Advertisement scheduling on commercial radio station using genetics algorithm

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Abstract. On the commercial radio station, the advertising schedule is done manually, which resulted in ineffectiveness of ads schedule. Playback time consists of two types such as prime time and regular time. Radio Ads scheduling will be discussed in this research is based on ad playback schedule between 5am until 12am which rules every 15 minutes. It provides 3 slots ads with playback duration per ads maximum is 1 minute. If the radio broadcast time per day is 12 hours, then the maximum number of ads per day which can be aired is 76 ads. The other is the enactment of rules of prime time, namely the hours where the common people (listeners) have the greatest opportunity to listen to the radio, namely between the hours and hours of 4 am – 8 am, 6 pm – 10 pm. The number of screenings of the same ads on one day are limited to prime time ie 5 times, while for regular time is 8 times. Radio scheduling process is done using genetic algorithms which are composed of processes initialization chromosomes, selection, crossover and mutation. Study on chromosome 3 genes, each chromosome will be evaluated based on the value of fitness calculated based on the number of infractions that occurred on each individual chromosome. Where rule 1 is the number of screenings per ads must not be more than 5 times per day and rule 2 is there should never be two or more scheduling ads delivered on the same day and time. After fitness value of each chromosome is acquired, then the do the selection, crossover and mutation. From this research result, the optimal advertising schedule with schedule a whole day and ads data playback time ads with this level of accuracy: the average percentage was 83.79%.

Keyword: Radio ads Scheduling, Genetic Algorithms, random function.

1. Introduction
Nowadays technological advances are increasingly fast and sophisticated. The computer is used as a tool for management and control. On the electronic media, the commercial radio the operation of radio stations needs large costs and good management. In order to run with optimum, radio stations have to maximize the quality of broadcast to gain acceptance with advertising services provided by the company or individual products. Ads is a serving form and non-private paid promotion contains idea, product or service by identified sponsors [1]. Ads serving on electronic media require a good management which includes ordering broadcast schedule, broadcast hours and broadcast fees in accordance with the duration and frequency of ads. A bad management will result in a loss on the company because of the lack of interest of listener in ads serving. Research on the algorithm of scheduling the ads using Genetic algorithm has been used. Genetic algorithm is a computational approach to resolve the problem that is modeled in the process of biological evolution, including selection, crossover, and mutation [14]. Thus,
this algorithm used to set scheduling a recurring activity including scheduling radio advertisement commercial. Based on the problem above, this research purpose is to build a system Advertising Scheduling on Commercial Radio Stations Using Genetic Algorithms.

2. Previous research
Genetics Algorithm before is not used to solve a problem, but a study of adaptation phenomenon in the nature and make attempts to apply it to computer system [2]. The genetics algorithm is different with conventional convergent. It using the nature selection mechanism and genetics study so the common names used in this algorithm same as genetics in biology. A solution that has been raised by the algorithm called chromosome. A collection of chromosome is called population. Every chromosome is evaluated and the success rate is called Fitness. [3]

Some previous research that is relevant to the subject matter of this discussion among others are: Entitled research about an automated scheduling system using genetic algorithms in the Faculty of science and Technology, concluded that genetic algorithms with the preparation can generate a schedule with the guarantee of a lecturer does not teach in a full day of classes semester package and not scheduled sequence in one day. Then, another research is Genetic Algorithm for solving scheduling the lecture and lab course. With genetic algorithm scheduling solution can search for lectures and practical work with the time more quickly. The test results with the input parameter values in the same or different, the process of scheduling yield generation and iteration. [4]

By using the genetic algorithm program can produce a schedule of lectures, based on the results of the test parameters, the method of selection is the best selection of tournaments, the best methods of cross-breeding is the cross-breeding of many points, without elitism generally more quickly resolve scheduling and better population figures for model of chromosome problems scheduling courses that have around 300 genes is around 100 individuals, but no sooner in time compared to the total population. [5]

3. General method
The method proposed in this research will be done by scheduling advertising on commercial radio stations using genetic algorithms. In the process of scheduling the ads, there are some important things to be done for the application of genetic algorithm such as encoding of chromosomes, evoking the initial population, the process of selection, crossover, mutation process until the process of looping regeneration is eligible or not [6][7]. The general architecture of this method can be seen at figure 1.

![Diagram](image)

**Figure 1.** General Architecture
3.1 Chromosome representation
Genetic algorithms in scheduling problems required chromosome representation. A chromosome is represented by the matrix $m \times n = [504]$ [3], where $m$ or row in the matrix represents the number of ads, while the $n$ or the columns of the matrix represents the chromosomes [8], namely IDIklan, IDWaktu and IDHari. Defines the number of chromosome representation of genes being used and can represent the solution of the problem. This parameter is named gene that banded together to form chromosomes. The chromosome representation can be seen on table 1.

Table 1. Chromosome Representation

| Kromosom | IDIklan | IDHari | IDWaktu |
|----------|---------|--------|---------|
| 1        | 0022    | 5      | 03      |
| 2        | 0006    | 3      | 12      |
| 3        | 0010    | 1      | 14      |
| .        | .       | .      | .       |
| 171      | 0171    | 7      | 04      |

For every 15 minutes is provided 3 slots in minutes to 15, 30 and 45 at any hour. On each ad unit performed playback 3 ads per ad with duration of maximum 1 minute. So, if the radio broadcast time per day there are 19, then the maximum number of ads per play date that can be aired is 19 hours x 3 x 3 slots ads into ad 171. So, the length of a chromosome itself from each individual is as much as 171 chromosomes from the number of ads will be broadcast. While the length of a chromosome is composed of 3 genes. the initial Population was later resurrected at random for the next evaluation process conducted every single chromosome.

The matrix of the Chromosome representation schedule broadcasting advertisements created at random in the following way:
- Determine the number of hours of playback according to the number of ad slots.
- Random values from 0001 to IDIklan gene 0171
- Random gene IDWaktu of value 01 to 99 (05:15-24:00)
- The number of Playback advertising on demand.

3.2 Initial population
The process of initializing a population revoke a random population without concern to value of the fitness. This process is to encode information into the slot of chromosomes. Initial population made randomly from chromosome to slot some number of individuals in a single population [9][14]. As for the stages of the process from the initial population is as follows:
- Initialisation is created by entering parameter values of genetics that is the initial population.
- Initial population $= n$ (number of individuals).
- Initial population made of chromosome representation as much as n.

3.3 Fitness Evaluation
Fitness will be calculated based on the number of breaches that occur at each individual chromosome in a slot. The rules referred to in this research are:
- Rule 1 is not to be going on the existence of a number of screenings per ads more than 5 times in one day
- Rule 2 is the existence of two or more scheduling ads delivered on the same day and time.
As for the stages of the process of evaluation of the fitness is as follows:

- Each chromosome in one individual checks each value cause penalty or not by checking the way of chromosome 1 to 504 for the type of playback time Prime Time and 693 for the kind of Regular playing time Time.
- Count the number of chromosomes that exposed violations of rules divided by the total number of chromosomes or 504/693.

### 3.4 Selection
Data selection method in this research using Wheel Roulette. Parents will be selected based on the value of fitness, the greater the value of the fitness will get a greater possibility for elected as parent. Probability selection process. Individual that has the greatest probability was chosen as the first master for the formation of new breeds to the process of chromosomal crossover [10][11]. Thus, individual with second great probability was chosen for the formation of new breeds on the election of individuals to the process of chromosomal crossover.

### 3.5 Crossover and mutation
When the selection process has been implemented and has been elected to the new parent, then the next stages of the genetic algorithm is the crossover operator. Crossover is a way of combining the parent genes to produce new breeds. Crossover is done by way of exchanging value genes in the same gene position of both carriers [10]. The following are the stages of the process of chromosomal crossover stem with two individuals exchange value gen IDHari, IDWaktu:

| Chromosome 1 Parent | Chromosome 1 Parent 2 |
|---------------------|----------------------|
| Chromosome 8        | 0006  | 5          | 22          |
| Chromosome 9        | 0010  | 1          | 14          |

And here are the results of the generation process of stem from two individual crossovers:

| Child 1 Parent 1 | 0006 | 1 | 14 |
| Child 1 Parent 2 | 0010 | 3 | 22 |

The next stage after the crossover that is a mutation. The mutation is performed by selecting one of the genes randomly selected genes are then inserted into the other position. The mutation will be conducted randomly by selecting two positions of genes from chromosome and then its value is replaced with the value of the random Data display ads served to do the infusion information advertising into the database [12][13].

The value of IDWaktu and IDHari genes selected randomly as well. The mutation will be conducted randomly by selecting two positions of genes from chromosome and then its value is replaced with the value of the random too. The following are the stages of the process of chromosomal mutation in two individuals exchange genes with stem IDWaktu. The chromosomes are randomly selected as much as the value of the probability of mutations is as follows:

| Random chromosome in IDWaktu | Chromosome | IDIklan | IDHari | IDWaktu |
|-----------------------------|------------|---------|--------|---------|
| 2                           | 0006       | 3       | 12     |

| Random chromosome in IDIklan | Chromosome | IDIklan | IDHari | IDWaktu |
|------------------------------|------------|---------|--------|---------|
| 2                            | 0006       | 3       | 51     |

| Random chromosome in IDHari  | Chromosome | IDIklan | IDHari | IDWaktu |
|-------------------------------|------------|---------|--------|---------|
| 2                             | 0006       | 3       | 12     |

### 4. Result and discussion
As for the result of the design of systems that have been constructed are as follows:
4.1. Scheduling Process
Scheduling processes used to generate prime schedule for the ads. The process result can be seen on Figure 2.

4.2. Display of Prime-Time Scheduling Report
Prime Time Scheduling Schedule Display serves to display information on the results of radio ad scheduling process at Prime-Time time. The Prime-Time Scheduling Report view can be seen as in Figure 2.

4.3. Display of Regular Time Scheduling Report
Regular Time Scheduling Schedule Display serves to display information on the results of the radio ad scheduling process at Regular Time.

Figure 2. Scheduling Process Output

Figure 3. Prime Time Scheduling Report
4.4. Scheduling Tests with Genetic Parameter Variations

Genetic algorithms function to produce the best schedule. In the testing phase, to be able to produce the test is done by entering the input value of varied genetic parameters. The result of comparison of scheduling test with Regular Time time can be seen in Table 2.

Table 2. Genetics Parameter Test View at Team Regular Time

| No | Number of individuals | Average fitness | Cross-over Probability | Probability of Mutation | Generation | Max Generation | Optimum Percentage |
|----|-----------------------|-----------------|------------------------|-------------------------|------------|----------------|-------------------|
| 1  | 50                    | 1               | 0,70                   | 0,10                    | 4          | 1000           | 100               |
| 2  | 100                   | 0,97            | 0,70                   | 0,10                    | 285        | 1000           | 93                |
| 3  | 150                   | 0,95            | 0,70                   | 0,10                    | 51         | 1000           | 90                |
| 4  | 200                   | 0,94            | 0,70                   | 0,10                    | 317        | 1000           | 88,5              |
| 5  | 250                   | 0,92            | 0,70                   | 0,10                    | 424        | 1000           | 83,6              |
| 6  | 300                   | 0,92            | 0,70                   | 0,10                    | 107        | 1000           | 83,33             |
| 7  | 350                   | 0,93            | 0,70                   | 0,10                    | 382        | 1000           | 79,43             |
| 8  | 400                   | 0,88            | 0,70                   | 0,10                    | 1000       | 1000           | 76,75             |
| 9  | 450                   | 0,86            | 0,70                   | 0,10                    | 1000       | 1000           | 73,33             |
| 10 | 500                   | 0,85            | 0,70                   | 0,10                    | 1000       | 1000           | 71                |

4.5. Data Testing

4.5.1. Testing with 50 Ads for 12/01/2016

There are 50 adult data processing or viewing on the time series that is regular time with genetic parameter of 70% crossover probability, 10% mutation probability, and maximum iteration of 1000 gained an average fitness of 1 and optimum percentage as much as 100% On the 4th iteration with a 6-second processing time.
4.5.2. Testing with 300 Ads for 12/01/2015
In Figure 5, there are 300 ad population processing or viewing on the showtime type ie regular time with genetic parameter 70% crossover probability, 10% mutation probability, and maximum iteration of 1000 gained an average fitness of 0.92 and the number of individuals Optimally as much as 83.33% at the 107th iteration with a processing time of 32 minutes 37 seconds.

![Testing Data with 300 Ads](image)

Figure 5. Testing Data with 300 Ads

5. Conclusions and recommendations
Based on the discussion and evaluation, this research concludes the genetic algorithm can be used for radio ad scheduling with prime-time type and regular time. Which are heavily influenced by random functions, so it is not always given the optimal result. The genetic algorithm can search for a solution of radio advertisement scheduling with faster time while the test results with the input values of the same or different genetic parameters, the scheduling process yields different optimum percentage values this is due to the random function. The larger the population or the scheduled ad data the longer scheduling time is due to more random values.

It’s possibly for the next research and development is to compare the accuracy of genetic algorithms with other optimization algorithms such as Backpropagation neural network algorithm and Learning Vector Quantization.

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