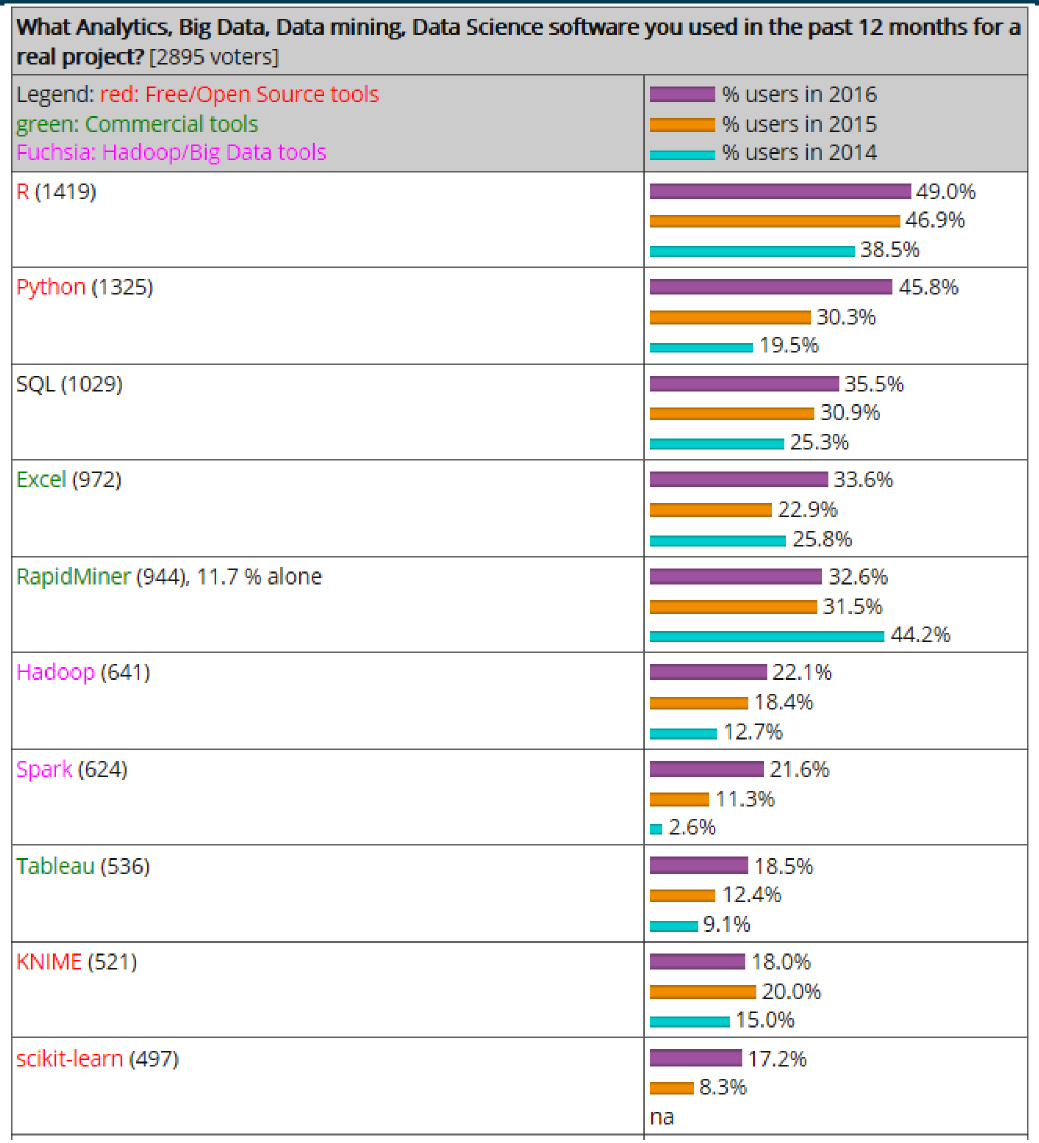
Introduction to RapidMiner

RapidMiner

- A very comprehensive open-source data mining tool
  - The data mining process is visually modeled as an operator chain
  - RapidMiner has over 400 build in data mining operators
  - RapidMiner provides broad collection of charts for visualizing data
- Project started in 2001 by Ralf Klinkenberg, Ingo Mierswa, and Simon Fischer at University of Dortmund, Germany
- Today: Maintained by commercial company plus open-source developers
- RapidMiner Editions
  - Community Edition: Free
    (= Second Last Edition)
  - Enterprise Edition: Commercial
    (= Last Edition plus professional support)

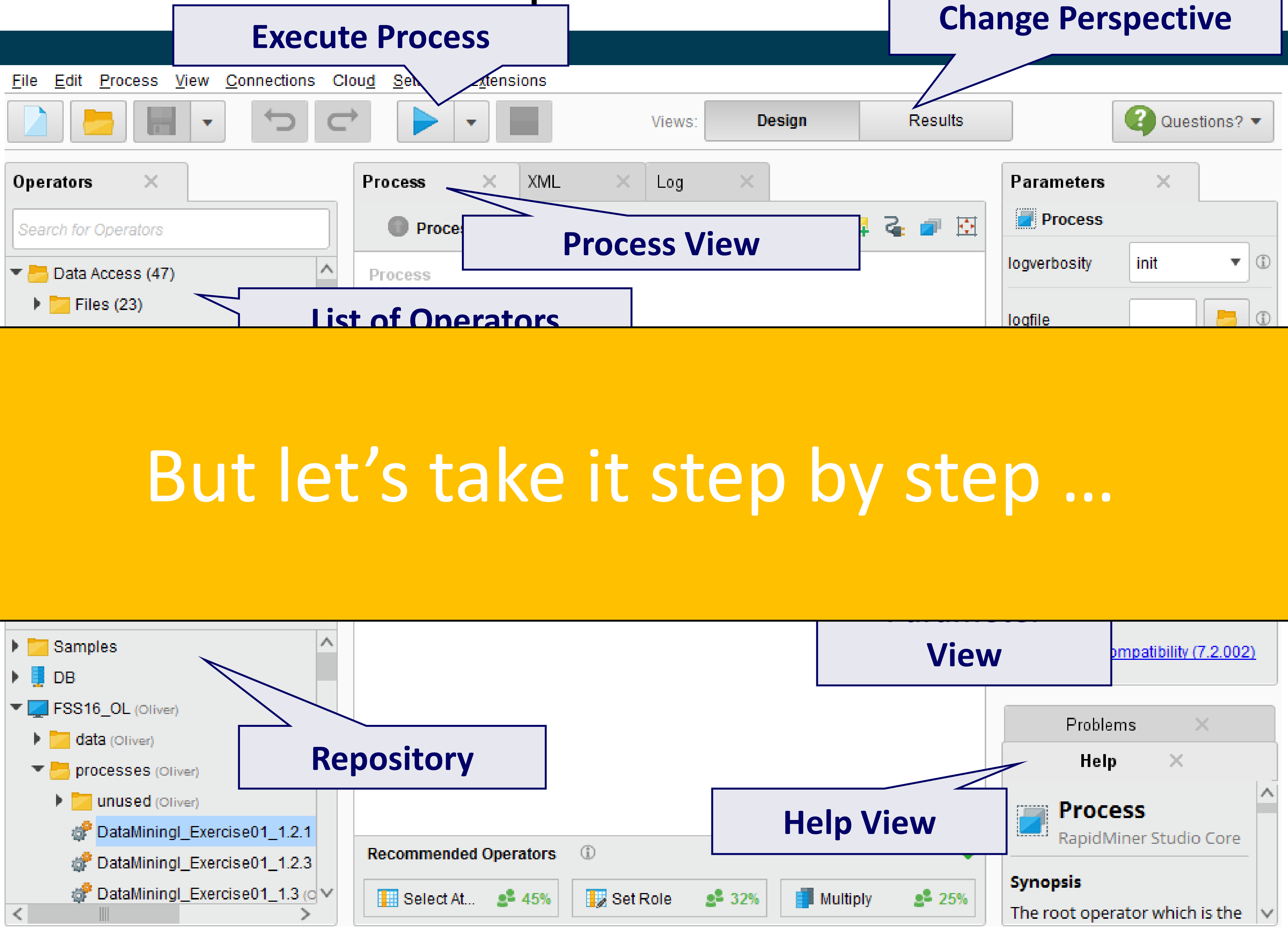
KDnuggets Poll: Which Software is used?



What Analytics, Big Data, Data mining, Data Science software you used in the past 12 months for a real project? [2895 voters]

Legend: red: Free/Open Source tools green: Commercial tools Fuchsia: Hadoop/Big Data tools	🟪 % users in 2016 🟧 % users in 2015 🟦 % users in 2014
R (1419)	49.0% 46.9% 38.5%
Python (1325)	45.8% 30.3% 19.5%
SQL (1029)	35.5% 30.9% 25.3%
Excel (972)	33.6% 22.9% 25.8%
RapidMiner (944), 11.7 % alone	32.6% 31.5% 44.2%
Hadoop (641)	22.1% 18.4% 12.7%
Spark (624)	21.6% 11.3% 2.6%
Tableau (536)	18.5% 12.4% 9.1%
KNIME (521)	18.0% 20.0% 15.0%
scikit-learn (497)	17.2% 8.3% na

Let’s have a look at RapidMiner



Execute Process

Change Perspective

Process View

List of Operators

View

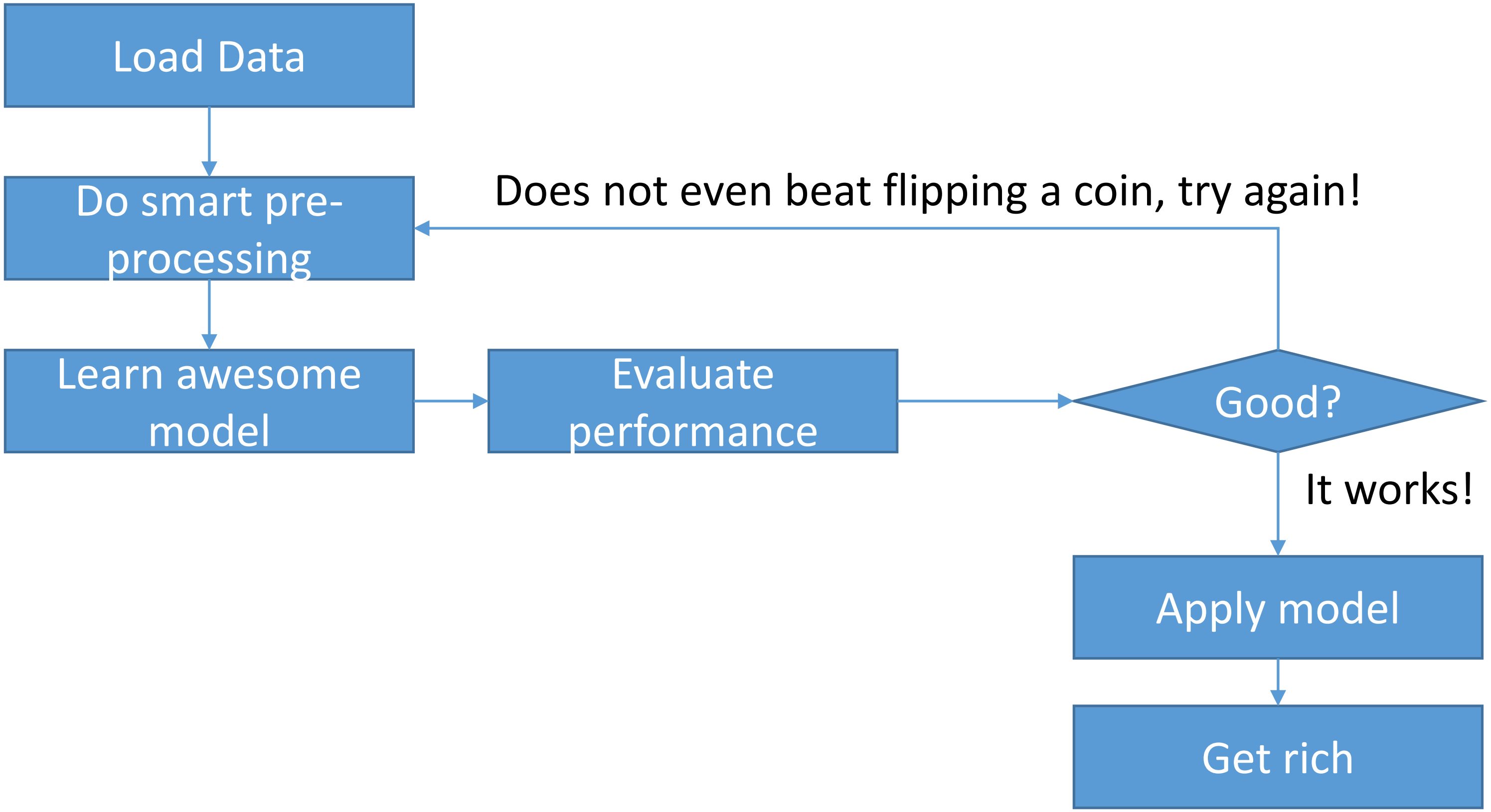
Repository

Help View

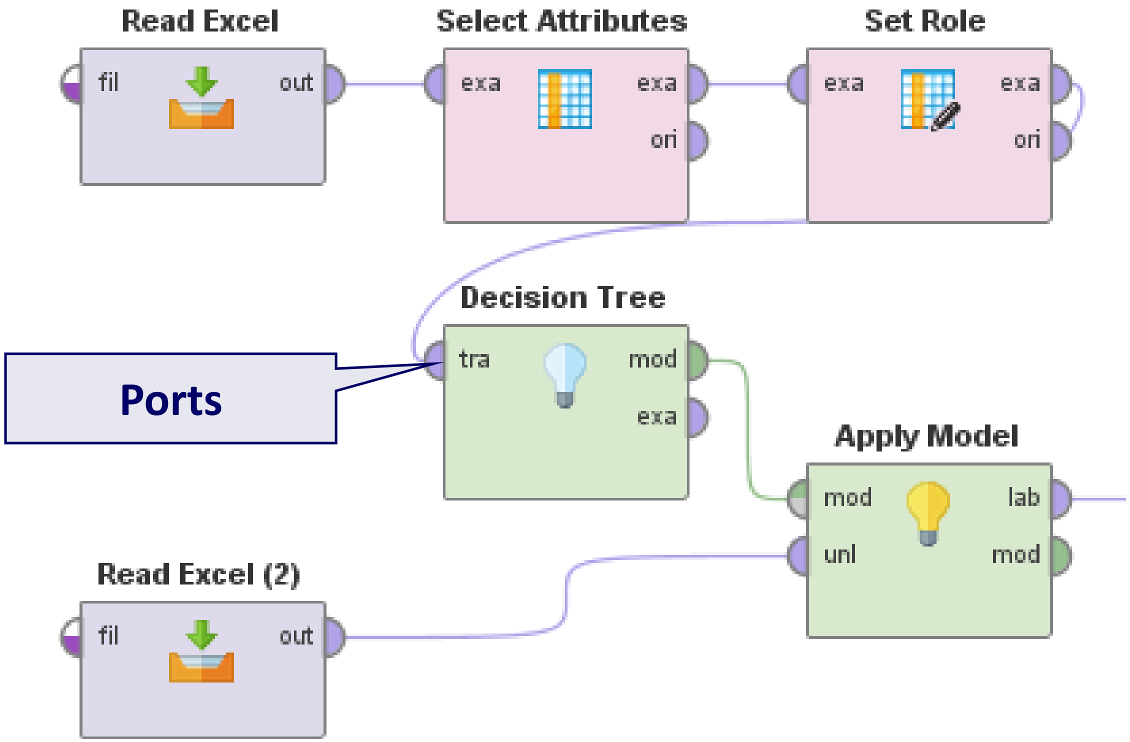
But let’s take it step by step …

How does it work?

- You visually design a data mining process
- A process is like a flow chart for mining operators



Specifying a Process by Chaining Operators



Common Port Names

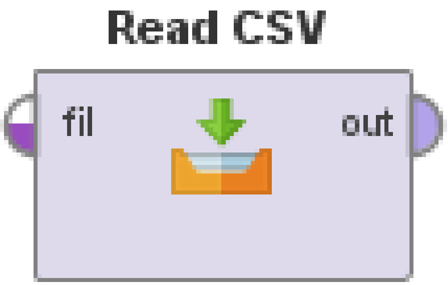
Name	Meaning
out	Output
exa	Example Set
ori	Original Input
tra	Training Data
mod	Model
unl	Unlabelled Data
lab	Labelled Data
per	Performance

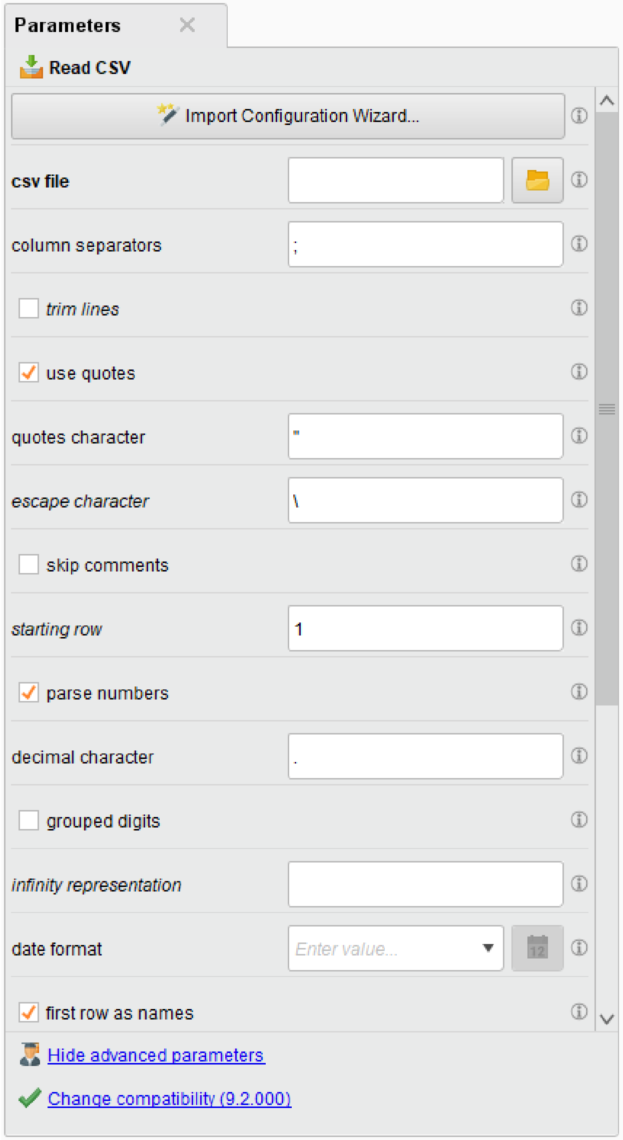
RapidMiner Operators: Loading Data

- Many operators to read data from files

- Output Port labelled “out”
  - Creates an **Example Set**

- An Example Set contains your data!
  - The records are called **Examples**




Parameters

Read CSV

Import Configuration Wizard...

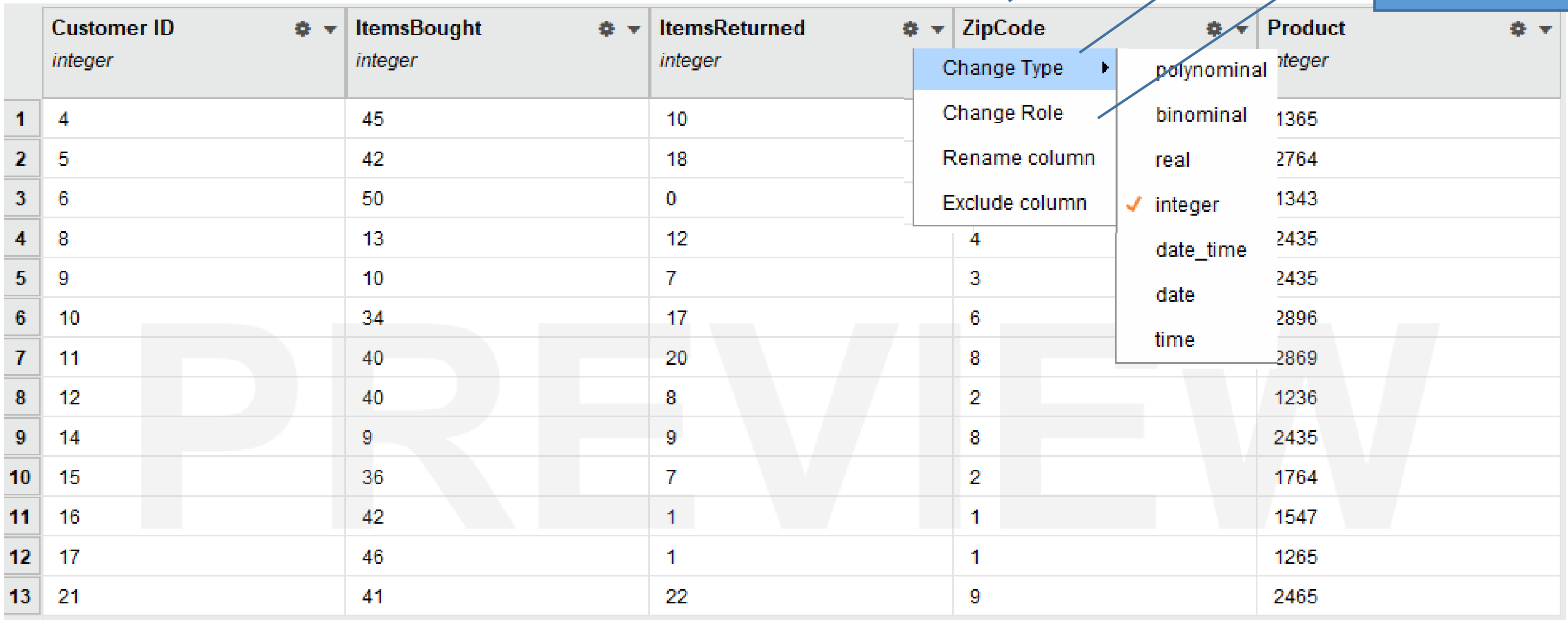
csv file	
column separators	;
□ *trim lines*	
☑ use quotes	
quotes character	"
escape character	\
□ skip comments	
starting row	1
☑ parse numbers	
decimal character	.
□ grouped digits	
infinity representation	
date format	*Enter value...*
☑ first row as names	

Hide advanced parameters

Change compatibility (9.2.000)

Data in RapidMiner

- All data that you load will be contained in an example set
- Each example is described by **Attributes** (a.k.a. features)
  - Attributes have **Value Types**
  - Attributes have **Roles**



	Customer ID *integer*	ItemsBought *integer*	ItemsReturned *integer*	ZipCode	Product *integer*
1	4	45	10		1365
2	5	42	18		2764
3	6	50	0		1343
4	8	13	12	4	2435
5	9	10	7	3	2435
6	10	34	17	6	2896
7	11	40	20	8	2869
8	12	40	8	2	1236
9	14	9	9	8	2435
10	15	36	7	2	1764
11	16	42	1	1	1547
12	17	46	1	1	1265
13	21	41	22	9	2465

Attribute Names

Value Types

Roles

Data in RapidMiner

- Value types define how data is treated
  - Numeric data has an order (2 is closer to 1 than to 5)
  - Nominal data has no order (red is as different from green as from blue)

Value Type	Description
binominal	Only two different values are permitted
polynominal	More than two different values are permitted
integer	Whole numbers, positive and negative
real	Real numbers, positive and negative
date_time	Date as well as time
date	Only date
time	Only time

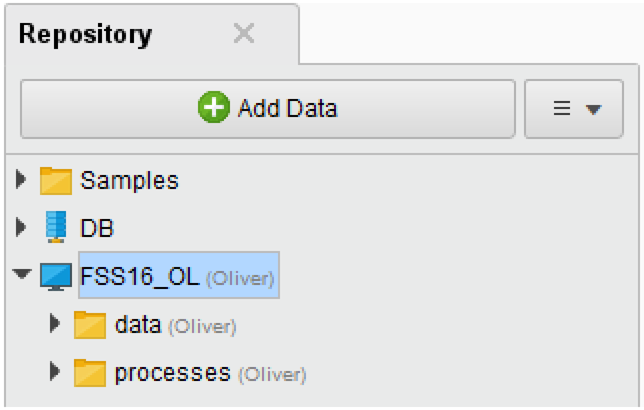
Data in RapidMiner

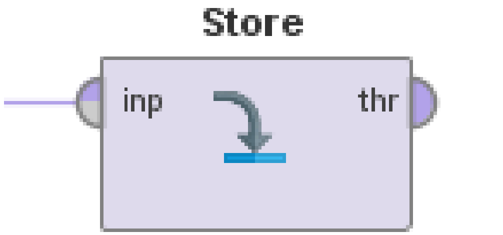
- Roles define how the attribute is treated by the Operators

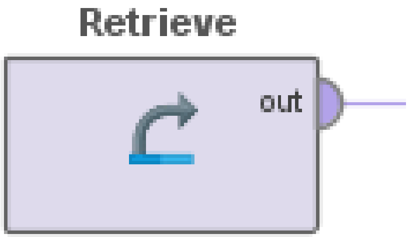
Role	Description
Id	A unique identifier, no two examples in an example set can have the same value
Regular (default)	Regular attribute that contains data
Label	The target attribute for classification tasks
Weight	The weight of the Examples with regard to the label
Cluster	Created by RapidMiner as the result of a clustering task
Prediction	Created by RapidMiner as the result of a classification task

The Repository

- This is where you store your data and processes
- Stores data and its meta data (!)
  - Only if you load data from the repository, RapidMiner can show you which attributes exist
- Add data via the “Add Data” button or the “Store” operator
- Load data via drag ‘n’ drop or the “Retrieve” operator



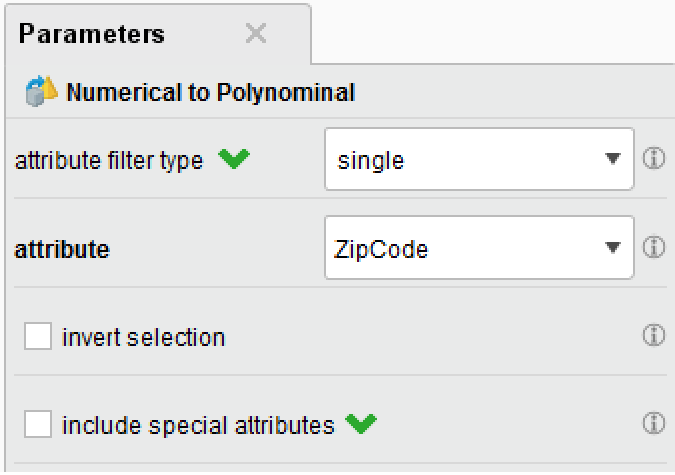




If your have a question starting with
“**Why does RapidMiner not show me …?**”
Then the answer most likely is
“**Because you did not load your data into the Repository!**”

RapidMiner Operators: Pre-Processing

- Type and Role Conversions
  - “TypeA to TypeB”: Change the type
  - “Set Role”: Change the role
- Attribute Set Transformation
  - “Select Attributes”: Remove attributes
  - “Generate Attributes: Create new attributes
- Value Transformation
  - “Normalize”: transform all values to a certain range
- Filtering
  - “Filter examples”: Remove examples
- Aggregation
  - “Aggregate”: SQL-like aggregation (count, sum)



Parameters

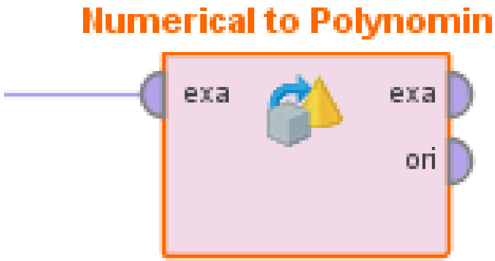
Numerical to Polynominal

attribute filter type ✓ single

attribute ZipCode

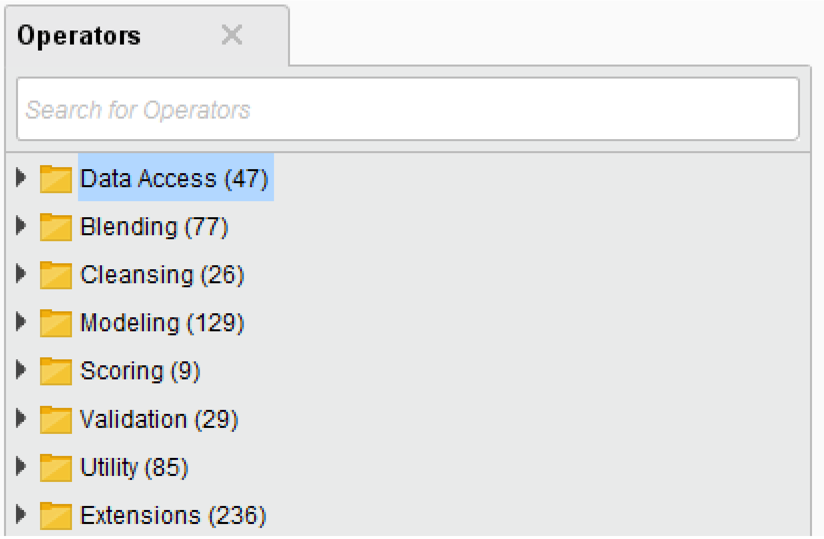
□ invert selection

□ include special attributes ✓



How to find Operators

- The Operators Panel lets you browse all available operators
- You can search for operators by typing in the search bar
- You add operators by double clicking or by dragging them onto the process view



Frequently Asked Questions – And their surprising answers …

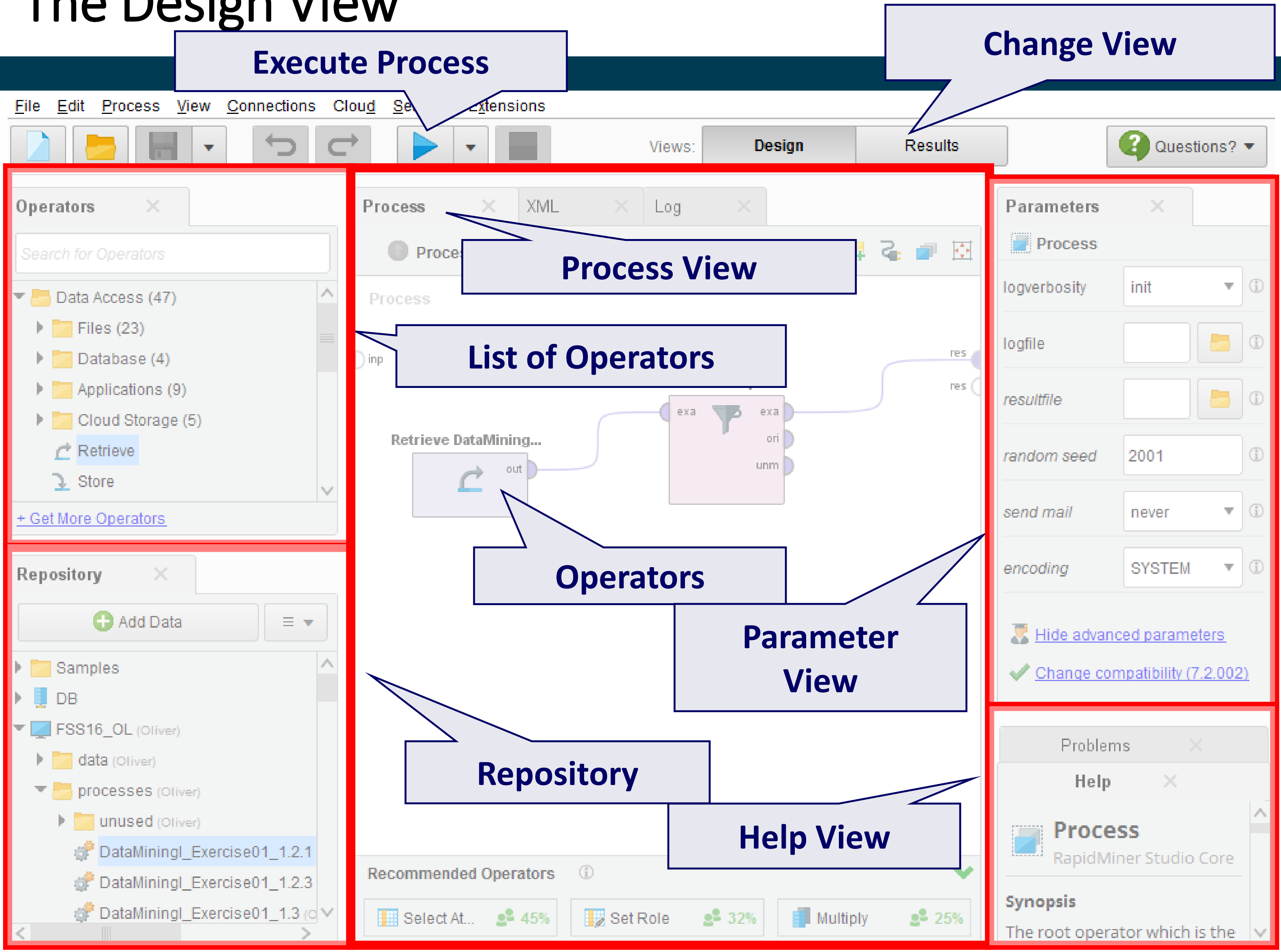
How can I …?	Type … into the search bar!
Select which Attributes to use?	Select Attributes
Filter out examples?	Filter Examples
Read a CSV file	Read CSV
Learn a decision tree	Decision Tree

How to use RapidMiner

- Use the “Design Perspective” to create your Process
  - See your current Process – “Process”
  - Access your data and processes – “Repository”
  - Add operators to the process – “Operators”
  - Configure the operators – “Parameters”
  - Learn about operators – “Help”

- Use the “Results Perspective” to inspect the output
  - The “Data View” shows your example set
  - The “Statistics View” contains meta data and statistics
  - The “Visualizations View” allows you to visualise the data

The Design View



Execute Process

Change View

Process View

List of Operators

Operators

Parameter View

Repository

Help View

Parameters – Process

logverbosity	init
logfile	
resultfile	
random seed	2001
send mail	never
encoding	SYSTEM

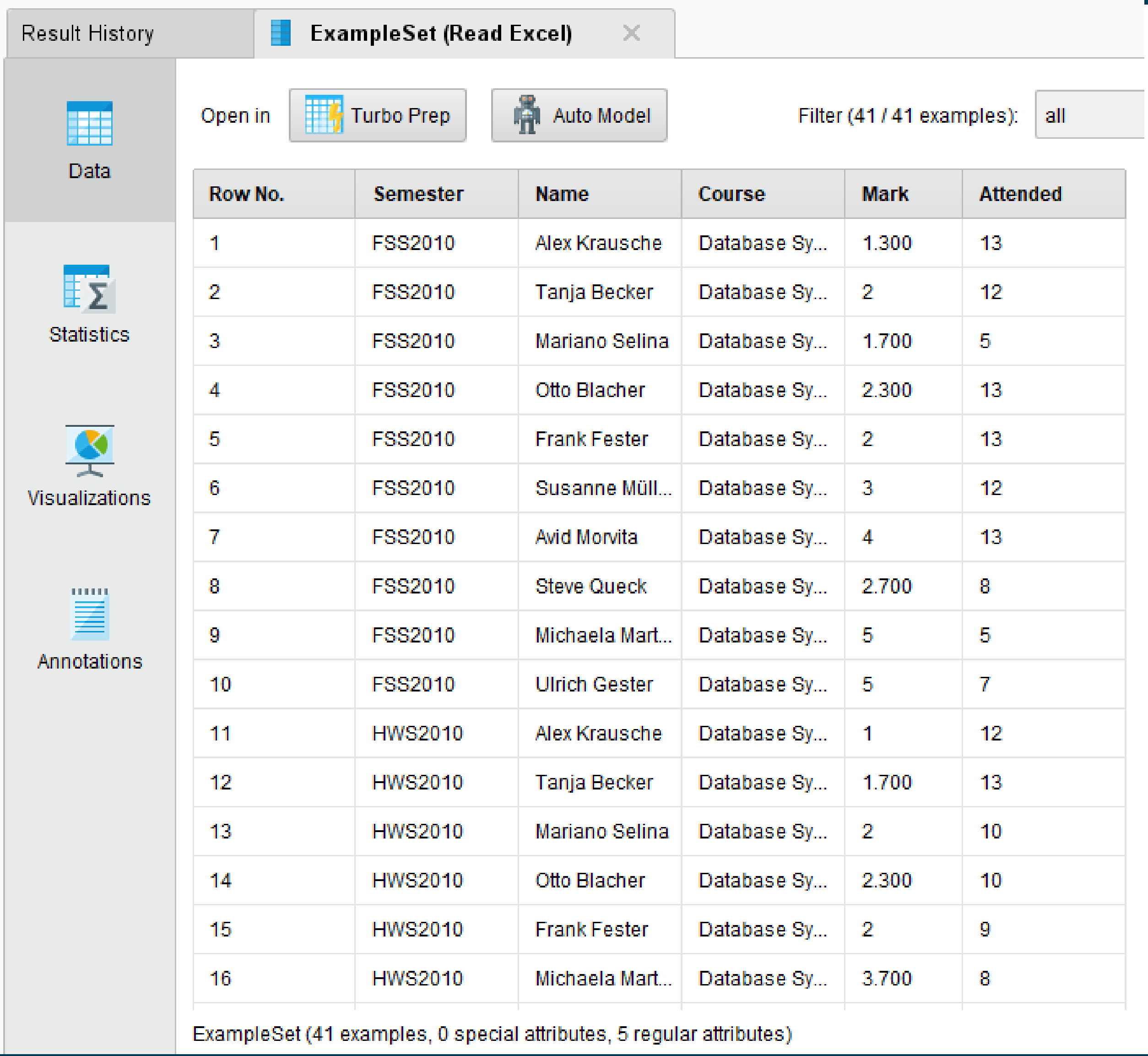
Help – Process

RapidMiner Studio Core

Synopsis

The root operator which is the

The Results View - Data

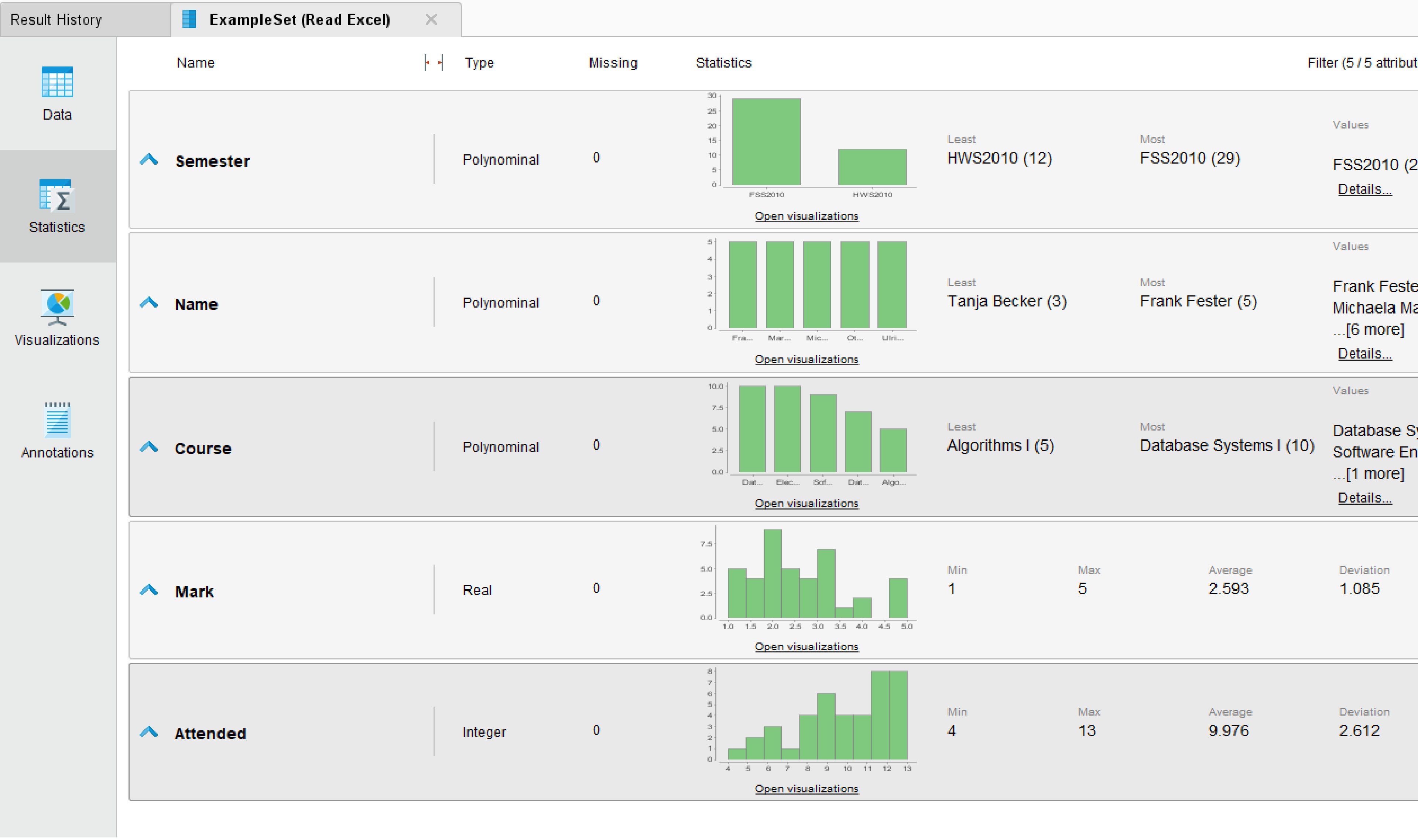


Filter (41 / 41 examples): all

Row No.	Semester	Name	Course	Mark	Attended
1	FSS2010	Alex Krausche	Database Sy...	1.300	13
2	FSS2010	Tanja Becker	Database Sy...	2	12
3	FSS2010	Mariano Selina	Database Sy...	1.700	5
4	FSS2010	Otto Blacher	Database Sy...	2.300	13
5	FSS2010	Frank Fester	Database Sy...	2	13
6	FSS2010	Susanne Müll...	Database Sy...	3	12
7	FSS2010	Avid Morvita	Database Sy...	4	13
8	FSS2010	Steve Queck	Database Sy...	2.700	8
9	FSS2010	Michaela Mart...	Database Sy...	5	5
10	FSS2010	Ulrich Gester	Database Sy...	5	7
11	HWS2010	Alex Krausche	Database Sy...	1	12
12	HWS2010	Tanja Becker	Database Sy...	1.700	13
13	HWS2010	Mariano Selina	Database Sy...	2	10
14	HWS2010	Otto Blacher	Database Sy...	2.300	10
15	HWS2010	Frank Fester	Database Sy...	2	9
16	HWS2010	Michaela Mart...	Database Sy...	3.700	8

ExampleSet (41 examples, 0 special attributes, 5 regular attributes)

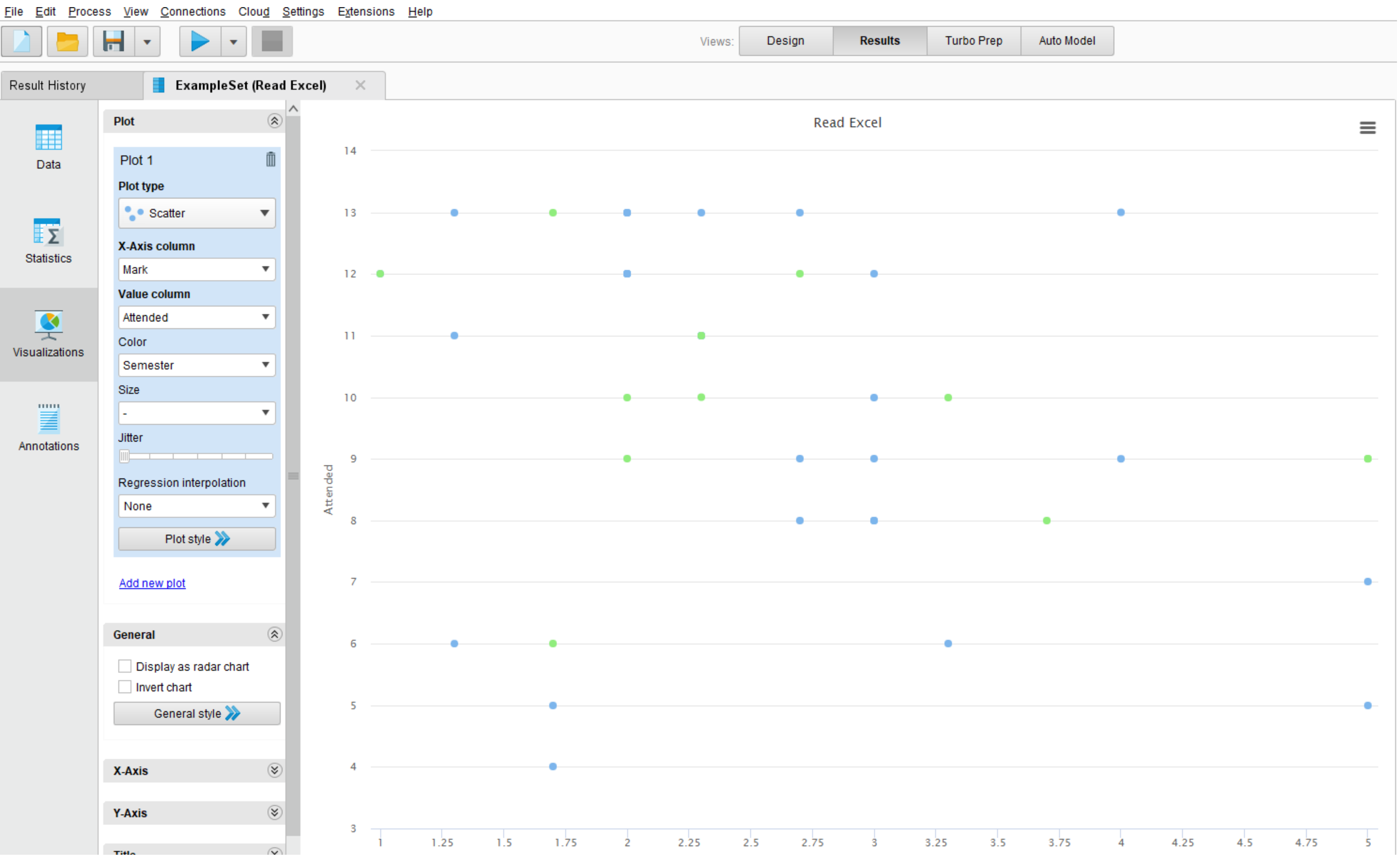
The Results View - Statistics



Filter (5 / 5 attribut

Name	Type	Missing	Statistics				
Semester	Polynominal	0	Open visualizations	Least HWS2010 (12)	Most FSS2010 (29)		Values FSS2010 (2 Details...
Name	Polynominal	0	Open visualizations	Least Tanja Becker (3)	Most Frank Fester (5)		Values Frank Feste Michaela Ma ...[6 more] Details...
Course	Polynominal	0	Open visualizations	Least Algorithms I (5)	Most Database Systems I (10)		Values Database Sy Software En ...[1 more] Details...
Mark	Real	0	Open visualizations	Min 1	Max 5	Average 2.593	Deviation 1.085
Attended	Integer	0	Open visualizations	Min 4	Max 13	Average 9.976	Deviation 2.612

The Visualizations View - Charts



Plot type: Scatter

X-Axis column: Mark

Value column: Attended

Color: Semester

Size: -

Regression interpolation: None

□ Display as radar chart

□ Invert chart

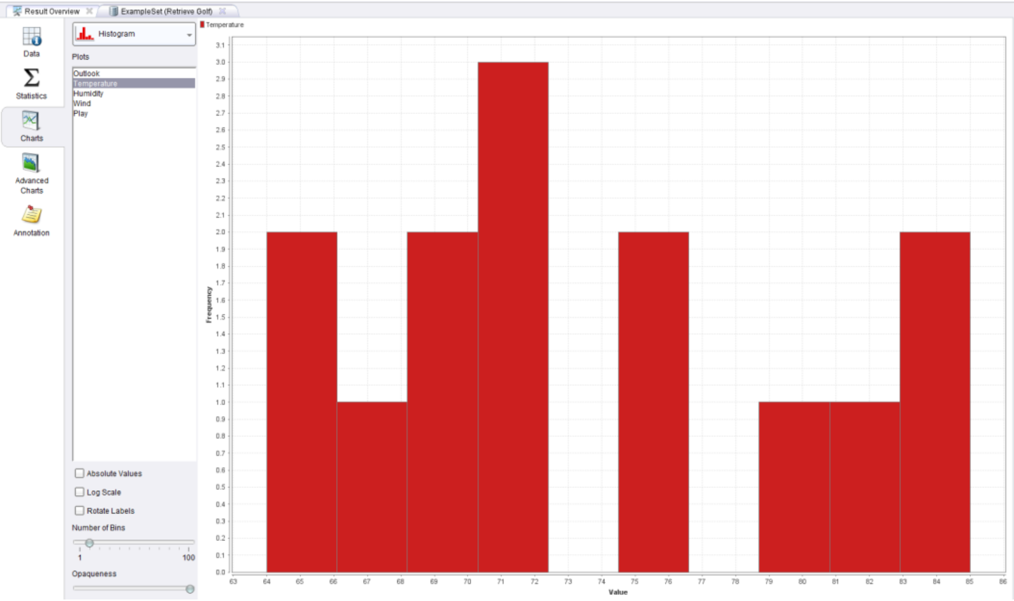
Data Visualisation

- Visualisation of data is one of the most powerful and appealing techniques for data exploration
  - Humans have a well developed ability to analyse large amounts of information that is presented visually
  - Can detect general patterns and trends
  - Can detect outliers and unusual patterns

Visualisation is the conversion of data into a visual format so that the characteristics of the data and the relationships among data items or attributes can be analysed.

Visualisation Techniques: Histogram

- Usually used to display the distribution of values of a single attribute
  - Divide the values into bins and show a bar plot of the number of objects in each bin
  - The height of each bar indicates the number of objects per bin
  - Shape of histogram depends on the number of bins



Histogram

Plots

Outlook
Temperature
Humidity
Wind
Play

□ Absolute Values

□ Log Scale

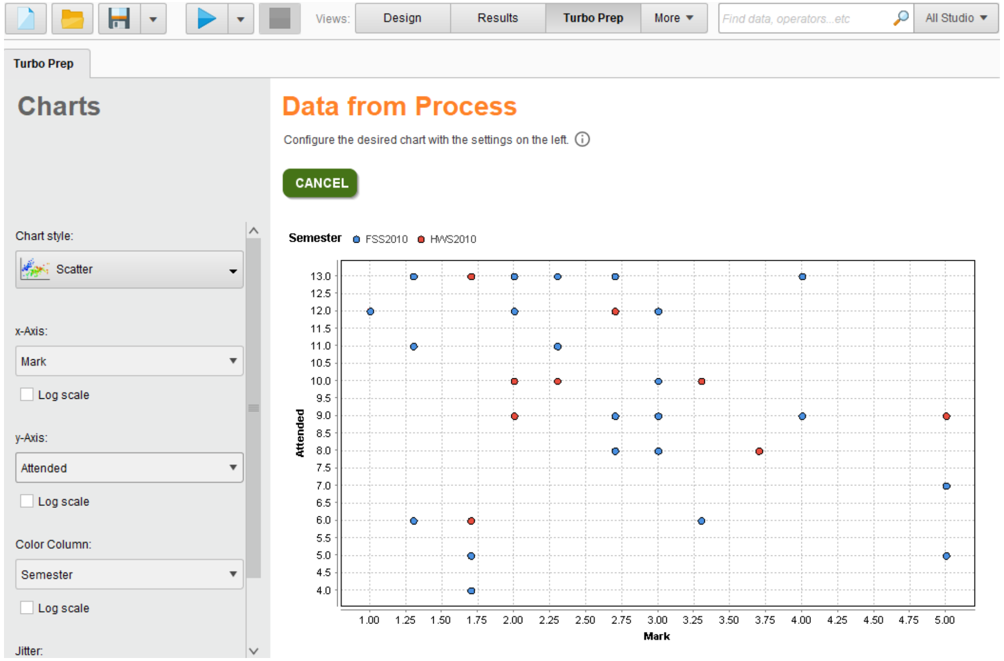
□ Rotate Labels

Number of Bins

Opaqueness

Visualisation Techniques: Scatter Charts

- Two-dimensional scatter charts are most commonly used
- Often additional attributes/dimensions are displayed by using the size, shape, and color of the markers that represent the objects
- It is useful to have arrays of scatter charts that can compactly summarise the relationships of several pairs of attributes
- RapidMiner Scatter Charts
  - Scatter (single chart)
  - Scatter Multiple
  - Scatter Matrix
  - Scatter 3D



Charts

Data from Process

Configure the desired chart with the settings on the left.

Chart style: Scatter

x-Axis: Mark

□ Log scale

y-Axis: Attended

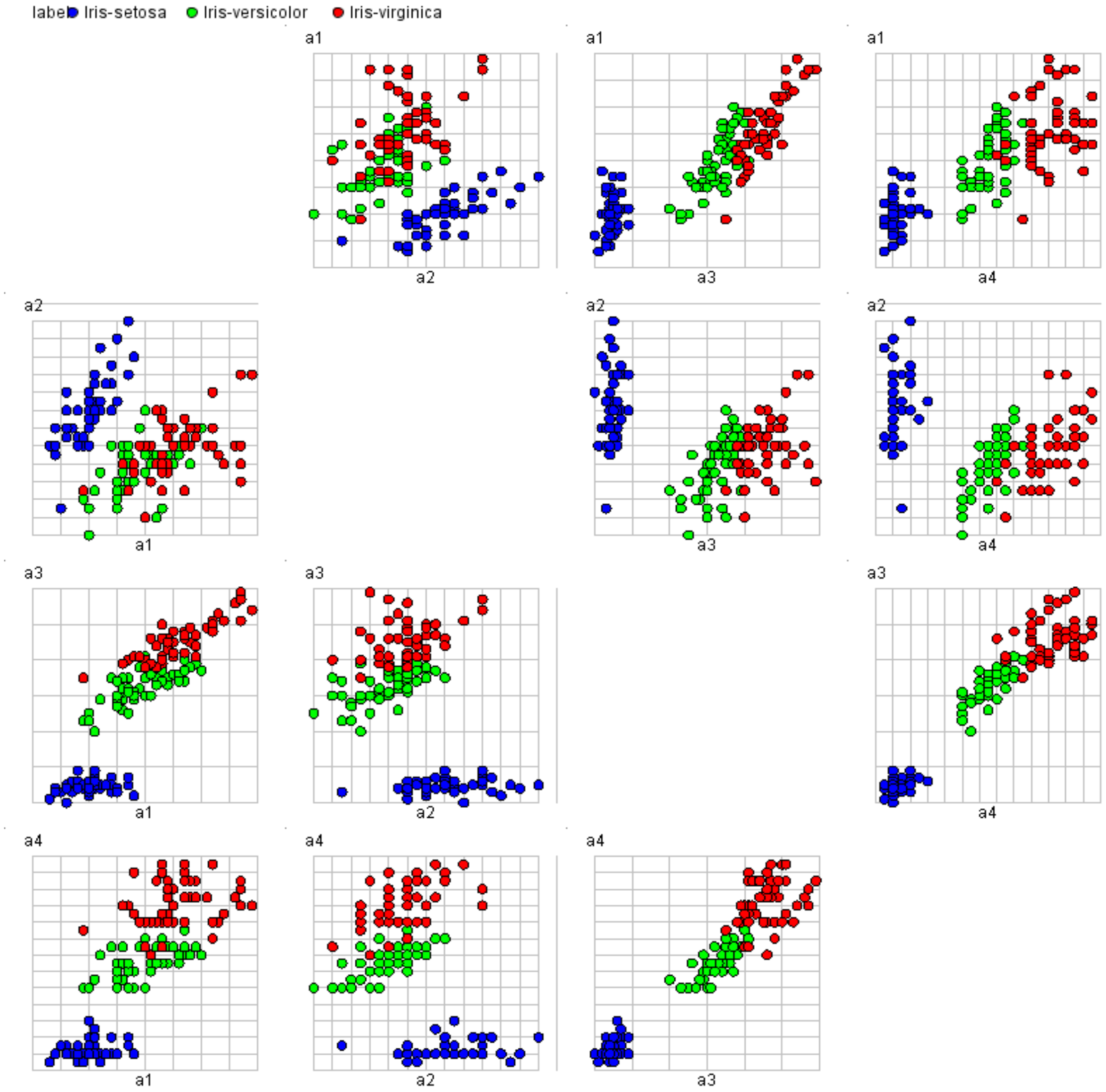
□ Log scale

Color Column: Semester

□ Log scale

Jitter:

RapidMiner Chart: Scatter Matrix



RapidMiner Resources

- RapidMiner 9.2:
  - https://my.rapidminer.com/nexus/account/index.html#downloads
- Rapidminer User Manuals: http://rapidminer.com/documentation/
- Open Access Book covering RapidMiner
  - Matthew North: Data Mining For The Masses: https://docs.rapidminer.com/downloads/DataMiningForTheMasses.pdf
- Operator Documentation: https://docs.rapidminer.com/latest/studio/operators/
- RapidMiner Forum and Discussion Groups: https://community.rapidminer.com/
- Video Tutorials
  - by Rapid-I: https://www.youtube.com/user/RapidIVideos
  - by NDLR: https://dspace.ndlr.ie/jspui/handle/10633/2353
  - by Neutral Market Trends: http://www.neuralmarkettrends.com/tutorials/
- MyExperiment: process repository: http://www.myexperiment.org/

Hands-on!

- Now start RapidMiner
- Load your first dataset
- Start exploring the data!

Examples for Data Profiling

- Students Data Set

Course	Taught in	# Students	Grade Range	Max. Attend
Algorithms I	HWS2010	5	1.7 – 5.0	12
Database Systems I	FSS2010	10	1.3 – 5.0	13
Database Systems II	HWS2010	7	1.0 – 5.0	13
Electronic Markets	FSS2010	10	1.0 – 3.0	13
Software Engineering	FSS2010	9	1.3 – 4.0	13

- Scatter Chart
  - Y-Axis: Course
  - X-Axis: try!