

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

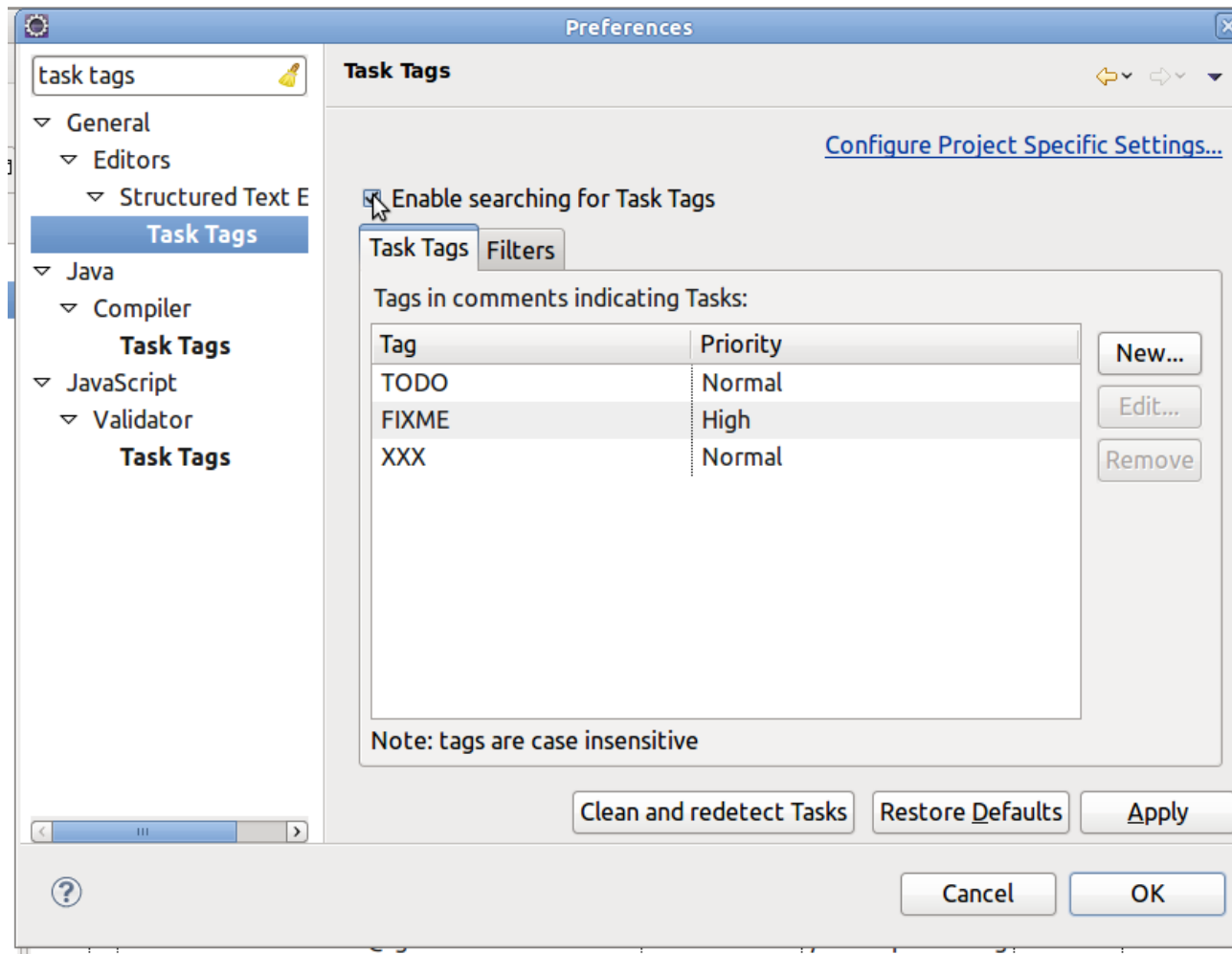
The screenshot displays an IDE interface. On the left, a project explorer shows a tree structure with the following items: 'hello-world-start', 'skip-solution', 'skip-start', and 'springbatch'. The main editor area is divided into tabs: 'Problems', 'Javadoc', 'Declaration', and 'Tasks'. The 'Tasks' tab is active, showing a list of 10 items. The list has columns for 'Description', 'Resource', 'Path', 'Location', and 'Type'. The items are as follows:

Description	Resource	Path	Location	Type
TODO 01 fill in the list with String objects	StringItemRea	/chunk-processing-	line 22	Java Task
TODO 02 remove items from the list until it's e	StringItemRea	/chunk-processing-	line 32	Java Task
TODO 03 decorate the incoming item with star	StringItemProc	/chunk-processing-	line 19	Java Task
TODO 04 output items one after the other with	StringItemWr	/chunk-processing-	line 25	Java Task
TODO 05 declare Spring beans for the item read	chunk-proces	/chunk-processing-	line 10	XML Task
TODO 06 configure the job with the chunk-orie	chunk-proces	/chunk-processing-	line 8	XML Task
TODO 07 remove the @Ignore annotation on t	ChunkProcess	/chunk-processing-	line 21	Java Task
TODO 08 run the job with the job launcher. Use	ChunkProcess	/chunk-processing-	line 32	Java Task
TODO 09 check the returned JobExecution	ChunkProcess	/chunk-processing-	line 34	Java Task
TODO 10 run the test! you should see the deco	ChunkProcess	/chunk-processing-	line 37	Java Task

The bottom status bar shows 'chunk-processing-start'.

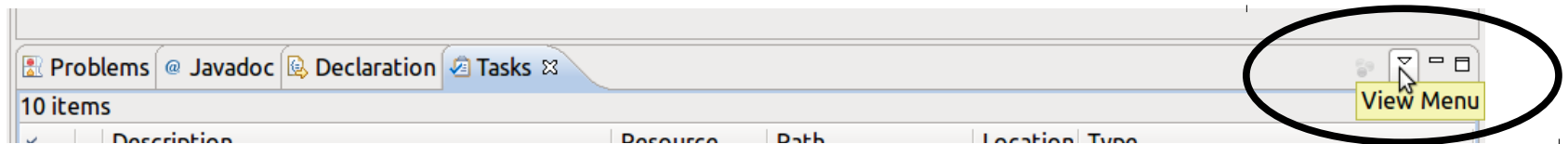
TODO with Eclipse

- Window > Preferences > “tasks tag” in filter

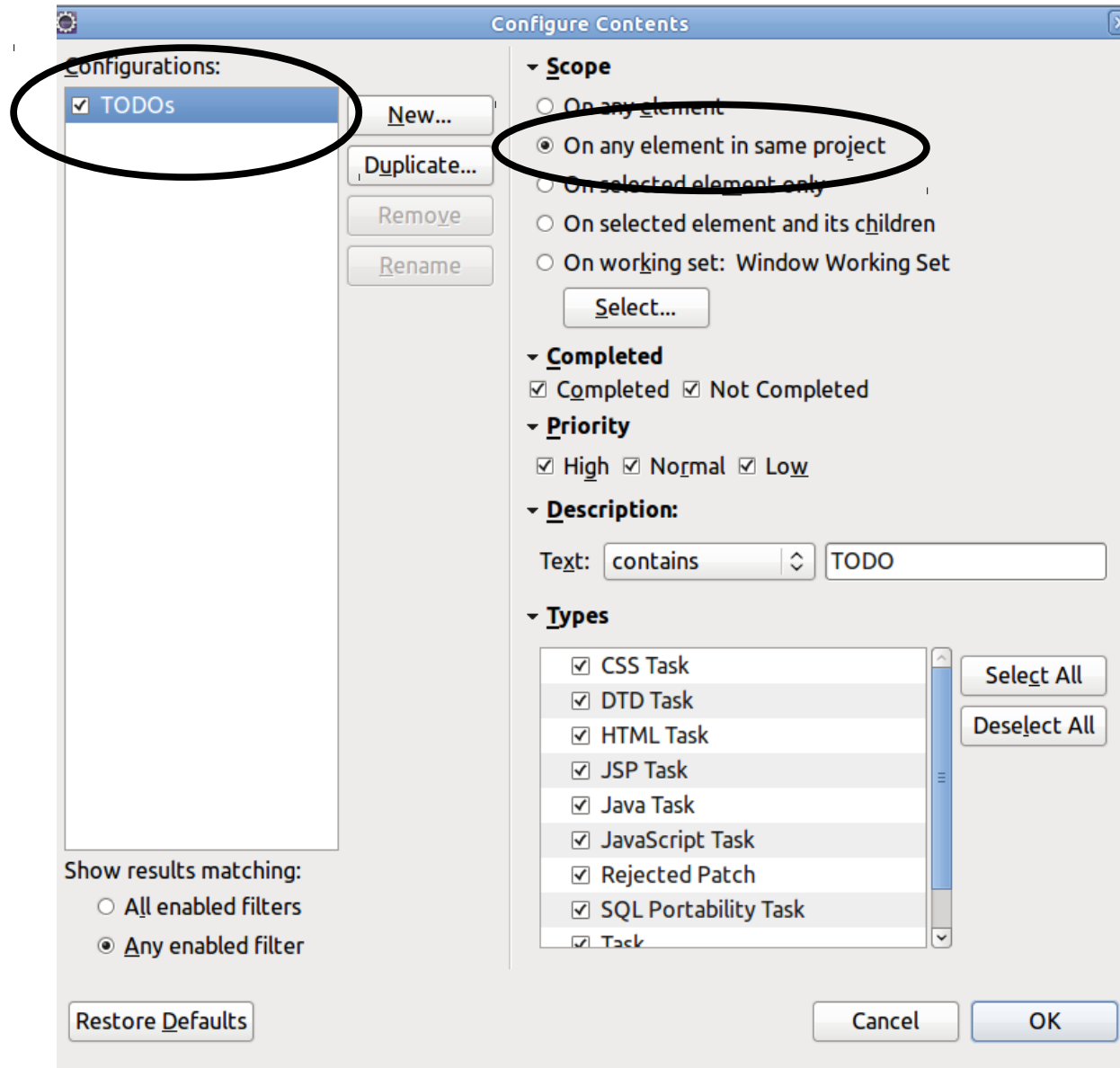


TODO with Eclipse

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

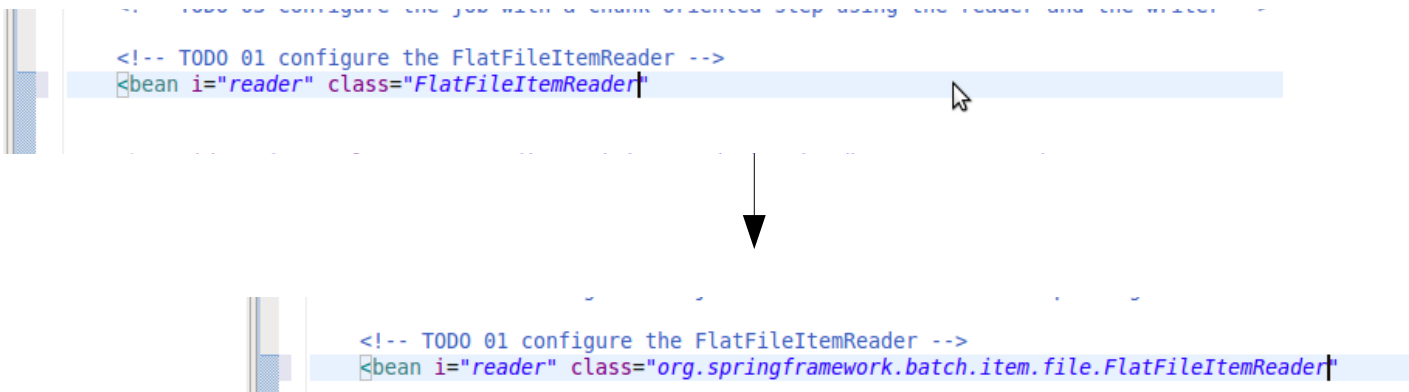


TODO with Eclipse



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.csv" />
  </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

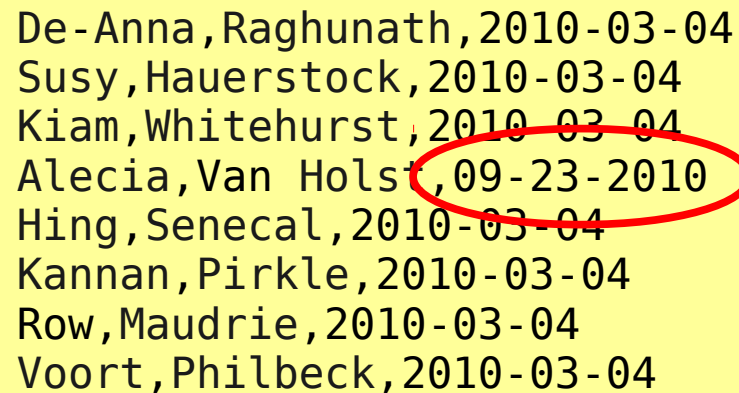
- Going further...
 - FlatFileItemWriter to write flat file
 - Fixed-length format (different tokenizer)
 - Skipping badly formatted lines

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

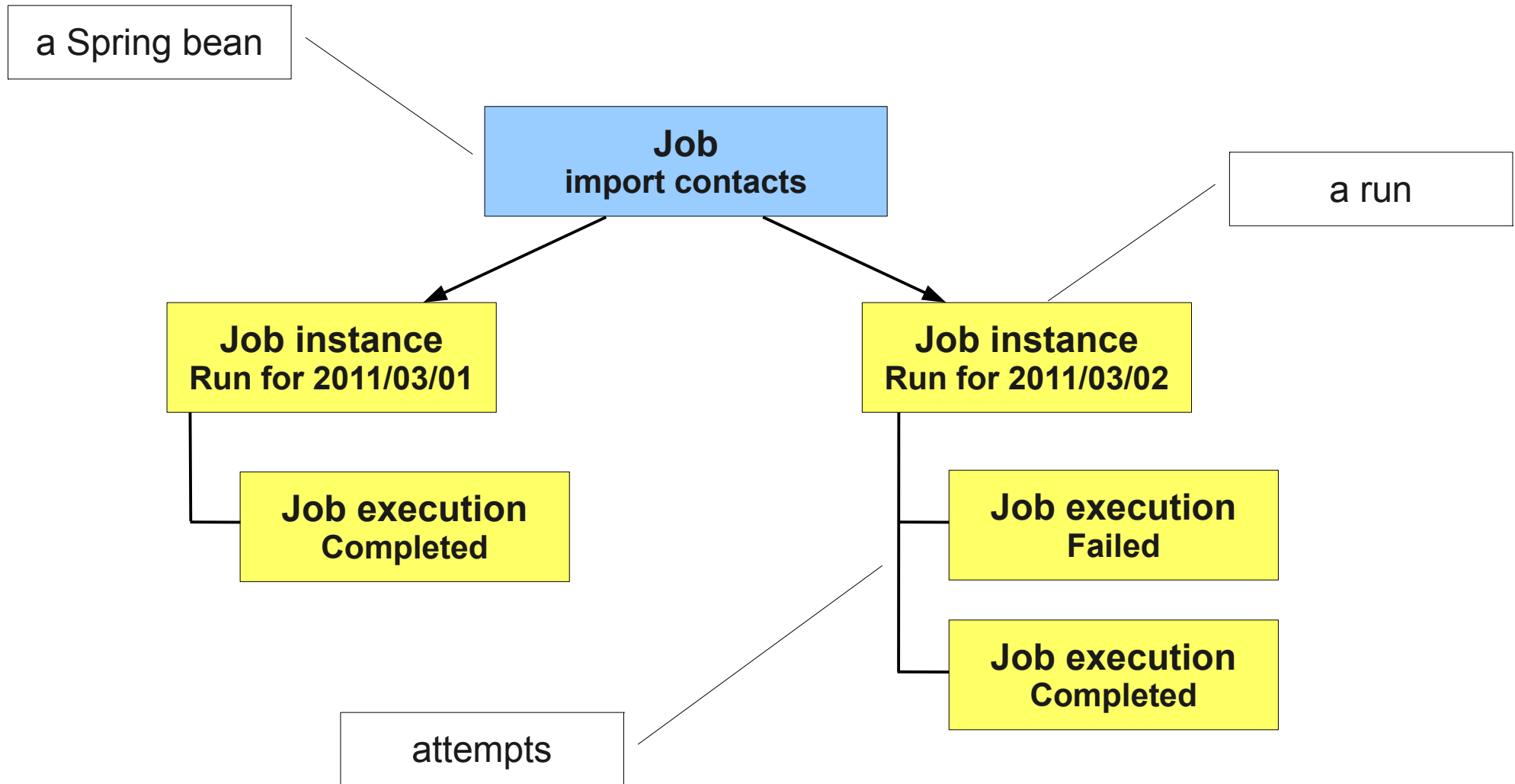
Execution metadata

- 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

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

```
<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



Business logic

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

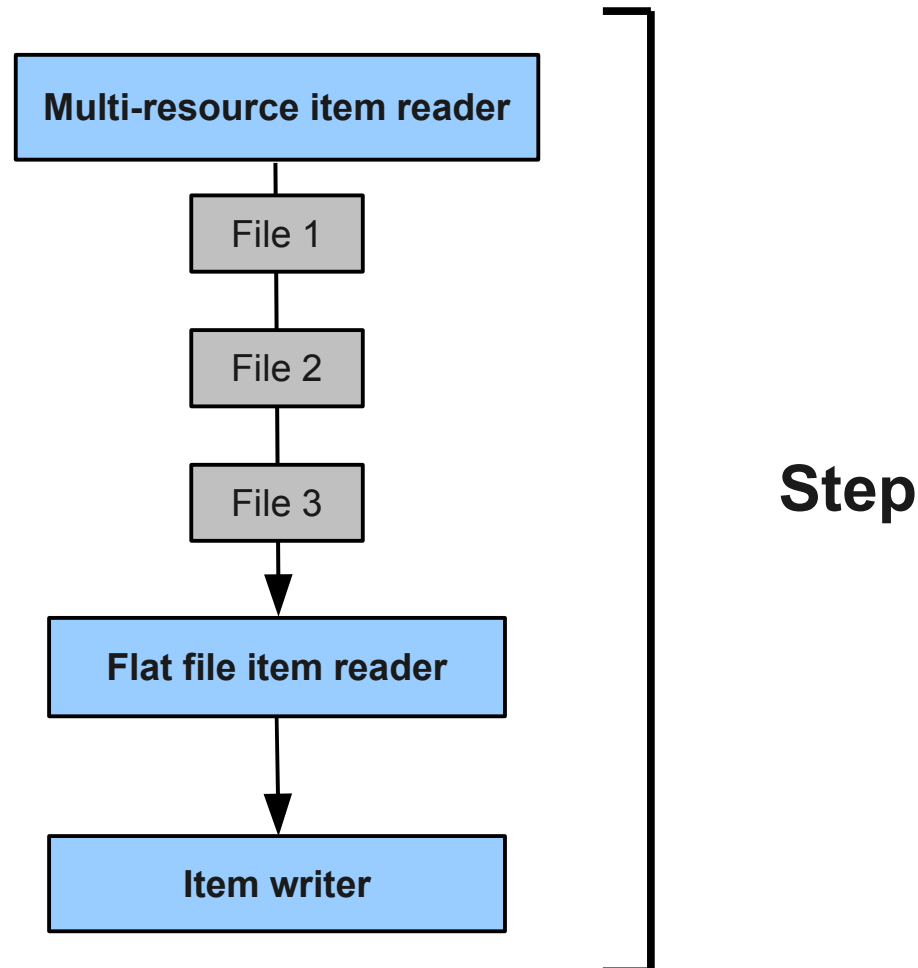
- Going further...
 - Other listeners in Spring Batch
 - ChunkListener, Item(Read/Process/Write)Listener, ItemStream, StepExecutionListener, JobExecutionListener

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)

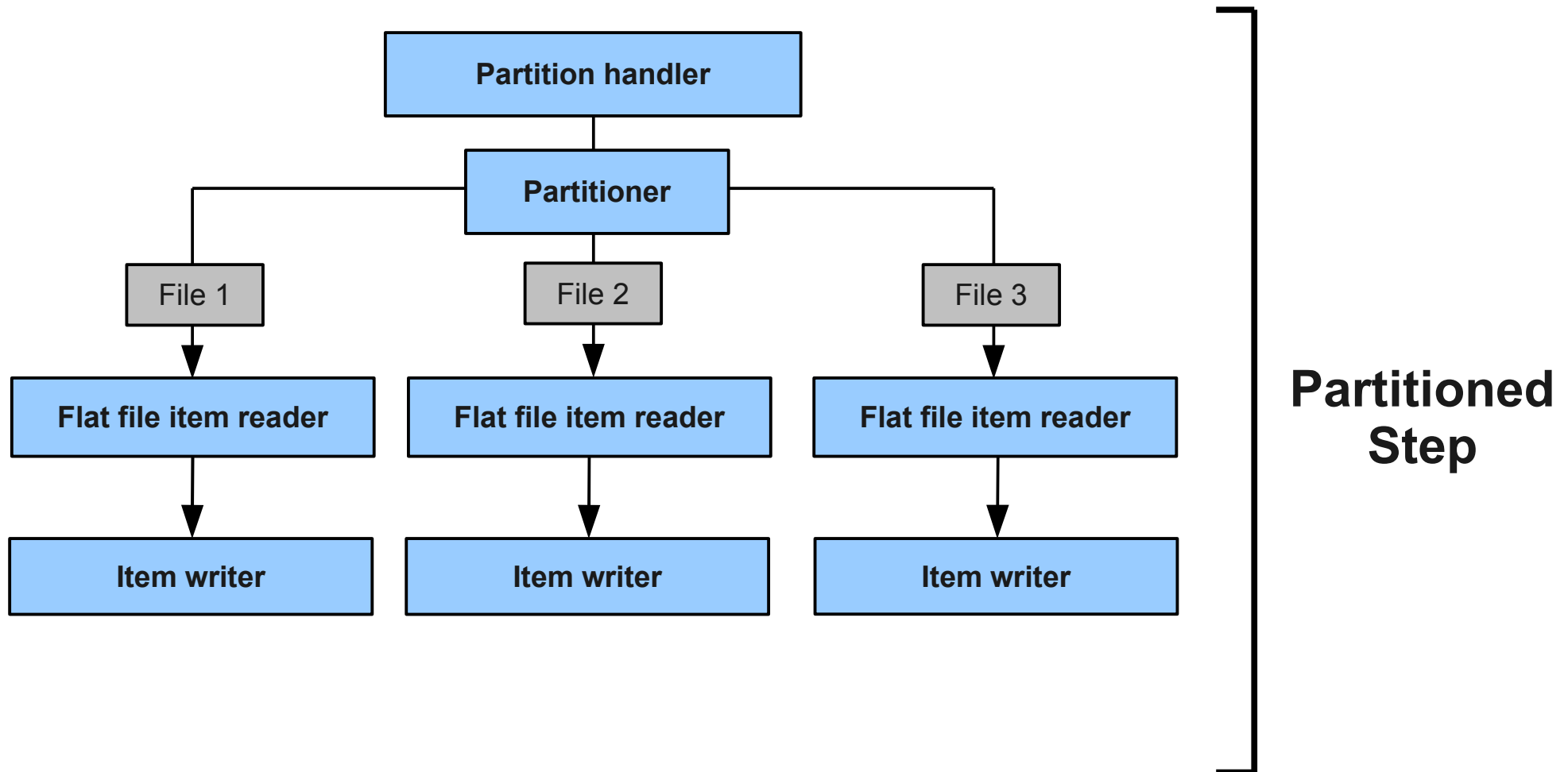


File reading partitioning

- 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)