



ARC 2017 Annual Report

January 2018

Motivation

- Algorithms and stochastic processes are ubiquitous, notable examples:
 - Google's PageRank: directed Markov chain
 - Compressed sensing
 - Optimization
 - Deep learning
 - Markov Chain Monte Carlo (MCMC)
 - Statistical physics phase transitions
 - Scheduling, packing

Motivation

- Goals:
 - Fast optimization
 - Algorithms for sharing economy (Uber, Lyft, etc.)
 - Smart logistics (Amazon)
 - Mechanism design (Google)
 - Machine learning
 - Stochastic processes: modeling and applications
 - Connections between fields
- Synergy with TRIAD

ARC faculty

- **Mathematics:**

- M. Baker, G. Blekherman, E. Croot, E. Ezra, C. Heitsch, V. Koltchinskii, M. Lacey, A. Leykin, P. Tetali, R. Thomas, W. Trotter, X. Yu, L. Warnke, J. Yu, M. Zhilova

- **Engineering (ISyE & ECE):**

- Shabbir Ahmed, Santanu Dey, Swati Gupta, Xiaoming Huo, Shiva Maguluri, Renato Monteiro, George Nemhauser, Arkadi Nemirovski, Sebastian Pokutta, Justin Romberg, Mohit Singh, Craig Tovey, Yao Xie, Huan Xu, Tuo Zhao, Enlu Zhou

- **Computer Science:**

- J. Abernethy, A. Boldyreva, B. Dilkina, L. Fortnow, M. Mihail, R. Lipton, R. Peng, D. Randall, L. Song, V. Vazirani, S. Vempala, E. Vigoda

Activities

- PhD Fellowships
 - 7 joint ARC-TRIAD fellowships
- Research lunches: 5 informal talks last year
- Seminar series
- ARC days: 2 Special Events
- Workshops: May '18
- Postdocs:
 - Current: 2 Joint Funded (Grants+ARC)
 - Future: 2-4 Joint Funded (Grants+ARC+TRIAD)
- Research visitors

Research Lunches

- Informal talk to explore connections and possible collaborations.
- Recent talks:
 - March 2018: *Eva Dyer (BME)*:
 - Low-dimensional models for large-scale neural data
 - April 2017: *Will Ratcliff (Bio)*:
 - The evolution and ecology of competition
 - January 2017: *Emanuele DiLorenzo (EAS)*:
 - Climate models
 - December 2016: *Thad Starner (IC)*:
 - *Dolphin communication*
 - September 2016: *Chris Rozell (ECE)*:
 - Dimensionality Reduction and Neural Computation
 - May 2016: *Dan Goldman (Physics)*:
 - Active matter in need of algorithms
- Outcomes: New interdisciplinary projects:
 - Theoretical Neuroscience Day in Spring '17
 - NSF project by *Dan Goldman* and *Dana Randall*
 - Collaboration of *Yao Xie (ISyE)* and *Thad Starner (IC)* on motif finding in time-series data
 - 3 collaborative EAGER grants

Theoretical Neuroscience Day

March 2017

- Joint event: ARC + GT Neuro
- Keynote: [Bruno Olshausen](#) (Berkeley)
 - Neural computations for active perception
- [Chris Rozell](#) (ECE)
- [Santosh Vempala](#) (CS)

ARC 11

March 2017

- 11th annual event
- Keynote: [Robert Schapire](#) (Microsoft)
 - Machine Learning Algorithms
- ARC postdocs:
 - John Wilmes
 - Learning Neural Networks
 - Antonio Blanca
 - Markov Chain Monte Carlo (MCMC) algorithms

Spring '18 PhD Fellowships

- ARC-TRIAD fellowships:
 - *G. Kerchev* (Math), advisor: C. Houdre (Math)
 - *Rui Gao* (ISyE), advisor: Anton Kleywegt (ISyE)
 - *Adrian Cardoso* (ISyE), advisor: Huan Xu (ISyE)
 - *Zhehui Chen* (ISyE), advisor: Tuo Zhao (ISyE)
 - *T. Tantipongpipat* (CS), advisor: Mohit Singh (ISyE)
 - *Jun-Kun Wang* (CS), advisor: Jacob Abernethy (CS)
- ARC-ACO fellowship:
 - *He Guo* (Math ACO), advisor: Lutz Warnke (Math)

PhD Fellowships

- *Spring 2017:*
 - Marcel Celaya (ACO PhD, Math)
 - Alfredo Torrico (OR PhD, ISyE)
 - Di Wu (OR PhD, ISyE)
 - Samira Samida (CS PhD) ARC-IISP fellowship
- *Fall 2016:*
 - David Durfee (ACO PhD, CS)
 - Ezgi Karabulut (OR PhD, ISyE)
 - Kevin Lai (ACO PhD, CS)
 - Tung Mai (ACO PhD, CS)
 - Tianxin Tang (CS PhD, CS) ARC-IISP fellowship

Postdocs

- *New:*
 - Megan Bernstein (Stanford, GT SoM), mentors: Prasad, Dana, and Eric
 - Greg Bodwin (MIT), mentors: Prasad Tetali and Santosh Vempala
 - Vivek Madan (UIUC), mentor: Mohit Singh (ISyE)
- *Current:*
 - John Wilmes (PhD U. Chicago Math)
 - Deep learning
 - Antonio Blanca (PhD Berkeley CS)
 - Markov Chain Monte Carlo (MCMC)
- *Recent Postdocs:*
 - Ruta Mehta, UIUC CS
 - Jugal Garg, UIUC Ind. & Ent. Sys. Eng.
 - Laszlo Vegh, LSE Math
 - Elena Grigorescu, Purdue CS
 - Jinwoo Shin, KAIST ECE
 - Lev Reyzin, UIC, Stat. & CS
 - Charilaos Efthymiou, Frankfurt Math
 - Anup Rao, Adobe

Seminar Series

- Weekly seminar
 - Well attended: 20-40 people, mix of PhD students and faculty from ISyE, CS, Math, ECE, and CSE.
 - Opportunities for students+faculty to meet with speaker
 - Quantum computing: 100+ attended
 - Machine learning theory: 100+ attended
 - Often joint with TRIAD
- Student seminars: Quantum computing, convex optimization

Workshops

- *Algorithms & Randomness. May 2018*
- *The Power of Randomness in Computation.* March 2015.
- *ARC-RIM industry day.* April 2013.
 - Organizers: P. Tetali and H. Christensen.
- *Network Topology and Economics.* November 2012.
 - Organizers: C. Dovrolis (CS), A. Fabrikant (Google), M. Shapira (Hebrew), and P. Tetali (Math)
- *Computation and Phase Transitions.* June 2012.
 - Organizers: Randall, Tetali, Vigoda
- *Modern Aspects of Submodularity.* March 2012
 - Organizers: S. Ahmed (ISyE), N. Balcan (CS), S. Iwata (Kyoto), and Prasad Tetali (Math)

World-class team

- ISyE: #1
- Discrete Math/Combinatorics: #2 (US News)
- CS Theory: #8
- Many awards:
 - 2 NAE members
 - Fulkerson and Godel prizes, Guggenheim Fellows
 - Editors in chief of top journals
 - Many IEEE, AMS, ACM, and SIAM Fellows

Future plans

- *Strengthen ties between CoS, CoE, and CS:*
 - *Research lunches and seminar speakers*
- *International visibility:*
 - Seminar series with prominent (junior & senior) speakers
 - ARC distinguished lectures
 - High-profile inter-disciplinary workshops
- *Industry support:*
 - Microsoft, Google, Facebook

ARC joint grants

- Vempala, Vigoda, Stefankovic (Rochester). NSF Medium \$1.2 million, 2016-2020.
- Extremely Energy Efficient Collective Electronics (EXCEL): \$4.4 million. PI: S. Dutta (Notre Dame), GT co-PI's: Arijit Raychowdhury, Justin Romberg (ECE), and Santosh Vempala (CS).
- Dan Goldman and Dana Randall, NSF: A Distributed and Stochastic Algorithmic Framework for Active Matter, 2016-18.
- Tetali: Expedition proposal → 3 EAGER awards (900k total) 2014-17.
- Tetali: Symbotic, 30k, 2013.
- Tetali: Yandex Corporate (Russia), 41k for '12 workshop on computer networking.
- Randall, Tetali, Vempala, Vigoda, Stefankovic (Rochester). NSF Large \$1.08 million 2009-13.
- Many individual NSF grants.