Curriculum Vitae – KARIMIREDDY

Personal information

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Address: INJ 338, EPFL, Lausanne CH 1015 **Phone:** (+41)786851439
Research Interests: Optimization, Collaborative (federated, decentralized) learning.

Education

EPFL Lausanne 09.2016–08.2021
PhD candidate in Computer Science
Advised by Prof. Martin Jaggi. PhD thesis defense scheduled on 15.08.2021.
Thesis title: *Optimization Algorithms for Collaborative Machine Learning.*

Indian Institute of Technology, New Delhi 07.2011–06.2016
Bachelor and Master of Technology in Computer Science
Advised by Prof. Sandeep Sen. Master thesis defended in 06.2016.
Thesis title: *Sampling Techniques in Computational Geometry.*

Employment

EPFL, Lausanne 09.2016–present
PhD in optimization for machine learning advised by Prof. Martin Jaggi.

Google Research, Remote 06.2020–08.2020
Internship hosted by Satyen Kale and Theertha Suresh.
Developed new scalable algorithms and software for federated learning.

Google Research, New York 07.2019–11.2019
Internship hosted by Satyen Kale and Sashank Reddi.
Developed new optimization methods for NLP and for federated learning.

The Broadline, New Delhi (now rebranded as Loki.ai) 05.2016–08.2016
Developed core recommendation engine and tools to assist journalists using NLP.

Microsoft Research, Bangalore 04.2015–06.2015
Worked on Multi-armed bandit problems with Shipra Agrawal.

Xerox Research Center India, Bangalore 04.2014–06.2014
Worked on distributed and privacy preserving data mining with Shailesh Vaya.

Awards

Outstanding performance bonus (thrice) awarded by EPFL. *2018, 2019, 2020*
Top Reviewer (twice) awarded at ICML and NeurIPS *2019, 2020*
Travel Awards (thrice) to present research at ICML and NeurIPS *2018, 2019, 2019*
EDIC Fellowship awarded by EPFL to selected PhD students *2016–2017*
Xerox Travel Award (twice) to present at CSCW, and PODC *2016, 2016*
Ministry of Human Resource Development Scholarship *2015–2016*
Semester Merit Award given to the top 7% of the batch *2015*
Kishore Vaigyanik Protsahana Yojana scholarship *2009–2011*

Student projects supervised

Master Theses:

1. Eloise Berthier, *Differential privacy of cyclic non-convex SGD.* 04.2019–07.2019
2. Ignacio Aleman, *Scalable causal inference from noise residuals.* 03.2020–08.2020
3. Felix Grimberg, *Optimal model averaging for collaborative learning.* 09.2020–01.2021
4. William Cappelletti, *Byzantine robust decentralized optimization.* 09.2020–01.2021

Semester projects and internships:

1. Anastasiia Koloskova, *Efficient greedy methods for optimization.* 06.2017–09.2017
2. Quentin Rebjock, *Error feedback for gradient compression.* 09.2018–01.2019
3. Fedor Moiseev, *Bias correction for non-iid federated learning data.* 09.2019–01.2020
4. Felix Grimberg, *Incentivizing decentralized learning.* 02.2020–05.2020
5. Ilyas Fatkhullin, *Accelerated inexact gradient descent.* 06.2020–10.2020
6. Mahmoud Hegazy, *Transfer learning via parameter sharing.* 06.2020–10.2020
7. Andrei Afonin, *Bias correction for semi-supervised learning.* 09.2020–01.2021
8. Andrei Afonin, *Model agnostic communication protocols.* 02.2021–05.2021
9. Usmann A. Khan, *Federated image segmentation for science.* 02.2021–05.2021

Junior PhD students mentored who became my co-authors:

1. Thijs Vogels, *Low rank methods for practical gradient compression.* 09.2018–present
2. Lie He, *Scalable private, secure and robust machine learning.* 03.2020–present

Teaching activities

Teaching assistant for the following courses

1. *Sublinear algorithms for big data analysis* (CS-448) Spring 2017.
   Along with helping grading and tutorial sessions, calibrated the difficulty of exams.
2. *Machine learning* (CS-443) Fall 2017, 2018, 2019, 2020.
   Developed several practical exercises, held tutorial sessions, and set exam questions.
3. *Optimization for machine learning* (CS-439) Spring 2018, 2019, 2020.
   Developed most of the exercises and exam questions. Also held tutorial sessions.

Service

Co-organized the AutoTrain challenge at AMLD 2020.
Reviewing activity:

- ICML 2018, 2019, 2020. Awarded top reviewer 2019, 2020.
- Expert reviewer at ICML 2021.
- NeurIPS 2018, 2019, 2020. Awarded top reviewer 2019.
- AISTATS 2018, 2019, 2020.
- ALT 2020.
- Journal of Machine Learning (JMLR)
- IEEE/ACM Transactions on Networking (ToN)
- European Journal of Operational Research (EJOR)
- Optimization Methods and Software

Public outreach and knowledge transfer

1. **Advisory member** at the Infectious Diseases Data Observatory (IDDO), Oxford.
   Developing a collaborative data sharing platform for health crises. 06.2020–12.2021

2. **Interviewed** by ZettaBytes, EPFL's public outreach channel, on the challenges and opportunities in federated learning (watch here).

3. Helped Facebook implement our algorithm PowerSGD in **PyTorch**, the most popular open-source deep learning framework. This potentially reduces the communication costs up to 100× and energy requirements up to 2× for deep learning.

4. Helped **Google** implement our federated learning algorithms SCAFFOLD and MIME. These are currently being tested for production and might potentially become the backbone of Google's future machine learning platform.

Open source software

Released and maintain open source and ready to use software for open science.

1. Running fast and flexible federated learning simulations: (FedJAX)
2. Real world decentralized learning across devices: (DecentralizedAI)
3. Efficient compressed communication for deep learning: (PowerSGD)
4. Compressed communication for decentralized deep learning: (PowerGossip)
5. Implementing sign based gradient compression: (Error feedback SGD)

Invited Talks

- **SIAM MDS** Mathematics of Data Science 06.2020: *Optimization for deep learning.*
- **Federated learning one world seminar** 06.2020: *SCAFFOLD: Stochastic controlled averaging for federated learning.*
- **ZettaBytes** (interview) 11.2019: *Challenges and opportunities in federated learning*
- **Google** Federated Learning Talks 11.2019: *SCAFFOLD for federated learning.*
- **Google** 08.2019, New York: *Error-feedback fixes gradient compression methods*
- **MIT** 11.2018, Boston: *Optimal inexact accelerated algorithms*
- **ETH Zurich** 08.2018: *Accelerated first order methods with approximate subproblems*
- **International Symposia on Mathematical Programming** 07.2018, Bordeaux: *Accelerated first order methods with approximate subproblems*
- **Swiss Machine Learning Day** 11.2017, Lausanne: *Making optimization algorithms adaptive to system conditions*

See next pages for a list of all publications.

Full Publications List

*Note: * indicates that the authors with equal contributions and alphabetical ordering.*

Peer-reviewed publications

1. Practical Communication Compression in Decentralized Deep Learning.
   NeurIPS 2020 (url).
   Thijs Vogels, **Sai Praneeth Karimireddy**, Martin Jaggi.

2. Why are Adaptive Methods Good for Attention Models?
   NeurIPS 2020 (url).
   Jingzhao Zhang, **Sai Praneeth Karimireddy**, Andreas Veit, Seungyeon Kim, Sashank Reddi, Sanjiv Kumar

3. Weight Erosion: An Update Aggregation Scheme for Personalized Collaborative Machine Learning.
   DART 2020 (url).
   Felix Grimberg, Mary-Anne Hartley, Martin Jaggi, **Sai Praneeth Karimireddy**.

4. Accelerated Gradient Boosted Machines.
   AISTATS 2020 (url).
   Haihao Lu*, **Sai Praneeth Karimireddy***, Natalia Ponomareva, Vahab Mirrokni.

5. SCAFFOLD: Stochastic Controlled Averaging for Federated Learning.
   ICML 2020 (url).
   Sai Praneeth Karimireddy, Satyen Kale, Mehryar Mohri, Sashank Reddi, Sebastian Stich, Ananda Theertha Suresh.

6. The Error-Feedback Framework: Better Rates for SGD with Delayed Gradients and Compressed Communication.
   JMLR 2020 (url).
   Sebastian Stich, **Sai Praneeth Karimireddy**.

7. PowerSGD: Practical Low-rank Gradient Compression for Distributed Opt.
   NeurIPS 2019 (url).
   Thijs Vogels, **Sai Praneeth Karimireddy**, Martin Jaggi.

8. Error Feedback fixes SignSGD and other Gradient Compression Schemes.
   ICML 2019 (url) ***Long talk.***
   Sai Praneeth Karimireddy, Quentin Rebjock, Sebastian Stich, Martin Jaggi.

9. Efficient greedy coordinate descent for composite problems.
   AISTATS 2019 (url)
   Sai Praneeth Karimireddy*, Anastasia Koloskova*, S Stich, Martin Jaggi.

10. On Matching Pursuit and Coordinate Descent.
    ICML 2018 (url)
    Francesco Locatello*, Anant Raj*, **Sai Praneeth Karimireddy**, Sebastian Stich, Martin Jaggi.

11. Adaptive Balancing of Gradient and Update Computation Times using Approximate Subproblem Solvers.
    AISTATS 2018 (url) ***Oral.***
    Sai Praneeth Karimireddy, Sebastian Stich, Martin Jaggi.

12. Some results on a class of mixed van der Waerden numbers.
Rocky Mountain Journal of Mathematics Vol.48 2018 (url). (Pre-PhD work)
Kaushik Maran*, **Sai Praneeth Reddy***, Dravyansh Sharma*, Amitabha Tripati*.

13. Assignment Techniques for Crowdsourcing Sensitive Tasks.
CSCW 2016 (url) (pre-PhD work).
Elisa Celis*, **Sai Praneeth Reddy***, Ishaan Singh*, Shailesh Vaya*.

14. Brief Announcement: Multi-Broadcasting under the SINR Model.
PODC 2016 (url) (pre-PhD work).
Sai Praneeth Reddy, Shailesh Vaya.

Workshop and posters

1. Byzantine-Robust Learning on Heterogeneous Datasets via Resampling.
NeurIPS workshop 2020 (SPICY FL) (url)
Lie He*, **Sai Praneeth Karimireddy***, Martin Jaggi.

2. Secure Byzantine Machine Learning.
NeurIPS workshop 2020 (SPICY FL) (url)
Lie He, **Sai Praneeth Karimireddy**, Martin Jaggi.

Submitted/under review publications

1. Mime: Mimicking Centralized Stochastic Algorithms in Federated Learning.
Submitted to ICML 2021 (url).
Sai Praneeth Karimireddy, Martin Jaggi, Satyen Kale, Mehryar Mohri, Sashank Reddi, Sebastian Stich, Ananda Theertha Suresh.

2. Learning from History for Byzantine Robust Optimization.
Submitted to ICML 2021 (url)
Sai Praneeth Karimireddy, Lie He, Martin Jaggi.

3. Byzantine-Robust Learning on Heterogeneous Datasets via Resampling.
Submitted to ICML 2021 (url)
Lie He*, **Sai Praneeth Karimireddy***, Martin Jaggi.

4. Quasi-global Momentum: Decentralized Deep Learning on Heterogeneous Data.
Submitted to ICML 2021 (url)
Tao Lin, **Sai Praneeth Karimireddy**, Sebastian Stich, Martin Jaggi.

5. Optimal Weighted Model Averaging for Personalized Collaborative Learning .
Submitted to ICML 2021
Felix Grimberg, Mary-Anne Hartley, Martin Jaggi, **Sai Praneeth Karimireddy**.

6. Secure Byzantine Machine Learning.
Submitted to TIST Special Issue on Federated Learning (url)
Lie He, **Sai Praneeth Karimireddy**, Martin Jaggi.

Patents

1. Methods and systems for creating tasks.
Applied in US 2013, Granted in US 2017 (url).
Shailesh Vaya*, Akshayaram Srinivasan*, **Sai Praneeth Reddy K***.

2. Methods and systems for recognizing handwriting in handwritten documents.
   Applied in US 2013, Granted in US 2015 (url).
   Shailesh Vaya*, Akshayaram Srinivasan*, **Sai Praneeth Reddy K***.

3. Apparatus and method for secure digital coupon verification.
   Applied in US 2015, Pending (url)
   Sai Praneeth Reddy K*, Ishaan Preet Singh*, Shailesh Vaya*