

# **Masters Theses Preparation and Submission Guidelines**

*Columbus State University School of Computer Science*

## **STATEMENT ON PLAGIARISM**

Plagiarism is a form of falsely presenting someone else's words or ideas as one's own, in whole or in part, either explicitly or implicitly, either word-for-word or by paraphrasing. When students wish to include in their own work a passage from any source (print, electronic, or other), they may ethically do so by 1) quoting verbatim, or 2) paraphrasing the source, then acknowledging the source with footnotes, endnotes or parenthetical notes. Plagiarism can also include submitting someone else's work as one's own.

Columbus State University takes plagiarism very seriously and will not tolerate it.

**Last Revised: November, 2011**

## **TABLE OF CONTENTS**

<b>CHECKLIST FOR SUBMISSION OF THESES</b>	<b>4</b>
<b>GENERAL INFORMATION FOR FILING OF THESES</b>	<b>5</b>
INTRODUCTION	5
REQUIREMENTS FOR ALL THESES	5
Language	5
Final Inspection by the School of Computer Science	5
Copyrighting	5
Binding Fees and Binding Extra Copies of the Thesis	6
<b>PRODUCING THE THESIS</b>	<b>8</b>
GENERAL	8
Typists	8
Paper	8
Typing or Printing the Thesis	8
FORMATTING	8
Character Size	9
Fonts	9
Printers	9
Symbols	9
Duplicating the Thesis	9
Style Manuals	9
Justification	9
Margins	10
PAGINATION	10
Preliminary Pages	10
Text	10
INTRODUCTION	11
FOOTNOTES, CHAPTER NOTES, OR END NOTES	11

ILLUSTRATIONS	11
Captions and Legends	12
Facing Caption Pages	12
Tables	12
Figures	12
Color	12
Oversize Illustrations	12
Reduction	13
Folding	13
Pockets	13
BIBLIOGRAPHY OR LIST OF REFERENCES	13
APPENDICES	13
<b>ARRANGEMENT OF PAGES</b>	<b>14</b>
<b>PAGE FORMAT</b>	<b>15</b>
TITLE PAGE	15
Unit Awarding the Degree	15
Title	15
Author's Name	15
Degree Title	15
Date of Degree Conferral	15
Copyright	15
Number of Copies of the Title Page	16
PRELIMINARY PAGES	16
Pagination	16
SIGNATORY PAGE	16
ABSTRACT	16
TABLE OF CONTENTS	16
Preliminary Pages	16
Appendices	16
Pocket Materials	17
LIST OF FIGURES, LIST OF TABLES, ETC.	17
Page Arrangement and Pagination	17
Captions	17
Format	17
ACKNOWLEDGEMENTS	17
Pagination	17
<b>APPENDIX - SAMPLE PAGES</b>	<b>18</b>

## CHECKLIST FOR SUBMISSION OF THESES

- Three identical copies are available for binding.
- All pages of the thesis have margins of 1.5 inches on the binding side and 1 inch on the other three sides.
- The correct degree title and year of award appear on the title page.
- The student's name appears consistently, first name first, with the first and last names conforming exactly to the Columbus State University records.
- The original signatures of the members of the relevant Thesis Committee appear on the Signatory Page submitted.
- The Signatory Page includes the student's original signature.
- Each copy of the thesis is set up with proper preliminary page arrangement and pagination.
- Pagination has been checked throughout. Page numbers in the body of the thesis must be consecutive, including references, bibliography, appendices, etc. Theses that are missing page numbers or have duplicate page numbers will not be accepted. Only whole numbers are acceptable for page numbers.
- Every page is clear and readable. Copies should be checked after duplication. Poor copies are not acceptable.
- The binding fee for each copy has been paid to the Periodicals Assistant and a CSU Binding File Slip has been filled out.
- Each copy of the thesis is presented in a large manila envelope with a copy of the title page taped securely to the front (these title pages may be photocopies).

Further clarifications may be obtained from the Chair of the Graduate Program Committee by calling (706) 565-2410, sending an e-mail to [cs@columbusstate.edu](mailto:cs@columbusstate.edu), or visiting the School of Computer Science Office, CCT 453 Center for Commerce and Technology, during normal business hours, Monday through Friday.

## **GENERAL INFORMATION FOR FILING OF THESES**

### **INTRODUCTION**

The requirements described in this Thesis Preparation and Submission Guidelines document have been established so that theses are presented in a form suitable for library cataloging and shelving. The thesis takes its place in the library as a product of original thinking and research, and it is, therefore, designed to appear in a form comparable to a published work.

It is the student's responsibility to read and follow the requirements presented here and to submit documents of highest quality. The final copies will not be accepted with corrections, insufficient margins, or if they are of such poor quality that copies cannot be made.

Because these preparation guidelines may be revised on occasion, students should not use library or departmental copies of previous Columbus State University theses as sole examples of proper format.

The thesis advisor in the School of Computer Science is available for questions and should be consulted before the final preparation and presentation of the thesis. It is strongly suggested that a draft of the entire thesis be reviewed by the thesis advisor well before the final copies are made.

### **REQUIREMENTS FOR ALL THESES**

#### **Language**

The thesis must be written in English.

#### **Final Inspection by the School of Computer Science**

The thesis must be presented in person at the office of the School of Computer Science. The student may designate someone else to bring the thesis to the School. The Chair of the Graduate Program Committee and the Chair of the School of Computer Science will inspect the thesis and determine whether its final form is satisfactory. If the stated requirements are not met, the thesis will not be accepted by the School of Computer Science until the necessary corrections have been made. Thus, it is advisable to have the thesis reviewed by the thesis advisor well before submitting the final copies.

#### **Copyrighting**

It is recommended that candidates apply for a copyright on their thesis. If they choose to do so, a copyright page must be inserted in each copy of the thesis.

## **Binding Fees and Binding Extra Copies of the Thesis**

The School of Computer Science has arranged for the binding of theses through the CSU library. After binding the three required copies, two copies are placed in the library and one is kept in the office of the School of Computer Science. The [library's policy for the binding of theses](#) is as follows:

1. Theses should be turned in for binding to the Cataloging Department in the Simon Schwob Memorial Library, room 114 (Darlene Cooper, 565-3557 or Eric Van Bibber, 562-1491).
2. Theses are accepted Monday through Friday between the hours of 8:00am and 4:30pm.
3. Three copies must be printed on 100% cotton bond paper. Two of these copies are retained by the library; the other is a departmental copy.
4. If the theses include CD's, two copies of the CD must be submitted. The CD's should be labeled with the student's name and the title of the thesis. The Library will place self-adhesive CD pockets in the back of the two library copies of the thesis. The student is responsible for putting CD pockets in the other copies.
5. Each copy submitted for binding must be in a separate manila envelope. Each envelope should be marked with the student's name, degree earned, and semester and year of graduation. The three envelopes containing the library copies and the departmental copy must be clearly marked as such to differentiate them from personal copies. (See details on [Thesis Binding Checklist](#) (PDF)).
6. The library considers all theses presented for binding as being in their final form. All editing and collating must be completed prior to submitting the material to the library. No material will be returned for revision once it has been accepted for binding.
7. The library assumes no responsibility for, and will not correct, misspellings or collation errors (missing pages, misnumbered pages, etc.).
8. If there are separate illustrations that accompany the thesis text, they must be glued in by the student. The library will provide special glue for this procedure.
9. All copies to be bound must be paid for in advance and turned in together.
10. The student will pay for the binding of all copies (the three required copies and any personal copies that he/she desires). Cost of each copy will be \$12.50 (effective August 2010). Checks should be made payable to Columbus State University Library.
11. The student will complete a CSU Binding File Slip at the time copies are turned in and paid for. This slip will serve as the student's receipt. ([Printable Binding Slip](#) (PDF))
12. Price for each copy includes gold lettering as follows:
  - o author's last name and year on spine
  - o full author and title on front cover
13. Theses will be bound in the following colors:
  - o blue - Public Administration and Music
  - o green - Computer Science
  - o red - Environmental Science
  - o gold - Honors
14. The Cataloging Department will inform the student of the estimated date of return for the bound theses. Normally, bound theses will be ready approximately 4-6 weeks after drop-off at the library. However, the bindery's pick-up schedule may affect turnaround time.
15. Thesis authors are responsible for picking up any personal copies as well as departmental copies (if applicable). Thesis authors moving out of the area immediately after graduation should make arrangements to have their personal and departmental copies picked up by

another person. Please provide local contact information on this other person on the Binding Slip. The Cataloging Department will notify the author, or his designee, when a thesis is ready for pickup. Theses may be picked up Monday through Friday between the hours of 8:00am and 4:30pm.

It is the student's responsibility to determine whether additional copies of the thesis should be made. All students are advised to retain a copy of the thesis for their own use. Inquiries regarding binding of personal copies should be directed to the Periodicals Assistant in the Library. It is considered a professional courtesy to provide the thesis advisor and, at the student's discretion, other members of the thesis committee with a copy of the thesis.

## **PRODUCING THE THESIS**

### **GENERAL**

#### **Typists**

Manuscripts may either be prepared by students themselves or be done for them by a professional. The School of Computer Science does not recommend individual typists. It is advisable to make early arrangements since it may be difficult to obtain these services during the latter part of an academic semester. Students should ensure that the typist has a current copy of this manual.

#### **Paper**

It is essential for maximum strength, durability, and permanence that the three official copies of the thesis be submitted on paper that is: no less than 20 pound, 8.5" by 11", and 100% cotton bond. Paper of this quality will also have the required opacity to prevent type from the following page from showing through when photocopied. It may be possible to purchase the appropriate paper at cost through the CSU Print Shop.

#### **Typing or Printing the Thesis**

Theses must be typed or printed, single-sided, using black characters on white paper. The text should be separated into main divisions of chapters or major sections (i.e., Introduction, Methods, Results, Discussion, etc.) Each chapter or major section must begin on a new page with the chapter/section heading at the top of the page. Do not start sub-sections within chapters or their equivalent on a new page; they must follow one after the other with no page breaks.

The text must be double-spaced. Footnotes, tables and quotations may be single-spaced, and the Bibliography or List of References may be single-spaced within entries and 1.5 or double-spaced between entries.

### **FORMATTING**

All requirements set forward in this manual must be met when producing a word-processed thesis. The School of Computer Science requirements will not be changed to meet the limitation of the word-processing program used. Specific rules regarding typesetting are as follows:

#### **Character Size**

The use of a font that has a size of 12 point is recommended. Subscripts or superscripts must not be smaller than 9 point. Theses using over-sized or small font sizes will not be accepted.

## Fonts

The same typeface and size must be used throughout the text. However, approval may be given for illustrations to be in a different typeface.

Use a standard, clearly legible font. Exotic fonts will not be accepted. Bold, italics, and underlines are acceptable, but only if they remain in the same character size as the rest of the text. If there are any questions regarding a particular font, an original example may be brought to the Chair of the School of Computer Science Graduate Program Committee.

## Printers

It is recommended that the final copy be produced by a high quality laser printer. Most laser printers will produce an acceptable thesis. In case of any questions, a sample may be submitted for prior approval.

Many bubble/ink jet printers will produce an acceptable thesis. If this type of printer is used, an original printed sample should be brought to the Chair of the School of Computer Science Graduate Program Committee for approval.

The final copies must be neatly executed and correct in spelling, punctuation, and format. The print must be of the same intensity throughout. Corrections on the submitted copies (i.e., whiteout, correction tape, interlineations, etc.) will not be accepted.

## Symbols

Certain symbols that are otherwise unavailable may be written neatly by hand with black ink. However, every attempt should be made to obtain a dry-transfer version or use international, scientific, or mathematical fonts in the word-processing package used.

## Duplicating the Thesis

Only black print copies on white paper (of the quality previously described) are acceptable; copies that are too dark or too light will not be accepted. Computer generated copies are also acceptable with the same criteria.

## Style Manuals

General questions of appearance, arrangement of pages, and bindability are answered in this manual. Other style manuals may be referred to, but, if they differ, this one will take precedence over the others.

## Justification

The text of the thesis will be presented with full justification on the prescribed margins.

## Margins

The margin is defined as the blank space surrounding printed matter. The mechanics of binding require that theses have at least a 1.5-inch margin on the binding side of the page and a 1-inch margin on the remaining three sides. No margin may be greater than 1.5 inches. Please note that the page number is included in the text area and must not violate the margins. The margin above the page number must be at least 1 inch. Insufficient margins seriously affect the readability and appearance of the thesis. Theses that do not meet these requirements will not be accepted.

Margin requirements apply to all materials to be bound within the thesis, including appendices.

In a single-sided presentation using facing caption pages for illustrations, the margins on the facing pages are reversed (i.e., the right margin is 1.5 inches, and the top, bottom, and left margins are 1 inch.)

## PAGINATION

**Please note: two separate numbering systems are used in formatting the thesis:**

### Preliminary Pages

The Title Page is page one, but is not numbered. Small roman numerals (i.e., ii, iii, iv, etc.) are used for all other preliminary pages, including subsequent pages of the Signatory Page, Abstract, Table of Contents, List of Figures, List of Tables, Acknowledgments, Dedication, etc. The numbers must appear in the upper right-hand corner of the page at least 1 inch from the edge of the paper to allow for the standard margin. A Preface is optional but if it is included, it must be listed in the Table of Contents.

### Text

The text is numbered with Arabic numerals, without embellishment or punctuation (i.e., initials, hyphens, running heads or footers, lines across the page, etc.,) centered at the top of the page or placed in the upper right-hand corner so that they are at least 1 inch from the top and right edges of the paper. Only whole numerals are acceptable and must be in the same typeface and location throughout. Pages numbered 1a, 1b, etc., will not be accepted.

Every page must have a page number. However, the number will not appear on the following pages:

- The first page of text (the second page is page 2)
- The first page of each Chapter
- The first page of the Bibliography or References Cited
- The first page of each Appendix.

Minor sections within chapters are not considered title pages and must carry a page number.

## INTRODUCTION

If an Introduction to the thesis is included, it is numbered with the text. There is only one introduction to a thesis. Introductions to chapters must be titled as such.

## FOOTNOTES, CHAPTER NOTES, OR END NOTES

Notes contain additional textual material or references to specific citations in the text and may be presented in one of three ways:

- Footnotes at the bottom of each page.
- Notes at the end of each chapter, beginning on a new page and titled “Notes to Chapter \_.” A page number appears on every page, including the first page. Notes may not be titled “References.”
- End Notes at the end of the text and placed before the Bibliography or List of References. The page number does not appear on the first page of End Notes.

When citing literature, as much information should be given on the page where the citation is made as is consistent with publication practice in the relevant field of research. Only one of the above note methods must be used. Footnotes, Chapter Notes, or End Notes do not take the place of a Bibliography or List of References.

## ILLUSTRATIONS

For the purpose of this guidelines document, the term *illustrations* refers to informational material that illustrates and enhances the text. Figures, images, and tables are all examples of illustrations and are either inserted throughout the text, appearing as soon as possible after the references to them have been made, or grouped at the end of each chapter. The method chosen for inserting illustrations must be used consistently.

All illustrations must conform to the margin requirements. Please consult a thesis advisor for help with an oversize illustration. If an illustration continues for more than one page, subsequent pages are numbered consecutively with the rest of the text. The illustration number is followed by the word *continued* placed appropriately. (EXAMPLE: Table 2 (continued)). All illustrations, including those appearing in appendices, must be numbered, titled, and listed in the appropriate preliminary pages. They may be numbered consecutively throughout the text or within each chapter or appendix. If they are numbered within each chapter or section, each of them must be identified with the chapter or section number. For example: Figure 1.1\_(Title), Table II.2\_(Title). Any illustrations taken from previously published material and presented as appendices, may retain the original identification and should not be listed in the preliminary pages.

## Captions and Legends

A caption consists of the illustration number (e.g., Figure 1:) and its title. Captions may be single spaced and must all be in the same typeface. If illustrations are reduced, the caption and page number must remain the same size as the text. Captions must not appear on mounted material. If illustrations appear horizontally (i.e., landscape format) in the text, the top must be on the left margin, and the caption, whether on the same or a facing page, must also appear horizontally. The page number remains vertical (i.e., portrait format), consistent with the rest of the text. Table captions appear above the table, while all other illustrations are captioned below, except when a facing page is used.

## Facing Caption Pages

In single-sided presentations, a facing page may be used only to carry a caption for an illustration and only one page number is assigned. The caption appears on the left (facing) page and the illustration on the right. The facing page is bound on the right; therefore, the right margin must be 1.5 inches. Because both pages are considered as one, only one page number is assigned. This number appears on the facing page either centered or in the upper left corner, whichever corresponds to the rest of the text. Please note: In single-sided presentation, the facing page may not be the back of the preceding page.

## Tables

Tables contain information placed in a columnar arrangement and are the only illustrations numbered and captioned above.

## Figures

Figures may include photographs (original or photocopied), charts, diagrams, graphs, and drawings. If original photographs are used, they must be included in all official copies of the thesis.

They must all be listed in the preliminary pages in a List of Figures. Figure titles in the List of Figures may be abbreviated, if necessary. Figure numbers and captions appear below the figure. (See example below.)

## Color

Color figures may be included, provided no loss of relevant information would result should the page containing a color figure need to be printed out on a B&W printer. Color photocopy is acceptable.

## Oversize Illustrations

All illustrations must conform to margin requirements. If these materials are larger than 8.5 x 11 inches, there are three alternatives: reduction, folding, or a pocket.

## **Reduction**

This is the preferred method of handling oversize materials. However, the reduced material must be clearly legible and copyable. Please note: page numbers and captions must remain full-sized.

## **Folding**

If it is not possible to reduce the material, an oversize page (11 x 17) may be bound into the thesis. This oversize page can be trimmed down, maintaining appropriate margins, to 11 x 16 for folding. Please do not fold these pages without consulting a thesis advisor. If it is not done correctly, they may be damaged in the binding process.

Correct margins must be maintained on the oversize page, and page numbers are placed on the printed side of the paper to correspond with pagination in the rest of the text.

## **Pockets**

If neither of the above methods is feasible, a request may be made that the bindery provide a pocket in the back binding of the thesis to place the oversize materials in. Pocket material must be folded to within 7 x 10 inches. Although no page number is required, pocket materials must be listed in the Table of Contents. This method should be used only in exceptional circumstances, because pocket materials are frequently lost from the bound copies of the thesis.

## **BIBLIOGRAPHY OR LIST OF REFERENCES**

A Bibliography or List of References is a comprehensive list of all sources used by the author and is required at the end of each thesis, appearing immediately after the text. The School of Computer Science will accept any recognized format but it must be used consistently throughout.

## **APPENDICES**

Appendices may consist of material that is related to, but not appropriate for, inclusion in the main body of the text. They appear after the Bibliography or List of References and must be titled. They are listed, along with their titles, in the Table of Contents, not on a separate list of appendices. Pagination is continuous with the text, and the first page of each appendix is treated like the first page of a chapter in the text (i.e., counted, but not numbered).

Appendix material need not be retyped unless it fails to meet School of Computer Science requirements for margins and readability. Material may be reduced as long as it remains legible. However, appendix titles and page numbers must remain full-size; it is recommended that they be added to the page after reduction. Any illustrations appearing in the appendices which are not from previously published material must be captioned and placed in the appropriate list. (See section on illustrations)

## **ARRANGEMENT OF PAGES**

Each copy of the master's thesis submitted to the School of Computer Science must include the following in the order listed: (Sample pages are provided in the following section.)

- Title/Copyright page (See sample)
  - o Title Page, which includes the correct degree title, the correct year the degree is awarded, and the first and last names of the author conforming exactly to University records. (See sample.)
- Signatory Page with all original signatures. (See sample.)
- Abstract
- Table of Contents. (See sample.)
- List of Figures, List of Tables, etc., if the thesis contains such illustrations, each starting on a separate page. (See sample.)
- Any optional preliminary pages, such as a Glossary, List of Abbreviations, Preface, etc., will appear next.
- Acknowledgments.
- Dedication (optional) in English (may be accompanied by a translation in another language).
- Text of the thesis.
- Bibliography or List of References.
- Appendices (if included).
- Pocket material (if included).

## PAGE FORMAT

### TITLE PAGE

All text appearing on the Title Page must be centered on the margins.

#### Unit Awarding the Degree

The name of the University, the name of the College and the name of the Graduate Unit from which the degree will be received must be put at the top of the title page.

#### Title

The Columbus State University transcript will allow a total of two hundred characters, including spaces, in the title. Formulas, symbols, superscripts, subscripts, Greek letters, and chemical names must be expressed in words. If these requirements present a problem, the School of Computer Science Graduate Program Committee Chair should be contacted. The title should be single-spaced and in sentence format but with all important words capitalized.

#### Author's Name

The author's name is preceded by the following statement: "A Thesis in <degree program> by".

The name must appear consistently, first name first, with the first and last names conforming exactly to Columbus State University records. PLEASE NOTE: NO PROFESSIONAL OR OTHER TITLES OR INITIALS MAY ACCOMPANY THE THESIS AUTHOR'S NAME.

#### Degree Title

The degree title is presented as follows:

Submitted in Partial Fulfillment  
of the Requirements

**for the Degree of** Master of Science

#### Date of Degree Conferral

The month and year of conferral of the degree must appear on the title page.

#### Copyright

The copyright symbol followed by the year and the author's name.

#### Number of Copies of the Title Page

A total of six title pages are required for submission of the master's thesis. Three must be original copies. These three are placed with the copies of the thesis inside the manila envelopes. Three other title pages are taped securely to the front of the envelope.

## **PRELIMINARY PAGES**

Preliminary pages include the Signatory Page, Abstract, Table of Contents, any lists (List of Figures, List of Tables), Preface, Acknowledgments, and Dedication, if applicable. Each will appear on a separate page.

### **Pagination**

Preliminary pages are numbered with lower-case Roman numerals in the upper right-hand corner of the page at least 1 inch from the edge of the paper. The title page is page one (i) but is not numbered. The Signatory Page is page 2 (ii), the abstract is page 3 (iii), etc.

## **SIGNATORY PAGE**

Each copy of the thesis or dissertation must include a Signatory Page prepared according to the appropriate sample appearing here. It should have the original signature of the author and the original signatures of the thesis committee members on each copy along with the date of each signature.

## **ABSTRACT**

An abstract is a single paragraph in which the essence of the thesis work is summarized - why the work was done, what problem was addressed, how the problem was approached, what major results were found, what major conclusions were drawn. It would be unusual for an abstract to be longer than two pages.

## **TABLE OF CONTENTS**

Each thesis must have only one Table of Contents listing all of the chapters or main sections and their appropriate page numbers. The listing of subdivisions within chapters is optional. Only major divisions, whether called chapters or not, will start on a new page; divisions within chapters must be contiguous with the previous text. The numbering and wording of titles and headings in the Table of Contents must be consistent with the text.

### **Preliminary Pages**

All preliminary pages must be included in the Table of Contents except the Title Page and Signatory Page.

### **Appendices**

Each appendix must be identified separately, including a title, and must be listed in the Table of Contents, NOT on a separate List of Appendices. Appendices are paginated consecutively with the text.

### **Pocket Materials**

Pocket materials to be included in the inside back cover must be listed after the appendices.

## **LIST OF FIGURES, LIST OF TABLES ETC.**

If the thesis includes any figures, tables, etc., they must be identified in a List of Figures, List of Tables, etc., in the preliminary pages.

### **Page Arrangement and Pagination**

Each List of Figures, List of Tables, or List of Illustrations included in the preliminary pages must appear on a separate page and must be numbered in small Roman numerals centered at the bottom of the page, at least one inch from the edge of the paper, in the order in which they are to be bound.

### **Captions**

All illustrations must be numbered and titled. Captions must appear on the appropriate list in the preliminary pages. These may be abbreviated titles if the full title is too long for inclusion.

### **Format**

The sample List of Figures shows the format to be used in preparing any additional lists to be included.

## **ACKNOWLEDGEMENTS**

Acknowledgments recognize the persons to whom the student is indebted for guidance and assistance and those to whom you are grateful for any special or non-routine aid. Graduate Faculty members serve on thesis committees as part of their regular work and do not require formal acknowledgment. However, in most cases the help given far exceeds any requirement and should, as a matter of courtesy, be recognized. Acknowledgments should be expressed simply and tactfully. They should be 1.5 or double-spaced and conform to margin requirements.

### **Pagination**

Acknowledgments are numbered consecutively with the other preliminary pages with small Roman numerals centered at the bottom of the page. Please note: Acknowledgments and/or Dedication are not listed in the Table of Contents.

## **APPENDIX - SAMPLE PAGES**

This appendix contains samples of thesis pages as listed below:

- Title/Copyright Page
- Signatory Page
- Table of Contents (see the TOC for this document)
- List of Figures (the List of Tables, etc. will have the same basic format)

Columbus State University  
D. Abbott Turner College of Business and Computer Science  
The Graduate Program in Applied Computer Science

**Statistical Tools for  
Linking Engine-generated Malware to its Engine**

A Thesis in  
Applied Computer Science  
by  
Edna Chelangat Milgo

Submitted in Partial Fulfillment  
of the Requirements  
for the Degree of

Master of Science

December 2009

©2009 by Edna Chelangat Milgo

I have submitted this thesis in partial fulfillment of the requirements for the degree of Master of Science

---

Date

---

Edna Chelangat Milgo

We approve the thesis of Edna Chelangat Milgo as presented here.

---

Date

---

Mohamed R. Chouchane Assistant Professor  
of Computer Science, Thesis Advisor

---

Date

---

Edward L. Bosworth, Associate Professor of  
Computer Science

---

Date

---

Jianhua Yang, Associate Professor of  
Computer Science

---

Date

---

Lei Li, Associate Professor of Computer  
Information Systems Management

## TABLE OF CONTENTS

ABSTRACT.....	iii
LIST OF FIGURES .....	vii
Chapter 1: Introduction .....	1
1.1    A Brief Look at Malware .....	1
1.1.1    Classification.....	1
1.1.2    Current State of Threat .....	4
1.1.3    Engine-generated Malware.....	6
1.1.4    Malware Detection .....	7
1.2 Challenges .....	8
1.3 Our Contributions.....	9
1.4 Impact of Our Contributions .....	10
1.5 Organization of this Thesis .....	11
Chapter 2: The Detection Problem of Engine-generated Malware.....	12
2.1 Existing Detection Methods.....	12
2.1.1    Generic Detection .....	12
2.1.2    Normalization .....	14
2.1.3    Engine Signatures .....	16
2.2 IFVs and NFVs as Feature Vectors.....	18
Chapter 3: Using IFVs to Detect Engine-generated Malware .....	20
3.1 Motivation .....	20
3.2 Approach .....	21
3.2.1    Evaluation.....	23

3.2.2 Discussion.....	25
Chapter 4: Using NFVs to Detect Engine-generated Malware.....	26
4.1 Motivation .....	26
4.2 Approach .....	26
4.2.1 Evaluation.....	30
4.2.2 Discussion.....	31
Chapter 5: Conclusions and Directions for Further Work .....	34
5.1 Research Outcomes .....	34
5.2 Directions for Future Work.....	35
Bibliography .....	36

## **LIST OF FIGURES**

Figure 1.1: Code Obfuscation .....	2
Figure 1.2: Morphing Engine.....	3
Figure 1.3: Malware Growth per Year.....	4
Figure 1.4 : The Next Generation Virus Creation Kit. ....	6
Figure 1.5: Morphing Transformations.....	9
Figure 2.1: Malware Analysis Pipeline.....	13
Figure 2.2: Normalization.....	16
Figure 2.3: Engine Signature .....	17
Figure 3.1: IFV Construction.....	21
Figure 3.2: IFV Classifier for RI=4 .....	24
Figure 3.3 : IFV Classifier for RI=5 .....	24
Figure 4.1: Construction of NFV.....	27
Figure 4.2: Engine Signatures as a Decision Procedure .....	29
Figure 4.3 : RI Selection Strategy for NFV Classification.....	31
Figure 4.4: RB Selection Strategy for NFV Classification.....	32