

abstract

COMPUTER SCIENCE/DISCRETE MATH I

Topic:

Speaker:

Affiliation:

Date:

Time/Room:

We study the complexity of restricted versions of st-connectivity, which is the standard complete problem for NL. Grid graphs are a useful tool in this regard, since * reachability on grid graphs is logspace-equivalent to reachability in general planar digraphs, and * reachability on certain classes of grid graphs gives natural examples of problems that are hard for NC^1 under AC^0 reductions but are not known to be hard for L; they thus give insight into the structure of L.

In addition to explicating the structure of L, another of our goals is to expand the class of digraphs for which connectivity can be solved in logspace, by building on the work of Jakoby et al., who showed that reachability in series-parallel digraphs is solvable in L.

Our main results are:

* Reachability on planar graphs (and grid graphs) is logspace-equivalent to reachability on graphs of genus 1. Nothing is known about genus 2 and higher, except for the trivial NL upper bound. * Reachability on "layered" grid graphs can be done in UL (a subclass of NL). Recently, Bourke, Tiwari, and Vinodchandran have extended this to show that all reachability on planar graphs can be done in UL; the lecture will present this result as well.

* Many of the natural restrictions on grid-graph reachability (GGR) are equivalent under AC^0 reductions (for instance, undirected GGR, out-degree-one GGR, and indegree-one-outdegree-one GGR are all equivalent). These problems are all equivalent to the problem of determining if a completed game position in HEX is a winning position, as well as to the problem of reachability in mazes studied by Blum and Kozen. This gives rise to a hierarchy

abstract

of complexity classes between NC^1 and L .

* Series-Parallel digraphs are a special case of single-source-single-sink planar dags; reachability for such graphs logspace reduces to single-source-single-sink acyclic grid graphs. We show that reachability on such grid graphs AC^0 reduces to undirected GGR. * We build on this to show that reachability for single-source multiple-sink planar dags is solvable in L .

This is joint work with David A. Mix Barrington, Tanmoy Chakraborty, Samir Datta, and Sambuddha Roy.