Some Example Research Projects

This document serves as information for students interested in joining my group as Post-doc, PhD student,

Research Assistant, Research Intern, Undergraduate Student Researcher, and so one.

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1 Example Project #1

Over the past decade or so, there has been a lot of research progress on blockchains. Such research efforts have significantly improved the performance of blockchains. For example, modern blockchains can easily achieve multiple orders of magnitude better transaction throughput than Bitcoin.

On the other hand, nearly all existing blockchains can still only tolerate an adversarial power of $f < \frac{1}{2}$, which is not any better than Bitcoin. Roughly speading, this means that they no longer work if more than half of the nodes in the system are malicious.

In this work, we show for the first time that it is possible for a blockchain to tolerate $f \geq \frac{1}{2}$, while still achieving practically usable performance. (This may sound too good to be true – but it is true, and we have both complete formal proofs as well as a real implementation.)

2 Example Project #2

This work considers computer networks whose topologies may change over time, for example, due to mobility of the nodes. Because of the topology changes in such networks, even basic problems (such as counting the number of nodes) become challenging to solve.

In this work, we propose the first sublinear algorithm for counting the nodes in such networks. Our algorithm is based on a rather novel idea of *massively parallel aggregation*. For example, when we want to send a numerical value from a node v to a node u, we split the value evenly across all the paths (or at most a certain length) from v to u. Note that there can be an exponential number of such paths. It turns out that such split helps to constrain the damage caused by potential topology changes, which eventually leads to a sublinear algorithm. This work won the Best Paper Award in ACM Symposium on Parallelism in Algorithms and Architectures (SPAA) 2020.