

# AsynFL

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## 1 Introduction

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**Algorithm 1:** Server update model

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**Data:**  $\alpha_k$  data quality of dataset  $k$  ( $\sum \alpha_k = 1$ ), pre-train model  $W_p$ ,  $t$   
time to update,  $Q$ : queue to store the model of clients  
 $W_0^g \leftarrow W_p$ ;  
notify\_client();  
 $i \leftarrow 0$  ; /\* Global model update version \*/  
**while** *training* = *True* **do**  
    **if**  $Q$  *is empty* **then**  
        sleep( $t$ );  
    **else**  
         $i += 1$  ;  
         $W_i^g = \frac{1}{\|Q\|} \sum \frac{\alpha_k}{i-j} W_j^k$  ;   /\*  $k$  is client,  $j$  is global model  
        version that client has been updated in local. \*/  
        notify\_client()  
    **end**  
**end**  
**end**

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**Algorithm 2:** Client update model

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**Data:**  $D$ : dataset,  $\alpha \in (0, 1)$   
 $W_0^l \leftarrow W_t^g$  ;                      */\* Get latest global model from server \*/*  
 $stop \leftarrow False$  ; */\* Training may be stopped by server or user \*/*  
**while**  $stop = False$  **do**  
    **foreach**  $d_i \in D$  **do**  
        **if** *receive new global model from server* **then**  
            */\* merge models \*/*  
            */\* Let  $W_j^g$  be global model at update step  $j$  \*/*  
             $g_{d_i} \leftarrow$  gradient of  $W^l$  at  $d_i$ ;  
             $W_{d_i}^l \leftarrow$  apply  $g_{d_i}$  to  $W^l d_{i-1}$ ;  
             $e \leftarrow W_j^g - W_{d_i}^l$ ;  
             $W_{d_i}^l \leftarrow \begin{cases} W_j^g & \text{If } g_{d_i} * e \geq 0 \\ (1 - \alpha) * W_j^g + \alpha * W_{d_i}^l & \text{otherwise} \end{cases}$   
        **else**  
            */\* Update model by gradient descent \*/*  
        **end**  
    **end**  
    send  $W_j^l$  to server;  
**end**

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