App Mining: Finding the Real Value of Mobile Applications

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ABSTRACT

In this poster, we present a new model for estimating the actual value of mobile applications (Apps) to the users. The model assumes that users are implicitly evaluating the value of the apps in their smart phones when they choose to uninstall some apps. Our proposed method thus makes use of the install and uninstall log in a mobile app store to estimate the value of the apps. Experiments using data from a popular mobile app store show that our model is better in predicting the future download trend of the apps as well as the future uninstallation rate of the apps. We believe such model will be very useful in generating more credible and appropriate mobile app recommendations to users, or in generating features for machine learning systems in more complex prediction tasks.

Categories and Subject Descriptors

H.3.3 [**Information Storage and Retrieval**]: Information Search and Retrieval

General Terms

Algorithms, User Model

Keywords

Mobile apps, app recommendation, ranking, mobile

1. INTRODUCTION

The popularity of smart phones and mobile applications (Apps) has been rising rapidly in recent years. As a result, App markets (mobile Apps where smart phone users download mobile Apps) have become an important channel for App developers to advertise and promote their Apps. While users are keen to discover new and useful Apps, existing App recommendations are often not able to take credibility and user satisfaction into consideration. In addition, recommendations based on popularity or user feedback may not be robust enough against abuse actions, as many developers and companies are keen to promote their Apps by all means in order to make more profit.

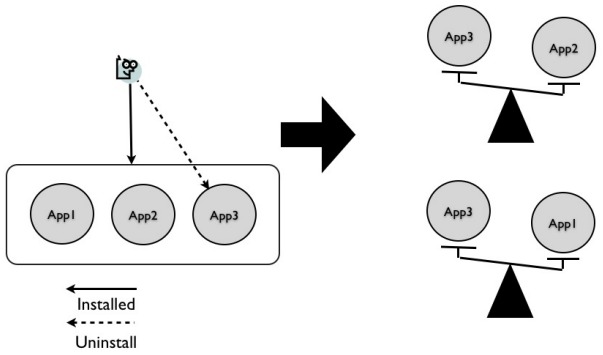

Figure 1: Illustration of our assumption that when a user uninstalls an App, its value is being considered to be lower than other Apps in the smart phone.

While existing research on recommender systems usually assumes that a user is interested in an item when he/she takes an action to obtain the item, this is not always true, especially in the context of App recommendation. We argue that choosing to download a mobile App is only a *weak indicator* of whether the user likes that App or the user thinks that the App is useful. In order to identify the *actual value* of mobile Apps, we need better methods. By actual value, we refer to the judgment of an App that relates to the assessment of its satisfaction and attractiveness after a user downloads and uses the mobile App [3].

We propose to estimate the actual value of a mobile App by using the uninstallation actions of the users. We believe uninstallation strongly indicates that a user no long finds the App useful. We assume that when a user chooses to uninstall an App, he either consciously or unconsciously compares this App with all the other Apps in the smart phone, and judges that this App is *less valuable* than the other Apps. Figure 1 illustrates this idea graphically.

The work described in this paper can be broadly classified into mobile App ranking and mobile App recommendation. The study of recommender systems [1] has been an active research area. Some recent methods to recommend mobile Apps include considering the interests of the friends in the users' social network, or recommending Apps based on con-

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textual information such as the location of the user and the point-of-interests in the vicinity Woerndl *et al.* [2]. In addition, Yin *et al.* [3] present the concepts of *satisfactory value* and *tempting value*, and propose that the process of a user adopting an app involves a contest between the owned Apps' satisfactory value and the candidate App's tempting value.

Compared to the related works, we take a step back and consider some fundamental problems in mobile App recommendation. App recommendation is basically a problem of ranking. It is important that this ranking puts Apps that are useful to the user. Thus, we are interested in measuring the *actual value* of a mobile App, which can be used as one of the important criteria in generating recommendations.

2. ACTUAL VALUE MODEL

We consider that the *actual value* of an App depends not only on its popularity as defined by the number of downloads, but also depends on how likely the App will be kept in the users' smart phone, and on the behavior of these users. This concept is very similar to the concept of mutual reinforcement in the HITS algorithm, where the authority and hub of the nodes in a network are mutually dependent on each other.

Formally, let $\mathbf{a} = \{a_1, a_2, ..., a_m\}$ be the actual value scores of a total of M mobile Apps, and $\mathbf{u} = \{u_1, u_2, ..., u_n\}$ represent the expertise score of N users. We consider install and uninstall actions within a certain period of time $[t_0, t_1]$. Let $F(u)$ be the set of Apps installed by user u before this period, and $G(u)$ be the set of Apps uninstalled by user u in this period.

Firstly, users' expertise scores are updated by: $u_i = \sum_{a \in F(u_i)} a$. Next, we update each App's actual value score by using the following equation:

$$a_i \leftarrow \sum_{u_j \in T(a_i)} \sum_{a_k \in G(u_j)} a_k \times \frac{u_i}{|G(u_j)|}$$

where $T(a_i)$ denotes the set of user who keeps App a_i in their smart phones in the period $[t_0, t_1]$.

This equation means that, when an App gets uninstalled by a user, its actual value score is distributed to other Apps that are still kept in the device. At the end of one iteration, the actual value scores of the Apps are normalized. Algorithm 1 presents the pseudo-code of our proposed algorithm.

3. EXPERIMENTS

In order to evaluate our proposed method, we used data collected from HiCloud.[1], a popular mobile App store in China. Our data set contains about 460,000 users and 62,000 Apps. As a proxy to the actual value of the Apps, we try to use our model to predict the Apps' future download trend. 'Download trend' refers to the change in the number of downloads over a period of time. We first come up with a ranking of the Apps using the actual value scores returned by our algorithm run on data of one week. Apps with a higher actual value scores will be given higher ranks. We then check how well this ranking predicts the relative number of downloads of these Apps in the future, using NDCG (normalized discounted cumulative gain) as a performance measure. Our preliminary results show that our method produces ranking that is more correlated to the ground truth, when compared with some baseline methods such as ranking by the number of downloads or the number of times the Apps get uninstalled.

[1] `http://app.vmall.com/`

Data: Install and Uninstall Log
Result: User score vector **u**, App score vector **a**
for $a_i \in \mathbf{a}$ **do**
  $a_i = 1$
end
while *iteration I* **do**
  for $u_i \in \mathbf{u}$ **do**
    for $a_k \in F(u_i)$ **do**
      $u_i += a_k$
    end
  end
  $\widehat{a} = \mathbf{a}$
  for $u_i \in \mathbf{u}$ **do**
    for $a_j \in G(u_i)$ **do**
      for $a_k \in F(u_i)$ **do**
        $\widehat{a_k} += \frac{u_i}{|G(u_i)|} * a_j$
      end
    end
  end
  for $a'_i \in \widehat{a}$ **do**
    $a_i = \frac{a'_i - min(\widehat{a})}{max(\widehat{a}) - min(\widehat{a})}$
  end
end
Return u and **a**

Algorithm 1: App Actual Value Algorithm

4. CONCLUSIONS

In this paper, we have presented a novel actual value model to estimate the actual value of mobile Apps, based on mobile users uninstallation records in a certain period of time. Unlike other approaches that mainly focus on users' download history, comments or ratings, the model focuses on estimating the actual value of Apps and on whether they bring true satisfaction to users.

5. REFERENCES

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