

Geographic Knowledge Graph

GEOG 176C

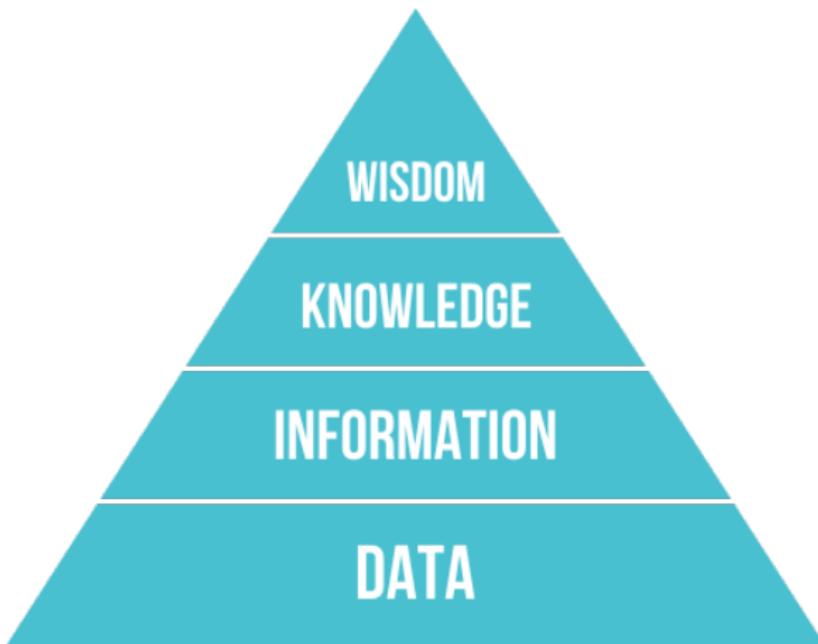
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May 21st, 2018



Knowledge



- Facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject. (*Oxford Dictionary*)

Graph



simple graph



multigraph



pseudograph



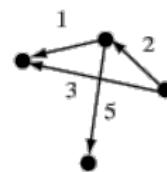
undirected graph



oriented graph



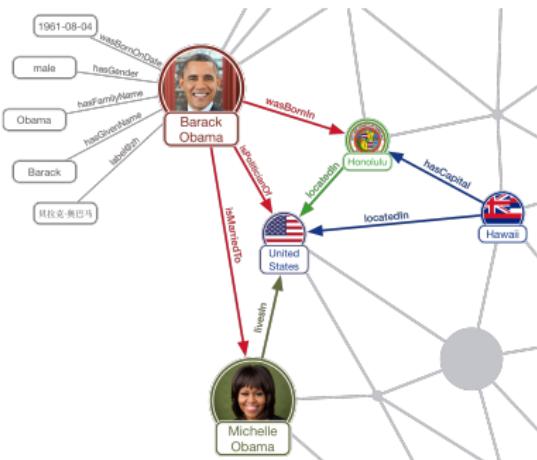
directed graph



network

- A graph is an ordered pair $G = (V, E)$; where V is a set of vertices (nodes) and E is a set of edges (arcs) which are 2-element subsets of V (every edge is connected to two vertices)

Knowledge Graph

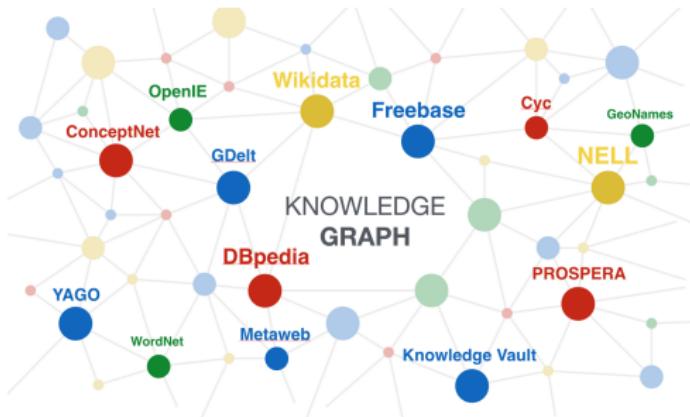


- A KG is typically organized in the form of a graph, e.g., a directed multi-relational graph, such that the nodes represent (real-world) entities and edges represent their relations.
 - A knowledge graph (KG) is a data repository that describes entities and their relationships across domains according to some schema, e.g., an ontology

Knowledge Graph

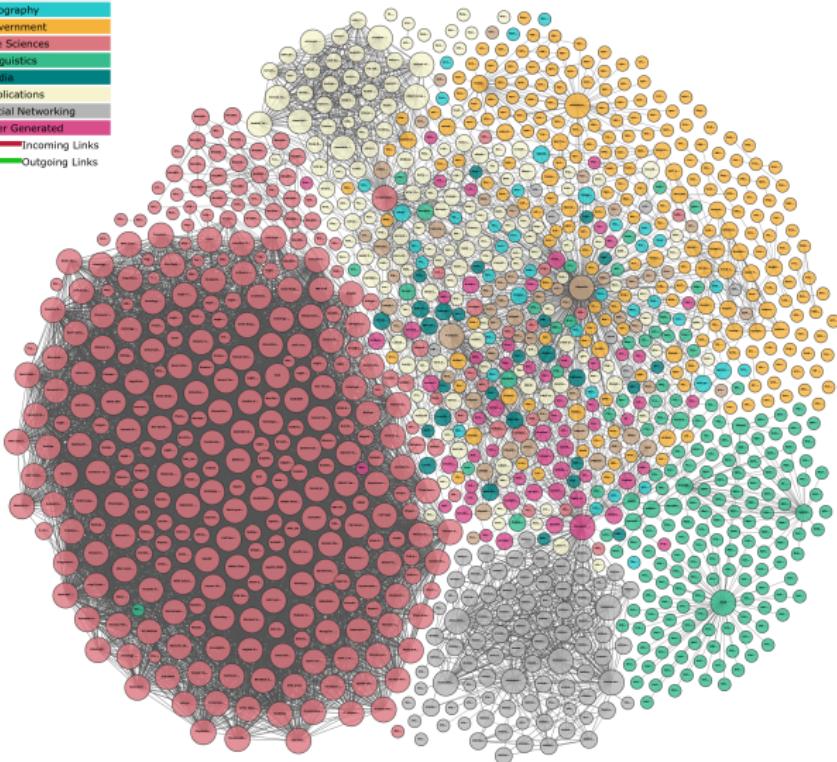
- A collection of triples/statement in the form of (*subject - predicate - object*)
 - (dbr:Santa_Barbara, _California , dbo:isPartOf , dbr:California)
 - Example: Google Knowledge Graph, MicrosoftâŽs Satori, and Freebase to KGs based on W3C technologies such as DBpedia, YAGO, and Wikidata.

Knowledge Graph



- These data repository can be linked with each other based on ontology alignment (`owl:equivalentClass`) and instance level alignment (`owl:sameAs`)
 - (`dbr:Place, owl:equivalentClass, schma-org:Place`)
 - (`dbr:Santa_Barbara,_California, owl:sameAs, freebase:Santa_Barbara,_California`)

Knowledge Graph & Linked Data Cloud



Applications of Knowledge Graph

- Questions and Answering, e.g. Apple Siri, Google Duplex



Apple Siri



Google Duplex

Applications of Knowledge Graph

- Information Retrieval, e.g. Google Knowledge Graph

santa barbara

All Flights Maps News Images More Settings Tools

About 1,250,000 results (0.60 seconds)

Santa Barbara, CA | Hotels, Restaurants, Events & Activities
<https://santabarbaraca.com/> •
Welcome to Santa Barbara—the American Riviera! Plan your trip, find restaurants, things to do, wine tasting, shopping, outdoor activities and more.
Santa Barbara Beauty in the ... Santa Barbara Bowl · Santa Barbara County ...

Visit Santa Barbara (@SantaBarbara) · Twitter
<https://twitter.com/SantaBarbara>

Delicious food, great cocktails and stunning views of the Stearns Wharf. What more could you ask for at Blue Water Grill? #AmericanRiveria @BogdanTelety pic.twitter.com/MQPrmlU... 2 days ago · Twitter

Modern chic meets Spanish romance. Introducing the new @HiltonSBisort. #AmericanRiveries bit.ly/2K4axWx pic.twitter.com/9sD2ZkH... 2 days ago · Twitter

Winery-hopping around the Santa Barbara area just got a little easier with UberWINE. @TravelLeisure 2 days ago · Twitter

Santa Barbara, California - Wikipedia
https://en.wikipedia.org/wiki/Santa_Barbara,_California •
Santa Barbara (Spanish for "Saint Barbara") is the county seat of Santa Barbara County in the U.S. state of California. Situated on a south-facing section of ... History of Santa Barbara Santa Barbara County, California

Things to do in Santa Barbara

Mission Santa Barbara
18th-century mission & Catholic church

Santa Barbara Zoo
Compact zoo with hundreds of animals

Santa Barbara Presidio
Green space featuring a 1782 fortress

Santa Barbara County Courthouse
Spanish Colonial Revival courthouse

Santa Barbara travel guide

3-star hotel averaging \$230, 5-star averaging \$492

Upcoming Events

Colleges and Universities: University of California, Santa Barbara, MORE

People also search for

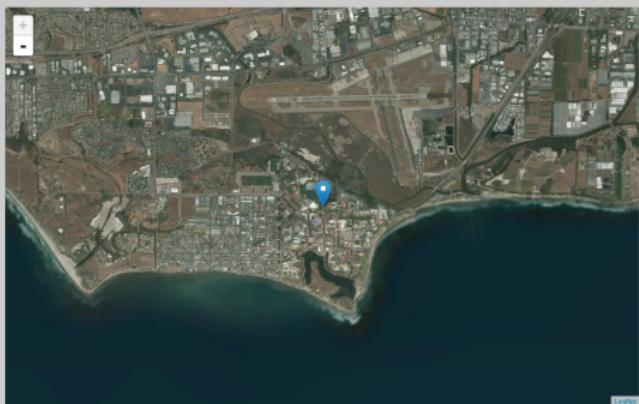
California United States of America Los Angeles San Diego San Francisco

More about Santa Barbara

Geographic Knowledge Graph

ADL Gazetteer Linked Data

adlg:university_of_california_at_santa_barbara_6486074	
rdftype	- adlg:ont:educational_facility adlg:ont:place
adlg:ont:hasAlternateName	- "University of California at Santa Barbara" "University of California Santa Barbara"
adlg:ont:hasDescription	- ""
adlg:ont:hasEntryDate	- August 30, 1999
adlg:ont:hasModificationDate	- February 24, 2004
adlg:ont:partOf	- Santa Barbara
adlg:ont:geomType	- "Point"
w3geo:lat	- "34.416111"
w3geo:long	- "-119.848061"
adlg:ont:hasWARC034	- "\$S@W119°50'53"S@E034°24'57\$\$W119°50'53"S@N034°24'57"
adlg:ont:hasWARC295	- "\$S@W 119°50'53"-N 34°24'57"/W 119°50'53"-N 34°24'57"
ago:hasGeometry	- adlg:ontology_centered_related-6486074 --- no incoming properties --



- A **geographic knowledge graph** is a KG which encodes geographic information.

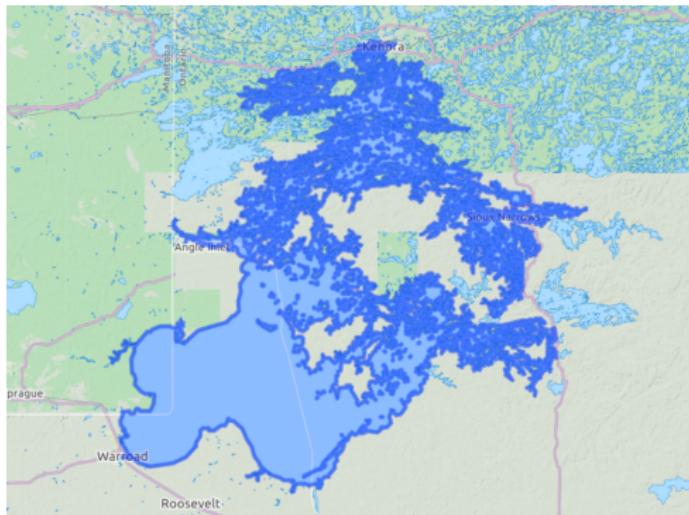
Geographic Knowledge Graph

- Specific problems for geographic knowledge graphs¹:
 - How to meaningfully encode geographic information (complex geometries) in a KG? [7]
 - How to meaningfully visualize geographic knowledge graphs? [6]
 - How to enable GIS computations on geographic knowledge graphs on the fly?

¹Some works are done by other STKO members

Representations of Complex Geometries in Geographic KG

- How to serialize complex geometries in geographic knowledge graphs?



- GeoSPARQL
- Awesemantic-Geo [7]

Multipart polygon representing the Lake of the Woods [7]

GeoSPARQL

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .  
  
@prefix geo: <http://www.opengis.net/ont/geosparql#> .  
  
@prefix ex: <http://www.example.org/POI#> .  
  
@prefix sf: <http://www.opengis.net/ont/sf#> .  
  
  
ex:NationalMall a ex:Park;  
  
    rdfs:label "National_Mall";  
  
    geo:hasGeometry ex:NMPoly .  
  
ex:NMPoly a sf:Polygon;  
  
    geo:asWKT "POLYGON((-77.050125_38.892086,-77.039482_38.892036,-77.039482_  
    ↗ 38.895393,-77.033669_38.895508,-77.033585_38.892052,-77.031906_  
    ↗ 38.892086,-77.031883_38.887474,-77.050232_38.887142,-77.050125_  
    ↗ 38.892086))"^^geo:wktLiteral.
```

- Store the entire geometry and the coordinate system in a single RDF literal, thus eliminating any issues brought on by embedding complex structures as RDF

GeoSPARQL

- pros:
 - storing serialized geometry data within RDF triples;
 - supporting coordinate reference systems;
 - maintaining the distinction between entities and their geometric representation;
 - enabling geospatial queries on linked geographic data;
- cons:
 - Challenges associated with the storage and transmission of large WKT strings;
 - Timely execution of SPARQL queries that make use of geospatial functions.

GeoSPARQL

The Well-Known Text string for the geometry of Western Australia taken from Open Street Map

Awesemantic-Geo

```
base uri          geometry ID
http://ex.co/geometry/polygon/12345#113.05281,-38.11945/153.30671,-11.15957
      geometry type      WGS84 bounding box coordinates
```

Encoding scheme used to mint URIs representing a geometry [7]

- Using dereferencable Uniform Resource Identifiers (URIs) to represent the geometry as a resource;
- Including important information (geometry type; bounding box) in the URIs;
- Can not get raw geometries information using SPARQL.

Visualization of Geographic Knowledge Graph

 DBpedia [Browse using](#) [Formats](#) [Faceted Browser](#) [Sparql Endpoint](#)

About: Santa Barbara, California

An Entity of Type : County seat, from Named Graph : <http://dbpedia.org>, within Data Space : dbpedia.org

Santa Barbara (Spanish for "Saint Barbara") is the county seat of Santa Barbara County in the U.S. state of California. Situated on a south-facing section of coastline, the longest such section on the West Coast of the United States, the city lies between the steeply rising Santa Ynez Mountains and the Pacific Ocean. Santa Barbara's climate is often described as Mediterranean, and the city has been promoted as the "American Riviera". As of 2014, the city had an estimated population of 91,196, up from 88,410 in 2010, making it the second most populous city in the county after Santa Maria while the contiguous urban area, which includes the cities of Goleta and Carpinteria, along with the unincorporated regions of Isla Vista, Montecito, Mission Canyon, Hope Ranch, Summerland, and others, has

Property	Value
thePopulationOfIslandsAreaTotal	<ul style="list-style-type: none">108,996,210,145,8125108,697
the abstract	<p>Santa Barbara (Spanish for "Saint Barbara") is the county seat of Santa Barbara County in the U.S. state of California. Situated on a south-facing section of coastline, the longest such section on the West Coast of the United States, the city lies between the steeply rising Santa Ynez Mountains and the Pacific Ocean. Santa Barbara's climate is often described as Mediterranean, and the city has been promoted as the "American Riviera". As of 2014, the city had an estimated population of 91,196, up from 88,410 in 2010, making it the second most populous city in the county after Santa Maria while the contiguous urban area, which includes the cities of Goleta and Carpinteria, along with the unincorporated regions of Isla Vista, Montecito, Mission Canyon, Hope Ranch, Summerland, and others, has an approximate population of 220,000. The population of the entire county in 2010 was 423,696. In addition to being a popular tourist and resort destination, the city includes a large service sector, education, technology, health care, finance, agriculture, manufacturing, and retail sectors. In 2004, the city ranked as the 10th most expensive place to live in the United States. Education is well represented, with five institutions of higher learning on the south coast (the University of California, Santa Barbara, Santa Barbara City College, Westmont College, Antioch University, and the Brooks Institute of Photography). The Santa Barbara Airport serves the city, as does Amtrak. U.S. Highway 101 connects the Santa Barbara area with Los Angeles to the southeast and San Francisco to the northwest. Beyond the 101 and beyond the Santa Ynez Mountains, is the Los Padres National Forest, which contains several remote wilderness areas. Channel Islands National Park and Channel Islands National Marine Sanctuary are located approximately 20 miles (32 km) offshore. [en]</p>
theAreaCode	<ul style="list-style-type: none">805
theContinent	<ul style="list-style-type: none">50421389_53202 (instance)50422300_000000 (instance)
theAreaTotal	<ul style="list-style-type: none">108,996,210,145,8125 (instance)108,697,000,000,000 (instance)
theAreaWater	<ul style="list-style-type: none">58274732_482560 (instance)58275000_000000 (instance)
theCountry	<ul style="list-style-type: none">abc:United_States

- **Geographic Knowledge Graphs explicitly encode the semantic of geographic entities.**
- **Spatial information:** can be easily visualized by maps.
- **Semantic information:** can not be easily visualized.

Visualize Geographic KG in Multiple Ways

- Graph View

The visualization displays a network graph representing cruise ship routes. The central node is 'globe:cruise' (red). Numerous blue nodes labeled 'cruise stop' are connected to it by grey lines. Orange nodes, representing specific cruise routes, are also connected to the central node and to each other. One route, '37388', is highlighted with a red box. A green node labeled 'More Paths...' is located near the bottom center. On the right side, there is a sidebar with the following controls:

- Search Entity** (button)
- Relationship Finder** (button)
- First Node** (Section)
 - Type: **Cruises** (dropdown menu)
 - Select:
- Second Node** (Section)
 - Type: **Researchers** (dropdown menu)
 - Select: (<http://www.geolink.org/globe/>)
- Relationship Query Setting** (Section)
 - Path Max Distance: 3
 - Max Num. of Paths: 10
 - Show TBox Relationship:
- Relationship Query** (button)

Visualize Geographic KG in Multiple Ways

- Map View

Layer Legend:

- Cruises0
- Layers

SEARCH Type your search keyword here... **Search**

Result Count: 1
AE0904

Property	Value
is githasCruise of	AE05693
is githasCruise of	AE05908
is githasCruise of	AE08950
is githasCruise of	AE08918
is githasCruise of	AE09006
is githasCruise of	AE09008
owl:sameAs of	AE08917
is	AE0904
githasCruiseScientist of	AE0904

Map Result

Visualize Geographic KG in Multiple Ways

• Table View

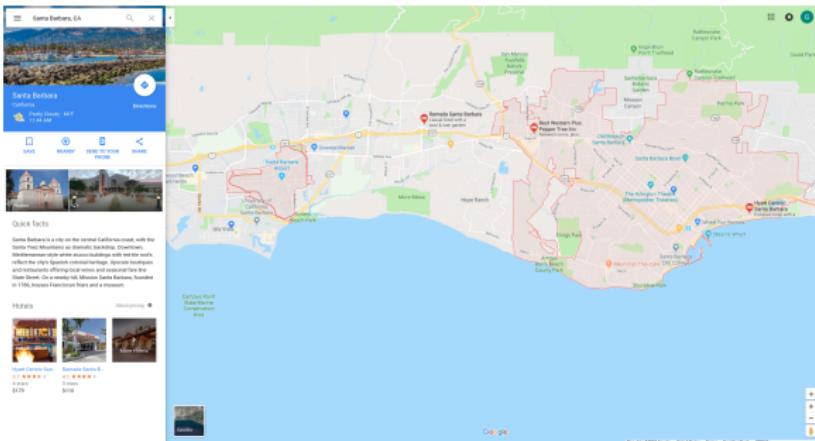
The screenshot shows a web-based application for visualizing geographic knowledge graphs. At the top, there's a header with the EARTH CUBE logo, the title "GeoLink: Cruises", and search/filter options like "Switch to a different view" and "Include CloseMatch". Below the header is a search bar with placeholder text "Type your search keyword here..." and a "Search" button.

The main content area displays a table titled "AE0904" with an item count of 1000. The table has two columns: "Property" and "Value". The properties listed include "is gl:hasCruise of", "is owl:sameAs of", "gl:isChiefScientistOf", "is gl:hasCruise of", "hasAward", "hasChiefScientist", "hasCruiseType", and "hasEndPortCall". The values for these properties are URIs such as :455653, :58917, :50759, nodeID:/b6136900, NSF 06-48016, Johnson, Rodney, http://voc.datausa.us/cruise/op_science, and Atlantic Explorer :2009-03-20 :arrivePort.

On the right side of the table, there are icons for "Switch to a different view" and "Include CloseMatch". At the bottom right, there are navigation icons for back, forward, and search.

A Semantically Enriched Visualization

- Maps: extensively used to visualize GI and spatial relationships.



- Difficult to directly express non-spatial relationships (semantic similarity) using such maps.

A Semantically Enriched Visualization

A Semantically Enriched Visualization: An analogy of thematic maps to visualize the distribution of geographic features in a semantic space.

- Points: Geographic Coordinates → Locations in the Semantic Space
- Polygons: Administration Regions/Continents → Semantic Continents

A Semantically Enriched Visualization

A Semantically Enriched Visualization:

- Semantically similar entities are clusters within the same region;
- The distance between geographic features represents how similar they are.

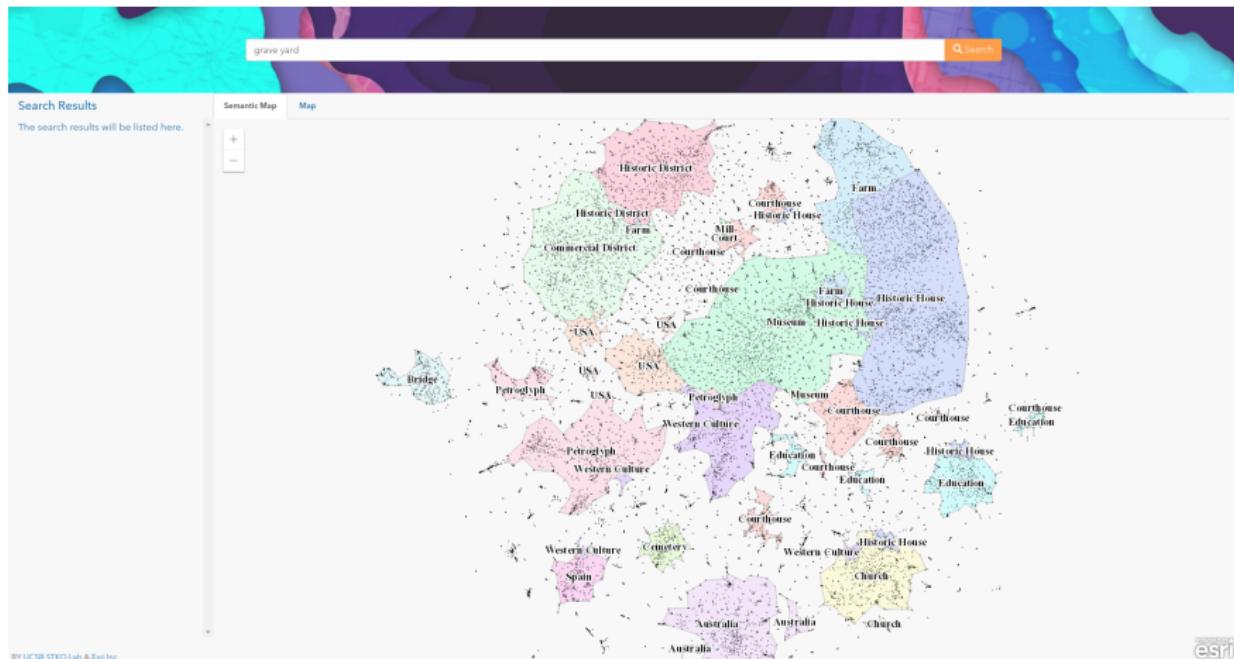
A Semantically Enriched Visualization

- In this work, a **semantically enriched** geospatial data **visualization** and **searching** framework are presented.
- We evaluate it using a subset of places from DBpedia.



- Multiple techniques:
 - Paragraph Vector
 - Spatial Clustering
 - Concave Hull Construction
 - Information Retrieval (IR) Model

A Semantically Enriched Visualization

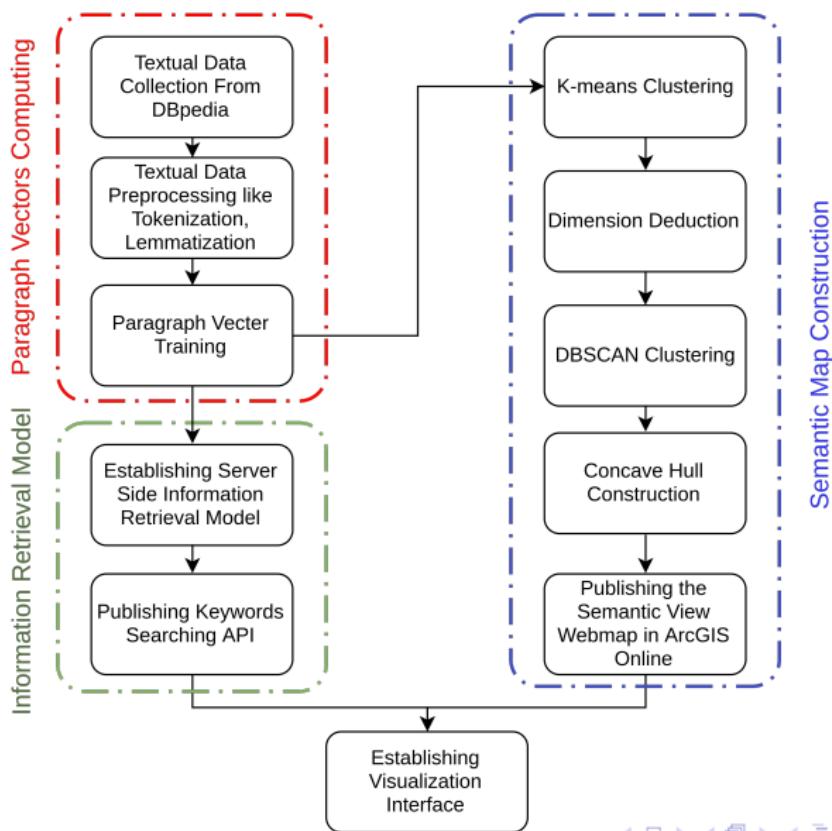


BY UCSB STKO Lab & Esri Inc.

esri

A semantically enriched visualization resembles cartographic layouts

The Workflow



Paragraph Vectors Computing

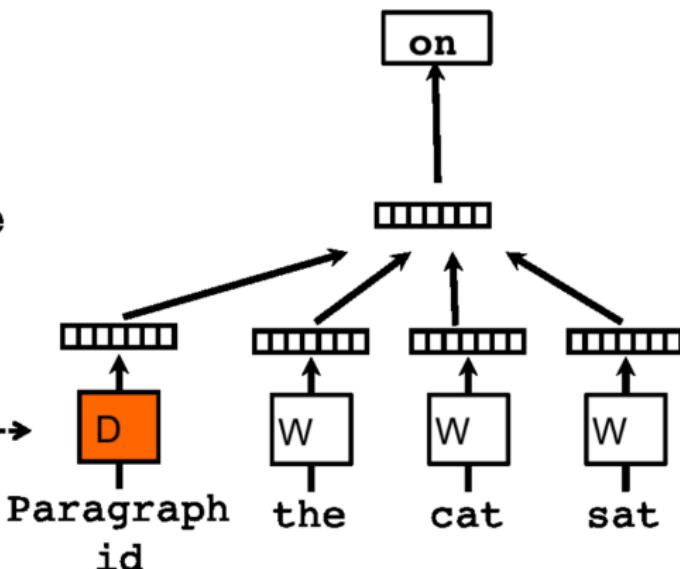
- **Paragraph Vector** (or called **Doc2Vec**) is a representation learning method proposed by Natural Language Processing community.
- **Idea:** Give a collection of documents, Doc2Vec learns a high-dimensional continuous vector (embedding) for each document.
- The **cosine similarity** between the learned document vectors represents the **semantic similarity** between their corresponding documents.

Paragraph Vectors Computing

Classifier

Average/Concatenate

Paragraph Matrix----->



The two-layer neural network architectural of Doc2Vec

Paragraph Vectors Computing

Outputs of Doc2Vec:

- Embeddings of documents;
- Embeddings of word tokens in the document corpus.

Paragraph Vectors Computing

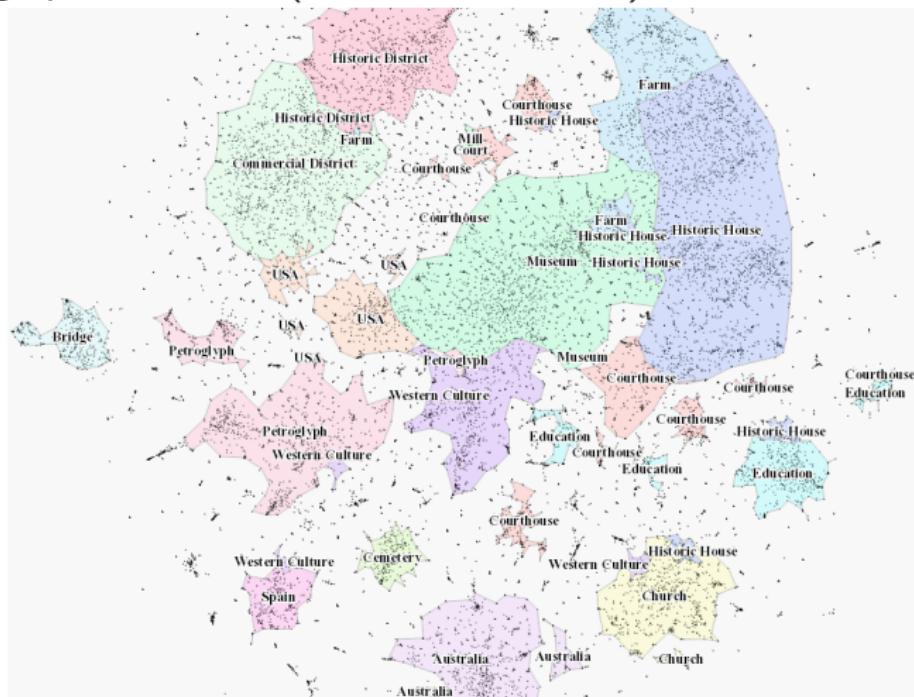
- **Data Source:** All entities typed dbo:HistoricalPlace in DBpedia (21010 places)
 - Each historic place has an abstract, comments, images, and geographic coordinates.
- **Method:** Doc2Vec Model (PVDM [5])
 - **Textual data collection:** Treat each place as a document whose content is its abstract and comments
 - **Textual data preprocessing:** tokenization and lemmatization
 - **Paragraph vector training:** embedding dimension $K = 300$; window size $N = 10$; learning rate $\alpha = 0.025$

Information Retrieval Model

- **Place Embeddings:** the learned embedding of each historic place from Doc2Vec.
- **Query Embeddings:**
 - Utilize the *Doc2Vec.infer_vector()* function from gensim's Doc2Vec package
 - The TF-IDF score weighted embedding based on word embeddings of query word tokens
 - **The simple average of the query tokens' embeddings after stop words removal**
- **Semantic Similarity Score Function:** the cosine similarity between the query embedding and place embeddings
- An API ² is provided for the semantic searching functionality among *DBpedia* historic places.

Semantic Similarity Map Construction

Spatialization: how to construct an overview of the semantic distribution of geographic entities such that it follows a cartographic tradition (*semantic continent*).



Semantic Similarity Map Construction

K-means clustering: group these place embeddings into different clusters;

- Try $\#(\text{clusters})$ from 2 to 30 and compute silhouette coefficient [8] of the clustering results;
- $\#(\text{clusters}) = 16$ gives the highest silhouette coefficient;
- The descriptions of places in each cluster are combined as one document;
- Word clouds are produced from 10 word with highest TF-IDF score;
- Each cluster is named according to its top 10 words.

Elementary
Frame Maine
Library
Shaker
Schoolhouse
Oneroom

The word cloud for *Education* cluster

Semantic Similarity Map Construction

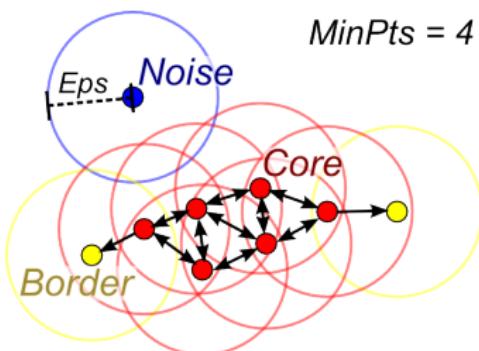
Dimension reduction: to visualize the semantic distribution of geographic entities in a 2-dimensional space

- Different dimension deduction methods including PCA and t-SNE are experimented;
- t-SNE performs best and the clusters derived from k-means are still well separated.

Semantic Similarity Map Construction

DBSCAN:

- Although t-SNE produces a good dimension reduction result, some points are far away from their cluster centroids and scattered in the 2D space.
- We apply DBSCAN [3] to each projected k-means cluster to extract the “core” parts of them.
- Visual interpretation are used to select the parameter combination for DBSCAN. ($Eps = 1.1$ and $MinPts = 6$)

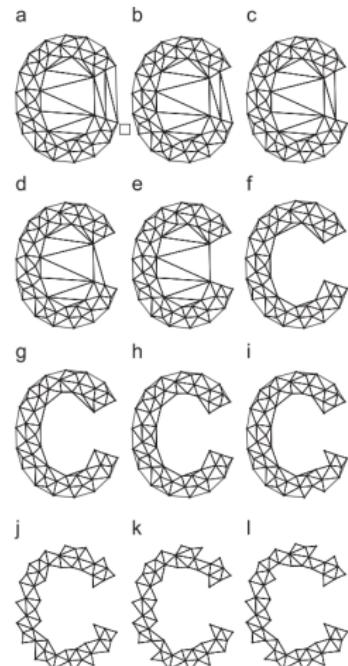


Semantic Similarity Map Construction

Concave Hull Construction: Chi-shape algorithm [2]

- It first constructs a Delaunay triangulation;
- It erodes the boundary by deleting boundary's edges until the longest edge less than a threshold.
- A normalized length parameter $\lambda_p \in [1, 100]$ controls this threshold;
- To get optimal λ_p , a fitness score function [1] is used to balance the *complexity* and *emptiness* of the resulting concave hull.

$$\phi(P, D) = \text{Emptiness}(P, D) + C * \text{Complexity}(P) \quad (1)$$

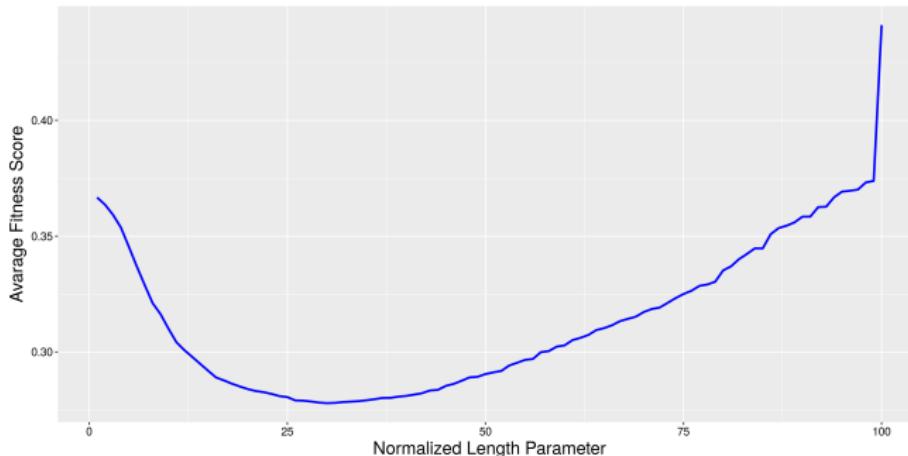


P : the derived simple polygon; D : the Delaunay triangulation of the corresponding point cluster.

Semantic Similarity Map Construction

Concave Hull Construction:

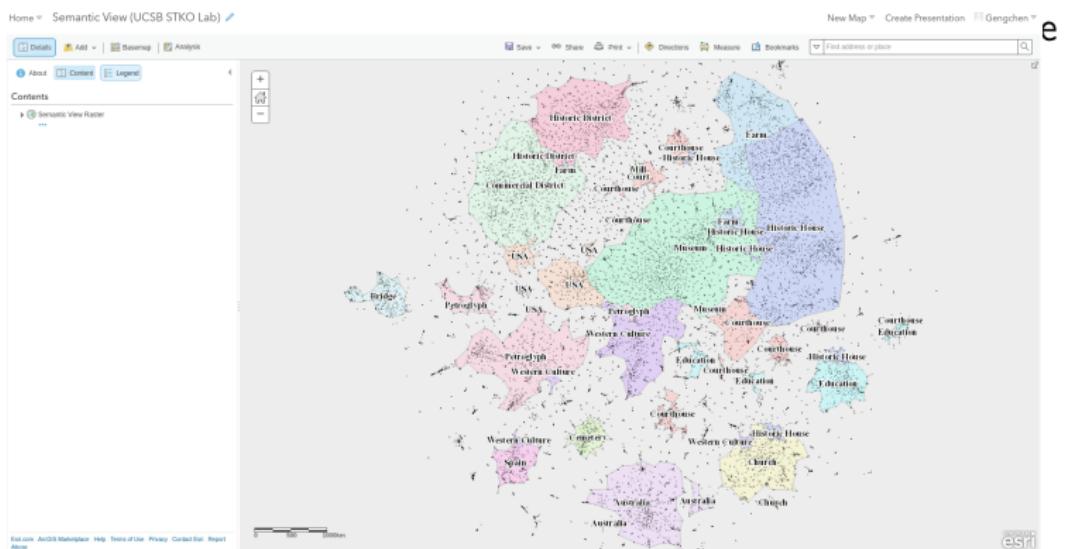
- We iterate λ_p from 1 to 100 and compute the average fitness score of all point clusters produced by DBSCAN;
- The optimal λ_p with the lowest average fitness score is 30.



The average fitness score for different λ_p among all DBSCAN clusters.

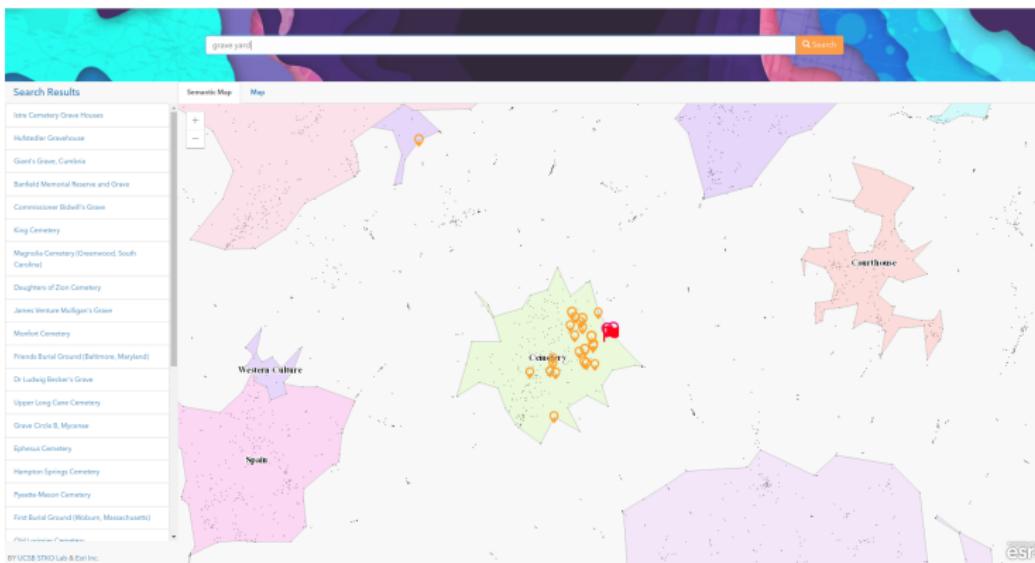
Semantic Similarity Map Construction

Publishing the Semantic View Webmap in ArcGIS Online:



Result

We have deployed a web-based user interface⁴ to showcase the functionality using the historical places dataset.

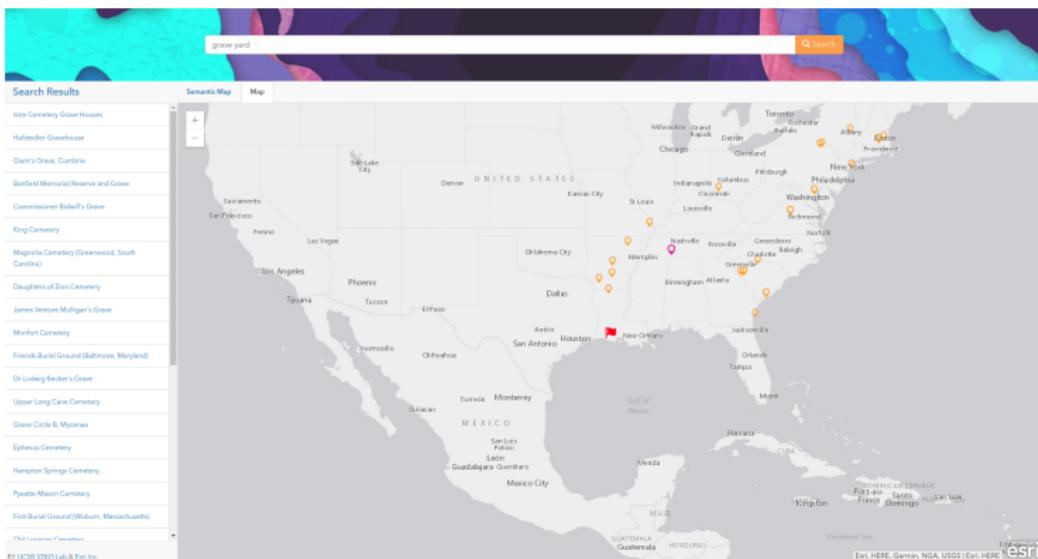


the search result of “grave yard” in the semantic space

⁴

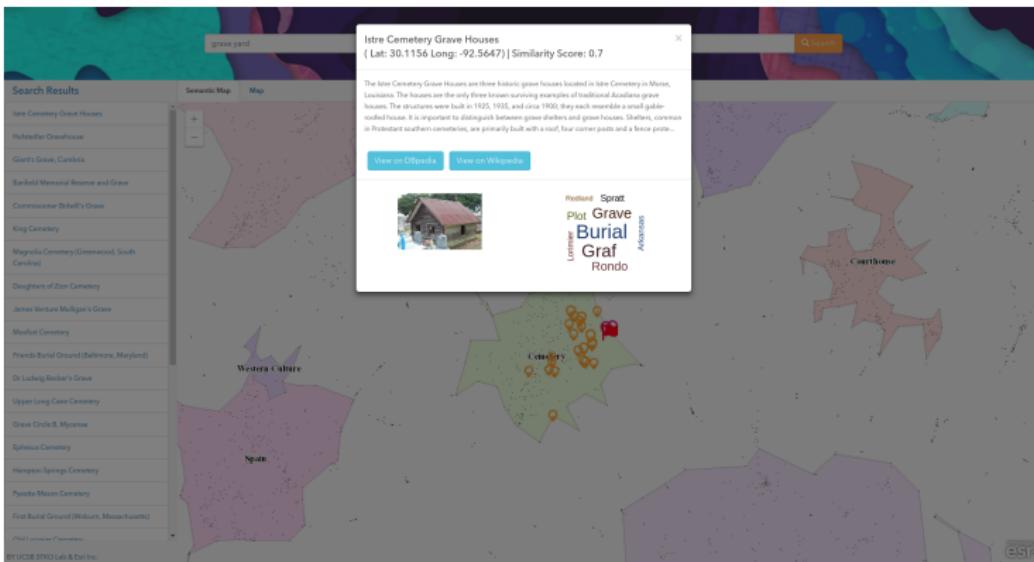
<http://stko-testing.geog.ucsb.edu:3050/>

Result



the search result of “grave yard” in the geographic space

Result



The pop-up window shows some basic information for

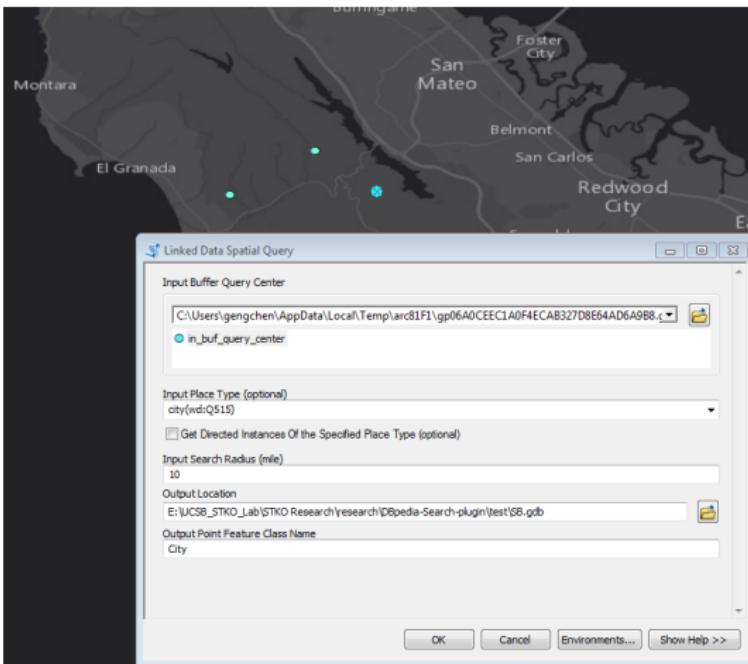
`dbo:Istre_Cemetery_Grave_Houses`.

A Deep Integration of Geographic Linked Data with GIS

- From a GIS perspective, Linked Data seems almost like a one-way street.
- Considerations when integrate Linked Data with GIS:
 - How GIS and its users should interact with Linked Data?
 - How these key benefits of Linked Data can be maintained during conversion into GIS data formats and analysis without having to flatten the data back to a tabular format?
 - How to utilize the ontologies used to semantically lift Linked Data instead of merely relying on strings?

ESRI Linked Data Connector

- Buffer Search on Geographic KG:
 - Find cities around the search center



ESRI Linked Data Connector

- Property Enrichment for Geographic Entities
(Utilize Semantic Web reasoning and ontologies to extract additional properties by using subsumption reasoning and (inverse) partonomical relations as examples):

- People that died in San Francisco / Bay Area?

Table

The screenshot shows a table titled "SanMateoCounty_wikiURL_subDivisionRL_DBpediaRL_is_deathPlace_OF". The table has three columns: "OBJECTID", "DBpediaID", and "is_deathPlace_OF". The "DBpediaID" column contains URLs starting with "http://dbpedia.org/resource/". The "is_deathPlace_OF" column contains URLs starting with "http://dbpedia.org/resource/". There are 174 rows in the table.

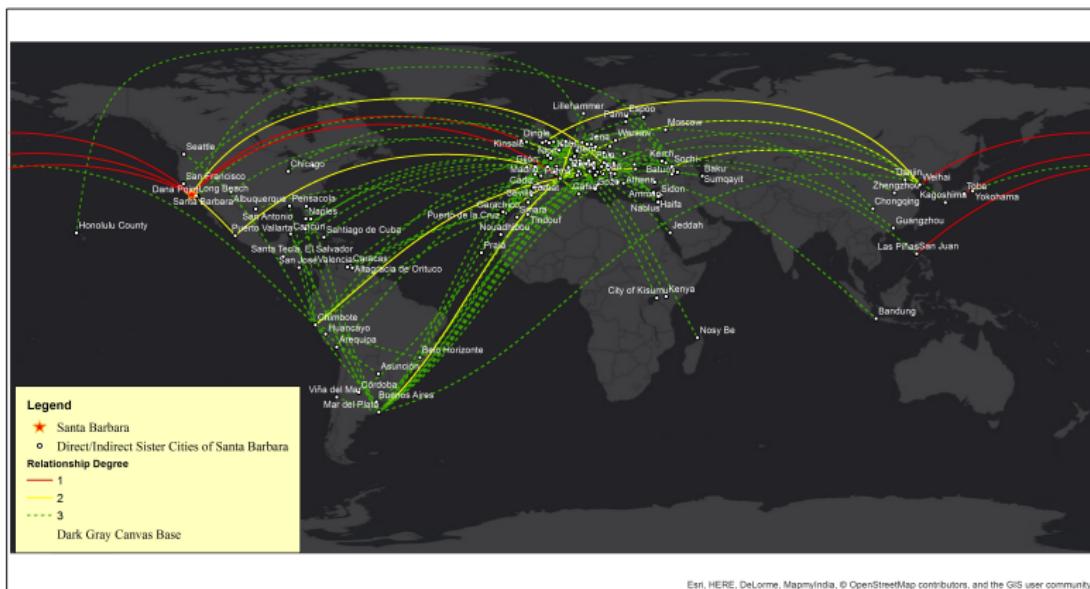
OBJECTID	DBpediaID	is_deathPlace_OF
1	http://dbpedia.org/resource/Brentano,_California	http://dbpedia.org/resource/Lafayette_Thomas
2	http://dbpedia.org/resource/San_Mateo,_California	http://dbpedia.org/resource/Robert_Cottrell
3	http://dbpedia.org/resource/Pacifica,_California	http://dbpedia.org/resource/Christian_Theodore_Pedersen
4	http://dbpedia.org/resource/Menlo_Park,_California	http://dbpedia.org/resource/Charles_N._Fenton
5	http://dbpedia.org/resource/Milpitas,_California	http://dbpedia.org/resource/Albert_Johnson_(pockey)
6	http://dbpedia.org/resource/San_Mateo,_California	http://dbpedia.org/resource/Greta_Johansson
7	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/Wille_Herzer
8	http://dbpedia.org/resource/South_San_Francisco,_California	http://dbpedia.org/resource/John_L._Wasserman
9	http://dbpedia.org/resource/Menlo_Park,_California	http://dbpedia.org/resource/Nan_Wood_Graham
10	http://dbpedia.org/resource/La_Honda,_California	http://dbpedia.org/resource/Ben_Kell
11	http://dbpedia.org/resource/Burlingame,_California	http://dbpedia.org/resource/Michael_T._Gottlieb
12	http://dbpedia.org/resource/Burke,_California	http://dbpedia.org/resource/Lurine_Matson_Roth
13	http://dbpedia.org/resource/San_Mateo,_California	http://dbpedia.org/resource/Be_Viere
14	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/Con_Dempsey
15	http://dbpedia.org/resource/San_Mateo,_California	http://dbpedia.org/resource/Morris_Kirskey
16	http://dbpedia.org/resource/Burlingame,_California	http://dbpedia.org/resource/Dick_Jones_(baseball)
17	http://dbpedia.org/resource/Daly_City,_California	http://dbpedia.org/resource/Babe_Pirelli
18	http://dbpedia.org/resource/Pacifica,_California	http://dbpedia.org/resource/Miriam_Stewart
19	http://dbpedia.org/resource/Menlo_Park,_California	http://dbpedia.org/resource/Cuckoo_Christensen
20	http://dbpedia.org/resource/Daly_City,_California	http://dbpedia.org/resource/Henry_Liu
21	http://dbpedia.org/resource/San_Mateo,_California	http://dbpedia.org/resource/Wagner_Jorgenson
22	http://dbpedia.org/resource/San_Mateo,_California	http://dbpedia.org/resource/Ray_Apolakis
23	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/Bob_Garber
24	http://dbpedia.org/resource/Atherton,_California	http://dbpedia.org/resource/John_R._Beckett
25	http://dbpedia.org/resource/Hillsborough,_California	http://dbpedia.org/resource/Eugene_Lopez_Jr.
26	http://dbpedia.org/resource/San_Carlos,_California	http://dbpedia.org/resource/Omar_Ahmed_(politician)
27	http://dbpedia.org/resource/Milpitas,_California	http://dbpedia.org/resource/Ronald_Montrose
28	http://dbpedia.org/resource/Menlo_Park,_California	http://dbpedia.org/resource/Thomas_A._Baley
29	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/Robert_D._Barry
30	http://dbpedia.org/resource/Atherton,_California	http://dbpedia.org/resource/Rajeev_Itohani
31	http://dbpedia.org/resource/San_Mateo,_California	http://dbpedia.org/resource/Alan_Nevins
32	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/John_Davenport
33	http://dbpedia.org/resource/San_Mateo,_California	http://dbpedia.org/resource/Barrett_Cole
34	http://dbpedia.org/resource/Portola_Valley,_California	http://dbpedia.org/resource/Albert_H._Bowker
35	http://dbpedia.org/resource/Menlo_Park,_California	http://dbpedia.org/resource/Abraham_Maslow
36	http://dbpedia.org/resource/Pacifica,_California	http://dbpedia.org/resource/Ragnar_Hasselgren
37	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/Wally_Neary
38	http://dbpedia.org/resource/San_Bruno,_California	http://dbpedia.org/resource/Mosheh_Feaster
39	http://dbpedia.org/resource/San_Carlos,_California	http://dbpedia.org/resource/Tom_Tenner
40	http://dbpedia.org/resource/Atherton,_California	http://dbpedia.org/resource/Samuel_M._Shortridge
41	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/Margie_Deanne
42	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/Harry_Cheek
43	http://dbpedia.org/resource/San_Mateo,_California	http://dbpedia.org/resource/Ray_Mederos
44	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/Jennison_Heaton
45	http://dbpedia.org/resource/Burlingame,_California	http://dbpedia.org/resource/Levi_Belmont
46	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/David_Breeden
47	http://dbpedia.org/resource/Redwood_City,_California	http://dbpedia.org/resource/Charly_Lin_Tee
48	http://dbpedia.org/resource/San_Mateo,_California	http://dbpedia.org/resource/Seanne_Manford
49	http://dbpedia.org/resource/Daly_City,_California	http://dbpedia.org/resource/Emile_Despres
50	http://dbpedia.org/resource/Portola_Valley,_California	http://dbpedia.org/resource/Julio_Bonelli
51	http://dbpedia.org/resource/Belmont,_California	http://dbpedia.org/resource/Richard_Tweddle
52	http://dbpedia.org/resource/Redwood_Shores,_California	

(0 out of 174 Selected)

SanMateoCounty_wikiURL_subDivisionRL_DBpediaRL_is_deathPlace_OF

ESRI Linked Data Connector

- Relationship Finder between geospatial entities:
 - Which cities are 3-degree sister cities of Santa Barbara?



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