Empowering Women Distinguished Lecture

My Story:
From Industry
To Government
To Academia

Dr. Bhavani Thuraisingham

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Outline

- **A version of this presentation was given at the University of Texas at Dallas as the inaugural lecture as part of the Grace Series to empower women and honor the late Admiral Grace Murray Hopper on April 1, 2015.**
- **Part I of the Presentation will discuss how I got here starting from my early years in Sri-Lanka to my education in England to my career in the USA**
- **Part II of the Presentation will discuss the Challenges Encountered and Lessons Learned**
- **Part III/Appendix of the Presentation will discuss my technical work and research contributions from Theory of Computation to Cyber Security and Data Analytics**
- **This presentation was prepared to be given as the Inaugural Grace lecture for empowering women at the University of Texas at Dallas on April 1, 2015**
- **Acknowledgements: Thanks to all who have helped me in my education and career; Special thanks to John Cleave, Roger Hindley, John Shepherdson (graduate advisors), CV Ramamoorthy, Marion Pour-EL (mentors), Ron Swan, Keith Lamar (Control Data), Patricia Dwyer, Saeed Rahimi (Honeywell), Henry Bayard, Reid Gerhart, Al Grasso, Dale Johnson, Harvey Rubinovitz, John Maurer (MITRE), Maria Zemankova and Colleagues (NSF), Robert Herklotz (Air Force), Marion Ceruti (Navy), Elisa Bertino (friend and colleague), My Team, Students and Administration (UT Dallas); Above all my husband Thevendra for his support and encouragement throughout the past 40 years**

Part I
From Sri-Lanka to the United Kingdom to the United States of America

Early Years

- **Born in Colombo Sri-Lanka of Tamil origin, youngest of many sisters**
- **Father was high school educated and an Inspector of Excise; Mother was a house-wife, who quit 1st year of College studying Mathematics to get married; later she worked as a seamstress to put me through school**
- **Attended private Convent schools for 10 years (part in a boarding school) run by Irish nuns and last 2 years in a government high school**
- **My mother strongly supported me to study Mathematics; and I exceled in Math and Science**
- **Did well in all the public exams: CTA (8th grade), GCE OL (10th grade) and GCE AL (12th grade)**
- **My father passed away unexpectedly when I was 16 in 1971**
- **Attended University of Ceylon in 1972 and completed B.Sc. in 1975 with a First Class in Pure Math, Applied Math and Physics.**

Marriage and Graduate School

- **Married soon after the final exams in 1975, Arranged Marriage by my maternal uncle, although I had the choice to say yes or no**
- **My husband was 8 years older and finishing his PhD at University of Cambridge and known to my family**
- **My husband said he chose me because of "my interest in math and science and the ability to play classical music and my looks helped"**
- **I followed my husband to England to do my M.Sc. at the University of Bristol in Mathematical Logic**
- **I followed my husband to the University of Wales and completed my PhD in Theory of Computing**
- **My son was born around the time I finished my PhD**
- **Soon after we moved to the United States in 1980**

Visiting Faculty Years: 1980-1983

- **Followed my husband to New Mexico Institute of Technology in 1980 and worked as visiting faculty (was offered a tenure track faculty position which I declined due to family commitments)**
- **Taught courses in Theory of Computation, Mathematical Logic for Computer Scientists, and Advanced Calculus**
- **Conducted research in Theory of Computation and wrote several journal papers (later accepted in the Journal of Computer and Systems Sciences, Notre Dame Journal of Formal Logic and the Journal of Mathematical Logic)**
- **Followed my husband to Minneapolis and worked as visiting faculty and worked with Prof. Marion Pour-El in Algorithmic Information Theory at the University of Minnesota**

Control Data Years: 1983-1986

- **Became interested in practical aspects of Computer Science and took courses at the University in operating systems, networks and database systems (with substantial implementation) while working as visiting faculty**
- **By 1983 I had enough credits to get an MS in Computer Science with a 4.0 GPA and started working as senior developer at Control Data Corporation in the CDCNET system and Distributed Processing**
- **Really enjoyed working as a developer and learned about developing systems in a commercial environment**
- **My mother passed away in October 1984 and soon after that I wanted a change and get back into research.**
- **A year later in 1985 Fall Honeywell was looking for someone with my expertise to work in database security on an Air Force Contract**
- **A major milestone at Control Data was my significant involvement with the release of the CDCNET Version 1 product in December 1985**

Honeywell Years: 1986-1989

- **I became a US Citizen in December 1985 and was offered a job at Honeywell a week later which I accepted**
- **This began my career in what has now come to be known as Cyber Security**
- **While I worked 50% of my time in database security, I also worked on distributed database management, data modeling network operating system, and expert system for process control systems**
- **I also got a position at the University of Minnesota as adjunct professor and member of the graduate faculty; co-advised PhD students**
- **Published several journal and conference papers in database security; these were the crucial years in my career**

MITRE Years: 1989 – 1992

- **Followed my Husband to Boston in January 1989 and joined the MITRE Corporation**
- **I worked 100% in Cyber security from 1989 – 1992 and led teams in secure distributed database systems, secure object systems and inference controllers**
- **Published numerous papers in top tier venues, obtained patents, gave tutorials in database security to government agencies**
- **Significant contributions included proving that the Inference Problem was Unsolvable, developing novel inference controllers, developing one of the first secure distributed database system prototypes that connected several sites at MITRE**

MITRE Years: 1992-1995

- **In 1992 I moved to a different division and started working in data management in addition to database security**
- **In Fall 1993 I started working in real-time data management in addition to database security and continued to publish papers in top tier venues**
- **During this time I also started to work on a major initiative for the Intelligence Community on Massive Digital Data Systems**
- **Gave my first keynote/featured address at the Federal Database Colloquium in August 1994; also led MITRE's research effort in data management**
- **In 1995 became a department head and started working in data mining (in addition to real-time data management and data security)**

MITRE Years: 1995-1999

- **Signed the contract for my first book in 1995**
- **Built the department and grew it from 8 to 28 in 4 years and also continued to give keynote addresses and published papers in top tier venues**
- **By 1999 I was finishing my third book, edited several more books, chaired conferences, granted 3 patents**
- **Built a very strong community and support system in data security, data mining and real-time data management**
- **August 1997 became the first woman to receive the highly prestigious IEEE Computer Society's Technical Achievement Award**
- **My son went to College in Fall 1997**

MITRE Years: 1999-2001

- By 1999 I wanted a change and moved to a different division at MITRE
- I started to work on a very high priority project for the Department of Treasury while continuing to provide support to the Air Force
- This was also a time to reflect what I wanted to do next now that my son was away in college
- I continued to chair conferences, write papers and books and work as adjunct faculty at Boston University
- January 2001 I participated on an NSF Panel and my colleague and friend at NSF wanted me to join NSF for a year and take over her position
- My husband was concerned as this was the first time I moved on my own but gave me his 100% support

NSF Years: 2001-2004

- **Joined NSF (on IPA from MITRE) on October 1, 2001; it was a difficult time soon after 9/11**
- **I had challenging assignments, Year 1 I was a program director in Information and Data Management**
- **Year 2 I started a new program in Data and Applications Security and managed the Information Management thrust for NSF's ITR initiative**
- **Year 3 I was member of the Cyber Trust theme**
- **I learnt a lot during my NSF years including how the government worked**
- **Continued to publish papers and books and give keynote talks**
- **Became a Fellow of IEEE and AAAS**
- **At the end of my NSF stint, got an offer from UTD to develop cyber security**

UT Dallas Years: 2004-2007

- **Joining academia after 20+ years in industry and government was a challenge**
- **I had to learn about how academia worked and also conduct my own research and develop cyber security**
- **Took 1 year to get my first grant from AFOSR (with Latifur Khan)**
- **Murat Kantarcioglu joined in 2005 and Kevin Hamlen joined in 2006**
- **It took us 3 years to "get our feet wet"; all the while we worked really hard to write proposals and establish our team**
- **We made significant research contributions to assured information sharing**
- **Became a Fellow of the British Computer Society**

UT Dallas Years: 2007-2014

- **2007-2008 was the breakthrough period for us; we started getting several grants as a team including some $1M+ grants**
- **Started focusing on our education program in 2010; Kamil Sarac joined our team to head the education component and we got a multi-million dollar award for cyber security education**
- **Expanded our faculty (e.g., Zhiqiang Lin, Yvo Desmedt, Alvaro Cardenas) and published in top tier venues in cyber sec. and data**
- **I continued to take professional certifications and also obtained the prestigious earned higher doctorate at the University of Bristol, England for my published research in 2011.**
- **We celebrated our 10 year anniversary in October 2014 having generated $25M+ in research and $7M+ in education funding**
- **I received numerous awards from IEEE, ACM and other organizations as well as IBM Faculty Award**

The Future: 2014-?

- **Plan transition and empower the junior faculty by encouraging them to take leadership positions**
- **Spend more time giving motivational talks – e.g., gave the CRA Distinguished Lecturers at the Missouri Science and Technology in March 2015; Women in Cyber Security Conference Board, 2015**
- **Strong focus on education and outreach as well as technology transfer of our research**
- **Mentor Junior Faculty, Students, Women and Minority Communities**
- **My husband has followed me to Texas and has his ceramic rotary engine startup in Dallas and spends 1 week a month in Boston**
- **Continue to enjoy my family and work**

Part II: Challenges and Lessons Learned

Challenges Encountered and How I Overcame them

- **A few minor adversaries in my career; Either I won them over or ignored them and forged ahead with my work**
- **One major adversary who I heard from others was “out to get me”; This person undermined my technical work and tried to stop me from publishing papers as well as said negative things about me behind my back to others**
- **Here is a situation where one needs a strong support network; The support network I had built praised my technical work, my team approach, and my enthusiasm to key people; this helped my career.**
- **I also ignored this person and was even more focused and worked harder; was rewarded with promotions and some of the most prestigious awards (e.g., IEEE Technical Achievement, IEEE Fellow, ACM SIGSAC)**
- **I went from strength to strength while this person hardly progressed**
- **Throughout I had the strong support and advice from my husband**

Some Lessons Learned Over The Years

- **Never give up; Keep trying until you succeed; Take advantage of all the opportunities in front of you**
- **Maximize your strengths and Minimize your weaknesses**
- **Never lament on what you don't have, be grateful for what you have**
- **Think positive; Only your enemies will benefit from your downfall**
- **Don't say "what if", have a "can-do" attitude**
- **Build a strong support network and develop mentors**
- **Stick to the point; Never get into unnecessary arguments and discussions**
- **Everyone makes mistakes, the successful learn from them and the failures dwell on them**
- **Life is not picture perfect; there are many challenges; find smart solutions; Remember, every cloud has a silver lining**
- **You are never too old; There is only one life, enjoy every minute of it**

Why a Career in Computer Science for Women?

- **Given the opportunity women can excel in any subject especially in computer science**
- **Computer Science is a very exciting field with so many innovations and developments happening so rapidly**
- **Computer Science has many options from research and academia to product development to start-ups**
- **Millennial women and beyond have the flexibility and freedom to choose careers and have female role models in computer science that us baby boomers never had.**
- **Computer Science is a flexible field; you can work from home most days making it ideal for women to have a family and career**
- **Computer Science is a highly paid field with numerous job opportunities; why not women take advantage of these benefits?**
- **Most important: Women can be financially independent with a career in Computer Science; Financial independence implies self respect, less stress and confidence.**

Words of Dr. Jennifer Widom: Professor of Computer Science Stanford University

- ***"I think the most critical factor by far in managing children and having a career is to have the right husband … So, for those of you watching or reading this, think about that before it is too late! … Having the right husband is the primary factor, but the next most important factor is being efficient, knowing what's important and what's not important, …focusing one's time and energy on what really matters at work, so that you free up time for your family."***
  http://www.sigmod.org/publications/interview/pdf/p57-widom-winslett.pdf
- **Yes, I agree with Prof. Widom. To have a successful career within a marriage a woman must have a strongly supportive husband; she must also be focused and flexible.**

Part III/Appendix
My Research and Technical Contributions

Theory of Computation (1975-1983)

- **Extended Raymond Smullyan's (student of Alonzo Church) formal systems and Grzegorczyk's recursion theory with computable functionals**
- **Developed a Theory of System Functions and Studied their decision problems with respect to**
  - **Non-simple sets**
  - **Creative sets**
  - **Representation of many-one degrees and one-one degrees**
  - **Complexity classes**
  - **Formal languages**
- **Explored Turing Halting Problem with respect to Algorithmic Information Theory**
- **10 Publications in the Journal of Computer and Systems Sciences, Notre Dame Journal of Formal Logic and the Journal of Mathematical Logic**

Computer Networks and Distributed Systems (1983-1985)

- **Design and Development of the following modules of the CDCNET (Control Data Communications Network) product**
  - **Transport Layer**
  - **Session Layer**
  - **X.25 Network Layer Interface**
  - **Command Processors**
  - **Memory Management**
- **Design and Implementation of a Local Area Network**
- **Design and Implementation of Binary Tree Task Model for Fault Tolerant Systems**
- **Publications in IEEE Transactions on Software Engineering, IEEE Local Area Network Conference**

Database Security (1985-1989)

- **Design of the Lock Data Views System; it is a secure database systems hosted on top of the Lock Operating System**
- **Design of Secure Query Processing techniques using intelligent data management strategies**
- **Design of a database inference controller using deductive database techniques**
- **Design of SODA: Secure Object-Oriented Database System**
- **Prototyping as a Design tool for Secure Data Management**
- **Secure Distributed and Functional Database Systems Designs**
- **Numerous Publications including in IEEE Computer, IEEE Transactions on Knowledge and Data Engineering, Computers and Security, Data and Knowledge Engineering, IEEE ACSAC Conference, National Computer Security Conference**

Data Management, Artificial Intelligence, Networking, Economic Modeling (1985-1989)

- **Design of a Distributed Data Dictionary for Control systems**
- **Design of XIMKON: An Expert System for Control Systems**
- **Design of a Network Operating System for Space Stations**
- **Design of Information and Data Models for Engineering Information Systems**
- **Design of a Distributed Object System for Control Systems**
- **Design of a Transformer from rules to frames and vice versa**
- **Economic Modeling and Evaluation of Alternate Strategies for Developing Infrastructures for Control Systems**
- **Publications including in IEEE ICDE, Information Systems Journal, AI in Control Systems, AI Expert, IEEE Network**

Database Security (1989-2001)

- **Proved that the Inference Problem was unsolvable; quoted by NSA as a significant development in database security in 1990**
- **Developed a Logic called NTML (Nonmonotonic Typed Multi-level Logic) for Secure deductive database system**
- **Design, Implementation and Simulation of Secure Distributed Query Processing and Secure Transaction Management Techniques**
- **Design and Implementation of a Secure Multimedia System and a Secure Object Database System**
- **Design and Implementation of a Database Inference Controller and a Distributed Database Inference Controller**
- **Design of Conceptual Structures and Expert System for the Inference Problem**
- **Design of Secure federated and heterogeneous database system**
- **Approach for detecting the violation of the Inference Problem due to Data Mining**
- **3 Patents and Numerous publications including in IEEE Transactions on Knowledge and Data Engineering, Journal of Object-Oriented Programming, Data and Knowledge Engineering Journal, Information and Management, IFIP 11.3, ACM OOPSLA, Computers and Security, IEEE ACSAC, Computer Security Foundations Workshop, ACM Computer Conference**

Dependable and Real-time Data Management (1993-2001)

- **Design and Implementation of Priority ceiling-based Concurrency Control Algorithms for Object Database Systems**
- **Design and Implementation of a real-time object database system**
- **Design ad implementation of an object-based infrastructure for evolvable command and control systems**
- **Design and implementation of an adaptable real-time infrastructure and data manager for command and control applications**
- **Design of secure real-time transaction processing techniques**
- **Design of dependable real-time command and control systems**
- **Design of a Real-time Object Requites Broker (and submission to OMG)**
- **Numerous publications including in IEEE Transactions on Parallel and Distributed Processing, IEEE Transactions on Knowledge and Data Engineering, Real-time Systems Journal. VLDB, IEEE RTAS, IEEE WORDS, IEEE COMPSAC, IEEE ISORC and IEEE ISADS**

Data Management and Mining (1993-2001)

- **Design of the following systems**
  - **Heterogeneous Database Integration**
  - **Multimedia Data Management and Mining for Text, Images and Video data**
  - **Real-time Data Management and Mining**
  - **Data Management and Mining for E-Commerce Systems**
  - **Visualizing Data Mining Results**
  - **Managing Very Large Databases**
  - **Semantic Web for Information Integration**
- **5 Books: Data Management Systems; Data Mining Technologies, Techniques, Tools and Trends; Web Data Management and Electronic Commerce; Management and Mining Multimedia Data; XML, Semi-structured Databases and Semantic Web**
- **Publications including in IEEE ISORC, IEEE COMPSAC, AIPASG, Dual-Use Technology Conference, British Database Conference, IEEE Multimedia**
- **Keynote/Featured/Plenary Panel addresses including at Federal Database Conference, PAKDD, FEDOOTS, IEEE ICDE, IEEE ICTAI**

Data Management, Data Mining, Data Security and Privacy (2001-2004)

- **Approaches for Securing the Semantic Web**
- **Design and Implementation of Third Party Publication of XML Data**
- **Design of a Database Privacy Controller**
- **Design of a Secure Data Warehouse**
- **Data Mining Techniques for Counter-terrorism Applications and the Privacy Implications**
- **Design of a Secure Sensor Database Systems**
- **2 Books: Data Mining for Counter-Terrorism Applications; Database and Applications Security**
- **Publications in IEEE Transactions on Knowledge and Data Engineering, Data and Knowledge Engineering, EDBT Conference, IEEE Signal Processing, IFIP 11.3**
- **Keynote/Featured/Plenary Panel Addresses at IEEE WORDS, EDBT, IEEE COMPSAC, IEEE ICDE.**

Data Security and Privacy (2004-2014)

- **Design and Implementation of Secure Semantic Web and Ontology Matching Techniques**
- **Design and Implementation of Policy-based Assured Information Sharing**
- **Data Mining Tools for Malware Detection and Insider Threat Detection**
- **Design and Implementation of a Secure Social Media System and Social Media Analytics System**
- **Design and Implementation of Technologies for Secure Cloud, Secure Web Services and Big Data Techniques**
- **Privacy Preserving Decision Tree techniques**
- **Design and Implementation of Smart Phone Malware Detection Framework**
- **Multiple Patents; 8 Books: Secure Semantic Web, Secure Cloud, Inference Controller, Secure Web Services, Data Mining Tools,. Data Mining for Malware; Secure Social Media, Insider Threat**
- **Over 50 Keynote/Feature addresses and numerous publications including in several IEEE and ACM Transactions, IEEE ICDM, ACM KDD, IEEE Cloud, IEEE ICWS, ACM CODASPY, ECML, IEEE Big Data**

Future Plans for Technical Work: 2014-?

- **Explore the Foundations of Data Security and Privacy**
- **Design and Implementation of Large Scale Social Media Systems**
- **Interdisciplinary Research on Cyber Security and Social Sciences**
- **Big Data Security and Privacy**
- **Re-focus on Big Data Analytics for Counter-Terrorism**
- **Integrating Research with Education in Cyber Security and Big Data Analytics**
- **Continue to enhance my knowledge by reading research papers, books and popular articles related to my work**