BYZANTINE ROBUSTNESS AND PARTIAL PARTICIPATION CAN BE ACHIEVED SIMULTANEOUSLY: JUST CLIP GRADIENT DIFFERENCES

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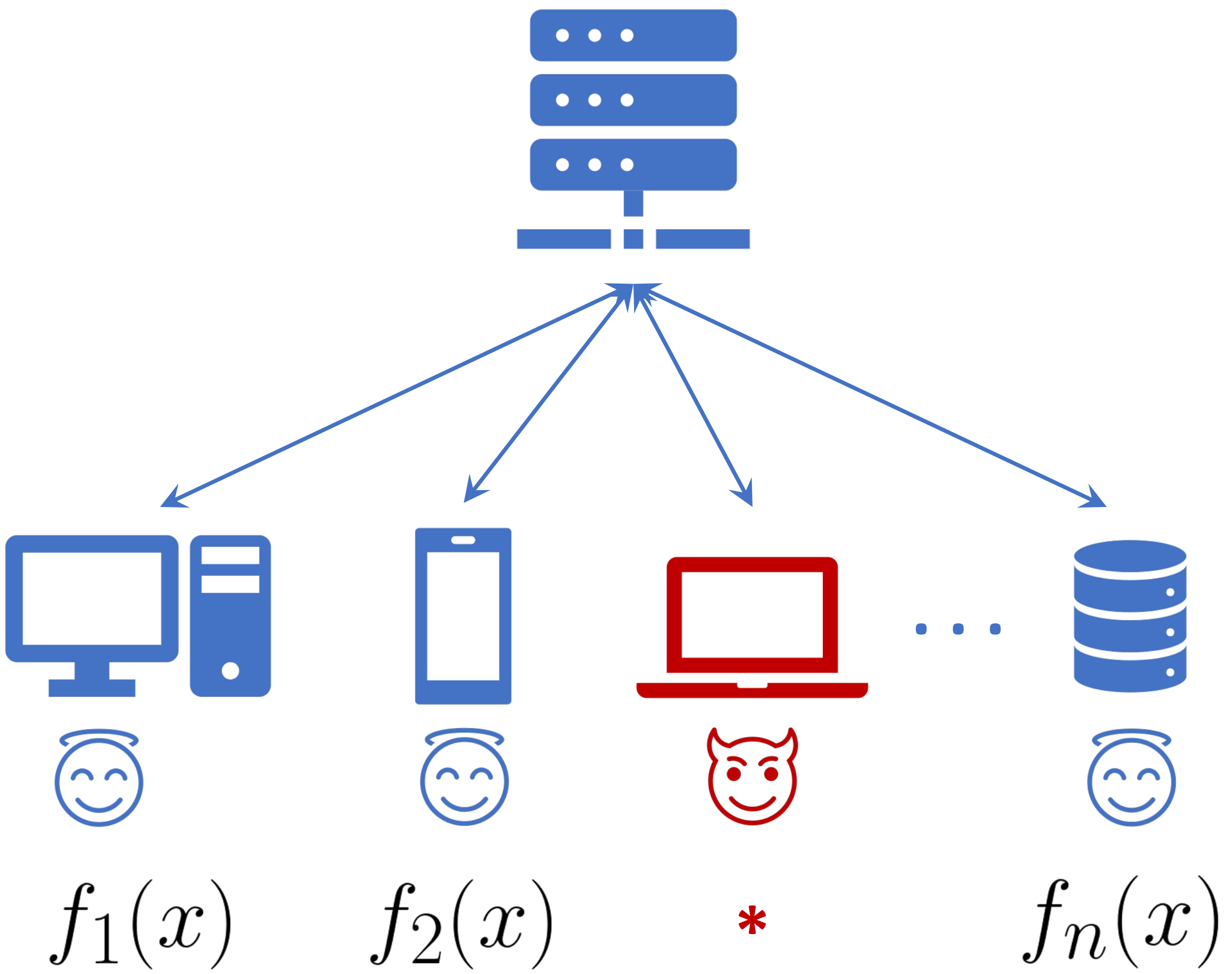
Refined Problem Formulation



$$\min_{x \in \mathbb{R}^d} \left\{ f(x) := \frac{1}{G} \sum_{i \in \mathcal{G}} f_i(x) \right\}$$

Good workers form the majority:

- $\mathcal{G}$ – good workers
- $\mathcal{B}$ – Byzantines (see the page "Byzantine fault" in Wikipedia)
- $\mathcal{G} \sqcup \mathcal{B} = [n], \ \ |\mathcal{G}| = G, \ \ |\mathcal{B}| = B$
- $B \leq \delta n, \ \ \delta < {}^{1}/_{2}$
- Byzantines are omniscient

Partial Participation of clients

$$\min_{x\in\mathbb{R}^d}\left\{f(x) := \frac{1}{G}\sum_{i\in\mathcal{G}} f_i(x)\right\}$$

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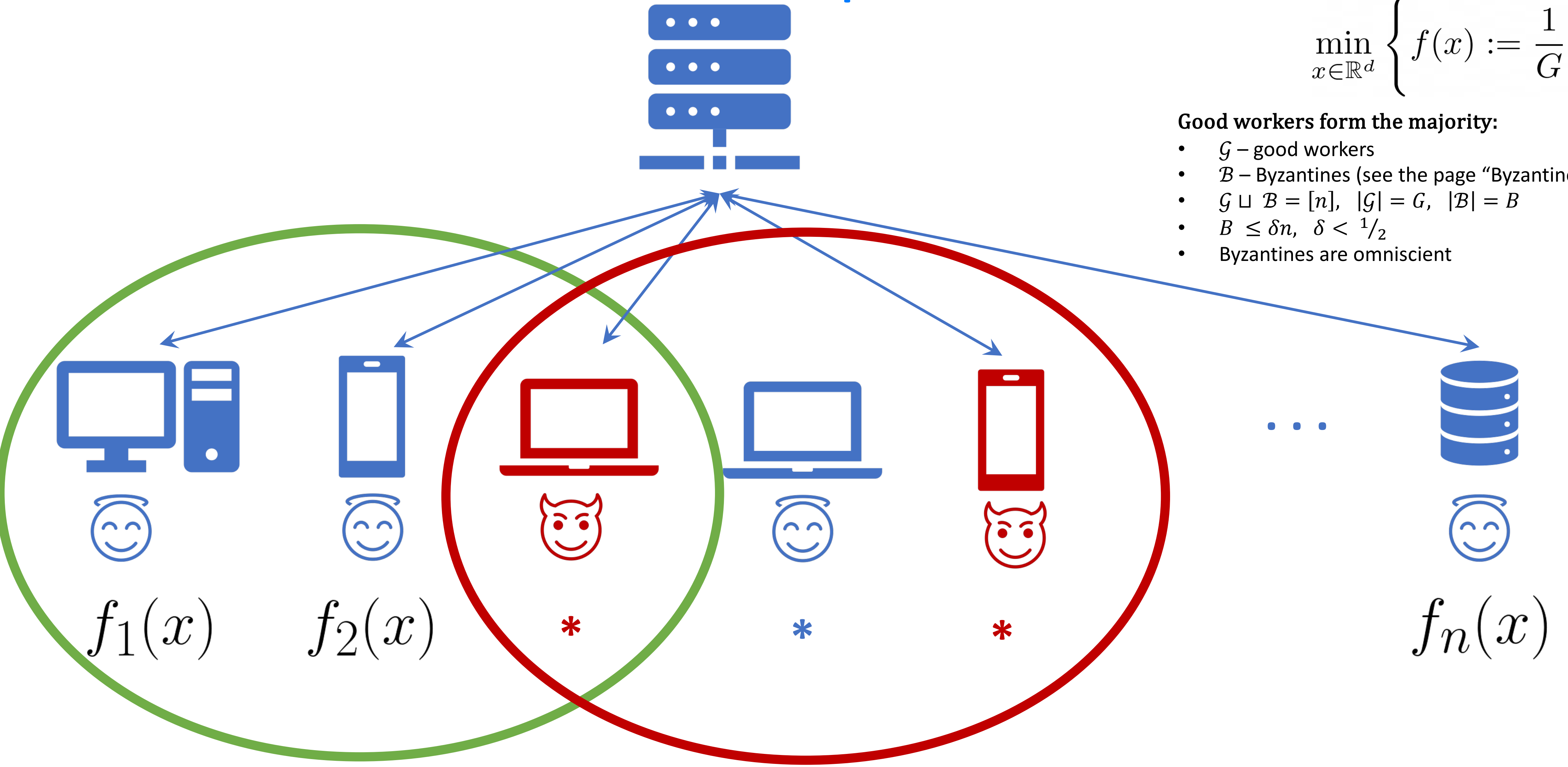

Question: how to solve such problems?

Remedy to majority of Byzantines

$$\min_{x\in\mathbb{R}^d}\left\{f(x) := \frac{1}{G}\sum_{i\in\mathcal{G}} f_i(x)\right\}$$

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Clipping of updates

$$\mathrm{clip}_{\lambda_{k+1}}\left(\nabla f_i(x^{k+1}) - \nabla f_i(x^k)\right)$$

Level of clipping

$$\lambda_{k+1} = \alpha_{k+1}\left\|x^{k+1} - x^k\right\|$$

Lipschitz smoothness

$$\|\nabla f_i(x) - \nabla f_i(y)\| \leqslant L_i\|x - y\|$$

Byz-VR-MARINA-PP

Contributions

1. Application of clipping to Byz-VR-MARINA

2. General non-convex and PL analysis

3. Additional variants of algorithm

4. General framework

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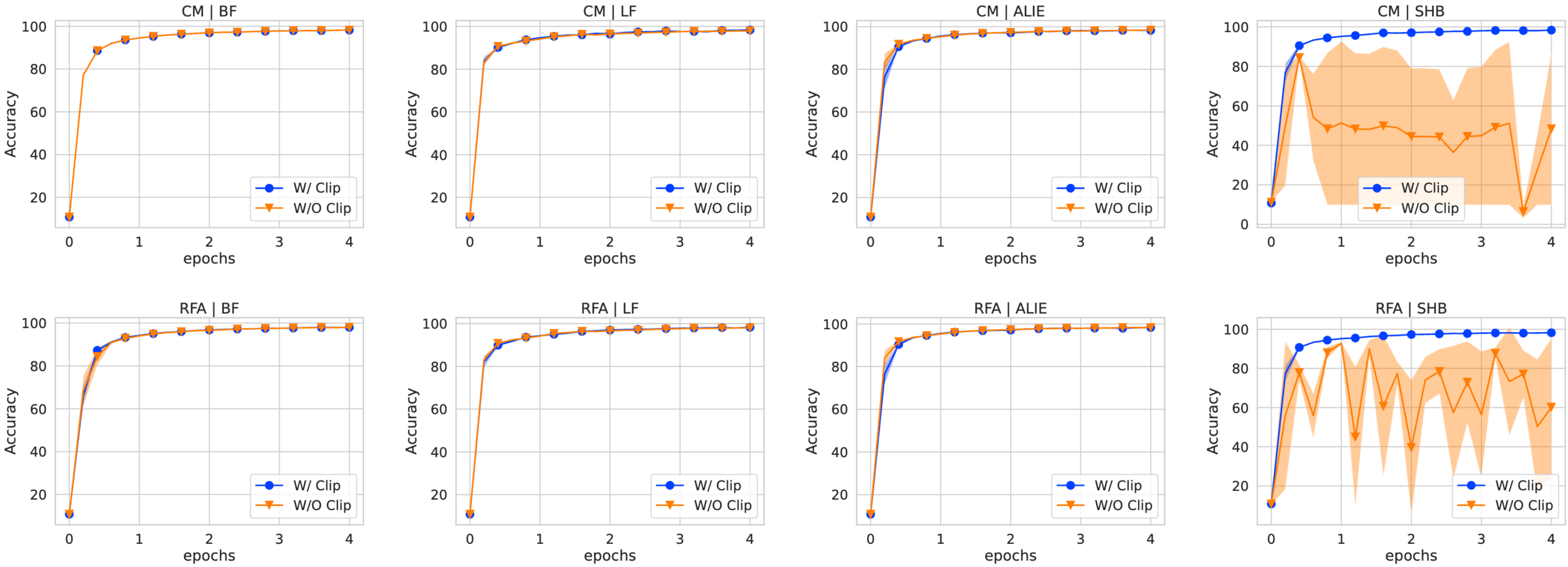
Numerical Results: Neural Network Training



- Clipping does not spoil the convergence
- Clipping helps when Byzantine workers form majority (see SHB attack)