zookeeper概念

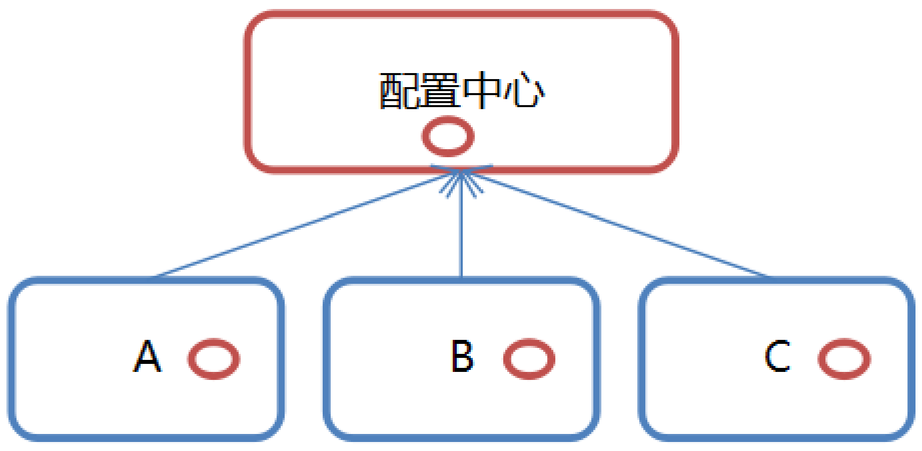
Zookeeper 是一个分布式的、开源的分布式应用程序的协调服务

三个主要功能：

Zookeeper 提供的主要功能包括：

- 配置管理

将公共的配置抽出来放到配置中心中**【比如：数据库配置信息】**

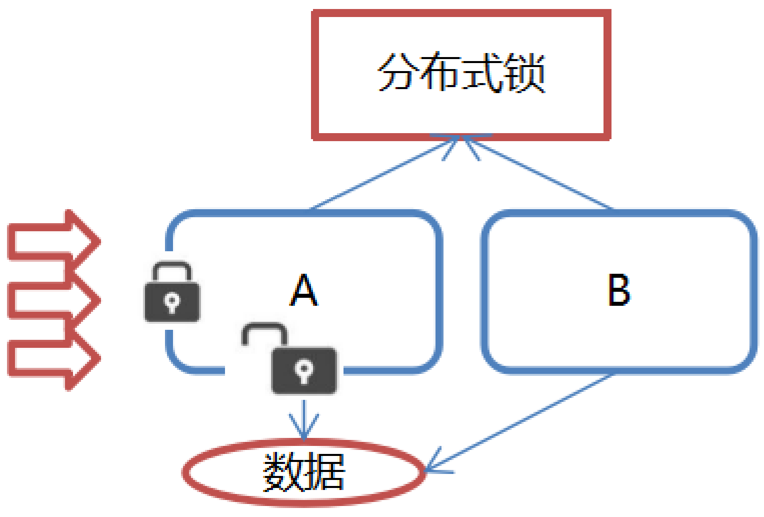


- 分布式锁

无论是内置锁还是Lock都只能工作在一台机器上：

普通的加锁仅能保证本机器上线程安全；所以引入分布式锁；

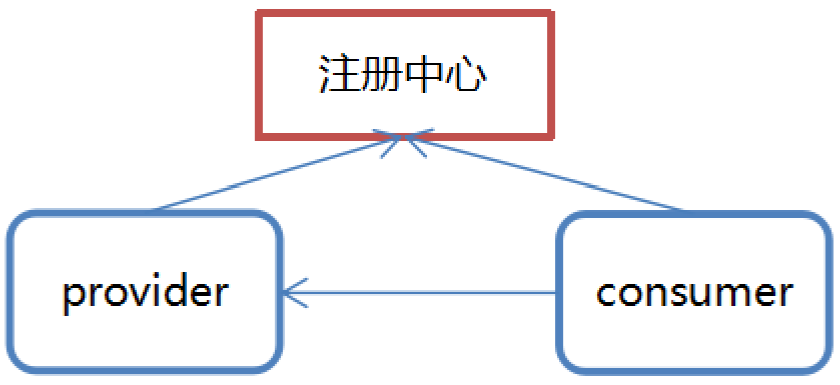
多台机器操作同一个资源，先获取一个第三方的锁：分布式锁



- 集群管理

服务提供者先将自己的地址给到注册中心，服务调用者想要调用某个服务时，从注册中心中获取目标服务所在的服务器地址；

再通过RPC远程调用目标服务



zookeeper的安装

1.1 下载安装

1、环境准备

ZooKeeper服务器是用Java创建的，它运行在JVM之上。需要安装JDK 7或更高版本。

2、上传

将下载的ZooKeeper放到/opt/ZooKeeper目录下

```
#上传zookeeper alt+p
put f:/setup/apache-zookeeper-3.5.6-bin.tar.gz
#打开 opt目录
cd /opt
#创建zooKeeper目录
mkdir  zooKeeper
#将zookeeper安装包移动到 /opt/zooKeeper
mv apache-zookeeper-3.5.6-bin.tar.gz /opt/zookeeper/
```

3、解压

将tar包解压到/opt/zookeeper目录下

```
tar -zxvf apache-ZooKeeper-3.5.6-bin.tar.gz
```

1.2 配置启动

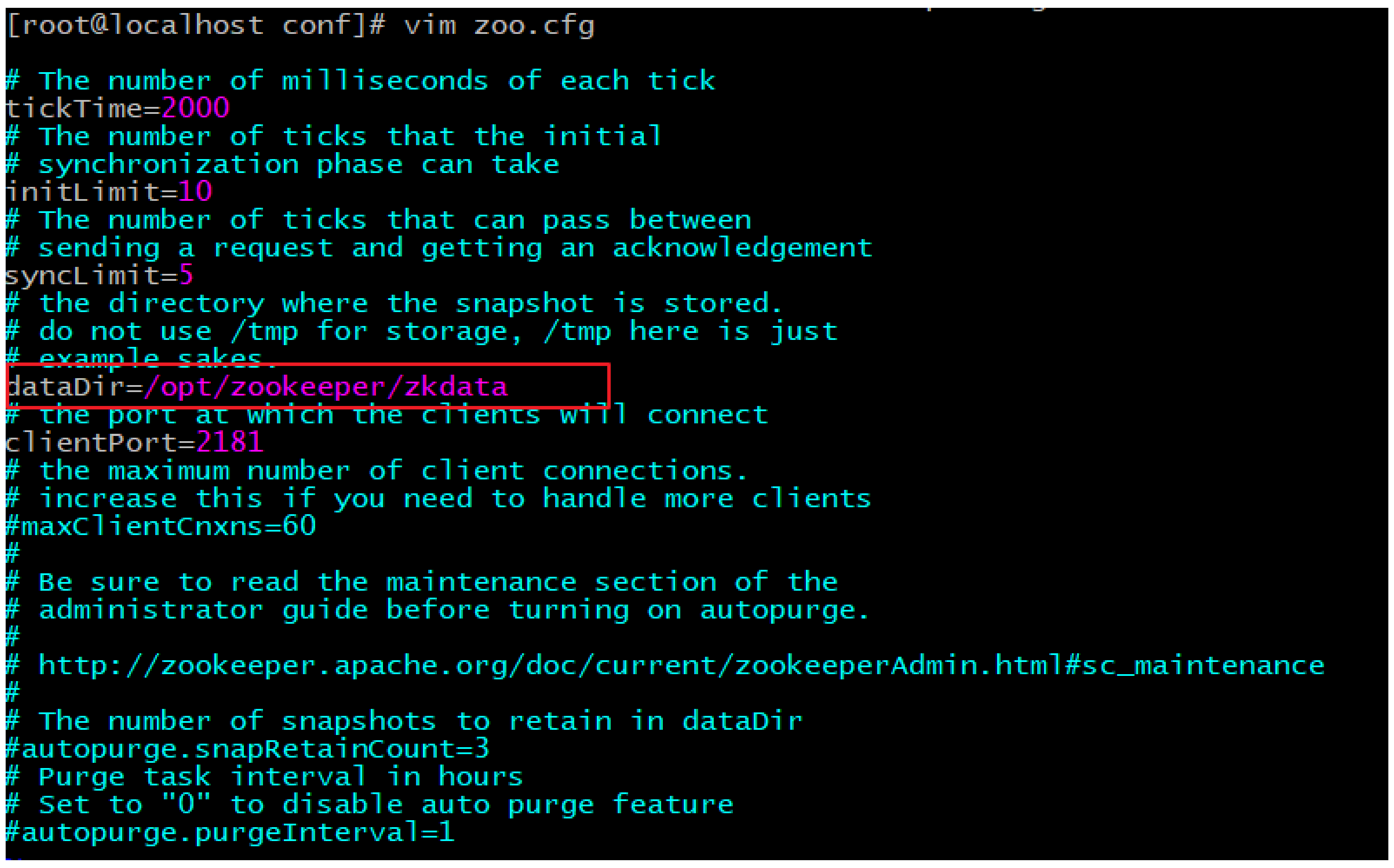
1、配置zoo.cfg

进入到conf目录拷贝一个zoo_sample.cfg并完成配置

```
#进入到conf目录
cd /opt/zooKeeper/apache-zooKeeper-3.5.6-bin/conf/
#拷贝cd
cp  zoo_sample.cfg  zoo.cfg
```

修改zoo.cfg

```
#打开目录
cd /opt/zooKeeper/
#创建zooKeeper存储目录
mkdir  zkdata
#修改zoo.cfg
vim /opt/zooKeeper/apache-zooKeeper-3.5.6-bin/conf/zoo.cfg
```

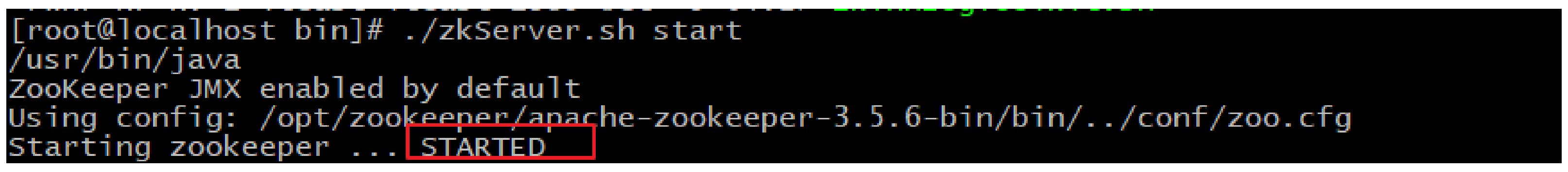


```
[root@localhost conf]# vim zoo.cfg

# The number of milliseconds of each tick
tickTime=2000
# The number of ticks that the initial
# synchronization phase can take
initLimit=10
# The number of ticks that can pass between
# sending a request and getting an acknowledgement
syncLimit=5
# the directory where the snapshot is stored.
# do not use /tmp for storage, /tmp here is just
# example sakes.
dataDir=/opt/zookeeper/zkdata
# the port at which the clients will connect
clientPort=2181
# the maximum number of client connections.
# increase this if you need to handle more clients
#maxClientCnxns=60
#
# Be sure to read the maintenance section of the
# administrator guide before turning on autopurge.
#
# http://zookeeper.apache.org/doc/current/zookeeperAdmin.html#sc_maintenance
#
# The number of snapshots to retain in dataDir
#autopurge.snapRetainCount=3
# Purge task interval in hours
# Set to "0" to disable auto purge feature
#autopurge.purgeInterval=1
```

修改存储目录：dataDir=/opt/zookeeper/zkdata

2、启动ZooKeeper

```
cd /opt/zooKeeper/apache-zooKeeper-3.5.6-bin/bin/
#启动
 ./zkServer.sh  start
```



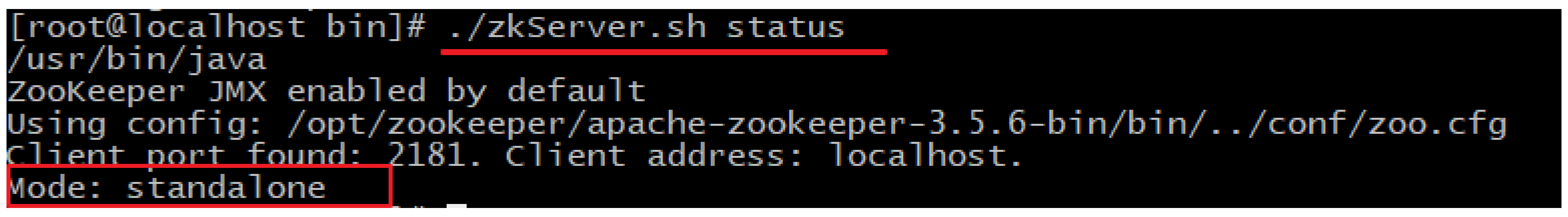
```
[root@localhost bin]# ./zkServer.sh start
/usr/bin/java
ZooKeeper JMX enabled by default
Using config: /opt/zookeeper/apache-zookeeper-3.5.6-bin/bin/../conf/zoo.cfg
Starting zookeeper ... STARTED
```

看到上图表示ZooKeeper成功启动

3、查看ZooKeeper状态

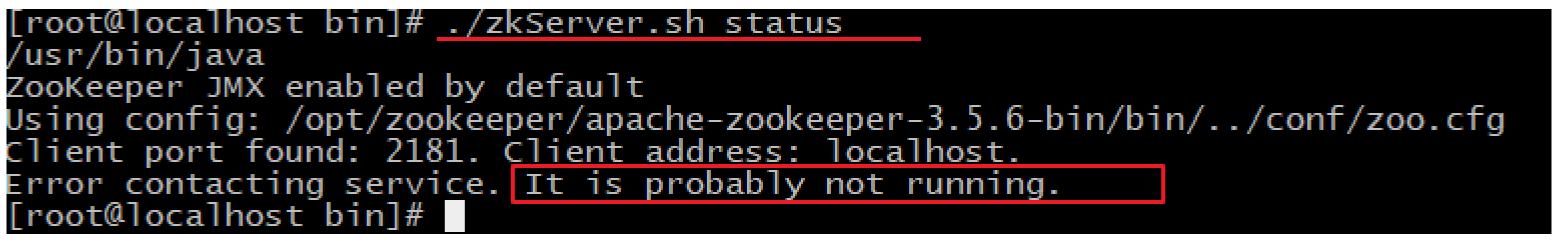
```
./zkServer.sh status
```

zookeeper启动成功。standalone代表zk没有搭建集群，现在是单节点



```
[root@localhost bin]# ./zkServer.sh status
/usr/bin/java
ZooKeeper JMX enabled by default
Using config: /opt/zookeeper/apache-zookeeper-3.5.6-bin/bin/../conf/zoo.cfg
Client port found: 2181. Client address: localhost.
Mode: standalone
```

zookeeper没有启动



```
[root@localhost bin]# ./zkServer.sh status
/usr/bin/java
ZooKeeper JMX enabled by default
Using config: /opt/zookeeper/apache-zookeeper-3.5.6-bin/bin/../conf/zoo.cfg
Client port found: 2181. Client address: localhost.
Error contacting service. It is probably not running.
[root@localhost bin]#
```

zookeeper命令操作

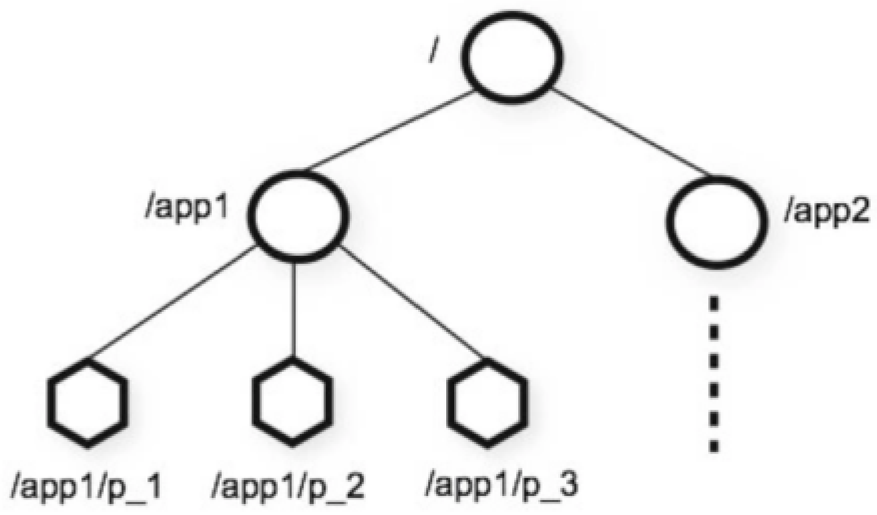
Zookeeper 数据模型

ZooKeeper 是一个树形目录服务,其数据模型和Unix的文件系统目录树很类似，拥有一个层次化结构

这里面的每一个节点都被称为： ZNode，每个节点上都会保存自己的**数据和节点信息**

节点可以拥有**子节点**，同时也允许少量（1MB）数据存储在该节点之下

即：节点中　有数据、有节点信息、有子节点



节点可以分为四大类：

- PERSISTENT 持久化节点
- EPHEMERAL 临时节点：-e
- PERSISTENT_SEQUENTIAL 持久化顺序节点：-s
- EPHEMERAL_SEQUENTIAL 临时顺序节点 ：-es

Zookeeper 服务端常用命令

启动 ZooKeeper 服务: ./zkServer.sh start
查看 ZooKeeper 服务状态: ./zkServer.sh status
停止 ZooKeeper 服务: ./zkServer.sh stop
重启 ZooKeeper 服务: ./zkServer.sh restart

Zookeeper 客户端常用命令

连接ZooKeeper服务端

```
./zkCli.sh –server ip:port
```

断开连接

```
quit
```

设置节点值

```
set /节点path value
```

查看命令帮助

```
help
```

显示指定目录下节点

```
ls 目录
ls /
```

创建节点

```
create /节点path value
```

获取节点值

```
get /节点path
```

设置节点值

```
set /节点path value
```

删除单个节点

```
delete /节点path
```

删除带有子节点的节点

```
deleteall /节点path
```

- 示例

```
//查看根目录的节点
[zk: localhost:2181(CONNECTED) 0] ls /
[zookeeper]

 //查看根目录下的zookeeper节点
[zk: localhost:2181(CONNECTED) 1] ls /zookeeper
[config, quota]

 //查看的目录必须从根目录开始
[zk: localhost:2181(CONNECTED) 2] ls con
config    connect

[zk: localhost:2181(CONNECTED) 2] ls config
Path must start with / character

[zk: localhost:2181(CONNECTED) 3] ls /config
Node does not exist: /config



[zk: localhost:2181(CONNECTED) 4] ls /
[zookeeper]

//查看根目录下的zookeeper下的config节点 【空】
[zk: localhost:2181(CONNECTED) 5] ls /zookeeper/config
[]

//创建节点并添加数据
[zk: localhost:2181(CONNECTED) 6] create /app1 数据
Created /app1

//获取某个节点的数据
[zk: localhost:2181(CONNECTED) 7] get /app1
数据


//没有从跟开始
[zk: localhost:2181(CONNECTED) 8] create app2
Path must start with / character

[zk: localhost:2181(CONNECTED) 9] ls /
[app1, zookeeper]
[zk: localhost:2181(CONNECTED) 10] get app2
Path must start with / character
[zk: localhost:2181(CONNECTED) 11]
[zk: localhost:2181(CONNECTED) 11] get /app2
org.apache.zookeeper.KeeperException$NoNodeException: KeeperErrorCode = NoNode for /app2

//创建节点不带数据
[zk: localhost:2181(CONNECTED) 12] create /app2
Created /app2

//获取某个节点中的数据
[zk: localhost:2181(CONNECTED) 13] get /app2
null

//删除某个节点
[zk: localhost:2181(CONNECTED) 14] delete /app1
[zk: localhost:2181(CONNECTED) 15] ls /
[app2, zookeeper]


//不能创建同名节点
[zk: localhost:2181(CONNECTED) 17] create /app1
Created /app1
[zk: localhost:2181(CONNECTED) 18] create /app1
Node already exists: /app1

//创建多级目录下的索引
[zk: localhost:2181(CONNECTED) 19] create /app1/app1\1
Created /app1/app1\1
[zk: localhost:2181(CONNECTED) 20] ls /app1
[app1\1]
```

```
//删除包含子节点的节点【失败】
[zk: localhost:2181(CONNECTED) 21] delete /app1
Node not empty: /app1
//删除包含子节点的节点
[zk: localhost:2181(CONNECTED) 22] deleteall /app1

[zk: localhost:2181(CONNECTED) 23] ls /
[app2, zookeeper]
```

注意：

默认是持久化节点

创建临时节点

```
create -e /节点path value
```

创建顺序节点

```
create -s /节点path value
```

查询节点详细信息

```
ls -s /节点path
```

- 示例

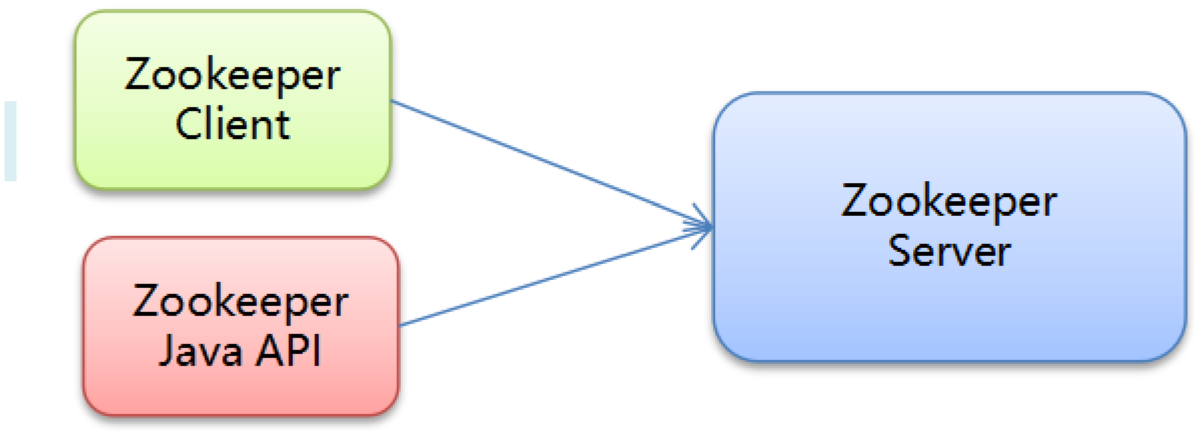
```
//查看节点详细信息，不建议这么使用
[zk: localhost:2181(CONNECTED) 0] ls2 /
'ls2' has been deprecated. Please use 'ls [-s] path' instead.
[zookeeper, app2]
cZxid = 0x0
ctime = Thu Jan 01 08:00:00 CST 1970
mZxid = 0x0
mtime = Thu Jan 01 08:00:00 CST 1970
pZxid = 0xa
cversion = 4
dataVersion = 0
aclVersion = 0
ephemeralOwner = 0x0
dataLength = 0
numChildren = 2

//查看节点详细信息，不建议这么使用
[zk: localhost:2181(CONNECTED) 1] ls2 /zookeeper
'ls2' has been deprecated. Please use 'ls [-s] path' instead.
[config, quota]
cZxid = 0x0
ctime = Thu Jan 01 08:00:00 CST 1970
mZxid = 0x0
mtime = Thu Jan 01 08:00:00 CST 1970
pZxid = 0x0
cversion = -2
dataVersion = 0
aclVersion = 0
ephemeralOwner = 0x0
dataLength = 0
numChildren = 2
[zk: localhost:2181(CONNECTED) 2] ls -s /app2
[]cZxid = 0x3
ctime = Thu May 19 16:46:53 CST 2022
mZxid = 0x3
mtime = Thu May 19 16:46:53 CST 2022
pZxid = 0x3
cversion = 0
dataVersion = 0
aclVersion = 0
ephemeralOwner = 0x0
dataLength = 0
numChildren = 0

//创建临时节点
[zk: localhost:2181(CONNECTED) 3] create -e /app1
Created /app1

//不能创建重复节点
[zk: localhost:2181(CONNECTED) 4] create -e /app1
Node already exists: /app1
[zk: localhost:2181(CONNECTED) 5] create -e /app1
Node already exists: /app1
[zk: localhost:2181(CONNECTED) 6] create -e /app1
Node already exists: /app1
[zk: localhost:2181(CONNECTED) 7] create -e /app1
Node already exists: /app1


[zk: localhost:2181(CONNECTED) 8] ls /
[app1, app2, zookeeper]

//不能创建多级临时节点
[zk: localhost:2181(CONNECTED) 9] create -e /app1/a1
Ephemerals cannot have children: /app1/a1

//创建临时顺序节点
[zk: localhost:2181(CONNECTED) 10] create -es /app1
Created /app10000000004
[zk: localhost:2181(CONNECTED) 11] create -es /app1
Created /app10000000005
[zk: localhost:2181(CONNECTED) 12] create -es /app1
Created /app10000000006
[zk: localhost:2181(CONNECTED) 13] create -es /app1
Created /app10000000007
[zk: localhost:2181(CONNECTED) 14] create -es /app1
```

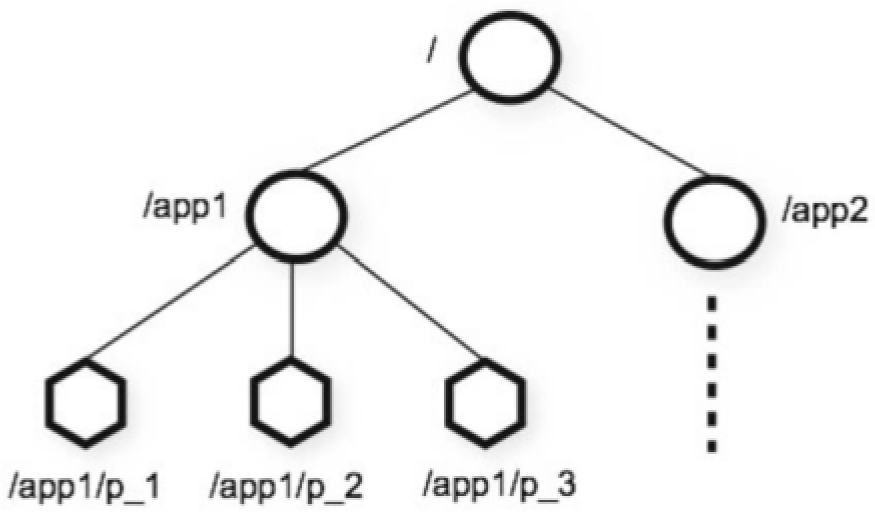
```
Created /app10000000008

[zk: localhost:2181(CONNECTED) 15] ls /
[app1, app10000000004, app10000000005, app10000000006, app10000000007, app10000000008, app2, zookeeper]
```

详细信息参数：

czxid：节点被创建的事务ID
ctime: 创建时间
mzxid: 最后一次被更新的事务ID
mtime: 修改时间
pzxid：子节点列表最后一次被更新的事务ID
cversion：子节点的版本号

dataversion：数据版本号
aclversion：权限版本号
ephemeralOwner：用于临时节点，代表临时节点的事务ID，如果为持久节点则为0
dataLength：节点存储的数据的长度
numChildren：当前节点的子节点个数





ZooKeeper JavaAPI 操作

Curator 是 Apache ZooKeeper 的ZooKeeper Java API

建立连接

- pom

```
<?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.itheima</groupId>
    <artifactId>curator-zk</artifactId>
    <version>1.0-SNAPSHOT</version>



    <dependencies>

        <dependency>
            <groupId>junit</groupId>
            <artifactId>junit</artifactId>
            <version>4.10</version>
            <scope>test</scope>
        </dependency>

        <!--curator-->
        <dependency>
            <groupId>org.apache.curator</groupId>
            <artifactId>curator-framework</artifactId>
            <version>4.0.0</version>
        </dependency>

        <dependency>
            <groupId>org.apache.curator</groupId>
            <artifactId>curator-recipes</artifactId>
            <version>4.0.0</version>
        </dependency>
        <!--日志-->
        <dependency>
            <groupId>org.slf4j</groupId>
            <artifactId>slf4j-api</artifactId>
            <version>1.7.21</version>
        </dependency>

        <dependency>
            <groupId>org.slf4j</groupId>
            <artifactId>slf4j-log4j12</artifactId>
            <version>1.7.21</version>
        </dependency>

    </dependencies>


    <build>
        <plugins>
            <plugin>
                <groupId>org.apache.maven.plugins</groupId>
                <artifactId>maven-compiler-plugin</artifactId>
                <version>3.1</version>
                <configuration>
                    <source>1.8</source>
                    <target>1.8</target>
                </configuration>
            </plugin>
        </plugins>
    </build>

</project>
```

- log4j.properties

```
log4j.rootLogger=off,stdout

log4j.appender.stdout = org.apache.log4j.ConsoleAppender
log4j.appender.stdout.Target = System.out
log4j.appender.stdout.layout = org.apache.log4j.PatternLayout
log4j.appender.stdout.layout.ConversionPattern = [%d{yyyy-MM-dd HH/:mm/:ss}]%-5p %c(line/:%L) %x-%m%n
```

- test

```
    public void testConnect() {

        /*
         *
         * @param connectString       连接字符串。zk server 地址和端口
"192.168.149.135:2181,192.168.149.136:2181"
         * @param sessionTimeoutMs    会话超时时间 单位ms
         * @param connectionTimeoutMs 连接超时时间 单位ms
         * @param retryPolicy         重试策略
         */
       /*
       //1.第一种方式
       //重试策略
        RetryPolicy retryPolicy = new ExponentialBackoffRetry(3000,10);
        CuratorFramework client = CuratorFrameworkFactory.newClient("192.168.149.135:2181",
                60 * 1000, 15 * 1000, retryPolicy);*/
        //重试策略
        RetryPolicy retryPolicy = new ExponentialBackoffRetry(3000, 10);


        //2.第二种方式
        //CuratorFrameworkFactory.builder();
        client = CuratorFrameworkFactory.builder()
                .connectString("192.168.149.135:2181")
                .sessionTimeoutMs(60 * 1000)
                .connectionTimeoutMs(15 * 1000)
                .retryPolicy(retryPolicy)
                .namespace("itheima")
                .build();

        //开启连接
        client.start();

    }
```

添加节点

```
/**
     * 创建节点：create 持久 临时 顺序 数据
     * 1. 基本创建 ：create().forPath("")
     * 2. 创建节点 带有数据:create().forPath("",data)
     * 3. 设置节点的类型：create().withMode().forPath("",data)
     * 4. 创建多级节点  /app1/p1 ：create().creatingParentsIfNeeded().forPath("",data)
     */

    @Test
    public void testCreate2() throws Exception {
        //1. 基本创建
        //如果创建节点，没有指定数据，则默认将当前客户端的ip作为数据存储
        String path = client.create().forPath("/app1");
        System.out.println(path);
    }


    @Test
    public void testCreate() throws Exception {
        //2. 创建节点 带有数据
        //如果创建节点，没有指定数据，则默认将当前客户端的ip作为数据存储
        String path = client.create().forPath("/app2", "hehe".getBytes());
        System.out.println(path);
    }



    @Test
    public void testCreate3() throws Exception {
        //3. 设置节点的类型
        //默认类型：持久化
        //这里是创建临时节点会话关闭节点就被删除
        String path = client.create().withMode(CreateMode.EPHEMERAL).forPath("/app3");
        System.out.println(path);
        //不让会话停止
        while (true){
        }
    }

    @Test
    public void testCreate4() throws Exception {
        //父节点不存在 不可以创建子节点 都不行【api cli】

        //4. 创建多级节点  /app1/p1
        //creatingParentsIfNeeded():如果父节点不存在，则创建父节点
        String path = client.create().creatingParentsIfNeeded().forPath("/app4/p1");
        System.out.println(path);
    }
```

删除节点

```
    /**
     * 删除节点： delete、deleteall
     * 1. 删除单个节点:delete().forPath("/app1");
     * 2. 删除带有子节点的节点:delete().deletingChildrenIfNeeded().forPath("/app1");
     * 3. 必须成功的删除:为了防止网络抖动。本质就是重试。  client.delete().guaranteed().forPath("/app2");
     * 4. 回调：inBackground
     *
     * @throws Exception
     */


    @Test
    public void testDelete() throws Exception {
        // 1. 删除单个节点
        client.delete().forPath("/app1");
    }

    @Test
    public void testDelete2() throws Exception {
        //2. 删除带有子节点的节点
        client.delete().deletingChildrenIfNeeded().forPath("/app4");
    }

    @Test
    public void testDelete3() throws Exception {
        //3. 必须成功的删除
        client.delete().guaranteed().forPath("/app2");
    }

    @Test
    public void testDelete4() throws Exception {
        //4. 回调
        client.delete().guaranteed().inBackground(new BackgroundCallback() {

            @Override
            public void processResult(CuratorFramework client, CuratorEvent event) throws Exception {
                System.out.println("我被删除了~");
                System.out.println(event);
            }
        }).forPath("/app1");
    }
```

修改节点

```
  /**
     * 修改数据
     * 1. 基本修改数据：setData().forPath()
     * 2. 根据版本修改: setData().withVersion().forPath()
     * * version 是通过查询出来的。目的就是为了让其他客户端或者线程不干扰我。
     *
     * @throws Exception
     */
    @Test
    public void testSet() throws Exception {
        client.setData().forPath("/app1", "itcast".getBytes());
    }


    @Test
    public void testSetForVersion() throws Exception {

        Stat status = new Stat();
        //3. 查询节点状态信息：ls -s
        client.getData().storingStatIn(status).forPath("/app1");
        int version = status.getVersion();//查询出来的 3

        System.out.println(version);

        //修改时的节点状态与之前查询的状态一致时才可以修改；否则抛错
        client.setData().withVersion(version).forPath("/app1", "hehe".getBytes());
    }
```

查询节点

```
    /**
     * 查询节点：
     * 1. 查询数据：get: getData().forPath()
     * 2. 查询子节点： ls: getChildren().forPath()
     * 3. 查询节点状态信息：ls -s:getData().storingStatIn(状态对象).forPath()
     */

    @Test
    public void testGet1() throws Exception {
        //1. 查询某个节点下的数据：get
        byte[] data = client.getData().forPath("/app1");
        System.out.println(new String(data));
    }

    @Test
    public void testGet2() throws Exception {
        // 2. 查询子节点：  相当于 ls /itheima
        List<String> path = client.getChildren().forPath("/");
        System.out.println(path);
    }

    @Test
    public void testGet3() throws Exception {
        //把状态信息封装到该对象中
        Stat status = new Stat();
        System.out.println(status);
        //3. 查询节点状态信息：ls -s
        client.getData().storingStatIn(status).forPath("/app1");
        System.out.println(status);

    }
```

总结

```
package com.itheima.curator;

import org.apache.curator.RetryPolicy;
import org.apache.curator.framework.CuratorFramework;
import org.apache.curator.framework.CuratorFrameworkFactory;
import org.apache.curator.framework.api.BackgroundCallback;
import org.apache.curator.framework.api.CuratorEvent;
import org.apache.curator.retry.ExponentialBackoffRetry;
import org.apache.zookeeper.CreateMode;
import org.apache.zookeeper.data.Stat;
import org.junit.After;
import org.junit.Before;
import org.junit.Test;

import java.util.List;

public class CuratorTest {


    private CuratorFramework client;

    /**
     * 建立连接
     */
    @Before
    public void testConnect() {

        /*
         *
         * @param connectString       连接字符串。zk server 地址和端口
"192.168.149.135:2181,192.168.149.136:2181"
         * @param sessionTimeoutMs    会话超时时间 单位ms
         * @param connectionTimeoutMs 连接超时时间 单位ms
         * @param retryPolicy         重试策略
         */
       /* //重试策略
        RetryPolicy retryPolicy = new ExponentialBackoffRetry(3000,10);
        //1.第一种方式
        CuratorFramework client = CuratorFrameworkFactory.newClient("192.168.149.135:2181",
                60 * 1000, 15 * 1000, retryPolicy);*/
        //重试策略
        RetryPolicy retryPolicy = new ExponentialBackoffRetry(3000, 10);
        //2.第二种方式
        //CuratorFrameworkFactory.builder();
        client = CuratorFrameworkFactory.builder()
                .connectString("43.142.48.199")
                .sessionTimeoutMs(60 * 1000)
                .connectionTimeoutMs(15 * 1000)
                .retryPolicy(retryPolicy)
                .namespace("itheima")
                .build();

        //开启连接
        client.start();

    }

//==============================create=====================================================================
========

    /**
     * 创建节点：create 持久 临时 顺序 数据
     * 1. 基本创建 ：create().forPath("")
     * 2. 创建节点 带有数据:create().forPath("",data)
     * 3. 设置节点的类型：create().withMode().forPath("",data)
     * 4. 创建多级节点  /app1/p1 ：create().creatingParentsIfNeeded().forPath("",data)
     */
    @Test
    public void testCreate() throws Exception {
        //2. 创建节点 带有数据
        //如果创建节点，没有指定数据，则默认将当前客户端的ip作为数据存储
        String path = client.create().forPath("/app2", "hehe".getBytes());
        System.out.println(path);

    }

    @Test
    public void testCreate2() throws Exception {
        //1. 基本创建
        //如果创建节点，没有指定数据，则默认将当前客户端的ip作为数据存储
        String path = client.create().forPath("/app1");
        System.out.println(path);

    }
```

```java
    @Test
    public void testCreate3() throws Exception {
        //3. 设置节点的类型
        //默认类型：持久化
        //这里是创建临时节点会话关闭节点就被删除
        String path = client.create().withMode(CreateMode.EPHEMERAL).forPath("/app3");
        System.out.println(path);
        //不让会话停止
        while (true){

        }
    }

    @Test
    public void testCreate4() throws Exception {
        //父节点不存在 不可以创建子节点 都不行【api cli】

        //4. 创建多级节点  /app1/p1
        //creatingParentsIfNeeded():如果父节点不存在，则创建父节点
        String path = client.create().creatingParentsIfNeeded().forPath("/app4/p1");
        System.out.println(path);
    }
//===========================get============================================================================
=====

    /**
     * 查询节点：
     * 1. 查询数据：get: getData().forPath()
     * 2. 查询子节点：  ls: getChildren().forPath()
     * 3. 查询节点状态信息：ls -s:getData().storingStatIn(状态对象).forPath()
     */

    @Test
    public void testGet1() throws Exception {
        //1. 查询某个节点下的数据：get
        byte[] data = client.getData().forPath("/app1");
        System.out.println(new String(data));
    }

    @Test
    public void testGet2() throws Exception {
        // 2. 查询子节点：   相当于 ls /itheima
        List<String> path = client.getChildren().forPath("/");
        System.out.println(path);
    }

    @Test
    public void testGet3() throws Exception {
        Stat status = new Stat();
        System.out.println(status);
        //3. 查询节点状态信息：ls -s
        client.getData().storingStatIn(status).forPath("/app1");
        System.out.println(status);

    }


 //===========================set===========================================================================
======

    /**
     * 修改数据
     * 1. 基本修改数据：setData().forPath()
     * 2. 根据版本修改: setData().withVersion().forPath()
     * * version 是通过查询出来的。目的就是为了让其他客户端或者线程不干扰我。
     *
     * @throws Exception
     */
    @Test
    public void testSet() throws Exception {
        client.setData().forPath("/app1", "itcast".getBytes());
    }


    @Test
    public void testSetForVersion() throws Exception {

        Stat status = new Stat();
        //3. 查询节点状态信息：ls -s
        client.getData().storingStatIn(status).forPath("/app1");


        int version = status.getVersion();//查询出来的 3
        System.out.println(version);
        client.setData().withVersion(version).forPath("/app1", "hehe".getBytes());
    }


 //===========================delete========================================================================
=========

    /**
     * 删除节点： delete、deleteall
     * 1. 删除单个节点:delete().forPath("/app1");
     * 2. 删除带有子节点的节点:delete().deletingChildrenIfNeeded().forPath("/app1");
     * 3. 必须成功的删除:为了防止网络抖动。本质就是重试。  client.delete().guaranteed().forPath("/app2");
     * 4. 回调：inBackground
     *
     * @throws Exception
     */


    @Test
    public void testDelete() throws Exception {
        // 1. 删除单个节点
        client.delete().forPath("/app1");
    }

    @Test
    public void testDelete2() throws Exception {
        //2. 删除带有子节点的节点
        client.delete().deletingChildrenIfNeeded().forPath("/app4");
    }

    @Test
    public void testDelete3() throws Exception {
        //3. 必须成功的删除
        client.delete().guaranteed().forPath("/app2");
    }

    @Test
    public void testDelete4() throws Exception {
        //4. 回调
        client.delete().guaranteed().inBackground(new BackgroundCallback() {

            @Override
            public void processResult(CuratorFramework client, CuratorEvent event) throws Exception {
                System.out.println("我被删除了~");
                System.out.println(event);
            }
        }).forPath("/app1");
    }

    @After
    public void close() {
        if (client != null) {
            client.close();
        }
    }
}
```

Watch事件监听

概念

- ZooKeeper 允许用户在指定节点上注册一些Watcher，并且在一些特定事件触发的时候，ZooKeeper 服务端会将事件通知到感兴趣的客户端上去，该机制是

  ZooKeeper 实现分布式协调服务的重要特性

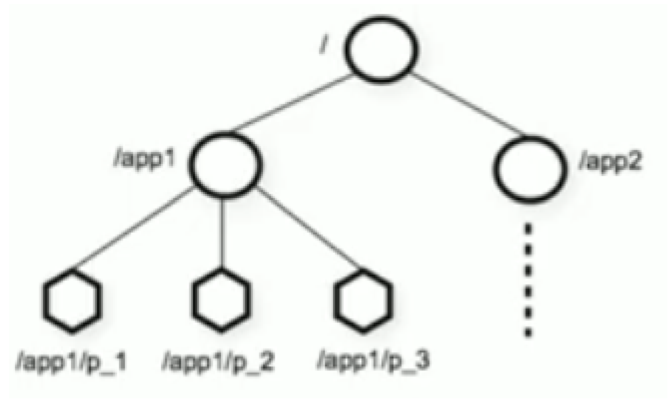
- ZooKeeper 中引入了Watcher机制来实现了发布/订阅功能，能够让多个订阅者同时监听某一个对象，当一个对象自身状态变化时，会通知所有订阅者

- ZooKeeper 原生支持通过注册Watcher来进行事件监听，但是其使用并不是特别方便 需要开发人员自己反复注册Watcher，比较繁琐。

  Curator引入了 Cache 来实现对 ZooKeeper 服务端事件的监听

ZooKeeper提供了三种Watcher：

- NodeCache : 只是监听某一个特定的节点
- PathChildrenCache : 监控一个ZNode的子节点
- TreeCache : 可以监控整个树上的所有节点，类似于PathChildrenCache和NodeCache的组合【本身加上儿子们】



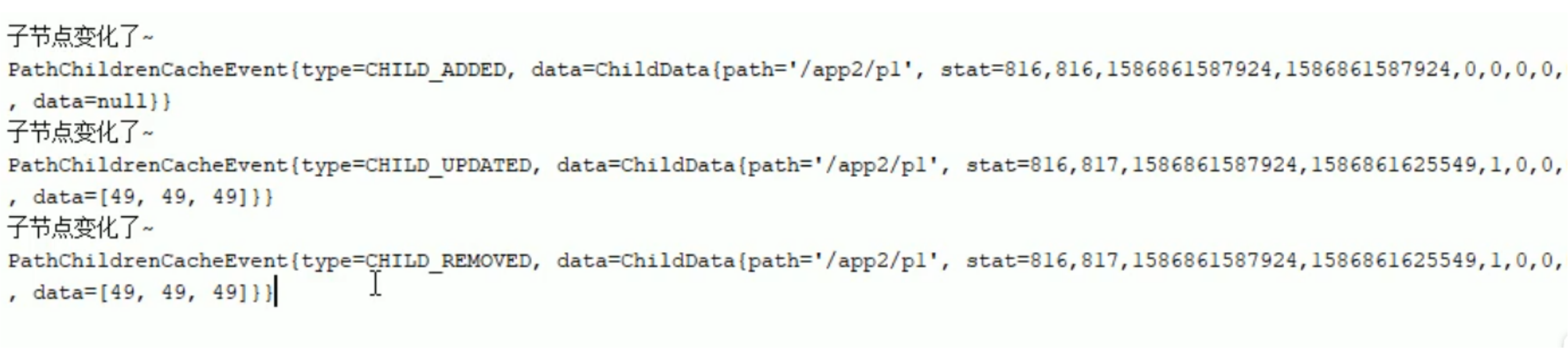
监听某个节点

```
    /**
     * 演示 NodeCache：给指定一个节点注册监听器
     */

    @Test
    public void testNodeCache() throws Exception {
        //1. 创建NodeCache对象 false代表不压缩数据
        final NodeCache nodeCache = new NodeCache(client,"/app1",false);

        //2. 注册监听
        nodeCache.getListenable().addListener(new NodeCacheListener() {
            @Override
            public void nodeChanged() throws Exception {
                System.out.println("节点变化了~");

                //获取修改节点后的数据
                byte[] data = nodeCache.getCurrentData().getData();
                System.out.println(new String(data));
            }
        });

        //3. 开启监听.如果设置为true，则开启监听是，加载缓冲数据
        nodeCache.start(true);


        while (true){

        }
    }
```

监听子节点

```
    /**
```

```
     * 演示 PathChildrenCache：监听某个节点的所有子节点们
     */

    @Test
    public void testPathChildrenCache() throws Exception {
        //1.创建监听对象
        PathChildrenCache pathChildrenCache = new PathChildrenCache(client,"/app2",true);

        //2. 绑定监听器
        pathChildrenCache.getListenable().addListener(new PathChildrenCacheListener() {
            @Override
            public void childEvent(CuratorFramework client, PathChildrenCacheEvent event) throws Exception
{
                System.out.println("子节点变化了~");
                System.out.println(event);
                //监听子节点的数据变更，并且拿到变更后的数据
                //1.获取类型
                PathChildrenCacheEvent.Type type = event.getType();
                //2.判断类型是否是update
                if(type.equals(PathChildrenCacheEvent.Type.CHILD_UPDATED)){
                    System.out.println("数据变了！！！");
                    byte[] data = event.getData().getData();
                    System.out.println(new String(data));
                }
            }
        });
        //3. 开启
        pathChildrenCache.start();
        while (true){
        }
    }
```



```
子节点变化了~
PathChildrenCacheEvent{type=CHILD_ADDED, data=ChildData{path='/app2/p1', stat=816,816,1586861587924,1586861587924,0,0,0,0,
, data=null}}
子节点变化了~
PathChildrenCacheEvent{type=CHILD_UPDATED, data=ChildData{path='/app2/p1', stat=816,817,1586861587924,1586861625549,1,0,0,
, data=[49, 49, 49]}}
子节点变化了~
PathChildrenCacheEvent{type=CHILD_REMOVED, data=ChildData{path='/app2/p1', stat=816,817,1586861587924,1586861625549,1,0,0,
, data=[49, 49, 49]}}
```

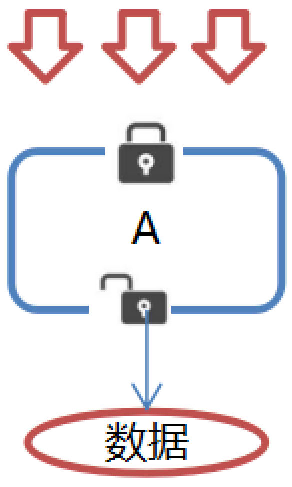
监听某个节点自己和所有子节点们

```
 /**
     * 演示 TreeCache：监听某个节点自己和所有子节点们
     */

    @Test
    public void testTreeCache() throws Exception {
        //1. 创建监听器
        TreeCache treeCache = new TreeCache(client,"/app2");

        //2. 注册监听
        treeCache.getListenable().addListener(new TreeCacheListener() {
            @Override
            public void childEvent(CuratorFramework client, TreeCacheEvent event) throws Exception {
                System.out.println("节点变化了");
                System.out.println(event);
            }
        });

        //3. 开启
        treeCache.start();

        while (true){

        }
    }
```

分布式锁

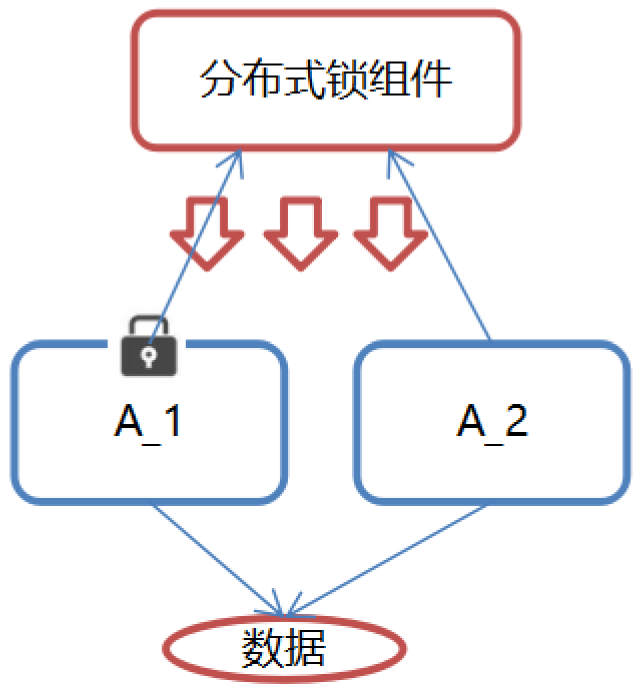
- 单机应用

　　涉及并发同步的时候，我们往往采用synchronized或者Lock的方式来解决多线程间的代码同步问题，这时多线程的运行都是在同一个JVM之下，没有任何问题



- 集群

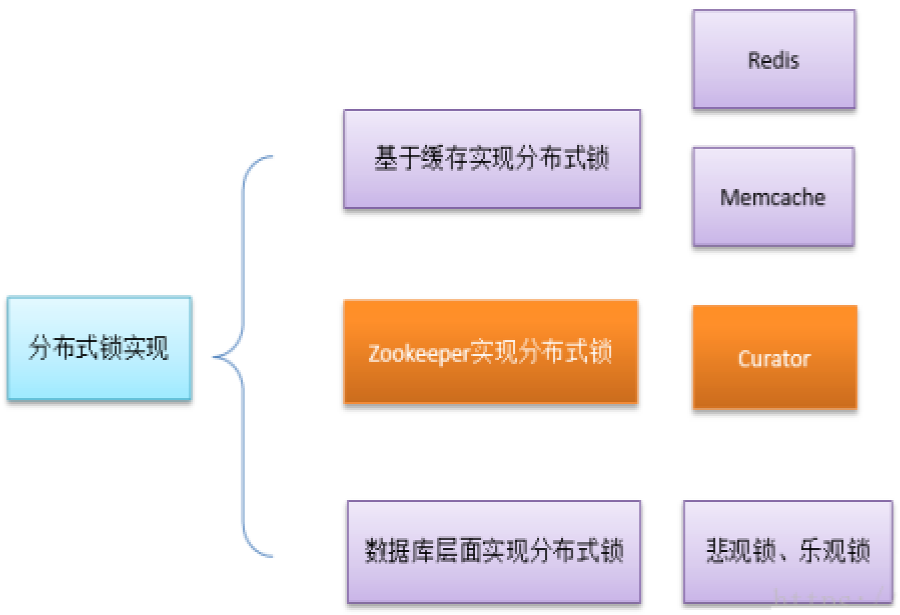
　　当我们的应用是分布式集群工作的情况下，属于多JVM下的工作环境，**跨JVM之间**已经**无法通过**多线程的**锁解决同步问题**



- 分布式锁

  那么就需要一种更加高级的锁机制，来处理种**跨机器的进程之间的数据同步问题**——这就是分布式锁

- 分布式锁的多种方案



1. 基于缓存的分布式锁不可靠：

   以redis为例，当从节点还没与主节点完成同步时，主节点宕机了；此时会出现多个机器获取到锁的情况

2. 数据库层面实现分布式锁：

   性能比较低下；数据库的性能本来就不是很好；

3. zookeeper实现分布式锁：

   综合性能和可靠性

zookeeper的原理

- 分布式锁的核心思想：

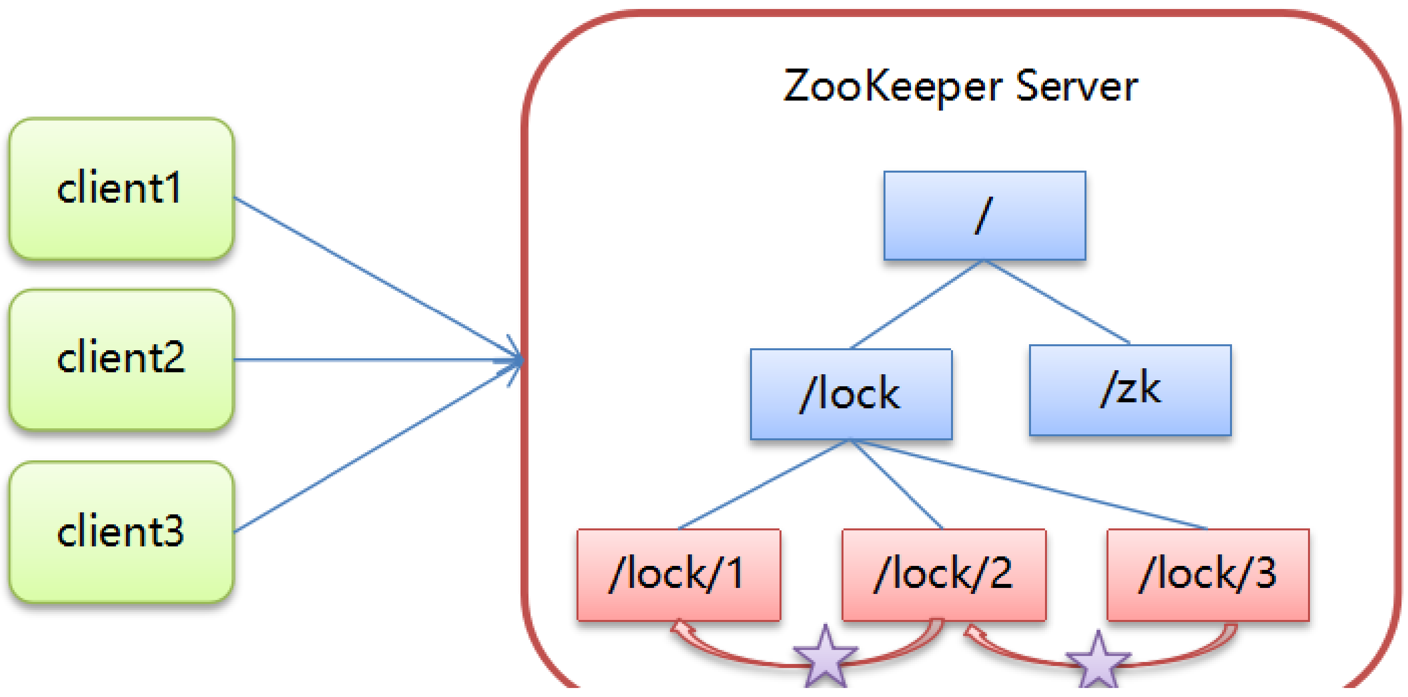
  当客户端要获取锁，则创建节点，使用完锁，则删除该节点

- 实现步骤：

  ```
  1. 客户端获取锁时，在lock节点【某个节点】下创建临时顺序节点【临时：即使服务器宕机了，此节点也会因为会话断开而被删除；即是让出该锁】
  1. 然后获取lock下面的所有子节点，客户端获取到所有的子节点之后，如果发现自己创建的子节点序号最小，那么就认为该客户端获取到了锁。
  ```

  使用完锁后，将该节点删除

3. 如果发现自己创建的节点**并非**lock所有子节点中最小的，说明自己还没有获取到锁，此时客户端需要找到比自己小的那个节点，同时对其注册事件监听器，监听删除事件
4. 如果发现比自己小的那个节点被删除，则客户端的Watcher会收到相应通知，此时再次判断自己创建的节点是否是lock子节点中序号最小的，如果是则获取到了锁， 如果不是则重复以上步骤继续获取到比自己小的一个节点并注册监听



模拟12306售票案例

Curator实现分布式锁API

在Curator中有五种锁方案：

InterProcessSemaphoreMutex：分布式排它锁（非可重入锁）

InterProcessMutex：分布式可重入排它锁

InterProcessReadWriteLock：分布式读写锁

InterProcessMultiLock：将多个锁作为单个实体管理的容器

InterProcessSemaphoreV2：共享信号量

- 提供买票服务

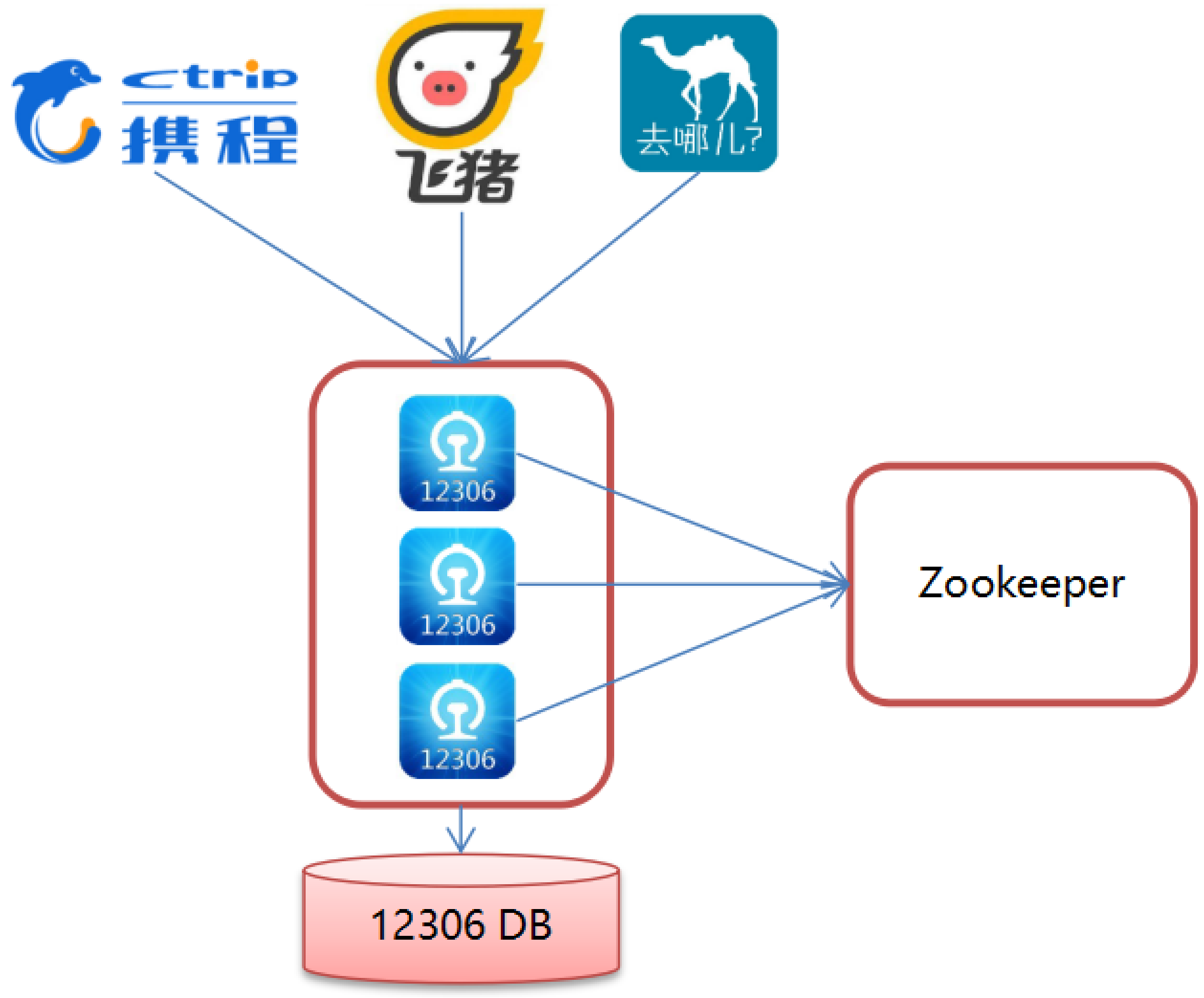
```
package com.itheima.curator;

import org.apache.curator.RetryPolicy;
import org.apache.curator.framework.CuratorFramework;
import org.apache.curator.framework.CuratorFrameworkFactory;
import org.apache.curator.framework.recipes.locks.InterProcessMutex;
import org.apache.curator.retry.ExponentialBackoffRetry;

import java.util.concurrent.TimeUnit;

public class Ticket12306 implements Runnable{

    private int tickets = 10;//数据库的票数

    private InterProcessMutex lock ;

    //实例代码块初始化实例成员变量
    {
        RetryPolicy retryPolicy = new ExponentialBackoffRetry(3000, 10);
        CuratorFramework client = CuratorFrameworkFactory.builder()
                .connectString("43.142.48.199:2181")
                .sessionTimeoutMs(60 * 1000)
                .connectionTimeoutMs(15 * 1000)
                .retryPolicy(retryPolicy)
                .build();

        //开启连接
        client.start();

        //在/lock节点下创建临时顺序节点
        lock = new InterProcessMutex(client,"/lock");
    }


    @Override
    public void run() {

        while(true){
            //获取锁
            try {
                //判断自己是不是/lock节点下顺序数最小的节点；如果是则说明获取锁；进行后续操作；否则等待三秒，再判断是否是最小顺序
                lock.acquire(3, TimeUnit.SECONDS);
                if(tickets > 0){
                    System.out.println(Thread.currentThread()+":"+tickets);
                    //执行速度过快会出现问题
                    Thread.sleep(100);
                    tickets--;
                }
            } catch (Exception e) {
                e.printStackTrace();
            }finally {

                try {
                     //删除节点 释放锁
                    lock.release();
                } catch (Exception e) {
                    e.printStackTrace();
                }
            }
        }
    }
}
```

- 多个客户端进行购票

```
public class LockTest {


    public static void main(String[] args) {
        Ticket12306 ticket12306 = new Ticket12306();

        //创建客户端
        Thread t1 = new Thread(ticket12306,"携程");
        Thread t2 = new Thread(ticket12306,"飞猪");

        t1.start();
        t2.start();
    }

}
```

```
Thread[携程,5,main]:10
java.lang.IllegalMonitorStateException: You do not own the lock: /lock
    at org.apache.curator.framework.recipes.locks.InterProcessMutex.release(InterProcessMutex.java:140)
    at com.itheima.curator.Ticket12306.run(Ticket12306.java:51)
    at java.base/java.lang.Thread.run(Thread.java:833)
Thread[飞猪,5,main]:9
```

```
java.lang.IllegalMonitorStateException: You do not own the lock: /lock
    at org.apache.curator.framework.recipes.locks.InterProcessMutex.release(InterProcessMutex.java:140)
    at com.itheima.curator.Ticket12306.run(Ticket12306.java:51)
    at java.base/java.lang.Thread.run(Thread.java:833)
Thread[携程,5,main]:8
java.lang.IllegalMonitorStateException: You do not own the lock: /lock
    at org.apache.curator.framework.recipes.locks.InterProcessMutex.release(InterProcessMutex.java:140)
    at com.itheima.curator.Ticket12306.run(Ticket12306.java:51)
    at java.base/java.lang.Thread.run(Thread.java:833)
Thread[飞猪,5,main]:7
java.lang.IllegalMonitorStateException: You do not own the lock: /lock
    at org.apache.curator.framework.recipes.locks.InterProcessMutex.release(InterProcessMutex.java:140)
    at com.itheima.curator.Ticket12306.run(Ticket12306.java:51)
    at java.base/java.lang.Thread.run(Thread.java:833)
Thread[携程,5,main]:6
java.lang.IllegalMonitorStateException: You do not own the lock: /lock
    at org.apache.curator.framework.recipes.locks.InterProcessMutex.release(InterProcessMutex.java:140)
    at com.itheima.curator.Ticket12306.run(Ticket12306.java:51)
    at java.base/java.lang.Thread.run(Thread.java:833)
Thread[飞猪,5,main]:5
java.lang.IllegalMonitorStateException: You do not own the lock: /lock
    at org.apache.curator.framework.recipes.locks.InterProcessMutex.release(InterProcessMutex.java:140)
    at com.itheima.curator.Ticket12306.run(Ticket12306.java:51)
    at java.base/java.lang.Thread.run(Thread.java:833)
Thread[携程,5,main]:4
java.lang.IllegalMonitorStateException: You do not own the lock: /lock
    at org.apache.curator.framework.recipes.locks.InterProcessMutex.release(InterProcessMutex.java:140)
    at com.itheima.curator.Ticket12306.run(Ticket12306.java:51)
    at java.base/java.lang.Thread.run(Thread.java:833)
Thread[飞猪,5,main]:3
java.lang.IllegalMonitorStateException: You do not own the lock: /lock
    at org.apache.curator.framework.recipes.locks.InterProcessMutex.release(InterProcessMutex.java:140)
    at com.itheima.curator.Ticket12306.run(Ticket12306.java:51)
    at java.base/java.lang.Thread.run(Thread.java:833)
Thread[携程,5,main]:2
java.lang.IllegalMonitorStateException: You do not own the lock: /lock
    at org.apache.curator.framework.recipes.locks.InterProcessMutex.release(InterProcessMutex.java:140)
    at com.itheima.curator.Ticket12306.run(Ticket12306.java:51)
    at java.base/java.lang.Thread.run(Thread.java:833)
Thread[飞猪,5,main]:1
```



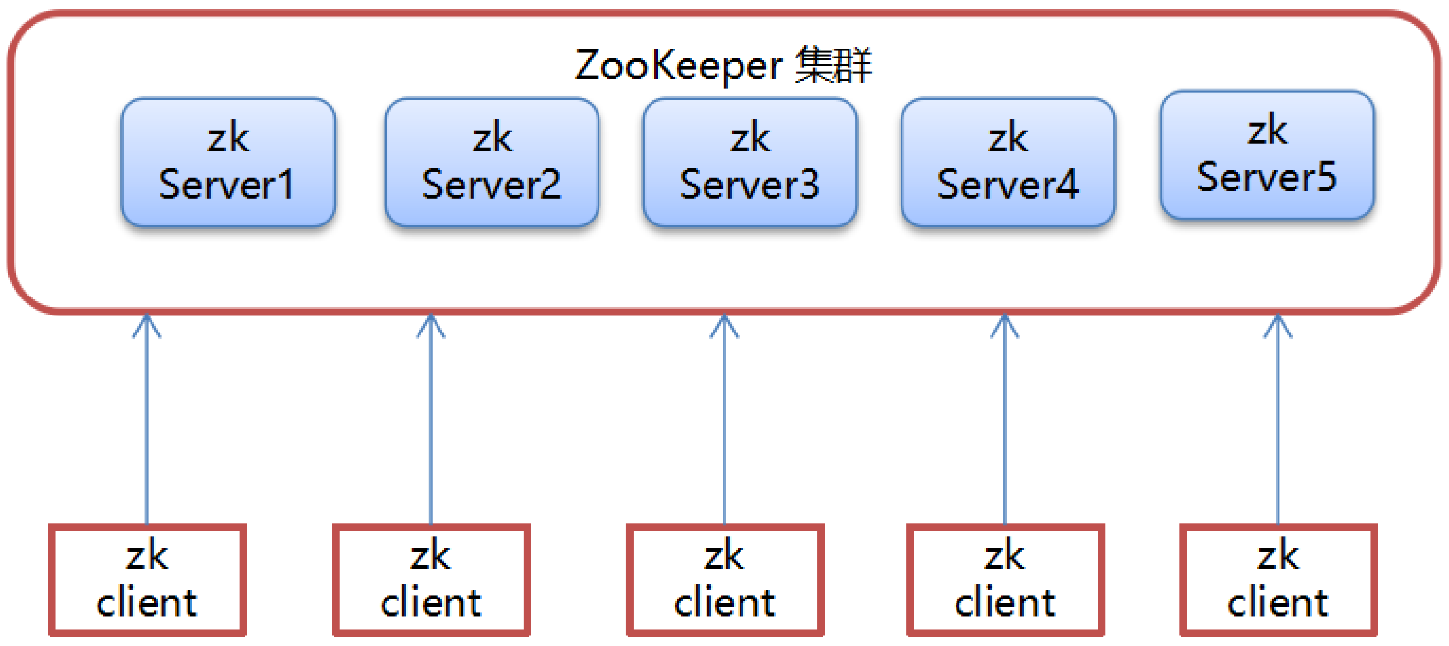
ZooKeeper 集群搭建

ZooKeeper 集群介绍

- Leader选举：
  - Serverid：服务器ID
    比如有三台服务器，编号分别是1,2,3
    编号越大在选择算法中的权重越大

  - Zxid：数据ID
    服务器中存放的最大数据ID.值越大说明数据 越新，在选举算法中数据**越新权重越大**
  - 在Leader选举的过程中，如果某台ZooKeeper 获得了超过半数的选票，
    则此ZooKeeper就可以成为Leader了

```
1--------------》一票
12--------------》两票
123-------------》三票过半 3>(2/5)
已选出
```



ZooKeeper 集群搭建

搭建Zookeeper集群

1.1 搭建要求

真实的集群是需要部署在不同的服务器上的，但是在我们测试时同时启动很多个虚拟机内存会吃不消，所以我们通常会搭建**伪集群**，也就是把所有的服务都搭建在一台虚拟机上，用端口进行区分。

我们这里要求搭建一个三个节点的Zookeeper集群（伪集群）

1.2 准备工作

重新部署一台虚拟机作为我们搭建集群的测试服务器。

（1）安装JDK 【此步骤省略】。

（2）Zookeeper压缩包上传到服务器

（3）将Zookeeper解压 ，建立/usr/local/zookeeper-cluster目录，将解压后的Zookeeper复制到以下三个目录

/usr/local/zookeeper-cluster/zookeeper-1

/usr/local/zookeeper-cluster/zookeeper-2

/usr/local/zookeeper-cluster/zookeeper-3

```
[root@localhost ~]# mkdir /usr/local/zookeeper-cluster
[root@localhost ~]# cp -r  apache-zookeeper-3.5.6-bin /usr/local/zookeeper-cluster/zookeeper-1
[root@localhost ~]# cp -r  apache-zookeeper-3.5.6-bin /usr/local/zookeeper-cluster/zookeeper-2
[root@localhost ~]# cp -r  apache-zookeeper-3.5.6-bin /usr/local/zookeeper-cluster/zookeeper-3
```

（4）创建data目录 ，并且将 conf下zoo_sample.cfg 文件改名为 zoo.cfg

```
mkdir /usr/local/zookeeper-cluster/zookeeper-1/data
mkdir /usr/local/zookeeper-cluster/zookeeper-2/data
mkdir /usr/local/zookeeper-cluster/zookeeper-3/data

mv  /usr/local/zookeeper-cluster/zookeeper-1/conf/zoo_sample.cfg  /usr/local/zookeeper-cluster/zookeeper-1/conf/zoo.cfg
mv  /usr/local/zookeeper-cluster/zookeeper-2/conf/zoo_sample.cfg  /usr/local/zookeeper-cluster/zookeeper-2/conf/zoo.cfg
mv  /usr/local/zookeeper-cluster/zookeeper-3/conf/zoo_sample.cfg  /usr/local/zookeeper-cluster/zookeeper-3/conf/zoo.cfg
```

（5） 配置每一个Zookeeper 的dataDir 和 clientPort 分别为2181 2182 2183

修改/usr/local/zookeeper-cluster/zookeeper-1/conf/zoo.cfg

```
vim /usr/local/zookeeper-cluster/zookeeper-1/conf/zoo.cfg

clientPort=2181
dataDir=/usr/local/zookeeper-cluster/zookeeper-1/data
```

修改/usr/local/zookeeper-cluster/zookeeper-2/conf/zoo.cfg

```
vim /usr/local/zookeeper-cluster/zookeeper-2/conf/zoo.cfg

clientPort=2182
dataDir=/usr/local/zookeeper-cluster/zookeeper-2/data
```

修改/usr/local/zookeeper-cluster/zookeeper-3/conf/zoo.cfg

```
vim /usr/local/zookeeper-cluster/zookeeper-3/conf/zoo.cfg

clientPort=2183
dataDir=/usr/local/zookeeper-cluster/zookeeper-3/data
```

1.3 配置集群

（1）在每个zookeeper的 data 目录下创建一个 myid 文件，内容分别是1、2、3 。这个文件就是记录每个服务器的ID

```
echo 1 >/usr/local/zookeeper-cluster/zookeeper-1/data/myid
echo 2 >/usr/local/zookeeper-cluster/zookeeper-2/data/myid
echo 3 >/usr/local/zookeeper-cluster/zookeeper-3/data/myid
```

（2）在每一个zookeeper 的 zoo.cfg配置客户端访问端口（clientPort）和集群服务器IP列表。

集群服务器IP列表如下：【由此表可知：每个zookeeper的id和端口】

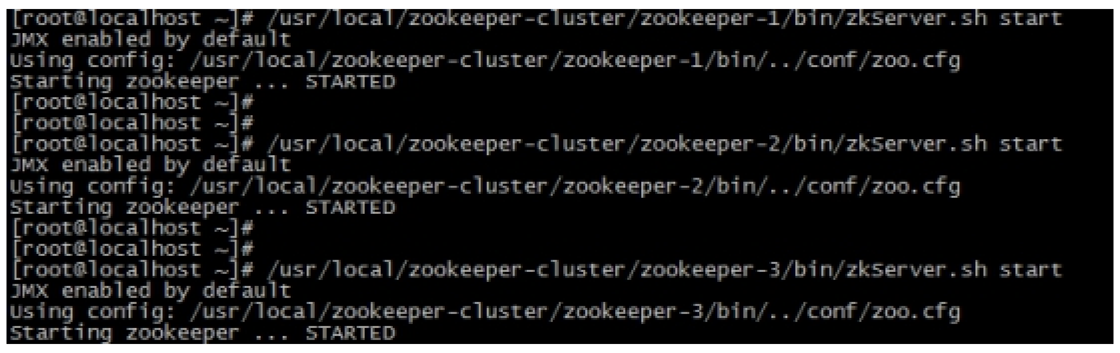
```
vim /usr/local/zookeeper-cluster/zookeeper-1/conf/zoo.cfg
vim /usr/local/zookeeper-cluster/zookeeper-2/conf/zoo.cfg
vim /usr/local/zookeeper-cluster/zookeeper-3/conf/zoo.cfg

server.1=192.168.149.135:2881:3881
server.2=192.168.149.135:2882:3882
server.3=192.168.149.135:2883:3883
```

解释：server.服务器ID=服务器IP地址：服务器之间通信端口：服务器之间投票选举端口

1.4 启动集群

启动集群就是分别启动每个实例。

```
/usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh start
/usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh start
/usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh start
```

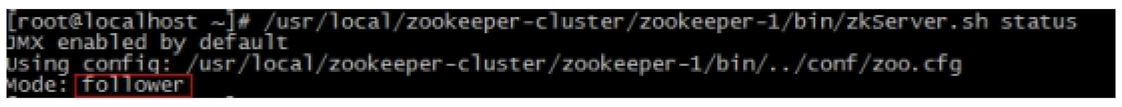


```
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh start
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-1/bin/../conf/zoo.cfg
Starting zookeeper ... STARTED
[root@localhost ~]#
[root@localhost ~]#
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh start
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-2/bin/../conf/zoo.cfg
Starting zookeeper ... STARTED
[root@localhost ~]#
[root@localhost ~]#
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh start
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-3/bin/../conf/zoo.cfg
Starting zookeeper ... STARTED
```

启动后我们查询一下每个实例的运行状态

```
/usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh status
/usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh status
/usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh status
```

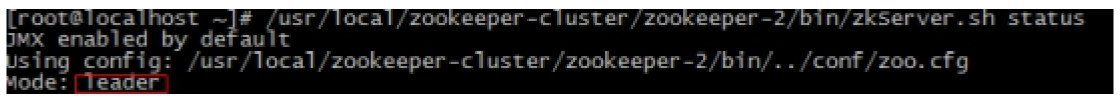
先查询第一个服务



```
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-1/bin/../conf/zoo.cfg
Mode: follower
```

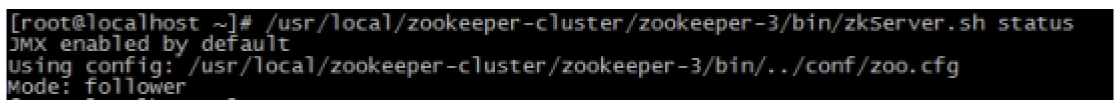
Mode为follower表示是**跟随者**（从）

再查询第二个服务Mod 为leader表示是**领导者**（主）



```
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-2/bin/../conf/zoo.cfg
Mode: leader
```

查询第三个为跟随者（从）



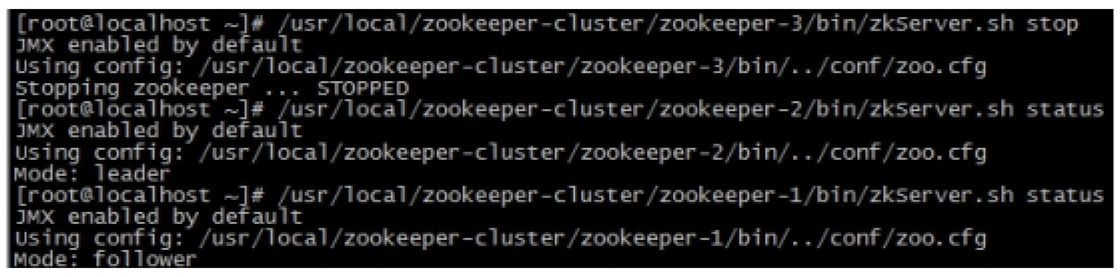
```
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-3/bin/../conf/zoo.cfg
Mode: follower
```

1.5 模拟集群异常

（1）首先我们先测试如果是从服务器挂掉，会怎么样

把3号服务器停掉，观察1号和2号，发现状态并没有变化

```
/usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh stop

/usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh status
/usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh status
```

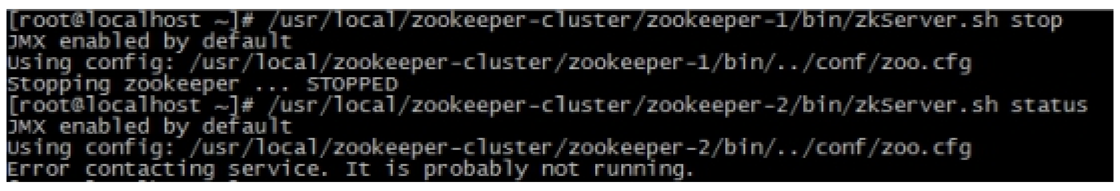


```
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh stop
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-3/bin/../conf/zoo.cfg
Stopping zookeeper ... STOPPED
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-2/bin/../conf/zoo.cfg
Mode: leader
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-1/bin/../conf/zoo.cfg
Mode: follower
```

由此得出结论，3个节点的集群，从服务器挂掉，集群正常

（2）我们再把1号服务器（从服务器）也停掉，查看2号（主服务器）的状态，发现已经停止运行了。

```
/usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh stop

/usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh status
```

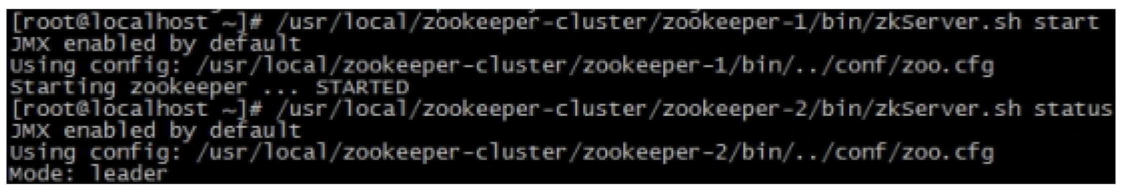


```
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh stop
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-1/bin/../conf/zoo.cfg
Stopping zookeeper ... STOPPED
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-2/bin/../conf/zoo.cfg
Error contacting service. It is probably not running.
```

由此得出结论，3个节点的集群，2个从服务器都挂掉，主服务器也无法运行。因为可运行的机器没有超过集群总数量的半数。

（3）我们再次把1号服务器启动起来，发现2号服务器又开始正常工作了。而且依然是领导者。

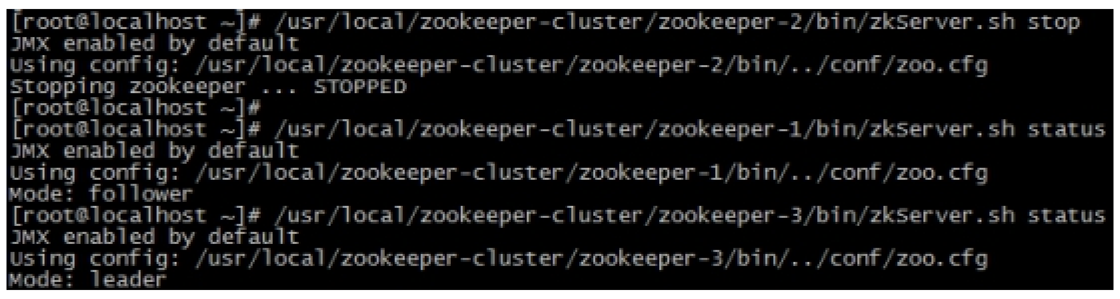
```
/usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh start

/usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh status
```



```
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh start
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-1/bin/../conf/zoo.cfg
Starting zookeeper ... STARTED
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-2/bin/../conf/zoo.cfg
Mode: leader
```

（4）我们把3号服务器也启动起来，把2号服务器停掉,停掉后观察1号和3号的状态。

```
/usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh start
/usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh stop

/usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh status
/usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh status
```



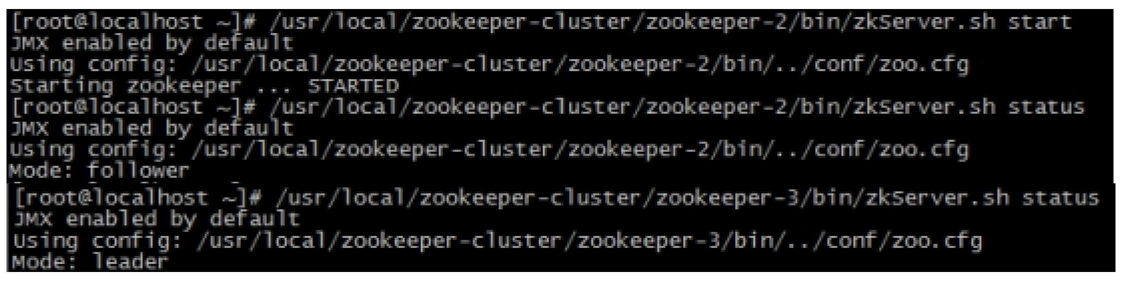
```
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh stop
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-2/bin/../conf/zoo.cfg
Stopping zookeeper ... STOPPED
[root@localhost ~]#
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-1/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-1/bin/../conf/zoo.cfg
Mode: follower
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-3/bin/../conf/zoo.cfg
Mode: leader
```

发现新的leader产生了~

由此我们得出结论，当集群中的主服务器挂了，集群中的其他服务器会自动进行选举状态，然后产生新得leader

（5）我们再次测试，当我们把2号服务器重新启动起来启动后，会发生什么？2号服务器会再次成为新的领导吗？我们看结果

```
/usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh start

/usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh status
/usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh status
```

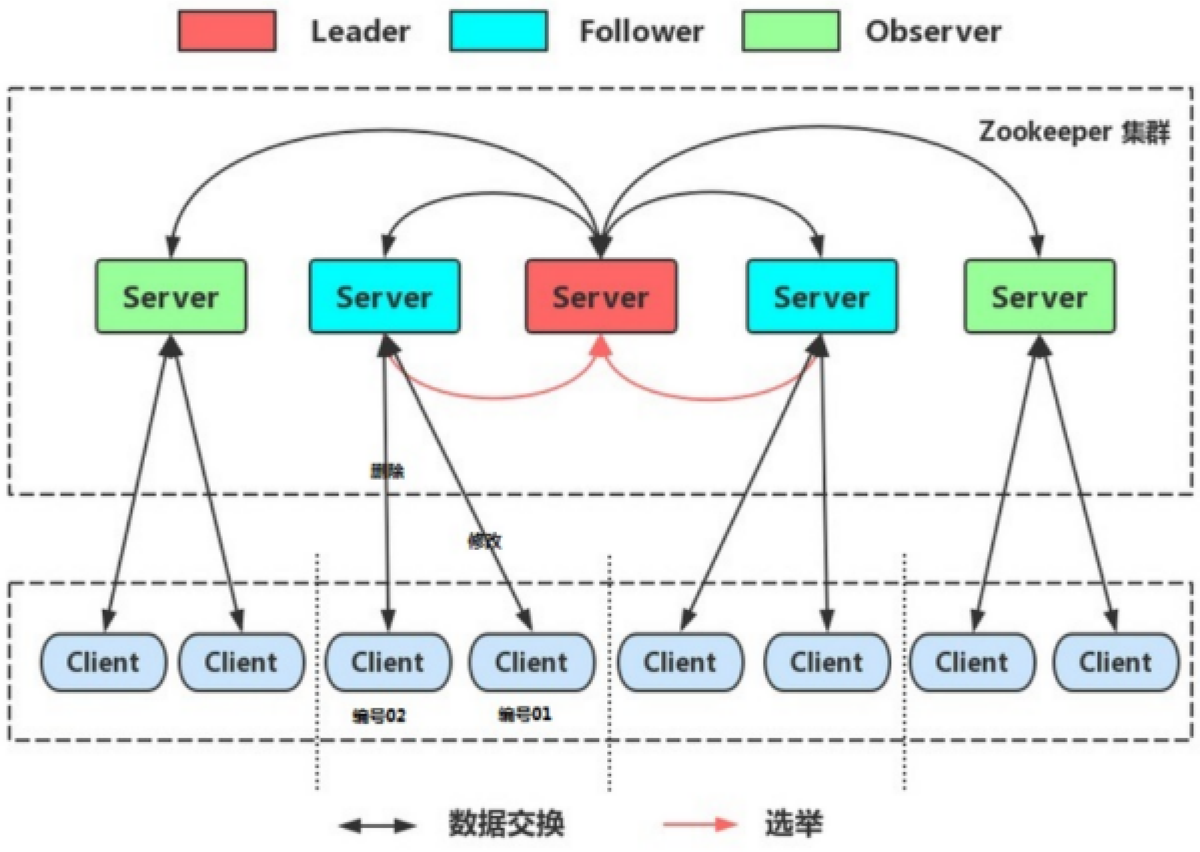


```
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh start
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-2/bin/../conf/zoo.cfg
Starting zookeeper ... STARTED
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-2/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-2/bin/../conf/zoo.cfg
Mode: follower
[root@localhost ~]# /usr/local/zookeeper-cluster/zookeeper-3/bin/zkServer.sh status
JMX enabled by default
Using config: /usr/local/zookeeper-cluster/zookeeper-3/bin/../conf/zoo.cfg
Mode: leader
```

我们会发现，2号服务器启动后依然是跟随者（从服务器），3号服务器依然是领导者（主服务器），没有撼动3号服务器的领导地位。

由此我们得出结论，当领导者产生后，再次有新服务器加入集群，不会影响到现任领导者。

Zookeeper 核心理论



在ZooKeeper集群服中务中有三个角色:

Leader 领导者 :

处理**事务请求**【增删改】

集群内部各服务器的调度者【将节点数据同步到其他节点】

Follower 跟随者 :

1. 处理客户端**非事务请求**，**转发事务请求**给Leader服务器
2. 参与Leader**选举投票**

Observer 观察者:

处理客户端**非事务请求**，**转发事务请求给Leader服务器**