Concluding – Advanced Computer Architecture 2018 and beyond

- This brings Adv Comp Arch 2018 to a close
- How do you think this course will have to change for
  - 2019?
  - 2022?
  - 2028?
  - The end of your career?
- Which parts are wrong? Misguided? Irrelevant?
- Where is the scope for theory?

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Advanced Computer Architecture
Chapter 9

Theoretical computer architecture

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Overview

- The role of theory in computer architecture
  - Computing at the end of Moore's Law
  - Asympotics versus reality
- Latency hiding in sequential machines with pipelined memory
  - Under what conditions can you hide latency, so performance is independent of RAM size?
  - Decoupling, address depth
- Latency hiding in parallel machines
  - Can you do this in a parallel machine?
- Models of computation for sequential computing
  - Counting FLOPs isn't enough: can we reason abstractly about the metrics that matter?
  - Uniform memory hierarchy: distinguishing cache-efficient algorithms
  - Cache-oblivious algorithms

Overview

- Models of computation for parallel computing
  - VLSI models; Area-time tradeoffs
  - BSP, Parallel memory hierarchy (PMH)
  - PRAM emulation; Ranade's machine (combining, randomisation, two-phase random routing)
- Caches: LRU stacks, cache obliviousness, AC/DC and the Bellman equation?
- Competitive strategies: spinlocks, paging, victim caches
- Some key algorithms: sorting, FFT, prefix scan, sparse matrix-vector multiply, geometric multigrid, parallel graph search
- Communication-avoiding algorithms
- Physical fundamentals: "plenty of room at the bottom", noise, reliability, reversibility
- Frontier questions
  - Why is the physical universe such a bad platform for simulating the physical universe?

Topics we should try to include…

- Transactional memory and lock elision
- Datacentre architecture
- More on cache-coherency protocols
- More on interconnection networks
- More on memory system architecture – stacked, processor-in-memory
- More on power
- Dark silicon
- More on GPU architecture
- More on graphics aspects of GPU architecture
- More on performance optimisation methodology and tools
- More compiler topics eg instruction scheduling
- Your ideas?