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Adding Geographic Scopes to Web Resources

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http://xldb.fc.ul.pt

You heard it in the halls

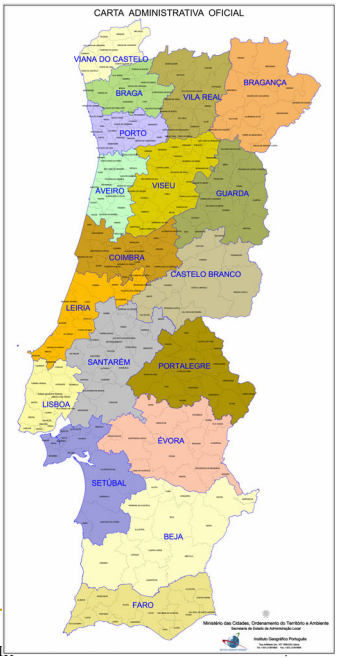
- Many Web information sources are primarily relevant to geographically delimited communities.
- Users frequently use geographic terms as “filters” in queries

Tumba!

- **National** Web search engine
  - Public service since 2002
- See it in action at **http://tumba.pt**

Geographic Information on Web Pages/Logs

- Portuguese Web test collection (3.5 Mdocs)
- Counted # of Municipality references
  - 308 municipalities
  - 8,000 to 500000 voters each
- 2.17 times/document (average)
- occur in 4% of the queries



Scope/Context definitions

- Orkut Buyukkokten et al., WebDB'99
  - **globality of entities**, conjectures that web linkage could be used.
- Junyan Ding, Gravano et al., VLDB'2000
  - **scope** is geographical area that the creator intends to reach
  - scopes defined both by linkage and content
- McKurley WWW10'2001
  - **geocoding HTML** or **geographic context** for web pages – no definition
- Jones et al., SIGIR'02
  - **geographical context** = "geographic information about a page", later renamed **web page footprint**
- Amitay et al., SIGIR'04:
  - **focus** is the locality that a page discusses as a whole

Geographical Scope of Web Resources

- Region where more people than average would find the resource relevant.

Goal

- **Build and evaluate** a research search system for GeoIR.
  - Avoid getting spatial
  - Assign a scope (if it exists) to each page.

Outline

- Motivation
- **Architectural Overview**
- Assigning Scopes to Web Pages
- Searching with Web scopes
- Evaluation plan
- Conclusion

IR with Geographic Scopes

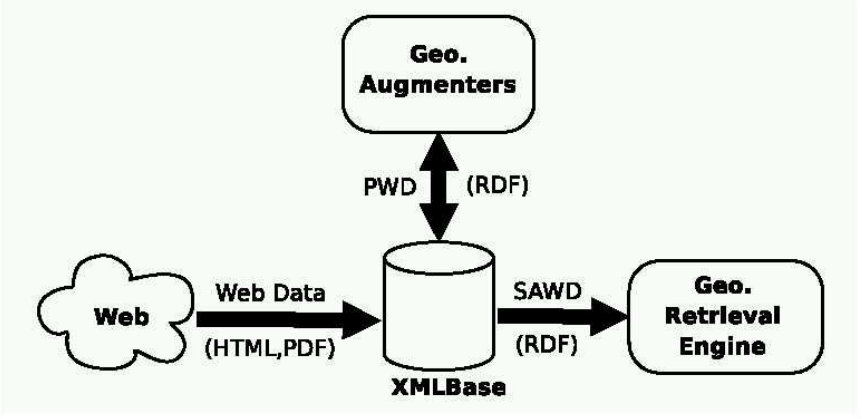
Data Sources:

- Contents (text and meta-data)
- Linkage between pages
- **External** Information Sources
  - Mikheev et al., 1999: precision of geo-entities recognition w/o gazetteers is small.

Goals:

- Rank / Cluster results by geo scope (**IF that matters**)
- Find resources nearby.
- Limit search to a particular region
- Display spatial distribution of the results

Architectural Overview



Web Data → **Purified** Web Documents → **Scope Augmented** Web Documents

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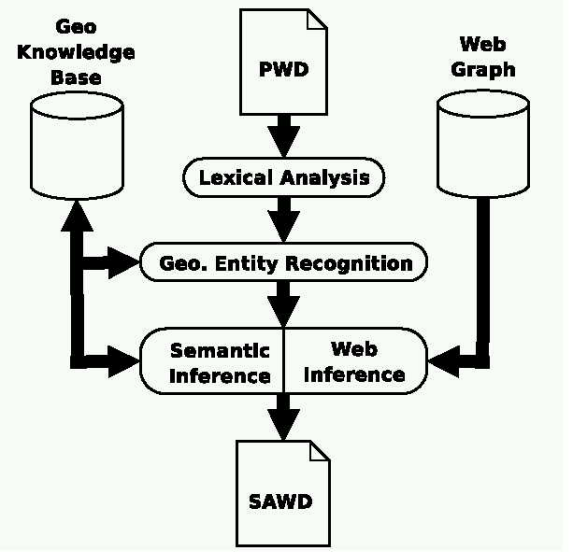
Assigning Scopes



Lexical Analysis

- Web data file ->PWD
  - Tokenization
  - HTML markup is important
  - HTML pages are not regular text documents

Geo-Named Entity Recognition

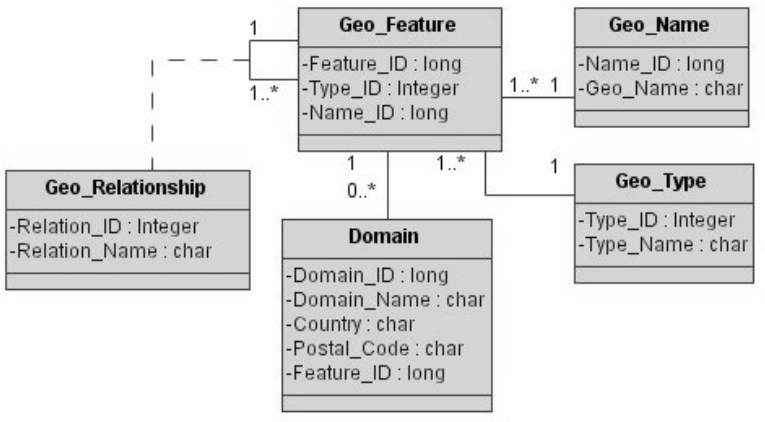
- Machine Learning
  - Can tag names not in gazetteer
  - Needs large amounts of training data
- Simple pattern match
  - Detects
    - location expressions
    - GKB's place names

    "Port of" + "New York"
  - Does not detect names not in gazetteer
    - We don't need them anyway!

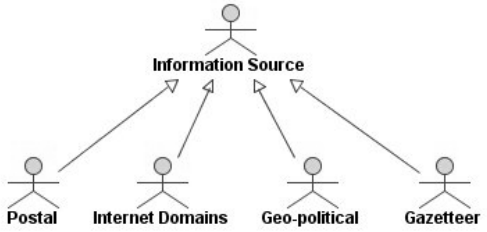
GKB – Shared Knowledge Base

- DNS sub-domains information
  - Yahoo.com, foo.blogspot.com
- Names with known location
  - Cities, landmarks, postal codes, …
- Relationships
  - Equivalent names
  - Hierarchical broader-narrower names
  - Adjacent names
  - Related names
- **Data quality** is an issue

Prototype Class Diagram



External Information Sources



- Postal codes database
  CTT, Portuguese Post Office
- .PT TLD registry information (postal codes only)
  FCCN, Registrar
- Geopolitical organization and demographics data
  INE, Statistics Bureau
- Phone plan numbering information
  ANACOM, National Telecom Authority

Web Inference

- **Input**:
  - Web graph with nodes partially tagged
    - Many web pages don't have associated geo tags
- **Algorithm**:
  - Propagate tagged entities to adjacent pages
  - Pages from same site more closely associated
    - Example: small company site with "contacts" page
  - Set of tags shows spread of "scope"

Semantic Inference

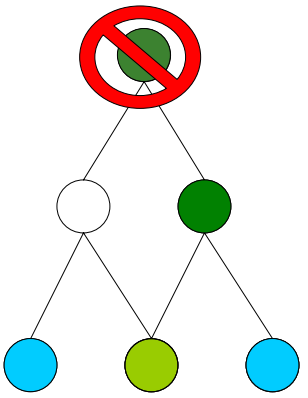
- **Inputs**:
  - Tagged pages
  - Tagged domains (whois registrants highly correlated to scope!)
  - Relationships among tagged entities (GKB)
  - Some GKB entities labelled as scopes
- **Output**:
  - Pages labelled with scopes
- **Algorithm**:
  - Weighted sum of tagged entities
  - Weights fine-tuned during evaluation

Semantic Inference Algorithm (1)

- Weights assigned to tagged entities
  - Multipliers > 1: Anchors, title, meta , typeface , whois registrant
  - Multipliers < 1: propagated from same site, from different site
- Weights "propagated" to GKB-related entities
  - Equivalence: same score
  - Broader/narrower, Adjacent, Related: fraction of score

Semantic Inference Algorithm (2)

- Assign to page:
  - No scope if all < th
  - scope with highest score, if >> other scopes
  - parent scope, if it exists
  - scope with largest population count



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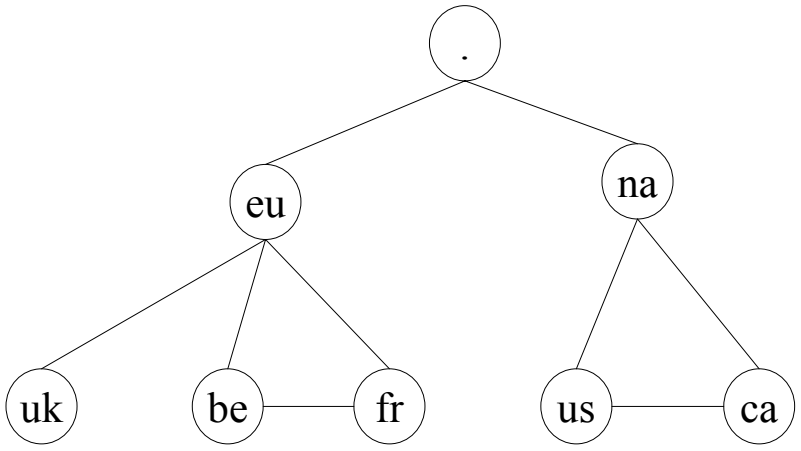
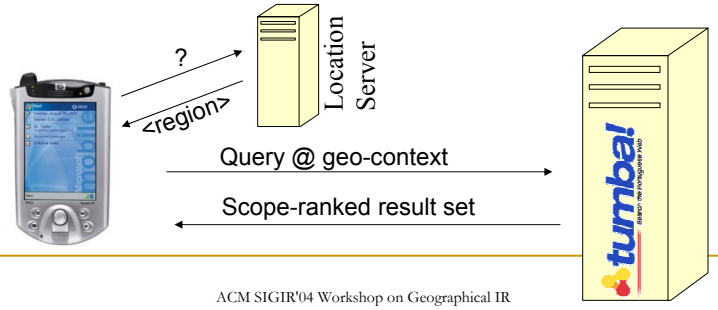
Proximity measure



Topologic Distances Graph

Search

- Translate user geo context (e.g. coordinates) into scope of query
- Detect global/local queries
- Incorporate proximity in global ranking function



Evaluation

- Tagging – Extraction
  - Participation on joint evaluation on Portuguese NER
  - Use the consensus rules to derive heuristics
- Scopes Classification
  - Test collection
    - DMOZ data
      - Top:Regional:Europe:Portugal is very limited
    - Proprietary directories (not open)
- Retrieval Evaluation
  - Query becomes subject @ geo context
  - Relevance Judgments @ geo context
  - Joint evaluation task needed

Conclusion

- Geographic search can be decomposed in several (still hard) problems
  - Ambiguity
  - Incorrect/incomplete data
  - Evaluation
- Much of the IR work on modelling and evalution can be used as foundation