

# On Expressing Observation and Interpretation through Visual Interaction

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Analytics is poised to become the next **general-purpose** methodological science.

Interactive visualization is the face of analytics.

**Visualization** helps us share ideas about data.

**Interaction** helps us express and explore them.

It doesn't matter whether data is

**quantitative or qualitative,**  
**simple or complex,**  
**big or small.**

Is it *interesting* or *useful*  
for human understanding?

Visual analytics research is increasingly focusing on deeply **textured** data and **structured** information.

How can interactive visualization support  
a comprehensive digital workspace  
for humanities scholarship?



the visualization and humanities communities are still looking at the design of digital tools primarily in terms of

# representation

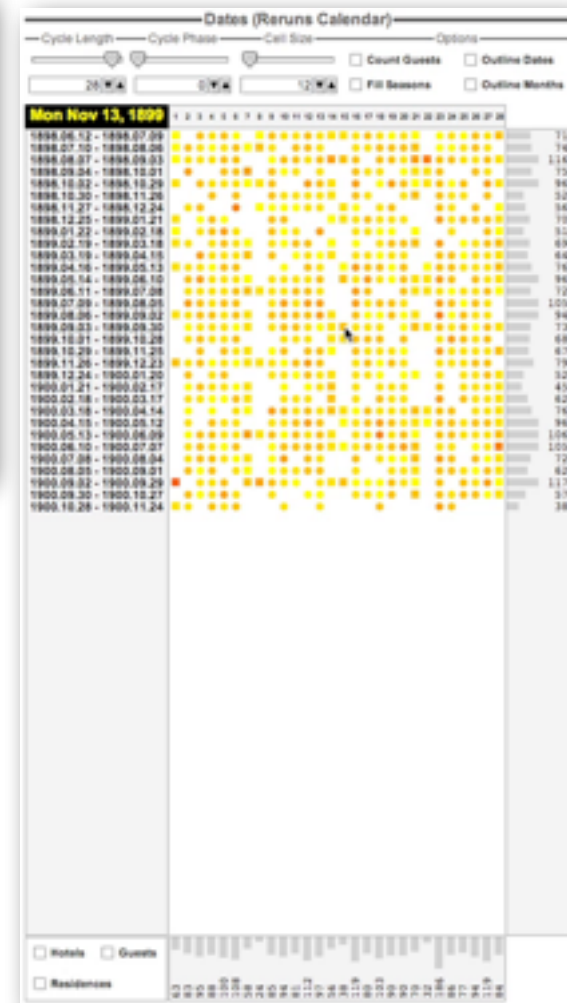
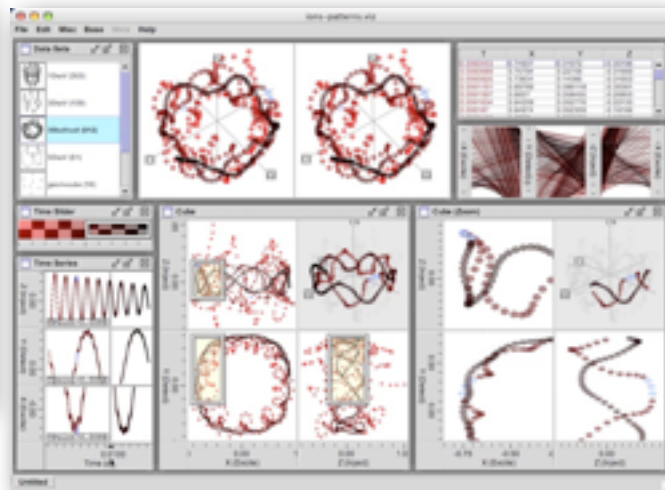
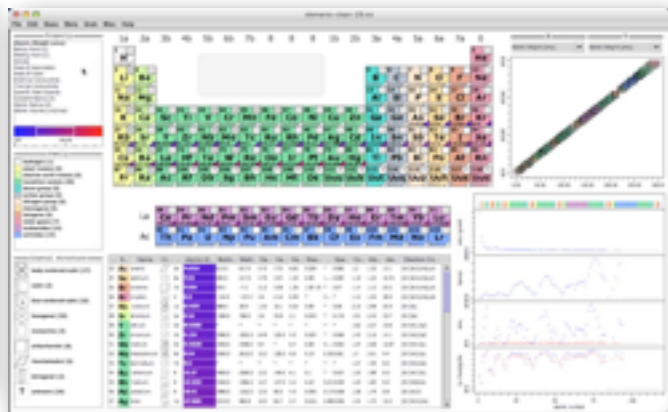
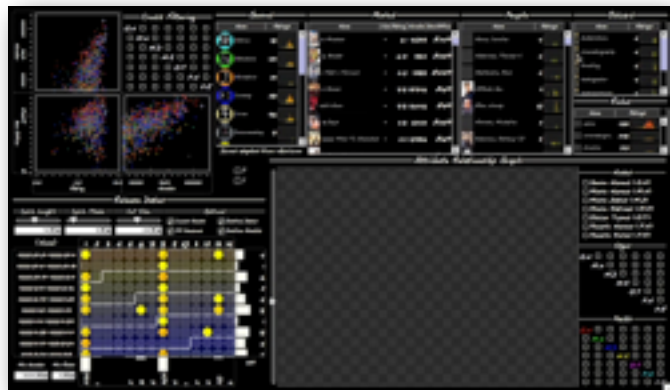
interaction

# process

we need to ask two new, big questions about interaction

*how does the visual representation of data affect how we can interact with it?*

*how can interaction allow us to express our ideas as data?*



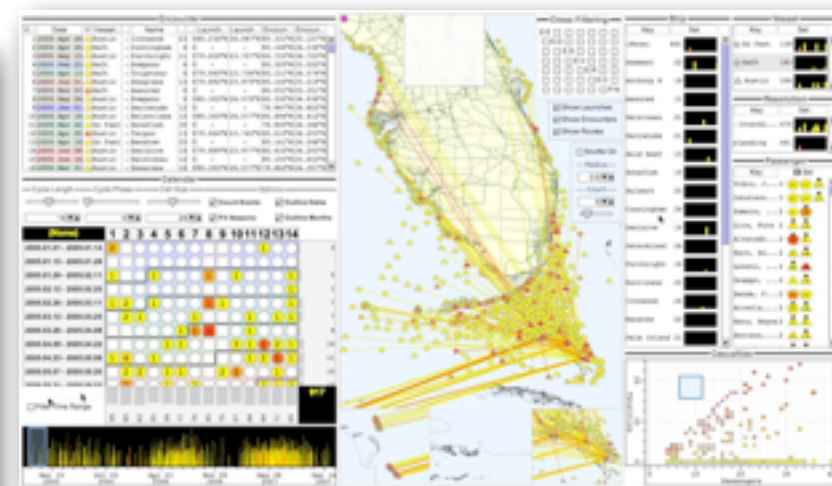
there are many well-known ways to visually **encode** individual data items, visually **represent** entire data collections, and interactively **gesture** to navigate the resulting views



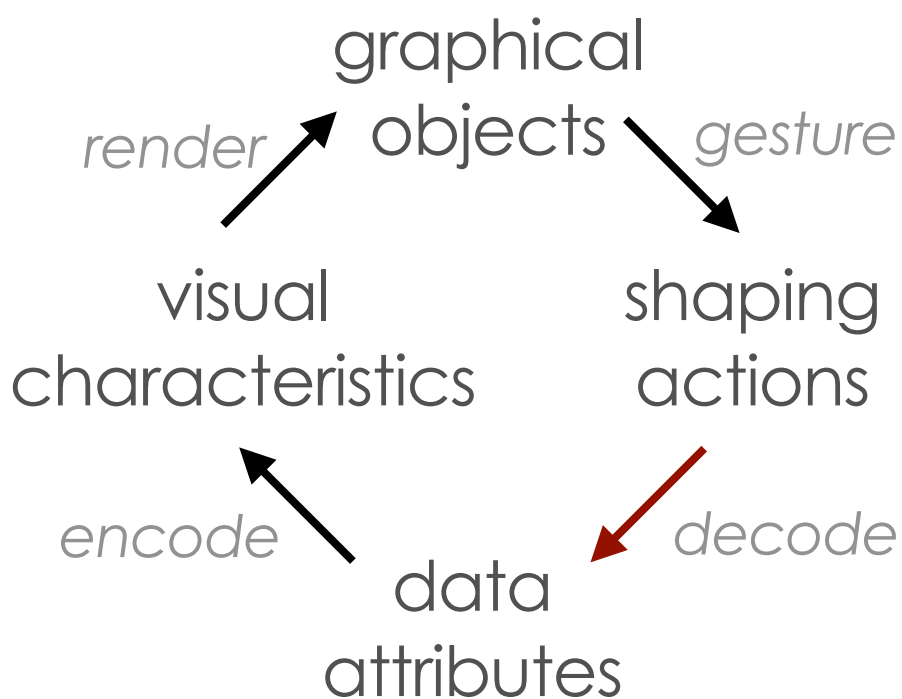
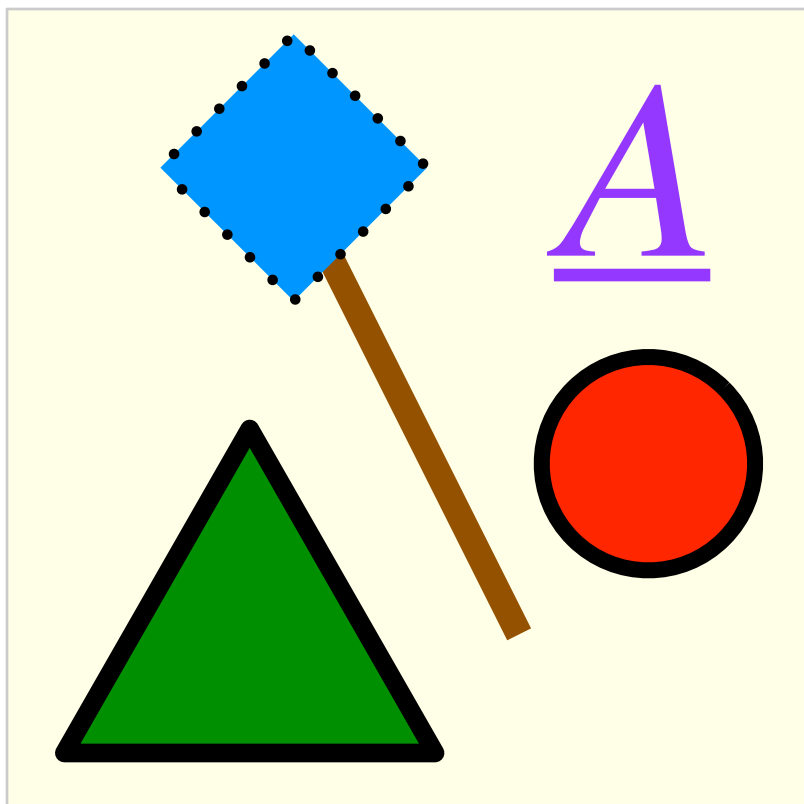
almost all interaction with data items is either:  
*selecting items (in views)*  
*adjusting values (in widgets)*  
*labeling items (using a text box)*

richer ways of interacting with data items are app-specific:  
*paint an item with color*  
*drop a pin on a map*  
*type text in a form*

how can we generalize this?



# how does the visual representation of data affect how we can interact with it?



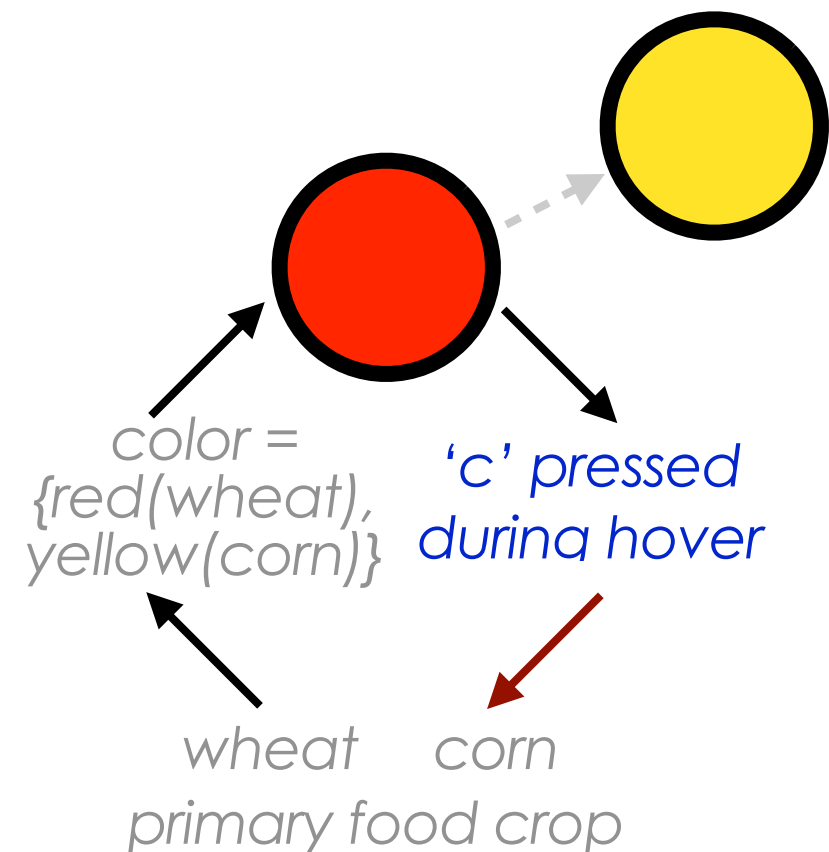
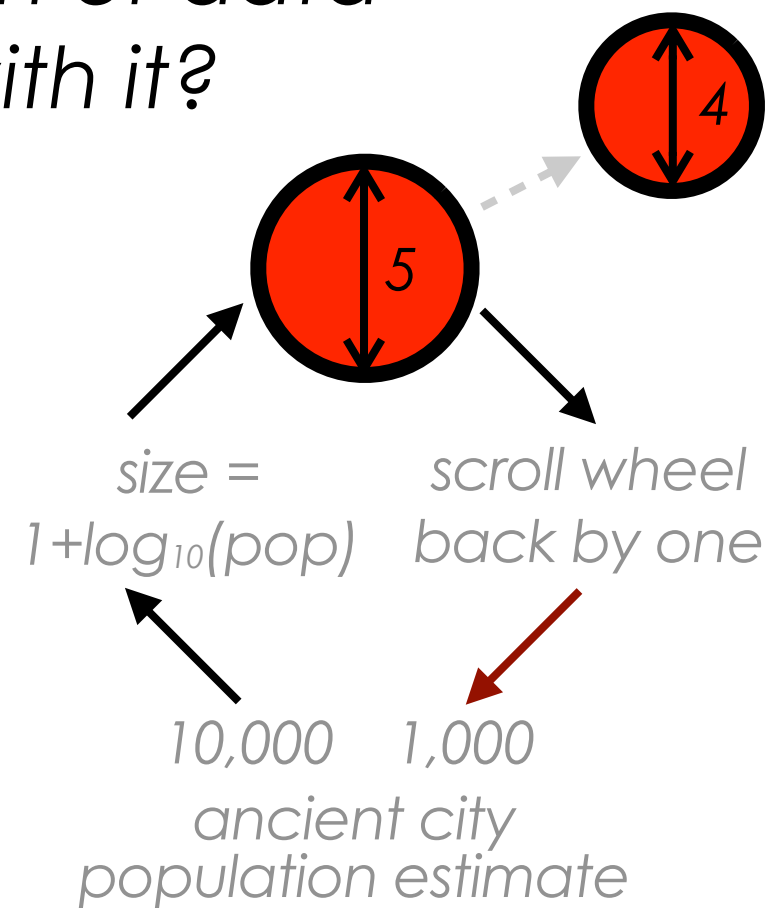
*form follows function follows form...*

objects offer affordances for sensible interaction

graphical characteristics constrain effecting movements

bounds of motion determine possible changes to data

*but not necessarily via literal geometry*



# how does the visual representation of data affect how we can interact with it?

this is more than literal **drawing**

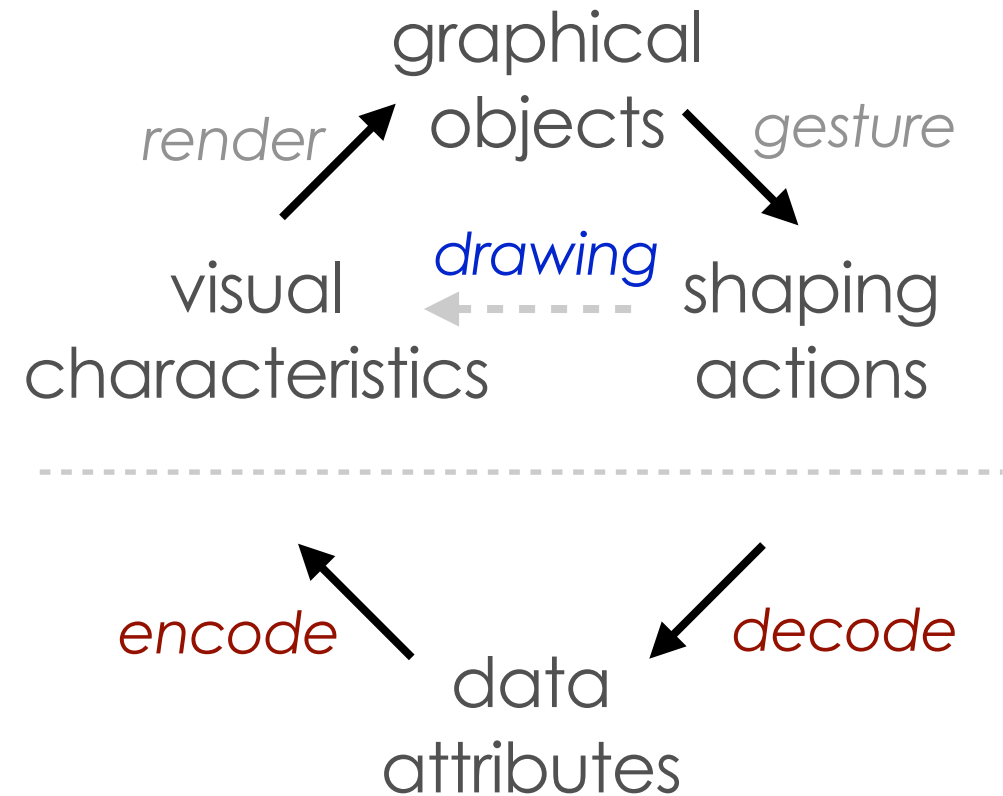
actions always change visual characteristics indirectly through data

objects and actions need not have corresponding geometries

to design an action, one must define a **decoding** function to sensibly “invert” the **encoding**

*inversions are often ambiguous and sometimes impossible to solve in closed form*

*automatic algorithms can often solve them in practice by relaxing assumptions (as in the constraint-based UIs of the 80's)*



indirectness provides design flexibility

encoding and decoding need not be exact inverse functions

it's enough if users can learn and use them together effectively

*we're working on a declarative language for defining **both***



*how can interaction allow us to express our ideas as data?*

## entities

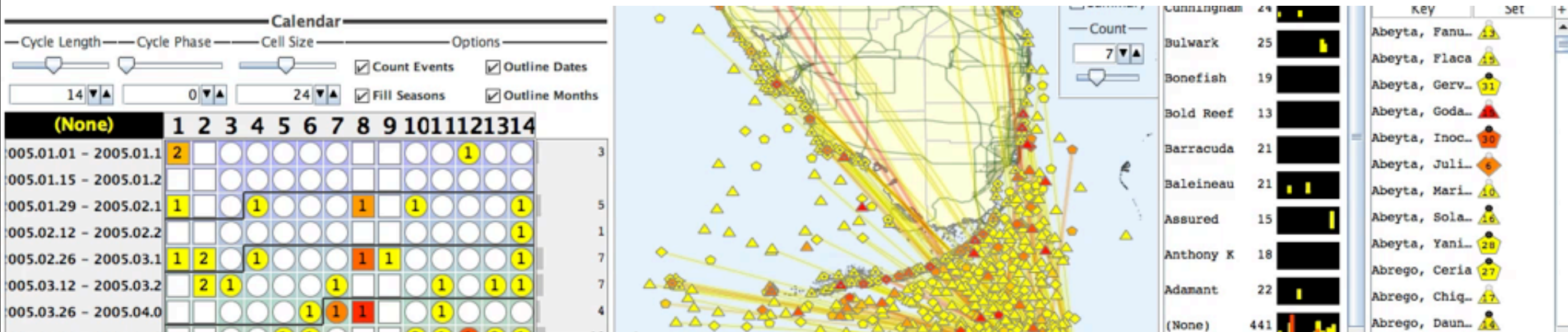
**actions express characteristics**

*Drag things on a map to adjust location.*

*Nudge events to reorder them on a timeline.*

*Pinch to associate uncertainty with a measurement.*

*Click and type to name, label, or annotate.*



## relationships

**actions express connections**

*Draw, move, erase arrows to edit links between items.*

*Press modifier keys to group or ungroup selected items.*

*Wheel scroll over an item to classify all items in its group.*

*Draw a path to sequence a set of locations over time.*

how can interaction allow us to express our ideas as data?

## reasoning

actions express comprehension

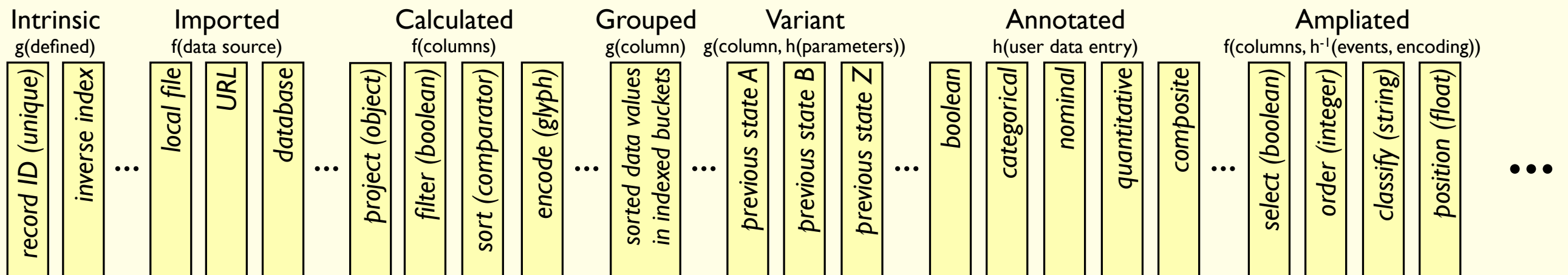
Change column values to record observations.

Create multiple columns to record other interpretations.

Define columns that transform, filter and sort others.

Aggregate and define categories using linked tables.

### open-ended editing by defining and populating columns dynamically



## sharing

actions express collaboration

Associate columns with users, times, and purposes.

Specify access and editing options for each column.

Define columns that adjudicate multiple interpretations.

Snapshot copies of columns for recall and export.



annotation shouldn't  
be an endpoint

we think of annotation as

writing in the margin

adding a mark to a map

drawing an arrow to connect things

but in digital tools,  
annotations are really data

in which writing is hand-formatted text

and symbols encode quantities

and arrows imply relationships

and in a sense,

all data is annotation

because whether by writing it down directly

or recording it with designed instruments

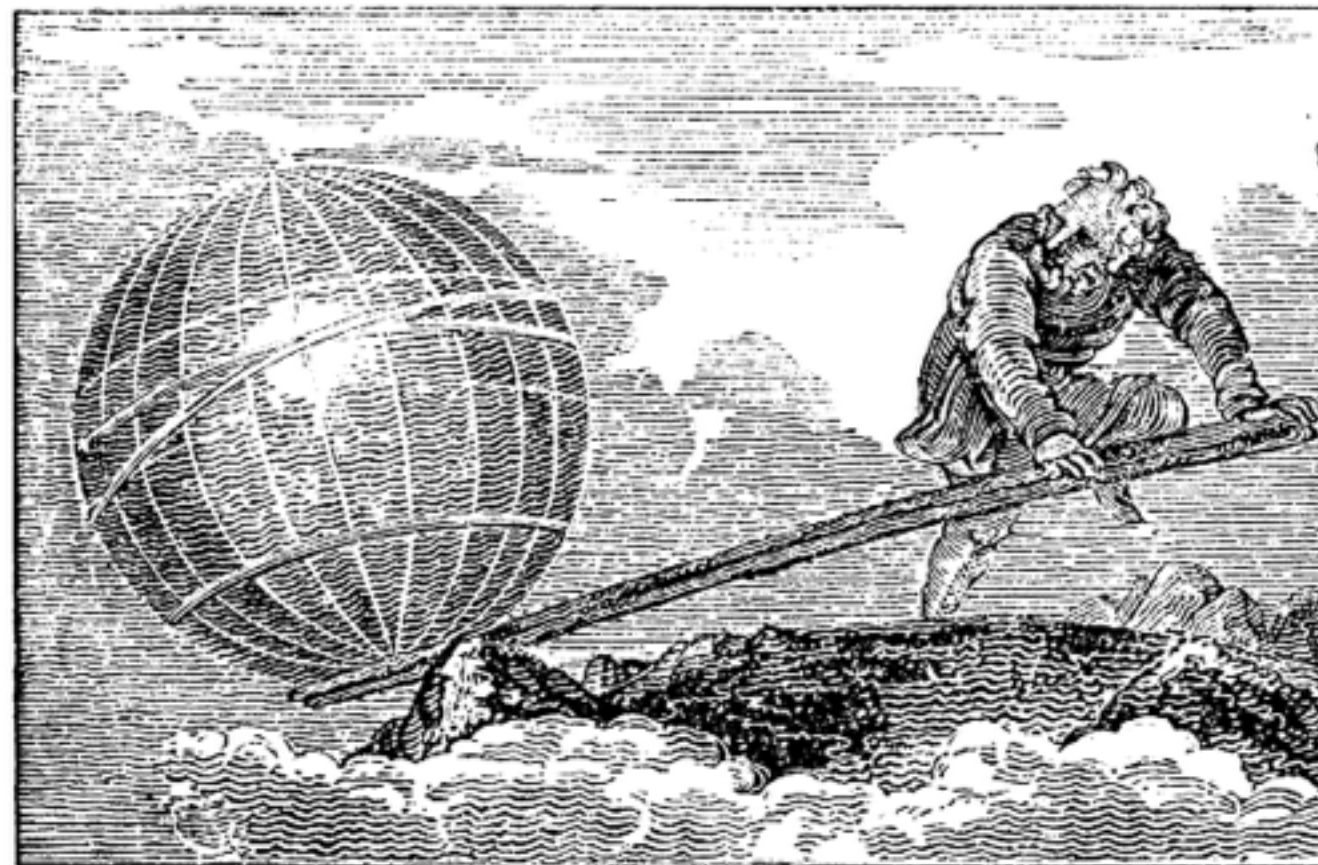
**it ultimately comes from us...**

**...interpreting the world**

# ampliation

open-ended, interpretation-driven  
extension and modification of data  
directly within visual representations

annotation as a part of open-ended interaction  
to question, observe, reason, conclude, and share



[www.math.nyu.edu/~crottes/Archimedes/Lever/leverBigCorners.gif](http://www.math.nyu.edu/~crottes/Archimedes/Lever/leverBigCorners.gif)

## **Ampliative**

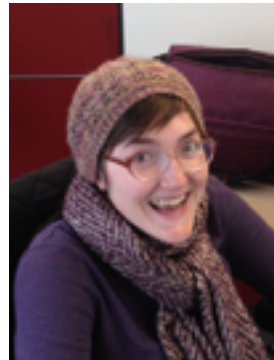
from Latin *ampliare*, "to enlarge"  
used in logic to mean "extending" or  
"adding to that which is already known."

In Norman law,  
an "ampliation" was  
a postponement of a sentence  
to obtain further evidence.



# Interactive Gesture-Based Data Manipulation and Visualization for Exploratory Learning and Research

with a variety of DH collaborators at OU and Stanford  
*National Science Foundation*

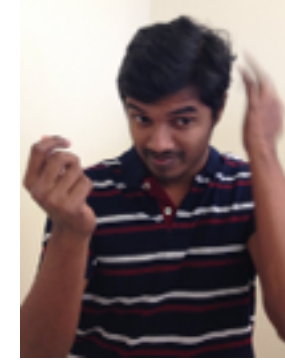


Emily Grimes

forms of data interaction in existing visualization tools

Jeyachandran Rathnam

a data editing architecture for web-based visualization



## Library of Digital Latin Texts

with Sam Huskey (Classics) and June Abbas (SLIS) at OU  
*Andrew W. Mellon Foundation*



Bharathi Asokarajan

pixel-based visualization of classical critical editions

Shejuti Silvia

storyline visualization of classical critical editions



Vamshi Krishna Sunchu

relational querying of TEI documents

Sudarshan Reddy Vangala

high-level provenance of interactive visual analysis



Our software workbench for creating visualizations is called **Improvise**.



To see more, visit [www.cs.ou.edu/~weaver/improvise](http://www.cs.ou.edu/~weaver/improvise)

The next major version of **Improvise** is in planning. New features will include a data editing specification language and end-user ampliation capabilities.

Stay tuned!

# Thanks!

Fall 2014  
Tuesdays and Thursdays  
6:30 - 8:45 pm  
Carson Engineering Center (CEC)  
Room 119

Non-Computer Science students welcome!  
Prerequisite for all: permission of instructor →

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## Computer Science 5093

### Visual Analytics

*the science of analytical reasoning facilitated by interactive visual interfaces*

Analytic reasoning is a process that encompasses perception, cognition, discourse, and collaboration. This course considers methods and tools that support analytic reasoning by combining human visual capabilities with computational devices and algorithms. Topics include data representation and transformation, data mining and knowledge discovery, visual representation and interaction, sense-making, production and dissemination of knowledge, and the challenges that information complexity and scalability pose for the very human process of reasoning.

The seminar format will include reading, discussion, and application of existing software environments to problems in visual analytics. The goals of this course are for students to: (1) develop a comprehensive understanding of this emerging, multidisciplinary field; (2) apply that understanding to a tightly focused research problem in a domain of personal interest (computational, geospatial, meteorological, historical, etc.) Course research projects may involve: advancing the theory of visually-enabled analytical reasoning, developing new methods to support analytic tasks in specific domains, applying existing methods and tools to analytic challenges in these domains, or evaluating and improving the usefulness and usability of applications. Discussion will include a range of topics from information visualization, geographic information systems, data mining, and cognitive science.

**Illuminating the Path**  
The Research and Development Agenda for Visual Analytics  
Edited by James J. Healey and Kristin E. Cook

data

us

textbook (free!)

computer science  
college of engineering

Please tell students about CS 5093 Visual Analytics an old-fashioned seminar offered in Fall semesters. It's not just for CS students!