Bertifier: New Interactions for Crafting Tabular Visualizations

Charles Perin, Pierre Dragicevic, Jean-Daniel Fekete

Bertifier: New Interactions for Crafting Tabular Visualizations

Charles Perin
INRIA, Univ. Paris-Sud &
CNRS-LIMSI
Bat. 660, Orsay, France
charles.perin@inria.fr

Pierre Dragicevic
INRIA
Bat. 660, Orsay, France
pierre.dragicevic@inria.fr

Jean-Daniel Fekete
INRIA
Bat. 660, Orsay, France
jean-daniel.fekete@inria.fr

ABSTRACT
Bertifier is a Web app for rapidly creating tabular visualizations from spreadsheets. It directly draws from Jacques Bertin's matrix analysis method, whose goal was to "simplify without destroying" by encoding cell values visually and grouping similar rows and columns. Bertifier has the potential to bring Bertin's method to a wide audience of both technical and non-technical users, and empower them with data analysis and communication tools that were so far only accessible to a handful of specialists. `www.aviz.fr/Bertifier` contains additional material materials, a tutorial, and a link to the online open-source application.

Key Words
Visualization; Bertifier; Crossing; Crossets; Bertin Matrices; Tables.

ACM Classification Keywords
H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous.

INTRODUCTION

Standard GUIs use only one dimension of the screen 2D space—and one dimension of the mouse—to interact with sliders, while several works take advantage of the dimension orthogonal to the sliders' axis [2, 6], that we call the orthogonal dimension. Despite the fact that crossing [1] for selecting several objects in a single gesture is well suited to the simultaneous manipulation of multiple sliders, this technique has never been applied to manipulate the orthogonal dimension of sliders. While pointing requires to target an object and press the mouse button to activate it, crossing consists of pressing the mouse button and moving the cursor in a series of graphical objects to activate them all.

Crossets [9] are beneficial for interfaces presenting objects that are *similar, aligned, and on which users often perform the same small set of actions over a range of consecutive objects*. Spreadsheet calculators for example, would benefit from Crossets to apply specific formatting/coloring to a subset of rows (or columns). Currently, users have to select the rows on which to apply the action, then open a menu and apply the action using a selection-action-deselection cycle. Crossets can avoid the selection-deselection, and apply the action directly with continuous feedback. In this demonstration, we present Bertifier [10], an online application entirely based on crossets for crafting tabular visualization from quantitative spreadsheets.

BERTIFIER

Bertifier is an online application for crafting tabular visualizations from quantitative spreadsheets, based on Jacques Bertin's matrices analysis method [4, 5]. As detailed in [10], Bertifier remains faithful to Bertin's method while leveraging recent advances in HCI in order to provide a tool accessible to a wide range of users.

Bertifier loads any spreadsheet containing quantitative data. It allows for visually encoding cell values using various encodings (*e. g.,*barchart, circle height, and position). Moreover, as heterogeneous data implies heterogeneous visual encodings, each dimension of the table can be encoded independently. . Following Bertin's method, Bertifier features formatting tools (*e. g.,*separators, rows and columns resizing) and free annotation tools to both improve the visual exploration process and the communication process. One of the main characteristics of Bertifier is the visual reordering it provides. Rows and columns can be dragged and dropped to manually reorder the table, but subsets of rows and columns can also be automatically reordered using associated crossets; as a result, Bertifier makes it possible to reorder visually numerical tables without requiring any mathematical or statistical background, as this was confirmed during a qualitative user study [10]. Finally, an export functionality allows users to export the final visualization as a vector graphic file for further modifications.

To summarize, Bertifier features the following functionalists, based on Jacques Bertin's requirements for matrices analysis:

1. allow the creation of a table from raw data
2. perform data conditioning: scale, clamp range, discretize (step), and inverse rows/columns values so they become comparable
3. select an encoding for cell values
4. present the table visually
5. reorder the rows/columns to group similar items together and move apart dissimilar ones
6. group rows/columns that form meaningful chunks
7. annotate the matrix (name groups)
8. finalize the results for communication / publication

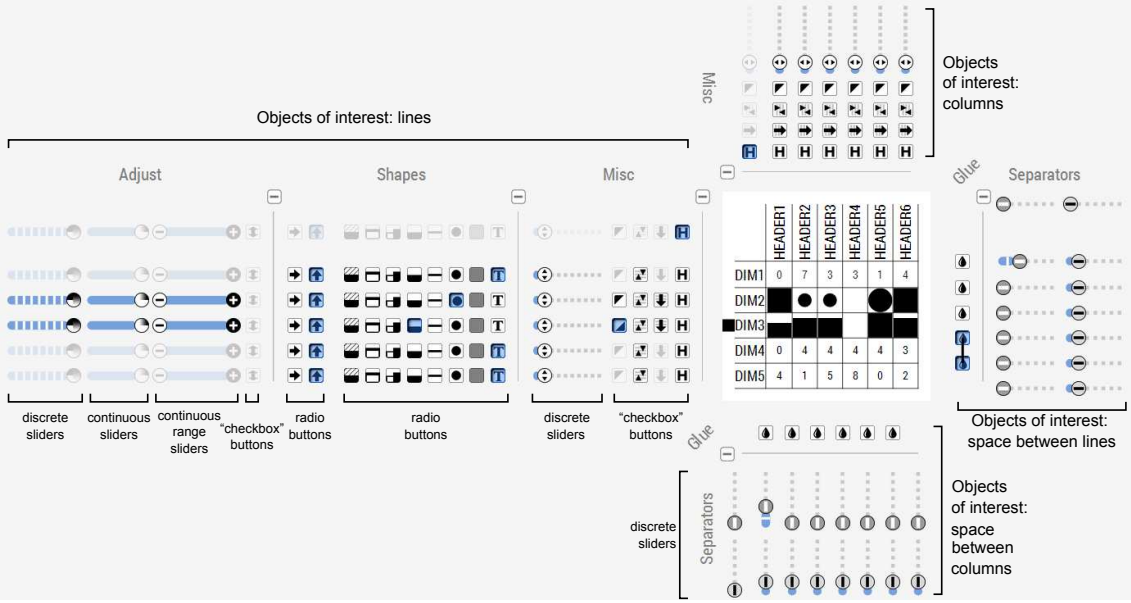

Figure 1. The Bertifier interface with crossets laid out around the table.

CROSSETS FOR BERTIFIER

In Bertifier (see Figure 1), Crossets are placed next to rows and columns, and make it possible to perform actions on arbitrary groups of adjacent rows and columns.

UI Guidelines recommend avoiding too many widgets [12]. However, the multiplication of Crossets is a strength of Bertifier. Indeed, it deals with the challenge of applying an action on several objects of interest by one unique interaction [7]. Moreover, applying actions does not require to specify the selection in advance which is made on-the-fly—as opposed to the traditional selection-action sequential approach, and the gesture's reversibility makes the system tolerant to errors.

As Crossets are aligned with their target row or column, their spatial offset is null according to one of the two dimensions of the space. Thus, their spatial indirectness [3] is lower than widgets not designed to be aligned with the objects of interest and far from them.

The selection of objects of interest and the manipulation of values are performed in a unique gesture with immediate feedback [11, 8], and the actions are instantaneously applied to the objects of interest. Thus, Crossets minimize temporal indirectness [3] and articulatory distance [8].

Designing an entire interface involves tradeoffs, and internal consistency can conflict with the degree of compatibility [3] of some Crossets. For example, to modify the width of a column, the user has to drag the slider thumb up and down while a horizontal dragging would be more cognitively congruent.

A recognized challenge of direct manipulation interfaces is targeting invisible objects [7]. Crossets must be visible in the viewport to be reachable, which may be a problem when the table is too large (Bertifier reaches its limits for tables larger than 1000 cells), requiring to perform several gestures coupled with page scrolling. However, zooming out solves the problem in most cases.

CONCLUSION

Bertifier is a semi-automatic approach for reordering matrices based on visual reordering. Bertifier leverages recent advances in HCI—crossing interaction—to apply actions on multiple rows and columns in a single gesture, avoiding the standard selection–action sequential approach. Bertifier resurrects an ancient and forgotten method and we believe it will finally democratize Bertin's work, while many previous attempts failed before. The tool is designed to be accessible to a wide range of users, from researchers—for communicating experimental results to school pupils—for learning by manipulation, and we believe it has a high pedagogical value. Some teachers and students from a French University already use it during a class, and we hope it is the sign of a wider adoption.

BIBLIOGRAPHY

1. Accot J. & Zhai S. More than dotting the i's — foundations for crossing-based interfaces. In *Proc. CHI '02*, ACM (2002), 73–80.
2. Appert C. & Fekete J.-D. Orthozoom scroller: 1d multi-scale navigation. In *Proc. CHI '06*, ACM (2006), 21–30.
3. Beaudouin-Lafon M. Instrumental interaction: An interaction model for designing post-wimp user interfaces. In *Proc. CHI '00*, ACM (2000), 446–453.
4. Bertin J. *La graphique et le traitement graphique de l'information*. Nouvelle bibliothèque scientifique. Flammarion, 1975.
5. Bertin J. *Graphics and Graphic Information Processing*. De Gruyter, Berlin, 1981. Translation: William J. Berg, Paul Scott.
6. Fekete J. The infovis toolkit. In *INFOVIS '04* (2004), 167–174.
7. Frohlich D. M. Direct manipulation and other lessons. In *Handbook of human-computer interaction (2nd ed)*, Elsevier (1997), 463–488.
8. Hutchins E. L., Hollan J. D. & Norman D. A. Direct manipulation interfaces. *Hum.-Comput. Interact. 1*, 4 (1985), 311–338.
9. Perin C. & Dragicevic P. Manipulation de Sliders Multiples par Franchissement. *26th French Speaking Conference on Human-Computer Interaction* (2014).
10. Perin C., Dragicevic P. & Fekete J. Revisiting bertin matrices: New interactions for crafting tabular visualizations. *TVCG* (2014).
11. Shneiderman B. Direct manipulation: A step beyond programming languages. *Computer 16*, 8 (1983), 57–69.
12. Van Dam A. Post-wimp user interfaces. *Commun. ACM 40*, 2 (1997), 63–67.