Interactive Visualization

Tuesday 30 Oct 2007

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Today's Lecture

Goals of interactive infovis

Techniques
- showing both overview and detail
- showing details-on-demand
- more…

Examples

Dynamic Queries
- common task: finding a best match

Static information visualization

Goal

How to achieve it

Supporting context

Static information visualization

Goal: clear, concise view of desired message(s)
- Effectiveness: faster, easier, more accurate to interpret
- Expressiveness: show all the data and do not mislead

How to achieve it
- Data encodings: color, shape, size, orientation, …
- Techniques: micro/macro, small multiples, …

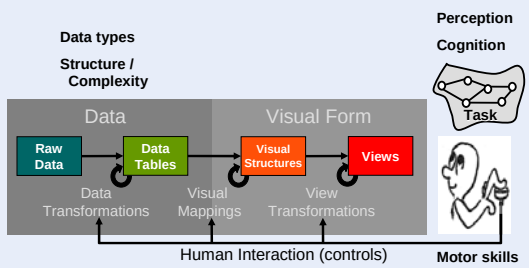
Supporting context
- Human perception: popout, Gestalt principles, …
- User goals/tasks: explore, communicate, …
- User messages: comparison, ranking, part-to-whole, deviation, correlation, frequency distribution, time series

Interactive information visualization

Goal: interactive system that supports user goals
- Good static views linked together well
- Allow user to focus on goals rather than controls
  - "staying in the flow", "using vision to think"

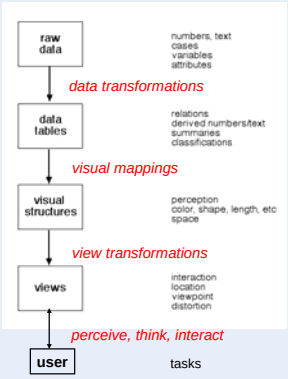
How to achieve it
- Presentation (choosing what to present)
- Interaction techniques

Supporting context
- Human abilities: motor skills, perception, cognitive skills
- User goals/tasks: explore, find best match, …
- User operations/tasks: overview, zoom, filter, details-on-demand, relate, history, extract [Shneiderman]



1. Find or collect raw data
2. Clean & structure data
3. Select appropriate data encodings
4. Present (subset of) data
5. Handle user interaction

Information Visualization Model (Revealed)



Response Time

.1 sec
- animation, visual continuity, sliders

1 sec
- system response, conversation break

10 sec
- cognitive response

Slide adapted from John Stasko

Interaction

It's what distinguishes infovis from static visual representations on paper

Analysis is a process, often iterative with branches and side journeys

How do you define "interactive"?

Slide adapted from John Stasko

Visual Information Seeking Mantra

Overview, zoom & filter, details-on-demand
Overview, zoom & filter, details-on-demand
Overview, zoom & filter, details-on-demand
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Overview, zoom & filter, details-on-demand
Overview, zoom & filter, details-on-demand

Recalling Shneiderman's Tasks

Overview: see overall patterns, trends
Zoom: see a smaller subset of the data
Filter: see a subset based on values, …
Details on demand: see values of objects
Relate: see relationships, compare values
History: keep track of actions & insights
Extract: mark & capture data

Simple Interactive Example

Even simple interaction can be quite powerful
Stacked histogram

http://www.hiraeth.com/alan/topics/vis/hist.html

Slide adapted from John Stasko

Interactive Temporal Map

www.digitalhistory.uh.edu/timeline/timeline.cfm

Slide adapted from John Stasko

Techniques for overview & details

Overview + details

Focus + context

Semantic zooming

Overview + Details

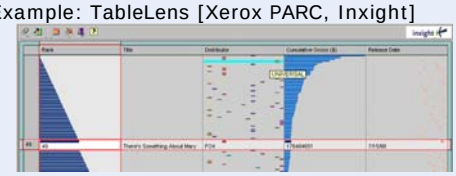
Separate views
- + No distortion
- + Shows overview + detail simultaneously
- - Information is fragmented across multiple views

Example: Google Maps

Focus + Context

Single view shows info in context
- + Contextual info is close to focal point
- - Distortion may make some parts hard to interpret
- - Distortion may obscure structure in data

Example: TableLens [Xerox PARC, Inxight]



Semantic Zooming

Show more/different info as you zoom in or drill down

Example: Pad++ presentation tool [Perlin, NYU]

Specific Interaction Techniques

Selection
- Mouseover/hover/tooltip
- Selection

Rearrange view
- Rearrange
- Sort

Change representation

Highlight connections
- Brushing & linking

Filtering

Panning & zooming

Pop-up tooltips

Hovering mouse cursor brings up details of item

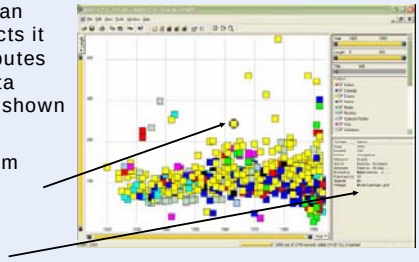
Slide adapted from John Stasko

Mouse Selection

Clicking on an item selects it and attributes of the data point are shown

Selected item

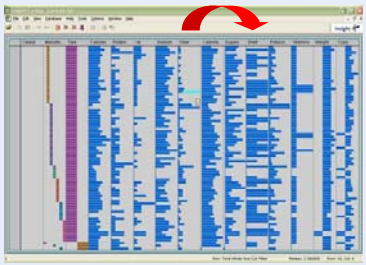
Attributes



Slide adapted from John Stasko

Rearrange

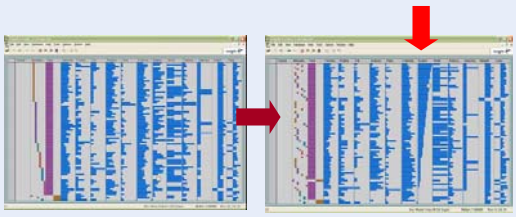
In TableLens you can move columns (attributes) left and right



Slide adapted from John Stasko

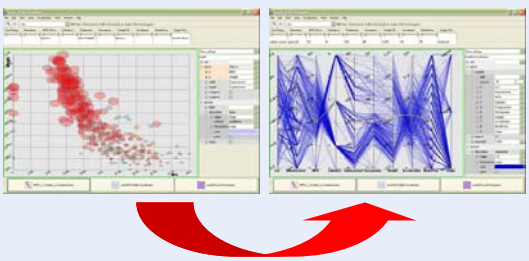
Sorting

Can sort data with respect to a particular attribute in Table Lens



Slide adapted from John Stasko

Changing Representation



Selecting different representation from options at bottom

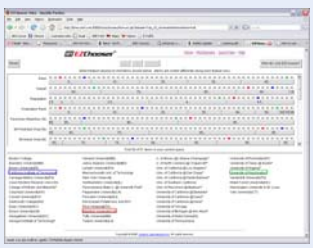
Slide adapted from John Stasko

http://brisa.merl.com:8080/myezchooser/

Brushing & Linking

Highlights that relate datapoints in multiple views

Example: EZChooser [MERL]



Zooming / Panning

Many infovis systems provide zooming and panning capabilities on display

- Pure geometric zoom
  - Google Maps
- Semantic zoom
  - Perlin Presentation tool

Dynamic Queries

Well-known and very useful infovis technique

Let's explore more details...

Video [Shneiderman & Ahlberg '94]

Slide adapted from John Stasko

Database Queries

Query language

Select house-address
From atl-real-db
Where price >= 200,000 **and**
price <= 400,000 **and**
bathrooms >= 3 **and**
garage == 2 **and**
bedrooms >= 4

Slide adapted from John Stasko

Database Queries

Pluses?

Minuses?

Slide adapted from John Stasko

Typical Query Response

124 hits found

- 1. 748 Oak St. - a beautiful ...
- 2. 623 Pine Ave. -
- ...

0 hits found

Slide adapted from John Stasko

Problems

Must learn language
Only shows exact matches
Don't know magnitude of results
No helpful context is shown
Reformulating to a new query can be slow
...

Slide adapted from John Stasko

Dynamic Query Rationale

Specifying a query brings immediate display of results

Responsive interaction (< .1 sec) with data, concurrent presentation of solution

"Fly through the data", promote exploration, make it a much more "live" experience

- Timesharing vs. batch

Slide adapted from John Stasko

Dynamic Query Features

Visual representation of world of action including both the objects and actions

Rapid, incremental and reversible actions

Selection by pointing (not typing)

Immediate and continuous display of results

Slide adapted from John Stasko

Imperfection

Idea at heart of Dynamic Queries

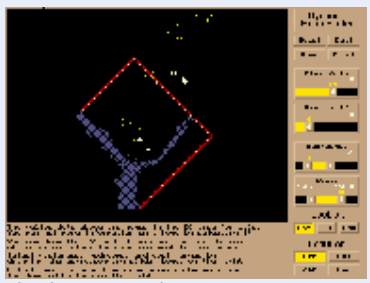
- There often simply isn't one perfect response to a query
- Want to understand a set of tradeoffs and choose some "best" compromise
- You may learn more about your problem as you explore

Slide adapted from John Stasko

Dynamic HomeFinder

Dynamic queries

Video



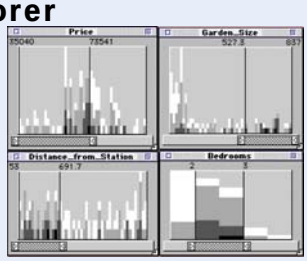
Shows exploration for house purchase

Williamson, U of Maryland 1993

Attribute Explorer

Dynamic queries
Brushing & linking

Video



Shows exploration for house purchase
Color-encoded query sensitivity information

Spence & Tweedie, Imperial College 1998

Dynamic query apps on the Web

www.myrateplan.com/cellphones

www.bluenile.com/diamond_search.asp?track=dss

Slide adapted from John Stasko

DQ Critique

Strengths
- Work is faster
- Promote reversing, undo, exploration
- Very natural interaction
- Shows the data

Weaknesses
- Operations are fundamentally conjunctive
- Can you formulate an arbitrary boolean expression?
  - !(A1 V A2) ^ A3 V (A4 V A5 ^ A6) V …
  - But may not be frequent
- Controls take space

Slide adapted from John Stasko

Summary

Goals of interactive infovis

Techniques
- showing both overview and detail
  - separate views: overview+detail
  - unified view: focus+context
  - semantic zooming
- showing details-on-demand
  - mouseover/hover queries vs. selection queries
  - brushing & linking

Examples

Dynamic Queries
- Common task: finding a best match

Links

Interactive stacked histograms
http://www.hiraeth.com/alan/topics/vis/hist.html

US Digital History
http://www.digitalhistory.uh.edu/timeline/timelineN.cfm

Google Maps http://maps.google.com/maps

TableLens http://www.inxight.com/products/sdks/tl/

Pad++ Presentation Tool
http://mrl.nyu.edu/~perlin/experiments/zoom/Presentation.html

EZChooser
http://brisa.merl.com:8080/myezchooser/mydatasets.jsp?directory=/showcase

Home Finder video http://www.cs.umd.edu/hcil/pubs/video94.shtml

Cell Phone Finder http://www.myrateplan.com/cellphones/

Blue Nile Diamond Search
http://www.bluenile.com/diamond_search.asp?track=dss