Making Sense of the World, One Photo at a Time

TEN MILLION

Mor Naaman
Yahoo! Research Berkeley
Attraction Map of Paris

Stanley Milgram, 1976.
Psychological Maps of Paris
Attraction Map of Paris

Talk Outline

• Mining information from geo-tagged photos
  - Location-driven
  - Tag-driven

• Applications
  - World Explorer
  - ZoneTag
This Talk is Not About Photos

- Geo-referenced data
  - Photos
  - Blog posts (GeoRSS)
  - Geo-annotated Web pages
  - KML-based collections
- Similar issues, similar potential
Information Overload?

Flickr “geotagged”

Mor Naaman - YIRB
http://www.yahooresearchberkeley.com/
Data Description

May 28, 2006, 2:13pm. Barry Bonds breaks the Babe’s home career four bagger, taken from club level 310, row J, seat 10.

Tags
- Barry
- Bonds
- Barry Bonds
- 715
- homerun

Taken in San Francisco, California

37°46'42" N, 122°23'24" W
What can we derive?

- Location-driven model
- Tag-driven model

Dataset:

(\text{photo\_id, user\_id, time, latitude, longitude})

(\text{photo\_id, tag})
Issues to Tackle

- Noisy data
- Photographer biases
  - In locations
  - In Tags
- Wrong data

Whatever, color, city, spectrum, santa barbara, california, usa, Lookatme, Herbert Bayer Chromatic Gate
Location-driven Modeling

- Derive meaningful data about map regions
- E.g., representative tags, photos
Intuition

More “activity” in a certain location indicates importance of that location

Tag that are unique to a certain location can represent the location better
Translation into simple algorithm

- Clustering of photos
- Scoring of tags
  - TF / IDF / UF
More details...

- Multiple levels L1, ... L16
- Arbitrary non-overlapping regions R
More details...

- For each region $R$, level $L$:
  - Clustering: k-Means, get set of k clusters
  - “Document” $C$ is bag of all tags in cluster
  - Scores computed for each tag:
    - $TF_t = |P(C,t)|$
    - $IDF_t = |P(R)| / |P(R, t)|$
For example:

TF(Car) = 1
IDF(Car) = 5/2

TF(Bridge) = 2
IDF(Bridge) = 5/2
Tag Maps - Paris
Tag Maps - SF
Tag Maps - Know this place?

Map
Hybrid
Satellite

University Avenue
Palo Alto
Professorville

Stanford
Mayfield

SLAC
dish
PARC

Baylands
Mayfield Slough
Charleston Slough

shoreline
goole
Summary of San Francisco

- Golden Gate Bridge
- TransAmerica
- AT&T Baseball Park
- Golden Gate
- Twin Peaks
- Golden Gate
- Ocean Beach
- Bay Bridge
- Chinatown
Talk Outline

• Mining information from geo-tagged photos
  - Location-driven
  - Tag-driven

• Applications
  - World Explorer
  - ZoneTag
Tag-based Modeling

• Derive meaningful data about individual tags
• Based on the tag’s metadata patterns
• E.g., Yahoo! Research Berkeley, VLDB2006.
Tag Maps - Paris - Les Blogs?

![Map of Paris with landmarks labeled as 'lesblogs', 'Arc de Triomphe', 'Opera', 'Eiffel', 'Grand Palais', 'LOUVI Pompidou', 'Notre Dame', 'BASTILLE', 'Seine', 'Rue Mouffetard', 'Montmartre', 'Gare du Nord']

Mor Naaman - YIRB
http://www.yahooresearchberkeley.com/
Tag Semantics: Why?

• Improved image search through query semantics
• Automatic place- and event- gazetteers
• Association of missing time/place data based on tags
• ...
Tag patterns
Tag patterns
Tag Patterns - San Francisco
Tag Patterns - San Francisco

[Map of San Francisco with various locations marked]

http://www.yahooresearchberkeley.com/
Definitions

- Event tag: expected to exhibit significant time-based patterns
- Location tag: expected to exhibit significant place-based patterns
Problem...

Can we extract event/place semantics from unstructured tags given their usage distribution – (time and location patterns)?
Fundamental issues...

• “Regions” of semantic relevance
  - “church” in a neighborhood is a place
  - “carnival” in Rio de Janeiro is an event
  - “California” in SF is not a place

• Semantic ambiguity
  - “apple”
  - “turkey”
  - “pride”
Proposed Solutions

• Naïve Scan
  - Burst detection

• Spatial Scan Statistics
  - Borrowed from disease outbreak detection

• Scale-structure method
  - Examine the “structure” of the tag’s patterns in multiple scales
Talk Outline

- Mining information from geo-tagged photos
  - Location-driven
  - Tag-driven
- Applications
  - World Explorer
  - ZoneTag
Next Few Minutes

• Intuition behind the three methods
• Experiment
• Summary of tag-based modeling
Naïve Scan
Spatial Scan
Issues

• First two methods just look for a local burst in usage (in either time or space)
Scale-structure Identification

- Select a scale
  - Find the structure of the data for the scale
  - Calculate the entropy of the structure
- Increase scale, repeat
- Is the information “well organized”?
Scale-structure Identification
Scale-structure Identification

Entropy = 1.421621

Entropy = 0.766263

Entropy = 0.555915

Entropy = 0.062760
San Francisco Dataset:
42,000 Photos
800+ popular tags
Ground Truth: BYOBW?
Experiments

• Given a ground truth:
  – Run the three methods, vary thresholds
  – Precision vs. recall
The obligatory slide where I show you that our curve is above the others
## Experiments

<table>
<thead>
<tr>
<th></th>
<th>P-R area</th>
<th>Max F1</th>
<th>Min CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naïve Scan</td>
<td>0.4455</td>
<td>0.5279</td>
<td>0.2914</td>
</tr>
<tr>
<td>Spatial Scan</td>
<td>0.6028</td>
<td>0.5907</td>
<td>0.2441</td>
</tr>
<tr>
<td>Scale-structure</td>
<td>0.7034</td>
<td>0.6655</td>
<td>0.1930</td>
</tr>
<tr>
<td>Naïve Scan</td>
<td>0.3291</td>
<td>0.3636</td>
<td>0.1009</td>
</tr>
<tr>
<td>Spatial Scan</td>
<td>0.4130</td>
<td>0.4811</td>
<td>0.1034</td>
</tr>
<tr>
<td>Scale-structure</td>
<td>0.6420</td>
<td>0.6533</td>
<td>0.0648</td>
</tr>
</tbody>
</table>
Future Work

• Multiple regions
• Different spatially and temporally encoded data (e.g., blogs)
• Other metadata domains besides time and space
  - Visual features: shape primitives, color
  - Semantic features
Talk Outline

• Mining information from geo-tagged photos
  - Location-driven
  - Tag-driven

• Applications
  - World Explorer
  - ZoneTag
Social Media Cycle

Community

How?

User

Why?

Encourage, enable

Support, motivate

What?

Analyze, extract patterns
Another Look at the Tag Map
Make it into World Explorer

http://tagmaps.research.yahoo.com
ZoneTag(?)

“Everything in the world exists to end up in a photograph” -- Susan Sontag

How would we:
Create/store?
Find?
Share?
Discover?
Current mobile experience?
ZoneTag Experience

- 2-click upload (same key!)
- Photo uploaded with location and time metadata
ZoneTag Experience

- Tagging made easy
  - Tag/annotate your photos from the phone
Where do locations come from?

- Bluetooth GPS (when available)
- User-contributed cell tower mapping
Where do tags come from?

• Tags I used in this context (‘home’)
• Tags my friends used in this context (‘Research Meeting’)
• Tags other people used in this context (‘Stanford’, ‘Gates Building’, ‘InfoSeminar’)
  – E.g., TagMaps data
Where do tags come from?

- **Stuff around you:**
  - Yahoo! Local
  - Upcoming.org (`Mor Naaman @ InfoSeminar’, `Stanford University’)

- **Stuff from you (any RSS 2.0 feed):**
  - Calendar (G, Upcoming.org,... )
  - Favorite hangouts (Wayfaring, Plazes, Socialight)
“When I went to upload, there were already all these exotic tags like "Bill Graham Civic Auditorium" and "Bob Dylan live" available...it sure was convenient to just select and go...”
Where do tags go?

• Back to the original RSS items
  – Upcoming.org

• Action Tags
  – Trigger a call to a web service
    • With parameters
  – Command line - from your phone

Rotate:right  Email:dad  Group:zonetag  Scanr:document
I’m Too Lazy (you’re not alone)

- Tagging is the means, not the goal
- Benefits even if you never tagged a single image

(Bradley Horowitz, elatable.com)
Conclusions

• Geo-referenced data now abundant
• Many unstructured collections
• Knowledge can be extracted...
• ... and used in real-life applications
Final Notes: APIs For All

- Everything we can do, you can do (better). Use our APIs:
  - Cell ID translation
  - Suggested Tags
  - TagMaps data
  - TagMaps Widget
  - Extend ZoneTag with RSS feeds, ActionTags
  - …

- Email me
Thanks

With: Shane Ahern, Simon King, Rahul Nair, Nathan Good, Marc Davis, Alex Jaffe, Tamir Tassa, Tye Rattenbury

Read more, follow:
http://www.yahooresearchberkeley.com
Slides: http://slideshare.net/mor