Social Networks: Service Selection and Recommendation

Jebrin Al-Sharawneh

Submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy (Information Systems)

Faculty of Engineering and Information Technology

University of Technology, Sydney

September, 2012

Abstract

The Service-Oriented Computing paradigm is widely acknowledged for its potential to revolutionize the world of computing through the utilization of Web services. It is expected that Web services will fully leverage the Semantic Web to outsource some of their functionalities to other Web services that provide value-added services, and by integrating the business logic of Web services in the form of business to business and business to consumer e-commerce applications.

In the Service Web, Web services and Web-Based Social Networks are emerging in which a wide range of similar functionalities are expected to be offered by a vast number of Web services, and applications can search and compose services according to users' needs in a seamless and an automatic fashion. Web services are expected to outsource some of their functionalities to other Web services. In such situations, some services may be new to the service market, and some may act maliciously in order to be selected. A key requirement is to provide mechanisms for quality selection and recommendation of relevant Web services with perceived risk considerations.

Although the future of Web service selection and recommendation looks promising, there are challenging issues related to user knowledge and behavior, as well as issues related to recommendation approaches. This dissertation addresses the demanding issues in Web service selection and recommendation from theory and practice perspectives. These challenges include cold-start users, who represent more than 50% of the social network population, the capture of users' preferences, risk mitigation in service selection, customers' privacy and application scalability.

This dissertation proposes a novel approach to automate social-based Web service selection and recommendation in a dynamic environment. It utilizes Web-Based Social Networks and the "Follow the Leader" strategy, for a Credibility-based framework that includes two credibility models: the user Credibility model which is used to qualify

consumers as either leaders or followers based on their credibility, and the service Credibility model which is used to identify the best services that act as market leaders.

Experimental evaluation results demonstrate that the social network service selection and recommendation approach utilizing the credibility-based framework and “Follow the Leader” strategy provides an efficient, effective and scalable provision of credible services, especially for cold-start users. The research results take a further step towards developing a social-based automated and dynamically adaptive Web service selection and recommendation system in the future.

Certificate of Authorship/Originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Jebrin Al-Sharawneh

September, 2012

To the souls of my parents
who taught me to love learning

Acknowledgments

Although I planned to complete this degree thirty five years ago, as the Italian proverb says "The right time comes but once". I think this research project would not have been possible without the support of the following people:

First and foremost, I would like to express my gratitude to my supervisor Professor Mary-Anne Williams for her wise advice, careful guidance, useful connections, constant support and enduring patience throughout my studies and while writing this dissertation. Mary-Anne's advice on the use of "Follow the Leader" strategy was the turning point of my research. Learning how to research and produce publications is much easier with a supervisor who has as much experience and enthusiasm as Mary-Anne. I would like also to thank my co-supervisor, Associate Professor David Goldbaum for giving me the opportunity to work with him on the simulations of "Follow the Leader" project and for his invaluable inputs on "Follow the Leader" strategy.

I must also acknowledge the following people from the University of Technology (UTS): My fellow students in the Innovation and Enterprise Research Laboratory, through countless discussions, they have provided me with insightful suggestions and valuable feedbacks that have helped enhance my work, special thanks also go to Dr. Benjamin Johnston who provided me with valuable feedback that enhanced the final version of this dissertation. QCIS people for their support. Special thanks go to all people at UTS who provided me with the needed support. The many researchers, including Dr. Mohammad Momani, Jamal and all other friends, whose kind suggestions, feedback and advice were invaluable in my research.

Last, but not the least, I would like to thank my family for the endless support they provided me throughout my life. Without their love, patience and encouragements I would not have finished this thesis. First, I would like to thank my wife and best friend, Intisar, for supporting me and keeping me happy throughout my life until we achieved our mission towards our sons and this degree. I would like to thank my sons and their partners: Samer and Hanna, Rami and Marium, Fadi and Rawan for their love and support. Special thanks go to my daughters Hanna, Susan and Rawan who provided me with a continuous proof reading throughout my doctoral stint. I would also like to thank all my brothers and my sister for their support. Special thanks go to my brothers and friends: Ahmad, Yousef and

Abu-Suhail, for giving me perspective whenever I needed it and all the numerous friends who have been there for me in times of need and helped me stay during the long, hard and ultimately enriching time that I have spent as a graduate student.

In conclusion, I recognize that this research would not have been possible without the financial assistance from the University of Technology through the Australian Postgraduate Awards (APA), Faculty of Engineering and Information Technology (FEIT), Centre of Quantum Computation and Intelligent Systems (QCIS), and Innovation and Enterprise Research Laboratory; I express my gratitude to these agencies.

Table of Contents

Extended Table of Contents

List of Figures

List of Tables

List of Abbreviations

ABMS	Agent-based Modeling and Simulation
B2B	Business-to-Business
B2C	Business-to-Consumer
BPEL4WS	Business Process Execution Language for Web Services
CF	Collaborative Filtering
HITS	Hyperlink-Induced Topic Search
IOPE	Input, Output, Post-conditions and Effects
MAE	Mean Absolute Error
OWL	Web Ontology Language
P2P	Peer to Peer
QoS	Quality of Service
QoWS	Quality of Web Service
RDF	Resource Description Framework
RS	Recommender System
SLA	Service Level Agreement
SNA	Social Network Analysis
SNAS	Social Network Analysis Studio
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SOC	Service Oriented Computing
SSSRM	Social-based Service Selection and Recommendation Model
SWS	Semantic Web Services
TECBF	Trustworthiness Expertise Credibility-Based Framework
UCrM	User Credibility Model
UDDI	Universal Description, Discovery and Integration
UDK	User Domain Knowledge
URI	Uniform Resource Identifier

W3C	World Wide Web Consortium
WBSN	Web-based Social Network
WS	Web Service
WSCrM	Web Service Credibility Model
WSDL	Web Service Description Language
WS-Policy	Web Services Policy Framework
XML	Extensible Markup Language