Spring Batch Workshop

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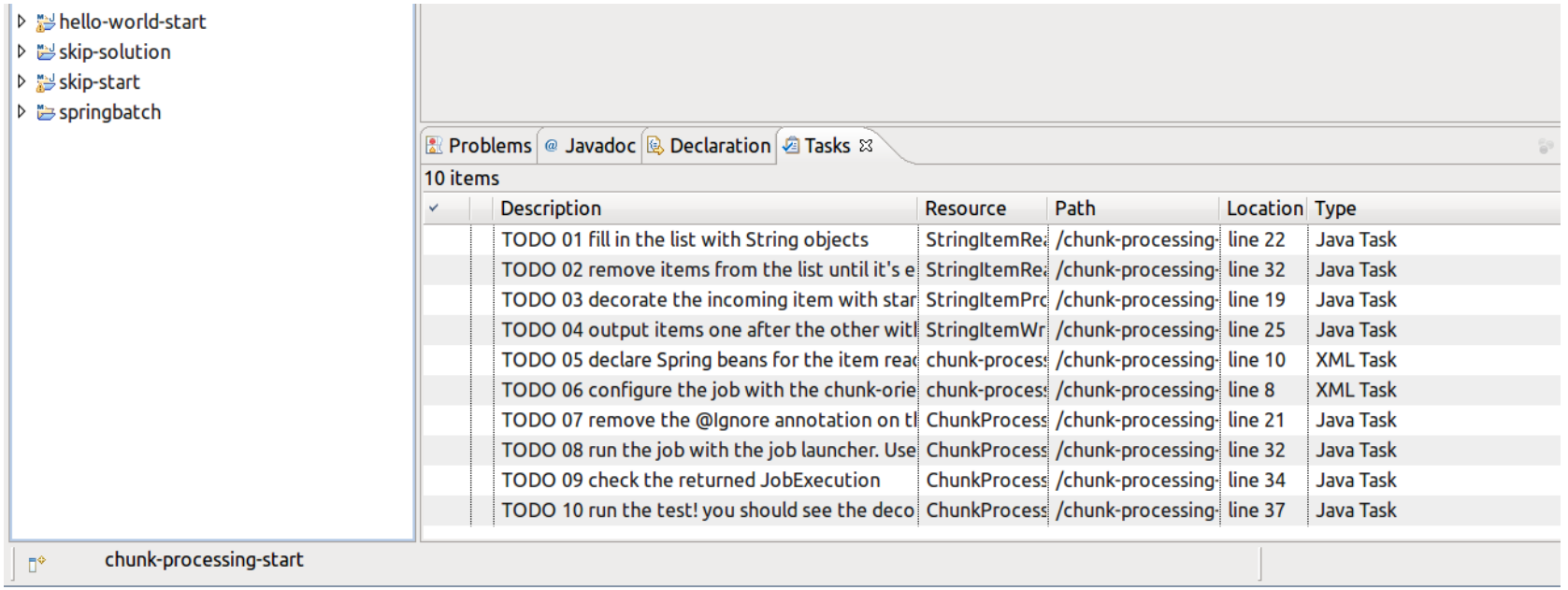
Overview

- This workshop highlights Spring Batch features
- Problem/solution approach
  - A few slides to cover the feature
  - A project to start from, just follow the TODOs
- Prerequisites :
  - Basics about Java and Java EE
  - Spring: dependency injection, enterprise support
- https://github.com/acogoluegnes/Spring-Batch-Workshop

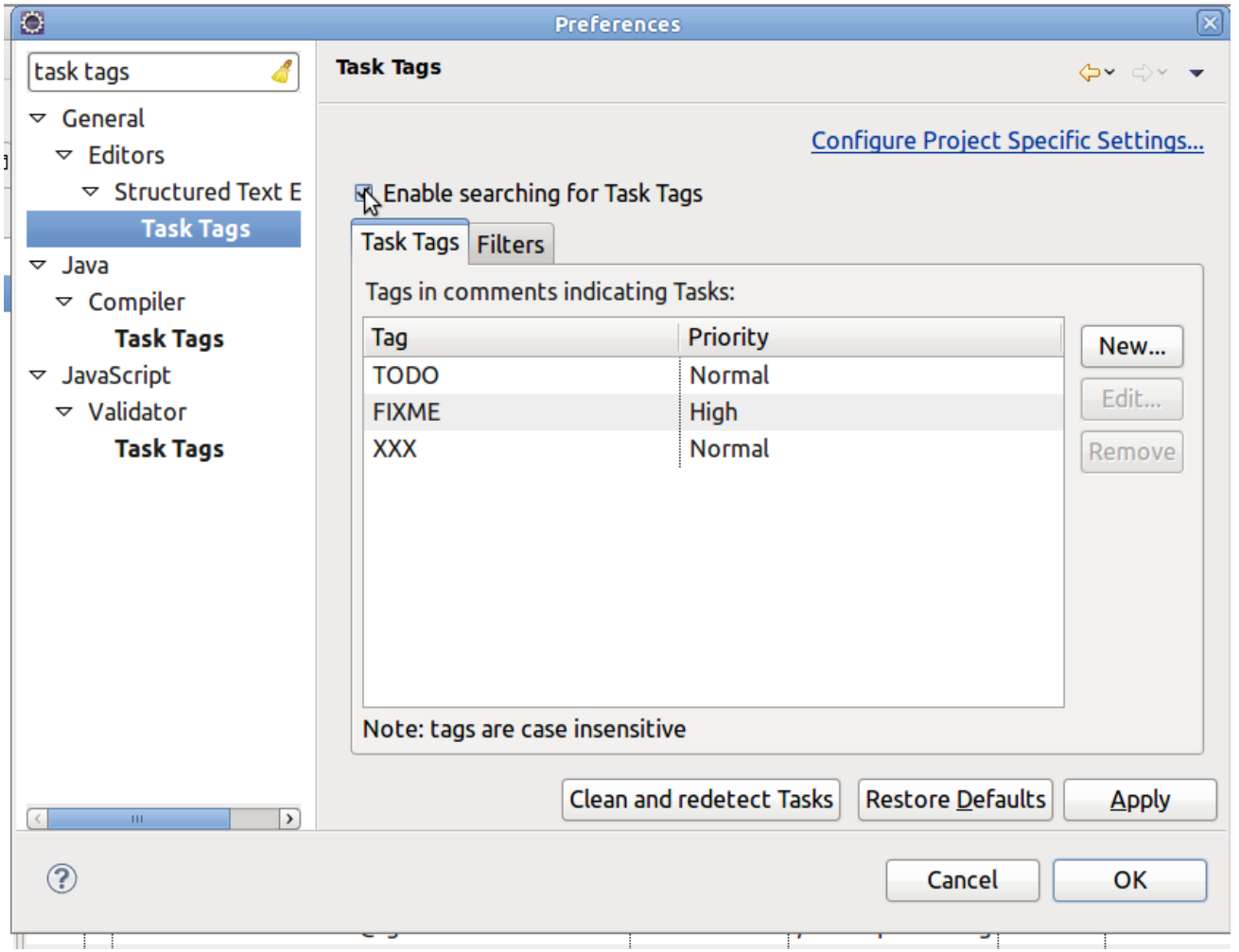
Settings

- Track the TODO in the *-start projects!
- It's easier with support from the IDE



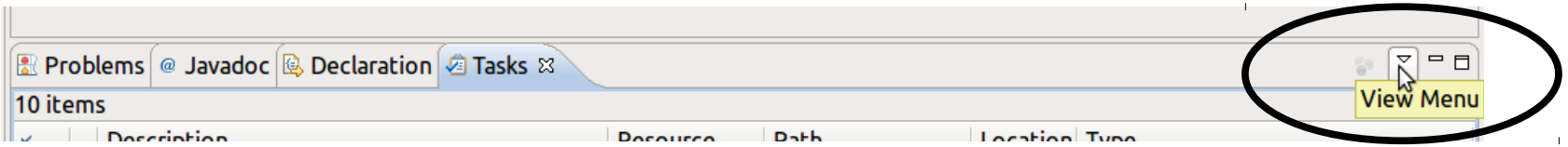
TODO with Eclipse

- Window > Preferences > “tasks tag” in filter

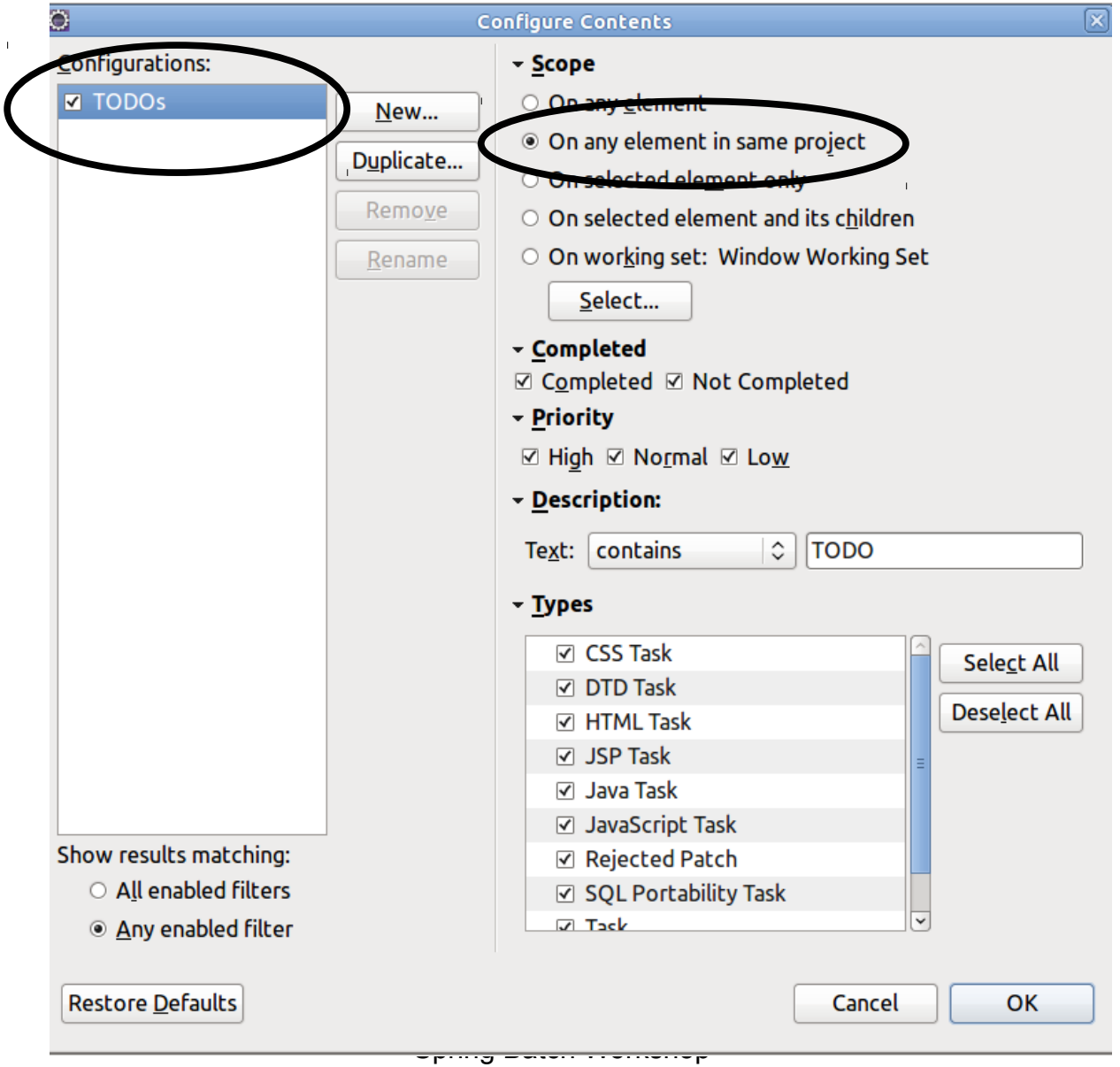


TODO with Eclipse

- Open the “Tasks” view and “configure contents”

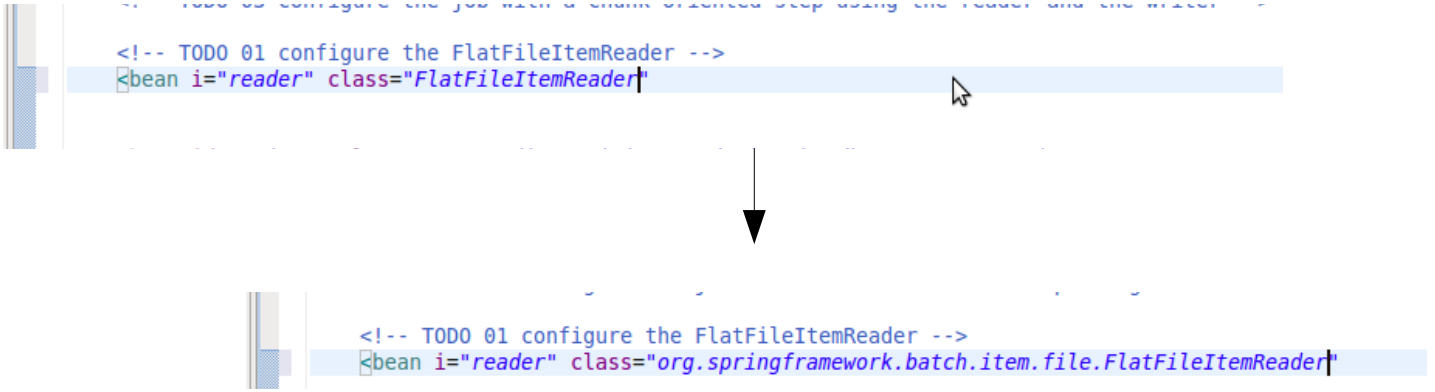


TODO with Eclipse



Spring support in IDE

- Spring support in IDE is a +
- e.g. code completion in SpringSource Tool Suite



Spring Batch overview

- Read – process – write large amounts of data, efficiently
- Ready-to-use components to read from/write to
  - Flat/XML files
  - Databases (JDBC, Hibernate, JPA, iBatis)
  - JMS queues
  - Emails
- Numerous extension points/hooks

Spring Batch overview

- Configuration to skip/retry items
- Execution metadata
  - Monitoring
  - Restart after failure
- Scaling strategies
  - Local/remote
  - Partitioning, remote processing

Hello World

- Problem: getting started with Spring Batch
- Solution: writing a simple “Hello world” job

Hello World

- A Spring Batch job is made of steps
- The Hello World job has one step
- The processing is implemented in a *Tasklet*

Hello World

- The Hello World Tasklet

```
public class HelloWorldTasklet implements Tasklet {

  @Override
  public RepeatStatus execute(
      StepContribution contribution,
      ChunkContext chunkContext) throws Exception {
    System.out.println("Hello world!");
    return RepeatStatus.FINISHED;
  }

}
```

Hello World

- The configuration of the Hello World job
  - Notice the <batch /> namespace

```
<batch:job id="helloWorldJob">
  <batch:step id="helloWorldStep">
    <batch:tasklet>
      <bean class="com.zenika.workshop.springbatch.HelloWorldTasklet" />
    </batch:tasklet>
  </batch:step>
</batch:job>
```

Hello World

- Spring Batch needs some infrastructure beans
  - Let's use the typical test configuration

```
<bean id="transactionManager"
      class="o.s.b.support.transaction.ResourcelessTransactionManager" />

<bean id="jobRepository"
      class="o.s.b.core.repository.support.MapJobRepositoryFactoryBean" />

<bean id="jobLauncher"
      class="o.s.b.core.launch.support.SimpleJobLauncher">
  <property name="jobRepository" ref="jobRepository" />
</bean>
```

Hello World

- Let's test!

```
@RunWith(SpringJUnit4ClassRunner.class)
@ContextConfiguration("/hello-world-job.xml")
public class HelloWorldJobTest {

  @Autowired
  private Job job;

  @Autowired
  private JobLauncher jobLauncher;

  @Test public void helloWorld() throws Exception {
    JobExecution execution = jobLauncher.run(job, new JobParameters());
    assertEquals(ExitStatus.COMPLETED, execution.getExitStatus());
  }

}
```

Chunk processing

- Problem: processing large amounts of data efficiently
- Solution: using chunk processing

Chunk processing

- Batch jobs often read, process, and write items
- e.g.
  - Reading items from a file
  - Then processing (converting) items
  - Writing items to a database
- Spring Batch calls this “chunk processing”
  - a chunk = a set of items

Chunk processing

- Spring Batch
  - handles the iteration logic
  - uses a transaction for each chunk
  - lets you choose the chunk size
  - defines interfaces for each part of the processing

Chunk processing

- ItemReader
  - Reading ends when read() returns null

```
public interface ItemReader<T> {

  T read() throws Exception, UnexpectedInputException,
                  ParseException, NonTransientResourceException;

}
```

Chunk processing

- ItemProcessor
  - optional

```
public interface ItemProcessor<I, O> {

  O process(I item) throws Exception;

}
```

Chunk processing

- ItemWriting
  - Receive all the items of the chunk
  - Allows for batch update (more efficient)

```
public interface ItemWriter<T> {

  void write(List<? extends T> items) throws Exception;

}
```

Chunk processing

- Let's implement a (too?) simple chunk-oriented step!

Chunk processing

- The ItemReader

```
package com.zenika.workshop.springbatch;

import java.util.ArrayList;
import java.util.Arrays;
import java.util.List;
import org.springframework.batch.item.ItemReader;
import org.springframework.batch.item.NonTransientResourceException;
import org.springframework.batch.item.ParseException;
import org.springframework.batch.item.UnexpectedInputException;

public class StringItemReader implements ItemReader<String> {

  private List<String> list;

  public StringItemReader() {
    this.list = new ArrayList<String>(Arrays.asList("1","2","3","4","5","6","7"));
  }

  @Override
  public String read() throws Exception, UnexpectedInputException,
                        ParseException, NonTransientResourceException {
    return !list.isEmpty() ? list.remove(0) : null;
  }
}
```

Chunk processing

- The ItemProcessor

```
package com.zenika.workshop.springbatch;

import org.springframework.batch.item.ItemProcessor;

public class StringItemProcessor implements ItemProcessor<String, String> {

  @Override
  public String process(String item) throws Exception {
    return "*** "+item+" ***";
  }

}
```

Chunk processing

- The ItemWriter

```
package com.zenika.workshop.springbatch;

import java.util.List;
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;
import org.springframework.batch.item.ItemWriter;

public class StringItemWriter implements ItemWriter<String> {

  private static final Logger LOGGER =
    LoggerFactory.getLogger(StringItemWriter.class);

  @Override
  public void write(List<? extends String> items) throws Exception {
    for(String item : items) {
      LOGGER.info("writing "+item);
    }
  }

}
```

Chunk processing

- Configuring the job

```
<batch:job id="chunkProcessingJob">
  <batch:step id="chunkProcessingStep">
    <batch:tasklet>
      <batch:chunk reader="reader" processor="processor" writer="writer"
                   commit-interval="3"
      />
    </batch:tasklet>
  </batch:step>
</batch:job>

<bean id="reader" class="com.zenika.workshop.springbatch.StringItemReader" />

<bean id="processor" class="com.zenika.workshop.springbatch.StringItemProcessor" />

<bean id="writer" class="com.zenika.workshop.springbatch.StringItemWriter" />
```

Chunk processing

- Do I always need to write my ItemReader/Processor/Writer?
- No, Spring Batch provides ready-to-use components for common datastores
  - Flat/XML files, databases, JMS, etc.
- You
  - Configure these components
  - Provides some logic
    - e.g. mapping a line with a domain object

Chunk processing

- Going further...
  - Reader/writer implementation for flat/XML files, database, JMS
  - Skipping items when something goes wrong
  - Listeners to react to the chunk processing

Flat file reading

- Problem: reading lines from a flat file and sending them to another source (e.g. database)
- Solution: using the FlatFileItemReader

Flat file reading

- Spring Batch has built-in support for flat files
  - Through the FlatFileItemReader for reading
- The FlatFileItemReader handles I/O
- 2 main steps:
  - Configuring the FlatFileItemReader
  - Providing a line – object mapping strategy

Flat file reading

- The usual suspects:

```
De-Anna,Raghunath,2010-03-04
Susy,Hauerstock,2010-03-04
Kiam,Whitehurst,2010-03-04
Alecia,Van Holst,2010-03-04
Hing,Senecal,2010-03-04
```

```
public class Contact {

  private Long id;
  private String firstname,lastname;
  private Date birth;

  (...)
}
```

Flat file reading

- What do we need to read a flat file?
  - How to tokenize a line
  - How to map the line with a Java object
  - Where to find the file to read

Flat file reading

Tokenization

```
<bean id="reader"
      class="org.springframework.batch.item.file.FlatFileItemReader">
  <property name="lineMapper">
    <bean class="org.springframework.batch.item.file.mapping.DefaultLineMapper">
      <property name="lineTokenizer">
        <bean
  class="org.springframework.batch.item.file.transform.DelimitedLineTokenizer">
          <property name="names" value="firstname,lastname,birth" />
        </bean>
      </property>
      <property name="fieldSetMapper">
        <bean class="com.zenika.workshop.springbatch.ContactFieldSetMapper" />
      </property>
    </bean>
  </property>
  <property name="resource" value="classpath:contacts.txt" />
</bean>
```

File to read

Line – object mapping

Flat file reading

- A FieldSetMapper to map a line with an object
- More about business logic, so typically implemented by developer
  - Spring Batch provides simple implementations

Flat file reading

```
package com.zenika.workshop.springbatch;

import org.springframework.batch.item.file.mapping.FieldSetMapper;
import org.springframework.batch.item.file.transform.FieldSet;
import org.springframework.validation.BindException;

public class ContactFieldSetMapper implements FieldSetMapper<Contact> {

  @Override
  public Contact mapFieldSet(FieldSet fieldSet) throws BindException {
    return new Contact(
      fieldSet.readString("firstname"),
      fieldSet.readString("lastname"),
      fieldSet.readDate("birth","yyyy-MM-dd")
    );
  }
}
```

Flat file reading

- Going further...
  - FlatFileItemWriter to write flat file
  - Fixed-length format (different tokenizer)
  - Skipping badly formatted lines

Skip

- Problem: my job fails miserably because of a tiny error in my input file
- Solution: skipping lines without failing the whole execution

Skip

- Skipping lines is sometimes acceptable

```
De-Anna,Raghunath,2010-03-04
Susy,Hauerstock,2010-03-04
Kiam,Whitehurst,2010-03-04
Alecia,Van Holst,09-23-2010
Hing,Senecal,2010-03-04
Kannan,Pirkle,2010-03-04
Row,Maudrie,2010-03-04
Voort,Philbeck,2010-03-04
```

Skip

- Skip in Spring Batch
  - Choose the exceptions to skip
  - Set the max number of items to skip

```
<batch:job id="skipJob">
  <batch:step id="skipStep">
    <batch:tasklet>
      <batch:chunk reader="reader" writer="writer" commit-interval="3"
                   skip-limit="10">
        <batch:skippable-exception-classes>
          <batch:include
          class="org.springframework.batch.item.file.FlatFileParseException"/>
        </batch:skippable-exception-classes>
      </batch:chunk>
    </batch:tasklet>
  </batch:step>
</batch:job>
```

Skip

- Going further...
  - Logging skipped items with a SkipListener
  - Setting a custom SkipPolicy

Dynamic job parameters

- Problem: passing values to the configuration when launching a job
- Solution: using job parameters and late binding

Dynamic job parameters

- Use case: providing a input file dynamically to the item reader

```
JobParameters jobParameters = new JobParametersBuilder()
  .addString("input.file", "file:./input/contacts-01.txt")
  .toJobParameters();
JobExecution execution = jobLauncher.run(job, jobParameters);
```

```
<bean id="reader"
      class="org.springframework.batch.item.file.FlatFileItemReader"
      scope="step">
  <property name="resource" value="#{jobParameters['input.file']}" />
  (...)
</bean>
```

Dynamic job parameters

- Going further...
  - Checking other available variables in an expression

JDBC paging

- Problem: reading large result sets from the database with a stable memory footprint
- Solution: using the JdbcPagingItemReader, which uses paging to handle large result sets

JDBC paging

```
<bean id="reader"
      class="org.springframework.batch.item.database.JdbcPagingItemReader">
  <property name="dataSource" ref="dataSource" />
  <property name="pageSize" value="10" />
  <property name="queryProvider">
    <bean class="o.s.b.item.database.support.SqlPagingQueryProviderFactoryBean">
      <property name="dataSource" ref="dataSource" />
      <property name="selectClause"
                value="select id,firstname,lastname,birth" />
      <property name="fromClause" value="from contact" />
      <property name="sortKey" value="id" />
    </bean>
  </property>
  <property name="rowMapper">
    <bean class="com.zenika.workshop.springbatch.ContactRowMapper" />
  </property>
</bean>
```

JDBC paging

- By paging, you send multiple queries to the database
- Alternative: cursor-based item reader
  - Spring Batch “streams” the result set from the DB
  - Only one query
- Paging always works, cursor-based reader depends on driver implementation

JDBC paging

- Going further...
  - Paging readers for Hibernate, JPA, iBatis
  - Cursor-based readers

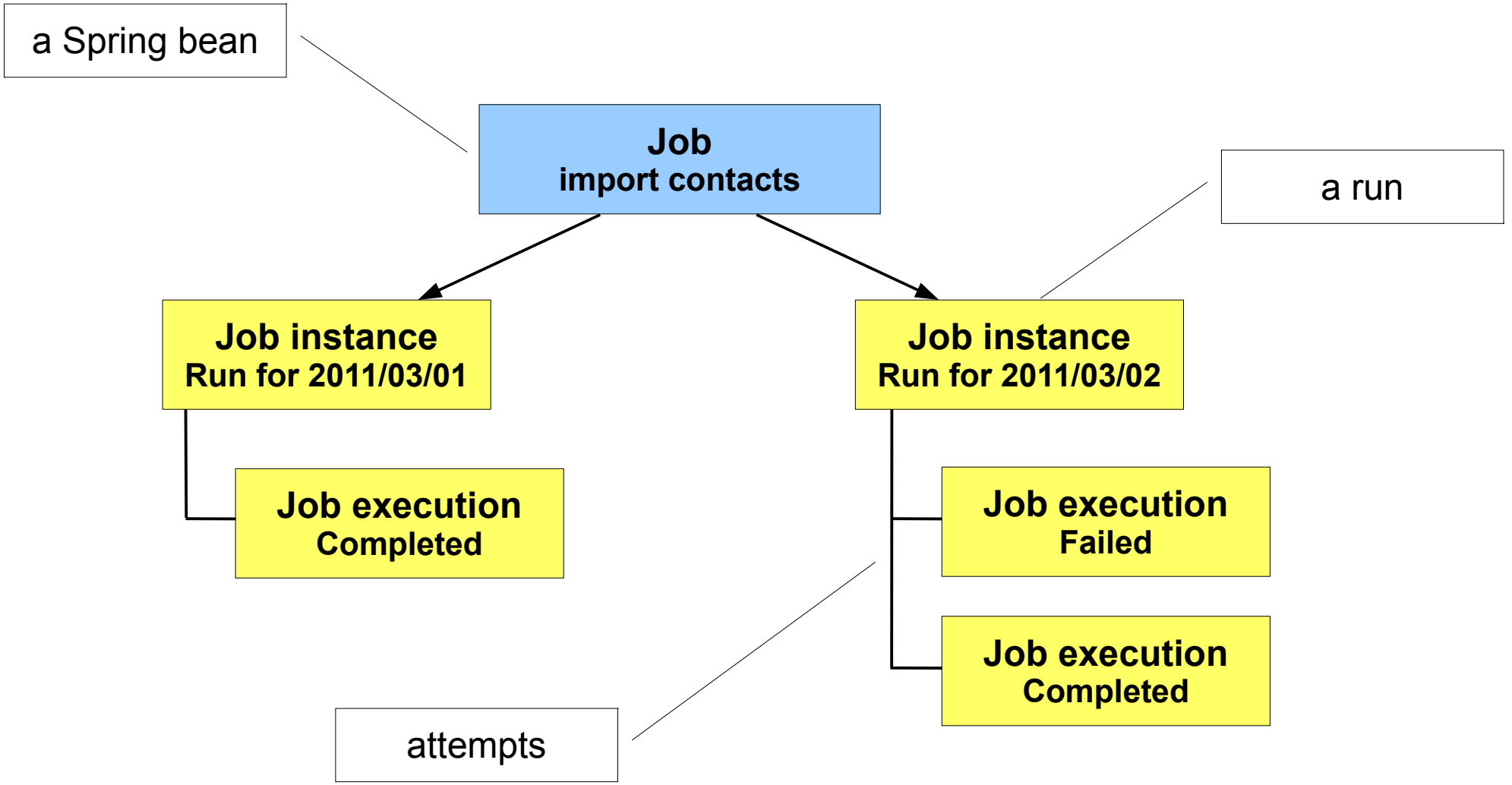
Execution metadata

- Problem: monitoring the execution of batch jobs
- Solution: letting Spring Batch storing execution metadata in a database

Execution metadata

- Spring Batch keeps track of batch execution
- Enables:
  - Monitoring by querying metadata tables
  - Restarting after a failure

Execution metadata



Execution metadata

- How to define a job instance?
- Thanks to job parameters
  - They define the identity of the job instance

Execution metadata

- Metadata are stored in a database
  - In-memory implementation for test/development
- Monitoring tools can query metadata tables
  - e.g. Spring Batch Admin

Execution metadata

- Going further...
  - Spring Batch Admin set-up
  - JobExplorer and JobOperator interfaces
  - Spring JMX support

Scheduling

- Problem: scheduling a job to execute periodically
- Solution: using the scheduling support in Spring

Scheduling

```java
public class ImportLauncher {

  public void launch() throws Exception {
    JobExecution exec = jobLauncher.run(
      job,
      new JobParametersBuilder()
        .addLong("time", System.currentTimeMillis())
        .toJobParameters()
      );
  }
}
```

```xml
<bean id="importLauncher"
      class="com.zenika.workshop.springbatch.ImportLauncher" />

<task:scheduled-tasks>
  <task:scheduled ref="importLauncher" method="launch"
                  fixed-delay="1000" />
</task:scheduled-tasks>
```

A “cron” attribute is available

Scheduling

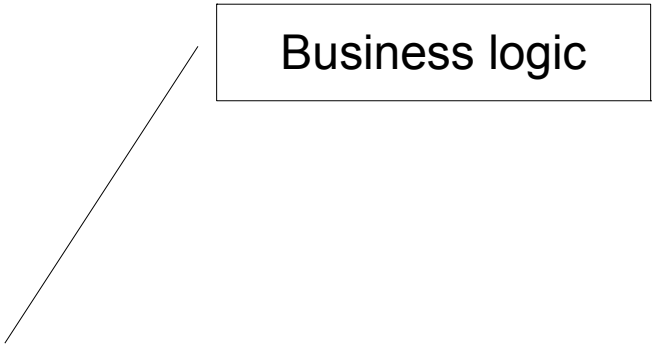
- Going further...
  - Threading settings in Spring Scheduler
  - Spring support for Quartz

Item processor

- Problem: I want to add some business logic before writing the items I just read
- Solution: use an item processor to process/convert read items before sending them to the item writer

Item processor

- Use case:
  - Reading contacts from a flat file
  - Registering them into the system
  - Writing the registration confirmations to the database



Item processor

```
public interface ItemProcessor<I, O> {

  O process(I item) throws Exception;

}
```

Item processor

- Delegate to business service

```
public class ContactItemProcessor implements
             ItemProcessor<Contact, RegistrationConfirmation> {

  private RegistrationService registrationService;

  @Override
  public RegistrationConfirmation process(Contact item)
       throws Exception {
     return registrationService.process(item);
  }

}
```

Item processor

- Register the item processor on the step

```
<batch:job id="itemProcessorJob">
  <batch:step id="itemProcessorStep">
    <batch:tasklet>
      <batch:chunk reader="reader" processor="processor"
                   writer="writer" commit-interval="3"/>
    </batch:tasklet>
  </batch:step>
</batch:job>

<bean id="registrationService"
      class="com.zenika.workshop.springbatch.RegistrationService" />

<bean id="processor"
      class="com.zenika.workshop.springbatch.ContactItemProcessor">
  <property name="registrationService" ref="registrationService" />
</bean>
```

Item processor

- Going further...
  - Available ItemProcessor implementations

Logging skipped items

- Problem: logging skipped items
- Solution: using a skip listener

Logging skipped items

- 2 steps:
  - Writing the skip listener (and the logging code)
  - Registering the listener on the step

Logging skipped items

- Writing the skip listener

```
package com.zenika.workshop.springbatch;

import org.slf4j.Logger;
import org.slf4j.LoggerFactory;
import org.springframework.batch.core.listener.SkipListenerSupport;

public class Slf4jSkipListener<T,S> extends SkipListenerSupport<T, S> {

  private static final Logger LOG = LoggerFactory.getLogger(
      Slf4jSkipListener.class);

  @Override
  public void onSkipInRead(Throwable t) {
    LOG.warn("skipped item: {}",t.toString());
  }

}
```

Logging skipped items

- Registering the skip listener

```
<batch:job id="loggingSkippedItemsJob">
  <batch:step id="loggingSkippedItemsStep">
    <batch:tasklet>
      <batch:chunk reader="reader" writer="writer" commit-interval="3"
                   skip-limit="10">
        <batch:skippable-exception-classes>
          <batch:include
              class="org.springframework.batch.item.file.FlatFileParseException"/>
        </batch:skippable-exception-classes>
      </batch:chunk>
      <batch:listeners>
        <batch:listener ref="skipListener" />
      </batch:listeners>
    </batch:tasklet>
  </batch:step>
</batch:job>

<bean id="skipListener" class="com.zenika.workshop.springbatch.Slf4jSkipListener" />
```

Logging skipped items

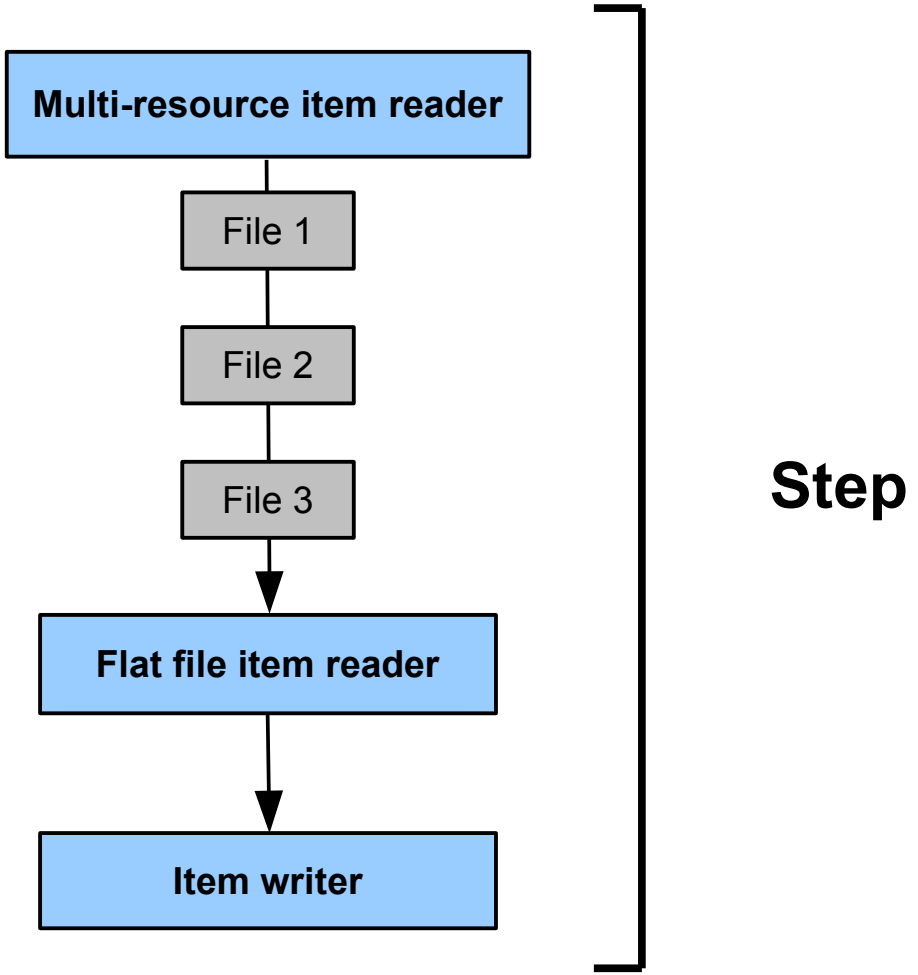
- Going further...
  - Other listeners in Spring Batch
    - ChunkListener, Item(Read/Process/Write)Listener, ItemStream, StepExecutionListener, JobExecutionListener

File reading partitioning

- Problem: I have multiple input files and I want to process them in parallel
- Solution: use partitioning to parallelize the processing on multiple threads

File reading partitioning

- No partitioning (one file after the other)

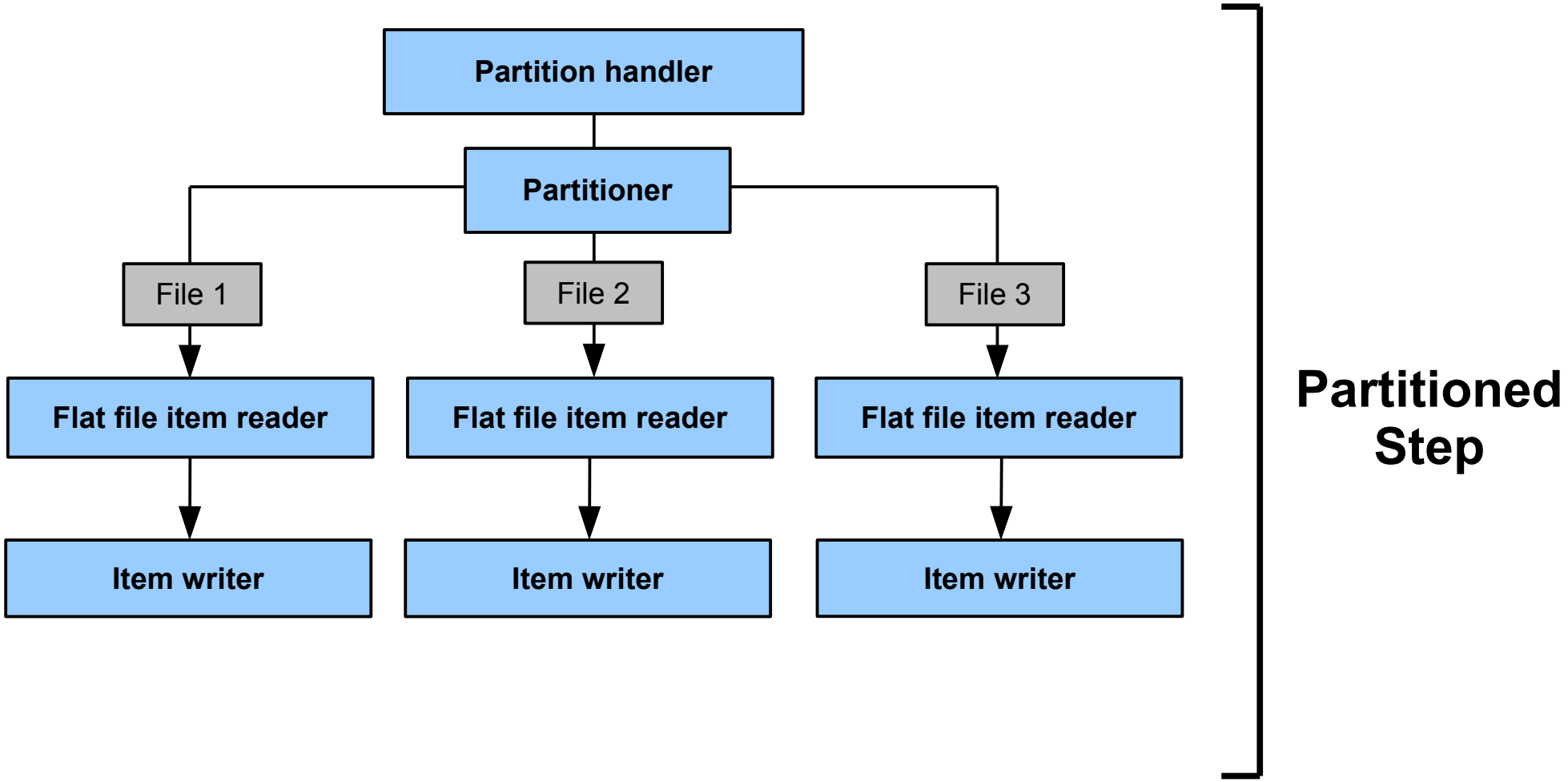


File reading partitioning

- Partitioning principle in Spring Batch:
  - Partition the data
    - e.g. one input file = one partition
  - Execute the partition in a dedicated step
- Partitioning is easy to set up but need some knowledge about the data
- Partition handler implementation
  - Multi-threaded
  - Spring Integration

File reading partitioning

- Multi-threaded partitioning



File reading partitioning

- Partitioner for input files

```
<bean id="partitioner"
      class="o.s.b.core.partition.support.MultiResourcePartitioner">
  <property name="resources"
            value="file:./src/main/resources/input/*.txt" />
</bean>
```

- Set a context for the steps to run

```
<bean id="reader"
      class="org.springframework.batch.item.file.FlatFileItemReader"
      scope="step">
  (...)
  <property name="resource" value="#{stepExecutionContext['fileName']}" />
</bean>
```

File reading partitioning

- Using the multi-threaded partition handler

```
<batch:job id="fileReadingPartitioningJob">
  <batch:step id="partitionedStep" >
    <batch:partition step="readWriteContactsPartitionedStep"
                     partitioner="partitioner">
      <batch:handler task-executor="taskExecutor" />
    </batch:partition>
  </batch:step>
</batch:job>

<batch:step id="readWriteContactsPartitionedStep">
  <batch:tasklet>
    <batch:chunk reader="reader" writer="writer" commit-interval="10" />
  </batch:tasklet>
</batch:step>
```

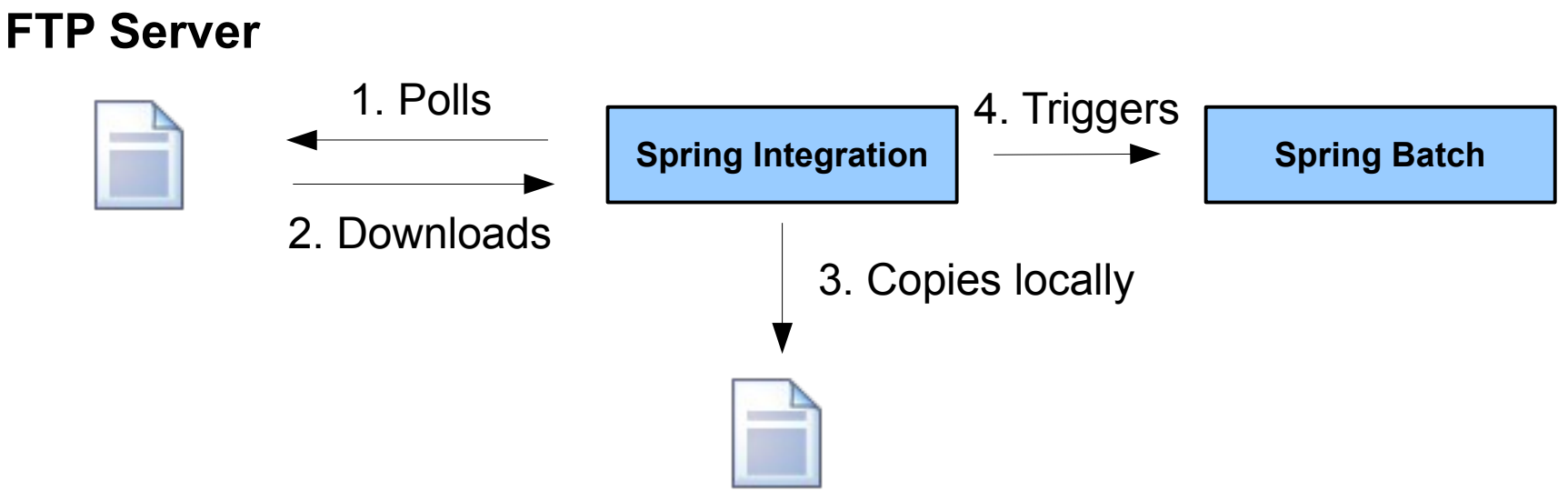
File reading partitioning

- Going further...
  - Spring Integration partition handler implementation
  - Other scaling approaches (parallel steps, remote chunking, multi-threaded step)

File dropping launching

- Problem: downloading files from a FTP server and processing them with Spring Batch
- Solution: use Spring Integration to poll the FTP server and trigger Spring Batch accordingly

File dropping launching



File dropping launching

- The launching code

The local copy

```
public class FileContactJobLauncher {

  public void launch(File file) throws Exception {
      JobExecution exec = jobLauncher.run(
        job,
        new JobParametersBuilder()
          .addString("input.file", "file:"+file.getAbsolutePath())
          .toJobParameters()
      );
  }

}
```

File dropping launching

- Listening to the FTP server

```
<int:channel id="fileIn" />

<int-ftp:inbound-channel-adapter local-directory="file:./input"
    channel="fileIn" session-factory="ftpClientFactory"
    remote-directory="/" auto-create-local-directory="true">
  <int:poller fixed-rate="1000" />
</int-ftp:inbound-channel-adapter>

<bean id="ftpClientFactory"
      class="com.zenika.workshop.springbatch.integration.DefaultFtpSessionFactory">
  <property name="host" value="localhost"/>
  <property name="port" value="2222"/>
  <property name="username" value="admin"/>
  <property name="password" value="admin"/>
</bean>
```

File dropping launching

- Calling the launcher on an inbound message

```
<int:channel id="fileIn" />

<int:service-activator input-channel="fileIn">
  <bean class="com.zenika.workshop.springbatch.integration.FileContactJobLauncher">
    <property name="job" ref="fileDroppingLaunchingJob" />
    <property name="jobLauncher" ref="jobLauncher" />
  </bean>
</int:service-activator>
```

File dropping message

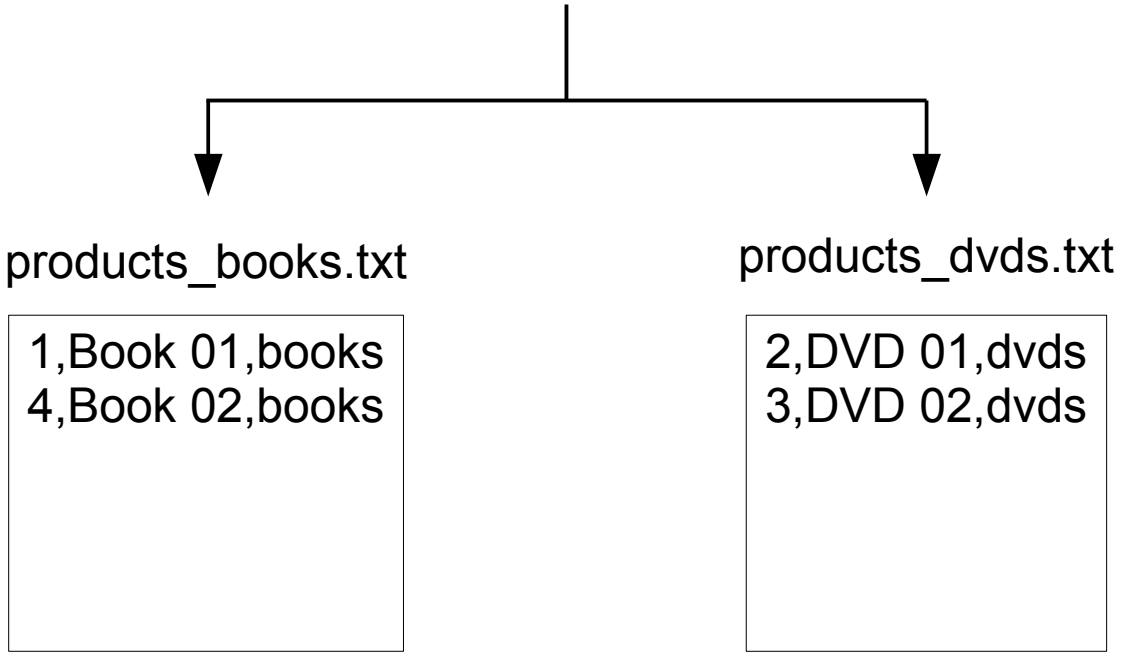
- Going further...
  - Checking Spring Integration connectors
    - Local file system, FTPS, SFTP, HTTP, JMS, etc.
  - Checking operations on messages
    - Filtering, transforming, routing, etc.

Database reading partitioning

- Problem: I want to export items from different categories from a database to files
- Solution: provide a partition strategy and use partitioning

Database reading partitioning

ID	name	category
1	Book 01	books
2	DVD 01	dvds
3	DVD 02	dvds
4	Book 02	books



Database reading partitioning

- Partitioning based on categories
  - 2 partitions in this case

ID	name	category
1	Book 01	books
2	DVD 01	dvds
3	DVD 02	dvds
4	Book 02	books

Database reading partitioning

- Implement the partitioning logic
  - Spring Batch's Partitioner interface

```
public class ProductCategoryPartitioner implements Partitioner {
  (...)

  @Override
  public Map<String, ExecutionContext> partition(int gridSize) {
    List<String> categories = jdbcTemplate.queryForList(
      "select distinct(category) from product",
      String.class
    );
    Map<String, ExecutionContext> results = new LinkedHashMap<String, ExecutionContext>();
    for(String category : categories) {
      ExecutionContext context = new ExecutionContext();
      context.put("category", category);
      results.put("partition."+category, context);
    }
    return results;
  }
}
```

Database reading partitioning

- Components can refer to partition parameters
  - They need to use the step scope!

```
<bean id="reader"
      class="org.springframework.batch.item.database.JdbcCursorItemReader" scope="step">
  <property name="sql" value="select id,name,category from product where category = ?" />
  <property name="preparedStatementSetter">
    <bean class="org.springframework.jdbc.core.ArgPreparedStatementSetter">
      <constructor-arg value="#{stepExecutionContext['category']}" />
    </bean>
  </property>
</bean>

<bean id="writer"
      class="org.springframework.batch.item.file.FlatFileItemWriter" scope="step">
  <property name="resource"
            value="file:./target/products_#{stepExecutionContext['category']}.txt" />

  (...)
</bean>
```

Database reading partitioning

- Configure the partitioned step
  - The default implementation is multi-threaded

```
<batch:job id="databaseReadingPartitioningJob">
  <batch:step id="partitionedStep" >
    <batch:partition step="readWriteProductsPartitionedStep" partitioner="partitioner">
      <batch:handler task-executor="taskExecutor" />
    </batch:partition>
  </batch:step>
</batch:job>

<batch:step id="readWriteProductsPartitionedStep">
  <batch:tasklet>
    <batch:chunk reader="reader" writer="writer" commit-interval="10" />
  </batch:tasklet>
</batch:step>
```

Database reading partitioning

- Going further...
  - Check existing partitioner implementations
  - Check other partition handler implementations
    - The default one is multi-threaded (local)
  - Check other scaling strategies