

MATH DEPARTMENT L^AT_EX STYLE GUIDE II: THIS TIME IT'S PERSONAL
NO REALLY, I MEAN IT THIS TIME

A Thesis

Presented to

The Faculty of the Department of Mathematics

San José State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

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June 2011

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The Designated Thesis Committee Approves the Thesis Titled

MATH DEPARTMENT L^AT_EX STYLE GUIDE II: THIS TIME IT'S PERSONAL
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by

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ABSTRACT
MATH DEPARTMENT L^AT_EX STYLE GUIDE II: THIS TIME IT'S PERSONAL
NO REALLY, I MEAN IT THIS TIME

by James E. Kittock

We describe how to use the L^AT_EX document system to write an SJSU master's thesis. It's great — everyone should do it! Actually, for more on writing an abstract, see the section on the abstract and the introduction.

This document is based on the document class `sjsuthesis.cls` developed by James Kittock, with style guide by Tim Hsu. Current revision, to match Graduate Studies and Research requirements: Summer 2019.

And here's a third paragraph in this sample abstract, just to see what happens. You can never be too sure about these kinds of things.

ACKNOWLEDGMENTS

This section is optional. Feel free to acknowledge friends and family for support.

This document is based on the Latex document class, `sjsuthesis.cls`, developed by James Kittock, with style guide by Tim Hsu to match Graduate Studies requirements of Spring 2011, and additional edits by K. Muster, K. Chng, and D. Almada in Summer 2019.

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LIST OF ABBREVIATIONS

AC	alternating (current)
\mathcal{O}	order of magnitude
SI	International System of Units
TLA	three-letter acronym

I. GETTING STARTED WITH L^AT_EX AND OUR THESIS TEMPLATE

First words go here. You can put the entire chapter in one file. I recommend using the “input” command for easier navigation, re-ordering, and deletion of sections. Note that this is different from the “insert” command used for chapters. The command, “input,” works the same as copying and pasting the L^AT_EX code.

1.1 Latex Setup

There are several reasons you should write your thesis using L^AT_EX and our math department style file.

- Our style file has been customized, with the help of Graduate Studies and Research, to fulfill the SJSU thesis formatting requirements without any extra effort.
- Once you get the hang of using L^AT_EX, typesetting and formatting mathematics is very natural. (In comparison, typesetting mathematics in most word-processing systems can be painful and time-consuming.)
- In L^AT_EX, numbering and referencing of chapters, sections, equations, and so on, is automatic, allowing for great flexibility in making changes. For example, if you want to insert an extra section or an extra chapter in the middle of your thesis, or reorder the sections within a chapter, in L^AT_EX this takes just a few minutes! (See Section 1.1.1 for an example of how this works.)
- The same L^AT_EX code you use to typeset the math in your thesis can be moved painlessly to a slide format for a poster presentation or for your thesis defense.
- Using L^AT_EX lets you concentrate on content and forget about appearance of your text.
- Finally, L^AT_EX is often used in technical/engineering workplaces to write manuals, so learning L^AT_EX is potentially a valuable job skill.

The downsides of using \LaTeX are that you will have to put in some time learning a new system and a slightly different way of thinking about word processing/typesetting; and to some extent, you will have to trade off ease of use (i.e., the point-and-click, drag-and-drop approach) for precise control. You may also occasionally have to experiment and fiddle with things to make them work. Nevertheless, for many people, this investment of time is well worth it, and often ends up saving time in the end.

1.1.1 *Typesetting math in \LaTeX*

When you write math in \LaTeX , it is often naturally divided into *environments* that correspond to the way mathematics is organized. For example, our math department thesis format has environments corresponding to standard definitions, theorems, and proofs.

Definition 1.1.1. Definitions look one way.

Theorem 1.1.2. *On the other hand, theorems look like this.*

Proof. And their proofs like this. Check out how equations look:

$$\int_a^b \frac{df}{dx} dx = f(b) - f(a) \tag{1.1}$$

(for f such that $f'(x) = \frac{df}{dx}$ is continuous on $[a, b]$, for example). \square

Note that the equation number appearing above is not typed in by hand, but actually generated by the \LaTeX program itself. The great thing about automatic numbering is that you can refer to Theorem 1.1.2 (in the original \LaTeX code, something like `Theorem \ref{thm:sample}`), and it will always refer to the correct theorem, even if you change the position of the theorem or rearrange the sections. (Try it on the `example.tex` file!) Something similar is true for equations, though referring to them works a little differently; e.g., see (1.1) (in \LaTeX , something like `\eqref{eq:ftc}`).

1.1.2

Getting L^AT_EX

One thing about how L^AT_EX works that may be different for you is that, unlike a word processing program, the file that you type into is different from the file that you print out. Specifically, for most up-to-date L^AT_EX systems, you type into a file called something like `thesis.tex`, using a type of program called a *text editor*, you run the L^AT_EX program to produce a PDF file called something like `thesis.pdf`, and you print out `thesis.pdf`. Some systems keep the text editor separate from the L^AT_EX part, and some systems integrate them, but either way, you should be aware that the parts are there somewhere.

Here are some popular ways to run L^AT_EX (this was written before 2010, so some information may be outdated):

- **Browser, use an online editor.** Websites like Overleaf, found on <https://www.overleaf.com>, make using and sharing L^AT_EX files simple. It is recommended to enable a Main file and make PDF a separate tab by making it fullscreen.
- **PC, separate text editor and L^AT_EX.** Download the following programs:
 - (1) Get L^AT_EX for **free** at <http://www.miktex.org>. *One tricky point:* When you install MiKTeX, at some point, you will be asked what your favorite paper is; make sure you answer “Letter paper” and not the British paper size “A4” (which is the default!).
 - (2) Get the WinEdt text editor at <http://www.winedt.com>. The creators of WinEdt request a **\$30** shareware fee, which we urge you to pay to help keep WinEdt going.
- **PC, integrated environment.** Buy PCTeX at <http://www.pctex.com>. This is **\$150** (student price) for the “Publisher” version, which is recommended if you

have the money, and **\$50** (student price) for the “Writer” version, which is recommended (sort of, see below) if you don’t.

- **Mac, integrated environment.** Download the TeXShop system for **free** at <http://www.uoregon.edu/~koch/texshop/>.
- **Linux or Mac OS X, separate text editor and L^AT_EX.** If you run Linux at home, L^AT_EX is almost certainly already installed on your machine, as is the text editor emacs. (Of course, if you’re a Linux user, you’re the sort of person who doesn’t need instructions.)

Also, if you have a Mac running OS X, and you’re fond of the command line, you can download L^AT_EX and emacs for **free** from the usual sources — but if your taste in computing is *that* perverse, you really don’t need instructions on how to do that. (Spoken from experience: This style guide was produced using command-line L^AT_EX and emacs.)

More specifically, if you own a PC, it seems that the best option for most people is to use WinEdt and MikTeX. If you are strongly computer-phobic, try the “Publisher” version of PCTeX, which can produce PDF output, whereas the “Writer” version cannot. Only if you are both strongly computer-phobic and short on cash should you buy the “Writer” version of PCTeX.

1.1.3 *First step: Compile the example*

The next step is to run L^AT_EX on the file `example.tex` in this directory, to see if you can reproduce this file, `example.pdf`. (Make a copy of this version in a safe place first.) We refer you to the instructions that go along with your software for details, but the most important distinction is between systems that use PDF-style latex (“pdf_latex” systems) and systems that use plain (old-school) latex. This distinction becomes important if you want to put pictures in your thesis, so please read ahead a bit before you do this. It is also

important to note that if you want to use JPEG pictures (e.g., digital photos) directly, you should use a pdflatex system like WinEdt/MikTeX or TeXShop.

- WinEdt/MikTeX (a pdflatex system): Open `example.tex` using WinEdt, and press the “bear” (pdflatex) button on the menu bar.
- PCTeX (a plain latex system): Open `example.tex` using PCTeX, modify the figure environments in the section “Including pictures in your thesis”, below, and press the “latex” button (see PCTeX instructions).
- TeXShop (a pdflatex system): Open `example.tex` using TeXShop, and press the “Typeset” button on the menu bar.
- Command-line systems (Linux, Mac OS X, etc.): You can choose either the command `pdflatex example` or the command `latex example`. If you choose the latter, the output file will be a file called `example.dvi`, which you can convert to PDF (printable) format by the commands:

```
dvips example -o
ps2pdf example.ps
```

You may want to put that in a macro. Note that pdflatex is more direct, but you may prefer to use plain latex to include certain kinds of pictures; see Section 1.4.1.

1.2 Other Setup

This section is a collection of commands and ways to include objects in the thesis body.

1.2.1 *References and Bibliography*

The way L^AT_EX handles references is that bibliographic information goes in a file like the file `refs.bib` included in this directory. Then, when you refer to a book in the course

of your thesis, you type something like `Artin~\cite{Artin:Algebra}`, press some appropriate sequence of typesetting buttons (see below), and hey presto, the reference Artin [1] appears appropriately formatted. Again, you just concentrate on content, and \LaTeX and our style file take care of making things look good!

Though to be precise, that is not completely true. In your text, you *do* need to refer to papers and books in a standard style, which goes something like:

(name(s) of author(s)) [reference tag]

The basic idea is that you refer to a reference by the name(s) of its author(s), and the [name] tag is supplied by \LaTeX . A good rule of thumb is that if the tag is erased, your text should still make sense. For example: “In Pomerance [2], we see that...” or “For our standard algebra reference, we use Artin [1, Ch. 2].” It may be a little strange, at first, to refer to a book by its author’s name, but that is the standard practice. (See the bibliography section at the end of this document to see what the tags are referring to.)

Your references are stored in a file called `refs.bib`, which you need to edit separately. Precise details of the format of a `.bib` file can be found elsewhere, but for the purposes of your thesis, you will almost certainly be able just to imitate one of the entries in the version of `refs.bib` included in this package. These include the following types of bibliographic references. (Compare the source code of `example.tex` with how these references appear in print in the text of this document and the bibliography section.)

- References to articles in a mathematical or scientific journal look like
Pomerance [2] or Bektemirov, Mazur, Stein, and Watkins [3].
- You can refer to a book, like Artin [1], or a chapter within that book, as in
Artin [1, Ch. 4]. Articles and books are the most common types of references to appear in theses.
- You may need to refer to an unpublished paper or preprint, like Fermat [4].

- The entry Asimov [5] illustrates two points. First, this kind of .bib entry is used for articles that appear in non-journal collections of articles, like conference proceedings. The other point is that L^AT_EX will often turn capital letters in titles to lowercase letters (this is part of many standard bibliographic styles). Therefore, if something like a proper noun (e.g., someone's name) appears in a title, you need to put it inside brackets in your .bib file to tell L^AT_EX not to lowercase it.
- Finally, you may need to cite a web page or other informally published electronic material. As always, the main point is that you need to give enough information for the reader to check your citation, so make sure you include a very complete URL for all web pages. See the entry for Dunn [6].

Now, the first time you latex a file that contains bibliographic citations, the citations may look like [??]. To make the references in a document appear properly, try the following sequence of commands, or the analogous button-pushing sequence.

```
latex example
bibtex example
latex example
latex example
```

WinEdt, PCTeX, and TeXShop all do this sequence automatically when necessary, but it never hurts to bibtex and latex a few more times just to make sure, especially if, for example, you're just about to turn in the final draft of your thesis.

1.3 Abstract and introduction

When you have completed the technical content of your thesis, one of the very last things you should do is to write your abstract and your introduction. Both are summaries of your thesis, but roughly speaking, the abstract is for experts, and the introduction is for novices. More precisely:

- Your abstract should give a very brief (at most 150 words, by Graduate Studies and Research rules) technical summary of what you did in your thesis. You do not need to give much, if any, context for what you did; the point is to let an expert know very quickly what is contained in your thesis.
- Your introduction should also summarize what is in your thesis, but should provide context and background for the reader unfamiliar with your subject. A good introduction answers questions like: What is the point of all this? What previous work has been done on this topic? What is new or original here, and what is previously well-known?

If you make your entire Chapter 1 your introduction (recommended), here is a good way to structure it. (Of course, this is only one way to write an introduction, and you are not required to use this approach, but it does seem to work quite well.)

- Section 1.1: Try to state the main problem you are considering to the extent that you can without going too much into details of definitions. Give context and history for the problem: What has been done previously, who did it, and when? Try to give a clear idea of what is new here, what is standard material, and what is somewhere in the middle (new exposition of well-known facts).
- Section 1.2: Give an overview of what is contained in your thesis. A seemingly boring but actually very useful way to do this is to expand on your table of contents: “In Chapter 2, we In Chapter 3, we”
- Section 1.3: Define any unusual notation you might be using.

Of course, one of the great things about doing your thesis in \LaTeX is that you can insert a new Chapter 1 near the end of your writing process, and the rest of your thesis will automatically renumber itself to match!

1.4.1

Typesetting Commands
Including pictures in your thesis

Again, the precise method of including pictures depends on whether your version of \LaTeX is a modern pdf \LaTeX system (e.g., WinEdt/MikTeX, TeXShop) or an old-school plain latex system (e.g., PCTeX). In any case, the basic idea is that each picture goes in a figure environment, whose placement is somewhat independent of the regular placement of other text in your thesis.

With pdf \LaTeX -style systems, you can include either PDF (vector graphics) pictures or JPEG (raster/bitmap graphics) pictures. shows the result of including a PDF file in a \LaTeX document, and Figure FIG. 1.2 shows the result of including a JPEG file in a \LaTeX document. Note that figures will often *not* appear in the location in your text where you originally ask them to appear, so your text should not depend on a figure appearing in one particular location. In other words, your main text should still make sense if the figure is removed completely. (As a rule, however, there should be a reference to a figure soon before it appears in your thesis, much as we have referred to Figures FIG. 1.1 and FIG. 1.2 here just before they actually appear.)

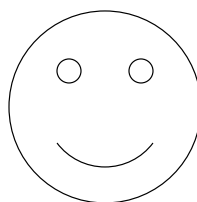


FIG. 1.1. A PDF figure

The following is an example of a multi-part figure with labels “a,” “b,” and “c.”



FIG. 1.2. A JPEG figure. This caption should be single spaced as specified by the Graduate Studies style guide.

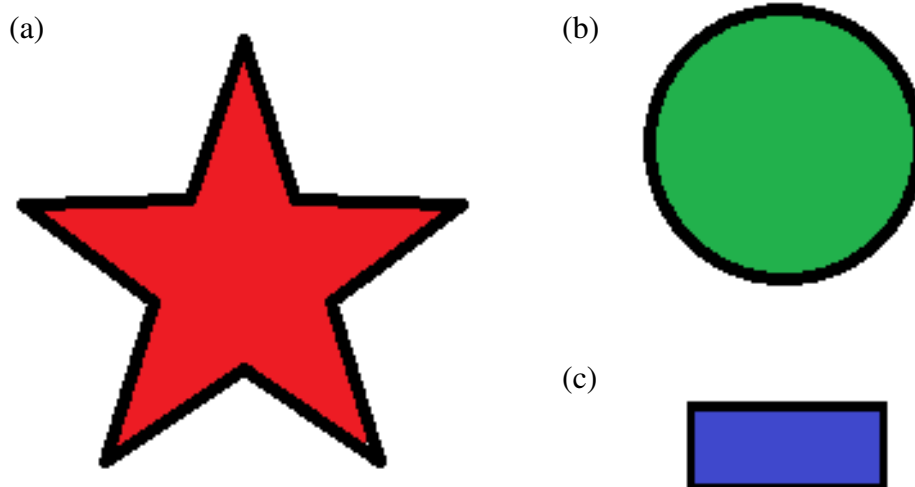


FIG. 1.3. Several shapes were produced in Microsoft Paint, (a) a red star, (b) a green circle, and (c) a blue rectangle.

Finally, as promised, FIG. 1.4 shows the result of including an EPS file in a \LaTeX document. Again, note that this will not work for pdf \LaTeX -style systems, so make sure you plan ahead.

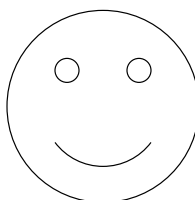


FIG. 1.4. An EPS (encapsulated Postscript) figure

Note that currently, this file automatically produces a List of Figures in its front matter (things before Chapter 1). If fewer than three figures appear in your thesis (e.g., if you do not use any figures), you should remove the List of Figures by changing the line at the beginning of this file that says `%\emptyLoF` to `\emptyLoF`.

1.4.2 *Tables*

Tables are handled much the same as figures, though since tables are easier to typeset, they can be made within \LaTeX without the use of some external program. Table TABLE 1.1 gives an example of a table and how it is labeled by its caption. Note that as a rule, table captions are placed above the table and not below, though this can vary with different standard styles. Again, tables should be referred to in the text soon before they actually appear.

TABLE 1.1. Starting salaries at NSA

Highest degree earned	Average starting salary
Bachelor's	\$42,207
Master's ¹	\$58,203
Ph. D. ²	\$86,172

If you have more than 3 tables within your thesis, you will need to have a List of Tables, similar to the List of Figures mentioned in . Just put a % in front of the `\emptyLoT` command at the beginning of this file to make the List of Tables appear.

1.4.3 *Writing mathematics well*

What we have discussed so far should give you some idea of how to produce a reasonable-looking document using our \LaTeX document class. What we have not really discussed, however, is how to write mathematics *well*. This is a complicated and subtle issue that, to be honest, many mathematicians have not mastered. We therefore mention only a few key points.

- (1) Theses in mathematics should be written using the usual conventions of formal writing. For example, do not use contractions.
- (2) The strangest conventions of written mathematics are the use of the “mathematical we” (first person plural) and the present tense. The basic idea is that, in a situation where a scientific paper might use the passive voice and the past tense (“The groups of order 144 were studied”), a math paper uses “we” in the present tense (“We study the groups of order 144”). In general, all of your thesis except the introduction should be written in the present tense.
- (3) In an introduction, the past tense is useful for distinguishing between work previously done on your topic and what you are doing in your thesis: “Wiles and Taylor showed that. . . . We show that. . . .”
- (4) The biggest key is to be organized. Give your work structure and put it into some kind of outline framework, instead of just telling a story 5-year-old-style: “And then. . . . And then. . . .”
- (5) A few small things:
 - Words like Theorem x.y, Lemma x.y, Chapter x, Section x.y, should all be capitalized.
 - Do not start a sentence with a mathematical symbol. For example, instead of “ G is therefore abelian,” use “Therefore, G is abelian” or “The group G is therefore abelian.”
 - There are different ways to deal with equations mod n , depending on whether the equation appears in text or in a stand-alone equation. In text, an equation might look like $2 + 2 \equiv 21 \pmod{n}$, and as a stand-alone equation, the same equation would become

$$2 + 2 \equiv 21 \pmod{n}. \tag{1.2}$$

Compare the source code for `example.tex` to see how those two equations are produced.

For more ideas on the style and substance of writing mathematics, see *The Chicago Manual of Style* [7, Ch. 14] (note how this citation shows how L^AT_EX handles references with no author or editor) and Knuth, Larrabee, and Roberts [8]. A free version of the latter source can be found in the file `mathwriting.pdf`; pages 1–6 give a good list of tips to help you get started.

1.4.4 *Making pictures for your thesis*

Things get a little more complicated if you want to use pictures in your thesis. Before you start, you need to answer three questions.

- (1) Do you want to use precise, line-drawing, diagram-type pictures; do you want to use more fuzzy, photograph-like pictures; or do you need both types? If you need to make the first kind of picture, you'll want to get a *vector graphics editor*, and if you want to make the second kind of picture, you'll want to get a *raster (bitmap) graphics editor*.
- (2) Will you be using picture formats compatible with `pdflatex`, namely, PDF and JPEG/.jpg files, or will you be using the picture format compatible with plain latex, namely, EPS? Note that you will have to choose one approach or the other and stick with it; there is no mixing the two systems.
- (3) Will you be using some kind of well-known mathematical software (e.g., MATLAB or Maple) to make pictures? If so, which of the above output formats does your program produce?

Once you've answered those questions, you can decide which program(s) to buy or download.

- If you need a vector graphics editor (diagram-type pictures), the standard commercial program is Adobe Illustrator (**\$200** student price, PC and Mac, Spartan Bookstore). Xfig is a good **free** program that is close enough to Illustrator for most purposes; it can be downloaded for Linux or Mac OS X at <http://xfig.org/>. (For Mac OS X, you may first have to install the X Window system from the Optional Packages folder of the Mac OS X Install DVD.) Winfig, which is basically the Windows/PC version of xfig, is available at <http://www.schmidt-web-berlin.de/winfig/> for a **\$25** shareware registration fee.
- If you need a raster/bitmap graphics editor (photograph-type pictures), the standard commercial program is Adobe Photoshop (**\$300** student price, PC and Mac, Spartan Bookstore). There is an excellent **free** program named, unfortunately, GIMP (GNU Image Manipulation Program) that is downloadable at <http://www.gimp.org/>, in PC and Mac/Linux versions. (Again, for Mac OS X, you will first need to install the X Window system.)

1.5

Last Words

You may have noticed that all of the chapter and section titles in this document are capitalized in what is known as *sentence case*; for example, the title of Section 1.4.3 is “Writing mathematics well”, not “Writing Mathematics Well,” as one would do in *headline style*. When submitted in Summer 2019, Graduate Studies required title case, in which you capitalize every word except for minor words like “the,” “of,” and “from.”

For more about L^AT_EX, try the following references. All can be purchased online at the usual places or at many technical bookstores.

- Griffiths and Higham [9] is a very good beginner’s guide, and is especially notable for its brevity (just 94 pages).

- Lamport [10] is the classic guide, and while it is neither entirely for beginners nor exhaustive as a reference, it strikes a good balance between the two extremes.
- Kopka and Daly [11] is encyclopedic and thorough. Not at all meant for beginners, but a good reference.
- For the truly hardcore who want to try things like rewriting style files, there is always Knuth [12].

Please send corrections and suggestions to Tim Hsu (tim.hsu@sjsu.edu), who maintains this template. And have fun!

II. EXPERIMENTAL METHODS

This other chapter is just to illustrate how the table of contents, etc., work. Note that chapters after the first chapter all get page numbers. (Though one of the best parts of using our L^AT_EX style file is that you no longer have to think about things like that!)

2.1 A section of words

It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way- in short, the period was so far like the present period, that some of its noisiest authorities insisted on its being received, for good or for evil, in the superlative degree of comparison only.

2.2 Just another section

To show how the table of contents stuff works, and how multiple sections work.

III. RESULTS AND ANALYSIS

Results go here.

IV. CONCLUSION

Conclusion goes here. You probably don't need a separate folder for this.

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APPENDIX

A. DERIVATIONS

This section includes relevant derivations and technical discussions for equations used in the thesis.

A.1 The quadratic formula

The quadratic formula is used to solve functions of the type,

$$y = ax^2 + bx + c . \quad (\text{A.1})$$

The two solutions of Equation (A.1) can be evaluated with the quadratic formula,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} . \quad (\text{A.2})$$

The solutions evaluated using Equation (A.2) may be both real or both imaginary.

A.2 Maxwell's equations

The electric and magnetic fields are governed by Maxwell's equations,[13]

$$\nabla \cdot B = 0 , \quad (\text{A.3a})$$

$$\nabla \cdot D = \rho , \quad (\text{A.3b})$$

$$\nabla E + \frac{\partial B}{\partial t} = 0 , \quad (\text{A.3c})$$

$$\nabla H - \frac{\partial D}{\partial t} = J , \quad (\text{A.3d})$$

where E and B are the total electric and magnetic fields, D and H are external fields, ρ is the free charge density, and J is the free current density.[13] These are useful equations for any physics student to memorize.

A.3 Simple algebra

Here I demonstrate how to solve an algebraic equation. This is done as an example of math formatting. We start with the equation,

$$2x + 3 = x - 1 . \quad (\text{A.4})$$

Equation (A.4) is a linear equation, so Equation (A.2) discussed in Derivation A.1 is not needed. We start by moving expressions around by performing the same operations on both sides,

$$2x + 3 - x = x - 1 - x$$

$$x + 3 = -1 \tag{A.5}$$

$$x + 3 - 3 = -1 - 3$$

$$x = -4 . \tag{A.6}$$

In Equation (A.5), we move all terms with x to the left. Then in Equation (A.6) we move all numeric terms to the right side. This gives us the solution, $x = -4$.

APPENDIX

B. SECOND APPENDIX

Nothing to see here.