Constructing Travel Itineraries from Tagged Geo-Temporal Breadcrumbs

Munmun De Choudhury  Moran Feldman  Sihem Amer-Yahia  Nadav Golbandi  Ronny Lempel  Cong Yu
Email: munm@asu.edu, moranfe@cs.technion.ac.il, {sihem, nadavg, rlempel, congyu}@yahoo-inc.com

Motivation

- Itinerary planning – where to go first, how much time to spend and how much time to account for, for transiting to the next place?
- How to help users by automatically suggesting travel itineraries based on community-contributed knowledge (or media, such as photos?)

Current State-of-the-art & Problems

- Manually compiled guides / friends provides just one
- Manual trip planning is time consuming and laborious.
- Undirected POI graph,
- Transit times
- Let
- Visit times
- How to help users by automatically suggesting travel POIs
- Translating times
- Let
- Average Error Fraction, show promising results against itineraries from bus tour companies.

Problem Statement

Given a user \( u \), city \( C \) and a time constraint budget \( B \), suggest alternative travel itineraries \( \{ I_1(C), I_2(C), \ldots \} \) that cover the popular points of interest \( \{ \ell_1, \ell_2, \ldots, \ell_k \} \subset C \) such that the total visit time \( \sum \alpha(\ell_i) \) and transit time \( \sum \beta(\ell_i, \ell_j) \) of each itinerary \( I_m(C) \) is \( \leq B \).

Experimental Evaluation

<table>
<thead>
<tr>
<th>City</th>
<th>#POIs</th>
<th>#Timed Paths</th>
<th>Sample POIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barcelona</td>
<td>74</td>
<td>6,087</td>
<td>Museu Picasso, Plaza Reial</td>
</tr>
<tr>
<td>London</td>
<td>163</td>
<td>19,052</td>
<td>Buckingham Palace</td>
</tr>
<tr>
<td>NYC</td>
<td>100</td>
<td>3,991</td>
<td>Brooklyn Bridge, Ellis Island</td>
</tr>
<tr>
<td>Paris</td>
<td>114</td>
<td>10,651</td>
<td>Musee du Louvre</td>
</tr>
<tr>
<td>San Fran.</td>
<td>80</td>
<td>12,308</td>
<td>Aquarium of the Bay</td>
</tr>
</tbody>
</table>

Summary

- Extensive user studies conducted on ~450 Amazon Mechanical Turk Workers. Itineraries on give major cities – Barcelona, London, NYC, Paris and San Francisco.
- Evaluation using metrics: (a) Mean Response Volume, (b) Mean Average Response and (c) Mean Average Error Fraction, show promising results against itineraries from bus tour companies.

Constructing Timed Paths

Constructing Itineraries

- Undirected POI graph, \( G_C(V=L_C, E=L_C \times L_C) \) with the following predicates:
  - \( T(\ell \in E_L) \), the visit time at each POI \( \ell \).
  - \( T(\ell \in E) \), the median transit time between two POIs.
  - \( V(\ell \in L_C) \), the prize or value that an itinerary gets from visiting each POI \( \ell \) in \( L_C \).

An itinerary is a path in graph \( G_C \), where a node (POI) in the path may be visited more than once.

Problem Instance:

- Let \( I \) be an itinerary; its prize \( V(I) \) is the sum of prizes of the unique POIs along the path.
- The time \( T(I) \) is the sum of visit times to the unique POIs, plus the transit times along all edges.

Objective (solution using Orienteering Problem Approximation):

Find an itinerary in \( G_C \) from \( s \) to \( t \) of cost (=time) at most \( B \) maximizing total node prizes.

Independent evaluation

<table>
<thead>
<tr>
<th>City</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
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</thead>
<tbody>
<tr>
<td>London</td>
<td>3.1</td>
<td>2.9</td>
<td>2.7</td>
<td>2.8</td>
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<tr>
<td>It. 1</td>
<td>3.5</td>
<td>2.1</td>
<td>2.7</td>
<td>2.1</td>
</tr>
<tr>
<td>It. 2</td>
<td>3.4</td>
<td>2.5</td>
<td>2.8</td>
<td>2.7</td>
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<tr>
<td>It. 3</td>
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<td>3.1</td>
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<tr>
<td>GT</td>
<td>3.4</td>
<td>2.6</td>
<td>2.6</td>
<td>2.6</td>
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