MultiSkipList: A Self-stabilizing Overlay Network with Monotonic Searchability Maintained

Linghui Luo

April 20, 2017

Abstract

In this thesis I have researched a self-stabilizing solution to the perfect skip list which satisfies the monotonic searchability at the same time. There were two main challenges during my research. The first one is that the perfect skip list is not locally verifiable, which means it is impossible for each node to know if the locally stored links belong to the perfect skip list topology given only the local information. Another challenge is how to maintain the monotonic searchability during the self-stabilization process, since researchers have already found out that monotonic searchability can not be satisfied with the existence of corrupt messages in an asynchronous system. Therefore, the desired solution for monotonic searchability is based on non-existence of corrupt messages.

Despite of these two challenges I propose two protocols in this thesis. I first came up with the idea to find a relaxed solution called MultiSkipList with the desired topology being a supergraph of the perfect skip list, since the monotonic searchability can be preserved easily with this approach. After solving this relaxed problem I proposed another self-stabilizing solution called MultiSkipList* in which nodes organize themselves to be exactly the perfect skip list topology. For each of the two protocols I have also provided a search algorithm.

In order to find out how efficient the two protocols are, I have conducted a series of experiments in a simulated asynchronous system. Values indicating time and space complexity were recorded in the experiments. Since there is no other similar existing work for the perfect skip list, the focus of the experiments was mainly on the comparison of these two protocols.