Architecture of Enterprise Applications 2
Messaging

2021/9/17

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Contents and Objective

- Contents
  - Messaging in Java EE Applications
    - What is a Messaging?
    - What is JMS API?
    - JMS Programming Model
  - Kafka
    - Introduction
    - Quick start

- Objective
  - 能够根据系统需求，分析后端适用于异步通信机制的业务场景，并设计并实现基于消息中间件的实现方案

What Is Messaging?

- Messaging is a method of communication between software components or applications.
  - A messaging system is a peer-to-peer facility:
  - A messaging client can send messages to, and receive messages from, any other client.
  - Each client connects to a messaging agent that provides facilities for creating, sending, receiving, and reading messages.

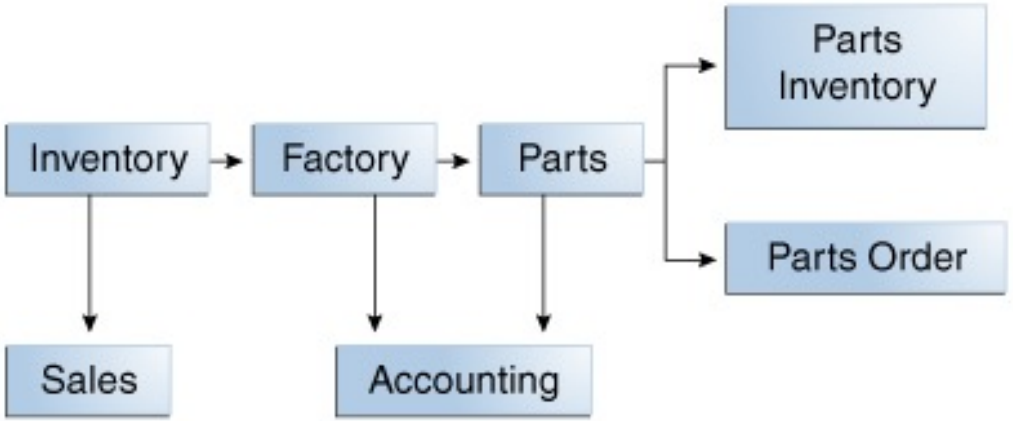
- Messaging enables distributed communication that is loosely coupled.

What Is the JMS API?

- The Java Message Service is a Java API that allows applications to create, send, receive, and read messages.

- JMS enables communication that is not only loosely coupled but also:
  - **Asynchronous**: A receiving client does not have to receive messages at the same time the sending client sends them. The sending client can send them and go on to other tasks; the receiving client can receive them much later.
  - **Reliable**: A messaging provider that implements the JMS API can ensure that a message is delivered once and only once. Lower levels of reliability are available for applications that can afford to miss messages or to receive duplicate messages.

When Can We Use Messaging?



JMS API Work with the Java EE Platform

- The JMS API in the Java EE platform has the following features.
  - Application clients, Enterprise JavaBeans (EJB) components, and web components can send or synchronously receive a JMS message. Application clients can in addition set a message listener that allows JMS messages to be delivered to it asynchronously by being notified when a message is available.
  - Message-driven beans, which are a kind of enterprise bean, enable the asynchronous consumption of messages in the EJB container. An application server typically pools message-driven beans to implement concurrent processing of messages.
  - Message send and receive operations can participate in Java Transaction API (JTA) transactions, which allow JMS operations and database accesses to take place within a single transaction.

Message

- Applications produce or consume messages

- The format of message is elastic, including three parts:
  - A header
  - Properties (optional)
  - A body (optional)

- Includes some pre-defined fields
  - JMSDestination (S)
  - JMSDeliveryMode (S)
  - JMSMessageID (S)
  - JMSTimestamp (S)
  - JMSCorrelationID (C)
  - JMSReplyTo (C)
  - JMSRedelivered (P)
  - JMSType (C)
  - JMSExpiration (S)
  - JMSPriority (S)

- Clients can not extend the fields

Properties

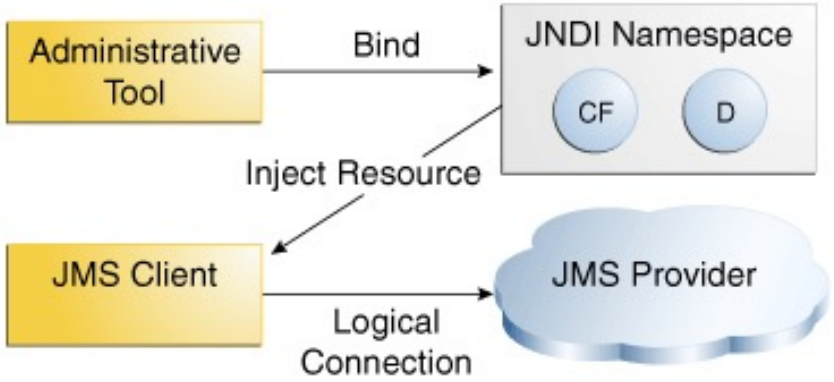
- Includes some pre-defined fields
  - JMSXUserID (S)
  - JMSXAppID (S)
  - JMSXDeliveryCount (S)
  - JMSXGroupID (C)
  - JMSXGroupSeq (C)
  - JMSXProducerTXID (S)
  - JMSXConsumerTXID (S)
  - JMSXRcvTimestamp (S)
  - JMSXState (P)

- Clients can extend the fields
  - Property name: follows the rule of naming selectors
  - Property value: boolean, byte, short, int, long, float, double, String

Body

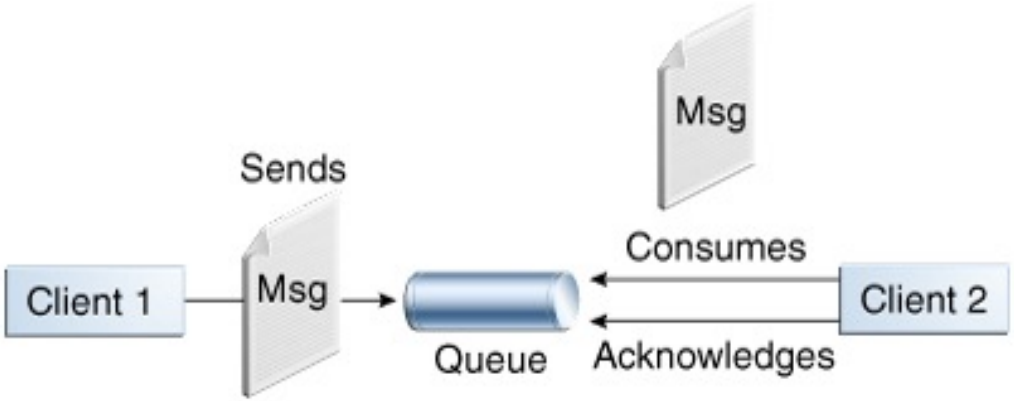
Message Type	Body Contains
TextMessage	A java.lang.String object (for example, the contents of an XML file).
MapMessage	A set of name-value pairs, with names as String objects and values as primitive types in the Java programming language. The entries can be accessed sequentially by enumerator or randomly by name. The order of the entries is undefined.
BytesMessage	A stream of uninterpreted bytes. This message type is for literally encoding a body to match an existing message format.
StreamMessage	A stream of primitive values in the Java programming language, filled and read sequentially.
ObjectMessage	A Serializable object in the Java programming language.
Message	Nothing. Composed of header fields and properties only. This message type is useful when a message body is not required.

JMS API Architecture



Messaging Styles

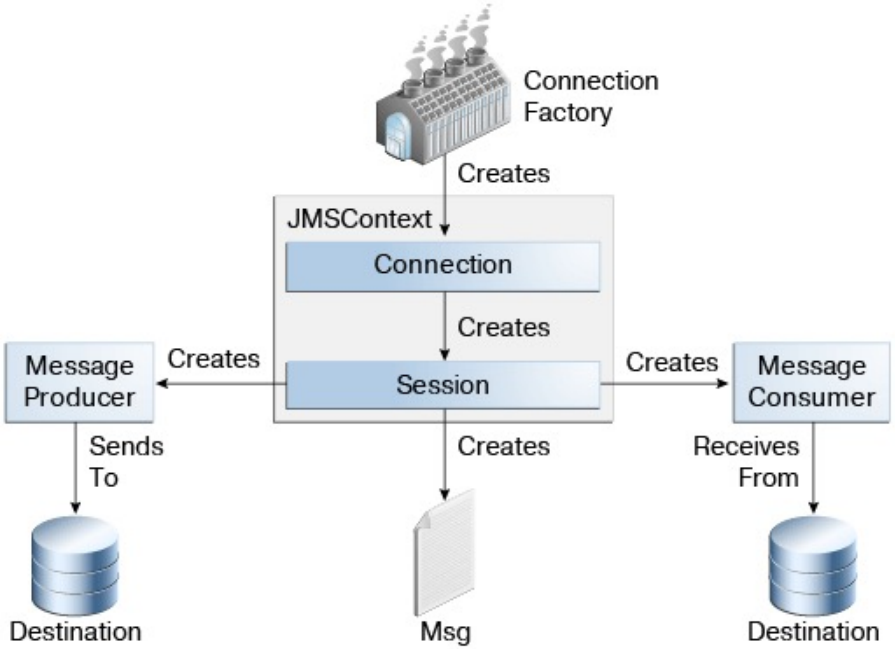
- A **point-to-point** (PTP) product or application is built on the concept of message **queues**, senders, and receivers.
  - Each message has only one consumer.
  - The receiver can fetch the message whether or not it was running when the client sent the message.



Messaging Styles

- In a **publish/subscribe** (pub/sub) product or application, clients address messages to a **topic**, which functions somewhat like a bulletin board. Publishers and subscribers can dynamically publish or subscribe to the topic.
  - Each message can have multiple consumers.
  - A client that subscribes to a topic can consume only messages sent *after* the client has created a subscription, and the consumer must continue to be active in order for it to consume messages.

The JMS API Programming Model



JMS programming model

- Get a reference to `ConnectionFactory`
- A **connection factory** is the object a client uses to create a connection to a provider.

```
import javax.naming.*;
import javax.jms.*;
QueueConnectionFactory queueConnectionFactory;
Context messaging = new InitialContext();
queueConnectionFactory = (QueueConnectionFactory)
    messaging.lookup(“QueueConnectionFactory”);
```

- or

```
@Resource(lookup = "java:comp/DefaultJMSConnectionFactory")
private static ConnectionFactory connectionFactory;
```

JMS programming model

- A **destination** is the object a client uses to specify the target of messages it produces and the source of messages it consumes.
  - In the PTP messaging style, destinations are called queues.
  - In the pub/sub messaging style, destinations are called topics.

```
Queue queue;
queue = (Queue)messaging.lookup(“theQueue");
Topic topic;
topic = (Topic)messaging.lookup(“theTopic");
```

- Or

```
@Resource(lookup = "jms/MyQueue")
private static Queue queue;
@Resource(lookup = "jms/MyTopic")
private static Topic topic;
```

JMS programming model

- Get a Connection and a Session

- A **connection** encapsulates a virtual connection with a JMS provider.
- A **session** is a single-threaded context for producing and consuming messages.
  - You normally create a session (as well as a connection) by creating a JMSContext object

```
JMSContext context = connectionFactory.createContext();
```

JMS programming model

- Create a Producer or a Consumer

```
try (JMSContext context = connectionFactory.createContext();) {
 JMSProducer producer = context.createProducer();
 ...
 context.createProducer().send(dest, message);
```

- Or

```
try (JMSContext context = connectionFactory.createContext();) {
 JMSConsumer consumer = context.createConsumer(dest);
 ...
 Message m = consumer.receive();
 Message m = consumer.receive(1000);
```

JMS programming model

- Create a message

```
TextMessage message = context.createTextMessage();
message.setText(msg_text); // msg_text is a String
context.createProducer().send(message);

Message m = consumer.receive();
if (m instanceof TextMessage) {
 String message = m.getBody(String.class);
 System.out.println("Reading message: " + message);
} else {
 // Handle error or process another message type
}
```

JMS programming model

- JMS Message Listener
- A message listener is an object that acts as an asynchronous event handler for messages.

```
Listener myListener = new Listener();
consumer.setMessageListener(myListener);

Listener:
   void onMessage(Message inMessage)
```

JMS programming model

- Selection of messages
- Producer:

```
String data;
TextMessage message;
message = session.createTextMessage();
message.setText(data);
message.setStringProperty("Selector", "Technology");
```

JMS programming model

- Selection of messages
- Consumer:

```
String selector;
selector = new String(“ (Selector = ‘Technology’) ”);

JMSConsumer consumer = context.createConsumer(dest, selector);
```

JMS programming model

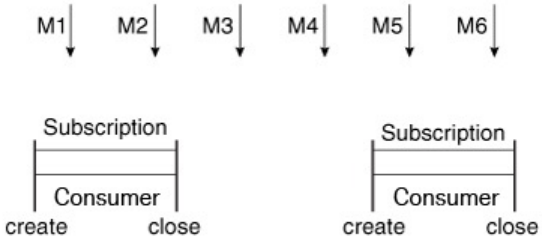
- Durable subscription

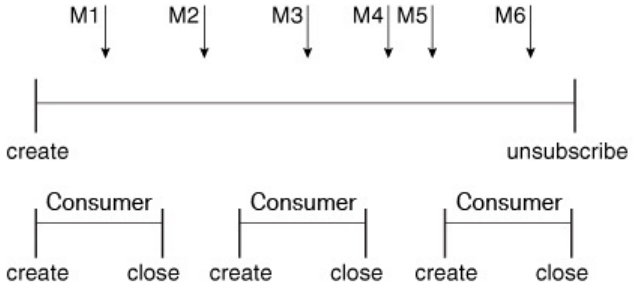
```
String subName = "MySub";
JMSConsumer consumer = context.createDurableConsumer(myTopic, subName);

consumer.close();
context.unsubscribe(subName);

JMSConsumer consumer =
   context.createSharedDurableConsumer(topic, "MakeItLast");
```

JMS programming model





JMS programming model

- JMS Browser
  - allows you to browse the messages in the queue and display the header values for each message.

```
QueueBrowser browser = context.createBrowser(queue);
```

JMS programming model

- JMS Exception Handling
  - The root class for all checked exceptions in the JMS API is `JMSException`

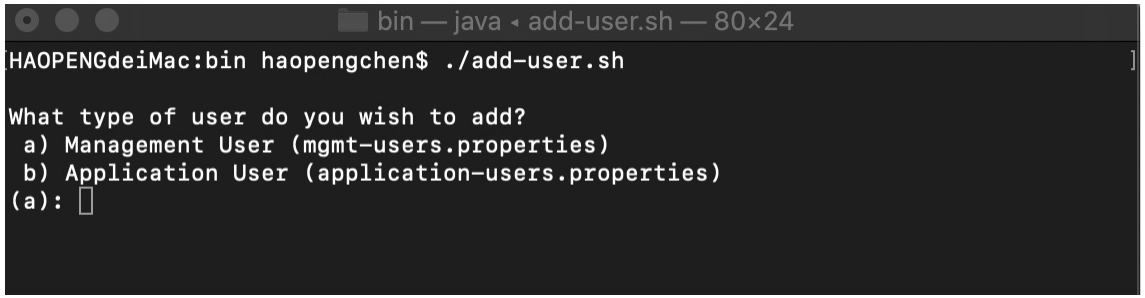
A JMS Sample

- Intellij IDEA 创建消息驱动Bean - 接收JMS消息
  - https://www.cnblogs.com/yangyquin/p/5346104.html

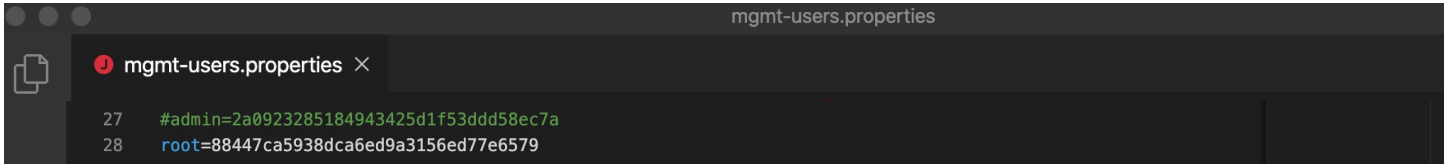
- Wildfly Messaging Configuration
  - https://docs.jboss.org/author/display/WFLY/Messaging+configuration

A JMS Sample

- Add User
  - $WILDFLY_HOME/bin/add-user.sh

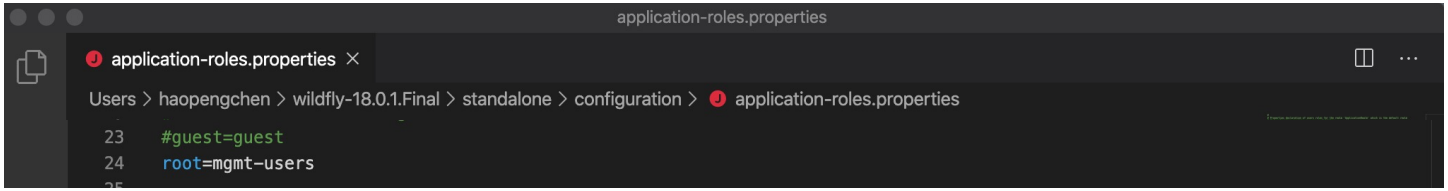


  - Add a `mgmt-user`
  - For example: username: root, password: wildfly2020!
  - In $WILDFLY_HOME/standalone/configuration/mgmt-users.properties



A JMS Sample

- Assign a role to the new user
  - In /standalone/configuration/appications-roles.properties

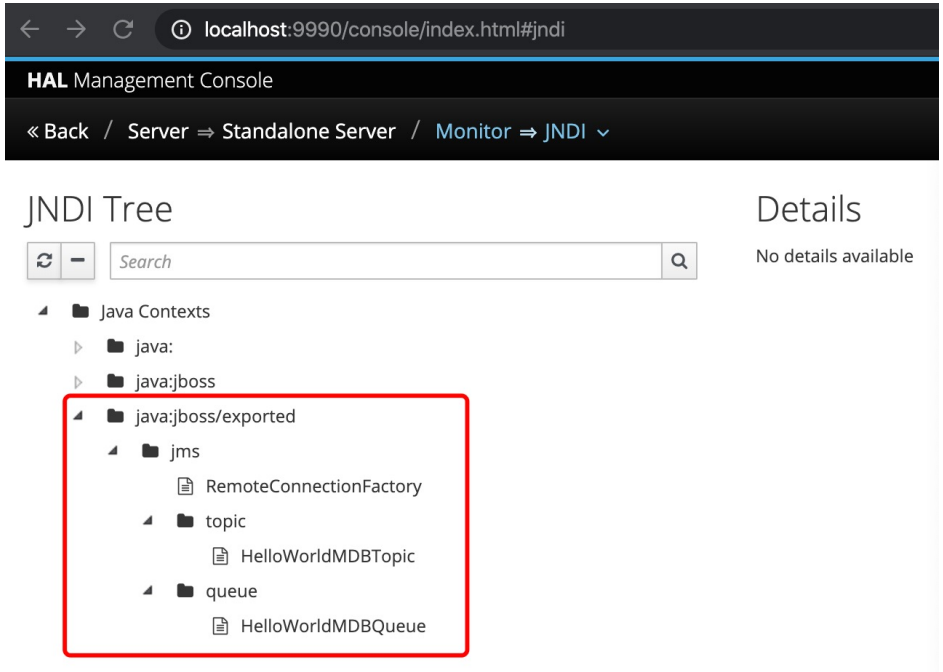


- Add JMS Server & Destination in `standalone.xml`

```
        <extension module="org.wildfly.extension.messaging-activemq"/>
        <!--   messaging server     -->
        <subsystem xmlns="urn:jboss:domain:messaging-activemq:8.0">
            <server name="default">
                <statistics enabled="${wildfly.messaging-activemq.statistics-enabled:${wildfly.statis
                <security-setting name="#">
                    <role name="mgmt-users" send="true" consume="true" create-non-durable-queue="true
                </security-setting>
<!--    Sample Queue & Topic            -->
<jms-queue name="HelloWorldMDBQueue" entries="java:jboss/exported/jms/queue/HelloWorldMDBQueue"/>
<jms-topic name="HelloWorldMDBTopic" entries="java:jboss/exported/jms/topic/HelloWorldMDBTopic"/>
```

A JMS Sample

- Run Wildfly Server, and check the JMS conf on console



A JMS Sample - Queue

JMSProducer.java

```
public class JMSProducer {
    private static final Logger log = Logger.getLogger(JMSProducer.class.getName());
    private static final String DEFAULT_MESSAGE = "这是JMS信息.....";
    private static final String DEFAULT_CONNECTION_FACTORY = "jms/RemoteConnectionFactory";
    private static final String DEFAULT_DESTINATION = "/jms/queue/HelloWorldMDBQueue";
    private static final String DEFAULT_MESSAGE_COUNT = "10";
    private static final String DEFAULT_USERNAME = "root";
    private static final String DEFAULT_PASSWORD = "reins2011!";
    private static final String INITIAL_CONTEXT_FACTORY = "org.wildfly.naming.client.WildFlyInitialContextFactory";
    private static final String PROVIDER_URL = "http-remoting://localhost:8080";
    public static void main(String[] args) throws Exception {
        Context context=null;
        Connection connection=null;
        try {
            final Properties env = new Properties();
            env.put(Context.INITIAL_CONTEXT_FACTORY, INITIAL_CONTEXT_FACTORY);
            // 该KEY的值为初始化Context的工厂类,JNDI驱动的类名
            env.put(Context.PROVIDER_URL, PROVIDER_URL);
            // 该KEY的值为Context服务提供者的URL.命名服务提供者的URL
            env.put(Context.SECURITY_PRINCIPAL, DEFAULT_USERNAME);
            env.put(Context.SECURITY_CREDENTIALS, DEFAULT_PASSWORD);//应用用户的登录名,密码.
            // 获取到InitialContext对象.
            context = new InitialContext(env);
            Destination destination = (Destination) context.lookup(DEFAULT_DESTINATION);
```

A JMS Sample - Queue

JMSProducer.java

```
        // 创建JMS连接、会话、生产者和消费者
        connection = connectionFactory.createConnection(DEFAULT_USERNAME, DEFAULT_PASSWORD);
        Session session = connection.createSession(false, Session.AUTO_ACKNOWLEDGE);
        MessageProducer producer = session.createProducer(destination);
        connection.start();
        int count = Integer.parseInt(DEFAULT_MESSAGE_COUNT);
        // 发送特定数目的消息
        TextMessage message = null;
        for (int i = 0; i < count; i++) {
          message = session.createTextMessage(DEFAULT_MESSAGE);
          producer.send(message);
        }
        // 等待30秒退出
        CountDownLatch latch = new CountDownLatch(1);
        latch.await(30, TimeUnit.SECONDS);
      } catch (Exception e) {  log.severe(e.getMessage()); throw e;
      } finally {
        if (context != null) {  context.close();  }
        if (connection != null) {  connection.close();  }
      }
    }
}
```

A JMS Sample - Queue

JMSConsumer.java

```
public class JMSConsumer {
    private static final Logger log = Logger.getLogger(JMSConsumer.class.getName());
    private static final String DEFAULT_CONNECTION_FACTORY = "jms/RemoteConnectionFactory";
    private static final String DEFAULT_DESTINATION = "/jms/queue/HelloWorldMDBQueue";
    private static final String DEFAULT_USERNAME = "root";
    private static final String DEFAULT_PASSWORD = "reins2011!";
    private static final String INITIAL_CONTEXT_FACTORY = "org.wildfly.naming.client.WildFlyInitialContextFactory";
    private static final String PROVIDER_URL = "http-remoting://localhost:8080";
    private static final int WAIT_COUNT = 5;

    public static void main(String[] args) throws Exception {
        ConnectionFactory connectionFactory = null;
        Connection connection = null;
        Session session = null;
        MessageConsumer consumer = null;
        Destination destination = null;
        TextMessage message = null;
        Context context = null;
        try {
            final Properties env = new Properties();
            env.put(Context.INITIAL_CONTEXT_FACTORY, INITIAL_CONTEXT_FACTORY);
            env.put(Context.PROVIDER_URL, PROVIDER_URL);
            env.put(Context.SECURITY_PRINCIPAL, DEFAULT_USERNAME);
            env.put(Context.SECURITY_CREDENTIALS, DEFAULT_PASSWORD);
            context = new InitialContext(env);
            connectionFactory = (ConnectionFactory) context.lookup(DEFAULT_CONNECTION_FACTORY);
            destination = (Destination) context.lookup(DEFAULT_DESTINATION);
```

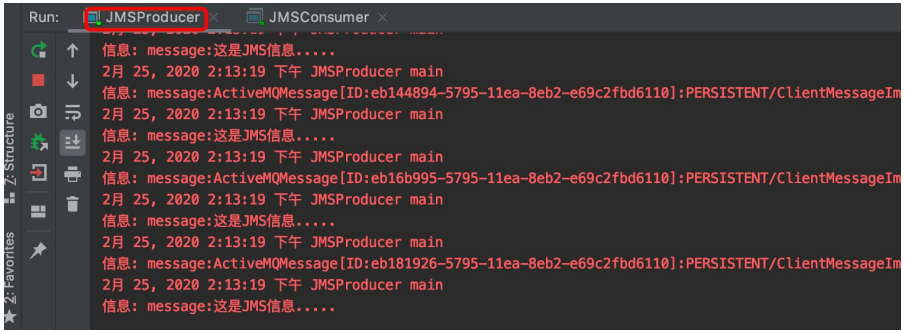
A JMS Sample - Queue

JMSConsumer.java

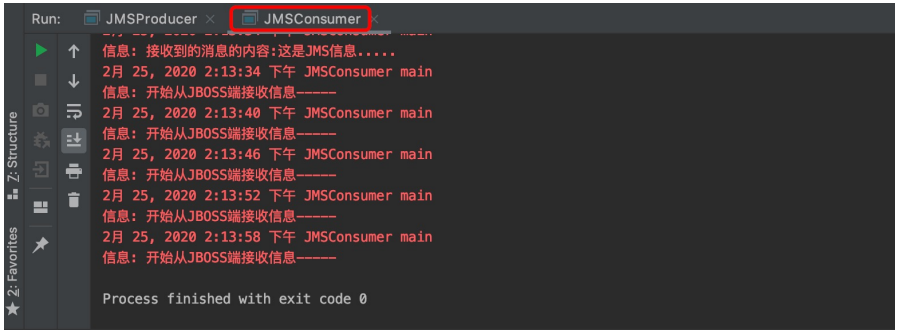
```
        connection = connectionFactory.createConnection(DEFAULT_USERNAME, DEFAULT_PASSWORD);
        session = connection.createSession(false, Session.AUTO_ACKNOWLEDGE);
        consumer = session.createConsumer(destination);
        connection.start();
        // 等待30秒退出
        CountDownLatch latch = new CountDownLatch(1);
        log.info("开始从JBOSS端接收信息-----");
        int i = 0;
        for (; i < WAIT_COUNT; i++) {
          if (message != null) {
            log.info("接收到的消息的内容:" + message.getText());
            i = 0;
          }
          log.info("开始从JBOSS端接收信息-----");
          message = (TextMessage) consumer.receive(5000);
          latch.await(1, TimeUnit.SECONDS);
        }
      } catch (Exception e) {  log.severe(e.getMessage()); throw e;
      } finally {
        if (context != null) {  context.close();  }
        if (connection != null) {  connection.close();  }
      }
    }
}
```

A JMS Sample - Queue

- Run `JMSProducer`



- Run `JMSConsumer`



A JMS Sample - Topic

JMSPub.java

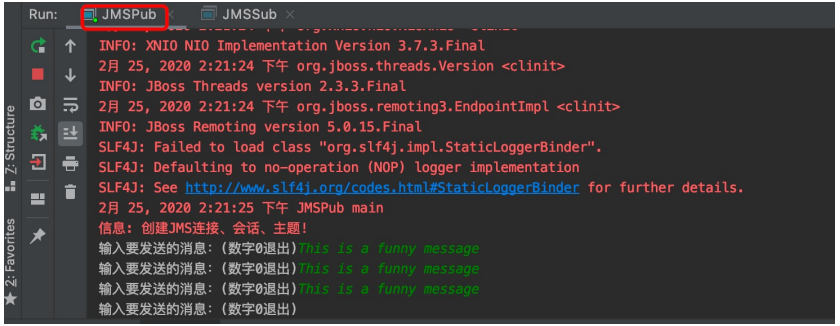
```
System.out.print("输入要发送的消息：(数字0退出)");
line = msgStream.readLine();
if (line != null && line.trim().length() != 0) {
   TextMessage textMessage = session.createTextMessage();
   textMessage.setText(line);
   textMessage.setStringProperty("Selector", "Funny");
   producer.send(textMessage);
   quitNow = line.equalsIgnoreCase("0");
}
```

JMSSub.java

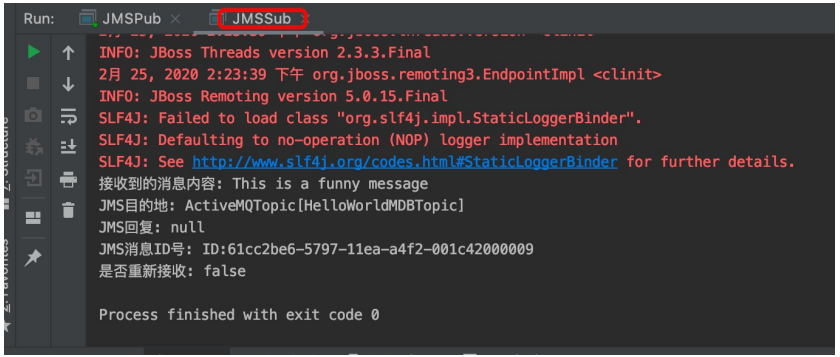
```
String selector;
selector = new String("(Selector = 'Funny')");
consumer = session.createConsumer(topic, selector);
consumer.setMessageListener(new javax.jms.MessageListener() {
   public void onMessage(Message message) {
      try {
         TextMessage tm = (TextMessage) message;
         System.out.println("接收到的消息内容: " + tm.getText().toString());
         System.out.println("JMS目的地: " + tm.getJMSDestination());
         System.out.println("JMS回复: " + tm.getJMSReplyTo());
         System.out.println("JMS消息ID号: " + tm.getJMSMessageID());
         System.out.println("是否重新接收: " + tm.getJMSRedelivered());
      } catch (JMSException e1) {
         e1.printStackTrace();
      }
   }
});
```

A JMS Sample - Topic

- Run `JMSPub`



- Run `JMSSub`



Messaging with JMS

- Spring provides the means to publish messages to any POJO (Plain Old Java Object).

Email.java

```
public class Email {

  private String to;
  private String body;

  public Email() {
  }

  public Email(String to, String body) {
    this.to = to;
    this.body = body;
  }

  public String getTo() {
    return to;
  }

  public void setTo(String to) {
    this.to = to;
  }

  public String getBody() {
    return body;
  }

  public void setBody(String body) {
    this.body = body;
  }

  @Override
  public String toString() {
    return String.format("Email{to=%s, body=%s}", getTo(), getBody());
  }

}
```

- This POJO is quite simple, containing two fields (**to** and **body**), along with the presumed set of getters and setters.

Messaging with JMS

- Message Receiver

Receiver.java

```
package org.reins.demo;

import org.springframework.jms.annotation.JmsListener;
import org.springframework.stereotype.Component;

@Component
public class Receiver {

  @JmsListener(destination = "mailbox")//, containerFactory = "myFactory")
  public void receiveMessage(Email email) {
    System.out.println("Received <" + email + ">");
  }

}
```

Messaging with JMS

- Send and receive JMS messages with Spring

Application.java

```
package org.reins.demo;
@SpringBootApplication
@EnableJms
public class Application {
  @Bean
  public JmsListenerContainerFactory<?> myFactory(@Qualifier("jmsConnectionFactory") ConnectionFactory
                                        connectionFactory, DefaultJmsListenerContainerFactoryConfigurer configurer) {
    DefaultJmsListenerContainerFactory factory = new DefaultJmsListenerContainerFactory();
    // This provides all boot's default to this factory, including the message converter
    configurer.configure(factory, connectionFactory);
    // You could still override some of Boot's default if necessary.
    return factory;
  }

  @Bean // Serialize message content to json using TextMessage
  public MessageConverter jacksonJmsMessageConverter() {
    MappingJackson2MessageConverter converter = new MappingJackson2MessageConverter();
    converter.setTargetType(MessageType.TEXT);
    converter.setTypeIdPropertyName("_type");
    return converter;
  }
```

Messaging with JMS

- Send and receive JMS messages with Spring

Application.java

```
public static void main(String[] args) {
    // Launch the application
    ConfigurableApplicationContext context = SpringApplication.run(Application.class, args);

    JmsTemplate jmsTemplate = context.getBean(JmsTemplate.class);

    // Send a message with a POJO - the template reuse the message converter
    System.out.println("Sending an email message.");
    jmsTemplate.convertAndSend("mailbox", new Email("info@example.com", "Hello"));
  }

}
```

Messaging with JMS

- Send and receive JMS messages with Spring

MsgController.java

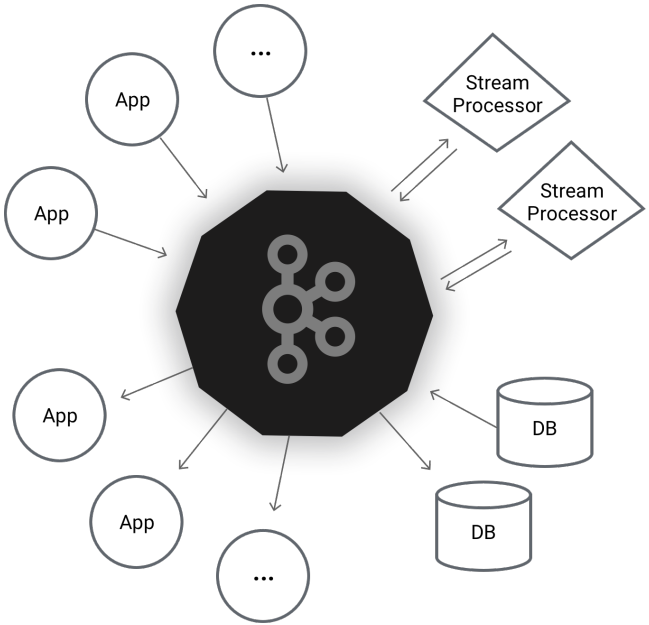
```
@RestController
public class MsgController {
   @Autowired
   WebApplicationContext applicationContext;

   @GetMapping(value = "/msg")
   public void findOne( ) {
      JmsTemplate jmsTemplate = applicationContext.getBean(JmsTemplate.class);

      // Send a message with a POJO - the template reuse the message converter
      System.out.println("Sending an email message.");
      jmsTemplate.convertAndSend("mailbox", new Email("info@example.com", "Hello Msg"));
   };
}
```

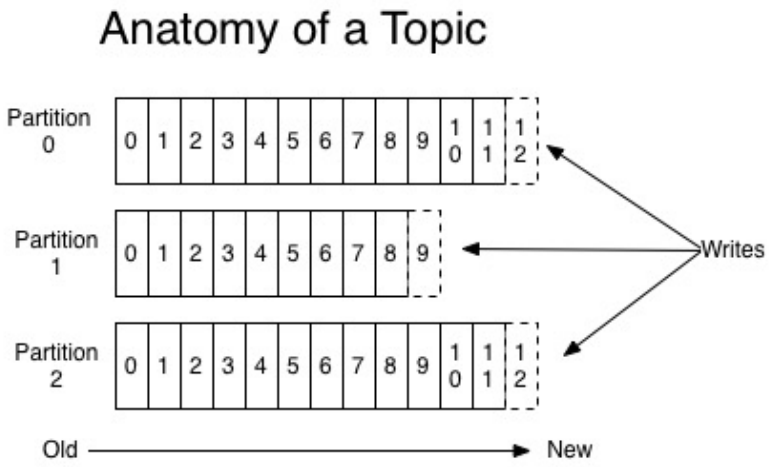
Apache Kafka

- http://kafka.apache.org
- **PUBLISH & SUBSCRIBE**
  - Read and write streams of data like a messaging system.
- **PROCESS**
  - Write scalable stream processing applications that react to events in real-time.
- **STORE**
  - Store streams of data safely in a distributed, replicated, fault-tolerant cluster.

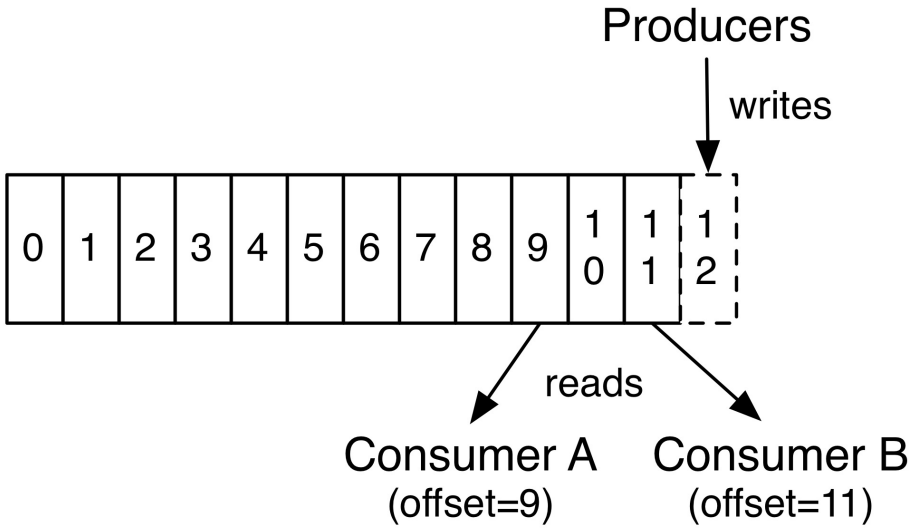


- **Apache Kafka® is *a distributed streaming platform*.**
- Kafka has four core APIs:
  - The Producer API allows an application to publish a stream of records to one or more Kafka topics.
  - The Consumer API allows an application to subscribe to one or more topics and process the stream of records produced to them.
  - The Streams API allows an application to act as a *stream processor*, consuming an input stream from one or more topics and producing an output stream to one or more output topics, effectively transforming the input streams to output streams.
  - The Connector API allows building and running reusable producers or consumers that connect Kafka topics to existing applications or data systems. For example, a connector to a relational database might capture every change to a table.

- Topics and log
  - A topic is a category or feed name to which records are published. Topics in Kafka are always multi-subscriber; that is, a topic can have zero, one, or many consumers that subscribe to the data written to it.
  - For each topic, the Kafka cluster maintains a partitioned log that looks like this:



- The Kafka cluster durably persists all published records—whether or not they have been consumed—using a configurable retention period.



Kafka - Quickstart

- Quickstart
  - https://kafka.apache.org/quickstart

STEP 1: GET KAFKA

Download the latest Kafka release and extract it:

```
$ tar -xzf kafka_2.13-2.8.0.tgz
$ cd kafka_2.13-2.8.0
```

STEP 2: START THE KAFKA ENVIRONMENT

NOTE: Your local environment must have Java 8+ installed.

Run the following commands in order to start all services in the correct order:

```
# Start the ZooKeeper service
# Note: Soon, ZooKeeper will no longer be required by Apache Kafka.
$ bin/zookeeper-server-start.sh config/zookeeper.properties
```

Open another terminal session and run:

```
# Start the Kafka broker service
$ bin/kafka-server-start.sh config/server.properties
```

Once all services have successfully launched, you will have a basic Kafka environment running and ready to use.

Kafka - Quickstart

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STEP 3: CREATE A TOPIC TO STORE YOUR EVENTS

Kafka is a distributed *event streaming platform* that lets you read, write, store, and process *events* (also called *records* or *messages* in the documentation) across many machines.

Example events are payment transactions, geolocation updates from mobile phones, shipping orders, sensor measurements from IoT devices or medical equipment, and much more. These events are organized and stored in *topics*. Very simplified, a topic is similar to a folder in a filesystem, and the events are the files in that folder.

So before you can write your first events, you must create a topic. Open another terminal session and run:

```
$ bin/kafka-topics.sh --create --topic quickstart-events --bootstrap-server localhost:9092
```

All of Kafka's command line tools have additional options: run the `kafka-topics.sh` command without any arguments to display usage information. For example, it can also show you details such as the partition count of the new topic:

```
1 $ bin/kafka-topics.sh --describe --topic quickstart-events --bootstrap-server localhost:9092
2 Topic:quickstart-events  PartitionCount:1    ReplicationFactor:1 Configs:
3     Topic: quickstart-events Partition: 0    Leader: 0   Replicas: 0 Isr: 0
```

STEP 4: WRITE SOME EVENTS INTO THE TOPIC

A Kafka client communicates with the Kafka brokers via the network for writing (or reading) events. Once received, the brokers will store the events in a durable and fault-tolerant manner for as long as you need—even forever.

Run the console producer client to write a few events into your topic. By default, each line you enter will result in a separate event being written to the topic.

```
$ bin/kafka-console-producer.sh --topic quickstart-events --bootstrap-server localhost:9092
This is my first event
This is my second event
```

You can stop the producer client with `Ctrl-C` at any time.

STEP 5: READ THE EVENTS

Open another terminal session and run the console consumer client to read the events you just created:

```
$ bin/kafka-console-consumer.sh --topic quickstart-events --from-beginning
This is my first event                                    --bootstrap-server localhost:9092
This is my second event
```

You can stop the consumer client with `Ctrl-C` at any time.

Feel free to experiment: for example, switch back to your producer terminal (previous step) to write additional events, and see how the events immediately show up in your consumer terminal.

Because events are durably stored in Kafka, they can be read as many times and by as many consumers as you want. You can easily verify this by opening yet another terminal session and re-running the previous command again.

- Access Kafka with Java
  - To use Producer API and Consumer API, you can use the following maven dependency:

```
<dependency>
  <groupId>org.apache.kafka</groupId>
  <artifactId>kafka-clients</artifactId>
  <version>2.8.0</version>
</dependency>
<dependency>
  <groupId>org.apache.kafka</groupId>
  <artifactId>kafka-clients</artifactId>
  <version>2.8.0</version>
</dependency>
```

Apache Kafka

KafkaPro.java

```
public class KafkaPro {
   public static void main(String[] args) throws Exception {
      Properties props = new Properties();
      props.put("bootstrap.servers", "localhost:9092");
      props.setProperty("transactional.id", "my-transactional-id");

      Producer<String, String> producer = null;

      try {
         producer = new KafkaProducer<String, String>(props, new StringSerializer(), new StringSerializer());
         producer.initTransactions();

         producer.beginTransaction();
         for (int i = 0; i < 100; i++)
            producer.send(new ProducerRecord<>("test", Integer.toString(i), "Message " + Integer.toString(i)));
         producer.commitTransaction();
      } catch (ProducerFencedException e) {
         producer.close();
      } catch (OutOfOrderSequenceException e) {
         producer.close();
      } catch (AuthorizationException e) {
         producer.close();
      } catch (KafkaException e) {
         producer.abortTransaction();
      }
      producer.close();
   }
}
```

KafkaCon.java

```
public class KafkaCon {
   public static void main(String[] args) throws Exception {
      Properties props = new Properties();
      props.setProperty("bootstrap.servers", "localhost:9092");
      props.setProperty("group.id", "test");
      props.setProperty("enable.auto.commit", "true");
      props.setProperty("auto.commit.interval.ms", "1000");
      props.setProperty("key.deserializer", "org.apache.kafka.common.serialization.StringDeserializer");
      props.setProperty("value.deserializer", "org.apache.kafka.common.serialization.StringDeserializer");

      KafkaConsumer<String, String> consumer = new KafkaConsumer<>(props);
      consumer.subscribe(Arrays.asList("test"));

      while (true) {
         ConsumerRecords<String, String> records = consumer.poll(Duration.ofMillis(100));
         for (ConsumerRecord<String, String> record : records)
            System.out.printf("offset = %d, key = %s, value = %s%n", record.offset(), record.key(), record.value());
      }
   }
}
```

Apache Kafka

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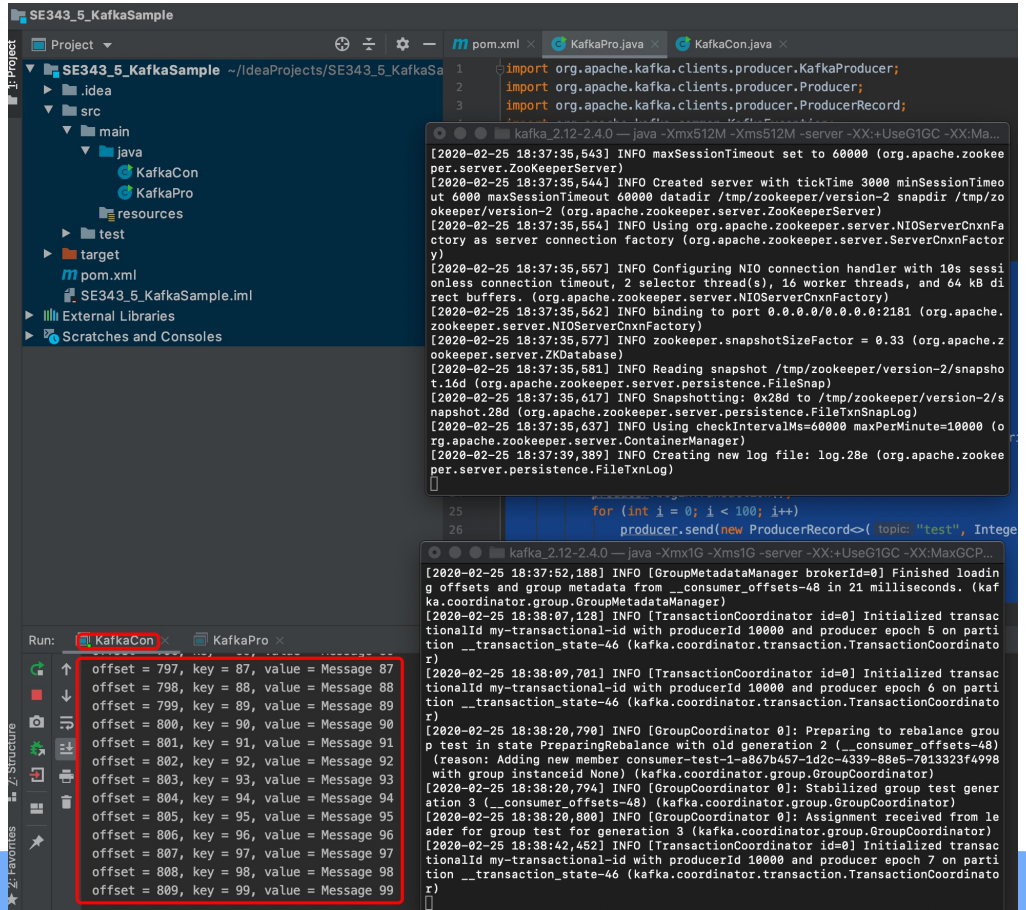

作业一

- 请你在大二开发的E-Book系统的基础上，完成下列任务：
  1. 优化服务层设计，确定有状态与无状态服务的运用方式，要求至少分别选择一个服务设计成有状态的和无状态的，并观察它们的差异，确认你的设计合理。
  2. 编写一个JMS程序，用来接收并异步地处理订单，具体功能与现有E-Book中的下订单相同，具体流程为：
     - 1) 用户通过Web前端下订单到服务器，你的服务器端程序 A(Controller) 应该先反馈给用户订单已接收；
     - 2) A 将订单数据发送到 “Order” 队列；
     - 3) 服务器端另一个程序 B(Service) 一直监听Order队列，一旦读到消息，就立刻进行处理，将数据写入数据库。
  - 你应该将上述功能集成到你的E-Book系统中，如果你无法将上述功能集成到你的E-Book系统中，可以单独建立工程实现，但是会适当扣分。
  - 请将你编写的相关代码整体压缩后上传，请勿压缩整个工程提交。

- 评分标准：
  1. 选择的有状态服务和无状态服务合理，代码编写正确（2分）
  2. JMS功能实现正确无误 (3 分)

References

- Messaging with JMS
  - https://spring.io/guides/gs/messaging-jms/
- Apache Kafka Quick Start
  - https://kafka.apache.org/quickstart
- Java Message Service Concepts
  - https://javaee.github.io/tutorial/jms-concepts.html

Thank You!