AI Planning for Automating Web Service Composition in Tourism Domain

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Abstract

Web services are changing the way how online business operates, especially in tourism domain. Typically, existing Web services are built individually as atomic services. The rapid growth of Web services has created the need for Web service composition so that clients can compose atomic services to achieve more complex tasks. Thus, to ease the process, automation is important. Automation means that the service composition is done with less or no user interference. Hence, we propose a framework to automatically compose Web services using SHOP2 planner. SHOP2 is a planner that implements AI planning technique, called Hierarchical Task Network (HTN). We propose and implement a framework to compose services available from the Australian Tourism Data Warehouse (ATDW) and present the example execution results. We also outline some drawbacks of our approach, identify open problems, and suggest future work to improve the framework.

Keywords: Web service composition, automatic composition, AI planning, SHOP2, ATDW
CR Categories: D.1.3, D.1.6, D.1.5, I.2.8

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In memory of Jimmy, Timmy, and Abu.

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CHAPTER 1

Introduction

The Web is no longer only an information repository, but evolving towards a virtual environment for business process integration. This vision is realized by many of Web services available for interactive business purposes. A Web Service is a software system designed to support interoperable machine-to-machine interactions over the Web [9]. *Interoperable* means that Web services are operable and composable regardless of the programming languages, the platform, and the communication protocol used [13]. Online banking, flight booking, temperature control, hotel reservations, online bookshop, etc. are examples of Web services that are available and ready for client consumptions. Web service has created enormous industry commitment because of its potential for improving the way we do business online [39].

1.1 Problem Definition and Motivation

According to Gartner Inc. review [1, 17], a survey on 111 companies in the U.S. shows that 65% of the companies are already working on Web service projects or they are considering implementing the services very soon. According to the survey report, these companies still engaging in Web service projects despite the economic slowdown in 2003. The survey also estimated that $3 billions worth of Web service projects have been carried out in 2003. By 2008, it will increase to $15.8 billions. However, the developed Web services are individual, standalone services termed as atomic services. As the services grow rapidly on the Web, the clients' needs for achieving more complex tasks increase. Web service composition is seen as a new way of accessing or consuming the services online. Service composition is a powerful key promise of service-oriented programming paradigm. With service composition, not only can we consume a single atomic Web service, we can now integrate existing services together to perform more complex tasks. One of the most promising domain for such integration is in tourism, where we already have access to many Web services. For example, flight booking,

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Bibliography

[1] Gartner survey shows companies continuing web services development despite economic slowdown. http://www.webservices.org/index.php/ws/content/view/full/3228, July 2003.

[2] Web services: A practical introduction to soap web services, 2003. By Systinet Corporation.

[3] Australian tourism web service: Distributor guideline, July 2004. By Australian Tourism Data Warehouse Pty. Ltd.

[4] Viamichelin web services. http://ws.viamichelin.com/wswebsite/, 2004.

[5] whereis.com. http://www.whereis.com.au, 2004.

[6] Mappoints web service. http://www.spatialpoint.com/mappoint-web-service.asp, 2005.

[7] Regular expression. http://java.sun.com/docs/books/tutorial/extra/regex/intro.html, 2005.

[8] Armstrong, E., Ball, J., Bodoff, S., Carson, D. B., Evans, I., Fisher, M., Fordin, S., Green, D., Haase, K., and Jendrock, E. Java web service tutorial, December.

[9] Booth, D., Haas, H., McCabe, F., Newcomer, E., Champion, M., Ferris, C., and Orchard, D. Web services architecture, February 2004. Also available at http://www.w3.org/TR/ws-arch/.

[10] Carman, M., Serafini, L., and Traverso, P. Web service composition as planning, 2003.

[11] Casati, F., Ilnicki, S., Jin, L., Krishnamoorthy, V., and Shan, M.-C. Adaptive and dynamic service composition in eflow. Tech. rep., 2000. Also available at http://www.hpl.hp.com/techreports/2000/HPL-2000-39.pdf.

[12] Chandrasekaran, S., Miller, J. A., Silver, G. S., Arpinar, B., and Sheth, A. P. Composition, performance analysis and simulation of web services.

[13] Cohen, F. Understanding web service interoperability. http://www-106.ibm.com/developerworks/webservices/library/ws-inter.html, February 2002.

[14] Gottschalk, K., Graham, S., Kreger, H., and Snell, J. Introduction to web services architecture. *IBM Systems Journal 41*, 2 (2002).

[15] Harkey, D., Appajodu, S., and Larkin, M. *Wireless Java Programming for Enterprise Applications: Mobile Devices Go Corporate*. Wiley Publicshing Inc., 2000.

[16] Hendler, J., and McGuiness, D. The darpa agent markup language. *IEEE Intelligent Systems 15*, 6 (November/December 2000), 72–73.

[17] Hogan, J. Gartner: Web services projects rising out project cuts. http://searchwebservices.techtarget.com/, July 2003.

[18] Lasilla, O. The resource description framework. *IEEE Intelligent Systems 15*, 6 (November/December 2000), 67–69.

[19] Martin, D. Owl-s: Semantic markup for web services, December 2003.

[20] McIlraith, S. A., Song, T. C., and Zeng, H. Semantic web services. *IEEE Intelligent Systems* (March/April 2001), 46–53.

[21] Peer, J. Towards automatic web service composition using ai planning techniques (first draft), August 2003.

[22] Peltz, C. Web services orchestration: A review of emerging technologies, tools, and standards, January 2003.

[23] Ponnekanti, S. R., and Fox, A. Sword: A developer toolkit for web service composition. In *Proceedings of the Eleventh International World Wide Web Conference*.

[24] Rao, J., and Su, X. A survey of automated web service composition methods.

[25] Russel, S., and Norvig, P. *Artificial Intelligence: A Modern Approach*, second ed. Prentice-Hall Inc., 1995.

[26] Singh, I., Brydon, S., Murray, G., Ramachandran, V., Violleau, T., and Stearns, B. *Designing Web Services with the J2EE 1.4 Platform: JAX-RPC, SOAP, and XML Technologies*. Addison-Wesley, 2004.

[27] Sirin, E., Parsia, B., Wu, D., Hendler, J., and Nau, D. Htn planning for web service composition using shop2.

[28] Skonnard, A. The xml files: The birth of web services. http://msdn.microsoft.com/webservices/understanding/webservicebasics/default.aspx, October 2002.

[29] Skonnard, A. Understanding soap. http://msdn.microsoft.com/webservices/understanding/webservicebasics/default.aspx, March 2003.

[30] Skonnard, A. Web services basics: Understanding wsdl. http://msdn.microsoft.com/webservices/understanding/webservicebasics/default.aspx, October 2003.

[31] Snell, J. The web services insider, part 4: Introducing web services flow language. http://www-106.ibm.com/developerworks/webservices/library/ws-ref4/?dwzone=webservices, 2001.

[32] Srivastava, B., and Koehler, J. Web service composition—current solutions and open problems.

[33] Srivastava, B., and Koehler, J. Planning with workflows—an emerging paradigm for web service composition. http://www.isi.edu/ikcap/icaps04-workshop/final/srivastava.pdf, 2004.

[34] Staab, S. Web services: Been there, done that? *IEEE Intelligent System* (January/February 2003), 72.

[35] van der Aalst, W. Don't go with the flow: Web services composition standards exposed. *IEEE Intelligent System* (Jan./Feb. 2003), 72–76.

[36] van der Aalst, W. M., Dumas, M., and ter Hofstede, A. H. Web service composition language: Old wine in new bottles? In *Proceedings of the 29th EUROMICRO Conference: New Waves in System Architecture* (2003), pp. 298–305.

[37] van Harmelen, F., and Horrocks, I. Faqs on oil: Ontology inference layer. *IEEE Intelligent Systems 15*, 6 (November/December 2000), 69–72.

[38] Wilkins, D. E. *Practical Planning: Extending The Classical AI Planning Paradigm*. Morgan Kaufmann Publishers, Inc., 1988.

[39] Wong, W. Web services: Beyond the hype. http://www.zdnet.com.au/news/business/0,39023166,20264085,00.htm, 2002.

[40] Yang, Q. *Intelligent Planning: A Decomposition and Abstraction Based Approach*. Springer-Verlag Berlin Heidelberg, 1997.