Yahya Hussain Essa (Ezzeldin)

CONTACT INFORMATION

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RESEARCH INTERESTS

Privacy and Fairness in Machine Learning, Distributed Computing, Machine Learning for Wireless, Information Theory

WORK EXPERIENCE

Postdoctoral Associate at University of Southern California (May 2021 – Present)
Postdoctoral Associate in the Electrical and Computer Engineering (ECE) Department, USC, working with Prof. Salman Avestimehr. My main research focus is on developing privacy-preserving federated learning algorithms with applications in federated analytics and demographic fairness in training.

Postdoctoral Associate at University of California, Los Angeles (Feb 2021 – May 2021)
Postdoctoral Associate in the Electrical and Computer Engineering (ECE) Department, UCLA, working with Prof. Christina Fragouli.

Machine Learning Platform Engineer (*Intel Corporation*) ***(June 2018 – August 2018)***
Development of tracing tools to model machine learning workloads such as convolutional and recurrent neural networks on the next generation Vision Processing Unit, which help drive decisions for next generation IPs. (Deep Learning Frameworks: Caffe, PyTorch, Onnx)

EDUCATION

University of California, Los Angeles (UCLA) (October 2014 – December 2020)
Ph.D. in Electrical and Computer Engineering (GPA: 3.94)
Advisor: Prof. Christina Fragouli

Alexandria University, Egypt **(October 2011 – August 2014)**
M.Sc. in Electrical Engineering (GPA: 4.00)
Advisor: Prof. Karim G. Seddik
Thesis: Lattices in wireless communications: interference alignment and lattice-based LDPC codes

Alexandria University, Egypt **(September 2006 – July 2011)**
B.Sc. in Electrical Engineering (Grade: 91.92/100)
Graduation Project: Baseband Implementation of LTE Advanced Uplink Physical Layer

HONORS AND AWARDS

- Distinguished Ph.D. Dissertation Award from UCLA ECE Department in 2020-2021.
- Dissertation Year Fellowship 2019-2020.
- Samueli Fellowship in 2016 for EE 102 honors course development.
- Graduate Division Award in 2014-2015 academic year.
- Ranked $\mathbf{2^{nd}}$ over Electrical Engineering Class of 2011, Alexandria University.
- Awarded Certificate of Merit, First Class Honors, for being one of the top ten students in Electrical Engineering during my undergraduate studies (2006-2011).
- Ranked $\mathbf{1^{st}}$ over IGCSE students in Alexandria and $\mathbf{12^{th}}$ over Egypt in 2006.

RESEARCH PROJECTS

Practical and Safe Federated Systems

Fairness-aware and privacy-preserving federated learning

- Developing privacy-preserving aggregation schemes to train demographically fair machine learning models using federated learning, while maintaining the privacy of users' datasets. [**NeurIPS workshop 2021, AAAI 2023**]
- Deriving upper bounds on information leakage in terms of mutual information federated systems that utilize secure aggregation (SecAgg) and analyzing the leakage dependency on system parameters such as cohort size, model size, and number of training rounds. [**PoPETS 2023**]
- Developing privacy-preserving approaches for solving federated set intersection queries. [**CIKM 2022, APSIPA 2023**]

Efficient Communication for Distributed and Federated Learning

- Developing adaptive quantization schemes for feature compression in federated learning that improve over state of the art quantization schemes. [**JSAIT 2020**]
- Developing data-dtiven quantization schemes for inference from distributed feature sources. [**ISIT 2019, JSAIT 2020**]
- Deriving trade-offs between storage, computation and communication in a Map-Reduce distributed computation setting. [**ITW 2017**]

Physical layer technologies in emerging wireless networks

- Investigate the capacity guarantees for network simplification in Full-Duplex and Half-Duplex Gaussian relay networks operating with physical layer cooperation. The best subnetwork is chosen to operate instead of the full network, to reduce power utilization, and coordination overhead and give the potential for resource sharing between different data transmission sources. [**ISIT 2016, TIT 2020**]
- Deriving closed-form expression for the approximate capacity of Gaussian Half-Duplex Line networks and developing polynomial-time algorithms to construct an operating schedule that achieves the approximate capacity. [**ISIT 2017, TIT 2020**]
- Investigate the capacity of relay networks that employ directed antennas to model mmWave communication in 5G and derive min-cut bounds as well as achievable strategies for approximating the capacity in terms of the route capacities in the network. [**ISIT 2018, ISIT 2019, TIT 2020, TOC 2021**]

Journal Papers and Pre-prints

Ahmed ElKordy, **Yahya H. Ezzeldin**, Shanshan Han, Shantanu Sharma, Chaoyang He, Sharad Mehrotra, Salman Avestimehr, "Federated Analytics: A survey", *accepted to appear in APSIPA Transactions on Signal and Information Processing, Issue 1, 2023.*

Ahmed ElKordy, Jiang Zhang, **Yahya H. Ezzeldin**, Konstantinos Psounis, Salman Avestimehr, "How Much Privacy Does Federated Learning with Secure Aggregation Guarantee?", *Proceedings on Privacy Enhancing Technologies, Volume 2023.*

Mine Gokce Dogan, **Yahya H. Ezzeldin**, Christina Fragouli, "Gomory-Hu Trees Over Wireless" *IEEE Communications Letters, Feb. 2022.*

Osama A. Hanna, **Yahya H. Ezzeldin**, Christina Fragouli, Suhas Diggavi, "Quantization of distributed data for learning", *IEEE Journal on Selected Areas in Information Theory, Aug. 2021.*

Xiaoshen Song, **Yahya H. Ezzeldin**, Giuseppe Caire, Christina Fragouli, "Efficient Beam Scheduling for Half-Duplex mmWave Relay Networks", *IEEE Transactions on Communications, June. 2021.*

Yahya H. Ezzeldin, Martina Cardone, Christina Fragouli, Giuseppe Caire, "Gaussian 1-2-1 Networks: Capacity Results for mmWave Communications", *IEEE Transactions on Information Theory, Nov. 2020.*

Yahya H. Ezzeldin, Ayan Sengupta, Christina Fragouli, "Wireless Network Simplification: The Performance of Routing", *IEEE Transactions on Information Theory, July 2020.*

Yahya H. Ezzeldin, Martina Cardone, Christina Fragouli, Daniela Tuninetti, "The Approximate Capacity of Half-Duplex Line Networks", *IEEE Transactions on Information Theory, May 2020.*

Osama A. Hanna, **Yahya H. Ezzeldin**, Tara Sadjadpour, Christina Fragouli, Suhas Diggavi, "On Distributed Quantization for Classification", *IEEE Journal on Selected Areas in Information Theory, May 2020.*

Yahya H. Ezzeldin, Martina Cardone, Christina Fragouli, Daniela Tuninetti, "Network Simplification in Half-Duplex: Building on Submodularity", *IEEE Transactions on Information Theory, Oct. 2019.*

Yahya H. Ezzeldin, Karim G. Seddik, "Pseudo-Lattice Treatment for Subspace Aligned Interference Signals", *IEEE Transactions on Vehicular Technology, Nov. 2014.*

Conference & Workshop Papers

Yahya H. Ezzeldin, Shen Yan, Chaoyang He, Emilio Ferrara, Salman Avestimehr, " FairFed: Enabling Group Fairness in Federated Learning," *2023 AAAI Conference on Artificial Intelligence (AAAI), Washington DC, USA, Feb. 2023 (Acceptance rate: 19.6%).*

Ahmed ElKordy, Jiang Zhang, **Yahya H. Ezzeldin**, Konstantinos Psounis, Salman Avestimehr, "How Much Privacy Does Federated Learning with Secure Aggregation Guarantee?", *Privacy Enhancing Technologies Symposium 2023 (Acceptance rate: 24%).*

Ahmed ElKordy, **Yahya H. Ezzeldin**, Salman Avestimehr, "Federated K-Private Set Intersection", *ACM International Conference on Information and Knowledge Management (CIKM'22), Atlanta, USA, Oct. 2022.*

Yahya H. Ezzeldin, Shen Yan, Chaoyang He, Emilio Ferrara, Salman Avestimehr, " FairFed: Enabling Group Fairness in Federated Learning," *2021 Neural Information Processing Systems (NeurIPS) Workshop "New Frontiers in Federated Learning: Privacy, Fairness, Robustness, Personalization and Data Ownership", Dec 2021.*

Mine Gokce Dogan, **Yahya H. Ezzeldin**, Christina Fragouli, Addison W Bohannon, "A Reinforcement Learning Approach for Scheduling in mmWave Networks", *2021 IEEE Military Communications Conference (MILCOM), San Diego, USA, Nov. 2021.*

Mine Gokce Dogan, **Yahya H. Ezzeldin**, Christina Fragouli, "On optimal relay placement in directional networks", in Proc. of *IEEE International Symposium on Information Theory (ISIT), Melbourne, Australia, Jul. 2021.*

Yahya H. Ezzeldin, Martina Cardone, Christina Fragouli, "Multilevel Secrecy over 1-2-1 Networks", in Proc. of *Information Theory Workshop (ITW), Riva del Garda, Italy, April 2021.*

Juan C. Rebanal, **Yahya H. Ezzeldin**, Christina Fragouli, Paulo Tabuada, "A coding approach to localization using landmarks," *2020 IEEE Global Communications Conference (GLOBECOM), Taipei City, Taiwan, Dec. 2020.*

Yahya H. Ezzeldin, Martina Cardone, Christina Fragouli, Giuseppe Caire, "Gaussian 1-2-1 Networks with Imperfect Beamforming", in Proc. of *IEEE International Symposium on Information Theory (ISIT), Los Angeles, CA, USA, Jul. 2020.*

Yahya H. Ezzeldin, Christina Fragouli, Suhas Diggavi, "Quantizing Signals for Linear Classification", in Proc. of *IEEE International Symposium on Information Theory (ISIT), Paris, France, Jul. 2019.*

Yahya H. Ezzeldin, Martina Cardone, Christina Fragouli, Giuseppe Caire, "Polynomial-time Capacity Calculation and Scheduling for Half-Duplex 1-2-1 Networks", in Proc. of *IEEE International Symposium on Information Theory (ISIT), Paris, France, Jul. 2019.*

Yahya H. Ezzeldin, Martina Cardone, Christina Fragouli, Giuseppe Caire, "On the Multicast Capacity of Full-Duplex 1-2-1 Networks", in Proc. of *IEEE International Symposium on Information Theory (ISIT), Paris, France, Jul. 2019.*

Yahya H. Ezzeldin, Martina Cardone, Christina Fragouli, Giuseppe Caire, "Gaussian 1-2-1 Networks: Capacity Results for mmWave Communications", in Proc. of *IEEE International Symposium on Information Theory (ISIT), Vail, CO, USA, Jun. 2018.*

Gaurav Kumar Agarwal, **Yahya H. Ezzeldin**, Martina Cardone, Christina Fragouli, "Secure Communication over 1-2-1 Networks", in Proc. of *IEEE International Symposium on Information Theory (ISIT), Vail, CO, USA, Jun. 2018.*

Yahya H. Ezzeldin, Martina Cardone, Christina Fragouli, Daniela Tuninetti, "Half-Duplex Routing is NP-hard", in Proc. of *55th Annual Allerton Conference, Monticello, IL USA, Oct, 2017.*

Yahya H. Ezzeldin, Mohammed Karmoose, Christina Fragouli, "Communication vs Distributed Computation: an alternative trade-off curve", in Proc. of *Information Theory Workshop (ITW), Kaohsiung, Taiwan, Nov. 2017.*

Yahya H. Ezzeldin, Martina Cardone, Christina Fragouli, Daniela Tuninetti, "Efficiently Finding Simple Schedules in Gaussian Half-Duplex Relay Line Networks", in Proc. of *IEEE International Symposium on Information Theory (ISIT), Aachen, Gernmany, Jun. 2017.*

Yahya H. Ezzeldin, Ayan Sengupta, Christina Fragouli, "Wireless Network Simplification: Beyond Diamond Networks", in Proc. of *IEEE International Symposium on Information Theory (ISIT), Barcelona, Spain, Jul. 2016.*

Yahya H. Ezzeldin, Mustafa Nainay, "PNCR: A Physical Network Coding Framework for Routing in Wireless Ad-hoc Networks", in Proc. of *IEEE Wireless Communications and Networking Conference (WCNC), Istanbul, Turkey, Apr. 2014.*

Yahya H. Ezzeldin, Ahmed Sultan, Moustafa Youssef, "Best Relay Selection for Underlay Cognitive Radio Systems with Collision Probability Minimization", in Proc. of *IEEE International Conference on Computing, Networking and communications (ICNC), Honolulu, HI, USA, Feb. 2014.*

Yahya H. Ezzeldin, Radwa A. Sultan, Karim G. Seddik, "Sparse Reconstruction-Based Detection of Spatial Dimension Holes in Cognitive Radio Networks", in Proc. of *IEEE International Symposium on Personal Indoor and Mobile Radio Communications, London, UK, Sep. 2013.*

Talks and Posters

All accepted conference papers have resulted in conference presentation and one poster (WCNC 2014). Below some selected instances delivered by Yahya H. Ezzeldin are shown.

[Presentation] **Yahya H. Ezzeldin***, Martina Cardone, Christina Fragouli, Giuseppe Caire, "Gaussian 1-2-1 Networks: Capacity Results for mmWave Communications",
IEEE ISIT, Vail, CO, USA, Jun. 2018 [**TPC Choice Session**].

[Presentation] **Yahya H. Ezzeldin***, Martina Cardone, Christina Fragouli, Daniela Tuninetti, "Efficiently Finding Simple Schedules in Gaussian Half-Duplex Relay Line Networks",
IEEE ISIT, Aachen, Gernmany, Jun. 2017.

[Presentation] **Yahya H. Ezzeldin***, Ayan Sengupta, Christina Fragouli, "Wireless Network Simplification: Beyond Diamond Networks",
IEEE ISIT, Barcelona, Spain, Jul. 2016.

[Presentation] **Yahya H. Ezzeldin***, Ahmed Sultan, Moustafa Youssef, "Best Relay Selection for Underlay Cognitive Radio Systems with Collision Probability Minimization",
IEEE ICNC, Honolulu, HI, USA, Feb. 2014.

[Poster] **Yahya H. Ezzeldin***, Mustafa Nainay, "PNCR: A Physical Network Coding Framework for Routing in Wireless Ad-hoc Networks",
IEEE WCNC, Istanbul, Turkey, Apr. 2014.

Teaching Experience

University of California, Los Angeles, California, USA
[Teaching Assistant] *(Fall 2016 and Fall 2017)*

- Linear Programming
- Systems and Signals
- Systems and Signals Seminar (Honors)

Alexandria University, Alexandria, Egypt
[Teaching Assistant] *(Fall 2011 – Spring 2014)*

- Digital Communications
- Communication Systems
- Advanced Communications
- Introduction to Antenna Theory

Technical Services

- Reviewer (Journals)
  - IEEE Transactions on Information Theory
  - IEEE Transactions on Communications
  - IEEE/ACM Transactions on Networking
  - IEEE Transactions on Wireless Communications

- Reviewer (Conferences)
  - International Conference on Artificial Intelligence and Statistics (AISTATS)
  - IEEE International Symposium on Information Theory (ISIT)
  - IEEE Global Telecommunications Conference (GLOBECOM)
  - IEEE Wireless Communications and Networking Conference (WCNC)
- Mentor
  - Summer Undergraduate Scholars Program at UCLA HSSEAS
  - High School Summer Research Program at UCLA HSSEAS

Technical Courses

Selected Courses at UCLA

- Probability Theory (MATH 275A, B, C)
- Combinatorial Theory (MATH 206A)
- Deep Learning (EE239AS)
- Convex Optimization (EE236B)
- Information Theory (EE231A)
- Adaptation and Learning (EE210A)
- Network Information Theory (EE239AS)
- Real Analysis (MATH 131BH)
- Linear Programming (EE236A)
- Network Coding (EE234A)

Skills & Background

Programming Languages: *Matlab, Python, C/C++, Linux shell scripting*
Frameworks: *GNURadio, Click Modular Router, WARPLab, TensorFlow, Caffe, PyTorch*

References

Prof. Christina Fragouli
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Prof. Salman Avestimehr
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