Week3 Report

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1. Another Version of XNOR-NET(with CUDA code in C++)

Situation:

- Meet some bug in compiling the make file. Therefore, the *binop* and related files can not be compiled.

2. Backpropagation of quantization neural network

Situation:

- 通过对 xnor-net 以及 Binarized neural network 这两篇文章的阅读，以及 xnor-net 的 Pytorch 版本的代码学习，已经大致理解其传播过程

3. Report Learning curve of CIFAR-10 of XNOR-NET

Situation:

- 与第一部分任务相同

No.

Date

Deep Learning with Limited Numerical Precision (2015 ICML)

- Abstract
  - 16-bit wide fixed-point number representation
  - Stochastic rounding (SR)

3. Limited Precision Arithmetic

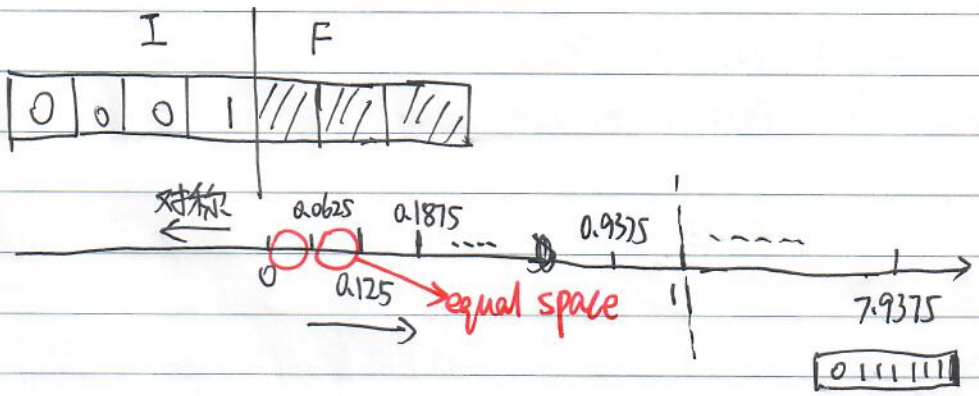
- Standard training via BP: Using 32-bit floating-point representation of real numbers for storage and manipulation.

通用的浮点数表示方法: [QI.QF]

- 总位数 = ILen + FLen = WL
- ε: Smallest positive number that may be represented in the given fixed-point format.
- Range: $[-2^{IL-1}, 2^{IL-1} - 2^{-FL}]$ $\varepsilon = 2^{-FL}$

  ↳有1个符号位

3.1 Rounding Modes (高精度浮点数 → 低精度定点数)



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□ Round to nearest:

$$\text{Round}(X, \langle IL, FL \rangle) = \begin{cases} \lfloor X \rfloor & , \text{if } \lfloor X \rfloor \le X \le \lfloor X \rfloor + \frac{\varepsilon}{2} \\ \lfloor X \rfloor + \varepsilon & , \text{if } \lfloor X \rfloor + \frac{\varepsilon}{2} < X \le \lfloor X \rfloor + \varepsilon \end{cases}$$

□ Stochastic Rounding: The probability of rounding X to $\lfloor X \rfloor$ is proportional to the proximity (距离) of X to $\lfloor X \rfloor$.

$$\text{Round}(X, \langle IL, FL \rangle) = \begin{cases} \lfloor X \rfloor, & \text{w.p. } 1 - \frac{X - \lfloor X \rfloor}{\varepsilon} \\ \lfloor X \rfloor + \varepsilon, & \text{w.p. } \frac{X - \lfloor X \rfloor}{\varepsilon} \end{cases}$$

○ 3-2 Multiply and accumulate (MAC) operation

□ Step 1. Compute $z = \sum_{i=1}^{d} a_i b_i$

□ step 2. $c_0 = \text{Convert}(z, \langle \hat{IL}, \hat{FL} \rangle)$