Flickr Tag Recommendation based on Collective Knowledge

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Introduction

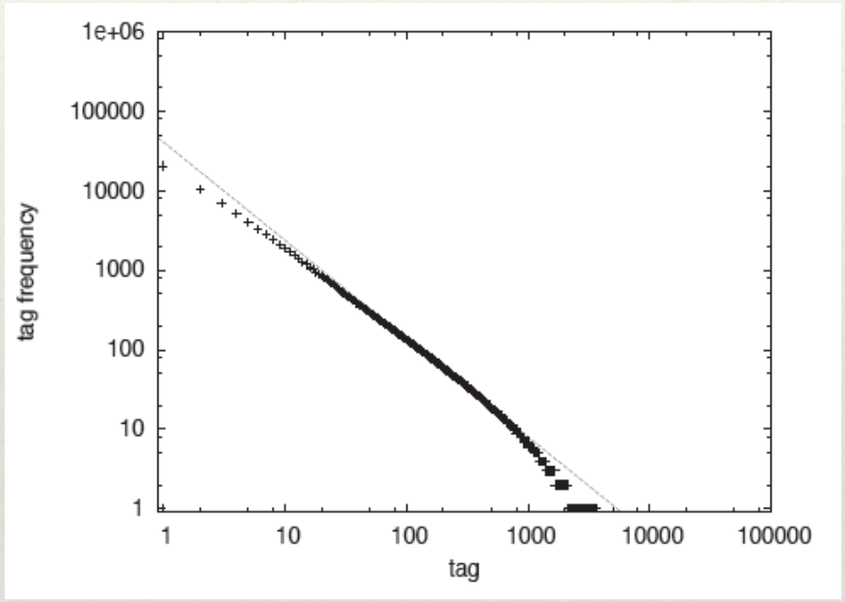
- Tagging
  - Adding keywords(tags) to objects

- Tags
  - Meaningful descriptions of the objects
  - Can help to organize and Index contents
  - Useful with multimedia objects that provide little or no textual context, such as bookmarks, photos and videos

- Tags on social media
  - Users can provide semantic context tags through manual annotations
  - User can tag their photos to make them can be accessible to searching

Tagging Behavior

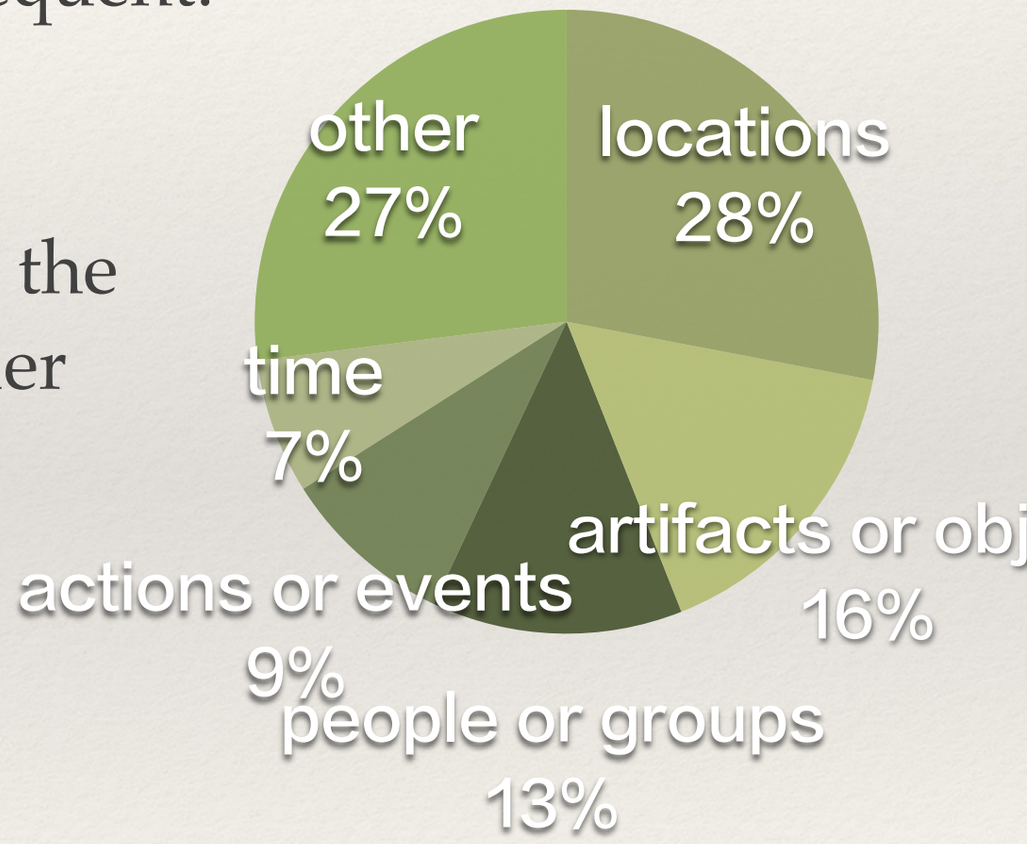
- Tag Frequency
    - The distribution of tag frequency can be modeled by a power law [19, 1]



    - The head of the power law contains tags that would be too generic to be useful as a tag suggestion
    - The tail of the power law may contains some highly specific tags that will only e useful recommendation in exceptional cases

Tagging Behavior

- Based on the tags information over the WordNet categories, the locations are tagged most frequent.



- Users do not only tag the visual contents of the photo, but to a large extent provide a broader context
    - location
    - time
    - actions in photos

Tag Recommendation System

- Tag co-occurrence
  - The co-occurrence between two tags is the number of photos where both tags are used in the same annotation
  - Find candidate tags based on user-defined tags by calculating co-occurrence coefficients between of two tags
- Normalization methods
    - Symmetric measures
    - Asymmetric measures

Symmetric Measures

- Jaccard's coefficient: statistics used for computing and normalizing the similarity and diversity of tags

$$J(t_i, t_j) := \frac{|t_i \cap t_j|}{|t_i \cup t_j|}$$

- Use the number of intersections between the two tags, divided by the union of two tags
- Good at identifying equivalent tags
- Example:
    - Eiffel tower: Tour Eiffel, Eiffel, Seine, La tour Eiffel, Paris

Asymmetric Measures

- Alternatively, tag co-occurrence can be normalized using the frequency of one of the tags

$$P(t_j \mid t_i) := \frac{|t_i \cap t_j|}{|t_i|}$$

- Take the number of intersections between two tags and then normalized by the total frequency of one tag
- Good at providing more diverse candidates than symmetric measures
- Example:
    - Eiffel Tower: Paris, France, Tour Eiffel, Eiffel, Europe

Tag Aggregation and Promotion

- Definitions
  - User-defined tags **(U)** - the set of tags that user assigned to a photo
  - Candidate tags (C_u) - the ranked list with the top m most co-occuring tags
  - Union of Candidate tags (C) - the union of all candidate tags for each user-defined tags u in U
  - Recommended tag (R) - the ranked list of n most relevant tags produced by the tag recommendation systems

Tag Aggregation: Vote

- The voting strategy computes a score for each candidate tag c in C, where a vote for c is a cast, whenever c in C_u

$$vote(u,c) = 1 \quad if \;\; c \in C_u$$

- The list of recommended tags R is obtained by sorting the candidate tags on the number of votes

$$score(c) := \sum_{u \in U} vote(u,c)$$

Tag Aggregation: Sum

- Take the union of all candidate tag lists (C), and sums over the co-occurrence values of the tags

$$score(c) := \sum_{u \in U} P(c \mid u) \quad if \;\; c \in C_u$$

- $P(c \mid u)$ - calculate the asymmetric co-occurrence value

Tag Promotion

- Stability-promotion

$$stability(u) := \frac{k_s}{k_s + |k_s - \log(|u|)|}$$

  - To make user-defined tags with lower frequency (tags in the tail of the power law distribution) less reliable

- Descriptiveness-promotion

$$descriptive(c) := \frac{k_d}{k_d + |k_d - \log(|c|)|}$$

  - To avoid general tags (tags in the head of the power law distribution)with few information tanked too highly

- Rank-promotion

$$rank(u,c) := \frac{k_r}{k_r + (r-1)}$$

  - To count for the position r of the candidate tags c in C_u for a given user-defined tag c

Tag Promotion

- Combined promotion function

$$promotion(u,c) = rank(u,c) + stability(u) + descriptive(c)$$

  - Can be applied on a tag pair (u, c) in combination with either voting or summing aggregation function

- For voting case: $score(c) := \sum_{u \in U} vote(u,c) \cdot promotion(u,c)$
- For summing case: $score(c) := \sum_{u \in U} P(c \mid u) \quad if \ \ c \in C_u \cdot promotion(u,c)$

Tag Aggregation and Promotion System Overview

User-defined Tags

Segrada Familia Barcelona

Candidate Tags

Sagrada Familia:

Barcelona, Gaudi, Spain
architecture, Catalunya church

Barcelona:

Spain, Gaudi, 2006
Catalunya, Europe, travel

Recommended Tags

Gaudi, Spain, Catalunya, architecture, church