

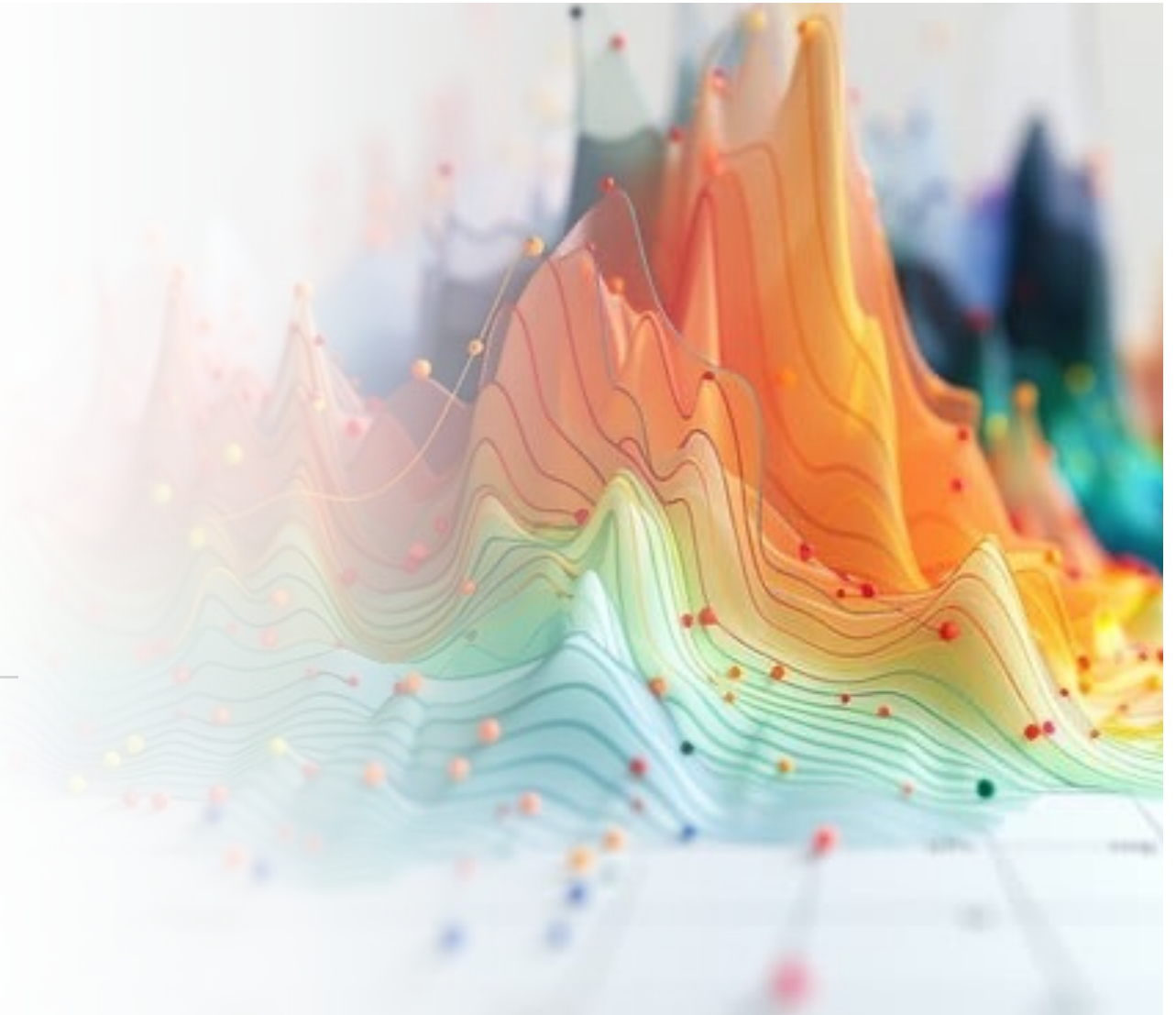


# Data Visualization

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# Review of Previous Session

- CLT: Keep visuals clear; avoid overloading short-term memory.
- Multimedia: Combine words + pictures → better learning.
- Key Principles:
  - **Redundancy**: Do not repeat the same information
  - **Contiguity**: Place related words and images close together and show them at the same time.
  - **Coherence**: Remove unnecessary decoration, text, or sound.
  - **Signaling**: Use highlights, labels, or headings to guide attention.
  - **Personalization**: Use a friendly, conversational tone.
  - **Pre-training**: Teach key terms and parts before complex explanations
  - Models: Theoretical | Descriptive | Prescriptive.
- Frameworks: ASSERT (Ask–Search–Structure–Explore–Reveal–Tell).



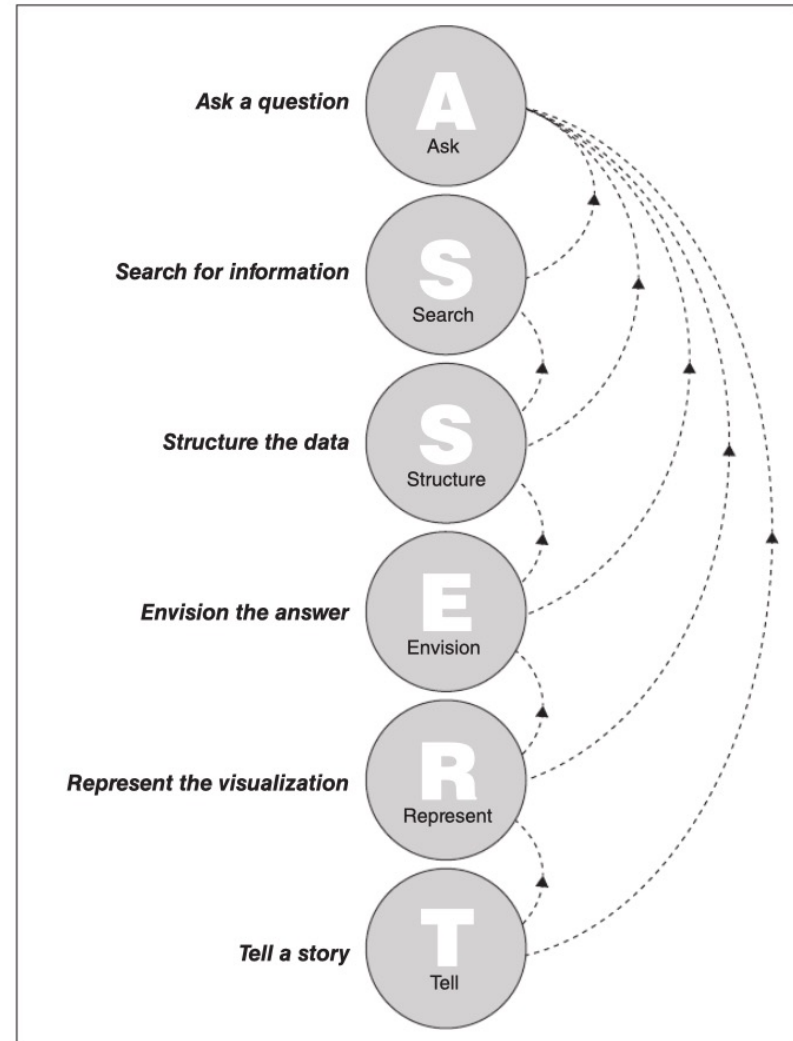
# Learning Objectives

By the end of this session, you will be able to:

- Explain why **good questions** are the foundation of visualization projects.
- **Identify audience needs** to shape meaningful, data-driven questions.
- **Narrow broad topics** into focused, researchable questions.
- Apply strategies like **Three-Part Query** and **K–W–L** to generate strong questions.
- Use **Creative Problem-Solving** to explore alternative perspectives.
- Recognize and **locate reliable data sources** (primary, secondary, tertiary).
- Evaluate data quality — clean, complete, and relevant — for visualization.



# Ask a Question



- Good visualizations are driven by good questions.
  - The goal is to ask specific questions about the topic that can be answered by accessible and reliable data.
  - Questions should be able to address why you or anyone would care.
  - The questions should guide the subsequent phases and be used as a test for inclusion or rejection of a source or method.

- Defining the Audience: it is important to have a good understanding of who its audience will be.
  - Audience Needs and Capabilities
  - Their Background Knowledge
  - The Information They Want to Know
  - Their Content Sensitivity
  - Their Availability of Technology

- Narrowing the Question ' s Scope: It is critical to narrow the scope of the topic so that a meaningful (and presumably answerable) question can be found
  - Time
  - Location
  - People
  - other attributes that might constrict the topic
- On the other hand, a too focused topic may not have enough information to support



How does the gas price affect software companies of Alberta in 2020?

How does the gas price affect economy of Alberta in 2020?

How does the gas price affect economy of Alberta?

How does gas price affect economy?

# Questions

- How does climate change affect agriculture?
- How does social media affect students?
- How does online learning affect academic performance?
- How does traffic congestion affect daily life?
- How does air pollution affect public health?
- How does product price affect customer behavior?
- How does remote work affect employee productivity?

# Answers

- **How does climate change affect agriculture?**  
→ *How have rising temperatures affected crop yields in Western Canada over the last 10 years?*
- **How does social media affect students?**  
→ *How does daily social media usage affect study time among undergraduate students?*
- **How does online learning affect academic performance?**  
→ *How did online learning affect exam scores of first-year university students during the COVID-19 period?*
- **How does traffic congestion affect daily life?**  
→ *How does weekday traffic congestion affect commute times in downtown Toronto?*
- **How does air pollution affect public health?**  
→ *How does long-term air pollution exposure affect respiratory hospital admissions in urban areas?*
- **How does product price affect customer behavior?**  
→ *How do price discounts affect purchasing behavior of online shoppers during holiday sales?*
- **How does remote work affect employee productivity?**  
→ *How does remote work affect productivity of software developers in mid-sized tech companies?*

# Turning Topics into Questions

- Extract specific questions that are suitable for visualization
- In general, questions that offer more complex answers than a simple “ yes ” or “ no ” tend to be more interesting pursuits.

“ Was slavery the cause of the Civil War? ”



“ What degree of economic advantage did slavery offer the South to maintain it? ”

- Strategies for methodically generating and assessing the quality of questions
  - The three-part query
  - K-W-L

- Strategies for methodically generating and assessing the quality of questions

- The three-part query

- identifying a focused **topic** , the **questions** to ask about information needed to explore, and the **reason** to care about exploring it
- We are looking at [ *topic* ] because we want to find out [ *who/where/when/why/what/how* ] in order for my audience to *understand* [ *significance* ].

Example: We are looking at [the University of Virginia 1828 library](#) to find out [where the books were published](#) in order for my audience to see [the geographic spread of eighteenth century scholarship](#). (Booth et al., 2003)

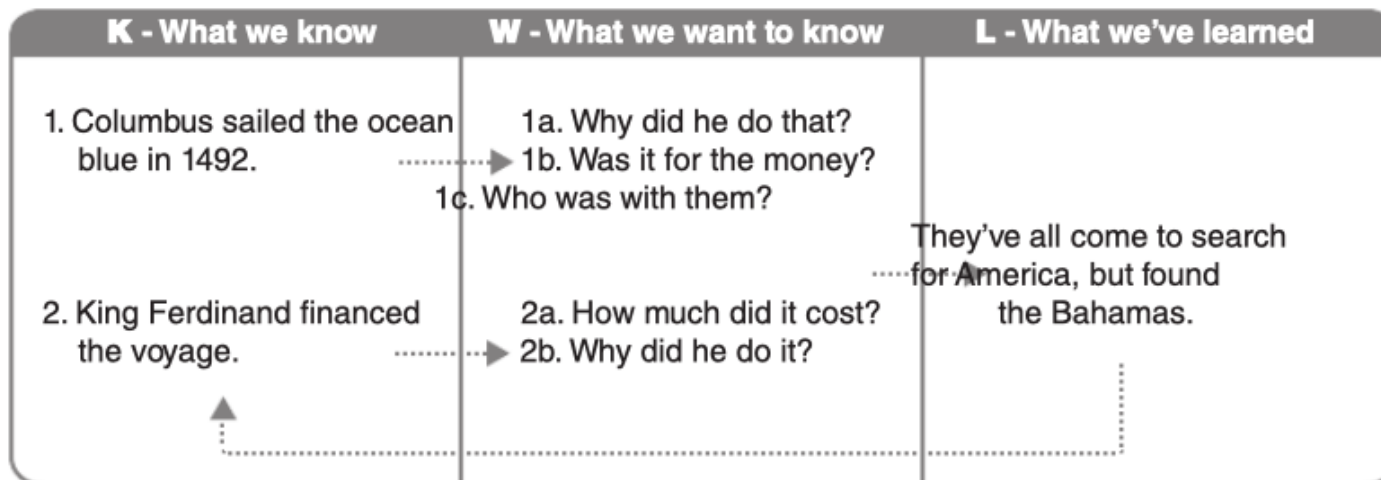
- K-W-L

- Strategies for methodically generating and assessing the quality of questions

- The three-part query

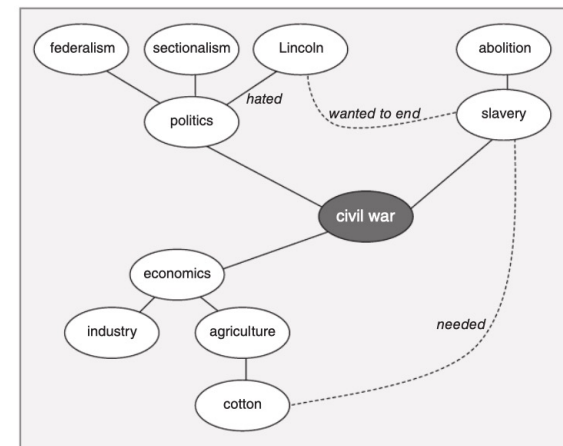
- K-W-L

- what we already **K**now about the topic
- what we **W**ant to learn about the topic
- what we have **L**earned



# Creative Problem-Solving Techniques

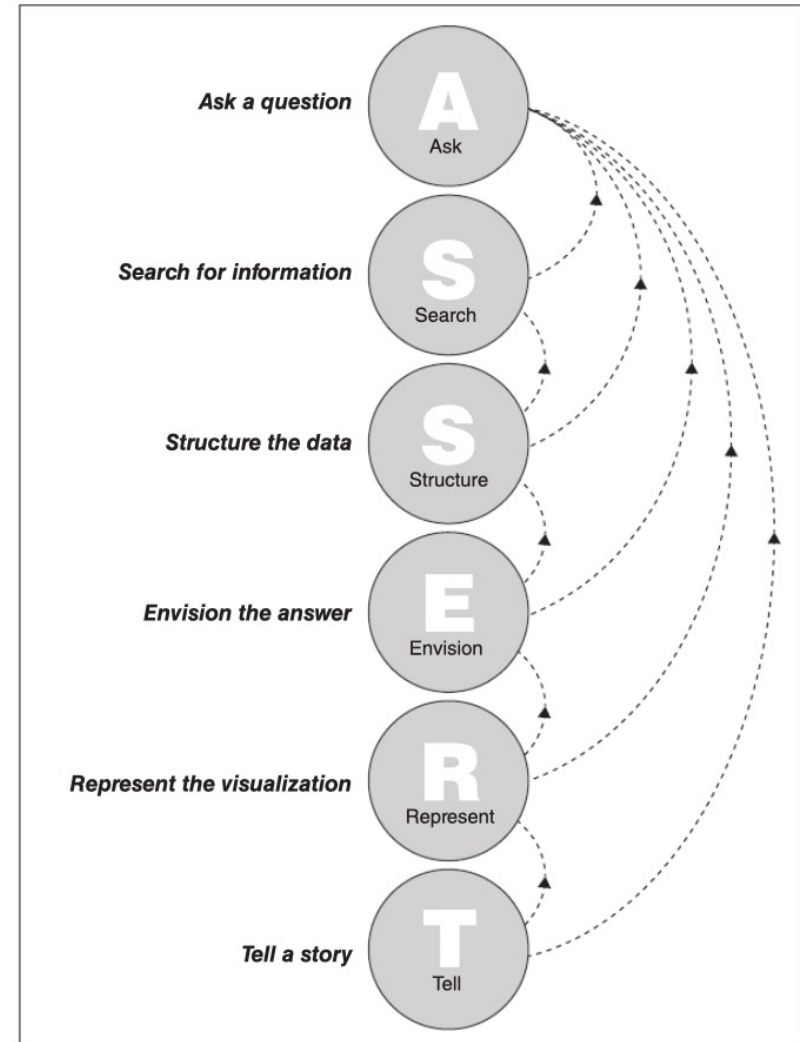
- Creative Problem-Solving (CPS) is to generate ideas (options) and then systematically evaluates the options.
- The CPS framework begins by identifying the broad goal in order to understand the problem to be solved – through data exploration and problem framing
- CPS tools: Brainstorming, Group discussion, Concept Map



# Generating Questions from Questions

- The best source of new questions about the topic may come from questions already asked.
  - drilling down deeper into the question
  - examining the question from multiple perspectives
    - i.e., northerners, southerners, slaves, and slave-holders
  - asking the question from an opposite point of view

# Search for Information

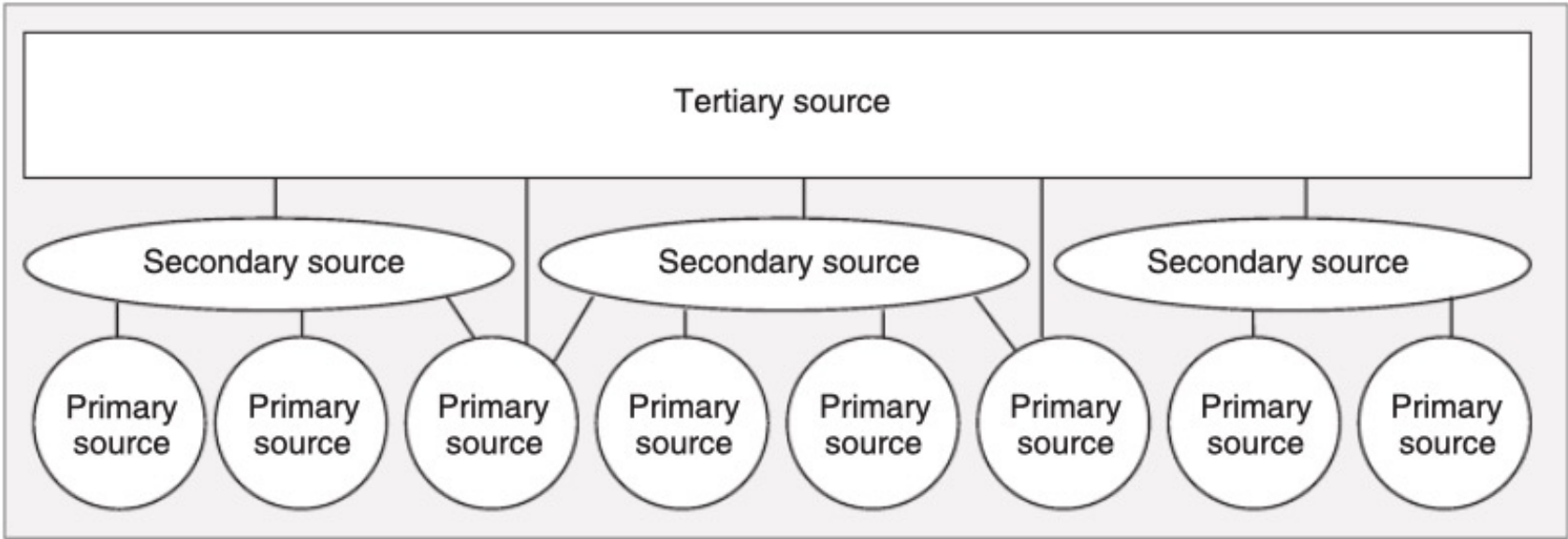


# Types of Raw Data

- *Numbers*: such as populations and rainfall amounts
- *Documents*: such as court records, birth and death records, letters, diaries and other personal writings,
- *Multimedia*: photographs, drawings, and audio and video recordings used in oral histories, news coverage, and documentaries.

# Types of Data Sources

- Primary sources are data taken directly from the event, such as a first-hand witness account or temperature readings.
- Secondary sources are books and other resources that aggregate the information from primary sources, and finally,
- Tertiary resources such as encyclopedias pull from both primary and secondary sources to provide broad but shallow overviews of a topic.



- Successful visualizations depend on the availability of effective and sufficient sources of data to draw on as evidence
- Secondary and even tertiary sources are a good starting point for finding relevant primary sources
- Many places to find data: libraries, museums, historical societies, courthouses, public records, etc.

# Effective Quantitative Data

- Not all data are useful enough to be included in an information visualization.
- Effective Data: more likely to yield insights when visualized
  - High volume
  - Historical
  - Consistent
  - Multivariate
  - Atomic
  - Clean
  - Structured
  - Sourced
  - Accessible
  - Representative