

Investigating Idiosyncrasy: Toward a Comprehensive Methodology of Visual Exploration and Analysis for Humanities Scholarship

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Interpretation is at the heart of all
humanities scholarship.

Pooh redacted.
Oh me, oh my!

Scholars seek to characterize
complex webs of idiosyncratic structure
in historical and social systems.

This structure arises within and across spatial,
temporal, and relational dimensions and scales.

But, most existing visualization approaches
target the methodological norms of the sciences
rather than the humanities.

Digging Into the Enlightenment: Mapping the Republic of Letters

An international
collaboration with:

Dan Edelstein,
Paula Findlen,
Nicole Coleman
(Stanford)

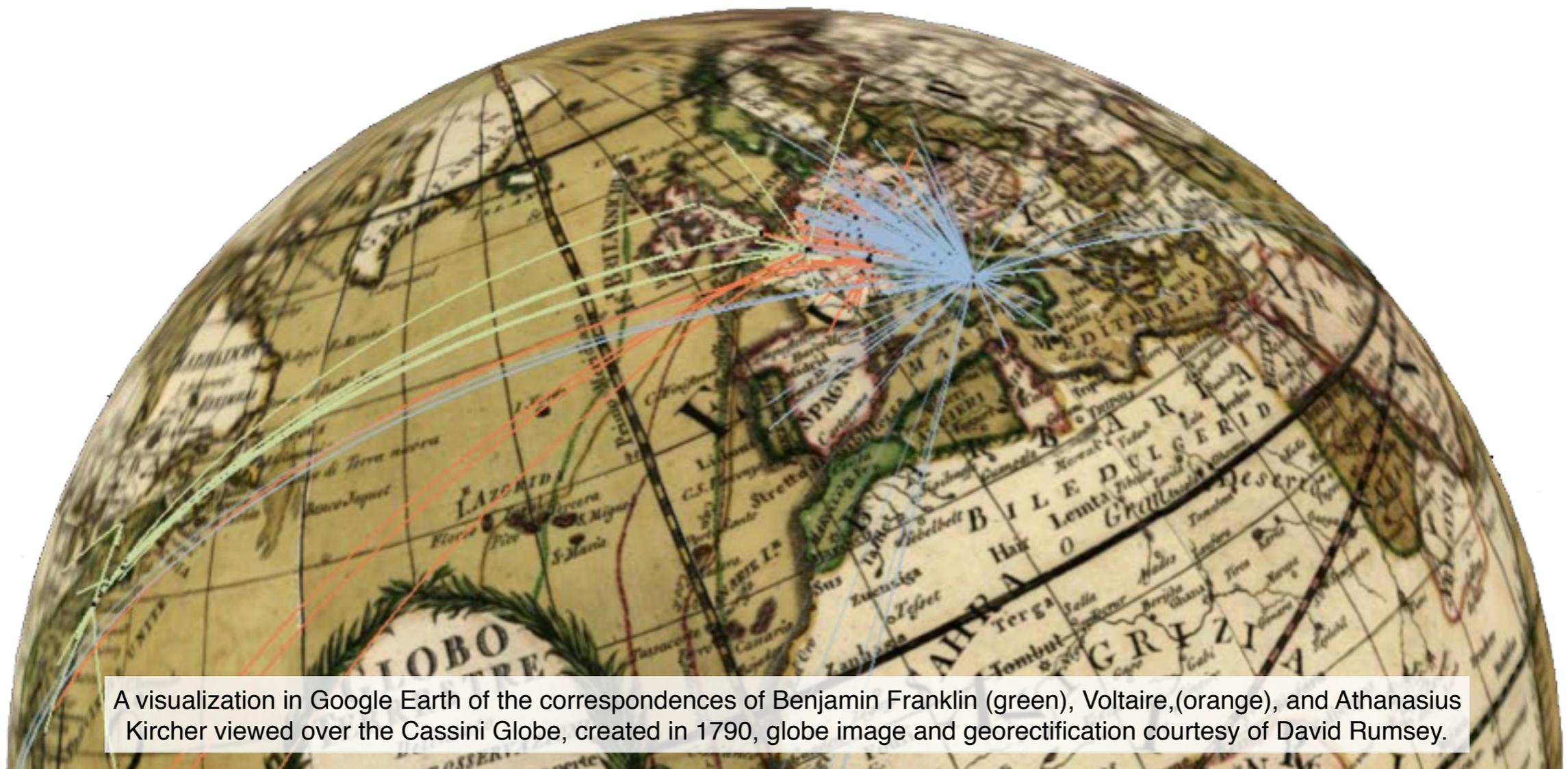
Robert McNamee,
Mark Rogerson,
Peter Damian-Grint
(Oxford)



developing new visualization techniques and tools
to support individual and collaborative interpretation of
the *Electronic Enlightenment* collection of
53,000 letters, 80,000 document sources, 230,000 scholarly annotations

Our goal is to initiate

a highly interactive and computationally augmented
visual externalization
of the open-ended and fundamentally interpretive
reasoning processes
at the core of humanities research.



A visualization in Google Earth of the correspondences of Benjamin Franklin (green), Voltaire,(orange), and Athanasius Kircher viewed over the Cassini Globe, created in 1790, globe image and georectification courtesy of David Rumsey.

Visually Infuse the Analytic Process

Enable Expression of Complex Questions

Facilitate Pattern Discovery

Embrace Negativity

Utilize Uncertainty

How?

Elucidate Querying

Integrate Categorization

Liberate Annotation

Recollect Queries

Engage Analytic Provenance

Encourage Collaboration

Visually Infuse the (Entire?) Analytic Process

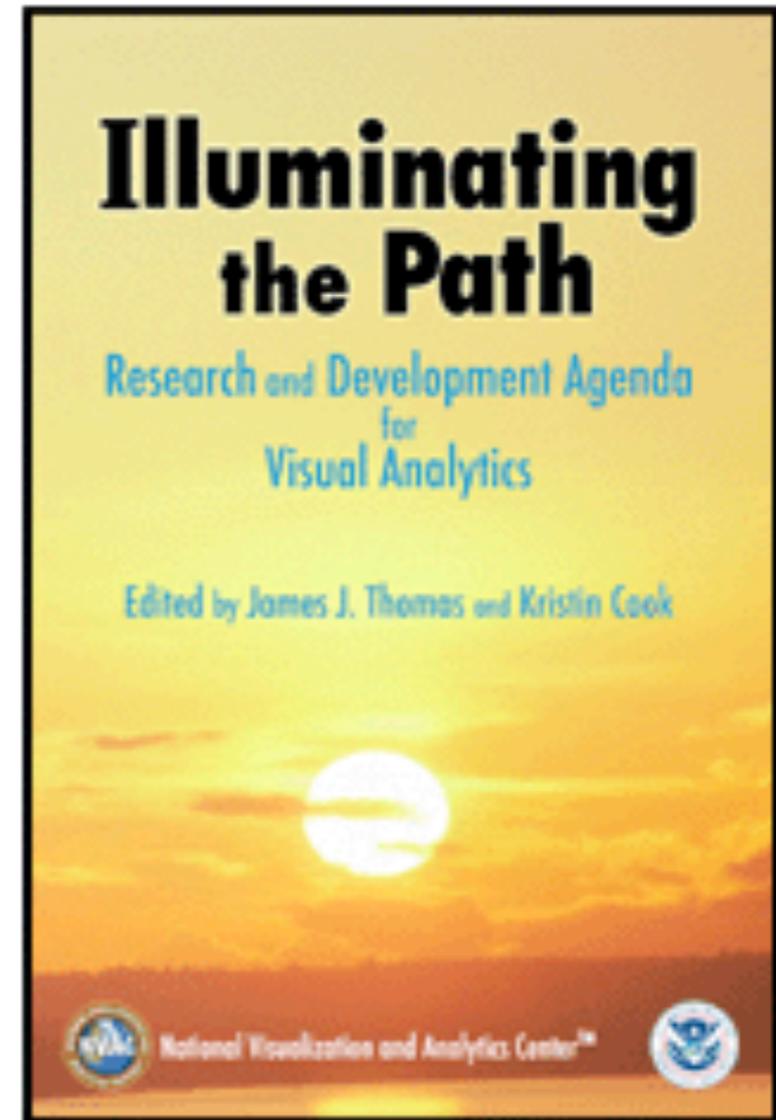
You can't stay in your corner of the forest, waiting for others to come to you; you have to go to them sometimes.

Pooh redacted.
Oh me, oh my!

Before beginning a Hunt, it is wise to ask someone what you are looking for before you begin looking for it.

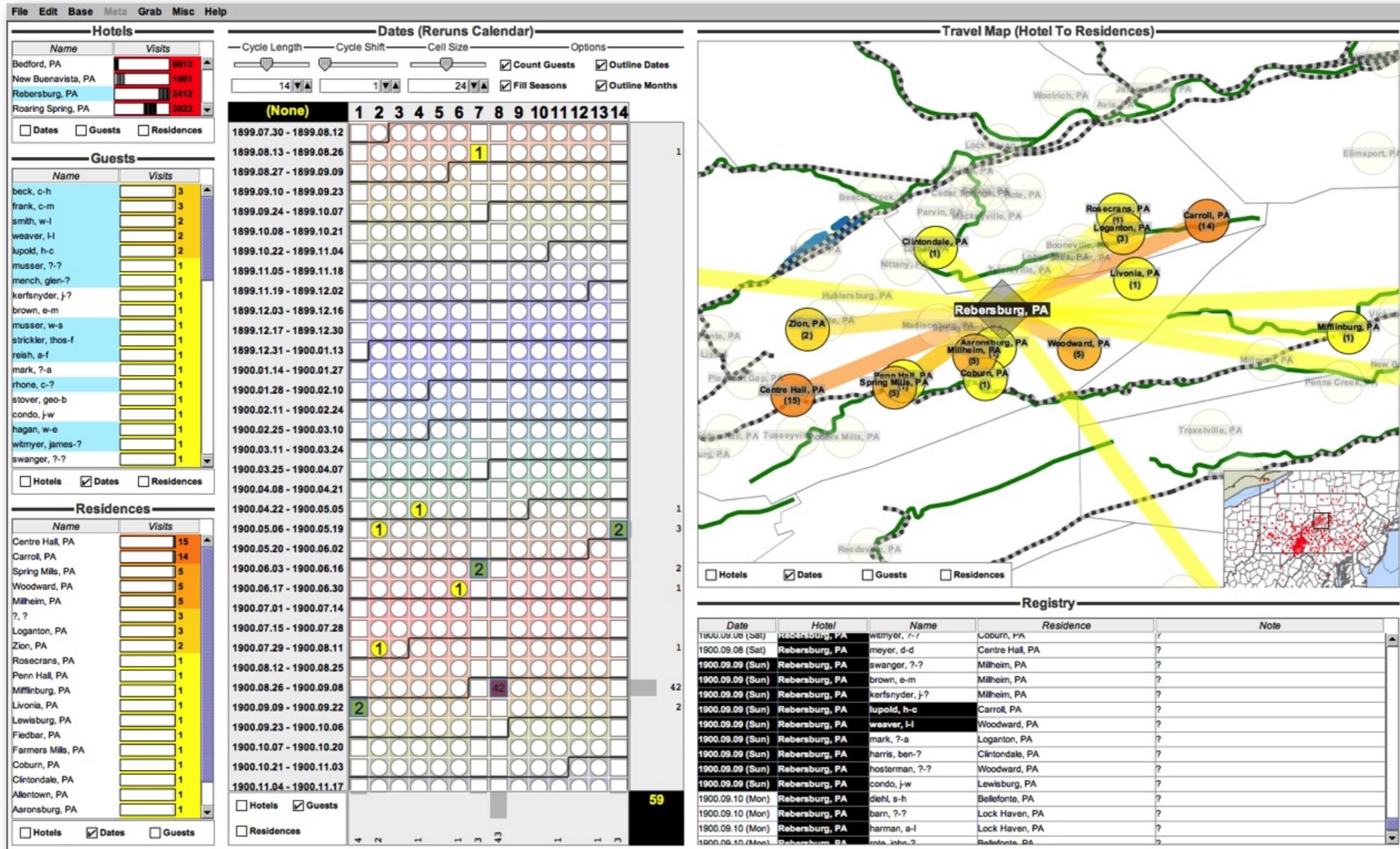
“Visual analytics is the science of analytical reasoning facilitated by interactive visual interfaces.”

- The process of analytic reasoning: perception, cognition, discourse, collaboration
- Data representation and transformation
- Visual representation and interaction
- Production, presentation, dissemination
- *Sense-making*: gather info, re-represent, develop insight, produce results



<http://nvac.pnl.gov/agenda.stm>

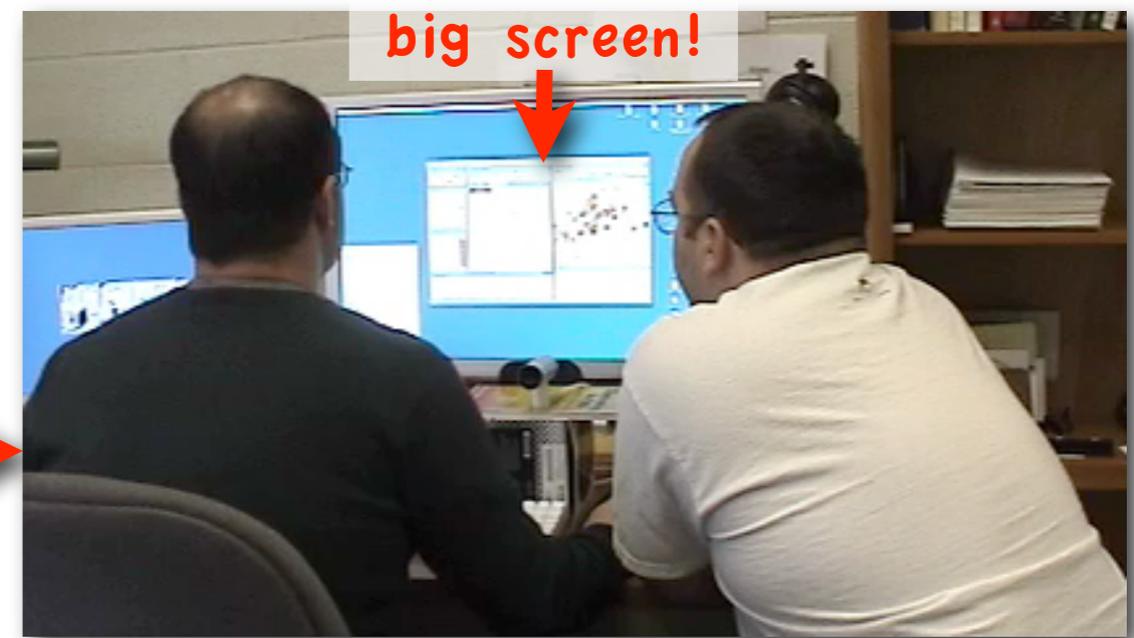
A Case Study: Visual Analysis of Historic Hotel Visitation Patterns



Collaborators at Penn State:

David Fyfe & Deryck Holdsworth (*Historical Geography*)
 Anthony Robinson, Donna Peuquet, Alan MacEachren (*GIS*)

Hotel Registries Visualization + Analysis



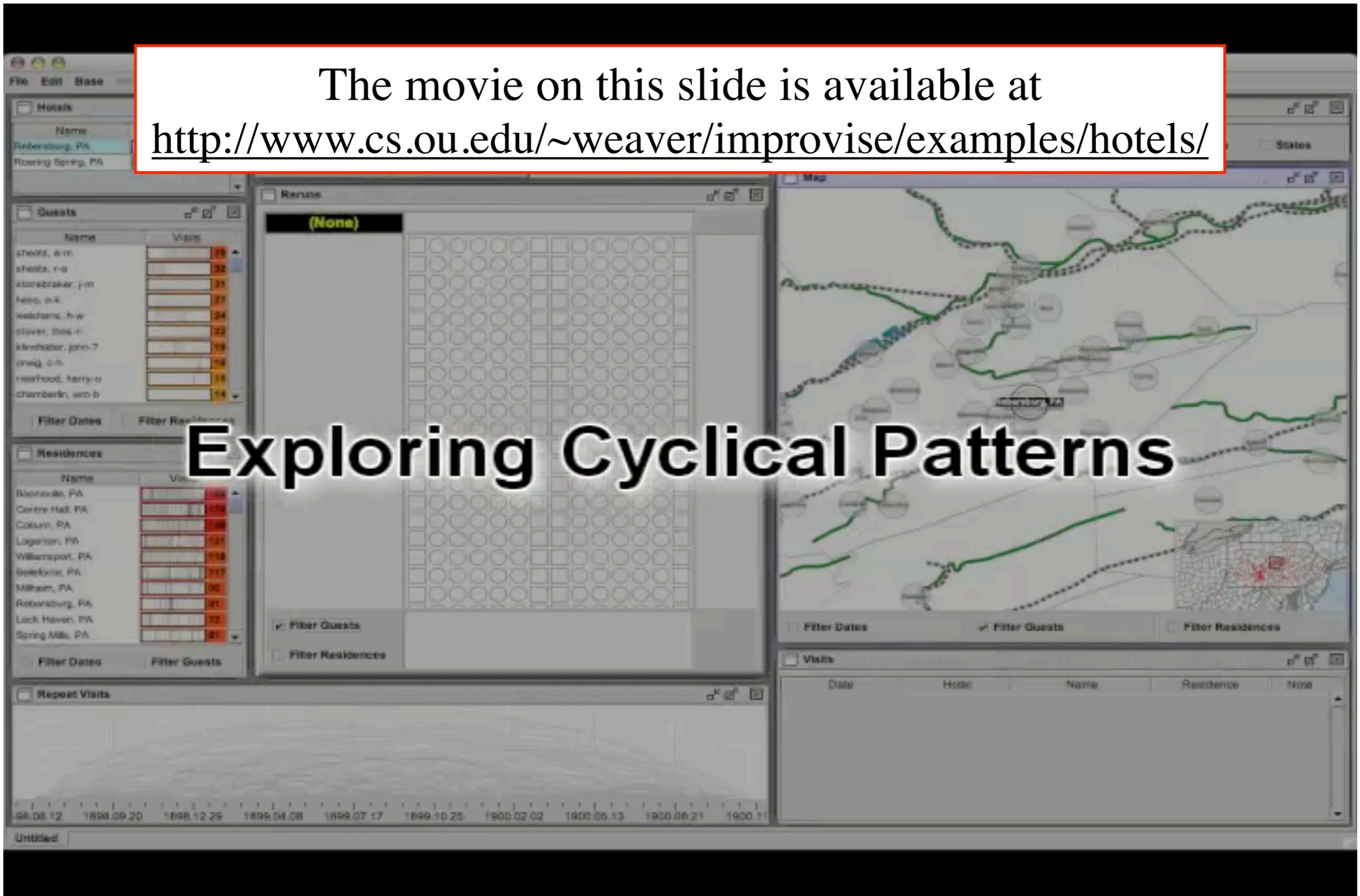
computer scientist →

↑
historical
geographer

- Process
 - Integrated visual software development
 - Rapid tool evolution using simple, common visual techniques
 - Immediate usability/usefulness feedback (not quite exploratory)
- Data
 - Space, time, and abstract attributes (people, places, and times)
 - Multiple sources of uncertainty
 - Of research interest to real users (historical geographers)
- Tasks
 - Explore behavioral patterns of individuals and groups
 - Correlate with multiple sources of external information: transportation schedules, weather records, newspaper reports, etc.

The movie on this slide is available at <http://www.cs.ou.edu/~weaver/improvise/examples/hotels/>

Exploring Cyclical Patterns



Many temporal patterns, but...

Alternate time scales?

Spatial patterns?

Space-time patterns?

Data

“externalities”?

(Unrecorded dimensions?)

Interpretation?

Periodicity	Visits	Guest/Home/Occupation	Hotel	Observations
Weekly Same Day	45	Harry Welshans Booneville Huckster	Rebersburg Hotel	Vertical pattern. Almost all visits on Tuesday.
Weekly Different Days	62	S. D. Fessler Hollidaysburg Unknown	National Hotel	Vertical pattern. Most visits Monday, Tuesday or Wednesday.
Biweekly Same Day	21	Harry McCloskey Coburn Unknown	Rebersburg Hotel	Vertical pattern. Almost all visits on Monday.
Biweekly Different Days	24	R. W. McEldowney Altoona Wholesale Salesman	National Hotel	Vertical pattern. Two weeks apart but no single day prominent.
Biweekly Mixed Days	36	John G. Felty Harrisburg Unknown	National Hotel	Vertical patterns. Several cases of two visits the same week (mostly Mondays, Thursdays).
Multiweekly Same Day	40	E. K. Hess Williamsport Traveling Salesman	Rebersburg Hotel	Vertical pattern. Most visits on Thursday. Always even number of weeks (up to 8) apart.
Multiweekly Different Days	27	Wm. R. Lylte Altoona Salesman	National Hotel	Vertical pattern. Almost always Monday-Wednesday, usually even number of weeks apart.
Bimonthly	48	R. L. Ehrenfeld Unknown (bar tender in 1900 census)	National Hotel	Diagonal Pattern. Visits during the middle and end/beginning of months.
Monthly Consecutive Days	30	Samuel McCurdy Hollidaysburg Unknown	National Hotel	Diagonal pattern. Consecutive days most months.
Monthly	44	Wm. Smeltzer Woodbury Unknown	National Hotel	Diagonal pattern. Most visits occurring from the 17th to the 22nd of each month.
Mixed	44	Thos. Weir Altoona Unknown	National Hotel	Begins with vertical pattern every other Monday. Switches to diagonal pattern during the middle of the month (15th).
Weekday/Weekend	Various	N/A	Both	Vertical patterns. Fewer on weekends than weekdays.
Seasonal	Various	N/A	Both	Vertical histograms undulate with seasons. More visits during the summer than winter.
Seasonal Variation	78	A. M. Sheats Booneville Huckster	Rebersburg Hotel	Deviations from vertical pattern during winter months.

visualization is both a
noun and a **verb**

as a **noun**, a visualization is a static
or interactive graphical artifact

as a **verb**, visualization is the
generation, perception, cognition,
and communication of such artifacts

unlike most graphical representations,
visualizations depict details (items) and data
(collections) in ways that are *readable*

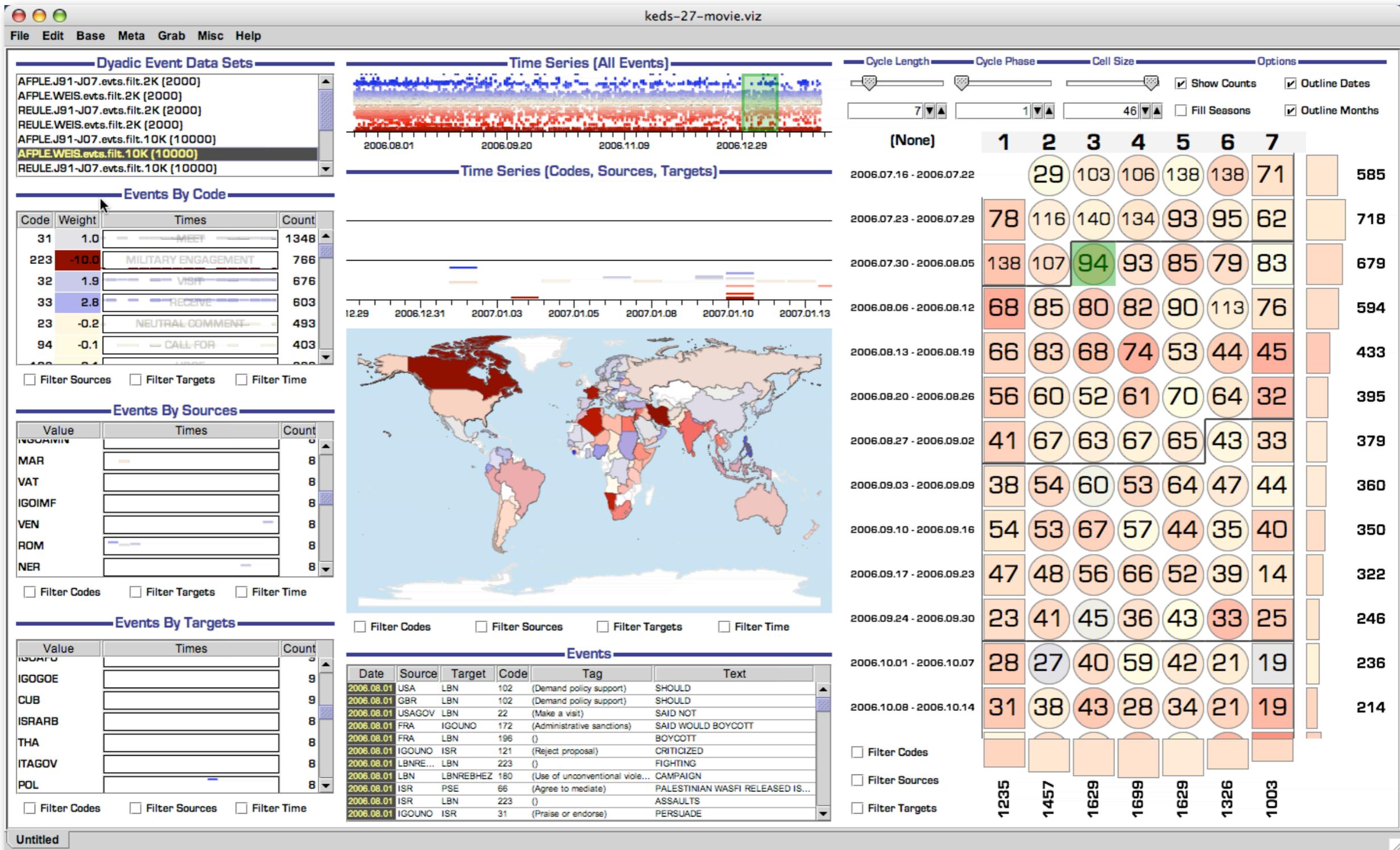
Enable Expression of Complex Questions

By Combining Simple Interactions and Representations

I am a Bear of Very Little Brain,
and long words Bother me.

Pooh redacted.
Oh me, oh my!

To the uneducated,
an A is just three sticks.



KEDS (Kansas Event Data System)

newswire-extracted international events between state-level actors

Collaborator and Data Source: Phil Schrod, University of Kansas Department of Political Science

Cross-Dimensional Data Dissection

methods for expressing sequences of multidimensional set queries by interactively associating unique data values across multiple views

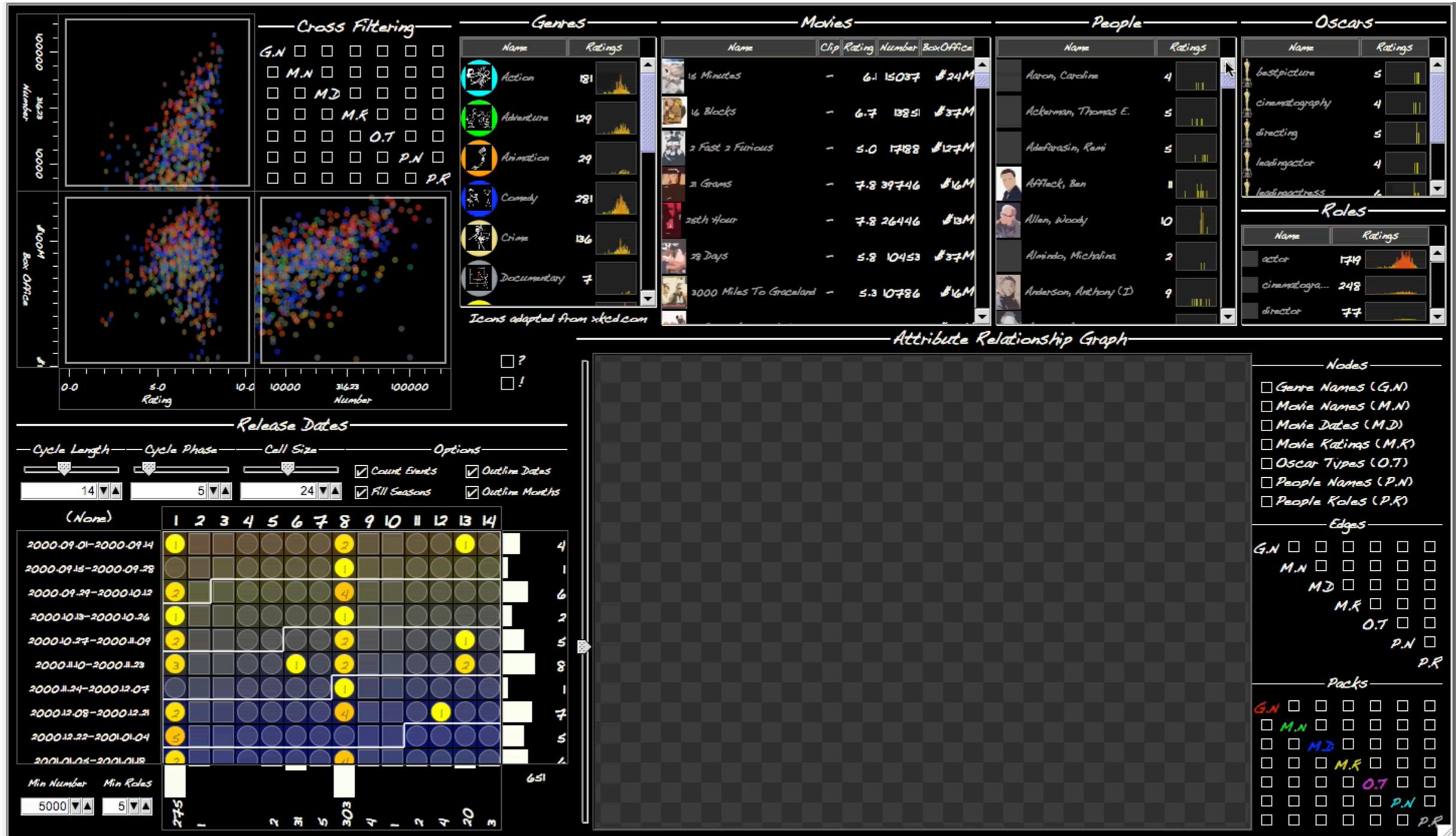
- Multiple views support selection over **sets of unique attribute values** in multiple raw or derived data columns, across one or more tables.
- Attributes are displayed in **dimensionally-appropriate view(s)** that supports a binary categorization of values by selection or navigation.
- Users can **rapidly toggle dependencies** between pairs of views to pose complex drill-down set queries: *effect (show or highlight) only those values in view B that co-occur in the data with the values selected in view A*
- Attributes are also displayed in a **entity-relationship view** (e.g., **a graph**) that shows co-occurrences between values.
- Users can **rapidly toggle visibility of attributes and attribute relationships** to dissect the data by slicing in and across data columns
- Analysts can form hypotheses and **follow chains of evidence** by successive selection/deselection and filtering of values.

Facilitate Pattern Discovery in People, Places, and Times, and Across Scales

They're funny things, Accidents.
You never have them till you're having them.

Pooh redacted.
Oh me, oh my!

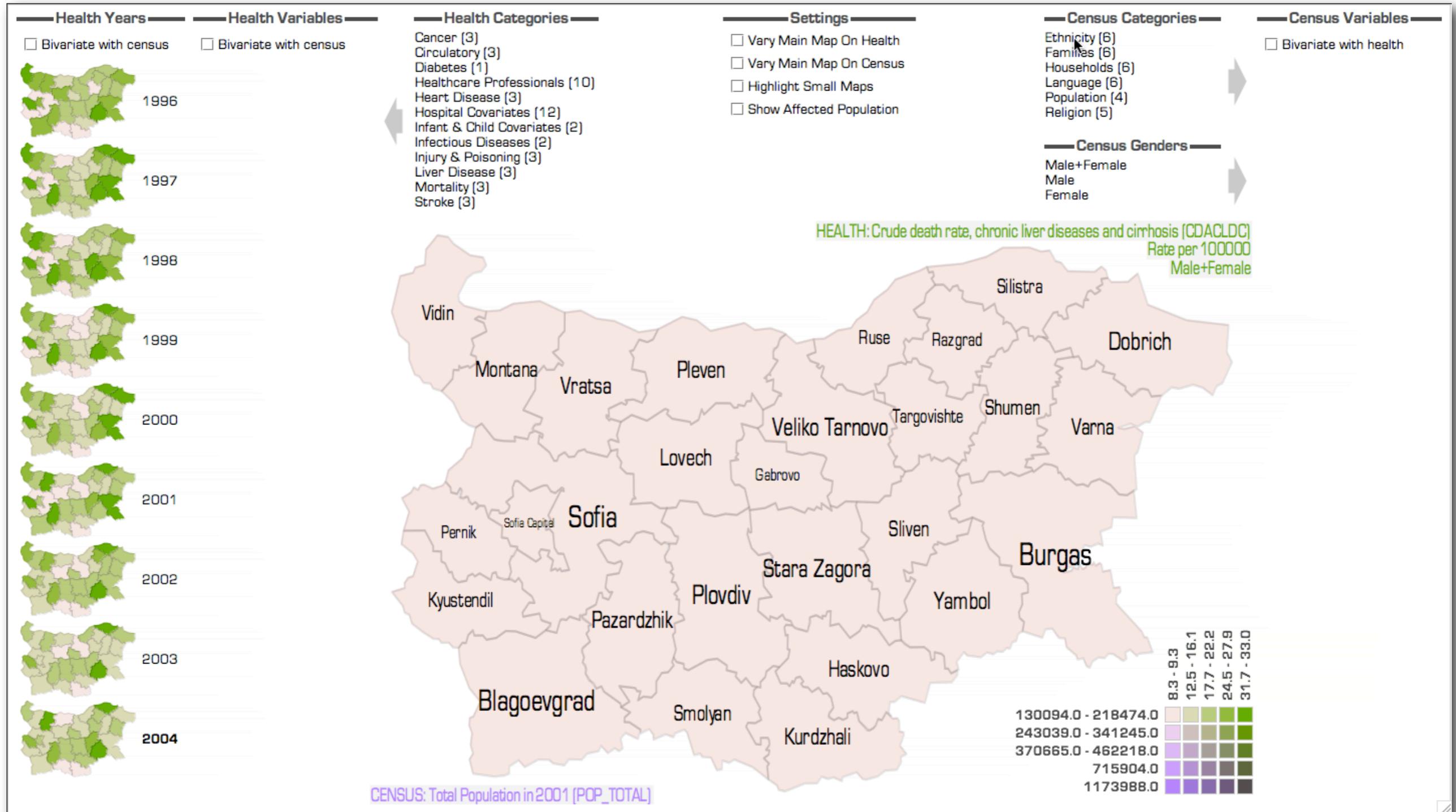
relationships + dates + quantities



Cinegraph

High-dimensional drill-down into people, genres, awards, release dates, and box office characteristics of mainstream movies

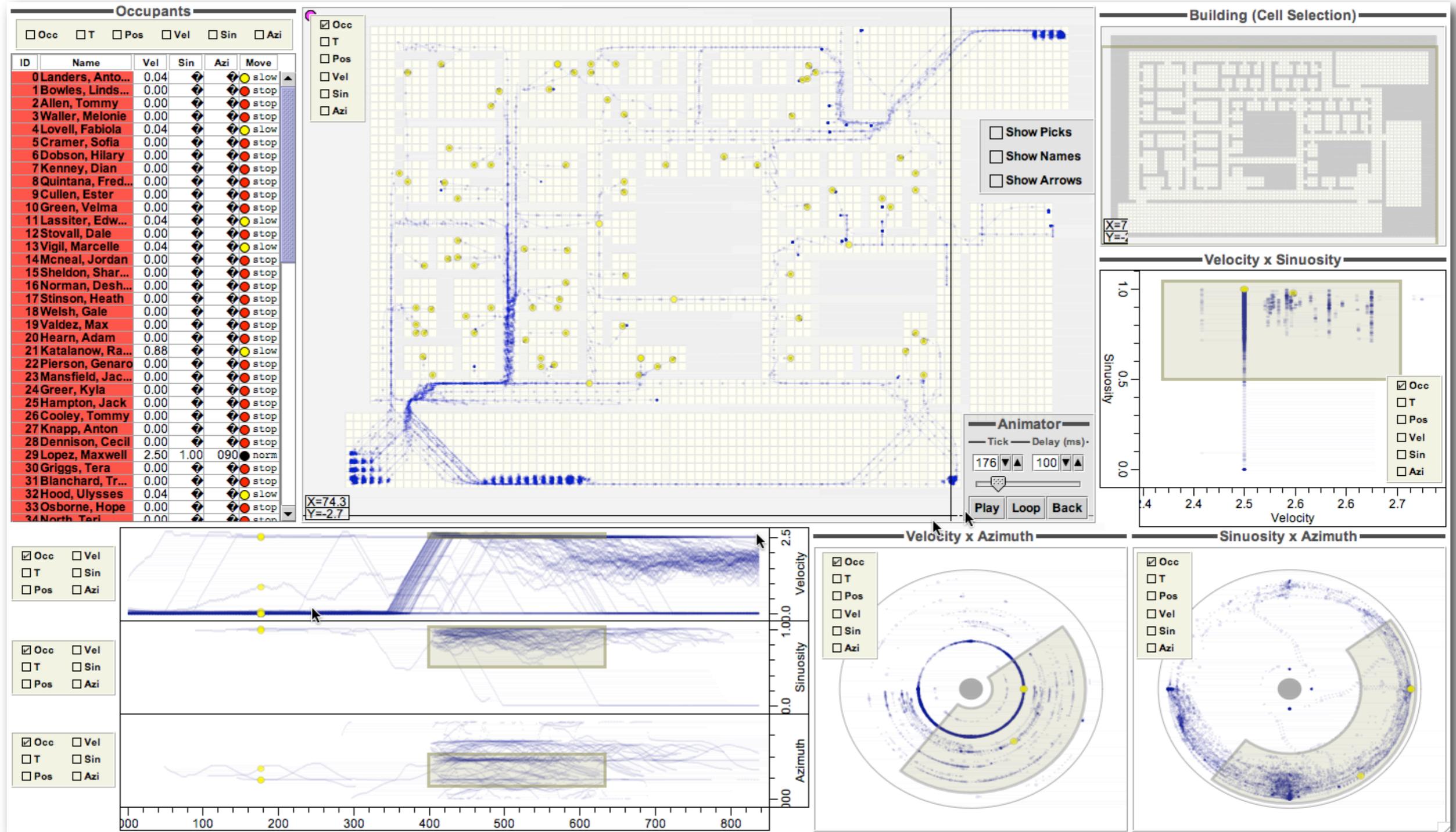
populations + years + regions



bulgaria

oblast-level health demographics from 1996 to 2004

individuals + clocks + spaces



evac

a visualization of movements of RDIF-carrying health care workers and visitors

Data Source: VAST 2008 Challenge, Evacuation Mini-Challenge (synthetic)

Visualization Design: Chris Weaver and Anthony Robinson

Embrace Negativity

In the Ways We Can Ask About Things, That Is

"I saw one once," said Piglet. "At least, I think I did," he said.

"Only perhaps it wasn't."

"So did I," said Pooh, wondering what a Heffalump was like.

"You don't often see them," said Christopher Robin carelessly.

"Not now," said Piglet.

"Not at this time of the year," said Pooh.

Pooh redacted.

Oh me, oh my!

Sometimes We Need To Be A Little Bit Not-ty

- Cross-dimensional queries can be thought of as ANDs of ORs:

$(\text{"Action"} \vee \text{"Comedy"}) \wedge (\text{"Cinematographer"} \vee \text{"Director"})$
 $\rightarrow (\text{"Ed Harris"} \vee \text{"Ron Howard"} \vee \dots)$

- But a lot of questions involve more than disjunction:

*"Which movies have won best picture **but not** best director?"*

*"Who has acted in **both** adventures **and** comedies?"*

*"Show me movies in which these two people acted **together** but this third person had **no** role."*

*"Now show awards in all the **other** genres."*

How might we express such negation, conjunction, and complement?

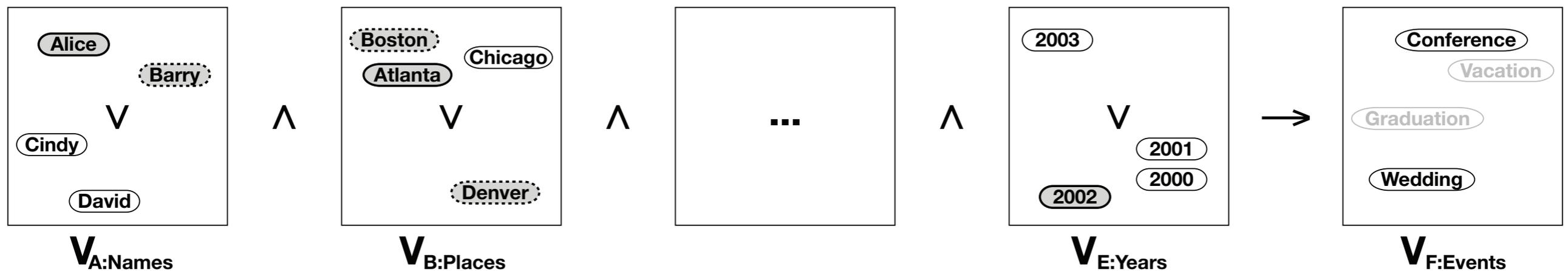
How might we rapidly and easily express **sequences** of such questions through visual interaction?

Conjunctive Visual Forms

<i>A: Name</i>	<i>B: Place</i>	<i>...</i>	<i>E: Year</i>	<i>F: Event</i>
Alice	Atlanta		2002	Conference
Alice	Atlanta		2002	Wedding
Alice	Boston		2000	Vacation
Barry	Boston		2000	Graduation
Barry	Chicago		2001	Vacation
Cindy	Atlanta		2001	Graduation
Cindy	Atlanta		2003	Wedding
David	Denver		2002	Conference

“Show me the (kinds of) events attended by Alice but not Barry, in Atlanta but not Boston or Denver, in 2002.”

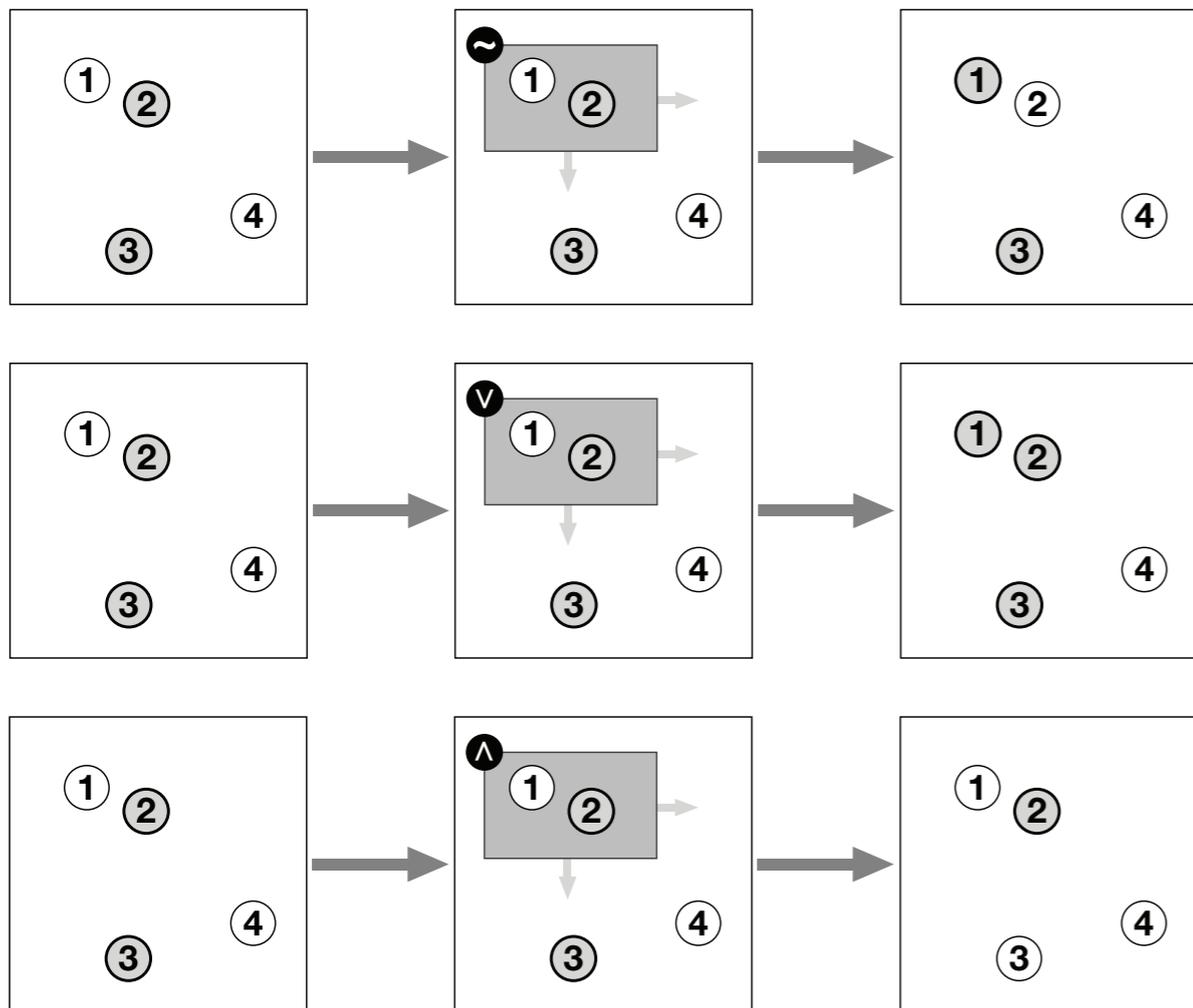
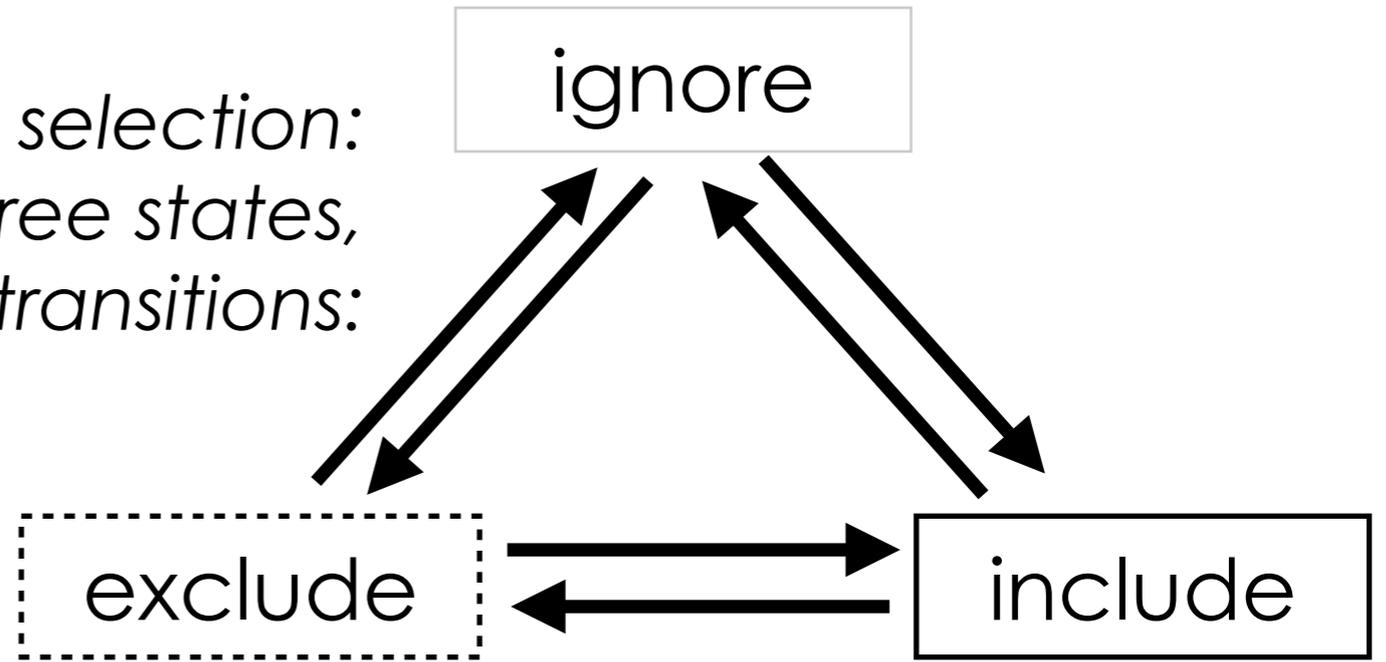
the representational states and interactive transitions of a cross-filtered design as an evolving set of boolean formulas in conjunctive normal form (CNF)



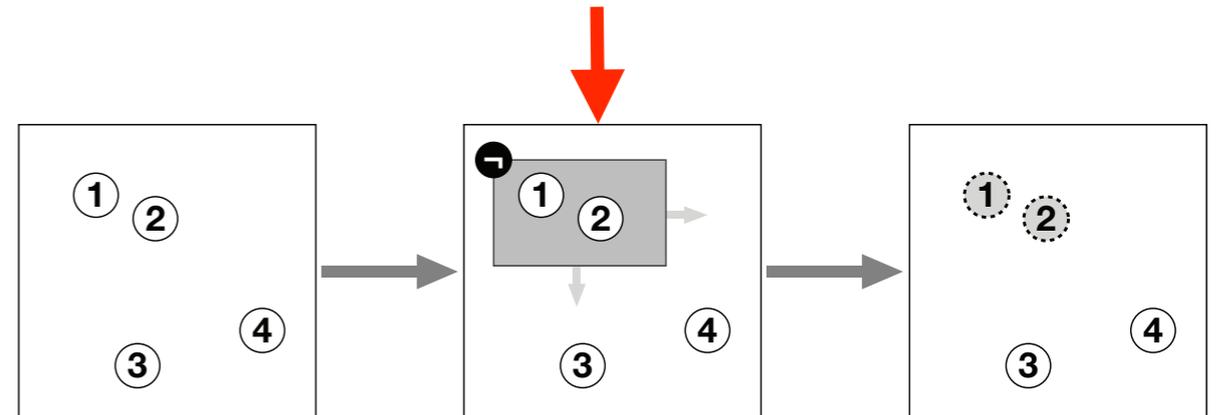
a multiple view visualization as a symmetrically interdependent set of **visual disjunctions** of **value literals**

Selecting and Negating Values

selection:
three states,
six transitions:

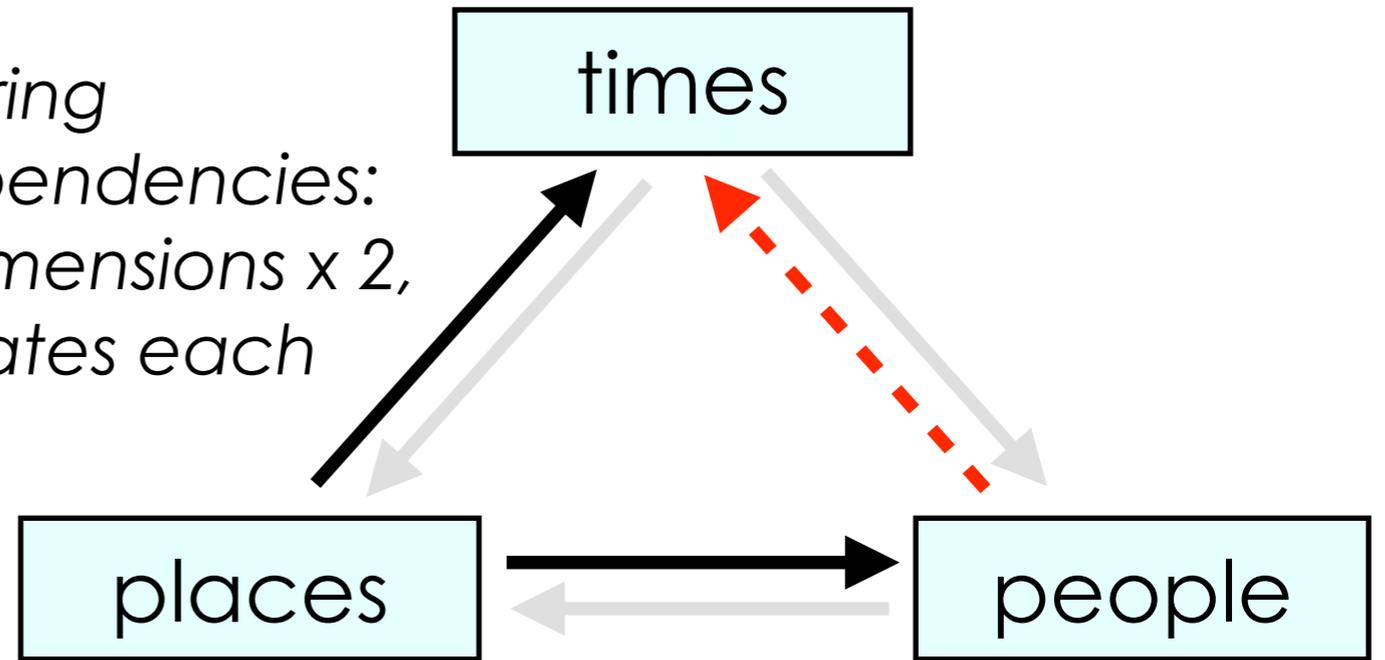


- Allow regular “include” selection of items (including complement and composite gestures).
- Add a parallel set of gestures for “exclude” selection of items.



Selecting and Negating Views

filtering dependencies:
#dimensions x 2,
3 states each



$$V_{\text{places}} \wedge \neg V_{\text{people}} \rightarrow V_{\text{times}}$$

$$V_{\text{places}} \rightarrow V_{\text{people}}$$

$$\mathbf{true} \rightarrow V_{\text{places}}$$

Cross Filtering						
<i>G.N</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<i>M.N</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<i>M.D</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>M.R</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>O.T</i>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>P.N</i>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>P.R</i>

- A checkbox matrix as (one) way to select **dimensions** (metadata) rather than **values** (data).
- Pick which views (visual disjunctions) to include in each view's overall filter (conjunction).
- Checkboxes with **three** states: positive, negative, off

Bonus! De Morgan's Law turns views into visual conjunctions:

$$\neg((A \neq \text{'Alice'}) \vee (A \neq \text{'Barry'})) \Leftrightarrow ((A == \text{'Alice'}) \wedge (A == \text{'Barry'}))$$

Utilize Uncertainty

In Data Values and Our Interpretation of Them

You can't help respecting anybody who can spell TUESDAY, even if he doesn't spell it right; but spelling isn't everything. There are days when spelling Tuesday simply doesn't count.

Pooh redacted.
Oh me, oh my!

Uncertainty in Documents and Data

- Intrinsic sources
 - Incompleteness and variability in references (names, locations, dates) and how they are formatted
 - Obscurity in text passages, drawings, marks, annotations
 - Duplicity in the recording
- Extrinsic sources
 - Fading, damage, fragmentation
 - Transcription errors
 - **Speculative correction!**
 - Guessing dates
 - Merging similar names, residences
 - Mapping locations into modern place names

JOHN Meals Served at all RESIDENCE.

NAME. SATURDAY. JULY. 7

NAME	Meals Served	RESIDENCE
J.P. HARRIS	5	2
GEO FOREPAUGH	5	2
FRANK Mc CORMICK	9	2
IDA Mc CORMICK	9	2
ELMER SUTLIFF	8	1
EDNA SUTLIFF	8	2
HENERY GEASY	7	2
NELLIE GEASY	7	2
	4	2
	4	

UNCLE TOMS CABIN

The movie on this slide is available at <http://www.cs.ou.edu/~weaver/improvise/examples/hotels/>

Evaluating Data Quality



Residences	
Name	Visits
lbg, PA	1
logantown, PA	2
lowe, ?	1
mpes?, ?	1
none given, ?	1
north ??, ?	1
not legible, ?	1
not legible, FL	1
not legible, NY	1
not legible, No Residenc...	3
not legible, PA	77
not legible, not legible	1
np, PA	859
ronola?, ?	1
union Co., ?	1

Hotels Dates Guests

- Many sources of uncertainty are important and interesting in and of themselves.
- Preserve uncertainty in both data representations and visual representations.
- Both can indicate uncertainty **qualitatively**, such as '?' in text, as well as **quantitatively**.
- How much of the analog character of the original documents should we preserve?

- **Depend on expert knowledge to define similarity within an analytic context.**
- Hypotheses are conceptual associations of items.
- Express hypotheses by collecting similar items into groups interactively.
- Later: characterize associations by annotating groups **including expressions of uncertainty**.

Guests	
Name	Visits
menm, tris-t	1
hering, h-b	2
herman, lizzie-?	1
hess, ?-?	2
hess, ?-k	3
hess, c-b	1
hess, d-k	5
hess, e-k	27
hess, e-m	1
hess, ed-keagy	1
hess, j-p	1
hess, o-?	1
hettinger, e-c	1
heuch, nicholas-paul	1
heyburn, c-f	1
hickman, daniel?	1

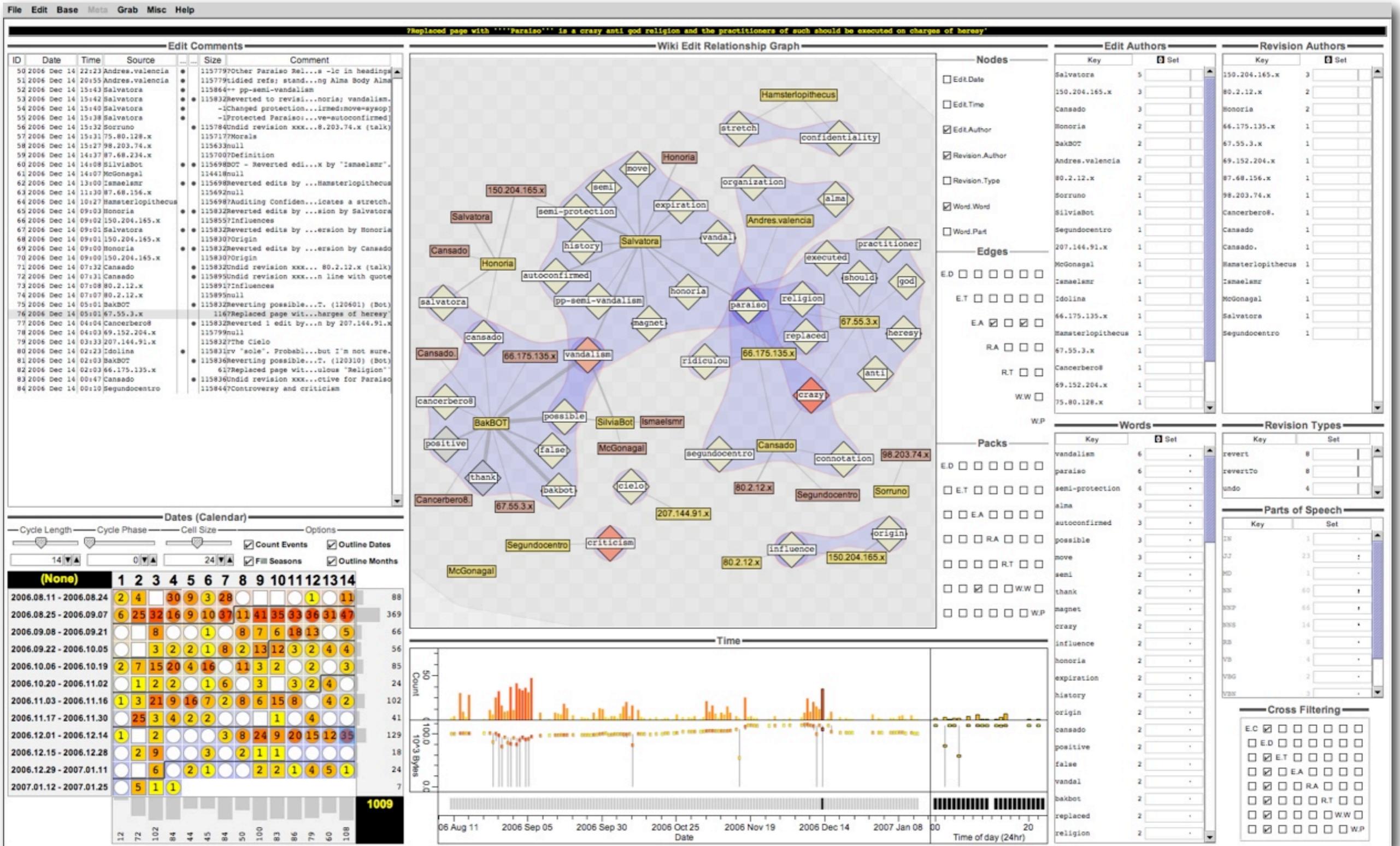
Hotels Dates Residences

Elucidate Querying

It is more fun to talk with someone who doesn't use long, difficult words but rather short, easy words like "What about lunch?"

If you want to make a song more hummy, add a few tiddely poms.

Pooh redacted.
Oh me, oh my!



wiki

a visualization of authors and language over time in a wiki edit history

Data Source: VAST 2008 Challenge, Wiki Edit Mini-Challenge (synthetic)

Visualization Design: Chris Weaver, Chi-chun Pan, Don Pellegrino, Prasenjit Mitra

Individual interactions in these visualizations are simple and (demonstrably) intuitive.

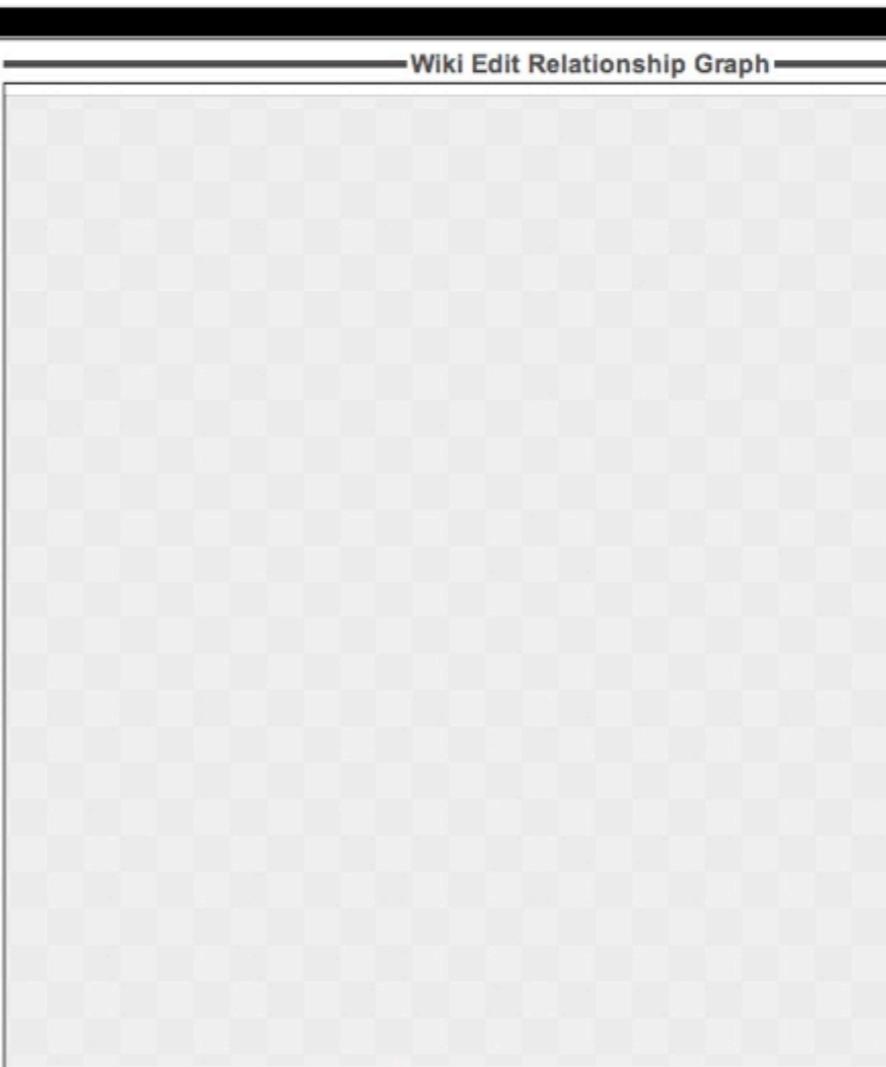
So much so, that **sequences of interactions** often make sense only to the user, and only while they're being performed!

Visual states don't say much about how (let alone why) they came to be.

How can visualization serve interpretation if it affords no natural explanation?

Can we capture the essential analytic intent of interaction sequences in a more readily understandable form?

ID	Date	Time	Source	...	Size	Comment
1	2007 Jan 15	23:44	Alonzo		100571	Scientific critic...so beliefs - link
2	2007 Jan 14	03:21	Alfonso		100552	External links - ... links (see talk)
3	2007 Jan 13	18:36	Adriano		102461	When first propose...BLP violation, et
4	2007 Jan 13	16:45	DailiosTamanca		100959	Undid revision xxx...Gustava's changes
5	2007 Jan 13	15:35	Moisescorral		102461	Undid revision xxx... then you DELETE!
6	2007 Jan 13	14:44	Gustava		100959	Undid revision xxx...l free to join it
7	2007 Jan 13	00:15	Moisescorral		102461	Undid revision xxx...d criteria FIRST!
8	2007 Jan 11	19:26	Gustava		100959	External links - ...- DO NOT EDIT WAR
9	2007 Jan 10	23:51	Strider		102461	Paraiso and psych...lled" per WP:NPOV
10	2007 Jan 10	20:00	Robertocarlosgo		102464	Paraiso and celebrities
11	2007 Jan 10	19:13	Robertocarlosgo		102464	Morals and Ethics
12	2007 Jan 10	16:24	Edemir		102458	Reverted good fait...hology.. using TW
13	2007 Jan 10	09:11	Dragon		102477	null
14	2007 Jan 09	16:17	Selena		102458	Undid revision xxx...undoing own undo.
15	2007 Jan 09	16:06	Selena		102549	Undid revision xxx...d is appropriate.
16	2007 Jan 09	15:54	Gustava		102458	rem off-topic EL t...ection to Paraiso
17	2007 Jan 09	13:41	Harrydelfimo		102549	External links
18	2007 Jan 08	16:00	Gustava		102458	unsourced > sourced
19	2007 Jan 07	18:05	ROMANO		102179	fixed grammar
20	2007 Jan 07	02:09	Abran		102179	See also
21	2007 Jan 06	14:20	Agustin		102171	Auditing confiden... part of the flow
22	2007 Jan 06	11:20	ISMRwiki		102169	Auditing confidentiality



Nodes

E.D (Edit.Date)

E.T (Edit.Time)

E.A (Edit.Author)

R.A (Revision.Author)

R.T (Revision.Type)

W.W (Word.Word)

W.P (Word.Part of Speech)

Edges

E.D

E.T

E.A

R.A

R.T

W.W

W.P

Packs

E.D

E.T

E.A

R.A

R.T

W.W

W.P

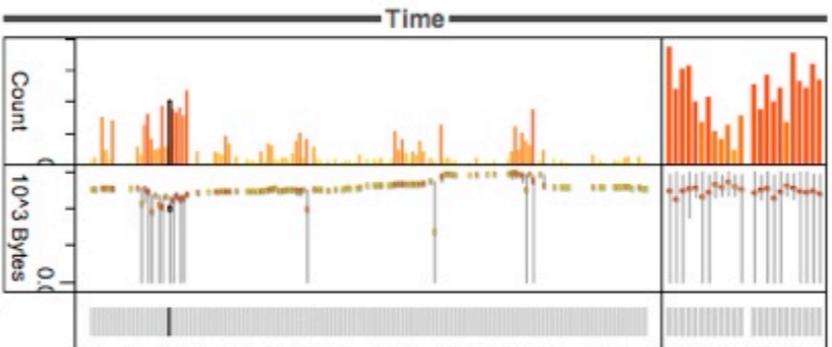
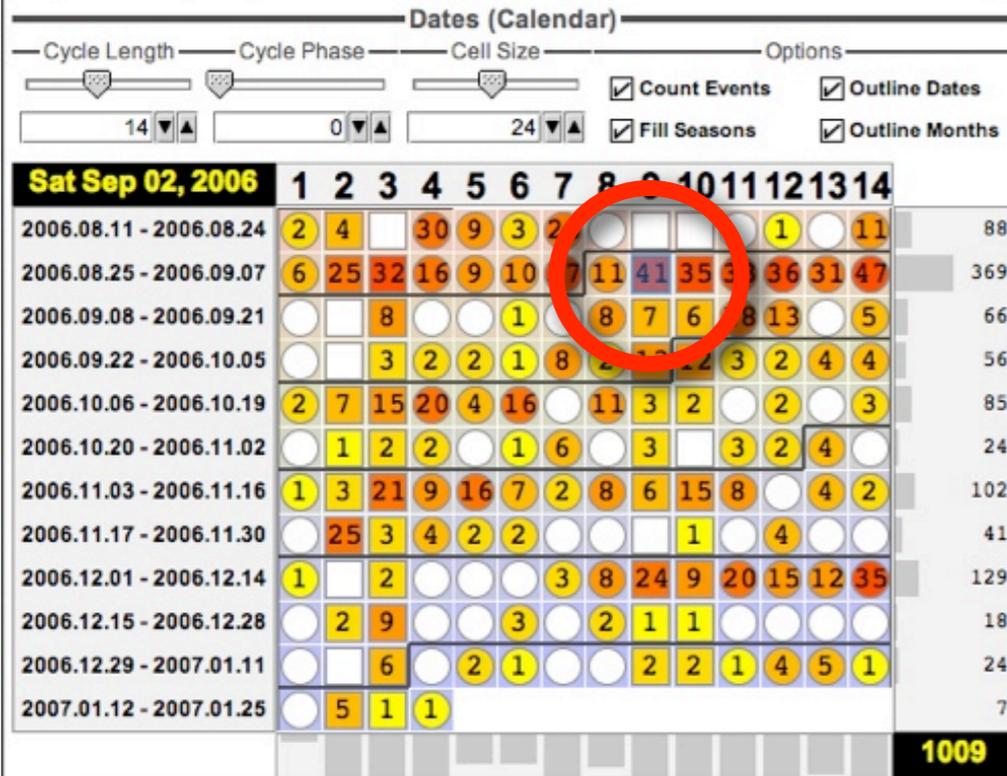
Key	Set
12.196.12.x	1
12.196.13.x	2
121.44.3.x	2
124.186.233.x	1
124.189.51.x	1
125.238.243.x	1

Key	Set
12.196.12.x	1
124.186.233.x	1
124.189.51.x	1
128.125.81.x	1
128.174.36.x	1
131.174.244.x	1

Key	Set
revert	121
revertTo	70
undo	86

Key	Set
CC	2
CD	5
DT	7
FW	3
IN	39

Key	Set
--still	1
--add	1
-lc	1
1960s	1
1st	2



Cross Filtering

E.C

E.D

E.T

E.A

R.A

R.T

W.W

W.P

On September 2, 2006

File Edit Base Meta Grab Misc Help

Edit Comments

ID	Date	Time	Source	Size	Comment
1	2007 Jan 15	23:44	Alonzo	100571	Scientific critic...so beliefs - link
2	2007 Jan 14	03:21	Alfonso	100552	External links - ... links (see talk)
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17	2007 Jan 09	13:41	Harrydelfimo	102549	External links
18	2007 Jan 08	16:00	Gustava	102458	unsourced > sourced
19	2007 Jan 07	18:05	ROMANO	102179	fixed grammar
20	2007 Jan 07	02:09	Abran	102179	See also
21	2007 Jan 06	14:20	Agustin	102171	Auditing confiden... part of the flow
22	2007 Jan 06	11:20	ISMRwiki	102169	Auditing confidentiality

Wiki Edit Relationship Graph

Edit Authors

Key	Set
86.135.211.x	1
Adalberto	1
Alarico	1
Alejo	6
Amado	18
BakBOT	1

Revision Authors

Key	Set
12.19...12.x	1
124...6.233.x	1
12...89.51.x	1
1...125.81.x	1
28.174.36.x	1
131.174.244.x	1

Revision Types

Key	Set
revert	121
revertTo	70
undo	86

Parts of Speech

Key	Set
CC	2
CD	5
DT	7
FW	3
IN	39

Words

Key	Set
--still	1
--add	1
--lc	1
1960s	1
1st	2

Dates (Calendar)

Cycle Length: 14 | Cycle Phase: 0 | Cell Size: 24

Options: Count Events Outline Dates Fill Seasons Outline Months

(None)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
2006.08.11 - 2006.08.24	2	4		30	9	3	2					1		11	88
2006.08.25 - 2006.09.07	6	25	32	16	9	10	7	11	41	35	3	36	31	47	369
2006.09.08 - 2006.09.21			8			1		8	7	6		13		5	66
2006.09.22 - 2006.10.05			3	2	2	1	8	2	15	2	3	2	4	4	56
2006.10.06 - 2006.10.19	2	7	15	20	4	16		11	3	2		2		3	85
2006.10.20 - 2006.11.02		1	2	2		1	6		3		3	2	4		24
2006.11.03 - 2006.11.16	1	3	21	9	16	7	2	8	6	15	8		4	2	102
2006.11.17 - 2006.11.30		25	3	4	2	2					1		4		41
2006.12.01 - 2006.12.14	1		2				3	8	24	9	20	15	12	35	129
2006.12.15 - 2006.12.28		2	9			3		2	1	1					18
2006.12.29 - 2007.01.11			6		2	1			2	2	1	4	5	1	24
2007.01.12 - 2007.01.25		5	1	1											7

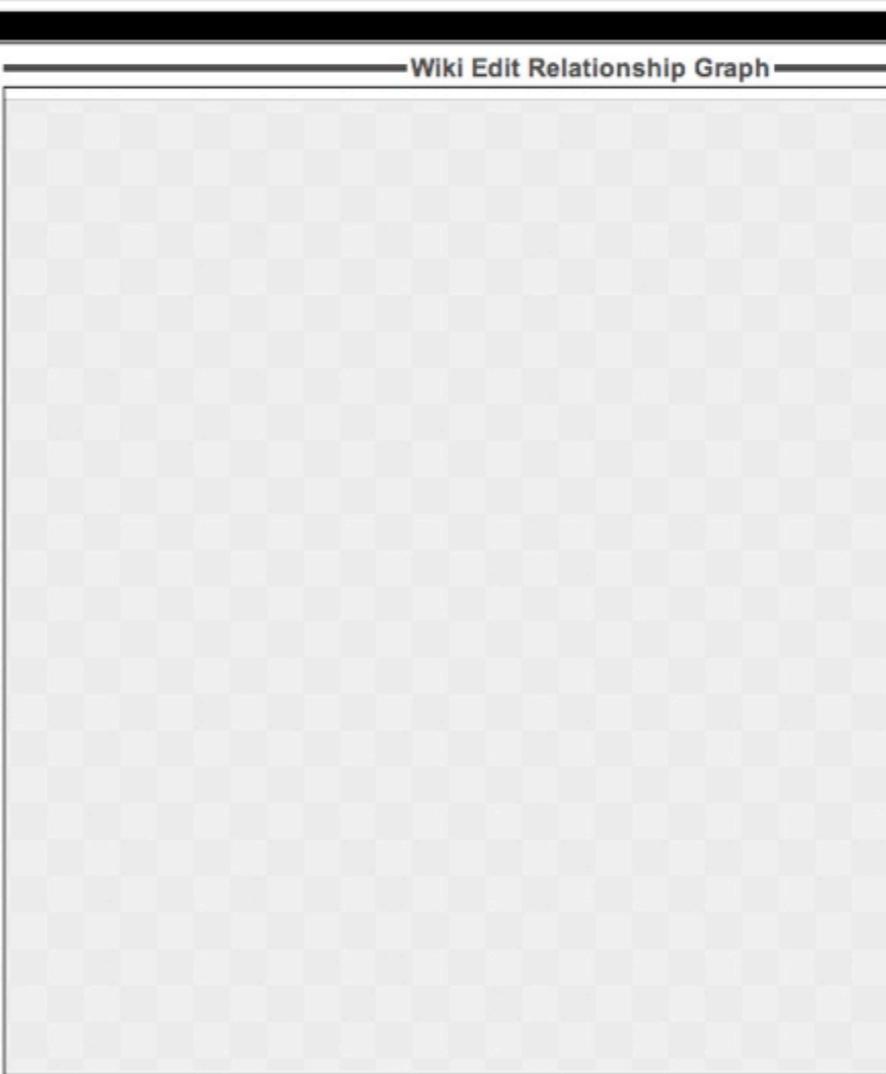
Time

Cross Filtering

<input type="checkbox"/>	E.C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	E.D	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	E.T	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	E.A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	R.A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	R.T	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	W.W	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	W.P	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

On September 2, 2006...
Who edits an article?

ID	Date	Time	Source	Size	Comment
1	2007 Jan 15	23:44	Alonzo	100571	?Scientific critic...so beliefs - link
2	2007 Jan 14	03:21	Alfonso	100552	?External links - ... links (see talk)
3	2007 Jan 13	18:36	Adriano	102461	When first propose...BLP violation, et
4	2007 Jan 13	16:45	DailosTamanca	100959	Undid revision xxx...Gustava's changes
5	2007 Jan 13	15:35	Moisescorral	102461	Undid revision xxx... then you DELETE!
6	2007 Jan 13	14:44	Gustava	100959	Undid revision xxx...l free to join it
7	2007 Jan 13	00:15	Moisescorral	102461	Undid revision xxx...d criteria FIRST!
8	2007 Jan 11	19:26	Gustava	100959	?External links - ...- DO NOT EDIT WAR
9	2007 Jan 10	23:51	Strider	102461	?Paraiso and psych...lled" per WP:NPOV
10	2007 Jan 10	20:00	Robertocarlosgo	102464	?Paraiso and celebrities
11	2007 Jan 10	19:13	Robertocarlosgo	102464	?Morals and Ethics
12	2007 Jan 10	16:24	Edemir	102458	Reverted good fait...hology.. using TW
13	2007 Jan 10	09:11	Dragon	102477	null
14	2007 Jan 09	16:17	Selena	102458	Undid revision xxx...undoing own undo.
15	2007 Jan 09	16:06	Selena	102549	Undid revision xxx...d is appropriate.
16	2007 Jan 09	15:54	Gustava	102458	rem off-topic EL t...ection to Paraiso
17	2007 Jan 09	13:41	Harrydelfimo	102549	?External links
18	2007 Jan 08	16:00	Gustava	102458	unsourced > sourced
19	2007 Jan 07	18:05	ROMANO	102179	fixed grammar
20	2007 Jan 07	02:09	Abran	102179	?See also
21	2007 Jan 06	14:20	Agustin	102171	?Auditing confiden... part of the flow
22	2007 Jan 06	11:20	ISMRwiki	102169	?Auditing confidentiality



Wiki Edit Relationship Graph

Nodes

- E.D (Edit.Date)
- E.T (Edit.Time)
- E.A (Edit.Author)
- R.A (Revision.Author)
- R.T (Revision.Type)
- W.W (Word.Word)
- W.P (Word.Part of Speech)

Edges

E.D

E.T

E.A

R.A

R.T

W.W

W.P

Packs

E.D

E.T

E.A

R.A

R.T

W.W

W.P

Cross Filtering

E.C

E.D

E.T

E.A

R.A

R.T

W.W

W.P

Ed Authors

Key	Set
Amado	18
Alejo	6
Kurrop	
Rm99	4
VictoriaV	2
86.135.211.x	1

Revision Authors

Key	Set
12.196.12.x	1
124.186.233.x	1
124.189.51.x	1
128.125.81.x	1
128.174.36.x	1
131.174.244.x	1

Revision Types

Key	Set
revert	121
revertTo	70
undo	86

Parts of Speech

Key	Set
CC	2
CD	5
DZ	7
FW	3
IN	39

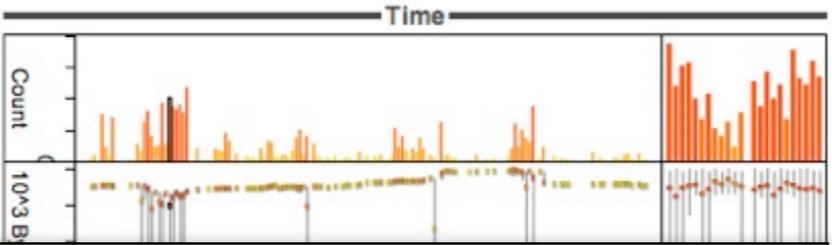
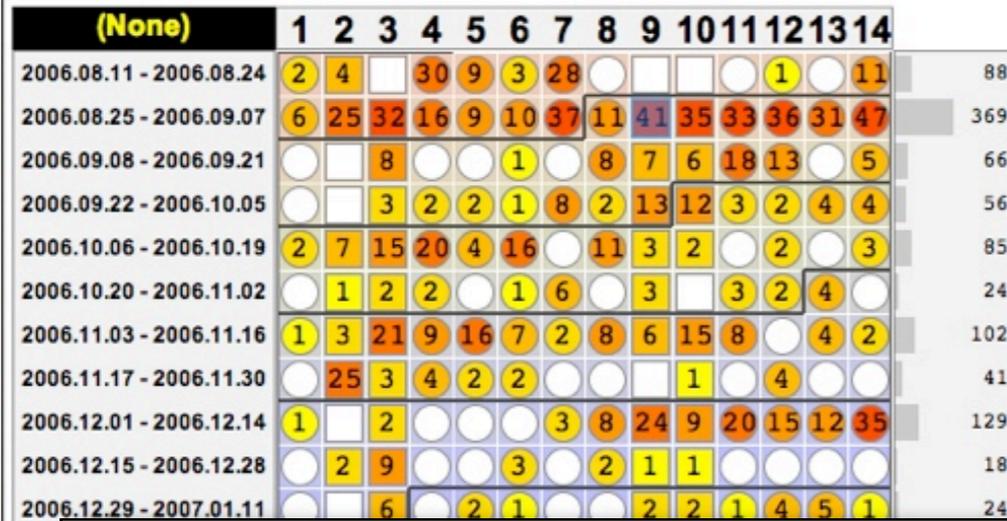
Words

Key	Set
--still	1
--add	1
--lc	1
1960s	1
1st	2

Dates (Calendar)

Cycle Length: 14 | Cycle Phase: 0 | Cell Size: 24

Options: Count Events Outline Dates Fill Seasons Outline Months



On September 2, 2006...

Who edits an article?

Who edits the most articles?

Edit Comments

ID	Date	Time	Source	Size	Comment
1	2007 Jan 15	23:44	Alonzo	100571	?Scientific critic...so beliefs - link
2	2007 Jan 14	03:21	Alfonso	100552	?External links - ... links (see talk)
3	2007 Jan 13	18:36	Adriano	102461	When first propose...BLP violation, et
4	2007 Jan 13	16:45	DailosTamanca	100959	Undid revision xxx...Gustava's changes
5	2007 Jan 13	15:35	Moisescorral	102461	Undid revision xxx... then you DELETE!
6	2007 Jan 13	14:44	Gustava	100959	Undid revision xxx...l free to join it
7	2007 Jan 13	00:15	Moisescorral	102461	Undid revision xxx...d criteria FIRST!
8	2007 Jan 11	19:26	Gustava	100959	?External links - ...- DO NOT EDIT WAR
9	2007 Jan 10	23:51	Strider	102461	?Paraiso and psych...lled" per WP:NPOV
10	2007 Jan 10	20:00	Robertocarlosgo	102464	?Paraiso and celebrities
11	2007 Jan 10	19:13	Robertocarlosgo	102464	?Morals and Ethics
12	2007 Jan 10	16:24	Edemir	102458	Reverted good fait...hology.. using TW
13	2007 Jan 10	09:11	Dragon	102477	null
14	2007 Jan 09	16:17	Selena	102458	Undid revision xxx...undoing own undo.
15	2007 Jan 09	16:06	Selena	102549	Undid revision xxx...d is appropriate.
16	2007 Jan 09	15:54	Gustava	102458	rem off-topic EL t...ection to Paraiso
17	2007 Jan 09	13:41	Harrydelfimo	102549	?External links
18	2007 Jan 08	16:00	Gustava	102458	unsourced > sourced
19	2007 Jan 07	18:05	ROMANO	102179	fixed grammar
20	2007 Jan 07	02:09	Abran	102179	?See also
21	2007 Jan 06	14:20	Agustin	102171	?Auditing confiden... part of the flow
22	2007 Jan 06	11:20	ISMRwiki	102169	?Auditing confidentiality

Wiki Edit Relationship Graph

Edit Authors

Key	Set
Anado	18
Alejo	6
Kurrop	5
Rm99	4
VictoriaV	2
86.135.211.x	1

Revision Authors

Key	Set
12.196.12.x	1
124.186.233.x	1
124.189.51.x	1
128.125.81.x	1
128.174.36.x	1
131.174.244.x	1

Revision Types

Key	Set
revert	121
revertto	70
undo	86

Parts of Speech

Key	Set
CC	2
CD	5
DZ	7
FW	3
IN	39

Dates (Calendar)

Cycle Length: 14 | Cycle Phase: 0 | Cell Size: 24

Options: Count Events Outline Dates Fill Seasons Outline Months

(None)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
2006.08.11 - 2006.08.24	2	4		30	9	3	2					1		11	88
2006.08.25 - 2006.09.07	6	25	32	16	9	10	7	11	41	35	3	36	31	47	369
2006.09.08 - 2006.09.21			8			1		8	7	6		13		5	66
2006.09.22 - 2006.10.05			3	2	2	1	8			13	2	3	2	4	56
2006.10.06 - 2006.10.19	2	7	15	20	4	16		11	3	2		2		3	24
2006.10.20 - 2006.11.02		1	2	2		1	6		3		3	2	4		24
2006.11.03 - 2006.11.16	1	3	21	9	16	7	2	8	6	15	8		4	2	102
2006.11.17 - 2006.11.30		25	3	4	2	2				1		4			41

On September 2, 2006...

~~Who~~ edits an article?

Who edits the most articles?

and

What words appear in comments?

Nodes

E.D (Edit.Date)

E.T (Edit.Time)

E.A (Edit.Author)

R.A (Revision.Author)

R.T (Revision.Type)

W.W (Word.Word)

W.P (Word.Part of Speech)

Edges

E.D

E.T

E.A

R.A

R.T

W.W

W.P

Packs

E.D

E.T

E.A

R.A

R.T

W.W

W.P

Cross Filtering

E.C

E.D

E.T

E.A

R.A

R.T

W.W

W.P

Words

Key	Set
ist	2
accordance	1
added	15
after	1
alma	1

Edit Comments

ID	Date	Time	Source	Size	Comment
1	2007 Jan 15	23:44	Alonzo	100571	?Scientific critic...so beliefs - link
2	2007 Jan 14	03:21	Alfonso	100552	?External links - ... links (see talk)
3	2007 Jan 13	18:36	Adriano	102461	When first propose...BLP violation, et
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8	2007 Jan 11	19:26	Gustava	100959	?External links - ...- DO NOT EDIT WAR
9	2007 Jan 10	23:51	Strider	102461	?Paraiso and psych...lled" per WP:NPOV
10	2007 Jan 10	20:00	Robertocarlosgo	102464	?Paraiso and celebrities
11	2007 Jan 10	19:13	Robertocarlosgo	102464	?Morals and Ethics
12	2007 Jan 10	16:24	Edemir	102458	Reverted good fait...hology.. using TW
13	2007 Jan 10	09:11	Dragon	102477	null
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18	2007 Jan 08	16:00	Gustava	102458	unsourced > sourced
19	2007 Jan 07	18:05	ROMANO	102179	fixed grammar
20	2007 Jan 07	02:09	Abran	102179	?See also
21	2007 Jan 06	14:20	Agustin	102171	?Auditing confiden... part of the flow
22	2007 Jan 06	11:20	ISMRwiki	102169	?Auditing confidentiality

Wiki Edit Relationship Graph

Edit Authors

Key	Set
Amado	18
Alejo	6
Kurrop	5
Rm99	4
VictoriaV	2
86.135.211.x	1

Dates (Calendar)

Cycle Length: 14 | Cycle Phase: 0 | Cell Size: 24

Options: Count Events Outline Dates Fill Seasons Outline Months

(None)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Count
2006.08.11 - 2006.08.24	2	4		30	9	3	2					1		11	88
2006.08.25 - 2006.09.07	6	25	32	16	9	10	7	11	41	35	3	36	31	47	369
2006.09.08 - 2006.09.21			8			1		8	7	6		13		5	66
2006.09.22 - 2006.10.05			3	2	2	1	8			13	2	3	2	4	56
2006.10.06 - 2006.10.19	2	7	15	20	4	16		11	3	2		2		3	25
2006.10.20 - 2006.11.02		1	2	2		1	6		3		3	2	4		24
2006.11.03 - 2006.11.16	1	3	21	9	16	7	2	8	6	15	8		4	2	102
2006.11.17 - 2006.11.30		25	3	4	2	2				1		4			41

On September 2, 2006...

~~Who edits an article?~~

Who edits the most articles?

For editor Amado,

What words appear in comments?

Nodes

- E.D (Edit.Date)
- E.T (Edit.Time)
- E.A (Edit.Author)
- R.A (Revision.Author)
- R.T (Revision.Type)
- W.W (Word.Word)
- W.P (Word.Part of Speech)

Edges

- E.D
- E.T
- E.A
- R.A
- R.T
- W.W
- W.P

Packs

- E.D
- E.T
- E.A
- R.A
- R.T
- W.W
- W.P

Revision Types

Key	Set
revert	21
revertTo	70
undo	36

Parts of Speech

Key	Set
CC	2
CD	5
DZ	1
FW	1
IN	39

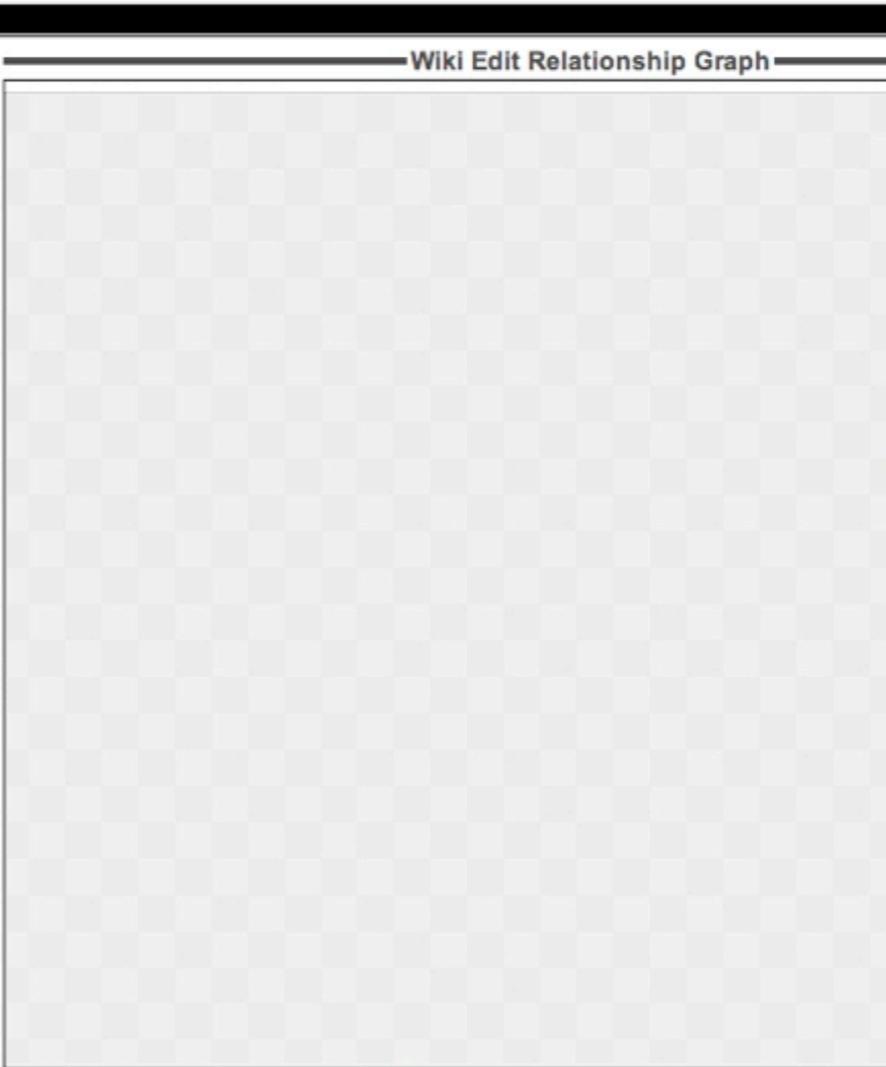
Cross Filtering

- E.C
- E.D
- E.T
- E.A
- R.A
- R.T
- W.W
- W.P

Words

Key	Set
added	6
belief	4
	1
citacion	1
citation	1

ID	Date	Time	Source	Size	Comment
1	2007 Jan 15	23:44	Alonzo	100571	?Scientific critic...so beliefs - link
2	2007 Jan 14	03:21	Alfonso	100552	?External links - ... links (see talk)
3	2007 Jan 13	18:36	Adriano	102461	When first propose...BLP violation, et
4	2007 Jan 13	16:45	DailosTamanca	100959	Undid revision xxx...Gustava's changes
5	2007 Jan 13	15:35	Moisescorral	102461	Undid revision xxx... then you DELETE!
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9	2007 Jan 10	23:51	Strider	102461	?Paraiso and psych...lled" per WP:NPOV
10	2007 Jan 10	20:00	Robertocarlosgo	102464	?Paraiso and celebrities
11	2007 Jan 10	19:13	Robertocarlosgo	102464	?Morals and Ethics
12	2007 Jan 10	16:24	Edemir	102458	Reverted good fait...hology.. using TW
13	2007 Jan 10	09:11	Dragon	102477	null
14	2007 Jan 09	16:17	Selena	102458	Undid revision xxx...undoing own undo.
15	2007 Jan 09	16:06	Selena	102549	Undid revision xxx...d is appropriate.
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17	2007 Jan 09	13:41	Harrydelfimo	102549	?External links
18	2007 Jan 08	16:00	Gustava	102458	unsourced > sourced
19	2007 Jan 07	18:05	ROMANO	102179	fixed grammar
20	2007 Jan 07	02:09	Abran	102179	?See also
21	2007 Jan 06	14:20	Agustin	102171	?Auditing confiden... part of the flow
22	2007 Jan 06	11:20	ISMRwiki	102169	?Auditing confidentiality



Edit Authors

Key	Set
Amado	18
Alejo	6
Kurrop	5
Rm99	4
VictoriaV	2
86.135.211.x	1

Revision Authors

Key	Set
12.196.12.x	1
124.186.233.x	1
124.189.51.x	1
128.125.81.x.	1
128.174.36.x	1
131.174.244.x.	1

Revision Types

Key	Set
revert	121
revertTo	70
undo	86

Parts of Speech

Key	Set
CC	2
CD	5
DZ	7
FW	3
IN	39

Words

Key	Set
paraiso	9
added	6
belief	4
movement	3
intro	3

Nodes

- E.D (Edit.Date)
- E.T (Edit.Time)
- E.A (Edit.Author)
- R.A (Revision.Author)
- R.T (Revision.Type)
- W.W (Word.Word)
- W.P (Word.Part of Speech)

Edges

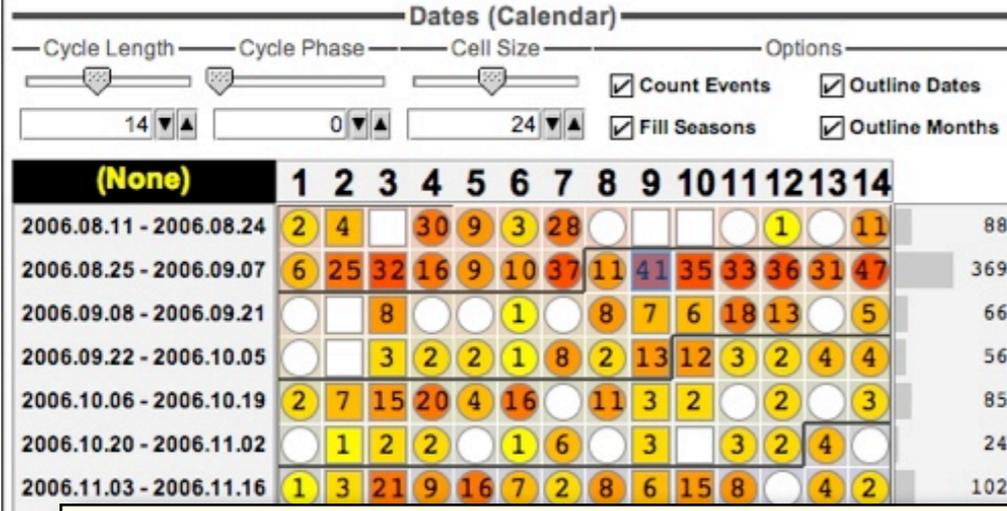
- E.D
- E.T
- E.A
- R.A
- R.T
- W.W
- W.P

Packs

- E.D
- E.T
- E.A
- R.A
- R.T
- W.W
- W.P

Cross Filtering

- E.C
- E.D
- E.T
- E.A
- R.A
- R.T
- W.W
- W.P



On September 2, 2006...

~~Who edits an article?~~

Who edits the most articles?

For editor Amado,

What words appear in comments?

For words paraiso, belief, or movement,

The screenshot shows a software interface with several panels:

- Edit Comments:** A table with columns for ID, Date, Time, Source, Size, and Comment. It lists various users and their comments from January 2007.
- Dates (Calendar):** A calendar view showing the number of events per day for various time periods. A yellow box highlights the period from 2006.09.08 to 2006.09.21, with a focus on September 2, 2006.
- Wiki Edit Relationship Graph:** A large empty grid area.
- Nodes:** A list of nodes with checkboxes for different edit types (E.D, E.T, E.A, R.A, R.T, W.W, W.P).
- Edges:** A grid of checkboxes for different edge types.
- Packs:** A grid of checkboxes for different packs.
- Cross Filtering:** A grid of checkboxes for cross-filtering options.
- Words:** A list of words with checkboxes and counts. Red circles highlight the words 'paraiso', 'belief', and 'movement'.
- Revision Types:** A list of revision types with checkboxes.
- Parts of Speech:** A list of parts of speech with checkboxes.
- Edit Authors:** A list of authors with checkboxes and counts. A red circle highlights the author 'Amado'.

On September 2, 2006...

For editor Amado,

What words appear in comments?

and

For words paraiso, belief, or movement,

Who edits them in comments?

File Edit Base Meta Grab Misc Help

Edit Comments

ID	Date	Time	Source	Size	Comment
1	2007 Jan 15	23:44	Alonzo	100571	?Scientific critic...so beliefs - link
2	2007 Jan 14	03:21	Alfonso	100552	?External links - ... links (see talk)
3	2007 Jan 13	18:36	Adriano	102461	When first propose...BLP violation, et
4	2007 Jan 13	16:45	DailosTamanca	100959	Undid revision xxx...Gustava's changes
5	2007 Jan 13	15:35	Moisescorral	102461	Undid revision xxx... then you DELETE!
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9	2007 Jan 10	23:51	Strider	102461	?Paraiso and psych...lled" per WP:NPOV
10	2007 Jan 10	20:00	Robertocarlosgo	102464	?Paraiso and celebrities
11	2007 Jan 10	19:13	Robertocarlosgo	102464	?Morals and Ethics
12	2007 Jan 10	16:24	Edemir	102458	Reverted good fait...hology.. using TW
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14	2007 Jan 09	16:17	Selena	102458	Undid revision xxx...undoing own undo.
15	2007 Jan 09	16:06	Selena	102549	Undid revision xxx...d is appropriate.
16	2007 Jan 09	15:54	Gustava	102458	rem off-topic EL t...ection to Paraiso
17	2007 Jan 09	13:41	Harrydelfimo	102549	?External links
18	2007 Jan 08	16:00	Gustava	102458	unsourced > sourced
19	2007 Jan 07	18:05	ROMANO	102179	fixed grammar
20	2007 Jan 07	02:09	Abran	102179	?See also
21	2007 Jan 06	14:20	Agustin	102171	?Auditing confiden... part of the flow
22	2007 Jan 06	11:20	ISMRwiki	102169	?Auditing confidentiality

Wiki Edit Relationship Graph

Nodes

- E.D (Edit.Date)
- E.T (Edit.Time)
- E.A (Edit.Author)
- R.A (Revision.Author)
- R.T (Revision.Type)
- W.W (Word.Word)

Edges

- E.D
- E.T
- E.A
- R.A
- R.T
- W.W

Edit Authors

Key	Set
Amado	6
Adalberto	1
Alejo	1

Revision Authors

Key	Set
196.12.x	1
186.233.x	1
189.51.x	1
125.81.x	1
128.174.36.x	1
131.174.244.x	1

Revision Types

Key	Set
revert	21
revertto	70
undo	86

Parts of Speech

Key	Set
CC	2
CD	5
DZ	7
FW	3
IN	3

Words

Key	Set
paraiso	10
page	7
added	6
belief	5
replaced	5

Dates (Calendar)

Cycle Length: 14, Cycle Phase: 0, Cell Size: 24

Options: Count Events, Outline Dates, Fill Seasons, Outline Months

(None)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
2006.08.11 - 2006.08.24	2	4		30	9	3	28					1		11	88
2006.08.25 - 2006.09.07	6	25	32	16	9	10	37	11	41	35	33	36	31	47	369
2006.09.08 - 2006.09.21			8			1		8	7	6	18	13		5	66
2006.09.22 - 2006.10.05			3	2	2	1	8	2	13	12	3	2	4	4	56
2006.10.06 - 2006.10.19	2	7	15	20	4	16		11	3	2				3	85
2006.10.20 - 2006.11.02		1	2	2		1	6		3		3	2	4		24
2006.11.03 - 2006.11.16	1	3	21	9	16	7	2	8	6	15	8		4	2	102
2006.11.17 - 2006.11.30		25	3	4	2	2				1		4			41
2006.12.01 - 2006.12.14	1		2				3	8	24	9	20	15	12	35	129

Time

Cross Filtering

- E.C
- E.D
- E.T
- E.A
- R.A
- R.T
- W.W
- W.P

On September 2, 2006...

For editors Amado, Adalberto, or Alejo and words paraiso, belief, or movement, Who edits which words? (*tiddely pom*)

Rule-Based Visual Query to Question Translation

Map the interaction sequences that trigger data queries and results into a structured, pseudo natural language.

- Query steps as sets of emerging *Who, What, When, Where* questions
- Highlighting of attribute values and dimensional types in questions
- Inline graphics for enumerating larger sets, à la  (sparklines)
- A concurrent, scrolling sidebar
- Reversion to earlier interactive states

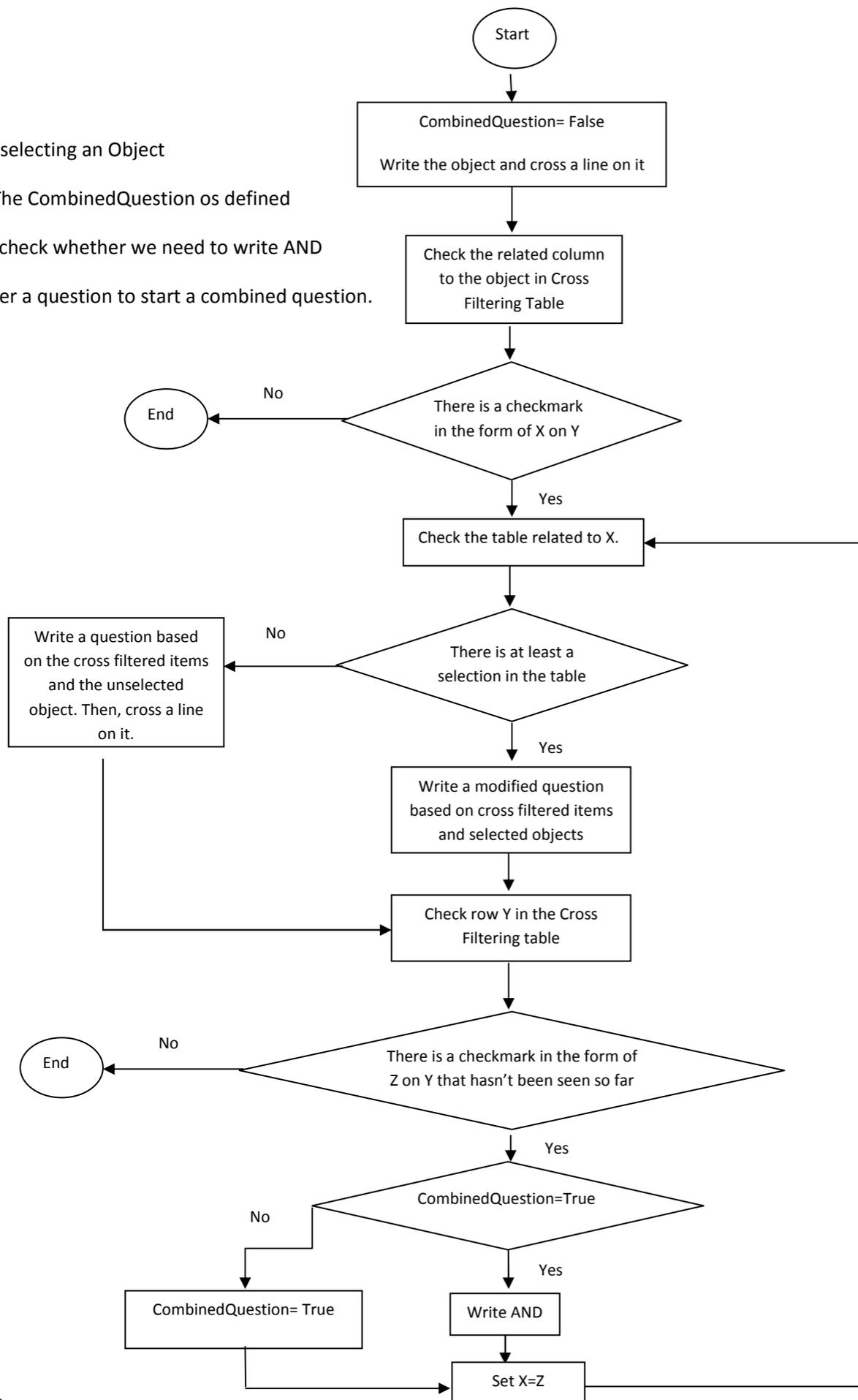
We're making amazingly rapid progress on understanding how to do this for cross-filtering!

Unselecting an Object

* The CombinedQuestion is defined

to check whether we need to write AND

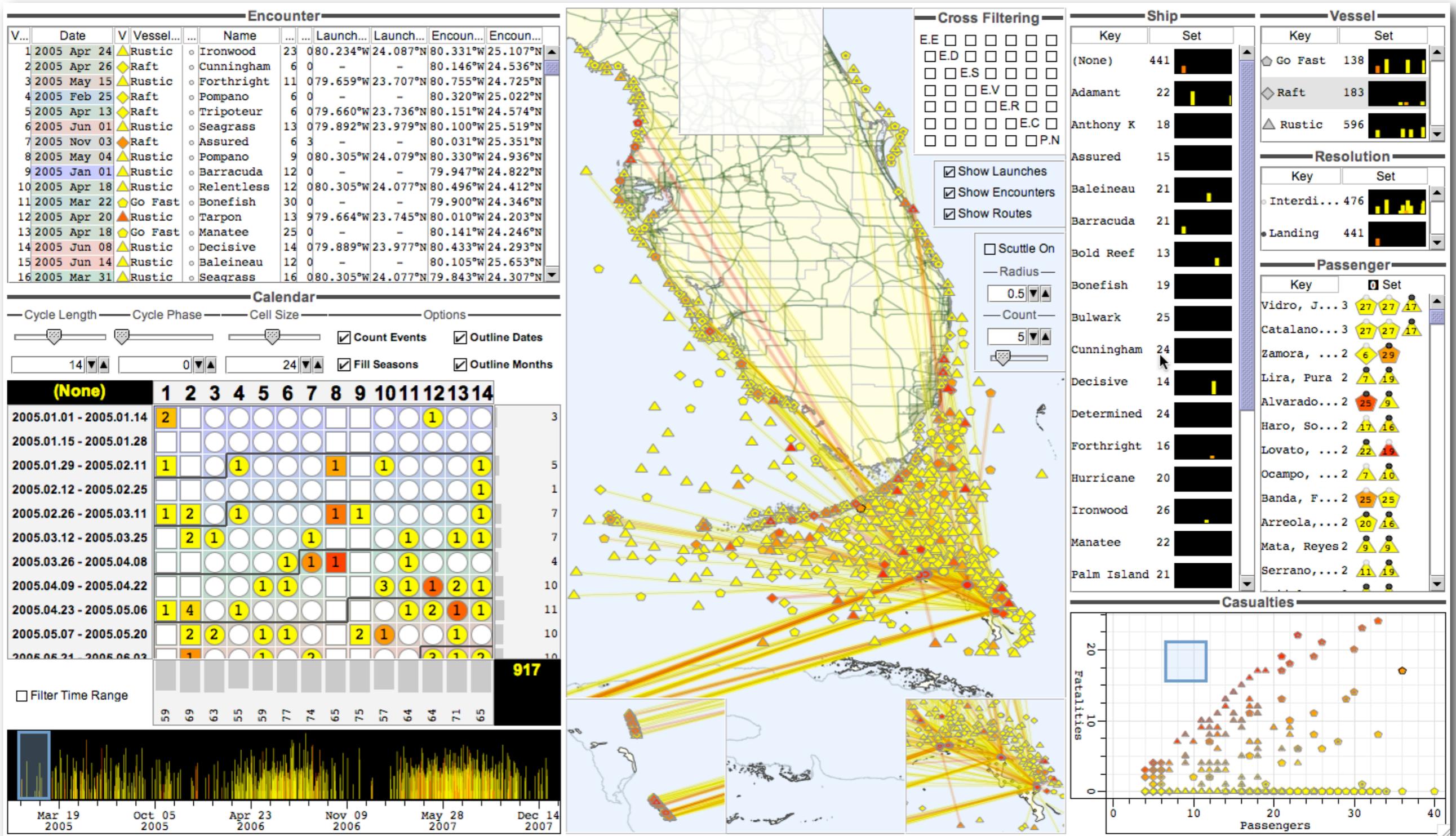
after a question to start a combined question.



Integrate Categorization

Pooh redacted.
Oh me, oh my!

When looking at your two paws,
as soon as you have decided which of them is the right one,
then you can be sure the other one is the left.



boat

a visualization of migrant/refugee boat landings and interdictions (synthetic!)

Data Source: VAST 2008 Challenge, Boats Mini-Challenge
 Visualization Design: Chris Weaver, Michael Stryker, Ian Turton

The ongoing specification and evaluation of evolving categories is central to the interpretation of information.

Yet we integrate categories into our (digital) analytic process by:
hard-coding extra dimensions of predetermined identifiers into our “raw” data
or
occasionally asking a (magic?) algorithm to slice things up for us

Visualization does provide ways to categorize data values on-the-fly:
selection+highlighting: split things into two classes
and
color tagging: split things into up to about 11 classes

How can we extend interactive categorization to allow an evolving multiplicity of categorizations, each of arbitrary cardinality, dimensionality, visual differentiability, and gestural distinguishability?

Liberate Annotation

It gets you nowhere if the other person's tail is only just in sight for the second half of the conversation.

Pooh redacted.
Oh me, oh my!

why is annotation in visualization so limited?

why aren't data visualizations also data editors?

because translating annotations into data
is not only a natural language problem,
but a graphical language problem
in a million local visual dialects

we muddle through with a few interactive grunts & clicks
that make sense everywhere

this thing
these things
tag, here
mark, there

annotation can be more expressive

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

Idea: Behavioral Encoding

- Annotations are merely values in discovered/invented data dimensions.
- Just as **visual encoding** maps data attributes — names, times, locations, quantities — into *aspects of graphical form*...
- ...**behavioral encoding** maps gesture attributes — keystrokes, modifiers, mouse location, gaze location, glove orientation — into *aspects of behavioral form*.

Press modifier keys to alternately select, negate, or otherwise classify values.

Draw and erase arrows to add and remove value co-occurrences.

Pinch or type to associate a numeric or textual uncertainty with one value or a set

Populate new data sets by annotating values and associations in order to classify them into categories...endlessly?

- This could vastly expand the range of **formal** visualization design.
 - Behavioral encodings could depend on primary data, and thus be defined in terms of an evolving multidimensional visual context.
 - Visual encoding could depend on gesture data, and thus be defined in terms of current and past interactions.
- **But visually infused interpretation also begs for design empowerment.**

Recollect Queries

"I don't see much sense in that," said Rabbit.

"No," said Pooh humbly, "there isn't. But there was going to be when I began it. It's just that something happened to it along the way."

Pooh redacted.
Oh me, oh my!

multidimensional visualization is like chess:
easy to learn the moves, hard to play well

it's easy to forget

where you are in a chain of interactions
what your earlier queries were
why you posed them at all
how you interpreted their results

it's easy to get distracted
by new questions

chains of interaction reveal many
enticing paths for exploration
data dissection techniques seem
dangerously effective this way

there's a lot of **foraging**, not enough **sense-making**

if we don't remember our queries,
are we doomed to repeat them?

queries can be collected as structured data

we can visualize this data to recollect queries themselves
using the same techniques as for “regular” data

what kinds of questions
which dimensions
which values
when

“Show me last week’s queries in which I looked at when
Voltaire visited places that I’ve classified as hub cities.”

the record of visual forms plus queries becomes
a living interpretive document

We’re starting to grasp how to design and implement this.

Engage

Analytic Provenance

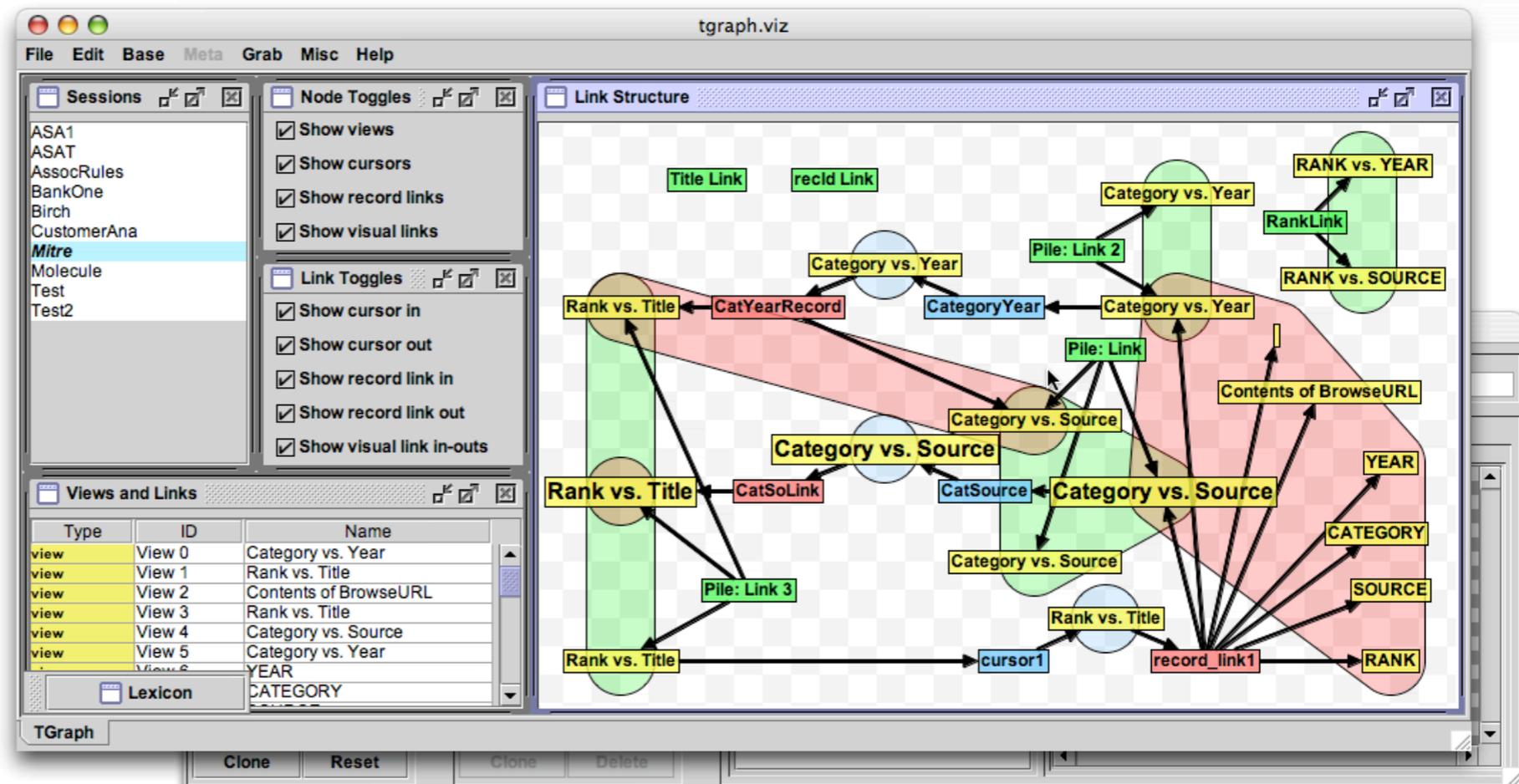
Always watch where you are going. Otherwise, you may step on a piece of the Forest that was left out by mistake.

Pooh redacted.
Oh me, oh my!

Visualize the Analytic Process Itself

- Capture and restore visual+analytic state
 - Intrinsic information about interactive process (“easy”)
 - Extrinsic information about interpretive process? (“hard”)
- Idea: Scrubbable Interfaces
 - Browsing paths in the graphs of provenance
 - Hyperlinking and replay for teaching, documentation, etc.
 - Indexing (and keyframing) of points of interest

A living notebook of data exploration and interpretation in its broader scholarly context.

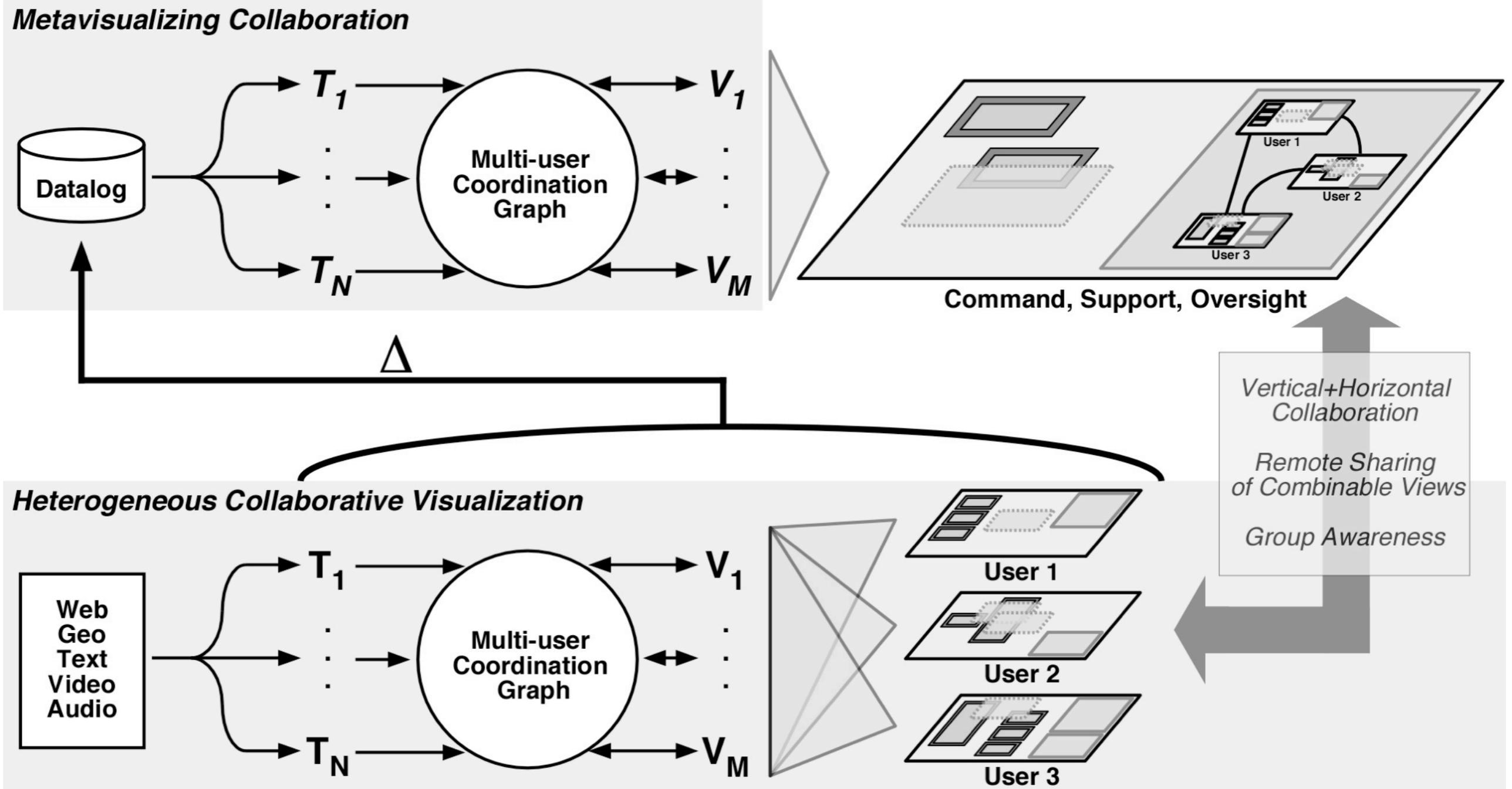


Encourage Collaboration

Pooh redacted.
Oh me, oh my!

When you are a
Bear of Very Little Brain,
and Think of Things,
you find sometimes that a Thing
which seemed very Thingish inside you
is quite different when it gets out into the open
and has other people looking at it.

Collaborative Visualization



Visualizing Collaboration

- Real-time visual management of the collaborative visual analytics process
- Visually immersive record for ongoing analysis, discussion, teaching, publishing
- Economical reuse of visual analytics infrastructure for **reflective** analysis

- Model the collaborative social process as a living, persistent information source.
- Instrument the entire visualization system for continuous logging of all events.
- Support synchronous and time-shifted visualization of the complete record.

- Extend the existing visualization architecture to support collaborative processes.
- Integrate this architecture into a complete collaborative visualization system.



And by and by Christopher Robin came
to an end of things, and he was silent,
and he sat there, looking out over the
world, just wishing it wouldn't stop.

Pooh redacted.
Oh me, oh my!

Thanks! Queries?