CS-E4740 Federated Learning

"FL Project"

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FL Project

pick any application you like and model it as a FL problem

you must:

- define/choose local datasets (train/val/test sets)
- define/choose local models
- define/choose loss functions
- define/choose edges and their weights
- define/choose discrepancy measure

Local Datasets

each local dataset $\mathcal{D}^{(i)}$

```
G.nodes[node_i]["ytrain"]
G.nodes[node_i]["Xtrain"]
```

consists of a

- train set: used to define local loss in GTVMin
- val set: used to select local models and/or edges
- test set: used for final performance assessment

Local Models

- local dataset $\mathcal{D}^{(i)}$

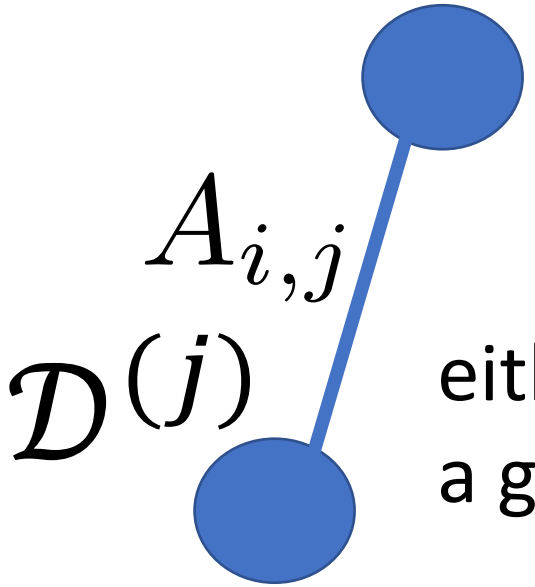
  local model can be anything listed in MyCourses Section “FL Project”

```
Gin.nodes[node_i]["model"] = DecisionTreeRegressor(max_depth=4)
```

where did we choose loss function here?

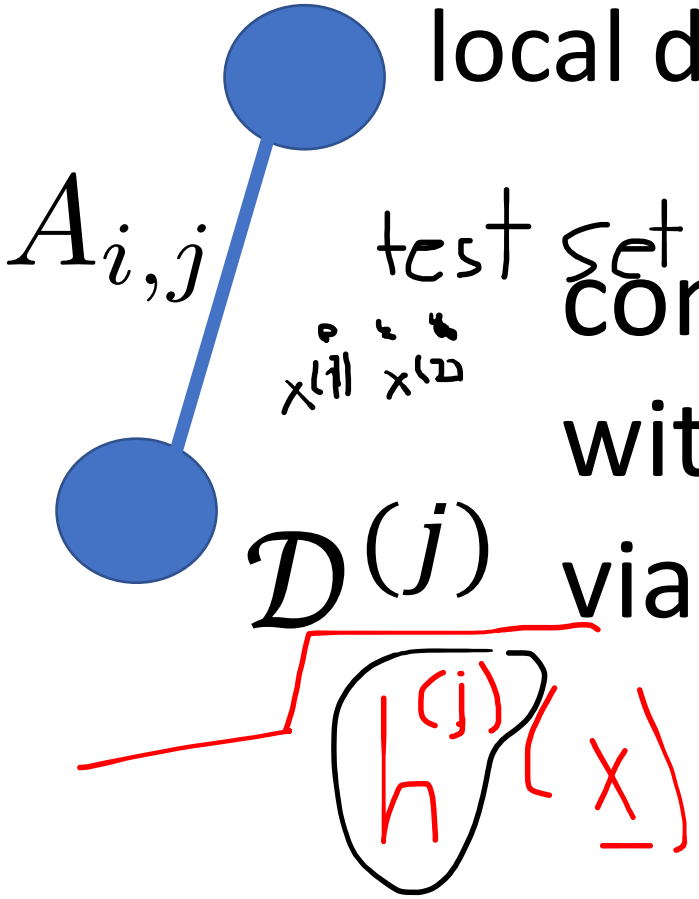
Choose Edges and Weights

local dataset $\mathcal{D}^{(i)}$



either choose manually (using your domain expertise) or a graph learning method (see Sec. 7.5 of lecture notes)

Discrepancy Measure (Variation)

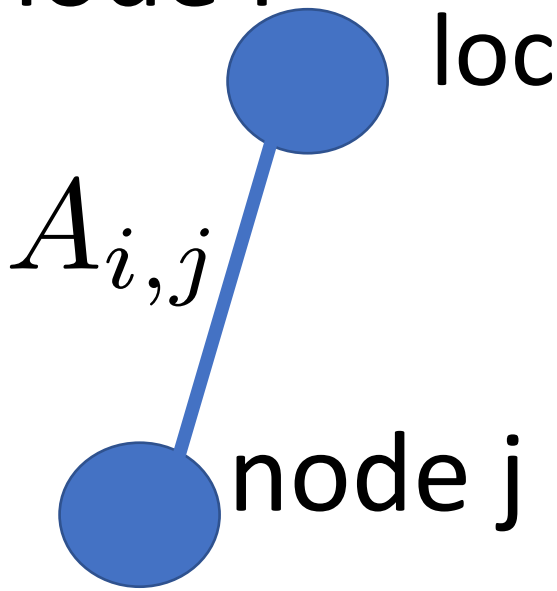


local dataset $\mathcal{D}^{(i)}$

compare local hypothesis at node i with local hypothesis at node j via some discrepancy measure

$$\mathrm{d}\left(\boldsymbol{h}^{(i)}, \boldsymbol{h}^{(j)}\right)$$

Variation of Parametric Models

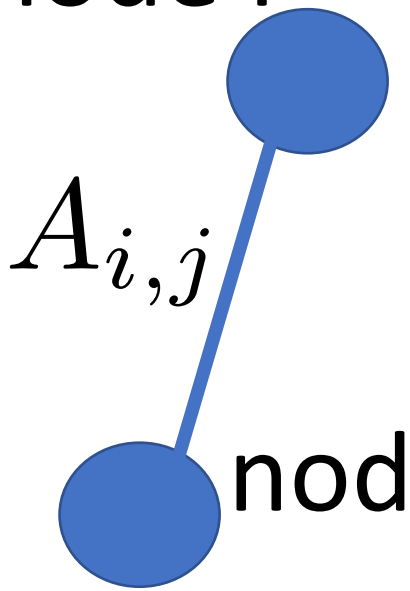


local model param. vec. $\mathbf{w}^{(i)}$

$$\mathrm{d}\left(\boldsymbol{h}^{(i)}, \boldsymbol{h}^{(j)}\right) = \left\| \mathbf{w}^{(i)} - \mathbf{w}^{(j)} \right\|^2$$

local model parameters $\mathbf{w}^{(j)}$

Variation of Non-Param. Models



local hypothesis map $\boldsymbol{h}^{(i)}$

$$\mathrm{d}\left(\boldsymbol{h}^{(i)}, \boldsymbol{h}^{(j)}\right)$$

local hypoth. $\boldsymbol{h}^{(j)}$

Putting Together the Pieces

$$\min_{\mathbf{w}} \sum_{i} L^{(i)}\left(\mathbf{w}^{(i)}\right) + \lambda \sum_{\{i,j\}} A_{i,j}\, \mathrm{d}\left(\boldsymbol{h}^{(i)}, \boldsymbol{h}^{(j)}\right)$$

$\sum_{n[i]} (y^{(i)} - \mathbf{w}^T x^{(i)})^2 + \alpha \|\mathbf{w}\|_2^2$

Ridge Regression

FedRelax

FedSGD

FL Algos obtained by applying (very) well-known optimization methods to solve this GTVMin [1, Sec. 9]

FL Project Credits and Grades

- extends course from 5 to 10 credits
- project points P2 (max. 80 report/max 20 review)
- basic variant points P1 (max 100)
- grade for 10 credit variant determined from

½ (P1 + P2)

1: 50-59; 2: 60-69; 3: 70-79; 4: 80-89; 5: 90-

FL Project Deliverables

- project teams of max. three students
- each student submits project report + notebook
- peer grading during 15 – 31.05.2023
- final submission = project report + python notebook + response to peer reviews

FL Project Schedule

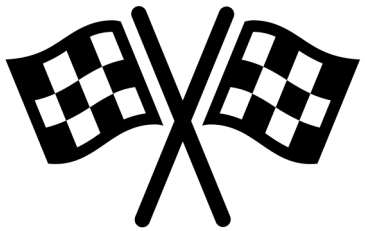
now

prepare project report +
notebook with experiments

15.05.2023

peer review

31.05.2023



revise project report +
notebook with experiments
prepare response letter

1. Introduction
2. Problem Formulation
3. Methods
4. Results
5. Conclusion

1. Introduction

- describe application domain
- summarize existing work
- outline of paper

2. Problem Formulation

provide qualitative description of local datasets:

- what are datapoints? [2, Ch. 2]
- what is the quantity of interest (label)? [2,Ch. 2]
- what is the data source ?
- intrinsic similarity betw. local datas.? [1, Sec. 6]

3. Methods

- how data split into train/val/test set? [2, Ch. 6]
- which local models/local loss and why those?
- which discrepancy measure ? [1, Sec. 7.1, 7.4]
- which FL algorithm used ? [1, Sec. 9]
- how did you validate trained models? [2, Ch. 6]

4. Results

- report train/val errors for each local model
- diagnose FL algorithm [2, Ch. 6.6.]
- final choice for edge weights, GTVMin param. λ
- final chosen local models and their test errors?

5. Conclusion

- recap your findings during the project work
- ponder about limitations and possible improvements

References

[1] AJ, “Lecture Notes CS-E4740”, 2023

[2] AJ, “Machine Learning: The Basics,”, Springer, 2023

Peer Review Questions

draft for you to comment: click here

revise report and notebook based on peer review

Final Submission:

- revised report (pdf)
- revised notebook with experiments (ipynb)
- response letter that explains how you used the peer review (sample)

Thank you for your attention!