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

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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

Worcester Polytechnic Institute
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

The graph compares the rank score over queries for two different systems: Hapori (blue line) and Mobile Bing Local (red line). The y-axis represents the rank score, ranging from 0 to 100, while the x-axis represents the number of queries, ranging from 0 to 18,000.
# Rank Score Comparison

<table>
<thead>
<tr>
<th>POI Category</th>
<th>Haporit Score</th>
<th>Mobile Score</th>
<th>Bing Local Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourist Activities</td>
<td>2.6</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>Indian Restaurants</td>
<td>3.5</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>Mens Apparel</td>
<td>7.8</td>
<td>13.2</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Rank Score comparison using narrow POI categories

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<tbody>
<tr>
<td>Recreational Activities</td>
<td>8.5</td>
<td>20.3</td>
<td></td>
</tr>
<tr>
<td>Restaurants and General Food</td>
<td>6.1</td>
<td>31.2</td>
<td></td>
</tr>
<tr>
<td>Shopping and Services</td>
<td>9.3</td>
<td>17.9</td>
<td></td>
</tr>
</tbody>
</table>

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