Developing Visual Analytics Applications: Lessons Learned from the Trenches

John Stasko & Carsten Görg

Information Interfaces Research Group
School of Interactive Computing
Georgia Institute of Technology
Jigsaw

- Visualization for Investigative Analysis and Sense-making across Document Collections

“Putting the pieces together”
Example Documents

2) Report Date: 22 February, 2003. Surveillance report on Cesar Arze, whose residence is 77 Avenue Francis, Santo Domingo, Dominican Republic. Arze, who moved from Havana, Cuba to Santo Domingo in 1992, works as a medical technician in Santo Domingo. Arze is under surveillance because of information that he is associated with Cuban intelligence services. Arze was photographed in company with a man identified as Hector Lopez in Bogota, Columbia on 23 January, 2003. Lopez, a known representative of FARC, has conducted narcotics distribution activities throughout South and Central America and the Caribbean.

1) Report Date: 12 July, 2004. A routine customs inspection was performed on a package that was sent by a person named Pieter Doppel, 22 Hoveniersstraat, Antwerp, Belgium. This package was addressed to A. Hijazi, 1212 Lyons Ave., Newark, NJ. The customs form stated that this package contained two decorative clocks having a commercial value of $250.00. The package instead contained 111 polished diamonds, whose value is estimated to be $47,000. Discussions with the FBI resulted in a decision not to pursue a customs violation charge against Hijazi. The reason is that Hijazi is currently under FBI surveillance. This package was resealed and delivered to Hijazi by USPS.

1) Report Date: 11 November, 2003. On 1 November, 2003 Mousa Salah, of no fixed address in Herndon, VA., was arrested at Dulles International Airport as he attempted to board a flight to London Heathrow. At the time of his arrest he was using a Jordanian passport in the name Shadi abu Hoshar. Salah has been wanted in connection with Hamas fund-raising and other activities in Northern Virginia. It is believed that Salah entered the USA illegally from Windsor, Canada into Detroit, MI in 2002. Salah was in possession of a Virginia driver’s license # T21-23-8820 registered in the name Mousa Salah. Virginia DOT records show that this same license number was issued on 10 August, 2001 to a woman named April Stevens of Roanoke, VA. Ms Stevens is not the subject of further investigations; she teaches kindergarten classes in Roanoke. The address shown on Salah’s driver’s license does not exist. Several numbers and initials were written on the back of an envelope in possession of Salah at the time of his arrest; they are: (i) J. T., Detroit, (ii) A. H., Newark, (iii) M. M., Laurel.
Our Focus

• Entities within the documents
  – Person, place, organization, phone number, date, license plate, etc.

• Thesis: A bigger story or insight from the documents will involve a set of interconnected entities working in coordination

• (We use entity identification software from others)
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

- 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
The Need for Pixels
Even More!
Demo Data

• NSF awards from 2000-now (abstract & key meta-data)

• Big thanks to Remco Chang & UNCC folks

• Demo focus: CSE awards (12,243)
People routinely encounter and seek to make sense of large collections of data that include both
<report>
  <reportId>0915788</reportId>
  <reportDate>August 1, 2009</reportDate>
  <referencedReport/>
  <reportSource/>
  <reportDescription>
    III: Small: Supporting Investigative Analysts and Researchers in Sense-making across Large Document Col
    People routinely encounter and seek to make sense of large collections of data that include both unstru
  </reportDescription>
  <program>GRAPHICS &amp; VISUALIZATION</program>
  <division>IIS</division>
  <directorate>CSE</directorate>
  <pi>Stasko, John</pi>
  <organization>GA Tech Research Corporation - GA Institute of Technology</organization>
  <state>GA</state>
  <progmgr>Ephraim P. Glinert</progmgr>
  <award-instr>Continuing grant</award-instr>
  <amount>218691</amount>
  <programelementcode>7453</programelementcode>
  <programreferencecode>HPCC</programreferencecode>
  <programreferencecode>9215</programreferencecode>
  <programreferencecode>7923</programreferencecode>
  <programreferencecode>7453</programreferencecode>
  <fieldofapplication>0116000 Human Subjects</fieldofapplication>
</report>
Demo
What We’re Working On

• Jigsaw is heavy on the user-directed visual exploration, but light on the automated computational analysis
Recommend Related Entities

<table>
<thead>
<tr>
<th>date</th>
<th>money</th>
<th>organization</th>
<th>person</th>
<th>place</th>
<th>time</th>
</tr>
</thead>
<tbody>
<tr>
<td>today</td>
<td></td>
<td></td>
<td></td>
<td>United States</td>
<td>last night</td>
</tr>
<tr>
<td>last year</td>
<td></td>
<td></td>
<td></td>
<td>U.S. Washington</td>
<td>late night</td>
</tr>
<tr>
<td>Wednesday</td>
<td></td>
<td></td>
<td></td>
<td>America</td>
<td></td>
</tr>
<tr>
<td>last week</td>
<td></td>
<td></td>
<td></td>
<td>Texas</td>
<td></td>
</tr>
<tr>
<td>Thursday</td>
<td></td>
<td></td>
<td></td>
<td>California</td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td></td>
<td></td>
<td></td>
<td>Europe</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td></td>
<td></td>
<td>Africa</td>
<td></td>
</tr>
<tr>
<td>last month</td>
<td></td>
<td></td>
<td></td>
<td>Los Angeles</td>
<td></td>
</tr>
<tr>
<td>Last year</td>
<td></td>
<td></td>
<td></td>
<td>San Francisco</td>
<td></td>
</tr>
<tr>
<td>this month</td>
<td></td>
<td></td>
<td></td>
<td>Cho</td>
<td></td>
</tr>
<tr>
<td>last fall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Recommended entity: Faron Gardner

Path: Los Angeles Times - (20030714-2_25) - Animal Justice League - (20030502-1_66 / 20030818_23) - Faron Gardner

Path: Cesar Gil - (20030609_4) - Faron Gardner
Adding Computational Analysis

- Document themes & clustering
Adding Computational Analysis

- Document themes & clustering
- Document similarity
Most similar
Adding Computational Analysis

- Document themes & clustering
- Document similarity
- Document summarization
Earthquake hits Pacific island of Vanuatu.
Adding Computational Analysis

- Document themes & clustering
- Document similarity
- Document summarization
- Sentiment analysis
Most negative

Most positive
Lessons Learned

• A quick recap of some things we’ve learned from working with partners from
  – Homeland security
  – Law enforcement
  – Intelligence analysis
  – Investigative reporting
  – Business intelligence

and from our experience developing systems like Jigsaw
Focus on the user’s task & goals
But in many instances, you don’t know the questions
As the data scales up, we still want interactive visualization
Online algorithms are better than offline algorithms

– Real-time is great
For real systems, pragmatics matter

- “Common” programming languages
- Others must be able to access your code
- Documentation, tutorials, ...
- “Good” is usually good enough, especially at first
  (great would be wonderful)
You don’t get training data
Real data doesn’t necessarily have nice clusters
Evaluation doesn’t necessarily have a good quantitative measure
Fundamental algorithmic research

Application-driven problems
Acknowledgments

• Work conducted as part of the Southeastern Regional Visualization and Analytics Center, supported by DHS and NVAC and the new DHS Center of Excellence in Command, Control & Interoperability (VACCINE Center)

• Supported by NSF IIS-0414667, CCF-0808863 (FODAVA lead), NSF IIS-0915788