Lecture 2: Design Studies

Information Visualization
CPSC 533C, Fall 2006

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Questions

- impressed by quality so far!
- want at least one question per reading
  - if <5 texts you can pick which to use for multiple Qs
- plain (ASCII) text not Word/PDF/etc

Papers Covered

Cluster and Calendar based Visualization of Time Series Data.
Jarke J. van Wijk and Edward R. van Selow
Proc. InfoVis 99, pp 4-9
http://www.win.tue.nl/~vanwijk/clv.pdf

Using Multilevel Call Matrices in Large Software Projects.
Frank van Ham
Proc. InfoVis 2003, pp 227-232
http://www.win.tue.nl/~fvham/DL/callmatrix.pdf

Constellation: Linguistic Semantic Networks
Tamara Munzner
Interactive Visualization of Large Graphs and Networks (PhD thesis) Chapter 5, Stanford University, 2000, pp 87-122
http://graphics.stanford.edu/papers/munzner_thesis

Design Study

- describe task
- justify solution
- refine until satisfied

Design Study Definition

Design study papers explore the choices made when applying infovis techniques in an application area, for example relating the visual encodings and interaction techniques to the requirements of the target task. Although a limited amount of application domain background information can be useful to provide a framing context in which to discuss the specifics of the target task, the primary focus of the case study must be the infovis content. Describing new techniques and algorithms developed to solve the target problem will strengthen a design study paper, but the requirements for novelty are less stringent than in a Technique paper.

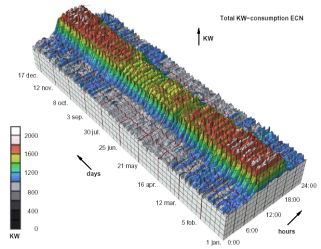
[InfoVis03 CFP, infovis.org/infovis2003/CFP]

Cluster-Calendar, van Wijk

- data: N pairs of (value, time)
  - N large: 50K
- tasks
  - find standard day patterns
  - find how patterns distributed over year, week, season
  - find outliers from standard daily patterns
  - want overview first, then detail on demand
- possibilities
  - predictive mathematical models
    - details lost, multiscale not addressed
  - scale-space approaches (wavelet, fourier, fractal)
    - hard to interpret, known scales lost
  - 3D mountain: x hours, y value, z days
- excellent example, emulate for project writeups!

3D Time-series Data

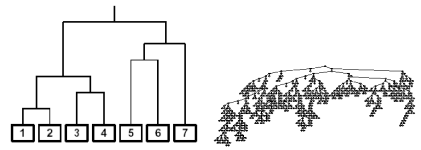
- 3D extrusion pretty but not useful
  - daily, weekly patterns hard to see



[van Wijk and van Selow, Cluster and Calender based Visualization of Time Series Data, InfoVis99, http://www.win.tue.nl/~vanwijk/clv.pdf]

Hierarchical Clustering

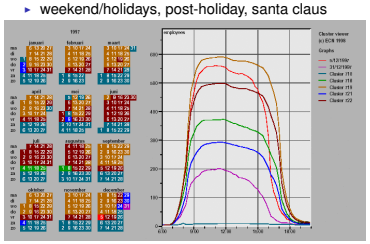
- start with all M day patterns
  - compute mutual differences, merge most similar: M-1
  - continue up to 1 root cluster
- result: binary hierarchy of clusters
- choice of distance metrics
- dendrogram display common
  - but shows structure of hierarchy, not time distribution



[van Wijk and van Selow, Cluster and Calender based Visualization of Time Series Data, InfoVis99, http://www.win.tue.nl/~vanwijk/clv.pdf]

Link Clusters and Calendar

- 2D linked clusters-calendars shows patterns
  - number of employees:
  - office hours, fridays in/and summer, school break
  - weekend/holidays, post-holiday, santa claus



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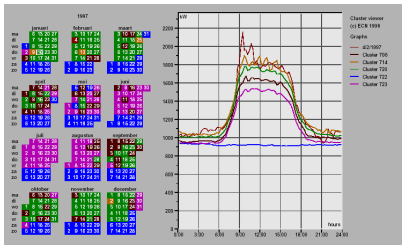
Power Consumption



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Lessons

- derived space: clusters
- visual representation of time: calendar
  - linked display
  - interactive exploration
- clear task analysis guided choices
  - reject standard 3D extrusion
  - reject standard dendrogram
- critique

Lessons

- derived space: clusters
- visual representation of time: calendar
  - linked display
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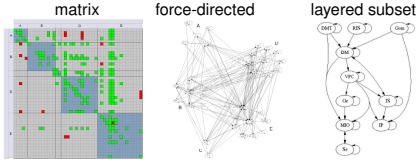
  - reject standard dendrogram
- critique
  - color choice not so discriminable
  - especially legend

Multilevel Call Matrices, van Ham

- large software project, implementation vs. spec
- link matrix vs. node network

matrix | force-directed | layered subset

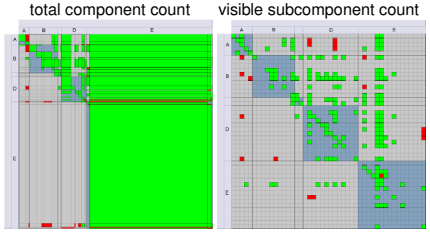


[van Ham, Using Multilevel Call Matrices in Large Software Projects. InfoVis03 http://www.win.tue.nl/~fvham/DL/callmatrix.pdf]

Matrices

- uniform, recursive, stable
- subdivide by

total component count | visible subcomponent count



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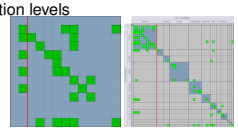
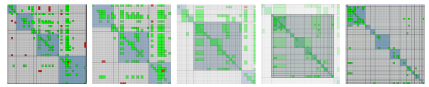
Zooming

- abstraction levels



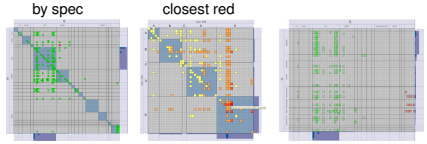
- linear interpolation plus crossfade
- trajectories: will read van Wijk 03 in week 6



[van Ham, Using Multilevel Call Matrices in Large Software Projects. InfoVis03 http://www.win.tue.nl/~fvham/DL/callmatrix.pdf]

Additional Encoding

color: call allowed by spec | color: local region closest red | transparency: call density



- histograms: size distribution

[van Ham, Using Multilevel Call Matrices in Large Software Projects. InfoVis03 http://www.win.tue.nl/~fvham/DL/callmatrix.pdf]

Tasks Succesfully Supported

- visual categorization
  - i.e. libraries with mostly incoming calls
- previous summary shown to be incomplete
- spotting unwanted calls
- determining component dependencies

Linguistic Networks, Munzner

- data: MindNet query results
- definition graph
  - dictionary entry sentence
  - nodes: word senses
  - links: relation types

```
kangaroo100 (@000000099.7)
 Hyp>        marsupial100 1.1668e-007
   Mod>        herbivorous102 2.1727e-010
 Locn>       island107 1.1668e-007
   Mod>        adjacent103 9.5719e-010
 Part>       forelimb100 1.1695e-007
   Mod>        short104 1.4191e-009
   hind_limb100 1.1695e-007
   Mod>        large110 6.5013e-010
 <Part       Macropodidae_of_Australia
 Purp>       leap111 1.1722e-007
   tail101 1.1668e-007
 <Tobj       adapt104 1.1668e-007
```

[Munzner, Interactive Visualization of Large Graphs and Networks (PhD thesis), Stanford University, 2000, http://graphics.stanford.edu/papers/munzner_thesis]

Semantic Network

- definition graphs used as building blocks
- unify shared words
- large network
  - millions of nodes
  - grammar checking now, translation future
  - global structure known: dense
- probes return local info

Path Query

- best N paths between two words
- words on path itself

kangaroo100—Part→forelimb100—Mod→short104—Join→short←Mod—tail100

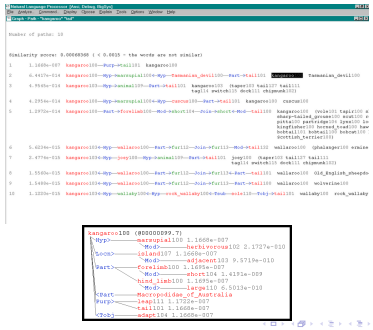
- definition graphs used in computation

```
kangaroo100  (vole101 tapir100 s
sharp-tailed_grouse100 scut100 r
pitta100 partridge104 lynx100 lo
kingfisher100 horned_toad100 haw
bobtail101 bobtail100 bobcat100
Scottish_terrier100)
```

Task: Plausibility Checking

- paths ordered by computed plausibility
- researcher hand-checks results
  - high-ranking paths believable?
  - believable paths high-ranked?
  - are stop words all filtered out?

Top 10 Paths Kangaroo→ Tail



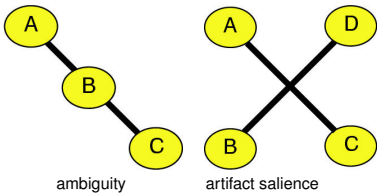
Goal

- create a unified view of relationships between paths and definition graphs
  - shared words are key
  - thousands of words (not millions)
- special purpose algorithm debugging tools
  - not understand structure of English

Constellation Video

Traditional Layout

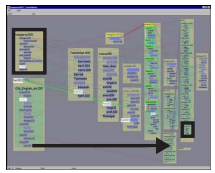
- avoid crossings
- reason: avoid false attachments



ambiguity artifact salience

Information Visualization Approach

- spatial position is strongest perceptual cue
  - encode domain specific attribute
  - plausibility gradient

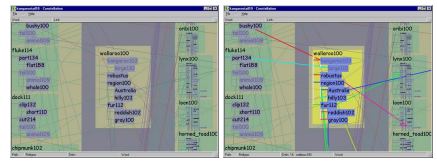


Constellation Semantic Layout

- novel layout algorithm
  - paths as backbone, definition graphs attached
  - curvilinear grid
  - iterative design for maximum semantics with reasonable information density
- allow crossings for long-distance proxy links

Selective Emphasis

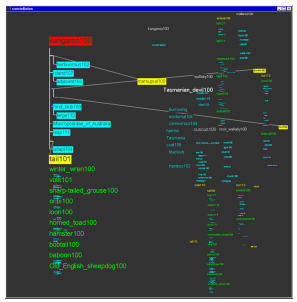
- highlight sets of boxes and edges
  - interaction
  - additional perceptual channels
- avoid perception of false attachments



Hidden State

- avoid hidden state
  - change salience instead of toggle drawing
- why? closed world assumption
  - implicit assumption: if not visible, doesn't exist
  - easy to forget previous actions
    - draw false negative conclusions

Single vs. Multiple Word Instances

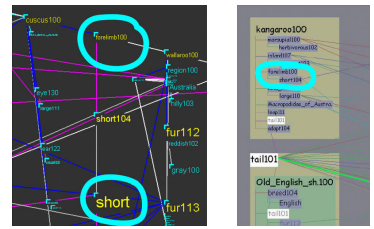


Information Density

- early prototype: poor

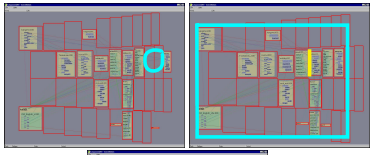
Information Density

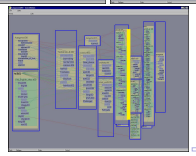
- design tradeoff with visual salience



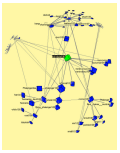
Information Density

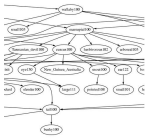
- grid adjustment





Task-oriented design





- task-specific methods