Java Batch Lab

Contents

Lab 8: Java Batch lab

Java Batch is a new specification in Java EE 7 for offline data processing. In this lab we will demonstrate how to use JavaBatch via a set of job steps to populate and process data in a database.

Please refer to the following table for file and resource location references on different operating systems.

Location Ref.	OS	Absolute Path
{LAB_HOME}	Windows	`C:\WLP_<version>`
	Linux	`~/WLP_<version>` `Or choose your directory`
	Mac OSX	`choose your directory`

8.1 Prerequisites

The following preparation must be completed prior to beginning this lab:

1. Complete the Getting Started lab to set up the lab environment, including JRE, Liberty runtime, and eclipse with WDT. You should be familiar with how to use WDT to code a web application, creating a new server, start/stopping servers.

8.2 Overview

The requirements for this lab are:

1. Create the Derby database
2. Create an empty table in a database
3. Populate the database with input from a text file.
4. Calculate statistics from rows in the database. We will only be counting the number of rows, but the sample is detailed enough to enable you to perform much more complex processing on your own.

The artifacts for a batch job include:

1. Steps that compose a job
2. Components of a step, including
    a. A Batchlet: used for code that does not involve record processing
    b. A Chunk: used to process records
3. Flow control including:
    a. splits and flows to enable groups of steps to run concurrently. A split is composed of multiple flows, each of which can run independently. A flow is composed of a number of steps.
    b. Partitions: for concurrent processing within a step.
4. Listeners with callback for various phases of batch processing.

For this lab we will be constructing three steps. We will use partitions for concurrent processing within a step. And we will be using listeners as needed to complete the implementation of our job. This lab will not cover splits and flows, which are natural extensions to the basic lab.

From the requirements for this lab, we will construct the following batch artifacts:

1. A step containing a batchlet to create an empty table in a database
2. A step containing a chunk to populate the database table with input from a text file. The artifacts include:
    a. An ItemReader to read input from text file
    b. An ItemProcessor to convert text into an Employee record
    c. An ItemWriter to populate the table with Employee records
3. A step containing a chunk to perform processing on the database tables. The artifacts include:
    a. An ItemReader to read input from the database
    b. An ItemProcessor to process the input.
    c. An ItemWriter to write the output.
    d. Two partition instances of the chunk, each processing half of the database concurrently.
    e. A PartitionCollector, one instance for each chunk, to collect statistics from each chunk
    f. A PartitionAnalyzer that receives data from each chunk on the main job processing thread
    g. A PartitionReducer that produces the final output with data received by PartitionAnalyzer

We will go through this lab in the following sequence:

1. Create the Derby database required for the lab
2. Import batch artifacts into WDT
3. Walkthrough the code to learn how the jobs steps are put together
4. Run the batch job
5. Use command line utility to submit jobs

8.3 Create the Derby Database

A Derby database is required for this lab. If you completed the JDBC lab, you will already have the Derby database created. If you did not run the JDBC lab, then you need to follow the steps below to Install Derby.

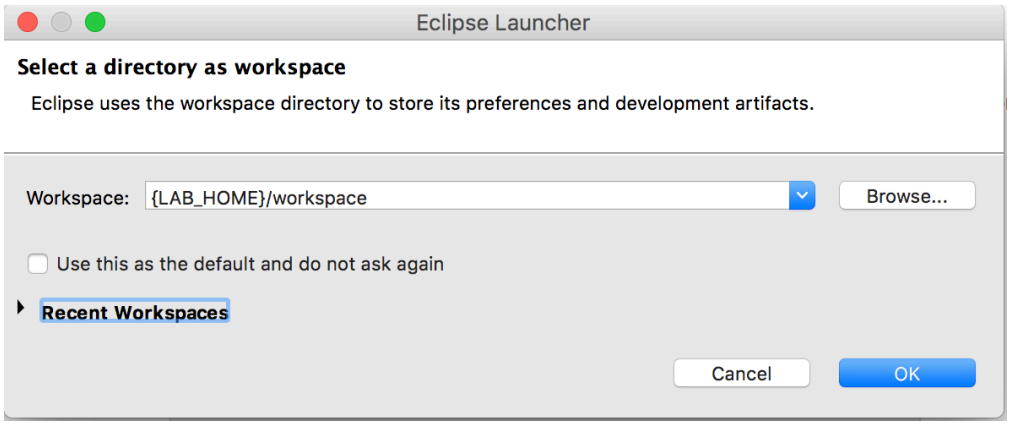
__a. Install Derby Database

__a. **For Windows or Mac**:
extract **{LAB_HOME}\derby\db-derby-10.14.1.0-lib.zip to {LAB_HOME}** directory.

__b. **For Linux** :
extract **{LAB_HOME}/derby/db- -10.14.1.0-lib.tar.gz to {LAB_HOME}** directory

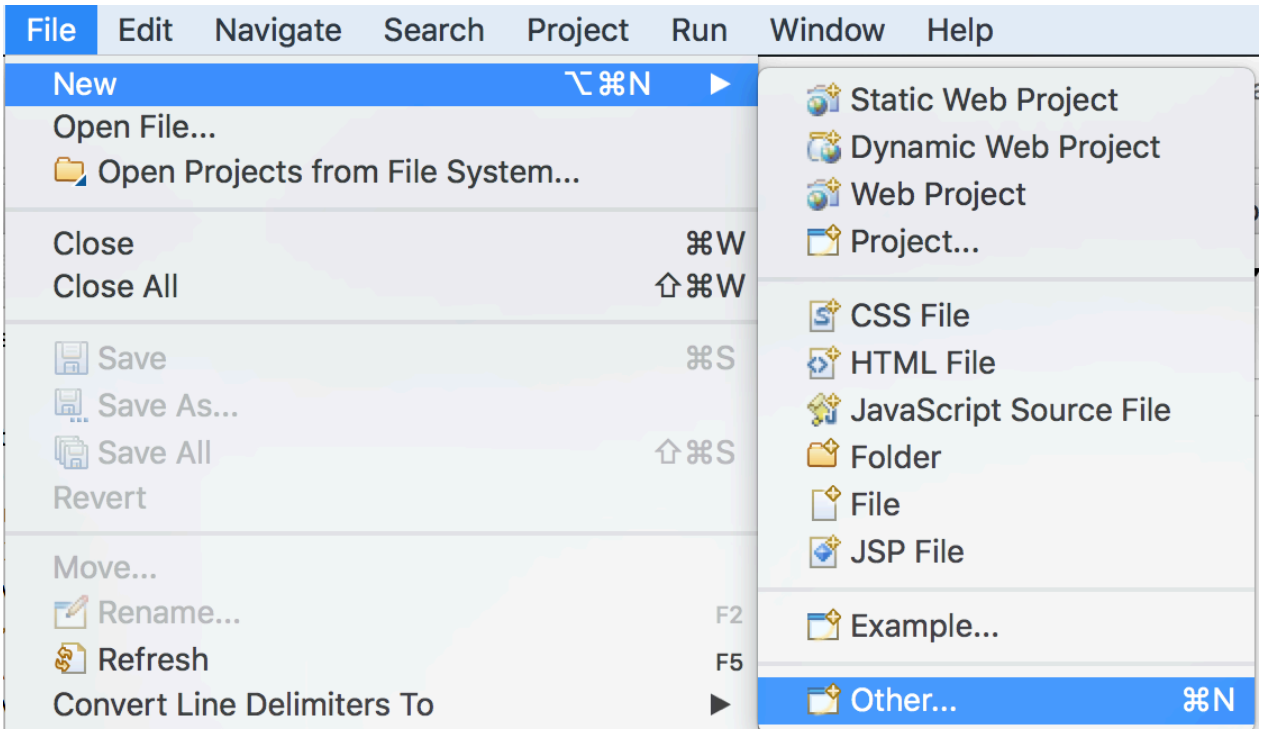
8.4 Import the Batch Artifacts

__2. Start Eclipse by running ***{LAB_HOME}*\wdt\eclipse\eclipse.exe** and select the workspace at *{LAB_HOME}*\workspace.

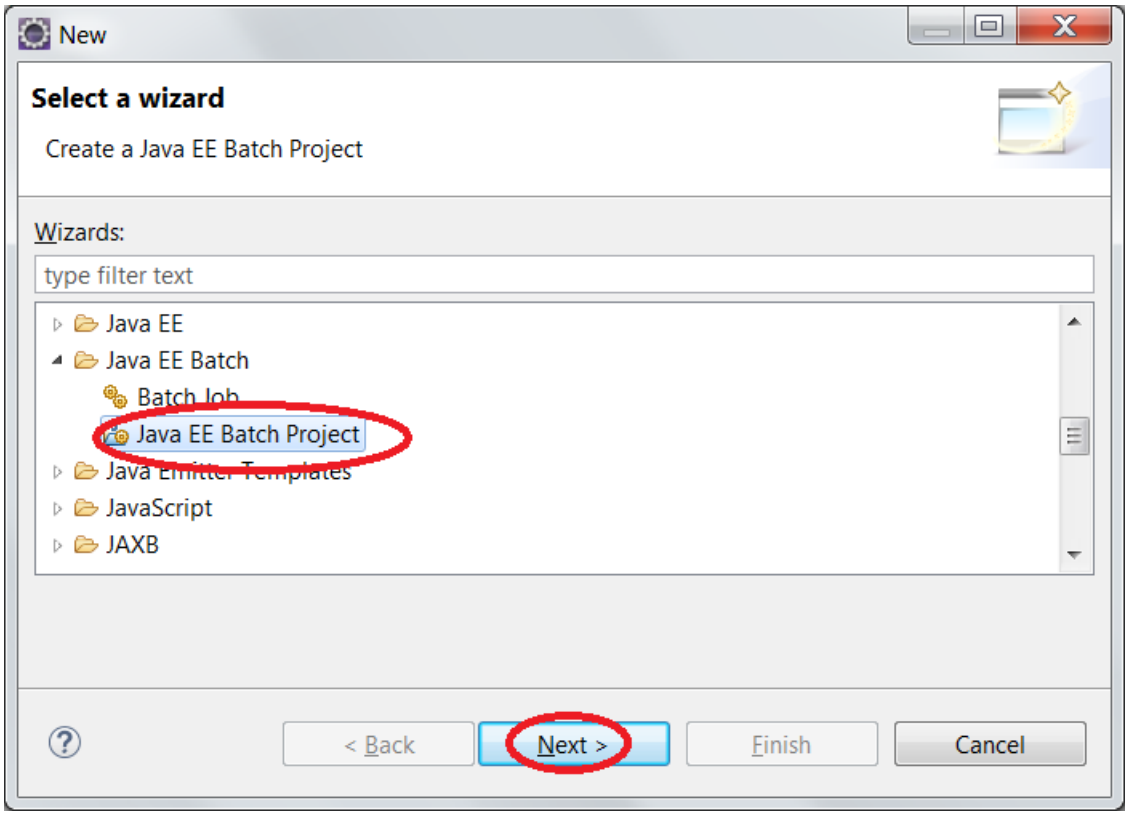


__3. Create a Java EE Batch Project called **EmployeeBatch.**

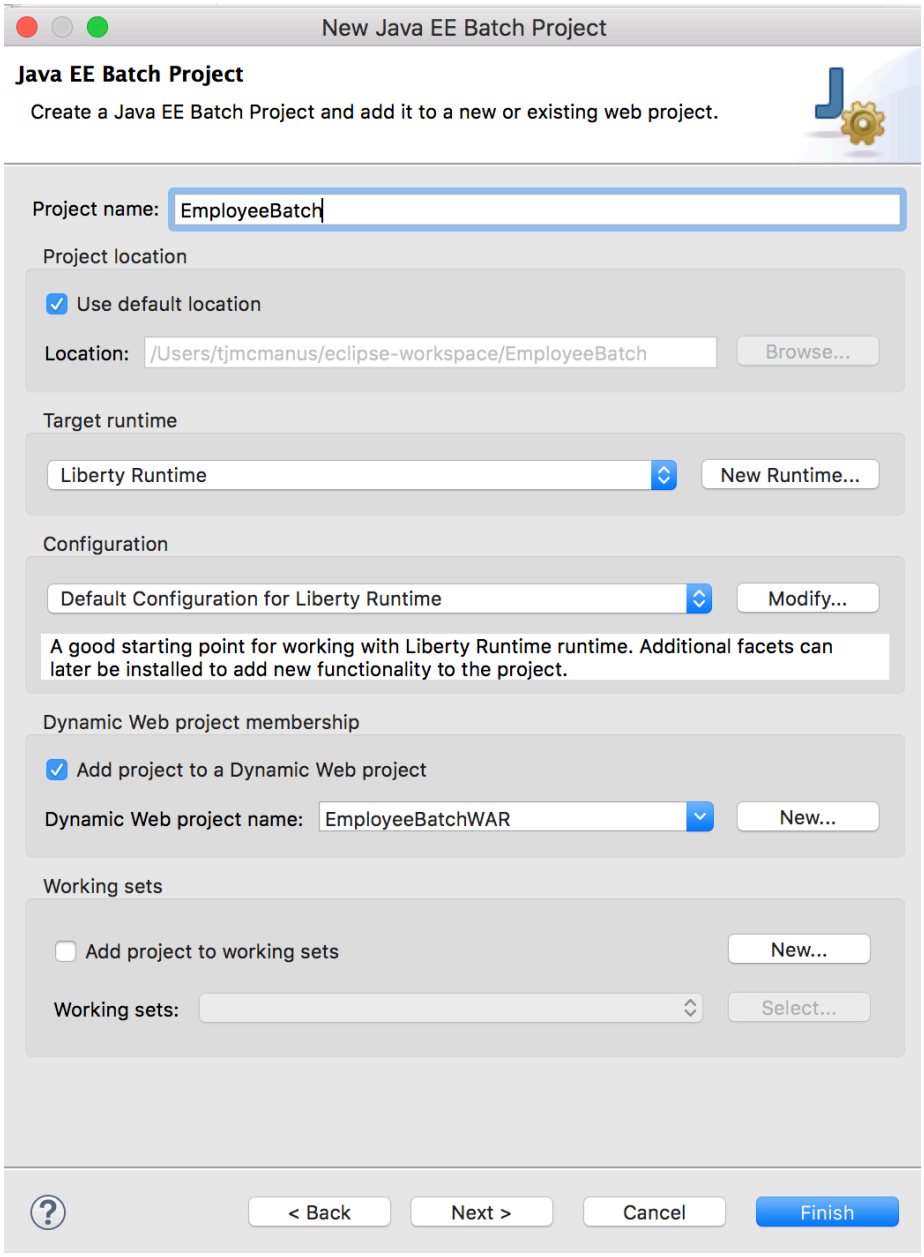
__a. Click **File > New > Other**



__b. Click **Java EE Batch Project**, then click **Next.**

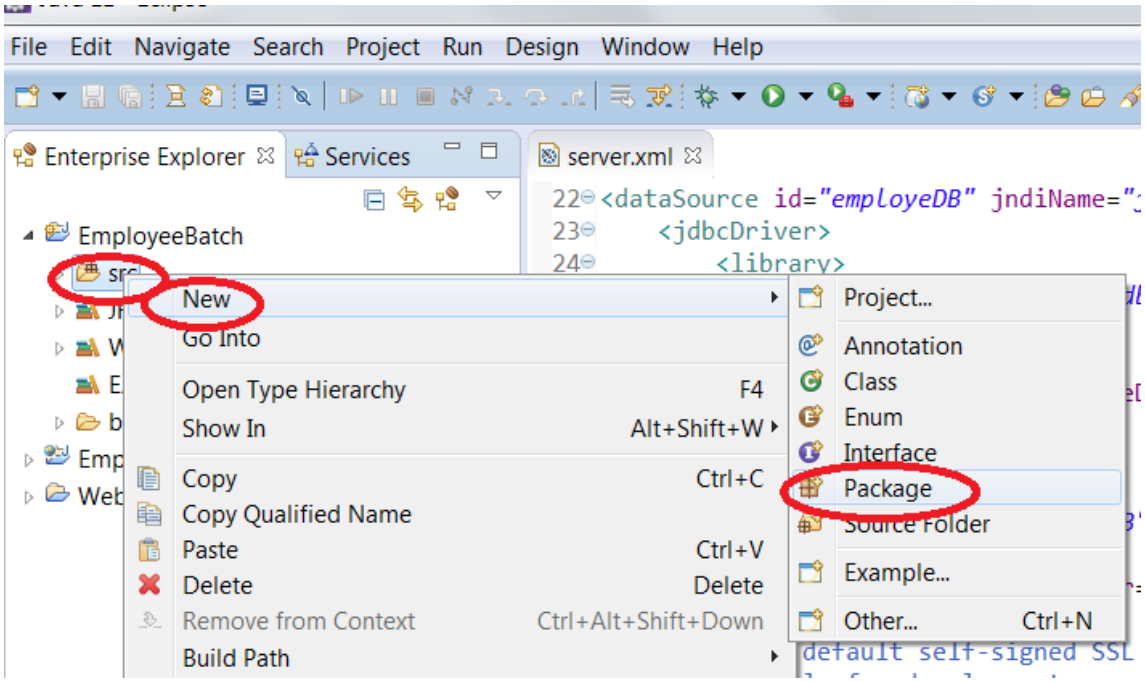


__c. For Project name, enter **EmployeeBatch.** Ensure **Add project to a Dynamic Web project** is checked, and the name is **EmployeeBatchWar.** Click **Finish.**

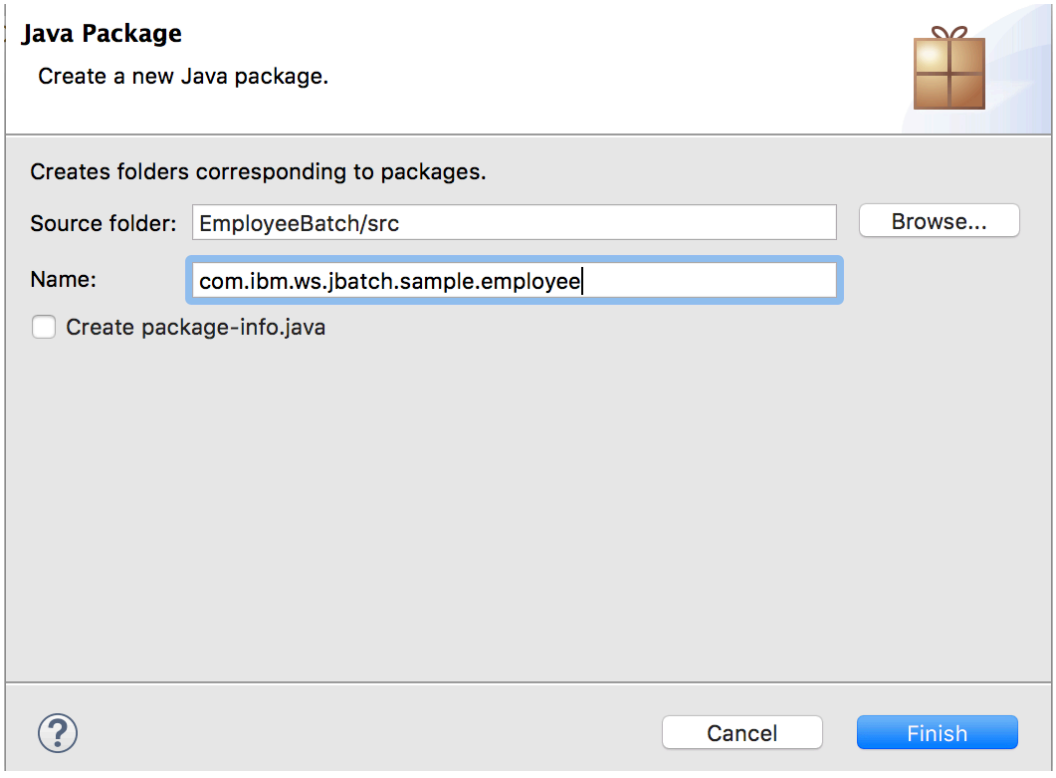


__4. Import sample artifacts

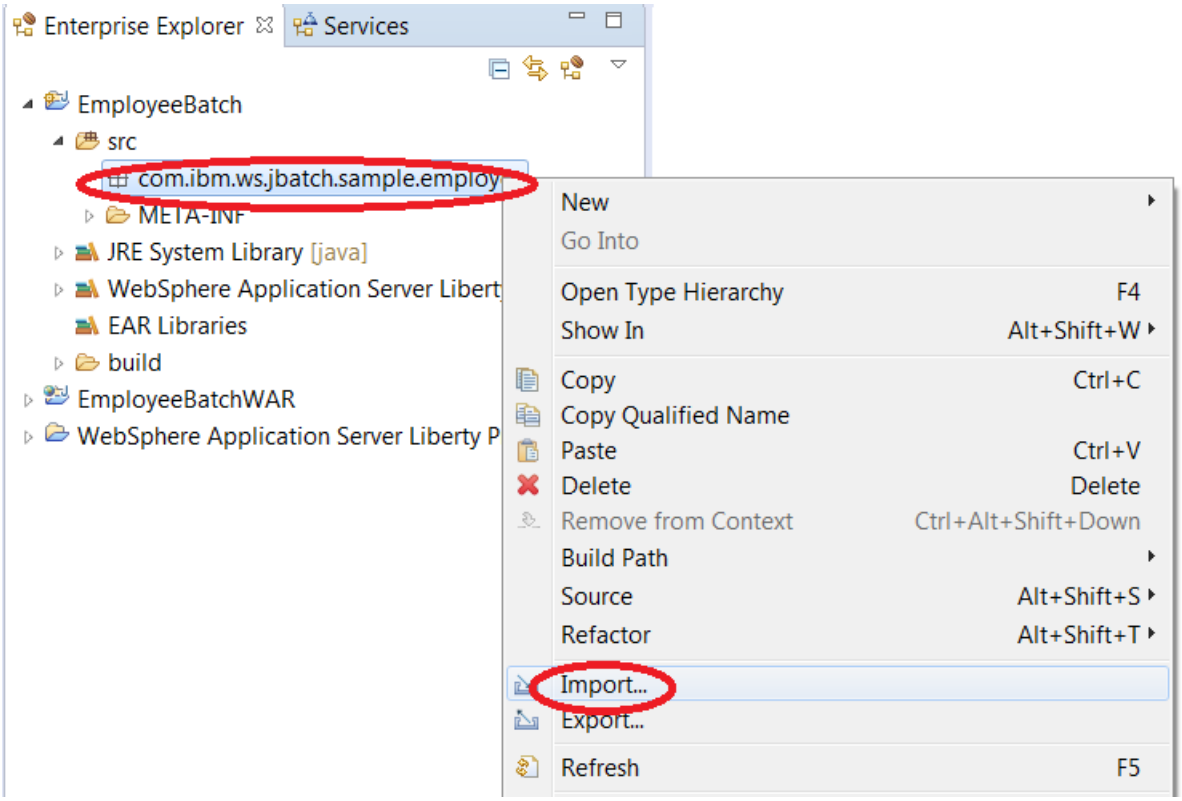
__a. From **Enterprise Explorer**, navigate to **EmployeeBatch > src.** Right click **src** and select **New > package**



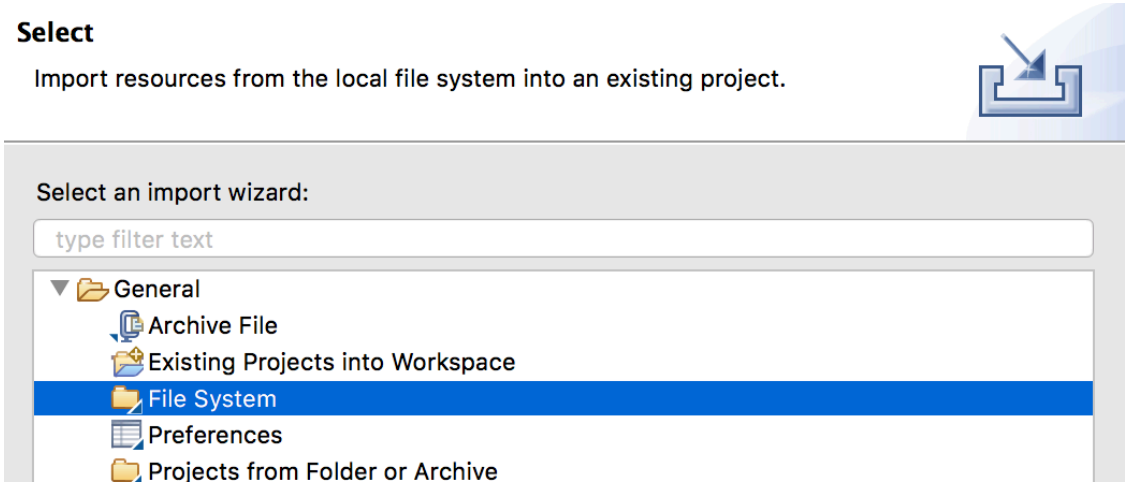
__b. For Name, enter **com.ibm.ws.jbatch.sample.employee.** Click **Finish.**



__c. Right click **com.ibm.ws.jbatch.sample.employee** package and select **import**



__d. Select **General > File System,** then click **Next**



__e. Browse **to {LAB_HOME}/labs/development/8_JavaBatch_<timestamp>** directory, select all the .java files for this lab, then click **Finish.** The java files include

__a. Employee.java

__b. InitializationBatchlet.java

__c. JDBCDataHolder.java

__d. JDBCReader.java

__e. JDBCReaderChunkListener.java

__f. JDBCWriter.java

__g. ReadTextStepListener.java

__h. StatAnalyzer.java

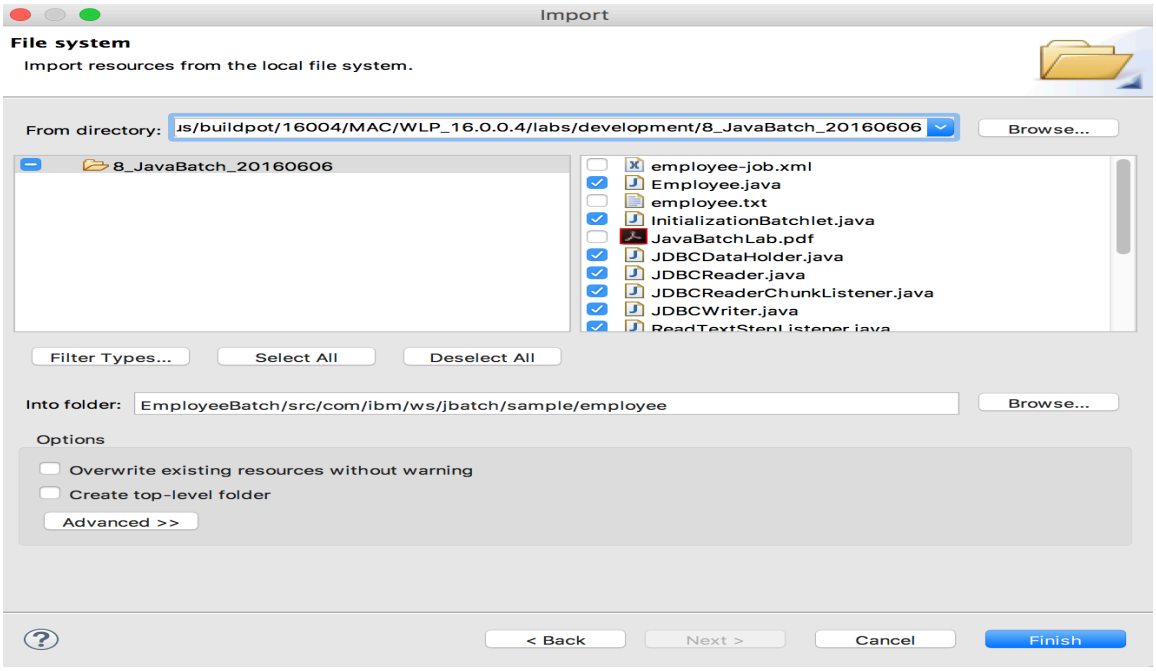
__i. StatCollector.java

__j. StatReducer.java

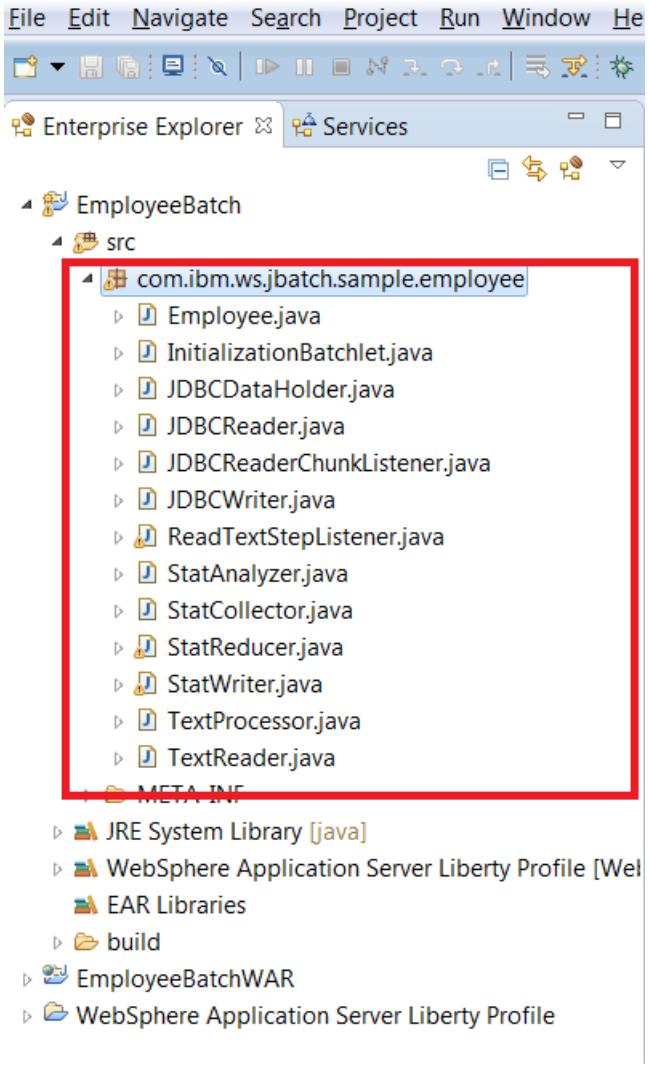
__k. StatWriter.java

__l. TextProcessor.java

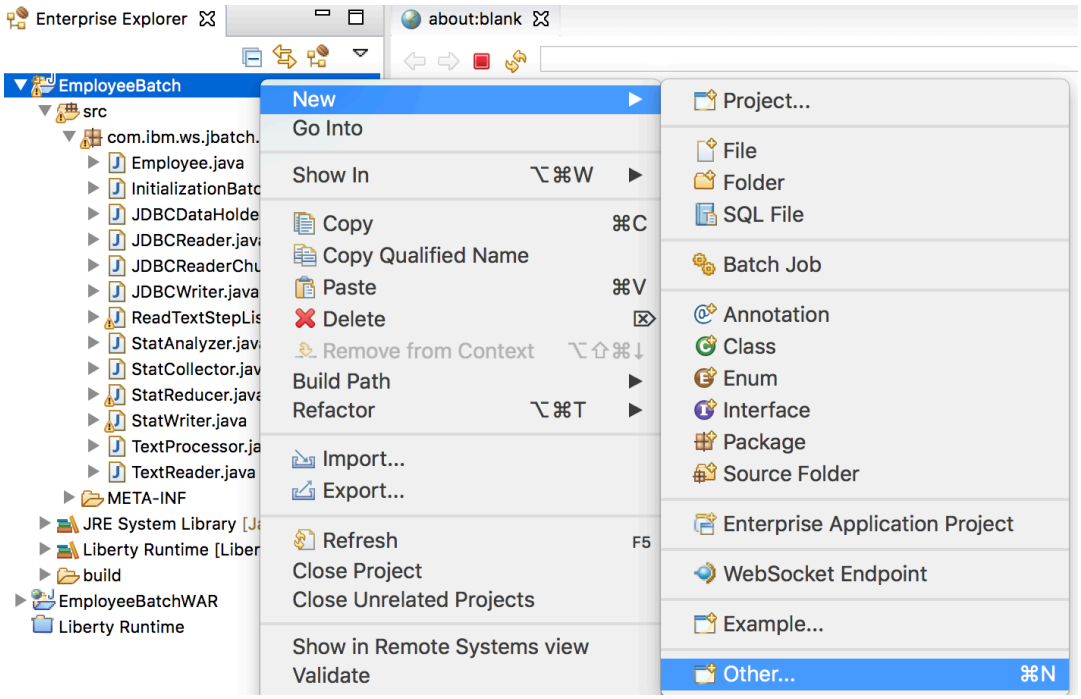
__m. TextReader.java



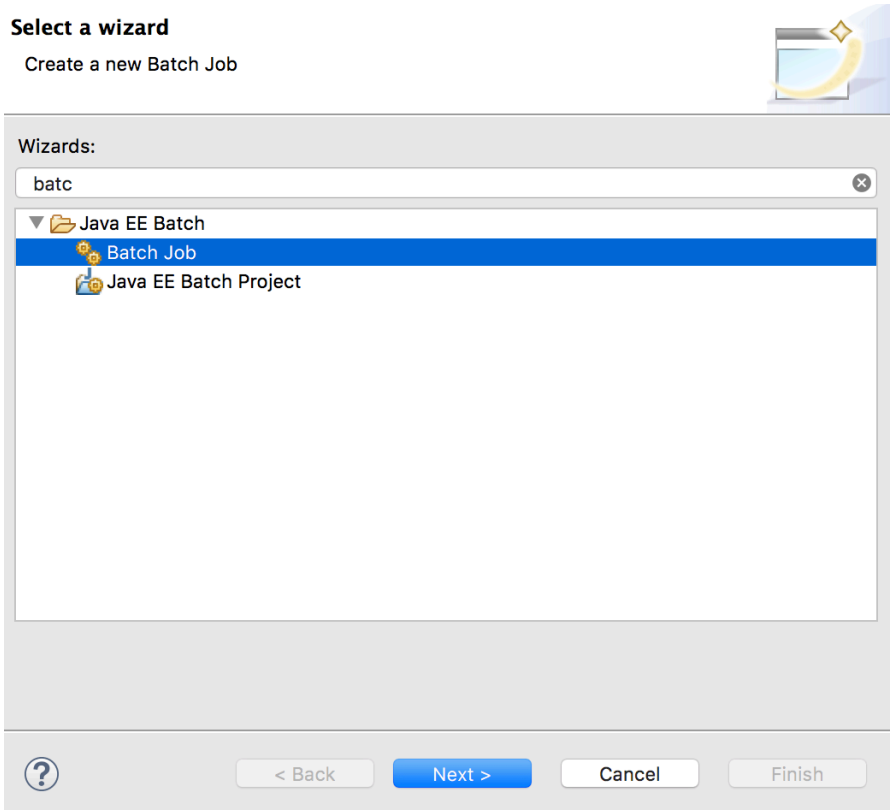
__f. Double check that all files are imported within the package



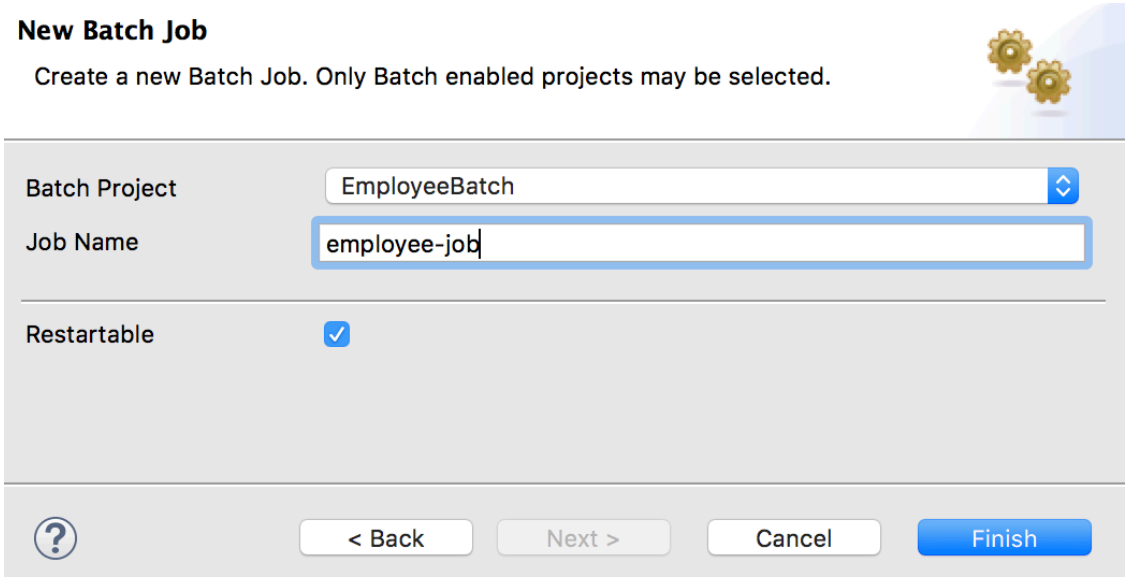
__h. Right click **EmployeeBatch** project, and navigate to **new > other**



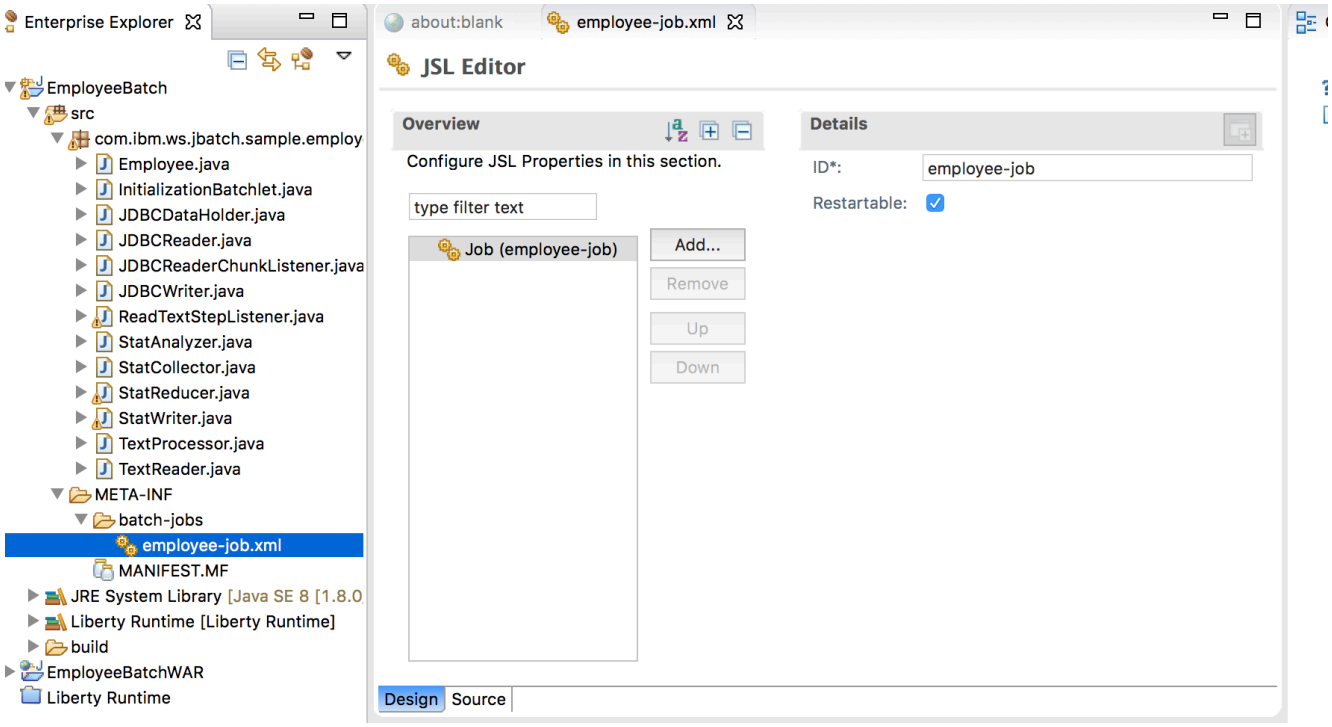
__i. Select **Batch Job** then click **Next**



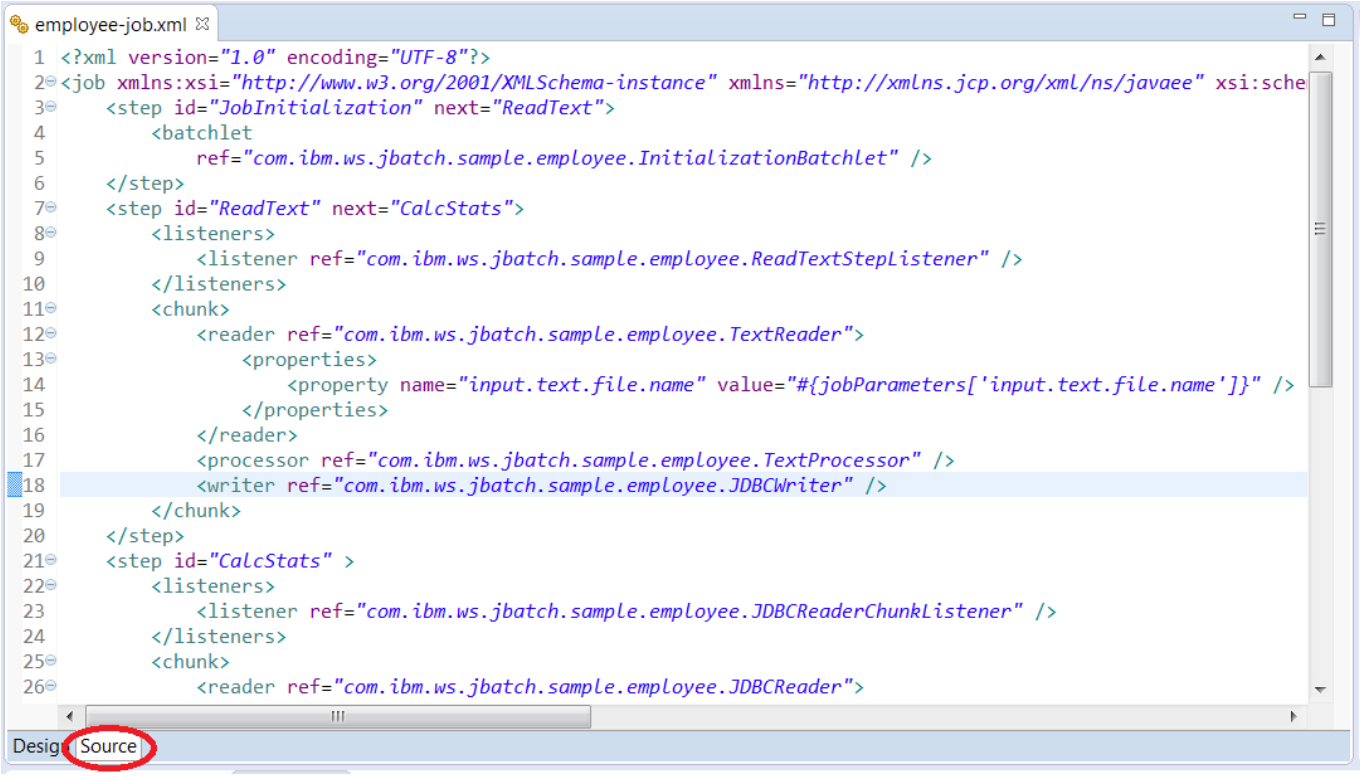
__j. For Job Name, enter **employee-job.** Click **Finish**



__l. The location of the job definition is **EmployeeBatch > src > META-INF > batch-jobs > employee-job.xml.**



__n. Click **Source** view. Copy and paste the contents of **{LAB_HOME}/labs/development/8_JavaBatch_<timestampe>/employee-job.xml to the window**. Alternately you could import this file to the project.




```
<?xml version="1.0" encoding="UTF-8"?>
<job xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="http://xmlns.jcp.org/xml/ns/javaee" xsi:sche
    <step id="JobInitialization" next="ReadText">
        <batchlet
            ref="com.ibm.ws.jbatch.sample.employee.InitializationBatchlet" />
    </step>
    <step id="ReadText" next="CalcStats">
        <listeners>
            <listener ref="com.ibm.ws.jbatch.sample.employee.ReadTextStepListener" />
        </listeners>
        <chunk>
            <reader ref="com.ibm.ws.jbatch.sample.employee.TextReader">
                <properties>
                    <property name="input.text.file.name" value="#{jobParameters['input.text.file.name']}" />
                </properties>
            </reader>
            <processor ref="com.ibm.ws.jbatch.sample.employee.TextProcessor" />
            <writer ref="com.ibm.ws.jbatch.sample.employee.JDBCWriter" />
        </chunk>
    </step>
    <step id="CalcStats" >
        <listeners>
            <listener ref="com.ibm.ws.jbatch.sample.employee.JDBCReaderChunkListener" />
        </listeners>
        <chunk>
            <reader ref="com.ibm.ws.jbatch.sample.employee.JDBCReader">
```

8.5 Code Walk Through

8.5.1 Step1: Job Initialization

The first step of our job is creating an empty table in the database.

__1. Bring up employee-job.xml in Eclipse, and review the first step. Note that it is a batchlet implemented by InitializationBatchlet

```
<step id="JobInitialization" next="ReadText">
      <batchlet
            ref="com.ibm.ws.jbatch.sample.employee.InitializationBatchlet" /> </step>
```

__2. Bring up InitializationBatchlet.java in Eclipse. A batchlet may be used to implement any arbitrary function, such as environment set up, or clean up. For our sample, the **process** method is used to create an empty table in the database.

8.5.2 Step 2: Populate Database

The second step of our job is to populate the database table with input from a text file.

__1. Bring up **employee-job.xml** in Eclipse, and review the second step, “ReadText”. Note that

__a. This is a chunk with

__a. Reader: TextReader

(1) The property **input.text.file.name** is associated with job parameter input.text.file.name. The job parameter and its value is specified when starting the job later in this lab.

__b. Processor: TextProcessor

__c. Writer: JDBCWriter

__b. A listener called ReadTextStepListener is used. The listener implements the `javax.batch.api.listener.StepListener` interface. The `afterStep()` method is implemented, which counts and prints the number of records inserted into the Employee database table.

```
<step id="ReadText" next="CalcStats">
<listeners>
      <listener ref="com.ibm.ws.jbatch.sample.employee.ReadTextStepListener" />
</listeners>
<chunk>
      <reader ref="com.ibm.ws.jbatch.sample.employee.TextReader">
            <properties>
                  <property name="input.text.file.name"
value="#{jobParameters['input.text.file.name']}" />
            </properties>
      </reader>
      <processor ref="com.ibm.ws.jbatch.sample.employee.TextProcessor" />
      <writer ref="com.ibm.ws.jbatch.sample.employee.JDBCWriter" />
</chunk>
</step>
```

__3. Bring up TextReader, the class used to read a record from a text file and note:

__a. It gets the input file name from the batch property input.text.file.name. This is associated with job parameter input.text.file.name in employee-job.xml

```
@Inject
  @BatchProperty(name = "input.text.file.name")

            String inputFileName;
```

__b. The variable lastRecord is used to track the position of the last record read. This variable is also the checkpoint information. If the step fails, the batch container can ask the reader to restart from the last known checkpoint.

```
private Long lastRecord = new Long(0);
```

__c. The method **readItem** just reads the next line from the input file, and increments the **lastRecord** variable.

__d. The method **open** is called with variable **checkPoint** set to null on first call. In this case, the reader will read the file from the beginning. If the **checkPoint** is not null, then it is the position of the last record read. The code will skip all previously records to start reading at the correct place indicated by the checkpoint.

```
  public void open(Serializable checkPoint) throws java.io.IOException {

            input = new BufferedReader(new FileReader(inputFileName));
            lastRecord = (Long)checkPoint;
            if ( lastRecord == null) {
                 // No previous checkpoint. Read from beginning
               lastRecord = new Long(0);
            }
            // skip up to last record
            for (long i=0; i < lastRecord.longValue(); i++){
               input.readLine();
            }
}
```

__e. The **checkpointInfo** method returns the value of **lastRecord** variable as the checkpoint.

__4. Bring up **TextProcessor,** the class used to process each item read by TextReader. Note the **processItem** method is used to convert one input string into an **Employee** record.

__5. Bring up **JDBCWriter,** the class used to populate the database table with **Employee** records.

__a. The **open** method is used to initialize the data source connection.

__b. The **writeItems** method is used to write a List of Employee objects into the database. The batch container reads items in chunks, by default 10 at time. Each item read is passed to an ItemProcessor, in our case the TextProcessor. After collecting the results of processing the entire chucnk, they are then sent to the ItemWriter, in this case our JDBCWriter, to write one chunk worth of records.

__c. Note that a transaction is committed at the end of chunk processing. If an error occurs, the transaction is rolled back, and the container may restart from the last checkpoint.

__6. Bring up **ReadTextStepListener** and note that the **afterStep** method, called at the completion of the step, is used to print out the total number of records in the database table for sanity check.

8.5.4 Step 3: Read from Database and Calculate Statistics

The third step of our job is to count the number of rows in the database using two partitions. This sample may be easily extended to cover more complex scenarios.

__1. Bring up employee-job.xml and examine the last step, “calcStats”.. Note that

- __a. It is a chunk with
  - __a. JDBCReader to read from the database. The properties **firstID** and **lastID** needed by the reader are mapped to the partition plan.
  - __b. No processor. The JDBCReader is already reading Employee records. Therefore, no processor is required.
  - __c. StatWriter to write the output.
- __b. It contains two partitions. Each partition runs on a different thread, and uses one instance of reader/processor/writier.
  - __a. Partition 0 is used to process employees whose IDs range from 1230000 to 1230049.
  - __b. Partition 1 is used to process employees whose IDs range from 1230050 to 1230099.
- __c. It uses StatCollector to collect statistics for each chunk. A collector runs in the same thread as the chunk.
- __d. It uses StatAnalyzer to receive data from each chunk. An analyzer runs on the same thread as the parent step.
- __e. It uses StatReducer to output the final statistics. A reducer runs on the same thread as the parent step.

__g. It uses chunk listener JDBCReaderChunkListener to receive callbacks during chunk processing and perform additional operations.

```
      <step id="CalcStats" >
            <listeners>
                  <listener ref="com.ibm.ws.jbatch.sample.employee.JDBCReaderChunkListener"
/>
            </listeners>
            <chunk>
                  <reader ref="com.ibm.ws.jbatch.sample.employee.JDBCReader">
                        <properties>
                              <property name="firstID" value="#{partitionPlan['firstID']}"
/>
                              <property name="lastID" value="#{partitionPlan['lastID']}"
/>
                        </properties>
                  </reader>
                  <writer ref="com.ibm.ws.jbatch.sample.employee.StatWriter" />
            </chunk>
            <partition>
                  <plan partitions="2">
                        <properties partition="0">
                              <property name="firstID" value="1230000" />
                              <property name="lastID" value="1230049" />
                        </properties>
                        <properties partition="1">
                              <property name="firstID" value="1230050" />
                        </properties>
                  </plan>
                  <collector ref="com.ibm.ws.jbatch.sample.employee.StatCollector" />
                  <analyzer ref="com.ibm.ws.jbatch.sample.employee.StatAnalyzer" />
                  <reducer ref="com.ibm.ws.jbatch.sample.employee.StatReducer" />
            </partition>
</step>
```

__2. Bring up JDBCReader.java and note

__a. the properties **firstID** and **lastID.** When using partitions, each partition contains a different instance of the reader/processor/writer. Therefore, the properties **fisrtID** and **lastID** are used to control which part of the database is to be read by the partition instance.

__b. the **open** method is called with checkpoint information. If the variable **checkpt** is null, there was no previous checkpoint. All the relevant data is stored in the JDBCDataHolder. Some of the data, such as firstID and lastID, are transient, and need to be repopulated.

__c. The **readItem** method merely gets the next record from the JDBC ResultSet. The result set is stored in the step context JDBCDataHolder. The result set is initialized during chunk start by the JDBCReaderChunkListener.

__d. The **readItem** method also increments the number of records read by one.

__3. Bring up JDBCWriter.java. Note that this is a dummy class to satisfy the requirement of having an ItemWriter. The actual operations of the step does not require a writer.

__4. Bring up JDBCReaderChunkListener.java and note that

__a. In the **beforeChunk** method, it resets the number of records read to 0, and produces a new ResultSet for the next batch of records. This is required because the batch container commits the transaction after processing each chunk, by default after10 records. After the transaction commits, the ResultSet is no longer valid. There are two solutions for this issue:

__a. Use a ChunkListener to re-issue an updated query at the beginning of chunk processing, the solution in the sample.

__b. Use a non-transactional data source. This is also a suitable solution for scenarios involving reading records from the database to produce statistics.

__5. Bring up **StatCollector.** A collector runs on the chunk's thread, and is called at the end of chunk processing to produce data for the chunk to be passed to the analyzer. The **StatCollector** merely produces the number of records read for the current chunk.

__6. Bring up **StatAnalyzer.** An analyzer runs in the threads of the parent step to consolidate information coming from the chunks at the end of chunk processing. For **StatAnalyzer** it just adds the number of additional records read by the chunk to the number of records it keeps track on the step context's transient data. Note that the parent thread and the children threads for each partition do not share the same step context.

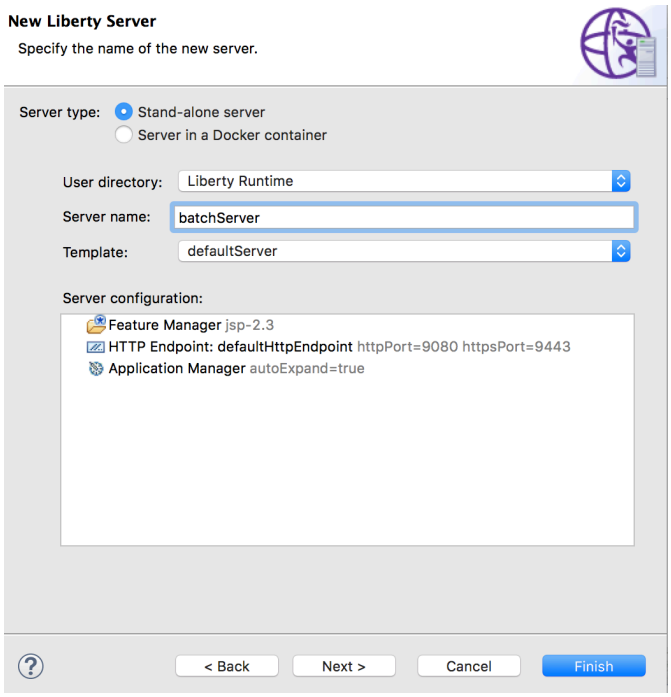
__7. Bring up **StatReducer** and note that it prints the final tally in the **afterPartitionedStepCompletion** method.

8.6 Running the Lab

8.6.1 Now that we understand how the sample is put together, we are now ready to run it.

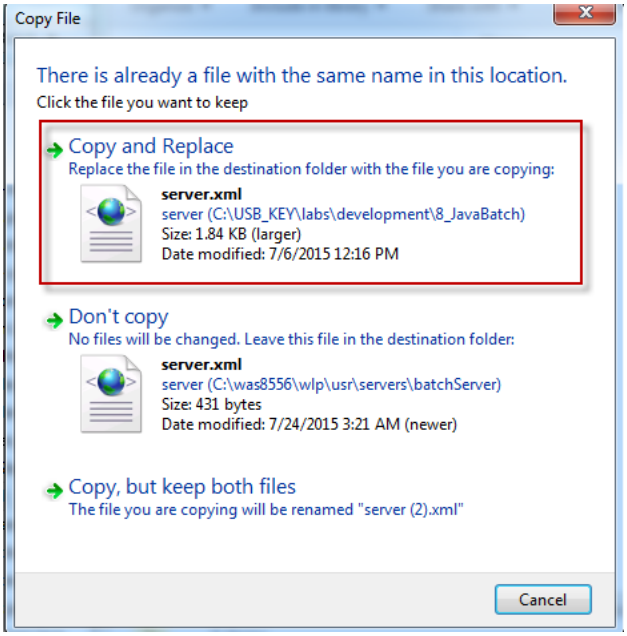
__8. From Eclipse WDT, create a new server called **batchServer**.

Ensure you select the “Existing installation path for Liberty, when creating the server.



__9. Copy the file {**LAB_HOME}/labs/development/8_JavaBatch_<timestamp>/employee.txt** to **{LAB_HOME}/wlp/usr/servers/batchServer** directory. This is the input text file to be used to populate the database. It contains information for 100 employees.

__10. Copy / paste {LAB_HOME}/labs/development/8_JavaBatch_<timestamp>/server.xml to **{LAB_HOME}/wlp/usr/servers/batchServer/server.xml.** When prompted to overwrite the file, select 'YES" or 'OK".



__11. Open the server.xml file located in {LAB_HOME}/wlp/usr/servers/batchServer and observer the following:

__a. The feature **batchManager-1.0** is used for running and managing batch jobs.

__b. The batchDB data source is required by the batch container to store job related information, including checkpoints.

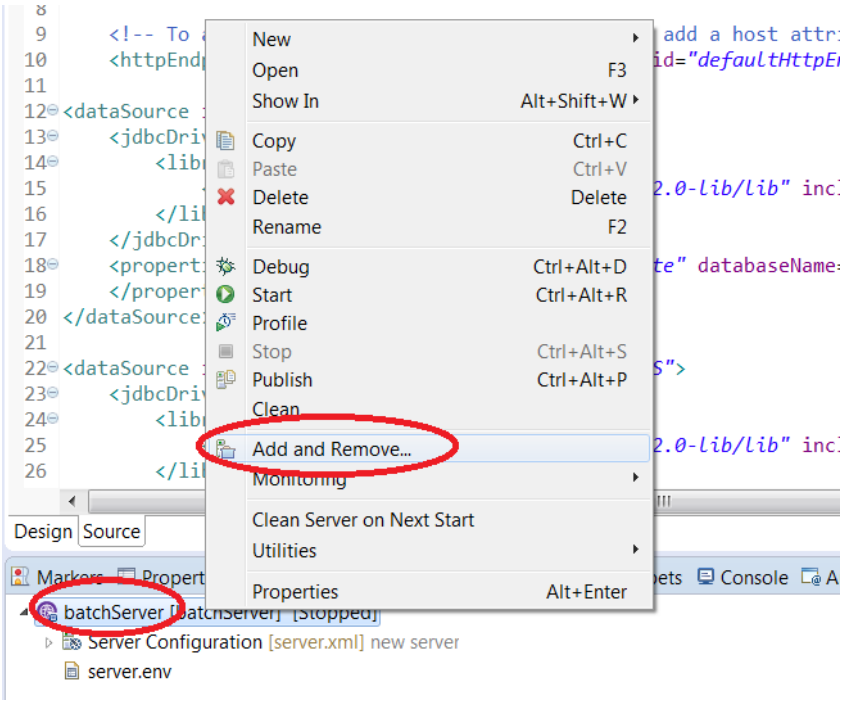
__c. The employeeDB data source is used to access the employee table

__d. Change the derby driver location in the fileset tag. Then save

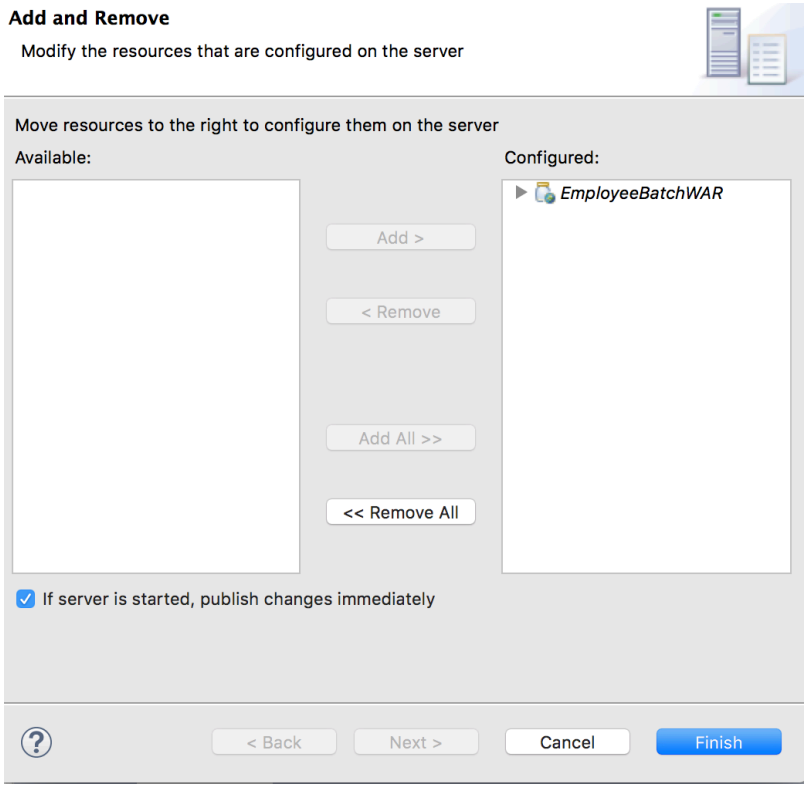
```
<dataSource id="batchDB" jndiName="jdbc/batch">
    <jdbcDriver>
        <library>
            <fileset dir="${LAB_HOME}/db-derby-10.14.1.0-lib/lib" includes="derby.jar"/>
        </library>
    </jdbcDriver>
    <properties.derby.embedded createDatabase="create"
databaseName="${server.config.dir}/resources/BATCHDB">
    </properties.derby.embedded>
</dataSource>

<dataSource id="employeDB" jndiName="jdbc/employeeDS">
    <jdbcDriver>
        <library>
            <fileset dir="${LAB_HOME}/db-derby-10.14.1.0-lib/lib" includes="derby.jar"/>
        </library>
    </jdbcDriver>
    <properties.derby.embedded createDatabase="create"
databaseName="${server.config.dir}/resources/EMPLOYEEDB">
    </properties.derby.embedded>
</dataSource>
```

__12. Add EmployeeBatchWar web application to the server

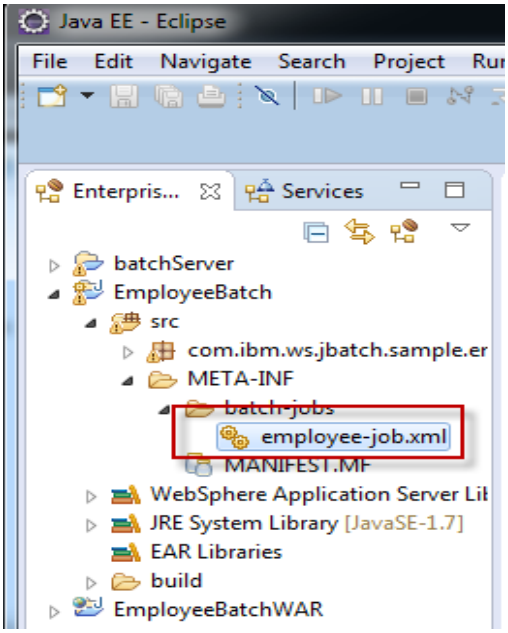
__a. Right click batchServer and select **Add and Remove**



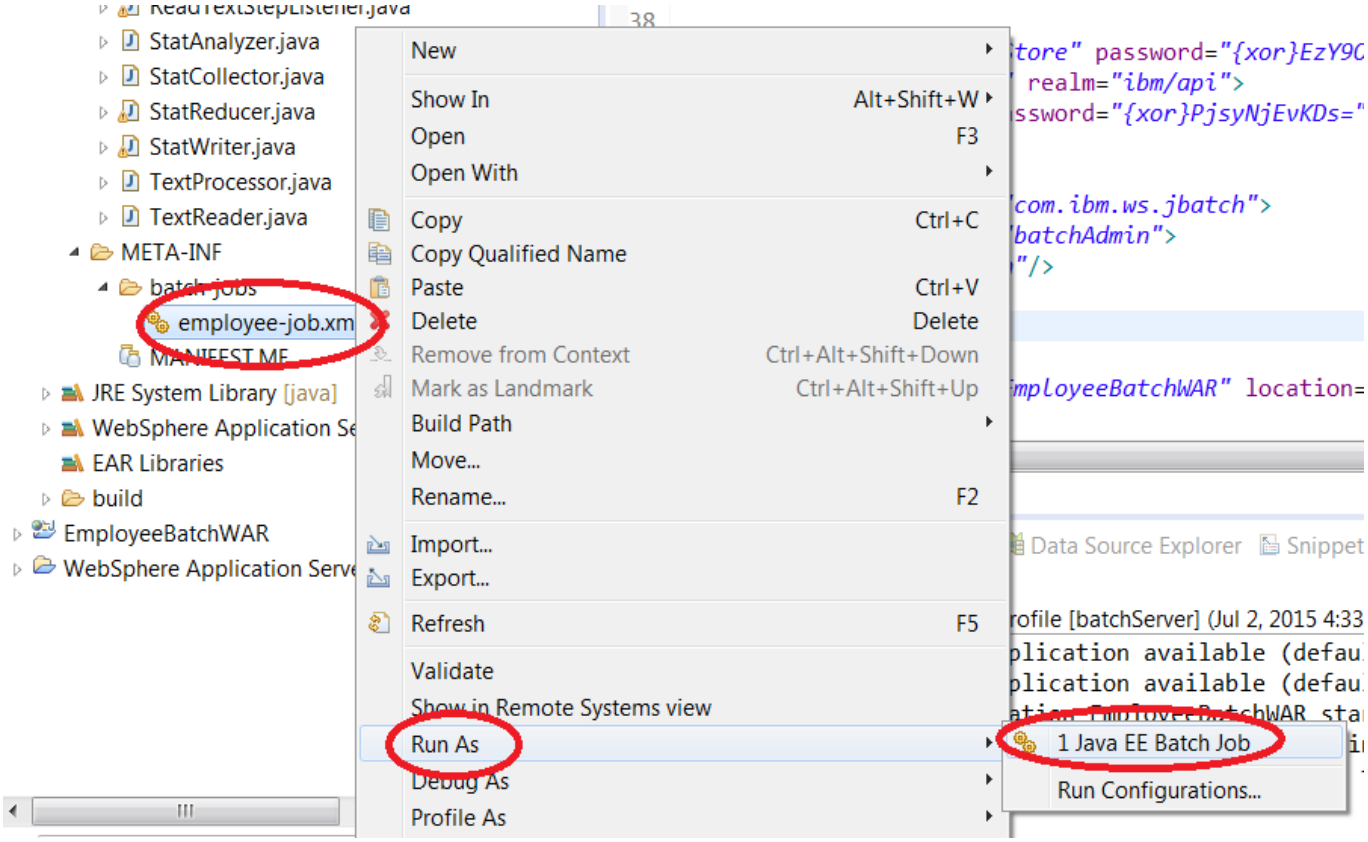
__b. Add EmployeeBatchWar and click **Finish.**



__13. Start batchServer



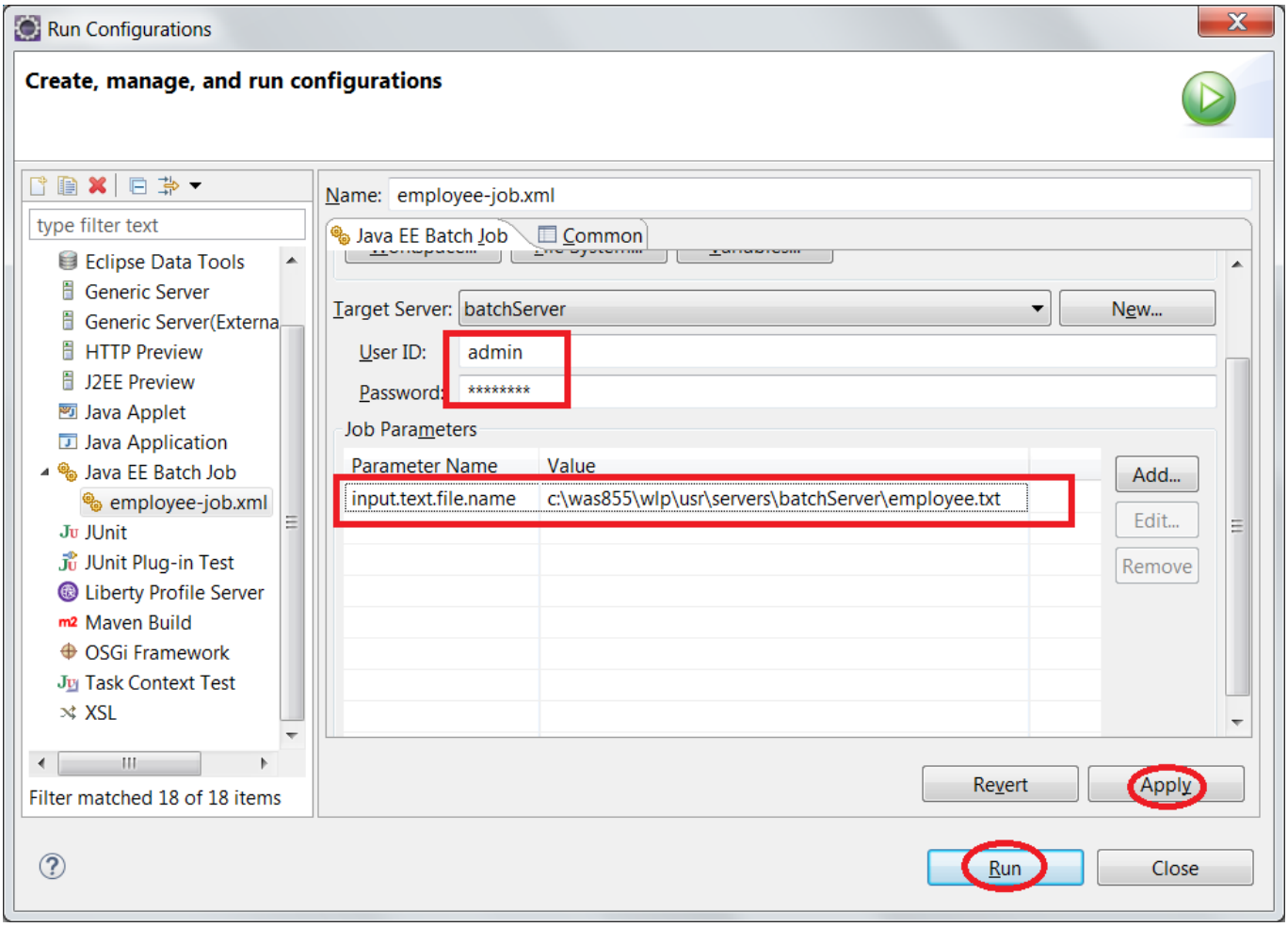
__14. Right click **employee-job.xml** and select **Run As > Java EE Batch Job**



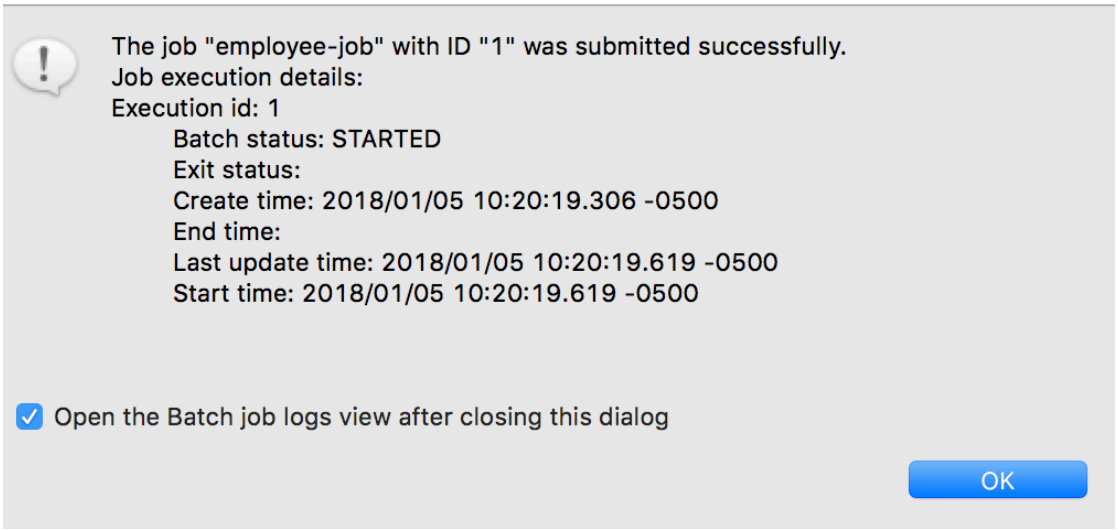
__15. For User ID, enter **admin**. For password, enter **adminpwd.** Add a new job parameter with

Parameter Name: **input.text.file.name**

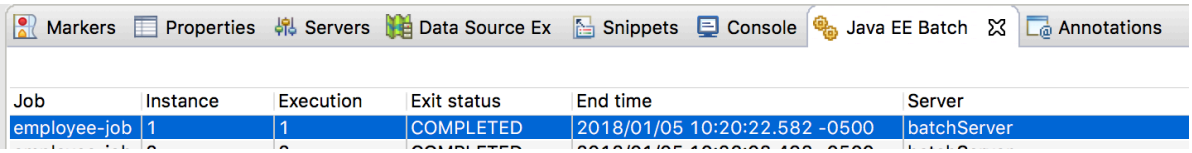
Value: **{LAB_HOME}\wlp\usr\servers\batchServer\employee.txt**



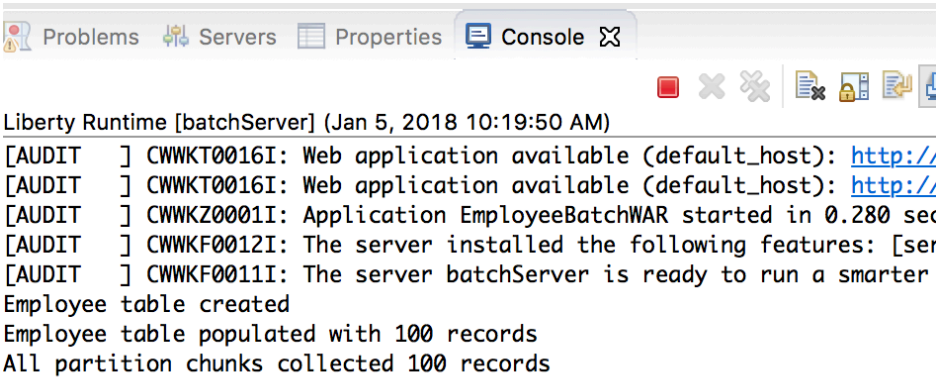
__16. Click OK for the pop-up about job submission.



__17. The Java EE Job Logs window should show job completed successfully.



__18. The console window should show the output from the three steps:



__19. (Optional) Take a look at the contents of {LAB_HOME}/wlp/usr/servers/batchServer/logs/jobLogs directory.

8.6.2 Command Line Utility

Change directory to {LAB_HOME}/wlp/bin and try the following commands:

__1. Submit a job. Note the option --trustSslCertificates bypasses certificate verification, and should only be used if you trust the host/port you're connecting to.

```
batchManager submit --user=admin --password=adminpwd --
batchManager=localhost:9443 --jobXMLName=employee-job --
moduleName=EmployeeBatchWAR.war --trustSslCertificates --
jobParameter=input.text.file.name={LAB_HOME}/wlp/usr/servers/batchServer/empl
oyee.txt
```

__2. List jobs and their status

```
batchManager listJobs --user=admin --password=adminpwd --
batchManager=localhost:9443 --trustSslCertificates
```

__3. Get more information about batchManager

```
batchManager –help
```

8.7 Clean up after lab

__1. Stop the server **batchServer.**

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