

# Literature review of Formal Methods applied to Blockchain technology

HENOCH VITUREIRA, Instituto Politécnico de Setúbal, Portugal

A clear and well-documented  $\LaTeX$  document is presented as an article formatted for publication by ACM in a conference proceedings or journal publication. Based on the “acmart” document class, this article presents and explains many of the common variations, as well as many of the formatting elements an author may use in the preparation of the documentation of their work.

CCS Concepts: • **Software and its engineering** → **Process validation**; • **Security and privacy** → **Cryptography**.

Additional Key Words and Phrases: Software Quality, Formal Methods, Blockchain, Smartcontracts

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## 1 INTRODUCTION

ACM’s consolidated article template, introduced in 2017, provides a consistent  $\LaTeX$  style for use across ACM publications, and incorporates accessibility and metadata-extraction functionality necessary for future Digital Library endeavors. Numerous ACM and SIG-specific  $\LaTeX$  templates have been examined, and their unique features incorporated into this single new template.

If you are new to publishing with ACM, this document is a valuable guide to the process of preparing your work for publication. If you have published with ACM before, this document provides insight and instruction into more recent changes to the article template.

The “acmart” document class can be used to prepare articles for any ACM publication — conference or journal, and for any stage of publication, from review to final “camera-ready” copy, to the author’s own version, with *very* few changes to the source.

## 2 SECTIONING COMMANDS

Your work should use standard  $\LaTeX$  sectioning commands: section, subsection, subsubsection, and paragraph. They should be numbered; do not remove the numbering from the commands.

Simulating a sectioning command by setting the first word or words of a paragraph in boldface or italicized text is **not allowed**.

## 3 TABLES

The “acmart” document class includes the “booktabs” package — <https://ctan.org/pkg/booktabs> — for preparing high-quality tables.

Table captions are placed *above* the table.

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Author’s address: Henoch Vitureira, Instituto Politécnico de Setúbal, Campus do IPS - Estefanilha, 2910-761, Setúbal, Portugal, 2016041081@estudantes.ips.pt.

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Table 1. Frequency of Special Characters

Non-English or Math	Frequency	Comments
Ø	1 in 1,000	For Swedish names
$\pi$	1 in 5	Common in math
\$	4 in 5	Used in business
$\Psi_1^2$	1 in 40,000	Unexplained usage

Table 2. Some Typical Commands

Command	A Number	Comments
<code>\author</code>	100	Author
<code>\table</code>	300	For tables
<code>\table*</code>	400	For wider tables

Because tables cannot be split across pages, the best placement for them is typically the top of the page nearest their initial cite. To ensure this proper “floating” placement of tables, use the environment **table** to enclose the table’s contents and the table caption. The contents of the table itself must go in the **tabular** environment, to be aligned properly in rows and columns, with the desired horizontal and vertical rules. Again, detailed instructions on **tabular** material are found in the *L<sup>A</sup>T<sub>E</sub>X User’s Guide*.

Immediately following this sentence is the point at which Table 1 is included in the input file; compare the placement of the table here with the table in the printed output of this document.

To set a wider table, which takes up the whole width of the page’s live area, use the environment **table\*** to enclose the table’s contents and the table caption. As with a single-column table, this wide table will “float” to a location deemed more desirable. Immediately following this sentence is the point at which Table 2 is included in the input file; again, it is instructive to compare the placement of the table here with the table in the printed output of this document.

Always use `midrule` to separate table header rows from data rows, and use it only for this purpose. This enables assistive technologies to recognise table headers and support their users in navigating tables more easily.

## 4 MATH EQUATIONS

You may want to display math equations in three distinct styles: inline, numbered or non-numbered display. Each of the three are discussed in the next sections.

### 4.1 Inline (In-text) Equations

A formula that appears in the running text is called an inline or in-text formula. It is produced by the **math** environment, which can be invoked with the usual `\begin . . . \end` construction or with the short form `$ . . . $`. You can use any of the symbols and structures, from  $\alpha$  to  $\omega$ , available in L<sup>A</sup>T<sub>E</sub>X [? ]; this section will simply show a few examples of in-text equations in context. Notice how this equation:  $\lim_{n \rightarrow \infty} x = 0$ , set here in in-line math style, looks slightly different when set in display style. (See next section).

## 4.2 Display Equations

A numbered display equation—one set off by vertical space from the text and centered horizontally—is produced by the **equation** environment. An unnumbered display equation is produced by the **displaymath** environment.

Again, in either environment, you can use any of the symbols and structures available in  $\LaTeX$ ; this section will just give a couple of examples of display equations in context. First, consider the equation, shown as an inline equation above:

$$\lim_{n \rightarrow \infty} x = 0 \quad (1)$$

Notice how it is formatted somewhat differently in the **displaymath** environment. Now, we'll enter an unnumbered equation:

$$\sum_{i=0}^{\infty} x + 1$$

and follow it with another numbered equation:

$$\sum_{i=0}^{\infty} x_i = \int_0^{\pi+2} f \quad (2)$$

just to demonstrate  $\LaTeX$ 's able handling of numbering.

## 5 FIGURES

The “figure” environment should be used for figures. One or more images can be placed within a figure. If your figure contains third-party material, you must clearly identify it as such, as shown in the example below.

Your figures should contain a caption which describes the figure to the reader.

Figure captions are placed *below* the figure.

Every figure should also have a figure description unless it is purely decorative. These descriptions convey what's in the image to someone who cannot see it. They are also used by search engine crawlers for indexing images, and when images cannot be loaded.

A figure description must be unformatted plain text less than 2000 characters long (including spaces). **Figure descriptions should not repeat the figure caption – their purpose is to capture important information that is not already provided in the caption or the main text of the paper.** For figures that convey important and complex new information, a short text description may not be adequate. More complex alternative descriptions can be placed in an appendix and referenced in a short figure description. For example, provide a data table capturing the information in a bar chart, or a structured list representing a graph. For additional information regarding how best to write figure descriptions and why doing this is so important, please see <https://www.acm.org/publications/taps/describing-figures/>.

### 5.1 The “Teaser Figure”

A “teaser figure” is an image, or set of images in one figure, that are placed after all author and affiliation information, and before the body of the article, spanning the page. If you wish to have such a figure in your article, place the command immediately before the `\maketitle` command:

```
\begin{teaserfigure}
\includegraphics[width=\textwidth]{sampleteaser}
\caption{figure caption}
```



Fig. 1. 1907 Franklin Model D roadster. Photograph by Harris & Ewing, Inc. [Public domain], via Wikimedia Commons. (<https://goo.gl/VLCRBB>).

```
\Description{figure description}
\end{teaserfigure}
```

## 6 CITATIONS AND BIBLIOGRAPHIES

Some examples. A paginated journal article [1], an enumerated journal article [6], a reference to an entire issue [5], a monograph (whole book) [2], a monograph/whole book in a series (see 2a in spec. document) [3], a divisible-book such as an anthology or compilation [4] followed by the same example, however we only output the series if the volume number is given.

## 7 ACKNOWLEDGMENTS

Identification of funding sources and other support, and thanks to individuals and groups that assisted in the research and the preparation of the work should be included in an acknowledgment section, which is placed just before the reference section in your document.

This section has a special environment:

```
\begin{acks}
...
\end{acks}
```

so that the information contained therein can be more easily collected during the article metadata extraction phase, and to ensure consistency in the spelling of the section heading.

Authors should not prepare this section as a numbered or unnumbered `\section`; please use the “acks” environment.

## 8 APPENDICES

If your work needs an appendix, add it before the “`\end{document}`” command at the conclusion of your source document.

Start the appendix with the “appendix” command:

```
\appendix
```

and note that in the appendix, sections are lettered, not numbered. This document has two appendices, demonstrating the section and subsection identification method.

## 9 SIGCHI EXTENDED ABSTRACTS

The “sigchi-a” template style (available only in  $\LaTeX$  and not in Word) produces a landscape-orientation formatted article, with a wide left margin. Three environments are available for use with the “sigchi-a” template style, and produce formatted output in the margin:

- sidebar: Place formatted text in the margin.
- marginfigure: Place a figure in the margin.
- margintable: Place a table in the margin.

## ACKNOWLEDGMENTS

To Robert, for the bagels and explaining CMYK and color spaces.

## REFERENCES

- [1] Muhammad Fayez Afzaal, Anika Rehman, Saba Latif, and Nazir Ahmad Zafar. 2021. Blockchain-based Automated Formal Model for Smart Market System. *Proceedings of 18th International Bhurban Conference on Applied Sciences and Technologies, IBCAST 2021* (2021), 395–400. <https://doi.org/10.1109/IBCAST51254.2021.9393231>
- [2] Zhangbo Duan, Hongliang Mao, Zhidong Chen, Xiaomin Bai, Kai Hu, and Jean Pierre Talpin. 2018. Formal modeling and verification of blockchain system. *ACM International Conference Proceeding Series* 86 (2018), 231–235. <https://doi.org/10.1145/3177457.3177485>
- [3] Ryo Kawahara. 2020. Verification of customizable blockchain consensus rule using a formal method. *IEEE International Conference on Blockchain and Cryptocurrency, ICBC 2020* (2020), 14–16. <https://doi.org/10.1109/ICBC48266.2020.9169472>
- [4] Zhentian Liu and Jing Liu. 2019. Formal verification of blockchain smart contract based on colored petri net models. *Proceedings - International Computer Software and Applications Conference* 2 (2019), 555–560. <https://doi.org/10.1109/COMPSAC.2019.10265>
- [5] Shin'Ichiro Matsuo. 2017. How formal analysis and verification add security to blockchain-based systems. *Proceedings of the 17th Conference on Formal Methods in Computer-Aided Design, FMCAD 2017* (2017), 1–4. <https://doi.org/10.23919/FMCAD.2017.8102228>
- [6] Yvonne Murray and David A. Anisi. 2019. Survey of formal verification methods for smart contracts on blockchain. *2019 10th IFIP International Conference on New Technologies, Mobility and Security, NTMS 2019 - Proceedings and Workshop 2* (2019), 1–6. <https://doi.org/10.1109/NTMS.2019.8763832>

## A RESEARCH METHODS

### A.1 Part One

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi malesuada, quam in pulvinar varius, metus nunc fermentum urna, id sollicitudin purus odio sit amet enim. Aliquam ullamcorper eu ipsum vel mollis. Curabitur quis dictum nisl. Phasellus vel semper risus, et lacinia dolor. Integer ultricies commodo sem nec semper.

### A.2 Part Two

Etiam commodo feugiat nisl pulvinar pellentesque. Etiam auctor sodales ligula, non varius nibh pulvinar semper. Suspendisse nec lectus non ipsum convallis congue hendrerit vitae sapien. Donec at laoreet eros. Vivamus non purus placerat, scelerisque diam eu, cursus ante. Etiam aliquam tortor auctor efficitur mattis.

## B ONLINE RESOURCES

Nam id fermentum dui. Suspendisse sagittis tortor a nulla mollis, in pulvinar ex pretium. Sed interdum orci quis metus euismod, et sagittis enim maximus. Vestibulum gravida massa ut felis suscipit congue. Quisque mattis elit a risus ultrices commodo venenatis eget dui. Etiam sagittis eleifend elementum.

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