



# LinkDaViz

*Visualizing & Exploring Linked Data*

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# + Approach

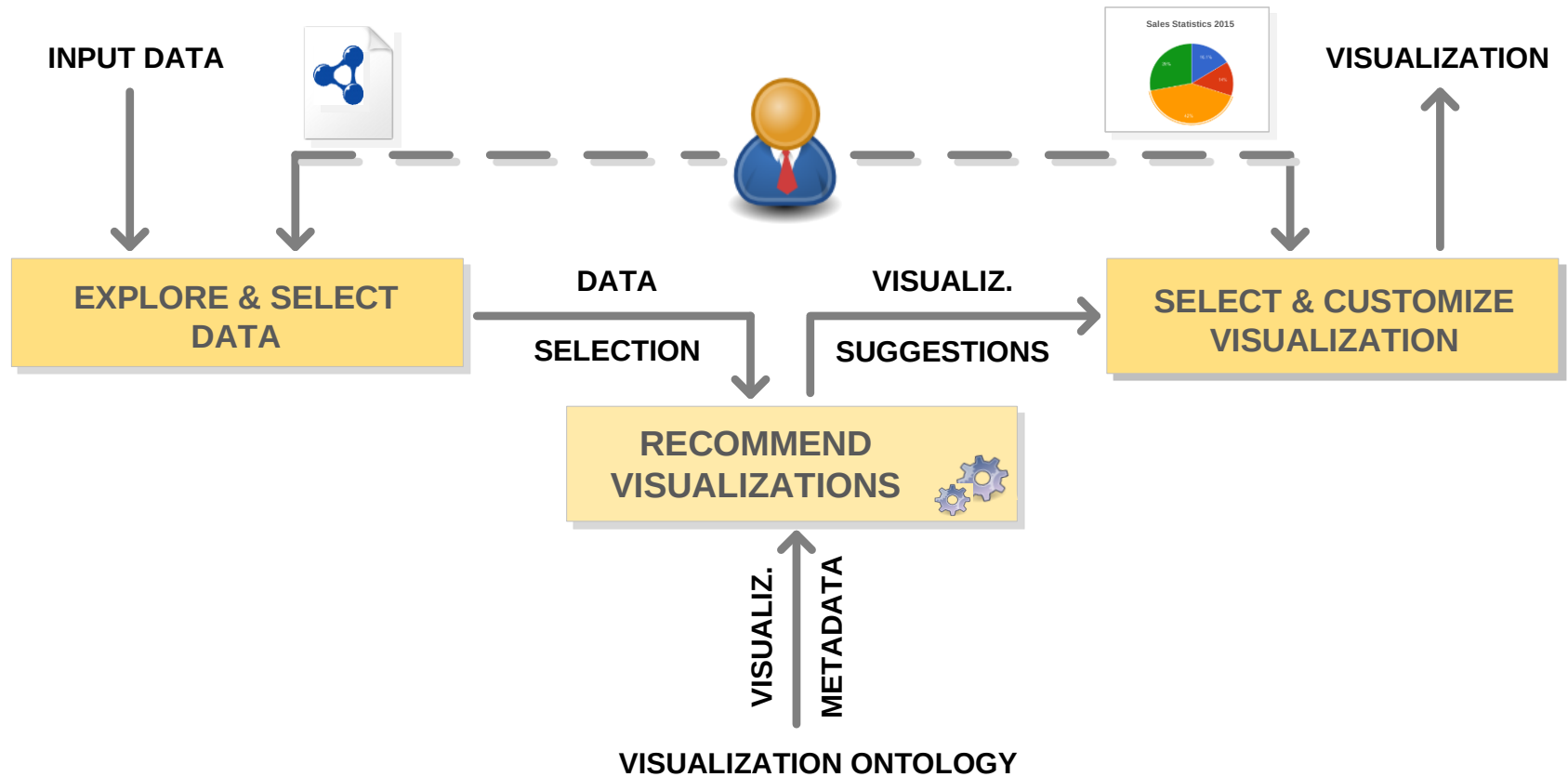


# Approach

- Largely automatic visualization workflow
  - ➔ Guide user through selecting and visualizing data
  - ➔ Compute visualization recommendations
- Heuristic analysis of the input data
  - ➔ Data categorization
- Automatic matching and binding of data to visualizations
  - ➔ Weighted bipartite graph matching problem



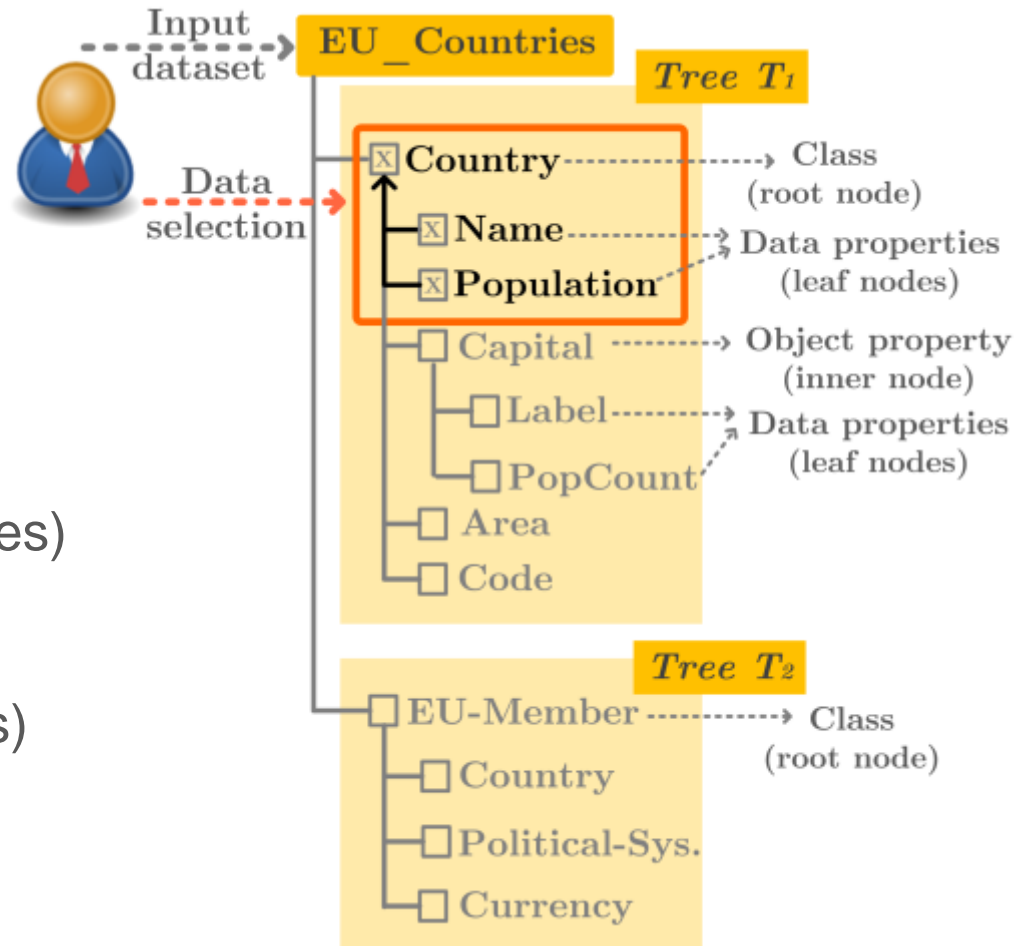
# Visualization Workflow





# Dataset Representation

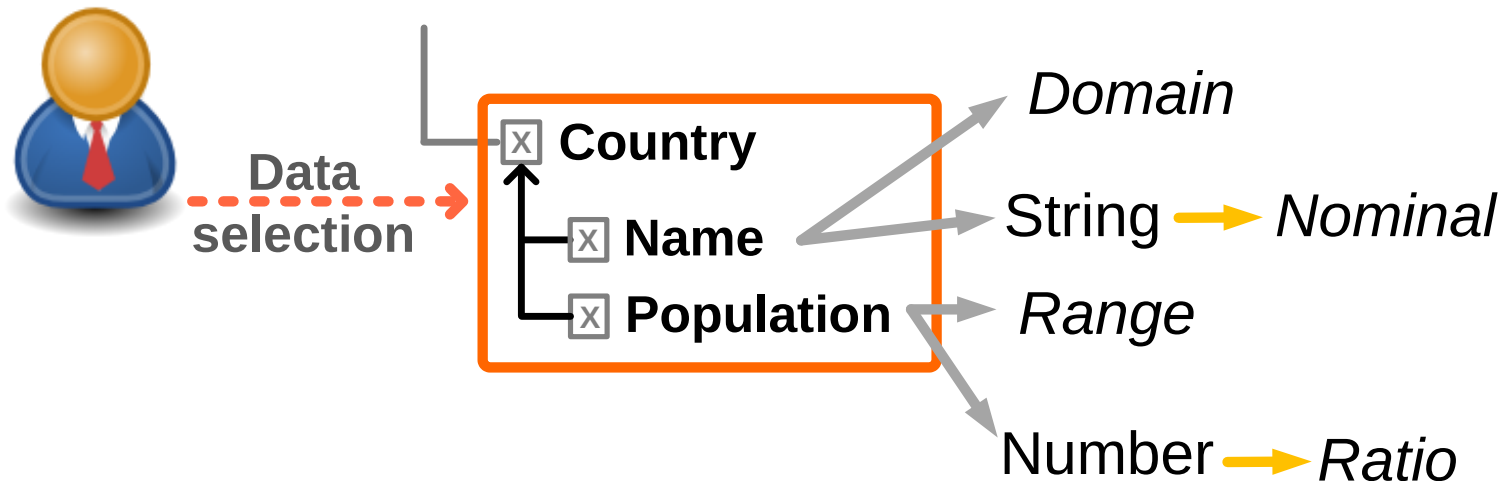
- Dataset as a list of trees
- Each directed tree has a
  - Root node (RDF class)
  - Set of nodes:
    - Inner nodes (RDF object properties)
    - Leaf nodes (RDF data properties)



# + Data Representation

- Data properties have a
  - Scale:** *Nominal* ← *Interval* ← *Ratio* (Hierarchy by S.S. Stevens)
  - Role:** *Domain*, *Range*

➔ Heuristically categorize input data based on data types and specific (metadata) vocabularies

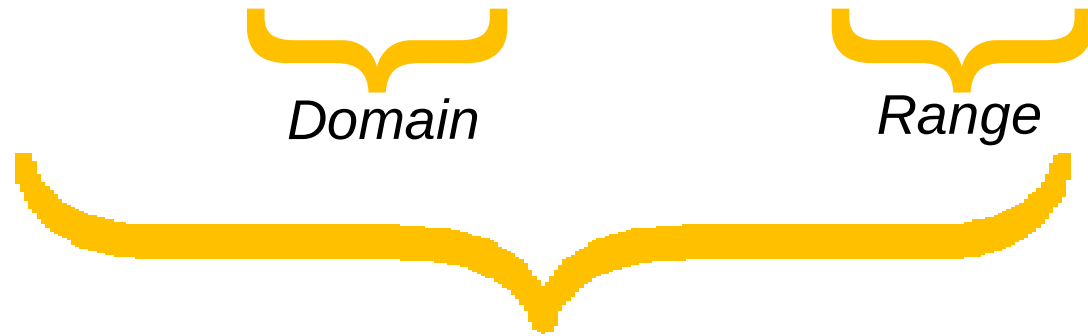
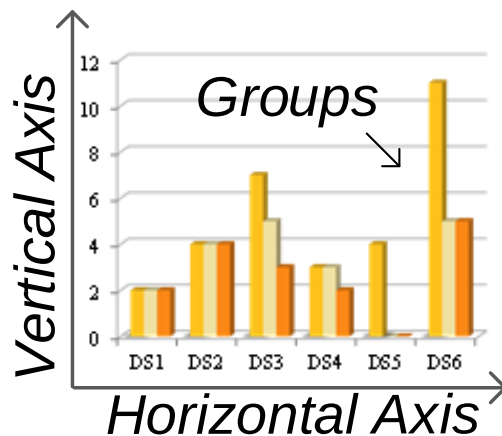




# Visualization Representation

- Visualization as a set of structural and layout parameters
- Structural parameters describe the visualization skeleton

**Column Chart:** *Horizontal Axis X Groups?* → *Vertical Axis*



**Visualization Parameter Pattern**

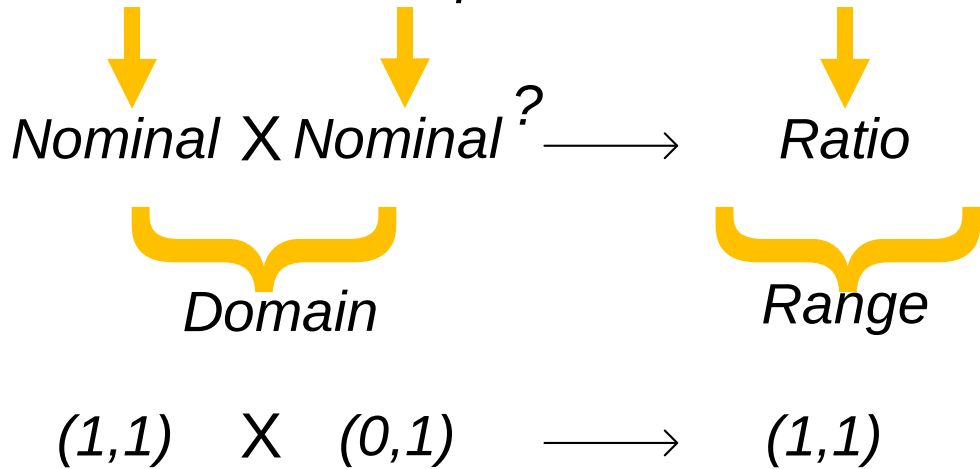
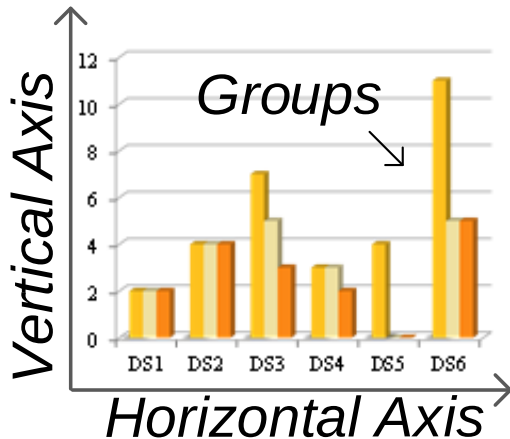




# Structural Parameters

- **Set of scales:** *Nominal* ← *Interval* ← *Ratio*
- **Role:** *Domain, Range*
- **Cardinality:**  $(0, 1)$ ,  $(0, *)$ ,  $(1, *)$ ,  $(1, 1)$

**Column Chart:** *Horizontal Axis X Groups?* → *Vertical Axis*

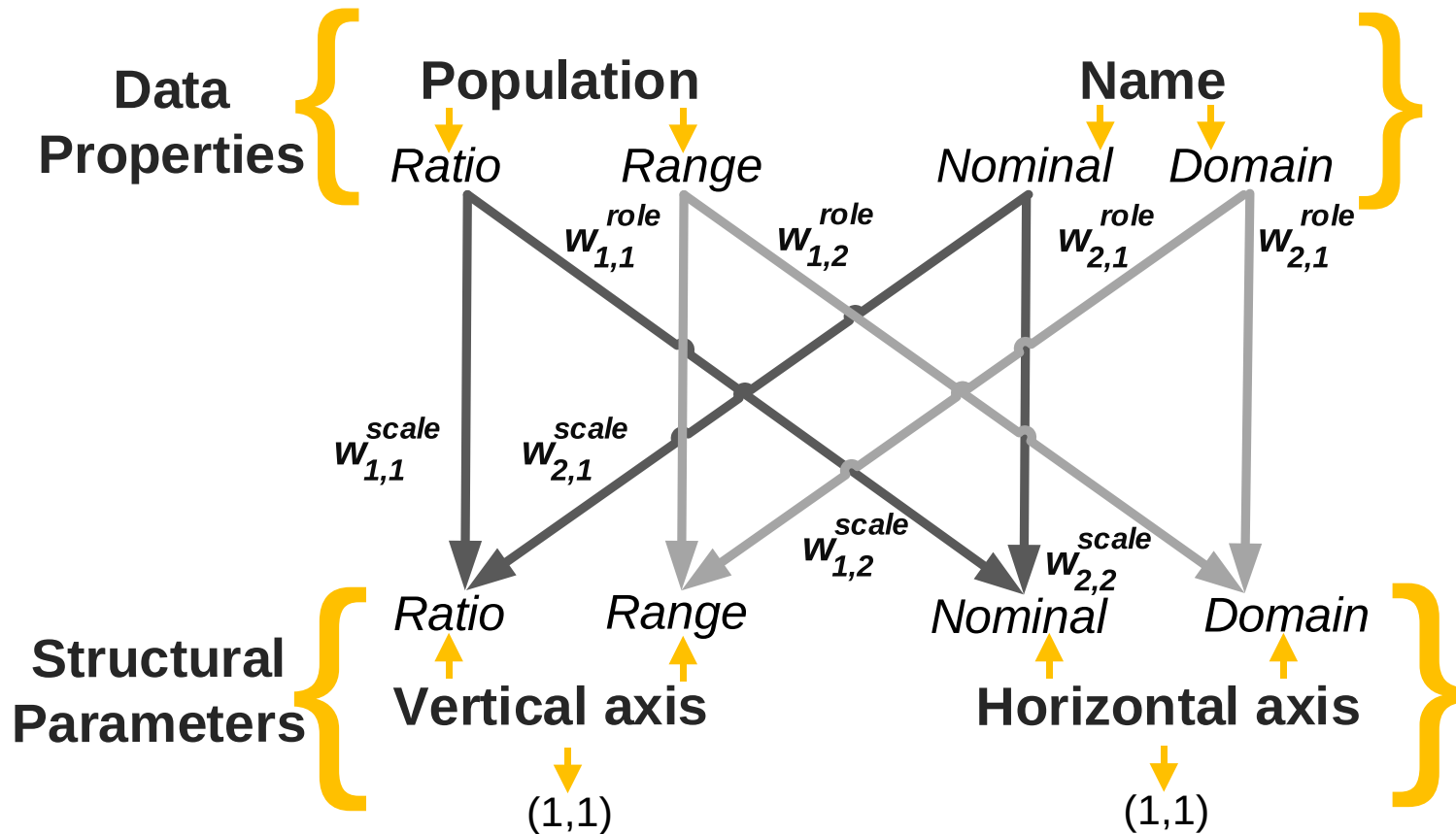






# Mapping Data to Visualizations

- ... find a mapping with max assignments and min cost





# Scales Penalty

- Match btw. data property and structural visualization parameter scale:
  - Perfect:** Data scale = Parameter scale
  - Invalid:** More generic data scale → Specific parameter scale
  - Penalize** (depending on information loss):
    - Specific data scale → Generic parameter scale
- E.g. higher penalty for Ratio data → Nominal parameter than for Interval data → Nominal parameter (Stevens scale hierarchy)

*Nominal* ← *Ordinal* ← *Interval* ← *Ratio*





Most generic



Most specific

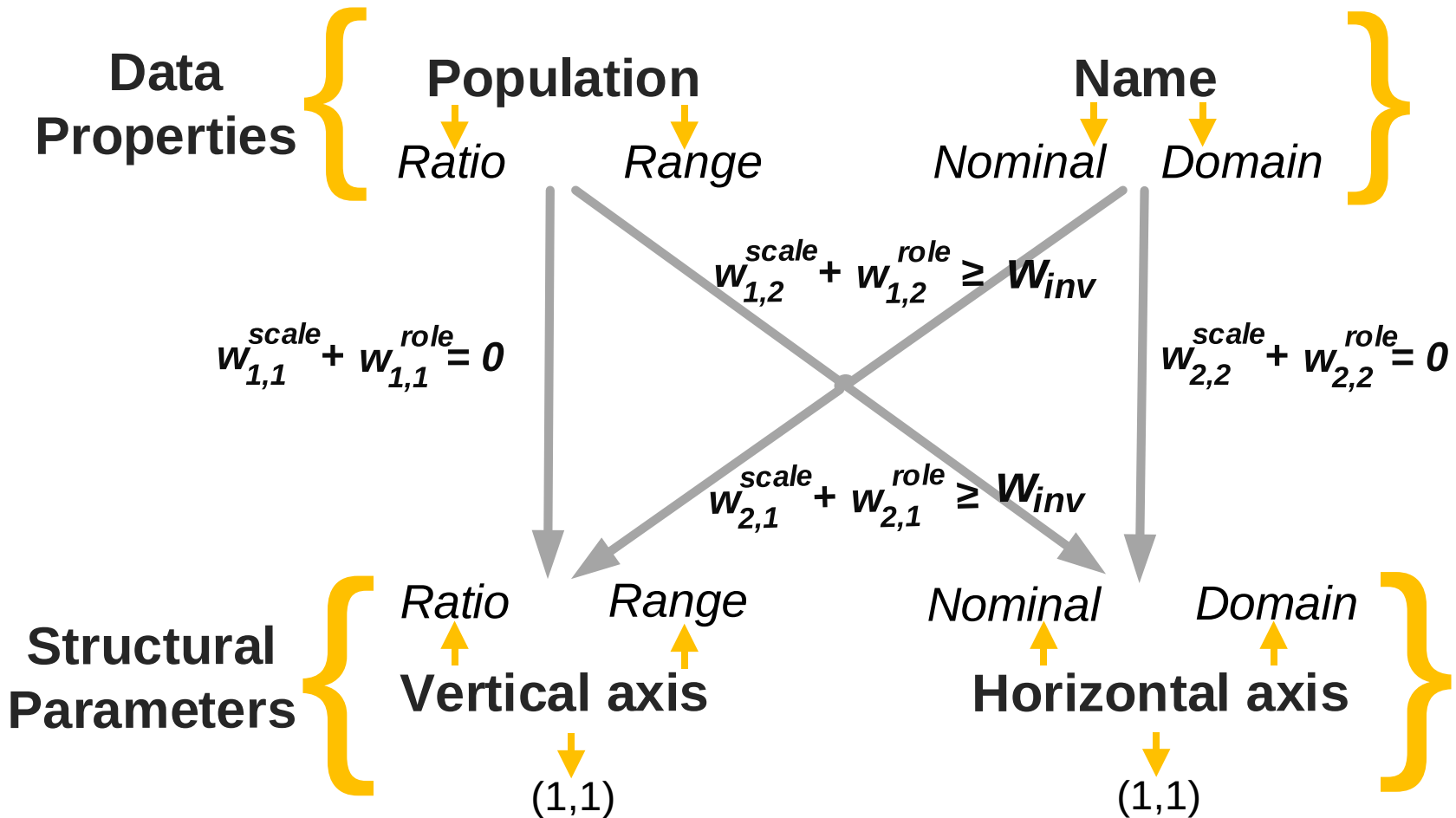


# Roles Penalty

- **Perfect Match:** Domain  $\rightarrow$  Domain, Range  $\rightarrow$  Range  
and Unknown  $\rightarrow$  Undefined
- **Invalid Match:** Domain  $\rightarrow$  Range and Range  $\rightarrow$  Domain
- **Penalize:**
  - Unknown data role  $\rightarrow$  Defined parameter role  
 To prefer mappings with matching roles
  - Known data role  $\rightarrow$  Undefined parameter role  
 To prefer mappings to parameters with defined role

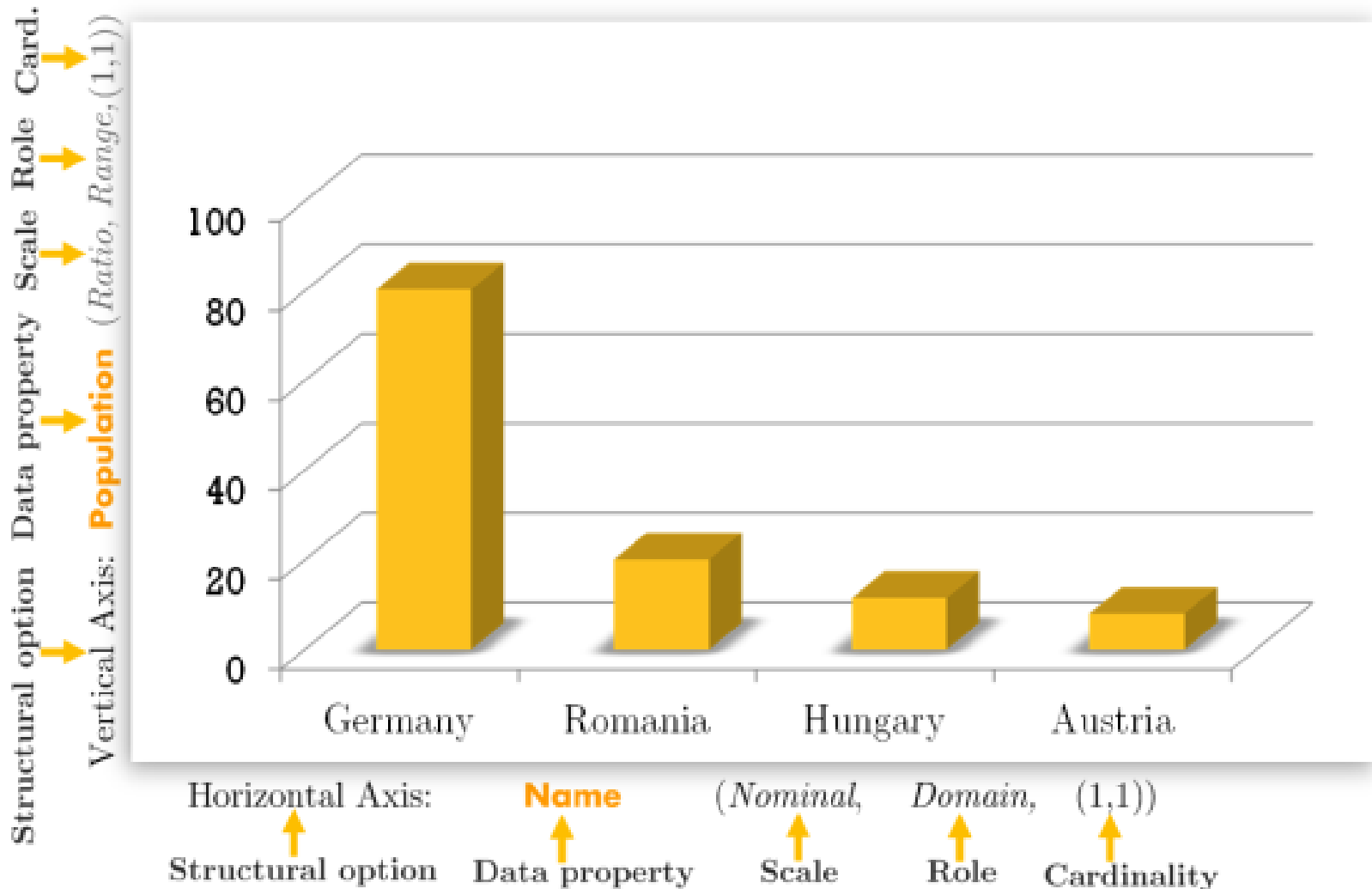


# Mapping Data to Visualizations





# Mapping Data to Visualizations





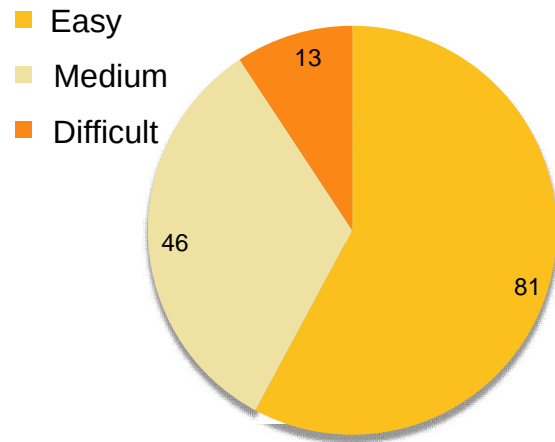
# + Evaluation



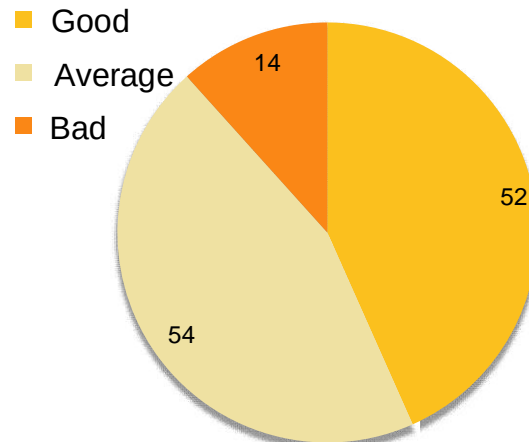


# User Study

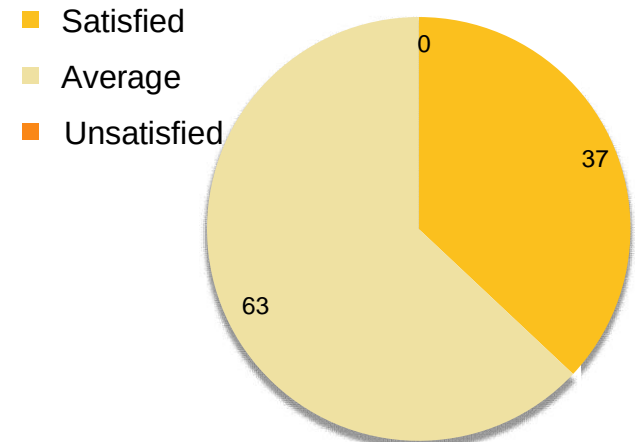
- Study for evaluating level of difficulty and UI design
- 20 participants; Seven tasks plus corresponding question



Level of Difficulty



Design

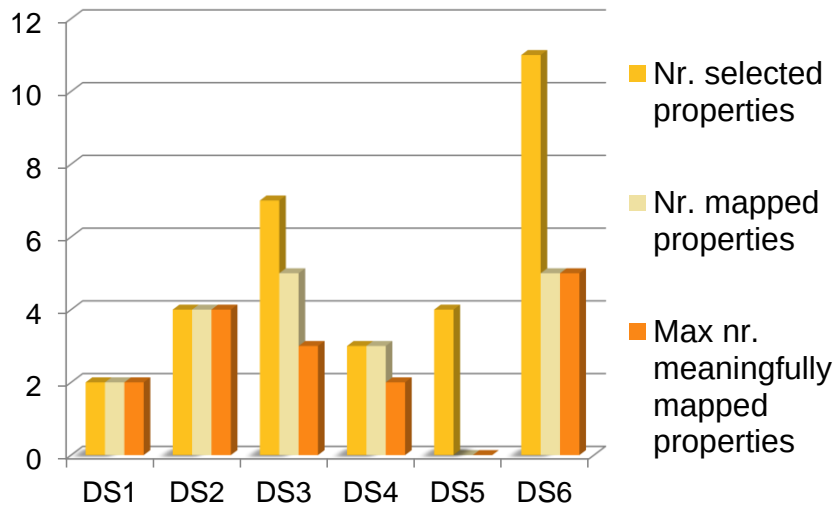


Level of Satisfaction

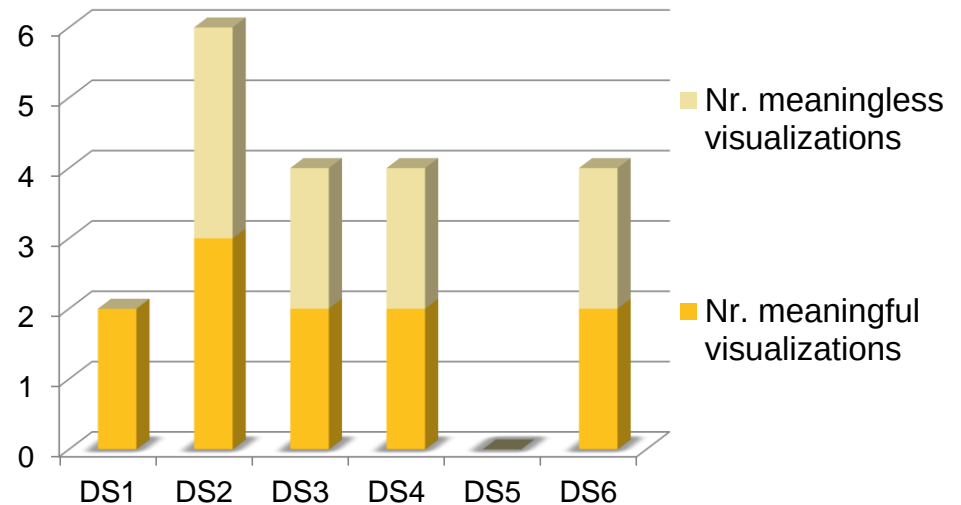


# Effectiveness

- Effectiveness of the recommendation algorithm on six datasets:
  - Data coverage and information value of visualizations
- Quality of recommendations depends on:
  - Quality of dataset and number of selected data properties



Data coverage



Informative value



**Thank you! Questions?**

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