Locally Optimal Load Balancing

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Abstract. This work studies distributed algorithms for *locally optimal load-balancing*: We are given a graph of maximum degree Δ, and each node has up to L units of load. The task is to distribute the load more evenly so that the loads of adjacent nodes differ by at most 1.

If the graph is a path ($\Delta = 2$), it is easy to solve the *fractional* version of the problem in $O(L)$ communication rounds, independently of the number of nodes. We show that this is tight, and we show that it is possible to solve also the *discrete* version of the problem in $O(L)$ rounds in paths.

For the general case ($\Delta > 2$), we show that fractional load balancing can be solved in $\mathrm{poly}(L, \Delta)$ rounds and discrete load balancing in $f(L, \Delta)$ rounds for some function f, independently of the number of nodes.