

Scientific Word; T_EX à la WYSIWYG

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Abstract

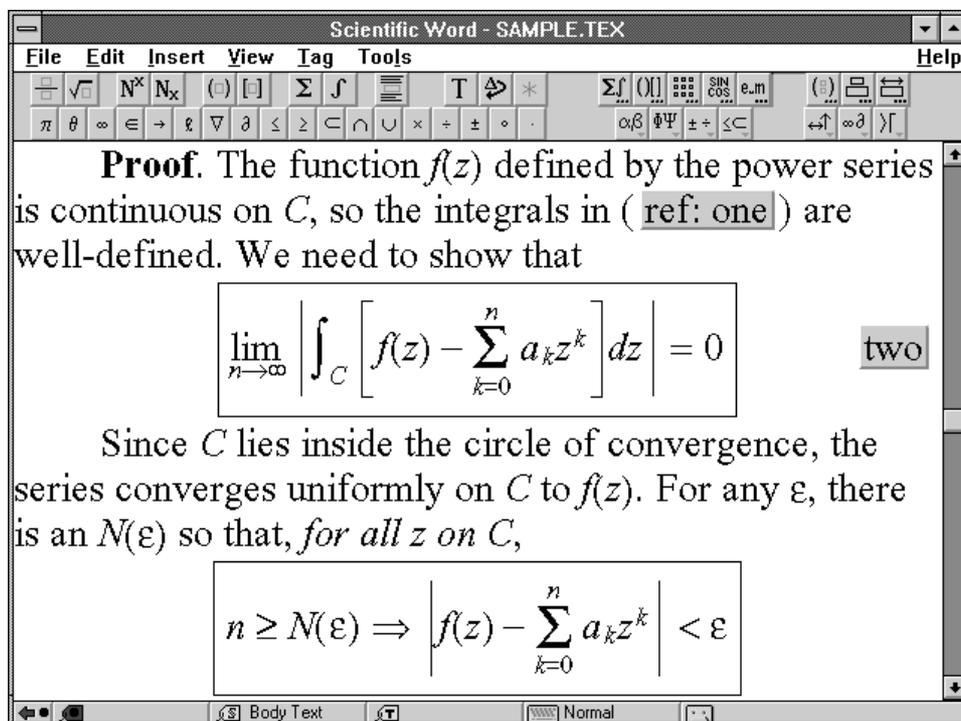
A software package for Windows and OS2WIN for inputting mathematical formulas WYSIWYG according to all T_EX rules. Internal storage format is a mixture of T_EX, L^AT_EX and macros of own design. Mathematical formulas are immediately shown the way they will be printed. Line width for text is limited to the width of the window for ease of use. The built in previewer from TurboT_EX shows the whole document layout. There are also dvi drivers included for PostScript, LaserJet, DeskJet and matrixprinters. Pictures can be called just as easy as formulas can be inputted. A description of the philosophy of this package and how to work with it.

1 Introduction

SCIENTIFIC WORD is a Windows front-end to L^AT_EX. It is a full document editor, not just an equation editor. The SCIENTIFIC WORD package includes a complete implementation of T_EX for Windows. If you want the outstanding typeset output provided by T_EX, but don't want to use the T_EX language, SCIENTIFIC WORD is the

word processor for you.

In SCIENTIFIC WORD, you interact directly with mathematics in familiar form, not with T_EX codes. You can create your document at the computer with no intermediate coding step. Making changes and corrections is equally straightforward.



Scientific Word screen at 2x view

*In cooperation with TCI Software Research

1.1 Save Time and Increase Your Productivity

SCIENTIFIC WORD will save you time in five essential ways:

1. Time spent entering and correcting T_EX codes is “dead time” during which you cannot think about the content of the document itself. By eliminating the coding and by showing mathematics on-screen in familiar form, SCIENTIFIC WORD lets you compose your document directly at the computer.
2. SCIENTIFIC WORD eliminates the need to print or preview a document to check that it is correctly coded. A Windows previewer is provided for you to check the final printed appearance.
3. Some word processors include an equation editor. While they are fine to type an occasional equation, you waste time going back and forth between the body text and equation frames. With SCIENTIFIC WORD, you enter text and mathematics on one continuous screen so you don't waste time popping in and out of equation boxes.
4. By handling all of the spacing, by automatically italicizing mathematics, and by providing intelligent objects like fractions, radicals and matrices, SCIENTIFIC WORD saves you the tedious job of hand formatting which often leads to inconsistent results.
5. Unlike other Windows word processors which focus on the appearance of text, SCIENTIFIC WORD focuses on the meaning or content. If you've ever been through the process of changing the format of an even moderately sized document with a WYSIWYG (What You See Is What You Get) system, you'll appreciate that SCIENTIFIC WORD's revolutionary approach has the potential to save you an extraordinary amount of time. The small initial investment in “unlearning” the habits developed for WYSIWYG systems is handsomely rewarded in a very short time. For more details, see the section entitled **Logical Design**.

1.2 Objects

SCIENTIFIC WORD is object-oriented. That means the program deals with familiar objects you understand, such as fractions, matrices, brackets, and radicals. You'll find these objects have specific properties and that they behave intelligently.

For example, the numerator and denominator of a fraction are automatically centered and the fraction bar expands as you type. Brackets and radicals also expand or contract as you enter an expression. Because the objects themselves are intelligent and adjust themselves as you build a complex expression, it makes your job of entering mathematics that much easier.

Furthermore, SCIENTIFIC WORD is an intelligent interpreter of what you type. If you are in mathematics and type cos, the software recognizes it as a function and stores and displays it accordingly. And SCIENTIFIC WORD selects the correct typeface, spacing and placement of limits required by functions as you type.

2 Entering Mathematics—An Example

In the following two tables, we describe two ways you can enter the expression $\int_a^b \frac{2}{\sqrt{3-5x^2}} dx + 1$ in SCIENTIFIC WORD. The first uses the mouse wherever possible and the second uses the keyboard only. In this example, you will see that you add limits to an operator like \int by applying a subscript and a superscript. An alternative approach taken by other systems is to provide a special icon with the limits already present. This leads to a bewildering array of icons on the screen. The SCIENTIFIC WORD approach uses a much smaller set of icons. Another large reduction in the number of icons comes from the unique feature that the size and position of limits on operators like \sum change automatically from their in-line form $\sum_{n=1}^{\infty}$ to their display form

$$\sum_{n=1}^{\infty} .$$

Here are the steps to enter $\int_a^b \frac{2}{\sqrt{3-5x^2}} dx + 1$ using the mouse.

Entering an Integral Using the Mouse	
Action	Result
Click 	\int
Click 	\int_a^b

Action	Result
Type a , click to the right, click 	\int_a^b
Type b , click to the right, click 	$\int_a^b \frac{\square}{\square}$
Type 2 and click in the denominator box	$\int_a^b \frac{2}{\square}$
Click 	$\int_a^b \frac{2}{\sqrt{\square}}$
Type $3 - 5x$, click  type 2, click to the right	$\int_a^b \frac{2}{\sqrt{3-5x^2}} \Big $
Type $dx + 1$	$\int_a^b \frac{2}{\sqrt{3-5x^2}} dx + 1 \Big $

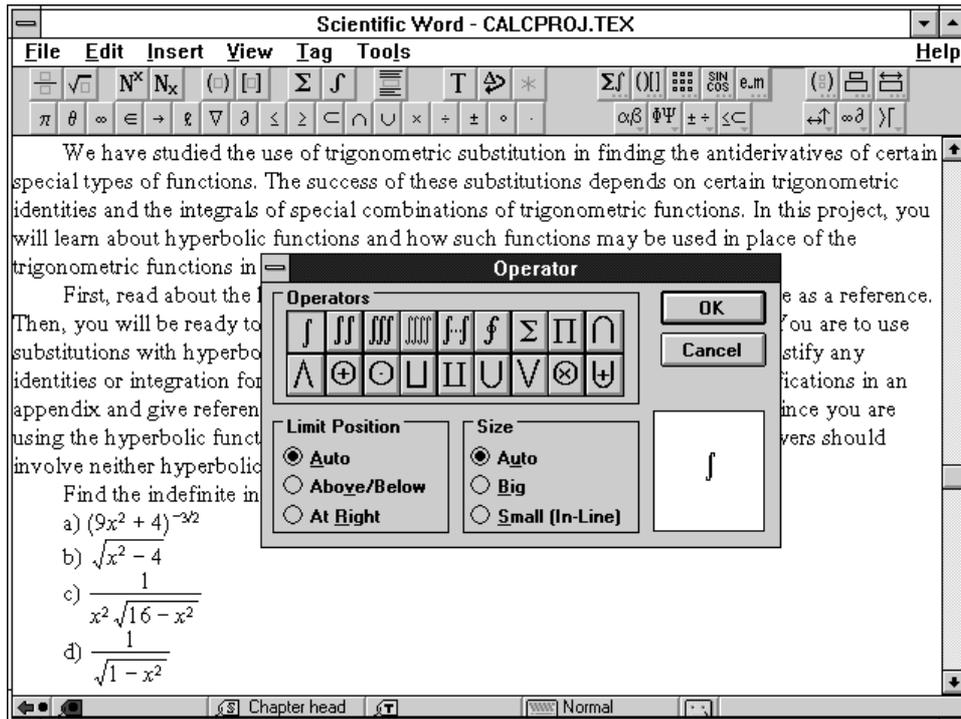
Here are the steps to enter the same formula $\int_a^b \frac{2}{\sqrt{3-5x^2}} dx + 1$ directly from the keyboard.

Entering an Integral Using the Keyboard	
Action	Result
Press <i>ctrl+i</i>	$\int \Big $
Press <i>ctrl+l</i> or <i>ctrl+down arrow</i>	$\int \square$
Type a , press <i>tab</i>	\int_a^b
Type b , press <i>spacebar</i> , press <i>ctrl+f</i>	$\int_a^b \frac{\square}{\square}$
Type 2, press <i>down arrow</i>	$\int_a^b \frac{2}{\square}$
Type <i>ctrl+r</i>	$\int_a^b \frac{2}{\sqrt{\square}}$
Type $3 - 5x$, press <i>ctrl+H</i> , type 2, press <i>end</i>	$\int_a^b \frac{2}{\sqrt{3-5x^2}} \Big $
Type $dx + 1$	$\int_a^b \frac{2}{\sqrt{3-5x^2}} dx + 1 \Big $

The number of keystrokes is small and follows the same logic as the mouse operations. SCIENTIFIC WORD is designed so that you can get started using the mouse with very little effort. Once you learn the keyboard shortcuts, you can enter text and mathematics very quickly without the mouse.

3 Available Symbols

The available symbols are grouped in seven drop-down panels. The symbol panels drop down from the icon area at the top of the screen:



The Operator dialog

To create a mathematical display, you click the display icon and type the mathematics. Or, you can select the mathematics and click the display icon. A display can be set up so that it is automatically numbered. Displays can be given symbol names so that they can be cross-referenced in the body of the document. When the document is printed, the cross-reference is replaced by the automatically generated equation number.

Complex expressions are easy to create. The process is made even easier by the ability to apply radicals, brackets, fractions, and displays to selections. For example, if you have already typed a large expression and you want to apply brackets to all or part of it, you select that part, then click on the brackets icon.

You enter a matrix by specifying the number of rows and columns. Typing the entries is the same as entering any other mathematics in SCIENTIFIC WORD. You can select rows or columns and delete them. You can left, center, or right align columns, and you can align the entire matrix vertically at its center, at the top row, or at the bottom row. It is a simple matter to insert additional rows or columns in an existing matrix.

The document you are now reading was created with SCIENTIFIC WORD. The following sample expressions were created using the operations discussed above.

$$\begin{pmatrix} 1 & 0 & \dots & 0 & 0 & \dots & 0 \\ 0 & 1 & & & & & \\ \vdots & & \ddots & \vdots & \vdots & & \vdots \\ 0 & \dots & 1 & 0 & \dots & 0 \\ \frac{\partial F_1}{\partial x_1} & \dots & \frac{\partial F_1}{\partial x_n} & \frac{\partial F_1}{\partial y_1} & \dots & \frac{\partial F_1}{\partial y_m} \\ \vdots & & \vdots & \vdots & & \vdots \\ \frac{\partial F_m}{\partial x_1} & \dots & \frac{\partial F_m}{\partial x_n} & \frac{\partial F_m}{\partial y_1} & \dots & \frac{\partial F_m}{\partial y_m} \end{pmatrix}$$

$$iB_r [a_{kl}^n] \equiv \frac{1}{2}(h_{n-1}+h_n) \int_0^R 2\pi r dr [\rho_k^{n*}(r)] \frac{d}{dr} [\Psi_l^n(r)],$$

$$[D_{r,kl}^n]^{-1} \equiv \int_0^R 2\pi r dr \int_{z_n - \frac{1}{2}h_{n-1}}^{z_n + \frac{1}{2}h_n} [\rho_k^{n*}(r)] [D^{-1}(r, z)] [\rho_l^n(r)],$$

$$\psi = -\frac{\kappa \varpi \varpi'}{4\pi} \int_0^{2\pi} \frac{\cos(\theta - \theta') d\theta}{\sqrt{\{(x - x')^2 + \varpi^2 + \varpi'^2 - 2\varpi \varpi' \cos(\theta - \theta')\}}}$$

$$1/f(x) = \frac{1}{c_0} \left[\frac{1}{1 + \left(\sum_1^{\infty} + \sum_{-\infty}^{-1} \right) \frac{c_n}{c_0} e^{inx}} \right]$$



$$\prod_{j \geq 0} \left(\sum_{k \geq 0} a_{jk} z^k \right) = \sum_{n \geq 0} z^n \left(\sum_{\substack{k_0, k_1, \dots \geq 0 \\ k_0 + k_1 + \dots = n}} a_{0k_0} a_{1k_1} \dots \right)$$

system, you may at first be surprised by some of the differences:

- WYSIWYG systems divide documents into pages according to their anticipated typeset appearance. To see an entire line, you often have to scroll horizontally because the screen dimensions and page dimensions do not match. In a logical design, working with pages is unnecessary, since the division of a document into pages has no connection with the document's logical structure. Thus, SCIENTIFIC WORD breaks lines to fit the window. If you resize the window, SCIENTIFIC WORD reshapes the text to fit. You never need to scroll horizontally.
- In WYSIWYG systems, you are constantly giving commands which affect the appearance of text—you select text and then select a font, point size, or typeface. You apply alignment commands like center, left justify, and right justify. To center an equation, you select it and choose the center alignment. In SCIENTIFIC WORD, all of these commands are replaced by commands which define the logical structure instead of the appearance. There is no command to center—it is replaced by commands to create a title, to create a section head, and to create a displayed equation. The format of the title, the alignment of section heads, and the alignment of equations, are all determined separately by the print style, which can be changed in an instant. SCIENTIFIC WORD comes with a range of pre-defined styles. If none of these fits your needs, TCI will endeavour to create one for you. L^AT_EX style experts can create their own and add them to the list of pre-defined styles available within SCIENTIFIC WORD.
- In systems that focus on appearance instead of content, pressing the *spacebar* inserts a space that shows on the screen and is duplicated in print. Pressing the *spacebar* a second time inserts a second space. In a logical system like SCIENTIFIC WORD, a space is the separation between words. Pressing the *spacebar* a second time has no meaning, so it has no effect.

SCIENTIFIC WORD's emphasis on logical structure doesn't ignore the fact that documents must still be printed in a readable, organized, and visually pleasing format. SCIENTIFIC WORD provides a variety of article, report, and books styles that you can apply to your document to produce a high-quality, typeset appearance in print. Because you must be able to see how a document will look without actually printing it, SCIENTIFIC WORD provides an on-screen preview feature.

10 Scientific Word File Formats

SCIENTIFIC WORD stores documents as ASCII files in L^AT_EX format. Wherever possible, SCIENTIFIC WORD writes standard L^AT_EX commands. In cases where this is not possible, SCIENTIFIC WORD uses special macros supplied with the system. These include macros for mathematical constructs not directly supported in L^AT_EX, and macros for importing graphics.

Most existing L^AT_EX documents can be read into SCIENTIFIC WORD.

SCIENTIFIC WORD imports documents created by T³'s T3toTeX converter.

11 Scientific Word's Mathematics

The mathematical objects in SCIENTIFIC WORD are designed to provide the simplest and most natural editing possible. When we read plain text, we deal with whole words at a time. However, the best and most natural text editors deal with individual characters at the lowest level—the cursor moves between the letters of a word and you make changes at the lowest level by inserting or deleting individual characters. Although there are hundreds of thousands of words in the English language, there are only 26 characters and a few punctuation symbols which are the “atoms” of plain text editing. In the same way, SCIENTIFIC WORD provides a small set of mathematical “characters” as the atoms for the two-dimensional structure of familiar mathematical notation. This notation is used to represent thousands of mathematical objects and concepts.

For example, the SCIENTIFIC WORD formula $\int_a^b \frac{2}{\sqrt{3-5x^2}} dx + 1$ is a five-element list: an integral operator, a fraction, the word *dx*, the binary operator *+*, and the word *1*. The integral operator is a template containing the two one-element lists *a* and *b*. The fraction is a template containing the one-element list *2* and a one-element list containing a radical. The radical is a template containing a four-element list: the word *3*, the binary operator *-*, the word *5x*, and a superscript. The superscript contains the one-element list *2*. The atoms are the operator, fraction, radical, and superscript. The cursor moves naturally through this structure, and you can edit it without constraint.

This approach avoids the awkwardness of systems which insist, for example, that operators have a distinct argument component ($\frac{2}{\sqrt{3-5x^2}}$ in our example), forcing the user to be aware of invisible boundaries. To get around this, the argument region is surrounded by a dotted box on screen, cluttering the screen and making the mathematics unreadable.

Another feature of SCIENTIFIC WORD's objects is that the empty input boxes of templates like operators are suppressed as much as possible, again with the goal of making the mathematics look as natural as possible at all times to enhance readability.

12 Summary

Scientific Word is a Windows based software package that makes it possible that even the non-knowledgeable T_EX-person can write T_EX documents! The knowledgeable T_EX-person can add to the internal storage format his knowledge, either by making small changes or by adding macros or complete style sheets to the many

provided. The price of the package is H.Fl. 2000,—² Further information³ can be obtained from Technical Marketing Consulting, Gagelweg 3, 4651 VL Steenberg, phone 01670-64422 and fax 01670-66555.

A Note added in proof by Kees van der Laan

T_EX à la WYSIWYG does appeal. Like similar systems it suffers from the following general drawbacks.

- **Cost-effectiveness**
It is doubtful whether the keyboarding is the most expensive part of (La)T_EX-ing, see experience $\mathcal{A}\mathcal{M}\mathcal{S}$. Syntactical correction and fine-tuning—that is adaptation of the results to the traditional high-quality proofs—is hard.
- **Incompleteness**
What about graphics? What about tables? What about programmable items? What about general constructs, for example figures, which are reused, slightly modified? And what about real difficult things like commutative diagrams?
- **Entering vs. correction**
What about correcting/adapting an already existing document?
- **Context dependence**
From the example on the first page the integral sign is too small and does not ‘know of’ the size of the integrand. The systems I have seen lack context awareness.
- **Interfacing with other tools**
What about inclusion of encapsulated PostScript? What about Metafont prepared graphics à la ‘When Metafont and T_EX work together?’
- **High-Quality?**
For high-quality typesetting math explicit kernings and awareness of formula classes are needed. The classical example is ‘:’ as operator or as separator. Furthermore, the general advice to keep the typesetting as simple as possible is neglected. Confer the example of $1/f(x)$, and the representation of $\hat{\beta}$.
- **Formats**
What about the role of formats c.q. sty-fyles?
- **Portability**
Can resulting documents easily be exchanged via e-mail?

Remember that this kind of software needs a powerful machine, while elementary processing —*plain+know-how*— can be done on a very modest equipped machine, and is portable.

B Note added by MAPS editor

Up to now, I have the following experience with this product:

- The paper in this issue of the MAPS was originally generated by SCIENTIFIC WORD. Both L^AT_EX files, style files and encapsulated PostScript files were send by author to the editor using diskettes. After a minor correction within the SCIENTIFIC WORD style file, the pictures were included in the MAPS without any problem.
- The main function of SCIENTIFIC WORD is in my opinion the easy generation of mathematics L^AT_EX code, especially for the novice and occasional user. Besides that,

the software could be a first introduction for the use of L^AT_EX, or can be used by the non-L^AT_EX interested (or WordPerfect minded) user community.

- This kind of tools could force the user not to start directly with T_EX. As most of my colleagues knows, your MAPS editor strongly discourage the use of *plain* T_EX, both by novice and experienced users. The only function of plain T_EX should be the construction of building blocks (objects/macros) in order to use these in a logical (con)text environment (L^AT_EX).

In additions to this, A. Al Dahir forwarded me the following information:

- SCIENTIFIC WORD is based on L^AT_EX, with corresponding restrictions.
- It is not really WYSIWYG. On the screen you see PostScript ATM fonts (also for mathematics). In the printing or preview mode, CM fonts are used. SCIENTIFIC WORD has an interface with TurboT_EX for windows, and works as a layer between Windows and L^AT_EX of TurboT_EX.
- Tables were not used, but they can be expected in a next release.

C Note added by author

- **Cost-effective for the average user**
SCIENTIFIC WORD is intended to make it easy for the user to input text and formula’s. The resulting document can be fine-tuned within SCIENTIFIC WORD to a large degree. But for the final publication the publisher with its elaborate practical experience can and will fine-tune the document created by SCIENTIFIC WORD anyway.
- **Incompleteness**
Graphics are supported and tables will be fully supported in the next release. General constructs can be stored as keyboard macro’s and be recalled.
- **Entering and correction**
A T_EX document under SCIENTIFIC WORD is much easier to correct than a document without a WYSIWYG interface. In many instances an existing T_EX document can be read into SCIENTIFIC WORD for correction.
- **Context dependence**
SCIENTIFIC WORD has full context awareness. Size of subscript and superscript is dependent on the contents like for in-line or display formula’s. Due to the limited screen resolution that may not always be visible on the screen but it is there on the print out.
- **Interfacing with other tools**
SCIENTIFIC WORD does import Encapsulated PostScript files not Metafont files.
- **High Quality**
High quality can be accomplished but the average user can and will leave this to the final publisher, see under Cost-effective.
- **Formats**
SCIENTIFIC WORD is delivered with many style files. With T_EX knowledge they can be changed.
- **Portability**
There is freely available a special utility to ‘pack’ a SCIENTIFIC WORD file into a format suited for e-mail. Obviously it can do the reverse too.

²Special for NTG members there will be a 25% discount if they order the software before the end of this year. More details about this offer can be found elsewhere in this MAPS.

³In the next issue of the MAPS, an evaluation of Scientific Word by one of the NTG members, will be published