



A HIERARCHICAL ATTENTION MODEL FOR SOCIAL CONTEXTUAL IMAGE RECOMMENDATION

J Raju¹, Ragipanhi Kiranmai², Rakesh Kumar³, Padala Vishal Kumar⁴, Marri Raju⁵

^{2,3,4,5} UG Scholars, Department of CSE, AVN Institute of Engineering and
Technology, Hyderabad, Telangana, India.

¹ Assistant Professor, Department of CSE, AVN Institute of Engineering and Technology,
Hyderabad, Telangana, India.

ABSTRACT

Image based social networks are among the most popular social networking services in recent years. With tremendous images uploaded every day, understanding users' preferences on user-generated images and making recommendations have become an urgent need. In fact, many hybrid models have been proposed to fuse various kinds of side information (e.g., image visual representation, social network) and user-item historical behavior for enhancing recommendation performance. However, due to the unique characteristics of the user generated images in social image platforms, the previous studies failed to capture the complex aspects that influence users' preferences in a unified framework. Moreover, most of these hybrid models relied on predefined weights in combining different kinds of information, which usually resulted in sub-optimal recommendation performance. To this end, in this paper, we develop a hierarchical attention model for social contextual image recommendation. In addition to basic latent user interest modeling in the popular matrix factorization based recommendation, we identify three key aspects (i.e., upload history, social influence, and owner admiration) that affect each user's latent preferences, where each aspect

summarizes a contextual factor from the complex relationships between users and images. After that, we design a hierarchical attention network that naturally mirrors the hierarchical relationship (elements in each aspects level, and the aspect level) of users' latent interests with the identified key aspects. Specifically, by taking embeddings from state-of-the-art deep learning models that are tailored for each kind of data, the hierarchical attention network could learn to attend differently to more or less content. Finally, extensive experimental results on real-world datasets clearly show the superiority of our proposed model.

INTRODUCTION

There is an old saying "a picture is worth a thousand words". When it comes to social media, it turns out that visual images are growing much more popularity to attract users. Especially with the increasing adoption of smartphones, users could easily take qualified images and upload them to various social image platforms to share these visually appealing pictures with others. Many image-based social sharing services have emerged, such as Instagram¹, Pinterest², and Flickr³. With hundreds of millions of images uploaded every day, image recommendation has become an urgent need to deal with the image



overload problem. By providing personalized image suggestions to each active user in image recommender system, users gain more satisfaction for platform prosperity. E.g., as reported by Pinterest, image recommendation powers over 40% of user engagement of this social platform. Naturally, the standard recommendation algorithms provide a direct solution for the image recommendation task. For example, many classical latent factors based Collaborative Filtering (CF) algorithms in recommender systems could be applied to deal with user-image interaction matrix. Successful as they are, the extreme data sparsity of the user-image interaction behavior limits the recommendation performance. On one hand, some recent works proposed to enhance recommendation performance with visual contents learned from a (pre-trained) deep neural network. On the other hand, as users perform image preferences in social platforms, some social based recommendation algorithms utilized the social influence among users to alleviate data sparsity for better recommendation. In summary, these studies partially solved the data sparsity issue of social-based image recommendation. Nevertheless, the problem of how to better exploit the unique characteristics of the social image platforms in a holistic way to enhance recommendation performance is still under explored.

In this paper, we study the problem of understanding users' preferences for images and recommending images in social image based platforms. An example of a typical social image application. Each image is

associated with visual information. Besides showing likeness to images, users are also creators of these images with the upload behavior. In addition, users connect with others to form a social network to share their image preferences. The rich heterogeneous contextual data provides valuable clues to infer users' preferences to images. Given rich heterogeneous contextual data, the problem of how to summarize the heterogeneous social contextual aspects that influence users' preferences to these highly subjective content is still unclear. What's more, in the preference decision process, different users care about different social contextual aspects for their personalized image preference. E.g. Lily likes images that are similar to her uploaded images, while Bob is easily swayed by social neighbors to present similar preference as her social friends. In other words, the unique user preference for balancing these complex social contextual aspect makes the recommendation problem more challenging.

To address the challenges mentioned above, in this paper, we design a hierarchical attention model for social image recommendation. The proposed model is built on the popular latent factor based models, which assumes users and items could be projected in a low latent space. In our proposed model, for each user, in addition to basic latent user interest vector, we identify three key aspects (i.e., upload history, social influence and owner admiration) that affect each user's preference, where each aspect summarizes a contextual factor from the complex relationships between users and images. Specifically, the upload history aspect



summarizes each user's uploaded images to characterize her interest. The social influence aspect characterizes the influence from the social network structure, and the owner admiration aspect depicts the influence from the uploader of the recommended image. The three key aspects are combined to form the auxiliary user latent embedding. Furthermore, since not all aspects are equally important for personalized image recommendation, we design a hierarchical attention structure that attentively weight different aspects for each user's auxiliary embedding. The proposed hierarchical structure aims at capturing the following two distinctive characteristics. First, as social contextual recommendation naturally exhibits the hierarchical structure (various elements from each aspect, and the three aspects of each user), we likewise construct user interest representation with a hierarchical structure. In the hierarchical structure, we first build auxiliary aspect representations of each user, and then aggregate the three aspect representations into an auxiliary user interest vector. Second, as different elements within each aspect, and different aspects are differentially informative for each user in the recommendation process, the hierarchical attention network builds two levels of attention mechanisms that apply at the element level and the aspect level.

LITERATURAL SURVEY

Toward the next generation of recommender systems: a survey of the state-of-the-art and possible extensions

We endorse accept as true with SVD, a believe primarily based matrix factorization method for pointers. Believe SVD integrates

more than one records resources into the recommendation version so one can reduce the data sacristy and cold begin issues and their degradation of recommendation performance. An analysis of social believe facts from 4 actual-world statistics units shows that now not handiest the explicit but also the implicit have an impact on of both scores and consider have to be taken into consideration in a advice version. Believe SVD consequently builds on top of a today's advice set of rules, SVD++ (which makes use of the explicit and implicit impact of rated items), via similarly incorporating each the explicit and implicit affect of relied on and trusting customers at the prediction of gadgets for an active user. The proposed technique is the primaries to extend SVD++ with social believe records. Experimental consequences on the 4 statistics units exhibit that believe SVD achieves better accuracy than different ten opposite numbers' advice strategies.

Influence and correlation in social networks.

Social recommender framework, utilizing social connection arranges as extra contribution to improve the precision of customary recommender frameworks, has become a significant research theme. Be that as it may, most existing strategies use the whole client relationship coordinate with no thought to its colossal size, scarcity, awkwardness, and commotion issues. This may debase the effectiveness and exactness of social recommender frameworks. This examination proposes another way to deal with deal with the multifaceted nature of adding social connection systems to recommender frameworks. Our strategy



initially creates an individual relationship organize (IRN) for every client and thing by building up a novel fitting calculation of relationship systems to control the relationship engendering and contracting. We at that point meld network factorization with social regularization and the local model utilizing IRN's to produce proposals. Our methodology is very broad, and can likewise be applied to the thing relationship arrange by exchanging the jobs of clients and things. Investigations on four datasets with various sizes, scarcity levels, and relationship types show that our methodology can improve prescient exactness and increase a superior versatility contrasted and best in class social suggestion techniques.

Neural machine translation by jointly learning to align and translate

Proposal framework is created to coordinate customers with item to meet their assortment of extraordinary needs and tastes so as to upgrade client fulfillment and dependability. The fame of customized proposal framework has been expanded as of late and applied in a few territories incorporate films, tunes, books, news, companion suggestions via web-based networking media, travel items and different items as a rule. Shared Filtering strategies are generally utilized in proposal frameworks. The community separating technique is isolated into neighborhood-based and model-based. In this examination, we are executing lattice factorization which is a piece of model-based that learns idle factor for every client and thing and utilizations them to make rating expectations. The strategy will be prepared utilizing stochastic angle drop and streamlining of regularization

hyperparameter. At last, neighborhood-based cooperative separating and framework factorization with various estimations of regularization hyperparameter will be analyzed. Our outcome shows that framework factorization technique is superior to anything thing based community oriented sifting strategy and shockingly better with tuning the regularization hyperparameter by accomplishing most minimal RMSE score. In this examination, the pre-owned capacities are accessible from Graphlab and utilizing Movielens 100k informational collection for building the proposal frameworks

Attentive collaborative filtering: multimedia recommendation with item and component-level attention

The issue of semi-directed chart hub grouping is to surmise the marks of unlabeled hubs dependent on a mostly named diagram. Diagram installing is a viable technique for this issue, which uses the setting created by neighbors' data. Some ongoing methodologies safeguard high-request vicinity to smooth the highlights implanted with long-extend structure reliance. Be that as it may, the highlights created by high-request nearness might be excessively smooth to lost individual attributes. To deal with this issue, we propose Adaptive High-Order Graph Embedding (AHOGE), a start to finish diagram neural system that actualizes inserting and characterization in a bound together model, to hold singular subtleties while saving high-request closeness. Roused by Densely Connected Convolutional Networks (DenseNets), AHOGE adaptively embraces the data of k th - request vicinity for various k , utilizing the strategies of Highway



Network. Also, we acquaint multi-class pivot misfortune with manage the hard explained marks and class cover. Examinations on three benchmark reference arrange datasets show that our methodology accomplishes best in class exhibitions.

Context-aware image tweet modelling and recommendation

Given a somewhat named chart, the semi-regulated issue of hub order is to gather the obscure names of the unlabeled hubs. We mean to prepare diagram based classifiers start to finish dependent on chart implanting. From the viewpoint of characterization and highlight installing, we present two novel neural system models separately for semi-administered hub arrangement. Spurred by pixel-level marking undertakings, we present Conditional Random Fields (CRFs) to smooth the grouping consequences of Graph Convolutional Network (GCN). By detailing mean-field surmised derivation for CRFs as Recurrent Neural Networks, we build up a profound start to finish arrange called GCN-CRF, prepared with the standard backpropagation calculation. Also, so as to catch k-step social data, we present Graph Gated Recurrent Units (Graph-GRU), actualizing GRU to diagram organized information as a feed-forward procedure with k shrouded layers. Examinations on three benchmark references arrange datasets exhibit that our two methodologies outflank a few as of late proposed strategies

SYSTEM ANALYSIS

Existing System:

General Recommendation. Recommender systems could be classified into three categories: content based methods,

Collaborative Filtering (CF) and the hybrid models. Among all models for building recommender systems, latent factor based models from the CF category are among the most popular techniques due to their relatively high performance in practice. These latent factor based models decomposed both users and items in a low latent space, and the preference of a user to an item could be approximated as the inner product between the corresponding user and item latent vectors. In the real-world applications, instead of the explicit ratings, users usually implicitly express their opinions through action or inaction. Bayesian Personalized Ranking (BPR) is such a popular latent factor based model that deals with the implicit feedback. Specifically, BPR optimized a pair wise based ranking loss, such that the observed implicit feedbacks are preferred to rank higher than that of the unobserved ones. As users may simultaneously express their opinions with several kinds of feedbacks (e.g., click behavior, consumption behavior). SVD++ is proposed to incorporate users' different feedbacks by extending the classical latent factor based models, assuming each user's latent factor is composed of a base latent factor, and an auxiliary latent factor that can be derived from other kinds of feedbacks. Due to the performance improvement and extensibility of SVD++, it is widely studied to incorporate different kinds of information, e.g., item text, multi-class preference of users.

Image Recommendation. In many image based social networks, images are associated with rich context information, e.g., the text in the image, the hash tags. Researchers proposed to apply factorization machines for



image recommendation by considering the rich context information. Recently, deep Convolutional Neural Networks (CNNs) have been successfully applied to analyzing visual imagery by automatic image representation in the modeling process. Thus, it is a natural idea to leverage visual features of CNNs to enhance image recommendation performance. E.g., VBPR is an extension of BPR for image recommendation, on top of which it learned an additional visual dimension from CNN that modeled users' visual preferences. There are some other image recommendation models that tackled the temporal dynamics of users' preferences to images over time, or users' location preferences for image recommendation. As well studied in the computer vision community, in parallel to the visual content information from deep CNNs, images convey rich style information. Researchers showed that many brands post images that show the philosophy and lifestyle of a brand, images posted by users also reflect users' personality. Recently, Gatys et al. proposed a new model of extracting image styles based on the feature maps of convolutional neural networks. The proposed model showed high perceptual quality for extracting image style, and has been successfully applied to related tasks, such as image style transfer, and high-resolution image stylisation. We argue that the visual image style also plays a vital role for evaluating users' visual experience in recommender systems. Thus, we leverage both the image content and the image style for recommendation.

Social Contextual Recommendation. Social scientists have long converged that a user's

preference is similar to or influenced by her social connections, with the social theories of homophily and social influence. With the prevalence of social networks, a popular research direction is to leverage the social data to improve recommendation performance. E.g., Ma et al. proposed a latent factor based model with social regularization terms for recommendation. Since most of these social recommendation tasks are formulated as non-convex optimizing problems, researchers have designed an unsupervised deep learning model to initialize model parameters for better performance. Besides, ContextMF is proposed to fuse the individual preference and interpersonal influence with auxiliary text content information from social networks. As the implicit influence of trusts and ratings are valuable for recommendation, TrustSVD is proposed to incorporate the influence of trusted users on the prediction of items for an active user. The proposed technique extended the SVD++ with social trust information. Social recommendation has also been considered with social circle, online social recommendation, social network evolution, and so on.

Disadvantages:

- In the existing work, the latent factor based models decomposed both users and items in a low latent space, and the preference of a user to an item could be approximated as the inner product between the corresponding user and item latent vectors.



- The system is less effective due to lack of content based recommendations.

Proposed System:

- ❖ The proposed model is built on the popular latent factor based models, which assumes users and items could be projected in a low latent space. In our proposed model, for each user, in addition to basic latent user interest vector, we identify three key aspects (i.e., upload history, social influence and owner admiration) that affect each user's preference, where each aspect summarizes a contextual factor from the complex relationships between users and images. Specifically, the upload history aspect summarizes each user's uploaded images to characterize her interest. The social influence aspect characterizes the influence from the social network structure, and the owner admiration aspect depicts the influence from the uploader of the recommended image. The three key aspects are combined to form the auxiliary user latent embedding. Furthermore, since not all aspects are equally important for personalized image recommendation, we design a hierarchical attention structure that attentively weight different aspects for each user's auxiliary embedding.
- ❖ The proposed hierarchical structure aims at capturing the following two distinctive characteristics. First, as social contextual recommendation naturally exhibits the hierarchical structure (various elements from each aspect, and the three aspects of

each user), we likewise construct user interest representation with a hierarchical structure. In the hierarchical structure, we first build auxiliary aspect representations of each user, and then aggregate the three aspect representations into an auxiliary user interest vector. Second, as different elements within each aspect, and different aspects are differentially informative for each user in the recommendation process, the hierarchical attention network builds two levels of attention mechanisms that apply at the element level and the aspect level.

- ❖ The system studies the problem of image recommendation in social image based platforms. By considering the uniqueness of these platforms, we identify three social contextual aspects that affect users' preferences from heterogeneous data sources.
- ❖ The system designs a hierarchical attention network to model the hierarchical structure of social contextual recommendation. In the attention networks, we feed embeddings from state-of-the-art deep learning models that are tailored for each kind of data into the attention networks. Thus, the attention networks could learn to attend differently based on the rich contextual information for user interest modeling.
- ❖ The system conducts extensive experiments on real-world datasets. The experimental results clearly show the effectiveness of our proposed model.

**Advantages:**

- The system is more effective since the proposed model is built on the popular latent factor based models, which assumes users and items could be projected in a low latent space.
- For each user, in addition to basic latent user interest vector, we identify three key aspects (i.e., upload history, social influence and owner admiration) that affect each user's preference, where each aspect summarizes a contextual factor from the complex relationships between users and images.

IMPLEMENTATION**MODULES**

- **OSN Server**

In this module, the Admin has to login by using valid user name and password. After login successful he can perform some operations such as View All Users And Authorize, View Friend Request and Response, View All Matched Users, View All User Post Posts, View All Posts Recommended Details, View All Friend Recommended Details, View All Collusion Attacker Details, View Posts Scores Results ,View Collusion Attacker Results

Friend Request & Response

In this module, the admin can view all the friend requests and responses. Here all the requests and responses will be displayed with their tags such as Id, requested user photo, requested

user name, user name request to, status and time & date. If the user accepts the request then the status will be changed to accepted or else the status will remains as waiting.

Social Network Friends

In this module, the admin can see all the friends who are all belongs to the same site. The details such as, Request From, Requested user's site, Request To Name, Request To user's site.

All Recommended Posts

In this module, the admin can see all the posts which are shared among the friends in same and other network sites. The details such as post image, title, description, recommend by name and recommend to name.

- **User**

In this module, there are n numbers of users are present. User should register before performing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user can perform some operations like My Profile, View All Matched Users, Search Friend and Find Friend Request, View All My Friends List, Add Post, View All My Post Posts, View All My Friends Posts ,View All Recommended Posts, All User Friends Recommended Details.

Searching Users

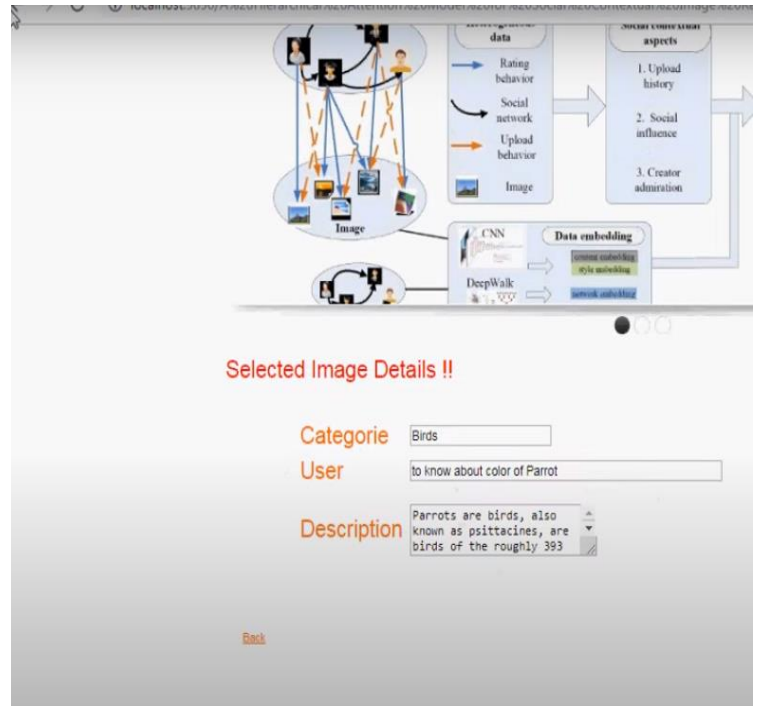
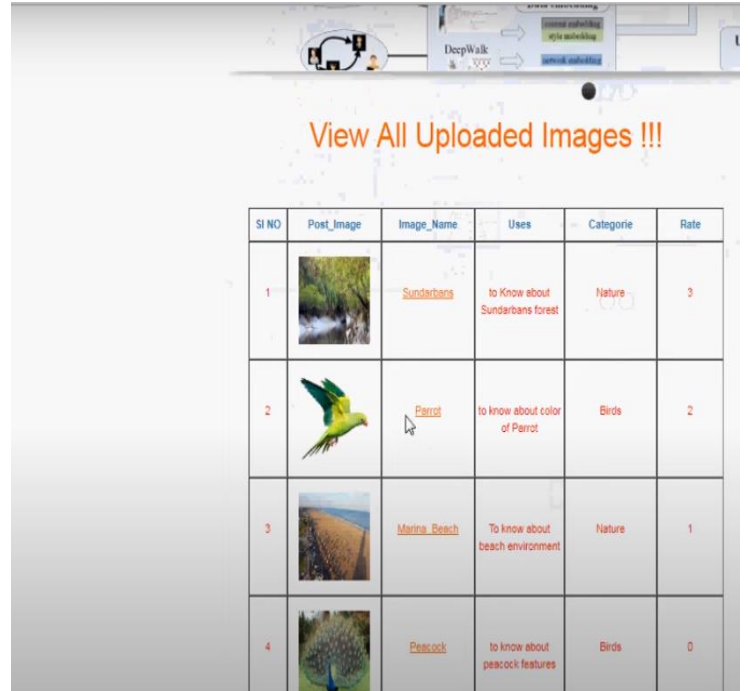
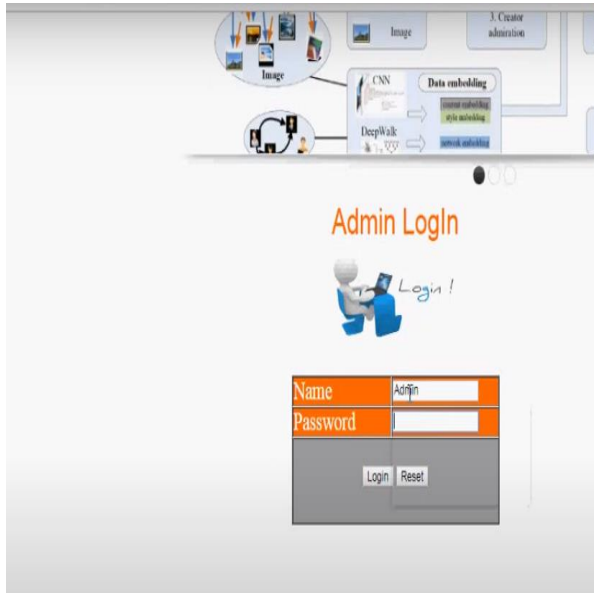
In this module, the user searches for users in Same Site and in Different Sites and sends friend requests to

them. The user can search for users in other sites to make friends only if they have permission.

Adding Posts

In this module, the user adds posts details such as title, description and the image of the post. The post details such as title and description will be encrypted and stores into the database.

Results





View Social Influence Attention Image !!!

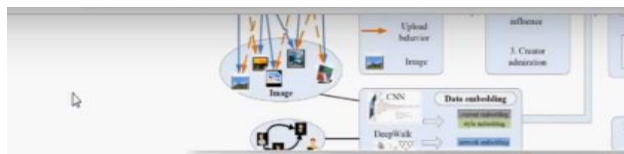
ID	Post Image	Influencer Image_Metric	Views	Category	Rate
1		0.8	1000	Nature	0.8



All Recommendations on post

Parrot

	Post Name	Parrot
	Category	Birds
	Rate	2
	Description	Parrots are birds, also known as psittacines, are birds of the roughly 393 species in 52 genera that make up the order Psittaciformes, found in most tropical and subtropical regions.
Recommended By	Recommended To	
Haresh	Kumar	
Haresh	Haresh	



All Recommendations on post

Marina_Beach

	Post Name	Marina_Beach
	Category	Nature
	Rate	1
	Description	Marina Beach is a natural carbon beach in Chennai Tamil Nadu, India, along the Bay of Bengal. The beach runs from near Fort St. George in the north to the Marina Square in the south, a distance of 6.5 km. It is the longest natural carbon beach in the world.
Recommended By	Recommended To	
Kumar	Haresh	

CONCLUSION

In this paper, we have proposed a hierarchical attentive social contextual model of HASC for social contextual image recommendation. Specifically, in addition to user interest modeling, we have identified three social contextual aspects that influence a user's preference to an image from heterogeneous data: the upload history aspect, the social influence aspect, and the owner admiration aspect. We designed a hierarchical attention network that naturally mirrored the hierarchical relationship of users' interest given the three identified aspects. In the meantime, by feeding the data embedding from rich heterogeneous data sources, the hierarchical attention networks could learn to attend differently to more or less important content. Extensive experiments on real-world datasets clearly demonstrated that our proposed HASC model consistently outperforms various state-of-the-art baselines for image recommendation.



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