# Michael Newman Fortunato

michaelfortunato.dev | Chicago, IL | michael.n.fortunato@gmail.com | +1 (917) 373 3628 | github.com/michaelfortunato

## Education

**The University of Chicago** Chicago, IL
*Masters of Science, Computer Science* *Sep 2024 — Dec 2025 (Expected)*
- *Cumulative GPA: 3.95/4.00*
- *Pre-Doctoral Program*[1]

**The University of Chicago** Chicago, IL
*Bachelors's of Science, Mathematics* *Sep 2016 — June 2020*
- *Major GPA: 3.51/4.00, Cumulative GPA: 3.33/4.00*

## Research Experience

**Research Assistant to Professor Rose Yu** June 2025 — Present
University of California, San Diego *La Jolla, CA*
- First author of upcoming paper *Local Symmetry Discovery With Finite Groups*
  - Please contact me to view preprint (December 2025)
  - Plan to submit to ICML (2026)
- Paper introduces new neural network (SymD) that learn **local** symmetry (group equivariances) of functions between vector spaces.
  - Learning is unsupervised and end-to-end differentiable, made possible by a novel architecture that uses what we call "sequential" straight through estimation (Bengio et al., 2013).
- Formalized the notion of local symmetry of functions between vector spaces as group representations that decompose into a direct sum of the trivial representation on the complement space and any sub-representation on the region.
- Demonstrated order-of-magnitude efficiency improvements–while improving accuracy–on benchmark set by the current state of the art (Karjol et al., 2024).
- Showed the importance of learning local symmetry by showing how SymD regularization during GNN training results in state of the art performant GNNs on Open Graph Benchmark (Hu et al., 2021).
- First method to be able to discover local/regional *equivariance*, whereas the current state of the art only handles local/regional *invariance*.
- Prior works like LieGAN (Yang et al., 2023) only learn symmetries of Lie groups, whereas we chose to learn symmetries of finite (permutation) groups, which is a much less explored area (see (Zhou et al., 2021), (Karjol & Kashyap, n.d.), (Calvo-Barlés et al., 2025) for finite groups)
- Prior work on local symmetry discovery AtlasD (Bhat et al., 2025) defined local symmetry in terms of pullback group actions of Lie Groups on charts, but did not actually *learn* the location of the symmetry. Instead, it required the user to provide the location beforehand, and instead discovered the group action. In contrast, our work explicitly learns the location of the symmetry, while formalizing it in the ubiquitous language of representation theory.

**Research Assistant to Professor John Lafferty** June 2019 — September 2019
Yale Univeristy *New Haven, CT*
- Investigated methods for estimating joint distributions on data with both discrete and continuous components.
- Helped implement a method that uses Score Matching (Siwei Lyu, 2009) for joint density estimation, and a second method for joint density estimation that used Monotonic Neural Density Estimation (Pawel Chilinksi & Ricardo Silva, 2018) for estimating the continuous marginal and a Gaussian Copula for linking with the discrete marginals.
- Sampled data from the estimated joint distribution show our method generate realistic synthetic data.

**Lead Undergraduate Research Assistant For Professor William Cong and Tengyuan Liang** January 2018 — June 2020
Univeristy of Chicago Booth School of Business

[1]Research-track CS masters meant to prepare students for a PhD. As part of the program, *all* courses are PhD (CMSC 300) level courses, *not* masters-level courses (MPSC). **Highly selective** program (in 2024, 120 regular master admissions, 4 pre-doctoral admissions). See https://masters.cs.uchicago.edu/academics/pre-doctoral-ms-computer-science for more info.

- Lead undergraduate researcher for the team that developed the first version of Textual Factors (Cong et al., 2019).
- Important contributor to the development and implementation of the algorithm, which uses natural language processing to measure the semantics of a large corpus of financial articles (30GB), and then uses statistics to associate that measurement with a given share price.
- Received honorable mention (see page 1 of Cong et al. (2019)) for significant contributions in the published paper, despite not being listed as an author due to the graduate author focus.

## Projects

**Contributor To PyTorch Geometric** March 2025 — June 2025
University of Chicago

- Added MeshCNN (Hanocka et al., 2019) to Pytorch Geometric https://pytorch-geometric.readthedocs.io/en/latest/generated/torch_geometric.nn.conv.MeshCNNConv.html after many years of prior attempted PRs.
- The commit by me https://github.com/pyg-team/pytorch_geometric/commit/05827c8e60aa9f0ade0063d4418424538c2472be to the popular PyTorch Geometric framework.
- Communicated with the owner of PyTorch Geometric, Dr. Matthias Fey, to coordinate my integration of MeshCNN for his repository.

**Independent Work: Characterizing Schur Net's Expressivity Via Homomorphism Expressivity** March 2025
University of Chicago

- Preprint: https://github.com/michaelfortunato/homomorphism-expressivity/blob/main/main.pdf
- This work used Homomorphism Expressivity (Zhang et al., 2023), a new hierarchy for graph neural network expressivity (as opposed to WL-tests), to compare Schur Nets (Zhang et al., 2025) a new spectral-based GNN to Autobahn (Thiede et al., 2021), an automorphism based GNN.
- Successfully showed that networks like Autobahn which allow GNN designers to base their GNNs off a template graph can distinguish sub-graphs in fewer iterations than spectral-invariant GNNs like Schur Nets, and thus has a higher homomorphism expressivity for that sub-graph.
- In contrast, leveraged the new results in (Gai et al., 2024) to characterize the homomorphism expressivity for Schur Nets more generally (without computing the homomorphism expressivity for a particular choice of sub-graph).
- This application of Homomorphism Expressivity shows a clear way of the computing the benefits/trade-offs of using spectral GNNs verses bespoke GNNs designed around sub-graph automorphisms.
- Concluded that, except in applications when you clearly know the relevant sub-graphs, such as a benzine-ring when using a GNN to predict the function of a molecule, that Schur Nets is more readily applicable.

## Work Experience

**InterSystems** *Cambridge, MA*
*Senior Systems Developer - Kernel Group* July 2023 — July 2024

- Due to veritable performance in our company's healthcare department, I was transferred to become one of the youngest ever members of InterSystem's "Kernel group". This is the group of around 12 developers responsible for architecting, implementing, and researching the IRIS database, which is InterSystem's core technology and is the database powering companies such as Epic Systems and Morgan Stanley.
- *Compiler Work*:
  - Developed and improved the performance of ObjectScript, a strongly-typed byte-code language (most similar to Java) that is executed within the IRIS runtime
  - Improving the speed and modularity of the ObjectScript lexer and parser
  - Conceived of optimizing passes that the ObjectScript compiler could perform
- *Networking*:
  - I wrote the SSH daemon for the IRIS database from scratch in Rust. Subsystems dealt with and created included:
    - Read and implemented all the SSH RFCs faithfully for the IRIS daemon
    - Multithreaded, async I/O done with low level usage of Mio and higher level Tokio primitives.
    - Full Authentication Layer (Public Key, Password, Key phrase) with UI and distributed systems logic, which was done in consultation with security team.
    - All terminal escape sequences implemented (e.g. reverse incremental search), which was done via termios and ioctl.
- Wrote in C, assembly, and Rust

*Senior Developer*[2] July 2020 — July 2023

- Conceived of, architected, and built the Data Profiling Tool, an enterprise grade application for analyzing millions of HL7v2 messages. The application included full-stack SSO user authentication, multi-threading, and complex scheduling and concurrency management features, along with advanced data analytics algorithms with a emphasis on performance acceptable to users needs. Technologies included:
  - Solely designed and built database (SQL), manufactured bitmap indexes, NLP indexes, and considered normalization layouts verses computation layouts.
  - Built the REST API, working closely with a principal UI developer assigned to this project part-time.
  - Created and wrote new *highly performant* algorithms for analyzing production grade amounts of HL7v2 data, in both real-time and offline settings.
- Put on special 1-person team to research the cost of on-boarding new hospitals into InterSystems' technology, in order to propose a software solution and build that solution. The Data Profiling Tool was the end-result of this work.
- Mentored 7 developers. Two of the developers are now technical leads of the Data Profiling Tool, the other 5 developers are now working for other various companies such as Samsung.

## Awards

**Dean's List** University of Chicago (2019)

**Data Profiling Tool** InterSystems (July 2023)

*Voted "Most Exciting and Likely To Use Technology" By Customers At InterSystems Global Summit*

## Courses

- CMSC 35400, Deep Learning in 3D (Rana Hanocka), A
- CMSC 35410, Machine Learning on Graph, Groups, and Manifolds (Risi Kondor), A-
- CMSC 35300, Mathematical Foundations of Machine Learning, A-
- CMSC 33300, Advanced Operating Systems, A
- STAT 28000, Optimization, A,
- STAT 24500, Statistical Theorey II, A
- MATH 28100, Introduction To Complexity Theory, A
- CMSC 27200, Algorithms, A
- MATH 25500, Basic Algebra II, A

# Bibliography


Bengio, Y., Léonard, N., & Courville, A. (2013, August 15). *Estimating or Propagating Gradients Through Stochastic Neurons for Conditional Computation*. https://doi.org/10.48550/arxiv.1308.3432

Bhat, M., Park, J., Yang, J., Dehmamy, N., Walters, R., & Yu, R. (2025, April 15). *AtlasD: Automatic Local Symmetry Discovery*. https://doi.org/10.48550/arXiv.2504.10777

Calvo-Barlés, P., Rodrigo, S. G., & Martín-Moreno, L. (2025, March 4). *Learning Finite Symmetry Groups of Dynamical Systems via Equivariance Detection*. https://doi.org/10.48550/arXiv.2503.03014

Cong, L. W., Liang, T., Zhang, X., & Zhu, W. (2019, September 1). *Textual Factors: A Scalable, Interpretable, and Data-Driven Approach to Analyzing Unstructured Information** [SSRN Scholarly Paper]. https://doi.org/10.2139/ssrn.3307057

Gai, J., Du, Y., Zhang, B., Maron, H., & Wang, L. (2024, October 4). *Homomorphism Expressivity of Spectral Invariant Graph Neural Networks*. The Thirteenth International Conference on Learning Representations. https://openreview.net/forum?id=rdv6yeMFpn

Hanocka, R., Hertz, A., Fish, N., Giryes, R., Fleishman, S., & Cohen-Or, D. (2019). MeshCNN: A Network with an Edge. *ACM Transactions on Graphics*, *38*(4), 1–12. https://doi.org/10.1145/3306346.3322959

Hu, W., Fey, M., Zitnik, M., Dong, Y., Ren, H., Liu, B., Catasta, M., & Leskovec, J. (2021, February 25). *Open Graph Benchmark: Datasets for Machine Learning on Graphs*. https://doi.org/10.48550/arXiv.2005.00687

Karjol, P., & Kashyap, R. (n.d.). *Neural Discovery of Permutation Subgroups*.


[2]Promoted from Developer to Senior Developer April 2022

Karjol, P., Kashyap, R., Gopalan, A., & Prathosh, A. P. (2024). A Unified Framework for Discovering Discrete Symmetries. *Proceedings of The 27th International Conference on Artificial Intelligence and Statistics*, 793–801. https://proceedings.mlr.press/v238/karjol24a.html

Thiede, E., Zhou, W., & Kondor, R. (2021). Autobahn: Automorphism-based Graph Neural Nets. *Advances in Neural Information Processing Systems*, *34*, 29922–29934. https://proceedings.neurips.cc/paper/2021/hash/faf02b2358de8933f480a146f4d2d98e-Abstract.html

Yang, J., Walters, R., Dehmamy, N., & Yu, R. (2023). Generative Adversarial Symmetry Discovery. *International Conference on Machine Learning*, 39488–39508. https://proceedings.mlr.press/v202/yang23n.html

Zhang, B., Feng, G., Du, Y., He, D., & Wang, L. (2023). A Complete Expressiveness Hierarchy for Subgraph Gnns via Subgraph Weisfeiler-Lehman Tests. *International Conference on Machine Learning*, 41019–41077. https://proceedings.mlr.press/v202/zhang23k.html

Zhang, Q., Xu, R., & Kondor, R. (2025). Schur Nets: Exploiting Local Structure for Equivariance in Higher Order Graph Neural Networks. *Advances in Neural Information Processing Systems*, *37*, 5528–5551. https://proceedings.neurips.cc/paper_files/paper/2024/hash/0a0e2c6a487314f821346bdc04869e36-Abstract-Conference.html

Zhou, A., Knowles, T., & Finn, C. (2021, March 30). *Meta-Learning Symmetries by Reparameterization*. https://doi.org/10.48550/arXiv.2007.02933