Training 100,000 Classes on a Single Titan X in 7 Hours or 15 Minutes with 25 Titan Xs*

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ABSTRACT

In this talk, I will present Merged-Averaged Classifiers via Hashing (MACH) for K -classification with ultra-large values of K . Compared to traditional one-vs-all classifiers that require $O(Kd)$ memory and inference cost, MACH only need $O(d \log K)$ (d is dimensionality) memory while only requiring $O(K \log K + d \log K)$ operation for inference. MACH is a generic K -classification algorithm, with provably theoretical guarantees, without any assumption on the relationship between classes. MACH uses universal hashing to reduce classification with a large number of classes to few (logarithmic many) independent classification tasks with small (constant) number of classes. I will show the first quantification of discriminability-memory tradeoff in multi-class classification. Using the simple idea of hashing, we can train ODP dataset with 100,000 classes and 400,000 features on a single Titan X GPU, with the classification accuracy of 19.28%, which is the best-reported accuracy on this dataset. Before this work, the best performing baseline is a one-vs-all classifier that requires 40 billion parameters (160 GB model size) and achieves 9% accuracy. In contrast, MACH can achieve 9% accuracy with 480x reduction in the model size (of mere 0.3GB). With MACH, we also demonstrate complete training of feature extracted fine-grained imagenet dataset (compressed size 104GB), with 21,000 classes, on a single GPU. To the best of our knowledge, this is the first work to demonstrate complete training of these extreme-class datasets on a single Titan X. Furthermore, the algorithm is trivially parallelizable. Our experiments show that we can train ODP datasets in 7 hours on a single GPU or in 15 minutes with 25 GPUs. Similarly, we can train classifiers over the fine-grained imagenet dataset in 24 hours on a single GPU which can be reduced to little over 1 hour with 20 GPUs.

CCS CONCEPTS

• **Mathematics of computing** → Probabilistic algorithms; Information theory; • **Information systems** → Clustering and classification; • **Theory of computation** → Distributed algorithms; • **Computing methodologies** → Parallel computing methodologies; Machine learning; Supervised learning by classification; Neural networks;

KEYWORDS

Large-scale Learning, Extreme Classification, Hashing, Sketching, Distributed Machine Learning, GPU

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