QUIC-FL: Quick Unblased Compression for Federated Learning

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The DME Problem

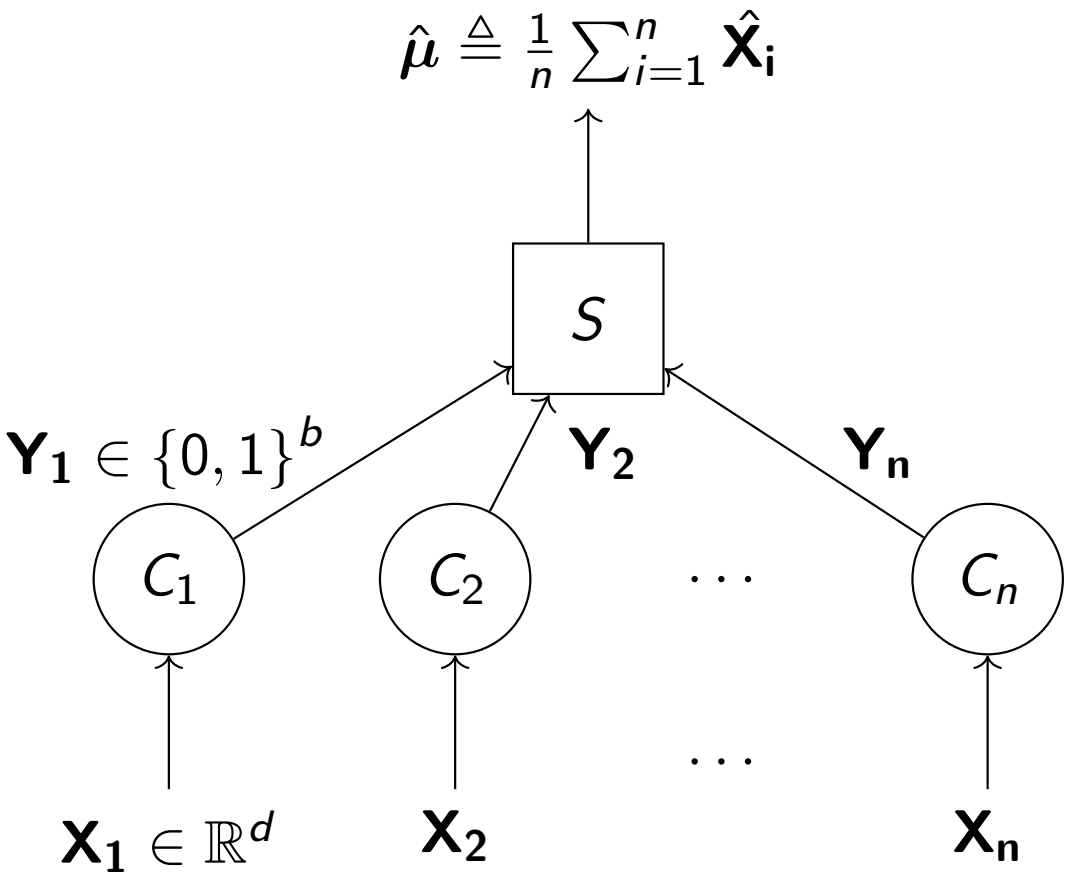

Figure 1: Illustration of the DME Problem. Here, $\hat{\mathbf{X}}_\mathbf{i}$ denotes the server estimate for $\mathbf{X}_\mathbf{i}$.

vNMSE and NMSE

1. The *vector Normalized Mean Square Error* of $\mathbf{x}$ is defined as

$$\mathrm{vNMSE}\left(\mathbf{x}\right) \triangleq \frac{\mathbb{E}\left[\left\|\hat{\mathbf{x}}-\mathbf{x}\right\|_2^2\right]}{\left\|\mathbf{x}\right\|_2^2}. \tag{1}$$

   It is normalized with respect to the L_2-norm of $\mathbf{x}$.

2. The *Normalized Mean Square Error* in the case of the DME problem is defined as

$$\mathrm{NMSE} \triangleq \frac{\mathbb{E}\left[\left\|\hat{\boldsymbol{\mu}}-\boldsymbol{\mu}\right\|_2^2\right]}{\frac{1}{n}\sum_{i=1}^{n}\left\|\mathbf{x_i}\right\|_2^2} = \frac{\mathbb{E}\left[\left\|\hat{\boldsymbol{\mu}}-\frac{1}{n}\sum_{i=1}^{n}\mathbf{x_i}\right\|_2^2\right]}{\frac{1}{n}\sum_{i=1}^{n}\left\|\mathbf{x_i}\right\|_2^2}. \tag{2}$$