[L2-DW] KNIME Analytics Platform for Data Wranglers: Advanced

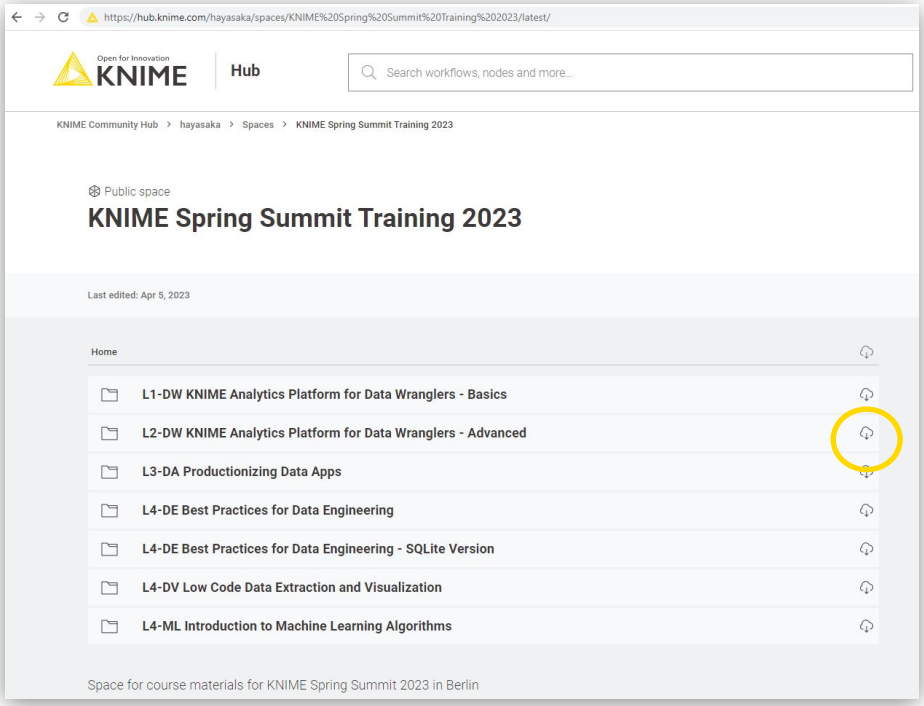
April 17, 2023

Structure of the course

- This course consists of five sessions
  - Data/Time and Data Export
  - Flow Variables and Shared Components
  - Workflow Control: Loops, Switch, and Try-Catch
  - Formatting Excel Tables and Introduction to Data Science
  - Q&A and Summary
- Structure of each session
  - Introduction to the topic
  - Hands-on exercise
  - Solution walk-through

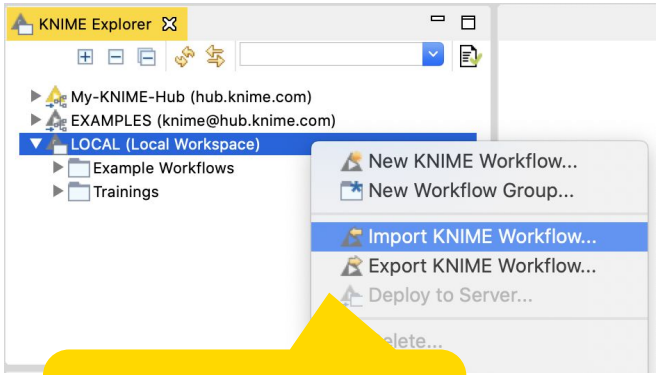
Downloading the Exercises

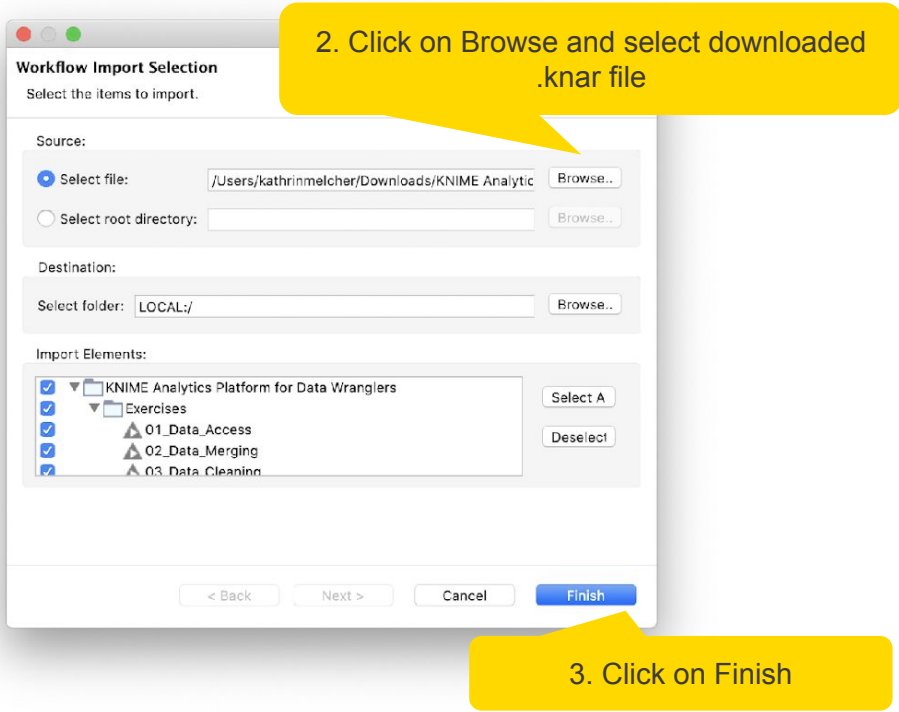
- Download the course material from the KNIME Community Hub
  https://hub.knime.com/hayasaka/spaces/KNIME%20Spring%20Summit%20Training%202023/latest/



Importing the Exercises

- Import the course material to KNIME Analytics Platform

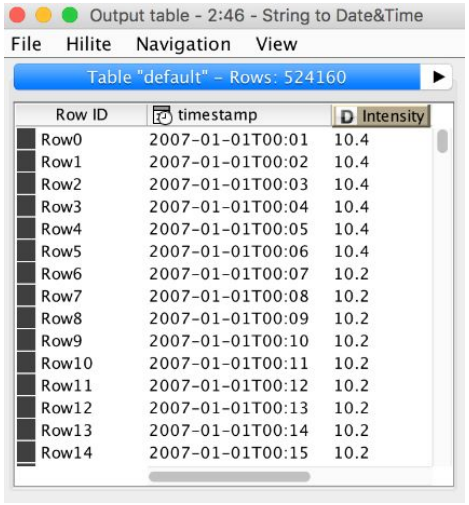


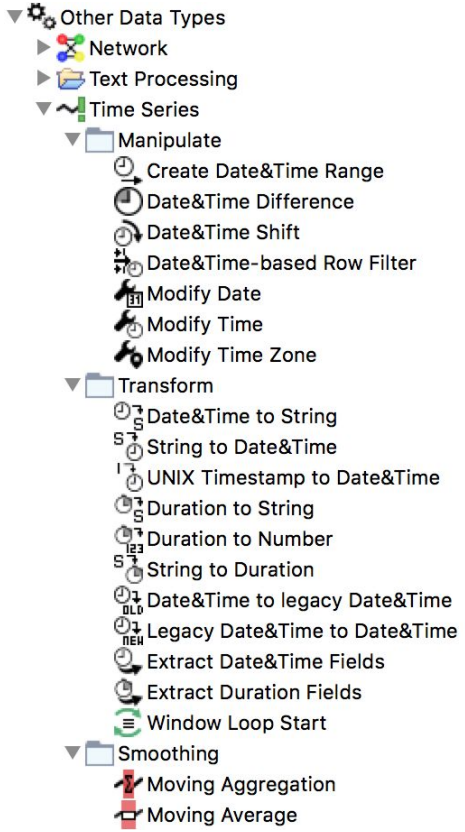


Date/Time Data

Date & Time Overview

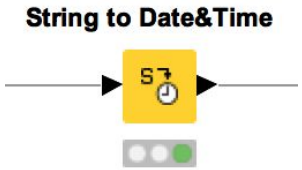
- Dedicated data type for date and time data
- Supported in Date&Time nodes
  - (and others: GroupBy, Pivot, Line Plot)
- Complete re-write in KNIME 3.4

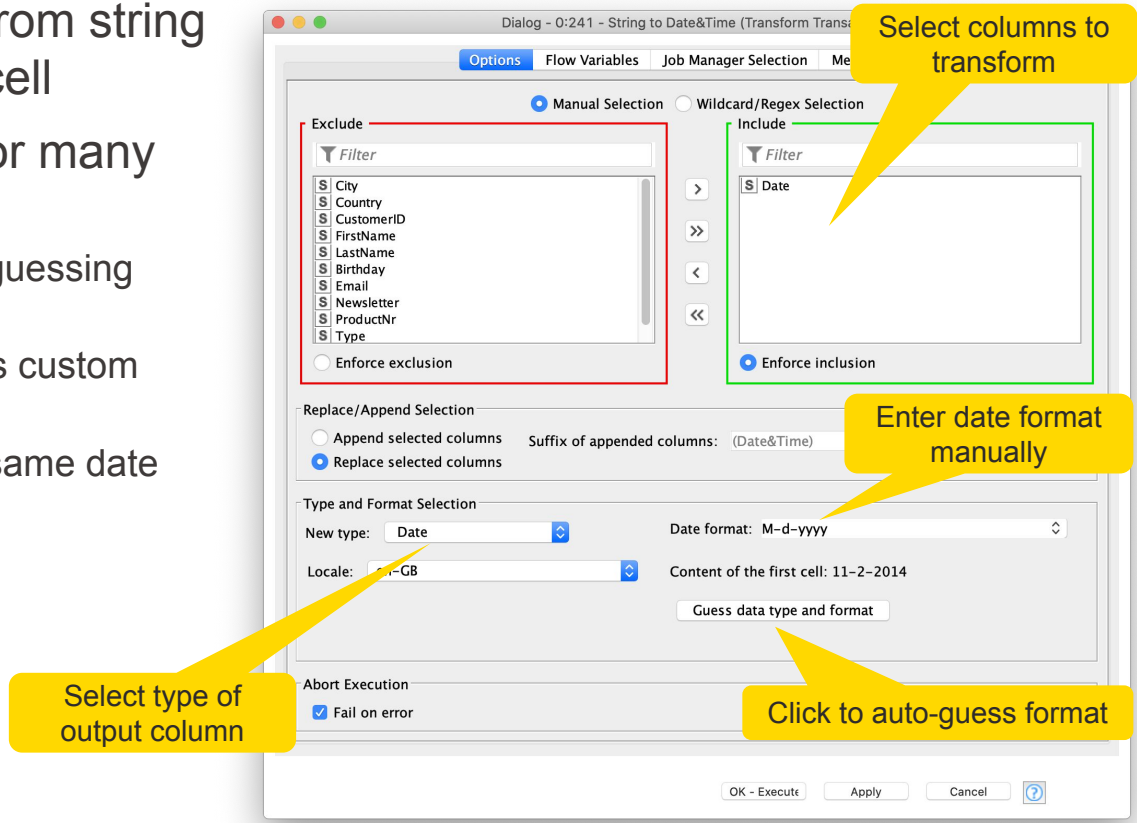




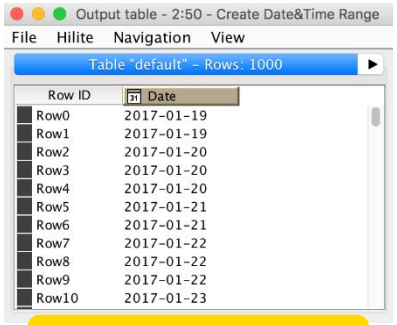
String to Date&Time

- Converts date/time data from string into a native Date&Time cell
- Guesses correct format for many types of date formatting
  - Enter format manually if auto-guessing didn‘t work
    - KNIME automatically adds custom formats to auto-guess list
  - Converts multiple columns of same date format in one node

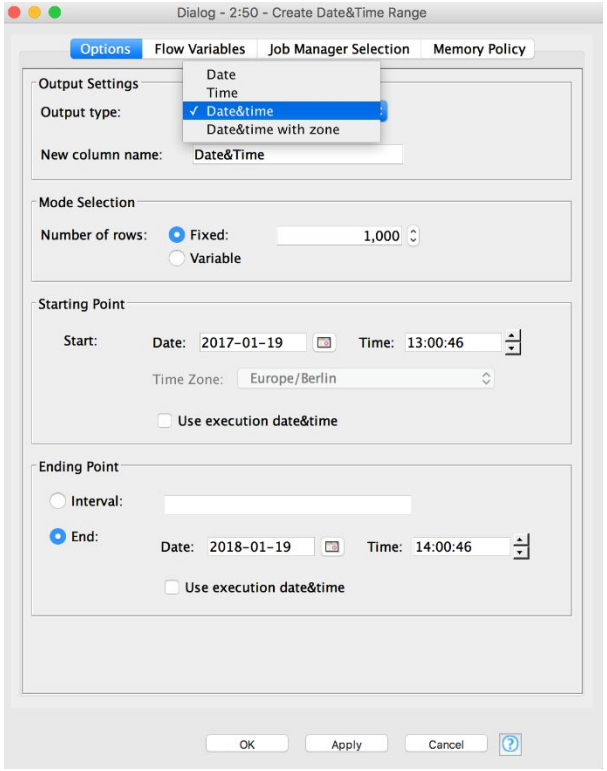


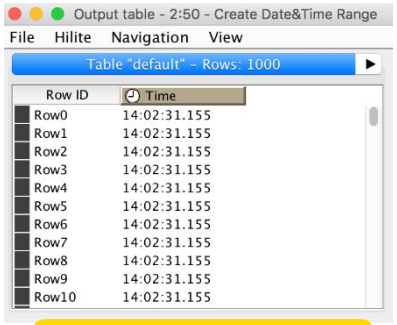


Date&Time – Data Types

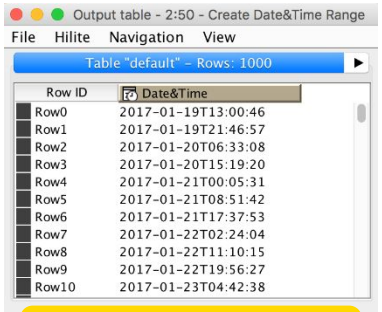


Date

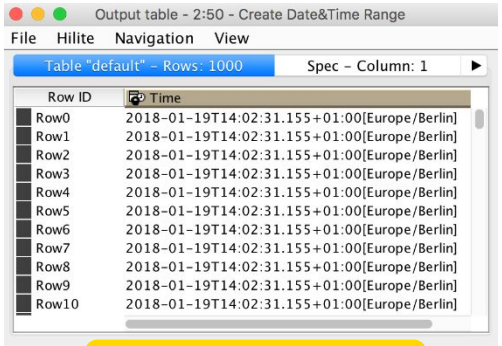




Time



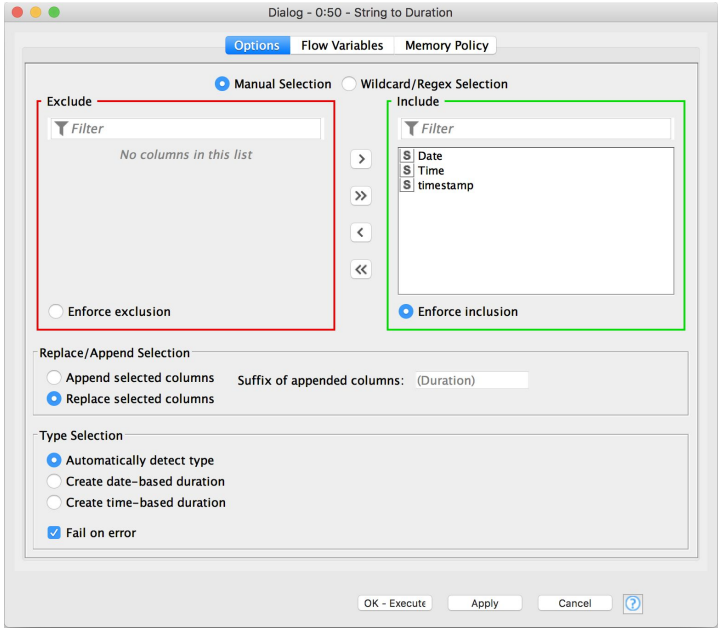
Date & Time

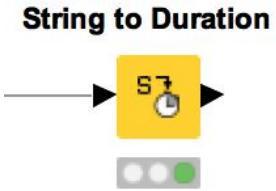


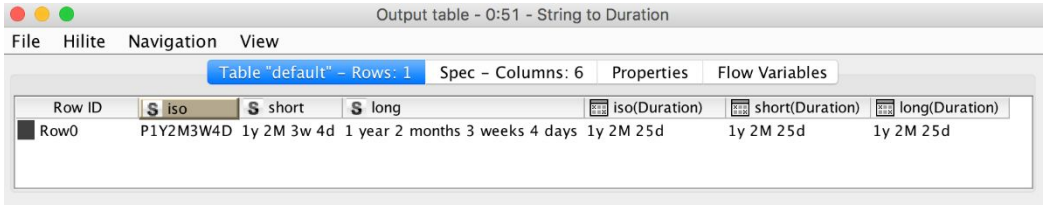
Date & Time +
Time zone

String to Duration

- Takes a string and converts it to a duration cell
  - Three different options to format input strings
- Example: Convert 1 year, 2 months, 3 weeks, and 4 days to duration cell
  - ISO-8601: “P1Y2M3W4D“
  - Short letter: “1y 2M 3w 4d”
  - Long word: “1 year 2 months 3 weeks 4 days”

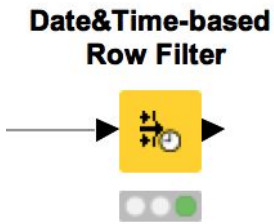


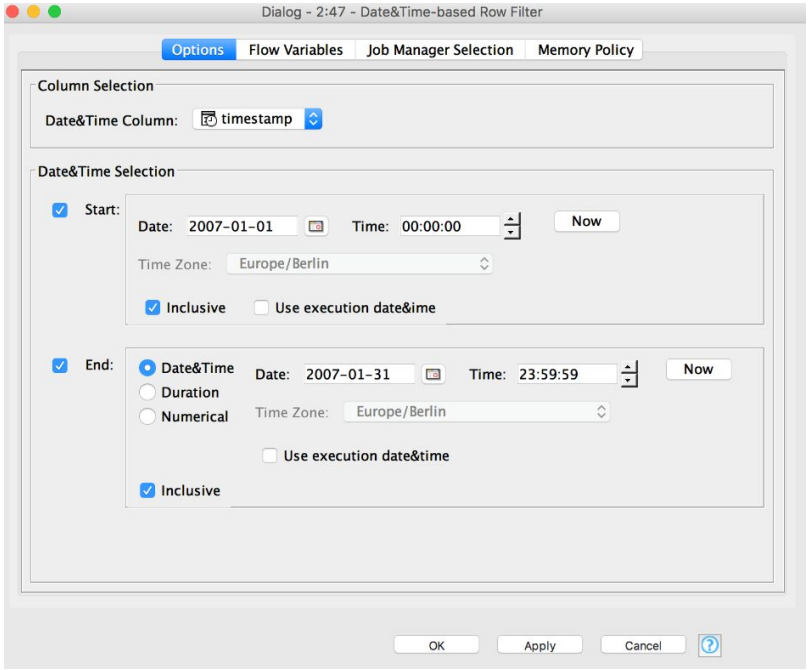




Date&Time-based Row Filter

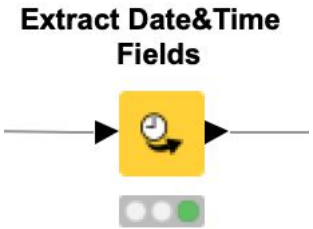
- Filters rows from a specified time period
- Range can be limited on upper bound, lower bound or both
- Options for end point:
  - Date&Time: Fixed data and time
  - Duration: Duration string (e.g. 2y 3M)
  - Numerical: Select granularity from dropdown and enter number

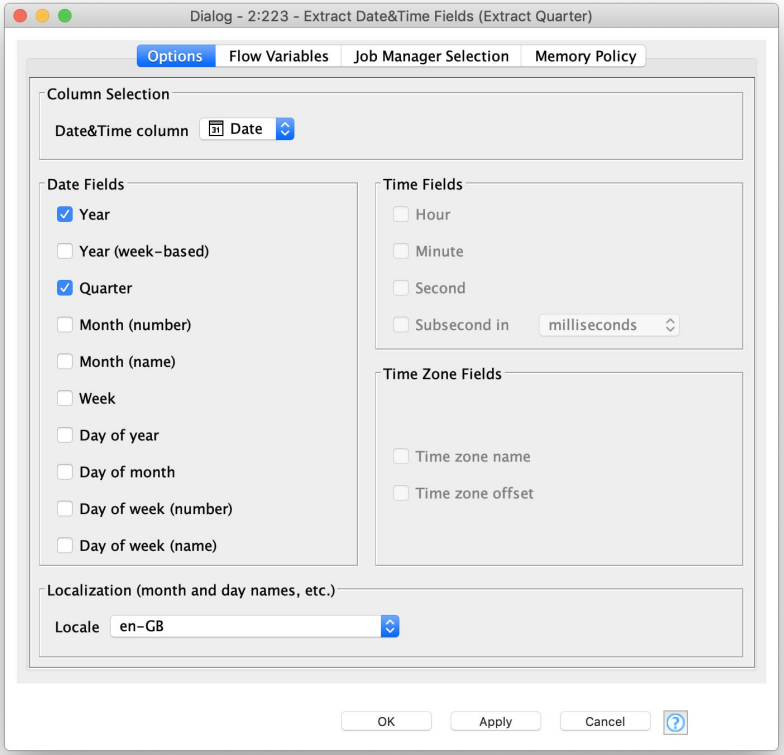




Extract Date&Time Fields

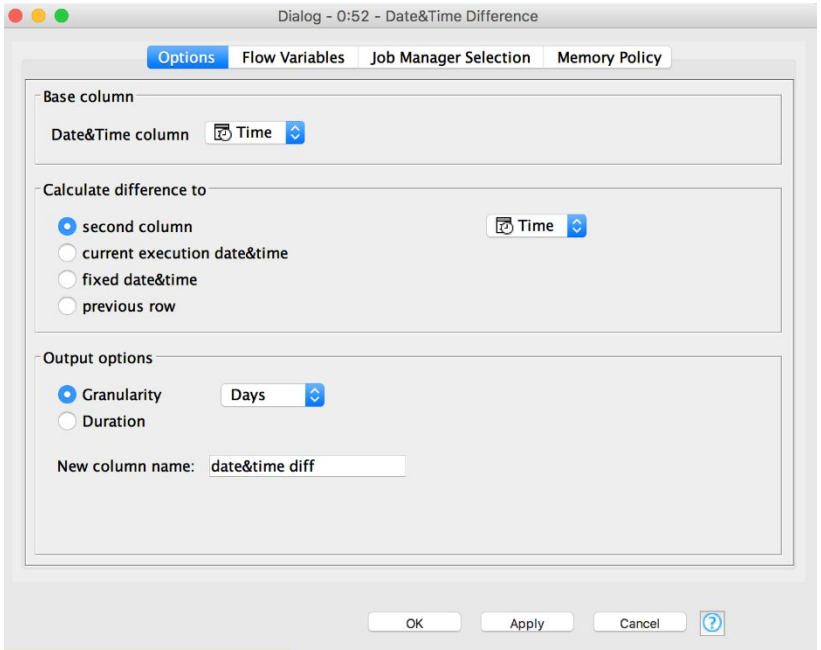
- Extracts date fields (year, day, month) or time fields (hour, minute, second) from a date&time cell.
- You can pick and choose which fields to include
- Useful when used in combination with data aggregation nodes (groupby, pivot etc.)

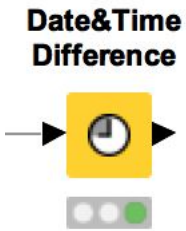




Date&Time Difference

- Check the difference between a time column and…
  - Another time column
  - Execution time
  - User-defined time
  - Time from previous row
- Choose desired resolution (days, hours, minutes, etc.)

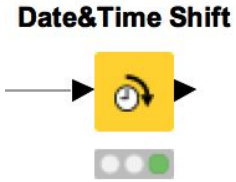


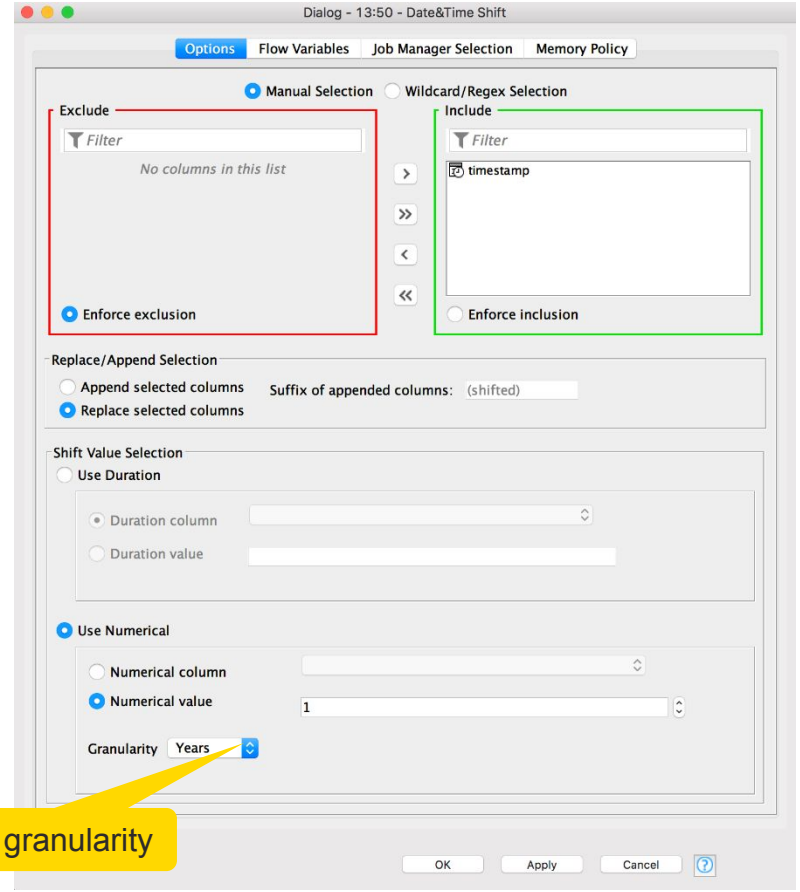


To calculate difference to second column, both columns need to have the same type!

Date&Time Shift

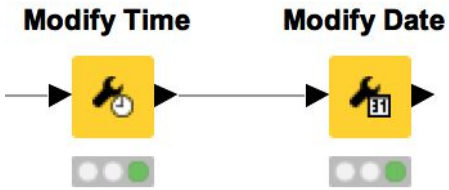
- Shifts date or time by either a duration or a numerical value
- Use duration:
  - Use duration column
  - Or shift by user-defined value
    - E.g. 1y, 2M, 5h, etc.
- Use numerical in combination with user-defined granularity
  - Use numerical column
  - Or shift by user-defined value

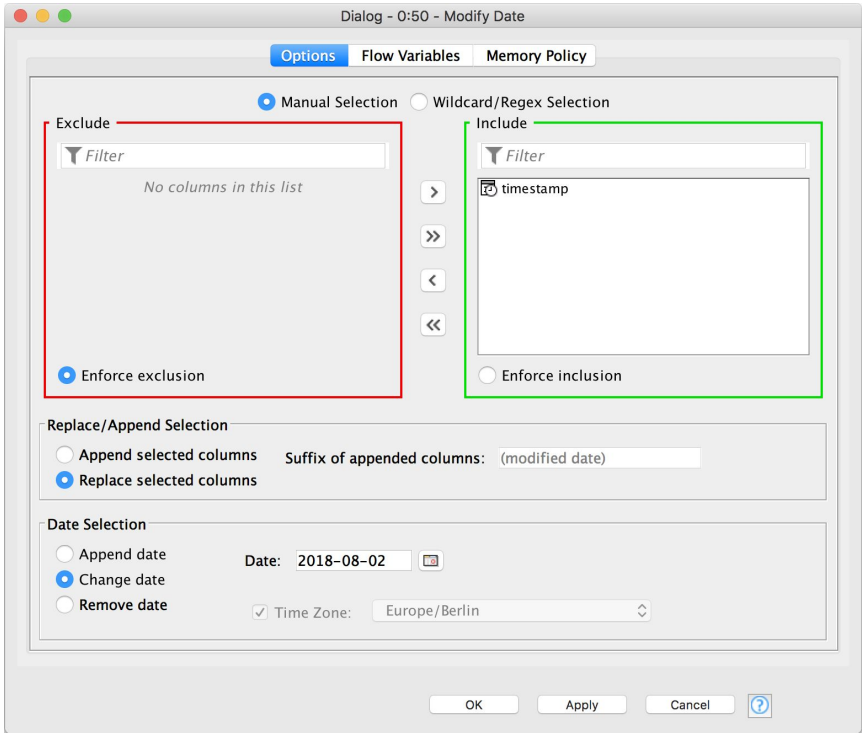




Modify Time / Modify Date

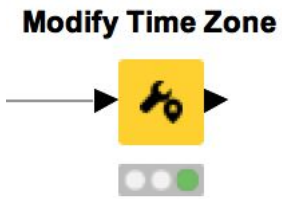
- Modify Date&Time columns
- Three options:
  - Appends time (date) to date (time) column
  - Changes time (date) to fixed value
  - Removes time (date) from Date&Time column
- Column selection shows only columns suitable for currently selected option

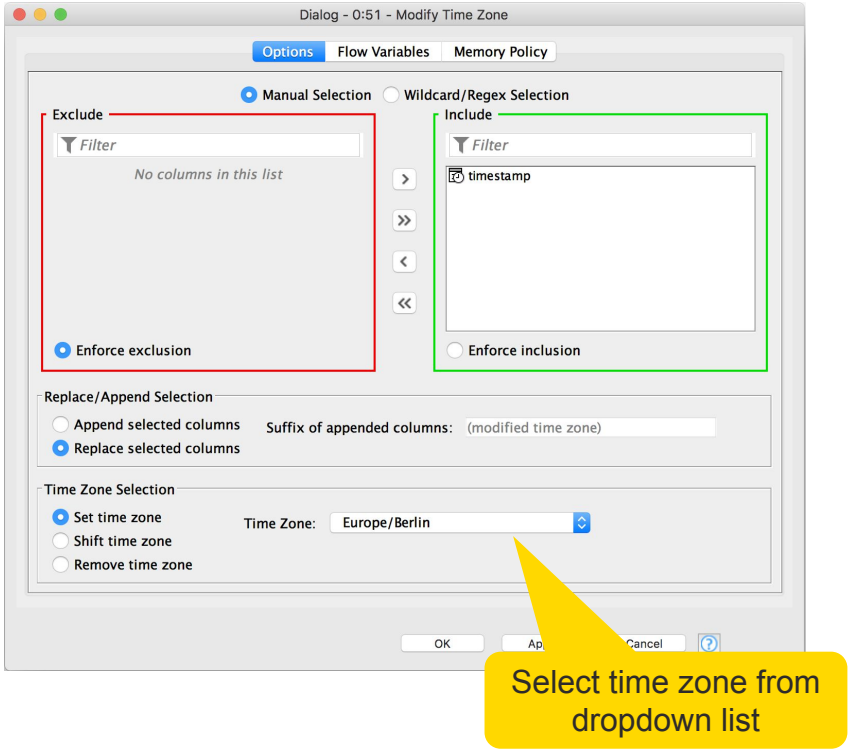




Modify Time Zone

- Similar to Modify Time/Modify Date
- Input: Date&Time
  - Set time zone
- Input: Date&Time (Time zone)
  - Set time zone
  - Shift time zone
  - Remove time zone





Exercise: 08_DateTime_Manipulation

- Convert order dates from string to Date&Time
- Extract the product purchases that were submitted in 2019
- Extract the remaining product purchases into a separate table
- Extract monthly and year of each product purchase into separate columns
- Plot monthly sales in a line plot

Exporting Data & Deployment

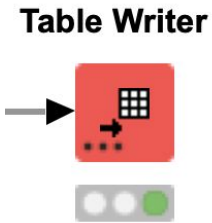
Exporting Data

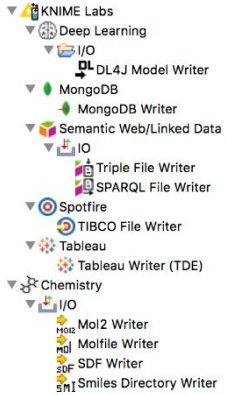
After an analysis is completed, what next?

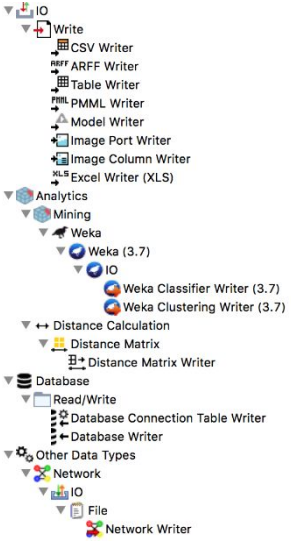
- Write results to a file
- Upload results to a Cloud Storage
- Create/update a database
- Generate a rich report using BIRT
- Send your data to Tableau, Spotfire, PowerBI to create a report
- Deploy via KNIME KNIME Business Hub
- Deploy your model as RESTful web service

Data Export Nodes

- Typically characterized by:
  - Magenta color
  - 1 input port, no output ports
  - Create file on file system or write to database

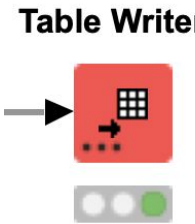


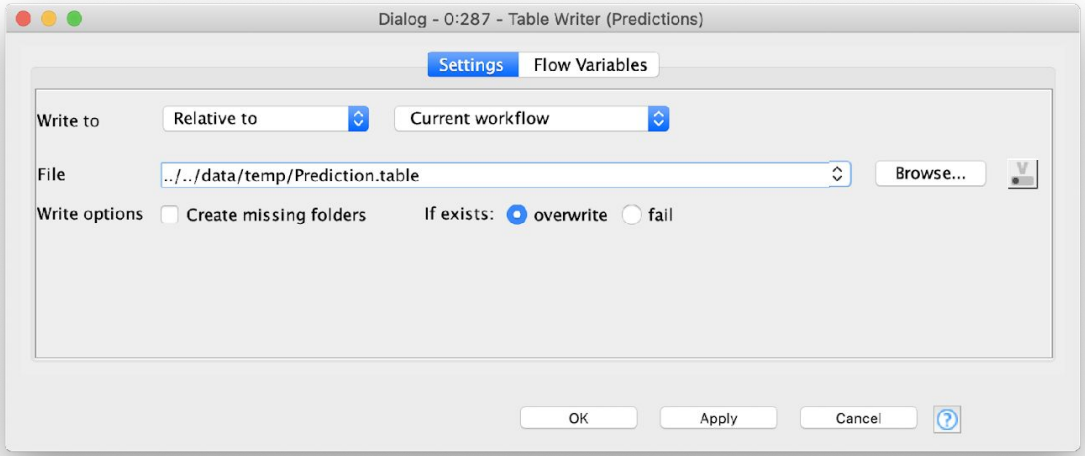




https://www.youtube.com/watch?v=Og7VZOJhsOc&feature=youtu.be

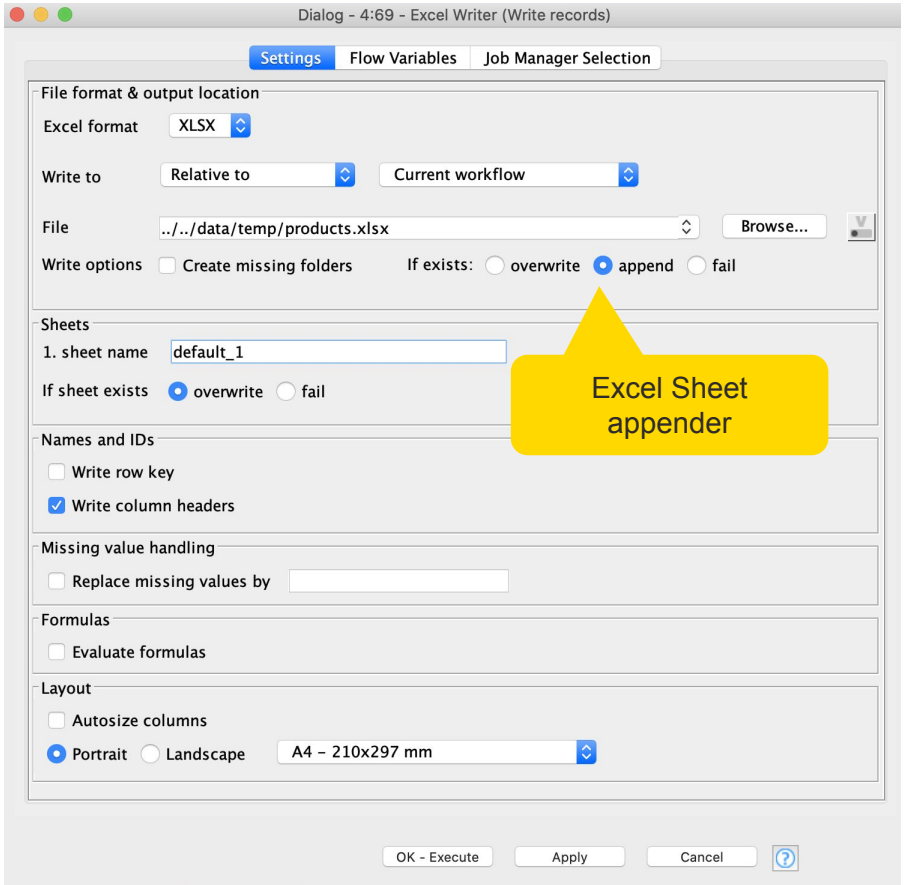
Table Writer





Excel Writer

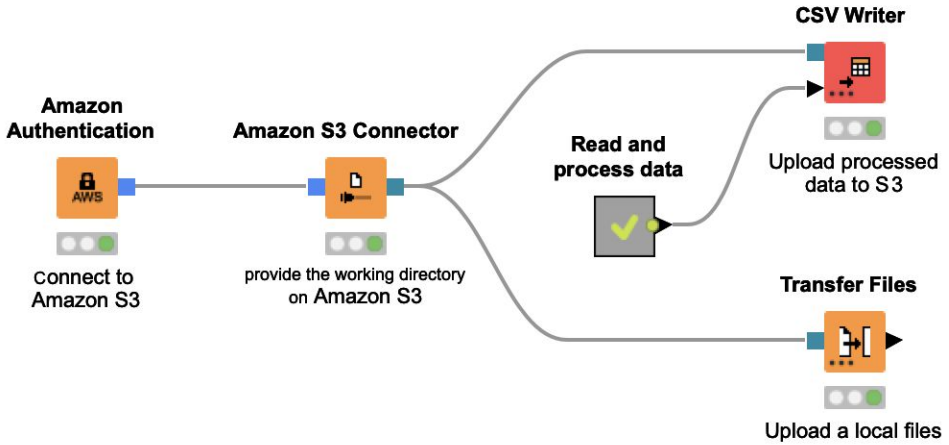
- Writes the input table into a spreadsheet of an Excel file
- Select append, to append a spreadsheet to an existing Excel File and define the name of the new sheet



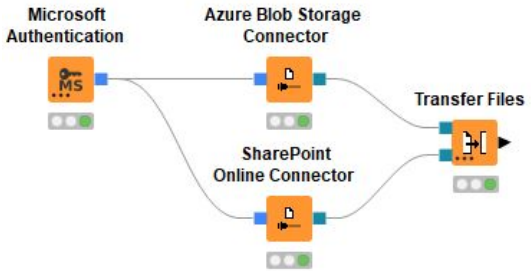
Write Files to a Remote File System

- The new file handling framework makes it easy to upload data to remote file systems
  - Write processed data directly with a writer node
  - Upload local files with the Transfer Files node

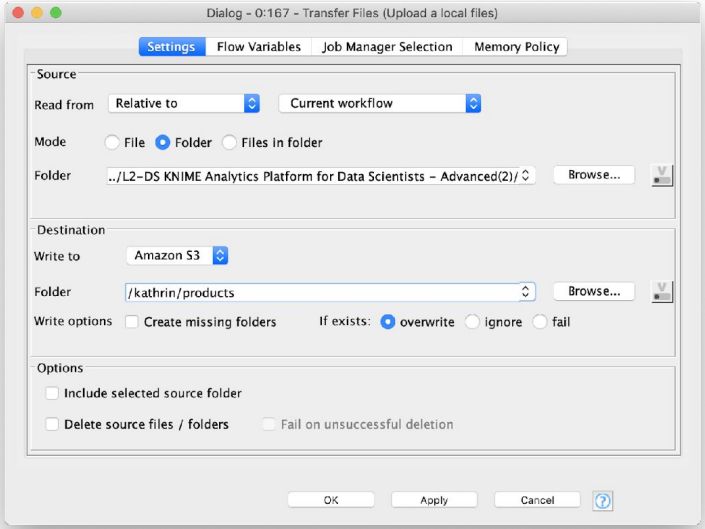
- Supported file systems
  - Microsoft Azure
  - Google
  - Amazon
  - Databricks
  - BigData file systems (hdfs, httpFS, …)
  - On-premise (e.g. ssh, ftp, …)

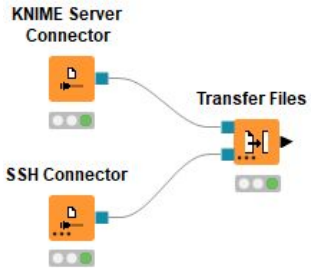


Full Flexibility with the Transfer Files node

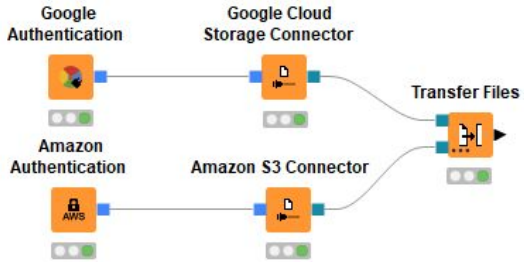


Same cloud environment





On-premise

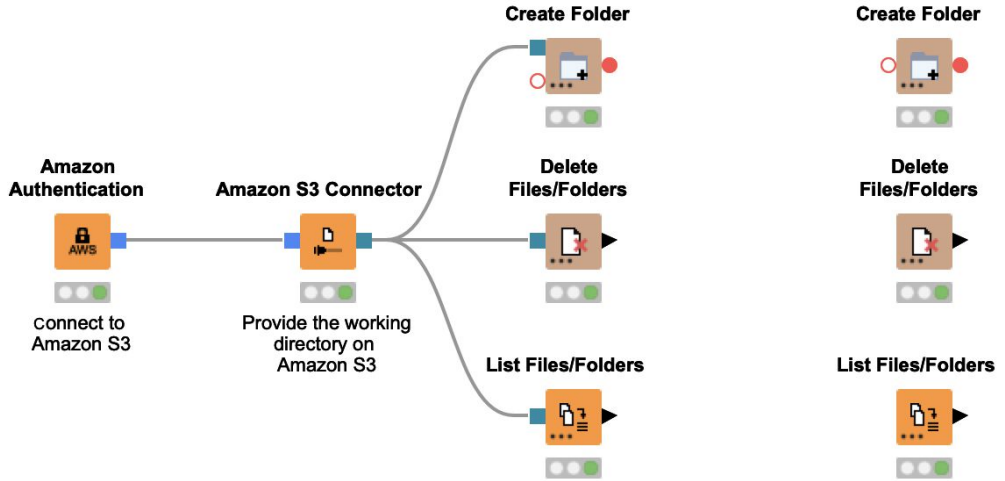


Cross cloud environments

Other Utility Nodes

Can be used with local and remote file systems

- Create a folder
- Delete files or folders
- List all files in a folder

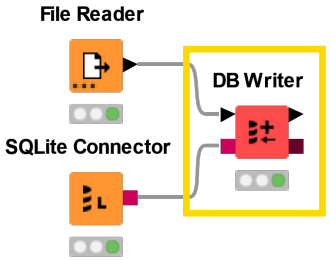


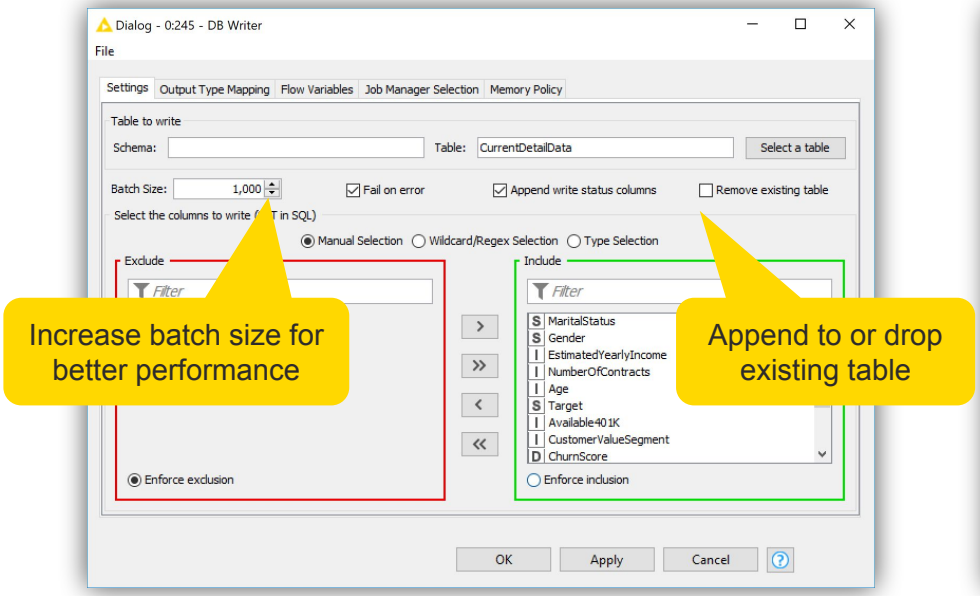
- Further information about file handling

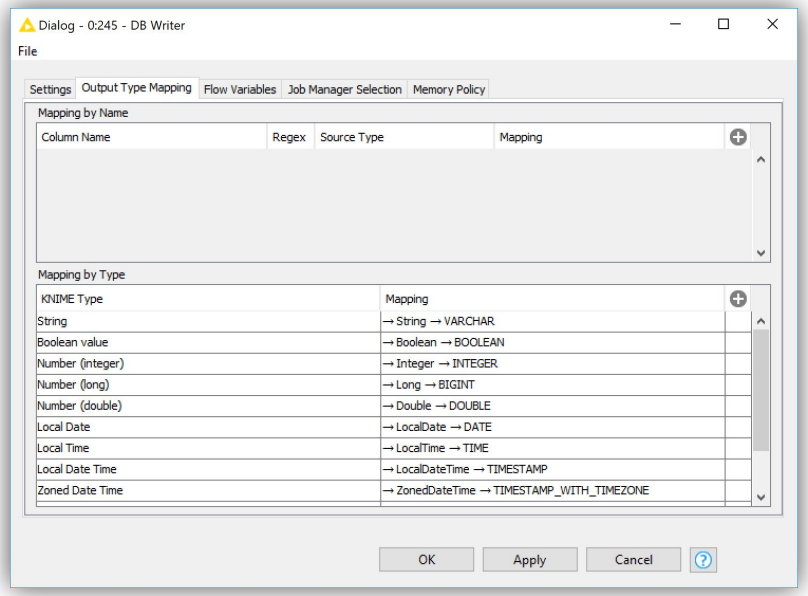
https://docs.knime.com/latest/analytics_platform_file_handling_guide/index.html

DB Writer

- Writes data from a KNIME data table **directly** into a database table

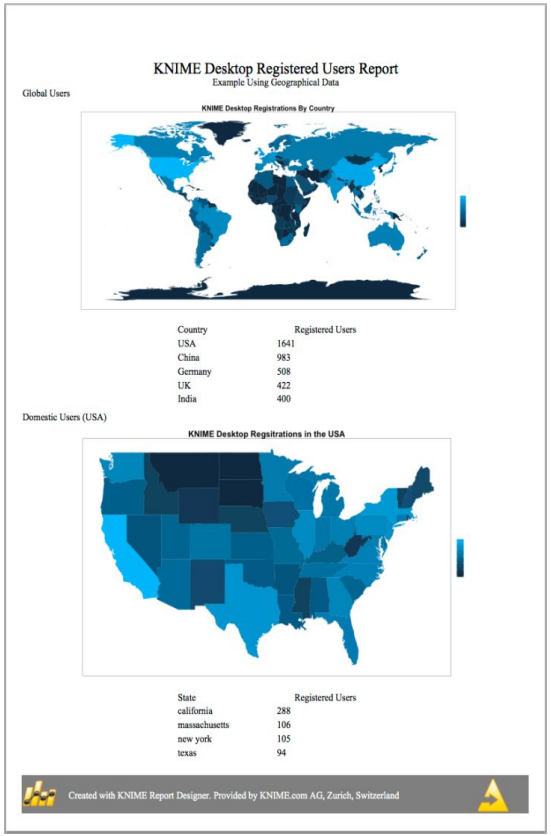






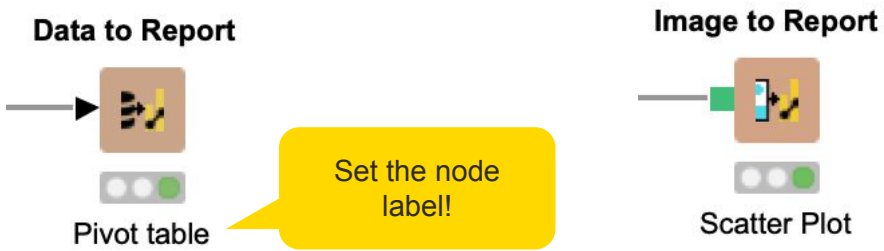
Reporting in KNIME

- Reporting in KNIME is done via a 3rd party application named BIRT (Business Intelligence Reporting Tool)
- Data is sent to BIRT from KNIME using special nodes.
- Reports in BIRT are constructed from report items, which may include images, tables, charts and labels.
- Reports may be generated in a variety of formats (html, pdf, pptx, xlsx, docx, …)



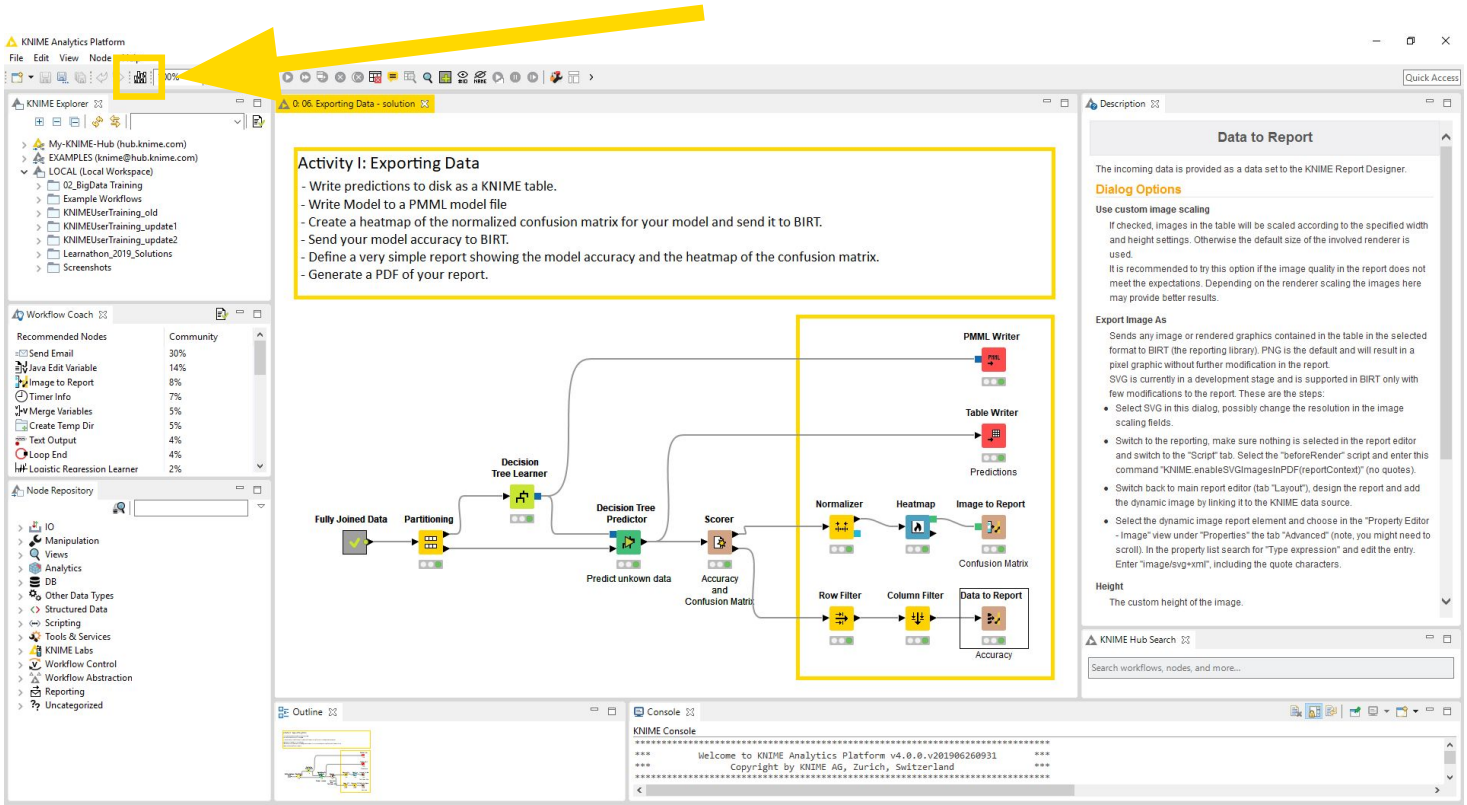
Send Image / Data to Report

- Sends a data table or images to BIRT
- PNG and SVG are supported formats (see node description for details)
- Hint: The node label will be used to identify the data source in the reporting view -> Make sure to use fitting labels if you have more than one data source



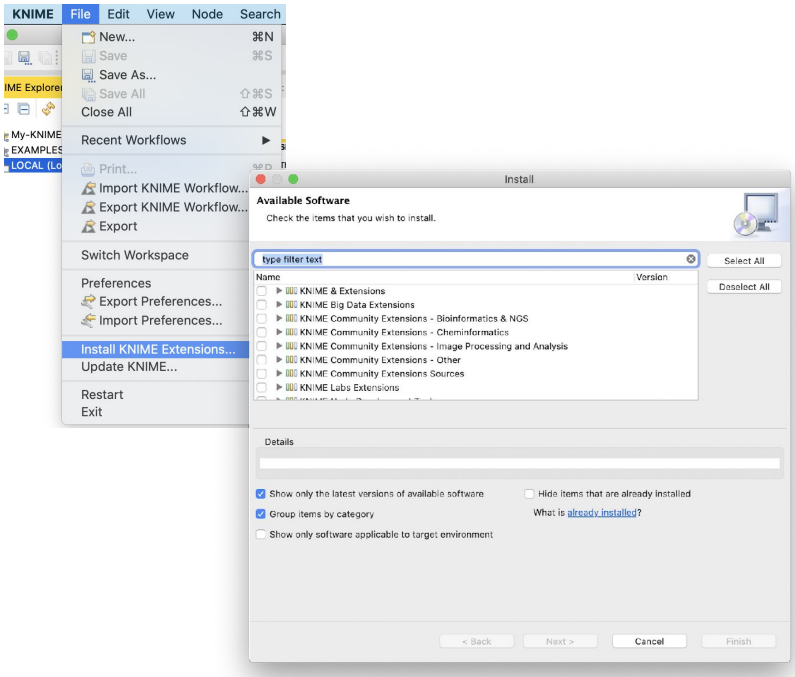
Edit the Report

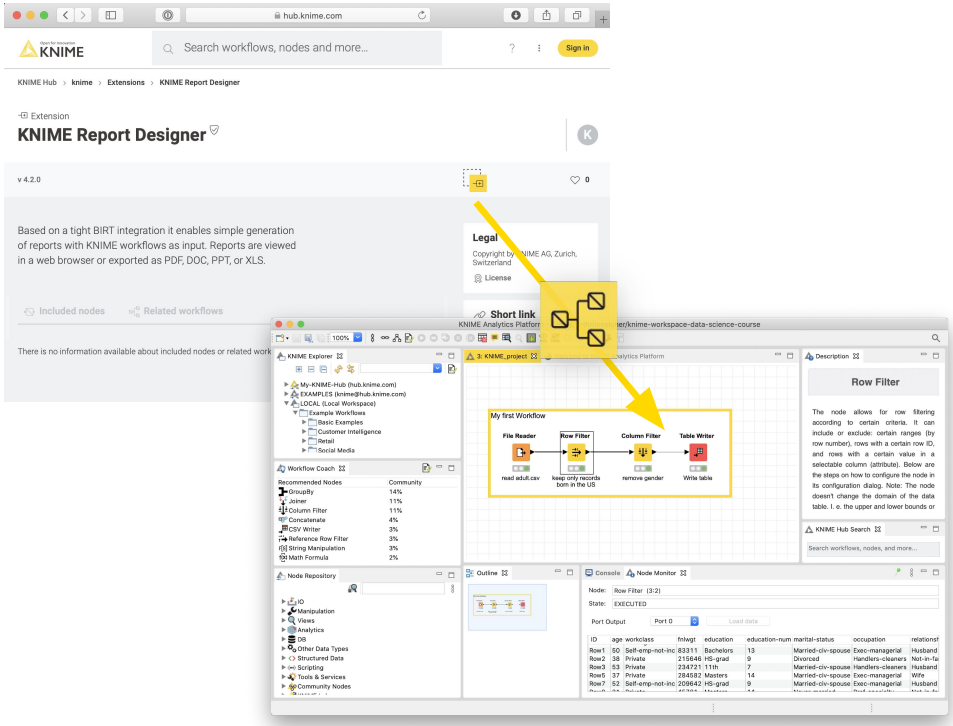
Open the workflow > Click the Report Editor button in the tool bar



Installing Extensions

- Install the KNIME Report Designer Extension to use BIRT
- Install extension by going to File -> Install KNIME Extension or via Drag & Drop from the KNIME Community Hub



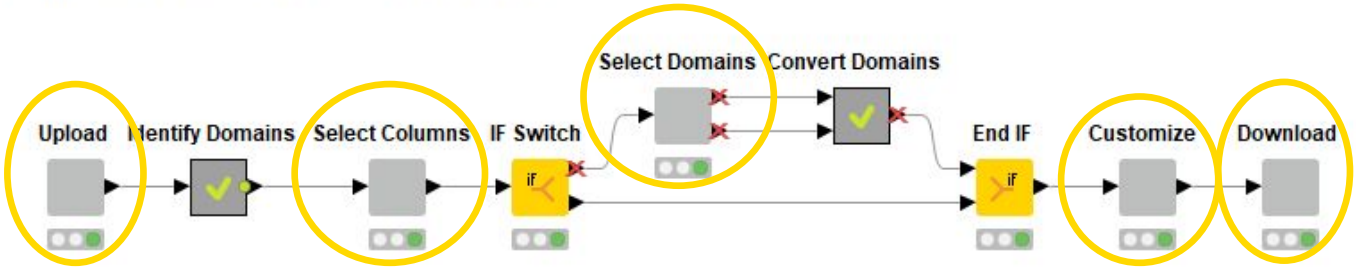


Open for Innovation KNIME

Creating a Data App on KNIME Business Hub

The Process Step by Step

1. Upload your data / Select one of the available datasets
2. Select the columns to visualize (maximum 3)
3. Convert the domain of the columns (OPTIONAL)
4. Customize the visualizations interactively
5. Download the images of the customized charts



Step 1
Upload File

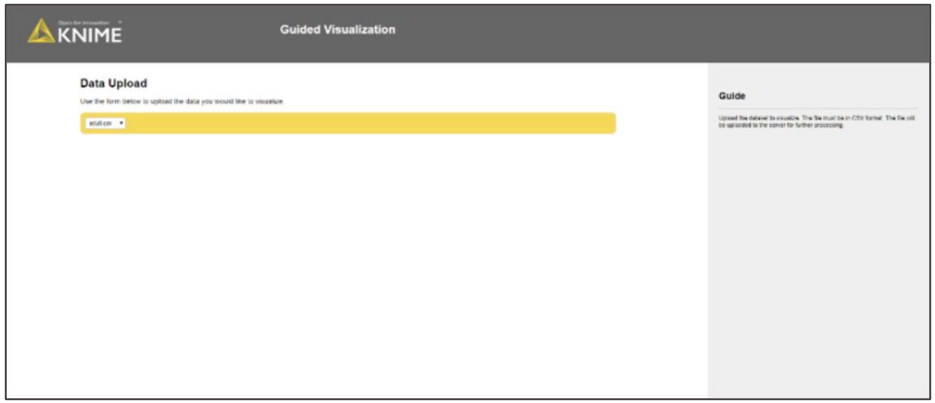
Step 2
Select Columns

Step 3
Customize Column Domains

Step 4
Interactive View

Step 5
Download Image

Execute Workflow as Data App on KNIME Business Hub

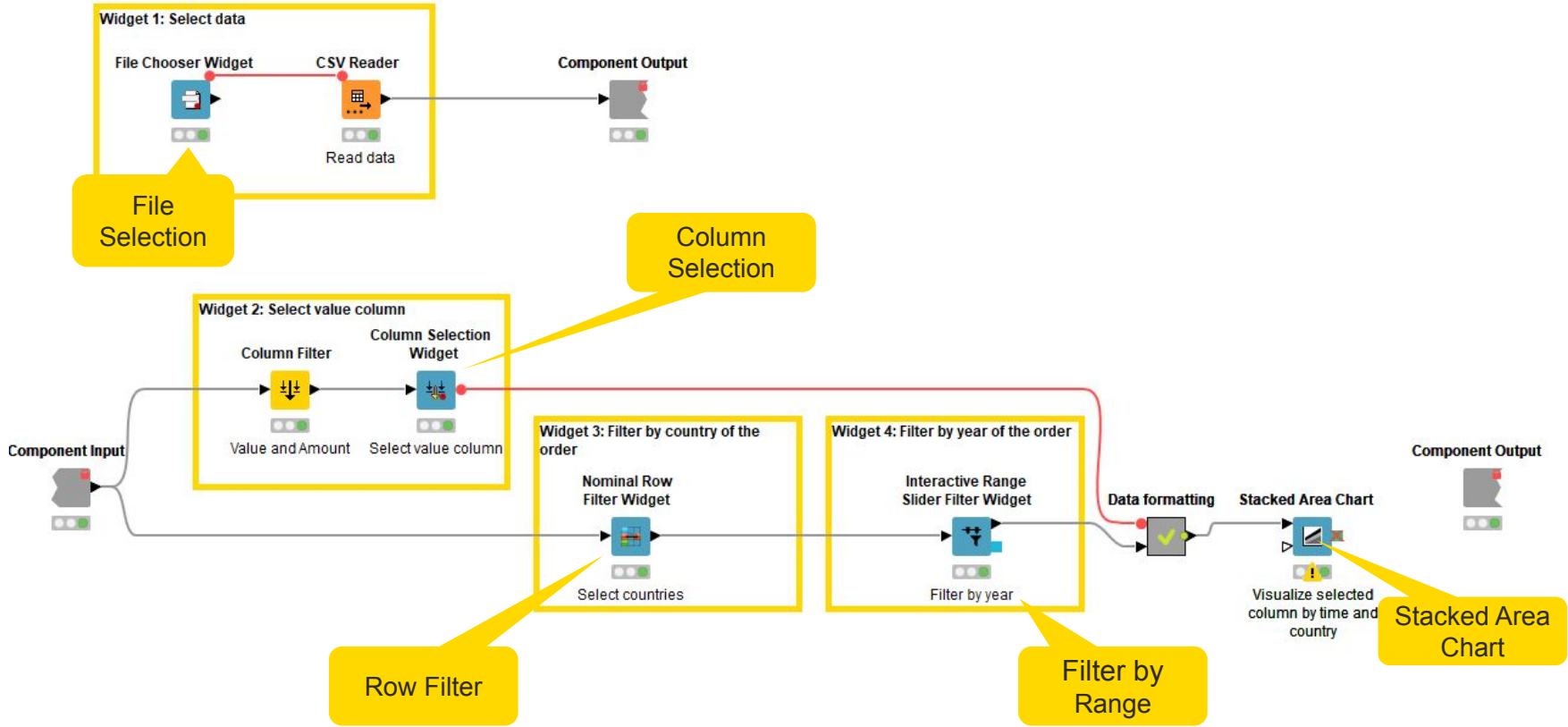


Data App Page (Step 1)
Upload File

Data App Page (Step 4)
Interactive View

Available in KNIME Business Hub

Components to Produce Dashboard on Web Page



Exercise: 09_Deployment

- Write the clean customer data to an Excel file into the folder "data/temp"
- Write the full transaction data to the "Transactions.sqlite" database

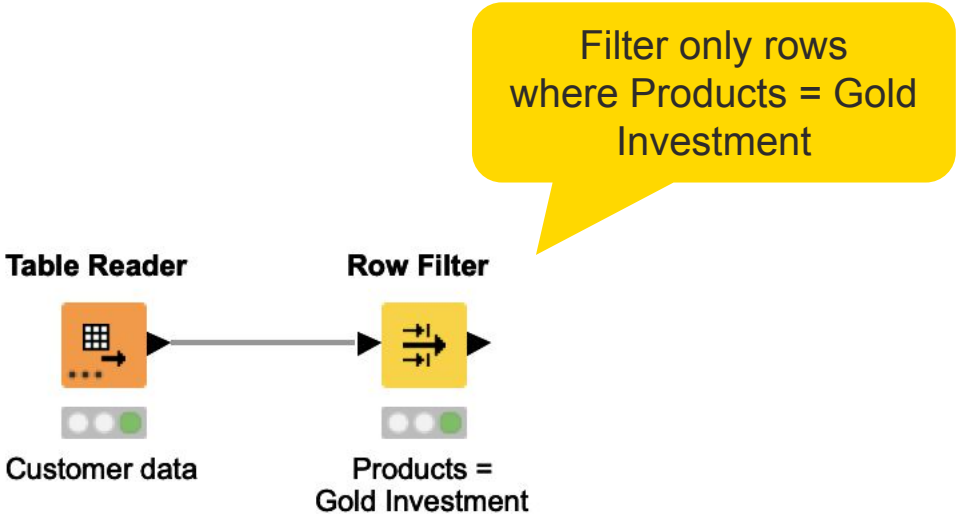
Flow Variables

Goal of this Session

- What is a Flow Variable?
- Create a Flow Variable
- Use a Flow Variable as a parameter in the node settings
- Use a Configuration node to parameterize a Component
- Use a Widget node to enable interaction on a Data App page

Flow Variables: Usage Example

- Each month you need to produce a sales report for the most popular product



Flow Variables: Usage Example

- Each month I need to launch the Analytics Platform, aggregate the data to identify the most popular product, and update the Row Filter accordingly
- Or do I? Maybe Flow Variables can help…

Automatically Filter by Most Popular Product

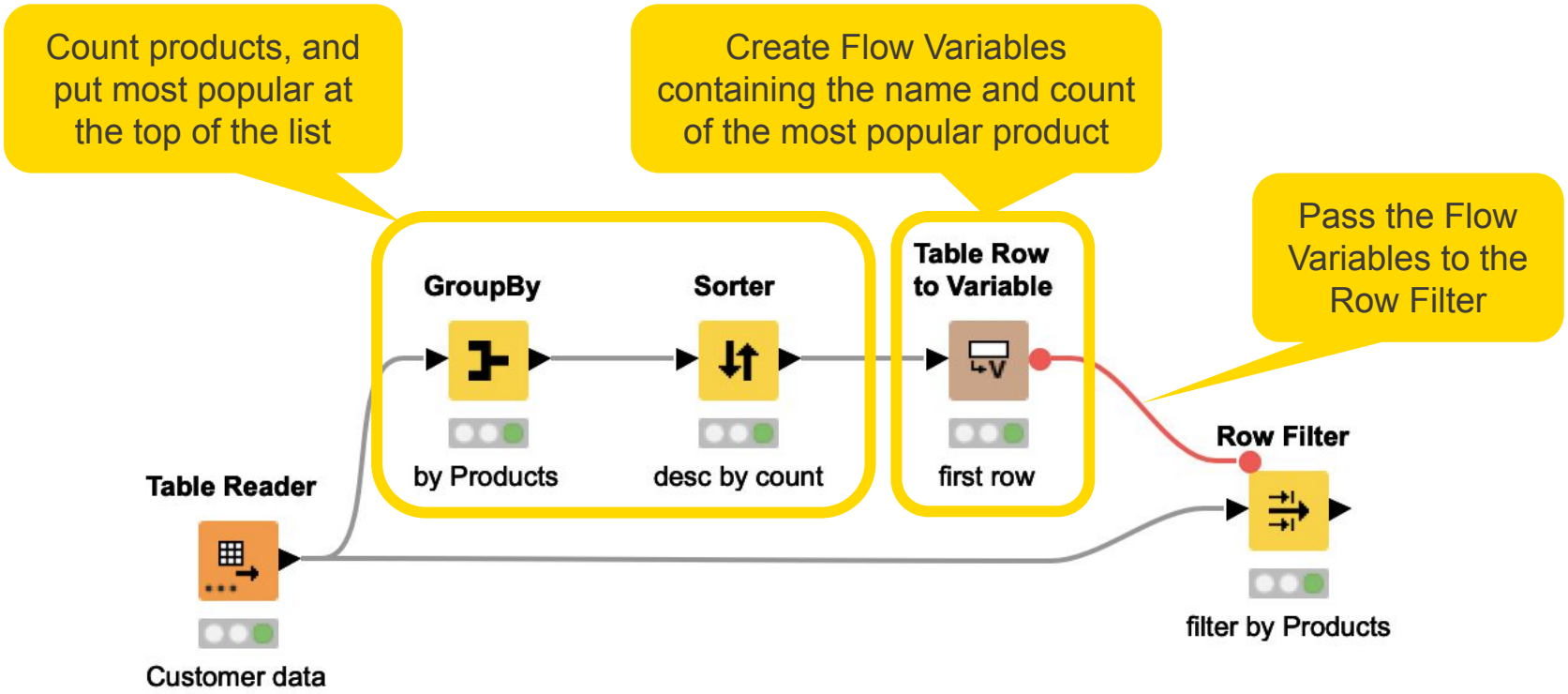
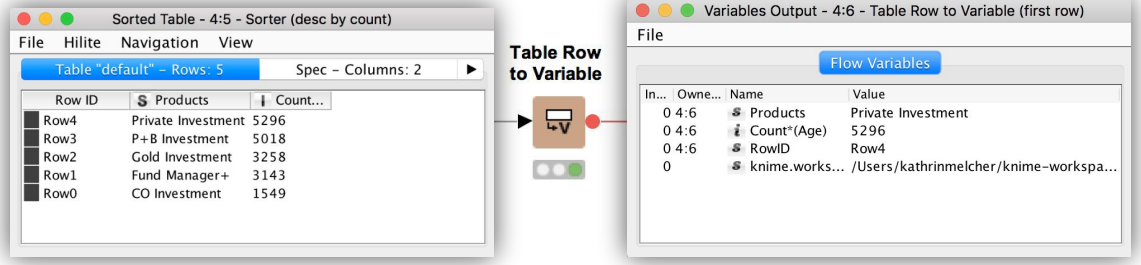
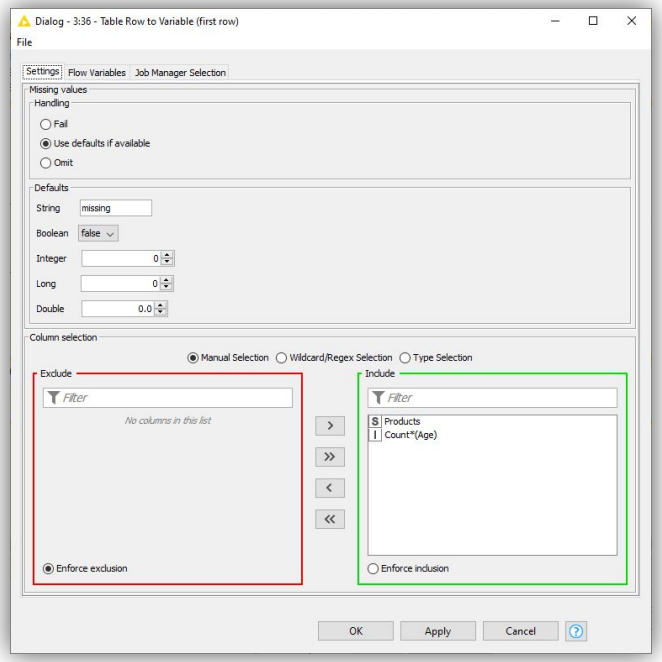


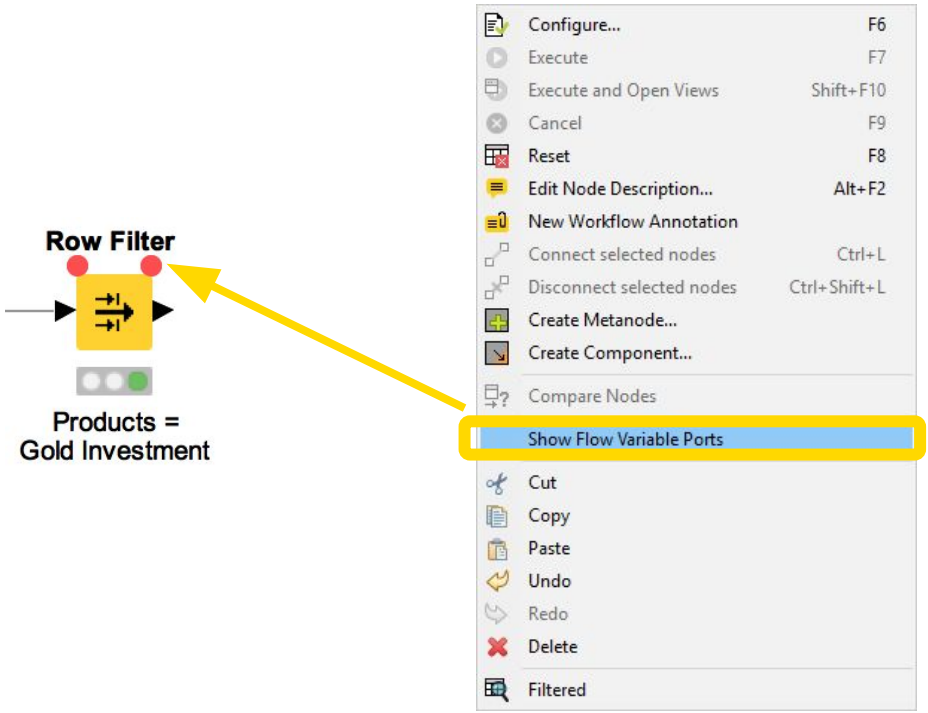
Table Row to Variable

- Takes a table as input and converts the first row to Flow Variables
  - Column names -> Flow Variable names
  - Column values -> Flow Variable values
- Only the first row is transformed, additional rows are discarded

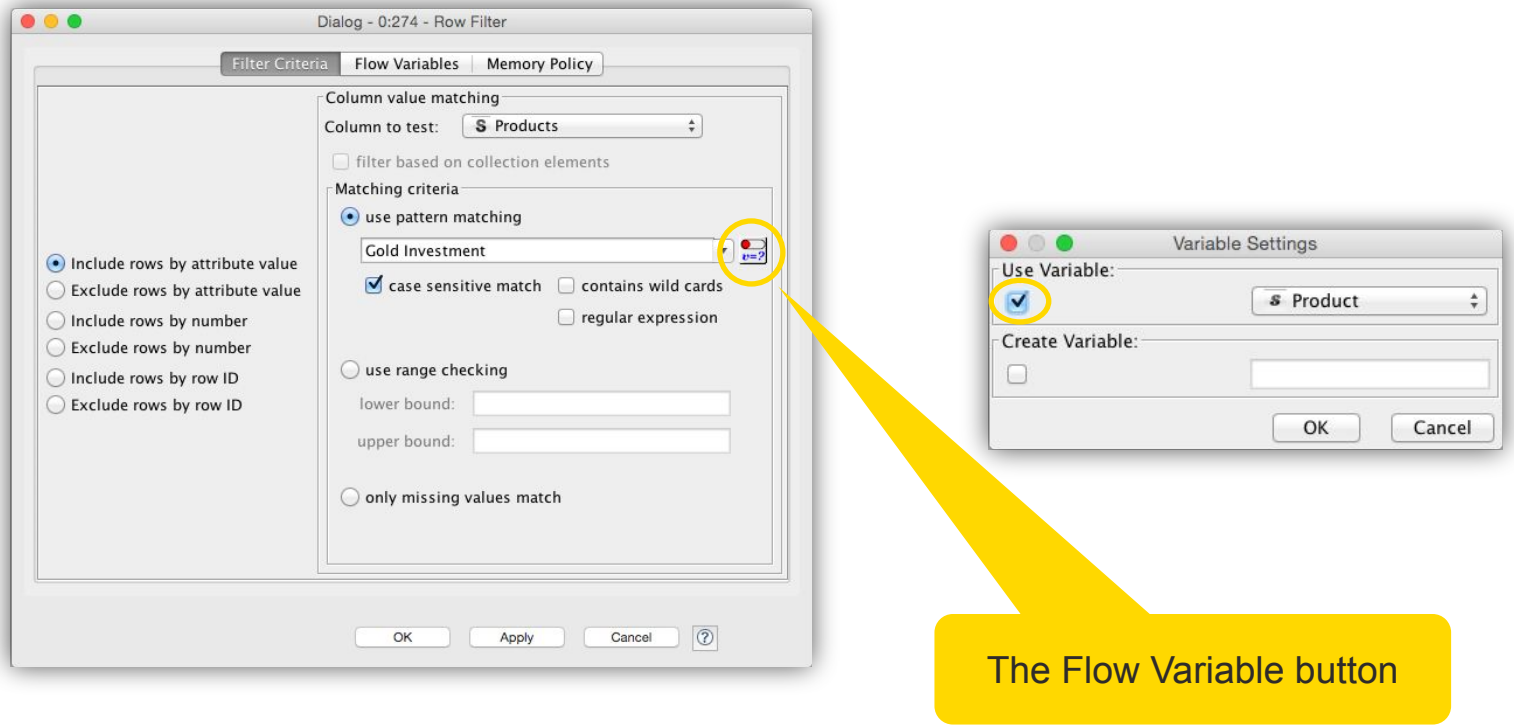




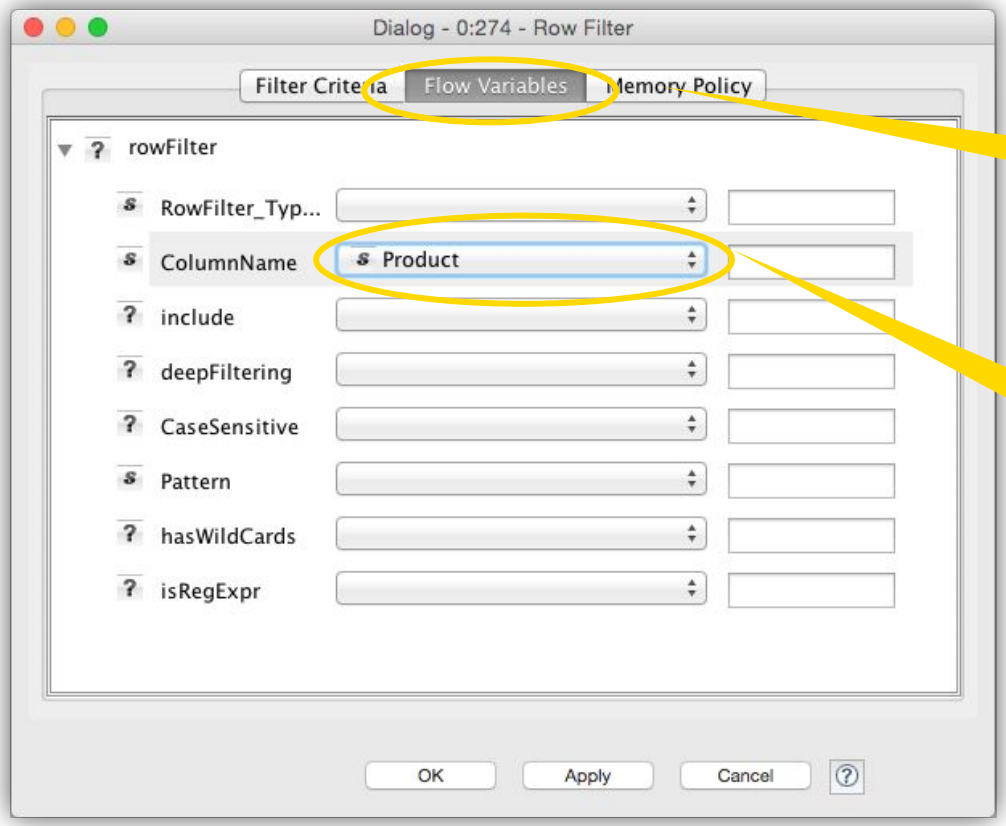
Flow Variable Ports



Apply a Flow Variable (Button)



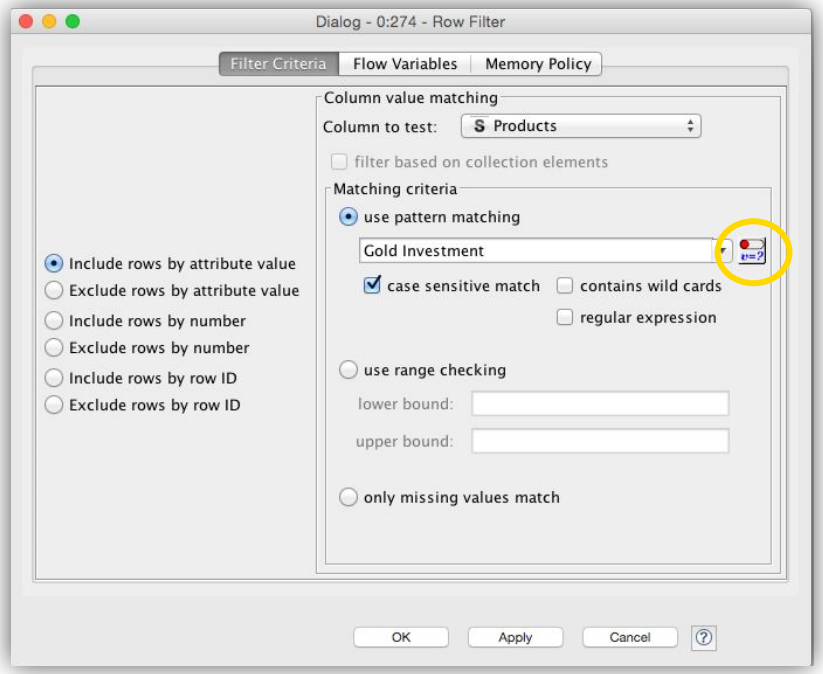
Apply a Flow Variable (Advanced)

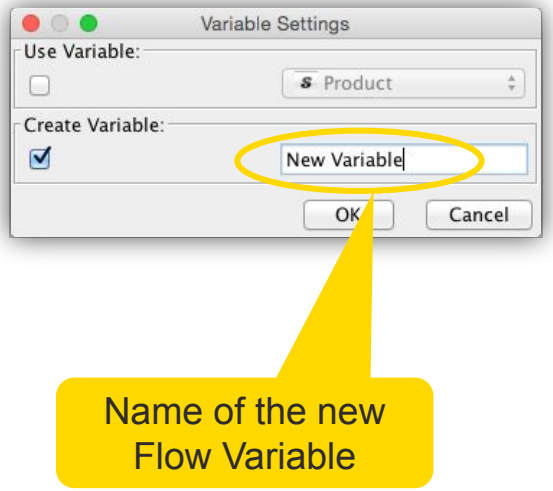


The Flow Variables tab

List of available Flow Variables

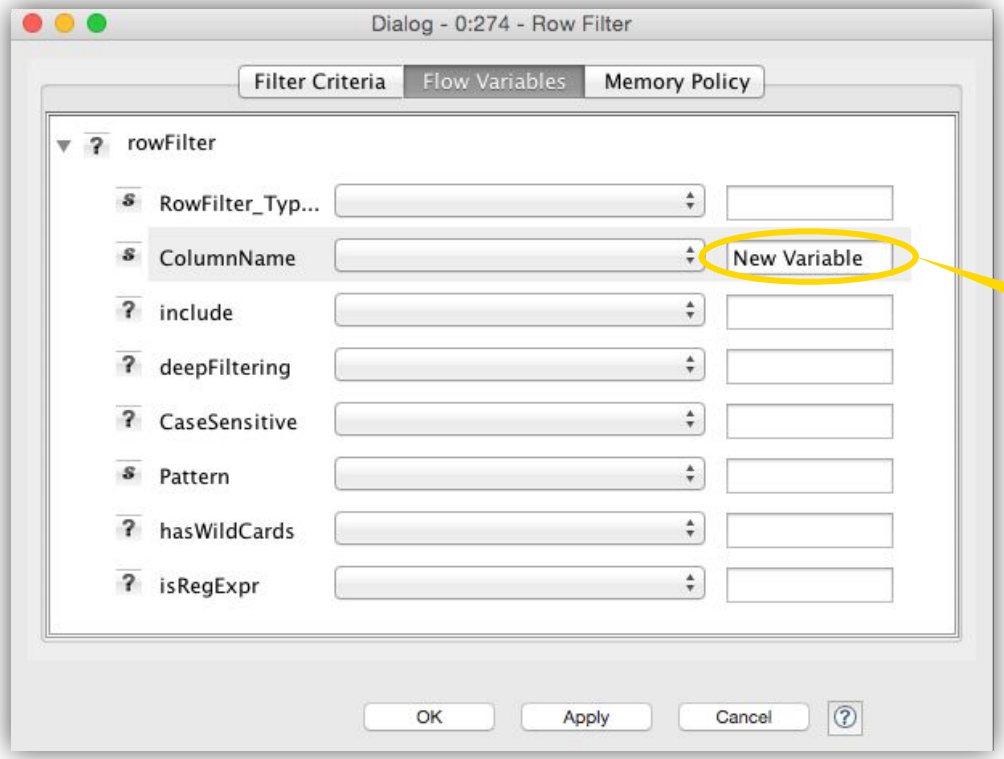
Create a Flow Variable (Button)





Create a Flow Variable (Advanced)

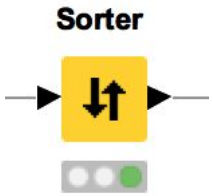
- Converting a setting value into a Flow Variable

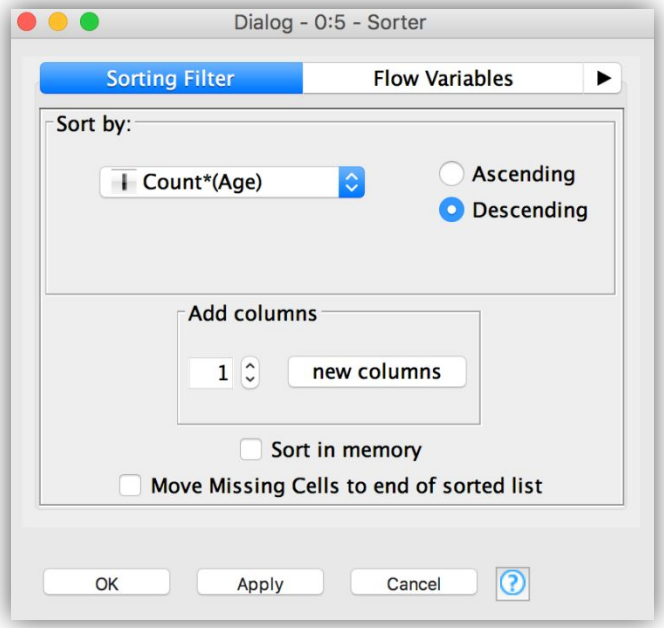


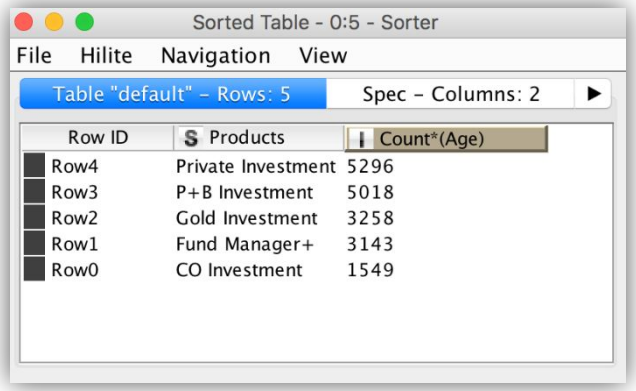
Name of the new Flow Variable

Sorter

- Sorts a table!
- Choice of ascending or descending
- Sort by multiple columns

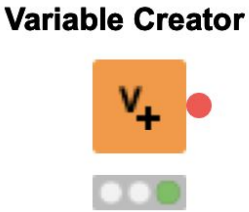


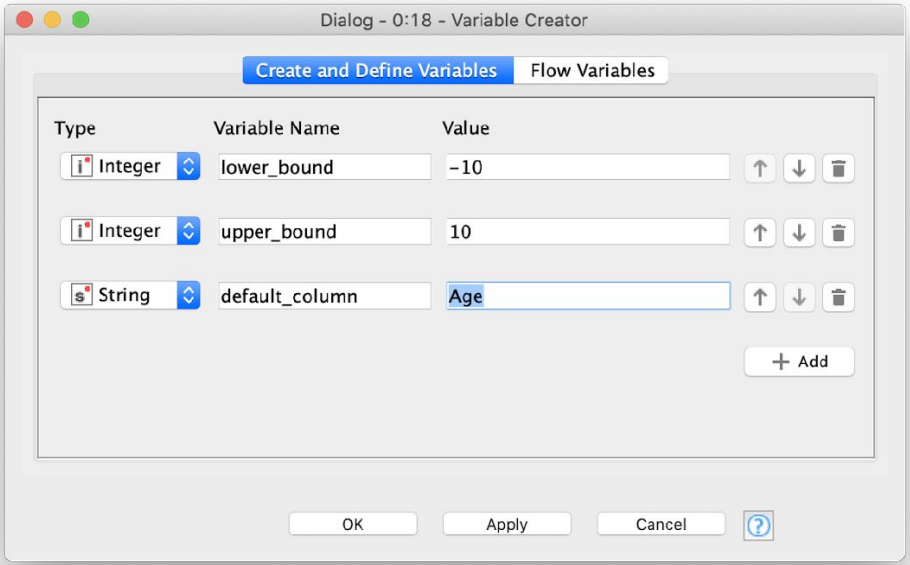




Variable Creator

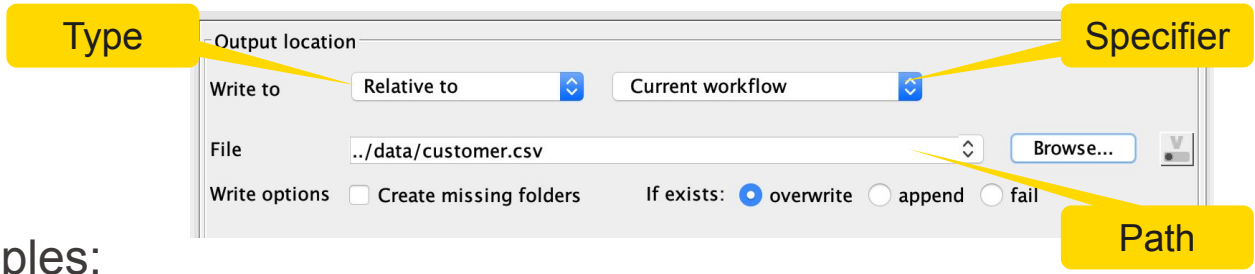
- Allows to create flow variables of different types
- Click on “+ Add” to add a new variable and define a custom
  - Variable Name
  - Variable Value





Path Variables

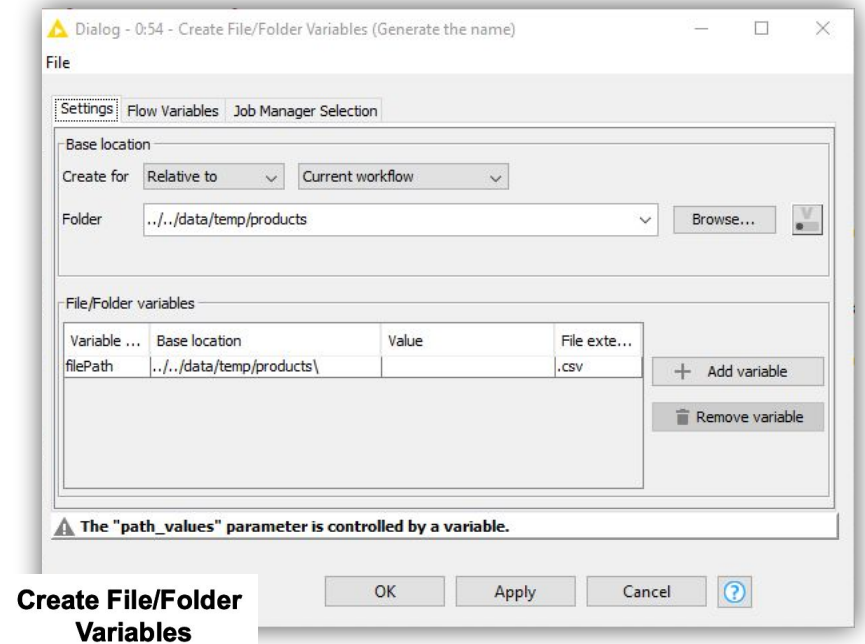
- Special flow variable type to point to a file or folder
  - E.g. to control output location of a file
- A path type consists of three parts:
  - **Type**: Specifies the file system type e.g. local, relative, mountpoint, custome_url or connected.
  - **Specifier**: Optional string with additional file system specific information e.g. relative to which location (knime.workflow)
  - **Path**: Specifies the location within the file system



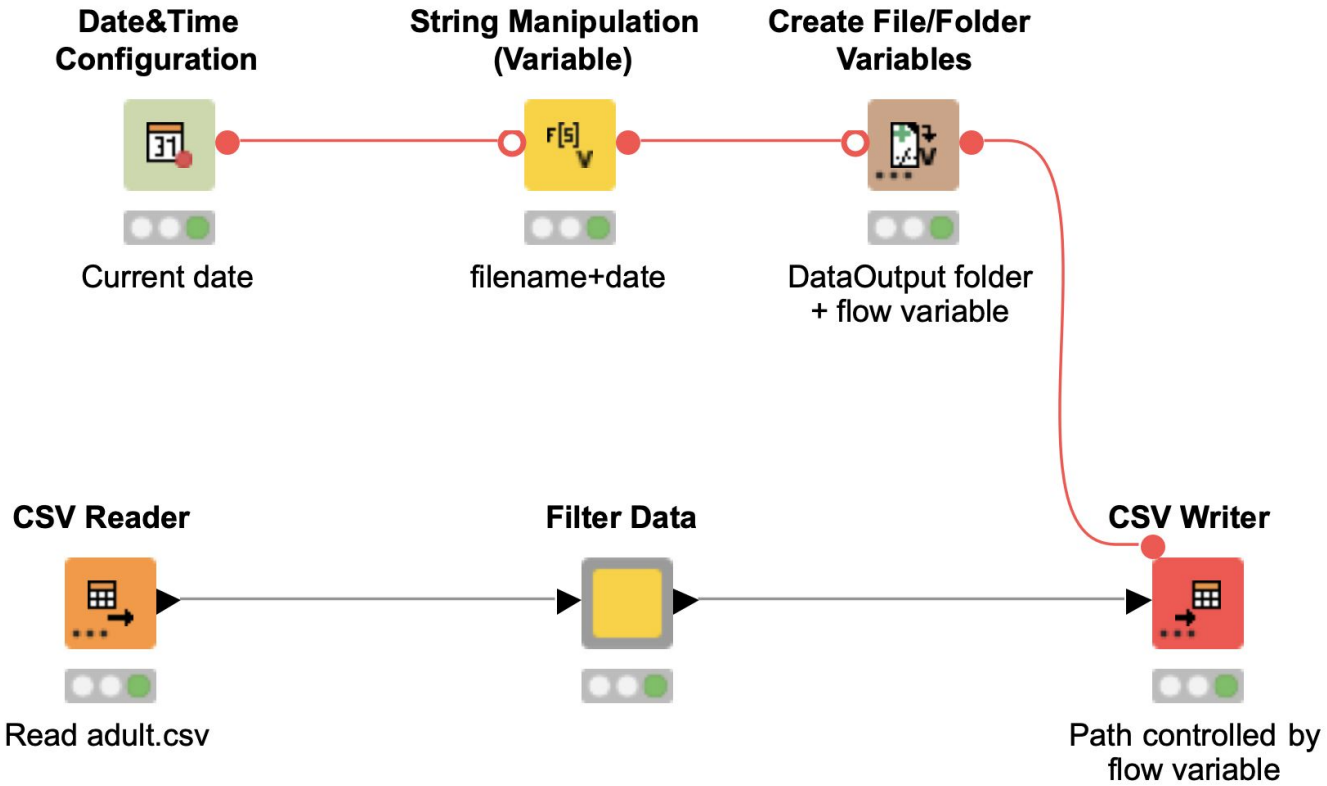
- Examples:
  - (LOCAL, , C:\Users\username\Desktop)
  - (RELATIVE, knime.workflow, file1.csv)
  - (MOUNTPOINT, MOUNTPOINT_NAME, /path/to/file1.csv)
  - (CONNECTED, amazon-s3:eu-west-1, /mybucket/file1.csv)

Create File/Folder Variables

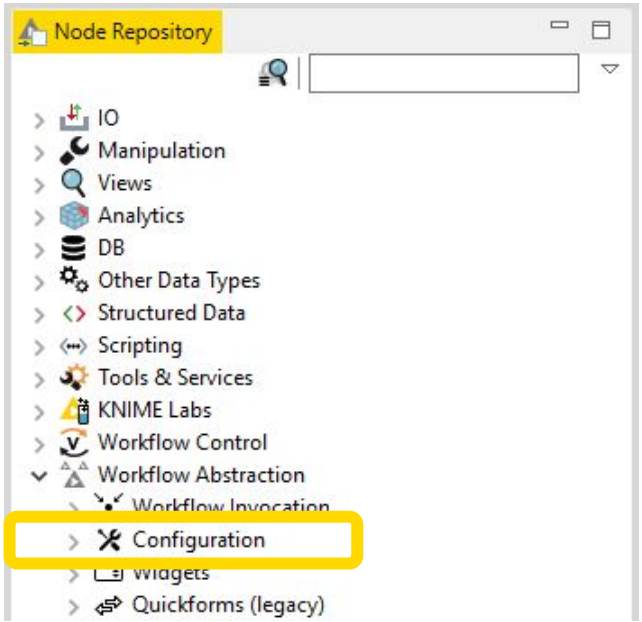
- Creates one or multiple path flow variable(s) pointing to files / folders
- Inputs:
  - Base location
  - Flow variable name(s)
  - Value (file name or path relative to base location)
  - File extension (optional)
- Output variables can be used to control the output location in writer nodes.

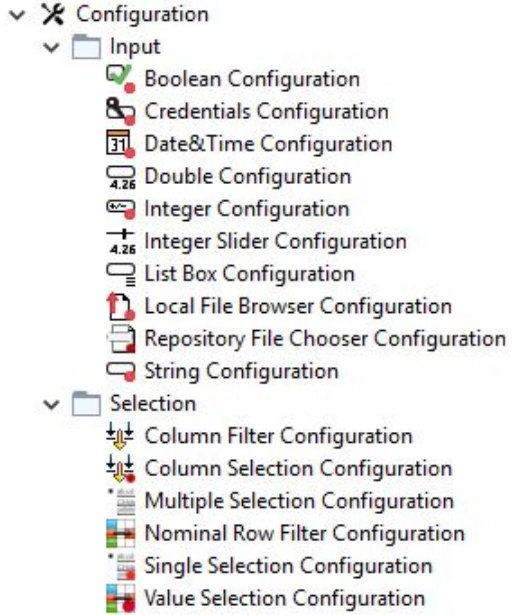


Example: Add Execution Date to File Name



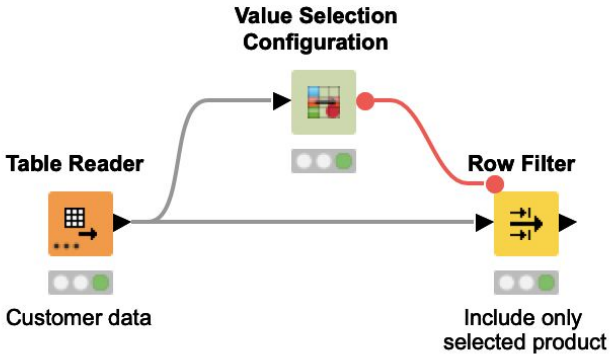
Configuration Nodes for Variable Creation and Output

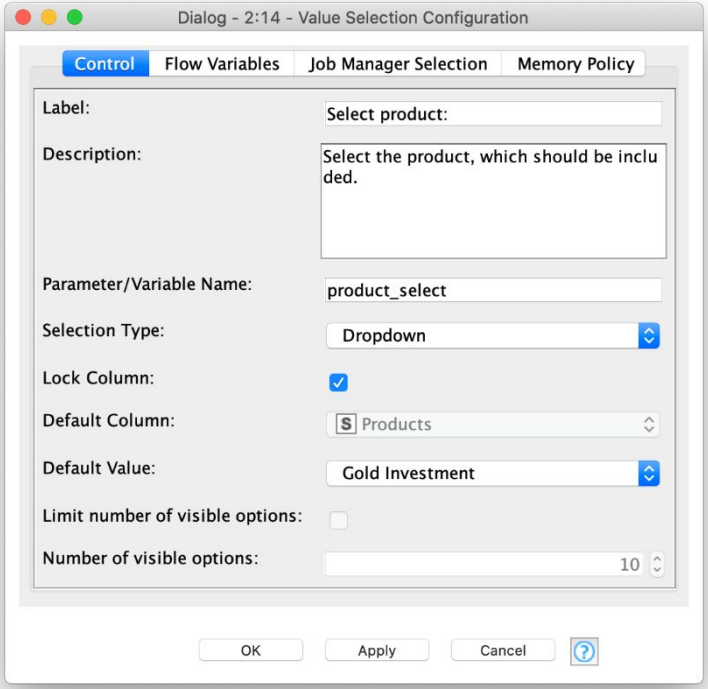




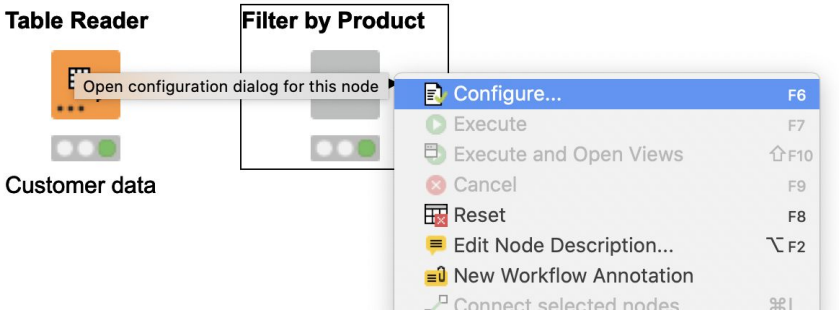
Configuration Node Configuration

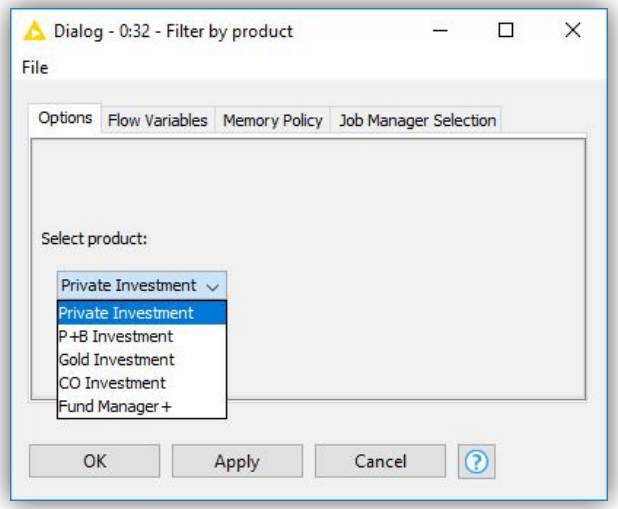
Use Configuration nodes to create Flow Variables





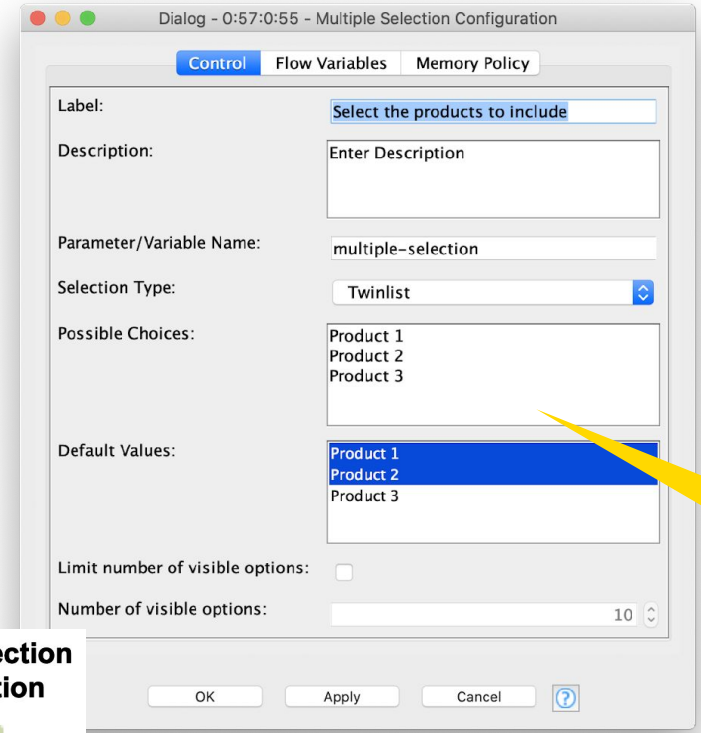
Simple Configuration of Component

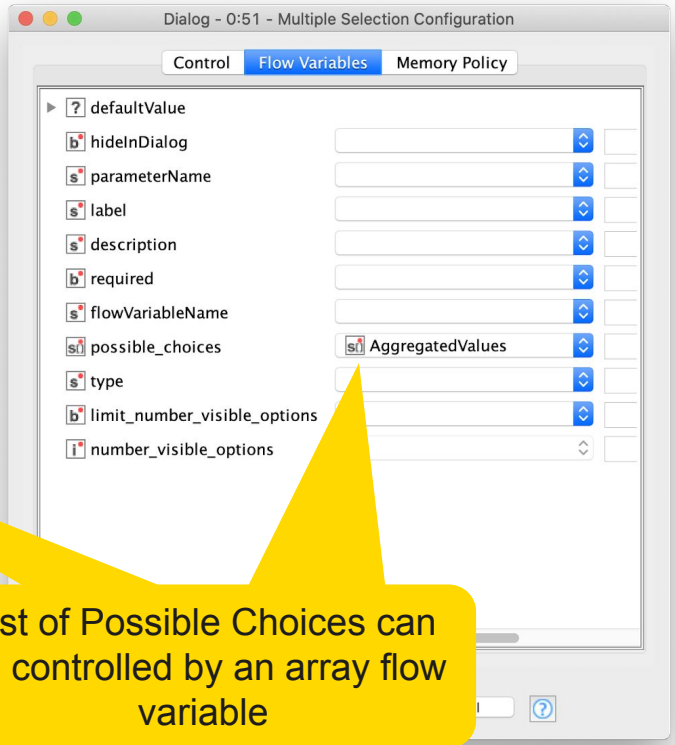




- Double click a component to configure it
- For use on the KNIME Business Hub as a Data App, replace Configuration nodes with Widget nodes

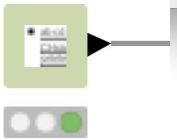
Multiple Selection Configuration Node





List of Possible Choices can be controlled by an array flow variable

Multiple Selection Configuration



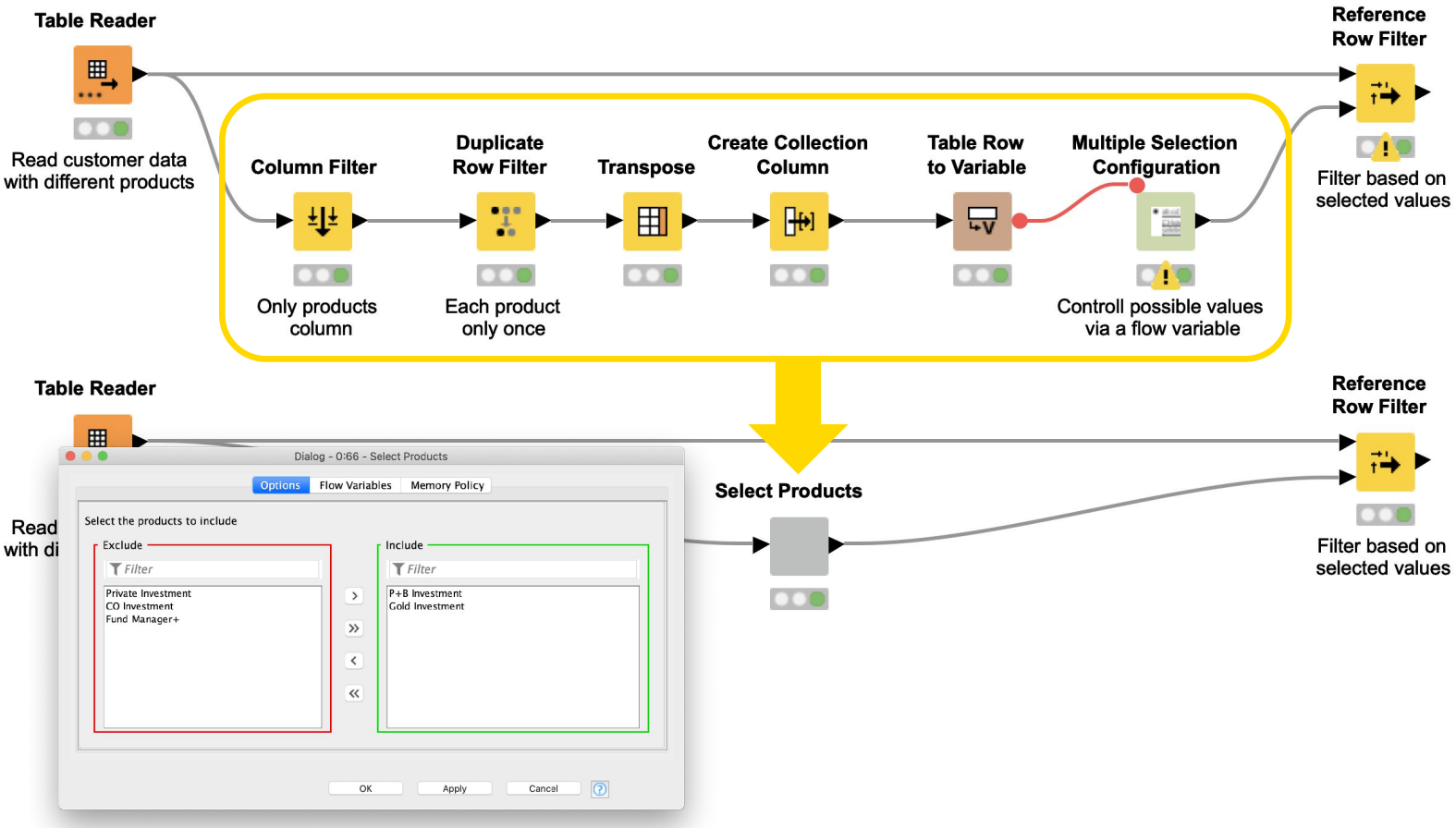
Array Variables

- An array flow variable is a flow variable with many values

- Can be used to control setting options with more than one value, e.g.
  - Include / exclude of columns
  - Define list of possible values
  - Control the variable names and values in the Create File / Folder Variables node

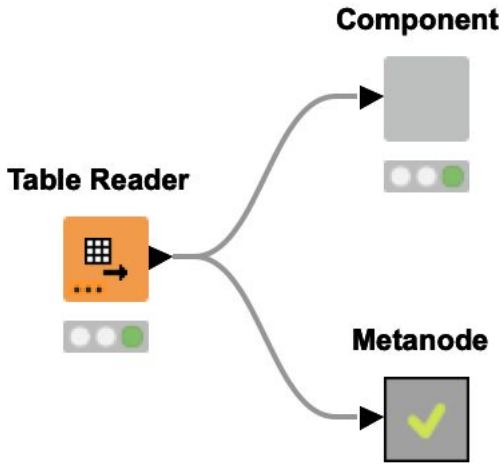
- How to create an array flow variable?
  - Step 1: Create a collection cell (e.g. Create Collection Column node or GroupBy node)
  - Step 2: Use the Table Row to Variable node to create the array flow variable based on the collection cell

Example: Creating an Array Flow Variable

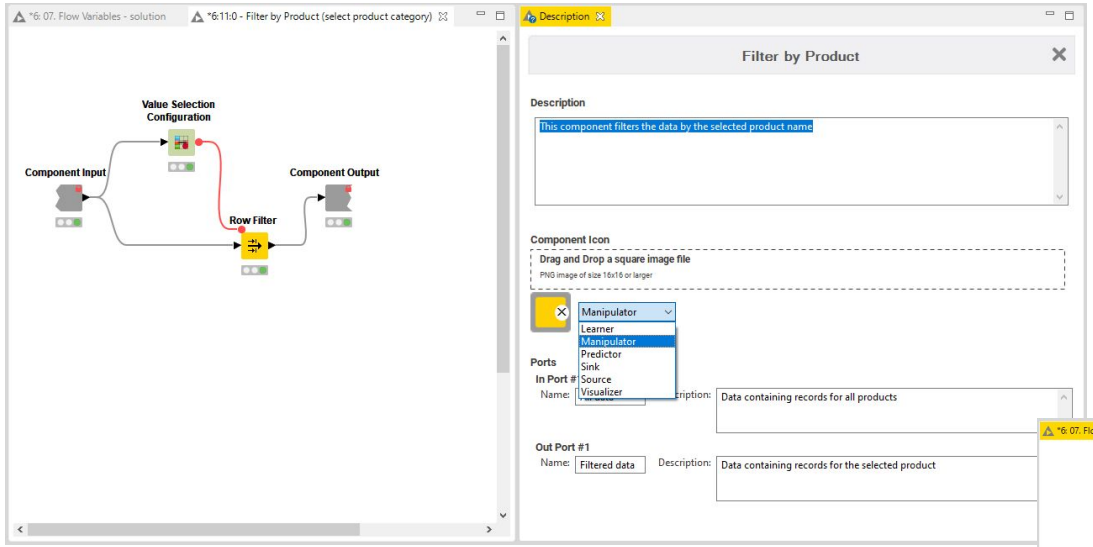


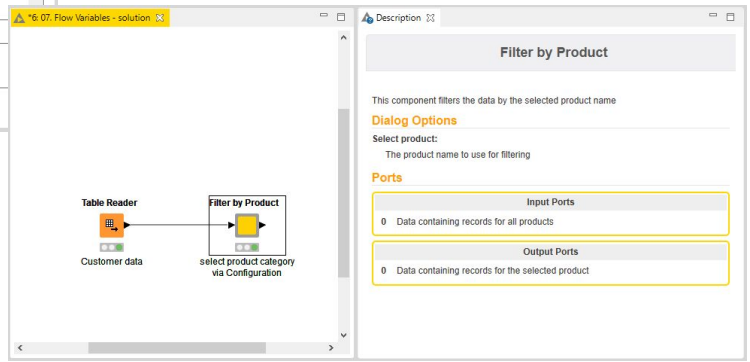
Components

- Encapsulate a functionality for reuse and sharing
- Main features:
  - Local Flow Variable scope
  - Configurable via Configuration nodes
- Key to advanced functionality in KNIME products
  - Component corresponds to a KNIME Data App page
  - Configurations on a Data App page are defined using Widge
  - Can be shared via KNIME Community Hub



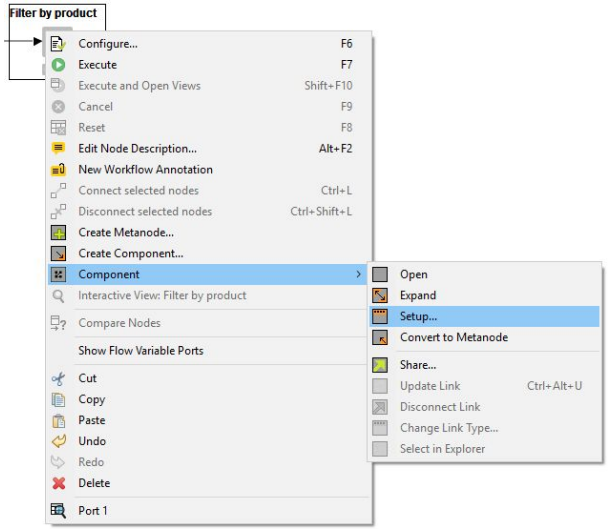
Component Description



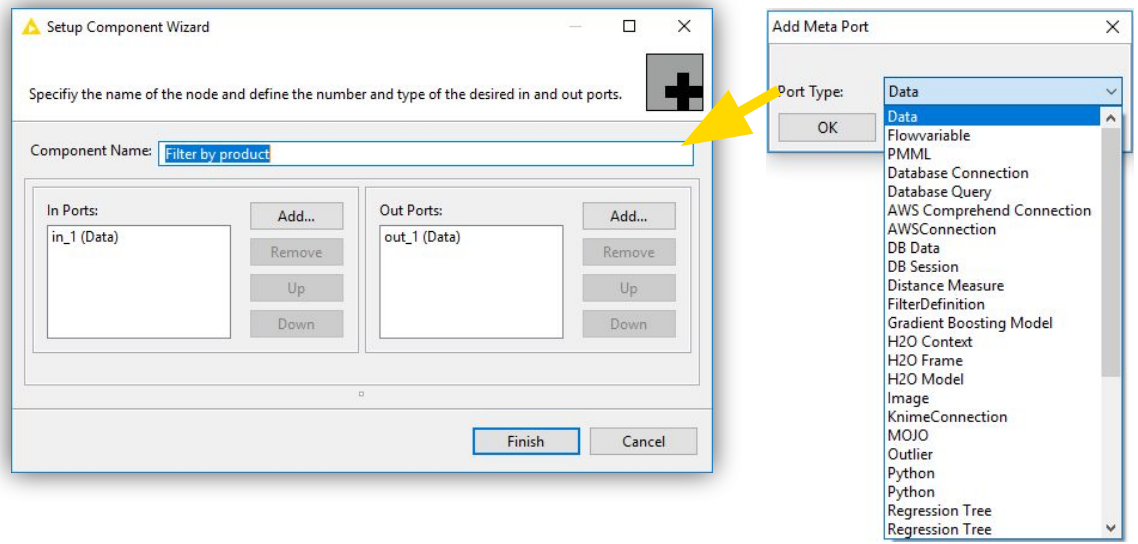


- Double click a component to configure it
- For use on the KNIME Business Hub as Data App, replace Configuration nodes with Widget nodes

Configure Component Ports

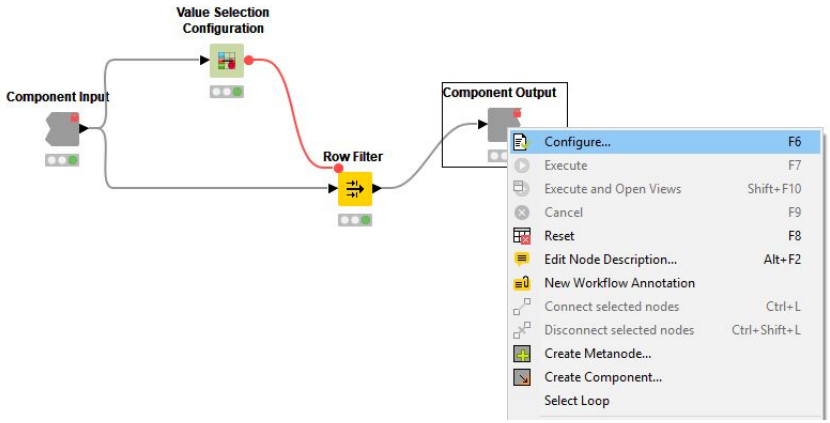


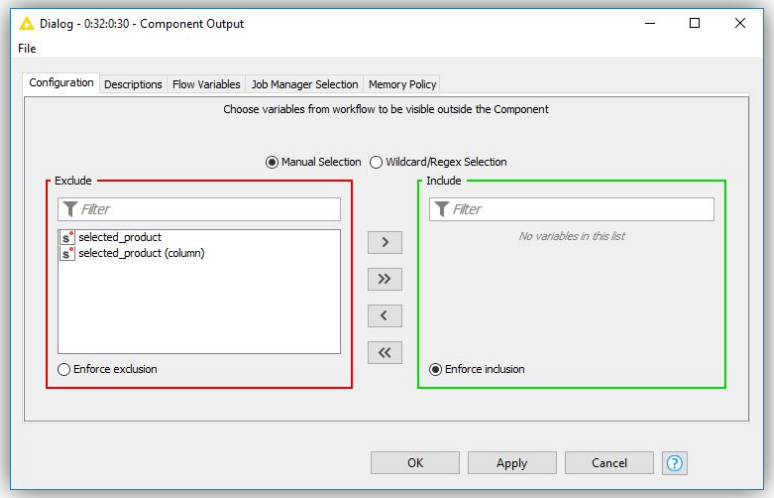
- Add input and output ports to metanodes/components
- Remove ports to adapt to changes after creation of the metanode/component



Passing Variables from Components

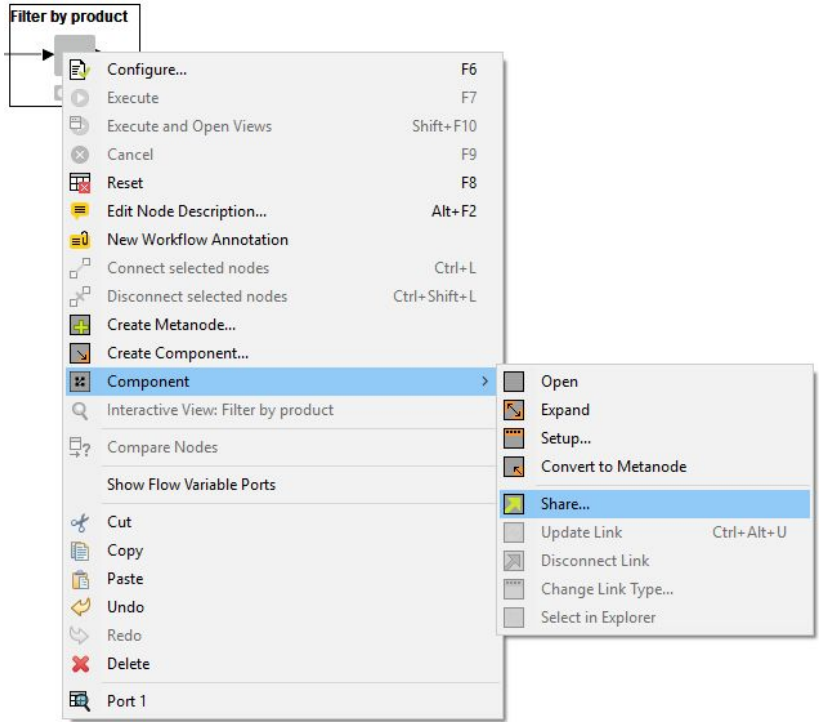
- Flow Variables are -by default - only available locally inside the component
- Configure the component input/output to pass Flow Variables from/to outside the component





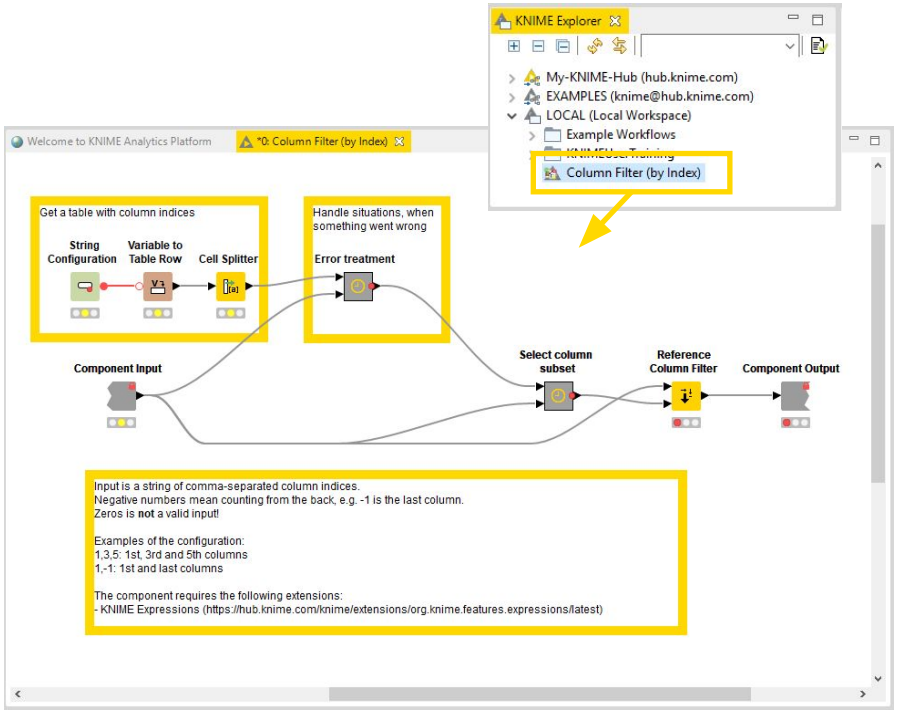
What is a Shared Component?

- Components can be saved in your KNIME workspace for later reuse
- To do this, simply right-click any component and select “Share…”
- Shared components are read-only instances of a component
- Public Shared Components are available on the EXAMPLES Server and on the KNIME Community Hub



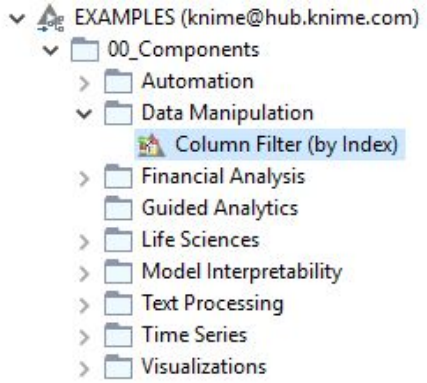
How can you Edit a Shared Component?

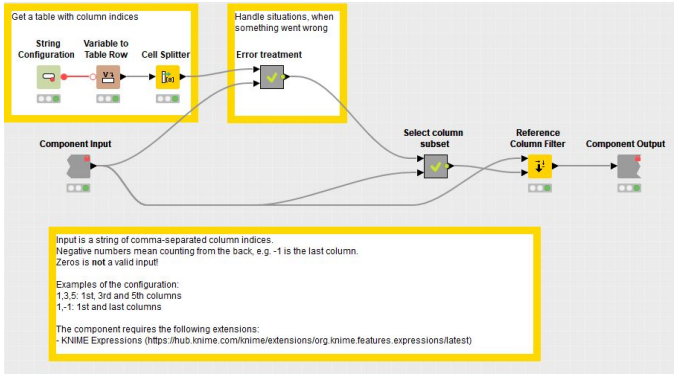
- Components can be edited using the Component Editor, similar to workflows
- To edit a component using the Component Editor, double-click the component in its location in the KNIME Explorer
- To ensure components are executable when opened in the Component Editor, choose the option to “Include input data with component” when sharing it



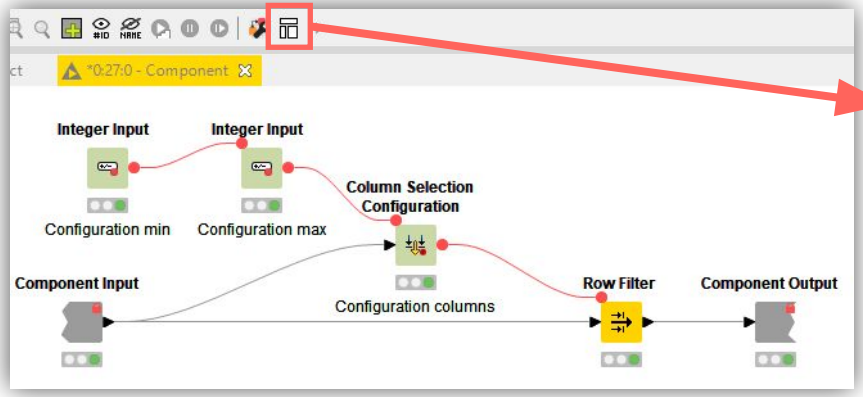
How can you Use a Shared Component?

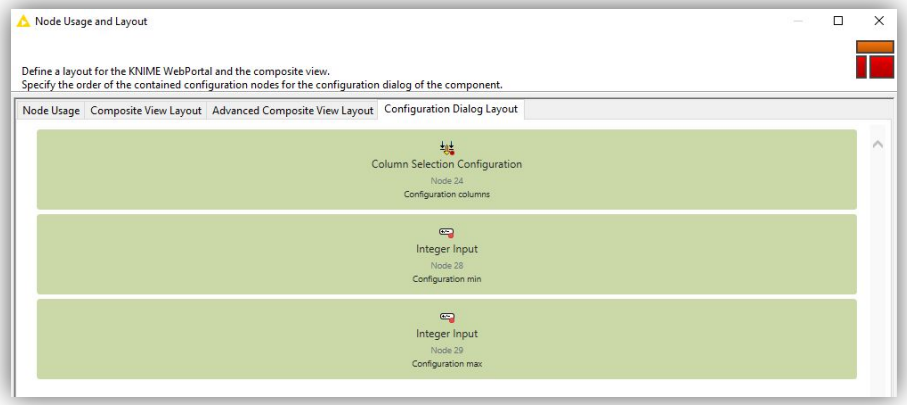
- To use a Shared Component, drag and drop it to your workflow editor
- Instances of Shared Components can be updated either manually or when the workflow is opened
- A Shared Component can also be unlinked from its original location, which makes it editable in the workflow directly
- Update Shared Components by overwriting them



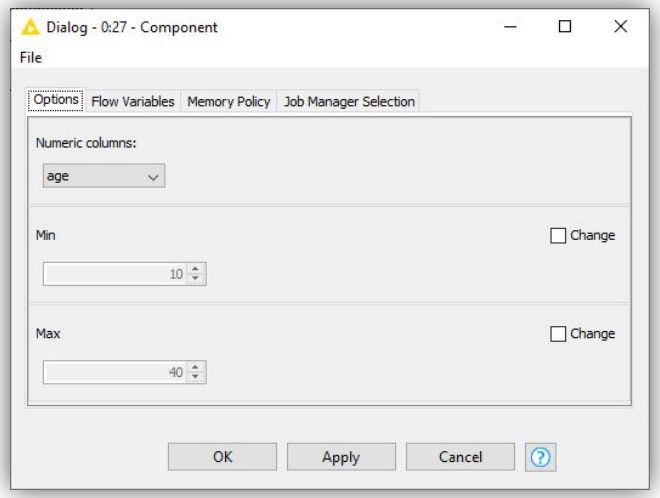


Configuration Dialog Layout



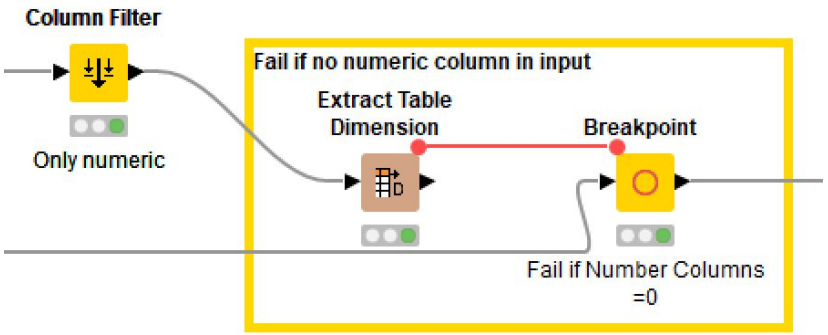


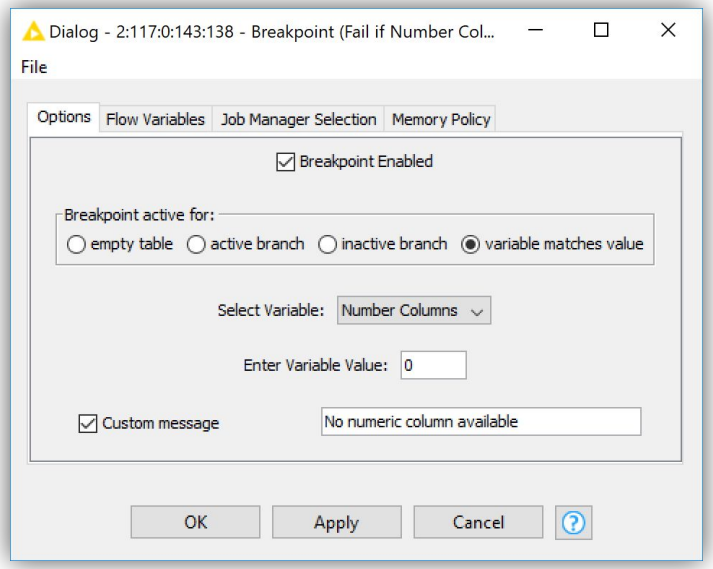
- Click layout button when inside component to modify the order of the setting options in configuration window of the component



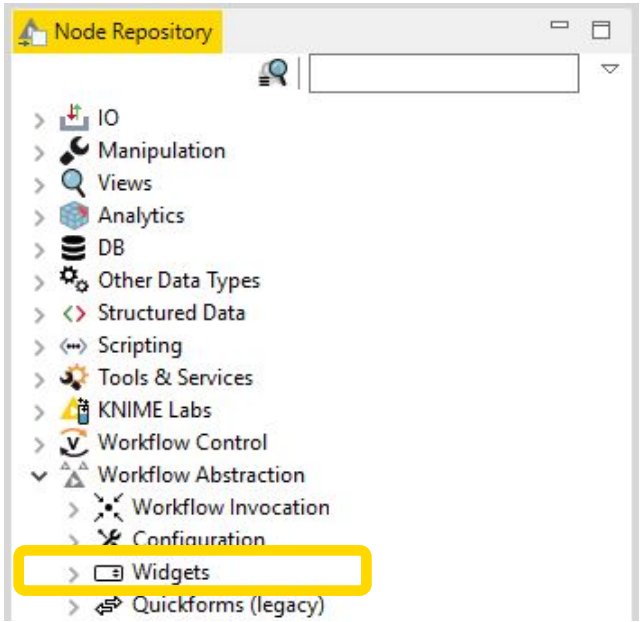
Breakpoint

- Stops execution of a workflow branch
- Useful to stop the execution of a component and provide a custom error message
- Execution stops based on the selected condition:
  - Empty table
  - Active/Inactive branch
  - Flow Variable value



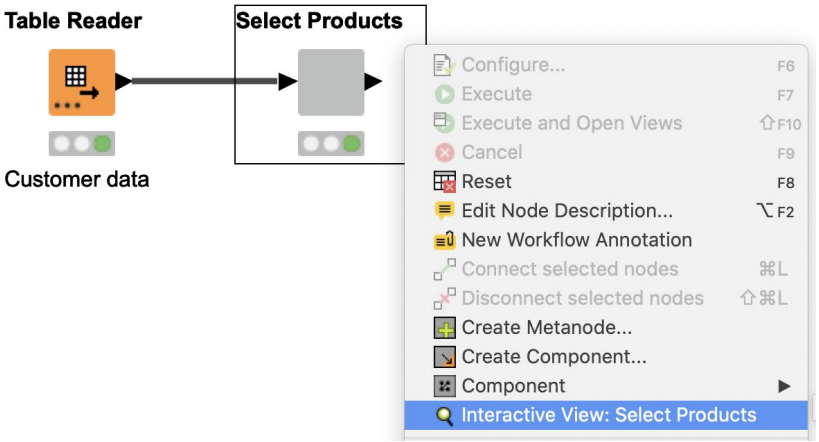


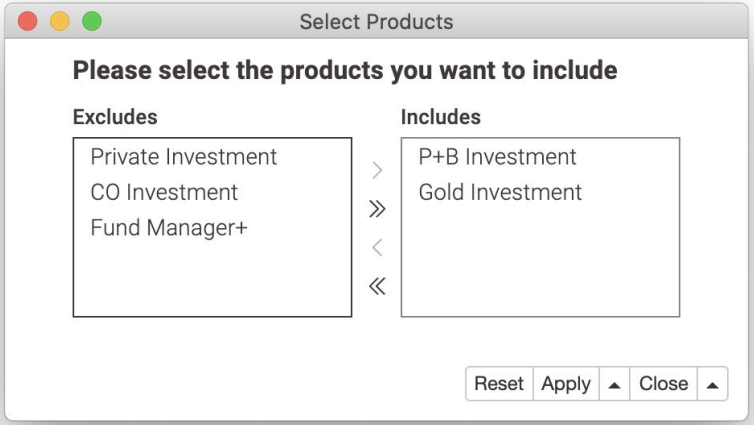
Widget Nodes for Variable Creation and Output



- Widgets
  - Input
    - Boolean Widget
    - Credentials Widget
    - Date&Time Widget
    - Double Widget
    - File Chooser Widget
    - File Upload Widget
    - Integer Widget
    - List Box Widget
    - Slider Widget
    - String Widget
    - Autocomplete Text Widget
  - Selection
    - Column Filter Widget
    - Column Selection Widget
    - Multiple Selection Widget
    - Nominal Row Filter Widget
    - Single Selection Widget
    - Value Selection Widget
  - Filter
    - Interactive Range Slider Filter Widget
    - Interactive Value Filter Widget
  - Output
    - File Download Widget
    - Image Output Widget
    - Text Output Widget

Simple Configuration of Component





Summary: Flow Variables

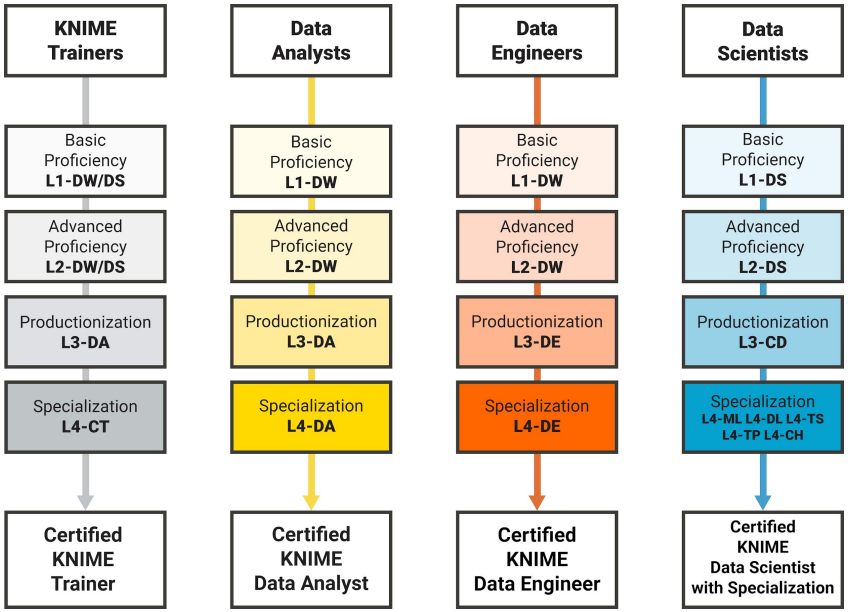
- Flow Variables are workflow parameters used to overwrite existing node settings
- A Flow Variable is carried along workflow branches (parallel branches don’t share local Flow Variables)
- Flow Variables can be of type String, Integer, Double, Boolean, Long, Paths and Array
- Flow Variables can be created
  - 1. in the “Flow Variables” tab of any node
  - 2. using specific nodes, e.g. Table Row to Variable, Variable Creator
  - 3. using Configuration and Widget nodes

Exercise: 10_Flow_Variables

- Activity I: Filter the customer data to
  - Customers of the "Gold Investment" product
  - Customers of the most common product in the data
- Activity II: Create a component that allows a user to choose an investment product and filter the data by that product
- Activity III (optional): Create a path variable that automatically has the current execution date in the file name and write the filtered table into a CSV file
- Activity IV (optional): Create a component that allows to select multiple products out of all available products, using a flow variable of type array

KNIME Learning Paths

From level **L1** to level **L4** for various professional profiles



Self-paced courses: videos and exercises at your own pace and for free

Instructor led courses: Scheduled sessions and guided exercises in paid courses

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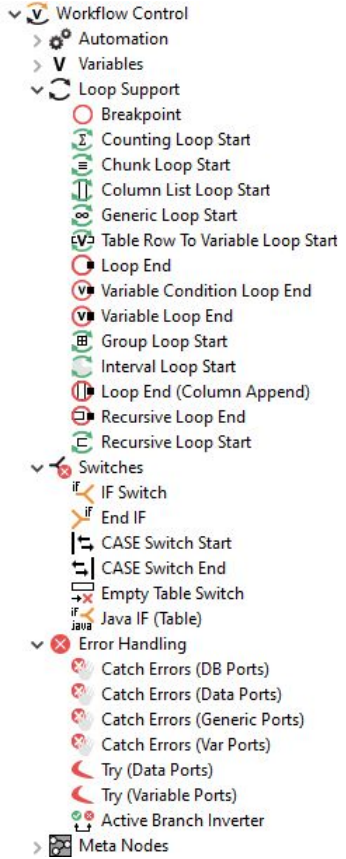
Workflow Control
Loops, Switches, Try-Catch

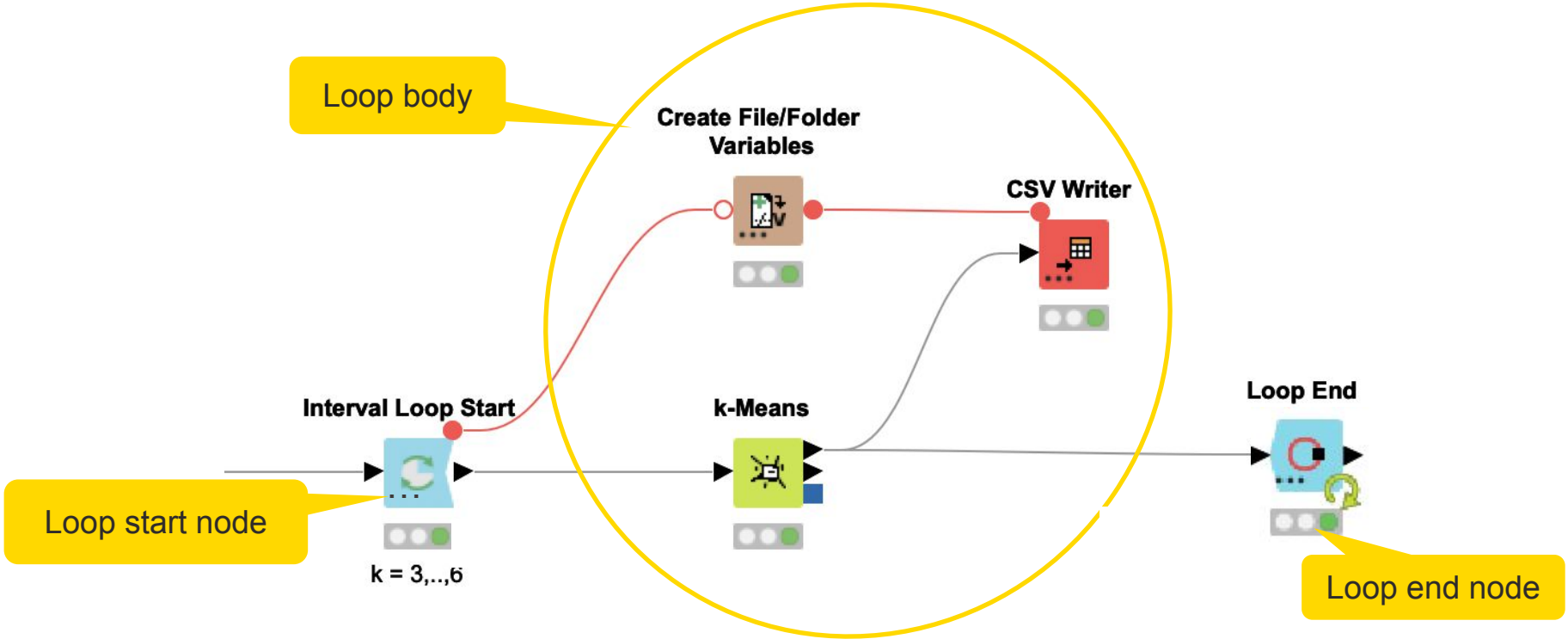
Workflow Control Structures

- Loops
  - Iterate over a workflow snippet with variable inputs.
- Switches
  - Direct the path of a workflow by selectively executing one or more workflow branches.
- Try-Catch
  - Handle workflow branches that may fail in execution - when you don't know about this before executing



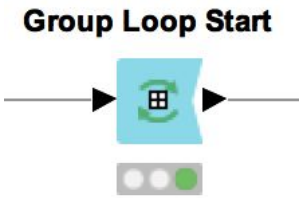
The Loop Block

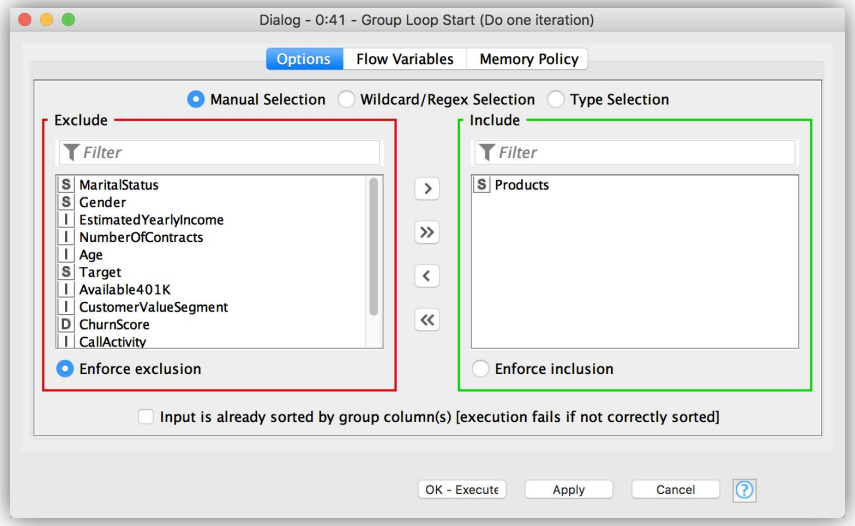
- A loop block is defined by the appropriate loop start and loop end nodes.
- Loop body = the nodes in between (including the side branches).



Group Loop Start

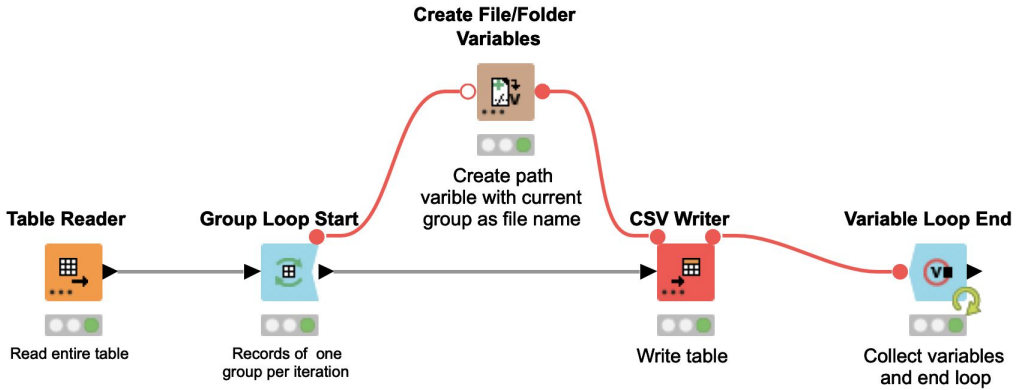
- Similar to GroupBy except without aggregation tab.
- Each iteration of the loop passes the next group of rows.
- You can implement an aggregation task. It can be anything from a complex calculation to updating a database.





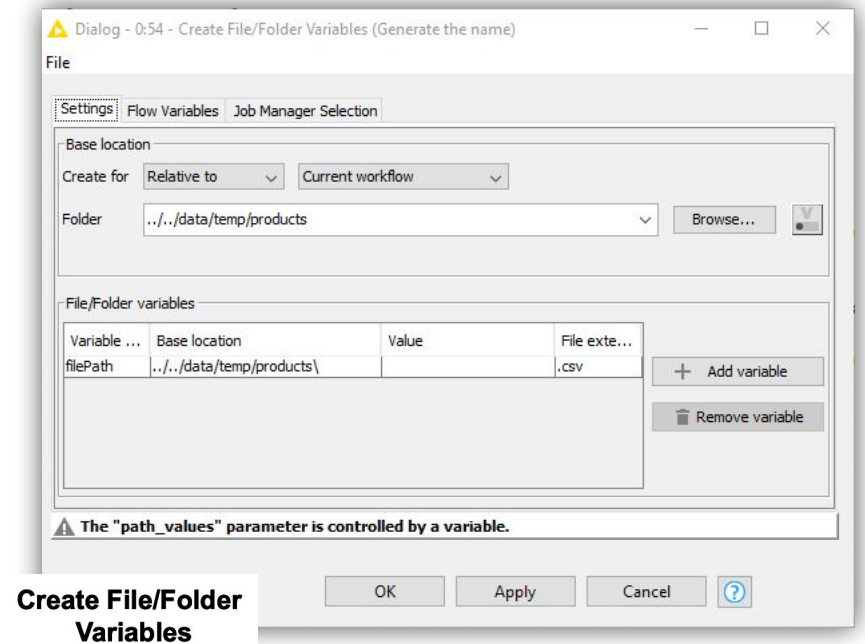
Example: Writing Aggregated Files

- Group Loop Start Variable Loop End
- Group data by specific column values
- Iterate over all groups of data
- Create an appropriate file name
- Write grouped data to tables with new file name

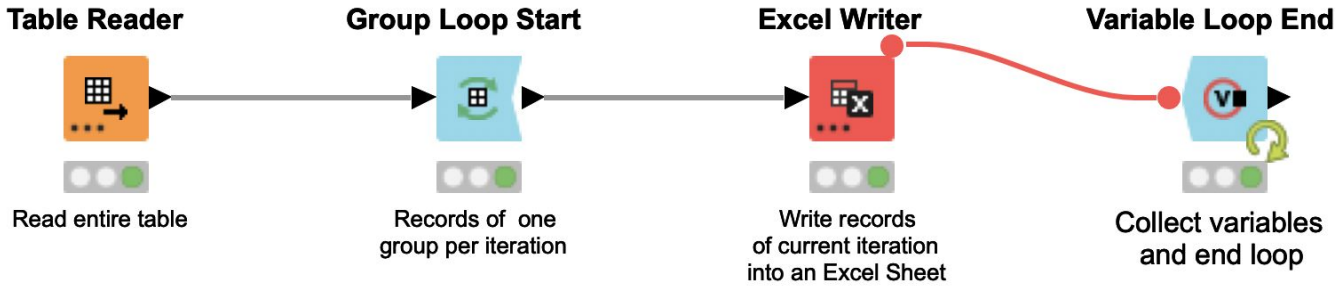


Create File/Folder Variables

- Creates one or multiple path flow variable(s) pointing to files / folders
- Inputs:
  - Base location
  - Flow variable name(s)
  - Value (file name or path relative to base location)
  - File extension (optional)
- Output variables can be used to control the output location in writer nodes.

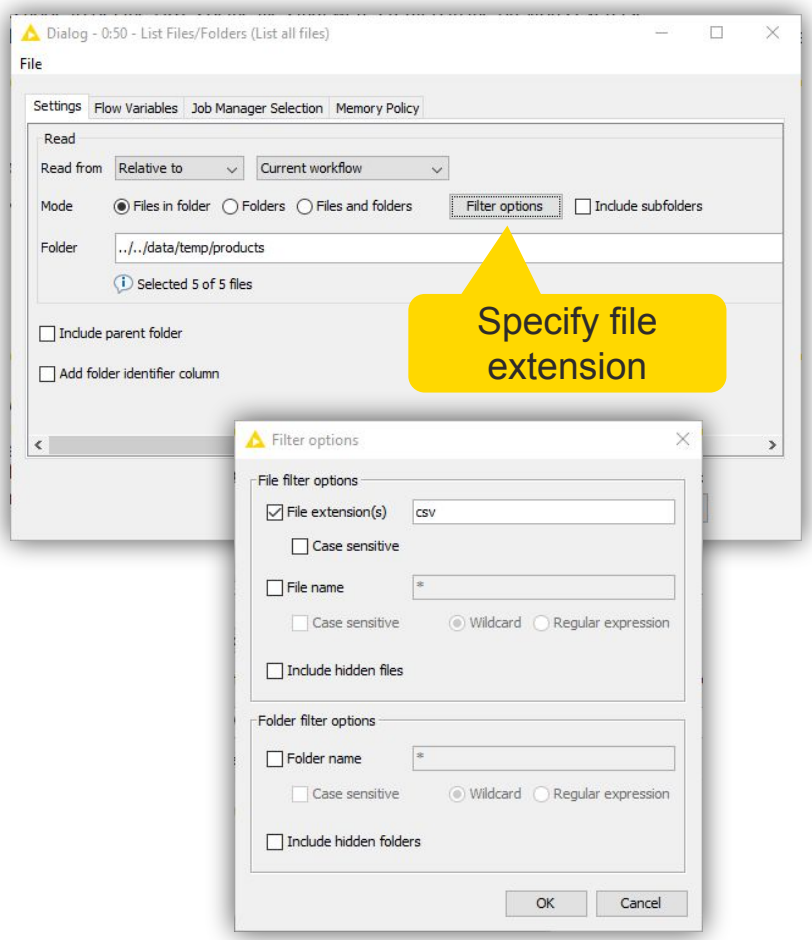


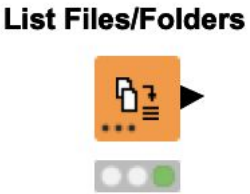
Example: Writing Multiple Excel Sheets



List Files/Folders

- List all files in a directory
- Restrict to:
  - Top level directory (i.e. not recursive)
  - Specific file extensions
  - Matching name patterns (regex or wildcard)
- Provide file references as a table of URLs and absolute paths





Example: Reading Many Excel Sheets

- List all sheet names of an Excel file
- Convert sheet name into a flow variable (1 sheet name per iteration)
- In each iteration, read the spreadsheet with the current sheet name
- Close the loop and collect the results

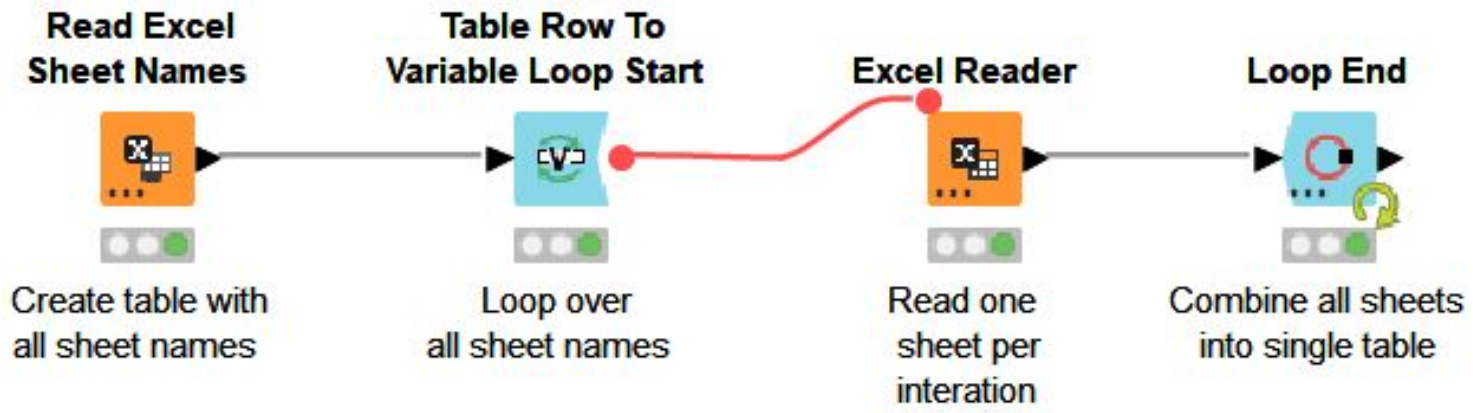
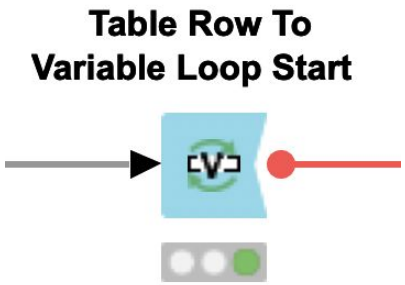
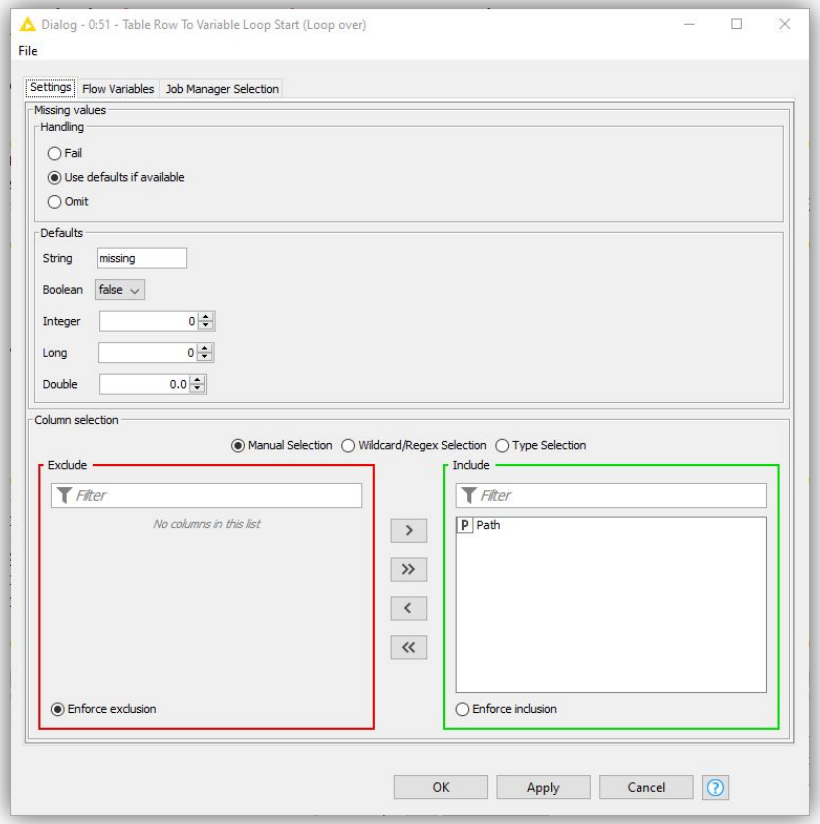


Table Row to Variable Loop Start

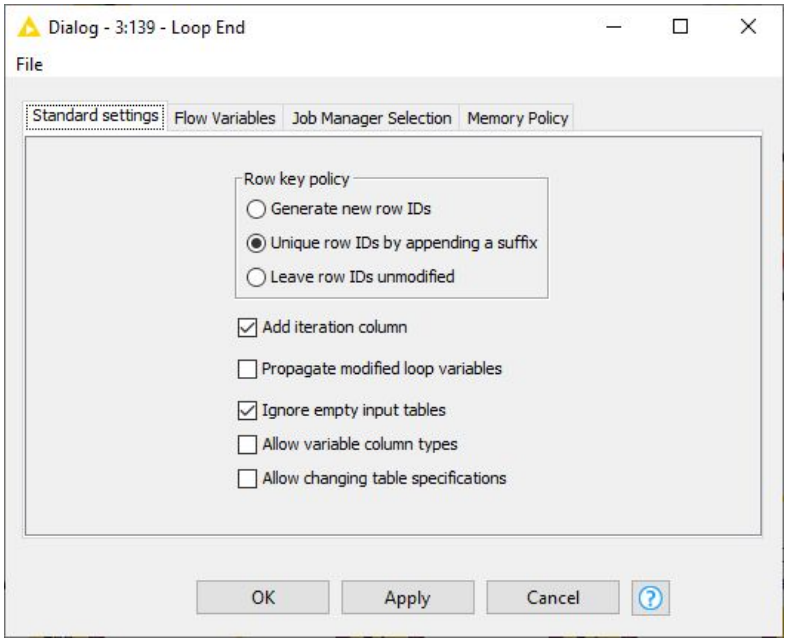
- Similar to the
  Table Row to Variable node
- Each iteration of the loop converts the next row of the input table into Flow Variables
- Injects variables into other nodes to re-execute subflows with a progression of settings

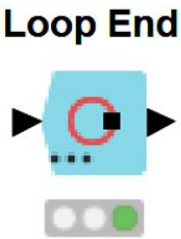




Loop End

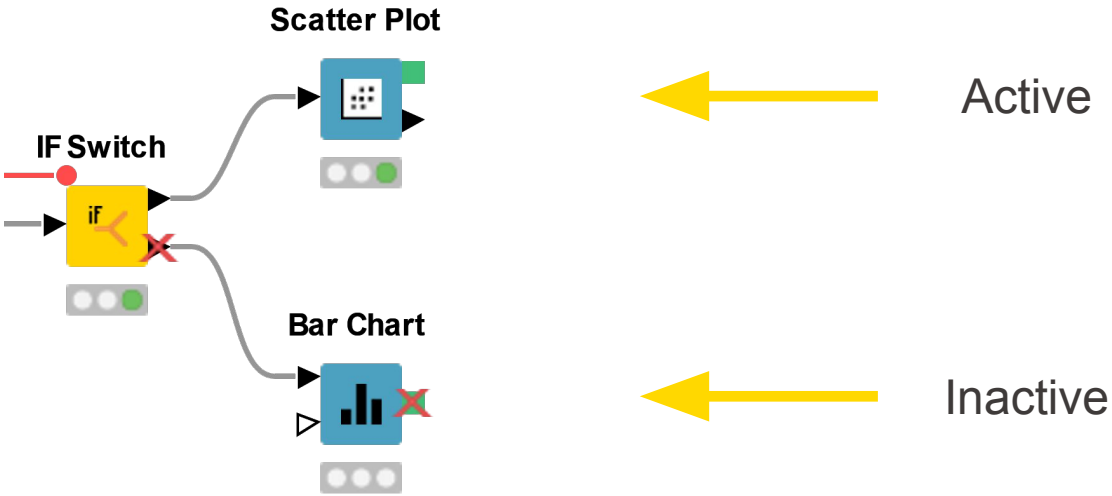
- Can be used to end of a loop
- Collects the results of the different iterations by row-wise concatenation of the incoming tables
- Provides options to:
  - Add a column with the iteration number
  - Propagate modified loop variables
  - Allow variable column types
  - Allow changing table specifications





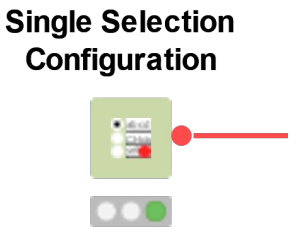
Switches

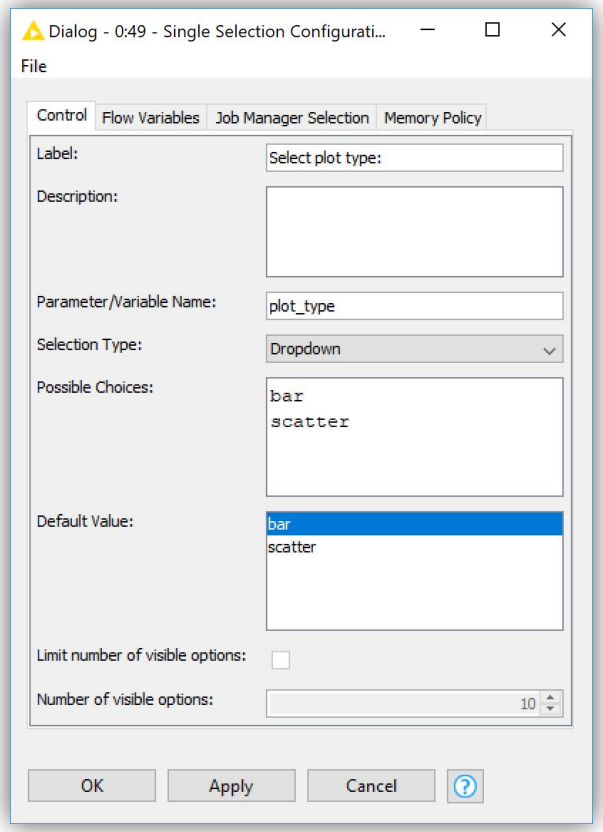
- A switch allows you to selectively activate branches of a workflow
- Inactive branches are marked with a red x on their output ports. Inactive nodes propagate down stream.



Single Selection Configuration

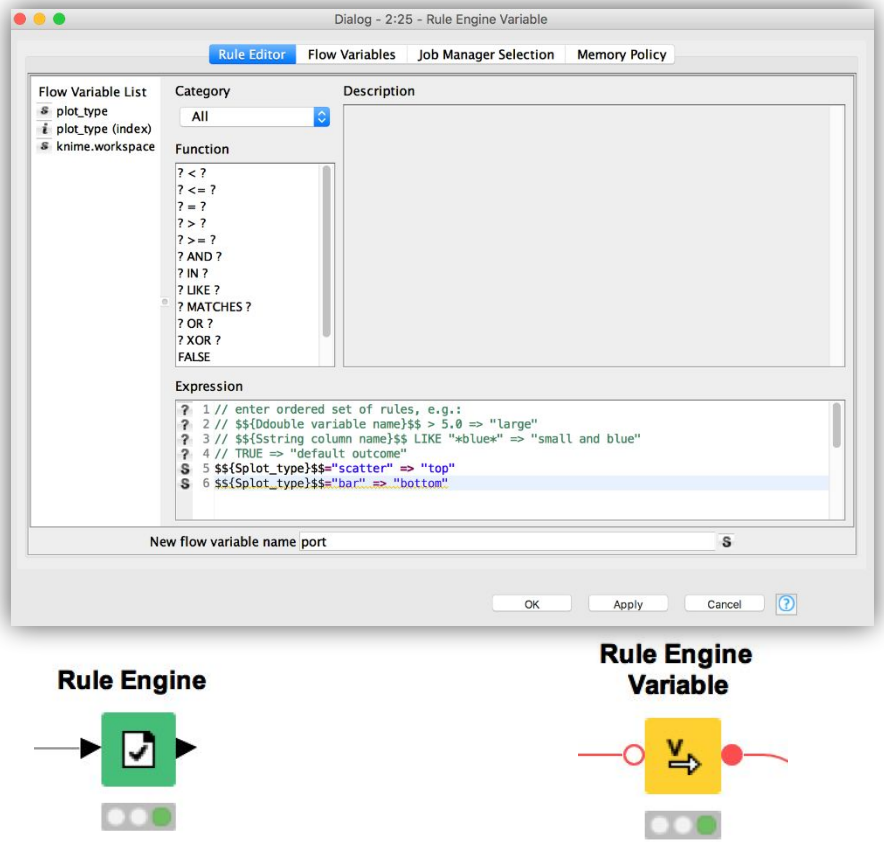
- Configuration: Select single value from list of Strings
- Returns selection as string type Flow Variable
- Choose between different layout options (dropdown, radio buttons...)





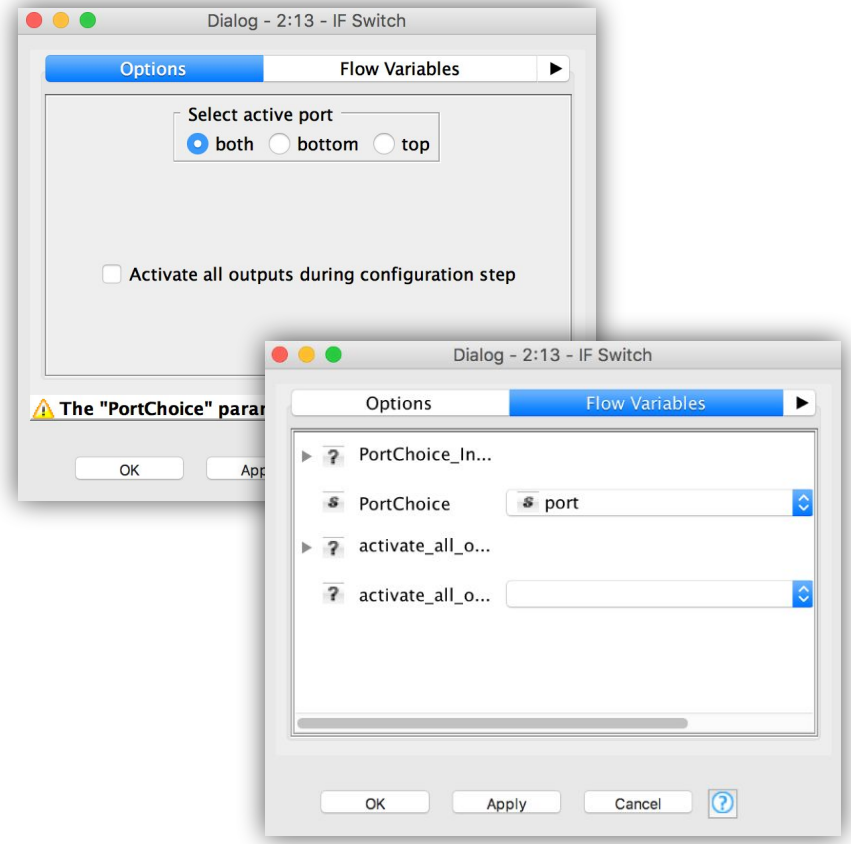
Rule Engine/Rule Engine Variable

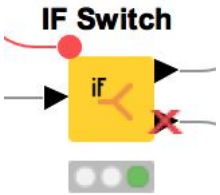
- Defines custom logic for using simple rules.
- Rules like: <Antecedent> => <Consequence>
  - (1=1 => “true”)
- May be used in Flow Variables or tables
- Easiest way to encode logic for switches



If Switch

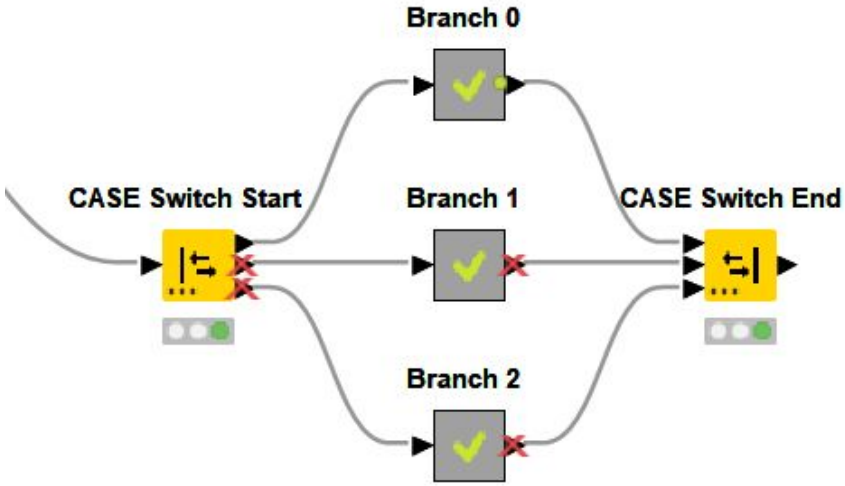
- Controls which branches of your workflow are active programmatically
- Controlled with a Flow Variable, setting the value to the literal Strings: “top”, “bottom”, “both”
- May be used in Flow Variables or tables (different nodes)





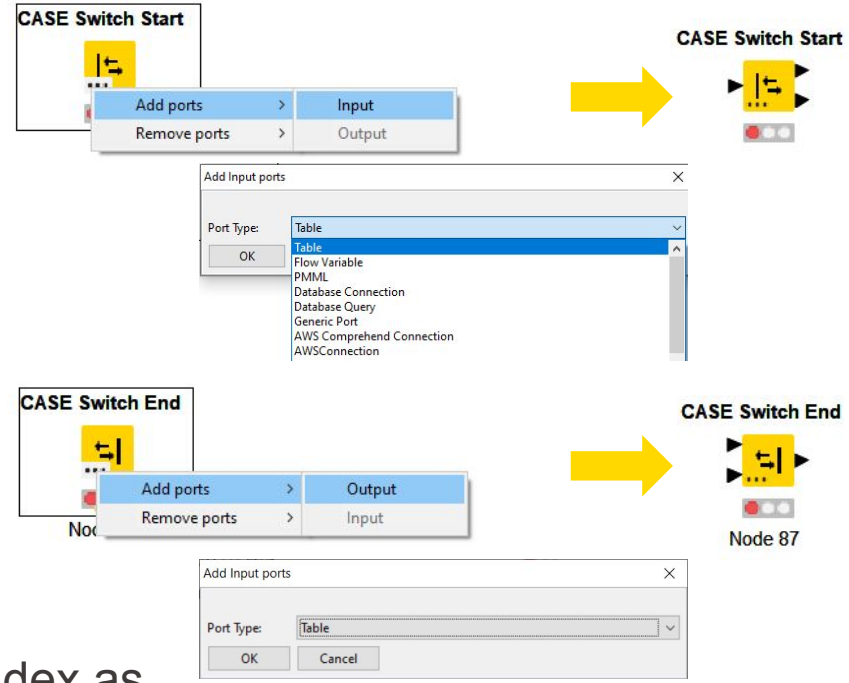
Case Switch Start & End

- Similar to If-Switch: Takes data from single input port and passes it to the active output port
- Nodes connected to inactive branches are not executed



Case Switch Start & End

- Case Switch Start
  - Add an input port with a specific type (e.g., Data)
  - □ Two output ports are also added
  - □ Additional output ports can be added
- Case Switch End
  - Add an output port with a specific type (e.g., Data)
  - □ Two input ports are also added
  - □ Additional input ports can be added



- Configure via node dialog, or pass port index as Flow Variable
  - From the top, 0, 1, 2, ... (however many ports there are)

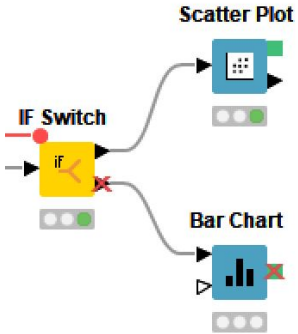
The Difference between Loops and Switches

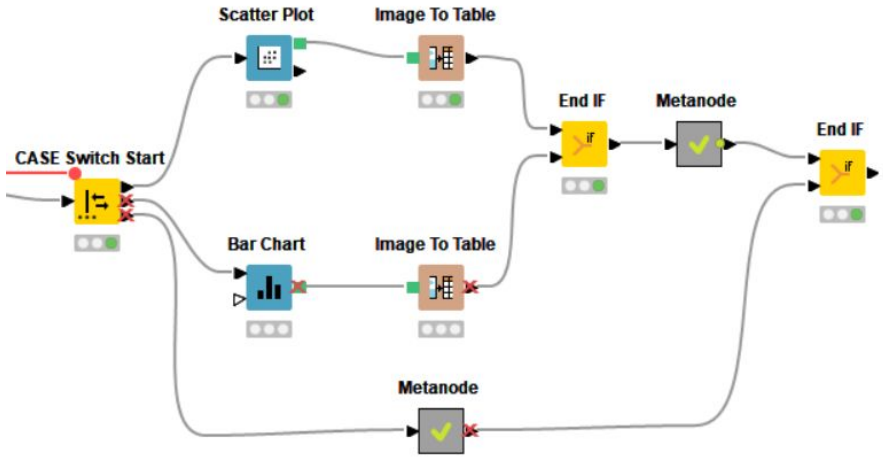
Loops

- The Loop Start is connected to the Loop End node; they form a pair.
- A loop iterates over a workflow part.

Switches

- A Switch Start can be used without a corresponding Switch End.
  They can also be combined.

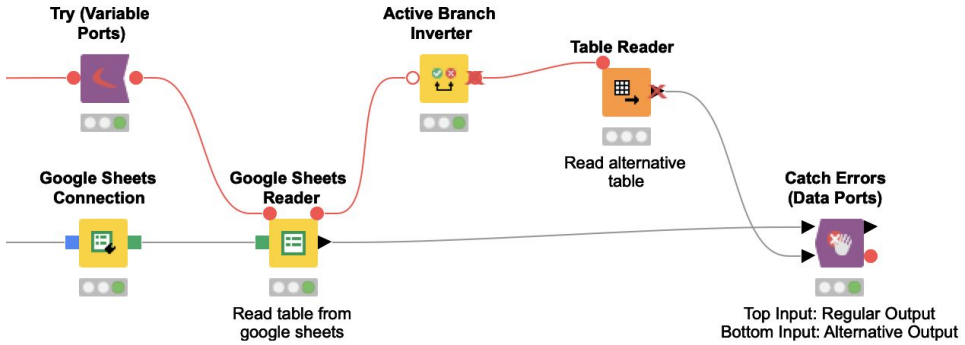




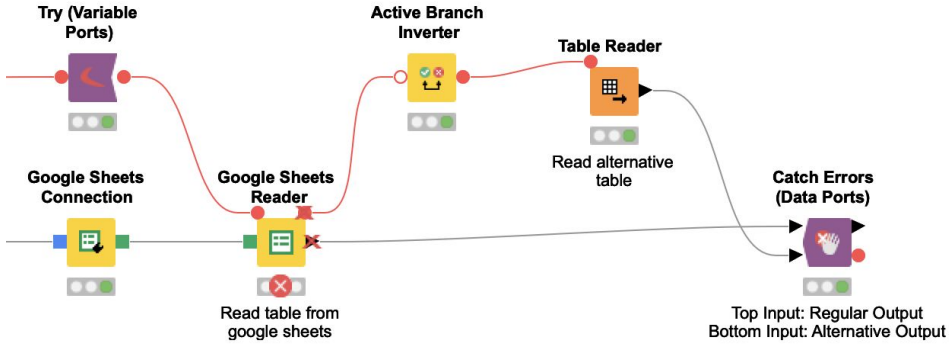
Try-Catch

- A way to catch errors in workflows
- Useful when it is hard to know if a node will execute (for example,
  when reading from a Google Sheet)
- KNIME tries to execute the nodes, but if it fails will fall back to
  an alternative branch

Regular Execution



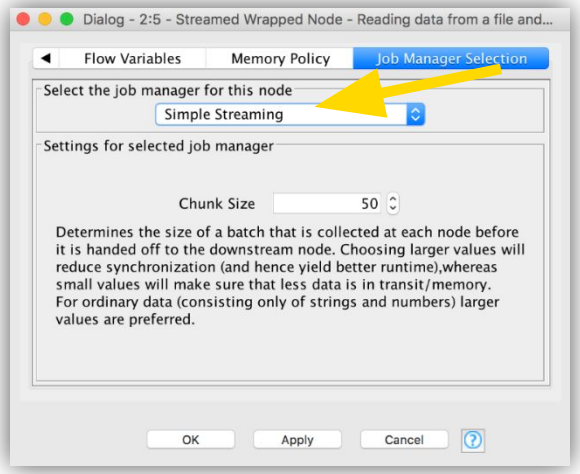
Alternative Execution



Streaming

- Standard execution: Node by node. The node processes all data, finishes, then passes the data to the next node, etc.
- Streaming: Nodes executed concurrently, each nodes passes data to the next as soon as it is available, i.e. before node is fully executed
  - Faster execution, esp. for reading/preprocessing data
- Install KNIME Streaming Execution (Beta) extension
- Create Component -> Configure -> Job Manager Selection -> Simple Streaming
  - Not available for all nodes (show in node repository)
  - Can only execute entire metanode, not individual nodes
  - Intermediate results not available since nothing is cached

Streaming



Streamed Component - Reading data from a file and process

Sub Workflow as Component.
To open it:
- right click > Component > Open
- Ctrl + Double Click

Exercise: 11_Workflow_Control, Activity I

Goal: Build a loop that will create an Excel file with separate Excel sheets for the records of different products.

- Read the table CurrentDetailData.table (Table Reader node)
- Start a loop that handles the records for the different products in separate iterations (Group Loop Start node)
- For each product write one Excel sheet into a single Excel file (Excel Writer node)
- Close and execute the loop (Variable Loop End node)

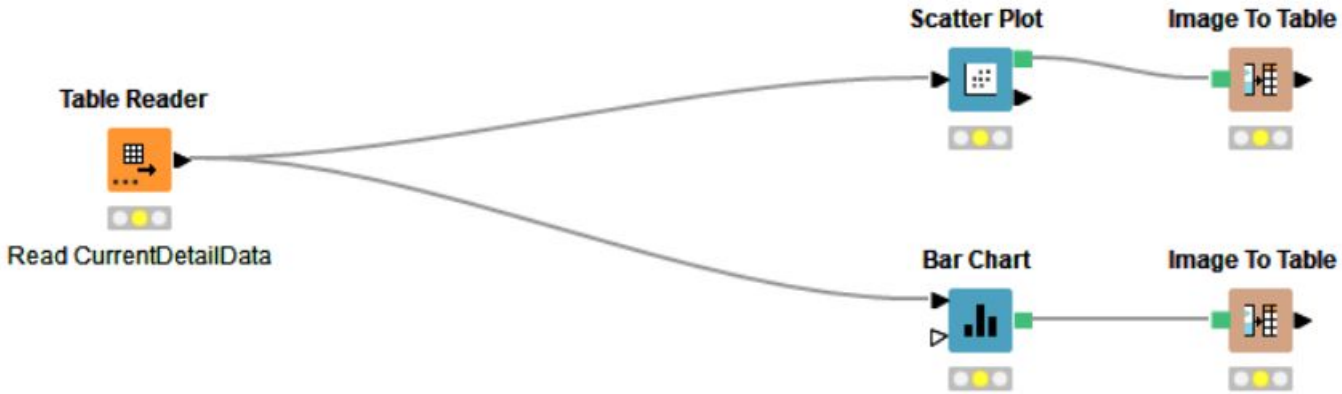
Exercise: 11_Workflow_Control, Activity II

Goal: Create a loop that reads and concatenates all the sheets in an Excel file.

- Create a table that contains all sheet names of the Excel file created in Activity I (Read Excel Sheet Names node)
- Start a loop that iterates over the sheet names (Table Row to Variable Loop Start node)
- Read the Excel sheet with the sheet name in the current iteration (Excel Reader node)
- Close the loop and concatenate the tables from the different iterations (Loop End node)

Exercise: 11_Workflow_Control, Activity III

- Extend the workflow below with a switch that only creates one type of visualization
  - Create a Single Selection Configuration node with the possible values "scatter" and "bar"
  - Use the CASE Switch Data (Start) that activates the top or the middle branch depending on the selection scatter/bar (Use the "...(index)" flow variable to define the active port)
  - Combine the outputs of the two branches with the CASE Switch Data (End) node



Instructor-Led Courses: Schedule 2023

Sep 11 - 16	**L1**	**L1-DW** KNIME Analytics Platform for Data Wranglers: Basics	**Data Analysts**
Sep 18 - 22	**L2**	**L2-DW** KNIME Analytics Platform for Data Wranglers: Advanced	
Oct 23 - 27	**L3**	**L3-DA** Productionizing Data Apps*	
Nov 6 - 10	**L4**	**L4-DV** Low Code Data Extraction and Visualization*	

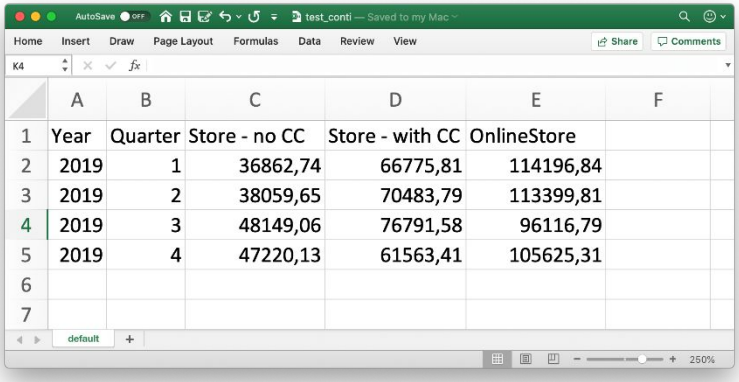
Jun 19 - 23	**L1**	**L1-DS** KNIME Analytics Platform for Data Scientists: Basics	**Data Scientists**
Jun 26 - 30	**L2**	**L2-DS** KNIME Analytics Platform for Data Scientists: Advanced	
Jul 10 - 14	**L3**	**L3-CD** Continuous Deployment and MLOps*	
Jul 17 - 21	**L4**	**L4-ML** Introduction to Machine Learning Algorithms	
Jul 24 - 28	**L4**	**L4-DL** Introduction to Neural Networks and Deep Learning	
Aug 21 - 25	**L4**	**L4-TS** Introduction to Time Series Analysis*	
Aug 28 - Sep 1	**L4**	**L4-TP** Introduction to Text Processing	

Sep 11 - 16	**L1**	**L1-DW** KNIME Analytics Platform for Data Wranglers: Basics	**Data Engineers**
Sep 18 - 22	**L2**	**L2-DW** KNIME Analytics Platform for Data Wranglers: Advanced	
Oct 9 - 13	**L3**	**L3-DE** Productionizing Data Engineering Applications*	
Oct 16 - 20	**L4**	**L4-DE** Best Practices for Data Engineering*	

Styling EXCEL Tables

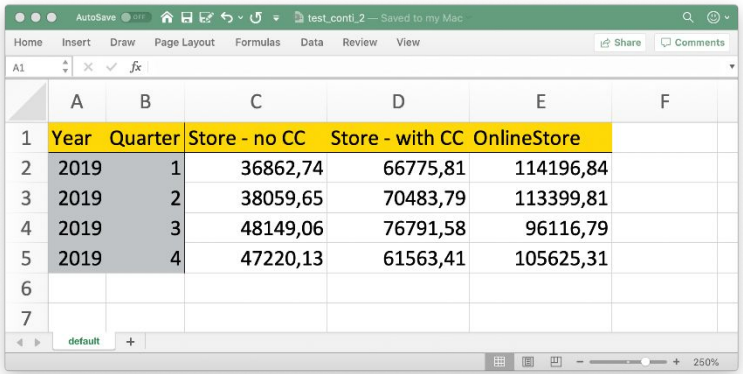
Styling EXCEL tables

Standard written table



	A	B	C	D	E	F
1	Year	Quarter	Store - no CC	Store - with CC	OnlineStore	
2	2019	1	36862,74	66775,81	114196,84	
3	2019	2	38059,65	70483,79	113399,81	
4	2019	3	48149,06	76791,58	96116,79	
5	2019	4	47220,13	61563,41	105625,31	
6						
7						

Styled table



	A	B	C	D	E	F
1	Year	Quarter	Store - no CC	Store - with CC	OnlineStore	
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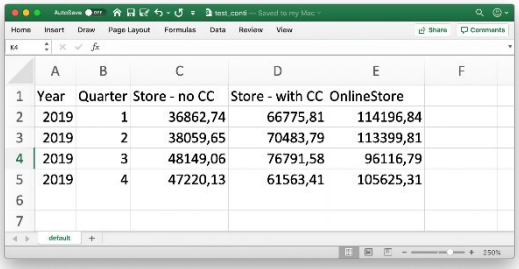
5	2019	4	47220,13	61563,41	105625,31	
6						
7						

Continental Nodes for KNIME
XLS Formatter Nodes

Additional tag table - the key to a styled table:



	A	B	C	D	E	F
1	Year	Quarter	Store - no CC	Store - with CC	OnlineStore	
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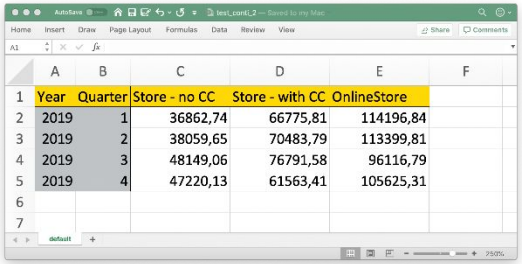
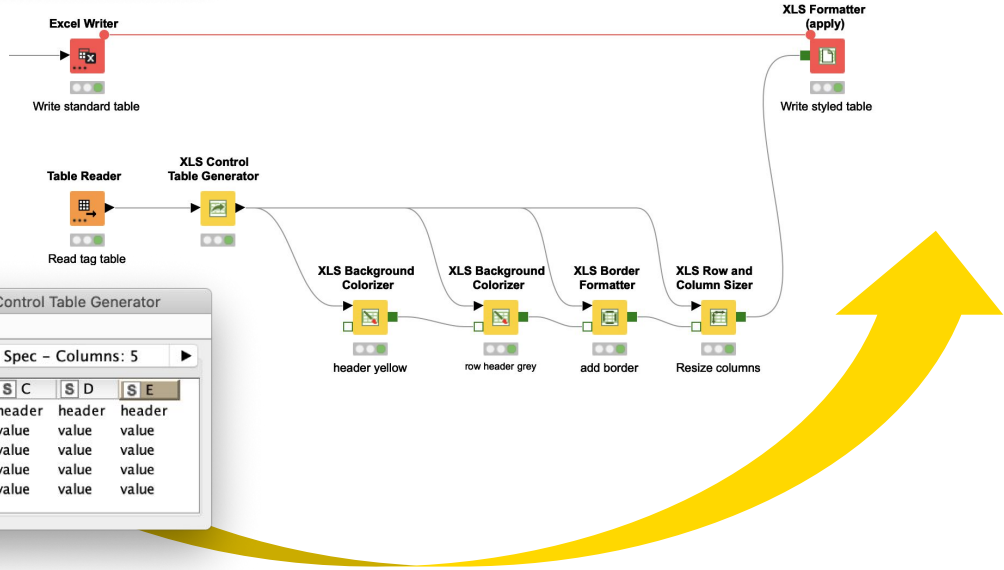
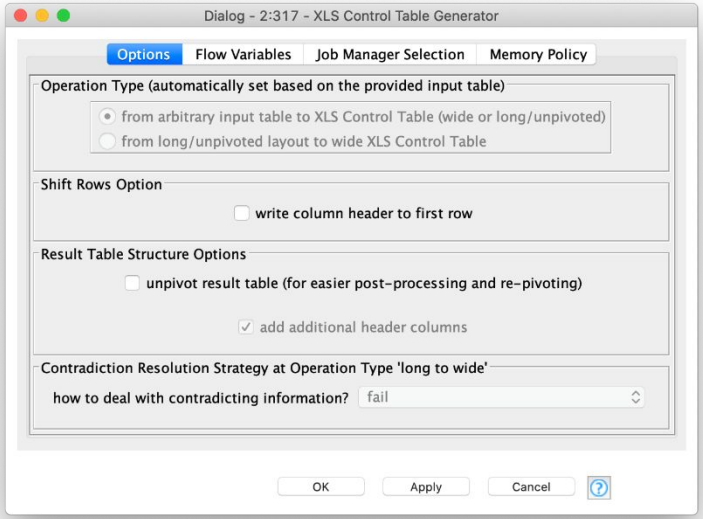


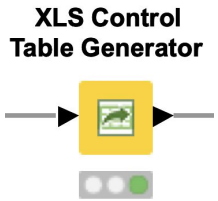
	A	B	C	D	E	F
1	Year	Quarter	Store - no CC	Store - with CC	OnlineStore	
2	2019	1	36862,74	66775,81	114196,84	
3	2019	2	38059,65	70483,79	113399,81	
4	2019	3	48149,06	76791,58	96116,79	
5	2019	4	47220,13	61563,41	105625,31	
6						
7						



XLS Control Table Creator

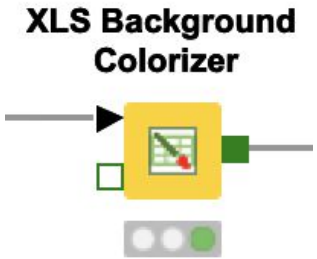
- Kick off node to your styled table
- Transforms input table into an XLS Control Table
- Column names => A, B, C, ….
- Row IDs => 1, 2, 3, …
- The unpivoted table is a great base to transform values into tags,
  e.g. with the Rule Engine node

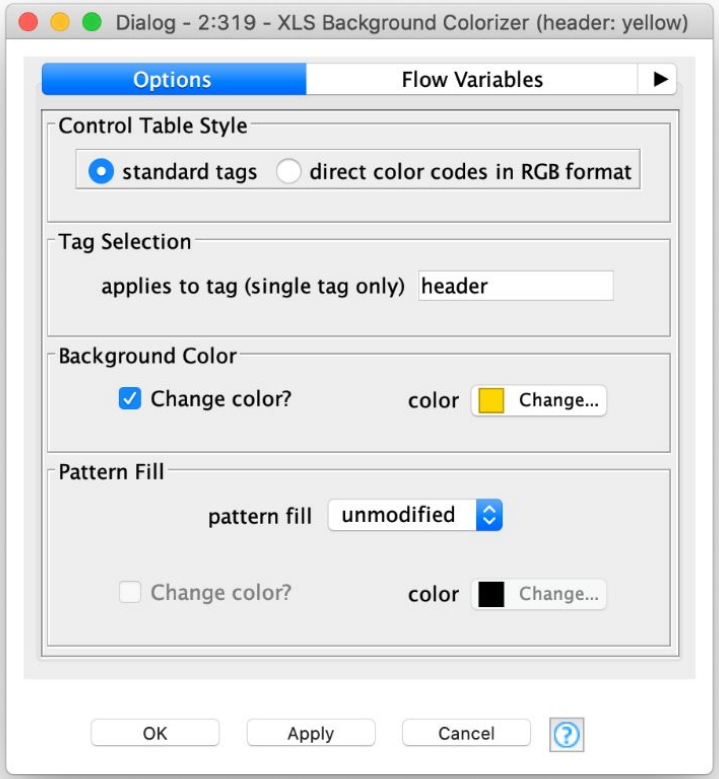




XLS Background Colorizer

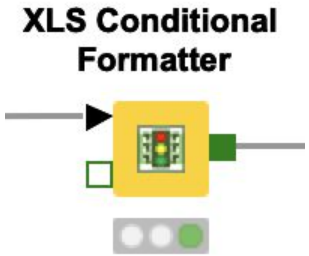
- Changes the background of a cell into a static color and/or pattern fill
- Select between
  - Assigning a color to a tag value
  - Using a table with RGB values

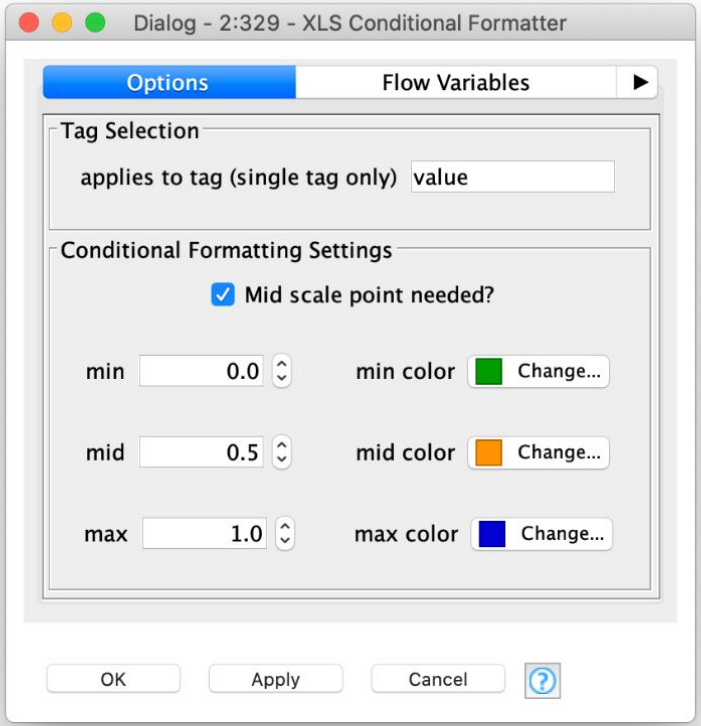




XLS Conditional Formatter

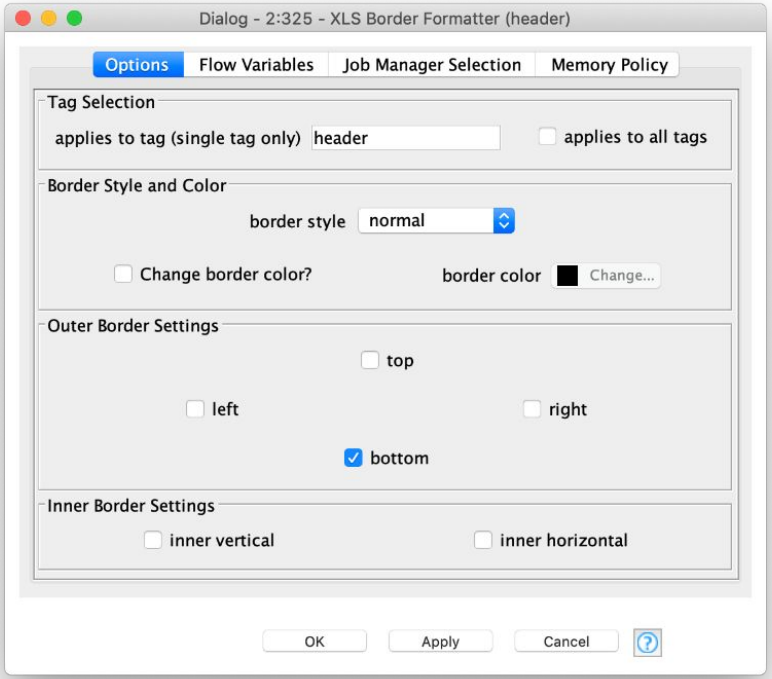
- Changes the cells' background according to their numerical value
- Allows you to optionally define a mid scale point





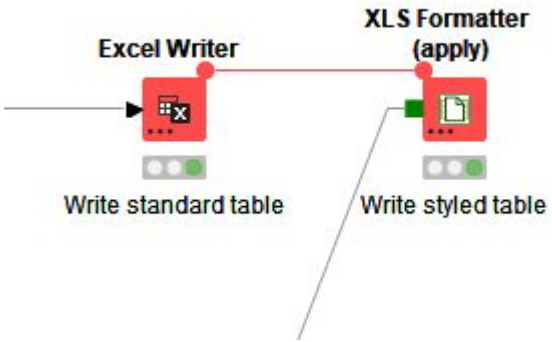
XLS Border Formatter

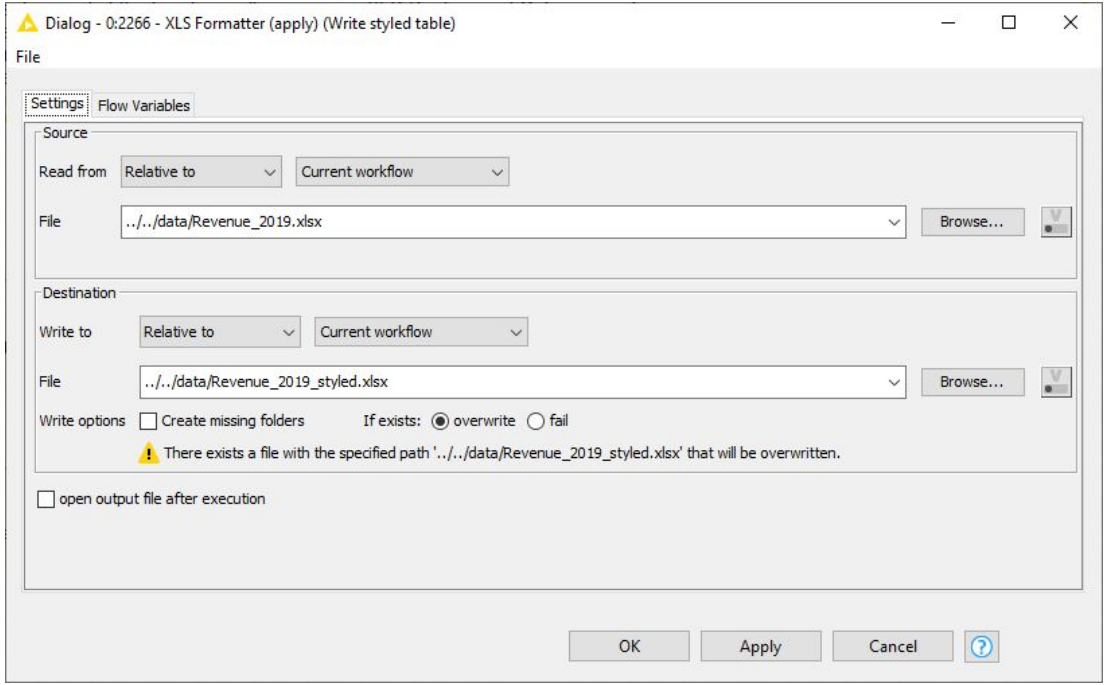
- Changes the borders of a given range specified by tags
- Option to use boarders inside the specified range
  - Inner vertical
  - Inner horizontal



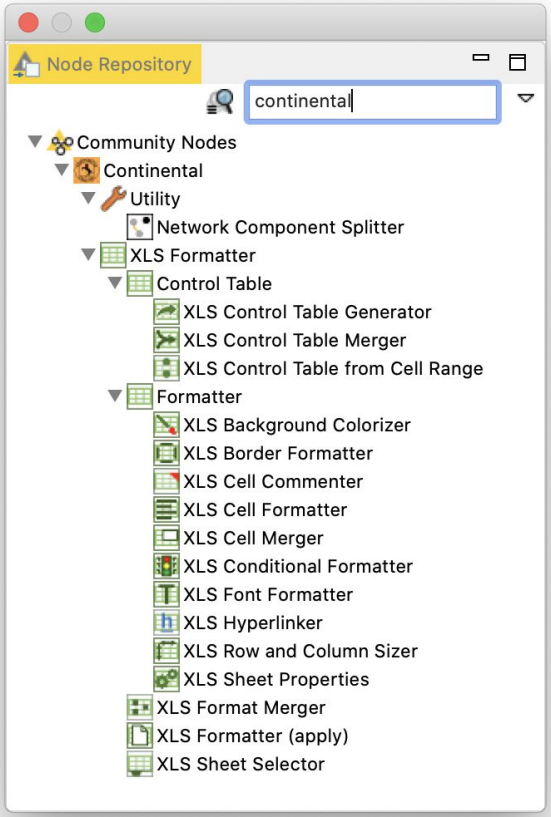
XLS Formatter (apply)

- Applies the chained commands from the XLS Formatter nodes
- Important:
  - The table must be written before with Excel Writer node
  - The input file may not contain any formatting yet

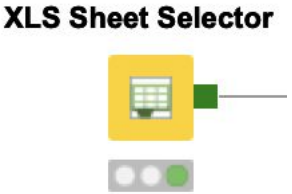




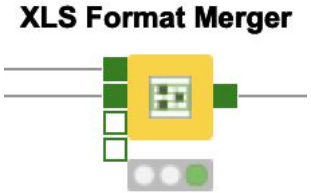
Other Important Nodes of the Extension

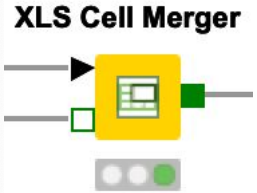


By default the styling is always applied to the first sheet. Change this with the XLS Sheet Selector node.



Want to style more than one sheet? Merge different sheet stylings with the XLS Format Merger node.

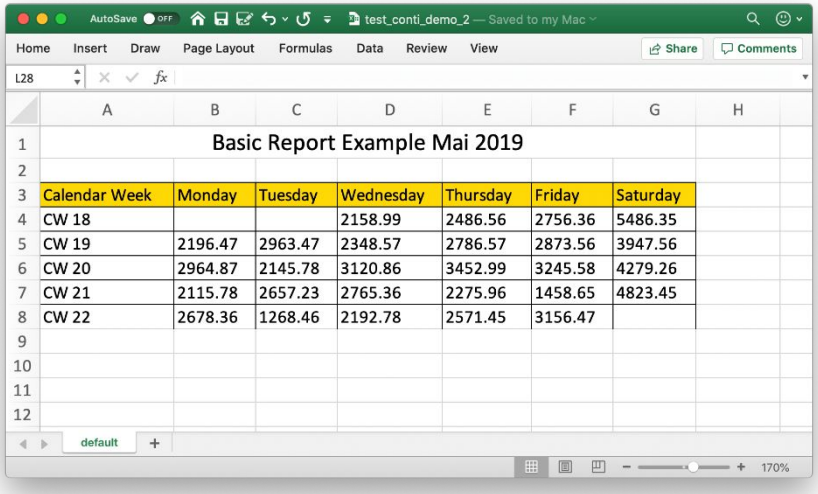




Want to add a header to your table? Merge multiple cells with the XLS Cell Merger node.

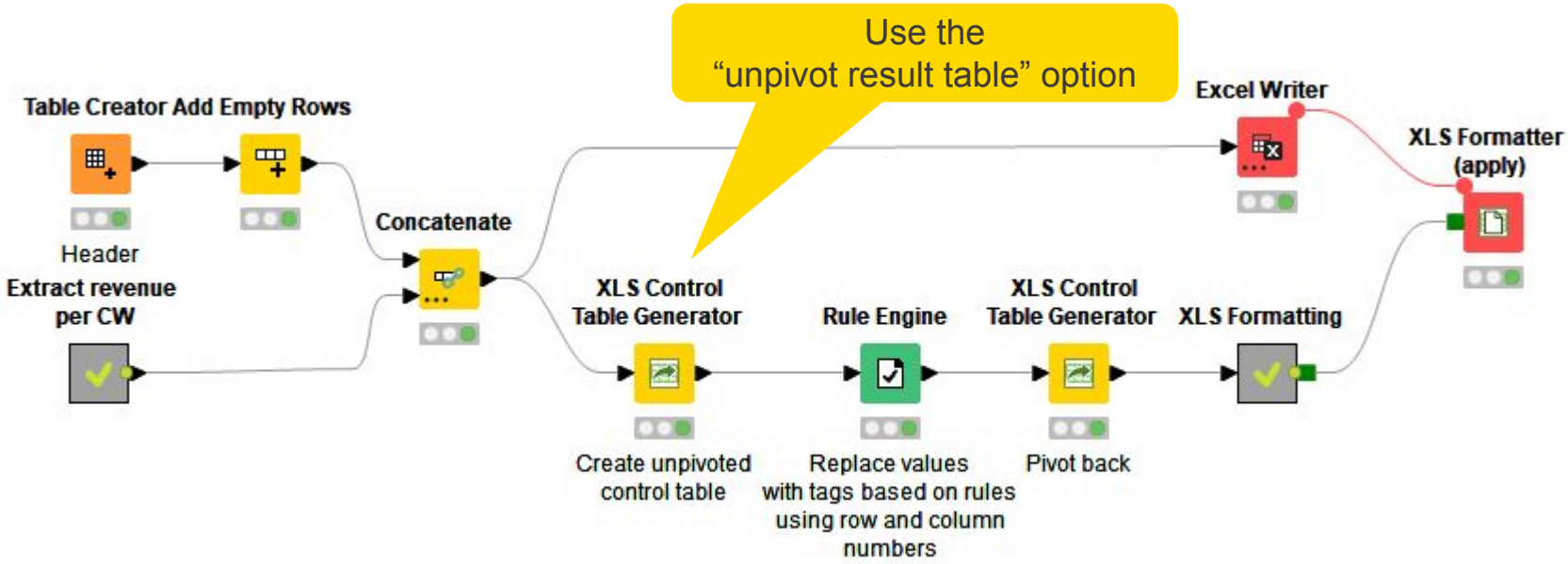
Tips & Tricks for the Continental Extension

- How can you automate creating a tag table?
  - Handle changing number of rows
  - Handle changing number of columns
- How can you add empty rows between different tables?

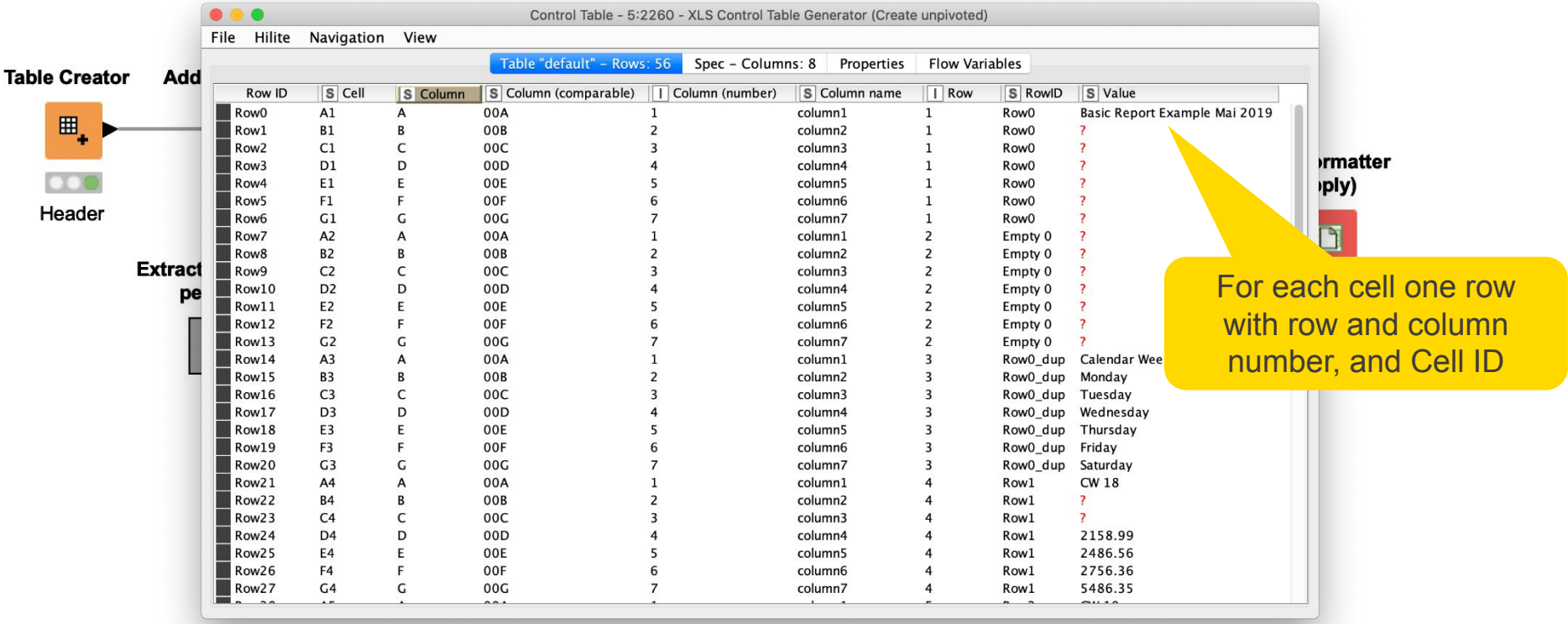


Calendar Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
CW 18			2158.99	2486.56	2756.36	5486.35
CW 19	2196.47	2963.47	2348.57	2786.57	2873.56	3947.56
CW 20	2964.87	2145.78	3120.86	3452.99	3245.58	4279.26
CW 21	2115.78	2657.23	2765.36	2275.96	1458.65	4823.45
CW 22	2678.36	1268.46	2192.78	2571.45	3156.47	

Tips & Tricks for the Continental extension

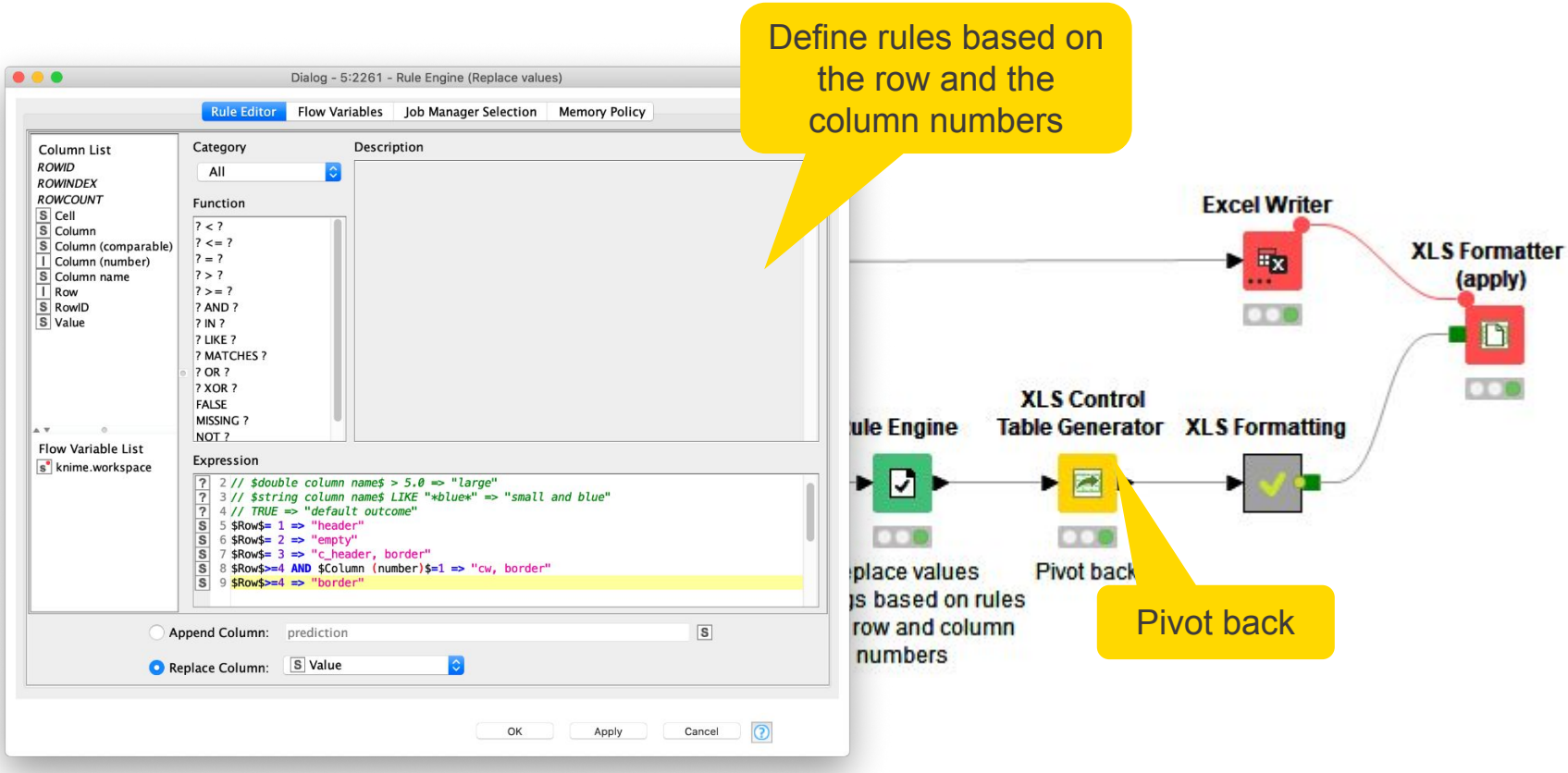


Tips & Tricks for the Continental extension

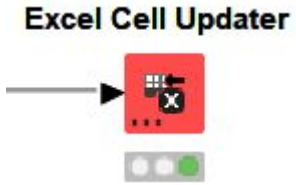


Row ID	Cell	Column	Column (comparable)	Column (number)	Column name	Row	RowID	Value
Row0	A1	A	00A	1	column1	1	Row0	Basic Report Example Mai 2019
Row1	B1	B	00B	2	column2	1	Row0	?
Row2	C1	C	00C	3	column3	1	Row0	?
Row3	D1	D	00D	4	column4	1	Row0	?
Row4	E1	E	00E	5	column5	1	Row0	?
Row5	F1	F	00F	6	column6	1	Row0	?
Row6	G1	G	00G	7	column7	1	Row0	?
Row7	A2	A	00A	1	column1	2	Empty 0	?
Row8	B2	B	00B	2	column2	2	Empty 0	?
Row9	C2	C	00C	3	column3	2	Empty 0	?
Row10	D2	D	00D	4	column4	2	Empty 0	?
Row11	E2	E	00E	5	column5	2	Empty 0	?
Row12	F2	F	00F	6	column6	2	Empty 0	?
Row13	G2	G	00G	7	column7	2	Empty 0	?
Row14	A3	A	00A	1	column1	3	Row0_dup	Calendar Wee
Row15	B3	B	00B	2	column2	3	Row0_dup	Monday
Row16	C3	C	00C	3	column3	3	Row0_dup	Tuesday
Row17	D3	D	00D	4	column4	3	Row0_dup	Wednesday
Row18	E3	E	00E	5	column5	3	Row0_dup	Thursday
Row19	F3	F	00F	6	column6	3	Row0_dup	Friday
Row20	G3	G	00G	7	column7	3	Row0_dup	Saturday
Row21	A4	A	00A	1	column1	4	Row1	CW 18
Row22	B4	B	00B	2	column2	4	Row1	?
Row23	C4	C	00C	3	column3	4	Row1	?
Row24	D4	D	00D	4	column4	4	Row1	2158.99
Row25	E4	E	00E	5	column5	4	Row1	2486.56
Row26	F4	F	00F	6	column6	4	Row1	2756.36
Row27	G4	G	00G	7	column7	4	Row1	5486.35

Tips & Tricks for the Continental extension



Excel Cell Updater



- Updates values of cells at specified address in an Excel file
  - While retaining the cell format
- Provide an input table of cell addresses and values to be replaced
  - Example

Address	String	Integer
A5	Ok	?
5:96	?	50
OZ23914	?	?

  - Missing values are denoted by “?”
  - Cell A5 is replaced with a string “OK”
  - Cell 5-th row, 96-th column is replaced with an integer 50
  - Cell OZ23914 is cleared

Excel Cell Updater

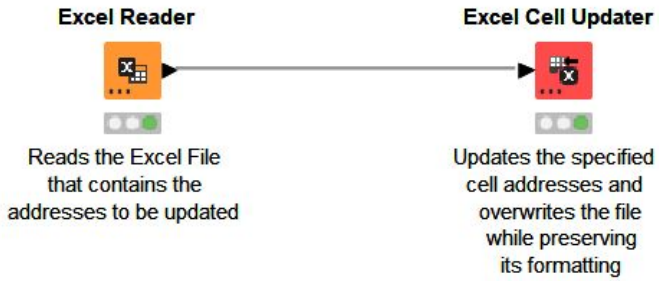


Table with replacement values

Row ID	Address	String	Integer
Row0	H13	yes	?
Row1	H16	yes	?

Original Excel file

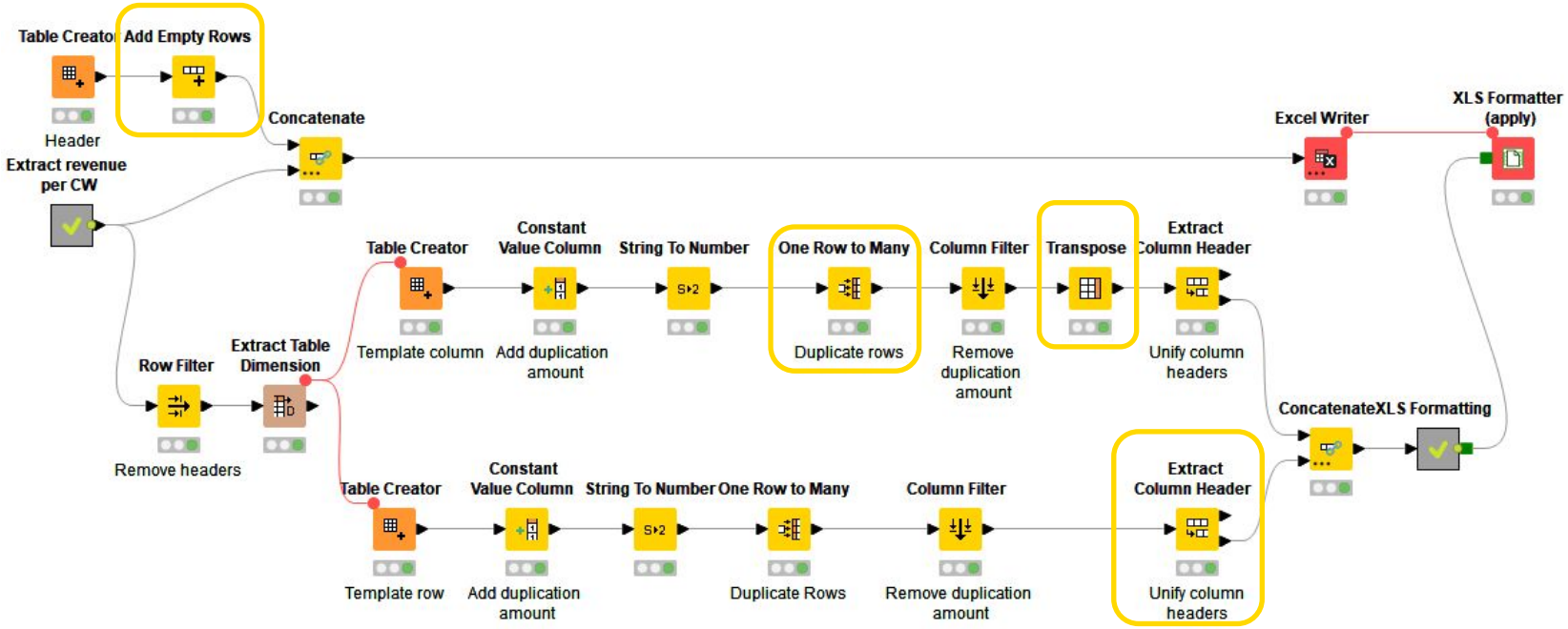
	A	B	C	D	E	F	G	H	
1	age	job	marital	education	default	balance	housing	loan	cont
2	58	managem	married	tertiary	no	2143	yes	no	unkn
3	44	technician	single	secondary	no	29	yes	no	unkn
4	33	entrepren	married	secondary	no	2	yes	yes	unkn
5	47	blue-colla	married	unknown	no	1506	yes	no	unkn
6	33	unknown	single	unknown	no	1	no	no	unkn
7	35	managem	married	tertiary	no	231	yes	no	unkn
8	28	managem	single	tertiary	no	447	yes	yes	unkn
9	42	entrepren	divorced	tertiary	yes	2	yes	no	unkn
10	58	retired	married	primary	no	121	yes	no	unkn
11	43	technician	single	secondary	no	593	yes	no	unkn
12	41	admin.	divorced	secondary	no	270	yes	no	unkn
13	29	admin.	single	secondary	no	390	no	no	unkn
14	53	technician	married	secondary	no	6	yes	no	unkn
15	58	technician	married	unknown	no	71	yes	no	unkn
16	57	services	married	secondary	no	162	no	no	unkn

Updated Excel file

G	H	
using	loan	cont
s	no	unkn
s	no	unkn
s	yes	unkn
s	no	unkn
	no	unkn
s	no	unkn
s	yes	unkn
s	no	unkn
s	no	unkn
s	no	unkn
s	no	unkn
	yes	unkn
s	no	unkn
s	no	unkn
	yes	unkn

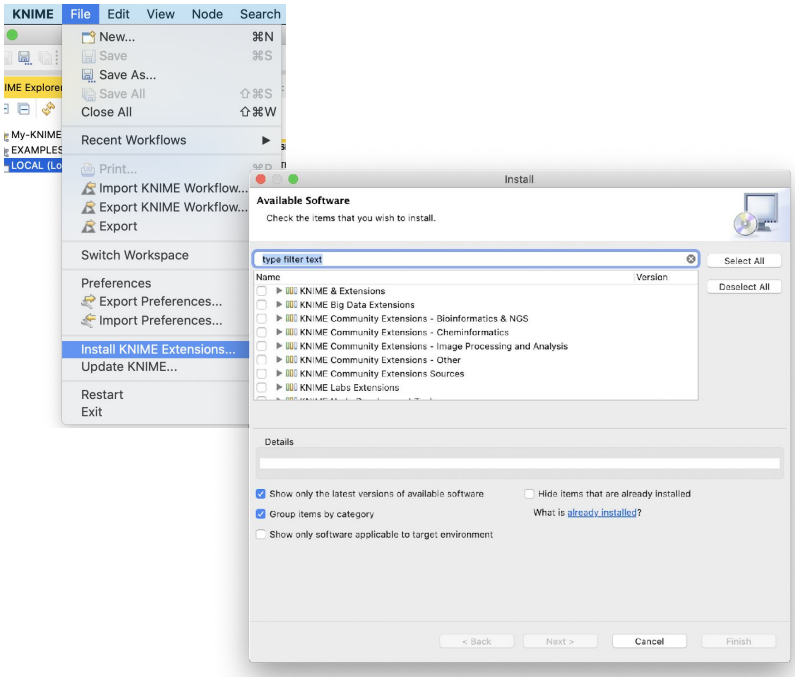
Conditional formatting is preserved

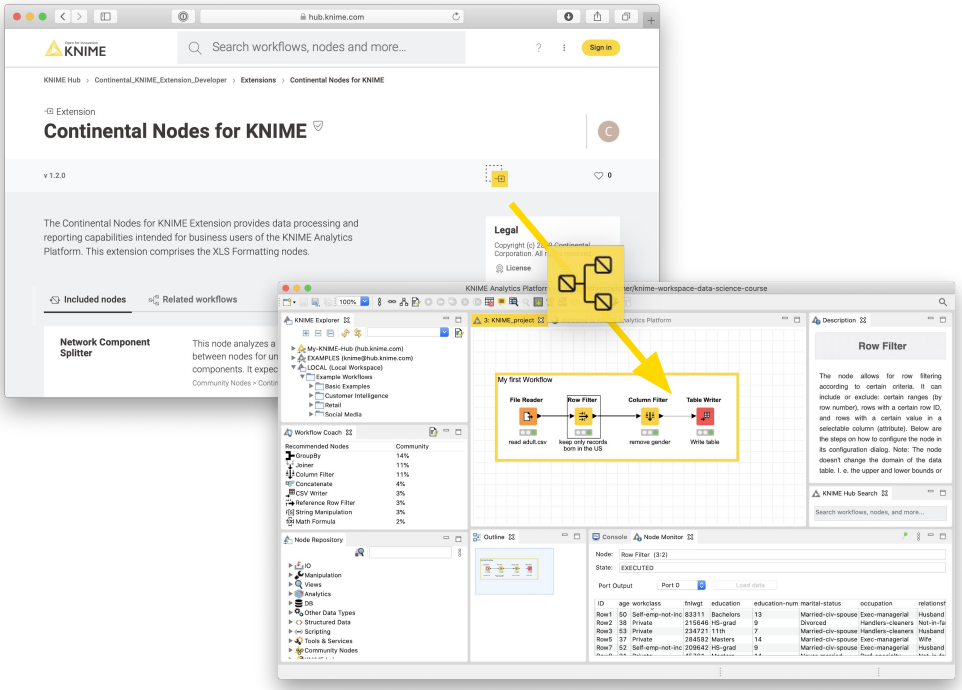
Tips & Tricks for the Continental extension



Installing Extensions

- Install the Continental Nodes for KNIME extension
- Install extension by going to File -> Install KNIME Extension or via Drag & Drop from the KNIME Community Hub





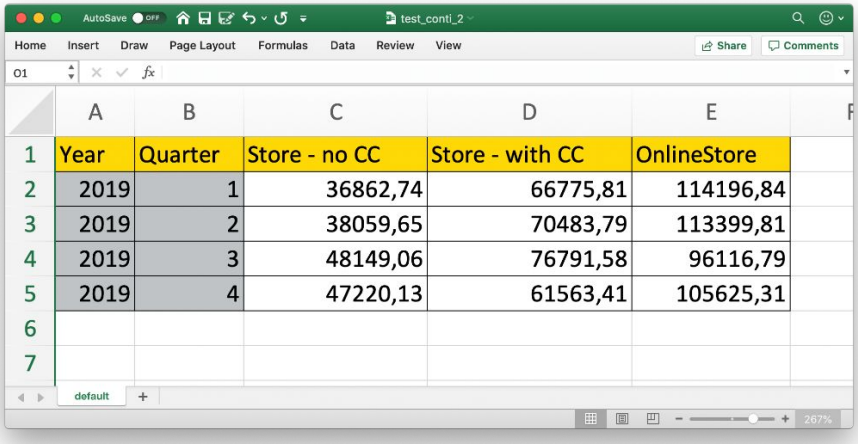
Open for Innovation KNIME

Exercise: 12_Styling_Excel_Tables

- Read the files: TagTable.table and RevenuePerQuarter.table and have a look at the tables.
- Use the XLS Formatter node to change the styling of the RevenuePerQuarter.table table to look like this, below:

Hint: Use the following nodes:

- XLS Control Table Generator
- XLS Background Colorizer
- XLS Border Formatter
- XLS Row and Columns Sizer (optional)



	A	B	C	D	E
1	Year	Quarter	Store - no CC	Store - with CC	OnlineStore
2	2019	1	36862,74	66775,81	114196,84
3	2019	2	38059,65	70483,79	113399,81
4	2019	3	48149,06	76791,58	96116,79
5	2019	4	47220,13	61563,41	105625,31
6					
7					

Introduction to Data Science

Churn Prediction

CRM System
Data about your customer

- Demographics
- Behavior
- Revenues

Model

- Churn Prediction
- Upselling Likelihood
- Product Propensity /NBO
- Campaign Management
- Customer Segmentation
- …

Customer Segmentation

CRM System
Data about your customer

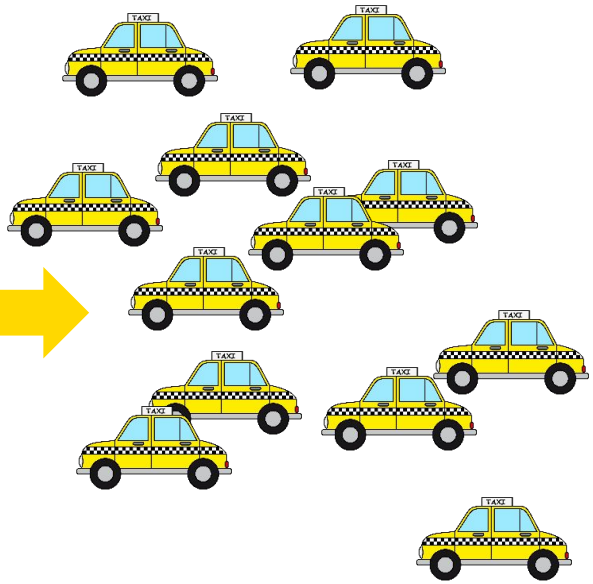
- Demographics
- Behavior
- Revenues

Model

- Churn Prediction
- Upselling Likelihood
- Product Propensity /NBO
- Campaign Management
- Customer Segmentation
- …

Demand Prediction

How many taxis do I need in NYC on Wednesday at 12:00?



Recommendation Engines / Market Basket Analysis

Model

$$Rule: X \Rightarrow Y$$

$$Support = \frac{frq(X,Y)}{N}$$

$$Confidence = \frac{frq(X,Y)}{frq(X)}$$

$$Lift = \frac{Support}{Supp(X) \times Supp(Y)}$$

Recommendation

IF  => 

Sentiment Analysis

Samsung

Samsung Galaxy S7 Edge G935A 32GB Unlocked - Gold Platinum

★★★★☆ 125 customer reviews | 606 answered questions

★★★★★ **Beautiful phone from a wonderful seller!**

By . on May 29, 2017

Color: Gold | **Verified Purchase**

This practically new beautiful phone well exceeded my expectations!

★☆☆☆☆ **One Star**

By on August 3, 2016

Color: Black Onyx | **Verified Purchase**

Very bad experience

Today's Challenge – Analyze Some Customer Data

Initial situation:

- Customer data in two datasets:
  - Phone usage
  - Contract information
- Column “Phone” is in both datasets
- Column “churn” encodes whether a customer is happy

Goal:

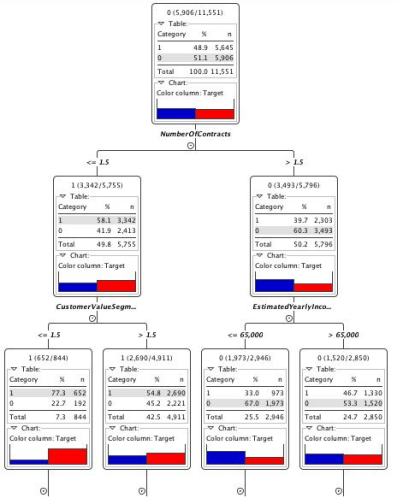
- Find rules that describe happy and unhappy customers by
  - training a decision tree model
  - calculating aggregations (optional)

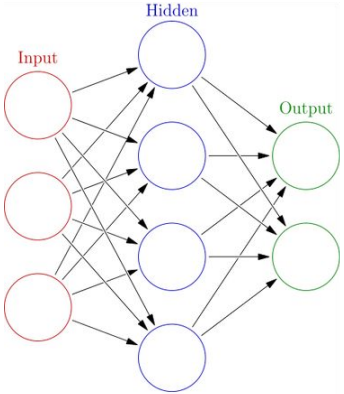
Classification

Predict *nominal* outcomes on existing data (supervised)

- Applications
  - Churn analysis (yes/no)
  - Chemical activity (active/inactive)
  - Spam detection (spam/not spam)
  - Optical character recognition (A-Z)

- Methods
  - Decision Trees
  - Neural Networks
  - Naïve Bayes
  - Logistic Regression





Class counts for Target

Class:	0	1
Count:	5906	5645

Total count: 11551

Threshold to used for zero probabilities: 0.0

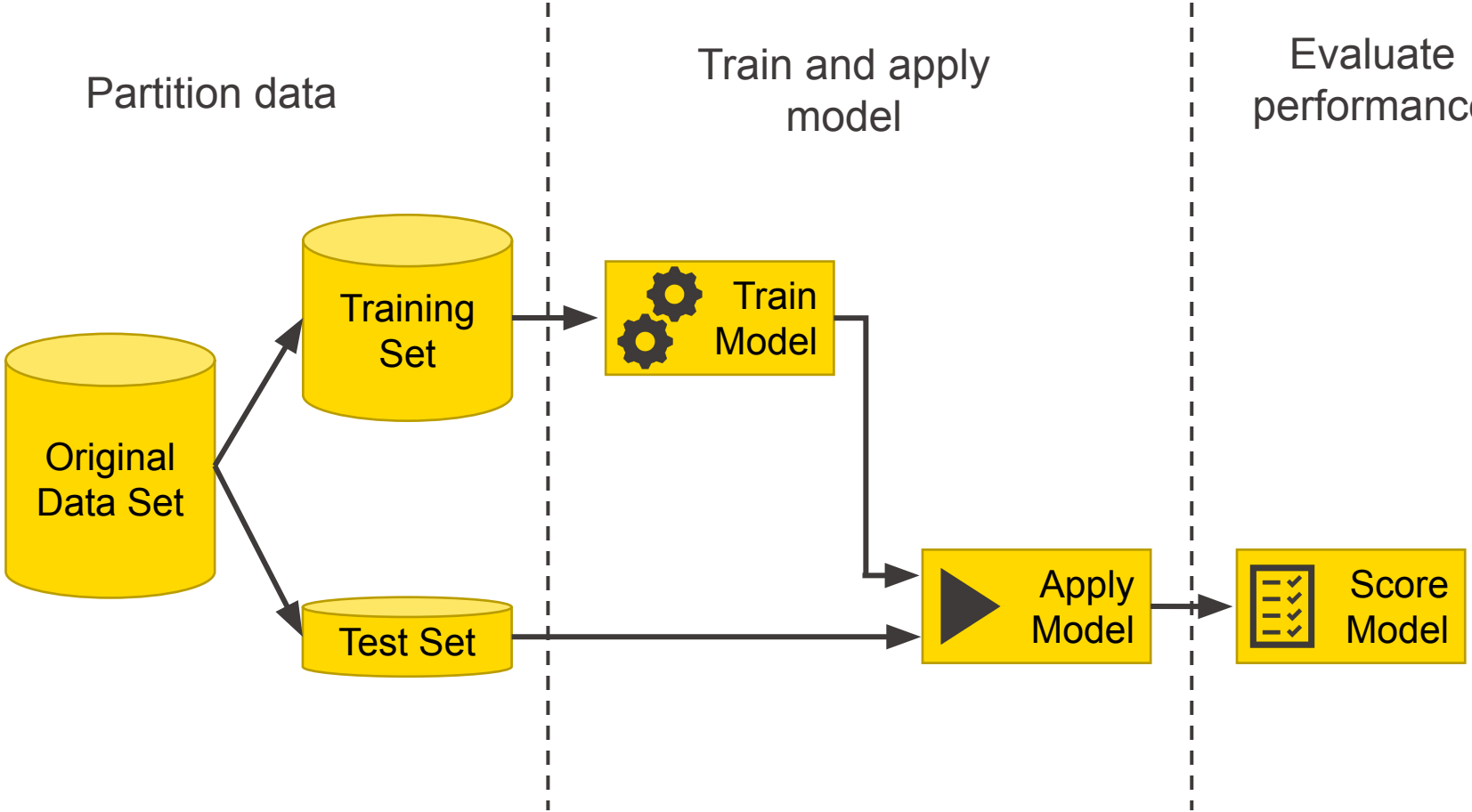
Gaussian distribution for Age per class value

	0	1
Count:	5906	5645
Mean:	49.68557	46.82604
Std. Deviation:	12.27388	10.16363
Rate:	51%	49%

Gaussian distribution for Available401K per class value

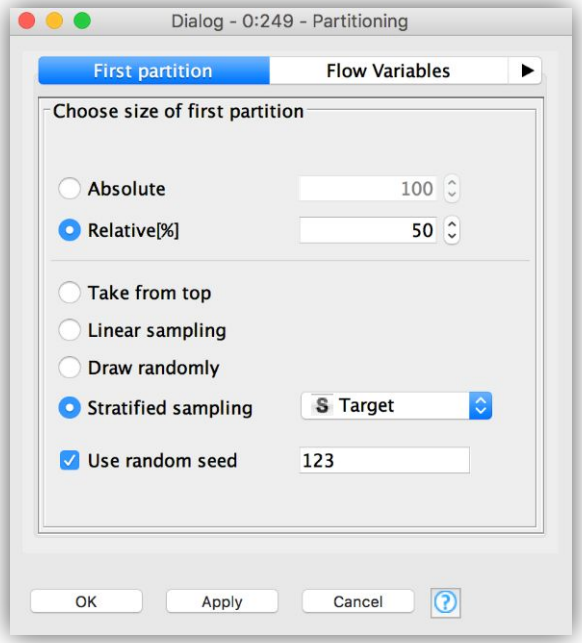
	0	1
Count:	5906	5645
Mean:	0.68134	0.68485
Std. Deviation:	0.466	0.46462
Rate:	51%	49%

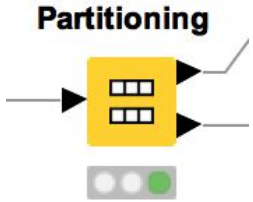
Data Mining: Process Overview

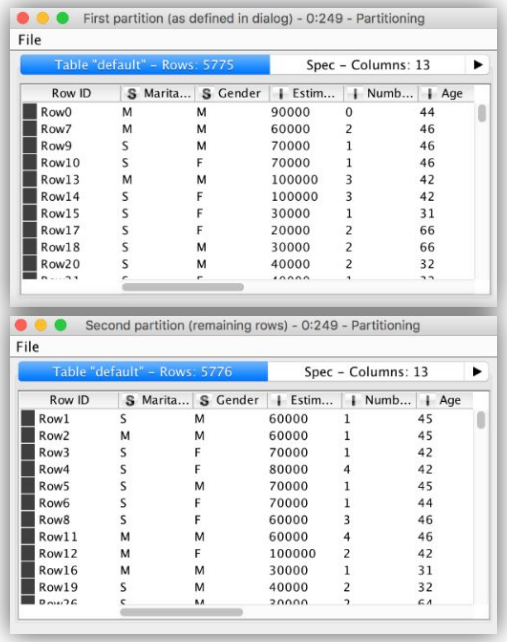


Partitioning

- Use to split data into training and evaluation sets
  - Partition by count (e.g. 10 rows) or fraction (e.g. 10%)
  - Sample by a variety of methods; random, linear, stratified

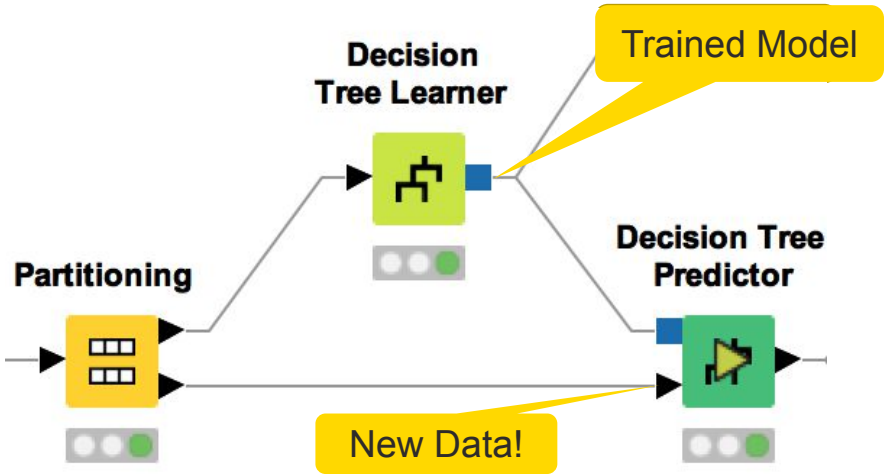






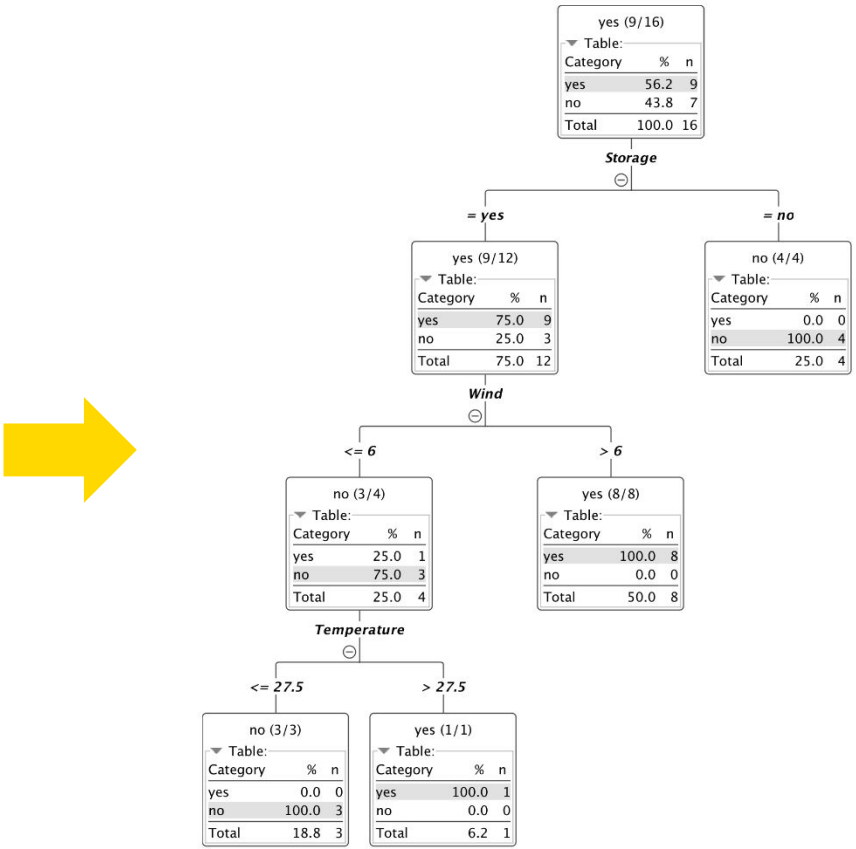
Learner-Predictor Motif

- Most data mining approaches in KNIME use a Learner-predictor motif.
- The Learner node trains the model with its input data.
- The Predictor node applies the model to a different subset of data.

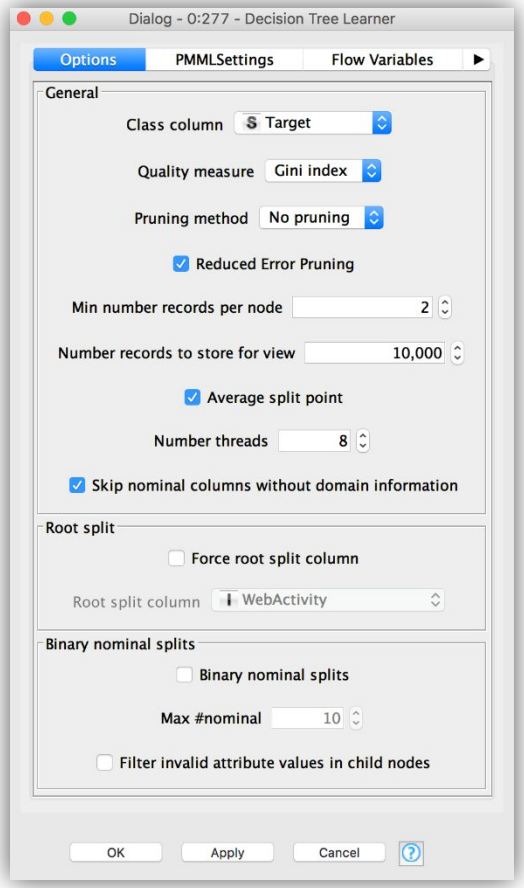


Goal: A Decision Tree

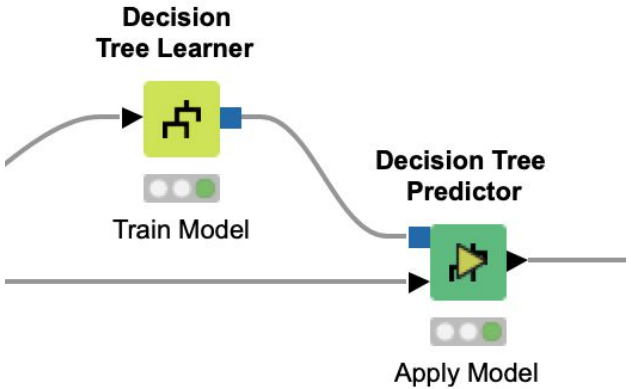
Outlook	Wind	Temp	Storage	Sailing
sunny	3	30	yes	yes
sunny	3	25	yes	no
rain	12	15	yes	yes
overcast	15	2	no	no
rain	16	25	yes	yes
sunny	14	18	yes	yes
rain	3	5	no	no
sunny	9	20	yes	yes
overcast	14	5	no	no
sunny	1	7	no	no
rain	4	25	yes	no
rain	14	24	yes	yes
sunny	11	20	yes	yes
sunny	2	18	yes	no
overcast	8	22	yes	yes
overcast	13	24	yes	yes



Decision Tree Learner



Applying the Model – What are the Outputs?



Classified Data - 0:65 - Decision Tree Predictor (Apply Model)

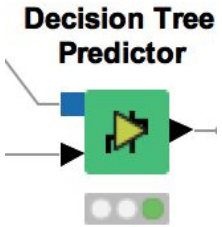
File Hilite Navigation View

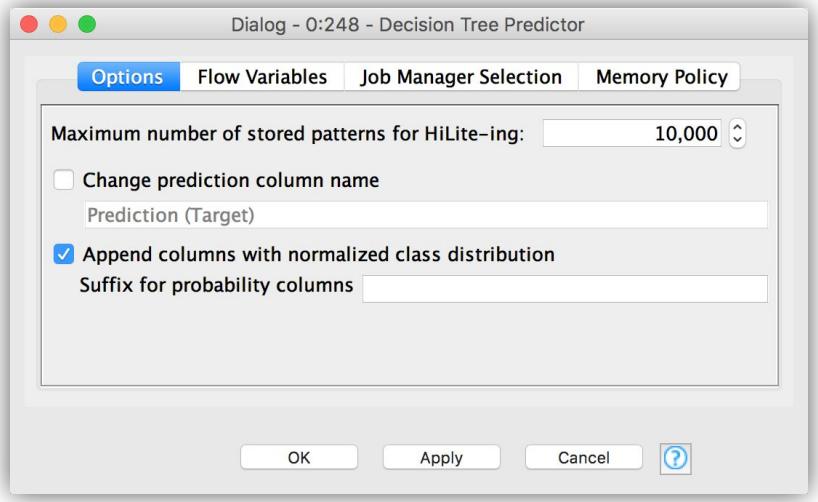
Table "default" – Rows: 879 | Spec – Columns: 82 | Properties | Flow Variables

Row ID	..	I SalePr...	S rank	D P (rank=Low)	D P (rank=High)	S Prediction (rank)
10		189000	Low	0.889	0.111	Low
11		175900	Low	1	0	Low
13		180400	Low	1	0	Low
15		212000	Low	0.946	0.054	Low
21		190000	High	0	1	High
22		170000	High	0.2	0.8	High
27		126000	Low	1	0	Low
28		115000	Low	1	0	Low
33		127500	Low	1	0	Low

Decision Tree Predictor

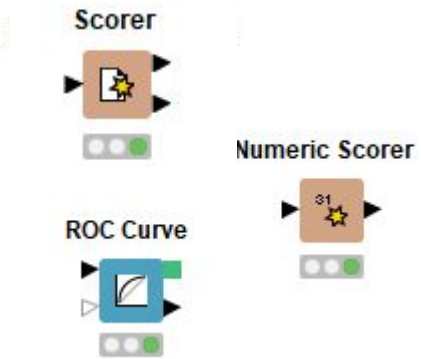
- Takes a decision tree model and apply it to new data
- Check the box to append class probabilities





Evaluation Metrics

- Why evaluation metrics?
  - Quantify the power of the model as a classifier/predictor
  - Compare model configurations and/or models, and select the best performing one
  - Obtain the expected performance of the model for new data
- Different model evaluation techniques are available for
  - Classification/regression models
  - Imbalanced/balanced target class distributions



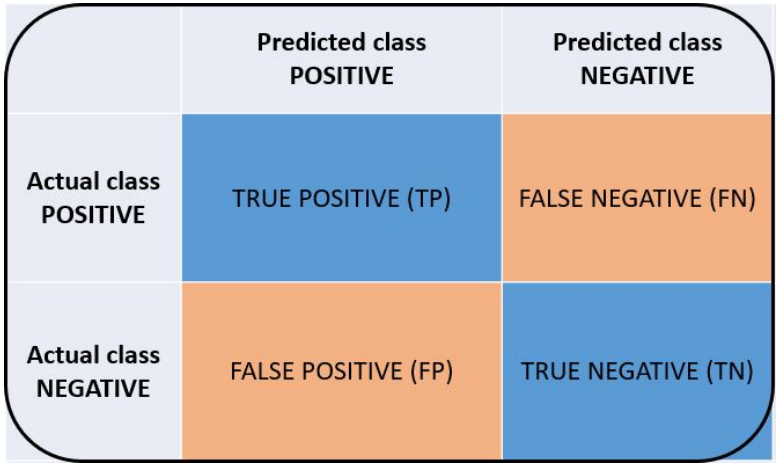
Overall Accuracy

$$Overall\ Accuracy = \frac{\#\ Correct\ Classifications}{\#\ All\ Events}$$

- The proportion of correct classifications
- Downsides:
  - Only considers the performance in general and not for the different target classes
  - Therefore, not informative when the target class distribution is unbalanced

Confusion Matrix

Arbitrarily define one target class as POSITIVE and the remaining class(es) as NEGATIVE



TRUE POSITIVE (**TP**): Actual and predicted class is positive

TRUE NEGATIVE (**TN**): Actual and predicted class is negative

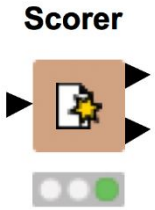
FALSE NEGATIVE (**FN**): Actual class is positive and predicted negative

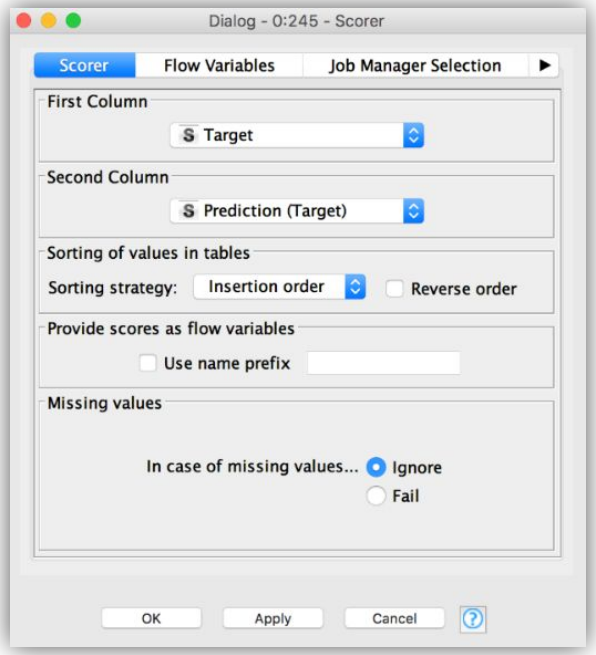
FALSE POSITIVE (**FP**): Actual class is negative and predicted positive

- Use these four statistics to calculate other evaluation metrics, such as *overall accuracy*, *true positive rate,* and *false positive rate*

Scorer

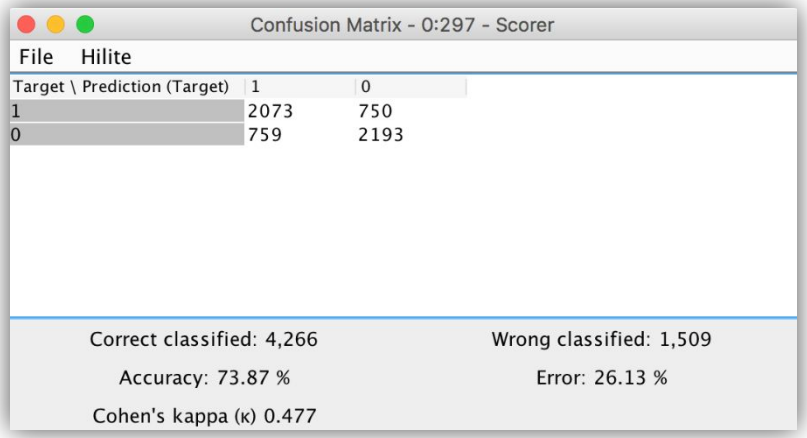
Compare predicted results to known truth in order to evaluate model quality



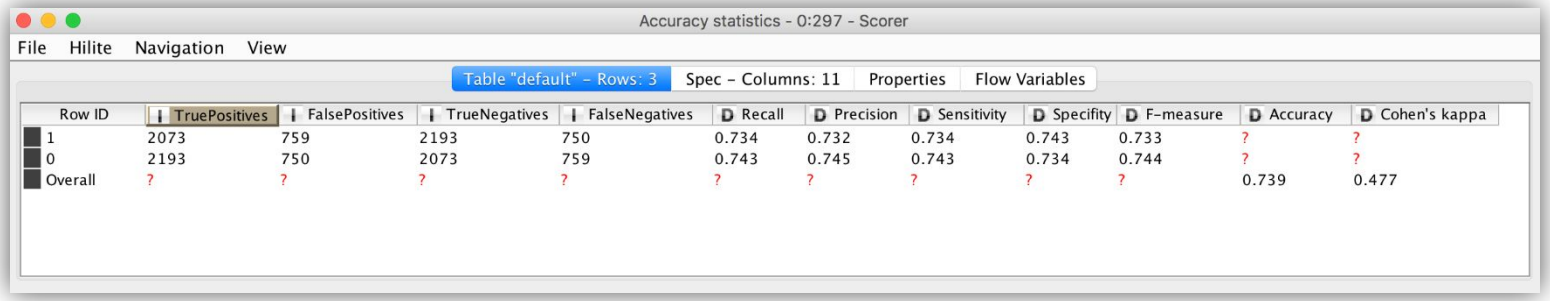


Scorer

Confusion matrix shows the distribution of model errors



An accuracy statistics table provides a detailed analysis of model quality



Row ID	TruePositives	FalsePositives	TrueNegatives	FalseNegatives	Recall	Precision	Sensitivity	Specifity	F-measure	Accuracy	Cohen's kappa
1	2073	759	2193	750	0.734	0.732	0.734	0.743	0.733	?	?
0	2193	750	2073	759	0.743	0.745	0.743	0.734	0.744	?	?
Overall	?	?	?	?	?	?	?	?	?	0.739	0.477

Exercise: 13_Training_a_Churn_Prediction_Model

- Read the CallsData.xls and ContractData.csv files
- Join the two data tables based on the columns “Area Code” and “Phone”
- Change the data type of the columns “Area Code” and “Churn” to string
- Partition the data into a training set and a test set
- Train a decision tree to detect customers that are likely to churn
- Apply the mode to the test set and evaluate the model performance

Confirmation of Attendance and Survey

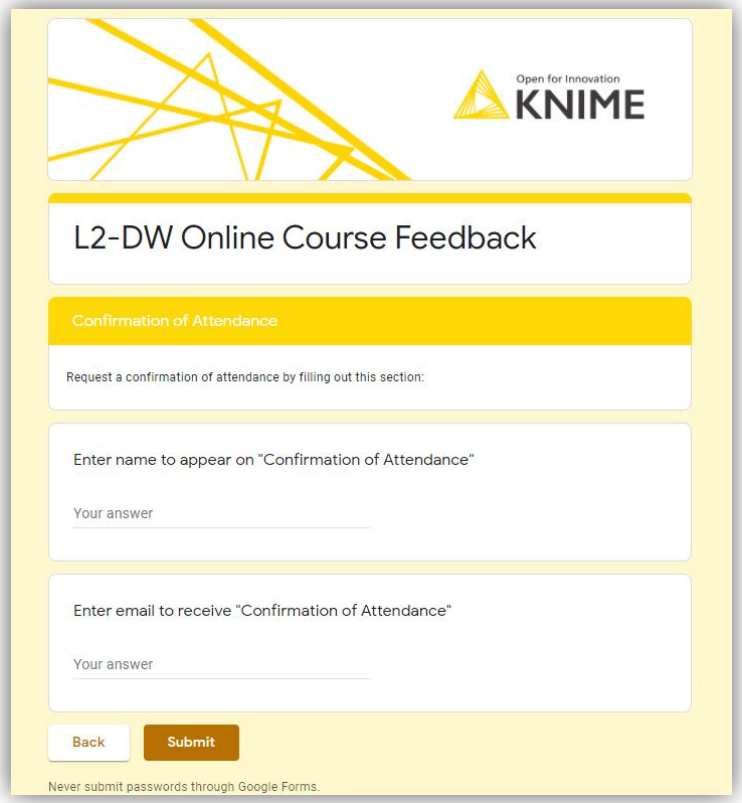
- If you would like to get a “Confirmation of Attendance” please click on the link below*

Confirmation of Attendance and Survey

- The link also takes you to our course feedback survey. Filling it in is optional but highly appreciated!

Thank you!

*Please send your request within the next 3 days



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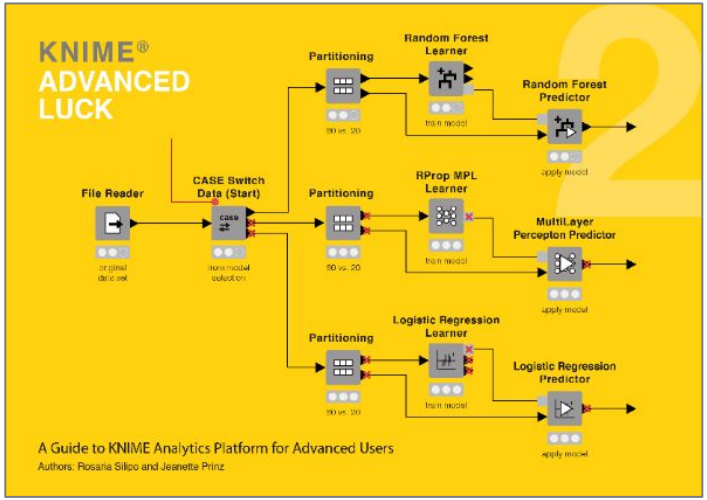

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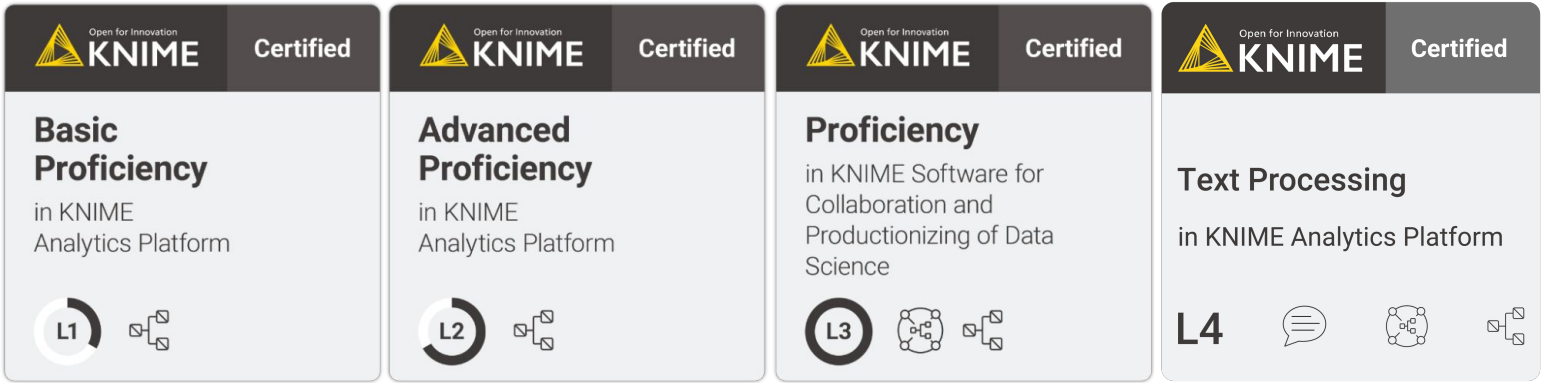

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Attachment:
How to use a local update site to install extensions

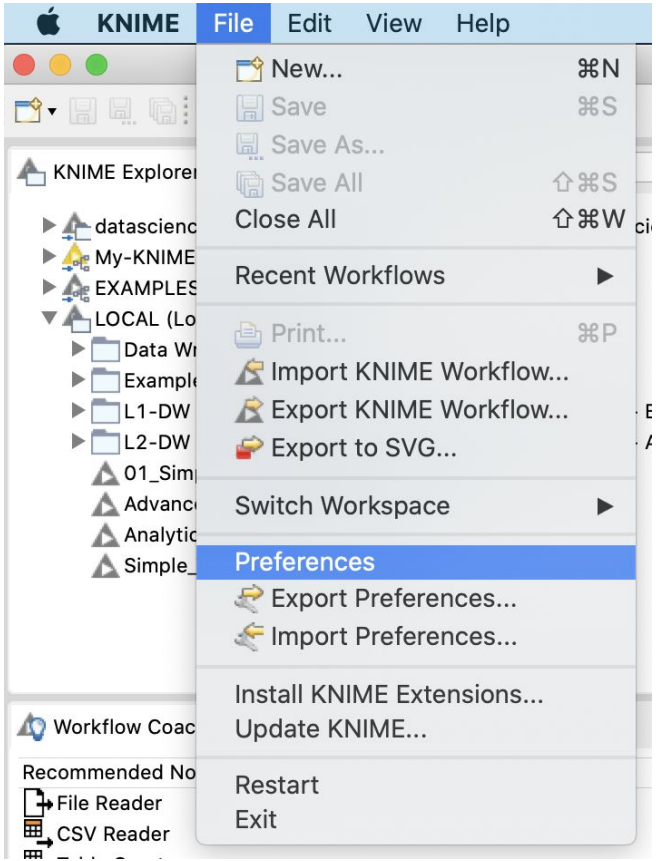
Adding a Local Update Site

- Download the update site as zip
  - KNIME update site as zip
  - Previous versions of the KNIME update site as zip
  - Community update sites as zip

Adding a Local Update Site

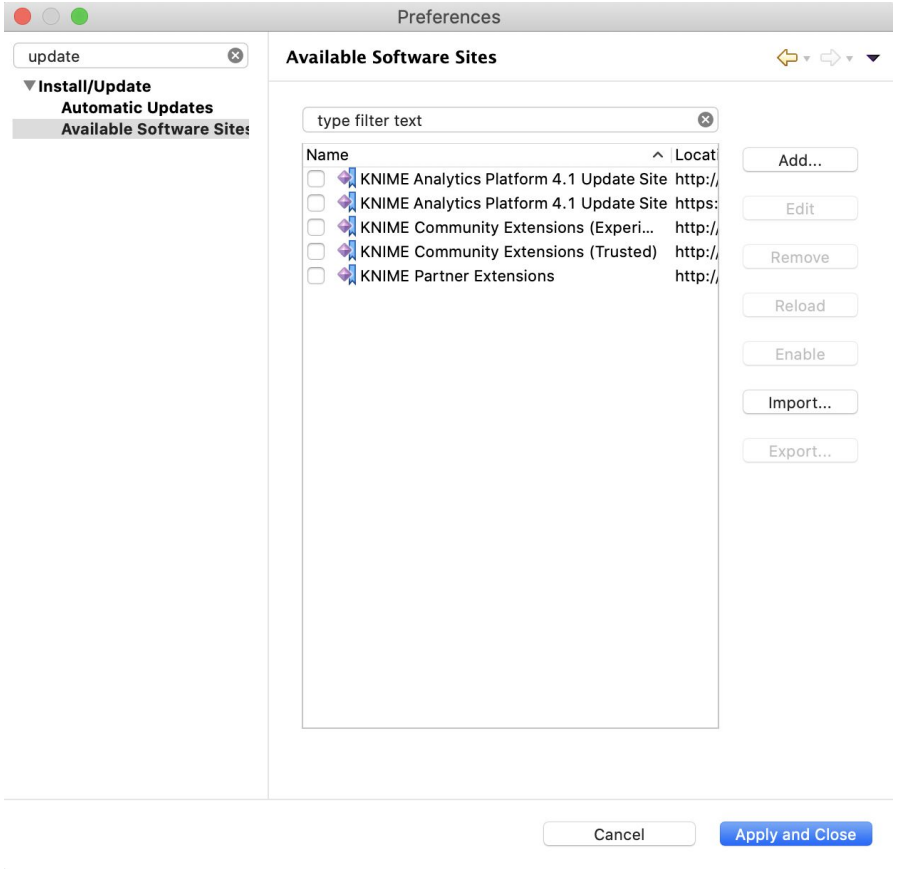
Open KNIME Analytics Platform and go to the preference page by clicking on

File -> Preferences



Adding a Local Update Site

1. Search for update (upper left search bar) and go to Available Software sites.
2. Uncheck all existing software sites.
3. Click on Add.. on the upper right.



Adding a Local Update Site

1. Define a name
2. Click on Archive and select the folder you've just downloaded
3. Click OK
4. Click Apply and Close