$$\underset{(m)}{y} = \underset{(m,n)}{A}\,\underset{(n)}{x} + \underset{(m)}{b} \qquad Z = \mathrm{ReLU}(y)$$

$$\hat{y} \times y_{scale} = A_q \, A_{scale} \, \hat{x} \, x_{scale} + b$$

Define $\hat{y} = y_q - y_{zero}$, $\hat{x} = x_q - x_{zero}$

$\hat{z} = z_q - z_{zero}$

$$\hat{y} = \frac{A_{scale}\, x_{scale}}{y_{scale}} \cdot A_q \hat{x} + \frac{b}{y_{scale}}$$

Given a constant S.

1. Approximate: $\dfrac{A_{scale}\; x_{scale}}{y_{scale}} \approx u \times 2^{-S}$

$$\frac{b}{y_{sale}} \approx v \times 2^{-S}$$

Define $\underset{(m,n)}{\tilde{A}} = \underset{(m,n)}{A_q} \cdot \underset{(m)}{u}$

$$\underset{(m,)}{\hat{y}} = \Big(\underset{(m,n)}{\tilde{A}}\ \underset{(n,)}{\hat{x}} + \underset{(m,)}{v}\Big) \times \underbrace{2^{-S}}_{\text{constant}}$$

A_{scale} : $(m,)$

x_{scale} : $(\,)$

y_{sale} : $(\,)$

u : $(m,)$

b : $(m,)$

v : $(m,)$

Because $\hat{y}$ is already subtracted by y_{zero}

$$\hat{z} = \mathrm{ReLU}(\hat{y}) = \mathrm{ReLU}\left[\left(\tilde{A}\,\hat{x} + v\right) \times 2^{-S}\right]$$