

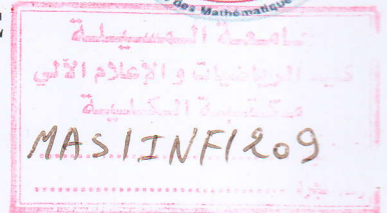
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SUJET

Tabu Search algorithm ^{for} to solve the minimum weight vertex cover problem

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Table 1: experimentation on NP instances

Table 4: experimentation on NP instances

Table 5: experimentation on LP instances

Introduction

Optimization is a scientific discipline that is concerned with obtaining the best result under given circumstances. Many challenging applications in business, economics, and engineering can be modeled as optimization problems. In fact, real-life problems solving are often complex and difficult to solve to which optimization plays a key role in finding feasible solutions to these problems.

Combinatorial optimization is a lively field of applied mathematics, combining techniques from combinatorics, linear programming, and the theory of algorithms, to solve optimization problems over discrete structures [Cook 1998]. A combinatorial optimisation problem is defined over a set of instances (admissible input data); each instance has a finite set of feasible solutions associated with it. Given an instance, the aim is to determine solutions that maximize or minimize a certain measure function.

The minimum weight vertex cover problem (MWVC) is a basic combinatorial optimization problem that finds many uses in solving many specific real-world situations as varied as location theory or telecommunications network and circuit design [Voß 2012].

MWVC can be defined as follows. Given a simple undirected graph with positive weights on its vertices, the goal is to determine a subset of the vertices which covers all edges such that the sum of the related weights values is minimized. Unfortunately, this problem belongs to the class of NP-hard problem. Since the optimal solution is computationally intractable, many studies are concentrated on approximate algorithms that can find good suboptimal solutions in a reasonable time.

The aim of this thesis is to propose a modified version of the Tabu Search algorithm proposed by T. Zhou et al. [Zhou 2015] in the hope to enhance the quality of produced solutions. The concept of greedy heuristics is used to generate initial candidate solutions with good results. Moreover, performances of our approach have been tested on well known dataset.

This thesis is structured as follows.

Chapter 1 gives a general introduction to the basic terminology of graph theory pertinent to our study.

Chapter 2 reviews some the basic concept of combinatorial optimization problems algorithms, including the complexity class of problems (Class P, class NP and Class NP-complete), methods of resolution such as exact methods, approximate methods such as heuristics and metaheuristics.

Chapter 3 provides a deep description of the minimum weight vertex cover.

Chapter 4 explains the principal basics of Tabu Search that have been applied to tackle the MWVC problem.

Chapter 5 reports the results of an experimental performance evaluation of this approach on several well-known benchmark datasets and the last chapter concludes the thesis.

Chapter 1

Graph theory

General conclusion:

The minimum weight vertex cover problem still one of the hardest NP-complete problems that has its real applications everywhere.

The question is how to find a good solutions within respected times, and for this reason we have done this work.

The objective of this thesis was a proposition of an approach to tackle this problem giving comparable results with the existent state of art. using the strong C++ language we implemented this approach where we confronted many problems concerning how to really learn and apply the basics of the Tabu search strategy especially in how to get innovated for the creation of diversification procedures.

Though the good results of this approach, it still missing a convenient behavior with the large instances because we saw clearly the decreasing of its performance on it, as a consequence we aim in the near future to hybridize another initial solutions construction procedures with the tabu search strategy in order to improve the results that already obtained such as the genetic algorithms or the Simplex method. In the other hand, we will focus on other technics to accelerate the process in the search core, specifically how to pick the best neighbor solution quickly where we will try to use the hash functions.

As a major perspective, we shall try to move this approach to another level, we are going to introduce the term of parallelization, because nowadays the parallelization became a real new future idea for the NP-complete problems. As a primary idea, we will make the iterations of tabu search runs in parallel making them exchange the obtained results, we aim from this idea to improve the computational time and the solution quality as well.

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Abstract:

In the study we deal with minimum weight vertex cover problem as one of the fundamental problems in graph theory with many important real-life applications such as, for example, in wireless communication, circuit design and network flows. It is a well-known NP-complete problem and hence no polynomial-time algorithm has been found yet for solving it to optimality.

We have implemented a modified Tabu search algorithm for tackling this problem in order to obtain good feasible solutions in the available time. The latter is enhanced by introducing greedy heuristics to improve the quality of initial seed solutions. The performance of our approach has been tested on well known dataset.

Keywords: NP-complete problem, Tabu search, minimum weight vertex cover problem, greedy heuristics.

Résumé

Dans cette étude, nous traitons un des problèmes fondamentaux de la théorie des graphes avec de nombreuses applications importantes de la vie réelle, tels que, par exemple, dans la communication sans fil, la conception de circuits et les flux du réseau. Il est un problème NP-complet bien connu et donc aucun algorithme polynomial n'a encore été trouvé pour le résoudre à l'optimalité.

Nous avons implémenté un algorithme de recherche Tabu modifié pour résoudre ce problème afin d'obtenir de bonnes solutions dans un temps raisonnable. Ce dernier est renforcé par l'introduction d'heuristiques gloutons pour améliorer la qualité des solutions initiales.

La performance de notre approche a été testée sur des données bien connues.

Mots clés : NP-complet, recherche tabu, heuristiques gloutons

ملخص

نعالج في هذا العمل احد المشاكل المعروفة بتطبيقات مهمة ومتنوعة في الواقع مثل الاتصالات اللاسلكية او معالجة تدفقات الشبكات، يعتبر هذا المشكل معروف جدا ولا يوجد لحد الان خوارزمية لحله بوقت معقول

لقد طبقنا خوارزمية تعتمد أساسا على البحث باستعمال الطابوهات من أجل حل هذه المشكله، هذه الخوارزمية مدعمة ببعض الطرق لانشاء حل ابتدائي بجودة أفضل.

أداء هذه الخوارزمية جرب على عينات معروفة ومتفق عليها

الكلمات المفتاحية: البحث باستعمال الطابوهات، خوارزمية