An Approximation Algorithm for a Heterogeneous Capacitated Vehicle Routing Problem

Haniyeh Fallah* University of Amirkabir
Farzad Didehvar University of Amirkabir
Farhad Rahmati University of Amirkabir

Abstract

The capacitated vehicle routing problems with heterogeneous vehicles (HCVRP) arise in many logistics and distribution problems. The vehicles in these problems can be variant in their capacities or per unit distance costs. In this paper, we present an approximation algorithm for the HCVRP where there exist a fixed number of heterogeneous vehicles at the depot and the fleet of vehicles is non-uniform in their capacity and per unit distance cost and the objective is to minimize the total cost of travel. We have assumed that the distance between two locations/customers is symmetric and satisfies the triangle inequality.

Keywords: Heterogeneous Capacitated Vehicle Routing Problem (HCVRP), Approximation Algorithms, Generalized assignment problem
Mathematics Subject Classification [2010]: 68W25, 90B99, 05C99.

1 Introduction

The vehicle routing problem (VRP) is one of the most important and more studied combinatorial optimization problems. It calls for the determination of the optimal set of routes to be performed by a fleet of vehicles to serve a given set of customers. Logistics management and distribution are two central places for variants of these problems, specially capacitated VRP (CVRP). In logistical and transportation problems the company uses multiple vehicles in parallel for the distribution. The objective in this case is to minimize the number of tours or the overall cost of travel. The vehicles may be identical (i.e. have same capacity and cost) or heterogeneous (have different capacity or different per unit distance cost). The routes have to be designed according to the characteristics (i.e. capacity and cost) of vehicles. In this article, vehicles are considered to be heterogeneous if they differ in capacity and per unit cost of distance travel. There exists a good survey for vehicle routing problems in [4], [1]. A related work is heterogeneous traveling salesman problem with 2 depots and the objective function of minimizing the total cost of travel [2]. The vehicles at the depots differ in per unit cost of distance travel. In that manuscript Bae and Rathinam obtained a 2-approximation for HTSP by the use of primal-Dual technique. The first result in this area is related to Yadlapalli et al. which obtains a 8-approximation ratio [6]. Recently they have improved this result to a 3-approximation ratio [7]. The main

*Speaker