Flarty: recommending art routes using check-ins latent topics

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ABSTRACT
In this demo we present Flarty, a mobile location-based social network for the dynamic construction and recommendation of art routes in the city of Florence, Italy, via item based similarity algorithms, places topic extraction and user interest modeling. To achieve this goal Flarty derives knowledge from users check-ins and combines clustering techniques and recommendation algorithms, as well as features such as geo-location, to define groups of similar artworks or POIs (Points Of Interest) and to compute the most efficient routes likely to meet user’s interests. Model analysis takes into account ratings, topics extracted from textual features associated with the POIs, and users preferences computed exploiting collaborative filtering techniques on their past behavior.

Categories and Subject Descriptors
H.3.5 [Information Storage and Retrieval]: Online Information Services; H.3.3 [Information Storage and Retrieval]: Information Search and Retrieval—Clustering, retrieval model

Keywords
Mobile, topic modeling, recommendation systems, location-based services

1. INTRODUCTION
With the widespread diffusion of location sharing sites like Foursquare, Gowalla and Facebook Places in the last years and the millions of geo-located user generated check-ins, computer applications have become capable of a deep understanding of the geospatial behaviors of people and the social dynamics of our cities. In the research in the field of human mobility there have been a lot of studies on friendship/location prediction and places classification through social activity streams [2]. Joseph et al. [5] group people through geo-location and location awareness systems categorizing and extracting features of the places where people go. Cheng et al. [3] show how the analysis of temporal, spatial and textual aspects of footprints in location share services can give a better understanding of how people interact with these services. So this huge amount of collective knowledge can be usefully used for better understanding the correlation between users and locations and for the implementation of mobile location-based services exploiting traditional macro patterns of recommendation systems. Horozov et al. [4] have demonstrated that recommendations in mobile environments perform better if used in combination with “convenience” metrics, like geo-location, which improves the effectiveness of the recommendations systems themselves. In this demo we present Flarty, a prototype of a mobile social network that combines user behavior analysis and clustering techniques in a location aware system in order to improve recommendation services for cultural heritage in the city of Florence. However, the system is configurable and the dataset of POIs can be easily replaced to work with POIs of other cities or regions. In particular we take into account three factors: 1) users check-ins and check-ins rates, 2) representative topics of POIs and users, and 3) geo-location.

2. THE SYSTEM
The mobile application has been developed in Java using the Android SDK. The backend is composed by three modules: a set of PHP scripts to store and retrieve data from a MySQL database and two modules respectively for the execution of clustering and recommendations algorithms. The algorithms use a map/reduce paradigm, implemented in the Apache Mahout library, and run on an Hadoop cluster. The application can be accessed through his own login system or through Facebook APIs and authentication services. Geo-location is obtained through Google APIs.

Flarty allows the user to check-in and vote the several points of interest which are part of a route. This information is used by the system to profile users, in order to suggest personalized paths and users with similar interests. Each user is described mainly by two vectors: a vector of topics extracted by the places he checked-in and a vector of the ratings expressed on these check-ins. To deal with the so called “cold start scenario” issue the system provides some initial
gamification techniques to have a first user model: at the very first access the user is asked to give a rating from 1 to 5 on some representative POIs. Flarty proposes to users two types of art routes: 1) custom: calculated weighting results of recommendation algorithms and clustering techniques according to user interests, and 2) classic: predefined routes of POI “must see”. The custom routes are created starting from the results returned by the Recommender module that are further elaborated and filtered by the results of the Clustering module. The user’s affinity with the set of POIs suggested by the Recommender is refined comparing their representative topics with the topics extracted from users’ check-ins. Furthermore each topic is represented by a vector of “tags” on whose best occurrences match is based the selection of the main shared topics. Both types of routes are filtered and ordered automatically by the system considering geo-location: Flarty suggests routes only partially contained within a given radius from the user. The application provides three different routes visualization paradigms: a list view, a map view and an augmented reality view. The POIs that are part of the routes can be filtered and customized manually through addition/deletion/reordering. Several filtering criteria can be applied (e.g. distance and average vote) to allow the user to optimize the routes on the basis of their preferences. Every time the user selects a route he is continuously localized through GPS and guided by the application in the visit.

Flarty is also a social network. Users can interact with each other and share their activities and preferences on their profile or on Facebook. Flarty uses social and gamification techniques (such as badges and rewards) with the aim of increasing the use of the system itself and the amount of check-ins. This improves user profiles and consequently the refinement of recommendations and automatic routes creation.

Recommender module.
The Recommender module uses a standard collaborative filtering item-based algorithm, implemented in Apache Mahout, to find sets of recommended POIs for each user based on their initial profile. The initial profile is built considering the results of an interactive poll in the “cold start scenario” when users are given a set of POIs to vote. The algorithm runs as a distributed recommendation process on Hadoop. With this item-based collaborative filtering approach the module evaluates how users interact with items (in this case localized POIs) and from this information tries to understand which items are more similar. Flarty gets this information by explicit indicators, e.g. ratings expressed with number of stars. Considering the past preferences of the user, the system then attempts to predict the future in a “content agnostic” way not using items properties, strategy that Flarty adopts in the Clustering Module to refine Recommender results. It is well known that item-based recommendation systems perform better when the number of items is significantly lower than the number of users. Furthermore, in this kind of scenario, we have to consider that the POIs are going to change far less frequently than the users. The algorithm uses a co-occurrence matrix for computing POIs similarity feeding a log-likelihood similarity function which evaluates the likelihood of a set of parameter values given some observed outcomes (e.g. user ratings).

Clustering module.
Flarty identifies the “candidates” POIs to be used for routes construction filtering recommendations extracted for each user by the Recommender module. To do this it considers the affinity of topics of the recommended POIs with the most significant topics of the places he checked-in. Topics are used to group similar POIs in the repository. Each POI is represented in the model by its own Wikipedia page. The algorithm used for grouping is CVB, Collapsed Variational Bayesian inference algorithm for LDA (Latent Dirichlet allocation), a topic model first introduced in [1], implemented in a map/reduce paradigm to run on a cluster. The algorithm returns data containing the distribution between POIs and topics and between topics and words or “tags”; in this way it is possible to extract the following information: 1) which POIs are related to topics; 2) which are the “tags” that characterize the topics.

3. CONCLUSIONS
Flarty is a scalable mobile application for recommending custom routes of POIs to users on the basis of their interest profile. Flarty enables users to follow the routes in realtime and to complete the individual steps through check-ins. The user profile is inferred from check-ins combining classic recommendations algorithms and clustering techniques. Flarty utilizes state-of-the-art libraries for recommendations and clustering and implements scalable algorithms runnable in a distributed system in order to improve the overall quality of recommendations. Future work will include: 1) the realization of a prototype providing automatic check-ins through the use of sensor networks, 2) routes optimization by integrating city public web services and open-data regarding traffic, public transport and opening/closing museums timetables, 3) computer vision systems for artworks recognition in the augmented reality view.

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5. REFERENCES