CIS 4930/6930-902
Scientific Visualization

Single View, Multiview, & Focus+Context

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slides credits Miriah Meyer (U of Utah)
Administrative

project 2 due Tuesday
project 3 released Tuesday
reading for Tuesday
project 2 presentations Thursday
SINGLE VS MULTIPLE VIEWS

eyes over memory—trade-off of display space and working memory

similar situation with partitioning vs layering
A VARIETY OF OPTIONS...
LINKED VIEWS

multiple views that are simultaneously visible and linked together such that actions in one view affect the others
**What to show**

**encoding**: same or multiform

**dataset**: share all, subset, or none

**How to interact**

**highlighting**: to link, or not

**navigation**: to share, or not
MULTIFORM

different visual encodings are used between the views

rational: single, monolithic view has strong limits on the number of attributes that can be shown simultaneously
VisBricks: Multiform Visualization of Large, Inhomogeneous Data

Alexander Lex, Hans-Jörg Schulz, Marc Streit, Christian Partl and Dieter Schmalstieg
**WHAT TO SHOW**

**encoding**: same or multiform  
**dataset**: share all, subset, or none

**HOW TO INTERACT**

**highlighting**: to link, or not  
**navigation**: to share, or not
SHARED DATA

showing all data in each view, but with different encoding schemes

rational: different views support different tasks
MATRIXEXPLORER
OVERVIEW + DETAIL

one view shows (often summarized) information about entire dataset, while additional view(s) shows more detailed information about a subset of the data

rational: for large or complex data, a single view of the entire dataset cannot capture fine details
SMALL MULTIPLES

each view uses the same visual encoding, but shows a different subset of the data

rational: quickly compare different parts of a data set, relying on eyes instead of memory
<table>
<thead>
<tr>
<th>Shared Encoding</th>
<th>Shared Data</th>
<th>All</th>
<th>Subset</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same</td>
<td>Redundant</td>
<td></td>
<td>Overview/Detail</td>
<td>Small Multiples</td>
</tr>
<tr>
<td>Different</td>
<td>Multiform</td>
<td></td>
<td>Multiform, Overview/Detail</td>
<td>No Linkage</td>
</tr>
</tbody>
</table>
**WHAT TO SHOW**

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**dataset**: share all, subset, or none

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**HOW TO INTERACT**

**highlighting**: to link, or not

**navigation**: to share, or not
LINKED HIGHLIGHTING
WHAT TO SHOW

encoding: same or multiform
dataset: share all, subset, or none

HOW TO INTERACT

highlighting: to link, or not
navigation: to share, or not
LINKED NAVIGATION

http://www.historyshots.com/rockmusic/
A variety of options...
PARTITIONING

action on the dataset that separates the data into groups

main design choices

how to divide data up between views, given a hierarchy of attributes
how many splits, and order of splits how many views (usually data driven)

partition attribute(s)

typically categorical
SCATTERPLOT MATRIX (SPLOM)

3.65 CONDITIONING. A scatterplot matrix displays trivariate data: measurements of abrasion loss, hardness, and tensile strength for 30 rubber specimens. The "+" plotting symbols encode the data for those specimens with hardness less than 62 °Shore.

Cleveland 1994
TRELLISED VIEWS

panel variables: attributes encoded in individual views

partitioning variables: partitioning attributes assigned to columns, rows, and pages
non-trellised scatter plot

trellising this visualization based on Gender and Political affiliation

From https://docs.tibco.com/pub/spotfire/5.5.0-march-2013/UsersGuide/vis/vis_trellis_visualizations.htm
Hierarchical Visual Expression

**HIVE**

**partitioning**: transform data attributes into a hierarchy

**reconfigure hierarchies** to explore data space

treemaps used as spacefilling layouts
TREEMAP
Hierarchical Visual Expression

**HiVE**

**partitioning**: transform data attributes into a hierarchy

**reconfigure hierarchies** to explore data space

**treemaps used as spacefilling layouts**

each rectangle is a partitioned subset

nested graphical summaries

size, shape, color used to show subset properties

containment ordering by partition variables
Configuring Hierarchical Layouts to Address Research Questions

Aidan Slingsby, Jason Dykes and Jo Wood

giCentre, Department of Information Science, City University London
http://www.gicentre.org/hierarchical_layouts/
GLYPHS

a graphical object with internal structure that arises from multiple marks

ambiguity: little distinct line between glyph and view!
gather metadata for obtaining a set of names
or, things you want to represent

build a taxonomy
propose several categorization schemes

develop visual design
determine order of visual channels
propose optional mappings
identify metaphoric abstractions

implement a glyph-based system
A VARIETY OF OPTIONS...
LAYERING

combining multiple views on top of one another to form a composite view

rational: supports a larger, more detailed view than using multiple views

trade-off: layering imposes constraints on visual encoding choice as well as number of layers that can be shown
GLOBAL COMPOSITING

Les abscisses représentent les années et les ordonnées les tonnages correspondants.
OVERLAYS
EDGE BUNDLING

Holton 2006
MULTIPLE ENCODINGS
ITEM-LEVEL STACKING
Consommations approximatives de la Houille dans la Grande Bretagne de 1850 à 1864.

Les abscisses représentent les années et les ordonnées les quantités annuelles de houille consommées.
Les couleurs indiquent les espèces de consommation. Les taupiers d'intersections comportent dans leur module non les quantités de houille consommée à cause de deux milliards pour un million de tonnes.

1781-1870

JOSEPH MINARD
STREAMGRAPH
How Different Groups Spend Their Day

The American Time Use Survey asks thousands of American residents to recall every minute of a day. Here is how people over age 15 spent their time in 2009. Related article

Everyone
Sleeping, eating, working and watching television take up about two-thirds of the average day.

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 a.m. - Noon</td>
<td>30%</td>
</tr>
<tr>
<td>Noon - 4 p.m.</td>
<td>50%</td>
</tr>
<tr>
<td>4 p.m. - Midnight</td>
<td>20%</td>
</tr>
</tbody>
</table>

Breakdown by Demographic:

- Women
- Men
- Households
- Age groups
- Education levels
- Employment status
- Number of children
FOCUS + CONTEXT

techniques to show detail (focus) and overview (context) simultaneously

requires: carefully pick what to show and hinting at what you are not showing
FOCUS + CONTEXT

synthesis of visual encoding and interaction

user selects region of interest (focus) through navigation or selection

provide context through aggregation, reduction, or layering
FOCUS+CONTEXT

- Embed
  - Elide Data
  - Superimpose Layer
  - Distort Geometry
Embed

Elide Data

Superimpose Layer

Distort Geometry

ELISION means “suppression” focus items shown in detail, other items summarized (suppressed) for context
Degree-of-Interest Tree with extras

Heer 2004
degree of interest

based on observation that humans often represent their own neighborhood in detail, yet only major landmarks far away

goal is balance between local detail and global context
DOITree

interactive trees with animated transitions that fit within a bounded region of space
layout depends on the user’s estimated DOI

use...

logical filtering based on DOI
geometric distortion of node size based on DOI
semantic zooming on content based on node size
aggregate representations of elided subtrees
SUPERIMPOSE

focus layer limited to a local region of view, instead of stretching across the entire view
TOOLGLASS & MAGIC LENSES

Toolglass & Magic Lenses: The See-Through Interface
EXPLORING INFORMATION SPACES BY USING TANGIBLE MAGIC LENSES IN A TABLETOP ENVIRONMENT
magnification

highlight | suppress
DISTORT

use geometric distortion of the contextual regions to make room for the details in the focus region(s)
FISHEYE

http://www.cs.umd.edu/class/fall2002/cmsc838s/tichi/fisheye.html
Unfolding - Fisheye and Zoom lens example
HYPERBOLIC GEOMETRY
DISTORTION CONCERNS

unsuitable for relative spatial judgments

overhead of tracking distortion

visual communication of distortion

girdlines, shading
DISTORTION CONCERNS (CONT.)

target acquisition problem
lens displacing items away from screen location
mixed results compared to separate views and temporal navigation
fisheye follow-up: concern with enthusiasm over distortion
what is being shown: selective filtering
how it is being shown: distortion as one possibility
REMINDERS

project 2 due Tuesday

reading for Tuesday
