DFINITY Thesis Proposal

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I am in my second year and so have not yet formally proposed; people typically do not propose until their 4th year in my program. However, the following is a short summary of work that I have done and intend to do leading up to my thesis proposal.

Proposal

The advent of massive distributed systems poses novel algorithmic challenges. Specifically, the scale of modern distributed systems demands that algorithm designers consider the inevitable faults that occur in these systems and the intricacy of these systems motivates algorithms that flexibly optimize for different parameters.

In my thesis I plan to give algorithms for classic distributed problems which are both noise-resilient and optimal along several parameters. Recent work that I have done in this space includes: broadcast algorithms for wireless, peer-to-peer networks in the presence of noise [CHHHZ17]; algorithms for wired, peer-to-peer networks that simultaneously optimize the number of messages sent and the amount of time taken [HHW18]; erasure correction for algorithms on wireless, peer-to-peer networks [CHHHZ18]; and algorithms for scheduling of jobs in wired, peer-to-peer networks that optimize both the total amount of computation performed and the total amount of communication [HHKP18].

I plan to further study noise-resilience and optimization of multiple parameters in a distributed setting along two major axes. First, nearly every classic model of distributed computation assumes no faults occur. For instance, the well-studied radio network, CONGEST and LOCAL [Pel00] models all make such an assumption. In my past work [CHHHZ17, CHHHZ18] I have given algorithms that are robust to noise for the radio network model but very few noise-robust algorithms for CONGEST and LOCAL exist. I plan to give algorithms for such models. Second, most distributed algorithms for peer-to-peer networks seek only to minimize the total amount of communication performed. A unified theory of distributed algorithms that take the computation performed on each node into account is a wide open question. We have promising results for algorithms in such a setting provided a centralized scheduler can coordinate a network [HHKP18] but what fully distributed algorithms exist that optimize both for communication and computation performed is a wide-open question. I intend to give algorithms which simultaneously optimize both these metrics in a distributed setting.

References

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