Application of Multi-Layered Semantic Augmented Social Networks to Collaborative Filtering

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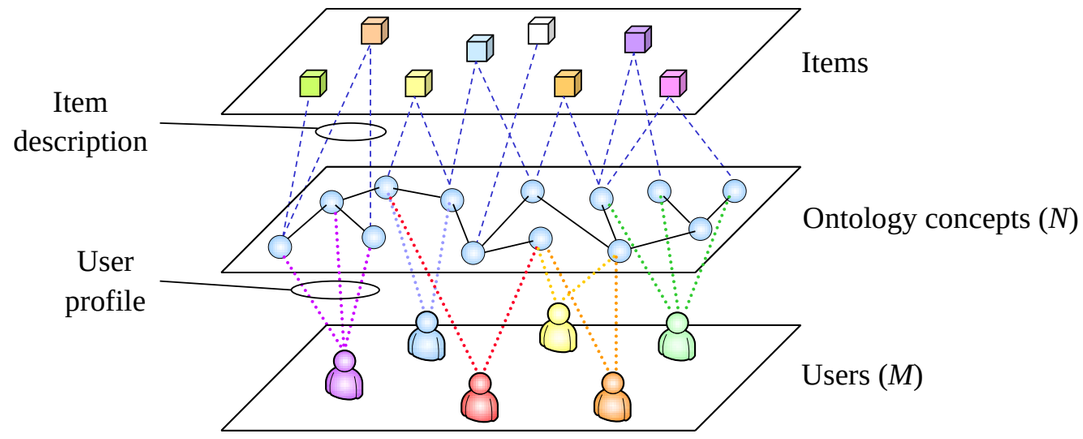
Introduction

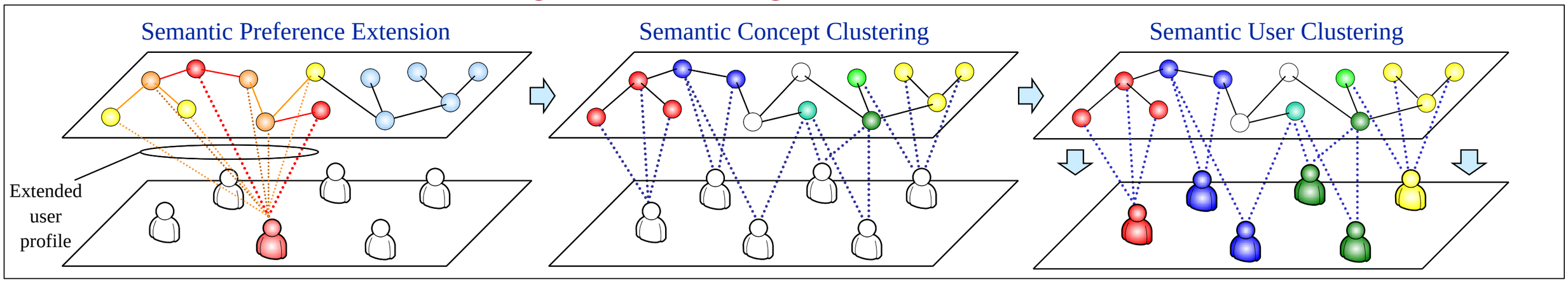
- Context
  - Ontology-Based User Profiles
    - Exploit the Semantic Web technologies to better describe the interests and preferences of users
  - Augmented Social Networks
    - Find hidden links between users based on the similarity of their common (not overall) preferences
- Idea
  - A multi-layered model that allows to cluster the users' preferences and find (weighted) semantic relations between them
- Application
  - A Collaborative Filtering strategy that recommends ranked item lists based on the obtained clusters and multi-layered augmented social networks

Ontology-Based User Profiles

- A user profile is represented as a vector $u_m = (u_{m,1}, u_{m,2}, \ldots, u_{m,N})$, where $u_{m,n} \in [0,1]$ is the weight that measures the intensity of user u_m for concept c_n in a domain ontology



Emergent Semantic Augmented Social Networks



Multi-Layered Models for Collaborative Filtering

- Notation:
  - u_i = user profile
  - d_k = item description vector
  - C_r = concept cluster
  - u_i^r, d_k^r = the projections of u_i and d_k onto cluster C_r
    (i.e., the j-th component of u_i^r and d_k^r is $u_{i,j}$ and $d_{k,j}$ respectively, if $c_j \in C_r$ and 0 otherwise)
- Recommender models

Model UP *(user profile-based)*

$$pref(d_k,u_i) = \sum_r nsim(d_k,C_r) \sum_l nsim_r(u_i,u_l) \cdot sim_r(d_k,u_l)$$

Model NUP *(no user profile)*

$$pref_r(d_k,u_i) = \frac{1}{M} \sum_r nsim(d_k,C_r) \sum_l sim_r(d_k,u_l)$$

Model UP-r *(user profile, considering a specific cluster C_r)*

$$pref_r(d_k,u_i) = \sum_l nsim(u_i,u_l) \cdot sim_r(d_k,u_l)$$

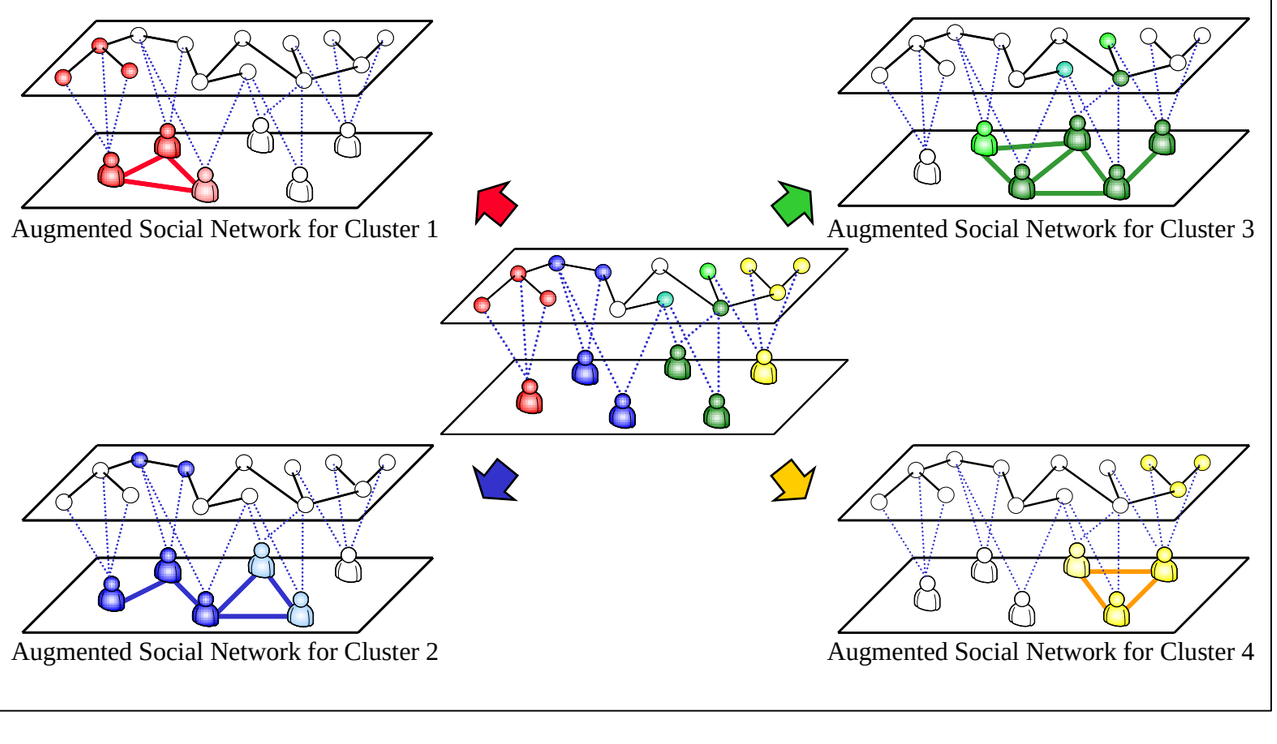
Model NUP-r

$$pref_r(d_k,u_i) = \frac{1}{M} \sum_l sim_r(d_k,u_l)$$

$$sim_r(u_i,u_l) = \cos(u_i^r,u_l^r) = \frac{u_i^r \cdot u_l^r}{\| u_i^r \| \cdot \| u_l^r \|}, \quad nsim_r(u_i,u_l) = \frac{sim_r(u_i,u_l)}{\sum_l sim_r(u_i,u_l)}$$

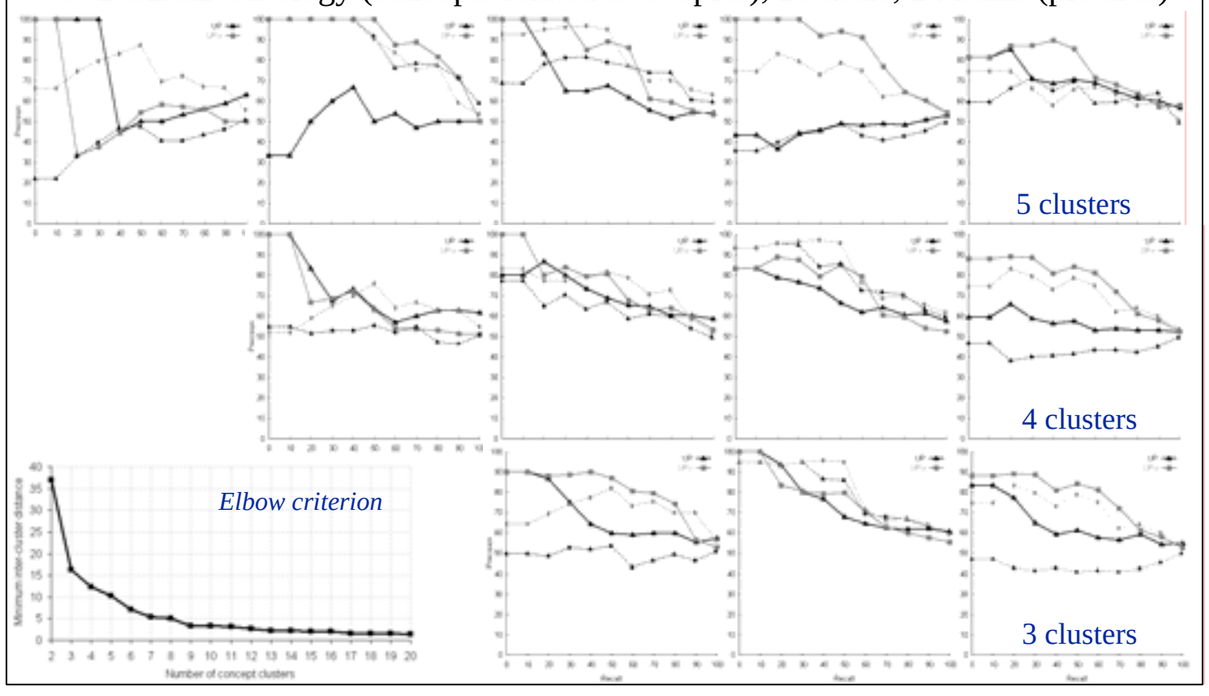
$$sim(d_k,C_r) = \frac{\sum_{c_j \in C_r} d_{k,j}}{\| d_k \| \sqrt{|C_r|}}, \quad nsim(d_k,C_r) = \frac{sim(d_k,C_r)}{\sum_l sim(d_k,C_l)}$$

$$sim_r(d_k,u_i) = \cos(d_k^r,u_i^r) = \frac{d_k^r \cdot u_i^r}{\| d_k^r \| \cdot \| u_i^r \|}$$



Early Experiments

- Average Precision/Recall curves from a Personalized Retrieval System
  - DOLCE Ontology (concepts related to 6 topics), 20 users, 24 items (pictures)



Conclusions and Future Work

- Summary
  - We present an ontology-based user profile model that allows to *find semantic relations between common interests* of a group of individuals
  - We divide the user profiles into clusters of cohesive interests, and based on this, *several layers of augmented social networks* are found
  - We introduce *recommender strategies* that take into account the emerged user relations and clusters
- Future Work
  - Statistically significant experiments: IMDB database
  - Implementation of a web application
  - Efficient (scalable) clustering strategies: SVD, co-clustering techniques,...
  - Hybrid recommedation approaches: item-based + collaborative filtering
  - Context-aware recommendation
  - Automatic user preference learning methods
  - Explicit social relations: FOAF (Friend Of A Friend) technology
  - Social Network Analysis