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Improving Population Services with Application of Genetic Algorithm

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Abstrak - Sistem komputer saat ini sudah menjadi salah satu alat yang bisa di manfaatkan setiap orang dalam melakukan perkerjaan seperti pekerjaan kantoran, pengurusan pengajuan kk, akta lahir, ktp jikan di kantor camat. Dalam hal ini masalah yang sering tejadi pada kantor lurah atau kantor camat adalah antrian yang terlalu panjang dalam pelayanan setiap masyarakat yang akan mengurus pengajuan pembuat berkas-berkas mereka. Maka dengan itu perlu ada sebuah sistem yang akan membantu setiap pegawai yang dapat meminimalisir kinerja dari penanggung jawab pengurusan berkas tersebut. Pada peneltiian ini akan menggunakan metotode penjadwalan dengan algoritma genetika. Hasil dari penelitin berhasil meminimalisir waktu tunggu oleh masyarakat yang akan mengajukan berkas pada kantor camat pancur batu. Waktu yang diperlukan untuk registrasi sebanyak 5 menit per orang.

Kata Kunci: Metode Genetika, Penjadwalan, pelayanan, meminimalisir

Abstract - The computer system has now become one of the tools that can be used by everyone in doing work such as office work, managing family card applications, birth certificates, ID cards at the sub-district office. In this case, the problem that often occurs in the lurah office or sub-district office is the queue that is too long in the service of each community who will take care of submitting their file maker. So with that there needs to be a system that will help every employee who can minimize the performance of the person in charge of managing the file. In this research will use scheduling method with genetic algorithm. The results of the research succeeded in minimizing the waiting time by the community who would submit files at the Pancur Batu sub-district office. The time required for registration is 5 minutes per person.

Keywords*: Genetic Method, Scheduling, Service, Minimize*

INTRODUCTION

In an office company, it has become the main good service to every consumer as well as in an office in the community such as the sub-district office, to minimize the work of employees or employees, every few community services are processed into a software system (Sharma & Nelson, 2019). Improving services is one of the strategic ways to bind customers in a business world and if in an office, service is also very important, such as in sub-district offices and other institutions related to public services (Karno et al., 2017).

Genetic methods solve the problem in a good way. every process of natural evolution while looking for a good solution in solving problems is one of the advantages of genetic algorithms (Gautama, 2016), (Septyanto et al., 2018). In this research, try to solve the problems that exist in the sub-district office in community service in managing every letter needed. The algorithm to be used is a genetic algorithm. It is hoped that with this system, service problems at the sub-district office which always require a long time can be resolved with this scheduling method.

The schedule is a setting of the number of hours that will be used both working and in the administrative queue, while scheduling is a structure of activities that have been arranged (Samaher & Firdaus Mahmudy, 2015), (Gunawan, 2021). A genetic algorithm is a search algorithm in which the mechanism of the system is based on genetics and natural selection. In contrast to conventional genetic algorithms, where the results are obtained randomly from the set of solutions. in a set-set algorithm called puplation, each individual is named a chrom some resulting from a solution. In the genetic algorithm, chromosomes are the most important part, because the chromosome model used will influence the quality of the solution given (al., 2018). Chrome-chromasone process that will continue which is called generation. in each generation, each kromson will be analyzed based on the evaluation function (Pane, Awangga, et al., 2019), (Luh Gede Pivin Suwirmayanti et al., 2016). After several generations then the genetic algorithm

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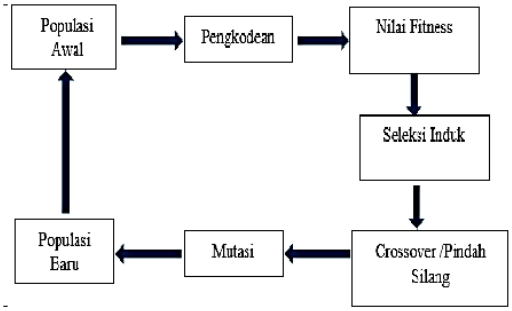
will converge on the best chromosomes, which is expected to be the optimal solution (Yunus et al., 2018).

Service scheduling in each institution becomes a problem if it is not managed properly, when the schedule is compiled in excel or manual form, there is a high probability that data input errors will occur. (Oktarina & Hajjah, 2019). Information systems help everyone's activities (Siddik & Sirait, 2018). The stages of the Genetic Algorithm ((Jollyta et al., 2017) can be seen in the image below.

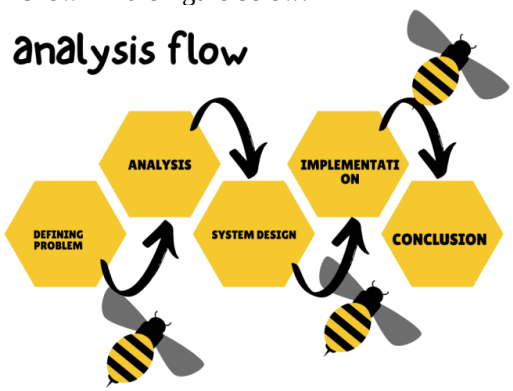


Source: (Yonata laia et al, 2022)

Figure 1. Genetic Algorithm Stages

RESEARCH METHODOLOGY

1. Data Collection Methods
   This study will use the collection of information with literature studies from library sources to be the basis for problem analysis.
2. Flow of Analysis
   The flow of this study begins with the collection of information processed by genetic methods as shown in the figure below.



Souerce: (Laia et al, 2022)

Figure 2. System Work Process

In order to work on the system, the author makes a research stage as follows

1. Data Collection
   In this study, it uses 3 data collection processes as follows:
   a. Literatur Review
      At this stage, the author seeks references in order to get better ideas in data collection, so the author looks for sources such as national and international journals, books, or sources that can support research.
   b. Interview
      At this stage, the author will conduct direct interviews with people related to the object of study so that the data can be more accurate.
   c. System Analysis
      At this stage, data analysis will be carried out in order to find out what kind of system the analyst will also know the limit to where.

a. How the Genetic Algorithm Method Works

1. Formula Of Finding Chromosome Evaluation

$a+2b+3c+4d+...+Nn-X$

Information:

a, b, c, … n	= the value of the chromosome 1, 2, 3, … n.
2, 3, 4, … n	= the number remains in the formula of the genetic algorithm.
X	= obtained from the number of chromosomes formed.

2. Formula determining the Average Looking for Fitness Value

objective function 1 + objective function 2 + objective function 3 + ... + objective function N / number of objective functions

3. Formula for Determining Fitness ValueRumus Menentukan Nilai Fitness

1 / (objective function+1)

Information:

1	= Is a fixed number in division and summation

objective function= The value of the objective function

4. Formula for Finding Probability

P[i] = fitness[i] / total_fitness

Keterangan:

P[i]	= Probability
Fitness[i]	= fitness value
Total_fitness	= amount of fitness generated

❖ **Algorithm Working Process**

- Data Collection
  At this stage is the beginning of the research conducted by means of direct observation or interviews to obtain data such as the name of the head of the family and the names of family members.

- Individual Definition
  What is meant in the individual definition stage is naming the gene to be analyzed, which aims to make it easier when carrying out the genetic algorithm process.
- Inisialisasi Chromosome
  Determine the value of the chromosome randomly and according to the maximum value.

- Chromosome Evaluation
  Finding the value and objective function of each chromosome obtained from the genetic algorithm formula. For example, Equation a+2b+3c+4d = 30, so
  objective function (chromosome) = |(a+2b+3c+4d)– 30 |We calculate the objective function of the generated chromosome:
  objective function (chromosome[1])= Abs((10 + 2*6 + 3*4 + 4*9) – 32) = Abs((10 + 12 + 12 + 36) – 32) = Abs(70– 32) = 38

  - Chromosome Selection Process
    Looking for fitness value, probability value, and probability cumulative value.
  - Crossover
    Crossover or called cross-breeding is to find new values. Combining two or more chromosomes to form a new chromosome (Pane, Maulana Awangga, et al., 2019). The purpose of crossover is to increase the diversity of strings in a population by crossing between the strings obtained from the previous reproduction. The results of the crossover of the next 2 parental chromosomes will produce 2 offspring, therefore, the number of populations is increased by 2 times from the initial population.
  - Mutation Process
    The mutation process is that the selected chromosome will be randomly mutated, then the mutation point on the chromosome is determined randomly as well.

RESULTS AND DISCUSSION

The results of this study were obtained from problem-solving using Genetic Algorithm. From the results of these data, the scheduling process for population services can be helped. So the results of this study can be used by the civil registry.

❖ **Genetic Algorithm Method**

- Individual Definition
  At the individual definition stage, 65 genes were formed from the total number of registrants. For NIK numbers, they are sorted according to the order of the registrants, in the genetic algorithm process, this number is the initialization. Table 1 is the genes that will be processed in the genetic algorithm.

Table 1. Participant Table

No	Participant Name	Plan	Re-Plan
1	Andi	17/02/22	24/02/22
2	Anton	17/02/22	24/02/22
3	Agung	17/02/22	24/02/22
4	M.Rahmad	17/02/22	24/02/22
5	Hasanudin	17/02/22	24/02/22
6	Arya Adit	17/02/22	24/02/22
65	Markus. T	17/02/22	24/02/19

Source: (Laia et al, 2022)

- Chromosome Initialization
  At this stage, 13 chromosomes are formed from the number of registrants, so that 13 chromosomes from 65 genes are divided with a maximum schedule of retrieval in 1 day. The rules stipulate 5 working days in a week, then the appropriate date is used as a chromosome.
  Genes that make up chromosomes come from variables a, b, c, d, e.
  a = integer[30]
  a,b,c,d,e = integer[10]
  information
  coromsome= c
  The following is an example of determining the gene allele to the 13th chromosome.
  C[1] = [a;b;c;d;e] = [03;08;02;05;10]
  C [2] = [a;b;c;d;e] = [13;06;04;07;09]
  C [3] = [a;b;c;d;e] = [11;10;03;02;08]
  C [4] = [a;b;c;d;e] = [07;04;06;09;05]
  C [5] = [a;b;c;d;e] = [04;02;10;03;07]
  C [6] = [a;b;c;d;e] = [29;03;05;08;10]
  C [7] = [a;b;c;d;e] = [16;05;09;04;02]
  C [8] = [a;b;c;d;e] = [08;10;07;06;03]
  C [9] = [a;b;c;d;e] = [24;07;08;10;10]
  C [10] = [a;b;c;d;e] = [02;09;10;10;04]
  C [11] = [a;b;c;d;e] = [10;04;10;08;10]
  C [12] = [a;b;c;d;e] = [28;08;03;05;07]
  C [13] = [a;b;c;d;e] = [21;02;06;08;03]

Table 2. Chromosome Initialization

Generation 1			
No.	The first week	Chromosomes	Allele Gene
1	group Ke-1	C 1	0308020510
2	group Ke-2	C 2	1306040709
3	group Ke-3	C 3	1110030208

4	group Ke-4	C 4	0704060905
5	group Ke-5	C 5	0402100307
6	group Ke-6	C 6	2903050810
7	group Ke-7	C 7	1605090402
8	group Ke-8	C 8	0810070603
9	group Ke-9	C 9	2407081010
10	group Ke-10	C 10	0209101004
11	group Ke-11	C 11	1004100810
12	group Ke-12	C 12	2808030507
13	group Ke-13	C13	2102060803

Source: (Laia, et al, 2022)

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- Chromosome Evaluation
  In order to maximize the results of the daily scheduling, the objective function is used. The objective of the objective function is to maximize the fitness value. The value sought in the evaluation of chromosomes is the objective function of each chromosome where the value is obtained from the formula in the genetic algorithm and is generated as shown in the following table:
  objective function (chromosome[1])
  = Abs((2 + 8*2 + 2*3 + 5*4 + 10*5) – 30)
  = Abs((2 + 16 + 6 + 20 + 50) – 30)
  = Abs(94 – 30)
  = 64

Table 3. Chromosome Evaluation

Objective Function	Number of Objective Functions
C 1	64
C 2	80
C 3	58
C 4	64
C 5	55
C 6	102
C 7	49
C 8	58
C 9	122
C 10	80
C 11	110
C 12	78
C 13	60
Rata-Rata	75,384

Source: (Laia et al, 2022)

- Chromosome Selection Process
  In this process there are 3 values that are sought, namely the fitness value, the probability value and the cumulative probability value
  fitness[1] = 1 / (*objective function* [1]+1)
  = 1 / (64+1)
  = 1/65
  = 0,0153

Table 4. Fitness Score

Participant	Value
P 1	0,0153
P 2	0,0123
P 3	0,0169
P 4	0,0153
P 5	0.0178
P 6	0,0009
P 7	0,02
P 8	0,0169
P 9	0,0081
P 10	0,0123
P 11	0,0009
P 12	0,0126
P 13	0,0163
Total	0,1656

Source: (Laia, et al, 2022)

.

P[i] = P[i] / total_P
P[1] = 0.0153/ 0.1678
= 0.0923

Table 5. Probability Value

Probability	Value
PRB 1	0.0923
PRB 2	0.0742
PRB 3	0.1020
PRB 4	0.0923
PRB 5	0.1074
PRB 6	0.0054
PRB 7	0.1207
PRB 8	0.1020
PRB 9	0.0489
PRB 10	0.0742
PRB 11	0.0054
PRB 12	0.0760
PRB 13	0.0984
Komulatif Probabilitas	0.9992

Source: (Laia et al, 2022)

CONCLUSION

Based on the background of the problem, this research optimizes the waiting time for community services in managing letters at the sub-district office. The results of this study are based on data that each participant can save about 2 hours, where usually the sub-district office has to wait up to 3 hours and even up to 4 hours, or today it is no longer served.

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