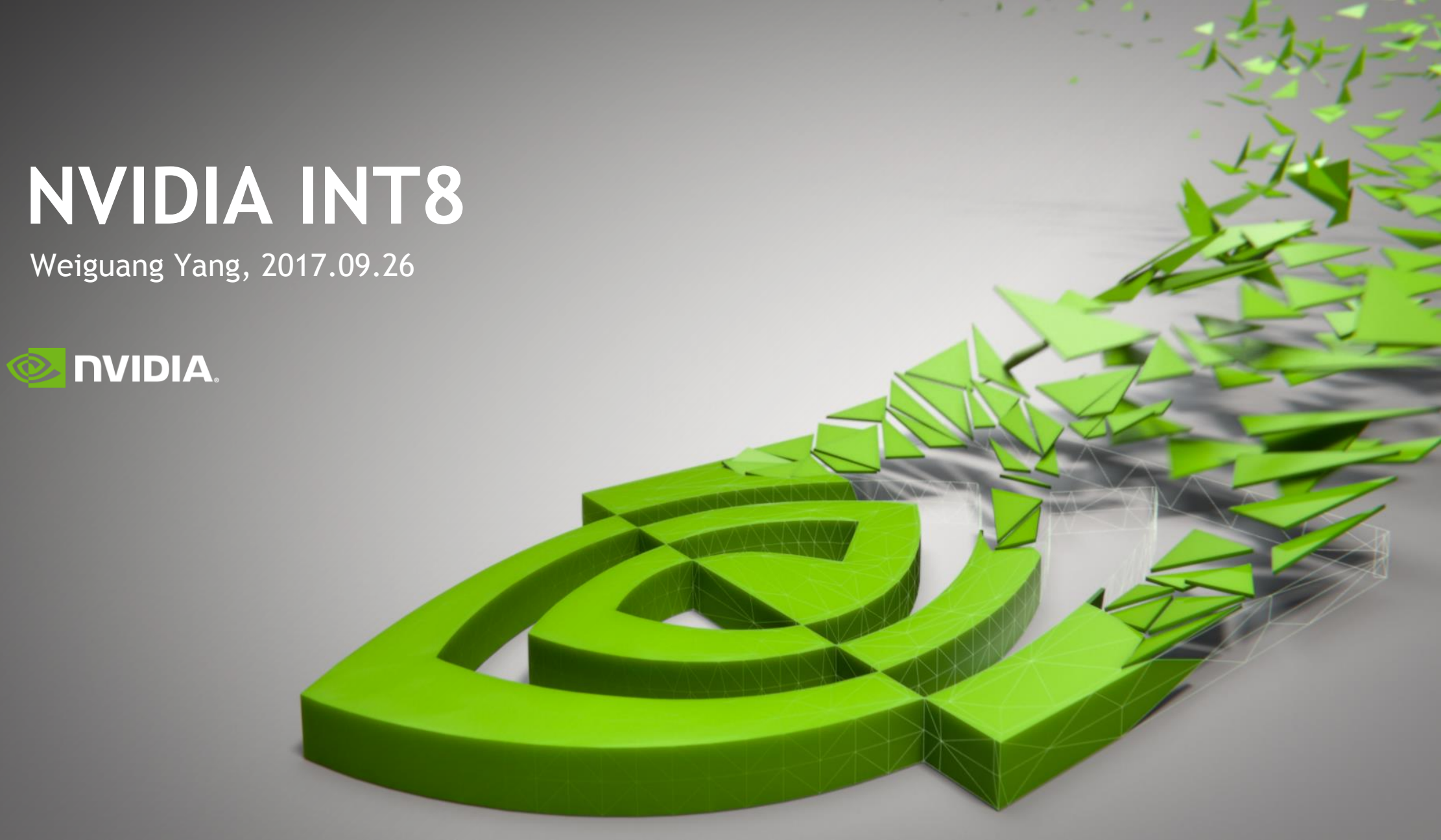
NVIDIA INT8

Weiguang Yang, 2017.09.26



NVIDIA INT8

GTC China 2017 Community Corner

什么是 NVIDIA INT8？

为什么要使用INT8加速？

如何使用 NVIDIA INT8？

INT8 最大的挑战是什么？

评价 NVIDIA INT8的两种使用方式

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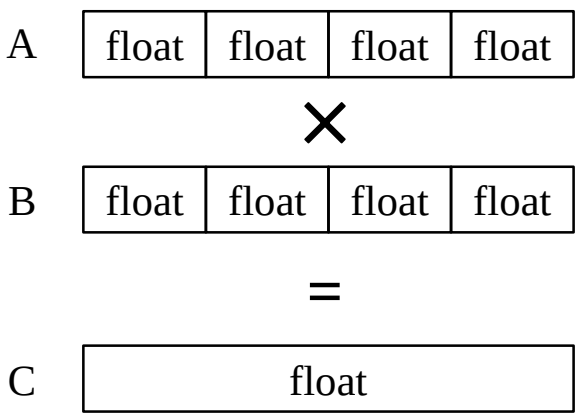
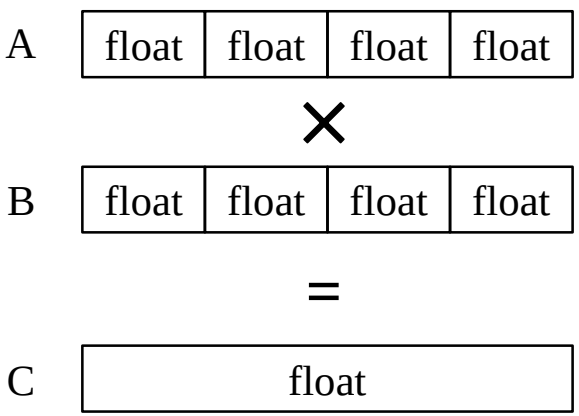
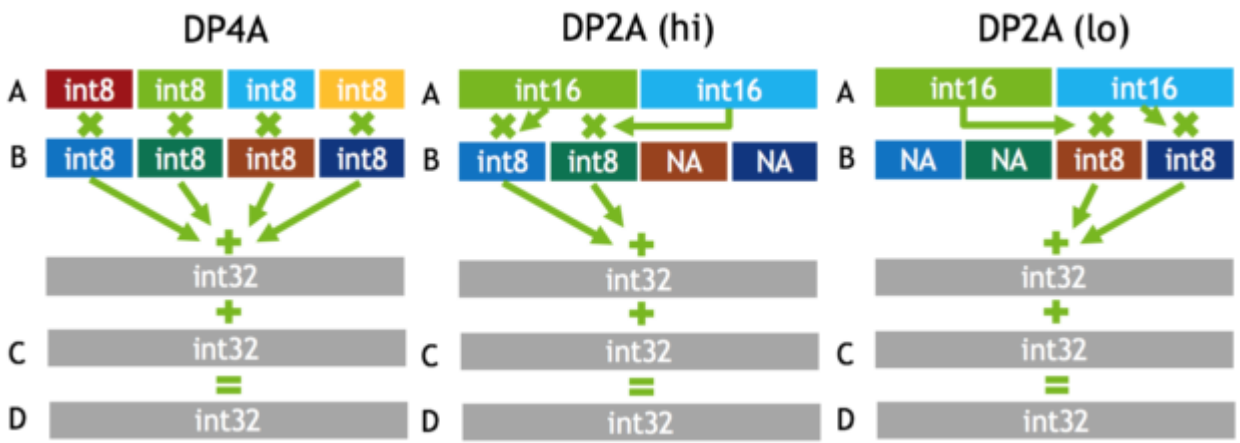


四次乘法+四次加法

https://devblogs.nvidia.com/parallelforall/mixed-precision-programming-cuda-8/

什么是 NVIDIA INT8 ?





High Performance with Low-Precision Integers

四次乘法+四次加法

一次dp4a

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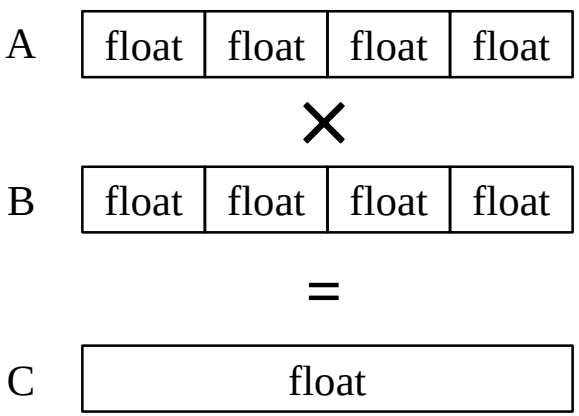

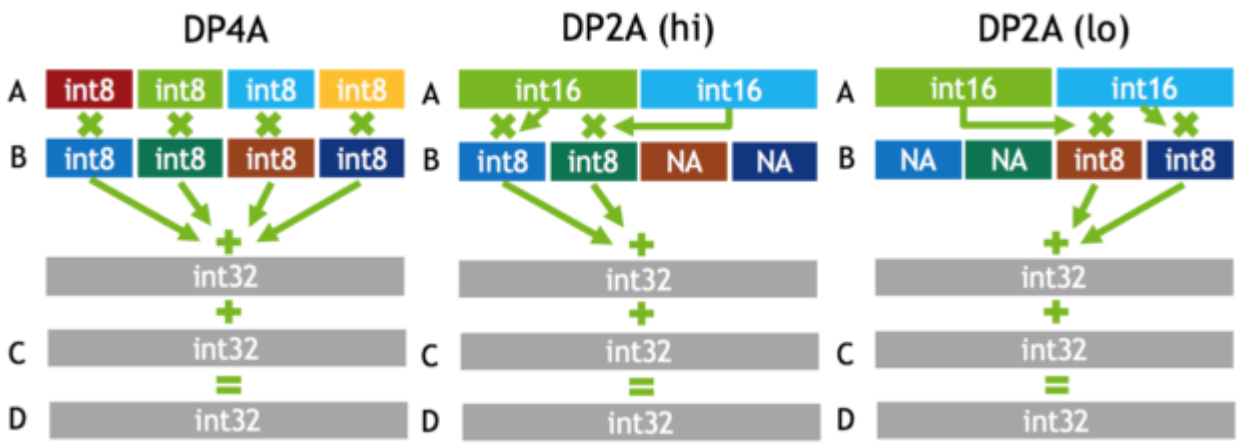

High Performance with Low-Precision Integers

四次乘法+四次加法

理论上4倍加速

模型压缩75%

一次dp4a

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为什么要使用INT8加速？

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线上推理的计算压力随着用户群体的增大而增大

移动端、嵌入式设备内存和计算资源不足

模型越来越大

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INT8加速技术可以有效缓解这些问题

使用INT8加速技术对深度学习模型进行加速是非常必要的

INT8 加速技术成功案例

硬件

Google TPU

NVIDIA INT8

Intel SSE

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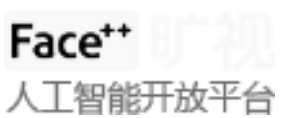
深度学习应用



微软亚洲研究院

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如何使用 NVIDIA INT8 ?

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TENSORRT

a. 神经网络线上推理加速库

b. TensorRT 1支持FP16加速，TensorRT 2支持INT8加速

CUBLAS

使用cublasGemmEx函数的CUDA_R_32I计算模式对矩阵乘进行INT8加速

CUDNN

使用cudnnConvolutionForward函数的INT8,INT8_EXT,INT8x4,INT8x4_EXT配置对卷积操作进行INT8加速

现成的库

自己动手，丰衣足食

INT8 最大的挑战是什么？

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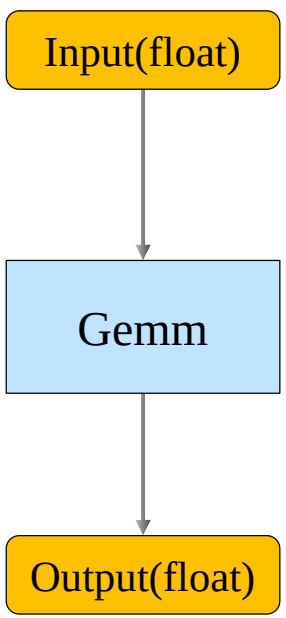
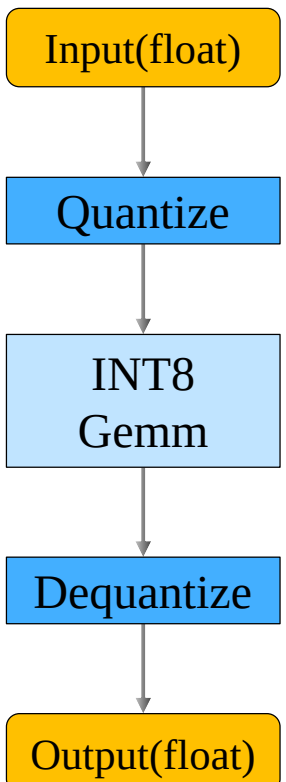
精度问题





量化(quantize)

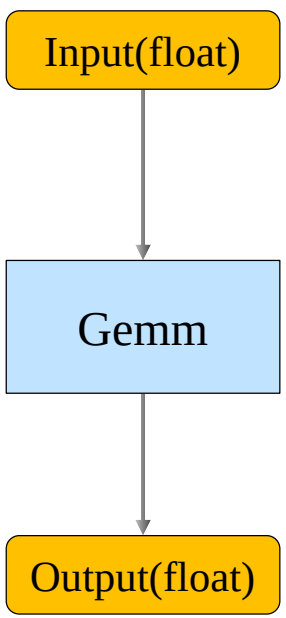
将32位浮点压缩成INT8 (char or uchar)

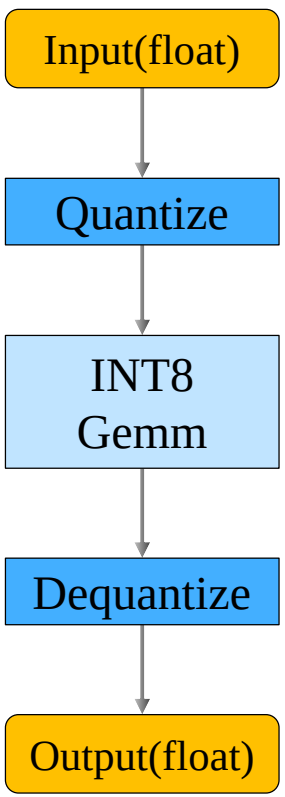
反量化(dequantize)

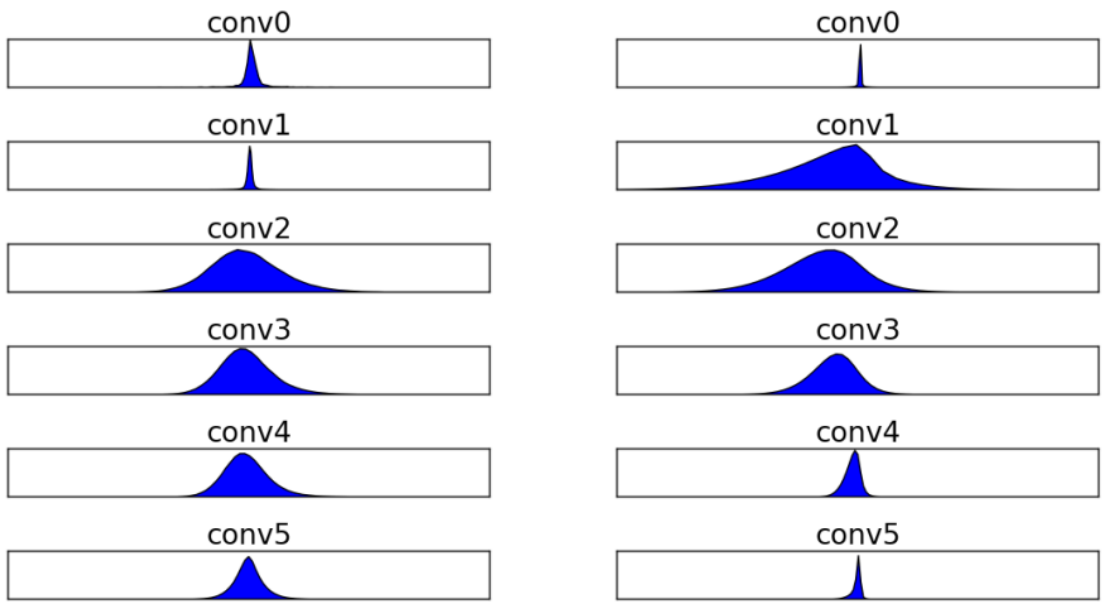
将INT8还原成32位浮点

INT8 最大的挑战是什么?

精度问题







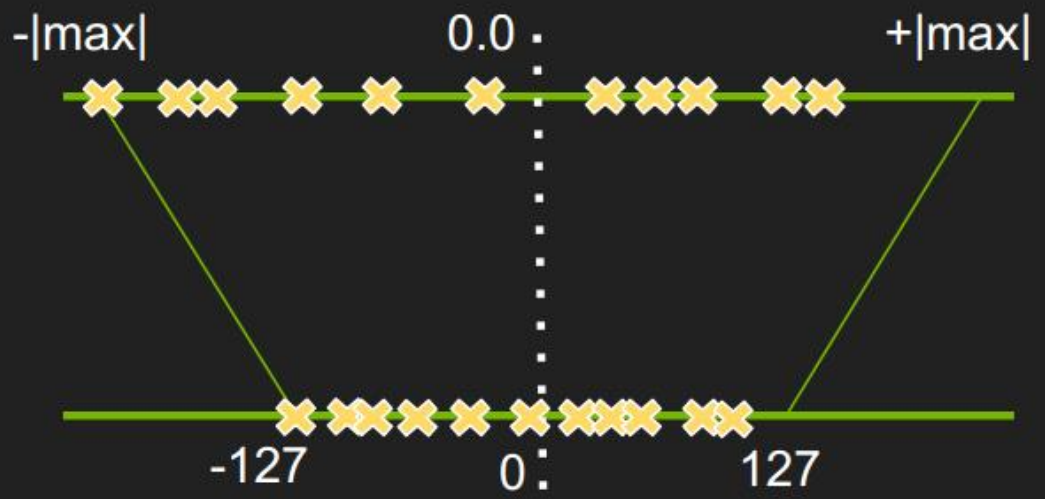
(a) Histogram of weights (b) Histogram of activations

Figure 2. Distribution of weights & activations in a DCN design for CIFAR-10 benchmark.

Lin D D, Talathi S S, Annapureddy V S. Fixed Point Quantization of Deep Convolutional Networks[J]. Computer Science, 2015.

TENSORRT INT8量化方式

- No saturation: map |max| to 127



real_value = scale * (quantized_value)

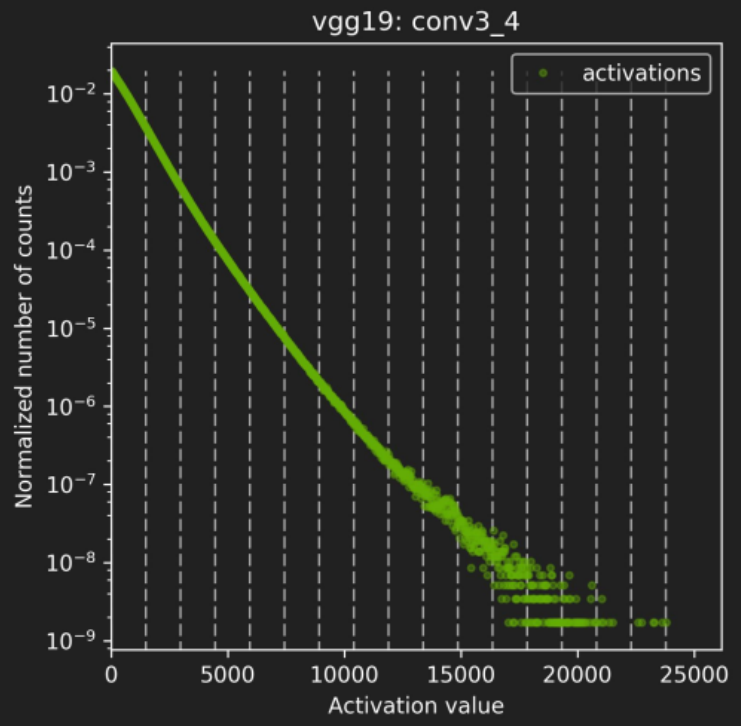
- Significant accuracy loss, in general

- Saturate above |threshold| to 127

- Weights: no accuracy improvement
- Activations: improved accuracy
- Which |threshold| is optimal?

TENSORRT INT8量化方式-解决精度问题

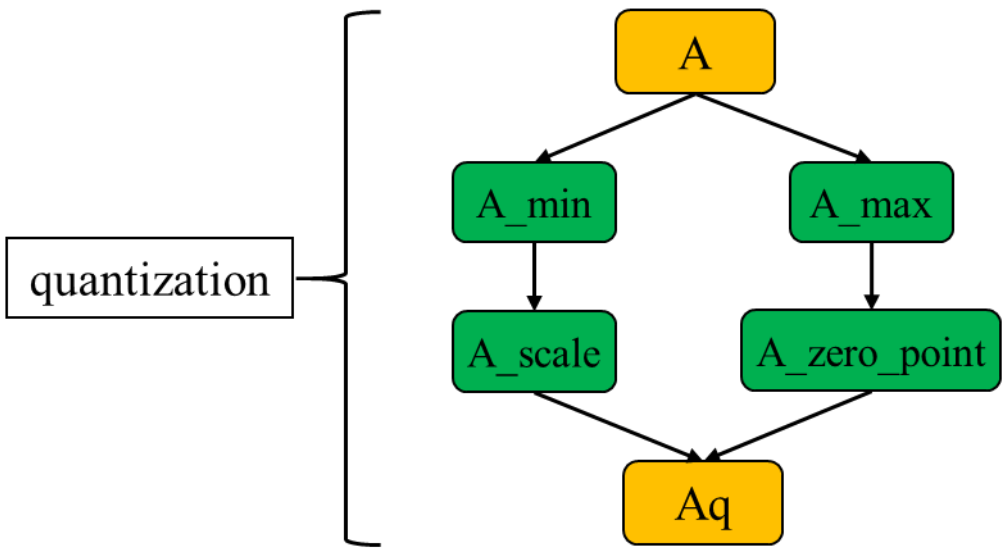
Solution: Calibration



- Run FP32 inference on Calibration Dataset.
- For each Layer:
  - collect histograms of activations.
  - generate many quantized distributions with different saturation thresholds.
  - pick threshold which minimizes KL_divergence(ref_distr, quant_distr).
- Entire process takes a few minutes on a typical desktop workstation.

TENSORFLOW INT8量化方式

real_value = scale * (quantized_value - zero_point)



优点：精度损失更低，适用范围更广

缺点：流程较复杂，损失一定的性能提升

https://petewarden.com/2016/05/03/how-to-quantize-neural-networks-with-tensorflow/

评价 NVIDIA INT8的两种使用方式

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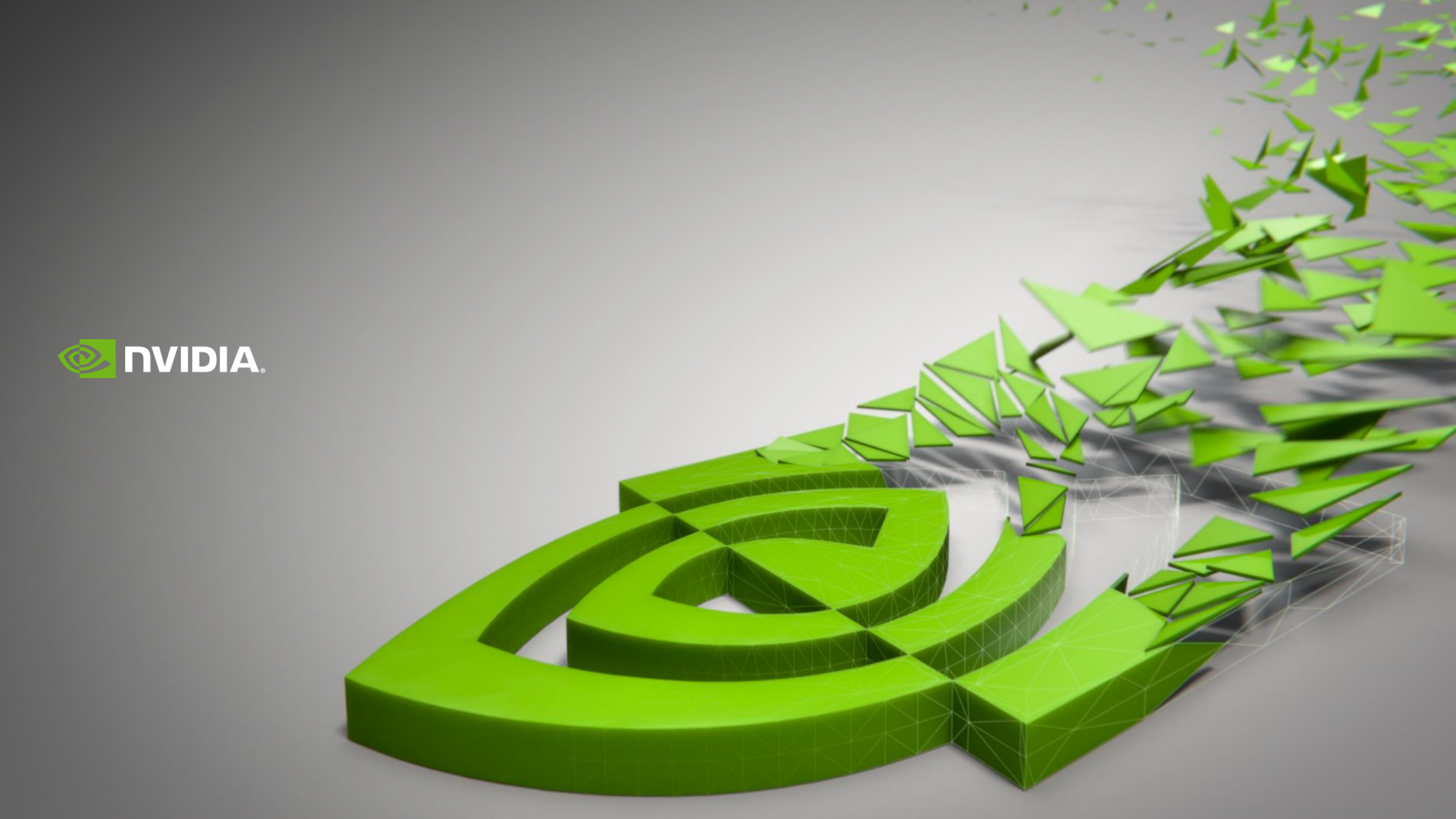
	优点	缺点
TensorRT	开发成本低 性能提升有保障	灵活性低 闭源软件且比较新，文档资料少
自己动手，丰衣足食	灵活性强，适用于复杂情况	开发成本高

TensorRT Tutorial：https://github.com/LitLeo/TensorRT_Tutorial

Source: Source information is 8 pt, italic


NVIDIA