FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Diplomarbeitspräsentation:

A Hybrid Approach for the Partition Coloring Problem

Masterstudium:
Computational Intelligence

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Motivation

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

- use of **optical links** instead of electrical ones,
- **Wavelength Division Multiplexing** (WDM) permits simultaneous transmissiotn 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.

Problem Definition

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

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

A **solution** contains subgraph consisting of one node per cluster and an assignment of a color to each node, where for no two ajacent nodes the same color may be assigned.

The **goal** is the minimization of the numer of colors used.

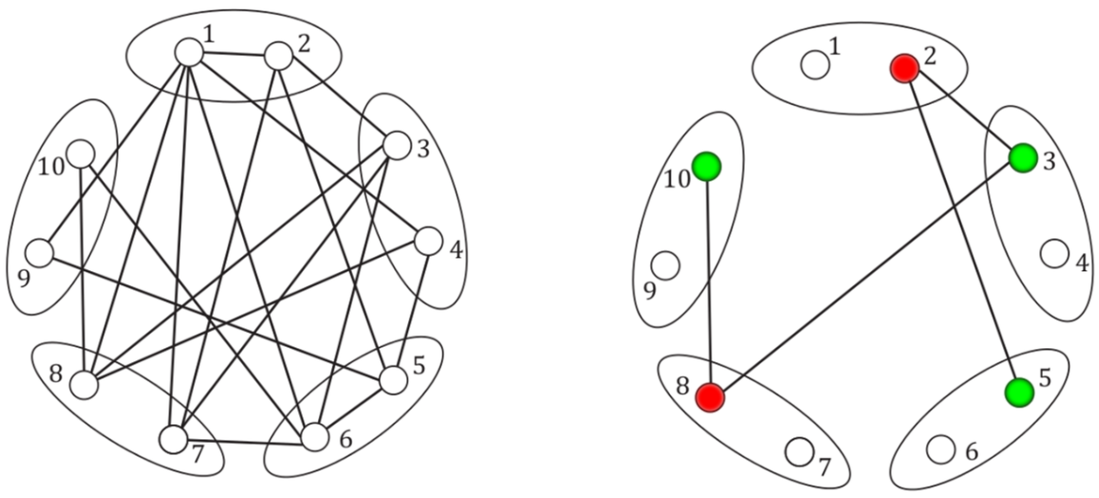
Complexity: NP-hard

Solution Approach

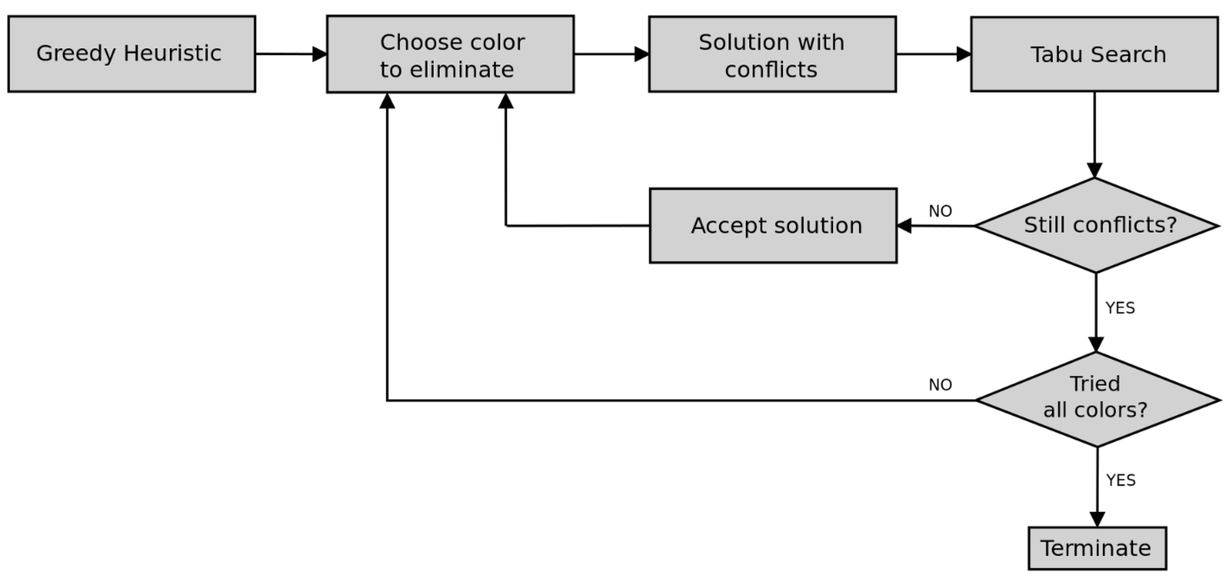
The **hybrid approach** combines greedy heuristics, Integer Linear Programming (ILP) and Tabu Search (TS) in the following manner:

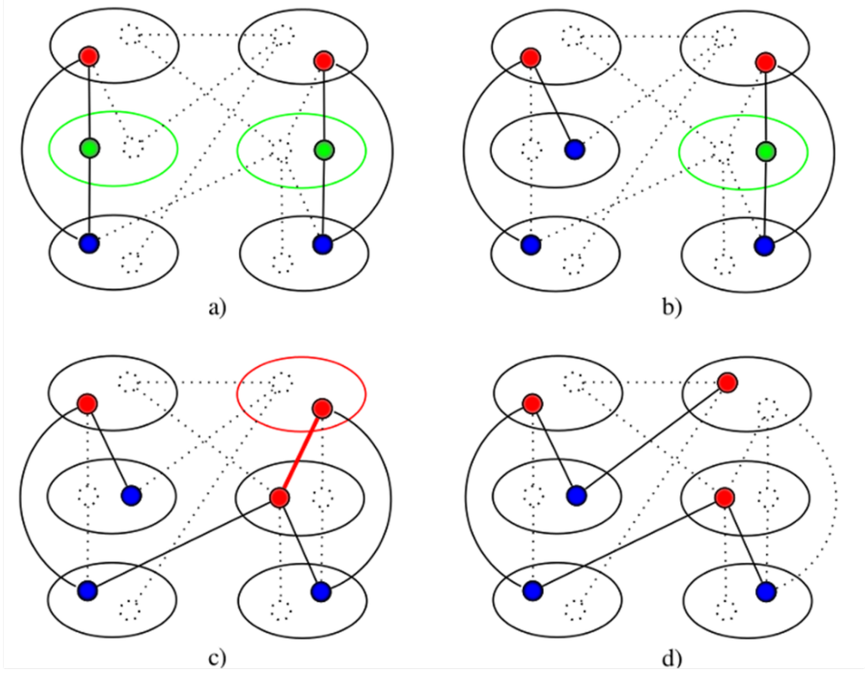
- **Initial solutions** are calculated by two different **greedy heuristics**.
- A **color** is picked and **eliminated** using **different methods, including ILP**, aiming to minimize the number of caused conflicts.
- **Tabu Search eliminates** the potential **conflicts**.

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



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

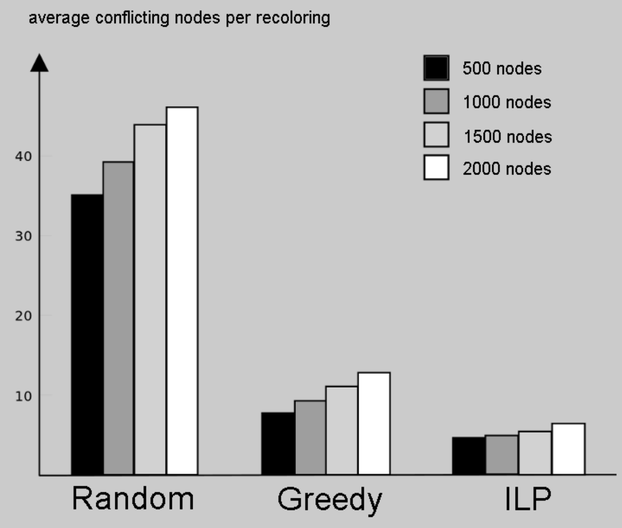




a) a feasible solution with 3 colors; b,c) recoloring phase: dark grey is intended to be eliminated. An infeasible solution with one conflict results; d) elimintation of the conflict by tabu search.

Results

The **number of conflicts** can be **reduced drastically** by using greedy heuristics and exact methods, instead of random assignment, as used in related works.
The **number of colours** used by the the hybrid algorithm is **approximately 80% of that used by the construction heuristic**, which is as least as good as previously known algorithms.



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.

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