Notes for Class 9: Space and Order

Objectives
By the end of the class, you will be able to…

• Design small multiple techniques for visualizing data. Explain why they can be effective.
• Explain why ordering is an important factor in design and how good orderings can be achieved.

Agenda for Class

• Design activity
• Discussion of Small Multiples
• Discussion of ordering, with examples

Reading Assignment
Tufte Chap. 4: Small Multiples

Notes:

1. What are small multiples?
One or more small visualizations of a piece of the data, repeated for different pieces of data.

2. Why are small multiples an effective way to visualize complex or multivariate data?
   • Encourage direct comparison of the small images so you can see differences.
   • Enable you to see trends.
   • Avoid putting everything into one image where it may be too complex to analyze.
   • Show you the range of the data or alternatives all at once.

3. Is it better to show small multiples repeated spatially (small multiples) or over time (as a movie)? Why?
   • Side-by-side is generally better than sequences of images over time
     • A glance is very fast, much faster than a button press to get to the next frame, or even just waiting for the next frame to appear automatically (e.g., Tufte image on page 76 is stranded away from the 4 images on the previous page, making comparisons difficult).
     • Any pair of images can be compared, or multiple images can be compared
   • However, in some cases the temporal approach may be useful:
     • If the items have one natural order and if high resolution is needed to see each item
       • Example: “cine” mode in radiology. Radiologists view one slice of the body and then drag a slider to view consecutive slices. There is only one natural order of the slices (their spatial order in the body) and each

- Can effectively show process of change
- Can flip back and forth between two similar images to identify subtle differences (differences pop out via motion)

4. In a small multiple design, how should items on each axis be ordered?

*Consider the rivers on Tufte page 77.*

Ordered by decreasing length.
- This is useful if you are comparing relative lengths of rivers, or searching for long or short rivers.
- It isn’t very useful if you want to compare rivers in the same geographic region.

*Consider the Neurometric maps on p. 78. How are the images ordered in x and y*

Ordering seems somewhat arbitrary. This makes some sense since the data is nominal. However, it makes it easier to compare items that are side by side (e.g. Unipolar and Bipolar) than those far apart (e.g. Unipolar and Dementia).

**Crux:** Dynamic ordering can be useful. Enable the user to dynamically move and reorder items as appropriate for their task.

**Dynamic Ordering**

Supports interactive queries. No single order would be ideal for answering every question.

**Example 1:** Table Lens http://www.avizsoft.com/contents/table-lens-demo.htm

Possible actions with the Table Lens:
- Order all the data by a particular axis (increasing or decreasing order). Allows you to examine trends like “If Protein is high, which vitamins are high?” or “If Carbs are high, is protein high?”.
- In original version, you could reorder the dimensions (columns) to look at interesting ones side-by-side. Could also see details of multiple rows at once for comparison.
Example 2: Rivet [Bosch, HPCA6 2000].
The image below shows idle time of 39 processes.
The zoom window shows a small time slice.

Reordering reveals a pattern where a kernel lock is passed from one process to the next.

Demonstrates automatic ordering of data.

E.g. Barley growth data:
6 locations (Wasesca, University Farm, etc)
10 varieties of Barley (Wisconsin No. 38, etc)
2 years (1931 and 1932)

Ordering each dimension by median value shows trend much more clearly.
Also allows us to identify an error in the data: Years were mixed up for the Morris location (3rd from top in ordered visualization).
Key Concepts for Today:

1. Small multiples can be an effective way to visualize multivariate data.
2. Data ordering strongly affects our ability to see patterns and trends.
3. Dynamic ordering is often important. It enables the user to see different patterns in the data and customize the display to answer their own specific questions.