It’s CRNCH Time!

Summit 2023

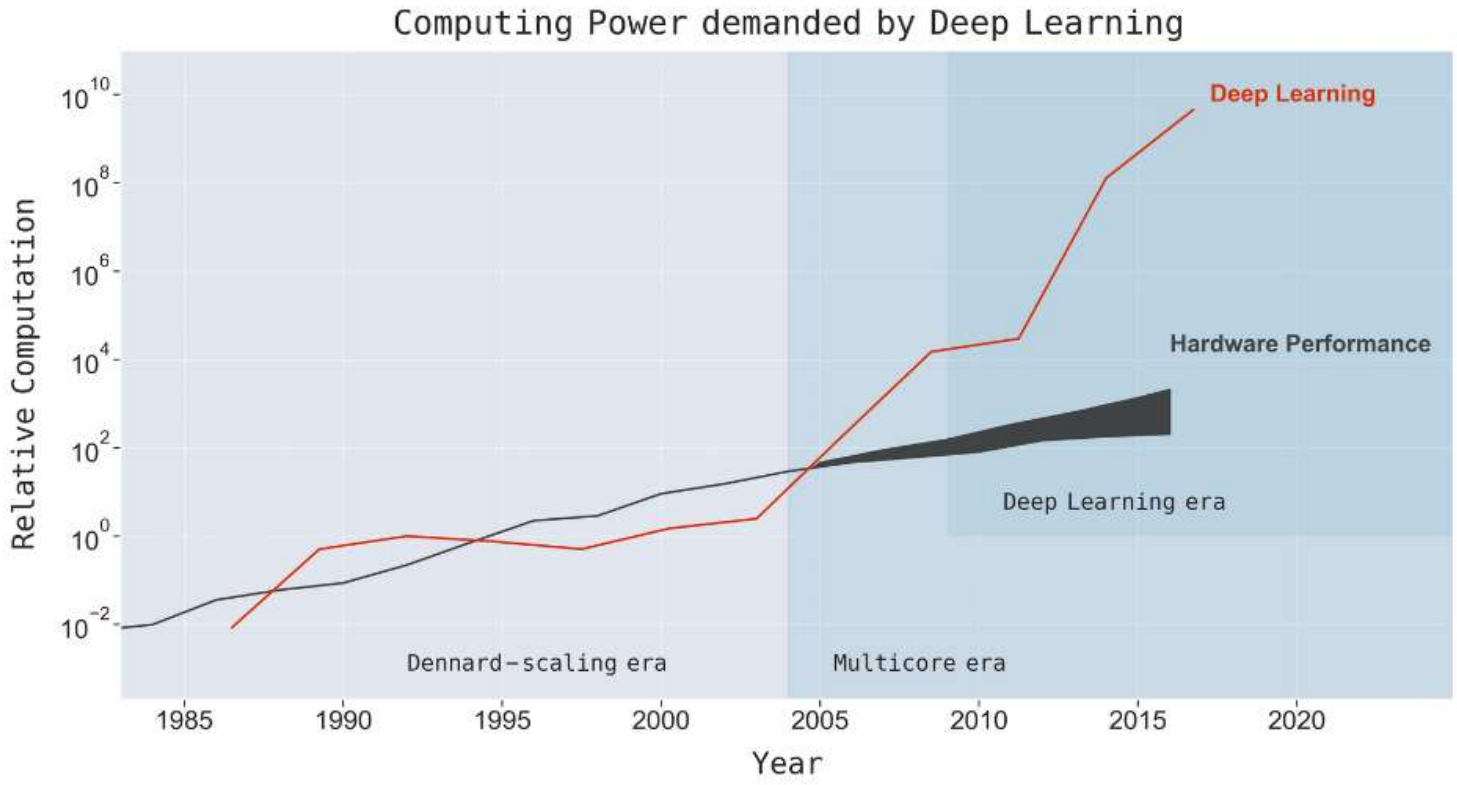
Hyesoon Kim (CS), **Rich Vuduc** (CSE) — Co-Directors
Tushar Krishna (ECE) — Associate Director
Jeff Young (CS) — Rogues Gallery Director
Melissa Raine (CoC) — Administrative Support

Georgia Tech College of Computing
Center for Research into Novel Computing Hierarchies

Satiating the beast…

We live in an era of unprecedented, ”super-exponential” demand for computing power, which far outstrips supply even under a bullish view of Moore’s Law.

Thompson et al. (2020). *The computational limits of deep learning*. arXiv:2007.05558.



CRNCH: Computing Beyond the Conventional

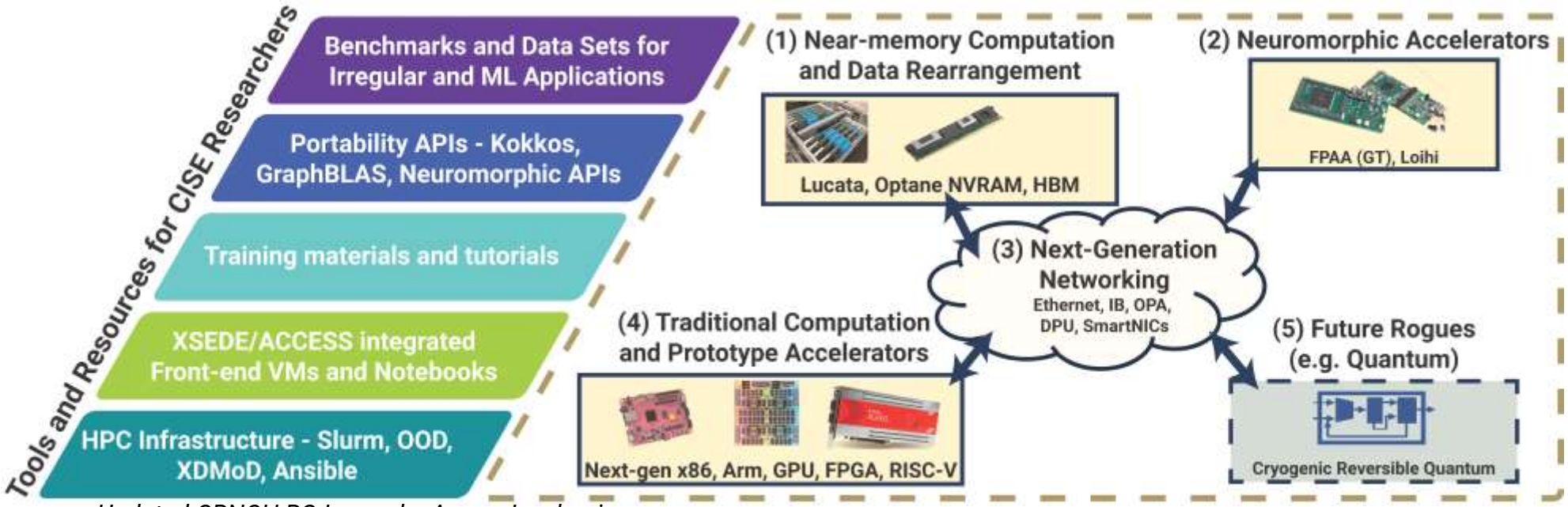
- **Community**: Gathering researchers at GT across long-term post-Moore areas like neuromorphic, quantum, reversible, and approximate computing
- **Multidisciplinary**: Engaging people across sciences, engineering, computing, and GTRI; and connecting them with external partners like ORNL, Sandia, Lucata, Northrup Grumman, …
- **Infrastructure & training**: Deploying unconventional computer hardware (e.g., Rogues Gallery)
- **Education**: Designing and promoting curricula aimed at helping the next generation “speak across the stack”

Rogues Gallery: Infrastructure for Post-Moore Computing Research

The Rogues Gallery is $1.3 million NSF project to create a testbed, including training materials, for the CISE research community.

At present, there are about 20 VMs, 30 servers, numerous boards, 150+ users (including 35 external), and over 120 students supported via a GT ”TechFee” (2021-2023).

Current hardware includes a rack-scale Lucata Pathfinder (16 nodes), neuromorphic accelerators; smart networking + 5G equipment; backend infrastructure; and novel chips and related benchmarking and testing.



Updated CRNCH RG Image by Aaron Jezghani

CRNCH Ph.D. Fellowship Winners — AY 2023

Albert Cho (ECE)

Rethinking server memory hierarchies in the era of CXL

Advisor: Alex Daglis (CS)

Zhixin Song (PHYS)

Error mitigation for solving differential equations on noisy quantum processors

Advisor: Spencer Bryngelson (CSE)

Afolabi Ige (ECE)

Automated synthesis for analog computing

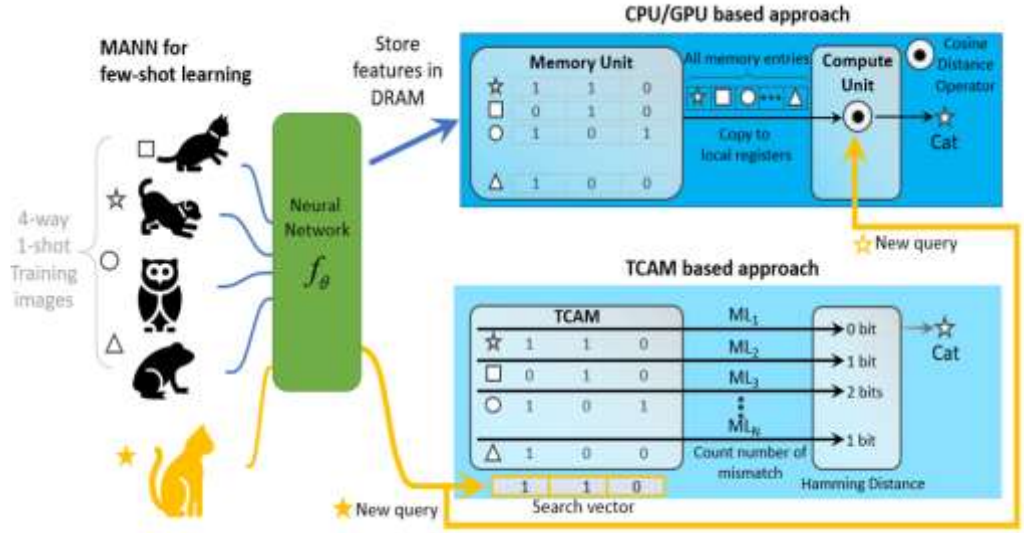
Advisor: Jennifer Hasler (ECE)

Rishov Sarkar (ECE)

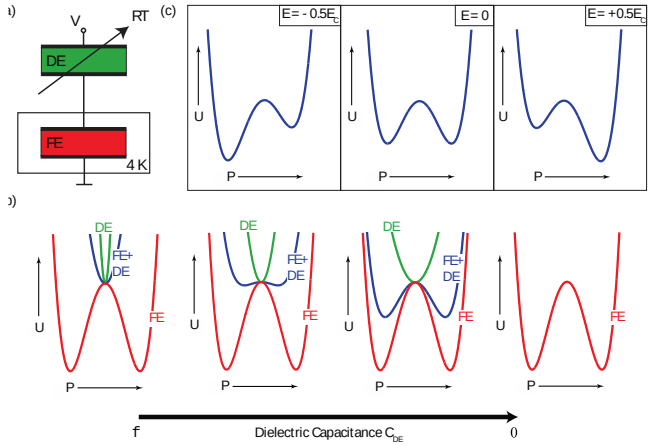
Hyperscale distributed GNN training with tri-design: near storage, device, and system

Advisor: Callie Hao (ECE)

Past CRNCH Fellowship Recipients



Narla: New circuit-level designs for memory architectures tuned to ML workloads



Ravindran: Exploring alternative material substrates for implementing qubits

- **Siri Narla** (ECE), “Ultra-low power magnetoelectric random access memory for TCAM applications.” Advisor: Dr. Azad Naeemi
- **Prasanna Ravindran** (MSE/ECE), “Quantum annealing in ferroelectronic platforms.” Advisor: Dr. Asif Khan
- (Honorable mention) **Daniel Zakha** (CS), “Building disaggregated resource runtimes on next-generation interconnects.” Advisor: Dr. Ada Gavrilovska
- **Samantha Lubaba Noor** (ECE), "System-level Figure of Merit Optimization of a Plasmon-based Integrated Computing Network", Advisor, Dr. Azad Naeem
- **Chunxing Yin** (CSE), "Tensorized neural networks for faster training and better co-design.” Advisor: Rich Vuduc
- **Dingtian Zhang** (IC), "Self powered computational photodetectors based on organic semiconductor devices." Advisor: Dr. Gregory Abowd
- **Muliang 'James' Zhu** (ECE), "Cortex-inspired optical computing enabled by photonic metasurfaces", Advisor: Dr. Ali Adibi

Partner Highlights

CRNCH is grateful to its partners for enabling new efforts, so thanks, y'all!

RG expansion, research, tutorials, personnel transfers; CRNCH and Lucata were #46 on the Green Graph500 in 2021!

Novel computer architectures

Architecture, in-network computing, solvers, graphs, tensors, programming models

Just a (pseudo)random sample!

Summit 2023 — Themes

Co-design and future architectures

Advancing foundations of devices and communication

Next-generation cyberinfrastructure, including for quantum systems

Aggressive specialization

Neuromorphic computing

Applications in “Scientific AI”

Meet students today at the lunchtime poster session

crnch.gatech.edu