

# Guidelines for Collaboration

Zhiyang Ong \*

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## Abstract

This is a set of guidelines for development/design processes, methodologies, and practices, as well as conduct while collaborating on open source projects, spanning engineering, computer science, data science, and network science. It also includes guidelines for creating a shared `BIBTeX` database.

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\*Email correspondence to: ✉ [ongz@acm.org](mailto:ongz@acm.org)

## Revision History

Revision history:

1. Version 1, October 2, 2014. Initial version of the guideline (for another project).
2. Version 1.1, December 23, 2014. Version ported for this boilerplate code project.
3. Version 2, October 20, 2015. Added guidelines for **Doxygen**-supported, **Javadoc**-based coding standard. This coding standard is also known as coding style, coding style guide, coding guideline, coding scheme, code convention, code documentation guideline, programming guideline, or programming style.
4. Version 2.1, October 21, 2015. Finished guidelines for **Doxygen**-supported, **Javadoc**-based coding standard for *C++*.
5. Version 2.2, June 4, 2016. Finished section for additional guidelines: to include documentation using *Markdown*, and tools for software development, integrated circuit and cyber-physical system design, and documentation.
6. Version 3, November 3, 2016. Added guidelines for: documenting *GNU Octave* and MATLAB code, in order to facilitate documentation generation using *Texinfo* [373–375, 422]; sharing of source code, design files, sets of benchmarks, data sets, and documentation on online repositories [120, 146]; and added section on exception safety.
7. Version 3.1, November 4, 2016. Fixed references for indent style conventions.
8. Version 3.2, December 20, 2016. Update guidelines for conduct.
9. Version 3.3, February 3, 2017. Update information about usage of *GitHub*’s services.
10. Version 3.4, March 11, 2017. Update information on naming convention.
11. Version 3.5, October 9, 2017. Update guidelines on commenting/writing code.
12. Version 3.6, December 24, 2017. Fix grammatical error in a sentence.
13. Version 3.7, January 25, 2018. Added suggestions for software architecture of my computer programs.
14. Version 3.8, January 31, 2018. Added information about coding style guideline for different computer languages, and also about online repositories that facilitate research reproducibility, replicability, and repeatability.
15. Version 3.9, February 1, 2018. Added information about developing software in a *Pythonic* style.
16. Version 4.0, June 8, 2018. Added information about specifying (co-)authors’ full name, and research reproducibility, and other best practices from software development, and embedded/cyber-physical system and integrated circuit design.
17. Version 4.1, September 19, 2018. Updated ACM Code of Ethics and Professional Conduct; added The Joint ACM/IEEE-CS Software Engineering Code of Ethics and Professional Practice; and updated guidelines on exception handling.
18. Version 4.2, September 21, 2018. Added acknowledgements, shout outs, for people who helped me with automated regression testing. And, refactored document.
19. Version 4.3, September 22-25, 2018. Added references on agile SoC design, and hardware/VLSI/RTL/HDL refactoring.
20. Version 4.4, December 29-30, 2018. Added template information for the **Annote** and **Howpublished** **BIBTeX** fields to help me identify particular information about the document/publication.
21. Version 4.5, February 11, 2019. Extend recommendations and suggestions to projects in data science and (applied) machine learning.

22. Version 4.6, February 14, 2019. Add references for *Git* and its substitute, *Mercurial SCM*, for distributed version/revision control (or software configuration management). Also, add “Acknowledgments” and “Revision History” sections to the “Table of Contents”.
23. Version 4.7, March 13, 2019. Add comment on how to include mathematical expressions in *Markdown* documents. In addition, fix minor errors.
24. Version 4.8, January 22, 2020. Fix  $\text{\LaTeX}$  key error (renamed for a publication), and added references regarding design by contract (or programming by contract, or contract programming) and Hoare logic.
25. Version 4.9, March 11, 2021. Fix minor errors in guidelines for creating shared  $\text{\LaTeX}$  databases.
26. Version 5.0, June 20, 2021. Refactor §2.2 to include information about publications in the **Annote** field of  $\text{\LaTeX}$  entries.
27. Version 5.1, October 31, 2021. Add a To-Do list.
28. Version 5.2, April 25, 2022. Updated document with clarifications, in the abstract and conduct guideline.
29. Version 5.3, June 4, 2022. Updated document with information about converting text into all uppercase or lowercase, which is useful for writing dissertations and theses.
30. Version 5.4, June 4, 2022. Updated §6 on best/good practices for software development, integrated circuit design, and cyber-physical system design projects for more clarity.

## 1 Guidelines for Conduct

Collaborators of open source software and/or hardware projects that we are involved in should follow the *Code of Conduct* of the *Institute of Electrical and Electronics Engineers* (IEEE) [183–185] and the *ACM Code of Ethics and Professional Practice* of the *Association for Computing Machinery* (ACM) [5, 21, 51–53, 157–159, 433], including the “The Joint ACM/IEEE-CS Software Engineering Code of Ethics and Professional Practice” [160, 161]. Also, actions of discrimination are not acceptable [186]; we should intentionally commit to inclusive diversity, equity, justice, and accessibility [334] as well as honesty [49, 65, 70, 98, 141, 168, 221, 251, 254, 274, 285, 305, 321, 328, 329, 349, 350, 383] and accountability [6, 46, 63, 74, 75, 80, 91, 104, 110, 122, 124, 134, 137, 150, 152, 273, 301, 302, 328, 333, 344, 365, 378, 394, 411]. In addition, we should embrace the values and principles of agile software development [36, 67, 304]. An additional guideline is “Dave Packard’s 11 simple rules” [175].

While collaborating, we should practice ethical and healthy conflict resolution (Cite this!!!), and engage in scalable compassion (Cite this!!!) by working on projects for social, economic, and environmental good (Cite this!!!). We should also exercise intellectual humility and servant leadership (Cite this!!!).

In addition, when there is a dispute about which technology, algorithm, design paradigm/style/-pattern, process, or methodology to use, follow or adhere to the “Code Wins Arguments” [218, 441] guideline. Also, when considerable effort has been invested in an automated regression testing/verification infrastructure, do not be afraid to “move fast and break things” [111, 123].

Lastly, we should adopt a mission-focused and value-based approach to participate in meetings and discussions for the project(s). We should be intellectually curious (CITE THIS!!!)

and flexible/liberal enough to consider and explore viable alternate approaches to do things and solve problems [35, 36]. Where disputes occur, a data-driven, fact-based approach based on the “Code Wins Arguments” guideline should be used to resolve conflicts.

## 2 Guidelines for Creating a Shared BIB<sub>T</sub>E<sub>X</sub> Database

Guidelines for creating BIB<sub>T</sub>E<sub>X</sub> entries and the BIB<sub>T</sub>E<sub>X</sub> database, which is used for writing the paper, are given as follows:

1. Each BIB<sub>T</sub>E<sub>X</sub> key should be unique:
  - (a) Check if your desired BIB<sub>T</sub>E<sub>X</sub> key already exists in the BIB<sub>T</sub>E<sub>X</sub> database:
    - i. If it does, and the BIB<sub>T</sub>E<sub>X</sub> entry for the publication already exists in the BIB<sub>T</sub>E<sub>X</sub> database, do not add it to the BIB<sub>T</sub>E<sub>X</sub> database.
    - ii. Else if the desired BIB<sub>T</sub>E<sub>X</sub> key exists in the database, but the BIB<sub>T</sub>E<sub>X</sub> entry for the publication does not exist in the BIB<sub>T</sub>E<sub>X</sub> database, repeat the process with an updated BIB<sub>T</sub>E<sub>X</sub> key (add the letter “a”, select the next letter in the English alphabet, or pick the next number), and add information about the publication to the BIB<sub>T</sub>E<sub>X</sub> database.
    - iii. Else if the desired BIB<sub>T</sub>E<sub>X</sub> key and associated publication do not exist in the database, add it to the BIB<sub>T</sub>E<sub>X</sub> database.
  - (b) Use the following format for creating BIB<sub>T</sub>E<sub>X</sub> keys: [first] author’s last name, appended by the year of publication. E.g., my first conference paper would have the BIB<sub>T</sub>E<sub>X</sub> key Ong2004. If the year of publication is not known, use an approximate year, with XY for the last 2 digits in the year (e.g., 20XY). Alternatively, if you cannot determine if it was published this millennium or the previous millennium (or much earlier), use UNKNOWN for the “year”. For example, use KleinbergUNKNOWN (preferred for unknown millennium), or Smith20XY (for unknown year in the 21<sup>st</sup> century).
    - i. For (last) names that end with a number, append the year to it anyway. We can still process the last four characters/digits of the year to determine the year of publication. I assume that there are no publications before 0 C.E. (common era).
  - (c) Remove duplicate entries in the BIB<sub>T</sub>E<sub>X</sub> database. **WARNING! Before doing this, perform a union operation on the fields of the BIB<sub>T</sub>E<sub>X</sub> entries. For example, if a BIB<sub>T</sub>E<sub>X</sub> entry has information that the other BIB<sub>T</sub>E<sub>X</sub> entry does not have, or vice versa, merge the information to one BIB<sub>T</sub>E<sub>X</sub> entry.:**
    - i. **Rationale: Duplicate BIB<sub>T</sub>E<sub>X</sub> entries will cause problems in typesetting.**
  - (d) Regarding hash collision of BIB<sub>T</sub>E<sub>X</sub> keys, such as multiple instances of Gratz2014, distinguish them by appending a letter to them. E.g., use Gratz2014, Gratz2014a, Gratz2014b, Gratz2014c, and so on. If we run out of letters, append it with “a” followed by a number. The use of the letter “a” separates the year from the instance of BIB<sub>T</sub>E<sub>X</sub> key. That is, Gratz2014a2 tells me that it is the 29<sup>th</sup> instance of Gratz2014, as opposed to Gratz201429.
  - (e) If possible, restrict the characters of each BIB<sub>T</sub>E<sub>X</sub> key to be alphanumeric. The year is always numeric, and is appended to the (first) author’s last name.
    - i. If the (first) author’s last name has characters with diacritical marks, accents, or diacritics, remove/trim the characters used to typeset the diacritical marks (or accents) from the (first) author’s last name, and append the year of publication to it. E.g., *Sőménzi* (year 2000) becomes *Somenzi2000*.
    - ii. If the (first) author’s last name has characters that are not letters in English, anglicize those characters. Unless specified by the co-authors, we should avoid using the

transliteration for a given non-English language, since such transliteration may not be standardized (for non-commonly spoken/used languages). Also, supporting letters from other languages is a tedious task. Hence, we can use the anglicized version of their last names instead.

- (f) For reports, manuals, booklets, and other publications that list the author as the name of the organization publishing it, specify the author field and BIB<sub>T</sub>E<sub>X</sub> key as follows:

- i. Author =  $\{ \{ [\text{Name-of-Organization}] \text{ staff} \} \}$ ,
  - A. **Append the word “staff” to the name of the organization, and use this as the author’s name.** Ensure that this name would typeset as it appears as one token by surrounding/encapsulating this name with round brackets (or parentheses). The name of the organization in this example is given within square brackets.
- ii. Its BIB<sub>T</sub>E<sub>X</sub> key, for the publication year of 20XY, is: NameOfOrganizationStaff20XY.
  - A. For names of organizations with multiple words, concatenate the words while capitalizing the first letter of each word (even for articles and conjunctions, such as “of”, “the”, and “and”). This makes the BIB<sub>T</sub>E<sub>X</sub> key easier to read.
  - B. If the name of an organization is a capitalized acronym, such as CIAO, concatenate its name with the word “staff” without capitalizing the first letter “s” in “staff”. This also makes the BIB<sub>T</sub>E<sub>X</sub> key easier to read. An example for a publication year of 20XY is: CIAOstaff20XY.
  - C. Similarly, if the name of an organization ends with a capital letter, such as TrentoSMT, concatenate its name with the word “staff” without capitalizing the first letter “s” in “staff”. This also makes the BIB<sub>T</sub>E<sub>X</sub> key easier to read. An example for a publication year of 20XY is: TrentoSMTstaff20XY.
- iii. **Likewise, for communities and non-profit organizations, the words “members” or “contributors” can be used instead**, such as:
  - A. Author =  $\{ \{ [\text{Name-of-Organization}] \text{ members} \} \}$ ,
  - B. NameOfOrganizationMembers20XY
  - C. CIAOmembers20XY
  - D. TrentoSMTmembers20XY
  - E. Author =  $\{ \{ [\text{Name-of-Organization}] \text{ contributors} \} \}$ ,
  - F. NameOfOrganizationContributors20XY
  - G. CIAOcontributors20XY
  - H. TrentoSMTcontributors20XY

2. If possible, use the full name for each author.

- (a) We justify this as follows.
- (b) When writing research publications, if we need to reduce the authors’ first name to just their initial, we can use a script to transform their names.
- (c) If we need to use their full names in the reference list, or to differentiate multiple authors with the same initials for their first name and the same last name, and if we do not include their full names, we have to look up these references again in the future to include their full names.

3. For terms that should be typeset as is, place them in between braces (i.e., curly brackets). That is, put curly braces around acronyms and mixed-case names.

- (a) For example, terms in upper or mixed cases (upper and lower cases), such as names (e.g., McMullen) and acronyms (e.g., SIGDA), place them in between braces (i.e., {McMullen} and {SIGDA}). This prevents the titles (or another BIB<sub>T</sub>E<sub>X</sub> field) from changing the term into lower case, with exception for the first term/word. E.g., “ICCAD Update: A Report from SIGDA” may typeset into “Iccad Update: A Report from Sigda”.

4. For special symbols that are typeset with L<sup>A</sup>T<sub>E</sub>X in the `math mode`, such as  $\alpha$ , place them in between a pair of dollar signs (i.e., `\alpha`).
5. For each B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> entry, check if all required fields are complete. See pages 8 and 9 in §3.1 of [303] for a list of B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> entry types; alternatively, refer to the *Wikipedia* entry for B<sub>I</sub>B<sub>T</sub>E<sub>X</sub>, or [208, §12.2.1, pp. 230–231]. In this/these list(s), the required fields are listed for each B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> entry.
6. For the `Pages` field, ensure that all page ranges are indicated with double hyphens. E.g., “Page = {11–34},”. This makes the page range look better.
7. For the `Pages` field, ensure that multiple pages and/or page ranges are separated by commas. E.g., “Page = {11-34, 57, 88, 109–187},”.
8. For books and journal articles that have an associated digital object identifier (DOI) [188], ensure that the `Doi` field is included in the B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> entry with the DOI of the publication. This makes it easier for people to access the Web page for the book or journal/conference paper.
9. Stylistic validation of the references can be carried out as follows:
  - (a) Include all B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> keys in one citation, or a set of citations (for more than 1,000 B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> keys, or even 100 B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> keys, for a single L<sup>A</sup>T<sub>E</sub>X `\cite` command), using the L<sup>A</sup>T<sub>E</sub>X `\cite` command in a simple, template-based L<sup>A</sup>T<sub>E</sub>X document:
    - i. The L<sup>A</sup>T<sub>E</sub>X `\nocite{*}` command allows the generation of a bibliography, or list of references, containing all the B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> entries without including all their B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> keys in a L<sup>A</sup>T<sub>E</sub>X `\cite` command (would fail to work for large B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> databases, such as those with >10,000 B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> entries), or set of L<sup>A</sup>T<sub>E</sub>X `\cite` commands to partition a large number of B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> keys into multiple L<sup>A</sup>T<sub>E</sub>X `\cite` commands [417, in §2 Citations: §2.4 No cite].
    - ii. Use the `typeset_to_pdf.py` Python script [287] to obtain the set of B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> keys from a B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> database, and include them in citations using multiple L<sup>A</sup>T<sub>E</sub>X `\cite` commands, in a standalone L<sup>A</sup>T<sub>E</sub>X file that can be included in a simple L<sup>A</sup>T<sub>E</sub>X template for typesetting; see [https://github.com/eda-ricercatore/bibtex-analytics/blob/master/typeset\\_to\\_pdf.py](https://github.com/eda-ricercatore/bibtex-analytics/blob/master/typeset_to_pdf.py).
  - (b) Typeset the L<sup>A</sup>T<sub>E</sub>X document:
    - i. Typesetting the L<sup>A</sup>T<sub>E</sub>X document using the L<sup>A</sup>T<sub>E</sub>X `\nocite{*}` command should run faster than using a L<sup>A</sup>T<sub>E</sub>X `\cite` command or multiple L<sup>A</sup>T<sub>E</sub>X `\cite` commands.
  - (c) Check that the font and style of the reference list is correct.
  - (d) If there are errors, correct the errors as appropriate.
  - (e) Finally, the B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> database should be correct.
10. Information that I would include when citing common sources of information, such as *Wikipedia*, using the Harvard Referencing Style [258, 259, 397, 398, 428, 429]:
  - (a) Wikipedia contributors, “TITLE\_OF\_THE\_ARTICLE,” in {*\it* Wikipedia, The Free Encyclopedia: CATEGORY}, Wikimedia Foundation, San Francisco, CA, MONTH DATE, YEAR. Available online at: `\url{URL}`; last accessed on August 26, 2014.
  - (b) Wikibooks contributors, “CHAPTER\_NAME,” in {*\it* TITLE\_OF\_THE\_BOOK}, Wikibooks: Open books for an open world, Wikimedia Foundation, San Francisco, CA, MONTH DATE, YEAR. Available online at: `\url{URL}`; last accessed on August 26, 2014.
  - (c) Wikibooks contributors, “SECTION,” in {*\it* CHAPTER} of {*\it* TITLE OF THE BOOK}, Wikibooks: Open books for an open world, Wikimedia Foundation, San Francisco, CA, MONTH DATE, YEAR. Available online at: `\url{URL}`; last accessed on August 26, 2014.

- (d) Wikibooks contributors, “TITLE\_OF\_THE\_BOOK,” Wikibooks: Open books for an open world, Wikimedia Foundation, San Francisco, CA, MONTH DATE, YEAR. Available online at: \url{URL}; last accessed on August 26, 2014.
  - (e) Wikiquote contributors, “TITLE,” Wikiquote, Wikimedia Foundation, San Francisco, CA, MONTH DATE, YEAR. Available online at: \url{URL}; last accessed on August 26, 2014.
  - (f) Wiktionary contributors, “TITLE,” Wiktionary, Wikimedia Foundation, San Francisco, CA, MONTH DATE, YEAR. Available online at: \url{URL}; last accessed on August 26, 2014.
  - (g) Dictionary.com, “WORD,” IAC, Oakland, CA, MONTH DATE, YEAR. Available online at: \url{URL}; last accessed on August 26, 2014.
  - (h) AUTHOR, “TITLE,” in {\it The New York Times: The Opinion Pages: Op-Ed Contributor}, The New York Times Company, New York, NY, MONTH DATE, YEAR. Available online at: \url{URL}; last accessed on August 26, 2014.
  - (i) AUTHOR, “QUESTION”, in {\it CATEGORY}, Quora, Inc., Mountain View, CA, MONTH DATE, YEAR. Available online at: \url{URL}; last accessed on August 26, 2014.
  - (j) AUTHOR, Answer to “QUESTION”, in {\it CATEGORY: QUESTION}, Quora, Inc., Mountain View, CA, MONTH DATE, YEAR. Available online at: \url{URL}; last accessed on August 26, 2014.
  - (k) AUTHOR, “TITLE OF POST”, in {\it BLOG TITLE}, Quora, Inc., Mountain View, CA, MONTH DATE, YEAR. Available online at: \url{URL}; last accessed on August 26, 2014.
  - (l) AUTHOR, “TITLE,” Stack Exchange Inc., New York, NY, MONTH DAY, YEAR. Available online from {\it Stack Exchange Inc.: Stack Overflow: Questions} at: \url{URL}; March 16, 2016 was the last accessed date.
  - (m) AUTHOR, “TITLE OF REPOSITORY,” GitHub, Inc., San Francisco, CA, MONTH DAY, YEAR. Available online from {\it {GitHub: GitHub user’s (full) name or USERNAME (or NAME OF ORGANIZATION)}: at: \url{URL}; March 16, 2016 was the last accessed date.
  - (n) AUTHOR, “TITLE OF PAPER,” Cornell University, Ithaca, NY, MONTH DAY, YEAR. Available online (as Version XYZ) from {\it {arXiv: FIELD(s)}: at: \url{URL}; March 16, 2016 was the last accessed date.
  - (o) When BIB<sub>T</sub>E<sub>X</sub> entries are created for the aforementioned sources of information, populate the appropriate fields so that each information in the aforementioned sources are included in the BIB<sub>T</sub>E<sub>X</sub> entries.
  - (p) **For other organizations, communities, and groups, use the term “contributors” instead of “members” to indicate that only a subset of them contributed to a publication, unless otherwise specified.** Else, use “members”.
11. Refer to the file “bibtex-template.txt” for templates for selected BIB<sub>T</sub>E<sub>X</sub> entry types. The more information that you can put in, the easier you can protect yourself from accusations of plagiarism and to make it easier for people (including yourself) to find the reference again. This is especially true for Web-based references/resources.
  12. When the names of authors and editors are unknown, list them as “Anonymous contributors”:
    - (a) An exception is made for a list of anonymous professors; use the following instead: [Name-of-Organization/University] professors.

## 2.1 Recommended Fields for BIB<sub>T</sub>E<sub>X</sub> Entries

The recommended fields for BIB<sub>T</sub>E<sub>X</sub> entries are:

1. booklet:
  - (a) Address

- (b) Author or Editor
- (c) Edition
- (d) Howpublished
- (e) Keywords
- (f) Month
- (g) Pages
- (h) Publisher
- (i) Series
- (j) Title
- (k) URL
- (l) Volume
- (m) Year

2. techreport:

- (a) Address
- (b) Author or Editor
- (c) DOI
- (d) Howpublished
- (e) Institution
- (f) Keywords
- (g) Month
- (h) Number
- (i) Title
- (j) URL
- (k) Year

3. proceedings:

- (a) Address
- (b) DOI
- (c) Editor
- (d) Keywords
- (e) Month
- (f) Organization
- (g) Publisher
- (h) Series
- (i) Title
- (j) Volume
- (k) Year

4. manual:

- (a) Address
- (b) Author or Editor
- (c) Howpublished
- (d) Keywords
- (e) Month
- (f) Number
- (g) Organization
- (h) Title



- (i) URL
- (j) Year

5. inbook:

- (a) Address
- (b) Author or Editor
- (c) Booktitle
- (d) Chapter (optional)
- (e) DOI
- (f) Edition
- (g) Howpublished
- (h) Keywords
- (i) Month
- (j) Number
- (k) Pages
- (l) Publisher
- (m) Series
- (n) Title
- (o) URL
- (p) Volume
- (q) Year

6. incollection:

- (a) Address
- (b) Author or Editor
- (c) Booktitle
- (d) Chapter
- (e) DOI
- (f) Edition
- (g) Howpublished
- (h) Keywords
- (i) Month
- (j) Number
- (k) Pages
- (l) Publisher
- (m) Series
- (n) Title
- (o) URL
- (p) Volume
- (q) Year

7. inproceedings:

- (a) Address
- (b) Author
- (c) Booktitle
- (d) DOI
- (e) Keywords
- (f) Month

- (g) Number
- (h) Organization
- (i) Pages
- (j) Publisher
- (k) Series
- (l) Title
- (m) Volume
- (n) Year

8. article:

- (a) Address
- (b) Author
- (c) DOI
- (d) Journal
- (e) Keywords
- (f) Month
- (g) Number
- (h) Pages
- (i) Publisher
- (j) Title
- (k) Volume
- (l) Year

9. phdthesis (or mastersthesis):

- (a) Address
- (b) Author
- (c) DOI (there are multiple research universities that assign DOIs to Ph.D. dissertations, and possibly Masters theses)
- (d) Howpublished
- (e) Keywords
- (f) Month
- (g) Number:
  - i. Some BIB<sub>T</sub>E<sub>X</sub> bibliography styles don't indicate the number, or show the number but hide some other important information.
  - ii. Hence, if the number is important include it in the Annote field.
- (h) School
- (i) Title
- (j) URL
- (k) Year
- (l) Annote

10. misc:

- (a) Address
- (b) Author
- (c) Howpublished
- (d) Keywords
- (e) Month
- (f) Publisher or School

- (g) Title
- (h) URL
- (i) Year

11. book:

- (a) Address
- (b) Author
- (c) DOI
- (d) Edition
- (e) Keywords
- (f) Month
- (g) Pages
- (h) Publisher
- (i) Series
- (j) Title
- (k) Volume
- (l) Year

For additional notes and annotations for publications, I can use the BIB<sub>T</sub>E<sub>X</sub> fields **Annote** or **Note** to include that information in the BIB<sub>T</sub>E<sub>X</sub> entry. Please kindly note that information from the BIB<sub>T</sub>E<sub>X</sub> field **Note** may end up in the reference list (or list of references), while information from the BIB<sub>T</sub>E<sub>X</sub> field **Annote** would not.

In addition, to cite the specific page numbers of interest, use the BIB<sub>T</sub>E<sub>X</sub> field **Pages**.

## 2.2 Template Information for the Annote BIB<sub>T</sub>E<sub>X</sub> Field

This is a list of template information for the **Annote** BIB<sub>T</sub>E<sub>X</sub> field to help me identify particular information about the document/publication:

1. Alternate names of authors: blah, blah blah, blah blah blah, ...
  - (a) Deprecated:
    - i. Authors' names (alternate): BLAH-1 and BLAH-2.
    - ii. Full names of authors: BLAH-1 and BLAH-2.
    - iii. Alternate names of [Author XYZ]: BLAH-1 and BLAH-2.
    - iv. Actual name of author: BLAH.
    - v. Actual name of co-authors: BLAH and BLAH.
    - vi. No authors are associated with this document, but the authors associated with the BibTeX-KEY document are also associated with this document; they are published as a set. Hence, instead of using anonymous contributors, I use their names instead.
  - (b) Previously indicated the staff or members of the following organizations as co-authors, instead of individuals: ORG-ABC, ORG-DEF, and ORG-HIG.:
    - i. For the author field, we should use names of individuals or their staff/community members (in cases when individual contributors are unknown). E.g., "NVIDIA staff" as the value for the author field, only if the specific employees at NVIDIA who contributed to the publication are unknown.
  - (c) Previously indicated set of co-authors: Blah-1, Blah-2, Blah-3, and Blah-4.
  - (d) Alternate order of co-authors, since the order between the front cover and title page (and copyright page) is different): Blah-1, Blah-2, Blah-3, and Blah-4.

- (e) For publications that many contributors, select the major contributors to have their names listed and include the following to complete the list of co-authors: “and other contributors”, or “and other [PROJECT-NAME] contributors”.
  - i. This allows us to indicate the subset of members of the organization or community that contributed to the publication, data set, or project, instead of the more inclusive “members” term.
- 2. Addressing the problem of ghostwriters:
  - (a) Ghostwriters for the book are: BLAH.
- 3. Addressing the problem of namesakes:
  - (a) This is a namesake of: NAME-OF-NAMESAKE.
  - (b) This is a namesake of: NAME-OF-NAMESAKE-1, NAME-OF-NAMESAKE-2, NAME-OF-NAMESAKE-3, and NAME-OF-NAMESAKE-4.
    - i. The (co-)author has the following alternate names: *NAME-OF-NAMESAKE-1*, *NAME-OF-NAMESAKE-2*, *NAME-OF-NAMESAKE-3*, and *NAME-OF-NAMESAKE-4*.
- 4. Editors: BLAH ... BLAH ... BLAH.:
  - (a) When citing from this entry, shift the names of the authors from the author field to the editor field.
    - i. Since certain BIB<sub>T</sub>E<sub>X</sub> styles require a non-empty author field, I have placed the information of editors in the authors field.
    - ii. Swap them back when using them for publications, by changing the **Author** field to the **Editor** field.
  - (b) Editors of the book: BLAH-1 and BLAH-2.
  - (c) Editors of conference proceedings: BLAH-1, BLAH-2, and BLAH-3.
- 5. Publication issues:
  - (a) Repeated/duplicate BIB<sub>T</sub>E<sub>X</sub> entries:
    - i. Repeat entry. See \cite{BibTeX keys}.
    - ii. Merged with the entry for BLAH-BIBTEX-KEY, since they refer to the same publication.
  - (b) Dates of publication:
    - i. Originally published in: 20XY. See BIBTEX-KEY.
    - ii. Also, published in: 20XY. See BIBTEX-KEY.
    - iii. Conference proceedings published in: 20XY.:
      - A. Dates of the conference are: MONTH DAY1-DAY2, YEAR.
      - B. Dates of the workshop are: MONTH DAY1-DAY2, YEAR.
    - iv. Reprinted in 20XY by BLAH. See BIBTEX-KEY.
    - v. Copyright renewed in 20XY.
    - vi. Years of publication for previous editions: First edition in 19XY-1, Second edition in 200X-1, Third edition in 201X-1, and Fourth edition in 202X-1.
    - vii. Previously indicated dates are probably incorrect: DATE-1, DATE-2, and DATE-3.
    - viii. Date of publication is probably incorrect: DATE. Repeat entry. See \cite{BibTeX-KEYS}.
    - ix. 20X1, 20X2, and 20X3 are the alternate years of publication, cited by: SOURCES.
    - x. 20XY is the alternate year of publication, cited by: SOURCE.
    - xi. Possible year of publication: 20XY.
    - xii. Year of publication may be incorrect: 20XY.
    - xiii. Date of publication may be incorrect: MONTH, DAY, YEAR.
  - (c) Addresses of publisher(s):
    - i. Address of publisher, rather than conference location is: BLAH.
    - ii. Address of conference location, rather than publisher is: BLAH.

- iii. Address is officially stated as: BLAH.
- iv. Alternate address: BLAH.
- v. Address of conference venue is previous indicated as: BLAH.:
  - A. Address of conference venue is previous indicated as: Muenchen, Germany. It is a German name (or rather, München, Germany) of Munich, Germany.
- vi. Deprecated templates:
  - A. Address is officially stated in: BLAH.
- (d) Alternate **names** of publisher:
  - i. Alternate publisher name: BLAH.
  - ii. Unknown publisher; see the following for an alternate BibTeX entry with an associated publisher: BIBTEX-KEY.
  - iii. Unknown publisher; see the following for an alternate BibTeX entry without an associated publisher: BIBTEX-KEY.
- (e) Organizations associated with the publication:
  - i. Organizations that are recognized as involved in this publication: BLAH-1 and BLAH-2.
  - ii. Alternate names of organizations that are recognized as involved in this publication: BLAH-1 and BLAH-2.
  - iii. Deprecated templates:
    - A. BLAH-1 and BLAH-2 are recognized as organizations involved in this report.
- (f) **Other publishers** of the publication:
  - i. Previously indicated publisher is: BLAH.
  - ii. Additional publisher: BLAH.
  - iii. Distributed by: BLAH.
- (g) Alternate set of publication **titles** and **series** (and alternate **volume number**):
  - i. Also, published as BLAH (old series title and old volume number).
  - ii. Alternate series title: BLAH.
  - iii. Regarding translations, and translated titles in a particular language, see the set of items for **Translation-based templates**.
  - iv. This title was used in the reprint in 20XY: BLAH-BLAH-BLAH.
- (h) Alternate titles of the publication:
  - i. Alternate title: *Another title for the document/publication*.
  - ii. Alternate booktitle: *Another title for the conference proceedings*.
  - iii. Alternate subtitle: *BLAH*.
  - iv. Subsubtitle: *BLAH*.
  - v. Alternate subsubtitle: *BLAH*.
  - vi. Title of previous edition/printing: *Another title for the document/publication*.
  - vii. Differences from the online version with the print version:
    - A. Differences from the online version with the print version. Title of the print version: “How My Generation Broke America” (on the cover of the magazine). Title of the online version: “My Generation was Supposed to Level America’s Playing Field. Instead, We Rigged It for Ourselves” (online article).
    - B. Differences from the online version with the print version. Title of the print version on the cover of the magazine: How My Generation Broke America. Title of the print version for the actual article: My Generation was Supposed to Level America’s Playing Field. Instead, We Rigged It for Ourselves.
  - viii. Differences from the front cover version with the title page version (in the front matter):
    - A. Differences from the front cover version with the title page version (in the front matter). Title of the front cover version: “Beautiful Souls: The Courage and Conscience of Ordinary People in Extraordinary Times” (on the front cover version). Title of

- the title page version (in the front matter): “Beautiful Souls: Saying No, Breaking Ranks, and Heeding the Voice of Conscience in Dark Times” (title page version).
- ix. Actual title, not used in the `Title` field due to typesetting errors: *Actual title for the document/publication*.
  - (i) Alternate series of publication:
    - i. Possible series: BLAH.
    - ii. Series was previously known as: BLAH.
  - (j) Alternate editions of publication:
    - i. Reprinted, paperback edition.
    - ii. Previous editions are published by BLAH in: 1987, 1991, 1999, and 2009.
  - (k) DOI problems:
    - i. Warning: DOI does not link back to the Web page URL.
    - ii. Digital Object Identifier (DOI) redirects to the Web page for the BLAH-X edition of the book, while the PDF preview document on that Web page is for the BLAH-Y edition of the book.
  - (l) URLs:
    - i. Alternate URL: BLAH.
    - ii. Available online as `{\it The \LaTeX\ Project}` at: `\url{}`.
    - iii. Scans of the magazines are available at: URL.
    - iv. PDF copy of a draft of the publication is available at: URL.
    - v. PDF copies of the book can be downloaded on this Web page.
  - (m) Subsets of publications:
    - i. For the following BIB<sub>TEX</sub> entry types:
      - A. `incollection` (with titles for chapters, sections, subsections, and subsubsections), for the `book`, `booklet`, `techreport`, `phdthesis`, and `mastersthesis`, and `manual` BIB<sub>TEX</sub> entry types.
      - B. `inbook` (without titles for chapters, sections, subsections, and subsubsections), for the `book`, `booklet`, `techreport`, `phdthesis`, and `mastersthesis`, and `manual` BIB<sub>TEX</sub> entry types.
      - C. `inproceedings`, for the `proceedings` BIB<sub>TEX</sub> entry type.
      - D. `article`, for the `book` and `booklet` BIB<sub>TEX</sub> entry types.
    - ii. Part of the book/report: BLAH.
    - iii. This article is part of the journal/magazine issue: BibTeX-KEY.
  - (n) Abstracts of publications listed as separate publications:
    - i. Abstract is available from BLAH at: BLAH-BLAH-BLAH.
  - (o) Multiple fields of publication:
    - i. Originally published by BLAH, ADDRESS, in: YEAR.
    - ii. Originally published by BLAH in: YEAR.
    - iii. Originally published by BLAH, ADDRESS.
    - iv. Also, published by BLAH, ADDRESS, in YEAR.
    - v. Also, published by BLAH, ADDRESS.
    - vi. Deprecated templates:
      - A. Originally published by BLAH in BLAH-BLAH.
      - B. Also, published by BLAH in BLAH-BLAH.
  - (p) Prepublication information:
    - i. BibTeX entry completed with very limited prepublication information. This needs to be updated.
6. **Translation**-based templates:
- (a) Translated by: BLAH.

- (b) BibTeX key of English translation: BLAH.
- (c) BibTeX key of original German version: BLAH.
- (d) Original French title: BLAH.
- (e) Translated English title: BLAH.
- (f) Original French title: BLAH.
- (g) Originally published in German in the year: 20XY.
- (h) Original French series: BLAH.
- (i) Deprecated templates:
  - i. English translation of title: BLAH.

**7. Associated files for the publication:**

- (a) Associated files are formerly named: BLAH.file\_extension, ...
- (b) Original filename of PDF copy of the publication: BLAH.pdf.
- (c) Refer to BLAH-BibTeX-Key for a PDF copy of this publication.
- (d) Refer to BLAH-BibTeX-Key for a PDF copy of this publication. Only the front matter is available in the PDF copy.
- (e) PDF copy of this publication is not available.

**8. Tracking updates to BIB<sub>T</sub>E<sub>X</sub> keys:**

- (a) Former BibTeX key is: Former BibTeX key.
- (b) Former BibTeX keys are: Former BibTeX key #1 and Former BibTeX key #2 ...
- (c) Keep BibTeX key as: BIPMJCGMWG2VIMcontributors2012. This enables the acronym to be differentiated from the term "contributors".

**9. Similar publications:**

- (a) Similar dissertations: [List of BIB<sub>T</sub>E<sub>X</sub> keys].
- (b) Similar publications: [List of BIB<sub>T</sub>E<sub>X</sub> keys].
- (c) Differences between multiple publications, which are similar:
  - i. Differences between multiple publications are listed as follows. PUBLICATION1 addresses XYZ, but PUBLICATION2 and PUBLICATION3 do not.

**10. Questionable correctness of BIB<sub>T</sub>E<sub>X</sub> entries:**

- (a) Questionable correctness of BibTeX entry. Information is probably obtained from secondary sources of information, such as publications that cite this publication.

**11. Templates for the email receipt of a copy of the publication, such as a PDF copy:**

- (a) Received a copy of this *report/document/publication/thesis/dissertation* by email.
- (b) Received a copy of this report by email.

**12. Information on how to cite the publication, if it is located on a different URL (or Web page) than the URL included in the URL field of the BIB<sub>T</sub>E<sub>X</sub> entry, especially for the misc BIB<sub>T</sub>E<sub>X</sub> type.**

- (a) Information of how to cite this publication is provided as follows. Available online from {\it Home Page: Path to the Web page providing information on how to cite the publication} at: \url{URL}; MONTH DAY, YEAR was the last accessed date.

**13. Common alternate names for the publication: BLAH.:**

- (a) E.g., "Dragon book" [426] refers to [11, 12].
- (b) E.g., "CLRS" [427] refers to [83–85].

**14. Book derived from Ph.D. dissertation: [BibTeX-Key of Ph.D. dissertation].**

**15. Book derived from Master's thesis: [BibTeX-Key of Master's thesis].**

**16. Undergraduate Honors/Senior thesis.**

**17. PDF copy of this publication is not available.**

**18. DOI of this publication is not available.**

## 2.3 Template Information for the Howpublished BIB<sub>T</sub>E<sub>X</sub> Field

For the Howpublished BIB<sub>T</sub>E<sub>X</sub> field, the suggested template information is:

- Available online at: \url{}; self-published; MONTH DAY, YEAR was the last accessed date.
- Available online from *main Web page: ABC section: XYZ subsection* as Version X.Y.Z at: \url{}; self-published; MONTH DAY, YEAR was the last accessed date.
- Available online from *main Web page: ABC section: XYZ subsection* in Italian at: \url{}; self-published; MONTH DAY, YEAR was the last accessed date.
- Available online from *main Web page: ABC section: XYZ subsection* in Italian and Spanish at: \url{}; self-published; MONTH DAY, YEAR was the last accessed date.

When the date is not known so that it can be provided in the “MONTH DAY, YEAR” format, use the following phrase instead of “MONTH DAY, YEAR was the last accessed date”.

- the last accessed date is unknown

If the information for the BIB<sub>T</sub>E<sub>X</sub> entry was obtained on multiple dates, include the following information in the Howpublished BIB<sub>T</sub>E<sub>X</sub> field:

1. BLAH-1 and BLAH-2 were the last accessed dates

## 2.4 Additional Recommendations for Managing a Shared BIB<sub>T</sub>E<sub>X</sub> Database

Use `crossref` for BIB<sub>T</sub>E<sub>X</sub> entries using the BIB<sub>T</sub>E<sub>X</sub> entry type `inproceedings` to share information about the conference proceedings without having to copy and paste fields that are commonly shared by articles/papers in conference proceedings [208, §12.2.3, pp. 234]. It might not work with BIB<sub>T</sub>E<sub>X</sub> entry types `inbook` and `incollection` for parts, subsections, sections, and chapters of books; this is not mentioned in BIB<sub>T</sub>E<sub>X</sub> specifications/references, and `crossref` is probably not supported for these BIB<sub>T</sub>E<sub>X</sub> entry types. Hence, I am currently not using `crossref`, unless I have to cite multiple (more than 15, > 15, or even five, > 5) conference papers in a given conference proceedings.

When copying (and pasting) text from a document or a Web page, non-ASCII hidden characters may be accidentally copied from the source (document or Web page) to the BIB<sub>T</sub>E<sub>X</sub> database. Consequently, this can cause command-line utilities for UNIX-like operating systems, such as `grep`, to fail to recognize the BIB<sub>T</sub>E<sub>X</sub> database as a text file. While some text editors or integrated development environments (IDEs) have features that highlight or indicate such non-ASCII hidden characters, they are not effective for finding/detecting these characters in large text files (BIB<sub>T</sub>E<sub>X</sub> databases in this case) without knowing what these characters are. If these characters are known, the search feature of these text editors or IDEs can find and delete these non-ASCII hidden characters.

An alternative is to develop and use a script to concatenate all the BIB<sub>T</sub>E<sub>X</sub> keys (of a BIB<sub>T</sub>E<sub>X</sub> database) in a `\cite{}` L<sub>A</sub>T<sub>E</sub>X command to automatically generate a listing of the references in a particular BIB<sub>T</sub>E<sub>X</sub> style of your choice. This results in the L<sub>A</sub>T<sub>E</sub>X and BIB<sub>T</sub>E<sub>X</sub> interpreters parsing and processing your L<sub>A</sub>T<sub>E</sub>X and BIB<sub>T</sub>E<sub>X</sub> sources. If non-ASCII hidden characters exist in your L<sub>A</sub>T<sub>E</sub>X and BIB<sub>T</sub>E<sub>X</sub> source files, this process should abruptly pause your L<sub>A</sub>T<sub>E</sub>X and BIB<sub>T</sub>E<sub>X</sub> interpretation processes to warn you of the syntax errors due to these characters.

In addition, note that corruption in memory subsystems or storage devices (such as a solid-state drives) and data transfer between computers can result in corrupting text files to produce non-ASCII hidden characters in these files.



### 3 Coding Standard

This is a guideline for Doxygen-supported [404], Javadoc-based [239] coding standard that shall be used for this boilerplate code project and other projects. The term “coding standard” is used interchangeably/synonymously with coding style, coding style guide, coding guideline, coding scheme, code convention, code documentation guideline, programming guideline, or programming style. Our coding style/standard shall be self-documenting. The documentation generator that shall be supported is: Doxygen. Since we are using Doxygen for generating documentation, we can use L<sup>A</sup>T<sub>E</sub>X to provide richer markup.

#### Document the known bugs for each function/method.

Our indent style would be the *1TBS* variant of the *K&R* style, which is an abbreviation of “*The One True Brace Style*”. It is also equivalent to the *Kernel Normal Form style* (or *BSD KNF style*) [419].

Classes, functions/methods, constants, macros, and static and instance variables shall be named using complete words or well-known abbreviations that are concatenated with an underscore in *C++*; this is a deviation from the *Hungarian notation* that uses an upper case letter to distinguish words/abbreviations in the name (i.e., the *Start case style of writing*; see letter case). That is, the naming convention followed is using multiple-word identifiers, via delimiter-separated words rather than letter-case separated words (e.g., *Hungarian notation*) [423].

For *C++* programs, the following tags shall be used in the comments:

1. @author *Author's\_Name*: indicate the author (*Author's\_Name*) of the file/function
  - (a) @modified by NAME, DATE in “Month Day, Year” format.
2. @version *X.Y*: indicate the version (*X.Y*) of the file
3. @section *SECTION\_NAME*: indicate the section (*SECTION\_NAME*) of the file, which can be: *LICENSE* or *DESCRIPTION*
4. @param *x*: indicate the parameter (*x*) of the constructor or function
  - (a) By default, use “@param None” to indicate that the function/method has no parameters.
5. @exception *Exception\_Name*, or @throws *Exception\_Name*: an exception that a function/method can throw
6. @return *Return\_Statement*: indicate the return (type and) action of the function
7. @see *reference*: a link to another element in the documentation; e.g., @see *Class\_Name*, or @see *Class\_Name#member\_function\_name*
8. @since *X.Y: Month-Day-Year*: This functionality has been added since version *X.Y* (and on the date *Month-Day-Year*)
9. @deprecated *description*: Describe an outdated function/method, and indicate when the function/method has deprecated
10. “@link ... *URL*... @endlink” is used to include hyperlinks in the generated documentation for Doxygen
11. ##### IMPORTANT NOTES: Notes that are critical for helping the reader understanding assumptions and decisions made while developing the software
12. @todo(<message>, <version>) (or ##### TO BE COMPLETED): Task to be finished at a later time. If it is busywork (or, busy work), indicate that it is busywork.
13. ##### TO BE FIXED: Task to be fixed at a later time, including:

- (a) bugs to be debugged
  - (b) errors/faults to be fixed
  - (c) software/hardware/system architecture or source code to be refactored
  - (d) completion of feature implementation
14. @migration(<message>, <version>): Code is being migrated to another function/method, or class.
  15. See <http://www.stack.nl/~dimitri/doxygen/commands.html> for more information of tags that are recognized by Doxygen.
  16. @pre (or @precondition): Precondition(s) of the function.
  17. @assert (or @assertion): Assertion(s) of the function.
  18. @post (or @postcondition): Postcondition(s) of the function.

The order of tags in different sections of the *C++* code is given as follows:

1. Headers/Interfaces and Classes: @version, @author, @since, @link, @todo, @deprecated, @migration, and @see
2. Constructors: @param, @throws, @since, @link, @todo, @deprecated, @migration, and @see. For collaborators modifying or extending my code, they should include the @version and @author tags before the @param tag(s).
3. Functions/Methods: @param, @pre, @assert, @post, @return, @throws, @since, @link, @todo, @deprecated, @migration, and @see. For collaborators modifying or extending my code, they should include the @version and @author tags before the @param tag(s).
4. Variables can use the @see tags.
5. The @deprecated tag can be used for headers/interfaces, classes, constructors, functions/methods, and variables.

Additional coding style guidelines can be found in [31, 64, 87, 177, 269, 319, 362, 392].

For a suggested coding style for *Python* and *Ruby* scripts, see [295, 405] and [242], respectively. Regarding coding style guidelines for embedded *C*, see [30, 220]. In addition, there exists coding style guidelines for *Java* [66, 239, 288–291, 369] and *LabVIEW* [45, 81]. Coding style guidelines for *Verilog* can be found at: [39, 40]. Likewise, the coding style guide for *SystemVerilog* can be found at [268]. For other coding style guidelines, see [61, 115, 121, 187, 202, 207, 224, 253, 357, 360, 366, 403, 410, 432]. *Google* style guides [156] has provided documentation about best practices [297] for coding standards and the philosophy [296] of Google's coding standards.

While well-documented source code is desired, natural language programming [420] is usually infeasible due to the choices of programming/computer languages used. Also, while literate programming [205, 206, 253, 279, 293, 357, 384] is encouraged, we are currently not following it due to the tedious process of developing software using literate programming. Hence, a short development time for well-commented, functionally correct, and efficient source code is prioritized over code written according to the literate programming approach.

## 4 Exception Safety

When developing software using programming/scripting languages that enable exceptions or errors to be thrown and caught, adopt "a set of contractual guidelines" [418] to support exception/error management.

This “set of contractual guidelines” is based on exception safety guarantees in *C++* [3, 4, 418] [416, Subsection §4.4 on “Writing exception safe code”].

The levels of exception/error safety listed in descending order of safety guarantees are [3, 4, 416, 418]:

1. no throw guarantee, or failure transparency: “Best level of exception safety.”
2. strong exception safety, commit/rollback semantics, or no-change guarantee
3. basic exception safety
4. minimal exception safety, no-leak guarantee
5. no exception safety: “No guarantees are made. (Worst level of exception safety)”

These aforementioned levels of exception/error safety can be partially handled. Also, the use of guards is strongly recommended for making the software and library (or, circuit or system) exception safe.

These guidelines about exceptions help software developers know what to do about fatal exceptions, boneheaded exceptions, vexing exceptions (due to unfortunate design decisions). Vexing exceptions and boneheaded exceptions, to a lesser extent, are preventable exceptions [238]. Hence, we should develop software that avoids triggering preventable exceptions.

Please judiciously consider what to do with the semipredicate problem [421].

## 5 Suggested Software Architecture

At the software system level, the software architecture can be described by the following modules/components:

1. parser(s):
  - (a) For input benchmarks
2. utilities:
  - (a) output generator(s)
  - (b) flag/switch -based printing information to standard output/error:
    - i. Print statements only when debugging mode is on.
    - ii. Else, squelch print/trace statements to speed up computation/performance.
3. solvers:
  - (a) ODE solver(s) for ordinary differential equations (ODEs):
    - i. ODE solver(s) for nonlinear ODEs.
  - (b) PDE solver(s) for partial differential equations (PDEs):
    - i. PDE solver(s) for nonlinear PDEs.
  - (c) satisfiability modulo theories (SMT) solver(s)
  - (d) boolean/proposition satisfiability (SAT) solver(s)
  - (e) maximum satisfiability modulo theories (Max-SMT) solver(s)
  - (f) maximum satisfiability (Max-SAT) solver(s)
  - (g) pseudo-boolean optimization (PBO) solver(s)
  - (h) quadratic unconstrained binary optimization (QUBO) solver(s)
  - (i) weighted boolean optimization (WBO) solver(s)
  - (j) framework for algorithmic portfolio optimization

4. data structures:
  - (a) directed graphs:
    - i. directed acyclic graphs (DAGs)
    - ii. binary decision diagrams (BDDs)
    - iii. AND-inverter graphs (AIGs)
  - (b) undirected graphs:
    - i. heaps
    - ii. trees
  - (c) maps, dictionaries, and hash tables
5. graphical user interface (GUI), if required.

Lastly, suggestions are not available for digital and mixed-signal integrated circuits (ICs) and very large-scale integrated (VLSI) systems, such as system-on-chips (SoCs). More work needs to be done in terms of looking at hardware refactoring, and hardware design patterns.

## 6 Adoption of Best Practices

Where possible, we shall try to adopt best/good practices from leading product teams (i.e., R&D teams) in the semiconductor and IT industries, and also good researchers spanning electrical engineering and computer science. These practices include: research reproducibility and reproducible research [29, 33, 44, 77, 89, 93, 132, 133, 135, 204, 212, 237, 244, 343, 359, 382], build automation [78, 90, 107, 121, 165, 178, 197, 292, 325, 336, 356–358, 385], distributed version/revision control (or software configuration management) [13, 23, 61, 62, 68, 69, 78, 90, 108, 126, 142–145, 147–149, 167, 178, 250, 252, 293, 298, 299, 317, 325, 355, 357, 366, 387, 390, 415], design by contract (DbC; or, contract programming, programming by contract, or design-by-contract programming) [55, 166, 182, 266, 348, 380, 389, 437] when using the procedural/imperative programming paradigm [26, 37, 233, 240, 245, 271, 306, 332, 364, 396, 409, 424] and Hoare logic [28, 169, 182, 209, 217, 223, 270, 277, 307, 348, 361, 431, 437, 440], regression testing [10, 320, 356, 358, 406], automated software testing [41, 61, 88, 92, 118, 178, 189, 201, 219, 267, 278, 286, 300, 320, 322, 338, 346, 356, 358, 370, 380, 384, 400, 412, 437], and automated regression testing [320, 335]. VLSI verification engineers can use regression verification [7, 8, 10, 26, 48, 58, 151, 236, 309–313, 368, 393] for VLSI system design to check if incremental additions/modifications to the existing IC design components and system would introduce IC design bugs (e.g., functional or security bugs); this is an analogy of regression testing for software. Similarly, endeavor to use the concepts of abstraction [72, 79, 129, 140, 170, 173, 181, 214, 214, 232, 255, 376, 407, 408] and encapsulation [28, 54, 81, 116, 173, 213, 233, 245, 256, 314, 325, 327, 363, 371] with hierarchical design methodologies [9, 60, 121, 164, 210, 211, 283, 345, 401], hierarchical design space exploration [386], top-down hierarchical approach for design steps [73, 103, 128, 131, 176, 194, 241, 351, 413] and bottom-up hierarchical approach for verification steps [72, 128, 255, 323, 408], or rather top-down approach of incremental verification (also known as the modified V approach) [26], and platform-based design [26, 27, 59, 71, 99, 131, 203, 243, 246, 347, 351–354] in our projects involving VLSI design. In addition, use design patterns (Add Citations!!!) to improve VLSI system architecture designs. In general, adopt good practices from software development and data science to improve IC design flows (Add Citations!!!, from my USC report comparing software test automation with VLSI test automation to a Quora post to job descriptions from that firm paying FPGA design interns at least US\$125 per hour).

In addition, try to use agile (software development and VLSI design) methodologies [1, 15, 17, 18, 22, 25, 34–36, 47, 61, 76, 78, 82, 86, 90, 94, 96, 101, 109, 126, 139, 154, 180, 190, 191, 198, 199, 223, 226–231, 234,

247–249, 284, 308, 318, 320, 324, 339–342, 357, 366, 377, 381, 384, 402, 436] to develop software as well as design electronic circuits and systems [43, 153, 174, 192, 257, 430] [138, Chapter 6, §6.2.2.3, pp. 243], and cyber-physical systems (or embedded systems) [275, 276]. A strong motivation for using these methodologies and their associated practices is to reduce technical debt [1, 50, 78, 163, 215, 280, 326, 339, 379, 395]. In addition, iterative and incremental development (I.I.D.) can help software developers, integrated circuit/system designers, and cyber-physical system designers validate earlier versions (from earlier iterations) of their software builds, and VLSI system and cyber-physical system designs, with (project) stakeholders, repeat this (much) more frequently, and make necessary changes before incurring huge costs with inflexible software development process models or engineering workflows (such as VLSI design and verification flows) for VLSI systems and cyber-physical systems [1, 25, 32, 46, 47, 54, 56, 117, 189, 216, 225–228, 337, 357, 366, 367, 370, 384, 434].

Also, carry out refactoring [119, 125] on an ad-hoc basis to improve the software [1, 25, 38, 57, 90, 102, 105, 112, 115, 126, 190, 200, 207, 253, 265, 366, 372, 380], hardware [113, 114, 171–173, 195, 196, 425, 438, 439], and/or system [78, 222, 339] architecture as well as databases [19]. In terms of personal and professional development, collaborators are strongly encouraged to refactor their wetware [179] and reduce their personal technical debt [2, 95, 130, 235, 315], too.

We shall also use project portfolio management [340, 341] to help us manage projects that we are involved in.

Moreover, for projects involving integrated circuit design (and embedded hardware or cyber-physical system design), morph your process for VLSI CAD engineering into hardware DevOps (hardware/IC development and information-technology operations) [281].

## 6.1 Practice of Automated Regression Testing

Regarding the practice of automated regression testing, Mr. Heiko Maurer (then a lecturer at the University of Adelaide) and Dr./Mr. Tishampati Dhar (a former classmate at the University of Adelaide) suggests printing information regarding passed test cases to a file (or to standard output) and printing information regarding failed test cases to another file (or to standard error). During build automation of software, such as `gem5` [42, 136], carry out automated (regression) testing during the last stage of the build/installation process to ensure that the build/installation was done correctly. When performing automated software testing (or software test automation), list the the test cases and their test results (i.e., “OK”/“Fail”), just like `gem5` during the testing phase of build automation. At the end of each automated software testing run (or round/run of automated software testing), indicate the total number of test cases used, the total number of test cases passed, and the percentage of test cases passed (with respect to the total number of test cases used).

[391, §Testing Guidelines] provides a set of testing guidelines for *Python* libraries and packages, or software in general.

## 6.2 Cloud-based Data Science and Machine Learning

Regarding data science projects, we shall use a lot of the aforementioned software development practices and methodologies [61]. Also, we can use cloud-based machine learning (and deep learning) platforms, such as Google’s *Colaboratory* [155], Anaconda’s *Anaconda Cloud* [20], and Amazon’s *Amazon Web Services* (AWS) [16]. These cloud-based software services, also known as software as a service (SaaS),

helps to bring data science, machine learning, and deep learning capabilities to more people, since they do not need expensive, modern hardware to run computationally intensive tasks for data analytics and machine learning.

## 7 Intellectual Property Protection, via Licenses

To be continued...

Add references for:

1. source-available software (get information from Wikipedia)
2. MIT license
3. GNU General Public License, GNU GPL, GPL:
  - (a) GPL version 3, GPLv3
  - (b) GPL version 2, GPLv2
4. Creative Commons (CC) license

## 8 Additional Guidelines

Please kindly use the *Markdown* language for writing text documents. This is because *Bitbucket* will treat my text file as a file written in the *Markdown* syntax. That said, the raw file looks a lot better than the represented *Markdown* files. Their (*Bitbucket*) formatting for *Markdown* is messed up. *GitHub*'s formatting for *Markdown* works as expected. To insert mathematical expressions into *Markdown* documents, use *TexPaste* [282] to typeset the mathematical expressions via  $\text{\LaTeX}$  and insert snapshots of these mathematical expressions as pictures in the *Markdown* documents. A recommended style guide for *Markdown* is from *Google* [399].

In addition, tools for working with source code and  $\text{\LaTeX}$  source files include:

1. `git` (or Git) [108, 167]:
  - (a) `Mercurial` SCM [24, 97, 260–264, 298] can be used as a substitute.
2. `latexdiff`: “determine and markup differences between two latex files”
  - (a) Evan Driscoll, “*Latexdiff notes*,” from *Evan Driscoll’s Web page: Writings on Software:  $\text{\LaTeX}$* , the Department of Computer Sciences, University of Wisconsin-Madison College of Engineering, University of Wisconsin-Madison, Madison, WI. Available online at: <http://pages.cs.wisc.edu/~driscoll/software/latex/latexdiff.html>; last accessed on February 15, 2016 [106].
3. documentation generators:
  - (a) `Doxygen` [404]
  - (b) `Texinfo`-based generators [373–375, 422]
4. Build automation:
  - (a) `SCons` [107]

Data sets and sets of benchmarks for experiments shall be publicly published using an online repository, via *figshare* LLP [120] and/or *DataHub* [93]. For each data set, or each set of benchmarks, create a unique Digital Object Identifier (DOI) [188] to identify it.



Repositories for software as well as designs of integrated circuits and cyber-physical systems shall be stored online, using online repositories such as *GitHub* [146]. Each repository shall have a unique DOI to identify it, and include all source code, documentation, and design files. There also exists cloud-based repositories for the source code of software/hardware projects that allow me to execute my software (or simulate my hardware). E.g., see [77, 343] as examples to facilitate research reproducibility, replicability, and repeatability. This supports research reproducibility and reproducible research [29, 33, 44, 77, 89, 93, 132, 133, 135, 204, 212, 237, 244, 343, 359, 382].

Please kindly note that *GitHub* [146]:

1. Does not allow a *GitHub*-based page to be refreshed/reloaded many times in a few seconds. Else, it would report the following:
  - (a) “Whoa there!”
  - (b) “You have triggered an abuse detection mechanism.”
  - (c) “Please wait a few minutes before you try again.”

If possible, develop *Python* software in a *Pythonic* style [14, Chapter 1, pp. 1–12, 12–17] [127, 193, 316, 330, 331, 405].

As aforementioned in §2.4, when copying (and pasting) text from a document or a Web page, non-ASCII hidden characters may be accidentally copied from the source (document or Web page) to the source code for a computer language. Similarly, corruption in memory subsystems or storage devices (such as a solid-state drives) and data transfer between computers can result in corrupting text files to produce non-ASCII hidden characters in these files. Therefore, if these text files use a particular computer language, use parsers (for software such as compilers, interpreters, electronic design automation software, or other software applications) for these languages to detect/find these non-ASCII hidden characters.

If text is required to be in the uppercase or capitals, it can still be written as normal, but use the  $\text{\LaTeX}$  command `\uppercase` to turn the text within the braces or curly brackets into uppercase. An example is provided as follows: “THIS IS AN EXAMPLE OF TEXT TURNED INTO UPPERCASE” [388, §8.2.4, pp. 239]. Another method is to use the  $\text{\LaTeX}$  command `\MakeUppercase` [208, §Appendix G.1, pp. 512], and an example is: “ANOTHER EXAMPLE OF TEXT TURNED INTO UPPERCASE” [162, §6.8, pp. 47; §23.2, pp. 212–213] [272, §2.2.2, pp. 31; §3.1.5, pp. 85–87; §3.1.7, pp. 91; §4.4.2, pp. 229; §9.4.1, pp. 571] [388, §3.5, pp. 60] [435, §5, Changing Letter Case].

Their dual  $\text{\LaTeX}$  commands are: `\lowercase` and `\MakeLowercase` [208, §Appendix G.1, pp. 512]. Examples for these are: “this is an example of text turned into lowercase” [388, §8.2.4, pp. 239] and “another example of text turned into lowercase” [162, §23.2, pp. 212–213] [272, §2.2.6, pp. 37; §3.1.5, pp. 85–87; §7.3.1, pp. 341; §9.4.1, pp. 571] [388, §3.5, pp. 60] [435, §5, Changing Letter Case].

## 8.1 Suggested Guidelines for Benchmarking

## 8.2 Suggested Prefixes for Labels of Parts of a $\text{\LaTeX}$ Document

Add one of the following prefixes to labels in my  $\text{\LaTeX}$  documents for parts, such as chapters, sections, subsections, subsubsections, figures, tables, equations, code listings, definitions, theorems, lemmas, corollaries, propositions, proofs, examples, and remarks:

1. “chp.” for chapter

2. “sec:” for section
3. “ssec:” for subsection
4. “sssec:” for subsubsection
5. “fig:” for figure
6. “tab:” for table
7. “eqn:” for equation
8. “lst:” for code listing
9. “defn:” for definition
10. “thrm:” for theorem
11. “lem:” for lemma
12. “crly:” for corollary
13. “prop:” for proposition
14. “prf:” for proof
15. “eg:” for example
16. “rem:” for remark

This practice makes it easier for collaborators and paper/reviewers to determine if the label for a part of the  $\text{\LaTeX}$  document, belongs to a label or refers to something else. This should be done with cross-referencing different parts of my  $\text{\LaTeX}$  documents to make it easier for readers to follow the storyline, and look up information.

## Acknowledgments

Mr. David Knight (then a lecturer at the University of Adelaide) and Dr. Charles Lakos (then a senior lecturer at the University of Adelaide) introduced me to regression testing and automated software testing during their introductory course on software engineering. During programming assignments and projects for this course, Dr. Nikolay Stoimenov helped me honed my skills in regression testing and automated software testing, via the practice of pair programming [100, 126, 189, 294, 366, 414]. Subsequently, Mr. Heiko Maurer (then a lecturer at the University of Adelaide) planted the seeds of automated regression testing with his suggestion of separating the results of test cases that passed from the results of test cases that failed. Shortly after, Dr./Mr. Tishampati Dhar (a former classmate at the University of Adelaide) suggests printing information regarding passed test cases to a file (or to standard output) and printing information regarding failed test cases to another file (or to standard error). Months later, Dr. Francis Vaughan (then a senior lecturer at the University of Adelaide), Mr. Kevin J. Maciunas (then a lecturer at the University of Adelaide), and Dr. Robert Esser (then a senior lecturer at the University of Adelaide) helped me develop a sound methodology towards automated regression testing. In addition, Dr. Lakos and Dr. Esser introduced me to using formal methods and software formal verification in the software development process.

One of my favorite directors at a Latinx/Latine/Hispanic organization that I have been part of talked to us about ethical and healthy conflict resolution, during a training session that she ran for our organization. I am keeping her name and organization anonymous to protect our privacy.

## To-Do List

To-do list:

1. Update guidelines with references (such as books) on:



- (a) DevOps:
    - i. Agile DevOps
  - (b) DevSecOps:
    - i. Agile DevSecOps
  - (c) MLOps, ML Ops:
    - i. MLSecOps
  - (d) DataOps:
    - i. Including tools to manage data pipelines:
      - A. Apache Beam:
        - “open-source unified programming model, and set of software development kits (SDKs), to define and execute data processing pipelines, including ETL, batch and stream (continuous) processing. The data pipelines (Beam Pipelines) are executed in one of the supported distributed processing back-ends (Beam supported runners).”
    - ii. DataSecOps
  - (e) ModelOps
  - (f) AIOps
  - (g) workflow management tools:
    - i. Apache Airflow
  - (h) Ignore the following, since it is beyond the scope of what I can do as a researcher or research group leader:
    - i. ITOps
    - ii. IT operations analytics, ITOA
2. incremental computing:
- (a) [https://en.wikipedia.org/wiki/Incremental\\_computing](https://en.wikipedia.org/wiki/Incremental_computing).
  - (b) Include references for checkpointing, to save intermediate set of simulation results.

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