

THESES AND DISSERTATIONS

INSTRUCTIONS FOR THE PREPARATION OF THESES AND DISSERTATIONS AT THE SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY (SDSM&T)

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INSTRUCTIONS FOR THE PREPARATION OF THESES AND DISSERTATIONS AT SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY (SDSM&T)

1. INTRODUCTION

These instructions are effective for all theses and dissertations completed in the fall semester of 2008 or later.

Master's and professional theses and doctoral dissertations are placed in the Devereaux Library collection at the South Dakota School of Mines and Technology (SDSM&T). In addition, they may be submitted to University Microfilms Incorporated (UMI), a commercial dissertation archiving and distribution company. This manual contains the requirements and regulations of the Office of Graduate Education, the Faculty, and UMI, for uniform style and format of these documents. The standards are flexible to be consistent with the specialized requirements of primary publications in associated fields.

Division of responsibilities for preparing a thesis or dissertation:

- Faculty regulations pertaining to procedures for the supervision, approval, and defense of theses and dissertations are described in the current Graduate Catalog. Both student and advisor are responsible for following these procedures.
- The student is responsible for preparing a thesis or dissertation following formatting guidelines described below.
- The Office of Graduate Education has responsibility for monitoring the physical format of theses and dissertations to make certain that the format conforms to university guidelines and that the quality of the master copy of the manuscript will allow satisfactory reproduction. The SDSM&T Business Services Office is authorized by the Dean of Graduate Education to reject manuscripts that do not meet these requirements. PhD Dissertations should be submitted to UMI and Dissertation/Thesis of all levels including MS and PhD should be submitted to the Graduate Office in an electronic form. The student pays the fees for UMI archival. Detailed instructions are posted at: <http://www.umi.com>

• **1.1. CHECKLIST OF APPROVAL, REPRODUCTION, AND BINDING PROCEDURES FOR THESES AND DISSERTATIONS**

1. Candidate has thesis or dissertation approved by committee; student, major professor, and department chair sign master copy.
2. Candidate takes master copy to the Business Services Office for approval of format by signing check-out sheet.
3. Candidate takes master copy to Dean of Graduate Education for approval and signature.
4. Candidate takes the master copy of the manuscript and the appropriate number of sets of any maps and photographs to SDSM&T Business Services Office. (The minimum number of sets of maps and photographs required is four, plus those for any additional bound copies requested by the candidate.) If candidate is providing his own complete copies, then at a minimum one master and 3 copies must be delivered to Business Services Office, reproduced on the specified type of paper (See Section 4.2). Otherwise, the candidate has the necessary copies of the manuscript produced and collated and the candidate pays the charges for printing, binding and processing. Candidate should check copies for quality and collation. The total of four copies is distributed as follows:

- The unbound master copy, plus one bound copy, must be delivered to the Library.
- Two bound copies must be delivered to the candidate's major department.

In addition, 2 electronic versions of the thesis are also required on CD, one for the Graduate Education Office and one for the department.

Note that the preceding minimum requirements do not include any copies for the candidate, unless the department chooses to provide the candidate one of its two bound copies.

5. Candidate submits an unbound paper or a digital copy of the thesis/dissertation to UMI in a format acceptable to them and pays necessary fees. Digital submission must be the format prescribed by UMI. If a paper copy is submitted, then it may be sent through normal public or commercial mail delivery services.

2. CONSTRAINTS ON THESIS/DISSERTATION CONTENT

2.1 Use of Works Previously Published by Others

The author of the thesis or dissertation must sign the title page certifying that the document is the author's original work. The use of material copyrighted by others must be properly acknowledged and, unless it falls within the doctrine of fair use, may be used only with written permission of the copyright owner. A copy of the owner's written permission must accompany the document in its final form.

2.2 Use of Works Previously Published by the Author

The thesis/dissertation author's prior published works may not appear in their published form in the main text of the thesis/dissertation. They may be summarized and referenced like any other source materials. They may be presented in reprint form as pocket materials at the end. If the author's published work represents a substantial part of the research effort reported in the thesis/dissertation, it should be so acknowledged in the text where first mentioned.

2.3 Works Previously Published When Thesis/Dissertation Author is Co-Author

A statement must be made (in footnote or in text) indicating the portions of previous work done by the author.

3. COPYRIGHTING THESES OR DISSERTATIONS

3.1 Ownership

The ownership rights to theses and dissertations created by students shall be governed by the following policy.

Copyright ownership of theses and dissertations resulting from research which is performed in whole or in part by the student with financial support in the form of wages, salaries, stipend or grant by SDSM&T shall be determined in accordance with the terms of the support agreement, or in the absence of such terms, shall become the property of the University. Requests for permission to publish such theses and dissertations should be addressed to the Dean of Graduate Education.

The student must, as a condition of a degree award, grant royalty-free permission to the School to reproduce, use, and publicly distribute copies of the thesis or dissertation. Forms for granting to SDSM&T royalty-free use of author-owned copyrighted theses or dissertations are available in the Office of Graduate Education.

3.2 Registration and Deposit

Copyright registration of theses and dissertations is optional. Forms for copyright registration are available in Business Services Office, and copyright can also be arranged through UMI.

The United States Copyright Act of 1976 adopts the principle of automatic copyright. Works created after 1 January 1978 are copyrighted under federal statute upon creation. While registration with the United States Copyright Office and use of a copyright notice are not conditions for securing initial copyright for these works, registration and notice are still important to ensure full protection of rights under the law. If copyright registration is desired by the copyright owner, all copies should carry a copyright notice (i.e. the word “Copyright” or a symbol—e.g., © 2003 Jane Smith) and the words “All Rights Reserved” beneath the notice. If a thesis or dissertation bears a copyright notice, it becomes subject to mandatory deposit with the Library of Congress (two copies).

3.3 Further Information on Copyright Law

Additional information on federal copyright law, institutional copyright policy, and copyright matters in general is found in the SDSM&T Copyright Handbook. Inquiries may be directed to the Vice President for Research.

4. SPECIFIC REQUIREMENTS

4.1 Master Copy Preparation

Theses and dissertations must be mechanically or digitally printed and error-free, since the master copy is kept as a permanent record of research and academic achievement by the student, and is used for reproduction.

Further details and specifications concerning submission of a thesis or dissertation to UMI may be found at: <http://www.umi.com>

In general, theses/dissertations that meet SDSM&T standards also will be acceptable to UMI. Theses may be submitted to UMI either in the form of an Adobe Acrobat file or in paper form. If digital format is used, the file may be submitted to UMI on a CD or by file transfer over the Internet. See complete instructions at the above URL for further details.

4.2 Paper

The paper used in the master copy must be synergy paper, 8 ½ x 11, 24 pound, pure white, 25 percent cotton, smooth finish bond. This paper can be purchased directly from Business Services Office, Room 106, O’Harra Building.

4.3 Illustrations

All copies deposited in the Devereaux Library must be fully illustrated. Illustrations may be oriented lengthwise on the page, but must be placed in such a manner that when the thesis is held in reading position, the bottom of such an illustration and its caption will be at the right side of the page. All page size (8½ x 11) illustrations must conform to margin limitations as indicated under Item 5.7 (Style and Margins). Large tables, charts, maps, etc., must be folded no larger than 7 x 10 inches with plate number and/or title in bottom right corner, to allow trimming of the bound volume without damaging the material. Business Services Office will make the necessary reproductions of all illustrations that are no larger than 11 x 17 inches. For larger illustrations, the appropriate number of copies must be supplied. **UNDER NO CIRCUMSTANCES ARE ANY CONTINUOUS-TONE PHOTOGRAPHS TO BE ELECTROSTATICALLY REPRODUCED (PHOTOCOPIED).**

Images and charts reproduced using digital printers should be printed directly on the proper paper using archival-quality inks/dyes/toner.

4.4 Captions for Illustrations, 8½ x 11 inches

Captions for all illustrations must be within margin limitations as set forth under Item 4.7 (Style and Margins). All captions must be placed at the bottom or on the right-hand side of an illustration.

4.5 Preparing Maps, Graphs, Tables

Maps, graphs, and tables are, in most cases, produced electronically. If not, the following instructions apply.

To prepare a good original by hand:

1. Draw on high quality reproducible paper or film.
2. Draw with black, waterproof (non-transferring) India ink. **DO NOT USE FELT TIP PENS.**
3. All lines should be dark, crisp and clear.
4. Drawing should be clean of any film.
5. When shading, use dark, clear patterns.
6. Do not use blueline. Not all bluelines can be reproduced.
7. Follow guidelines for margins as instructed in sections 4.4 under "Captions for Illustrations" and 4.7 "Style and Margins."

When doing thesis drawings larger than 8 1/2" x 11" (i.e. geographic maps) keep in mind that they are to be folded down to a 7" x 10" format. Therefore, you need to put the identifying information (plate, title, preparer's name) in the bottom or bottom right corner so it can be easily displayed when folded.

4.6 Including Material on Digital Media

Follow UMI instructions for submission of such material in digital format. See <http://www.umi.com>

4.7 Style and Margins

Fonts used should be clean and easily readable. Minimum font size is 10 pts. The same font should be used for the principle text all the way through the work, although other fonts and styles may be employed for smaller segments. Page numbers must be in the same font and size as the body of the text and placed on all pages including Abstract and Table of Contents. Page numbers must be in the upper right-hand corner, 3/4 inch down from the top, and 3/4 inch from the right-hand side.

Margins are to be 1 1/2 inches on the left side and 1 inch on the other three sides. (See page gauge below.) Margins are to be blank—without punched holes, writing, or other marks. The margins set in many word processing packages may not measure the same on the printed page. Measure the margins on printed test pages and adjust the software settings accordingly to meet the above requirements.

Pages which have printed text only must be oriented in the same manner as the pages of this instruction manual, often called "portrait." When necessary, graphs, photographs, tables, and figures may be oriented facing to the right. The manuscript is to be double-spaced with paragraph indentation and tables typed in accordance with format(s) of journal(s) in the candidate's particular discipline and printed on one side of the paper only.

4.8. Style References

The bibliographic style used in the thesis or dissertation is determined by the candidate's department or professional society and by consultation with the candidate's major professor. The Office of Graduate Education and Sponsored Programs encourages preparation of theses/dissertations in a format suitable for submission for publication in leading journals in the candidate's field.

The following section provides examples for citing a wide variety of sources in the American Psychological Association (APA) style, a commonly used style similar to the bibliographic styles used in many disciplines. In some fields, styles may differ considerably. The candidate should follow a format required by the publication to which he/she plans to submit the work. However, if there is no specific format in a given field,

and the candidate's department has no specific guidelines, use of this APA style is encouraged.

Parenthetical citations: APA

The American Psychological Association (APA) recommends an author/date style of in-text citations. These citations refer readers to a list of references at the end of the paper. APA's in-text citations provide at least the author's last name and the date of publication. For direct quotations, a page number is given as well. In APA style, the alphabetical list of works cited is entitled **References**. The general principles are as follows:

1. Invert *all* author names and use initials instead of first names. With two or more authors, use the word *and*. Separate the names with commas.
2. Use all authors' names; do not use "et
3. Place the date of publication in parentheses immediately after the last author's name. **Examples:** (Levy, 1997). (National Institute of Mental Health [NIMH], 1999) and in later citations (NIMH, 1999)
4. Underline titles and subtitles of books; capitalize only the first word of the title and subtitle (as well as all proper nouns).
5. Do not place titles of articles in quotation marks, and capitalize only the first word of the title and subtitle (and all proper nouns). Capitalize names of periodicals as you would capitalize them ordinarily. Underline the volume number of periodicals.
6. Use the abbreviation *p.* (or *pp.* for plural) before page numbers of newspaper articles and works in anthologies, but do not use it before page numbers of articles appearing in magazines and scholarly journals.
7. You may use a short form of the publisher's name as long as it is easily identifiable.
8. Alphabetize your list by the last name of the author (or editor); if there is no author or editor, alphabetize by the first word of the title other than *a*, *an* or *the*.
9. In many applications using APA, the first line is indented, subsequent ones full width—like a paragraph. This is the style that appears in the APA manual. However, some APA applications employ the hanging indent (first line full width, subsequent lines indented).

BOOKS (check capitalization for this book section)

(BASIC FORMAT FOR A BOOK)

Schaller, G. B. (1993). *The last panda*. Chicago: University of Chicago Press.

(TWO OR MORE AUTHORS)

Eggen, P. D. and Kauchall, D. (1992). *Educational psychology: Classroom Connections*. New York: Merrill.

Caplow, T., Bahr, H. M., Chadwick, B. A., Hill, R., and Williamson, M. H. (1982). *Middletown families: Fifty years of Change and Continuity*. Minneapolis: University of Minnesota Press.

(CORPORATE AUTHOR)

Fidelity Investments. (1993). *Fidelity Brokerage Services handbook*. Boston: Author.

[**Note:** When the author is an organization, the publisher is often the same organization. In such a case, give the publisher's name as "Author."]

(UNKNOWN AUTHOR)

The Times atlas of the world (9th ed.). (1992). New York: Times Books.

(EDITORS)

Fox, R. W., and Lears, T. J. F. (Eds.). (1993). *The power of Culture: Critical essays in American history*. Chicago: University of Chicago Press.

(TRANSLATION)

Miller, A. (1990). *The untouched key: Tracing childhood trauma in creativity and destructiveness* (H. & H. Hannum, Trans.). New York: Doubleday. (Original work published 1988)

(EDITION OTHER THAN FIRST)

Cavanaugh, J. C. (1993). *Adult development and aging* (2nd ed.). Pacific Grove, CA: Brooks/Cole.

(WORK IN AN ANTHOLOGY)

Ochs, F., and Schieffelin, B. (1984). Language acquisition and socialization: Three developmental stories. In R. Schweder & R. Levine (Eds.), *Culture theory: Essays in mind, self, and emotion* (pp. 276–320). New York: Cambridge University Press.

(TWO OR MORE WORKS BY THE SAME AUTHOR)

Davis, F. (1973). *Inside intuition: What about nonverbal communication*. New York: McGraw-Hill.

Davis, F. (1978). *Eloquent animals: A study in animal communication*. New York: Coward, Geoghegan.

[**Note:** Use author's name for first and subsequent entries. Arrange entries by date, *earliest* first.]

ARTICLES IN PERIODICALS

(ARTICLE IN A JOURNAL PAGINATED BY VOLUME)

Block, N. (1992). Begging the question: Against phenomenal consciousness. *Behavioral and Brain Sciences*, 15, 205–206.

(ARTICLE IN A JOURNAL PAGINATED BY ISSUE)

Searle, J. (1990). Is the brain a digital computer? *Proceedings of the American Philosophical Association*, 64(3), 21–37.

(ARTICLE IN A MAGAZINE)

Caputo, R. (1993, August). Tragedy stalks the Horn of Africa. *National Geographic*, 184, 88–121.

(ARTICLE IN A DAILY NEWSPAPER)

Goleman, D. (1993, July 13). New treatments for autism arouse hope, skepticism. *The New York Times*, pp. C1, C11.

(LETTER TO THE EDITOR)

Fuller, K. S. (1993). The issue of ivory [Letter to the editor]. *Audubon*, 95(4), 12.

(REVIEW)

Blaut, J. M. (1993). [Review of the book *Global capitalism: Theories of societal development*]. *Science and Society*, 57(1), 106–107.

(TWO OR MORE WORKS BY THE SAME AUTHOR IN THE SAME YEAR)

Eckholm, Erik. (1985a, June 25). Kanzi the chimp: A life in science. *The New York Times*, pp. C1, C3.

Eckholm, Erik. (1985b, June 24). Pygmy chimp learns language skill. *The New York Times*, pp. A1, B7.

[**Note:** Cite works according to the usual style, and arrange them alphabetically by title. Add lower-case letters beginning with “a,” “b,” and so on within parentheses immediately following the year.

OTHER SOURCES

(DISSERTATION ABSTRACT)

Pellman, J. L. (1988). Community integration: Its influence on the stress of widowhood. (Doctoral dissertation, University of Missouri, 1988). *Dissertation Abstracts International*, 49, 2367.

(GOVERNMENT DOCUMENT)

U.S. Bureau of the Census. (1989). *Statistical abstract of the United States* (109th ed.). Washington, DC: U.S. Government Printing Office.

(PROCEEDINGS OF A CONFERENCE)

Waterhouse, L. U (1982). Maternal speech patterns and differential development. In C. E. Johnson & C. L. Thew (Eds.), *Proceedings of the Second Annual International Study of Child Language* (pp. 442–454). Washington, DC: University Press of America.

(RADIO OR TV PROGRAM)

MacNeil, R. (Interviewer). (1991, August 22). [Interview with G. F. Kennan]. *The MacNeil/Lehrer NewsHour* (Program 4144). New York and Washington, DC: PBS.

(VIDEOTAPE)

National Geographic Society (Producer). (1987). *In the shadow of Vesuvius* [Videotape]. Washington, DC: National Geographic Society.

(ONLINE: ARTICLE FROM A NEWSPAPER ON THE WEB)

Lewis, R. (1995, December 24). Chronobiology researchers say their field's time has come. *The Scientist*, 9, p. 14 [On-line newspaper]. Retrieved December 30, 1997, from the World Wide Web: http://web.the-scientist.library.upenn.edu/jr1995/chrono_951211.html

[**Note:** No punctuation is used at the end of the URL.]

(ONLINE: ARTICLE FROM A JOURNAL OR MAGAZINE ON THE WEB)

Broydo, L. (1998, January 13–18). The clean cleaner cover-up. *Mother Jones*, January/February 1998. *Mother Jones the Mojo Wire*. [Magazine, selected stories on-line]. Retrieved January 15, 1998, from the World Wide Web: http://www.mojojones.com/mother_jones/JF98/homeplanet.html

(ONLINE: ANNOUNCEMENT POSTED ON THE WEB)

National Institute of Mental Health. (1997, May 15). *Mammalian clock gene closed*. [Press release posted on the World Wide Web]. Bethesda, MD: Author. Retrieved December 30, 1997, from the World Wide Web: <http://www.nimh.gov/events/prnorth.htm>

(ONLINE: MATERIAL FROM AN FTP SITE)

Beck, A. (1994, July 2). Glass, a fractal gif. [On-line graphic]. Swedish University Network SUNET. Retrieved January 17, 2000: <ftp://ftp.sunet.se/pub/pictures/fractals/>

(ONLINE DOCUMENT WITHOUT A PRINT VERSION)

Wallach, D. S. (1993, September 22). FAQ: Typing injuries (2/5): General info. [On-line]. Available FTP: <rtfm.mit.edu>

[**Note:** No end punctuation is used at the end of the URL.]

(COMPUTER SOFTWARE)

Transparent Language Presentation Program (Version 6 for Windows) [Computer software]. (1999). Hollis, HH: Transparent Language.

(ABSTRACT ON CD-ROM)

Marcus, H. F., & Kitayamo, S. (1991). Culture and the self: Implications for group dynamics [CD-ROM]. *Psychological Review*, 88(2), 224, 253. Abstract from: SilverPlatter File: PsycLIT Item: 78-23878.

(INFORMATION SERVICES: ERIC)

Chiang, L. H. (1993). Beyond the Language: Native Americans' nonverbal communication. (ERIC Document Reproduction Service No. ED 368 540).

(INFORMATION SERVICES: NEWSBANK)

Wenzell, R. (1990). Businesses prepare for a more diverse work force. (Newsbank Document Reproduction Service No. EMP 27:D12).

4.9 Bibliographic Style

The author may use either footnotes or references to a bibliography at the end of the thesis or dissertation. As stated above, bibliographic style (footnotes, references, citations, etc.) and type (mathematical notation, symbols, etc.) should be those consistent with the guidelines established by the candidate's department or professional society. The style of the principal abstracting journal of the candidate's discipline is otherwise a good guide. Whenever possible, periodical titles should be abbreviated according to the standards outlined by the AMERICAN NATIONAL STANDARDS INSTITUTE.

Some specific journals and bibliographies in various disciplines are:

Atmospheric Sciences: J. of the Atmospheric Sciences; Meteorological and Geostrophysical Abstracts

Chemical Engineering: Chemical Abstracts; Engineering Index.

Chemistry: Chemical Abstracts; Analytical Abstracts.

Civil Engineering: ASCE Publications Abstracts; Engineering Index.

Electrical Engineering: Electrical and Electronic Abstracts; Engineering Index;

Electronics and Communications Abstracts Journal.

Geology and Geological Engineering: Annotated Bibliography of Economic Geology; Bibliography and Index of Geology; Bibliography of North American Geology; Geological Society of America, Bulletin; Geophysical Abstracts.

Mathematics: American Mathematical Monthly; American Mathematical Society ,Proceedings; Mathematical Reviews.

Mechanical Engineering: American Society of Mechanical Engineers, Transactions. Series A to J; Engineering Index; Mechanical Engineering.

Metallurgical Engineering: American Institute of Mining, Metallurgical and Petroleum Engineers, Transactions. American Society of Metals, Transactions; Engineering Index; Metals Abstracts; Chemical Abstracts.

Mining Engineering: Geological Society of America, Bulletin; Mining Engineering. Engineering Index, IMM Abstracts, Energy Research Abstracts.

Paleontology: Camp, Charles Lewis, Bibliography of Fossil Vertebrates, 1954-1958, Geological Society of America (New York), 1964. (Z6033/.P2/C342); Bibliography and Index of Geology.

Physics: Nuclear Science Abstracts; Solid State Abstracts Journal; Physics Abstracts; Physical Review A-D.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC., American National Standard for the Abbreviation of Titles of Periodicals. 1970. (Z39.5-1969—which is a revision of Z39.5-1963).

4.10 Title Page

The title page must show the title, author, whether the document is a master's thesis or a doctoral dissertation, its purpose, name of the college, date, author's signature, and signature approvals of the major professor, the chair of the major department, and the Dean of the Graduate Education and Sponsored Programs. Names should be printed below signatures. An example follows.

Sample title page:

(TITLE)

by

(Author)

A thesis submitted to the Graduate Office
in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE IN (DISCIPLINE)
SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY
RAPID CITY, SOUTH DAKOTA

20__

Prepared by:

Degree Candidate

Approved by:

Major Professor (Print name below signature)

Chairman, Department of (name) (Print name)

Dean, Graduate Education

(Optional)

© year, owner

All Rights Reserved

4.11 Thesis and Dissertation Titles

Theses and dissertations can be valuable reference works when they can be easily located. Titles must be informative, meaningful, and descriptive—rather than just indicative of the content of the material. For example, it would be well to avoid such meaningless phrases as:

“Factors affecting...”

“Some causes and effects of...”

“An experiment on...”

NOTE: The method, process, instrument, device, etc., developed or used should be identified in the title if it's a significant part of the research.

Authors of master's theses and doctoral dissertations must substitute, in the title, appropriate words for formulas, symbols, superscripts, Greek letters, etc. For example, the term “Fission-Fragment Synthesis of $K Mn(CN)$ ” is to be written as “Fission-Fragment Synthesis of Potassium Manganicyanide.” This is a requirement of UMI so that dissertations may be microfilmed and/or preserved digitally, and also facilitates readability when the work is included in thesis and dissertation abstracts

4.12 Abstracts

The format of the abstract at South Dakota School of Mines and Technology is as follows:

- A. Must be on a single, separate page, adhering to margin requirements.
- B. Limit to 250 to 350 words—preferably not to exceed 300 words for a thesis, or 350 words for a dissertation.
- C. Text will be single-spaced.
- D. The abstract page comes after the title page and before the Table of Contents.

An abstract should be informative. It should not state: “this is discussed,” “that was investigated” or “conclusions are given.” Be as specific on each point as space allows. Avoid stating what the material is about. Concentrate instead on what work has been done. For example, do not write: “the gravity anomalies in the area are discussed.” Rather, state that: “A gravity high of 25 milligals suggests that”

Report your information impersonally. This is a convention, and the restriction on the use of “I” makes the use of passive voice common in abstracts. Example: “On 30 June a sunspot almost 20 times the size of the planet Earth was observed on the east limb of the sun.”

The abstract summarizes three major elements of the full document:

- Objectives of the research
- Methodology used in the research

—Findings, including results, conclusions, and recommendations.

Example (from NASA JPL):

Title: An Object-oriented Software Architecture for Planetary Dexterous Manipulators

Planetary rover software tends to become very complex due to the rover's complex hardware architecture, numerous scientific instruments, and the requirements for real-time determinism and efficiency. The authors of this report developed an extendible object-oriented system decomposition and architecture to manage this complexity and to provide a powerful, robust yet easy set of tools for developers of higher-level applications. A version of this object-oriented architecture has been implemented on the Mars prototype rover, Rocky 7, to assist in employing autonomous manipulation on the rover. This architecture is being adapted for the next generation Mars rover prototype.

Object-oriented design provides a powerful tool for developing a system architecture that can be used on a wide range of planetary rovers with varying hardware components. A flexible five-layer, object-oriented system decomposition has been developed. At the lowest level is the hardware dependent device driver layer, which describes system components such as digital and analog I/O boards, cameras, frame-grabbers, and motors. The second layer is a hardware abstraction layer that provides an object-oriented hardware independent interface to the device driver layer. The third layer implements the basic independent subsystem operations such as arm, mast, vehicle, and other instruments. Such behaviors include vehicle obstacle avoidance for navigation, sensor-based manipulation, and so on. Finally, the highest level is the autonomous operations layer, where complete operations such as long-range path planning and navigation, sample acquisition of a specified target, and instrument placement on a target several meters away can be executed.

Criteria such as code reusability, extendibility, and portability played a key role in the design.

The preparation of a good abstract is an art to be acquired through care, thought, and practice. It should convey a maximum amount of information with a minimum number of words, and this requires more writing and re-writing than does almost any other part of the work.

4.13 Vita

A copy of a vita, not over one page in length, is to be included as the last page of all theses and dissertations deposited in the Devereaux Library. The vita is to be written in the third person and should contain the following information:

- A. Place and date of birth.
- B. Place and date of high school graduation.
- C. Place and date of college graduation—with degree and major.
- D. Place and date of receipt of master's degree—with major.
- E. Vocational and professional experience (not summer jobs)—including dates, nature of position, and school or organization.
- F. Military experience, with indication of professional relevance—if any.
- G. Scholarly publications, exhibits of creative work, membership in professional organizations and honorary societies.

4.14 Acknowledgements

If included, place between the abstract and the table of contents.

4.15 Table of Contents

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5. A PRIMER ON GRAMMAR

COMMON GRAMMATICAL ERRORS:

Apostrophe omitted from possessive (see item 1 below)

Failure to use a question mark with a question (see 9)

Use of a run-on sentence (see 4 and 5)

Use of a sentence fragment (see 6)

Misuse of semicolon (see 5)

Misuse of colon (see 8)

Confusion of *every day* with *everyday*

Confusion of *affect* with *effect*

Confusion of *its* with *it's* (see 1b)

Confusion of *cite* with *site*

Confusion of *to* with *too*

Confusion of *their* with *there*

1. Form the possessive singular of nouns by adding 's. The apostrophe must always be used. Follow this rule whatever the final consonant. Examples:

It was James's project.

This is his student's work.

This is all of his students' work. (The noun phrase *student work* is less awkward.)

The candidate's response was appropriate.

The response of the candidates was appropriate.

Candidate response was appropriate.

a. The pronominal possessives *hers* (analogous to *his*), *its*, *theirs*, *yours*, and *ours* have no apostrophe. Indefinite pronouns, however, use the apostrophe to show possession.

One's rights are sacred.

Somebody else's umbrella was left next to mine, and the two were identical.

b. A common error is to write *it's* for *its*, or vice versa. *It's* is a contraction, for "it is." The form *its* is a possessive. Example: It's this circuit that can run its own diagnostics.

2. In the names of business firms, the final comma is usually omitted. Follow the usage of the individual firm. Example: Merrill Lynch, Pierce, Fenner & Smith, Inc.

3. Enclose parenthetical expressions between commas.

The best way to see Greece, if you have the time, is to travel by car.

a. Dates contain parenthetical elements—June 3, 2002—but it is permissible to omit the comma when day precedes month, as in 3 June 2002.

b. The abbreviations *etc.* and *Jr.* are parenthetical, as are the abbreviations for academic degrees.

Orville Wright, Jr. was honored today.

All letters, packages, etc., should be left here.
John McEntire, Ph.D., presided over the conference.

4. Place a comma before a conjunction introducing an independent clause.

The early records of Rome have all but disappeared, and an account of its first years is fragmentary, at best.

5. Join independent clauses by a semicolon, not a comma.

Incorrect: It is nearly half past six, we cannot reach home before dark.

Correct: It is nearly half past six; we cannot reach home before dark.

Exception: short phrases that are related. Example: Here today, gone tomorrow.

6. Do not use sentence fragments in formal writing.

Avoid: Tutwiler is an interesting person. Full of himself but still remarkable.

Preferable: Tutwiler is an interesting person—full of himself but still remarkable.

7. A participial phrase at the beginning of a sentence must be adjacent to the subject.

Incorrect: On arriving in Minneapolis, a company representative met us at the gate.

(It was not the company representative who arrived, but us.)

Correct: On arriving in Minneapolis, we were met at the gate by the company representative.

8. The colon is properly used to call attention to the words that follow it.

Incorrect: The heart's two pumps each consist of: the atrium, or upper chamber, and the ventricle, or lower chamber.

Correct: South Dakota has only three seasons: July, August, and winter.

9. The double dash is used to set off parenthetical material that deserves emphasis.

Everything that went wrong that day—from the power failure first thing in the morning to the fire at sunset—can be attributed to human error.

10. Use square brackets to enclose any words or phrases that you have inserted into a direct quotation.

Scientific American reports that “if there are not enough young to offset deaths, the end of the species [the Bald Eagle] is only a matter of time.”

11. Use an ellipsis to indicate that material has been deleted from a direct quotation.

Barnes reports that “when the amount of cholesterol circulating in the blood rises over . . . 300 milligrams per 100, heart attack chances increase significantly.”

Note: A fourth period is added to the ellipsis if the deletion comes at the end of the sentence.

12. Use single quotation marks to enclose a quotation within a quotation.

“I was there when Ali claimed that he could ‘float like a butterfly and sting like a bee’.”