# Should I Install LaTeX , MiKTeX or TexStudio?

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# Should I Install LaTeX, MiKTeX or TexStudio?

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**Abstract**

In various guises, this is a common question, seemingly innocent, but actually betraying a fundamental confusion about LaTeX directory, and the levels of operation in the TeX/LaTeX ; concepts, distributions, editors, various implementations, and the TeX family and friends. TeX is a typesetting language developed by Donald E. Kunth, and today's worldwide de facto standard for high quality document typesetting for writers/authors in the academics and publishers of journals and books, including Elsevier, PlosOne, JSON and Nature Springer. LateX and ConTeXt are the two main evolution direction of TeX. LaTeX, a TeX macro and extension original created by Leslie Lamport. It is a free document typesetting and processing system for creating high quality rich document format, and outputs in device transferable formats(DVI, PDF, HTML, etc) suitable for submission to journals, institutions and publishers for ultimate publication. It is in principle and editing style different from a Word Processor, and was meant to encourage and enable authors concentrate more on writing rich contents, leaving document design to expert document designers. MiKTeX is a modern TeX distribution for Microsoft Windows, Linux and macOS, while TexStudio (likewise TeXnicenter) are TeX document editors. The purpose of this article is to clear the confusion and give a comprehensive introduction to anyone, (authors including academics) to choose between TeX/LaTeX distributions and editors to install given offered particular feature advantages, an the particular of the user's academic field and level of productivity on their project, report or document. The author relied on primary source documents, chats with LaTeX development members on stackexchange.com, literatures, and extensive software features testing and hoped this publication fills the gaps in knowledge and literature, aside numerous plagiarized blogs , confusing articles (as learning LaTeX itself). Also discussed are the future of LaTeX project, the dropped parallel LaTeX3 , the new policy of "gentle re-factory of Latex2e", tagged PDF and both the limits and challenges ahead of LaTeX project. The most important breakthroughs/evolution in TeX extension and development projects are the creation of pdfTeX in 2014, graphic editors, GUI and online TeX editors, expl3 language as part of LaTeX kernel in 2020, and syncing/integrating tools to other platforms/environment.

**Keywords**: LaTeX Distribution, Scientific Typesetting, TeX Editor, TeX implementation, Installing LaTeX, pdfTeX, expl3 programming .

## Introduction

LaTeX, actually LaTeX2e(2020) as upgraded by the LaTeX/LaTeX3 Project Team, and ConTeXt are the two major full document preparation or typesetting system (built on top of TeX) for high-quality document with tools for high resolution graphics, scientific paper typesetting especially for mathematics, chemical and technical equations. The LaTeX typesetting system (or simply **"TeX Distribution and Editors"**) is increasingly being used today by researchers, academics, laboratories, journals and academic institutions to publish reports, books, notes, thesis and also make presentations which include step computational analysis, STEM and Chemical Symbols, Statistical Analysis and complex mathematical equations in academic journals, project presentations and professional seminars.

LaTeX is not a WYSIWYG solution, you have to compile and then check the output as you edit and insert markups used for formatting. That is, when writing, the writer uses plain text as opposed to the

formatted text found in "What You See Is What You Get" marketing of Word Processors like Microsoft Word, LibreOffice Writer, Google Docs, and Apple Pages. The writer uses markup tagging conventions (i.e., LaTeX syntax and commands, "Sweave's knitting environment codes", markdown language, etc) to define the general structure of a document (such as article, book, beam/slideshow and letter), to stylise text throughout a document (as header, section, footnote, link, bold and italics, etc), and to add citations and cross-references( using BibTex, etc). A TeX engine in a distribution such as TeXLive or proTeXt/MiKTeX is used to produce an output file (such as PDF or DVI) suitable for printing or digital distribution . Fortunately, there are some programs such as TeXMaker that offer a better user experience and Overleaf that gives you both the source codes and the compiled PDF to compare.

It is true, "LaTeX has a much steeper learning curve when compared with Microsoft Word" as voiced by many users Wikipedia.com [2021], Group [2021].

Also, unprotected commands are disobeyed, while LaTeX, xparse hence pdfTeX get confused with floating figures, TeX characters in 'secondary codes' and positioning/wrapping texts about table and graphic objects. The practice is **" design and code, compile to see, cut and adjust, recompile"**. Vignette and Package Documentation are really important for corrective and guided adherence to particular command's parameters and required units of measurement. Interestingly, many academics are very passionate about LATEX! And, though it is most often used for medium-to-large technical or scientific documents but it can be used today for almost any form of publishing. A significant benefit of LaTeX is that it is a free software [*i.e.,there are no license fees, etc.*] It is usually obtained as a distribution and with the editors, (free TeX family sources, shareware or paid licences and services), and compilers or output engines (e.g., pdfTeX, luaLaTeX, xeTeX, conTeXt, etc) which generate shareable and portable-device transferable documents formats like PDF, PS, DVI and HTML documents. The main full distribution of TeX/LaTeXe are Texlive, MikTeX or ProTeXt (Windows OS) and MacTeX (MacOS).

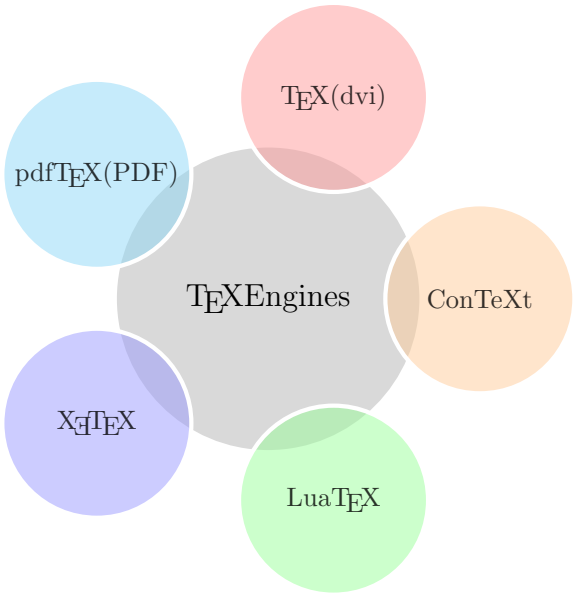


Figure 1: **TeX Output Engines**. PS:ConTeXt is a standalone, not of LaTeX system

This article was intended to clears the confusion and give a comprehensive introduction to the World of LaTeX. From the history and evolution to the description of the LaTeX/Tex directory, full and basic distributions (also levels of implementations), to choosing and installing the basic LaTeX distributions, LaTeX Editors. Section before the conclusion compares word processors to latex system, etc. Hopefully, this article and guideline should provide rich information, education and also sufficient technical resource for anyone, authors including academics, on TeX/LaTeX, the best distributions for the various Operating System platforms, and document typesetting using TeX/LaTeX system.

For instance, MiKTeX is known by many as a Windows O/S based TeX/LaTeX distributions, i.e., a collection of TeX macros, LaTeX language structure and basic packages. MiKTeX is a modern full and basic ("just enough TeX") distribution not only for Windows OS but Linux and MacOS too. Other LaTeX distributions include MacTeX for Mac OS and Texlive for Linux and Unix. And, TexStudio is a popular Microsoft Windows' GUI TeX editor dependent (not a standalone) on MikTeX (or MacTeX on MacOS).

The author relied on primary source documents, chats with LaTeX development members on stack-

exchange.com, literatures, and extensive features testing on some of the softwares/editors. The vision include giving a comprehensive introduction to the World of LaTeX, and providing sufficient information and technical bases for anyone - authors, project students, researchers including those in academic careers to choose between the major LaTeX/Tex distributions and install given the features offered by the distribution.

### The Philosophy behind LaTeX Project

LaTeX is not a word processor! Indeed, *"there are philosophical reasons why the way TeX has developed is ill-suited to the WYSIWYG style"*Lamport,[ FAQshttps://www.texfaq.org/FAQ-notWYSIWYG]. First, there is a fundamental problem with applying WYSIWYG techniques to TeX: the complexity of TeX makes it hard to get the equivalent of TeX's output without actually running TeX over the whole of the document being prepared.

The System, LaTeX, encourages authors to concentrate on getting the right content than worrying (too much) about the appearance of their documents. LaTeX is based on the idea that it is better to leave document design to document designers, and to let authors get on with writing documents. Instead of visually formatting your text, you enter your manuscript text intertwined with TeX commands(markup language or LaTeX syntax) in a plain text file, i.e., plainTeX. You then run TeX to produce formatted output, such as a PDF file. Other format include OpTEX, a LuaTEX format based on Plain TEX macros with power from OPmac (fonts selection system, colors, graphics, references, hyperlinks, ...) with unicode fonts. Thus, in contrast to standard word processors, your document is a separate file that does not pretend to be a representation of the final typeset output, and so can be easily edited and manipulated.

And,this is one of the significant benefits of LaTeX, especially in situation where Institution or Academic Journal desired or specified a particular format, grouping of contents and other particulars, experts can design these in a customized latex package, which allows uniformity, collaboration which include supervisors inputs, and both ease of submission and final processing the documents.

In most typesetting or word-processing systems, the author would have to decide what layout to use, so would select (say) 18pt Times Roman for the title, 12pt Times Italic for the name, and so on. This has two frequent results: authors wasting their time with designs; and a lot of badly designed documents!

According to the LaTeX Project Team, *it's a policy that will continue to encourage authors to concentrate on getting the right content than worrying (too much) about the appearance of their documents.* The project shall be an open source, where macros, custom packages and technical demands are to be left with experts and developers. And, obviously LaTeX Power users.

## The History of TeX/LaTeX

TeX is a typesetting system written by Donald E. Knuth, who said that it is "intended for the creation of beautiful books and especially for books that contain a lot of mathematics". It's actually a pretty good general typesetting system. Knuth developed the first version of TeX in 1978. The idea proved popular and Knuth produced a second version (in 1982) which is the basis of what we use today.

LaTeXis a TeX macro package, originally written by Leslie Lamport, that provides macros that would support TeX as a document processing system. According to Wikipedia/LaTeX Wikipedia.com [2021] LaTeX is intended to provide a high-level, descriptive markup language that accesses the power of TeX in an easier way for writers. In essence, TeX handles the layout side, while LaTeX handles the content side for document processing. LaTeX comprises a collection of TeX macros and a program to process LaTeX documents, and because the plain TeX formatting commands are elementary, it provides authors with ready-made commands for formatting and layout requirements such as chapter headings,

footnotes, cross-references and bibliographies.

And, according to leslie's personal notes (at LamportNotes2021http://lamport.azurewebsites.net/pubs/pubs.html this researcher believed the major encouragement was Addison-Wesley's editors vision-visit in 1983, the vision was "to publish a computer-based document processing system specifically designed for scientists and engineers, in both academic and professional environments." LaTeX was originally written in the early 1980s by Leslie Lamport at SRI International [1977-1985] but now with Microsoft Inc. {i.e., LaTeX allows markup to describe the structure of a document, so that the user need not think about presentation}. By using document classes and add-on packages, the same document can be produced in a variety of different layouts. Lamport's last version of LaTeX was LaTeX 2.09, last updated in 1992. Impressively, LATEX has stayed surprisingly relevant given that its original design dates back to the 1980s.

**TUG youthful enthusiastic movement** TeX Users Group, TUG, is a group of international and mostly fanatic visioneers of TeX prospects and power. Following the talks and criticism at the 1989 TUG international conference at Stanford, (with Leslie Lamport and Don Knuth in attendance,) and after a long meeting following the talk, Leslie Lamport passed the maintenance and future development of LATEX on to Chris Rowley, Rainer Schopf and Frank Mittelbach ( ie., the LATEX Project Team). Others, including younger ones, were recruited into the project, vis-a-vis David Carlisle, Johannes Braams, Alan Jeffrey, Denys Duchier, Michael Downes and Robin Fairbairns.Mittelbach and the LATEX Project Team [2020].

Leslie continued to work with the young developers and programmers, discussing concepts and interfaces, but did not participate in any of the coding for a new version. And, by the time LaTeX2e got released he had fully retired from working on LaTeX (except for sending in the occasional bug report like any other user). Thus, late August 1989 marked the origin of the LaTeX Project, later often referred to as now dropped alias the LaTeX3 project.

LaTeX Project Team thus set out in 1989 to improve LATEX 2.09 and produce a new version (a.k.a. LaTeX3), however, it was not at all easy to build applications on top of LATEX2.09 and, of course, LATEX was only a few years in use, and modern fast computers with storage and features for cascading like sheet wasn't existing then. Hence, LaTeX2e was introduced by LaTeX Project/LaTeX3 team in 1994 and is now the only readily-available stable version of LaTeX. That is, instead of continuing with LaTeX3 the team cleaned up all the extensions and improvements made for LATEX2.09, developed a graphics and color abstraction and bundled everything under the name **LaTeX2e**!

This was then promoted as the "newly revised LATEX standard". It draws together several threads of LaTeX development from the later days of LaTeX 2.09. The "e" of the name is (in the official logo) a single-stroke epsilon ($\epsilon$, supposedly indicative of no more than a small change). Part work done for LaTeX3 was released as a package on CTAN named expl3 in 1995, and mainly to preserve it till computers got faster - it seemed that the code could become usable after all at some point in the future. That was right! In fact, expl3 has gone through many reviews and , and by 2014 became stable public release.

LaTeX2e, however, has several enhancements over LaTeX 2.09 and was "feature frozen" till 2015 when policy changed, and the journey of what the team called "gentle re-factory" began, with another policy change in 2018 which allows the switch from legacy 8-bit code pages to Unicode, (or more precisely to the UTF-8 encoding in 2018). Really, development of the LaTeX2e kernel was somewhat limited by the need to retain compatibility with a very large ecosystem of third-party packages.

However, LaTeX2e offered a package management system with `\usepackage`, command declaration with optional arguments and other goodies for users and package developers and so over time people started

to provide more and more packages for LATEX that filled the needs of any niche. And, nowadays several thousand packages for LATEX are on CTAN. This, in part made parallel LaTeX3 impossible, practically and in principle. Team [2019]

The LaTeX Project (used to be LaTeX3 project in alias) has finally made the decision to drop the idea of a separate LaTeX3 format that would exist in parallel to LaTeX2e, but instead decided to gradually modernize LaTeX to keep it competitive in today's world while maintaining compatibility methods for older documents. [LaTeX3https://www.latex-project.org/latex3/].

And, as part of this **change of focus** and new policies, the following major improvements have been introduced in the last few years: 2018, Full support for Unicode input and UTF-8 became the default encoding in LaTeX; in 2019 witness the introduction of the LaTeX development formats to allow people to try out upcoming releases with ease; Integration of the L3 programming layer into the LaTeX format in 2020- the first uses of this layer inside the format are a new general hook management system for LaTeX, and the xparse document commands (formerly available as a package). Also, the interface extensions to NFSS (*the LaTeX font selection scheme*) to better support modern fonts (i.e., OpenType and others). As described in the LATEX Newsletter, we now have an "improved load-times for expl3".Mittelbach and the LATEX Project Team [2020], and Team [2019].


Figure 2: LaTeX Project Team Logo

Great! Thirty years after first dreaming about the LaTeX3, and Leslie handling over of LaTeX 2.09 to 'the Project Team', as of October 2020 both xparse and expl3 programming language are officially parts of the LATEX core(kernel). And, on compiling a document through my **MikTeX/TeXwork**, on the output console comes:

LaTeX2e ¡2020-10-01¿ patch level 4
L3 programming layer ¡2021-02-18¿ xparse¡2020-03-03¿
This is pdfTeX version 3.1415' MikTeX 21.2

LATEX, as of today, finally comes equipped with the LATEX3 programming layer included as part of the system format. And, for the future, at the **TUG conference 2020**, the group had announced the start of a multi-year project (financially supported in part by Adobe) to provide LaTeX support for the straightforward production of 'tagged PDF'. See also LaTeXProjectPublicationshttps://www.latex-project.org/publications/indexbyyear/2020. Team [2019]

And in the words of Frank Mittelbach, and on behalf of the Team, i.e., Mittelbach and the LATEX Project Team [2020]:

> *'LaTeX Project's plans for the upcoming years, which will primarily be focused on providing an out-of-the-box solution for generating tagged PDF with LATEX and will include* **"gentle refactoring"** *of parts of the core LATEX and providing important functionality, such as extended standard support for color, hyperlinks, etc., as part of the kernel.'*

And, currently, arrangements are being worked with the sources or providers of the major TeX distributions, i.e., TeXLive, MacTeX and MikTeX, to provide so called "LATEX development releases", allowing users and package developers to test pre-releases of LaTeX with ease. In fact, much credit goes to Leslie Lamport for LaTeX. By extending TeX resourcefulness and creating a standardised package system for LaTeX, Leslie Lamport laid a foundation that allowed the community to grow huge.

The TeX program has about 300 commands built in, but other commands can The TeX program has about 300 commands built in, but other commands can be defined within it. Donald Knuth wrote another 600 or so useful commands from within TeX, in a package called Plain TeX which makes some common typesetting tasks easier. The first major difference between LATEX 2.09 style files and LATEX2e packages and classes is that LATEX2e supports modularity, in the sense of building files from small building-blocks rather than using large single files. A LaTeX package

or class can load a package as follows: `\RequirePackage[options]{package-name}` or style file `\usepackage{name.sty}, or \inputencoding{definition}`

Another, perhaps the largest difference between LATEX 2.09 and LaTeX2e is in the commands used to write packages and classes. In LATEX 2.09, there was very little support for writing .sty files, and so writers had to resort to using low-level commands. The other major difference between LATEX 2.09 styles and LaTeX2e packages and classes is in option handling. Packages and classes can now declare options and these can be specified by authors; for example, the article document class' two column option is declared by the article class. For example, document class in the preamble section can be loaded with the command `\usepackage[options e.g a4paper, 10pt, doublecolumn]{class, version [1994/06/01]}` . And, a command can be thus renewed, `\renewcommand{\newcommand}[No. of parameter]{\definition}[#No.]`.

More detailed differences between LaTeX2e and LaTeX 2.09 are outlined in a series of "guide" files that are available in every LaTeX distribution (the same directory also contains "news" about each new release(pack) of LaTeX2e). *PS: The LaTeX Project Team is a small group of volunteers whose aim is to produce a major new document processing system based on the principles pioneered by Leslie Lamport in the current LaTeX.*

The LaTeX Project Team have since introduced to LaTeX2e, in form of **"gentle refractory"** principle and the solutions achieved by the LaTeX3 Project. That is, font encoding, further language support, pdfTeX, xparse and L3 programming. LaTeX development and extension still continues, with amazing results and production enhancing packages, Integrated Development Environment s (IDEs), backends and front-ends softwares including GUI, auto-complete and SyncPDF features For example, take a look at TikZ or PGFplots extension packages among thousands, which allows flowcharts, and scientific diagrams on latex documents. Latex can be inserted as runn-able snippet or plug-in on other standalone application terminals. Examples include on Microsoft Excel terminal (Excel2latex); Rstudio (Sweave-ing and sTangle-ing documents in fo.Rnw file using Sweave and Knitr packages, with MikTeX or tinyTeX as LaTeX editor); and Standalone/frontend IDEs and web pages.

## Significant Evolution/Development in History

TeX has evolved in two major directions (and perhaps four evolution formats, and clearly from LATEX evolution and extensions) and then varying different ways. The two evolved implementation and development over TeX are LaTeX [now LaTeX2e(2020), its gentle but major re-factory] and ConTeXt. There are varying extension and developed integrations to other independent environment and terminals which include online implementation and small mobiles distributions.

Starting from LaTeX (which as a TeX macro) comes with the addition of easier to use commands on top of the original TeX system. Then, LATEX extended in specific academic/functional field packages contributions, programming language and macro development, and also in integrated development environment(IDEs) and implementations.

The introduction of pdfTeX which is an engine update to the underlying TeX program to support transferable PDF outputs instead of just postscripts was a significant evolution. The first version of the PDF specification (PDF 1.0) was officially released on June 15, 1993 , followed by PDF 1.4 in 2001, (including tagged PDF, which is now the focus of LaTeX Project Team). However, the latest is PDF 2.0 and is not yet well supported by TeX engines.

And from the defunct LaTeX3 project, we have the expl3 programming language, which is now the main LaTeX3 re-factory of LaTeX2e, and also part of core LaTeX since October 2020, and with xparse package. And, the fourth is graphics and plots in LaTeX. TeX itself is not concerned with plots and graphs. The PStricks and pgfplots (based on tikz) packages are powerful tools dedicated to create scientific plots and graphs. Today, we have many graphic editors and IDE of LaTeX. Also, recent trends include LaTeX integration/synchronization to other terminals, including Microsoft Word, Python and

R terminals through Sweave-knitr supports.

There have been continuing efforts to modernize TeX, and extend its family and usage globally. First, AMS-TeX was originally written by Michael Spivak, and was used by the AMS from 1983 to 1985. The successor, AMS-LaTeX, is a collection of LaTeX document classes and packages developed for the American Mathematical Society (AMS) and offers access to a family of TeX-related products for the convenience of authors and MathSciNet searchers. Its additions to LaTeX include the typesetting of multi-line and other mathematical statements, document classes, and fonts containing numerous mathematical symbols and equation alignment. For example,

```
\begin {align}
y &= (x+1) ^ 2 \\
  &= (x+1)(x+1) \\
  &= x ^ 2+2x+1
\end {align}
```

(a) The "align" Codes

$$y = (x+1)^2 \tag{1}$$
$$= (x+1)(x+1) \tag{2}$$
$$= x^2 + 2x + 1 \tag{3}$$

(b) The Equation Alignment Result

Figure 3: Using the **aligned environment** to align equations

AMS-LaTeX has largely superseded the plain TeX macro package AMS-TeX. [AMSPublicationshttp://www.ams.org/publications/authors/tex/tex] Also, it includes many flexible commands for formatting and numbering theorems, lemmas, etc. With `\usepackage { amsmath }` in the preamble, the command `\AmS - \LaTeX` will produce the AMS logo, $\mathcal{AMS}$- LaTeX.
Three collections provide basic support for preparation of mathematical publications: AMS-LaTeX v2.20, AMS-TeX v2.2, and AMSFonts v3.0. These are bundled as zip files suitable for all platforms. While **MRef** is the free AMS tool for creating standard references with links to MathSciNet. However, the TeX program is not available from the AMS. It can be obtained as freeware,(CTAN) or shareware, or from the commercial TeX vendors.

**Important note:** *If you are working on a system based on a TeX Live (or MiKTeX or MacTeX) distribution later than 2005, AMS-LaTeX will be included as part of the LaTeX "required" collection, no need to download or install it separately. There are two components to AMS-LaTeX: the document classes, and amsmath,i.e., the amscls2.zip and amsmath. They may be separately obtained from CTAN. The amscls archive will unpack into an existing TEXMF structure, in most cases providing a ready-to-use installation.*

**ConTeXt** was developed in 1990 by Hans Hagen from PRAGMA Advanced Document Engineering (Pragma ADE), a Netherlands-based company. ConTeXt, which aims to provide an easy interface to advanced typography features by taking the TeX macros to modern programming that results to high-quality digital documents. In April 2019, there was a new implementation of ConTeXt, named ConTeXt LMTX.[ LMTX uses a compilation and scripting engine that is specifically developed with ConTeXt in mind: LuaMetaTeX]

In 2004 Jonathon Kew created XeTeX which allows the use of other languages and font styles. It is a TEX typesetting engine using Unicode and supporting modern font technologies such as OpenType, TrueType or Apple Advanced Typography (AAT), including OpenType mathematics fonts.

In 2007, LuaTeX (was introduced in beta form at TUG 2007) and was meant as an attempt to extend the original TeX program with a more sensible programming language. From the user perspective we may have pdfTeX as stable and more or less frozen 8 bit engine, XeTeX as unicode input extension, and font aware engine using libraries for font handling including non English letters or alphabets, and LuaTeX as engine that is programmable and delegates as much as possible to Lua, (the embedded

scripting language), with the objective to keep the core engine lean and mean.

The most important improvement of the 1990s was the creation of pdfTeX by Han The Thanh for his PhD thesis. The original TeX program outputs the typeset document into a custom format called DVI (DeVice Independent format), that can later be turned into a PostScript file for printing. However, the PDF format came along in 1993 and we can see today that it clearly won as the better format over PostScript. See L [1994]

The first version of the PDF specification (PDF 1.0) was officially released on June 15, 1993 , followed by PDF 1.4 in 2001, (including the introduction of "tagged PDF") and the latest release (PDF 2.0) which, based on reports, has significantly overhauled accessibility features. PDF 2.0 is not yet well supported by TeX engines. Over time the PDF specification has evolved to provide features which enable and support the production of accessible PDF documents using a "stylized" flavour of PDF which Adobe calls tagged PDF. However, TeX engines do not use space characters to separate words in typeset text; instead, they convert space characters into a form of flexible spacing called **glue**. This aspect of TeX's typesetting has implications for copying/pasting text from its PDFs and for assistive software trying to read aloud the typeset text in PDFs produced by TeX engines.

In 2014 pdfTeX introduced 2 new primitives to improve accessibility support by enabling the use of space characters between words in the PDFs it outputs. And, currently, efforts at producing tagged PDF has started. Although tagging allows identification of content items present within a PDF compiled from TeX document, some types of content, such as graphics or complex mathematics, require additional data or information if they are to be made accessible via software designed to read PDF file or support visually impaired people. To provide and support accessibility for a wide range of content types, the PDF specification provides the ability to attach "Alternate Descriptions" or "Actual-Text" to content items, providing suitable textual descriptions or other machine-readable representations.

Development of graphic languages like PStricks and PGF/TikZ for producing vector graphics (e.g., technical illustrations and drawings) and also graphic editors marked another significant extension of the power of TeX/LaTeX. From a geometric/algebraic description, with standard features including the drawing of points, lines, arrows, paths, circles, ellipses and polygons. PGF is a lower-level language, while Ti k Z is a set of higher-level macros that use PGF. The top-level PGF and Ti kZ commands are invoked as TeX macros, but in contrast with PSTricks, the PGF/Ti kZ graphics themselves are described in a language that resembles MetaPost .( https://en.m.wikipedia.org/wiki/PGF/TikZ)

Till Tantau is the designer of the PGF and TikZ languages. He is also the main developer of the only known interpreter which is written in TeX. PGF is an acronym for "Portable Graphics Format". And, TikZ was introduced in version 0.95 of PGF. Graphic editors include LaTeXPiX, TikzEdt and TpX, a freeware for graphics and pdf graphics, written for Microsoft Windows. KtikZ code editor, an open source written for Microsoft Windows , Ubuntu and Debian. And, GraTeX written in Java for MS Windows, Linux, MacOS.

Despite being over 30 years old, LaTeX is still partly a GUI and command line programming and typesetting system that awkwardly cycle from the level of writing, compiling and checking the output. CTAN (the Comprehensive TeX Archive Network) is the principal public archive of TeX materials. CTAN is a synchronized worldwide network of hosts and mirror sites which can be accessed either via a Web browser or directly by FTP.

## The Tex/Latex Family and Friends

Tex Family and Friends are really descriptions of TeX/LaTeX extensions, developers and implementations on various system platforms, and as concepted and indexed in the Latex Development Directory or Family

tree. Included are the various levels of associates, projects including LaTeX Project Team (formerly LaTeX3 Project) and the main users groups, (TUG). And, starting at the top of the LaTeX directory:

## TeX/LaTeX Distributions and Installers

A collection of basic or full TeX/LaTeX typesetting system, tools for implementation (on a platform or operating system OS), documentation and the installation file is called a "TeX distribution", and usually with macro-adds, compilers, and solutions, also packages built on TeX/LaTeX foundation, e.g., BibTeX for Bibliography and referencing, expl3 programming language, packs of fonts, colors and document classes (styles or .sty files). Clearly defined are the basic or required packages, specifics of compilers' output (mostly web markup texts and transferable self contained documents,e.g., PDF, PS, and HTML,etc) and other tools that will help you to "perform the TEX's magic" on your PCs as you get along document and project work typesetting and publication. It must be emphasized, each distribution, comes with distinct programs and features specific to various PC's Operating Systems, the internet access situation and the download size preferences and settings needed personally and in users' field of research, publication and career.

They are called the coherent collections of TeX-family software to be downloaded and installed to be able to use the typesetting system. When someone says *"I need to install TeX on my machine"*, usually what that person is looking for is a distribution type which come as suite or collection of integrated basic and structural soft-wares i.e., Tex editor, required packages, and TeX document output printer or compilers, etc.

## Front-ends and Tex Editors

There are many advanced text editors specifically dedicated to LATEX for the most popular operating systems, including small mobiles (PC). There are also TeX basic implementation as plug-in/Integrated Development Environment (like Vim with Tex, TinyTeX on RStudio terminal). Some of them can be downloaded for free while others are proprietary software:

| **Open Source** | **Freeware** | **Proprietary and Share-ware** | **Online Editors and Services** | **LaTeX Plugin on IDE** |
|---|---|---|---|---|
| AucTeX, GNU TeXmacs, Gummi, Kile or (LaTeX-ila), MeWa, TeXShop, TeXnicCen-ter, Texmaker, TeXstudio, etc.<br><br>They are under GNU or MIT free license. | LEd, Win-Shell, TeX-work,TinyTex, etc. | Inlage, Scientific WorkPlace, WinEdt, Bakoma TeXWord, Archimedes, etc. | The LaTeX online services include Papeeria, Over-leaf, ShareLaTeX,Datazar and latex base.<br><br>All offer the ability to edit, view and download LaTeX files and resulting PDFs. This is rather not well moderated field of LaTeX implementation | TeX implementa-tion on Integrated development En-vironment (IDE), and with plug-in such as Winefish, Winshell, gedit with gedit-latex plug-in, also Vim with LaTeX-Box and vinTeX, etc. |

Table 1: **End-distribution of TeX/LaTeX Editors**

These editors are what you use to create a TeX document file, with great flexibility, scalability and outputs quality better than that from word processors. You may use word processors like Microsoft Word or Wordpad to create batches of text and paste in LaTeX environment. Some (e.g., TeXShop) are devoted specifically to TeX, others (e.g., Emacs) can be used to edit just any file format. Three are described as follow:

**WinEdt** is a powerful and versatile all-purpose text editor for Windows. A shareware Unicode LaTeX editor and shell for Microsoft Windows. It is used as a front-end (Integrated Development

Environment) for compilers and typesetting systems, such as TeX, HTML or NSIS. It is primarily used for the creation of TeX documents, but can also be used to edit HTML or any other type of text file. https://www.winedt.com/

**TeXShop** is a free LaTeX and TeX editor and previewer for MacOS. It is licensed under the GNU GPL.[ Released since July 2000.] Like TeXworks, which is bundled with MiKTeX, TeXShop is a TeX front end: you can use it to write LaTeX documents. http://pages.uoregon.edu/koch/texshop/

**VerbTeX LaTeX Editor** a free, collaborative LaTeX Editor for your Android device. VerbTeX allows you to create and manage LaTeX projects directly on your Android device and generate a PDF by using the LaTeX service available at verbosus.com. That is, VerbTeX uses the web services available at verbosus to generate a PDF from your LaTeX code. There's a full TeXLive distribution working in the background so you have the full power at your fingertips. You can collaborate with other users by using the integrated collaboration feature (Cloud Mode) or by using Dropbox or Box (Local Mode) to share your work and work anywhere at anytime. (https://www.verbosus.com/android-latex-editor.html)

## Tex Engines and Compilers

The styles, contents and layout in a LATEX document are defined by means of tags or commands in a plain .tex file, this file can be used to generate several types of "human-readable" versions of the document. The easiest way to generate this final output is by compiling the document using compiler settings: LaTeX (for DVI file output), pdfLaTeX (the default; PDF file), XeLaTeX and LuaLaTeX.

For example, at the LaTeX Distribution System Terminal, if you want to compile a file named "mydocument.tex" you can use one of the next commands: `latex mydocument.tex` and this will create "mydocument.dvi", a DVI document. Alternative is `pdflatex mydocument.tex` This will generate "mydocument.pdf", a PDF document. The Compilers are the executable binaries which implement different TeX document output variants.e.g., PDF files, DVI files , LaTeX (for DVI files), etc. For instance, **pdfTeX**implements direct PDF and tagged PDF output, along with a variety of programming and other extensions.

**XeTeX** does the above, and also supports Unicode natively, OpenType and TrueType fonts and, access to system fonts,etc

**LuaTeX** LuaTeX is a TeX-based computer typesetting system which started as a version of pdfTeX with a Lua scripting engine embedded. And, besides supporting a Lua interpreter, LuaTeX brings to pdfTeX quite the same changes as XeLaTeX and XeTeX, native Unicode support, support for system fonts, except for microtype supports, partial movies support and font-names.

After some experiments it was adopted by the TeX Live distribution as a successor to pdfTeX (itself an extension of e-TeX , which generates PDFs ). Later in the project, some functionality of Aleph was included (especially, the multi-directional typesetting). **PS:** *The project was originally sponsored by the Oriental TeX project, founded by Idris Samawi Hamid, Hans Hagen, and Taco Hoekwater. And, by far, the most programmable engine.*

While the **[e][u]pTeX** provide full support for Japanese typesetting. There are other engines, but the above are by far the most commonly used nowadays.

The TeX document page styles include LaTeX, some markups, plain TeX, OpTeX, and Fancy texts, etc. These are the TeX-based languages in which one actually writes documents.

### TeX Typeset Output File

There are three output formats available in all TEX distribution. The description of each output format is provided below:

- (DVI) Device independent file format consists of binary data describing the visual layout of a document in a manner not reliant on any specific image format, display hardware or printer.
- (PS) Post-Script file format describes text and graphics on page and it is based on vector graphics. Postscript is, until now, a standard in desktop publishing areas.

- (PDF) Portable Document Format is a file format, based on Post-Script, used to represent documents in a manner independent of application software, hardware, and operating systems. It is now widely used as a file format for printing and for distribution on the Web.

TeX source files can be typeset into several different output formats, depending on the engine. Notably, the pdfTeX engine (despite its name) can output both DVI and PDF files.

### TeX Packages and Macros:

These are add on to the basic TeX system, developed independently, providing additional typesetting features, fonts, documentation, etc. A package might or might not work with any given format and/or engine; for example, many are designed specifically for LaTeX, but there are plenty of others, too.

The CTAN sites provide access to the vast majority of packages in the TeX world. The Comprehensive TeX Archive Network (CTAN) is the central place for all kinds of material around TeX. CTAN has currently 6017 packages. 2768 contributors have contributed to it. Most of the packages are free and can be downloaded and used immediately. Christian Schenk(2021). CTAN website.website.

## The Major TeX/LaTeX Distributions

These are full distributions built on TeX; LateX distributions (TeXlive, ProTeXt, MikTeX, etc) and ConTeXt [*a standalone and general purpose document processor built on TeX like LaTeX(really LateX2e)*]. While, aside the online implementations, the group of TeX Portal, TeX Writer, TeX Pad, TinyTeX and verbTeX, etc., are specialised distributions, generally smaller and sometimes minimal, for specific needs as for use on small mobile devices and ipads and plugin to IDEs.

If you are looking to install a complete system, we recommend TeXLive for Unix/GNU/Linux, MacTeX for MacOSX, and proTeXt for Windows. You can join TUG or another user group and have physical discs sent to you, or you can purchase the distributions without joining.

### MikTeX

MiKTeX (pronounced mick-tech) is an up-to-date implementation of TeX/LaTeX and related programs. MiKTeX is a modern TeX distribution for Windows, Linux and macOS. Also included in the distribution package are the MiKTeX Console which helps you to keep your TeX system up-to-date by installing the latest package updates, and TeXworks, a TeX front-end which you can use it to edit and preview LaTeX documents. There are currently 4077 packages in the MiKTeX package repository as updated on March 25, 2021.Schenk [2021].

**Requirements/Operating Systems** You are advise to read the tutorials on the MikTeX ReadMe files. However, the System requirements are as follow:

- MiKTeX for Windows requires one of the following Windows operating systems: Windows 10; Windows Server 2016; Windows 7 [pack 2]/8/8.1 (all editions except RT); Windows Server 2012. You can install from the net (MikTeX.org) and from downloaded MikTeX Portable Edition (on usb flash drive or external disk drive). The portable edition allows you to run MiKTeX from a portable storage device.
  MikTeX installer. File name: `basic-miktex-21.2-x64.exe`
  Size:243.83 MB
  File. [https://miktex.org/download/ctan/systems/win32/miktex/setup/windows-x64/basic-miktex-21.2-x64.exe]
- MiKTeX for Mac requires one of the following Macintosh Operating Systems: macOS 10.15 (Catalina); macOS 10.14 (Mojave); macOS 10.13 (High Sierra); macOS 10.12 (Sierra) Only x64 platforms are supported.
  File name: `miktex-21.3-darwin-x86_64.dmg`
  Size: 58.3 MB
  https://miktex.org/download/ctan/systems/win32/miktex/setup/darwin-x86_64/

miktex-21.3-darwin-x86_64.dmg
MiKTeX for Mac is distributed as a disk image (.dmg) file. To install simply drag the MiKTeX icon onto the Applications shortcut icon. This will install the MiKTeX Console application and essential support files (executables, frameworks, configuration files). Before you can use MiKTeX, you have to finish the setup in the MikTeX Console.

An alternative, the Docker image, which allows you to run MiKTeX on any computer that supports Docker. You can obtain the image from Docker hub: docker pull miktex/miktex. Please beware that the Docker image is still in an experimental stage.

- MiKTeX for Linux distribution requires one of the following Linux operating systems: Linux (only x64): Linux Mint 20, Linux Mint 19, and Linux Mint 18.3; You need to register the GPG key with which MiKTeX installation packages and metadata is signed, (the key ID is as this: D6BC243565B2087BC3F897C9277A7293F59E4889; register the installation source depends on the Linux distribution version. Finish the setup and upgrade your TeX distribution packages.
- MikTeX for Ubuntu OS: Ubuntu 20.04 (Focal), Ubuntu 18.04 (Bionic), and Ubuntu 16.04 (Xenial);
- MikTeX for Debian OS : Debian 10 (Buster), Debian 9 (Stretch), and Fedora; Fedora 32, 30 and 28.

**During installation you need to make some decisions!** "Do you want to set up a private (for you only) TeX installation, or do you want to set up a shared (system-wide) TeX installation?". You probably may want to choose the first option but the second option makes sense if you are the administrator of a multi-user system. It should be noted that MiKTeX supports the notion of a scalable TeX system. You can turn on the auto-install feature (during installation or in the MikTeX Console after). This will let MiKTeX install missing packages on-the-fly.

This will help you to keep your TeX installation as minimal as possible ("Just enough TeX") which gives freedom to choose packages and sizes of MikTeX on your system. Necessary files/packages are installed when they are called for on compiling Tex documents. i.e., if you run a TeX engine (pdflatex, xelatex, lualatex) the first time, or there is a need for a particular package for a particular newly used document structure being compiled. Be patient, take a shake of milk and relax till installation is completed. For more information about MiKTEX, visit MikTeXhttp://www.miktex.org

The MikTeX distribution for Windows is actively maintained by Christian Schenk. Many Windows users prefer MikTeX to TeX Live for ease of installation because it is based on a Windows Wizard. Recently it has also been ported to Linux and macOS, and major implementation on small mobiles. Schenk [2021].

## Texlive

Texlive provides a comprehensive TeX system with binaries for most flavors of Unix, including GNU/Linux, macOS, and also Windows. It includes all the major TeX-related programs, macro packages, and fonts that are free software, including support for many languages around the world. Many operating systems provide it via their own distributions. TeXLive has been developed since 1996 by collaboration between the TeX user groups, TUG. It was originally perpetrated or created by Sebastian Rahtz. Present collaboration include Akira Kakuto, Karl Berry, Luigi Scarso, Mojca Miklavec, Norbert Preining, Reinhard Kotucha, Siep Kroonenberg, and thousands of others.
Texlive have the special advantages of tlmgr, cross-platform, excellent support, very well maintained, extremely active community. And, while Windows 7 and later are supported, and Windows Vista may still mostly work, the partially frozen TeXLive will no longer even install on Windows XP or earlier. We await new release of Texlive! TeX Live includes no 64-bit executables for Windows, but the 32-bit executables should run on 64-bit systems too. For better clarification, please, you can see https://tug.org/texlive/windows.html for options to add 64-bit binaries.

**Basic installation of TeX Live** You can install TeX Live either from DVD or over the Internet (https://tug.org/texlive/acquire.html). The net installer itself is small, and downloads everything

requested from the Internet. The DVD installer lets you install to a local disk. You cannot run TeX Live directly from the TeX Collection DVD (or its .iso image), but you can prepare a runnable installation on, e.g., a USB stick.

For Unix, the installation script is **install-tl** whereas, on Windows you should instead invoke **install-tl-windows**. The installer will operate in a graphical mode given the option `-gui (default for Windows and Mac OS X), or a text mode given the option -gui=text (default for ever` One of the installed items is the 'TeX Live Manager' program, named tlmgr. Like the installer, it can be used in both GUI mode and in text mode. You can use it to install and uninstall packages and do various configuration tasks.

## ConTeXt

ConTeXt is a general-purpose document processor . Like LaTeX , it is derived from TeX. It is especially suited for structured documents, automated document production, very fine typography, and multi-lingual typesetting. It is based in part on the TeX typesetting system, and uses a document markup language for manuscript preparation. According to Wikipedia/wiki/context, "the typographical and automated capabilities of ConTeXt are extensive, including interfaces for handling micro-typography , multiple footnotes and footnote classes, and manipulating OpenType fonts and features. Moreover, it offers extensive support for colors, backgrounds, hyperlinks, presentations, figure-text integration, and conditional compilation." The system gives the user extensive control over formatting while making it easy to create new layouts and styles without learning the low-level TeX macro language.

ConTeXt may be compared and contrasted with LaTeX , but the primary philosophy and core system/kernels of the two are rather distinct. The two were evolved implementation and development over TeX; LaTeX [now LaTeX2e(2020), its gentle but major re-factory] and ConTeXt. ConTeXt was concepted as a typography and typesetting system meant to provide users easy and consistent access to advanced typographical control that are important for general-purpose typesetting tasks. And, the original vision of LaTeX was a philosophy and aimed at insulating the users from typographical decisions, thus leaving page and document structure and style to experts and this is a useful approach to digital document creation that supports submitting e.g. articles for a scientific journal and publishers. LaTeX has evolved from that original vision so also ConTeXt, but retains its unified design which avoids package clashes that happens often with LaTeX.

ConTeXt provides a multi-lingual user interface with support for markup in English, Dutch, German, French, and Italian and support for output in many languages including western European, eastern European, Arabic-script, Chinese, Japanese, and Korean. Its system features allows the user to use different TeX engines like pdfTeX, XeTeX , and LuaTeX without changing the user interface. ConTeXt provides macro packages for specific field typesetting, including chemical structure diagrams with TeX called PPCHTeX , and also supports for the use of other external drawing engines, like PGF/TikZ and postscript equivalent, PSTrick. This package can also be used with plain TeX and LaTeX. As its native drawing engine, ConTeXt integrates a super-set of MetaPost called MetaFun, which allows the users to use the drawing abilities of MetaPost (which can also be used with stand alone MetaPost) for page backgrounds and ornaments.

Originally called **"pragmatex"**, the name changed to ConTeXt around 1996. ConTeXt is free software created by Hans Hagen from PRAGMA Advanced Document Engineering (Pragma ADE), a Netherlands-based company. The program code (i.e. anything not under the /doc subtree) is distributed under the GNU GPL licence and the documentation is provided under Creative Commons Attribution "Non-Commercial" .

**Some Security considerations** Though the core TeX programs themselves are (and always have been) extremely robust. However, the contributed programs in TeXLive and other LaTeX distributions may not reach the same level, hence conflicts and unnecessary duplication despite everyone's best efforts.

As always, you should be careful when running programs on un-trusted input; use packages approved in your institution and with known support status. Thus, checking for suspicious files in the current directory, especially executable (binaries or scripts) is recommended. Ordinarily they should not be present, and definitely should not normally be created by merely processing a document. Finally, TeX (and its companion programs) are able to write files when processing documents, a feature that can also be abused in a wide variety of ways and often destroy large files.

## Basic LaTeX Installation

Tex/LaTeX installation can be complete (full package) or basic installation. The 'basic distribution' is catalogued separately, at latex-base; apart from a large set of contributed packages and third-party documentation (elsewhere on the archive), distribution includes:

1. a bunch of 'required packages', which LATEX authors are "entitled to assume" will be present on any system running LATEX. Packages which must be available (required) - are essential tools (tools), core graphics and color support (graphics), key mathematics support (amsmath); and
2. a minimal set of documentation detailing differences from the 'old' version of LATEX in the areas of user commands, font selection and control, class and package writing, font encoding, configuration options and modification of LATEX.

Installation of the basic TeX/LaTeX system have different procedures and sources relative to the PC's Operating System type, i.e., Windows, MacOS and Linux distribution (Ubuntu, Mint, Debian, and Fedora). The installations can be through the net (with good internet connection), installation CD/DVD or you can download the installer or basic installation packages for each of the platforms, windows OS, Linux and a "drag and drop" for MacOS.

**LaTeX Distribution Repository:** The normal way to obtain LaTeX distribution, (the basic version for slow Internet devices, snippets for online interfaces and the full version), is therefore not to get it from CTAN repository, or CD (TeXLive) from TeX User Group, (TUG) as a member and the various listed Mirrors and also the particular distribution developers and maintainers' websites. However, the packages, macros and dependencies are available from CTAN repository at https://www.ctan.org

General Required Document Typesetting Components In order for LaTeX distribution to run smoothly, you need to have all of these components:

**Components to Run TeX Document**

| | |
|---|---|
| 1 **Postscript Interpreter** | e.g. GPL GhostScript |
| 2 **Postscript Viewer** | GhostVIew, GSview, etc |
| 3 **PDF viewer** | Adobe Reader |
| 4 **Tex/LaTex compiler** | conTeXt, luatex, pdfLaTeX, etc |
| 5 **Tex Editors** | WinEdt, TexMaker, TexStudio and TeXnicCenter, etc |
| 6 **Font and Style packages** | Chinese, Arabic,Portuguese,etc |

Table 2: Basic Components to Run TeX Document

# Making the Choice/Operating System (OS)

**Unix-type Systems, including GNU/Linux**: the best choice is TeXLive, which contains many packages and programs. It is freely available over the Internet or on disc. Note that most Unix systems have TeX as an installation option so you might already have it or be able to easily get it using your system administration package management tool: RPM, or DEB, or whatever.

This is highly maintained TeX distribution, with tens of developers with choice particular on all operating systems. Some GNU/Linux distributions provide it in their packaging framework (Debian, Fedora, OpenSUSE, but these prepackaged versions usually lag behind the basic one.

**Macintosh OS**: you need to get the MacTeX distribution, which is TeXLive with some Mac-specific features. Current distribution is MacTeX-2020 which consists of several packages. A custom install option allows users to select which packages to install among: GUI applications such as TeXShop , LaTeXiT, and some documentation Ghostscript 9.50 and Ghostscript libgs.

However, two programs could not be included in MacTeX because their authors have not yet notarized them. Users can retrieve them directly from their web sites: BibDesk and TeX Live Utility. For more information, (http://tug.org/mactex and http://tug.org/mactex/aboutarm.html). It is essentially the same as TeX Live, but only for Mac OS X and with added features for compatibility with the OS. The MacTeX-2020 distribution requires Mac OS 10.13, High Sierra, or higher and runs on Intel and Arm processors. To download, click MacTeX Download, http://tug.org/mactex/mactex-download.html

## MikTeX and TeXlive

For most users, making choices between MikTeX (with option of TexStudio or TeXnicCenter) and TeXlive is largely down to 'personal opinion' or 'what you try first'! However, TUG advise that MikTeX as more robust in term if security, and allows minimum packages to be downloaded, and on the fly as need arise.

Texlive is a complete TeX distribution for all modern platforms, with all freely available fonts, packages, and programs. It is a collaborative effort by the TeX user groups and many individuals worldwide. TeX Live contains binaries for many Unix-based platforms, including GNU/Linux, Mac OS X, and Cygwin.

While TeXlive is designed to support multi-user systems, including being installed on a servers and used on network clients, and possibly with mixed architectures and OSs. (https://tex.stackexchange.com/questions/20036/what-are-the-advantages-of-tex-live-over-miktex.)

MikTeX supports (more or less) only windows which means that it can concentrate on windows problems and how windows "look and feel" now and the future. Apart from that:

- Miktex has both 32 bit (stable) and 64 bit (experimental). It is a pity that TeXlive for Windows is available only for 32 bit.
- MikTeX supports more packages and its packages are more complete as it doesn't restrict itself to "free software".
- Only MiKTeX can do 'on the fly' package installation, as TeX Live is more focused on having a system that works well on multi-user systems. On-the-fly installation of missing Packages is a great feature. It updates binaries also between releases so its binaries often were newer than the one in TeXLive at a given new update (nowadays you can update binaries in TeXlive tlcontrib so it also can be the other way round.)
- Deciding the install location of your own packages and classes is easier on MiKTeX. Installing them is just as easy on TeX Live if you use one of the predefined locations. However, TeXLive is maintained by TUG, that is, by more than one person, which makes it more future-safe. It supports many platforms, not just Windows. (The first paragraph of )

## MikTeX and proTeXt.

proTeXt is a MiKTeX-based distribution for Windows. That is, proTeXt is a bundle that contains, among other things, MiKTeX, which is one of the two major TeX distributions (the other being TeXLive).

proTeXt adds a few independent tools to MiKTeX, notably TeXnicCenter and Ghostscript. TeXnicCenter is a LaTeX editor that works quite well with MiKTeX, Ghostscript is software for processing PostScript (*.ps) files.

It aims to be an easy-to-install TeX distribution for Windows, based on MiKTeX. After downloading, a wizard (available in several languages) guides the installation.

The current proTeXt actually contains TeXstudio as an editor, and not TeXnicCenter anymore, but that information hasn't even reached all of their own web sites yet. Old MikTeX users usually download TexStudio as a better alternative editor to Texwork.

What makes the difference between MiKTeX's 164 MB and proTeXt's 1195 MB is the fact that MiKTeX is a Basic Installer that loads further packages on-the-fly, when necessary. The MiKTeX included in proTeXt has that ability, too, of course; however, it comes with many (all?) packages included, so it's a "full" install.

If you're completely new to LaTeX and you have a decent Internet connection, I recommend going for proTeXt because it gives you all you need for a start and offers a nice installation-flow manual.

Some Popular TeX/LaTeX Distribution have become obsolete with operating system advancement.

# LaTeX Editors

## Inlarge

One of the best LaTeX development environment (LDE) for MS Windows® XP/Vista/7/8. The philosophy, by employing intelligent auto-completion of markups/commands, to have few menu items and toolbars as much as possible. Inlage needs no work support for DDE support (Adobe® Reader and SumatraPDF) and uses a sophisticated docking-system that allows you to define your own layout too. If you don't know the command for a symbol or equation you can use the Windows® 7 Math Input Panel to insert it directly into your document. Features of the editor include syntax highlighting, code folding, auto-indention, word wrap, bracket highlighting, auto-completion and spell checker.

It also include advanced features such as the huge docking system, a console and sketch panel. The LaTeX features on the IDE are Math Input Panel to LaTeX, Excel/Calc tables to LaTeX, inverse/forward search with SumatraPDF, unicode and master file supports, etc.

## Technicenter

TeXnicCenter is an integrated documentation environment (IDE) for LaTeX. That means that TeXnicCenter integrates all the functionality you need to create, write, build, fix, view and print your LaTeX documents. Instead of having to use several different tools, like an editor for writing the document and the LaTeX command line tools for building them, TeXnicCenter provides all the necessary tools and integrator from within its powerful user interface, GUI. TechnicCenterfeatures https://www.texniccenter.org/about/feature/ The user interface(UI) features are:

- LaTeX code snippets, and simple insertion of 'LaTeX constructs' via toolbars and menus
- Tabbed MDI window. You can open as many files as needed, each represented by an opened tab.
- Customizable window layout. All panes can be docket to any window edge or undocked if required.
- Integratable tools, including any third party tools into TeXnicCenter's tools menu
- Multi language. Support for English and German and other Translations.

The editor's features include syntax highlighting, auto completion, real time spell checking, dynamic word wrapping and a lot more makes it a joy to enter and maintain your texts. Tons of predefined text snippets and LaTeX commands available from the menus and the toolbars make it needless to search the LaTeX reference. The project support in conjunction with the sophisticated structure parser helps

| SOME TEX/LATEX EDITORS: ONLINE/OFFLINE/IDE | | | | |
|---|---|---|---|---|
| **TeX/LaTeX Editor** | **Editing style [see *] & Output** | **Native Operating Systems** | **Inverse Search** | **Cost & Payment** |
| Archimedes(GUI Editor) | Source. SyncTeX. Autocomplition | macOS, OSX | Yes | Commercial: $4.99 on Apple Store |
| Atom | source. SyncTeX.Autocompletion | Windows OS and MacOS | Yes. Builtin PDF Viewer | free. MIT licence |
| Emacs(AUCTeX/WhizzyTeX) | Source, autocompletion, SyncTeX | Unix,Linux, macOS, Windows | Yes. SyncTeX | Free, GPL |
| Authorea | Source & SyncTeX; plaintext, html & LaTeX | Online IDE*. | builtin viewer Partial-WYSIWYW | Free. Basic & Paid Edition |
| Auto-Latex Equations | Source | Online,Google Doc plug-in | No | free |
| Bakoma TeX Word | An innovative WYSIWYG Editor | Microsoft Windows, OSX, Linus | Yes | Commercial:$101, 55Euros licence |
| CoCalc | Source | Online and Standalone | No | Free |
| GNOME LaTeX (old LaTeXila) | Source.SyncTeX.Autocomplete | GNOME IDE on Linux | Yes, with Evince PDF | GPLv3 Free |
| Kile | Source. Autocompletion. SyncTeX | Linux, Windows XP/7/Vista | Yes. VI input | Free. GNU GPL 2 |
| LEd | Source | Microsoft Windows | Yes | Free |
| LyX | Intuitive GUI & WYSIWYM marketing | Linux, macOS, Microsoft Windows | Yes | Free Latex backend |
| JEdit and MeWa | Source | Microsoft Windows | No | Free |
| Notepad++ | Source. Autocomple, SyncTeX | Microsoft Windows | Yes with sumatraPDF | Free. RTL/bidi |
| Overleaf and Papeera | Source and sychTeX | Online IDE* | Yes | Free Basic and Paid Premium |
| Scientific WorkPlace | WYSIWYM | Windows | No | Free |
| TinyTeX(RStudio IDE plugin) | Source. Partly WYSIWYM | A small[78mb] TeXlive on Windows OS, MacOS | No | Free |
| TexLab & TeXPen | Source-WYSIWYG | Windows | | Free |
| TeXmacs | WYSIWYG | Linux, macOS, Windows | Yes | Free |
| Texmaker | Source. Autocompletion. SyncTeX | Linux,OS X10.5+, Windows XP/Vista/7/8 | Builtin Viewer | Free, GPL licence |
| TeXnicCenter | Source; SyncTeX. Autocompletion & spelling | Windows XP/Vista/7/8/10 and MacOS | Yes. External viewer, sumatraPDF | Free (within ProTeXt/ MiKTeX) |
| TeXShop | Source.SyncTeX.Autocompletion | macOS | Yes | Free. shipped with MacTeX |
| TeXstudio(A GUI Editor) | Source; autocompletion & spelling | Linux, Windows, macOS | Yes | Free |
| TeXworks | Source (within MikTeX installation) | Linux, OS X, Windows XP/Vista/7/8 | Yes. Poppler-based | Free, GPL |
| Verbosus(verbTeX;iOS & Andriod) | Source but no autocorrect | Online TeXLive Implementation. | No | Free Basic and Paid Premium Edition |
| WinEdt | Source. Autocompletion | Windows OS | External output viewer. | Shareware, personal $60 |
| WinShell and Winefish | An IDE for LaTeX | Windows OS | Not known | free |
| Vim (LatexBox/suite or Vintex plugin) | source. syncTeX | Vim IDE for Windows, Mac & Linux | No buit=in viewer | free, charityware |

** **OnlineEditors:** *The features include Project Management and Submission to Partner Publishers, Journals and Repositories (with DOI attached)*

- ***Source** means you can see and edit the TeX source files. * **Inverse search** means that one can locate the relevant part of the source code from the viewer
- **WYSIWYM** means "What You See Is What You Mean", i.e. you see and edit formatted text as you write
- **Inverse search** means that one can locate the relevant part of the source code from the viewer (e.g., double-clicking in dvi or pdf file brings up the appropriate line/paragraph in the latex code)

Figure 4: Some LaTeX Editors/IDEs/Online Editors

you to always keep the overview of your whole document, even if it is spread about several files and contains hundreds of pages. *i.e., the structure parser always shows the document structure and jumping to another section or inserting references just requires a mouse click.*

These features and the fact that it is a Free Open Source Software (GPL) makes TechnicCenter the first choice for LaTeX authors working on the Windows OS platform. The system have supports for either command line or DDE calls enables a tight integration of your favourite document viewer like i.e. MiKTeX's Previewer, Ghostview and Adobe Reader including features like forward and inverse search and instance re-usage (open new documents in the already running instance of the viewer instead of opening a new one).

**Installation:** To start working with LaTeX, you also need a TeX distribution and a PDF viewer. MikTeX distribution and Sumatra PDF viewer were the recommended supports. And, you have options compatible with your operating system: TeXnicCenter 2.02 Stable (32 Bit) , and TeXnicCenter 2.02 Stable (64 Bit) *To update, you can simply install the new version on top of your existing TeXnicCenter installation.*

## TeXstudio: LATEX make easy and comfortable.

TeXstudio is an integrated writing environment for creating LaTeX documents. The goal is to make writing LaTeX as easy and comfortable as possible, hence the highly technical, intuitively resourceful and numerous features like syntax-highlighting, integrated viewer, reference checking, tutorial playing, and various assistants.

It has built-in support for various LaTeX compilers, index, bibliography and glossary tools, Latexmk, pdflatex, and many more. The other features and benefits include:

1. Automatic detection of the need for multiple LaTeX runs and dependency for a package, consequently download the package.
2. It also has Advanced syntax highlighting, and Intelligent interface: these enables Interactive spellchecking, live interactive grammar checker and reference checker. Also, clear display of LaTeX errors and warnings (in the editor and as a list).
3. You can generate blocks of code using assistants without the need for detailed LaTeX knowledge. A UI menu which allows you choose form for table, graphics and mathematics terms and operators. columns with a single click. The table auto-formatter helps you align the chosen table code.
4. You can run any program you like including completely customized creation for desired complete document(style and type).
5. You can use the integrated PDF viewer with (almost) word-level syncing, live-updating inline preview for formulas and code segments to preview your project or latex document.
6. It has a Tool-tip preview for included images which are inserted in `\includegraphic` command structure.

TeXstudio has been forked from Texmaker in 2009, because of the non-open development process of Texmaker and due to different philosophies concerning being configurable and features. Originally, it was called TeXmakerX because it started off as a small set of extensions to Texmaker with the hope that they would get integrated into Texmaker someday. While at some points you can still see that TeXstudio originates from Texmaker, significant changes in features and the code base have made it to a fully independent program. TeXstudio runs on Windows, Unix/Linux, BSD, Ubuntu, and Mac OS X. It is licensed under the GPL v2.

It does not provide LaTeX itself so the user must have to choose a distribution of LaTeX and install it first. Itis written in C++ / Qt and supported on operating systems such as Unix-like , Microsoft Windows (version 3.1.1 released February 2021, size 23.7mb ), macOS (42.7mb), and Linux (12-18 MB). Available in 11 different languages.

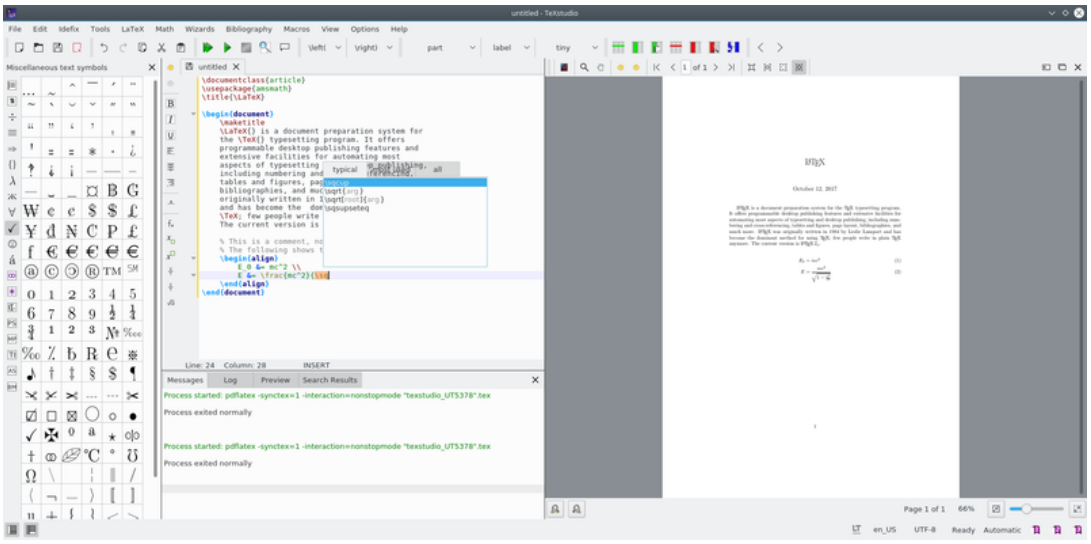

Figure 5: LaTeX Editor Family: TexStudio Screen Credit:Wikipedia, Alexander W. Wilms [2021]

TeXstudio Authors are Benito van der Zander, Jan Sundermeyer, Daniel Braun, Tim Hoffmann. See, http://texstudio.sourceforge.net for more information.

## Overleaf

Overleaf is an online distribution and platform that support your learning and practice of LaTeX. You can generate or see collection of templates including journals' which you can use and send final project or document through Overleaf support engine to the journal submission centre or collaborators. In fact, this

research started on Authorean but the packages, project management and learning resources on Overleaf was so good the research typesetting and management moved to Overleaf richly helpful environment. Here are some key features to help you get the most out of the service:

- Overleaf have learning and educating resources to help you learn LATEX, collaborate and share your work. One of such is Learn LaTeX in 30 minutes{ https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes?}: In this tutorial is a quick and easy first introduction to LaTeX with no prior knowledge required. By the time you are finished, you will have written your first LaTeX document!
- Find a beautiful template:{https://www.overleaf.com/latex/templates?} If you're looking for a template or example to get started, we've a large selection available in our template gallery, including CVs, project reports, journal articles and more.
- Real-time collaboration: This is a key feature that Overleaf offers. It helps you understand what each author is contributing to the development of a research paper. This, in turn, provides transparency into each author's contribution to the project and edits.
- Easy sharing: the system allows you to share free your research paper with limited co-authors, reviewers, instructors, etc.? Every project you has a shareable secret link. All you need to do is copy that link and share it with the respective person to view, comment and edit your document.
- Real-time preview: In Overleaf, you can see real-time changes (or preview) as you write your document. Essentially, Overleaf compiles your project in the backend for you to see the actual output.
- Find mistakes quickly: Overleaf warns you of errors as you write to help you detect them early on. It also shows the errors in-line so you don't have to find them the LaTeX log.
- Protected Projects: In Overleaf Pro, you can actually make your projects protected which means that you choose who will have access to the project. You can add or delete collaborators anytime you want.
- Pricing: Overleaf has 3 plans: Free, Pro, an Pro + Teach. They offer a few features in the free version. To utilize all the features of the tool, you need to buy a paid plan which starts at $15/month.

## ShareLaTeX

ShareLaTeX is a web-based LaTeX writing and collaboration tool which can be accessed through an internet browser. It takes all your document editing tasks online without the task of installing the software. The best thing about ShareLaTeX is that it comes with over 400 ready to use templates. Templates include research papers for journals, scientific articles, CVs, Resumes, etc. This resource (and its tools) is used by over 1,000,000 researchers, academics and students across the globe. The Features:

- With ShareLaTeX, you can now view in real-time, what edits your co-authors, mentors, etc. are making. There's only one master version which everyone has access to.
- This editor comes loaded with all the necessary LaTeX packages and templates to help you get started without any delay. With this tool, you get the same set-up irrespective of location, browser, etc.
- Entire doc history: With document history, you can view all the changes i.e., what's been added or removed from the document since its creation. Besides that, you can conveniently restore to an older version if needed. This enables you to revert back to the last saved version, in case you lose your work.
- Pricing: ShareLaTeX offers 3 plans to its users: Free, Collaborator and Professional. They offer a limited set of features in the free version. For all the features, you need to buy a paid plan which starts at $15/month.

ShareLaTeX is an online LaTeX editor which you can access through top web browsers such as Google Chrome, Firefox, Safari, Edge, etc. **Note:** *Overleaf has acquired ShareLaTeX. So, it doesn't make much difference if you choose one over the other.*

## Authorea

Authorea is an online writing and research system that helps researchers not only write, but collaborate, host data and publish their works. This composite editor , also known as the "Google Docs for Scientists", is advanced and lets you write your manuscript in both LaTeX and Markdown language. You can also publish your paper to multiple open access journals besides automatically formatting your paper to the selected journal style. The free version of the service provides unlimited viewing access to public documents but limited slots for writing and using templates. The features:

- In Authorea, multiple users can write and edit a document at the same time. You and your team (or other users) can select a part of the document and annotate that part with comments. The comments so posted can be made publicly visible to everyone or private to you or a group of users with access to that comment. Authorea is actually built on Git which makes its version control system one of the best as compared to its competitors.
- Formatting and citations: Authorea has an in-built citation search which allows you to search and add any citation from PubMed, CrossRef or by inserting the paper's DOI. In fact, the system supports over 40 publisher and journal styles and can automatically formats references as per the guidelines of a particular publisher on export. It also supports equations written in LaTeX markup language.
- Rich content: In Authorea, you can drag and drop figures directly into the manuscript or upload the same from your computer. Authorea allows you to use iPython Notebook (aka Jupyter Notebook) and interactive figures using D3.js.
- Import and export: You can link your document with a GitHub account for backup as well as editing it offline. On top of that, you can export your document into a Word, PDF or LaTeX formats. You can also import a LaTeX or a .docx document to create a new Authorea document.

Authorea has 4 pricing plans: Free, Groups, Enterprise. However, limited number of features are offered in the free version. For the complete set of features, you need to buy a paid plan which starts at about $10/month. Authorea is an online LaTeX editor which is can be accessed from top web browsers such as Google Chrome, Mozilla Firefox, Safari, Edge, etc.

## LyX

Lyx is a document processor that basically works on the concept of WYSIWYM (aka What You See Is What You Mean). It enhances the flexibility and versatility of TeX/LaTeX with the ease of a GUI. With Lyx, you can create quality documents like a thesis, books, research papers with intensive mathematical content (via the fully integrated equation editor). Lyx is for people who want to produce beautiful documents without any (or minimal) hassle. The other features include:

- The editor: Lyx boasts to have the best math formula editor. You can enter equations via a point-and-click interface or via entering LaTeX commands. Lyx also provides support for math macros. You also get support from various CAS aka Computer Algebra Systems.
  Besides this, it supports all kinds of graphics formatting, WYSIWYG tables, and image editing features, distinct text class creation, dedicated modules creation, etc. The available character styles provide access to fully semantic markup.
- International support: With Lyx, you can write your document in multiple languages. Support for Right-to-Left languages like Hebrew and Arabic is also provided. Lyx also provides its menus, guides, error messages and key bindings in various languages.
- Multiple document formats: Import and export to many formats (LaTeX, PDF, Postscript, DVI, ASCII, HTML, OpenDocument, RTF, MS Word, and others) via configurable converters. Besides these, you get SGML tools support (DocBook DTDs), literate programming support (Noweb, Sweave), etc.
- UI/UX and Document Management: The fantastic GUI of Lyx give access to all important functions right from menus. On top of that, it serves you with text completion and typesetting in the background as you write. On the part of doc management, you can track changes, integrate it with external version control systems like GitHub, RCS, Subversion, etc. and other important features.

Pricing? Lyx is free software with an Open Source license. Compatible and useable on Linux/Unix, Windows, MacOS.

## Word to LaTeX / TeX / XML Converter

Word-to-LaTeX tools can convert all kinds of Microsoft Word documents to XML, LaTeX, TeX, AMS-LaTeX, and other TeX flavors. You can create EPS Graphics From a MS Word Figure or Table. The output XML file can be later transformer in whatever format you need by applying a custom XSLT transformation (e.g., some customers use a XSLT transformation to create DocBook or HTML from Word files using Word-to-LaTeX).
It allows you to insert your Excel graph, a Word table, or an image in a LaTeX document. *see the pdf manual for more information. [http://www.wordtolatex.com/manual.pdf] .*

You can simply upload your document to the online site and you will receive a camera-ready document (in TeX/LaTeX and PDF) without the need to know anything about TeX/LaTeX. The software is fast, accurate, and highly configurable. It runs on MS Windows XP/Vista/7/8 with MS Office XP/2003/2007/2010/2013 installed.

The default Word-to-LaTeX installation works with both 32-bit and 64-bit versions of Windows. But, if you have Microsoft Office 64-bit (which is not very common) you will have install Word-to-LaTeX 64-bit (Word-to-LaTeX 32-bit will not work with MS Office 64-bit).

Every single Microsoft Word document is different. Different documents use different font sizes, some documents use hard-coded tabs for indenting, some authors do it more clever using styles, somebody uses built-in styles for headings, somebody not, etc. The huge variety of Word documents is the reason why it is good to consider changing the default Word-to-LaTeX configuration for each document you convert. http://www.wordtolatex.com Other variants include Doc2latex, and PDF to latex, etc.

## Summary: Free LaTeX Distribution

Some notable TeX (frozen) and LateX implementations that are entirely, or least primarily, free software include:

- TeX Live is a distribution provided by most TeX user groups which supports many Unix systems, MacOSX, and Windows.
- MacTeX, TeX Live with additions and easy installation for MacOSX.
- MiKTeX, an independent distribution for Windows with a flexible package manager.
- proTeXt, MiKTeX with additions and a thorough installation guide for Windows.
- KerTeX, from Thierry Laronde, a TeX kernel system.Knoppix, a live GNU/Linux system on a bootable CD that includes TeX.
- TeX-FPC, from Wolfgang Helbig, change files for TeX to work with Free Pascal compiler, along with installation scripts.
- Wallstone Creativity Desktop, a large free software collection for dealing with documents, photos, video, project planning, and more; includes (La)TeX

## LaTeX packages

We have so numerous and complementary packages by independent and group contributors aside the essential latex packages. Add-ins such as texpoint, an add-in for Microsoft PowerPoint and Word to enable use of LaTeX; IguanaTeX, a free software package for inserting LaTeX equations into PowerPoint.

## How to Install LaTeX Packages

Some common packages, like amsmath, are included in most TeX distributions, but the vast majority are not. Any additional packages must be installed in order to compile the document.

1. Installation During Compiling (using MikTeX). When processing a .tex file which has packages listed in its preamble that are not yet installed, MikTeX can install those packages as part of the process of compiling the document. And, on the fly Group [2006], Schenk [2021].

2. Installation using a Package Manager. MiKTeX and TeXlive both include package managers which will find and install a specified LaTeX package for the user. For MiKTeX, this is done using the MiKTeX Console, a program which is included when MiKTeX is installed.

   TeXLive (and hence MacTeX) installs packages via the command line or terminal. Installing the geometry package, for example, can be done using the following commands: tlmgr install geometry with TeX Live (Linux), sudo tlmgr install geometry with MacTeX(Mac) as explained by wayne.edu(2021), Library [2021].

**Packages and programmes for dealing with graphics include:**

- graphics and graphicx, the core LaTeX packages.
- bmpsize, Heiko Oberdiek's package for finding bitmap bounding boxes; supports most bitmap formats.
- PSTricks graphics, a widely-used graphics package, maintained by Herbert Vongermn.
- PGF/TikZ, a second widely-used graphics package, by Till Tantau. KtikZ, is a graphics editor for family tree of TikZ.[ Read, Graphics with PGF/TikZ, an article by Andrew Mertz and William Slough using graduated examples.]
- PGFplots, LaTeX package for creating plots in two and three dimensions.
- Xy-pic graphics, a third widely-used graphics package, by Kristoffer Rose and Ross Moore, specializing in commutative diagrams.

## LaTeX System Versus Word Processor: Microsoft Words

In terms of differences relating to Word processors like the Microsoft Words, LaTeX is conceptually different. Word processors like Microsoft Word, LibreOffice Writer, Abiword or Calligra are not fit for typography and document typesetting but for words formatting, referencing and document editing and sharing. LaTeX adopts WYSIWYM (What you see is what you mean), while Microsoft Word applies the concept (also marketing) (of WYSIWYG (What you see is what you get) in editing, formating and positioning text, paragraphs and images as you type, with differing output results on different platform.

LaTeX is a typesetting system designed with detachable structured documents, with styled pages in mind. i.e., it has adjustable presets or templates for types of documents e.g., letter, article, book, CV etc. In a sense, one takes care of the content LaTeX takes care of the structure, TOC, and with consistent formatting. However, latex can be frustrating with error alert and detail compliance to rule on function, .sty specifications and environment declaration. [One must be familiar with these practices, and leave no extra dot, brackets or miss up the slashes "/" and "\".

LaTeX is designed to manage mathematical equations. They are much easy-standard and reproducible on cross platform and online LaTeX editors like Authorea. LaTeX has integrated citation managers (BibTeX, BibLaTeX) that makes the process of scientific writing easy. Microsoft Words also have reference manager and add-in reference manager like that of Elsevier's. LaTeX could be written using almost any editor whether in command line, shell or under GUI as it is a text file. Then, compilation is a different process.

We are getting there: Word Processor (online and offline) users can also write directly in LaTeX syntax, and then click to convert it into a formatted equation as is now possible with Rstudio using TinyTeX, a small implementation of Texlive. Microsoft says that "most" LaTeX expressions are supported, although its website lists 20 keywords that are not supported yet. And, for Google Docs users, "the Auto-LaTeX add-on" can turn LaTeX equations into embedded images/object in the document IBILOYE [2021].

### Here are some popular Word Processors

- **iWork** is an office suite of applications created by Apple Inc. for its macOS and iOS operating systems, and also available cross-platform through the iCloud website. It includes Keynote, a presentation program; the word processing and the desktop. The initial release: January 11, 2005.

- **LibreOffice** is a free and open-source office productivity software suite, a project of The Document Foundation. It was forked in 2010 from OpenOffice.org which was an open-sourced version of the earlier StarOffice. Wikipedia https:/www.wikipedia.om/libreoffice. Initial release date was 25 January 2011
- **AbiWord** a free and open-source software word processor. It is written in C++ ( version 3, based on GTK+ 3). The name "AbiWord" is derived from the root of the Spanish word "abierto", meaning "open". Wikipedia. Developer(s): AbiSource https://www.abisource.com/. [Preview release: none (Linux), 2.9.4 (Windows). Initial release was on December 1, 1998.]
- **Microsoft Word** an all-time-reliable word processor developed by MicrosoftInchttps://www.microsoft.org. It was first released on October 25, 1983, under the name Multi-Tool Word for Xenix systems, and has variants. It is part of the applications provided by Microsoft Office Suite, or simply MS Office. The suite is a family of client software, server software, and services developed by Microsoft. It was first announced by Bill Gates on August 1, 1988, at COMDEX in Las Vegas. The initial release date was 19 November 1990. The suite includes full office desktop apps such as MS Word, PowerPoint, Excel, Outlook, Publisher and Access for Windows PCs, as well as access to additional OneNote features ( varies from platform to platform).
- **Pages** a word processor developed by Apple Inc. It is part of the iWork productivity suite and runs on the macOS, iPadOS, and iOS operating systems. It is also available on iCloud on the web. The first version of Pages was released in February. Wikipedia https://www.wikipedia.com/pages Developer: Apple [Stable release: 11.0 / March 23, 2021]
- **Apache OpenOffice** is an open-source office productivity software suite. It is one of the successor projects of OpenOffice.org and the designated successor of IBM Lotus Symphony. It is a close cousin of LibreOffice and NeoOffice. [Initial release date: 8 May 2012. Stable release: 4.1.9 (February 7, 2021)]

The strength of Word Processors like Microsoft Word is in writing short, relatively simple documents(e.g., short letter, a cover page, or a report to the administration,etc), since you immediately see how what you wrote looks like (WYSIWYG). In fact, Basic Word features are very easy to use and everybody can produce a simple document with reasonable layout and relatively short time compared to LaTeX. However, if you are writing a long document like a master/PhD thesis, an article, or a review, you are better of with LaTeX, which would give you a professional layout, and help greatly with referencing and graphics. Tables are difficult to build even for experts, but there are macros that enables tables from Excel to be formatted to LaTeX syntax and embedded in Tex Document.

LaTeX supports the use of "tracked changes" when collaborating with multiple authors, etc. You can also reverts to old working formats on some online editors like overleaf learn [2021]. The original TeX program outputs the typeset document into a custom format called DVI (Device Independent format), that can later be turned into a PostScript file for printing. The advent of PDF format in 1993 (thanks to Han The Thanh for the creation of pdfTeX for his PhD thesis) , the Sweave-knitr and other pairing packages that allows compilation of Tex document (including markup language, spreadsheet tables) to quality Web documents, 'templated journal articles' and PDF on the web, Python and R Editors (Rstudio) terminals marks a significant advances for LaTeX and we can see today that it clearly won as the better format over PostScripts and Word Documents(doc, RTF, etc)

## Conclusion

TeX is a typesetting system written by Donald Ervin Knuth. He reportedly said "it is intended for the creation of beautiful books and especially for books that contain a lot of Mathematics." Group [2006], L [1994].While LaTeXis a TeX macro package, originally written by Leslie Lamport, that provides a document processing and using markup to describe the structure of a document, so that the user need not think about presentation. Lamport's last version of LaTeX was LaTeX 2.09, last updated in 1992. Frank Mittelbach Mittelbach and the LATEX Project Team [2020] and the LaTeX Project Team set out in 1989 to improve LATEX 2.09 and produce a new version (a.k.a. LaTeX3), however, it was not

at all easy to build applications on top of LATEX2.09 and, of course, LATEX was only a few years in use, and modern fast computers with storage and features for cascading like sheet wasn't existing then. Thus, LaTeX2e was introduced by the LaTeX Project/LaTeX3 team in 1994, and is now the only readily-available stable version of LaTeX with expl3 language as part of the kernel (2020). Schenk [2021], Group [2021]. Another document typesetting system built on top of TeX is ConTeXt, the second direction of TeX evolution and original extension.
The LaTeX typesetting system (or simply TeX distribution and editors) is increasingly being used today by researchers, academics, laboratories, journals and academic institutions to publish reports, books, notes, thesis and also make presentations which include step computational analysis, STEM and Chemical Symbols, Statistical Analysis and complex mathematical equations in academic journals, project presentations and professional seminars.

This article, relying on primary source documents, chats with LaTeX development members on stackexchange.com, literatures, and extensive software feature testing, has given a comprehensive introduction to the World of LaTeX, and contains sufficient information (and basic technical resource) for anyone - authors, project students, researchers including those in academic careers to choose between the major LaTeX/Tex distributions and install given the features offered by the distribution in terms of download size, operating system, and specific LaTeX engines and Compilers needed by their project, presentation or document typesetting structure and font management.

A collection of basic or full TeX/LaTeX typesetting system which include required tools for implementation (on a platform or OS), documentation and the installation file is called a "**TeX Distribution**", and usually with macro-adds, compilers, and solutions, also packages built on TeX/LaTeX foundation, e.g., BibTeX for Bibliography and referencing, expl3 programming language, packs of fonts, colors and document classes (styles or .sty files). Clearly defined are the basic or required packages, specifics of compilers' output (mostly web markup texts and transferable self contained documents,e.g PDF, PS, and HTML,etc) and other tools that will help you to *"perform the TEX's magic"* on your PCs, and as you get along your report, research and project work typesetting and submission for publication. It must be emphasized, each distribution, comes with distinct programs and features specific to various PC's Operating Systems, the internet access situation and the download size preferences and settings needed personally and in users' field of research, publication and career.

The future of LaTeX will seriously depend on its comparative advantage and distinctive philosophy hence features (including color, fonts, tagged PDF project and synchronous digital output formats to other terminals like web pages, database management systems and R) that makes it the preferred in document typesetting in the academic and research communities and for printing high quality and standardized books and other publications.

More extension of LaTeX are emerging including Excel2latex, graphic editors based on TikZ, small mobiles TeX/LaTeX Editors and Word-to-LaTeX "interface and productivity softwares". Meanwhile, more research and development are needed in the area of cross platform integration with terminals like R and Python, auto-correcting and intelligent assistance in writing in proper LaTeX syntax and page structure that would reduce overflow, numerous error flags on missing or extra `"{" and "(" also "-"` not within maths environment. Few macro packages were removed from CTAN and TUG, because they conflict and depricate legitimate functions of standard package and/or the maintainers refused to correct the errors. Downloading just style file and package can damage your PC and Latex installation.

LaTeX is not a WYSIWYG solution. You have to compile and then check the output. Fortunately, there are some programs such as TeXMaker that offer a better user experience and Overleaf that gives you both the source codes and the compiled PDF to compare. It is true, "LaTeX has a much steeper learning curve when compared with MS Word" as voiced by many users IBILOYE [2021]. For instance, getting a basic LaTeX (text, figures, titles, tables) document is not so difficult, thousands of examples, but the complexity is in understanding the particular floating concepts for desired results. These

problems not only frustrate authors but waste time compared to doing same on a word Processor.

Yes, LaTeX can be difficult to learn, and there are so many similar packages doing same thing, what of the log of numerous error flags just for omitted parameter, the unit, and "missing "{" or "}" and being stuck with outputs not fitting for the project. Getting a printed copy of the "packages documentation" can be really helpful and time saving as you code, use package syntax and parameters and typeset, the error logs can be confusing, at least to me without the documentation]. Really, regulations, standardization (as obtained on sister system, conTeXt) and official adoption of templates as the case of citation style (including fonts and packages) by institution and journals are needed for sanity and credibility on the use of LaTeX system for typesetting.

The significant advantages of LaTeX remains at most time users and authors only need to be concerned about the contents, spellings and sentence structure and some adherence to the rules as one type. LaTeX system can takes care of document style, page structure and typographic details such as page layout, indentation, and italicizing identifiers. Your document can be in batches and parts files (such as .Rnw, .Rtex, .R, .tex, .PDF, .tex, etc) which are included in specific environment in the main document, be it Code listing or running, figure or table, etc. learn [2021], /Articles [2021]

Many are just addicted to LATEX, given the great free and GUI LaTeX Editors and using LaTeX based Questions and Answer forum groups like on stackexchange.com. I am using Microsoft Windows 10 OS, TeXstudio ( which is my number one), TeXniCenter , TeXwork, WinEdt and LyX are really great, user friendly and with auto-correction feature! Good luck!

### Notes and Recommendations

I believe you are shifting from *"should I install LaTeX , MiKTeX or TeXstudio?"* to *"Which LaTeX Distribution should I install on my OS, my language support, and how much space and packages do I need, now or on the fly?"*

*Please, note that the choice of distribution by some people may just be on personal preference, or possibly the one trending in their institution or region. Few, really, do make a choice informed by the type of PC, the operating system, and the nature of project needs given their fields and technical skills.*

The Microsoft Excel plugin, **Excel2LATEX (Version 3.5.0)** Can convert Excel spreadsheets to LATEX tables. Making tables in LATEX can be tedious, especially if some columns are calculated. This converter allows you to write a table in Excel instead, and export the current selection as LATEX markup which can be pasted into an existing LATEX document, or exported to a file and included via the `\input command` . Package Excel2LaTeX Repository (`https://github.com/krlmlr/Excel2LaTeX`)

### LaTeX Project(s) for the upcoming Years

With challenges and backloads of bugs outlined by users and TUGs over the years Mittelbach and the LATEX Project Team [2020], the LaTeX Project Team, in changed policy and new commitment, would be focusing on a number of areas of fixes and development:

- Embrace and integrate more functionality from existing packages into the LATEX kernel;
- Provide extended and unified color management, with graphics and font (glyphs) integration;
- Provide standard interfaces for functionality currently available only in an ad hoc way, or not available at all;
- Enable LATEX to automatically produce tagged PDF. Also plans to integrate important functionality from existing packages directly into LATEX so that it is directly available for user and package writers through standard interfaces. Examples for this are hyperlinks and colors. Team [2019]

In addition, the 'Team' plan to provide standard interfaces for some important capabilities that are currently not available at all or only in rudimentary and ad hoc fashion. Mittelbach and the LATEX Project Team [2020], Group [2021], /Articles [2021], Team [2019]. **Acknowledgement/Special Thanks** Thanks to Alexander Wilms (2017) for the Screenshot of TeXstudio used in this article, and other TeX editors screenshot images at Wikipedia. Also, my gratitude goes to Urlike Fischer and Joseph Wright at url=chatRoom https://chat.stackexchange.com/rooms/122802/discussion-on-question-by-ibiloye-abiodun-christian-what-is-latex3-correcting-in and other LateX package developers on the stackexchange.com/latex/questions, also the TeX Users Group: {TUGhttps://www.tug.org/

### Declaration of Interest

The author declare that there is no known conflicting interest as relating to the article and discuss.

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