Repast Simphony Database Outputter Plugin - Documentation

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1 Introduction

This documentation version is related to the plugin version 0.90 for Repast Symphony 2.0.0. The database outputter works analogous to a file outputter extending log4j's `JDBCAppender`. Like the file outputter, the database outputter is configured via a 2-step wizard reusing/extending the file outputter and JDBC freezedryer wizards. The code should integrate well into simphony as a plugin.

The performance of writing to a DB compared to a file is addressed by adding the option to cache a certain number of SQL statements and execute these at once. This might reduce the additional time to a negligible amount. The advantage is to directly put data in the database without getting confused about numerous files somewhere on the hard disk.

Features include:

- Caching of a definable number of outputs before SQL execution
- Uses prepared statements (MySQL)
- Configuration via 2-step wizard
  - Auto-completion for URL and driver in database properties wizard step
  - Ability to test MySQL connection
  - Choose whether to store login information or to be prompted
- Integrates well in Repast Simphony as plugin folder
- Uses RS parameters to add information
  - `RUN_ID`
  - `PARAM_SET_ID`
- Creates MySQL table if it does not exist
- Run information management

1.1 Selection of applied runID

The run information entry is usually made in the dabase at the first loggin, even if caching is enabled. The run id for that entry is usually indentified during the outputter's initialisation during context building (see table). An exception occurs when `getCurrentMaxRunId()` is called before.

RUN_ID (RS)	run info table given	run id
set	yes	RUN_ID or next valid number
set	no	RUN_ID
not set	yes	MAX(runID) + 1 in run info
not set	no	MAX(runID) + 1 in result table
any error		1

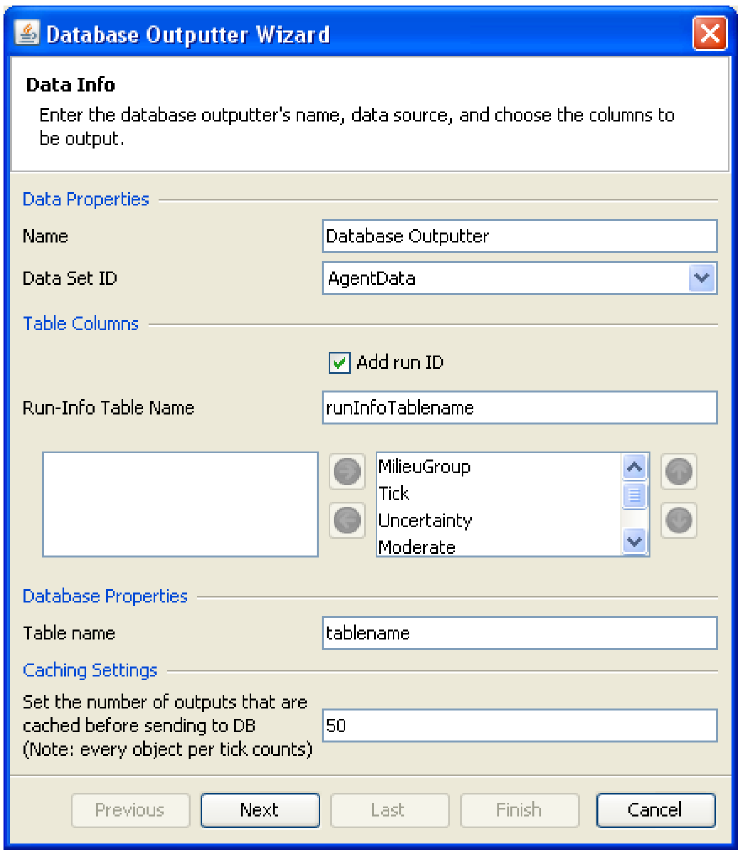
2 Installation

Just extract the zip file `RsDbOutputter4Rs2.0.0-0.90.zip` into your eclipse installation folder. The result should be a new folder called `repast.simphony.data.batch_2.0.0` and `repast.simphony.data.db_2.0.0.jar` within the plugin folder. Furthermore, the existing file `repast.simphony.bin_and_src_2.0.0/repast.simphony.bin_and_src.jar` should have been overwritten.
If you use the file `repast.simphony.bin_and_src.jar` at other lcoations (it is required for batch runs) you should exchange these as well.

3 Setting up a Database Outputter Action

A Database outputter action is configured similar to a file outputter action. After you configured one or more data sets, in the scenario tree, right-click on "Outputters" and choose "Add DB Outputter". The wizard's first step page (figure 1) appears:

- Data Properties
  - **Name:** Choose an arbitrary name for the outputter action that itentifies the outputter in the sceanrio tree.
  - **Data Set ID:** Use the drop-down menu to choose a previously configured data set.
- Table Columns
  - **Add run ID:** This is important for batch runs. In case it is activated the plugin adds a column "runID" to each data row. The highest runID will be queried from the table and increased. In case of a new table it start with 1.
  - **Run-Info Table Name:** Specify the name of the table that contains run information. This is used to assign unique run IDs. However, if there is another DB-Outputter used before in a particular run, the corresponding run-info table name is used. Furthermore, if there is an earlier call to `DefaultDBOutputter.getCurrentMaxRunId( runInfoName, dbConInfo)` that run-info table is used.


Database Outputter Wizard

Data Info

Enter the database outputter's name, data source, and choose the columns to be output.

Data Properties

Name	Database Outputter
Data Set ID	AgentData

Table Columns

[✓] Add run ID

Run-Info Table Name	runInfoTablename

MilieuGroup
Tick
Uncertainty
Moderate

Database Properties

Table name	tablename

Caching Settings

Set the number of outputs that are cached before sending to DB (Note: every object per tick counts)	50

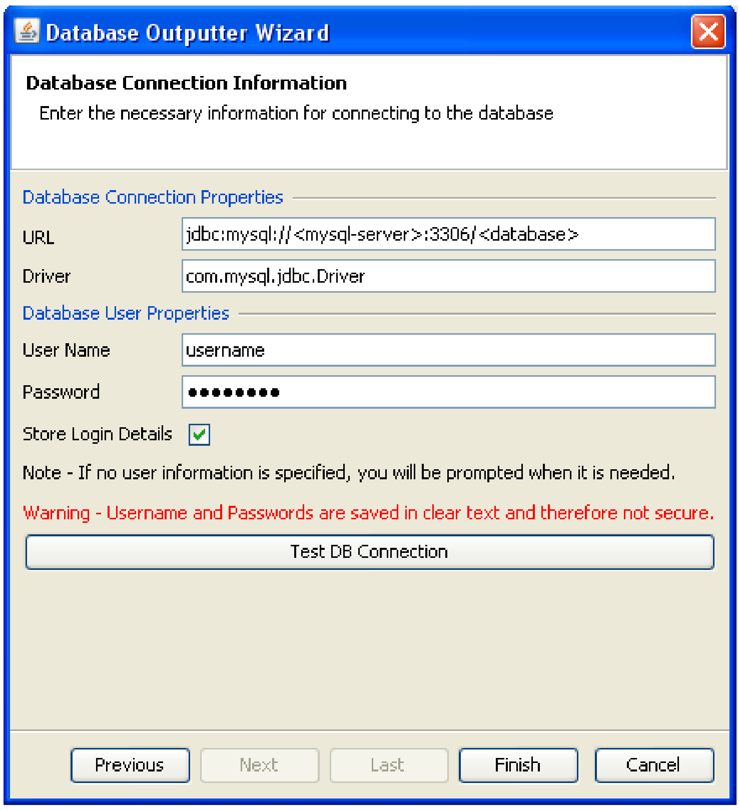
Figure 1: Wizard Step 1

  - Move the columns that shall be stored in DB to the left.

- Data Base Properties
  - **Table name:** Type in the name of the table the data shall be stored in. NOTE: If the table does not exist, the plugin tries to create a new table.

- Caching Settings
  - Specify the number of outputs that are cached before the data is sent to the database. This can save an enormous amount of time since a single database query could be very time consuming. Every object per tick counts. I.e., if the data set is defined to gather data from 5 agents every second tick, data will be passed to the database after 20 ticks when the number of outputs to cache is 50. Note that the interval of data storage is defined during the configuration of the data sets.

The second wizard step (figure 2) deals with database connection properties:



Database Connection Information

Enter the necessary information for connecting to the database

Database Connection Properties

URL	jdbc:mysql://<mysql-server>:3306/<database>
Driver	com.mysql.jdbc.Driver

Database User Properties

User Name	username
Password	••••••••
Store Login Details	✓

Note - If no user information is specified, you will be prompted when it is needed.

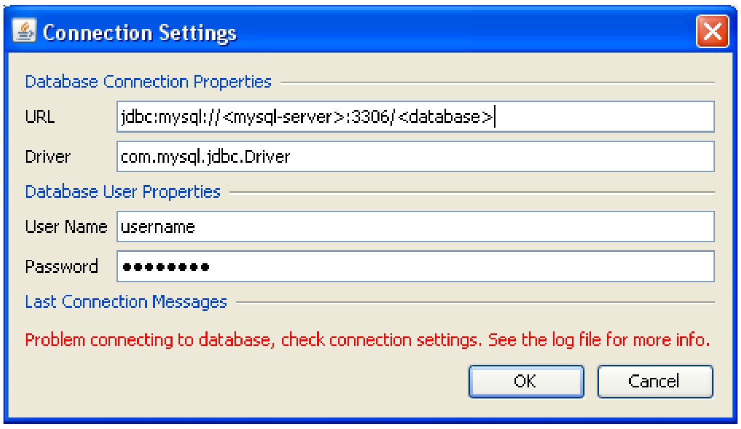
Warning - Username and Passwords are saved in clear text and therefore not secure.

Figure 2: Wizard Step 2

- Database Connection Properties
  - **URL:** State the URL of the database you want to connect to, e.g. `jdbc:mysql://mysql:3306/simulations`. This text field features auto completion.
  - **Driver:** Specify the JDBC driver class according to your database, for instance `com.mysql.jdbc.Driver`. Make sure that the driver is available at the classpath. The MySQL Connector-J library containing the driver may be downloaded from `http://www.mysql.com/downloads/connector/j/`. This text field features auto completion.
- Database User Properties
  - **User:** The username to connect with.
  - **Password:** Specify the password to log on at the database if there are no security concerns since passwords are stored in clear text in the outputter deciption XML file within the model configuration folder (*.rs). If there are concers, uncheck to following box.
  - **Store Login Details:** If it is checked username and password will be stored in clear text to the configuration file. If the box is

unchecked, input fields for username and password are disabled. Furthermore, the “Test DB Connection”-Button is diabled since it is not possible to check the connection without username and password. However, it is possible to check the box, fill in username and password, check the connection, and uncheck the box to prevent storing login data. When no username and password are given, the plugin prompts for login data when the simulations is initialised. Then, also a connection test is performed (figure 3).

– **Test DB Connection-Button:** Press the button to test a connection to the MySQL-Database with given parameters. If the test fails, a dialog (figure 3) appears and gives the opportunity to correct the data. If the test passes, the newly entered data is passed to the second wizard step.


Connection Settings

Database Connection Properties

URL jdbc:mysql://<mysql-server>:3306/<database>

Driver com.mysql.jdbc.Driver

Database User Properties

User Name username

Password ••••••••

Last Connection Messages

Problem connecting to database, check connection settings. See the log file for more info.

Figure 3: Wizard Step 2 Communication Settings

4 Implementation

4.1 DefaultDBOutputter

`DefaultDBOutputter. CachedJdbcAppender` extends `JDBCAppender` and uses most of the functionality. To enable chaching, `DefaultDBOutputter. CachedJdbcAppender` overwrites `JDBCAppender#execute()` and stores all sql statements into a buffer until the limit is reached. Furthermore, it adds the column definitions as the first part of SQL statement. To flush the buffer on `close()`, `DefaultDBOutputter. CachedJdbcAppender` also overwrites `JDBCAppender#close()` and directly calls `JDBCAppender#execute()` to by-pass caching.

Overwriting `JDBCAppender#getLogStatement()` is used to generate the SQL peace for every column defined in the `DbOutputterDescriptor. CachedJdbcAppender` and also adds the `runID` if activated.

To ensure all cache is sent to the database, the `DbOutputterDescriptor. CachedJdbcAppender`’s `close()` method is scheduled at the last tick with priority `ScheduleParameters. LAST_PRIORITY`. Otherwise, `close()` is not called before the simualtion is reset, and in case the user closes the application without resetting the cached data is missed.

4.2 Error Handling

The plugin does not throw `SQLExceptions` in order not to interrupt simulations because of output errors. Instead, a ERROR-Logging to the Repast Simphony Message Center is triggered.

4.3 Run Information Handling

Since Repast Simphony 2.0.0, initialisation of data outputters take place not before the first data is logged. Therefore, calls to `DefaultDBOutputter.getCurrentMaxRunId()` before the first data is logged cannot access any information required to connect to the database. That's why `DefaultDBOutputter.getCurrentMaxRunId(runInfoTable, dbConInfo)` was added.

5 Things to Do

- Adjust dialog dimensions
- Check for column types using `DbOutputterDescriptor.CachedJdbcAppender#doesTableDefinitionExist(String tableName, Map<String, Object> cols)`. Since the `DataGathererDescriptor` does not contain any type information this is not straight forward.
- Create additional table columns if requiered
- Handle more objects (e.g. arrays) to log
- Check for valid characters in table name.
- Enable to disable data outputter activities.
- Make save against database write processes inbetween (e.g. regarding runID).
- create date field for run information instead of String

6 Changes

6.1 0.9

- FEATURE: error logging in CustomJDBCAppendergetConnection
- FEATURE: add logging in CustomJDBCAppender's initialiser (runID)
- FEATURE: add CustomJDBCAppendergetCurrentMaxRunId
- FEATURE: add static CustomJDBCAppendergetCurrentMaxRunId
- FEAUTRE: add labels in wizard step 1

  - BUGFIX: start with runID = INTEGER.MIN$_{V}ALUEBUGFIX : addnewoutputterstorunIdCalculati$

- MINOR: rename CustomJDBCAppendergetRunID() to getRunIDStatic()
- MINOR: make CustomJDBCAppendergetConnection(Connection con, DBConnectionInfo dbConInfo) static - MINOR: add CustomJDBCAppendergetRunID()

6.2 0.85

- feature: independed table for run information (integration in Descriptor, GUI and `getRunId()`)
- feature: allowing `runID` that are lower than the largerst in table but do not conflict
- feature: integrating prepared statements (also applies to last revision)
- feature: added `DefaultDBOutputter.getCurrentRunID()`
- feature: added `DefaultDBOutputter.getCurrentMaxRunId(runInfoTable, dbConInfo)` to access the `runID` before first data loggin.
- bugfix: added `runIdCalculations.put(this, new Boolean(false));` (forces runID to check also before output)
- bugfix: incrementing index
- bugfix: `get(Object o)` > add Integer support (data types for output)
- bugfix: substitute `PoolingConenctionSource` by simple DriverManager.getConnection
- bugfix: `DefaultDBOutputter#doesTableDefinitionExist()` > use upper case to search for column in table
- bug fix: `DefaultDBOutputter.CustomJdbcAppender#doesTableDefinitionExist(String tableName, List<String> cols)` > converting string to lower case before comparing
- bug fix: `DefaultDBOutputter.CustomJdbcAppender#getRunID(DbOutputterDescriptor descriptor, Connection con)`
- minor: adding more debug loggings
- minor: removing `getRunID` from `CustomJDBCAppender#Constructor`
- minor: changed `PARAMS_ID` to `PARAM_SET_ID`
- minor: added exception management for missing RS parameters
- minor: added exception management for missing run info tablename
- minor: changed runID map

6.3 0.81

- Added handling for boolean
- Corrected calculation of runID
- Added separate run information table
- Consider RS parameter `RUN_ID` as runID (only use it when it exceeds to last runID in current table)

7 Developer'S Notes

When the `DbOutputterDescriptor` is altered regarding its fields, old DB Outputter definitions might become invalid!

8 Contact

Any suggestions and bug reports are appreciated. Please, send an eMail to `holzhauer@usf.uni-kassel.de`.