

The RecSys 2010 Industry Panel

Will Recommenders Kill Search?

Recommender Systems – An Industry Perspective

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ABSTRACT

At the 2010 annual ACM Conference on Recommender Systems (RecSys 2010) a panel addressed emerging topics regarding recommender systems as a whole and specifically their role in industry. This report summarizes answers from a distinguished group of industry leaders representing different industries in which recommender systems are highly relevant. Panel members discuss questions regarding the role of recommender systems in their own industry area, killer applications, opportunities, and future directions.

Categories and Subject Descriptors

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

General Terms

Algorithms, Management, Measurement, Performance, Design, Human Factors.

Keywords

Recommender Systems, Industry, Collaborative Filtering, Search

1. INTRODUCTION

Recommender systems (RS) have been a fertile research area in the past 15 years [1], with collaborative filtering (CF) [4] approaches gradually becoming more popular than traditional content-based (CB) [8] recommenders, and hybrid RS [3] becoming common as well. As the volumes of information people are exposed to continue to grow dramatically, the importance of RS is likely to continue to grow and play a key role in many different industry domains.

A few early examples of applications were introduced in [9]: GroupLens [7] applies CF for recommending news articles; Fab [2] is a hybrid CF-CB RS for web pages; and ReferralWeb [6] combines social networks and CF to recommend people and communities and improve search results through these recommendations.

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RS have evolved to become an important business tool that is reshaping the world of e-commerce [10], helping customers find and purchase products, such as songs, books, movies, or restaurants. With the emergence of the social web, RS are starting to appear in leading social media services, taking advantage of folksonomies and social networks formed by the crowd [5].

In this paper, we discuss the state-of-the-art of RS in industry, as well as directions and opportunities towards the future. Panel participants span large and small companies, serving different roles within these companies, applying both online and offline recommender technologies, and in different fields and scales. They refer to questions around the key aspects making a RS successful, the relation to search engines, the use and value of RS within their organizations and the way they are evaluated, the potential killer application, and finally enumerate the most important business and technological challenges for RS looking forward.

2. PANEL QUESTIONS

2.1 Where do you position the area of RS w.r.t existing domains - IR, HCI, data mining? What other areas play key role for RS?

Henrik Schinzel. We are entering the age of recommendations. We will go from a world where text logical search is ubiquitous in finding content, to a world where recommendations will be the key technology in finding content. Thus recommendation systems will be key in information retrieval and finding content. An area I predict that RS will have a tremendous impact is advertising.

Pat Moore. I have found that IR, HCI and machine learning all play a key role in helping RS to perform better, but in the area of news personalization I have found performance to be more sensitive to IR methodology. I have seen approaches with strong IR methodology and no data mining with a particular HCI treatment outperform average IR methodology with strong data mining having the same HCI treatment.

Palash Nandy. I would position RS in between data mining and HCI.

Chahab Natar. Personalization and context-awareness are also central to building relevant RS. Personalization is about customizing the system w.r.t user profiles in general; context-awareness is an additional layer – customization is w.r.t data, sessions or users in particular. Note that personalization and

context-awareness actually involve IR, HCI and data mining but they are worth mentioning as standalone domains.

Pau Agullo. Neo Metrics uses different methodologies to approach each of the different business problems to solve. This may include supervised models that predict one individual behaviour (purchase product A) or models that deal with N products at a time (long tail). The decision is based on predictive power, data availability and overall cost-benefit.

2.2 What makes a RS successful? Particularly, what is the relative importance of the backend infrastructure, the algorithms, and the user interface? Are there any other important factors?

Palash Nandy. I think in terms of the solution, user experience is 50% of the game, with relevant usable data being 20%, and algorithms and infrastructure as 15% each.

Pau Agullo. Obviously, all three elements are important for the performance of RS. Given that we are not a ‘pure’ RS provider, our stress is to define systems that combine the statistical predictive power with business rules and economic logic, so that the resulting recommendation makes business sense.

Henrik Schinzel. In my answer, I have taken the perspective that “successful” is a commercially viable product and “importance” as the cost to develop the different parts. Then, 20% administration interface, 20% measuring and reporting the performance of the recommendations, 20% algorithms, and 40% auxiliary features (ease of integration, ease of administration, powerful filtering, easy to set up A/B tests and so on).

Pat Moore. I haven’t had the chance to experiment with backend infrastructure and no user interfaces yet. However, I have had a chance to do extensive algorithm testing. The key finding is that an ensemble approach has an enormous positive effect on performance. Combining even just two average performing algorithms has had stunning results. As far as other important factors go, for us, having an accurate taxonomy in terms of document topic labels has had a big positive effect.

Chahab Nastar. They are all important. HCI is particularly important for user adoption. It should be intuitive and simple yet non-intrusive (remember the MS Office “trombone” avatar).

2.3 Will RS kill search? What, in your view, makes RS different from search engines? What is the relationship between the two? Do you think the Web 3.0 is going to be about RS? Will users get what they need w/o needing to search?

Pat Moore. RS will not kill search, but they will offer serious competition in a few years. Human intent and interest are very difficult to predict and most algorithms aren’t there yet. The Amazon, Google News and iTunes Genius RS do not offer serious competition to search, but the Pandora RS does.

Palash Nandy. RS is a push system delivering content based on previous history of the user. Search is pull with the user

articulating and expressing intent. I think search will always be needed so that users can express interest in novel items and because users will come to know about existence of items out of band. The ideal system in my opinion will contain elements of both push and pull and allow seamless transitions between the two.

Pau Agullo. Indeed, the result of a search can be interpreted as a recommendation. Our view is that search engines will evolve to offer more customized responses to each individual user and both will converge in algorithms and methodologies.

Henrik Schinzel. Recommendations systems will not kill search, but will be an integral and essential part of search. Any system for finding content of the web that is popular five years from now will rely heavily on recommendations. This transformation is already happening.

Chahab Nastar. Search involves an active user pushing an explicit query. Relevance of the answer is a must. The system needs to filter the potential answers to maximize relevance to the query. RS act in the background with the user being usually passive. Implicit, potentially-relevant answers are pulled by the system. Relevance of the answer is somewhat less essential: when search is “closing in”, RS are about “opening up” the universe of answers. RS may not answer a query but rather provide additional views on a given subject.

Note that Web Search Engines are fiercely moving towards profiling the users in order to “recommend” targeted advertisement to them. In this case, one could argue that RS are a generalization of the search paradigm, or search is a specific case of RSs in which the query is explicit.

Finally, note that RSs make more sense within a website (or an enterprise) as opposed to the whole Internet.

2.4 How many of your organization's products include RS? Give one example where recommender systems have been shown to be useful in your organization.

Pau Agullo. Neo Metrics does not use RS internally at the moment. For our clients, we have two main families of recommendation systems:

- Best next action systems, designed for traditional sectors with a limited number of products and services and abundant information on customer behaviour, which allows a recommendation based on past behaviour (purchasing and non-purchasing).
- Long tail recommendation systems, designed to address product recommendation where there exists a large number of products, and typically there is only information on customers’ past purchases.

Chahab Nastar. The SAP BusinessObjects Explorer product uses RS to:

- Find the most relevant information space when a search query is performed
- Recommend of the best visualization of a dataset (Best Chart Recommendation)

Another product is “Search to Query” – inspecting structured data sources to suggest structured queries from an unstructured query. Finally, we are doing research on Text2Query – illustrating unstructured data with relevant visualizations derived from structured sources.

Pat Moore. We have three financial news and information web sites that will use RS in the very near future: www.bloomberg.com, www.businessweek.com and energy.bloomberg.com. In testing we have seen click rates on our related stories increase more than 3x.

Palash Nandy. Google has many user facing recommendation products. The ones I use most frequently are news personalization, reader recommendation, and YouTube related videos and recommendations. Recommendations on YouTube have significantly improved the number of playbacks of video on the site.

2.5 What are the main financial benefits of recommenders? Are they a feature or should they be part of the business strategy? What are the possible RS-based business models?

Pat Moore. For us, the main financial benefits of RS are the increased engagement we get from our visitors to whom we can deliver more ads. RS are part of our business strategy. We expect to differentiate ourselves from the competition by providing more relevant news and information to our visitors largely due to personalization.

Chahab Nastar. RS became popular in the context of e-commerce: Amazon, Netflix, etc. The objective is to transform a regular user into a buyer. The great advantage of a RS in a commercial website is that its ROI is somehow measurable. However, some RS may not be designed to directly generate sales, like “people you may know” on Social Networks (Facebook, LinkedIn). However, by profiling users, revenue generation through targeted advertisement is the objective.

Palash Nandy. RS require trust from users to be successful and I think the primary goal for RS should be increased traffic and greater user engagement with financial benefit being a side-effect of the user centric goal. However, if there is sufficient trust in a RS, it can be used as a tool to directly promote items that may be financially advantageous to the business trading-off with optimal user experience. For such a system, I would strongly recommend that promotional items are differentiated in the UI from the non-promotional items so as not to compromise user trust in the RS.

Pau Agullo. Our opinion is that the customization of any customer-company interaction must be a central part of any company strategy. RS support this demand in a number of cases and its development and deployment on customer interaction systems must be considered strategic for any company.

Henrik Schinzel. The financial benefits are:

- Better ROI on displayed content (products on e-commerce sites, targeted advertising).
- Attracting more visits to advertising financed sites/systems and/or customers to paid-for-sites/systems as the recommendations are a user friendly feature.

- Saving employees' time by allowing finding information faster and being part of help systems.

For a company like Avail, whose customers are e-commerce companies, it is pretty straightforward: revenue share, we take a cut of the sales we generate. For information systems, I would recommend a cost-per-recommendation request. This is a low entry barrier that scales well, is easy to administrate and is transparent.

2.6 Have we already seen the killer RS application? If so, what is it, and if we have not seen it, in which industry do you see the highest growth potential?

Palash Nandy. I think the killer RS application is in music. Music has some good properties for RS: 1) Users are interested in discovering novel music, 2) For audio-only music streams, the cost of evaluating a novel item is low due to passive consumption, 3) Users are often interested in types of music rather than a specific track, 4) Search for type of music is hard to articulate other than in terms of known examples and 5) there is good structured data available around music. We have seen some excellent RS based online radios but I believe there is still tremendous untapped potential here.

Pau Agullo. It is very likely for web search engines to become commodities in recommendation systems on the online world. We have not seen this trend yet, but it is likely to happen soon.

Pat Moore. I would say Pandora is the closest thing to a killer RS application so far.

Henrik Schinzel. The highest potential is in 1) engines that identify content on the Internet, 2) the entertainment industry where everything will move to on-demand, and 3) advertisement industry. Also, it is inevitable that search engines will have recommendation technology thus this is an area in which RS will blossom.

Media as we know it today - radio and TV - will fade out. In the next few years we will go from being served content to ordering content. Everything will be on-demand (“TV”-shows, movies, news, music, and so on). It will be impossible to navigate this plethora of choices without recommendation engines. It is inevitable that we are entering the age of recommendations.

Chahab Nastar. I don't think there is a killer RS yet. The major drawback of RS is that they are costly to build and often need to integrate lots of specific rules and algorithms, depending on the type of item to recommend. Google might actually have the best RS application around right now, with Adwords and Adsense. Recommender Systems are certainly bound to play a big role in the next generation of the Web (a.k.a the Semantic Web and the Internet of Things).

2.7 How do you evaluate RS? What are the most important aspects for a good evaluation for a RS?

Pat Moore. We consider click rates, time spent per visit, page views per visit (PVPV) and visits per visitor (VPV) when evaluating RS. PVPV and VPV are the most important measures of success for us due to the higher correlation with revenue.

Henrik Schinzel. The evaluation method depends on the industry. For a company like Avail, whose customers are in the e-commerce domain, it is fairly straightforward: how much money do we earn a customer over the customer's total cost of ownership of our system/service costs.

Palash Nandy. For Youtube, we evaluate performance of RS online with a set of standard metrics of user behavior, e.g., the number of video-playbacks per user for users exposed to recommendations. For changes to algorithms, we do A/B testing; dividing up the user traffic into experimental and control groups and measuring the performance of the new algorithms against the baseline using the standard metrics.

Pau Agullo. Ease of implementation, ability to include business rules and transparency on the motivations of the recommendations, wherever possible.

Chahab Nastar. There are two aspects in our evaluation:

- *Algorithmic:* RS are evaluated in two directions, inherited from IR considerations: precision and coverage (or recall). The precision of a RS determines how relevant its suggestions are, and its coverage determines how much of available resources it can recommend. Coverage is clearly important, but precision is generally the most important objective: how much of the world you can recommend does not matter if what you propose does not seem appropriate.
- *HCI:* The evaluation is empirical.

2.8 How is the recent explosion of the real-time web going to affect RSs and how can services based on platforms like Twitter benefit from RS?

Chahab Nastar. Most current RS techniques rely on extremely heavy pre-processing of data, for instance to compute correlation matrices. These methods would require significant re-design to be applicable to real-time data (when possible). Tweets, Facebook posts and other instant status updates represent a huge amount of information on users. However, these platforms and related services face the important problem of information overload for their users: how to determine the information that is going to be useful to the user when some other may just be noise.

Palash Nandy. I think we will see an increased need for RS that help users filter content from real-time web.

Pau Agullo. These platforms can benefit from RS to customize customer experience of all their users. These platforms have lots of available information on user environment and behaviour and this kind of data is extremely useful for RS.

Henrik Schinzel. With the real-time data information-hoses, recommender systems will be pivotal in harnessing this data by highlighting the relevant content in the rapid flow of information. Twitter should definitely have a RS that recommends people to follow and highlights tweets that are likely to be of personal interest to me.

Pat Moore. The real-time web introduces new contextual features for consideration. We are already layering context into the algorithms and it plays an important part in our ability to deal with

such things as the cold-start problem. However, we haven't seen much of an effect from services like Twitter and Facebook. That may be due to the fact that our audience is not particularly engaged with those services.

2.9 What are, in your opinion, the three most important business challenges in RS?

Henrik Schinzel. As RS are becoming a commodity, one business challenge will be to go from trying to convince potential customers that you have the largest amount of advanced algorithms in your "magic black box" to giving down-to-earth business logical reasons for why your system should be chosen rather than that of a competitor. Also, companies considering using a recommendation system will increasingly run competing systems against each other in live A/B-tests to see which performs the best. Thus it will be critical for RS to have top performing algorithms and - more importantly - an understanding of what type of recommendations performs the best for different verticals and how these should be configured.

Pau Agullo.

- Convincing industry of the strategic importance of customizing customer interactions to maximize yield, using recommendation systems, among others.
- Convincing users that data gathering on her tastes, profile and behaviour are necessary to make more customized recommendations and that is beneficial for her, and not an invasion of privacy.
- Extend the application of RS to nonstandard sectors such as politics or healthcare.

Pat Moore. 1) Getting Editorial to agree to let a machine make content recommendations, 2) getting visitors to embrace the RS and provide feedback, and 3) finding experienced talent.

Chahab Nastar. RS need to grow into more mature technology with re-usable methods and some generic algorithms. Very interesting technologies have been developed for and around RS in a web context, which help users buy and explore. One question we are interested in is: how can this technology be applied to an enterprise scenario to help business users cope with their daily job in a corporate environment? As an example, rating systems which are very common on the web do not make sense for the enterprise (I am not going to go against my CEO's rating...).

2.10 What are, in your opinion, the three most important technical challenges in RSs (and suggested directions)?

Palash Nandy. 1) Infrastructure that can scale to billions of items, 2) Algorithms that can handle billions of items and hundreds of millions of users with very sparse data, and 3) Systems that can combine search and recommendations seamlessly.

Pau Agullo. 1) Be able to make high quality recommendations on limited user information and 2) Add to user's preferences information on the preferences of her community (friends, family, etc.), which could influence her opinions or simply help infer better.

Henrik Schinzel. Performance (as in number of recommendations per second) will be a key issue. As we are moving into the age of recommendations, recommendations will be used in more and more high volume systems. Many recommendations systems and algorithms will be hard pressed to handle the volumes in many of these systems without substantial hardware investments. Personally I would be glad if the academic world would focus somewhat less on ratings - which was prevalent in RecSys09 - and more on other types of input, such as time spent on page, number of times viewed, product added to cart, product purchased and so on.

Pat Moore. 1) Collecting quality data, 2) getting the HCI right, and 3) (for news personalization) getting the taxonomy right. The results of the Netflix Prize suggest that an ensemble approach provides a large positive effect on performance and we have seen that in our testing. Perhaps an ensemble approach to document classification (i.e., a taxonomy ensemble) would provide a similarly large positive effect on performance for news personalization.

Chahab Natar. 1) Application and scalability of recommendation methods in real-time (or at least fast-changing) environments, 2) context awareness: this is already an important topic, but RS need to include more and more understanding of a user's intentions to provide more accurate suggestions, 3) semantics of recommendations: focus on meaning and added value rather than statistical correlations.

3. CONCLUSIONS

This panel covered a wide range of topics related to recommender systems in industry and presented several industry angles on the contribution, opportunities and challenges for recommender technologies. Participants highlighted both the importance of algorithms and performance to the success of a RS, but some mention that the user experience is the most important factor. Panelists review the use of RS in their areas, demonstrating the diversity of potential RS use cases, including e-commerce and online purchasing, search and visualization, online video and online news. The ROI on RS is measured mainly through impact on traffic and on delivered ads.

There is a consensus that RS will not kill search, but rather will be integrated more tightly and smartly into search engines, helping to enhance and personalize the search results, and playing a vital role in the success of future search technologies. While the differences between search as a "pull" and RS as a "push" system are emphasized, it is also argued that search can be viewed as a specific case of a RS that is contextually coupled with the user query. Panelists also agree that the killer application for RS has not been introduced yet. There is a prominent emphasis on online music recommendation as a high-impact high-potential area that is currently closest to presenting the best recommender applications.

In terms of evaluation, when a live system is available, a wide range of user behavior measurements are considered, such as page views, clicks, site visits, video playbacks, and more. In e-commerce, the goal is to increase income through recommender technologies relative to the cost of their deployments. This relates to some of the business challenges pointed out by the panelists, referring to the need to convince both service providers and users to accept advice from a "machine" and trust it over time. A few

other interesting challenges include handling privacy issues that have become more acute recently in many countries, extending the impact of RS within enterprises, and expanding to domains such as healthcare and governance.

Among the prominent technical challenges, coping with cold-start and data sparsity is mentioned by a few of our participants. Handling large scale in terms of infrastructure and algorithm performance is also highlighted. Treating real-time data, integration with search systems, and inferring context and semantics in a smarter way are also mentioned as key technological challenges towards the future.

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5. ABOUT THE PANELISTS

Pau Agulló. Director of Neo Metrics Barcelona. Pau holds a BA in Economics from Universitat Pompeu Fabra in Barcelona and an MSc in Economics and Econometrics from the European University Institute in Florence. Professionally he has developed in analytical consulting in telecom, banking among other sectors, working in several countries. Currently, he heads the Barcelona office of Neo Metrics, a leading consulting company specialized in marketing intelligence.

Pat Moore. Statistician, Bloomberg.com. Pat has a Masters Degree in Statistics from Cornell University, a Masters Degree in Math from the University of Nevada and a Masters Degree in Economics from the University of Colorado. He has worked as a

statistician at several prominent web sites including: NYTimes.com and Bloomberg.com. Among other things, Pat is an expert in the design and evaluation of online page tests generating millions of dollars of revenue through the execution of almost 200 tests. In his current role at Bloomberg.com, Pat manages the Content Personalization Research project which involves experimentation across a variety of content types and recommendation algorithms.

Palash Nandy. Manager, YouTube Discovery. Palash Nandy currently heads up the Discovery group at YouTube focusing on developing algorithms and systems such as personalized recommendations that allow users to find the best videos on the site. At YouTube for 3.5 years Palash is also interested in anomaly detection and spam prevention. Prior to YouTube, Palash managed the Fraud R&D team at PayPal which applied machine learning and genetic algorithm to find financial fraud. In his copious spare time, he likes to hack on microcontrollers, build walking robots and fly kites. Palash holds a B.Sc. in Computer Science from Stanford University.

Chahab Nastar. Sr. Scientific Director, SAP BusinessObjects. Chahab is the head the SAP BusinessObjects Academic Research Center (ARC), an open innovation effort focused on Business Intelligence. Previously, he was a successful entrepreneur in computer vision software, as well as the head of a research group on multimedia indexing at INRIA. Chahab graduated from Ecole des Ponts ParisTech (Engineering'91, PhD'94) and is a former fellow of the MIT Media Lab.

Henrik Schinzel. CTO, Avail Intelligence. As Chief Technology Officer at Avail Intelligence, Henrik's role is to foresee and understand the market trends, capture new ideas and translate these into features for Avail's software. Prior to co-founding Avail, Henrik was an AI expert and led developer at e-commerce software company Absalon (later Infobank and Izodia).

6. ABOUT THE ORGANIZERS

Ido Guy. Ido currently manages the Social Technologies group at the IBM Haifa Research Lab, to which he joined in 2000. He started his work as a student at the Verification Technologies and Asset Management groups, and then joined the Collaboration Technologies group in 2004. Since then, Ido has led and contributed to various projects around synchronous collaboration, telecommunication, social network mining and analysis, recommender systems, and social search. Ido holds B.Sc (Software Engineering) and M.Sc (Computer Science) from the Technion, Israel Institute of Technology. He is co-author of conference and journal papers in the fields of Data Mining, Human-Computer Interaction, Computer-Supported Cooperative Work, and Recommender Systems.

Alejandro Jaimes. Alex is Senior Research Scientist at Yahoo! Research where he manages the Social Media Engagement group. His work has led to over 70 technical publications in international conferences and journals. He has been granted several patents, and has been an invited speaker at Practitioner Web Analytics 2010, CIVR 2010, ECML-PKDD 2010 and KDD 2009 and (Industry tracks), ACM Recommender Systems 2008 (panel), DAGM 2008 (keynote), and several others. Before joining Yahoo! Dr. Jaimes was a visiting professor at U. Carlos III in Madrid and founded and managed the User Modeling and Data Mining group at Telefónica Research. Prior to that Dr. Jaimes was Scientific Manager at IDIAP-EPFL (Switzerland), and was previously at Fuji Xerox (Japan), IBM TJ Watson (USA), IBM Tokyo Research Laboratory (Japan), Siemens Corporate Research (USA), and AT&T Bell Laboratories (USA). Dr. Jaimes received a Ph.D. in Electrical Engineering (2003) and a M.S. in Computer Science from Columbia U. (1997) in NYC.