Parallel Robust Principal Component Analysis

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Robust PCA
- Decompose a matrix into a low rank component and a sparse component:
  \[ M = L + S \]
- M, L and S are videos
- Each column is a frame
- Dimension roughly 100,000 x N for N frames
  
  Emanuel Candès, 2009

Algorithm

Singular Value Threshold (L)

Matrix Dimensions Determine the Algorithms
- Matrix is generally not wide enough to provide enough parallelism in the 'n' direction. Must also divide in the 'm' direction and use atomic add when necessary.
- Best results came from minimizing the number of parallel reductions in our SGEMV
- Global barrier could potentially be avoided, but synchronization costs were a second-order concern for this size matrix

Robust PCA Speedup
- Can process 10 seconds of video in 11 seconds
  Went from 28x slower than real-time to near real-time