COMPARING MEDICAL ASSISTANT SCHEDULING MEN AND WOMEN WITHIN DIFFERENT WORK SHIFTS USING A GENETIC ALGORITHM, A CASE STUDY AT NASIRIYAH HEART HOSPITAL

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ABSTRACT

Organizations today invest their resources optimally through the scheduling process, which is the process of allocating those resources in a certain period of time by achieving a set of constraints , as it has an important role in achieving the goals of organizations and increasing their efficiency, as the service production system in most service organizations, especially specialized hospitals, suffers from a large momentum in the numbers of patients and Providing health services to all governorates and working to improve the service provided to customers (patients).

This study aims to schedule the assistant medical staff at the Nasiriyah Heart Hospital using the genetic algorithm, one of the Meta heuristic algorithms. A comparison was made between the number of male workers in the men's lobby and the number of female laxatives in the women's lobby, as work in the men's lobby is based on a two-shift system. As for work in women's lobby, it is done with a Trible shift system of work, the problem of scheduling workers was solved through selection (according to those with double shifts by the roulette wheel selection method, and the problem of scheduling triple-shift workers was solved by the tournament selection method) and then Crossover, mutation. The study reached several conclusions, the most important of which is the efficiency of the genetic algorithm in reaching the optimal solution in terms of speed and time. Also, scheduling in specialized hospitals such as the heart Hospital requires special attention because it deals with heart patients who must be They have special attention and more care, especially women

Keywords: Scheduling, Medical assistant, Genetic Algorithm.

INTRODUCTION

In service organizations, where there is high interaction with customers, they work to fulfill customers' requirements and fulfill their needs. Service organizations want to achieve their goals through their working members and thus achieve customer satisfaction with the services provided to them. In health service organizations in particular, the problems of work and business scheduling are complex problems. Very important due to dealing with many restrictions and rules that must be achieved and dealt with. The development of effective health production systems has become more important in the past few decades for two main reasons: the rapid increase in health services expenditures in more developed countries, especially specialized diseases such as heart diseases and others, as well as the simultaneous growth in demand for health services and patient expectations. As a result, governments and

decision makers seek to The field of health services is constantly working to develop more efficient health systems, as timely service is crucial to patients and also represents a challenge for senior management. Therefore, scheduling workers and scheduling operations is one of the most effective ways to match demand with supply, thus ensuring the availability of a sufficient number of workers to provide health services to patients, as well as reducing waiting times for them and meeting their requirements, as well as achieving timetables that reduce the workload and are fair to all workers without exception. Good scheduling contributes to increasing the well-being of workers and achieving their satisfaction, thus focusing their interests on providing appropriate health services to patients.

In recent years, the Genetic Algorithm (GA) has emerged as a useful tool among Meta Heuristic algorithms for solving complex optimization problems, including scheduling, due to its high efficiency, comprehensiveness, and ability to find solutions. The GA is an effective and ideal technique for solving scheduling problems. Therefore, the study includes solving the problem of scheduling assistant medical staff using a genetic algorithm.

The research included four sections. The first section was devoted to the research methodology. The second section included the theoretical framework. The third section included the practical framework for the study. The fourth section included recommendations and conclusions.

I. FIRST SECTION: STUDY METHODOLOGY

FIRST: STUDY PROBLEM

Employee scheduling is the process of creating work schedules for all individuals to work so that the organization can meet the demand for its goods or services, as the first part of this process involves determining the number of individuals with special skills needed to meet the demand for service and then the personnel are distributed to shifts in order to meet the required work levels at different times and then work is assigned duties to individuals in each of those shifts.

The problem of scheduling workers is a whole NP problem that deals with the problem of assigning a group of workers to a schedule that meets the restrictions resulting from that work, as some of these restrictions are mandatory verification and some of them are preferential, as there are difficult restrictions that are determined in the form of rules through which the scheduling of the work of the health staff is formed, while there are easy restrictions that improve the quality of the scheduling result, and thus the violation of the schedule is reduced, for the decision-making process in various service programs.

The problem of scheduling employees means a way to find a schedule for employees that includes dividing them fairly within specific shifts, whether they are double shifts (morning, evening) or triple shifts (morning, evening, night), in order to ensure that the work of one of them does not intersect with the work of others, so that the lowest possible cost is achieved, which is calculated from the target function and service to customers (patients).

Second: Study significance

The importance of the research is derived from the importance of the topic it deals with and the goals that the study seeks to achieve. This significance could be summarized in the following points:

1. Demonstrate the importance of scheduling employees in improving the quality of services provided to customers.

2. A statement of the importance of Human Resources Management and attention to their requirements to reduce the overall cost of the hospital and improve the quality of services provided, as they represent the image of the organization and its ambassadors in front of its customers.

3. An attempt to draw the attention of senior management to how it contributes to achieving justice, fairness and non-favoritism for the staff working at Nasiriyah Heart Hospital and determining the appropriate number of staff to achieve the required level of service through the use of scientific methods.

Third: Study objectives

The objectives of the study are represented by the purpose that the study wants to achieve and are as follows:

1. Improving the quality of services provided to customers by scheduling employees and determining the appropriate and sufficient number of personnel working to provide health services.

2. Achieving fairness in the distribution and scheduling of employees to achieve employee satisfaction, increase morale, and ensure that the Times that suit them are determined to achieve the provision of services throughout the day, as they represent the image of the organization and thus reduce the burden and work pressures on them and ensure patient safety.

3. Facilitate the procedures of the service delivery process and reduce waste to the extent possible resulting from immobility and waiting times.

4. Comparing the numbers of women and men workers in the different work lobby in the hospital, namely the men's and women's lobby.

Fourth: The general formulation of the issue of scheduling employees:

One of the most common and most famous methods in the method of solving the scheduling of workers is the Formula Mix Integer Liner Programming or what is called MILP, which is one of the methods of numerical linear programming, through which the solution takes only integers, and the mixed ones take two values, either the value of 0 or the value of 1 in addition to integers, the mathematical model of this method may be formulated as follows:

$$\text{Min Z} = \sum_{j=1}^{m} \sum_{i=1}^{n} \text{Xij. Yij}$$

$$\sum_{i=1}^{n} \text{Xij} = 1$$

$$\sum_{j=1}^{m} \sum_{i=1}^{n} \text{Zjx. Bik. Xij} \geq D\,k, s$$

The equations represent the following:

Equation No. 1: represents the sum of the target function (cost function), which requires to be reduced to the lowest possible value, which represents the sum of the penalty costs of the penalty costs for allocating nurse j to work within the Shift k

Equation No. 2: represents the first limitation of the issue, which includes that each of the hospital workers works within one shift per day, whether that shift is (morning, evening) or (Morning, Evening, night).

Equation No. 3: represents the second limitation of the issue, which includes that the demand for the service is met by the employees who work in the hospital and their various job titles (a doctor, a nurse, etc.)… The numbers must be available within the minimum and maximum limits and according to the shifts that exist at work.

Fifth: Cost calculation:

The goal function that has been formed depends on achieving a set of difficult constraints and easy constraints that can be achieved, as there are three costs to be determined and the total cost of scheduling represents the sum of these three costs, as the goal function for scheduling work represents:

F= C1.W1 + C2.W2 + C3.W3

Where F represents the total cost of scheduling work, which is calculated based on hard constraints and easy constraints.

The W value represents the weight value that is calculated for both hard and easy constraints as follows:

The value W1 = 100 represents the weight of exceeding the hard constraint of the first type.

The value W2 = 100 represents the weight of exceeding the hard constraint of the second type.

The value W3 = 1 represents the weight of exceeding the easy constraints.

The value of C represents the cost calculation value for both hard and easy constraints as follows:

1. The first cost is C1: the cost of the penalty for violating the Hard constraints of the first type, where the total number of the number of mornings, evening and night shifts must be within the upper and lower limits, and each violation of these constraints will increase the value of C1 by 1.

2. The second Cost C2: represents the cost of the penalty for violating the Hard constraints of the second type, where there should not be three consecutive night shifts for each worker and the absence of a morning shift after an evening shift for each worker for two shifts, in addition to the absence of a morning shift after a night shift for each worker for triple shifts and that each violation of these constraints will increase the value of C2 by 1.

3. The third cost C3: represents the cost of the penalty for violating the easy constraints, where the total number of days off for each worker must be within the upper and lower limit, the number of days of morning shifts for each worker within the upper and lower limit, and the number of days of evening shifts for each worker within the upper and lower limit for double shifts and add the number of days of night shifts for each worker within the upper and lower limit for triple shifts and each violation of these constraints will increase the value of C3 by 1.

II. THEORETICAL FORMWORK

Scheduling plays an important role in achieving the goals and success of organizations by increasing their efficiency, ensuring optimal use of resources, making the most of their energy, achieving outstanding performance and speed of completion, achieving customer requirements and satisfaction through timely execution of work and reducing waiting times to the extent possible.

First: Scheduling concept:

To begin with, the concept of schedule is a plan for performing a series of specific tasks within a certain time frame (Bamford & Forrester,2010:84), since the schedule is what determines when a particular activity occurs and what resources are used (cunha,2021:2), While scheduling means meeting different performance criteria or factors by allocating available production resources over time (Chawla & Singari, 2022: 198), scheduling is also about allocating limited resources to activities in order to improve performance measures depending on the situation as resources and activities can take many different forms (Ramkumar et al., 2011: 282), whereas, (Ansari & Saubari,2020:1) pointed out that scheduling is the activity of allocating existing resources to perform a set of tasks during a certain period of time, as scheduling has two meanings, namely:

A. Scheduling as a decision-making function: scheduling is defined as the process of scheduling.

B. Scheduling as a theory: scheduling is defined as a set of principles, models, techniques and logical conclusions in decision-making.

He defines it (Madureira et al., 2004:3)Assign time-limited work to time-limited resources within a predetermined time frame, which represents the entire time horizon of the schedule, as the accepted schedule must meet a set of fixed and flexible restrictions imposed on the work and resources. As he defined it (Pinedo,2016:1). A decision-making process that is regularly used in many manufacturing and service industries, in which the allocation of resources to tasks is handled and during certain periods of time one or more goals are improved.

Table (1) shows the definition of scheduling from the point of view of a number of researchers, as follows:

Table (1) the concept of Scheduling

Source	Definition
Russell& Taylor, 2019:751	Determining the time of need for labor, equipment and material facilities to produce a product or provide a service, as it represents the last stage of planning before production occurs.
Santisteban,2019:15	Allocating scarce resources to tasks over time, it is part of any process that requires time and resources, as Schedule design involves allocating activities or operations at a specific place and time.
Stevenson,2021:693	Determining the timing of the use of equipment, physical facilities and human activities in the organization as scheduling takes the resource plan and translates it into specific operational tasks on a detailed basis as schedules for physical facilities can be developed by allocating activities and making use of them efficiently
Anwar et al.,2021:404	A method used to allocate limited resources to complete a set of works at a predetermined time, as the scheduling function is to make adjustments between the number of works and the limited number of resources that the organization has.
Krajewski & Malhotra ,2022:420	The introduction of the resource plan and its translation into specific operational tasks on a detailed basis, as the schedules of production facilities can be developed by allocating activities to them and making use of them efficiently

Second: Scheduling employees

scheduling employees refers to the design of the shift for each medical staffing worker in accordance with the regulations and policies of health organizations as medical staffing works around the clock, usually divided into three to four shifts per day (Pahlevanzadeh et al.,2021:3317). Problems of scheduling employees are a big problem for the health sector due to the work structure of health organizations and various restrictions (Sulak & Bayhan,2016:755)). one of the main challenges in improving the efficiency of Health Services is the shortage of medical staffing (Akhavizadegan et al.,2015:2), Medical Staffing is one of the resources that plays an important role in determining the performance and quality of health organizations because they are directly responsible for meeting the patient's needs 24 hours a day to increase patient satisfaction however, there are often cases when the number of available personnel is insufficient due to the large number of patients that can lead to fatigue, therefore the performance Undesirable mistakes in dealing with patients, as the working hours of medical staff must be properly organized (Ariyani et al.,2021:1).

Scheduling problems often require a combination of several elements, which is very confusing due to various restrictions such as orientation and assignment (Asif et al., 2022:306)). the appointment of medical staff in the right place and time to do the right work is a major concern for health organizations. these organizations are usually divided into specialized units, which include many job positions, each of which requires a specific set of skills, and this leads to a large number of possible work schedules when combined with demand and changing situation (Lim et al.,2016:35), as health organizations are under increasing pressure to reduce service costs as these expenses account for more than 40% of their total budget and thus help Providing effective and customized scheduling for employees such as doctors and nurses in relieving this pressure (Hamid et al.,2020:279).

Third: Genetic Algorithm

Many scientists in the last century have developed evolutionary-inspired algorithms for optimization and machine learning (Mitchell,1996:2). in the Fifties and sixties of the last century, many computer scientists independently studied evolutionary systems taking into account the idea of using evolution as a tool to improve engineering problems. the idea in all these systems was to develop a set of candidate solutions to a particular problem, using factors inspired by natural genetic variation and natural selection (Mitchell, 1999:2), the history of genetic algorithms dates back to Turing is called machine learning machine) in which it simulates the way of using the principles of evolution (drachal & Pawłowski,2021:5), machine learning is synonymous with advanced computing, the complex or incomprehensible nature of many problem areas, such as data mining or process control, has led to the need for technologies that can adapt to the task they face (Bull, 2004), the genetic algorithm was proposed and developed in the Sixties by John Holland, his students and colleagues at the University of Michigan (Avin et al.,2012: 257), and the beginning of GA research in general was marked by the publication of Holland's book in 1975 (Roeva et al.,2021:1)), in his book adaptation in natural and artificial systems, he presented the genetic algorithm as an idea of biological evolution and provided a theoretical framework for adaptation under GA, which is a method of transition from one set of chromosomes such as (1,0, or bits) to a new set of society

using a kind of natural selection along with genetic factors inspired by exchange factors Mutation and recombination and then the selection factor selects those chromosomes in the population that will allow them to reproduce (Mitchell, 1998:2), the original goal of which was to create a research method that was more powerful than the traditional methods of that time. inspiration was taken from nature and Darwin's theory of evolution and survival of the fittest. since then, it has been proven both theoretically and experimentally to be a powerful algorithm even in complex problems (Bengtlars& Väljamets, 2014:7).

The genetic algorithm GA is defined as a class of randomized population-based search methods within evolutionary algorithms (EAs) (Wang,2006:17), and is one of the classes of evolutionary algorithms inspired by evolutionary genetics (Karakaya & Soykasap,2009:478). evolutionary algorithms are defined as optimization procedures that search for a solution that improves a particular function in a specific search space (Karimi & Jahanian, 2012:81) and is one of the most commonly used algorithms of all evolutionary algorithms (Helal et al.,2012: 2).

GA works on a set of possible solutions that apply the principle of survival of the fittest to produce better approximations of a solution and in each generation of GA ,A new set of approximations is created through a process of individual selection (Chipperfield & Fleming, 1995:1), initially several individual solutions are randomly generated to form an initial set(Lamini et al.,2018: 181), and individual solutions are selected in a random way and according to their trade-off values which are calculated from the trade-off function of the specific problem and which carry genetic factors (hybridization and mutation) to produce a new generation (Rooki et al.,2012:164), and at each step, individuals are selected from a group Current solutions and consider them as parents for the application of genetic processes to produce individuals for the next generation and over successive generations, " society evolves and the optimal solution is reached (Mudduluru, & Chizari,2021:3) .

Table (2) shows the definition of scheduling from the point of view of a number of researchers, as follows:

Table (2) the concept of GA

Source	Definition
Sheppard,2016:2	One of the tools that we can use to apply machine learning to find good, and sometimes ideal, solutions to problems that have zero potential solutions is through the use of biological processes in programs to find answers to problems that have large search spaces through the continuous generation of candidate solutions, evaluating the extent to which Solutions trade-off for desired results, and optimizing the best
Murthy et al.,2017:127	It is a random process that searches a complex and multimedia space, as it is a random method in that it uses domain-specific knowledge, in the form of a target function, to conduct a random directed search.
Fouad et al.,2018:1062	A research method that uses a random choice to guide a highly exploitative search, by maintaining a balance between exploring the area of feasible research and exploiting good solutions.
Mudduluru & Chizari,2021:2	It is an evolutionary optimization technique that simulates the process of natural selection to solve constrained and unrestricted optimization problems as the algorithm iteratively modifies the initial set of individual solutions. .
Baghalzadeh et al.,2022:1445	A set of computational models that encode possible solutions or possible hypotheses of a particular problem in a chromosome-like data structure

GA has been implemented in many service systems, including health services such as health care services, including radiology, the use of (MRI), computed tomography (CT), ultrasound, and oncology, which is made possible by screening tests when combined with appropriate treatment and increased patient survival rates (Fofanah & Hwase, 2022:226), according to (Fofanah et al.,2023: 382) that the more effective AI applications are, the fewer problems with complexity and optimization problems.

According to (Akarsu & Küçükdeniz, 2022: 18) the adoption of the genetic algorithm to solve the scheduling problem has many useful features compared to other descriptive characteristics, namely:

1. Flexibility in determining constraints and quality standards.
2. Ability to work with continuous and intermittent variables.
3. The ability to a comprehensive search space.
4. The ability to offer several optimal or good solutions.
5. Use parallel calculation techniques to reduce processing time.

Fourth: Advantage and limitations GA:

The genetic algorithm is a method that is often used for the purpose of solving complex optimization problems based on the genetic concept and has been applied in solving various problems in various fields Umar et al.,2022:169)), has been identified by (Rani & Kumar, 2017: 617; Lambora et al.,2019,382 ، Hormozi et al.,2022:5) features of the genetic algorithm, namely:

a. It has faster and more efficiency compared to traditional methods.
b. No need for simulated information (which does not exist for most real-life problems).
c. More comprehensive and better compared to primitive methods and possessing well-coordinated abilities.
d. Promote both continuous and distinct functions along with multi-objective problems.
e. It aims to provide the best solution rather than a single one.
f. Getting a satisfactory answer to problems, which improves over time.
g. They are easily distributed and are a good choice for large-scale optimization problems.
h. A large and comprehensive space for Space Research in data centers.

Third Section: Practical framework

The solution method used through the genetic algorithm based on the genetic algorithm, where the problem will be solved first for binary work shifts (morning, evening) and then solve the scheduling problem using the genetic algorithm for Triple work shifts (morning, evening, night), as the steps of the genetic algorithm to solve work scheduling are as follows:

1. Initialization: it is done by generating the initial matrices, as the initial data is initialized to generate matrices consisting of the number of workers n multiplied by the number of days D and the elements of the Matrix contain the types of lips S for the workers where:

In binary shifts there are Morning lips, evening lips and a lip that represents the holiday for each worker.

In triple shifts there are three lips, morning lip, evening lip, night lip and a lip that represents the holiday for each worker.

2. Determination of the parameters of the work of the genetic algorithm: the determination includes the following:

❖ The size of the population: represents the population required to be generated for the solution, as the size of the population here is represented by 1000 tables.

❖ Number of generations: represents the number of possible generations achievable for the solution.

❖ Stop condition: stop generating random solutions when the value of the objective function is equal to zero, that is, the total cost of the hard and easy constraints has been exceeded and all those constraints have been achieved.

3. Creating a random population: a random population is formed that represents the possible solutions and according to the parameters that have been formed, represented by the size of the population.

4. Calculation of the goal function (cost function): the goal function is calculated for the difficult and easy constraints that have been configured for all the tables created in the population, which are randomly configured, where the creation of solutions is stopped if the value of the goal function is equal to zero, where it represents the optimal solution, but if the difficult constraints are not met, the steps of the genetic algorithm will be continued.

5. Selection: the selection process mimics the concept of the selection process in nature, which is the survival of the fittest. In our study, two selection methods were selected based on the number of seizures in the hospital, as follows:

a. The roulette wheel method: This method may be similar to how to use the roulette wheel and how to allocate a part of the wheel to each individual commensurate with the value of his trade-off, and when rotating the wheel, the probabilities of choosing each individual are proportional to the size of the part of the wheel that it occupies, and the genetic algorithm will select the best individuals and abandon the worst, and in our study we used this method to schedule work with two shifts (morning, evening), as we choose the value of the trade-off based on the calculated cost of each a table where the first table with the lowest cost for the target function is chosen to be the first parent (P1), and then the second table is chosen, which represents the second The least cost is calculated for the target function to be the second father (P2) and then carry out the exchange process for the formation of new offspring (new offspring).

b. Tournament method: this method depends on the value of the individual's trade-off, as the selection of a tournament requires determining the size of the tournament, which determines the number of individuals from the population who must be selected to compete in a tournament and entails randomly selecting individuals from the chromosome set to participate in the tournament, as the winner of each tournament is selected to reproduce for selection, and weaker individuals in society have less chance to be selected to reproduce if the tournament size is large . In our study, we used this method to schedule work with three shifts (morning, evening, night) and the size of the tournament was determined by three, we choose the value of the trade-off based on the calculated cost of each table, the first table is chosen at the lowest cost of the target function to be the first Father (P1) and then choose the second table, which represents the second lowest cost calculated for the target function to be the second father (P2) and then choose the third table, which represents the third lowest

cost calculated for the target function to be the third father (P3) and then the process of exchange for the formation of new offspring (new offspring).

6.   Crossover: It is the process of replacing some genes in one parent with the corresponding genes in the other parent. Two chromosomes may be randomly selected from the population and combined to form a new offspring. This newly created chromosome may carry better parameters and trade-off values for each parent.:

7.   Mutation: it is a genetic factor used to maintain genetic diversity from one generation of the chromosome set to the next generation and its procedure begins by determining which of the individuals from the community that were created from the process of substitution interference to be mutated based on the percentage of mutation specified in the input data. Mutation leads to random differences in the community as the mutation rate is part of the bits or values within the community. this process occurs at each position in the bit string with a specific probability and this specific probability is generally determined between 0.1 or less according to the length of the community.

8.   Termination: in which the work of the genetic algorithm is completed, where the final solution is the total cost calculated for the target function, depending on the hard constraints and easy constraints created to configure the scheduling of work and according to the number of binary and triple shifts.

A comparison will be made between the scheduling of nurses with two shifts and doctors with three shifts, as nurses work in various departments, while doctors work throughout the hospital.

1. **Medical assistant scheduling in working Two Shift.**

The work of medical assistant is to provide health services and follow up on the health conditions of patients in the Men's lobby. The Hard and easy constraints to solve the problem of scheduling workers for this job description are represented by the following, according to Table (3):

Table (3) The Hard and easy constraints

Type of constraints	constraints	Minimum	Maximum
hard constraints1	Number of workers in the morning shift	*4*	7
	Number of workers in the evening shift	3	6
hard constraints2	nonexistence of three consecutive shifts night No morning shift after an evening shift		
easy constraints	The total number of vacation days for each worker	2	*2*
	Number of days of morning work shifts for each worker	*2*	*3*
	Number of days of evening work shifts for each worker	*1*	*2*

As the number of patients working in Men's lobby is (14), they must be distributed into bilateral shifts in a way that ensures achieving the lowest possible cost by calculating the costs for the Hard and easy constraints and achieving the optimal solution, which includes the value of the Hard constraints of the first type being zero and the constraints of the first type The second is zero. As for the easy constraints, they can be achieved as little as possible, as all the

constraints achieved through the genetic algorithm were zero. Table (4) shows the scheduling of nurses through the genetic algorithm.

Table (4) scheduling Nurses by GA

Source	Day1	Day2	Day3	Day4	Day5	Day6	Day7
Medic1	M	M	M	OFF	N	N	OFF
Medic2	N	N	OFF	M	OFF	M	M
Medic3	M	OFF	M	N	N	OFF	M
Medic4	M	M	M	OFF	N	OFF	N
Medic5	OFF	M	M	M	OFF	M	N
Medic6	M	OFF	N	OFF	M	N	N
Medic7	M	M	N	OFF	N	OFF	M
Medic8	N	N	OFF	M	M	N	OFF
Medic9	OFF	M	M	OFF	M	N	N
Medic10	N	OFF	M	N	OFF	M	M
Medic11	M	M	OFF	M	N	N	OFF
Medic12	OFF	M	M	N	OFF	N	N
Medic13	M	N	N	OFF	M	M	OFF
Medic14	OFF	N	OFF	M	M	M	N

2. Medical assistant scheduling in working Three Shift.
The work of medical assistant is to provide health services and follow up on the health conditions of patients in the Women's lobby. The Hard and easy constraints to solve the problem of scheduling workers for this job description are represented by the following, according to Table (5):

Table (5) The Hard and easy constraints

Type of constraints	constraints	Minimum	Maximum
hard constraints1	Number of workers in the morning shift	4	6
	Number of workers in the evening shift	3	6
	Number of workers in the Night shift	2	3
hard constraints2	nonexistence of three consecutive shifts night No morning shift after an evening shift No morning shift after an Night shift		
easy constraints	The total number of vacation days for each worker	2	2
	Number of days of morning work shifts for each worker	*2*	*3*
	Number of days of evening work shifts for each worker	*1*	*2*
	Number of days of Night work shifts for each worker	1	2

As the number of medical assistants working in women's lobby is (18), they must be distributed into bilateral shifts in a way that ensures achieving the lowest possible cost by calculating the costs for the Hard and easy constraints and achieving the optimal solution, which includes the value of the Hard constraints of the first type being zero and the constraints of the first type The second is zero. As for the easy constraints, they can be achieved as little as possible, as all the constraints achieved through the genetic algorithm were zero. Table (6) shows the scheduling of nurses through the genetic algorithm.

Table (6) scheduling Nurses by GA

Source	Day1	Day2	Day3	Day4	Day5	Day6	Day7
Medic1	OFF	OFF	N	E	E	M	M
Medic2	E	E	OFF	N	OFF	M	M
Medic3	OFF	N	OFF	E	E	M	M
Medic4	E	M	M	OFF	N	E	OFF
Medic5	M	M	OFF	E	OFF	E	N
Medic6	M	M	OFF	E	N	E	OFF
Medic7	OFF	OFF	E	N	E	M	M
Medic8	N	E	M	M	OFF	OFF	E
Medic9	E	N	M	OFF	M	OFF	E
Medic10	E	M	OFF	M	OFF	E	N
Medic11	M	OFF	N	OFF	E	E	M
Medic12	E	N	E	M	M	OFF	OFF
Medic13	M	OFF	M	OFF	E	N	E
Medic14	OFF	E	N	E	M	M	OFF
Medic15	N	E	M	OFF	M	OFF	E
Medic16	OFF	OFF	E	E	N	M	M
Medic17	N	OFF	E	M	M	OFF	E
Medic18	M	M	OFF	E	E	N	OFF

FOURTH SECTION. CONCLUSIONS AND RECOMMENDATIONS
The conclusions and recommendations of the study are presented as follows

First: Conclusions
1. The work of the medical assistant working in the women's lobby requires more care and attention from the hospital, as there are three work shifts to cover the needs of patients.
2. The work of the medical assistant in the men's lobby is less than the women's lobby in terms of the number of work shifts, as there are two work shifts for the staff due to their

experience and knowledge. Also, the number of patients in these lobby is less than in the women's lobby.

3. There is a high efficiency of the genetic algorithm in solving the problem of scheduling workers in terms of speed and time and reaching the optimal solution as quickly as possible and in an ideal time. The genetic algorithm can prepare more than 1000 schedules in a very short time not exceeding a minute and thus the optimal solution can be reached easily.

4. Using genetic algorithms to solve the problem of scheduling workers, especially in women's lobby, achieves efficiency and speed in reaching the optimal solution, better than the manual solution.

5. The use of genetic algorithm contributes to improving the quality of the service system provided in the hospital, as it works to achieve the presence of a sufficient number of workers for the purpose of providing service to patients with various job titles who work within the different departments.

6. The use of the genetic algorithm contributes to achieving justice, fairness and impartiality among health personnel in terms of the number of shifts each worker works, as the genetic algorithm is the one that prepares this scheduling and therefore it will be fair for everyone.

Second: Recommendations

1. The need to pay attention to algorithms, including the genetic algorithm, in solving the problem of scheduling workers with different job titles, and working to invest them in facilitating the process of providing service to clients and ensuring the presence of sufficient staffing of workers.

2. The need to pay more attention to achieving the satisfaction of working individuals by investing in their abilities and encouraging them, and making it easy to determine the work shifts they want that meet their needs and desires.

3. The necessity of investing in personnel and providing them with adequate training before working in the hospital, especially for newly appointed staff with various job titles, as the hospital requires individuals with experience, high competence, and skills as it deals with difficult cases, especially for patients with heart and blood vessels.

4. It is necessary to provide women's lobby with more staff to cover the work and reduce the burden on the medical staff.

5. It is necessary to make the men's lobby work in a triple shift system to reduce the workload on the male medical staff and improve their satisfaction.

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