LazyTable: Distributed Machine Learning with the Stale Synchronous Parallel Model

Henggang Cui

James Cipar, Qirong Ho, Jin Kyu Kim, Abhimanu Kumar, Seunghak Lee, Wei Dai, Jinliang Wei, Greg Ganger, Phil Gibbons (Intel), Garth Gibson, Eric Xing

PARALLEL DATA LABORATORY

Carnegie Mellon University
Partitioned input data  Parallel iterative program  Model parameters (solution)
Bulk Synchronous Parallel

- Bulk Synchronous Parallel (BSP)
  - Common approach to parallelizing
  - A barrier and data exchange every iteration
  - Problem of stragglers
  - Too much synchronization
Big Data Analytics

Partitioned input data ➔ Parallel iterative program ➔ Model parameters (solution)

Parameter server (LazyTable)
Stale Synchronous Parallel

- Stale Synchronous Parallel (SSP)
  - Threads are allowed to be some number of iterations ahead of the slowest thread
    - The “slack” parameter
  - Why? Speed!
    - Less synchronizing among threads
    - More using cached values
    - Tolerant of transient stragglers
Tradeoffs of Data Staleness

The sweet spot

Convergence per iteration

Iterations per second

Convergence per second

Fresher data

Staler data
Straggler Tolerance

Artificial Straggler Delay (sec) vs. Time per iteration (sec)

- **ideal**
- **slack=0 (BSP)**

Carnegie Mellon University Parallel Data Laboratory

http://www.pdl.cmu.edu/
Straggler Tolerance

Time per iteration (sec) vs. Artificial Straggler Delay (sec)

- **ideal**
- **slack=0 (BSP)**
- **slack=1 (SSP)**