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# Effective page recommendation algorithms based on distributed learning automata and weighted association rules

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**Authors** R. Forsati
Department of Computer Engineering, Islamic Azad University, Qazvin Branch, Qazvin, Iran
M. R. Meybodi
Department of Computer Engineering and Information Technology, Amirkabir University of Technology, Tehran, Iran and School of Computer Science, Institute for Research in Fundamental Sciences (IPM), P.O. Box 19395-5746, Tehran, Iran

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## ABSTRACT

Different efforts have been done to address the problem of information overload on the Internet. Recommender systems aim at directing users through this information space, toward the resources that best meet their needs and interests by extracting knowledge from the previous users' interactions. In this paper, we propose three algorithms to solve the web page recommendation problem. In our first algorithm, we use distributed learning automata to learn the behavior of previous users' and recommend pages to the current user based on learned patterns. By introducing a novel weighted association rule mining algorithm, we present our second algorithm for recommendation purpose. Also, a novel method is proposed to pure the current session window. One of the challenging problems in recommendation systems is dealing with unvisited or newly added pages. By considering this problem and improving the efficiency of first two algorithms we present a hybrid algorithm based on distributed learning automata and proposed weighted association rule mining algorithm. In the hybrid algorithm we employ the HITS algorithm to extend the recommendation set. Our experiments on real data set show that the hybrid algorithm performs better than the other algorithms we compared to and, at the same time, it is less complex than other proposed algorithms with respect to memory usage and computational cost too.

## REFERENCES

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| | |
|---|---|
| Agrawal and Srikant, 1994. | Agrawal, R., & Srikant, R. (1994). Fast algorithms for mining association rules in large databases. In Proceedings of the 20th international conference on very large data bases VLDB'94, Santiago, Chile (pp. 487-499). |
| Agrawal et al., 1993. | Agrawal, R., Imielinski, T., & Swami, A. (1993). Mining association between sets of items in massive database. In International proceedings of the ACM-SIGMOD international conference on management of data (pp. 207-216). |
| Anand and | Anand, S. S., & Mobasher, B. (2005). Intelligent techniques in web |

| | |
|---|---|
| Mobasher, 2005. | personalization. In Lecture notes in artificial intelligence (Vol. 3, pp. 1-37). Berlin, Germany: Springer-Verlag. |
| Beigy and Meybodi, 2002. | Beigy, H., & Meybodi, M. R. (2002). A new distributed learning automata based algorithm for solving stochastic shortest path problem. In Proceedings of the sixth international joint conference on information science, Durham, USA (pp. 339-343). |
| Bose et al., 2006. | Bose, A., Beemanapalli, K., Srivastava, J., & Sahar, S. (2006). Incorporating concept hierarchies into usage mining based recommendations. In Proceedings of the eighth WEBKDD workshop. |
| Burke, 2002. | Burke, R. (2002). Hybrid recommender systems: Survey and experiments. In User modeling and user-adapted interaction. |
| Cai et al., 1998. | Cai, C. H., Fu, A. W. C., Cheng, C. H., & Kwong, W. W. (1998). Mining association rules with weighted items. In Database engineering and applications symposium. Proceedings IDEAS'98 (pp. 68-77). |
| Chan, 1999. | Chan, P. K. (1999). Non-invasive learning approach to building web user profiles. In Workshop on web usage analysis and user profiling, fifth international conference on knowledge discovery and data mining, San Diego. |
| Cooley et al., 1997. | Cooley, R., Mobasher, B., & Srivastava, J. (1997). Web mining: Information and pattern discovery on the World Wide Web. In Proceedings of IEEE international conference tools with AI (pp. 558-567). |
| Cooley et al., 1999. | Data preparation for mining World Wide Web browsing patterns. Journal of Knowledge and Information Systems. 5-32. |
| Deshpande and Karypis, 2004. | Item-based top-n recommendation algorithms. ACM Transactions on Information Systems (TOIS). |
| Dumais et al., 2003. | Dumais, S., Joachims, T., Bharat, K., & Weigend, A. (2003). Implicit measures of user interests and preferences. Workshop report: ACM SIGIR Forum, Fall 2003. |
| Eirinaki et al., 2003. | Eirinaki, M., Vazirgiannis, M., & Varlamis, I. (2003). SEWeP: Using site semantics and taxonomy to enhance the web personalization process. In Proceedings of the nineth SIGKDD conference. |
| Eirinaki et al., 2004. | Eirinaki, M., Lampos, C., Paulakis, S., & Vazirgiannis, M. (2004). Web personalization integrating content semantics and navigational patterns. In Proceedings of the sixth ACM workshop on Web Information and Data Management (WIDM). |
| Eirinaki and Vazirgiannis, 2003. | Web mining for web personalization. ACM Transactions on Internet Technology. v3 i1. 1-27. |
| Fu et al., 2000. | Fu, X., Budzik, J., & Hammond, K. (2000). Mining navigation history for recommendation. In Proceedings of the fifth international conference on intelligent user interfaces (pp. 106-112). |
| Gery and Haddad, 2003. | Gery, M., & Haddad, H. (2003). Evaluation of web usage mining approaches for user's next request prediction. In Proceedings of the fifth ACM international workshop on web information and data management (pp. 74-81). |
| Herlocker et al., 2000. | Herlocker, J., Konstan, J., Brochers, A., & Riedel, J. (2000). An algorithmic framework for performing collaborative filtering. In Proceedings of 200 conference on research and development in information retrieval. |
| Keselj et al., 2003. | Keselj, V., Peng, F., Cercone, N., & Thomas, C. (2003). N-gram-based author profiles for authorship attribution. In Proceedings of the conference pacific association for computational linguistics, Nova Scotia, Canada. |
| Kleinberg, 1999. | Authoritative sources in a hyperlinked environment. Journal of the ACM. v46 i5. 604-632. |

| | |
|---|---|
| Langville and Meyer, 2004. | Deeper inside PageRank. Internet Mathematics. 335-400. |
| Li and Zaiane, 2004. | Li, J., & Zaiane, O. R. (2004). Combining usage content and structure data to improve web site recommendation. In Fifth international conference on electronic commerce and web. |
| Liang and Chunping, 2006. | Liang, Y.,& Chunping, L. (2006). Incorporating pageview weight into an association-rule-based web recommendation system, AI 2006, LNAI 4304 (pp. 577-586). Berlin, Heidelberg: Springer-Verlag. |
| Liue and Keselj, 2007. | Combined mining of web server logs and web contents for classifying user navigation patterns and predicting users' future requests. Data and Knowledge Engineering. |
| Mahony et al., 2004. | Collaborative recommendations: A robustness analysis. ACM Transactions on Internet Technology. v4 i4. 344-377. |
| Meybodi and Beigy, 2001. | Meybodi, M. R., & Beigy, H. (2001). Solving stochastic path problem using distributed learning automata. In Proceedings of the sixth annual international CSI computer conference, CSICC2001, Isfahan, Iran (pp. 70-86). |
| Meybodi and Beigy, 2003. | Meybodi, M. R., & Beigy, H. (2003). Solving stochastic shortest path problem using Monte Carlo sampling method: A distributed learning automata approach. In Lecture notes in advances in soft computing: Neural networks and soft computing (pp. 626-632). Springer-Verlag. |
| Miao et al., 2004. | Miao, Y., Keselj, V., & Milios, E. E. (2004). Comparing document clustering using N-grams terms and words. Master's thesis, Faculty of Computer Science, Dalhousie University. |
| Mobasher, 2005. | Web usage mining and personalization. In: Singh, P., Munindar, M. (Eds.), Practical handbook of internet computing, CRC Press. |
| Mobasher et al., 2000. | Automatic personalization based on web usage mining. Communications of the ACM. v43 i8. 142-151. |
| Mobasher et al., 2002. | Discovery and evaluation of aggregate usage profiles for web personalization. Data Mining and Knowledge Discovery. 61-82. |
| Mobasher et al., 2000. | Mobasher, B., Dai, H., Luo, T., Sun, Y., & Zhu, J. (2000). Integrating web usage and content mining for more effective personalization. In EC-Web (pp. 165-176). |
| Mobasher et al., 2001a. | Mobasher, B., Dai, H., Luo, T., & Nakagawa, M. (2001a). Effective personalization based on association rule discovery from web usage data. In Proceedings of the third ACM Workshop on Web Information and Data Management (WIDM01), Atlanta, Georgia. |
| Mobasher et al., 2001b. | Mobasher, B., Dai, H., Luo, T., & Nakagawa, M. (2001b). Improving the effectiveness of collaborative filtering on anonymous web usage data. In Proceedings of the IJCAI 2001 Workshop on Intelligent Techniques for Web Personalization (ITWP01). |
| Morita and Shinoda, 1994. | Morita, M., & Shinoda, Y. (1994). Information filtering based on user behavior analysis and best match text retrieval. In Proceedings of the 17th annual international ACM SIGIR conference on research and development in information retrieval (pp. 272-281). Dublin, Ireland: Springer-Verlag, New York Inc. |
| Mulvenna et al., 2000a. | Personalization on the net using web mining. Communication of the ACM. 8-43. |
| Mulvenna et al., 2000b. | Personalization on the net using web mining. Communications of the ACM. v43 i8. 123-125. |
| Nakagawa and Mobasher, 2003. | Nakagawa, M., & Mobasher, B. (2003). A hybrid web personalization model based on site connectivity. In The fifth international WEBKDD workshop: Web mining as a premise to effective and intelligent web applications (pp. 59-70). |

| | |
|---|---|
| Narendra and Thathachar, 1989. | Learning automata: An introduction. Prentice Hall, Englewood Cliffs, NJ. |
| Page et al., 1998. | The PageRank citation ranking: Bringing order to the web. Stanford University. |
| Resnick et al., 1994. | Resnick, P., Iacovou, N., Sushak, M., Bergstrom, P., & Riedl, J. (1994). Grouplens: An open architecture for collaborative filtering of Netnews. In Proceedings of the 1994 computer supported collaborative work conference. |
| Sarwar et al., 2001. | Sarwar, B., Karypis, G., Konstan, J., & Riedl, J. (2001). Item-based collaborative filtering recommendation algorithms. In Proceedings of the 10th international World Wide Web conference, Hong Kong. |
| Shahabi et al., 1997. | Shahabi, C., Zarkesh, A., Abidi, J., & Shah, V. (1997). Knowledge discovery from user's web-page navigation. In Proceedings of the seventh IEEE international, workshop on research issues in data engineering. |
| Sinha and Swearingen, 2001. | Sinha, R., & Swearingen, K. (2001). Comparing recommendations made by online systems and friends. In Proceedings of the Delos-NSF workshop on personalization and recommender systems in digital libraries. |
| Smyth and Mcclave, 2001. | Smyth, B., & Mcclave, P. (2001). Similarity vs diversity. In Proceedings of the fourth international conference on case-based reasoning: Case-based reasoning research and development (pp. 347-361). |
| Srivastava et al., 2001. | Web usage mining: Discovery and applications of usage patterns from Web Data. SIGKDD Explorations. v1 i2. 2-23. |
| Tao et al., 2003. | Tao, F., Murtagh, F., & Farid, M. (2003). Weighted association rule mining using Weighted Support and Significance Framework. In Proceedings of the nineth SIGKDD conference. |
| Thathachar and Harita Bhaskar, 1987. | Learning automata with changing number of actions. IEEE Transactions on Systems Man and Cybernetics. v17 i6. 1095-1100. |
| Tomovic et al., 2005. | N-gram-based classification and hierarchical clustering of genome sequences. Computer Methods and Programs in Biomedicine. |
| Wasfi, 1999. | Wasfi, A. M. (1999). Collecting user access patterns for building user profiles and collaborative filtering. In IUI'99: Proceedings of the 1999 international conference on intelligent user interfaces. |
| Zaiane and Zaiane, 2004. | Li, J., & Zaiane, O. R. (2004). Combining usage, content and structure data to improve web site recommendation. In Fifth international conference on electronic commerce and web. |
| Za$#239;ane et al., 2007. | Mission-based navigational behavior modeling for web recommender system. Springer-Verlag, Berlin, Heidelberg. |
| Ziegler et al., 2004. | Ziegler, C., Lausen, G., & Schmidt-Thieme, L. (2004). Taxonomy-driven computation of product recommendations. In Proceedings of the ACM conference on information and knowledge management (pp. 406-415). |
| Ziegler et al., 2005. | Ziegler, C., Mcnee, S. M., Konstan, J. A., & Lausen, G. (2005). Improving recommendation lists through topic diversification. In Proceedings of the 14th international conference on the World Wide Web (pp. 22-32). |


## INDEX TERMS

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