Ch 14: Embed Focus+Context Papers: TreeJuxtaposer

Tamara Munzner
Department of Computer Science
University of British Columbia

CPSC 547, Information Visualization
Day 14: 5 November 2015

http://www.cs.ubc.ca/~tmm/courses/547-15

News

- reminder: proposals due by Mon 5pm

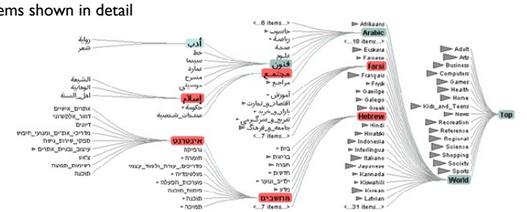
Embed: Focus+Context

- combine information within single view
- elide
  - selectively filter and aggregate
- superimpose layer
  - local lens
- distortion design choices
  - region shape: radial, rectilinear, complex
  - how many regions: one, many
  - region extent: local, global
  - interaction metaphor

Embed
→ Elide Data
→ Superimpose Layer
→ Distort Geometry

Idiom: **DOITrees Revisited**

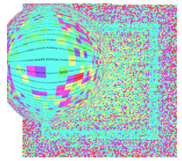
- elide
  - some items dynamically filtered out
  - some items dynamically aggregated together
  - some items shown in detail

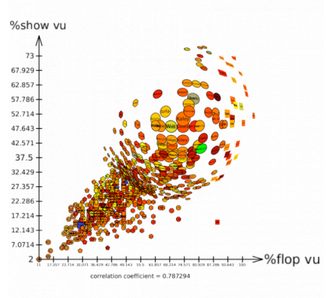


[DOITrees Revisited: Scalable, Space-Constrained Visualization of Hierarchical Data. Heer and Card. Proc. Advanced Visual Interfaces (AVI), pp. 421–424, 2004.]

Idiom: **Fisheye Lens**

- distort geometry
  - shape: radial
  - focus: single extent
  - extent: local
  - metaphor: draggable lens

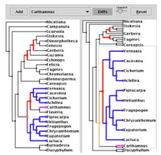




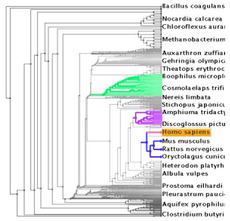
http://tulip.labri.fr/TulipDrupal/?q=node/351
http://tulip.labri.fr/TulipDrupal/?q=node/377

Idiom: **Stretch and Squish Navigation**

- distort geometry
  - shape: rectilinear
  - foci: multiple
  - impact: global
  - metaphor: stretch and squish, borders fixed



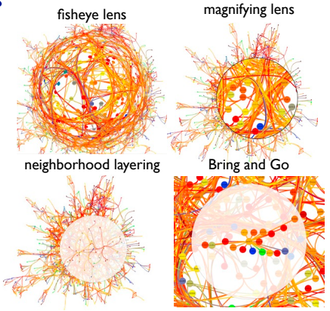
System: **TreeJuxtaposer**



[TreeJuxtaposer: Scalable Tree Comparison Using Focus+Context With Guaranteed Visibility. Munzner, Guimbretiere, Tasiran, Zhang, and Zhou. ACM Transactions on Graphics (Proc. SIGGRAPH) 22:3 (2003), 453– 462.]

Distortion costs and benefits

- benefits
  - combine focus and context information in single view
- costs
  - length comparisons impaired
    - network/tree topology comparisons unaffected: connection, containment
  - effects of distortion unclear if original structure unfamiliar
  - object constancy/tracking maybe impaired

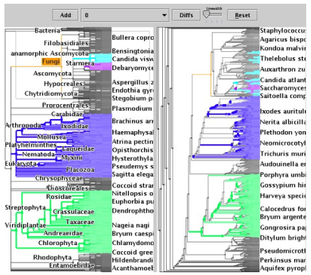


[Living Flows: Enhanced Exploration of Edge-Bundled Graphs Based on GPU-Intensive Edge Rendering. Lambert, Auber, and Melançon. Proc. Intl. Conf. Information Visualisation (IV), pp. 523–530, 2010.]

Further reading

- Visualization Analysis and Design. Munzner. AK Peters / CRC Press, Oct 2014.
  - *Chap 14: Embed: Focus+Context*
- *A Review of Overview+Detail, Zooming, and Focus+Context Interfaces.* Cockburn, Karlson, and Bederson. ACM Computing Surveys 41:1 (2008), 1–31.
- *A Guide to Visual Multi-Level Interface Design From Synthesis of Empirical Study Evidence.* Lam and Munzner. Synthesis Lectures on Visualization Series, Morgan Claypool, 2010.
- *Hierarchical Aggregation for Information Visualization: Overview, Techniques and Design Guidelines.* Elmqvist and Fekete. IEEE Transactions on Visualization and Computer Graphics 16:3 (2010), 439–454.
- *A Fisheye Follow-up: Further Reflection on Focus + Context.* Furnas. Proc. ACM Conf. Human Factors in Computing Systems (CHI), pp. 999–1008, 2006.

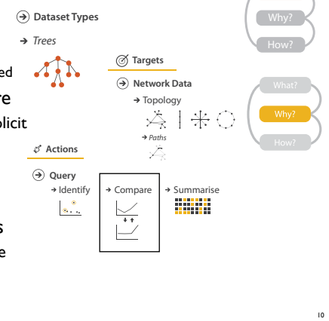
TreeJuxtaposer video



[TreeJuxtaposer: Scalable Tree Comparison using Focus+Context with Guaranteed Visibility. Munzner, Guimbretière, Tasiran, Zhang, Zhou. Proc. SIGGRAPH 2003.]

What and why: Data and task abstraction

- data: trees
  - phylogenetic tree reconstruction
    - siblings unordered, interior nodes inferred
- task: compare topological structure
  - larger query scopes require more explicit tool support
    - compare several is more difficult than identify/inspect one
      - even trickier: summarize all
- derived data: structural differences
  - best corresponding node in other tree

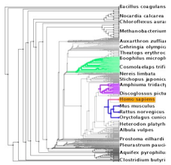


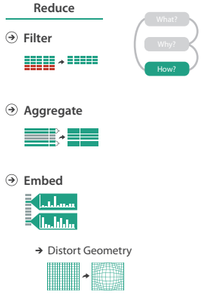
How: Idiom design decisions

- juxtapose linked views
  - show two tree layouts side by side
  - linked navigation
- encode with color: linked highlighting
  - structural differences
  - corresponding subtree (click select)
  - best corresponding node (hover select)

How: Idiom design decisions

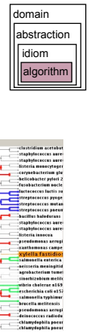
- embed focus+context in single view
  - reduce with complex combination of filtering and aggregation
- distort geometry
  - metaphor: stretch and squish navigation
  - shape: rectilinear
  - foci: multiple
  - impact: global

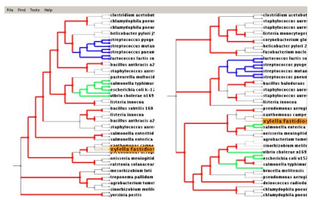




Algorithm: Stretch and squish navigation

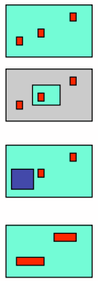
- guaranteed visibility of semantically important marks even when squished small
  - TJ: scalability to 500K nodes
    - all preprocessing subquadratic
    - all realtime rendering sublinear
- guaranteed visibility
  - marks always visible
  - easy with small datasets





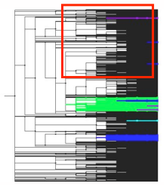
Guaranteed visibility challenges

- hard with larger datasets
- reasons a mark could be invisible
  - outside the window
    - AD solution: constrained navigation
  - underneath other marks
    - AD solution: avoid 3D
  - smaller than a pixel
    - AD solution: smart culling

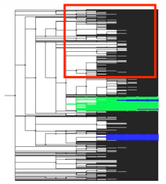


Guaranteed visibility: Small items

- naïve culling may not draw all marked items



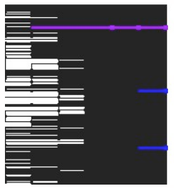
Guaranteed visibility of marks



No guaranteed visibility

Guaranteed visibility: Small items

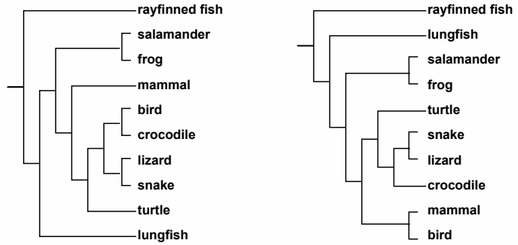
- Naïve culling may not draw all marked items



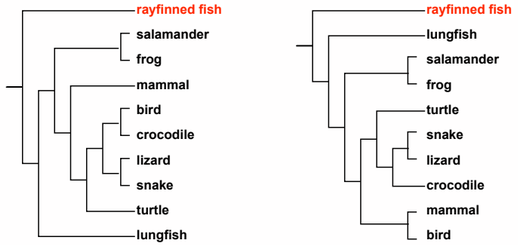
Guaranteed visibility of marks

No guaranteed visibility

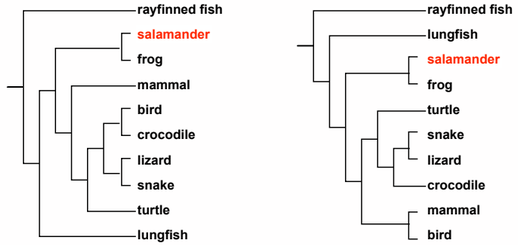
Structural comparison



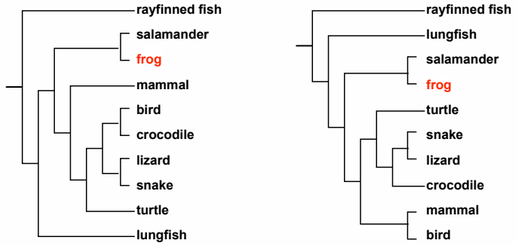
Matching leaf nodes



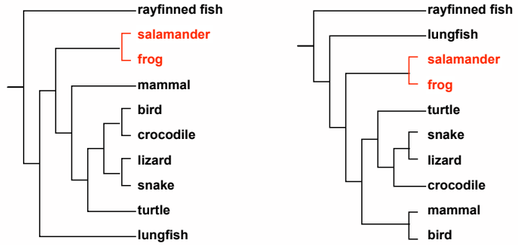
Matching leaf nodes



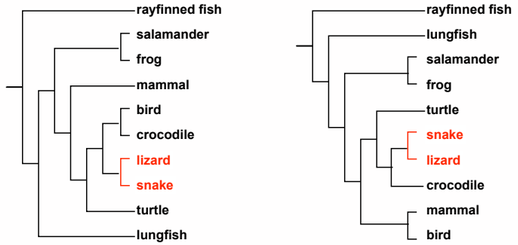
Matching leaf nodes



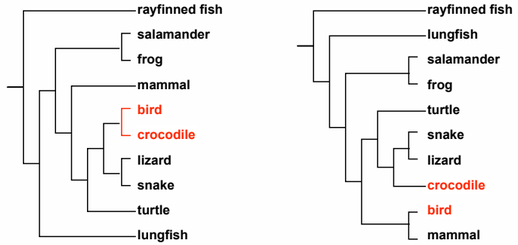
Matching interior nodes



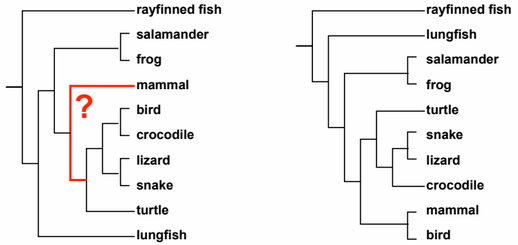
Matching interior nodes



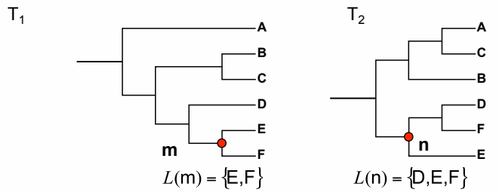
Matching interior nodes



Matching interior nodes



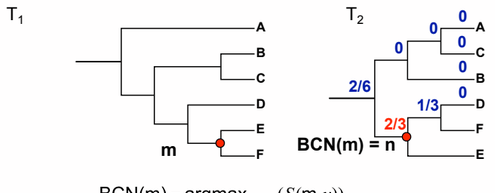
Similarity score: S(m,n)



$L(\text{m}) = \{\text{E,F}\}$ $L(\text{n}) = \{\text{D,E,F}\}$

$$S(\text{m,n}) = \frac{|L(\text{m}) \cap L(\text{n})|}{|L(\text{m}) \cup L(\text{n})|} = \frac{|\{\text{E,F}\}|}{|\{\text{D,E,F}\}|} = \frac{2}{3}$$

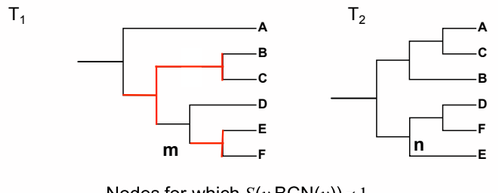
Best Corresponding Node



$\text{BCN(m)} = \text{argmax}_{v \in T_2}(S(\text{m}, v))$

- computable in O(n $\log^2$ n)
- linked highlighting

Marking structural differences



Nodes for which $S(v, \text{BCN}(v)) \neq 1$

- matches intuition

Next Time

- proposals: by 5pm Mon
- Thu Nov 5, to read
  - VAD Ch. 15: Analysis Case Studies
  - An Algebraic Process for Visualization Design, Carlos Scheidegger and Gordon Kindlmann. IEEE TVCG (Proc. InfoVis 2014), 20(12):2181-2190.