My current research topic as a PhD student in computer science at Georgetown University is *resilient distributed optimization algorithms* and their application to machine learning. Specifically, I, along with other members in the research group, studied the impact of redundancy property of cost functions of agents in achieving resilient distributed optimization, against Byzantine faulty agents (agents that can behave arbitrarily) and asynchronous agents (agents that take longer time to run). We show the need of such redundancy in solving Byzantine fault-tolerant distributed optimization problems [3]. We also present algorithms that solves these resilient optimization problems practically [3, 4]. Furthermore, we demonstrate the applicability of these results in scenarios of distributed machine learning, both in theory and empirically [1, 3–5]. My works also include a survey in fault-tolerant distributed optimization [2].

The empirical studies in the aforementioned publications is conducted using a simulator of distributed machine learning written by me using *Python* with *PyTorch*.

My master thesis studied a possible privacy attack against social media accounts that can reveal hidden information of a target user, utilizing background knowledge built up on information of the members that have strong connections with the target user [6].

I am interested in research topics and opportunities related to my experiences, including but not limited to distributed optimization, machine learning, privacy, social media analysis, etc.

References

[1] Nirupam Gupta, Shuo Liu, and Nitin Vaidya. Byzantine fault-tolerant distributed machine learning with norm-based comparative gradient elimination. In *2021 51st Annual IEEE/IFIP International Conference on Dependable Systems and Networks Workshops (DSN-W)*, pages 175–181. IEEE, 2021.

[2] Shuo Liu. A survey on fault-tolerance in distributed optimization and machine learning. *arXiv preprint arXiv:2106.08545*, 2021.

[3] Shuo Liu, Nirupam Gupta, and Nitin H. Vaidya. Approximate byzantine fault-tolerance in distributed optimization. In *Proceedings of the 2021 ACM Symposium on Principles of Distributed Computing*, PODC'21, page 379–389, New York, NY, USA, 2021. Association for Computing Machinery.

[4] Shuo Liu, Nirupam Gupta, and Nitin H Vaidya. Asynchronous distributed optimization with redundancy in cost functions. *arXiv preprint arXiv:2106.03998*, 2021.

[5] Shuo Liu, Nirupam Gupta, and Nitin H Vaidya. Utilizing redundancy in cost functions for resilience in distributed optimization and learning. *arXiv preprint (to appear)*, 2021.

[6] Shuo Liu, Lisa Singh, and Kevin Tian. Information exposure from relational background knowledge on social media. In *2020 IEEE 7th International Conference on Data Science and Advanced Analytics (DSAA)*, pages 282–291. IEEE, 2020.