What am I Gonna Wear?: Scenario-Oriented Recommendation

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ABSTRACT
Electronic Commerce on the Web is thriving, but consumers still have trouble finding products that will meet their needs and desires. AI has offered many kinds of Recommender Systems [11], but they are all oriented toward searching based on concrete attributes of the product (e.g. price, color) or the user (as in Collaborative Filtering). Based on commonsense reasoning technology, we introduce a novel recommendation technique, Scenario-Oriented Recommendation, which helps users by mapping their daily scenarios to product attributes, and works even when users don't know exactly what products they are looking for.

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General terms: Design, Algorithms

Keywords: Scenario-Oriented Recommendation, commonsense reasoning, recommender system.

INTRODUCTION
Suppose you are planning to attend your boss's birthday party at his house. You decide to find something nice, not too formal, but still you are not sure what particular outfit or brand to buy. So, you go to a department store, and turn to a salesperson. It's no use just trying to ask for the location of specific clothing attributes (etc. brands, styles or sizes). Instead, you describe the situation of the party and ask for suggestions. The salesperson might respond with "If I was going, I'd wear…" or "Our more formal clothing is in this section…". This way, even if you don't get exact recommendations, it helps you on the road to making a decision, because you're communicating based on the *scenario of use* of a product, which the salesperson can map to the attributes of the appropriate items by applying common sense.

In view of the need of finding desirable products without knowing exactly what they are, we introduce a novel recommendation technique, *Scenario-Oriented Recommendation*. Unlike other recommender systems that require users to provide specific product attributes, our approach analyzes users' goals, and maps them to possible characteristics of the products that might be relevant. While a more sophisticated approach may be required for real-world commercial usage, it is the first system that shows the promises of providing recommendation based on users' textual description of scenarios over a broad range of everyday situations.

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SCENARIO-ORIENTED FASHION RECOMMENDATION
We implemented a fashion recommendation system, "What am I Gonna Wear?" (Figure 1). Each user has an online wardrobe that contains all his/her clothing "items" (e.g., a cab or a pair of shorts), and "outfits" that are combinations of several items including upper wear, lower wear, shoes, accessories, etc (e.g., a sports outfit for playing tennis). The clothes are labeled with brands (e.g. Nike), types (e.g. jeans), and can be annotated with English sentences to describe their styles (e.g. "This suit makes me look sexy"). There are two input entries for users to find items for particular occasions or moods, i.e., "I am going to …" and "I want to look more…". Based on commonsense reasoning, the system matches the clothes' styles and functions with the concepts needed for the context. It returns suggestions for complete outfits, and the selected outfits will be recorded as users' feedback to the system's recommendation for these particular occasions. Users can also make up the outfits by selecting the items themselves, or by asking their friends. The system also relates the users to others sharing similar tastes, and allows them to browse each others' items. Currently, this system is not linked to any commercial websites, so it oriented around a user's personal wardrobe and does not provide any shopping functionality. However, we believe the approach can be easily extended to collections of products available for purchase at a store in addition to selection from the user's personal collection.

We believe what we wear reflects our manner, taste, or how we regard the events that we attend and the people that we interact with. Hence, we formulate this problem as: a) how the clothes function and express our character, and b) what the occasions, and people we are to meet, mean to us. Thus, in our system, the input text of the scenario will be processed by a *style sensor*, a *function sensor*, and an *occasion network.*

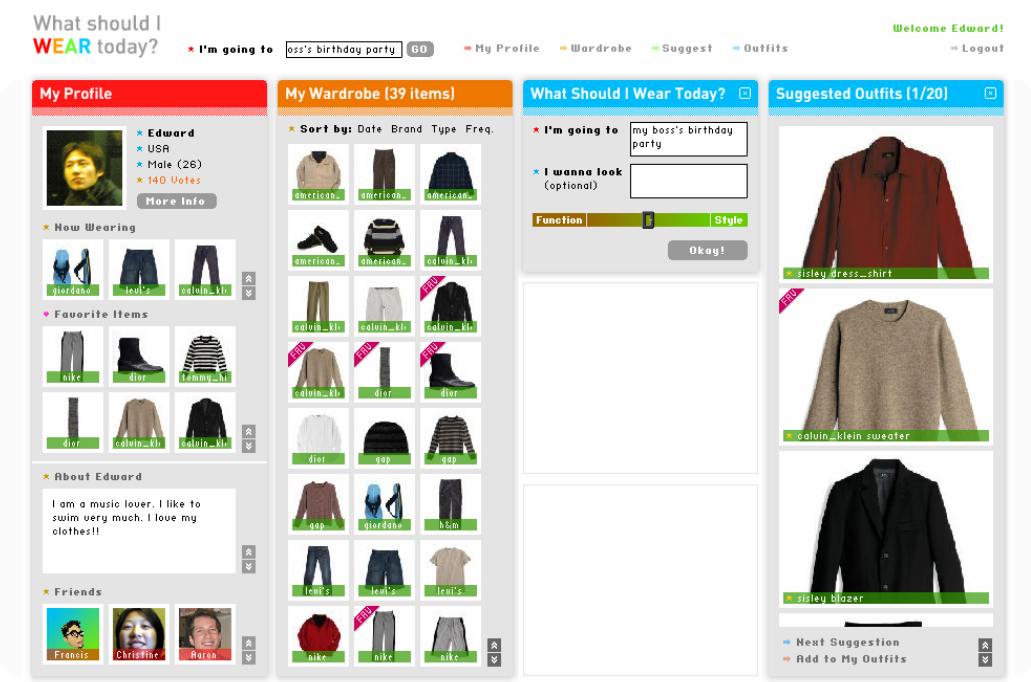

Figure 1: The fashion recommendation website with partial result for "I'm going to my boss's birthday party"

Commonsense Reasoning Resource

The knowledge used in our scenario-oriented fashion recommendation system is all derived from Open Mind Common Sense (OMCS) [9], which contains over 800,000 English sentences about commonsense. ConceptNet [10], an open-source tool for using the commonsense knowledge collected in OMCS, is a semantic network with 20 link types that describe different relations among things, events, characters, etc, and is the major technology used in our fashion system. The following subsection introduces how we employ ConceptNet in our system.

Style Sensing and Spreading Activation

Both the styles in users' input text and clothes will be sensed before they are matched. The styles are extracted according to four types of information, including the clothing items' brands, types, and materials, and words that are related to the occasions. All these types of information are processed with a uniform computational representation. We use a six-tuple to represent the dimensions of the concept "style": luxurious, formal, funky, elegant, trendy, and sporty. Using this mathematical form, we are able to express the style for any pieces of clothing, and for any English sentences or phrases.

We hand-crafted a key file for each of the four information types. Each of the six numbers for a key ranges from 0 to 10. Example keys are:

- Levi's: [4, 2, 7, 3, 6, 6]
- Shirt: [7, 8, 4, 6, 5, 1]

As the reader can see, the formal and elegant values are high for shirts, the funky value for the brand Levi's is higher than all its other dimensions, and so on. Based on the handcrafted keys, the default style value for any clothing item can be derived by averaging its brand, type, and material, (and natural language description, if provided) when it is uploaded. Users can also adjust the values if they do not agree with the default style. All the possible brands, types, and materials need to be listed in the style key files, but not all the occasions. This is because it is difficult for the system to infer the style for an unknown brand.

The choice of particular attributes for clothing styles and their values for particular clothing items is, of course, not well determined, and is subject to some dispute. We hope, that our basic methodology is not so sensitive to the particulars of these choices, and we are looking for plausible, not necessarily accurate, descriptions. Future versions could even determine the parameter types or parameter values by learning these from analysis of natural language descriptions in catalogs, fashion journalism, and online fashion forums.

Using commonsense reasoning our system can guess the style for any English word, even if it does not appear in the occasion key file. Following the affect sensing approach by Liu et al [8], we achieve style inferencing by performing spreading activation. For each procedure during the spreading activation process, the style value of a node in ConceptNet is propagated outwards to its neighboring nodes with a discount factor *d* (0.25 in our system). So, suppose the word "wedding" is in the occasion key file, but "church" and "chapel" are not. Then, because of the two existing relations, LocationOf(wedding, church)and IsA(chapel, church), in ConceptNet, after the first iteration, the word "church" will have the style [1.25, 2.25, 1.25, 2.25, 1.25, 0.25], and word "chapel" will in turn become [0.3125, 0.5625, 0.3125, 0.5625, 0.3125, 0.0625]. Based on

this approach, our system successfully provides plausible style sensing outcome for any common English words, even with only several tens of words in the occasion key file.

Function Sensing

Unlike style sensing, when finding the function for clothes and occasions, only three relations in ConceptNet are employed, namely, "used for", "location of", and "capable of receiving action". We use these relations to find the possible occasions for the clothes according to their types, and match them with the input description during the online interaction. For the example input, "I am going to swim", swimsuit will be prompted as an suggestion, because swimming is a possible occasion for wearing a swimsuit according to the UsedFor(swimsuit, swim) relation appearing in ConceptNet. It is a different approach from the style-sensing algorithm. The reason is, since function is a one-to-one relationship, it is unsuitable for spreading activation. To give an example, using spreading activation for function sensing might match "raincoat" for "going to the beach", because they are both related to the concept "water".

Personalization and Social Recommendation

In the above subsections, we discussed how we apply commonsense to the decision making process. The users' own personal fashion style, however, is extremely important, too. Our system gradually learns individuals' tastes and fashion preferences along the interaction, which makes it a real personalized recommendation tool. While the textual network derived from OMCS provides linkage information between conceptually-related words or phrases [10], items in our system are also linked if they share similar styles. We call this the *occasion network*. When a user presses the "Wear it now" button, the system attaches the input occasions to the selected items, and the occasions will be spreading activated through the links between items. Therefore, if, say, I wear a T-shirt for going bowling today, the system will not only learn that I'd like to wear this T-shirt for bowling next time, but also some pair of shoes, jeans, or another T-shirt, if similar with this T-shirt.

We also detect users' personal styles within resources such as their textual personal profiles, their wardrobes' average styles and so on. The detected styles are used as another approach toward personalized recommendation. (For example, if the user is fond of sports, i.e., having a profile with a high sporty value, the items with higher sporty values will be preferred.) Meanwhile, they are also used to relate different users, as mentioned in the previous section of scenario-oriented recommendation's benefits.

Using the Fashion Recommendation System

Table 1 provides the system's recommendation for several different scenarios. Each row has a natural language description in its left-most column, and its other columns show the suggestions based on this description. We try to make the recommendations complete outfits, but, say, if the styles of all the possible shoes' scores are below our specified threshold, the system will not recommend any shoes, and will let the users make their own decision.

The first row and the second row show our system's capability of recognizing the styles in different occasions, i.e., "going to the beach" is a sportier and more casual event, whereas going to a dinner is relatively more formal and elegant. Also, the system detects the needed function of clothing for going to the beach, and gives the recommendation of a swimsuit. The remaining two rows can be compared with the second one. They both share the same content with the second one, but more information is provided to contribute to the overall style. That is, "look more casual" and "with my boss" made the result more casual and formal, respectively.

EVALUATION

There are 7 subjects in this study, all of which are either graduate or undergraduate students at MIT. There are in all 87 clothing items in 82 types and 21 brands, all of which are assigned with style values, varying from 0 to 10, according to our understanding of how these brands or types are generally considered by the public. All the types are assigned with function values as well. The main part of the study comes in two stages.

In each stage, the subject is asked to find clothing items that he would want to wear the most by using either a traditional

Table 1: Example results of the fashion recommendation system

I am going to the beach	
I am going to have dinner	
I am going to have dinner. I want to look more casual.	
I am going to have dinner with my boss	

online catalog or our recommendation system, according to the 5 given scenarios, such as "I am going to the bookstore", and 2 user-specified ones. Finally, they were asked to fill a 3-page questionnaire.

The reactions of the subjects are generally positive. They find the recommendations useful, think the recommended items appropriate for the scenarios, find it easier to make decisions on outfits with the help of the recommendation, and so on. More than 80% of the subjects agree or strongly agree that the recommendation system ought to be used in online stores, from either customers' or owners' points of view. In summary, the study shows that our approach has the potential of providing useful clothing item recommendation under the specified scenarios, making the decision-making process easier, and is desirable in either online and physical stores. Nevertheless, it is only a pilot study, meaning that the subjects of more diversity (e.g., gender, age, etc.) and more controlled experimental conditions need to be involved in order to make a definitive judgment as to its effectiveness.

RELATED WORK

The term "recommender systems" typically refers to systems that suggest books, music albums, from a set of input parameters, possibly including user profiles, purchase history, product attributes, etc. In recent years, a popular technique has been Collaborative Filtering [11], which works by clustering users' purchase history. While capturing the "word-of-mouth" concept, many of these systems do not consider users' goals in the search activity. More advanced systems take into account user preferences or even lifestyles [1, 3, 5, 12]. These systems try to capture users' goals by applying critiquing interaction, complex user models, and other techniques, but they either require users to provide specific descriptions in terms of product attributes, or require thatthe correspondence between scenarios and product attributes be explicitly coded. Our approach differs from all the above techniques in that, thanks to commonsense reasoning, a broad range of scenarios and user goals can be covered without explicitly programming them, and implicit goals can often be recognized. Finally, our system is also different from Case-Based Reasoning (CBR) systems [2], since that 1) our knowledge base, OMCS, is not a case repository that captures scenario-product relations but a general-purpose commonsense corpus, and 2) we use common sense as a kind of "generic user model" that describes an "average" or "typical" user as a default in the absence of more specific user preferences. As for the input modality, most systems use check boxes and forms that are by nature suitable for narrowing down search spaces, but less suitable for open-ended exploration. There are also approaches enabling natural language descriptions [4], but discourse is limited in a specific domain.

CONCLUSION

In this paper, we introduce a novel recommender technique, *Scenario-Oriented Recommendation*. Based on OMCS, a knowledge corpus containing common sense about people's everyday life, it is the first technique providing product suggestions based on real-world user scenarios across a broad range of topics. It helps users by matching the characteristics of the circumstances and the possible products, and helps people to determine the ideal products more easily, even if they don't know what that might be. We describe design details of our prototype system, *What am I Gonna Wear?*. Not everybody is rich enough to have a personal shopping assistant, but with scenario-oriented recommendation, maybe we can give them the next best thing.

REFERENCES

1. Burke, R., Hammond, K., and Young, B. The FindMe Approach to Assisted Browsing. *IEEE Expert*, 12(4), 1997, 32-40.
2. Göker, M. H. and Thompson, C. A. *Personalized Conversational Case-Based Recommendation*, Springer, 2000.
3. Fano, A. and Kurth, S. W. Personal Choice Point: Helping users visualize what it means to buy a BMW. *Proc of IUI 2003*: 46-52.
4. Fleischman, M. and Hovy, E. Recommendations without User Preferences: A Natural Language Processing Approach. *Proc of IUI 2003*: 242-244.
5. Ha, V., and Haddawy, P. Problem-Focused Incremental Elicitation of Multi-Attribute Utility Models. *Proc. UAI97*: 215-222.
6. Lenat, D.B. CYC: A large-scale investment in knowledge infrastructure. *Communications of the ACM.* 38(11), 1995, 33-38.
7. Lieberman, H., Liu, H., Singh, P., and Barry, B. Beating Common Sense into Interactive Applications. *Artificial Intelligence Magazine*, 25(4), 2004, 63-76.
8. Liu, H., Lieberman, H., and Selker, T. A Model of Textual Affect Sensing using Real-World Knowledge. *Proc of IUI 2003*.
9. Singh, P., Lin, T., Mueller, E. T., Lim, G., Perkins, T., and Zhu, W. Li. Open Mind Common Sense: Knowledge acquisition from the general public. *Proc. of the 1st International Conference on Ontologies, Databases, and Applications of Semantics for Large Scale Information Systems,* 2002.
10. Liu, H. and Singh, P. ConceptNet: a practical commonsense reasoning toolkit. *BT Technology Journal*, 22(4), 2004, 211-226.
11. Resnick, P. and Varian, H. R. Recommender Systems. *Communications of the ACM*, 40(3), 1997, 56–58.
12. Shearin, S. and Lieberman, H. Intelligent Profiling by Example. *Proc of IUI 2001*: 145-151.