Visual Analytics 2

CS 7450 - Information Visualization
March 31, 2011
John Stasko

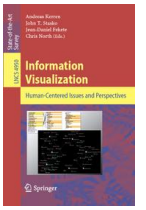
Agenda

- Last time
  - Overview of what the term means and how it relates to information visualization
  - Some example VA research projects
- Today
  - Specific example, Jigsaw, helping investigative analysis
  - Related systems

VA Definition

Review

- Visual analytics combines automated analysis techniques with interactive visualizations for an effective understanding, reasoning and decision making on the basis of very large and complex data sets



Keim et al, chapter in *Information Visualization: Human-Centered Issues and Perspectives*, 2008

Application Area

- Investigative & Intelligence Analysis
  - Gather information from various sources then analyze and reason about what you find and know
  - Analyze situations, understand the particulars, anticipate what may happen

Definitions

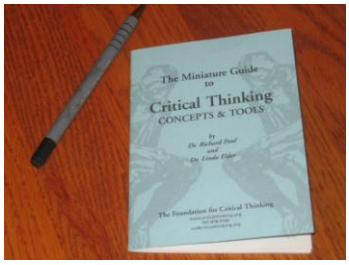
- Thinking[1] - or reasoning - involves objectively connecting present beliefs with evidence in order to believe something else
- Critical Thinking[1] is a deliberate meta-cognitive(thinking about thinking) thinking act whereby a person reflects on the quality of the reasoning process simultaneously while reasoning to a conclusion.
- Intelligence[1] is a specialized form of knowledge, an activity, and an organization. As knowledge, intelligence informs leaders, uniquely aiding their judgment and decision-making. …

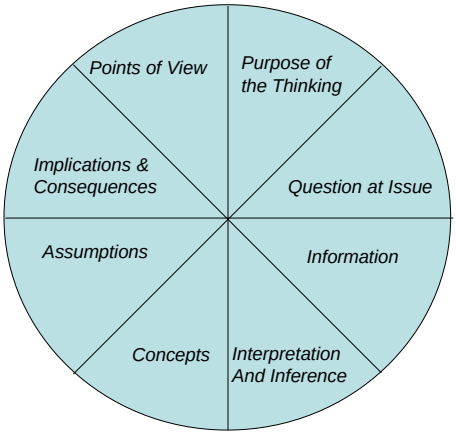
1. *Critical Thinking and Intelligence Analysis: David Moore*

Critical Thinking*

"…the quality of our life and that of what we produce, make, or build depends precisely on the quality of our thoughts."

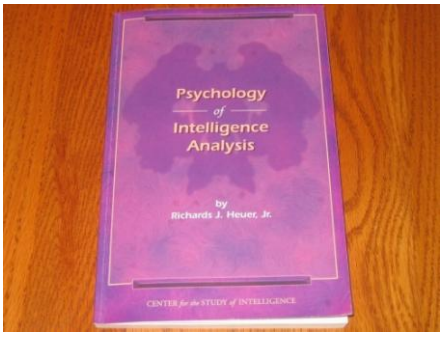
Elements of thought:





* Foundations of Critical Thinking www.criticalthinking.org

Example: Heuer's Central Ideas



- "Tools and techniques that gear the analyst's mind to apply higher levels of critical thinking can substantially improve analysis… structuring information, challenging assumptions, and exploring alternative interpretations."

Intelligence Process

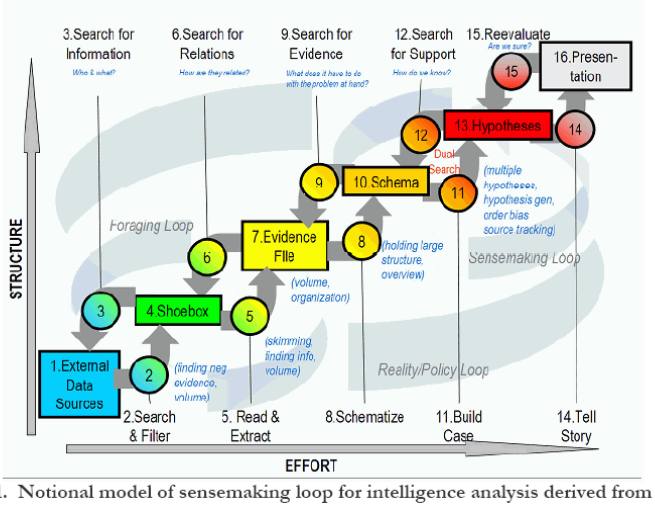


Figure 2.1. Notional model of sensemaking loop for intelligence analysis derived from CTA.

Pirolli & Card
Intl Conf Intelligence Analysis '05

Pain Points

- Cost structure of scanning and selecting items for further attention
- Analysts' span of attention for evidence and hypotheses

HW 8 – Investigative Analysis

- Did you encounter those pain points?

- Discuss
  - How did you work on the problem?
  - What were the main challenges?

Jigsaw

Visualization for Investigative Analysis across Document Collections

- Law enforcement & intelligence community
- Fraud (finance, accounting, banking)
- Academic research
- Journalism & reporting
- Consumer research

"Putting the pieces together"

The Jigsaw Team

Current:

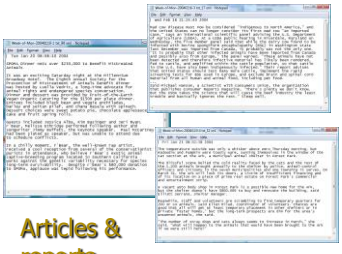
Carsten Görg
Zhicheng Liu
Youn-ah Kang
Jaeyeon Kihm

and many alumni

Problem Addressed

Analogy

Help "investigators" explore, analyze and understand large document collections



Articles & reports

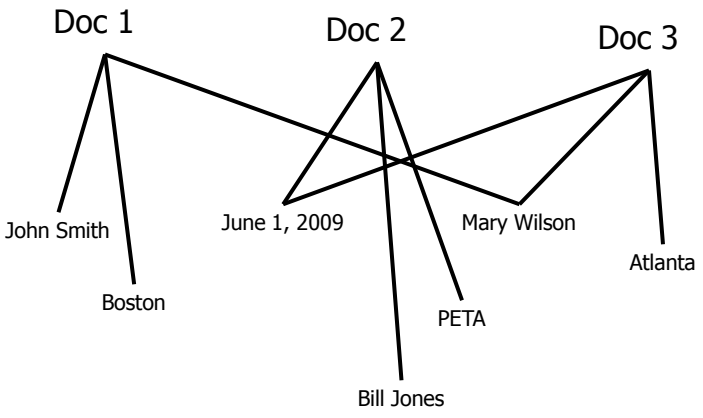
Spreadsheets

Blogs

XML documents

Our Focus

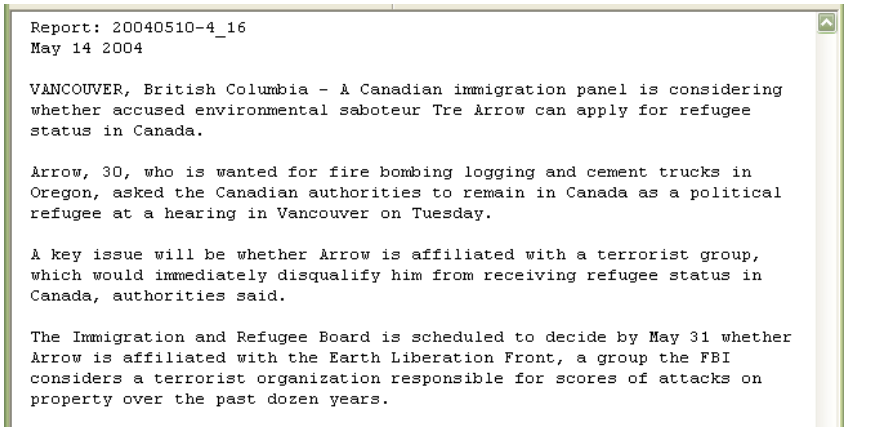
- Entities within the documents
  - Person, place, organization, phone number, date, license plate, etc.
- Thesis: A story/narrative/plot/threat within the documents will involve a set of entities in coordination



Entity Identification

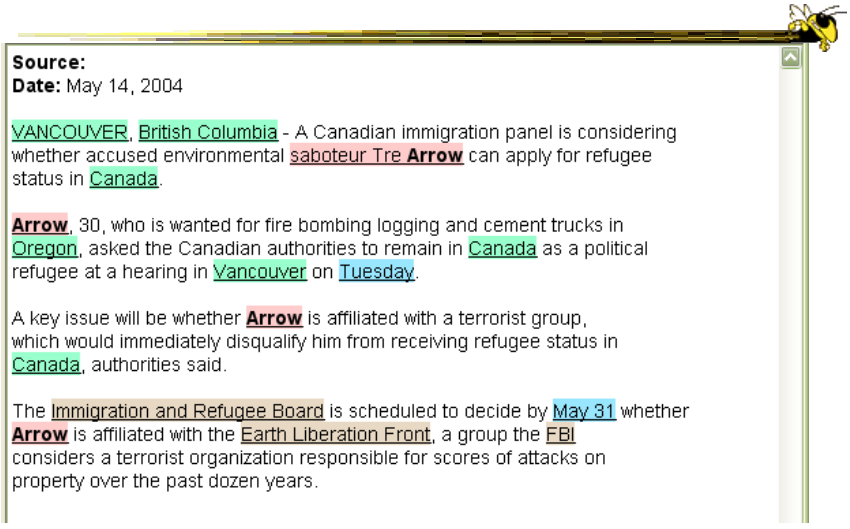
- Must identify and extract entities from plain text documents
  - Crucial for our work
- Not our main research focus – We use tools from others

Sample Document



```
Report: 20040510-4_16
May 14 2004

VANCOUVER, British Columbia - A Canadian immigration panel is considering
whether accused environmental saboteur Tre Arrow can apply for refugee
status in Canada.

Arrow, 30, who is wanted for fire bombing logging and cement trucks in
Oregon, asked the Canadian authorities to remain in Canada as a political
refugee at a hearing in Vancouver on Tuesday.

A key issue will be whether Arrow is affiliated with a terrorist group,
which would immediately disqualify him from receiving refugee status in
Canada, authorities said.

The Immigration and Refugee Board is scheduled to decide by May 31 whether
Arrow is affiliated with the Earth Liberation Front, a group the FBI
considers a terrorist organization responsible for scores of attacks on
property over the past dozen years.
```


Entities Identified



Source:
Date: May 14, 2004

VANCOUVER, British Columbia - A Canadian immigration panel is considering whether accused environmental saboteur Tre **Arrow** can apply for refugee status in Canada.

Arrow, 30, who is wanted for fire bombing logging and cement trucks in Oregon, asked the Canadian authorities to remain in Canada as a political refugee at a hearing in Vancouver on Tuesday.

A key issue will be whether **Arrow** is affiliated with a terrorist group, which would immediately disqualify him from receiving refugee status in Canada, authorities said.

The Immigration and Refugee Board is scheduled to decide by May 31 whether **Arrow** is affiliated with the Earth Liberation Front, a group the FBI considers a terrorist organization responsible for scores of attacks on property over the past dozen years.

Sample Document 2

Title: Proving Columbus was Wrong
Abstract: In this work, we show the world is really flat. To do this, we build a bunch of ships. Then we…
PI: Amerigo Vespucci
Co-PI: Vasco de Gama, Ponce de Leon
Organization: Northwest Central Univ.
Amount: 123,456
Program Mgr: Ephraim Glinert
Division: IIS
ProgramElementCode: 2860

Entities Already Identified

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Abstract: In this work, we show the world is really flat. To do this, we build a bunch of ships. Then we…
PI: Amerigo Vespucci
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Entities

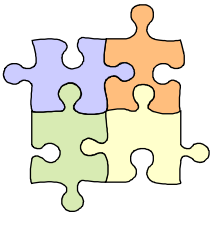
Connections

- Entities relate/connect to each other to make a larger "story"
- Connection definition:
  - Two entities are connected if they appear in a document together
  - The more documents they appear in together, the stronger the connection

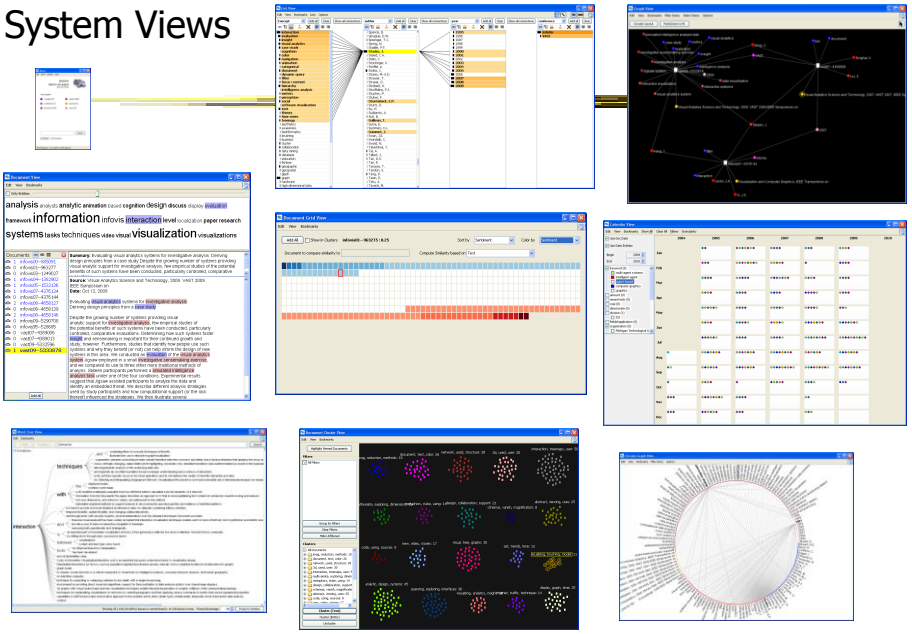
Jigsaw

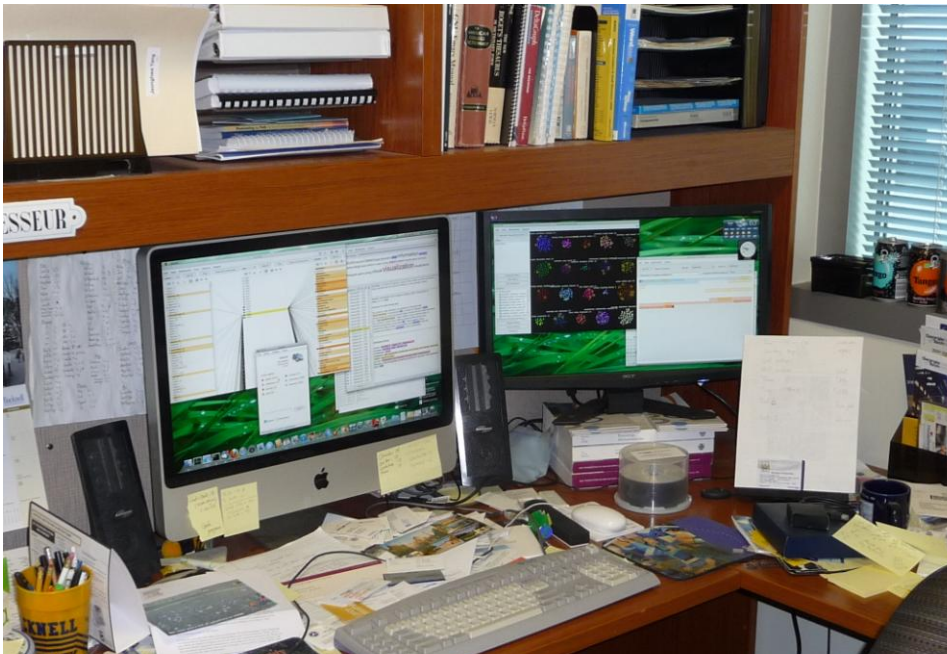
"Putting the pieces together"

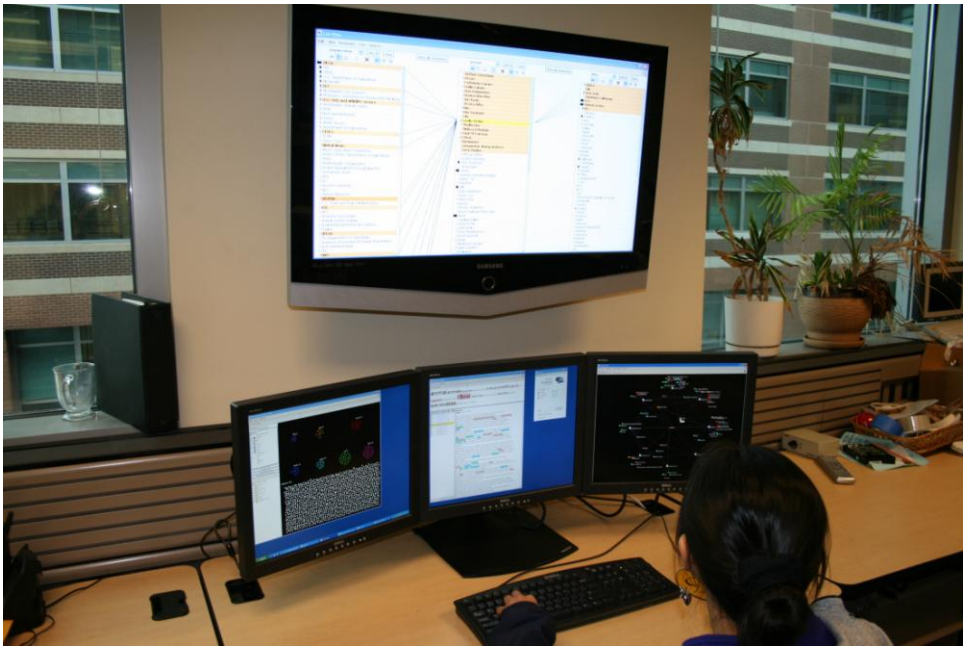
- Multiple visualizations (views) of documents, entities, & their connections
- Views are highly interactive and coordinated
- User actions generate events that are transmitted to and (possibly) reflected in other views

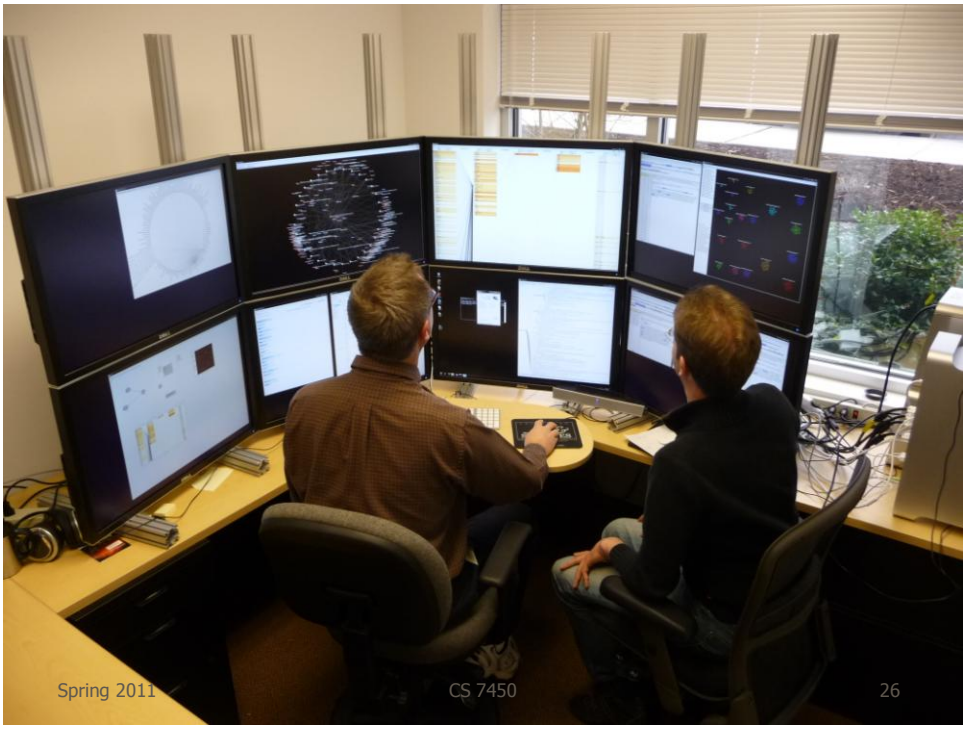


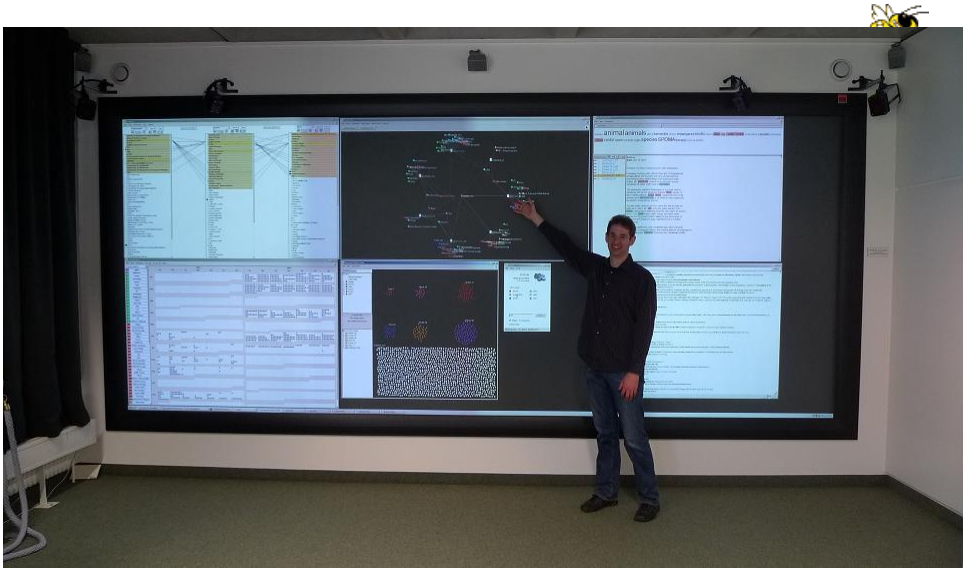
System Views











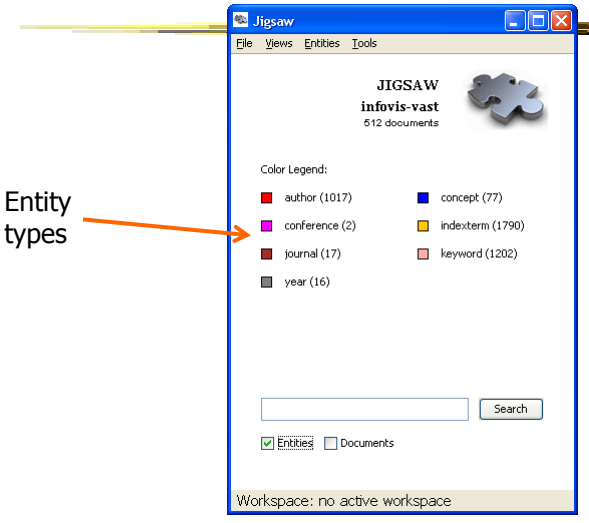
Demo 1

- Data from HW 8
- Let's find the bad guys!

Demo 2

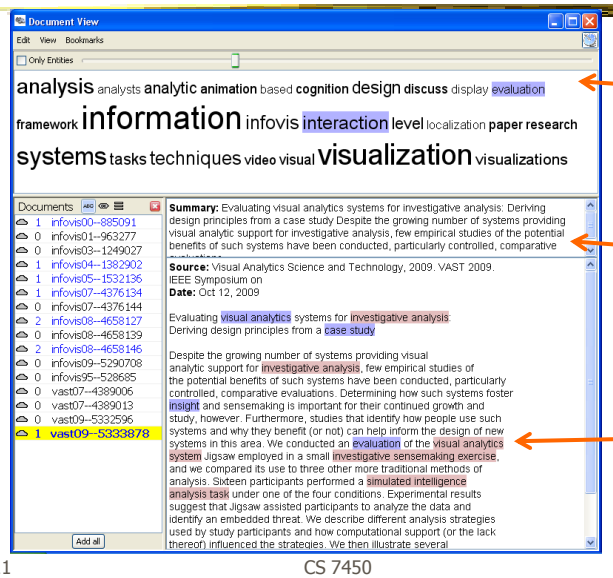
- Car reviews
  - Text: Consumer's comments
  - Entities: Various ratings (1-10), car features, other makes & models

Console



Entity types

Document View



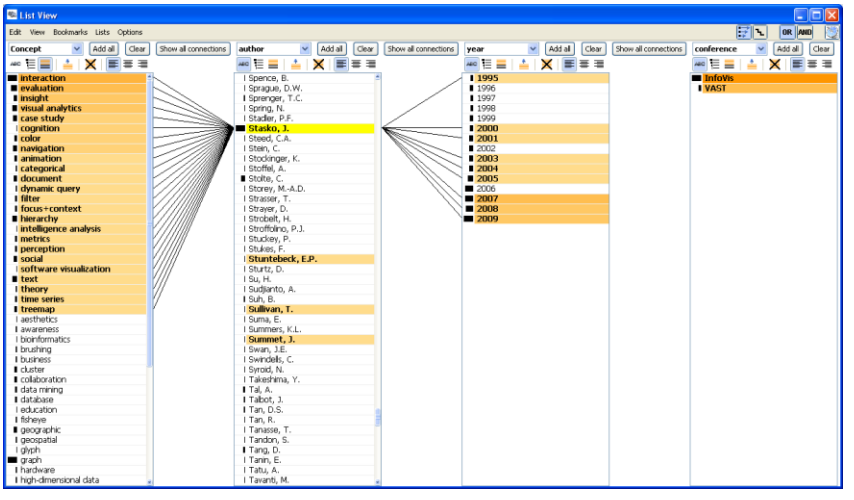
Important words in loaded docs

Automatic summary

Entities identified

List View

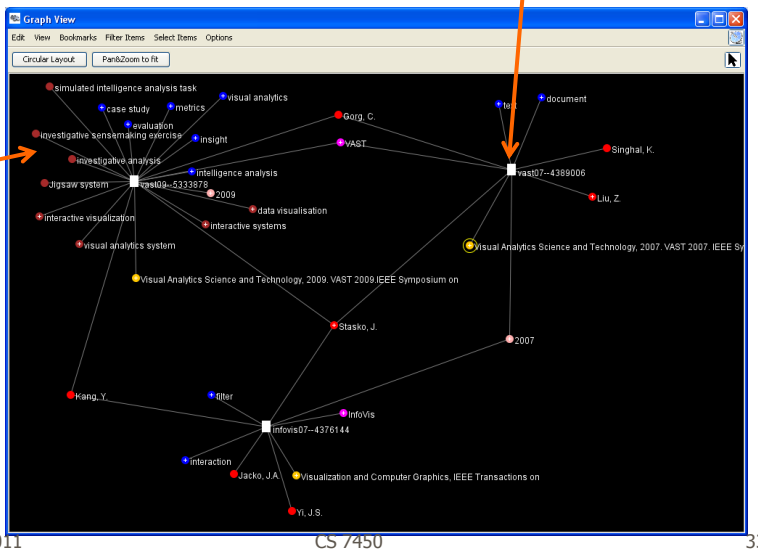
Lists of entities by type
Connections highlighted



Graph View

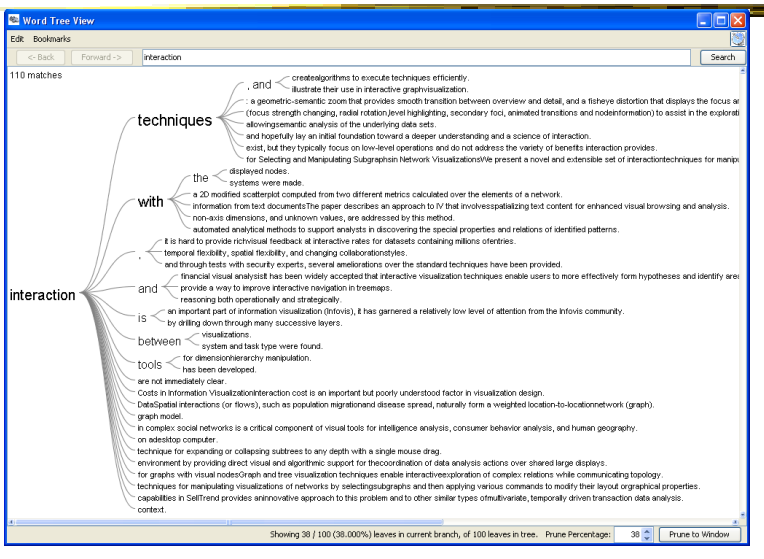
Document

Entities



WordTree View

Context of a word in the collection

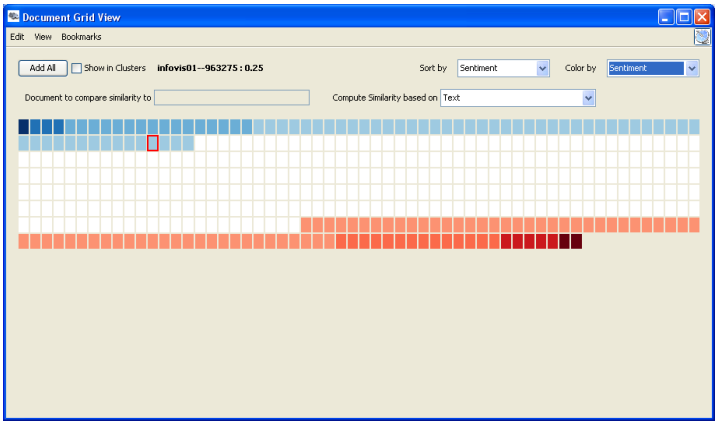


Document Cluster View

Clustered by document text or by entities

Summarized by three words

Document Grid View

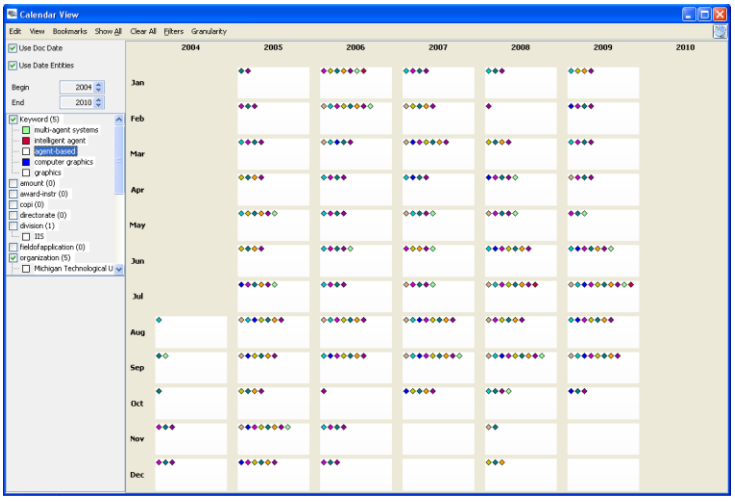


User controls order and color

Sentiment analysis shown here

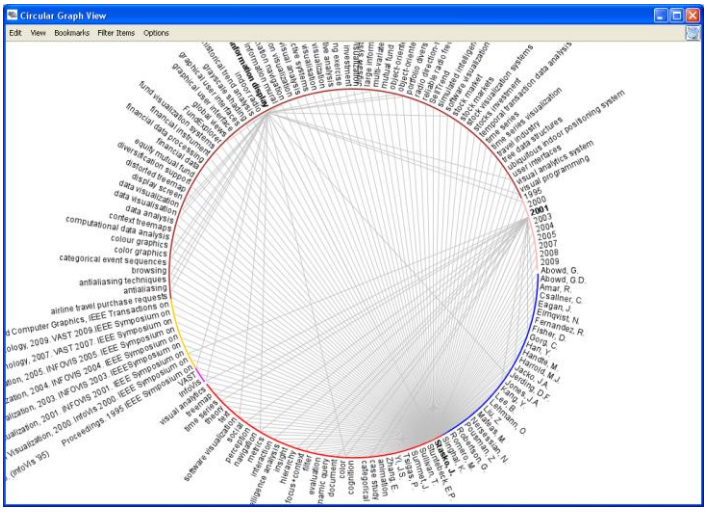
Calendar View

Showing connections between entities and dates



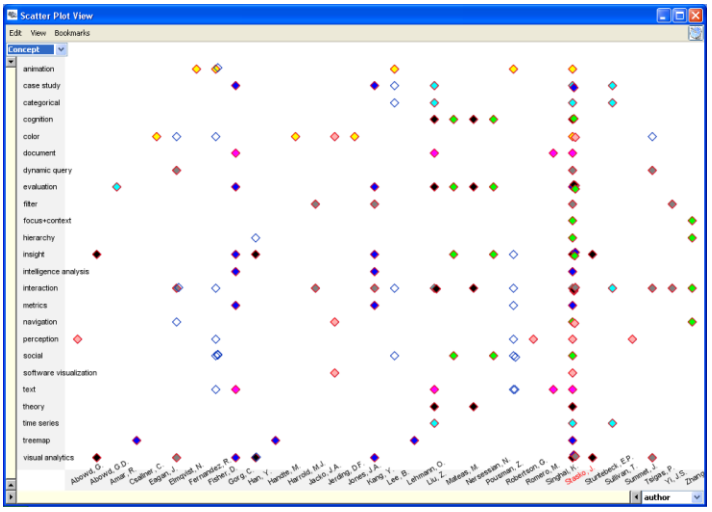
Circular Graph View

Connections between entities



Scatterplot View

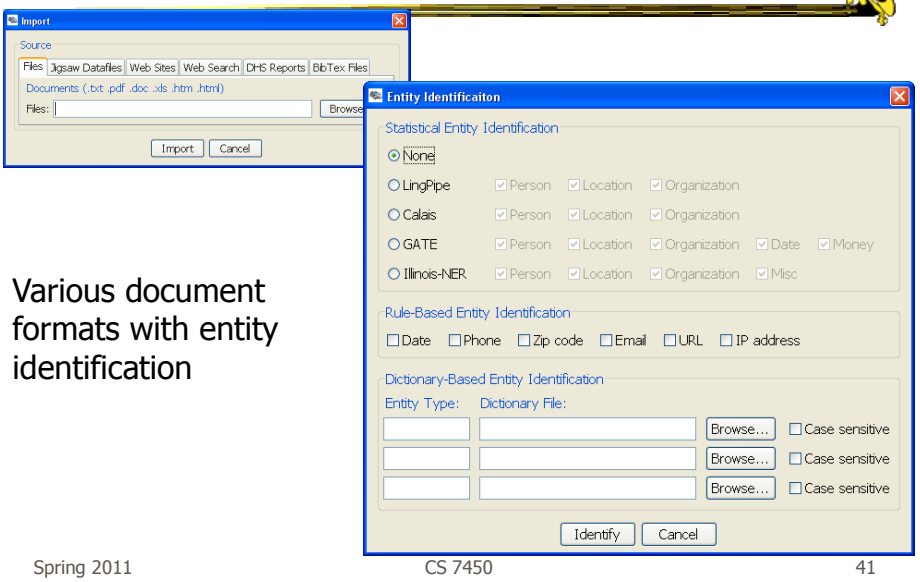
Documents containing pairs of entities



Computational Analyses

- Document summarization
- Document similarity
- Document clustering by content
  - Text or entities
- Sentiment analysis

Document Import



Various document formats with entity identification

Input Data Formats

- Text, pdf, Word, html, Excel
- Jigsaw data file format
  - Our own xml

- DB?
  - Go to Excel
  - Go to text, transform to Jigsaw data file

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Scraped XML


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    Data Analysis and Visualization) Lead research team at the Georgia Institute of Technology provides unified
    expertise in the critical areas for providing leadership of the FODAVA effort, including machine learning and
    computational statistics, information visualization, massive-dataset algorithms and data structures, and
    optimization theory.  The team is focused on the fundamental theory and approaches to make breakthroughs in data
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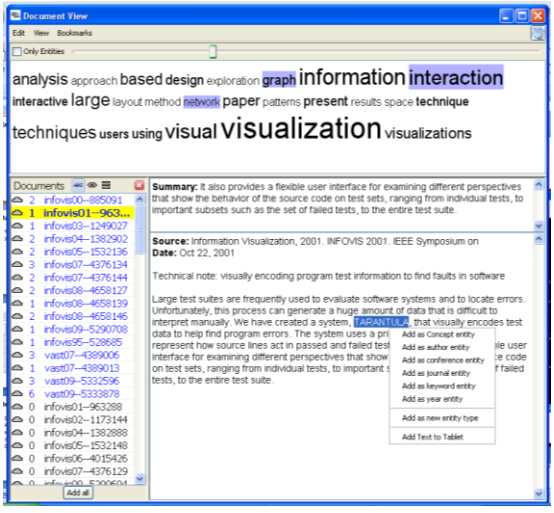
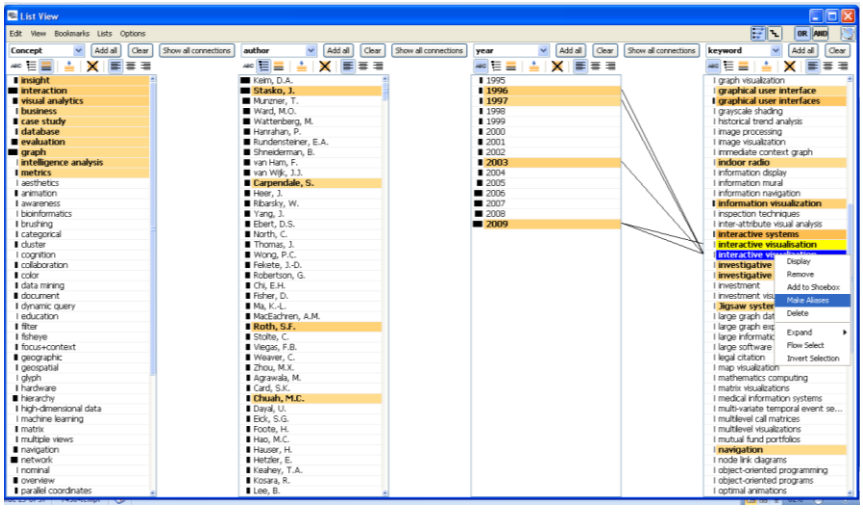
Jigsaw Datafile Format

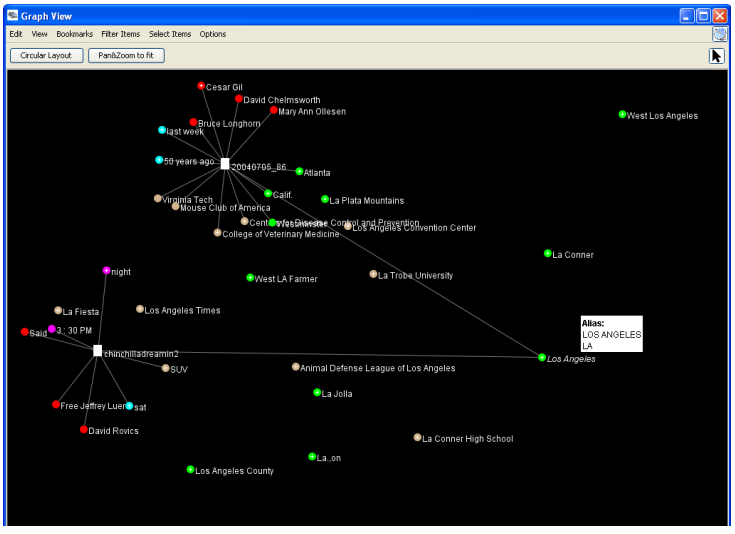
EI Correction



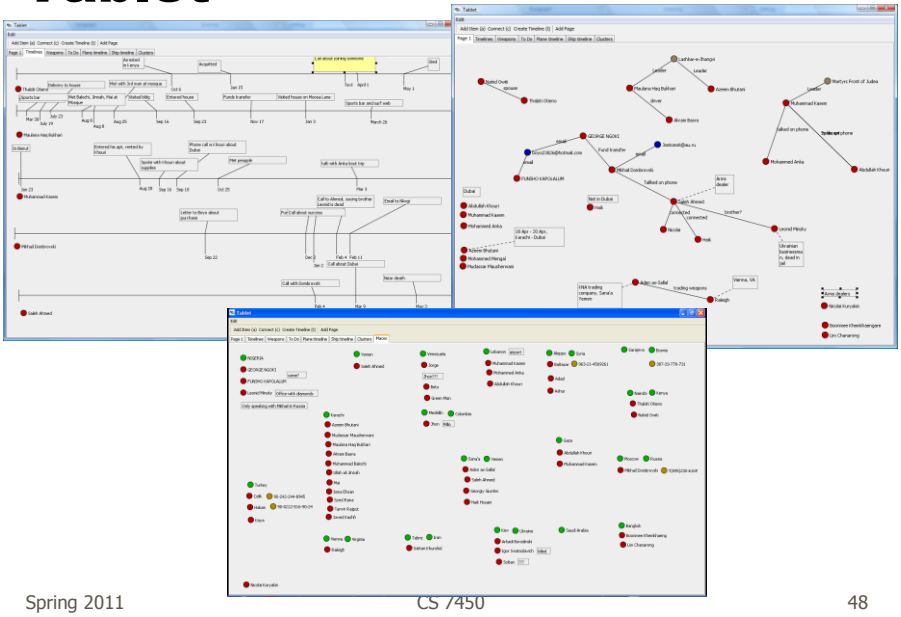
Entity Aliasing



Alias Representation



Tablet



Application Domains

- Intelligence & law enforcement
  - Police cases
  - Won 2007 VAST Contest
  - Stasko et al, *Information Visualization* '08
- Academic papers, PubMed
  - All InfoVis & VAST papers
  - CHI papers
  - Görg et al, KES '10
- Investigative reporting
- Fraud
  - Finance, accounting, banking
- Grants
  - NSF CISE awards from 2000
- Topics on the web (medical condition)
  - Autism
- Consumer reviews
  - Amazon product reviews, edmunds.com, tripadvisor.com
  - Görg et al, HCIR '10
- Business Intelligence
  - Patents, press releases, corporate agreements, …
- Emails
  - White House logs
- Software
  - Source code repositories
  - Ruan et al, SoftVis '10

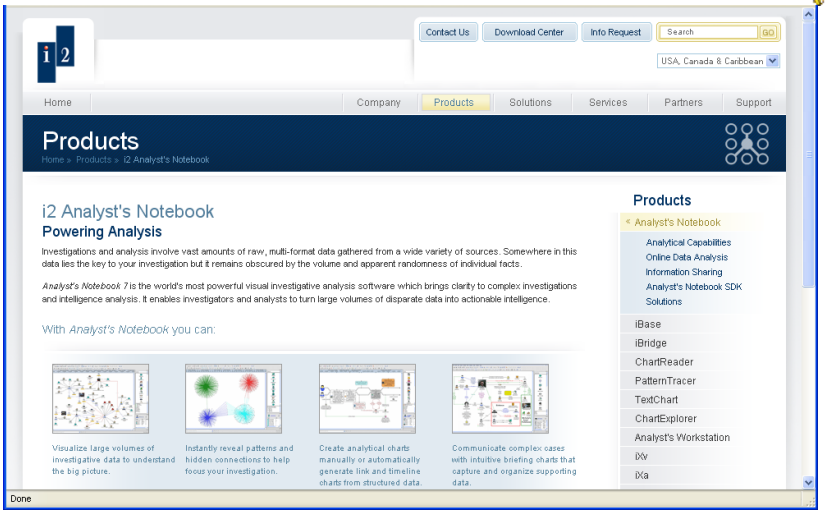
Potential Jigsaw Future Work

- Collaborative capabilities
- Improved evidence marshalling
- Present/browse investigation history
- Scalability upward
- Web document ingest
- Implement network algorithms
- DB import
- Wikipedia & Intellipedia
- Geospatial view
- Better timeline capabilities
- Reliability/uncertainty
- Other types of data
- Active crawling/RSS ingest
- Try it on display wall
- Deployment to real clients

Room to Improve

- What Jigsaw doesn't do so well now
  - The end-part of the Pirolli-Card model
    Helping the analyst take notes, organize evidence, generate hypotheses, etc.
    (The Tablet is a first step)
  - Sometimes called "evidence marshalling"
  - Others have focused more on that aspect…

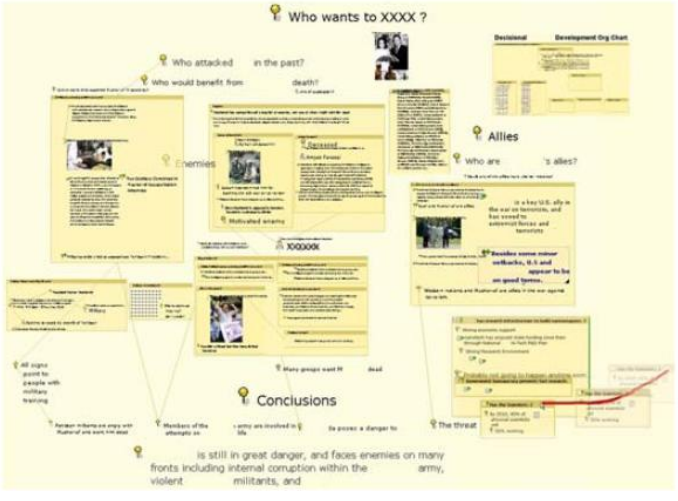
i2's Analyst Notebook



Analyst's Notebook

- Leading commercial tool in this space (law enforcement and intelligence agencies)
- Large zooming workspace where analyst creates networks of entities and notes
- Often used to produce presentation or story of analysis done

Oculus' Sandbox



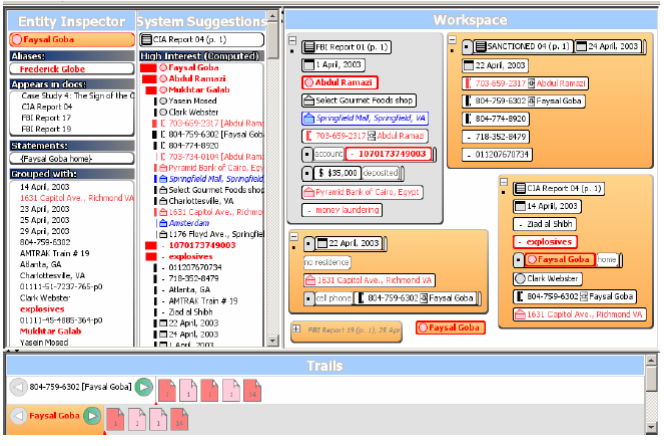
Video

Wright et al CHI '06

Sandbox

- Flexible space for inserting text and graphics
- Objects can be dragged-and-dropped from their other analysis tools
- Flexible level of detail
- Flexible gestures for making space, inserting, etc.
- Assertions with evidence gates
- Reasoning templates

PARC's Entity Workspace



Video

Bier, Card & Bodnar
VAST '08

Entity Workspace

- Tools for rapid ingest of entities from documents
- Can snap together entities into groups
- Can indicate level of interest in objects
- Four main view panels, with zooming UI

Related Area of Interest

- Sensemaking
- A general term that has been used in a number of different contexts
  - E.g., How large corporations make decisions
- To me, ultimately about people working with data and information to understand it better

Sensemaking

Nice definition:

"A motivated , continuous effort to understand connections (which can be among people, places, and events) in order to anticipate their trajectories and act effectively."

– Klein, Moon and Hoffman
IEEE Intelligent Systems '06

Alternate Definition

"The process of creating situation awareness in situations of uncertainty"

– D. Leedom, '01 SM Symp. Report

Situation awareness:
"It's knowing what's going on so you know what to do"

– B. McGuinness, quoting an Air Force pilot

This Topic

- I work on it a lot now
- Interested in getting more work in this area started

HW 5

- Commercial tools critiques
- Things we noticed

Upcoming

- Zooming & panning
  - Reading
- Time Series Data
  - Reading
    Aigner et al