Outline

Federated Learning

- Data transfer, data privacy

A more complex slide

This slide illustrates the use of Beamer blocks. The following text, with its own headline, is displayed in a block:

Theorem (Org mode increases productivity)

- *org mode means not having to remember LaTeX commands.*
- *it is based on ascii text which is inherently portable.*
- *Emacs!*

□

Hedonic Game (Game theoretic approach)

- different distributions
- join only for benefit

Model of federated learning

- Error model for
  - Uniform federation
  - Coarse-grained federation
  - Fine-grained federation
- Explain these different types of federation

Stability

Uniform Federation

- Same number of samples
- Small/large number of samples

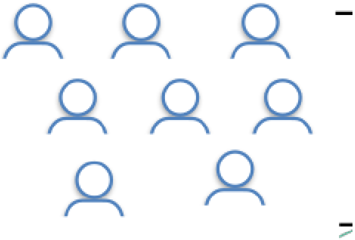
Coarse-grained federation

- Same number of samples
- Small/large number of samples

Fine-grained federation

- this is fine grained company
- this is fine grained company
- this is fine grained company

Example (Fine grained image)



Optimality

- Optimal: minimizes weighted sum of errors across all agents
- Algorithm:
  - Start with every agent doing local learning
  - Group the agents togetner in ascending order of size, stopping when the first agent would increase its error by joining the coalition
- Equivalence of player preference and reducing cost
- Error model taken from the paper "Model sharing games" by the same author
- Swapping
- Monotonicity of joining
- Monotonicity of leaving
- Merging
- Model

$$\hat{\theta}_C = \frac{1}{\sum_{i \in C} n_i} . \sum_{i \in C} n_i . \hat{\theta}_i$$

$$err_j(C) = \frac{\mu_e}{\sum \cdots} + \sigma^2 . \frac{\sum_{i \in C, i \neq j} n_i^2 + \left(\sum_{i \in C, i \neq j} n_i \right)^2}{\cdots}$$

Price of Anarchy

- for $n_i \geq \frac{\mu_e}{\sigma^2}, \forall i$, the grand coalition π_g is always core stable
- for $n_i \leq \frac{\mu_e}{\sigma^2}, \forall i$, the individually stable or core stable is also optimal
- Π_M is maximum cost IS partition, then $err_i(\Pi_M) \leq \frac{\mu_e}{n_i}$ for all players i
- Error lower bound when a player j joins coalition C

$$err_j(C \cup \{n_j\}) \geq \begin{cases} \frac{1}{2} . \frac{\mu_e}{n_j}, n_j \geq \frac{\mu_e + \sigma^2}{2\sigma^2} \\ \sigma^2, \text{otherwise} \end{cases}$$

- Error upper bound when a player j joins coalition C if total number of samples $N_C \geq \frac{\mu_e}{3\sigma^2}$, then

$$err_j(C \cup \{n_j\} \leq 7.25 . \sigma^2$$

- $n_i \leq \frac{\mu_e}{3\sigma^2}, \forall i$, with atleast one player in a coalition with mass of its partners no more than $\frac{\mu_e}{3\sigma^2}$, then the only stable arrangement of these players is to have all of them federating together
- Price of Anarchy

Limitations

- Theoretical study, results might be different in practice
- Optimality bound has some assumptions, this may lead to different bounds

Related Work

- Donahue and Kleinberg studied models of fairness
- Hu et al. 2023 models clients behaviour in network
- Cui et al 2021 tries to find collaboration equilibrium
- Le et al. 2021 analyzes incentives for agents to contribute computational resources while using an auction approach

My extension

- Nothing as of now

Conclusion

Thank You