Gaps Between Big Computing and Big Data: Dynamic Graphs and Knowledge Understanding

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Graphs – Pervasive, Dynamic, Unstructured

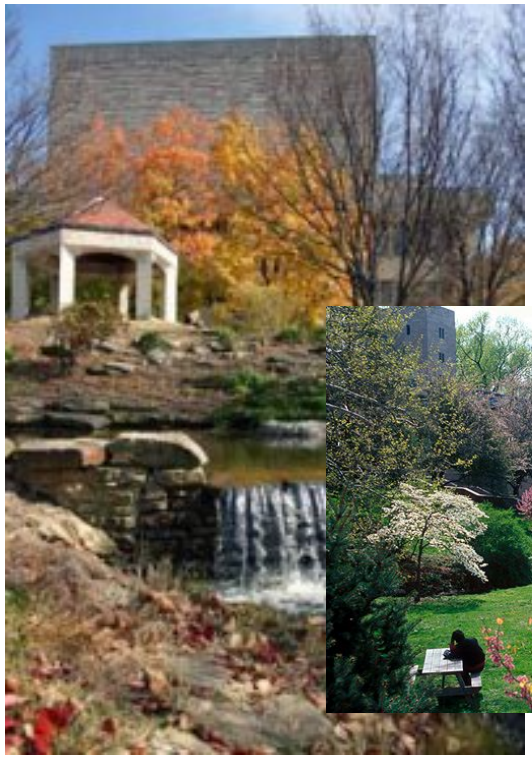
- Historically, big compute (HPC):
  - emphasis on floating point operations
  - HPC memory hierarchy assumes matrices & vectors
    - Rapid indexing through arrays
    - Static structures
    - Exploits spatial and temporal locality to minimize latency and power
- Future Big data (science or informatics):
  - limited in arithmetic operations
  - HPC Graph processing
    - Global data structures
    - Unstructured
    - Dynamic in form
  - Parallelism, synchronization amorphous structure dependent
  - Logical locality

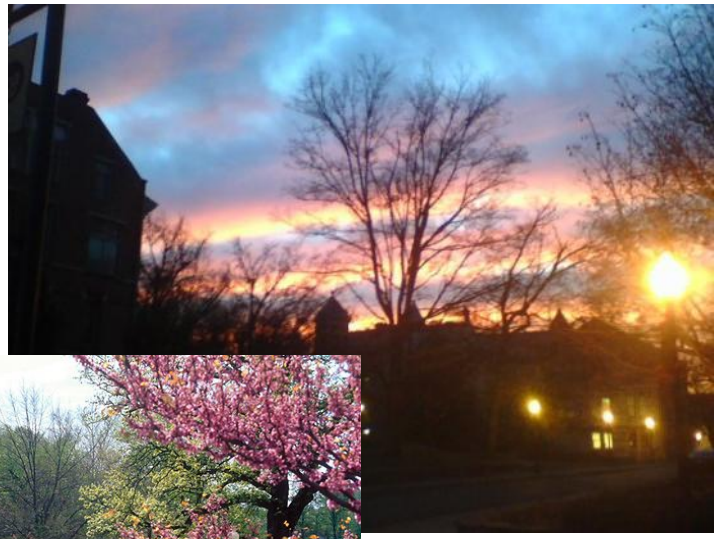
HPGC – High Performance Graph Computing

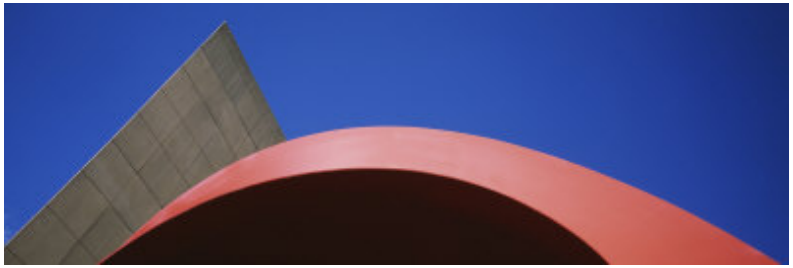
- Concurrency of operation
  - Meta-data structure parallelism
  - Data-directed parallelism discovery
  - Embedded synchronization for decentralized control in the presence of conflicting actions
  - Conventional storage sequentializes parallelism via degree of links
- Low data reuse – high operation repetition
- Suggested transitions
  - Execution model derived to serve new modalities and co-design
  - Message-driven computing to move work to data
  - Powerful synchronization embedded in data
  - Multi threaded
  - Global address space and first class objects

Understanding Knowledge for Knowledge Understanding

- Goal: declarative interrogatives, decisions, discovery, & control
- Computers use data as actionable for operation
- People use knowledge as actionable for understanding
- The gap between "data processing" & "knowledge understanding"
- How to get from Tycho's Mars data to Newton's inverse square law Knowledge (with Galileo's experiments and Kepler's laws)
- But – we confuse knowledge with data correlations and patterns
- Knowledge is about semantics based on absolute foundations
- Machine understanding through knowledge management is ultimate
- Not big data → Smart Knowledge







Thank You