User Guide

ELTMaestro

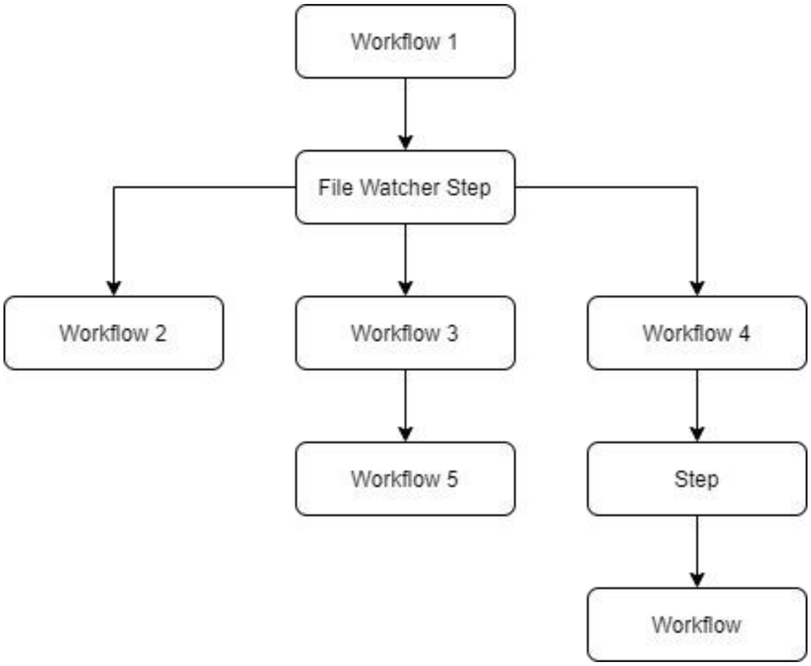
Contents

Graph Workflow Architecture

ELT Maestro workflow architecture has nodal hierarchy. For example, a job or workflow can be a node, a step can be a node, a step of type job can also be a node. There is no limitation on hierarchy level.
For example,
You can design a workflow which can call or second hierarchy level workflow which can execute third hierarchy level workflow … and so on. There is no limitation on hierarchy level.

Consider following hypothetical workflow structure diagram.

Figure: ELT Maestro Workflow Hierarchy

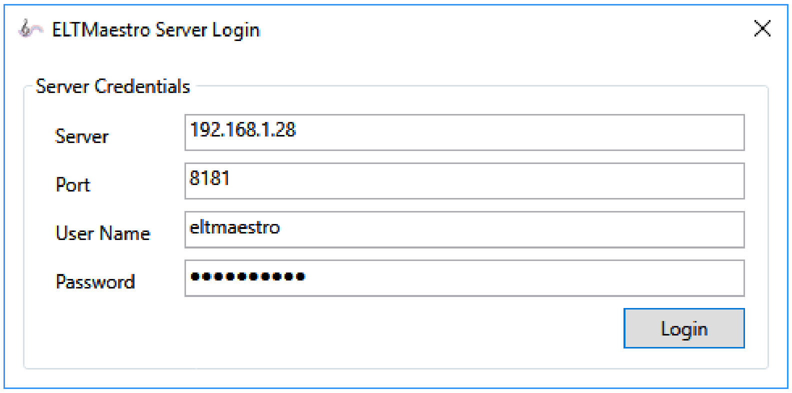


ELT Maestro Client

Starting Client

When you launch the ELT Maestro Data Integration Client, the Login screen appears as shown below:

Figure: Login Dialog



ELTMaestro Server Login

Server Credentials

Server: 192.168.1.28

Port: 8181

User Name: eltmaestro

Password: ●●●●●●●●●●●

Parameters:

Property	**Type**	**Info**
Server	Text	Hostname or ip address of ELT Maestro server.
Port	Text	ELT Maestro server messaging port. Default is 8181.
User Name	Text	ELT Maestro data integration username. The credentials are not affiliated with other accounts.
Password	Text	ELT Maestro data integration user password.

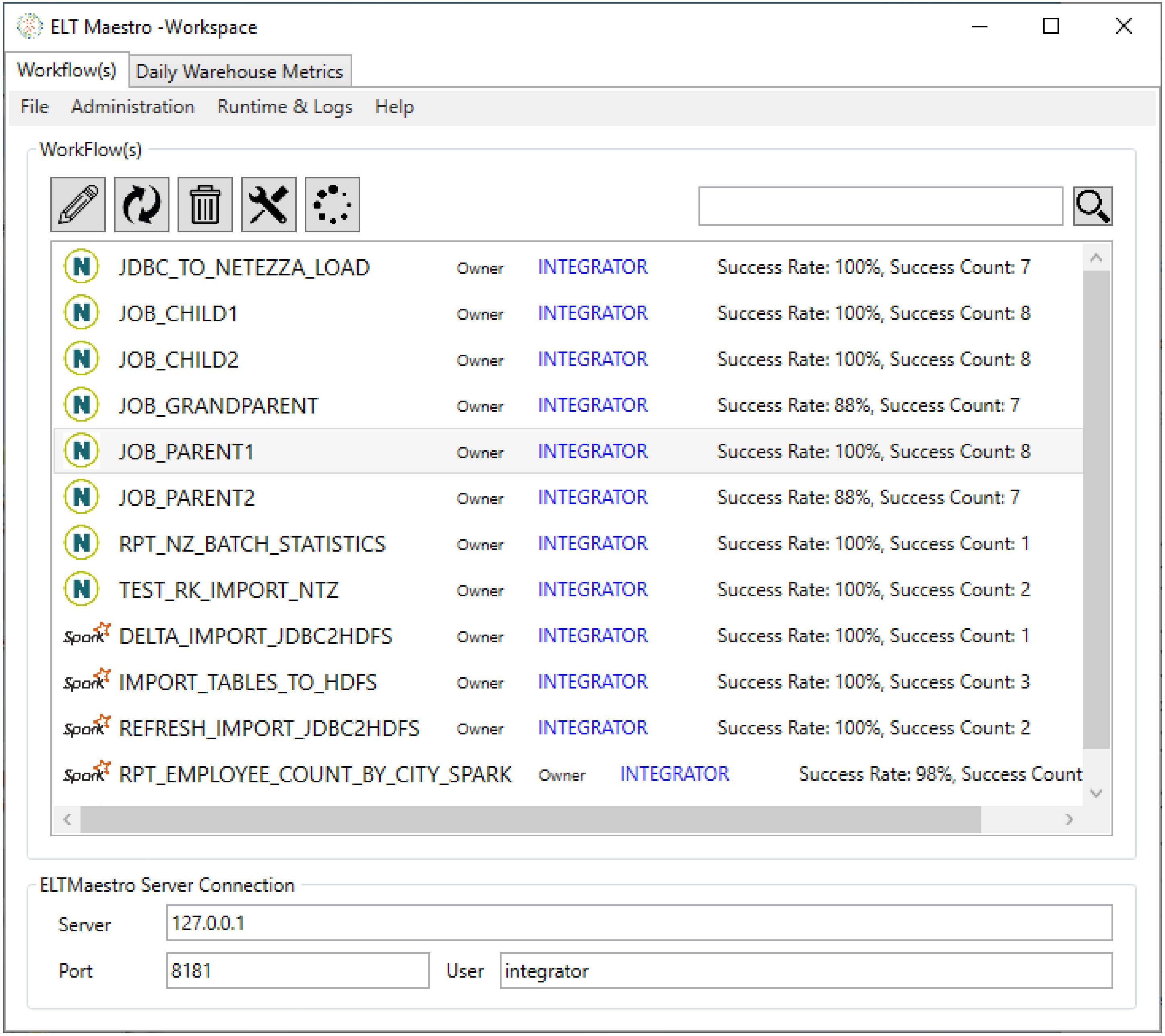
- Click [Login] after entering required credentials.

Upon successful login the Workspace Window should appear. You can then start creating workflow jobs and build dataflow diagrams.

The Workspace

All created jobs loaded from workspace folder appear on this screen. Workflow jobs can be created or edited from this screen. This is the first window that appears after successful login.

Figure: Workspace Window



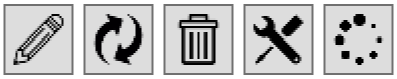
JDBC_TO_NETEZZA_LOAD	Owner	INTEGRATOR	Success Rate: 100%, Success Count: 7
JOB_CHILD1	Owner	INTEGRATOR	Success Rate: 100%, Success Count: 8
JOB_CHILD2	Owner	INTEGRATOR	Success Rate: 100%, Success Count: 8
JOB_GRANDPARENT	Owner	INTEGRATOR	Success Rate: 88%, Success Count: 7
JOB_PARENT1	Owner	INTEGRATOR	Success Rate: 100%, Success Count: 8
JOB_PARENT2	Owner	INTEGRATOR	Success Rate: 88%, Success Count: 7
RPT_NZ_BATCH_STATISTICS	Owner	INTEGRATOR	Success Rate: 100%, Success Count: 1
TEST_RK_IMPORT_NTZ	Owner	INTEGRATOR	Success Rate: 100%, Success Count: 2
DELTA_IMPORT_JDBC2HDFS	Owner	INTEGRATOR	Success Rate: 100%, Success Count: 1
IMPORT_TABLES_TO_HDFS	Owner	INTEGRATOR	Success Rate: 100%, Success Count: 3
REFRESH_IMPORT_JDBC2HDFS	Owner	INTEGRATOR	Success Rate: 100%, Success Count: 2
RPT_EMPLOYEE_COUNT_BY_CITY_SPARK	Owner	INTEGRATOR	Success Rate: 98%, Success Count

ELTMaestro Server Connection

Server 127.0.0.1

Port 8181 User integrator

Quick launch buttons



From Left to Right

1. Create workflow
2. Refresh workflow list
3. Delete selected workflow(s)
4. Edit workflow configuration

5. Open selected workflow designer

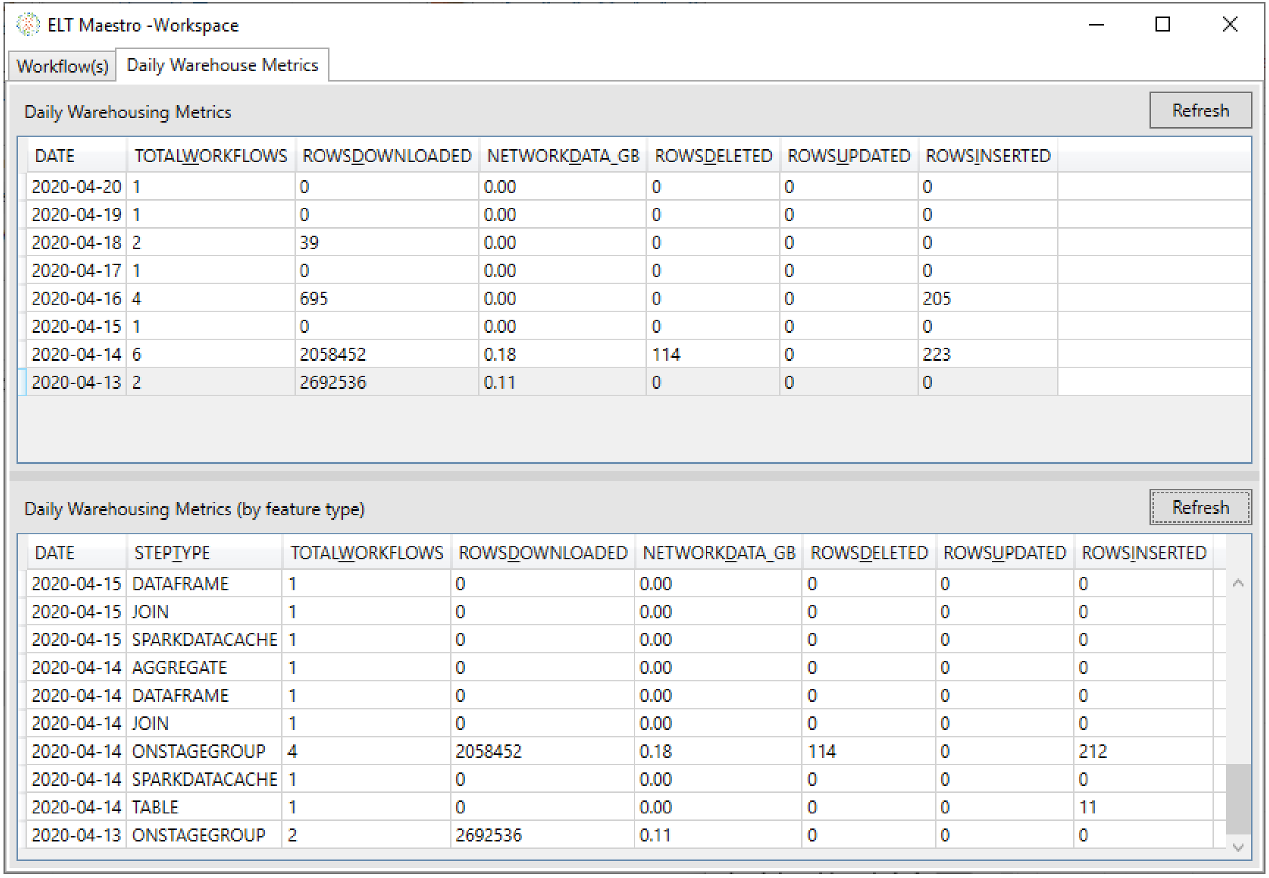
Workspace Menu Items

File -> Create Workflow	Creates workflow
File -> Exit	Exits application
Administration -> Configure	Resource configuration
Administration -> Metrics Configuration -> Control Test	Configure control test metrics
Administration -> Scheduler	Cron scheduler interface
Administration -> Migration -> Export	Exports workflow to local system
Administration -> Migration -> Import	Imports workflow from local system
Runtime & Logs -> Logging -> Workflow Logs	View workflow log history
Runtime & Logs -> Logging -> Server Logs	View ELT Maestro server logs
Runtime & Logs -> Reports -> Metrics Report	View metrics report
Runtime & Logs -> Runtime Operations	Manage ELT Maestro process(s)
Help -> About	View product information

Daily Warehouse Metrics

This tab provides system wide summary of historical metrics. Data is aggregated by day and calculations performed on file size and row counts processed using ELT Maestro.

Figure: Daily Warehouse Metrics Report



Daily Warehousing Metrics

DATE	TOTALWORKFLOWS	ROWSDOWNLOADED	NETWORKDATA_GB	ROWSDELETED	ROWSUPDATED	ROWSINSERTED
2020-04-20	1	0	0.00	0	0	0
2020-04-19	1	0	0.00	0	0	0
2020-04-18	2	39	0.00	0	0	0
2020-04-17	1	0	0.00	0	0	0
2020-04-16	4	695	0.00	0	0	205
2020-04-15	1	0	0.00	0	0	0
2020-04-14	6	2058452	0.18	114	0	223
2020-04-13	2	2692536	0.11	0	0	0

Daily Warehousing Metrics (by feature type)

DATE	STEPTYPE	TOTALWORKFLOWS	ROWSDOWNLOADED	NETWORKDATA_GB	ROWSDELETED	ROWSUPDATED	ROWSINSERTED
2020-04-15	DATAFRAME	1	0	0.00	0	0	0
2020-04-15	JOIN	1	0	0.00	0	0	0
2020-04-15	SPARKDATACACHE	1	0	0.00	0	0	0
2020-04-14	AGGREGATE	1	0	0.00	0	0	0
2020-04-14	DATAFRAME	1	0	0.00	0	0	0
2020-04-14	JOIN	1	0	0.00	0	0	0
2020-04-14	ONSTAGEGROUP	4	2058452	0.18	114	0	212
2020-04-14	SPARKDATACACHE	1	0	0.00	0	0	0
2020-04-14	TABLE	1	0	0.00	0	0	11
2020-04-13	ONSTAGEGROUP	2	2692536	0.11	0	0	0

Workflow (Job)

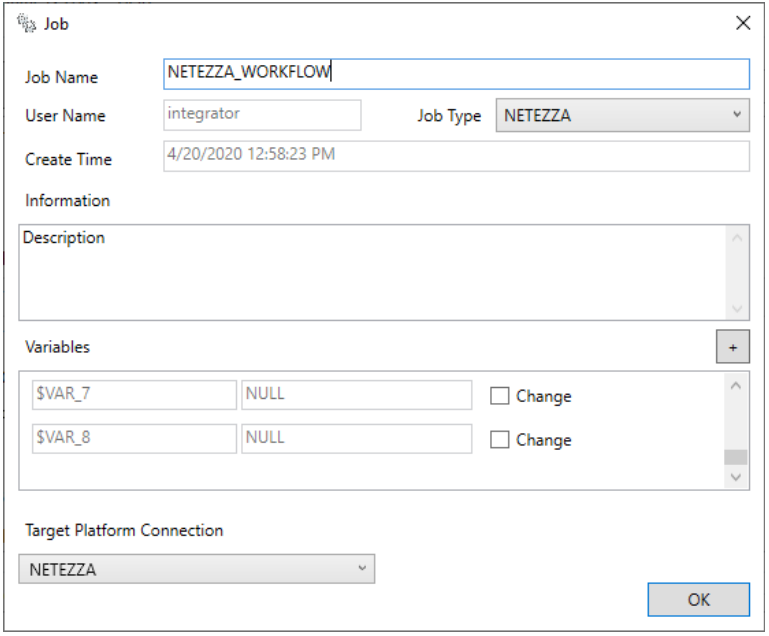
Creating New Workflow/Job

Most of ELT mapping design happens on a workflo. Jobs contain steps and mapping lines. Steps are the smallest purpose-driven objects. Mapping lines link the steps together, control parallelism, order data flow and map columns.

- Click [Create] button on workspace to open a new job dialog.
- Add [Job Name], select [Job Type], select [Target Platform Connection] then Click [OK]

Once workflow is created a message box may appear asking if you want to edit/open workflow. Click [Yes] to continue working on created workflow.

Figure: Create Workflow Dialog



Job

Job Name: NETEZZA_WORKFLOW

User Name: integrator

Job Type: NETEZZA

Create Time: 4/20/2020 12:58:23 PM

Information

Description

Variables +

$VAR_7	NULL	□ Change
$VAR_8	NULL	□ Change

Target Platform Connection: NETEZZA

Job Variables

Default variables are created when creating a new workflow. Variables with name $VAR_ can be modified during runtime using “Set Variable” step.

Editing Workflow

- On main workspace window, Double Click on workflow name to open editor or
- Select workflow and then Click to open editor.

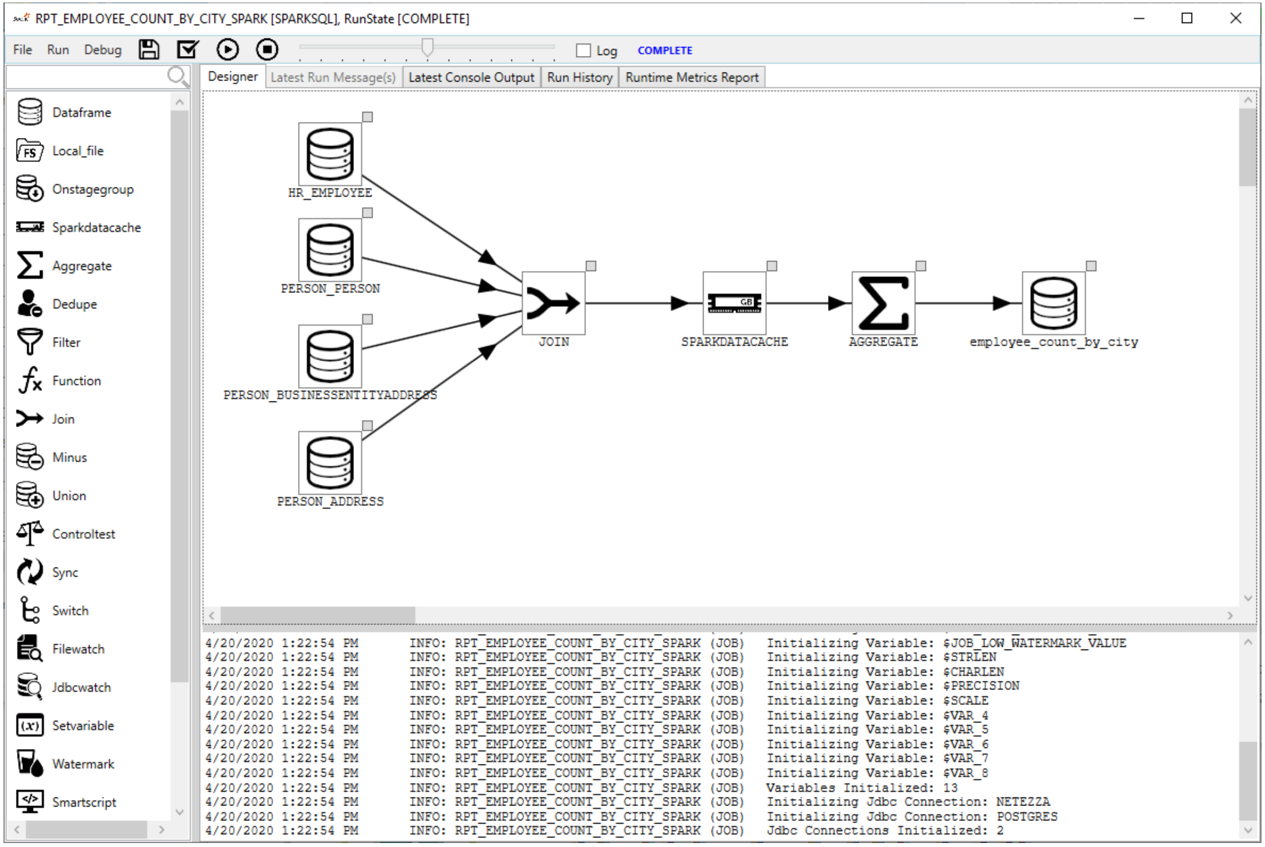
Workflow Designer / Editor

Introduction

Workflow designer or job editor contains tools required to designed ELT workflow.

1. Left panel contains list of Steps (also called nodes) which can be dragged and dropped into canvas area.
2. Right-Center panel is the canvas area that represents workflow item(s).
3. Bottom-Right panel contains workflow related messages.

Figure: Workflow Designer



```
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $JOB_LOW_WATERMARK_VALUE
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $STRLEN
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $CHARLEN
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $PRECISION
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $SCALE
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $VAR_4
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $VAR_5
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $VAR_6
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $VAR_7
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $VAR_8
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Variables Initialized: 13
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Jdbc Connection: NETEZZA
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Jdbc Connection: POSTGRES
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Jdbc Connections Initialized: 2
```

Workflow Tab Items

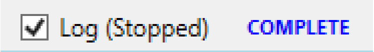
Designer contains main workflow canvas where development work happens.

1. [Last Run Message] displays latest runtime log for selected step (when Log is checked)
2. [Last Console Output] displays last console log
3. [Run History] displays it's historical execution states
4. [Runtime Metrics Report] displays count metrics and other measurements based on recent execution

Quick Launch Buttons (from left to right)

1. Save Workflow
2. Check for Workflow Mapping Errors
3. Run Workflow
4. Stop/Terminate Workflow

Logging (recent execution state)


☑ Log (Stopped) COMPLETE

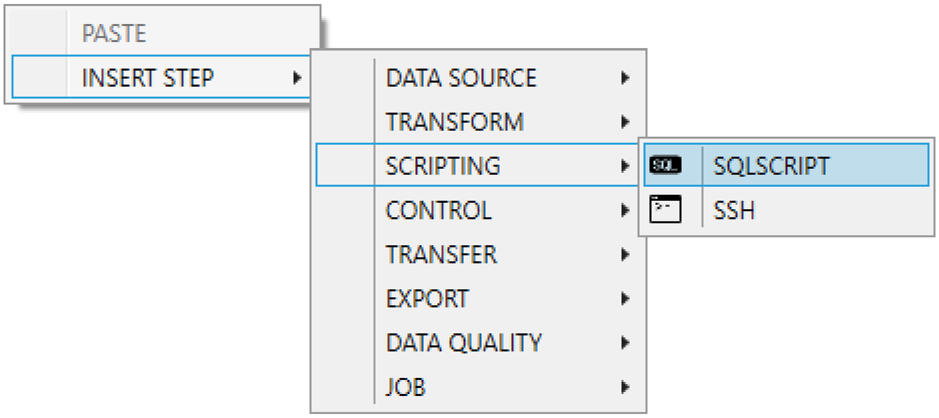
Log View mode times out after 1 minute automatically. You must uncheck then check mark Log to refresh.

Workflow Operations

Adding/Deleting/Editing Steps & Flow Control

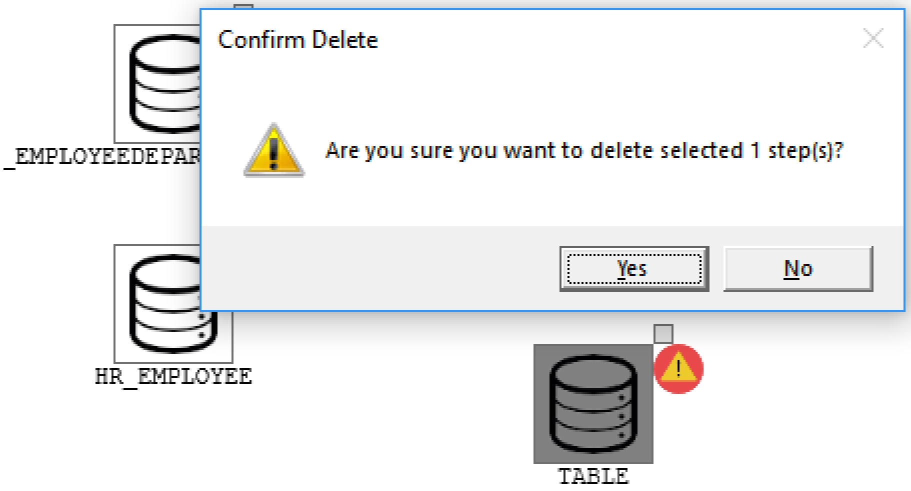
Adding a step

- [Right] click on canvas and [select] step to add on cursor position.
- or drag-drop a step from left panel



Deleting a step

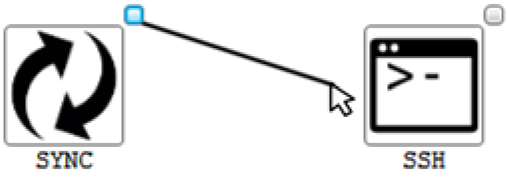
- [Left] single click to select a step, then click [Delete], then confirm [Yes]/[No]

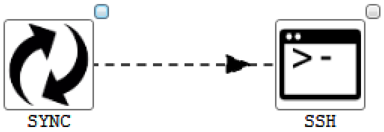

Confirm Delete

Are you sure you want to delete selected 1 step(s)?

Adding Flow Line / Mapper (Connecting Steps)

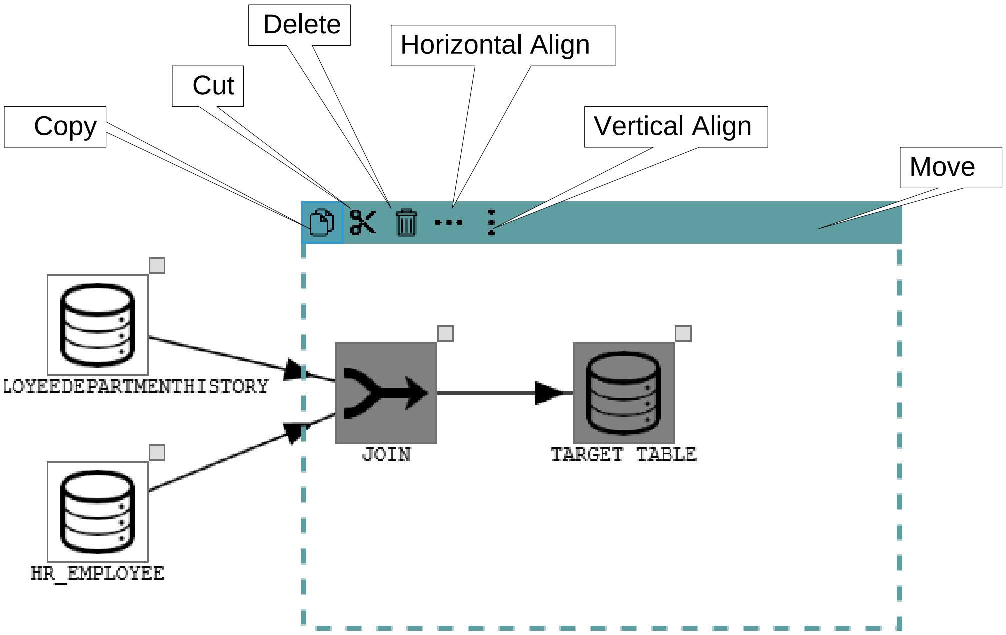
- While holding mouse button move cursor on target step and release.





Group Actions

- Select multiple steps by creating a rectangle on canvas, then perform action.



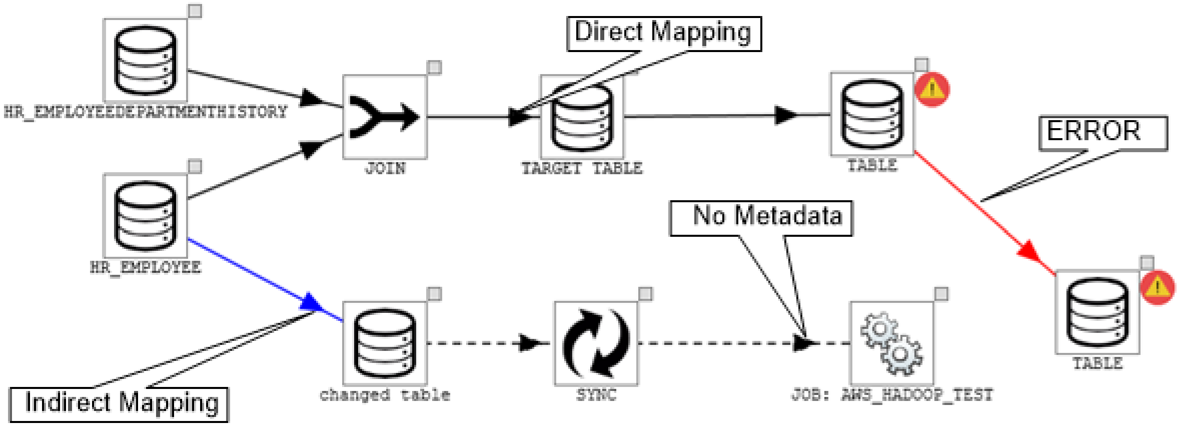
- To paste copied or cut objects, [Right] click on canvas and click [Paste]

Line Color & Metadata

1. RED No metadata found when connecting data steps
2. BLUE At least one column mapped from source step to target step has different name
3. Solid BLACK All columns are mapped with same name on source and target steps
4. Dotted BLACK Metadata is not required. This is an execution flow.

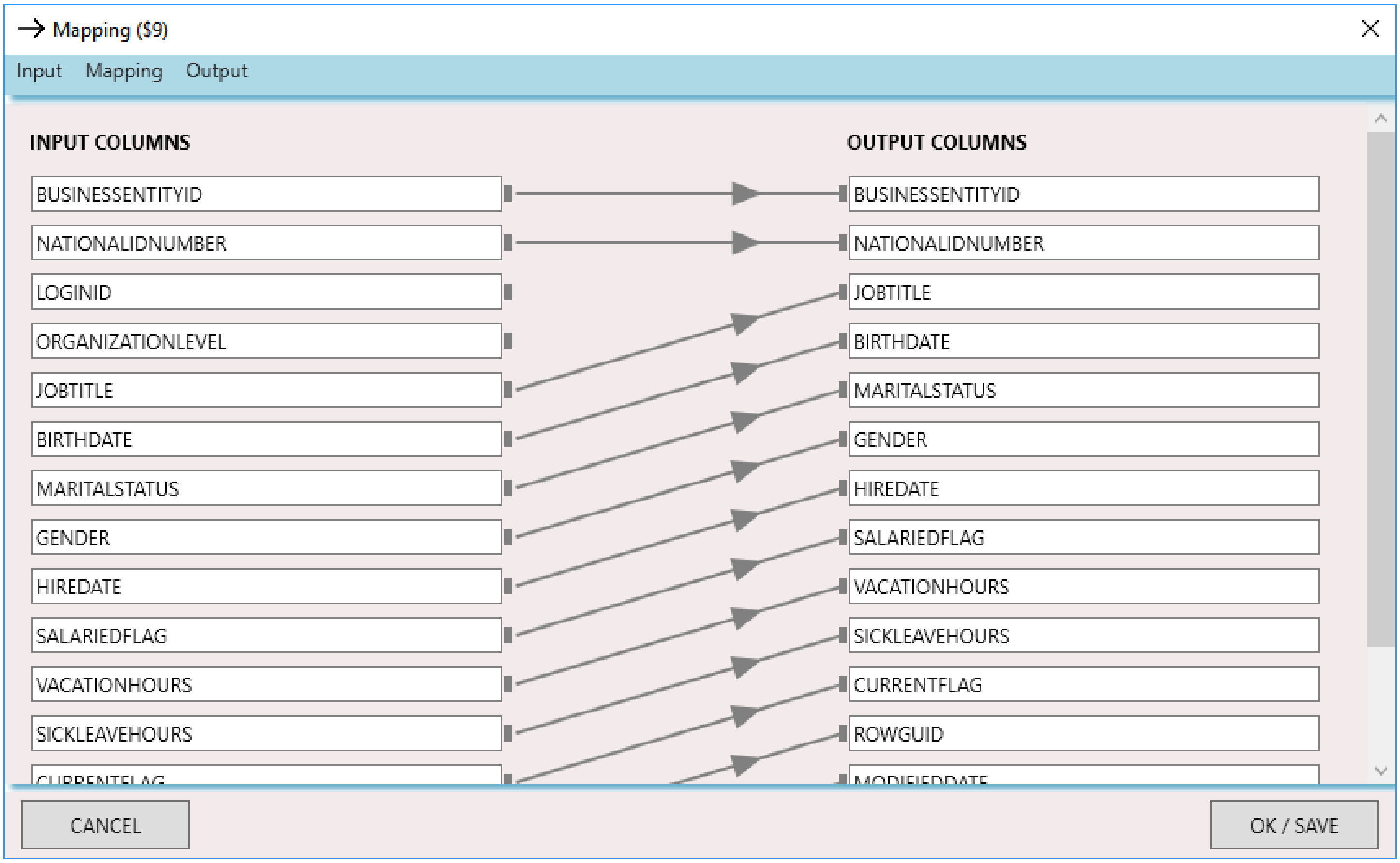
By default, the arrow direction indicates control flow. In addition, the solid arrows indicate data flow.

Figure: Line Colors



Editing Mapping / Flow

- ➢ [Click] on the line arrow head to open mapping editor.



Menu Items Description

1. [Input -> Refresh] refreshes incoming column names and data types
2. [Input -> Push to Output] refreshes output column names
3. [Mapping -> Clear] removes column mapping linkers
4. [Mapping -> Guess Mapping -> Option] draws linkers based on selection

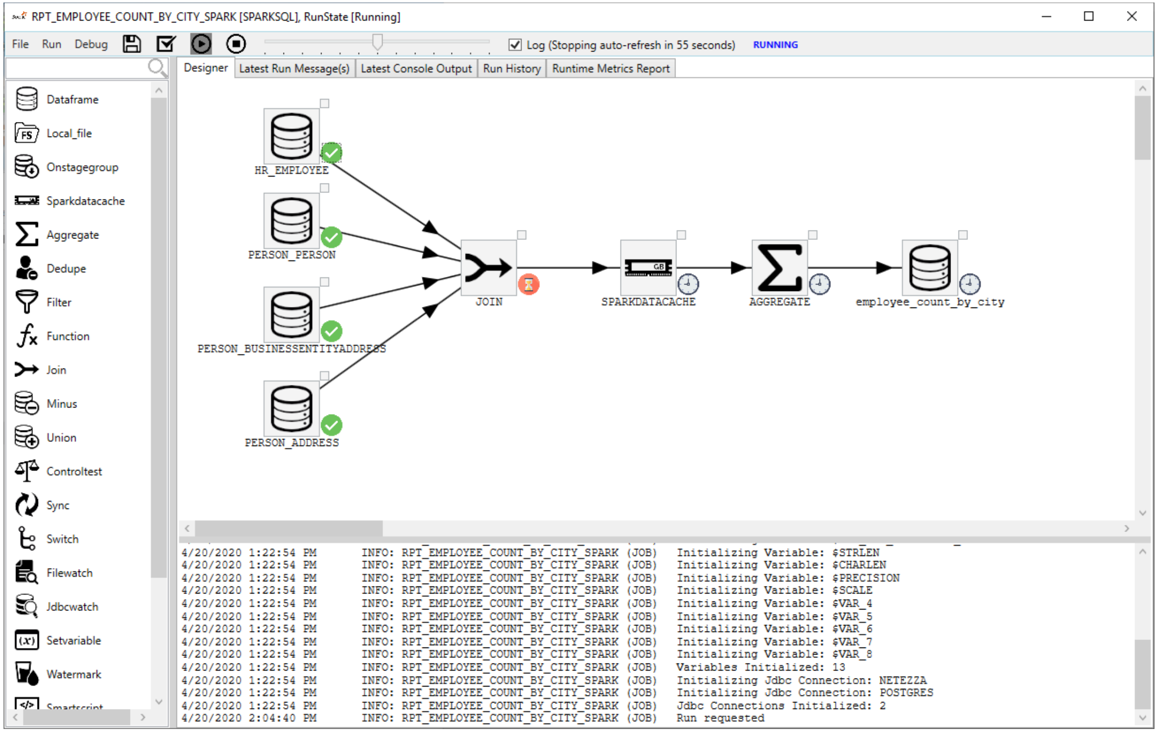
[Output -> Refresh] refreshes output columns list based on target step's metadata

Running Workflow & Analyzing Log

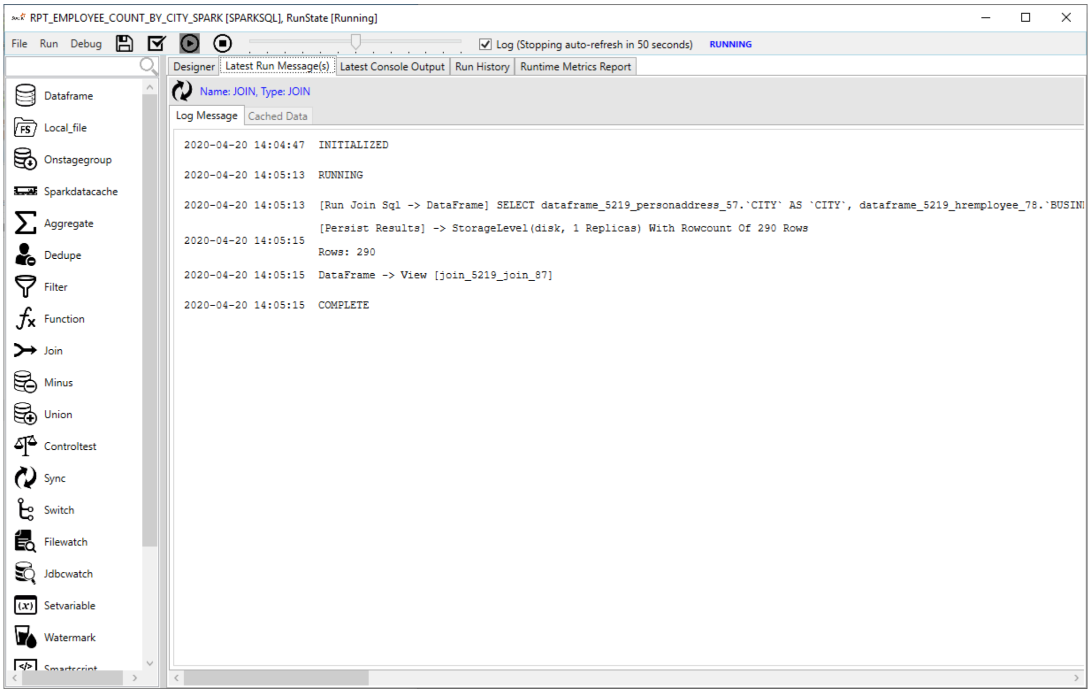
- ➢ Click [Play Button] to run current workflow.

Additionally you will receive a dialog for run configuration. When workflow is running Log Mode is checked by default. You may click on status icon to view detailed message about specific step.

Figure: Running Workflow



```
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $STRLEN
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $CHARLEN
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $PRECISION
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $SCALE
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $VAR_4
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $VAR_5
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $VAR_6
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $VAR_7
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Variable: $VAR_8
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Variables Initialized: 13
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Jdbc Connection: NETEZZA
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Initializing Jdbc Connection: POSTGRES
4/20/2020 1:22:54 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Jdbc Connections Initialized: 2
4/20/2020 2:04:40 PM      INFO: RPT_EMPLOYEE_COUNT_BY_CITY_SPARK (JOB)   Run requested
```



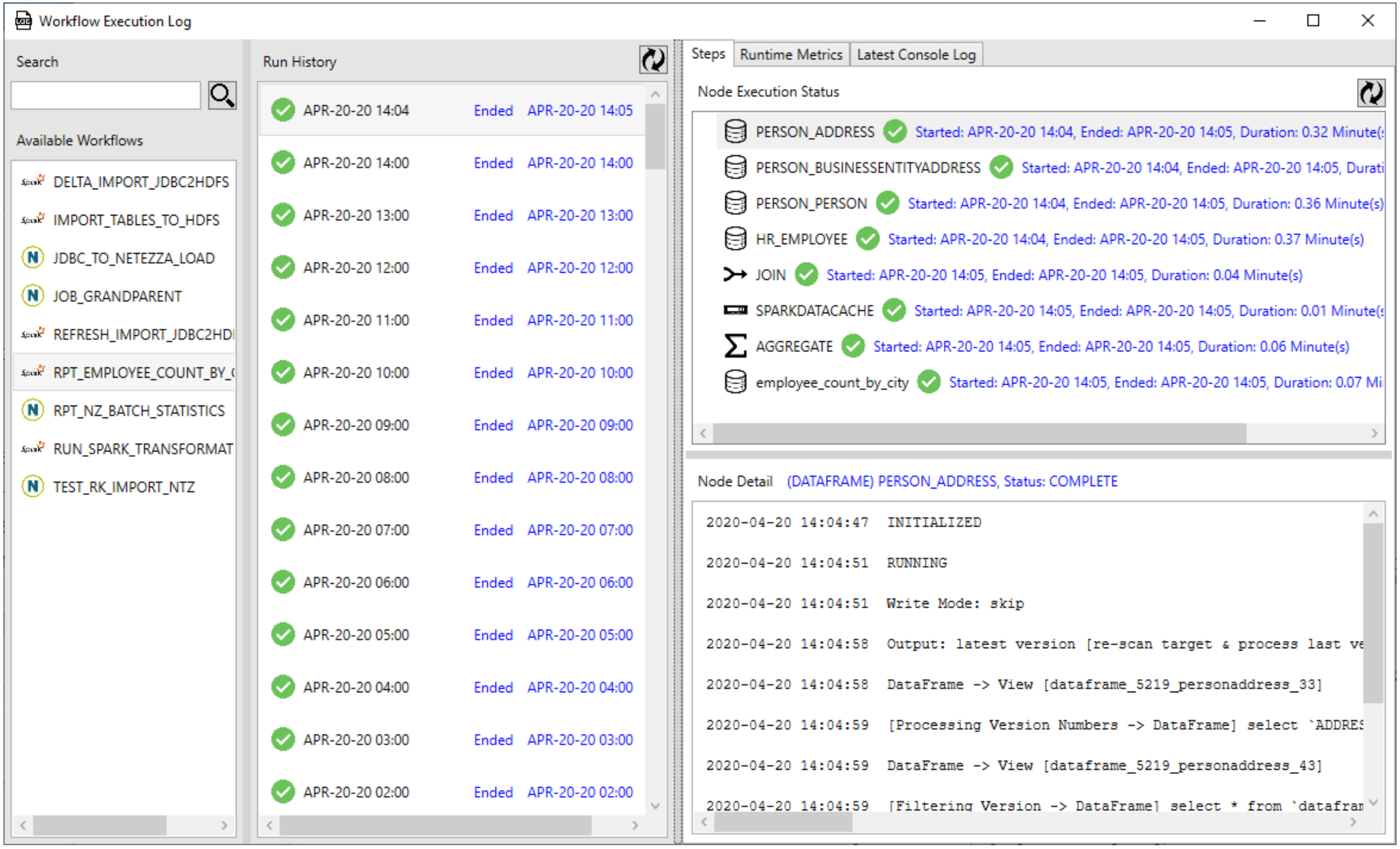
```
2020-04-20 14:04:47  INITIALIZED

2020-04-20 14:05:13  RUNNING

2020-04-20 14:05:13  [Run Join Sql -> DataFrame] SELECT dataframe_5219_personaddress_57.`CITY` AS `CITY`, dataframe_5219_hremployee_78.`BUSIN

                     [Persist Results] -> StorageLevel(disk, 1 Replicas) With Rowcount Of 290 Rows
2020-04-20 14:05:15
                     Rows: 290

2020-04-20 14:05:15  DataFrame -> View [join_5219_join_87]

2020-04-20 14:05:15  COMPLETE
```

Analyzing Historical Logs

Open log viewer from Workspace/Main Window

- ➢ Click [Runtime & Logs] -> [Logging] -> [Workflow Logs]

Figure: Log Viewer



- DELTA_IMPORT_JDBC2HDFS
- IMPORT_TABLES_TO_HDFS
- JDBC_TO_NETEZZA_LOAD
- JOB_GRANDPARENT
- REFRESH_IMPORT_JDBC2HDI
- RPT_EMPLOYEE_COUNT_BY_(
- RPT_NZ_BATCH_STATISTICS
- RUN_SPARK_TRANSFORMAT
- TEST_RK_IMPORT_NTZ

✓ APR-20-20 14:04	Ended	APR-20-20 14:05
✓ APR-20-20 14:00	Ended	APR-20-20 14:00
✓ APR-20-20 13:00	Ended	APR-20-20 13:00
✓ APR-20-20 12:00	Ended	APR-20-20 12:00
✓ APR-20-20 11:00	Ended	APR-20-20 11:00
✓ APR-20-20 10:00	Ended	APR-20-20 10:00
✓ APR-20-20 09:00	Ended	APR-20-20 09:00
✓ APR-20-20 08:00	Ended	APR-20-20 08:00
✓ APR-20-20 07:00	Ended	APR-20-20 07:00
✓ APR-20-20 06:00	Ended	APR-20-20 06:00
✓ APR-20-20 05:00	Ended	APR-20-20 05:00
✓ APR-20-20 04:00	Ended	APR-20-20 04:00
✓ APR-20-20 03:00	Ended	APR-20-20 03:00
✓ APR-20-20 02:00	Ended	APR-20-20 02:00

- PERSON_ADDRESS ✓ Started: APR-20-20 14:04, Ended: APR-20-20 14:05, Duration: 0.32 Minute(
- PERSON_BUSINESSENTITYADDRESS ✓ Started: APR-20-20 14:04, Ended: APR-20-20 14:05, Durati
- PERSON_PERSON ✓ Started: APR-20-20 14:04, Ended: APR-20-20 14:05, Duration: 0.36 Minute(s)
- HR_EMPLOYEE ✓ Started: APR-20-20 14:04, Ended: APR-20-20 14:05, Duration: 0.37 Minute(s)
- JOIN ✓ Started: APR-20-20 14:05, Ended: APR-20-20 14:05, Duration: 0.04 Minute(s)
- SPARKDATACACHE ✓ Started: APR-20-20 14:05, Ended: APR-20-20 14:05, Duration: 0.01 Minute(
- AGGREGATE ✓ Started: APR-20-20 14:05, Ended: APR-20-20 14:05, Duration: 0.06 Minute(s)
- employee_count_by_city ✓ Started: APR-20-20 14:05, Ended: APR-20-20 14:05, Duration: 0.07 Mi

Node Detail (DATAFRAME) PERSON_ADDRESS, Status: COMPLETE

```
2020-04-20 14:04:47  INITIALIZED
2020-04-20 14:04:51  RUNNING
2020-04-20 14:04:51  Write Mode: skip
2020-04-20 14:04:58  Output: latest version [re-scan target & process last ve
2020-04-20 14:04:58  DataFrame -> View [dataframe_5219_personaddress_33]
2020-04-20 14:04:59  [Processing Version Numbers -> DataFrame] select `ADDRES
2020-04-20 14:04:59  DataFrame -> View [dataframe_5219_personaddress_43]
2020-04-20 14:04:59  [Filtering Version -> DataFrame] select * from `datafran
```

Panels

1. Left Panel contains workflow names
2. Middle Panel contains run history by date time
3. Top Right Panel contains nodes executed
4. Bottom Right Panel contains selected node messages

Other Tabs

1. Runtime Metrics contains object metrics counts, like rows, bytes etc for that run date/time
2. Latest Console Log contains last logfile content

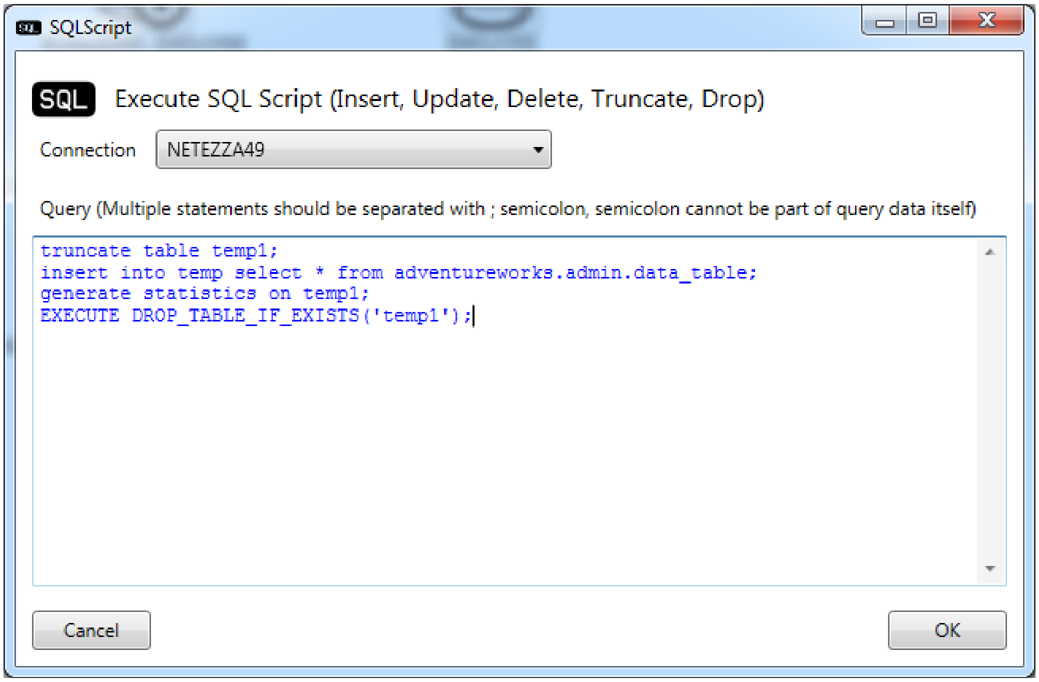
Steps / Nodes

SQL Script

Introduction

SQL Script step enables executing SQL queries on a JDBC connection. Statements are separated by semi colon.

Example,



Connection NETEZZA49

Query (Multiple statements should be separated with ; semicolon, semicolon cannot be part of query data itself)

```
truncate table temp1;
insert into temp select * from adventureworks.admin.data_table;
generate statistics on temp1;
EXECUTE DROP_TABLE_IF_EXISTS('temp1');
```

SQL Statements

Multiple SQL statements are separated by semi-colon. Semi-colon cannot be part of query statement.
For example, using following statement will result in error during runtime.

```
insert into MY_DATA_TABLE select COLUMN1, COLUMN2||'added;' from
MY_SOURCE_DATA_TABLE
```

While above statement is still valid, runtime module splits entire content with semi-colon into multiple statements which leads to one or more invalid SQL.

Calling Stored Procedures

Executing procedures in SQLScript step is also possible which can be achieved by simply inserting call procedure statement. Stored procedure calls only work on your targeted platform connection.

Example,

```
EXECUTE DROP_TABLE_IF_EXISTS('temp1');
```

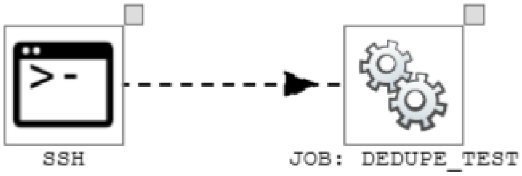
SSH

Introduction

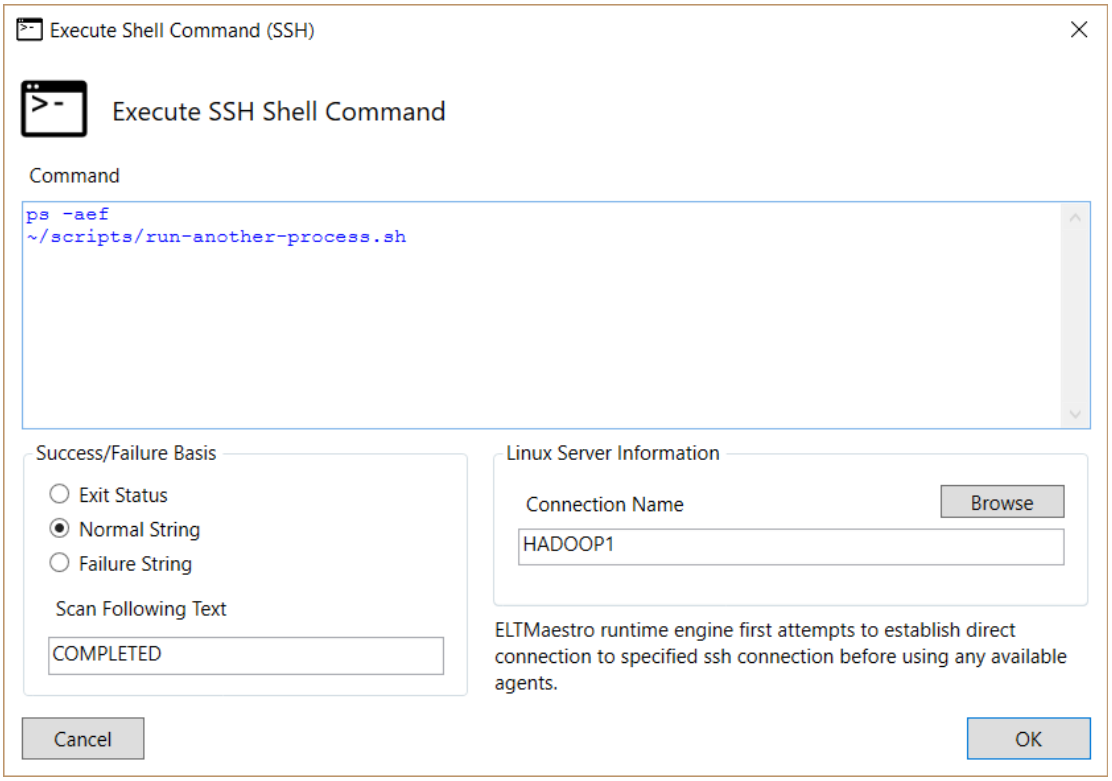
The SSH step runs a shell command on one of the Spark nodes. You can use the result of the shell command to control the execution of a subsequent step.

Example,

We set up our job as follows:



In the properties of the SSH command, we enter the following:



Execute Shell Command (SSH)

Execute SSH Shell Command

Command

```
ps -aef
~/scripts/run-another-process.sh
```

Success/Failure Basis

○ Exit Status
● Normal String
○ Failure String

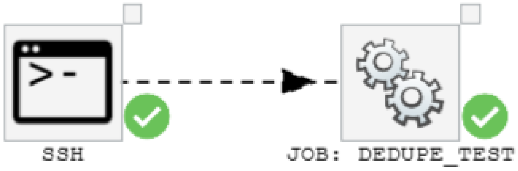
Scan Following Text: COMPLETED

Linux Server Information

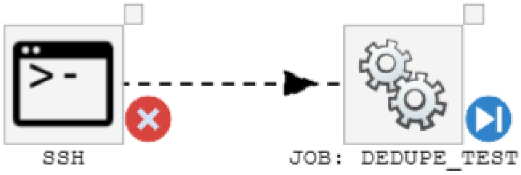
Connection Name: HADOOP1

ELTMaestro runtime engine first attempts to establish direct connection to specified ssh connection before using any available agents.

where run-another-process.sh is a shell script that may or may not echo the string 'COMPLETED' to standard output. When the script indeed produces the string 'COMPLETED', the step is successful, which then causes the DEDUPE_TEST job to run; this action can be observed on the job canvas with Debug mode enabled:



If we alter the script so that it no longer echoes ‘COMPLETED’, the SSH step fails, and the DEDUPE_TEST job does not run.



<u>Success or Failure Options</u>

Exit Status

If exit status code of shell script equals zero then set this step status to SUCCESSFUL, otherwise FAIL.

Normal String

If output contains mentioned string to be scanned set step status to SUCCESSFUL, otherwise FAIL.
Exit status is ignored if this option is checked.

Failure String

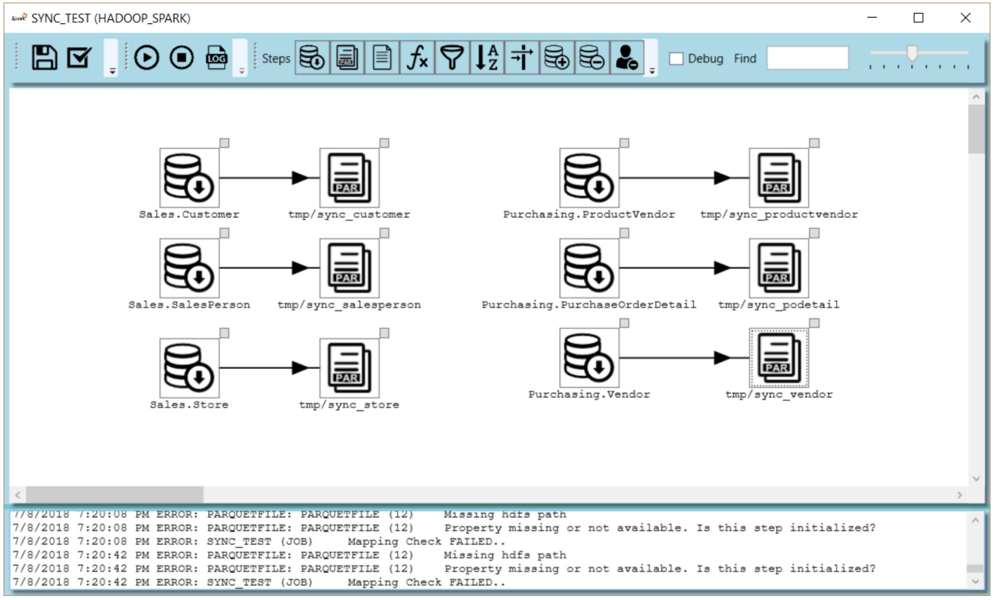
If output of script contains mentioned string to be scanned set step status to FAIL, otherwise SUCCESSFUL.
Exit status is ignored if this option is checked.

Sync

Introduction

Sync is a dummy step which always returns successful state if executed. The purpose of this step is to control ELT parallelism for certain MPP systems that contain high throughput and low concurrency. Sync step does not have any configuration property.

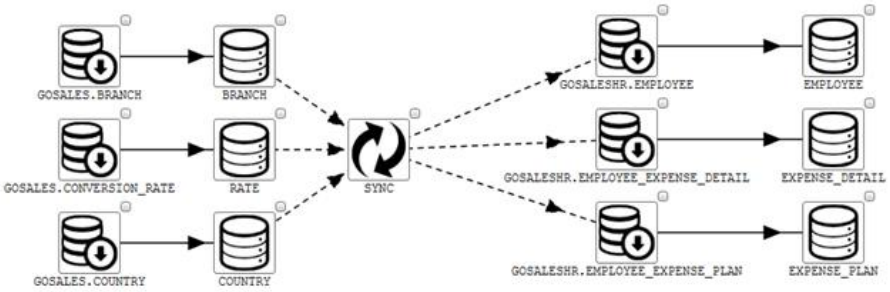
Example, (Without Sync Step)



```
7/8/2018 7:20:08 PM ERROR: PARQUETFILE: PARQUETFILE (12)    Missing hdfs path
7/8/2018 7:20:08 PM ERROR: PARQUETFILE: PARQUETFILE (12)    Property missing or not available. Is this step initialized?
7/8/2018 7:20:08 PM ERROR: SYNC_TEST (JOB)     Mapping Check FAILED..
7/8/2018 7:20:42 PM ERROR: PARQUETFILE: PARQUETFILE (12)    Missing hdfs path
7/8/2018 7:20:42 PM ERROR: PARQUETFILE: PARQUETFILE (12)    Property missing or not available. Is this step initialized?
7/8/2018 7:20:42 PM ERROR: SYNC_TEST (JOB)     Mapping Check FAILED..
```

Above workflow executes 6 workflow paths in parallel, which means the number of connections on source and target amounts to 12 (6 on source, 6 on target). This number can easily go very high when adding more tables. To implement phasing mechanism which is to load few, wait, load more, repeat kind of operation Sync step should be considered when designing parallel processes.

Example,



Above workflow executes in following order:

1. Load three tables in parallel.
2. Sync waits for completion.
3. Load three more in parallel.

Note

ELT Maestro engine dynamically manages all connection requests to ensure workflow process is not reserving any idle connections at any given instant to free up those resources automatically.

Switch

Introduction

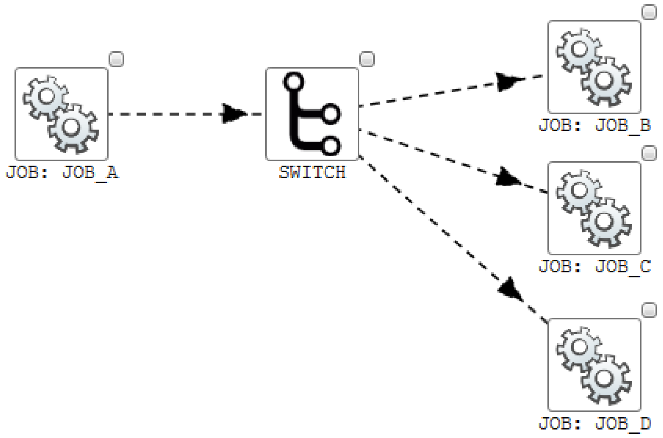
Branch success/failure paths based on input step state.

Example,

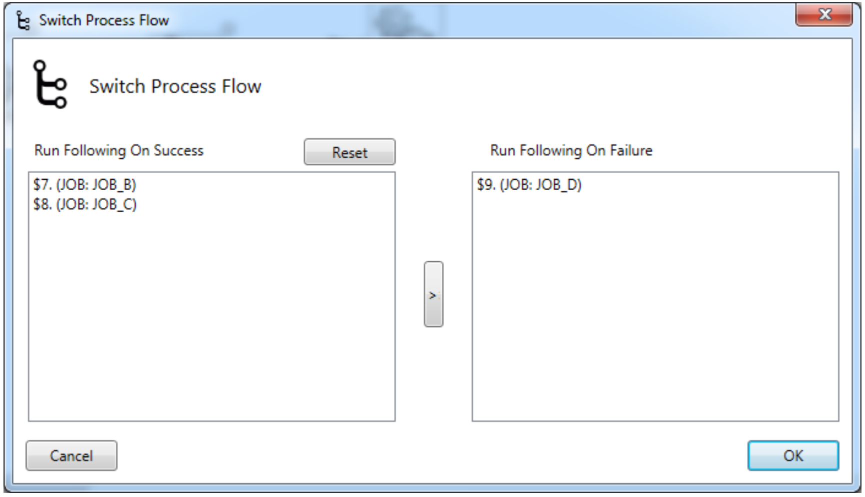
Sample dependency logic

1. Run JOB_A
2. If JOB_A succeeds Run JOB_B and JOB_C (Skip Failure Path)
3. If JOB_A fails Run JOB_D (Skip Success Path)

Workflow should look something like following.



Switch step property example.



Run Following On Success

$7. (JOB: JOB_B)
$8. (JOB: JOB_C)

Run Following On Failure

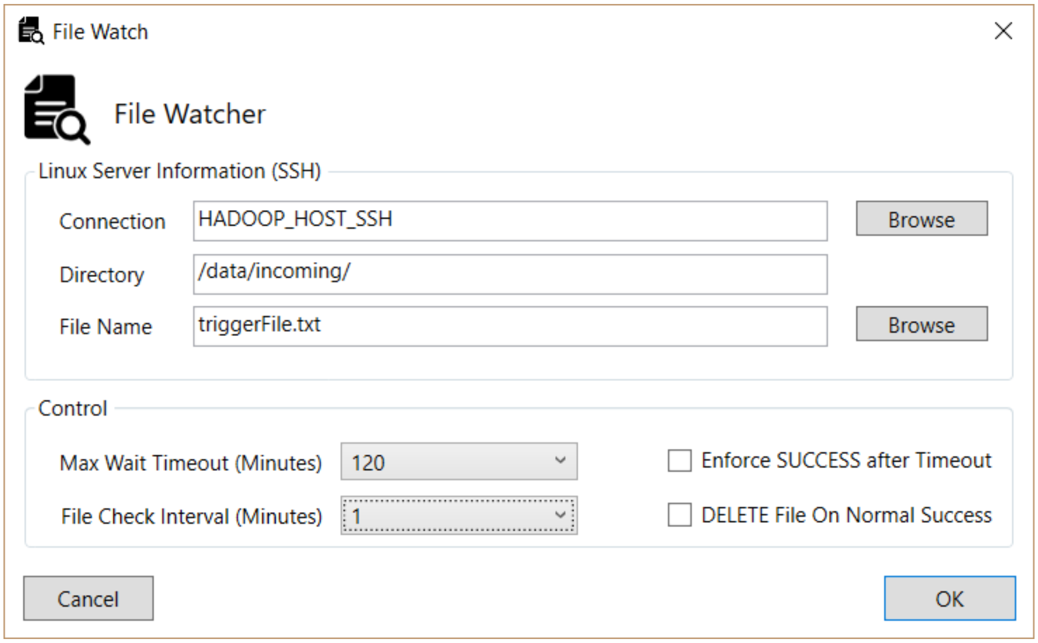
$9. (JOB: JOB_D)

File Watch

Introduction

File Watch step waits until certain file on Unix/Linux system becomes available until timeout.

Example,



Connection: HADOOP_HOST_SSH

Directory: /data/incoming/

File Name: triggerFile.txt

Max Wait Timeout (Minutes): 120

File Check Interval (Minutes): 1

□ Enforce SUCCESS after Timeout

□ DELETE File On Normal Success

Linux Server Information

Linux server ssh credentials. Directory to be scanned and filename to watch for.

Max Wait Timeout

Wait for certain minutes until timeout has occurred.

File Check Interval

Interval to Check availability of file.

Enforce SUCCESS after Timeout

If option is checked step status will not fail after timeout. Leaving unchecked sets step status to Failed if file is not found and timeout has occurred.

Delete File On Normal Success

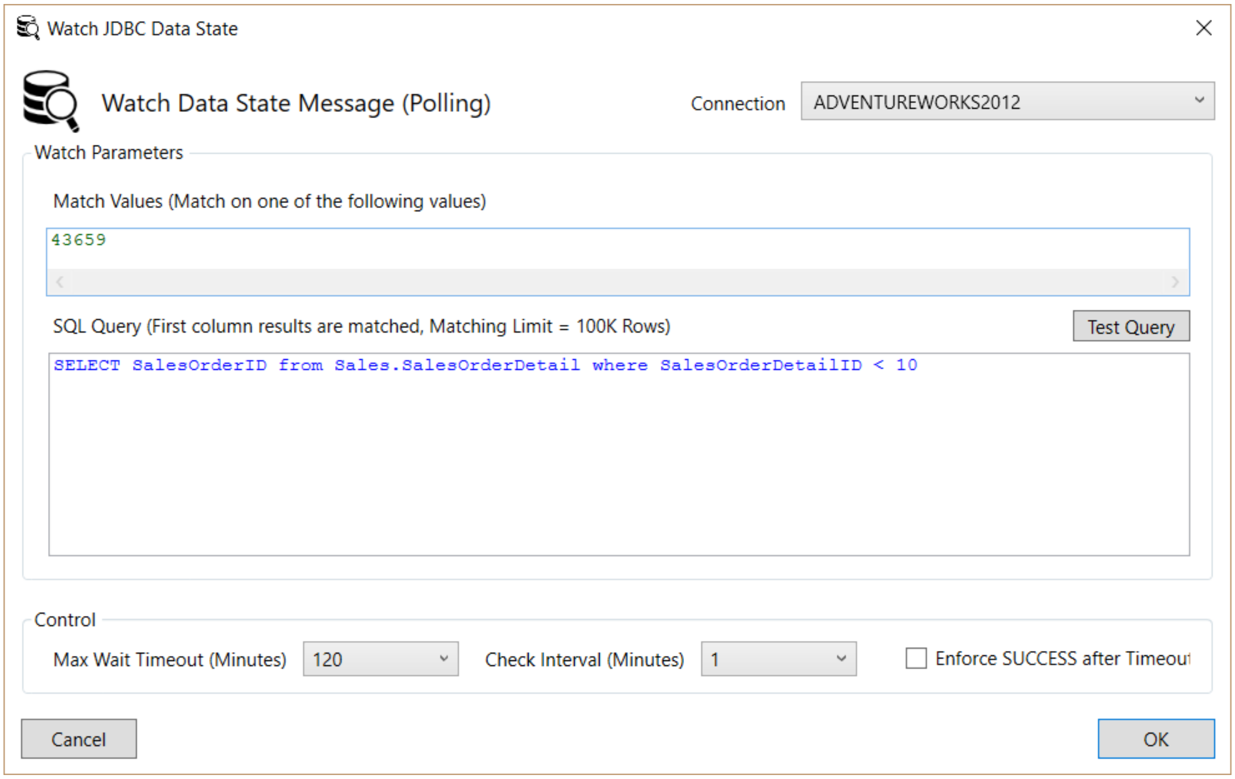
If checked, file gets deleted after setting status to success.

JDBC Watch

Introduction

JDBC Watch step waits until query returns certain value on a specified connection.

Example,



Connection: ADVENTUREWORKS2012

Match Values (Match on one of the following values): 43659

SQL Query (First column results are matched, Matching Limit = 100K Rows)

```
SELECT SalesOrderID from Sales.SalesOrderDetail where SalesOrderDetailID < 10
```

Max Wait Timeout (Minutes): 120

Check Interval (Minutes): 1

□ Enforce SUCCESS after Timeout

Match Values

Output to be matched against. True if one of the values match.

SQL Query

SQL query to collect output. State is success if any result tuple matches any specified match value (First row-column value).

Max Wait Timeout

Wait for certain minutes until timeout has occurred.

Check Interval

Interval to repeat query.

Enforce SUCCESS after Timeout

If option is checked, step status will not fail after timeout. Leaving unchecked sets step status to failed if match is not found.

Set Variable

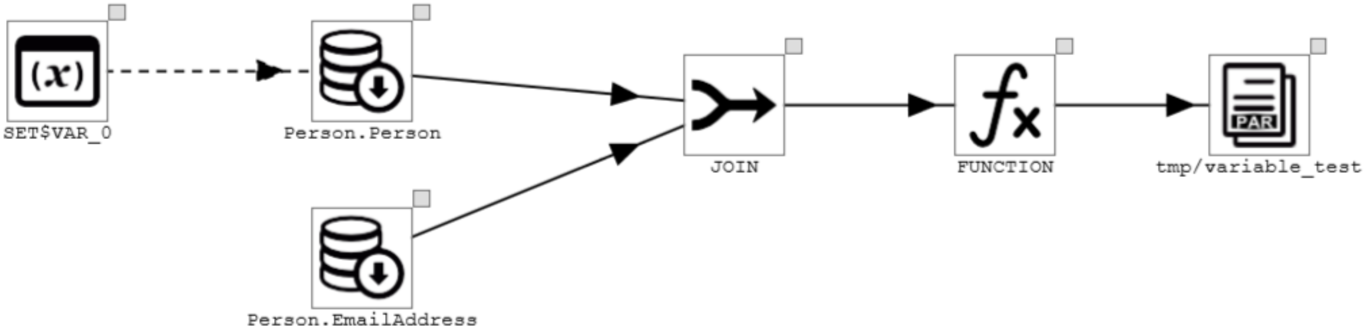
Introduction

The Set Variable step adds the ability to communicate between a Unix shell or an SQL database and an ELT Maestro program.

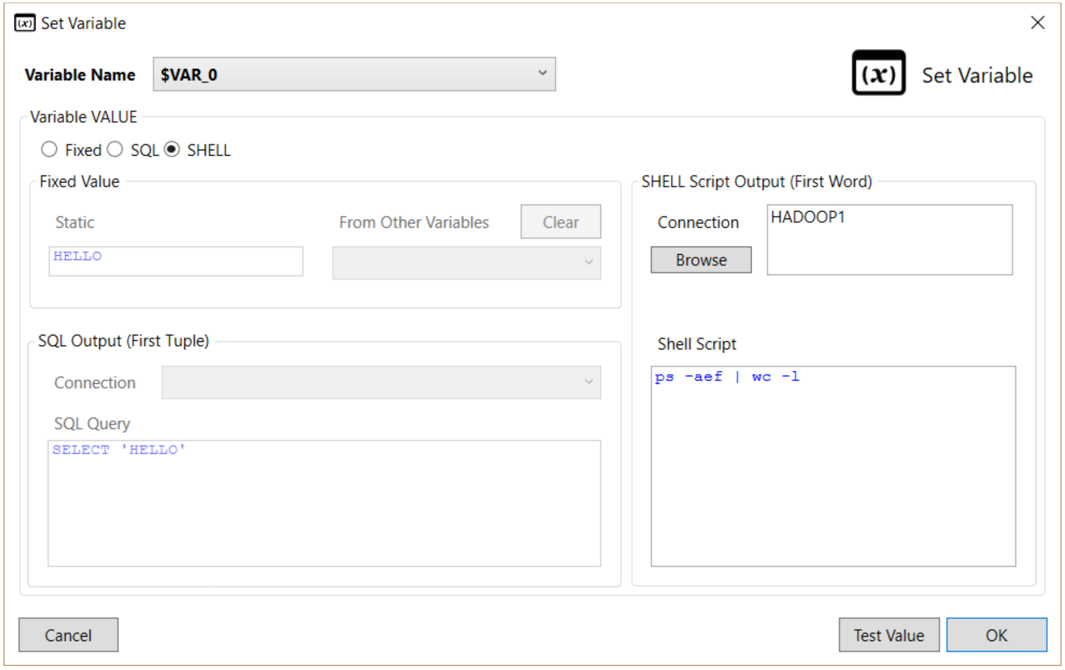
Each job is associated with a number of user variables, named $VAR_0, $VAR_1, $VAR_2, … (in addition to a number of system variables such as $JOB_NAME, $JOB_ID, etc.). The user variables are set in the Set Variable stage and accessed by various other stages. Variables facilitate communication between different parts of ELT Maestro programs. Because the Set Variable stage allows variables to have their values set by interaction with Unix shells and databases with which ELT Maestro can establish a connection, the Set Variable stage also facilitates communication between ELT Maestro processing Unix shells or databases of interest.

Example,

In this example, we use the Set Variable step to track the number of processes on one of the machines in the Spark cluster while the job is running and write that number to a column in an output table. Here we use a simple Join job, like the one used to demonstrate the Join command above. Next, we connect the Set Variable step to one of the OnStage input steps at the beginning of the program, as shown below:



Now open the Set Variable step:



Set Variable

Variable Name: $VAR_0

Variable VALUE

○ Fixed ○ SQL ● SHELL

Fixed Value

Static: HELLO

From Other Variables

SHELL Script Output (First Word)

Connection: HADOOP1

SQL Output (First Tuple)

Connection

SQL Query:

```
SELECT 'HELLO'
```

Shell Script:

```
ps -aef | wc -l
```

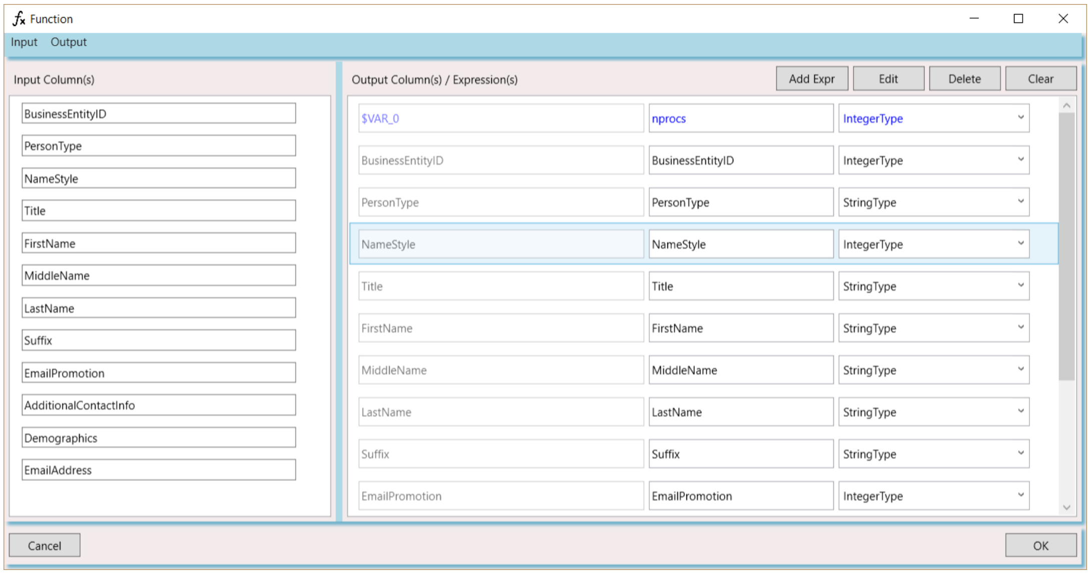
In the Variable Name dropdown list, we have selected $VAR_0 – in other words, $VAR_0 is the particular variable we are setting.

From among the Fixed, SQL, and SHELL radio buttons, we have selected SHELL, indicating that the value that winds up in $VAR_0 will come from a shell script.

HADOOP1 happens to be the name of the Unix machine we connect to. (That would likely be different in your case.)

The shell script contains a short program to count the lines produced by the command **ps -aef**.

Note that we have also introduced a Function step between the Join step and the output file. The Function step allows us to retrieve the value of the variable and add it to the dataflow. Let's take a look inside the Function step:



Function

Input Column(s):

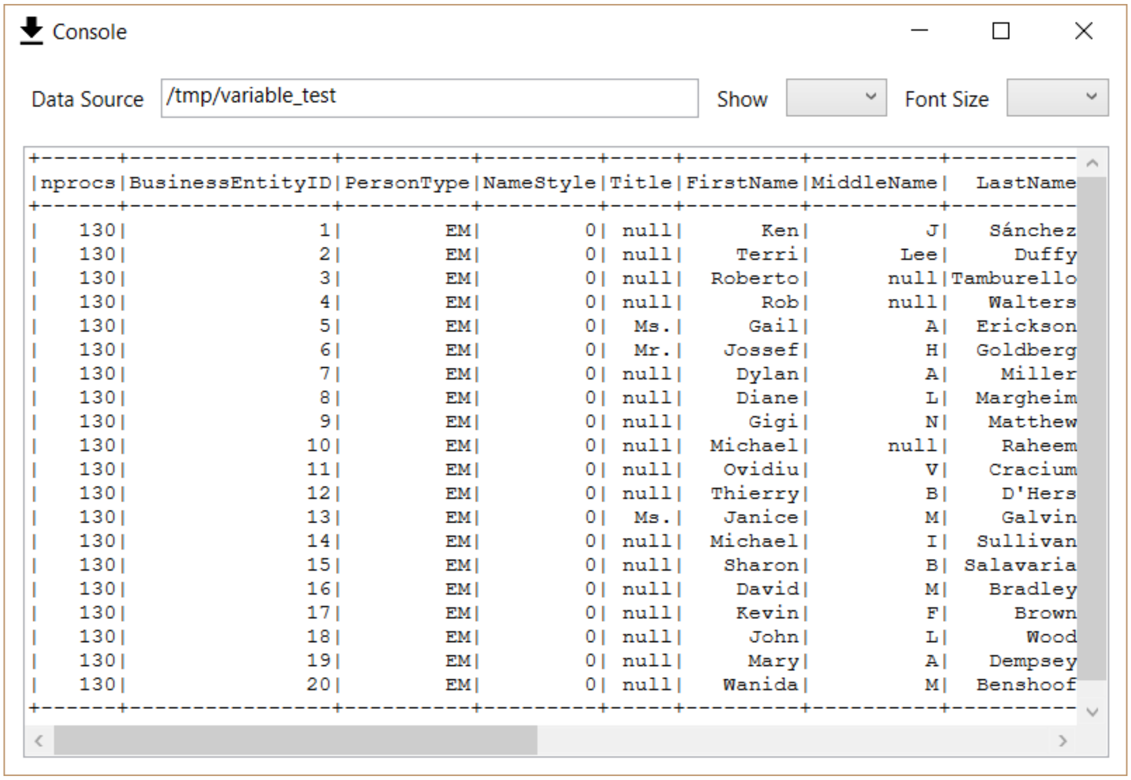
- BusinessEntityID
- PersonType
- NameStyle
- Title
- FirstName
- MiddleName
- LastName
- Suffix
- EmailPromotion
- AdditionalContactInfo
- Demographics
- EmailAddress

Output Column(s) / Expression(s)

$VAR_0	nprocs	IntegerType
BusinessEntityID	BusinessEntityID	IntegerType
PersonType	PersonType	StringType
NameStyle	NameStyle	IntegerType
Title	Title	StringType
FirstName	FirstName	StringType
MiddleName	MiddleName	StringType
LastName	LastName	StringType
Suffix	Suffix	StringType
EmailPromotion	EmailPromotion	IntegerType

Here we see that we have added a new output column, named **nprocs**, of type integer, and set it to $VAR_0.

After running the program, the results appear as follows:



Data Source /tmp/variable_test

```
+------+----------------+----------+---------+-----+---------+----------+----------
|nprocs|BusinessEntityID|PersonType|NameStyle|Title|FirstName|MiddleName|  LastName
+------+----------------+----------+---------+-----+---------+----------+----------
|   130|               1|        EM|        0| null|      Ken|         J|   Sánchez
|   130|               2|        EM|        0| null|    Terri|       Lee|     Duffy
|   130|               3|        EM|        0| null|  Roberto|      null|Tamburello
|   130|               4|        EM|        0| null|      Rob|      null|   Walters
|   130|               5|        EM|        0|  Ms.|     Gail|         A|  Erickson
|   130|               6|        EM|        0|  Mr.|   Jossef|         H|  Goldberg
|   130|               7|        EM|        0| null|    Dylan|         A|    Miller
|   130|               8|        EM|        0| null|    Diane|         L|  Margheim
|   130|               9|        EM|        0| null|     Gigi|         N|   Matthew
|   130|              10|        EM|        0| null|  Michael|      null|    Raheem
|   130|              11|        EM|        0| null|   Ovidiu|         V|   Cracium
|   130|              12|        EM|        0| null|  Thierry|         B|    D'Hers
|   130|              13|        EM|        0|  Ms.|   Janice|         M|    Galvin
|   130|              14|        EM|        0| null|  Michael|         I|  Sullivan
|   130|              15|        EM|        0| null|   Sharon|         B| Salavaria
|   130|              16|        EM|        0| null|    David|         M|   Bradley
|   130|              17|        EM|        0| null|    Kevin|         F|     Brown
|   130|              18|        EM|        0| null|     John|         L|      Wood
|   130|              19|        EM|        0| null|     Mary|         A|   Dempsey
|   130|              20|        EM|        0| null|   Wanida|         M|  Benshoof
+------+----------------+----------+---------+-----+---------+----------+----------
```

That is, there were evidently 130 processes running on HADOOP1 as the Join job shown above ran.

Variable Name

Name of variable defined while creating job.

Variable Values

Fixed: Can be static value or copy from another variable.

SQL Output: Output of SQL query on specified connection is used to load variable value. First tuple (first row-column) is used from query result.

Shell Script: Output of shell script is used to load variable value. First word displayed on standard output is selected.

Note

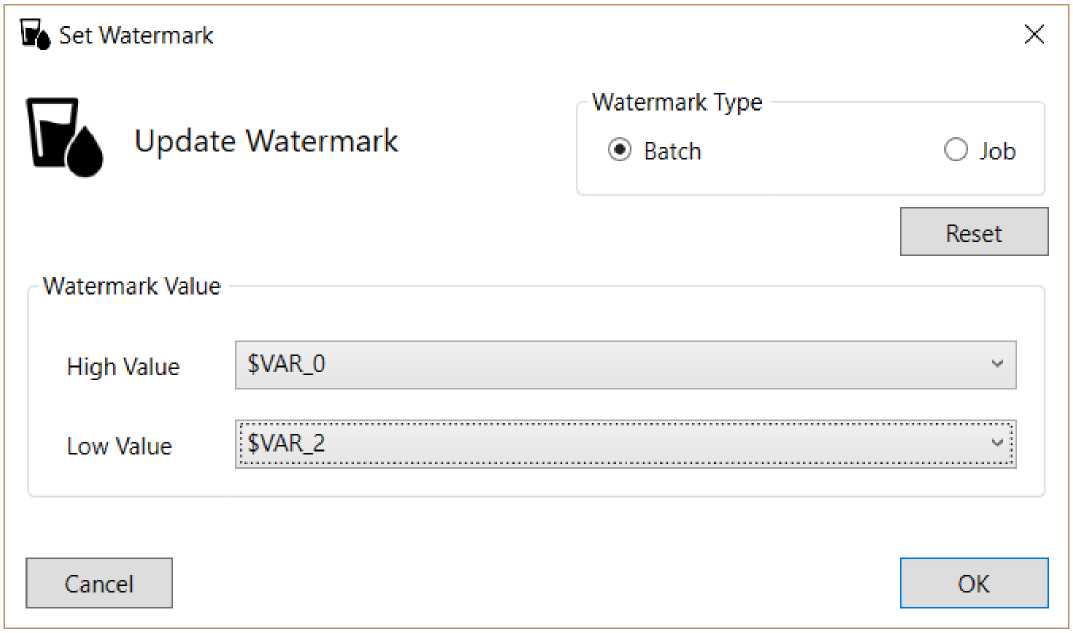
All variable values are re-evaluated during runtime.

Watermark

Introduction

Sets workflow JOB or root job (batch) watermark from another variable. Watermark values can only be set by copying from pre-initialized variables (current job variables).

Example,



Set Watermark

Update Watermark

Watermark Type

● Batch ○ Job

Watermark Value

High Value $VAR_0

Low Value $VAR_2

Watermark Types

Batch:	Root job watermark.
Job:	Current job watermark.

Watermark Values

High Value:	High watermark value for checked watermark type.
Low Value:	Low watermark value for checked watermark type.

Note

When a workflow runs following watermark values are initialized automatically by the engine. The watermark values are captured from last successful run state.
$BATCH_LOW_WATERMARK_VALUE
$BATCH_HIGH_WATERMARK_VALUE
$JOB_HIGH_WATERMARK_VALUE
$JOB_LOW_WATERMARK_VALUE

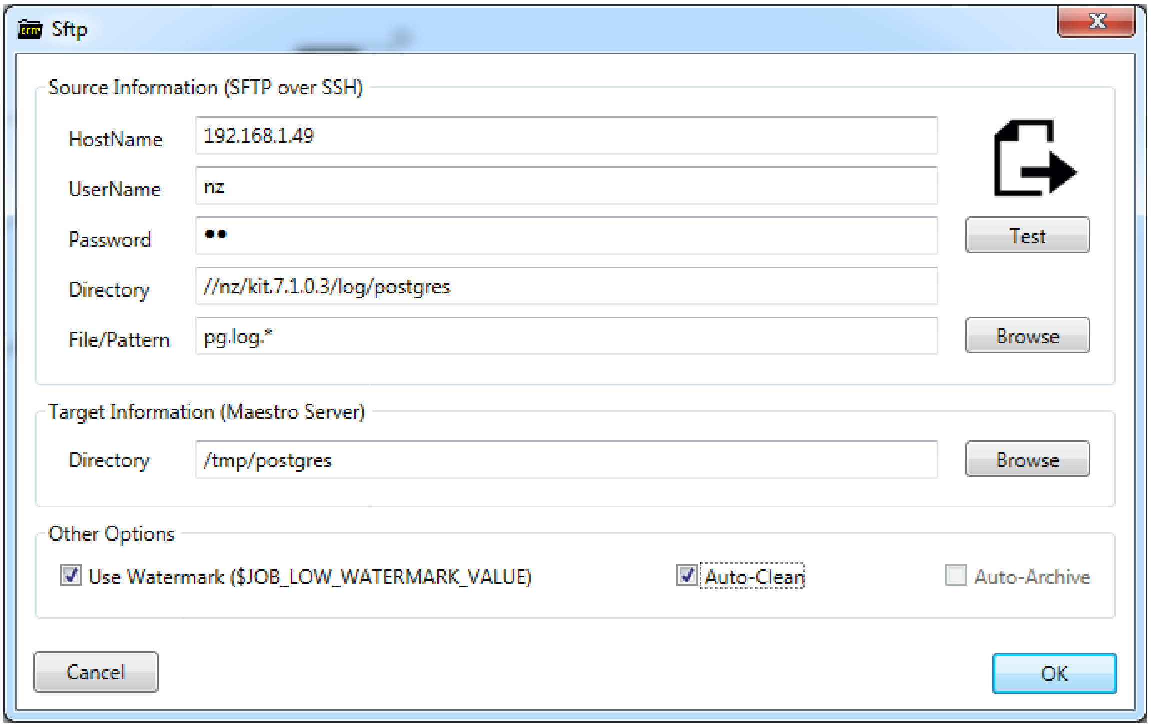
Browse to **Variables and Watermark** section for more information.

SFTP

Introduction

SFTP step enables downloading files from remote UNIX/Linux servers. ELT Maestro connects using SSH protocol to retrieve files using secure channel. SFTP step can also utilize watermarks to enable downloading changed files.

Example,



Source Information (SFTP over SSH)

HostName 192.168.1.49
UserName nz
Password ••
Directory //nz/kit.7.1.0.3/log/postgres
File/Pattern pg.log.*

Target Information (Maestro Server)

Directory /tmp/postgres

Other Options

☑ Use Watermark ($JOB_LOW_WATERMARK_VALUE) ☑ Auto-Clean □ Auto-Archive

Source Information

SSH Login: SSH credentials for SFTP server.
Directory: Source Directory
File/Pattern: File Name or Pattern. POSIX expression is used to evaluate file names.

Target Information

Directory: Directory path on ELT Maestro server.

Use Watermark Option

If this option is checked ensure that current workflow does not set Job Low Watermark Value. Watermark option utilizes job low watermark value to obtain only the changed files since last load. SFTP step automatically keeps track of latest file modified timestamp based on source server time zone and updates job low watermark value automatically.

Auto Clean Option

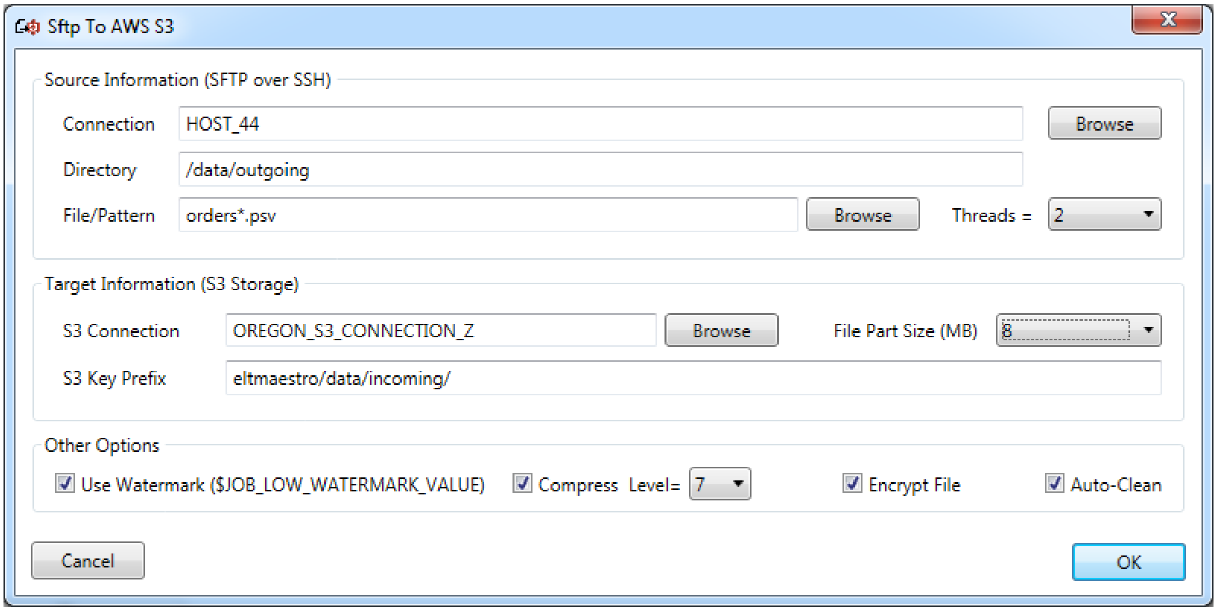
If this option is checked upon completion of root job (BATCH) the downloaded files are automatically deleted. Auto-Clean option is useful specially when freeing up disk resources on ELT Maestro server after loading them into database tables.

SFTP2S3 -Deprecated

Introduction

SFTP2S3 step enables downloading files from remote UNIX/Linux servers into one of the active agent systems and then uploading those files to S3 bucket. ELT Maestro connects using SSH protocol to retrieve files using secure channel. SFTP step can also utilize watermarks to enable downloading changed files. File(s) can be encrypted and/or compressed before uploading into S3 bucket. Client side AES256 bit encryption is default encryption algorithm.

Example,



Source Information (SFTP over SSH)

Connection: HOST_44

Directory: /data/outgoing

File/Pattern: orders*.psv

Threads = 2

Target Information (S3 Storage)

S3 Connection: OREGON_S3_CONNECTION_Z

File Part Size (MB): 8

S3 Key Prefix: eltmaestro/data/incoming/

Other Options

☑ Use Watermark ($JOB_LOW_WATERMARK_VALUE) ☑ Compress Level= 7 ☑ Encrypt File ☑ Auto-Clean

Parameters

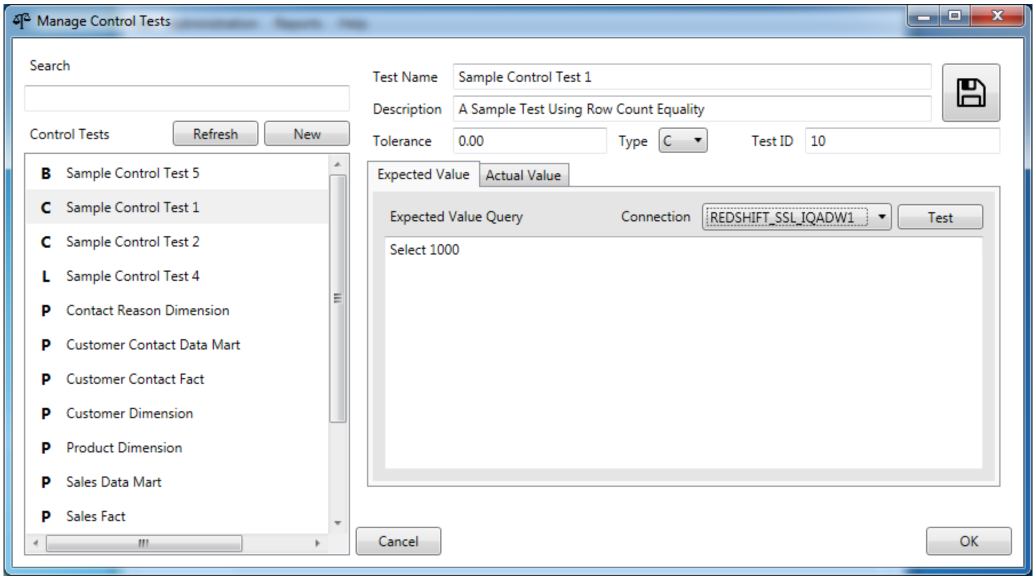
Property	Type	Info
Connection	Text	SSH Connection Name
Directory	Text	Source Directory
File / Pattern	Text	Filename or POSIX Pattern
Threads	Selection	Number of threads for parallel uploads. (Applies to pattern matched files)
File Part Size (MB)	Selection	S3 upload file partition size for larger files.
S3 Connection	Text	S3 Connection Name
S3 Key Prefix	Text	Key Prefix to append
Use Watermark	Check Box	Optional: Uses low watermark variable.
Compress	Selection	Optional: Uses bzip2 compression, 9 is highest compression level
Encrypt File	Check Box	Encrypts file before uploading using specified key configured on S3 Connection. Uses AES256 bit client side symmetric key.
Auto-Clean	Check Box	Deletes uploaded files from S3 upon job completion.

Control Test

Introduction

Enables running data quality tests to measure the correctness or reasonableness of data as it is moved and transformed within or across workflows. A Control Test must be defined before it can be inserted into a workflow. The definition is performed using the Control Test Designer, which is accessed from the Administration Menu on the main ribbon.

To open control test editor, on the main window Click [Administration], Click [Metrics Configuration] then Click [Control Test]



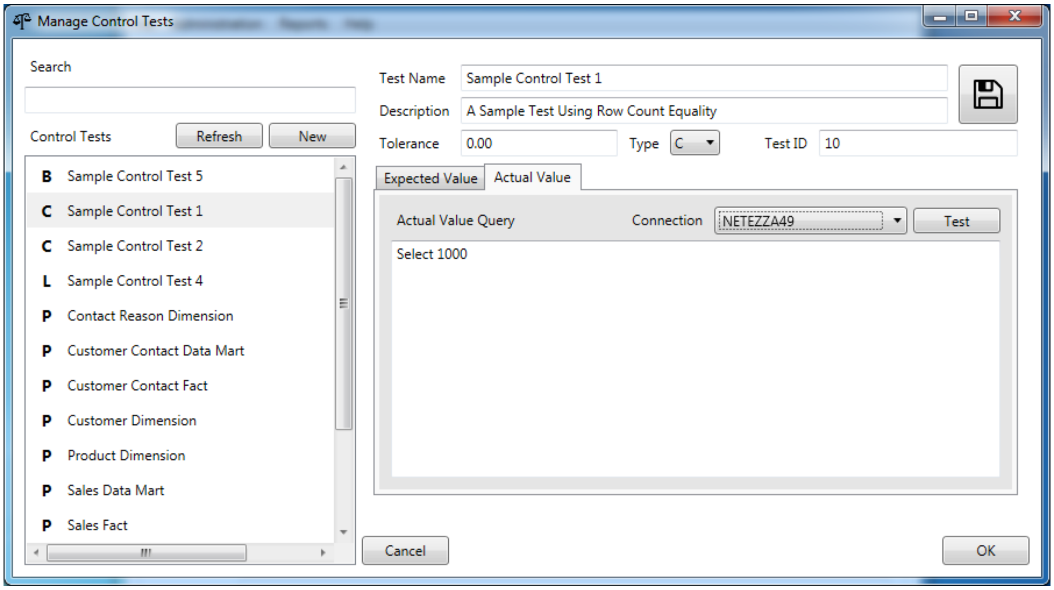
Control Tests:

B	Sample Control Test 5
C	Sample Control Test 1
C	Sample Control Test 2
L	Sample Control Test 4
P	Contact Reason Dimension
P	Customer Contact Data Mart
P	Customer Contact Fact
P	Customer Dimension
P	Product Dimension
P	Sales Data Mart
P	Sales Fact

Test Name: Sample Control Test 1
Description: A Sample Test Using Row Count Equality
Tolerance: 0.00 Type: C Test ID: 10
Expected Value Query Connection: REDSHIFT_SSL_IQADW1

```
Select 1000
```

After giving a name, an identifier, and defining the test type, tolerance, and the expected value query. We then define the connection and the actual value query as shown below. All normal control tests will require both an expected value query and an actual value query which are then compared to determine if the control test passed or failed. Control Test Type 'M' which indicates we are performing a measurement rather than a control test, is used to probe and report on queryable system parameters we may wish to know about and run trending analysis on. Example include measuring database size growth over time, capturing end-user counts, or tracing the number of reports run.



Control Tests:

B	Sample Control Test 5
C	Sample Control Test 1
C	Sample Control Test 2
L	Sample Control Test 4
P	Contact Reason Dimension
P	Customer Contact Data Mart
P	Customer Contact Fact
P	Customer Dimension
P	Product Dimension
P	Sales Data Mart
P	Sales Fact

Test Name: Sample Control Test 1
Description: A Sample Test Using Row Count Equality
Tolerance: 0.00 Type: C Test ID: 10
Actual Value Query Connection: NETEZZA49

```
Select 1000
```

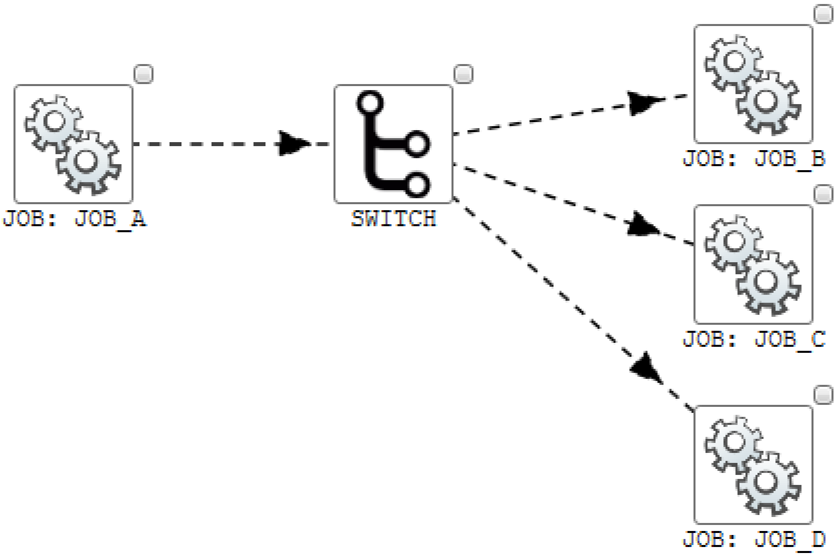
We can now save the Control Test and then call it within a workflow. The illustration below shows how it is selected from within the workflow designer.

Job

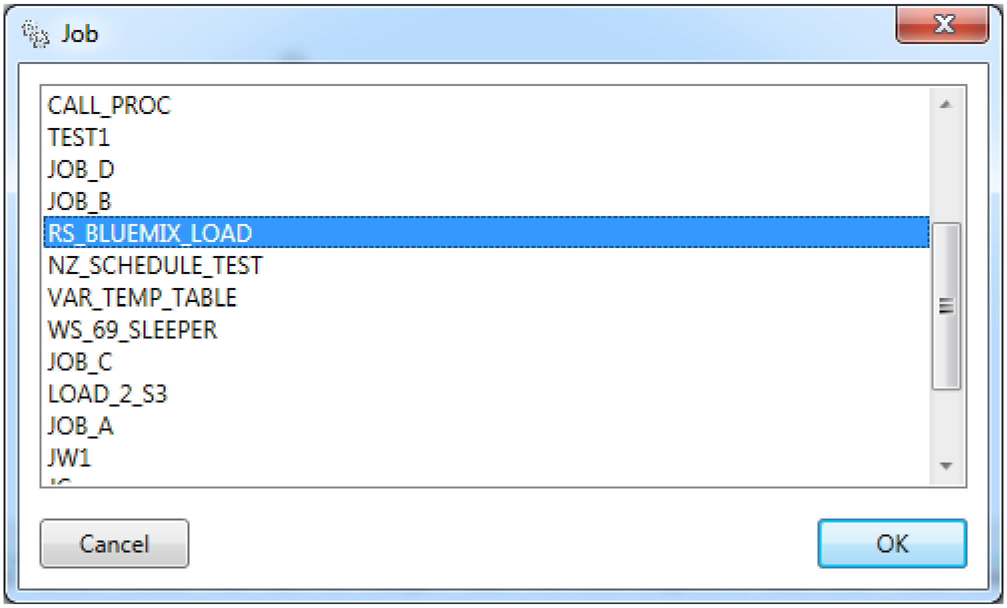
Introduction

Allows current workflow to execute deployed workflow. Job can be used with Switch to design success and recovery workflow path as well.

Example Workflow Implementation,



Example,



CALL_PROC
TEST1
JOB_D
JOB_B
RS_BLUEMIX_LOAD
NZ_SCHEDULE_TEST
VAR_TEMP_TABLE
WS_69_SLEEPER
JOB_C
LOAD_2_S3
JOB_A
JW1

Job

Job Step executes selected deployed job.

Note: ELT Maestro engine can only execute one instance of a job in a workflow to avoid execution recursion.

Local File

Introduction

Local File step allows loading delimited (csv), parquet, json, orc and text files from sources including aws s3 storage and local filesystem. To build loading pipeline, local file, redshift stage and table step is required as shown below.

Figure: Local File, Redshift Stage, Table pipeline

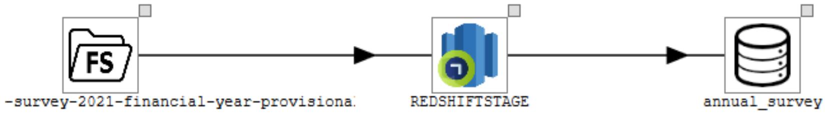
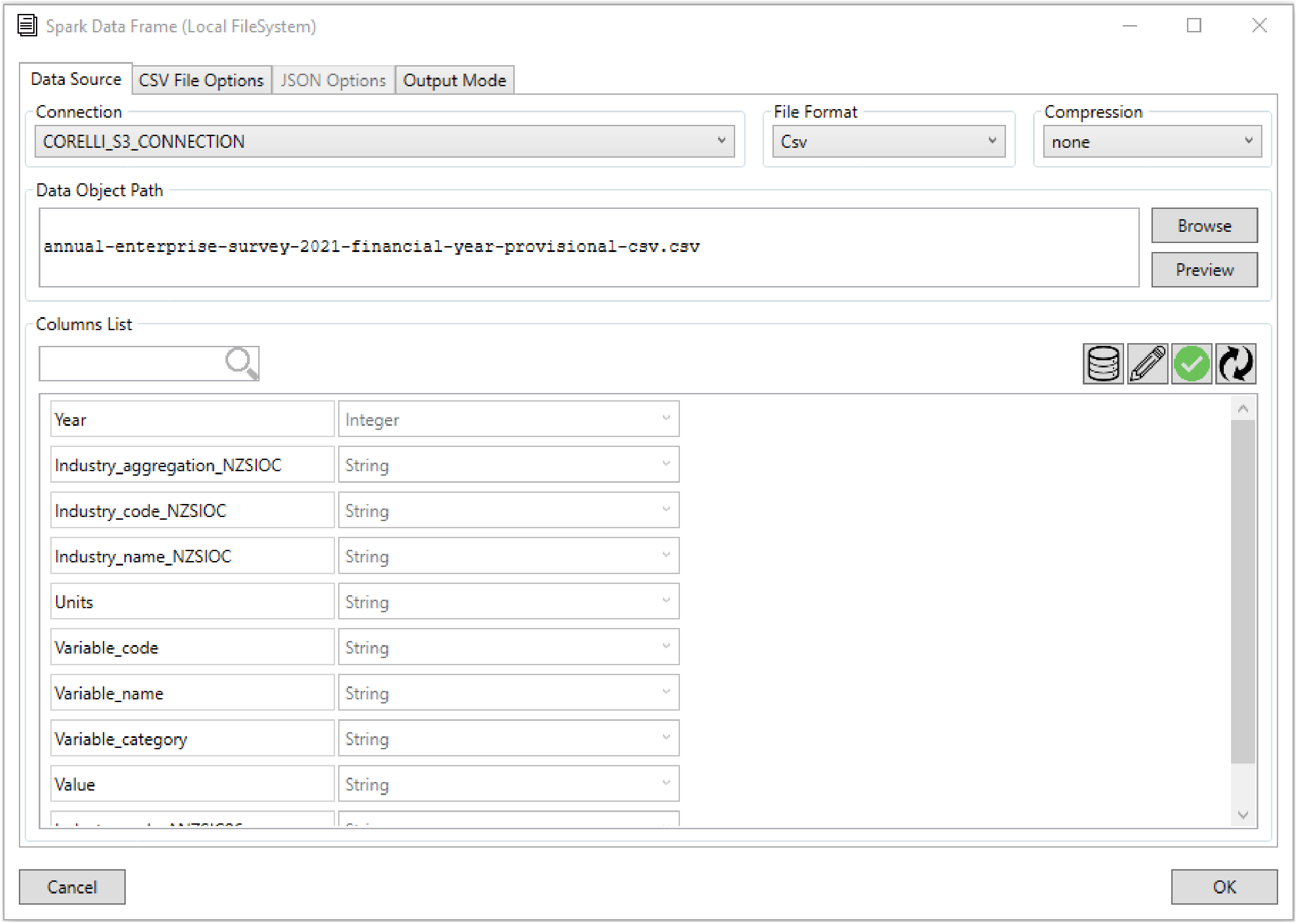


Figure: Local File Step



Connection: CORELLI_S3_CONNECTION

File Format: Csv

Compression: none

Data Object Path: annual-enterprise-survey-2021-financial-year-provisional-csv.csv

Columns List

Year	Integer
Industry_aggregation_NZSIOC	String
Industry_code_NZSIOC	String
Industry_name_NZSIOC	String
Units	String
Variable_code	String
Variable_name	String
Variable_category	String
Value	String

Requirements

- ➢ A file data source connection must exist that points to aws s3 or local filesystem.

Loader Configuration Steps

- ➢ Select source connection, file format, compression.
- ➢ Browse data object path or manually modify file path.
- ➢ Modify CSV File Options or JSON Options.

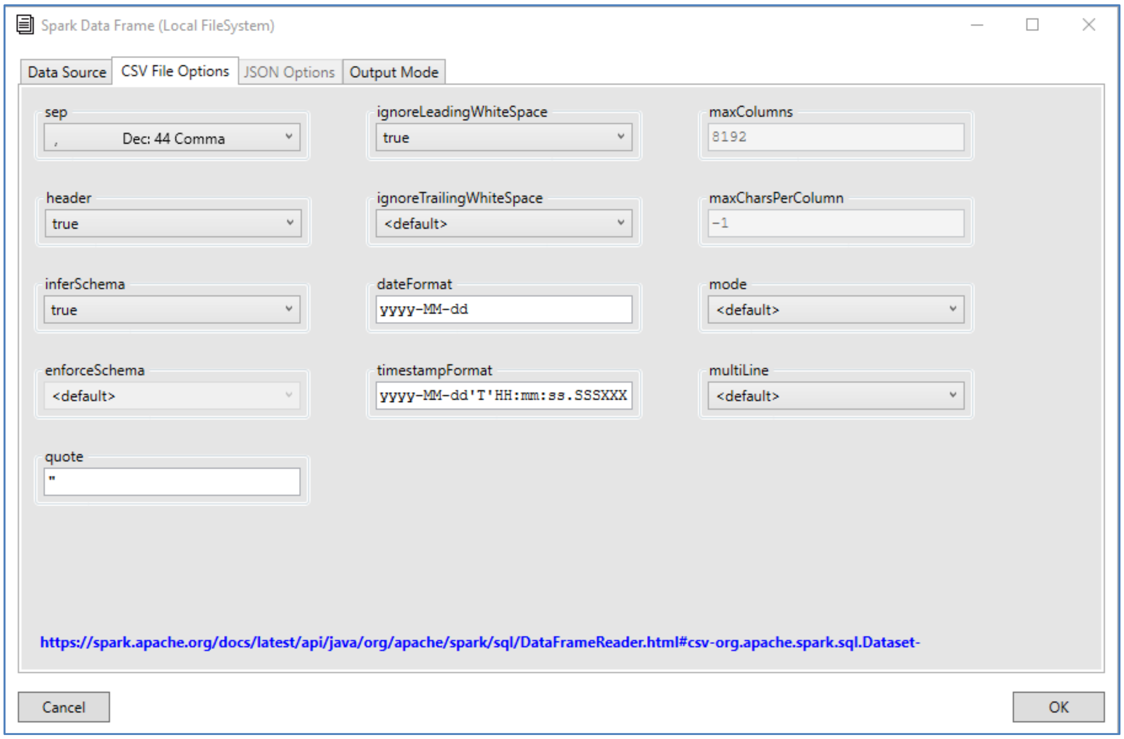
- On Output Mode, check mark ON Re-Profile Metadata (this option profiles data files, check mark OFF re-profile flag upon successful metadata detection)

For information on file load options, please spark site and scroll to parameter definitions listed.
https://spark.apache.org/docs/latest/sql-data-sources-csv.html
https://spark.apache.org/docs/latest/sql-data-sources-json.html

General CSV Options

Option	***Description***
sep	Delimiter
header	True = first line contains header as column names
inferSchema	True = guess data types, False = read data as string
quote	Character used to quote data on files
ignoreLeading/TrailingWhitespace	Trim whitespace on left/right (trim)

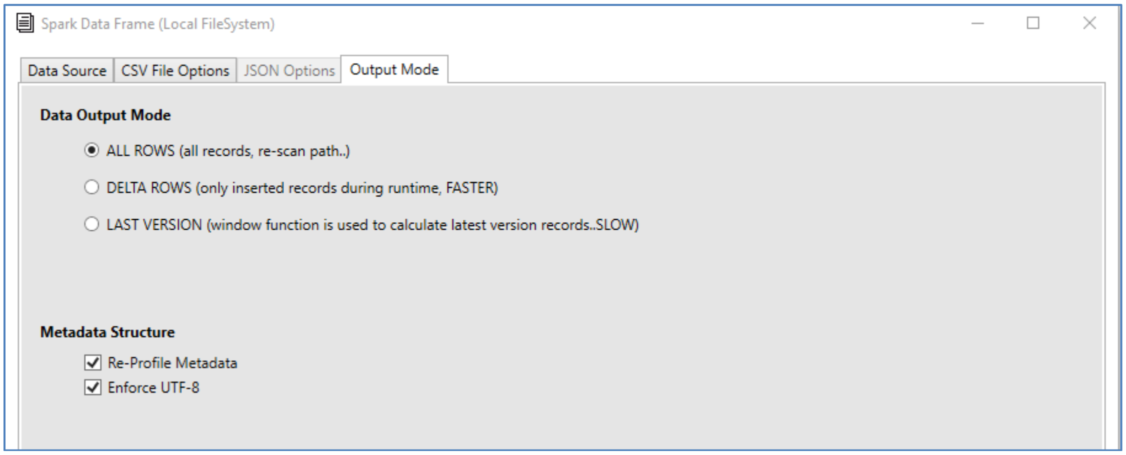
Example,
Open local file step and configure file options on [CSV File Options] tab. Options depend on selected file format. Text, parquet, orc formats do not need any configuration except compression.



sep: , Dec: 44 Comma
header: true
inferSchema: true
enforceSchema: <default>
quote: "
ignoreLeadingWhiteSpace: true
ignoreTrailingWhiteSpace: <default>
dateFormat: yyyy-MM-dd
timestampFormat: yyyy-MM-dd'T'HH:mm:ss.SSSXXX
maxColumns: 8192
maxCharsPerColumn: -1
mode: <default>
multiLine: <default>

https://spark.apache.org/docs/latest/api/java/org/apache/spark/sql/DataFrameReader.html#csv-org.apache.spark.sql.Dataset-

On [CSV File Options] tab check mark ON Re-Profile Metadata. This enforces data profiler mode only during runtime.



Data Output Mode

● ALL ROWS (all records, re-scan path..)

○ DELTA ROWS (only inserted records during runtime, FASTER)

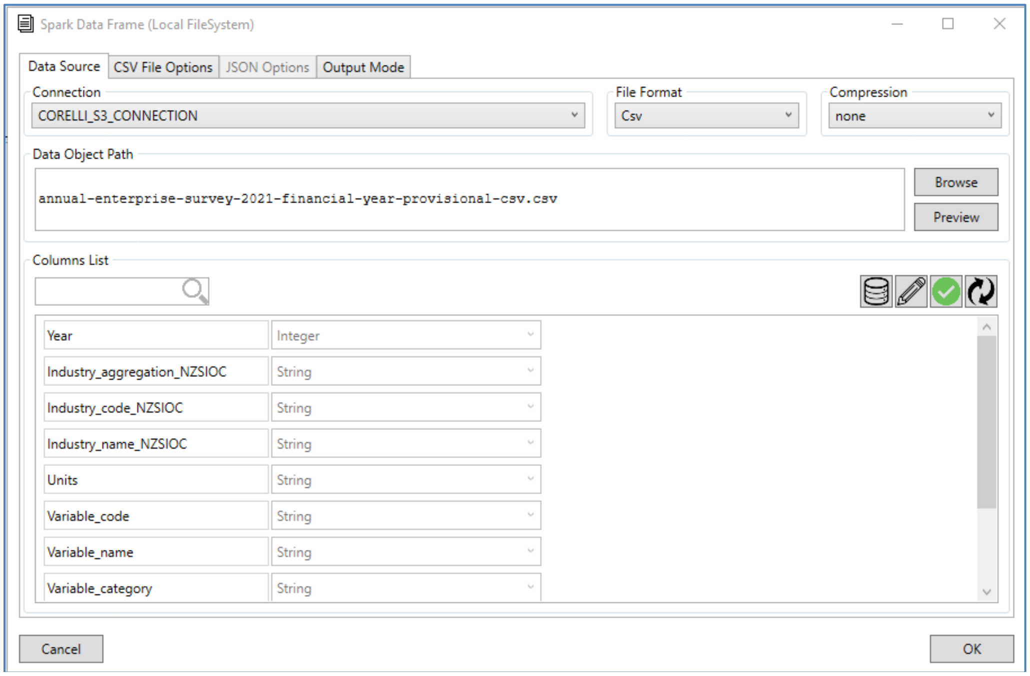
○ LAST VERSION (window function is used to calculate latest version records..SLOW)

Metadata Structure

☑ Re-Profile Metadata

☑ Enforce UTF-8

On [Data Source] tab select Connection, File Format, Compression and Data Object Path (Browse if necessary), then click Refresh.



Connection: CORELLI_S3_CONNECTION

File Format: Csv

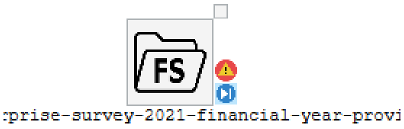
Compression: none

Data Object Path: `annual-enterprise-survey-2021-financial-year-provisional-csv.csv`

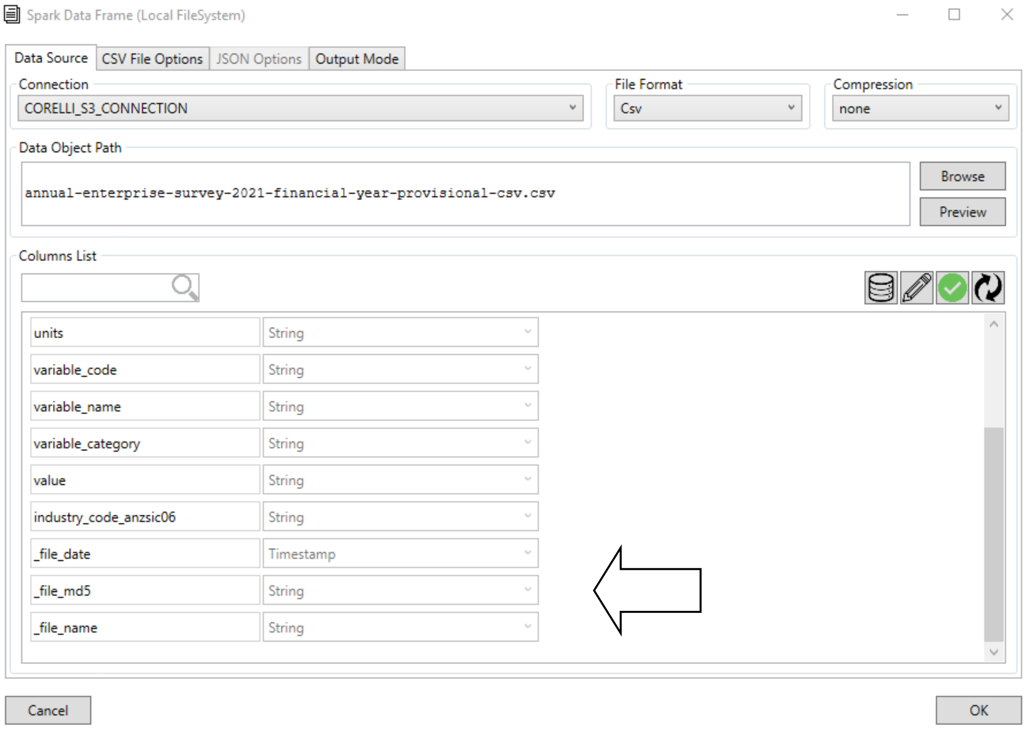
Columns List

Year	Integer
Industry_aggregation_NZSIOC	String
Industry_code_NZSIOC	String
Industry_name_NZSIOC	String
Units	String
Variable_code	String
Variable_name	String
Variable_category	String

Then Click [OK] to save and execute workflow. After workflow runs, the local file step will have skipped status when successful.



Uncheck log and re-open local file step, then click refresh button so that additional maintenance columns (_file_date, _file_md5, _file_name) appear at the bottom of the list.



Spark Data Frame (Local FileSystem)

Connection: CORELLI_S3_CONNECTION

File Format: Csv

Compression: none

Data Object Path: annual-enterprise-survey-2021-financial-year-provisional-csv.csv

Columns List

units	String
variable_code	String
variable_name	String
variable_category	String
value	String
industry_code_anzsic06	String
_file_date	Timestamp
_file_md5	String
_file_name	String

On [Output Mode] tab, check mark OFF [Re-Profile Metadata] so that the step does not skip. Click [OK] to save and continue adding RedshiftStage on the pipeline.

Redshift Stage [Redshift]

Introduction

This step pushes data files into S3 temporarily in parquet file format generated by Local File step, creates a temporary table on Redshift, loads staged files into Redshift, and deletes the temporary files from S3. Use this step with Local File step as a source and Table step as target.

Figure: Local File, Redshift Stage, Table pipeline

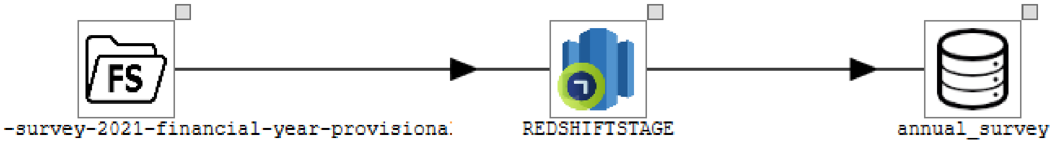
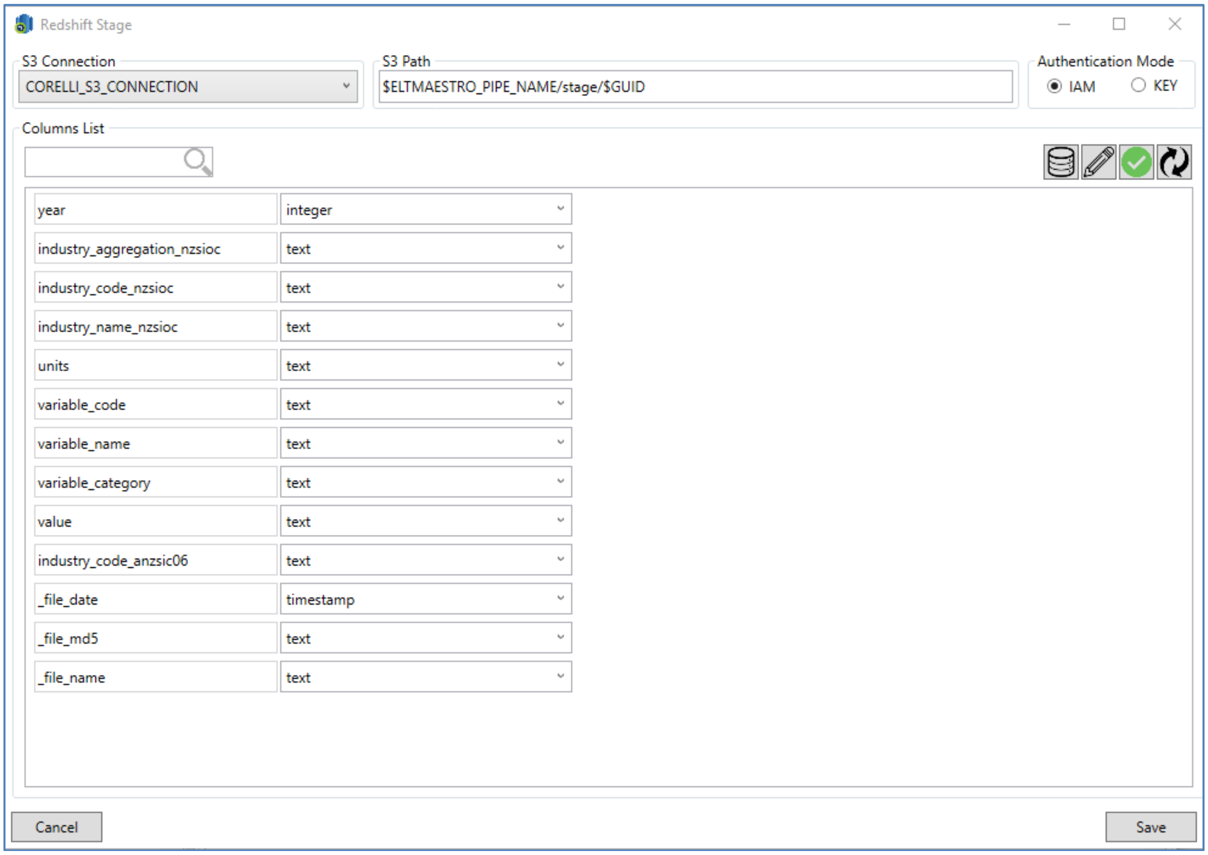


Figure: Redshift Stage Step



S3 Connection: CORELLI_S3_CONNECTION

S3 Path: $ELTMAESTRO_PIPE_NAME/stage/$GUID

Authentication Mode: ● IAM ○ KEY

Columns List

year	integer
industry_aggregation_nzsioc	text
industry_code_nzsioc	text
industry_name_nzsioc	text
units	text
variable_code	text
variable_name	text
variable_category	text
value	text
industry_code_anzsic06	text
_file_date	timestamp
_file_md5	text
_file_name	text

Requirements

- Source is Local File step; Target is Table step.
- S3 Connection is AWS S3 connection for ELTMaestro data staging use.

Loader Configuration Steps

- Select S3 Connection. S3 Path can be left unchanged.
- Select [IAM] if S3 bucket has redshift IAM policy, else select [KEY] on authentication mode.
- Click [Refresh] button to reload columns if the list is empty, then click Save.s
- Link output of this step to Table step.

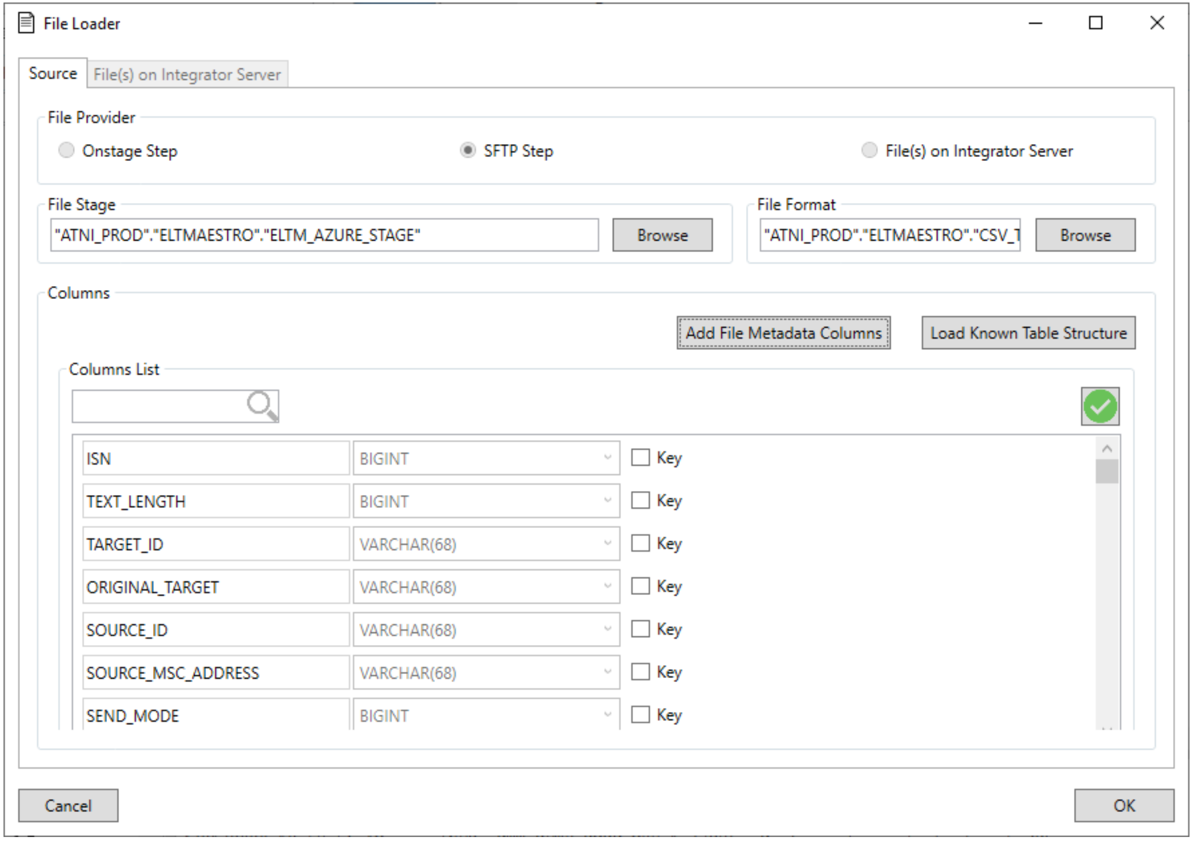
Refer to Table Step on Page 37.

File Loader [Snowflake]

Introduction

File loader step allows loading flat files into existing table. The table structure must match data file structure. Output of file loader step should point to physical table. File Loader step can load files from Onstage source, SFTP source or files located on ELT Maestro server.

Figure: File Loader Step


File Loader
Source
File(s) on Integrator Server
Browse
Browse
Add File Metadata Columns
Load Known Table Structure
Cancel
OK

File Provider: ○ Onstage Step ● SFTP Step ○ File(s) on Integrator Server

File Stage: "ATNI_PROD"."ELTMAESTRO"."ELTM_AZURE_STAGE"

File Format: "ATNI_PROD"."ELTMAESTRO"."CSV_1

Columns

Columns List

ISN	BIGINT	□ Key
TEXT_LENGTH	BIGINT	□ Key
TARGET_ID	VARCHAR(68)	□ Key
ORIGINAL_TARGET	VARCHAR(68)	□ Key
SOURCE_ID	VARCHAR(68)	□ Key
SOURCE_MSC_ADDRESS	VARCHAR(68)	□ Key
SEND_MODE	BIGINT	□ Key

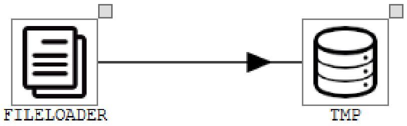
Requirements

- A table must exist on database that matches metadata with file so a known structure can be referenced
- File path must be specified if loading from files located on ELT Maestro server
- Optionally based on file construct you must alter [Load Query Options], refer to Netezza external table options for customizing load options
- An External File Stage must be configured
- File Format must be configured

Loader Configuration Steps

- Create a table on Snowflake database that matches with file structure
- Reference whether file is provided by sftp, onstage or locally present
- Attach output to table step as shown on figure below.

Figure: File Loader to Table

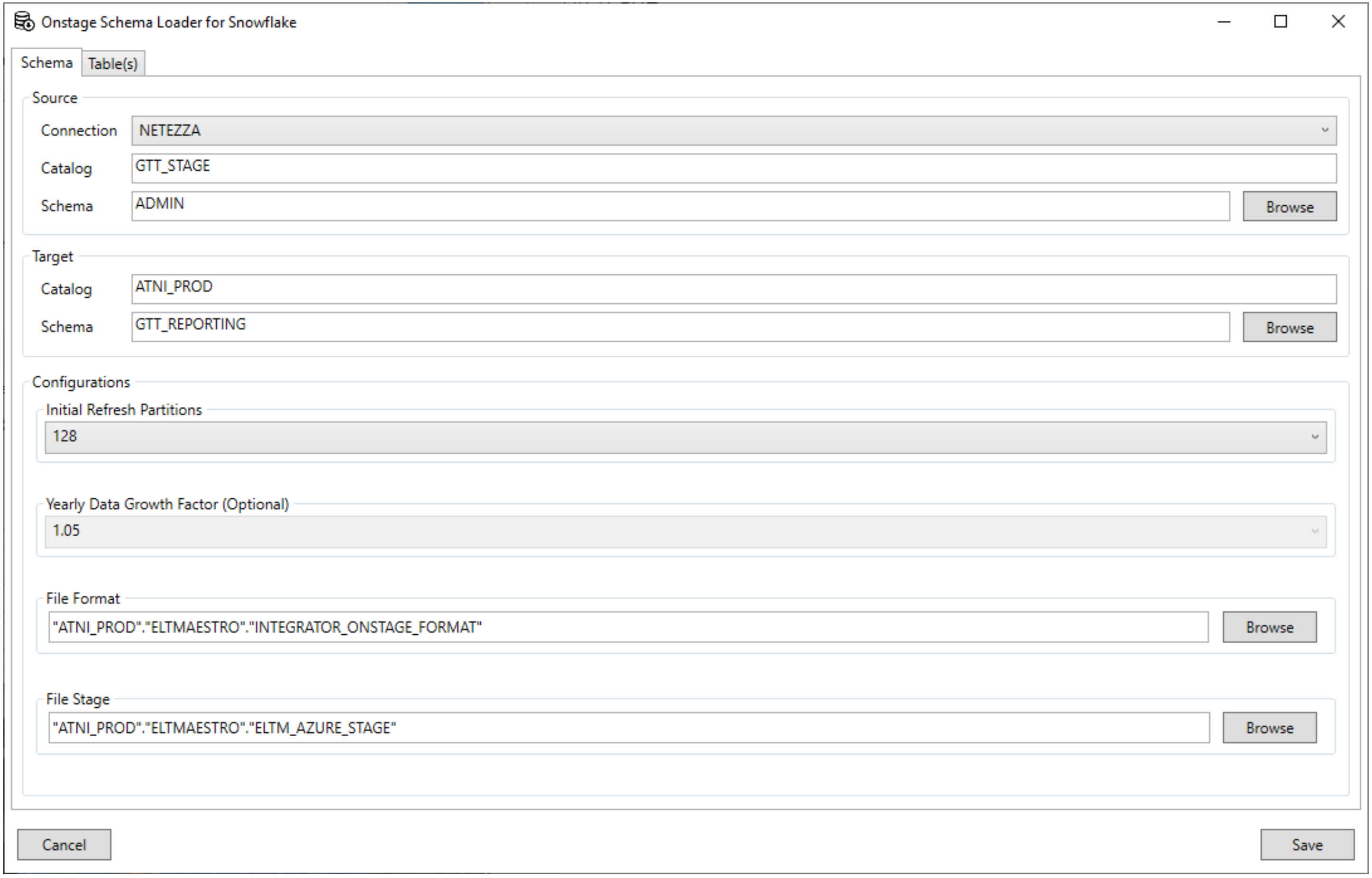


Onstage Group [Snowflake]

Introduction

Onstage Group also known as schema loader is used to load multiple databases tables from a source jdbc connection. This step is a database migration utility that can generate objects on target system like Snowflake and loads data from source systems. Incremental loads can be achieved by utilizing watermark columns.

Figure: Onstage Group Loader [Schema Tab]



Onstage Schema Loader for Snowflake

Source
Connection: NETEZZA
Catalog: GTT_STAGE
Schema: ADMIN

Target
Catalog: ATNI_PROD
Schema: GTT_REPORTING

Configurations
Initial Refresh Partitions: 128
Yearly Data Growth Factor (Optional): 1.05
File Format: "ATNI_PROD"."ELTMAESTRO"."INTEGRATOR_ONSTAGE_FORMAT"
File Stage: "ATNI_PROD"."ELTMAESTRO"."ELTM_AZURE_STAGE"

Configuration

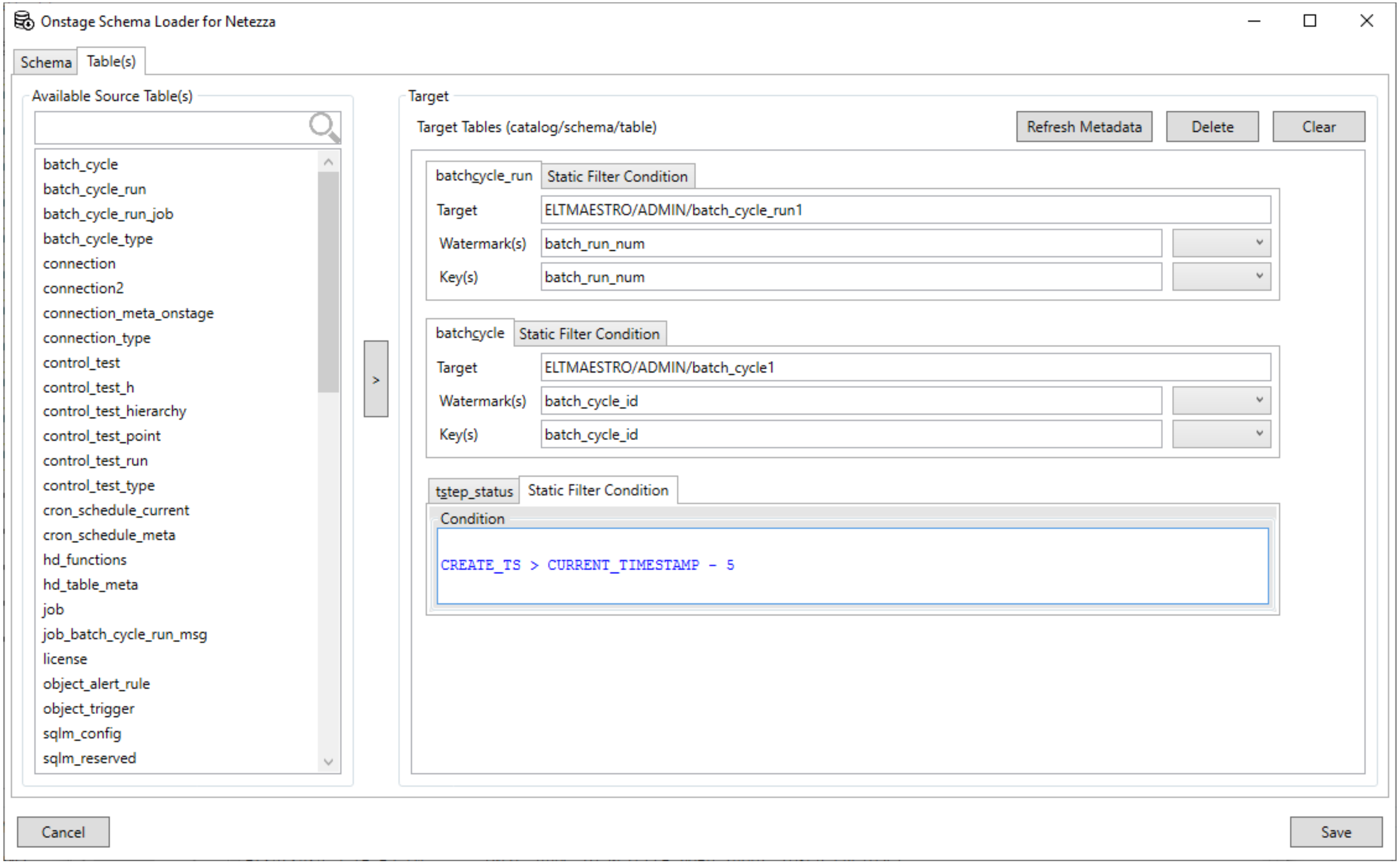
- Browse to [Select] source connection, catalog and schema to migrate tables from
- Browse to [Select] target catalog and schema to migrate tables to
- Select [Initial Load Partitions] to bucket initial load sql script into multiple conditions
- Select [Initial Load Threads] to specify parallelism factor on partitions
- Select [File Format] and [File Stage]
- Optionally if you set [Run Count Metrics] to true, ELT Maestro automatically runs source/target row counts before and after load has been completed.

Example,

If you set initial load partitions to 16 and load threads to 4 then ELT Maestro will generate 16 range based SQL queries to execute on source system and executes those 16 queries 4 at a time, the load is also performed at parallelism of 4. Setting initial load partitions is best if you are loading a very large tables.

Note: A numeric or timestamp based watermark column is always required to partition the data

Figure: Table(s)


Onstage Schema Loader for Netezza
Schema
Table(s)
Available Source Table(s)
Target
Target Tables (catalog/schema/table)
Refresh Metadata
Delete
Clear
>
Static Filter Condition
Cancel
Save

batch_cycle
batch_cycle_run
batch_cycle_run_job
batch_cycle_type
connection
connection2
connection_meta_onstage
connection_type
control_test
control_test_h
control_test_hierarchy
control_test_point
control_test_run
control_test_type
cron_schedule_current
cron_schedule_meta
hd_functions
hd_table_meta
job
job_batch_cycle_run_msg
license
object_alert_rule
object_trigger
sqlm_config
sqlm_reserved

batchcycle_run
Target: ELTMAESTRO/ADMIN/batch_cycle_run1
Watermark(s): batch_run_num
Key(s): batch_run_num

batchcycle
Target: ELTMAESTRO/ADMIN/batch_cycle1
Watermark(s): batch_cycle_id
Key(s): batch_cycle_id

tstep_status
Condition

```
CREATE_TS > CURRENT_TIMESTAMP - 5
```

Adding Tables

- Select tables on left panel and Click [>] button to add to list on right panel
- Click [Refresh Metadata] button to load metadata information after all required tables have been added

Delta Configuration (Option 1 if you know delta columns)

- For each table, select [watermark] column, you can select multiple watermark columns for delta load
- Specify [key] columns so that updates can be upserted. If keys are not specified the loader will only perform inserts

Reach-Back or Manual SQL Configuration (Option 2 if you don't know delta columns)

- Modify [Static Filter Condition] and add a filter expression. As shown on above diagram for third table a static filter is added that goes back 4 days to obtain records.

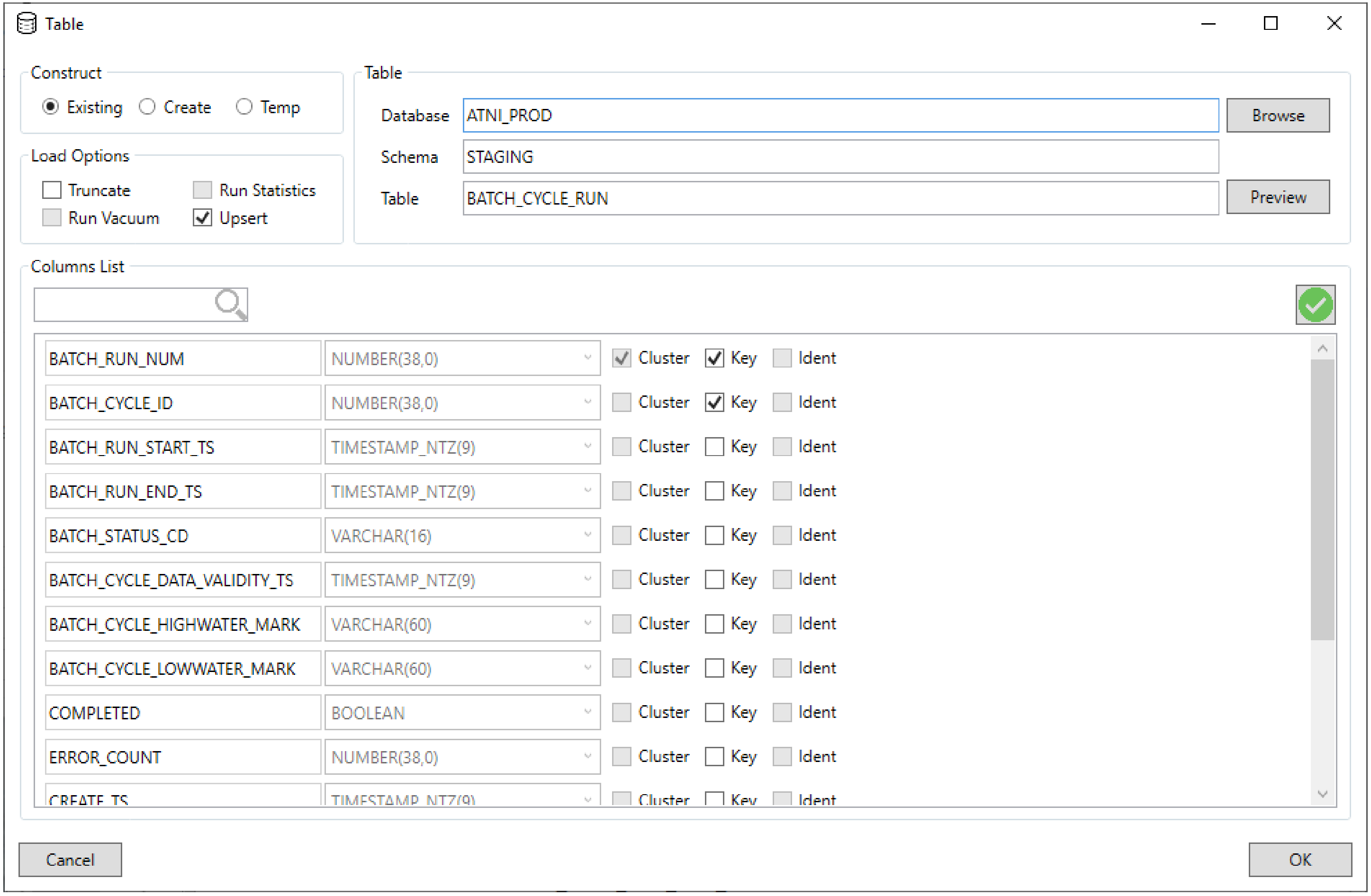
Note: Object path is referenced with path format of catalog/schema/table. If you are going to change table names on target please use this format.

Table [Most Platforms]

Introduction

Table step can read from or write to referenced table.

Figure: Table Step



Construct: ● Existing ○ Create ○ Temp

Load Options: □ Truncate □ Run Statistics □ Run Vacuum ☑ Upsert

Table

Database: ATNI_PROD

Schema: STAGING

Table: BATCH_CYCLE_RUN

BATCH_RUN_NUM	NUMBER(38,0)	☑ Cluster	☑ Key	□ Ident
BATCH_CYCLE_ID	NUMBER(38,0)	□ Cluster	☑ Key	□ Ident
BATCH_RUN_START_TS	TIMESTAMP_NTZ(9)	□ Cluster	□ Key	□ Ident
BATCH_RUN_END_TS	TIMESTAMP_NTZ(9)	□ Cluster	□ Key	□ Ident
BATCH_STATUS_CD	VARCHAR(16)	□ Cluster	□ Key	□ Ident
BATCH_CYCLE_DATA_VALIDITY_TS	TIMESTAMP_NTZ(9)	□ Cluster	□ Key	□ Ident
BATCH_CYCLE_HIGHWATER_MARK	VARCHAR(60)	□ Cluster	□ Key	□ Ident
BATCH_CYCLE_LOWWATER_MARK	VARCHAR(60)	□ Cluster	□ Key	□ Ident
COMPLETED	BOOLEAN	□ Cluster	□ Key	□ Ident
ERROR_COUNT	NUMBER(38,0)	□ Cluster	□ Key	□ Ident
CREATE_TS	TIMESTAMP_NTZ(9)	□ Cluster	□ Key	□ Ident

s

Construct

1. [Existing] Reference existing table and metadata from database schema
2. [Create] Create table if it does not exist
3. [Temp] Write output to a temp table, then drop it after workflow execution is completed

Load Options

1. [Truncate] Truncate table before inserting data
2. [Run Statistics] Run GENERATE STATISTICS command on table after data has been inserted or updated
3. [Run Vacuum] Run GROOM command on table after data has been inserted or updated
4. [Upsert] Update + Insert data on table by detecting key column reference

Column Properties

1. [Cluster] Cluster rows based on check marked column
2. [Key] Mark column as a logical key (required for upsert mode)
3. [Ident] Mark column as identity/auto incrementing column

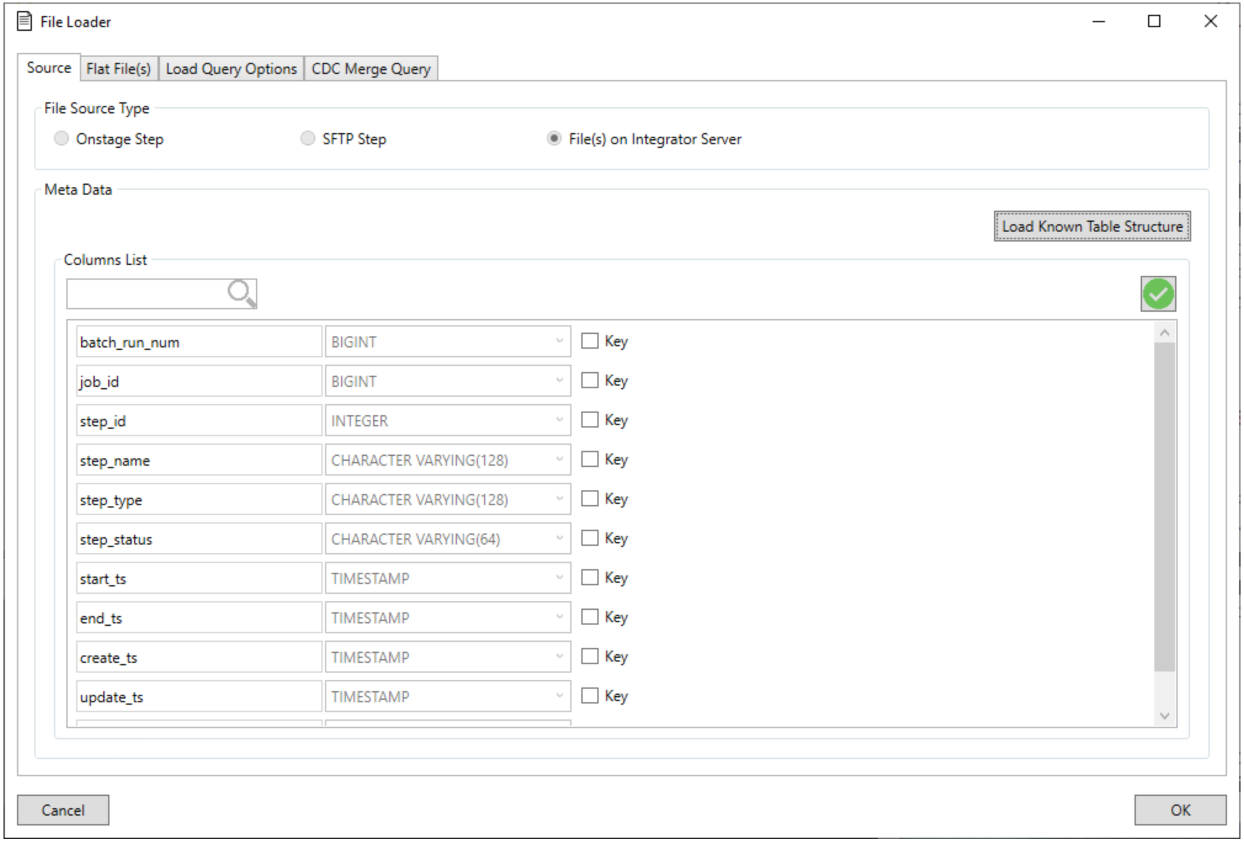
You can only add/remove columns for construct type [Create] or [Temp] or set Ident flag to true.

File Loader [Netezza]

Introduction

File loader step allows loading flat files into existing table. The table structure must match data file structure. Output of file loader step should point to physical table. File Loader step can load files from Onstage source, SFTP source or files located on ELT Maestro server.

Figure: File Loader Step



File Loader

Source | Flat File(s) | Load Query Options | CDC Merge Query

File Source Type

○ Onstage Step ○ SFTP Step ● File(s) on Integrator Server

Meta Data

Load Known Table Structure

Columns List

batch_run_num	BIGINT	□ Key
job_id	BIGINT	□ Key
step_id	INTEGER	□ Key
step_name	CHARACTER VARYING(128)	□ Key
step_type	CHARACTER VARYING(128)	□ Key
step_status	CHARACTER VARYING(64)	□ Key
start_ts	TIMESTAMP	□ Key
end_ts	TIMESTAMP	□ Key
create_ts	TIMESTAMP	□ Key
update_ts	TIMESTAMP	□ Key

Cancel OK

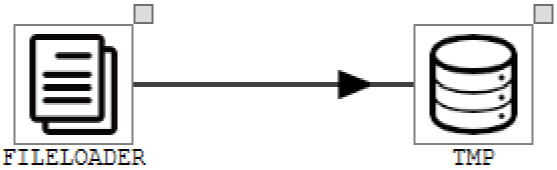
Requirements

- A table must exist on database that matches metadata with file so a known structure can be referenced
- File path must be specified if loading from files located on ELT Maestro server
- Optionally based on file construct you must alter [Load Query Options], refer to Netezza external table options for customizing load options

Loader Configuration Steps

- Create a table on Netezza database that matches with file structure
- Reference whether file is provided by sftp, onstage or locally present
- Modify external table load options without changing $ variable references
- Attach output to table step as shown on figure below.

Figure: File Loader to Table

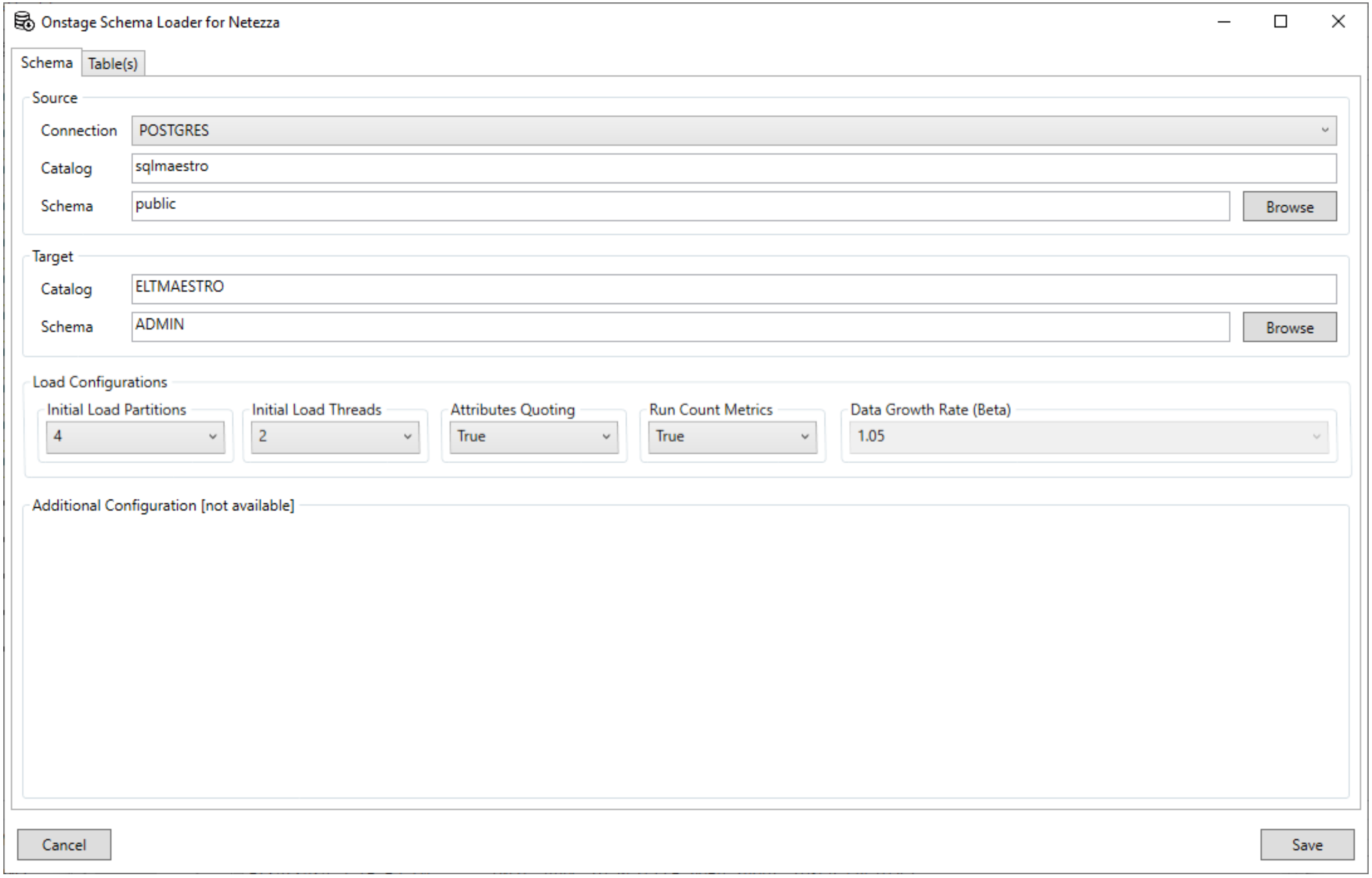


Onstage Group [Netezza]

Introduction

Onstage Group also known as schema loader is used to load multiple databases tables from a source jdbc connection. This step is a database migration utility that can generate objects on target system like Netezza and loads data from source systems. Incremental loads can be achieved by utilizing watermark columns.

Figure: Onstage Group Loader [Schema Tab]



Onstage Schema Loader for Netezza

Source

Connection: POSTGRES

Catalog: sqlmaestro

Schema: public

Target

Catalog: ELTMAESTRO

Schema: ADMIN

Load Configurations

Initial Load Partitions: 4

Initial Load Threads: 2

Attributes Quoting: True

Run Count Metrics: True

Data Growth Rate (Beta): 1.05

Additional Configuration [not available]

Configuration

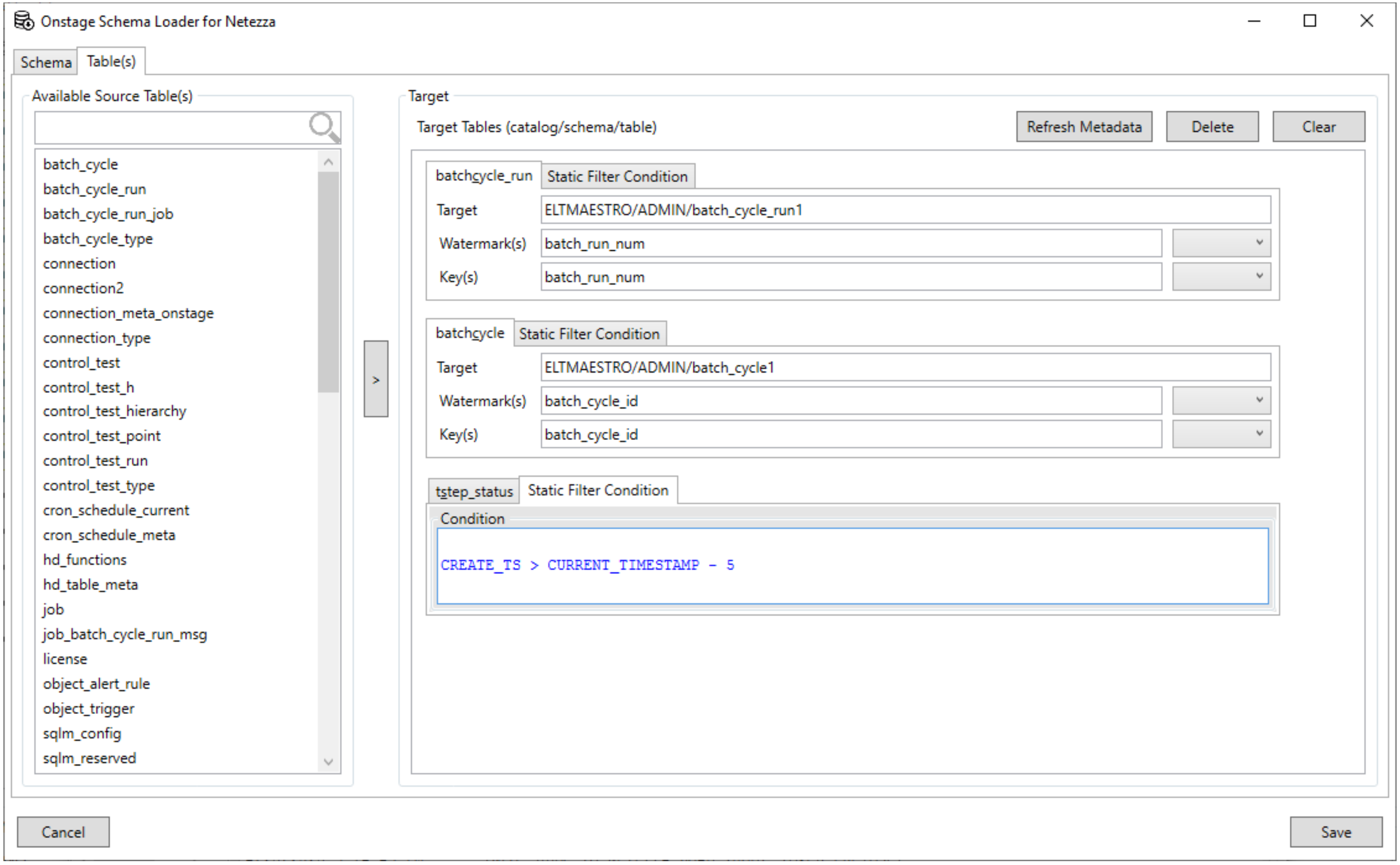
- Browse to [Select] source connection, catalog and schema to migrate tables from
- Browse to [Select] target catalog and schema to migrate tables to
- Select [Initial Load Partitions] to bucket initial load sql script into multiple conditions
- Select [Initial Load Threads] to specify parallelism factor on partitions
- Optionally if you set [Run Count Metrics] to true, ELT Maestro automatically runs source/target row counts before and after load has been completed.

Example,

If you set initial load partitions to 16 and load threads to 4 then ELT Maestro will generate 16 range based SQL queries to execute on source system and executes those 16 queries 4 at a time, the load is also performed at parallelism of 4. Setting initial load partitions is best if you are loading a very large tables.

Note: A numeric or timestamp based watermark column is always required to partition the data

Figure: Table(s)


Onstage Schema Loader for Netezza
Schema
Table(s)
Available Source Table(s)
Target
Target Tables (catalog/schema/table)
Refresh Metadata
Delete
Clear
>
Static Filter Condition
Cancel
Save

Available Source Table(s):

batch_cycle
batch_cycle_run
batch_cycle_run_job
batch_cycle_type
connection
connection2
connection_meta_onstage
connection_type
control_test
control_test_h
control_test_hierarchy
control_test_point
control_test_run
control_test_type
cron_schedule_current
cron_schedule_meta
hd_functions
hd_table_meta
job
job_batch_cycle_run_msg
license
object_alert_rule
object_trigger
sqlm_config
sqlm_reserved

batchcycle_run
Target: ELTMAESTRO/ADMIN/batch_cycle_run1
Watermark(s): batch_run_num
Key(s): batch_run_num

batchcycle
Target: ELTMAESTRO/ADMIN/batch_cycle1
Watermark(s): batch_cycle_id
Key(s): batch_cycle_id

tstep_status — Static Filter Condition
Condition:

```
CREATE_TS > CURRENT_TIMESTAMP - 5
```

Adding Tables

- Select tables on left panel and Click [>] button to add to list on right panel
- Click [Refresh Metadata] button to load metadata information after all required tables have been added

Delta Configuration (Option 1 if you know delta columns)

- For each table, select [watermark] column, you can select multiple watermark columns for delta load
- Specify [key] columns so that updates can be upserted. If keys are not specified the loader will only perform inserts

Reach-Back or Manual SQL Configuration (Option 2 if you don't know delta columns)

- Modify [Static Filter Condition] and add a filter expression. As shown on above diagram for third table a static filter is added that goes back 4 days to obtain records.

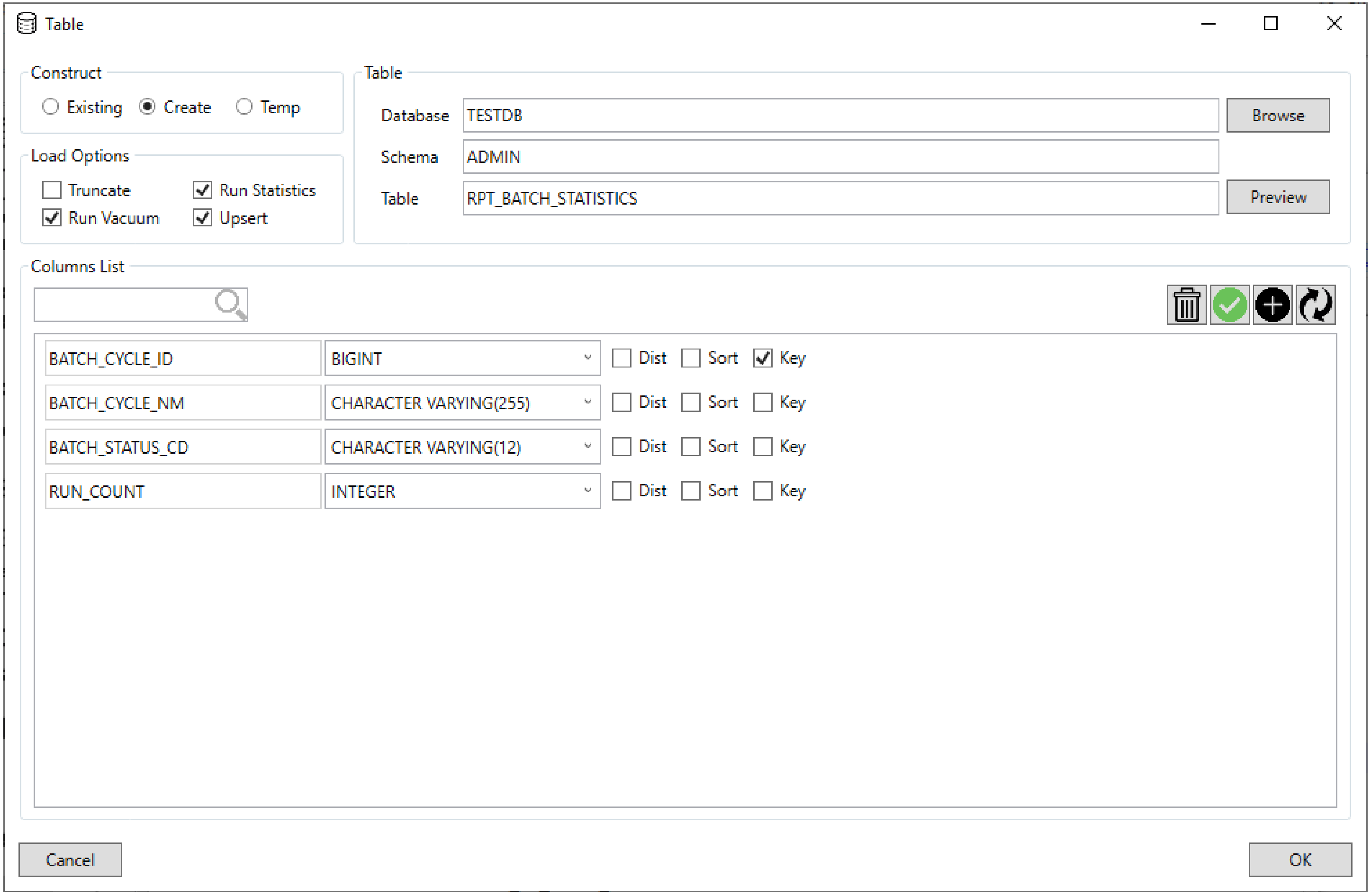
Note: Object path is referenced with path format of catalog/schema/table. If you are going to change table names on target (Netezza) please use this format.

Table [Netezza]

Introduction

Table step can read from or write to referenced table.

Figure: Table Step



Construct

○ Existing ● Create ○ Temp

Load Options

□ Truncate ☑ Run Statistics
☑ Run Vacuum ☑ Upsert

Table

Database: TESTDB
Schema: ADMIN
Table: RPT_BATCH_STATISTICS

Columns List

BATCH_CYCLE_ID	BIGINT	□ Dist	□ Sort	☑ Key
BATCH_CYCLE_NM	CHARACTER VARYING(255)	□ Dist	□ Sort	□ Key
BATCH_STATUS_CD	CHARACTER VARYING(12)	□ Dist	□ Sort	□ Key
RUN_COUNT	INTEGER	□ Dist	□ Sort	□ Key

Construct

4. [Existing] Reference existing table and metadata from database schema
5. [Create] Create table if it does not exist
6. [Temp] Write output to a temp table, then drop it after workflow execution is completed

Load Options

5. [Truncate] Truncate table before inserting data
6. [Run Statistics] Run GENERATE STATISTICS command on table after data has been inserted or updated
7. [Run Vacuum] Run GROOM command on table after data has been inserted or updated
8. [Upsert] Update + Insert data on table by detecting key column reference

Column Properties

4. [Dist] Distribute data based on check marked column (DISTRIBUTE ON)
5. [Sort] Organize/Cluster data based on check marked column (ORGANIZE ON)
6. [Key] Mark column as a logical key (required for upsert mode)

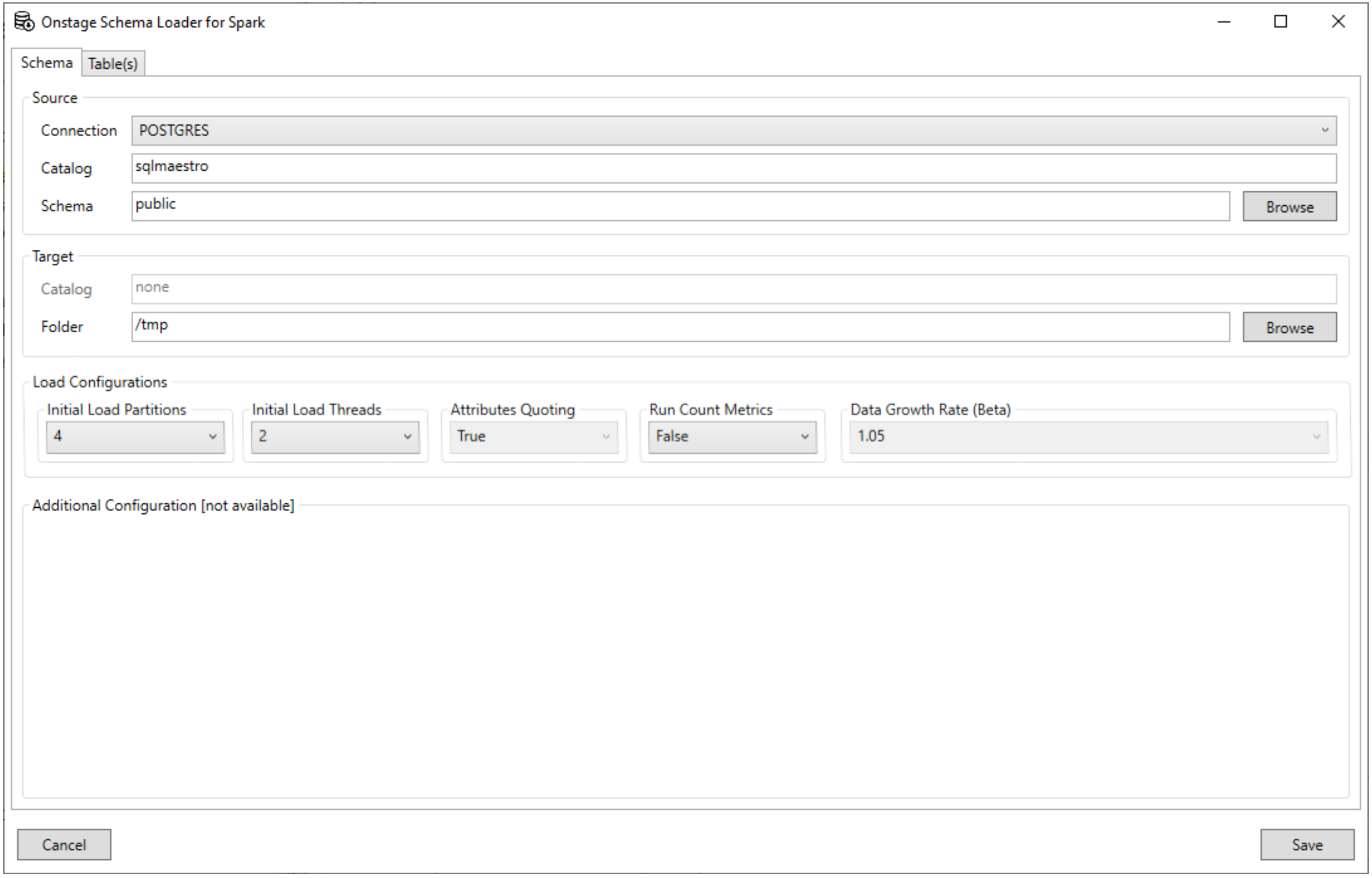
You can only add/remove columns for construct type [Create] or [Temp]

Onstage Group [Spark SQL]

Introduction

Onstage Group also known as schema loader is used to load multiple databases tables from a source jdbc connection. This step is a database migration utility that can generate objects on target system like Hadoop and loads data from source systems. Incremental loads can be achieved by utilizing watermark columns.

Figure: Onstage Group Loader [Schema Tab]



Onstage Schema Loader for Spark

Source
Connection: POSTGRES
Catalog: sqlmaestro
Schema: public

Target
Catalog: none
Folder: /tmp

Load Configurations
Initial Load Partitions: 4
Initial Load Threads: 2
Attributes Quoting: True
Run Count Metrics: False
Data Growth Rate (Beta): 1.05

Additional Configuration [not available]

Configuration

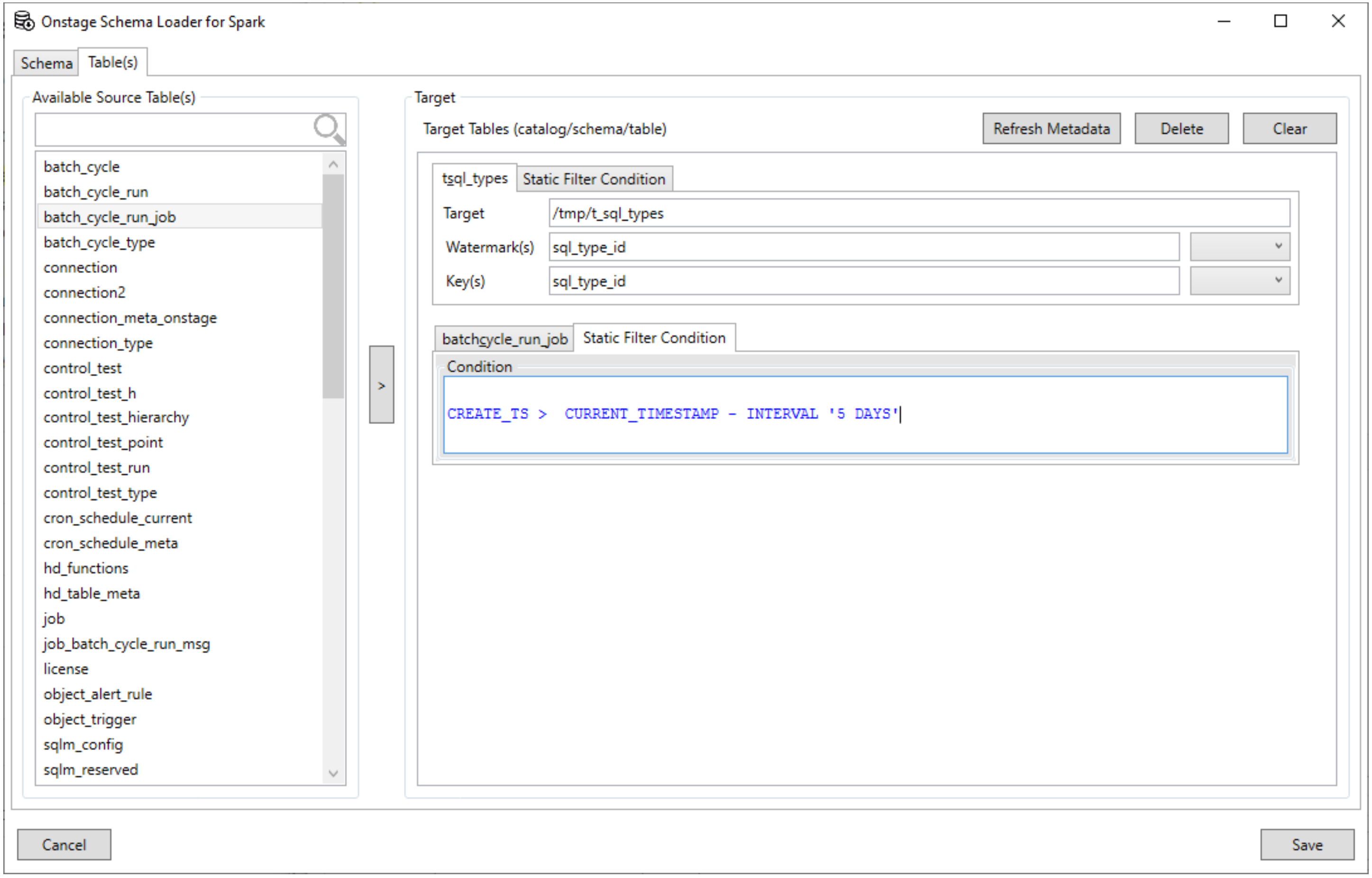
- Browse to [Select] source connection, catalog and schema to migrate tables from
- Browse to [Select] target hdfs path and schema to migrate tables to
- Select [Initial Load Partitions] to bucket initial load sql script into multiple conditions
- Select [Initial Load Threads] to specify parallelism factor on partitions
- Optionally if you set [Run Count Metrics] to true, ELT Maestro automatically runs source/target row counts before and after load has been completed.

Example,

If you set initial load partitions to 16 and load threads to 4 then ELT Maestro will generate 16 range based SQL queries to execute on source system and executes those 16 queries 4 at a time, the load is also performed at parallelism of 4. Setting initial load partitions is best if you are loading a very large tables.

Note: A numeric or timestamp based watermark column is always required to partition the data

Figure: Table(s)



Onstage Schema Loader for Spark
Schema
Table(s)
Available Source Table(s)
Target
Target Tables (catalog/schema/table)
Refresh Metadata
Delete
Clear
>
Cancel
Save

- batch_cycle
- batch_cycle_run
- batch_cycle_run_job
- batch_cycle_type
- connection
- connection2
- connection_meta_onstage
- connection_type
- control_test
- control_test_h
- control_test_hierarchy
- control_test_point
- control_test_run
- control_test_type
- cron_schedule_current
- cron_schedule_meta
- hd_functions
- hd_table_meta
- job
- job_batch_cycle_run_msg
- license
- object_alert_rule
- object_trigger
- sqlm_config
- sqlm_reserved

tsql_types | Static Filter Condition

Target: /tmp/t_sql_types

Watermark(s): sql_type_id

Key(s): sql_type_id

batchcycle_run_job | Static Filter Condition

Condition

```
CREATE_TS >  CURRENT_TIMESTAMP - INTERVAL '5 DAYS'
```

Adding Tables

- ➢ Select tables on left panel and Click [>] button to add to list on right panel
- ➢ Click [Refresh Metadata] button to load metadata information after all required tables have been added

Delta Configuration (Option 1 if you know delta columns)

- ➢ For each table, select [watermark] column, you can select multiple watermark columns for delta load
- ➢ Specify [key] columns so that updates can be upserted. If keys are not specified the loader will only perform inserts

Reach-Back or Manual SQL Configuration (Option 2 if you don’t know delta columns)

- ➢ Modify [Static Filter Condition] and add a filter expression. As shown on above diagram for third table a static filter is added that goes back 4 days to obtain records.

Note: Object path is referenced with HDFS path format without url prefix.

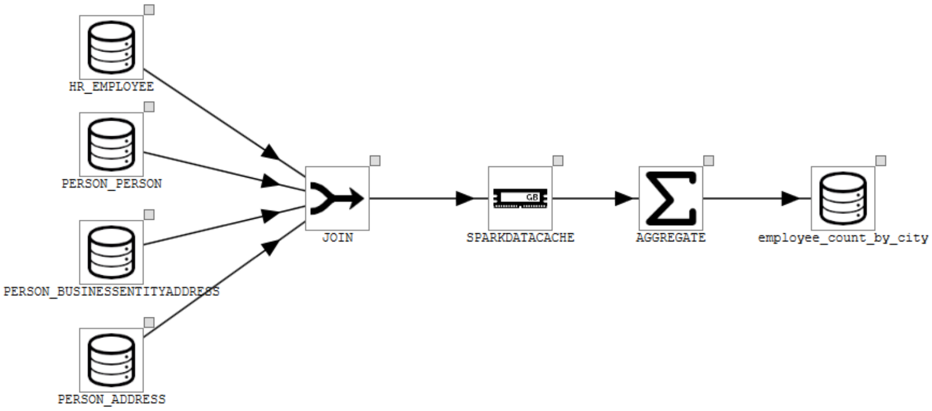
Data Frame [Spark SQL]

Introduction

Data Frame step reads file(s) or folder on HDFS and converts into data frame object. Additionally this step also creates a temporary global view for SQL operation. This step can load file types such as Parquet, Orc, Csv, Json and Text and convert into structured data frame object. This step is very similar to table step.

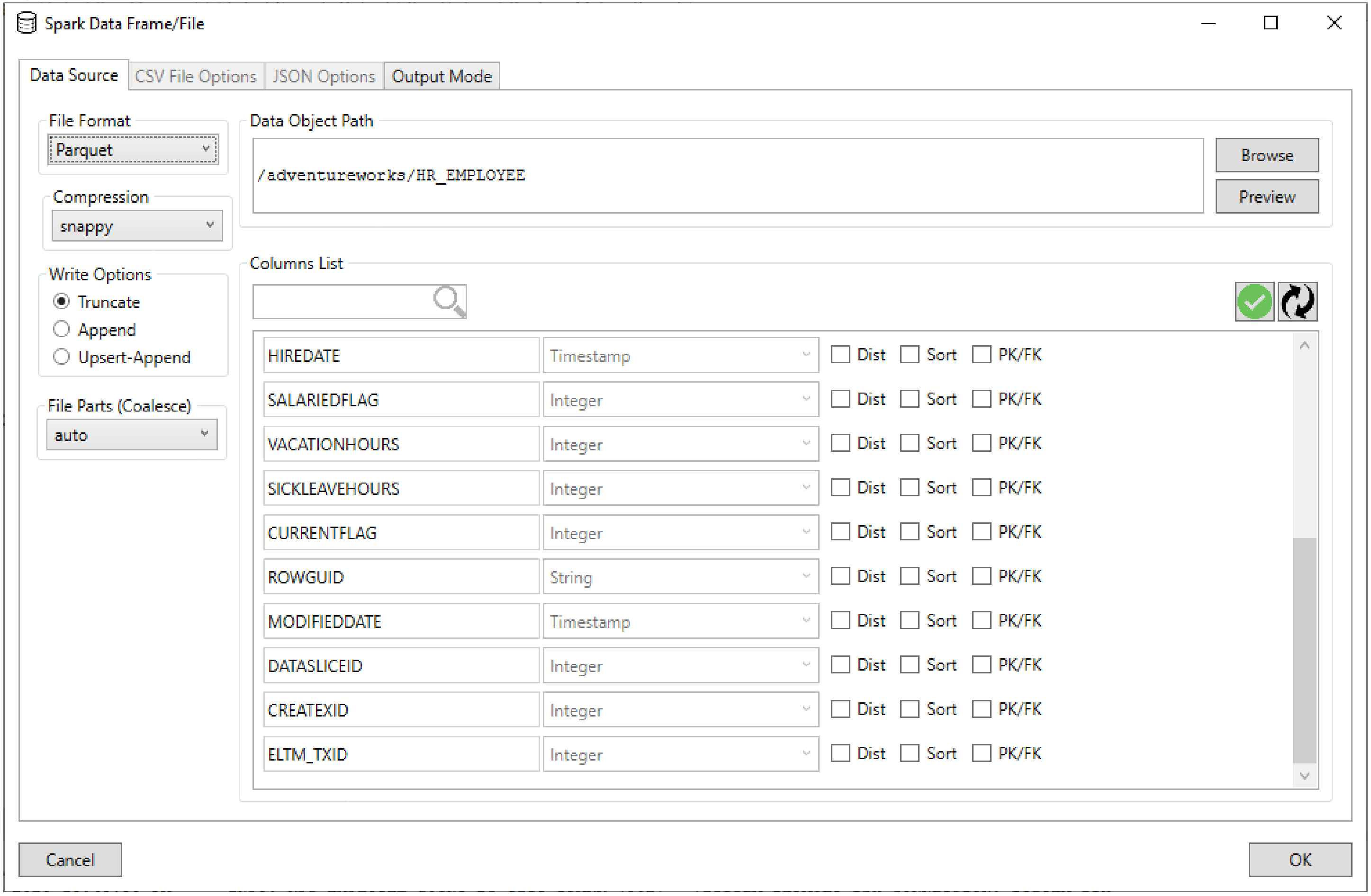
Consider following workflow

Figure: Data Frame on a workflow



The 4 data-frame steps on left are reader steps and the last one (employee_count_by_city) is a writer step. You can tell this by looking at the connecting arrow(s). The tail represents read and head represents write.

Figure: Data Frame



File Format: Parquet

Compression: snappy

Write Options
● Truncate
○ Append
○ Upsert-Append

File Parts (Coalesce): auto

Data Object Path: /adventureworks/HR_EMPLOYEE

Columns List

HIREDATE	Timestamp	□ Dist	□ Sort	□ PK/FK
SALARIEDFLAG	Integer	□ Dist	□ Sort	□ PK/FK
VACATIONHOURS	Integer	□ Dist	□ Sort	□ PK/FK
SICKLEAVEHOURS	Integer	□ Dist	□ Sort	□ PK/FK
CURRENTFLAG	Integer	□ Dist	□ Sort	□ PK/FK
ROWGUID	String	□ Dist	□ Sort	□ PK/FK
MODIFIEDDATE	Timestamp	□ Dist	□ Sort	□ PK/FK
DATASLICEID	Integer	□ Dist	□ Sort	□ PK/FK
CREATEXID	Integer	□ Dist	□ Sort	□ PK/FK
ELTM_TXID	Integer	□ Dist	□ Sort	□ PK/FK

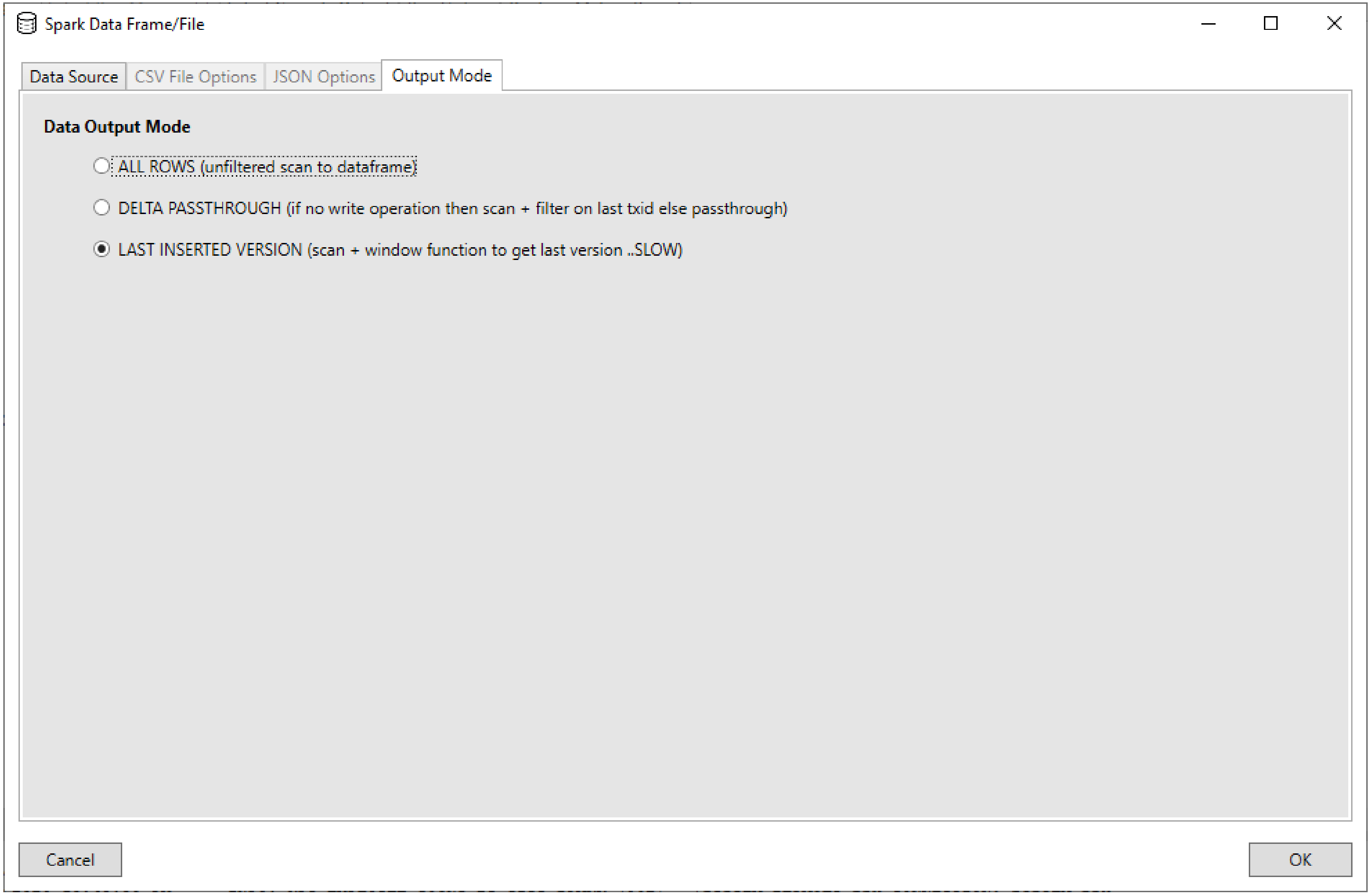
Data Frame Criteria

- If supplied path exists, you can read or append/write
- If supplied path does not exist, you can append/write

Configurations

- [File Format] can be Parquet, Orc, Csv, Json or Text and supported compression for these formats. For CSV or Json type please verify additional format configuration.
- [Compression] depends on supported file format by spark application.
- [Write Option] can be truncate which over-writes target path, append which keeps creating new files or upsert-append which keeps latest version of keys.
- [File Parts] is the number of files to write/create during write operation.

Figure: Data Frame output mode



Data Output Mode

○ ALL ROWS (unfiltered scan to dataframe)

○ DELTA PASSTHROUGH (if no write operation then scan + filter on last txid else passthrough)

● LAST INSERTED VERSION (scan + window function to get last version ..SLOW)

Output Mode

- [All Rows] option provides all records available on specified path
- [Delta Passthrough] option provides records inserted by current workflow
- [Last Inserted Version] option provides latest record, for this to work you need to specify kdy columns for last version calculation.

Not implemented (YET)

- Enforcing distribution and sort columns.

Local File [Spark SQL]

Introduction

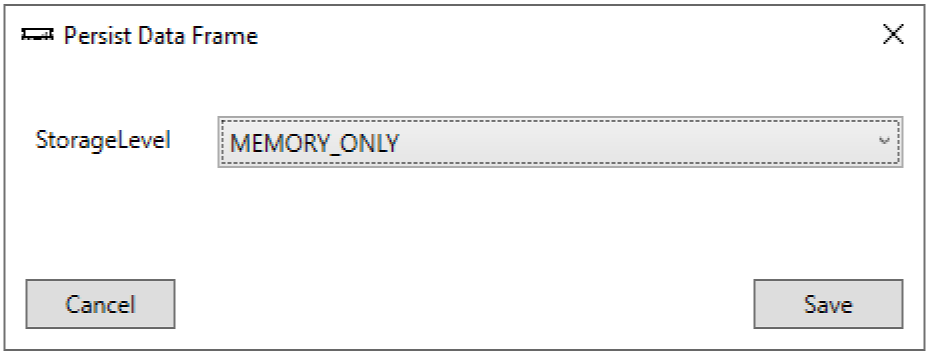
- Local File step is like data frame step with a condition that it is only a READER for file(s) or folder located on runtime ELT Maestro master or slave server.
- You cannot write to path referenced
- You can only run spark job on non-cluster mode (because you are referencing local file)

Spark Data Cache / Persistance [Spark SQL]

Introduction

Spark Data Cache allows caching data frame into disk, memory or both with options. This step does exactly what a spark persist function does and has same output as input.

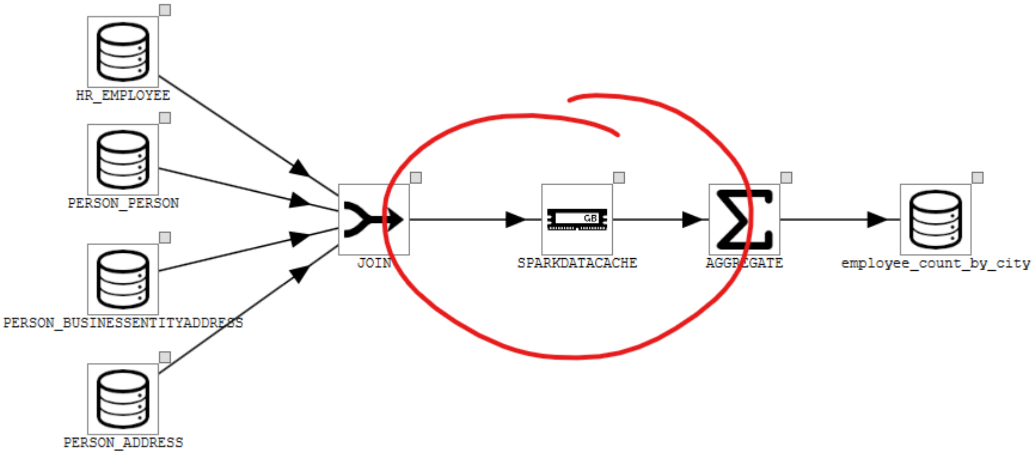
Figure: Spark Data Cache



Persist Data Frame

StorageLevel: MEMORY_ONLY

Figure: Spark Data Cache step on workflow



Available Cache/Persistance Options

- DISK_ONLY
- DISK_ONLY_2
- MEMORY_AND_DISK
- MEMORY_AND_DISK_2
- MEMORY_AND_DISK_SER
- MEMORY_AND_DISK_SER_2
- MEMORY_ONLY
- MEMORY_ONLY_2
- MEMORY_ONLY_SER
- MEMORY_ONLY_SER_2

Ref: https://spark.apache.org/docs/latest/rdd-programming-guide.html#rdd-persistence

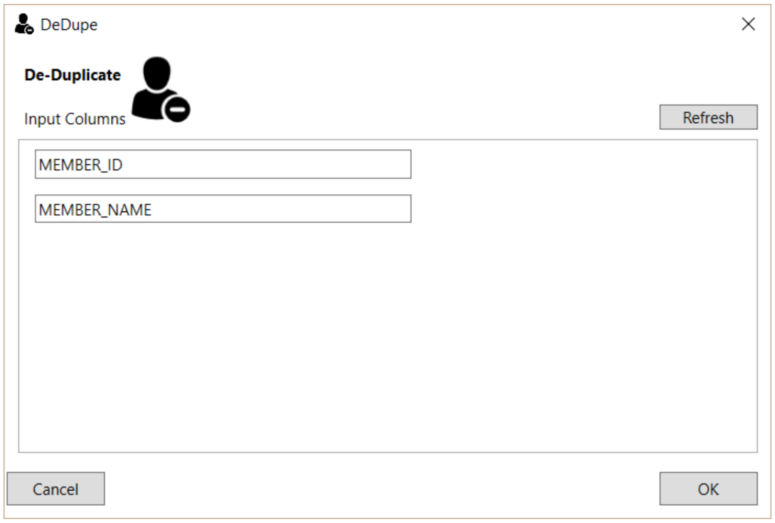
Dedupe

Introduction

The Dedupe step removes duplicate rows from a dataset.

Example,

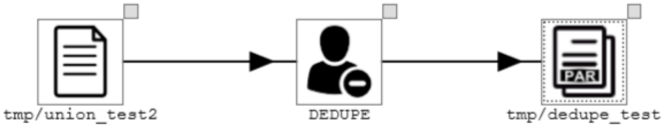
There are no properties to set.



MEMBER_ID

MEMBER_NAME

Consider the following job:



Input

```
+---------+-----------+
|MEMBER_ID|MEMBER_NAME|
+---------+-----------+
|     1001|       aaaa|
|     1002|       bbbb|
|     1003|       cccc|
|     1004|       dddd|
|     1021|       uuuu|
|     1022|       vvvv|
|     1001|       aaaa|
|     1002|       bbbb|
|     1003|       cccc|
|     1004|       dddd|
|     1021|       uuuu|
|     1022|       vvvv|
+---------+-----------+
```

Output (after dedupe)

```
+---------+-----------+
|MEMBER_ID|MEMBER_NAME|
+---------+-----------+
|     1002|       bbbb|
|     1021|       uuuu|
|     1022|       vvvv|
|     1004|       dddd|
|     1001|       aaaa|
|     1003|       cccc|
+---------+-----------+
```

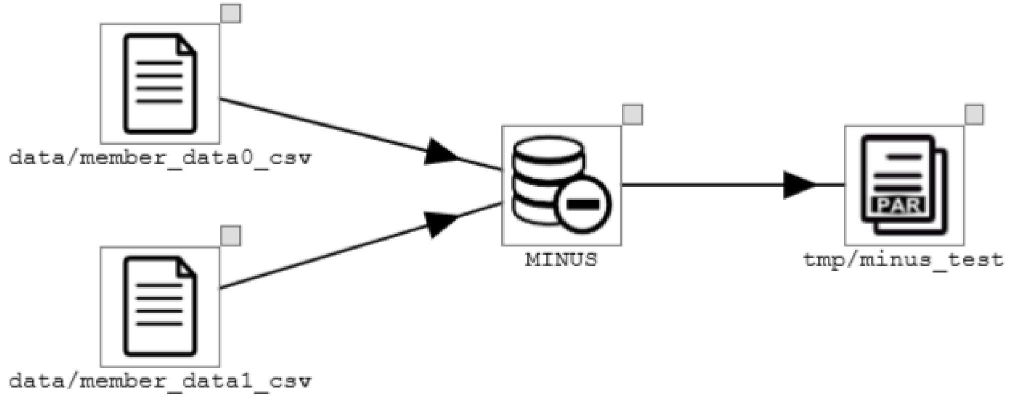
Minus

Introduction

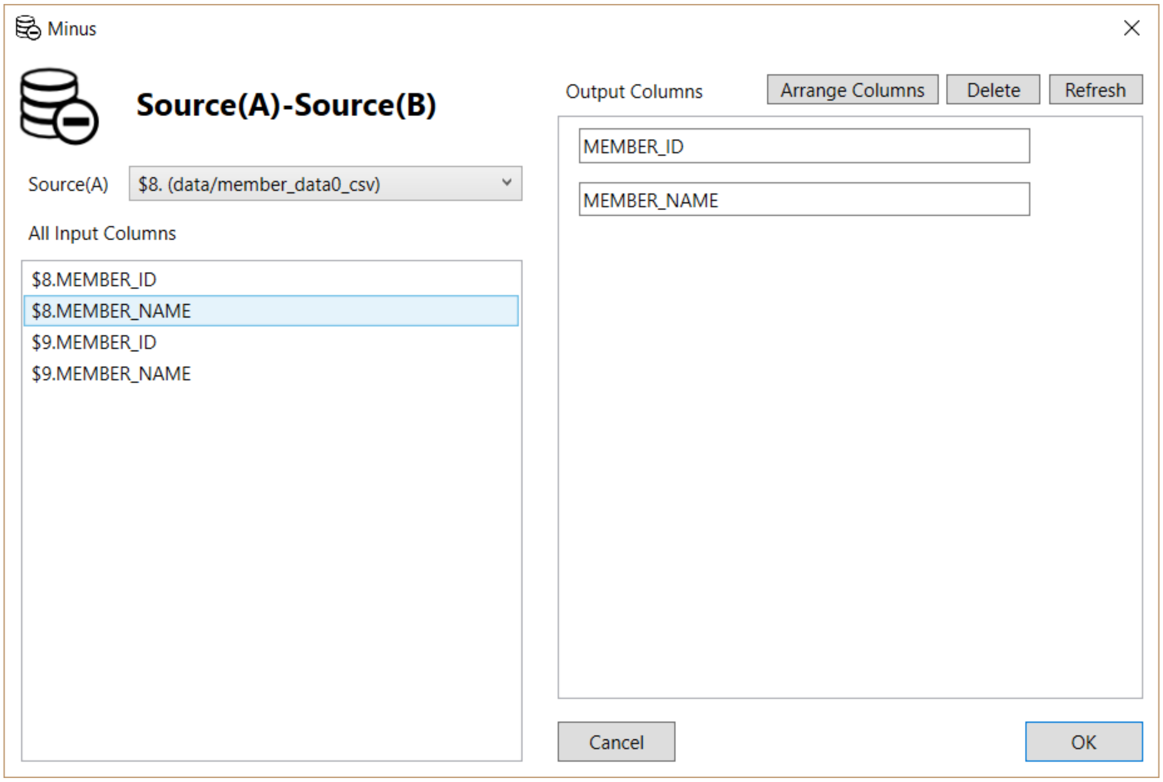
The Minus step subtracts the contents of one dataset from another.

Example,

Consider the job shown below:



In this job, the contents of the table MEMBER_NAMES_2 are subtracted from the contents of the table MEMBER_NAMES. The column metadata for both inputs must be the same. In the properties window, you specify which dataset is the minuend (i.e. Source(A)) and which dataset is the subtrahend (i.e. Source(B)).



Source(A)-Source(B)

Source(A) $8. (data/member_data0_csv)

All Input Columns

- $8.MEMBER_ID
- $8.MEMBER_NAME
- $9.MEMBER_ID
- $9.MEMBER_NAME

Output Columns

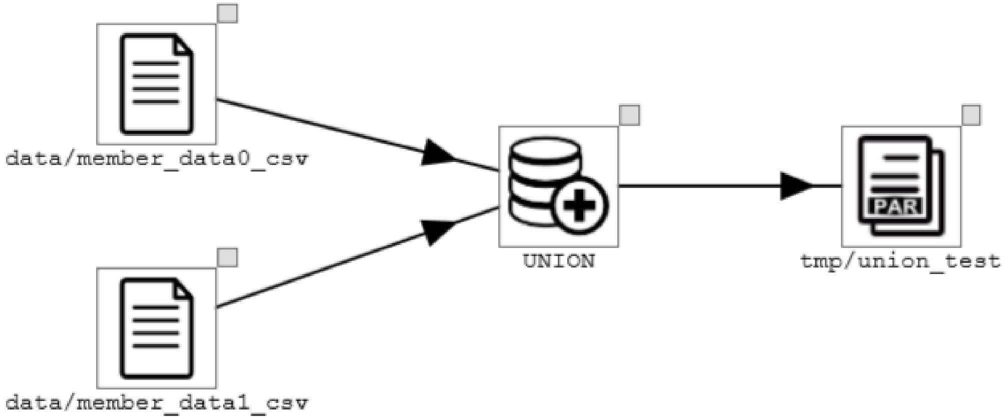
- MEMBER_ID
- MEMBER_NAME

Union

Introduction

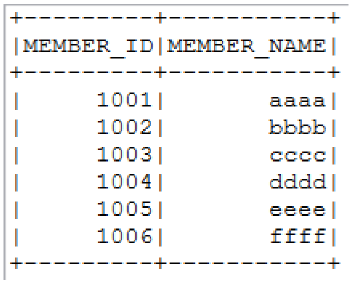
The Union step combines two datasets. The datasets have to have the same column metadata.

Example,



Here, the Union step is used to combine the contents of two flat files, and the result is loaded to a table.

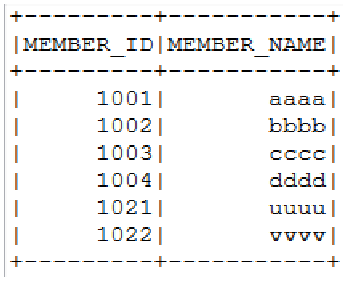
The contents of the first flat file is



```
+---------+-----------+
|MEMBER_ID|MEMBER_NAME|
+---------+-----------+
|     1001|       aaaa|
|     1002|       bbbb|
|     1003|       cccc|
|     1004|       dddd|
|     1005|       eeee|
|     1006|       ffff|
+---------+-----------+
```

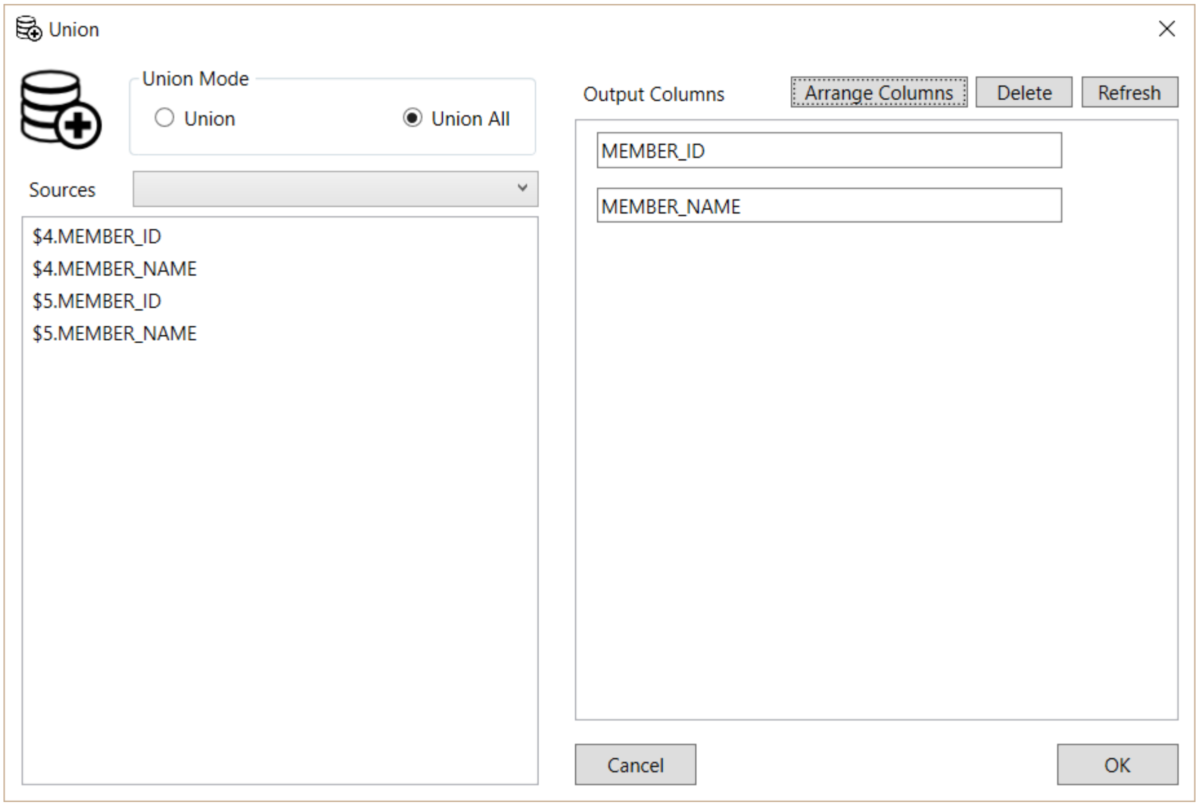
and the contents of the second flat file is

.



```
+---------+-----------+
|MEMBER_ID|MEMBER_NAME|
+---------+-----------+
|     1001|       aaaa|
|     1002|       bbbb|
|     1003|       cccc|
|     1004|       dddd|
|     1021|       uuuu|
|     1022|       vvvv|
+---------+-----------+
```

The Union step properties window is set up as follows:



Union Mode: ○ Union ● Union All

Sources:

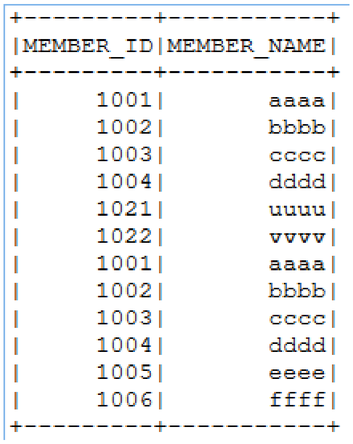
$4.MEMBER_ID
$4.MEMBER_NAME
$5.MEMBER_ID
$5.MEMBER_NAME

Output Columns:

MEMBER_ID
MEMBER_NAME

In the Sources drop-down list choose ALL.

The output is:

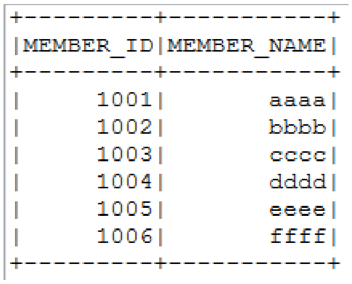


```
+---------+-----------+
|MEMBER_ID|MEMBER_NAME|
+---------+-----------+
|     1001|       aaaa|
|     1002|       bbbb|
|     1003|       cccc|
|     1004|       dddd|
|     1021|       uuuu|
|     1022|       vvvv|
|     1001|       aaaa|
|     1002|       bbbb|
|     1003|       cccc|
|     1004|       dddd|
|     1005|       eeee|
|     1006|       ffff|
+---------+-----------+
```

Only the Union All option is available in ELT Maestro for Spark. (In other ELT Maestro editions, the Union option would remove duplicates.)

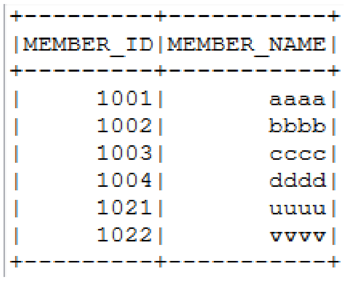
All rows in Source(A) matching any row in Source(B) will be removed from the result, regardless of how many duplicates there are. For example if the inputs are as follows:

Source(A):



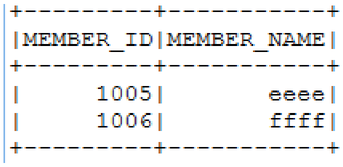
```
+---------+-----------+
|MEMBER_ID|MEMBER_NAME|
+---------+-----------+
|     1001|       aaaa|
|     1002|       bbbb|
|     1003|       cccc|
|     1004|       dddd|
|     1005|       eeee|
|     1006|       ffff|
+---------+-----------+
```

Source(B):



```
+---------+-----------+
|MEMBER_ID|MEMBER_NAME|
+---------+-----------+
|     1001|       aaaa|
|     1002|       bbbb|
|     1003|       cccc|
|     1004|       dddd|
|     1021|       uuuu|
|     1022|       vvvv|
+---------+-----------+
```

The output will be:

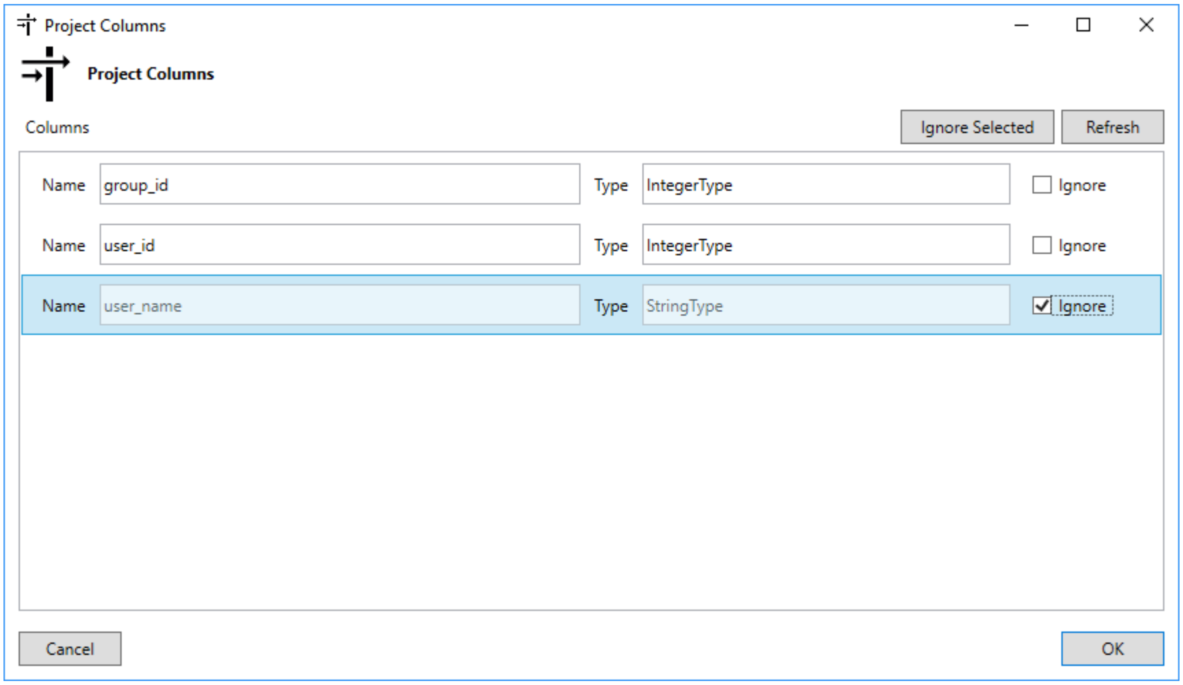


```
+---------+-----------+
|MEMBER_ID|MEMBER_NAME|
+---------+-----------+
|     1005|       eeee|
|     1006|       ffff|
+---------+-----------+
```

Projection (Deprecated)

Introduction

The Project Columns step allows you to drop some of the columns from a dataset. It has a very straightforward interface. This step is used to limit columns.



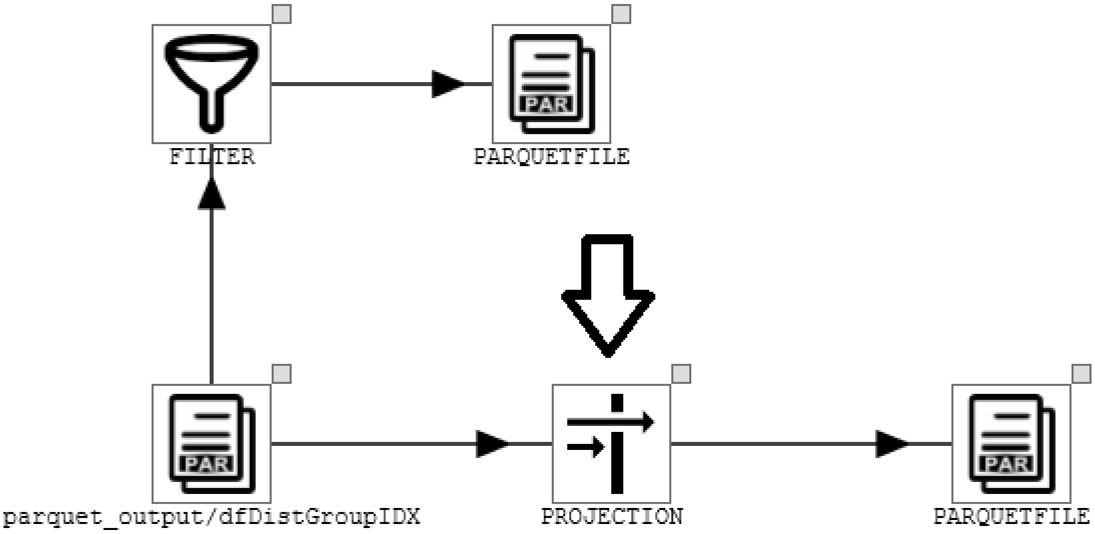
Columns

Name	group_id	Type	IntegerType	☐ Ignore
Name	user_id	Type	IntegerType	☐ Ignore
Name	user_name	Type	StringType	☑ Ignore

Example,

Simply check Ignore on the columns you wish to drop.

The example above is taken from the following job:



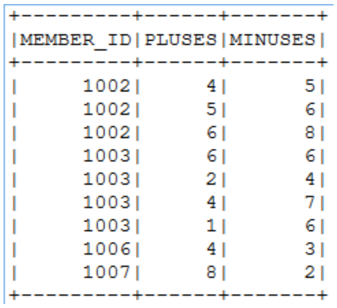
Aggregate

Introduction

The Aggregate step performs aggregations.

Example,

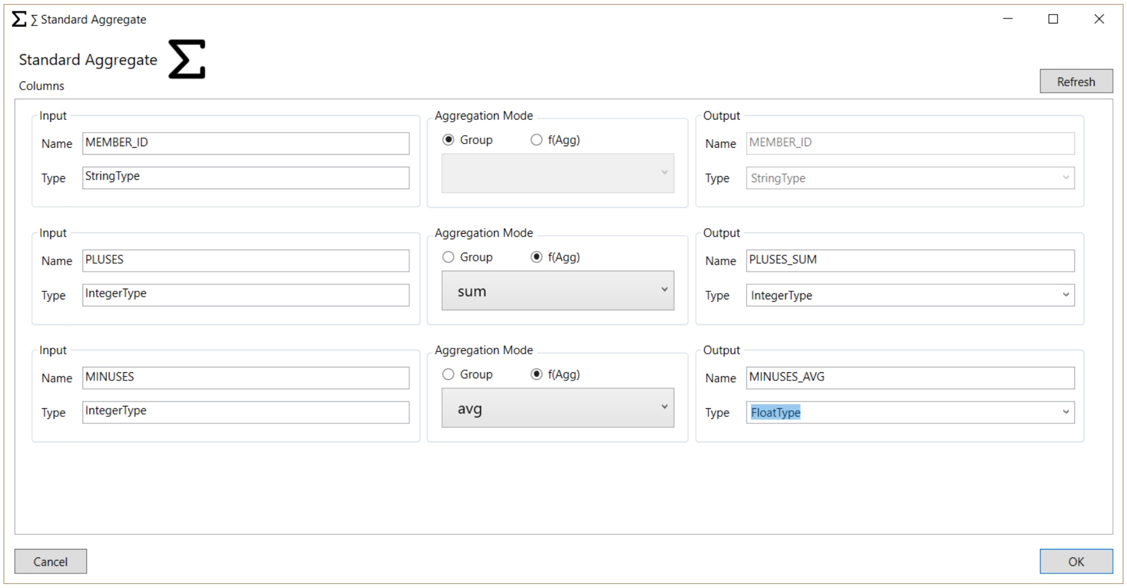
Suppose the table MEMBER_SCORES contains the following data:



```
+---------+------+-------+
|MEMBER_ID|PLUSES|MINUSES|
+---------+------+-------+
|     1002|     4|      5|
|     1002|     5|      6|
|     1002|     6|      8|
|     1003|     6|      6|
|     1003|     2|      4|
|     1003|     4|      7|
|     1003|     1|      6|
|     1006|     4|      3|
|     1007|     8|      2|
+---------+------+-------+
```

We will create a job to aggregate by MEMBER_ID, summing all of the PLUSES with the same MEMBER_ID and averaging all of the MINUSES with the same MEMBER_ID. The job looks like this:

The properties window for the Aggregate step will be as follows:



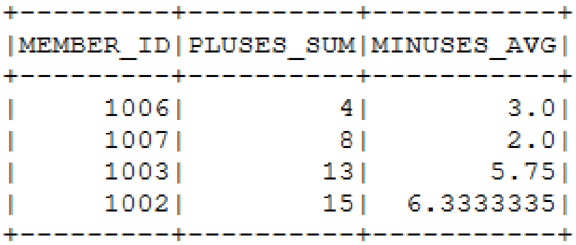
Input — Name: MEMBER_ID; Type: StringType | Aggregation Mode: ● Group ○ f(Agg) | Output — Name: MEMBER_ID; Type: StringType

Input — Name: PLUSES; Type: IntegerType | Aggregation Mode: ○ Group ● f(Agg); sum | Output — Name: PLUSES_SUM; Type: IntegerType

Input — Name: MINUSES; Type: IntegerType | Aggregation Mode: ○ Group ● f(Agg); avg | Output — Name: MINUSES_AVG; Type: FloatType

We choose Group for the column(s) (in this case, MEMBER_ID) that we are aggregating on, and f(Agg) for the columns that we are aggregating (in this case, summing on PLUSES and averaging on MINUSES). The interface suggests output column names and types for the aggregation columns, which you can edit.

In this case, the output will be as follows:



```
+---------+----------+-----------+
|MEMBER_ID|PLUSES_SUM|MINUSES_AVG|
+---------+----------+-----------+
|     1006|         4|        3.0|
|     1007|         8|        2.0|
|     1003|        13|       5.75|
|     1002|        15|  6.3333335|
+---------+----------+-----------+
```

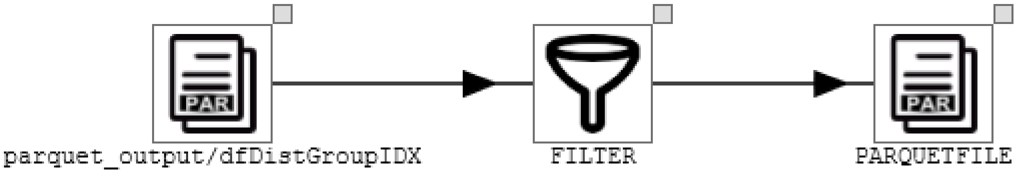
Filter

Introduction

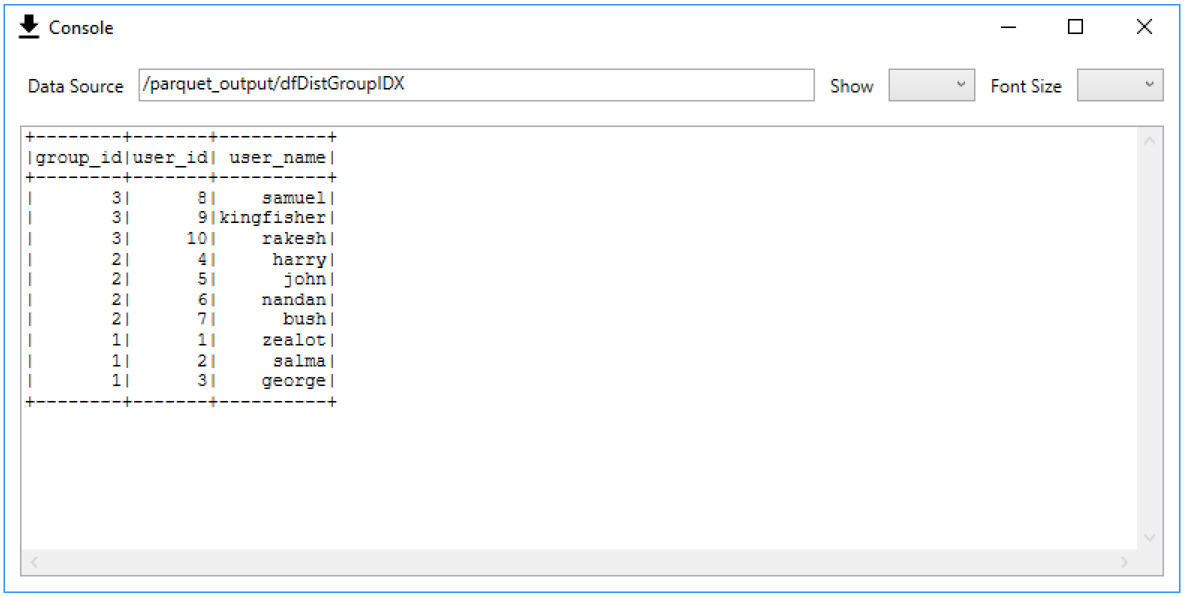
The Filter step allows you to filter the data flow, using an expression that, in SQL, would be placed in a WHERE clause. Note that the interface does not parse the expression for syntax errors before runtime; if the expression is complex or if you are unsure of your SQL syntax, it is best to try it out in an SQL parser beforehand.

Example,

In this example, we use a Parquet file as input to the Filter step:



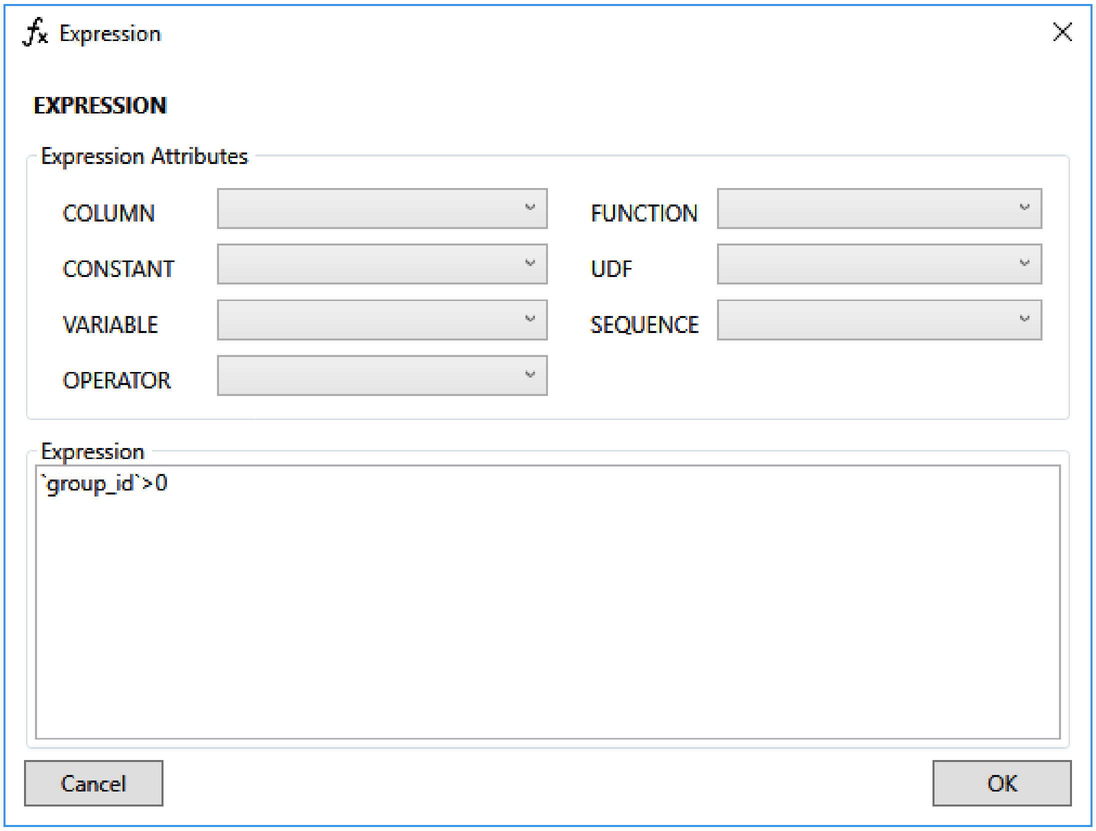
The input appears as follows:



Data Source /parquet_output/dfDistGroupIDX

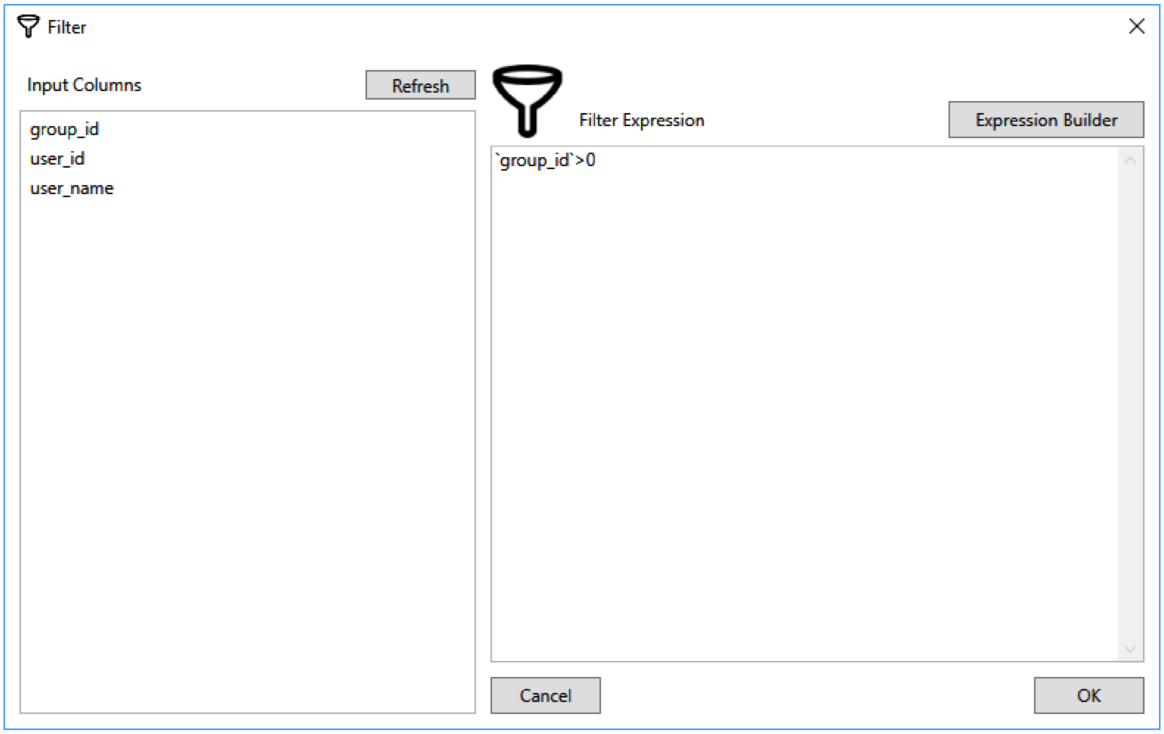
```
+--------+-------+----------+
|group_id|user_id| user_name|
+--------+-------+----------+
|       3|      8|    samuel|
|       3|      9|kingfisher|
|       3|     10|    rakesh|
|       2|      4|     harry|
|       2|      5|      john|
|       2|      6|    nandan|
|       2|      7|      bush|
|       1|      1|    zealot|
|       1|      2|     salma|
|       1|      3|    george|
+--------+-------+----------+
```

Inside the Filter step's properties, we click on Expression Builder, and enter an expression corresponding to a WHERE clause.



Expression

```
`group_id`>0
```



Input Columns

group_id
user_id
user_name

Filter Expression

```
`group_id`>0
```

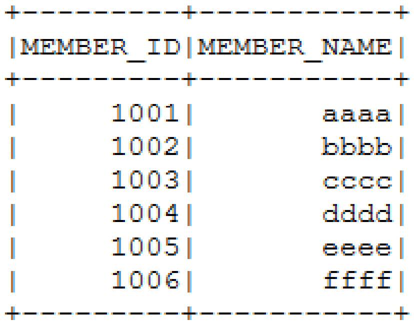
Join

Introduction

The Join step performs SQL-type joins on datasets.

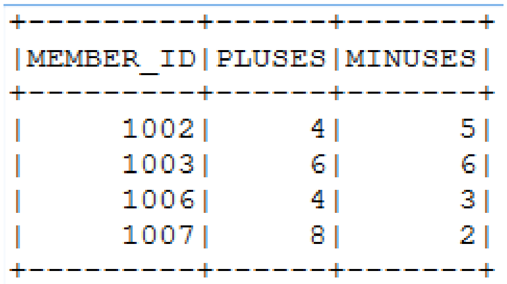
Example,

Suppose we have two tables, MEMBER_DATA and MEMBER_SCORES, containing the data



```
+---------+-----------+
|MEMBER_ID|MEMBER_NAME|
+---------+-----------+
|     1001|       aaaa|
|     1002|       bbbb|
|     1003|       cccc|
|     1004|       dddd|
|     1005|       eeee|
|     1006|       ffff|
+---------+-----------+
```

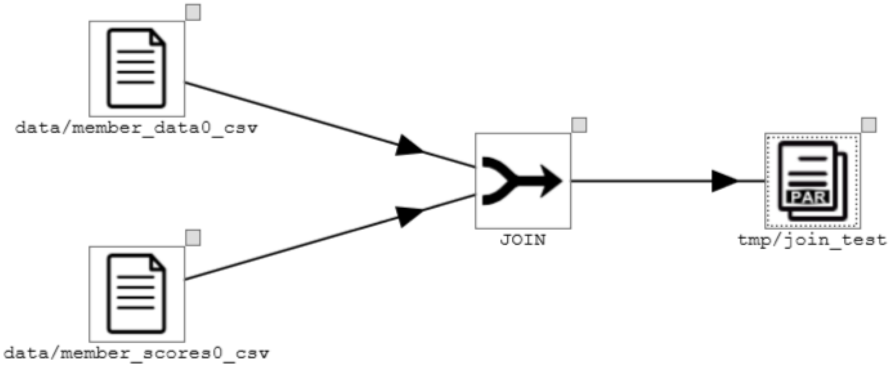
and

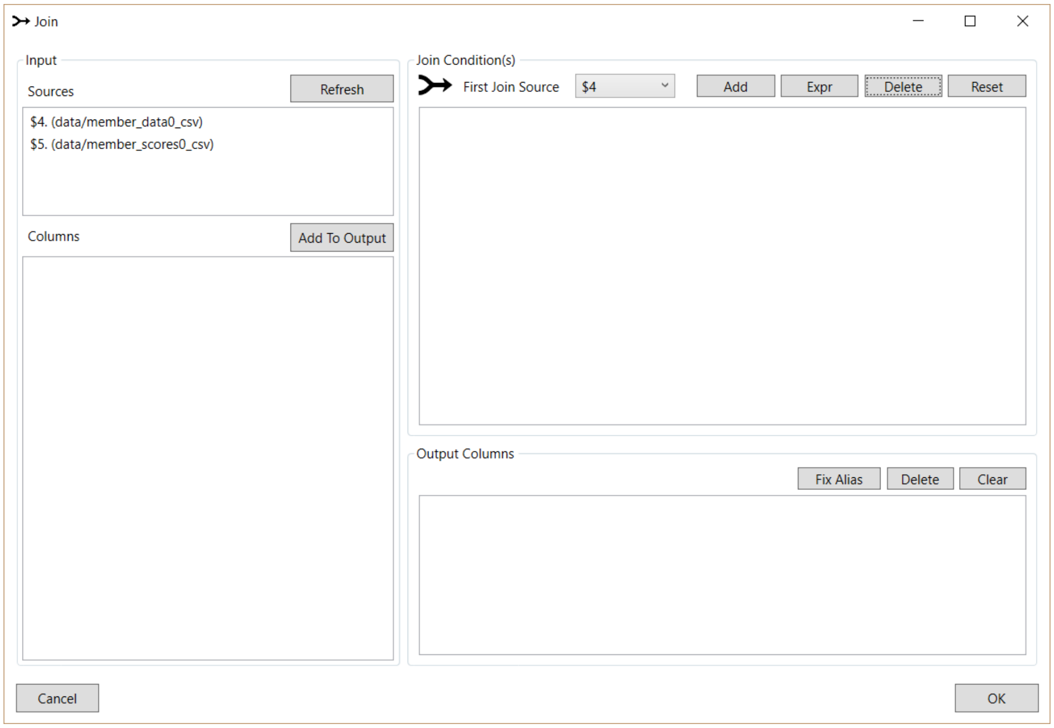


```
+---------+------+-------+
|MEMBER_ID|PLUSES|MINUSES|
+---------+------+-------+
|     1002|     4|      5|
|     1003|     6|      6|
|     1006|     4|      3|
|     1007|     8|      2|
+---------+------+-------+
```

respectively.

We'll write a job to use the Join step to do an inner join on these two tables.

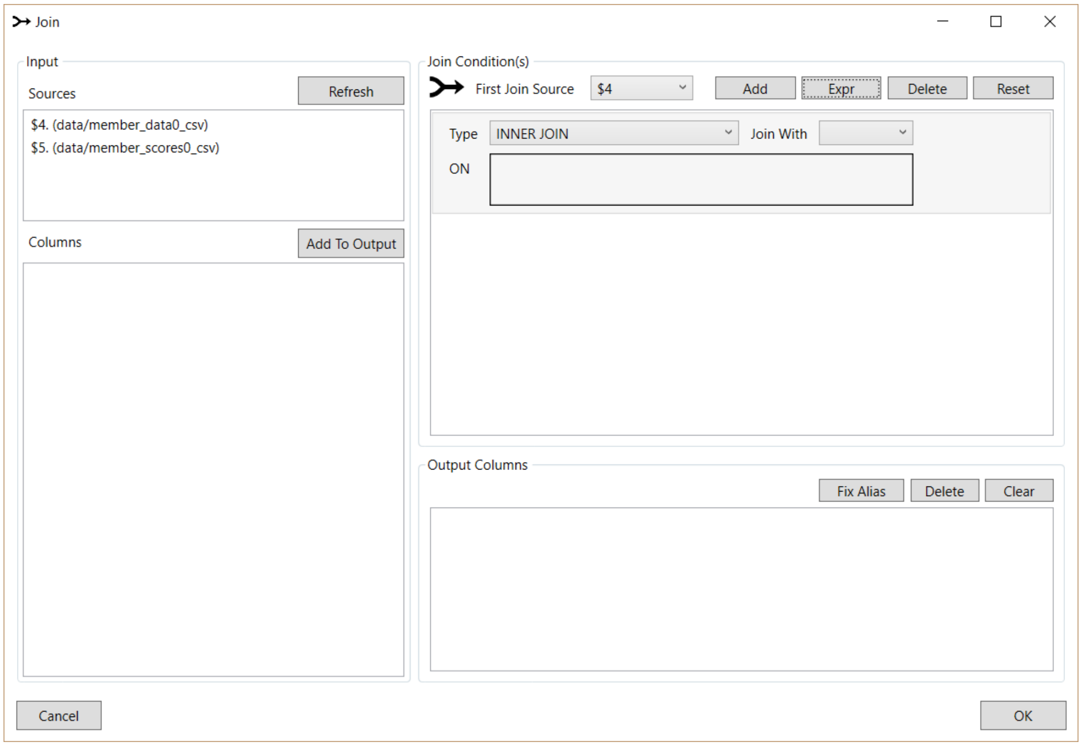




First Join Source $4

$4. (data/member_data0_csv)
$5. (data/member_scores0_csv)

First, assign the role of First Join Source (or Left join source) to MEMBER_DATA, by choosing its number (in this case, $4) from the drop-down list. Then Click on [Add] to add a join expression:



First Join Source $4

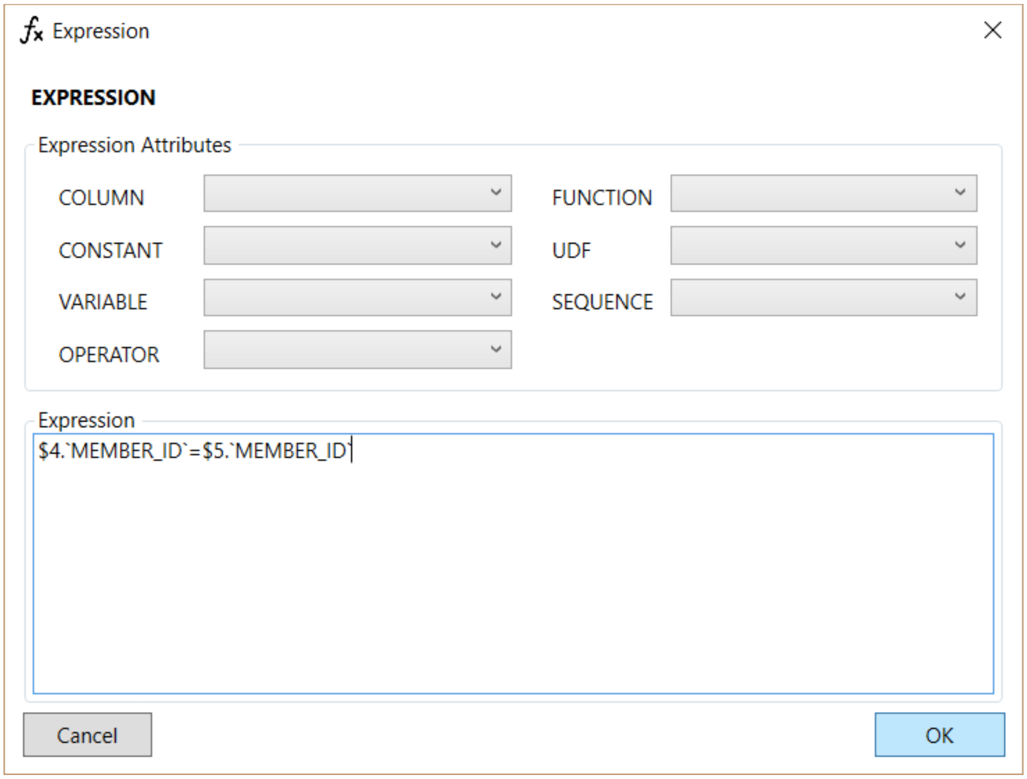
$4. (data/member_data0_csv)
$5. (data/member_scores0_csv)

Type INNER JOIN Join With

ON

Choose the join type from the Type drop-down list. In this case, we'll keep the default choice, INNER JOIN. Choose the number for MEMBER_SCORES in the Join With drop-down list. (This seems superfluous in this case, since there is only one other table, but Join can take more than two inputs, so in general, there may be more than one choice.). Now click on the Expr button.

This will bring up an expression editor:

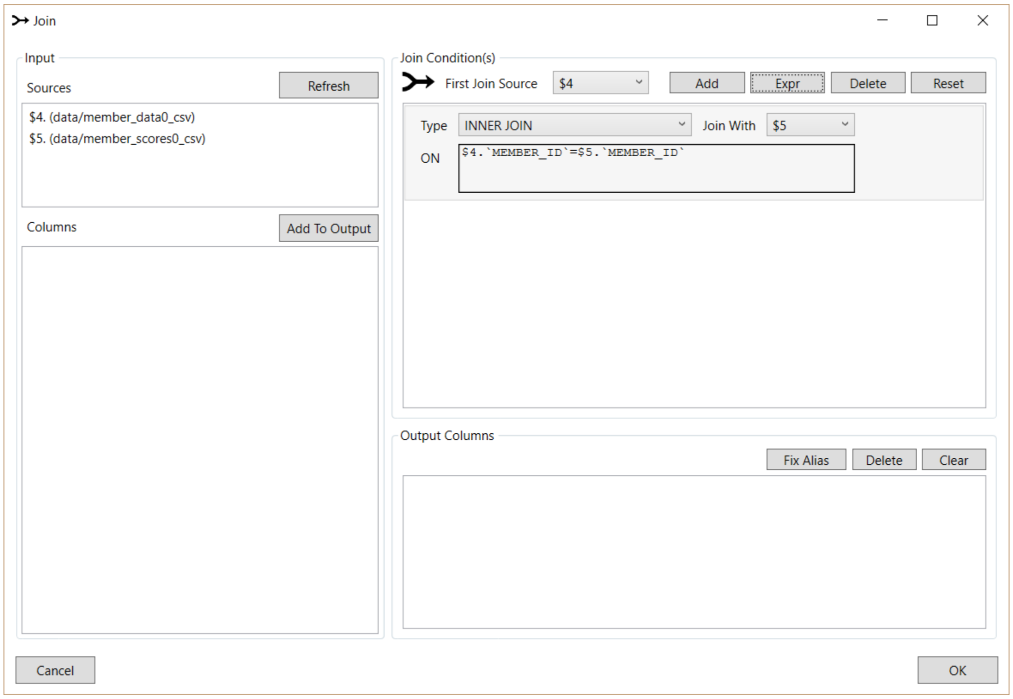


$4.`MEMBER_ID`=$5.`MEMBER_ID`

Enter an appropriate join expression in the editor – in our case, simply $4.`MEMBER_ID`=$5.`MEMBER_ID`. (Remember that column names must be surrounded by backquotes (`), as shown in the example. The COLUMN dropdown list will automatically supply them, but if you type the column names in yourself, the backquotes are your responsibility!)

Click [OK] to return to the properties window.

Now we must decide what columns get mapped from the input to the output.



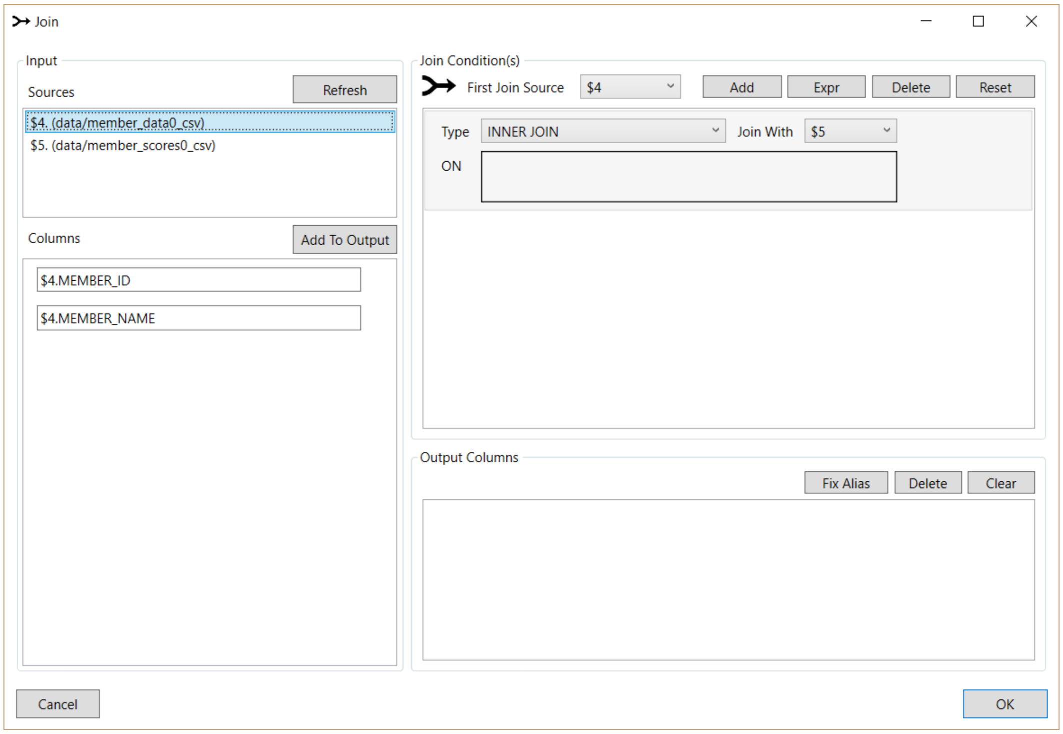
$4. (data/member_data0_csv)
$5. (data/member_scores0_csv)

First Join Source: $4

Type: INNER JOIN Join With: $5

ON: $4.`MEMBER_ID`=$5.`MEMBER_ID`

The input tables are listed in the upper left-hand corner, under Sources. Clicking on each source will cause that source's columns to appear in the Columns section:

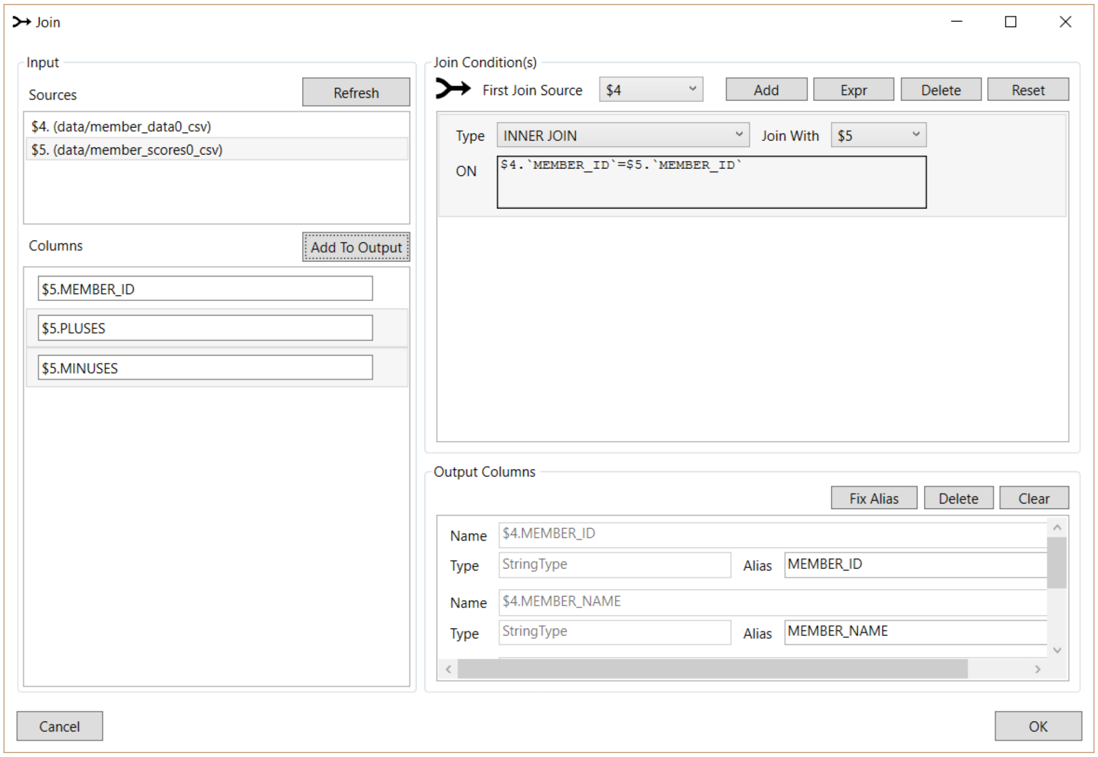


Sources:
$4. (data/member_data0_csv)
$5. (data/member_scores0_csv)

Columns:
$4.MEMBER_ID
$4.MEMBER_NAME

First Join Source: $4
Type: INNER JOIN
Join With: $5
ON

Then select the columns you wish to add to the output and Click the Add to Output button. You can select multiple columns at once by using the shift key. In our case, we'll add both MEMBER_ID and MEMBER_NAME from the MEMBER_NAMES dataset to the output. Then Click on the MEMBER_SCORES source and add PLUSES and MINUSES to the output.



Sources:
$4. (data/member_data0_csv)
$5. (data/member_scores0_csv)

Columns:
$5.MEMBER_ID
$5.PLUSES
$5.MINUSES

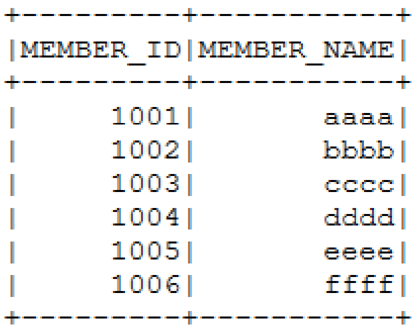
First Join Source: $4
Type: INNER JOIN
Join With: $5
ON: $4.`MEMBER_ID`=$5.`MEMBER_ID`

Output Columns:
Name: $4.MEMBER_ID
Type: StringType Alias: MEMBER_ID
Name: $4.MEMBER_NAME
Type: StringType Alias: MEMBER_NAME

Click [OK] to exit the properties window.

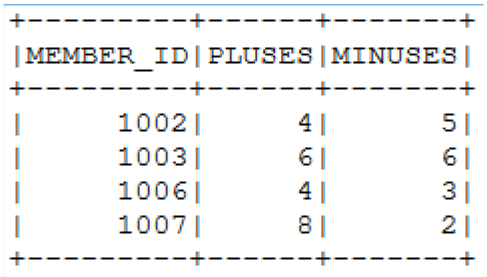
You will still need to complete the job by mapping the join output to an output stage and setting up the output stage by giving it the name of an output file and setting its other properties.

After running the job with the following input:



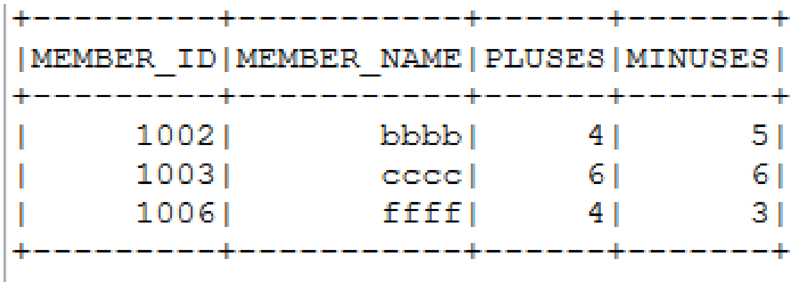
```
+---------+-----------+
|MEMBER_ID|MEMBER_NAME|
+---------+-----------+
|     1001|       aaaa|
|     1002|       bbbb|
|     1003|       cccc|
|     1004|       dddd|
|     1005|       eeee|
|     1006|       ffff|
+---------+-----------+
```

and



```
+---------+------+-------+
|MEMBER_ID|PLUSES|MINUSES|
+---------+------+-------+
|     1002|     4|      5|
|     1003|     6|      6|
|     1006|     4|      3|
|     1007|     8|      2|
+---------+------+-------+
```

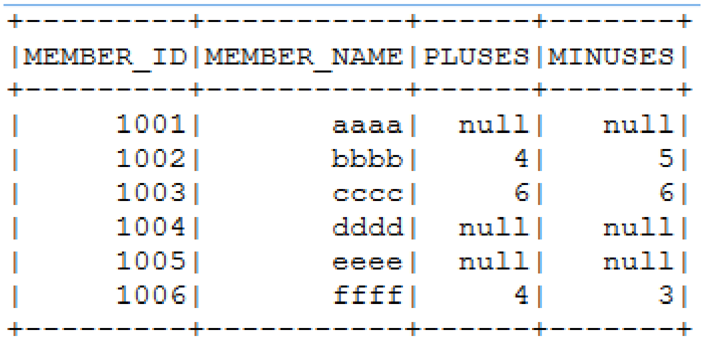
the output will be



```
+---------+-----------+------+-------+
|MEMBER_ID|MEMBER_NAME|PLUSES|MINUSES|
+---------+-----------+------+-------+
|     1002|       bbbb|     4|      5|
|     1003|       cccc|     6|      6|
|     1006|       ffff|     4|      3|
+---------+-----------+------+-------+
```

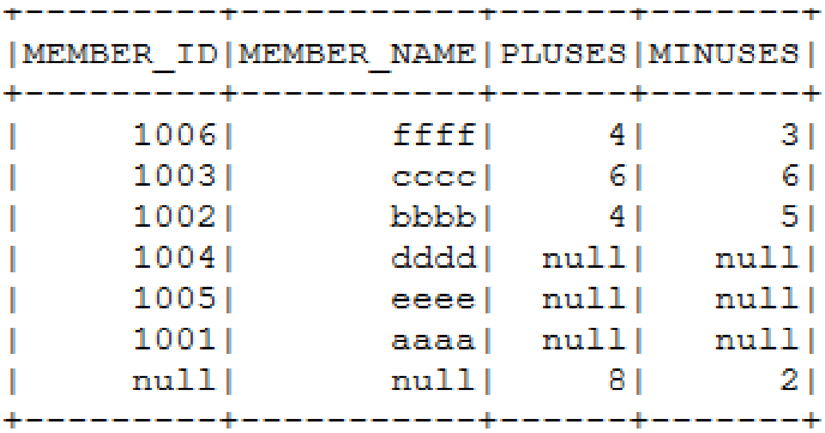
.

Had we chosen Join type of LEFT OUTER JOIN, the output would be



```
+---------+-----------+------+-------+
|MEMBER_ID|MEMBER_NAME|PLUSES|MINUSES|
+---------+-----------+------+-------+
|     1001|       aaaa|  null|   null|
|     1002|       bbbb|     4|      5|
|     1003|       cccc|     6|      6|
|     1004|       dddd|  null|   null|
|     1005|       eeee|  null|   null|
|     1006|       ffff|     4|      3|
+---------+-----------+------+-------+
```

The output for FULL OUTER JOIN would be



```
+---------+-----------+------+-------+
|MEMBER_ID|MEMBER_NAME|PLUSES|MINUSES|
+---------+-----------+------+-------+
|     1006|       ffff|     4|      3|
|     1003|       cccc|     6|      6|
|     1002|       bbbb|     4|      5|
|     1004|       dddd|  null|   null|
|     1005|       eeee|  null|   null|
|     1001|       aaaa|  null|   null|
|     null|       null|     8|      2|
+---------+-----------+------+-------+
```

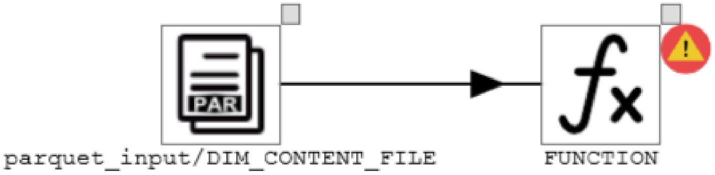
Function

Introduction

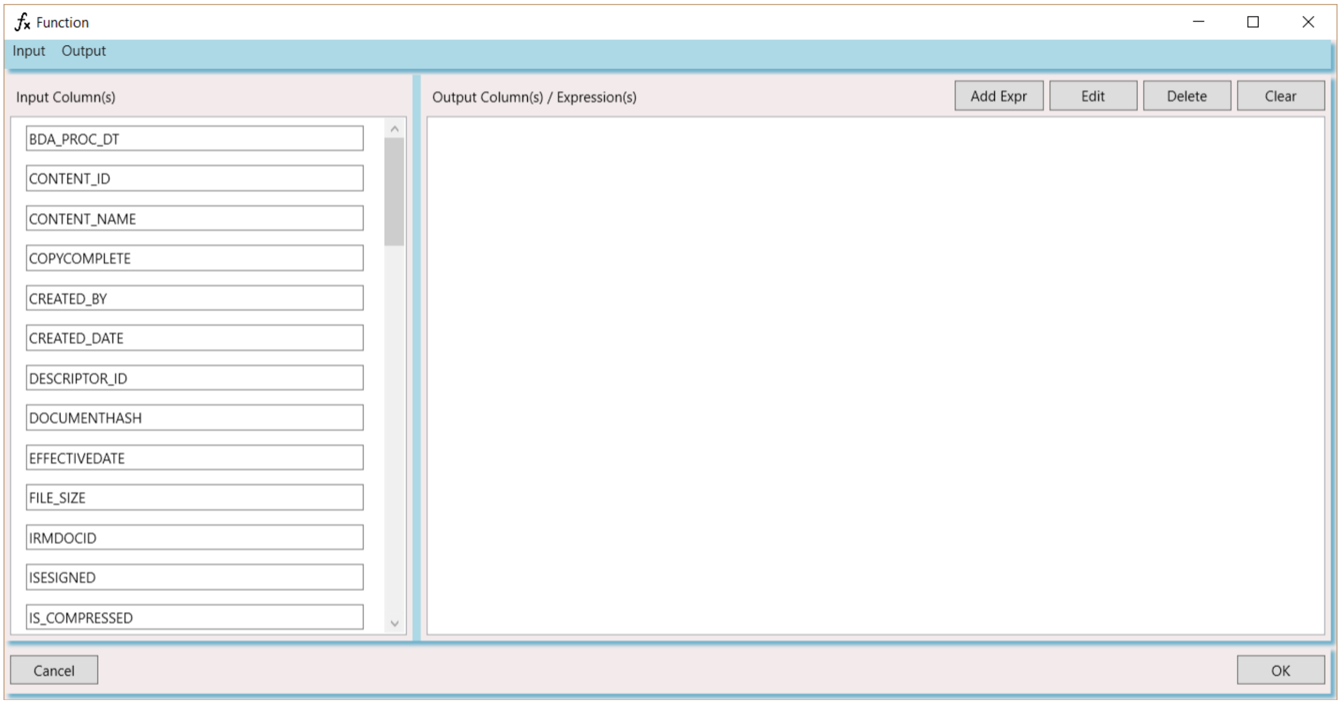
The Function step allows you to apply functions to columns and combinations of columns. The functions may be mathematical functions, string manipulation functions, date and time manipulation functions, conversion functions, or other functions appropriate to the data types. The Function step allows you to create new columns and to drop exiting columns.

Example,

The Function step must be connected to a source of metadata for you to access its properties. Suppose the Function step is connected to a data source as shown below:



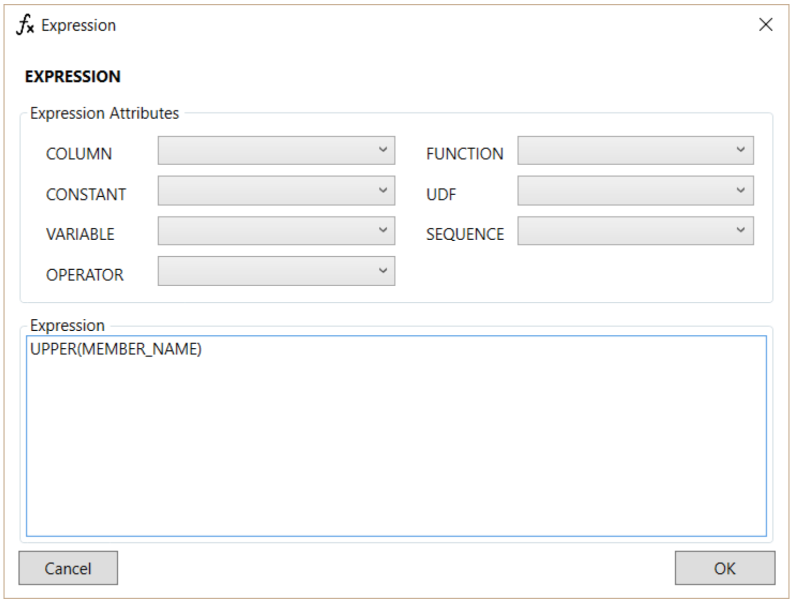
The properties window for the Function step will initially appear as follows:



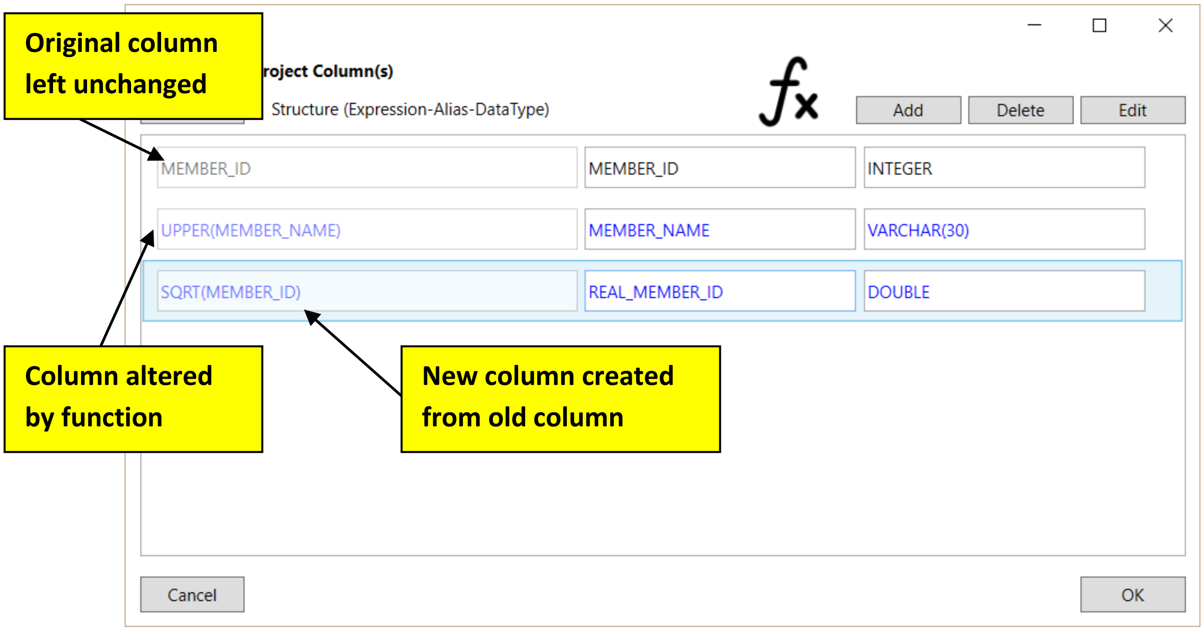
Input Column(s)

BDA_PROC_DT
CONTENT_ID
CONTENT_NAME
COPYCOMPLETE
CREATED_BY
CREATED_DATE
DESCRIPTOR_ID
DOCUMENTHASH
EFFECTIVEDATE
FILE_SIZE
IRMDOCID
ISESIGNED
IS_COMPRESSED

Output Column(s) / Expression(s)

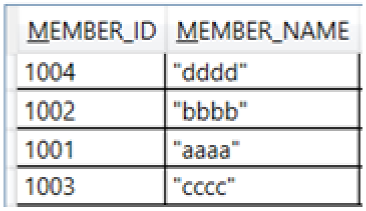


Expression: UPPER(MEMBER_NAME)

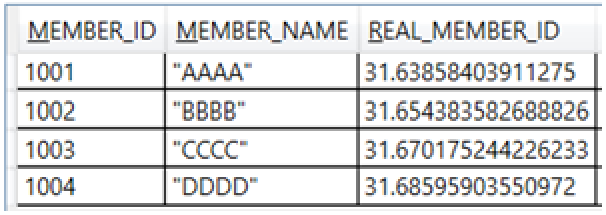

roject Column(s)
Structure (Expression-Alias-DataType)
Add
Delete
Edit
Cancel
OK
Original column left unchanged
Column altered by function
New column created from old column

MEMBER_ID	MEMBER_ID	INTEGER
UPPER(MEMBER_NAME)	MEMBER_NAME	VARCHAR(30)
SQRT(MEMBER_ID)	REAL_MEMBER_ID	DOUBLE

Input and output for this example:



MEMBER_ID	MEMBER_NAME
1004	"dddd"
1002	"bbbb"
1001	"aaaa"
1003	"cccc"



MEMBER_ID	MEMBER_NAME	REAL_MEMBER_ID
1001	"AAAA"	31.63858403911275
1002	"BBBB"	31.654383582688826
1003	"CCCC"	31.670175244226233
1004	"DDDD"	31.68595903550972

SCD2

Introduction

SCD2 implements “Slowly Changing Dimensions Type 2.”

In data warehousing, some attributes of objects, such as, say, the prices of Veggie Burgers, may be referred to as *dimensions*, and stored as columns in *dimension tables.* Sometimes those attributes change, slowly relative to the frequency of loading the data warehouse – so, for example, a restaurant might raise the price of its Veggie Burgers. In this case they are referred to as *slowly changing dimensions.* It is often considered desirable to have a system that keeps track of the changes to dimensions, and makes it clear not only what the current value of the dimension is (in our example, what the current price of Veggie Burgers is), but also makes it possible to discover what the previous values were.

SCD2 is one of several ways to implement such a system. In SCD2, rows associated with dimension values are marked with effective timestamps and expiration timestamps. The row with the current dimension value will have the most recent effective timestamp and an expiration timestamp of “infinity” (usually something like 12/31/9999 23:59).

Example,

id	name	type_key	price	modified_date	dim_id	eff_ts	exp_ts
1	Chicken Burger	1	$3.70	10/7/2016 19:03	1	10/7/2016 19:03	12/31/9999 23:59
2	Veggie Burger	1	$3.20	10/7/2016 19:03	2	10/7/2016 19:03	12/31/9999 23:59
3	French Fries	2	$2.00	10/7/2016 19:03	3	10/7/2016 19:03	12/31/9999 23:59
4	Twister Fries	2	$2.20	10/7/2016 19:03	4	10/7/2016 19:03	12/31/9999 23:59

Consider the example shown above. Here we see the initial state of a price dimension table for restaurant food items. The fields id and name identify a certain food item, so, for example, id = 1 will always be a Chicken Burger, and id = 3 will always be French Fries. The type_key field identifies food type – for example, burgers, vs. fries. The dim_id is a unique identifier for the row. The modified_date field is the time when the values in the row were last changed, and will be the same as the effective timestamp. The effective timestamp (“eff_ts”) of all of the items is 10/7/2016 19:03, and the expiration timestamp (“exp_ts”) for all items is 12/31/9999 23:59, meaning that all items are current. In particular, the current price of a Veggie Burger is $3.20.

Next, we update the price of Veggie Burgers, so that the price is now $3.25.

id	name	type_key	price	modified_date	dim_id	eff_ts	exp_ts
1	Chicken Burger	1	$3.70	10/7/2016 19:03	1	10/7/2016 19:03	12/31/9999 23:59
2	Veggie Burger	1	$3.25	10/7/2016 20:08	5	10/7/2016 20:08	12/31/9999 23:59
2	Veggie Burger	1	$3.20	10/7/2016 19:03	2	10/7/2016 19:03	10/7/2016 20:08
3	French Fries	2	$2.00	10/7/2016 19:03	3	10/7/2016 19:03	12/31/9999 23:59
4	Twister Fries	2	$2.20	10/7/2016 19:03	4	10/7/2016 19:03	12/31/9999 23:59

The table above has been updated to reflect the price change according to the SCD2 scheme. The row with the old price, identified by dim_id = 2, has been “expired,” by setting exp_ts to 10/7/2016 20:08. We have created a new row, identified by dim_id = 5, where price is now $3.25. We know that the latter row, where price = $3.25 and dim_id = 5 is the current row because its exp_ts is 12/31/9999 23:59. The table thus contains an indication of the current row as well a history of the previous prices.

How to Use the SCD2 Step

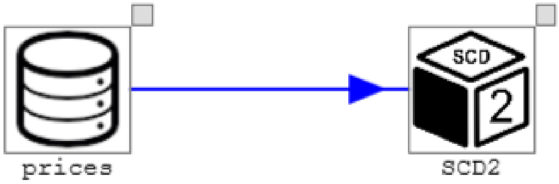
The SCD2 Step automates the maintenance of an SCD2 scheme like the one shown above. The user must provide appropriate input and dimension tables, and must label the columns as to their role. In the example below, we'll show how to use the SCD2 step to obtain a dimension table like the one above.

The source for our dimension table is a table called **prices**, which initially looks like this:

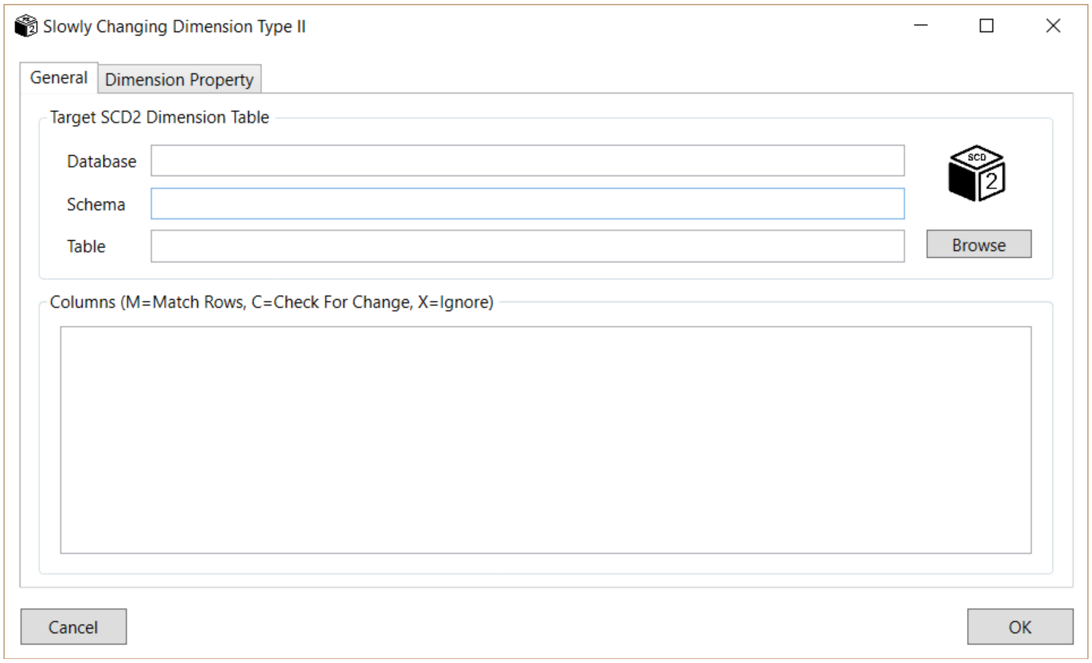
id	name	type_key	price	modified_date
1	Chicken Burger	1	$3.70	10/7/2016 19:03
2	VeggieBurger	1	$3.20	10/7/2016 19:03
3	French Fries	2	$2.00	10/7/2016 19:03
4	Twister Fries	2	$2.20	10/7/2016 19:03

We must also create another table called **prices_dim**, consisting of all of the columns of the **prices** table plus, if they do not already exist, the columns dim_id, eff_dt, and exp_dt, which are BIGINT, TIMESTAMP, and TIMESTAMP respectively.

We will set up a simple, two-step ELT Maestro job as shown below:



The table step on the left is connected to the **prices** table. Now open the properties of the SCD2 step:


Slowly Changing Dimension Type II

General | Dimension Property

Target SCD2 Dimension Table

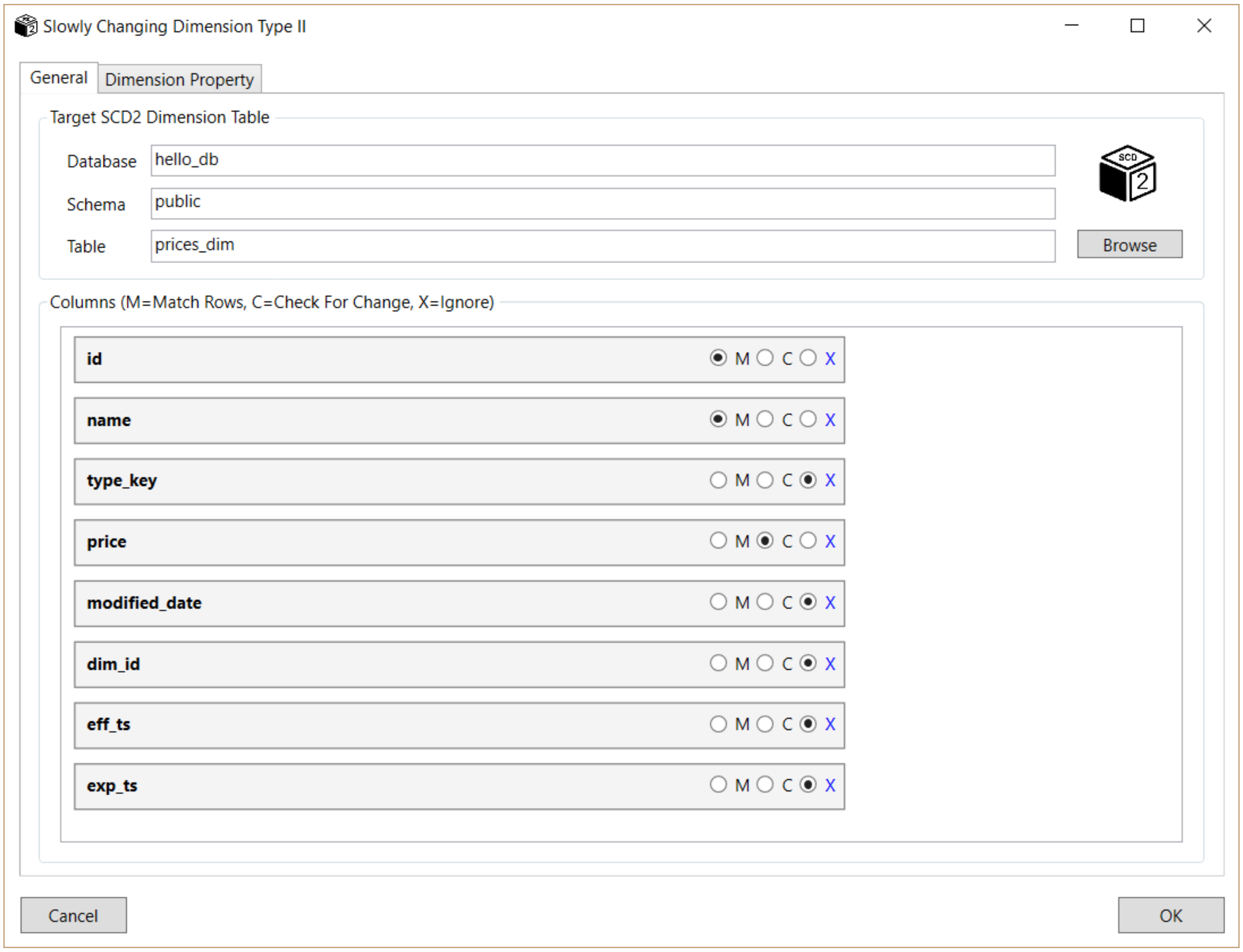
Database

Schema

Table

Columns (M=Match Rows, C=Check For Change, X=Ignore)

In the General tab, click on the Browse button and navigate to and select the **prices_dim** table:



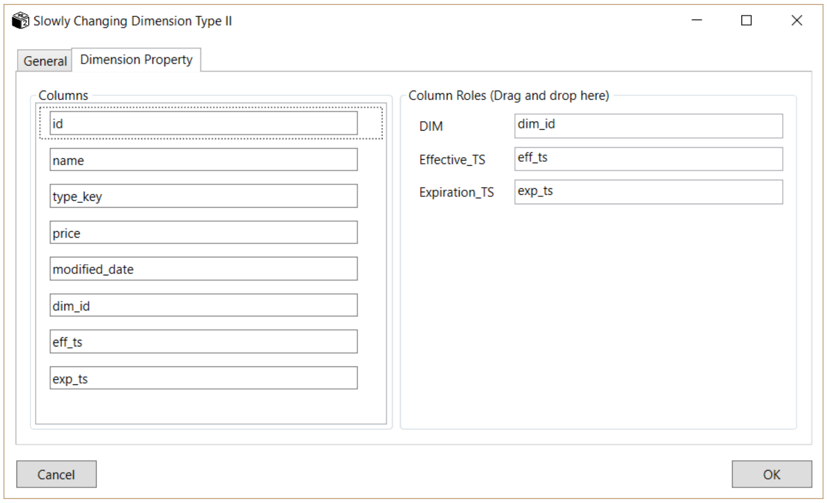
Target SCD2 Dimension Table

Database: hello_db
Schema: public
Table: prices_dim

Columns (M=Match Rows, C=Check For Change, X=Ignore)

id	● M	○ C	○ X
name	● M	○ C	○ X
type_key	○ M	○ C	● X
price	○ M	● C	○ X
modified_date	○ M	○ C	● X
dim_id	○ M	○ C	● X
eff_ts	○ M	○ C	● X
exp_ts	○ M	○ C	● X

Each column in the dimension table needs to be classified as either a *match (M), check for change (C)* or *ignore (X)* column. The columns that *identify* the object as the one described by the attribute (aka dimension) in question should be marked with an M. In our case, these columns are id and name. The dimension itself – the column or columns whose change we are tracking are marked with a C – in our case, the price column. All other columns should be marked with an X.



Columns

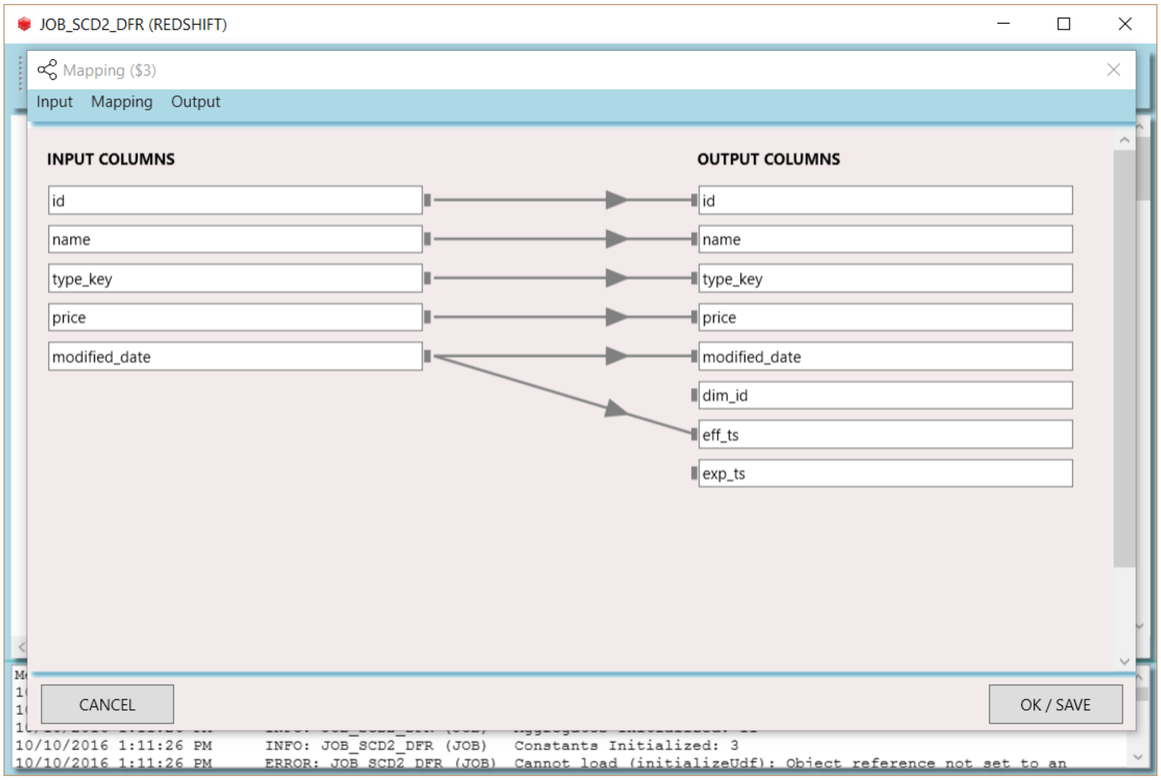
- id
- name
- type_key
- price
- modified_date
- dim_id
- eff_ts
- exp_ts

Column Roles (Drag and drop here)

DIM: dim_id
Effective_TS: eff_ts
Expiration_TS: exp_ts

On the Dimension Property tab, we specify which columns fill the roles of dimension identifier, effective timestamp, and expiration timestamp; in our case these will be the columns we created for this purpose.

In some cases, a preexisting column from the input table may fill one of these roles – for example, we could have used modified date as our effective timestamp.



INPUT COLUMNS

- id
- name
- type_key
- price
- modified_date

OUTPUT COLUMNS

- id
- name
- type_key
- price
- modified_date
- dim_id
- eff_ts
- exp_ts

```
10/10/2016 1:11:26 PM      INFO: JOB_SCD2_DFR (JOB)   Constants Initialized: 3
10/10/2016 1:11:26 PM      ERROR: JOB_SCD2_DFR (JOB)  Cannot load (initializeUdf): Object reference not set to an
```

After clicking OK in the Dimension Property tab, the user is shown the mapping editor. In our case, we want to make sure that modified_date in the **prices** table maps to eff_ts (effective timestamp) as well as modified_date in the **prices_dim** table.

After clicking OK/SAVE, the job will be set up correctly to update the **prices_dim** table according to the SCD2 scheme.

Smart Script

Introduction

Smart script step is an item list processor. Let us define a simple use case to better understand how this step can be utilized.

Use Case

I have hundreds of text files on a Linux machine located at folder path(/home/maestro/files). I want to compress these files using gzip command. Ideally, I want to call 8 parallel gzip commands so that the process can be faster utilizing a multi core system. Then I want to run another script in parallel using 4 threads that does something with compressed files.

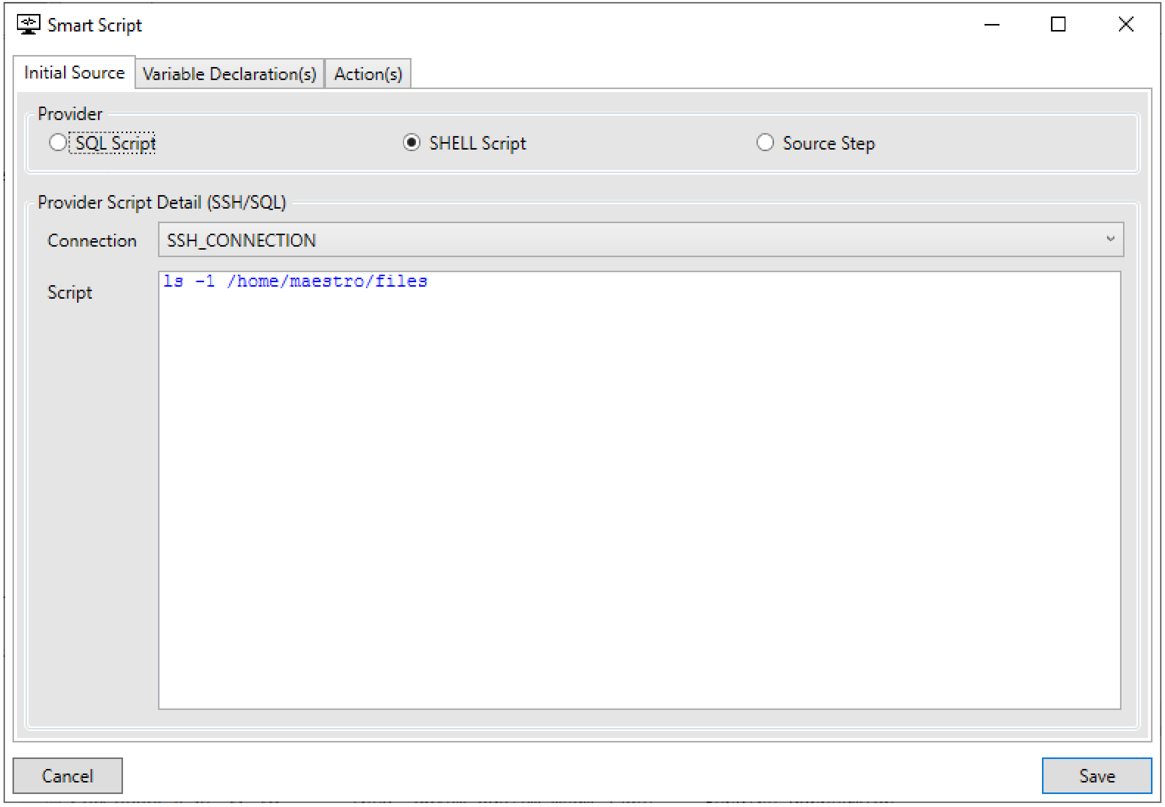
Design Template

- **[INPUT] is provided in form of a list of values generated by script**. This list can be output of a shell script or SQL. If shell script is provided the program splits standard output by new line and converts into array of values so that each line is a value item. If SQL script is provided the program retrieves array of value from the first column so that each row of first column is a value item.
- **[DECLARATIONS] are done to convert value from one form to another**. You can only use echo command to convert single input value to another.

- **[ACTIONS] are final execution of either SQL or SHELL script**. Variable declarations and conversions performed on previous step are referenced here. You can specify number of parallel calls in action.

Note: You can only declare and reference variables with $ prefix.

Figure: Smart Script [INPUT]



Provider

○ SQL Script ● SHELL Script ○ Source Step

Provider Script Detail (SSH/SQL)

Connection: SSH_CONNECTION

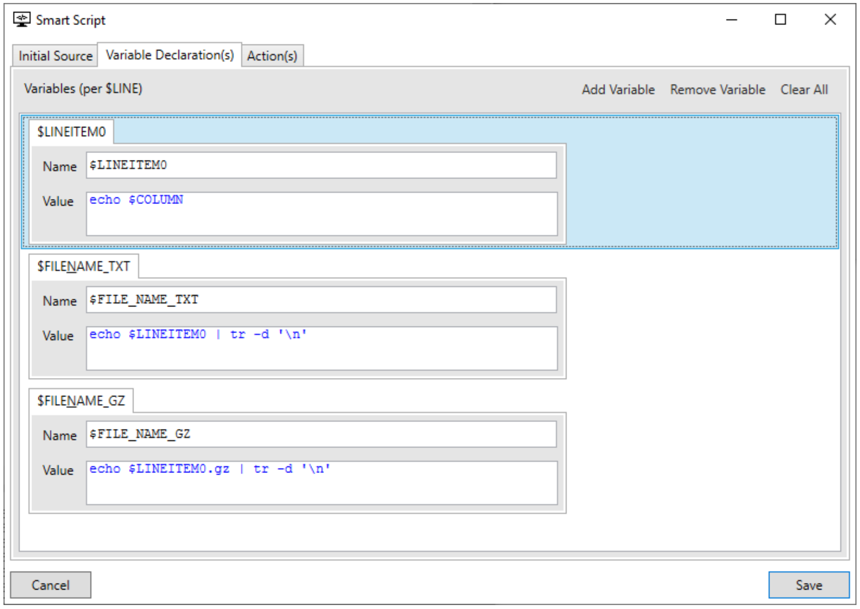
Script:

```
ls -1 /home/maestro/files
```

In this phase [INPUT]

I am running a shell script to list all file names located on a specified directory running ls command.
My input command to generate files list is ls -1 /home/maestro/files

Figure: Smart Script [Declaration]



Variables (per $LINE)

$LINEITEM0

Name: $LINEITEM0

Value:

```
echo $COLUMN
```

$FILENAME_TXT

Name: $FILE_NAME_TXT

Value:

```
echo $LINEITEM0 | tr -d '\n'
```

$FILENAME_GZ

Name: $FILE_NAME_GZ

Value:

```
echo $LINEITEM0.gz | tr -d '\n'
```

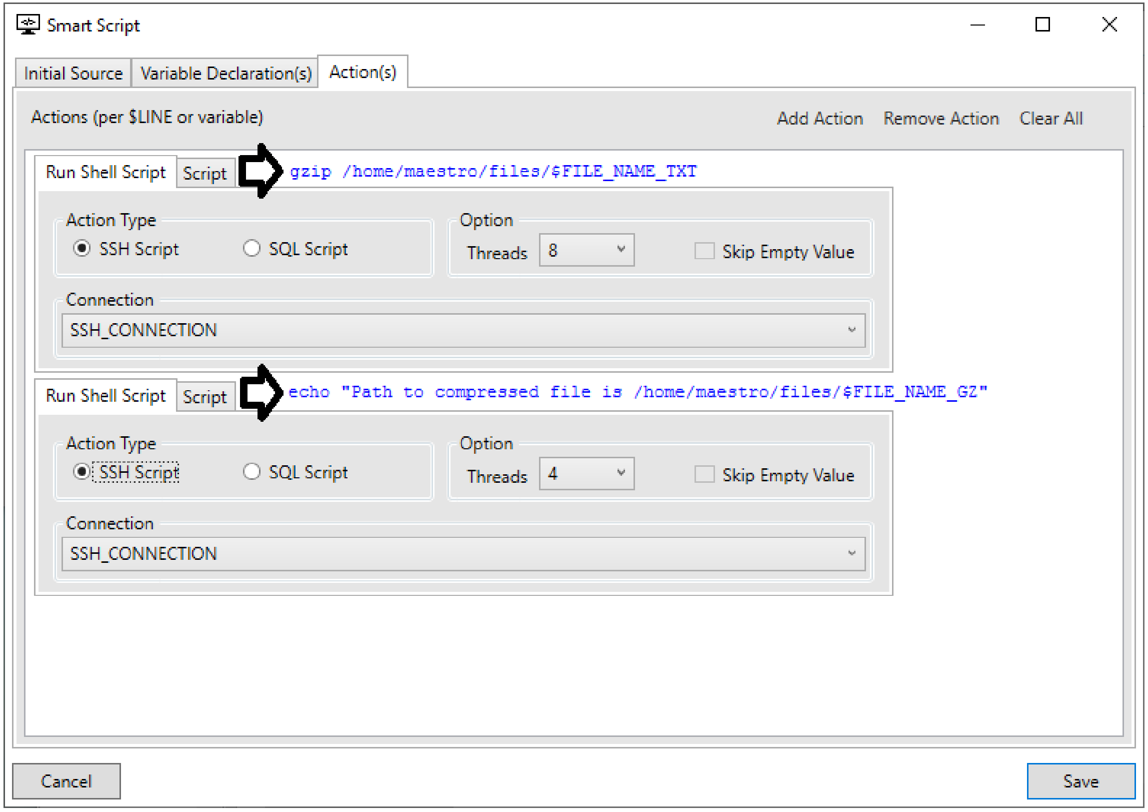
In this phase [Declaration]
The first declaration $LINEITEM0 has default value $COLUMN. Each output line from previous initial step is assigned to $COLUMN during runtime. The first declaration just copies that value into $LINEITEM0 using echo command.

The second declaration $FILE_NAME_TXT = echo $LINEITEM0 | tr -d '\n' does pretty much the same thing, but it removes new lines from value and assigns to $FILE_NAME_TXT.

The third declaration $FILE_NAME_GZ = echo $LINEITEM0.gz | tr -d '\n' calculates that the compressed file name is going to be.

Why 3 declarations?
When I run gzip command, the name of file gets changed to it's original name and extra extension is added. So if input has value file.186.txt, the file name changes to file.186.txt.gz after running gzip command on action tab.

Figure: Smart Script [Action]



```
gzip /home/maestro/files/$FILE_NAME_TXT
```

● SSH Script ○ SQL Script

Threads 8

□ Skip Empty Value

Connection: SSH_CONNECTION

```
echo "Path to compressed file is /home/maestro/files/$FILE_NAME_GZ"
```

● SSH Script ○ SQL Script

Threads 4

□ Skip Empty Value

Connection: SSH_CONNECTION

In this phase [Action]
I am running gzip command in parallel mode using 8 threads at a time until all files are compressed. Then I have second action which runs echo command using 4 threads at a time.

Rules

- Initial source must be provided by either a shell script or sql script
- Declarations can only be done by shell script
- Actions could be either

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