Decidability issues in the theory of queueing networks

Abstract

One of the basic properties of a queueing network is stability. Roughly speaking it is the property that the total number of jobs in the network remains bounded as a function of time. One of the key questions related to the stability issue is determining the exact conditions under which a given queueing network operating under a given scheduling policy stable. While initially there was a lot of progress in addressing this question, most of the obtained results were partial at best, and the complete characterization of stable queueing networks is lacking.

We resolve this important open problem, albeit in a somewhat unexpected way. We show that characterizing stable queueing networks is an algorithmically undecidable problem for the case of non-preemptive static buffer priority scheduling policies and deterministic interarrival and service times. Thus no constructive characterization of stable queueing networks operating under this class of policies is possible. Our approach builds on an earlier work of the speaker and uses the so-called counter machine device as a reduction tool.

Joint work with D. Katz.