

RINA PANIGRAHY

Phone: 4083064607

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Email:rinapy@gmail.com

<http://theory.stanford.edu/~rinap>

Summary

Worked on a variety of applied algorithms including deep learning, nearest neighbor search, locality sensitive hashing, balls and bins processes, cuckoo hashing, learning and prediction (that led to a tool for [stock prediction](#)) large graphs such as distance estimation, streaming and sketching algorithms. Led to impact in areas including model understanding and compression, distributed caching for content delivery networks (that led to the founding of **Akamai** Technologies), fast regular expression for worm detection in networks (at Cisco Systems), fast IP lookups using TCAMs, and ad-matching. Served on several program committees for research conferences spanning algorithms, machine learning, and big data. Organized a workshop on “[Conceptual Understanding of Deep Learning](#)” that aired live on youtube including a panel discussion on “[Is there a mathematical model of the mind](#)” with speakers including two Turing award winners. Also organized a workshop including a [tutorial on deep learning](#) that brought together statistical physicists, mathematicians and computer scientists. Also see “[How does the mind store information](#)”

50+ **patents** issued spanning large number of technologies including networks, power management, hashing and sketching, video indexing, prediction and learning.

75+ publications in conference/journals.

Experience

Google Inc (Nov 2014 - present)

Mountain View, CA

Research Scientist

TLM for a small team on efforts on several problems related to model understanding and compression.

- Model compression ([matrix-compression-library](#), [pruning-library](#), [blog-post](#)) algorithms for trading off model size vs accuracy for variety of problems including Speech Recognition, Search Ranking, Android Text-classifier, Assistant, Translate.
- Modular understanding of Deep Learning for Language understanding based on higher levels of abstraction of a deep network
- Worked on algorithms for matching search ads to user queries based on features from the long term query history of the user.

Microsoft Research (Feb 07- Nov 2014)

Mountain View, CA

Principal. Researcher (Mar 2014 – Nov 2014)

Senior Researcher (Mar 2010 – Mar 2017)

Researcher (Feb 07 – Mar 2010)

Member of the Microsoft research lab at Silicon Valley specializing in applied and theoretical algorithms. Worked on problems related to several applications such as web search, load balancing for virtualization, stock prediction, and theoretical problems such as hashing, lower bounds for high dimensional search, learning sparse polynomials and learning using neural networks. Collaborated with several product groups at Microsoft including Bing Search and Ads, MSN, Virtual Machine Management,, SQL Assure, Capital Markets Groups and Xbox. These collaborations resulted in ideas that were implemented in production systems. Product collaborations:

- **Virtual Machine Load Balancing:** Collaborated with the hypervisor VMM team (and the SQL Azure team) on algorithms for multidimensional load-balancing of VMs on physical machines
- **Capital Markets Groups:** Worked with the internal finance team on worst case risk reward analysis for stock investments to produce a technical indicator for algorithmic trading. These algorithms produced better risk/reward ratios such as sharpe and calmar ratios for index funds.
- **Xbox:** Worked on video search and indexing algorithms -- experimented with several methods such as LSH(Locality Sensitive Hashing), LDA(Latent Discriminant Analysis), PCA, K-means and neural networks.
- **Bing Ads:** Worked on measuring and modeling click position bias of search ads for estimating CTR of ads.
- **Bing Social search:** Worked on algorithms for estimating social distance between nodes in a social network in real time for social search on Bing.
- **MSN:** Worked on clustering similar news stories using min-hashing for CDS(content delivery services)

CISCO SYSTEMS (Aug 98 – Mar 2006)

San Jose, CA

Sr Software Engineer

Worked on research/design/implementation of algorithmic solutions for several problems in networking - including - algorithms for regular expression matching and packet parsing at high speeds, algorithmic solutions for longest prefix match at low power using Ternary CAMs, algorithms for high dimensional search for packet classification, algorithms for efficient memory management for tree based longest prefix match, algorithms for

switch scheduling. Filed over 15 patents with USPTO. Also worked on publications in the field of Algorithms and Networking during this period in collaboration with members at Stanford University.

- Worked on invention of a Ternary CAM architecture for IP forwarding at low-power that shows how to perform longest prefix match at a Ternary CAM with a peak power consumption of 2W.
- Worked on scalable algorithms for regular expression matching at high speeds in a load balancing device for URL based load balancing. Invented algorithms to handle a large number of wild-card “.*” characters in regular expressions that normally lead to exponential memory requirements when combined into a single state machine. These algorithms were implemented on the Intel IXP 2800 network processor interacting with Power PC processor with VxWorks.
- Worked on invention of architecture of a parsing chip that performs deep content inspection on packets at a line rate of 10Gbps looking for preconfigured signatures. This chip had a proprietary instruction set that would allow programming it in high-level language using constructs such as if-then -else and loops.
- Designed efficient scalable hashing algorithms to be used in Netflow packet lookups at a rate of 60 million lookups per second while maintaining high memory utilization.
- Worked on design/implementation of Content Processing portions of SSLVPN device using Broadcom 1250 processor.
- Cisco Champion for University research projects with Prof Mitzenmacher at Harvard University on Hashing for Network search and summarization, and Prof Nourani at U.T. Dallas on low power network search. The champion plays a central role in funding, approving and working jointly on the progress of the research project.

Vista Research (Nov 05 – Sep 06)

Palo Alto, CA

Member of a ‘Society of Industry Leaders’ to provide consulting advice on technology and market trends in network device search engines.

ORACLE CORPORATION (June 97 – Aug 99)

Redwood Shores, CA

Staff Consultant at Oracle Consulting Services. Worked on integrating heterogeneous applications for customers. Involved working on a Messaging middleware system to transport database objects across applications.

Stanford University (Summer 06)

Palo Alto, CA

Course instructor for Introduction to Algorithms. Responsibilities include preparing and delivering course lectures and working with TA on homework and exam preparation and administration. Also served as a teaching assistant for this class in Autumn 06.

Education

STANFORD UNIVERSITY (Sep 2004-Dec 2006)

Palo Alto, CA

Ph.D. in computer science, Dec 2006. Advisor: Rajeev Motwani.

Thesis on hashing and sketching for space efficient search in high dimensional spaces with applications such as web document similarity search and image search.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY (Aug 1995-1997)

Cambridge, MA

M.S. in Computer Science, June 1997. **GPA 5.0/5.0.**

Masters Thesis: "Relieving Hot Spots on the World Wide Web". Involved design and implementation of replication and caching techniques for managing load on Web sites with excessive demand. This work was used in the founding of **Akamai Technologies**

INDIAN INSTITUTE OF TECHNOLOGY (June 1991-1995)

Bombay, India

B.Tech. degree in Computer Science, June, 1995. Bachelor Thesis: "Online Algorithms for competitive Paged Caching". **GPA 9.9/10.0. (3rd rank in the Institute)**

Awards and Honors

Best paper award in PODS 2008.

Best student paper award in SODA 2005.

Received the Gold Star Award at Microsoft Research for technology transfer and product impact 2010

Masters Thesis work at MIT was used at the founding technology at Akamai Technologies.

Won a **Gold Medal** at the 31st **International Mathematics Olympiad**, 1990, Beijing, China among 308 participants from 53 countries. Also won a **Silver Medal** at the 32nd International Mathematics Olympiad, 1991, Sigtuna, Sweden.

Won Gold Medal at the National Standard Examination in Physics for the years 1990 and 1991.

Top rank at the **All India Entrance Examination** for admission to IIT among **80,000** candidates nationwide, 1990.

Won the National Talent Search Scholarship. Only 700 students all over India are offered the scholarship

Won the Essar Scholarship 1991. Only ten students all over India are offered this scholarship based on academic achievements, original thinking and drive for success.

Program Committees

PC member at KDD 14, WWW 14, ICWSM 14, STOC 2013, WSDM 2013, STOC 2012, KDD 2012, SODA 2012, ESA 2012, WWW 2012, KDD 2011, WWW 2011, SODA 2010, ICDM 2010, ALENEX09, WWW09.

Served as an **NSF Panelist (Algorithms)** in 2011 and 2015.

Invited Talks

Invited talks at ICAA 2014, Data Streams Workshop (Dortmund) 2013, TIFR (Mumbai) 2012, Synergies in Lower bounds (Aarhus) 2011, Data Streams (Kharagpur) 2011, Engineering Cool Talk (Microsoft) 2011, Georgia Tech Algorithms Seminar 2009, Nerd Lunch (Cisco Systems).

Students Advised (as summer interns)

Alex Andoni from MIT, now faculty member at Columbia University,

Krsyztoff Onak from MIT, now at IBM T.J. Watson

Nikhil Srivastava from Yale, now faculty member at U.C.Berkeley,

Atish Das Sarma from Georgia Tech,

Ding Yuan from UIUC, now at UToronto,

Preyas Popat from UIUC, now at Google,

Mikhail Kapralov from Stanford, soon to be at EPFL

Behnam Neyshabur from TTI Chicago.

Majid Janzamin from UC Irvine.

Publications

Available online at <http://theory.stanford.edu/~rinap>

