Naifeng Zhang

Department of Electrical and Computer Engineering
College of Engineering
Carnegie Mellon University

naifengz@cmu.edu
+1 323 868 5267
naifengz.com

EDUCATION

Ph.D. Electrical and Computer Engineering, Carnegie Mellon University, 2021-
Advisor: Prof. Franz Franchetti

B.S. Computer Science, University of Southern California, 2021
Advisor: Prof. Viktor K. Prasanna
W.V.T. Rusch Undergraduate Engineering Honors Program
magna cum laude

B.S. Mathematics, University of Southern California, 2021
Departmental Honors Program
magna cum laude

AWARDS

2023 Outstanding Short Paper Award
IEEE High Performance Extreme Computing

2023 Second place in ACM Student Research Competition
IEEE/ACM Code Generation and Optimization

2021 Discovery Scholar Distinction
University of Southern California

2018–21 Academic Achievement Award
University of Southern California

FELLOWSHIPS

2021 Carnegie Institute of Technology Dean's Fellowship

2019–21 University of Southern California Provost's Research Fellowship

RESEARCH EXPERIENCE

2023- *SciDAC: Simulation of the Response of Structural Metals in Molten Salt Environment*
Applied SPIRAL's formalism to optimize elasto-viscoplastic fast Fourier transform (EVPFFT) for materials science simulations.
DoE

2022- *Neocortex: SPIRAL Code Generation for Wafer-Scale Engine*
Extended SPIRAL to target Cerebras second-generation Wafer-Scale Engine (WSE-2).
NSF

2021-	*Trebuchet: NTTX for OpenFHE*

2021-   *Trebuchet: NTTX for OpenFHE*
        Developed SPIRAL NTTX package to automatically generate high-performance vectorized number
        theoretic transform (NTT) code for fully homomorphic encryption (FHE) applications.
        DARPA DPRIVE

2022–23 *Performance Analysis and Optimization of Quantum Library*
        Conducted real-world performance analysis and optimizations of IBM's quantum library Qiskit for
        Shor's Algorithm.

2020–21 *Compiler Abstractions Supporting High Performance on Extreme-scale Resources (CASPER)*
        Developed a compiler-oriented autotuner that automatically profiles a kernel and performs tuning
        guided by performance prediction.
        DARPA PAPPA

2019   *Dynamic Data-Aware Reconfiguration, INtegration and Generation (DDARING)*
        Developed a lightweight augmented neural network for performance prediction.
        DARPA SDH

PUBLICATIONS

Conference Proceedings

2023   N. Zhang, A. Ebel, N. Neda, P. Brinich, B. Reynwar, A. G. Schmidt, M. Franusich, J. Johnson, B.
        Reagen, F. Franchetti. "Generating High-Performance Number Theoretic Transform Implementations
        for Vector Architectures." IEEE High Performance Extreme Computing Conference (HPEC).

2023   D. Sun, N. Zhang, F. Franchetti. "Optimization and Performance Analysis of Shor's Algorithm in
        Qiskit." IEEE High Performance Extreme Computing Conference (HPEC).

2023   D. Soni, N. Neda, N. Zhang, B. Reynwar, H. Gamil, B. Heyman, M. N. T. Moopan, A. Al Badawi, Y.
        Polyakov, K. Canida, M. Pedram, M. Maniatakos, D. B. Cousins, F. Franchetti, M. French, A. Schmidt,
        B. Reagen. "RPU: The Ring Processing Unit." IEEE International Symposium on Performance
        Analysis of Systems and Software (ISPASS).

2021   N. Zhang, A. Srivastava, R. Kannan, V. K. Prasanna. "GenMAT: A General-PurposeMachine
        Learning-Driven Auto-Tunerfor Heterogeneous Platforms." Workshop on Programming
        Environments for Heterogeneous Computing (PEHC).

2020   A. Srivastava*, N. Zhang*, R. Kannan, V. K. Prasanna. "Towards High Performance, Portability, and
        Productivity: Lightweight Augmented Neural Networks for Performance Prediction." International
        Conference on High Performance Computing, Data, and Analytics (HiPC). *Equal contribution*.

2020   C. Imes, A. Colin, N. Zhang, A. Srivastava, V. K. Prasanna, J. P. Walters. "Compiler Abstractions and
        Runtime for Extreme-scale SAR and CFD Workloads." Workshop on Extreme Scale Programming
        Models and Middleware (ESPM2).

Other Conference Papers, Technical Reports, Extended Abstracts, and Posters

2023   P. Brinich, N. Zhang, A. Ebel, F. Franchetti, J. Johnson. "Twiddle Factor Generation for a Vectorized
        Number Theoretic Transform." IEEE High Performance Extreme Computing Conference (HPEC),
        Extended abstract. **Outstanding Short Paper Award**.

2023   H. Mankad, A. Rovinelli, M. Zecevic, P. McCorquodale, F. Franchetti, N. Zhang, S. Rao, R. A.
        Lebensohn, L. Capolungo "EVPFFTX: A First Look at FFTX Applications in Material Science." IEEE
        High Performance Extreme Computing Conference (HPEC), Extended abstract.

2023   D. B. Cousins, Y. Polyakov, A. Al Badawi, M. French, A. Schmidt, A. Jacob, B. Reynwar, K. Canida, A.
        Jaiswal, C. Mathew, H. Gamil, N. Neda, D. Soni, M. Maniatakos, B. Reagen, N. Zhang, F. Franchetti, P.

Brinich, J. Johnson, P. Broderick, M. Franusich B. Zhang, Z. Cheng, M. Pedram. "TREBUCHET: Fully Homomorphic Encryption Accelerator for Deep Computation." Government Microcircuit Applications and Critical Technology Conference (GOMACTech), Preprint.

2023   N. Zhang, F. Franchetti. "Generating Number Theoretic Transforms for Multi-Word Integer Data Types." IEEE/ACM International Symposium on Code Generation and Optimization (CGO), Poster with extended abstract. **Second Place in ACM Student Research Competition**.

2022   N. Zhang, H. Gamil, P. Brinich, B. Reynwar, A. Al Badawi, N. Neda, D. Soni, K. Canida, Y. Polyakov, P. Broderick, M. Maniatakos, A. G. Schmidt, M. Franusich, J. Johnson, B. Reagen, D. B. Cousins, F. Franchetti. "Towards Full-Stack Acceleration for Fully Homomorphic Encryption." IEEE High Performance Extreme Computing Conference (HPEC), Extended abstract.

2022   I. Grosof, N. Zhang, M. Heule. "Towards the shortest DRAT proof of the Pigeonhole Principle." Pragmatics of SAT International Workshop (PoS), Preprint.

TALKS

Conference Presentations

2023   "Generating High-Performance Number Theoretic Transform Implementations for Vector Architectures." IEEE High Performance Extreme Computing Conference. Virtual. Sep 29.

2023   "Generating Number Theoretic Transforms for Multi-Word Integer Data Types." IEEE/ACM International Symposium on Code Generation and Optimization. Montreal, Canada. Feb 28.

2022   "Towards Full-Stack Acceleration for Fully Homomorphic Encryption." IEEE High Performance Extreme Computing Conference. Virtual. Sep 23.

2021   "GenMAT: A General-Purpose Machine Learning-Driven Auto-Tuner for Heterogeneous Platforms." Workshop on Programming Environments for Heterogeneous Computing. Virtual. Nov 19.

2020   "Towards High Performance, Portability, and Productivity: Lightweight Augmented Neural Networks for Performance Prediction." International Conference on High Performance Computing, Data, and Analytics. Virtual. Dec 16.

Tutorials Given

2023   "Open Source SPIRAL 8.5 Tutorial." IEEE High Performance Extreme Computing Conference. Virtual. Sep 27. Together with F. Franchetti, M. Franusich, P. Broderick.

TEACHING EXPERIENCE

Carnegie Mellon Univeristy

Teaching Assistant

23 Spring   Computational Problem Solving for Engineers

University of Southern California

Undergraduate Teaching Assistant

21 Spring   Special Topics - Accelerated Computing Using FPGAs

20 Fall   Parallel and Distributed Computation

20 Spring   Special Topics - Accelerated Computing Using FPGAs
Discrete Methods in Computer Science

19 Fall   Parallel and Distributed Computation
Discrete Methods in Computer Science

MENTORING

Master's

2023-   Kofi Poku

2022–23   Dewang Sun

2022   Hongbo Sun

Undergraduate

2023-   Gordon Xu

2022–23   Matt Ngaw

2022–23   Jimmy Zhou

SERVICE

Conference Peer Review

IEEE International Conference on Big Data (BigData)

IEEE High Performance Extreme Computing Conference (HPEC)

Service to the University

CMU ECE Faculty Hiring Student Council, 2022–23

Updated October 2023