Methods for Visualizing Biodiversity & Building Rewarding Collaborations

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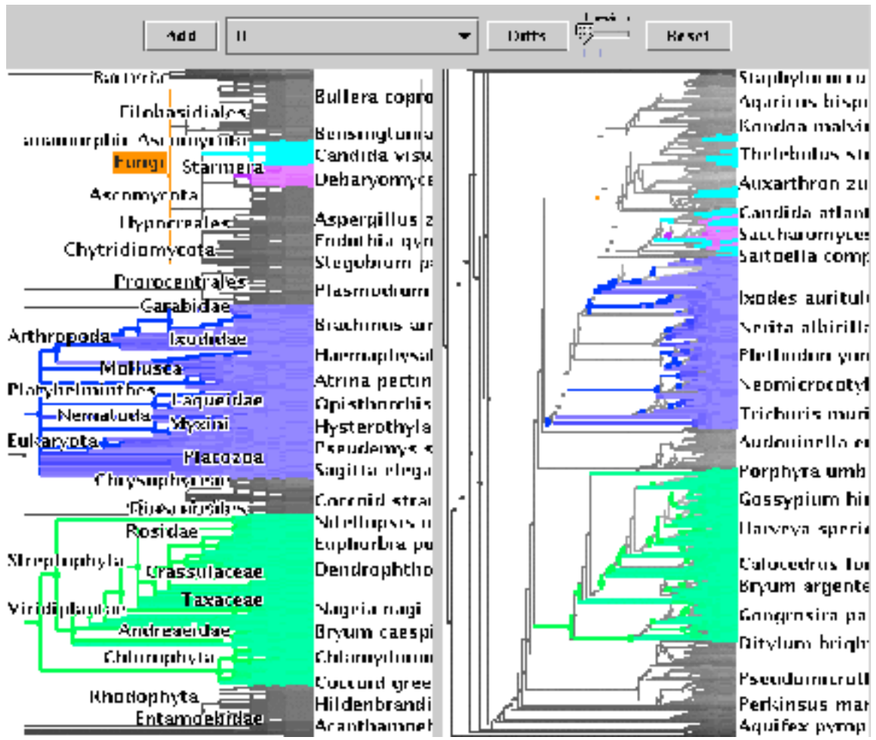
UBC Biodiversity Challenge Retreat, Hakai Institute
11 June 2019

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

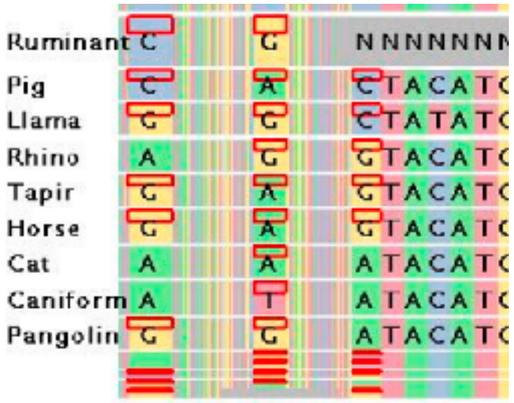
@tamaramunzner

TreeJuxtaposer: Visual tree comparison

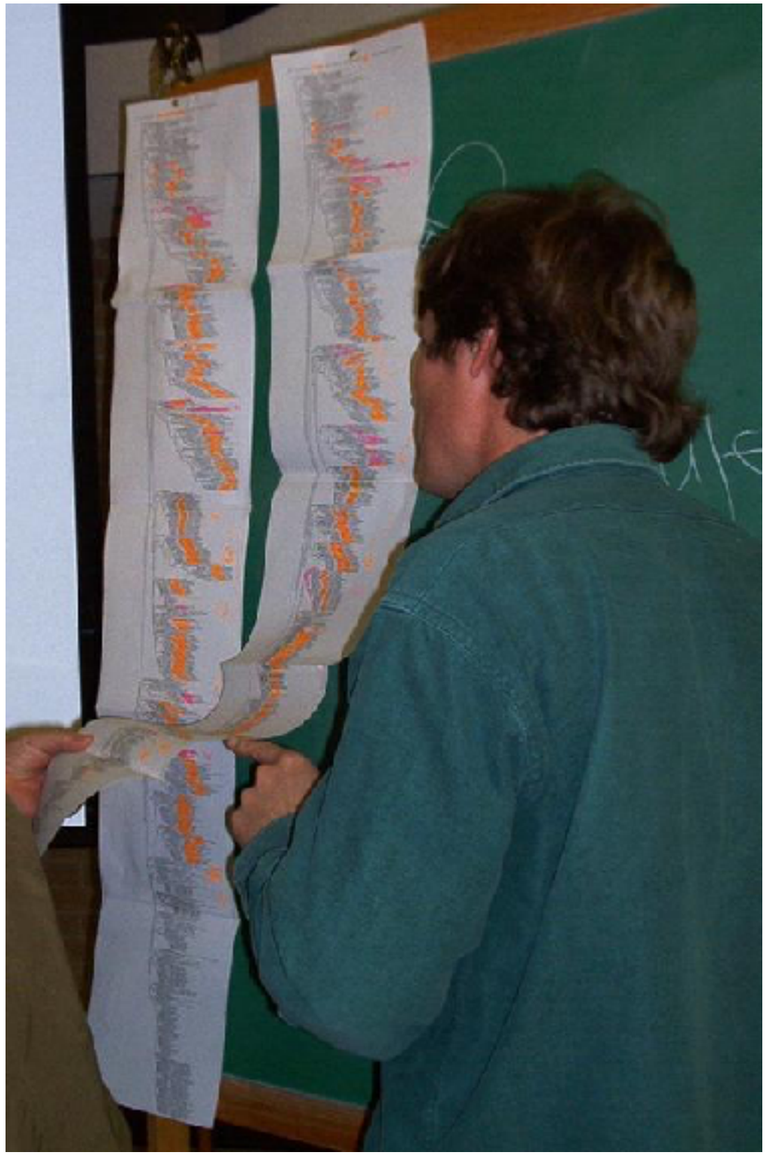
- driving problem from UT Austin Hillis Lab in 2001: phylogenetic trees
- algorithm focus on scale, later extended to gene sequences



TreeJuxtaposer https://youtu.be/GdaPj8a9QEo



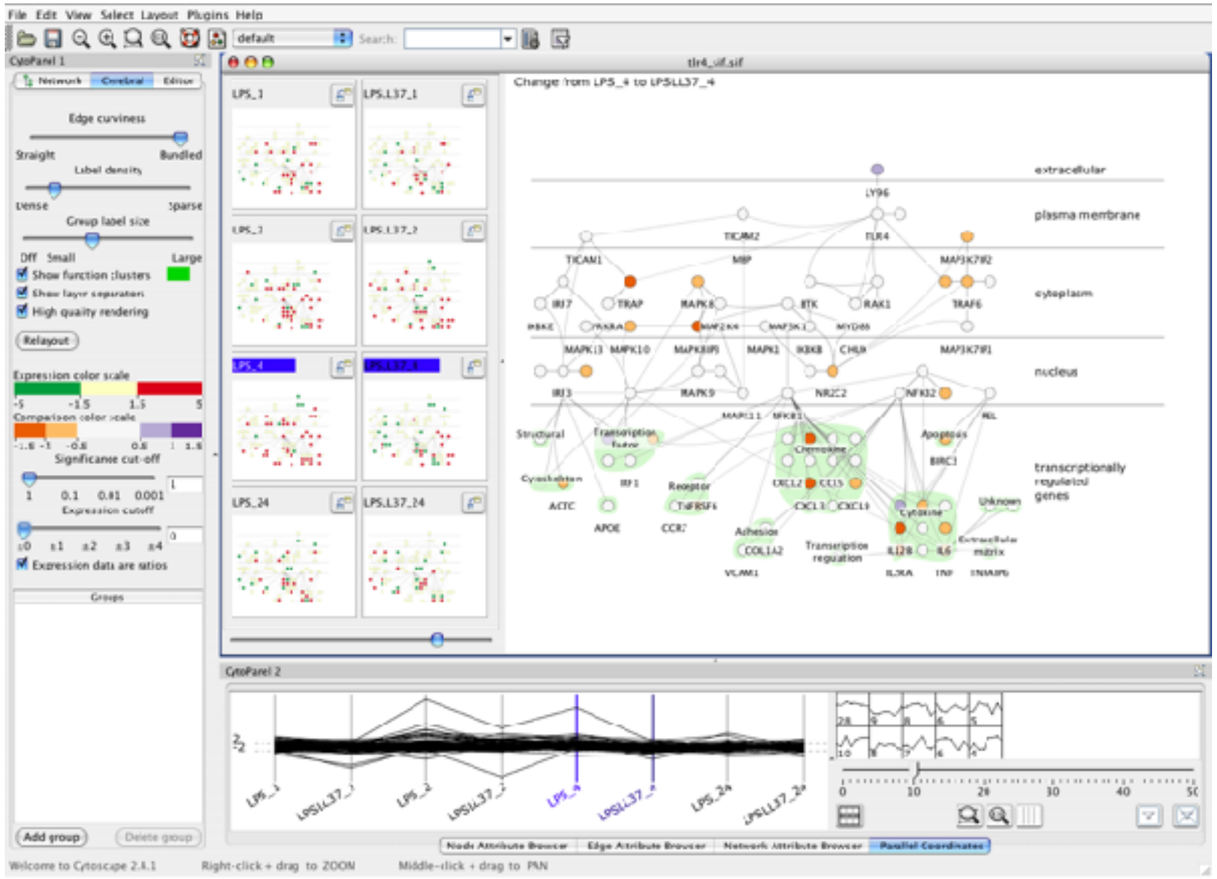
SequenceJuxtaposer



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

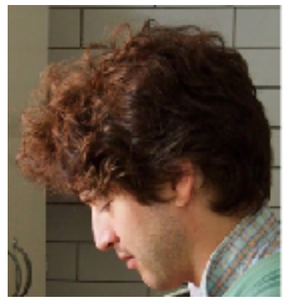
Cerebral: Integrating gene expression w/ interaction network

- 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

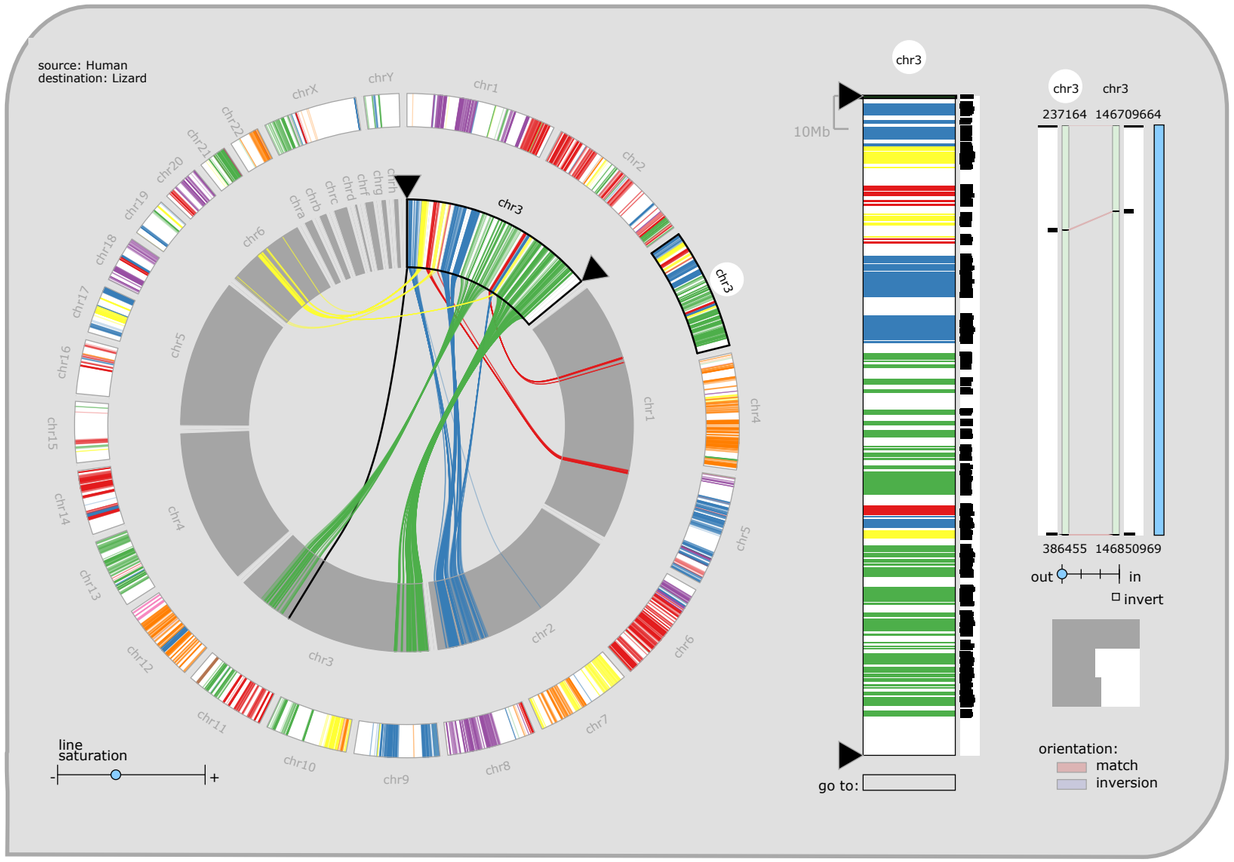


Jenn Gardy
(Microbio: Hancock)

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



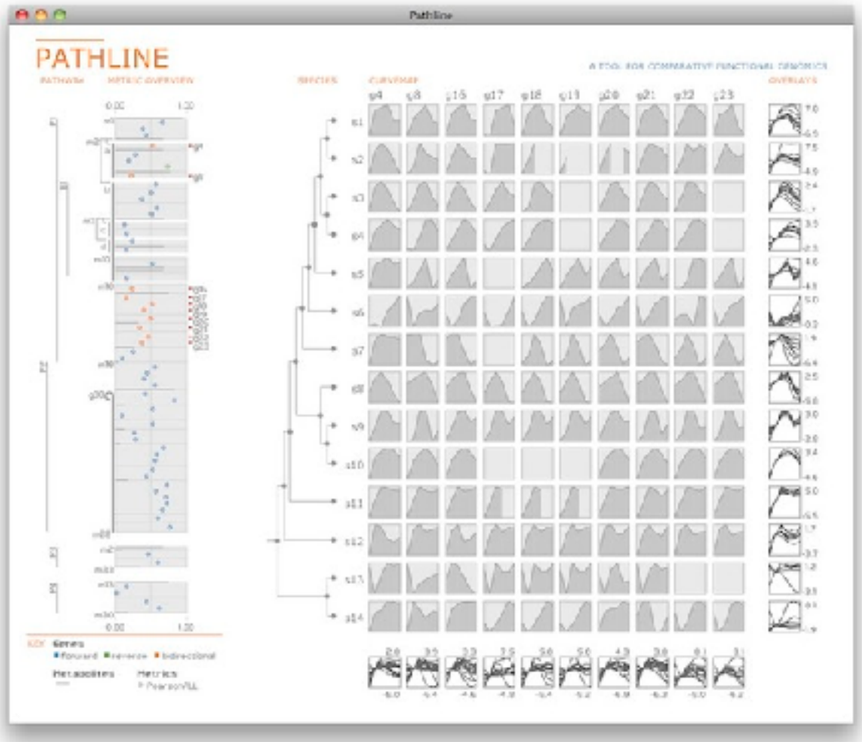
MizBee https://youtu.be/86p7brwuz2g

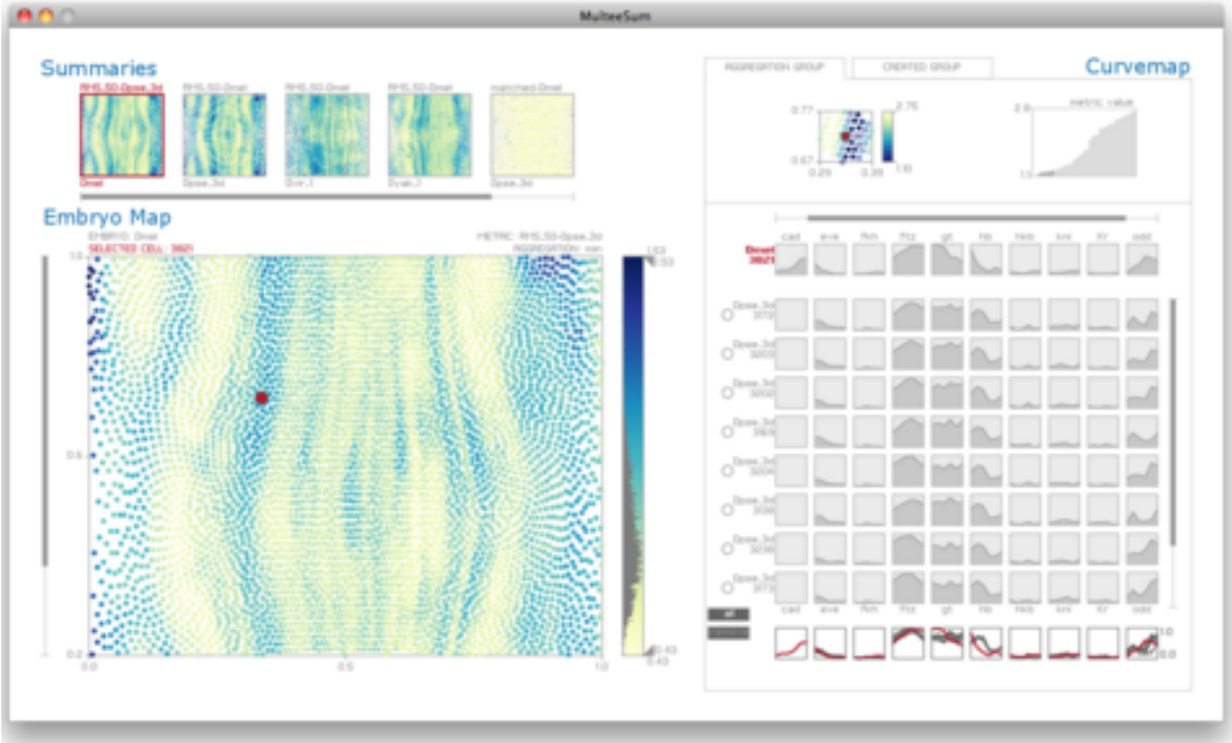
Hanspeter Pfister (Harvard)

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

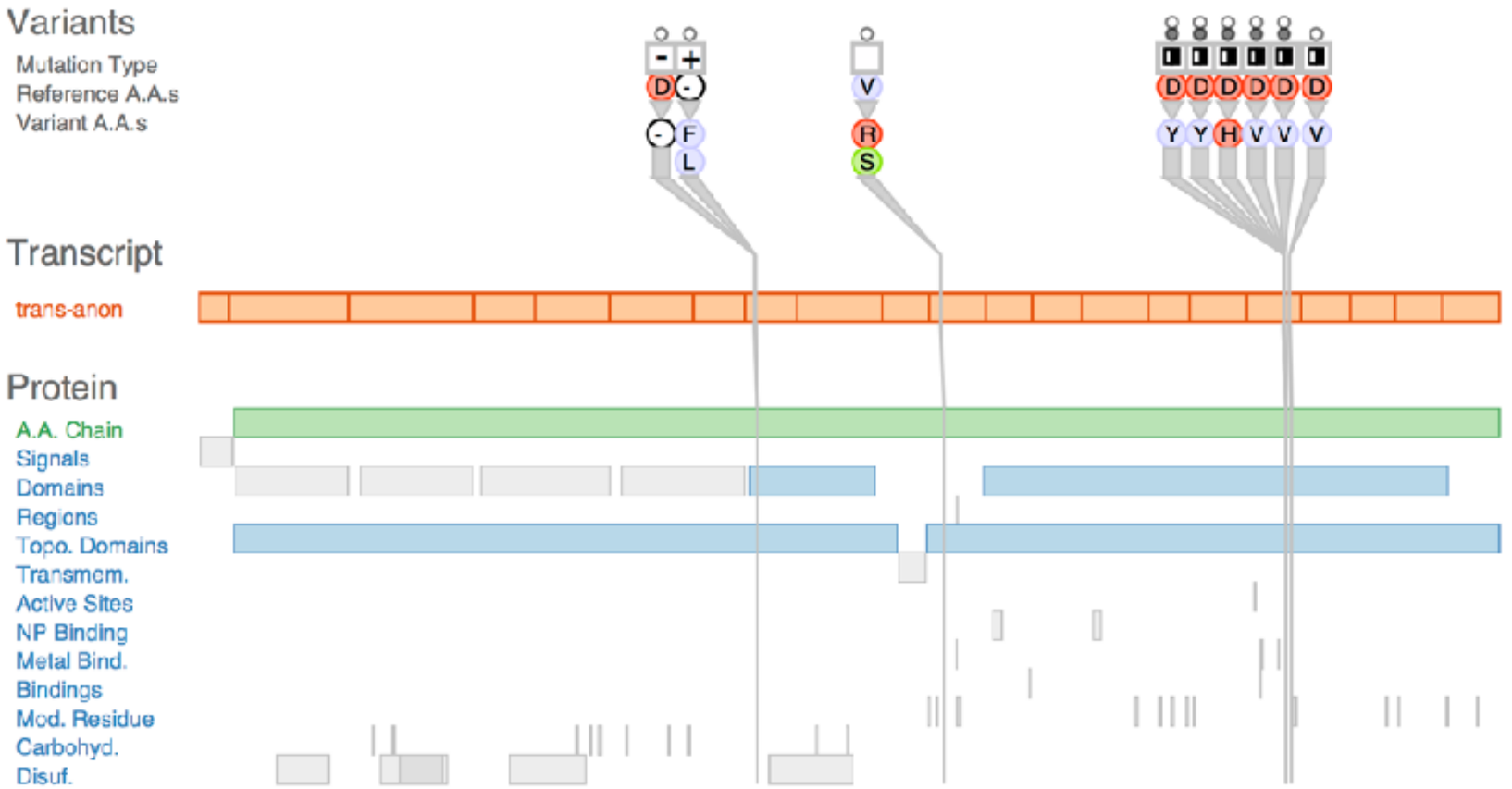




joint work with: Meyer, Pfister, Wong, Styczynski, dePace

Variant View: 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)



Joel Ferstay

Cydney Nielsen
(BC Cancer)

Variant View https://youtu.be/AHDnv_qMXxQ

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

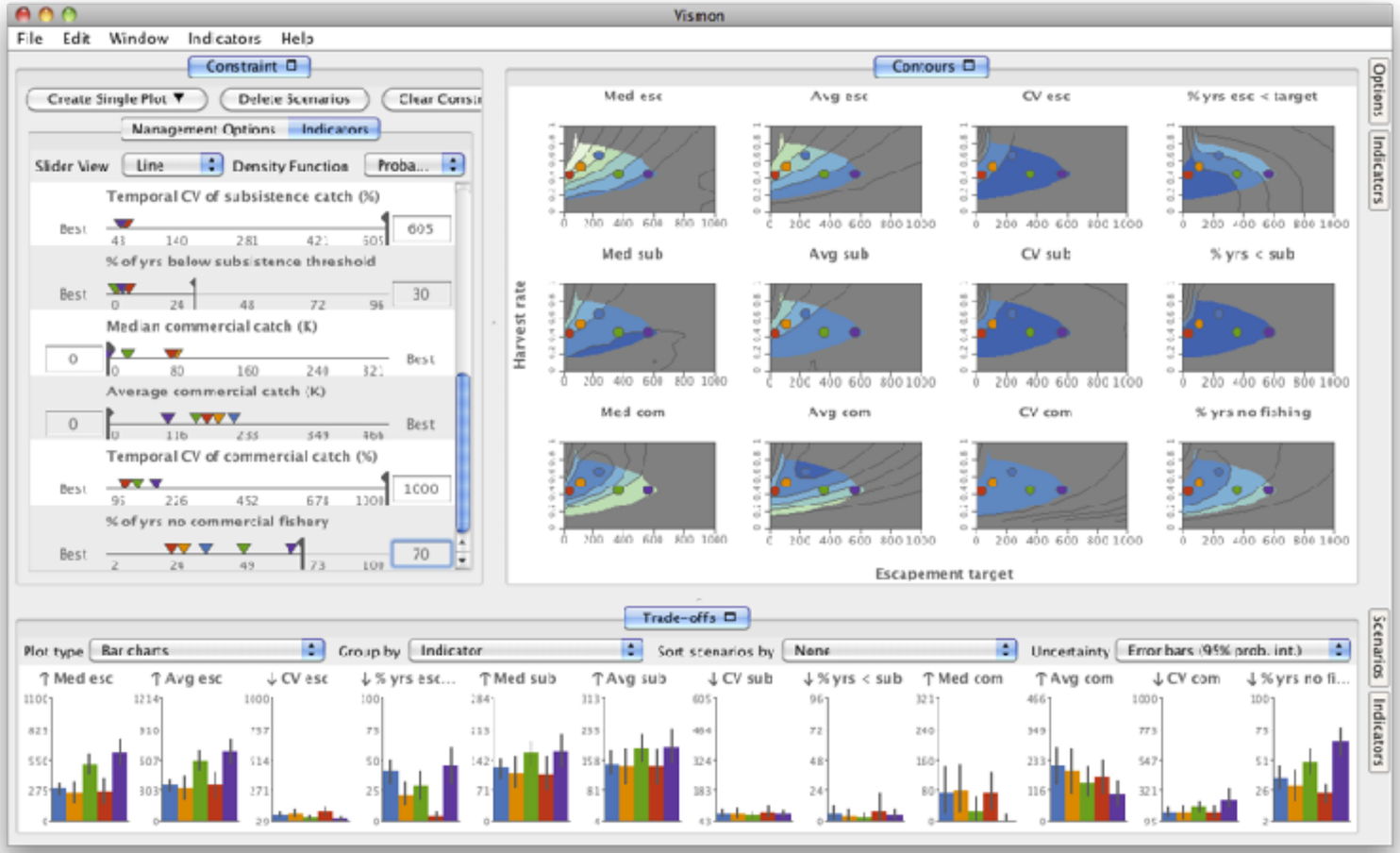
Zipeng Liu

Shing Hei Zhan

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

Vismon: Fisheries simulation

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



Vismon https://youtu.be/h0kHoS4VYmk

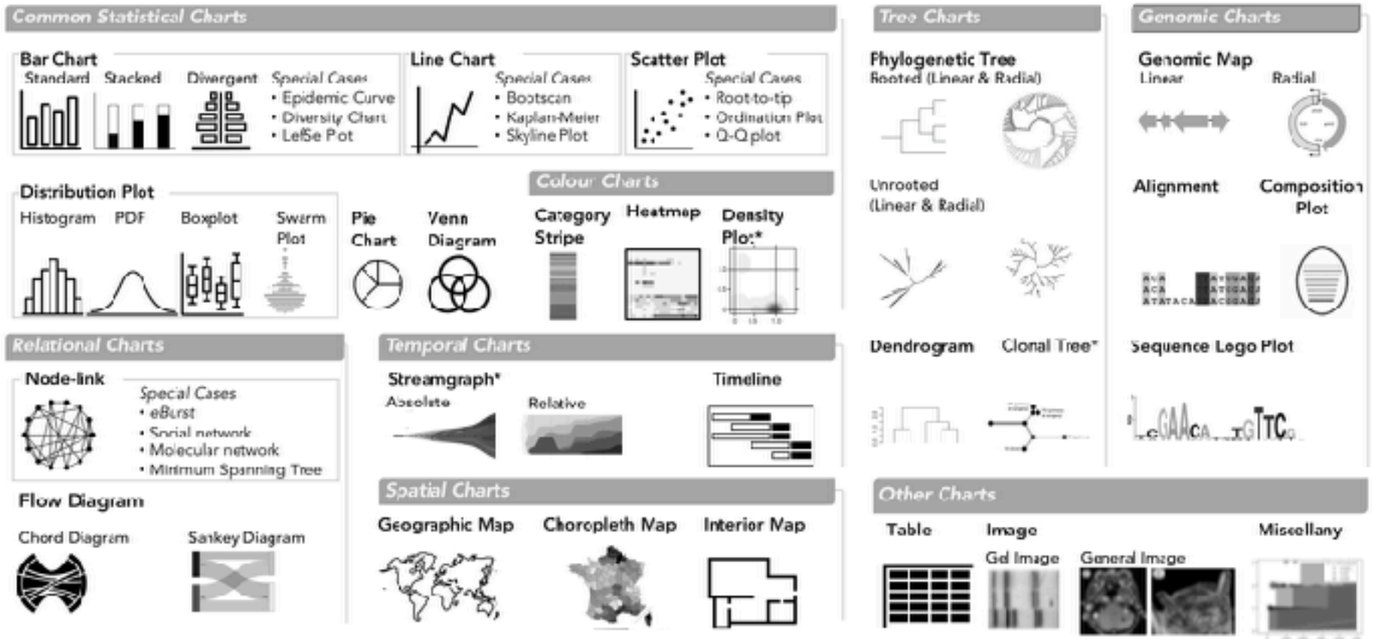
Maryam Booshehrian

Torsten Moeller (SFU)

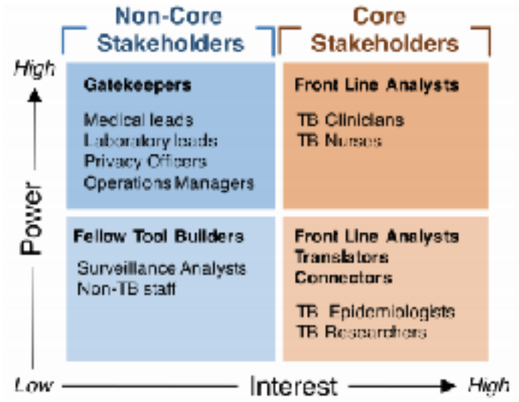
Integrating visualization & biostats methods

- 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



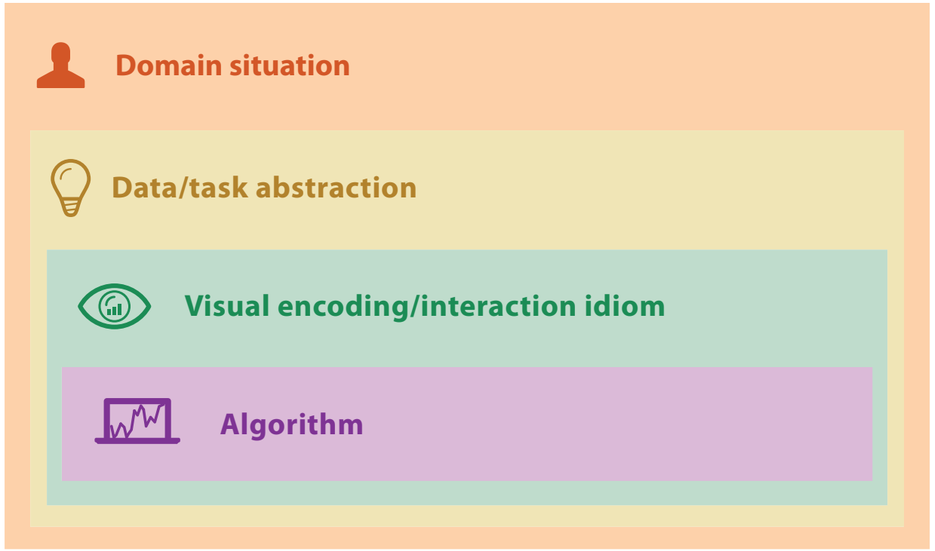
GEViT: Genomic Epidemiology Visualization Typology
https://gevit.net



Regulatory & Organizational Constraints

Jenn Gardy
BCCDC/SPPH

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

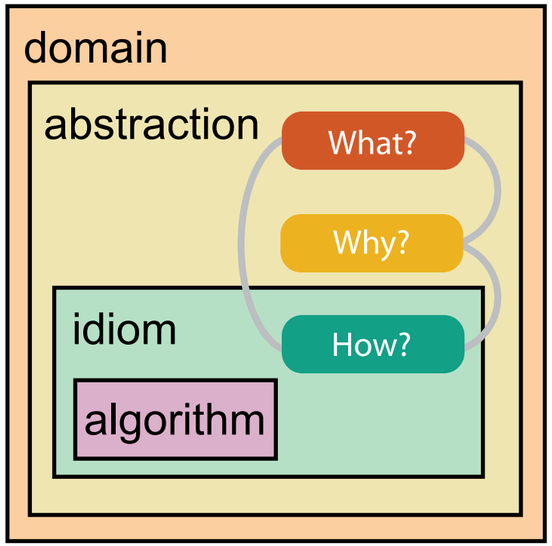
http://www.cs.ubc.ca/labs/imager/tr/2009/NestedModel

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

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

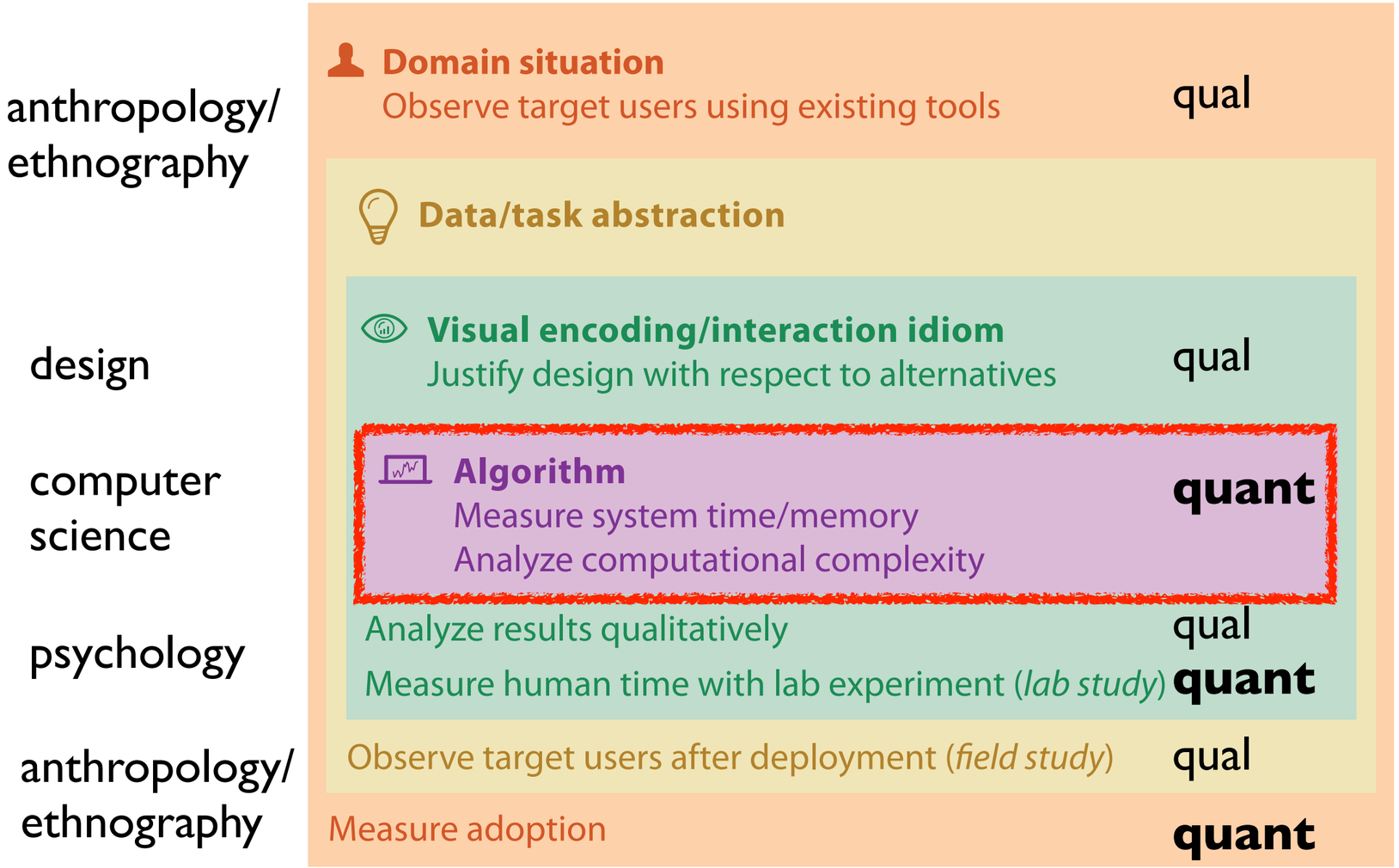


[A Multi-Level Typology of Abstract Visualization Tasks *Brehmer and Munzner. IEEE TVCG 19(12):2376-2385, 2013 (Proc. InfoVis 2013).*]

Different threats to validity at each level

Interdisciplinary: need methods from different fields at each level

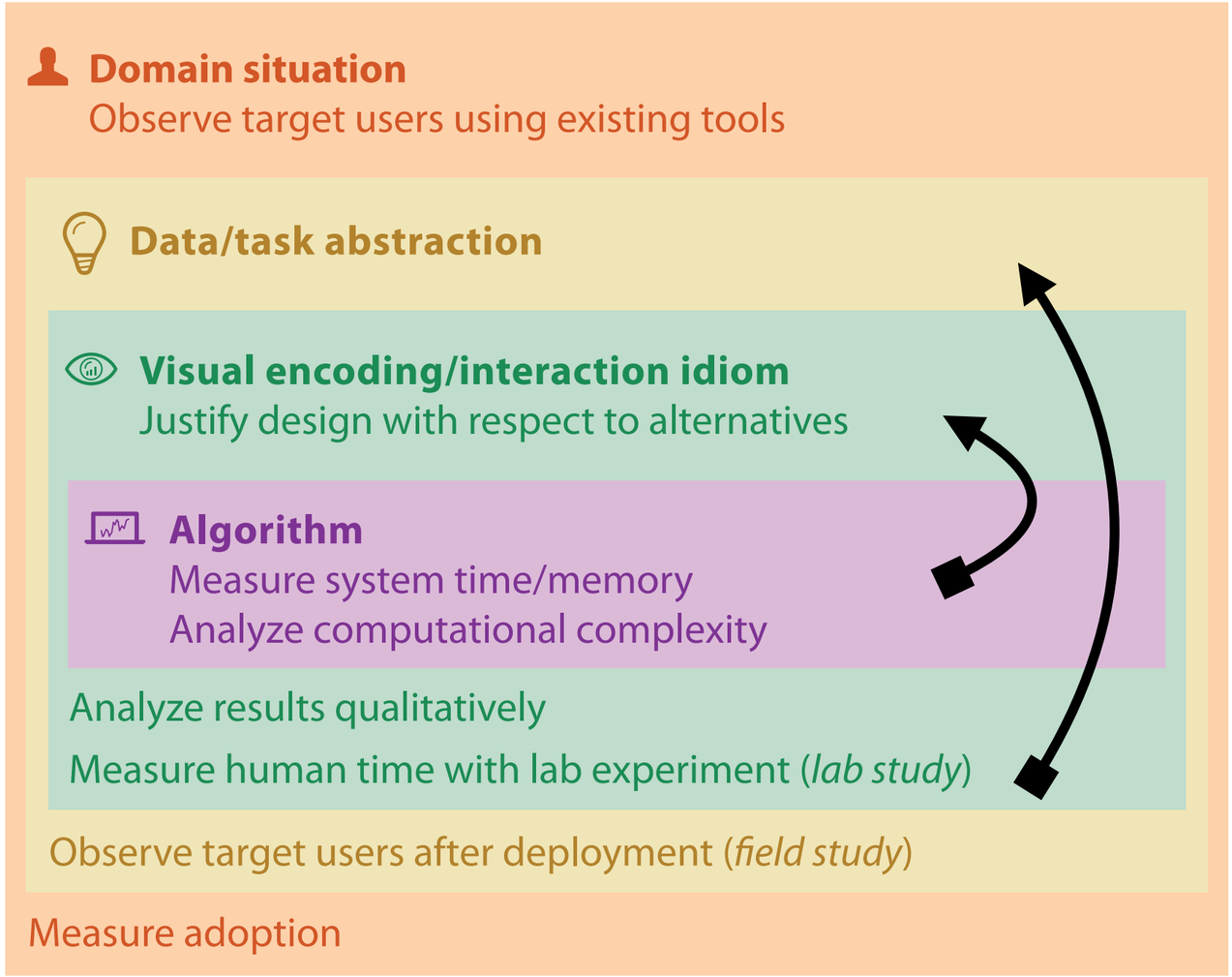
- mix of qual and quant approaches (typically)



problem-driven work

technique-driven work

Mismatches: Common problem

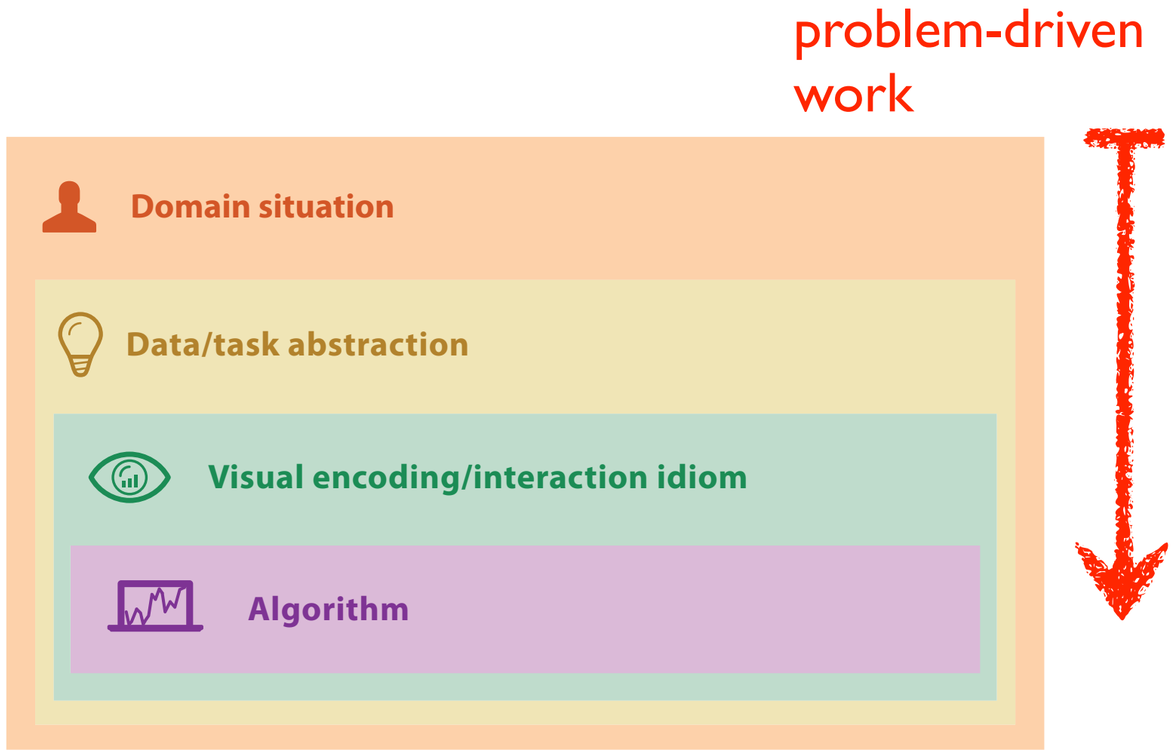


benchmarks can't confirm design

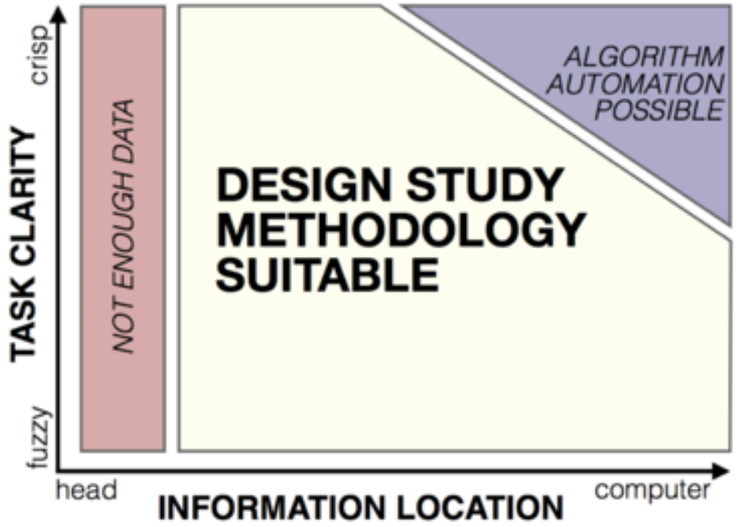
lab studies can't confirm task abstraction

Problem-driven collaborations

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



Building Rewarding Collaborations



Michael Sedlmair

Miriah Meyer

Design Study Methodology

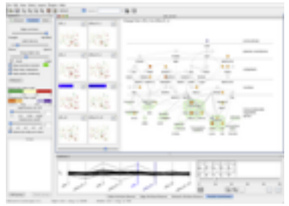
Reflections from the Trenches and from the Stacks

Tamara Munzner
@tamaramunzner

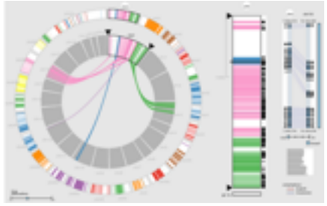
http://www.cs.ubc.ca/labs/imager/tr/2012/dsm/

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

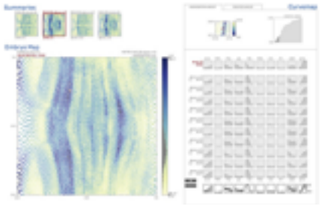


Cerebral
genomics

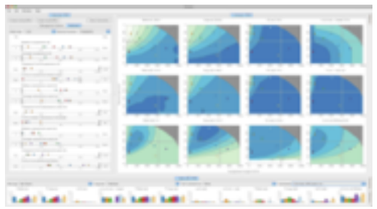


MizBee
genomics

Pathline
genomics



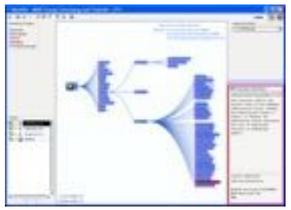
MulteeSum
genomics



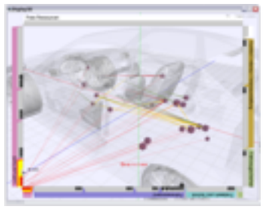
Vismon
fisheries management

QuestVis
sustainability

WiKeVis
in-car networks



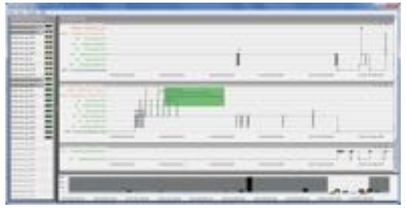
MostVis
in-car networks



Car-X-Ray
in-car networks

ProgSpy2010
in-car networks

RelEx
in-car networks

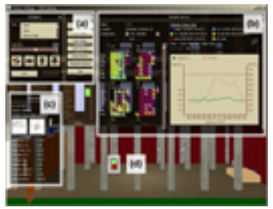


Cardiogram
in-car networks

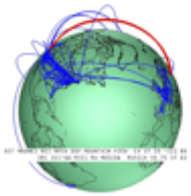
AutobahnVis
in-car networks

VisTra
in-car networks

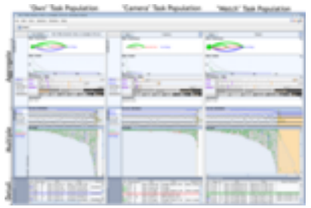
Constellation
linguistics



LibVis
cultural heritage

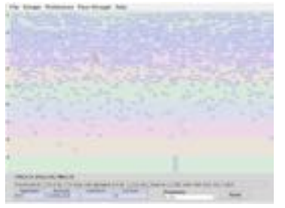


Caidants
multicast

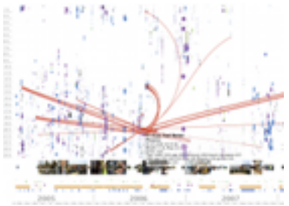


SessionViewer
web log analysis

LiveRAC
server hosting



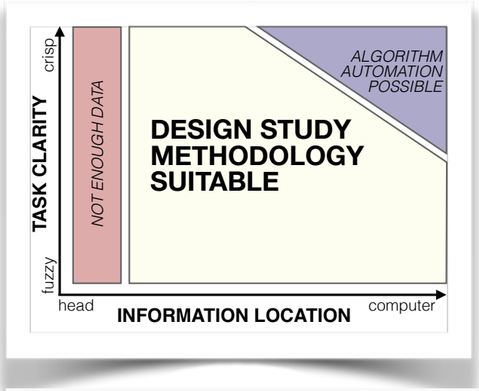
PowerSetViewer
data mining

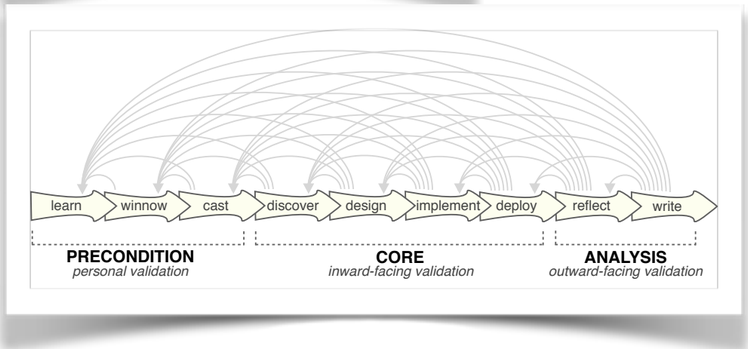


LastHistory
music listening

Methodology for problem-driven work

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





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

Design study methodology: 32 pitfalls

- and how to avoid them

PF-1	premature advance: jumping forward over stages	general
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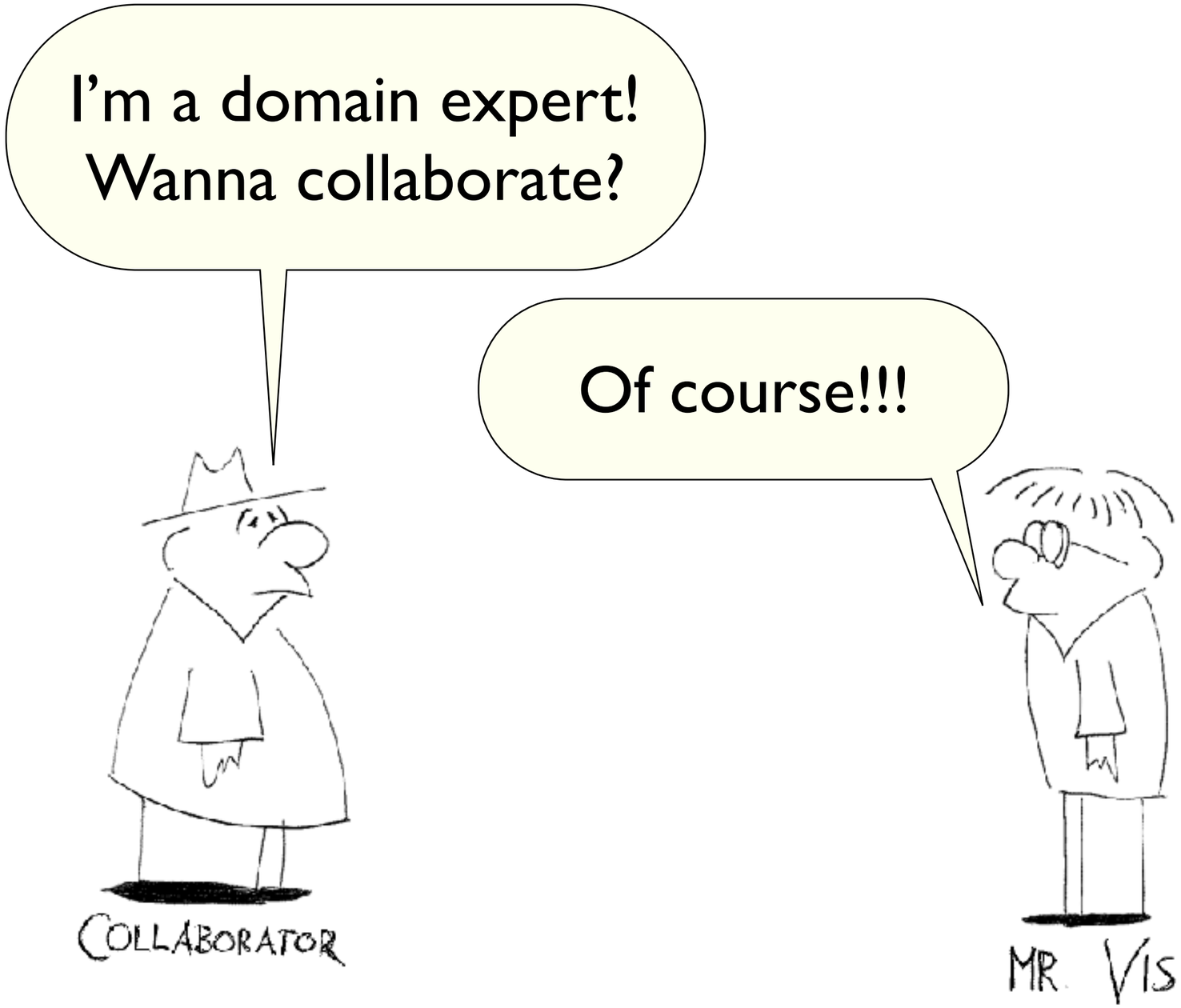
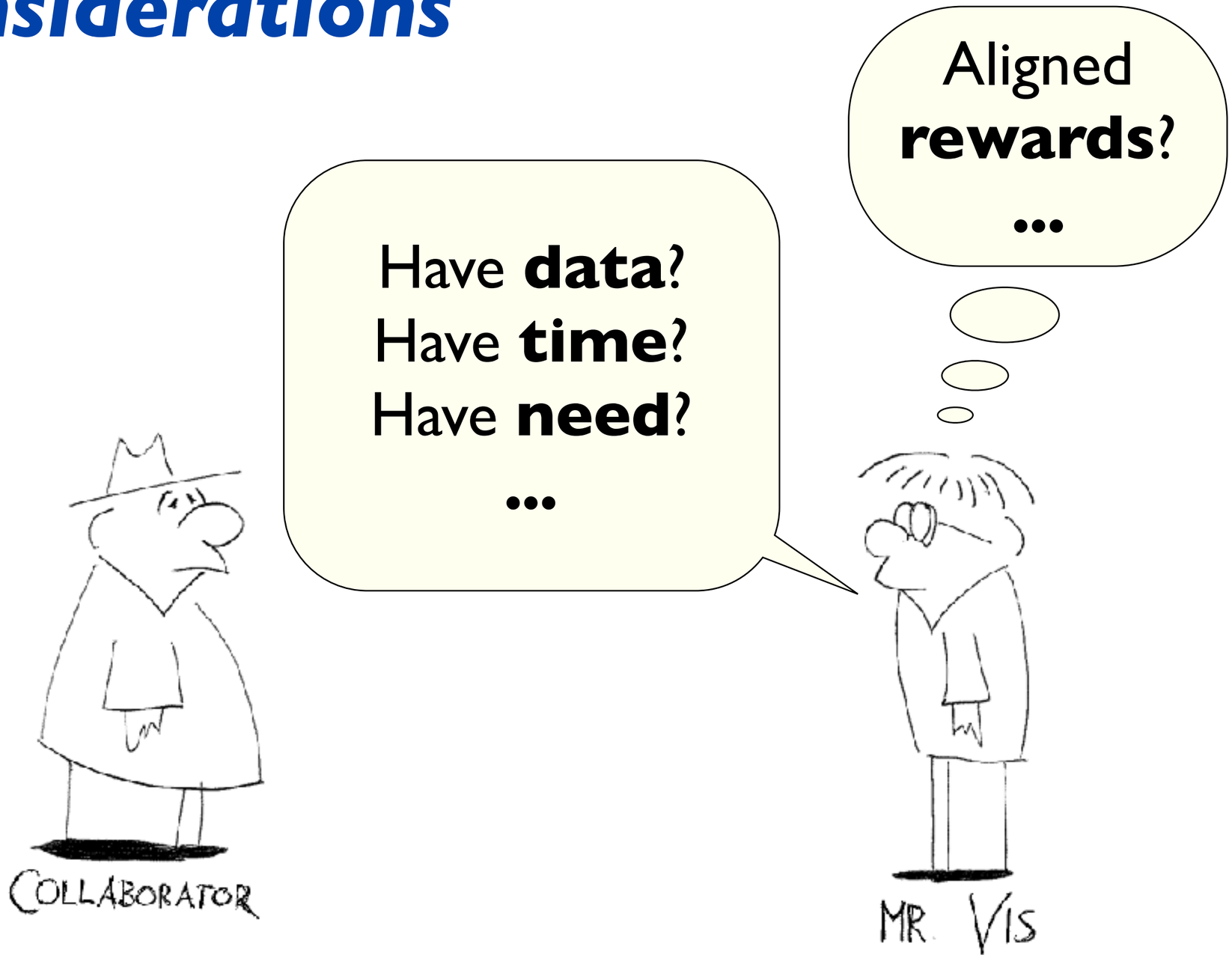
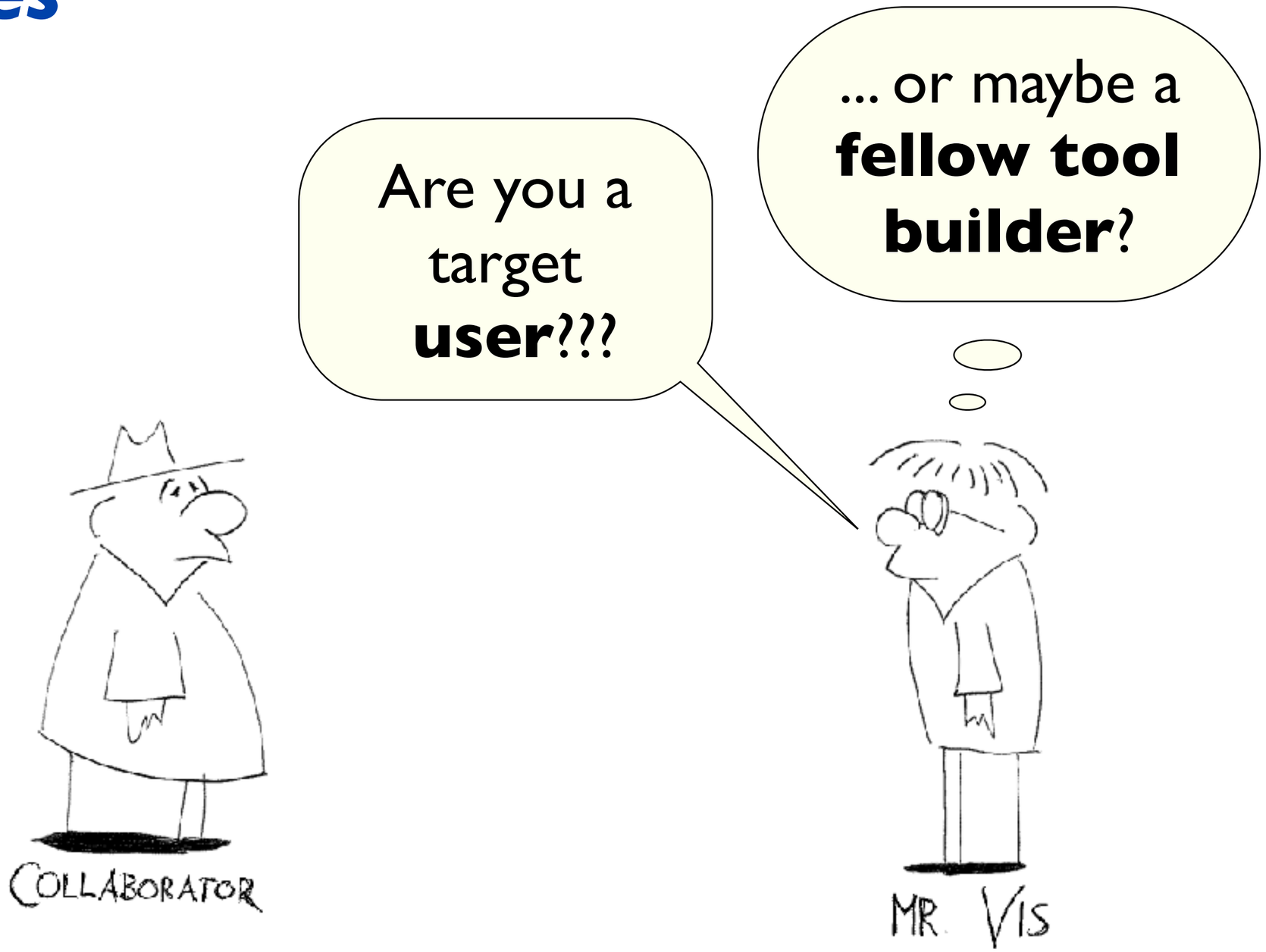

I'm a domain expert!
Wanna collaborate?
Of course!!!
COLLABORATOR
MR. VIS

considerations



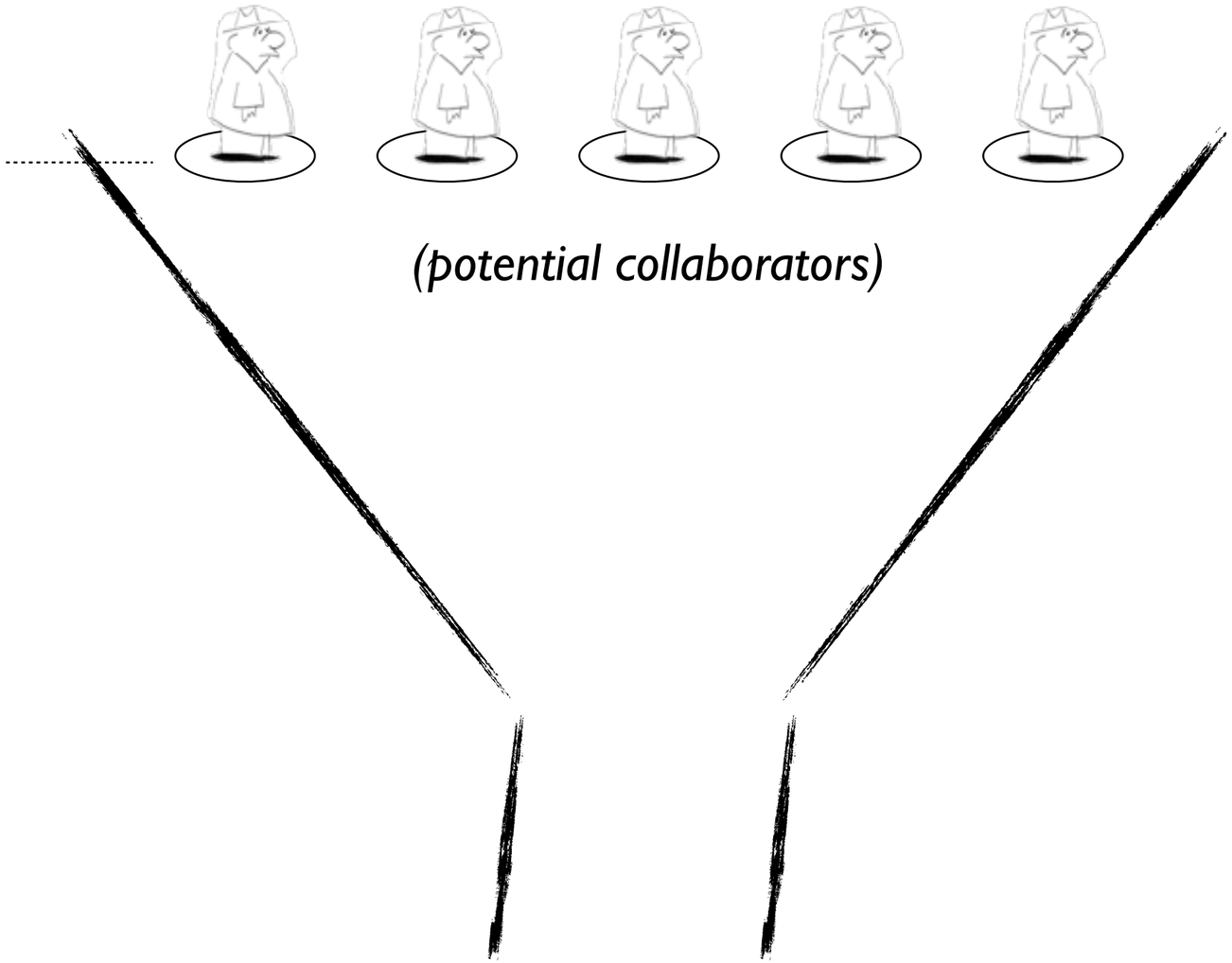
roles


Are you a target **user**???
... or maybe a **fellow tool builder**?
COLLABORATOR
MR. VIS

METAPHOR
Winnowing

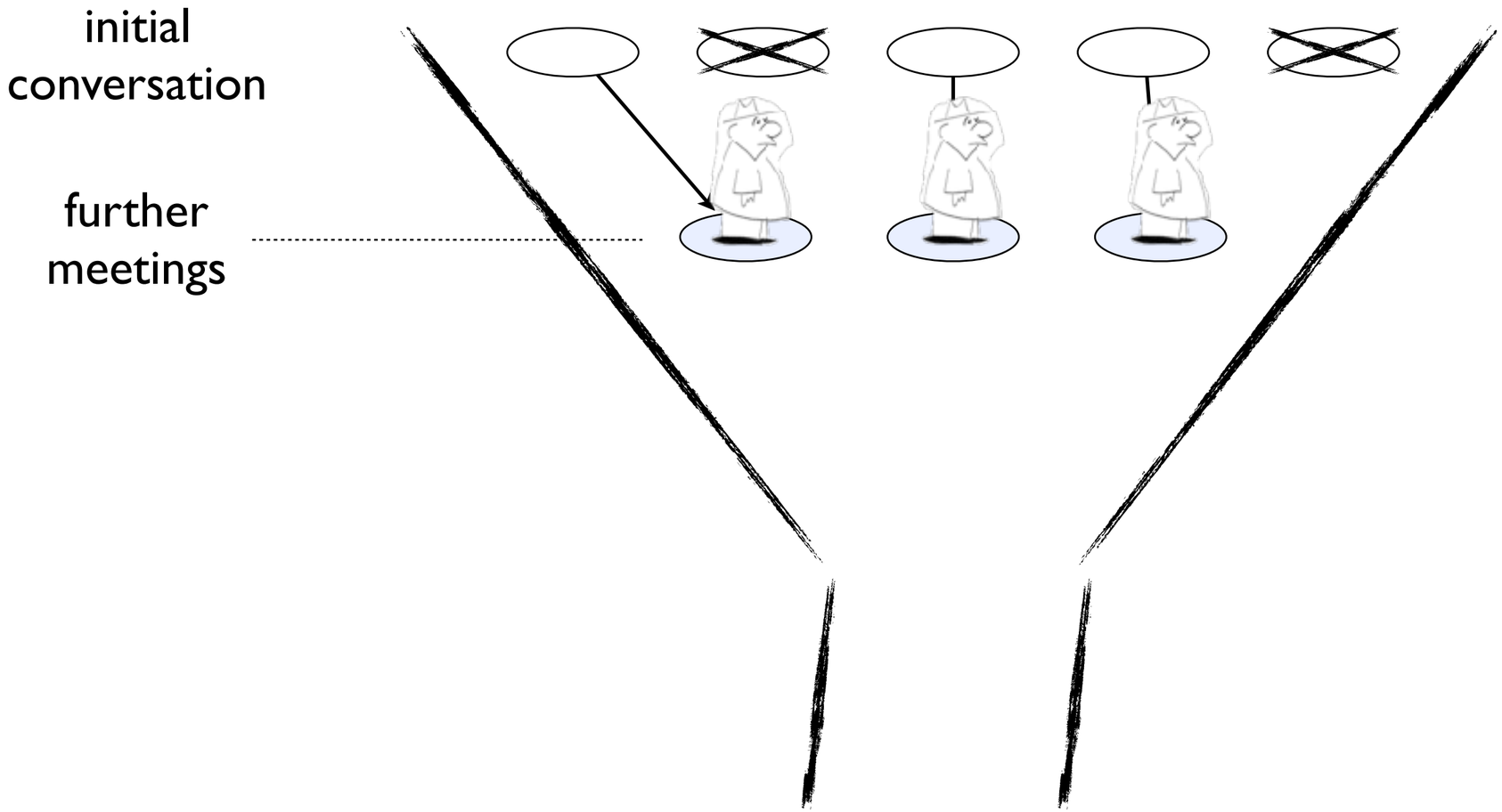
Collaborator winnowing

initial conversation

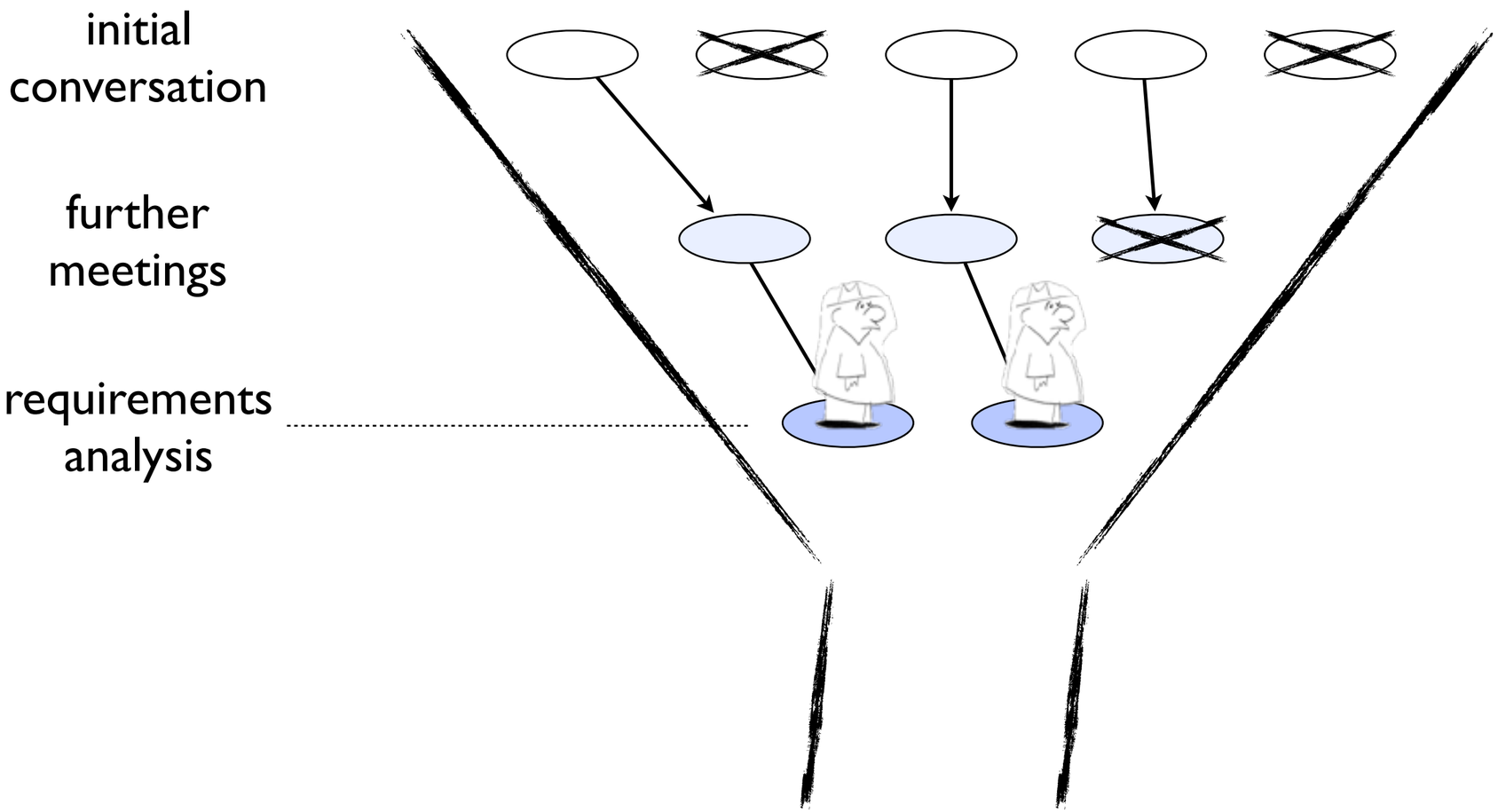


(potential collaborators)

Collaborator winnowing



Collaborator winnowing



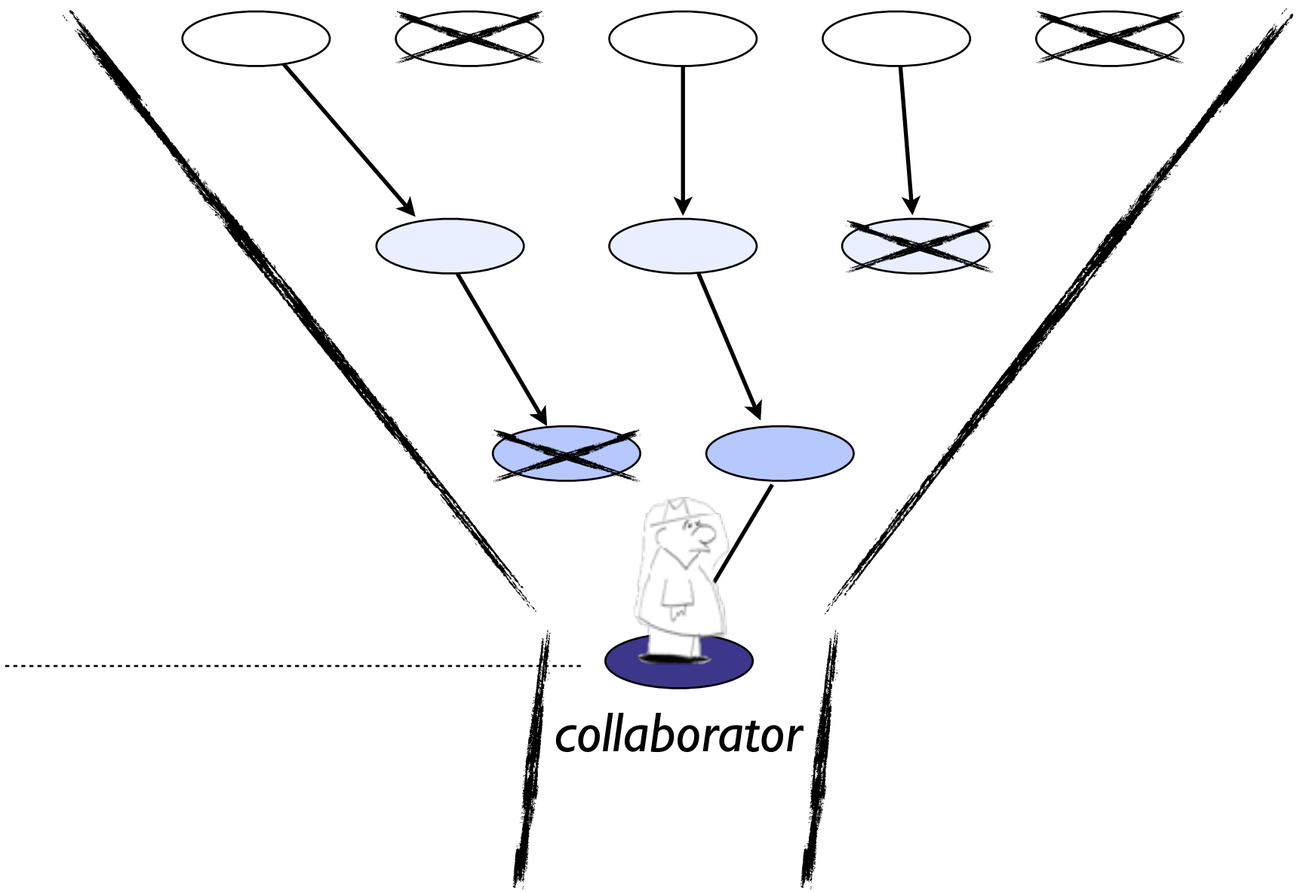
Collaborator winnowing

initial conversation

further meetings

requirements analysis

full collaboration



Collaborator winnowing

Talk with many, stay with few!

Design study methodology: 32 pitfalls

- and how to avoid them

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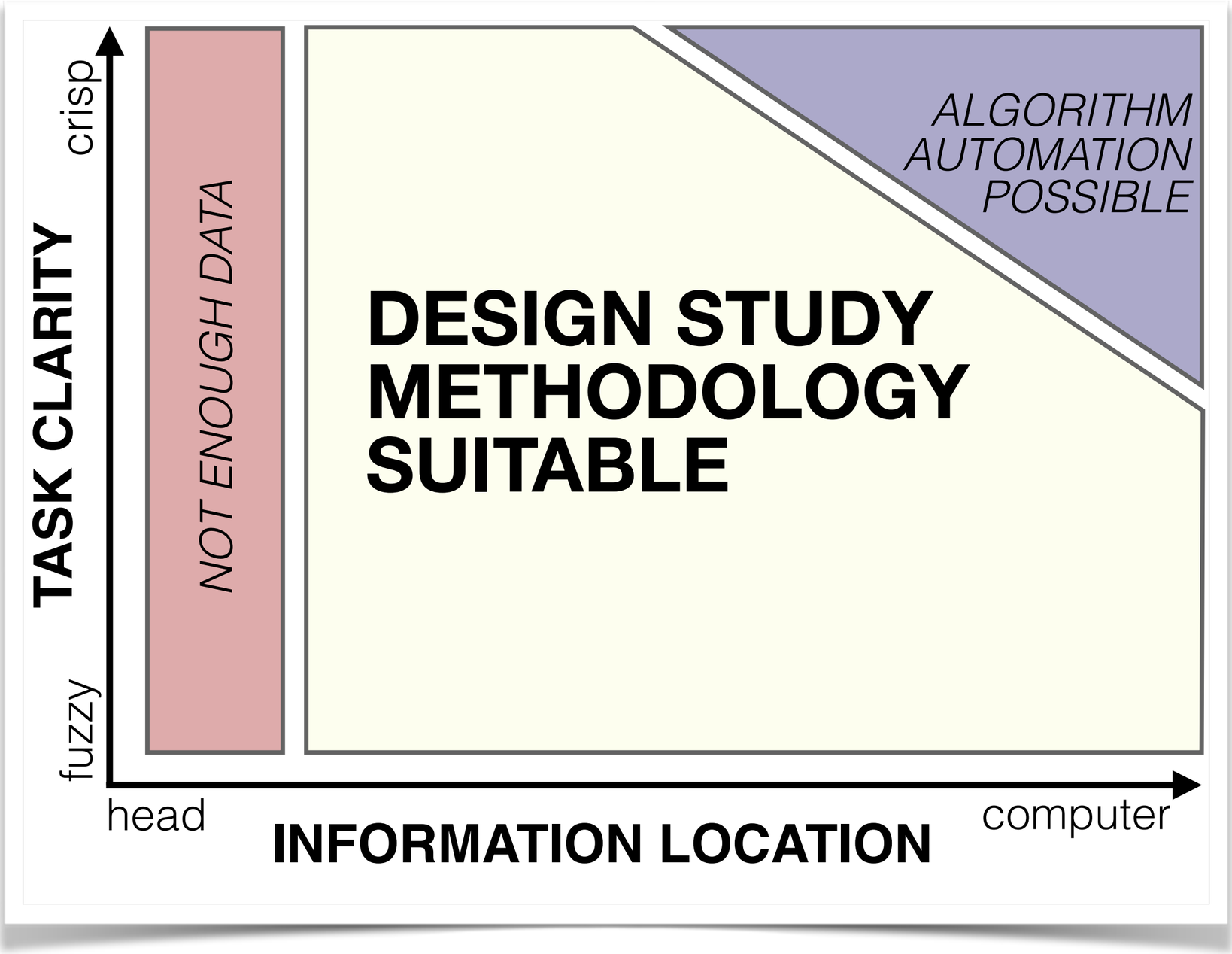
Design study methodology: definitions



More Information

- this talk
  https://www.cs.ubc.ca/~tmm/talks.html#hakai19-methods

- papers, videos, software, talks, courses
  http://www.cs.ubc.ca/group/infovis
  http://www.cs.ubc.ca/~tmm

@tamaramunzner