Distributed symmetry-breaking in static and dynamic networks

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Abstract

In the distributed message passing model a communication network is represented by a graph whose vertices host processors that communicate over the edges. Our goal is solving graph-theoretic tasks (vertex-coloring, maximal matching, maximal independent set, etc.), where the network graph is the input. (The input is provided in a distributed manner.) The running time is the number of rounds required for all vertices to output their answers. Although some networks remain the same throughout the entire execution, other networks are very dynamic and may change significantly. This is the case in wireless ad-hoc networks, social networks, mobile networks and many other networks. Consequently, distributed algorithms must handle not only static graphs, but also the ones that change rapidly. In the latter scenario, even when a correct solution has been computed, the network may change, and a correction to the solution may be required. In this case, the number of rounds required for correcting the solution after a topology change is the dynamic running time. While distributed symmetry-breaking has been studied for decades, some complexity barriers were surpassed only recently. This progress was achieved thanks to the discovery of novel methodologies and distributed structures for coloring, maximal independent set, and related symmetry-breaking problems. We will discuss these advances and the ways they were obtained, and illustrate the interplay between static and dynamic settings.