

# Michael Newman Fortunato

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## EDUCATION

### The University of Chicago

*Masters of Science, Computer Science*

Chicago, IL

Sep 2024 — Dec 2025 (*Expected*)

- Cumulative GPA: 3.85/4.00
- Pre-Doctoral Program<sup>1</sup>

### The University of Chicago

*Bachelors's of Science, Mathematics*

Chicago, IL

Sep 2016 — June 2020

- Major GPA: 3.51/4.00, Cumulative GPA: 3.33/4.00

## RESEARCH EXPERIENCE

### Project: Adding MeshCNN To PyTorch Geometric

March 2025 — Present

University of Chicago

- Given explicit permission from Professor Rana Hanocka to add MeshCNN [1] to the popular PyTorch Geometric framework.
- Pull Request 1 (In Review): [https://github.com/pyg-team/pytorch\\_geometric/pull/10222](https://github.com/pyg-team/pytorch_geometric/pull/10222)
- Communicated with the owner of PyTorch Geometric, Dr. Matthias Fey, to coordinate my integration of MeshCNN for his repository.
- Researching CUDA kernel to compute the edges that, if collapsed, would *keep the mesh manifold*. This GPU based approach could be an improvement from the original implementation of the MeshCNN pooling layer.

### 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 [2], a new hierarchy for graph neural network expressivity (as opposed to WL-tests), to compare Schur Nets [3] a new spectral-based GNN to Autobahn [4], 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 [5] to characterize the homomorphism expressivity for Schur Nets more generally (without computing the homomorphism expressivity for a particular choice of sub-graph).
- Completely novel idea and one of the first complete applications of Homomorphism Expressivity that I know to date.
- Homomorphism Expressivity allowed me to show readers a clear way of computing the benefits verses trade-offs of using spectral GNNs verses bespoke GNNs designed around automorphisms to a specific sub-graph.
- Concluded that, except in applications when you clearly know the relevant sub-graphs, such as a benzene-ring when using a GNN to predict the function of a molecule, that Schur Nets is more readily applicable.

### Research Assistant to Professor John Lafferty

June 2019 — September 2019

Yale University

New Haven, CT

- Helped design and build new techniques for estimating joint distributions on data with both discrete and continuous components.
- Helped theorize and implement a method that uses Score Matching (Siwei Lyu, 2009) for joint density estimation, and a second method that used Monotonic Neural Density Estimation (Pawel Chilinski & Ricardo Silva, 2018) for estimating the conditions and a Gaussian Copula for linking.
- Demonstrated our work by inferencing the estimating joint distribution to generate synthetic data.

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<sup>1</sup>Highly selective program (in 2024, 120 regular admissions, 4 pre-doctoral admissions) 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). <https://masters.cs.uchicago.edu/academics/pre-doctoral-ms-computer-science>

Univeristy of Chicago Booth School of Business

- Lead undergraduate researcher for a team that developed an influential algorithm called Textual Factors (Cong, Liang, Lin, 2019), resulting in a published paper.
- 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 for significant contributions in the published paper, despite not being listed as an author due to the graduate author focus.

## WORK EXPERIENCE

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### 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<sup>2</sup>*

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

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**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*

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<sup>2</sup>Promoted from Developer to Senior Developer April 2022

## COURSES

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- 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

- [1] R. Hanocka, A. Hertz, N. Fish, R. Giryes, S. Fleishman, and D. Cohen-Or, “MeshCNN: A Network with an Edge,” *ACM Transactions on Graphics*, vol. 38, no. 4, pp. 1–12, Aug. 2019, doi: [10.1145/3306346.3322959](https://doi.org/10.1145/3306346.3322959).
- [2] B. Zhang, G. Feng, Y. Du, D. He, and L. Wang, “A Complete Expressiveness Hierarchy for Subgraph Gnns via Subgraph Weisfeiler-Lehman Tests,” in *International Conference on Machine Learning*, PMLR, 2023, pp. 41019–41077. Accessed: Mar. 09, 2025. [Online]. Available: <https://proceedings.mlr.press/v202/zhang23k.html>
- [3] Q. Zhang, R. Xu, and R. Kondor, “Schur Nets: Exploiting Local Structure for Equivariance in Higher Order Graph Neural Networks,” *Advances in Neural Information Processing Systems*, vol. 37, pp. 5528–5551, Jan. 2025, Accessed: Feb. 20, 2025. [Online]. Available: [https://proceedings.neurips.cc/paper\\_files/paper/2024/hash/0a0e2c6a487314f821346bdc04869e36-Abstract-Conference.html](https://proceedings.neurips.cc/paper_files/paper/2024/hash/0a0e2c6a487314f821346bdc04869e36-Abstract-Conference.html)
- [4] E. Thiede, W. Zhou, and R. Kondor, “Autobahn: Automorphism-based Graph Neural Nets,” in *Advances in Neural Information Processing Systems*, Curran Associates, Inc., 2021, pp. 29922–29934. Accessed: Mar. 07, 2025. [Online]. Available: <https://proceedings.neurips.cc/paper/2021/hash/faf02b2358de8933f480a146f4d2d98e-Abstract.html>
- [5] J. Gai, Y. Du, B. Zhang, H. Maron, and L. Wang, “Homomorphism Expressivity of Spectral Invariant Graph Neural Networks,” presented at the The Thirteenth International Conference on Learning Representations, Oct. 2024. Accessed: Feb. 20, 2025. [Online]. Available: <https://openreview.net/forum?id=rdv6yeMFpn>