

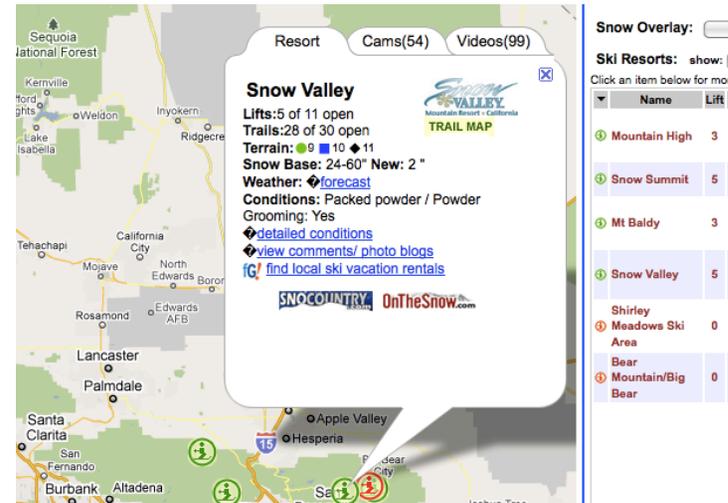
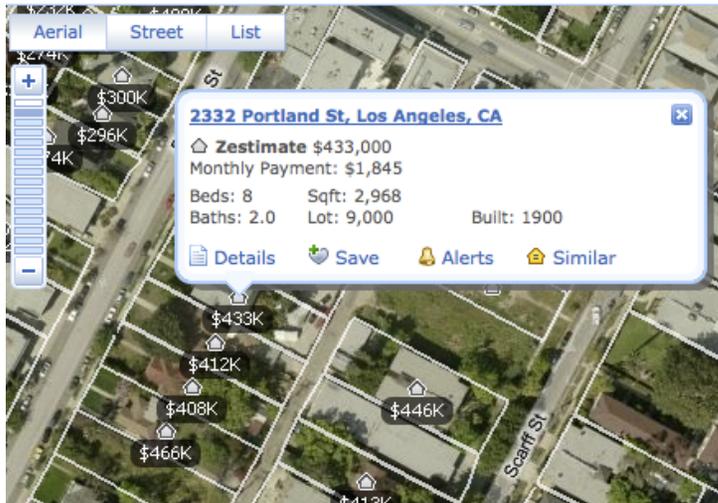
Building Geospatial Mashups to Visualize Information for Crisis Management

Shubham Gupta and Craig A. Knoblock

University of Southern California

WHAT IS A GEOSPATIAL MASHUP?

Integrated View of data combined from diverse data sources
on a **Map**



- Real Estate Listing
- Property Tax



- Snow Report
- Weather (Weather Underground)
- Snow Resorts

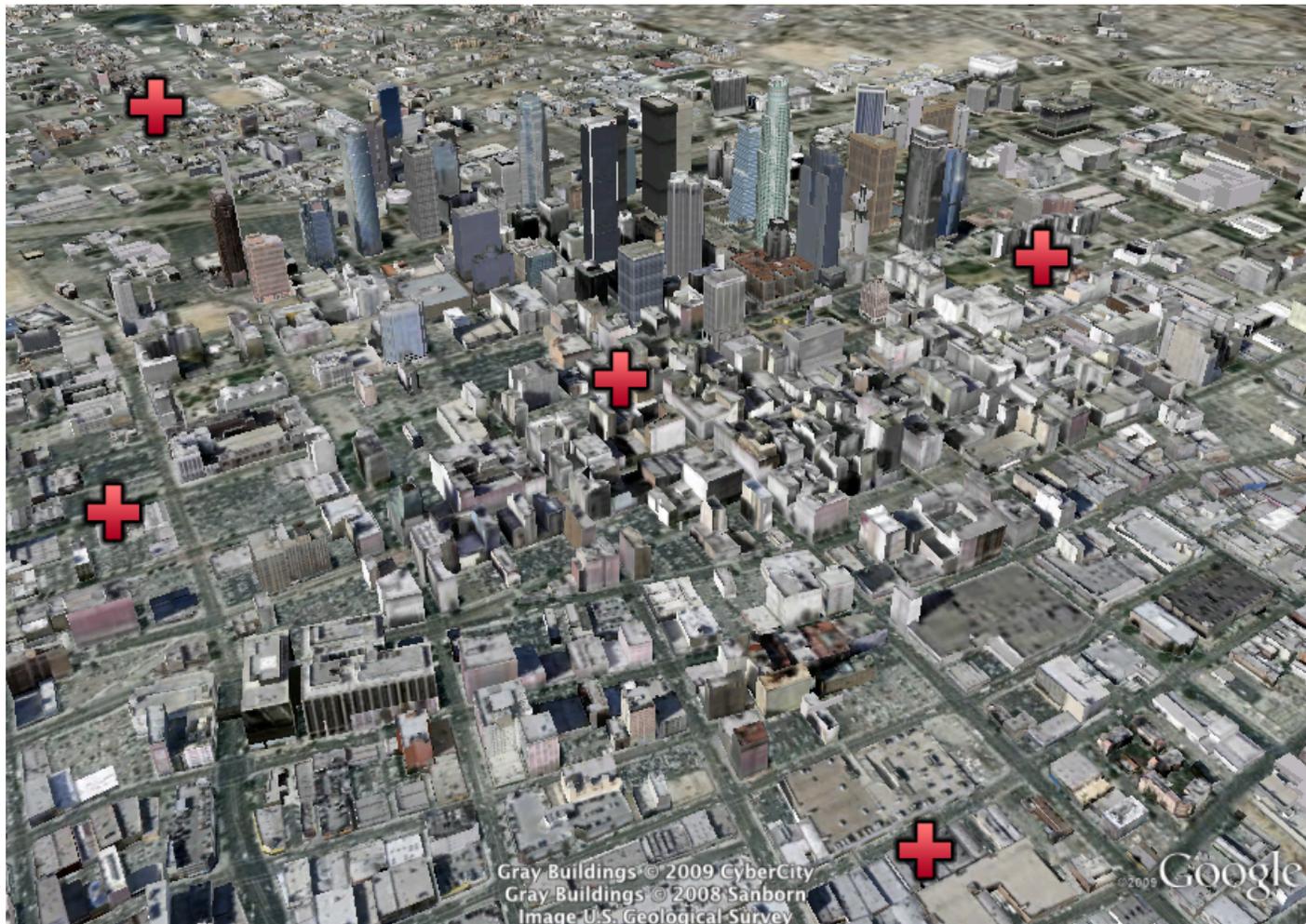
MOTIVATION: CRISIS MANAGEMENT

Characteristics of decision-making in such scenarios:

- ▶ Employs **multiple data sources** with heterogeneous data access and data representation types
- ▶ Takes place in **time-sensitive** environment: Every decision has to be taken promptly
- ▶ Various **data visualization** techniques are used such as graphs, timeline charts, etc. to understand the data better

MOTIVATION: CRISIS MANAGEMENT

- ▶ An imaginary earthquake relief scenario in Los Angeles.



MOTIVATION: CRISIS MANAGEMENT

- ▶ Analyst employs multiple data sources for decision-making

TIME CONSUMING APPROACH

GEOSPATIAL MASHUPS CAN SAVE TIME!

X Managing multiple software packages
 X Need to switch back and forth b/w sources
 X No good data visualization may be provided

✓ Only Web browser required
 ✓ Integrated view of all sources
 ✓ Customize visualization as per needs

EvacCenter: Evac Center 3
 Address: 268 Redoni Blvd.
 City: Los Angeles
 Contact: 326-789-2738
 ESC Name: John Smith

PHONE NO.

326-789-2738
326-342-2396
232-323-4356

GOOGLE NEWS WEBSITE:
 UN appeals to members for \$1.5bn Haiti aid
 "Before last month's disaster, we had a plan for Haiti's long-term reconstruction."
 LOS ANGELES EARTHQUAKE BLAMED FOR HEART ATTACKS
 Author: AP. Doctors have long suspected that sudden stress can trigger cardiac arrest, and ...

CURRENT STATISTICS

INJURIES	CASUALTIES
10	10
15	15
20	20
30	30
40	40
50	50
60	60

for Emergency MySQL Database

Date	IN.
1/9/07 20:00	
1/9/07 14:00	
1/8/07 20:00	
1/8/07 14:00	
1/7/07 20:00	
1/7/07 14:00	
1/6/07 20:00	
1/6/07 14:00	

City
 druff Ave, Arcadia
 llwood Dr, El Monte
 shall St, Rosemead
 press Ave, Monrovia
 (line St, El Monte
 ea Rd, Pasadena

Latest Injuries Statis in CSV Text File

MASHUP BUILDING ISSUES

Evacuation Centers
CSV Text File

EvacCenter_ID	Address	City
1	31 W Woodruff Ave, Arcadia	Arcadia
2	12116 Hallwood Dr, El Monte	El Monte
3	8805 Marshall St, Rosemead	Rosemead
4	131 W Cypress Ave, Monrovia	Monrovia
5	12021 Exline St, El Monte	El Monte
6	857 Chapea Rd, Pasadena	Pasadena
7		
8		
9		

Emer. Coordinator
MySQL DB

NAME	CITY	PHONE NO.
Ralph Nunez	City of El Monte	326-789-2738
Lisa Derderian	City of Pasadena	326-342-2396
John Baenen	City of Burbank	323-323-4356
.....		

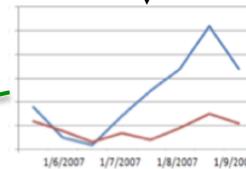
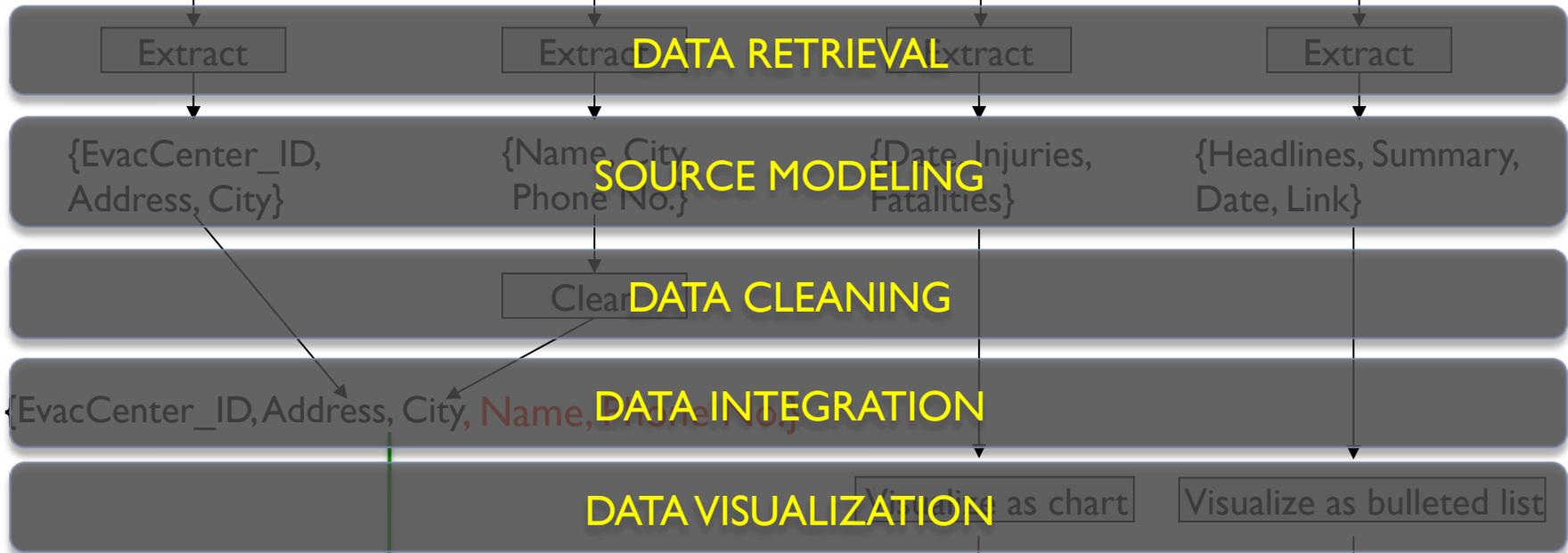
Injury statistics in
Excel Spreadsheet

A	B
Date	INJURIES
1/9/07 20:00	18
1/9/07 14:00	5
1/8/07 20:00	2
1/8/07 14:00	14

Google News Website

Google news

News

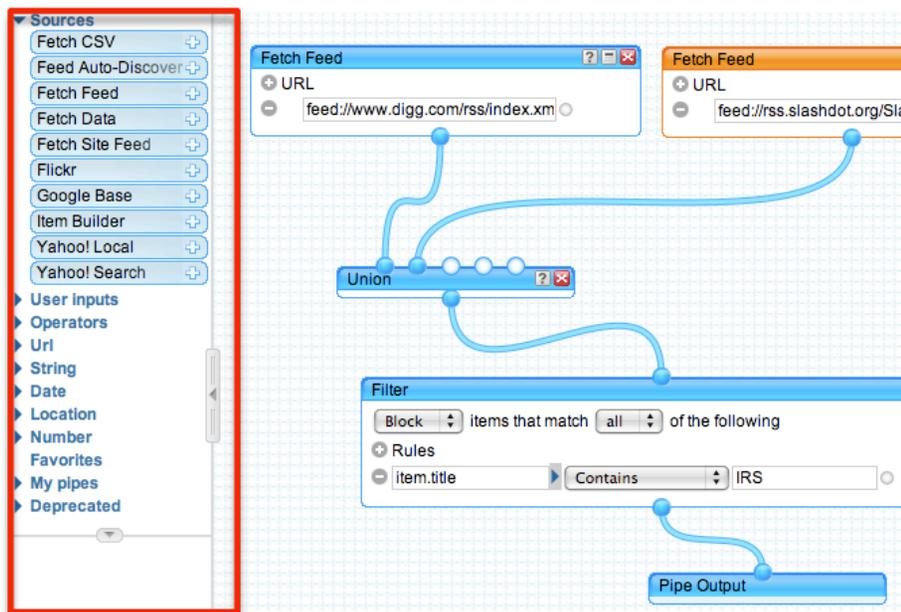


Visualize as bulleted list

- UN appeals to member "Before last month's di Ban said, according to
- LOS ANGELES EARTHQ

EXISTING APPROACHES

Existing solutions require some prior programming knowledge



1. Mostly based on **Widget Paradigm**
 - Widgets (i.e., **43** for Pipes, **300+** for MS) represents an operation on the data
 - Locating and learning to customize widget can be **time consuming**
2. None of the current tools support **customized data visualization!**

Can we come up with a framework that addresses all of the issues while still making the Mashup building process easy?

OUR APPROACH

- ▶ In our earlier work, we introduced **Programming-by-Demonstration approach** to Mashup building.
 - ▶ Does not require any programming or widget knowledge.
 - ▶ Enables user to create a mashup by simply demonstrating the system on one or more concrete example.
- ▶ We present a **Programming by Demonstration** approach to support **customized Data Visualization**.

KARMA USER INTERFACE

The screenshot displays the KARMA user interface. At the top, there is a window title bar with the name 'Karma' and standard window controls. Below this, a 'Table' section contains two tabs: 'Source1' and 'Source2'. The 'Source1' tab is active, showing a data table with the following columns: 'PR-TimeDuration', 'PR-Number', 'Data Type', and 'Data Ty'. The 'PR-Number' column is highlighted in yellow. Below the table, there are four buttons: 'Import', 'Clean', 'Integrate', and 'Publish'. Below these buttons, there are five tabs for data source types: 'Wrapper', 'Database', 'Excel', 'Text File', and 'KML File'. The 'Excel' tab is selected, and a 'Choose Excel File' button is visible. Two callout boxes provide additional information: one points to the data table with the text 'Data Table – Spreadsheet Type Interface', and another points to the 'Integrate' button with the text 'Various Information Integration Operations'. A third callout box points to the 'Excel' tab with the text 'Data Source Types Currently Supported by Karma'.

PR-TimeDuration	PR-Number	Data Type	Data Ty
2009-07-31 00:00:00	446.04		
2009-07-24 00:00:00	429.88		
2009-07-17 00:00:00	416.17		
2009-07-10 00:00:00	406.5		
2009-07-02 00:00:00	426.0		
2009-06-26 00:00:00	416.95		
2009-06-19 00:00:00	421.5		
2009-06-12 00:00:00	439.5		
2009-06-05 00:00:00	418.73		
2009-05-29 00:00:00	391.95		
2009-05-22 00:00:00	394.73		
2009-05-15 00:00:00	402.8		
2009-05-08 00:00:00	399.17		

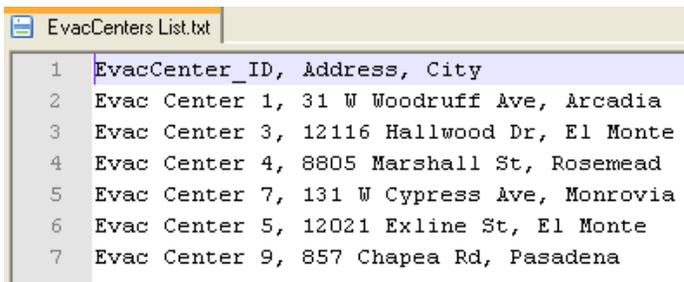
Data Table – Spreadsheet Type Interface

Various Information Integration Operations

Data Source Types Currently Supported by Karma

DATA RETRIEVAL

- ▶ Karma facilitates retrieval of data from structured data-sources, such as Excel spreadsheets, MySQL databases and CSV files.
- ▶ Karma also facilitates the extraction of data from semi-structured data sources such as web pages.

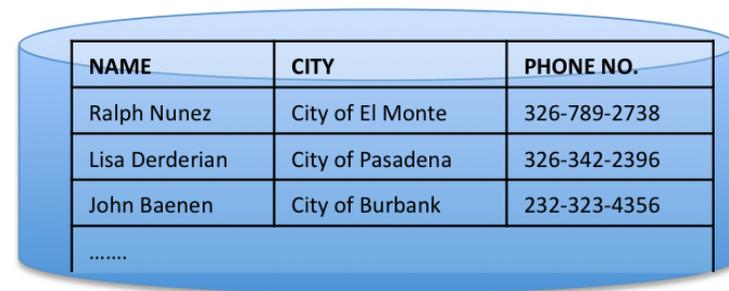


1	EvacCenter_ID	Address	City
2	Evac Center 1,	31 W Woodruff Ave,	Arcadia
3	Evac Center 3,	12116 Hallwood Dr,	El Monte
4	Evac Center 4,	8805 Marshall St,	Rosemead
5	Evac Center 7,	131 W Cypress Ave,	Monrovia
6	Evac Center 5,	12021 Exline St,	El Monte
7	Evac Center 9,	857 Chapea Rd,	Pasadena

CSV Text File

A	B	C
Date	INJURIES	FATALITIES
1/9/07 20:00	18	12
1/9/07 14:00	5	8
1/8/07 20:00	2	3
1/8/07 14:00	14	7
1/7/07 20:00	25	4
1/7/07 14:00	34	9
1/6/07 20:00	52	15
1/6/07 14:00	34	11

10 Excel Spreadsheet



NAME	CITY	PHONE NO.
Ralph Nunez	City of El Monte	326-789-2738
Lisa Derderian	City of Pasadena	326-342-2396
John Baenen	City of Burbank	232-323-4356
.....		

MySQL Database



Google news los angeles earthquake Search

News

[Top Stories](#)
[More sections](#) ▼

☆ [UN appeals to members](#)
Press TV - 2 hours ago
"Before last month's disaster, we reconstruction," Ban said, accord

› All news
[Images](#)

Press TV

HTML Web Page

DATA RETRIEVAL

- ▶ The retrieval of data from structured data-sources, such as Excel sheets and CSV files is done through a drag and drop mechanism.
- ▶ The user is only required to select a sample data-element and drop it into Karma's data table.

The screenshot illustrates the data retrieval process in Karma. On the left, a text file named 'EvacCenters List.txt' is open, displaying a list of evacuation centers with their IDs and addresses. A blue arrow points from the second row of this file to the 'EvacCenter_ID' column of a data table on the right. The data table has two columns: 'PR-String' and 'Data Type'. The 'PR-String' column contains the names of the evacuation centers, and the 'Data Type' column is currently empty. Below the data table, there are buttons for 'Import', 'Clean', 'Integrate', and 'Publish'. At the bottom, there are tabs for 'Wrapper', 'Database', 'Excel', 'Text File', and 'KML File'. The 'Text File' tab is selected, and a 'Choose Text File' button is visible. A checkbox labeled 'First line contains column names' is checked.

PR-String	Data Type
EvacCenter_ID	Column Name
Evac Center 1	
Evac Center 3	
Evac Center 4	
Evac Center 7	
Evac Center 5	
Evac Center 9	

DATA RETRIEVAL

- ▶ Extraction of data from HTML web-pages is done using software wrappers.

Table

Source1	Source2				
PR-String	PR-String	PR-String	PR-String	PR-String	Data T
Headline	Summary	Url	Datetime	Source	Column
UN appeals to member...	"Before last month's dis...	http://news.google.com/...	9 hours ago	Monsters and Critics.com	
LOS ANGELES EARTH...	Author: AP. Doctors hav...	http://news.google.com/...	1 hour ago	Los Angeles Times	
Not guilty plea...Digging...	LOS ANGELES (AP) — ...	http://news.google.com/...	17 hours ago	9&10 News	
Style Star: Rihanna	Rihanna performs on st...	http://news.google.com/...	2 hours ago	Access Hollywood	
6.0 Earthquake in Califo...	According the the US G...	http://news.google.com/...	Feb 4, 2010	Gather.com	
Haiti is a reminder of ho...	In the aftermath of the d...	http://news.google.com/...	Feb 8, 2010	Los Angeles Times	
Earthquakes Weekly Up...	... former Seattle Sound...	http://news.google.com/...	17 hours ago	OurSports Central (pres...	
US & World News, Tue...	Meanwhile, about 500 r...	http://news.google.com/...	1 hour ago	WTWW	
Shake, Shake, Shake	But the US Geological S...	http://news.google.com/...	15 hours ago	New University Online	
At a Haiti school's reop...	(Carolyn Cole / Los Ang...	http://news.google.com/...	Feb 1, 2010	L	

Import Clean Integrate Publish

Wrapper Database Excel Text File KML File

Load Fetch Agents Repository

Fetch Agents

Wrapper Name	Input Parameter Names	Output Parameter Names	Input values	Execute
Alacra2	CompanyType, Compan...	CompanyName,Addres...		Execute
flightStats2	airport, airlines			Execute
GoogleNews	q	Headline,Summary,Url,...	Los Angeles Earthquake	Execute
GoogleSearch	searchInfo			Execute
LATimes	SearchQuery			Execute
SICCodeDescription	psic	Category,IndustryGroup,...		Execute

Enter values for input parameters in yellow column to execute wrapper!

Wrapper Library: Karma lists all the available wrappers on the local machine.

SOURCE MODELING

- ▶ Karma automatically generates the semantic types of each attribute to learn the underlying model of the data source.
- ▶ Supervised machine learning techniques are used to generate a set of patterns for each semantic type from training data.

Source1	Source2	Source3
PR-String		PR-String
StreetAddress		City
2353 Portland St.		Los Angeles
543 Orchard Ave.		Burbank
417 Glenmoor Cir.		Milpitas
6472 Hawthorne Blvd		Pasadena
325 Abbot Ave.		Santa Clara

Initial Semantic Type



Source1	Source2	Source3
PR-Address		PR-String
StreetAddress		City
2353 Portland St.		Los Angeles
543 Orchard Ave.		Burbank
417 Glenmoor Cir.		Milpitas
6472 Hawthorne Blvd		Pasadena
325 Abbot Ave.		Santa Clara

Manually label the data with the correct semantic type for training

Source1	Source2	Source3	Source4
PR-Address			PR-String
Address			EvacCenter_ID
31 W Woodruff Ave			Evac Center 1
12116 Hallwood Dr			Evac Center 3
8805 Marshall St			Evac Center 4
131 W Cypress Ave			Evac Center 7
12021 Exline St			Evac Center 5
857 Chapea Rd			Evac Center 9

When the new data is imported of same type, Karma automatically labels it correctly

DATA CLEANING

- ▶ Karma performs the data cleaning by learning and applying the transformation rules that are learnt from the user specified example.
- ▶ Example:

Source1	Source2
PR-String	PR-String
City	Coordinator_Name
City of Agoura Hills	Carol Tubelis
City of Alhambra	Bat. Chief Ray Mosack
City of Arcadia	Chief Dave Odell
City of Artesia	Madalena Galindo
City of Duarte	Brian Villalobos
City of El Monte	Ralph Nunez

Initial data source

Source1	Source2	Cleaning Table
PR-String		Data Type
City		User Defined Values
City of Agoura Hills		Agoura Hills
City of Alhambra		
City of Arcadia		
City of Artesia		
City of Duarte		
City of El Monte		

User provides example

Source1	Source2	Source3
PR-String		PR-String
City		Coordinator_Name
Agoura Hills		Carol Tubelis
Alhambra		Bat. Chief Ray Mosack
Arcadia		Chief Dave Odell
Artesia		Madalena Galindo
Duarte		Brian Villalobos
El Monte		Ralph Nunez

Data source after cleaning

Source1	Source2	Cleaning Table
PR-String		Data Type
City		User Defined Values
City of Agoura Hills		Agoura Hills
City of Alhambra		Alhambra
City of Arcadia		Arcadia
City of Artesia		Artesia
City of Duarte		Duarte
City of El Monte		El Monte

Karma applies the learned transformation rules over remaining data

DATA INTEGRATION

- ▶ Karma detects and ranks its potential integration with other sources based on the common attribute names and matching semantic types.
- ▶ Karma suggests potential joins between the current data sources in the form of column completions.

Source1	Source2		
PR-String	PR-Address	PR-String	Data Type
EvacCenter_ID	Address	City	Column Name
Evac Center 1	31 W Woodruff Ave	Arcadia	
Evac Center 3	12116 Hallwood Dr	El Monte	
Evac Center 4	8805 Marshall St	Rosemead	
Evac Center 7	131 W Cypress Ave	Monrovia	
Evac Center 5	12021 Exline St	El Monte	
Evac Center 9	857 Chapea Rd	Pasadena	

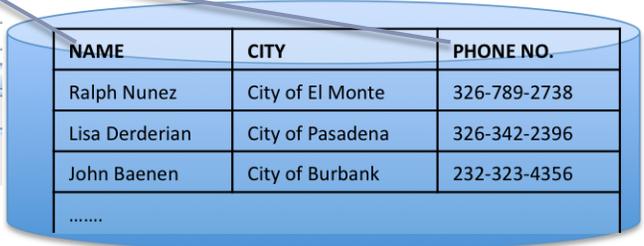
Column completion

DATA INTEGRATION

Source1	Source2	Source3	
R-String	PR-Address	PR-String	Data Type
vacCenter_ID	Address	City	Select Column Name
vac Center 1	31 W Woodruff Ave	Arcadia	Select Column Name
vac Center 3	12116 Hallwood Dr	El Monte	Name
vac Center 4	8805 Marshall St	Rosemead	Phone No
vac Center 7	131 W Cypress Ave	Monrovia	
vac Center 5	12021 Exline St	El Monte	
vac Center 9	857 Chapea Rd	Pasadena	

Import Clean Integrate Publish

Join



NAME	CITY	PHONE NO.
Ralph Nunez	City of El Monte	326-789-2738
Lisa Derderian	City of Pasadena	326-342-2396
John Baenen	City of Burbank	232-323-4356
.....		

Karma suggests the possible column completions in a drop down list



MySQL Database loaded as a another source in Karma

Source1	Source2	Source3	
PR-String	PR-Address	PR-String	PR-String
EvacCenter_ID	Address	City	Name
Evac Center 1	31 W Woodruff Ave	Arcadia	Chief Dave Odell
Evac Center 3	12116 Hallwood Dr	El Monte	Ralph Nunez
Evac Center 4	8805 Marshall St	Rosemead	Donna Wagner
Evac Center 7	131 W Cypress Ave	Monrovia	Dave Dennis
Evac Center 5	12021 Exline St	El Monte	Ralph Nunez
Evac Center 9	857 Chapea Rd	Pasadena	Lisa Derderian

Karma executes the join query once the user selects an option and displays the result

DATA VISUALIZATION

- ▶ Definition: Representation of data in a visual form to amplify cognition.
- ▶ Example: Timeline charts, Graphs, Tables, etc.
- ▶ Application:
 - ▶ Summarization of large data
 - ▶ Providing qualitative overview
 - ▶ Detecting patterns, anomalies and relationships in data
 - ▶ Identify regions of interest in large and complex datasets

CRITICAL TOOL FOR EFFICIENT DATA ANALYSIS!



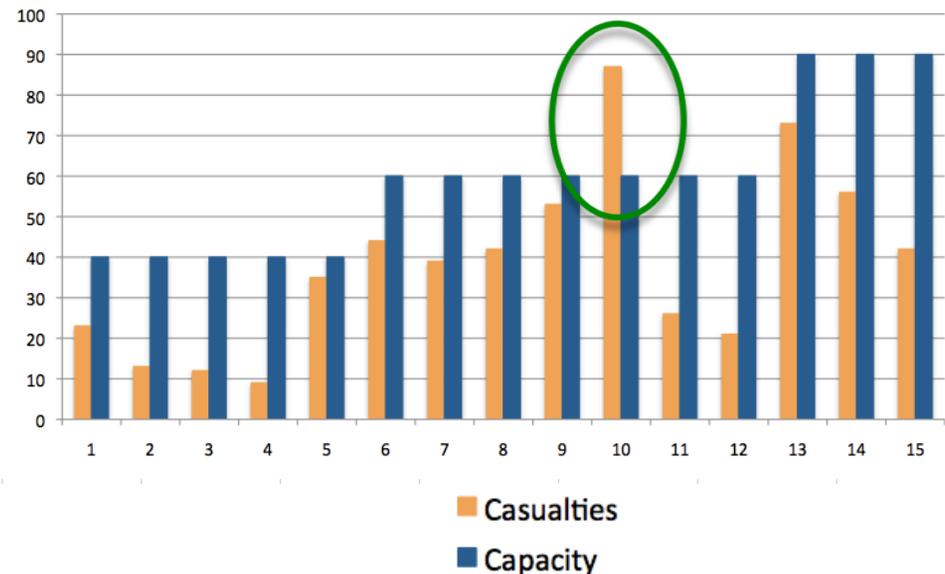
CRITICAL IN CRISIS AND DISASTER SCENARIOS

DATA VISUALIZATION

▶ Example:

Which evacuation center is handling more casualties than its capacity?

◇	A	B	C
1	Evacuation Center ID	Casualties	Capacity
2	1	23	40
3	2	13	40
4	3	12	40
5	4	9	40
6	5	35	40
7	6	44	60
8	7	39	60
9	8	42	60
10	9	53	60
11	10	87	60
12	11	26	60
13	12	21	60
14	13	73	90
15	14	56	90
16	15	42	90



BETTER VISUALIZATION!

VISUALIZATION BY DEMONSTRATION

- ▶ The user demonstrates the desired data visualization by specifying some **examples** using a **drag and drop** mechanism. E.g. Visualize News data as bulleted lists in final mashup:

The screenshot shows a software interface for data visualization. At the top, there's a table with columns: PR-String, PR-Date, PR-String, PR-URL, and Data Type. Below the table are buttons for 'Import', 'Clean', 'Integrate', and 'Publish'. Under 'Publish', there are tabs for 'HTML', 'KML', 'XML', 'CSV Text File', and 'Database'. The 'HTML' tab is active, showing 'Publish HTML' and 'Save HTML' buttons. On the right, an 'Output Preview Window' displays a bulleted list of news items. Below the preview, there are three dashed blue boxes representing different visualization formats: 'LIST FORMAT', 'PARAGRAPH FORMAT', and 'TABLE FORMAT', each with a note to drag data to that section.

PR-String	PR-Date	PR-String	PR-URL	Data Type
Headline	Date	Summary	Link	
KILLER QUAKE: AFTERSH...	1/9/2007	The anniversary Tuesday of...		
LOS ANGELES EARTHQU...	1/9/2007	Author: AP. Doctors have lo...	http://www...	
Man Indicted in Earthquake...	1/9/2007	This is considered the larg...	http://www.reuters.com/arti...	
4.9 Earthquake Rattles Muc...	1/9/2007	A series of aftershocks fro...	http://www.staugustine.co...	
MINOR EARTHQUAKE SHA...	1/9/2007	A moderate earthquake jolt...	http://www.reuters.com/arti...	

Preview Generated

Output Preview Window

- KILLER QUAKE: AFTERSHOCKS OF CHAOS FEAR WORLD AWAY BUT
The anniversary Tuesday of the terrible Los Angeles earthquake was supposed to be a day of celebration a time to look back proudly on the

LIST FORMAT
(Drag data to this section for List format)

PARAGRAPH FORMAT
(Drag data to this section for Paragraph format)

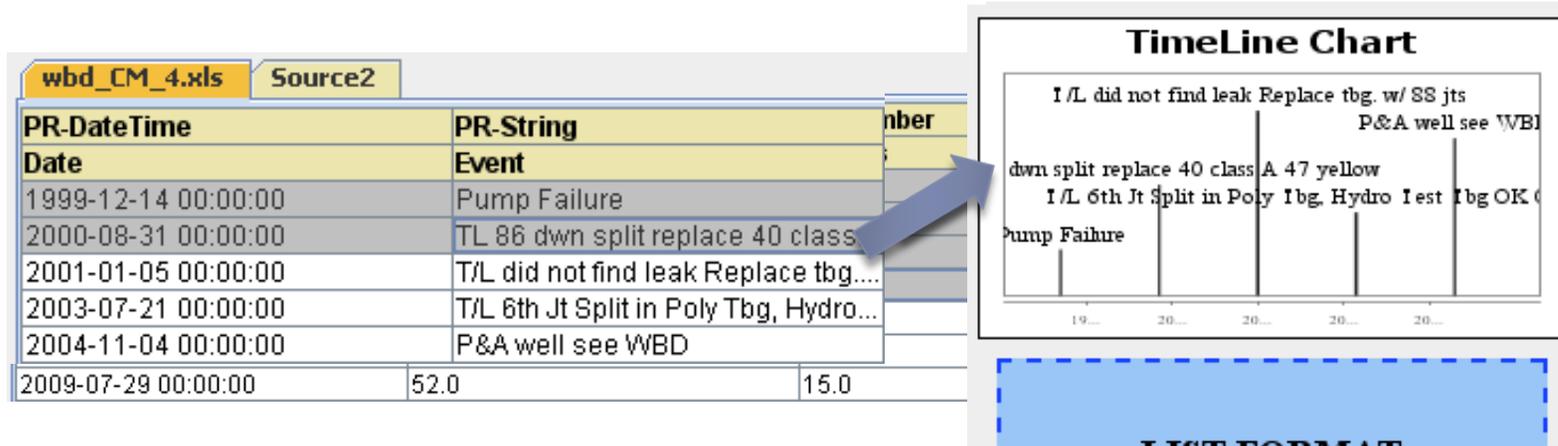
TABLE FORMAT
(Drag data to this section for Table format)

VISUALIZATION BY DEMONSTRATION

Karma currently supports four types of visualization formats:

I. Chart Format:

- Useful for visualizing:
 - Numerical Statistics
 - Time Based Events
- Karma uses Google Charts API to dynamically generate charts in final mashup.
- Karma attempts to find the best suitable chart for data using its semantic types.



VISUALIZATION BY DEMONSTRATION

Karma currently supports four types of visualization formats:

2. Paragraph Format:

- Useful for visualizing descriptive text data such as Wikipedia definitions.

Source1	Source2
PR-String	PR-String
Paragraph1	Paragraph1
Los Angeles (pronounced /lɒs 'ændʒələs/ los-AN-jə-las; Spanish: [los 'aŋxeles], Spanish for "the angels") is the largest city in the state of California and the second largest in the United States. [1] Often abbreviated as L.A. and nicknamed The City of Angels, Los Angeles has an estimated population of 3.8 million[2] and spans over	Los Angeles (pronounced /lɒs 'ændʒələs/ los-AN-jə-las; Spanish: [los 'aŋxeles], Spanish for "the angels") is the largest city in the state of California and the second largest in the United States. [1] Often abbreviated as L.A. and nicknamed The City of Angels, Los Angeles has an estimated population of 3.8 million[2] and spans over

3. List Format:

- Useful for visualizing information in a bulleted list such as list of summarized news articles.

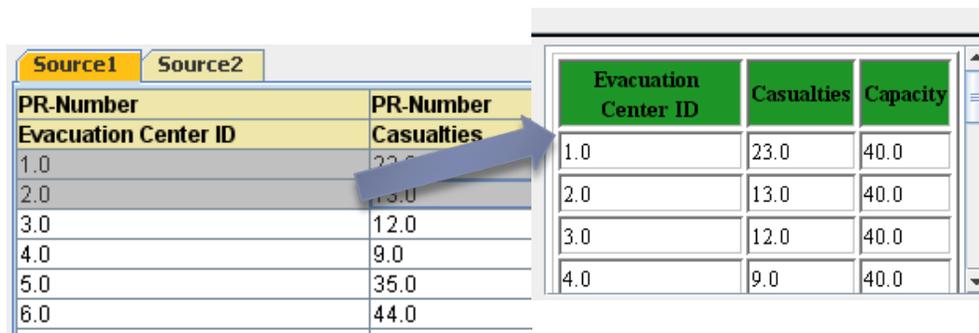
Source1	Source2
PR-String	PR-DateT
Headline	Date
KILLER QUAKE: AFTERSHOCKS OF CHAOS, FEAR WORLD AWAY BUT ...	1/9/2007
LOS ANGELES EARTHQUAKE...	1/9/2007
Man Indicted in Earthquake...	1/9/2007
4.9 Earthquake Rattles Muc...	1/9/2007
MINOR EARTHQUAKE SHA...	1/9/2007

VISUALIZATION BY DEMONSTRATION

Karma currently supports four types of visualization formats:

4. Table Format:

- Useful for visualizing information that is best presented in a row-and-column format such as numerical values etc.



The image shows a data visualization interface. On the left, there are two tabs labeled 'Source1' and 'Source2'. Below them is a table with two columns: 'PR-Number' and 'Evacuation Center ID' (under Source1), and 'PR-Number' and 'Casualties' (under Source2). The data rows are:

PR-Number	Evacuation Center ID	PR-Number	Casualties
1.0		23.0	40.0
2.0		13.0	40.0
3.0		12.0	40.0
4.0		9.0	40.0
5.0		35.0	40.0
6.0		44.0	40.0

A blue arrow points from the 'Casualties' column of the first row in the Source2 table to a zoomed-in view of the same data on the right. The zoomed-in view shows a table with three columns: 'Evacuation Center ID', 'Casualties', and 'Capacity'. The data rows are:

Evacuation Center ID	Casualties	Capacity
1.0	23.0	40.0
2.0	13.0	40.0
3.0	12.0	40.0
4.0	9.0	40.0

RESULTS CAN BE PUBLISHED IN MULTIPLE FORMATS

- ▶ Karma lets you export your final mashup in variety of formats:
 - HTML Page
 - Database table
 - KML Layer
 - XML File
 - CSV Text File

The screenshot displays the Karma interface. At the top, there are four tabs labeled 'Source1', 'Source2', 'Source3', and 'Source4'. Below these is a table with five columns: 'PR-String', 'PR-Address', 'PR-String', 'PR-String', and 'PR-String'. The first row of data has headers: 'EvacCenter_ID', 'Address', 'City', 'Coordinator_Name', and 'Phone'. The table contains seven rows of data. Below the table is a toolbar with buttons for 'Import', 'Clean', 'Integrate', and 'Publish'. Underneath the toolbar is a row of format options: 'HTML', 'KML', 'XML', 'CSV Text File', and 'Database'. The 'XML' option is highlighted. Below these options are two buttons: 'Publish XML' and 'Save XML'. A blue oval highlights the 'Publish' button and the format options row. A callout box points to the 'Publish XML' button.

PR-String	PR-Address	PR-String	PR-String	PR-String
EvacCenter_ID	Address	City	Coordinator_Name	Phone
Evac Center 1	31 W Woodruff Ave	Arcadia	Chief Dave Odell	(626) 574-5102
Evac Center 3	12116 Hallwood Dr	El Monte	Ralph Nunez	(626) 580-2065
Evac Center 4	8805 Marshall St	Rosemead	Donna Wagner	(626) 569-2102
Evac Center 7	131 W Cypress Ave	Monrovia	Dave Dennis	(626) 256-8104
Evac Center 5	12021 Exline St	El Monte	Ralph Nunez	(626) 580-2065
Evac Center 9	857 Chapea Rd	Pasadena	Lisa Derderian	(626) 744-7276

Different mashup
publishing options

AUTOMATICALLY FINDS GEOSPATIAL REFERENCES

- ▶ Final mashup output in HTML web page format:

The screenshot displays a web application interface with several components:

- Table:** A table with columns: PR-String, PR-String, PR-String, PR-String, PR-String, and Data T. The data rows are:

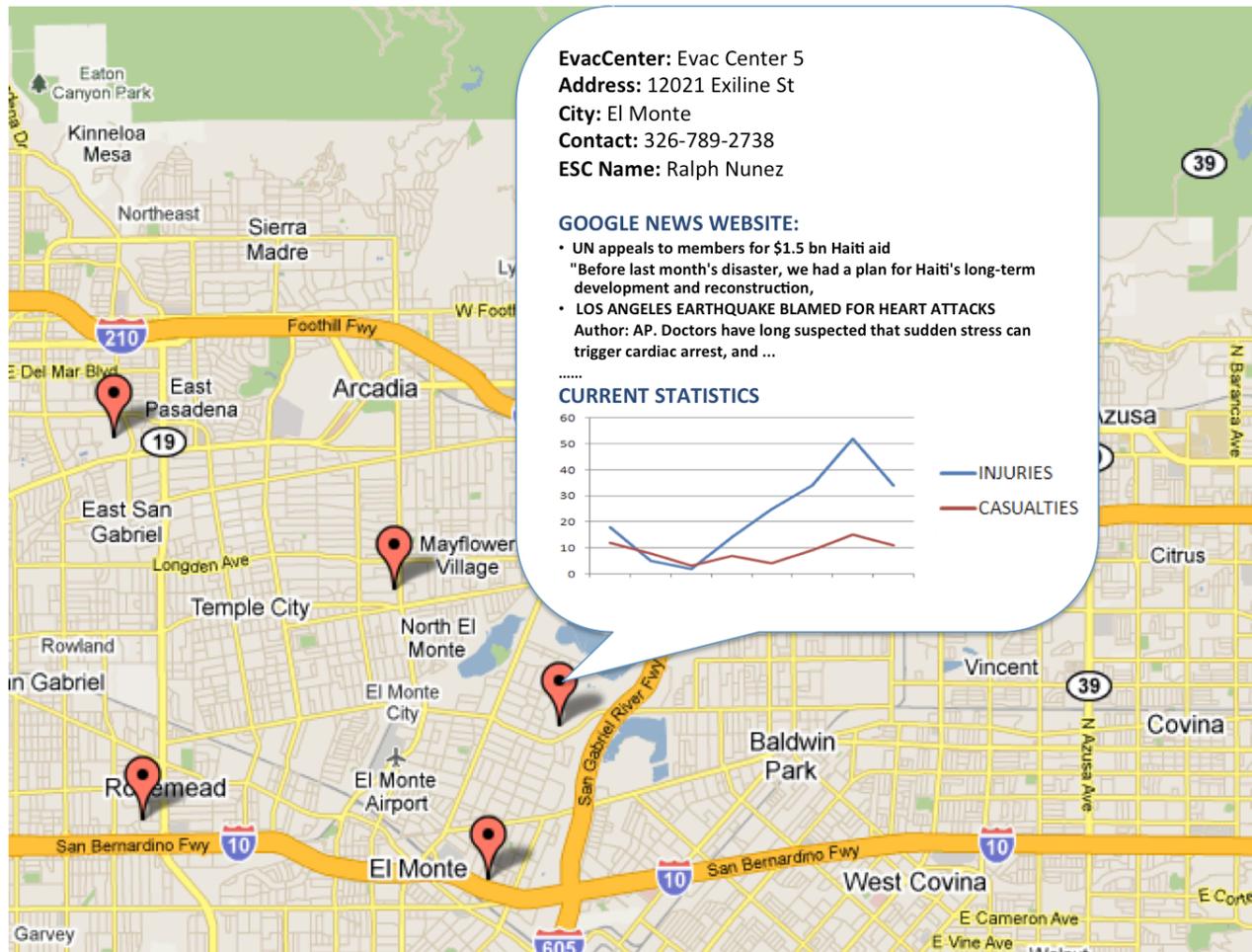
EvacCenter_ID	Address	City	Coordinator_Name	Phone	Data T
Evac Center 1	31 W Woodruff Ave	Arcadia	Chief Dave Odell	(626) 574-5102	
Evac Center 3	12116 Hallwood Dr	El Monte	Ralph Nunez	(626) 580-2065	
Evac Center 4	8805 Marshall St	Rosemead	Donna Wagner	(626) 569-2102	
Evac Center 7	131 W Cypress Ave	Monrovia	Dave Dennis	(626) 256-8104	
Evac Center 5	12021 Exline St	El Monte	Ralph Nunez	(626) 580-2065	
Evac Center 9	857 Chapea Rd	Pasadena	Lisa Derderian	(626) 744-7276	
- Buttons:** Import, Clean, Integrate, Publish, HTML, KML, XML, CSV Text File, Database, Publish HTML, Save HTML.
- Text Snippet:** ● KILLER QUAKE: AFTERSHOCKS OF CHAOS FEAR WORLD AWAY BUT
The anniversary Tuesday of the terrible Los Angeles earthquake was supposed to be a day of celebration a time to look back proudly on the
- Line Chart:** A line chart titled "Line Chart" showing "Casualties" (red line with squares) and "Injuries" (blue line with circles) over time. The x-axis is labeled "Jul-2009" and the y-axis ranges from 0 to 50. Casualties show a significant increase, peaking at 50, while injuries remain relatively low, around 10-15.
- Paragraph Format:** A blue dashed box containing the text "PARAGRAPH FORMAT" and "(Drag data to this section for Paragraph format)".

A callout box points to the table with the following text:

- Geospatial references automatically detected using semantic types.
- Google geocoding service used to get coordinates.
- Markers are placed on those coordinates in the final mashup.

CONSTRUCTS A MAP WITH USER-DEFINED LAYOUT

- ▶ Final mashup output in HTML web page format:



RELATED WORK

- ▶ Existing and Past mashup building tools:



- ▶ Lot of research has been done on data visualization, esp. within data mining and knowledge discovery communities.
 - ▶ Improved Sammon algorithm for visualizing sparse data [Martin et al. 2004].
 - ▶ Interactive High dimensional data visualization [Buja et al. 1996]
- ▶ None of the current (or past) mashup building tools support customized data visualization in the final mashup output.

CONCLUSION

- ✓ Geospatial Mashups can be instrumental for efficient and judicious decision-making in crisis management.
- ✓ Visualization By Demonstration approach lets the user customize the mashup output without any programming.
- ✓ Users can now construct a mashup in one seamless integrated process including data visualization.

FUTURE WORK

- ▶ Integrate more visualization formats such as scatter plots, 2D/3D isosurfaces, etc.
- ▶ Provide the ability to save the plans for extracting and integrating the data so that they can be applied to the new data.
- ▶ Provide the ability to support dynamic view of data (to reflect the changes made to data in the mashup).
- ▶ Support the integration of geospatial data in mashups (i.e., vector layers, raster layers).

THANK YOU!

Any Questions? Comments?