Lecture 11: Interaction

Information Visualization
CPSC 533C, Fall 2006

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UBC Computer Science

17 Oct 2006

Topics

- Topic choices due this Friday 5pm
- Tell me the three topics you do want
- Tell me up to two times you do not want from the four possible (Nov 7, 9, 21, 23)
- Email subject: `533 submit topics`
- No need to resend unless changed mind

Topic Choices

- application domains
  - software engineering
  - computer networks
  - databases / datamining
  - cartography
  - social networks
- data domains
  - time-series
  - text / document collections
  - tree / hierarchy
  - graphs / graph drawing
  - high dimensional
  - low dimensional (statistical graphics)
- techniques/approaches
  - interaction
  - focus+context
  - navigation/zooming
  - glyphs
  - animation
  - brushing/linking
- other
  - frameworks/taxonomies
  - perception
  - evaluation
- anything to add?

Proposals

- everybody must have met with me by end of this week
  - the 3 of you haven't yet, talk to me after class to set time
  - my schedule is very tight, office hours today 1:30-2:30 would be safest
- written proposals due next Fri Oct 27
  - format: HTML or PDF
  - length: at least 2 pages
- handin email should have
  - URL
  - Subject: 533 submit proposal

Proposal Expectations

- name/email address of team (1 or 2 people)
- description of domain, task, dataset
- personal expertise
- proposed infovis solution
  - should address abstraction of domain problem
- scenario of use
  - including sketch/mockup illustrations!
- implementation approach
  - high-level, what if any toolkits you'll use
- milestones
  - be specific, include dates
- previous work

Papers Covered

- Ware, Chapter 10: Interacting with Visualizations
- Ware, Chapter 11: Thinking with Visualizations
- The cognitive coprocessor architecture for interactive user interfaces George Robertson, Stuart K. Card, and Jock D. Mackinlay, Proc. UIST '89, pp 10-18.
- Visual information seeking: Tight coupling of dynamic query filters with starfield displays Chris Ahlberg and Ben Shneiderman, Proc SIGCHI '94, pages 313-317.
- SDM: Selective Dynamic Manipulation of Visualizations, Mei C. Chuah, Steven F. Roth, Joe Mattis, John Kolojejchick, Proc. UIST '95

Further Reading

- Toolglass and magic lenses: the see-through interface. Eric A. Bier, Maureen C. Stone, Ken Pier, William Buxton, and Tony D. DeRose, Proc. SIGGRAPH'93, pp. 73-76.

- Visual Exploration of Large Structured Datasets. Graham J. Wills. In New Techniques and Trends in Statistics, 237-246. IOS Press, 1995.

Ware Interaction

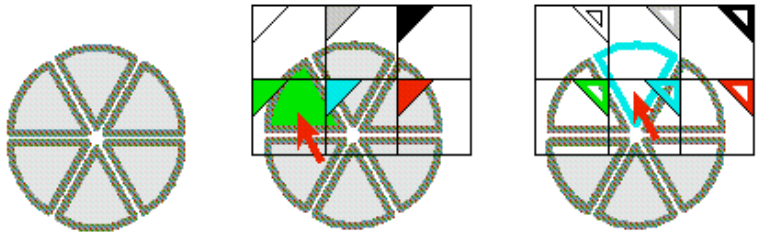
- low-level control loops, data manipulation
  - choice reaction time
    - depends on number of choices
  - selection time: Fitts' Law
    - depends on distance, target size
  - path tracing
    - depends on width
  - learning: power law of practice
    - also subtask chunking

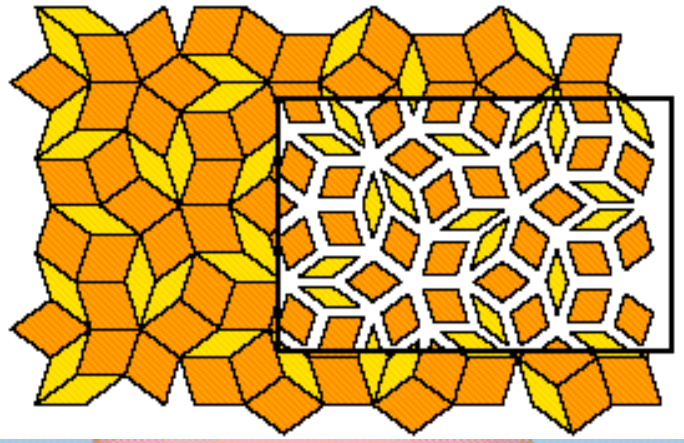
Ware Interaction

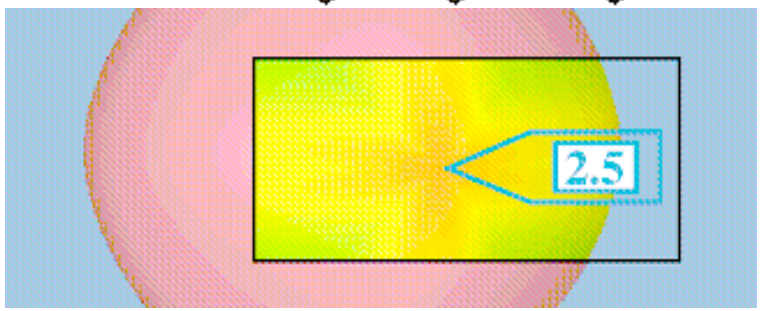
- low-level control loops
  - two-handed interaction: Guiard's theory
    - coarse vs. fine control
      e.g. paper vs. pen positioning
  - vigilance
    - difficult, erodes with fatigue
  - control compatability
    - learning/transfer: adaption time depends
  - hover/mouseover/tooltip
    - faster than explicit click

Toolglass/Lenses

- two-handed interaction
- toolglass: semi-transparent interactive tool
  - e.g. click-through buttons
- magic lens:
  - e.g. scaling, curvature







Toolglass and magic lenses: the see-through interface. Eric A. Bier, Maureen C. Stone, Ken Pier, William Buxton, and Tony D. DeRose, Proc. SIGGRAPH'93, pp. 73-76.

Ware Interaction

- exploration and navigation loops
  - navigation
    - next time
  - rapid zooming
    - next time
  - distortion
    - previous
  - multiple windows, linked highlighting
    - more today
  - dynamic queries
    - more today

Ware Thinking with Viz

- problem solving loops
  - external representations
  - "cognitive cyborgs"
- cost of knowledge
  - Pirolli/Rao: information foraging/scent theory
  - attention as most limited resource

Visual Working Memory

- characteristics
  - different from verbal working memory
  - low capacity (3-5?)
  - locations egocentric
  - controlled by attention
  - time to change attention: 100ms
  - time to get gist: 100ms
  - not fed automatically to longterm memory

Visual Working Memory

- multiple attributes per object stored
  - position (egocentric), shape, color, texture
    - integration into glyphs allows more info
- change blindness (Rensink)
  - world is its own memory
- inattentional blindness
- attracting attention
  - motion (or appear/disappear?)

Memory and Loops

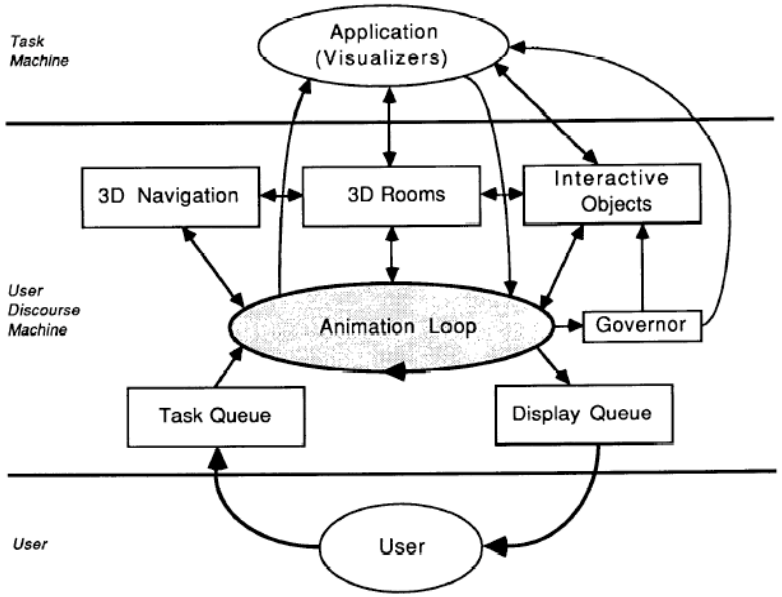
- long term memory
  - chunking
  - memory palaces (method of loci)
- nested loops
  - problem-solving strategy
  - visual query construction
  - pattern-finding loop
  - eye movement control loop
  - intrasaccadic image-scanning loop

InfoVis Implications

- visual query patterns
- navigation/interaction cost
- multiple windows vs. zoom

Cognitive Co-Processor

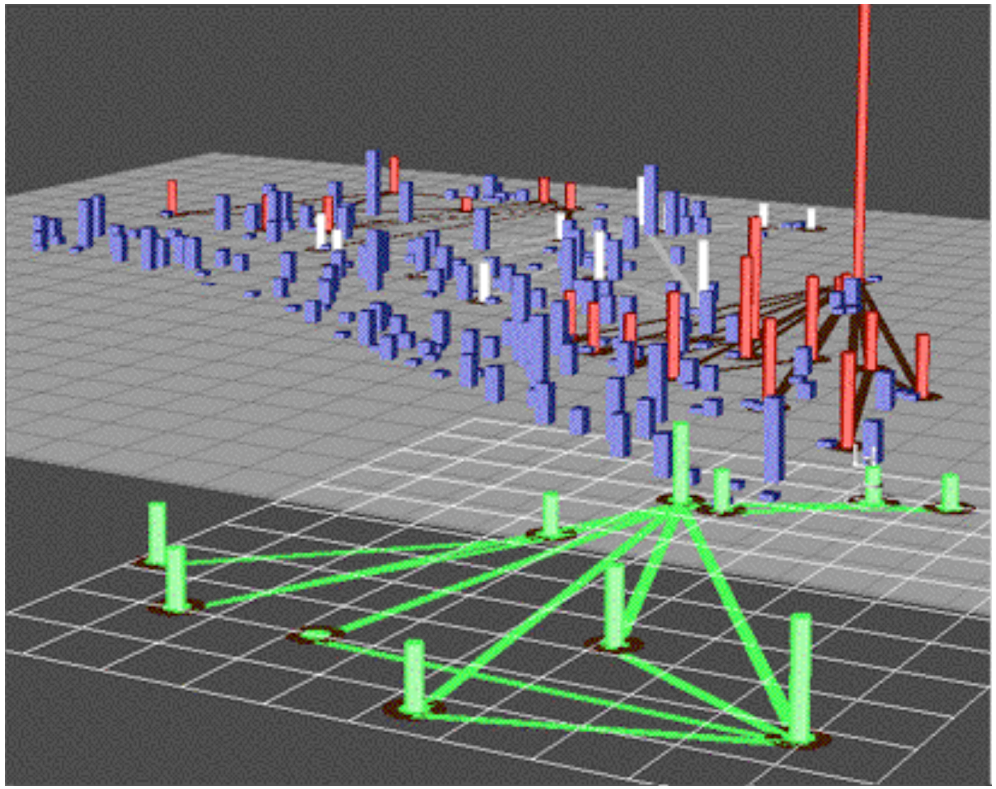
- animated transitions
  - object constancy
  - fixed frame rate required
- architectural solution
  - split work into small chunks
  - animation vs. idle states
  - governor controls frame rate



- [video: 3D rooms]

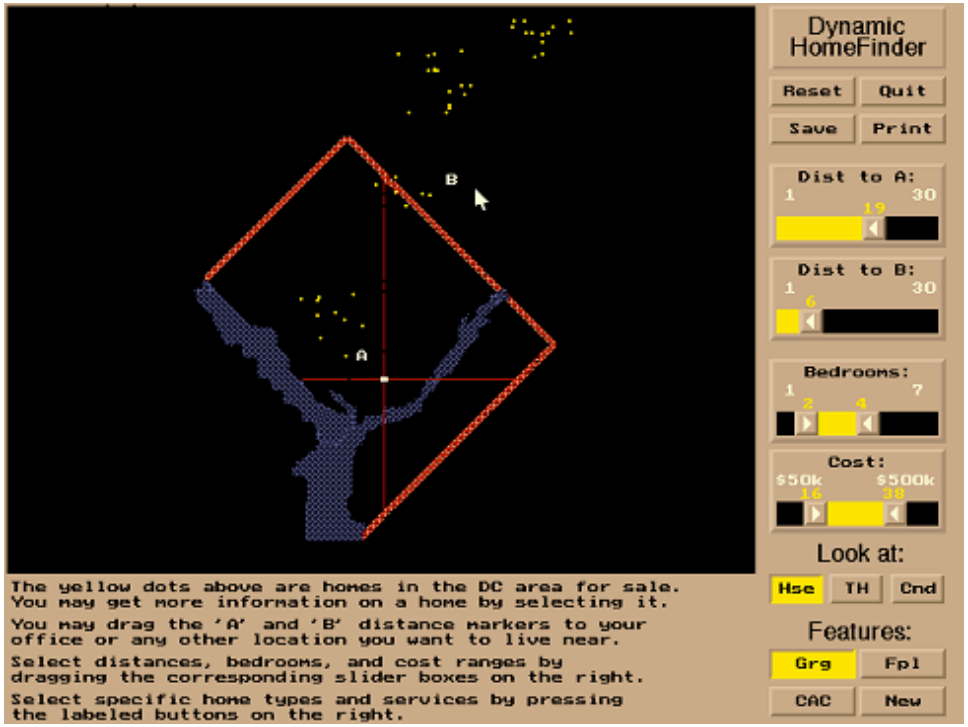
SDM

- sophisticated selection, highlighting, object manipulation
- [video]

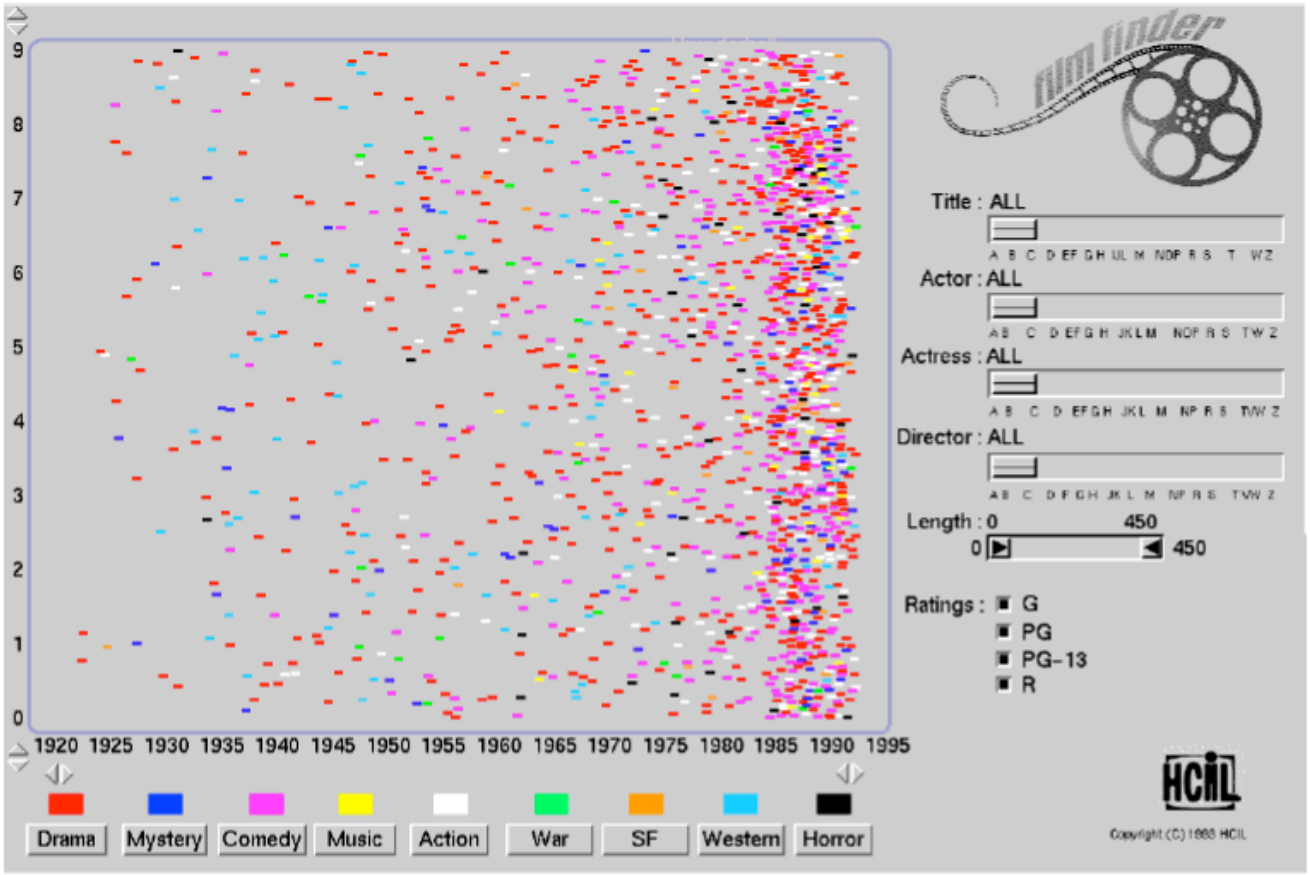


Dynamic Queries: HomeFinder

- filter with immediate visual feedback
- “starfield”: scatterplot
- [video]

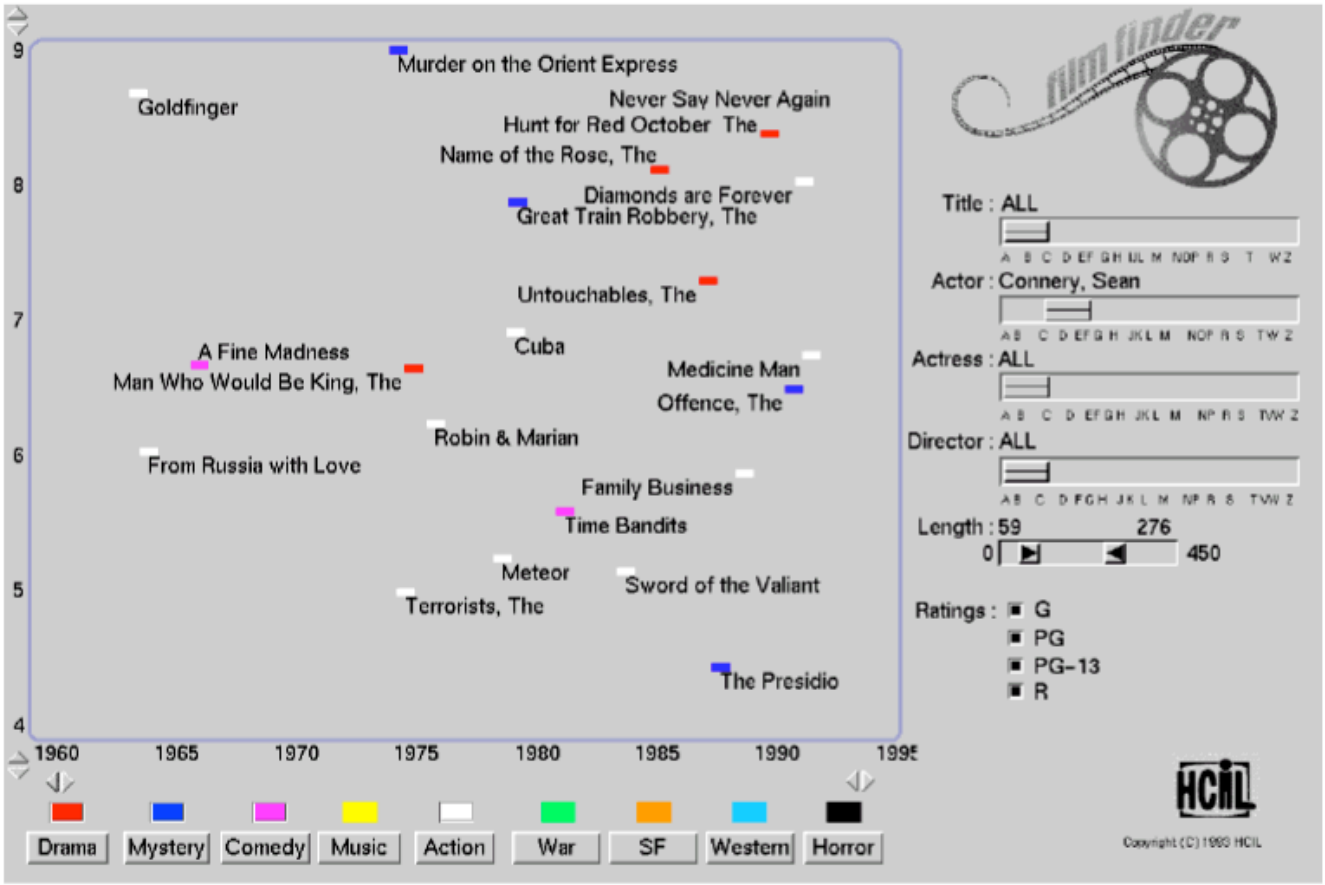


DQ 2: FilmFinder



Ahlberg & Shneiderman, Color plate 1. The FilmFinder.

DQ 2: FilmFinder



Ahlberg & Shneiderman, Color plate 2. Categories have been selected, the displayed is zoomed

More Linked Views

key infovis interaction principle

so far: Ware, Trellis, cluster calendar, ….

brushing: linked highlighting
- Becker and Cleveland, “Brushing Scatterplots”, Technometrics 29, 127-142

new examples:
- EDV
- Attribute Explorer

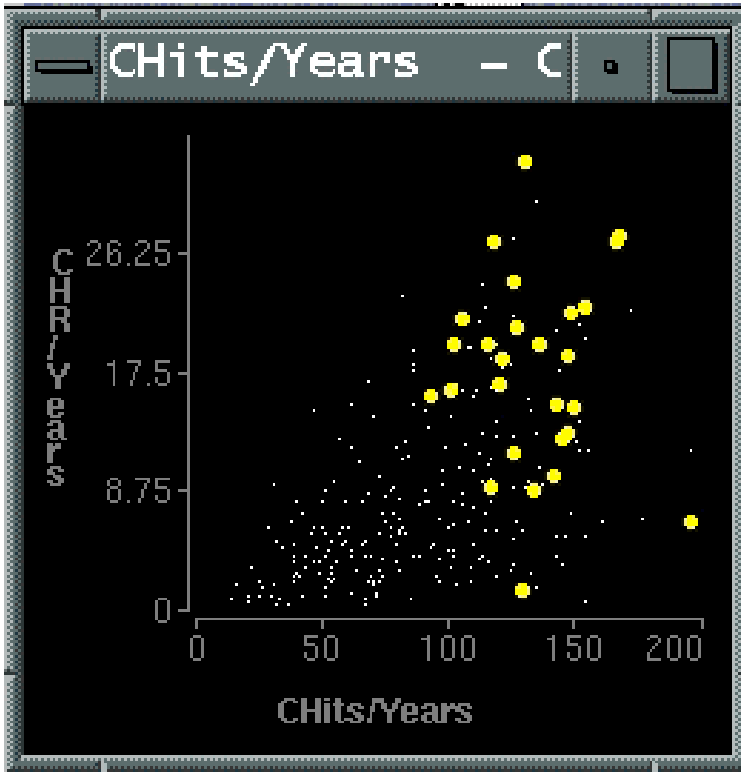
EDV

Exploratory Data Visualizer

Graham J. Wills. Visual Exploration of Large Structured Datasets. In *New Techniques and Trends in Statistics*, 237-246. IOS Press, 1995.

Highlighting (Focusing)

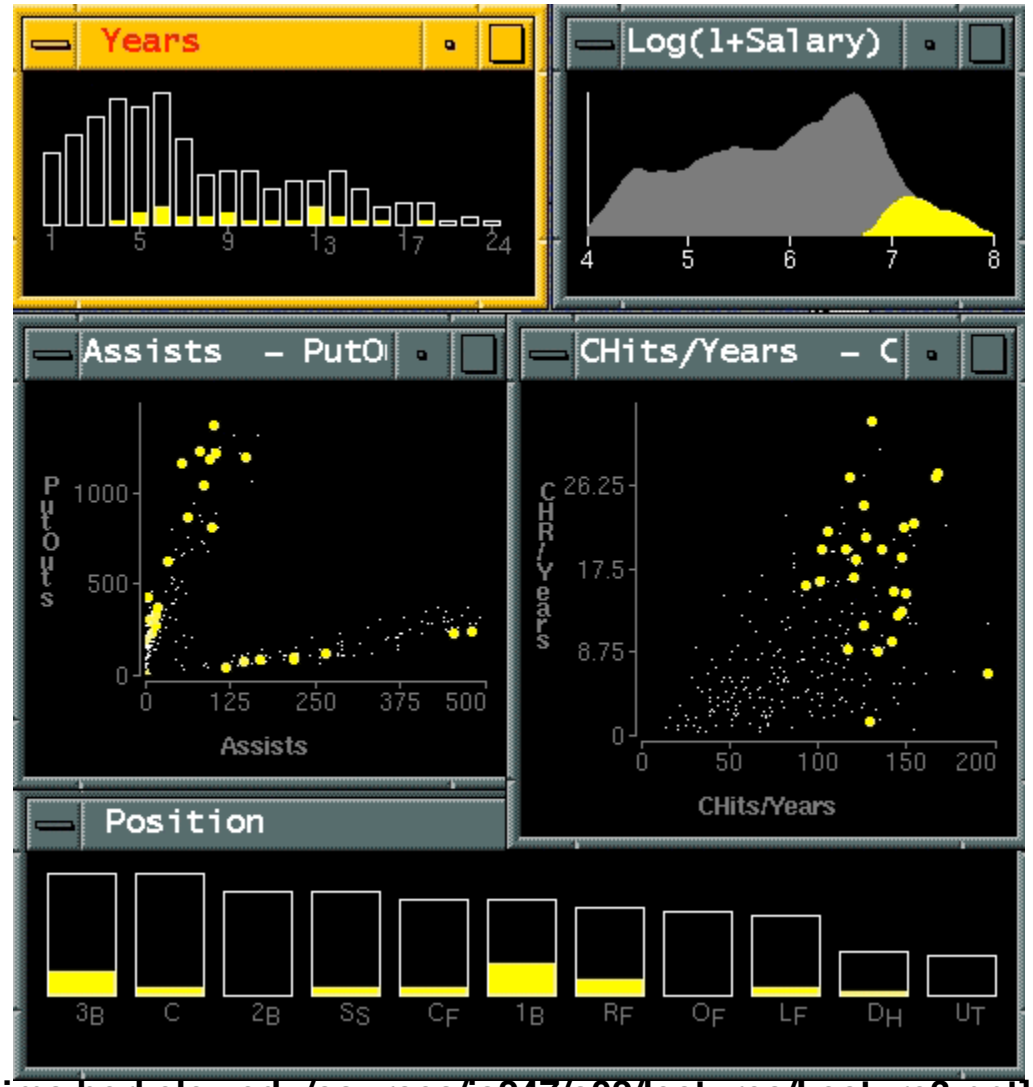
Focus user attention on a subset of the data within one graph (from Wills 95)



[www.sims.berkeley.edu/courses/is247/s02/lectures/Lecture3.ppt]

Link different types of graphs: Scatterplots and histograms and bars

(from Wills 95)



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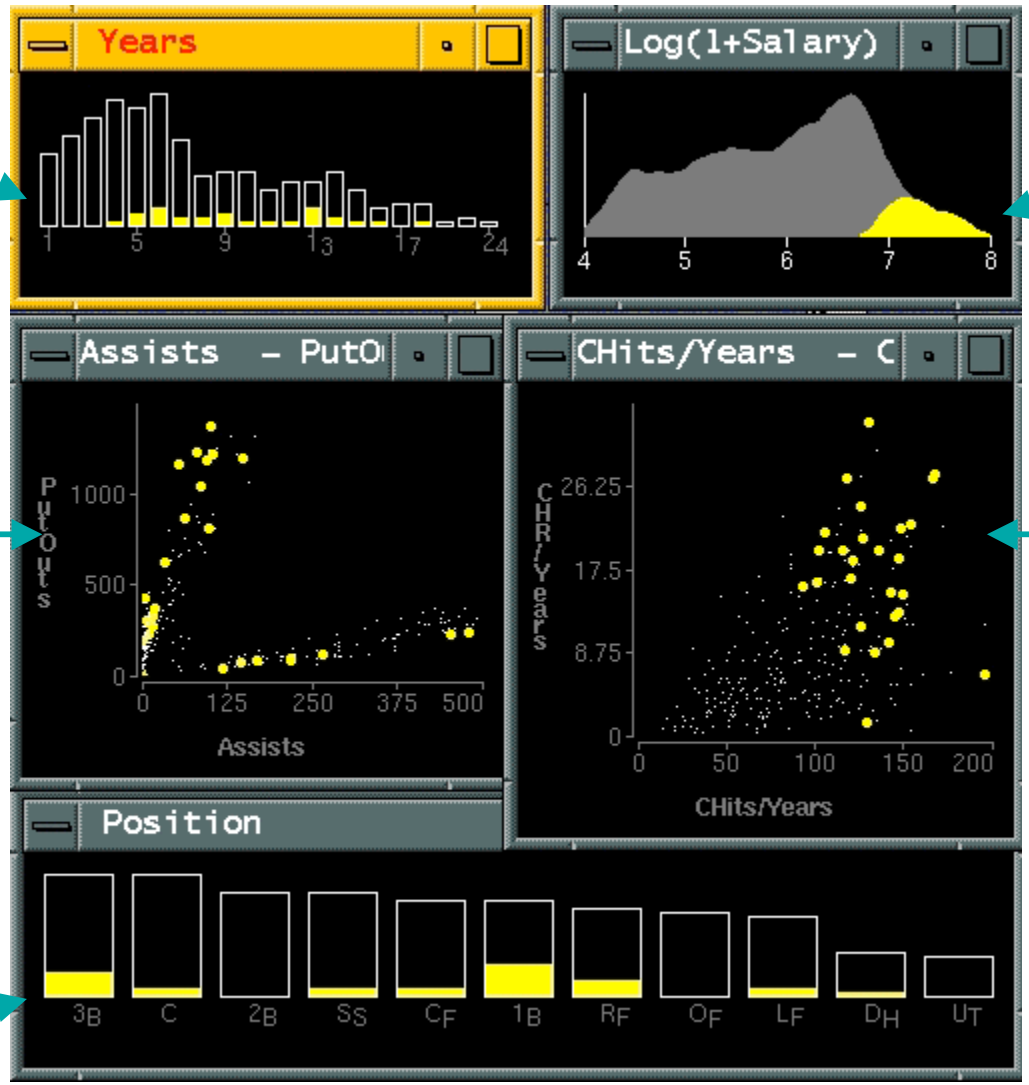
Baseball data: Scatterplots and histograms and bars
(from Wills 95)

how long in majors



select high salaries

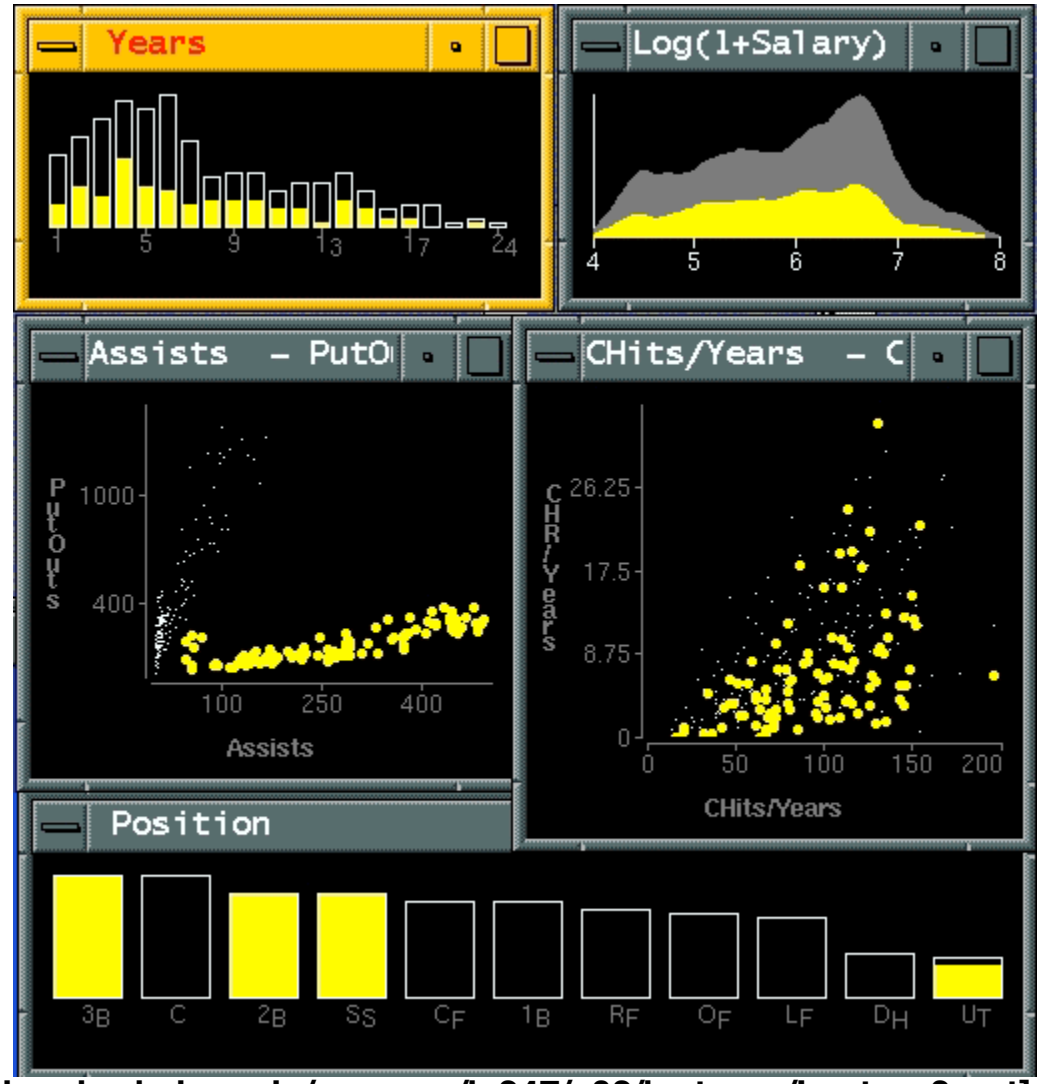
avg assists vs avg putouts (fielding ability)

avg career HRs vs avg career hits (batting ability)

distribution of positions played

[www.sims.berkeley.edu/courses/is247/s02/lectures/Lecture3.ppt]

Linking types of assist behavior to position played (from Wills 95)



[www.sims.berkeley.edu/courses/is247/s02/lectures/Lecture3.ppt]

Influence/Attribute Explorer

- Visualization for Functional Design, Bob Spense, Lisa Tweedie, Huw Dawkes, Hua Su, InfoVis 95

[video]