Guest & Research Lectures

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University of British Columbia

CPSC 547, Information Visualization
7 December 2022

http://www.cs.ubc.ca/~tmm/courses/547-22

Today

- Steve Kasica, UBC
  - qual study: TableScraps, *15 min*
  - Q&A, *5 min*
- Stephen Kobourov, Univ. Arizona
  - algorithms: Scalable Graph Drawing w/ SGD, *15 min*
  - algorithms: MetroSets, *15 min*
  - Q&A 5-10 min
- Mara Solen, UBC
  - survey: VisLit, *15 min*
  - Q&A, *5 min*
- break, *10 min*
- me
  - design spaces: Timelines Revisited, GEViT, *30 min*
  - design studies: Ocupado, Aggregated Dendrograms, *25 min*
  - imperfect models: TimelineCurator, *15 min*
  - Q&A, *10 min*

Steve Kasica

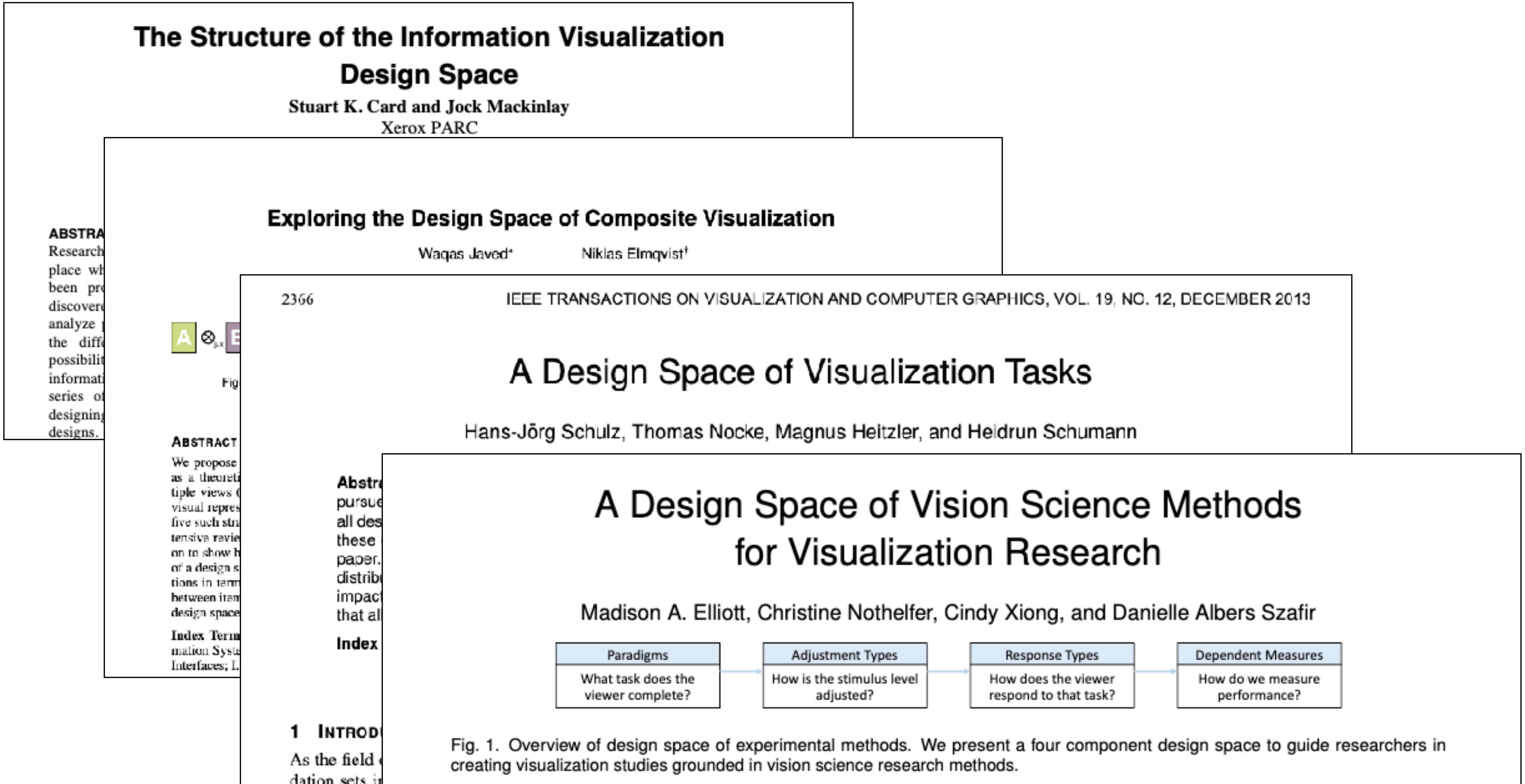
Stephen Kobourov

Mara Solen

break

design spaces

Design spaces: Continuing theme



The Structure of the Information Visualization Design Space

Stuart K. Card and Jock Mackinlay
Xerox PARC

Exploring the Design Space of Composite Visualization

Waqas Javed* Niklas Elmqvist†

A Design Space of Visualization Tasks

Hans-Jörg Schulz, Thomas Nocke, Magnus Heitzler, and Heidrun Schumann

A Design Space of Vision Science Methods for Visualization Research

Madison A. Elliott, Christine Nothelfer, Cindy Xiong, and Danielle Albers Szafir

Paradigms	Adjustment Types	Response Types	Dependent Measures
What task does the viewer complete?	How is the stimulus level adjusted?	How does the viewer respond to that task?	How do we measure performance?

Fig. 1. Overview of design space of experimental methods. We present a four component design space to guide researchers in creating visualization studies grounded in vision science research methods.

Design spaces: **What** are they?

- impose **systematic structure** on set of possibilities for specific problem
  - to capture the key variables at play
  - to support **reasoning about design choices**

- delineate
  - **cross-cutting** / independent / orthogonal
  - **axes** / dimensions / categories

- many names
  - design spaces, taxonomies, typologies, classifications, frameworks, models, ...
  - space within which to express design patterns *[Javed/Elmqvist]*

Design spaces: What are they **for**?

- describe and analyze portions of design space to **understand differences** among designs & **suggest new** possibilities
  [Card & Mackinlay 1997]

- design spaces provide an **actionable** structure for systematically reasoning about solutions *[Elliott et al 2020]*

- taxonomies increase **cognitive efficiency** & support **inferences**
  [Ralph. Toward Methodological Guidelines for Process Theories & Taxonomies in Software Engineering. IEEE TSE 2020]
  - by grouping similar instances together to facilitate **reasoning about classes** rather than instances

Design spaces: How to **assess**?

- Michel Beaudoin-Lafon, *Designing Interaction, not Interfaces. AVI 2004.*
  - **descriptive** power: ability to describe significant range of existing examples
  - **evaluative** power: ability to help assess multiple design alternatives
  - **generative** power: ability to help designers create new designs

Design spaces: How to **create**?

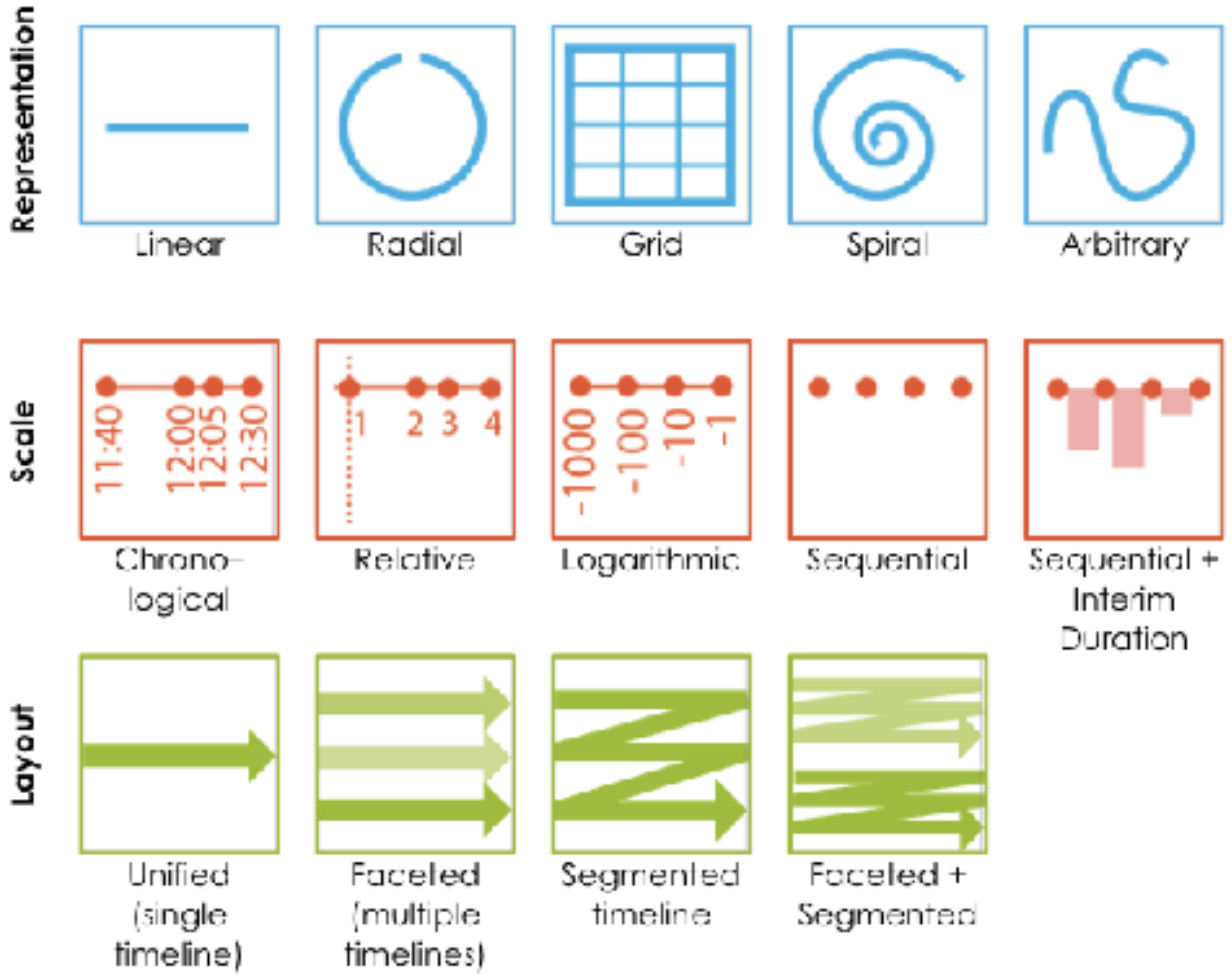
- **open coding** source material
  - grounded theory / thematic analysis / qualitative analysis
- **literature** review
  - synthesize across existing theories, compare & contextualize
- personal **reflection**
  - reflective synthesis

- complex combinations...

Design spaces: Multiple examples

- datatype: temporal, **timeline** visual encoding
- domain: **genomic epidemiology**, paper figure visual encoding
- domain: **journalism**, data **wrangling** activities
- domain agnostic: **abstract tasks**

Timelines



Matt
Brehmer

Bongshin
Lee

Benjamin
Bach

Timelines Revisited

A Design Space and Considerations for Expressive Storytelling

Nathalie
Henry Riche

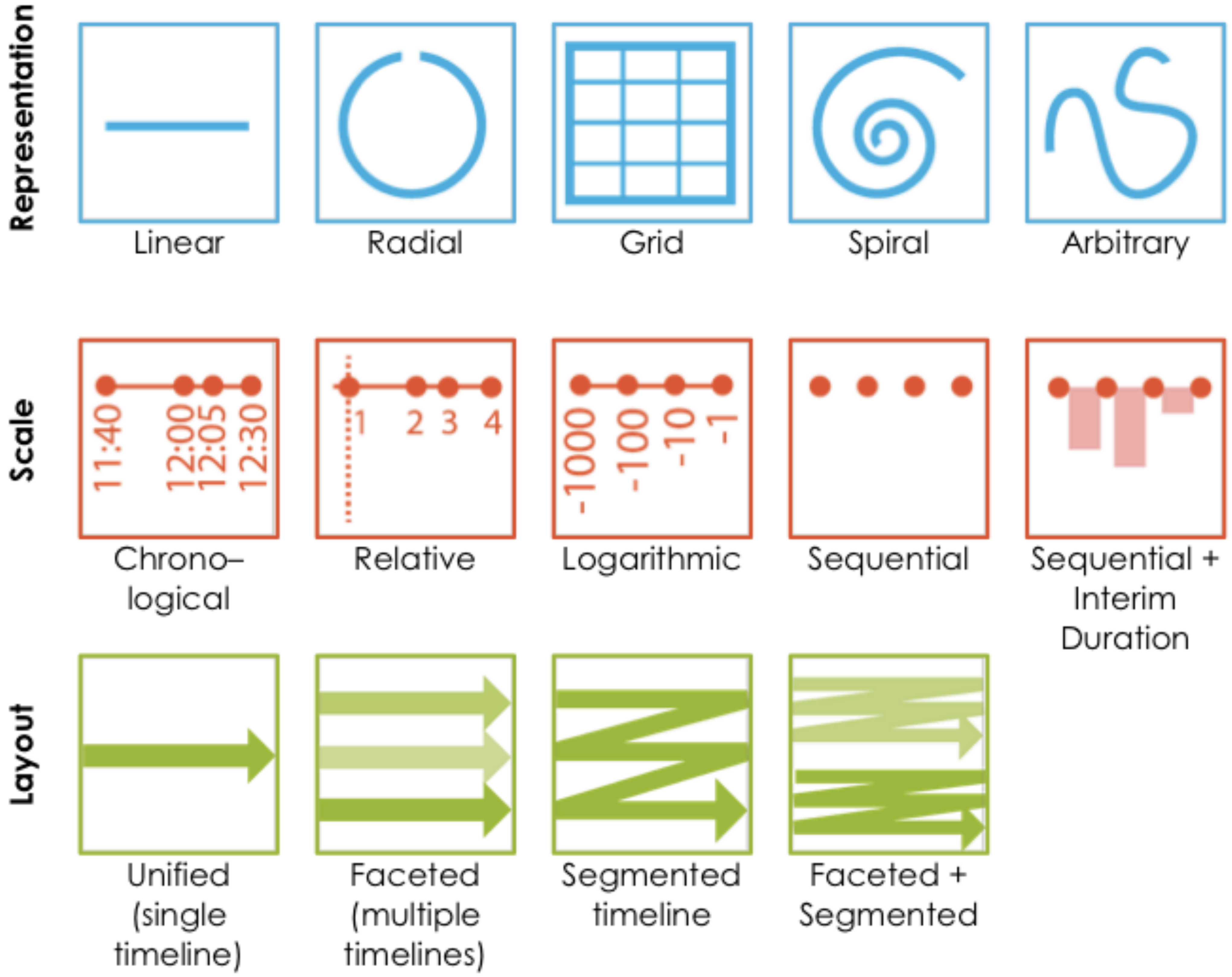
https://timelinesrevisited.github.io/

https://timelinestoryteller.com

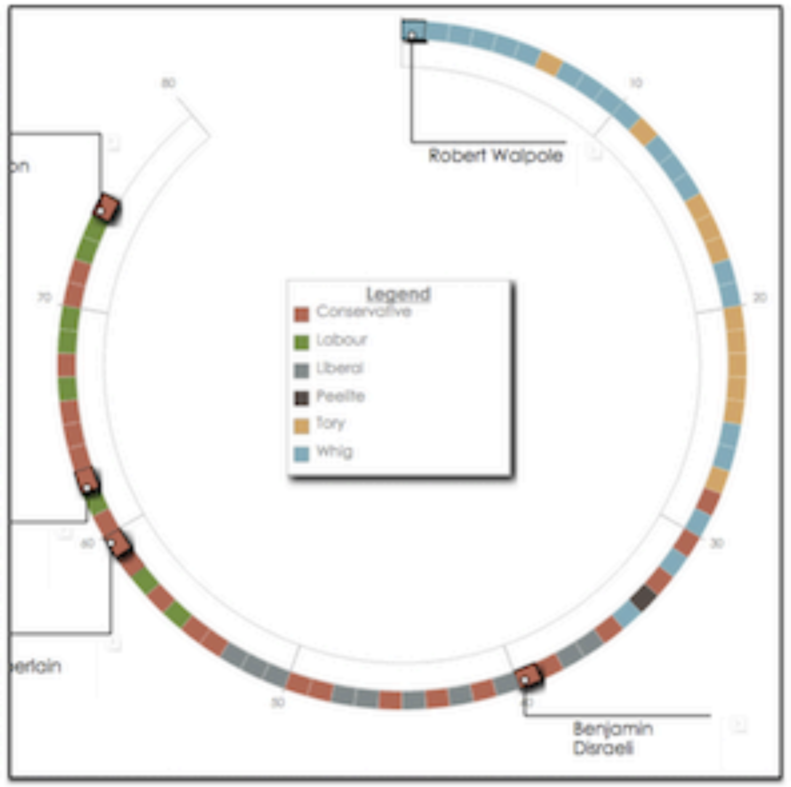
Timelines Revisited: A Design Space and Considerations for Expressive Storytelling
Brehmer, Lee, Bach, Henry Riche, Munzner. IEEE TVCG 23(9):2151-2164

Design space with three axes

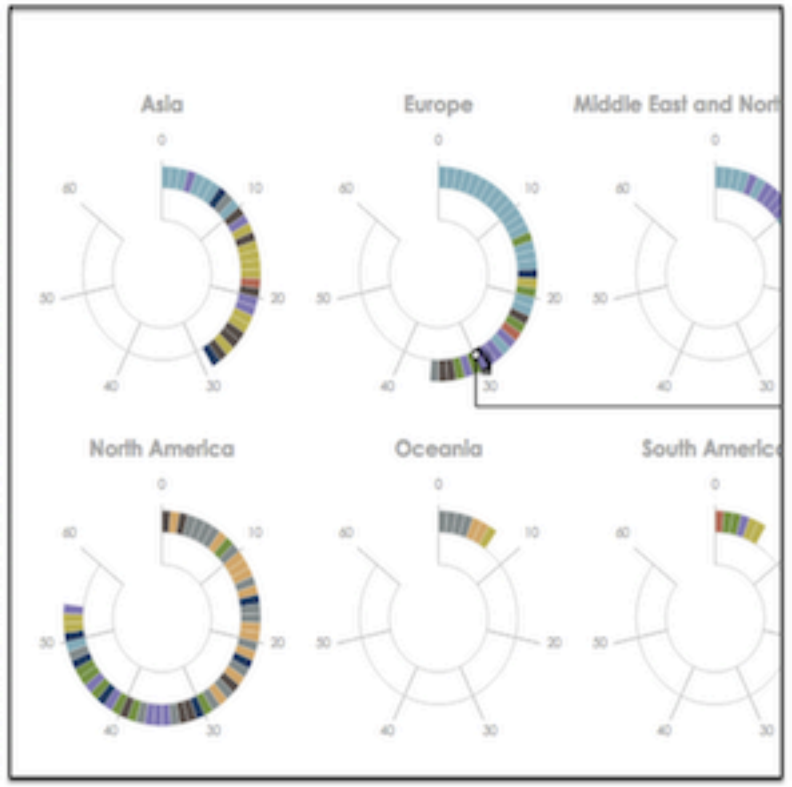
- representation
- scale
- layout



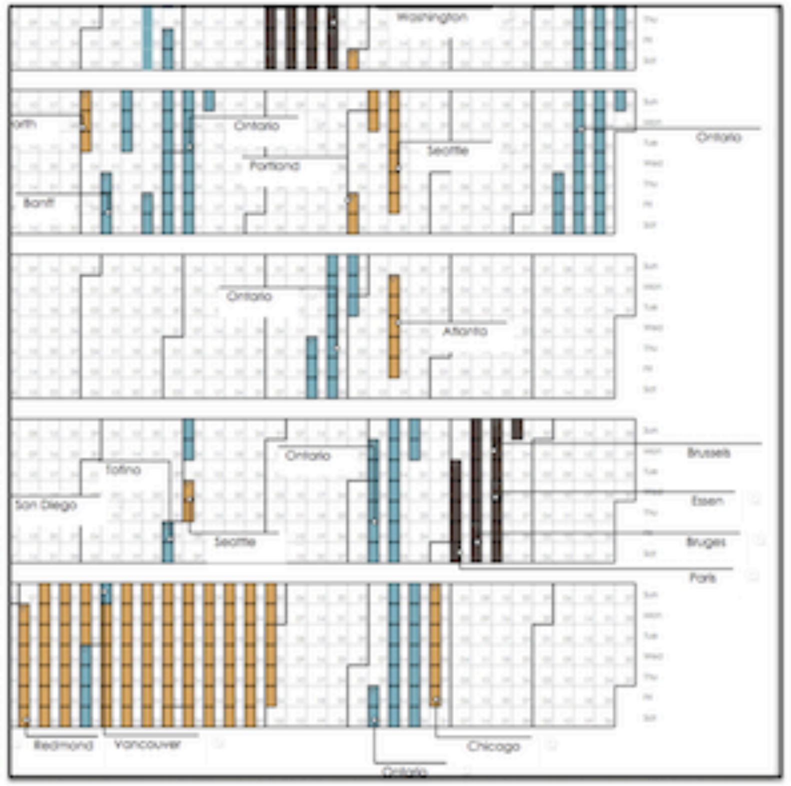
Combinations: Characterize narrative, perceptual



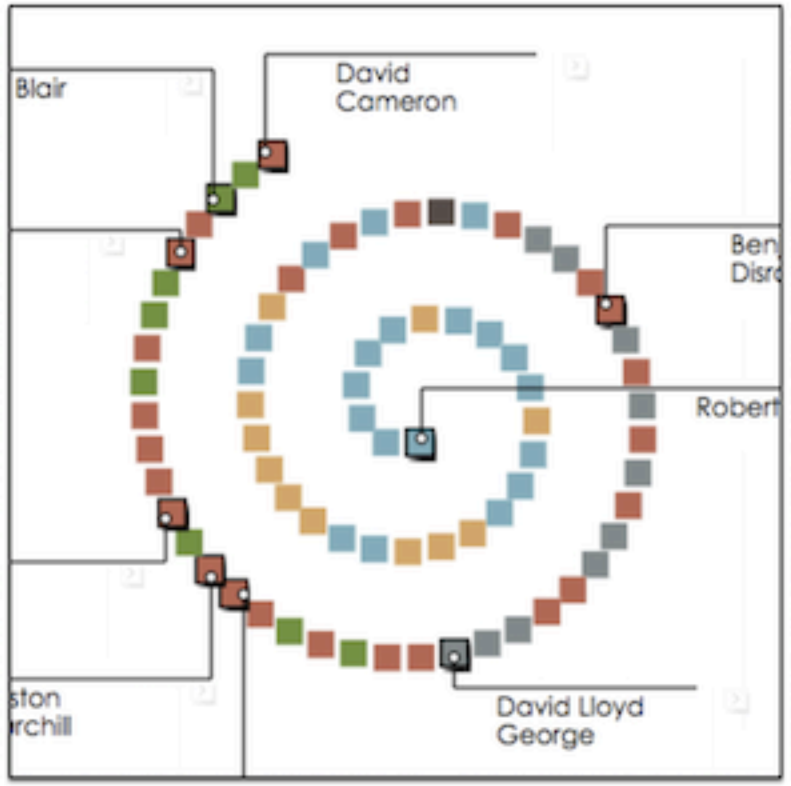
Narrative point: present a sequence of events.
Perceptual task: arc position judgments.
Comment: square aspect ratio.



Narrative point: (approximately) compare lengths of sequences between facets.
Perceptual task: arc length comparisons.



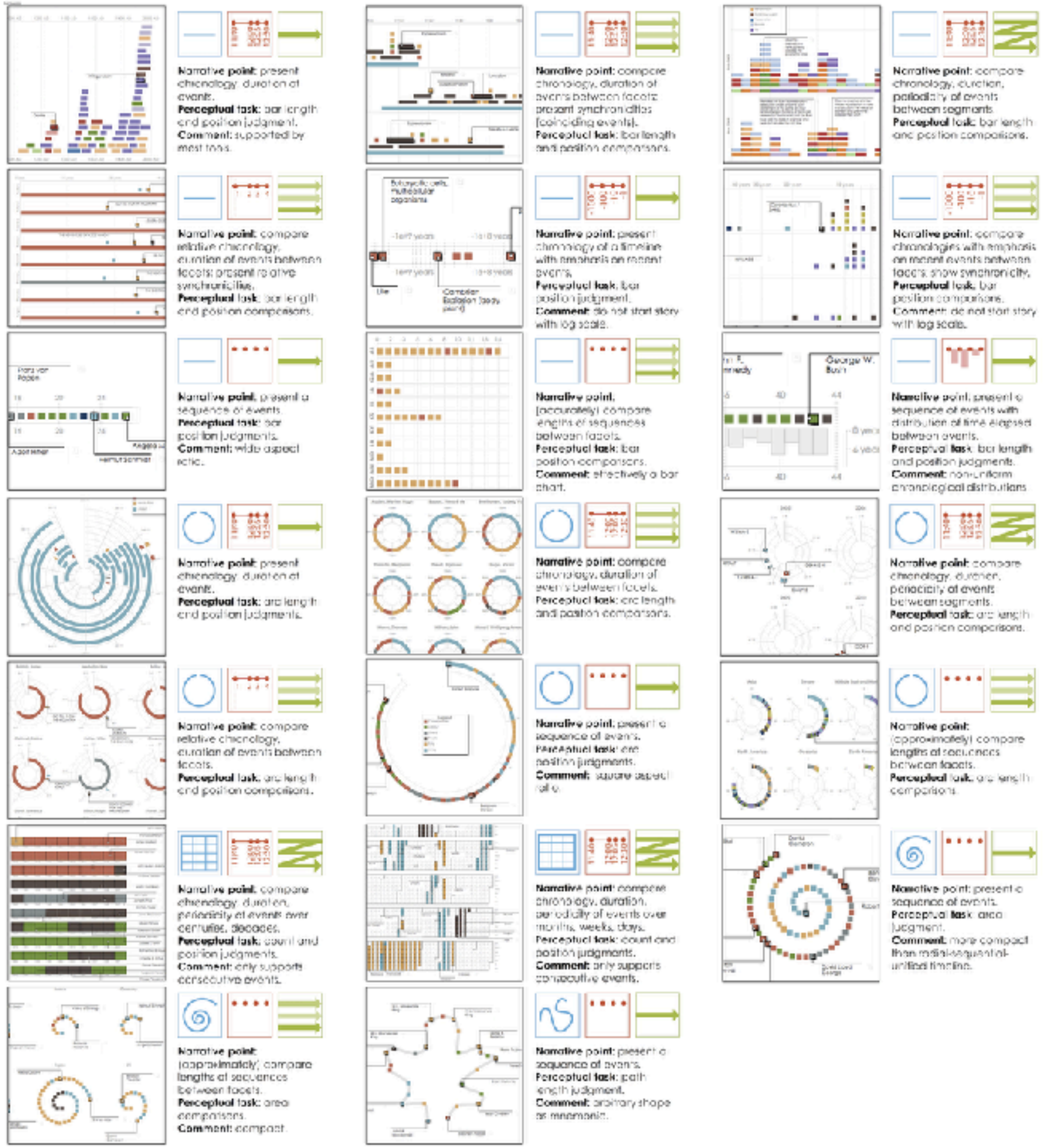
Narrative point: compare chronology, duration, periodicity of events over months, weeks, days.
Perceptual task: count and position judgments.
Comment: only supports consecutive events.



Narrative point: present a sequence of events.
Perceptual task: area judgment.
Comment: more compact than radial-sequential-unified timeline.

Viable combinations

- 20 out of 100
- criteria
  - purposeful
  - interpretable
  - generalizable



Process

- **create** design space
  - **assemble** source material corpus: 145 timeline visualizations & timeline tools
  - **open code** group timelines together, select example for group, sketch alternatives
  - result: 3-axis design space

- **analyze** design space
  - 24 unique combinations (of 100) found in corpus
  - 20 we deemed viable

Assessment & adoption

- descriptive power
  - **validated** coverage through checking 118 additional timelines ("test set")
    - all timelines can be described (263 total)
    - 253 characterized as viable
- generative power
  - **implemented** sandbox authoring software for 20 viable designs
    - & transitions between them
  - **created** designs for 28 representative datasets
    - 7 full story videos
- adoption
  - **open sourced** & distributed as Microsoft **product**
    - free browser version at https://timelinestoryteller.com/
    - free add-on for PowerBI

Genomic Epidemiology

A systematic method for surveying data visualizations and a resulting genomic epidemiology visualization typology:

GEViT

Anamaria Crisan
@amcrisan

Jenn Gardy
@jennifergardy

https://amcrisan.github.io/gevit

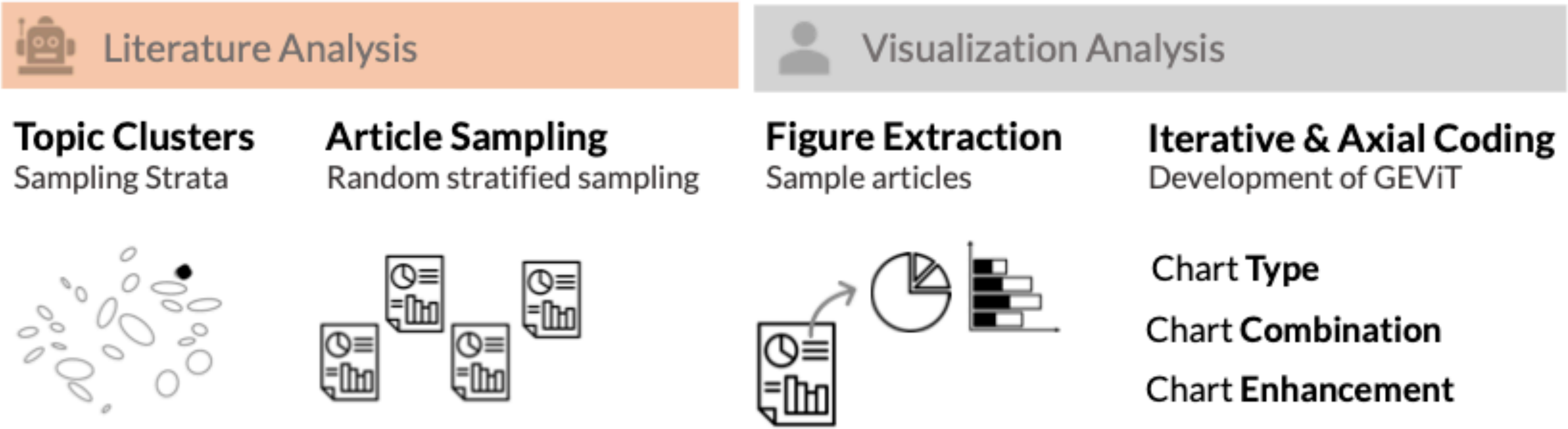
A systematic method for surveying data visualizations and a resulting genomic epidemiology visualization typology: GEViT.
Crisan, Gardy, Munzner. Oxford Bioinformatics 35(10):1668-1676, 2018.

Propose typology creation method: mixed qual and quant

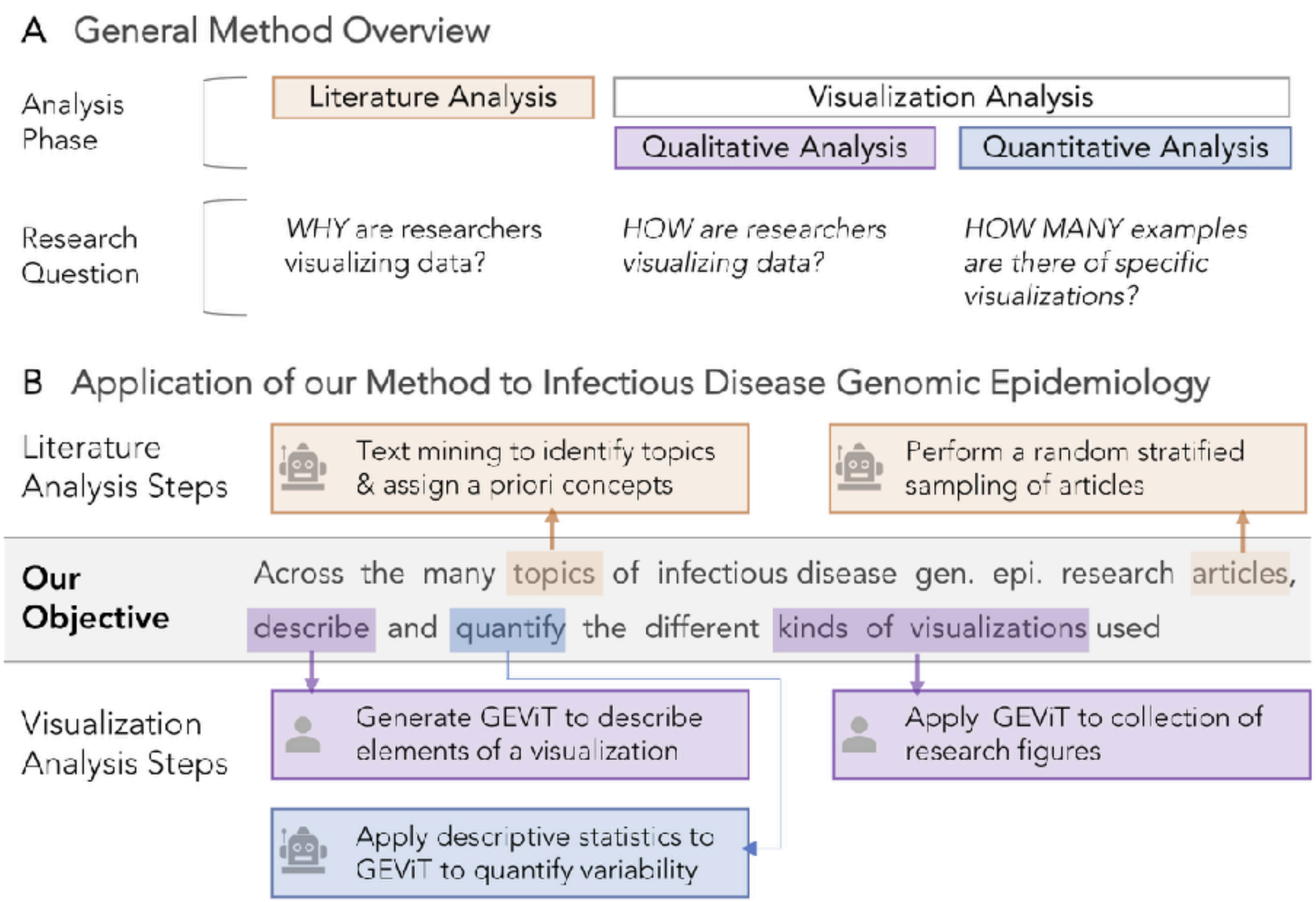
- Analyzed research articles
- Some analyses are automated ( ) and others are manual ( )

Use method to develop typology in specific domain

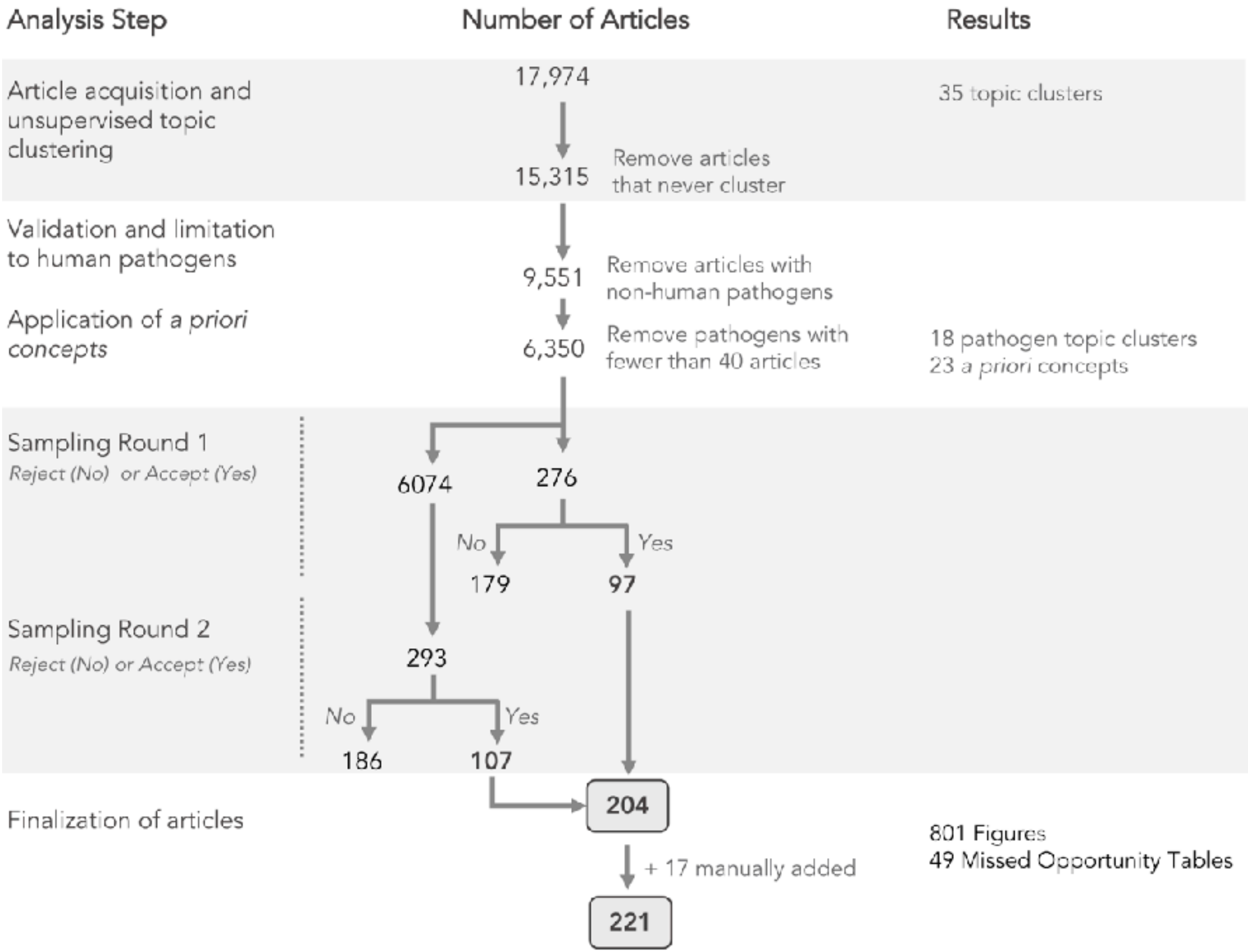
- Developed a Genomic Epidemiology Visualization Typology (GEViT)



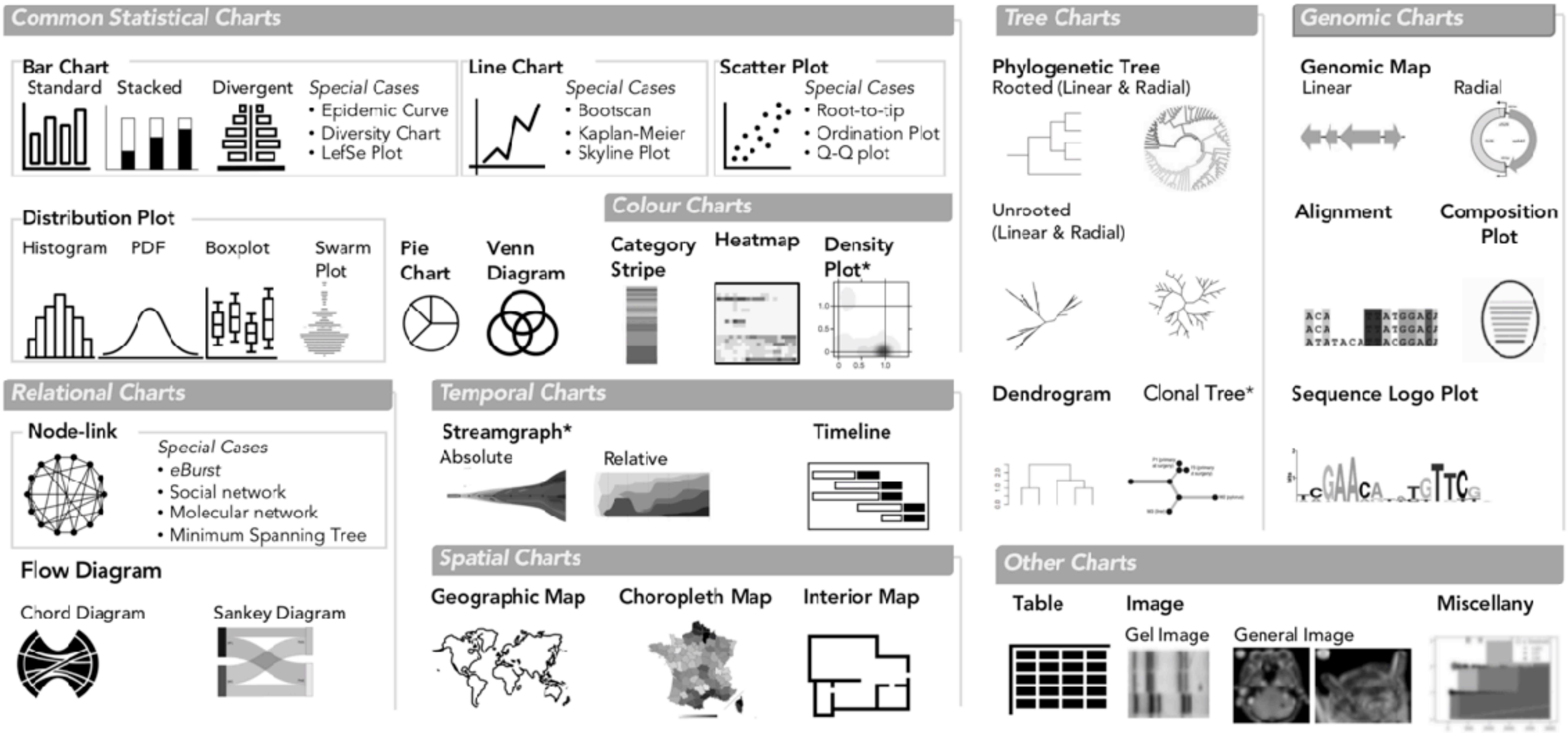
Domain prevalence design space



By the numbers



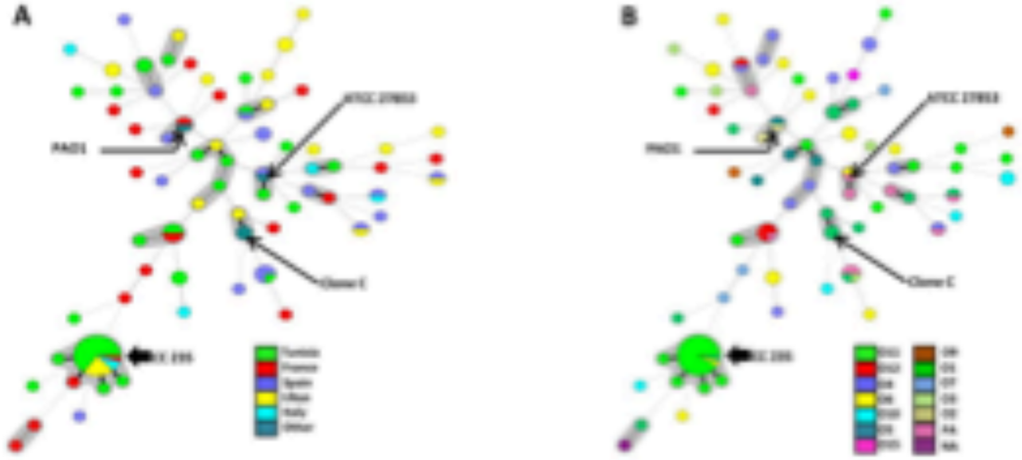
Design space axis: Chart types used in genEpi



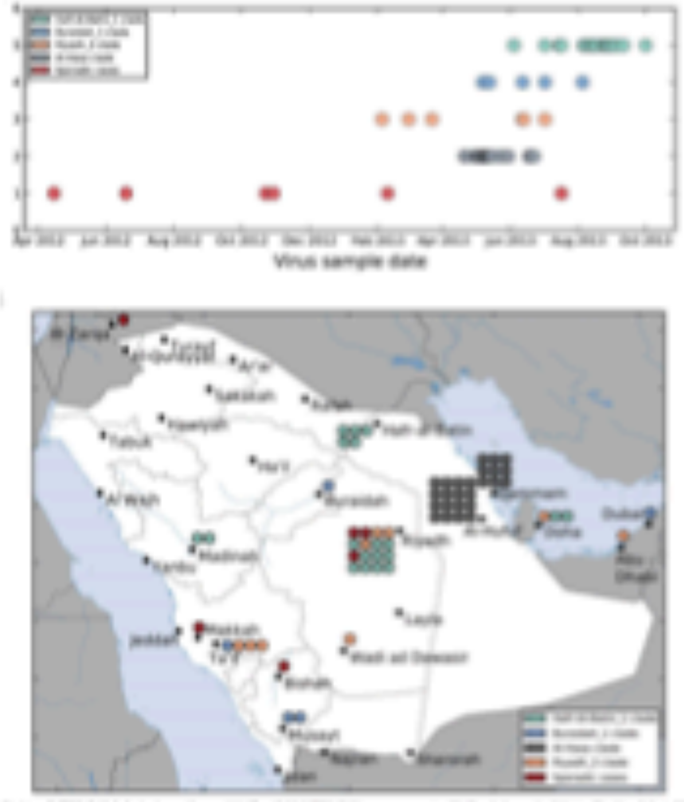
Design space axis: Chart combinations of heterogeneous data

Spatially Aligned
Horizontal / Vertical Alignment
20%

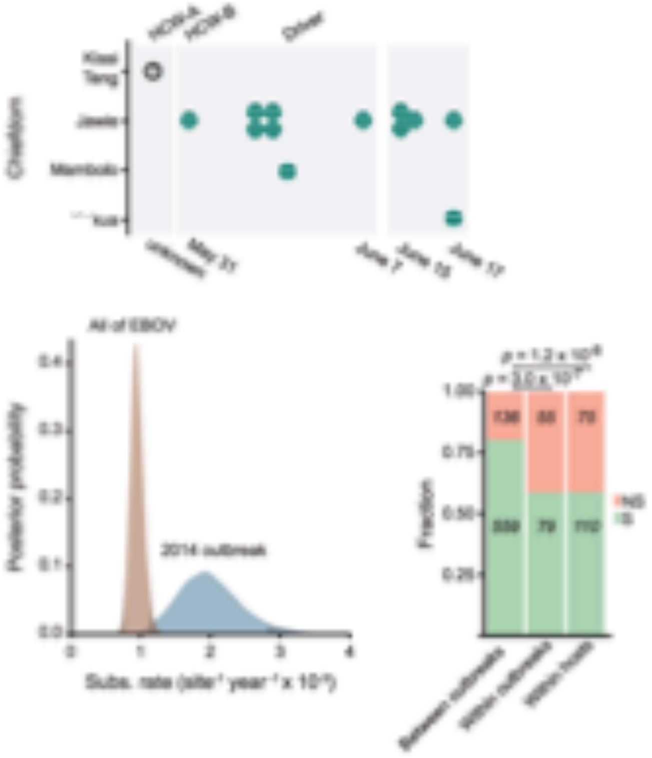
Small Multiples
Chart Alignment
17%



Visually Aligned
Colour / Shape Alignment
14%

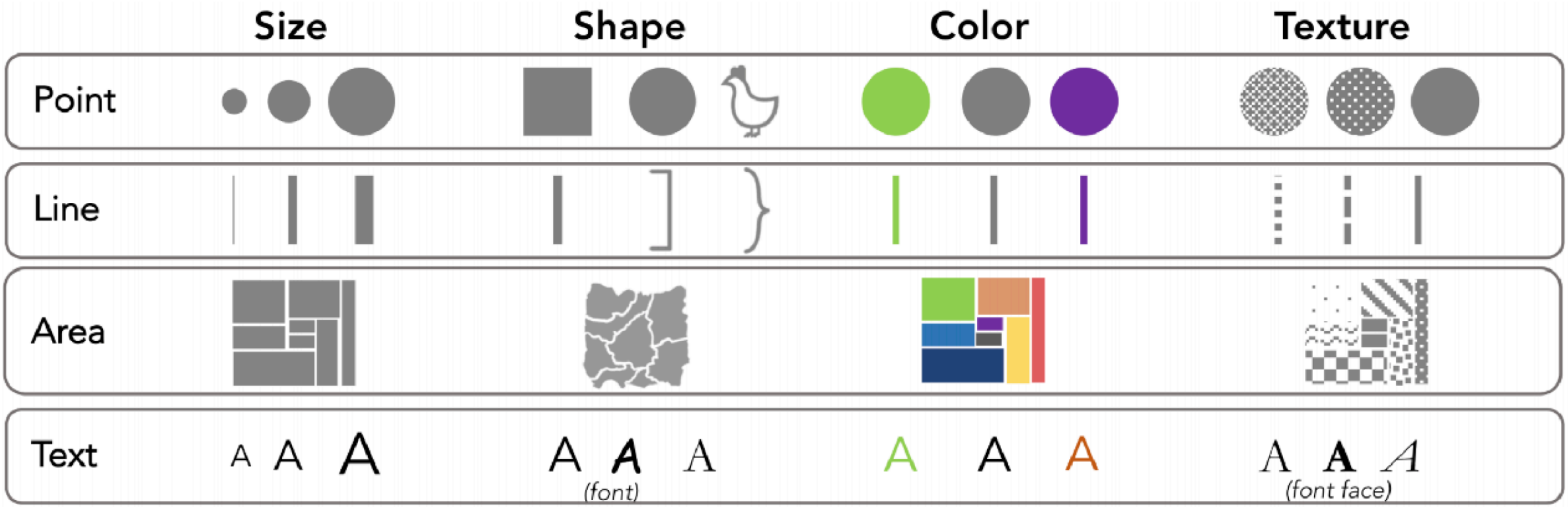


Unaligned
9%



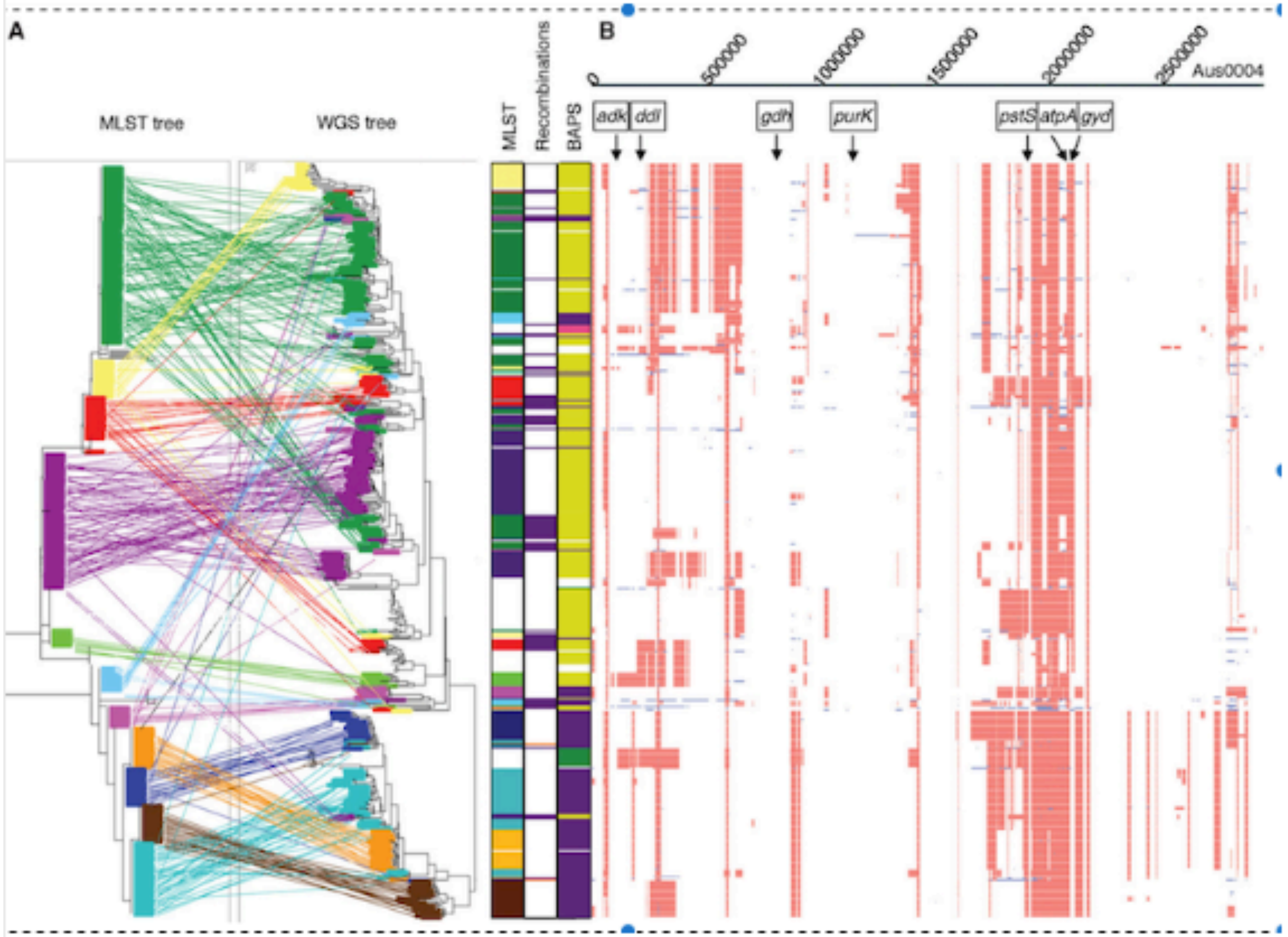
48

Design space axis: Enhancement choices, atop base chart types

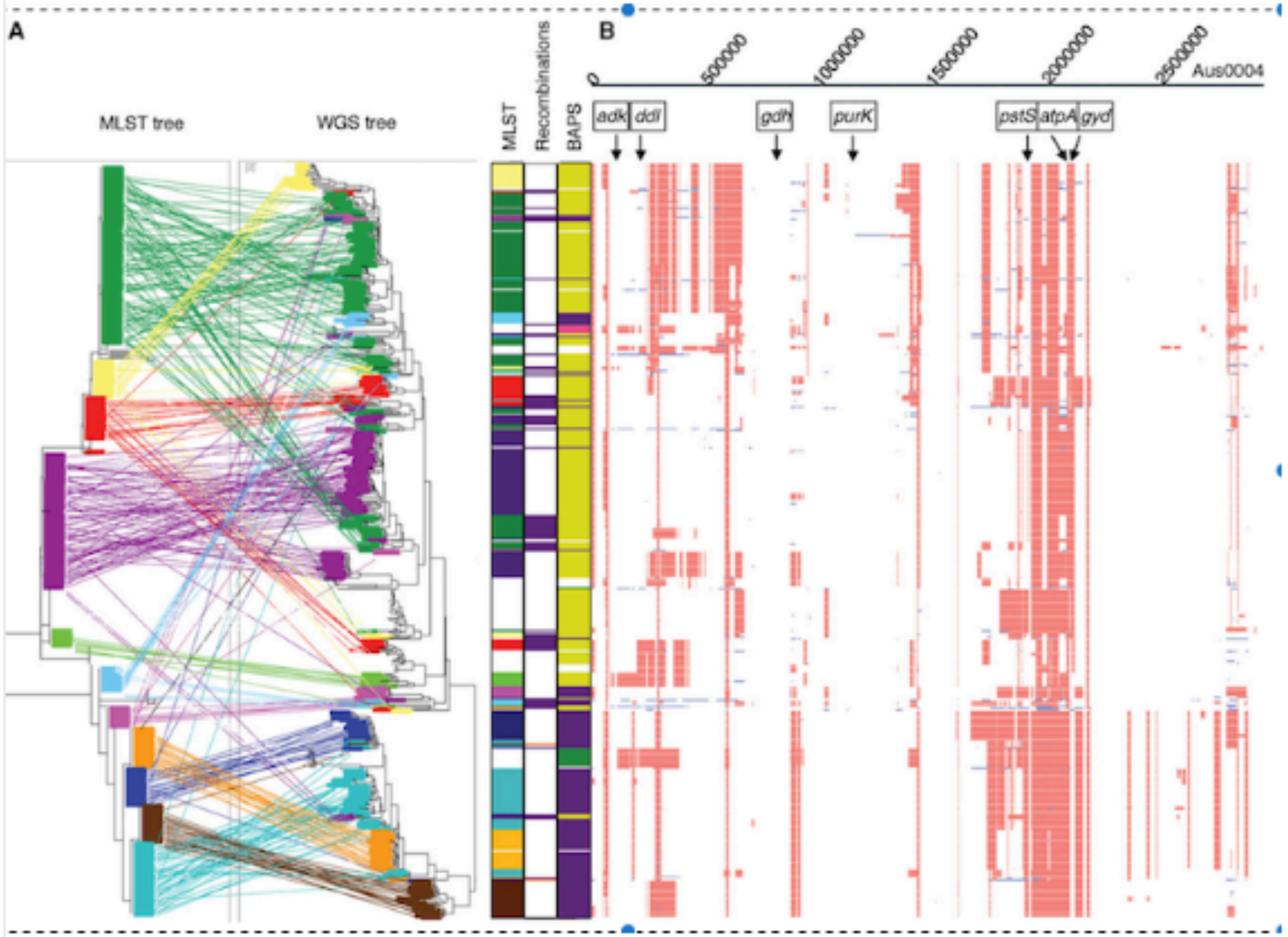


Current Practice >80% of all figures have some enhancement

GEViT example



GEViT example

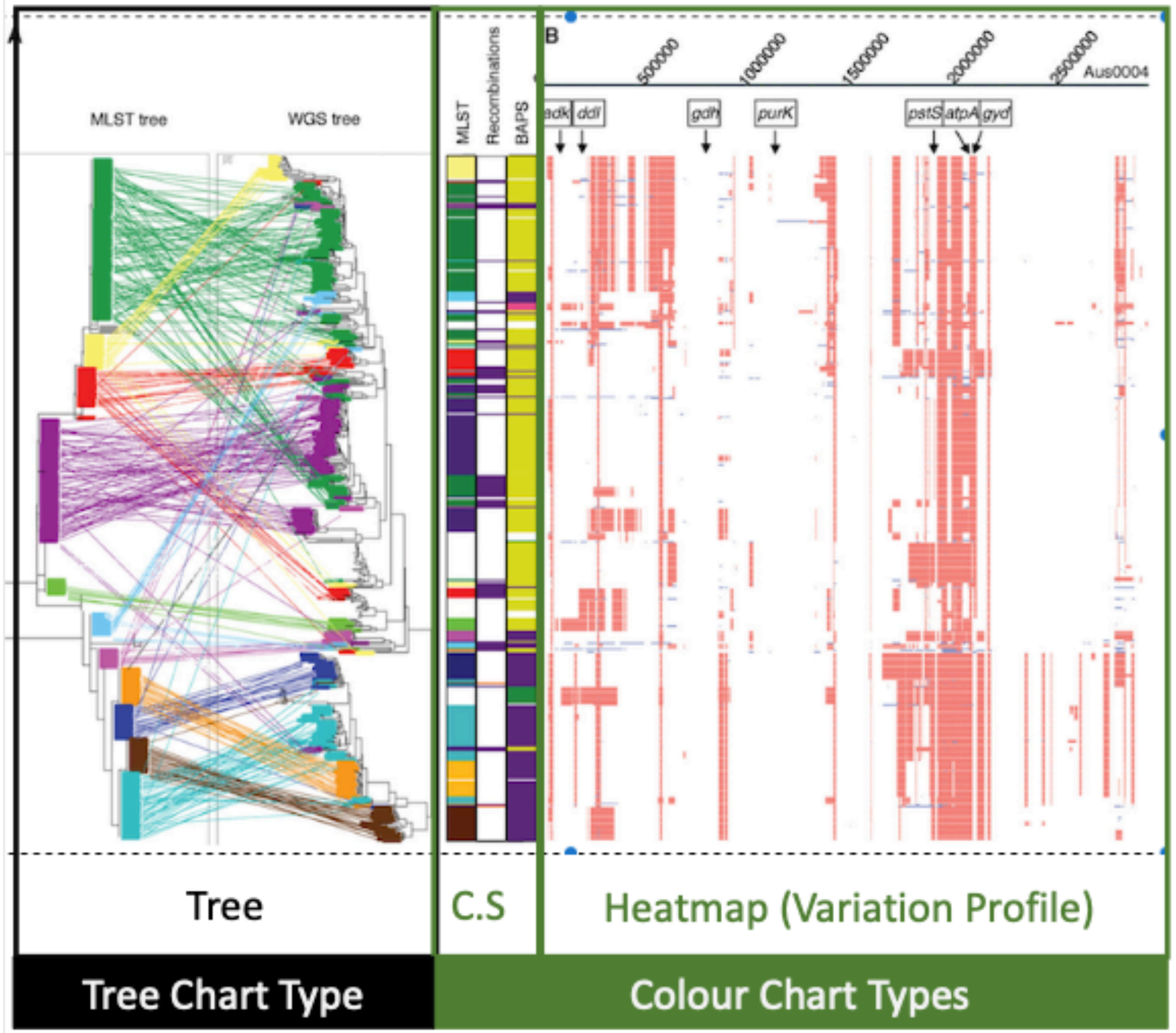


Visualization Breakdown

Literature Analysis **(why)**

- ***Pathogen***: *Enterococcus faecium*

GEViT example



Visualization Breakdown

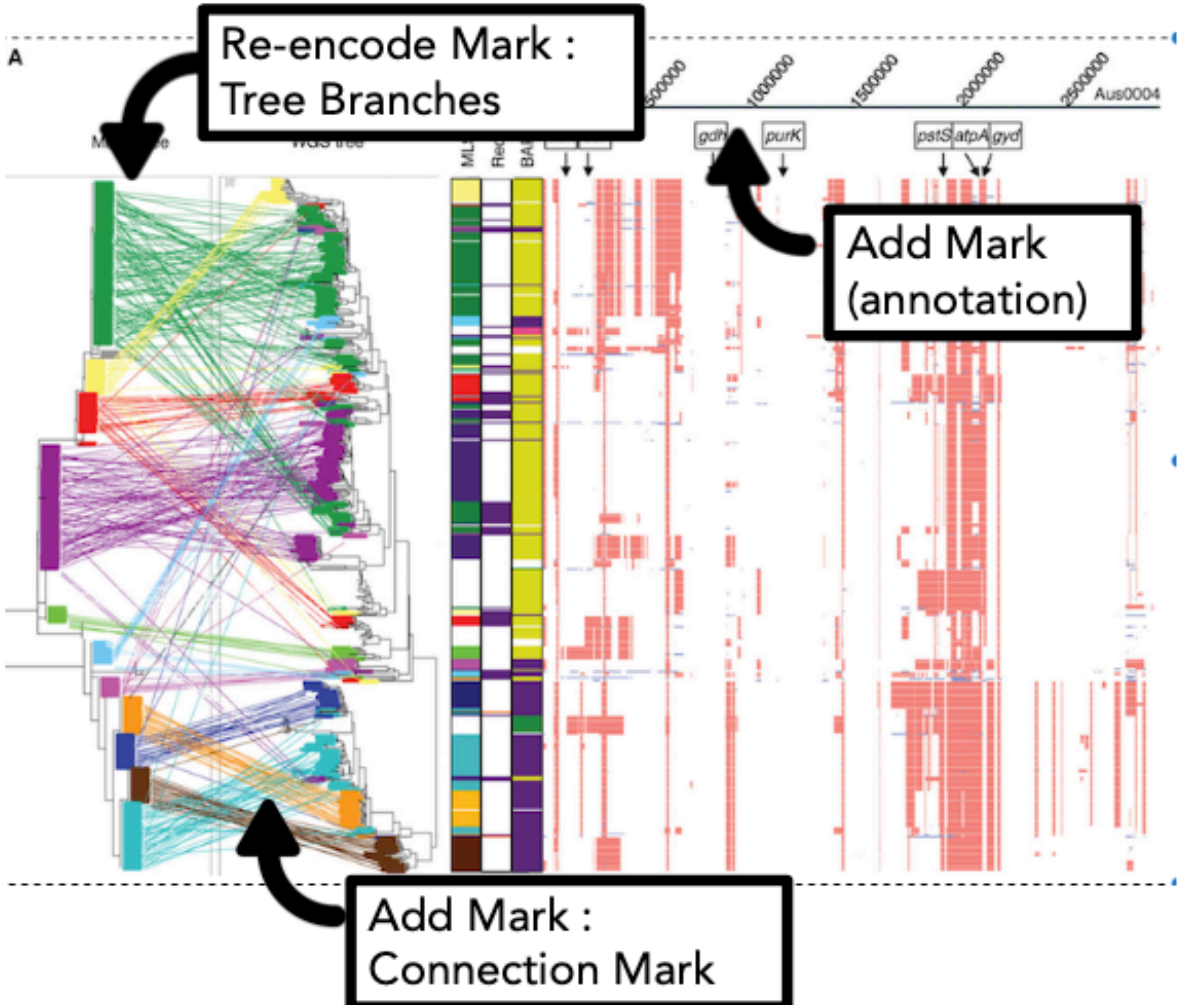
Literature Analysis ***(why)***

- ***Pathogen****: Enterococcus faecium*

Visualization Analysis ***(how)***

Chart Type	Tree (Rooted Phylogenetic Tree) Category Stripe Heatmap (Variation Profile)
Chart Combination	Spatially Aligned (*horizontal)*

GEViT example



Visualization Breakdown

*Literature Analysis (**why**)*

- ***Pathogen**: Enterococcus faecium*

*Visualization Analysis (**how**)*

Chart Type	Tree (Rooted Phylogenetic Tree) Category Stripe Heatmap (Variation Profile)	
Chart Combination	Spatially Aligned (*horizontal*)	
Chart Enhancement	Re-encode Marks	Tree – *branches*
	Add Marks	Tree - *Connection Marks*
	Add Mark (*unstructured*)	Heatmap – *Textboxes*

Assessment

- descriptive power
  - provided common language for describing data visualization in genEpi
  - established gap: **unmet tooling needs**
    - no existing tool handled full complexity of what people do manually
- evaluative power
  - **revealed shortfalls** in practices of some genEpi stakeholders
    - eg overuse of text
- generative power
  - validated in followup GEViTRec work
    - **build** automatic recommender system using domain prevalence design space

GEViTRec:

Data Reconnaissance Through Recommendation Using a Domain-Specific Visualization Prevalence Design Space

Anamaria Crisan
@amcrisan

Shannah Fisher

Jenn Gardy
@jennifergardy

https://github.com/amcrisan/GEVitRec

GEViTRec: Data Reconnaissance Through Recommendation Using a Domain-Specific Visualization Prevalence Design Space.
Crisan, Fisher, Gardy, Munzner. IEEE TVCG 29(12):4855-4872, 2022.

Summary: Multiple design spaces

Design Space	Open Coding Source Material	Sampling Strategy	Reflective Synthesis Timing	Vis Research Literature
timeline visual encoding	standalone timelines	assembled corpus	early	some source material
genEpi visual encoding	figures from papers	stratified random sampling with topic clusters	-	-
wrangling activities	software from repos	diversity criteria	late	terms: light mapping

Summary: Multiple design spaces

Design Space	Descriptive Power	Generative Power	Descriptive vs Generative	Evaluative Power
timeline visual encoding	validated against test set	software implementation of authoring system, used to create example gallery/videos	analysis to characterize viable subset	
genEpi visual encoding	systematic method yields comprehensive coverage	software implementation of automatic recommender (followup)	*same (detailed)*	
wrangling activities	high precision, gaps / divergence found for domain	concise framework (followup implementation TBD)	develop entirely new framework	

Design spaces: How to assess? Larger context: theory types

- Ben Shneiderman, *Designing the User Interface:* descriptive, explanatory, prescriptive, predictive
- Paul Ralph,
  Toward Methodological Guidelines for Process Theories & Taxonomies in Software Engineering, IEEE TSE 2020
  - theory types
    - theories for **understanding**: organizing what is happening into useful categories (taxonomies)
    - **process** theories: how something happens (often taxonomies++)
    - **variance** theories: why something happens, causal relationships between constructs
      - predictive
  - relevant criteria for taxonomies
    - **yes**: parsimony, transferability, theoretical saturation
    - **sometimes**: utility, originality, resonance/believability, testability
    - **no**: statistical generalizability, construct validity, internal validity, conclusion validity

design studies

Two design studies

- facilities management

- biology

Michael Oppermann

Ocupado

Visualizing Location-Based Counts Over Time Across Buildings

http://www.cs.ubc.ca/labs/imager/tr/2020/ocupado/

Ocupado: Visualizing Location-Based Counts Over Time Across Buildings.

Oppermann and Munzner. Computer Graphics Forum (Proc. EuroVis 2020) 39(3):127-138 2020.

Location-Based Counts

Previous measurement required physical counting or installation of additional hardware.

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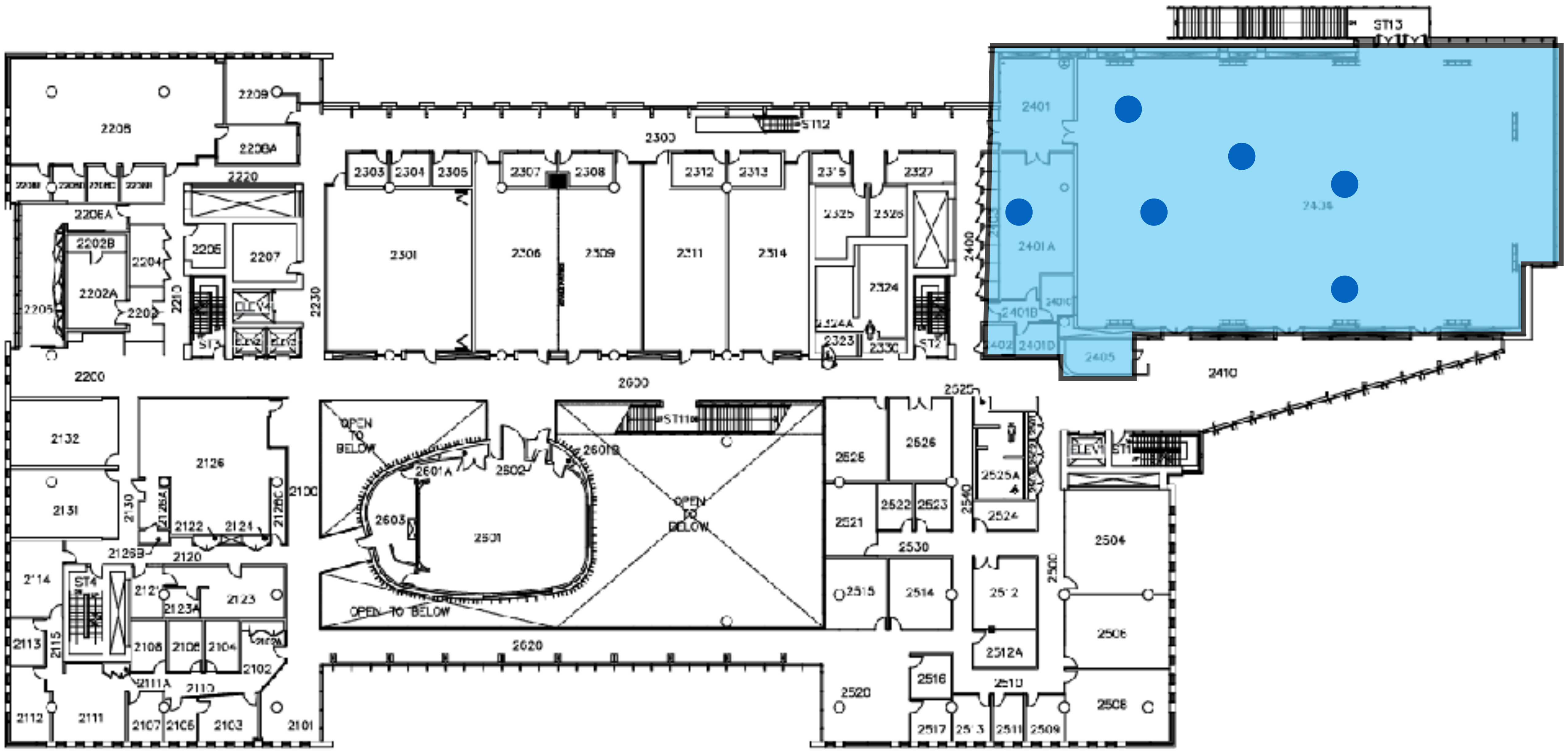
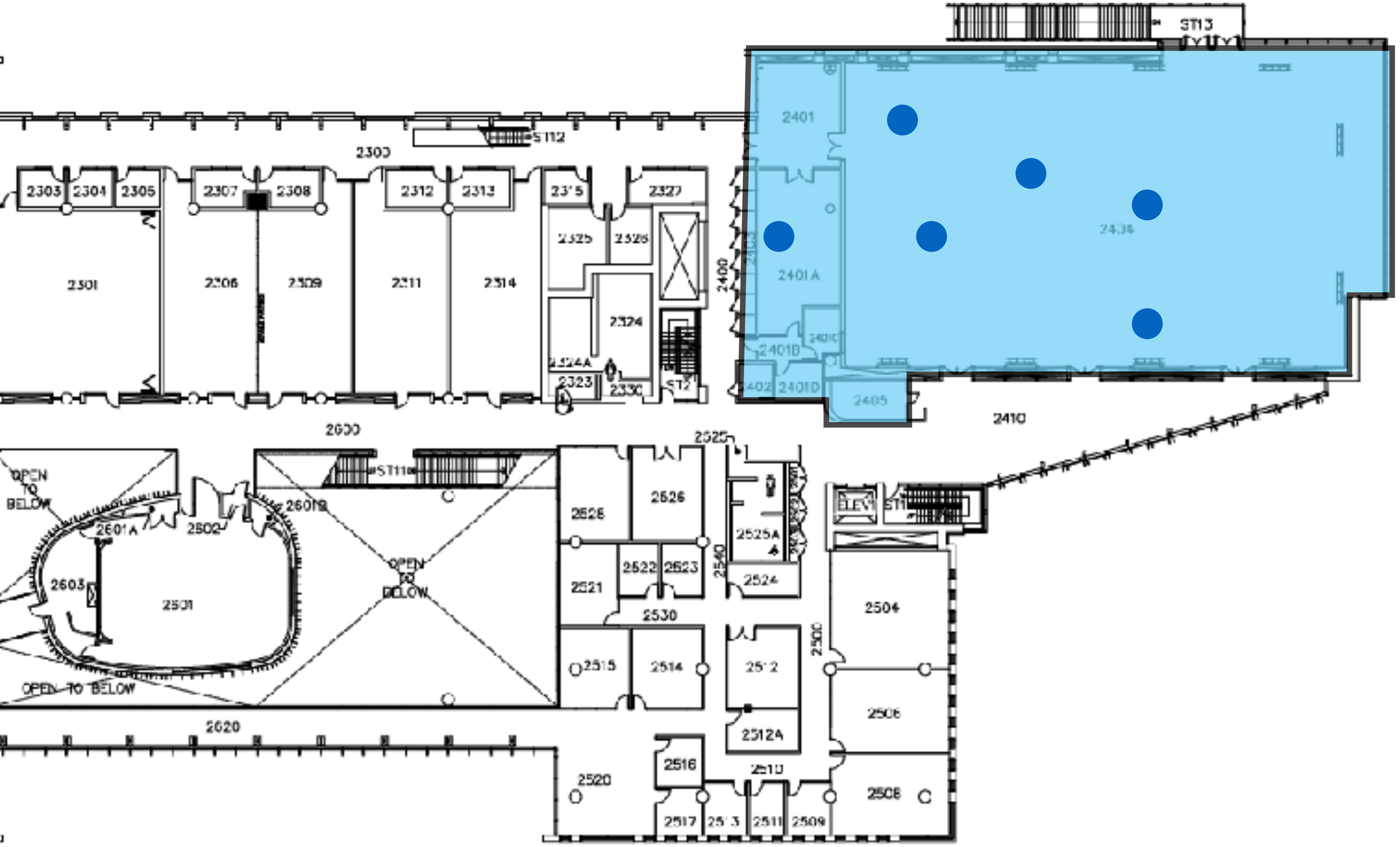
Previous visualization attempts were limited in space and time.

Design Study

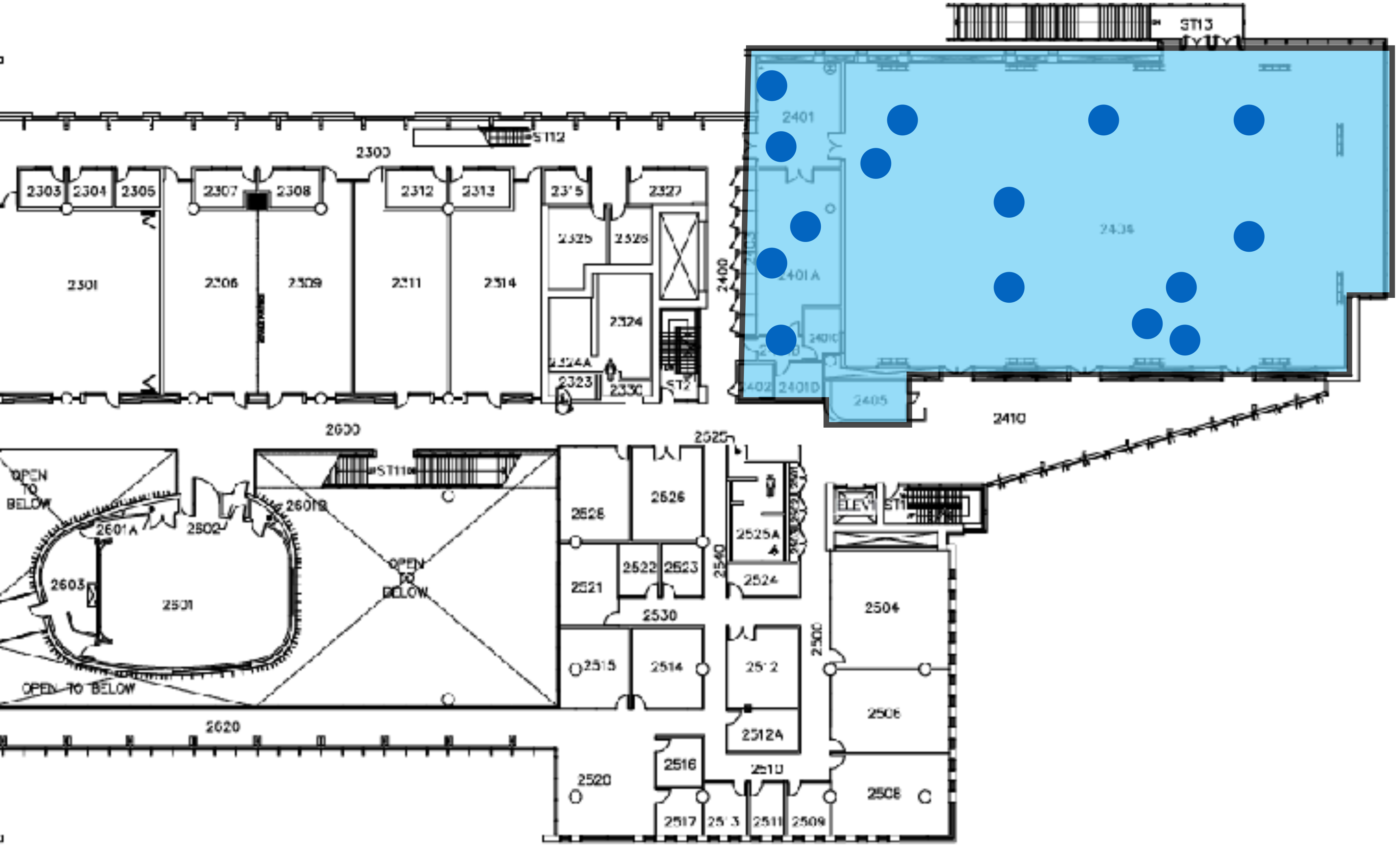
WiFi Connections: Location-Based Counts

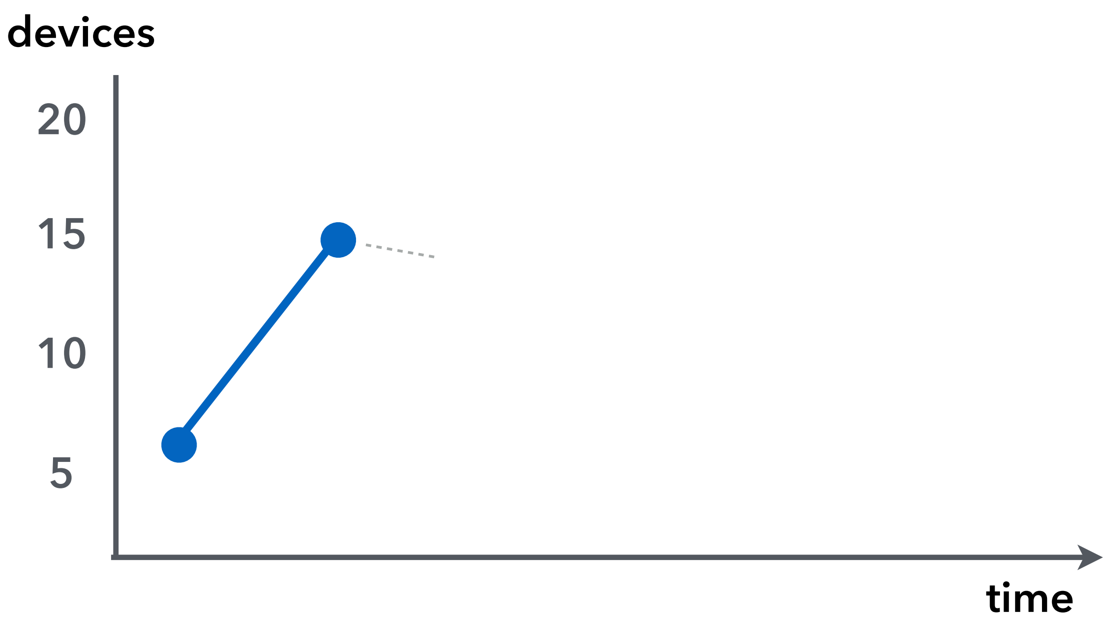


WiFi Connections: Location-Based Counts



WiFi Connections: Location-Based Counts





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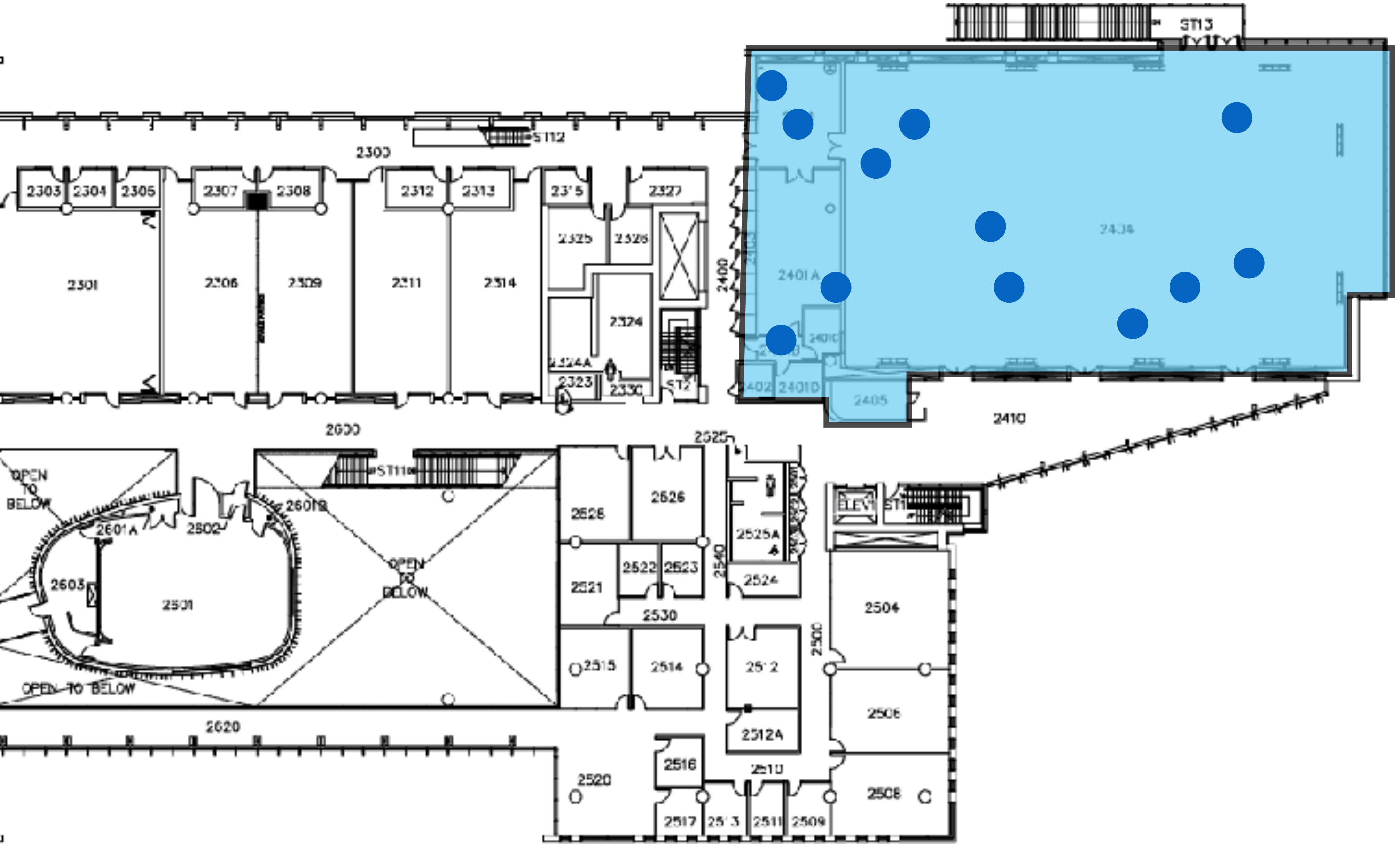

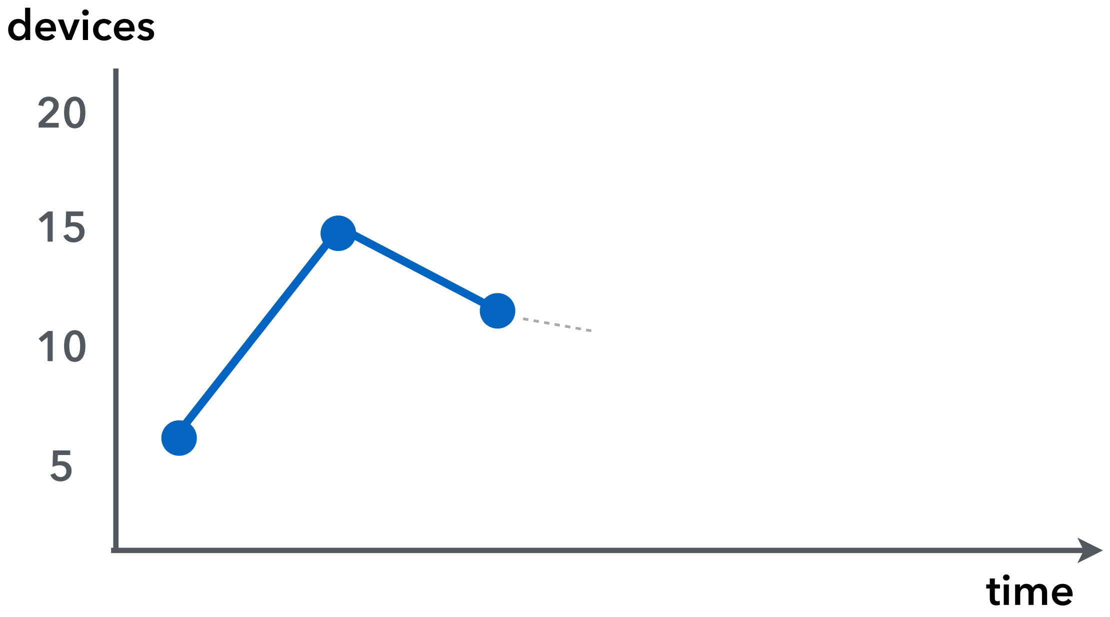

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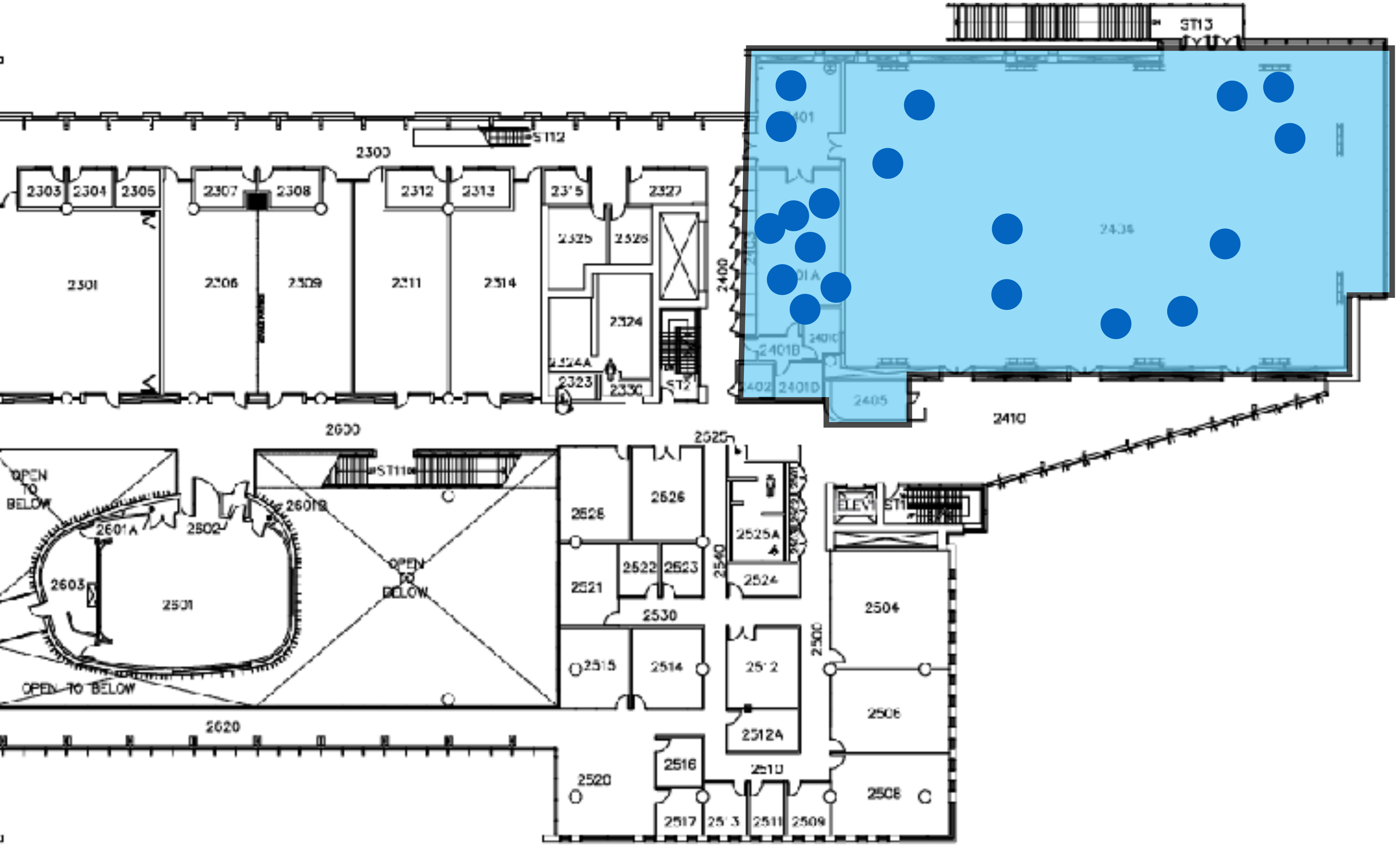
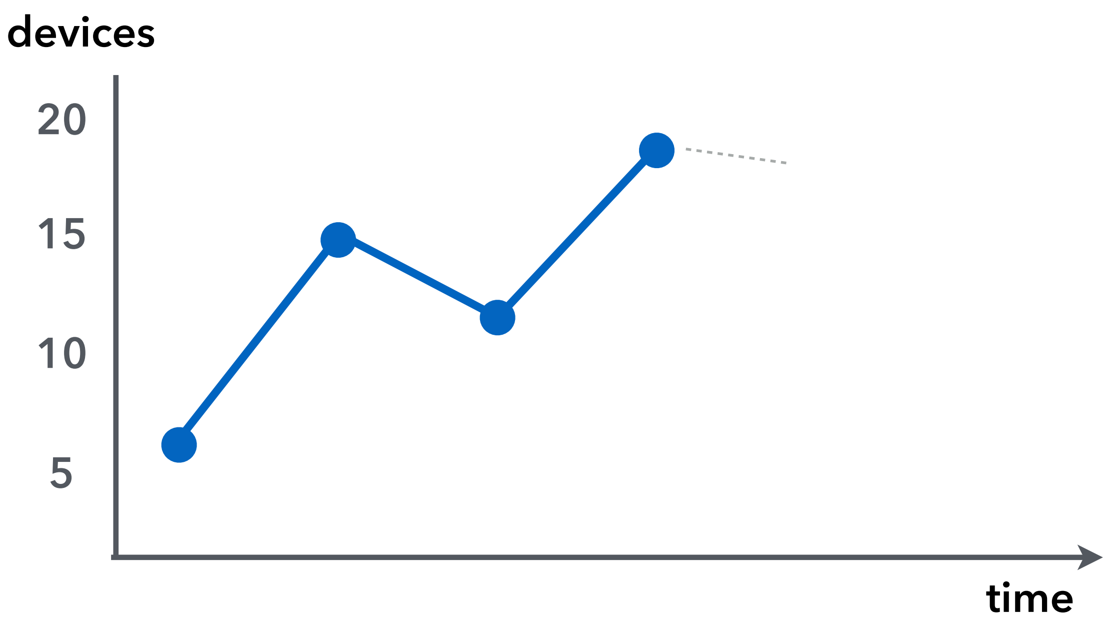
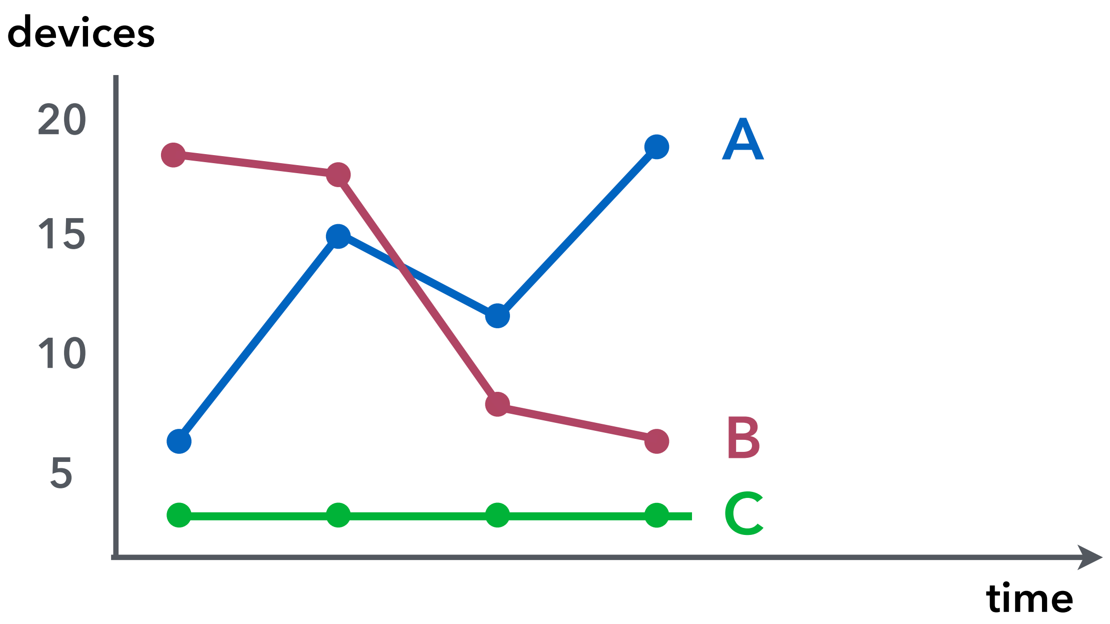




WiFi Connections: Location-Based Counts



WiFi Connections: Location-Based Counts

Location-Based Counts

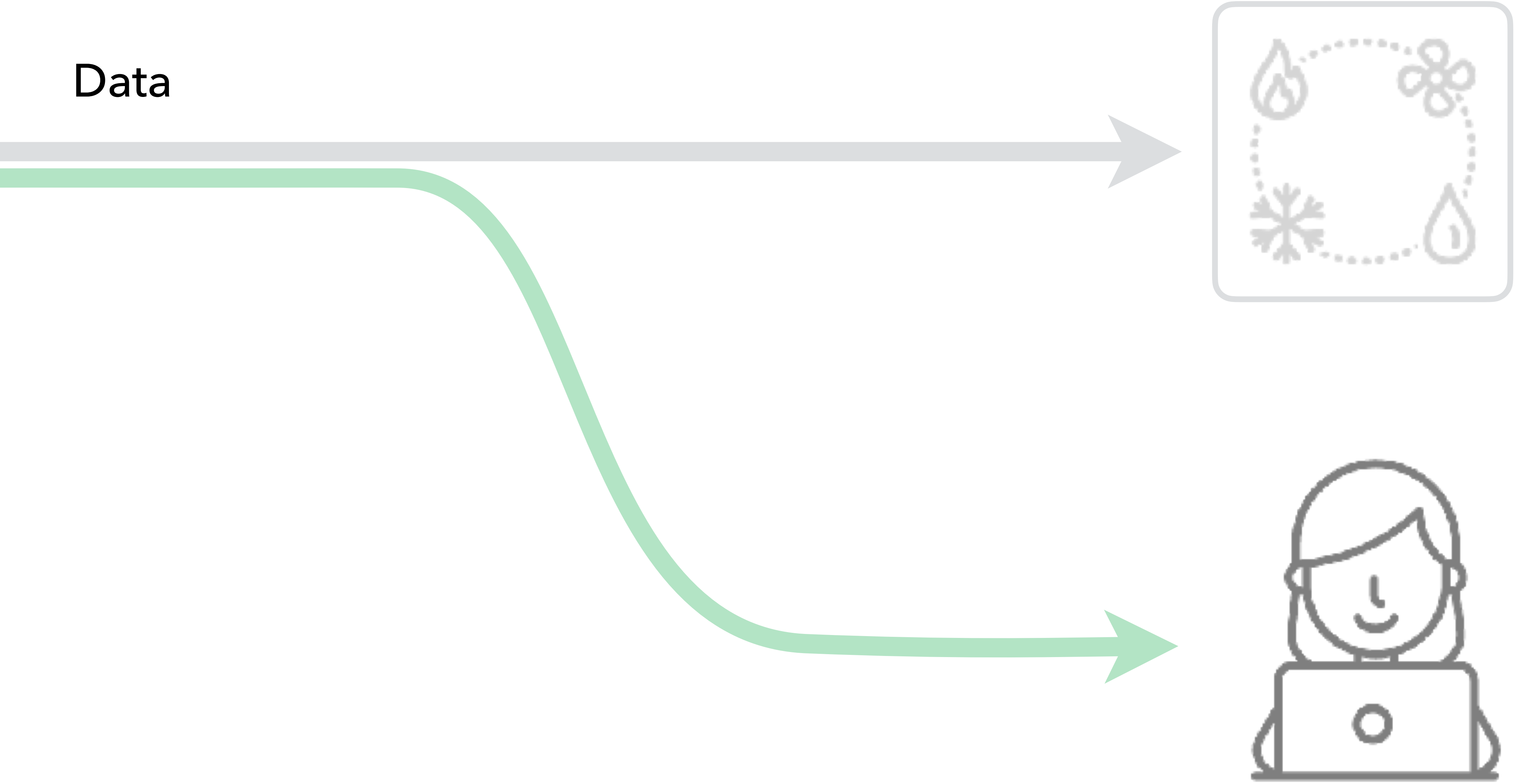
- Regular intervals (e.g., every 5 minutes)
- Spatial hierarchy (Zone → Floor → Building → Campus)
- No trajectories or device identifiers are recorded
- Intrinsic privacy advantages

Data

Automated HVAC control

Data

Data

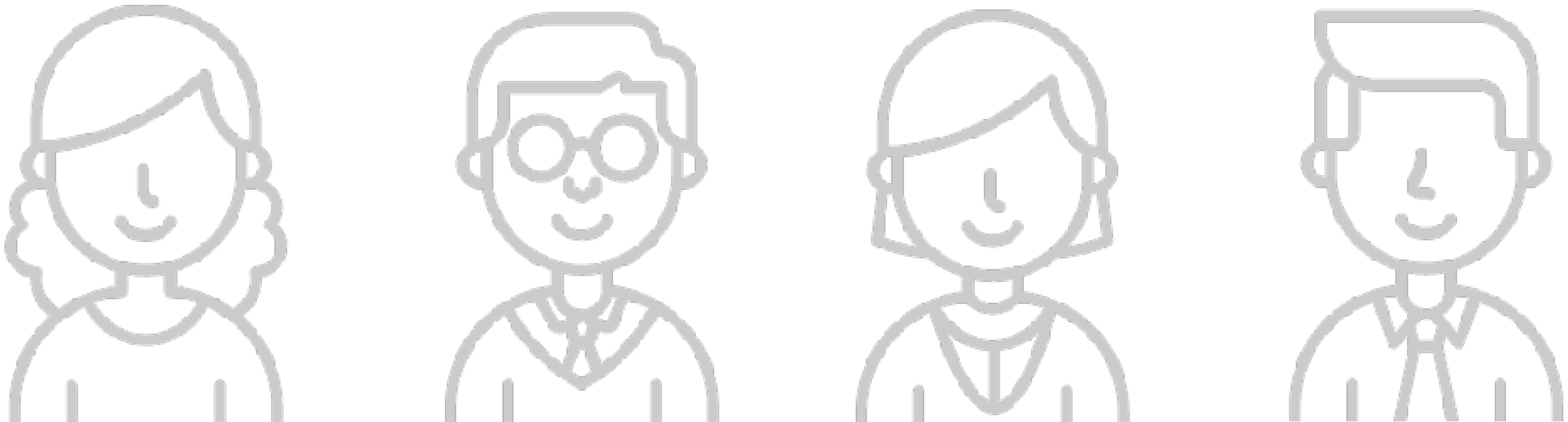


Decision making

WiFi connections as a proxy for occupancy

WiFi connections as a proxy for occupancy

Interviews with potential stakeholders



Focus Domains

- Space planning
- Building management
- Custodial services
- Classroom management
- Data quality control

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- Space planning
- Building management
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- Classroom management
- Data quality control

Semi-structured discussions and live demos

Tasks

Confirm assumptions or previous observations.

Do students occupy room x in evenings or on weekends?

Tasks

- ☑ **Confirm** assumptions or previous observations.
- ☑ **Monitor** the current/recent utilization rate.
  Which rooms are empty/busy?

Tasks

- **Confirm** assumptions or previous observations.
- **Monitor** the current/recent utilization rate.
- **Communicate** space usage and justify decisions.
  Space usage improved after renovation.

Tasks

- **Confirm** assumptions or previous observations.
- **Monitor** the current/recent utilization rate.
- **Communicate** space usage and justify decisions.
- **Validate** the data (quality control).
  Check minimum size of a room that can be captured.

Spatial and Temporal Data Granularities

Visualization Prototypes

Sandbox

Data sketches,
static data export

Time

Visualization Prototypes

Sandbox

Data sketches,
static data export

- original plan: different interface for each stakeholder
- realization: task & data abstractions match multiple stakeholders
  - if slice by space & time granularity

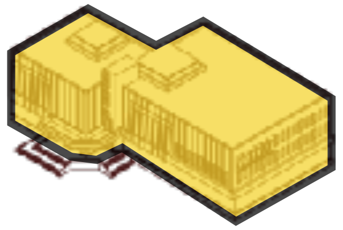
Spatial and Temporal Data Granularities

Regions of interest

Zone

Floor

Building



Spatial and Temporal Data Granularities

Regions of interest

Zone

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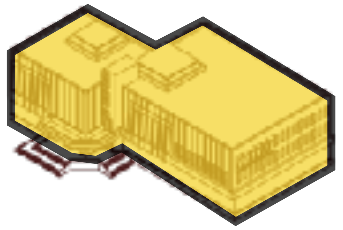
Building



Periods of interest

Mondays

Weekdays

last 12 hours

Summer term

Fr 8-10am

Weekends

Visualization Prototypes

Sandbox

Data sketches,
static data export

Campus Explorer

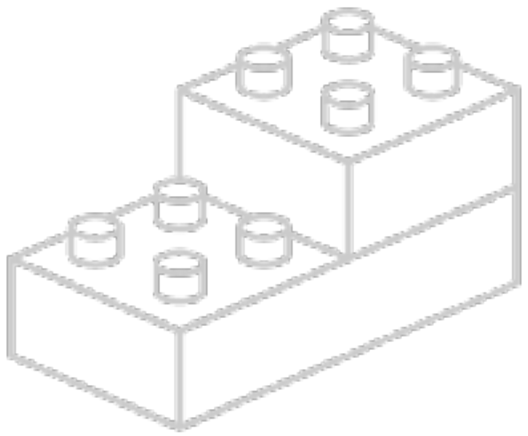
Live-data stream,
cross-building analysis

Building Recent

Building Long-term

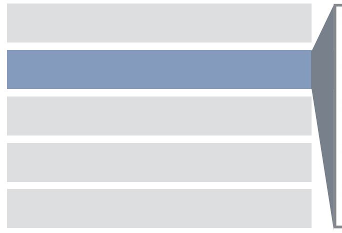
Region Compare

Time

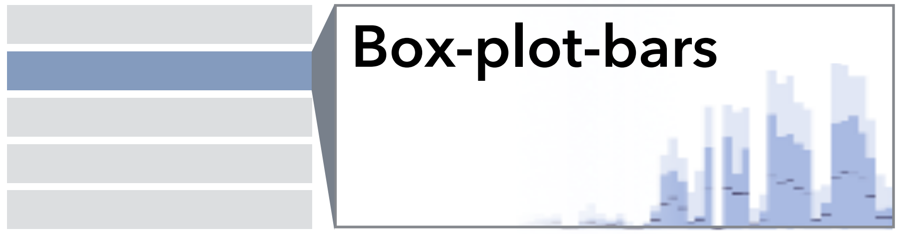


Reusable Visualization Components

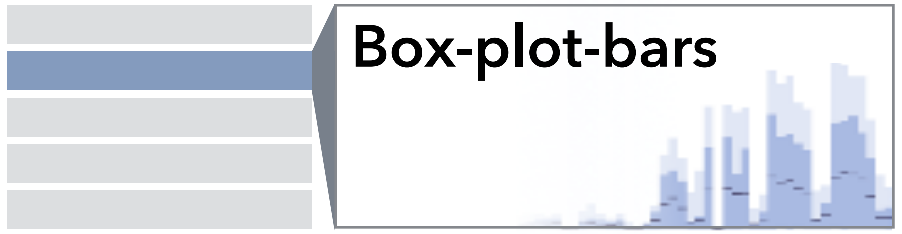
Reusable Visualization Components

Layout	Visual Encoding	Facet	Comparisons
	**Sparkline** 	Juxtaposition	Repeating patterns, trends, outliers (contiguous)

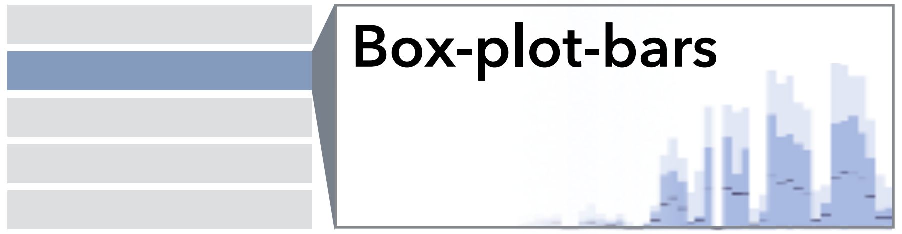
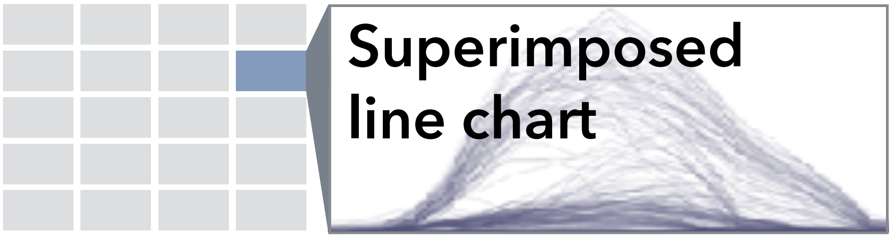
Reusable Visualization Components

Layout	Visual Encoding	Facet	Comparisons
	**Sparkline**	Juxtaposition	Repeating patterns, trends, outliers (contiguous)
	**Box-plot-bars**	Juxtaposition	Repeating patterns, trends, outliers *(non-contiguous)*

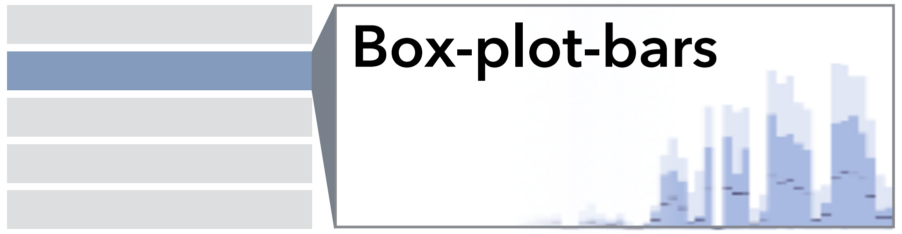
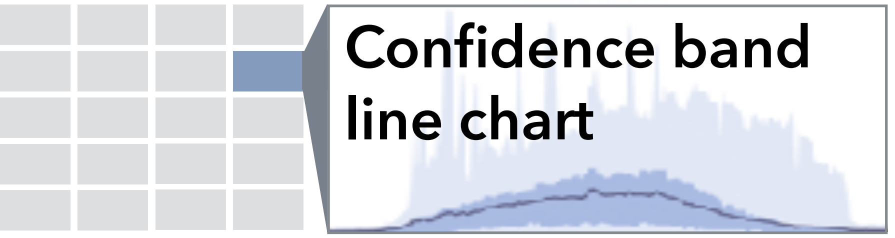
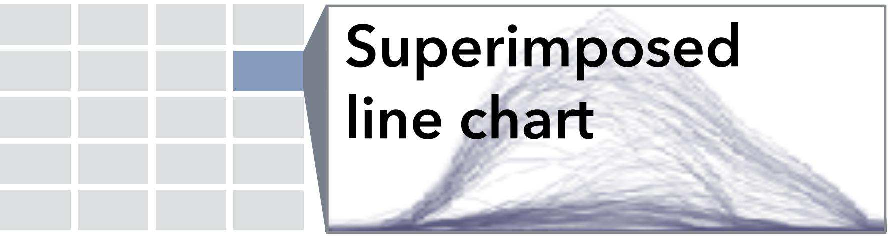
Reusable Visualization Components

Layout	Visual Encoding	Facet	Comparisons
	**Sparkline**	Juxtaposition	Repeating patterns, trends, outliers (contiguous)
	**Box-plot-bars**	Juxtaposition	Repeating patterns, trends, outliers *(non-contiguous)*
	**Confidence band line chart**	Aggregation	Typical utilization profiles

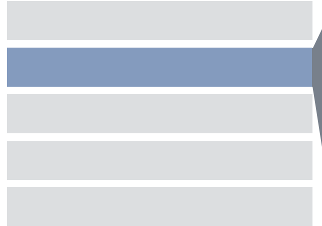
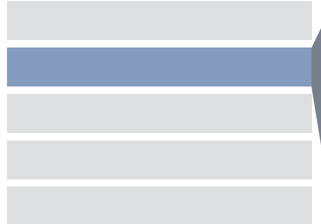
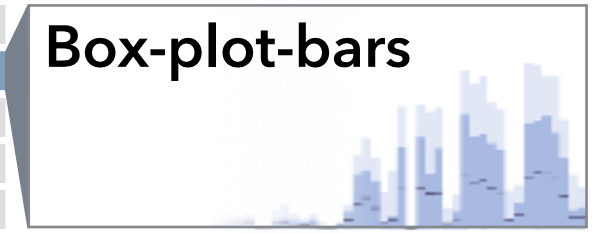
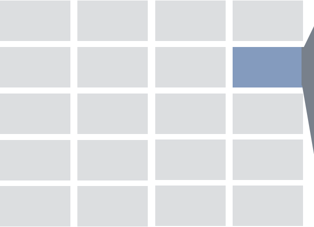
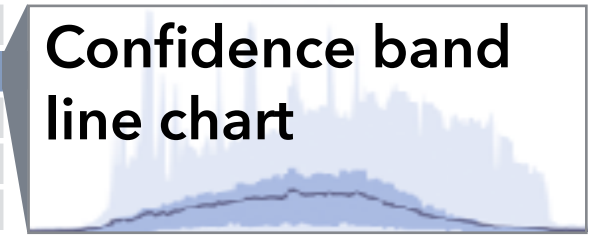
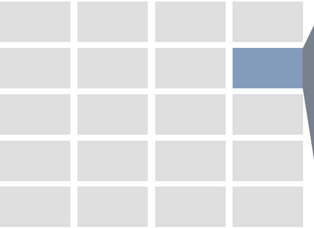
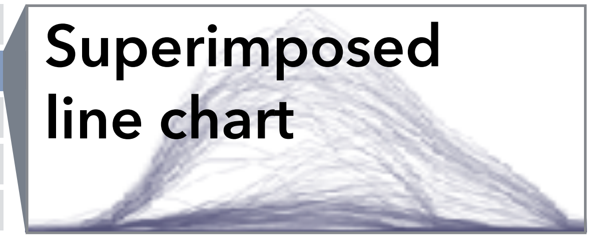
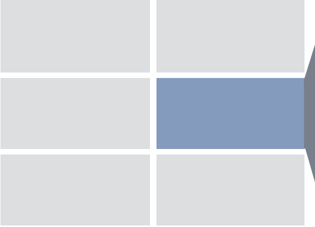
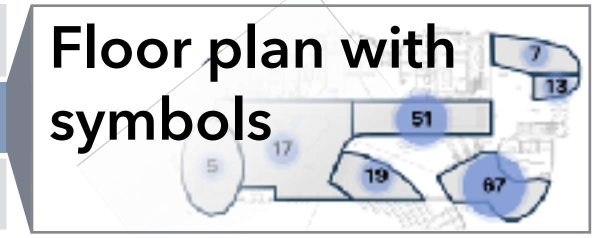
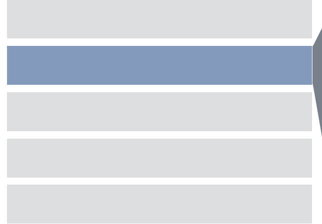
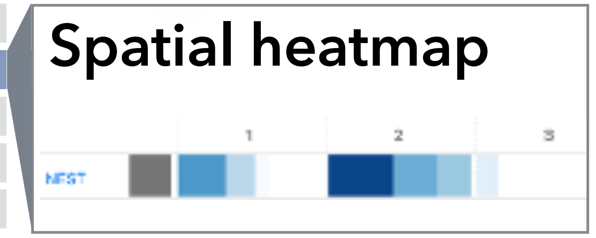
Reusable Visualization Components

Layout	Visual Encoding	Facet	Comparisons
	**Sparkline**	Juxtaposition	Repeating patterns, trends, outliers (contiguous)
	**Box-plot-bars**	Juxtaposition	Repeating patterns, trends, outliers *(non-contiguous)*
	**Confidence band line chart**	Aggregation	Typical utilization profiles
	**Superimposed line chart**	Superposition	Within-session patterns, outliers

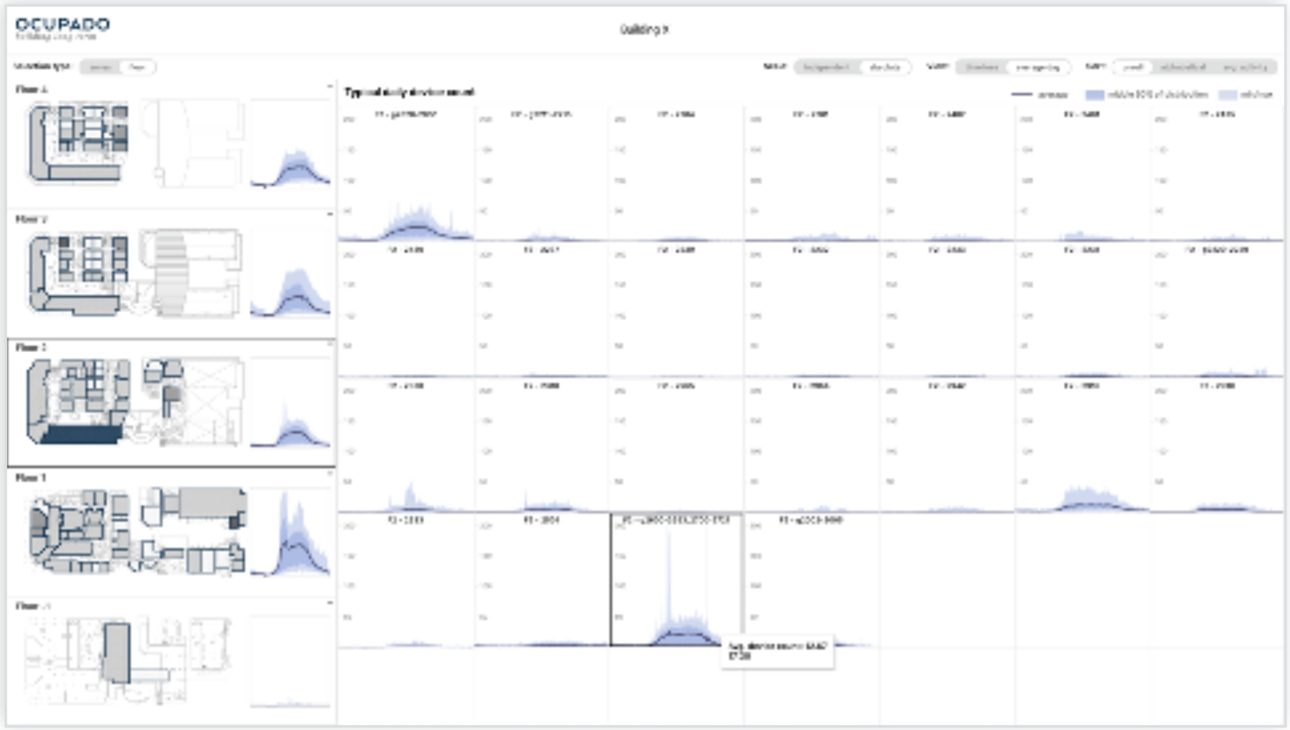
Reusable Visualization Components

	Layout / Visual Encoding	Facet	Comparisons
Temporal	 **Sparkline**	Juxtaposition	Repeating patterns, trends, outliers (contiguous)
	 **Box-plot-bars**	Juxtaposition	Repeating patterns, trends, outliers *(non-contiguous)*
	 **Confidence band line chart**	Aggregation	Typical utilization profiles
	 **Superimposed line chart**	Superposition	Within-session patterns, outliers

Reusable Visualization Components

	Layout	Visual Encoding	Facet	Comparisons
Temporal		**Sparkline** 	Juxtaposition	Repeating patterns, trends, outliers (contiguous)
		**Box-plot-bars** 	Juxtaposition	Repeating patterns, trends, outliers *(non-contiguous)*
		**Confidence band line chart** 	Aggregation	Typical utilization profiles
		**Superimposed line chart** 	Superposition	Within-session patterns, outliers
Spatial		**Floor plan with symbols** 	Superposition	Within local spatial neighborhood
		**Spatial heatmap** 	Containment (nested)	Across distributed regions

Ocupado Interfaces



Campus Explorer

Ocupado Contributions

- Analysis and abstraction of data and tasks for studying space utilization
- Ocupado, a set of visual decision support tools
- Generalizable design choices for visualizing non-trajectory spatiotemporal data relating to large-scale indoor environments

Two design studies

- facilities management

- biology

Zipeng Liu

Shing Hei Zhan

Aggregated Dendrograms

for Visual Comparison Between Many Phylogenetic Trees

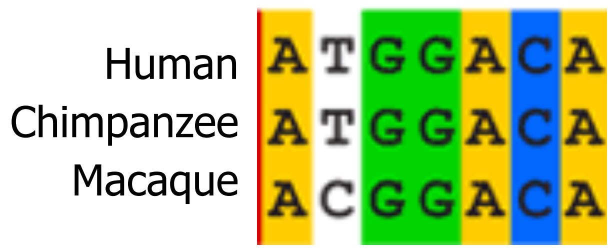
http://www.cs.ubc.ca/labs/imager/tr/2019/adview

Aggregated Dendrograms for Visual Comparison Between Many Phylogenetic Trees.

Liu, Zhan, Munzner. IEEE Trans. Visualization and Computer Graphics (TVCG) 26(9):2732-2747, 2019.

Phylogenetic tree

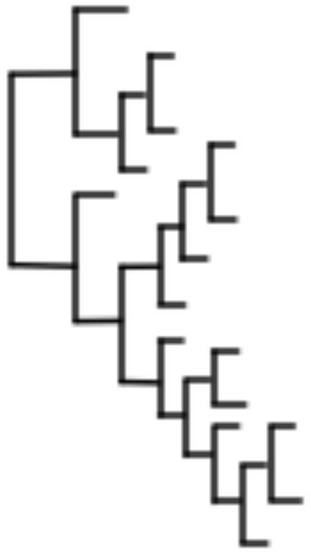
Evolutionary relationships of organisms



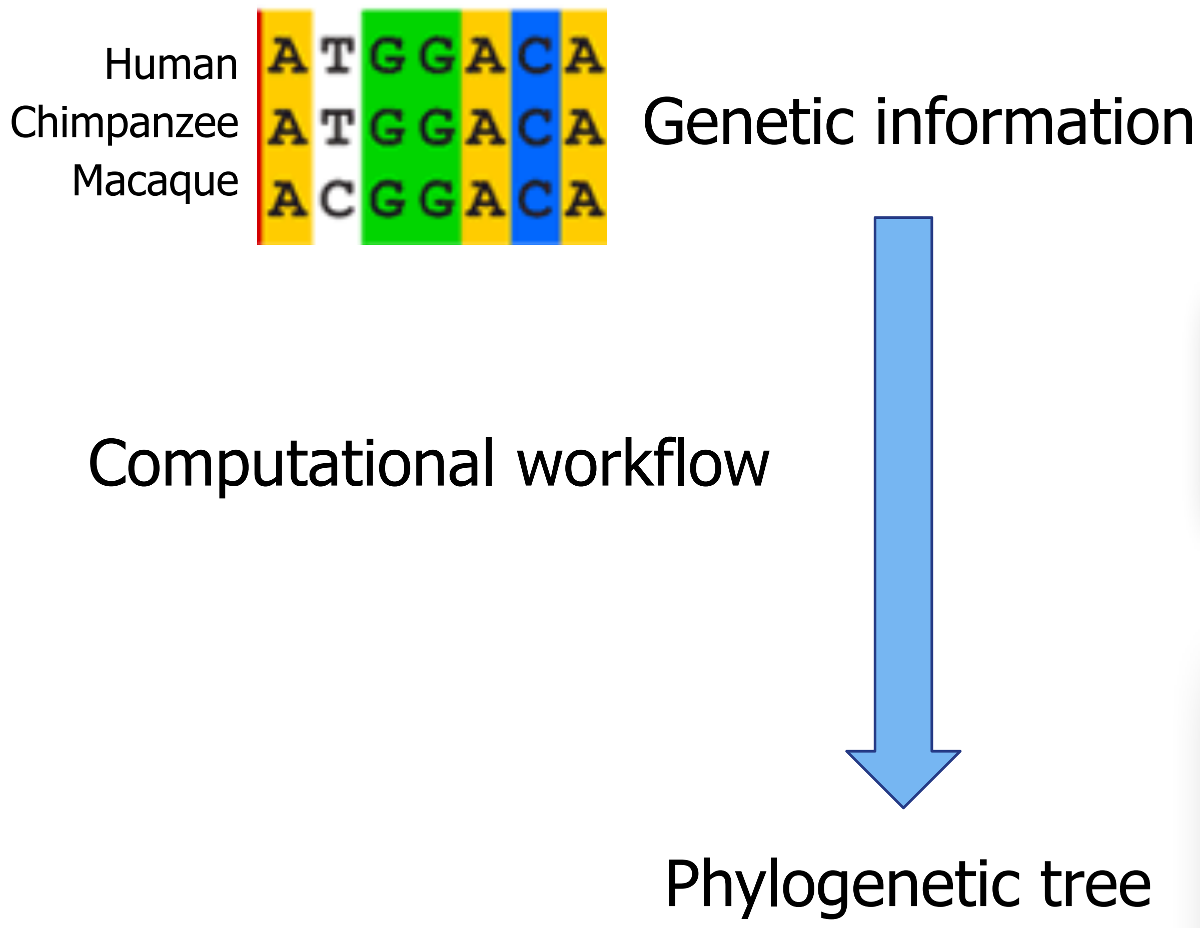
Genetic information

Computational workflow

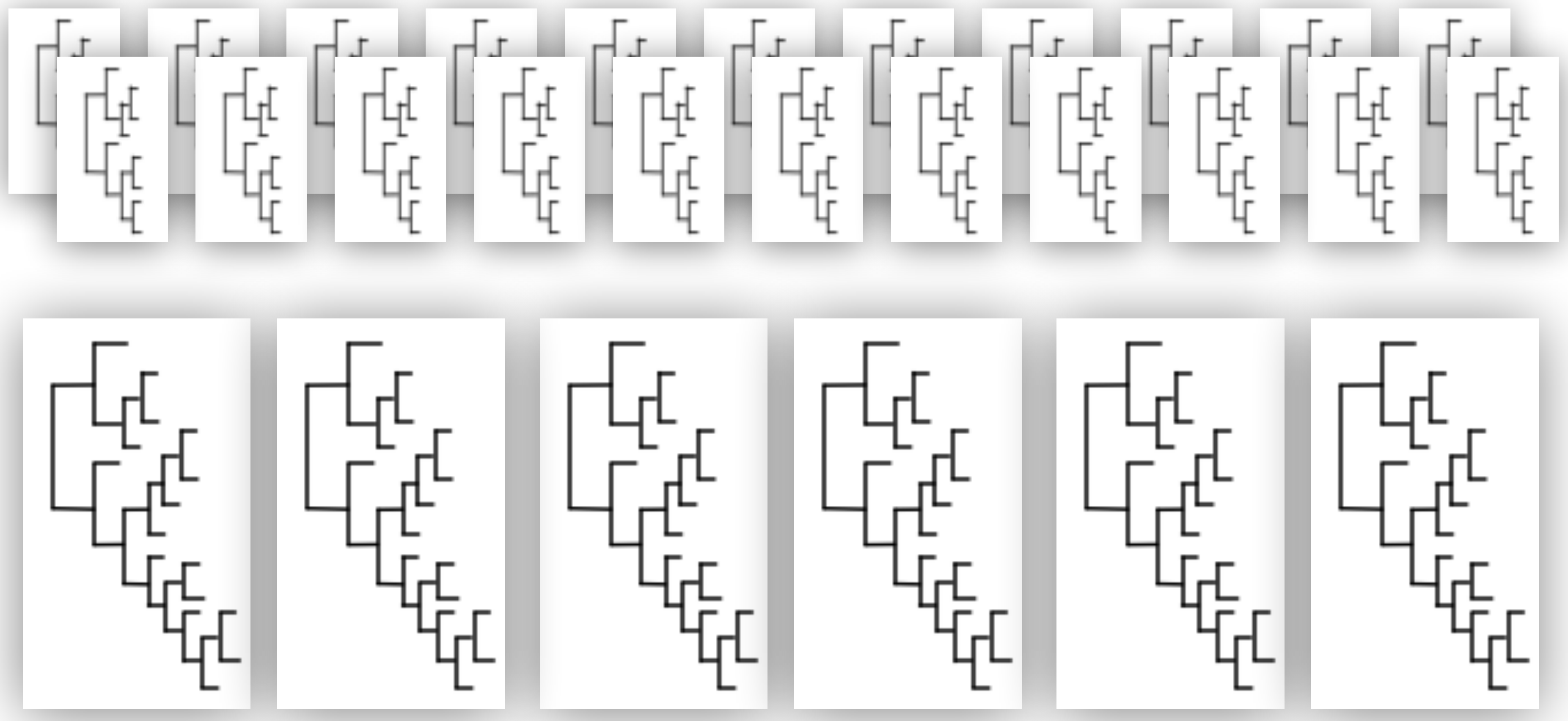
Phylogenetic tree



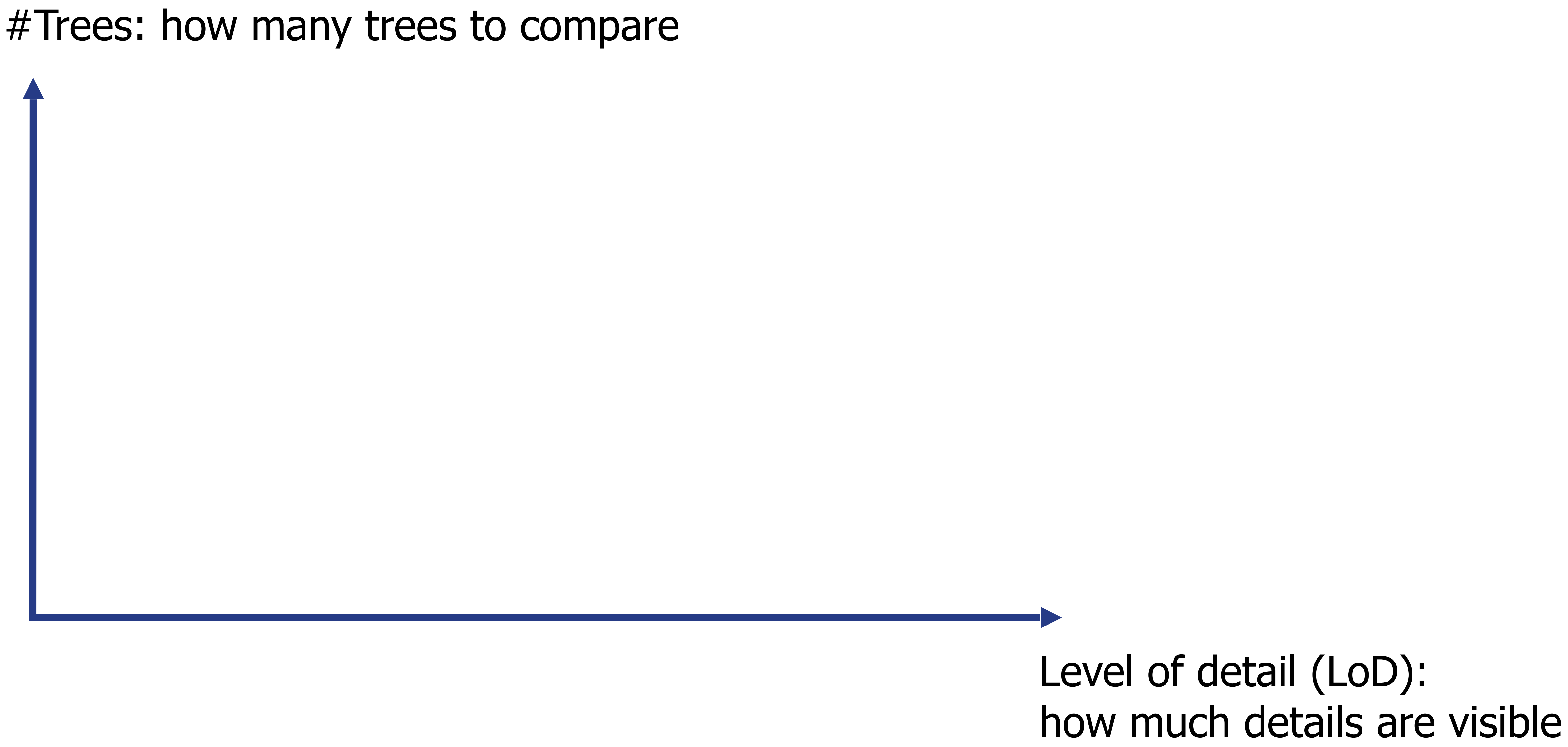
Many phylogenetic trees



- Understand relationships between genes and species trees
- Explore trees generated with different methods and data



Scalability of Existing Tree Comparison Systems



Scalability of Existing Tree Comparison Systems

#Trees: how many trees to compare

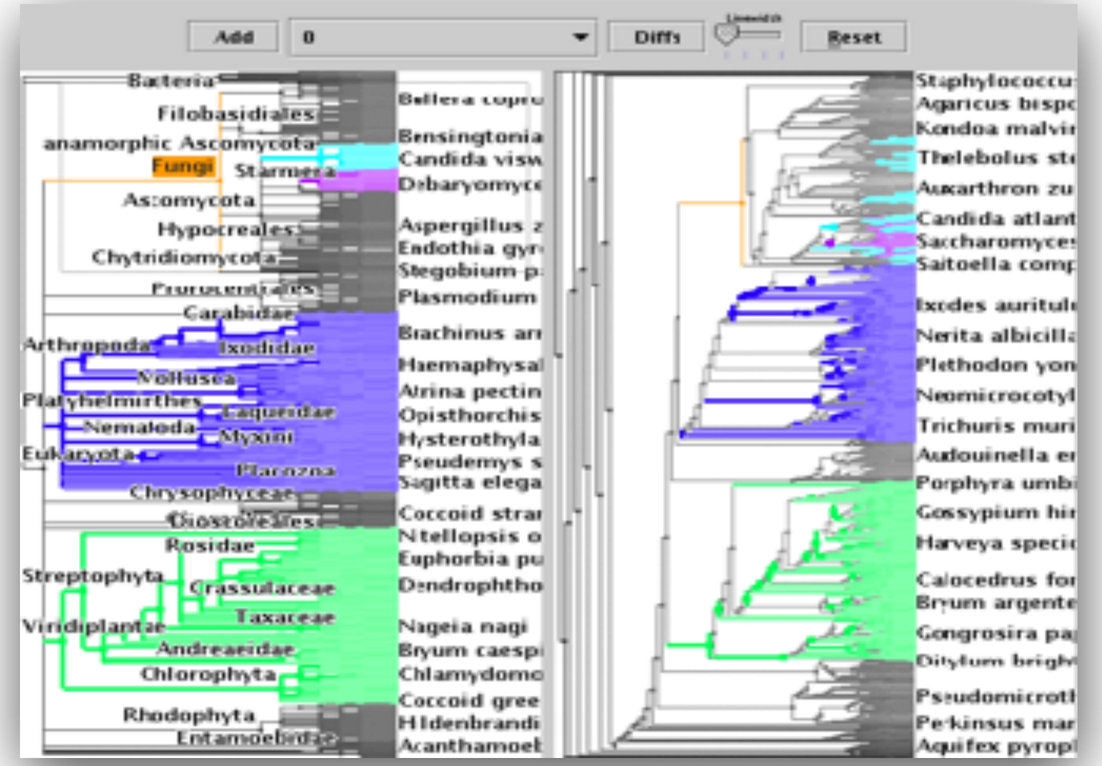
Pairs

Few in full

Simplified structure

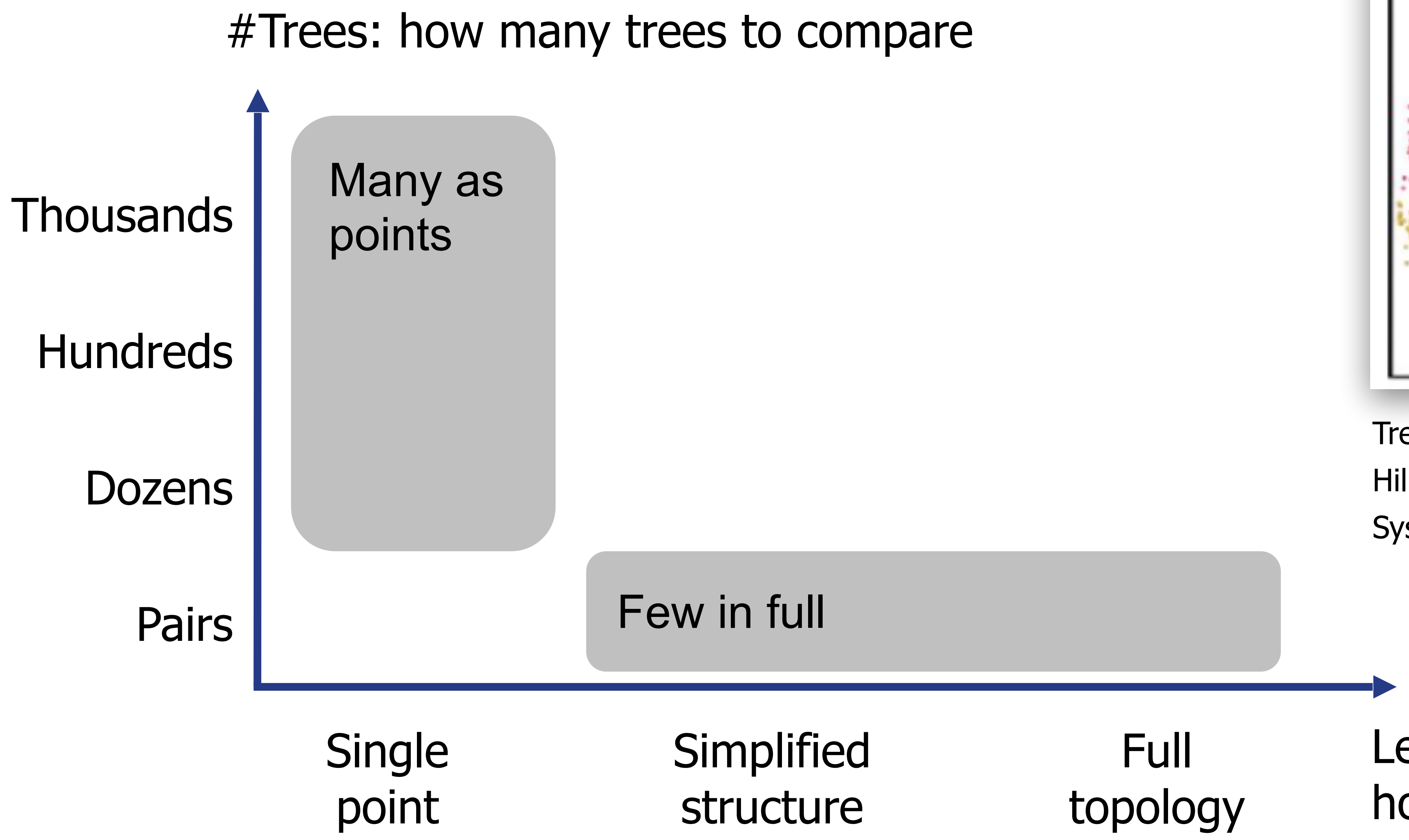
Full topology

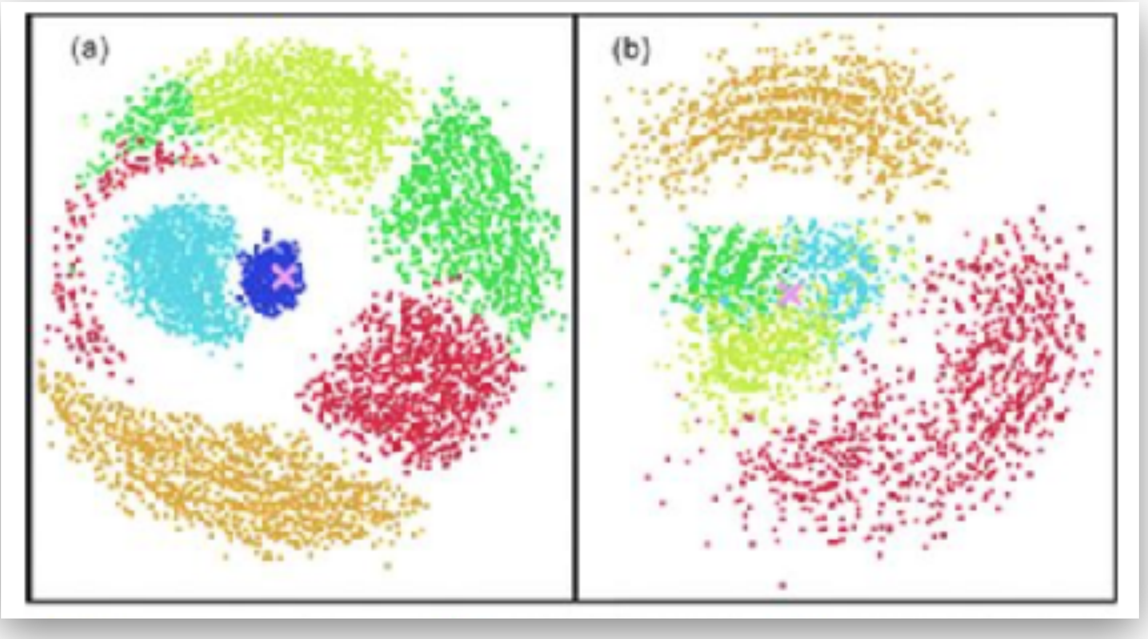
Level of detail (LoD):
how much details are visible



TreeJuxtaposer.
Munzner, Guimbretière, Zhang, Zhou.
SIGGRAPH 2003

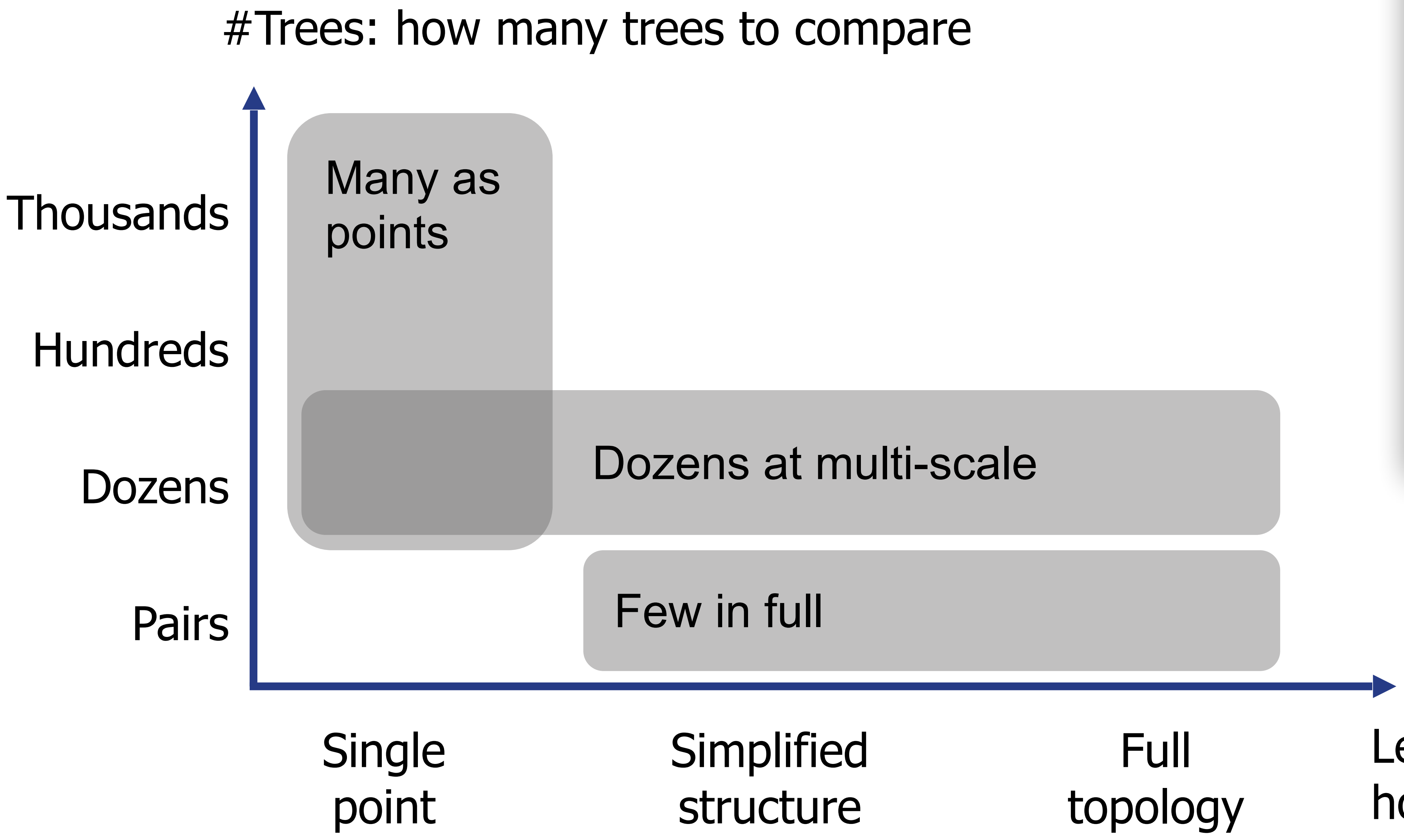
Scalability of Existing Tree Comparison Systems

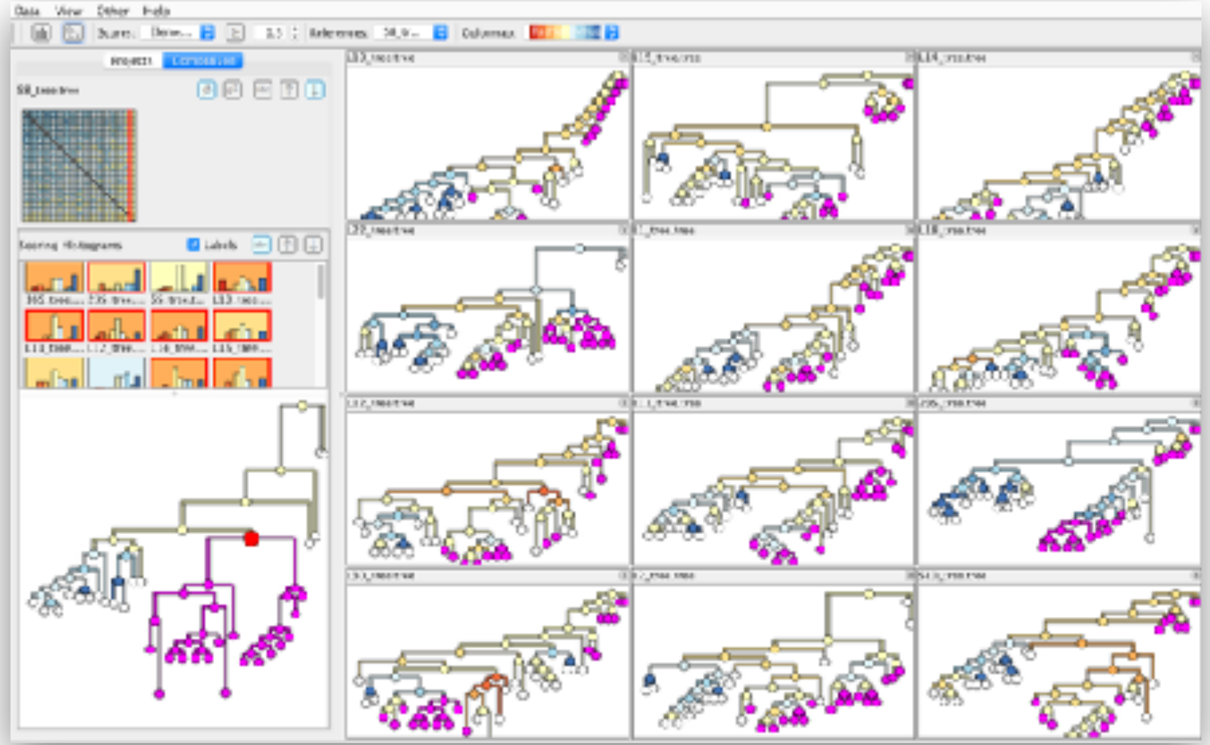




Tree space.
Hillis, Health, John.
Systematic Biology 2005.

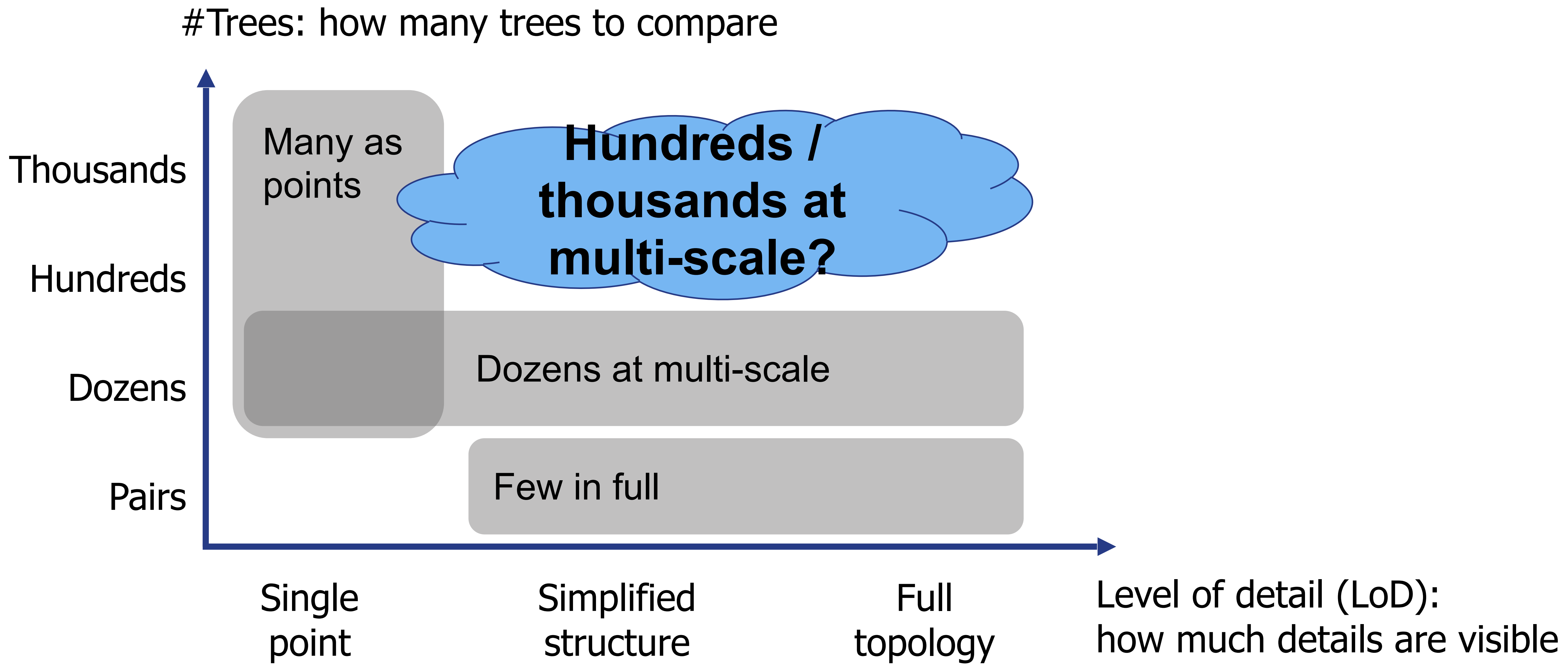
Scalability of Existing Tree Comparison Systems





Interactive visual comparison of multiple trees.
Bremm, Landesberger, Heß, Schreck, Weil, Hamacher.
VAST 2011.

Comparing many phylogenetic trees

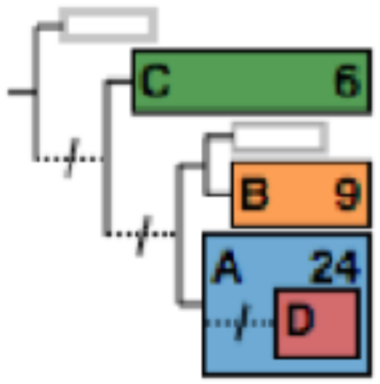


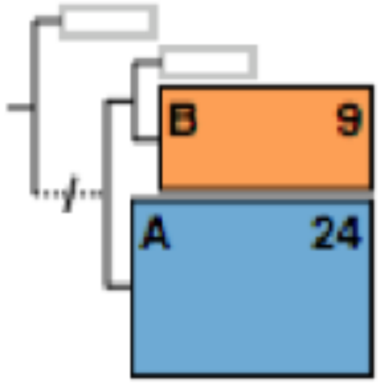
Contributions include idiom & algorithm levels

- Data and task abstractions for comparison of phylogenetic trees

Contributions include idiom & algorithm levels

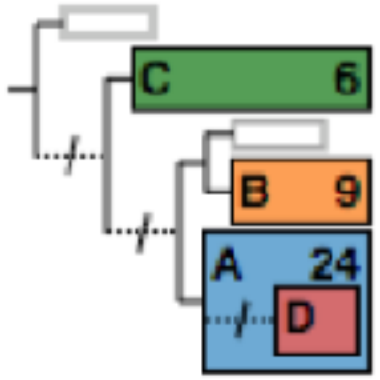
- Data and task abstractions for comparison of phylogenetic trees
- A new visual encoding: **Aggregated Dendrogram**
  - Compact tree representation that focuses on selected subtrees
  - Adapts to available screen space

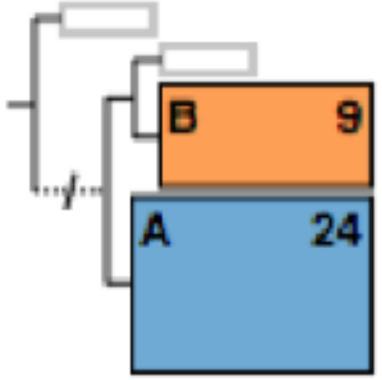




Contributions include idiom & algorithm levels

- Data and task abstractions for comparison of phylogenetic trees
- A new visual encoding: **Aggregated Dendrogram**
  - Compact tree representation that focuses on selected subtrees
  - Adapts to available screen space
- A multi-view interactive tool: **ADView**
  - Covers multiple levels of details for tree comparison



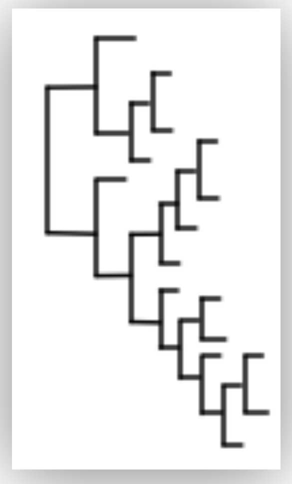


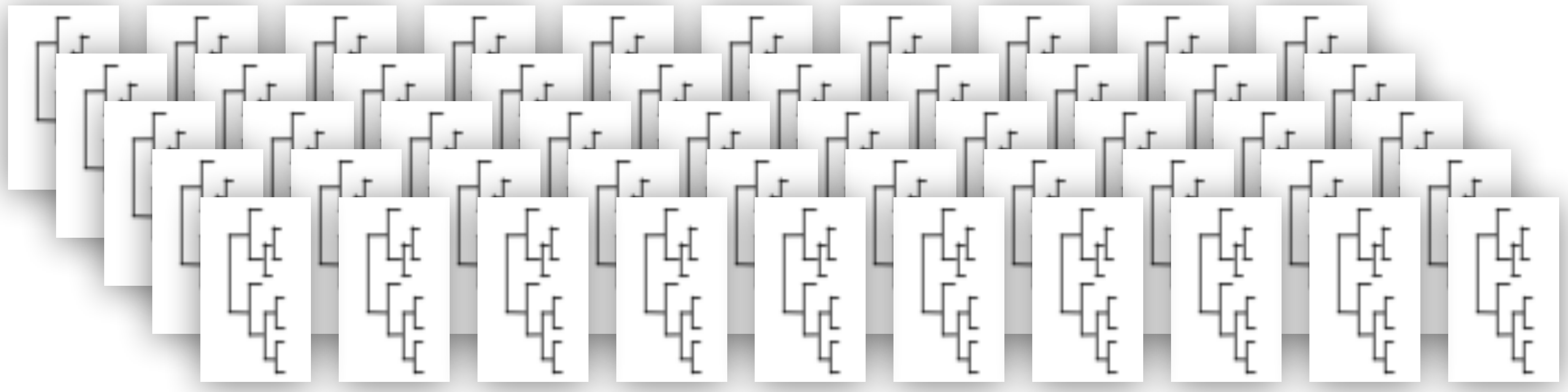
Data & Tasks

- Tree data
- Two crucial tasks

Tree data

Reference tree vs. Tree collection



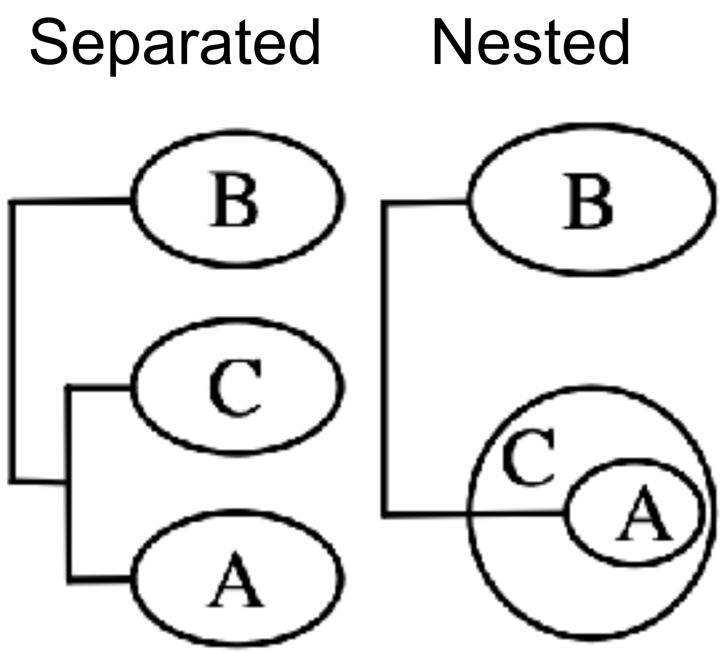


Two crucial tasks

Topological relationships between subtrees / leaf nodes

Two crucial tasks

Topological relationships between subtrees / leaf nodes

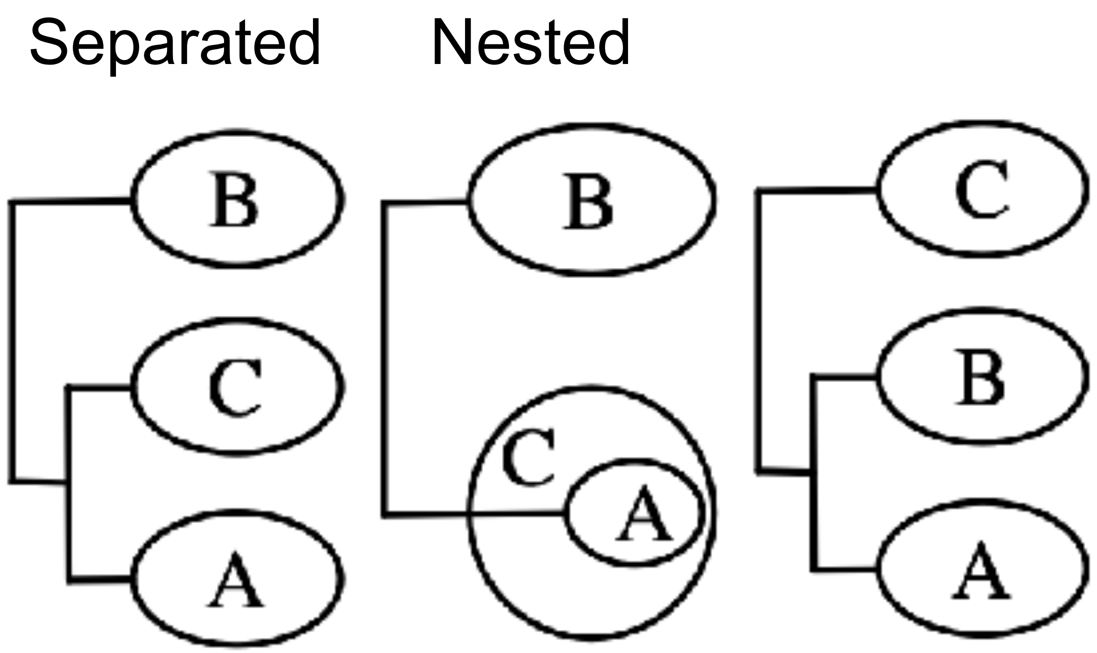


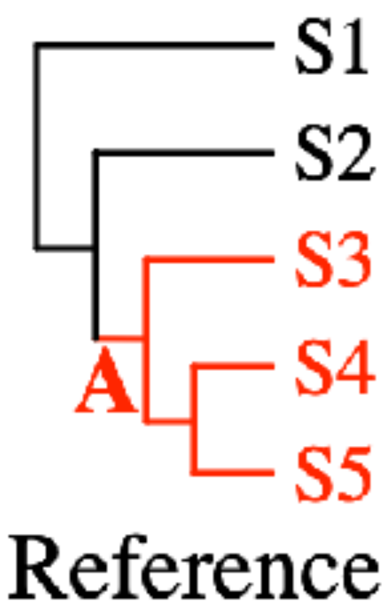
Two crucial tasks

Topological relationships between subtrees / leaf nodes

- Topological distance

Leaf node memberships compared to reference tree





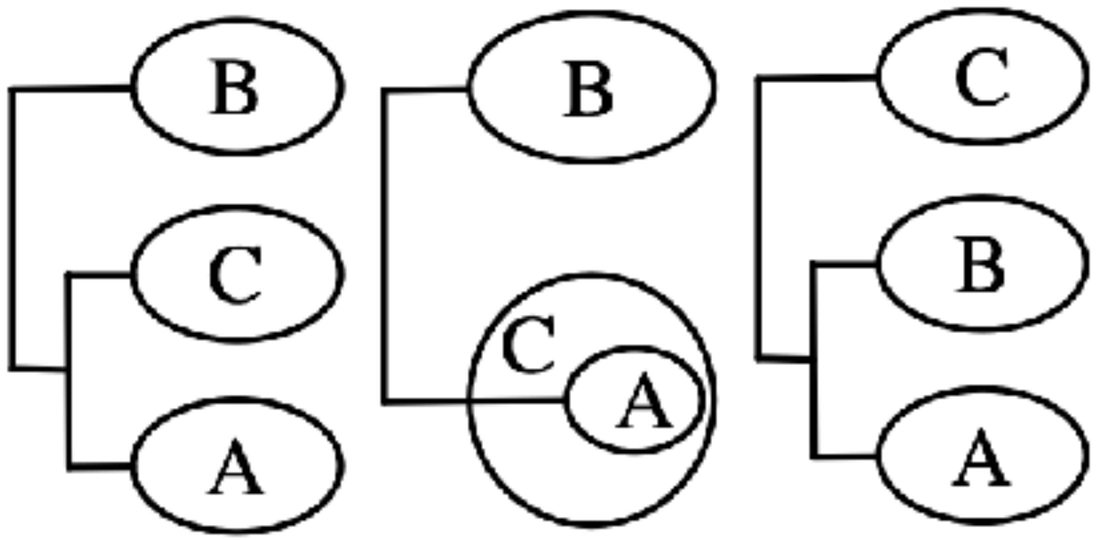
Two crucial tasks

Topological relationships between subtrees / leaf nodes

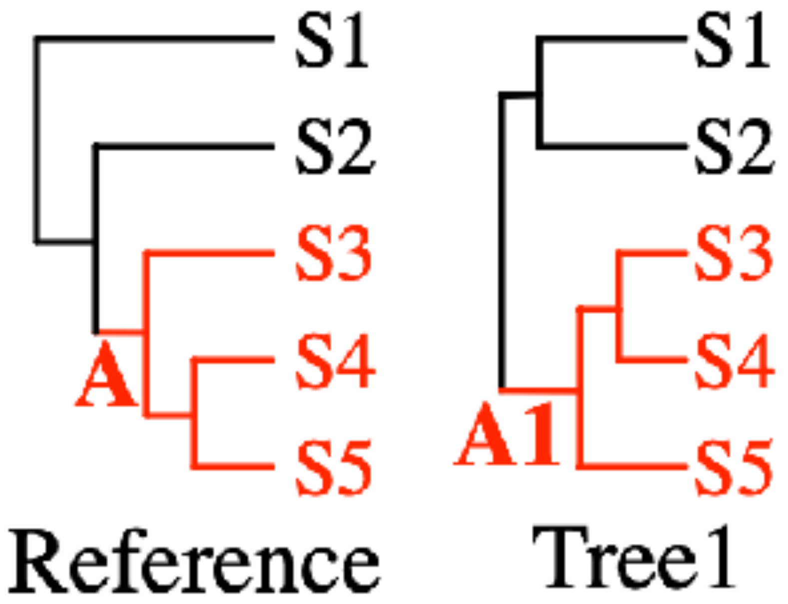
- Topological distance

Leaf node memberships compared to reference tree

Separated Nested



Exact match



Two crucial tasks

Topological relationships between subtrees / leaf nodes

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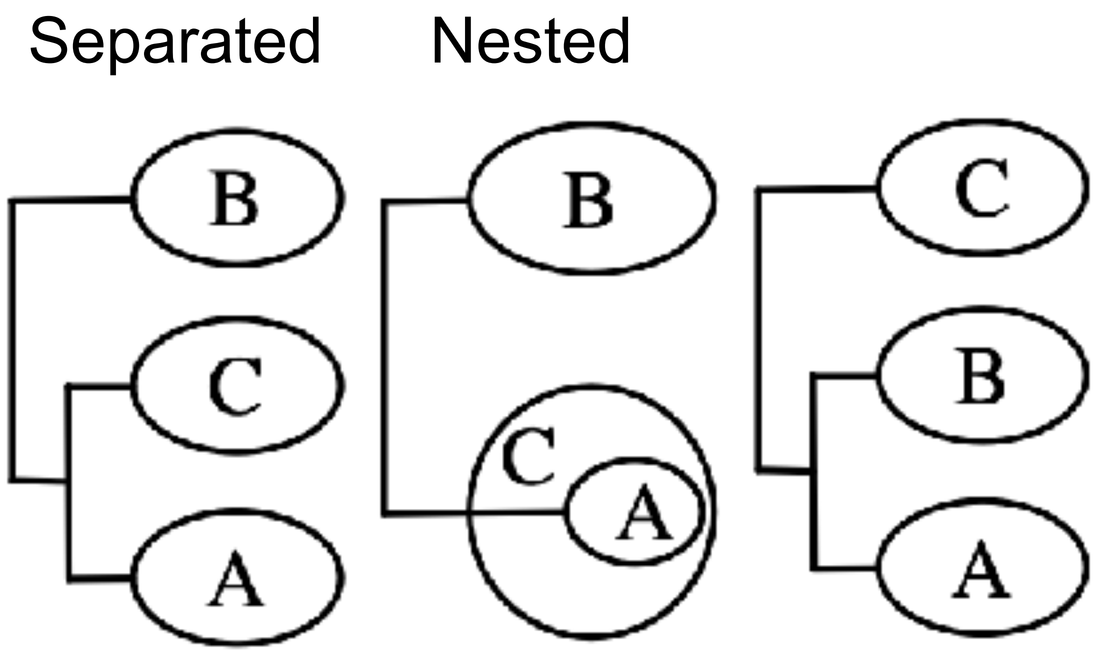
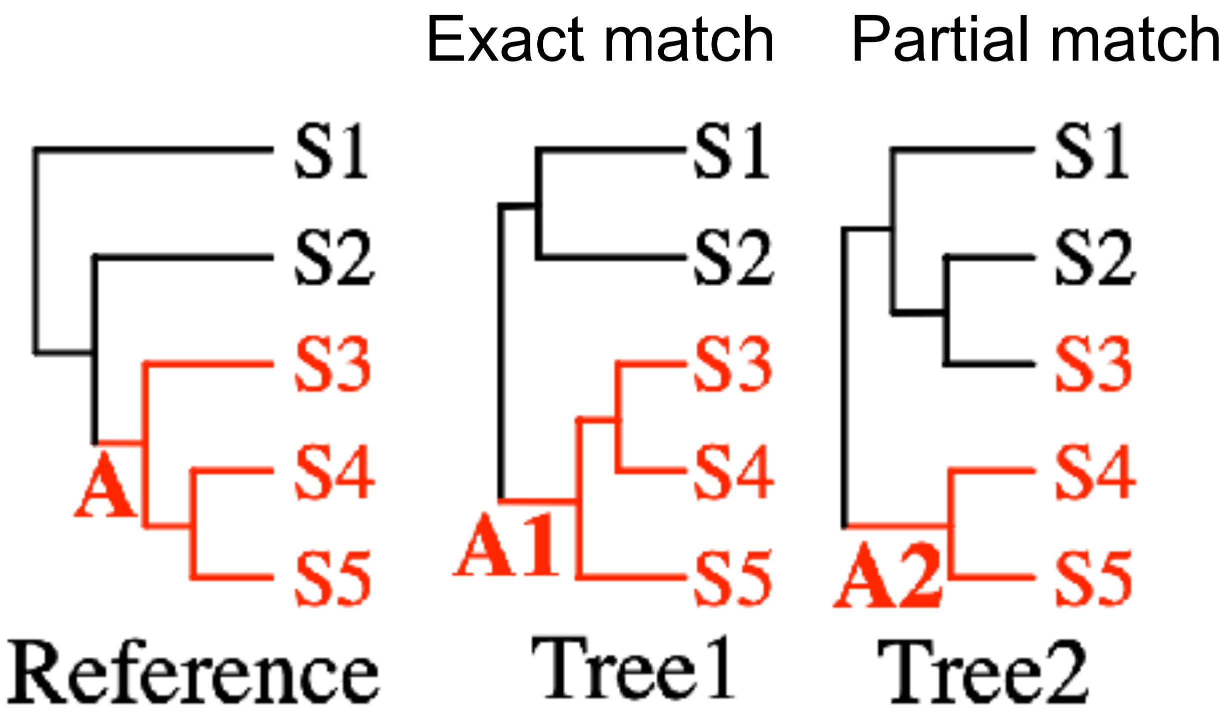


Leaf node memberships compared to reference tree

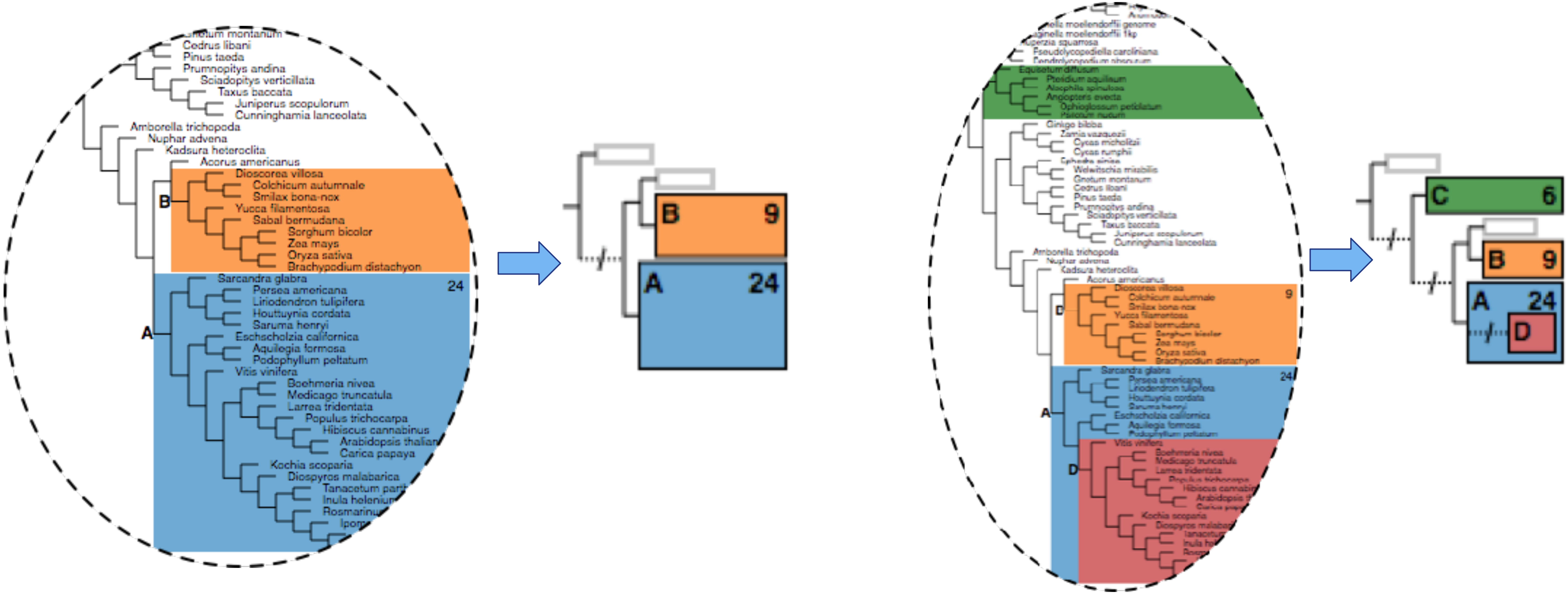


Aggregated Dendrogram (AD)

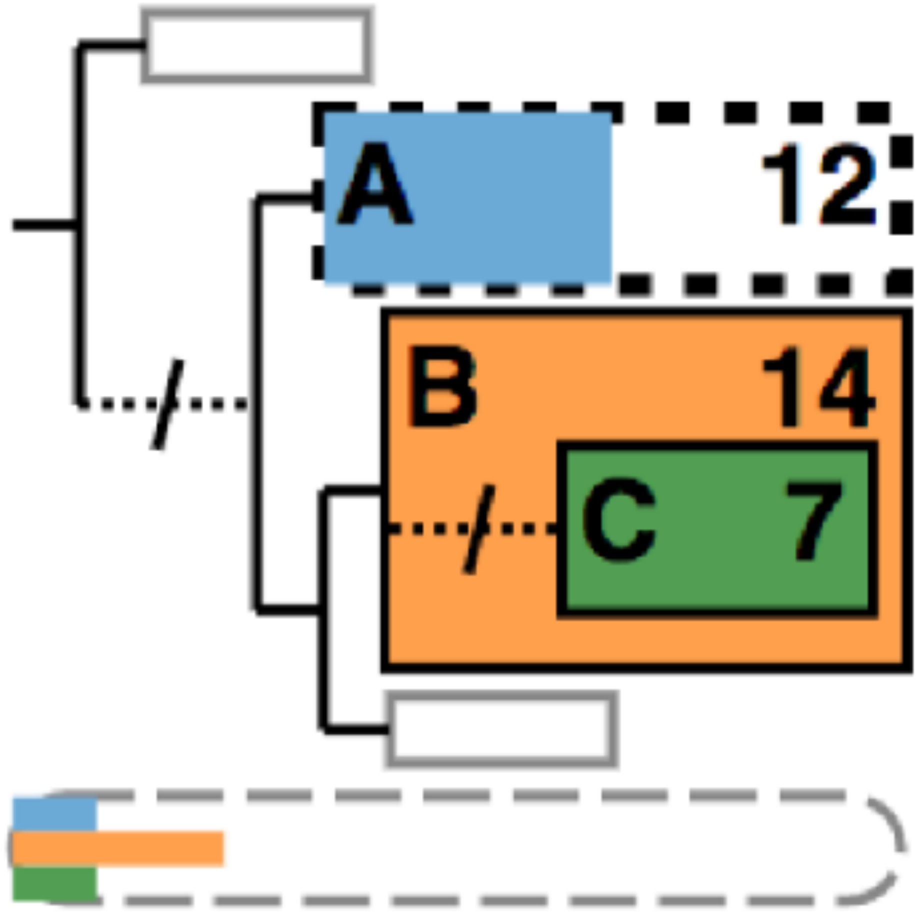
- Intuition
- Visual design

Intuition

Use glyphs to compress a tree according to user selections

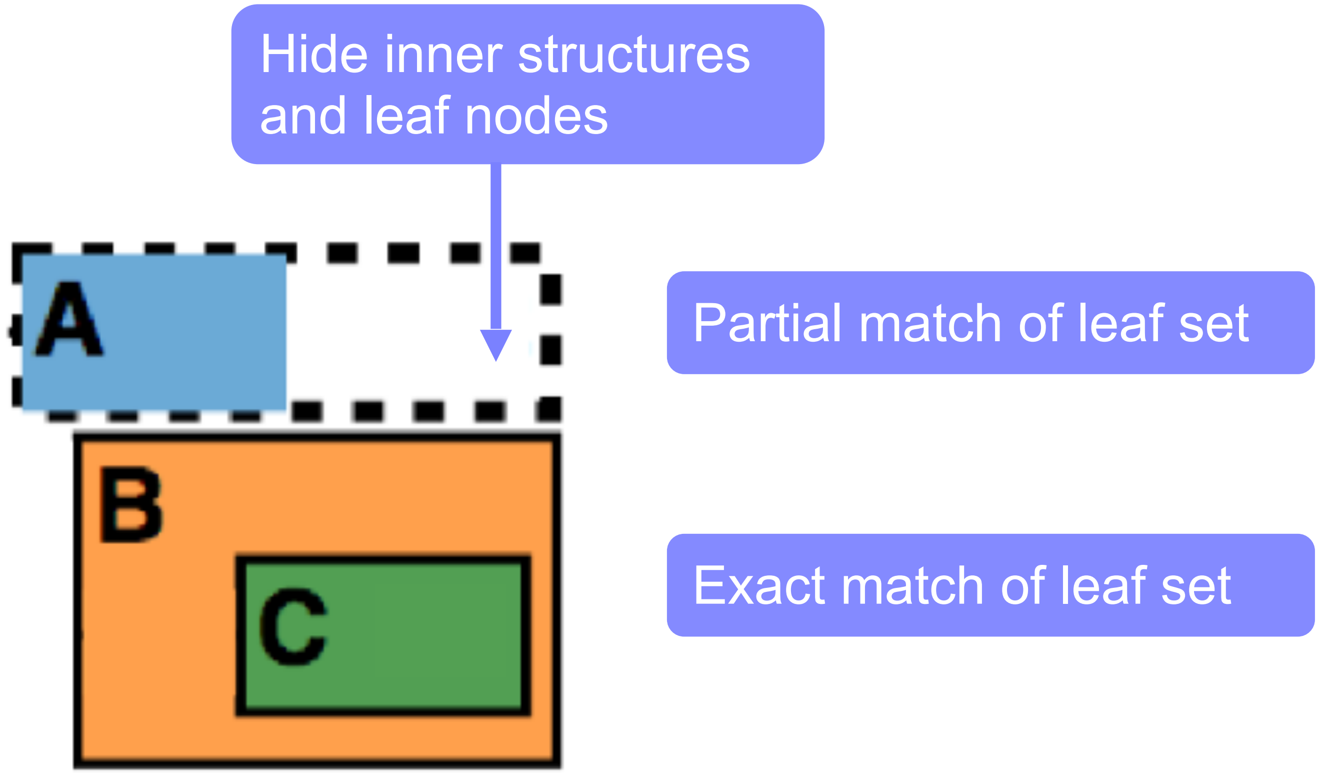


Visual design: focus + context



Visual design: focus + context

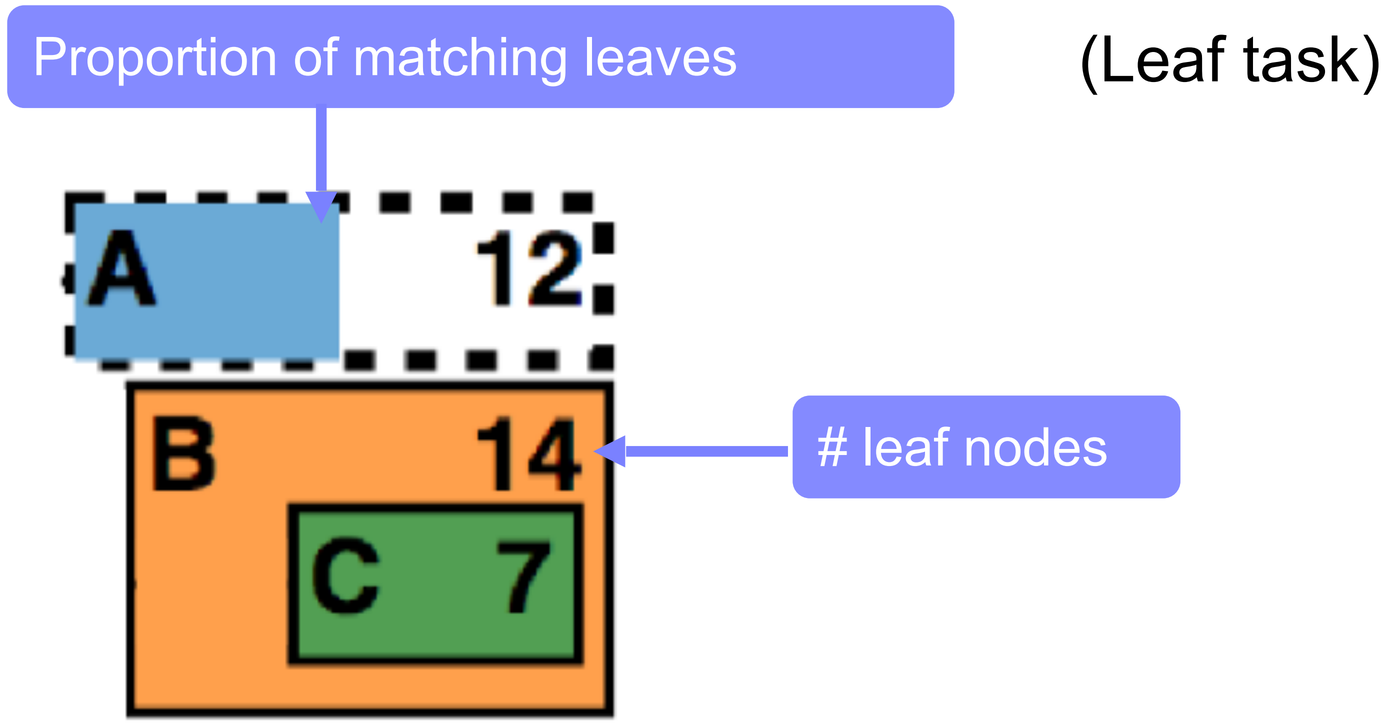
- Focus
  - Selected subtrees



(Leaf task)

Visual design: focus + context

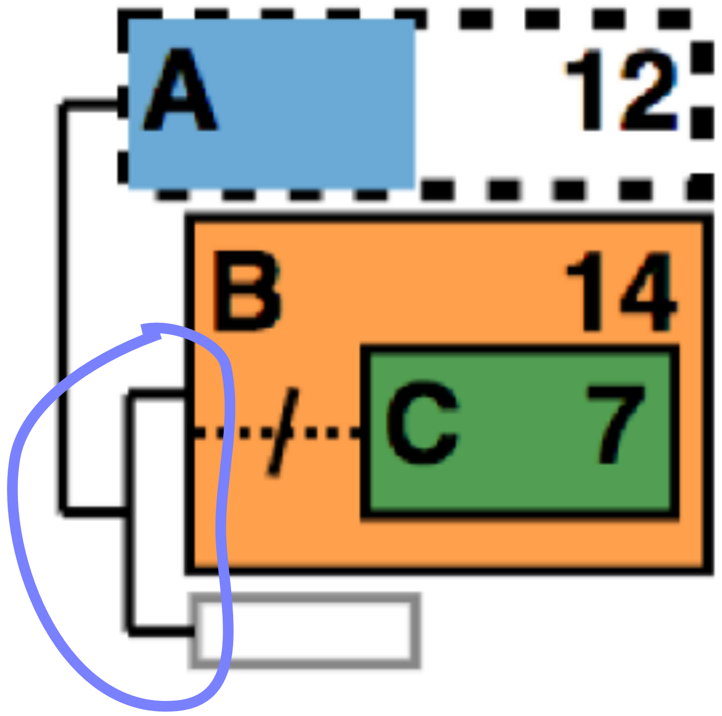
- Focus
  - Selected subtrees



Visual design: focus + context

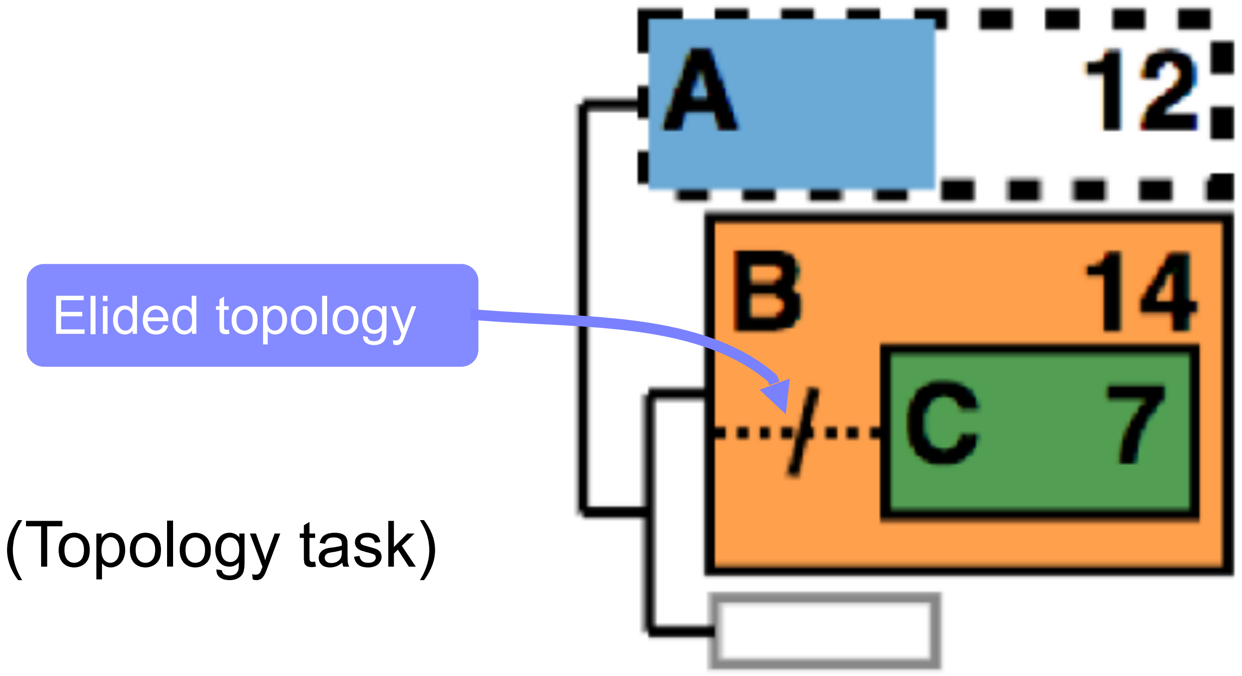
- Focus
  - Selected subtrees
  - Topological relationships between them

(Topology task)



Visual design: focus + context

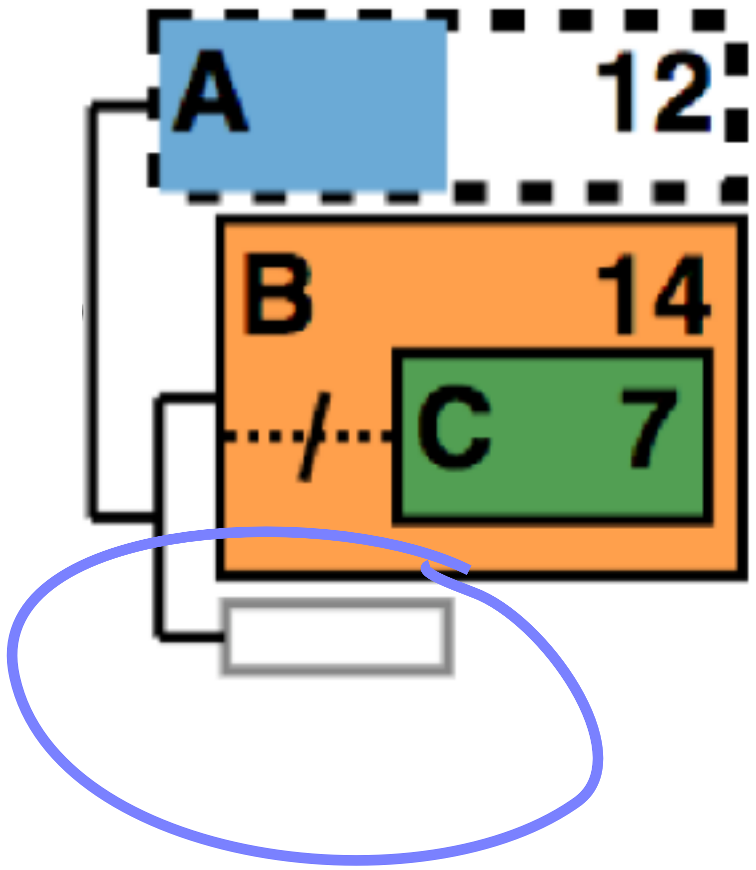
- Focus
  - Selected subtrees
  - Topological relationships between them



(Topology task)

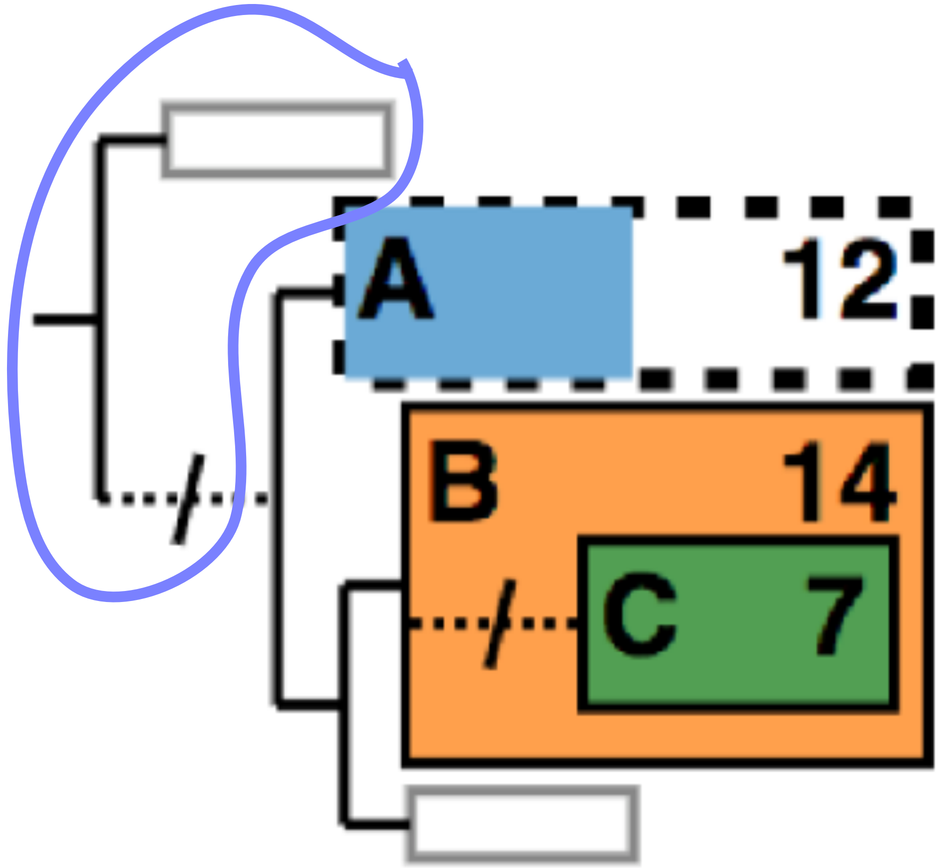
Visual design: focus + context

- Focus
  - Selected subtrees
  - Topological relationships between them
- Context
  - Neighboring subtrees



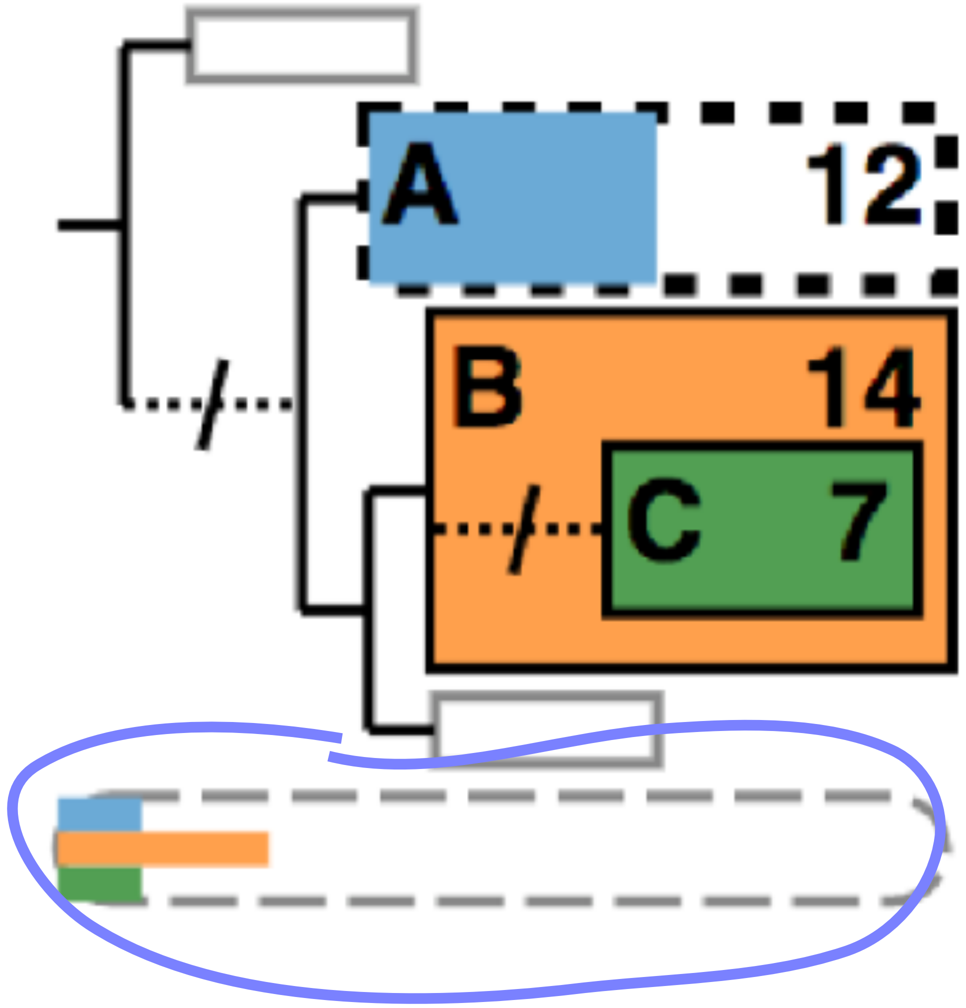
Visual design: focus + context

- Focus
  - Selected subtrees
  - Topological relationships between them
- Context
  - Neighboring subtrees
  - Upstream topology and root



Visual design: focus + context

- Focus
  - Selected subtrees
  - Topological relationships between them
- Context
  - Neighboring subtrees
  - Upstream topology and root
  - Missing leaf nodes

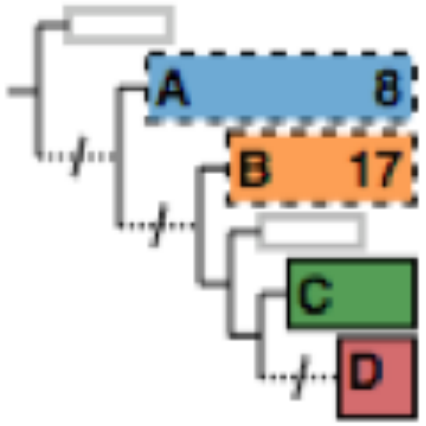


Visual design: algorithm adapts to space

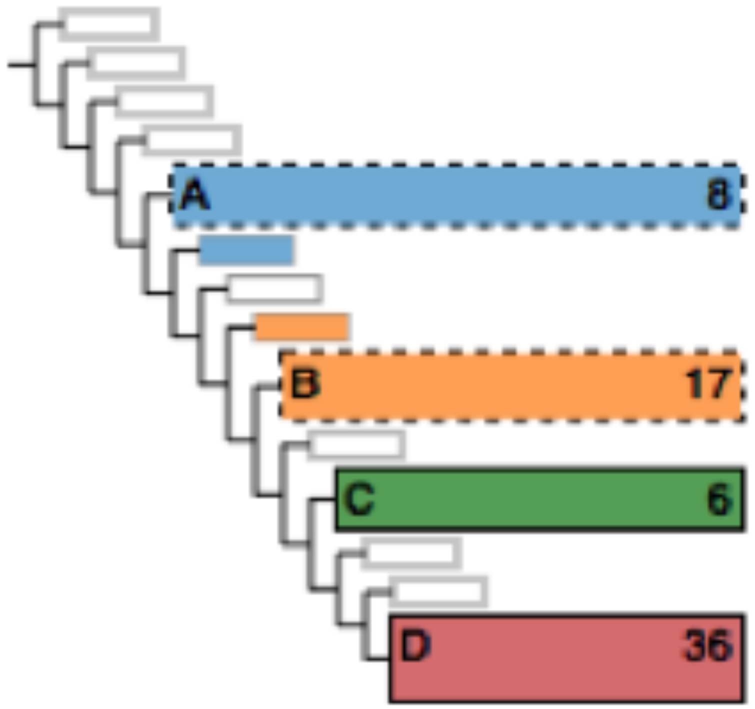
- Show more info when space permitted
  - Labels
  - #leaf nodes
  - Neighboring blocks

40x40 px

80x80 px

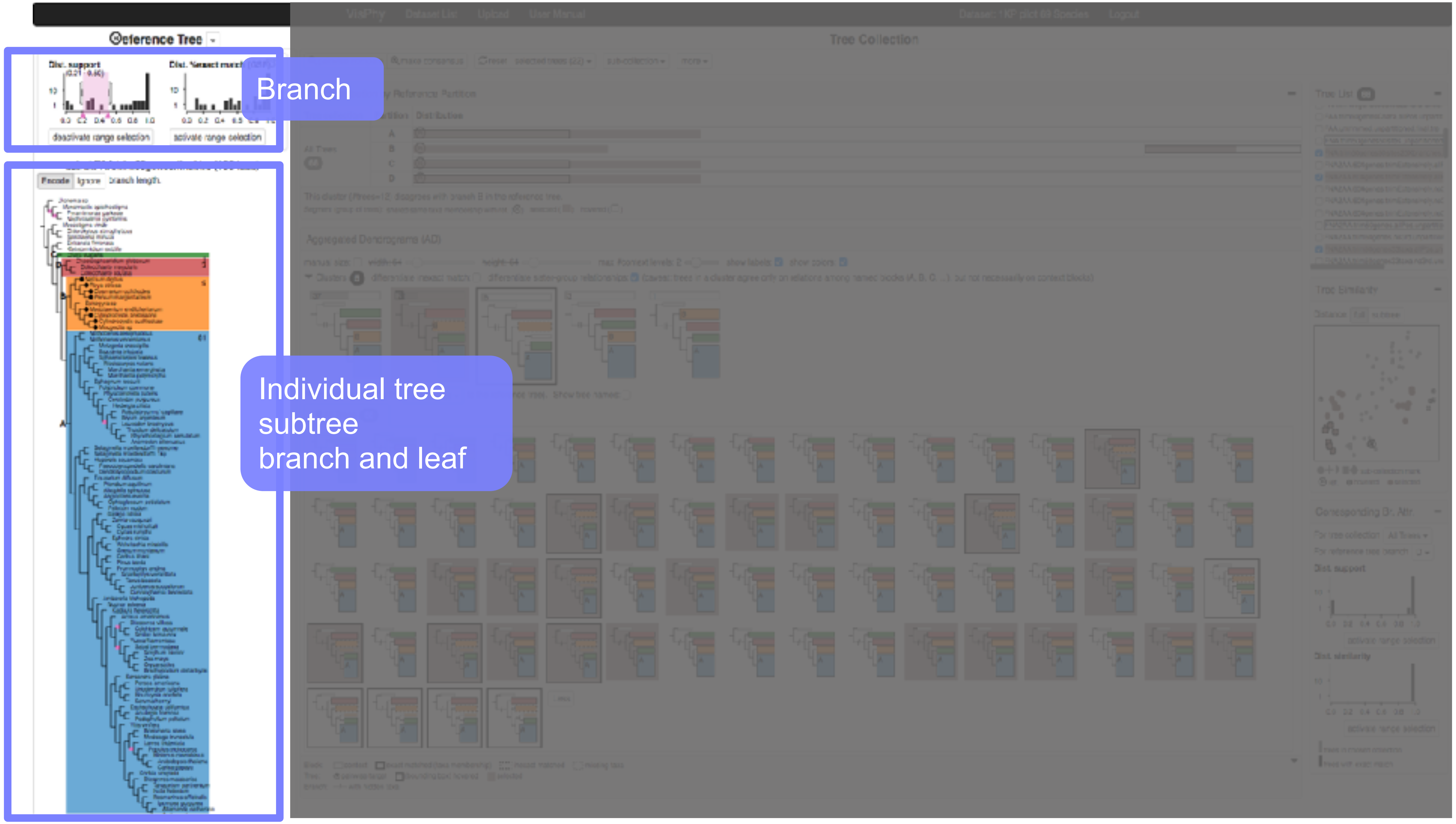


160x160 px

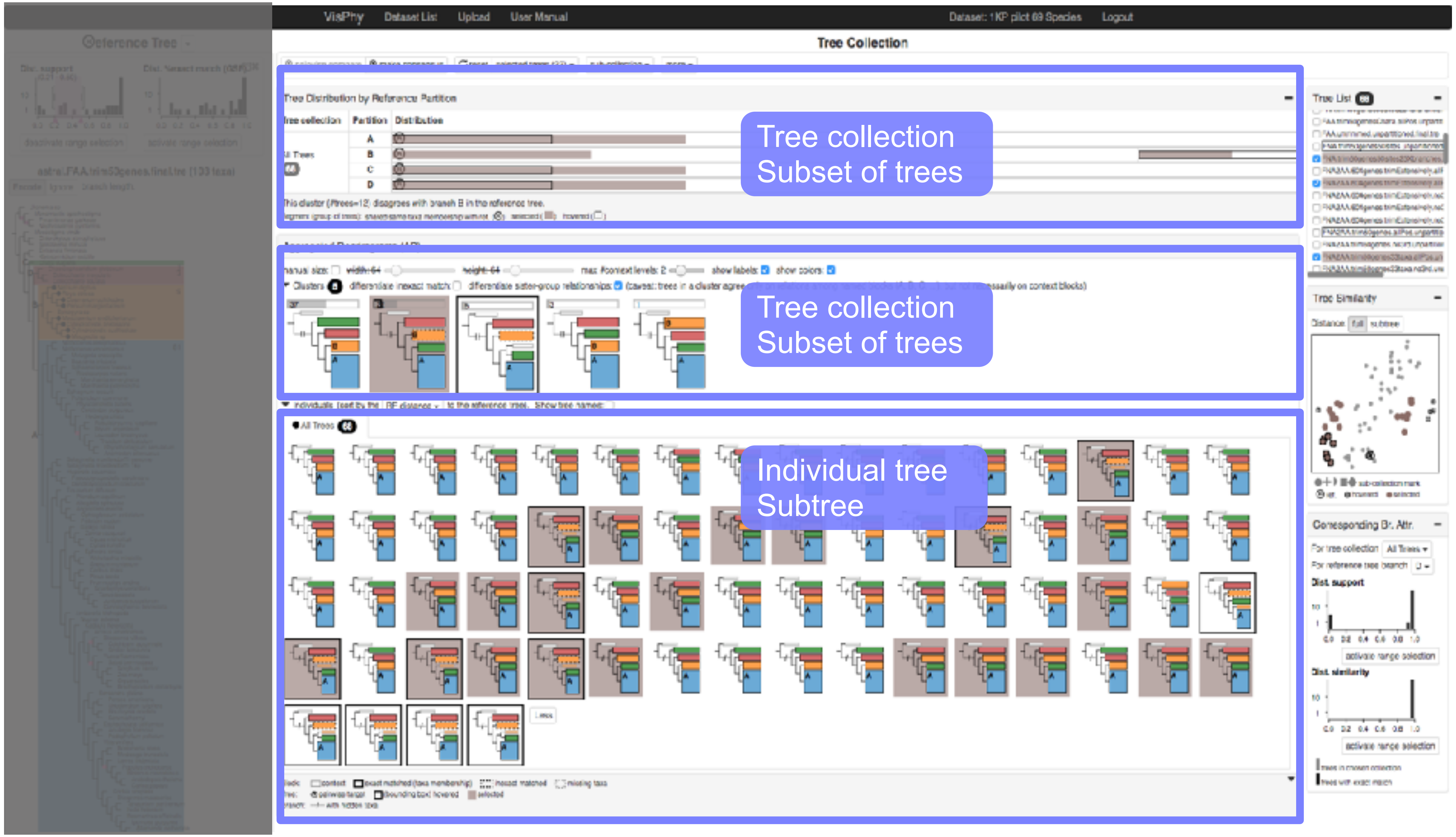


ADView Interface: Multi-level structure across views

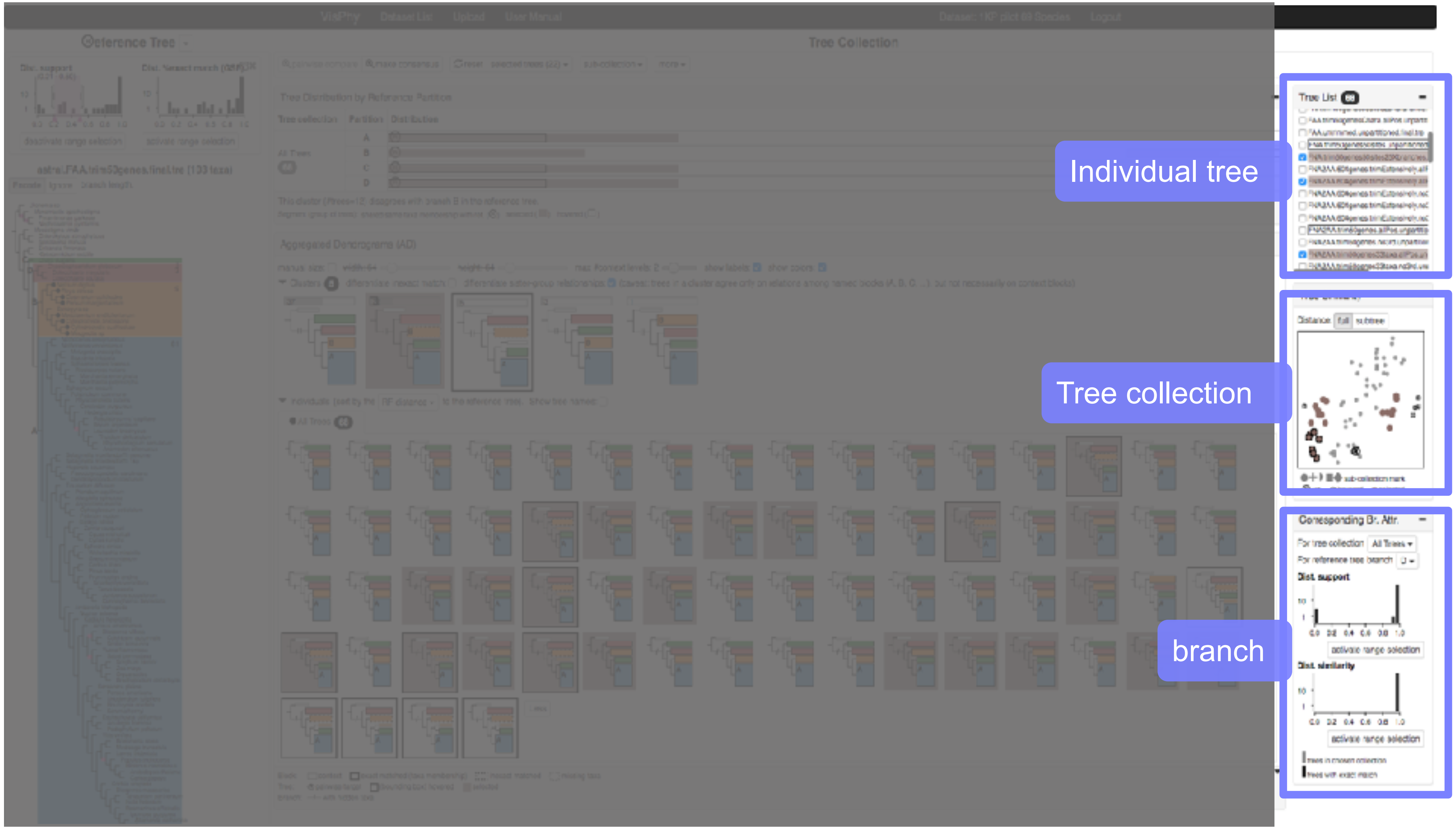
Multi-level structure across views



Interface walkthrough: tree collection main views



Interface walkthrough: tree collection aux. views



Aggregated Dendrograms for Visual Comparison between Many Phylogenetic Trees

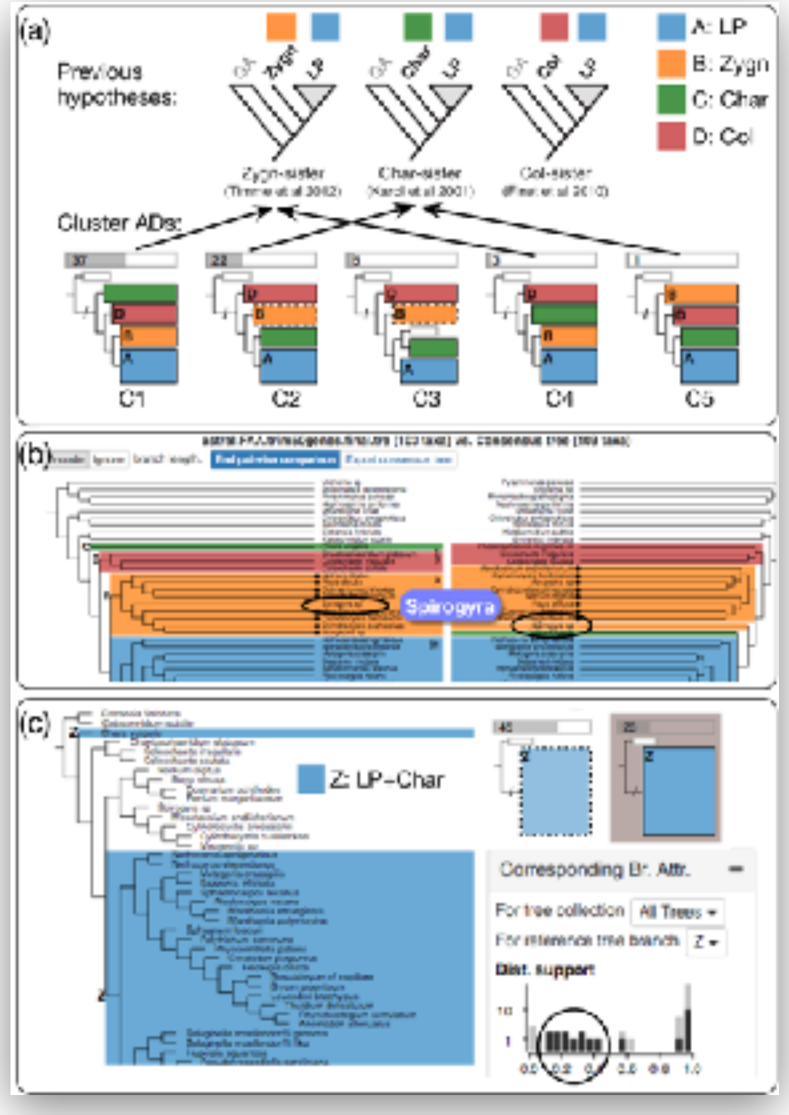
Zipeng Liu, Shing Hei Zhan, Tamara Munzner

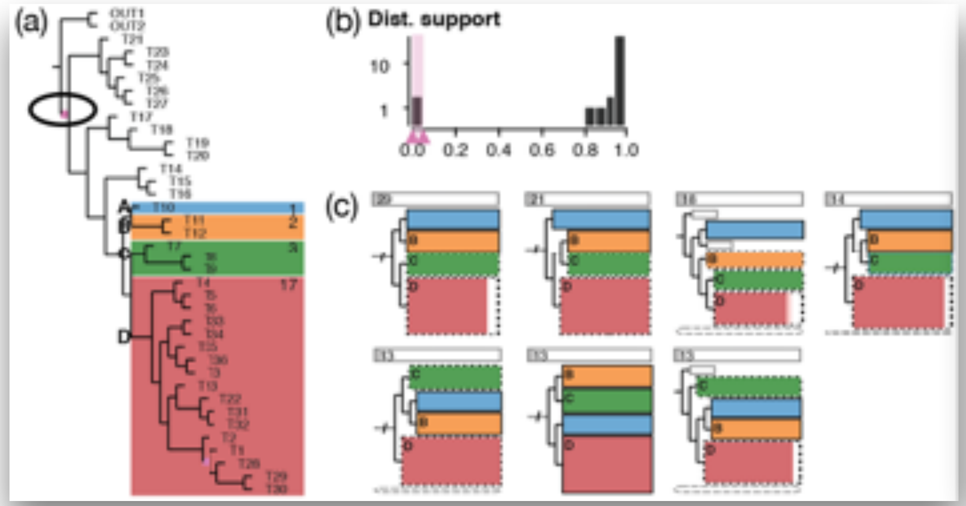
Validation with many biologists

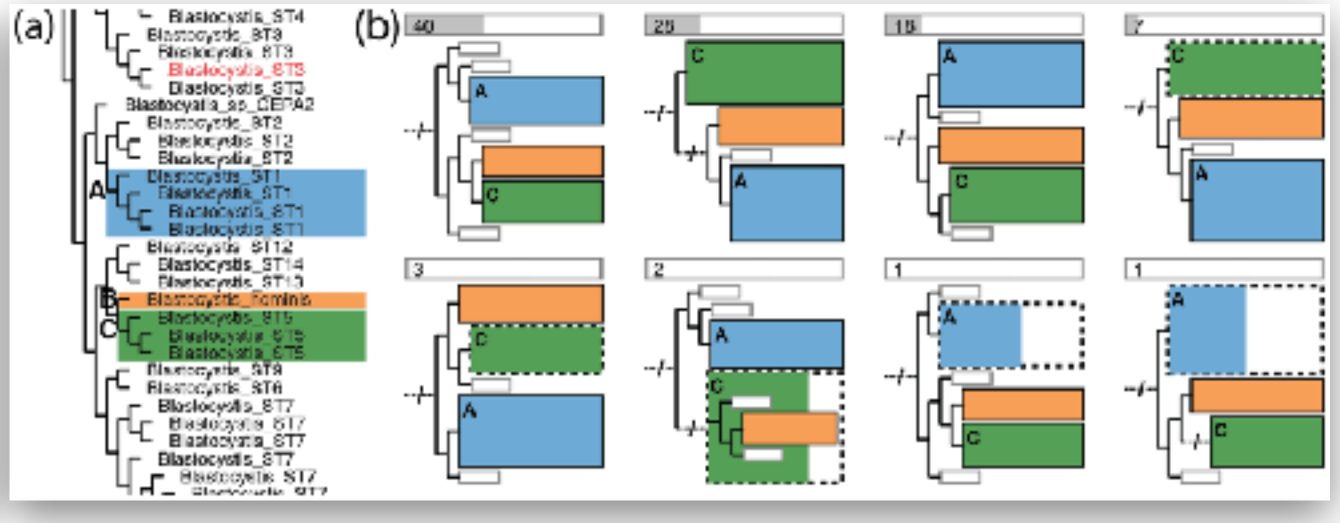
- Work closely with a biology PhD student (second author)
- Demos, interviews and discussions
  - 10 biologists at different times throughout project

Validation with many biologists

- Work closely with a biology PhD student (second author)
- Demos, interviews and discussions
  - 10 biologists at different times throughout project
- User study sessions
  - 5 biologists
  - Using their own datasets

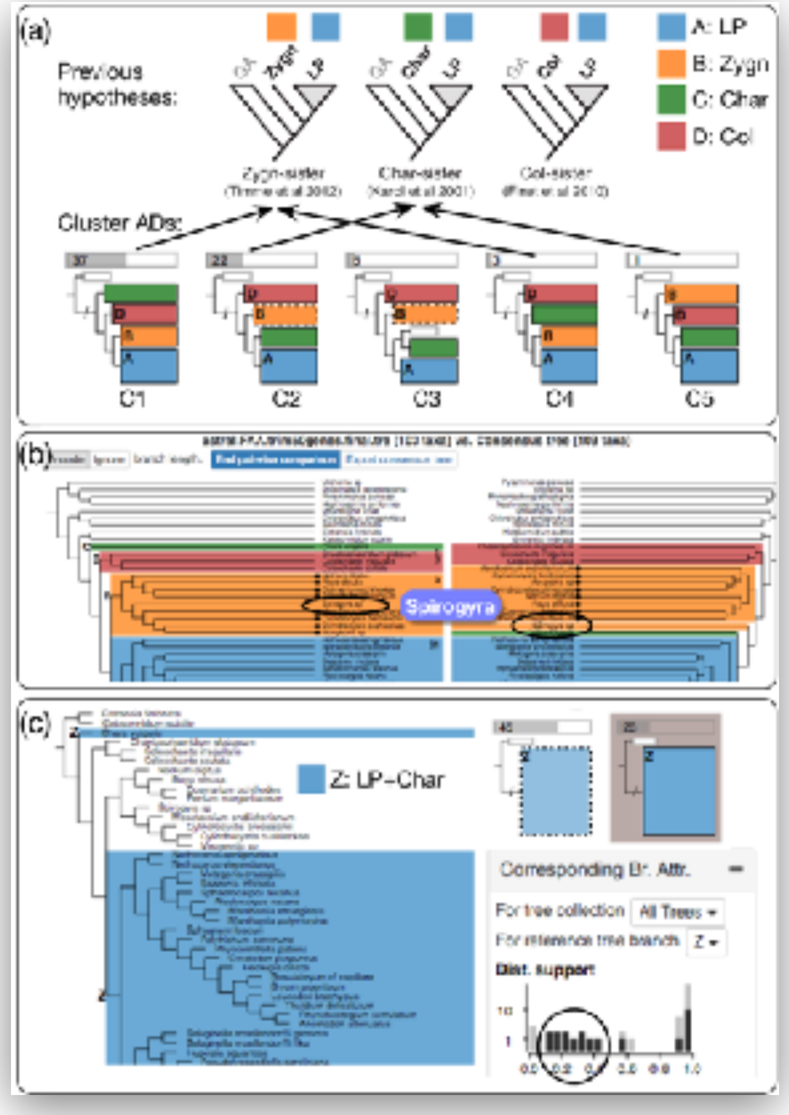


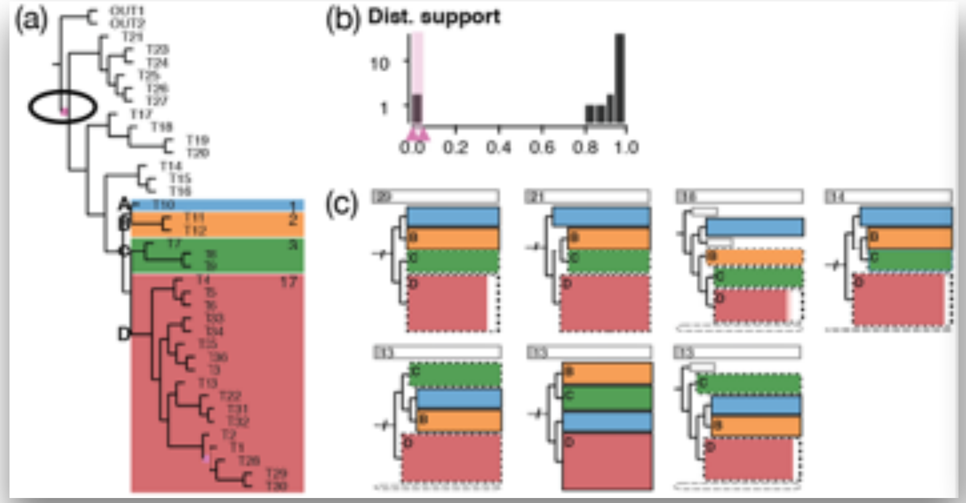


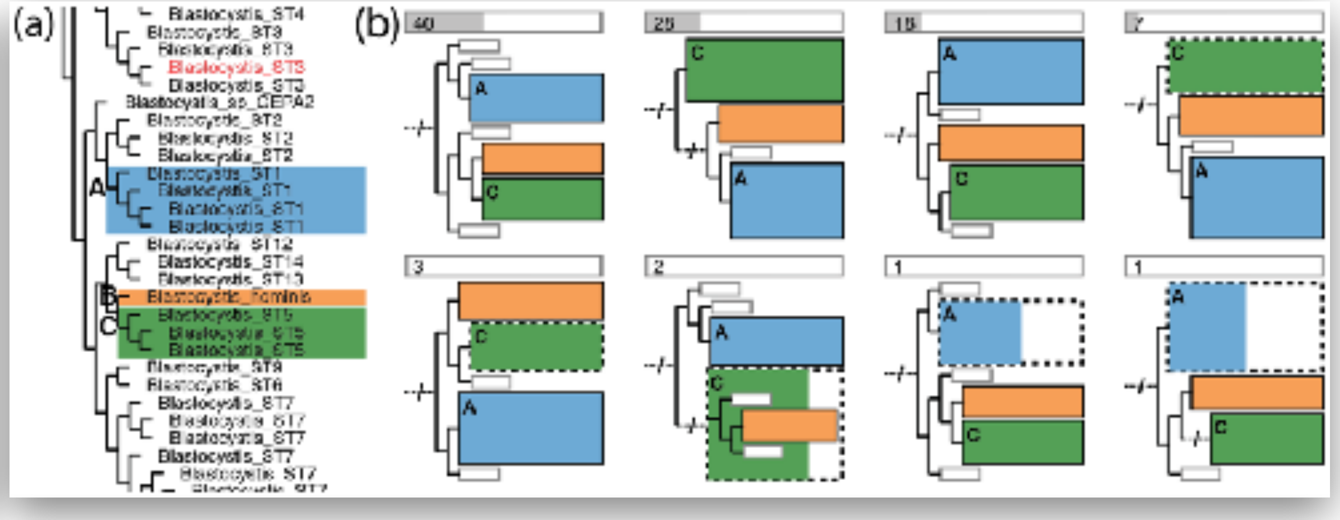


Validation with many biologists

- Work closely with a biology PhD student (second author)
- Demos, interviews and discussions
  - 10 biologists at different times throughout project
- User study sessions
  - 5 biologists
  - Using their own datasets
- Biologists confirmed
  - Validity of data and task abstractions
  - Utility of ADView

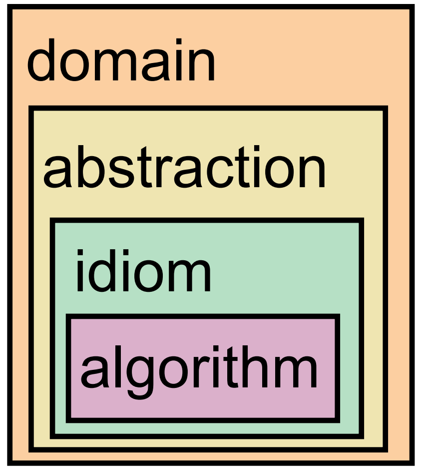






Problem-driven visualization through design studies

- methodology matters
  - identify abstractions
    - crucial & difficult, iterative process
  - select appropriate idioms
    - or create new ones if necessary



- two examples
  - different domains
  - different methods

imperfect models

One case study of visualizing imperfect models

- NLP for temporal data

time by Wayne Middleton from the Noun Project

TimeLineCurator

Interactive Authoring of Visual Timelines from Unstructured Text

Johanna Fulda
@jofu_

Matthew Brehmer
@mattbrehmer

Tamara Munzner
@tamaramunzner

http://about.timelinecurator.org
http://timelinecurator.org

TimeLineCurator: Interactive Authoring of Visual Timelines from Unstructured Text.
Fulda, Brehmer, Munzner. IEEE Trans. Visualization and Computer Graphics (Proc IEEE VAST 2015) 22(1):300-309, 2015.

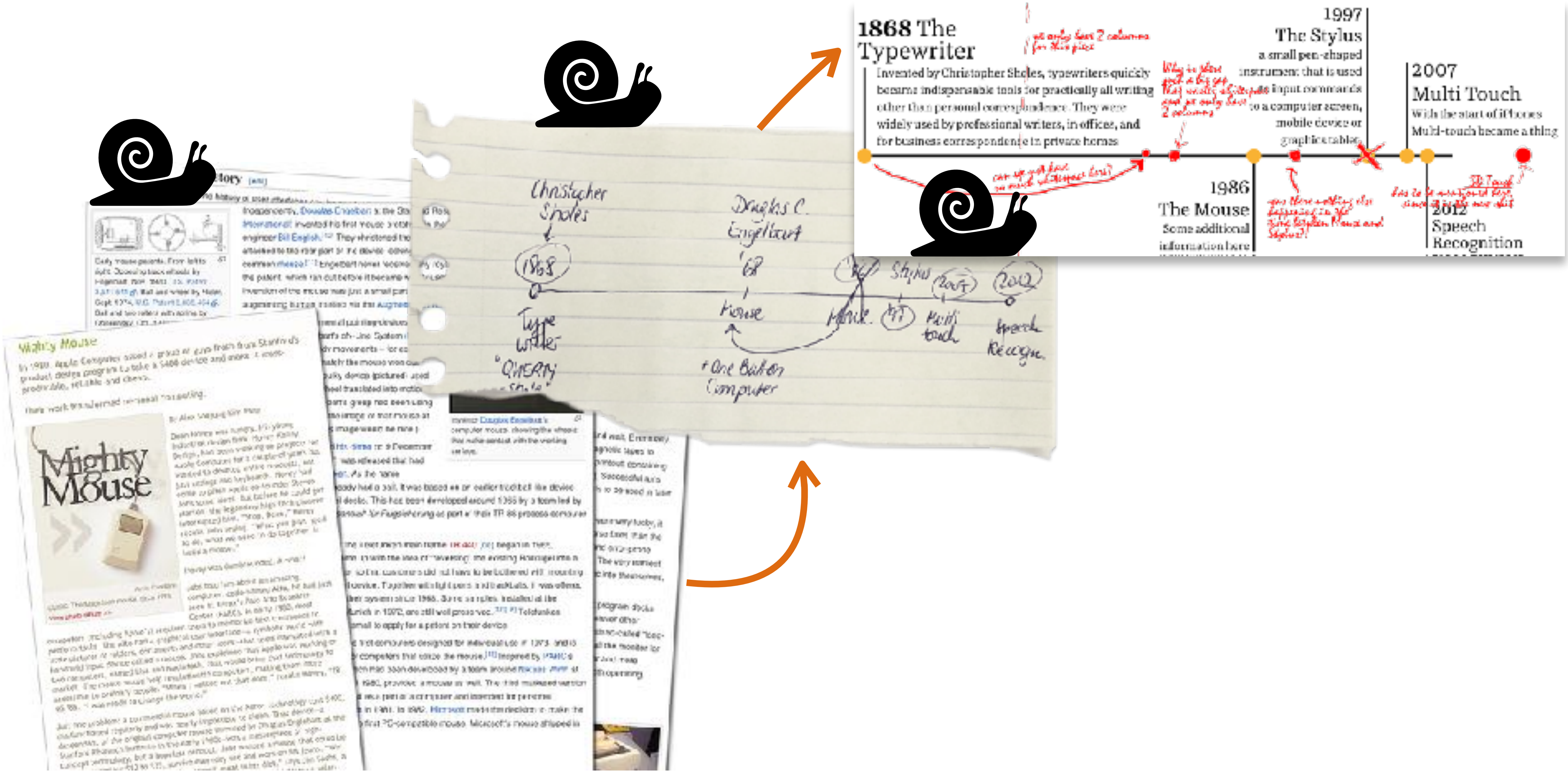
TimeLineCurator

visual & browser-based

https://vimeo.com/jofu/tlc

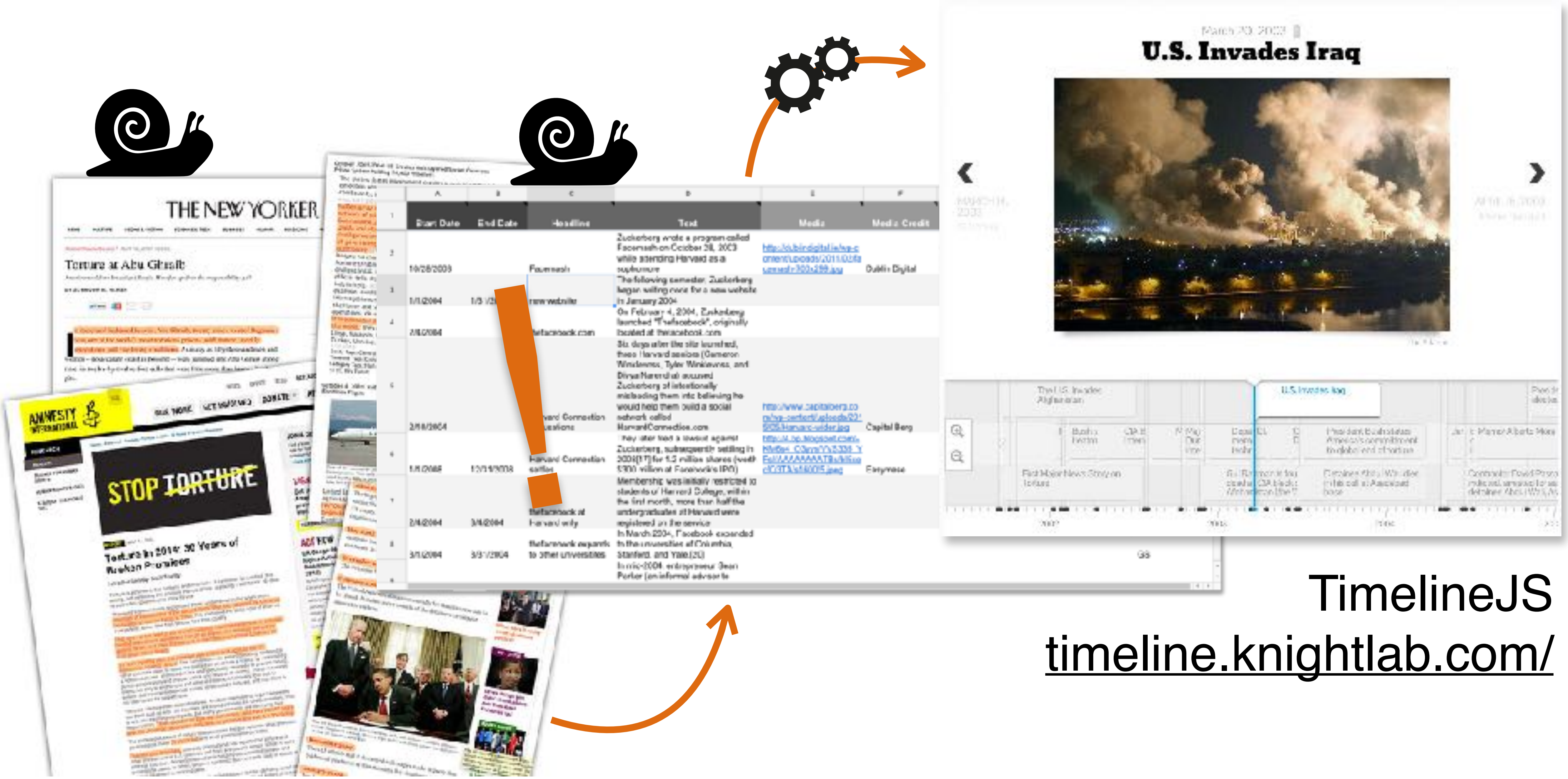
Manual creation process

Browse → Extract → Format → Show → Update



Structured creation process

Browse → Extract → Format → Show → Update



TimelineJS
timeline.knightlab.com/

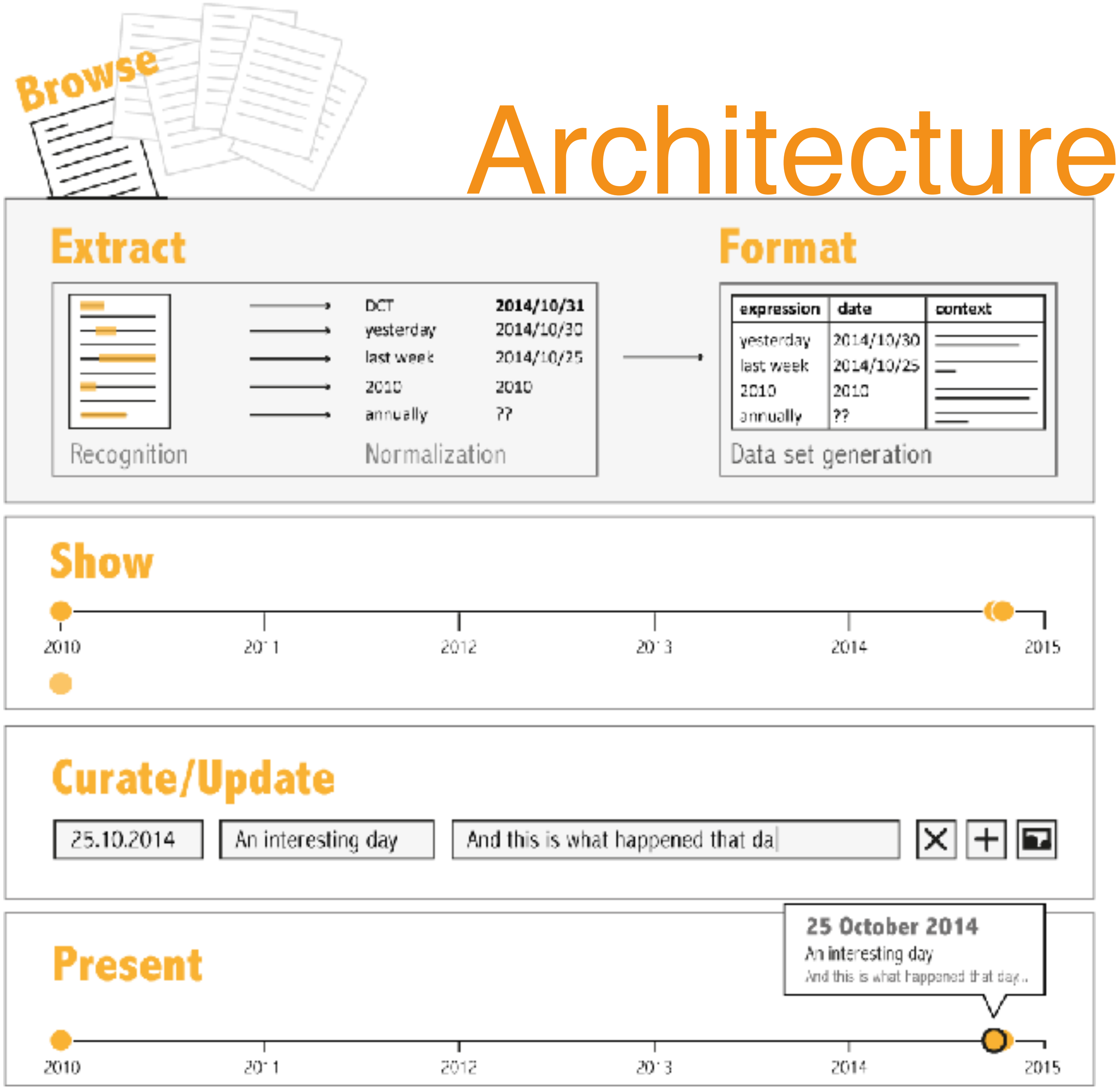
Timeline authoring model

- time required for each task

	Browse	Extract	Format	Show	Update
Manual Drawing	slow	slow		slow	slow
Structured Creation	slow	slow	slow	automated	fast
TimeLine Curator	fast	automated	automated	fast	fast

The general case for curation

- build for human in the loop as continuing need
  - automatic processing to accelerate not replace
  - **assume computational results good but not perfect**
    - for the indefinite future!
  - visual feedback to accelerate



The importance of being brisk

- cool use case: eureka moment
  - success: enable what was impossible before
  - vis tools for new insights & discoveries
- workhorse use case: workflow speedup
  - success: vis tools accelerate your prior workflow
    - sometimes enables the previously infeasible
- TLC use cases
  - started with speedup use case, for presentation
    - make this doc into a timeline now!
  - two other use cases nudge towards exploration
    - comparison between multiple timelines
    - speculative browsing

TimeLineCurator: Speculative Browsing

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Q&A

Come talk!

- encourage meeting with me to get advice/feedback before final present
  - chance to get feedback while you can still act on it
  - optional, not mandatory
  - wise to schedule in advance by email
    - can’t meet with all 14 teams in next week office hours, or in last few days!