UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AO KASPERSKY LAB
Petitioner

v.

WEBROOT, INC.
Patent Owner

IPR2023-_____
U.S. Patent No. 10,257,224

DECLARATION OF VENKATRAMANAN SIVA SUBRAHMANIAN IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,257,224

I. Engagement

1. I have been retained by DeWitt LLP, counsel for Petitioner, AO Kaspersky Lab in the matter of the *Inter Partes* Review of U.S. Patent No. 10,257,224 ("the '224 patent"). My compensation is not contingent on the outcome of this matter or the specifics of my testimony.

2. Specifically, I was asked to review the declaration of Dr. Wenke Lee that was submitted by the petitioners in IPR2023-00126 as Exhibit 1003 ("Lee Declaration") and form an opinion of whether I agreed with the facts, analysis, and conclusions in that declaration.

II. Background and Qualifications

3. I am the Walter P. Murphy Professor of Computer Science with tenure in the McCormick School of Engineering, Northwestern University (September 2021-present) and Faculty Fellow in the Buffett Institute of Global Affairs. Prior to this appointment, I was the Dartmouth College Distinguished Professor in Cybersecurity, Technology, and Society at Dartmouth College with tenure in the Computer Science Department (August 2017 – August 2021) and Director of the Institute for Security, Technology and Society (April 2018-August 2021). Prior to that appointment, I was on the faculty of the University of Maryland's Computer Science Department from 1989 to 2017, as an Assistant Professor from 1989 to 1995, as an Associate Professor with tenure from 1995 to

2000 and as a full Professor from 2000 to 2017. I also served as Director of the University of Maryland's Institute for Advanced Computer Studies.

4. I graduated from Syracuse University with a Master of Science degree in Computer Science (1987) and Doctor of Philosophy degree in Computer Science (1989).

5. I have particular expertise in cyber-security having developed some of the first secure query answering algorithms, flexible authentication frameworks, unexplained behavior detection algorithms, techniques for the scalable detection of known threats, identifying human behaviors linked with cyber-vulnerabilities, and combating intellectual property theft. I led the development of the first ever Global Cyber Vulnerability Report consisting of the analysis of billions of anti-virus telemetry reports to quantify the vulnerability of 44 major nations. I developed some of the first methods to predict which vulnerabilities will be exploited, when, and how severe they will be. In addition, I have developed methods for malware identification, deploying deception within networks in order to deceive attackers, and separating false security alarms from real ones.

6. As evidence of my expertise and leadership in computer security and cyber-security, I have written numerous papers, edited several important books, and been invited to speak at many international conferences on the subject matter. See my attached CV for a full listing of my writings and presentations, which is

attached to this report as Appendix A. A sample of my recent books and keynotes include:

A. Author of *The Global Cyber-Vulnerability Report* (Springer 2013) with M. Ovelgonne, T. Dumitras, and B. A. Prakash.

B. S. Jajodia, G. Cybenko, V.S. Subrahmanian, V. Swarup, C. Wang, and M. Wellman. (eds). Adaptive, Autonomous, Secure, Cyber Systems, Springer, 2020.

C. S. Jajodia, V.S. Subrahmanian, V. Swarup, C. Wang (eds). Cyber-Deception: Building the Scientific Foundation, Springer, 2016.

D. S. Jajodia, P. Shakarian, V.S. Subrahmanian, V. Swarup, C. Wang (eds). Cyber-Warfare: Building the Scientific Foundation, Springer 2015. *Also released as Chinese student edition in 2016.*

E. Moving Target Defense II (eds. S. Jajodia, A.K. Ghosh, Subrahmanian, V.S., Swarup, V., Wang, C., Wang, X.S.), Springer, September 2012. *Also released in 2014 as a special Chinese edition.*

F. Keynote Address on AI & Cybersecurity, Wells Fargo *Confluence* conference, Dec 2021. (via Zoom)

G. Keynote Speaker, 18th International Conference on Security and Cryptography (SECRYPT 2021), July 2021. (Via Zoom)

H. Keynote Speaker on Ransomware, United Health Group Healthcare Technology Advisory Council, June 30, 2021. (Via Zoom)

I. Keynote Speaker, 1st International Conference on Autonomous Intelligent Cyber-defence Agents, Paris France (but via Zoom), March 2021.

7. Further details of my qualifications are presented in my curriculum vitae, which is attached to this report as Appendix A. By my education, training, and experience, as evidenced by my curriculum vitae, I am qualified as one skilled in the art of computer security and cyber-security technology.

III. Information Considered

8. In drafting this declaration and forming the opinions therein, I relied on my years of education, research, and industry and academic experience. I also relied on the following materials:

A. Exhibit 1001 – U.S. Patent No. 10,257,224 to Jaroch et al.

B. Exhibit 1002 – File History of U.S. Patent No. 10,257,224

C. Exhibit 1004 – U.S. Publication No. 2013/0298244 to Kumar et al.

D. Exhibit 1005 – U.S. Publication No. 2007/0016953 to Morris et al.

E. Exhibit 1006 – U.S. Patent No. 8,087,087 to Van Oorschot et al.

F. Exhibit 1007 – U.S. Patent Pub. No. 2010/0077481 to Polyakov et al.

G. Exhibit 1008 – U.S. Publication No. 2011/0321166 to Capalik et al.

H. Exhibit 1009 – U.S. Publication No. 2012/0260340 to Morris et al.

I. Exhibit 1010 - File History of U.S. Patent No. 9,578,045 ("*'045 Patent File History*")

J. Exhibit 1012 – Natarajan Meghanathan, Sumanth Reddy Allam, and Loretta A. Moore, *Tools and Techniques for Network Forensics*, International Journal of Network Security & Its Applications (IJNSA), Vol. 1., No. 1 (April 2009)

K. Exhibit 1013 – SANS Institute, *Host- vs. Network-Based Intrusion Detection Systems* (2000-2005)

L. Exhibit 1014 – Securosis LLC, *Evolving Endpoint Malware Detection: Dealing with Advanced and Targeted Attacks*,

Version 1.3 (July 12, 2012)

M. Exhibit 1015 – Yanfang Ye, Weiwei Zhuang, Tao Li, Egemen Tas, Umesh Gupta, Shenghuo Zhu, Melih Abdulhayogiu, *Combining File Content and File Relations for Cloud Based Malware Detection* (August 2011)

N. Exhibit 1016 – U.S. Patent No. 6,944,772 to Dozortsev

O. Exhibit 1017 – U.S. Patent No. 6,772,346 to Chess et al.

P. Exhibit 1018 – WO 2002/033525 to Shyne-Song Chuang

Q. Exhibit 1019 – EP 1,549,012 to Kristof De Spiegeleer

R. Exhibit 1020 – EP 1,280,040 to Alexander James Hinchliffe et al.

S. Exhibit 1021 – Oracle, Java Documentation, *The Java Tutorials, What is a Path? (And Other File System Facts)* (available at the following link https://docs.oracle.com/javase/tutorial/essential/io/path.html) (last accessed October 2022)

T. Exhibit 1022 – U.S. Patent Publication No. 2004/0143753 to Hernacki et al.

U. Exhibit 1023 – U.S. Patent Publication No. 2011/0083180 to Mashevsky et al.

V. Exhibit 1024 – U.S. Patent No. 8,429,746 to Alen Capalik

W. Exhibit 1025 – *Server Hardware, Software and Architecture* by Abeer El Hadi El Zein El Nahas, University of Khartoum, Electrical and Electronics Engineering Dept. (Feb. 2008)

X. Ex. 1026 – Guofei Gu, Phillip Porras, Vinod Yegneswaran, Martin Fong, Wenke Lee, *BotHunter: Detecting Malware Infection Through IDSDriven Dialog Correlation*, In Proceedings of The 16th USENIX Security Symposium (August 2007)

Y. Ex. 1027 – Yacin Nadji, Manos Antonakakis, Roberto Perdisci, and Wenke Lee, *Understanding the Prevalence and Use of Alternative Plans in Malware with Network Games*, In Proceedings of The 27th Annual Computer Security Applications Conference (December 2011)

Z. Ex. 1028 – Manos Antonakakis, Roberto Perdisci, David Dagon, Wenke Lee, and Nick Feamster, *Building a Dynamic Reputation System for DNS*, In Proceedings of The 19th USENIX Security Symposium, (August 2010)

AA. Ex. 1029 – Long Lu, Vinod Yegneswaran, Phil Porras, and Wenke Lee, *BLADE: An Attack-Agnostic Approach for*

Preventing Drive-By Malware Infections, In Proceedings of The 17th ACM Conference on Computer and Communications Security (CCS), Chicago, IL (October 2010)

BB. Ex. 1030 – U.S. Patent Publication No. 2008/0016570 to Alen Capalik

9. I reserve the right to rely upon these materials and other materials to rebut arguments raised by the Patent Owner.

10. I reserve the right to supplement this declaration in response to additional evidence that may become known.

11. In connection with any testimony I may be asked to give to the Patent Trial and Appeal Board, I may use as exhibits various documents that relate to matters set forth in this declaration.

IV. Opinions

12. After considering the Lee Declaration and the other materials listed above, I agree with the facts, analysis, and conclusions in the Lee Declaration, and I adopt the testimony in section III of the Lee Declaration as my own for purposes of this proceeding.

I declare all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further

that the statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Respectfully submitted,

Executed: June 2, 2023

By: */Venkatramanan Siva Subrahmanian/*
Venkatramanan Siva Subrahmanian

APPENDIX A

Curriculum Vitae
V.S. Subrahmanian

Walter P. Murphy Professor of Computer Science
&
Buffett Faculty Fellow, Buffet Institute of Global Affairs
Northwestern University
Office: 847-467-2490
Cell: 301-257-9072
Email: vss@northwestern.edu
Web: https://vssubrah.github.io/

April 26 2023

I. Personal Information

I.A. UID, Last Name, First Name, Middle Name, Contact Information
Last Name: Subrahmanian
First Name: Venkatramanan
Middle Name: Siva
Email: vss@northwestern.edu
URL: https://vssubrah.github.io/

I.B. Academic Appointments

Northwestern University (Sep 1 2021 – to date)
Walter P. Murphy Professor (with tenure), Dept. of Computer Science
Buffett Faculty Fellow, Buffett Institute of Global Affairs.

Dartmouth College (Aug 1 2017 – Aug 31 2021)
The Dartmouth College Distinguished Professor in Cybersecurity, Technology, and Society (with tenure), 8/2017 to 8/2021
Director – Institute for Security, Technology, and Society, 4/1/2018 to 8/31/2021
Professor (with tenure), Computer Science Dept., 8/17 to 8/21

University of Maryland College Park
Professor (with tenure), Computer Science Dept. 7/00 to 7/17
Associate Professor (with tenure), CS Dept., 8/95 to 6/00
Assistant Professor, CS Dept., 8/89 to 8/95

I.C. Administrative Appointments
Director – Institute for Security, Technology, and Society, Dartmouth College, 4/1/2018 to 8/31/2021
Director, U. Md. Inst. for Advanced Computer Studies, 10/04 to 6/10

Interim Director, U. Md. Inst. for Advanced Computer Studies, 02/04 to 09/04
Director, Center for Digital International Government
Director, Lab for Computational Cultural Dynamics

I.D. Other Employment
Plumer Fellow, Oxford University, 1 month: June-July 2008
Institut de Recherche en Informatique de Toulouse, 4 months: Apr-July 2006

I.E. Educational Background
PhD, Computer Science, Syracuse University, 1989
M.S., Computer Science, Syracuse University, 1987
M.Sc. (Tech.) Computer Science, Birla Inst. of Tech. and Sci., India, 1985

I.F. Professional Certifications and Licenses

II. Research, Scholarly and Creative Activities

II.A. Books

II.A.1. Books Authored (s*pecify original or revised edition)*

1. Q. Han, S. Mandujano, S. Porst, V.S. Subrahmanian, S. Tetali, and Y. Xiong. Android Malware Detection with Machine Learning, under contract to be published by NoStarch Press. Order of authors and title might change. Expected to be published in Sep 2023. https://nostarch.com/androidmalwaredetection
2. V.S. Subrahmanian, C. Pulice, J. Brown and J. Bonen-Clark. A Machine Learning Model of Boko Haram, Springer, Jan 2021. *Foreword by Geert Kuiper, former Deputy Director of the Netherlands Defence Intelligence and Security Service.*
3. V.S. Subrahmanian, M. Ovelgonne, T. Dumitras, and B. A. Prakash. The Global Cyber-Vulnerability Report, Springer, Dec 2015. *Foreword by Gen. (Ret.) Isaac Ben-Israel, Founding Head of the National Cyber-Bureau (Israel) in the Prime Minister's Office.*
4. Austin Parker, Gerardo I. Simari, Amy Sliva, V.S. Subrahmanian: Data-driven Generation of Policies. Springer Briefs in Computer Science, Springer 2014, ISBN 978-1-4939-0273-6
5. V.S. Subrahmanian, A. Mannes, A. Roul, and R.K. Raghavan. Indian Mujahideen: Computational Analysis and Public Policy, Springer, November 2013. *Foreword by the Hon. Louis J. Freeh, former Director of the FBI. Also re-published as a special Indian edition.* ISBN 978-3-319-02818-7
6. V. Martinez, C. Molinaro, V.S. Subrahmanian, L. Amgoud. A General Framework for Reasoning on Inconsistency, Springer Briefs in Computer Science, Springer 2013, ISBN 978-1-4614-6750-2.
7. V.S. Subrahmanian, A. Mannes, A. Sliva, J. Shakarian and J. Dickerson. Computational Analysis of Terrorist Groups: Lashkar-e-Taiba, August 2012, Springer, Switzerland. *Foreword by James R. Woolsey, former Director of the Central Intelligence Agency. Also re-published as a special Indian edition*. ISBN 978-1-4614-4769-6
8. P. Shakarian and V.S. Subrahmanian. Geospatial Abduction: Principles and Practice, Springer, Nov. 2011. *Foreword by LTG (Ret) Charles Otstott.* ISBN 978-1-4614-1794-1

9. V.S. Subrahmanian, P. Bonatti, J. Dix, T. Eiter, S. Kraus, F. Ozcan and R. Ross. "Heterogeneous Agent Systems: Theory and Implementation", MIT Press, June 2000. ISBN 026-2-19436-8

II.A.2. Books Edited

1. V.S. Subrahmanian, J. Burgoon and N. Dunbar. (eds) Detecting Trust and Deception in Group Interaction, Springer, Feb 2021.
2. S. Jajodia, G. Cybenko, V.S. Subrahmanian, V. Swarup, C. Wang, and M. Wellman. (eds). Adaptive, Autonomous, Secure, Cyber Systems, Springer, 2020.
3. S. Jajodia, V.S. Subrahmanian, V. Swarup, C. Wang (eds). Cyber-Deception: Building the Scientific Foundation, Springer , 2016.
4. S. Jajodia, P. Shakarian, V.S. Subrahmanian, V. Swarup, C. Wang (eds). Cyber-Warfare: Building the Scientific Foundation, Springer 2015. *Also released as Chinese student edition in 2016.*
5. W. Liu, V.S. Subrahmanian and J. Wijsen. Proceedings 2013 International Conference on Scalable Uncertainty Management, Springer Lecture Notes in Computer Science, Vol. 8068, Sep 2013.
6. S. Alpern, R. Fokkink, L. Gasieniec, R. Lindelauf, V.S. Subrahmanian (eds.) Search Theory: A Game-Theoretic Perspective, Springer, May 2013, 311 pages.
7. Moving Target Defense II (eds. S. Jajodia, A.K. Ghosh, Subrahmanian, V.S., Swarup, V., Wang, C., Wang, X.S.), Springer, September 2012. *Also released in 2014 as a special Chinese edition.*
8. V.S. Subrahmanian (ed). Handbook of Computational Approaches to Counter-Terrorism, Springer, 2013, 578 pages.
9. Proceedings of the 2nd International Conference on Computational Cultural Dynamics (eds. V.S. Subrahmanian and A. Kruglanski), AAAI Press, Sep. 2008. ISBN 978-1-57735-389-8 (book), 978-1-57735-390-4 (CD).
10. Editor, Special Issue of Annals of Mathematics and Artificial Intelligence Journal celebrating Jack Minker's 80th birthday, Vol. 51, Nos. 2—4, Dec. 2007.
11. Editor (with H. Prade). Proceedings – 2007 International Conference on Scalable Uncertainty Management, Springer-Verlag Lecture Notes in Computer Science, Volume 4772, October 2007, Springer-Verlag, Heidelberg.
12. Guest editor, Multimedia Tools and Applications Journal, 2004
13. Guest editor, Journal of Logic Programming, Vol. 43, No. 1, April 2000. (with R. Ramakrishnan).
14. Multimedia Database Systems: Research Issues and Directions, (V.S. Subrahmanian and S. Jajodia, eds.), Springer Verlag, Nov. 1995. Reprinted as a Chinese Student Edition, 1998.
15. Multimedia Information Systems, V.S. Subrahmanian and S. Tripathi (eds.). Kluwer, July 1998.
16. Guest editor, ACM/Springer Multimedia Systems Journal, Vol. 6, Jan. 1998. (with S. Tripathi).
17. Guest editor, Multimedia Tools and Applications Journal, Vol. 7, Nr. 1/2, 1998. (with S. Tripathi).
18. Guest editor, Annals of Math and Artificial Intelligence, special issue on "Logic in Databases", Vol. 19, Nos. 1-2, 1997. (with D. Pedreschi)

19. Guest editor, Intl. Journal of Methods of Logic in Computer Science, special issue on Nonmonotonic Logic Programming, 1994. (with W. Marek and A. Nerode)
20. Proc. of the First International Workshop on Logic Programming and Non-Monotonic Reasoning, (A. Nerode, W. Marek and V.S. Subrahmanian, eds.), MIT Press, July 1991.

II.A.3. Books Translated (*as translator)*

II.A.4. Textbooks

1. C. Zaniolo, S. Ceri, C. Faloutsos, R. Snodgrass, V.S. Subrahmanian and R. Zicari. "Introduction to Advanced Database Systems", Morgan-Kaufmann, May 1997. (Textbook)
2. V.S. Subrahmanian. "Principles of Multimedia Database Systems", Jan. 1998. Morgan Kaufmann. Reprinted also as an Indian student edition. ISBN 978-1-5586-0466-7

II.A.5. Major Reference Works
II.A.6. Exhibition Catalogs
II.A.7. Other

<u>II.B. Chapters</u>
II.B.1. Books

1. Li S., Kumar S., Dumitras T., Subrahmanian V.S. (2018) Breaking Bad: Forecasting Adversarial Android Bad Behavior. In: Samarati P., Ray I., Ray I. (eds) From Database to Cyber Security. Lecture Notes in Computer Science, vol 11170. Springer.
2. J. Grant, F. Parisi, V.S. Subrahmanian. Research in Probabilistic Spatiotemporal Databases: The SPOT Framework. Advances in Probabilistic Databases for Uncertain Information Management 2013 (eds. Z. Ma and L. Yan), Springer, pp.1-22.
3. M. Albanese, M. Fayzullin, J. Shakarian and V.S. Subrahmanian. Automated Coding of Decision Support Variables, in: Handbook on Computational Approaches to Counterterrorism, pp. 69-80, Springer 2013.
4. A. Sliva, G. Simari, V. Martinez and V.S. Subrahmanian. SOMA: Stochastic Opponent Modeling Agents for Forecasting Violent Behavior, in: Handbook on Computational Approaches to Counterterrorism, pp. 99-127, Springer 2013.
5. G.I. Simari, D. Earp, M.V. Martinez, A. Sliva and V.S. Subrahmanian. Forecasting Group-level Actions using Similarity Measures, in: Handbook on Computational Approaches to Counterterrorism, pp. 181-199, Springer 2013.
6. M.V. Martinez, A. Sliva, G.I. Simari and V.S. Subrahmanian. Forecasting Changes in Terror Group Behavior, in: Handbook on Computational Approaches to Counterterrorism, pp. 225-243, Springer 2013.
7. J.P. Dickerson, G.I. Simari and V.S. Subrahmanian. Using Temporal Probabilistic Rules to Learn Group Behavior, in: Handbook on Computational Approaches to Counterterrorism, pp. 245-266, Springer 2013.
8. G.I. Simari, J.P. Dickerson, A. Sliva and V.S. Subrahmanian. Policy Analytics Generation Using Action Probabilistic Logic Programs, in: Handbook on Computational Approaches to Counterterrorism, pp. 515-542, Springer 2013.
9. J. Dix, W. Faber, and V.S. Subrahmanian. Privacy Preservation Using Multi-context Systems and Default Logic. Essays on Logic-Based AI in Honour of Vladimir Lifschitz (eds. E.

Erdem, J. Lee, Y. Erlier and D. Pearce), Lecture Notes in Computer Science Vol. 7265, pp. 195-210, Springer, 2012.
10. P. Shakarian and V.S. Subrahmanian. Region-based Geospatial Abduction with Counter-IED Applications, in: *Counterterrorism and Open Source Intelligence* (ed. U.K. Wiil), Springer Verlag Lecture Notes on Social Networks, pp. 105-142.
11. M. Albanese, M. Broecheler, J. Grant, V. Martinez and V.S. Subrahmanian. PLINI: A Probabilistic Logic Program Framework for Inconsistent News Information,: "Logic Programming, Knowledge Representation, and Nonmonotonic Reasoning: Essays Dedicated to Michael Gelfond on the Occasion of his 65th Birthday" (eds. S. Tran and M. Balduccini), pp. 347-376, 2011.
12. F. Parisi, A. Parker, J. Grant and V.S. Subrahmanian. Scaling Cautious Selection in Spatial Probabilistic Temporal Databases, accepted for publication in: Methods for Handling Imperfect Spatial Information (eds. R. Jeansoulin, O. Papini, H. Prade and S. Schockaert), Studies in Fuzziness and Soft Computing Vol. 256, pages Springer, 2011.
13. A. Parker, D. S. Nau, and V.S. Subrahmanian. Paranoia versus overconfidence in imperfect-information games. In R. Dechter, H. Geffner, and J. Y. Halpern, editors, "Heuristics, Probabilities, and Causality: A Tribute to Judea Pearl", pp. 63–87, 2010.
14. M. Albanese, R. Chellappa, A. Pugliese, P. Turaga, and V.S. Subrahmanian, Semantic Video Content Analysis, in "Video Search and Mining" (eds. Dan Schonfeld, Caifeng Shan, Dacheng Ta, and Liang Wang), Studies in Computational Intelligence Series, Springer Verlag, pp. 147-176, 2010.
15. A. Sliva, V.S. Subrahmanian, V. Martinez and G. Simari. CAPE: Automatically Predicting Changes in Terror Group Behavior, in *Mathematical Methods in Counterterrorism (*eds. N. Memon, J. Farley et al.), Springer Verlag page 253-269, 2009.
16. V.S. Subrahmanian. Probabilistic Temporal Databases, in *Encyclopedia of Database Systems* (eds. T. Ozsu and L. Liu), Springer Verlag, 2009, pp. 2165-2168.
17. V.S. Subrahmanian, V. Martinez and D. Reforgiato. Multimedia Presentation Databases, in *Encyclopedia of Database Systems* (eds. T. Ozsu and L. Liu), Springer Verlag, 2009, pp. 1829-1831.
18. R. Chellappa, N.P. Cuntoor, S.W. Joo, V.S. Subrahmanian and P. Turaga. Computational Vision Approaches for Event Modeling. In "Understanding Events: From Perception to Action", T. F. Shipley and J. Zacks (eds.), pp. 473-521, Oxford University Press, 2008.
19. A. Parker, D. Nau and V.S. Subrahmanian. The Role of Imperfect Information, in "Adversarial Reasoning: Computational Approaches to Reading the Opponent's Mind" (eds. A. Kott and W.M. McEneaney), pp. 209—229, Chapman and Hall, 2006.
20. M. Albanese, C. Cesarano, M. Fayzullin, A. Picariello and V.S. Subrahmanian. Video Databases, in "Encyclopedia of Multimedia" (ed. B. Furht), pp. 892-900, Springer, 2006.
21. M. Albanese, C. Cesarano, M. Fayzullin, A. Picariello and V.S. Subrahmanian. Video Summarization, in "Encyclopedia of Multimedia" (ed. B. Furht), pp. 917-925, Springer, 2006.
22. A. Picariello, M.L. Sapino and V.S. Subrahmanian. Algebraic Video Environment, in Handbook of Video Data Bases (e.g. B. Furht and O. Marques), CRC Press ISBN 084937006X, 2003.
23. T. Eiter, V. Mascardi, V.S. Subrahmanian. Error-Tolerant Agents. Computational Logic: Logic Programming and Beyond (eds. A. Kakas and F. Sadri) 2002: 586-625 Springer Verlag.

24. S. Jajodia, M. Kudo and V.S. Subrahmanian. Provisional Authorizations, in Recent Advances in Secure and Private E-Commerce (ed. A. Ghosh), Kluwer Academic Publishers, 2001.
25. J. Lu, B. Ludascher, J. Schue and V.S. Subrahmanian. Maintaining Well-Founded Views in Constraint Databases, in Logic Programming and Soft Computing (eds. T.P. Martin and F. A. Fontana), pp. 129-144, 1998.
26. S. Marcus and V.S. Subrahmanian. Towards a Theory of Multimedia Database Systems, in: Multimedia Database Systems: Issues and Research Directions (eds. V.S. Subrahmanian and S. Jajodia), Springer Verlag, Nov. 1995.
27. D. Perlis and V.S. Subrahmanian. Meta-languages, Reflection Principles, and Self-Reference, in: "Handbook of Logic in Artificial Intelligence and Logic Programming", pp. 323-358, ed. Dov Gabbay, Oxford Univ. Press, 1994.
28. R. Ng and V.S. Subrahmanian. Relating Dempster-Shafer Logic Programs and Stable Semantics, in: Logical Methods: In Honor of Anil Nerode's Sixtieth Birthday (eds. J. Crossley and J. Remmel), pp 654-704, Birkhauser, 1993.
29. H. Blair, A. Brown and V.S. Subrahmanian. Monotone Logic Programming, in: "Intensional Logics for Programming", (eds. L. Farinas del Cerro and M. Penttonen), pp 1-22, Oxford Univ. Press, 1992.
30. N.C.A. da Costa, L. Henschen, J. Lu and V.S. Subrahmanian. Reasoning in Paraconsistent Logics, in: "Automated Reasoning: Essays in Honor of Woody Bledsoe", pp. 181-210, ed. R. Boyer, Kluwer Academic Publishers, 1991.
31. V.S. Subrahmanian. A Simple Formulation of the Theory of Metalogic Programming, in: "Meta-Programming in Logic Programming", (eds. H. Abramson and M. Rogers), pp 65-101. MIT Press, 1989.

II.B.2. Collections
II.B.3. Encyclopedia
II.B.4. Series
II.B.5. Research Paper
II.B.6. Other

<u>II.C. Articles in Refereed Journals</u>

1. L. Pajola, D. Chen, M. Conti, and V.S. Subrahmanian. A Novel Review Helpfulness Measure based on the User-Review-Item Paradigm, accepted for publication in *ACM Transactions on the Web*, January 2023.
2. D. Byman, C. Gao, C. Meserole and V.S. Subrahmanian. Deepfakes and International Conflict. *Foreign Policy at Brookings* brief. January 2023.
3. G. Apruzzese and V.S. Subrahmanian. Mitigating Adversarial Gray-Box Attacks Against Phishing Detectors, to appear in *IEEE Transactions on Dependable & Security Computing*, accepted Sep 2022.
4. R.J. Fokkink, J.F. Brethouwer, K.T. Greene, R. Lindelauf, V.S. Subrahmanian, C. Tornquist. Rising tension in the Himalayas: a Geospatial Analysis of Chinese Border Incursions into India, *PloS One*, 2022 Nov 10;17(11):e0274999.
5. Y. Chen, D. Gartenstein-Ross, K. T. Greene, K. Kalif, S. Kraus, F. Parisi, C. Pulice, A. Subasic, and V.S. Subrahmanian. Linking Terrorist Network Structure to Lethality:

Algorithms and Analysis, accepted for publication in *IEEE Transactions on Computational Social Systems*, July 2022.
6. C. Bai, M. Bolonkin, V. Regunath and V.S. Subrahmanian. DIPS: A Dyadic Impression Prediction System for Group Interaction Videos, accepted for publication in *ACM Transactions on Multimedia Computing Communications and Applications*, April 2022. *https://dl.acm.org/doi/pdf/10.1145/3532865*
7. C. Bai, H. Chen, J. Leskovec, S. Kumar and V.S. Subrahmanian. M2P2: Multimodal Persuasion Prediction using Adaptive Fusion, accepted for publication in *IEEE Transactions on Multimedia*, November 2021. https://ieeexplore.ieee.org/abstract/document/9645309?casa_token=Ll2EbvR1s1QAAAAA:tkH5dnn1FxGPJzdaJQ7_7q4DKH_FlYcRRtsNQOpIdYXs_MzPMv3nA6MlS5nNFuG68pCIl0fW
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II.D. Published Conference Proceedings

II.D.1. Refereed Conference Proceedings

1. T. Deb, J, Dix, M. Jeong, C. Molinaro, A. Pugliese, A. Quattrini Li, E. Santos, V.S. Subrahmanian, S. Yang and Y. Zhang. DUCK: A Drone-Urban Cyber-Defense Framework based on Pareto-Optimal Deontic Logic Agents, accepted for publication at the *2023 Association for the Advancement AI Conference (AAAI 2023)*, demo paper.
2. C. Bai, M. Bolonkin, V. Regunath, and V.S. Subrahmanian. POLLY: A Multimodal Cross-Cultural Context-Sensitive Framework to Predict Political Lying from Videos, accepted for publication in: *Proc. 24th ACM International Conference on Multimodal Interaction, Bengaluru, Nov. 2022.*
3. Y. Zhang, S. Chakrabarty, R. Liu, A. Pugliese, and V.S. Subrahmanian. A New Dynamically Changing Attack on Review Fraud Systems and a Dynamically Changing Ensemble Defense, *Proc.* 20th IEEE International Conference on Dependable, Autonomic & Secure Computing". Sep 2022, Calabria, Italy. **Recipient of the Best Paper Award.**
4. Y. Zhang, B. An and V.S. Subrahmanian. Correlation-Based Algorithm for Team-Maxmin Equilibrium in Multiplayer Extensive-Form Games, *Proc. IJCAI 2022*, pages 606-612, July 2022, Vienna, Austria.
5. S. Kang, C. Molinaro, A. Pugliese, and V.S. Subrahmanian. Randomized Generation of Adversary-Aware Fake Knowledge Graphs to Combat Intellectual Property Theft, *Proc. AAAI 2021*, Feb 2-9, 2021. (9,034 submissions, 7,911 were sent for review, 1692 acceptances for an acceptance rate of either 18.73% or 21.39% depending on how you count).
6. C. Bai, S. Kumar, J. Leskovec, and V.S. Subrahmanian. Deception Prediction in Dynamic Face-To-Face Interaction Networks, accepted for publication in the *Proc. 2021 AAAI International Conference on the Web & Social Media*. (rolling acceptances, acceptance rate in Sep 2020 was 3/90 papers).
7. H. Chen, J. Liu, R. Liu, N. Park, and V.S. Subrahmanian, VASE: A Twitter-based Vulnerability Analysis and Score Engine, *Proc. 2019 IEEE Intl. Conf. on Data Mining* (ICDM 2019), Nov. 2019. *Acceptance rate: 18.5%*.
8. Lezi Wang, Chongyang Bai, Maksim Bolonkin, Judee Burgoon, Norah Dunbar, V. S. Subrahmanian, Dimitris N. Metaxas. Attention-based Facial Behavior Analytics. *Proc. 2019 British Machine Vision Conference*, Sep 2019, Cardiff, UK. *Acceptance rate: 25%.*

9. H. Chen, J. Liu, R. Liu, N. Park and V.S. Subrahmanian. VEST: A System for Vulnerability Exploit Scoring & Timing, Demo paper, *Proc. 2019 Intl. Joint Conference on Artificial Intelligence (IJCAI 2019)*, Aug 2019, Macao. *This paper was named the runner up for the Most Innovative Demo at IJCAI 2019.*
10. H. Chen, S. Jajodia, J. Liu, N. Park, V. Sokolov, V.S. Subrahmanian. FakeTables: Using GANs to Generate Functional Dependency Preserving Tables with Bounded Real Data, *Proc. 2019 Intl. Joint Conference on Artificial Intelligence (IJCAI 2019)*, Aug 2019, Macao. Acceptance rate: 17.89%.
11. C. Bai, M Bolonkin, S. Kumar, J. Leskovec, M. Metzger, J. Nunamaker, V.S. Subrahmanian. Extracting Interaction Networks from Multi-Person Discussion Videos, *Proc. 2019 Intl. Joint Conference on Artificial Intelligence (IJCAI 2019)*, Aug 2019, Macao. Acceptance rate: 17.89%.
12. C. Bai, M. Bolonkin, J. Burgoon, N. Dunbar, V.S. Subrahmanian. Predicting dominance in multi-person videos, Proc. 2019 Intl. Joint Conference on Artificial Intelligence (IJCAI 2019), Aug 2019, Macao. Acceptance rate: 17.89%.
13. H. Chen, R. Lui, N. Park, and V.S. Subrahmanian. Using Twitter to Predict When Vulnerabilities will be Exploited, *Proc. 2019 ACM Conference on Knowledge Discovery & Data Mining (KDD '19)*, Anchorage, Alaska, Aug 2019. Acceptance rate: 20.7% (including both papers and posters).
14. C. Bai, V.S. Subrahmanian, T. White, L. Xiao, P. Zhou. C2P2: A Collective Cryptocurrency Up/Down Price Prediction Engine, *Proc. 2019 IEEE International Conference on Blockchain*, Atlanta, Georgia, July 2019.
15. C. Bai, M. Bolonkin, J. Burgoon, C. Chen, N. Dunbar, B. Singh, V.S. Subrahmanian, Z. Wu. Automatic Long-Term Deception Detection in Group Interaction Videos, accepted *Proc. 2019 IEEE Intl. Conf. on Multimedia & Expo* (ICME 2019), Shanghai, July 2019. Acceptance rate: 30%
16. Z. Wu, B. Singh, L.S. Davis and V.S. Subrahmanian. Deception Detection in Videos, *Proc. AAAI* 2018, Feb 2018, acceptance rate: 24.55%.
17. S. Kumar, B. Hooi, M. Kumar, D. Makhija, C. Faloutsos, and V.S. Subrahmanian. REV2: Fraudulent User Prediction in Rating Platforms, *Proc. 11th ACM Conf. on Web Search & Data Mining (WSDM)*, Los Angeles, Feb 2018. Acceptance rate: 16.15%.
18. T. Chakraborty, D. Chandhok, and V.S. Subrahmanian. MC3: A Multi-Class Consensus Classification Framework,: *Proc. 2017 Pacific-Asia Knowledge Discovery & Data Mining Conference* (PAKDD-2017), Jeju, South Korea, Springer, May 2017. Regular presentation paper. Acceptance rate: 28.2%
19. S. Kumar, J. Cheng, J. Leskovec, and V.S. Subrahmanian. An Army of Me: Sockpuppets in Online Discussion Communities, *Proc. 26th International Conference on the World Wide Web (WWW 2017)*, Perth, Australia, April 2017. ***Received Best Paper Honorable Mention.*** Acceptance rate: 17%.
20. S. Kumar, F. Spezzano, V.S. Subrahmanian and C. Faloutsos. Edge Weight Prediction in Weighted Signed Networks, *Proc. 2016 IEEE International Conference on Data Mining (ICDM 2016)*, Barcelona, Spain, Dec 2016. Acceptance rate for regular papers: 8.5%.
21. B. An, H. Chen, N. Park, and V.S. Subrahmanian. MAP: Frequency-Based Maximization of Airline Profits based on an Ensemble Forecasting Approach, *Proc. 2016 ACM Conf. on Knowledge Discovery & Data Mining (KDD), August 2016, San Francisco, CA. Poster.* Acceptance rate (combined for papers + posters): 19.94%.

22. T. Chakraborty, N. Park, and V.S. Subrahmanian. Ensemble-Based Algorithms to Detect Disjoint and Overlapping Communities in Networks, *Proc. 2016 IEEE/ACM Conf. on Advances in Social Network Analysis and Mining*, San Francisco, Aug 2016. Acceptance rate: 13.61%. *Runner up for best paper award.*
23. S. Kumar, E. Serra, F. Spezzano, and V.S. Subrahmanian. Metric Logic Program Explanations for Complex Separator Functions, *Proc. 2016 Intl. Conf. on Scalable Uncertainty Management*, Nice, Sep 2016.
24. E. Serra, F. Spezzano, and V.S. Subrahmanian. ChoiceGAPs: Competitive Diffusion as a Massive Multi-Player Game in Social Networks, *Proc. 2016 Intl. Conf. on Scalable Uncertainty Management*, Nice, Sep 2016.
25. C. Kang, N. Park, B.A. Prakash, E. Serra, and V.S. Subrahmanian. Ensemble Models for Data-Driven Prediction of Malware Infections, *Proc. 9th ACM International Conf. on Web Science and Data Mining (WSDM 2016)*, San Francisco, Feb 2016. Acceptance rate: 18.2%.
26. S. Kumar, F. Spezzano, and V.S. Subrahmanian. VEWS: A Wikipedia Vandal Early Warning System, *Proc. 2015 ACM Conf. on Knowledge Discovery & Data Mining (KDD)*, August 2015, Sydney Australia, Acceptance rate: 19.4%
27. I. Andrews, S. Kumar, F. Spezzano and V.S. Subrahmanian. SPINN: Suspicion Prediction in Nuclear Networks, *Proc. 2015 IEEE International Conference on Intelligence and Security Informatics*, Baltimore, MD, May 2015.
28. S. Banaszak, E. Bowman, J. Dickerson, and V.S. Subrahmanian. Forecasting Country Stability in North Africa, *Proc. 2014 IEEE Joint Conference on Intelligence and Security Informatics (JISIC)*, The Hague, Sep 24-26 2014.
29. S. Kumar, F. Spezzano, V.S. Subrahmanian. Accurately Detecting Trolls in Slashdot Zoo via Decluttering, P*roc. ACM/IEEE Intl. Conf. on Advances in Social Network Analysis and Mining (ASONAM) 2014*, Beijing, August 2014. Acceptance rate: 18%.
30. J. Dickerson, V. Kagan, and V.S. Subrahmanian. Using Sentiment to Detect Bots on Twitter: Are Humans more Opinionated than Bots?, *Proc. ACM/IEEE Intl. Conf. on Advances in Social Network Analysis and Mining (ASONAM) 2014*, Beijing, August 2014. *This paper was selected as a significant research paper by the Science of Security Index of Significant Research in Cyber Security 2015.*
31. D. Skillicorn, F. Spezzano, V.S. Subrahmanian and M. Garber. Understanding South Asian Violent Extremist Group-Group Interactions, *Proc. ACM/IEEE International Symposium on Foundations of Open Source Intelligence and Security Informatics - FOSINT-SI 2014*, Beijing, August 2014.
32. C. Kang, A. Prakash, M. Purohit, V.S. Subrahmanian. Fast Influence-Based Coarsening for Large Networks, *Proc. ACM Conf. on Knowledge Discovery & Data Mining (KDD) 2014*, New York, August 2014. Acceptance rate: 14.6%.
33. S. Banaszak, V. Kagan, A. Stevens, and V.S. Subrahmanian. "COPTADS: Clinical Online PTSD and TBI Analysis and Detection System", *Proceedings of 2013 International Workshop on Visual Analytics in Healthcare*, Washington DC, Nov 2013.
34. M. Ovelgonne, N. Park and V.S. Subrahmanian. Pattern-based Centrality in Semantics Graphs, *Proc. SOCIALCOM 2013*, Washington DC. Sep 2013. Acceptance rate: 9.9%.
35. M. Ovelgonne, N. Park, V.S. Subrahmanian, L. Bowman and K., Ogaard. Personalized Best Answer Computation in Graph Databases, *Proc. 2013 Intl. Semantic Web Conference*, Oct 2013, Sydney, Australia, acceptance rate: 21.5%.

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38. C. Minoiu, C. Kang. A. Berea and V.S. Subrahmanian. The Role of Financial Connectedness in Predicting Crises, 2013 Conference on Interlinkages and Systemic Risk, July 2013, Ancona, Italy.
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40. C. Kang, J. Grant, A. Pugliese, and V.S. Subrahmanian. STUN: Spatio-Temporal Uncertain (Social) Networks, *Proc. 2012 International Conference on Advances in Social Network Analysis and Mining (ASONAM 2012*), August 2012, Istanbul, Turkey (full paper – 16% acceptance rate).
41. C. Kang, C. Molinaro, S. Kraus, Y. Shavitt, and V.S. Subrahmanian. Diffusion Centrality in Social Networks**,** *Proc. 2012 International Conference on Advances in Social Network Analysis and Mining (ASONAM 2012)*, August 2012, Istanbul, Turkey (short paper – 25% acceptance rate).
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43. M. Broecheler, A. Pugliese, and V.S. Subrahmanian. Efficient Multi-View Maintenance in the Social Semantic Web, *Proc. Intl. Conf. on the World Wide Web WWW* (Companion Volume) 2012: 467-468, poster presentation.
44. M. Albanese, S. Jajodia, A. Pugliese, V.S. Subrahmanian: Scalable Detection of Cyber Attacks. *Proc. 10th International Conference on Computer Information Systems - Analysis and Technologies, CISIM 2011*, Kolkata, India, December 14-16, 2011. Proceedings. Communications in Computer and Information Science Vol. 245 Springer 2011, (eds. N. Chaki and A. Cortesi), pp. 9-18.
45. M. Albanese, S. Jajodia, A. Pugliese, V.S. Subrahmanian: Scalable Analysis of Attack Scenarios. *Proc. European Symposium on Research in Computer Security (ESORICS)* 2011: 416-433, Sep. 2011, Belgium. Springer.
46. A. Mannes, A. Sliva, and V.S. Subrahmanian. A Computational Enabled Analysis of Lashkar-e-Taiba Attacks in Jammu & Kashmir, *Proc. 2011 IEEE European Intelligence & Security Informatics Conference*, Athens, Sep. 2011, pp. 224-229.
47. J. Dickerson, A. Mannes, and V.S. Subrahmanian Dealing with Lashkar-e-Taiba: A Multi-Player Game-Theoretic Perspective, P*roc. IEEE International Symposium on Open-Source Intelligence and Web Mining*, Athens, Greece, Sep. 2011, pp. 354-359.
48. M. Broecheler, A. Pugliese and V.S. Subrahmanian. Probabilistic Subgraph Matching on Huge Social Networks, *Proc. 2011 Intl. Conference on Advances in Social Network Analysis and* Mining, July 2011, Kohsiung, Taiwan, pp. 271-278.
49. M. Albanese, C. Molinaro, F. Persia, A. Picariello, V.S. Subrahmanian. Finding Unexplained Activities in Video, accepted as both a talk and a poster at the *2011 International Joint Conf.*

on Artificial Intelligence, Barcelona, July 2011. (acceptance rate as both talk and poster: 17%), pp. 1628-1634.

50. G. Simari, A. Sliva, A. Parker, V.S. Subrahmanian. Approximate Achievability in Event Databases, *Proc. 11th European Conf. on Symbolic & Quantitative Approaches to Reasoning with Uncertainty*, June 2011, Ireland, pp. 737-748.
51. P. Shakarian, M. Nagel, B. Schuetzle, and V.S. Subrahmanian. Abductive Inference for Combat: Using SCARE-S2 to Find High-Value Targets in Afghanistan, *Proc. 2011 Intl. Conf. on Innovative Applications of Artificial Intelligence,* Aug. 2011, AAAI Press.
52. M. Broecheler, A. Pugliese and V.S. Subrahmanian. "A Budget –based Algorithm for Efficient Subgraph Matching on Huge Networks", *Proc. 2011 International Conference on Graph Data Management,* Hanover, Germany, April 2011, pp. 94-99.
53. G.I. Simari, J. Dickerson and V.S. Subrahmanian. Cost-based Query Answering in Action Probabilistic Logic Programs, *Proc. 2010 Intl. Conf. on Scalable Uncertainty Management* (eds. A. Deshpande and A. Hunter), Springer Lecture Notes in Computer Science, Sep. 2010, Toulouse, France, pp. 319-332.
54. M.V. Martinez, F. Parisi, A. Pugliese, G.I. Simari, J. Dickerson and V.S. Subrahmanian. Efficient Policy-based Inconsistency Management, *Proc. 2010 Intl. Conf. on Scalable Uncertainty Management* (eds. A. Deshpande and A. Hunter), Springer Lecture Notes in Computer Science, Sep. 2010, Toulouse, France, pp. 264-277.
55. M. Broecheler, A. Pugliese and V.S. Subrahmanian. COSI: Cloud Oriented Subgraph Identification in Massive Social Networks, *Proc. 2010 Intl. Conf. on Advances in Social Networks and Mining* (ASONAM-2010), Aug. 2010, Odense, Denmark, pp. 248-255.
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58. J. Dickerson, G. Simari, S. Kraus and V.S. Subrahmanian. A Graph-Theoretic Approach to Protecting Static and Moving Targets from Adversaries, *Proc. 2010 Intl. Conf. on Autonomous Agents and Multi-Agent Systems*, Toronto, May 2010, pp. 299-306.
59. P. Shakarian, M.L. Sapino and V.S. Subrahmanian. *SCARE: A Case Study with Baghdad*, Proc. 2009 Intl. Conf. on Computational Cultural Dynamics (eds. D. Nau, A. Mannes), Dec. 2009, AAAI Press.
60. M. Broecheler, A. Pugliese and V.S. Subrahmanian. DOGMA: A Disk-Oriented Graph Matching Algorithm, *Proc. 2009 International Semantic Web Conference,* Washington DC, Oct. 2009.
61. A. Parker, V.S. Subrahmanian and J. Grant. Fast and Accurate Prediction of the Destination of Moving Objects, *Proc. 2009 Intl. Conf. on Scalable Uncertainty Management*, Washington DC, Sep. 2009, Springer Lectures Notes in Computer Science Vol. 5785 (eds. L. Godo and A. Pugliese), pp. 180-192.
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169. On the Semantics of Quantitative Logic Programs, *Proc. 4th IEEE Symp. on Logic Programming*, pp. 173-182, Computer Society Press. Sep. 1987.

Submitted conference papers are not listed above.

II.D.2. Non-Refereed Conference Proceedings
II.D.3. Historical Conference Proceedings (10+ years ago)
II.D.4. Other

<u>II.E. Conferences, Workshops, and Talks</u>
II.E.1. Keynotes

1. Keynote Address, Indo-Pacific Geointelligence, Delhi, June 2023.
2. Keynote Address, ITASEC 2023 Italian Conference on Cybersecurity, Bari, Italy, May 2023.
3. Keynote Address at a workshop at the First Global Summit on Responsible Artificial Intelligence in the Military Domain: REAIM 2023 organized by the Netherlands Ministry of Defense, The Hague, Feb 2023.
4. Keynote Address, TCS TACTiCS regional conference for North America - Latin America, Nov 2022.
5. Keynote Address, Wells Fargo *Confluence* conference, Dec 2021.
6. Keynote Speaker, 18th International, Conference on Security and Cryptography (SECRYPT 2021), July 2021.
7. Keynote Speaker, UnitedHealth Group Healthcare Technology Advisory Council, June 30, 2021.
8. Keynote Speaker, Working Group on Children Recruited by Terrorist and Violent Extremist Groups ("CRTG") Live Briefing, April 29 2021.
9. Keynote Speaker, 1st International Conference on Autonomous Intelligent Cyber-defence Agents, Paris France (but via Zoom), March 2021.
10. Keynote Speaker, 8th International Workshop on Parallel and Distributed Computing for Large-Scale Machine Learning and Big Data Analytics (ParLearning 2019), in conjunction with the 25th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD 2019), Anchorage, Alaska, Aug 2019.
11. Keynote Speaker, 17th International Conference on Practical Applications of Agents and Multi-Agent Systems, Avila, Spain, June 2019.
12. Keynote Speaker, 14th International Conference on Information Systems Security, Bangalore, India, Dec. 2018
13. Plenary Speaker, The World Academy of Science General Meeting, Trieste, Italy, Nov 2018.
14. Keynote Speaker, 2018 New York State Cybersecurity Conference, Albany, NY, June 2018.
15. Keynote Speaker, ADCOM-2016, Advanced Computing and Communications Society, Bangalore, India, Sep 2016.
16. Keynote Speaker, Cyber and Infrastructure Crime & Security Track, IEEE Joint Intelligence and Security Informatics Conference, The Hague, Sep 2014.
17. Keynote Speaker, Sentiment Analysis Symposium, May 2013, New York City.
18. Keynote Speaker, Computer Society of India Annual Convention, Dec. 1-2, 2012 Kolkata, India.
19. Keynote Speaker, Sentiment Analysis Symposium, Oct. 2012, San Francisco, CA. (Cancelled due to Hurricane Sandy).
20. Keynote address, Proc. 2008 First Intl. Workshop on Social Computing, Behavioral Modeling and Prediction, Phoenix, April 1-2, 2008.
21. Keynote address, 3rd International Conf. on Mobile and Ubiquitious Multimedia (MUM2004), College Park, MD, Oct. 2004.
22. Keynote address, 2004 IEEE International Conf. on Multiagent Security and Survivability, Philadelphia, PA, Aug. 2004.
23. Keynote Address 2004 Conference on Computational Logic in Multiagent Systems, Jan 2004, Ft. Lauderdale, FL.
24. Keynote Address 2003 "Symposium on Logic based Agent Implementation" Barcelona, Spain, Feb. 2003

25. Keynote address: 2001 International Conference on Multimedia Information Systems, Capri, Italy, Nov. 2001.
26. Keynote Address: 1998 Intl. Workshop on Query Processing and Multimedia Issues in Distributed Systems, August 26-27, Vienna, Austria.

II.E.2. Invited Talks (Talks at universities are not included here)

1. Invited Panel Chair, Geospatial World Forum, Rotterdam, Netherlands, May 2023.
2. Invited Talk, Geospatial Summit, United Nations (Dept. of Political & Peacebuilding Affairs), Feb 2023.
3. Invited Talk, Workshop on "The Irresponsibility of a Narrow Debate on Military AI" at the Responsible use of AI in the Military (RE-AIM 2023), The Hague, Feb 2023. Organized by the Netherlands Ministry of Foreign Affairs.
4. Invited Talk, West African Conference on Machine Learning/AI and Terrorism Prediction, (via Zoom), Ougadougou, Burkina Faso, November 2022.
5. Invited Talk, Dept. of Homeland Security, October 2022.
6. Invited Talk, Illinois Ignite 2022, Chicago, September 2022.
7. Invited Talk, Foundation Day Lecture of Society for Electronic Transactions and Security (SETS), India, June 2022
8. Invited Talk, DARPA SocialCyber AI Exploration PI meeting, June 2022.
9. Invited Panel, TCS Industry Panel on Future of Cyber Risk & Insurance, May 2022.
10. Invited Tutorial, Netherlands Ministry of Defense MasterClass on Data Science & AI for Security, targeted at top Generals in the Netherlands Defense establishment.
11. Invited Speaker, United Nations UNCCT/UNOCT/UNICRI Meeting on Building Good Practices for the Use of Artificial Intelligence for Social Network Analysis, March 2021.
12. Invited Panel, *TCS Innovation Day for India*, Dec 2021.
13. Invited Panel, *Foreign Policy magazine TechForum*, Nov 17 2021.
14. Invited Talk, *Resilience Week* 2021, organized by Argonne National Lab, Oct 2021.
15. Invited Talk (5-minute address) for Canadian National Rail Hackathon, June 2021, co-organized by CN Rail and Tata Consultancy Services.
16. Invited Talk, ai4 Virtual Conference on AI & Cybersecurity, Feb 2021.
17. Invited Talk, Global AI Summit, New York, NY, Dec 2020.
18. Invited Talk, 10th International Conference on Scalable Uncertainty Management, Bolzano, Italy, Sep 2020.
19. Invited Talk, ai4 Virtual Conference on AI, Aug 2020.
20. Invited Talk, National Institute for Advanced Studies, Bangalore, India, July 2020.
21. Invited Talk, US Army Science Board, July 2020.
22. Invited Talk, IEEE Hyderabad Chapter, May 2020.
23. Invited Talk, University of Rome Italy, May 2020
24. Invited Talk, AAAS/Elsevier/SenseAboutScience talk on "AI: Pros & Cons" at the AAAS Annual Conference, Feb 2020, Seattle, WA.
25. Invited Dinner Speaker, AAAS/Elsevier Dinner Speaker on Strengths & Weaknesses of Data Science, Feb 2020, Seattle, WA.
26. Invited Speaker on Fake Documents, Institute for Information Infrastructure Protection (I3P) Webinar, Feb 2020.
27. Invited Speaker at the Google Android Security Summit, Feb 2020

28. Dartmouth-Durham Global Debate on AI & Cybersecurity, Washington DC, Dec 2019.
29. Dartmouth-Durham Global Debate on AI & Cybersecurity, New York City, Dec 2019.
30. Invited Speaker to brief the President and other top executives of Samsung Electronics about "AI & Cybersecurity", Nov 2019.
31. Invited Speaker, 2019 Digital Meet, Padua, Italy, Oct 2019.
32. Invited Tutorial, 2019 Intl. Summer School on Machine Learning & Cybersecurity, Padua, Italy Sep 2019.
33. Keynote Speaker, 8th International Workshop on Parallel and Distributed Computing for Large-Scale Machine Learning and Big Data Analytics (ParLearning 2019), in conjunction with the 25th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD 2019), Anchorage, Alaska, Aug 2019.
34. Invited Speaker, 2019 ADP Executive Security Leadership Meeting, ADP Inc. (America's biggest payroll processing company), Hanover, NH, July 2019.
35. Invited Speaker, 13th International Conference on Flexible Query Answering Systems, Amantea, Italy, July 2019.
36. Plenary Speaker, 17th Intl. Conf. on Practical Applications of Agents & Multiagent Systems, Avila, Spain, June 2019.
37. Invited Speaker, Logic Programming & Non-Monotonic Reasoning Conference, Philadelphia, PA, June 2019.
38. Invited Speaker, Workshop on AI & Cybersecurity, Leiden, Netherlands, June 2019.
39. Keynote Speaker, 14th International Conference on Information Systems Security, Kolkata, India Dec 2018
40. Invited Speaker, General Assembly of The World Academy of Science, Trieste, Italy, Nov 2018.
41. Invited Speaker, Israeli National Cybersecurity Conference, Tel Aviv, June 2018.
42. Invited Speaker, 2018 ARO Workshop on Cyber Deception, College Park, MD Aug 2018.
43. Invited Speaker, ParSocial 2018, Vancouver, BC, May 2018.
44. Invited Speaker, 12th IEEE Intl. Conf. on Semantic Computing, Newport Beach, CA, Feb 2018.
45. Invited Speaker, 2017 World Science Forum, Amman, Jordan, Nov. 2017 in the plenary session titled "The Opportunities and Challenges of Digital Transformation".
46. Invited Speaker, 2017 Conference on Decision and Game Theory for Security (GameSec 2017), Vienna, Austria, Oct 2017.
47. Invited Speaker, 2017 Israeli National Cybersecurity Conference, Tel Aviv, June 2017.
48. Invited Speaker, 2017 Capital One Bank Data Intelligence Conference, June 2017.
49. Invited Speaker, The Middleburg Forum, Middleburg, VA, April 2017. Previous speakers in this series include Sandra Day O'Connor, David Ignatius, Hedrick Smith, and others.
50. Invited Speaker, 2017 Big Data Winter School, Bari, Italy, Feb 2017.
51. Invited Panelist, 2017 UNISSIG Conference of CISOs of UN Group Organizations, Geneva, Switzerland, January 2017. Another member of this panel included ITU Secretary General Houlin Zhao.
52. Invited Speaker, 12th International Conference on Information System Security, Jaipur, India, Dec 2016.
53. Invited Speaker, Workshop on Data Mining for Cyber-Security, Barcelona, Spain, Dec 2016, in conjunction with ICDM 2016.
54. Invited Speaker, United Nations Counter Terrorism Committee Executive Directorate

(CTED) technical meeting, UN Headquarters, NY, Nov. 2016. http://webtv.un.org/watch/session-i-preventing-the-exploitation-of-information-and-communications-technologies-for-terrorist-purposes-while-respecting-human-rights-and-fundamental-freedoms/5229657438001

55. Invited Speaker, Science Media Awards & Summit in the Hub, Boston, Sep 2016.
56. Invited Speaker, Social Data and Analytics DC, Washington DC, Sep 2016.
57. Invited Speaker, Israel National Cyber-Security Conference, Tel Aviv, June 2016.
58. Invited Speaker, Fourth International Conference on Data Mining for Business Intelligence, Beer-Sheva, Israel, May 2016.
59. Invited Panelist, Foundation for the Defense of Democracy Panel on "Global Cyber-Vulnerabilities: Threats, Challenges, and Opportunities" moderated by David Sanger (Chief National Security correspondent for the *New York Times*) and including former US Deputy Assistant Attorney General Luke Dembosky and counter-terrorism expert Daveed Gartenstein Ross. March 2016. Video at http://youtu.be/m7Ycg_POGco
60. Invited Participant, US-India Strategic Dialog (track 2) organized by the Aspen Institute and the Ananta Aspen Center, Dec 2015.
61. Invited Speaker, Conf. on Knowledge Discovery & Data Analysis, Algiers, Nov 2015.
62. Invited Speaker, Israel National Cyber-Security Conference, Tel-Aviv, June 2015.
63. Invited Speaker, Summer School on Business Intelligence and Big Data Analysis, Capri, Italy, June 2015.
64. Invited Speaker, Cyber-Security and Resilience Conference, Bombay Stock Exchange, Mumbai, India, April 2015.
65. Invited Participant, India-Israel Dialog (track 2), New Delhi, Dec 2014.
66. Invited Speaker, 4th Annual International Cybersecurity Conference, Yuval Ne'eman Workshop for Science, Technology and Security, Tel Aviv University, the Israeli National Cyber Bureau, Prime Minister Office and the Interdisciplinary Cyber Research Center (ICRC), Sep 2014.
67. Commencement/Graduation Speaker, PES Institute of Technology, Bangalore, India, Sep 2014.
68. Invited Speaker, 2014 IFIP Security Conference, Marrakech, Morocco, June 2-4, 2014.
69. Invited Speaker, NISA (Netherlands Intelligence Studies Association) Conference on Social Media Intelligence, Netherlands, March 7 2014.
70. Invited Participant, US-India Strategic Dialog (track 2), Washington DC, Feb 8-10, 2014.
71. Invited Speaker, Aspen Institute, Kolkata India (Jan 20 2014) and New Delhi (Jan 24 2014).
72. Invited Speaker on Cybersecurity and Member, India Israel Strategy Forum, Tel Aviv, Oct 28-30, 2013.
73. Invited Panel, Cyber-Security Financing Forum, Washington DC, Oct 21-22, 2013.
74. Invited Lecture, Aspen Institute and US Consulate General – Mumbai, May 30, 2013.
75. Invited Lecture, Observer Research Foundation, May 29, 2013, New Delhi.
76. Invited Speaker on Cybersecurity, US-India Strategic Dialog, Jan 12-13, New Delhi.
77. Invited Speaker, Aspen Institute, "Using IT to Fight Terrorism and Increase Security", Jan 9, 2013, New Delhi. Public lecture. Viewable at http://www.youtube.com/watch?v=4YOSkdv1R84&list=UUIvdd1ncT8Z9OtE6gEXc8HQ&index=1
78. Invited Speaker, the AAAI Fall Symposium on Social Networks and Social Contagion, Nov. 2-4, 2012, Washington DC.

79. Invited Speaker, Dutch Police Symposium on “Knowledge and Models”, The Hague, Dec. 2012.
80. Invited Speaker, Workshop on Data Management in the Social Semantic Web (DMSW-12), Istanbul, Turkey, Aug. 26-30, 2012.
81. Invited talk, 2011 Italian Database Conference (SEBD 2011), Maratea, Italy, June 2011.
82. Invited Talk, 2011 Bar-Ilan Symposium on Foundations of Artificial Intelligence, Bar-Ilan University, Israel, June 2011.
83. Invited lecture on *ICT Platforms for Regional and Global Human Resources Development,* Education presented at the “Regional Integration and Human Resources Development in S&T Fields”, organized by the American Association for the Advancement of Science and the Government of Rwanda, Dec. 2010.
84. Invited lecture, 2009 International Conference on Computational Cultural Dynamics, College Park, MD, Dec. 2009.
85. Invited lecture, *2009 International Conference on Database Engineering and Applications Symposium (IDEAS 2009)*, Cetraro, Italy, Sep. 2009.
86. Invited talk, Fourth Conference on Mathematical Methods in Counter-terrorism, Rochester, NY, Sep. 20-22, 2007.
87. Invited talk, International Conference on Computational Cultural Dynamics, Aug. 2007.
88. Invited talk, “Research on Computational Cultural Reasoning”, Capitol Hill, June 14, 2007. Attended by US Congressional representatives Rep. Adam Smith (D-WA), Rep. Jim Cooper (D-TN) and Rep. Jim Saxton (R-NJ) as well as several staffers from the offices of various Congressmen and Senators. Organized by AAAS.
89. Invited tutorial on Service-Oriented Architectures, Disruptive Technology Office InfoX Conference, Dallas, Texas, March 2007.
90. Invited Talk, Ontologies, Databases and Applications of Semantics (ODBASE 2005), Oct/Nov. 2005, Agia Napa, Cyprus.
91. Invited Talk, 2004 International Workshop on Monitoring, Security, and Rescue Tasks in Multi-Agent Systems 2004 (MSRAS 2004), Poland, June 2004.
92. Invited tutorial on Multimedia Presentations. 9th International Workshop on Multimedia Information Systems, Ischia, Italy, May 2003.
93. Invited talk: NETTAB 2002 workshop on Agents in Bioinformatics, July 12-14, 2002, Bologna, Italy.
94. Invited tutorial: SOFSEM 2002, Slovakia, November 2002. Had to cancel tutorial for unforeseen reasons.
95. Invited tutorial: JELIA 2002, Sep. 2002, Calabria, Italy. Had to cancel tutorial for unforeseen reasons.
96. Invited talk: 24th Austrian/German Conference on Artificial Intelligence, Vienna, Austria, Sep. 19-21, 2001.
97. Invited talk: International Workshop on Agent Oriented Information Systems, June 2001, Interlaken, Switzerland.
98. Jon Postel Distinguished Lecture Series at UCLA, March 2001.
99. Invited Tutorial: Multimedia Database Systems, IEEE Intl. Conf. and Multimedia Expo, New York City, July 2000.
100. Invited Talk: 1999 Intl. Symposium on Methodologies for Intelligent Systems (ISMIS-99), Warsaw, Poland, June 8-11, 1999.
101. Invited Talk: ALP/UK and Compulog Workshop on Logic Programming and Distributed

Knowledge Management, April 1999, London, UK.

102. 5 Invited Lectures on Logic-Based Heterogeneous Information Integration, GULP Summer School in Logic Programming, Acquafredda di Maratea, Italy, Sep. 7-12, 1998.
103. "Interestingness" Invited Talk, 1997 Intl. Workshop on Logic Programming and Non-Monotonic Reasoning, Dagstuhl, Germany.
104. Invited tutorial: 1996 Italian Conf. on Databases (SEBD-96), Gizzeria, July 1996.
105. Invited address: 1995 Workshop on Implementations of Nonmonotonic Reasoning, International Joint Conf. on Artificial Intelligence, Montreal, Aug. 1995.
106. Invited address: 1995 Intl. Conf. on Uncertainty in Artificial Intelligence, Montreal, Aug. 1995.
107. Invited Lectures: Italian Summer School on Databases and Knowledge Bases, Lipari, Italy, July 1995.
108. Invited address: 1995 Intl. Conf. on Tools for Artificial Intelligence, Washington, DC 1995.
109. "Hybrid Knowledge Bases for Intelligent Reasoning Systems", Proc. 1994 Intl. Workshop on Pattern Recognition in Practice, Vlieland, Holland.
110. "Heterogeneous Knowledge Systems", workshop on Hybrid Control and Autonomous Systems, Ithaca, NY, Oct. 1994.
111. "Hybrid Knowledge Bases", 1993 GULP Conference (Italian Conference on Logic Programming), June 1993.
112. Invited tutorial on "Semantics of Logic Programs", 1993 Intl. Conf. on Logic Programming, Budapest, Hungary, June 1993.
113. "Hybrid Knowledge Bases", Army Workshop on "Mathematical and Computer Science Issues in Virtual, Distributed Interactive Simulations," Research Triangle Park, NC, May 1993.
114. "Deduction as Optimization: The LOP Project", Workshop on Autonomous Control - 2nd Intl. Symp. on Artificial Intelligence and Mathematics, Ft. Lauderdale, Florida, 1993.
115. In addition to the above, V.S. Subrahmanian has given invited colloquium talks at a number of institutions including: CSIRO Australia, University of Rome, University of Kentucky, Northwestern University, University of Pennsylvania, SUNY at Stonybrook, Rutgers University, University of Michigan, Bell Communications Research, Xerox Palo Alto Research Center, Xerox Webster Research Center, IBM T.J. Watson Research Center, Syracuse University, US Army Ballistics Research Laboratory,, Columbia University, University of California, San Diego, Stanford University, Cornell University, Bar Ilan University, Hebrew University, University of Toronto, Technische Universitat Wien, NYNEX Corporation., Univ. of Calabria - Italy, Univ. of Torino - Italy, Univ. of Koblenz - Germany, Concordia Univ. - Canada, Universita di Pisa, CNR-Italy, Imperial College - London, University of Naples - Italy, Universite Paul Sabatier - Toulouse, France. LAAS – Toulouse, France, Oxford University, Ben-Gurion University of the Negev - Beersheba, Israel. There are too many to mention.

II.E.3. Refereed Presentations
II.E.4. Refereed Abstracts
II.E.5. Refereed Posters
II.E.6. Refereed Panels

1. Panel Chair at the ACM/IEEE International Conference on Advances in Social Network Analysis and Mining, August 2013, Niagara Falls, Canada.
2. Panel Chair at the ACM/IEEE International Conference on Advances in Social Network Analysis and Mining, August 2012, Istanbul.
3. Panel Chair on "Data Mining" at the Informatics Conference, Maritime Institute, Maryland, Nov. 2006.
4. Panel Discussion on Multimedia Systems, 4th Intl. Workshop on Multimedia Information Systems, Istanbul, Turkey, Sep. 1998.
5. Panel Discussion on Logic Programming and Nonmonotonic Reasoning, 1997 Intl. Conf. on Logic Programming and Nonmonotonic Reasoning, Dagstuhl, Germany, July 1997.
6. Panel Discussion on the Future of Logic Programming, 1997 Intl. Conf. on Logic Programming, Leuven, Belgium, July 1997.
7. Panel Discussion on Intelligent Agents and Mediator Systems, 1996 Conf. on Information and Knowledge management (CIKM-96), Rockville, MD, Nov. 1996.
8. Panel Discussion on the WWW, 1996 IEEE Intl. Conf. on Data Engineering, Feb. 1996.
9. Panel Discussion on Content-Based Multimedia Database Systems, 1995 IEEE Intl. Conf. on Multimedia Computing and Systems, Washington DC.
10. Panel Discussion on "Uncertainty and Incompleteness in Dynamic World Autonomous Systems." Panel Discussion on Content-Based Information, 1994 SPIE Conf. on Applied Imagery and Pattern Recognition, Washington DC, Oct. 1994.
11. Panel Discussion on "Directions for Non-Monotonic Reasoning." 1992 IEEE International Conference on Intelligent Robots and Systems, July 1992.

II.E.7. Non-Refereed Presentations
II.E.8. Non-Refereed Abstracts
II.E.9. Non-Refereed Posters
II.E.10. Non-Refereed Panels
II.E.11. Symposia
II.E.12. Workshops

1. Workshop on Logic Programming and Non-Monotonic Reasoning, Austin, Texas, Nov. 1990.

II.E.13. Colloquia
II.E.14. Historical Conferences, Workshops, Talks (10+ years ago)
II.E.15. Other

<u>II.F. Professional Publications</u>
II.F.1. Reports and Non-Refereed Monographs

1. E. Vargas-Baron, V.S. Subrahmanian, J. Dickerson, R. Lauricella, N. Tolani-Brown, L. Joseph, J. Dougherty. Country Profiles on Early Child Development: Sub-Saharan Africa for the Global Early Childhood Progress Report (INITIAL DRAFT), in *4th International Conference on Early Childhood Development*, Dakar, Senegal, Nov. 2009.

II.F.2. Pre-Print/Working Paper (Not Work in Progress)
II.F.3. Legal Briefs
II.F.4. Policy Briefs
II.F.5. Other

<u>II.G. Book Reviews, Notes, and Other Contributions</u>
II.G. 1. Book Reviews
II.G. 2. Essays
II.G. 3. Notes
II.G. 4. Manuals
II.G. 5.Other

<u>II.H. Completed Creative Works</u>
II.H.1. Digital Media (e.g., CDs, DVDs, YouTube)
II.H.2. Datasets
II.H.3. Constructed Projects
II.H.4. Demonstrations
II.H.5. Inventions
II.H.6. Original Plans and Designs
II.H.7. Photography
II.H.8. Software and Applications
II.H.9. Websites
II.H.10. Exhibitions and Installations
II.H.11. Curatorial Practice
II.H.12. Performance or Interpretation – Performing Arts
II.H.13. Direction - Performing Arts
II.H.14. Production - Performing Arts
II.H.15. Costume, Stage, Multimedia, and Theatrical Design
II.H.16. Artistic and Graphic Design
II.H.17. Dramaturgy
II.H.18. Artwork
II.H.19. Choreography
II.H.20. Playwriting, Screenwriting, and Musical Composition
II.H.21. Works of Creative Writing
II.H.22. Performance or Interpretation - Film, Video, and Multimedia
II.H.23. Direction - Film, Video, and Multimedia
II.H.24. Production - Film, Video, and Multimedia
II.H.25. Citations and Reviews
II.H.26. Historical Completed Creative Works (10+ years ago)
II.H.27. Other

<u>II.I Significant Works in Public Media</u>
Specify the following – Title, Publication/Media Name, Contributors, Types (Print, online, broadcast, video, documentary)
II.I.1. Explanatory, Investigative, or Long-Form Journalism
II.I.2. Other Significant Journalism
II.I.3. Commentary/Analysis
II.I.4. Interactive Online Database
II.I.5. Other

II.J. Sponsored Research

Because of moves I made from the University of Maryland to Dartmouth College in Aug 2017 and from Dartmouth College to Northwestern University in Sep 2021, the amounts listed below are the amounts funded at the institution that received the original grant.

1. SPADE: Strategic Probabilistic Attitudinal Diplomacy Engine, DARPA, $ 795,589, Jan 2022 to June 2023. I am the overall PI for this project. Co-PIs: Larry Birnbaum and Dana Nau.
2. SMART: Social Movement Analysis & Reasoning Tool, $300K, Sep 2022-Aug 2024, Buffett Institute for Global Affairs, Northwestern University. Co-PIs: Sirus Bouchat, Brayden King, Dan Linna, Aaron Shaw, Rob Voigt.
3. Deception Detection in Roswell Videos, October Films UK, $10,000. I am not sure whether this counts as a grant or as a license. October Films is producing a film on the Roswell incident and will pay $10K to Dartmouth for having us run a large number of video clips of testimony from witnesses of the Roswell incident through a deception detection tool that we have developed.
4. A Distributed Laboratory for Automated Document Generation Using Large-Scale Computational Methods, Office of Naval Research, $279,216. 2020-2022.
5. SCAN – Socio Cultural Attitudinal Networks, Overall PI, MURI Grant – US Army Research Office, 2016 – 2022, $ 6,250,000. My portion of this is $1,690,080. I was the overall PI of this MURI award when I was at UMD. When I left UMD, we appointed a placeholder PI at UMD and moved most of my part of the money via a subcontracts first to Dartmouth College and then to Northwestern University.
6. Generating Documents that are Consistent with a Knowledge Base, $2,125,00, Office of Naval Research MURI award, subcontract from George Mason Univ. July 2018 – June 2023. This grant was originally issued to Dartmouth College and then moved with me to Northwestern University.
7. Research on Blockchain, gift from VeChain Corp. $150,000 2019-2021.
8. Research on Stability Analysis of Android Malware, gift from Google, $34,000. 2020-2021
9. RII Track-2 FEC: Computational Methods and Autonomous Robotics Systems for Modeling and Predicting Harmful Cyanobacterial Blooms, Aug 2019-July 2023, $2,999,009.00. PI: A. Quattrini Li. I am listed as a key person on this grant but am not a PI.
10. A Computational Predictive Model of Boko Haram, Office of Naval Research, June 1 2016 – Dec 31 2018, $510,000.
11. IRAD Gray Zone and Detecting Firestorms, Johns Hopkins Univ. Applied Physics Lab, $69,441, Feb – Aug 2017.
12. Functional Targeting of Terror Networks: A Big Data Approach, Israel Ministry of Defense, Feb 2017-Dec 2018, $150,000.
13. Believable Fake Scientific Document Generation by Exploring Data Semantics, Office of Naval Research, Aug 1 2016 – July 31 2020. $605,000 (my share). Subcontract from George Mason University.
14. HATS: Hypergraph Analytics of Terrorism Splits, Office of Naval Research, Sep 1 2016 – July 31 2020, $1,562,393.
15. A Computational Predictive Model of Boko Haram, Office of Naval Research, June 1 2016 – Dec 31 2018, $510,000.

16. NDEWS: A New Paradigm for Drug Early Warning Systems, NIH - National Institute on Drug Abuse, $1.384M 2014-2016. PI: Eric Wish. I am a co-PI on a very small part of this award.
17. Cybersecurity: Deception, Disclosure, and Complexity, US Army Research Office, $480,000. June 2014-June 2017.
18. Establishing a Science of Security Research Lablet at the University of Maryland: Task Human Behavioral and Cyber-Vulnerability. PI: Jonathan Katz. My project portion is approximately 900K over 5 years. April 2014-Apr 2019.
19. ASSERT: Automated Security System Event Response Techniques, Office of Naval Research (subcontract from George Mason Univ), $737,850, Dec 2014-Dec 2018
20. Data Driven Game Theory, Army Research Office $1,500,000 (3 years). PI: V.S. Subrahmanian, Co-PIs: Dana Nau and Sarit Kraus.
21. Workshop on Geo-Spatial Abduction, $14,510, Feb 2011-Feb 2012. Army Research Office.
22. Probabilistic Spatio-Temporal RDF, Naval research Lab, $259,457. Two years. 2 years.
23. 2011 International Conference on Socio-Cultural Behavior and Prediction, $40,000, Air Force Office of Scientific Research, Sep. 2010-Aug. 2011.
24. Center for Language and Cultural Analysis, ARL $2M approx, Oct. 2009-Oct. 2012. (PI: A. Weinberg. I am a co-PI on approximately $880K on this grant).
25. MURI-Computer Aided Human Centric Cyber Situation Awareness, Penn State University (ARO Pass through funds), $470K, Nov. 2009-June 2016.
26. Fast Algorithms for Group Between Centrality in Massive Social Networks, US Army Research Office/Lab, $175,426 (1 year supplement to the PAGE grant).
27. Fast Algorithms for Group Between-ness Centrality in Massive Social Networks, Ministry of Defense – Government of Israel, $153,520.
28. Gorilla DB, $39,000, Dian Fossey Gorilla Fund International, Aug. 2011-Dec 2012.
29. GUARD-DOG, $400,000 (approx.), Sep. 2010-Oct. 2011. Subcontract from BAE Systems to UMD as part of a DARPA Contract.
30. ADEN: Anomaly Detection Engine for Networks, $3,750,000. DARPA. Approximately $1,500,000 is for UMD – the rest is for subcontractors, Boston Fusion Inc. and Lehigh University. 2011-2014.
31. Lockheed Martin. CLOVE: Cultural Learning Over Video Environments, Dec. 2009-Dec. 2010. $125,000 approx.
32. AFOSR. DURIP: Scaling Stochastic Opponent Modeling Agents, $436,753 May 1, 2009 – April 30, 2010.
33. ARO. Page: Policy Analytics Generation Engine. $412,000 April 2009-to date. An additional $200K increment was awarded in May 2010. More increments added in late 2012.
34. ``MURI: CARA: Collaborative Adversarial Reasoning Architecture'' PIs: Dana Nau and V.S. Subrahmanian, Air Force Office of Scientific Research, $5,805,000, June 2006-May 2011. MURI Award.
35. ONR. SIMS: Scalable Inconsistency and Incompleteness Management Strategies, 3/2009-3/2010, $150K (approx.).
36. ``Sunny Day Grant Funds'' PIs: Jacques Gansler, V.S. Subrahmanian and Amy Weinberg, State of Maryland Division of Business and Economic Development, $490,000, May 2006.
37. ``DURIP: Heterogeneous Uncertainty Management'', PI: V.S. Subrahmanian, Army Research Office, $300,000, June 2006-June 2007.

38. Federated Laboratory for Telecommunications through Lockheed Sanders, Inc. $5,250,000. (PIs: J. Baras, A. Ephremides, N. Farvardin and V.S. Subrahmanian). V.S. Subrahmanian is PI on approximately $900,000 of this grant.
39. NSF, The Ecology of Terrorist Organizations, 10/1/2008 to 9/30/2011, PIs: Gary LaFree, Jonathan Wilkenfeld, Laura Dugan, V.S. Subrahmanian. $749,354.
40. University of Lagos, Nigeria (funds from a World Bank loan to the Government of Nigeria) $70,000 approximately. Jan. 2009-Dec. 2009.
41. SAIC/DARPA, Integrated Crisis Early Warning System, 1/15/2008 to 12/31/2009, $350,000. PI: V.S. Subrahmanian Co-PI: Jonathan Wilkenfeld.
42. US Army/AMSAA Award $150K, Oct. 2006-Oct. 2007.
43. Logistics Management Institute, Oct. 2006-Oct 2007, $112K.
44. COVERT: Cultural Online Visualization Environment, NAVAIR, $2,765,000 approx., Oct. 2006-Oct. 2009. PI: V.S. Subrahmanian Co-PIs: Amitabh Varshney and Dana Nau.
45. Lockheed DARPA Award.
46. NSF, Profile-Aware Web: Rules, Proofs, and Trust on the Semantic Web, PI: Jim Hendler, Co-PI: V.S. Subrahmanian. (This really is Jim Hendler's award. I was named PI when he left Maryland, but credit for this award should go to him).
47. ``GIDSTAR: Global Infectious Disease Surveillance, Tracking Repository'' PI: V.S. Subrahmanian, NIH, June 2006-Sep. 2006, $30,000.
48. ``Lab for Computational Cultural Dynamics'' PIs: Dana Nau and V.S. Subrahmanian, Air Force Office of Scientific Research, $600,000, May 2005-May 2008.
49. ``Data Drive Power Systems Operations'' PIs: A. Sussman, E. Abed and V.S. Subrahmanian, NSF, $999K. Jan 2006-Dec. 2008.
50. "Joint Institute for Knowledge Discovery", PI: V.S. Subrahmanian, (Co-PIs: R. Chellappa, C. Espy-Wilson, J. Hendler), Department of Defense, $7,500,000. March 2005-March 2008.
51. "Temporal reasoning integrating probabilities", PI: V.S. Subrahmanian. DARPA subcontract via Univ. of California Berkeley, $1,219,000 approx. June 2004-June 2006.
52. ``Heterogeneous Uncertainty Management", PI: V.S. Subrahmanian, Army Research Office, $450,000 approx. July 2003-May 2007.
53. "Knowledge Integration Research Initiative", PI: V.S. Subrahmanian.(Co-PIs: B. Bederson, L. Davis, L. Getoor, J. Hendler). Army Research Lab, $6,000,000. Aug. 2003- Aug 2008.
54. "Ontology structures for FBKOF", Army Research Lab (part of the Telecommunications Collaborative Technology Alliance), $173,000. Aug. 2003 - Aug. 2004.
55. "Sensor decision making using sensor network data", PI: Y. Aloimonos, Co-PI: V.S. Subrahmanian, $230,000 received to data. July 2003-June 2006.
56. "Rapid Response Electronic Markets for Time Sensitive Applications", $2,000,000. PI: G. Anandalingam. Co-PIs: L. Ausubel, M. Ball, P. Cramton, H. Lucas, and V.S. Subrahmanian.
57. Dynamic ontology management", ITT, $20,000, June - Sep. 2003.
58. Army Research Lab (part of the Advanced Decision Architectures Collaborative Technology Alliance), $1,720,000, Sep. 2001-Aug. 2008.
59. Toshiba Corporation, $50,000, Apr. 2001 - Apr. 2002.
60. "Agent based Battlefield Management", Northrup Grumman Corporation, $50,000, March 2001 - March 2002.
61. "Optimizing Heavily Loaded Agents", Army Research Office, Aug. 2000, $225,000 approx.
62. Declarative Sensor Tasking Language, DARPA SenseIT program, $512,000, Sep.1999 - Sep. 2002. (PIs: Larry Davis and V.S. Subrahmanian).

63. “Agent Architecture Design Supporting JANUS”, Nations, Inc., (Subcontract from US Army STRICOM), $18,300 approx.
64. Workshop on Multimedia Database Systems, Army Research Office, Aug. 1998, $15,000.
65. Workshop on Multimedia Database Systems, Army Research Office, Aug. 1997, $15,000 (co-PI with S. Tripathi).
66. “Laboratory for Distributed Integrated Multimedia Systems for Simulations, $140,000, Army research Office, May 20, 1997 - Feb. 28, 2000.
67. “A Scalable Intelligent Agent Architecture for the 21st Century Battlefield”, $3,215,000.00, (approx.) Army Research Laboratory, March 1, 1997-Feb. 29, 2003. (PIs: V.S. Subrahmanian and D. Nau).
68. “The KNOW-IT System”, $442,832, Textwise, Inc. prime-contractor, with Univ. of Maryland as a subcontractor to DARPA. Proposal approved for funding, Jan. 1997. (co-PI with James Hendler).
69. “Integrating Probabilistic and Temporal Reasoning for the Digital Battlefield”, Lockheed Martin, $25,000.
70. Subcontractor to TASC Inc. on DARPA Dynamic Database Initiative, $700,000 approx. (PI: V.S. Subrahmanian).
71. Workshop on Multimedia Database Systems, Army Research Office, Sep. 1996, $15,000 (co-PI with S. Tripathi).
72. Intelligent Agents for the Digital Battlefield, Army Research Office. $150,000. July 1, 1996-June 30, 1997. (co-PI: J. Hendler). $1,602,873. (co-PIs: J. Hendler, S. Marcus, P. Venkat Rangan)
73. Workshop on Multimedia Database Systems, Army Research Office, Sep. 1995, $10,000 (co-PI with S. Tripathi).
74. “Distributed Multimedia Reasoning”, Army Research Office. $226,078, May 15, 1995-Dec. 14, 1998.
75. “Asynchronous, Distributed, Scalable Algorithms for Intelligent Reasoning with Geographically Dispersed, Hybrid Knowledge Bases,” DARPA, $698,886. Sep. 1993 to Sep. 1997.
76. “Reasoning with Multiple Knowledge Representation and Reasoning Paradigms,” NSF Young Investigator Award. August, 1993 - June 2000. $163,800).
77. “Amalgamating Heterogeneous Databases,” DoD AASERT grant. $70,000. June 1, 1993 - May 31, 1996.
78. National Science Foundation Young Investigator Award, 1993-1999. $163,800. ($125,000 base award + $25,000 matching funds $ $13,800 special international travel award). ($125,000 extendable up to $500,000).
79. “Database Support for Real-Time Robot Planning”, $7,000. National Institute of Standards and Technology. March 1993 - Feb 1994. (co-PI: S.K. Tripathi)
80. “Logic-based Real Time Problem Solving Systems,” Air Force Office of Scientific Research, Dec. 1992 - Aug. 1996, $275,342. Principal Investigator: V.S. Subrahmanian. Co-PI: Jim Hendler.
81. “Computation and Implementation of Non-Monotonic Deductive Databases”, Army Research Office. $215,000. Principal Investigator: V.S. Subrahmanian. June 15, 1992 - June 14, 1995.
82. “Reasoning with Inconsistency”, National Science Foundation, July 1, 1991 - June 31, 1993. $59,907. Principal Investigator: V.S. Subrahmanian.

83. “Answering First Order Queries in Paraconsistent Knowledge Bases”, General Research Board, University of Maryland, June 1990-May 1991. $5,200.

II.J.1. Grants

II.J.2. Contracts

II.J.3. Other

<u>II.K. Fellowships, Gifts and Other Funded Research</u>
II.K.1. Fellowships

II.K.2. Gifts
II.K.3. Other

<u>II.L. Submissions and Works in Progress</u>
List press, journal, or granting agency.
II.L.1. Current Grant Applications
II.L.2. Manuscripts in Preparation
II.L.3. Manuscripts under Review *(indicate status: submitted or revising to resubmit)*

1. M. Bolonkin, S. Chakrabarty, C. Molinaro, V.S. Subrahmanian. Judicial Support Tool: Finding the k-Most Likely Judicial Worlds, submitted to a technical journal in January 2023.
2. Y. Zhang and V.S. Subrahmanian. SmartVEP: A Smart Vulnerability Equities Process based on Multiplayer Adversarial Bandits, submitted to a technical journal in March 2023.
3. T. Deb, M. Jeong, A. Quattrini Li, C. Molinaro, A. Pugliese, E. Santos, V.S. Subrahmanian and Y. Zhang. Declarative Logic-based Pareto-Optimal Agent Decision Making, submitted to a technical journal in March 2023.
4. Y. Zhang, D. Chen, S. Jajodia, A. Pugliese, V.S. Subrahmanian, and Y. Xiong. GAIT: A Game-Theoretic Defense Against Intellectual Property Theft, submitted to a technical journal in Dec 2023.
5. L. Chu, C. Molinaro, A. Pugliese, C. Pulice, and V.S. Subrahmanian. Deterring Data and Intellectual Property Theft from Graph Data using Fake Knowledge Graphs, submitted to a technical journal in April 2023.

II.L.4. Working Papers in Preparation
II.L.5. Designs in Preparation
II.L.6. Other

<u>II.M. Centers for Research, Scholarship, and Creative Activities</u>
Specify Name of the Center, Description of Center, Collaborators, Start and End Dates.

II.M.1. Centers Established

1. *Northwestern Security & AI Lab (NSAIL).* Established in Oct 2022 through a joint effort of the McCormick School of Engineering and the Buffett Institute of Global Affairs at Northwestern University, NSAIL develops methods to build, develop, and/or use AI for a host of international security problems related to border issues, terrorism, and cybersecurity. The lab develops, validates and demonstrates the AI techniques needed to shape international security policy in coming years.
2. *Lab for Computational Cultural Dynamics.* Established in 2004, the Lab for Computational Cultural Dynamics consisted of about 15 faculty members drawn from a variety of disciplines to study the problem of data-driven, computation behavior modeling, prediction, and policy formation related to security related events in the context of foreign cultures. Consisting of faculty drawn from computer science, psychology, criminology, political science, and public policy. Since its inception, LCCD became a world leader in computational modeling of terrorist groups. LCCD collaborated over the years with companies such as Raytheon, Boeing, Lockheed Martin, BBN, SAIC/Leidos, and others.
3. *Center for Digital International Government.* Established in 2007, CDIG focuses on helping governments use data-driven methods of computing, statistics, and mathematics to better solve problems for their citizens. CDIG has worked with game parks in S. Africa and India to combat poaching, worked with the Dian Fossey Gorilla Fund to learn models of gorilla behavior, worked with support from Symantec to study the cyber-vulnerability of different countries, worked with IMF economists to predict systemic banking failures in countries, worked with the World Bank to study early childhood development, and more.
4. *Center for Bioinformatics and Computational Biology.* When I started my tenure as Director of the University of Maryland Institute for Advanced Computer Studies, this center was already on the books and had one faculty member in it. I played a central role in expanding the size of CBCB from just one faculty member to over a dozen researchers, by recruiting a significant portion of the senior bioinformatics personnel involved in the sequencing of the human genome at The Institute for Genomics Research (TIGR) as it was then called. I cannot claim to have established the center, but I did lead this recruiting effort, and secured funds from the campus to make this a large effort. Those folks then went on to build CBCB up to achieve a national reputation.
5. WIMAX Forum Lab. During my tenure as Director of UMIACS, I helped a faculty member establish the 2nd WIMAX forum lab in the world (and the first anywhere in the western hemisphere). This was the initiative of that faculty member, but I did help support the creation of this lab.

II.M.2. Centers Directed

1. Institute for Security, Technology, and Society (ISTS) Dartmouth College, April 2018 – Aug 31 2021.
2. University of Maryland Institute for Advanced Computer Studies (UMIACS), Jan 2004 – Sep 2004 as Interim Director and then from Oct 2004 – June 2010 as Director.
3. Lab for Computational Cultural Dynamics, University of Maryland College Park (since inception,

in partnership with Dana Nau till 2010, then as Director from 2010-2017)

4. Center for Digital International Government, University of Maryland College Park (since inception – till July 2017)

II.M.3. Symposia Organized (*through center*)
II.M.4. Other

<u>II.N. Patents</u>
II.N.1. Device
II.N.2. Other

1. Generating Fake Documents Using Word Embeddings to Deter Intellectual Property Theft, patent pending, provisional application filed Jan 3 2021. V.S. Subrahmanian, A. Abdibayev, H. Chen, D. Chen, and D. Poluru. Full patent filed Dec 2021.
2. Awarded US patent Nr. 10,296,996 dated May 21 2019 for an invention titled *System and Methods for Planning Location-Sensitive Probabilistic Behavior Based Evacuation Paths* by A. Pal, F. Parisi, V.S. Subrahmanian and S. Mazumdar.
3. Awarded US patent Nr. 10,216,485 dated Feb 26 2019 for an invention titled *Computer Platform for Development and Deployment of Sensor Data-based Applications and Services* by P. Misra, A. Pal, P. Balamuralidhar, C. Bhaumik, D. Swamy, V.S. Subrahmanian, D. Kar, S. Naskar, S. Ghosh and S. Adak.
4. Awarded US patent Nr. 9,990,182 dated June 5 2018 for an invention entitled *Computer Platform for Development and Deployment of Sensor-Driven Vehicle Telemetry Applications and Services* by P. Misra, A. Pal, P. Balamuralidhar, C. Bhaumik, D. Swamy, V.S. Subrahmanian, A. Ghose, and A. Sinha. *This parent and the preceding one led to the development (by others) of Tata Consultancy Service (TCS's) TCS Connected Universe Platform (TCUP) product, an IoT sensor platform that has been adopted as the basis for vehicle-based sensory systems for Rolls Royce in a contract estimated at $100M.*[1]
5. Awarded US patent Nr. 9,613,164 dated April 4 2017 for a method entitled *System and Method for Data Management in Large Data Networks* by Matthias Broecheler, V.S. Subrahmanian, and Andrea Pugliese, 2017. This patent was the basis for the company ThinkAurelius which was acquired by DataStax in Seattle in 2016.
6. Awarded US patent Nr. 8,296,168 dated October 23, 2012 for a method entitled *System and Method for Analysis of an Opinion Expressed in Documents with Regard to a Specific Topic* by V.S. Subrahmanian, D.R. Recupero, A. Sagoff and B. Dorr, 2012. This patent was the basis for the company, Sentimetrix, Inc. of Bethesda, MD.
7. Awarded US patent Nr. 7,474,987 dated January 6, 2009 for a method titled *Method and System for Optimal Data Diagnosis* by V.S. Subrahmanian and Jason Ernst. A predecessor of this patent was used by Toshiba to identify conditions on production lines that were linked to defective products.

<u>II.O. Other Research/Scholarship/Creative Activities</u>

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1 According to: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=19&ved=2ahUKEwj-_Oa88_7oAhWEYTUKHcjIDBsQFjASegQIARAB&url=https%3A%2F%2Fresearch.nelson-hall.com%2Fget_file.php%3Ffn%3DTCS-IoT_S-SVP-Abstract-2018-06-22.pdf%26fsh%3D1f1d89147dda8e359d3113f00e5ee1df%26type%3Dtoc&usg=AOvVaw2X8Mr8BsiRqVRqlAuHzKga

1. Was a member of a team that won the Harvard Med School /SUNY-Albany NGRID challenge on predicting psychological symptom severity from clinical nodes. November 2016.
2. Led the team that won the DARPA SMISC Twitter Bot Challenge to identify influence bots on Twitter. Feb/March 2015.

III. Teaching, Mentoring and Advising.

<u>III.A. Courses Taught</u>

1. COSC 74/274 "Machine Learning" taught several times between 2017 – to date at Dartmouth College. The class is a single course, co-listed as both an undergrad course (COSC 74) and a grad course (COSC 274). Joint enrolment varies between 68 and 75.
2. COSC 89/189 "Logic for AI". Again, this is a single course, co-listed as both an undergrad course (COSC 89) and a grad course (COSC 189). Joint enrolment was somewhere between 25-30.
3. CMSC-420 "Data Structures" (taught several times approximate enrollment varied between 30 to 70 students each time).
4. CMSC-620 "Problem Solving Methods in Artificial Intelligence" (taught several times, approximate enrollment varied between 30 and 40 students).
5. CMSC-112 "Introduction to Computer Science", approximate enrollment between 65 and 75.
6. CMSC-150 "Discrete Structures", approximate enrollment 65-70.
7. CMSC-624 "Database Systems Implementation", approximate enrollment 30.
8. CMSC 828-V, "Software agents".
9. CMSC 828 "Social Network Databases"
10. CMSC 828 "Logic and Artificial Intelligence"
11. CMSC-828S: Taught once as a seminar on Non-Classical Logic Programming.
12. CMSC-828S: Taught once as a seminar on "Hybrid Reasoning."
13. CMSC-828S: Taught as a seminar on "Multimedia Databases" in Spring 1995. Taught as CMSC 828S/498S in course form in Spring 1998.
14. CMSC 720: Taught once on Logic Programming. Approximate enrollment: 30.
15. CMSC 828-V, Taught twice as a course on "Software agents."
16. CMSC 828-T. Taught twice as a course on "ontologies and Databases".
17. CMSC 422: "Machine Learning" taught thrice (third time in progress). Approximate enrolment: 90.

<u>III.B. Teaching Innovations</u>

III.B.1. Major Programs Established

III.B.2. Education Abroad Established

III.B.3. Software, Applications, Online Education, etc.

III.B.4. Instructional Workshops and Seminars Established

III.B.5. Course or Curriculum Development

1. Developed a course on Multimedia Databases.
2. Developed a course on Software Agents.
3. Developed a course on Social Networks.
4. Developed a course on Machine Learning.

III.B.6. Historical Innovations (10+ years ago)
III.B.7. Other

1. Development of a set of course notes for (part of) CMSC 620 ("artificial intelligence").
2. Development of a set of slides for a course on multimedia databases.
3. Development of a textbook on multimedia database systems.
4. Development of a set of slides for a course on machine learning.

III.C. Advising: Research or Clinical

This refers to students whose projects the faculty has supervised as adviser, committee chair, or committee member (indicate role). The name of student, academic year(s) involved, and the name of institution if other than UMD should be indicated, as well as placement of the student(s), if the project is completed. List completed work first.

III.C.1. Undergraduate

1. Anatoly Levkov (late 90s), Vice-President, Morgan Stanley
2. Hassan Rifky (1993-94)
3. T.J. Rogers (1994-1996) , now at BBN – a Northrup Grumman Company
4. Robert Ross (1994-1996), now at BAE Systems
5. Eric Lemar (1996—1999), now at Isilon Systems
6. Piotr Puszkiewicz (2003-2005), currently at Amazon
7. Margo Nagel (2011-2012)
8. Brittany Schuetzle (2011-2012)
9. Ali Schumacher (2011-2012), Deloitte
10. Rennie Silva, (2010-2011), went on to a Presidential Management Fellow, and then to a position as a diplomat at the US Dept. of State.
11. Chris Barclay (1993) currently at Amazon
12. Gabi Farley 2017, currently at NSA
13. Alex Yu 2018, now at Appian
14. Eric Lancaster 2018, currently at Facebook
15. Wes Kendrick 2018-2019, currently at Amazon
16. Runze "Penny" Liu, 2018-2019
17. Linda Xiao, 2019-2020, currently at Google
18. Viney Regunath, 2019-current
19. Steve Karson, 2020, currently at Altman Solon
20. Jack Burgess, 2020, now at CMU (co-advised with Prof. Richard Granger in Dept. of Psychology)
21. Snow Kang, 2020 – 2021
22. Caroline Tornquist, 2020 – 2021
23. Sabrina Jain, 2020 – 2021
24. Lizzie Hernandez, 2020-2021
25. Saksham Arora, 2020 – 2021
26. Jack Sadoff, 2020 – 2021
27. Mihovil Mandic, 2019 – 2021
28. Will Eaton, 2021 – 2021.
29. John F. Keane, 2021 – to date

30. Alex Feng, 2022 – to date
31. Liam Patterson, 2022 – to date
32. Andrew Pulver, 2022 – to date
33. Aryan Jain, 2022 – to date
34. Priyanka Amin, 2022 – to date

III.C.2. Master's

1. Ross Emery (MS, 1992). Currently at Lockheed Martin.
2. Ian Andrews, Currently at National Nuclear Security Agency.
3. Des Chandhoke (MS 2017), joined TD Ameritrade upon graduation and now at Hive
4. Sachin Grover (MS 2018), currently at Carnegie-Mellon University
5. Chao Chen (MS 2018), currently at Facebook
6. Anja Subasic (MS 2019), at Bloomberg (New York City) starting summer 2019.
7. James Brown (MS 2020), joining American Express (New York City), summer 2020
8. Daniele Bellutta, 2017-2019, currently doing a PhD at CMU
9. Deepti Poluru 2018-2019, currently employed at Tuck School of Business/Dartmouth
10. Darshan Sundaram 2019-2020, currently at TISTA Science and Technology Corp.
11. Dongkai Chen, 2019-6/2021, currently at Google
12. Lingyue Chu, 2021 – Dec 2022.

III.C.3. Doctoral

1. Raymond Ng (PhD, 1992, currently Full Prof., Univ. of British Columbia)
2. Sibel Adali (PhD, 1996, currently Full Prof. of Computer Science, Rensselaer Polytechnic Institute).
3. Joachim Schue (PhD, 1995, University of Karlsruhe, Germany, currently CEO of Consileon, Gmbh, Germany). I was co-advisor for Dr. Schue, jointly with Prof. Jacques Calmet of the University of Karlsruhe.
4. Kasim Selcuk Candan (PhD 1997, currently Full Professor of Computer Science, Arizona State University).
5. Eenjun Hwang (PhD 1998, currently Full Professor of Electrical Engineering, Korea University, Seoul, S. Korea).
6. Alex Dekhtyar (PhD, Aug. 2000), currently Full Prof. Computer Science, Cal Poly.
7. Fatma Ozcan (PhD, Aug. 2002, IBM Almaden Research Center).
8. Robert Ross (PhD, Aug. 2003). Currently at BAE Systems, Arlington, VA.
9. Marat Fayzullin (PhD, Dec. 2004). Currently an independent software developer in Moscow.
10. Edward Hung (Ph.D., May 2005). Was Assistant Professor, Hong Kong Polytechnic University. Deceased.
11. Yu Deng (Ph.D., May 2006, IBM TJ Watson Research Center, NY).
12. Massimiliano Albanese (PhD – Currently Associate Professor at George Mason University. Dr. Albanese received his PhD from the Univ. of Naples, Italy, Dec. 2005. I was co-advisor for Mr. Albanese's thesis jointly with Prof. A. Picariello. He then stayed with me as a postdoctoral fellow for 5 years.
13. Carmine Cesarano (PhD – University of Naples, Italy, Dec. 2006). I was co-advisor for Mr. Cesarano's thesis jointly with Prof. A. Picariello.
14. Octavian Udrea (PhD – 2008). Currently a Member of the Research Staff at IBM TJ Watson Research Center

15. Austin Parker (PhD -2008). Currently at CCS, Maryland.
16. Gerardo Simari (PhD- Dec. 2010). Postdoctoral fellow at Oxford University, UK from 2010-2014. Currently at CONICET (in English, "National Scientific and Technical Research Council") in Argentina.
17. Paulo Shakarian (PhD-May 2011). Assistant Professor at US Military Academy, West Point (2011-5/2014). Currently an Assistant Professor at Arizona State University, Tempe, Arizona (5/2014-to date).
18. Vanina Martinez (PhD – August 2011). Postdoctoral fellow at Oxford University, UK from 2010-2014. Currently at CONICET (in English, "National Scientific and Technical Research Council") in Argentina.
19. Amy Sliva (PhD – May 2011). Assistant Professor at Northeastern University, Boston (2011-2014), then a researcher at Charles River Associates, now an Assistant Professor in King's College, PA.
20. M. Broecheler (PhD – Dec. 2011). Entrepreneur who started ThinkAurelius.com, acquired by DataStax in 2015.
21. Chanhyun Kang (PhD – Dec 2015), Currently at AT&T
22. Noseong Park (PhD – 2016), Assistant Professor at Univ. of North Carolina – Charlotte, then Assistant Professor at George Mason University, now Assistant Professor at Yonsei University n Korea,
23. Anshul Sawant (PhD -2016) , Currently at Google
24. Srijan Kumar, (PhD – May 2017). Assistant Professor – Georgia Tech.
25. Qian Han, current (expected graduation June 2021, will join Facebook)
26. Chongyang Bai, current (expected graduation June 2021, will join Microsoft)
27. Maksim Bolonkin, current (expected graduation Dec 2021)
28. Rui Liu, current (expected graduation June 2021, will join Facebook)
29. Almas Abdibayev (2018 - 2019)
30. Tommy White, (2018 – 2021)
31. Abigail Bartolomeo (2018-2019)
32. Youdinghuan Chen (2017-2020): "David" Chen was not my PhD student but has worked with me continuously while pursuing a PhD in Quantitative Biomedical Data Science at Dartmouth. He is with IBM San Francisco in the summer of 2020.
33. Qian Han (6/2021, Facebook)
34. Rui Liu (6/2021, Facebook)
35. Chongyang Bai (6/2021, Microsoft)
36. Maksim Bolonkin (8/2021)
37. Chongyang Gao, 2019 – to date.
38. Sayak Chakraborty, 2021 – Dec 2022
39. Tonmoay Deb, 2021 – to date
40. Natalia Denisenko, 7/2022 to date
41. Lirika Sola, 9/2022 to date

III.C.4. Post-doctoral

1. Aaron Mannes, currently a AAAS Science & Technology Policy Fellow at the Department of Homeland Security, Washington DC.

2. Edoardo Serra, currently an Assistant Professor of Computer Science at Boise State University, Boise, Idaho.
3. Francesca Spezzano, currently an Assistant Professor of Computer Science at Boise State University, Boise, Idaho.
4. B. Prabhakaran (1995-1997, currently Professor of Computer Science at Univ. of Texas-Dallas
5. S. Dasgupta (2002-2003), current location unknown.
6. R. Ross (2003-2004) currently at BAE Systems, Arlington, VA.
7. Z. Majkic (2005), current location unknown.
8. D. Reforgiato Recupero (April 2005-April 2008), currently a researcher at Univ. of Catania, Italy.
9. M. Albanese (Aug. 2006 – Aug 2011). Currently an Assistant Professor at George Mason University.
10. G. Infantes (Feb. 2007 - Feb 2008), now at ONERA-Toulouse.
11. C. Molinaro (Feb 2009 – Jan 2012). Assistant Professor at the University of Calabria, Italy)
12. R. Puzis (Nov. 2011-Nov 2012), currently an Associate Professor at Ben-Gurion University, Israel)).
13. C. Thomas (Jan. 1, 2012 – Jan 2013), currently at Samsung Research, California
14. M. Ovelgonne (Feb 2012 – June 2014), currently at a company in Germany
15. T. Chakraborty (Jan 2016 – May 2017), now an Assoc.. Prof. at IIT Delhi.
16. C. Pulice (Sep 2016 – Sep 2019), Chief Scientist at the Algorithm Objective Corporation, now Senior Research Associate at Northwestern U.
17. H. Chen (July 2018 – June 2020), postdoc at Harvard for 2 years, now an Asst. Prof. at College of William & Mary
18. Y. Xiong (July 2018 – June 2021), now an Assistant Professor at University of Louisville
19. K. Greene (July 2020 – Aug 2021), now a researcher at Princeton University
20. Y. Zhang (Aug 2020 – Aug 2022), now an Assistant Professor at the Centre for Artificial Intelligence and Robotics (CAIR), Hong Kong Institute of Science & Innovation, Chinese Academy of Sciences, Hong Kong.

III.C.5. Other Research Directions (*K-12 Interactions*)

Directed High School Students

1. Vijay Balakrishnan (2016), worked with me when he was a freshman and sophomore at Montgomery Blair High School in MD. Now an undergrad at the University of Maryland College Park.
2. Yaelle Goldschlag, summer intern from Montgomery Blair High School (MD) in 2015, joined UMD as an undergrad in Fall 2016.
3. Jason Ernst (early 2000s), worked with me from the time he was a high school senior to the end of his BS degree. Received a PhD from Carnegie-Mellon University, postdoc at MIT, now an Assistant Professor at UCLA.
4. Jeremy Hoffman (early 2000s), worked with me when he was a high school student, received a BS from Stanford, now at Google.
5. Amelia Sagoff (early 2000s), worked with me when she was a high school student, received a BS from Harvard, now at Dimagi.

III.D. Mentorship

III.D.1. Junior Faculty

1. Mentored Lise Getoor when she joined the University of Maryland as an Assistant Professor. Now a Full Professor at the University of California Santa Cruz.
2. Mentored John Dickerson from the time he joined the University of Maryland as an Assistant Professor.
3. Mentored Soroush Vosoughi from the time he joined Dartmouth College as an Assistant Professor.

III.D.2. Other

III.E. Advising: Other than Research Direction

III.E.1. Undergraduate
III.E.2. Master's
III.E.3. Doctoral
III.E.4. Post-doctoral
III.E.5. Other Advising Activities

Over 35 students have done independent studies with me.

Over the years, the following high school students from Montgomery Blair High School have worked with me while still attending Blair.

- Jason Ernst (PhD – CMU now an Associate Professor at UCLA),
- Jeremy Hoffman (at Stanford, now at Google), and
- Amelia Sagoff (Harvard, now at Broad Institute at MIT).
- Yaelle Goldschlag, summer 2015, joined UMD as an undergrad in Fall 2016.
- Vijay Balakrishnan, summer 2016, 2017. Undergrad in the Honors program at the University of Maryland College Park.

III.F. Professional and Extension Education

III.F.1. Professional Programs Established
III.F.2. Major Extension Programs
III.F.3. Workshops
III.F.4. Other

III.G. Other Teaching Activities

IV. Service and Outreach

IV.A. Editorships, Editorial Boards, and Reviewing Activities

Include participation for journals and other learned publications (print and electronic).

IV.A.1. Editorships

IV.A.2. Editorial Boards

1. Editor-In-Chief, *IEEE Intelligent Systems*, Jan 2017 – Dec 2021.
2. Member, Editorial Board, *ACM Transactions on Computational Logic*, Sep 2012-2021.
3. Member, Editorial Board, *ACM Transactions on Intelligent Systems & Technology*, 2012-to date.
4. Member, Editorial Board, *IEEE Transactions on Computational Social Systems*, 2013-to date.
5. Member, Board of Reviewing Editors, *Science* magazine, July 2012 – to date.
6. Member, Editorial Board, *Theory and Practice of Logic Programming*, Jan. 2001-2010.
7. Member, Editorial Board, *IEEE Transactions on Knowledge and Data Engineering*, April 2008-Dec. 2012.
8. Member, Editorial Board, *Annals of Mathematics and Artificial Intelligence*, Jan. 2000-2013.
9. Member, Editorial Board, *AI Communications* magazine, IOS Press, Magazine of the European AI Community, 1998-2000.
10. Member, Editorial Board, *Journal of Logic Programming*, June 1997-Dec. 2000.
11. Member, Editorial Board, *Distributed and Parallel Databases* Journal, Dec. 1998-several years.
12. Member, Editorial Board, *Multimedia Tools and Applications* Journal, June 1998-2015.
13. Member, Editorial Board, *IEEE Transactions on Knowledge and Data Engineering*, April 1996-Dec. 2000.
14. *Chair, Search Committee for Editor in Chief of the ACM Transactions on Intelligent Systems & Technology*.

IV.A.3. Reviewing Activities for Journals and Presses

Journals: The Journal of Logic Programming, ACM Transactions on Database Systems, IEEE Transactions on Knowledge and Data Engineering, IEEE Computer, Information and Computation, Computational Intelligence, Theoretical Computer Science, The Journal of Symbolic Computation, The Journal of Automated Reasoning, Fundamenta Informaticae, The Journal of Non-Classical Logic, Annals of Mathematics and Artificial Intelligence, The International Journal of Foundations of Computer Science, SIAM Journal of Control and Optimization, The Journal of Philosophical Logic, Methods of Logic in Computer Science, ACM Trans. on Database Systems, ACM Trans. on Computational Logic, Multimedia Tools and Applications, IEEE Security and Privacy, Science.
Books: The book Foundations of Deductive Databases & Logic Programming, (ed. Jack Minker), Morgan Kaufmann, 1988.

Too many more to mention.

IV.A.4. Reviewing Activities for Agencies and Foundations

National Science Foundation,
Army Research Office,
Air Force Office of Scientific Research,
Swedish Research Council for Engineering Science,
Israeli Science Foundation,

Foundation for R&D - South Africa,
Engineering and Physical Sciences Research Council (UK).

Member – NSF CISE Committee of Visitors, Oct-Nov 2019. Reviewed NSF CISE's procedures.

IV.A.5. Reviewing Activities for Conferences
4th, 5th, 6th and 7th International Conferences on Logic Programming (Melbourne, Seattle, Lisbon, Jerusalem), 8th, 9th and 12th International Conference on Foundations of Software Technology & Theoretical Computer Science, 1989 and 1990 North American Conference on Logic Programming, 1991 International Logic Programming Symposium, 1990 IEEE International Symp. on Multiple-Valued Logic, 10th International Conference on Automated Deduction, 11th International Conference on Application and Theory of Petri Nets, IJCAI-91, 1991 European Conf. on Symbolic and Computational Approaches for Uncertainty, 1992 International Conference on Data Engineering, 1992 International Conference on Fifth Generation Computer Systems, 1992 ACM Symposium on Principles of Database Systems, 1992 Intl. Conf. on Uncertainty in Artificial Intelligence.

Too many to mention since then – at least 5 conference committees per year on the average, including, in many cases, as Area Chair or Senior PC member.

IV.A.6. Historical Editorships, etc. (10+ years ago)

IV.A.7. Other

1. Elected Joint Co-Chair with Paul Theron (Thales, France) of the Autonomous Intelligent Cyber-defence Agents International Working Group, a follow on organization to NATO's IST-52 working group.

<u>IV.B. Committees, Professional & Campus Service</u>
IV.B.1. Campus Service – Department

1. Director – Institute for Security, Technology, and Society, Dartmouth College, Apr 2018 – to date
2. Director, UMIACS, Oct. 2004 – June 30, 2010.
3. Interim Director, UMIACS, Feb 2004 – Oct. 2004.
4. Director, Lab for Computational Cultural Dynamics
5. Director, Center for Digital International Government

IV.B.2. Campus Service – College

IV.B.3. Campus Service – University

1. Member, CS Department Curriculum Committee, 2019-2020
2. Chair, Cybersecurity Faculty Search Committee 2019-2020
3. Chair, Cybersecurity Faculty Search Committee 2018-2019
4. Member, Fraunhofer Center of MD, Advisory Board.

5. Member, Committee to Restructure Fraunhofer Center MD [representative of the Dean of the College of Math and Natural Sciences]
6. Chair, Computer Science Dept Strategic Planning Committee (2014-2015)
7. Chair, Computer Science Dept Committee to Plan a Departmental Retreat to Discuss a Dept Strategic Plan (2014)
8. Member, CS Departmental Council, 2004-2005.
9. Member, Committee to Evaluate the Chair of CS, 2004-05.
10. Member, Teaching Evaluation committee, 2003-2004.
11. Member, CS Departmental Council, 2002-2003.
12. Chair, Artificial Intelligence field committee, 2002-2003.
13. Member, ISR Executive Committee, Fall 2002.
14. Member, ISR Director Search Committee, 2002.
15. Member, CMPS APT Committee 2000-2002.
16. Member, UMIACS APT Committee 2000-2001.
17. Member, CMPS APT Committee 2000-2001.
18. Member, ISR APT Committee 2000-2001.
19. Member, CMPS Computer Science Building Fundraising Committee, 2000-2001.
20. In charge of revitalizing UMIACS/CS industrial affiliates program, 2000.
21. Member, CS Department Chair Search Committee, 1999-2000
22. Member, Computer Science Department Faculty Search Committee, 1998-2000.
23. Member, ISR Flagship Initiative Review Committee, 1998-1999.
24. Member, Campus Search Committee to find a Dean of the College of Math and Physical Sciences, 1998-1999.
25. Chair, Search Committee to find a Lab Director for CSD, 1997.
26. Member, UMIACS Steering Committee, 1996-1997.
27. Head, CS Department AI Field Committee, 1996-1997.
28. Head CS Department Lab Committee, 1996-1998.
29. Member, ISR Education Program Committee (1995)
30. Member, ISR Facilities and Services Committee. (1995).
31. Co-Chair, Departmental Colloquium Series, 1994-1995.
32. Member, UMIACS Academic Promotion and Tenure Committee, 1993.
33. Member, UMIACS Academic Promotion and Tenure Committee, 1991-92.
34. Member, Committee for selecting a suitable text for CMSC 112. (Spring/Summer 1990).
35. Organized the Orientation program for incoming graduate students in Computer Science. (Fall 1990).
36. Interacted with Rockville High School on behalf of the Computer Science Department. This interaction related to the high school programming contest being conducted by the department. (Fall 1990).
37. Member, Graduate Committee (1989 - to date).
38. Member of a departmental committee to develop a new 400-level logic course for CS undergraduates. (1989-1990).

IV.B.4. Campus Service - Special Administrative Assignment
IV.B.5. Campus Service - Other
IV.B.6. Offices and Committee Memberships
IV.B.7. Leadership Roles in Meetings and Conferences

IV.B.8. Other Non-University Committees, Memberships, Panels, etc.

1. Chair (with Shlomo Markel of Broadcom) of the India-Israel Roundtable on Cybersecurity, Tel Aviv, June 2018.
2. Chair (with Shlomo Markel of Broadcom) of the India-Israel Roundtable on Cybersecurity, Tel Aviv, June 2017.
3. General Chair, IEEE/ACM Conf. on Advances in Social Network Analysis and Mining (ASONAM) 2016, California, Aug 2016.
4. Program Chair, 2nd India KDD Conference on Knowledge Discovery & Data Science, Bangalore, India, March 2015. In cooperation with ACM SIGKDD.
5. General Chair, 2014 Conference on Behavioral, Economic, and Socio-Cultural Computing, Shanghai, China, Oct 2014
6. Program Chair, 2014 IEEE R10 Humanitarian Technology Conference, Chennai, India, Sep 2014.
7. Tutorial Chair, ASONAM 2014, Beijing, China
8. Invited Member, India-Israel Strategic Dialog (track 2) organized by the Aspen Institute (India), Tel Aviv, Oct 2013
9. Panel Chair at ASONAM Conference 2013, Niagara Falls, Canada, Aug 2013
10. Invited Member, US-India Strategic Dialog (track 2), Jan 2013, New Delhi. Invited to speak on cyber-security.
11. Workshop Chair, 2012 International Conference on the Analysis of Social Networks and Mining (ASONAM 2012), Istanbul, Aug. 2012.
12. Panelist at ASONAM 2012 Conference, Istanbul, Turkey, Aug. 2012.
13. Program Chair, 2008 International Conference on Computational Cultural Dynamics (Sep. 2008), College Park, MD.
14. Program Chair, 2007 Scalable Uncertainty Management Conference (SUM 2007), Oct. 2007, College Park, MD.
15. Program Vice-Chair, IEEE Intl. Symposium on Multimedia, Taiwan, Nov. 2007.
16. Program Chair, ODBASE 2006. Jointly with M. Lenzerini and E. Neuhold.
17. Member, Program Committee (incomplete list)
18. PODS 2009
19. ASONAM 2009
20. SOCIALCOMM 2009
21. AMW 2009
22. ISWC 2009
23. International Conf. on the Web and Social Media 2008
24. KR 2008
25. International Conf. on the Web and Social Media 2007
26. AAAI 2007
27. ODBASE 2007
28. 2007 Intl. Conf. on Computational Cultural Dynamics
29. ICDE 2007
30. AAAI Spring. Symp. On Computational Approaches to the Analysis of Weblogs 2006
31. ACM MMDB 2006
32. INCOMPLETENESS & INCONSISTENCY WORKSHOP 2006

33. RULE-ML 2006
34. IEEE ISM 2005
35. ISMIS 2005
36. ASIAN 2004
37. 2004 IEEE Intl. Conference on Information Reuse and Integration, Las Vegas, Nevada
38. CLIMA 2004
39. ISMIS 2004
40. ACM MMDB 2004
41. ACM MMDB 2003
42. 2002 IEEE International Conference on Multimedia and Expo (ICME 2002), Lausanne, Switzerland, Aug. 2002.
43. 2002 Intl. Conf. on Methodologies for Intelligent Systems, Lyon, France, June 27-29, 2002.
44. 2001 IEEE International Conference on Multimedia and Expo (ICME2001), Aug. 2001, Tokyo, Japan.
45. 2001 International Conference on Logic Programming, Paphos, Cyprus, Nov. 26-Dec. 1, 2001.
46. 2001 International Conference on Very Large Databases (VLDB'2001), Sep. 11-14, 2000, Rome, Italy.
47. 2001 ACM SIGMOD Conference, Santa Barbara, CA, May 2001.
48. 2000 International Symp. on Methodologies for Intelligent Systems, Charlotte, NC, Oct.2000.
49. 2000 IEEE International Conference on Multimedia and Expo, New York City, July 2000.
50. 2000 Intl. Conf. on Extending Database Technology, Konstanz, Germany.
51. 2000 Intl. Conf. on Database and Expert Systems Applications.
52. 1999 Intl. Conf. on Database and Expert Systems Applications, Florence, Italy, Sep. 1999.
53. 1999 IEEE Intl. Conf. on Multimedia Computing Systems, Florence, Italy, June 1999.
54. 1999 IEEE International Conf. on Data Engineering.
55. 8th IFIP 2.6 Working Conference on Database Semantics (DS-*) “Semantic Issues in Multimedia”, Jan. 5-8, 1999, Rotorua, New Zealand.
56. 1998 Intl. Conf. on Logic Programming, Manchester, UK. 1998 Intl. Conf. on Extending Database Technology, Valencia, Spain.
57. 1998 IEEE Intl. Conf. on Data Engineering.
58. 1997 Intl. Conf. on Deductive Object Oriented Databases.
59. 4th International Workshop on Logic Programming and Non-Monotonic Reasoning, Dagstuhl, Germany, June 1997.
60. 1997 Intl. Conference on Cooperative Information Systems, Charleston SC, June 1997.
61. 16th ACM SIGACT-SIGMOD-SIGART Symp. on Principles of Database Systems (PODS), Tucson, AZ, May 1997.
62. 1997 IEEE Intl. Conf. on Data Engineering, Birmingham, England
63. International Workshop on Advanced Transaction Models and Architectures, Aug. 1996, Goa, India.
64. Workshop on Materialized Views: Techniques and Applications (In co-operation with ACM Sigmod), June 1996, Montreal, Canada.
65. International Workshop on Logic in Databases, July 1996, San Miniato, Italy.
66. 1995 International Workshop on Temporal Object-Oriented Databases, Dec. 1995, Hong Kong.

67. 3rd International Workshop on Logic Programming and Non-Monotonic Reasoning, Lexington, KY, June 1995.
68. 20th International Conference on Very Large Databases (VLDB-94), Santiago, Chile, Sep. 1994.
69. Eleventh International Conference on Logic Programming, Genoa, Italy, June 1994.
70. Tenth International Conference on Logic Programming, Budapest, Hungary, June 1993.
71. Second International Workshop on Logic Programming and Non-Monotonic Reasoning, Portugal, June 1993.
72. International Workshop on Interval Methods in Artificial Intelligence, Lafayette, LA, Feb. 1993. In conjunction with: Intl. Conference on Numerical Analysis with Automatic Result Verification.
73. Panelist, NSF Research Initiation Awards, 1994.
74. General Chair, 2004 IEEE Intl. Confl. on Multiagent Security and Survivability, Philadelphia, PA.
75. Program Chair, 2003 Intl. Workshop on Multimedia Information Systems.
76. Ad Hoc Member (2001), Air Force Science Advisory Board Panel on Command and Control Database Migration Study.
77. Program Co-Chair 1997 Intl Conf. on Very Large Knowledge Bases, Washington, DC.
78. Second International Workshop on Multimedia Information Systems, West Point, NY, Sep. 1996.
79. First International Workshop on Multimedia Information Systems, Washington, DC, Sep. 1995.
80. First International Workshop on Logic Programming and Non-Monotonic Reasoning, Washington, DC, July 1991.
81. Workshop on Logic Programming and Non-Monotonic Reasoning, Austin, Texas, Nov. 1990.
82. Member (1996-2000), DARPA 6-person Executive Advisory Council on Advanced Logistics, headed by Lieutenant General (Retd.) L. Pigaty. Advisory Council on DARPA's Advanced Logistics Program.
83. Tutorials Chair, 1996 Conference on Information and Knowledge Management (CIKM'96).

IV.B.9. Historical Committees, etc. (10+ years ago)
IV.B.10. Other

<u>IV.C. External Service and Consulting</u>
IV.C.1. Community Engagements, Local, State, National, International
IV.C.2. International Activities

IV.C.3. Corporate and Other Board Memberships

1. Advisory Board, Maitreyi Capital Pvt. Ltd. – an IT-focused private equity firm based in India. Sep 2015 – Feb 2017.
2. Board of Directors, The Development Gateway – an organization set up by the World Bank in 1999 to help use ICT in the development goals of developing countries. Served as Chair of the Board’s Audit Committee for 5 years (2011-2021).

3. Board of Directors, SentiMetrix, Inc. – a company commercializing the OASYS opinion analysis system developed at UMD through an exclusive commercialization agreement.
4. Board of Directors, Icyanzu Pvt. Ltd. (UK) till 2019
5. Research Advisory Board, Tata Consultancy Services Ltd., Mumbai, India. India's biggest software company. Since approximately 2007 to date.
6. Advisory Board, CosmosID, Inc. – a biotech startup.
7. Syracuse University Electrical Engineering and Computer Science Department, Syracuse, NY.
8. DARPA UltraLog Technical Assessment Team (2001).
9. DARPA Executive Advisory Council on the Advanced Logistics Program (1996-2000).
10. Ad-hoc Member, US Air Force Science Advisory Board (2001).

IV.C.4. Entrepreneurial Activities

IV.C.5. Consultancies *(to local, state and federal agencies; companies; organizations)*
1. US Department of Defense
2. World Bank
3. Defense Advanced Research Projects Agency (through Los Alamos Technical Associates)
4. BAE Systems
5. General Dynamics
6. Vality Technologies (since acquired by IBM)
7. SAIC
8. Caterpillar
9. Boeing
10. User Technology Associates
11. IBM-Japan (Tokyo Research Lab)
12. Tata Consultancy Services (India)
13. Cravath, Swaine and Moore, LLP (New York)
14. Xerox
15. Collarity Inc.
16. Kirkland-Ellis, LLP
17. Capital One Bank
18. Dewitt LLP

IV.C.6. Historical External Service and Consulting (10+ years ago)
IV.C.7. Other

<u>IV.D. Non-Research Presentations</u>
IV.D.1. Outreach Presentations
IV.D.2 Other

<u>IV.E. Media Contributions</u>
IV.E.1. Internet
IV.E.2. TV
IV.E.3. Radio
IV.E.4. Digital Media

IV.E.5. Print Media (Op-eds)

1. D. Byman, C. Meserole, and V.S. Subrahmanian. **The Deepfake Dangers Ahead**, The Wall Street Journal, Feb 23 2023 (online), Feb 25 2025 (print edition). https://www.wsj.com/articles/the-deepfake-dangers-ahead-b08e4ecf?mod=Searchresults_pos1&page=1
2. V.S. Subrahmanian. *Cybersecurity Needs a New Alert System*, The Wall Street Journal, March 29 2021, https://www.wsj.com/articles/cybersecurity-needs-a-new-alert-system-11617039278?mod=opinion_lead_pos5
3. V.S. Subrahmanian, A. Mannes, and R.K. Raghavan, *No More Carrots, Only Sticks*, The Hindu, April 18 2015, http://www.thehindu.com/opinion/op-ed/pakistan-continues-to-support-terror-across-borders/article7114110.ece?homepage=true
4. A. Mannes, R.K. Raghavan, A. Roul, and V.S. Subrahmanian, *Intelligent Security*, Indian Express, Sep 5 2013, http://www.indianexpress.com/news/intelligent-security/1164726/
5. V.S. Subrahmanian. *Introducing the Software that can Predict New Leaders of Terror Groups*, The Guardian/Observer (UK), Sep 14 2013. Also in the print edition of the Observer, Sep 15 2013. http://www.theguardian.com/world/2013/sep/15/al-qaida-terrorist-leader
6. A. Mannes, R.K. Raghavan, A. Roul, and V.S. Subrahmanian, *Penetrating the Web of Terror*, The Hindu, Nov 2, 2013, http://www.thehindu.com/opinion/lead/penetrating-the-web-of-terror-networks/article5305816.ece
7. A. Mannes, R.K. Raghavan, A. Roul, and V.S. Subrahmanian, *Chennai Train Blasts: Why Indian Mujahideen cannot be Ruled Out*, First Post, May 2 2014, http://www.firstpost.com/india/chennai-train-blasts-why-indian-mujahideen-cant-be-ruled-out-1504749.htmldisqus_thread
8. A. Mannes, V.S. Subrahmanian, *Gaming: Tactical Advantage*, New York Sun, Nov. 14, 2007. http://www.nysun.com/opinion/gaming-tactical-advantage/66447/
9. V.S. Subrahmanian, A. Mannes, *Keeping Tabs on Terrorists*, Wall Street Journal (Asia Edition), Aug. 22, 2010. http://www.wsj.com/articles/SB10001424052748703461504575444634020591798
10. A. Mannes, R. Silva, V.S. Subrahmanian, *More Military Aid to Pakistan*, The Huffington Post, Nov. 22, 2010. http://www.huffingtonpost.com/aaron-mannes/more-military-aid-to-paki_1_b_786959.html.

IV.E.6. Blogs

http://x-journals.com/2009/military-scenerios-through-virtual-worlds/

IV.E.7. Feeds

IV.E.8. Other

IV.F Community & Other Service

V. Awards, Honors and Recognition

V.1. Research Fellowships, Prizes and Awards

1. Named a Fellow of the Asia-Pacific Artificial Intelligence Association, Nov. 2022.
2. Best Paper Award for the paper "A New Dynamically Changing Attack on Review Fraud Systems and a Dynamically Changing Ensemble Defense" by Youzhi Zhang, Sayak Chakrabarty, Rui Liu, Andrea Pugliese, and V.S. Subrahmanian at the The 20th IEEE International Conference on Dependable, Autonomic & Secure Computing (DASC 2022).
3. Named to IEEE Computer Society's Golden Core, Feb 2022.
4. Runner up, Most Innovative Demo, 2019 International Joint Conference on Artificial Intelligence, Macao, Aug 2019.
5. Named ***Professor of the Year*** by the Computer Science Department for teaching excellence in June 2017.
6. My 1997 paper "Hybrid Probabilistic Programs" with Alex Dekhtyar, published in Proc. 1997 Intl. Conf. on Logic Programming, Leuven, Belgium, July 8-12, 1997 was name the **recipient of the "20 Year Test of Time Award"from the 2017 International Conference on Logic Programming, Melbourne, Australia, Aug 2017.**
7. ***Named an IEEE/Tencent Rhino Bird International Academic Expert***, May 2017.
8. ***Runner Up for the Best Paper Award,*** 2017 World Wide Web Conference, Perth, Australia, April 2017.
9. ***2016 CEGS N-GRID Challenges in Natural Language Processing for Clinical Data***. Participated in the Sentimetrix team that won the challenge on predicting symptom severity. Nov 2016.
10. I was lead author on the paper "J. Dickerson, V. Kagan, and V.S. Subrahmanian. Using Sentiment to Detect Bots on Twitter: Are Humans more Opinionated than Bots?, *Proc. ACM/IEEE Intl. Conf. on Advances in Social Network Analysis and Mining (ASONAM) 2014*, Beijing, August 2014." *This paper was selected as a significant research paper by the Science of Security Index of Significant Research in Cyber Security 2015.*
11. ***DARPA SMISC Twitter Bot Challenge.*** Led the Sentimetrix team that won the DARPA SMISC Twitter Bot Challenge to identify influence bots on Twitter. Feb/March 2015.
12. ***Board of Visitors Distinguished Faculty Award***, University of Maryland College of Math & Natural Science Board of Visitors, 2011.
13. ***Elected to the rank of Fellow***, *Association for the Advancement of Artificial Intelligence (AAAI)* in April 2009 for "significant contributions to the study of probabilistic databases, logic programming and agent-based systems".
14. ***Elected to the rank of Fellow***, *American Association for the Advancement of Science (AAAS)* in November 2008 for "contributions in computer science and multidisciplinary computing, for techniques to implement multiple data sources, software programs, automatically build group behavioral models and forecast group behaviors".
15. Listed as the 16th most nurturing computer scientist based on citations of PhD students since 1992 in a study titled *Bharath Kumar M. and Y. N. Srikant "The Best Nurturers in Computer Science", Indian Institute of Science, Bangalore, IISc-CSA-TR-2004-10, Oct. 2004, Available online at* http://www.cs.cmu.edu/~christos/IN-THE-NEWS/NURTURERS_CSA-TR-2004-10.pdf .
16. Listed as the 35th most nurturing computer scientist since 1992 in the above study based on number of publications by PhD students.

17. Selected in 2006 for inclusion on *ISIHIghlycited.com* run by Thomson Scientific as part of their Web of Science initiative. According to ISIHighlyCited.com, "*ISIHighlyCited.com* will grow to include the top 250 preeminent individual researchers in each of 21 subject categories who have demonstrated great influence in their field as measured by citations to their work-the intellectual debt acknowledged by their colleagues." There were actually about 320 computer scientists listed by ISIHighlycited.com as of March 2007.
18. The ***OASYS*** system was a winner of the 2006 *Computer World Horizon Awards* competition.
19. Most highly ranked paper at the *2005 IEEE Intl. Conference on Multi-Agent Security and Survivability*, Philadelphia, PA, Aug. 2005.
20. The IMPACT system received an honorable mention (one of 20) in the 2005 *Computer World Horizon Awards* competition.
21. The STORY system received an honorable mention (one of 20) in the 2005 *Computer World Horizon Awards* competition.
22. Paper shortlisted for the Best Paper Award, 2005 Intl. Conf. on Autonomous Agents and Multi-Agent Systems, Utrecht, Netherlands. (One of 4 such papers).
23. National Science Foundation Young Investigator Award, 1993-1999. $163,800. ($125,000 base award + $25,000 matching funds $ $13,800 special international travel award). ($125,000 extendable up to $500,000).
24. Maryland Distinguished Young Scientist Award, April 1997.

V.2 Teaching Awards
V.3 Service Awards and Honors

V.4 Recognition in Media

1. Interviewed by the Austrian Broadcasting Co. for their *MATRIX* radio program in Sep. 2001. http://matrix.orf.at/bkframe/011021_1.htm
2. Interviewed by several TV channels in Naples Italy in Nov. 2002.
3. Featured on Canale 8, Italia Mia, Telenapoli, Canale 7, Tele Regione, TVA, Tele A, Napolitivu. : Multimedia Systems, Naples, Italy, Nov. 8-9, 2003.
4. Baltimore Daily Record, Feb 1, 2003. http://www.mddailyrecord.com/pub/3_176_statewide/businessnews/126636-1.html
5. Mentioned in Maryland Gazette, Feb 2003. http://gazette.net/gazette_archive/2003/200306/takoma/news/142356-1.html
6. Quoted in the Maryland Gazette, June 2005. http://gazette.net/gazette_archive/2005b/200523/business/news/279721-1.html
7. Work on STORY described in *ComputerWorld*, Sep. 12, 2005.
8. Work on OASYS described in *ComputerWorld*, Aug. 21, 2006.
9. Work on OASYS described in *Panorama* magazine, Sep. 21, 2006.
10. Work on OASYS described in *RAI Television*, Italy, Nov. 2006.
11. An article on OASYS appeared in *Sci.cam*, Italy. http://www.sci-cam.it/index.php?option=com_content&task=view&id=7&Itemid=43, May 2007.
12. Work on computational cultural dynamics described in *Science*, Vol. 316, April 2, 2007, pp. 534-535. Available online at http://www.sciencemag.org/cgi/reprint/316/5824/534.pdf.
13. An article on my work on computational cultural reasoning appeared on the home page of AAAS http://www.aaas.org/news/releases/2007/0625insurgents.shtml - June 25. 2007.

14. An article titled "Can computer-driven Models help to Quell Insurgent-driven Strife and Instability" discussed my AAAS sponsored talk on Capitol Hill. http://www.allamericanpatriots.com/48725699_computers_can_computer_models_help_quell_insurgent_drive_strife_and_instability
15. V.S. Subrahmanian was quoted in Science Magazine discussing a new Department of Defense funding initiative to improve expertise in national security, July 20, 2007.
16. Article on my work in *The New Scientist* magazine by Tom Simonite titled "A Model World". www.newscientist.com/blog/technology/2007/09/model-world.html. Sep. 13, 2007.
17. Article on my work on computational cultural models in *ACM Tech News*, Sep. 14, 2007. http://technews.acm.org/
18. Article on my work on computational cultural models in *ZEE News*, Sep. 16, 2007, India. http://news.google.com/news/url?sa=t&ct=us/0-0&fp=46f7b9023d182ca3&ei=7vT3RoqxLZWgavL54eIP&url=http%3A//www.zeenews.com/znnew/articles.asp%3Faid%3D395278%26ssid%3D29%26ssname%3DNet%2520News%26sid%3DENV%26sname%3D&cid=0
19. Article on my work on computational cultural models in *Hindustan Times*, New Delhi, Sep. 17, 2007.
20. *Voice of America* TV program on my work on computational cultural models. Channel: Headlines Today, Show: The World Today, Time: Sunday 6 PM; India time, Sunday 8:30 AM; US time and Monday 1 PM; India time, Monday 3:30 AM; US time.
21. Quoted in the *Washington Post* (October 8) on the UMD-Google-IBM Initiative on Cloud Computing.
22. Featured in the *Swiss Public Radio* program under "Computerspiel-Designer" (Dec. 8, 2007) – this program focused on my work on computational cultural models and its relationship to games. www.wissenschaft.drs.ch
23. Work on computational cultural dynamics extensively discussed in an op-ed piece in the *Manila Sunday Times*, Jan. 13, 2008, http://www.manilatimes.net/national/2008/jan/13/yehey/opinion/20080113opi2.html
24. *WBAL-TV 11*, Baltimore, MD. Friday, April 4, 2008.
25. *Telepolis*, German. March 30, 2008 http://www.heise.de/tp/r4/html/result.xhtml?url=/tp/r4/artikel/27/27564/1.html&words=Marcus%20born&T=marcus%20born
26. *New Scientist* Magazine, March 15, 2008 http://technology.newscientist.com/channel/tech/mg19726476.000-can-conflict-forecasts-predict-violence-hotspots.html
27. Financial Express India, March 03, 2008 http://www.financialexpress.com/news/Mapping-the-mind-of-a-terrorist/279471/
28. NewsTrack India, March 5, 2008 http://www.newstrackindia.com/newsdetails/2636
29. Times of India, March 2, 2008 http://timesofindia.indiatimes.com/Now_terrorists_behaviour_pattern_on_Internet/articleshow/2830619.cms
30. Sinlungnews.com Singapore. http://www.sinlung.com/?p=491
31. Information Week, Feb 28, 2008. http://www.informationweek.com/news/management/showArticle.jhtml;jsessionid=C44ZL5NQ2NDCWQSNDLPSKH0CJUNN2JVN?articleID=206900907&_requestid=420080
32. TV Interview, Canada AM, Canadian Public TV Interview, Feb 29, 2008.

33. Hindustan Times, India, March 2, 2008. http://www.hindustantimes.com/StoryPage/StoryPage.aspx?id=ad71d87a-0a8d-478e-82ea-2051921a91f4&&Headline=Terrorists'+behaviour+mapped+online
34. *American Public Media* FutureTense program, broadcast on over 100 US Public Radio Station. Feb 28, 2008. http://www.publicradio.org/columns/futuretense/2008/02/28.shtml015991
35. TechTree India, Feb 29, 2008. http://www.techtree.com/India/News/STOP_Terrorism_Software_Developed/551-87233-580.html
36. Government Computer News, Feb 27, 2008. http://www.gcn.com/online/vol1_no1/45888-1.html
37. Computerworld, Feb 26, 2008. This article contains some factual errors. http://www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=9064938
38. WhatPC UK, Feb 26, 2008. http://www.whatpc.co.uk/vnunet/news/2210496/researchers-engineer-software
39. Information World Review (UK), Feb 26, 2008. http://www.iwr.co.uk/information-world-review/news/2210503/researchers-promise-stop
40. Network World, Feb 26, 2008. http://www.networkworld.com/news/2008/022608-college-launches-data-portal-for.html
41. CIO Magazine, College launches data portal for counter-terrorism research, Feb 26, 2008, http://www.cio.de/news/cio_worldnews/851001/
42. Accountancy Age, Feb 26, 2008, Researchers promise to Stop terrorists, http://www.accountancyage.com/vnunet/news/2210496/researchers-engineer-software
43. Digital Trends, Feb 27, 2008. http://news.digitaltrends.com/news/story/15877/software_to_fight_terrorism
44. Daily India, Feb 27, 2008. http://www.dailyindia.com/show/219884.php/Indian-origin-researcher-unveils-STOP-terrorism-software
45. Malaysia Sun, Feb 27, 2008. http://story.malaysiasun.com/index.php/ct/9/cid/d805653303cbbba8/id/331644/cs/1/
46. Top News, India. Feb 27, 2008. http://www.topnews.in/indian-origin-researcher-unveils-stop-terrorism-software-222706
47. Thaiindian.com, Feb 27, 2008. ***http://www.thaindian.com/newsportal/health/indian-origin-researcher-unveils-stop-terrorism-software_10021671.html***
48. IT News, Australia, Feb 26, 2008. http://www.itnews.com.au/News/70955,researchers-promise-to-stop-terrorists.aspx
49. CRN UK, Feb 26, 2008. http://www.channelweb.co.uk/vnunet/news/2210496/researchers-engineer-software
50. Computing UK, Feb 26, 2008. http://www.computing.co.uk/vnunet/news/2210496/researchers-engineer-software
51. Security Management Magazine, June 2008 http://www.securitymanagement.com/article/calculating-margin-terror This article describes our work as "pioneering".
52. The Beirut Daily Star, Oct. 22, 2008. http://www.dailystar.com.lb/article.asp?edition_id=1&categ_id=2&article_id=96992 This article includes a response from Hezbollah to our work.

53. Danish National Broadcasting, Oct. 29, 2008.
54. WAMU 88.5 National Public Radio, the Kojo Nnamdi Show, http://wamu.org/programs/kn/08/11/25.php Nov. 25, 2008.
55. The Washington Post, Feb 16, 2009. My research with Jon Wilkenfeld on the use of computational methods for reasoning about terror groups was one of two pieces of research work highlighted in an article entitled "The Computer as a Road Map to Unknowable Territory". http://www.washingtonpost.com/wp-dyn/content/article/2009/02/15/AR2009021501794.html
56. The Examiner.com, Thumbs up or down, the business of tracking opinions online. This article highlights my work on sentiment analysis and opinion mining. Sep. 2, 2009.
57. *Scientific American.com* covered my work on virtual worlds for national security, Nov. 26, 2009. http://www.scientificamerican.com/article.cfm?id=virtual-war-games
58. The following articles covered my article in *Science* on virtual worlds on national security:
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151. My opinions on apparent Russian-backed cyberattacks were featured in a story titled "Experts say Russia gives hackers a 'tacit blessing' to attack foreign nations — as long as they don't target Russia or its allies" in *Times New Express*, June 18 2021, https://timesnewsexpress.com/news/finance/banking/experts-say-russia-gives-hackers-a-tacit-blessing-to-attack-foreign-nations-as-long-as-they-dont-target-russia-or-its-allies/

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162. Interviewed live on the 5am GMT edition of the BBC World News, BBC News Channel, and BBC One on Sep 21 2021 (UK time) on the data breach of the UK's Ministry of Defence.
163. Interviewed on NBC 5 Chicago News at 10pm on Oct 4 2021 in connection with the Facebook, Instagram, and Whatsapp downtimes.
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permanent control of disputed border areas: Study", Nov 11 2022, https://www.moneycontrol.com/news/india/chinese-incursions-into-india-strategically-planned-coordinated-effort-to-gain-permanent-control-of-disputed-border-areas-study-9502571.html

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VI. Administrative Credentials

1) **Interim Director, University of Maryland Institute for Advanced Computer Studies** (Feb 2004 – Oct 2004) and **Director, University of Maryland Institute for Advanced Computer Studies** (Oct 2004 to June 2010). Served as Interim Director and then Director of the University of Maryland Institute for Advanced Computer Studies (UMIACS). Tasks included:
    a. *Managing a state budget* line of approximately $3.5M per year and approximately $13M (2004) to $22-23M (2010) per year in external research funds.
    b. *Managing a set of approximately 150-200 employees* including 65 faculty with partial appointments in the Institute and approximately 80-100 researchers (including postdocs, PhD students, and visiting researchers).
    c. *Generating externally funded research funding*. During my term, I worked with our faculty to increase the research funding at the institute from $13M annually when I started to just under $23M.
    d. *Seeded and grew multiple new lines of research* including major multidisciplinary efforts.
    e. *Created multiple multidisciplinary innovative new researcher centers* including:
        i. The Joint Institute for Knowledge Discovery funded by the National Security Agency.
        ii. The Lab for Computational Cultural Dynamics funded by a number of DoD agencies including the Air Force Office of Scientific Research, the Army Research Office, and DARPA.
        iii. The Center for Digital International Government.
    f. *Recruiting*. Recruited over 20 faculty and 25-30 researchers during my tenure. In particular, I successfully recruited a Director for the nascent Center for Bioinformatics & Computational Biology, along with another dozen researchers

who were then based at The Institute for Genomics Research (TIGR) (now defunct) and helped these amazing researchers grow the center. Also recruited multiple star faculty including ones who occupied endowed chairs.

g. *Managed budgets & auditing*. Worked with accounting staff to create and manage the institute's annual budget. Also managed one external audit of UMIACS.

h. *Created and Shaped External Press Outreach*. During my term as Director of UMIACS, I made a strong effort to reach out to the press in order to gain maximal visibility for UMIACS research. Our work was covered by numerous top newspapers and media outlets.

2) **Director, Institute for Security, Technology & Society, Dartmouth College (Apr 2018 – Aug 2021).** I have served as the Director of Dartmouth's Institute for Security, Technology, and Society since April 2018. My responsibilities have included:

a. *Creating a strategic vision for Dartmouth's cybersecurity research.* My first task was to develop a consensual vision for Dartmouth's cybersecurity efforts. Through a series of meetings spanning 6 months, we were able to come up with a compelling vision for ISTS which spans four broad areas: securing the Internet of Things, managing attacks on social platforms, characterizing cyber-risk and how deception and deterrence can reduce risk, and managing cyber-vulnerabilities in settings where multiple products are composed together.

b. *Building a brand for Dartmouth's cybersecurity research.* Working from the strategic vision for ISTS, I worked with faculty and staff to develop a new website and promotional materials for the ISTS. We also launched two one day events (Washington DC and NY) on "AI and Cybersecurity" with the goal of getting Dartmouth research better exposure in the US Government and Wall Street Communities.

c. *Recruiting.* Since taking over as Director of ISTS, we have recruited two outstanding faculty – one from MIT who wrote the world's most cited paper on fake news and a female minority faculty member from Purdue who joined in December 2020. A third hire is under way for a cybersecurity position in the Government Dept. During the 2017-2020 time frame since I came to Dartmouth, the 6 core cybersecurity faculty raised grants worth approximately $19M. I also worked with faculty to fund and bring in multiple students and postdocs to work on cybersecurity related issues. In 2021, we expanded the core group of 7 faculty to 11 (including one now serving at DARPA).

d. *Raising External Research Dollars.* Since my arrival at Dartmouth in Fall 2017, the total number of research dollars awarded to ISTS faculty (not just me) is approximately $19M. This includes new funding sources such as DARPA, ARO, ONR which had not previously funded ISTS (to the best of my knowledge) as well as expansions of funding from existing sources such as NSF. We have also commenced efforts to build partnerships with corporations such as Google, Amazon who both currently fund some ISTS projects. We have also engaged with major corporations such as ADP, Bank of America, Lockheed Martin, TIBCO, TikTok, UL and others.

e. *Juniper Networks Lab.* I initiated the potential creation of a Juniper Networks Lab at Dartmouth College in May 2021. While the outcome will only be known in

subsequent months, I think it is fair to say that this could be a major industry funded lab at Dartmouth in the future.

f. *Other External Outreach.* ISTS also engages in a number of other educational activities including a free annual cybersecurity education summer course (sometime two) for high school students.
g. *Managing Budgets.* Work with accounting staff to manage ISTS's budget.

3) **Member, Board of Directors, Development Gateway.** I served on the Board of Directors of the Development Gateway (DG) which was set up by the World Bank in the late 1990s. DG's initial goal was to help achieve global development goals (e.g. poverty reduction, financial transparency) using IT techniques. The organization was initially funded by the World Bank and several governments – notably the governments of Germany, Australia, and Japan. I served on the board from approximately 2006-2020. During this time, I:
    a. Advised the CEO of the DG on an internal restructuring in order to reduce internal conflict within the organization.
    b. Served as the Chair of the Board's Audit Committee for several years (approximately 2012-2019). When I started in this role, DG's books were severely criticized by the external auditors. As a non-profit based in the US, DG needed to "pass" both US laws, as well as the laws of the foreign governments funding DG. Moreover, because DG had administrative offices in multiple overseas jurisdictions (e.g. Brussels, Dakar), the organization needed processes and practices consistent with those nations' laws. I worked closely with the external auditors and DG staff – first Gelman, Rosenberg & Friedman to improve the audit reports to a point where they had almost no reported issues. Later, worked with DG management to recruit a less expensive auditing firm.

4) **Member, Research Advisory Board, Tata Consultancy Services, India.** Tata Consultancy Services (TCS) is India's biggest IT firm – and with over 450K employees in 90+ countries, it is a global IT services powerhouse. In 2007, TCS's then CEO asked me to join its Research Advisory Board and helped shape the organization as a leader in applied IT research. As a first step, I helped recruit Jeff Ullman of Stanford (one of the world's premier computer scientists with also a wealth of corporate experience) to the board. We then worked closely with TCS' CTO (and periodically CEO) to restructure the research arm or TCS, build up what is not called TCS research, incentivize the researchers to publish in top conferences and journals, and generate high impact research with a commercial outcome. Specifically, we worked with TCS management to create a pipeline of research products that span multiple verticals and a transition mechanism to take these from the research labs to the TCS business units and from there to TCS's customers. Since then, TCS Research has successfully developed and transitioned high end research products for numerous companies (verticals include mining, steel, oil and gas, banking and finance, aerospace, hospitality, and more).