

# Yifan Yang

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## INTERESTS & EXPERTISE

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GPU, Deep Learning Inference, Low Latency Inference, LLM, Computer Architecture, Accelerator for Sparse and Irregular Applications, HW/SW Co-design, Domain-specific Accelerator, FPGA

## EDUCATION

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**Massachusetts Institute of Technology, EECS**

Cambridge, MA

Ph.D. in Electrical Engineering and Computer Science

September 2019 - May 2024

- GPA: 5.0/5.0
- Thesis advisor: Prof. Daniel Sanchez and Prof. Joel Emer
- Thesis title: Effective and Flexible Acceleration of Sparse Computations

S.M. in Electrical Engineering and Computer Science

September 2019 - June 2021

- GPA: 5.0/5.0
- Thesis advisor: Prof. Daniel Sanchez and Prof. Joel Emer
- Thesis title: Architectural Support for Efficient Processing of Sparse and Irregular Applications
- Coursework: Computer System Architecture, Hardware Architecture for Deep Learning, TinyML and Efficient Deep Learning Computing, Advances in Computer Vision, Theory of Computation

**Tsinghua University, Department of Physics**

Beijing, China

B.S. in Mathematics and Physics

August 2015 - July 2019

- GPA: 3.90/4.00
- Thesis advisor: Prof. Leibo Liu
- Thesis title: A Message Passing-based Graph Processing Framework on CPU-FPGA Heterogeneous System
- Selected coursework: Fundamental of Digital Logic and Processor, Digital Integrated Circuit Analysis and Design (English), Computer Organization and Architecture, Operating System, Principles and Practice of Compiler Construction, Distributed Computing, Principles of Analog Circuits, Data Structure, Introduction to Artificial Intelligence, Autonomous Driving

## INDUSTRY & TEACHING EXPERIENCE

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**Senior Deep Learning Architect**

June 2024 - present

Deep Learning Inference Architecture, Nvidia

Santa Clara, CA

- Performance exploration of Blackwell and future (uGPU) architecture for deep learning workloads
- Kernel optimization for low LLM inference (CUTLASS/Triton)
- Performance exploration of using prefetching for low latency LLM inference
- Hardware feature exploration for low latency LLM inference in future GPU architectures
- DeepSeek R1 low latency inference optimization
- Prototyping/Exploring speculative decoding techniques for popular LLM models
- Developing tools for better silicon performance observability of low latency LLM workloads on GPUs

**Platform Architecture Intern**

May 2022 - August 2022

Platform Architecture, Apple

Cupertino, CA

- CPU cache subsystem performance research

### Graduate Teaching Assistant

6.812/6.825 *Hardware Architecture for Deep Learning*, MIT

January 2022 - May 2022  
Cambridge, MA

- Held recitations and office hours
- Developed and graded lab assignments and paper review sessions
- Mentored and graded final design projects

## RESEARCH EXPERIENCE

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### Graduate Research Assistant

MIT Computer Science and Artificial Intelligence Laboratory

September 2019 - May 2024  
Cambridge, MA

- Advisor: Prof. Daniel Sanchez and Prof. Joel Emer
- Worked on a unified accelerator to accelerate matrix multiplication at all sparsity levels

Conduct performance analysis (C/PyTorch) of matrix multiplication on a broad set of application domains and sparsity levels (transformer, CNN, tensor algebra, graph analytics scientific computing, etc.)

Codesign dataflow and hardware architecture to efficiently support dense, mildly sparse, and highly sparse matrix multiplication with modest area overhead (evaluated using Verilog)

Evaluated the accelerator on a wide range of sparse levels and application domains, results show large perf/area gains over state-of-the-art accelerators

- Worked on leveraging inter-layer pipelining to accelerate sparse CNNs

Proposed input-stationary output-stationary (IS-OS) dataflow that minimizes inter-layer storage requirement

Designed the **ISOSceles** accelerator that implements IS-OS dataflow to efficiently pipeline multiple sparse layers in CNNs

Conducted end-to-end C++ simulation evaluation of ISOSceles on several sparse CNNs and achieved large speedup and off-chip traffic reduction over state-of-the-art accelerators

- Worked on offering architectural support to accelerate irregular applications using data compression

Designed **SpZip**, specialized hardware support for traversing and generating compressed data structures in irregular applications

Proposed the Dataflow Configuration Language (DCL) for the SpZip programmable hardware

Evaluated SpZip using zsim simulation on a broad set of irregular applications, results show large performance gains and data movement reductions over prior systems

### Undergraduate Research Assistant

Research Center for Mobile Computing, Tsinghua University

March 2017 - August 2019  
Beijing, China

- Advisor: Prof. Leibo Liu
- Worked on designing graph processing framework across the hardware software interface

Proposed the asynchronous Block Coordinate Descent (BCD) view of iterative graph algorithms to reveal the algorithmic and system trade-offs on achieving fast algorithm convergence

Designed **GraphABCD**, an asynchronous graph processing framework on heterogeneous system

Prototyped GraphABCD whole system in Verilog on Intel HARPv2 CPU-FPGA heterogeneous platform

### Undergraduate Research Assistant

Berkeley Artificial Intelligence Research Lab (BAIR), UC Berkeley

July 2018 - September 2018  
Berkeley, CA

- Advisor: Prof. Kurt Keutzer, collaboration with Kees Vissers and Michaela Blott from Xilinx Research Labs
- Worked on co-designing Convolutional Neural Network and its hardware accelerator

Designed **DiracDeltaNet** using PyTorch, a hardware efficient neural network targeting image classification task

Quantized DiracDeltaNet down to 4bit weight and 4bit activations with minor accuracy loss

Designed and implemented **Synetgy**: the hardware accelerator for DiracDeltaNet on embedded FPGA using HLS

## PUBLICATIONS

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1. Axel Feldmann, Courtney Golden, **Yifan Yang**, Joel S. Emer, and Daniel Sanchez, "[Azul: An Accelerator for Sparse Iterative Solvers Leveraging Distributed On-Chip Memory](#)", in Proceedings of the 57th annual international symposium on Microarchitecture (MICRO-57), 2024.
2. **Yifan Yang**, Joel S. Emer, and Daniel Sanchez, "[Trapezoid: A Versatile Accelerator for Dense and Sparse Matrix Multiplications](#)", in Proceedings of the 51th annual International Symposium on Computer Architecture (ISCA-51), 2024.
3. **Yifan Yang**, Joel S. Emer, and Daniel Sanchez, "[ISOSceles: Accelerating Sparse CNNs through Inter-Layer Pipelining](#)", in Proceedings of the 29th international symposium on High Performance Computer Architecture (HPCA-29), 2023.
4. **Yifan Yang**, Joel S. Emer, and Daniel Sanchez, "[SpZip: Architectural Support for Effective Data Compression In Irregular Applications](#)", in Proceedings of the 48th annual International Symposium on Computer Architecture (ISCA-48), 2021.
5. **Yifan Yang**, Zhaoshi Li, Yangdong Deng, Zhiwei Liu, Shouyi Yin, Shaojun Wei, and Leibo Liu, "[GraphABCD: Scaling Out Graph Analytics with Asynchronous Block Coordinate Descent](#)", in Proceedings of the 47th annual International Symposium on Computer Architecture (ISCA-47), 2020.
6. **Yifan Yang**, Qijing Huang, Bichen Wu, Tianjun Zhang, Liang Ma, Giulio Gambardella, Michaela Blott, Luciano Lavagno, Kees Vissers, John Wawrzynek, and Kurt Keutzer, "[Synetgy: Algorithm-hardware Co-design for ConvNet Accelerators on Embedded FPGAs](#)", in Proceedings of the 2019 ACM/SIGDA International Symposium on Field-Programmable Gate Arrays (FPGA), 2019.

## HONORS & AWARDS

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- MIT Jacobs Presidential Fellowship *Cambridge, 2019*
- Chi-sun Yeh Nominee Prize (8%) *Beijing, 2019*
- CNPC Scholarship (5%) *Beijing, 2018*
- National Scholarship (1/91) *Beijing, 2017*
- Outstanding Award in the 35<sup>th</sup> Tsinghua 'Challenge Cup' (Top 6/381)  
(Student Extracurricular Academic Science and Technology Works Competition) *Beijing, 2017*
- Zhang Mingwei Scholarship (10%) *Beijing, 2016*
- Bronze Medal in the 31<sup>st</sup> China Physics Olympiad *Hangzhou, 2014*

## **TECHNICAL SKILLS**

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**Programming:** CUDA, CUTLASS/CUTE, Triton, C/C++, Python, Verilog, System Verilog, Vivado HLS, Unix/Linux, Golang, R, MATLAB, Assembly

**Tools:** Pytorch, Nvidia toolchain (Nsys, NCU), Intel Pin, zsim, Intel(Altera) toolchain (Quartus, Qsys), Xilinx toolchain (Vivado, Vivado HLS, PYNQ), Modelsim, VCS

Updated on June 8, 2025