

Implementation of genetic algorithm for the assignment of academic advisory

Juan Carlos Huerta Mendoza

Student Doctorate / Da Vinci University, Mexico

Abstract: Academic advisory assignment is a process found at most colleges. The success of academic advising depends a lot on the teacher who gives the advice, providing a good assignment between the teacher and the student benefits in carrying out the advising since the teacher allows him to develop a teaching methodology of great impact to increase the guarantee of success and is reflected in the student's learning. In the tutoring department of the Reynosa Rodhe Multidisciplinary Academic Unit (UAMRR), this process is optimized by implementing genetic algorithms in a web application. This allows teachers to be evaluated and processed using the genetic operators of selection, crossing and mutation. In order to carry out the evaluation and processing of the teachers, 4 criteria are identified: their relationship with the subject, affinity with the student's area, relationship between the student's learning method with the teacher's teaching style, and finally, the teacher's availability. These criteria form a chromosome to which a value is assigned according to the fitness function. Having a fitness value begins the processing by the genetic algorithm. Upon completion, it provides the most optimal solution found and we identify the selected teacher.

Keywords: genetic algorithm, academic advice, artificial intelligence, optimization, processing

1. INTRODUCTION

Computational techniques have increased considerably, this has brought many benefits in solving real world problems providing better results and in less time.

The implementation of Genetic Algorithms for the solution of various problems in the educational sector has generated many successful results [1], some of which have been focused on the administration of schedules, assigning classes or evaluations. This research work emphasizes the optimization of the process of assigning academic consultancies from the tutoring department of the Reynosa Rodhe Multidisciplinary Academic Unit (UAMRR), a faculty belonging to the Autonomous University of Tamaulipas (UAT). The department has a deficiency in the process of assigning the teacher advisor for the student who requires academic advice, the staff takes a long time to review the academic record of the teachers to try to select the one that covers the requested subject, once selected it is not known if the teacher is available or is in active status. Due to this, many of the times the tutoring department staff selects the teacher as an advisor as they remember that they know that topic. Thus, affecting the quality of the advice and that the student cannot acquire the knowledge demanded by the subject.

In this research work, the implementation of genetic algorithms in a technological development in a web environment is presented for an optimal assignment of the advising teacher in academic advising. The optimal assignment is based on 4 criteria: relationship of the subject, affinity of the area, relationship between the student's learning method with the teacher's teaching style and finally the teacher's availability. These criteria together form an individual, that is, a solution to be processed by the different operators that make up a genetic algorithm: selection, crossing and mutation [2]. By processing the information of the teachers through the genetic algorithm, it will allow the department staff to have a better assigned counseling, guaranteeing that the student will have an advisor who knows the subject and who is related to their career, in addition that the advisor's way of teaching is the most compatible with the student's way of learning and finally that the teacher is available. Thus, having valid arguments to guarantee a higher quality in the advice.

This research work contributes to the solution of a great deficiency that universities have in the process of assigning academic advisory services, which should allow and guarantee as much as possible that the student develops the competencies that he could not obtain in the classroom lessons.

2. GENETIC ALGORITHMS

Genetic algorithms involve finding solutions to complex problems using a method based on the process of evolution that we see in nature. In the same way that nature develops creatures that are best designed to adapt to their environments by selecting characteristics that define it (survival of the fittest), genetic algorithms work by combining possible solutions to a problem. In this way it tends to produce better solutions in successive

generations [3]. The implementation of the genetic algorithm in this research work processes the information according to the following pseudocode [2].

```

GA ()
{
    InitializePopulation();
    EvaluatePopulation();
    while(!stopCondition)
    {
        Select the best-fit individuals for reproduction;
        Obtain offsprings through mutation, crossoveroperators on the previously selected individuals;
        Evaluate offsprings;
        Obtain new population by selecting best-fitindividuals from offsprings and the current
        population;
    }
}

```

3. IMPLEMENTATION OF THE GENETIC ALGORITHM

The UAMRR tutoring department offers the academic advisory service to approximately 2,000 students in all the careers it offers and a staff of 120 teachers. To attend a request for advice by a student is too tedious since you have to review in detail the academic record of the teacher to see if it is possible to attend the advice, also at the time of wanting to carry out the review many of the times you do not have the Available file, which causes the assignment of the advisory to not be carried out in an adequate manner, thereby affecting the advisory objective, which is to develop the student's competencies according to the subject provided. This is one of the reasons why this research work was proposed, in addition to being able to assign the most appropriate advice with the student and teacher. The implementation of genetic algorithms will allow a better assignment of academic advice based on the following criteria:

- a) Relationship with the theme.
- b) Teacher experience at the end of the student's career.
- c) Compatibility between the teacher's teaching style and the student's level of learning.
- d) Availability of the teacher.

The 4 criteria are evaluated for each teacher, which represent a possible solution, for the implementation of the genetic algorithm the union of the criteria is called a chromosome and each criterion is individually called a gene. With this structure it allows to have a good diversity of results among teachers, because the fact that the teacher has the most experience in the subject does not guarantee that it is the most optimal result to carry out the assessment [4]. On the contrary, if you have enough experience for the subject and a teaching style compatible with the student's learning level, you can be a better success in advising.

3.1 Population initialization

The UAMRR has a staff of 120 teachers, each of whom represents a possible solution (chromosome) to the assignment of counseling. For implementation from the genetic algorithm, the total population of 120 teachers is used, because if it is done randomly, good solutions can be lost from the beginning. (Fig. 1) shows the representation of a chromosome.

gen 1	gen 2	gen 3	gen 4
50 Relationship with the theme	15 Area related to the student	15 Compatibility Teaching	20 availability

Fig. 1. graphic representation of a chromosome

For the assignment of the value to each gene of each chromosome the following equations are had.

- a) Relationship with the theme.

$$G1 = \frac{C1 * Td}{Tt}$$

Fig. 2. Equation to assign value to gene 1 of the chromosome

Where $G1$ is the gene 1 of the chromosome, $C1$ is the value of the maximum percentage, Td is the total of the teacher's topics, Tt is the maximum value of the total of a teacher's topics

- b) Affinity of the teacher with the student's career.

$$G2 = \frac{C2 * Td}{Tt}$$

Fig. 3. Equation to assign value to gene 3 of the chromosome

Where $G2$ is the gene 2 of the chromosome, $C2$ is the value of the maximum percentage, Td is the total of the teacher's topics, Tt is the maximum value of the total of a teacher's topics related to the student's career.

- c) Compatibility between the teacher's teaching style and the student's level of learning.

$$G3 = \frac{C3 * De}{Te}$$

Fig. 4. Equation to assign value to gene 3 of the chromosome

Where $G3$ is gene 3 of the chromosome, $C3$ is the value of the maximum percentage, De is the value of the teacher's teaching style, Te is the maximum value of the total of styles with respect to the total levels of student learning.

- d) Teacher availability.

$$G4 = \frac{C4 * Dd}{Td}$$

Fig. 5. Ecuación para asignar valor al gen 3 del cromosoma

Where $G4$ is gene 4 of the chromosome, $C4$ is the value of the maximum percentage, Dd is the value of the teacher's availability with respect to the urgency of the student, Td is the value of the total availability

3.2 Population assessment

For the evaluation of each chromosome, the following aptitude function was determined.

$$f(x) = \sum_{i=C1}^{C4} i$$

Fig.6. Fitness function

(Fig. 6) shows the aptitude function, which is a fundamental part in the implementation of the genetic algorithm since it allows evaluating how suitable the solution is. That is to say, the teacher with those characteristics how optimal he is to give academic advice.

3.3Selection operator

With the population evaluation process, we have a point of reference to know where the best solutions are to solve our problem. To carry out the selection process, the tournament method is used, which is described below:

There are two versions of selection by tournament, the deterministic tournament and the probabilistic tournament, which are detailed below. In the deterministic version, a number p of individuals is randomly selected (generally $p = 2$ is chosen). Among the selected individuals, the most suitable is selected to be passed on to the next generation. The probabilistic version only differs in the step of selecting the winner of the tournament. Instead of always choosing the best, a random number is generated from the interval 0 and 1, if it is greater than a parameter p (fixed for the entire evolutionary process), the tallest individual is chosen and otherwise the least suitable [5].

For the implementation of the genetic algorithm in this research work, the deterministic method was chosen. In the implementation of this method, a validation was placed so that the random values will be generated with solutions that would have an impact on the first 2 genes of the chromosome, since this guarantees that the selected teacher has at least the academic competence or experience in the related area. to the student's career.

3.4Crossover operator

The main idea of the crossing is based on the fact that, if you take two individuals correctly adapted to the environment and obtain an offspring that shares genes from both, there is the possibility that the inherited genes are precisely the cause of the goodness of the parents. By sharing the good characteristics of two individuals, the offspring, or at least part of it, should have a greater goodness than each of the parents separately [5].

The method used in the genetic algorithm is the following:

1point crossing: Once two individuals have been selected, their chromosomes are cut at a randomly selected point to generate two differentiated segments in each of them: the head and the tail. The tails are exchanged between the two individuals to generate the new descendants. In this way both descendants inherit genetic information from their parents [3].

This method is interesting for the implementation in this work of research, the only determining factor that is assigned is that the exchange of the 2 parents will be carried out by means of a cut in the second position, due to the conditions of the characteristics the greatest impact on their improvement is in the gene 1 and 2 of the chromosome as shown in (Fig. 7).

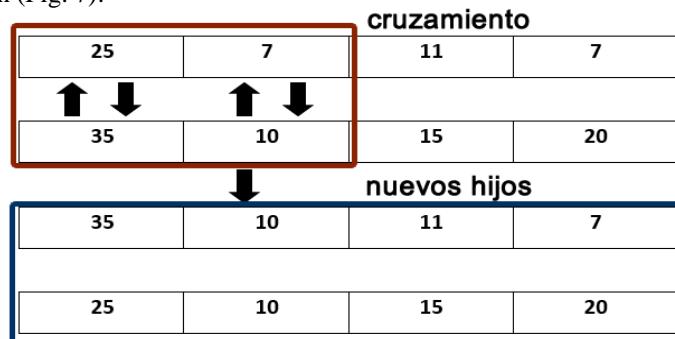


Fig.7.Crossing representation in the genetic algorithm

3.5Mutation operator

The mutation of an individual causes one of its genes, generally only one, to vary its value randomly. The probability of mutation is very low, generally less than 1%, for the implementation of the genetic algorithm there is a value of 0.2%.

(Fig. 8) Shows the random replacement mutation method. Which consists of randomly vary a gene on a chromosome [5].

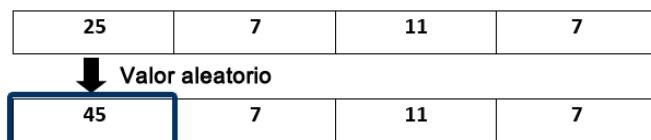


Fig.8.Mutation of a gene on the chromosome

4. IMPLEMENTATION OF THE GENETIC ALGORITHM IN A WEB APPLICATION

4.1 Database

One of the advantages of a web application is that both the student and the teacher can access the application from any device connected to the internet, and in this way the student can carry out and follow up on the request for academic advice. The teacher may be updating their academic information and attend to the student assigned as advisor. Having updated information allows the execution of the algorithm to be more efficient and produce better results.

All the information that is processed through the web application is stored in a data base. For the development of this research work, the Microsoft SQL Server Management System is used. (Fig. 9) shows the relational diagram of the academic advisory database.

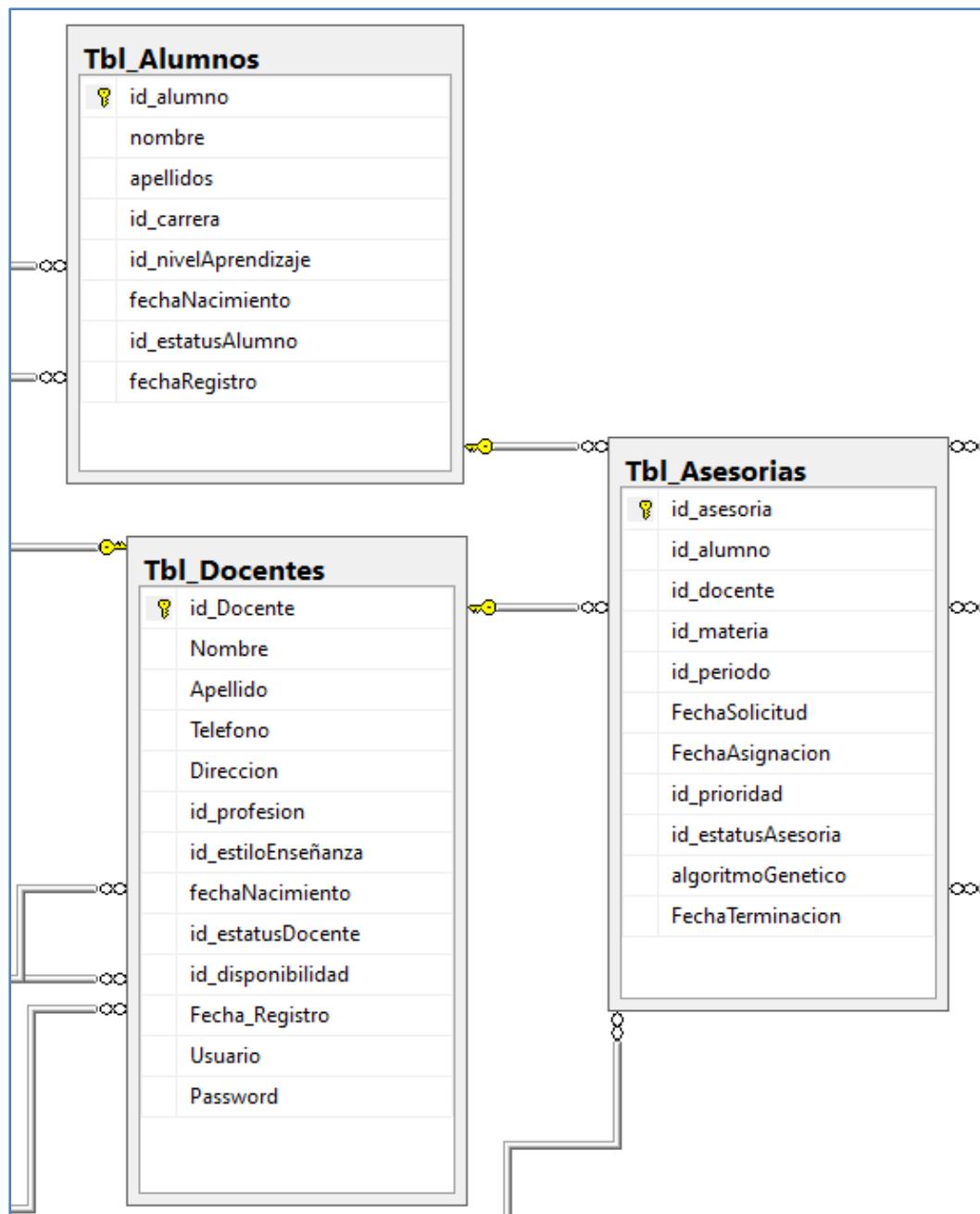


Fig.9. Main part of the web application Relational diagram

4.2 Genetic algorithm input data

One of the most important things so that the algorithm can be executed is that the student makes a request for academic advice, when he performs this procedure, he already has the necessary data to begin the execution of the algorithm. (Fig. 10) shows the information that the student provides for the assignment of academic advising.

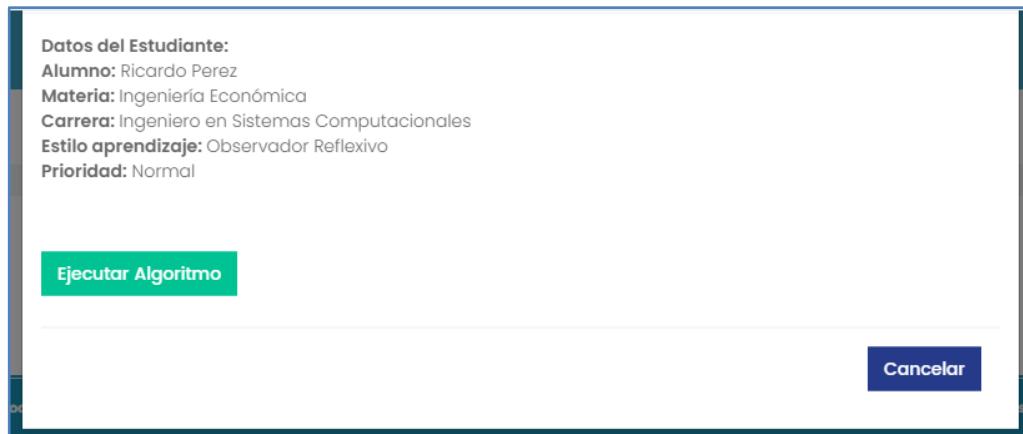


Fig.10. Student data

4.3 Genetic algorithm call in web environment

(Fig. 11) and (Fig. 12) show the call to the genetic algorithm through javascript technology.

```
function IniciaAlgoritmo() {
    var idAsesoriaAlg = $("#idAsesoriaAlg").text();
    $.ajax({
        url: "../serv/Asesorias.asmx/IniciaAlgoritmo",
        type: "POST",
        data: "{ 'idAsesoriaAlg': '" + idAsesoriaAlg + "'}",
        dataType: "json",
        contentType: 'application/json; charset=utf-8',
        success: function (data) { ... }}
```

Fig. 11. Call to the genetic algorithm

```
public string IniciaAlgoritmo(int idAsesoriaAlg)
{
    string resp = "";
    IniciaAlgPoblacionInicial(idAsesoriaAlg);
    while (iteracion<=40)
    {
        AlgSeleccionTorneo();
        AlgCruzamiento();
        AlgMutacion(iteracion);
    }

    string datosSol = obtenerResultados();
```

Fig. 12. Genetic algorithm operators

4.4 Result of genetic algorithm

When the genetic algorithm finishes carrying out its entire process, in the last generation it provides us with information with the best solutions it obtained, based on this information the most optimal is selected as shown in (Fig. 13).

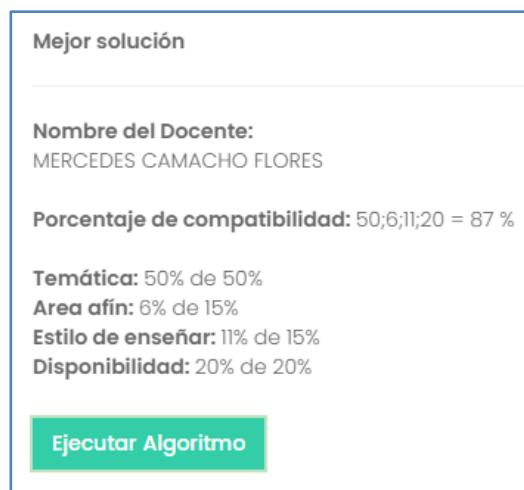


Fig. 13.Genetic algorithm operators

5. TESTS OF IMPLEMENTATION AND EXECUTION

(Fig. 14) (Fig. 15) show the detailed result of the implementation and execution tests of the genetic algorithm in the web application. For each test, a request for academic advice was made by the student.

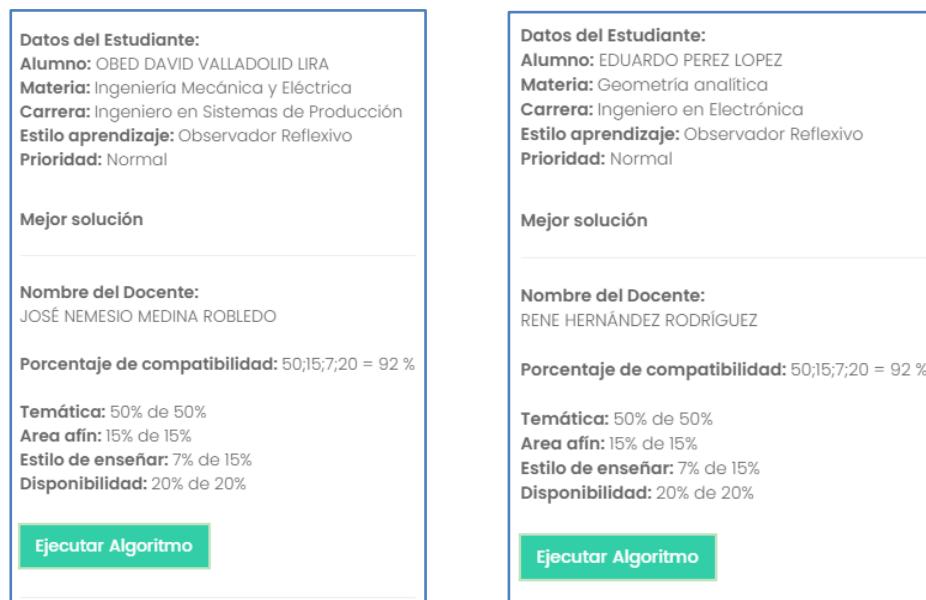


Fig. 14.Algorithm implementation test

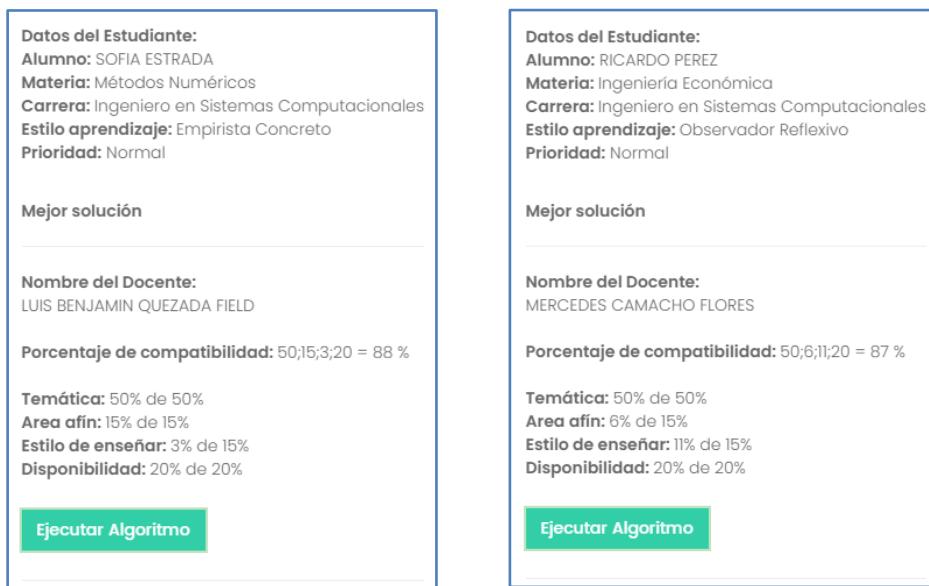


Fig. 15.Algorithm implementation test

6. ANALYSIS OF RESULTS

(Fig. 16) shows the result of different academic consultancies requested, with the information shown it can be determined that the result provided by the algorithm genetic is very good, since the percentage of compatibility between the student and the teacher averages above 85%. In addition, if the percentage of compatibility were up to 70%, a good result could also be generated because possibly the teacher's teaching methodology benefits the student's way of learning.

#	Alumno	Docente	materia	periodo M	prioridad	estatus	fechaAsignacion	evaluacion
1	RICARDO PEREZ	MERCEDES CAMACHO FLORES	Ingeniería Económica Ingeniero en Sistemas Computacionales	2021-I	Normal	Asignada	12/08/2021 12:00:00 a.m.	$50;6;11;20 = 87\%$
2	SOFIA ESTRADA	LUIS BENJAMIN QUEZADA FIELD	Métodos Numéricos Ingeniero en Sistemas Computacionales	2021-I	Normal	Asignada	14/09/2021 12:00:00 a.m.	$50;15;3;20 = 88\%$
3	ISAIAS CAMARGO	ERNESTO JUSTINO HEREDIA	Ingles inicial medio Ingeniero en Electrónica	2021-I	Urgente	Asignado	14/09/2021 12:00:00 a.m.	$50;15;7;20 = 92\%$
4	CARMEN EGUILA TELLEZ	ALFREDO PÉREZ	Planeación y Control de la Producción Ingeniero en Sistemas de Producción	2021-I	Normal	Asignado	14/09/2021 12:00:00 a.m.	$50;15;7;20 = 92\%$
5	EDUARDO PÉREZ LOPEZ	RENE HERNÁNDEZ RODRÍGUEZ	Geometría analítica Ingeniero en Electrónica	2021-I	Normal	Asignada	14/09/2021 12:00:00 a.m.	$50;15;7;20 = 92\%$
6	DAVID LOPEZ PEREZ	LENIN GARCIA MANZANO	Control Estadístico de la Calidad Ingeniero en Sistemas de Producción	2021-I	Normal	Asignada	14/09/2021 12:00:00 a.m.	$25;7;15;20 = 67\%$
7	OBED DAVID VALLADOLID LIRA	JOSÉ NEMESIO MEDINA ROBLEDO	Ingeniería Mecánica y Eléctrica Ingeniero en Sistemas de Producción	2021-I	Normal	Asignada	14/09/2021 12:00:00 a.m.	$50;15;7;20 = 92\%$
8	JUAN CARLOS ESPINOZA LIRA	ING. ANICETO RAMÍREZ ZAMARRON	Estructura de los Materiales Ingeniero en Sistemas de Producción	2021-I	Normal	Asignada	14/09/2021 12:00:00 a.m.	$50;15;11;20 = 96\%$
9	ALFONSO MENDEZ CABRERA	LENIN GARCIA MANZANO	Procesos de Manufactura Ingeniero en Sistemas de Producción	2021-I	Normal	Asignada	14/09/2021 12:00:00 a.m.	$50;15;11;20 = 96\%$

Fig. 16.General test of implementation and execution of the genetic algorithm

With the information provided in the implementation and execution tests of the algorithm, the following analyzes are obtained:

- The percentage of compatibility of the teacher with the student is very acceptable. This allows to increase the guarantee of success of the advisory, because the teacher, apart from having the knowledge of the subject, knows his teaching level according to the student, thereby facilitating the use of the methodology to be used in the advising.
- The greater experience of the teacher in the subject does not guarantee that it is the best solution for counseling, so the implementation of the genetic algorithm allows evaluating different characteristics to produce an optimal solution. Among the characteristics is the teaching style and the availability that he has to carry out the counseling.
- The more teachers are related to the subject of counseling, the genetic algorithm generates better results.

7. CONCLUSIONS

The implementation of the genetic algorithm for the optimization of the academic advisory assignment process allows the tutoring department to know that it will be carried out with solid arguments to increase the guarantee of success and be reflected in the student's learning. The development of this research work allows the following.

- The implementation of the genetic algorithm in a web environment allows the tutoring department to manage the process of assigning academic advice from any device connected to the internet.
- The information processed in each academic advisory is stored in the database to maintain the history.
- The genetic algorithm generates better solutions by having teachers related to the subject and profile of the student.

8. REFERENCES

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