TESTING THE IMPLEMENTATIONS OF A PARALLEL BATCH TRAINING ALGORITHM FOR DEEP NEURAL NETWORK

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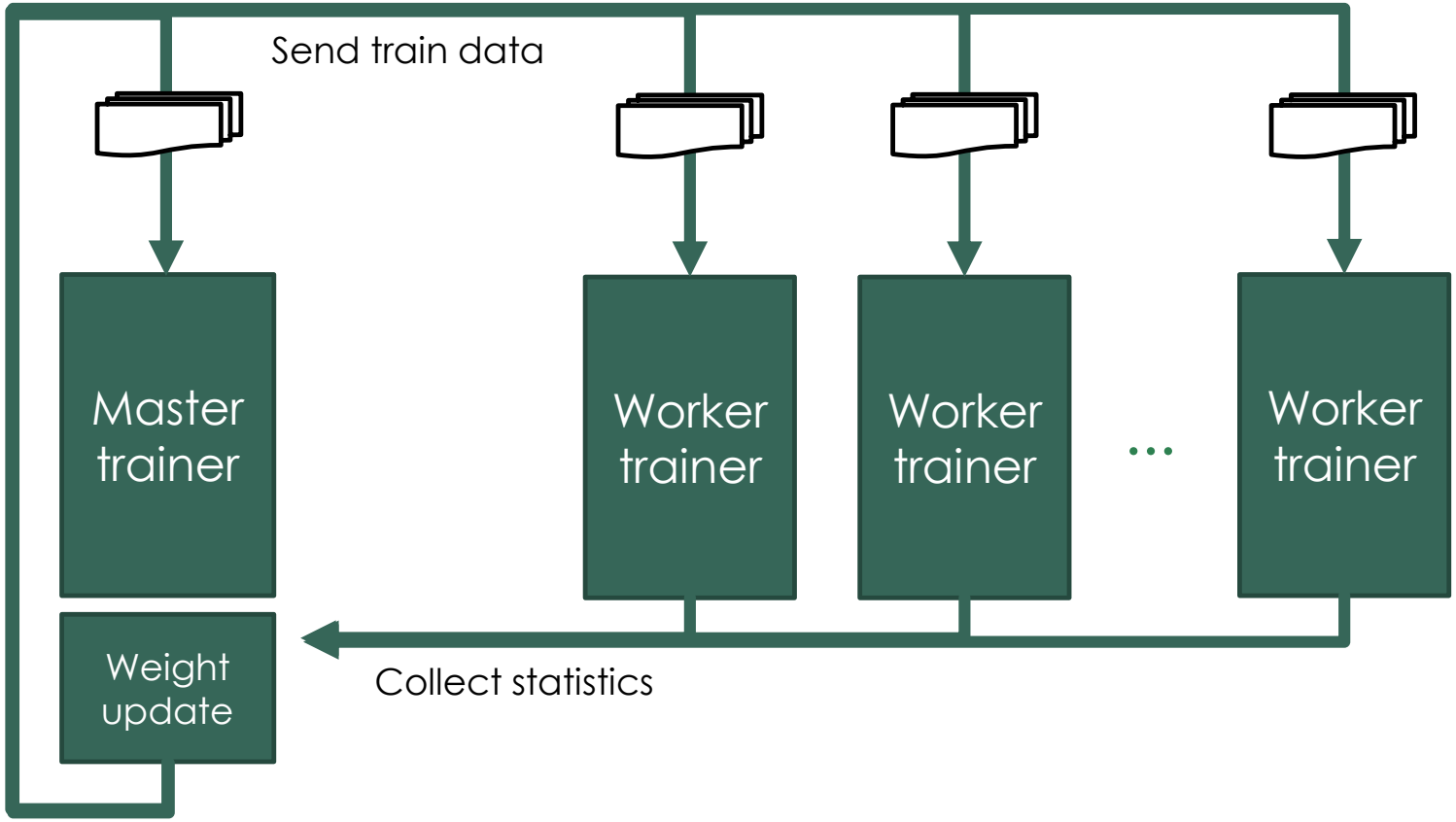
OUTLINE

- Review
- Testing scheme
  - Metric
  - parameters
- Experiment setup
  - Data set
  - Testing harness
  - Testing environment
  - Implementations to be tested
- Results

REVIEW OF THE ALGORITHM



- Concurrent training

TESTING SCHEME

- Use response time as testing metric
- The response time in this experiment is defined as the time used to train one epoch

- Response time is used because:
  - The training of epochs are serialized steps
  - We are interested in minimizing the training time

TESTING SCHEME

- There are 2 parameters that can affect the response time:
  - Number of threads used
  - Mini-batch size

- Measure
  - Response time vs. number of threads used
  - Response time vs. mini-batch size

EXPERIMENT SETUP

- Use MNIST data set for hand written digits recognition task
- The data set consist of 60,000 28x28 pixel images for training and 10,000 images for testing.
- The samples are classified into 10 categories: 0 ~ 9
- Network model size : 784-300-300-10

EXPERIMENT SETUP

- The testing is only measured on the training of MLP, since the implementation of RBM is similar to the implementation of MLP.
- The testing harness:
  - Read in data
  - For n runs of test
    - Create model and trainer
    - Ask trainer to perform full training process
      - Trainer train epoch by epoch
- Time is measured only at the beginning and the end of the trainEpoch() method.
- Discard the first run of test
- The mean and standard deviation of response time are computed over all the response time measured in the remaining runs of test

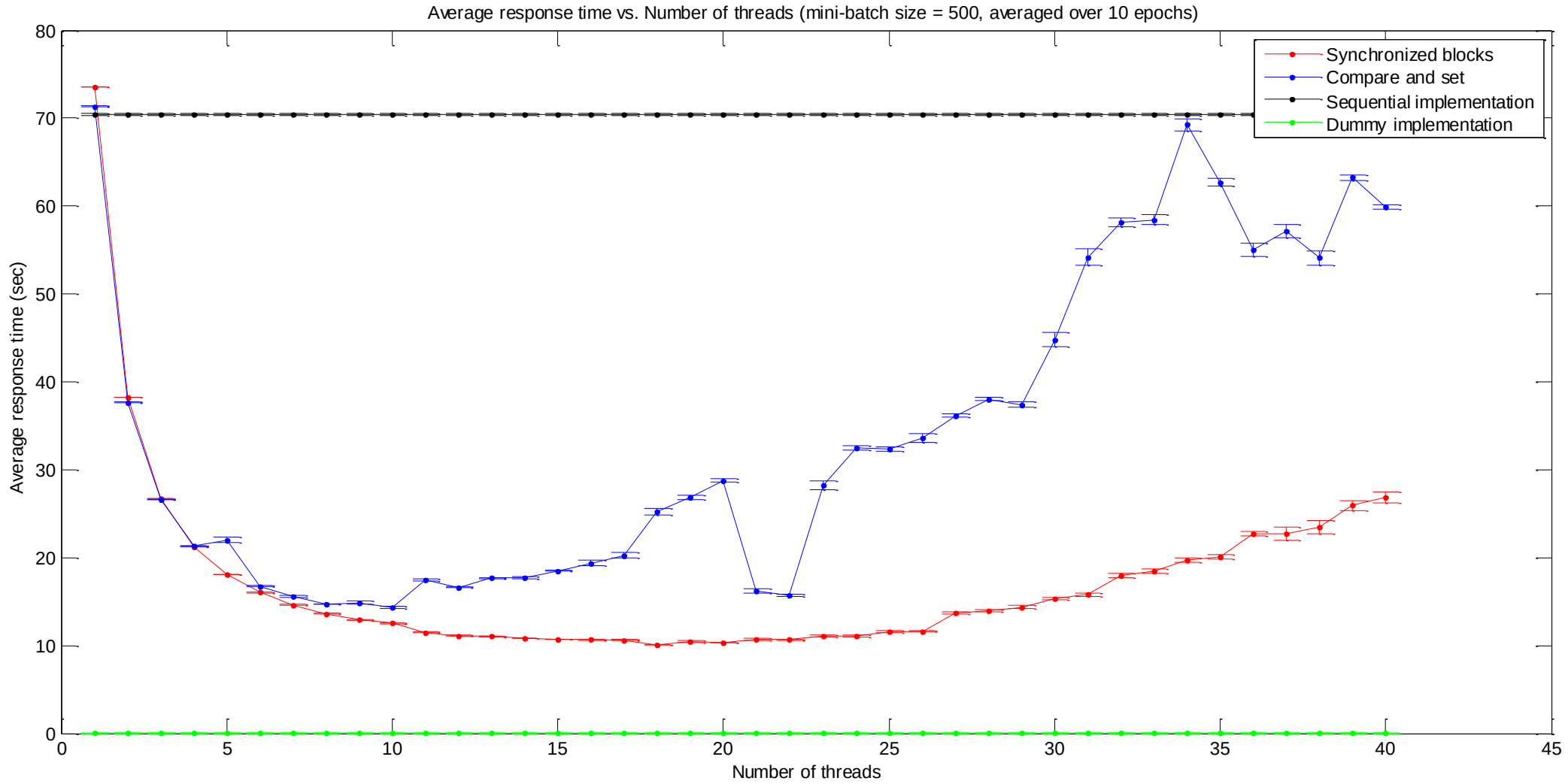
EXPERIMENT SETUP

- Experiment is conducted on the Intel Manycore Testing Lab (MTL)
- Cores available: 40; Cores used: 20
- OS: Linux
- JVM version: 1.7.0_01
- VM argument: -d64 -server -Xms1G -Xmx1G

EXPERIMENT SETUP

- Implementations to be tested:
  - SeqMLPTrainer (baseline): implementation of the sequential training algorithm
  - ConMLPTrainer: implementation of the parallel batch training algorithm that use synchronized blocks to synchronize access to shared variables
  - CASConMLPTrainer: implementation of the parallel batch training algorithm that use compare & set to synchronize access to shared variables
  - DummyMLPTrainer: does nothing in the trainEpoch() method

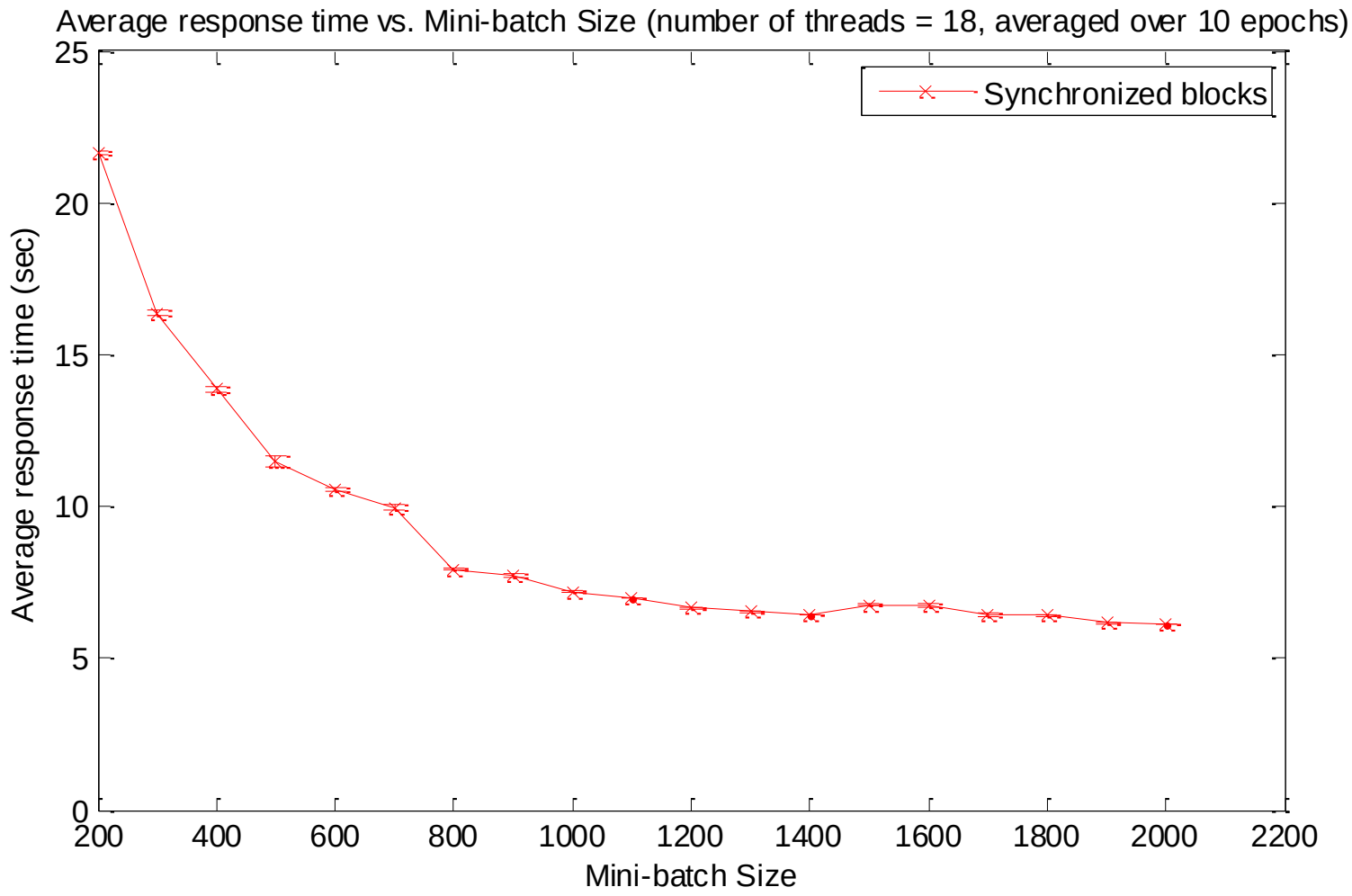
EXPERIMENT RESULTS



EXPERIMENT RESULTS

- The synchronized blocks implementation performs generally better than the compare and set implementation.
- This phenomenon is probably due the increased contention when using more threads.
- The best average response time of 10.07 sec/epoch is reached by the synchronized blocks implementation when using 18 threads.

EXPERIMENT RESULTS



EXPERIMENT RESULTS

- The average response time decreases as the size of mini-batch increases.
- The average response time asymptotically approaching around 6 sec/epoch, which is more that 10 times faster than the sequential implementation.

EXPERIMENT RESULTS

- Parallelization efficiency:
- $E = \frac{t_{seq}/t_{con}}{nThr} = \frac{70.41\ sec/10.07\ sec}{18} = 38.84\%$

EXPERIMENT RESULTS

- The classification performance of the trained model:
  - Only reaches 11.35% accuracy without pre-trained by RBM (trained 100 epochs)
  - Achieved 94.52% accuracy when pre-trained by RBM (trained 100 epochs)

- Stat-of-the-art: 99.77% accuracy by Multi-column DNN (D. Ciresan et al., 2012)

THANK YOU