



PROJECT REPORT

Crossword puzzle generator using Genetic
Algorithm with multithreaded fitness calculation

Donny Kurniawan Widodo

13.02.0031

2016

INFORMATICS ENGINEERING DEPARTMENT

FACULTY OF COMPUTER SCIENCE

SOEGIJAPRANATA CATHOLIC UNIVERSITY

APPROVAL AND RATIFICATION PAGE
PROJECT REPORT

Crossword puzzle generator using Genetic
Algorithm with multithreaded fitness calculation

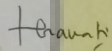
By

Donny Kurniawan Widodo – 13.02.0031

This project has been approved and ratified by the faculty of Computer
Science on December, 19 2016


With Approval,

Supervisor,

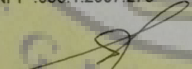

Rosita Herawati, ST, MT
NPP : 058.1.2004.263

Examiners,

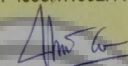
1.)


Hironimus Leong, S.Kom., M.Kom
NPP : 058.1.2007.273

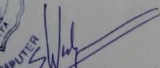
2.)


Suyanto Edward Antonius, Ir., M.Sc
NPP : 058.1.1992.116

3.)


Shinta Estri Wahyuningrum, S.Si., M.Cs
NPP : 058.1.2007.272

Dean of Faculty of Computer Science,


Erani Widarto Nugroho, ST., MT
NPP : 058.1. 2002.254

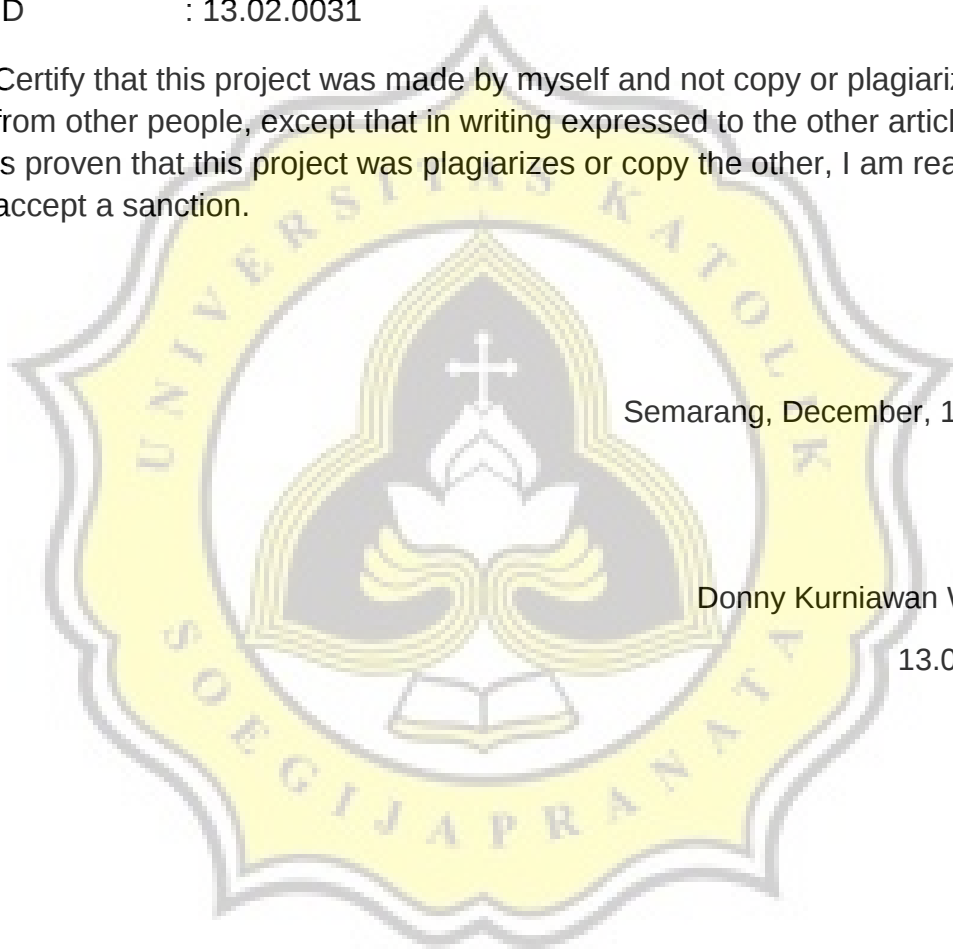
STATEMENT OF ORIGINALITY

I, the undersigned:

Name : Donny Kurniawan Widodo

ID : 13.02.0031

Certify that this project was made by myself and not copy or plagiarize from other people, except that in writing expressed to the other article. If it is proven that this project was plagiarizes or copy the other, I am ready to accept a sanction.



Semarang, December, 19 2016

Donny Kurniawan Widodo

13.02.0031

ABSTRACT

There are some problems and difficulties in creating a crossword puzzle such as the words must intersect each other. Each word also can not coincide with another. This project will discuss how to overcome this problem using a program. The program will be able to generate a crossword puzzle based on the answer that the user input. Genetic Algorithm will be used in the program to process the words. The solutions that created in Genetic Algorithm will use array of object as the data structure. To count the fitness value for each solution, the program will use multi threading. The best solution found by Genetic Algorithm can be vary in term of time. Sometime the best solution can be found in the first generation, but also can be found after hundreds of generation. This is happens because the initial population created randomly.

Keywords: Genetic Algorithm, Multi Threading, Crossword.



PREFACE

Crossword puzzle is a very popular word puzzle. In fact, some teacher use crossword in one of their method in teaching their student. However there are some difficulties in creating a crossword puzzle. This difficulties will be explained later in chapter one. The program to generate crossword puzzle will use Genetic algorithm. There are some data structure used in the program such as array and array of list. The program will also use multi threading in calculating the fitness value in the algorithm. The concept of the algorithm, data structure and multi threading will be explained in chapter two. In chapter three will explained about the research methodology used for this project. Chapter four will explained about the design of the program. Design of the program contains the flow of the program. Chapter five will show the implementation of the algorithm and testing with some cases. The result will be shown in chapter six.

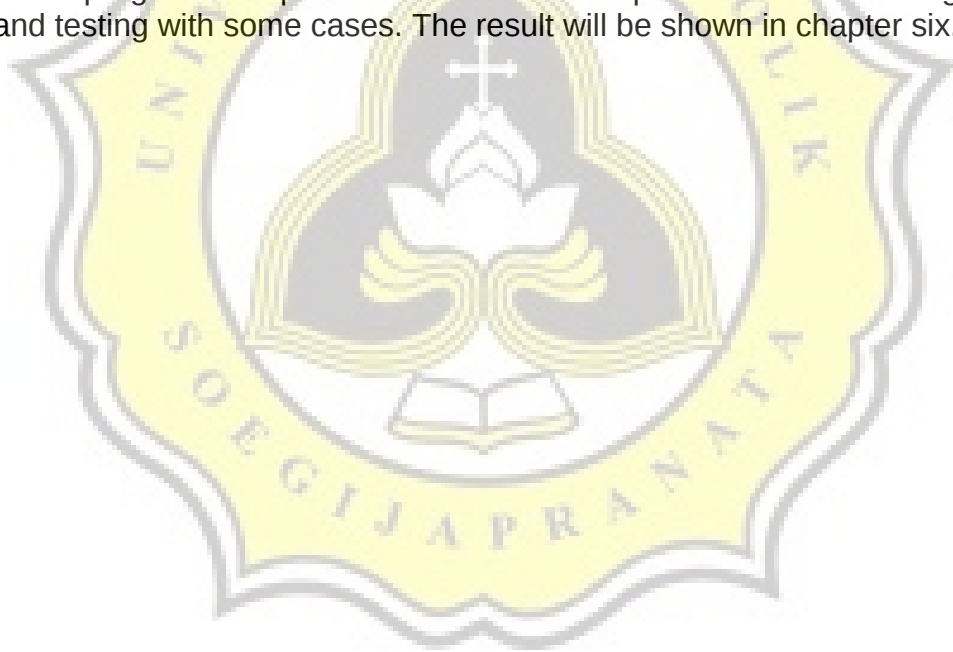


TABLE OF CONTENT

APPROVAL AND RATIFICATION PAGE.....	ii
STATEMENT OF ORIGINALITY.....	iii
ABSTRACT.....	iv
PREFACE.....	v
TABLE OF CONTENT.....	vi
TABLE OF TABLES.....	vii
TABLE OF FIGURES.....	viii
CHAPTER I.....	1
1.1. Background.....	1
1.2. Scope.....	2
1.3. Objective.....	2
CHAPTER II.....	3
2.1. British style grid Crossword.....	3
2.2. Genetic Algorithm.....	3
2.3. Data Structure.....	5
2.4. Multithreading.....	6
CHAPTER III.....	8
CHAPTER IV.....	10
4.1. Analysis.....	10
4.2. Design.....	11
CHAPTER V.....	19
5.1. Implementation.....	19
5.2. Testing.....	30
CHAPTER VI.....	33
REFERENCES.....	34

TABLE OF TABLES

Table 1. Two Dimensional Array.....	20
Table 2 Crossover Chance.....	25
Table 3 Roulette Wheel Selection.....	26



TABLE OF FIGURES

Figure 1. Genetic Algorithm's flowchart.....	4
Figure 2 Use Case Diagram.....	10
Figure 3. Flowchart Design of Genetic Algorithm.....	12
Figure 4 Encoding Set of Words and Set of Boolean.....	13
Figure 5 combine two arrays.....	13
Figure 6 Flowchart of Counting Fitness.....	14
Figure 7 Flowchart of Selection process.....	15
Figure 8 Crossover Process.....	16
Figure 9 Mutation Process.....	17
Figure 10 Class Diagram.....	18
Figure 11. Interface for Input.....	19
Figure 12. Interface Table Input.....	20
Figure 13 Creating an Individu.....	21
Figure 14 Placing the first word.....	23
Figure 15 Array of Horizontal List.....	23
Figure 16 Placing the second word.....	24
Figure 17 Array of Vertical List.....	24
Figure 18 Crossover Illustration.....	28
Figure 19 Mutation with example.....	29
Figure 20 Log program after input GA.....	30
Figure 21 File data.txt after input words and clue received.....	30
Figure 22 Log Program shows individu in population and fitness value.....	31
Figure 23 Simplified Board.....	31
Figure 24 Result's vertical and horizontal list.....	32