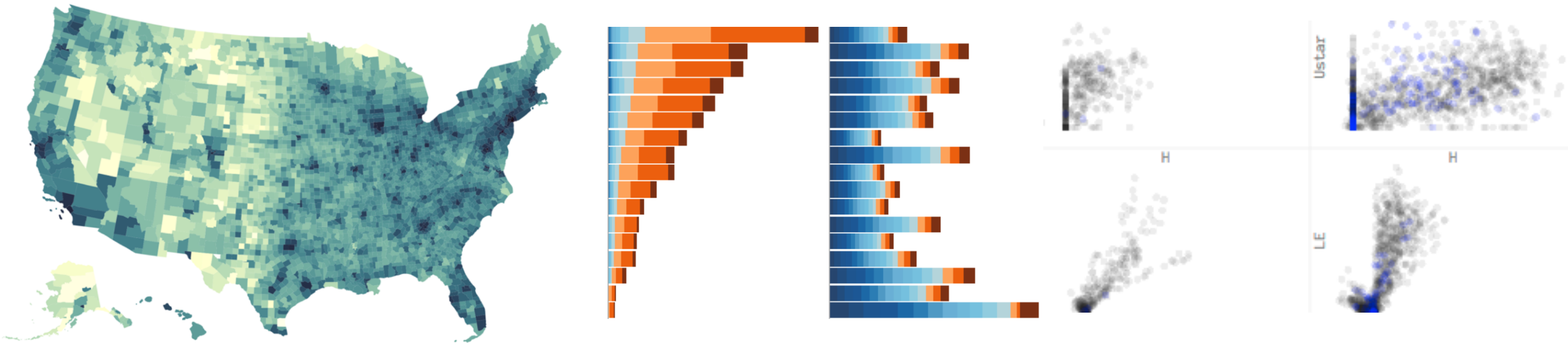
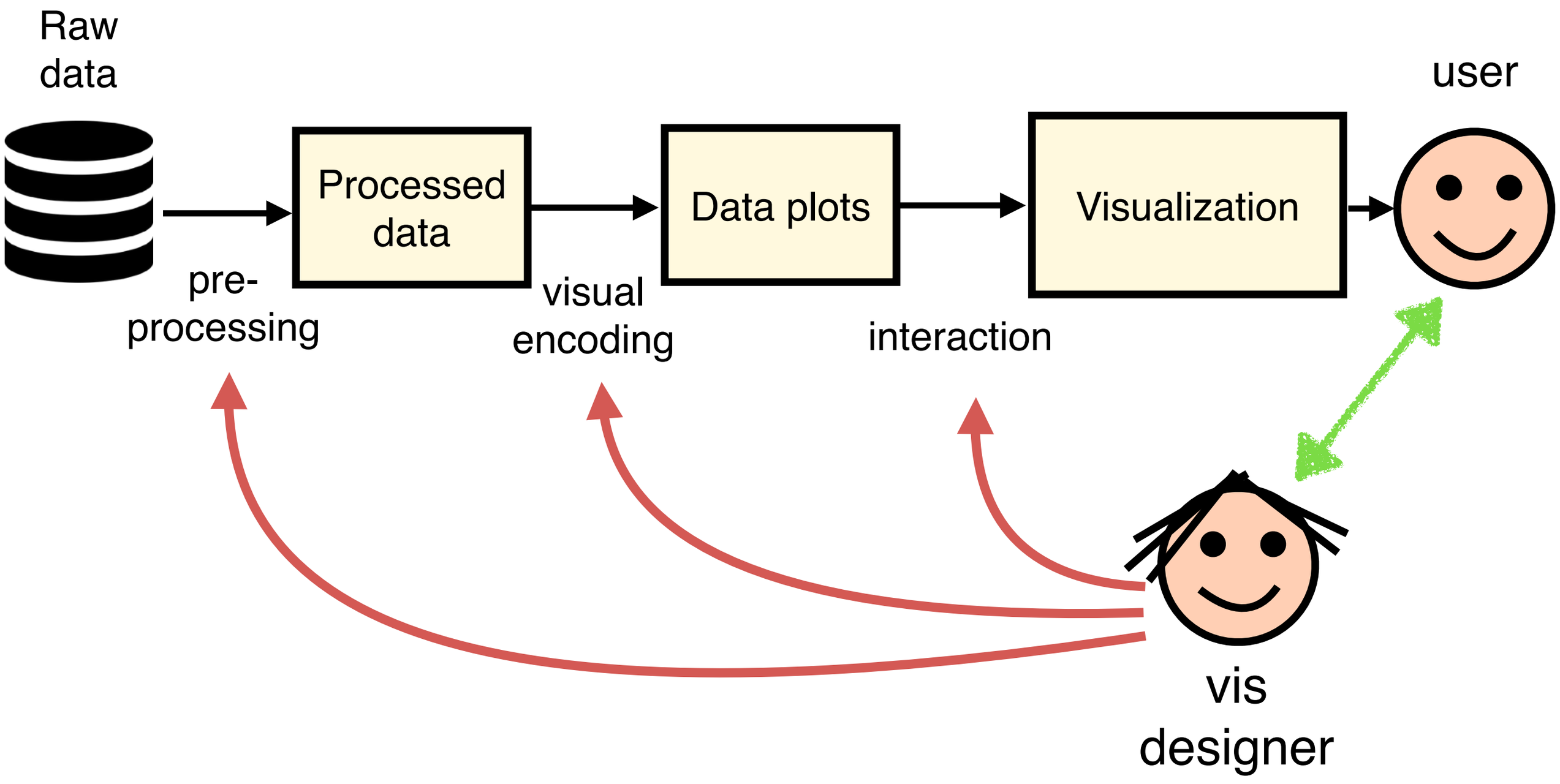


CS 526: Computer Graphics II

Week 12: Visualization Design & Evaluation

Khairi Reda | redak@uic.edu
UIC CS


Raw
data
Processed
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Data plots
Visualization
user
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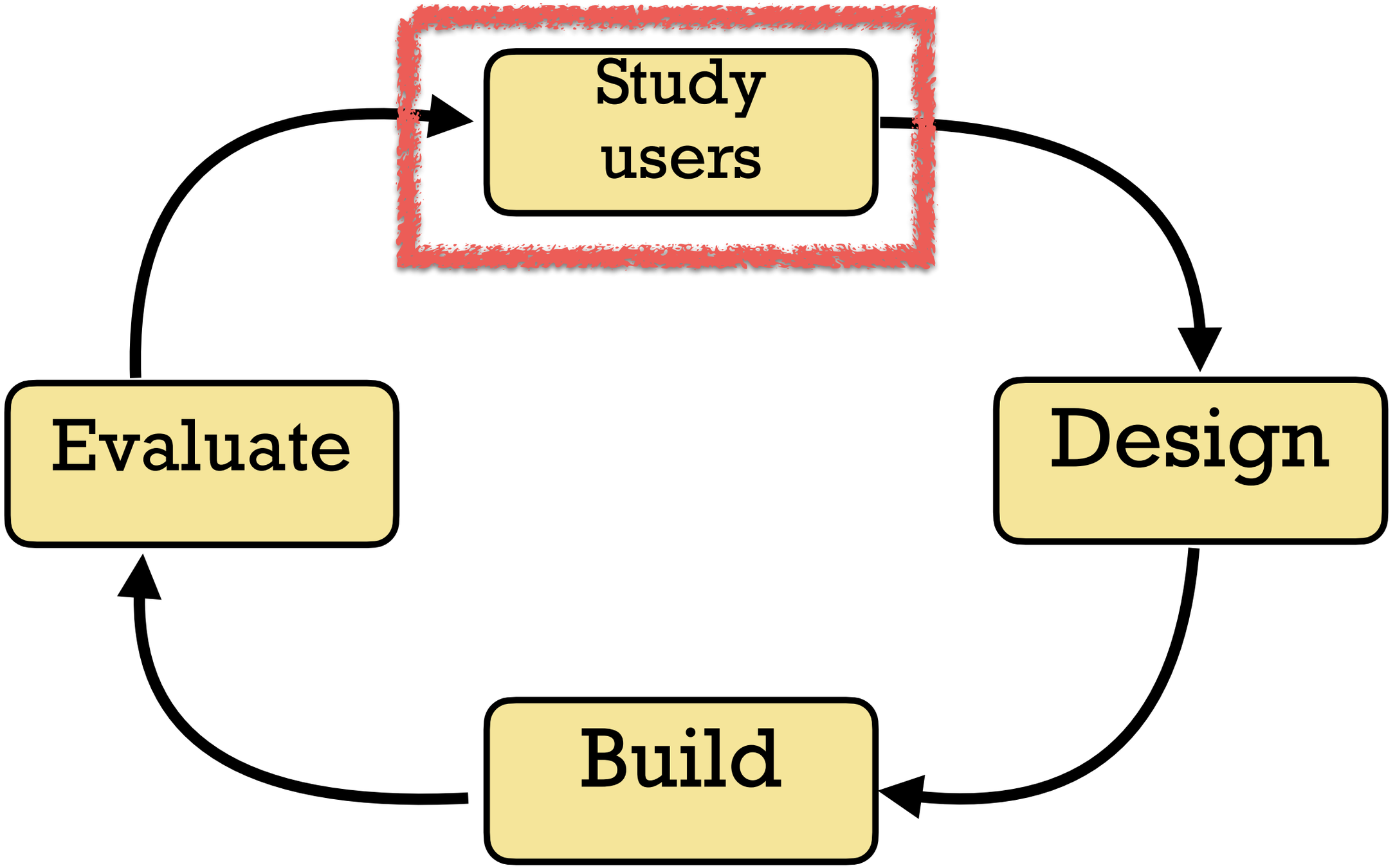
vis
designer

Visualization design process



Why study users?

Thesis 1: The purpose of visualization is insight, not pretty picture

Thesis 2: Visualization enable people to uncover insights by helping them execute a series of **tasks** on a dataset

or answer **questions** about data

Visualization tasks

sense making

- Understand and forecast trade patterns
- Explore the relationship between the expression of certain genes and cancer prognosis

- Analyze the distribution of sales
- Compare the incidence of asthma in different US states
- Identify the state with the highest number of asthma-related hospitalization

mid / low-level tasks

fuzzy

crisp

fuzzy

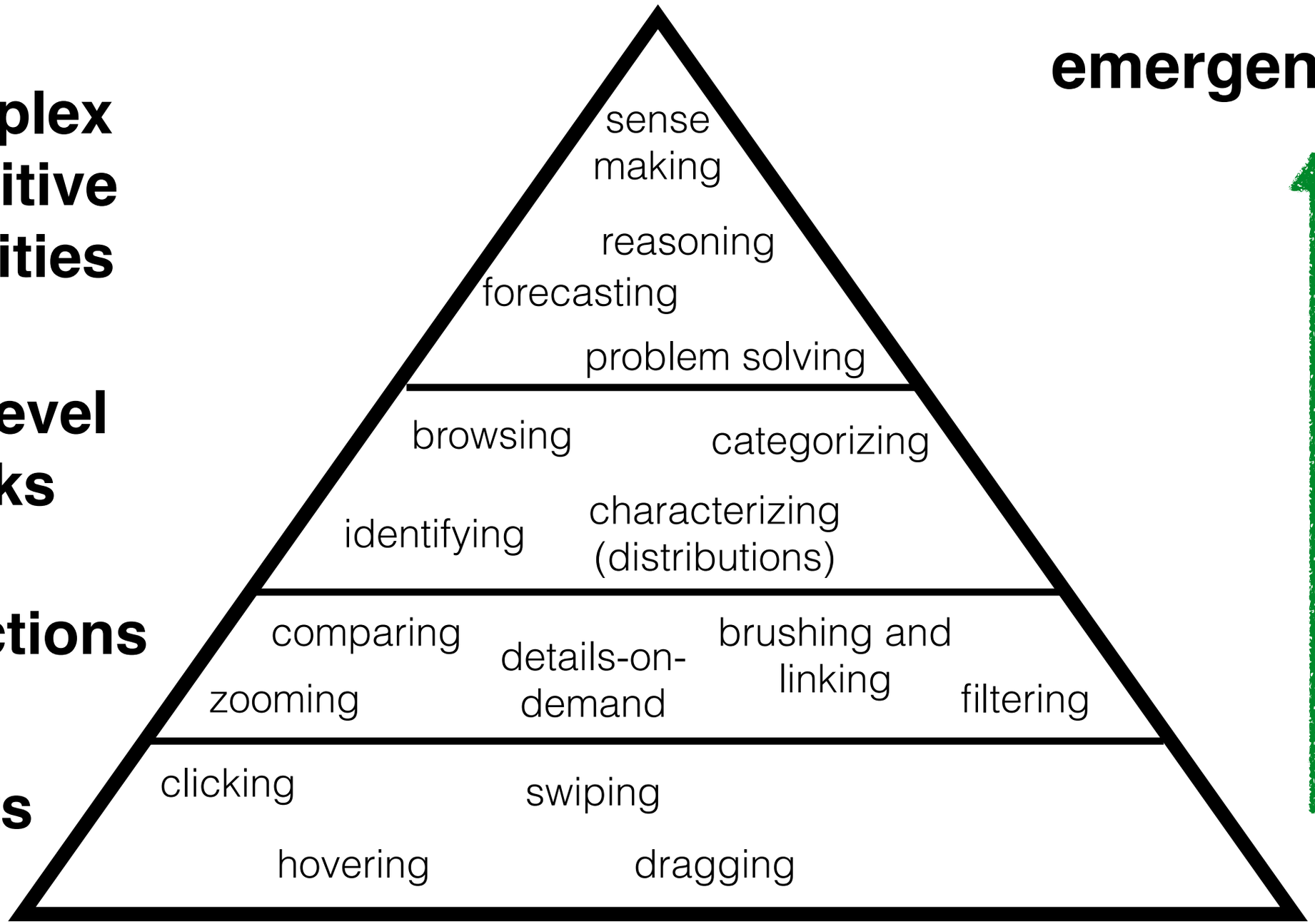
crisp

Complex cognitive activities

mid-level tasks

interactions

events



emergence

Sedig et al.

Domain task abstraction

{action, target} pairs

compare, trends

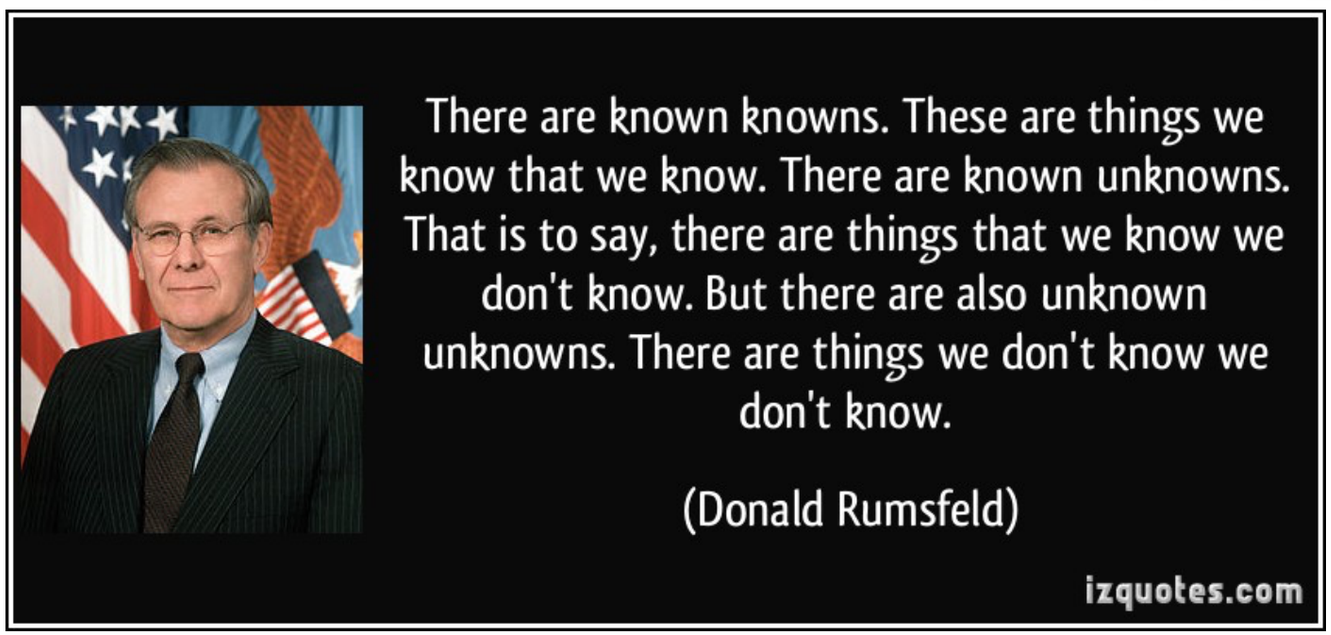
locate, nodes in network

browse, distribution

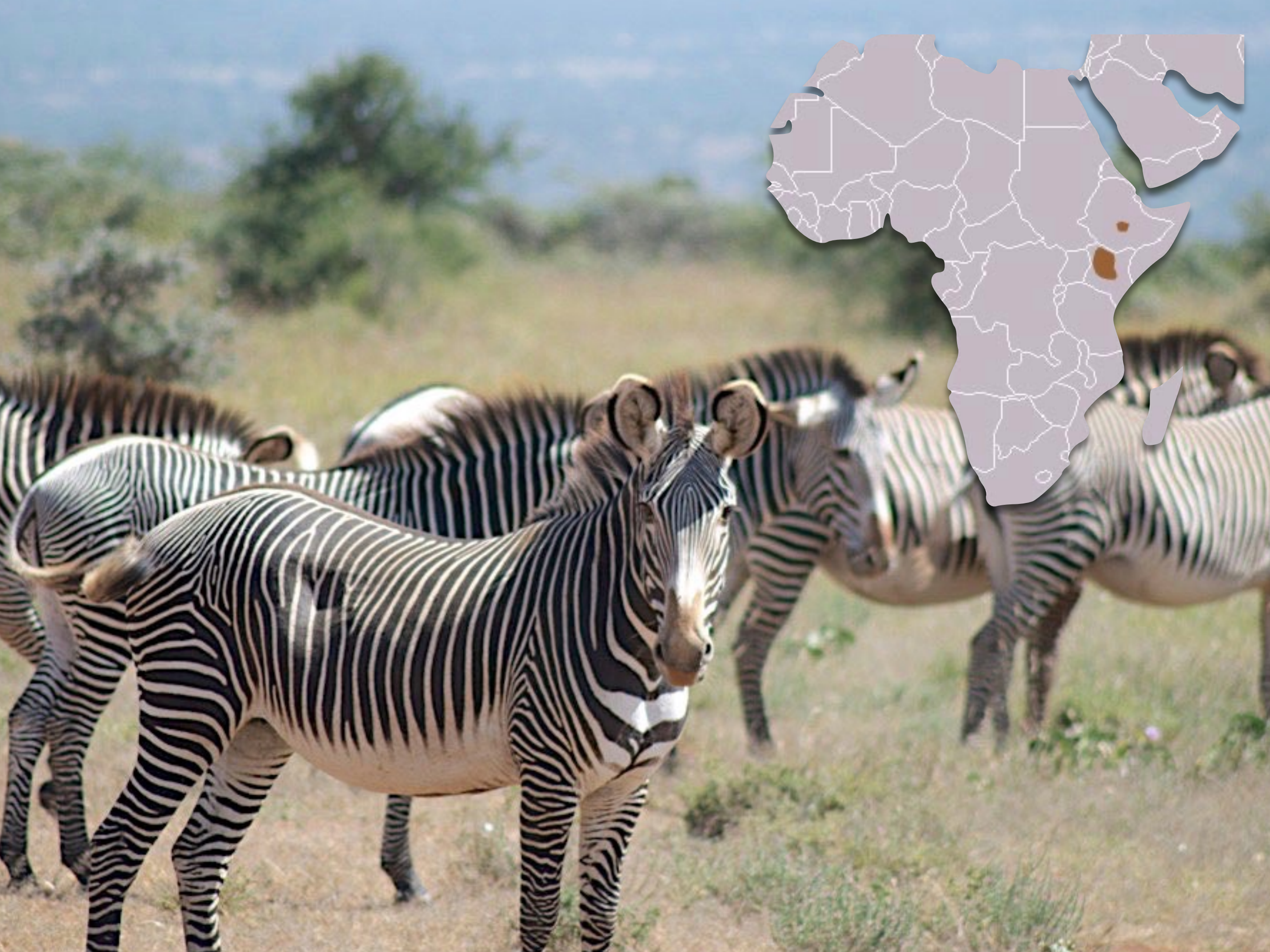
Domain task abstraction

{action, **target**} pairs

	Target known	Target unknown
Location known	Lookup	Browse
Location unknown	Locate	Explore



Example of Domain task abstraction



Inferring Grevy's social interactions

Mayank Lahiri

Domain Tasks

- Find communities in zebra society, and identify influential individuals who play a role in shaping the social structure
- Understand how the social structure of Grevy's zebra evolve over-time
- Understand how Grevy's zebra society responds to environmental variables

Domain Tasks

	Target known	Target unknown
Location known	*Lookup*	*Browse*
Location unknown	*Locate*	*Explore*

- Find communities in zebra society, and identify influential individuals who play a role in shaping the social structure

Action: Find = **Explore** (unknown target, unknown location)

Target: communities (loosely defined:
groups of zebras that hang out together)

Action: Identify = **locate** (known target, unknown location)

Target: influential individuals
(typically male stallions, or lactating females)

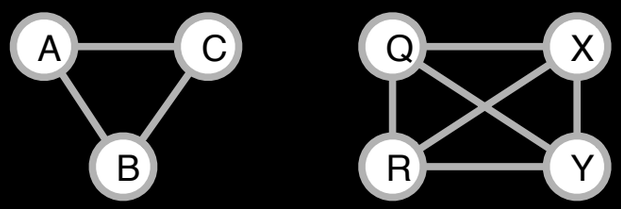
Domain Tasks

- Find communities in zebra society, and identify influential individuals who play a role in shaping the social structure
- Understand how the social structure of Grevy's zebra evolve over-time

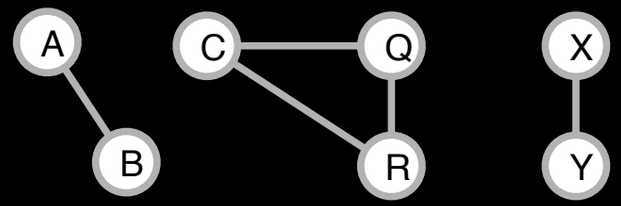
Action: Understand = Compare (mostly)

Target: All communities over time

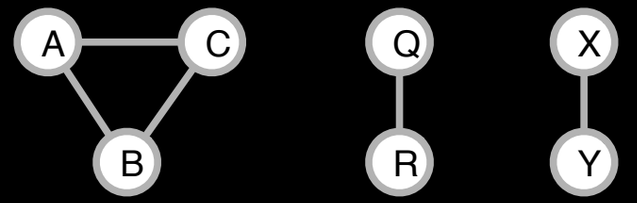
Find Communities



T1

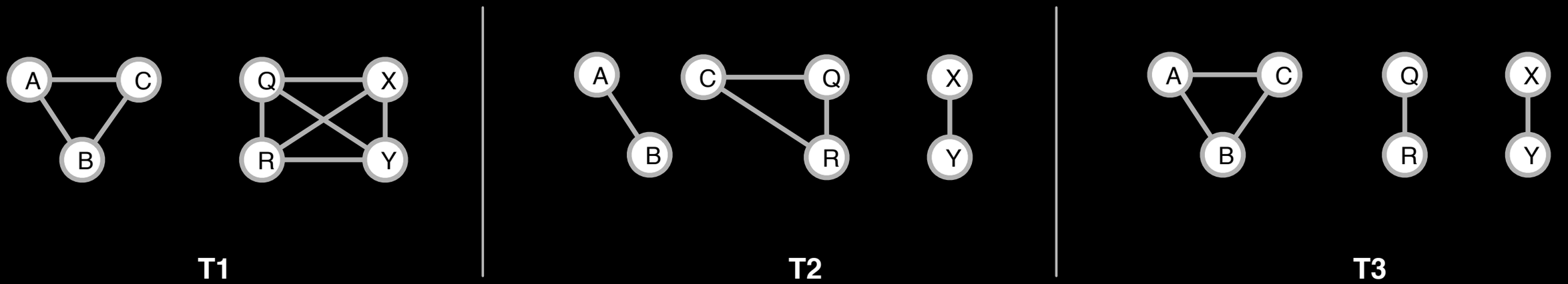


T2



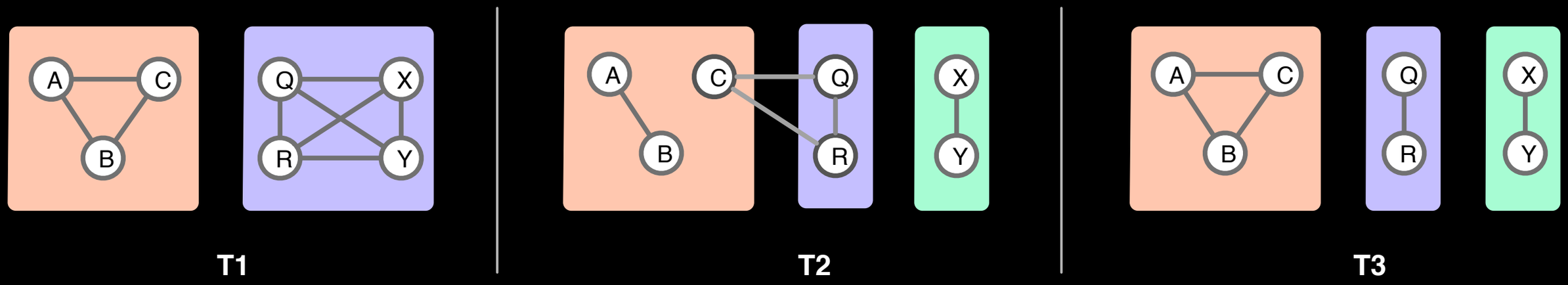
T3

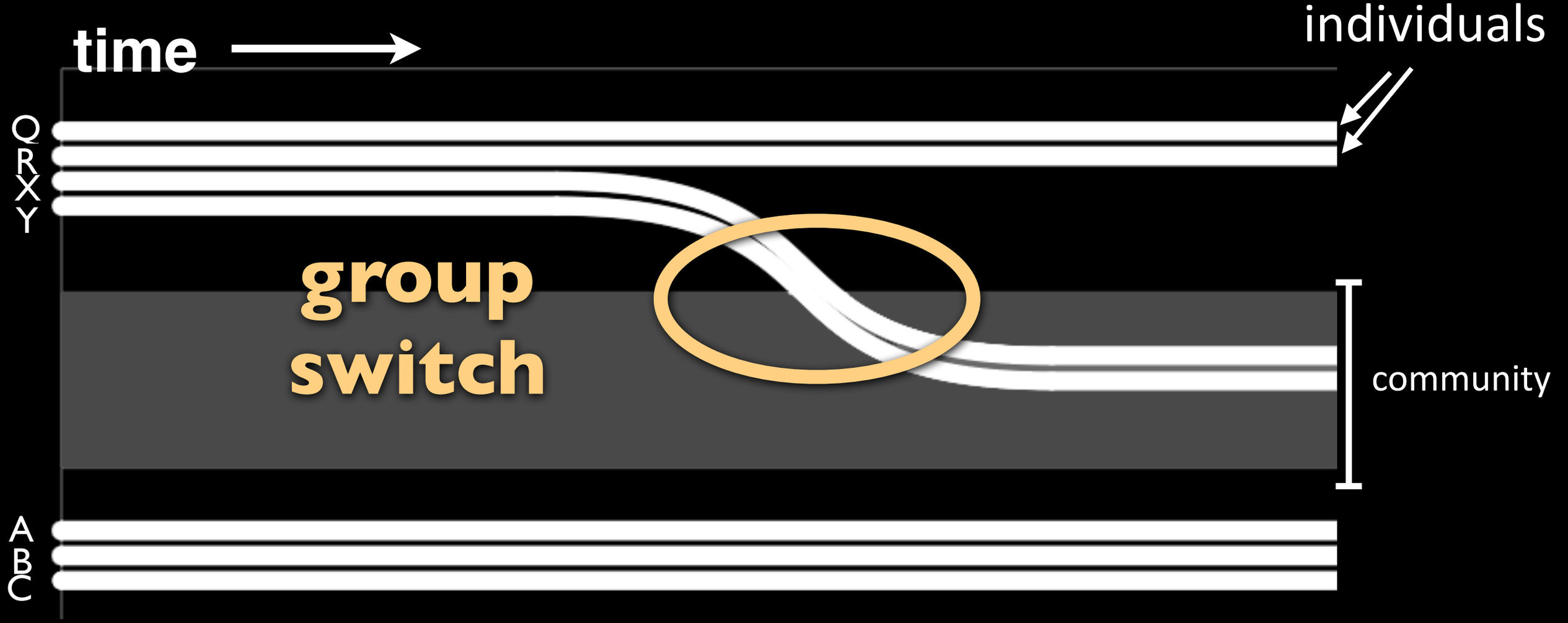
Find Communities



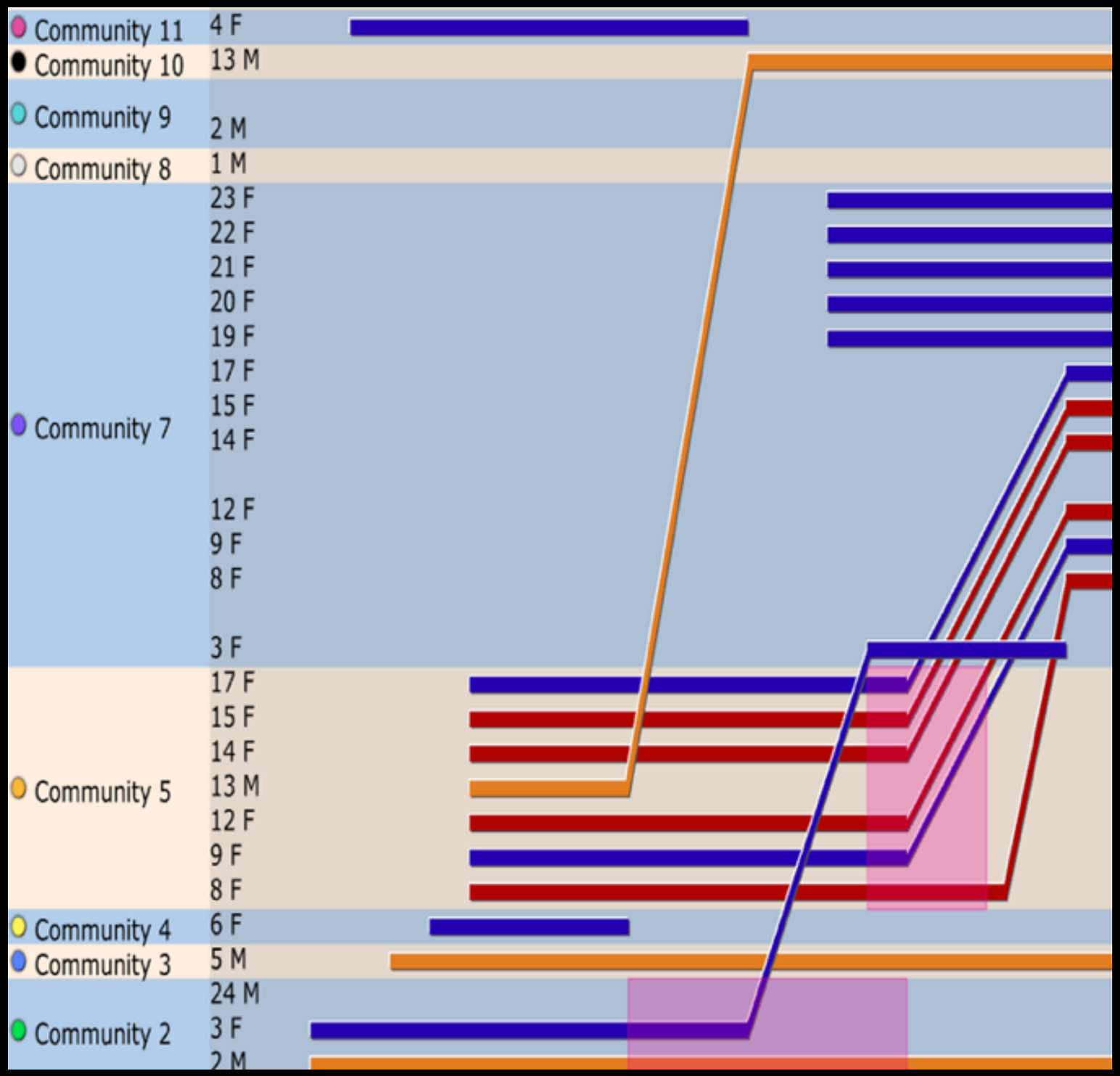
- Individual are reluctant to switch community - **switching cost**
- Individual are mostly seen with their community - **visiting cost**
- Individuals are rarely absent from their community - **absence cost**

Find Communities





Time-changing groups



individuals

community

Domain Tasks

- Find communities in zebra society, and identify influential individuals who play a role in shaping the social structure
- Understand how the social structure of Grevy's zebra evolve over-time
- Understand how Grevy's zebra society responds to environmental variables

Action: Link

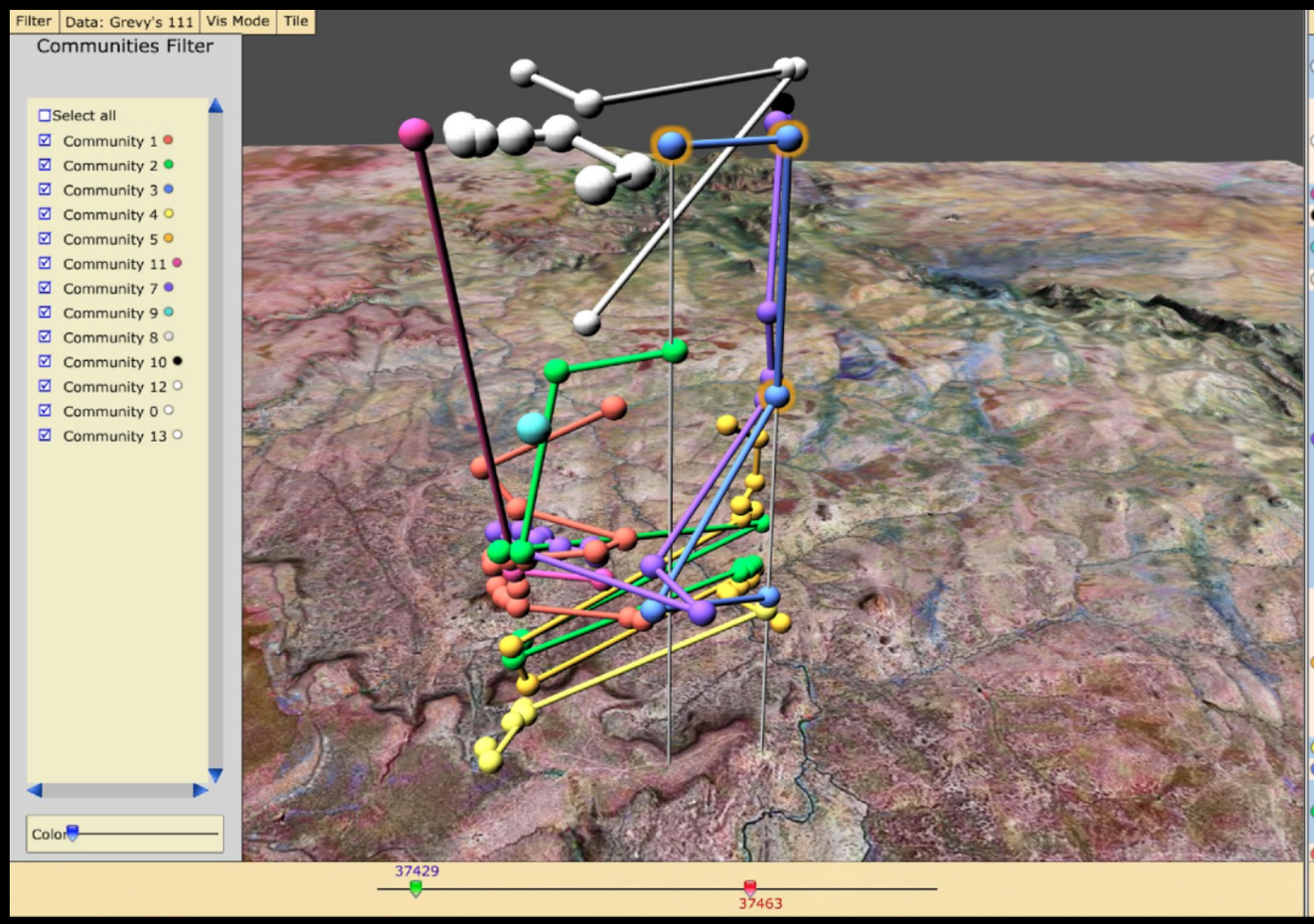
Target: Communities and their geo location

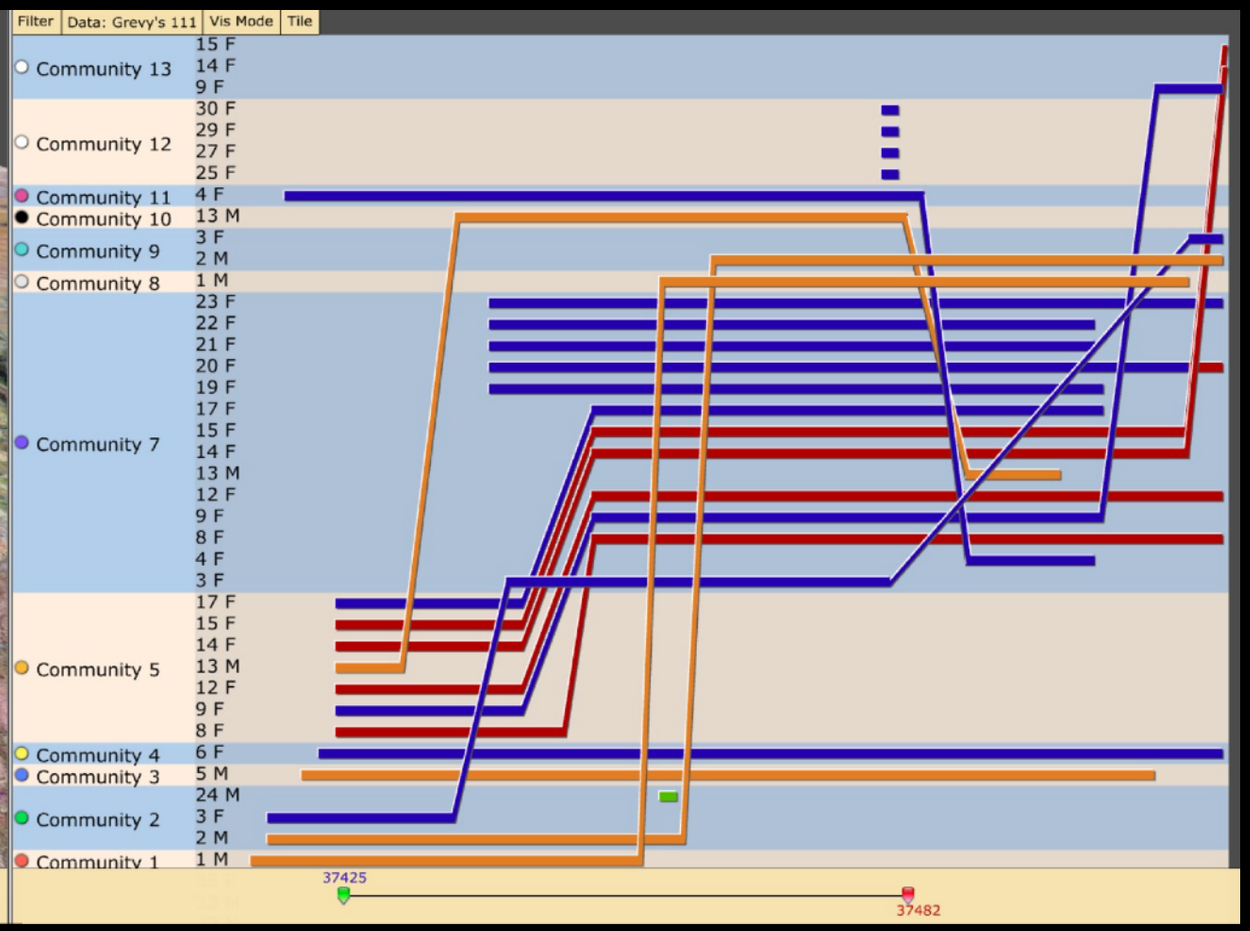
Social structure + geography

Group movement over space and time

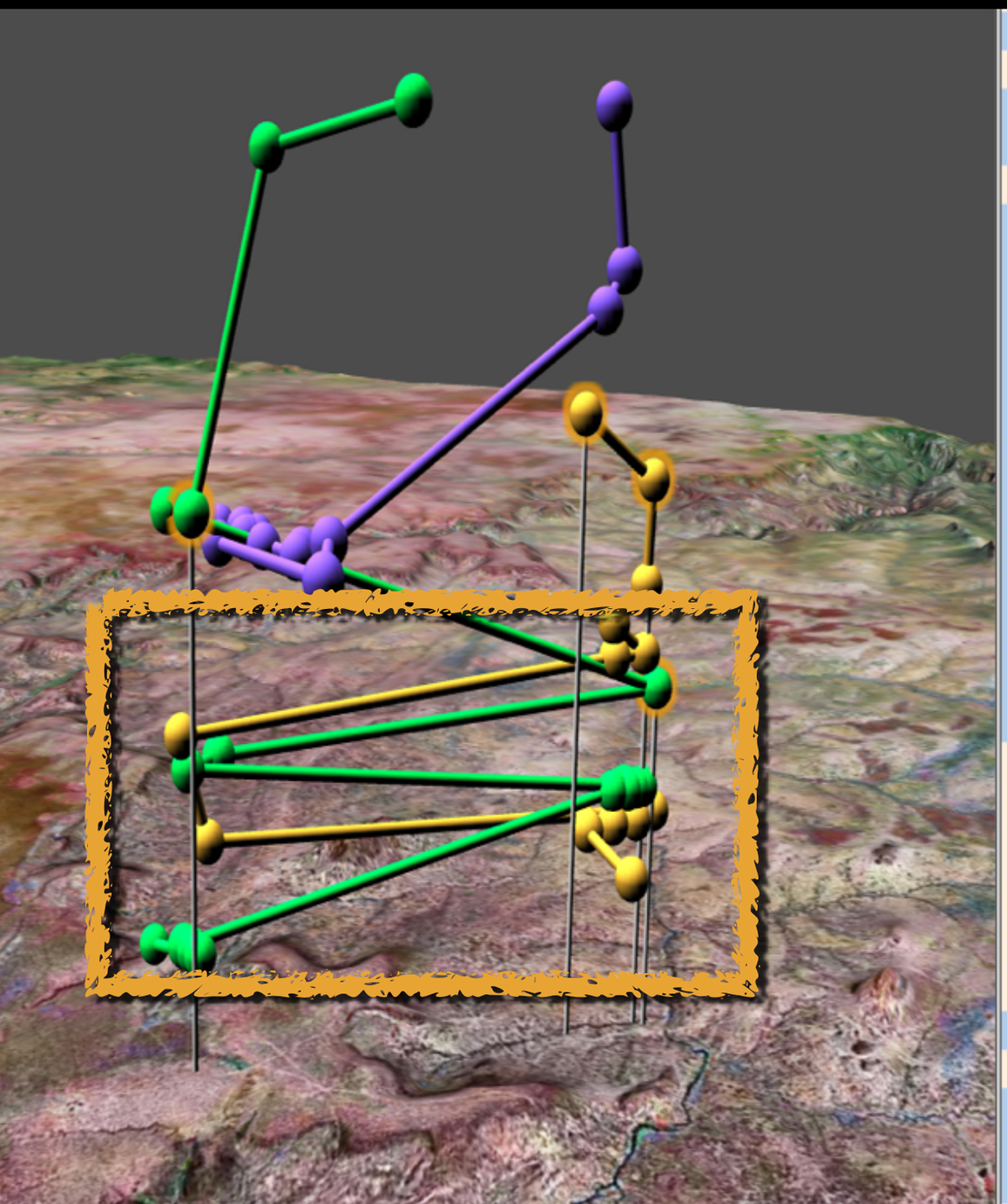
+

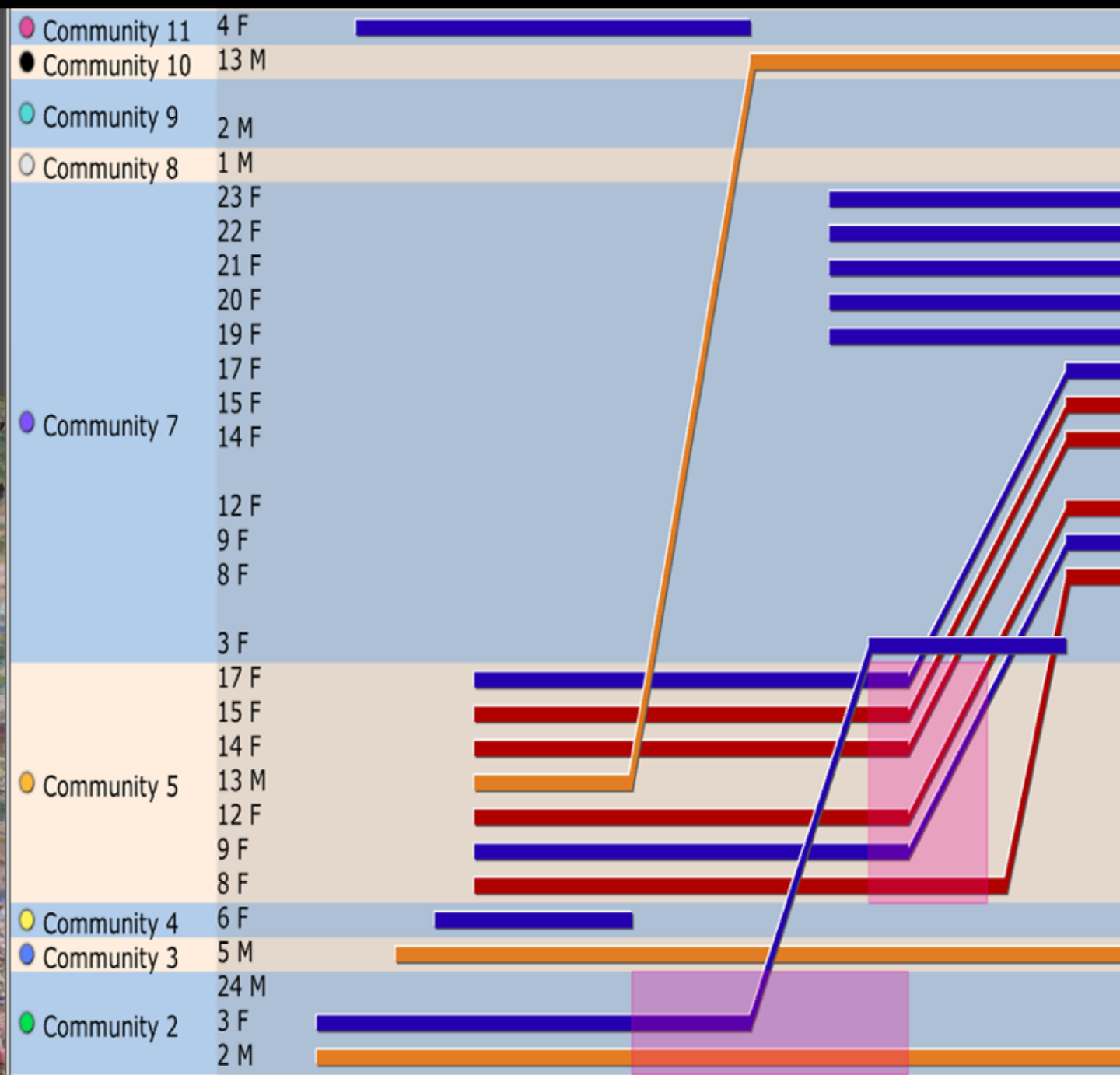
Social structure (communities)





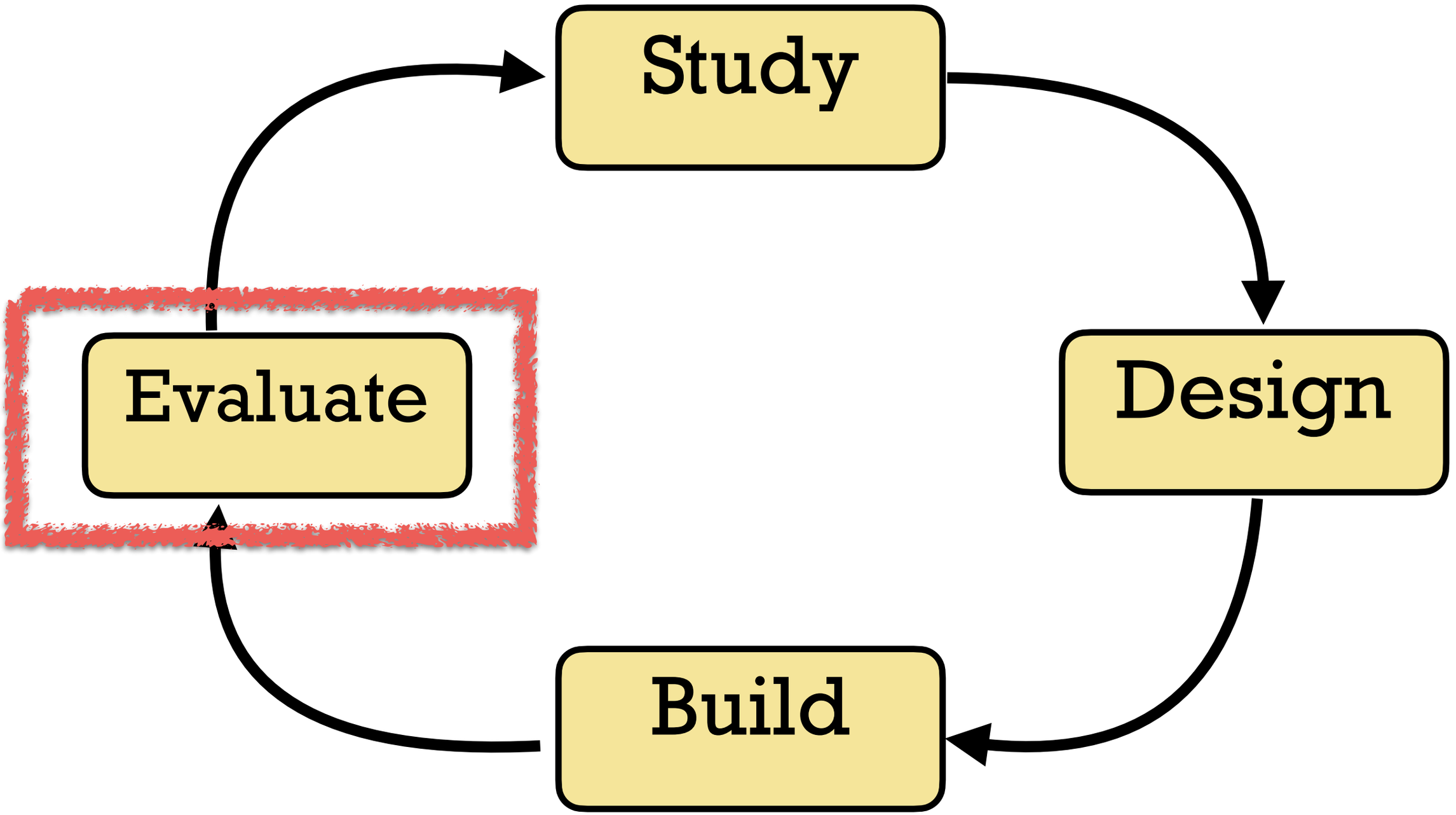
Social structure + geography





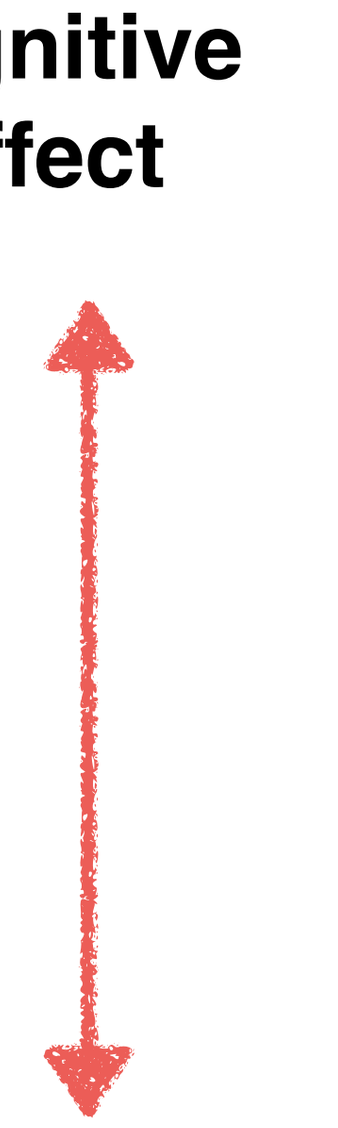
Evaluation

Visualization design process

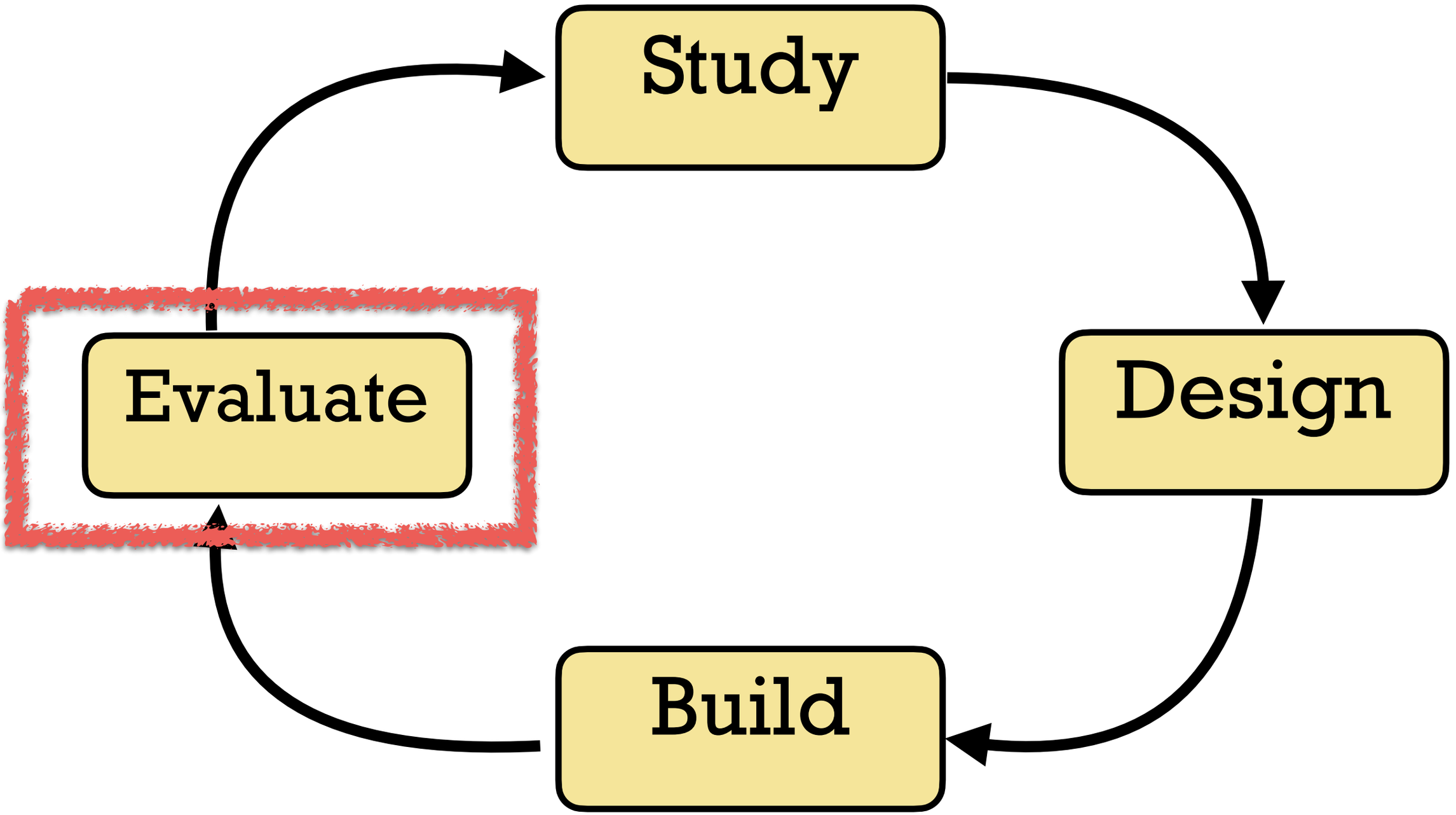


Why evaluate?

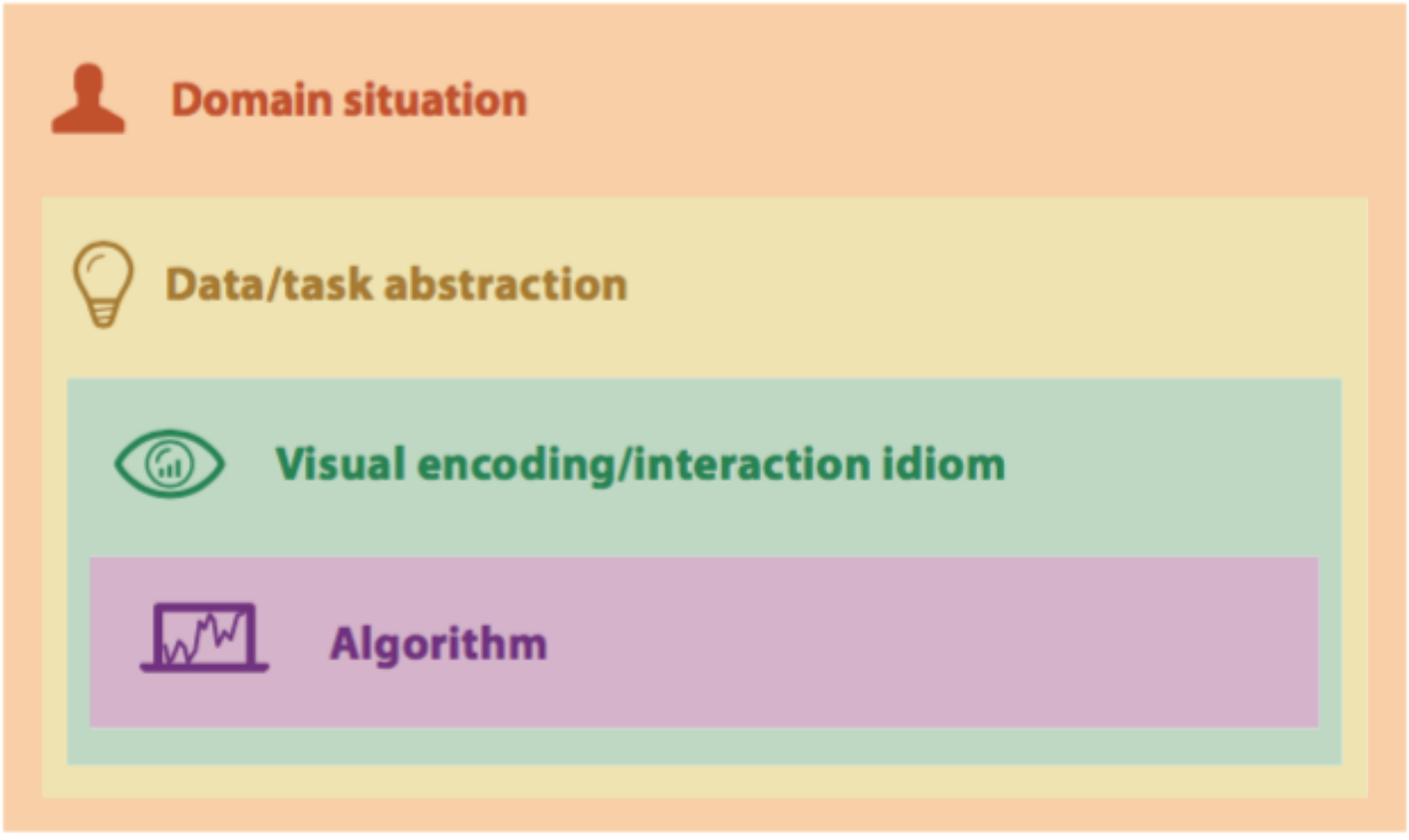
- **Evaluation / validation is "about whether you have built the right product"**
- Does it provide new insights about the data?
- Is the visualization memorable and/or engaging?
- Does it enable users to perform their intended analysis tasks?
- Does the visualization enable accurate perception of values, distributions, and/or trends in the data?
- Is it "easy" to use? Are there any usability issues in the interface?



Visualization design process

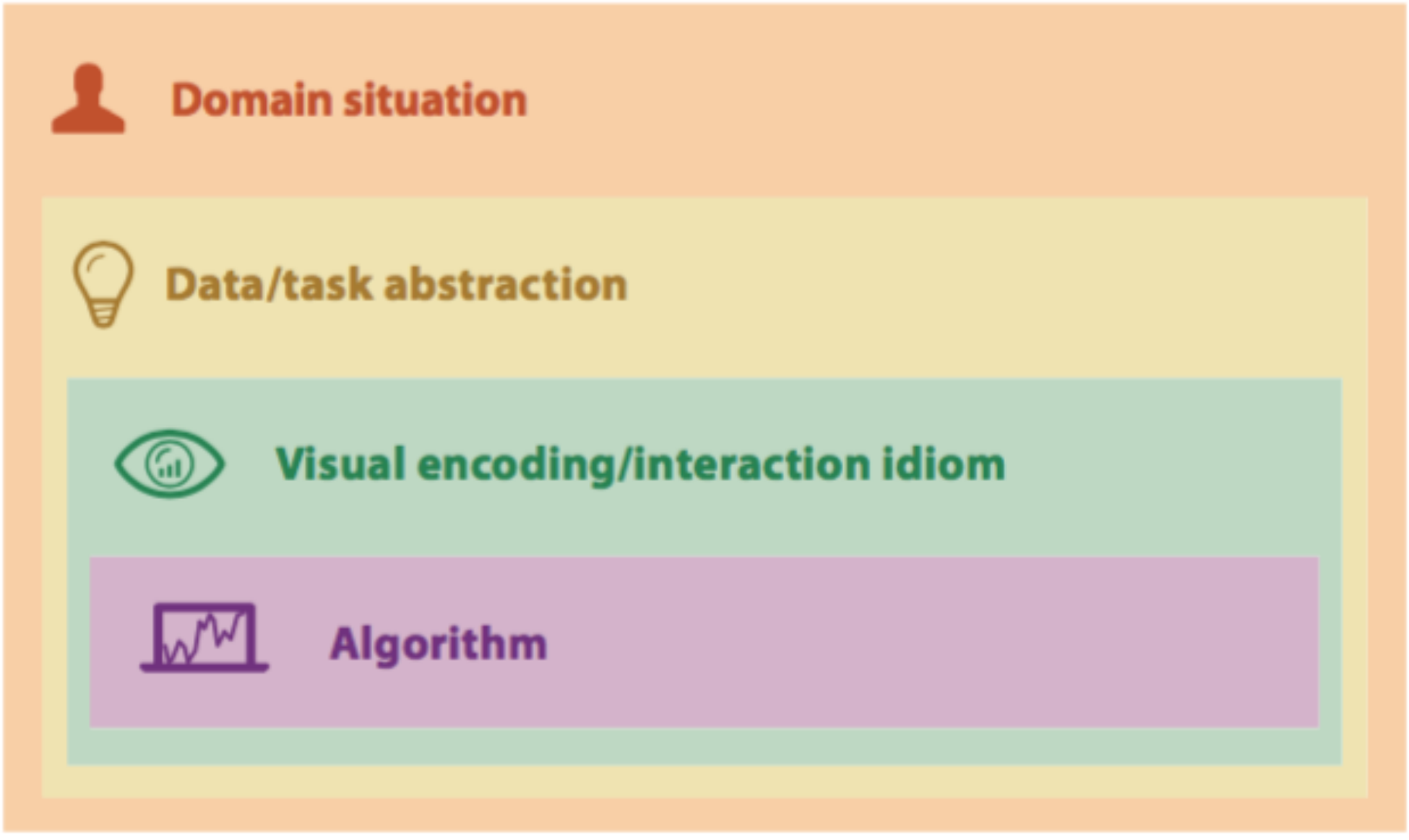


Four nested levels of vis design



Munzner, 2014

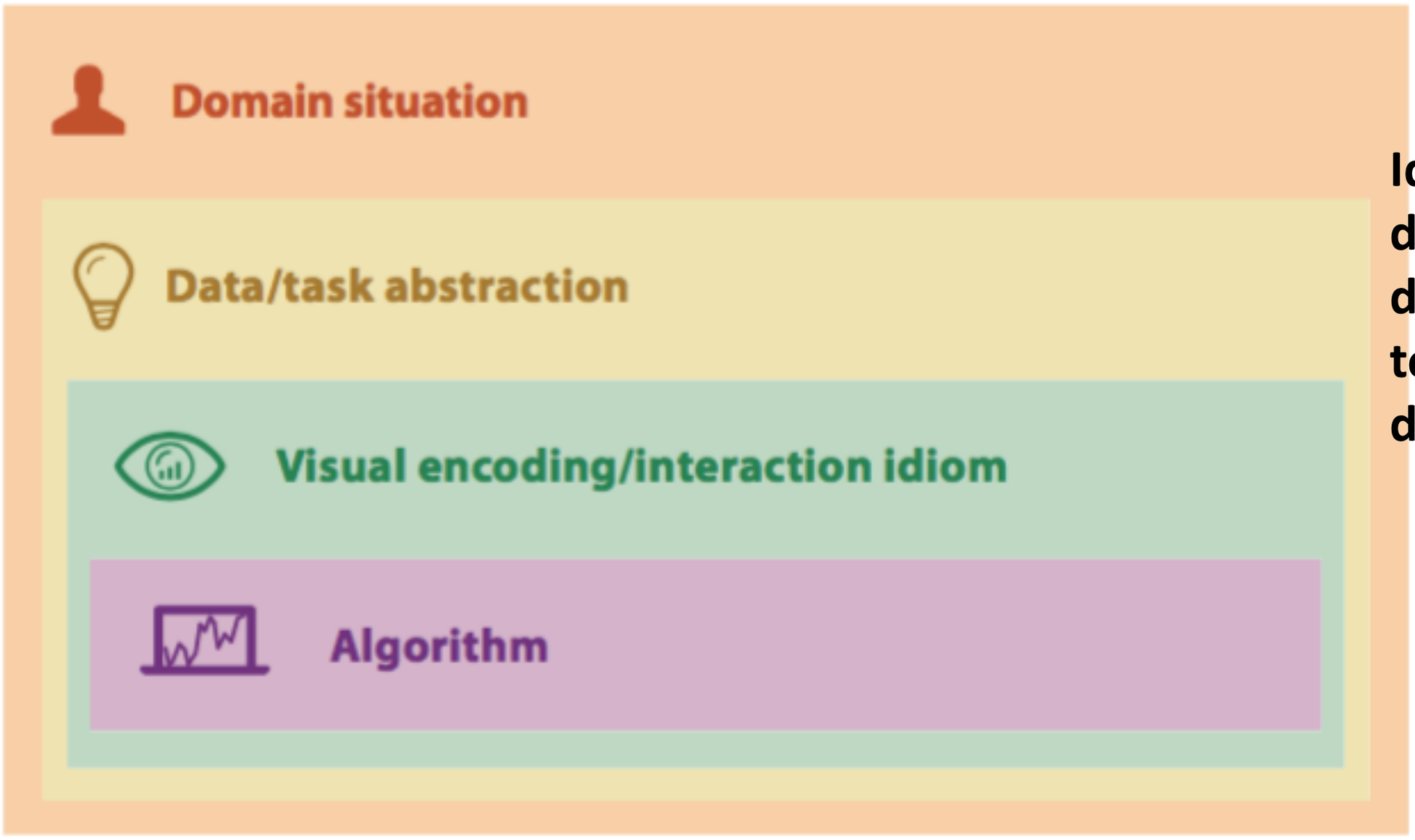
Four nested levels of vis design



Study domain, interview users, identify needs

Munzner, 2014

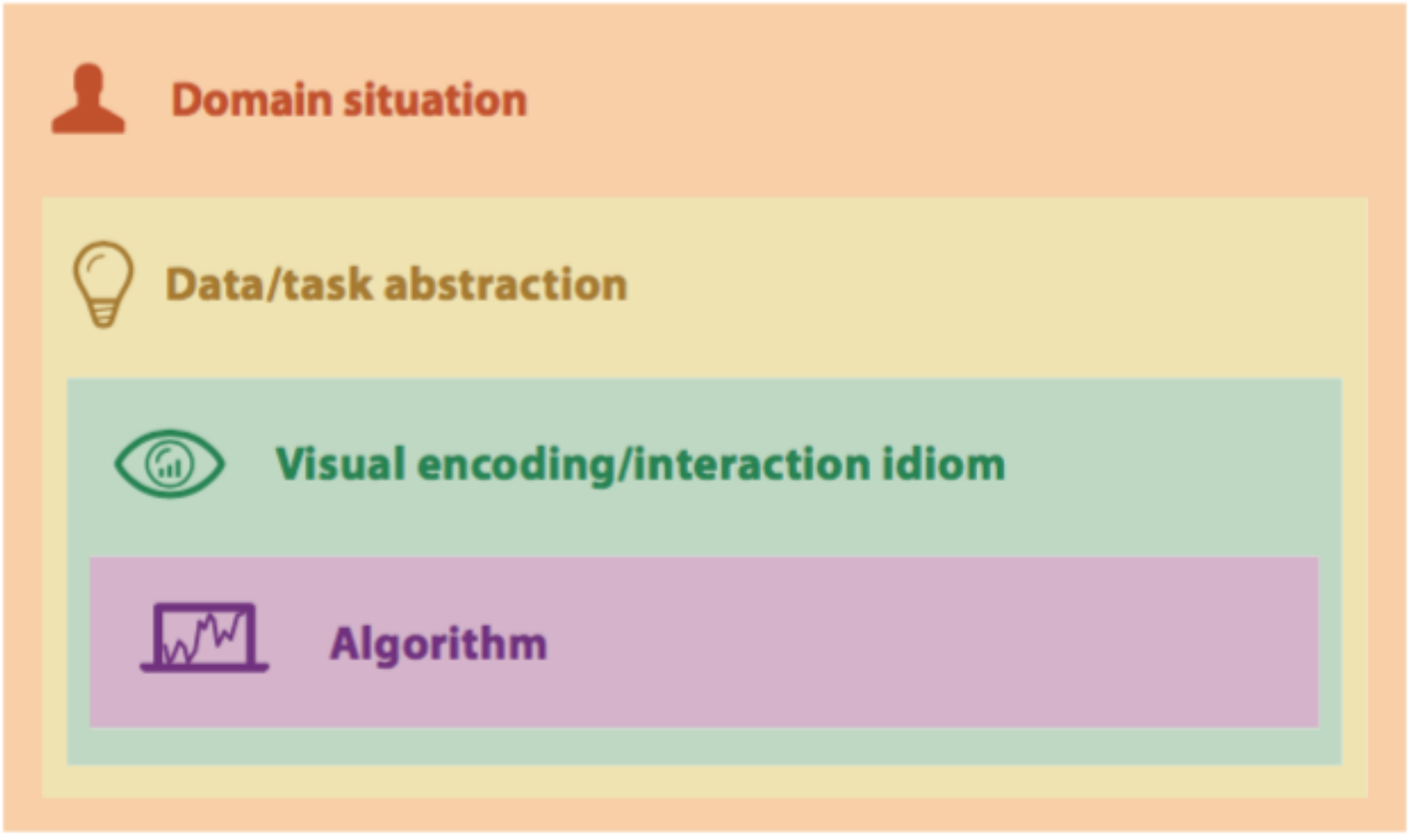
Four nested levels of vis design



Identify tasks and data. Translate from domain-dependent to abstract tasks and data types

Munzner, 2014

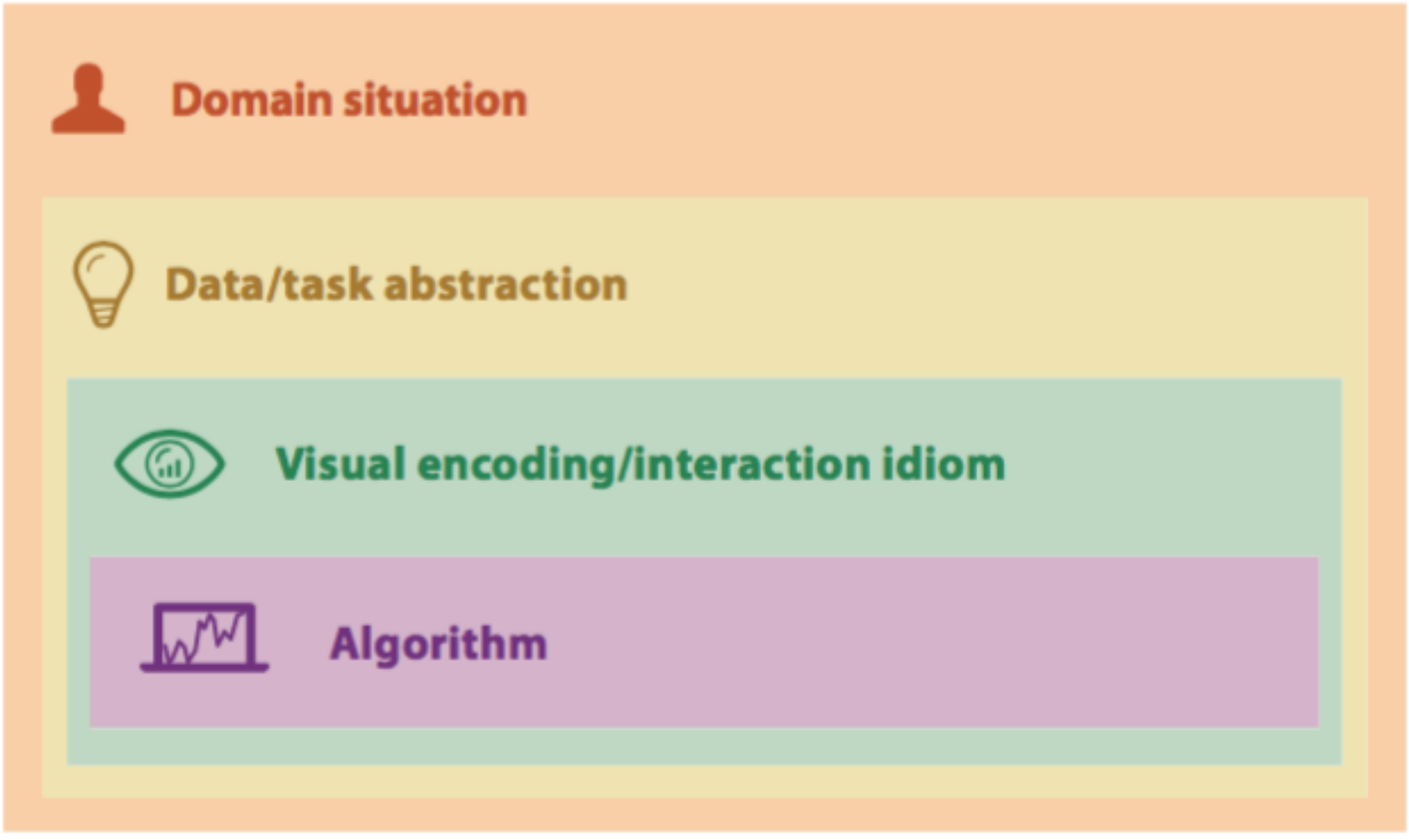
Four nested levels of vis design



Sketch/design visual encoding and interaction techniques

Munzner, 2014

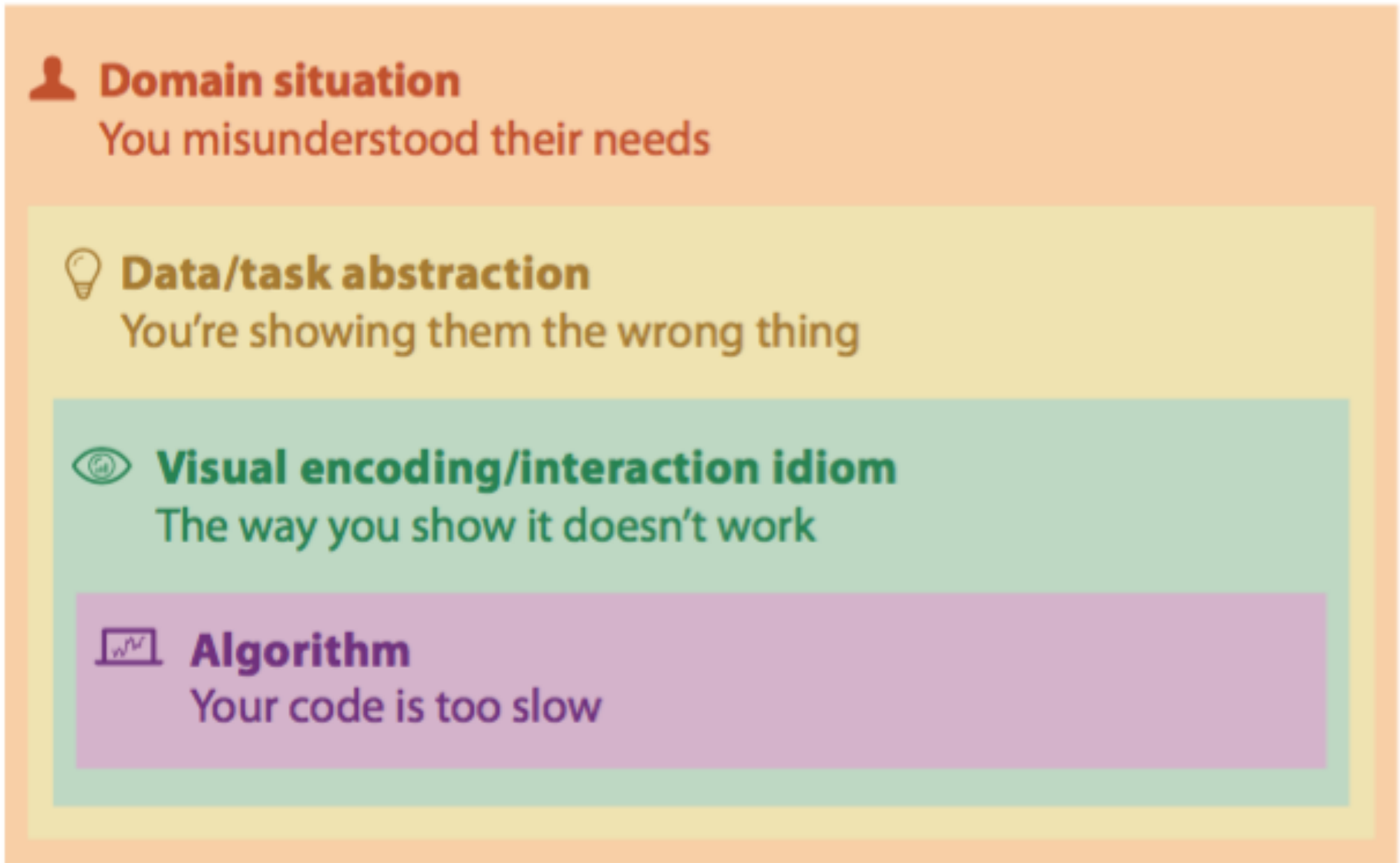
Four nested levels of vis design



Implement visualization using code

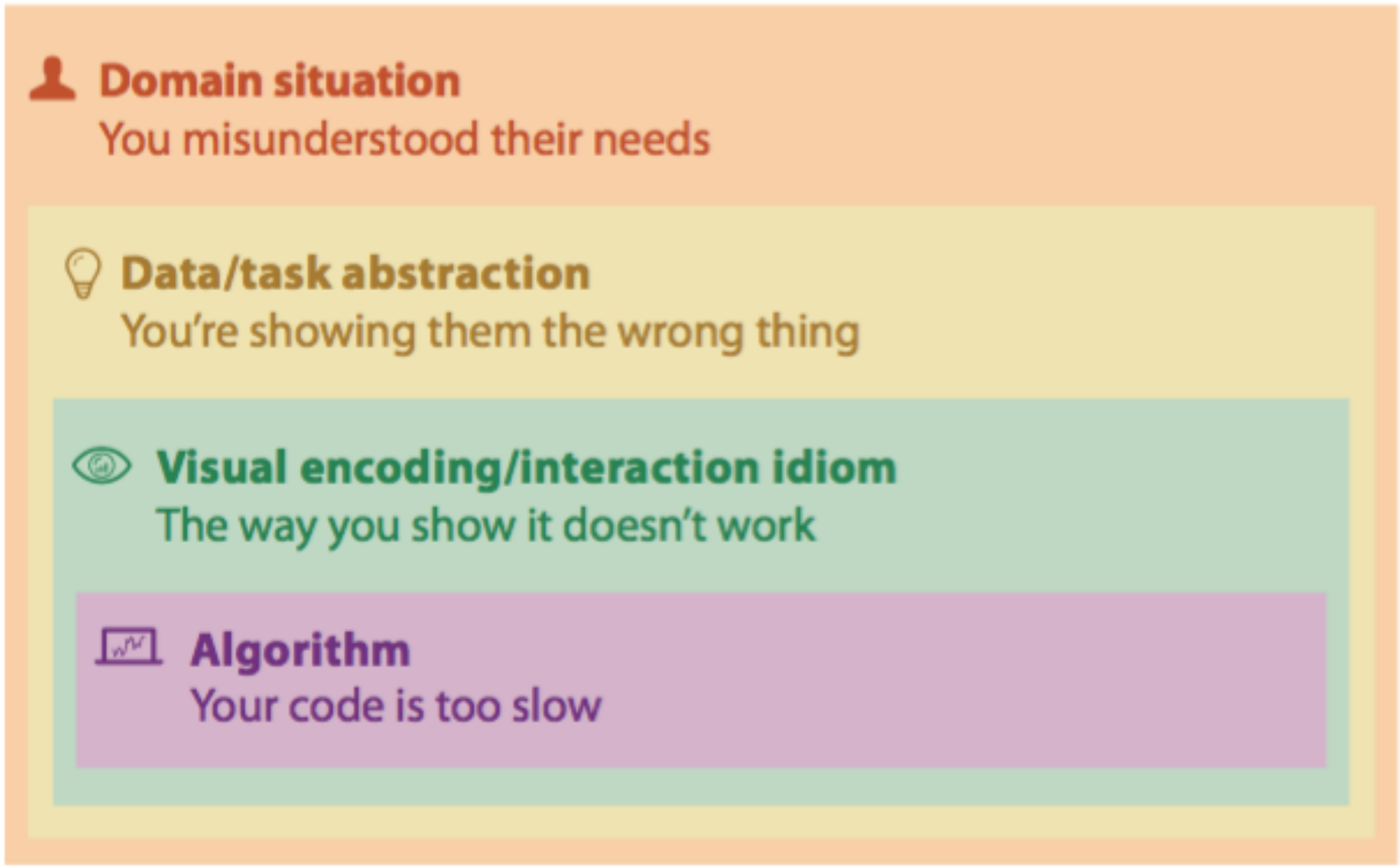
Munzner, 2014

Threats to validity



Munzner, 2014

Threats to validity



You misunderstood their needs

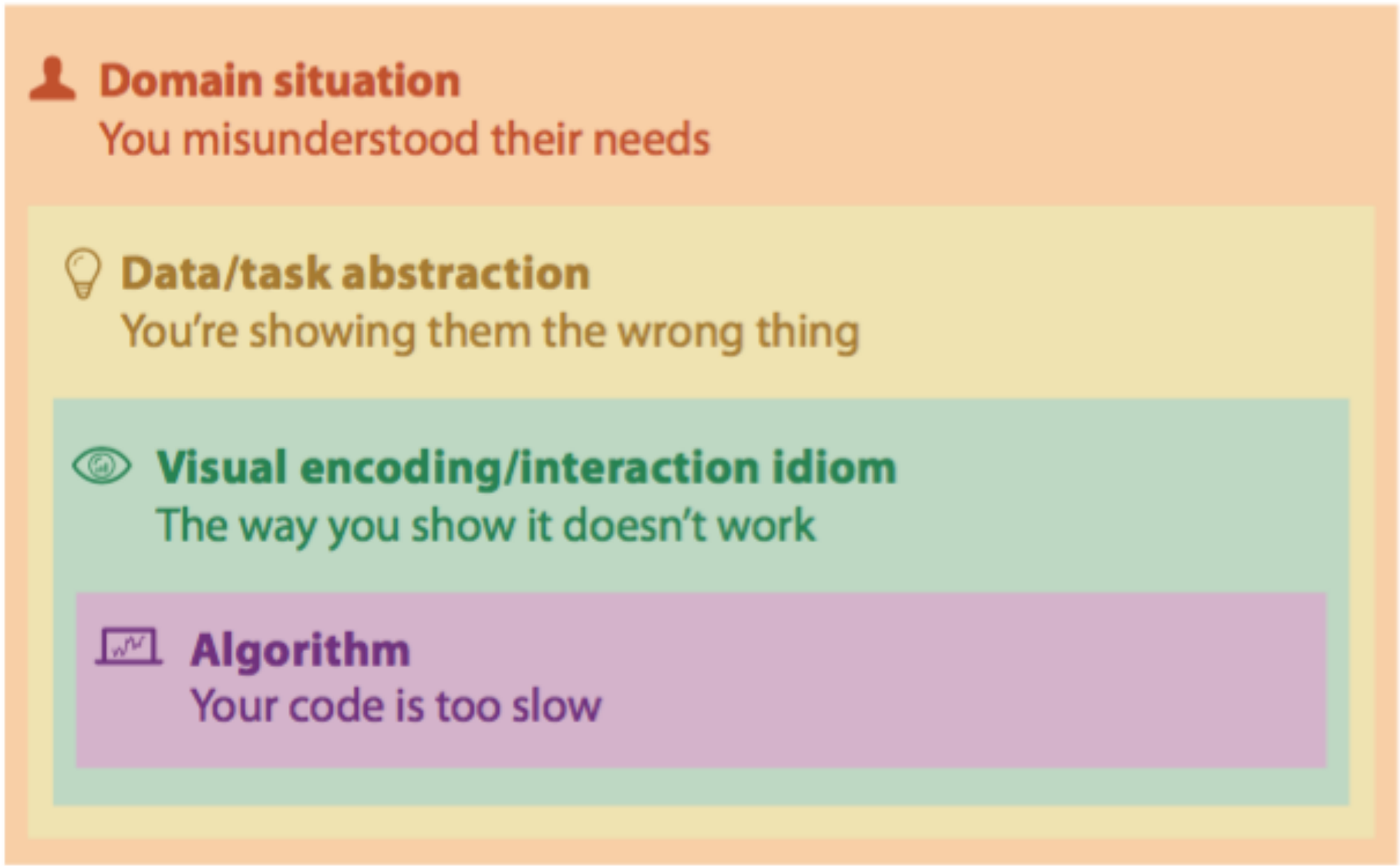
Munzner, 2014

Threats to validity

You're showing them the wrong thing

Munzner, 2014

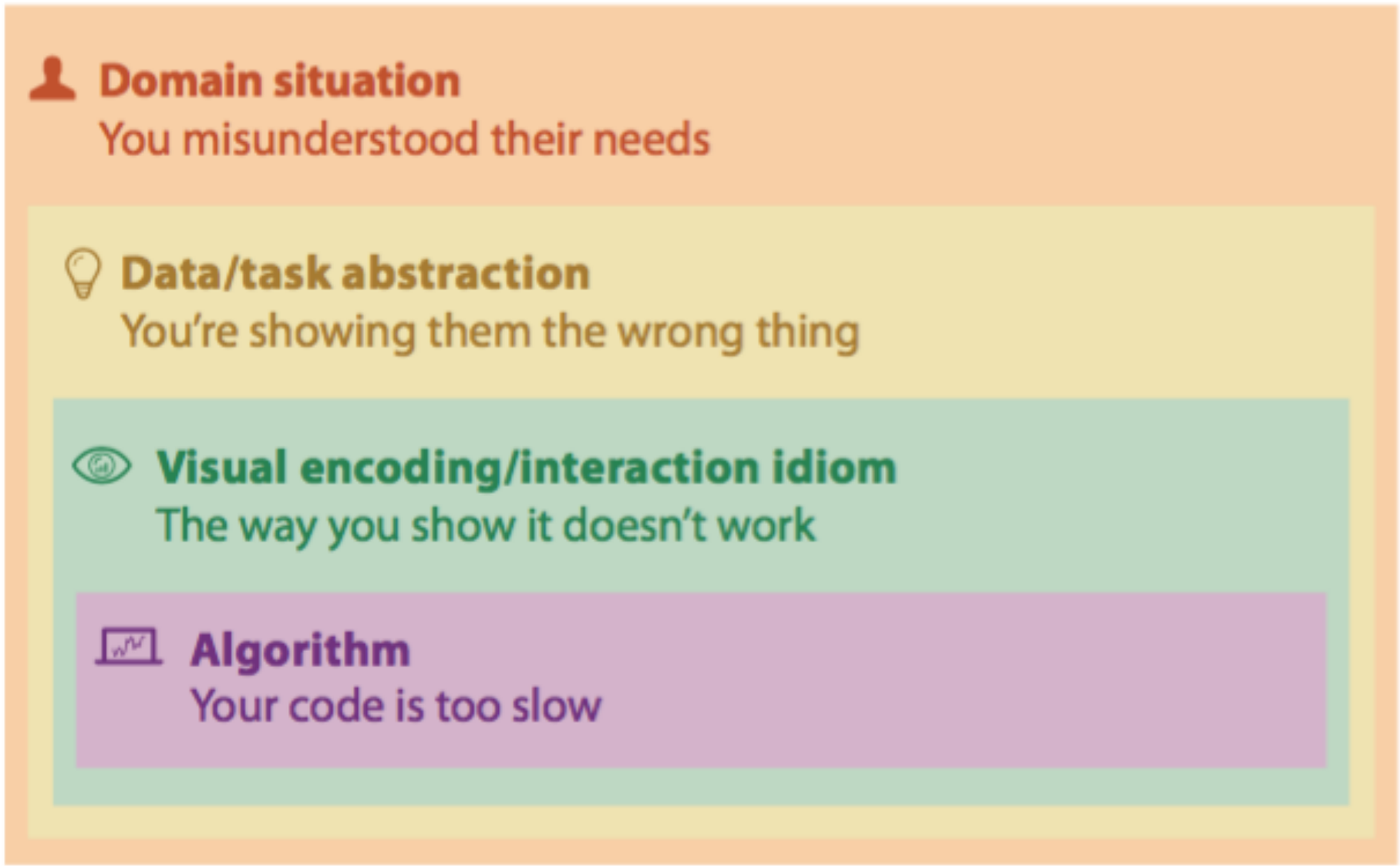
Threats to validity



The way you show it doesn't work

Munzner, 2014

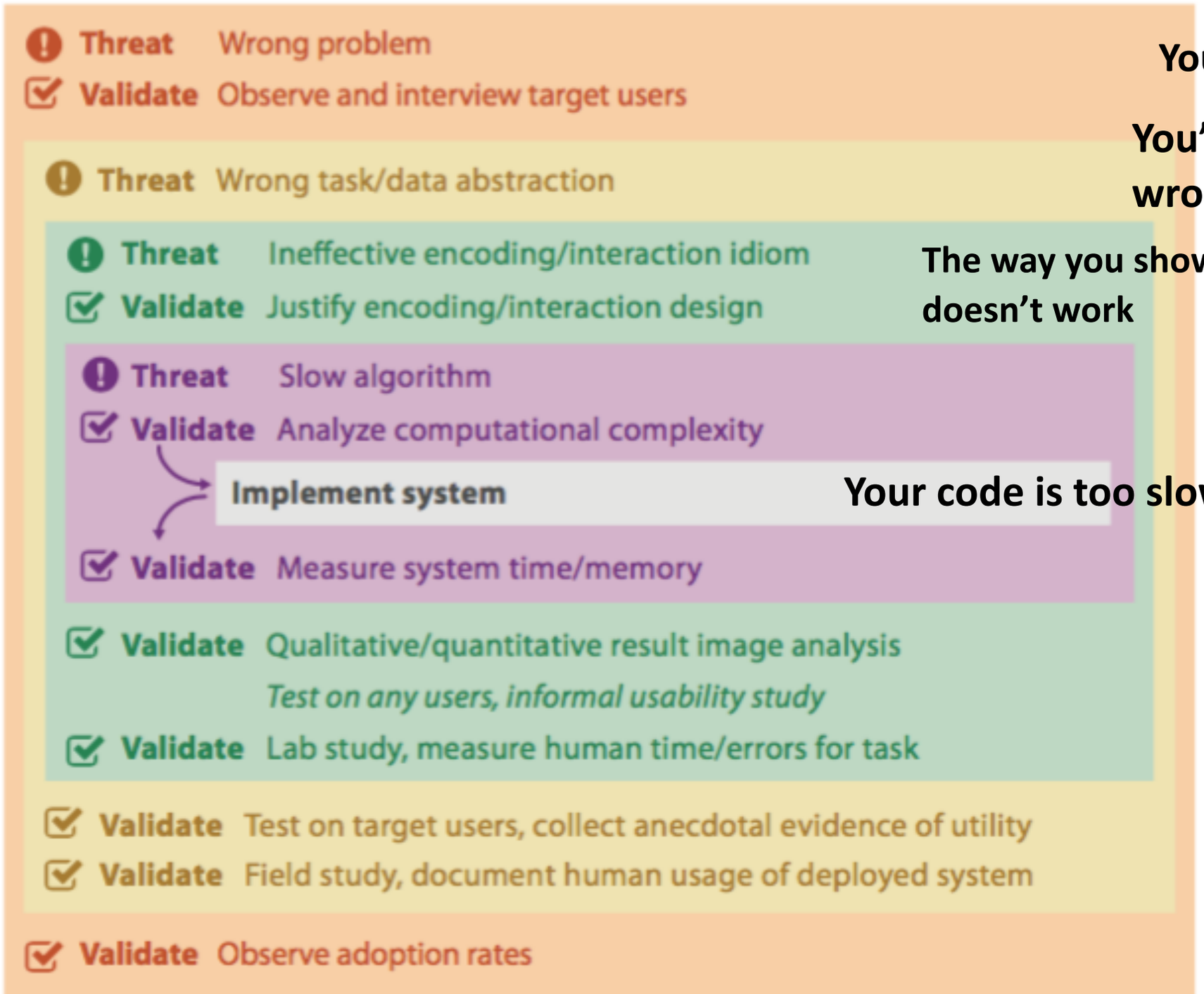
Threats to validity



Munzner, 2014

Your code is too slow

Guard against threats



You misunderstood their needs

You're showing them the wrong thing

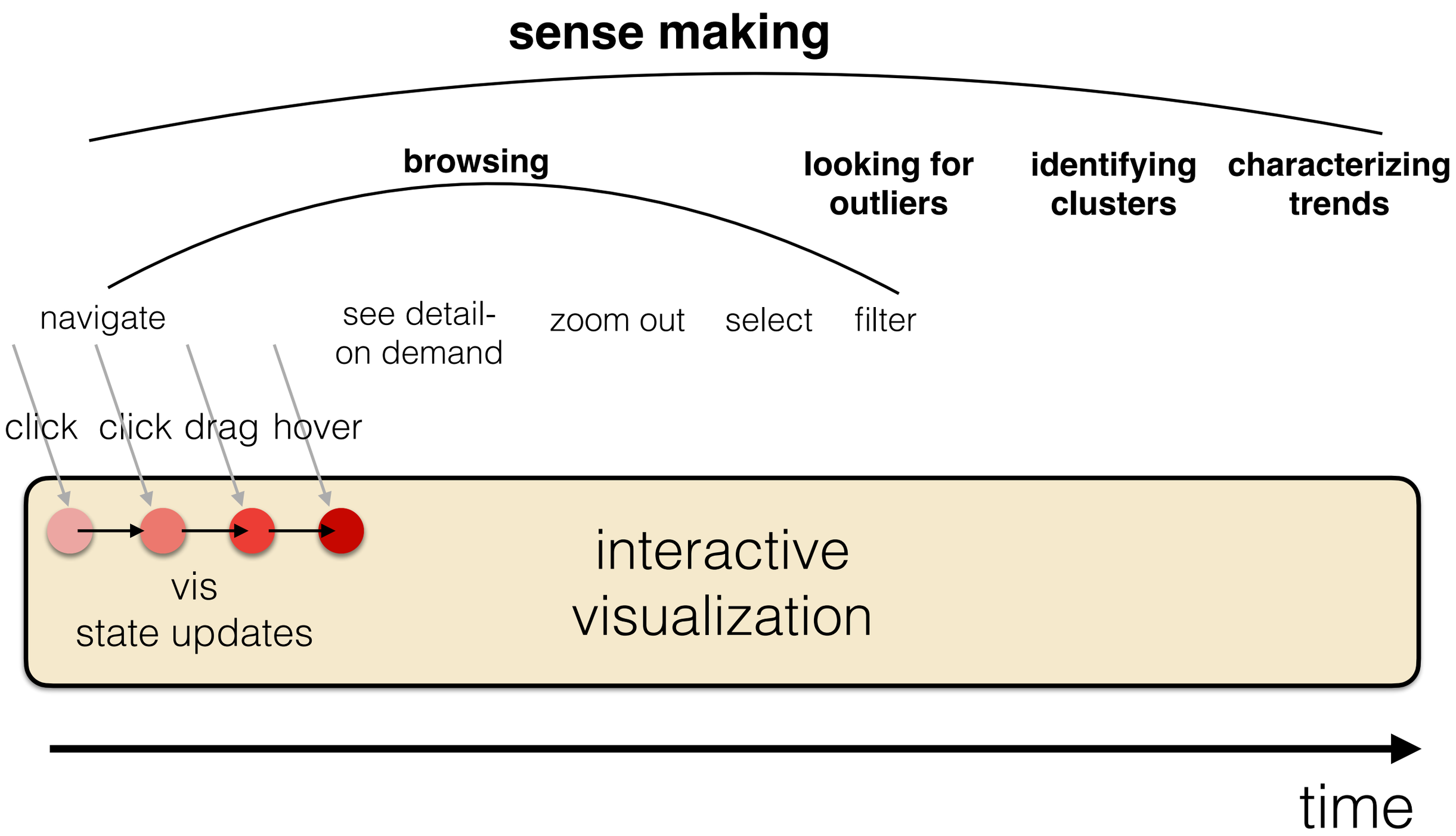
The way you show it doesn't work

Your code is too slow

Munzner, 2014

Extra

Visualization tasks



Evaluation methods

- Evaluate algorithm speed / memory usage
- **Controlled [lab] studies with any user**
- **Qualitative studies**
- **Insight-based evaluation**
- **Evaluating the data analysis process**
- Field deployment

Controlled [lab] studies

- Goal is to typically evaluate **graphical perception**
- Allows for **comparison** between different techniques or representations
- Generally provides accurate results, but they may not generalize beyond lab conditions or tested tasks
- Typically **quantitative** in nature
    - Finely-scoped tasks
    - Measure user accuracy, performance time, and/or subjective preference
    - Focus is typically on the **analysis outcome**

Qualitative studies

- Usually open-ended usage scenarios
- Smaller number of participants compared to quantitative lab studies
- More in-depth analysis of how participants use, interact with, and reason about the visualization
- Focus is on the **analysis process**
- Analyze videos, audio, or comments from users
- Can ask participants to fill surveys, or provide subjective feedback on the visualization
- Usually involves domain experts and target audience of the visualization

Insight-based evaluation

- The goal of visualization is to generally generate new insight
- Evaluation should therefore include **insight-generation**
- Think-aloud protocols: have the users say what they are thinking
- Transcribe and code:
  - Observation
  - Hypothesis
  - Question
  - Exploratory goal

Evaluating the data analysis / exploration process

- The focus is on the **visual analysis process** of users, as opposed to the outcome of the analysis
- Want to understand the analytic dialogue between the user and the data
- Want to capture and analyze multiple aspects:
  - **Interactions with the visualization**
    - Interaction logs, videos
  - **Reasoning process**
    - Think aloud protocol: have the participant say what they are thinking
  - **Eye gaze behavior**