Chapter 2
Solving Nurse Scheduling Problem via Genetic Algorithm in Home Healthcare

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ABSTRACT

The nurse scheduling problem (NSP) is the problem involving allocating the monthly shifts (day and night shifts, holidays, and so on) for nurses under various constraints. Generally, the NSP has a lot of constraints. As a result, it needs a lot of knowledge and experience to make the scheduling table with its constraints, and it has been made by the head nurse or the authority in the hospitals. This allocation of the shifts gives a lot of burden (time and efforts) to them, and it has been growing the demand for the automatic nurse scheduling system. This chapter aims to develop a genetic algorithm application for the Nurse Scheduling Problem (NSP). The application will be developed using Microsoft Visual Studio in C# programming language.

INTRODUCTION

Nurse scheduling problem deals with the jobs, vacations, and shifts arrangement for the nursing staffs in hospital's daily operation. Many factors need to be considered while the nurse chiefs arrange the nurse scheduling activities, for instance, the hospital management policies, the government regulations, and the fairness among nurses (Tsai and Li, 2009).

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Home health care is growing in the French medical sector since demands increase. Organizations providing home care services are willing to optimize their activities in order to meet the increasing demand for home care. Consequently, research on this problem has appeared by the end of the 20th century. Most of the work being application-based, the number of publications rises to cover the different variants of the problem. The problem is complicated by factors such as caregivers qualification, various patients demand, multiple home care offices, caregivers workload limitation, shared visits, patients availability and workload fairness among caregivers (Decerle et.al., 2017, Bertrand, 2010).

Home Health Care is a wide range of health care services that can be given in one's home for an illness or injury. In recent years, the health care industry has become one of the largest sectors of the economy in developed countries such as France, Germany, Australia, etc. Since the transportation cost is one of the most important spendings in the company activities, it is of great significance to optimize the vehicle routing problem in home health care company. According to a survey (Mankowska et al., 2014; Harris, 2015; Liu et al., 2013) of the home health care companies, each day, an HHC company carries out various logistics activities including the delivery of drugs or medical instruments from the pharmacy to patients, and pickup of the biological samples and waste from patients' home to the laboratory. A large number of patients are located in a town or village, and the task of a home health care company is to provide health care services to the patients at ones' homes one by one. The main operational process of the HHC can be summarized as three steps (Shi et.al., 2017: 13987):

1. The HHC company collects information from the patients, this information may include: name, address, sex, type of the illness, symptom and other related information;
2. The HHC company plan to arrange the visited routes and assign nurses according to the information collected;
3. The nurses are scheduled to visit the patients. Each nurse is assigned to a planned route, and he/she has to carry out all of the service-related activities for the route. This nurse will drive the vehicle to visit the patients one by one according to the designed route.

Among the first papers about home health care, Begur et al. (1997) described a decision support system not taking into account time window and shared visits in opposite to Cheng and Rich (1998) who considered patients and care givers time window as well as multiple home care offices. They solved small instances with exact and heuristic approaches. Shared visits have been lately studied in the literature. Eveborn et al. (2006) developed a decision support system for an application in Sweden