KNIME TUTORIAL

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Outline

- Introduction on KNIME
- KNIME components
- Exercise: Market Basket Analysis
- Exercise: Customer Segmentation
- Exercise: Churn Analysis
- Exercise: Social Network Analysis

What is KNIME?

- KNIME = Konstanz Information Miner
- Developed at University of Konstanz in Germany
- Desktop version available free of charge (Open Source)
- Modular platform for building and executing **workflows** using predefined components, called **nodes**
- Functionality available for tasks such as **standard data mining, data analysis** and **data manipulation**
- Extra features and functionalities available in KNIME by extensions
- Written in Java based on the Eclipse SDK platform

KNIME resources

- Web pages containing documentation
  - www.knime.org - tech.knime.org – tech.knime.org
  - installation-0
- Downloads
  - knime.org/download-desktop
- Community forum
  - tech.knime.org/forum
- Books and white papers
  - knime.org/node/33079

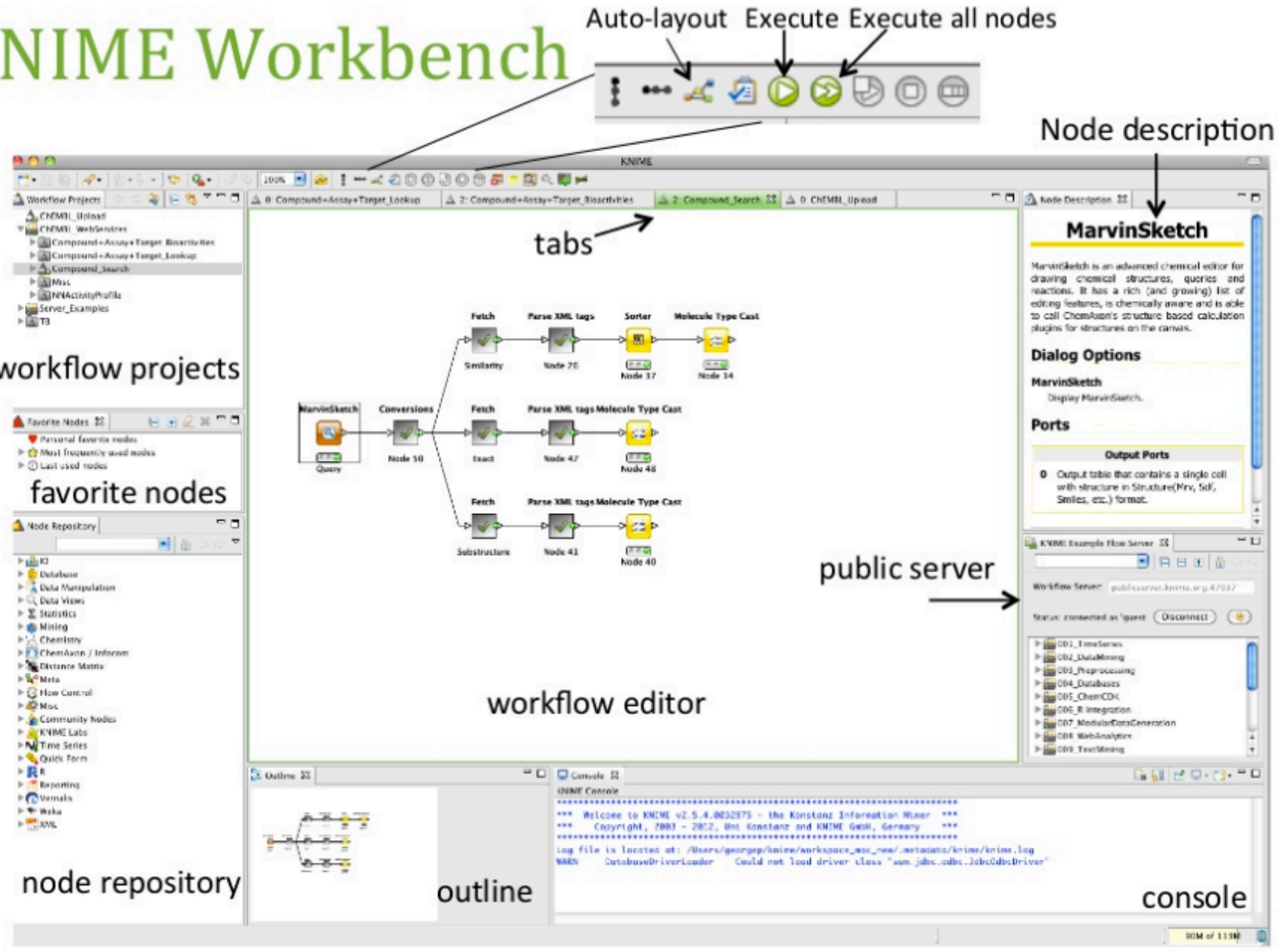
What can you do with KNIME?

- Data manipulation and analysis
  - File & database I/O, filtering, grouping, joining, ….
- Data mining / machine learning
  - WEKA, R, Interactive plotting
- Scripting Integration
  - R, Perl, Python, Matlab …
- Much more
  - Bioinformatics, text mining and network analysis

Installation and updates

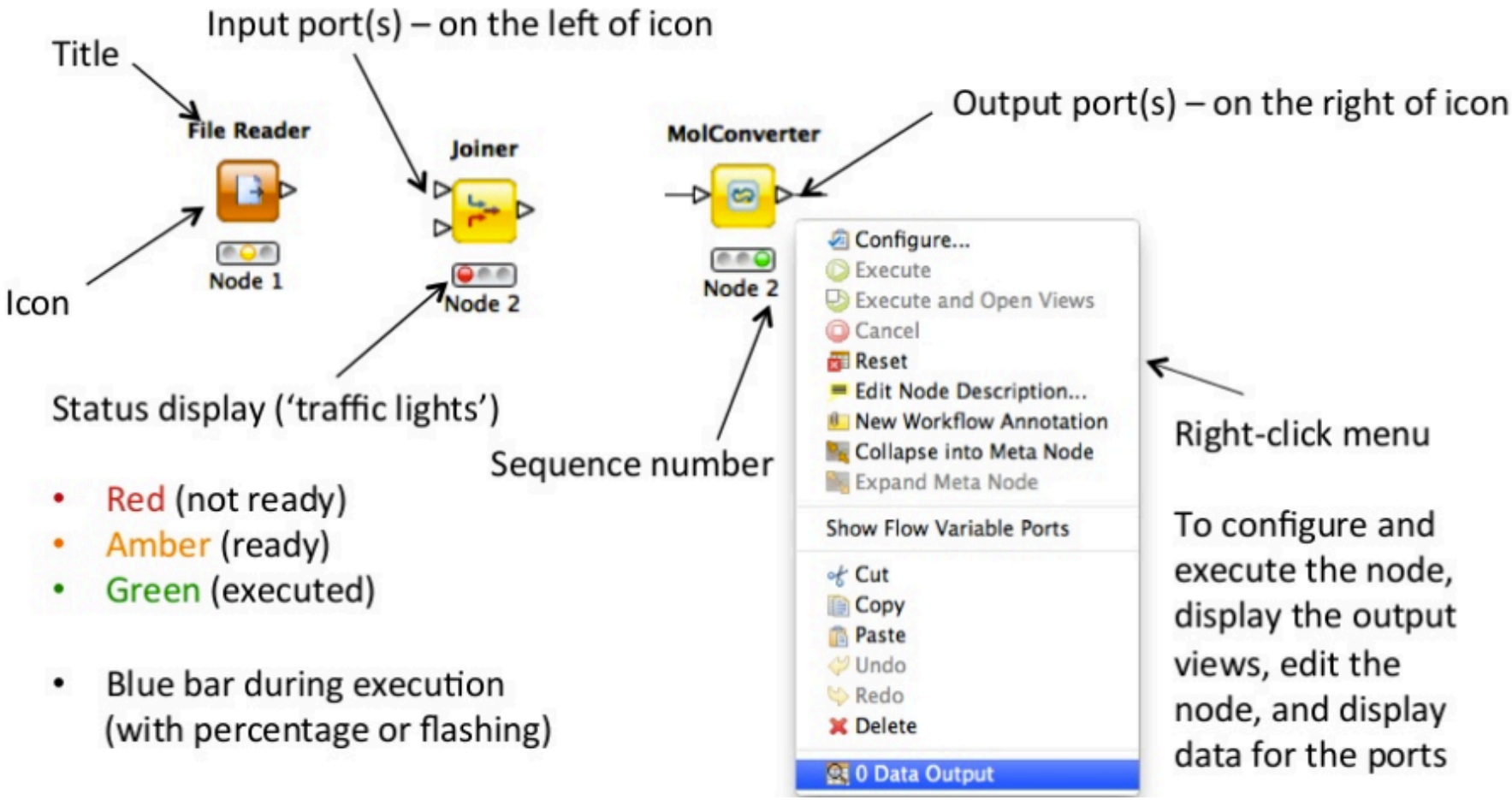
- Download and unzip KNIME
  - No further setup required
  - Additional nodes after first launch
- New software (nodes) from update sites
  - http://tech.knime.org/update/community-contributions/realease
- Workflows and data are stored in a *workspace*

KNIME Workbench



KNIME nodes: Overview

Node = basic processing unit of KNIME workflow which performs a particular task



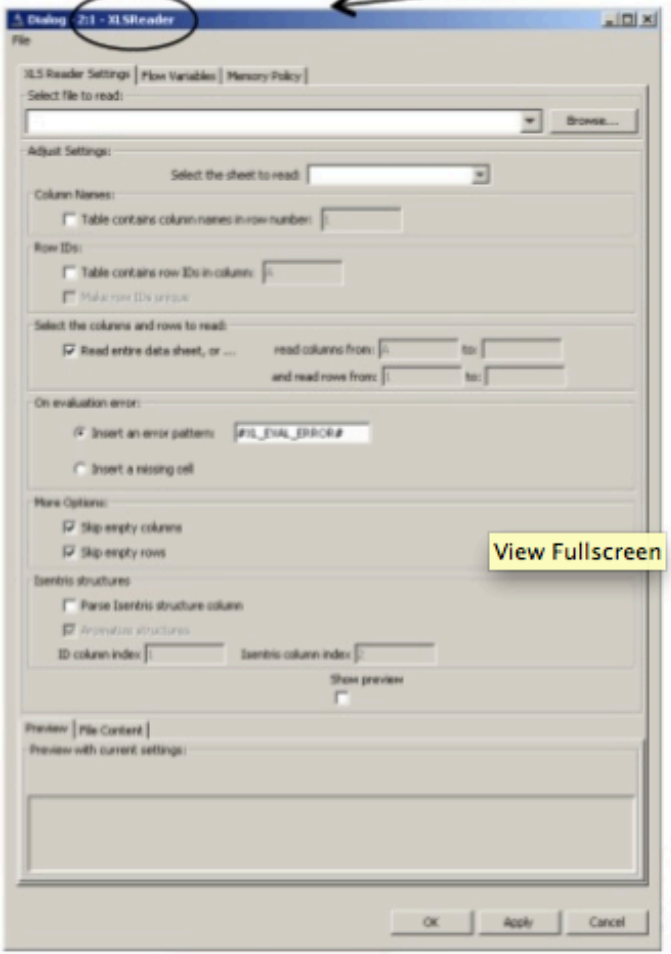
- Red (not ready)
- Amber (ready)
- Green (executed)

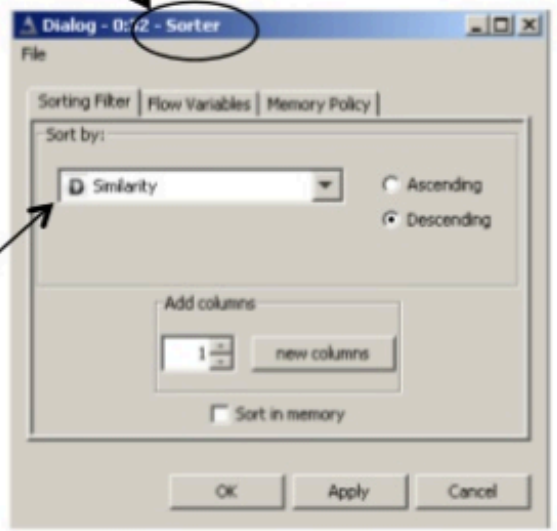
- Blue bar during execution (with percentage or flashing)

KNIME nodes: Dialogs

Double click to configure…

Configuration menus for selected nodes

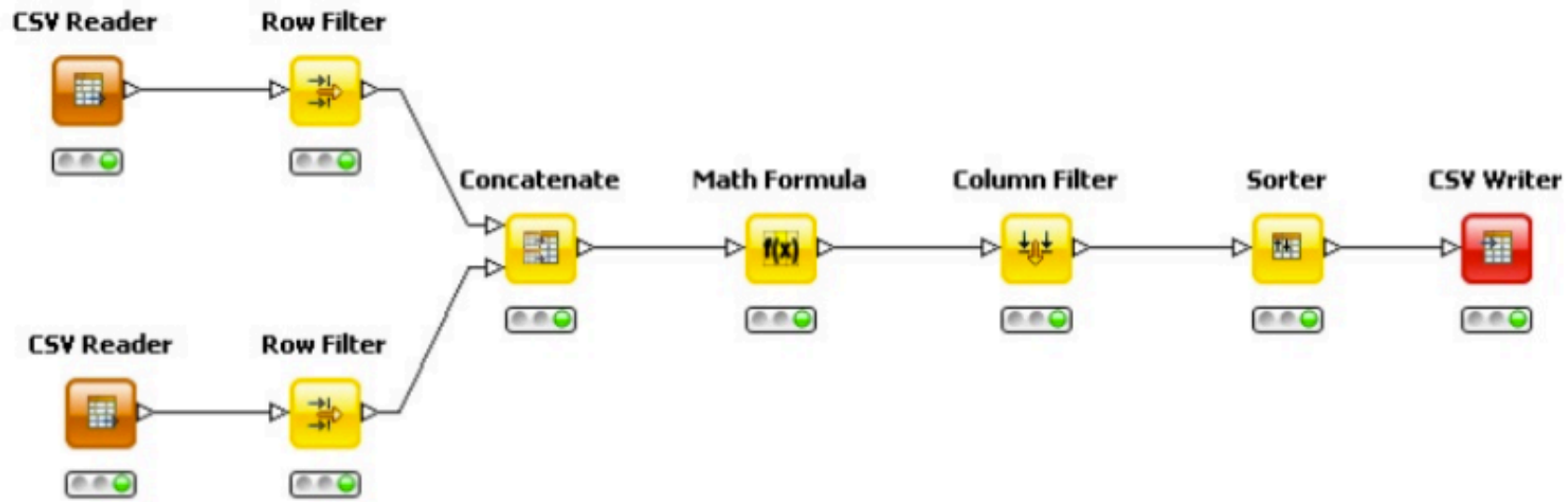




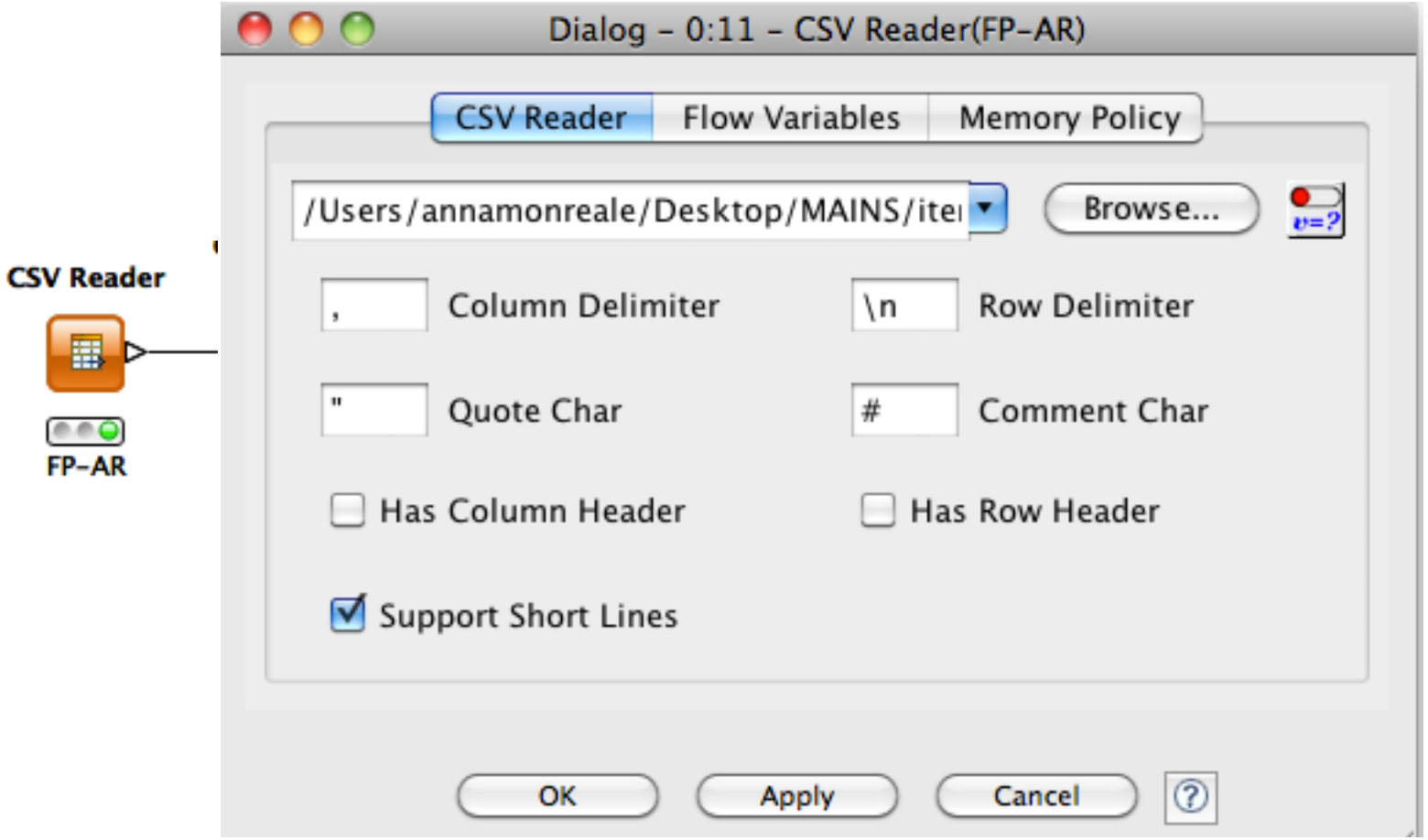
Explicit column type

An example of workflow

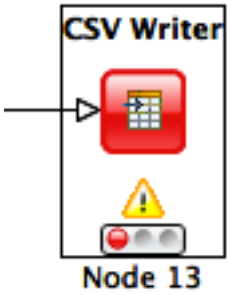
- Workflows can be imported and exported as .zip files
  - With or without the underlying data
  - File → Import KNIME workflow…
  - File → Export KNIME workflow…

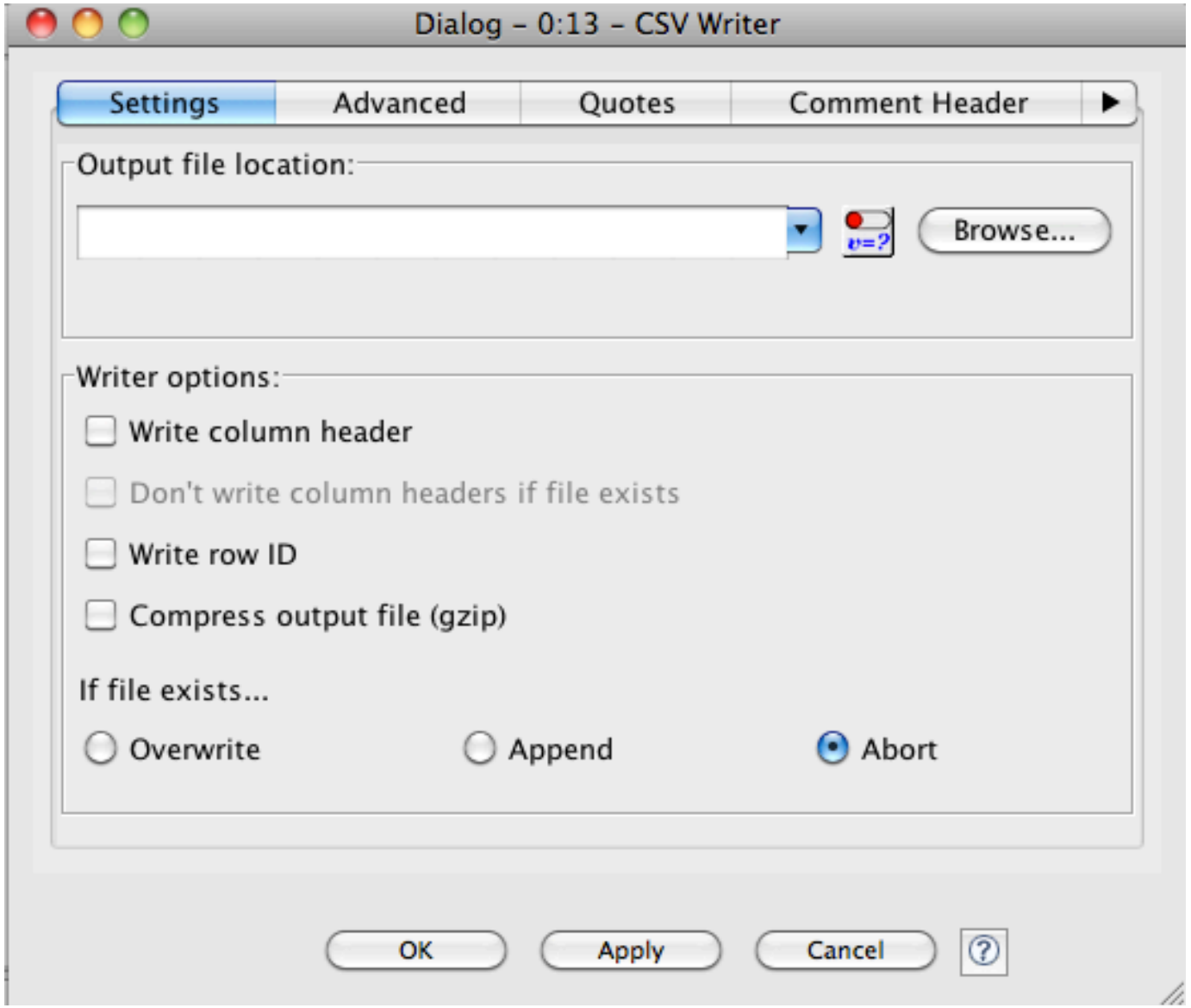


CSV Reader


CSV Reader
FP-AR
Dialog - 0:11 - CSV Reader(FP-AR)
CSV Reader
Flow Variables
Memory Policy
/Users/annamonreale/Desktop/MAINS/ite
Browse...
,
Column Delimiter
\n
Row Delimiter
"
Quote Char
#
Comment Char
Has Column Header
Has Row Header
Support Short Lines
OK
Apply
Cancel

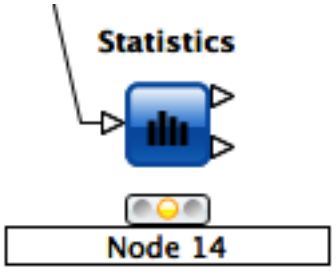
CSV Writer

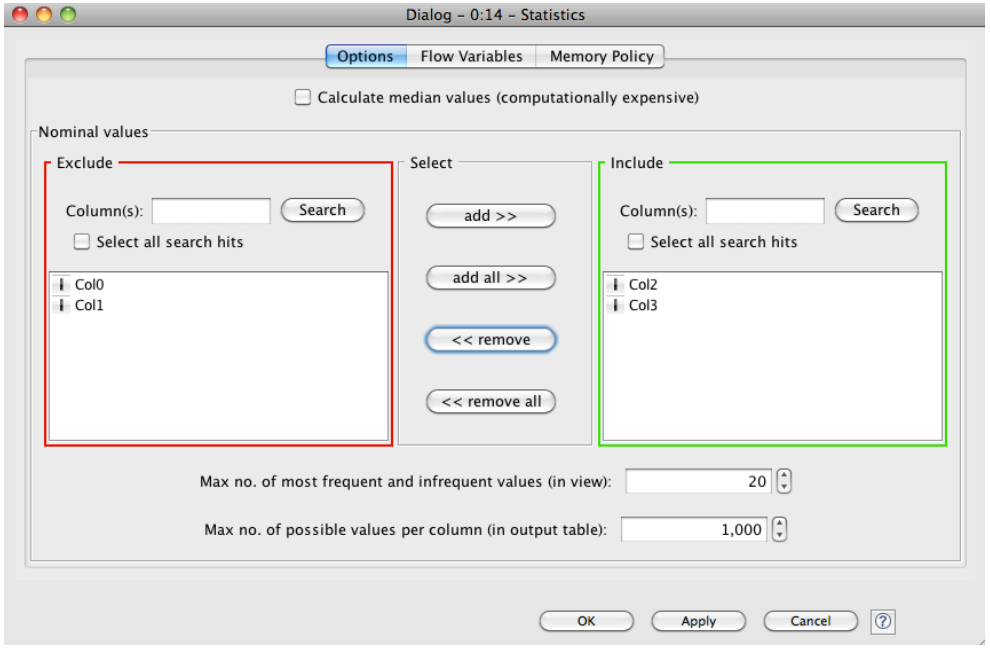

CSV Writer
Node 13


Dialog – 0:13 – CSV Writer
Settings
Advanced
Quotes
Comment Header
Output file location:
Browse...
Writer options:
Write column header
Don't write column headers if file exists
Write row ID
Compress output file (gzip)
If file exists...
Overwrite
Append
Abort
OK
Apply
Cancel

Statistics node

- For all numeric columns computes statistics such as
- **minimum**, **maximum**, **mean**, **standard deviation**, **variance**, **median**, **overall sum**, **number of missing values** and **row counts**
- For all nominal values counts them together with their occurrences.

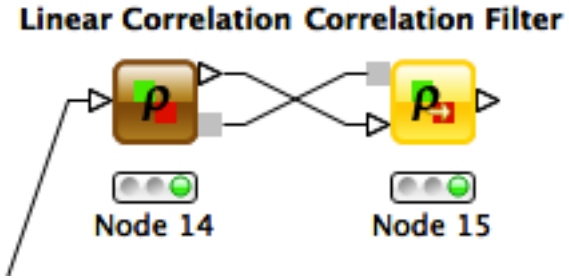




Correlation Analysis

- **Linear Correlation node** computes for each pair of selected columns a correlation coefficient, i.e. a measure of the correlation of the two variables
  - Pearson Correlation Coefficient

- **Correlation Filtering node** uses the model as generated by a Correlation node to determine which columns are redundant (i.e. correlated) and filters them out.
  - **The output table will contain the reduced set of columns.**



Data Views

- Box Plots
- Histograms,Pie Charts, Scatter plots, …
- Scatter Matrix

Data Manipulation

- Three main sections
  - **Columns**: binning, replace, filters, normalizer, missing values, …
  - **Rows**: filtering, sampling, partitioning, …
  - **Matrix**: Transpose

Mining Algorithms

- Clustering
  - Hierarchical
  - K-means
  - Fuzzy –c-Means
- Decision Tree
- Item sets / Association Rules
  - Borgelt's Algorithms
- Weka

EXERCISES

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Exercises and Final Exams

- **3 Exercises**
  - Market Basket Analysis
  - Customer segmentation with k-means
  - Churn analysis with decision trees

- **Final Exam**
- A report describing the three analysis and your findings

MARKET BASKET ANALYSIS

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Market Basket Analysis

- **Problem**: given a database of transactions of customers of a supermarket, find **the set of frequent items co-purchased** and analyze the **association rules** that is possible to derive from the frequent patterns.

- Provide a short document (max three pages in pdf, excluding figures/plots) which illustrates the input dataset, the adopted frequent pattern algorithm and the association rule analysis.

DATA DESCRIPTION

- A sample of transaction data from a Supermarket
  - 15 days of May 2010
  - About 35,200 transactions

- Two versions of the transaction dataset
  1. Each transaction (row) has the **list of product_id** purchased by a client (File: *TDB_product.csv*)
  2. Each transaction (row) has the **list of segment_id** of the product purchased by a client (File: *TDB_segment.csv*)

- Segment_id is an aggregation of articles

- Performing the analysis on both and compare the results

- Additional Files contain the **description of each code**
  - *Description_mkts.csv* and *Description_product.csv*

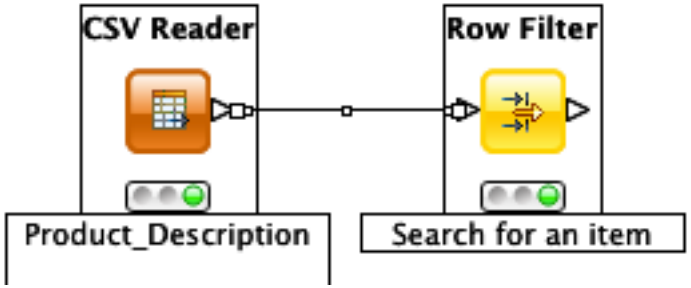
Frequent Patterns and AR in KNIME

- Use the nodes implementing the Borgelt's Algorithms:

- **Item Set Finder node** provides different algorithms:
  - Apriori (Agrawal et al. 1993)
  - FPgrowth (frequent pattern growth, Han et al 2000)
  - RElim (recursive elimination)
  - SaM (Split and Merge)
  - JIM (Jaccard Item Set Mining)
- **AR Learner uses Apriori Algorithm**

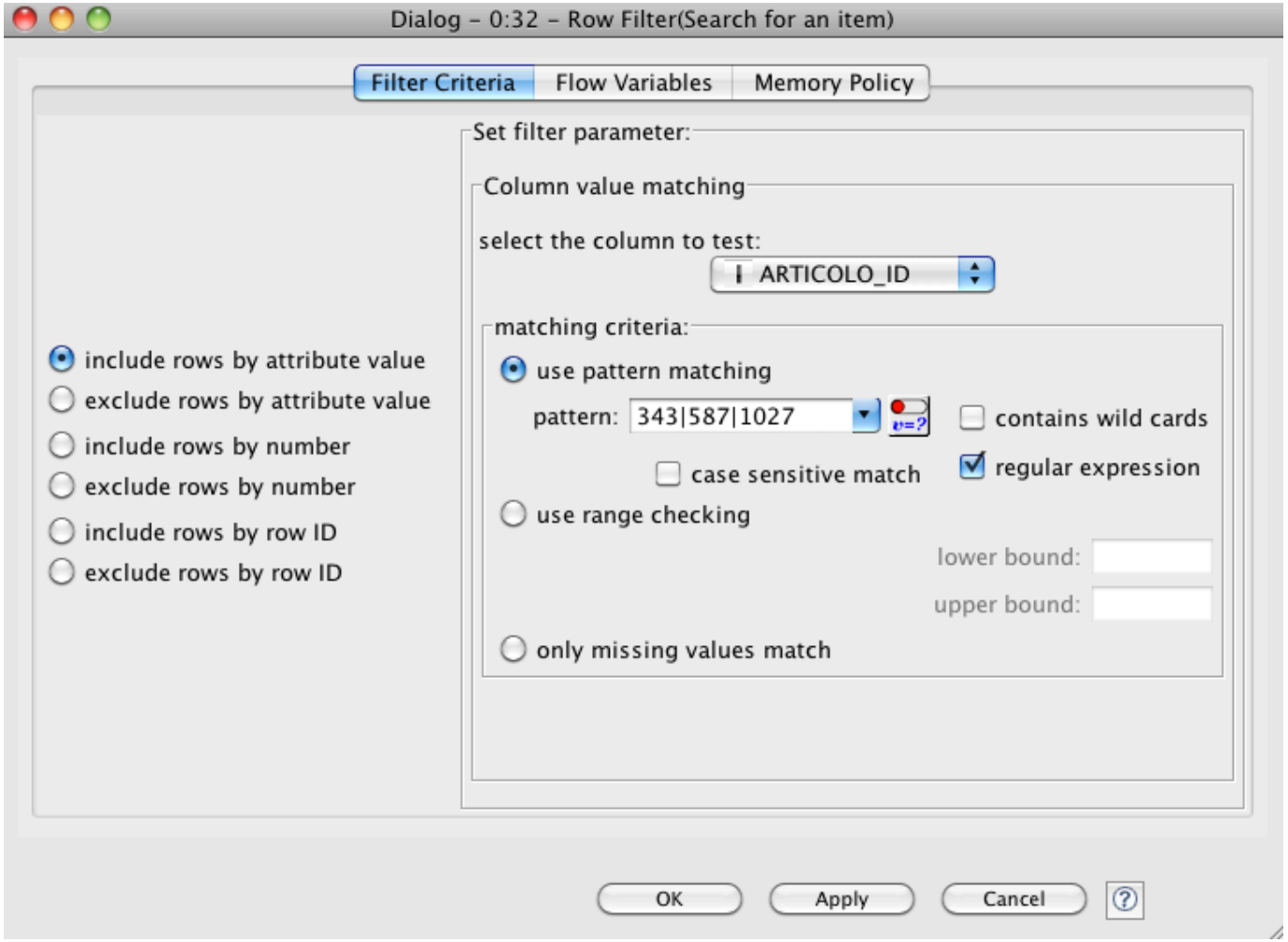
Search for description of items

- Suppose that the rule is [343,587] →[1027]
- Use the workflow for the product description to find the meaning of the products

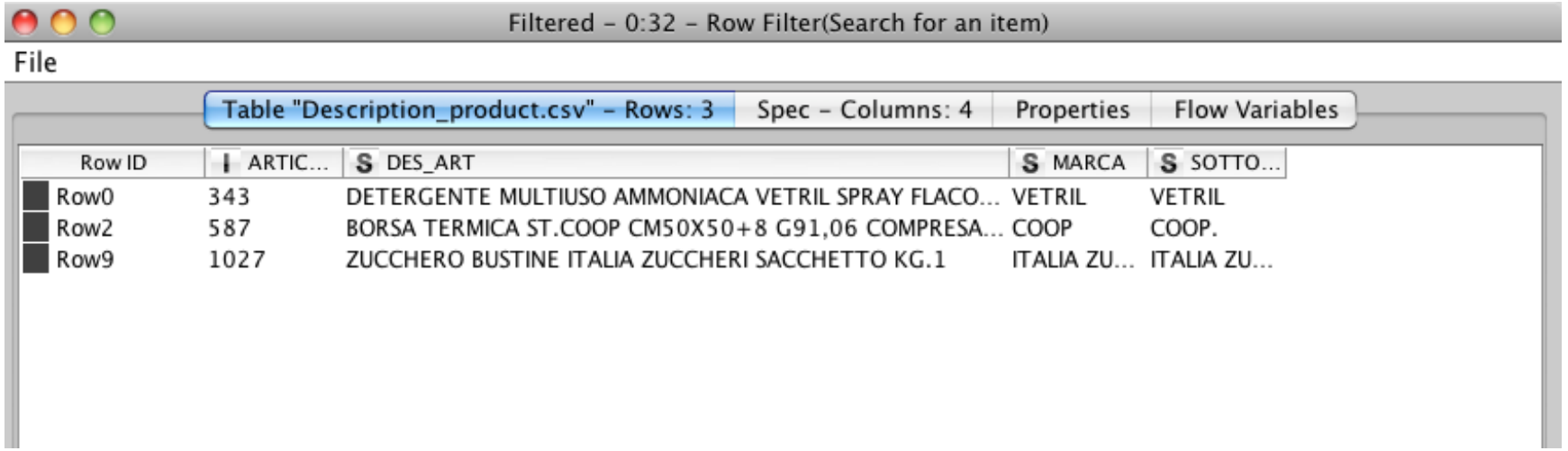


Search for description of items

- Configure Row Filter with a regular expression capturing all the records containing one of the 3 code products

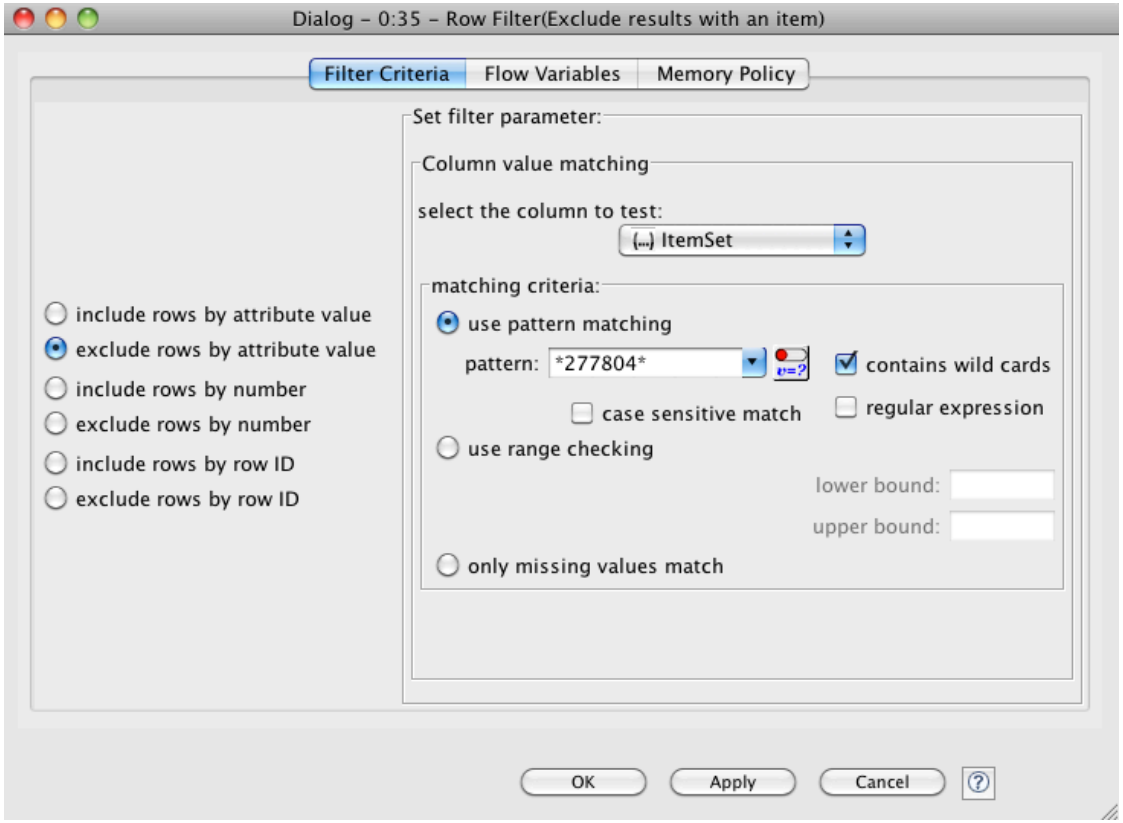


….. the output table



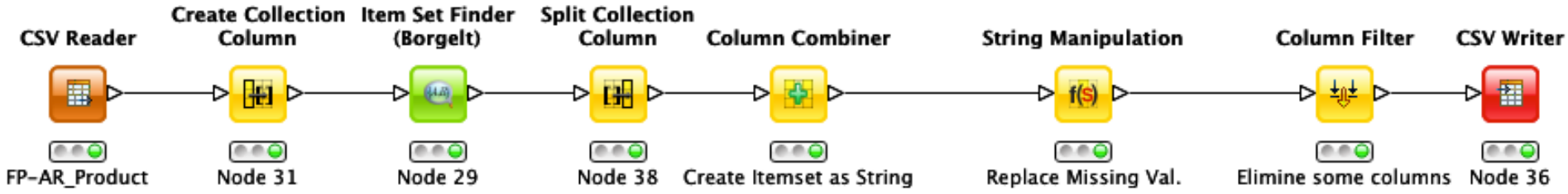
Filter out an item from output itemset/ AR

- Suppose that you want to filter out all item sets **containing the item 277804** (shopper bag).
- Configure Row Filter with the following regular expression



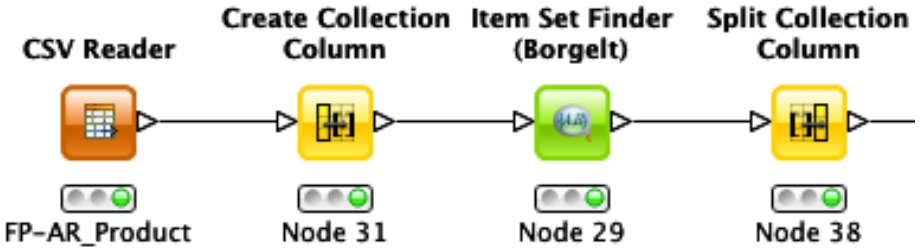
Write the itemsets in a file

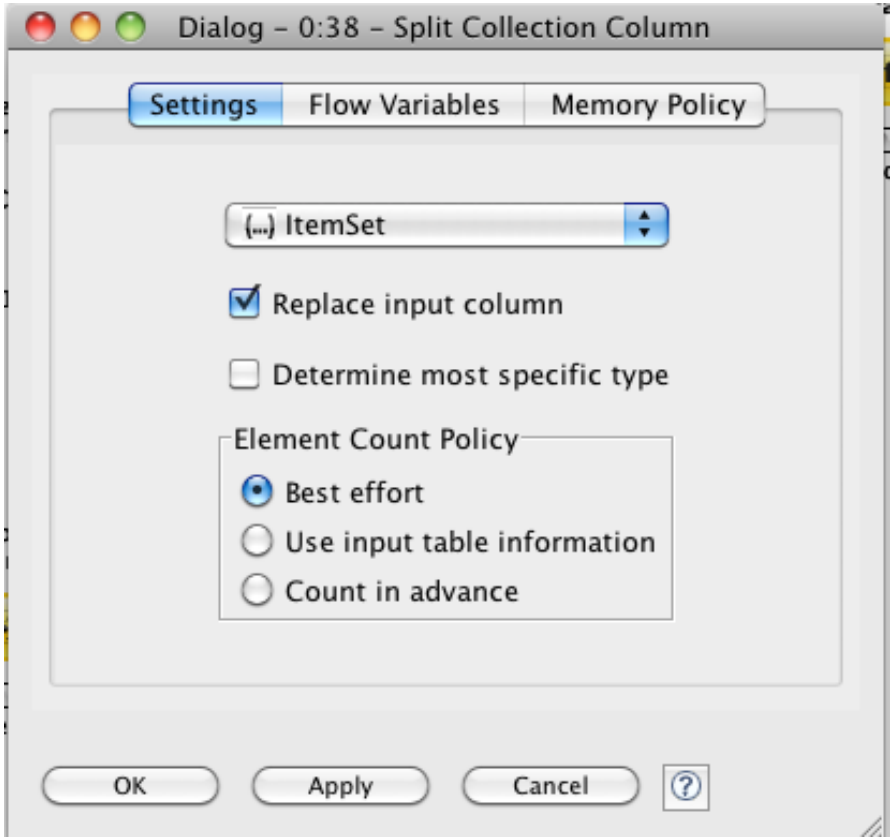
- Given the output of the Item set Finder node some time you cannot see all the components of the itemset so we need to transform it in a string and then we can also write the result in a file



Write the itemsets in a file

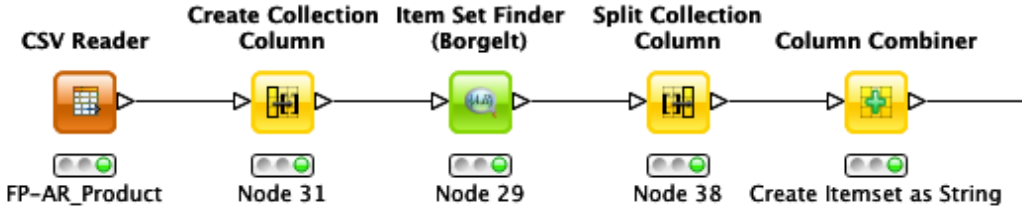
- First we need to split the collection

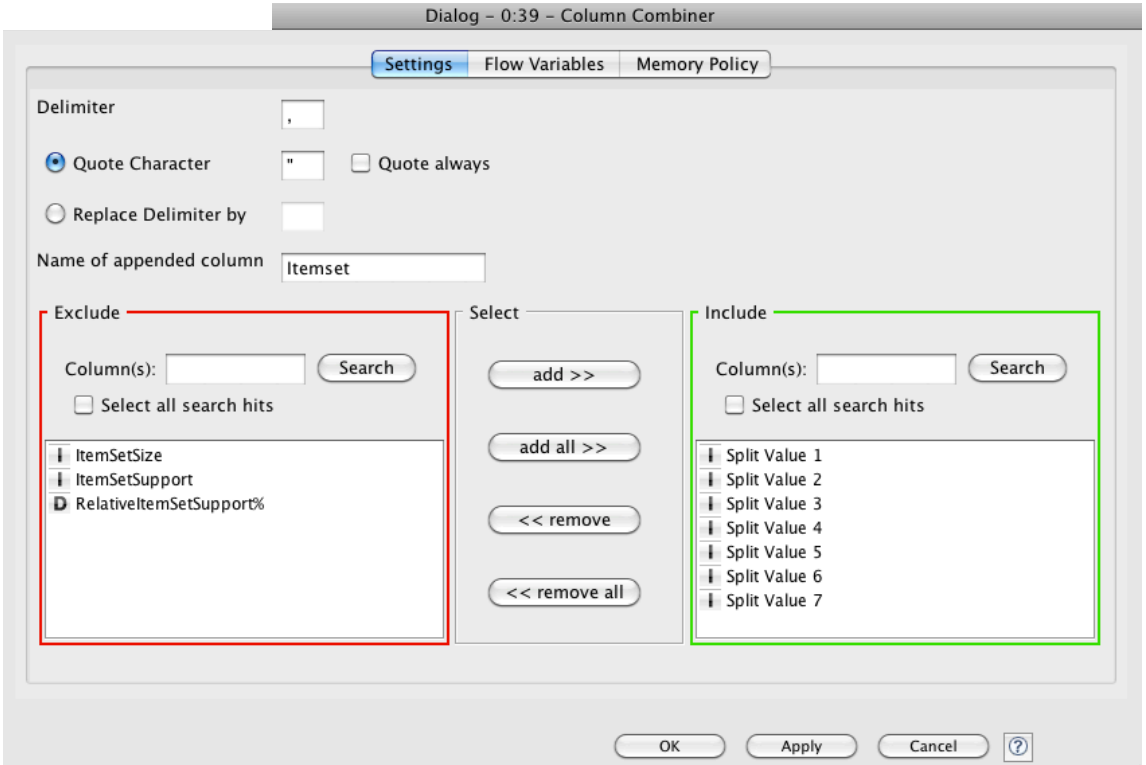




Write the itemsets in a file

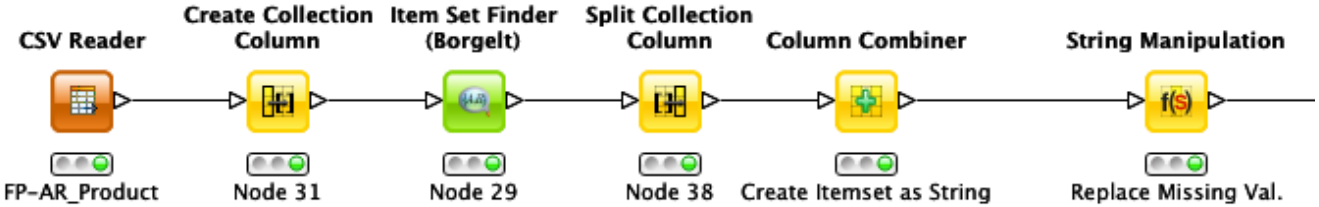
- Second we combine the columns that have to compose the itemset (string)



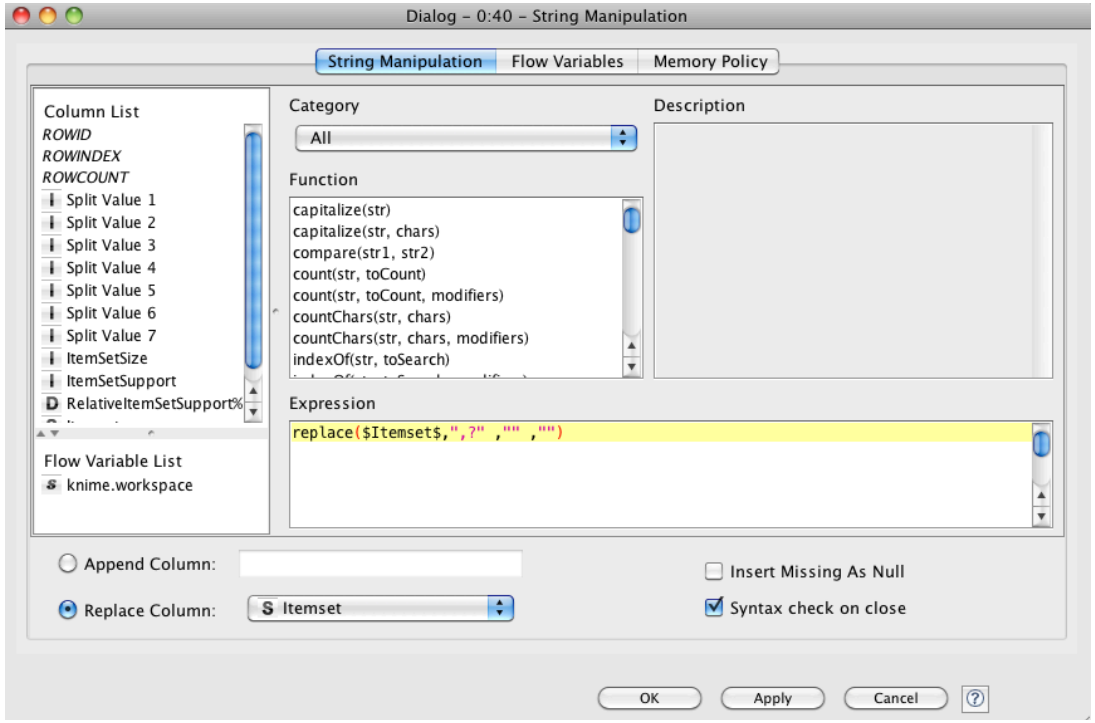


Write the itemsets in a file

- The combiner does not eliminate the missing values “?”
- The combined itemsets contain a lot of “?”

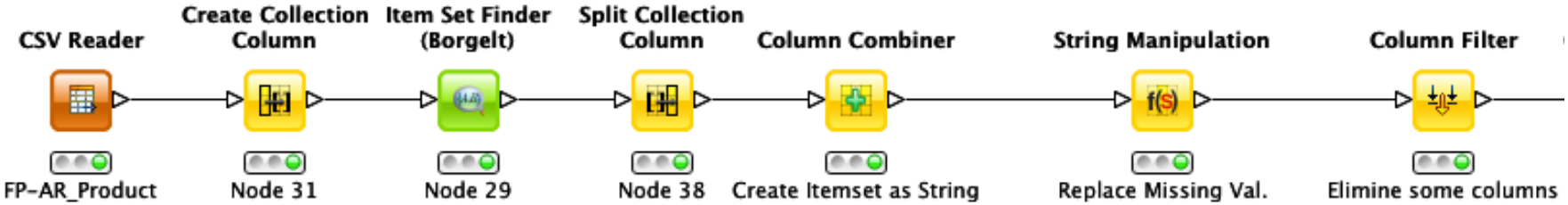


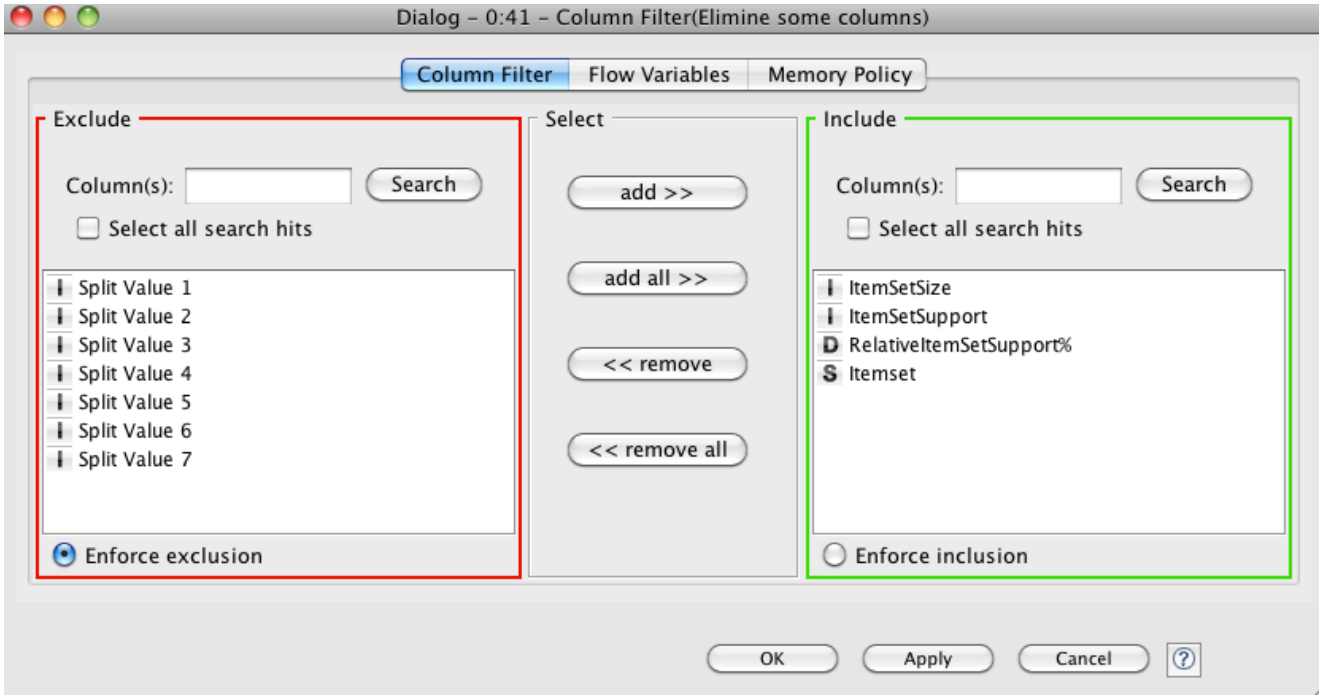
- We use the **replace** operation to eliminate them



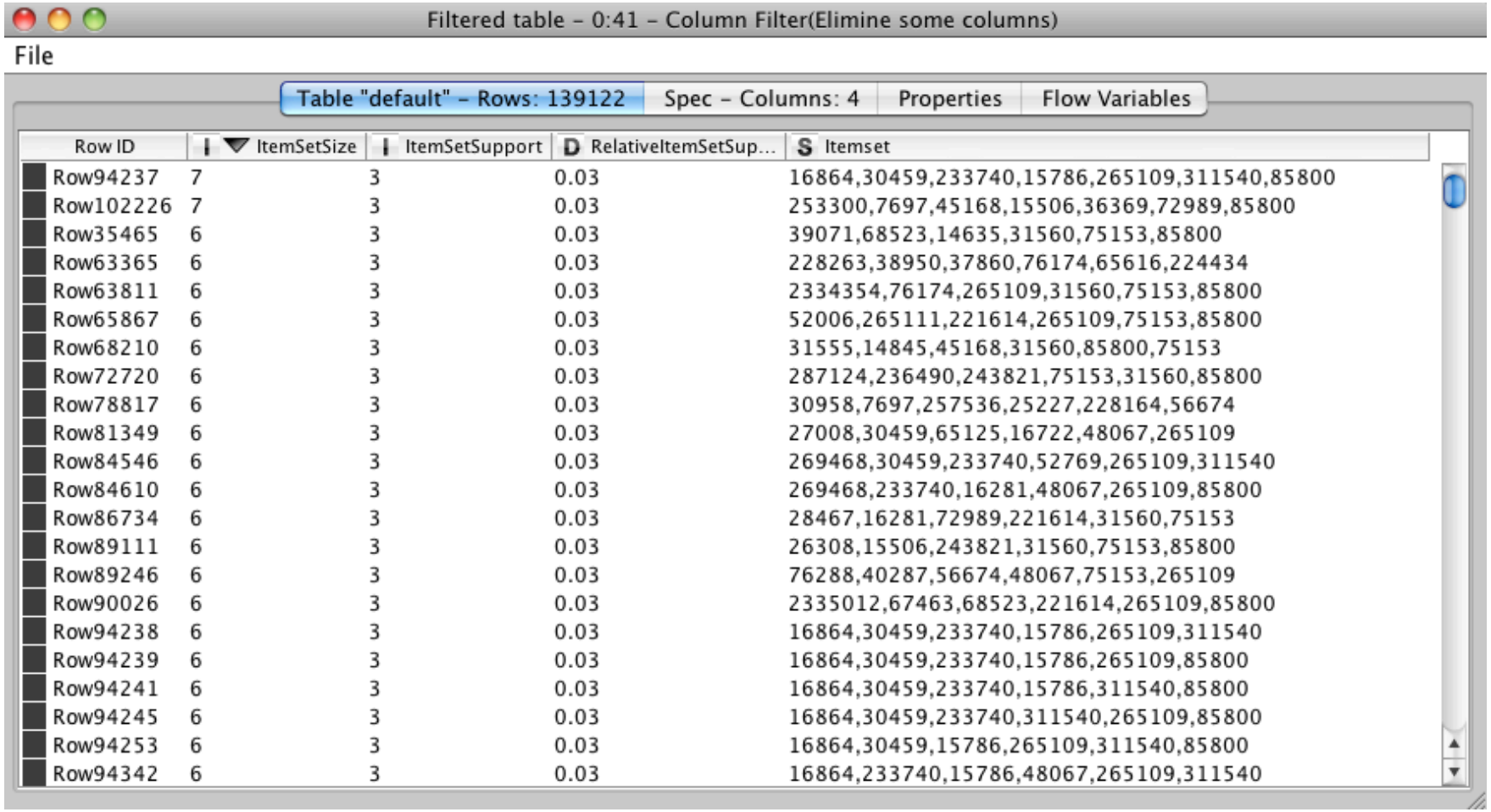
Write the itemsets in a file

- Before writing in a file eliminate the split columns





….. The output table that will write

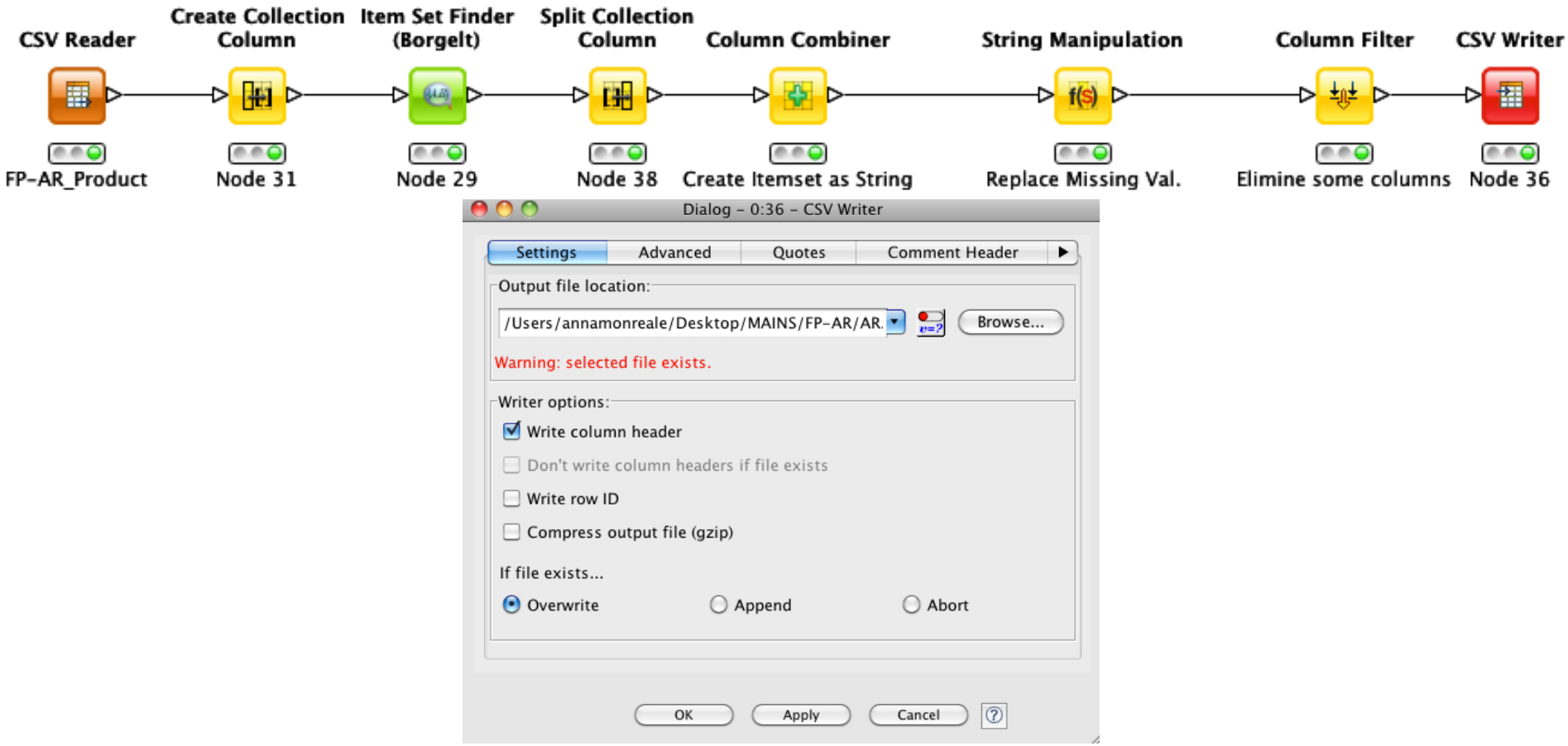


Row ID	ItemSetSize	ItemSetSupport	RelativeItemSetSup…	Itemset
Row94237	7	3	0.03	16864,30459,233740,15786,265109,311540,85800
Row102226	7	3	0.03	253300,7697,45168,15506,36369,72989,85800
Row35465	6	3	0.03	39071,68523,14635,31560,75153,85800
Row63365	6	3	0.03	228263,38950,37860,76174,65616,224434
Row63811	6	3	0.03	2334354,76174,265109,31560,75153,85800
Row65867	6	3	0.03	52006,265111,221614,265109,75153,85800
Row68210	6	3	0.03	31555,14845,45168,31560,85800,75153
Row72720	6	3	0.03	287124,236490,243821,75153,31560,85800
Row78817	6	3	0.03	30958,7697,257536,25227,228164,56674
Row81349	6	3	0.03	27008,30459,65125,16722,48067,265109
Row84546	6	3	0.03	269468,30459,233740,52769,265109,311540
Row84610	6	3	0.03	269468,233740,16281,48067,265109,85800
Row86734	6	3	0.03	28467,16281,72989,221614,31560,75153
Row89111	6	3	0.03	26308,15506,243821,31560,75153,85800
Row89246	6	3	0.03	76288,40287,56674,48067,75153,265109
Row90026	6	3	0.03	2335012,67463,68523,221614,265109,85800
Row94238	6	3	0.03	16864,30459,233740,15786,265109,311540
Row94239	6	3	0.03	16864,30459,233740,15786,265109,85800
Row94241	6	3	0.03	16864,30459,233740,15786,311540,85800
Row94245	6	3	0.03	16864,30459,233740,311540,265109,85800
Row94253	6	3	0.03	16864,30459,15786,265109,311540,85800
Row94342	6	3	0.03	16864,233740,15786,48067,265109,311540

- **Now you can see all the items in a set!!!**

Write the itemsets in a file

- Now we can complete the workflow with the **CSV Writer**



CUSTOMER SEGMENTATION

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Customer Segmentation

- **Problem:** given the dataset of RFM (Recency, Frequency and Monetary value) measurements of a set of customers of a supermarket, find a high-quality clustering using K-means and discuss the profile of each found cluster (in terms of the purchasing behavior of the customers of each cluster).

- Applying also the Hierarchical clustering and compare the results

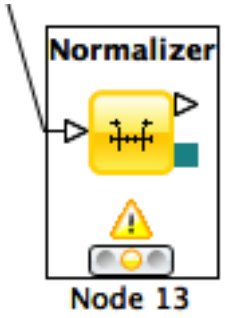
- Provide a short document (max three pages in pdf, excluding figures/plots) which illustrates the input dataset, the adopted clustering methodology and the cluster interpretation.

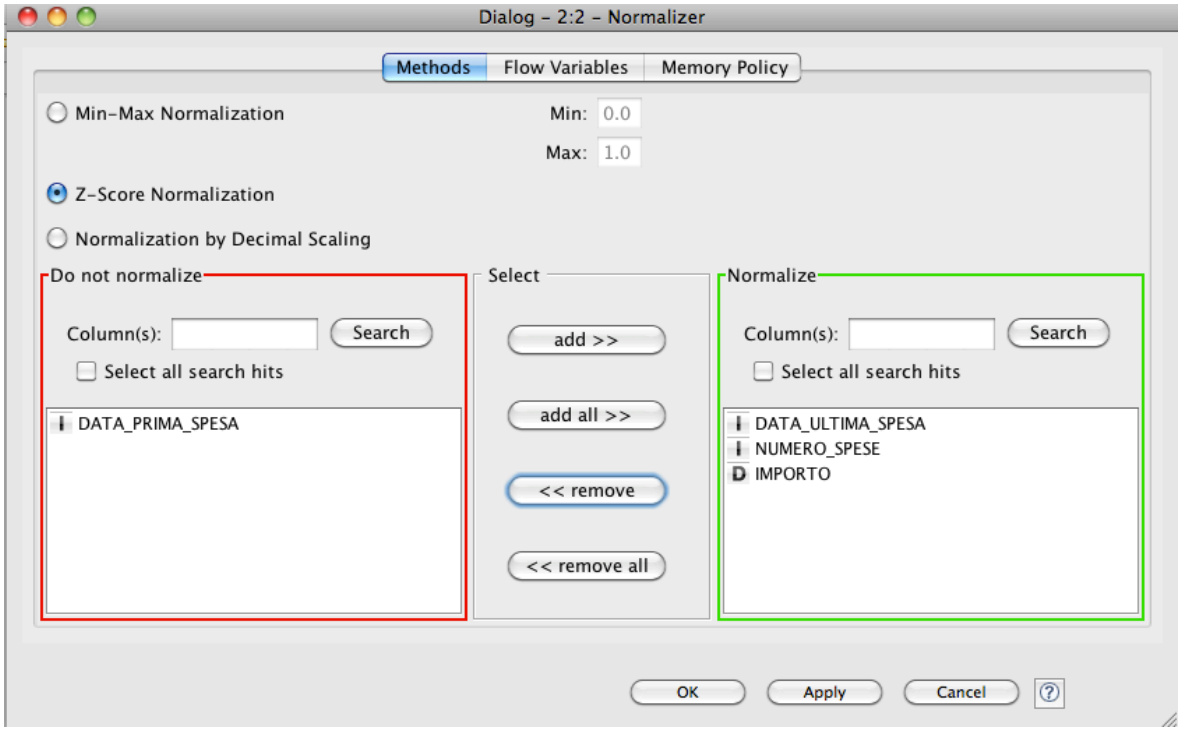
DATA

- **Dataset filename**: rfm_data.csv.
- **Dataset legend**: for each customer, the dataset contains
  - *date_first_purchase*: integer that indicates the date of the first purchase of the customer
  - *date_last_purchase*: integer that indicates the date of the last purchase of the customer
  - *Number of purchases*: number of different purchases in terms of receipts
  - *Amount*: total money spent by the customer
- Need to vompute the columns for
  - *Recency*: no. of days since last purchase
  - *Frequency*: no. of visits (shopping in the supermarket) in the observation period
  - *Monetary value*: total amount spent in purchases during the observation period.

Clustering in KNIME

- Data normalization
  - Min-max normalization
  - Z-score normalization
- Compare the clustering results before and after this operation and discuss the comparison

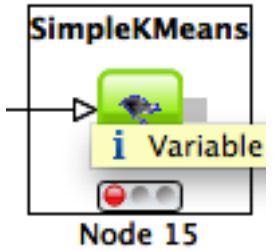




K-Means

- Two options
  - K-means in Mining section of Knime

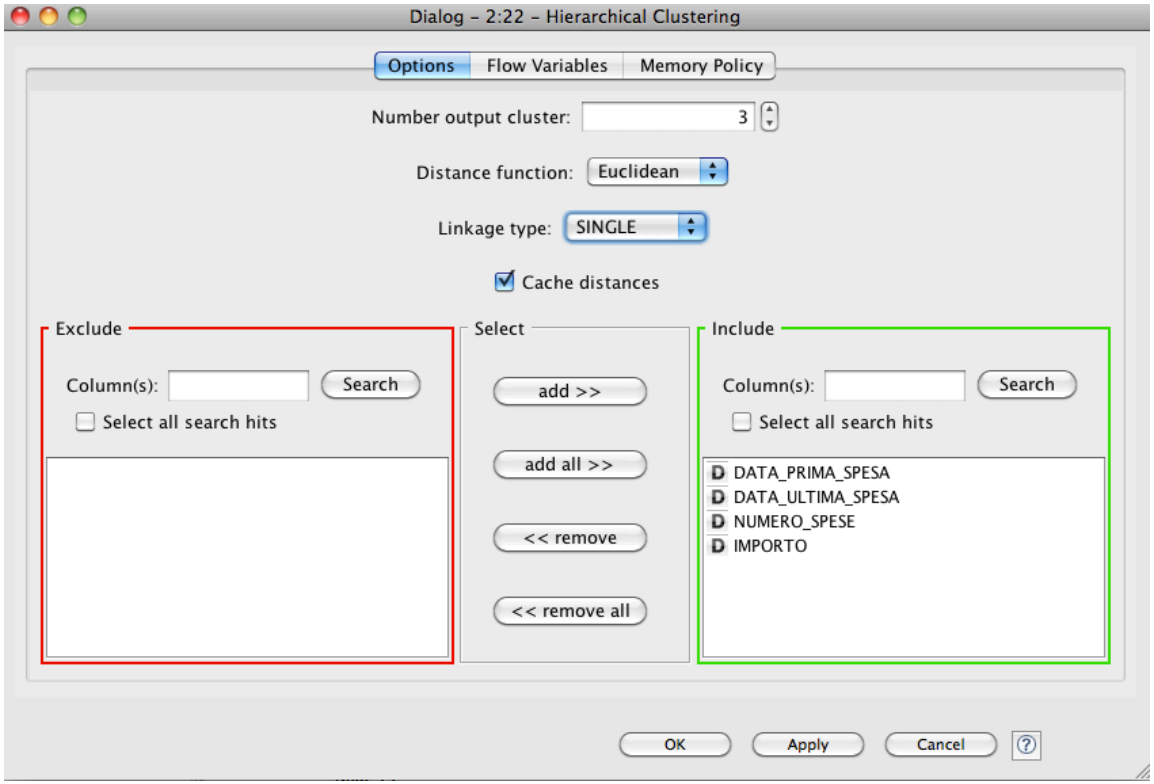
  - K-means in Weka section of Knime



- The second one allows the SSE computation useful for finding the best k value

Hierarchical Clustering

- The node is in Mining section
- Allow to generate the dendogram
- Various Distances



CHURN ANALYSIS

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Churn Analysis

- **Problem**: Problem: given a dataset of measurements over a set of customers of an e-commenrce site, find a high-quality classifier, using decision trees, which predicts whether each customers will place only one or more orders to the shop.

- Provide a short document (max three pages in pdf, excluding figures/plots) which illustrates the input dataset, the adopted clustering methodology and the cluster interpretation.

Data

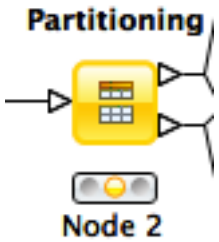
- Filename: *OneShotCustomersEX.csv*
  - Contains transactions from 15,000 online customers

- In the web page of the course you can download the attribute description

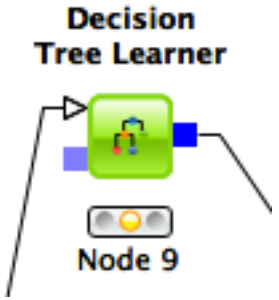
- The class of the data is **Customer Typology** that can be
  - **one shot = only 1 purchase**
  - **loyal = more than one purchase**

Decision Trees in Knime

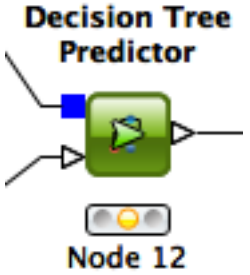
- For Classification by decision trees
  - Partitioning of the data in training and test set



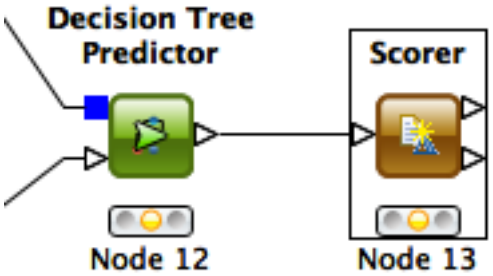
  - On the training set applying the learner



  - On the test set applying the predictor



Evaluation of our classification model



Confusion Matrix - 0:13 - Scorer

File Hilite

Tipologia...	One Shot	Loyal
One Shot	2713	0
Loyal	0	2387

Correct classified: 5,100 Wrong classified: 0

Accuracy: 100 % Error: 0 %

Accuracy statistics - 0:13 - Scorer

File

Table "default" - Rows: 3 | Spec - Columns: 10 | Properties | Flow Variables

Row ID	TruePositives	FalsePositives	TrueNegatives	FalseNegatives	Recall	Precision	Sensitivity	Specifity	F-measure
One Shot	2713	0	2387	0	1	1	1	1	1
Loyal	2387	0	2713	0	1	1	1	1	1
Overall	?	?	?	?	?	?	?	?	?