Methods for Visualizing Biodiversity & Building Rewarding Collaborations

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DESIGNING for PEOPLE
CAIDA
UBC Data Science Institute

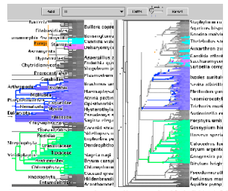
UBC Biodiversity Challenge Retreat, Hakai Institute
11 June 2019

www.cs.ubc.ca/~tmm/talks.html#hakai19-methods

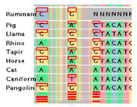
@tamaramunzner

TreeJuxtaposer: Visual tree comparison

- driving problem from UT Austin Hillis Lab in 2001: phylogenetic trees
- algorithm focus on scale, later extended to gene sequences



TreeJuxtaposer https://youtu.be/GdaPj8a9QEo

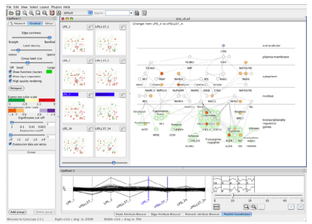


SequenceJuxtaposer

joint work with: Guimbretiere, Li, Zhang, and Zhou

Cerebral: Integrating gene expression w/ interaction network

- automatic network layout by subcellular location, like hand-drawn diagrams
- multiple views with linked highlighting and navigation
- Cytoscape plugin, funded by Agilent



Cerebral https://youtu.be/76HhG1FQngI

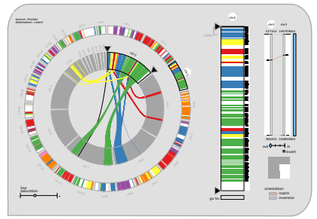
Aaron Barsky

Jenn Gardy (Microbio: Hancock)

Robert Kincaid (Agilent)

MizBee: Comparing genomes between species

- driving problems: Broad Inst. biologists studying fungus (Ma) and stickleback/pufferfish (Grabherr)
- two use phases: first fully validate computational pipeline, then can analyze biological questions
- investigated whole-genome duplication events, refined syntenic block construction algorithm



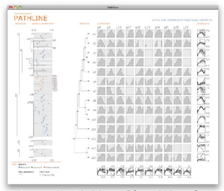
MizBee https://youtu.be/86p7brwuz2g

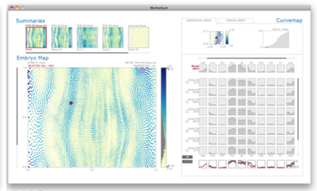
Hanspeter Pfister (Harvard)

Miriah Meyer

Comparative functional genomics

- Pathline: multiple pathways, multiple genes, multiple species - over time
  - Broad Institute, Regev Lab
  - curvemap as alternative to heatmap
- MulteeSum: all that + spatial location (cells within fruitfly embryo)
  - Harvard Med School, dePace Lab
  - compare summaries across multiple computational workflows

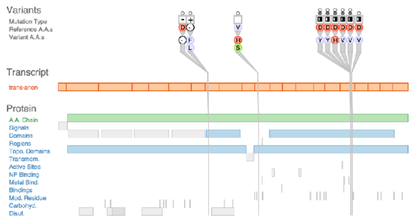




joint work with: Meyer, Pfister, Wong, Styczynski, dePace

VariantView: Visualizing sequence variants in genetic context

- concise overview supports reasoning about variant type & location
  - across several levels of biological context (vs extensive navigation w/ genome browsers)



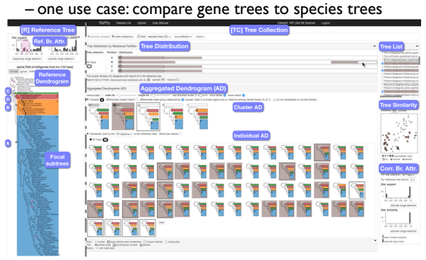
Variant View https://youtu.be/AHDnv_qMXxQ

Joel Ferstay

Cydney Nielsen (BC Cancer)

Aggregated Dendrograms: Visual comparison between many phylogenetic trees

- concisely summarize trees interactively wrt bio meaningful criteria
  - one use case: compare gene trees to species trees



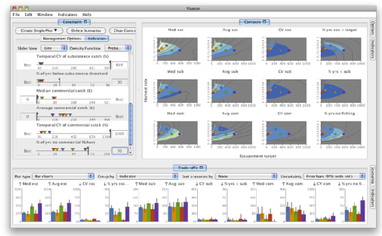
Aggregated Dendrograms https://youtu.be/2SLcz7KNLJw

Zipeng Liu

Shing Hei Zhan

Vismon: Fisheries simulation

- supporting decision-makers not expert in simulation & stats
  - sensitivity analysis, global trade-offs analysis, staged uncertainty



Vismon https://youtu.be/h0kHoS4VYmk

Maryam Booshehrian

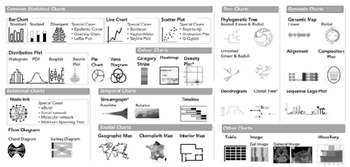
Torsten Moeller (SFU)

Integrating visualization & biostats methods

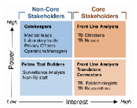
- Human-centered design & qualitative coding
- Epidemiology/health expectations & constraints
- Mixed initiative: automation and manual analysis
- Mixed methods: when to use qual & when to use quant

Anamaria Crisan

Jenn Gardy BCCDC/SPPH



GEViT: Genomic Epidemiology Visualization Typology
https://gevit.net

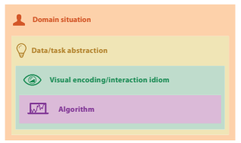


Regulatory & Organizational Constraints

Evidence-Based Design and Evaluation of a Whole Genome Sequencing Clinical Report for the Reference Microbiology Laboratory

A Nested Model

for Visualization Design and Validation



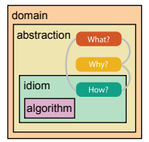
http://www.cs.ubc.ca/labs/imager/tr/2009/NestedModel

A Nested Model for Visualization Design and Validation.
Munzner. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 09), 15(6):921-928, 2009.

Nested model: Four levels of visualization design

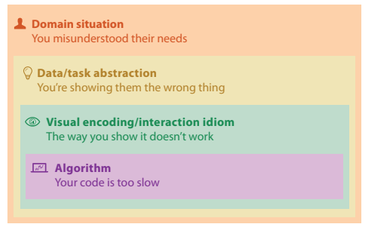
[A Nested Model of Visualization Design and Validation. *Munzner. IEEE TVCG 15(6):921-928, 2009 (Proc. InfoVis 2009).*]

- *domain situation*
  - who are the target users?
- *abstraction*
  - translate from specifics of domain to vocabulary of visualization
    - **what** is shown? **data** abstraction
    - **why** is the user looking at it? **task** abstraction
- *idiom*
  - **how** is it shown?
    - **visual encoding** idiom: how to draw
    - **interaction** idiom: how to manipulate
- *algorithm*
  - efficient computation



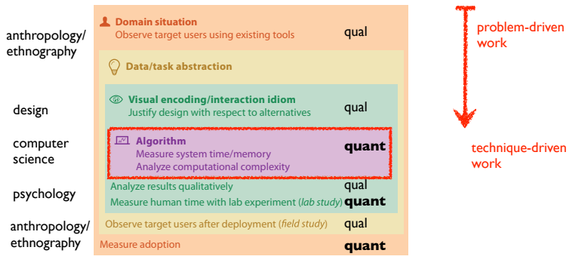
[A Multi-Level Typology of Abstract Visualization Tasks *Brehmer and Munzner. IEEE TVCG 19(12):2376-2385, 2013 (Proc. InfoVis 2013).*]

Different threats to validity at each level

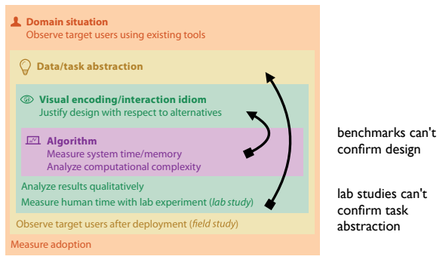


Interdisciplinary: need methods from different fields at each level

- mix of qual and quant approaches (typically)

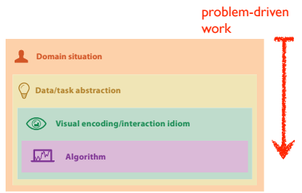


Mismatches: Common problem

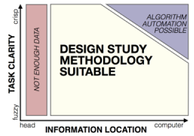


Problem-driven collaborations

- working with domain scientists
- translating from domain-specific language
  - how to pull this off?



Building Rewarding Collaborations



Michael Sedlmair

Miriah Meyer

Tamara Munzner
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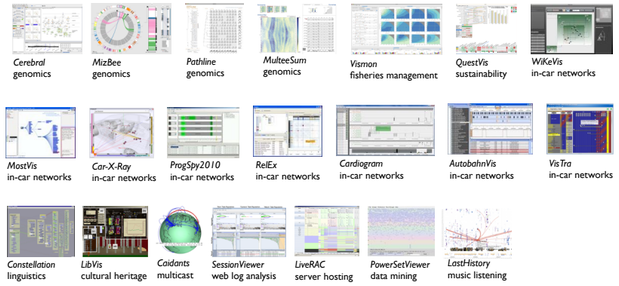
Design Study Methodology

Reflections from the Trenches and from the Stacks

http://www.cs.ubc.ca/labs/imager/tr/2012/dsm/

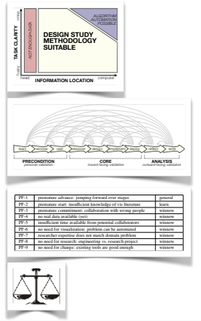
Design Study Methodology: Reflections from the Trenches and from the Stacks.
Sedlmair, Meyer, Munzner. IEEE Trans Visualization and Computer Graphics 18(12): 2431-2440, 2012 (Proc. InfoVis 2012).

Lessons learned from the trenches: 21 between us



Methodology for problem-driven work

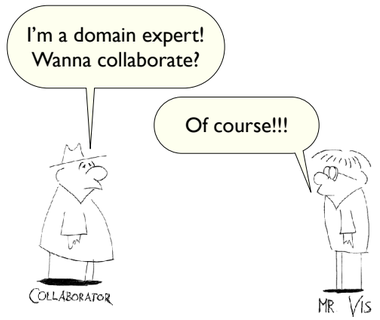
- definitions
- 9-stage framework
- 32 pitfalls & how to avoid them
- comparison to related methodologies



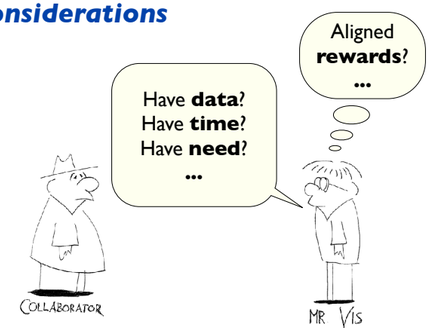
Design study methodology: 32 pitfalls

- and how to avoid them

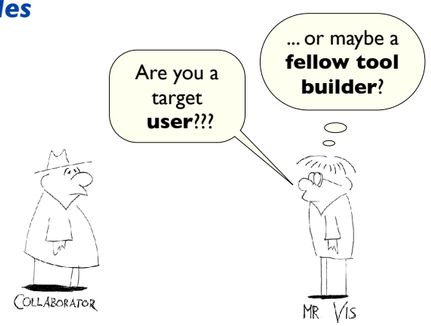
PF-1	premature advance: jumping forward over stages	general
PF-2	premature start: insufficient knowledge of vis literature	learn
PF-3	premature commitment: collaboration with wrong people	winnow
PF-4	no real data available (yet)	winnow
PF-5	insufficient time available from potential collaborators	winnow
PF-6	no need for visualization: problem can be automated	winnow
PF-7	researcher expertise does not match domain problem	winnow
PF-8	no need for research: engineering vs. research project	winnow
PF-9	no need for change: existing tools are good enough	winnow



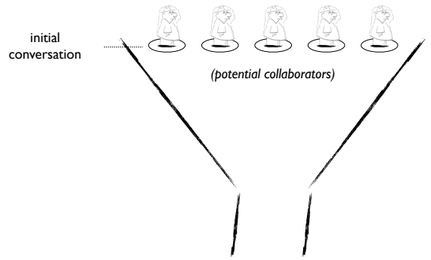
considerations



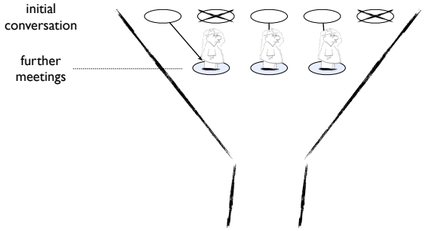
roles



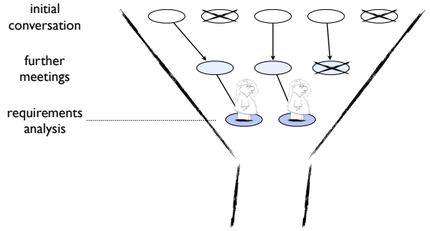
Collaborator winnowing



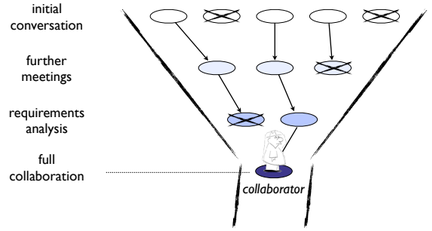
Collaborator winnowing



Collaborator winnowing



Collaborator winnowing



Collaborator winnowing

Talk with many, stay with few!

Design study methodology: 32 pitfalls

- and how to avoid them

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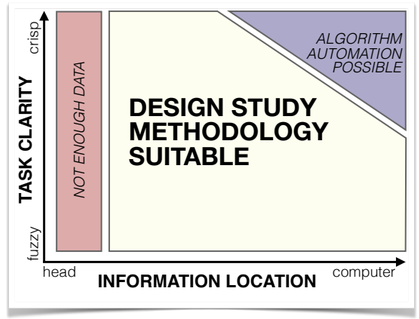
Design study methodology: definitions



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