Amit K. Chopra, Ph.D.

Curriculum Vitae *

Contents

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*Last updated: April 20, 2017

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1 Research Statement

I am interested in the engineering of *sociotechnical systems* (STS), that is, systems that involve interaction between *autonomous* social principals. Normally, a principal would either be a human or an organization. Important systems we routinely use, e.g., for health, finance and banking, travel, work, and e-commerce, are sociotechnical. Many of the smart IoT-driven ones we envisage building in the future are sociotechnical as well. For example, a sophisticated system of smart buildings may involve interaction between residents, buildings managers, maintenance companies, utility companies, and regulatory agencies. The most important observation about an STS is that because of the autonomy of principals, it would be incorrect to conceptualize the system as a unitary machine. Unfortunately, unitary machines (with potentially distributed implementations) is all that current computing research and practice offers.

How do we systematically build STSs? What is the architecture of an STS? Mainstream computing focuses exclusively on technical architectures but leaves the social architectures—relationships among principals—entirely epiphenomenal. Specifically, foundational notions such as *social norms* and *accountability* find no computational representation in system models. Trust is computed in ad hoc ways. Security and privacy, which are fundamentally about norms, lack appropriate representations in current systems. Systems research (e.g., in operating systems and networks) have taught us much about the management of resources in unitary machines, but they have little to say about *governance*: how does a group of autonomous principals collaboratively administer an STS?

My research ambition is to develop a methodology for high-fidelity specification and implementation of STSs that captures both the social and technical aspects of STSs and their interplay. In doing so, my hope is to significantly advance and simplify the engineering of complex, adaptive, distributed systems. My work draws upon many areas in computing, but primarily multiagent systems, software engineering, databases, and distributed systems, and in turn offers novel and rich ideas for newer areas such as social computing, security and privacy, and IoT-based systems.

2 Summary of Experience

I obtained academic training in computer science in universities in India and the United States. I honed my research skills at universities in the States, Italy, and the UK, where I am currently a lecturer. I have published six high-quality journal papers and 20 conference papers, of which 14 are in A* venues and the remaining in A venues (by CORE rankings). My research has been generously funded by prestigious fellowships and grants.

I am engaged in various editorial and workshop activities and have served on committees of important conferences (including as program chair). I have also worked for three years in industry as a software engineer.

3   Education

Ph.D. Computer Science, North Carolina State University, 2008

M.S. Computer Science, North Carolina State University, 2003

B.E. Computer Engineering, University of Pune, India, 1999

4   Professional Experience

Lecturer (Since October 2012) Lancaster University, UK

Postdoctoral Fellow (January 2009–September 2012) University of Trento, Italy

Graduate Research Assistant (January 2003–December 2005 and January 2007–May 2008) Department of Computer Science, North Carolina State University, USA

Software Intern (January 2006–December 2006) WebSphere Technology Institute, IBM, Research Triangle Park, North Carolina, USA

Member of Technical Staff (July 1999–June 2001) Persistent Systems, Pune, India

5   Funded Projects

Role	Title	Funder	Amount	Share	Duration
PI	Turtles: Protocol-based foundations for distributed multi-agent systems	EPSRC	£1,550,248	£686,507	Sep 2016–Sep 2020
PI	Requirements engineering for business protocols	Marie Curie IEF	€200,371	€200,371	Jul 2012–Jun 2014
PI	Business-level modeling and middleware for services: Reasoning about goals, compliance, interoperability, and adaptability	Marie Curie Fellowship, Trentino Cofund	€98,990	€98,990	May 2010–Apr 2012

(NB: I declined my Marie Curie IEF award in favor of a lectureship at Lancaster.)

6   Awards, Honors, Endorsements

- Best program committee member finalist (three out of 350), International Conference on Autonomous Agents and Multiagent Systems, 2010

- Best Student Paper Award, [26] below

- *Blue Ribbon* reviewer, International Joint Conference on Artificial Intelligence, 2016

7 Patents

- Amit K. Chopra, Brett G. King, Brandon J. W. Smith, and Aaron J. Tarter. HTTP-based publish-subscribe service. US Patent No. 7904559 B2, Issued: Mar 8, 2011.

8 Teaching

Units taught

I have taught several graduate and undergraduate modules.

- Fundamentals of Computer Science [SCC 120]: 2014, 2015
- Software Engineering Studio [SCC 230]: 2012, 2013, 2014, 2015
- Network Studio [SCC 330]: 2013
- Elements of Distributed Systems [SCC 401]: 2013
- Elements of Distributed Systems—Computer Science [SCC 401-CS]: 2014
- Elements of Distributed Systems—Data Science [SCC 401-DS]: 2014, 2015
- Software Architecture and Integration [SCC 411]: 2013, 2014

Professional Qualifications

- Fellow of the Higher Education Academy (HEA), 2016.

9 Administrative Roles

Group lead, Software Engineering for School of Computing and Communications, Lancaster University (2017 onward).

Undergraduate admissions tutor for the School of Computing and Communications (2013 onward). Responsible for evaluating applications, interacting with applicants during their visits, and advising the school and faculty on admissions criteria.

School Distinguished Seminar Series organizer (2014 onward). Responsible for inviting nominations for speakers, inviting the selected speakers, and making arrangements for their visit.

10 Peer-Reviewed Publications

10.1 Journals

1. Elda Paja, Amit K. Chopra, and Paolo Giorgini. Trust-based specification of sociotechnical systems. *Data and Knowledge Engineering*, 87:339–353, 2013, Elsevier.

2. Amit K. Chopra, Alexander Artikis, Jamal Bentahar, Marco Colombetti, Frank Dignum, Nicoletta Fornara, Andrew J. I. Jones, Munindar P. Singh, and Pınar Yolum. Research directions in agent communication. *ACM Transactions on Intelligent Systems and Technology*, 4(2):20:1–20:23, 2013.

3. Nirmit Desai, Amit K. Chopra, and Munindar P. Singh. Amoeba: A methodology for modeling and evolution of cross-organizational business processes. *ACM Transactions on Software Engineering and Methodology*, 19(2):6:1–6:45, 2009.

4. Munindar P. Singh, Amit K. Chopra, and Nirmit Desai. Commitment-based service-oriented architecture. *IEEE Computer*, 42(11):72–79, 2009.

5. Nirmit Desai, Ashok U. Mallya, Amit K. Chopra, and Munindar P. Singh. Interaction protocols as design abstractions for business processes. *IEEE Transactions on Software Engineering*, 31(12):1015–1027, December 2005.

6. Munindar P. Singh, Amit K. Chopra, Nirmit Desai, and Ashok U. Mallya. Protocols for processes: Programming in the large for open systems. *ACM SIGPLAN Notices*, 39(12): 73–83, December 2004.

10.2 Conferences

Annotated with the CORE Conference Ranking.

7. (A) Munindar P. Singh and Amit K. Chopra. The Internet of Things and Multiagent Systems: Decentralized Intelligence in Distributed Computing. In *Proceedings of the 37th IEEE International Conference on Distributed Computing Systems (ICDCS), Blue Sky Track*, 10 pages, in press, June 2017.

8. (A*) Amit K. Chopra, Samuel H. Christie V, and Munindar P. Singh. Splee: A declarative information-based language for multiagent interaction protocols. In *Proceedings of the Sixteenth International Conference on Autonomous Agents and Multiagent Systems*, 10 pages, in press, 2017.

9. (A*) Amit K. Chopra and Munindar P. Singh. Custard: Computing norm states over information stores. In *Proceedings of the Fifteenth International Conference on Autonomous Agents and Multiagent Systems*, pages 1096–1105, 2016.

10. (A*) Amit K. Chopra and Munindar P. Singh. From social machines to social protocols: Software engineering foundations for sociotechnical systems. In *Proceedings of the 25th International World Wide Web Conference*, pages 903–914, 2016.

11. (A*) Matteo Baldoni, Cristina Baroglio, Amit K. Chopra, and Munindar P. Singh. Composing and verifying commitment-based multiagent protocols. In *Proceedings of the 24th International Joint Conference on Artificial Intelligence (IJCAI)*, pages 10–17, 2015.

12. (A*) Amit K. Chopra and Munindar P. Singh. Generalized commitment alignment. In *Proceedings of the Fourteenth International Conference on Autonomous Agents and Multiagent Systems*, pages 453–461, 2015.

13. (A*) Amit K. Chopra and Munindar P. Singh. Cupid: Commitments in relational algebra. In *Proceedings of the Thirtieth International Conference on Artificial Intelligence (AAAI)*, pages 2052–2059, 2015.

14. (A) Amit K. Chopra, Fabiano Dalpiaz, Fatma Başak Aydemir, Paolo Giorgini, John Mylopoulos, and Munindar P. Singh. Protos: Foundations for engineering innovative sociotechnical systems. In *Proceedings of the 18th IEEE International Requirements Engineering Conference*, pages 53–62, 2014.

15. (A) Amit K. Chopra, Elda Paja, and Paolo Giorgini. Sociotechnical trust: An architectural approach. In *Proceedings of the 30th International Conference on Conceptual Modeling (ER)*, volume 6998 of *LNCS*, pages 104–117. Springer, 2011.

16. (A*) Elisa Marengo, Matteo Baldoni, Cristina Baroglio, Amit K. Chopra, Viviana Patti, and Munindar P. Singh. Commitments with regulations: Reasoning about safety and control. In *Proceedings of the 10th International Conference on Autonomous Agents and Multiagent Systems*, pages 467–474, 2011.

17. (A*) Amit K. Chopra and Munindar P. Singh. Specifying and applying commitment-based business patterns. In *Proceedings of the 10th International Conference on Autonomous Agents and Multiagent Systems*, pages 475–482, 2011.

18. (A) Fabiano Dalpiaz, Amit K. Chopra, Paolo Giorgini, and John Mylopoulos. Adaptation in open systems: Giving interaction its rightful place. In *Proceedings of the 29th International Conference on Conceptual Modeling (ER 2010)*, volume 6412 of *LNCS*, pages 31–45. Springer, 2010.

19. (A) Amit K. Chopra, Fabiano Dalpiaz, Paolo Giorgini, and John Mylopoulos. Modeling and reasoning about service-oriented applications via goals and commitments. In *Proceedings of the 22nd International Conference on Advanced Information Systems Engineering*, volume 6051 of *LNCS*, pages 113–128. Springer, 2010.

20. (A*) Amit K. Chopra, Fabiano Dalpiaz, Paolo Giorgini, and John Mylopoulos. Reasoning about agents and protocols via goals and commitments. In *Proceedings of the 9th International Conference on Autonomous Agents and Multiagent Systems*, pages 457–464, 2010.

21. (A*) Matteo Baldoni, Cristina Baroglio, Amit K. Chopra, Nirmit Desai, Viviana Patti, and Munindar P. Singh. Choice, interoperability, and conformance in interaction protocols and service choreographies. In *Proceedings of the 8th International Conference on Autonomous Agents and Multiagent Systems*, pages 843–850, 2009.

22. (A*) Amit K. Chopra and Munindar P. Singh. Multiagent commitment alignment. In *Proceedings of the 8th International Conference on Autonomous Agents and Multiagent Systems*, pages 937–944, 2009.

23. (A*) Amit K. Chopra and Munindar P. Singh. Constitutive interoperability. In *Proceedings of the 7th International Conference on Autonomous Agents and Multiagent Systems*, pages 794–804, 2008.

24. (A*) Nirmit Desai, Amit K. Chopra, and Munindar P. Singh. Representing and reasoning about commitments in business processes. In *Proceedings of the 22nd Conference on Artificial Intelligence*, pages 1328–1333, 2007.

25. (A) Nirmit Desai, Amit K. Chopra, Matthew Arrott, Bill Specht, and Munindar P. Singh. Engineering foreign exchange processes via commitment protocols. In *Proceedings of the 4th IEEE International Conference on Services Computing*, pages 514–521, 2007.

26. (A) Nirmit Desai, Amit K. Chopra, and Munindar P. Singh. Business process adaptations via protocols. In *Proceedings of the IEEE International Conference on Services Computing*, pages 103–110, 2006.

27. (A*) Amit K. Chopra and Munindar P. Singh. Contextualizing commitment protocols. In *Proceedings of the 5th International Joint Conference on Autonomous Agents and Multiagent Systems*, pages 1345–1352, 2006.

10.3 Workshops

28. Georgi Kanchev and Amit K. Chopra. Social media through the requirements lens: A case study of Google Maps. In *Proceedings of the IEEE First International Workshop on Crowd-Based Requirements Engineering*, pages 7–12, 2015.

29. Amit K. Chopra and Munindar P. Singh. The Evolution of Interoperability. Invited paper in *Declarative Agent Languages and Technologies IX 9th International Workshop, DALT 2011, Revised Selected and Invited Papers*, pages 90–94, volume 7169 of *LNCS*. Springer, 2011.

30. Amit K. Chopra. Requirements-driven adaptation: Compliance, context, uncertainty, and systems. In *Proceedings of the Requirements@Runtime Workshop*, pages 32–36. IEEE Computer Society, 2011.

31. Amit K. Chopra. Social computing: Principles, platforms, and applications. In *Proceedings of the IEEE Workshop on Requirements Engineering for Social Computing*, 26–29. IEEE Computer Society, 2011.

32. Amit K. Chopra and Paolo Giorgini. Requirements engineering for social applications. In *Proceedings of the istar Workshop*, pages 138–143, volume 766 of *CEUR* Workshop Proceedings. CEUR-WS.org, 2011.

33. Amit K. Chopra and Munindar P. Singh. Colaba: Collaborative design of cross-organizational business processes. In *Proceedings of the Workshop on Requirements Engineering for Systems, Services, and Systems of Systems*, pages 36–43. IEEE Computer Society, 2011.

34. Amit K. Chopra, Nir Oren, Sanjay Modgil, Nirmit Desai, Simon Miles, Michael Luck, and Munindar P. Singh. Analyzing contract robustness through a model of commitments. Invited paper. *11th International Workshop, AOSE 2010, Revised Selected Papers*, pages 17–36, volume 6788 of *LNCS*, Springer, 2011.

35. Raian Ali, Amit K. Chopra, Fabiano Dalpiaz, Paolo Giorgini, John Mylopoulos, and Vitor E. Silva Souza. The evolution of Tropos: Contexts, commitments and adaptivity. In *Proceedings*

of the 4th International i* Workshop, volume 586 of *CEUR*, pages 15–19. CEUR-WS.org, 2010.

36. Amit K. Chopra and Munindar P. Singh. An architecture for multiagent systems: An approach based on commitments. In *Proceedings of the Workshop on Programming Multiagent Systems*, volume 5919 of *LNCS*, pages 15–30, Springer, 2009.

37. Munindar P. Singh and Amit K. Chopra. Programming multiagent systems without programming agents. Invited paper. In *Proceedings of the Workshop on Programming Multiagent Systems*, volume 5919 of *LNCS*, pages 1–14, Springer, 2009.

38. Munindar P. Singh and Amit K. Chopra. Correctness properties for multiagent systems. In *Proceedings of the Workshop on Declarative Agent Languages and Technologies*, volume 5948 of LNCS, pages 192–207. Springer, 2009.

39. Amit K. Chopra and Munindar P. Singh. Interoperation in protocol enactment. In *Declarative Agent Languages and Technologies V: Selected, Revised, and Invited Papers*, volume 4897 of *LNCS*, pages 36–49. Springer, 2008.

40. Nirmit Desai, Ashok U. Mallya, Amit K. Chopra, and Munindar P. Singh. OWL-P: A methodology for business process development. In *Agent-Oriented Information Systems III, 7th International Bi-Conference Workshop, AOIS 2005*, volume 3529 of *LNCS*, pages 79–94. Springer, 2006.

41. Amit K. Chopra and Munindar P. Singh. Producing compliant interactions: conformance, coverage, and interoperability. In *Declarative Agent Languages and Technologies IV: Selected, Revised, and Invited Papers*, volume 4327 of *LNCS*, pages 1–15. Springer, 2006.

42. Amit Chopra and Munindar P. Singh. Nonmonotonic commitment machines. In *Advances in Agent Communication: Proceedings of the 2003 AAMAS Workshop on Agent Communication Languages*, volume 2922 of *LNAI*, pages 183–200. Springer, 2004.

10.4   Short Papers and Posters

43. Matteo Baldoni and Cristina Baroglio and Amit K. Chopra and Munindar P. Singh. Social contexts and social pragmatics. In *Proceedings of the 14th International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 1739–1740, 2015.

44. Amit K. Chopra and Munindar P. Singh, The Thing Itself Speaks: Accountability as a Foundation for Requirements in Sociotechnical Systems. *Proceedings of the 7th IEEE International Workshop on Requirements Engineering and Law*, page 22, 2014.

45. Amit K. Chopra and Munindar P. Singh. Choice and interoperation in protocol enactment. In *Proceedings of the 6th International Joint Conference on Autonomous Agents and Multiagent Systems*, page 29, 2007.

46. Nirmit Desai, Zhengang Cheng, Amit K. Chopra, and Munindar P. Singh. Toward verification of commitment protocols and their compositions. In *Proceedings of the 6th International Joint Conference on Autonomous Agents and Multiagent Systems*, page 33, 2007.

47. Nirmit Desai, Amit K. Chopra, and Munindar P. Singh. An overview of business process adaptations via protocols. In *Proceedings of the 5th International Joint Conference on Autonomous Agents and Multiagent Systems*, pages 1326–1328, 2006.

48. Ashok U. Mallya, Nirmit Desai, Amit K. Chopra, and Munindar P. Singh. OWL-P: OWL for protocol and processes. In *Proceedings of the 4th International Joint Conference on Autonomous Agents and Multiagent Systems*, pages 139–140, 2005.

49. Amit K. Chopra and Munindar P. Singh. Commitments for flexible business processes. In *Proceedings of the 3rd International Joint Conference on Autonomous Agents and Multiagent Systems*, pages 1362–1363, 2004.

50. Amit K. Chopra, Nirmit Desai, Ashok Mallya, Leena Wagle, and Munindar P. Singh. A Semantic Protocol-Based Approach for Developing Business Processes. In the *International Conference on Service Oriented Computing*, 2004.

11   Book Chapters

51. Amit K. Chopra and Munindar P. Singh. Agent Communication. In Gerhard Weiss, ed., *Multiagent Systems*, 2nd ed. MIT Press, 2013.

52. Fabiano Dalpiaz, Amit K. Chopra, John Mylopoulos, and Paolo Giorgini. From intentions to social commitments: Adaptation in multiagent systems. In Gerhard Lakemeyer and Sheila A. McIlraith, eds., *Knowing, Reasoning, and Acting: Essays in Honour of Hector J. Levesque*. College Publications, 2011.

53. Amit K. Chopra, John Mylopoulos, Fabiano Dalpiaz, Paolo Giorgini, and Munindar P. Singh. Requirements as goals and commitments too. In Selmin Nurcan, Camille Salinesi, Carine Souveyet, and Jolita Ralyté, eds., *Intentional Perspectives on Information Systems Engineering*, pages 137–152. Springer, 2010.

12   Professional Activities

12.1   Editorial

- Senior Associate Editor, *ACM Transactions on Internet Technology* (since July 2014).

- Associate Editor, *ACM Transactions on Internet Technology* (since January 2013).

- Guest Editor, Special issue on *Advances in Social Computing* in *ACM Transactions on Internet Technology*, ongoing.

- Guest Editor, Special issue on *Foundations of Social Computing* in *ACM Transactions on Internet Technology*, 14(4), 2014.

- Guest Editor, Special issue, *Agent Communication* in the *ACM Transactions on Intelligent Systems and Technology*, 4(2), 2013.

12.2   Tutorials Given

- Decentralized Multiagent Systems: AAMAS 2015, IJCAI 2015, AAMAS 2016

- Internet of Things and Multiagent Systems: RCIS 2015, IJCAI 2015, AAMAS 2016

12.3   Talks & Seminars

- Foundations for decentralized sociotechnical systems. Invited talk in the *iSocial Workshop*, Crete, September, 2016.

- Interaction-oriented software engineering: Foundations for sociotechnical systems. *University of Liverpool*, April 2016.

- Computing Commitments in Distributed Settings: Information and Alignment. *University of Luxembourg*, March 2015.

- Interaction-oriented software engineering. *British Computer Society*, London, Dec 2014.

- Interaction-oriented software engineering: Concepts and Principles. *University of Edinburgh*, February, 2013.

- Commitment alignment. *Imperial College London*, 2013.

- Interaction-oriented software engineering. *Bournemouth University*, UK, Nov 2012.

- Interaction-oriented software engineering. *Dagstuhl Seminar on Normative Multiagent Systems*, Germany, Mar 2012.

- Interaction-oriented software engineering: Concepts and Principles. *North Carolina State University*, USA, Dec 2011.

- Social computing. *Dagstuhl Seminar on Models@Runtime*, Germany, Nov 2011.

- Principles of interaction-oriented software engineering. *University of Bologna*, Mar 2011.

- Engineering sociotechnical systems via trust. *Workshop on Trust and Reputation*, Paris, France, Dec 2010.

- Interaction-oriented software engineering. *Interdisciplinary Laboratory on Interacting Knowledge Systems*, Trento, Italy, Nov 2010.

- Understanding interoperability in service engagements via commitments. *University of Torino*, Dec 2009.

12.4   Meetings

- Novel concepts for autonomous systems. Organized by Imperial College London in Ascot (Berkshire). March 2017.

12.5 Conference Organizing

- Program Chair, *International Conference on Principles and Practice of Multiagent Systems (PRIMA)*, 2016.

- Sponsorship Chair, *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, 2016.

- Publicity Chair, *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, 2015.

- Sponsorship Chair, *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, 2013.

12.6 Seminars and Workshops Organizing

- Joint Chair, *Second Workshop on Multiagent Foundations of Social Computing*, 2015.

- Joint Chair, *Dagstuhl Seminar on Normative Multi-Agent Systems*, 2015.

- Joint Chair, *First Workshop on Multiagent Foundations of Social Computing*, 2014.

- Joint Chair, *15th International Workshop on Coordination, Organisations, Institutions and Norms*, St. Paul, May 2013.

- Joint Chair, *First Workshop on Requirements Engineering for Social Computing*, Trento, Aug 2011.

- Joint Chair, *Workshop on Agent Communication*, Toronto, May 2010.

12.7 Select Program Committee Service

Senior Program Committee membership is indicated by *

- International Conference on Autonomous Agents and Multiagent Systems: 2010, 2011*, 2012, 2013, 2014, 2015, 2016, 2017*

- International Conference on Principles and Practice of Multiagent Systems: 2010, 2012, 2013, 2014, 2015

- AAAI Conference on Artificial Intelligence: 2012

- International Joint Conference on Artificial Intelligence: 2011, 2016, 2017

- European Conference on Artificial Intelligence: 2016

- International Conference on Social Informatics: 2012, 2013

12.8 Select Journal Reviewing

- ACM Computing Surveys

- Journal of Systems and Software, Elsevier

- Journal of Applied Logic, Elsevier

- World Wide Web Journal, Springer

- Journal of Autonomous Agents and Multiagent Systems, Springer

- ACM Transactions on Autonomous and Adaptive Systems

- Service Oriented Computing and Applications, Springer

12.9 Proposal Reviewing

- Invited thrice in the last four years by the National Science and Engineering Research Council (NSERC), Canada

- Invited once in the last four years by the Engineeering and Physical Sciences Research Council (EPSRC), UK

- Invited once in the last four year by Research Foundation—Flanders (FWO)

12.10 Collaborators & Students

Funded Postdoctoral Scholars

- Akın Günay (Turtles)

- Thomas C. King (Turtles)

PhD Students

- Georgi Kanchev

Others

Matteo Baldoni (University of Torino), Cristina Baroglio (University of Torino), Samuel H. Christie V (North Carolina State University), Fabiano Dalpiaz (University of Trento), Paolo Giorgini (University of Trento), John Mylopoulos (University of Ottawa), Elda Paja (University of Trento), Viviana Patti (University of Torino), Pete Sawyer (Lancaster University), Munindar P. Singh (North Carolina State University)