Cut-And-Stitch
Efficient Parallel Learning of Linear Dynamical Systems on SMPs

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Problem Definition

• Problem:
  Given a Linear Dynamical System, to find the model parameters.

• Traditional Method:
  Maximum Likelihood Estimation via Expectation-Maximization (EM) algorithm

• Objective:
  Parallelize the learning algorithm

• Tool:
  OpenMP with shared memory parallelism

Parameters: \( \theta = (u_0, V_0, A, \Gamma, C, \Sigma) \)
Observation: \( y_1...y_n \)
Hidden variables: \( z_1...z_n \)

Proposed Method: Cut-And-Stitch

“Leap of faith” start computation without feedback from previous node (cut), and reconcile later (stitch)

Experiments

• Dataset:
  58 motion capture sequences. Each with 93 dimensions (bone positions).

• Setup:
  tested on both SMP (SGI Altix) and desktop multicore (4-core)

Speed up over the sequential algorithm

Quality: Reconstructed v.s. Real

Conclusion

• General approximate parallel learning algorithm for LDS
• Near linear speed up
• Quality (RMSE): ~ identical to sequential learning
• Promising Extensions:
  - Cut-And-Stitch for HMM
  - Cut-And-Stitch for general Markov models

Dataset and software available at http://www.cs.cmu.edu/~leili/paralearn/