

# Michelle Lynn Gill

R&D Manager, NVIDIA Virtual Cell Team

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## Currently

I am an R&D Manager on NVIDIA's Virtual Cell team. Our team uses data, deep learning, and HPC to develop models that simulate cellular states. My focus is on the benchmarks and development of supporting tools that help evaluate and improve these models.

Previously I was a Senior Machine Learning Engineer and Data Scientist at BenevolentAI and a member of Arthur Palmer's research group where I developed and applied nuclear magnetic resonance (NMR) spin relaxation experiments to understand how enzyme dynamics are critical to biological function.

## Education

### Ph.D., Molecular Biophysics & Biochemistry

2003-2006

Yale University, New Haven, CT

Thesis: Development of 205TI NMR methods for the direct study of monovalent metal ions and ligands in nucleic acids

Advisors: J. Patrick Loria and Scott Strobel

### M.Phil., Molecular Biophysics & Biochemistry

2001-2003

Yale University, New Haven, CT

### B.S., Biochemistry

1997-2001

University of Kansas, Lawrence, KS

Highest Distinction and Honors (Summa Cum Laude)

## Experience

### Applied Research Manager, NVIDIA, Virtual Cell Team

2022-Present

Lead benchmarking efforts for virtual cell models, including internal and external collaborations

Developed benchmarking framework and tooling for model assessment and reproducibility

Collaboration with Chan Zuckerberg Initiative on cz-benchmarks for evaluating virtual cell models

### Scientific Lead, BioNeMo, NVIDIA

2019-2023

R&D Manager and Scientific Lead for Clara Discovery, NVIDIA's platform for accelerating drug discovery

Developed BioNeMo for pre-training and fine tuning of large language models for cheminformatics and proteomics

### Senior AI and Deep Learning Scientist, NVIDIA

2019-2023

Focused on proteomics including deep learning models to predict peptide spectral matches with >95% F1

Led team using GCNNs to predict molecular properties

**Senior Data Scientist and Machine Learning Engineer,**

BenevolentAI

2018-2019

Matrix factorization and GCNNs for drug mechanism importance in knowledge graphs

3D CNNs for ligand pose and affinity prediction

**Senior Deep Learning Consultant,** NVIDIA

Assisted clients in pharmaceutical and materials science in utilizing deep learning

**Scientist,** National Cancer Institute, NIH

2014-2016

Developed parallelized, compressed sensing methods for NMR data reconstruction

**Postdoctoral Research Fellow,** Columbia University, Department of Biochemistry and Molecular Biophysics

2008-2014

Demonstrated conformational selection in DNA methyltransferase AlkB

Developed multiple quantum NMR spin relaxation experiments

Advisor: Professor Arthur G. Palmer, III

**Publications**

Dicks, S., Heumos, L., Jimenez, S., Angerer, P., Gold, I., Virshup, I., Fischer, F., May, L., Nolet, C. J., Gill, M., Boerries, M., Theis, F.. "Accelerating single-cell analysis with GPU-enabled RAPIDS-singlecell." **In preparation** (2025).

Sevgen, E., Moller, J., Lange, A., Parker, J., Quigley, S., Mayer, J., Srivastava, P., Gayatri, S., Hosfield, D., Korshunova, M., Livne, M., Gill, M., Ranganathan, R., Costa, A.B., Ferguson, A.L.. "ProT-VAE: Protein transformer variational autoencoder for functional protein design." **Proceedings of the National Academy of Sciences** 122 (2025), doi: 10.1073/pnas.2408737122.

St. John, P., Lin, D., Binder, P., Greaves, M., Shah, V., St. John, J., Lange, A., Hsu, P., Illango, R., Ramanathan, A., Anandkumar, A., Brookes, D.H., Busia, A., Mahajan, A., Malina, S., Prasad, N., Sinai, S., Edwards, L., Gaudelet, T., Regep, C., Steinegger, M., Rost, B., Brace, A., Hippe, K., Naef, L., Kamata, K., Armstrong, G., Boyd, K., Cao, Z., Chou, H.Y., Chu, S., dos Santos Costa, A., Darabi, S., Dawson, E., Didi, K., Fu, C., Geiger, M., Gill, M., Hsu, D.J., Kaushik, G., Korshunova, M., Kothen-Hill, S., Lee, Y., Liu, M., Livne, M., McClure, Z., Mitchell, J., Moradzadeh, A., Mosafi, O., Nashed, Y., Paliwal, S., Peng, Y., Rabhi, S., Ramezanghorbani, F., Reidenbach, D., Ricketts, C., Roland, B.C., Shah, K., Shimko, T., Sirelkhatim, H., Srinivasan, S., Stern, A.C., Toczydlowska, D., Veccham, S.P., Venanzi, N.A.E., Vorontsov, A., Wilber, J., Wilkinson, I., Wong, W.J., Xue, E., Ye, C., Yu, X., Zhang, Y., Zhou, G., Zandstein, B., Chacon, A., Sohani, P., Stadler, M., Hundt, C., Zhu, F., Dallago, C., Trentini, B., Kucukbenli, E., Rvachov, T., Calleja, E., Israeli, J., Clifford, H.,

- Haukioja, R., Haemel, N., Tretina, K., Tadimeti, N., Costa, A.B.. "BioNeMo Framework: a modular, high-performance library for AI model development in drug discovery." **arXiv** (2024), doi: 10.48550/arXiv.2411.10548.
- Strauss, M.T., Bludau, I., Zeng, W.F., Voytik, E., Ammar, C., Schessner, J., Illango, R., Gill, M.L., Meier, F., Willems, S., Mann, M.. "AlphaPept, a modern and open framework for MS-based proteomics." **Nature Communications** 15 (2024), doi: 10.1038/s41467-024-46485-4.
- Gill, M.L.. "The rise of the machines in chemistry." **Magnetic Resonance in Chemistry** 60, 1044–1051 (2022), doi: 10.1002/mrc.5304.
- Reidenbach, D., Livne, M., Illango, R.K., Gill, M.L., Israeli, J.I.. "Improving small molecule generation using mutual information machine." **arXiv** (2022), doi: 10.48550/arXiv.2208.09016.
- Gill, M.L., Hsu, A., Palmer, A.G.. "Detection of chemical exchange in methyl groups of macromolecules." **Journal of Biomolecular NMR** 73, 443–450 (2019), doi: 10.1007/s10858-019-00240-w.
- Tong, M., Pelton, J., Gill, M.L., Zhang, W., Picart, F., Seeliger, M.. "Survey of solution dynamics in Src kinase reveals cross talk between the ligand binding and regulatory sites." **Nature Communications** 8, 2160 (2017), doi: 10.1038/s41467-017-02240-6.
- Gill, M.L., Byrd, R.A., Palmer, A.G.. "Dynamics of GCN4 facilitate DNA interaction: a model-free analysis of an intrinsically disordered region." **Physical Chemistry and Chemical Physics** 18, 5839–5849 (2016), doi: 10.1039/c5cp06197k.
- Sun, S., Gill, M.L., Li, Y., Huang, M., Byrd, R.A.. "Efficient and generalized processing of multidimensional NUS NMR data: the NESTA algorithm and comparison of regularization terms." **Journal of Biomolecular NMR** 62, 105–117 (2015), doi: 10.1007/s10858-015-9923-x.
- Gill, M.L., Palmer, A.G.. "Local isotropic diffusion approximation for coupled internal and overall molecular motions in NMR spin relaxation." **Journal of Physical Chemistry B** 118, 11120–11128 (2014), doi: 10.1021/jp506580c.
- Gill, M.L., Byrd, R.A.. "Dynamic activation of apoptosis: conformational ensembles of cIAP1 are linked to a spring-loaded mechanism." **Nature Structural Molecular Biology** 21, 1022–1023 (2014), doi: 10.1038/nsmb.2925.
- Ergel, B., Gill, M.L., Brown, L., Yu, B., Palmer, A.G., Hunt, J.F.. "Protein dynamics control the progression and efficiency of the catalytic reaction cycle of AlkB." **Journal of Biological Chemistry** 289, 29584–29601 (2014), doi: 10.1074/jbc.M114.575647.
- Gill, M.L., Palmer, A.G.. "Multiplet-filtered and gradient-selected zero-quantum TROSY experiments for <sup>13</sup>C<sub>1</sub>H<sub>3</sub> methyl groups in proteins." **Journal of Biomolecular NMR** 51, 245–251 (2011), doi: 10.1007/s10858-011-9533-1.

Ramsey, J.D., Gill, M.L., Kamerzell, T.J., Price, E.S., Joshi, S.B., Bishop, S.M., Oliver, C.N., Middaugh, C.R.. "Using empirical phase diagrams to understand the role of intramolecular dynamics in immunoglobulin G stability." **Journal of Pharmaceutical Sciences** 98, 2432–2447 (2009), doi: 10.1002/jps.21619.

Gill, M.L., Strobel, S.A., Loria, J.P.. "Crystallization and characterization of the thallium form of the *Oxytricha nova* G-quadruplex." **Nucleic Acids Research** 34, 4506–4514 (2006), doi: 10.1093/nar/gkl616.

Beach, H., Cole, R., Gill, M.L., Loria, J.P.. "Conservation of  $\mu$ -ms enzyme motions in the apo- and substrate-mimicked state." **Journal of the American Chemical Society** 127, 9167–9176 (2005), doi: 10.1021/ja0514949.

Gill, M.L., Strobel, S.A., Loria, J.P.. "205TI NMR methods for the study of monovalent metal binding sites in nucleic acids." **Journal of the American Chemical Society** 127, 16723–16732 (2005), doi: 10.1021/ja055358f.

Adams, P.L., Stahley, M.R., Gill, M.L., Kosek, A.B., Wang, J., Strobel, S.A.. "Crystal structure of a group I intron splicing intermediate." **RNA** 10, 1867–1887 (2004), doi: 10.1261/rna.7140504.

Wiethoff, C.M., Gill, M.L., Koe, G.S., Koe, J.G., Middaugh, C.R.. "A fluorescence study of the structure and accessibility of plasmid DNA condensed with cationic gene delivery vehicles." **Journal of Pharmaceutical Sciences** 92, 1272–1285 (2003), doi: 10.1002/jps.10391.

Wiethoff, C.M., Gill, M.L., Koe, G.S., Koe, J.G., Middaugh, C.R.. "The structural organization of cationic lipid-DNA complexes." **Journal of Biological Chemistry** 277, 44980–44987 (2002), doi: 10.1074/jbc.M207758200.

Silchenko, S., Sippel, M.L., Kuchment, O., Benson, D.R., Mauk, A.G., Altuve, A., Rivera, M.. "Hemin is kinetically trapped in cytochrome b5 from rat outer mitochondrial membrane." **Biochemical and Biophysical Research Communications** 273, 467–472 (2000), doi: 10.1006/bbrc.2000.2968.

Patents	Automated FEP Path Generation and Optimization by Molecule Foundation Models and Generative AI Peng, Y., Kucukbenli, E., Zhou, G., <u>Gill, M.L.</u> , Livne, M., Korshunova, M., Rvachov, T., Israeli, Y. US Patent Application No. 19/208,119; Filing Date: 2025/05/14	2025
	Extraction of Informative Embeddings from Encoder-Decoder Models Livne, M., <u>Gill, M.L.</u> US Patent Application No. 18/957,301; Filing Date: 2024/11/22	2024
	Contrastive Framework for Unified Generative and Discriminative Representation Learning	2024

Livne, M., <u>Gill, M.L.</u>		
US Patent Application No. 18/957,294; Filing Date: 2024/11/22		
Efficient Data Loading for Deep Learning Workloads	2024	
Darabi, S., Korshunova, M., Grewal, J., <u>Gill, M.L.</u> , Morkisz, P.		
US Patent Application No. 18/885,428; Filing Date: 2024/09/13		
Guardrails for Molecular Generation	2024	
Korshunova, M., Peng, Y., Zhou, G., Rvachov, T., <u>Gill, M.L.</u> , Kucukbenli, E., Israeli, Y.		
US Patent Application No. 18/807,805; Filing Date: 2024/08/16		
Guardrails for Conditional Molecular Generation	2024	
Korshunova, M., Peng, Y., Zhou, G., Rvachov, T., <u>Gill, M.L.</u> , Kucukbenli, E., Israeli, Y.		
US Patent Application No. 18/807,808; Filing Date: 2024/08/16		
Training-Time Guardrails for Molecular Generation	2024	
Korshunova, M., Peng, Y., Zhou, G., Rvachov, T., <u>Gill, M.L.</u> , Kucukbenli, E., Israeli, Y.		
US Patent Application No. 18/807,811; Filing Date: 2024/08/16		
Guardrails for Instruction-Tuned Molecular Generation	2024	
Korshunova, M., Peng, Y., Zhou, G., Rvachov, T., <u>Gill, M.L.</u> , Kucukbenli, E., Israeli, Y.		
US Patent Application No. 18/807,814; Filing Date: 2024/08/16		
End to End Deep Learning Workflow for <u>In Silico</u> Molecule Design	2024	
Stern, A., <u>Gill, M.L.</u> , Stepniewska-Dziubinska, M., Grzegorzek, T., Nowaczynski, A., Toczydlowska, D., Israeli, Y., Ribalta Lorenzo, P.		
US Patent Application No. 18/412,168; Filing Date: 2024/01/12		
Small Molecule Generation Using Machine Learning Models	2023	
Livne, M., Reidenbach, D., <u>Gill, M.L.</u> , Ilango, R., Israeli, Y.		
US Patent Application No. 18/450,745; Filing Date: 2023/08/16		

<b>Presentations</b>	<b>Scientific Discovery: From the Lab Bench to the GPU</b> , Andy Byrd Retirement Symposium	2024
	Invited Keynote, April 19, 2024, Institute for Bioscience & Biotechnology Research, University of Maryland, NIST, Bethesda, MD	
	<a href="#">Slides</a> · <a href="#">Program</a>	
	<b>Scientific Discovery: From the Lab Bench to the GPU</b> , PyData NYC	2023
	Invited Keynote, November 2, 2023, New York, NY	
	<a href="#">Slides</a> · <a href="#">Video</a> · <a href="#">Abstract</a>	
	<b>NVIDIA BioNeMo: A framework and service for development and use of generative AI in drug discovery</b> , 6th RSC-BMCS / RSC-CICAG Artificial Intelligence in Chemistry Conference	2023
	Invited Keynote, September 5, 2023, Cambridge, UK	
	<a href="#">Slides</a> · <a href="#">Program</a>	
	<b>Exploring Molecular Space and Accelerating Drug Discovery on the GPU with Clara Discovery</b> , Gates Foundation Grand	2021

Challenges: Applications of Artificial Intelligence in Machine Learning

Invited Talk, November 10, 2021, Virtual

**Accelerating Drug Discovery with Clara Discovery and MegaMolBART**, 4th RSC-BMCS / RSC-CICAG Artificial Intelligence in Chemistry

Invited Talk, September 27, 2021, Virtual  
[Slides](#)

2021

**Real Time, GPU-Accelerated Analysis and Visualization in the Life Sciences**, Ken Kennedy Institute Data Science Conference

[Michelle Gill](#) and Avantika Lal  
Invited Keynote, October 26-27, 2020, Virtual

[Slides](#) · [Abstract](#) · [Program](#)

2020

**Artificial intelligence driven drug discovery**, NYC R Conference

Invited Presentation, May 10, 2019, New York, NY  
[Slides](#)

2019

**Panel: Careers in data science**, Tri-Institutional Career Symposium

Panel, April 9, 2019, Memorial Sloan Kettering Cancer Center, The Rockefeller University and Weill Cornell Medicine, New York, NY  
[Program](#)

2019

**Machine learning for target identification and lead optimization in drug discovery**, New York Area Group for Informatics and Modeling

Alix Lacoste and [Michelle Gill](#)  
Invited Presentation, February 26, 2019, New York, NY  
[Abstract](#)

2019

**Accelerating the journey from data to medicine**, NeurIPS

Amir Saffari, Dan Neil, Alix Lacoste, and [Michelle Gill](#)  
Expo Talk, 2018, Montreal, Canada  
[Abstract](#)

2018

**Artificial intelligence as a catalyst for scientific discovery**,

JupyterCon  
Invited Keynote, 2018, New York, NY  
[Slides](#) · [Video](#) · [Abstract](#)

2018

**From structural biology to AI: a holistic approach to studying molecular machines**, Brookhaven National Laboratory

Invited Presentation, 2018, Upton, NY  
[Slides](#)

2018

**Efficient image search and identification: the making of Wine-O.AI**, SciPy Conference

Selected Presentation, 2017, Austin, TX  
[Slides](#) · [Video](#) · [Code](#)

2017

**Development of  $^{205}\text{TI}$  NMR methods for the direct study of monovalent metal ions and ligands in nucleic acids**, Ph.D. Thesis Defense, Yale University

Thesis Defense, 2006, New Haven, CT

[Slides](#) · [Thesis](#)

2006

**Awards**

NIH Postdoctoral Research Fellowship (F32 GM089047) 2009-2012

Global BCG Strategy Olympics, Winning Team 2007

NSF Graduate Research Fellowship 2002-2006

Barry M. Goldwater Scholar 2000-2001

Outstanding Undergraduate Honors Research Thesis 2001

Kansas Board of Regents Full Tuition Merit Scholarship 1997-2001

**Service**

**Judge, Preliminary and Final Rounds**, NYC STEM Fair, New York, NY 2022

Evaluated submissions in the biochemistry track

**Program Chair**, PyData NYC, New York, NY 2018

Responsible for conference content, proposal review, speaker selection, and scheduling

**Machine Learning Symposium Co-Chair**, SciPy Conference, Austin, TX 2018

Co-chair of machine learning / deep learning symposium

**Proposal Reviewer**, JupyterCon 2018

**Reviewer**, Journal of Open Source Software (JOSS) 2018-2019