

# Quantized Neural Networks:

Training Neural Nets with Low Precision Weights & Activations

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# Motivation

- ▶ Computational Efficiency (inkl. Horowitz)
- ▶ Improved Generalization
- ▶ Examples and related concepts: dropout, ReLu (sparse gradient), influence of feature discretization,

# Binarization Schemes

- ▶ Deterministic vs. Stochastic

# Gradient Estimation

- ▶ Path Derivative Gradient Estimators (reparametrization, ST, SlopeAnnealing)
- ▶ Score Function based Gradient Estimators (reinforce+many others)
- ▶ Expectation Backpropagation

See Gumble Softmax Paper for overview

# Algorithms: Adam + BNN

- ▶ General Review
- ▶ Illustrate their importance for QNNs
- ▶ Implement algorithm to see how it works without Adam and BN?

# Full Algorithm

- ▶ Try to visualize, illustrate procedure (highlight similarities and differences to conventional NN training and inference)

# Experiments

- ▶ Describe different NN architectures (DNN, CNN, RNN)
- ▶ Describe data sets (MNIST, CIFAR, ImageNet, PennTree)
- ▶ binary vs low precision

# Results

- ▶ Training results
- ▶ Performance results (look up older benchmarks to compare loss in in accuracy to)
- ▶ find comparisons from other references





# Further Reading I



*Training Neural Nets with Low Precision Weights & Activations.*

Itay Hubara, Matthieu Courbariaux, Daniel Soudry, Ran El-Yaniv, Yoshua Bengio  
[ArXiv 2016](#)



*DoReFa-Net: Training Low Bitwidth Convolutional Neural Networks with Low Bitwidth Gradients*

Shuchang Zhou, Zekun Ni, Xinyu Zhou, He Wen, Yuxin Wu, Yuheng Zou  
[ArXiv 2016](#)