

Elba User Manual

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Version 0.1

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1 About this Manual

This manual provides an introduction to Elba. Elba is an editor used to create Conceptual Information Systems (CIS) for ToscanaJ, a database frontend and browser for CIS. Conceptual Information Systems are based on Formal Concept Analysis (FCA), a mathematical method to structure and analyze data. A basic understanding of Formal Concept Analysis is assumed.

For further information on FCA please use the literature and sources listed in the appendix.

2 Overview

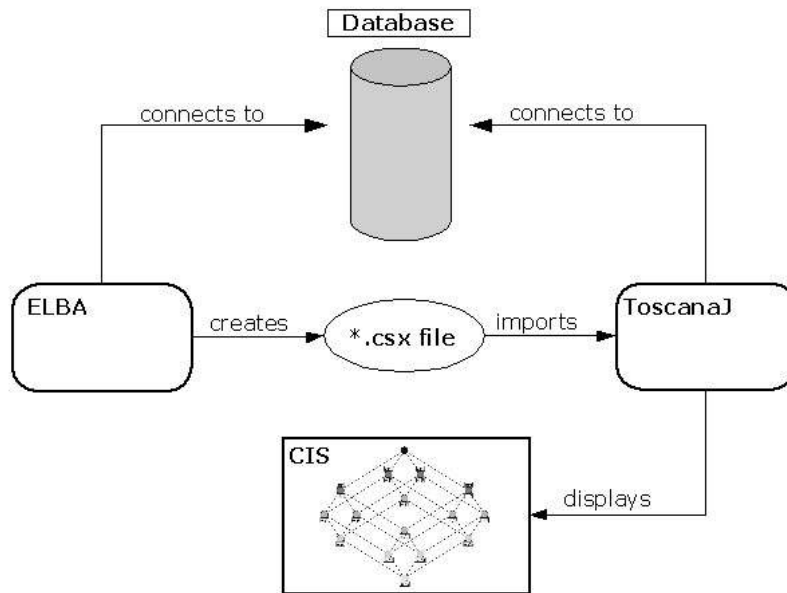
The standard workflow starts with an examination of the data that should become the basis of the CIS. The data usually needs to be converted to a single-valued or many-valued context (see Ganter/Wille for further details).

Most examples in this manual are based on the following "animals" database:

objects	size	legs	skin	weight	price	motion	mane	hooves
dove	small	twolegs	feathers	1	20	fly	.	.
hen	small	twolegs	feathers	1	5	.	.	.
duck	small	twolegs	feathers	2	8	fly/swim	.	.
goose	small	twolegs	feathers	6	30	fly/swim	.	.
owl	small	twolegs	feathers	3	200	fly/hunt	.	.
hawk	small	twolegs	feathers	3	300	fly/hunt	.	.
eagle	medium	twolegs	feathers	5	350	fly/hunt	.	.
fox	medium	fourlegs	hair	12	0	hunt/run	.	.
dog	medium	fourlegs	hair	17	50	run	.	.
wolf	medium	fourlegs	hair	33	500	hunt/run	x	.
cat	small	fourlegs	hair	4	10	hunt/run	.	.
tiger	big	fourlegs	hair	200	30000	hunt/run	.	.
lion	big	fourlegs	hair	300	30000	hunt/run	x	.
horse	big	fourlegs	hair	600	20000	run	x	x
zebra	big	fourlegs	hair	580	10000	run	x	x
cow	big	fourlegs	hair	800	900	.	.	x

Once the database has been prepared, Elba can be started. We will go through four main steps to create a CIS:

1. Connect Elba to the database
2. Conceptual Scaling / Creation of Diagrams
3. Create CSX file
4. Call the CSX from ToscanaJ



3 Starting Elba

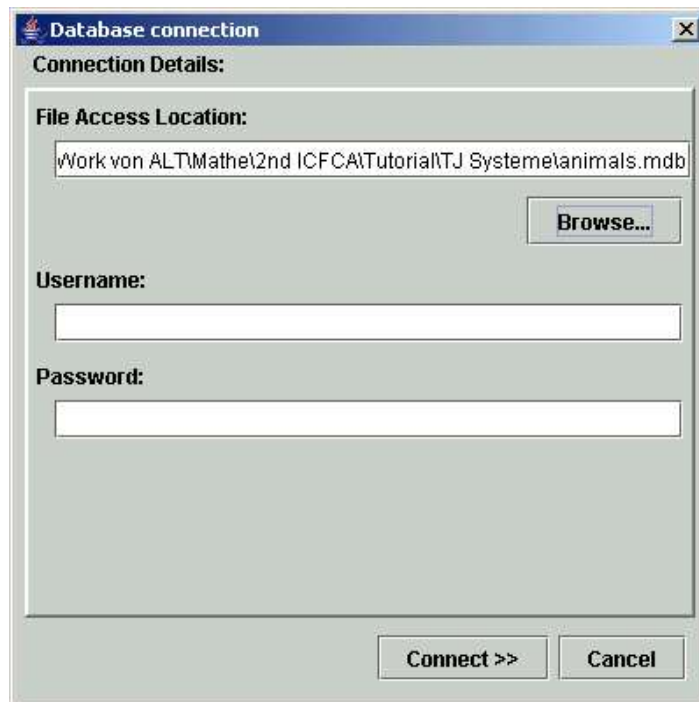
The folder extracted from the ToscanaJ package also contains start files to execute Elba. On a Windows OS double-click the batch file "run-elba", on a Linux or Unix OS choose "run-elba.sh" to start Elba. Elba always opens the last file that was used, we would like to create a new file, so choose "File -> New":

4 Establishing the database connection

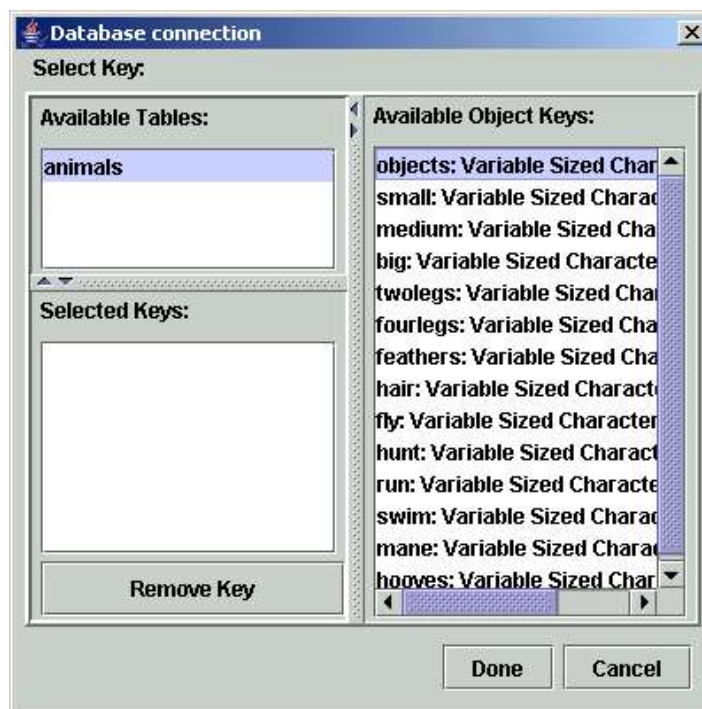
The database connection dialog will open:



Here you have to choose the database type you rely on. In the example used we will use Microsoft Access files. Select "Access File" and click on "Use selected type". The window "Connection details" opens:



Use the "Browse" button to select the database file. If the database is password protected, you also will have to enter username and password. "Connect" opens the view on the tables of the database. Select the table containing the data from the upper left frame. Then choose from the right frame the column of the table that contains the objects:

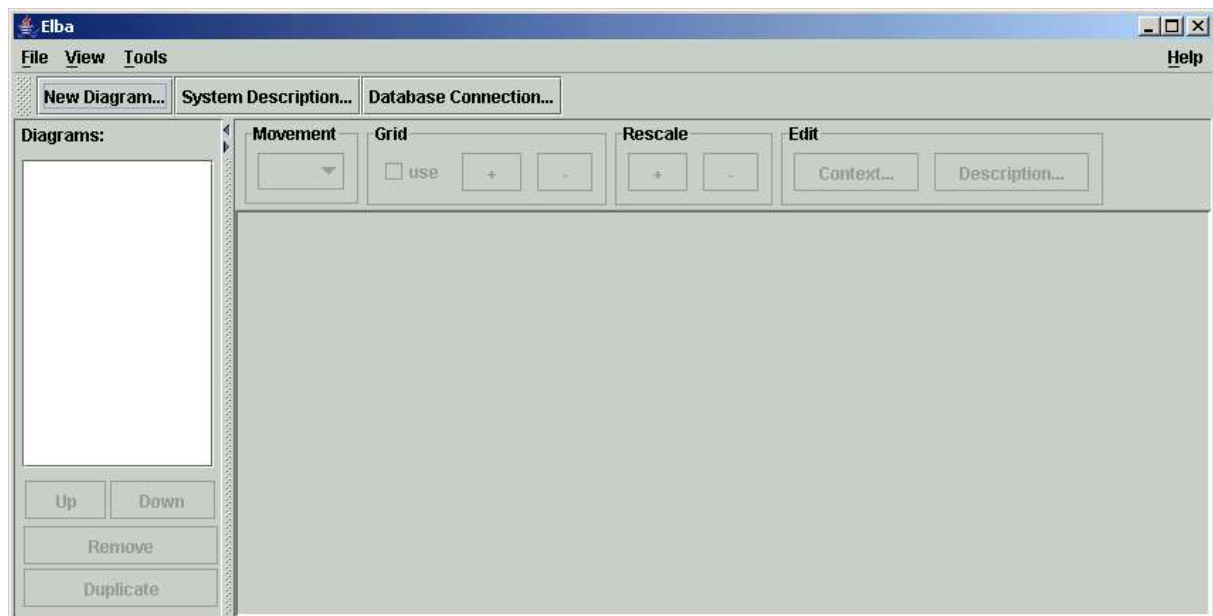


After selecting the key column it appears in the lower left frame of the window. "Done" establishes the database connection and closes the window.

5 Elba's Main Window

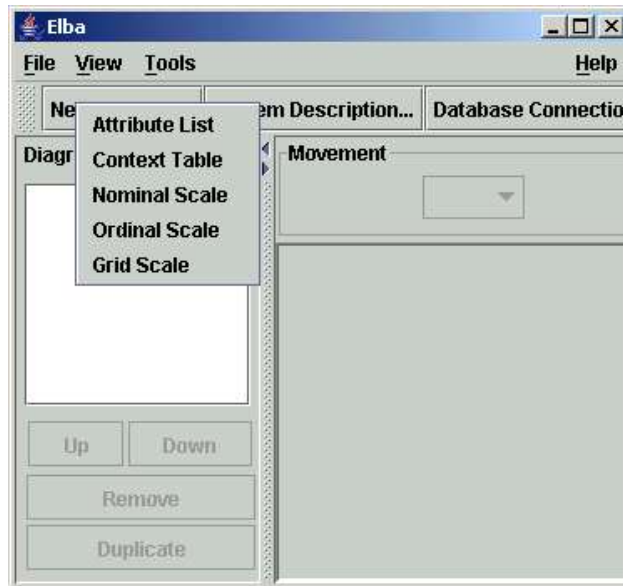
Elba's main window consists of two parts. The left one will display all conceptual scales that have been created. The order of the scales can be changed here, they can be selected, duplicated and deleted.

The right frame is the place where the diagrams will be manipulated. Above these two frames we have three buttons: "New Diagram", "System Description" and "Database Connection". The last button reopens the database dialog that was just explained and the first one is the first step for the creation of diagrams. The second button "System Description" opens a window with a little HTML editor. Here you can enter additional information about the CIS, which can be accessed from within ToscanaJ.



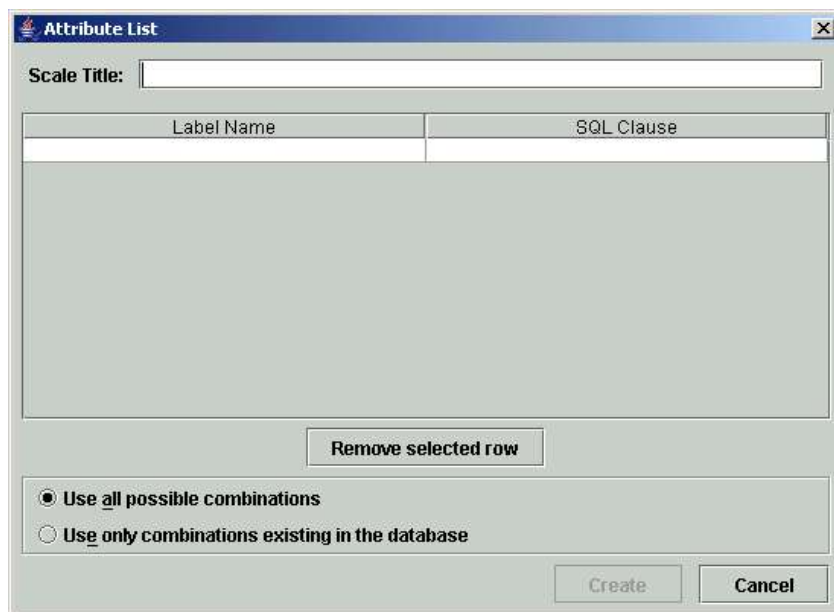
6 Creating Diagrams

Elba offers multiple methods to create diagrams respectively conceptual scales. The options "Attribute List", "Context Table", "Nominal Scale", "Ordinal Scale" and "Grid Scale" can be accessed via the "New Diagram" button below the menu bar. The options "Nominal Scale", "Ordinal Scale" and "Grid Scale" are standard scales, the last two require numerical data. "Nominal Scale" requires disjoint attribute values, "Context Table" is the manual version for experienced users and "Attribute List" offers an attribute centered view which allows creating complex scales intuitively.



6.1 Attribute List

Selecting "Attribute List" opens a new window:



First enter the title of the scale you will create. Then you will have to know the names of the columns of the database you connected to. In the middle of the window you see two columns, the left one labeled with "Label Name" and the right one with "SQL Clause". Below this you find a button to remove selected rows and two options to tick off.

The string entered in the left column will appear in the diagram as attribute label, the right column has to be filled with an SQL expression that selects those objects from the database that have the desired attribute. Simple SQL expression have the following structure:

```
name_of_column = 'value'
```

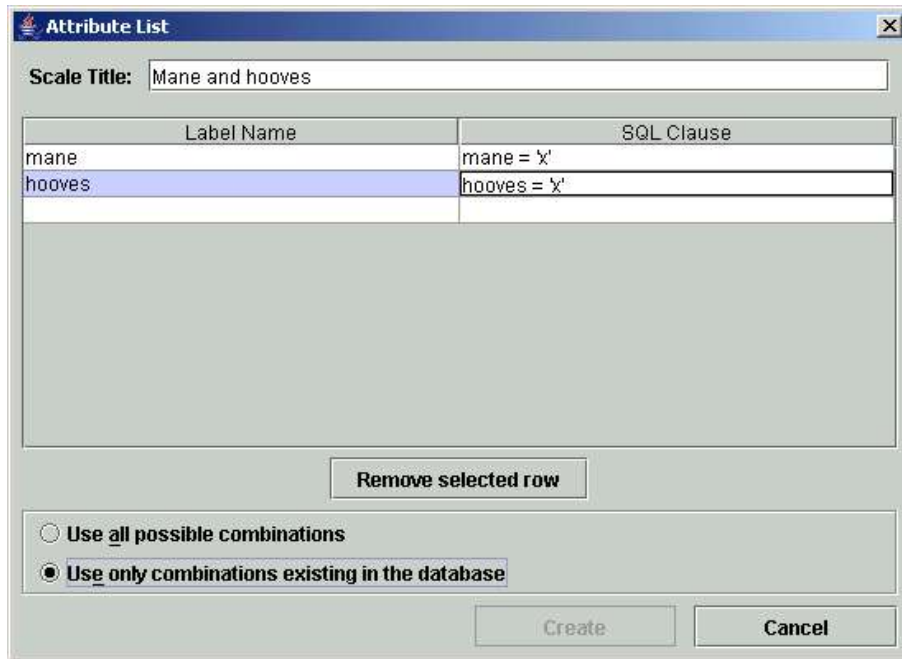
"name_of_column" is the name of the column in the database we are about to examine and "value" is the entry that stands for the desired attribute.

Alternatively you can create the SQL clause using the LIKE operator and wildcards, but this is only recommended to experienced users. Then the clause would look like following:

name_of_column like '%value%'

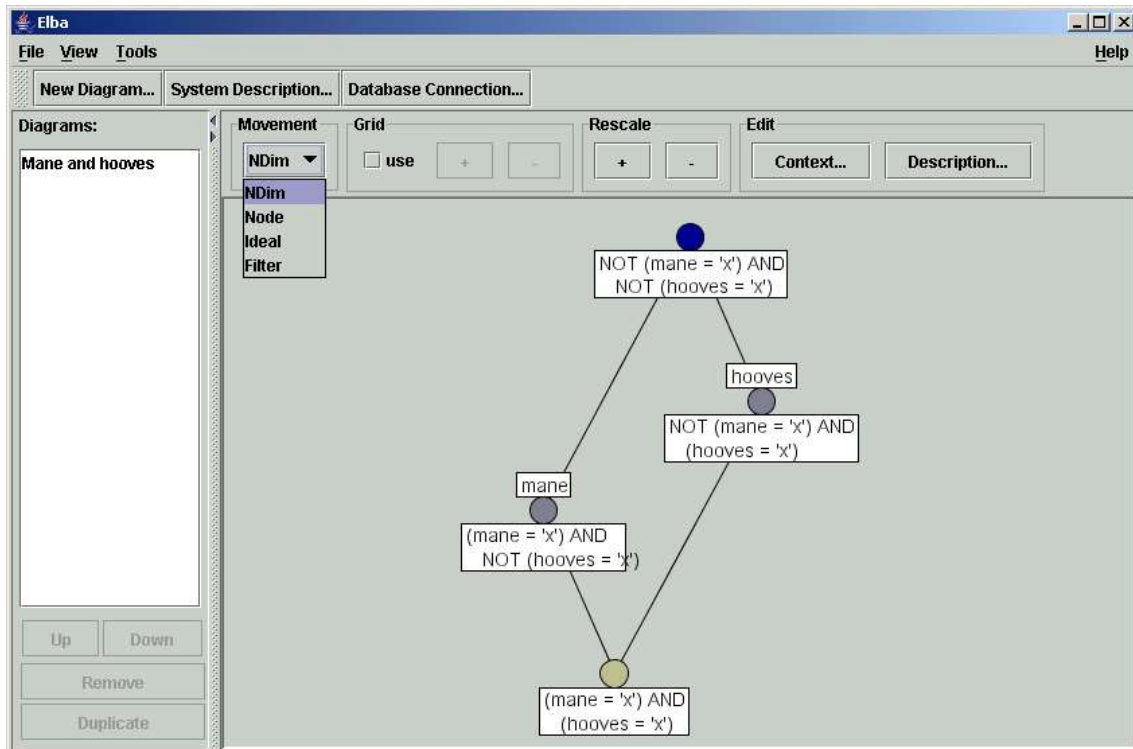
The "%" hereby denotes a wildcard. That means the SQL query would identify any string that contains the string between the wildcards.

For our database we start with the attributes "mane" and "hooves":



If the option "Use all possible combinations" is selected, a diagram of a boolean lattice of all listed attributes will be created, whether there exist objects in the database for each possible combination of attributes or not. If the option "Use only combinations existing in the database" is selected, the diagram will just consist of concepts that are derived from the data. These approaches are called theory driven and data driven conceptual scaling.

Clicking "Create" closes the window and displays the created diagram in the main frame of Elba:



You see the labels you entered as attribute labels above the nodes representing the concepts, the generated SQL queries covering the objects in the database appear below the nodes. The labels of attributes and objects can be hidden via the "View" entry in the menu bar.

For manipulation of the diagram's layout see the paragraph "Manipulations of Diagrams".

After finishing a scale it is recommended to save the file you are working on. To check if the created scales contain mistakes or if they cover the database, there is a function to check the scales consistency. It can be found in the menu bar: Tools -> Check Consistency With Database.

The consistency check makes sure that:

1. the SQL clauses used are valid;
2. all objects in the data are covered;
3. no object is assigned to two labels.

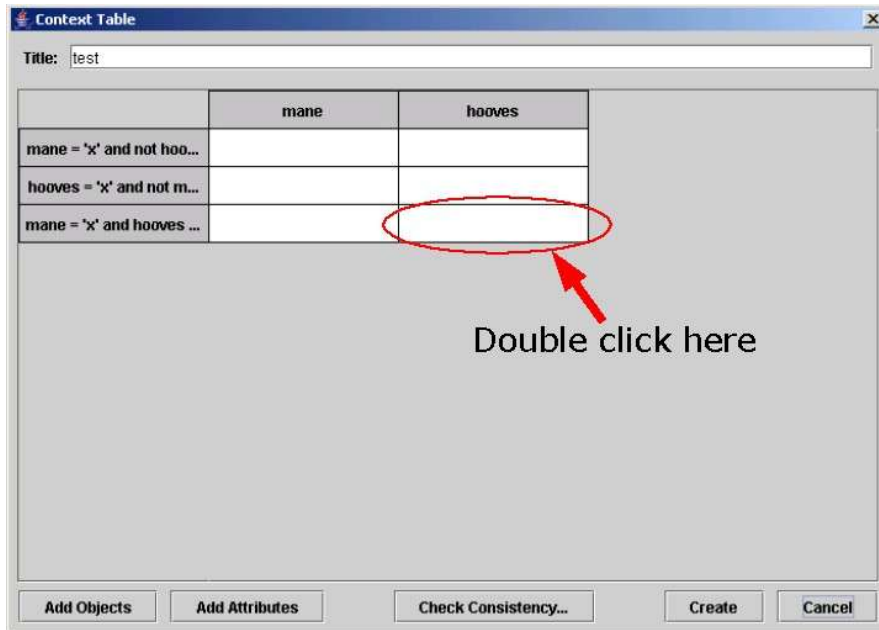
In case all the scales fulfill these criteria, you will get a notification "No Problems found", otherwise the problem and the affected scales will be named. How to check a single scale will be explained in the following section.

6.2 Context Table

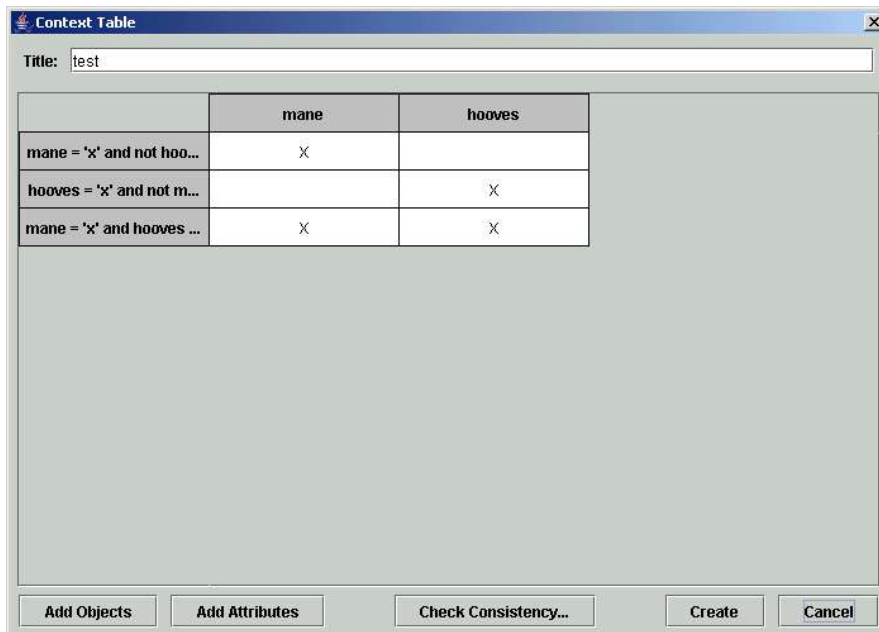
Please note that this option is recommended to experienced users.

Selecting "Context Table" to create a new diagram opens a new window with an empty formal context. We would like to create a new context, so we are asked to enter the context's name, its objects and attributes. Again, we enter as attributes the labels that should appear in the diagram. The objects are SQL expressions having the same structure as

the ones we used in the attribute list, but this time defining the object contingents. The result might look like this:



By double clicking in the cells of the table the incidence relation between objects and attributes can be established:



Via the "Add objects" and "Add attributes" buttons the context can be extended, right clicking the object or attribute names in the row or column header provides a context menu to change an entry, to change the order or to remove an entry.

The "Check consistency" button checks if the SQL clauses cover the database and if the SQL syntax is correct. If you do this right now you get the response "Object clauses do not cover database" because the case that the object has no entry for mane AND hooves is not

covered. So we add another object with the SQL clause "NOT mane='x' AND NOT hooves = 'x'". Checking again confirms that there are no problems with the database. The context table view should now look like this:

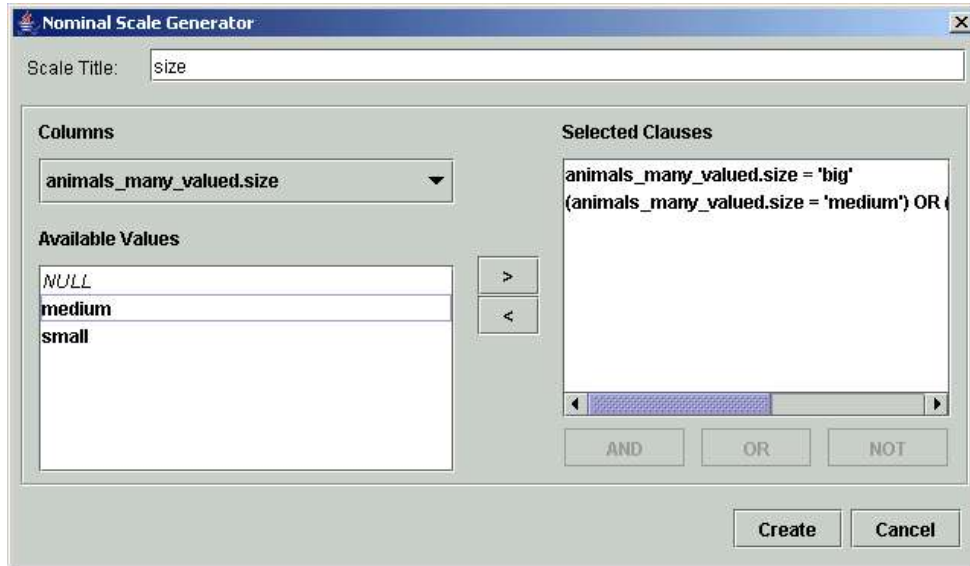
	mane	hooves
mane = 'x' and not hoo...	X	
hooves = 'x' and not m...		X
mane = 'x' and hooves ...	X	X
not mane='x' and not h...		

6.3 Nominal Scale

The nominal scale generator provides a view on the database. After selecting a column on the left side of the window, all entries of the selected column are displayed.

You can select the entries by double clicking or click the ">" in the middle of the window. Additionally you can combine the created clauses by selecting 2 or more with your mouse holding the Ctrl key. Possible operations are "OR", "AND" and the negation "NOT". Combining multiple column or using boolean expressions can result in inconsistent scales, please check your scales with the consistency check in case you use one of these options.

One result may look like this:

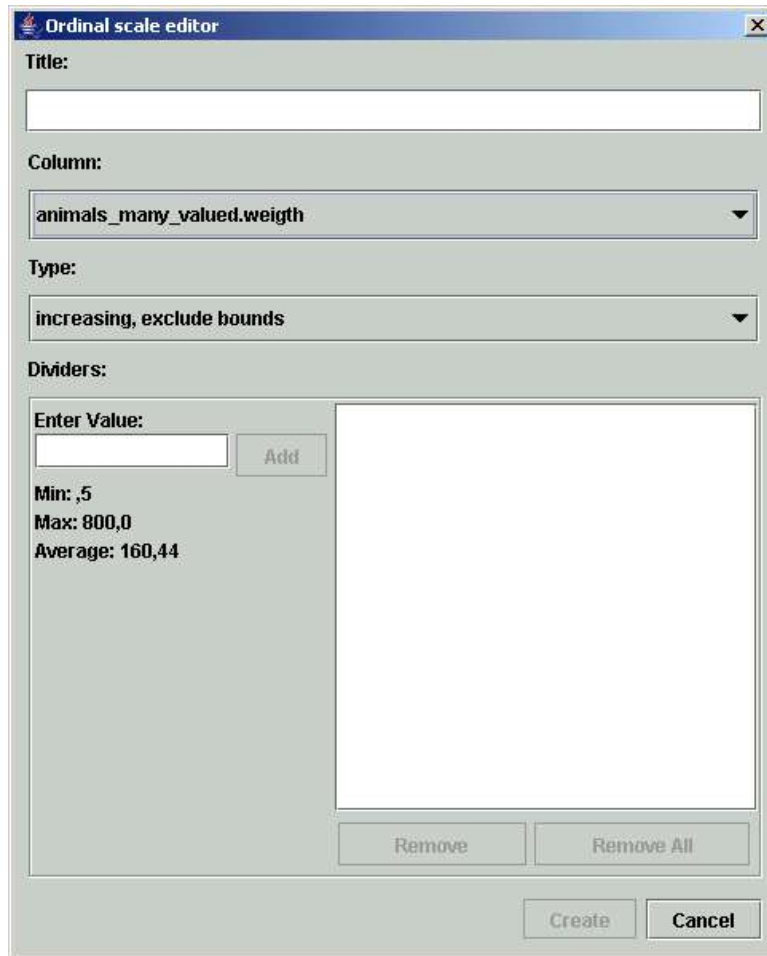


As usual "Create" creates the diagram.

6.4 Ordinal Scale

Ordinal scales are used to display numerical or attribute values that have a linear order. Using this dialog requires numerical data. Creating ordinal scales based on data given in text format has to be done via the "Context Table" wizard and/or conceptual scaling to a single-valued context.

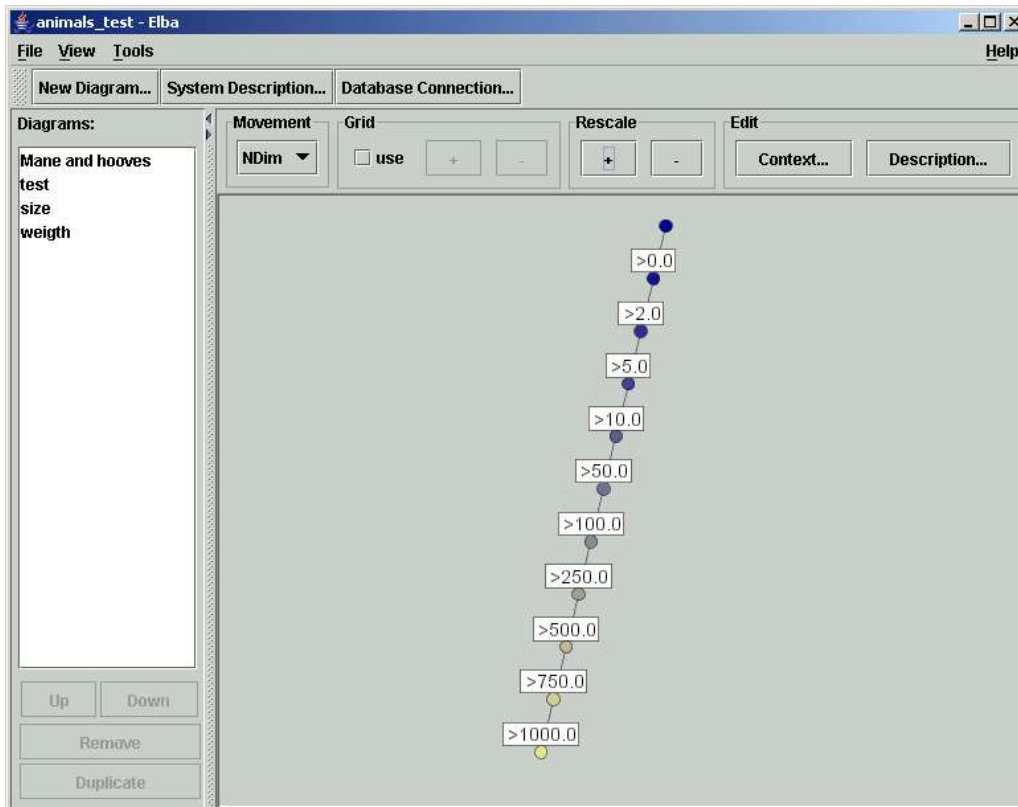
Selecting the ordinal scale wizard opens following window:



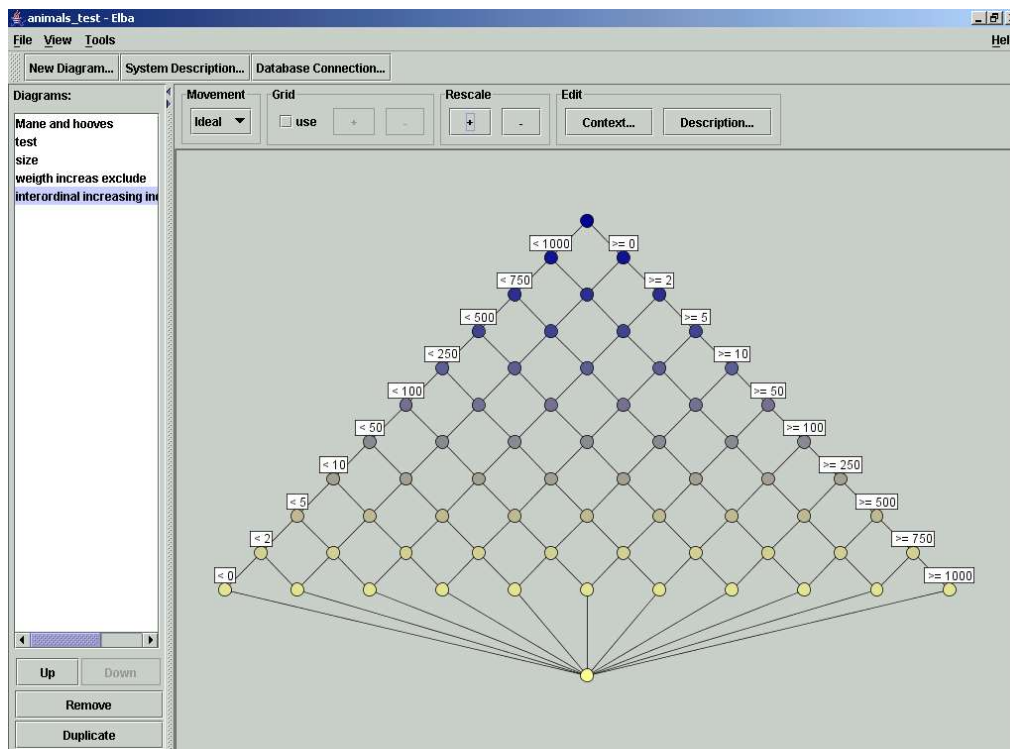
The drop-down field "Column" contains all columns of the database that consist of numerical data. Several types of ordinal scales can be selected in the "Type" field:

1. increasing, exclude bounds
2. increasing, include bounds
3. decreasing, exclude bounds
4. decreasing, include bounds
5. both, increasing side includes bounds
6. both, decreasing side includes bounds

Option 1. - 4. produce chain-formed lattices. The dividers respectively bounds that are specified by the user in the lower part of the window will become the attributes of the scale. Depending on the selected type the generator creates SQL clauses that collects objects from the database that are smaller or smaller or equal the entered values. Type 1., increasing, exclude bounds creates following:



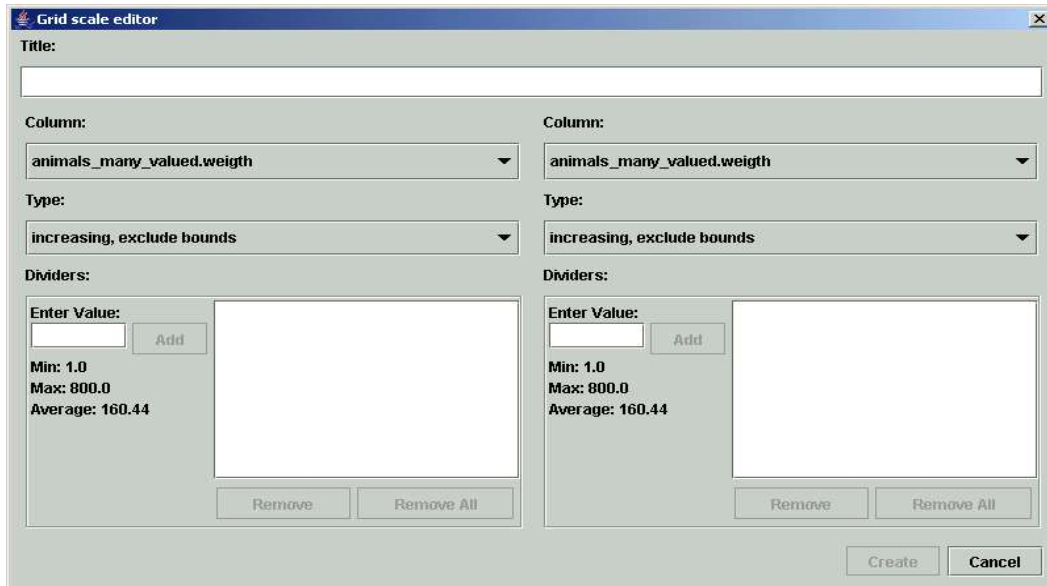
Option 5. and 6. produce so called interordinal scales. Interordinal scales are combinations of two ordinal scales of a single attribute defining ranges of ordinal data. The next picture shows a interordinal scale for the animals weights.



6.5 Grid Scale

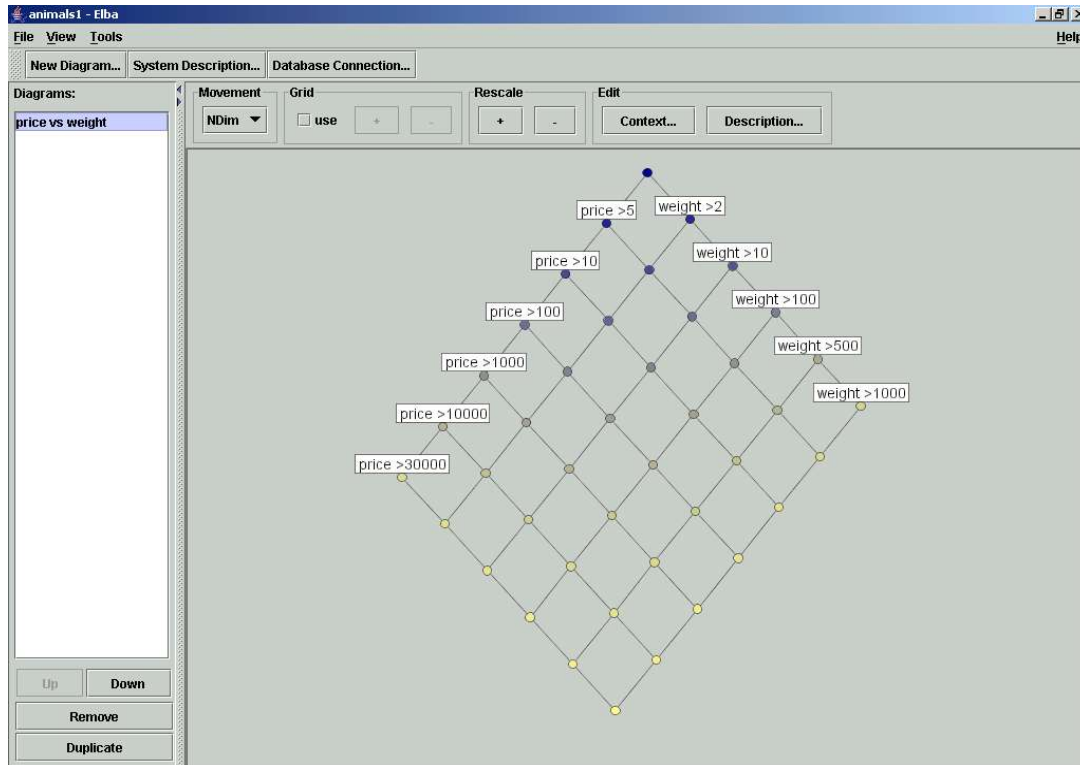
Grid scales are combinations of two independent ordinal scales. The resulting diagram can be compared with a matrix containing all combinations of all values of both attributes.

The grid scale wizard looks like this:



The screenshot shows a dialog box titled "Grid scale editor". It contains two identical panels side-by-side. Each panel has a "Title:" text box at the top. Below that, there are two "Column:" dropdown menus, both set to "animals_many_valued.weigth". Underneath the columns are two "Type:" dropdown menus, both set to "increasing, exclude bounds". The bottom section of each panel is labeled "Dividers:" and contains an "Enter Value:" text box with an "Add" button, and a large empty rectangular area. Below this area are "Remove" and "Remove All" buttons. At the bottom of the dialog, there are "Min: 1.0", "Max: 800.0", and "Average: 160.44" labels. At the very bottom of the dialog are "Create" and "Cancel" buttons.

It consists of two copies of the ordinal scale wizard. As in the ordinal scale wizard you have to select the columns of the database that you would like to combine. Again, only columns with numerical data are offered. A resulting grid scale might look like this:



7 Manipulating Diagrams

The diagram's initial layout is based on a n-dimensional vector space, so "NDim" is the name of one of the four movement options for diagrams. They can be accessed by clicking on the button below "Movement" in the panel above the diagram view.

If the layout Elba suggests is not satisfying, it is recommended to start with the "NDim" option and to pursue with "Ideal". Furthermore start to organize the diagram from top to bottom.

7.1 Movement

- "NDim": To manipulate the diagram, just click on a node and drag. You will see that dragging a node also moves other nodes, the "NDim" feature maintains the vector space the layout is based on.
- "Ideal" moves the node respectively concept and its order ideal, that are all subconcepts of the selected concept. To maintain additive line diagram you should move only the meet-irreducible concepts.
- "Filter" moves the nodes and its order filter, that are all superconcepts of the selected concept.
- "Node" just moves the selected concept.

7.2 Grid

The "Grid" section above the diagram view is used to activate or change a line grid. Select

the box to activate or hide the grid. Clicking on "+" or "-" change the grid's scale. Whenever the grid is enabled, dragged nodes and labels will snap to the grid positions.

7.3 Rescale

In the "Rescale" section you can change the size of the nodes and their labels.

7.4 Edit

The "Edit" section allows you to add additional information about the current scale to the CIS by selecting the "Description" button. These descriptions can be accessed in ToscanaJ.

Clicking "Context..." opens the context editor explained in paragraph 6.2. Please note that any changes to the context will cause the diagram to be recreated, thus losing the layout.

7.5 Context Menu

Right clicking the attribute label of a concept opens a context menu where you can access the description editor and rename the attribute without losing the diagram layout. Similarly you can change the object labels.

8 The Menu Bar

8.1 File

The file menu item consists of standard buttons like "New", "Save" and "Save As". Additionally there is the option to import *.CSC (Conscript) files from former versions of Toscana and Anaconda. You can also export the current diagram to many common image formats. PNG and JPEG is supported by default, EPS, SVG, PPM, PDF and others are supported by plugins. All plugins are installed by extracting the plugin files into the plugin directory below the main directory of ToscanaJ.

8.2 View

The view menu has the option to hide or show the attribute and object labels. Furthermore you can set a lower limit for the font size used in the labels.

8.3 Tools

The tools menu contains four features:

1. Export Realized Scales: Creates a XML files containing all concepts and scales of the CIS with their extent, intent and contingent sizes. Optionally the full extents, intents and contingents can be exported, too. A SQL expression can be provided to filter the object sets. The resulting XML file can be used for further processing.
2. Export Database as SQL: The database the created CIS is based on can be hereby easily exported into a SQL file. Having the database as SQL file provides the option to use the created CIS on different platforms. Using the SQL file requires changing the database connection to the exported file.
3. Create Speed Optimized System: a CIS on a large database can be slow if the queries are complex. To speed up such a system, Elba offers you to create a new, equivalent system that uses simpler queries. The main idea is to replace each contingent clause with a

simple clause of the form “__diagramX__ = Y”, where X is the diagram number and Y the number of the object contingent. Such a change is quite complex, but can speed up systems by large factors.

Whenever you call this feature in Elba, Elba will add new columns into the database and create an index structure on them. This requires matching access rights to the database. The conceptual schema will be changed to query these columns instead, you will be offered to save it into a new file during the process. Please note that it is usually hard to change the resulting schema, it is better to edit the original and create a new speed-optimized system.

4. Check Consistency with Database: This feature checks the consistency of the created scales with the database. You get a notification if the SQL is not correct, the SQL clauses do not cover the data or if they are not disjoint. Using this feature from the “tools” menu checks all scales. The according button in the context editor just checks the current scale.

9 Appendix

In the internet:

- <http://toscanaj.sourceforge.net>
- <http://tockit.org>

Literature:

- Ganter, B., Wille, R. (1996): *Formal Concept Analysis: Mathematical Foundations*. Springer, Berlin-Heidelberg.
- Wormuth, B., Becker, P.: *Tutorial: Introduction to Formal Concept Analysis*, <http://www.wormuth.info/icfca04/materials.html>