



Ministry of Higher Education  
and Scientific Research  
University of Diyala- College of Science  
Department of Computer Science



# ***Pattern Discovery for Text Mining Measured by Levenshtien Distance***

*A Thesis*

*Submitted to the Department of Computer Science\ College  
of Science\ University of Diyala in a Partial Fulfillment of  
the Requirements for the Degree of Master in Computer  
Science*

***By***

***Layla Abd Al.Hak Ismael***

*Supervised by*

***Prof. Naji Mutar Suhaib***

*September 2019*

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

هُوَ الَّذِي جَعَلَ الشَّمْسُ ضِيَاءً وَالْقَمَرَ نُورًا وَقَدَرَهُ مَنَازِلَ لِتَعْلَمُوا

عَدَدَ السِّنِّينَ وَالْحِسَابَ مَا خَلَقَ اللَّهُ ذَلِكَ إِلَّا بِالْحَقِّ يُفَصِّلُ الْآيَاتِ

لِقَوْمٍ يَعْلَمُونَ ﴿٥﴾

صدق الله العظيم

سورة يونس

الآية (٥)

## الإهداء

أهدي جهدي المتواضع هذا

إلى الذي سهر على تعليمي بتضحيات جسام.....إلى مدرستي الأولى في الحياة

أبي الغالي على قلبي أطال الله في عمره

إلى من كانت سندي في الشدائد..... وكانت دعواها لي دائما بالتوفيق

أمي الغالية جزاها الله عني خير الجزاء في الدارين

إلى من كانوا ملاذي وملجئي.....إلى من تذوقت معهم أجمل اللحظات

إلى من هم أقرب إليّ من روعي.....أخواتي

إلى من أنسني في دراستي وشاركني همومي.....زوجي العزيز

إلى الشموع التي ذابت في كبرياء.....لتنير كل خطوة في دربنا

فكانوا رسلاً للعلم والأخلاق.....أساتذتي

ليلى عبد الحق إسماعيل

## ***ACKNOWLEDGMENTS***

*First and foremost, I would like to thank to Allah SWT for his bless and mercy who has guided me in finishing this thesis. Then I would like to thank my supervisor, **prof. Naji Mutar Suhaib**, professor of computer science at Diyala University – collage of science, for the extraordinary exertion he applied, I would like to thank him for his profitable direction and backing through his supervision of this work. I am very fortunate to receive such great support from him.*

*I would like to thank my father, mother and sisters who have continued to provide encouragement and assistance over the last two years of study.*

*At long last, there are no words enough to thank my husband for being strong and having faith in me constantly and his support to complete this master project.*

## ***Abstract***

The textual based information amount is rapidly accumulating Which stored electronically on our computers or Web. Any computer (laptop or desktop) is capable of accommodating enormous data amounts owing to the improvements in the storage devices.

Texts are included in text dataset and this dataset are unstructured. These unstructured data can be handled by text mining. The complexity and the considerable number for these data uncover numerous new capabilities to the analysts. Therefore, this work presents an enhancement of extracting useful patterns from text documents in the field of text mining using Pattern Taxonomy Model (PTM) and Levenshtein Distance Algorithm (LDA).

There are various methods to handle text documents. In this thesis, text mining system was suggested to overcome the problems that have occurred in term-based method and phrase-based method. The proposed system based on the behavior of LDA algorithm and PTM for determining the best accuracy of the extracted patterns with a short time and to prove that pattern based method is the best solution for text mining without any problems in the information extracted from the text.

The strength of the two algorithms (PTM, LDA) are tested using threshold values from 1 to 10 to get 1% to 10% of information in the text. The proposed system used "Openosis opinion dataset" and "Reuters 50\_50 dataset" which stored in a file of ".txt" or text document.

The results of this test obtained by comparing among values of four features which are (global probability, local probability, absolute support, relative support) for the text to get higher average accuracy.

The results of proposed system have been compared with other systems. The proposed system get (98.68%) average accuracy for Unigram grammar and (99.65%) average accuracy for Bigram grammar while a system that used the Levenshtein Edit Distance for automatic lemmatization for modern English achieved an accuracy of 96% for English language and the system that used the process of pattern evolving and pattern deploying get 62% of precision and 82% of recall. So, using LDA with PTM achieved a better results compared to other systems.

## Lists of Contents

---

<b>ACKNOWLEDGMENTS</b> .....	<b>I</b>
<b>ABSTRACT</b> .....	<b>II</b>
<b>List of Contents</b> .....	<b>IV</b>
<b>List of Figures</b> .....	<b>VII</b>
<b>List of Tables</b> .....	<b>XI</b>
<b>List of Algorithms</b> .....	<b>XII</b>
<b>List of Abbreviations</b> .....	<b>XIII</b>
<b>CHAPTER 1 GENERAL INTRODUCTION</b> .....	<b>(1-7)</b>
<b>1.1 Introduction</b> .....	<b>1</b>
<b>1.2 Related Work</b> .....	<b>3</b>
<b>1.3 The Problem Statement</b> .....	<b>6</b>
<b>1.4 Aim of the Thesis</b> .....	<b>6</b>
<b>1.5 Outline of the Thesis</b> .....	<b>7</b>
<b>CHAPTER 2 THIORITICAL BACKGROUND</b> .....	<b>(8- 35)</b>
<b>2.1 Data Mining</b> .....	<b>8</b>
<b>2.2 Text Mining</b> .....	<b>9</b>
<b>2.3 The Text Mining Need</b> .....	<b>12</b>
<b>2.4 Text Mining Vs. Data Mining</b> .....	<b>12</b>
<b>2.5 The Discovery of Pattern</b> .....	<b>13</b>
<b>2.6 The Taxonomy of Pattern</b> .....	<b>13</b>
<b>2.7 Text Mining Methods</b> .....	<b>14</b>
<b>2.8 The Techniques of Text Mining</b> .....	<b>15</b>
<b>2.8.1 Summarizing Text</b> .....	<b>15</b>
<b>2.8.2 The Classification Technique</b> .....	<b>16</b>

2.8.3 The Clustering Technique.....	17
2.8.4 Information Extraction .....	18
2.8.5 Information Retrieval.....	19
2.8.6 The Visualization of Information.....	21
2.8.7 Natural Language Processing .....	22
2.8.8 A Comparison among The Techniques of Text Mining .....	23
2.9 Challenges of Text Mining Tasks.....	24
2.10 Stemming .....	26
2.11 Porter Stemmer .....	27
2.12 Edit Distance Algorithm.....	29
2.13 The measure of similarity among terms .....	32
2.14 N-grams .....	33
<b>CHAPTER 3 THE PROPOSED PATTERN DISCOVERY SYSTEM.....</b>	<b>(36-50)</b>
3.1 Introduction.....	36
3.2 The Proposed System.....	36
3.2.1 The Proposed System for Unigram Grammar .....	37
3.2.1 The Proposed System for Bigram Grammar .....	48
3.3 Accuracy .....	49
3.4 Average of Accuracy .....	50
3.5 The Total Time of Processing.....	50
<b>CHAPTER 4 THE EXPERIENTIAL RESULTS AND TESTS.....</b>	<b>(51-81)</b>
4.1 Introduction.....	51
4.2 The Environment of Implementation .....	51
4.3 Datasets.....	51
4.4 Proposed System Implementation for Unigram Grammar .....	52



4.4.1 Input Text.....	52
4.4.2 Extract Paragraph Step .....	53
4.4.3 Feature Extraction step .....	55
4.4.4 Update Document Information(Deploy Pattern).....	55
4.4.5 Applying Levenshtein Distance Algorithm .....	57
4.5 The Average Accuracy and Time of a Dataset .....	58
4.5.1 Results by Average Accuracy and Time for Dataset1 .....	59
4.5.2 Results by Average Accuracy and Time for Dataset2 .....	64
4.6 Proposed System Implementation for Bigram grammar .....	68
4.6.1 Update Document Information (Deploy Pattern).....	68
4.6.2 Applying Levenshtein Distance algorithm .....	69
4.7 The Average accuracy and Time of the Dataset for Bigram Grammar.....	71
4.7.1 Results by Average Accuracy and Time for Dataset1.....	72
4.7.2 Results by Average Accuracy and Time for Dataset2.....	76
4.8 Comparison between our Proposed System and Other Existing Systems.....	80
<b>CHAPTER 5 CONCLUSIONS &amp; SUGGESTIONS FOR FUTURE WORKS</b>	
5.1 Conclusions .....	82
5.2 Suggestions for Future Works .....	83
<b>REFERENCES.....</b>	<b>84</b>

## Lists of Figures

---

<b>Figure (2.1):</b> Structured Data Vs. Unstructured Data.....	<b>11</b>
<b>Figure (2.2):</b> Classification .....	<b>17</b>
<b>Figure (2.3):</b> Clustering.....	<b>18</b>
<b>Figure (2.4):</b> Information Extraction .....	<b>19</b>
<b>Figure (2.5):</b> Information Retrieval.....	<b>20</b>
<b>Figure (2.6):</b> The Relation Between the Set of Relevant Documents and the Set of Retrieved Documents .....	<b>21</b>
<b>Figure (2.7):</b> Kinds of Stemming Algorithms.....	<b>27</b>
<b>Figure (2.8):</b> The Steps of Porter Stemming Algorithm .....	<b>28</b>
<b>Figure (3.1):</b> The Proposed System Flowchart for Unigram Grammar .....	<b>37</b>
<b>Figure (3.2):</b> An Example of Text Documents .....	<b>38</b>
<b>Figure (3.3):</b> The Proposed PTM Flowchart for Absolute Support Comparison .....	<b>41</b>
<b>Figure (3.4):</b> The Proposed PTM Flowchart for Relative Support Comparison .....	<b>42</b>
<b>Figure (3.5):</b> The Proposed System Flowchart for Bigram Grammar. ....	<b>48</b>
<b>Figure (3.6):</b> An Example of Applying Bigram Grammar for The Text. ....	<b>49</b>
<b>Figure (4.1):</b> An Example of Input Text Step.....	<b>53</b>
<b>Figure (4.2):</b> The Division of The Text Into Paragraphs.....	<b>54</b>
<b>Figure(4.3):</b> The Calculation Process of Features for Each Term in The Document.....	<b>55</b>
<b>Figure (4.4):</b> An Example of The Most Frequent Terms of a Document for Various Threshold Values for Dataset1.....	<b>56</b>
<b>Figure (4.5):</b> An Example of The Most Frequent Terms of a Document for Various Threshold Values for Dataset2.....	<b>56</b>

**Figure (4.6):** The Calculation of The Accuracy of a Document When The Threshold is 1 for Global Probability for Dataset1..... **57**

**Figure (4.7):** The Calculation of The Accuracy of a Document When The Threshold is 3 for Absolute Support for Dataset2 ..... **57**

**Figure (4.8):** An Example of Calculating The Average Accuracy of a Dataset1 for Different Threshold Values..... **58**

**Figure (4.9):** An Example of Calculating The Average Accuracy of a Dataset2 for Different Threshold Values..... **59**

**Figure (4.10):** The Relationship Between Threshold values and features values for dataset1. .... **61**

**Figure (4.11):** The Relationship Between Threshold Values and Elapsed Time..... **62**

**Figure (4.12):** An Example of a Graph Representation of global probability When the threshold value =1 ..... **62**

**Figure (4.13):** An Example of a Graph Representation of Local Probability When The Threshold Value =1 ..... **63**

**Figure (4.14):** An Example of a Graph Representation of Absolute Support When The Threshold Value =7 ..... **63**

**Figure (4.15):** An Example of a Graph Representation of The Covering Set When The Threshold Value =5 ..... **63**

**Figure (4.16):** An Example of a Graph Representation of The Relative Support When The Threshold Value =5 ..... **64**

**Figure (4.17):** The Relationship Between threshold values and features values for dataset2..... **65**

**Figure (4.18):** The Relationship Between Threshold Values and Elapse Time..... **66**

<b>Figure (4.19):</b> An Example of a Graph Representation of The Relative Support When The Threshold Value =2.....	<b>66</b>
<b>Figure (4.20):</b> An Example of a Graph Representation of The Global Probability When The Threshold Value =8.....	<b>67</b>
<b>Figure (4.21):</b> An Example of a Graph Representation of The Covering Set When The Threshold Value =2.....	<b>67</b>
<b>Figure (4.22):</b> An Example of a Graph Representation of The Local Probability When The Threshold Value =5.....	<b>67</b>
<b>Figure (4.23):</b> An Example of The Most Frequent Terms of a Document for Various Threshold Values for dataset1.....	<b>68</b>
<b>Figure (4.24):</b> An Example of The Most Frequent Terms of a Document for Various Threshold Values for Dataset2.....	<b>69</b>
<b>Figure (4.25):</b> The Calculation of The Accuracy of Two Documents When The Threshold is 2 for Relative Support of Dataset1.....	<b>70</b>
<b>Figure (4.26):</b> The Calculation of The Accuracy of Two Documents When The Threshold is 4 for Absolute Support of Dataset2.....	<b>70</b>
<b>Figure (4.27):</b> An Example of Calculating The Average Accuracy of a Dataset1 for Bigram Grammar for Different Threshold Values and Different features values.....	<b>71</b>
<b>Figure (4.28):</b> An Example of Calculating the Average Accuracy of a Dataset2 Dataset1 for Bigram Grammar for Different Threshold Values and Different features values.....	<b>72</b>
<b>Figure (4.29):</b> The Relationship Between Threshold Values and Features Values for Bigram Grammar for Dataset1.....	<b>74</b>
<b>Figure (4.30):</b> The Relationship Between Threshold Values and Elapse Time for Bigram Grammar.....	<b>75</b>
<b>Figure (4.31):</b> An Example of a Graph Representation of Relative Support When The Threshold value =3.....	<b>75</b>
<b>Figure (4.32):</b> An Example of a Graph Representation of Global Probability When The Threshold Value =3.....	<b>75</b>
<b>Figure (4.33):</b> An Example of a Graph Representation of Local Probability When The Threshold Value =6.....	<b>76</b>

<b>Figure(4.34) :</b> An Example of a Graph Representation of Covering Set When The Threshold Value =3.....	<b>76</b>
<b>Figure(4.35):</b> The Relationship Between threshold values and features values for dataset2.....	<b>78</b>
<b>Figure(4.36):</b> The Relationship Between Threshold values and Elapse Time.....	<b>79</b>
<b>Figure (4.37):</b> An Example of a Graph Representation for Absolute Support When Threshold Value=5.....	<b>79</b>
<b>Figure (4.38):</b> An Example of a Graph Representation for Relative Support When Threshold Value = 4.....	<b>79</b>
<b>Figure (4.39):</b> An Example of a Graph Representation for Covering Set When Threshold Value = 4.....	<b>80</b>
<b>Figure (4.40):</b> An Example of a Graph Representation for Local Probability When Threshold Value = 1.....	<b>80</b>

## Lists of Tables

---

<b>Table (2.1):</b> Comparison Among Text Mining Techniques. ....	<b>24</b>
<b>Table (2.2) :</b> An Example of The Levenshtein Distance and The Measure of Similarity Between Two Sentences . ....	<b>32</b>
<b>Table (3.1):</b> Paragraphs set. ....	<b>39</b>
<b>Table (3.2):</b> "5" Frequent Patterns with Covering Sets .....	<b>39</b>
<b>Table (3.3):</b> An Examples of The Levenshtein Distance and The Measure of Similarity Between Two Short Texts.....	<b>47</b>
<b>Table (4.1):</b> The Average Accuracy and Time of The Proposed System on The Dataset1 for Unigram Grammar .....	<b>60</b>
<b>Table (4.2):</b> The Average Accuracy and Time of The Proposed System on The Dataset2 For Unigram Grammar .....	<b>64</b>
<b>Table (4.3):</b> The Average Accuracy and Time of The Proposed System on The Dataset1 For Bigram Grammar.....	<b>73</b>
<b>Table (4.4):</b> The Average Accuracy and Time of The Proposed System on The Dataset2 For Bigram Grammar.....	<b>77</b>

## List of Algorithms

---

<b>Algorithm (2.1):</b> Porter Algorithm.....	<b>29</b>
<b>Algorithm (2.2):</b> The Standard Algorithm of Levenshtein Edit Distance .....	<b>30</b>
<b>Algorithm (3.1):</b> PTM Algorithm for Global Probability Comparsion .....	<b>43</b>
<b>Algorithm (3.2):</b> Deploy Pattern Algorithm .....	<b>46</b>

## List of Abbreviations

---

<b>CCAT</b>	Criteria Cognitive Aptitude Test
<b>CSV</b>	Comma-Separated Values
<b>HTML</b>	Hyper Text Markup Language
<b>IE</b>	Information Extraction
<b>IF</b>	Intermediate Form
<b>IPE</b>	Individual Pattern Evaluation
<b>IR</b>	Information Retrieval
<b>IT</b>	Information Technology
<b>JSON</b>	Java Script Object Notation
<b>KDD</b>	Knowledge Discovery in Databases
<b>LDA</b>	Levenshtein Distance Algorithm
<b>NLG</b>	Natural Language Generation
<b>NLP</b>	Natural Language Processing
<b>NLU</b>	Natural Language Understanding
<b>NOSQL</b>	Not Only Structured Query Language
<b>PAT-tree</b>	Patricia Tree
<b>PTM</b>	Pattern Taxonomy Model
<b>RCV1</b>	Reuters Corpus Volume1
<b>SQL</b>	Structured Query Language
<b>SUP<sub>a</sub></b>	Absolute Support
<b>SUP<sub>r</sub></b>	Relative Support



<b>SVM</b>	Support Vector Machine
<b>TF</b>	Term Frequency
<b>T<sub>H</sub></b>	Threshold
<b>TM</b>	Text Mining
<b>TREC</b>	Text Retrieval Conference
<b>TXT</b>	Text Document
<b>XML</b>	Extensible Markup Language

# *Chapter One*

## *General Introduction*

## **Chapter One**

### **General Introduction**

#### **1.1 introduction**

80% of all the information saved in governments, businesses, industries, and other organizations are storing in the form of text. Texts are the most popular means of formally information exchanging. There is a requirement in our modernistic life to have a tool of business intelligence that is capable of extracting information as quickly as possible from texts. [1].

Data mining term is also called Knowledge mining that is the significant extracting of inherent, formerly unknown and possibly beneficial information from data in the dataset. It has many techniques such as Decision tree classifier, Neural network, Genetic algorithm, Rule extraction [2].

Different applications like business managing and market analyzing can benefit from the utilization of extraction information from a huge data amount. The process of knowledge discovery can be represented as a non-trivial extracting of information from big databases, information which is presented in an implicit manner in the data, formerly unknown and possibly beneficial to users. Data mining is a fundamental stage in the knowledge discovery process in dataset. Based on the approaches of data mining, a considerable number of patterns are created[3].

The processes of finding the effective use and updating the patterns remain an open research problem. The developed model of knowledge discovery satisfies this issue and is capable of applying the patterns in the domain of text mining [4].

The techniques of text mining are very useful to users for finding the desired knowledge from a massive data amount. It is extremely significant to retrieve efficient and relevant information for the users. Term-based approaches were used to provide these requirements. But these approaches have several drawbacks like polysemy and synonymy. Polysemy refers to a word which has several meanings, while synonymy refers to the words which have the same meaning[5].

For overcoming these drawbacks, the phrase-based approaches were presented. But these developed approaches also had several drawbacks such as

- 1- Lower statistical properties to terms.
- 2- The occurrence frequency of the phrases is minimal compared with the keywords
- 3- A considerable number of redundancy and noisy phrases.

In the presence of these drawbacks, pattern-based approach have been proposed to get rid of the problems in the previous approaches [6].

## **1.2 Related Work**

- Ning Zhong et al. (2012) [7], proposed a technique for discovering patterns to handle the issues of low frequency and misinterpretation of text mining. The experiments were conducted on Reuters Corpus Volume1(RCV1) data collection and Text Retrieval Conference (TREC) topics. This technique also used the pattern deploying and evolving processes for finding the obtained patterns in text documents.
- Dipti S. Charjan and Mukesh A. Pund (2013) [8], proposed a technique for patterns discovery that encompasses the pattern deploying and evolving processes for improving the efficiency of utilizing and updating discovered patterns to find interesting and pertinent information. The presented technique used a document of .txt as input and applies different algorithms for getting useful patterns.
- Bharate Laxman, and D. Sujatha (2013) [9], presented a technique to discover patterns and then compute the patterns specificities to evaluate the concept of weights as per their distribution in the obtained patterns. This technique works on updating patterns which show ambiguity that is a characteristic called pattern evolution. Patterns deploying and evolving are also used. The obtained results on the prototype application expose that the obtained result is useful in the text data mining field.
- Charushila Kadu et al. (2013) [10], presented a hybrid system is working on minimizing the dimension dataset and similarity constraints. A feature-based analysis is used to reduce the dimensional of the massive datasets. This system uses the evaluation of feature for reducing the high dimensionality of

text vector, and then identifies the term frequency, after that, these frequencies are weighted via utilizing the inverse document frequency technique. The documents weight is utilized in clustering. The system combines both the semantic and similarity constraints and combined the Individual Pattern Evaluation PTM (IPE).

- V. Aswini and S. K. Lavanya (2014) [11], presented a technique that utilized the pattern taxonomy model for discovering the patterns from a large data amount and seeking for important patterns. This technique includes the pattern evolving and deploying processes for improving the efficiency of utilizing and updating derived patterns to find important and relevant information. This technique get 62% of precision and 82% of recall as a result.
- Shivani D Gupta and B.P.Vasgi (2015) [12], the designed system that concentrates on the performing of a specific manner to deriving the pattern, in addition, to utilize them for retrieving the relevant text. The pattern deploying and evolving are two processes that are utilized for developing the efficiency of the obtained patterns. Then, the obtained patterns are utilized to search for important and relevant information. to develop the efficiency of utilizing and updating obtained patterns regarding the view of users, the testing on RCV1 data collection fulfills the users needed data from a document.
- Vaishali Pansare (2016) [13], proposed an approach that uses the association rule mining based on the AprioriAll algorithm for discovering frequent patterns in text documents. The input can take different formats of a text file. It uses Hash Tree structure to store candidate itemsets, and find frequent

patterns and itemsets within less time. This proposed approach finds a solution to the misinterpretation and low-frequency issue. The obtained results have demonstrated that the time of execution needed by the algorithm is minimal than the time needed by the other compared algorithms.

- S. R. Lomate (2016) [14], The proposed system introduced a technique for pattern discovery that consists of the pattern deploying and evolving processes, for improving the efficiency of utilizing and updating obtained patterns for finding the important and relevant information. The fundamental prototype of Pattern Taxonomy Model (PTM) using Advanced Apriori Algorithm which focuses on the problem of getting beneficial frequent patterns from the documents. This technique used substantial tests on RCV1 data collection shows that the obtained result provides a hopeful performance. A comparison between the Apriori algorithm and Advanced Apriori Algorithm is done for finding frequent patterns in pattern mining and a show advanced Apriori has better computation time for frequent patterns. Reduce computing time and rule count for frequent pattern generation.
- H. M. Mahedi Hasan et al. (2018) [15], presented a technique for key terms extraction that is depending on semantic relation. This approach is working on extracting a specified number of keywords from documents for identifying the main text content. The data set is collected from various sources like newspapers, books, journals, etcetera. To extract these keywords, several machine learning and statistical techniques have been utilized such as Logistic regression, support vector machine, word co-occurrences, and PAT-tree. This technique presented an approach of modified semantic relation with an accuracy of 77.6% precision and 84.3% recall to chosen data sets.

### **1.3 The Problem Statement**

Lots of researches in the field of text mining have concentrated on improving effective mining algorithms to discover various patterns from larger text documents. Hence, finding interesting and useful patterns remains an open issue. Within this field, the techniques of data mining can be utilized for finding a variety of text patterns, like frequent itemsets, and sequential patterns. This thesis deals with three problems which are:

- 1- Getting an effective deal with the massive amount of text document.
- 2- Discovering the useful patterns from digital text documents, and utilizing these mined patterns to develop the performance of the system.
- 3- How to improve and evaluate the efficiency of the discovered pattern from text documents.

### **1.4 Aim of the Thesis**

The aim of this thesis is to:

- 1- Extract interesting patterns from text document while these patterns contain accurate information about the document.
- 2- Reduce the time required for finding the patterns which describe the content of the document.
- 3- Increase the accuracy of information extracted from the text by using data mining techniques such as:
  - a- Summarization.
  - b- information extraction.
- 4- Proof that the discovery of a pattern is the best solution for text mining.



## **1.5 Outline of the Thesis**

The other chapters in this thesis are as follows:

### **Chapter Two: Theoretical Background**

This chapter gives the background and review of text mining and its techniques: (classification, clustering, retrieval information, extracting information, and summarization), the stemming, N-gram and Levenshtein algorithm

### **Chapter Three: The Proposed System**

This chapter describes the proposed pattern discovery system with its design and implementation.

### **Chapter Four: Experiential Results and Tests**

This chapter explains the results and evaluation that have been getting from the proposed system.

### **Chapter Five: Conclusions and Suggestions for Future Works**

This chapter presents the conclusions of this work. Furthermore, it justify provides suggestions for future work.