Distributed Shared Memory and Machine Learning

CSci 8211
Chai-Wen Hsieh
11/5/2018
Agenda

Distributed Shared memory

- Architecture: Shared Memory & Distributed Shared Memory

Machine Learning

- Supervised, Unsupervised Training
- Gradient Descent
- Model/Data Parallelism

Topics

- Problems We Could Solve
- Distributed Shared Memory
- Deep Learning & DSM
Architecture - Shared Memory

- Sharing one memory among several processors
- Communication through shared variables
- Architectures
  - SMP
  - NUMA
  - COMA

From Advanced Operating Systems - Udacity
Architecture - Distributed Shared Memory (DSM)

- Multiple independent processing nodes with local memory modules
- Models:
  - Message Passing v.s. DSM
- Hidden data movement
- Locality of reference
- Provides large virtual memory space
- Cheaper than multiprocessor system
- Unlimited number of nodes

From Advanced Operating Systems - Udacity
DSM Issues

- Rewrite to shared memory aware program
- Cache coherence problem - maintaining coherence among several copies of data item
- Performance loss
  - Network
  - Synchronization: lock, barrier
- Failure of nodes
- “Shared memory machines scale well when you don’t share memory”
  -- Chuck Thacker
Machine Learning

Supervised Learning
- Have input variables (X) and an output variable (Y) and you use an algorithm to learn the mapping function
- Problems:
  - Classification
  - Regression

Unsupervised Learning
- Only have input data (X) and no corresponding output variables
- Problems:
  - Clustering
  - Association
Deep Learning - Gradient descent

Gradient Descent For Minimizing Cost Function

\[
\theta_j := \theta_j - \alpha \frac{\partial}{\partial \theta_j} J(\theta)
\]
Multi-node Strategy: Data/Model Parallelism

Data Parallelism

Model Parallelism
Problems We Could Solve

1. Design a distributed shared memory framework that benefits machine learning training
2. Rewrite existing serial programs into parallel programs with ML
3. Adding nodes to a running system, where and when
4. Reduce overhead by prefetch, redistribution

需要選一個topic focus on it. Go deeper
Topics - Distributed Shared Memory


Topics - Deep Learning & DSM


Topics - Deep Learning & DSM - cont’
