Building the Brain-Memex

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Website

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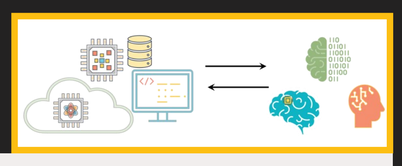
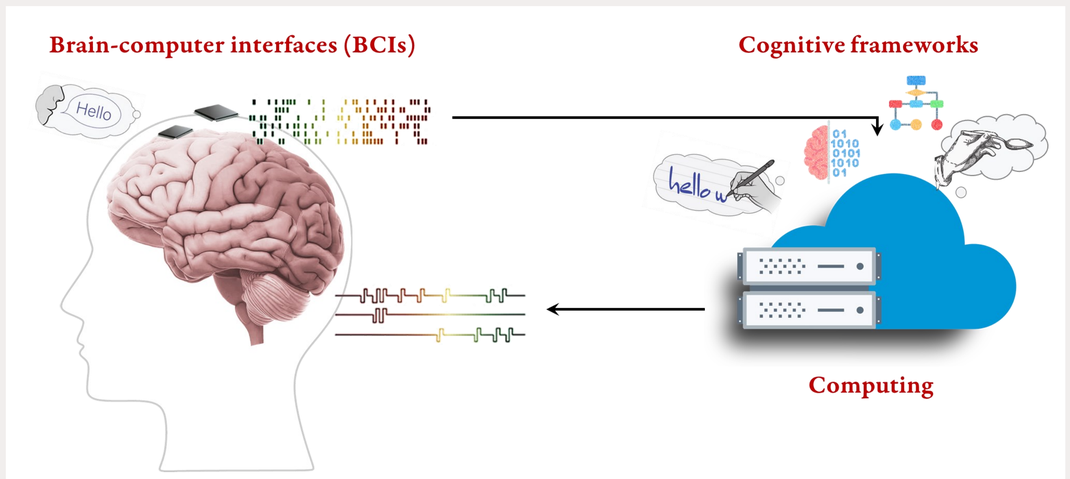
Mentors: Abhishek Bhattacharjee, Jonathan D Cohen (Princeton neuroscience)

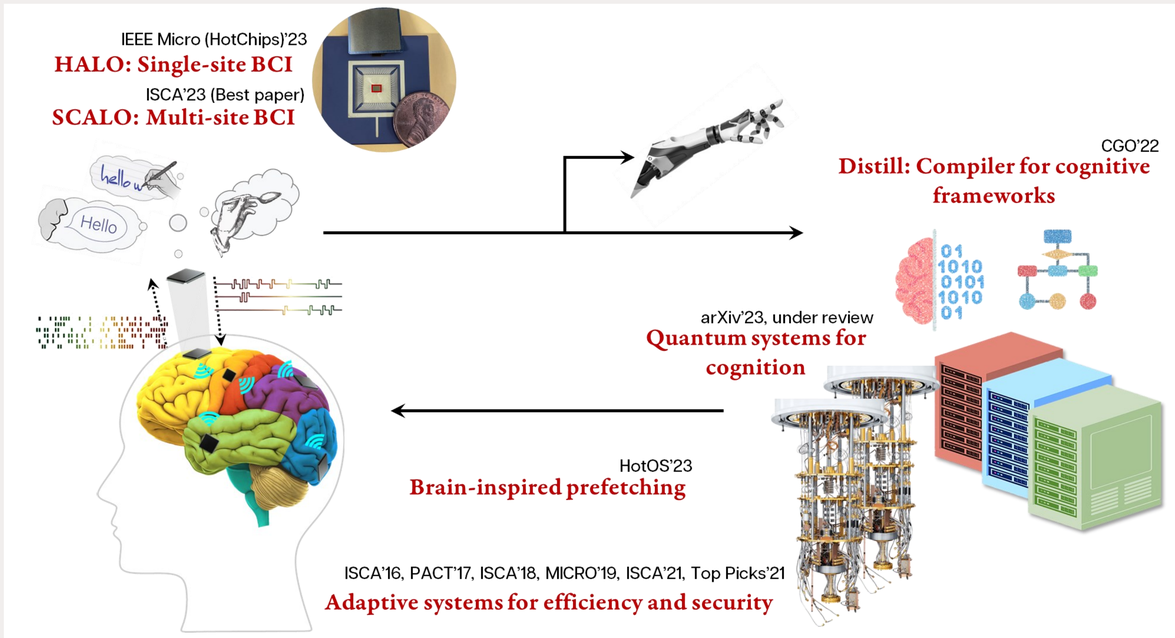
PhD Advisor: Josep Torrellas (UIUC)



My Vision: Brain, Mind, and Machines



My Research



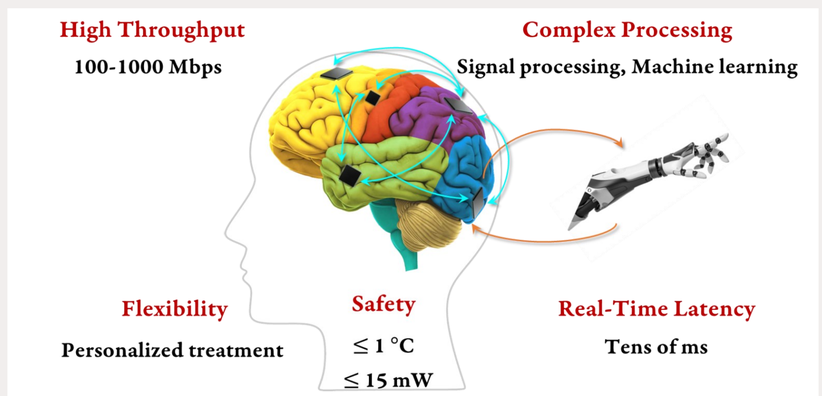
ISCA'23 Best Paper

SCALO: Multi-Site BCI

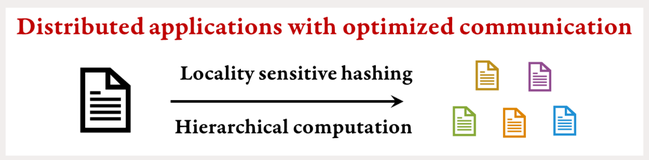
Example applications

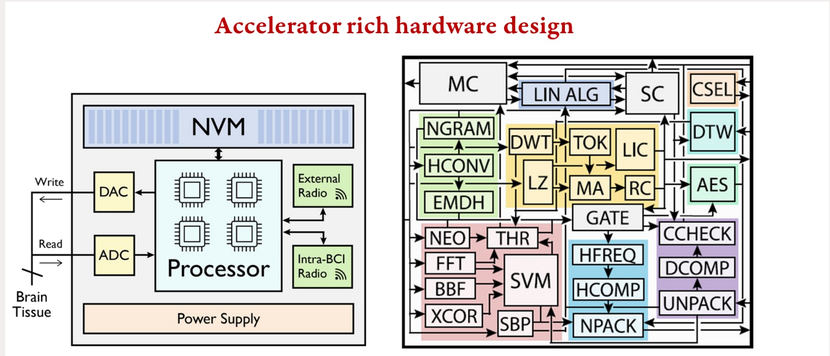
Seizure propagation, movement intent decoding

Design challenges



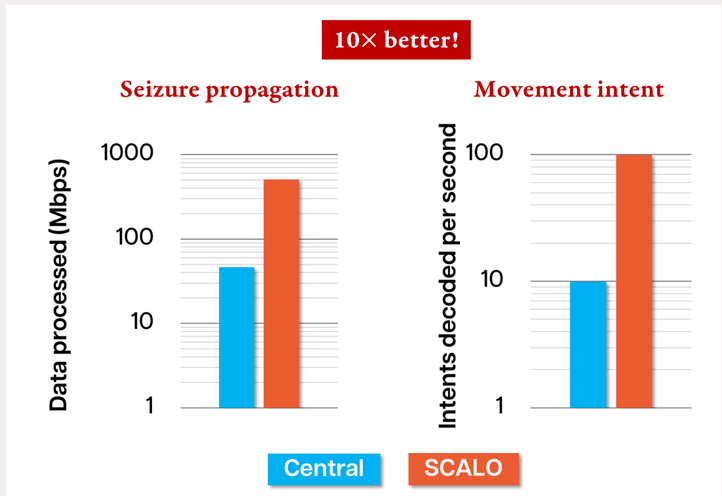
Aggressive cross-layer co-design





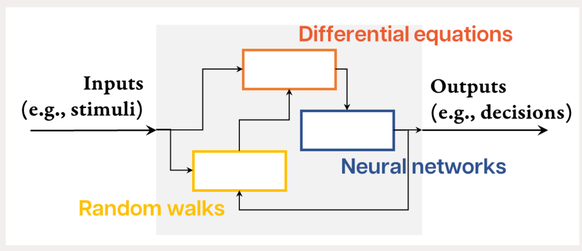
Intelligent PE design to optimize reuse and area
Per-PE clock, and frequency scaling
Configurable interconnect

Application performance

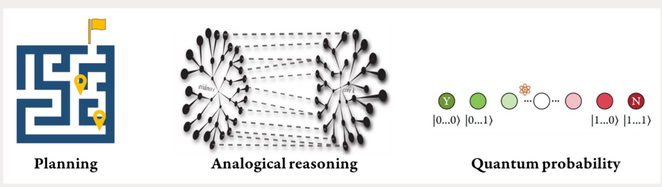


Quantum Systems for Cognitive Modeling

Cognitive frameworks

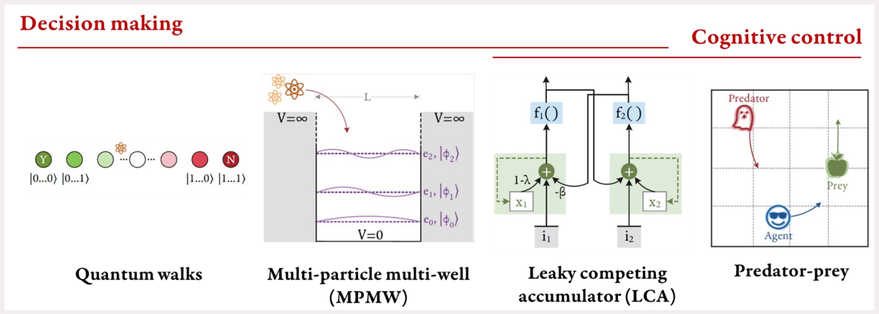


Challenging to run

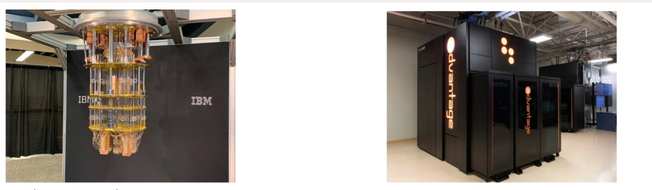


CGO'22
Distill: Compiler for cognitive frameworks to run on multicore CPUs and GPUs

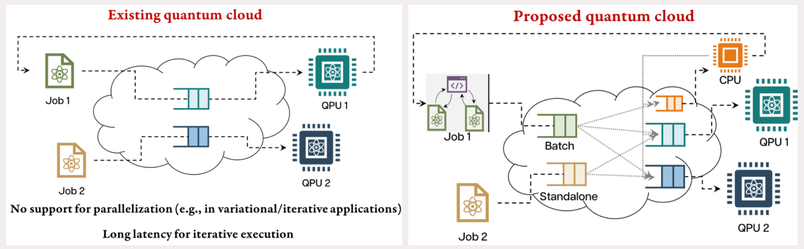
Can quantum computing help? How?

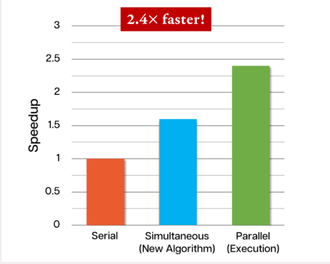


Used many algorithms: variational eigensolvers, imaginary time evolution, restricted Boltzmann machines (RBMs), quantum walks, nonlinear dynamics



Uncovered new systems research





Enabling Real Impact

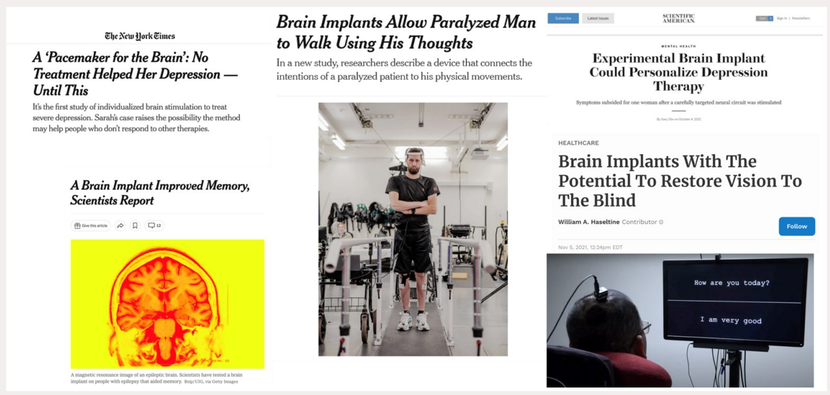
Yale School of Medicine

Cognitive modeling platforms

PsyNeuLink .mdf

The Possibilities are Many

Treat debilitating diseases



Teaming

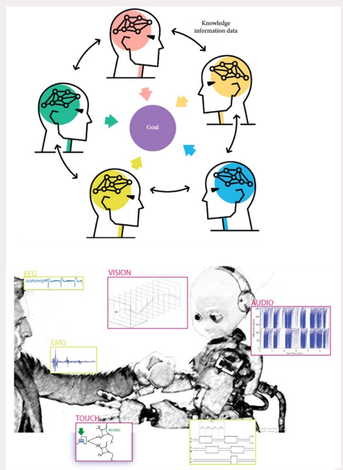


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Image credits: Brain signals (Bensmaia and Miller, Nat. Rev. Neurosci. 2014), Hello clouds (F. Willett et al./Nature 2021/Erika Woodrum), Flowchart; Digital brain; Quantum chip; Digital brain2 (flaticon.com), Server rack; Blue brain (freepik.com), Arm (Adobe Stock), Quantum (Rigetti), Analogical reasoning (Blokpoel et al. 2018), IBM quantum computer (IBM), D-Wave quantum (D-Wave), Artificial brain models (Magsood and Hadimani, Mat. Sci. & Eng. 2021), Swine (J.K. Shearer and A. Ramirez, http://vetmed.iastate.edu/), Rat head (Gill Brown, CC BY-NC 4.0, 2018), Rat brain (Biology 2e, OpenStax, CC BY 4.0), PsyNeuLink (PsyNeuLink), MDF (ModECI MDF), Mind communication (Cichocki and Kuleshov, Comput. Intellig. And Neurosci. 2021), Robot sense (Bartolozzi et al. Nat.Comm. 2022, CC-BY 4.0)