机建立通话的时间，时间格式：yyyy-MM-dd
  * @author: JinJi
  * @date:
  * @version: V1.0
  */
private Calendar randomDate(String startDate, String endDate) {
    SimpleDateFormat simpleDateFormat = new SimpleDateFormat("yyyy-MM-dd");
    try {
        Date start = simpleDateFormat.parse(startDate);
        Date end = simpleDateFormat.parse(endDate);

        if (start.getTime() > end.getTime()) return null;

        long resultTime = start.getTime() + (long) (Math.random() * (end.getTime() -
start.getTime()));
        Calendar calendar = Calendar.getInstance();
        calendar.setTimeInMillis(resultTime);
        return calendar;

    } catch (ParseException e) {
        e.printStackTrace();
    }
    return null;
}
```

3) 创建生产日志一条日志的方法：productLog

随机抽取两个电话号码，随机产生通话建立时间，随机通话时长，将这几个字段拼接成一个字符串，然后 return，便可以产生一条通话的记录。需要注意的是，如果随机出的两个电话号码一样，需要重新随机（随机过程可优化，但并非此次重点）。通话时长的随机为 20 分

钟以内，即：60 秒 ＊20，并格式化为 4 位数字，例如：0600(10 分钟)。

```
/**
 * @Description: 生成 Log 日志
 * @author: JinJi
 * @date:
 * @version: V1.0
 */
private String productLog() {
    int call1Index = random.nextInt(phoneList.size());
    int call2Index = -1;


    String call1 = phoneList.get(call1Index);
    String call2 = null;
    while (true) {
        call2Index = random.nextInt(phoneList.size());
        call2 = phoneList.get(call2Index);
        if (!call1.equals(call2)) break;
    }
    //通话时长，单位：秒
    int duration = random.nextInt(60 * 20) + 1;
    String durationString = new DecimalFormat("0000").format(duration);
    //通话建立时间:yyyy-MM-dd,月份：0~11，天：1~31
    Calendar calendarDate = randomDate("2017-01-01", "2017-10-17");
    String dateString = new SimpleDateFormat("yyyy-MM-dd
HH:mm:ss").format(calendarDate.getTime());
    //主叫人姓名
    String call1Name = contacts.get(String.valueOf(call1));
    //被叫人姓名
```

```
        String call2Name = contacts.get(String.valueOf(call2));

        StringBuilder logBuilder = new StringBuilder();

//              logBuilder.append(caller + ",")

//                              .append(callerName + ",")

//                              .append(callee + ",")

//                              .append(calleeName + ",")

//                              .append(dateString + ",")

//                              .append(durationString);

        logBuilder.append(call1 + ",")

                        .append(call2 + ",")

                        .append(dateString + ",")

                        .append(durationString);

        System.out.println(logBuilder);

        try {

                Thread.sleep(500);

        } catch (InterruptedException e) {

                e.printStackTrace();

        }

        return logBuilder.toString();

}
```

4) 创建写入日志方法：writeLog

productLog 每产生一条日志，便将日志写入到本地文件中，所以建立一个专门用于日志写入的方法，需要涉及到 IO 操作，需要注意的是，输出流每次写一条日之后需要 flush，不然可能导致积攒多条数据才输出一次。最后需要将 productLog 方法放置于 while 死循环中执行。

```
/**

 * @Description: 将产生的日志写入到本地文件 calllog 中

 * @author: JinJi
 * @date:
 * @version: V1.0
 */
public void writeLog(String filePath, ProductLog productLog) {
        OutputStreamWriter outputStreamWriter = null;
        try {
                outputStreamWriter = new OutputStreamWriter(new FileOutputStream(filePath,
true),"UTF-8");
//                      for (int i = 1; i <= CALL_COUNT; i++) {
//                              String log = productLog.productLog();
//                              if(i == CALL_COUNT){
//                                      outputStreamWriter.write(log);
//                              }else{
//                                      outputStreamWriter.write(log + "\n");
//                              }
//                      }
                while(true){
                        String log = productLog.productLog();
                        outputStreamWriter.write(log + "\n");
                        outputStreamWriter.flush();
                }
        } catch (IOException e) {
                e.printStackTrace();
        }finally {
                try {
                        outputStreamWriter.flush();
                        outputStreamWriter.close();
                } catch (IOException e) {
                        e.printStackTrace();
                }
        }
}
```

5) 在主函数中初始化以上逻辑，并测试：

```
public static void main(String[] args) {
        if(args == null || args.length <= 0) {
                System.out.println("no arguments");
                System.exit(1);
//                      args = new String[]{PATH_LOG};
        }
        ProductLog productLog = new ProductLog();
        productLog.initContacts();
        productLog.writeLog(args[0], productLog);
}
```

3.1.4、打包测试

1) 打包方式

如果在 eclipse 中，则需要如下 maven 参数进行打包：

```
-P local clean package：不打包第三方依赖
-P dev clean package install：打包第三方依赖
```

如果在 idea 中，则需要在 maven project 视图中一次选择如下按钮进行打包：详细操作请参看课堂演示

```
LifeCycle --> package(双击)
```

分别在 Windows 上和 Linux 中进行测试：

```
java -cp ct_producer-1.0-SNAPSHOT.jar com.china.producer.ProductLog /本地目录/callLog.csv
```

2) 为日志生成任务编写 bash 脚本：productlog.sh

```
#!/bin/bash
```

```
java -cp /home/admin/call/ct_product-0.0.1-SNAPSHOT.jar com.china.ct_product.ProductLog
/home/admin/call/calllog.csv
```

3.2、数据采集/消费(存储)

欢迎来到数据采集模块（消费），在企业中你要清楚流式数据采集框架 flume 和 kafka 的定位是什么。我们在此需要将实时数据通过 flume 采集到 kafka 然后供给给 hbase 消费。

flume：cloudera 公司研发

适合下游数据消费者不多的情况；

适合数据安全性要求不高的操作；

适合与 Hadoop 生态圈对接的操作。

kafka：linkedin 公司研发

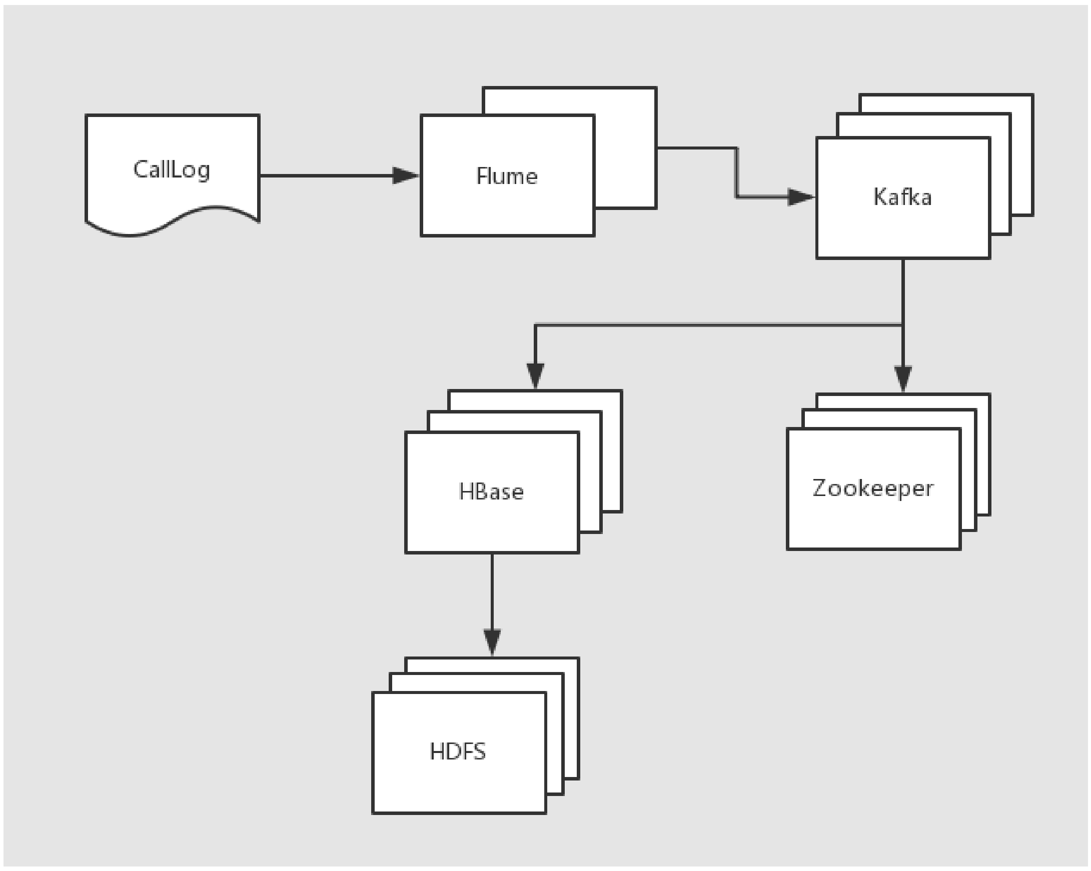
适合数据下游消费众多的情况；

适合数据安全性要求较高的操作（支持 replication）；

因此我们常用的一种模型是：

线上数据 --> flume --> kafka --> flume(根据情景增删该流程) --> HDFS

消费存储模块流程图：



3.2.1、数据采集：采集实时产生的数据到 kafka 集群

思路：

a) 配置 kafka，启动 zookeeper 和 kafka 集群；

b) 创建 kafka 主题；

c) 启动 kafka 控制台消费者（此消费者只用于测试使用）；

d) 配置 flume，监控日志文件；

e) 启动 flume 监控任务；

f) 运行日志生产脚本；

g)、观察测试。

1) 配置 kafka

server.properties

```
# Licensed to the Apache Software Foundation (ASF) under one or more
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# this work for additional information regarding copyright ownership.

# The ASF licenses this file to You under the Apache License, Version 2.0

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# See the License for the specific language governing permissions and

# limitations under the License.

# see kafka.server.KafkaConfig for additional details and defaults


############################# Server Basics #############################


# The id of the broker. This must be set to a unique integer for each broker.

broker.id=0


############################# Socket Server Settings #############################


# The port the socket server listens on

port=9092


# Hostname the broker will bind to. If not set, the server will bind to all interfaces

host.name=linux01


# Hostname the broker will advertise to producers and consumers. If not set, it uses the
# value for "host.name" if configured.   Otherwise, it will use the value returned from
# java.net.InetAddress.getCanonicalHostName().
#advertised.host.name=<hostname routable by clients>

# The port to publish to ZooKeeper for clients to use. If this is not set,
# it will publish the same port that the broker binds to.
#advertised.port=<port accessible by clients>

# The number of threads handling network requests
num.network.threads=3

# The number of threads doing disk I/O
num.io.threads=8

# The send buffer (SO_SNDBUF) used by the socket server
socket.send.buffer.bytes=102400

# The receive buffer (SO_RCVBUF) used by the socket server
socket.receive.buffer.bytes=102400

# The maximum size of a request that the socket server will accept (protection against OOM)
socket.request.max.bytes=104857600


############################# Log Basics #############################

# A comma seperated list of directories under which to store log files
log.dirs=/home/admin/modules/kafka_2.10-0.8.2.1/kafka-logs
```

```
# The default number of log partitions per topic. More partitions allow greater
# parallelism for consumption, but this will also result in more files across
# the brokers.
num.partitions=1

# The number of threads per data directory to be used for log recovery at startup and flushing at
shutdown.
# This value is recommended to be increased for installations with data dirs located in RAID array.
num.recovery.threads.per.data.dir=1

############################# Log Flush Policy #############################

# Messages are immediately written to the filesystem but by default we only fsync() to sync
# the OS cache lazily. The following configurations control the flush of data to disk.
# There are a few important trade-offs here:
#       1. Durability: Unflushed data may be lost if you are not using replication.
#       2. Latency: Very large flush intervals may lead to latency spikes when the flush does occur
as there will be a lot of data to flush.
#       3. Throughput: The flush is generally the most expensive operation, and a small flush
interval may lead to exceessive seeks.
# The settings below allow one to configure the flush policy to flush data after a period of time or
# every N messages (or both). This can be done globally and overridden on a per-topic basis.

# The number of messages to accept before forcing a flush of data to disk
#log.flush.interval.messages=10000

# The maximum amount of time a message can sit in a log before we force a flush
```

```
#log.flush.interval.ms=1000

############################# Log Retention Policy #############################

# The following configurations control the disposal of log segments. The policy can
# be set to delete segments after a period of time, or after a given size has accumulated.
# A segment will be deleted whenever *either* of these criteria are met. Deletion always happens
# from the end of the log.

# The minimum age of a log file to be eligible for deletion
log.retention.hours=168

# A size-based retention policy for logs. Segments are pruned from the log as long as the
remaining
# segments don't drop below log.retention.bytes.
#log.retention.bytes=1073741824

# The maximum size of a log segment file. When this size is reached a new log segment will be
created.
log.segment.bytes=1073741824

# The interval at which log segments are checked to see if they can be deleted according
# to the retention policies
log.retention.check.interval.ms=300000

# By default the log cleaner is disabled and the log retention policy will default to just delete
segments after their retention expires.
# If log.cleaner.enable=true is set the cleaner will be enabled and individual logs can then be
```

```
marked for log compaction.
log.cleaner.enable=false


############################# Zookeeper #############################


# Zookeeper connection string (see zookeeper docs for details).
# This is a comma separated host:port pairs, each corresponding to a zk
# server. e.g. "127.0.0.1:3000,127.0.0.1:3001,127.0.0.1:3002".
# You can also append an optional chroot string to the urls to specify the
# root directory for all kafka znodes.
zookeeper.connect=linux01:2181,linux02:2181,linux03:2181


# Timeout in ms for connecting to zookeeper
zookeeper.connection.timeout.ms=6000
```

尖叫提示：注意配置中标红部分每台机器的 server.properties 文件不一样，分发之后记得对应变量重新配置。

2) 启动 zookeeper，kafka 集群

```
$ /home/admin/modules/kafka_2.10-0.8.2.1/bin/kafka-server-start.sh
/home/admin/modules/kafka_2.10-0.8.2.1/config/server.properties
```

3) 创建 kafka 主题

```
$ /home/admin/modules/kafka_2.10-0.8.2.1/bin/kafka-topics.sh --zookeeper linux01:2181 --topic
calllog --create --replication-factor 1 --partitions 3
```

检查一下是否创建主题成功：

```
$ /home/admin/modules/kafka_2.10-0.8.2.1/bin/kafka-topics.sh --zookeeper linux01:2181 --list
```

4) 启动 kafka 控制台消费者，等待 flume 信息的输入

```
$ /home/admin/modules/kafka_2.10-0.8.2.1/bin/kafka-console-consumer.sh --zookeeper
linux01:2181 --topic calllog --from-beginning
```

5) 配置 flume(flume-kafka.conf)

```
# define

a1.sources = r1

a1.sinks = k1

a1.channels = c1


# source

a1.sources.r1.type = exec

a1.sources.r1.command = tail -F -c +0 /home/admin/call/calllog.csv

a1.sources.r1.shell = /bin/bash -c


# sink

a1.sinks.k1.type = org.apache.flume.sink.kafka.KafkaSink

a1.sinks.k1.brokerList = linux01:9092,linux02:9092,linux03:9092

a1.sinks.k1.topic = calllog

a1.sinks.k1.batchSize = 20

a1.sinks.k1.requiredAcks = 1


# channel

a1.channels.c1.type = memory

a1.channels.c1.capacity = 1000

a1.channels.c1.transactionCapacity = 100


# bind

a1.sources.r1.channels = c1

a1.sinks.k1.channel = c1
```

6) 进入 flume 根目录下，启动 flume

```
$ bin/flume-ng agent --conf conf/ --name a1 --conf-file jobs/flume-exec-kafka.conf
```

7) 运行生产日志的任务脚本，观察 kafka 控制台消费者是否成功显示产生的数据

```
$ sh productlog.sh
```

3.2.2、编写代码：数据消费（HBase）

如果以上操作均成功，则开始编写操作 HBase 的代码，用于消费数据，将产生的数据实时存储在 HBase 中。

思路：

a) 编写 kafka 消费者，读取 kafka 集群中缓存的消息，并打印到控制台以观察是否成功；

b) 既然能够读取到 kafka 中的数据了，就可以将读取出来的数据写入到 HBase 中，所以编写调用 HBaseAPI 相关方法，将从 Kafka 中读取出来的数据写入到 HBase；

c) 以上两步已经足够完成消费数据，存储数据的任务，但是涉及到解耦，所以过程中需要将一些属性文件外部化，HBase 通用性方法封装到某一个类中。

创建新的 module 项目：ct_consumer

pom.xml 文件配置：

```
<project xmlns="http://maven.apache.org/POM/4.0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
http://maven.apache.org/xsd/maven-4.0.0.xsd">
        <modelVersion>4.0.0</modelVersion>

        <groupId>com.china</groupId>
        <artifactId>ct_consumer</artifactId>
        <version>1.0-SNAPSHOT</version>
        <packaging>jar</packaging>

        <name>ct_consumer</name>
        <url>http://maven.apache.org</url>
```

```
<properties>
    <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
</properties>

<repositories>
    <repository>
        <id>cloudera</id>
        <url>https://repository.cloudera.com/artifactory/cloudera-repos/</url>
    </repository>

    <repository>
        <id>centor</id>
        <url>http://central.maven.org/maven2/</url>
    </repository>
</repositories>

<dependencies>
    <dependency>
        <groupId>junit</groupId>
        <artifactId>junit</artifactId>
        <version>4.12</version>
        <scope>test</scope>
    </dependency>

    <dependency>
        <groupId>org.apache.hbase</groupId>
        <artifactId>hbase-client</artifactId>
```

```
                <version>0.98.6-cdh5.3.6</version>
            </dependency>

            <dependency>
                <groupId>org.apache.hbase</groupId>
                <artifactId>hbase-server</artifactId>
                <version>0.98.6-cdh5.3.6</version>
            </dependency>

            <dependency>
                <groupId>org.apache.kafka</groupId>
                <artifactId>kafka_2.10</artifactId>
                <version>0.8.2.1</version>
            </dependency>
        </dependencies>

        <build>
            <plugins>
                <plugin>
                    <groupId>org.apache.maven.plugins</groupId>
                    <artifactId>maven-surefire-plugin</artifactId>
                    <version>2.12.4</version>
                    <configuration>
                        <skipTests>true</skipTests>
                    </configuration>
                </plugin>
            </plugins>
        </build>
```

```
</project>
```

1) 新建类：HBaseConsumer

该类主要用于读取 kafka 中缓存的数据，然后调用 HBaseAPI，持久化数据。

```
package com.china.kafka;


import java.util.HashMap;
import java.util.List;
import java.util.Map;



import com.china.dao.HBaseDAO;
import com.china.utils.PropertiesUtil;
import kafka.consumer.Consumer;
import kafka.consumer.ConsumerConfig;
import kafka.consumer.ConsumerIterator;
import kafka.consumer.KafkaStream;
import kafka.javaapi.consumer.ConsumerConnector;
import kafka.serializer.StringDecoder;
import kafka.utils.VerifiableProperties;

public class HBaseConsumer {
	public static void main(String[] args) {
		// 创建配置对象
		ConsumerConfig consumerConfig = new ConsumerConfig(PropertiesUtil.properties);
		// 得到当前消费主题
		String callLogTopic = PropertiesUtil.getProperty("topic");
```

```
        // 订阅主题，开始消费
        ConsumerConnector consumerConnector =
Consumer.createJavaConsumerConnector(consumerConfig);
        Map<String, Integer> topicMap = new HashMap<String, Integer>();
        topicMap.put(callLogTopic, 1);

        StringDecoder keyDecoder = new StringDecoder(new VerifiableProperties());
        StringDecoder valueDecoder = new StringDecoder(new VerifiableProperties());

        Map<String, List<KafkaStream<String, String>>> consumerMap =
consumerConnector.createMessageStreams(topicMap, keyDecoder, valueDecoder);
        KafkaStream<String, String> stream = consumerMap.get(callLogTopic).get(0);
        ConsumerIterator<String, String> it = stream.iterator();
        HBaseDAO hBaseDAO = new HBaseDAO();
        while (it.hasNext()) {
            // 将消息实时写入到 Hbase 中
            String msg = it.next().message();
            System.out.println(msg);
            hBaseDAO.put(msg);
        }
    }
}
```

2) 新建类：PropertiesUtil

该类主要用于将常用的项目所需的参数外部化，解耦，方便配置。

```
package com.china.utils;
```

```
import java.io.IOException;
import java.io.InputStream;
import java.util.Properties;



public class PropertiesUtil {
    public static Properties properties = null;
    static{
        try {
            // 加载配置属性
            InputStream inputStream =
ClassLoader.getSystemResourceAsStream("kafka.properties");
            properties = new Properties();
            properties.load(inputStream);
        } catch (IOException e) {
            e.printStackTrace();
        }
    }

    public static String getProperty(String key){
        return properties.getProperty(key);
    }
}
```

3) 创建 kafka.properties 文件，并放置于 resources 目录下

```
zookeeper.connect=linux01:2181,linux02:2181,linux03:2181
group.id=g1
zookeeper.session.timeout.ms=30000
zookeeper.sync.time.ms=250
num.io.threads=12
batch.size=65536
buffer.memory=524288
auto.commit.interval.ms=1000
auto.offset.reset=smallest
serializer.class=kafka.serializer.StringEncoder
topic=calllog

hbase.namespace=ns_telecom
hbase.table.name=ns_telecom:calllog
hbase.regions.count=6
hbase.caller.flag=1
```

4) 将 hdfs-site.xml、core-site.xml、hbase-site.xml、log4j.properties 放置于 resources 目录

5) 新建类：HBaseUtil

该类主要用于封装一些 HBase 的常用操作，比如创建命名空间，创建表等等。

```
package com.china.utils;

import java.io.IOException;
import java.text.DecimalFormat;
import java.util.Iterator;
import java.util.TreeSet;

import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.hbase.HColumnDescriptor;
import org.apache.hadoop.hbase.HTableDescriptor;
import org.apache.hadoop.hbase.MasterNotRunningException;
import org.apache.hadoop.hbase.NamespaceDescriptor;
import org.apache.hadoop.hbase.TableName;
import org.apache.hadoop.hbase.ZooKeeperConnectionException;
import org.apache.hadoop.hbase.client.HBaseAdmin;
import org.apache.hadoop.hbase.util.Bytes;

public class HBaseUtil {
    /**
     * 判断 HBase 表是否存在
     *
     * @throws IOException
     * @throws ZooKeeperConnectionException
     * @throws MasterNotRunningException
     */
    public static boolean isExistTable(Configuration conf, String tableName) {
        // 操作 HBase 表必须创建 HBaseAdmin 对象
        HBaseAdmin admin = null;
        try {
            admin = new HBaseAdmin(conf);
            return admin.tableExists(tableName);
        } catch (IOException e) {
            e.printStackTrace();
        } finally {
            try {
                if (admin != null) admin.close();
            } catch (IOException e) {
                e.printStackTrace();
            }
        }
        return false;
    }

    /**
     * 初始化命名空间
     */
    public static void initNamespace(Configuration conf, String namespace) {
        HBaseAdmin admin = null;
        try {
            admin = new HBaseAdmin(conf);
            //命名空间类似于关系型数据库中的 schema，可以想象成文件夹
            NamespaceDescriptor ns = NamespaceDescriptor
                    .create(namespace)
                    .addConfiguration("creator", "Jinji")
                    .addConfiguration("create_time",
String.valueOf(System.currentTimeMillis()))
                    .build();
            admin.createNamespace(ns);
        } catch (MasterNotRunningException e) {
            e.printStackTrace();
        } catch (ZooKeeperConnectionException e) {
            e.printStackTrace();
        } catch (IOException e) {
            e.printStackTrace();
        } finally {
            if (null != admin) {
                try {
                    admin.close();
                } catch (IOException e) {
                    e.printStackTrace();
                }
            }
        }
    }

    /**
     * 创建表
     *
     * @param tableName
     * @param columnFamily
     * @throws IOException
     * @throws ZooKeeperConnectionException
     * @throws MasterNotRunningException
     */
    public static void createTable(Configuration conf, String tableName, String... columnFamily)
{
        HBaseAdmin admin = null;
        try {
            admin = new HBaseAdmin(conf);
            // 判断表是否存在
            if (isExistTable(conf, tableName)) {
                // 存在
                System.out.println("表已经存在：" + tableName);
                System.exit(0);
            } else {
```

```
                // 不存在
                // 通过表名实例化“表描述器”
                HTableDescriptor tableDescriptor = new
HTableDescriptor(TableName.valueOf(tableName));
                for (String cf : columnFamily) {
                    tableDescriptor.addFamily(new
HColumnDescriptor(cf).setMaxVersions(3));
                }

//tableDescriptor.addCoprocessor("com.china.coprocessor.CalleeWriteObserver");
                int regions =
Integer.valueOf(PropertiesUtil.getProperty("hbase.regions.count"));
                admin.createTable(tableDescriptor, getSplitKeys(regions));
                System.out.println("表创建成功：" + tableName);
            }
        } catch (IOException e) {
            e.printStackTrace();
        } finally {
            try {
                if (admin != null) admin.close();
            } catch (IOException e) {
                e.printStackTrace();
            }
        }

    }

    /**
```

```
     * 预分区键
     * 例如：{"00|", "01|", "02|", "03|", "04|", "05|"}
     * @return
     */
    private static byte[][] getSplitKeys(int regions) {

        String[] keys = new String[regions];
        //这里默认不会超过两位数的分区，如果超过，需要变更设计，如果需要灵活操作，
也需要变更设计
        DecimalFormat df = new DecimalFormat("00");
        for(int i = 0; i < regions; i++){
            //例如：如果 regions = 6，则：{"00|", "01|", "02|", "03|", "04|", "05|"}
            keys[i] = df.format(i) + "|";
        }
        byte[][] splitKeys = new byte[keys.length][];
        TreeSet<byte[]> rows = new TreeSet<byte[]>(Bytes.BYTES_COMPARATOR);// 升序
排序
        for (int i = 0; i < keys.length; i++) {
            rows.add(Bytes.toBytes(keys[i]));
        }
        Iterator<byte[]> rowKeyIter = rows.iterator();
        int i = 0;
        while (rowKeyIter.hasNext()) {
            byte[] tempRow = rowKeyIter.next();
            rowKeyIter.remove();
            splitKeys[i] = tempRow;
            i++;
        }
        return splitKeys;
    }

    /**
     * 生成 rowkey
     *
     * @param regionHash
     * @param call1
     * @param dateTime
     * @param flag
     * @param duration
     * @return
     */
    public static String genRowKey(String regionHash, String call1, String dateTime, String
call2, String flag, String duration) {
        StringBuilder sb = new StringBuilder();
        sb.append(regionHash + "_")
                .append(call1 + "_")
                .append(dateTime + "_")
                .append(call2 + "_")
                .append(flag + "_")
                .append(duration);
        return sb.toString();
    }

    /**
     * 生成分区号
     * @return
     */
    public static String genPartitionCode(String call1, String callTime, int regions) {
        int len = call1.length();
        //取出后 4 位电话号码
        String last4Num = call1.substring(len - 4);
        //取出年月
        String first4Num = callTime.replace("-", "").substring(0, 6);
        //亦或后与初始化设定的 region 个数求模
        int hashCode = (Integer.valueOf(last4Num) ^ Integer.valueOf(first4Num)) % regions;
        return new DecimalFormat("00").format(hashCode);
    }
}
```

6) 新建类：HBaseDAO（完成以下内容后，考虑数据 put 的效率如何优化）

该类主要用于执行具体的保存数据的操作，rowkey 的生成规则等等。

```
package com.china.dao;


import java.io.IOException;
import java.text.DecimalFormat;
import java.text.ParseException;
import java.text.SimpleDateFormat;


import com.china.utils.HBaseUtil;
import com.china.utils.PropertiesUtil;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.hbase.HBaseConfiguration;
import org.apache.hadoop.hbase.client.HTable;
import org.apache.hadoop.hbase.client.Put;
import org.apache.hadoop.hbase.util.Bytes;


public class HBaseDAO {
    private int regions;
    private String namespace;
    private String tableName;
    private String flag;
    private SimpleDateFormat simpleDateFormat;


    private static Configuration conf = null;
    private HTable callLogTable;
    static{
        conf = HBaseConfiguration.create();
    }


    public HBaseDAO() {
        simpleDateFormat = new SimpleDateFormat("yyyy-MM-dd HH:mm:ss");


        tableName = PropertiesUtil.getProperty("hbase.table.name");
        regions = Integer.valueOf(PropertiesUtil.getProperty("hbase.regions.count"));
        namespace = PropertiesUtil.getProperty("hbase.namespace");
        flag = PropertiesUtil.getProperty("hbase.caller.flag");



        if(!HBaseUtil.isExistTable(conf, tableName)){
            HBaseUtil.initNamespace(conf, namespace);
            HBaseUtil.createTable(conf, tableName, "f1", "f2");
        }
    }
    /**
     * 15596505995,17519874292,2017-03-11 00:30:19,0652
     *  将当前数据 put 到 HTable 中
     * @param log
     */
    public void put(String log){
        try {
            callLogTable = new HTable(conf, tableName);

            String[] splits = log.split(",");

            String call1 = splits[0];
            String call2 = splits[1];
            String dateAndTime = splits[2];
            String timestamp = null;
            try {
                timestamp =
String.valueOf(simpleDateFormat.parse(dateAndTime).getTime());
            } catch (ParseException e) {
                e.printStackTrace();
            }
            String date = dateAndTime.split(" ")[0].replace("-", "");
            String time = dateAndTime.split(" ")[1].replace(":", "");
            String duration = splits[3];

            String regionHash = HBaseUtil.genPartitionCode(call1, date, regions);
            String rowKey = HBaseUtil.genRowKey(regionHash, call1, date + time, call2,
flag, duration);
            Put put = new Put(Bytes.toBytes(rowKey));

            put.add(Bytes.toBytes("f1"), Bytes.toBytes("call1"), Bytes.toBytes(call1));
            put.add(Bytes.toBytes("f1"), Bytes.toBytes("call2"), Bytes.toBytes(call2));
            put.add(Bytes.toBytes("f1"), Bytes.toBytes("date_time"), Bytes.toBytes(date +
time));
            put.add(Bytes.toBytes("f1"), Bytes.toBytes("date_time_ts"),
Bytes.toBytes(timestamp));
            put.add(Bytes.toBytes("f1"), Bytes.toBytes("duration"), Bytes.toBytes(duration));
            put.add(Bytes.toBytes("f1"), Bytes.toBytes("flag"), Bytes.toBytes(flag));

            callLogTable.put(put);
        } catch (IOException e) {
            e.printStackTrace();
        }
    }


}
```

3.2.3、编写测试单元：范围查找数据（本方案已弃用，但需掌握）

使用 scan 查看 HBase 中是否正确存储了数据，同时尝试使用过滤器查询扫描指定通话时间点的数据。进行该单元测试前，需要先运行数据采集任务，确保 HBase 中已有数据存在。

新建工具过滤器工具类：**HBaseFilterUtil**

```
package com.china.utils;

import org.apache.hadoop.hbase.filter.*;
import org.apache.hadoop.hbase.util.Bytes;


import java.util.Collection;


public class HBaseFilterUtil {
    /**
     * 获得相等过滤器。相当于 SQL 的 [字段] = [值]
     *
     * @param cf   列族名
     * @param col  列名
     * @param val  值
     * @return  过滤器
     */
    public static Filter eqFilter(String cf, String col, byte[] val) {
        SingleColumnValueFilter f = new SingleColumnValueFilter(Bytes.toBytes(cf),
Bytes.toBytes(col), CompareFilter.CompareOp.EQUAL, val);
        f.setLatestVersionOnly(true);
        f.setFilterIfMissing(true);
        return f;
    }

    /**
     * 获得大于过滤器。相当于 SQL 的 [字段] > [值]
     *
     * @param cf   列族名
     * @param col  列名
     * @param val  值
     * @return  过滤器
```

```
	 */
	public static Filter gtFilter(String cf, String col, byte[] val) {
		SingleColumnValueFilter f = new SingleColumnValueFilter(Bytes.toBytes(cf),
Bytes.toBytes(col), CompareFilter.CompareOp.GREATER, val);
		f.setLatestVersionOnly(true);
		f.setFilterIfMissing(true);
		return f;
	}

	/**
	 * 获得大于等于过滤器。相当于 SQL 的 [字段] >= [值]
	 *
	 * @param cf   列族名
	 * @param col  列名
	 * @param val  值
	 * @return  过滤器
	 */
	public static Filter gteqFilter(String cf, String col, byte[] val) {
		SingleColumnValueFilter f = new SingleColumnValueFilter(Bytes.toBytes(cf),
Bytes.toBytes(col), CompareFilter.CompareOp.GREATER_OR_EQUAL, val);
		f.setLatestVersionOnly(true);
		f.setFilterIfMissing(true);
		return f;
	}

	/**
	 * 获得小于过滤器。相当于 SQL 的 [字段] < [值]
	 *
	 * @param cf   列族名
	 * @param col  列名
	 * @param val  值
	 * @return  过滤器
	 */
	public static Filter ltFilter(String cf, String col, byte[] val) {
		SingleColumnValueFilter f = new SingleColumnValueFilter(Bytes.toBytes(cf),
Bytes.toBytes(col), CompareFilter.CompareOp.LESS, val);
		f.setLatestVersionOnly(true);
		f.setFilterIfMissing(true);
		return f;
	}

	/**
	 *  获得小于等于过滤器。相当于 SQL 的 [字段] <= [值]
	 *
	 * @param cf   列族名
	 * @param col  列名
	 * @param val  值
	 * @return  过滤器
	 */
	public static Filter lteqFilter(String cf, String col, byte[] val) {
		SingleColumnValueFilter f = new SingleColumnValueFilter(Bytes.toBytes(cf),
Bytes.toBytes(col), CompareFilter.CompareOp.LESS_OR_EQUAL, val);
		f.setLatestVersionOnly(true);
		f.setFilterIfMissing(true);
		return f;
	}
```

```
    /**
     * 获得不等于过滤器。相当于 SQL 的 [字段] != [值]
     *
     * @param cf  列族名
     * @param col 列名
     * @param val 值
     * @return 过滤器
     */
    public static Filter neqFilter(String cf, String col, byte[] val) {
        SingleColumnValueFilter f = new SingleColumnValueFilter(Bytes.toBytes(cf),
Bytes.toBytes(col), CompareFilter.CompareOp.NOT_EQUAL, val);
        f.setLatestVersionOnly(true);
        f.setFilterIfMissing(true);
        return f;
    }

    /**
     * 和过滤器 相当于 SQL 的 的 and
     *
     * @param filters 多个过滤器
     * @return 过滤器
     */
    public static Filter andFilter(Filter... filters) {
        FilterList filterList = new FilterList(FilterList.Operator.MUST_PASS_ALL);
        if (filters != null && filters.length > 0) {
            if (filters.length > 1) {
                for (Filter f : filters) {
                    filterList.addFilter(f);
                }
            }
            if (filters.length == 1) {
                return filters[0];
            }
        }
        return filterList;
    }

    /**
     * 和过滤器 相当于 SQL 的 的 and
     *
     * @param filters 多个过滤器
     * @return 过滤器
     */
    public static Filter andFilter(Collection<Filter> filters) {
        return andFilter(filters.toArray(new Filter[0]));
    }



    /**
     * 或过滤器 相当于 SQL 的 or
     *
     * @param filters 多个过滤器
     * @return 过滤器
     */
    public static Filter orFilter(Filter... filters) {
        FilterList filterList = new FilterList(FilterList.Operator.MUST_PASS_ONE);
        if (filters != null && filters.length > 0) {
            for (Filter f : filters) {
                filterList.addFilter(f);
            }
        }
        return filterList;
    }

    /**
     * 或过滤器 相当于 SQL 的 or
     *
     * @param filters 多个过滤器
     * @return 过滤器
     */
    public static Filter orFilter(Collection<Filter> filters) {
        return orFilter(filters.toArray(new Filter[0]));
    }

    /**
     * 非空过滤器 相当于 SQL 的 is not null
     *
     * @param cf  列族
     * @param col 列
     * @return 过滤器
     */
    public static Filter notNullFilter(String cf, String col) {
        SingleColumnValueFilter filter = new SingleColumnValueFilter(Bytes.toBytes(cf),
Bytes.toBytes(col), CompareFilter.CompareOp.NOT_EQUAL, new NullComparator());
            filter.setFilterIfMissing(true);
            filter.setLatestVersionOnly(true);
            return filter;
      }

      /**
       * 空过滤器 相当于 SQL 的 is null
       *
       * @param cf   列族
       * @param col  列
       * @return 过滤器
       */
      public static Filter nullFilter(String cf, String col) {
            SingleColumnValueFilter filter = new SingleColumnValueFilter(Bytes.toBytes(cf),
Bytes.toBytes(col), CompareFilter.CompareOp.EQUAL, new NullComparator());
            filter.setFilterIfMissing(false);
            filter.setLatestVersionOnly(true);
            return filter;
      }

      /**
       * 子字符串过滤器 相当于 SQL 的 like '%[val]%'
       *
       * @param cf   列族
       * @param col  列
       * @param sub  子字符串
       * @return 过滤器
```

```
     */
    public static Filter subStringFilter(String cf, String col, String sub) {
        SingleColumnValueFilter filter = new SingleColumnValueFilter(Bytes.toBytes(cf),
Bytes.toBytes(col), CompareFilter.CompareOp.EQUAL, new SubstringComparator(sub));
        filter.setFilterIfMissing(true);
        filter.setLatestVersionOnly(true);
        return filter;
    }

    /**
     * 正则过滤器 相当于 SQL 的 rlike '[regex]'
     *
     * @param cf      列族
     * @param col     列
     * @param regex  正则表达式
     * @return 过滤器
     */
    public static Filter regexFilter(String cf, String col, String regex) {
        SingleColumnValueFilter filter = new SingleColumnValueFilter(Bytes.toBytes(cf),
Bytes.toBytes(col), CompareFilter.CompareOp.EQUAL, new RegexStringComparator(regex));
        filter.setFilterIfMissing(true);
        filter.setLatestVersionOnly(true);
        return filter;
    }
}
```

新建单元测试类：**HBaseScanTest1**（这是个当前情景被废弃的方案，**现用方案：HBaseScanTest2 后续讲解**）

```
package com.china;


import com.china.utils.HBaseFilterUtil;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.hbase.Cell;
import org.apache.hadoop.hbase.CellUtil;
import org.apache.hadoop.hbase.HBaseConfiguration;
import org.apache.hadoop.hbase.client.HTable;
import org.apache.hadoop.hbase.client.Result;
import org.apache.hadoop.hbase.client.ResultScanner;
import org.apache.hadoop.hbase.client.Scan;
import org.apache.hadoop.hbase.filter.Filter;
import org.apache.hadoop.hbase.util.Bytes;
import org.junit.Test;


import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;


public class HBaseScanTest1 {
    private static Configuration conf = null;


    static{
        conf = HBaseConfiguration.create();
    }


    @Test
    public void scanTest() throws IOException {
        HTable hTable = new HTable(conf, "ns_telecom:calllog");
        Scan scan = new Scan();

        SimpleDateFormat simpleDateFormat = new SimpleDateFormat("yyyy-MM-dd");
        String startTimePoint = null;
        String endTimePoint = null;
        try {
            startTimePoint = String.valueOf(simpleDateFormat.parse("2017-01-1").getTime());
            endTimePoint = 
String.valueOf(simpleDateFormat.parse("2017-03-01").getTime());
        } catch (ParseException e) {
            e.printStackTrace();
        }
        Filter filter1 = HBaseFilterUtil.gteqFilter("f1", "date_time_ts", 
Bytes.toBytes(startTimePoint));
        Filter filter2 = HBaseFilterUtil.ltFilter("f1", "date_time_ts", 
Bytes.toBytes(endTimePoint));
        Filter filterList = HBaseFilterUtil.andFilter(filter1, filter2);
        scan.setFilter(filterList);

        ResultScanner resultScanner = hTable.getScanner(scan);
        //每一个 rowkey 对应一个 result
        for(Result result : resultScanner){
            //每一个 rowkey 里面包含多个 cell
            Cell[] cells = result.rawCells();
            for(Cell c: cells){
//                  System.out.println("行： " + Bytes.toString(CellUtil.cloneRow(c)));
//                  System.out.println("列族： " + Bytes.toString(CellUtil.cloneFamily(c)));
//                              System.out.println("列： " + Bytes.toString(CellUtil.cloneQualifier(c)));
//                              System.out.println("值： " + Bytes.toString(CellUtil.cloneValue(c)));
                              System.out.println(Bytes.toString(CellUtil.cloneRow(c))
                                      + ","
                                      + Bytes.toString(CellUtil.cloneFamily(c))
                                      + ":"
                                      + Bytes.toString(CellUtil.cloneQualifier(c))
                                      + ","
                                      + Bytes.toString(CellUtil.cloneValue(c)));
                        }
                  }
            }
}
```

3.2.4、运行测试：HBase 消费数据

尖叫提示：请将 Linux 允许打开的文件个数和进程数进行优化，优化 RegionServer 与 Zookeeper 会话的超时时间。（参考 HBase 文档中优化章节）

项目成功后，则将项目打包后在 linux 中运行测试。

1) 打包 HBase 消费者代码

a) 在 windows 中，进入工程的 pom.xml 所在目录下（建议将该工程的 pom.xml 文件拷贝到其他临时目录中，例如我把 pom.xml 文件拷贝到了 F:\maven-lib\目录下），然后使用 mvn 命令下载工程所有依赖的 jar 包

```
mvn -DoutputDirectory=./lib -DgroupId=com.china -DartifactId=ct_consumer
-Dversion=0.0.1-SNAPSHOT dependency:copy-dependencies
```

b) 使用 maven 打包工程

c) 测试执行该 jar 包

方案一：推荐，使用*通配符，将所有依赖加入到 classpath 中，不可使用*.jar 的方式。

注意：如果是在 Linux 中实行，注意文件夹之间的分隔符。自己的工程要单独在 cp 中指定，不要直接放在 maven-lib/lib 目录下。

```
java -cp F:\maven-lib\ct_consumer-0.0.1-SNAPSHOT.jar;F:\maven-lib\lib\*
com.china.ct_consumer.kafka.HBaseConsumer
```

方案二：最最推荐，使用 java.ext.dirs 参数将所有依赖的目录添加进 classpath 中。

注意：-Djava.ext.dirs=属性后边的路径不能为"~"

```
java -Djava.ext.dirs=F:\maven-lib\lib\ -cp F:\maven-lib\ct_consumer-0.0.1-SNAPSHOT.jar
com.china.ct_consumer.kafka.HBaseConsumer
```

方案三：不推荐，将所有依赖的 jar 包直接以绝对路径的方式添加进 classpath 中，以下为 windows 中的示例，linux 中需要把分号替换为冒号。

```
java -cp
F:\maven-lib\ct_consumer-0.0.1-SNAPSHOT.jar;F:\maven-lib\lib\activation-1.1.jar;F:\maven-lib\l
ib\apacheds-i18n-2.0.0-M15.jar;F:\maven-lib\lib\apacheds-kerberos-codec-2.0.0-M15.jar;F:\mave
n-lib\lib\api-asn1-api-1.0.0-M20.jar;F:\maven-lib\lib\api-util-1.0.0-M20.jar;F:\maven-lib\lib\asm-
3.1.jar;F:\maven-lib\lib\avro-1.7.6-cdh5.3.6.jar;F:\maven-lib\lib\commons-beanutils-1.7.0.jar;F:\m
aven-lib\lib\commons-beanutils-core-1.8.0.jar;F:\maven-lib\lib\commons-cli-1.2.jar;F:\maven-lib\
lib\commons-codec-1.7.jar;F:\maven-lib\lib\commons-collections-3.2.1.jar;F:\maven-lib\lib\com
mons-compress-1.4.1.jar;F:\maven-lib\lib\commons-configuration-1.6.jar;F:\maven-lib\lib\commo
ns-daemon-1.0.13.jar;F:\maven-lib\lib\commons-digester-1.8.jar;F:\maven-lib\lib\commons-el-1.0
.jar;F:\maven-lib\lib\commons-httpclient-3.1.jar;F:\maven-lib\lib\commons-io-2.4.jar;F:\maven-li
b\lib\commons-lang-2.6.jar;F:\maven-lib\lib\commons-logging-1.1.1.jar;F:\maven-lib\lib\common
s-math-2.1.jar;F:\maven-lib\lib\commons-math3-3.1.1.jar;F:\maven-lib\lib\commons-net-3.1.jar;F:
\maven-lib\lib\core-3.1.1.jar;F:\maven-lib\lib\curator-client-2.6.0.jar;F:\maven-lib\lib\curator-fram
ework-2.6.0.jar;F:\maven-lib\lib\curator-recipes-2.6.0.jar;F:\maven-lib\lib\findbugs-annotations-1.
3.9-1.jar;F:\maven-lib\lib\gson-2.2.4.jar;F:\maven-lib\lib\guava-12.0.1.jar;F:\maven-lib\lib\hadoop
-annotations-2.5.0-cdh5.3.6.jar;F:\maven-lib\lib\hadoop-auth-2.5.0-cdh5.3.6.jar;F:\maven-lib\lib\h
adoop-common-2.5.0-cdh5.3.6.jar;F:\maven-lib\lib\hadoop-core-2.5.0-mr1-cdh5.3.6.jar;F:\maven-
```

```
lib\lib\hadoop-hdfs-2.5.0-cdh5.3.6.jar;F:\maven-lib\lib\hadoop-hdfs-2.5.0-cdh5.3.6-tests.jar;F:\ma
ven-lib\lib\hbase-client-0.98.6-cdh5.3.6.jar;F:\maven-lib\lib\hbase-common-0.98.6-cdh5.3.6.jar;F:
\maven-lib\lib\hbase-common-0.98.6-cdh5.3.6-tests.jar;F:\maven-lib\lib\hbase-hadoop2-compat-0.
98.6-cdh5.3.6.jar;F:\maven-lib\lib\hbase-hadoop-compat-0.98.6-cdh5.3.6.jar;F:\maven-lib\lib\hbas
e-prefix-tree-0.98.6-cdh5.3.6.jar;F:\maven-lib\lib\hbase-protocol-0.98.6-cdh5.3.6.jar;F:\maven-lib\
lib\hbase-server-0.98.6-cdh5.3.6.jar;F:\maven-lib\lib\high-scale-lib-1.1.1.jar;F:\maven-lib\lib\hsql
db-1.8.0.10.jar;F:\maven-lib\lib\htrace-core-2.04.jar;F:\maven-lib\lib\httpclient-4.2.5.jar;F:\maven
-lib\lib\httpcore-4.1.2.jar;F:\maven-lib\lib\jackson-core-asl-1.8.8.jar;F:\maven-lib\lib\jackson-jaxrs
-1.8.8.jar;F:\maven-lib\lib\jackson-mapper-asl-1.8.8.jar;F:\maven-lib\lib\jackson-xc-1.7.1.jar;F:\m
aven-lib\lib\jamon-runtime-2.3.1.jar;F:\maven-lib\lib\jasper-compiler-5.5.23.jar;F:\maven-lib\lib\j
asper-runtime-5.5.23.jar;F:\maven-lib\lib\java-xmlbuilder-0.4.jar;F:\maven-lib\lib\jaxb-api-2.1.jar;
F:\maven-lib\lib\jaxb-impl-2.2.3-1.jar;F:\maven-lib\lib\jdk.tools-1.6.jar;F:\maven-lib\lib\jersey-co
re-1.8.jar;F:\maven-lib\lib\jersey-json-1.8.jar;F:\maven-lib\lib\jersey-server-1.8.jar;F:\maven-lib\li
b\jets3t-0.9.0.jar;F:\maven-lib\lib\jettison-1.1.jar;F:\maven-lib\lib\jetty-6.1.26.cloudera.4.jar;F:\ma
ven-lib\lib\jetty-sslengine-6.1.26.cloudera.4.jar;F:\maven-lib\lib\jetty-util-6.1.26.cloudera.4.jar;F:\
maven-lib\lib\jopt-simple-3.2.jar;F:\maven-lib\lib\jsch-0.1.42.jar;F:\maven-lib\lib\jsp-2.1-6.1.14.ja
r;F:\maven-lib\lib\jsp-api-2.1.jar;F:\maven-lib\lib\jsp-api-2.1-6.1.14.jar;F:\maven-lib\lib\jsr305-1.
3.9.jar;F:\maven-lib\lib\junit-3.8.1.jar;F:\maven-lib\lib\kafka_2.10-0.8.2.1.jar;F:\maven-lib\lib\kaf
ka-clients-0.8.2.1.jar;F:\maven-lib\lib\log4j-1.2.17.jar;F:\maven-lib\lib\lz4-1.2.0.jar;F:\maven-lib\l
ib\metrics-core-2.2.0.jar;F:\maven-lib\lib\netty-3.6.6.Final.jar;F:\maven-lib\lib\paranamer-2.3.jar;
F:\maven-lib\lib\protobuf-java-2.5.0.jar;F:\maven-lib\lib\scala-library-2.10.4.jar;F:\maven-lib\lib\s
ervlet-api-2.5.jar;F:\maven-lib\lib\servlet-api-2.5-6.1.14.jar;F:\maven-lib\lib\show.bat;F:\maven-li
b\lib\slf4j-api-1.7.5.jar;F:\maven-lib\lib\slf4j-log4j12-1.7.5.jar;F:\maven-lib\lib\snappy-java-1.1.1.
6.jar;F:\maven-lib\lib\xmlenc-0.52.jar;F:\maven-lib\lib\xz-1.0.jar;F:\maven-lib\lib\zkclient-0.3.jar;
F:\maven-lib\lib\zookeeper-3.4.5-cdh5.3.6.jar; com.china.ct_consumer.kafka.HBaseConsumer
```

3.2.5、编写代码：优化数据存储方案

现在我们要使用

使用 HBase 查找数据时，尽可能的使用 rowKey 去精准的定位数据位置，而非使用 ColumnValueFilter 或者 SingleColumnValueFilter，按照单元格 Cell 中的 Value 过滤数据，这样做在数据量巨大的情况下，效率是极低的——如果要涉及到全表扫描。所以尽量不要做这样可怕的事情。注意，这并非 ColumnValueFilter 就无用武之地。现在，我们将使用协处理器，将数据一分为二。

思路：

a) 编写协处理器类，用于协助处理 HBase 的相关操作（增删改查）

b) 在协处理器中，一条主叫日志成功插入后，将该日志切换为被叫视角再次插入一次，放入到与主叫日志不同的列族中。

c) 重新创建 hbase 表，并设置为该表设置协处理器。

d) 编译项目，发布协处理器的 jar 包到 hbase 的 lib 目录下，并群发该 jar 包

e) 修改 hbase-site.xml 文件，设置协处理器，并群发该 hbase-site.xml 文件

编码：

1) 新建协处理器类：CalleeWriteObserver，并覆写 postPut 方法，该方法会在数据成功插入之后被回调。

```
package com.china.coprocessor;


import com.china.utils.HBaseUtil;
import com.china.utils.PropertiesUtil;
import org.apache.commons.lang.StringUtils;
import org.apache.hadoop.hbase.TableName;
import org.apache.hadoop.hbase.client.*;
import org.apache.hadoop.hbase.coprocessor.BaseRegionObserver;
import org.apache.hadoop.hbase.coprocessor.ObserverContext;
import org.apache.hadoop.hbase.coprocessor.RegionCoprocessorEnvironment;
import org.apache.hadoop.hbase.regionserver.wal.WALEdit;
import org.apache.hadoop.hbase.util.Bytes;
import java.io.IOException;

import java.text.ParseException;

import java.text.SimpleDateFormat;


/**

 * 用于实现主叫日志插入成功之后，同时插入一条被叫日志

 */

public class CalleeWriteObserver extends BaseRegionObserver{

    @Override

    public void postPut(ObserverContext<RegionCoprocessorEnvironment> e, Put put, WALEdit
edit, Durability durability) throws IOException {

        super.postPut(e, put, edit, durability);

        //1、获取需要操作的表

        String targetTableName = PropertiesUtil.getProperty("hbase.table.name");

        //2、获取当前操作的表

        String currentTableName =
e.getEnvironment().getRegion().getRegionInfo().getTable().getNameAsString();

        //3、判断需要操作的表是否就是当前表，如果不是，则 return

        if (!StringUtils.equals(targetTableName, currentTableName)) return;


        //4、得到当前插入数据的值并封装新的数据，oriRowkey 举例：
01_15369468720_20170727081033_13720860202_1_0180

        String oriRowKey = Bytes.toString(put.getRow());

        String[] splits = oriRowKey.split("_");

        String flag = splits[4];

        //如果当前插入的是被叫数据，则直接返回(因为默认提供的数据全部为主叫数据)

        if(StringUtils.equals(flag, "0")) return;

        //当前插入的数据描述
        String caller = splits[1];
        String callee = splits[3];
        String dateTime = splits[2];
        String duration = splits[5];
        String timestamp = null;
        try {
            SimpleDateFormat sdf = new SimpleDateFormat("yyyyMMddHHmmss");
            timestamp = String.valueOf(sdf.parse(dateTime).getTime());
        } catch (ParseException e1) {
            e1.printStackTrace();
        }

        //组装新的数据所在分区号
        int regions = Integer.valueOf(PropertiesUtil.getProperty("hbase.regions.count"));
        String regionHash = HBaseUtil.genPartitionCode(callee, dateTime, regions);
        String newFlag = "0";
        String rowKey = HBaseUtil.genRowKey(regionHash, callee, dateTime, caller, newFlag,
duration);

        //开始存放被叫数据
        Put newPut = new Put(Bytes.toBytes(rowKey));

        newPut.add(Bytes.toBytes("f2"), Bytes.toBytes("call1"), Bytes.toBytes(callee));
        newPut.add(Bytes.toBytes("f2"), Bytes.toBytes("call2"), Bytes.toBytes(caller));
        newPut.add(Bytes.toBytes("f2"), Bytes.toBytes("date_time"), Bytes.toBytes(dateTime));
        newPut.add(Bytes.toBytes("f2"), Bytes.toBytes("date_time_ts"),
Bytes.toBytes(timestamp));
        newPut.add(Bytes.toBytes("f2"), Bytes.toBytes("duration"), Bytes.toBytes(duration));
```

```
            newPut.add(Bytes.toBytes("f2"), Bytes.toBytes("flag"), Bytes.toBytes(newFlag));

            HTableInterface hTable =
e.getEnvironment().getTable(TableName.valueOf(targetTableName));
            hTable.put(newPut);
            hTable.close();
        }
}
```

2) 重新创建 hbase 表，并设置为该表设置协处理器。在“表描述器”中调用 addCoprocessor 方法进行协处理器的设置，大概是这样的：（你需要找到你的建表的那部分代码，添加如下逻辑）

```
tableDescriptor.addCoprocessor("com.china.coprocessor.CalleeWriteObserver");
```

3.2.6、运行测试：协处理器

重新编译项目，**发布 jar 包到 hbase 的 lib 目录下**（注意需群发）：

```
$ scp lib/ct_consumer-1.0-SNAPSHOT.jar
linux02:/home/admin/modules/cdh/hbase-0.98.6-cdh5.3.6/lib/
$ scp lib/ct_consumer-1.0-SNAPSHOT.jar
linux03:/home/admin/modules/cdh/hbase-0.98.6-cdh5.3.6/lib/
```

重新修改 hbase-site.xml：

```
<property>
    <name>hbase.coprocessor.region.classes</name>
    <value>com.china.coprocessor.CalleeWriteObserver</value>
</property>
```

修改后群发：

```
$ scp -r conf/ linux02:/home/admin/modules/cdh/hbase-0.98.6-cdh5.3.6/
$ scp -r conf/ linux03:/home/admin/modules/cdh/hbase-0.98.6-cdh5.3.6/
```

完成以上步骤后，重新消费数据进行测试。

3.2.7、编写测试单元：范围查找数据

思路：

a) 已知要查询的手机号码以及起始时间节点和结束时间节点，查询该节点范围内的该手机号码的通话记录。

b) 拼装 startRowKey 和 stopRowKey，即扫描范围，要想拼接出扫描范围，首先需要了解 rowkey 组成结构，我们再来复习一下，举个大栗子：

```
rowkey：
分区号_手机号码 1_通话建立时间_手机号码 2_主(被)叫标记_通话持续时间
01_15837312345_20170527081033_1_0180
```

c) 比如按月查询通话记录，则 startRowKey 举例：

```
regionHash_158373123456_20170501000000
```

stopRowKey 举例：

```
regionHash_158373123456_20170601000000
```

注意：startRowKey 和 stopRowKey 设计时，后面的部分已经被去掉。

尖叫提示：rowKey 的扫描范围为前闭后开。

尖叫提示：rowKey 默认是有序的，排序规则为字符的按位比较

d) 如果查找所有的，需要多次 scan 表，每次 scan 设置为下一个时间窗口即可，该操作可放置于 for 循环中。

编码：

1) 新建工具类：ScanRowkeyUtil

该类主要用于根据传入指定的查询时间，生成若干组 startRowKey 和 stopRowKey

```
package com.china.utils;


import java.text.ParseException;
import java.text.SimpleDateFormat;
import java.util.ArrayList;
import java.util.Calendar;
import java.util.Date;

import java.util.List;


/**

 * 该类主要用于根据用户传入的手机号以及开始和结束时间点，按月生成多组 rowkey

 */

public class ScanRowkeyUtil {

    private String telephone;

    private String startDateString;

    private String stopDateString;

    List<String[]> list = null;


    int index = 0;


    private SimpleDateFormat sdf = new SimpleDateFormat("yyyy-MM-dd");

    private SimpleDateFormat sdf2 = new SimpleDateFormat("yyyyMMddHHmmss");


    public ScanRowkeyUtil(String telephone, String startDateString, String stopDateString) {

        this.telephone = telephone;

        this.startDateString = startDateString;

        this.stopDateString = stopDateString;

        list = new ArrayList<>();

        genRowKeys();


    }


    //01_15837312345_201711

    //15837312345 2017-01-01 2017-05-01
    public void genRowKeys(){
        int regions = Integer.valueOf(PropertyUtil.getProperty("hbase.regions.count"));
        try {
            Date startDate = sdf.parse(startDateString);
            Date stopDate = sdf.parse(stopDateString);

            //当前开始时间
            Calendar currentStartCalendar = Calendar.getInstance();
            currentStartCalendar.setTimeInMillis(startDate.getTime());
            //当前结束时间
            Calendar currentStopCalendar = Calendar.getInstance();
            currentStopCalendar.setTimeInMillis(startDate.getTime());
            currentStopCalendar.add(Calendar.MONTH, 1);

            while (currentStopCalendar.getTimeInMillis() <= stopDate.getTime()) {
                String regionCode = HBaseUtil.genPartitionCode(telephone, sdf2.format(new
Date(currentStartCalendar.getTimeInMillis())), regions);
                // 01_15837312345_201711
                String startRowKey = regionCode + "_" + telephone + "_" + sdf2.format(new
Date(currentStartCalendar.getTimeInMillis()));
                String stopRowKey = regionCode + "_" + telephone + "_" + sdf2.format(new
Date(currentStopCalendar.getTimeInMillis()));

                String[] rowkeys = {startRowKey, stopRowKey};
                list.add(rowkeys);
                currentStartCalendar.add(Calendar.MONTH, 1);
                currentStopCalendar.add(Calendar.MONTH, 1);
            }
```

```
		} catch (ParseException e) {
			e.printStackTrace();
		}
	}

	/**
	 *  判断 list 集合中是否还有下一组 rowkey
	 * @return
	 */
	public boolean hasNext() {
		if(index < list.size()){
			return true;
		}else{
			return false;
		}
	}

	/**
	 *   取出 list 集合中存放的下一组 rowkey
	 * @return
	 */
	public String[] next() {
		String[] rowkeys = list.get(index);
		index++;
		return rowkeys;
	}
}
```

2) 新建测试单元类 ：HBaseScanTest2

```
package com.china;


import com.china.utils.DateTimeUtil;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.hbase.Cell;
import org.apache.hadoop.hbase.CellUtil;
import org.apache.hadoop.hbase.HBaseConfiguration;
import org.apache.hadoop.hbase.client.HTable;
import org.apache.hadoop.hbase.client.Result;
import org.apache.hadoop.hbase.client.ResultScanner;
import org.apache.hadoop.hbase.client.Scan;
import org.apache.hadoop.hbase.util.Bytes;
import org.junit.Test;


import java.io.IOException;
import java.text.ParseException;


public class HBaseScanTest2 {
    private static Configuration conf = null;


    static {
        conf = HBaseConfiguration.create();
    }


    @Test
    public void scanTest() throws IOException, ParseException {
        String call = "14473548449";
        String startPoint = "2017-01-01";
        String stopPoint = "2017-09-01";


        HTable hTable = new HTable(conf, "ns_telecom:calllog");
        Scan scan = new Scan();
        ScanRowkeyUtil scanRowkeyUtil = new ScanRowkeyUtil (call, startPoint, stopPoint);
        while (scanRowkeyUtil.hasNext()) {
            String[] rowKeys = scanRowkeyUtil.next();
            scan.setStartRow(Bytes.toBytes(rowKeys[0]));
            scan.setStopRow(Bytes.toBytes(rowKeys[1]));

            System.out.println("时间范围" + rowKeys[0].substring(15, 21) + "---" +
rowKeys[1].substring(15, 21));

            ResultScanner resultScanner = hTable.getScanner(scan);
            //每一个 rowkey 对应一个 result
            for (Result result : resultScanner) {
                //每一个 rowkey 里面包含多个 cell
                Cell[] cells = result.rawCells();
                StringBuilder sb = new StringBuilder();
                sb.append(Bytes.toString(result.getRow())).append(",");
                for (Cell c : cells) {
                    sb.append(Bytes.toString(CellUtil.cloneValue(c))).append(",");
                }
                System.out.println(sb.toString());
            }
        }
    }
}
```

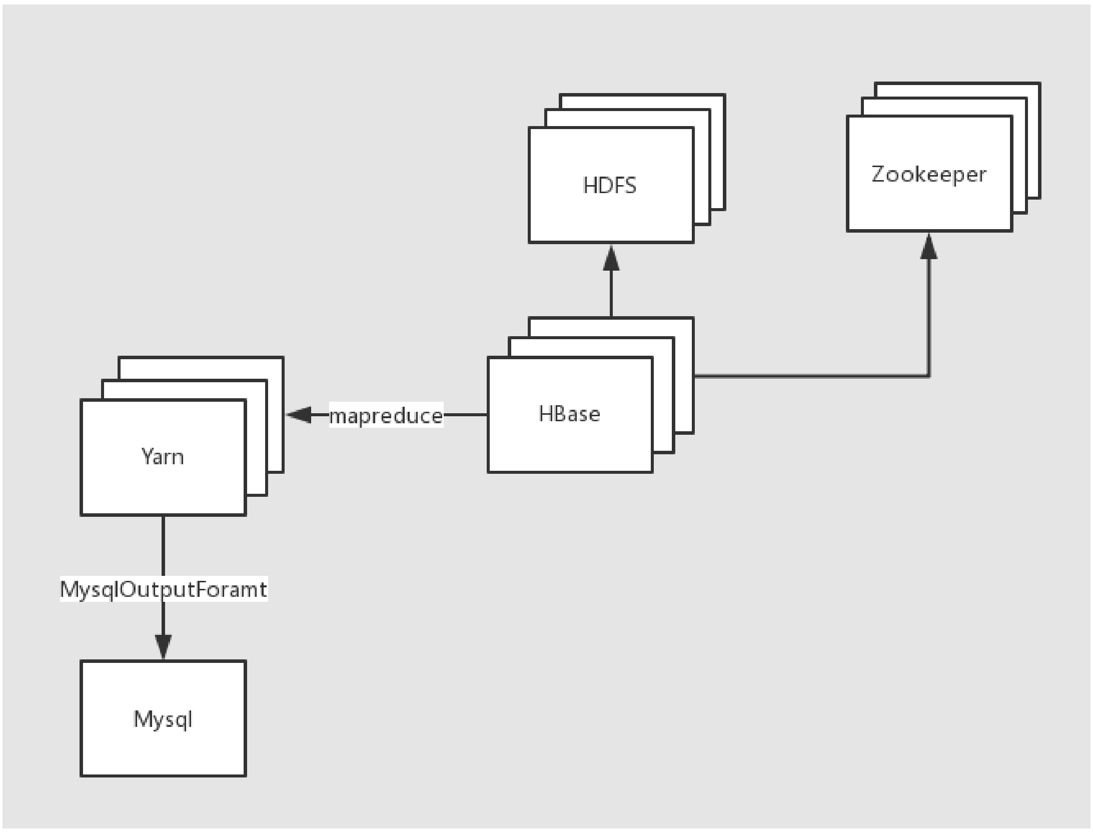
3) 运行测试

观察是否已经按照时间范围查询出对应的数据。

3.3、数据分析

我们的数据已经完整的采集到了 HBase 集群中，这次我们需要对采集到的数据进行分析，统计出我们想要的结果。注意，在分析的过程中，我们不一定会采取一个业务指标对应一个 mapreduce-job 的方式，如果情景允许，我们会采取一个 mapreduce 分析多个业务指标的方式来进行任务。具体何时采用哪种方式，我们后续会详细探讨。

分析模块流程图：



业务指标：

a) 用户每天主叫通话个数统计，通话时间统计。

b) 用户每月通话记录统计，通话时间统计。

c) 用户之间亲密关系统计。（通话次数与通话时间体现用户亲密关系）

3.3.1、Mysql 表结构设计

我们将分析的结果数据保存到 Mysql 中，以方便 Web 端进行查询展示。

1) 表：db_telecom.tb_contacts

用于存放用户手机号码与联系人姓名。

列	备注	类型
id	自增主键	int(11) NOT NULL
telephone	手机号码	varchar(255) NOT NULL
name	联系人姓名	varchar(255) NOT NULL

2) 表：db_telecom.tb_call

用于存放某个时间维度下通话次数与通话时长的总和。

列	备注	类型
id_date_contact	复合主键（联系人维度 id，时间维度 id）	varchar(255) NOT NULL
id_date_dimension	时间维度 id	int(11) NOT NULL
id_contact	查询人的电话号码	int(11) NOT NULL
call_sum	通话次数总和	int(11) NOT NULL DEFAULT 0
call_duration_sum	通话时长总和	int(11) NOT NULL DEFAULT 0

3) 表：db_telecom.tb_dimension_date

用于存放时间维度的相关数据

列	备注	类型
id	自增主键	int(11) NOT NULL
year	年，当前通话信息所在年	int(11) NOT NULL
month	月，当前通话信息所在月，如果按照年来统计信息，则 month 为-1。	int(11) NOT NULL
day	日，当前通话信息所在日，如果是按照月来统计信息，则	int(11) NOT NULL

	day 为-1。	

4) 表：db_telecom.tb_intimacy

用于存放所有用户用户关系的结果数据。（作业中使用）

列	备注	类型
id	自增主键	int(11) NOT NULL
intimacy_rank	好友亲密度排名	int(11) NOT NULL
id_contact1	联系人 1，当前所查询人	int(11) NOT NULL
id_contact2	联系人 2，与联系人为好友	int(11) NOT NULL
call_count	两联系人通话次数	int(11) NOT NULL DEFAULT 0
call_duration_count	两联系人通话持续时间	int(11) NOT NULL DEFAULT 0

3.3.2、需求：按照不同的维度统计通话

根据需求目标，设计出如上表结构。我们需要按照时间范围（年月日），结合 MapReduce 统计出所属时间范围内所有手机号码的通话次数总和以及通话时长总和。

思路：

a) 维度，即某个角度，某个视角，按照时间维度来统计通话，比如我想统计 2017 年所有月份所有日子的通话记录，那这个维度我们大概可以表述为 2017 年*月*日。

b) 通过 Mapper 将数据按照不同维度聚合给 Reducer

c) 通过 Reducer 拿到按照各个维度聚合过来的数据，进行汇总，输出。

d) 根据业务需求，将 Reducer 的输出通过 Outputformat 把数据

数据输入：HBase

数据输出：Mysql

HBase 中数据源结构：

标签	举例&说明
rowkey	hashregion_call1_datetime_call2_flag_duration 01_15837312345_20170527081033_13766889900_1_0180

family	f1 列族：存放主叫信息 f2 列族：存放被叫信息
call1	第一个手机号码
call2	第二个手机号码
date_time	通话建立的时间，例如：20171017081520
date_time_ts	date_time 对应的时间戳形式
duration	通话时长(单位：秒)
flag	标记 call1 是主叫还是被叫（call1 的身份与 call2 的身份互斥）

a) 已知目标，那么需要结合目标思考已有数据是否能够支撑目标实现；

b) 根据目标数据结构，构建 Mysql 表结构，建表；

c) 思考代码需要涉及到哪些功能模块，建立不同功能模块对应的包结构。

d) 描述数据，一定是基于某个维度（视角）的，所以构建维度类。比如按照“年”与“手机号码”的组合作为 key 聚合所有的数据，便可以统计这个手机号码，这一年的相关结果。

e) 自定义 OutputFormat 用于对接 Mysql，使数据输出。

f) 创建相关工具类。

3.3.3、环境准备

1) 新建 module：ct_analysis

pom 文件配置：

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>

    <groupId>com.china</groupId>
    <artifactId>ct_analysis</artifactId>
    <version>1.0-SNAPSHOT</version>

    <properties>
        <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
    </properties>

    <repositories>
        <repository>
            <id>cloudera</id>
            <url>https://repository.cloudera.com/artifactory/cloudera-repos/</url>
        </repository>

        <repository>
            <id>centor</id>
            <url>http://central.maven.org/maven2/</url>
        </repository>
    </repositories>

    <dependencies>
        <dependency>
            <groupId>junit</groupId>
            <artifactId>junit</artifactId>
            <version>4.12</version>
            <scope>test</scope>
        </dependency>

        <dependency>
            <groupId>org.apache.hadoop</groupId>

            <artifactId>hadoop-client</artifactId>

            <version>2.5.0-cdh5.3.6</version>

        </dependency>


        <dependency>

            <groupId>org.apache.hive</groupId>

            <artifactId>hive-exec</artifactId>

            <version>0.13.1-cdh5.3.6</version>

        </dependency>


        <dependency>

            <groupId>mysql</groupId>

            <artifactId>mysql-connector-java</artifactId>

            <version>5.1.27</version>

        </dependency>


        <dependency>

            <groupId>org.apache.hadoop</groupId>

            <artifactId>hadoop-yarn-server-resourcemanager</artifactId>

            <version>2.5.0-cdh5.3.6</version>

        </dependency>


        <dependency>

            <groupId>org.apache.hbase</groupId>

            <artifactId>hbase-client</artifactId>

            <version>0.98.6-cdh5.3.6</version>

        </dependency>
```

```
        <dependency>
            <groupId>org.apache.hbase</groupId>
            <artifactId>hbase-server</artifactId>
            <version>0.98.6-cdh5.3.6</version>
        </dependency>
    </dependencies>

    <build>
        <plugins>
            <plugin>
                <groupId>org.apache.maven.plugins</groupId>
                <artifactId>maven-surefire-plugin</artifactId>
                <version>2.12.4</version>
                <configuration>
                    <skipTests>true</skipTests>
                </configuration>
            </plugin>
        </plugins>
    </build>
</project>
```

2) 创建包结构，根包：com.china(不同颜色代表不同层级的递进)

analysis	constants	utils
analysis.converter		
analysis.format		
analysis.kv		
analysis.mapper		

analysis.reducer		
analysis.runner		
analysis.converter.impl		
analysis.kv.base		
analysis.kv.impl		

3) 类表

类名	备注
CountDurationMapper	数据分析的 Mapper 类，继承自 TableMapper
CountDurationReducer	数据分析的 Reducer 类，继承自 Reduccer
CountDurationRunner	数据分析的驱动类，组装 Job
MySQLOutputFormat	自定义 Outputformat，对接 Mysql
BaseDimension	维度（key）基类
BaseValue	值（value）基类
ComDimension	时间维度+联系人维度的组合维度
ContactDimension	联系人维度
DateDimension	时间维度
CountDurationValue	通话次数与通话时长的封装
JDBCUtil	连接 Mysql 的工具类
JDBCCacheBean	单例 JDBCConnection
IConverter	转化接口，用于根据传入的维度对象，得到该维度对象对应的数据库主键 id
DimensionConverter	IConverter 实现类，负责实际的维度转 id 功能
LRUCache	用于缓存已知的维度 id，减少对 mysql 的操作次数，提高效率
Constants	常量类

3.3.4、编写代码：数据分析

1) 创建类：CountDurationMapper

```
package com.china.analysis.mapper;


import com.china.analysis.kv.impl.ComDimension;
import com.china.analysis.kv.impl.ContactDimension;
import com.china.analysis.kv.impl.DateDimension;
import org.apache.commons.lang.StringUtils;
import org.apache.hadoop.hbase.client.Result;
import org.apache.hadoop.hbase.io.ImmutableBytesWritable;
import org.apache.hadoop.hbase.mapreduce.TableMapper;
import org.apache.hadoop.hbase.util.Bytes;
import org.apache.hadoop.io.Text;


import java.io.IOException;
import java.util.HashMap;
import java.util.Map;


public class CountDurationMapper extends TableMapper<ComDimension, Text>{
    //存放联系人电话与姓名的映射
    private Map<String, String> contacts;
    private byte[] family = Bytes.toBytes("f1");
    private ComDimension comDimension = new ComDimension();
    private void initContact(){
        contacts = new HashMap<String, String>();
        contacts.put("15369468720", "李雁");
        contacts.put("19920860202", "卫艺");
        contacts.put("18411925860", "仰莉");
        contacts.put("14473548449", "陶欣悦");
        contacts.put("18749966182", "施梅梅");
        contacts.put("19379884788", "金虹霖");
        contacts.put("19335715448", "魏明艳");
        contacts.put("18503558939", "华贞");
        contacts.put("13407209608", "华啟倩");
        contacts.put("15596505995", "仲采绿");
        contacts.put("17519874292", "卫丹");
        contacts.put("15178485516", "戚丽红");
        contacts.put("19877232369", "何翠柔");
        contacts.put("18706287692", "钱溶艳");
        contacts.put("18944239644", "钱琳");
        contacts.put("17325302007", "缪静欣");
        contacts.put("18839074540", "焦秋菊");
        contacts.put("19879419704", "吕访琴");
        contacts.put("16480981069", "沈丹");
        contacts.put("18674257265", "褚美丽");
    }

    @Override
    protected void setup(Context context) throws IOException, InterruptedException {
        initContact();
    }

    @Override
    protected void map(ImmutableBytesWritable key, Result value, Context context) throws
IOException, InterruptedException {
        //01_15837312345_20170810141024_13738909097_1_0180
        String rowKey = Bytes.toString(value.getRow());
```

```
            String[] values = rowKey.split("_");

            String flag = values[4];

            //只拿到主叫数据即可

            if(StringUtils.equals(flag, "0")) return;


            String date_time = values[2];

            String duration = values[5];


            String call1 = values[1];

            String call2 = values[3];


            int year = Integer.valueOf(date_time.substring(0, 4));

            int month = Integer.valueOf(date_time.substring(4, 6));

            int day = Integer.valueOf(date_time.substring(6, 8));


            DateDimension dateDimensionYear = new DateDimension(year, -1, -1);

            DateDimension dateDimensionMonth = new DateDimension(year, month, -1);

            DateDimension dateDimensionDay = new DateDimension(year, month, day);

            //第一个电话号码

            ContactDimension contactDimension1 = new ContactDimension(call1,
contacts.get(call1));

            comDimension.setContactDimension(contactDimension1);


            comDimension.setDateDimension(dateDimensionYear);

            context.write(comDimension, new Text(duration));


            comDimension.setDateDimension(dateDimensionMonth);

            context.write(comDimension, new Text(duration));
            comDimension.setDateDimension(dateDimensionDay);
            context.write(comDimension, new Text(duration));

            //第二个电话号码
            ContactDimension contactDimension2 = new ContactDimension(call2,
contacts.get(call2));
            comDimension.setContactDimension(contactDimension2);

            comDimension.setDateDimension(dateDimensionYear);
            context.write(comDimension, new Text(duration));

            comDimension.setDateDimension(dateDimensionMonth);
            context.write(comDimension, new Text(duration));

            comDimension.setDateDimension(dateDimensionDay);
            context.write(comDimension, new Text(duration));
      }
}
```

2) 创建类：CountDurationReducer

```
package com.china.analysis.reducer;

import com.china.analysis.kv.impl.ComDimension;
import com.china.analysis.kv.impl.CountDurationValue;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;
import java.io.IOException;


public class CountDurationReducer extends Reducer<ComDimension, Text, ComDimension, 
CountDurationValue>{
    @Override
    protected void reduce(ComDimension key, Iterable<Text> values, Context context) throws 
IOException, InterruptedException {

        int count = 0;
        int sumDuration = 0;
        for(Text text : values){
            count ++;
            sumDuration += Integer.valueOf(text.toString());
        }
        CountDurationValue countDurationValue = new CountDurationValue(count, 
sumDuration);
        context.write(key, countDurationValue);
    }
}
```

3) 创建类：CountDurationRunner

```
package com.china.analysis.runner;


import com.china.analysis.format.MySQLOutputFormat;
import com.china.analysis.kv.impl.ComDimension;
import com.china.analysis.kv.impl.CountDurationValue;
import com.china.analysis.mapper.CountDurationMapper;
import com.china.analysis.reducer.CountDurationReducer;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.conf.Configured;
import org.apache.hadoop.hbase.HBaseConfiguration;
import org.apache.hadoop.hbase.client.HBaseAdmin;
import org.apache.hadoop.hbase.client.Scan;
import org.apache.hadoop.hbase.mapreduce.TableMapReduceUtil;
import org.apache.hadoop.hbase.util.Bytes;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.util.Tool;
import org.apache.hadoop.util.ToolRunner;

import java.io.IOException;

public class CountDurationRunner implements Tool{
    private Configuration conf = null;
    @Override
    public void setConf(Configuration conf) {
        this.conf = HBaseConfiguration.create(conf);
    }

    @Override
    public Configuration getConf() {
        return this.conf;
    }

    @Override
    public int run(String[] args) throws Exception {
        //得到 conf 对象
        Configuration conf = this.getConf();
        //创建 Job
        Job job = Job.getInstance(conf, "CALL_LOG_ANALYSIS");
        job.setJarByClass(CountDurationRunner.class);
        //为 Job 设置 Mapper
        this.setHBaseInputConfig(job);
        //为 Job 设置 Reducer
        job.setReducerClass(CountDurationReducer.class);
        job.setOutputKeyClass(ComDimension.class);
        job.setOutputValueClass(CountDurationValue.class);
        //为 Job 设置 OutputFormat
        job.setOutputFormatClass(MySQLOutputFormat.class);
        return job.waitForCompletion(true) ? 0 : 1;
    }

    private void setHBaseInputConfig(Job job) {
        Configuration conf = job.getConfiguration();
        HBaseAdmin admin = null;
        try {
            admin = new HBaseAdmin(conf);
            //如果表不存在则直接返回，抛个异常也挺好
            if(!admin.tableExists("ns_telecom:calllog")) throw new
RuntimeException("Unable to find the specified table.");

            Scan scan = new Scan();
            scan.setAttribute(Scan.SCAN_ATTRIBUTES_TABLE_NAME,
Bytes.toBytes("ns_telecom:calllog"));
```

```
                TableMapReduceUtil.initTableMapperJob("ns_telecom:calllog", scan,
                        CountDurationMapper.class, ComDimension.class, Text.class,
                        job, true);
            } catch (IOException e) {
                e.printStackTrace();
            }finally {
                if(admin != null) try {
                    admin.close();
                } catch (IOException e) {
                    e.printStackTrace();
                }
            }
        }

        public static void main(String[] args) {
            try {
                int status = ToolRunner.run(new CountDurationRunner(), args);
                System.exit(status);
                if(status == 0){
                    System.out.println("运行成功");
                }else {
                    System.out.println("运行失败");
                }
            } catch (Exception e) {
                System.out.println("运行失败");
                e.printStackTrace();
            }
        }
```

```
}
```

4) 创建类：MySQLOutputFormat

```
package com.china.analysis.format;


import com.china.analysis.converter.impl.DimensionConverter;
import com.china.analysis.kv.base.BaseDimension;
import com.china.analysis.kv.base.BaseValue;
import com.china.analysis.kv.impl.ComDimension;
import com.china.analysis.kv.impl.CountDurationValue;
import com.china.constants.Constants;
import com.china.utils.JDBCCacheBean;
import com.china.utils.JDBCUtil;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.mapreduce.*;
import org.apache.hadoop.mapreduce.lib.output.FileOutputCommitter;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;


import java.io.IOException;
import java.sql.Connection;
import java.sql.PreparedStatement;
import java.sql.SQLException;


public class MySQLOutputFormat extends OutputFormat<BaseDimension, BaseValue> {
    @Override
    public RecordWriter<BaseDimension, BaseValue> getRecordWriter(TaskAttemptContext
taskAttemptContext) throws IOException, InterruptedException {
        //创建 jdbc 连接
        Connection conn = null;
        try {
            conn = JDBCCacheBean.getInstance();
            //关闭自动提交，以便于批量提交
            conn.setAutoCommit(false);
        } catch (SQLException e) {
            throw new IOException(e);
        }
        return new MysqlRecordWriter(conn);
    }

    @Override
    public void checkOutputSpecs(JobContext jobContext) throws IOException,
InterruptedException {
        // 校检输出
    }

    @Override
    public OutputCommitter getOutputCommitter(TaskAttemptContext taskAttemptContext)
throws IOException, InterruptedException {
        String name = taskAttemptContext.getConfiguration().get(FileOutputFormat.OUTDIR);
        Path output = name == null ? null : new Path(name);
        return new FileOutputCommitter(output, taskAttemptContext);
    }

    static class MysqlRecordWriter extends RecordWriter<BaseDimension, BaseValue> {
        private Connection conn = null;
        private DimensionConverter dimensionConverter = null;
```

```
	private PreparedStatement preparedStatement = null;
	private int batchNumber = 0;
	int count = 0;
	public MysqlRecordWriter(Connection conn) {
		this.conn = conn;
		this.batchNumber = Constants.JDBC_DEFAULT_BATCH_NUMBER;
		this.dimensionConverter = new DimensionConverter();
	}

	@Override
	public void write(BaseDimension key, BaseValue value) throws IOException,
InterruptedException {
		try {
			// 统计当前 PreparedStatement 对象待提交的数据量
			String sql = "INSERT INTO `tb_call`(`id_date_contact`, `id_date_dimension`,
`id_contact`, `call_sum`, `call_duration_sum`) VALUES(?, ?, ?, ?, ?) ON DUPLICATE KEY
UPDATE `id_date_contact` = ? ;";
			if (preparedStatement == null) {
				preparedStatement = conn.prepareStatement(sql);
			}
			// 本次 sql
			int i = 0;
			ComDimension comDimension = (ComDimension) key;
			CountDurationValue countDurationValue = (CountDurationValue) value;

			int id_date_dimension =
dimensionConverter.getDimensionId(comDimension.getDateDimension());
			int id_contact =
dimensionConverter.getDimensionId(comDimension.getContactDimension());
                int call_sum = countDurationValue.getCallSum();
                int call_duration_sum = countDurationValue.getCallDurationSum();

                String id_date_contact = id_date_dimension + "_" + id_contact;

                preparedStatement.setString(++i, id_date_contact);
                preparedStatement.setInt(++i, id_date_dimension);
                preparedStatement.setInt(++i, id_contact);
                preparedStatement.setInt(++i, call_sum);
                preparedStatement.setInt(++i, call_duration_sum);

                preparedStatement.setString(++i, id_date_contact);
                preparedStatement.addBatch();
                //当前缓存了多少个 sql 语句等待批量执行，计数器
                count++;

                // 批量提交
                if (count >= this.batchNumber) {
                    preparedStatement.executeBatch(); // 批量提交
                    conn.commit(); // 连接提交
                    count = 0;
                }
            } catch (SQLException e) {
                e.printStackTrace();
            }
        }
        @Override
        public void close(TaskAttemptContext context) throws IOException,
InterruptedException {
            try {
                preparedStatement.executeBatch();
                this.conn.commit();
            } catch (SQLException e) {
                e.printStackTrace();
            }finally {
                JDBCUtil.close(conn, preparedStatement, null);
            }
        }
    }
}
```

5) 创建类：BaseDimension

```
package com.china.analysis.kv.base;

import org.apache.hadoop.io.WritableComparable;

public abstract class BaseDimension implements WritableComparable<BaseDimension> {}
```

6) 创建类：BaseValue

```
package com.china.analysis.kv.base;

import org.apache.hadoop.io.Writable;

public abstract class BaseValue implements Writable { }
```

7) 创建类：ComDimension

```
package com.china.analysis.kv.impl;

import com.china.analysis.kv.base.BaseDimension;

import java.io.DataInput;
import java.io.DataOutput;
import java.io.IOException;

public class ComDimension extends BaseDimension{
    //时间维度
    private DateDimension dateDimension = new DateDimension();
    //联系人维度
    private ContactDimension contactDimension = new ContactDimension();

    public ComDimension() {
        super();
    }

    public ComDimension(DateDimension dateDimension, ContactDimension
contactDimension) {
        super();
        this.dateDimension = dateDimension;
        this.contactDimension = contactDimension;
    }

    public DateDimension getDateDimension() {
        return dateDimension;
    }
    public void setDateDimension(DateDimension dateDimension) {
        this.dateDimension = dateDimension;
    }

    public ContactDimension getContactDimension() {
        return contactDimension;
    }

    public void setContactDimension(ContactDimension contactDimension) {
        this.contactDimension = contactDimension;
    }

    @Override
    public int compareTo(BaseDimension o) {
        if(this == o) return 0;
        ComDimension comDimension = (ComDimension) o;

        int tmp = this.dateDimension.compareTo(comDimension.getDateDimension());
        if(tmp != 0) return tmp;

        tmp = this.contactDimension.compareTo(comDimension.getContactDimension());
        return tmp;
    }

    @Override
    public boolean equals(Object o) {
        if (this == o) return true;
        if (o == null || getClass() != o.getClass()) return false;

        ComDimension that = (ComDimension) o;

        if (dateDimension != null ? !dateDimension.equals(that.dateDimension) :
that.dateDimension != null) return false;
        return contactDimension != null ? contactDimension.equals(that.contactDimension) :
that.contactDimension == null;
    }

    @Override
    public int hashCode() {
        int result = dateDimension != null ? dateDimension.hashCode() : 0;
        result = 31 * result + (contactDimension != null ? contactDimension.hashCode() : 0);
        return result;
    }

    @Override
    public void write(DataOutput dataOutput) throws IOException {
        this.dateDimension.write(dataOutput);
        this.contactDimension.write(dataOutput);
    }

    @Override
    public void readFields(DataInput dataInput) throws IOException {
        this.dateDimension.readFields(dataInput);
        this.contactDimension.readFields(dataInput);
    }
```

```
}
```

8) 创建类：ContactDimension

```
package com.china.analysis.kv.impl;


import com.china.analysis.kv.base.BaseDimension;


import java.io.DataInput;
import java.io.DataOutput;
import java.io.IOException;


public class ContactDimension extends BaseDimension {
    //数据库主键
    private int id;
    //手机号码
    private String telephone;
    //姓名
    private String name;


    public ContactDimension() {
        super();
    }


    public ContactDimension(String telephone, String name) {
        super();
        this.telephone = telephone;
        this.name = name;
    }
    public int getId() {
        return id;
    }

    public void setId(int id) {
        this.id = id;
    }

    public String getTelephone() {
        return telephone;
    }

    public void setTelephone(String telephone) {
        this.telephone = telephone;
    }

    public String getName() {
        return name;
    }

    public void setName(String name) {
        this.name = name;
    }

    @Override
    public boolean equals(Object o) {
        if (this == o) return true;
        if (o == null || getClass() != o.getClass()) return false;

        ContactDimension that = (ContactDimension) o;

        if (id != that.id) return false;
        if (telephone != null ? !telephone.equals(that.telephone) : that.telephone != null) return
false;
        return name != null ? name.equals(that.name) : that.name == null;
    }

    @Override
    public int hashCode() {
        int result = id;
        result = 31 * result + (telephone != null ? telephone.hashCode() : 0);
        result = 31 * result + (name != null ? name.hashCode() : 0);
        return result;
    }

    @Override
    public int compareTo(BaseDimension o) {
        if (o == this) return 0;
        ContactDimension contactDimension = (ContactDimension) o;

        int tmp = Integer.compare(this.id, contactDimension.getId());
        if (tmp != 0) return tmp;

        tmp = this.telephone.compareTo(contactDimension.getTelephone());
        if (tmp != 0) return tmp;
        return this.name.compareTo(contactDimension.getName());
    }

    @Override
    public void write(DataOutput dataOutput) throws IOException {
        dataOutput.writeInt(this.id);
        dataOutput.writeUTF(this.telephone);
        dataOutput.writeUTF(this.name);
    }

    @Override
    public void readFields(DataInput dataInput) throws IOException {
        this.id = dataInput.readInt();
        this.telephone = dataInput.readUTF();
        this.name = dataInput.readUTF();
    }

    @Override
    public String toString() {
        return "ContactDimension{" +
                "id=" + id +
                ", telephone=" + telephone +
                ", name='" + name + '\'' +
                '}';
    }
}
```

9) 创建类：DateDimension

```
package com.china.analysis.kv.impl;


import com.china.analysis.kv.base.BaseDimension;


import java.io.DataInput;
import java.io.DataOutput;
import java.io.IOException;


/**
 * 时间维度类
 * @author 尽际
 */
public class DateDimension extends BaseDimension {
    //时间维度主键
    private int id;
    //时间维度：当前通话信息所在年
    private int year;
    //时间维度：当前通话信息所在月,如果按照年来统计信息，则 month 为-1
    private int month;
    //时间维度：当前通话信息所在日,如果按照年来统计信息，则 day 为-1。
    private int day;


    public DateDimension() {
        super();
    }


    public DateDimension(int year, int month, int day) {
        super();
        this.year = year;
        this.month = month;
        this.day = day;
    }

    public int getId() {
        return id;
    }

    public void setId(int id) {
        this.id = id;
    }

    public int getYear() {
        return year;
    }

    public void setYear(int year) {
        this.year = year;
    }

    public int getMonth() {
        return month;
    }

    public void setMonth(int month) {
        this.month = month;
    }
    public int getDay() {
        return day;
    }

    public void setDay(int day) {
        this.day = day;
    }

    @Override
    public boolean equals(Object o) {
        if (this == o) return true;
        if (o == null || getClass() != o.getClass()) return false;

        DateDimension that = (DateDimension) o;

        if (id != that.id) return false;
        if (year != that.year) return false;
        if (month != that.month) return false;
        return true;
    }

    @Override
    public int hashCode() {
        int result = id;
        result = 31 * result + year;
        result = 31 * result + month;
        result = 31 * result + day;
        return result;
    }

    @Override
    public int compareTo(BaseDimension o) {
        if(o == this) return 0;
        DateDimension dateDimension = (DateDimension) o;

        int tmp = Integer.compare(this.id, dateDimension.getId());
        if (tmp != 0) return tmp;

        tmp = Integer.compare(this.year, dateDimension.getYear());
        if (tmp != 0) return tmp;

        tmp = Integer.compare(this.month, dateDimension.getMonth());
        if (tmp != 0) return tmp;

        tmp = Integer.compare(this.day, dateDimension.getDay());

        return tmp;
    }

    @Override
    public void write(DataOutput dataOutput) throws IOException {
        dataOutput.writeInt(this.id);
        dataOutput.writeInt(this.year);
        dataOutput.writeInt(this.month);
        dataOutput.writeInt(this.day);
    }


    @Override
    public void readFields(DataInput dataInput) throws IOException {
        this.id = dataInput.readInt();
        this.year = dataInput.readInt();
        this.month = dataInput.readInt();
        this.day = dataInput.readInt();
    }


    @Override
    public String toString() {
        return "DateDimension{" +
                "id=" + id +
                ", year=" + year +
                ", month=" + month +
                ", day=" + day +
                '}';
    }
}
```

10) 创建类：CountDurationValue

```
package com.china.analysis.kv.impl;


import com.china.analysis.kv.base.BaseValue;


import java.io.DataInput;
import java.io.DataOutput;
import java.io.IOException;


public class CountDurationValue extends BaseValue {
    //某个维度通话次数总和
    private int callSum;
    //某个维度通话时间总和
    private int callDurationSum;


    public CountDurationValue() {
        super();
    }


    public CountDurationValue(int callSum, int callDurationSum) {
        super();
        this.callSum = callSum;
        this.callDurationSum = callDurationSum;
    }


    public int getCallSum() {
        return callSum;
    }


    public void setCallSum(int callSum) {
        this.callSum = callSum;
    }


    public int getCallDurationSum() {
        return callDurationSum;
    }


    public void setCallDurationSum(int callDurationSum) {
        this.callDurationSum = callDurationSum;
    }


    @Override
    public void write(DataOutput dataOutput) throws IOException {
        dataOutput.writeInt(this.callSum);
        dataOutput.writeInt(this.callDurationSum);
    }


    @Override
    public void readFields(DataInput dataInput) throws IOException {
        this.callSum = dataInput.readInt();
        this.callDurationSum = dataInput.readInt();
    }
}
```

11) 创建类：JDBCUtil

```
package com.china.utils;


import org.slf4j.Logger;
import org.slf4j.LoggerFactory;


import java.sql.*;


public class JDBCUtil {
	private static final Logger logger = LoggerFactory.getLogger(JDBCUtil.class);
	private static final String MYSQL_DRIVER_CLASS = "com.mysql.jdbc.Driver";
	private static final String MYSQL_URL = 
"jdbc:mysql://linux01:3306/db_telecom?useUnicode=true&characterEncoding=UTF-8";
	private static final String MYSQL_USERNAME = "root";
	private static final String MYSQL_PASSWORD = "123456";
	/**
	 *  获取 Mysql 数据库的连接
	 * @return
	 */
	public static Connection getConnection() throws SQLException {
		try {
			Class.forName(MYSQL_DRIVER_CLASS);
		} catch (ClassNotFoundException e) {
			e.printStackTrace();
		}
		return DriverManager.getConnection(MYSQL_URL, MYSQL_USERNAME, 
MYSQL_PASSWORD);
	}

	/**
	 *  关闭数据库连接释放资源
	 * @param connection
	 * @param statement
	 * @param resultSet
	 */
	public static void close(Connection connection, Statement statement, ResultSet resultSet){
		if(resultSet != null) try {
```

```
                resultSet.close();
            } catch (SQLException e) {
            }

            if(statement != null) try {
                statement.close();
            } catch (SQLException e) {
                e.printStackTrace();
            }

            if(connection != null) try {
                connection.close();
            } catch (SQLException e) {
                e.printStackTrace();
            }
        }
}
```

12) 创建类：JDBCCacheBean

```
package com.china.utils;

import java.sql.Connection;
import java.sql.SQLException;

public class JDBCCacheBean {
    private static Connection conn = null;
    private JDBCCacheBean(){}
    public static Connection getInstance(){
        try {
            if(conn == null || conn.isClosed() || conn.isValid(3)){
                conn = JDBCUtil.getConnection();
            }
        } catch (SQLException e) {
            e.printStackTrace();
        }
        return conn;
    }
}
```

13) 创建类：IConverter

```
package com.china.analysis.converter;


import com.china.analysis.kv.base.BaseDimension;


import java.io.Closeable;
import java.io.IOException;


public interface IConverter {
    // 根据传入的 dimension 对象，获取数据库中对应该对象数据的 id，如果不存在，则插入该数据再返回
    int getDimensionId(BaseDimension dimension) throws IOException;
}
```

14) 创建类：DimensionConverter

```
package com.china.analysis.converter.impl;


import com.china.analysis.converter.IConverter;
import com.china.analysis.kv.base.BaseDimension;
import com.china.analysis.kv.impl.ContactDimension;
import com.china.analysis.kv.impl.DateDimension;
import com.china.utils.JDBCCacheBean;
import com.china.utils.JDBCUtil;
import com.china.utils.LRUCache;
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;

import java.io.IOException;
import java.sql.Connection;
import java.sql.PreparedStatement;
import java.sql.ResultSet;
import java.sql.SQLException;

/**
 * 维度对象转维度 id 类
 *
 * @author 尽际
 */
public class DimensionConverter implements IConverter {
    //日志记录类，注意导包的正确性
    private static final Logger logger = LoggerFactory.getLogger(DimensionConverter.class);
    //每个线程保留自己的 Connection 实例
    private ThreadLocal<Connection> threadLocalConnection = new ThreadLocal<>();

    //创建数据缓存队列
    private LRUCache<String, Integer> lruCache = new LRUCache(3000);
    public DimensionConverter() {
        // JVM 虚拟机关闭时，尝试关闭数据库连接
        Runtime.getRuntime().addShutdownHook(new Thread(() -> {
            logger.info("stopping mysql connection...");
            JDBCUtil.close(threadLocalConnection.get(), null, null);
            logger.info("mysql connection is successfully closed");
        }));
    }

    /**
     * 1、判断内存缓存中是否已经有该维度的 id，如果存在则直接返回该 id
     * 2、如果内存缓存中没有，则查询数据库中是否有该维度 id，如果有，则查询出来，
返回该 id，并缓存到内存中。
     * 3、如果数据库中也没有该维度 id，则直接插入一条新的维度信息，成功插入后，重
新查询该维度，返回该 id，并缓存到内存中。
     *
     * @param dimension
     * @return
     */
    @Override
    public int getDimensionId(BaseDimension dimension) throws IOException {
        //1、根据传入的维度对象取得该维度对象对应的 cachekey
        String cacheKey = genCacheKey(dimension);
        //2、判断缓存中是否存在该 cacheKey 的缓存
        if (lruCache.containsKey(cacheKey)) {
            return lruCache.get(cacheKey);
        }
        //3、缓存中没有，查询数据库
        String[] sqls = null;
        if (dimension instanceof DateDimension) {
            // 时间维度表 tb_dimension_date
            sqls = genDateDimensionSQL();
        } else if (dimension instanceof ContactDimension) {
            //联系人表 tb_contacts
            sqls = genContactSQL();
        } else {
            //抛出 Checked 异常，提醒调用者可以自行处理。
            throw new IOException("Cannot match the dimession, unknown dimension.");
        }

        try {
            Connection conn = this.getConnection();
            int id = -1;
            synchronized (this) {
                id = execSQL(conn, sqls, dimension);
            }
            //将该 id 缓存到内存中
            lruCache.put(cacheKey, id);
            return id;
        } catch (SQLException e) {
            e.printStackTrace();
            throw new IOException(e);
        }
    }
    /**
     * LRUCACHE 中缓存的键值对形式例如：<date_dimension20170820, 3>
     *
     * @param dimension
     * @return
     */
    private String genCacheKey(BaseDimension dimension) {
        StringBuilder sb = new StringBuilder();
        if (dimension instanceof DateDimension) {
            DateDimension dateDimension = (DateDimension) dimension;
            //拼装缓存 id 对应的 key
            sb.append("date_dimension");

sb.append(dateDimension.getYear()).append(dateDimension.getMonth()).append(dateDimension.
getDay());
        } else if (dimension instanceof ContactDimension) {
            ContactDimension contactDimension = (ContactDimension) dimension;
            //拼装缓存 id 对应的 key
            sb.append("contact_dimension");

sb.append(contactDimension.getTelephone()).append(contactDimension.getName());
        }

        if (sb.length() <= 0) throw new RuntimeException("Cannot create cachekey." +
dimension);

        return sb.toString();
    }


    /**
     * 生成时间维度的数据库查询语句和插入语句
     *
     * @return
     */
    private String[] genDateDimensionSQL() {
        String query = "SELECT `id` FROM `tb_dimension_date` WHERE `year` = ? AND
`month` = ? AND `day` = ? order by `id`;";
        String insert = "INSERT INTO `tb_dimension_date`(`year`, `month`, `day`)
VALUES(?, ?, ?);";
        return new String[]{query, insert};
    }


    /**
     * 生成联系人的数据库查询语句和插入语句
     *
     * @return
     */
    private String[] genContactSQL() {
        String query = "SELECT `id` FROM `tb_contacts` WHERE `telephone` = ? AND
`name` = ? order by `id`;";
        String insert = "INSERT INTO `tb_contacts`(`telephone`, `name`) VALUES(?, ?);";
        return new String[]{query, insert};
    }


    /**
```

```
     * 尝试获取数据库连接对象：先从线程缓冲中获取，没有可用连接则创建。
     *
     * @return
     * @throws SQLException
     */
    private Connection getConnection() throws SQLException {
        Connection conn = null;
        synchronized (this) {
            conn = threadLocalConnection.get();
            if (conn == null || conn.isClosed() || conn.isValid(3)) {
                conn = JDBCCacheBean.getInstance();
            }
            threadLocalConnection.set(conn);
        }
        return conn;
    }

    /**
     * @param conn
     * @param sqls         第一个为查询语句，第二个为插入语句
     * @param dimension
     * @return
     */
    private int execSQL(Connection conn, String[] sqls, BaseDimension dimension) throws
SQLException {
        PreparedStatement preparedStatement = null;
        ResultSet resultSet = null;
        try {
            //1、假设数据库中有该条数据
            //封装查询 sql 语句
            preparedStatement = conn.prepareStatement(sqls[0]);
            setArguments(preparedStatement, dimension);

            //执行查询
            resultSet = preparedStatement.executeQuery();
            if (resultSet.next()) {
                return resultSet.getInt(1);
            }

            //2、假设 数据库中没有该条数据
            //封装插入 sql 语句
            preparedStatement = conn.prepareStatement(sqls[1]);
            setArguments(preparedStatement, dimension);
            preparedStatement.executeUpdate();
            JDBCUtil.close(null, preparedStatement, resultSet);

            //重新获取 id，调用自己即可。
            preparedStatement = conn.prepareStatement(sqls[0]);
            setArguments(preparedStatement, dimension);
            //执行查询
            resultSet = preparedStatement.executeQuery();
            if (resultSet.next()) {
                return resultSet.getInt(1);
            }
        } finally {
            JDBCUtil.close(null, preparedStatement, resultSet);
            }
            throw new RuntimeException("Failed to get id");
        }

        private void setArguments(PreparedStatement preparedStatement, BaseDimension
dimension) throws SQLException {
            int i = 0;
            if (dimension instanceof DateDimension) {
                DateDimension dateDimension = (DateDimension) dimension;
                preparedStatement.setInt(++i, dateDimension.getYear());
                preparedStatement.setInt(++i, dateDimension.getMonth());
                preparedStatement.setInt(++i, dateDimension.getDay());
            } else if (dimension instanceof ContactDimension) {
                ContactDimension contactDimension = (ContactDimension) dimension;
                preparedStatement.setString(++i, contactDimension.getTelephone());
                preparedStatement.setString(++i, contactDimension.getName());
            }
        }
}
```

15) 创建类：LRUCache

```
package com.china.utils;

import java.util.LinkedHashMap;
import java.util.Map;

public class LRUCache<K, V> extends LinkedHashMap<K, V> {
        private static final long serialVersionUID = -5907797767584803517L;
```

```
	protected int maxElements;


	public LRUCache(int maxSize) {
		super(maxSize, 0.75F, true);
		this.maxElements = maxSize;
	}


	/*
	 * (non-Javadoc)
	 *
	 * @see java.util.LinkedHashMap#removeEldestEntry(java.util.Map.Entry)
	 */
	@Override
	protected boolean removeEldestEntry(Map.Entry<K, V> eldest) {
		return (size() > this.maxElements);
	}
}
```

16) 创建类：Constants

```
package com.china.constants;


public class Constants {
	public static final int JDBC_DEFAULT_BATCH_NUMBER = 500;
}
```

3.3.5、运行测试

1) 将 mysql 驱动包放入到 hadoop 根目录的 lib 目录下

```
$ cp -a
~/softwares/installations/mysql-connector-java-5.1.27/mysql-connector-java-5.1.27-bin.jar ./lib
```

2) 提交任务

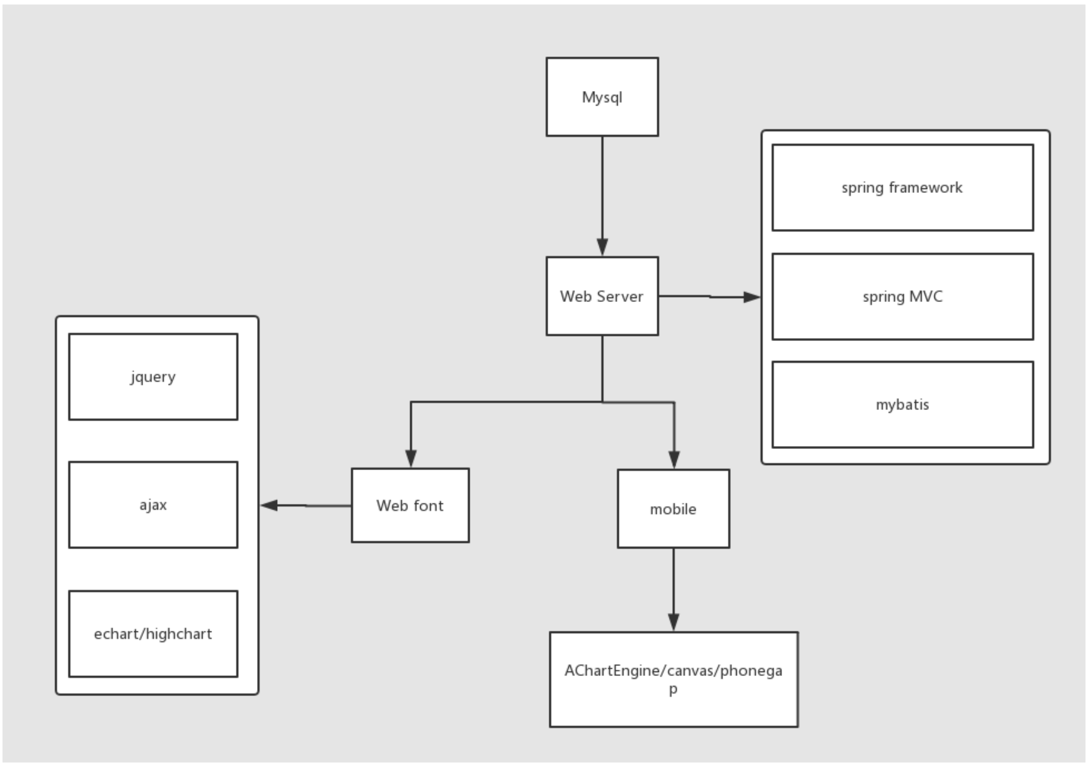
```
$ bin/yarn jar ~/softwares/jars/ct_analysis-1.0-SNAPSHOT.jar
com.china.analysis.runner.CountDurationRunner -libjars ./lib/mysql-connector-java-5.1.27-bin.jar
```

观察 Mysql 中的结果。

3.4、数据展示

令人兴奋的时刻马上到了，接下来我们需要将某人按照不同维度查询出来的结果，展示到 web 页面上。

数据展示模块流程图：



3.4.1、环境准备

1) 新建 module 或项目：ct_web

pom.xml 配置文件：

```
<project xmlns="http://maven.apache.org/POM/4.0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
            xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
```

```
http://maven.apache.org/maven-v4_0_0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <groupId>com.china</groupId>
    <artifactId>ct_web</artifactId>
    <packaging>war</packaging>
    <version>1.0-SNAPSHOT</version>
    <name>ct_web Maven Webapp</name>
    <url>http://maven.apache.org</url>

    <repositories>
        <repository>
            <id>cloudera</id>
            <url>https://repository.cloudera.com/artifactory/cloudera-repos/</url>
        </repository>

        <repository>
            <id>centor</id>
            <url>http://repo.maven.apache.org/maven2/</url>
        </repository>
    </repositories>

    <dependencies>
        <!-- https://mvnrepository.com/artifact/junit/junit -->
        <dependency>
            <groupId>junit</groupId>
            <artifactId>junit</artifactId>
            <version>4.12</version>
            <scope>test</scope>
        </dependency>


        <dependency>
            <groupId>mysql</groupId>
            <artifactId>mysql-connector-java</artifactId>
            <version>5.1.27</version>
        </dependency>


        <dependency>
            <groupId>c3p0</groupId>
            <artifactId>c3p0</artifactId>
            <version>0.9.1.2</version>
        </dependency>


        <dependency>
            <groupId>org.mybatis</groupId>
            <artifactId>mybatis</artifactId>
            <version>3.2.1</version>
        </dependency>


        <dependency>
            <groupId>org.springframework</groupId>
            <artifactId>spring-context-support</artifactId>
            <version>4.3.3.RELEASE</version>
        </dependency>
        <dependency>
            <groupId>org.springframework</groupId>
            <artifactId>spring-jdbc</artifactId>
            <version>4.3.3.RELEASE</version>
        </dependency>
        <dependency>
            <groupId>org.springframework</groupId>
            <artifactId>spring-webmvc</artifactId>
            <version>4.3.3.RELEASE</version>
        </dependency>
        <dependency>
            <groupId>org.mybatis</groupId>
            <artifactId>mybatis-spring</artifactId>
            <version>1.3.0</version>
        </dependency>
        <dependency>
            <groupId>org.aspectj</groupId>
            <artifactId>aspectjweaver</artifactId>
            <version>1.8.10</version>
        </dependency>
        <dependency>
            <groupId>javax.servlet</groupId>
            <artifactId>servlet-api</artifactId>
            <version>2.5</version>
        </dependency>
        <dependency>
            <groupId>javax.servlet</groupId>
            <artifactId>jstl</artifactId>
            <version>1.2</version>
        </dependency>
```

```
        <dependency>
            <groupId>org.apache.hbase</groupId>
            <artifactId>hbase-client</artifactId>
            <version>0.98.6-cdh5.3.6</version>
            <exclusions>
                <exclusion>
                    <!-- https://mvnrepository.com/artifact/org.xerial.snappy/snappy-java -->
                    <groupId>org.xerial.snappy</groupId>
                    <artifactId>snappy-java</artifactId>
                </exclusion>
            </exclusions>
        </dependency>
    </dependencies>
    <build>
        <finalName>ct_web</finalName>
        <plugins>
            <!--
            <plugin>
                <groupId>org.apache.tomcat.maven</groupId>
                <artifactId>tomcat7-maven-plugin</artifactId>
                <version>2.2</version>
                <configuration>
                    <path>/</path>
                    <port>8080</port>
                    <uriEncoding>UTF-8</uriEncoding>
                </configuration>
            </plugin>
            -->
```

```
                <plugin>
                    <groupId>org.apache.maven.plugins</groupId>
                    <artifactId>maven-surefire-plugin</artifactId>
                    <version>2.12.4</version>
                    <configuration>
                        <skipTests>true</skipTests>
                    </configuration>
                </plugin>
            </plugins>
        </build>
</project>
```

2) 创建包结构，根包：com.china

bean		
contants		
controller		
dao		
entries		

3) 类表

类名	备注
CallLog	用于封装数据分析结果的 JavaBean
Contact	用于封装联系人的 JavaBean
Contants	常量类
CallLogHandler	用于处理请求的 Controller
CallLogDAO	查询某人某个维度通话记录的 DAO
ContactDAO	查询联系人的 DAO
QueryInfo	用于封装向服务器发来的请求参数

4) web 目录结构，web 部分的根目录：webapp

文件夹名	备注
css	存放 css 静态资源的文件夹
html	存放 html 静态资源的文件夹
images	存放图片静态资源文件夹
js	存放 js 静态资源的文件夹
jsp	存放 jsp 页面的文件夹
WEB-INF	存放 web 相关配置的文件夹

5) resources 目录下创建 spring 相关配置文件

dbconfig.properties:用于存放数据库连接配置

```
user=root
password=123456
jdbcUrl=jdbc:mysql://linux01:3306/db_telecom?useUnicode=true&characterEncoding=UTF-8
driverClass=com.mysql.jdbc.Driver
```

applicationContext.xml：Spring&SpringMVC 配置

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xmlns:p="http://www.springframework.org/schema/p"
        xmlns:mvc="http://www.springframework.org/schema/mvc"
        xmlns:context="http://www.springframework.org/schema/context"
        xsi:schemaLocation="http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans.xsd
         http://www.springframework.org/schema/context
http://www.springframework.org/schema/context/spring-context.xsd
         http://www.springframework.org/schema/aop
http://www.springframework.org/schema/aop/spring-aop.xsd
         http://www.springframework.org/schema/mvc
```

```
http://www.springframework.org/schema/mvc/spring-mvc.xsd
            http://www.springframework.org/schema/jee
http://www.springframework.org/schema/jee/spring-jee.xsd
            http://www.springframework.org/schema/tx
http://www.springframework.org/schema/tx/spring-tx.xsd">
      <context:property-placeholder location="classpath:dbconfig.properties"/>

      <bean id="dataSource" class="com.mchange.v2.c3p0.ComboPooledDataSource">
            <property name="user" value="${user}"/>
            <property name="password" value="${password}"/>
            <property name="driverClass" value="${driverClass}"/>
            <property name="jdbcUrl" value="${jdbcUrl}"/>
      </bean>
      <bean id="jdbcTemplate" class="org.springframework.jdbc.core.JdbcTemplate">
            <constructor-arg name="dataSource" value="#{dataSource}"></constructor-arg>
      </bean>

      <bean id="namedParameterJdbcTemplate"
class="org.springframework.jdbc.core.namedparam.NamedParameterJdbcTemplate">
            <constructor-arg name="dataSource" value="#{dataSource}"></constructor-arg>
      </bean>
      <!-- 包扫描 -->
      <context:component-scan base-package="com.china.controller"></context:component-scan>
      <context:component-scan base-package="com.china.dao"></context:component-scan>
      <!-- 配置视图解析器-->
      <bean id="viewResolver"
class="org.springframework.web.servlet.view.InternalResourceViewResolver">
            <property name="prefix" value="/"/>
            <property name="suffix" value=".jsp"/>
      </bean>


      <!--<mvc:annotation-driven />-->
      <!--<mvc:default-servlet-handler />-->
      <!--<mvc:resources location="/images/" mapping="/images/**"/>-->
      <!--<mvc:resources location="/js/" mapping="/js/**"/>-->
      <!--<mvc:resources location="/css/" mapping="/css/**"/>-->
</beans>
```

6) WEB-INF 目录下创建 web 相关配置

web.xml：

```
<?xml version="1.0" encoding="UTF-8"?>
<web-app xmlns="http://xmlns.jcp.org/xml/ns/javaee"
                 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                 xsi:schemaLocation="http://xmlns.jcp.org/xml/ns/javaee
http://xmlns.jcp.org/xml/ns/javaee/web-app_3_1.xsd"
                 version="3.1">
        <display-name>SpringMVC_CRUD</display-name>
        <servlet>
            <servlet-name>dispatcherServlet</servlet-name>
            <servlet-class>org.springframework.web.servlet.DispatcherServlet</servlet-class>
            <init-param>
                <param-name>contextConfigLocation</param-name>
                <param-value>classpath:applicationContext.xml</param-value>
            </init-param>
            <load-on-startup>1</load-on-startup>
        </servlet>
```

```
    <servlet-mapping>
        <servlet-name>dispatcherServlet</servlet-name>
        <url-pattern>/</url-pattern>
    </servlet-mapping>
    <welcome-file-list>
        <welcome-file>index.jsp</welcome-file>
    </welcome-file-list>
    <filter>
        <filter-name>CharacterEncodingFilter</filter-name>
        <filter-class>org.springframework.web.filter.CharacterEncodingFilter</filter-class>
        <init-param>
            <param-name>encoding</param-name>
            <param-value>utf-8</param-value>
        </init-param>
        <init-param>
            <param-name>forceEncoding</param-name>
            <param-value>true</param-value>
        </init-param>
    </filter>
    <filter-mapping>
        <filter-name>CharacterEncodingFilter</filter-name>
        <url-pattern>/*</url-pattern>
    </filter-mapping>

    <servlet-mapping>
        <servlet-name>default</servlet-name>
        <url-pattern>*.jpg</url-pattern>
    </servlet-mapping>
```

```
        <servlet-mapping>
                <servlet-name>default</servlet-name>
                <url-pattern>*.js</url-pattern>
        </servlet-mapping>
        <servlet-mapping>
                <servlet-name>default</servlet-name>
                <url-pattern>*.css</url-pattern>
        </servlet-mapping>
</web-app>
```

7) 拷贝 js 框架到 js 目录下

```
框架名称：
echarts.min.js
jquery-3.2.0.min.js
```

3.4.2、编写代码

思路：

a) 首先测试数据通顺以及完整性，写一个联系人的测试用例。

b) 测试通过后，通过输入手机号码以及时间参数，查询指定维度的数据，并以图表展示。

代码：

1) 新建类： CallLog

```
package com.china.bean;


public class CallLog {
        private String id_date_contact;
        private String id_date_dimension;
        private String id_contact;
        private String call_sum;
        private String call_duration_sum;
```

```
    private String telephone;

    private String name;

    private String year;

    private String month;

    private String day;


    public String getId_date_contact() {

        return id_date_contact;

    }


    public void setId_date_contact(String id_date_contact) {

        this.id_date_contact = id_date_contact;

    }


    public String getId_date_dimension() {

        return id_date_dimension;

    }


    public void setId_date_dimension(String id_date_dimension) {

        this.id_date_dimension = id_date_dimension;

    }


    public String getId_contact() {

        return id_contact;

    }


    public void setId_contact(String id_contact) {

        this.id_contact = id_contact;
    }

    public String getCall_sum() {
        return call_sum;
    }

    public void setCall_sum(String call_sum) {
        this.call_sum = call_sum;
    }

    public String getCall_duration_sum() {
        return call_duration_sum;
    }

    public void setCall_duration_sum(String call_duration_sum) {
        this.call_duration_sum = call_duration_sum;
    }

    public String getTelephone() {
        return telephone;
    }

    public void setTelephone(String telephone) {
        this.telephone = telephone;
    }

    public String getName() {
        return name;
    }

    public void setName(String name) {
        this.name = name;
    }

    public String getYear() {
        return year;
    }

    public void setYear(String year) {
        this.year = year;
    }

    public String getMonth() {
        return month;
    }

    public void setMonth(String month) {
        this.month = month;
    }

    public String getDay() {
        return day;
    }

    public void setDay(String day) {
        this.day = day;
        }


        @Override
        public String toString() {
                return "CallLog{" +
                                "id_date_contact='" + id_date_contact + '\'' +
                                ", id_date_dimension='" + id_date_dimension + '\'' +
                                ", id_contact='" + id_contact + '\'' +
                                ", call_sum='" + call_sum + '\'' +
                                ", call_duration_sum='" + call_duration_sum + '\'' +
                                ", telephone='" + telephone + '\'' +
                                ", name='" + name + '\'' +
                                ", year='" + year + '\'' +
                                ", month='" + month + '\'' +
                                ", day='" + day + '\'' +
                                '}';
        }
}
```

2) 新建类： Contact

```
package com.china.bean;


public class Contact {
        private Integer id;
        private String telephone;
        private String name;


        public Contact() {
```

```
        super();
    }

    public Contact(int id, String telephone, String name) {
        super();
        this.id = id;
        this.telephone = telephone;
        this.name = name;
    }

    public Integer getId() {
        return id;
    }

    public void setId(Integer id) {
        this.id = id;
    }

    public String getTelephone() {
        return telephone;
    }

    public void setTelephone(String telephone) {
        this.telephone = telephone;
    }

    public String getName() {
        return name;
    }


    public void setName(String name) {
        this.name = name;
    }


    @Override
    public String toString() {
        return "Contact{" +
                "id=" + id +
                ", telephone='" + telephone + '\'' +
                ", name='" + name + '\'' +
                '}';
    }
}
```

3) 新建类：QueryInfo

```
package com.china.entries;


public class QueryInfo {
    private String telephone;
    private String year;
    private String month;
    private String day;


    public QueryInfo() {
        super();
    }
```

```
public QueryInfo(String telephone, String year, String month, String day) {
        super();
        this.telephone = telephone;
        this.year = year;
        this.month = month;
        this.day = day;
}

public String getTelephone() {
        return telephone;
}

public void setTelephone(String telephone) {
        this.telephone = telephone;
}

public String getYear() {
        return year;
}

public void setYear(String year) {
        this.year = year;
}

public String getMonth() {
        return month;
}
```

```
    public void setMonth(String month) {
        this.month = month;
    }

    public String getDay() {
        return day;
    }

    public void setDay(String day) {
        this.day = day;
    }
}
```

4) 新建类： CallLogDAO

```
package com.china.dao;



import com.china.bean.CallLog;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.jdbc.core.BeanPropertyRowMapper;
import org.springframework.jdbc.core.namedparam.NamedParameterJdbcTemplate;
import org.springframework.stereotype.Repository;

import java.util.HashMap;
import java.util.List;

@Repository
```

```
public class CallLogDAO {
        @Autowired
        private NamedParameterJdbcTemplate namedParameterJdbcTemplate;
        public List<CallLog> getCallLogList(HashMap<String, String> hashMap){
                //1、电话号码 2、年 3、日
                String sql = "SELECT t3.id_date_contact, t3.id_date_dimension, t3.id_contact,
t3.call_sum, t3.call_duration_sum , t3.telephone, t3.name, t4.year, t4.month, t4.day FROM
(SELECT t2.id_date_contact, t2.id_date_dimension, t2.id_contact, t2.call_sum,
t2.call_duration_sum , t1.telephone, t1.name FROM (SELECT id, telephone, name FROM
tb_contacts WHERE telephone = :telephone ) t1 INNER JOIN tb_call t2 ON t1.id =
t2.id_contact ) t3 INNER JOIN (SELECT id, year, month, day FROM tb_dimension_date
WHERE year = :year AND day = :day ) t4 ON t3.id_date_dimension = t4.id ORDER BY t4.year,
t4.month, t4.day;";
                BeanPropertyRowMapper<CallLog> contactBeanPropertyRowMapper = new
BeanPropertyRowMapper<>(CallLog.class);
                List<CallLog> contactList = namedParameterJdbcTemplate.query(sql, hashMap,
contactBeanPropertyRowMapper);
                return contactList;
        }

}
```

5) 新建类：ContactDAO

```
package com.china.dao;


import com.china.bean.Contact;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.jdbc.core.BeanPropertyRowMapper;
import org.springframework.jdbc.core.JdbcTemplate;
import org.springframework.jdbc.core.namedparam.NamedParameterJdbcTemplate;
import org.springframework.stereotype.Repository;

import java.util.HashMap;
import java.util.List;

@Repository
public class ContactDAO {
    @Autowired
    private JdbcTemplate jdbcTemplate;

    @Autowired
    private NamedParameterJdbcTemplate namedParameterJdbcTemplate;

    public List<Contact> getContacts(){
        String sql = "SELECT id, telephone, name FROM tb_contacts;";
        BeanPropertyRowMapper<Contact> contactBeanPropertyRowMapper = new
BeanPropertyRowMapper<>(Contact.class);
        List<Contact> contactList = jdbcTemplate.query(sql, contactBeanPropertyRowMapper);
        return contactList;
    }

    public List<Contact> getContactWithId(HashMap<String, String> hashMap){
        String sql = "SELECT id, telephone, name FROM tb_contacts WHERE id = :id;";
        BeanPropertyRowMapper<Contact> contactBeanPropertyRowMapper = new
BeanPropertyRowMapper<>(Contact.class);
        List<Contact> contactList = namedParameterJdbcTemplate.query(sql, hashMap,
contactBeanPropertyRowMapper);
            return contactList;
        }
}
```

6) 新建类： CallLogHandler

```
package com.china.controller;



import com.china.bean.CallLog;
import com.china.bean.Contact;
import com.china.dao.CallLogDAO;
import com.china.dao.ContactDAO;
import com.china.entries.QueryInfo;
import com.google.gson.Gson;
import org.springframework.context.ApplicationContext;
import org.springframework.context.support.ClassPathXmlApplicationContext;
import org.springframework.stereotype.Controller;
import org.springframework.ui.Model;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.servlet.ModelAndView;

import java.util.ArrayList;
import java.util.HashMap;
import java.util.List;
import java.util.Map;

@Controller
```

```
public class CallLogHandler {
        @RequestMapping("/queryContact")
        public ModelAndView query(Contact contact) {
                ApplicationContext applicationContext = new
ClassPathXmlApplicationContext("applicationContext.xml");
                ContactDAO contactDAO = applicationContext.getBean(ContactDAO.class);
                HashMap<String, String> paramMap = new HashMap<>();
                paramMap.put("id", String.valueOf(contact.getId()));
                List<Contact> contactList = contactDAO.getContactWithId(paramMap);

                ModelAndView modelAndView = new ModelAndView();
                modelAndView.setViewName("jsp/queryContact");
                modelAndView.addObject("contacts", contactList);
                return modelAndView;
        }

        @RequestMapping("/queryContactList")
        public ModelAndView querylist() {
                ApplicationContext applicationContext = new
ClassPathXmlApplicationContext("applicationContext.xml");
                ContactDAO contactDAO = applicationContext.getBean(ContactDAO.class);
                List<Contact> contactList = contactDAO.getContacts();
                ModelAndView modelAndView = new ModelAndView();
                modelAndView.setViewName("jsp/queryContact");
                modelAndView.addObject("contacts", contactList);
                return modelAndView;
        }
```

```
    @RequestMapping("/queryCallLogList")
    public ModelAndView queryCallLog(QueryInfo queryInfo){
        ApplicationContext applicationContext = new
ClassPathXmlApplicationContext("applicationContext.xml");
        CallLogDAO callLogDAO = applicationContext.getBean(CallLogDAO.class);

        HashMap<String, String> paramMap = new HashMap<>();
        paramMap.put("telephone", String.valueOf(queryInfo.getTelephone()));
        paramMap.put("year", String.valueOf(queryInfo.getYear()));
        paramMap.put("day", String.valueOf(queryInfo.getDay()));

        List<CallLog> callLogList = callLogDAO.getCallLogList(paramMap);

        Gson gson = new Gson();
        String resultList = gson.toJson(callLogList);

        ModelAndView modelAndView = new ModelAndView();
        modelAndView.setViewName("jsp/callLogList");
        modelAndView.addObject("callLogList", resultList);
        return modelAndView;
    }

    @RequestMapping("/queryCallLogList2")
    public String queryCallLog2(Model model, QueryInfo queryInfo){
        ApplicationContext applicationContext = new
ClassPathXmlApplicationContext("applicationContext.xml");
        CallLogDAO callLogDAO = applicationContext.getBean(CallLogDAO.class);
        HashMap<String, String> paramMap = new HashMap<>();
        paramMap.put("telephone", String.valueOf(queryInfo.getTelephone()));
        paramMap.put("year", String.valueOf(queryInfo.getYear()));
        paramMap.put("day", String.valueOf(queryInfo.getDay()));

        List<CallLog> callLogList = callLogDAO.getCallLogList(paramMap);

        StringBuilder dateString = new StringBuilder();
        StringBuilder countString = new StringBuilder();
        StringBuilder durationString = new StringBuilder();

        for(int i = 0; i < callLogList.size(); i++){
            CallLog callLog = callLogList.get(i);
            if(Integer.valueOf(callLog.getMonth()) > 0){
                dateString.append(callLog.getMonth()).append("月").append(",");
                countString.append(callLog.getCall_sum()).append(",");
                durationString.append(Float.valueOf(callLog.getCall_duration_sum()) /
60f).append(",");
            }
        }
        //1 月,2 月,3 月,4 月,5 月,6 月,7 月,8 月,9 月,10 月,11 月,12 月,
        model.addAttribute("telephone", callLogList.get(0).getTelephone());
        model.addAttribute("name", callLogList.get(0).getName());
        model.addAttribute("date", dateString.deleteCharAt(dateString.length() - 1));
        model.addAttribute("count", countString.deleteCharAt(countString.length() - 1));
        model.addAttribute("duration", durationString.deleteCharAt(durationString.length() -
1));
        return "jsp/callLogListEchart";
```

```
    }


}
```

7) 新建类：Contants

```
暂时没用上，也可以用上，主要用于存放一些常量。
```

8) 新建：index.jsp

```
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core" %>
<%@ page language="java" contentType="text/html; charset=utf-8"
         pageEncoding="utf-8" %>
<%
    String path = request.getContextPath();
%>
<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
"http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
    <meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
    <title>Show Time</title>
</head>
<body>
<form action="/queryContact">
    id:<input type="text" name="id"/>
    telephone:<input type="text" name="telephone"/>
    <input type="submit" value="查询联系人"/>
</form>
<form action="/queryContactList">
    <input type="submit" value="查询所有"/>
```

```
</form>
<br/>

<form action='<c:url value="/queryCallLogList2"/>' method="post">
        telephone:<input type="text" name="telephone"/>
        year:<input type="text" name="year"/>
        month:<input type="text" name="month"/>
        day:<input type="text" name="day"/>
        <input type="submit" value="查询该人通话记录"/>
</form>
</body>
</html>
```

9) 新建：queryContact.jsp

```
<%--
    Created by IntelliJ IDEA.
    User: Z
    Date: 2017/10/28
    Time: 10:36
    To change this template use File | Settings | File Templates.
--%>
<%@ page contentType="text/html;charset=UTF-8" language="java" isELIgnored = "false" %>
<html>
<head>
        <title>查询联系人</title>
</head>
<body>
查询结果：<br/>
```

```
<h1>${requestScope.contacts}</h1>
</body>
</html>
```

10) 新建：callLogList.jsp

```
<%--
  Created by IntelliJ IDEA.
  User: Z
  Date: 2017/10/28
  Time: 14:36
  To change this template use File | Settings | File Templates.
--%>
<%@ page contentType="text/html;charset=UTF-8" language="java" isELIgnored = "false" %>
<html>
<head>
    <title>显示通话记录</title>
</head>
<body>
查询结果：<br/>
<h1>${requestScope.callLogList}</h1>
</body>
</html>
```

11) 新建：callLogListEchart.jsp

```
<%--
  Created by IntelliJ IDEA.
  User: Z
  Date: 2017/10/28
  Time: 14:36
  To change this template use File | Settings | File Templates.
--%>
<%@ page contentType="text/html;charset=UTF-8" language="java" isELIgnored="false" %>
<html>
<head>
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
    <title>显示通话记录</title>
    <script type="text/javascript" src="../js/echarts.min.js"></script>
    <%--<script type="text/javascript"
src="${pageContext.request.contextPath}/js/echarts.min.js"></script>--%>
    <%--<script type="text/javascript"
src="${pageContext.request.contextPath}/jquery-3.2.0.min.js"></script>--%>
    <%--<script type="text/javascript"
src="http://echarts.baidu.com/gallery/vendors/echarts/echarts-all-3.js"></script>--%>
</head>
<body style="height: 100%; margin: 0">
<div id="container1" style="height: 100%; width: 50%; float:left"; m></div>
<div id="container2" style="height: 100%; width: 50%; float:right"></div>
<script type="text/javascript">
    var telephone = "${requestScope.telephone}"
    var name = "${requestScope.name}"

    var date = "${requestScope.date}"
    var count = "${requestScope.count}"

    var duration = "${requestScope.duration}"
    callog1();
    callog2();
```

```
function callog1() {
    var dom = document.getElementById("container1");
    var myChart = echarts.init(dom);
    myChart.showLoading();
    var option = {
        title: {
            text: '通话记录查询人： ' + name,
            textStyle: {
                //文字颜色
                color: '#2c2c2c',
                //字体风格,'normal','italic','oblique'
                fontStyle: 'normal',
                //字体粗细  'normal','bold','bolder','lighter',100 | 200 | 300 | 400...
                fontWeight: 'bold',
                //字体系列
                fontFamily: 'sans-serif',
                //字体大小
                fontSize: 20
            },
            itemGap: 12,
            subtext: '手机号码： ' + telephone,
            subtextStyle: {
                //文字颜色
                color: '#2c2c2c',
                //字体风格,'normal','italic','oblique'
                fontStyle: 'normal',
                //字体粗细  'normal','bold','bolder','lighter',100 | 200 | 300 | 400...
```

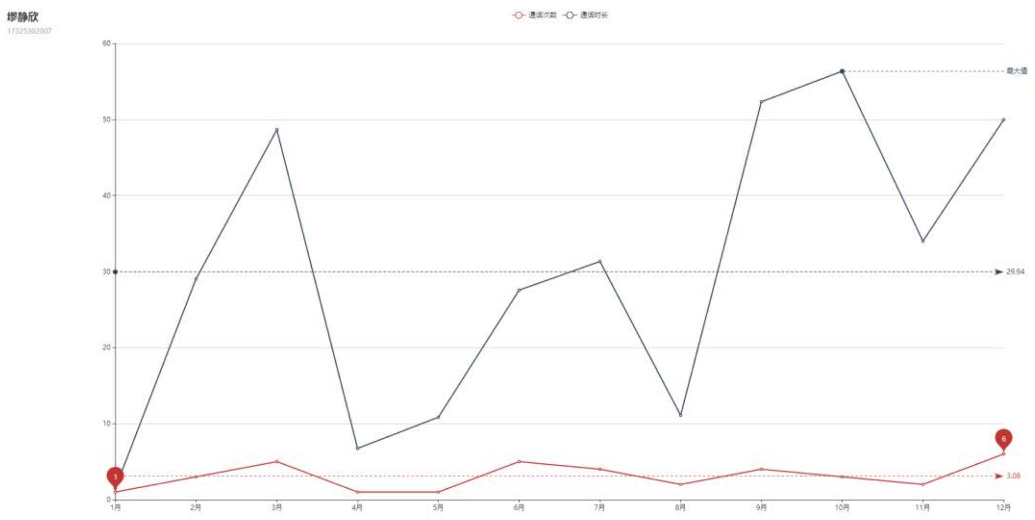
```
                    fontWeight: 'bold',
                    //字体系列
                    fontFamily: 'sans-serif',
                    //字体大小
                    fontSize: 18
                }
            },
            grid:{
                x:100,
                y:100,
                borderWidth:1
            },
            tooltip: {
                trigger: 'axis'
            },
            legend: {
                data: ['通话次数', '通话时长']
            },
            toolbox: {
                show: true,
                feature: {
                    dataZoom: {
                        yAxisIndex: 'none'
                    },
                    dataView: {readOnly: false},
                    magicType: {type: ['line', 'bar']},
                    restore: {},
                    saveAsImage: {}
                }
        },
        xAxis: {
                data: date.split(","),
        },
        yAxis: {},
        series: [
                {
                        name: '通话次数',
                        type: 'line',
                        data: count.split(","),
                        markPoint: {
                                data: [
                                        {type: 'max', name: '最大值'},
                                        {type: 'min', name: '最小值'}
                                ]
                        },
                        markLine: {
                                data: [
                                        {type: 'average', name: '平均值'}
                                ]
                        }
                },
                {
                        name: '通话时长',
                        type: 'line',
                        data: duration.split(","),
                        markPoint: {
                              data: [
                                    {name: '月最低', value: -2, xAxis: 1, yAxis: -1.5}
                              ]
                        },
                        markLine: {
                              data: [
                                    {type: 'average', name: '平均值'},
                                    [{
                                          symbol: 'none',
                                          x: '90%',
                                          yAxis: 'max'
                                    }, {
                                          symbol: 'circle',
                                          label: {
                                                normal: {
                                                      position: 'start',
                                                      formatter: '最大值'
                                                }
                                          },
                                          type: 'max',
                                          name: '最高点'
                                    }]
                              ]
                        }
                  },
            ]
      };
      if (option && typeof option === "object") {
```

```
                myChart.setOption(option, true);
            }
            myChart.hideLoading()
        }

        function callog2() {
            var dom = document.getElementById("container2");
            var myChart = echarts.init(dom);
            myChart.showLoading();
            var option = {
                tooltip: {
                    trigger: 'axis'
                },
                legend: {
                    data: ['通话次数', '通话时长']
                },
                toolbox: {
                    show: true,
                    feature: {
                        dataZoom: {
                            yAxisIndex: 'none'
                        },
                        dataView: {readOnly: false},
                        magicType: {type: ['line', 'bar']},
                        restore: {},
                        saveAsImage: {}
                    }
                },
grid:{
        x:100,
        y:100,
        borderWidth:1
},
xAxis: {
        data: date.split(","),
},
yAxis: {},
series: [
        {
                name: '通话次数',
                type: 'bar',
                data: count.split(","),
                markPoint: {
                        data: [
                                {type: 'max', name: '最大值'},
                                {type: 'min', name: '最小值'}
                        ]
                },
                markLine: {
                        data: [
                                {type: 'average', name: '平均值'}
                        ]
                }
        },
        {
                name: '通话时长',
                type: 'bar',
                data: duration.split(","),
                markPoint: {
                    data: [
                        {name: '月最低', value: -2, xAxis: 1, yAxis: -1.5}
                    ]
                },
                markLine: {
                    data: [
                        {type: 'average', name: '平均值'},
                        [{
                            symbol: 'none',
                            x: '90%',
                            yAxis: 'max'
                        }, {
                            symbol: 'circle',
                            label: {
                                normal: {
                                    position: 'start',
                                    formatter: '最大值'
                                }
                            },
                            type: 'max',
                            name: '最高点'
                        }]
                    ]
                }
            },
                ]
            };
            if (option && typeof option === "object") {
                myChart.setOption(option, true);
            }
            myChart.hideLoading()
        }

</script>
</body>
</html>
```

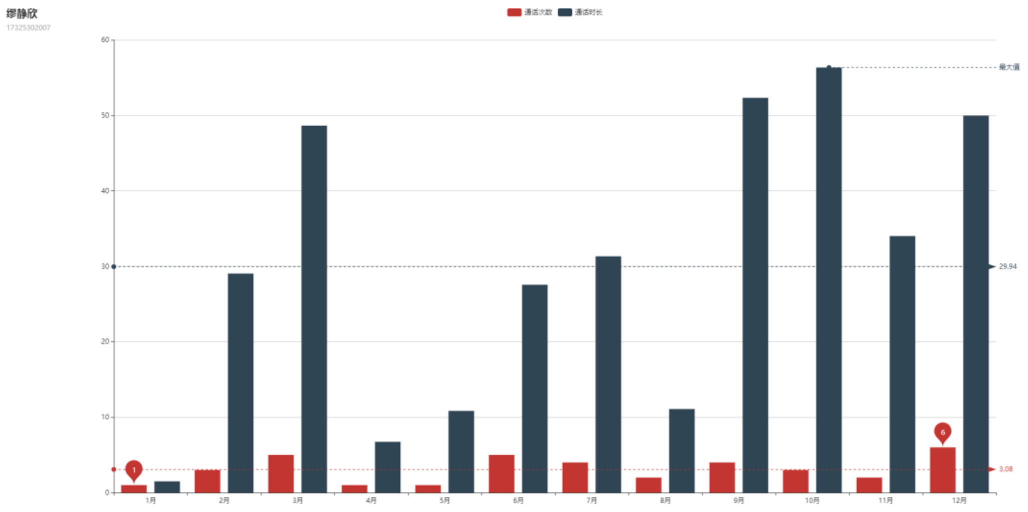
3.4.5、最终预览

查询人通话时长与通话次数统计大概如下所示：

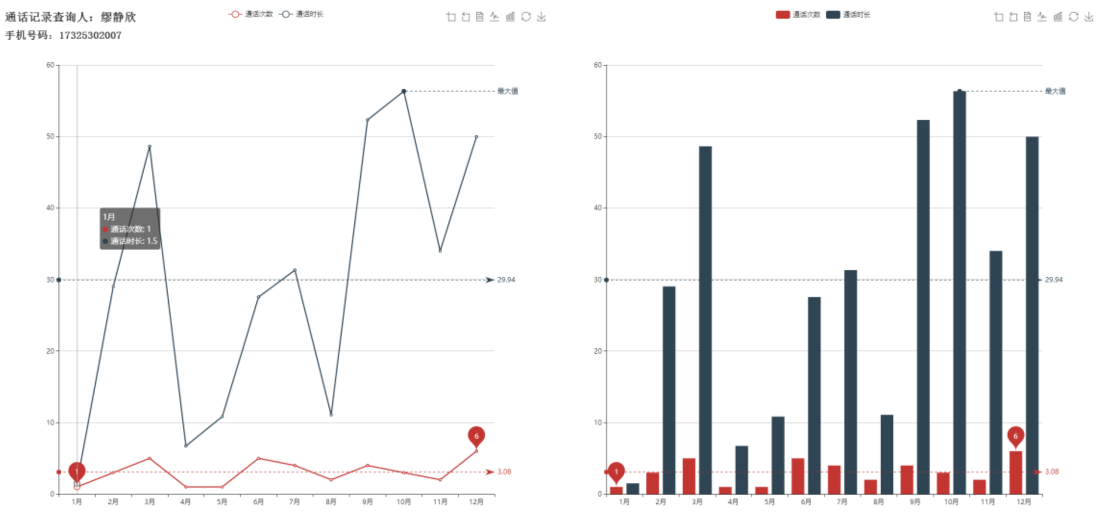
折线图：



柱状图：



统一展示：



3.5、定时任务

新的数据每天都会产生，所以我们每天都需要更新离线的分析结果，所以此时我们可以用各种各样的定时任务调度工具来完成此操作。此例我们使用 crontab 来执行该操作。

1) 编写任务脚本：analysis.sh

```
#!/bin/bash

/home/admin/modules/cdh/hadoop-2.5.0-cdh5.3.6/bin/yarn jar

~/softwares/jars/ct_analysis-1.0-SNAPSHOT.jar com.china.analysis.runner.CountDurationRunner

-libjars /home/admin/modules/cdh/hadoop-2.5.0-cdh5.3.6/lib/*
```

2) 制定 crontab 任务

```
# .----------------------------------------minute(0~59)
# | .---------------------------------------hours(0~23)
# | | .-------------------------------------day of month(1~31)
# | | | .-----------------------------------month(1~12)
# | | | | .---------------------------------day of week(0~6)
# | | | | | .-------------------------------command
# | | | | | |
# | | | | | |
0 0 * * * /home/admin/call/analysis.sh
```

3) 考虑数据处理手段是否安全

a、定时任务统计结果是否会重复

b、定时任务处理的数据是否全面

四、项目总结

重新总结梳理整个项目流程和方法论。

1、实现月查询（某个月每一天的数据展示）。

2、用户亲密度展示。

3、考虑 Hive 实现。

4、用户按照时间区间，查找所有的通话数据。