第三次作业 分布式随机信号分析系统 （topic）

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- 题目：

利用MOM消息队列技术实现一个分布式随机信号分析系统，具体要求：

1. 随机信号产生器每隔10毫秒左右就产生一个正态分布的随机数字，并作为一个消息发布
2. 多个随机信号分析模块订阅并接收该随机数字，然后对信号进行分析并实时显示分析结果。
   至少包含如下分析模块：
   - 计算随机信号的均值；
   - 计算过去N个随机信号的方差（N为常量，可设置）
   - 实现基于正态分布的异常点检测 $\mu \pm 3\sigma$
   - 实时绘制过去一段时间内随机信号的折线图（选作）

分析问题：

1. 实现一个消息发布 —— 随机信号产生器 Publisher.java

> 消息要求：
>
> 每隔10毫秒左右就产生一个正态分布的随机数字

要点：

- 每隔10ms 用sleep(10L) 来完成
- 正态分布随机数字 ： 用u（均值），v（标准差）

```
java.util.Random random = new java.util.Random();
double value = v*random.nextGaussian()+u;
```

2. 订阅模块

- 显示随机信号的数值
- 计算随机信号的均值
- 计算随机信号的标准差
- 计算过去N个随机信号的方差(N为常量，可设置)
- 计算过去N个随机信号的均值(N为常量，可设置)
- 实现基于正态分布的异常点检测 u±3v

> 代码设计
>
> - 显示随机信号的数值 AsyncConsumer.java
> - 计算随机信号的均值 标准差 average.java
> - 计算过去N个随机信号的均值 方差 aver_n.java
> - 实现基于正态分布的异常点检测 adnormal.java

3. 代码实现

- 随机信号产生器 Publisher.java

首先连接设置

```java
public class Publisher {

    private static String brokerURL = "tcp://localhost:61616";
    private static ConnectionFactory factory;
    private Connection connection;
    private Session session;
    private MessageProducer producer;
    private Topic topic;

    public Publisher(String topicName) throws JMSException {

        factory = new ActiveMQConnectionFactory(brokerURL);
        connection = factory.createConnection();

        session = connection.createSession( b: false, Session.AUTO_ACKNOWLEDGE);
        topic = session.createTopic(topicName);
        producer = session.createProducer(topic);

        connection.start();
    }

    public void close() throws JMSException {
        if (connection != null) {
            connection.close();
        }
```

之后重点生成随机数

```java
public static void main(String[] args) throws JMSException,
InterruptedException {
        Publisher publisher = new Publisher("MYTOPIC");
        int times  = 1000;
        int i =1;
        while(times !=0){
            sleep(10L);
            publisher.sendMessage(i);
            i++;
            times--;
        }
        publisher.close();


    }

    public void sendMessage(int i) throws JMSException {
        double u = 100.0, v = 2.3;
        java.util.Random random = new java.util.Random();
        double value = v*random.nextGaussian()+u;
        String s = Double.toString(value);
        Message message = session.createTextMessage(s);
        producer.send(message);
        System.out.println("Sent a message" +" number: "+
Integer.toString(i));
    }
```

- 显示随机信号的数值 AsyncConsumer.java

连接设置

```java
public static void main(String[] args) throws JMSException {
    String brokerURL = "tcp://localhost:61616";
    ConnectionFactory factory = null;
    Connection connection = null;
    Session session = null;
    Topic topic = null;
    MessageConsumer messageConsumer = null;
    MyListener listener = null;


    try {
        factory = new ActiveMQConnectionFactory(brokerURL);
        connection = factory.createConnection();

        session = connection.createSession( b: false, Session.AUTO_ACKNOWLEDGE);
        topic = session.createTopic( s: "MYTOPIC");

        messageConsumer = session.createConsumer(topic);

        listener = new MyListener();

        messageConsumer.setMessageListener(listener);

        connection.start();

        System.out.println("Press any key to exit.");
        System.in.read();   // Pause
```

接收队列中的值

```java
public class MyListener implements MessageListener {

    public void onMessage(Message message) {
        try {
            System.out.println("Received a message: "+
((TextMessage)message).getText());
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
```

- 计算随机信号的均值 标准差 average.java

连接设置：省略同上

均值，标准差求（所有值）

```java
double sum = 0;
    double aver = 0.0;
    double var = 0.0;
    ArrayList<Double> lists = new ArrayList<Double>();
    @Override
    public void onMessage(Message message) {
        try {
            String s = ((TextMessage)message).getText();
            double value = Double.parseDouble(s);
            lists.add(value);
            sum = 0.0;
            var = 0.0;
```

```
            aver = 0.0;
            for (double list : lists) {
                sum += list;
            }
            aver = sum/lists.size();
            double sum_error = 0.0;
            for (double list : lists) {
                sum_error += (aver - list)  * (aver - list);
            }
            var = Math.sqrt(sum_error/lists.size());
            System.out.println("  当前"+lists.size()+"个数字均值为" + aver + "
标准差为：" + var);


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

- 计算过去N个随机信号的均值 方差 aver_n.java

连接设置：省略同上

过去N个随机信号的均值 方差

```
String s = ((TextMessage)message).getText();
            double value = Double.parseDouble(s);
            lists.add(value);
            sum = 0.0;
            aver = 0.0;
            var = 0.0;
            if(lists.size()>=n){
                for (int i = lists.size()-1; i >=lists.size()-n ; i--) {
                    sum += lists.get(i);
                }
                aver = sum/n;
                double sum_error = 0.0;
                for (int i = lists.size()-1; i >=lists.size()-n ; i--) {
                    sum_error += (aver - lists.get(i))  * (aver -
lists.get(i));
                }
                var = sum_error/lists.size();
                System.out.println("  过去"+n+"个数字均值为" + aver + "  过
去"+n+"个数字方差为" + var);
            }
```

- 实现基于正态分布的异常点检测 adnormal.java

连接设置：省略同上

异常点检测

```
 String s = ((TextMessage)message).getText();
            double value = Double.parseDouble(s);
            lists.add(value);
            sum = 0.0;
```

```
            var = 0.0;
            aver = 0.0;
            for (double list : lists) {
                sum += list;
            }
            aver = sum/lists.size();
            double sum_error = 0.0;
            for (double list : lists) {
                sum_error += (aver - list)  * (aver - list);
            }
            var = Math.sqrt(sum_error/lists.size());
            System.out.print("目前异常值: ");
            for (double list : lists) {
                if(list>(aver+3*var) || list <(aver-3*var)){
                    System.out.print(list + " ");
                }
            }
            System.out.println();
```

程序结果

- 首先设置activemq

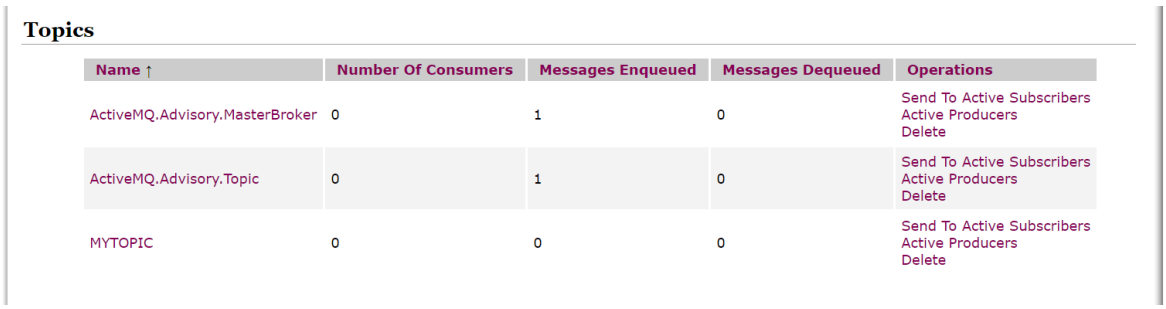
1. 下载解压
2. 进入bin目录，在cmd运行activemq start

```
D:\ActiveMQ\apache-activemq-5.16.2\bin>activemq start
Java Runtime: Oracle Corporation 1.8.0_271 D:\JDK\jdk8\jre
  Heap sizes: current=1005056k  free=989327k  max=1005056k
    JVM args: -Dcom.sun.management.jmxremote -Xms1G -Xmx1G -Djava.util.logging.config.file=logging.properties -Djava.se
urity.auth.login.config=D:\ActiveMQ\apache-activemq-5.16.2\bin\..\conf\login.config -Dactivemq.classpath=D:\ActiveMQ\ap
che-activemq-5.16.2\bin\..\conf;D:\ActiveMQ\apache-activemq-5.16.2\bin\../conf;D:\ActiveMQ\apache-activemq-5.16.2\bin\.
/conf; -Dactivemq.home=D:\ActiveMQ\apache-activemq-5.16.2\bin\.. -Dactivemq.base=D:\ActiveMQ\apache-activemq-5.16.2\bin
.. -Dactivemq.conf=D:\ActiveMQ\apache-activemq-5.16.2\bin\..\conf -Dactivemq.data=D:\ActiveMQ\apache-activemq-5.16.2\bi
```

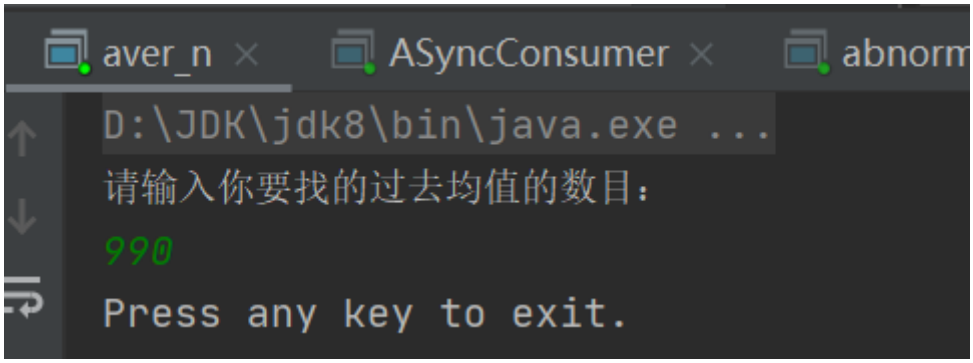
3. 进入网址：http://127.0.0.1:8161/

默认用户 密码 admin admin

点击topic页面



- 运行 显示随机信号的数值 AsyncConsumer.java
- 运行 计算随机信号的均值 标准差 average.java
- 运行· 计算过去N个随机信号的均值 方差 aver_n.java　（令N = 990）



- 运行 实现基于正态分布的异常点检测 adnormal.java
- 运行 随机信号产生器 Publisher.java

显示随机信号的数值 AsyncConsumer.java

```
Received a message: 98.86125235641926
Received a message: 100.35502920313691
Received a message: 99.43116439053439
Received a message: 98.03274856533766
Received a message: 101.60503920440826
Received a message: 99.40858250654613
Received a message: 102.23078031498032
Received a message: 98.47770572239705
Received a message: 98.50562336380979
Received a message: 96.5935661411044
Received a message: 97.92797648295267
Received a message: 102.28466743681288
Received a message: 98.37997857254919
Received a message: 102.77155860244751
Received a message: 102.25738110850226
Received a message: 100.32305443356172
Received a message: 99.14696303438082
Received a message: 101.71551648213318
Received a message: 102.28636611722322
Received a message: 100.25002293825148
```

随机信号的均值 标准差 average.java

```
当前983个数字均值为99.96816565257281 标准差为：2.3626947998805767
当前984个数字均值为99.96619876528904 标准差为：2.3622989861017403
当前985个数字均值为99.96786256268916 标准差为：2.361676309722936
当前986个数字均值为99.96729534153688 标准差为：2.360545529475729
当前987个数字均值为99.96958863938231 标准差为：2.3604480962627448
当前988个数字均值为99.9680786364299 标准差为：2.3597301317695676
当前989个数字均值为99.96659991522402 标准差为：2.3589947886003713
当前990个数字均值为99.96319281040168 标准差为：2.3602364324013565
当前991个数字均值为99.96113911077762 标准差为：2.359930129129292
当前992个数字均值为99.96348137723533 标准差为：2.3598925541087206
当前993个数字均值为99.9618867117724 标准差为：2.3592386759051553
当前994个数字均值为99.96471334345314 标准差为：2.3597333414732113
当前995个数字均值为99.96701753216173 标准差为：2.359665770759358
当前996个数字均值为99.96737499893021 标准差为：2.358507856502799
当前997个数字均值为99.96655211832385 标准差为：2.3574678016776818
当前998个数字均值为99.96830458762625 标准差为：2.3569360574985803
当前999个数字均值为99.97062496953777 标准差为：2.3568963224376995
当前1000个数字均值为99.97090436750649 标准差为：2.355734131774492
```

过去N个随机信号的均值 方差 aver_n.java

```
请输入你要找的过去均值的数目：
990
Press any key to exit.
  过去990个数字均值为99.96319281040175  过去990个数字方差为5.5707160168346865
  过去990个数字均值为99.96448930790942  过去990个数字方差为5.5581586317589595
  过去990个数字均值为99.96399166812294  过去990个数字方差为5.55000615730973
  过去990个数字均值为99.96021887154427  过去990个数字方差为5.542269963792123
  过去990个数字均值为99.960365051971  过去990个数字方差为5.537491766435627
  过去990个数字均值为99.96324170486072  过去990个数字方差为5.5369160282696415
  过去990个数字均值为99.95925969321344  过去990个数字方差为5.512889532958425
  过去990个数字均值为99.96063368115392  过去990个数字方差为5.503285838680141
  过去990个数字均值为99.96486866797602  过去990个数字方差为5.494884963664327
  过去990个数字均值为99.9679296767151  过去990个数字方差为5.4942669941464235
  过去990个数字均值为99.96516855076375  过去990个数字方差为5.4797508648537745
```

实现基于正态分布的异常点检测 adnormal.java

```
目前异常值：107.81517873778148 107.94619453298453
目前异常值：107.81517873778148 107.94619453298453
目前异常值：107.81517873778148 107.94619453298453
目前异常值：107.81517873778148 107.94619453298453
目前异常值：107.81517873778148 107.94619453298453 107.48424413753114
目前异常值：107.81517873778148 107.94619453298453 107.48424413753114
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目前异常值：107.81517873778148 107.94619453298453 107.48424413753114
目前异常值：107.81517873778148 107.94619453298453 107.48424413753114
```

随机信号产生器 Publisher.java	activemq （topic）
Sent a message number: 983 Sent a message number: 984 Sent a message number: 985 Sent a message number: 986 Sent a message number: 987 Sent a message number: 988 Sent a message number: 989 Sent a message number: 990 Sent a message number: 991 Sent a message number: 992 Sent a message number: 993 Sent a message number: 994 Sent a message number: 995 Sent a message number: 996 Sent a message number: 997 Sent a message number: 998 Sent a message number: 999 Sent a message number: 1000	**Topics** Name ↑ | Number Of Consumers | Messages Enqueued | Messages Dequeued | Operations ActiveMQ.Advisory.Connection | 0 | 10 | 0 | Send To Active Subscribers Active Producers Delete ActiveMQ.Advisory.Consumer.Topic.MYTOPIC | 0 | 6 | 0 | Send To Active Subscribers Active Producers Delete ActiveMQ.Advisory.MasterBroker | 0 | 1 | 0 | Send To Active Subscribers Active Producers Delete ActiveMQ.Advisory.Producer.Topic.MYTOPIC | 0 | 4 | 0 | Send To Active Subscribers Active Producers Delete ActiveMQ.Advisory.Topic | 0 | 1 | 0 | Send To Active Subscribers Active Producers Delete MYTOPIC | 4 | 2000 | 5000 | Send To Active Subscribers Active Producers Delete