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A Shortest Augmenting Path Algorithm for Dense and Sparse Linear Assignment Problems

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Abstract — Zusammenfassung

A Shortest Augmenting Path Algorithm for Dense and Sparse Linear Assignment Problems. We develop a shortest augmenting path algorithm for the linear assignment problem. It contains new initialization routines and a special implementation of Dijkstra's shortest path method. For both dense and sparse problems computational experiments show this algorithm to be uniformly faster than the best algorithms from the literature. A Pascal implementation is presented.

AMS Subject Classifications: 90C08, 68E10.

Key words: Linear assignment problem, shortest path methods, Pascal implementation.

Ein Algorithmus mit kürzesten alternierenden Wegen für dichte und dünne Zuordnungsprobleme. Wir entwickeln einen Algorithmus mit kürzesten alternierenden Wegen für das lineare Zuordnungsproblem. Er enthält neue Routinen für die Anfangswerte und eine spezielle Implementierung der Kürzesten-Wege-Methode von Dijkstra. Sowohl für dichte als auch für dünne Probleme zeigen Testläufe, daß unser Algorithmus gleichmäßig schneller als die besten Algorithmen aus der Literatur ist. Eine Implementierung in Pascal wird angegeben.

1. Introduction

The linear assignment problem (LAP) is useful as a relaxation for difficult combinatorial optimization problems like quadratic assignment, and traveling salesman. Furthermore, theoretical developments for the LAP can often be extended to other problems, such as minimum cost flow and transportation.

The first well known LAP algorithm, Kuhn's Hungarian method [22], was published in 1955. After 1977 several more or less new algorithms were proposed for example by Barr, Glover and Klingman [2], Hung and Rom [18], Bertsekas [3], and Balinski [1]. None of these authors even mentioned the existence of the shortest augmenting path algorithm of Tomizawa [29] from 1971. Dorhout [10, 11] improved it to what was for years the fastest LAP algorithm available. Still earlier, in 1969, Mack [24] developed an algorithm that is a forerunner of Tomizawa's. It is equivalent to the Hungarian method, but more comprehensible.

After a review of assignment algorithms, we describe in Sections 4, 5 and 6 a new algorithm, LAPJV, based on shortest augmenting paths. A Pascal code is presented