

CHAPTER V

IMPLEMENTATION AND TESTING

5.1 Implementation

5.1.1 Data for Schedule

All of the data will be stored in array 1 dimension. In this program the method to store data is readInput() method, this method will store the data from text file. There are 3 arrays to each data such as security, point guard, and working hour. There is a method to read how many securities for each point guard from text file that called readSecurityPerPointGuard().

5.1.2 Initialize Population

The first process in genetic algorithm is initialization to initialize population from all of the data (security, point guard, and working hour). In this project the method to do that is called initialization(), it will randomly created individual. Each individual has amount of chromosomes that depends of amount of point guard, working hour, and security per point guard. And the result will be stored in array 2 dimension name individual[][]. This method will be repeated based on total population.

5.1.3 Fitness Evaluation

After initialization, there is fitness evaluation that's used to calculate the fitness value each individual. The method in this project is called evaluation().

There are two calculation in this evaluation the female securities can't guard between 18:00 and 00:00 and each security can't guard more than one shift per day. The chromosome that isn't violate the two constraints will get two points. The maximum fitness value for each individual are 2 x total chromosomes of each individual.

5.1.4 Selection

The selection in this program is roulette wheel. The selection probability of each individual will be counted by divide the fitness value of a individual by total fitness value of a population. The method for this selection is selection(). Individual with higher fitness value will have higher probability, so it has a better chance to be selected. Then it will generate random iteration between 0 and 1 as much as the amount of individuals each population. These iterations will select the individual if the iteration located in the probability total.

For examples

$$\text{fitnessvalue}[0] = 142$$

$$\text{fitnessvalue}[1] = 150$$

$$\text{fitnessvalue}[2] = 135$$

$$\text{fitnessvalue}[3] = 120$$

$$\text{fitnessvalue}[4] = 155$$

$$\text{totalfitness} = 142 + 150 + 135 + 120 + 155 = 702$$

$$\text{probability}[0] = 142 / 702 = 0.20$$

$$\text{probability}[1] = 150 / 702 = 0.21$$

$$\text{probability}[2] = 135 / 702 = 0.19$$

$$\text{probability}[3] = 120 / 702 = 0.17$$

$$\text{probability}[4] = 155 / 702 = 0.22$$

$$\text{probabilityttl}[0] = 0.20$$

$$\text{probabilityttl}[1] = 0.20 + 0.21 = 0.41$$

$$\text{probabilityttl}[2] = 0.41 + 0.19 = 0.6$$

$$\text{probabilityttl}[3] = 0.6 + 0.17 = 0.77$$

$$\text{probabilityttl}[4] = 0.77 + 0.22 = 0.99$$

The roulette wheel selection will select individual if iteration[p] \leq probabilityttl[i] and iteration[p] \leq probabilityttl[i] && iteration[p] > probabilityttl[i-1]. If the iteration located in between the probability total then the iteration will be choose the individual.

5.1.5 Crossover

After selection, there is process to select two individuals randomly and then the values between that two parents will be crossover from one to another. That process in this project is called crossover() method. This method will switch row 1 to 3 from parent1 into row 4 to 6 from parent2 and switch row 4 to 6 from parent2 into row 1 to 3 from parent1.

For example

Parent1	Parent2
A	G
B	H
C	I
D	J
E	K

F	L
Result	
Parent1	Parent2
J	G
K	H
L	I
D	A
E	B
F	C

5.1.6 Mutation

⇒ The mutation rate of this project is 0.03. After crossover, there is a process to randomly change the value of individual. It's called mutation() method, it will choose random number between 0 to 0.1. And if mutation rate \geq random number, the mutation will be processed. This mutation will pick one random individual and change all of the data in that individual.

5.1.7 Evaluate the Best Individual

There is a method to evaluate the fitness value from individuals in the crossover and mutation processes. It's called evaluation2(). And the result() method will pick the best fitness value from the population.

5.2 Testing

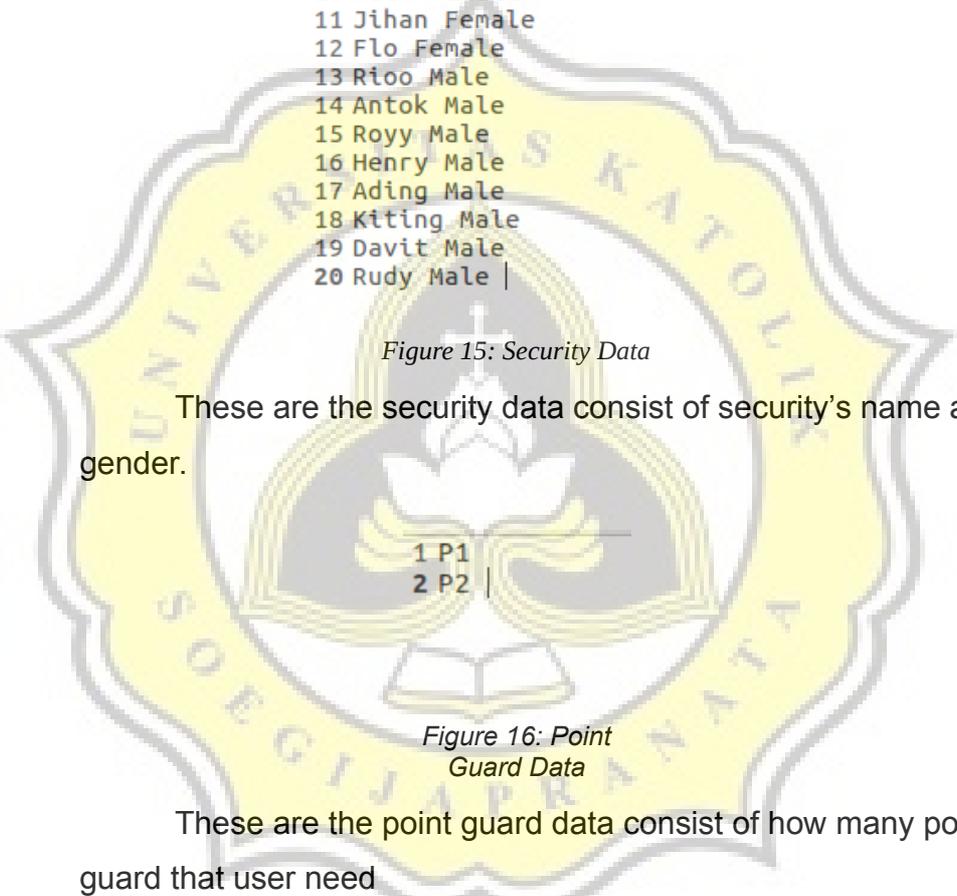
5.2.1 First Test

To test the program, user must input securities, point guards, shifts, and securities per point guard from the GUI. And then click “save as text file” to save each data into each file .txt.

The screenshot shows a software window titled "Input Data Scheduling". It contains several input fields and buttons. At the top, there are fields for "Name", "Gender" (with a dropdown menu showing "Male/Female"), "Total Point Guard", "Security per PG", "Start Working Hour" (with an "HH:mm" format indicator), and "Hour Per Shift". Each of these fields has a corresponding "Add" and "Delete" button. Below these fields are four empty table columns with headers: "Name", "Gender", "Point Guard", and "Working Hour". At the bottom of the window, there are two buttons: "Save As Text File" and "Generate Schedule".

Figure 14: Input GUI

First test begin with 20 securities, 2 point guards, 3 shifts, and 2 securities per point guard.



```

1 Ronny Male
2 Mario Male
3 Harry Male
4 Donny Male
5 Iwan Male
6 Ricky Male
7 Sindhu Male
8 Wiwit Female
9 Jeje Female
10 Acik Female
11 Jihan Female
12 Flo Female
13 Rioo Male
14 Antok Male
15 Royy Male
16 Henry Male
17 Ading Male
18 Kiting Male
19 Davit Male
20 Rudy Male |

```

Figure 15: Security Data

These are the security data consist of security's name and gender.

```

1 P1
2 P2 |

```

Figure 16: Point Guard Data

These are the point guard data consist of how many point guard that user need

```

1 06:00
2 12:00
3 18:00|

```

Figure 17: Working Hour Data

And then click “generate” from the GUI, then the program will be processed the genetic algorithm.

```

----- Individual 1 -----
*****
Iwan Male P1 06:00 | Iwan Male P1 06:00 | Flo Female P2 06:00 | Harry Male P
2 06:00 | Sindhu Male P1 12:00 | Rioo Male P1 12:00 | Mario Male P2 12:00 | R
udy Male P2 12:00 | Wiwit Female P1 18:00 | Rioo Male P1 18:00 | Donny Male
P2 18:00 | Ricky Male P2 18:00 |

Rioo Male P1 06:00 | Acik Female P1 06:00 | Acik Female P2 06:00 | Sindhu Mal
e P2 06:00 | Jihan Female P1 12:00 | Ricky Male P1 12:00 | Wiwit Female P2 1
2:00 | Wiwit Female P2 12:00 | Wiwit Female P1 18:00 | Harry Male P1 18:00 |
Royy Male P2 18:00 | Kiting Male P2 18:00 |

Wiwit Female P1 06:00 | Rudy Male P1 06:00 | Ronny Male P2 06:00 | Rioo Male
P2 06:00 | Rioo Male P1 12:00 | Wiwit Female P1 12:00 | Flo Female P2 12:00
| Royy Male P2 12:00 | Ronny Male P1 18:00 | Donny Male P1 18:00 | Ricky Male
P2 18:00 | Rioo Male P2 18:00 |

Acik Female P1 06:00 | Henry Male P1 06:00 | Donny Male P2 06:00 | Henry Male
P2 06:00 | Sindhu Male P1 12:00 | Harry Male P1 12:00 | Ricky Male P2 12:00
| Royy Male P2 12:00 | Davit Male P1 18:00 | Wiwit Female P1 18:00 | Royy Ma
le P2 18:00 | Flo Female P2 18:00 |

Donny Male P1 06:00 | Jeje Female P1 06:00 | Acik Female P2 06:00 | Jeje Fema
le P2 06:00 | Jeje Female P1 12:00 | Rudy Male P1 12:00 | Flo Female P2 12:0
0 | Donny Male P2 12:00 | Jeje Female P1 18:00 | Flo Female P1 18:00 | Kiting
Male P2 18:00 | Jeje Female P2 18:00 |

Mario Male P1 06:00 | Donny Male P1 06:00 | Antok Male P2 06:00 | Rioo Male
P2 06:00 | Ading Male P1 12:00 | Ading Male P1 12:00 | Ading Male P2 12:00 |
Rioo Male P2 12:00 | Royy Male P1 18:00 | Ricky Male P1 18:00 | Sindhu Male
P2 18:00 | Henry Male P2 18:00 |

Kiting Male P1 06:00 | Flo Female P1 06:00 | Rudy Male P2 06:00 | Davit Male
P2 06:00 | Rioo Male P1 12:00 | Ricky Male P1 12:00 | Kiting Male P2 12:00 |
Harry Male P2 12:00 | Rudy Male P1 18:00 | Davit Male P1 18:00 | Jeje Female
P2 18:00 | Iwan Male P2 18:00 |

Fitness Value = 120

```

Figure 18: Initialization Individual 1

There are 7 rows and 12 columns, 7 means 7 days in a week and 12 is from total point guard * total working hour * total securities per point guard = $2 * 3 * 2 = 12$.

Schedule			
Monday	Tuesday	Wednesday	Thursday
Davit Male P1 06:00	Sindhu Male P1 06:00	Rudy Male P1 06:00	Ronny Male P1 06:00
Flo Female P1 06:00	Sindhu Male P1 06:00	Kiting Male P1 06:00	Kiting Male P1 06:00
Ading Male P2 06:00	Harry Male P2 06:00	Donny Male P2 06:00	Antok Male P2 06:00
Kiting Male P2 06:00	Rudy Male P2 06:00	Iwan Male P2 06:00	Davit Male P2 06:00
Ricky Male P1 12:00	Mario Male P1 12:00	Mario Male P1 12:00	Donny Male P1 12:00
Iwan Male P1 12:00	Sindhu Male P1 12:00	Royy Male P1 12:00	Acik Female P1 12:00
Rudy Male P2 12:00	Royy Male P2 12:00	Rudy Male P2 12:00	Henry Male P2 12:00
Mario Male P2 12:00	Donny Male P2 12:00	Kiting Male P2 12:00	Ricky Male P2 12:00
Rioo Male P1 18:00	Wiwit Female P1 18:00	Ronny Male P1 18:00	Jeje Female P1 18:00
Jihan Female P1 18:00	Royy Male P1 18:00	Flo Female P1 18:00	Harry Male P1 18:00
Sindhu Male P2 18:00	Acik Female P2 18:00	Donny Male P2 18:00	Jihan Female P2 18:00
Rioo Male P2 18:00	Antok Male P2 18:00	Ricky Male P2 18:00	Henry Male P2 18:00

Friday	Saturday	Sunday
Harry Male P1 06:00	Wiwit Female P1 06:00	Harry Male P1 06:00
Wiwit Female P1 06:00	Ronny Male P1 06:00	Donny Male P1 06:00
Harry Male P2 06:00	Ading Male P2 06:00	Jihan Female P2 06:00
Rioo Male P2 06:00	Henry Male P2 06:00	Antok Male P2 06:00
Jihan Female P1 12:00	Henry Male P1 12:00	Wiwit Female P1 12:00
Henry Male P1 12:00	Kiting Male P1 12:00	Ronny Male P1 12:00
Henry Male P2 12:00	Davit Male P2 12:00	Kiting Male P2 12:00
Acik Female P2 12:00	Antok Male P2 12:00	Mario Male P2 12:00
Jihan Female P1 18:00	Donny Male P1 18:00	Ading Male P1 18:00
Harry Male P1 18:00	Iwan Male P1 18:00	Iwan Male P1 18:00
Ricky Male P2 18:00	Ading Male P2 18:00	Kiting Male P2 18:00
Kiting Male P2 18:00	Mario Male P2 18:00	Rudy Male P2 18:00

Figure 19: Result 1

Figure 19 shows the schedule in one week, there are seven columns that named by day, and there are twelve securities for each day.

5.2.2 Second Test

First test begin with 10 securities, 2 point guards, 4 shifts, and 1 securities per point guard.

1 Ronny Male
 2 Mario Male
 3 Harry Male
 4 Donny Male
 5 Iwan Male
 6 Ricky Male
 7 Sindhu Male
 8 Wiwit Female
 9 Jeje Female
 10 Acik Female

Figure 20: Security Data

1 P1
 2 P2 |

Figure 21: Point Guard Data

1 06:00
 2 12:00
 3 18:00
 4 00:00|

Figure 22: Working Hour Data

And then click “generate” from the GUI, then the program will be processed the genetic algorithm.

Monday	Tuesday	Wednesday	Thursday
Donny Male P1 06:00	Acik Female P1 06:00	Harry Male P1 06:00	Ronny Male P1 06:00
Iwan Male P2 06:00	Mario Male P2 06:00	Sindhu Male P2 06:00	Wiwit Female P2 06:00
Wiwit Female P1 12:00	Donny Male P1 12:00	Harry Male P1 12:00	Acik Female P1 12:00
Sindhu Male P2 12:00	Ronny Male P2 12:00	Ricky Male P2 12:00	Donny Male P2 12:00
Donny Male P1 18:00	Donny Male P1 18:00	Acik Female P1 18:00	Harry Male P1 18:00
Iwan Male P2 18:00	Ricky Male P2 18:00	Donny Male P2 18:00	Iwan Male P2 18:00
Ricky Male P1 00:00	Iwan Male P1 00:00	Ronny Male P1 00:00	Wiwit Female P1 00:00
Harry Male P2 00:00	Jeje Female P2 00:00	Iwan Male P2 00:00	Jeje Female P2 00:00

Friday	Saturday	Sunday
Donny Male P1 06:00	Acik Female P1 06:00	Wiwit Female P1 06:00
Donny Male P2 06:00	Iwan Male P2 06:00	Jeje Female P2 06:00
Jeje Female P1 12:00	Donny Male P1 12:00	Donny Male P1 12:00
Wiwit Female P2 12:00	Iwan Male P2 12:00	Ricky Male P2 12:00
Iwan Male P1 18:00	Mario Male P1 18:00	Ricky Male P1 18:00
Acik Female P2 18:00	Harry Male P2 18:00	Harry Male P2 18:00
Wiwit Female P1 00:00	Mario Male P1 00:00	Sindhu Male P1 00:00
Harry Male P2 00:00	Donny Male P2 00:00	Wiwit Female P2 00:00

Figure 23: Result 2

There are 7 rows and 8 columns, 7 means 7 days in a week and 8 is from total point guard * total working hour * total securities per point guard = $2 * 4 * 1 = 8$.