

# Dylan Hutchison

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**Objective:** To **bridge linear and relational algebra** systems in both theory and practice, applying techniques from each domain to accelerate data management and high performance computing applications such as graph analysis and machine learning

## Education

### University of Washington

Seattle, WA

*Ph.D. in Computer Science & Engineering, M.S. in Computer Science & Engineering (3/2017)*

9/2015–≈2019

**Awards** NSF Graduate Research Fellow

**Advisors** Bill Howe, Dan Suciu, Zachary Tatlock

### Stevens Institute of Technology

Hoboken, NJ

*M.S. in Computer Science, M.S. in Applied Mathematics, B.E. in Computer Engineering*

8/2010–5/2015

**GPA** 4.00 Graduate, 3.97 Undergraduate

**Thesis** *ModelWizard: Toward Interactive Model Construction*

advised by David A. Naumann, Philippos Mordohai, Andrew D. Gordon

**Awards** 2014 National Barry Goldwater Scholar, Association of Old Crows Scholar, Tau Beta Pi Scholar, Computing Research Association *Outstanding Undergraduate Researcher* Honorable Mention

**Societies** *Tau Beta Pi* (Engineering), *Upsilon Pi Epsilon* (Computer Science), *Eta Kappa Nu* (IEEE)

### University of Edinburgh

Edinburgh, UK

*Study Abroad Semester, 6 courses transferred*

1/2014–5/2014

## Experience

### Apache Accumulo – PMC Committer

10/2015–Future

- Contribute code and discussion to the Apache Accumulo database community

### Laboratory & Industry

#### IBM Research Almaden – Research Intern

San Jose, CA

*SystemML Team*; Mentors Matthias Boehm, Alexandre Evfimievski

6/2017–12/2017

- Develop cost-based optimization for Apache SystemML based on elementary rewrites over sum-product operators
- Achieve speedups as large as 20,000x on machine learning algorithm kernels

#### MIT Lincoln Laboratory – Research Engineer

Lexington, MA

*Computing and Analytics Group*; Advisors Jeremy Kepner, Vijay Gadepally

1/2015–9/2015

- Engineered Graphulo, a Java server-side matrix math library for the Accumulo database
- Recasted graph algorithms into the GraphBLAS standard; prototyped in Matlab

#### Microsoft Research – Research Intern

Cambridge, UK

*Programming Principles and Tools Group*; Advisor Andy Gordon

6/2014–8/2014

- Designed ModelWizard: a DSL in F# for interactive model construction targeting Tabular, a schema-based probabilistic programming language. Presented a concept poster at the Microsoft PhD Summer School

#### Sandia National Laboratories – Technical Intern

Livermore, CA

*Information Assurance Group*; Advisors Levi Lloyd, Tamara Kolda

5/2013–8/2013

- Pursued network anomaly detection via Accumulo schemas, machine learning and visualization
- Scaled LXC (Linux Containers) with MiniMega, a mass distributed VM experiment platform

#### MIT Lincoln Laboratory – Research Intern

Lexington, MA

*Computing and Analytics Group*; Advisor Jeremy Kepner

5/2012–8/2012

*Bioengineering and Systems Technology Group*; Advisor Darrell Ricke

- Integrated and benchmarked Accumulo distributed database features into D4M, a Matlab package delivering linear algebra and graph theory capabilities via Associative Arrays
- Applied D4M work to a DNA matching bioinformatics project, published in the *Lincoln Laboratory Journal*

## Brown Brothers Harriman – Web Development Co-op

Business Application Development; Advisors John David, Steve Hansen

Jersey City, NJ

1/2012–5/2012

- o Designed and developed front- and back-end web applications for financial reporting using SQL, C++, and jQuery

## Teaching.....

### Stevens Institute of Technology

Hoboken, NJ

Computer Science Department: Teaching Assistant

8/2012–12/2013

- o Teach, create and evaluate computer science coursework for classes ranging from 40 up to 70 students
- o CS 506: Intro to IT Security, CS 135: Discrete Structures, CS 334: Automata and Computation

Academic Support Center: Tutor

8/2011–12/2013

- o Teach individuals and groups in Mathematics, Computer Science, and Engineering

## Activities

**Global Grand Challenges Summit:** 2017, authored a Top 10 podcast with Sarah Engel on *The “Power” of the Internet*

▷ <https://www.ucl.ac.uk/steapp/professional-education/ggcs-how-to-change-the-world/podcasts/sustainability/sustainability-6>

**Reviewer for the Information Systems Journal:** 2016–2017, published by Wiley

**Myria Database Maintainer:** Maintain the Myria database alongside UWDB students

**Undergrad Activities:** Organized seminars as VP of the *Graduate Computer Science Society*; hosted a road race as President of the *Cycling Club*; led operations for the 2012 *Castle Point Anime Convention*, attracting over 2100 people

## Publications

### Conference Papers.....

- [C12] D. Hutchison, **Distributed triangle counting in the Graphulo matrix math library**, in *High Performance Extreme Computing (HPEC)*, IEEE, Sep. 2017. arXiv: 1709.01054 [cs.DC], Graph Challenge Honorable Mention; Poster: <https://github.com/dhutchis/documents/blob/master/posters/2017-09-Graphulo-TriangleCounting-poster.pdf>.
- [C11] L. Milechin, V. Gadepally, S. Samsi, J. Kepner, A. Chen, and D. Hutchison, **D4M 3.0: Extended database and language capabilities**, in *High Performance Extreme Computing (HPEC)*, IEEE, Sep. 2017. arXiv: 1708.02934 [cs.DB].
- [C10] D. Hutchison, B. Howe, and D. Suciu, **LaraDB: A minimalist kernel for linear and relational algebra computation**, in *SIGMOD Workshop on Algorithms and Systems for MapReduce and Beyond (BeyondMR)*, ACM, May 2017. DOI: 10.1145/3070607.3070608. arXiv: 1703.07342 [cs.DB]. Online: <https://youtu.be/d-ZY81Is5Pc?t=2m45s>, Slides: <https://sites.google.com/site/beyondmr2017/program>.
- [C9] J. Wang, T. Baker, M. Balazinska, D. Halperin, B. Haynes, B. Howe, D. Hutchison, S. Jain, R. Maas, P. Mehta, D. Moritz, B. Myers, J. Ortiz, D. Suciu, A. Whitaker, and S. Xu, **The Myria big data management and analytics system and cloud service**, in *Conference on Innovative Data Systems Research (CIDR)*, Jan. 2017. Online: <https://homes.cs.washington.edu/~magda/papers/wang-cidr17.pdf>, Slides: <http://cidrdb.org/cidr2017/slides/p37-wang-cidr17-slides.pdf>.
- [C8] D. Hutchison, J. Kepner, V. Gadepally, and B. Howe, **From NoSQL Accumulo to NewSQL Graphulo: Design and utility of graph algorithms inside a BigTable database**, in *High Performance Extreme Computing (HPEC)*, **Best Student Paper**, IEEE, Sep. 2016. DOI: 10.1109/HPEC.2016.7761577. arXiv: 1606.07085 [cs.DB], Slides: <https://github.com/Accla/graphulo/blob/master/docs/presentations/2016-09-HPEC-Graphulo-Algorithms.pdf>.
- [C7] J. Kepner, V. Gadepally, D. Hutchison, H. Jananathan, T. Mattson, S. Samsi, and A. Reuther, **Associative array model of SQL, NoSQL, and NewSQL databases**, in *High Performance Extreme Computing (HPEC)*, IEEE, Sep. 2016. DOI: 10.1109/HPEC.2016.7761647. arXiv: 1606.05797 [cs.DB].

- [C6] T. Weale, V. Gadepally, D. Hutchison, and J. Kepner, **Benchmarking the Graphulo processing framework**, in *High Performance Extreme Computing (HPEC)*, IEEE, Sep. 2016. DOI: 10.1109/HPEC.2016.7761640. arXiv: 1609.08642 [cs.DB].
- [C5] A. Chen, A. Edelman, J. Kepner, V. Gadepally, and D. Hutchison, **Julia implementation of the dynamic distributed dimensional data model**, in *High Performance Extreme Computing (HPEC), Best Paper*, IEEE, Sep. 2016. DOI: 10.1109/HPEC.2016.7761626. arXiv: 1608.04041 [cs.MS].
- [C4] J. Kepner, P. Aaltonen, D. Bader, A. Buluç, F. Franchetti, J. Gilbert, D. Hutchison, M. Kumar, A. Lumsdaine, H. Meyerhenke, S. McMillan, J. Moreira, J. D. Owens, C. Yang, M. Zalewski, and T. Mattson, **Mathematical foundations of the GraphBLAS**, in *High Performance Extreme Computing (HPEC)*, IEEE, Sep. 2016. DOI: 10.1109/HPEC.2016.7761646. arXiv: 1606.05790 [cs.MS].
- [C3] D. Hutchison, J. Kepner, V. Gadepally, and A. Fuchs, **Graphulo implementation of server-side sparse matrix multiply in the Accumulo database**, in *High Performance Extreme Computing (HPEC), Best Student Paper Finalist*, IEEE, Sep. 2015. DOI: 10.1109/HPEC.2015.7322448. arXiv: 1507.01066 [cs.DB], Slides: <https://github.com/Accla/graphulo/blob/master/docs/presentations/2015-09-HPEC-Graphulo-MatrixMultiply.pdf>.
- [C2] V. Gadepally, J. Bolewski, D. Hook, D. Hutchison, B. Miller, and J. Kepner, **Graphulo: Linear algebra graph kernels for NoSQL databases**, in *International Parallel & Distributed Processing Symposium Workshops (IPDPSW)*, IEEE, May 2015. DOI: 10.1109/IPDPSW.2015.19. arXiv: 1508.07372 [cs.DS], Slides: <https://github.com/Accla/graphulo/blob/master/docs/presentations/2015-05-GABB-GraphuloInGraphBLAS.pdf>.
- [C1] D. Hutchison and S. Kleinberg, **Causal inference under uncertainty via adjustments and SOPDs**, in *Causality and Experimentation in the Sciences*, Paris, France, Jul. 2013. Online: [http://caeits.sciencesconf.org/conference/caeits/hutchison\\_caeits2013.pdf](http://caeits.sciencesconf.org/conference/caeits/hutchison_caeits2013.pdf), Slides: <https://github.com/dhutchis/documents/blob/master/presentations/2013-06-caeits-sopd.pdf>.

#### Journal Papers.....

- [J2] M. J. Smith, V. Vaglica, M. Sajeve, N. McGough, D. Hutchison, A. D. Gordon, C. Russo, A. Ramarosandratana, and W. Stuppy, **Monitoring internet trade to inform species conservation actions**, *Endangered Species Research*, Mar. 2017. DOI: 10.3354/esr00803.
- [J1] J. Kepner, D. Ricke, and D. Hutchison, **Taming biological big data with D4M**, *Lincoln Laboratory Journal*, vol. 20, no. 1, 2013. Online: [https://www.ll.mit.edu/publications/journal/pdf/vol20\\_no1/20\\_1\\_6\\_Kepner.pdf](https://www.ll.mit.edu/publications/journal/pdf/vol20_no1/20_1_6_Kepner.pdf).

#### Thesis.....

- [T1] D. Hutchison, **ModelWizard: Toward interactive model construction**, M.S. Thesis, Stevens Institute of Technology, May 2015. arXiv: 1604.04639 [cs.PL].

#### Preprints.....

- [U1] D. Hutchison, B. Howe, and D. Suciu, **Lara: A key-value algebra underlying arrays and relations**, Apr. 2016. arXiv: 1604.03607 [cs.DB].

#### Blog Posts.....

- [B1] D. Hutchison, B. Howe, D. Suciu, and Z. Tatlock. (Apr. 2016). **PolyPEG: A proposal for polystore optimization**, Online: <http://istc-bigdata.org/index.php/polypeg-a-proposal-for-polystore-optimization>.

#### Posters.....

- [P10] D. Hutchison, M. Boehm, A. Evfimievski, B. Reinwald, P. Sen, and F. Ozcan, **Holistic sum-product optimization for large-scale machine learning**, Aug. 2017, Poster presented at IBM Intern Symposium.

- [P9] D. Hutchison, B. Howe, V. Gadepally, and J. Kepner, **In-database vs. external system analytics on a key-value store**, Jan. 2017. Online: <https://github.com/Accla/graphulo/blob/master/docs/posters/2017-01-Graphulo-MapReduce.pdf>, Poster presented at North East Database Day (NEDB).
- [P8] D. Hutchison, S. Jain, B. Howe, and D. Maier, **Ocean genomic analysis with Myria**, Aug. 2016. Online: <https://github.com/uwdb/related-work/blob/master/oceanography-istc/2016-08-Myria-ocean-ISTC.pdf>, Poster presented at summit for the Intel Science and Technology Center (ISTC) for Big Data.
- [P7] D. Hutchison, V. Gadepally, J. Kepner, and B. Howe, **Graphulo: Native linear algebra in a NoSQL DB**, Aug. 2016. Online: <https://github.com/Accla/graphulo/blob/master/docs/posters/2016-08-Graphulo-algorithms-ISTC.pdf>, Poster presented at summit for the Intel Science and Technology Center (ISTC) for Big Data.
- [P6] D. Hutchison, B. Howe, D. Suciu, and Z. Tatlock, **Polystore optimization via program expression graphs**, Jan. 2016. Online: <https://github.com/dhutchis/documents/blob/master/posters/2016-01-21-polypeg-poster.pdf>, Poster presented at North East Database Day (NEDB).
- [P5] D. Hutchison, J. Kepner, and V. Gadepally, **Graphulo: Graph processing for Accumulo databases**, Jan. 2016. Online: <https://github.com/Accla/graphulo/blob/master/docs/posters/2015-09-Graphulo-ISTC-Poster.pdf>, Poster presented at North East Database Day (NEDB) and Sep. 2015 retreat for the Intel Science and Technology Center (ISTC) for Big Data.
- [P4] L. Battle, L. Edwards, V. Gadepally, B. Gavin, B. Hancock, D. Hutchison, J. Kepner, and A. Moran, **Technologies for visualization of big medical text data**, Aug. 2015. Online: <https://github.com/Accla/graphulo/blob/master/docs/posters/2015-08-BigDAWG-MIMIC-Topic-Modeling.pdf>, Poster presented at Very Large Databases Conference (VLDB).
- [P3] D. Hutchison, E. Cherin, X. Li, and H. Yang, **HBaaS: Heterogeneously-accelerated bioinformatics-as-a-service**, Apr. 2015, Poster and demo presented at Stevens Institute Senior Design Expo.
- [P2] D. Hutchison and the Microsoft Research Tabular Team, **Structural clustering**, Jul. 2014. Online: <https://github.com/dhutchis/documents/blob/master/posters/2014-07-structural-clustering.pdf>, Poster presented at Microsoft PhD Summer School.
- [P1] D. Hutchison and D. Kleszyk, **Investigating the influence of infrastructure on the load response of stevens course servers**, Dec. 2011, Course project for CPE 345 Modeling and Simulation.

#### Other Talks and Demos.....

- [O11] D. Hutchison, **Holistic sum-product optimization for large-scale machine learning**, Aug. 2017, IBM Project Presentation.
- [O10] —, **In-database analytics for NoSQL key-value stores**, Dec. 2016. Online: <https://www.cs.washington.edu/qualexam/dhutchis>, Slides: <https://github.com/Accla/graphulo/blob/master/docs/presentations/2016-12-KeyValue-Analytics.pdf>.
- [O9] B. Howe, D. Hutchison, and S. Jain, **Demo of myria as a federated database**, Oct. 2016. Online: [https://github.com/uwescience/raco/blob/SPJA\\_federation/HPDA\\_review.ipynb](https://github.com/uwescience/raco/blob/SPJA_federation/HPDA_review.ipynb), Presentation and demo to government sponsors.
- [O8] D. Hutchison, J. Kepner, and V. Gadepally, **Lara: A language of linear and relational algebra for polystores**, Dec. 2015. Online: [http://db.cs.washington.edu/events/database\\_day/2015/database\\_day\\_2015.html](http://db.cs.washington.edu/events/database_day/2015/database_day_2015.html), UWDB Database Day industry talk.
- [O7] —, **Graphulo use and design**, Aug. 2015, Presentation and demo to government sponsors.
- [O6] V. Gadepally, L. Edwards, D. Hutchison, and J. Kepner, **Using d4m for rapid prototyping of analytics for apache accumulo**, Apr. 2015. Online: <http://accumulosummit.com/program/talks/using-d4m-for-rapid-prototyping-of-analytics-for-apache-accumulo/>, Presentation at Accumulo Summit.

- [O5] D. Hutchison, A. Gordon, and C. Russo, **ModelWizard: Interactive model construction for Tabular**, Aug. 2014. Online: <https://github.com/dhutchis/documents/blob/master/presentations/2014-08-modelwizard-tabular.pdf>, Presentation and demo to Programming Principles and Tools at Microsoft Research.
- [O4] D. Hutchison and L. Lloyd, **Network anomaly detection**, Aug. 2013. Online: <https://github.com/dhutchis/documents/blob/master/presentations/2013-08-network-anomaly-detection.pdf>, Presentation at an intern symposium at Sandia National Laboratories.
- [O3] D. Hutchison, **Our aims as modelers: Toward better predictions, explanations, interventions**, Aug. 2013. Online: [github.com/dhutchis/ModelTalk](https://github.com/dhutchis/ModelTalk), Presentation at a technical seminar at Sandia National Laboratories.
- [O2] —, **Uncertain? Represent your belief with SOPD**, Jan. 2013. Online: <https://github.com/dhutchis/documents/blob/master/presentations/2013-01-omm-sopd.pdf>, Minute madness talk at Programming Languages Mentoring Workshop (PLMW) at the Principles of Programming Languages Conference (POPL).
- [O1] —, **Accelerating bioinformatics with big data technologies**, Aug. 2012. Online: <https://github.com/dhutchis/documents/blob/master/presentations/2012-08-d4m-bioinformatics.pdf>, Presentation at an intern symposium at MIT Lincoln Laboratory.