ERCIM "Alain Bensoussan" Fellowship Scientific Report

Fellow: **Georgios Pitsilis**
Visited Location : **Center of Quantifiable Quality of Service, NTNU, Norway**
Duration of Visit: **12 Months, 4th March 2009 – 3rd March 2010**

I - Scientific activity

During my fellowship at NTNU I worked in the areas of Recommender Systems and Trust management. The research I performed was mainly based on work that I have been doing previously during my PhD studies. Although the filed of my work was not different, in NTNU I tried to research new directions.

The main focus was on providing recommender systems with the benefits of trust-based social networks. Key point in social networking is the propagation of user properties so that friends can be reached via friends. Such properties express the trust relationships. Trust derivation and propagation are two major challenges in such networks. The first one is related to the lack of evidence that is necessary for forming up the trust network. As far as trust propagation, many proprietary models have been proposed as candidate solutions in the context of social trust.

As the above two problems have been approached in my previous work, the first one by building empirical mathematical formulae for describing the data precisely into trust metrics, and the second one by using an established mathematical logic, in the present work we emphasized on investigating the impact of these solutions to the evolution characteristics of the user network.

In the view of the fact that the intermediate trust network may have positive or negative impact in the quality of various performance metrics, we wanted to show how this impact varies over the lifetime of the system. Recommender systems exist for at least 15 years as they were introduced in the mid nineties for alleviating the information overload problem that users encounter when they come to make choices in their everyday life. Although the theory exists for that long, the models and studies performed do not consider the dynamic nature of those systems. Therefore, performance results produced from past studies are not useful enough for studying time-related issues of recommender systems, such as the cold-start problem. For studying the pros and cons of trust-based recommender systems against the no-use of trust we performed various simulation-based experiments using time-stamped data. Also crucial for demonstrating time-related issues is the choice of appropriate metrics. Therefore we introduced a number of metrics for expressing the benefit that can be achieved by the use of the trust network.

I had also been given the opportunity to collaborate with students from the security group and explore concepts that I had in mind but there was no chance to experiment with before. More specifically, the cooperation with doctoral student P-H. Chia was found to be a nice opportunity for exploring recommender systems concepts in depth. More specifically in our cooperative work we focused on building criteria for nearest neighbourhood selection of users. We investigated the benefits, in terms of improved prediction accuracy, when the more experienced users or the most trusted are chosen for forming communities. Different from what I have experimented with before, that work encompassed exploration of behavioural aspects of users, as this inferred from information provided by the users themselves. The outcome of this work has been accepted for publication at a conference. (see reference [3]). Extension research work, with regard to this investigation, is currently underway and it is seen as an opportunity for future collaboration with Q2S-NTNU.

During my fellowship I had also been allocated tasks of reviewing papers for conferences and journals. In total I reviewed 6 papers for the following events:

- Special Issue of Electronic Commerce Research Journal on Trust and Privacy Aspects of Electronic Commerce (ECRJ): 3 papers, allocated by the Guest Editor, Phd Student: M. Tavakolifard.
- The 14th Nordic Conference on Secure IT Systems (NordSec): 2 papers, allocated by the program co-chair: Prof. Knapskog.
- Networked Services and Applications – Engineering, Control and Management – EUNICE 2010: 1 paper, allocated by program chair: Prof. Knapskog.
- Special Issue on "Trust and Trust Management" of JTAER (Journal of Theoretical and Applied Electronic Commerce Research: 1 paper,allocated by Guest Editor: Prof. Audun Josang.

II- Publication(s) during your fellowship

[1]. Pitsilis, G.," Trust-enhanced Recommender Systems for Efficient On-line collaboration", in proc IFIPTM 2009 International Conference on Privacy, Trust Management and Security, 15-20 June 2009, West Lafayette, USA, Springer IFIP series, ISBN : 978-3-642-02055-1.

Abstract: Trust has been explored by many researchers in the past as a solution for assisting the process of recommendation production. In this work we are examining the feasibility of building networks of trusted users using the existing evidence that would be provided by a standard recommender system. As there is lack of models today that could help in finding the relationship between trust and similarity we build our own that uses a set of empirical equations to map similarity metrics into Subjective Logic trust. In this paper we perform evaluation of the proposed model as being a part of a complete recommender system. Finally, we present the interesting results from this evaluation that shows the performance and benefits of our trust modeling technique as well as its impact on the user community as it evolves over time.

[2]. Pitsilis, G., **Knapskog J. S.,** "Social Trust as a solution to address sparsity-inherent problems of Recommender systems", in proc. ACM RecSys 2009 Workshop on Recommender Systems & The Social Web, Oct 2009, New York, USA. ISSN: 1613-0073, D.Jannach, W.Geyer, J.Freyne, S.Anand, C.Dugan, B.Mobasher, A.Kobsa.(Eds.)

Abstract: Trust has been explored by many researchers in the past as a successful solution for assisting recommender systems. Even though the approach of using a web-of-trust scheme for assisting the recommendation production is well adopted, issues like the sparsity problem have not been explored adequately so far with regard to this. In this work we are proposing and testing a scheme that uses the existing ratings of users to calculate the hypothetical trust that might exist between them. The purpose is to demonstrate how some basic social networking when applied to an existing system can help in alleviating problems of traditional recommender system schemes. Interestingly, such schemes are also alleviating the cold start problem from which mainly new users are suffering. In order to show how good the system is in that respect, we measure the performance at various times as the system evolves and we also contrast the solution with existing approaches. Finally, we present the results which justify that such schemes undoubtedly work better than a system that makes no use of trust at all.

[3]. Pitsilis, G., **Chia, H.P. ,** "Does Trust Matter for User Preferences? A study on Epinions ratings", to appear in proc. IFIPTM 2010 International Conference on Privacy, Trust Management and Security, Morioka, Iwate, Japan, 14-18 June-2010.

Abstract: Recommender systems have evolved during the last few years into useful online tools for assisting the daily e-commerce activities. The majority of recommender systems predict user preferences relating users with similar taste. Prior research has shown that trust networks improve the performance of recommender systems, predominantly using algorithms devised by individual researchers. In this work, omitting any specific trust inference algorithm, we investigate how useful it might be if explicit trust relationships (expressed by users for others) are used to select the best neighbours (or predictors), for the provision of accurate recommendations. We conducted our experiments using data from *Epinions.com,* a popular recommender system. Our analysis indicates that trust information can be helpful to provide a slight performance gain in a few cases especially when it comes to the less active users.

III -Attended Seminars, Workshops, and Conferences

I attended the following scientific conferences at which I also gave presentations of my work.

- IFIPTM 2009, Third IFIP WG 11.11 International Conference on Trust management, June 16th-19th , 2009, Purdue University, West Lafayette, USA.
- RecSys 2009, 3rd ACM Conference on Recommender Systems, October 22-25, 2009, New York City, New York, USA.

I also participated in two local events:

- IWSCN 2009, 1st International Workshop on Security and Communication Networks, NTNU, Trondheim. May 20-22, 2009.
- NISK 2009, Norwegean Information Security Conference. (National Event), Trondheim, November 23rd - 25th, 2009.

Also attended all the weekly seminars of the security group in Q2S,NTNU where the progress of the members of the group was presented. (phd-students and postdocs.) I also had the chance to present twice the progress of my work in this event.

IV – Research Exchange Programme (12 month scheme)

First Period: One week at EPFL, Lausanne, Switzerland. (21st – 26th June 2009).
Project group: Multimedia Signal Processing Group headed by Prof. Touraj Ebrahimi.
Scientific contact: Dr. Frederic Dufaux. (email: frederic.dufaux@epfl.ch)
During my visit at EPFL I investigated the possibility of cooperating with the group as specialist in the trust area. During the visit I have the chance to discuss my ideas with the members of the group on how a trust model could be useful in tag propagation problem in digital media. A presentation that also was given by me had been a good chance for reception of useful feedback on the integration of trust models into real world problems.

Second Period: One Week at FNR, Luxembourg. (31st January – 5th February 2010).
Project Group: Security and Trust of Computer Systems Group (SaToSS) headed by Prof. Sjouke Mauw.
Scientific contact: Prof. Sjouke Mauw. (email: sjouke.mauw@uni.lu).
During my stay I had the chance to meet almost with all members of the group individually (phd-students and postdocs) and discuss my potential contribution to their work. I also gave a presentation to the group in which the possibilities for future collaboration were examined. I also attended the presentations given by various group members and visitors at the time of my stay. As far as the context of a future collaboration, the conclusion of our discussions was that a possible context could be the formal modelling of attacks of recommender systems.

Acknowledgments

I would like to thank my scientific contact Prof. Knapskog for welcoming me in his research group and the administrative and technical stuff for the help they provided in many occasions.