Abram Magner

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OBJECTIVE, RESEARCH INTERESTS

My research interests are in the fields of network science and random graphs/complex networks, information theory, and design/analysis of algorithms, especially as applied to modeling, statistical inference/hypothesis testing/learning, and compression problems on real-world, structured data. I am also generally interested in mathematical problems arising in machine learning.

I am currently seeking positions which will allow me to work on problems in these or related areas that have both theoretical and practical components.

EDUCATION

Ph.D. – Computer Science, Purdue University, November 2015.

M.S. – Computer Science, Purdue University, May 2014.

B.S. – Computer Science (Honors), Mathematics, minor in psychology, Purdue University, May 2011.

EMPLOYMENT

Assistant professor in the Department of Computer Science at the University at Albany, State University of New York (September 2019 – present).

Research Fellow in the EECS department at the University of Michigan (mentored by Alfred Hero) (October 2018 – September 2019). Conducted research in network science, **mathematical methods for machine learning**, and design of novel deep learning approaches to biomolecule design.

NSF Center for the Science of Information postdoctoral fellow at the Coordinated Science Lab, UIUC (jointly mentored by Yuliy Baryshnikov (UIUC) and Ananth Grama (Purdue)) (2015-2018).

Research assistantship (advisor: Wojciech Szpankowski) (2011–2015).

Visiting researcher at LINCS, Paris, France (Summer 2014).

Sandia National Labs (Summer 2011): software engineering intern in modeling and simulation.

IBM (Summer 2010): Extreme Blue software engineering intern.

TrustBearer Labs (now Symantec) (Summer 2009): software engineering intern.

Forward Engineering (Summer 2008): software engineering intern.

AWARDS, HONORS

$\Phi\beta\kappa$ honor society membership (2011–present).

$\upsilon\pi\epsilon$ computing honor society membership (2010–present).

Purdue math department certificate of merit (2010).

Purdue computer science outstanding sophomore award (2009).

Purdue college of science outstanding student award (2009).

Purdue University dean's list (2007–2011).

Purdue University Top Scholar Award (2007).

National Merit Scholarship (2007).

Valedictorian Scholarship (2007).

PUBLICATIONS

Ph.D. thesis: Profiles of PATRICIA Tries – I gave a precise asymptotic distributional analysis of a key parameter of random tree data structures built on strings which arise in fundamental computer science applications, using complex analytic methods applied to generating functions. This led in subsequent work to progress on a long-standing information-theoretic/combinatorial problem posed by Alfred Rényi.

Journal papers

Baranwal, M., Magner, A., Elvati, P., Saldinger, J., Violi, A., and Hero, A.: A Deep Learning Architecture for Metabolic Pathway Prediction. Submitted.

Turowski, K., Magner, A., and Szpankowski, W.: Compression of Dynamic Graphs Generated by a Duplication Model. Submitted.

Łuczak, T., Magner, A., and Szpankowski, W.: Asymmetry and Structural Information in Preferential Attachment Graphs. *Random Structures and Algorithms* (to appear), 2018. `http://arxiv.org/pdf/1607.04102`

{ Sreedharan, J., Magner, A.}, Szpankowski, W., and Grama: Inferring Temporal Information from a Snapshot of a Dynamic Network. (The first two authors contributed equally). *Nature Scientific Reports* (to appear). 2019.

Gołebiewski, Z., Magner, A., and Szpankowski, W.: Entropy and Optimal Compression of Some General Plane Trees. *ACM Transactions on Algorithms*, 15(1), article 3, 2018.

Magner, A., Szpankowski, W., and Turowski, K., Lossless compression of binary trees with correlated vertex-names. *IEEE Transactions on Information Theory*, 64(9), 6070–6080, 2018.

Drmota, M., Magner, A., and Szpankowski, W., Asymmetric Rényi Problem and PATRICIA Tries. To appear in *Combinatorics, Probability, and Computing*, 2018. Published online 06/2018.

Magner, A., Duda, J., Grama., A., and Szpankowski, W.: Fundamental Bounds for Sequence Reconstruction from Nanopore Sequencers. *IEEE Transactions on Molecular, Biological, and Multi-Scale Communications, Special Issue on Biological Applications of Information Theory*, 2(1), 92–106, 2017.

Magner, A., and Szpankowski, W., Profiles of PATRICIA Tries. *Algorithmica*, 80(1), 331–397, 2018.

Magner, A., Kihara, D., and Szpankowski, W., A Study of the Boltzmann Sequence-Structure Channel, *Proceedings of the IEEE Special Issue on Foundations and Applications of Science of Information*, 105(2), 286-305, 2017.

Magner, A., Janson, S., Kollias, G., and Szpankowski, W., On Symmetry of Uniform and Preferential Attachment Graphs, *Electronic Journal of Combinatorics*, 3, P3.32, 2014.

Magner, A., Szpankowski, W., and Kihara, D., Origin of Protein Superfamilies and Superfolds. *Nature Scientific Reports*, 5:8166, 2015.

Refereed conference papers

Magner, A. and Szpankowski, W.: Toward Universal Testing of Dynamic Network Models (submitted), 2019.

T. Łuczak, Magner, A., and Szpankowski, W.: Compression of Preferential Attachment Graphs. Accepted to IEEE International Symposium on Information Theory (ISIT) 2019.

Magner, A. and Padakandla, A.: Network Archaeology via Epidemic Processes: The Case of Growing Trees. Accepted to Allerton Conference on Communication, Control, and Computing 2018.

Turowski, K., Magner, A., and Szpankowski, W.: Compression of Dynamic Graphs Generated by a Duplication Model. Accepted to Allerton Conference on Communication, Control, and Computing 2018.

Baryshnikov, Y. and Magner, A.: Large Deviations for Increasing Subsequences of Permutations and a Concurrency Application. *SIGMETRICS Performance Evaluation Review*, 45(2), 2017. This is an extended version of the workshop paper of the same name.

Magner, A., Grama, A., Sreedharan, J., and Szpankowski, W.: TIMES: Temporal Information Maximally Extracted from Structure. *Proceedings of the 2018 World Wide Web Conference*, 389–398, 2018.

Magner, A., Grama, A., Sreedharan, J., and Szpankowski, W.: Recovery of Vertex Orderings in Dynamic Graphs. *Proceedings of the IEEE International Symposium on Information Theory*. 2017, 1563–1567.

Gołebiewski, Z., Magner, A., and Szpankowski, W.: Entropy of Some General Plane Trees. *Proceedings of the IEEE International Symposium on Information Theory*. 2017, 1563–1567.

Magner, A., Duda, J., Grama, A., and Szpankowski, W.: Fundamental Bounds for Sequence Reconstruction from Nanopore Sequencers, *2017 Proceedings of the 9th International Conference on Bioinformatics and Computational Biology* (2017). This is an extended abstract of the journal paper.

Cichoń, J., Magner, A., Szpankowski, W., Turowski, K.: On Symmetries of Non-Plane Trees in a Non-Uniform Model. *2017 Proceedings of the Fourteenth Workshop on Analytic Algorithmics and Combinatorics (ANALCO)*. 156–163.

Drmota, M., Magner, A., and Szpankowski, W., Asymmetric Rényi Problem and PATRICIA Tries. *2016 Proceedings of the 27th International Conference on Probabilistic, Combinatorial and Asymptotic Methods for the Analysis of Algorithms*. 2016, 68–85. **Journal version invited to appear in *Combinatorics, Probability, and Computing***.

Magner, A., Szpankowski, W., and Turowski, K., Lossless Compression of Binary Trees with Correlated Vertex-Names. *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*. 2016, 1217-1221.

Magner, A., Kihara, D., and Szpankowski, W., The Boltzmann Sequence-Structure Channel. *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*. 2016, 255–259.

Jacquet, P., and Magner, A., Variance of Size in Regular Graph Tries. *2015 Proceedings of the Twelfth Workshop on Analytic Algorithmics and Combinatorics (ANALCO)*. 2015, 97–104.

Magner, A., Janson, S., Kollias, G., and Szpankowski, W., On Symmetry of Uniform and Preferential Attachment Graphs, *Proceedings of DMTCS, AofA*. 2014, 283–294.

Magner, A., Knessl, C., and Szpankowski, W., Expected External Profile of PATRICIA Tries. *2014 Proceedings of the Eleventh Workshop on Analytic Algorithmics and Combinatorics (ANALCO)*. 2014, 16–24.

Workshop papers

Baryshnikov, Y. and Magner, A.: Large Deviations for Increasing Subsequences of Random Permutations and a Concurrency Application. Accepted to/presented at SIGMETRICS Workshop on MAthematical performance Modeling and Analysis (MAMA) 2017.

Manuscripts

Magner, A., Mohammadi, S., and Grama, A., Combining Density and Overlap (CoDO): A New Method to Assess Significance of Overlap Among Subgraphs.

PUBLIC PRESENTATIONS

Invited talk at Purdue Conference on Foundations of Data Science (2019): Presented on goodness of fit testing for dynamic graph models.

Invited talk at University of Pennsylvania Probability seminar (2018): Presented on statistical problems on time-varying graphs.

Allerton (2018): Presented "Network Archaeology via Epidemic Processes: The Case of Growing Trees".

Invited talk at University of Michigan EECS theory seminar (2017): Presented on structural and temporal information in dynamic random graph models.

Invited talk at Johns Hopkins University applied mathematics and statistics department seminar (2017): Presented on structural and temporal information in dynamic random graph models.

Invited talk at Purdue University statistics department probability seminar (2017): Presenting on structural and temporal information in dynamic random graph models.

ISIT (2017): Presented "Recovery of Vertex Orderings in Dynamic Graphs".

ISIT (2017): Presented "Entropy of Some General Plane Trees".

ISIT (2016): Presented "Lossless Compression of Binary Trees with Correlated Vertex-Names".

AofA (2016): Presented "Asymmetric Rényi Problem and PATRICIA Tries".

Purdue CS theory reading group (2015): Presented an overview of the basics of the theory of graph limits.

Random Structures & Algorithms conference (2015): Presented a preliminary version of "The Boltzmann Sequence-Structure Channel".

ANALCO (2015): Presented "Variance of Size in Regular Graph Tries".

AofA (2014): Presented "On Symmetry of Uniform and Preferential Attachment Graphs".

Lake Michigan Workshop on Combinatorics and Graph Theory (2014): Presented "On Symmetry of Uniform and Preferential Attachment Graphs".

Purdue CS theory seminar (2014): Presented "Expected Profile of PATRICIA Tries", along with relevant background in analytic combinatorics.

ANALCO (2014): Presented "Expected Profile of PATRICIA Tries".

Purdue CS theory reading group (2013): Presented an overview of analytic combinatorics.

Purdue analytic combinatorics seminar (2013): Presented a preliminary version of "Expected Profile of PATRICIA Tries".

Purdue CS theory seminar (2012): Presented a preliminary version of "On Symmetry of Uniform and Preferential Attachment Graphs".

TEACHING EXPERIENCE

ICSI 401/501 – Numerical analysis and numerical linear algebra, Fall 2019

Independent study – Applications of information theory to machine learning and data science, Fall 2019

Analytic Combinatorics, with Applications, Spring 2017: Designed/taught a half-semester course on analytic combinatorics to graduate students in the mathematics department at UIUC.

Foundations of computer science, Spring 2015: Gave three lectures on elementary number theory to a large class of undergraduate CS majors.

OTHER EXPERIENCE

Participated in and presented at a CSoI workshop on data science with R (May 2017).

Completed a short course on R for data science applications (May 2017).

Invited participant at Banff Workshop on Analytic and Probabilistic Combinatorics (October 2016).

Performed teaching assistant duties for a graduate course on sublinear algorithms (Spring 2015).

Co-organized/periodically presented to the Purdue CS theory reading group (note that this is distinct from the CS theory seminar) (2011–2015).

Participated in IEEE and Center for the Science of Information (CSoI) information theory summer schools (2011–2013), including presenting posters.

Served as a reviewer for IEEE Transactions on Information Theory, Algorithmica, SIAM Journal on Computing, Probability in the Engineering and Informational Sciences, ANALCO, AofA, STACS, STOC, and ACM Transactions on Algorithms, Journal of Parallel and Distributed Computing, International Symposium on Information Theory, International Conference on Data Mining, IEEE Communications Letters, IEEE Transactions on Knowledge and Data Engineering, Advances in Applied Probability, Random Structures & Algorithms (2011–present).

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

Association for Computing Machinery (student member, 2009–present).

Institute for Mathematical Statistics (2017–present).

Bernoulli Society for for Mathematical Statistics and Probability (2017–present).

Center for the Science of Information (student member, 2011–present).

COMPUTATIONAL SKILLS

Languages: C, Java, Python, Sage, Matlab; some experience in R.

Some experience with PyTorch, familiarity with Tensorflow, NLTK

Experience with version control systems: CVS, Subversion

COMPUTATIONAL PROJECTS

This is a non-exhaustive list.

Implemented various process scheduling algorithms in a Unix-like operating system kernel.

Implemented a device driver.

Implemented a large portion of a Modula 3 compiler using JavaCC.

Designed/implemented numerical and combinatorial methods for studying information-theoretic aspects of the protein folding process.

Formalized and implemented the fundamental results in the theory of linear error correcting codes in Coq.

Applied hidden Markov models to the problem of part of speech recognition in computational linguistics.

Designed/implemented various standard supervised, unsupervised, and optimization algorithms (logistic regression, support vector machine, etc.).

Designed/implemented a filesystem that builds a directory tree based on user-specified file tags and implemented plugins for audio file tag formats.
