

# Basing on genetic algorithm to optimize schedule for students

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**Abstract—** UNIT PROGRAM (Credit system) model which started in the United States in the late 19th century has been spread in many countries around the world and has been introduced into Vietnam since 1975. This training model brings various benefits, and creates a new landmark to staff, teachers and students in many schools.

The new training model "student as the center" which has been widely applied allows students to register their learning plan by themselves, gives students the spirit of learning, dynamic, creative in order to achieve better results.

A genetic algorithm is inspired by Charles Darwin's theory of natural evolution. This algorithm is a search heuristic that reflects the process of natural selection where the fittest individuals are selected for reproduction in order to produce offspring of the next generation.

In this paper, from the theory of genetic algorithm, we will apply this algorithm to build a website that can help students choosing suitable schedule automatically.

**Index Terms—** Genetic algorithm; Evolutionary computing; credit system

## I. INTRODUCTION

Genetic Algorithm (GA) is a technique that aims to help solve common issues by simulating the evolution of humans or of organisms in general (based on evolutionary theory of Darwin) in the available event of environmental regulations. The target of GA does not provide an optimal solution, but accurately presents the relatively optimal solution. GA is based on the notions that the next generation is always better than the previous generation. This is a true axiom so it cannot prove and has become the law of evolution. In evolution, the two indispensable processes are essentially breeding and natural selection. They assure that the new generations always been born to replace the older generation and new generation will get more advantages than old one.

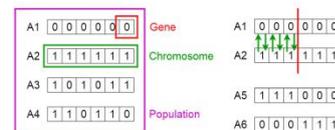
in GA [3], new populations iteratively are created from old by ranking the strings and interbreeding the fittest to create new strings. This aims to (hopefully) closer to the optimum solution of the problem in question and search strategy that is tailored for vast, complex, multimodal search spaces

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$$\Lambda = \{\Sigma, \Pi^N, \Phi, \Omega\}$$

## Genetic Algorithms



In genetics, every cell in the body carries a certain number of chromosomes (as in humans have 46 chromosomes). However, with GA, each individual is a chromosome. The chromosomes are made up of genes and genes with certain characteristics with certain locations on the chromosome. Genes may receive different values (the values of features). An evolutionary process is performed on a population corresponding chromosomes process to find an optimal solution to the problem. This finding must ensure two objectives: to exploit the best solution and the search space survey. GA is one of search techniques to create a balance between the exploitation significantly and the search space survey. The environment is a main factor that determines good or bad chromosome (called Fitness value). GA consists of five basic rules, including initial population, fitness function, selection, crossover, mutation [3]

### Initial Population

Population consists of a set of individuals which is a solution to the problem that needs to solve.

Each individual is characterized by a set of parameters (variables) known as Genes. Genes are joined into a string to form a Chromosome (solution).

In a genetic algorithm, the set of genes of an individual is represented using a string, in terms of an alphabet. Usually, binary values are used (string of 1s and 0s) in order to encode the genes in a chromosome.

### Fitness Function

The fitness function is used to give a fitness score to each individual and determine how fit an individual is (the ability of an individual to compete with other individuals). The probability that an individual will be selected for reproduction is based on its fitness score.

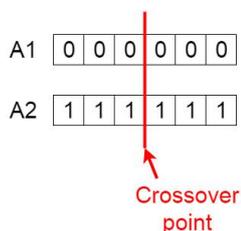
### Selection Operators

Selection phase is to select the fittest individuals and let them pass their genes to the next generation.

Two pairs of individuals (parents) are selected based on their fitness scores. Individuals with high fitness have more chance to be selected for reproduction.

*Crossover Operators*

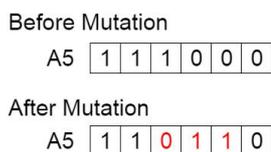
Crossover is the most significant phase in a genetic algorithm. For each pair of parents to be mated, a crossover point is chosen at random from within the genes.



*Mutation Operators*

In certain new offspring formed, some of their genes can be subjected to a mutation with a low random probability. This implies that some of the bits in the bit string can be flipped.

Mutation occurs to maintain diversity within the population and prevent premature convergence.



II. THE CONSTRUCTION OF GENETIC ALGORITHM

Begin

t = 0;

Initialize P(t);

Let calculator adaptability for individuals of P(t);  
While(loop conditions do not satisfy)

Begin

t = t + 1;

Selection from P(t)

Crossover from P(t)

Mutation from P(t)

End

End

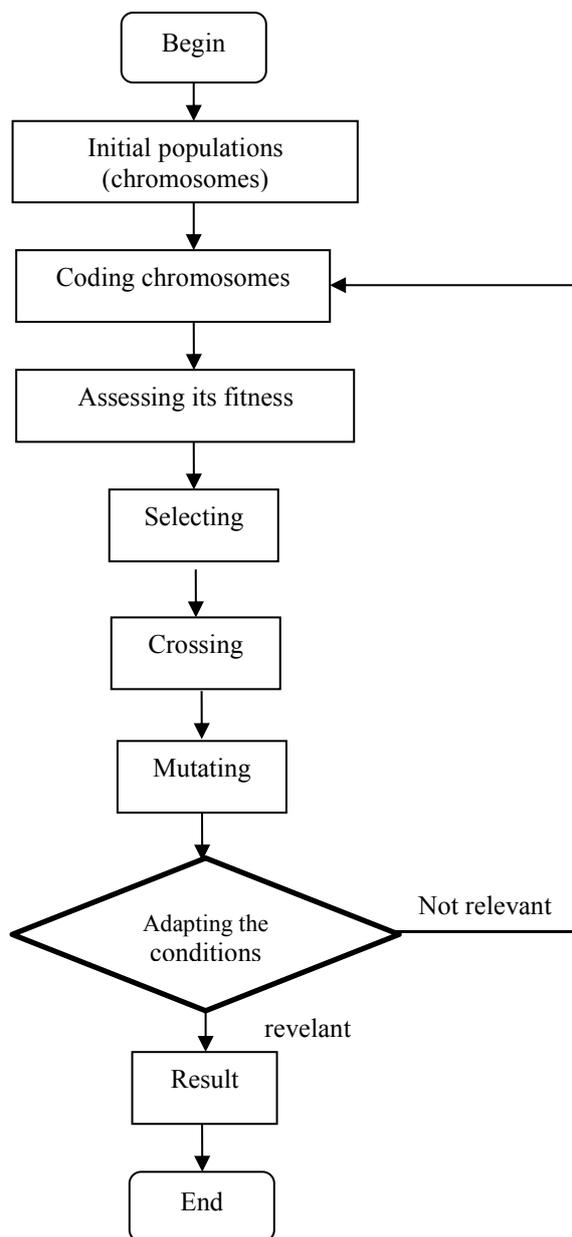


Fig. 1. Framework for the proposed method

III. BUILDING APPLICATION BASING ON GENETIC ALGORITHM

This system allows students to have the option modules per semester. Under the provisions of the credit system, when studying the module, students have to study all its prerequisite modules and modules in parallel. Specifically, students can improve module with the low score.

Before registering a module, students must be logged into the system, Student Supported System – SSS, then choose "Advisory selects new module". SSS will be based on the prerequisite and parallel conditions and school section to list the modules that students can register for the new semester. From this list of modules, students will decide the modules in the next semester. Conclusion, SSS will help students choose a suitable timetable. This timetable can adapt the criteria such as a same class hour, the less number of periods

This system is deployed with Java 1.8, Apache Tomcat Server 8.0.15.0, SQL Server 2008.

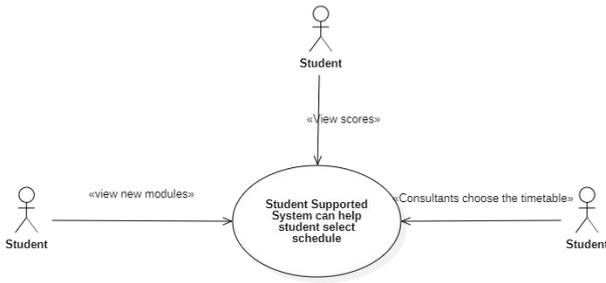


Fig. 2. Usecase diagram of SSS website

To perform the solution to this problem, we will first select an appropriate data structure. Each population (chromosomes) is represented by a vector containing the values that is the subject of LopHocPhan (Module). Thus, the gene ensures no overlapping genes.

Initiating chromosomes: this application has to ensure that gene in the each chromosome are not same because each student studies only one class. Thus, the same gene in chromosome will result in the failed results.

Operators: This application consists of four basic rules, including crossover, mutation, reproduction and natural selection. However, the mutation will change in order to ensure no overlapping genes.

Fitness function: in this application, the fitness function will base on the number of periods. This means that any chromosome with the less period will be appreciated better than one.

$$f(x) = \frac{1}{\text{number\_of\_periods}}$$

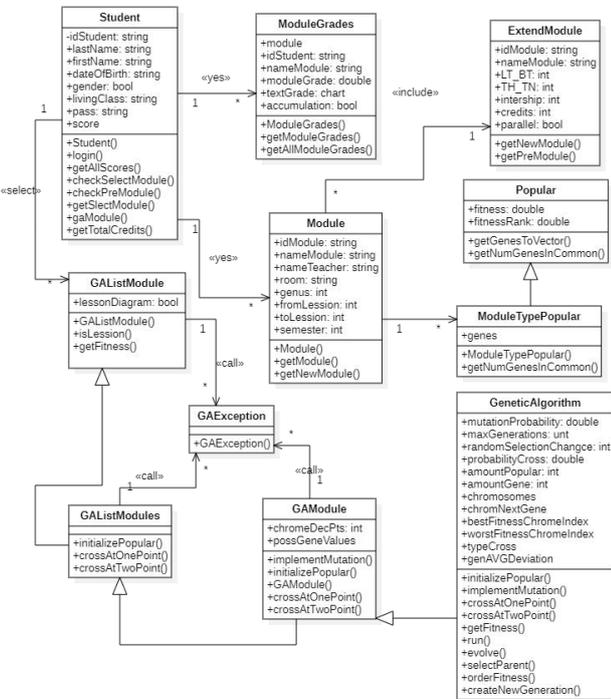


Fig. 3. Entity diagram of SSS website

A. EXPERIMENTAL RESULTS



Fig. 4. The template of SSS website

Academic transcript of student

maHP	TenHP	SoTC	DTKHP	DiemChu	TichLuy
5020020	Ngoại Ngữ I	3	4.0	D	false
5020020	Ngoại Ngữ I	3	8.0	B	true
5020040	Toán cao cấp I	4	3.0	F	false
5020040	Toán cao cấp I	4	6.0	C	true
5020050	Tiết học Mac-Lenin	3	3.0	F	false
5020050	Tiết học Mac-Lenin	3	6.0	C	true
5020140	Toán cao cấp II	3	5.0	D	true
5020281	Giáo dục môi trường	2	5.0	D	true
5020300	Giáo dục thể chất II	1	6.0	C	false
5020060	Vật lý I	3	6.0	C	true
5040031	Vẽ kỹ thuật I	3	5.0	D	true
5050021	Tin học đại cương	2	8.0	B	true
5050021T	TH Tin học đại cương	1	8.0	B	true
5020090	Kinh tế chính trị	3	6.0	C	true
5020100	Ngoại ngữ II	3	6.0	C	true
5020150	Vật lý II	3	6.0	C	true
5020180	Chủ nghĩa XHKH	2	6.7	C	true
5020200	Lịch sử Đảng	2	7.0	B	true
5020210	Tư tưởng Hồ Chí Minh	2	5.8	C	true
5020340	Đường lối CM của ĐCSVN	3	8.4	B	true

Fig. 5. Academic transcript of student that can search by SSS website

LIST OF MODULES IN THE SEMESTER110

MaHP	TenLHP	TenGV	Thu	Tu	Den	Phonghoc	ngayBD
5051673	10ĐAIT01	Nguyễn Văn Lành	2	9	10	A203	30/08/2010- G
5050753	10ĐAIT01A	Nguyễn Văn Lành	2	9	10	A203	30/08/2010- G
5051673	10ĐAIT02	Nguyễn Văn Lành	5	1	2	A203	30/08/2010-
5051673	10ĐAIT03	Hoàng Thị Mỹ Lệ	7	7	8	A203	30/08/2010-
5051673	10ĐAIT04	Hoàng Thị Mỹ Lệ	7	7	8	A203	30/08/2010-
5051673	10ĐAIT05	Hoàng Thị Mỹ Lệ	5	9	10	A207	30/08/2010-
5051673	10ĐAIT06	Nguyễn Văn Lành	5	9	10	B106	30/08/2010-
5053000	10ĐTNT01	Hoàng Thị Mỹ Lệ	0	0	X		30/08/2010-
5040052	10CHLT01	Nguyễn Văn Lành	3	9	11	B106	23/08/2010-
5040052	10CHLT02	Nguyễn Văn Lành	4	3	5	A214	06/09/2010-
5050063	10CSDL01	Hoàng Thị Mỹ Lệ	3	1	2	A215	06/09/2010-
5050113	10CSDL201	Nguyễn Văn Lành	5	3	5	A203	23/08/2010-
5050113	10CSDL202	Nguyễn Văn Lành	3	3	5	A203	23/08/2010-
5050673	10CTGT01	Hoàng Thị Mỹ Lệ	2	3	5	A211	23/08/2010-
5050053	10CTMT01	Đoàn Duy Bình	6	9	11	A210	06/09/2010
5051323	10CTMTA01	Đoàn Duy Bình	4	7	8	A205	23/08/2010
5050143	10HĐH01	Đoàn Duy Bình	4	9	11	A205	23/08/2010
5050143	10HĐH02	Đoàn Duy Bình	2	9	11	A216	23/08/2010
5050183	10JAVA101	Nguyễn Văn Lành	6	1	2	A203	23/08/2010-
5050183	10JAVA102	Nguyễn Văn Lành	4	1	2	A203	06/09/2010-
5050183	10JAVA103	Nguyễn Văn Lành	2	7	8	A203	23/08/2010-
5050513	10JAVA201	Nguyễn Văn Lành	6	7	8	A216	23/08/2010-
5051313	10KLT01	Hoàng Thị Mỹ Lệ	6	3	4	A211	06/09/2010-
5050013	10LTC01	Hoàng Thị Mỹ Lệ	3	3	5	A217	04/10/2010-
5050013	10LTC02	Hoàng Thị Mỹ Lệ	4	3	5	A216	06/09/2010-

Fig. 6. List modules are opened in semester

**LIST OF CLASS THAT STUDENT SHOULD REGISTER**

MODULE ID	MODULE NAME	CREDIT NUMBER	SELECTING
5050013T	TH Lập trình cơ bản với C	1	<input type="checkbox"/>
5050113	Cơ sở dữ liệu II - SQL Server	3	<input type="checkbox"/>
5050113T	TH Cơ sở dữ liệu II - SQL Server	1	<input type="checkbox"/>
5050143	Hệ điều hành	3	<input type="checkbox"/>
5050183T	TH Lập trình hướng đối tượng Java	1	<input type="checkbox"/>
5050513	Lập trình Java II	2	<input type="checkbox"/>
5050543	Phân tích thiết kế hướng đối tượng	3	<input type="checkbox"/>
5050553	Thiết kế Web	2	<input type="checkbox"/>
5050553T	TH Thiết kế Web	1	<input type="checkbox"/>
5050673	Cấu trúc dữ liệu và giải thuật	3	<input type="checkbox"/>
5050673T	TH Cấu trúc dữ liệu và giải thuật	1	<input type="checkbox"/>
5050803	Lập trình trực quan	2	<input type="checkbox"/>
5050803T	TH Lập trình trực quan	1	<input type="checkbox"/>

Submit Reset

**SUM OF CREDIT NUMBER:24**

Fig. 7. List of classes that student should register after suggesting by genetic algorithm in SSS website

**IV. CONCLUSION**

This paper described the concept of genetic algorithm and authors built SSS website that can help students choose suitable schedule in each semester. These timetables that are suggested from this system can adapt the criteria such as a same class hour, the less number of periods

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