

## DEPARTMENT OF COMPUTER SCIENCE

# Putting data on maps to show relationships

By Stephen Kobourov

SPECIAL TO THE ARIZONA DAILY STAR

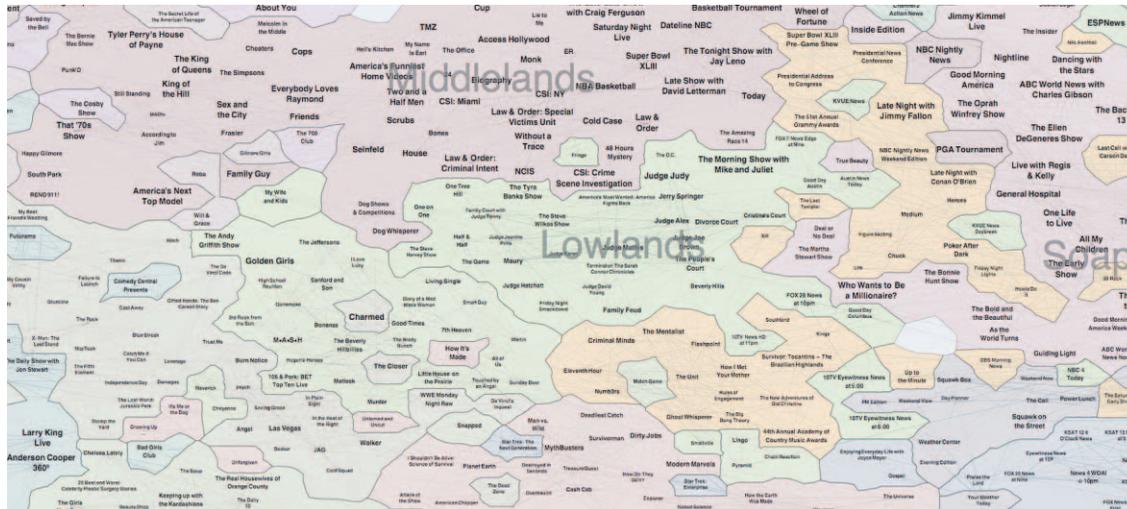
Information visualization is essential for understanding connections and patterns within large datasets, such as movies in the Netflix database, TV programs or social networks on Facebook.

However, traditional approaches such as pie charts, bar graphs and scatter-plots often don't show underlying patterns and relationships in the data.

My colleagues and I overcome these problems by using maps: aesthetically appealing visualizations that portray relationships among abstract concepts. A map representation is familiar and intuitive; most people use maps; and well-drawn maps can provide hours of enjoyable exploration.

We automate the process: It begins with the data and ends with a computer-generated drawing of a map, rather than a graph. Our maps reveal some surprising insights into how different aspects of the data relate to one another.

Our approach has many differ-



STEPHEN KOBOUROV/UA DEPARTMENT OF COMPUTER SCIENCE

This map reveals show-to-show similarity, based on viewing patterns from one month of 2009 data from more than 1 million subscribers to a digital TV service. Some countries correspond to channels, like PBS, whereas others correspond to programs with similar themes that are on different channels. The central countries shown here, Middlelands and Lowlands, contain the most popular shows, which are neither on the same channel, nor particularly similar. The full map: [cs.arizona.edu/~kobourov/PROJECTS/TVLand.png](http://cs.arizona.edu/~kobourov/PROJECTS/TVLand.png)

ent applications. In collaboration with AT&T Labs-Research, we have used our maps to visualize scientific collaboration networks, Netflix movies and books on Ama-

zon. Working with UA nutritional scientists, we are identifying and mapping barriers to healthy eating and physical activity.

We are also, in collaboration

with network engineers, using these map-based visualization techniques to better understand security threats to computer networks.

## ABOUT THE SCIENTIST



**Stephen Kobourov** is a professor of computer science at the University of Arizona. His research interests include information visualization and human-computer interaction. He has been at the UA since 2000. He spent a year at the University of Botswana as a Fulbright Scholar and a year at Tübingen University in Germany as a Humboldt Fellow.

## EXPERIENCE SCIENCE

- **Stephen Kobourov's webpage:** [cs.arizona.edu/~kobourov](http://cs.arizona.edu/~kobourov)
- **Stephen Kobourov's mapping projects:** [cs.arizona.edu/~kobourov/PROJECTS/maps.html](http://cs.arizona.edu/~kobourov/PROJECTS/maps.html)
- **UA department of computer science:** [www.cs.arizona.edu](http://www.cs.arizona.edu)

## DEPARTMENT OF COMPUTER SCIENCE

# Capturing the 'when' of life by better integration of time, information

By Richard Snodgrass

SPECIAL TO THE ARIZONA DAILY STAR

You purchase a book from an online seller. The government keeps records of your Social Security contributions. The University of Arizona tracks the courses a student takes.

These computer systems share a common feature: They capture information that changes over time. For example, the UA has an extensive system for course scheduling that goes back many years. But it has been quite difficult to ensure consistent information or to ask even simple ques-

tions of such information.

My research group has been developing some very practical solutions. First, we simplified how to add time to stored information. Then we simplified the computer language for asking questions.

Top information system com-

panies, including IBM here in Tucson and Oracle — which supplies the UA system — have recently announced that their systems now incorporate innovative technology we developed. So does an international standard for databases released just a few

months ago.

How will this affect you, the interested consumer?

Many online resources we have all come to depend on can now do a better job of capturing the "when" of life. How does my water bill as summer progresses compare with that of my neighbors? Has my spending each year on books from Amazon.com gone up or down?

Our technology lets us answer these questions more easily by better integrating information and time — two fundamental aspects of life.

## ABOUT THE SCIENTIST



**Richard Snodgrass** is a professor of computer science at the University of Arizona. He works with graduate and undergraduate

students on fundamental research questions concerning information that varies over time. Answering such questions will also help improve the utility and performance of computer systems we use every day.