Summary of Undergrads Work on Alt Comp

Hoang Tran: Cellular Automata (CA)

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2) They can be used to model many phenomena like forest fires
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3) Can they be simulated by alt computing?

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Got a one-dim CA working but not two-dim.

Simulation Software

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(Comment from Bill G) This is typical: (1) Sim software for classical computing is good, (2) Sim software for alt computing is terrible.

Ishan Kumtheka: Annealing Methods

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D-Wave is a company that sells a quantum annealing machine.

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Finding lower bounds on polynomial van der Waerden numbers.
This is new. This is actually a SAT problem; however the type of SAT problem it is fits well into the ISING model.
See next slide for description of poly VDW numbers

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Theorem Let $p(x) \in Z[x]$. Let $c \geq 2$. There exists $W = W(p(x); c)$ such that for all c-colorings of $\{1, \ldots, W\}$ there exists a, d such that
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Example There exists a W such that for all 3-colorings of $\{1, \ldots, W\}$ there exists two numbers, the same color, a square apart.

The actual numbers $W(p(x); c)$ are largely unknown

Numbers and Theorems

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We used the colorings found to guide us to conjectures that we were able to prove in a fully math way. The final proofs do not need the computer work though they were inspired by it.

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Sim annealing can handle far more variables.

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Sim Annealing gives many satisfying assignments, WALKSAT only gave one.

Ishan wrote his own Sim Annealer

Ishan wrote his own sim Annealer to find sat assignments for the formulas relate to Poly VDW.

Actually Using a Quantum Annealer

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Bill R applied for this and we are still waiting.

Upshot

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Classical Sim Annealing actually works.

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Quantum Sim Annealing seems to have severe limits.
NEED TO FIND OUT HOW LIMITED THIS IS- I HAVE EMAILED ISHAN ABOUT THIS.

Romero Schwartz: Neuromorphic Computing for Energy

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See next slide for good news.

Drones

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The Micro Air Vehicle Lab at TU Delft has worked on drone applications. Their research on Auto Piloting with Neuromorphic computing is promising. Initial tests included an on-board Loihi chip to run both control and optical flow tasks, and online depth estimating learning (also on a drone). The meromorphic pipeline consumed 3 times less power than a GPT while maintaining 64 times the throughput. These tasks were completed with event cameras rather than traditional video cameras. This helps reduce power.

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LAVA is Intel's library and can be used to simulate SNN's. However, LAVA was recently deprecated as a new library is being developed.

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Used the Lava emulator to simulate.

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There are some caveats to explain some of the slowness, but even given those, still slower.

Timothy Li: Reservoir Computing in General

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There are simulators but they all have problems with them.

General Problems Encountered

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Reversible circuits to save energy: much bigger than classical circuits.

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SciPy and others: Do many layers to get through.

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Results were mixed. See next slide.

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When local stretching was removed then Res-SAC did better.

When observation contained only normalized positions, both did well.

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Res-SAC was close to SAC in the default, high-drift, and state-only conditions. Res-SAC did better when local stretching information ws removed. But SAC was more reliable in the far-start condition. Overall Res-SAC is not better than SAC.

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Bill G take: I am surprised that Res-SAC was reasonable and wonder if there is some catch.