

# Genetic Algorithms to Optimizitize Lecturer Assessment's Criteria

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**Abstract:** The lecturer assessment criteria is used as a measurement of the lecturer's performance in a college environment. To determine the value for a criteria is complicated and often leads to doubt. The absence of a standard value for each assessment criteria will affect the final results of the assessment and become less presentational data for the leader of college in taking various policies relate to reward and punishment. The Genetic Algorithm comes as an algorithm capable of solving non-linear problems. Using chromosomes in the random initial population, one of the presentations is binary, evaluates the fitness function and uses crossover genetic operator and mutation to obtain the desired crossbreed. It aims to obtain the most optimum criteria values in terms of the fitness function of each chromosome. The training results show that Genetic Algorithm able to produce the optimal values of lecturer assessment criteria so that can be used by the college as a standard value for lecturer assessment criteria.

**Keywords:** Lecturer Assessment Criteria, Binary, Genetic Algorithm, College

## 1. Introduction

The College with its products in the form of education services is an institution that serves as a place to organize education or teaching, research and community service. The quality of college is strongly influenced by the presence of students, lecturers, facilities and infrastructure. Lecturers are professional educators with the main task of transforming, developing, and disseminating science, technology and the arts through education, research and devotion.

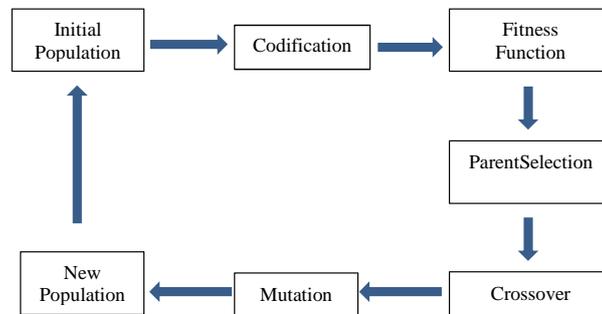
Education quality of the college is determined by the lecturer's eligibility to teach in accordance with his competency. In the college, the performance of lecturers is measured through questionnaires filled by students based on predetermined criteria. The problem that occurs is the difficulty in determining the optimal value standard for each criteria. The standard of value needs to be determined given the difficulty of providing value to pedagogic competence, professional competence, personality competence, and social competence of a lecturer. In addition, the assessment results can be used by the head of university as a consideration in taking various policies relating to the reward and punishment of lecturer.

Genetic Algorithm is a Heuristic algorithm based on the mechanism of biological evolution (Kusumadewi, 2003). Genetic algorithms can be applied to some types of non-linear objective functions and have the flexibility to be implemented efficiently on a particular problem (Zheng, etl, 1999). The determination of the standard value of each lecturer's assessment criteria can be calculated through criteria organized as a gene in each lecturer grouped into chromosomes. Through the stages of crosses and mutations, then the optimal value can be reviewed from the fitness function of each chromosome.



## 2. Metodology

The research methodology outlines all the activities carried out during the research. The stages passed in this research are shown in the following figure.



**Figure. 1** Research Stages of Optimization of Lecturer Assessment Criteria

### 2.1 The Initial Population

This stage is the beginning of the training process using Genetic Algorithm. The initial population is to determine the number of samples to be a population in studied. In this study, 24 samples were taken.

### 2.2 Codification

The coding technique is a technique that states the initial population as a potential solution of a problem to the chromosome (Gen and Cheng, 2000) as a key issue when using the Genetic Algorithm. Genes can be presented in binary form. Codification is needed to be processed using Genetic Algorithm. The lecturer to be assessed is encoded as a Chromosome. The criteria that lecturer assessment are coded as genes to be arranged in binary form.

### 2.3 Fitness Function

Each chromosome is assigned a fitness value. The chromosome with the highest fitness value will survive, while the chromosome with low fitness value will die.

### 2.4 Roulettewheel (Parent Selection)

Parent selection is performed to obtain a pair of chromosomes that are used as parent. To get it generated random value as much as the number of chromosomes. If the random value of a chromosome is smaller than the predetermined probability (pc), then the chromosome will be selected as the parent.

### 2.5 Crossover

This process is done after obtaining the parent chromosome. The parent chromosomes are then crossed with each other to get the off-spring.

### 2.6 Mutation

Mutation is done to replace the missing genes caused by selection. Mutation of genes are performed by generating a random number of each gene. Random number less than mutation probability (pm) will be mutated, 0 to 1 and 1 to 0.

### 2.7 New Population

The mutation result is become an initial population for the next generation. The new population will be reprocessed as well as the initial population. This process is done until the fitness values of all individuals are equal.

### 3. Experiment

The search for optimal values for each lecturer's assessment criteria, starting with codification in the first generation population. Codification performed on the data that has been prepared. These data consist of 24 lecturers at STIKOM college as shown in Table 3 were coded as individual chromosome L1-L24. Each individual has four criteria and each them has 4 sub criteria as shown in table 1. GA process performed on all lecturers.

**Table 1.** Lecturer Code

Number	Lecturer Code
1	L 1
2	L 2
3	L 3
-	-
23	L 23
24	L 24

**Table 2.** Codification of Lecturer Assessment Criteria

Lecturer Code	X1				X2			
	Pedagogic Competency				Professional Competency			
	G1	G2	G3	G4	G1	G2	G3	G4
Lecturer Code	X3				X4			
	Personality Competency				Sociality Competency			
	G1	G2	G3	G4	G1	G2	G3	G4

The Genetic Algorithm began by assigning binary bits to each gene of a chromosome and calculating its by the formula :

$$\text{Fitness (Pos)} = ((2 - SP) + 2(SP - 1)(Pos - 1)) / (N - 1) \dots \dots \dots (1)$$

Value Interval  $SP \in [1, 2]$

Following the calculation of the fitness value of each chromosome :

$$\begin{aligned} F(1) &= ((2 - 1.5) + 2 * (1.5 - 1) * (1 - 1)) / (24 - 1) \\ &= 0.02173913 \\ F(2) &= ((2 - 1.5) + 2 * (1.5 - 1) * (2 - 1)) / (24 - 1) \\ &= 0.065217391 \\ &\vdots \\ F(24) &= ((2 - 1.5) + 2 * (1.5 - 1) * (24 - 1)) / (24 - 1) \\ &= 1.02173913 \end{aligned}$$

The next step is to select the chromosome to become the parent chromosome. The chromosome is chosen proportionately according to its fitness value. The Roulettewheel method places each chromosome on a piece of the circle proportionately according to its fitness value. Chromosomes that have greater fitness values occupy larger circle cuts than low-value chromosomes.

To be able to perform chromosome selection, the steps that must be done is as follows ::

- Determine *fitness relative* ( $p_k$ ) of each chromosome
- $p1 = F1 / \text{Total of Fitness Value} = 0.02173913 / 12.56521739 = 0.002$
- Determine *fitness cumulative* ( $q_k$ ) of each chromosome  $q1 = p1 = 0.002$
- Generate *random* numbers as much as the number of chromosomes.
- Create a cumulative fitness value interval of each chromosome.

Next is the crossover process by generating random numbers. Crossover probability ( $pc$ ) is one of the parameters that shows the ratio of off-spring in each generation.  $Pc$  used is 0.25 by means of one-point crossover. The chromosome chosen as the parent is that has a random number smaller than  $pc$ .

**Table 3.** Random Numbers

Lecturer Code	Chromosome	Random Value
L 7	1*	0.04414
L 15	2*	0.45456
L 22	3*	0.03923
L20	4*	0.67293
L18	5*	0.07585
L20	6*	0.34349
L 13	7*	0.16861
L 18	8*	0.58825
L 12	9*	0.46987
L 9	10*	0.25414
L 20	11*	0.67622
L 7	12*	0.95616
L 23	13*	0.61232
L 24	14*	0.76767
L 21	15*	0.90898
L 17	16*	0.34174
L 19	17*	0.35652
L 15	18*	0.19751
L 22	19*	0.87489
L 24	20*	0.47587
L 20	21*	0.56944
L 9	22*	0.52767
L 10	23*	0.5182
L 18	24*	0.11539

**Table 4.** Parent Chromosome and Off-Spring

Parent Chromosome																		
L 7	1'	1	0	1	0	1	0	1	1	1	0	0	0	1	0	0	1	0,282608696
L 22	3'	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0,934782609
L 18	5'	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0,760869565
L 13	7'	1	0	1	1	1	0	1	0	1	0	0	1	1	0	0	0	0,543478261
L 5	18'	1	0	0	1	1	0	1	0	1	0	1	1	1	0	0	0	0,630434783
L 18	24'	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0,760869565
Off-Spring																		
L 7	1'	1	0	1	0	0	1	0	0	1	0	0	0	1	1	0	0	0,282608696
L 22	3'	0	0	0	0	1	0	1	1	1	0	0	0	1	0	0	1	0,934782609
L 18	5'	1	0	0	1	1	0	1	0	1	0	0	1	1	0	0	0	0,760869565
L 13	7'	1	0	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0,543478261
L 5	18'	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0,630434783
L 18	24'	1	0	0	1	1	0	1	0	1	0	1	1	1	0	0	0	0,760869565

From table 3 above there are 6 random numbers that smaller than pc. Chromosomes which has that random numbers, will be arrange in pairs as parent. One-point crossover is a method by determining the point of crossing. In this case, crossing point lies in the fourth bit. Any different genes from the parent pair, will be crossed. The crosses then become off-spring. The next process is a mutation, which starts by counting the number of bits in the population where :

$$\begin{aligned} \text{Number of bits} &= \text{popsize} * \text{Number of Genes} \dots \dots \dots (2) \\ &= 24 * 16 \\ &= 384 \end{aligned}$$

The mutation (pm) used is 0.05, meaning that there will be a 5% chance of the number of bits to be mutated, ie 20 bits. To specify the bits must be generated random numbers for each bit in the population (as many as 384 random numbers). The selected bit is a bit whose random number is less than pm. The selected bit will be mutated, 0 to 1 and 1 to 0. The mutation result is the final population on the whole of the first generation process. This final population became the initial population in the next generation.

#### 4. Result

Every generation will do the same steps. The training stops when fitness value of each individual is the same, means the number of generation can not be predicted. Some cases proved that the number of generation can reach up to 1000 even more. The articles about optimization using genetic algorithms showing up to 1000 generations [3]. Others showing that the generation up to 2500 [8]. It caused by random numbers and genes which influenced the training results.

Experiments of this research showed that the results of training on the data yield varying values for each assessment criterion. Training stopped at the 14th generation, where all individuals display the same fitness value of 1.02174.

To optimize the bit value of each gene, will be achieved by using the formula :

$$x = r_b + (r_a - r_b)(g_1x2^{-1} + g_2x2^{-2} + \dots + g_nx2^{-n}) \dots \dots \dots (3)$$

Note :

- $x$  = variable (criteria)
- $r_a$  = upper limit of interval value
- $r_b$  = lower limit of intervalvalue
- $g$  = gen of variable
- $2^{-n}$  = numbers of genin variable

The following calculation is to get  $x$  value (criteria) of first chromosome of first generation.

$$\begin{aligned} x_1 &= 1 + (16 - 1)((1(2^{-1}) + 0(2^{-2}) + 1(2^{-3}) + 0(2^{-4})) \\ &= 10,275 \end{aligned}$$

$$\begin{aligned} x_2 &= 1 + (16 - 1)((0(2^{-1}) + 1(2^{-2}) + 0(2^{-3}) + 0(2^{-4})) \\ &= 4,75 \end{aligned}$$

$$\begin{aligned} x_3 &= 1 + (16 - 1)((1(2^{-1}) + 0(2^{-2}) + 0(2^{-3}) + 0(2^{-4})) \\ &= 8,5 \end{aligned}$$

$$\begin{aligned} x_4 &= 1 + (16 - 1)((1(2^{-1}) + 1(2^{-2}) + 0(2^{-3}) + 0(2^{-4})) \\ &= 12,25 \end{aligned}$$

$$\sum x = 35,875$$

The optimization of bits applies to all genes of each generation. Optimization aims to find the best value of each criterion of each generation taking into account the highest total value of criteria (x). The highest total value of x of each generation, will be decisive to determine the optimal value of  $x$ .

The selection of the most optimal value of  $x$  can be determined by several reasons :

- Towards the end of generation, the value of  $x$  and the total value of  $x$  denotes the same value. The generation according to the reason was selected as the most optimal value.
- All generations showed different results. The generation with the highest value was selected as the most optimal value.

In this research, the optimal value shown by 3rd generation. The optimal value is taken from the individual that has the best criterion value and total value which is indicated by the total value of 47.125. This means, every criterion has obtained the most optimal value as follows :

**Table 5.** The Optimal Value of Lecturer Assessment Criteria

Variabel $x$	Name of Criteria	Optimal Value
$x_1$	Pedagogic Competency	<b>14,125</b>
$x_2$	Professional Competency	<b>9,4375</b>
$x_3$	Personality Competency	<b>13,1875</b>
$x_4$	Sociality Competency	<b>10,375</b>

## 5. Conclusion

The result of this research proved that Genetic Algorithm can achieve the optimize value of lecturer assessment criteria as follow :

Pedagogic Competency	: 14,125
Professional Competency	: 9,4375
Personality Competency	: 13,1875
Sociality Competency	: 10,375

Each criterion has the highest score is 16. Achievement of value through Genetic Algorithm process is the most optimal value that can be achieved by a lecturer, so it can be assessment measure for lecturer assessment criteria. The optimal values largely determined by the generation of random number and genes number because these influence the training result. The Optimal value is expected to facilitate universities in assessing the performance of lecturers through a questionnaire that will be filled by students so that the assessment becomes more appropriate and objective.

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