75,000,000,000 Streaming Inserts/Second Using Hierarchical Hypersparse GraphBLAS Matrices

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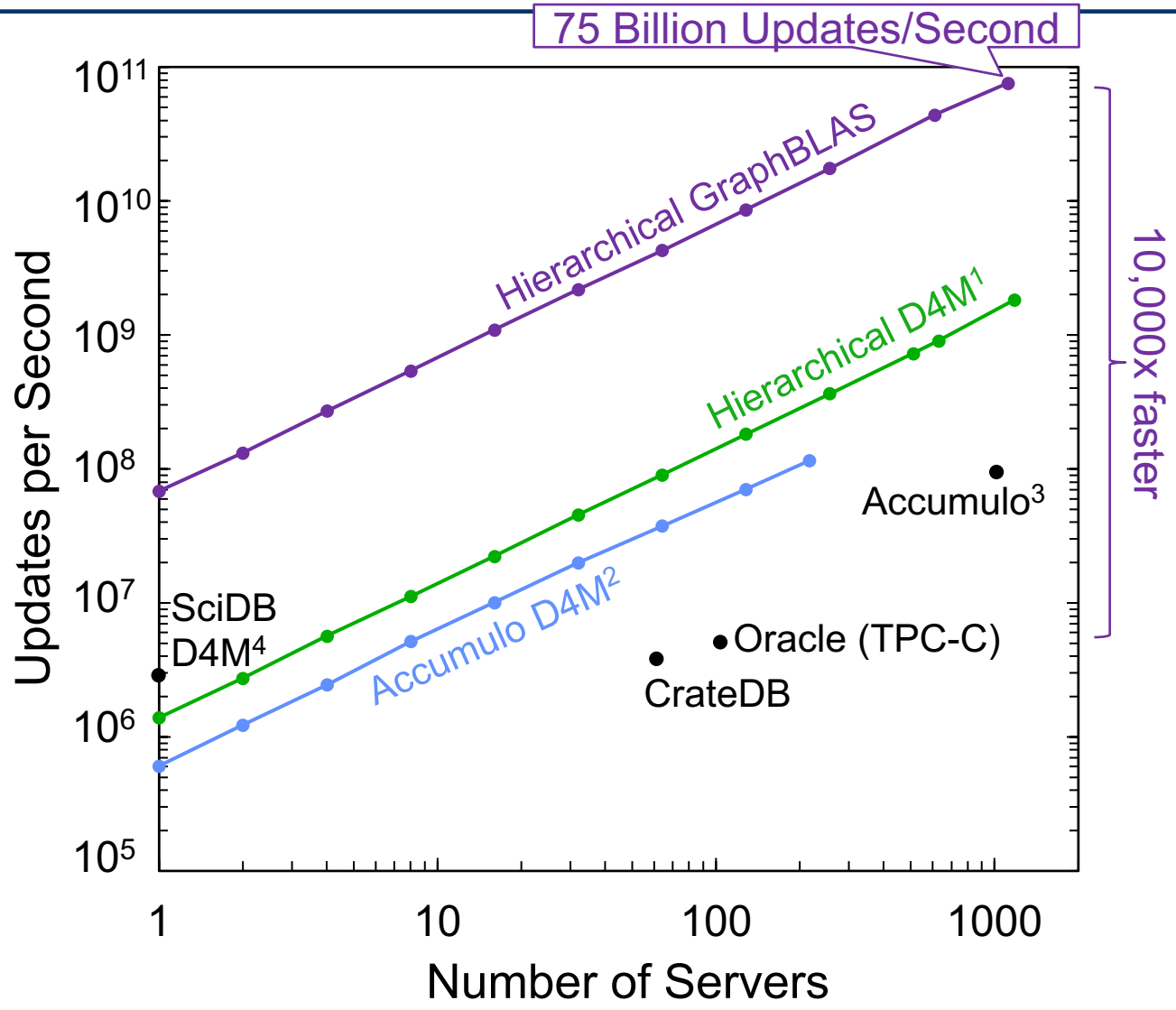
SUPERCOMPUTING CENTER

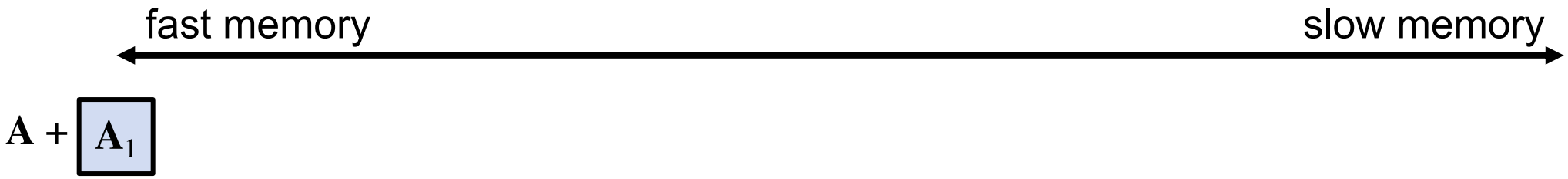
Hierarchical GraphBLAS In-Memory Database Performance

- **High performance streaming network analysis requires**
  - **High level programming environments**
  - **Rapid interaction and fast turnaround**
- **MIT SuperCloud optimizes every aspect of HPDA system to enable**
  - **34,000+ hierarchical GraphBLAS in-memory databases**
  - **1000+ servers**
  - **Launched in seconds**
- **Achieves 75 billion updates/seconds**
  - **Smashes prior Hierarchical D4M world record of 1.9 billion inserts/second[1]**
  - **10,000x faster than standard databases**
  - **20x the packet rate of projected 2022 North American non-Video Internet***



*Cisco Visual Networking Index: Forecast and Trends, 2017–2022; [1]*Streaming 1.9 Billion Hypersparse Network Updates per Second with D4M*, Kepner et al, IEEE HPEC 2019; [2]*Achieving 100,000,000 database inserts per second using Accumulo and D4M*, Kepner et al, IEEE HPEC 2014; [3]*Benchmarking Apache Accumulo BigData Distributed Table Store*, Sen et al, IEEE Big Data Congress 2013; [4]*Benchmarking SciDB Data Import on HPC Systems*, Samsi et al, IEEE HPEC 2016

Hierarchical GraphBLAS Arrays



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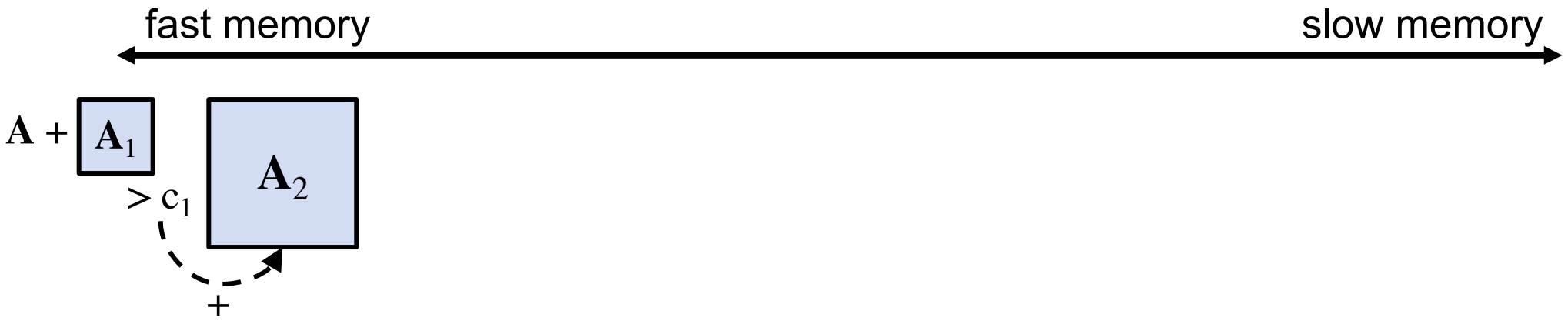

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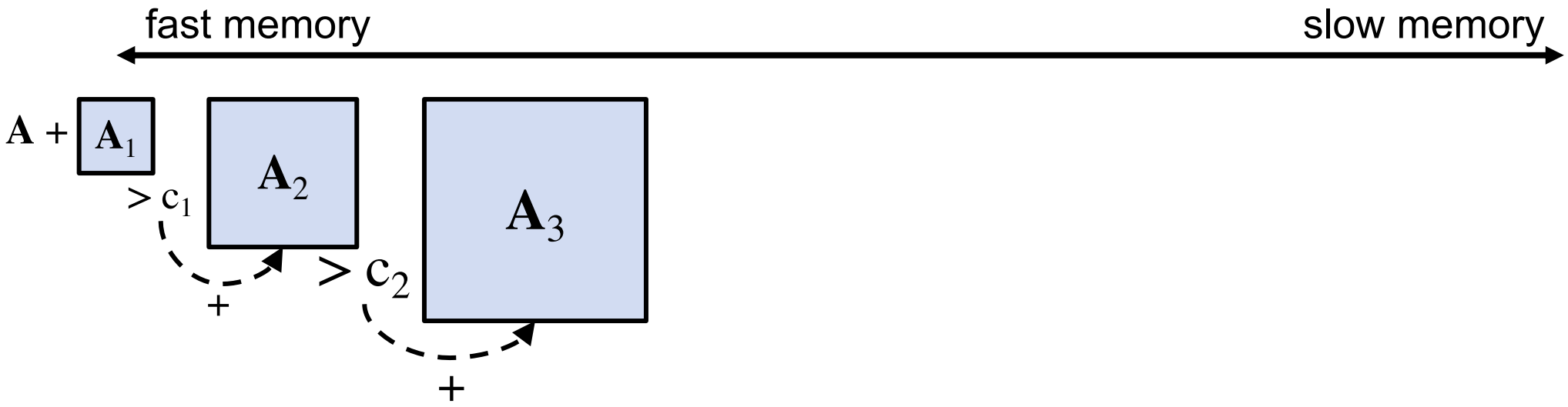
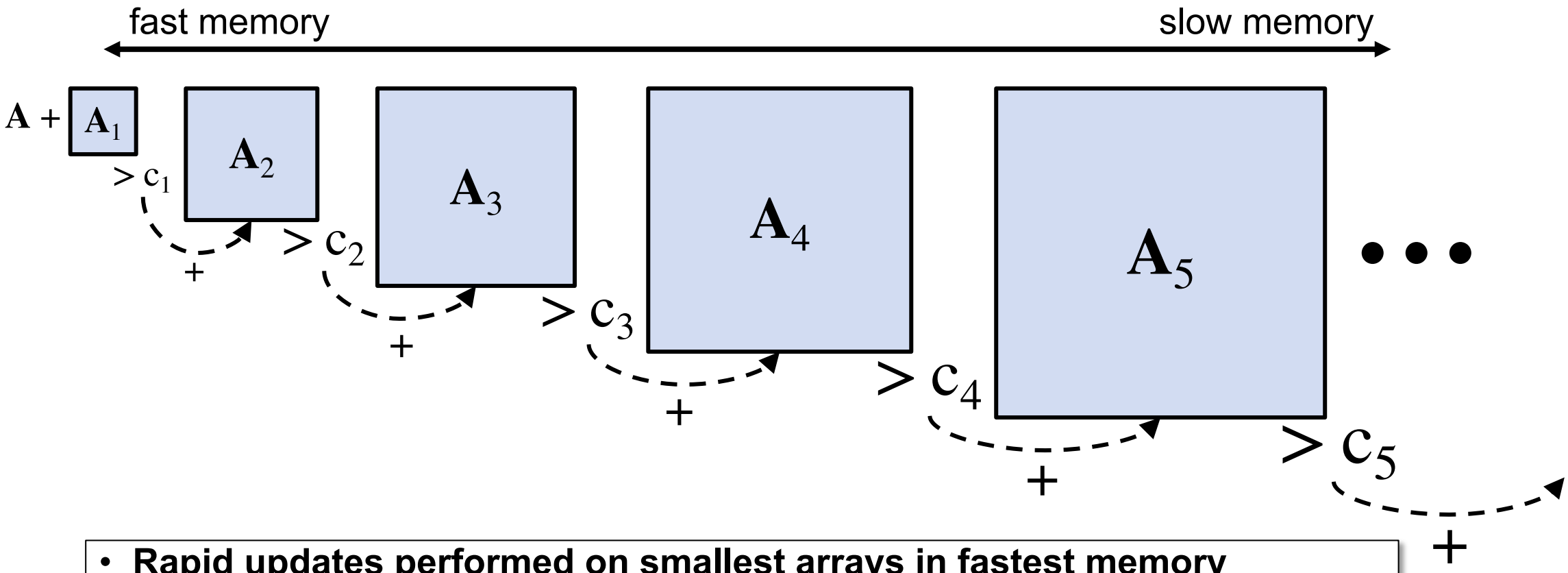


Hierarchical GraphBLAS Arrays



- **Rapid updates performed on smallest arrays in fastest memory**
- **If number of entries exceeds c_i, then A_i is added to A_{i+1} and A_i is cleared**
- **Dramatically reduces the number of updates to slow memory**
- **Upon query, all are summed into largest array**