Thesis and Dissertation Style Overview and Guide

Computer Science Department

Introduction

The purpose of the overview section is to give students a general outline of the departmental stylistic review process for theses (Plan A) and dissertations. This document in no way covers the overall process of writing a thesis, neither does it cover procedures and steps involved in setting up a defense nor other matters involved in the completion process.

Rationale for Stylistic Review

In addition to having the content itself of your thesis or dissertation approved by committee, you must demonstrate that you can produce a document that is ready to be submitted for publication. Thus, the flow and readability of your writing must be on par with that found in an academic journal, and you must demonstrate that you can adhere to stylistic guidelines.

Review Procedure

Departmental Stylistic Review

While the timing of the steps involved in having the readability and stylistic elements of your thesis approved largely depends on your major professor's preferences, there are some general guidelines to keep in mind.

The departmental thesis/dissertation coordinator (Myra Cook) must approve the readability and style of your thesis. Further, per the CS department, you must pay Myra $18/ hour for this service. Depending on the size of your thesis/dissertation and the shape it is in, this process usually takes her 3-10 hours. She typically takes three days to review theses and four days to review dissertations. If she has other documents ahead of yours in the review process and consequently will take longer to review your document, she will let you know.

Your major professor might ask you to have her review the document early in the preparation process – weeks before you defend, or you might not submit the document to Myra for review until after your defense. This is a matter students must work out with their major professors. Usually, however, having Myra review the document at least a week before your defense is the most efficient way of doing things. Typically, Myra takes one very thorough look at a document and returns it to the student for changes. However, occasionally Myra will ask to see the document a second time. Of course, students' questions to Myra regarding her changes and suggestions are welcome, and there is no extra charge for having questions answered.

Also, don't format your thesis or dissertation while sitting in a vacuum. As you put your document together, ask Myra questions. She is more than happy to guide you through the process. And certainly there is no charge for having your questions answered.

Graduate School Stylistic Review

After you have successfully defended and your committee agrees to the contents of your thesis/dissertation, your entire committee must sign the cover page of the thesis/dissertation. The ideal time to have your committee sign is at the end of the defense, so walking into your defense with a document that is "ready to go" is something to work toward. After your defense, Myra and your major professor must also sign a Thesis/Dissertation Format and Style form. This form can be found in your defense packet from the Grad School, on page 5 of the *USU Publication Guide for Graduate Students* (henceforth called the *Pub Guide* in this document and found at the following link http://www.usu.edu/graduateschool/) or you can obtain one from Myra. Myra fills out the form before it is signed. You submit a hard copy of your thesis with a signed cover page and the Thesis/Dissertation Format and Style form to the grad school for review.

The Graduate School gives students the option of scheduling a day to have their thesis/dissertation read. This can be done once you have successfully defended. Your defense packet contains the necessary form. Your major professor must sign this form before you submit it to the Grad School. Depending on when in the semester you defend, reserving a date for your thesis to be read can be very useful. Most students defend at the end of the semester, so because of the number of documents to be read and approved, the approval process can be very time-consuming. If you defend at the end of the semester and you do not submit your thesis to the Grad School on the day you defend, it is in your best interest to submit this Reading of Thesis/Dissertation Reservation form.

Steven Beck, Assistant Dean of Graduate Studies, conducts thesis and dissertation workshops during the school year in the Graduate School conference room. In each session, he provides a thorough survey of USU format requirements and guidelines, discusses journal and other departmental format options, and addresses student concerns and problems regarding thesis/dissertation preparation. It is preferable, though not essential, for graduate students who attend to have begun writing and to have selected a department-approved format and style (journal or style manual). Students should bring copies of completed portions of their papers as well as the style guides they are using. Sessions meet at 3:00 p.m. and last approximately 2 hours. Interested graduate students may register at the School of Graduate Studies, **Main 164**, or by phoning **797-1189**.

Format/Style Guides

Computer Science graduate students (Master's Plan A and PhD students) are answerable to two different format/style guides.

USU Publication Guide for Graduate Students

The first of these is the USU Publication Guide for Graduate Students (the *Pub Guide*). You can buy a copy at the USU Bookstore or access it at the School of Graduate Studies' website. http://www.usu.edu/graduateschool/ The *Pub Guide* governs most formatting aspects of your thesis. **Thus, this will serve as your primary format guide**.

Departmental Style Guide

Individual departments have jurisdiction over stylistic elements not covered in the *Pub Guide*. These include how references are handled, some aspects of subheadings, and presentation of table headings and figure captions. Per the *Pub Guide*, handling of subheadings can also fall in the department's jurisdiction when adequate guidelines are provided.

Generally speaking, students in the CS department have two options for their departmental style guide.

The first of these options is LaTeX, an open software. There are some drawbacks to using LaTeX. Your chairman, committee, and the departmental thesis/dissertation coordinator (myra.cook@usu.edu) aren't able to make electronic corrections. So, you need to make sure your chairman and committee find this acceptable. Frequently, students who use this option end up reworking the software quite a bit in order to get the proper results. Students are answerable to the Graduate School's formatting guidelines and the approved LaTeX format, regardless of the results they get using LaTeX. **Again, a word of caution**: If while formatting your thesis or dissertation using LaTeX, you have difficulty meeting the formatting requirements, you are still responsible to the approved format – regardless of the outcome you get from LaTeX. For a LaTeX template that has been approved by the Graduate School for computer science majors, contact Myra Cook myra.cook@usu.edu , (435) 797-8019, Main 424.

The second of these options is Communications of the ACM (ACM) style. The ACM does not have a style guide per se, so the guidelines set forth below are an extrapolation – reverse engineering – of ACM stylistic elements. Because ACM, the CS department's style source, does not provide subheadings adequate guidelines, the CS department uses the subheading guidelines given in the *Pub Guide*. The sections below provide ACM guidelines for handling references, tables, figures, and equations. Also, you may contact Myra for sample theses, and additional information regarding stylistic requirements.

In addition to the two departmental style options listed above, from time to time, students use another style. For example, if one or more chapters of your thesis or dissertation has been presented at a conference or published elsewhere, you may want to format your thesis or dissertation in what is called a multiple-paper format. For specific information on this option, see page 4 of the *Pub Guide*. Another instance in which students may opt for another style is when their major professor specifically requests that they do so. In such cases, you must provide the Graduate School with a published example of the style you are using. In other words, you need to provide them with a sample article from the journal or conference whose style you are following.

ACM STYLE GUIDE FOR REFERENCES, TABLES, FIGURES, AND EQUATIONS

This section covers those stylistic elements over which departments have jurisdiction, references and graphics (tables and figures). These sections serve as a guide for students who are using ACM as their departmental style guide. Departments also have jurisdiction over subheadings as long as the department's style guide gives adequate guidelines. Because ACM does not give adequate guidelines, the CS department uses the *Pub Guide.*

References

Ordering References for ACM Style

Students have the option of listing their references alphabetically according to the last name of the first author, or students may list their references according to when they are cited. For example, the first reference cited would be [1], the second [2], etc. While either option is fine, the second option makes keeping track of things much, much easier. Citing an additional reference means shifting subsequent references numerically, rather than going through a reference list alphabetically and making adjustments.

Citing References within the Text

When citing a reference within the text, use the reference number only to tie the citation to the reference. Use brackets to set off the reference number. When citing more than one reference in one place, order the numbers numerically and include all of them within one set of brackets. See the examples below.

EXAMPLE

The accuracy rate of breast ultrasound images can reach a high level in the diagnosis of simple benign cysts, and lesions characterized as benign cysts do not require biopsies [103]. It has been shown that breast sonography is superior to mammography in two aspects: (1) its ability to detect focal abnormalities in the dense breasts of adolescent women [105]; (2) the fact that ultrasound images are acquired in real-time, with a relatively low health risk to the patient, and at a low cost [122]. Sonography is an important adjunct to mammography in breast cancer detection and, to date, has been

primarily useful for differentiating cysts from solid tumors. To avoid unnecessary surgical procedures, many researchers are investigating the characteristics of solid breast masses for discriminating between benign and malignant cysts [2, 3, 15, 20, 51, 55, 72, 103].

In addition, one may use the reference number in place of the author(s)'s name. The exception is this: starting a sentence with a reference number is not acceptable. One would **not** say:

[28] asserts that the Fourier transform is efficient.

Here are some acceptable alternatives:

The authors of [28] assert that the Fourier transform is efficient.

Jones et al. assert that the Fourier transform is efficient [28].

Here are yet more examples:

EXAMPLE
According to [20], the hidden Markov model is an effective tool in this sort of problem.

The experiments reported in [15] are limited in their scope in that they do not include the results of any testing of their proposed system. The authors of [18] build on the research of [15] to include test runs. Their results show that the proposed system is, indeed, more efficient than other systems.

When citing directly from a source, one must include the page number(s) on which the quotation appears. The example below shows the punctuation, 12 being the reference number, 1 being the page on which the quotation appears. Note that the quotation marks surround the text only, not the reference and page numbers. However, the sentence period appears after the reference and page numbers.

EXAMPLE

"A coalition is a set of self interested agents that agree to cooperate to execute a task or achieve a goal" [12:1]. The formation of a coalition is often a result of an agent not being able to complete a task alone. Another motivation is recognizing that with the help of other agents, an agent can either increase its utility or complete the task by a desirable deadline.

Formatting and Punctuating Individual Citations

Below are some examples of how to punctuate the references within your reference list. For citations not included here, contact Myra Cook (myra.cook@usu.edu), the CS Department Thesis/Dissertation Coordinator.

ARTICLE FROM A JOURNAL

Single author *(note that regardless of the type of source, single author is always handled the same)*

Singh, G. Leader election in the presence of link failures. *IEEE Trans. On Parallel and Distributed Systems 7*, 3 (1996), 231-236.

Two authors *(note that regardless of the type of source, two authors are always handled the same)*

Compton, K. and Hauck, S. Reconfigurable computing: A survey of systems and software. *ACM Computing Surveys 34*, 2 (2002), 171-210.

More than two authors *(note that regardless of the type of source, more than two authors are always handled the same)*

Bigol, P., Cucos, A., Corcoran, P., Chahil, C., and Lusted, K. Transparent dynamically configurable RF network suitable for home automation applications. *IEEE Trans. on Consumer Electronics 45*, 3 (1999), 474-479.

PROCEEDINGS OF A CONFERENCE

Fukunaga, A. and Stechert, A. Evolving nonlinear predictive models for lossless image compression with genetic programming. In *Proceedings of the 3rd Annual Genetic Programming Conference*, 1998.

Carley, V., Outkin, A., Plate, T., and Gao, F. Learning, evolution and tick size effects in a simulation of the Nasdaq Stock market. In *Proceedings of the Joint 5th World Multiconference on Systemics, Cybernetics and Informatics*, 2001.

BOOK

Moore, E.F. *Shortest Path Through a Maze*. Harvard University Press, 1959.

Rappaport, T.S. *Wireless Communication, Principles and Practice*. Prentice-Hall, 1996.

CHAPTER IN A BOOK WITH EDITOR(S)

Cai, H. Gridless routing system for macro-cell design. In *Routing, Placement, and Partitioning*, G. Zobrist, Ed. Alex Publishing Corporation, 1994, 49-95.

EDITION OF A BOOK

Bhaskaran, V. and Konstantinides, K. *Image and Video Compression Standards: Algorithms and Architectures*, 2nd ed. Kluwer Academic Publishers, 1997.

TECHNICAL REPORT

Kim, A., Shelton, C., and Poggio, T. Modeling stock order flows and learning market-making from data. Technical Report, 2002-009, MIT Artificial Intelligence Laboratory, 2002.

Heckerman, D., Meek, C., and Cooper, G. A Bayesian approach to causal discovery. Technical Report, MSR-TR-97-05, Microsoft Research, 1997.

STANDARD

IEEE Std 802.3 1985. IEEE standards for local area networks. Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

ISO/IEC 14977 Std 1996. Information technology – Syntactic metalanguage – Extended BNF.

SPECIAL PUBLICATION OR TECHNICAL MANUAL
(These are similar to a technical report or even a standard, but they are large enough to stand alone – they're a book or a mini-book, as opposed to a paper-sized publication.)

Dworkin, M. *Recommendation for Block Cipher Modes of Operation: Methods and Techniques*. NIST Special Publication 800-38A, Dec. 2001.

National Institute of Standards and Technology. *FIPS Pub 197: Advanced Encryption Standard (AES)*. Nov. 26, 2001.

National Institute of Standards and Technology. *FIPS Pub 113: Computer Data Authentication*. May 30, 1985.

URL

Ellis Island. Explore your family history at Ellis Island. 2002. http://www.ellisisland. org/default.asp. August 2003.

McManis, C. The basics of Java class loaders. 1996. http://www.javaworld.com/ javaworld/jw-10-1996/jw-10-indepth.html. September 2006.

MASTER'S THESIS

Rice, A. *A Self-Configuring Avionic Network*. Master's Thesis, Utah State University, 2003.

DOCTORAL DISSERTATION

Hu, L. *Image Processing Based on Fuzzy Logic and Markov Random Field Models*. Doctoral Dissertation, Utah State University, 2006.

Formatting the Reference List

As stated above, references may be ordered alphabetically according to last name of the first author or in their order of appearance in the text. In addition, a reference list should be formatted as follows. (Please note that the following list is numerical, not alphabetical.)

[1] Singh, G. Leader election in the presence of link failures. *IEEE Trans. On Parallel and Distributed Systems, 7*, 3 (1996), 231-236.

[2] Compton, K. and Hauck, S. Reconfigurable computing: A survey of systems and software. *ACM Computing Surveys, 34*, 2 (2002), 171-210.

[3] Bigol, P., Cucos, A., Corcoran, P., Chahil, C., and Lusted, K. Transparent dynamically configurable RF network suitable for home automation applications. *IEEE Trans. on Consumer Electronics, 45*, 3 (1999), 474-479.

[4] Fukunaga, A. and Stechert, A. Evolving nonlinear predictive models for lossless image compression with genetic programming. In *Proceedings of the 3rd Annual Genetic Programming Conference*, 1998.

[5] Carley, V., Outkin, A., Plate, T., and Gao, F. Learning, evolution and tick size effects in a simulation of the Nasdaq Stock market. In *Proceedings of the Joint 5th World Multiconference on Systemics, Cybernetics and Informatics*, 2001.

[6] Moore, E.F. *Shortest Path Through a Maze*. Harvard University Press, 1959.

[7] Rappaport, T.S. *Wireless Communication, Principles and Practice*. Prentice-Hall, 1996.

[8] Cai, H. Gridless routing system for macro-cell design. In *Routing, Placement, and Partitioning*, G. Zobrist, Ed. Alex Publishing Corporation, 1994, 49-95.

[9] Bhaskaran, V. and Konstantinides, K. *Image and Video Compression Standards: Algorithms and Architectures*, 2nd ed. Kluwer Academic Publishers, 1997.

[10] Kim, A., Shelton, C., and Poggio, T. Modeling stock order flows and learning market-making from data. Technical Report, 2002-009, MIT Artificial Intelligence Laboratory, 2002.

[11] Heckerman, D., Meek, C., and Cooper, G. A Bayesian approach to causal discovery. Technical Report, MSR-TR-97-05, Microsoft Research, 1997.

[12] IEEE Std 802.3 1985. IEEE standards for local area networks. Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

[13] ISO/IEC 14977 Std 1996. Information technology – Syntactic metalanguage – Extended BNF.

[14] Dworkin, M. *Recommendation for Block Cipher Modes of Operation: Methods and Techniques*. NIST Special Publication 800-38A, Dec. 2001.

[15] National Institute of Standards and Technology. *FIPS Pub 197: Advanced Encryption Standard (AES)*. Nov. 26, 2001.

[16] National Institute of Standards and Technology. FIPS Pub 113: *Computer Data Authentication*. May 30, 1985.

[17] Ellis Island. Explore your family history at Ellis Island. 2002. http://www.ellisisland.org/default.asp. August 2003.

[18] McManis, C. The basics of Java class loaders. 1996. http://www.javaworld.com/javaworld/jw-10-1996/jw-10-indepth.html. September 2006.

[19] Rice, A. *A Self-Configuring Avionic Network*. Master's Thesis, Utah State University, 2003.

[20] Hu, L. *Image Processing Based on Fuzzy Logic and Markov Random Field Models*. Doctoral Dissertation, Utah State University, 2006.

Table Titles

A table title should be above the table and punctuated as shown in the examples below. Note that table titles have title capitalization, start with the capitalized word Table and the number of the table followed by a period, and have a period at the end of the title. Table titles must be in the same font and point size as the body of the document. Also, keep in mind that table titles are just that, titles. Hence, they should be brief, as is a title. If you require additional commentary on the table, include it in the body of your thesis or dissertation. Additionally, titles may either be centered above the table or flush left. Whichever option you choose, make sure that you are consistent throughout the entire document.

Figure Captions

Unlike a table title, a figure caption goes below the figure. Further, figure captions have sentence capitalization. Note that figure captions start with the capitalized word Figure and the number of the figure followed by a period, and have a period at the end of the caption. Figure captions must be in the same font and point size as the body of the document. While a figure caption may be longer than a table title, it should still be kept somewhat abbreviated. In depth commentary should be included in the body of your thesis or dissertation not in the caption itself. See Figures 1 and 2 below.

Table 1. This Is the Title of a Very, Very Important Table.

asdf	df	dasdf	S;df	ee
sdf	Dd	wojfojf	Weorui3	302u
asdf	df	dasdf	S;df	ee

Table 2. Some Very Interesting Sequences.

yyy	yesyesyes	iii
blue	green	purple
eerie	alskdfjals	sdfoj
nnn	nonono	eeeee

Table 3. Significant Data.

hope	hope	hope	hope
hi	hi	hi	hi
hoot	hoot	hoot	hoot
hope	hope	hope	hope
hi	hi	hi	hi

Figure 1. Elk climbing out of Flaming Gorge after swimming across reservoir. Note elk's darkened color from being immersed in water.

Figure 2. Elk catching its breath after swimming across Flaming Gorge reservoir. Note how elk's mouth is open from breathing hard from the swim.

Placement of Figures and Tables on the Page

Spacing around Tables and Figures

There should a triple space both above and below tables and figures. Also, the table title and table itself should appear on the same page. The same goes for figures and captions. Further, do not split a table between two or more pages. The only time it is allowable to have a table appear on more than one page is when the table itself is larger than one full page.

Stylistic Guidelines for Information within Tables and Figures

Text within tables and figures does not need to conform to the stylistic guidelines of the rest of the text of the thesis. In other words, changing the font and/or the point size is acceptable.

Juxtapositioning Tables and Figures with Text on the Page

Figures and tables of less than half a page should be treated as part of the continuing text, but do not place them in the middle of a paragraph – rather between paragraphs. The preferred placement is at the top or the bottom of the page. Figures and tables larger than half a page should appear either at the top or the bottom of the page, or if warranted alone on a page. For a

graphic to appear alone on a page, it must take up two-thirds of a page or be at the end of a chapter. Except for situations in which larger graphics are meant to appear alone on a page, do not leave large sections of "white space." Instead, fill the page with text. For more information, see the *Pub Guide*.

Introducing Tables and Figures within the Text

Often referred to as "calling out," introducing a table or figure before it actually appears is necessary. To do so, one does not need to give the entire name of the table, but one does need to give the number. For example, one might say something like this. "As can be seen in Table 2, the financial forecast is dismal." Also, something as simple as "see Figure 14," is a sufficient introduction.

Numbering Tables and Figures

Tables and figures must be numbered. They can be numbered locally, i.e., 1.1, 1.2, 1.3, etc. for the tables or figures within chapter 1 and 2.1, 2.2, 2.3, etc. for the figures or tables within chapter 2, and so on. Or, they may be number globally, 1, 2, 3, 4, 5, and so on.

Equations

Equations should have a triple space above and below them. While not required, they can be numbered either locally or globally. If equations are referred to frequently within the thesis, it is a good idea to number them for ease of reference.

USAGE GUIDE FOR THESES AND DISSERTATIONS

Introduction

While this section addresses some common style, usage, and formatting problems found in students' theses and dissertations, it is in no way intended to serve as a sole style resource for students. Rather, it is intended as a complement to the primary guides listed below. Hence, students should refer to these resources for answers not found here.

The Chicago Manual of Style, 15th ed., 2003.

Unless otherwise noted, *The Chicago Manual of Style* serves as the final word on matters of usage, such as punctuation.

Merriam-Webster's Collegiate Dictionary, 11th ed., 2003.

Unless otherwise noted, this dictionary serves as the final word on spelling.

Abbreviations

e.g.

The abbreviation e.g. (*exempli gratia*) means *namely* or *for example*. It can be used in expressions similar to *including*, when you are not intending to include an entire list. Use a comma after e.g. Unless the break before e.g. is greater than that signaled by a comma, use a comma before e.g. Do not italicize e.g. See the examples below.

EXAMPLES
The security of a system can be viewed at various levels, e.g., the physical level, the network level, the operating system level, and the application level.

Sloppy programming techniques produce a multitude of errors, e.g., this, that, one thing, and the other.

et al.

The abbreviation et al. (*et alii*) means *and others*. It is most commonly used to summarize a list more than two authors of a reference source. Students typically use this abbreviation correctly. However, they often punctuate it incorrectly. Thus, take especial note of the punctuation in the example below. No comma precedes it, and it isn't italicized, Also note that *et* does not require a period but *al.* does; *et* is a word, *al.* is an abbreviation. The abbreviation *al.* is not followed by a comma.

EXAMPLE
The work of Smith et al. uses the Fourier transform as its basis [13].

etc.

The abbreviation etc. (et cetera) means and the rest, and the like, and so on. Do not end a list of persons with *etc.* A comma is required after *etc.* unless it ends the sentence.

i.e.

The abbreviation i.e. (*id est*) means *that is*. It can be used in place of *in other words*. It specifies or clarifies. Use a comma after i.e. Unless the break before i.e. is greater than that signaled by a comma, use a comma before i.e. Do not italicize i.e. See the examples below.

> **EXAMPLES**
> Information such as the code used with these static analyzers, size of that code, i.e., number of lines, is not given.
>
> Sloppy programming techniques, i.e., laziness, lead to failing grades.

Acronyms

The first time you use an acronym, first spell out what the acronym stands for followed by the acronym in parentheses. From that point forward, use the acronym.

> **EXAMPLE**
> In genetic programming (GP) techniques, the computer evolves a program that performs
>
> a task needing to be done, without telling the computer exactly how to do it [10]. In the
>
> field of image compression, one GP technique is to generate approximation values that
>
> accurately represent an image.

Capitalization

Below is a summary of capitalization rules:

- Names of specific people: Vicki Allan, Don Cooley, Charles Yan
- Names of specific places or regions: the Milky Way, Logan, Utah, Camden Fields
- Names of specific agencies, organizations, or bodies: National Science Foundation, Association for Computing Machinery, Microsoft, Sun

- Names of historical events, periods, and documents: The Civil War, the Middle Ages, D-Day

- Names of days, months, holidays, and special days of observation: Mother's Day, Christmas, New Year's Day

- Titles of rank or respect before a name: Dr. Allan, Mrs. Smith, President Bush, Senator Jackson

- The principal words in titles of books, magazines, articles, etc.: The Chicago Manual of Style, IEEE Transactions on Image Processing NOTE: Be careful with this one. ACM style does capitalize the principle words in the titles of articles. Instead, it uses sentence caps. See the section entitled References.

- Words that show family relationship when used as names: Uncle Joe, Grandma (when directly addressing our grandmother or referring specifically to your grandmother)

- Words referring deities or holy books: the Koran, the Bible, God, Krishna

- Names of registered trademark products: Microsoft Office, Word, Java, Kleenex, Ford

- Exceptions: the Internet, the President, the Queen – all entities of great importance.

Below are two examples of *improper* capitalization. In example 1, genetic program is not a proper noun; hence, it should be lower case. In example 2, user interface, main memory database, and visualization are not a proper nouns, so they shouldn't be capitalized either. Huffman, on the other hand, is a proper noun.

EXAMPLE 1

The basic principle behind Genetic Programming (GP) is to have the computer evolve a program that performs a task needing to be done, without telling the computer exactly how to do it [10]. For image compression, what needs to be done is to generate the approximation values to represent an image.

EXAMPLE 2

The information retrieval support in the data layer receives the requests from the User Interface layer and answers the query accessing the Main Memory Database and in turn also supplies data to the Visualization layer. The files are converted into a compressed

format which is then read into the main memory. The text and files are compressed using the adapted version of Huffman coding and other complex methods.

Stirring the Pot a Bit: Capitalizing Classes is Okay. The CS department conforms to the practice in industry of capitalizing classes.

EXAMPLE
There are three main classes for the system: Generation, GPUtilities, and GPConfiguration. The Generation class provides the functions to initialize the first generation of functions, generate the next generation (including mating the programs to create offspring), evaluate, and compile the generation. GPUtilities provides many utility functions to the system including gathering statistics and creating the imagery.

Contractions

Contractions are not acceptable in theses and dissertations.

Nouns and Pronouns

Person

Generally speaking, like all good expository writing, theses and dissertations should be written in third person. Having said that, a central purpose of a thesis or dissertation is to report what you, the researcher, have done. Therefore, in those sections that describe implementing or testing your hypothesis, it is preferable to use either first person singular or plural. You should note that quite often your major professor might prefer singular to plural or vice versa. Below are a couple of examples.

EXAMPLE 1 – First Person Plural
We performed several controlled experiments on our proposed approach to demonstrate its capacity and security. Furthermore, we compared our approach with two state-of-the-art steganographic approaches, MB1 (without deblocking) and MB2 (with deblocking), using Fridrich's universal blind steganalysis features. In all experiments, we embedded

messages whose lengths are proportional to the number of non-zero DCT coefficients in each image to create the corresponding stego image database.

EXAMPLE 2 – First Person Singular

I examined the justifiability of each new feature based on its effect on speed and system performance. In particular, I looked at the time spent to encrypt and decrypt, the TCP transit time between the layers, and the time spent on database operations. I also examined CPU and memory utilization of the system under various load conditions. I gathered all of my test data on systems running the Linux operating system (2.6 kernel).

One way to determine whether to use first person is to try and say the same thing in third person. If doing so is very cumbersome, or if the only way to say the same thing is to use passive voice, chances are first person is the best choice. Try putting the two above examples into third person. There is no easy way to do so.

Pronouns: He or She, He, or They.

When referring to a nonspecific person, deciding which pronoun to use in referring back to the noun can be tricky. Consider the following examples:

1) When the user inputs the data, he should be aware of the following.
2) When the user inputs the data, he or she should be aware of the following.
3) When the user inputs the data, s/he should be aware of the following.
4) When users input the data, they should be aware of the following.

None of the above examples is wrong, per se. However, the English language is moving toward less gender-bias, so sentence 1) is the least preferable. While example 2) is not gender-biased and thus is preferable to example 1), it is somewhat cumbersome. Consequently, example 3) is more streamlined and is preferable to example 2). Example 4) uses plural and thus avoids the whole gender-bais issue altogether and is equally preferable to example 3).

Stick with whichever of the above options you choose. Be consistent. This is particularly important when referring back to the pronoun. You must have agreement between pronouns and their antecedents. Consider the following examples.

INCORRECT EXAMPLE

When the user chooses option 1, *s/he* should be aware that *they* are compromising the network's overall security.

CORRECT EXAMPLE

When the user chooses option 1, *s/he* should be aware that *he or she* is compromising the network's overall security.

That versus Which

In order to discuss this issue, we need to define a couple of terms: restrictive and nonrestrictive modifiers. Restrictive and nonrestrictive modifiers may be either phrases or clauses. Restrictive modifiers are integral to the meaning of the sentence; they restrict the thing being modified to a specific subset. Nonrestrictive modifiers, on the other hand, are not essential to the meaning of the sentence; they provide interesting information and commentary about the thing being modified.

In the sentence below, the *restrictive modifier* clause specifies which convertible hit the pedestrian. The modifier is essential to the meaning of the sentence because it specifies one of many convertibles. One uses *that* to introduce restrictive modifiers.

The convertible *that has its top down* is the vehicle that hit the pedestrian.

In the sentence below, there is only one convertible in question. Thus, while the *nonrestrictive modifier* is interesting, it is not crucial to the meaning of the sentence.

My convertible, *which is top of the line*, is fun to drive.

Consider the two following sentences. In sentence 1), only highly complex genetic algorithms produce satisfactory results. In sentence 2), all genetic algorithms produce satisfactory results, and by the way, genetic algorithms are highly complex.

1) Genetic algorithms that are highly complex produce satisfactory results.

2) Genetic algorithms, which are highly complex, produce satisfactory results.

Verb Tense

Discussion of Methods and Experiments

In the methods section of your thesis or dissertation, in other words when describing *what you did*, use past tense.

EXAMPLES

I implemented my hypothesis. It did not work as I had hoped, so I went back to the drawing board. After many modifications to the project, my second attempt succeeded.

In every experiment, our method outperformed the model proposed in [2], and its performance was comparable to that of the swish-swirl model.

When describing the *implications* of the results of your research use present tense.

> **EXAMPLES**
> These data demonstrate that our modification of the hidden Markov model improves image recognition.
>
> The results implemented in this project are very promising.
>
> Our experiments clearly demonstrate that the proposed model is superior to the swish-swirl search model.

Discussion of the Literature

Use of verb tense when discussing the literature can be confusing. Basically, when discussing the research of others the same rules apply as when discussing one's own research. When talking about what researchers did, use past tense. When discussing the implications of the research, use present tense. When discussing the report of the research, e.g., when discussing the text itself

Voice

Active voice is more direct and vigorous than passive voice. The subject of a passive sentence tends to get lost. Excessive passive voice makes for dull reading. Thus, in most instances, active voice is clearly preferable to passive.

Occasionally, especially in scientific writing, the object of the sentence is the thing that needs to be emphasized – not the subject. In such instances, passive writing is acceptable. Consider the following examples:

1) The system returns a null.
2) A null is returned.

In example 1), the active sentence, the subject, *the system*, is what is emphasized. Also, the sentence is cumbersome and wordy. In example 2), the passive sentence, the object, *null*, is what is emphasized. The sentence is streamlined. In such a situation, depending on what you the writer wants to emphasize, passive voice may be the best choice. Just remember to proceed with caution when using passive voice.