# A Method of Extracting the Generalized User Inclination for Service Integration

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***Abstract***

*One of the goals in service integration is to create additional values by grouping individual services. In order to achieve this goal, the integrated services should be closely related to each other. In this paper, we propose a method of extracting user's inclination, which indicates the closeness of services. Two services, which serve the users who have the same inclination, can be integrated. The way of extracting a user's inclination from services and adapting this inclination to other services is proposed. By this, the synergy of integrating services can be made with better efficiency.*

***Keywords:*** *Service Integration, User Inclination Model, Rule-based System*

## 1. Introduction

In these days, "integration" becomes one of the most significant keywords in service providers. One of the reasons of integration is to make a synergy. Several years ago, digital camera, PMP, MP3P, PDA, cell-phone and e-book reader are all independent product in the different markets. But these markets are converged into a single market as the smart phone absorbs all the functions of these devices. However, integration of functions does not always result the better outcome. Some integration can make synergy, which can make additional profits, but other integrations may fail to make any synergy. When Barnes & Noble allows Starbucks to run café in its bookstore, more customers come to buy books and enjoy coffee. But when Cisco buys Pure Digital, which manufactures video camera, the combination of networking and camera results a drastic cut in the staff. From these examples, we can say that the integration of services can make a benefit but not always. One of the key factors, which make these differences between success and failure, is the relation among the services to be integrated. And this relation can be inferred from the customer's inclination. For the prior example, the customers of Starbucks usually consume the service in their cultural activities such as listening music, reading books, or making conversations. This means that the most customers of Starbucks can be the customers of Barnes & Nobles and vice versa. But it is hard to say that the customers who buy networking devices will also purchase video equipment. As the customers of Barnes & Nobles and Starbucks have same inclination, these two services can be integrated and make synergy. But as the customers of Cisco and Pure Digital have different inclination, the integration of these services fails to make a synergy. Therefore in this paper, we mention that the service integration can make benefits if and only if the services are closely related. And this relation is based on the customer's inclination.

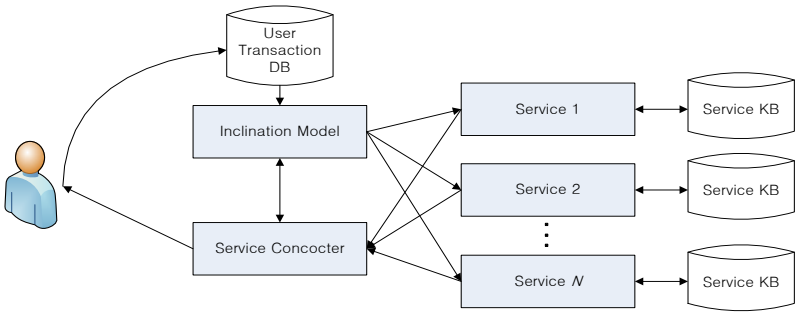


**Figure 1. Service Integration based on the Inclination Model**

Figure 1 shows the abstract architecture of proposed method. There are various services and each service has its own service knowledge. User's transactions for each service are stored in the User Transaction DB. And from this DB, the user's inclination is extracted. As this inclination is independent from the service domain, it can be referred by other services. Service Concocter (SC), which is shown in Figure 1, integrates services according to the user's inclination model. With this architecture, service providers can reuse other services' users' information by just referring the specific user's inclination. The rest of this paper will explain the structure of inclination model, the way of making a user's inclination from the existing the user's transaction data, which is generated by the other individual services, and the way of service converging process of the SC.

## 2. User Inclination Models

Personality is always revealed partially. Someone's best friend can be other's worst enemy. John who is a good father can be a mean employer in workplace. Therefore, even for the same person, the customer profile of one service provider is hard to be reused by other service providers. However, even if the revealed aspect of the user cannot show the person's true identity, it still implies the nature of her/him. Whether John is friend or enemy, if he is diligent, then he is diligent. All aspects of human, which reveal the partial personality according to the context, imply the true nature of that human. We assume that this essential identity is the person's inclination. As this inclination is independent from the domain-related situation, various services, which have different domain, can share the user's inclination.

**Table 1. MBTI Personality Model**

| Category | Attribute | Meaning |
|---|---|---|
| Attitude | Extraversion (E) | Those who are action oriented |
| | Introversion (I) | Those who are though oriented |
| Function | Sensing (S) | Those who tend to trust things that can be understood by the five senses |
| | Intuition (N) | Those who tend to trust flashes of insight from the unconscious mind |
| | Thinking (T) | Those who tend to decide things from a detached standpoint |
| | Feeling (F) | Those who tend to decide things by associating with the situation |
| Lifestyle | Perceiving (P) | Those who prefer to gather information |
| | Judging (J) | Those who prefer to make decisions |

There are various models, which have been proposed to express the user's inclination. However it is still an open problem how to extract inclination from the user's behaviors. In order to make a relevant inclination model, two features need to be considered. One is how to describe the inclination. And the other is how to fill the values of the attributes in the model. Even though many models are proposed and some of them are widely used to describe the personality of users, the ideal model for describing the personality seems not to be made. It is a strong assumption that all humans can be classified into the predefined several types; 16 types by MBTI or 9 types by Enneagram. Most widely used models are MBTI [1], Enneagram [2], MMPI [3], and PAS [4]. Even though these models have different criterions to classify the personality types, the resulted types are almost similar. In this paper, the attributes, which are employed in MBIT, are borrowed to make the inclination model.

MBTI model is proposed by Katharine Cook Briggs and Isabel Briggs Mayer using Carl Gustav Jung's typological theory [5]. This model indicates that the personality can be classified according to the 3 categories such as attitude, function, and lifestyle. Attitude shows whether the person's attitude to the environment is extraversion or introversion. Function shows the way of perceiving the environment and the way of judging the values. The perception is classified into sensing or intuition. The judgment is classified into thinking or feeling. Lifestyle shows the person's preference for the type of function; judging or perceiving. Table 1 shows each attribute and its meaning. In MBTI, by considering these attributes, which are shown in Table 1, 16 types of personality are made and by examining the user, one of the personality types is assigned. Therefore, if someone's personality is classified into ISTJ type, then we can say that the person has introversion attitude, tends to trust what can be recognized by sensing, makes decision by meditating the sensed information, and likes to have opinions about information than just to collect data. In order to trust the result of MBTI, it should be validated and analyzed by the expert. There is not a formalized function, which can extract the personality type of user automatically. Therefore, instead of using MBTI's personality type, we define the user's inclination model with 8 attributes and each attribute has normalized value. Figure 2 shows the inclination model used in this paper. This model does not employ the predefined types but the set of values.

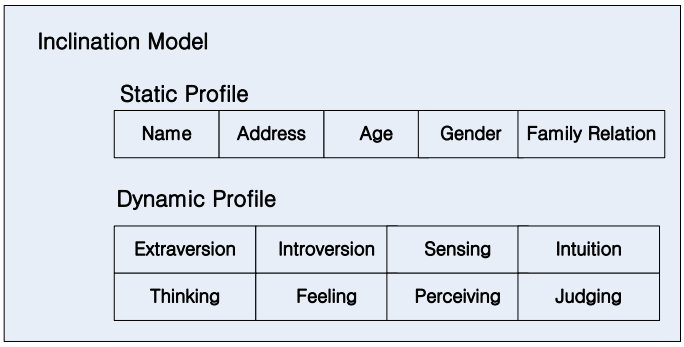


**Figure 2. The Structure of User Inclination Model**

It consists of two modules such as static and dynamic profiles. The static profile describes the user's explicit and fixed information such as name, address, age, gender, and family relation. The profile is directly inserted by the user. They dynamic profile is inferred from the user's history. This profile has 8 attributes, which are borrowed from the MBTI Model and have the same meanings as shown in Table 1. As the user's inclination, which is expressed by this model, can be used by any services, the service, which is newly provided to the existing users, can save the resource for analyzing them.

## 3. Generating Inclination from Data

As the model, which can describe the user's inclination, is made, each user's inclination needs to be made according to this model, For this object, the existing methods use survey sheet, which includes various questions, which can reveal the user's personality. However, it is not what we want to ask each user to answer the set of questions directly. The inclination profile, shown in Figure 2, is made from the user's behavior history. The values of 8 features, which form the dynamic profile in the inclination model, are filled by a rule-based engine. The rules, which are used by this engine, define the relations between a user's specific actions and his/her inclination.

In this process, the structure of the source data, which is borrowed from a specific service, should be shared by the rule engine. Even if the inclination model is domain independent, the process of making inclination is domain dependent. Therefore, the source data and the rule set, which indicates the way of translates the source data into the inclination is based on the source data's domain knowledge. In this chapter, we propose a sample rule base. This rule set is based on the online shopping mall domain. It has 8 rules and each rule describes the way of assigning each attribute's value in the dynamic profile from a user's history. This rule base is shown in Table 2 and it is literally an example. It means that new rules can be added into the base and the proposed rules can be removed from the rule base according to the history database. We do not insist that these rules are mandatory.

**Table 2. A Sample Rule Set**

| Rule ID | Attribute | Rule Content |
|---|---|---|
| 1 | Extraversion (E) | If the term from selection to settlement is short, this value increases. |
| 2 | Introversion (I) | If the number of cancellations is high, this value decreases. |
| 3 | Sensing (S) | If the seleted item is in the category of DIY, this value increases. |
| 4 | Intuition (N) | If various items, which have the same function, are purchased, this value increases. |
| 5 | Thinking (T) | If items in a cart are in different categories, this value increases. |
| 6 | Feeling (F) | If a review of the purchase is written, this value increases. |
| 7 | Perceiving (P) | If items are searched before a selection is made, this value increases. |
| 8 | Judging (J) | If a comment for other's reivew is written, this value increases. |

The semantics of each rule are like this. Rule 1 indicates the velocity of the user's decision making. Faster decision means higher extraversion. Rule 2 indicates the ration of the user's regrets. If the decision of the user is made from the mature consideration, the action of canceling may not occur. Rule 3 indicates the user's preference for the experience. If DIY items are purchased, the buyer can be assumed to like direct experience. Rule 4 indicates the user's impromptu purchase. The preference for the impromptu behavior shows the actor's bias for the unconscious. Rule 5 indicates the user's ability of isolating thoughts. If items, which are not related to one another, are put together, it is necessary to keep in mind the implicit boundaries, which describe the associative relation of the items. Rule 6 indicates the

user's ability of empathy. To write reviews is to share the information with strangers. Therefore, this behavior shows the user's intention for cooperation with strangers and it can be understood as the ability of empathy. Rule 7 indicates the amounts of data used for the user's behavior. If a user requires more information to make a decision, the bias for perceiving of the user will be higher. Rule 8 indicates the interests for others' behaviors. To make a comment for other's review, a user has to conclude the reviewer's opinion. Therefore, the number of comments can show the user's preference about judging. These rules can be modified according to the user's history database. In this chapter, we assume the history as a set of the user's online shopping mall transaction and the rules are specified for this database. This means that the rule base depends on the user's history database and the history database is dependent on the service.

The value of each feature in the inclination model is made by using the rules, and it is normalized. For Rule 2 in Table 2, if the total number of purchasing transactions is 100 and the number of canceled transactions is 10, the introversion tendency of the user will be 0.9. This value is normalized by comparing the values of other users, whom the online shopping mall service, which provides the user's history database, serves. If the service has 100 users and 75% of the users have lower value than the given user, the user's attribute value will be replaced as 0.75.

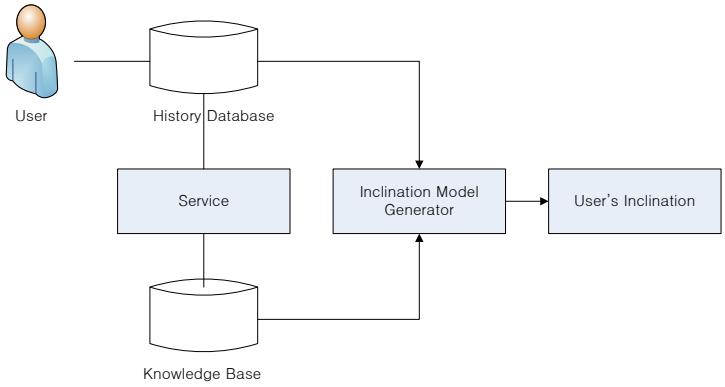


**Figure 3. The Process of User Inclination Generator**

The process of generating a user's inclination is shown in Figure 3. Each service has its user's history database and domain knowledge, which shows the rules for translating the user's history into the inclination model. As every service has its schema for the user history database, it is the service's responsibility to manage the rules.

## 4. Inclination based Service Converging

From above processes, we can get each user's inclination from his/her behaviors, which are dependent to specific services. The service-dependent behaviors are hard to be reused in other services. The data, which tell us that a user likes to buy meats more than to buy vegetables, do not propose us to suggest the user a running shoes not dress shoes. However, as this inclination is the information about the user in a higher abstract level, it can be referred by other services as the essential personality of the user. For a user who has higher feeling, the design of item is more important than the performance of item. The way of practical usage of inclination is what the service provider needs to consider. However, the responsibility of managing users' inclinations is not on the each specific service. Each service provides the given user's history data and its local domain knowledge base according to the request.

Therefore, when a user's inclination is made, the services, which are suitable for that inclination, can be integrated to make a synergy. Each integrated services does not have to know which services are selected. The Service Concocter (SC), which is one of the components in the proposed method shown in Figure 1, handles this task. The role of SC is to find the set of services which are suitable to the given user. In order to select the services, SC uses the users' inclination data only, because the goal of inclination model is to make the user model independent from the services. SC has a list of each user's inclination. By calculating the similarity among users, SC finds the relation among services. The similarity is calculated with both static and dynamic profiles which are shown in Figure 2. This process, which finds the suitable services and integrates them, is shown in Figure 4.

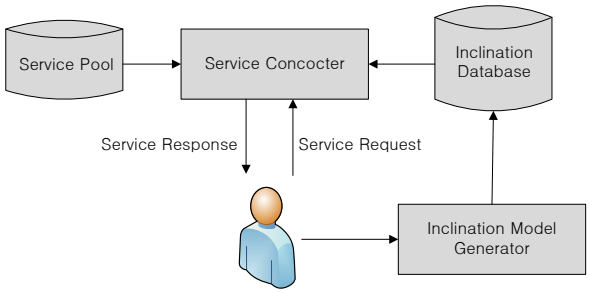


**Figure 4. The Process of Service Selection from the Service Pool**

First of all, the user, who wants to search services, which are suitable for the user's taste, needs to register the inclination into the inclination database. Then the registered user can request to find the service set. This request is sent to the SC. SC selects the suitable services from the service pool according to the requester's inclination. The inclination information consists of two profiles and each profile is used separately. Therefore, the rank of services, which indicates the suitability for the user, can be different according to the weight of each profile. SC makes two kinds of clustering for the registered users. One is using the static profile as criterion. The other is using the dynamic profile as criterion. With these data, SC makes the set of suitable services for the given user. Firstly, SC checks the weight and priority for the profile types, which is described in the request. According to this information, SC decides which cluster should be used. If it says weight of 50:50, SC compares the centroid of each cluster of the registered inclination data. According to the calculated similarity, more than one cluster can be selected and no cluster can be selected. If no cluster is selected, the process is stopped, as the given user is too identical to recommend other services by inferring the user's preference. When clusters are selected, the services, which are used by the users in the selected clusters, become the candidates for the given user's suitable services. From these services, the frequency of occurrence of service makes the rank of each service. As SC has two types of clusters, this process is executed for the static profile based clusters and the dynamic profile based clusters. Therefore, we have two lists of services with rank. As the weight of each process is 50%, the rank of each service in the extracted list is calculated by averaging the ranks in both processes. According to this rank, services are recommended as the elements of the service integration for the given user. With the user's confirmation, the verified services become the user's personalized service set.

As the model, which can describe the user's inclination, is made, each user's inclination needs to be made according to this model, For this object, the existing methods use survey

sheet, which includes various questions, which can reveal the user's personality. However, it is not what we want to ask

## 5. Total Process of the Proposed Method

The main goal of the proposed method is to find services to integrate for making synergy to the user. In order to make synergy, the integrated services should be closely related to each other. For finding this relation between services, user's inclination is employed. As the user's inclination is independent from the service domain, this inclination can be used as a criterion of indicating the relation among services, which have different domains. Until now, components for resolving this goal are described such as the structure of inclination model, transition rules which modify each service's user information to the inclination model, and the way of using inclination model to select services to be integrated for the user. In this chapter, the overall process of these components, which is shown in Figure 5, will be explained.

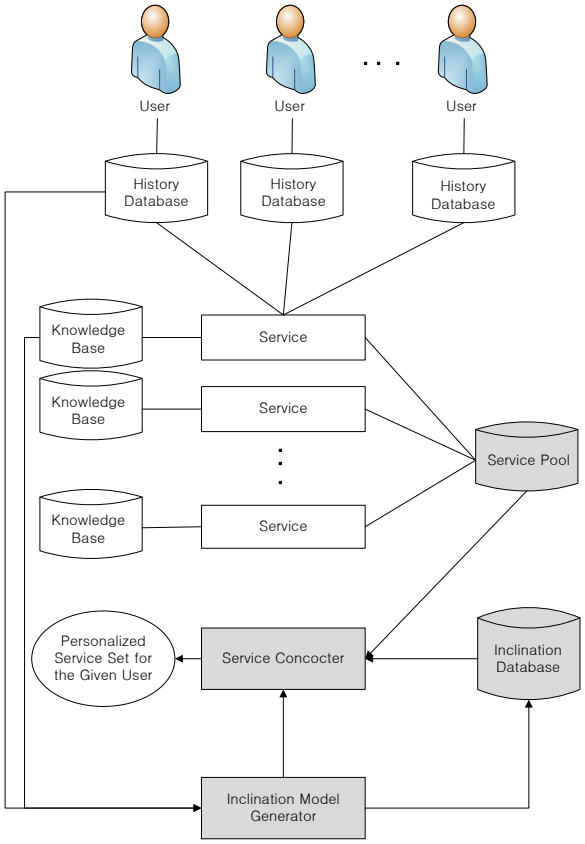


**Figure 5. The Overall Architecture of Inclination based Service Integration System**

The process of using inclination model can be separated into two parts. As shown in the above chapters, the first part is to make each user's inclination and the second part is to make a set of services which are to be recommended to the user. The first step of this process is service registration. The information of each service is stored in the Service Pool. For this registration, two kinds of information are required. One is the identification of each service and the other is the location of the users' database, which is used to make users' inclinations.

Each service should have three kinds of information. One is a list of users. Another is each user's behavior history. The other is the service's rule base that can be used to make the user's inclination. This rule base shows the way of translating the service's own database to the user's inclination. The example of rule base can be seen in Table 2. For the registered services, Inclination Model Generator (IMG) asks each service to send each user's history database and the service's rule base. IMG translates the user's history data into the user's inclination. This inclination is stored in the inclination database, which is used by the Service Concocter (SC). IMG executes when new service with its users is registered into the service pool, the existing service recruits new user, or the existing user's history database has changed.

SC makes clusters the inclinations in the inclination database with two criterions such as static profile and dynamic profile. Then any user in the inclination database can ask SC to recommend services, which are suitable for the user. When a request occurs, SC finds the clusters, whose centroid has high similarity to the requester's inclination. Each inclination in the selected clusters is connected to a specific service, which is used to make the user's inclination. From this relation, the list of services can be extracted and ranked in order of frequency. And the set of services, which have high rank, can be grouped and this set is recommended to the user as a personalized service set.

With the inclination data, users can be provided new services, which are suitable for their taste. And at the same time, the service provider can find the valuable target user without additional customer analyzing load.

## 6. Simulation and Result

The hypothesis of the proposed method is that the inclination, which is extracted from one service, can be applied to other service and the proposed inclination model can describe the user's general preference properly. In order to prove this hypothesis, this simulation is performed. First of all, online book store is selected as the sample service domain. 10 users and their purchasing histories are selected. As we cannot get the actual data, we ask 10 customers, who use the same service, to fill the sample data set. As the static profile of these users is similar, the dynamic profile is considered. The rule set, which translates the domain specific history data into the inclination model, is shown in Table 2. As the rules in Table 2 are made for the online shopping mall, they can be directly used in this simulation.

Firstly, the IMG generates each user's inclination using the transaction data and rules. Then the 10 inclinations are clustered using the x-means clustering algorithm. As the size of sample is too small to make meaningful clusters, we calculate each pair's similarity.

Then we surveyed each user's favorite sites, which s/he will to recommend to friends. From these sites, the rank is calculated according to the occurrence frequency and the high rankers are recommended to the users who have the similar inclination. The result shows that sites of other user, who has the higher similarity, are accepted with high ratio and sites of users, who have lower similarity, are generally rejected as the similarity decreases. Even though the simulation is limited in sample size and information's sophistication, the result shows that the inclination of one domain can tell the preference of other domain.

## 7. Conclusion

It is said that two heads are better than one. It can be true but not always true. In order to make that proverb true, each head should be closely related. Service integration can make better synergy and to make that synergy, the integrated services should be closely related. This relation can be inferred by analyzing each service's users. The services, which serve to the same user type, can be integrated. For this, the user type of each service needs to be

shared by various services. Therefore, in this paper, we propose a user's inclination model, which specifies the user's high-level information that can be shared by various services. With this information, user's information can be shared by services. And with this inclination of users, the service integration, which can make synergy, can be made.

The inclination model is based on the MBTI model. The proposed model has 8 features and each feature has normalized value. These values are extracted from the user's existing behavior history database by applying the transition rules. These rules show what kinds of actions, specified in the user's history database, are translated into the inclination model's feature value. For example, if the user's purchasing is confirmed right after items are selected and stored into the shopping cart, we can infer that the user's determination is fast made. And from that, the feeling feature of the user's inclination is reinforced. These transition rules perform important roles in this proposed method and they are domain dependent. If the existing database does not provide the required data such as the time term between the time of selecting items and the time of paying the bill, this rule cannot be executed. As these rules are depend on the source database, which is used to make a user's inclination, these rule should be provided by the service, whose database is employed. Once a user's inclination is made, it is compared with other users' inclinations and the set of users, who have the similar inclination, can be generated. Therefore, the services of users, who have similar inclination, can be regarded to have a close relation. Based on this relation, the services can be integrated to make synergy.

In short, the user inclination, which is proposed in this paper, can indicate the relation among services in different domain. Based on this inclination, the related services can be extracted and the integration of these services can guarantee the synergy for the users, who have the inclination. In this method, the inclination is made from a specific service's database and the service has responsibility of providing rules, which is used to translate the source database into the inclination information. As a future work, we plan to transfer this responsibility from the services to the IMG by employing ontology to describe the foreign source database and generate the rules for the given source database. Then this model and method can be more useful in real situation.

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## References

[1] I. B. Myers and P. B. Myers, "Gifts Differing: Understanding Personality Type, Mountain View", CA: Davies-Black Publishing, ISBN 0-89106-074-X.
[2] R. D. Richard and H. Russ, "Understanding the Enneagram: The Practical Guide to Personality Types", Houghton Mifflin Harcourt, ISBN 978-0-618-00415-7.
[3] J. N. Butcher, "A Beginner's Guide to the MMPI (Minnesota Multiphasic Personality Inventory)-2", Washington DC, The Americal Psychological Association, ISBN 978-7-4338-0922-4.
[4] C. Krauskopf and D. R. Saunders, "Personality and Ability: The Personality Assessment System", University Press of America, Maryland, ISBN 0-8191-9282-1.
[5] Jung, C. Gustav, "Psychological Types, Collected Works of C.G.Jung", vol. 6. Princeton University Press., ISBN 0-691-09774.
[6] D. H. Wolpert and K. Tumer, "An Introduction to Collective Intelligence", Technical Report, NASA-ARC-IC-99-63, NASA Ames Research Center, **(1999)**.
[7] B. Sarwar, G. Karypis, J. Konstan and J. Riedl, "Analysis of Recommendation Algorithms for E-Commerce", Proceedings of the ACM E-Commerce Conference, **(2000)**.

[8] S. M. McNee, J. Riedl and J. A. Konstan, "Making Recommendations Better: An Analytic Model for Human-Recommender Interaction", in the Extended Abstracts of the 2006 ACM Conference on Human Factors in Computing Systems, **(2006)**.
[9] B. Prasad, "Intelligent techniques for e-commerce", Journal of Electronic Commerce Research, **(2003)**.
[10] E. Rahm and P. A. Bernstein, "A Survey of Approaches to Automatic Schema Matching", VLDB Journal, **(2001)**.
[11] F. Ricci, L. Rokach and B. Shapira, "Introduction to Recommender Systems Handbook", Recommender Systems Handbook, Springer, **(2011)**.
[12] A. I. Schein, A. Popescul, L. H. Ungar and D. M. Pennock, "Methods and Metrics for Cold-Start Recommendations", Proceedings of the 25th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval, **(2002)**.

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