FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Diplomarbeitspräsentation:

A Hybrid Approach for the Partition Coloring Problem

Masterstudium:
Computational Intelligence

Gilbert Fritz

Technische Universität Wien
Institut für Algorithmen und Datenstrukturen
Betreuer: Univ.-Prof. Dr.techn. Günther Raidl,
Univ.Ass. Dr.techn. Bin Hu

Motivation

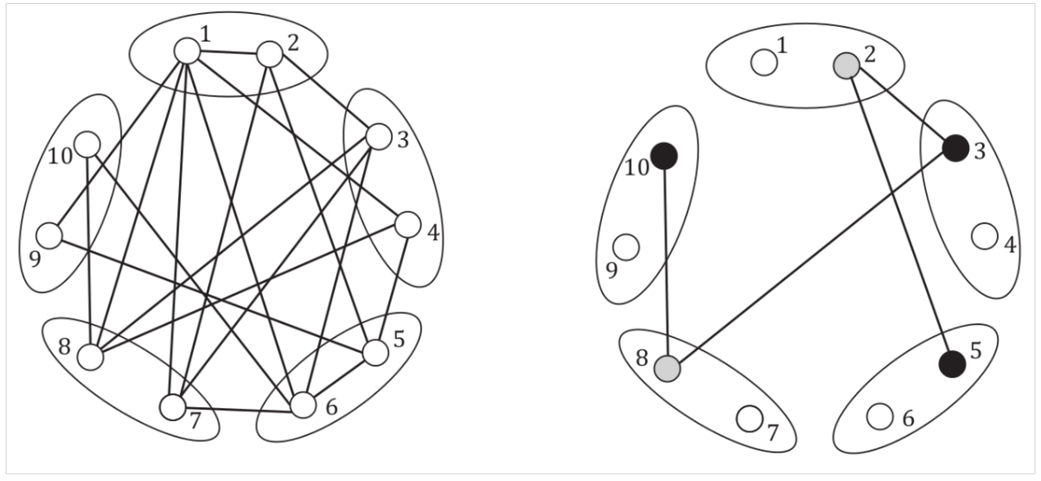
Obeying the increasing demand of network capacity is one of the biggest challenges of the telecommunication industry. Possible measurements are:

- use of optical instead of electrical links

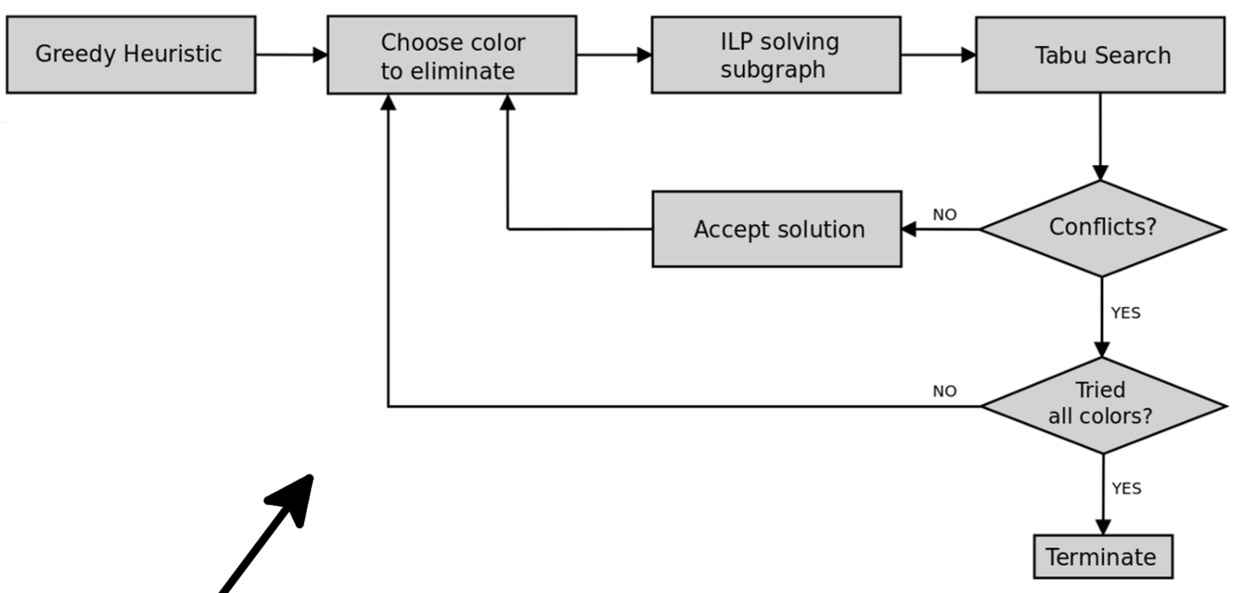
- Wavelength Division Multiplexing (WDM) permits simultaneous transmission of different channels along the same fiber.

- wavelength to light-path assignment optimization maximizes utilisation of WDM

The assignment optimization is equivalent to the Partition Coloring Problem.



A problem instance with 10 nodes and a feasibly solution using 2 colors



Problem Definition

The Partition Coloring Problem (PCP) is a generalization of the Vertex Coloring Problem (VCP).

Given a graph, its set of nodes is partitioned into mutually exclusive clusters.

Aims:
- select one node per cluster
- find a color for each selected node, such that no two adjacent nodes are colored with the same color
- minimize the number of overall colors used

Complexity: NP-hard

Solution Approach

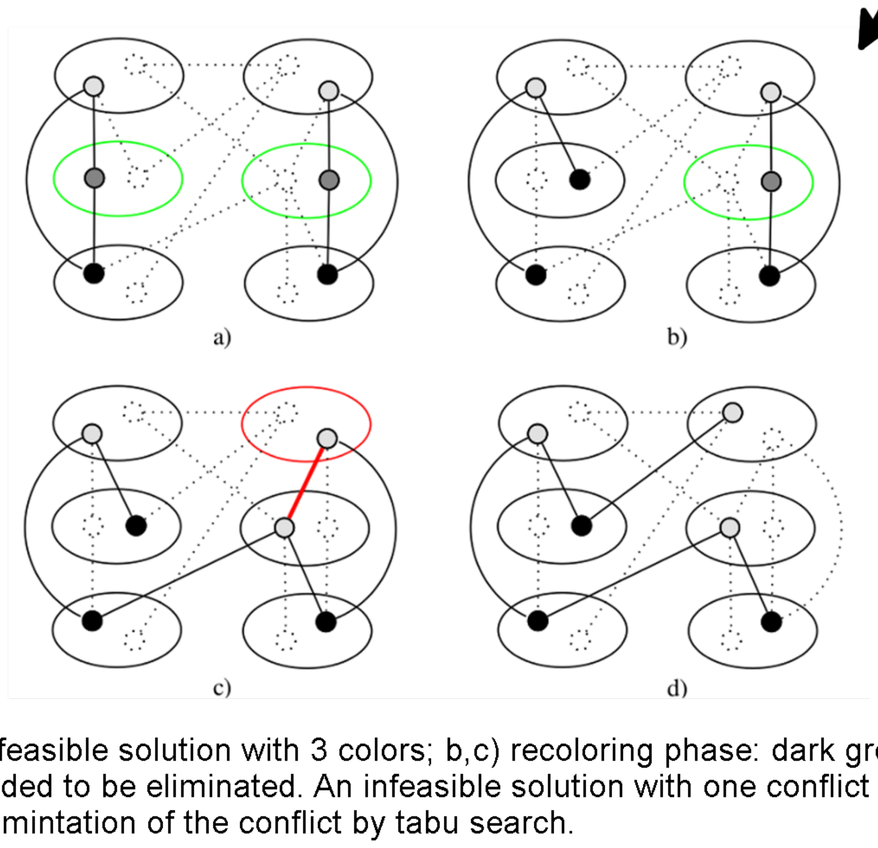
The hybrid approach combines greedy heuristics, Integer Linear Programming (ILP) and Tabu Search (TS) in the following manner:

- Initial solutions are calculated by two different greedy heuristics

- A color is picked and eliminated using different methods, including ILP, aiming to minimize the number of caused conflicts.

- TS eliminates the potential conflicts.

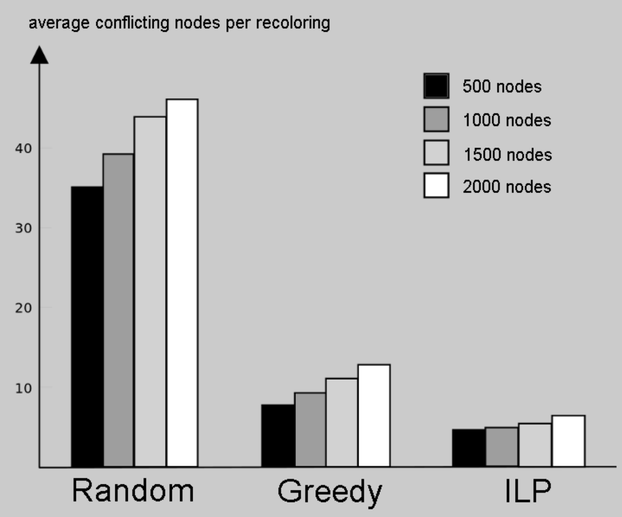
The algorithm terminates if no color can be eliminated in the way that a feasible solution can be established.



a) a feasible solution with 3 colors; b,c) recoloring phase: dark grey is intended to be eliminated. An infeasible solution with one conflict results; d) elimintation of the conflict by tabu search.

Results

When assigning alternate colors to the subgraph colored with a particular color, conflicts may arise. The number of conflicts could be reduced drastically by using greedy heuristics and exact methods, instead of random assignment, as used in related works.
This gap did not appear in the final results, where the results where not significantly better than the results of previous works.



Conclusion and Outlook

- The hybrid algorithm can compete with state-of-the art algorithms solving the PCP in terms of solution quality and runtime.

- Minimizing the amount of conflicting nodes in the recoloring process does not affect the final results significantly.

- A future approach could consider graph attributes like local density for selecting subgraphs to recolor.

Kontakt: gilbert.fritz@gmx.at