Hapori: Context-based Local Search for Mobile Phones using Community Behavioral Modeling and Similarity

Nicholas D. Lane, Dimitrios Lymberopoulos†, Feng Zhao† and Andrew T. Campbell
Dartmouth College, Microsoft Research†
{niclane,campbell}@cs.dartmouth.edu, {dlymper,zhao}@microsoft.com†

Presented by: Ravi Singh

Hapori

- **Framework for context based local search**
  - **Context information: location, time, weather, user activity, etc.**
  - **Behavioral Models of Users**
- **Goal: Identify relevant POI based on rich context information**
- **Design, Implementation and Evaluation**

Location Aware Searching

- **Prevalent in most mobile searching applications.**
- **Works well with a narrow range of queries.**
- **Does not take user preferences into account.**

Improving POI Search Relevance

- Capture significant context features
- Learning customized ranking metrics
- Modeling user differences
- Adapting to change

Motivation

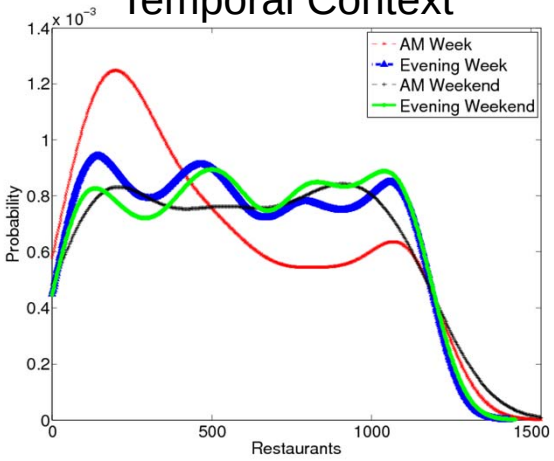
- **Context and Community Behavior**
  - **Analyzed data obtained as results from search queries to Mobile Bing Local.**
- **Search log:**
  - **Query terms**
  - **Unique identifier for POI**
  - **Coarse-grained location of the user**
  - **Exact date and time of query**
  - **Anonymized user identifier**

Motivation

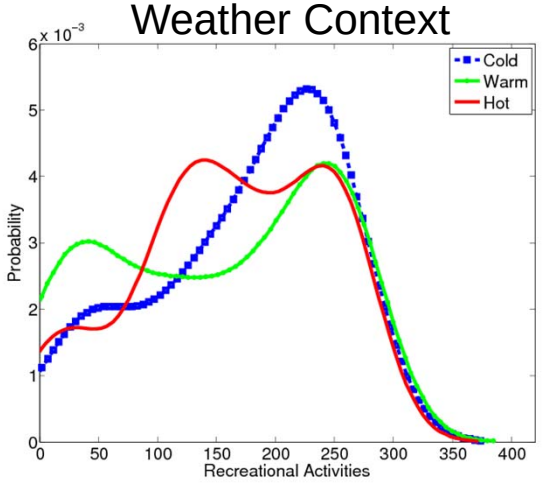
- **Analysis of search logs**
  - **Temporal Context**
  - **Weather Context**
  - **Personal Context**
  - **Spatial Context**

Analysis of Search Logs

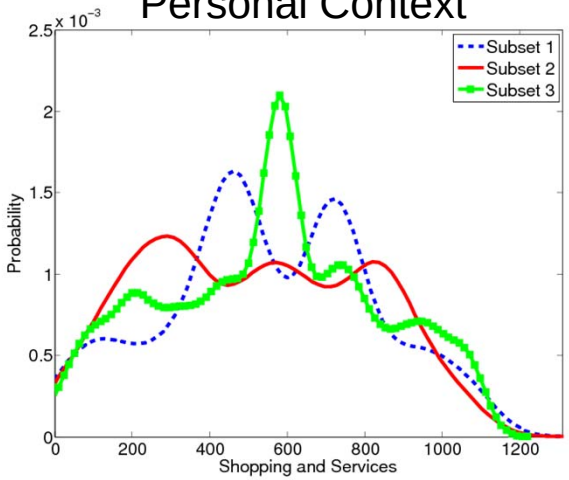
Temporal Context



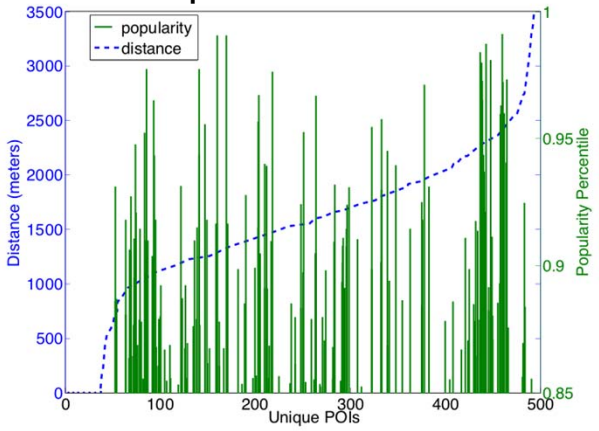
Weather Context



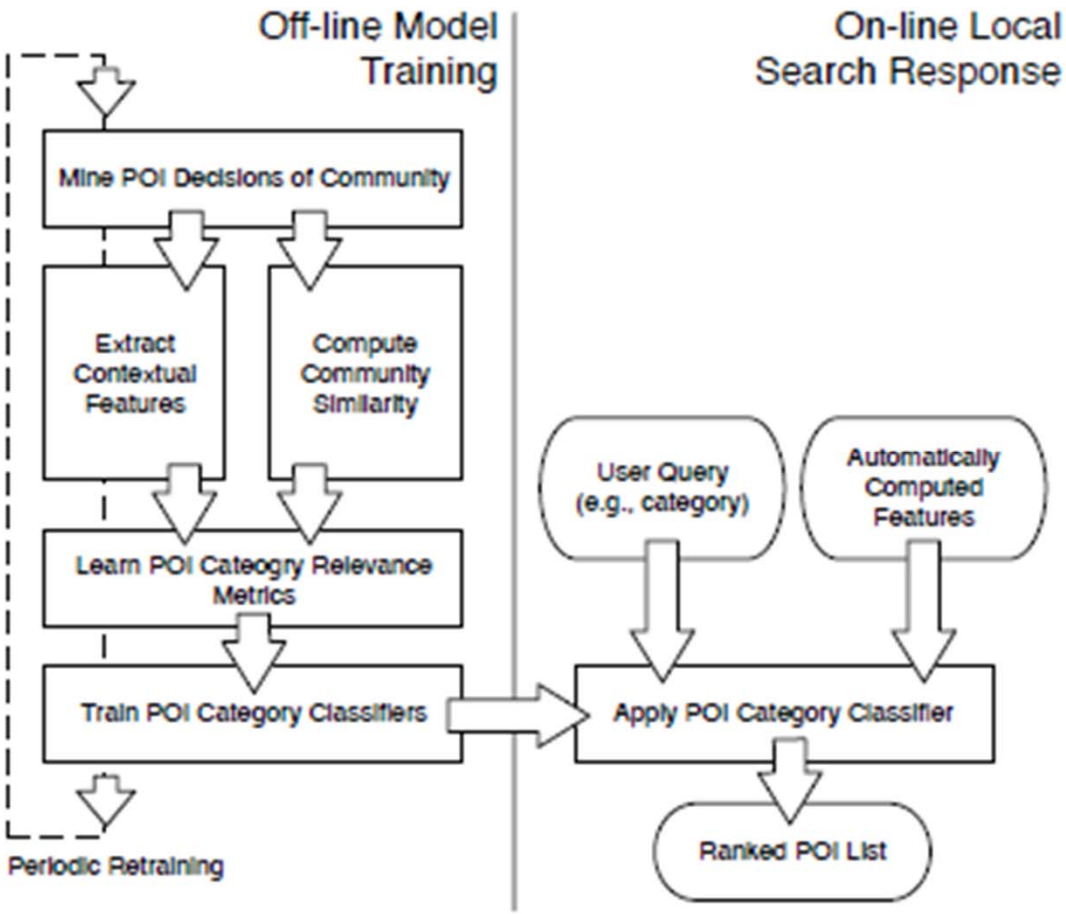
Personal Context



Spatial Context



Implementation

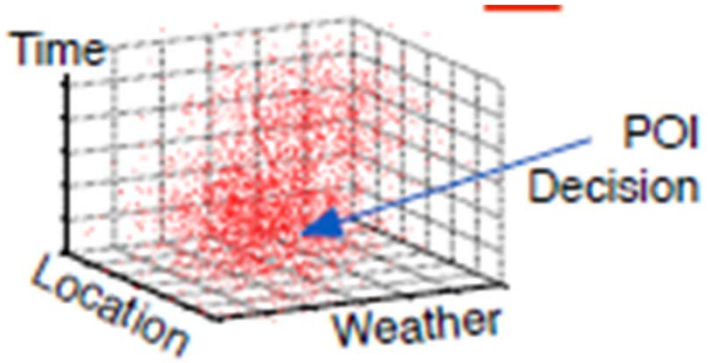


Mining Community POI Decisions

- **POI Decision**
  - **Interest in POI – clicking on one.**
  - **Could be mined from user actions through sensors.**
- **Information required by framework**
  - **Sensor data (location, time, etc.)**
  - **Ground truth POI decision**
  - **Session identifier**

Extract Contextual Features

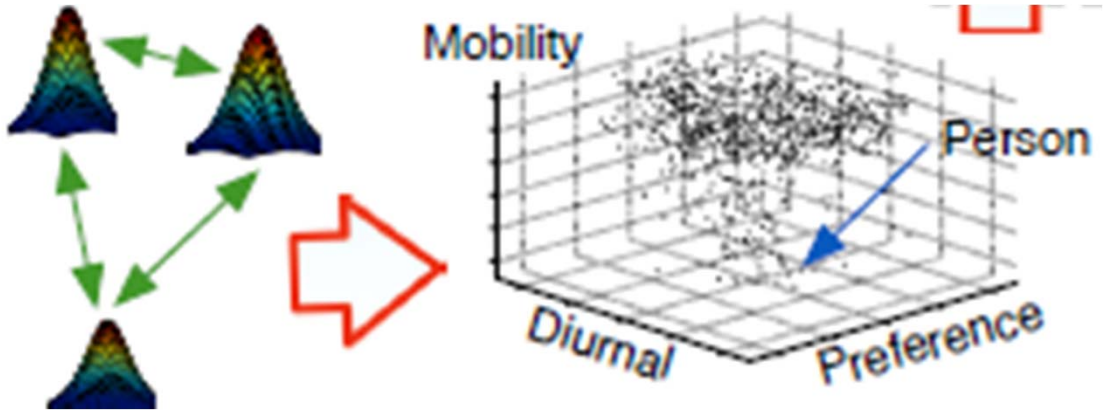
- **Features are extracted from mined POI decisions to construct a Context-Feature Space.**



- **Allows the model to learn contextual patterns.**

Compute Community Similarity

- **A community similarity metric is computed between all users**
- **Similarity Feature Space**



Basis for Similarity Features

- Time of query and day of the week
- Source location of query
- POI Category
- Specific POI

Similarity Metric

- **Computed using FINE**
  - **Fisher Information Non-parametric Embedding**
- **Allows for easier clustering analysis of common POI preferences.**
- **Data points obtained become additional features of POI decisions.**

Learn POI Category Relevance Metrics

- **The Learning Problem**
  - **To correctly label an unknown data point based on its features and examples provided by the community.**
  - **Transform feature space to cluster POI decisions.**
  - **Large Margin Nearest Neighbor (LMNN)**
    - **A distance metric learner**
    - **Maximizes k-nearest neighbor classification performance**

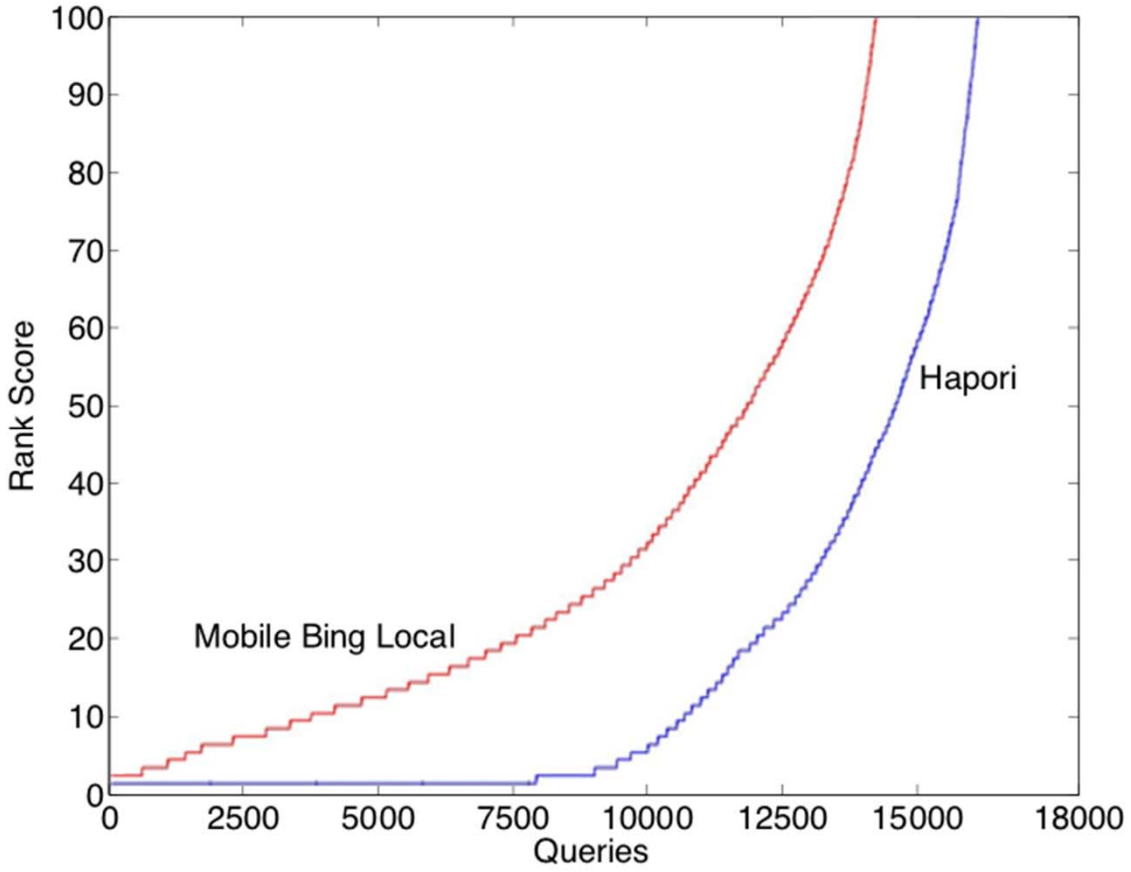
Evaluation

- Evaluated using real search query streams from Mobile Bing Local.
- Quantify relevance of results and Compare results to Mobile Bing Local.
- Quantify the impact of individual context and behavioral parameters.

Experimental Methodology

- Collection of local search logs over a period of 6 months
- Data containing
  - 4000 unique POIs
  - 80000 queries by 11,000 users
- Data collected in the Seattle, WA area

Overall Rank Score Comparison



Rank Score Comparison

	Rank Score	
	Hapori	Mobile Bing Local
Tourist Activities	2.6	4.3
Indian Restaurants	3.5	9.2
Mens Apparel	7.8	13.2

Table 1. Rank Score comparison using narrow POI categories

	Rank Score	
	Hapori	Mobile Bing Local
Recreational Activities	8.5	20.3
Restaurants and General Food	6.1	31.2
Shopping and Services	9.3	17.9

Table 2. Rank Score comparison using broad POI categories

Related Work

- Desktop web search
  - Prior user interactions
  - Community based search
- Recommendation Services
  - Netflix, Amazon, etc.
  - MovieLens Unplugged
- Context Aware Mobile Applications
  - CyberGuide

Questions