

Client-Side Many-Valued Context Scaling

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June 30, 2020

Contents

1	Task	2
1.1	Timetable	2
2	Mock-Up	3
2.1	Import-Panel	3
2.2	Selection-Panel	5
2.3	Scaling-Panel	6
2.4	Export-Panel	11
3	Implementation	12
3.1	Upload	12
3.2	Attribute-Selection	13
3.3	Scaling	14
3.4	Scaling Graph	15
3.5	Ordinal Scaling	16
3.6	Ordinal Context Scaling	17
3.7	Numeric Scaling	18
3.8	Export panel	19
4	Conclusion	20

Chapter 1

Task

Implementation of a client-side web-application to scale many-valued contexts in clojurescript using Reagent and Re-Frame. The CSS is done by using Bulma.

Up until now there was no easy to use interactive tool to scale many-valued contexts. These contexts are most commonly stored as comma-seperated values (.csv). In order to transform them into formal contexts and save them as such (.ctx) there are three scaling methods a tool must implement: nominal, ordinal and numeric scaling. All of them require completely different designs for the user interface in order to be intuitive. Additionally experienced users tend to skip most interfaces and might want to work directly with the data, the tool should provide such an option.

1.1 Timetable

There are several major steps to be taken in order to complete such a task:

1. A basic skeleton which reads in .csv files, scales them all in the most basic way and exports the resulting context as file. (2-3 weeks)
2. Implement functions for all types (nominal, ordinal and numeric) of scaling. (1-2 weeks)
3. Build an interface for the user to manipulate the scaling for each attribute with some helpful statistics. (3-4 weeks)
4. Export a config-file which can later be imported to quickly change the method of scaling. (1 week)
5. Implement algorithms to suggest more optimal scaling and minimize user input. (1-2 weeks)
6. Give more detailed statistics and graphs for each attribute. (optional)

Overall time for implementation: 8-12 weeks. The remaining weeks are to be used for the written part and presentation.

Chapter 2

Mock-Up

What follows is a basic collection of all screens created during the design process. As such they may be subject to change later one but all of them serve as basic guideline for the features each screen must include. They are ordered in the same way a user would experience them: First the data is uploaded in section 1, afterwards all attributed to be scaled are selected. The third and fourth panel then are used to scaled and export the final context respectively.

2.1 Import-Panel

The mock-up illustrates two versions of the 'Import-Panel' interface, separated by a horizontal line. The top version features a grey box on the left with the text 'Select .csv file with mv-context'. To its right is a white checkbox followed by the text 'Header?'. Below the checkbox is a grey button labeled 'Use'. The bottom version features a grey box on the left with the text 'Select .json file with configurations'. To its right is a grey button labeled 'Edit'.

Select .csv file with mv-context	<input type="checkbox"/> Header? Use
<hr/>	
Select .json file with configurations	Edit

Figure 2.1: The panel to select files (both versions)

Features

- Select any local .csv file with a mv-context
- Checkbox to mark existence of a header line
- Different input box to instead reuse a .json file with an old configuration
- Button to second panel

2.2 Selection-Panel

The UI consists of two main parts. The top part is a selection panel with three attribute labels: 'Attribute #1', 'Attribute #2', and 'Attribute #3'. 'Attribute #1' and 'Attribute #2' are highlighted in gray, indicating they are selected, while 'Attribute #3' is white, indicating it is excluded. To the right of these labels is a gray 'Go' button. The bottom part is a scrollable box containing a table with 4 rows and 4 columns. The columns are labeled 'Attribute #1', 'Attribute #2', and 'Attribute #3', with an additional unlabeled column on the left. The rows are labeled '#1' through '#4'. A vertical scrollbar is on the right side of the table.

	Attribute #1	Attribute #2	Attribute #3
#1	19	8	10
#2	88	7	29
#3	12	34	6
#4	9	70	23

Figure 2.2: Preselection panel

Features

- Select all Attributes (multi-select input) to scale (gray) and to exclude (white)
- Preview of the context in scroll-able box (x and y axis)
- Button to third panel

2.3 Scaling-Panel

Attribute #1

Scale nominal ▼

last next

Goto select ▼

-----Statistics-----

-----Settings-----

Figure 2.3: Scaling panel

- Preselected scaling option for each attribute
- Option to choose different measurement levels (ordinal and numeric)
- Descriptive statistics for values of each attribute
- Settings to change scaling
- Button to iterate attributes
- Selection to jump between attributes

Statistics

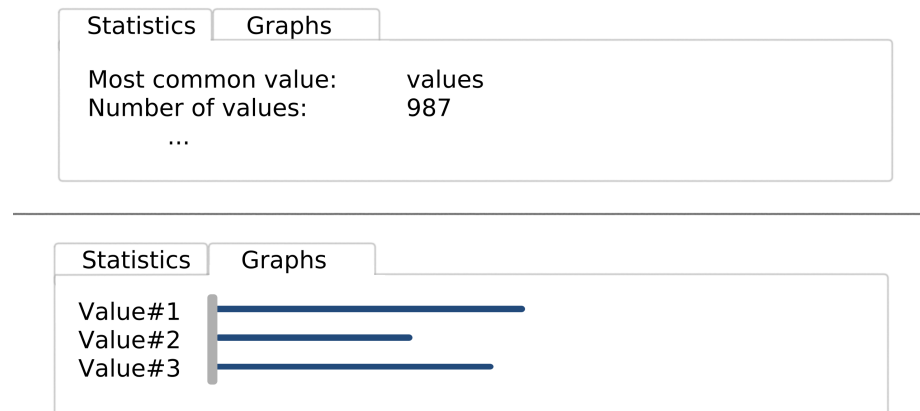


Figure 2.4: Statistics panel

- Based on data type and measure: mean, median, list of all values , most common element etc.
- Distribution graphs

Settings

- Nominal
 - Entirely automatic
- Ordinal

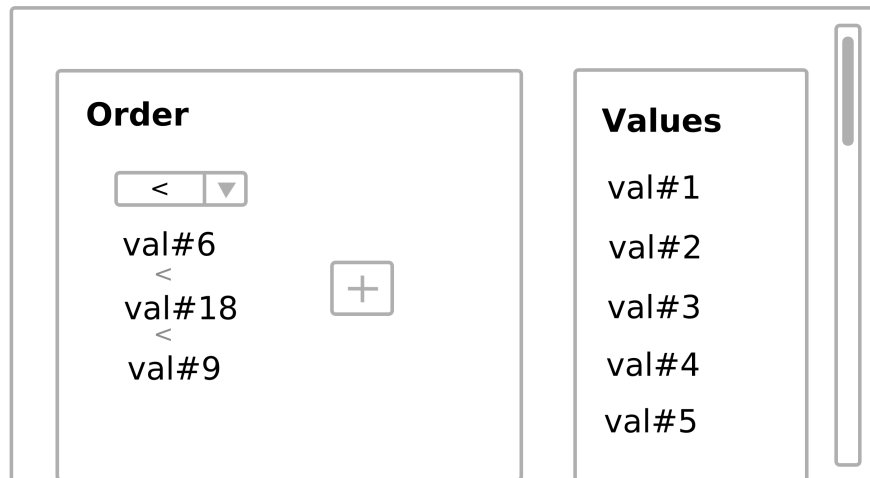


Figure 2.5: Drag and Drop Version

- Sort values with drag and drop
- Different incomparable groups
- Different types of order
- All unused values are scaled nominally

Scale context

–

–

	att#1	att#2	+
val#1	X	X	
val#2	X	X	
val#3		X	
val#4		X	
val#5			

Figure 2.6: Custom context

- Option to edit scale context directly
 - Add and remove rows
- Numeric

Assign

Generate

Intervals

Attribute#1

(

-100

–

0

)

–

[

0

–

100

]

–

+

Attribute#2

(

-100

–

0

]

–

new Att.

Figure 2.7: Custom intervals

- Use predefined intervals with custom amount

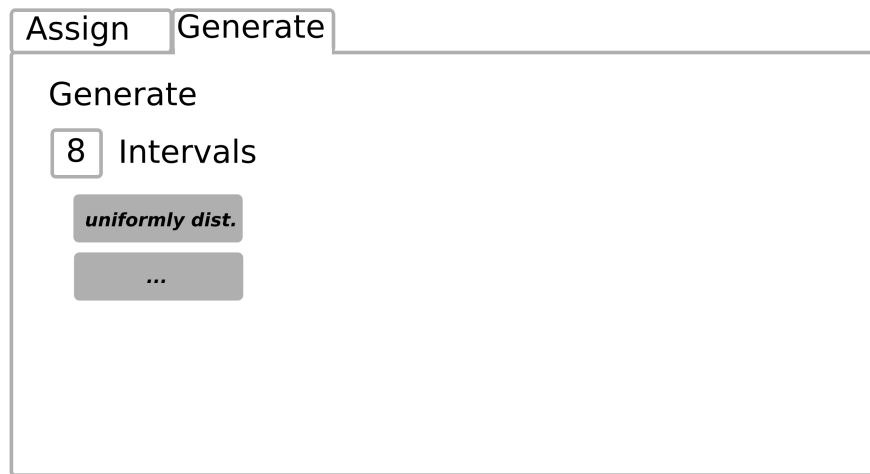


Figure 2.8: Generate predefined intervals

- Generate custom intervals

2.4 Export-Panel

Export

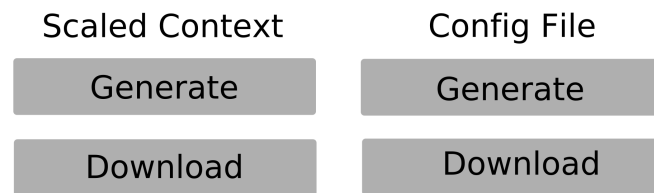


Figure 2.9: Export panel

- Apply scales to mv-context and download it
- Context in Burmeister format
- Option to download .json config file to edit the scaling later

Chapter 3

Implementation

In very much the same order as before the now completed scaling tool is explained. The basic design remained the same but now there are much more details to cover. Each screen is presented with numerous markers and descriptions for everything clickable.

3.1 Upload

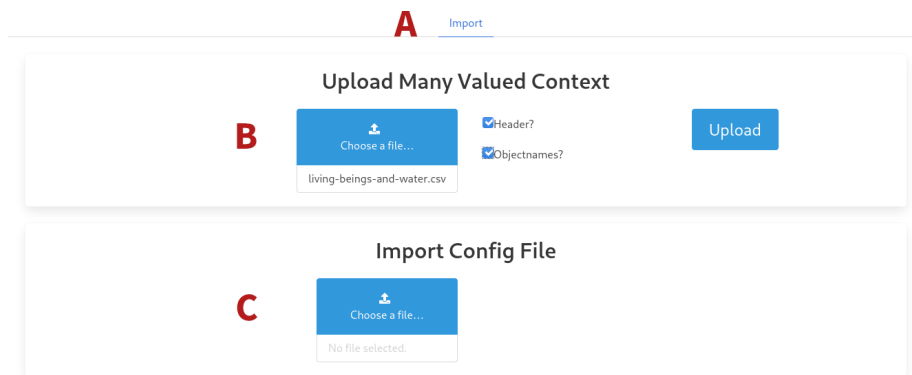


Figure 3.1: The panel to select files

Features

- The topmost bar (Fig. 3.1 A) allows for navigation and is updated with new panels whenever they get accessible.
- Select any local .csv file with a mv-context (Fig. 3.1 B).

- There is the option to include a "header" (first line in file) with attribute names.
- "Objectnames" can be included in the first column of the file.
- To upload the file, click the "Upload"-button.
- Example .csv file with "header" and "objectnames"

```

1      Age, Sex
2 PersonA, 30, m
3 PersonB, 25, d

```

- Additionally, you can edit already scaled contexts by importing config files (Fig. 3.1 C) generated by the last panel in this document.

3.2 Attribute-Selection

[Import](#) [Select](#)

Preview

breast f...	can move	dicotyle...	has limbs	lives in ...	lives on...	monoc...	needs c...	needs ...
0	0	1	0	0	1	0	1	1
0	1	0	1	1	0	0	0	1
0	0	0	0	0	1	1	1	1
1	1	0	1	0	1	0	0	1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

A

Attributes to scale

breast feeds

can move

dicotyledon

has limbs

lives in water

lives on land

monocotyledon

needs chlorophyll

needs water to live

B

Select

Figure 3.2: The panel to select attributes

Features

- The top half (Fig. 3.2 A) displays a preview of the uploaded data.
- The bottom half (Fig. 3.2 B) allows for attributes to be selected for scaling. By default all attributes are selected (green) but can be unselected (white) with a click.

- By holding down the mouse button multiple attributes can be de-/selected.
- Click "Select" to manually scale the chosen attributes.

3.3 Scaling

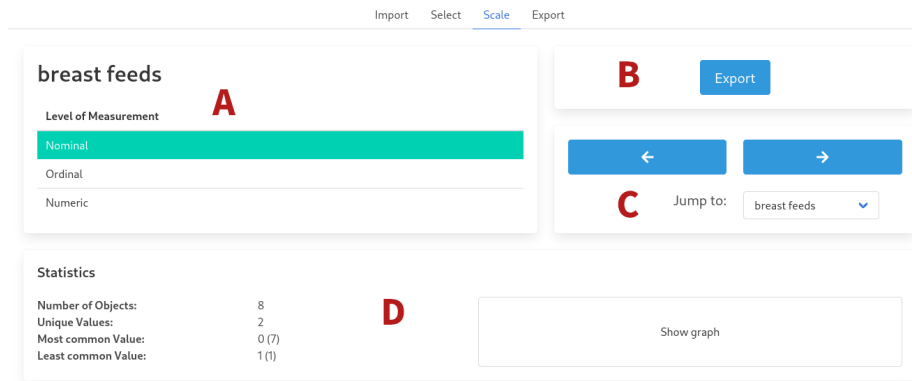


Figure 3.3: The panel to scale attributes

Features

- The top left half (Fig. 3.3 A) allows for the selection of the scaling method for the current attribute (title). Based on the corresponding data some options may not be selectable.
 - Subsequent sections will go into "Numeric" (Section 7) and "Ordinal" (Section 5-6) scaling, both of which will keep the header section as shown here. "Nominal" scaling is done automatically and therefore only consists of the header.
- The top right half (Fig. 3.3 B) allows for the "Export" of the scaled context. All unchanged attributes may be scaled nominally.
- Below the "Export" (Fig. 3.3 C) one can change the current attribute.
- Each scaling method shows "Statistics" (Fig. 3.3 D) relevant for the scaling and the option for a graph.

3.4 Scaling Graph



Figure 3.4: The panel to select attributes

Features

- By clicking the button (shown in Fig. 3.3 D) a temporary graph is generated (Fig. 3.4 A). The graph will disappear upon changing the scaling method or upon changing the current attribute and has to be generated again.

3.5 Ordinal Scaling



Figure 3.5: The panel to scale ordinal attributes

Features

- The default option to perform ordinal scaling is to build orders from the possible values.
- The box on top of the panel (Fig. 3.5 A) contains each different value the attribute has.
- Below a new order can be created either by clicking the "+" (Fig. 3.5 B) or by dragging values from the box above on the "+"-button.
 - Each order (Fig. 3.5 C) has a drop-down menu where an order relation can be selected.
 - By dragging values onto the grey areas the value is inserted into the order.
 - Values can also be dragged out of the order or into different positions by dragging the white box of the corresponding value.
- The "Context view"-button transforms the current orders into a context and changes the panel.

3.6 Ordinal Context Scaling

Ordinal Scaling

New Attribute Name Add **A**

- -

Relation	0	1
0	X	X
1		X

B

Reset

Figure 3.6: The second panel to scale ordinal attribute

Features

- Per default the generated context is quadratic (Fig. 3.6 B) and contains all orders previously built.
- New attributes can be generated by writing their name in the topmost input field and clicking "Add" (Fig. 3.6 B). Clicking the "-" removes the attribute below it.
- Attributes and objects can be sorted with drag and drop.
- The top left corner allows to name the relation used which is purely cosmetic.
- To swap a relation between " " and "x" click the corresponding field.
- "Reset" discards all changes done to the context and return to the previous panel with all orders built before.

3.7 Numeric Scaling

The image shows a software interface for numeric scaling, divided into two main sections labeled A and B.

Section A: Selected Attributes

- Header: "Selected Attributes" with an information icon.
- Attribute Name: "Attribute#0" with an information icon and a "remove Attribute" button.
- Interval Editor: A row containing a left bracket "(", a text input "1" (labeled C), a minus sign "-", a text input "0", a right bracket ")", a minus sign "-", and a plus/minus icon.
- Buttons: A "+" button below the interval editor and a "new Attribute" button at the bottom.

Section B: Generate Attributes

- Header: "Generate Attributes" with a red label B.
- Form: "Number of intervals:" (text input) and "Type:" (dropdown menu showing "equal length") with a "Generate" button.
- Buttons: A "new Attribute" button and a "select all Attributes" button at the bottom.

Figure 3.7: The panel to scale numeric attributes.

Features

- The upper panel (Fig. 3.7 A) contains all selected attributes.
 - "new Attribute" and "remove Attribute" add/delete attributes.
 - The attribute name can be clicked and written in to change it.
 - "+" and "-" add/delete intervals (Fig. 3.7 C) from an attribute.
 - A value is added to an attribute if it is contained in one of its intervals. The interval can be toggled to be open "(" and closed "]" by clicking the brackets.
 - Intervals can be moved to other attributes by drag and drop.
- The lower panel (Fig. 3.7 B) generates attributes.
 - By clicking "Generate" the written number of intervals is generated by the selected method from the drop-down menu.
 - Those attributes must be selected to be used by clicking "Select" or "Select all". Selected Attributes are moved to the upper half.

3.8 Export panel

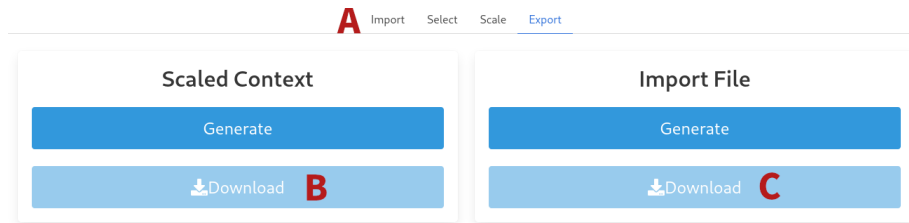


Figure 3.8: The panel to export the scaled context

Features

- On top is the navigation bar with all possible entries (Fig. 3.8 A).
- By clicking the corresponding button an import file and a scaled context can be "generated".
- The scaled context applies all chosen scales to the selected attributes and outputs the context in "Burmeister"-format (Fig. 3.8 B).
- The import file (Fig. 3.8 C) consists of a .json file with the current state of the application. This file can later be used to change the different scaling methods applied to the attributes or to change the selected attributes.

Chapter 4

Conclusion

The resulting tool both followed the initial timetable and the mock-up almost perfectly. Each of the different scaling methods received a matching user interface with rather simple instructions provided for each. While nominal scaling is done completely automatic, all other cases of ordinal scaling are implemented by building different orders of elements. This follows the rule that all concept lattices can be disjoint into linear orders. Additionally the resulting context can be edited directly. Numeric scaling is based on building new attributes from multiple assigned intervals, both inclusive and exclusive. While all of these options provide are more easy to use user interface than available before, the usability is also the most important goal to iterate upon in the future. Currently the tool still misses some options to simplify the scaling of larger contexts. Nominal scaling works automatic regardless of the initial size and numeric scaling features the automatic generation of intervals, but ordinal scaling lacks such a feature. Both the simple interface and the direct editing of the context would greatly benefit from a multi-select option or initial orders.