Comprehending City Economics from Heterogeneous Data

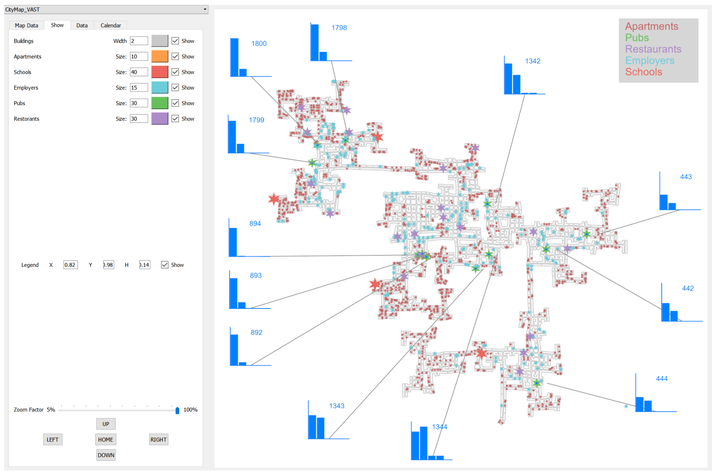
R. Splechtna[1], T. Hulka[1], D. Sardana[2],
N. D. Chandrashekar[2], D. Gračanin[2], and K. Matković[1]

[1]VRVis Research Center, Vienna, Austria; [2] Virginia Tech, Blacksburg, VA, USA

Introduction

This poster describes how we approach the IEEE VAST 2022 Challenge Three: *Economics*. We extend our existing coordinated multiple views solution—ComVis—in order to provide the necessary views and interaction for the predefined analysis tasks. In addition we use several F# and Python scripts to preprocess the data. The data is provided in several files and we need different data sets depending on the analysis tasks. We create citizen-centric and business-centric data sets. As we are analyzing spatial data, the newly developed map view is used in all configurations. We combine it with several standard views in order to solve different tasks.

The Map View



The newly developed map view loads coordinates of buildings, apartments, and businesses from several files and depicts the spatial context. Each business type can be represented with its own color and symbol. The user can configure what is shown.

In addition to the loaded data, various aggregated statistic values for businesses can be shown. In this example, the histograms show the distribution of distances which customers travel on their way towards a pub. Most of the visitors do not travel far in order to reach the pub. There are just a few pubs with customers from far away. Such overview statistics help in identifying widely popular pubs.

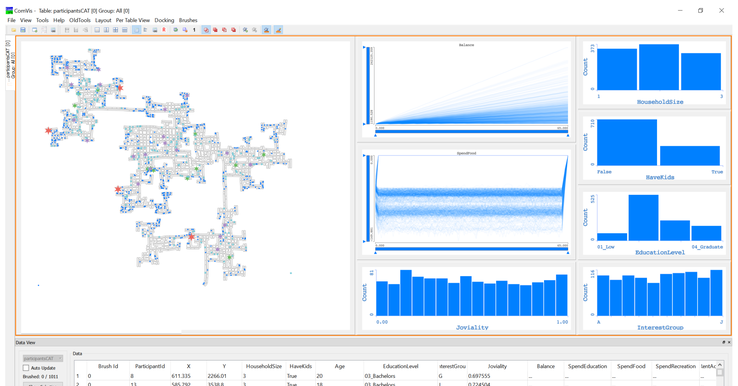
Interaction

All views in the system are linked. The user can brush the data in any view and the corresponding items in all other views are highlighted. Several brushes can be combined using Boolean operations to form composite brushes. Depending on the view type, different interactions are supported:

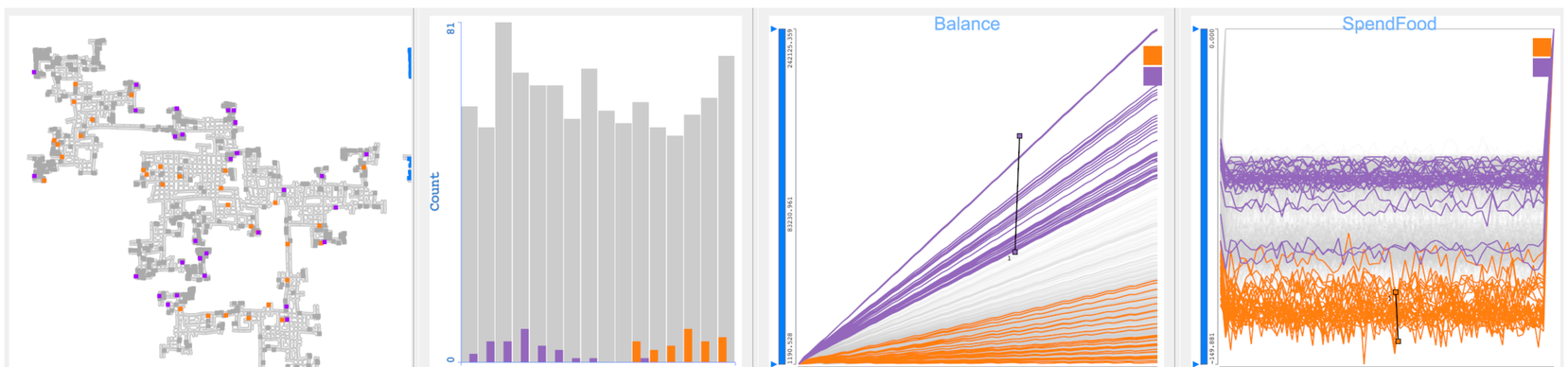
- **Histogram** - the user can select one or more bins.
- **Scatter Plot** - the user can select a rectangular area.
- **Curve View** - the user draws a line and all views that cross the line are selected.
- **Map View** - the user can zoom and pan, move the overlaid histograms, select what is shown, …

Citizen-centric Analysis: Food, Money, and Joviality

In the citizen-centric data set, each record corresponds to a citizen. There are several scalar time series attributes per record.



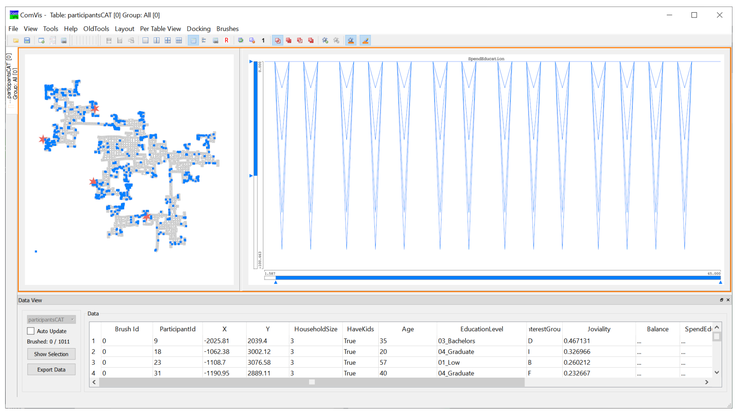
A configuration of the ComVis tool as used in the analysis. The map view is on the left, the two curve views show account balance and spending on food as functions of time, and five histograms show different scalar attributes.



If we brush the citizens with high spending on food (orange brush) we see that all of them have a relatively low account balance and a relatively high joviality value. If we create another brush now, and select citizens with high account balance (purple brush) we see that they do not spend much on food and have relatively low joviality values. The map view shows us where the two brushed groups live. We can see no obvious spatial groupings, they live next to each other across the city.

Citizen-centric Analysis: Education Fees

Let us look at the education expenses now. We are using only two views, the map view and the curve view that shows spending on education.



There is a regular pattern in paying education fees. Once a month, the fee has to be paid. There are four different fees that are paid, and there are four schools in the city.

If we brush the most expensive fee now, we can see where the citizens that pay this fee live. They are all in the vicinity of one school. The same is true for all other fees/schools as can be seen by the highlighted places of residence for each of the four different school fees citizens are paying. We can deduce the school fees of the individual schools from this correlation.

Conclusion

A holistic analysis of complex data as given in this challenge can be successfully conducted by means of visual analytics. Due to the complexity and heterogeneity of the data and tasks, an extensive data processing that results in several data sets is needed. Custom views are also often needed when analyzing such complex data. Coordinated multiple views with support for complex brushing make it possible to efficiently explore various hypothesis and comprehend the data.

Acknowledgments

VRVis is funded by BMK, BMDW, Styria, SFG, Tyrol and Vienna Business Agency in the scope of COMET – Competence Centers for Excellent Technologies (879730) which is managed by FFG. Parts of this work have been supported by Virginia Tech Institute for Creativity, Arts, and Technology.