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Paper Review Week 3
Mxnet: A flexible and efficient machine learning library for heterogeneous distributed systems

**CS 8803**

# 1 Paper Overview

"Mxnet: A flexible and efficient machine learning library for heterogeneous distributed systems", written by Tianqi Chen, Mu Li, et al. is a system paper in arXiv. Different computation and programming models have different emphasis, i.e. imperative programming focuses on calculation details, while declarative programming tends to define the overall model structures. Identifying the merits of mainstream computation and execution models for deep learning system, this paper proposes MXNET, a new machine learning system, with combined advantages, especially for deep learning. MXNET is a lightweight and self-contained system and provides interface for multiple programming language. This system aggressively reduces the consumed memory with memory reuse mechanism and provide distributed synchronization to support data parallelization. The performance evaluation of MXNET is illustrated at the end by comparing with mainstream machine learning systems, such as TensorFlow. Also, the memory consumption is investigated to show the efficiency. In general, the contributions of this paper is summarized as follows:

1. A flexible machine learning system especially for deep learning is introduced in this paper, including details about the system design and performance evaluation.

## 1.1 Problem Summary

The scale and complexity of machine learning (ML) algorithms are becoming increasingly large. The increasing problem scale and computation requirement brings challenges to machine learning system in terms of structural and computational complexity [1].

## 1.2 Related Works

- Imagenet large scale visual recognition challenge [2].
- Minerva: A scalable and highly efficient training platform for deep learning [3].

# 2 Paper Strengths

The whole paper is short and illustrative. The function comparison in the beginning to indicate the difference between MXNET and other mainstream machine learning systems is clear to see its contribution. Instead of merely covering the system design details, the comparison with present systems to illustrate the goodness of the proposed system make it easy to follow. By introducing the architectures and design consideration, it gives clear introduction path.

1. The design details and comparison with present systems are well illustrated.
2. The contribution of this paper is clearly illustrated and easy to identify.

# 3 Paper Weaknesses

Although this model provides considerable programming convenience, given its multiple programming interfaces, this work is more like an improved work in terms of implementation, instead of complete innovation. The notions mentioned in the design principles of MXNET are more or less contained in previous machine learning systems, such as TensorFlow. Moreover, this system put exclusive focus on deep learning, which leads its function as subset of other systems and less possibility for future extension. From my perspective, the biggest shortages of this paper are in the contribution of memory consumption and model evaluation.

As for memory consumption, the proposed memory-reuse algorithms are not that impressive, given its straightforward heuristics. Also, there is lack of illustration about the comparison with naive memory model and the so-called $O(n^2)$ optimal solution.

As for model evaluation, this paper only compares the training time with other machine learning systems, without memory consumption comparison. This would weaken the mentioned contribution for memory saving. And the scalability evaluation archives different model accuracy for 1 and 10 machines, which is an irrational result for me, indicating the difference in underlying training.

# References


[1] Tianqi Chen, Mu Li, Yutian Li, Min Lin, Naiyan Wang, Minjie Wang, Tianjun Xiao, Bing Xu, Chiyuan Zhang, and Zheng Zhang. Mxnet: A flexible and efficient machine learning library for heterogeneous distributed systems. *arXiv preprint arXiv:1512.01274*, 2015.

[2] Olga Russakovsky, Jia Deng, Hao Su, Jonathan Krause, Sanjeev Satheesh, Sean Ma, Zhiheng Huang, Andrej Karpathy, Aditya Khosla, Michael Bernstein, et al. Imagenet large scale visual recognition challenge. *International journal of computer vision*, 115(3):211–252, 2015.

[3] Minjie Wang, Tianjun Xiao, Jianpeng Li, Jiaxing Zhang, Chuntao Hong, and Zheng Zhang. Minerva: A scalable and highly efficient training platform for deep learning. In *NIPS Workshop, Distributed Machine Learning and Matrix Computations*, 2014.