

Shenglai Zeng

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RESEARCH INTEREST

I am a third-year undergraduate student at the University of Electronic Science and Technology of China. My research interests include federated learning, edge computing, and intelligent networks. I am also willing to try some new directions in the future like Game Theory/Metaverse .

EDUCATION

University of Electronic Science and Technology of China

Chengdu, China

Yingcai Honor School/B.Sc in Computer Science and Engineering

Sept 2019-Present

CGPA: 4.00/4.00

Weighted Average: 93.97/100(2th among 100 students)

Courses taught: Mathematical Analysis, Linear Algebra, Discrete Mathematics, Random mathematics, Signal and System, Digital Design and Computer Architecture, Computer Organization, Computer Network, Database Management System, Operating System, Artificial Intelligence, Theory of Computation, Algorithm and Data Structure, Computer Fundamentals

RESEARCH EXPERIENCE

Intelligent Networking and Applications Research Center, UESTC

Chengdu, China

Research Assistant/Research on the Optimization of Federated Learning

Sept 2020 - Present

-Mentor: Professor Hongfang Yu and Dr.Zonghang Li

- Proposed a novel idea of Sequential-to-Parallel training in FL.
Paper accepted by DASFAA 2022(First author): *Heterogeneous Federated Learning via Grouped Sequential-to-Parallel Training*.
- Designed a hierarchical FL system with novel user management architecture and training strategy.
National patent under verification(First inventor): *A Hierarchical User Training Management Architecture and Training Strategy for Non-i.i.d Data*.
- Reproduced the LEAF benchmark and change the original code (TensorFlow version) to Pytorch version.
(<https://github.com/slz-ai/leaf-torch>)
- Currently developing a dynamic and communication efficient federated learning framework suitable for streaming data in Industrial IoT.

The Pennsylvania State University

Pennsylvania, USA

Online Intern/Research on Semi-supervised Federated Learning

Jun 2021 - Present

-Mentor: Professor Fenglong Ma

- Implemented a semi-supervised federated learning system combined with novel personalized punning and structure-aware collaborative distillation techniques.
Paper submitted to CIKM 2022(Second Author)
- Currently focusing on FL applications in healthcare.

The University of Chicago

Chicago, USA

Online Intern/Research on the IOT & Sensing Security

Mar 2020 - Mar 2021

-Mentor: Dr.Shinan Liu(PhD candidate)

- Tried to use audio data collected by microphone to reconstruct user's state of motion during recording time.

- Proposed a mathematical-physical model to explain the correlation between different sensors' responses to motion.

University of British Columbia(Ongoing)

Summer Intern/Research on Fully Unsupervised Federated Learning

Vancouver, Canada

Jun 2022 - Oct 2022

-Mentor: Professor Xiaoxiao Li

- MITACS exchange program. Using data shapley to do federated data evaluation.

KEY SKILLS

Programming Language	Python, C, C++, Java, Matlab
Research Tool	Latex, Overleaf
AI Framework	Pytorch, Mxnet, Tensorflow
Network	Cisco Certified Network Associate(CCNA)

PUBLICATIONS

- Shenglai Zeng**, Zonghang Li, Hongfang Yu, Yihong He, Zenglin Xu, Dusit Niyato, Han Yu
"Heterogeneous Federated Learning via Grouped Sequential-to-Parallel Training" Accepted by the 27th International Conference on Database Systems for Advanced Applications (DASFAA-2022).

Under Review

- Jiaqi Wang, **Shenglai Zeng**, Zewei Long, Yaqing Wang, Houping Xiao, Fenglong Ma "FedEPS: Efficient Personalized Semi-supervised Federated Learning" Submitted to CIKM-2022.

Patterns

- Shenglai Zeng**, Zonghang Li, Yihong He, Xun Zhang, Hongfang Yu, Gang Sun
"A Hierarchical User Training Management Architecture and Training Strategy for Non-i.i.d Data" Chinese pattern under verification, Pattern id:202110959654.7

SELECTED ACADEMIC PROJECTS

Grouped Sequential-to-Parallel Training for Heterogeneous FL(FedGSP) Mar 2021- Oct 2021

- Proposed a new concept of dynamic collaborative Sequential-to-Parallel (STP) training to improve FL model performance.
- Proposed a novel Inter- Cluster Grouping (ICG) method to assign FL clients to a pre-specified number of groups using the centroid equivalence theorem.
- FedGSP improves model accuracy by 3.7% on average, and reduces training time and communication overhead by more than 90%
- This work is accepted by DASFAA-2022. (Big thanks to Dr.Zonghang Li, Prof.Hongfang Yu, and Prof.Dusit Niyato)

FedEPS: Efficient Personalized Semi-supervised Federated Learning

Jun 2021 – Feb 2022

- This work aims to develop a applicable federated learning mechanism in semi-supervised settings, considering personalization and communication efficiency simultaneously.
- We introduced neural network pruning techniques into semi-supervised federated learning and a novel structure-aware collaborative distillation approach which can aggregate models with different structures.
- My contribution
 - a) Implemented the whole FL system for both image and text tasks.
 - b) Discussed system design according to experimental results.
 - c) Conducted comparative experiment with other baselines such as PFedMe and FedMix.
- This work is submitted to CIKM 2022, finger crossed!

A Pytorch Implementation of LEAF

Dec 2020 – Mar 2021

- LEAF is a widely used benchmark for FL, which is originally implemented by TensorFlow.
- Reproduced the work in Pytorch version for rapidly growing Pytorch community.
- Details can be found in <https://github.com/slz-ai/leaf-torch>

Reconstruct Motion with Audio Data from Microphone

Mar 2020 – Mar 2021

- This work aims at using audio data collected by microphone to reconstruct user's state of motion during recording time.
- Conduct physical experiment/mathematical modeling/machine learning to explore the correlation between sensing data(collected by gyroscope, accelerometer sensor, G-Sensor)and audio data(collected by microphone in the same panel).
- This work is led by Shinan Liu(PhD candidate of Uchicago). it's my first research project in my freshman year where I learn basic skills of scientific research.

Dedicated MCU Design for Fourier Decomposition Function

Apr 2021 – Jun 2021

- Use VHDL language to design a MCU, which is compatible of MIPS instruction set and dedicated for Fourier Decomposition.
- It's a Digital Design competition, which aims at minimizing processing speed and hardware efficiency.
- Won 1st place among participating teams

ONGOING PROJECTS

Federated Learning Framework Design for Industrial Metaverse

Feb 2022 – Present

- This work mainly focuses on the non-i.i.d streaming data collected by distributed edge devices in Industrial IoT.(e.g. OCR applications in industrial parks.)
- A dynamic FL training paradigm designed for rapidly changing streaming data while eliminating data heterogeneity.
- A knowledge maintained online learning method for FL to prevent catastrophic forgetting
- Task decomposition in federated learning to reduce communication pressure on edge networks
- This work is the extended version of FedGSP. As the first author, I will move forward with this work as soon as possible.

AWARDS AND ACHIEVEMENTS

- **National Scholarship** in the session of 2019-2020.(Highest honor of undergraduate student)
- WAC Scholarship in the session of 2020-2021.(Only 10 undergraduate students in UESTC are awarded each year)
- 1st Outstanding Academic Scholarship in 2020 and 2021.(Top 5 % students)