Reconstructing the tree topology in telecommunication networks

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2 - Reconstructing the tree topology in telecommunication networks
Siv Sørensen, David Pisinger

We consider Hybrid fiber-coaxial (HFC) networks in which data is transmitted from a root node to a set of customers using a series of splitters and coaxial cable lines. The physical locations of the components in a HFC network are always known but frequently the cabling is not. This makes cable faults difficult to locate and resolve. In this study we consider time series data received by costumer cable modems, to reconstruct the topology of HFC networks. We assume that the data can be translated into a series of events relating the 'closeness' of costumers in the network depending on how many events are shared. This approach allows us to use maximum parsimony to minimize the total number of character-state changes in a tree based on observations in the leaf nodes. Although exact algorithms exist for calculating the parsimony score of a given tree, all possible trees must be constructed to guarantee that the most parsimonious tree is found. Maximum parsimony is well-studied in biology for unconstrained, binary trees. In our case the topology is non-binary, and we know the location of the internal nodes. We consider a two-stage approach in which we first construct a binary-tree using local search methods, and then map it to the known nodes. Furthermore, we consider a holistic approach, where the known nodes are taken into consideration while constructing the parsimony tree. Computational results are reported for simulated costumer data with various degrees of noise.

3 - An upper bound on clique coloring of B1-EPGt graphs
Vitor de Luca, María Pía, Fabiano Oliveira, Jayme Szwarcfiter

We consider the problem of clique coloring, that is, coloring the vertices of a given graph such that no (maximal) clique of size at least two is monocolored. The approaches for solving clique coloring can be very different from those for ordinary vertex coloring. The main reason is that clique coloring is not a hereditary property: it is possible that a graph is k-clique-colorable, but it has an induced subgraph that is not. Another difference is that even a 2-clique colorable graph can contain an arbitrarily large clique. However, clique coloring shares similarities with vertex coloring. For example, every k-coloring is also a k-clique coloring. Moreover, the clique number and the clique chromatic number of G coincide if G is triangle-free. The decision problem of clique-coloring on general graphs is coNP-complete, and NP-complete on graphs with maximum degree 3.

We study the clique coloring problem in the context of the edge intersection graphs of paths on a triangular grid (EPGt graphs). These graphs generalize the well-known intersection graphs of paths on a rectangular grid (EPG graphs). A motivation for studying EPGt graphs comes from circuit layout problems. The triangular grid has been studied in the context of the channel assignment problem with separation (CAPS).

Similarly to EPG graphs, a turn of a path at a grid point is called a bend. A graph is Bk-EPGt if each path of its EPGt model has at most k bends. We prove that B1-EPGt graphs are 7-clique colorable.

4 - All pairs shortest paths in O(nm) time.
James Orlin, Laszlo Vegh

We present an O(nm) algorithm for all-pairs shortest paths computations in a directed graph with n nodes, m arcs, and nonnegative integer arc costs. This matches the complexity bound attained by Thorup for the all-pairs problems in undirected graphs. Our main insight is that shortest paths problems with approximately balanced directed cost functions can be solved similarly to the undirected case. Our algorithm starts with a preprocessing step that transforms the cost vector into a reduced cost vector that is approximately balanced. Using these reduced costs, every shortest path query can be solved in O(m) time using an adaptation of Thorup's component hierarchy method. The balancing result is of independent interest, and gives the best currently known approximate balancing algorithm for the problem.

Tuesday, 16:30-17:30

■ TE-01

Tuesday, 16:30-17:30 - A

Andrea Lodi [IFORS Distinguished Lecture]

Stream: Plenaries
Plenary session
Chair: Dolores Romero Morales

1 - Fairness over time and dynamic resource allocation
Andrea Lodi

Decision making problems are typically concerned with maximizing efficiency. In contrast, we address resource allocation problems where there are multiple stakeholders and a centralized decision maker who is obliged to decide in a fair manner. Different decisions give different utility to each stakeholder. In cases where these decisions are made repeatedly, we provide efficient mathematical programming formulations to identify both the maximum fairness possible and the decisions that improve fairness over time, for reasonable metrics of fairness. We discuss the application of this framework to a number of contexts, for example in ambulance allocation, urban policing operations, and goods delivery. Where decisions in consecutive rounds are constrained, we prove structural results on identifying fair feasible allocation policies and provide a flexible exact algorithm based on column generation.