VISUAL LAMBDA MANUAL

DDMATH PROJECT

Digital learning in mathematics for blind students

ERASMUS+ Program

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VISUAL LAMBDA

USER MANUAL

Project within the ERASMUS+ program – School Education Gateway – Action KA2 - Strategic partnerships for digital education KA226 – Convention n. 2020-1-IT02-KA226-SCH-09557

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Abstract: User manual for the mathematical editor VISUAL LAMBDA

Sommario

1. Presentation

What is VisualLambda? It is a prototype of a new Lambda to do mathematics for visually impaired students, motor disabilities and for children with dyscalculia.

VisualLambda is a new product derived directly from the Lambda program, of which it exploits the positive characteristics that have been reported by the teachers and operators who have heavily tested it and experimented effectively and by those who used it in various situations, including at a distance with users with disabilities and special needs very different from those for which Lambda was designed.

It is known that Lambda is appreciated for linear writing for offering spoken mathematics, for the exclusive use of the keyboard to write mathematics, for the many compensatory functions it has.

Visual Lambda is instead dedicated:

• to those who have a severe motor disability, but are experts in the use of special keyboards such as those with enlarged keys, or membrane keyboards, or keyboards of small size, or with pointer and eye control,

• to visually impaired children who need vocal synthesis to support the representation on the screen, who ask for ease of writing the mathematical symbols on the keyboard and limited use of the mouse. In fact, in many cases it is problematic to manage the mouse to access the palettes of the signs to select the mathematical elements from time to time, and they have found it easier to use Lambda for writing signs with the keyboard. The only drawback is the need for a greater magnification of the characters and of the viewing window, and to be able to have personalized enlargements, greater contrast and customized colors.

• For children with dyscalculia who have appreciated the vocal synthesis and the orderly management of mathematical symbology in linear mode and who have found the writing of signs extremely simple and exploited the compensatory solutions offered by the Lambda program.

This new version of VisulaLambda will be able to start a new path of research and development in the future, to deepen the effectiveness of linear writing. In fact, Lambda linear writing no longer dedicated to the blind could be optimized

with new symbologies and simplified screen representations, being able to use colors, bolds, underlined or framed text. Ultimately, the presence of markers could be reduced for better readability and further writing speed, potentially being able to replace the cumbersome ways of writing mathematics to the computer of mathematical editors (such as Equation Editor) that require access to mathematical objects using the mouse to insert a defined space, and complete them with the numbers on the keyboard.

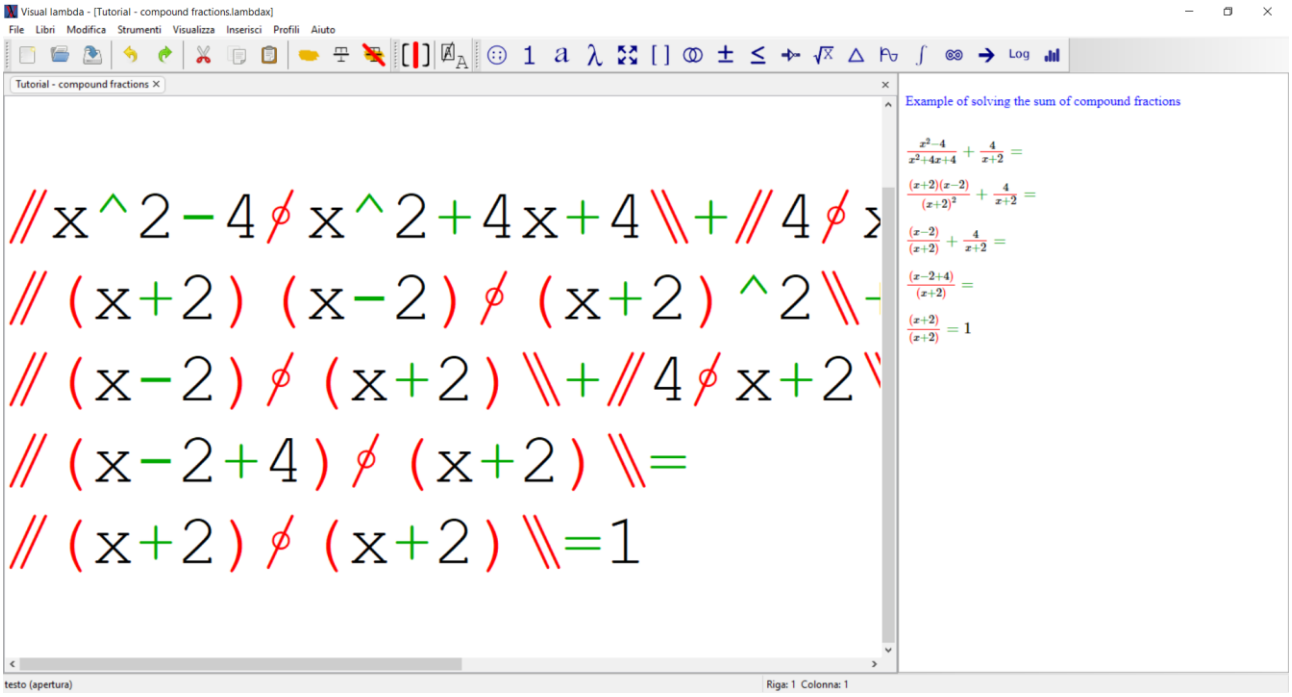
To this proposal it is reported that it has become common practice that mathematics teachers who have a blind student in class and who adopt Lambda and use it with skill, prefer to produce the papers (for example for a class test or an exercise), directly and faster with Lambda than with MSWord's Equation editor, being able to additionally do the work, once, and for all the kids in the class. Such a new linear coding would also become functional to be dictated with speech recognition systems.

VisualLambda as we said is a new program derived from the Lambda program, but with a new interface, including the possibility of customizing the insertion of mathematical elements from the keyboard (to be functional with special keyboards), the possibility of enlarging the screen is integrated. and the contrast for visually impaired users, a second window is set in static mode for reading the mathematical text in two-dimensional graphic mode inserted in linear mode. Mathematical formulas are written in text with a regular sequence of characters of the same size.

Graphics are always visible in a screen partition.

The system provides full compatibility with the mathematical marking language MathML version 2.0, defined by the international consortium W3C, which today represents the most widespread conversion and transformation standard worldwide. Through MathML the LAMBDA code will therefore be convertible, in input and output, with the most common mathematical writing formats.

Also through MathML it is possible to instantly obtain the graphical version of the mathematical text, to be destined for printing or displaying on the screen.


Visual lambda - [Tutorial - compound fractions.lambdax]
File Libri Modifica Strumenti Visualizza Inserisci Profili Aiuto
Tutorial - compound fractions
//x^2-4/x^2+4x+4\\+//4/x
//(x+2)(x-2)/(x+2)^2\\-
//(x-2)/(x+2)\\+//4/x+2\
//(x-2+4)/(x+2)\\=
//(x+2)/(x+2)\\=1
Example of solving the sum of compound fractions
testo (apertura)
Riga: 1 Colonna: 1

2. Installation

The complete installation of Visual Lambda requires a few simple steps.

2.1 Visual Lambda Installation

First, you install the Visual Lambda program by running the VisualLambdaSetup file.exe.

The procedure is very simple and carried out automatically by the installer.

You can customize the installation by choosing the language, working directory etc., or make a default installation. The program will be installed in: c/Program Files (x86), in a Visual Lambda folder. On the desktop we will find the icon for starting the program.

2.2 In case of problems with the installation

You must be a system administrator to install the program, but you do not need it to run. You typically need to check this if you are installing on a networked PC. In case you are installing on your personal PC it is very likely that you are already administrators and therefore you can proceed. If you are installing on a PC connected to the network, check your access rights or ask the network manager.

2.3 Configuring visual lambda on-screen display

The visually impaired student needs special attention in the configuration of the Visual Lambda as he is required a greater effort in the discrimination of symbols and long strings of mathematics.

The program provides some tricks that allow the student to work independently and with a remarkable operational and research speed.

Initially you will have to take care of the enlargement of characters and / or use a black screen against glare.

Let's start from FILE, scroll through the drop-down menu and look for PREFERENCES.

The window that opens will have some fields to consider:

INTERFACE

- **Font size** (choose the size from 10 to 96 by doing some tests to understand which is the best display for the student)
- **high contrast**: if you need a black screen to avoid fatigue or glare, choose yes;

  The cursor does not automatically change its color so it is invisible. To make it visible we must rely on the high-contrast display of Windows system. We then go to accessibility, in the left window we choose high contrast, in the section: use high contrast, choose activate high contrast and click on active; probably it will take a restart to make the settings active.

GRAPHIC

- **Docking position** (choose low to have the horizontal graphic bar, this is the best choice as it leaves the screen at the top free and therefore the possibility of having more space to be able to write).
- **docked window size** (choose the size of the window that allows you to see the graphics with the chosen magnification without sacrificing too much the operating space) small, medium or large.→
- **zoom** (choose the magnification of the graphic part) →in the drop-down menu the percentage of magnification is shown.
- **view single expression** (if I choose **yes**, in the graphics I will see only the expression I am working, if I choose **no** I will see the whole document and the cursor will be placed on the first line of the document and I will move with the sidebar).

TEXT TO SPEACH

enabled (if you choose yes, text-to-speech is enabled)→

active voice (you can choose the type of voice: Elsa for the voice in Italian, Zira for voice in English)

3. The general environment of the Visual Lambda editor

The management environment of the Visual Lambda mathematical editor is similar to that of a common writing program.

There you will find the normal commands to open a file and save it, correct and delete, select, copy, paste etc ... All common operations are handled as in any word processor.

A special feature of the Visual Lambda editor is the ability to move the cursor to any point on the screen, even where there is no text.

For example, with two lines like:

a+1

from+a+2

if the cursor is on the 2 of the second line, with a normal text editor by pressing the "up arrow" key the cursor would pass to the end of the previous line, that is, after the number 1 in our case.

With the Visual Lambda editor, on the other hand, it will be positioned exactly above the point where it was previously, even if it is outside the pre-existing line.

a+1

from+a+2

This way of moving the cursor allows you to access all the points of the screen by moving freely according to the vertical and horizontal axes; in the mathematical environment it will prove useful in many situations.

4. Mathematical symbols

To write a mathematical text it is necessary to have a much higher number of symbols than a normal literary text.

Each of them must be associated with:

- a graphic symbol for on-screen representation and ink printing;
- a textual expression to be pronounced through speech synthesis.

The Visual Lambda editor offers several support tools for entering characters not present in the keyboard and facilitates their recognition: their full name appears on the status line, at the bottom left, and can be read with the use of the windows lens (windows key + +; windows key + esc to exit).

Very important in a linear code are the markup symbols (tags) that act in relation to each other to define a block, that is, it is a portion of text delimited by an opening and a closing.

A block can be enclosed by the usual parentheses (round, square and braces) but also by symbols that delimit a fraction (numerator and denominator), or a root, an exponent or other.

The Visual Lambda system recognizes these relationships and offers various tools to efficiently manage both the markers connected to each other and the portion of text they define: it will be possible to automatically switch from one to the other, delete both with a single operation (which is very useful in the simplification phase), select all the contents of a block (from the "open" symbol to the corresponding "closed") to copy, move, delete, temporarily hide the text contained in the parentheses to highlight the general structure of the formula, and more.

The text that is entered into Visual Lambda must adhere to some simple formal rules. For example, for each symbol that opens a block (for example a parenthesis) there must be the corresponding closing symbol that the program inserts independently.

The program has various tools designed to facilitate the entry of a formally correct mathematical text.

4.1 The on-screen representation in the write partition

Each mathematical symbol is represented on the screen with a graphic character. Many of them are easily recognizable because they are analogous or attributable to their usual graphic notation. But some, such as markers that indicate a fraction, are specific to linear systems and do not have a correspondent in mathematical texts of a graphic type; they will then be represented with symbols that we are not used to using in other contexts.

To improve the readability of the text presented on the video, graphic symbols are also associated with colors:

- the markers of open/closed structure, and any intermediate, that delimit a block are red;
- operators and individual markers are green (without closure);
- isolated numbers, letters and symbols are black.

4.2 Textual elements

Some mathematical elements do not have associated symbols but are usually indicated in a textual way. For example, trigonometric functions (sen, cos, sec...), logarithms (log, ln), limit (lim).

Visual Lambda also writes and represents them in a textual way and therefore a normal alphabetical text. However, they too are managed and recognized by the system as a single element and can be deleted, selected, moved only globally, not acting on the individual characters that compose it.

5. Distinguishing between text and mathematics

The need to write a mixed document, text and formulas, is very frequent in all school orders: it can be the text of a problem, the header of a task, the proof of a theorem or other.

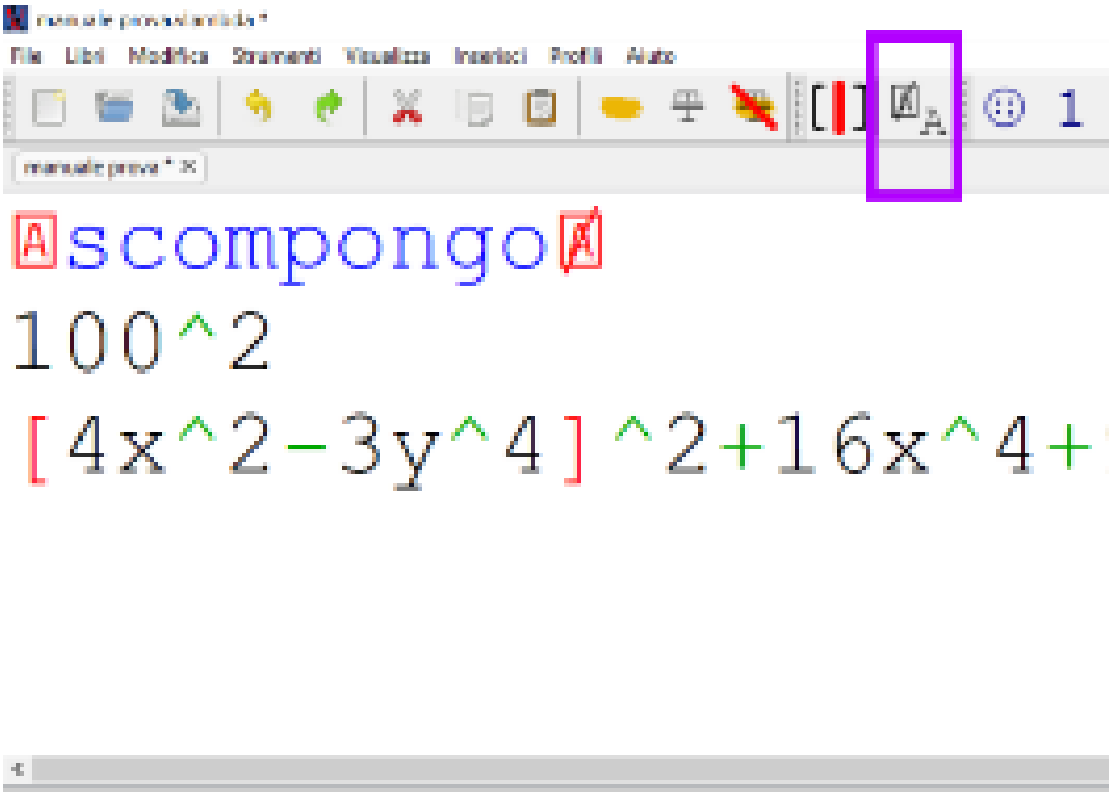
The mathematical environment of Visual Lambda follows some rather strict structural rules and is not suitable for handling simple text. In mathematics, for

example, speech synthesis always reads one letter at a time, as if they were names of variables, while in a text obviously be linked to each other and read as words.

The Visual Lambda editor has two distinct environments, one for text and the other for math, and you can switch freely from one to the other, even in the same line.

The mathematical rules and functions described in this manual apply only in a mathematical environment. In a textual environment, the available commands are the fundamental ones of a common text editor.

Each new Visual Lambda document opens by default in a mathematical environment. To enter the textual one you type CTRL + J or use the button: "change context" on the toolbar.



When you open a text section, the closing marker is also automatically inserted, with the cursor positioned inside the two markers A and A crossed out (text and end text).

The two symbols are read by speech synthesis.

It is therefore easy to understand in which area you are from the opening marker and the crossed-out closing marker, from the color of the text entered.

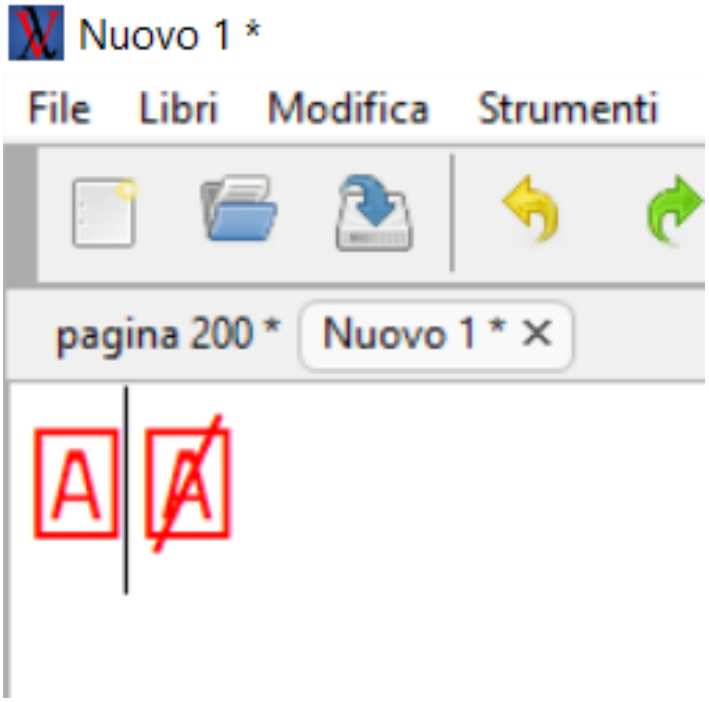
On the screen the textual part appears all blue while the mathematical one uses three different colors (black, green, red; while in high contrast white, green, red) depending on the type of elements.

In the status bar at the bottom left appears the name of the element on which you place the cursor if you are in a mathematical environment, if we are in a textual environment the corresponding alphabetical letter always appears.

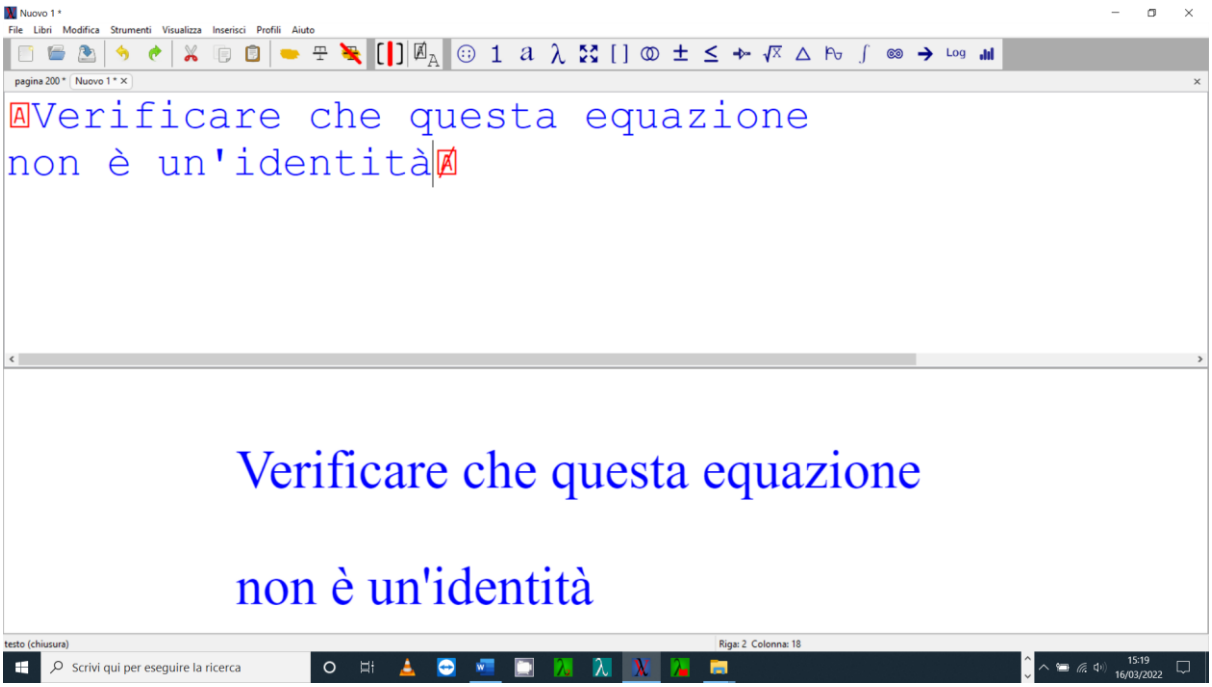
To exit the text section and switch to the mathematical one, you must move to the right with the cursor arrow when you are positioned at the end of the text, thus bypassing the closing marker.

Example

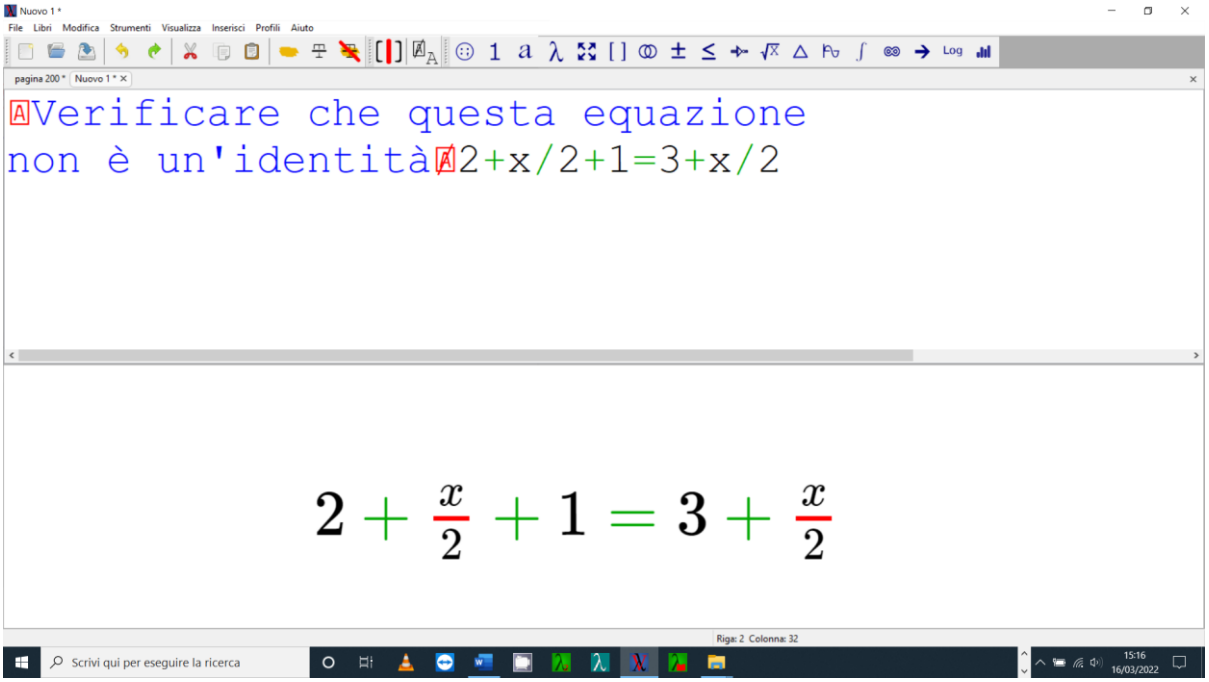
Typing Crlt + J inserts both text markers, open and closed, and the cursor is positioned in the middle of the two.



Non-mathematical text is written freely and speech synthesis reads words in the usual way.



At the end of the text, take the cursor out of the text area with the arrow key to the right. We are in the mathematical area: all the commands for mathematical editing offered by Visual Lambda are active and the synthesis pronounces the name of the various mathematical elements.



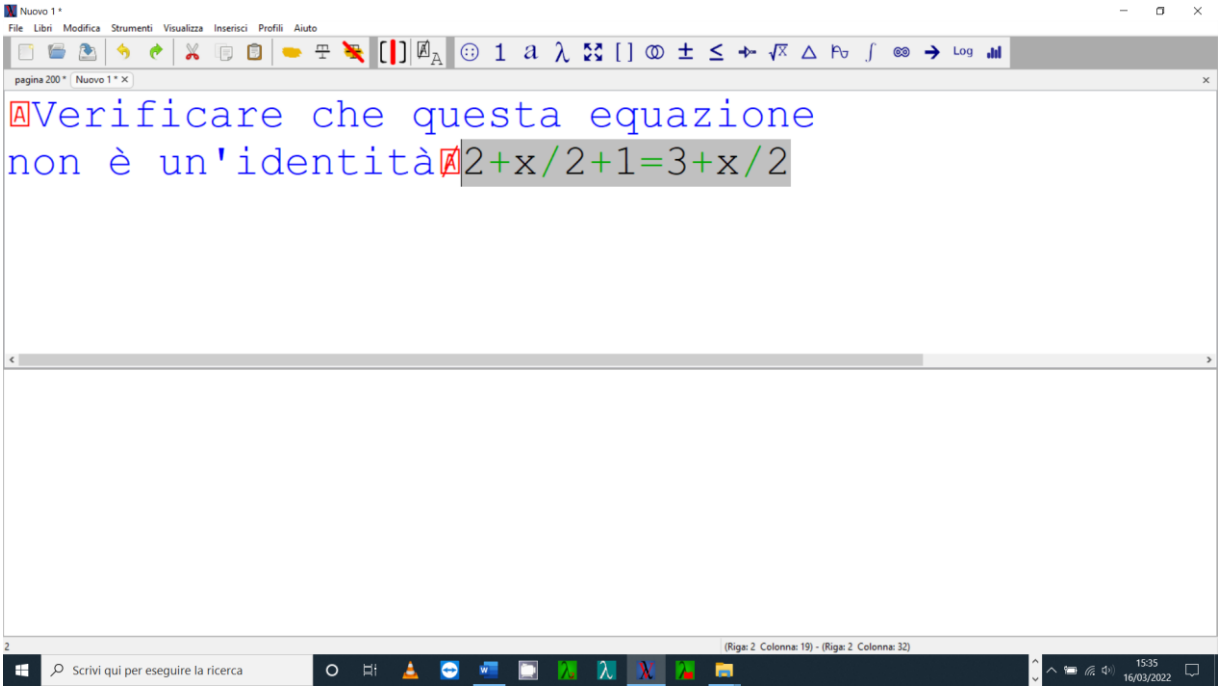
The distinction between the two environments, text and mathematics, is rigorous. Their operation is completely different and any situation of ambiguity should be avoided. For this reason, the two markers must always be present, and must therefore be inserted or deleted at the same time.

It is therefore not possible to delete markers to transform a text into mathematics or vice versa: markers can only be deleted together with the text contained within them.

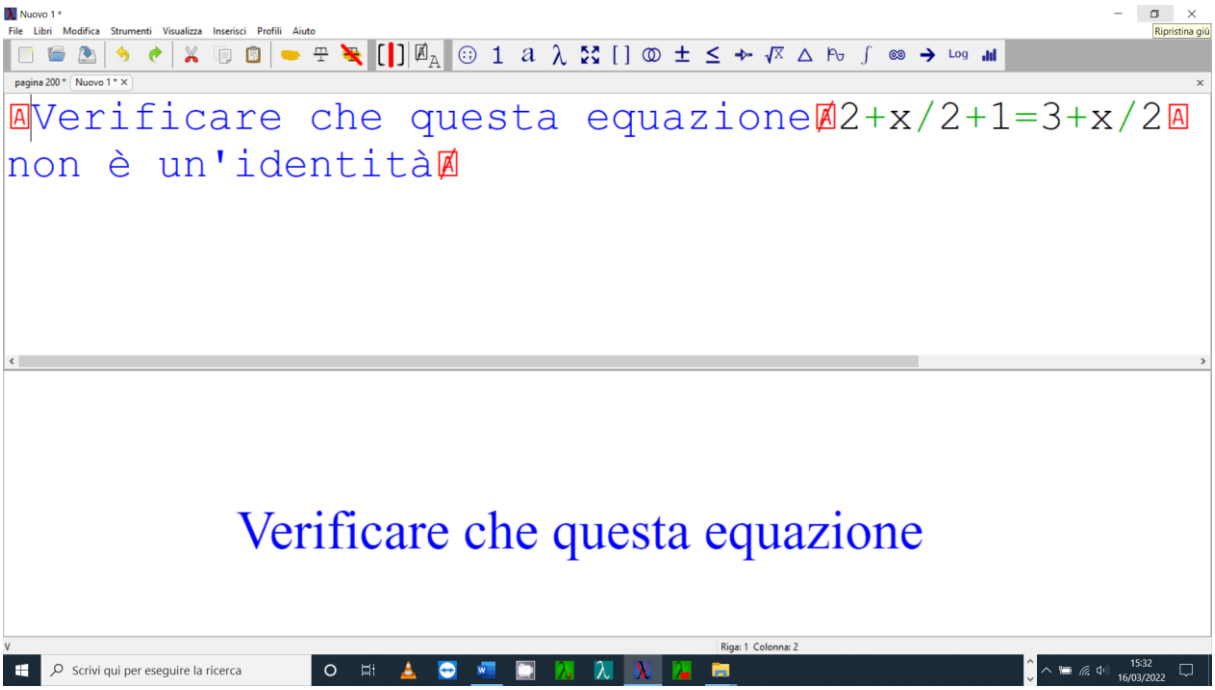
Any selection of text copied and pasted into a mathematical block will be automatically delimited by the two text markers. The same thing you will have by copying a mathematical selection into a text one.

Example

We transform the example of before by inserting the formula within the text. You select the mathematical part, cut it with CTRL + X.



When you insert it with CTRL V, the two resulting blocks of text are automatically correctly marked with new closing and opening symbols. Note that if the two blocks are present in the line, the graphic part shows the text or mathematics only when the cursor is placed within the desired scope.



6. Text-to-speech

The Visual Lambda gives the possibility to use a speech synthesis that will read both the mathematical part, with all the symbols used, and the textual one.
You cannot automatically read a file, but you must move line by line.
As mentioned before, it reads the symbols of opening and closing text.
It does not read the drop-down menus of the toolbar. To overcome e.g. F5 type the name of the symbol (the drop-down menu that appears is not enlarged) →→use the Windows lens (windows key + to enlarge, windows key + to reduce magnification, windows key + esc to exit the lens) with adequate magnification.
In the use of the calculator (F9) reads the numbers typed but not the result.

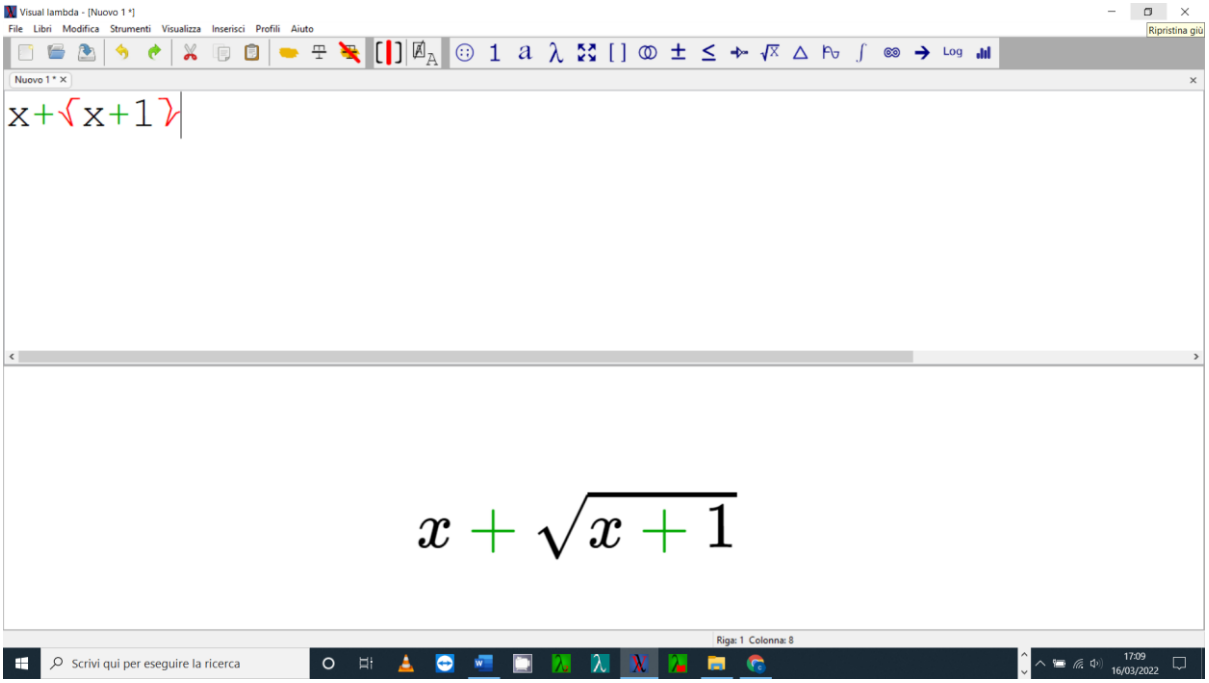
7. Linear mathematical writing

In a linear code, the role of markers (or tags) is fundamental, that is, the codes that delimit the mathematical structures.

For example, in this expression: [x + square root of (x+1)] the graphic symbol of the root not only indicates the operation to be performed but also delimits, with its shape and its extension, the part of the formula on which it is to be performed, that is (x+1) in this case.

This double information can only be provided in a linear notation by using a pair of specific symbols to indicate the beginning and end of the operand.

In linear notation Visual Lambda will therefore be:

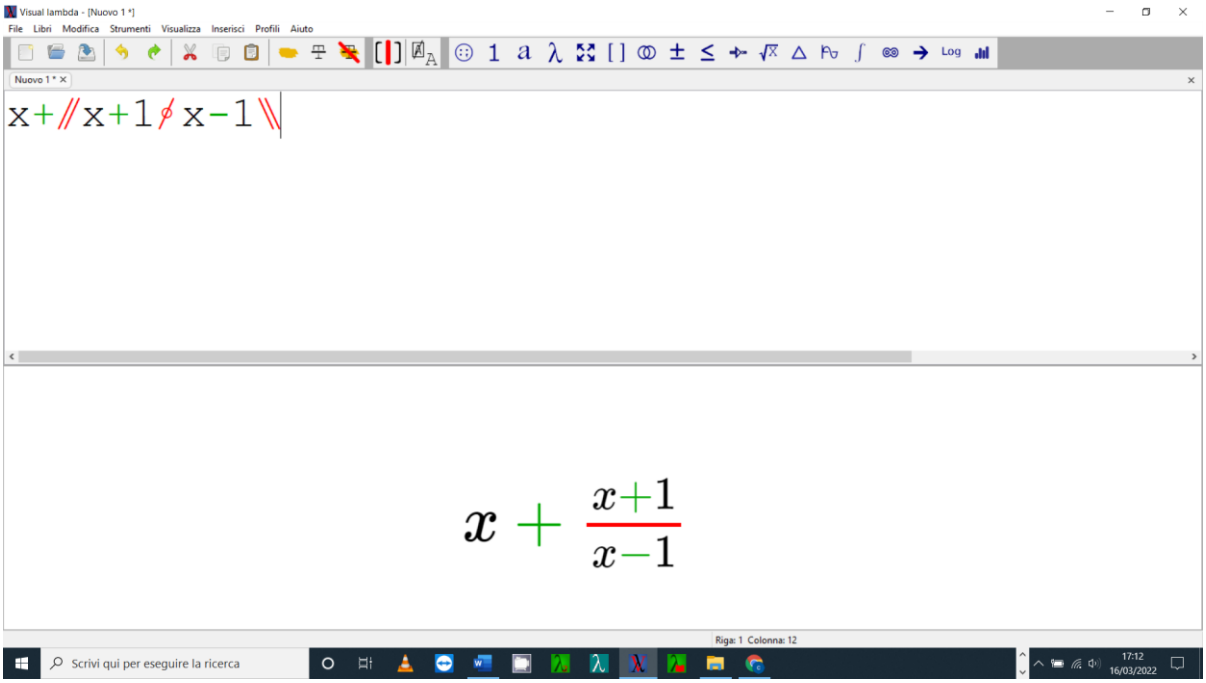


For some mathematical elements that enclose two objects, in addition to an initial and a final marker, an intermediate separator is also required. The most common case is

that of the fraction: [x + fraction with (x+1) fraction (x-1)]

Visual Lambda linear notation has an initial marker, an intermediate separator (corresponding to the fraction sign), and a final marker.

Here is the Visual Lambda linear representation of the example:



The Visual Lambda system makes great use of these pairs of open-closed markers, with the possible intermediate, which can be inserted several times one inside the other and thus represent in a linear way all the possible mathematical structures.

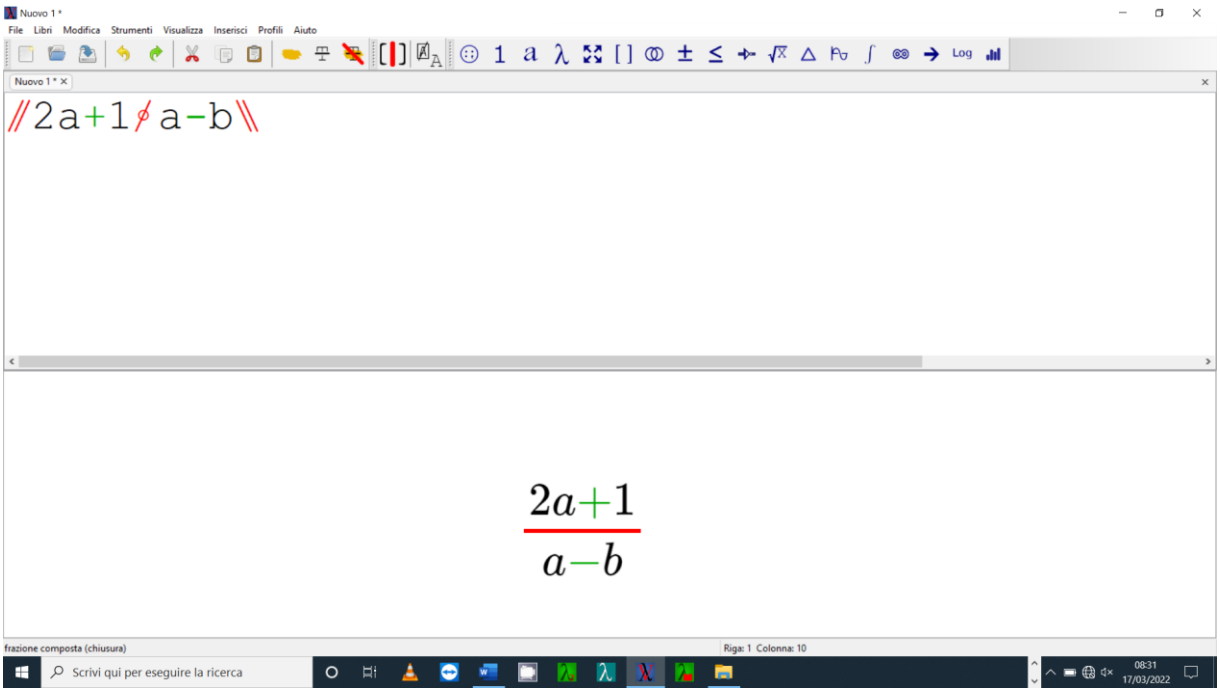
8. Main structures in LAMBDA

The LAMBDA system includes a few dozen block structures, with open and closed marker in addition to the possible intermediate. The program independently closes everything that in mathematics must be closed (eg: parentheses, complex fractions, complex roots, limits ...).

Some of the most frequently used structures are described here.

Note that the keyboard shortcuts for the intermediate are always the same: CTRL+I

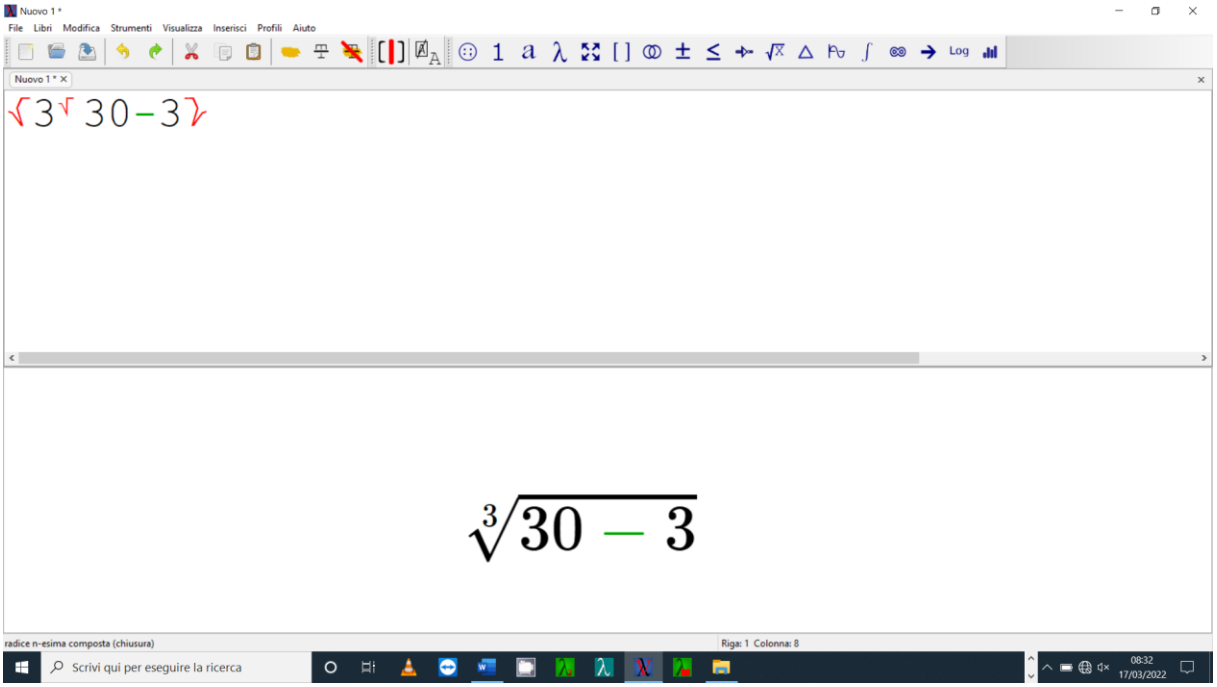
Fraction: Visual Lambda linear structure and graph: [(2a+1) fratto (a-b)]



Keyboard shortcuts:

Open: Ctrl+Q

Root: Visual Lambda linear structure and graph: [cubic root of (30-3)]

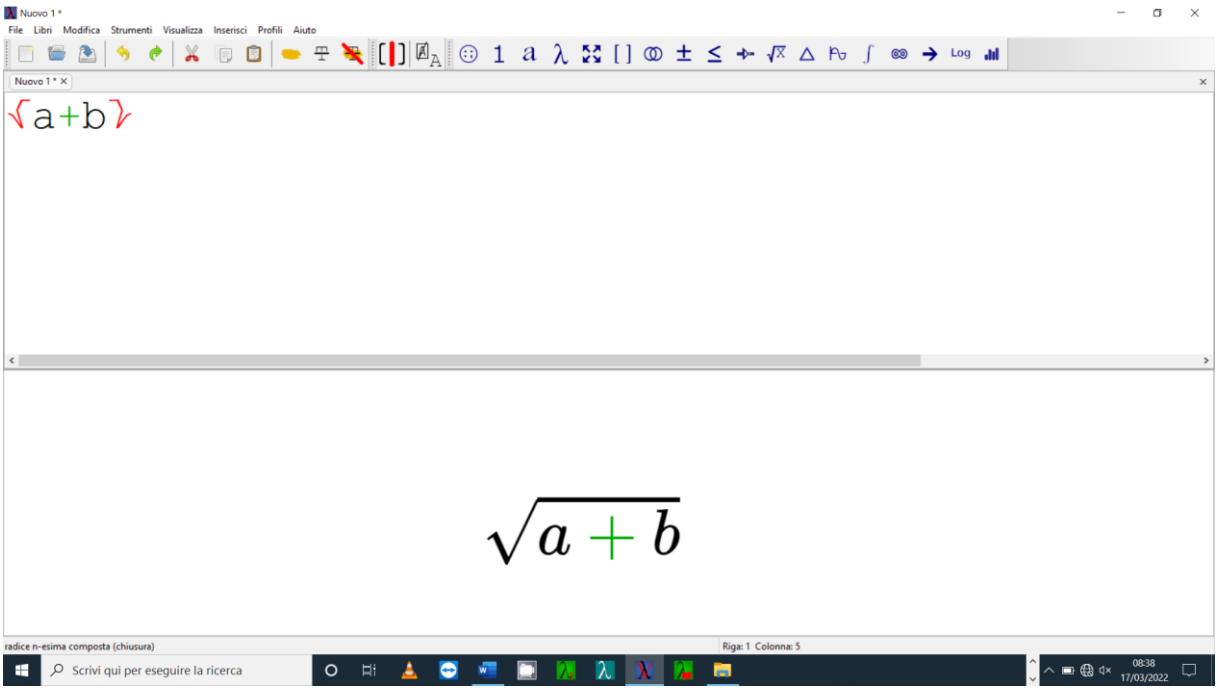


Keyboard shortcuts:

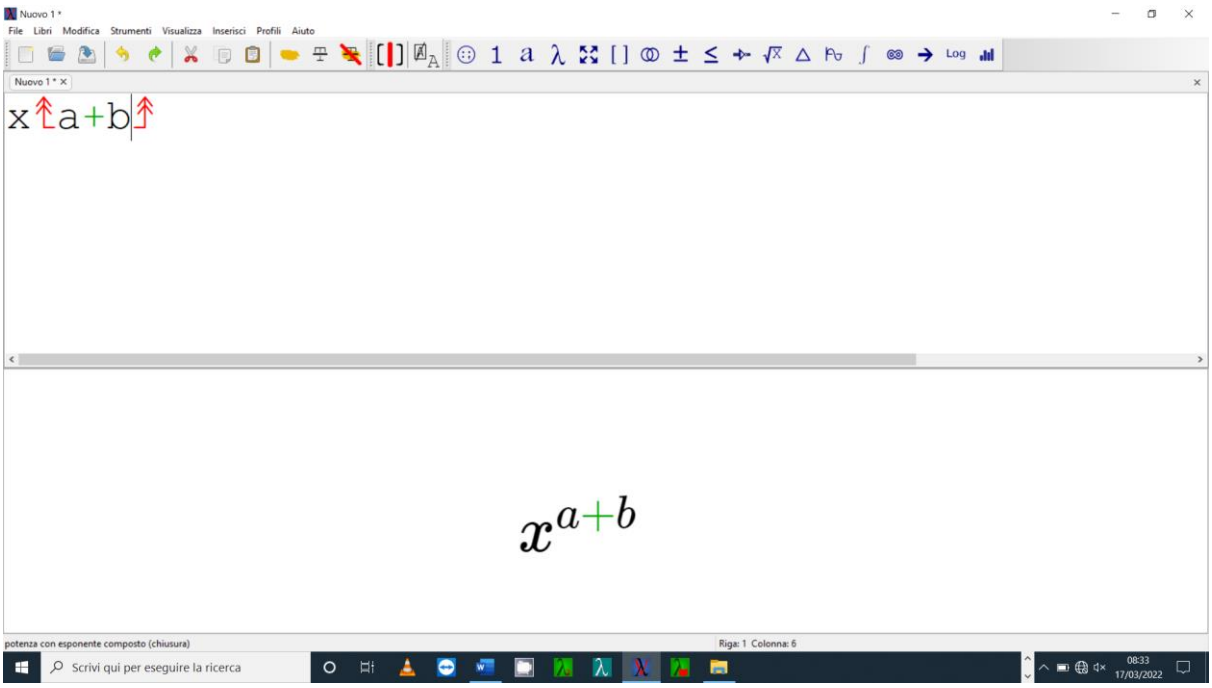
Open: Ctrl+Shift+R

Intermediate: CTRL+I

The index can be omitted (and in this case the separator is not needed) with the square roots: [root of (a+b)]



Exponent: Visual Lambda linear structure and graph:



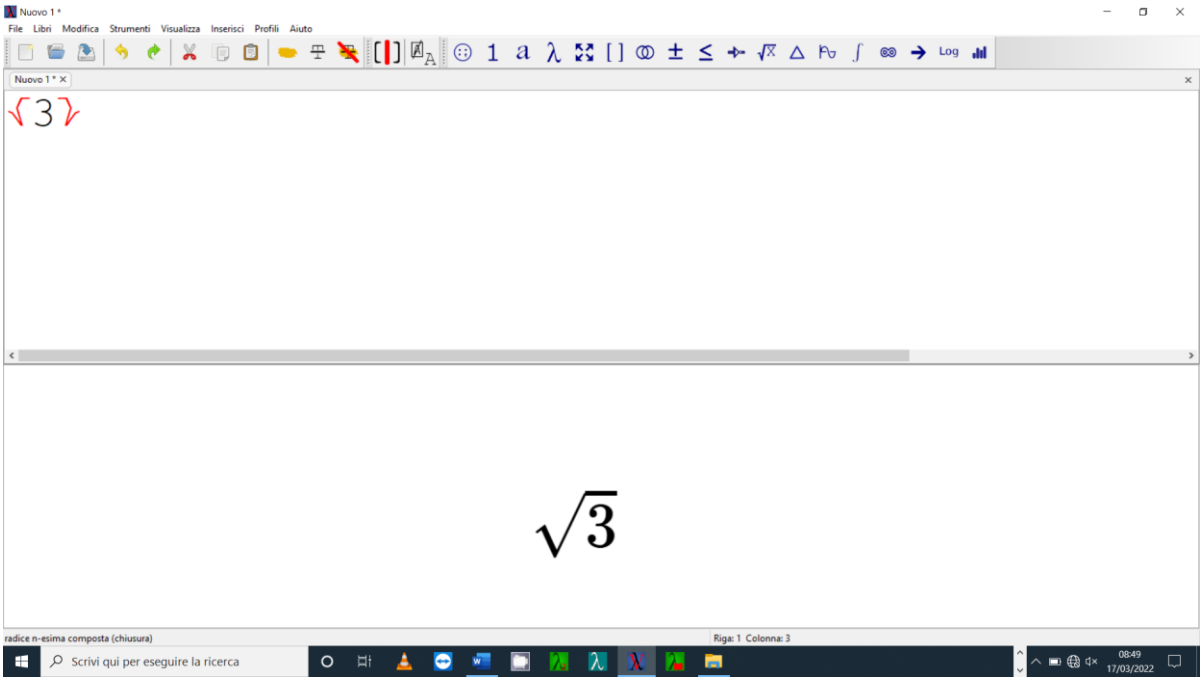
Keyboard shortcuts:

Open: Ctrl+Shift+Ì

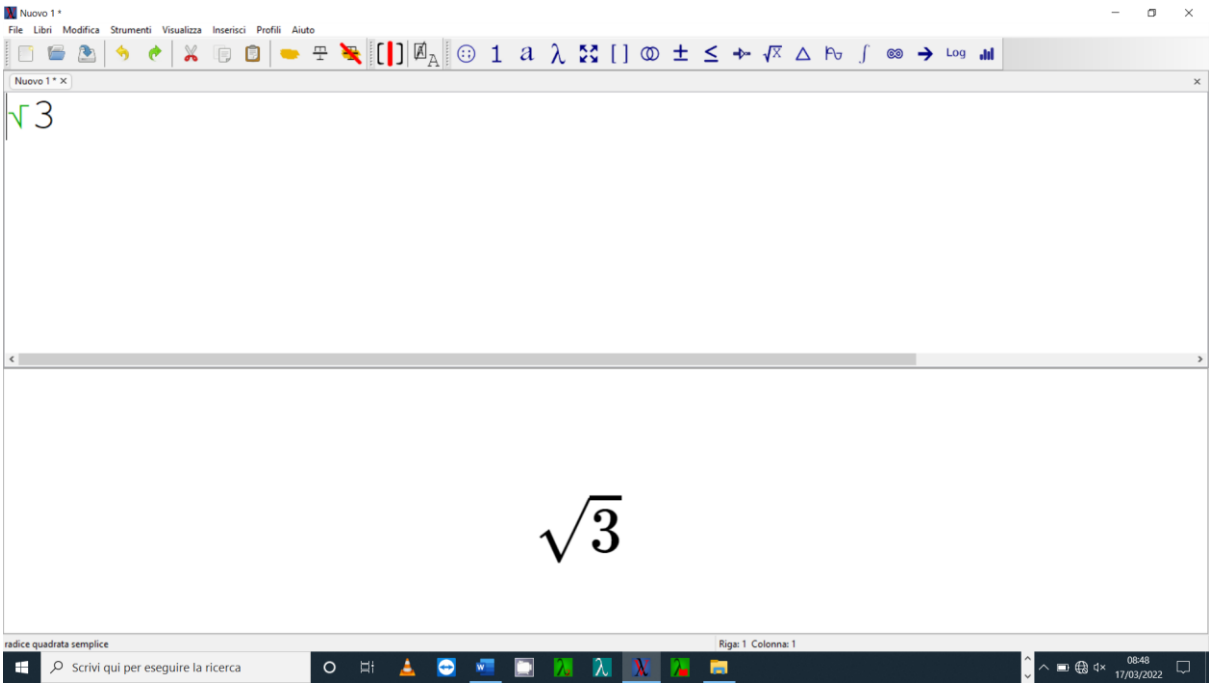
8.1 Abbreviations

For simple objects, that is, composed of a single well-defined element, it is also appropriate to provide for a shorter notation, without a closing marker. This is a useful abbreviation strategy to speed up writing operations and make the mathematical text more compact.

To represent, for example, 3 [root of 3]



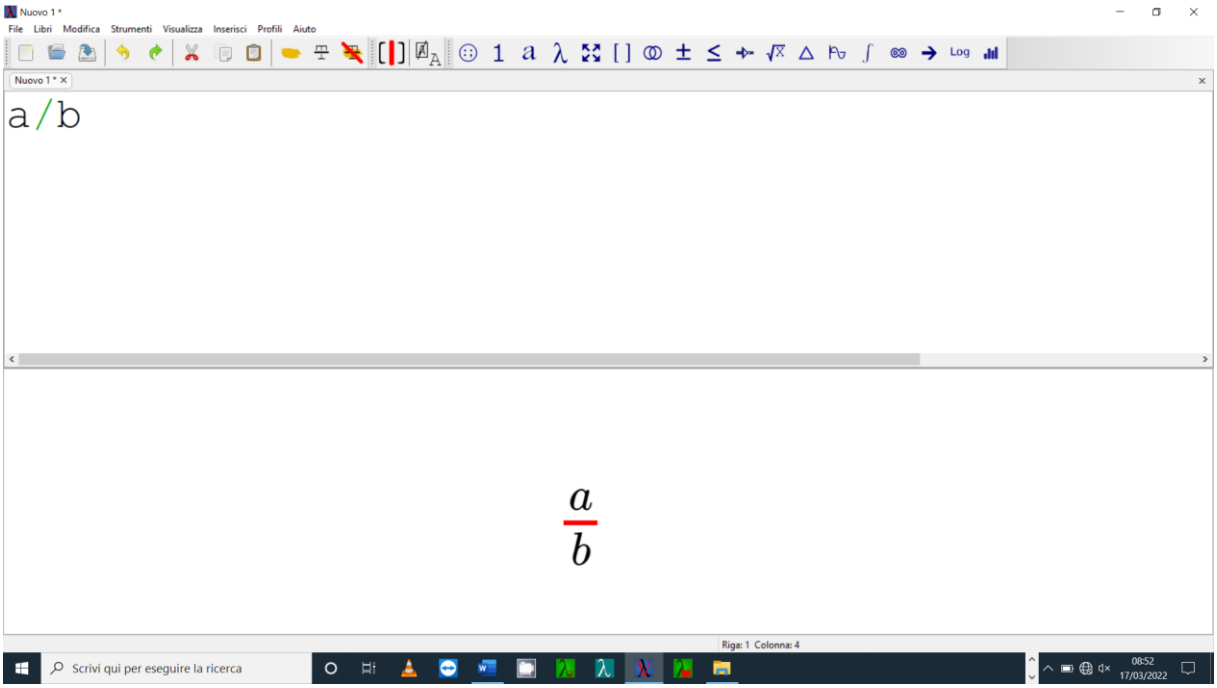
instead of the complete structure we can simply write



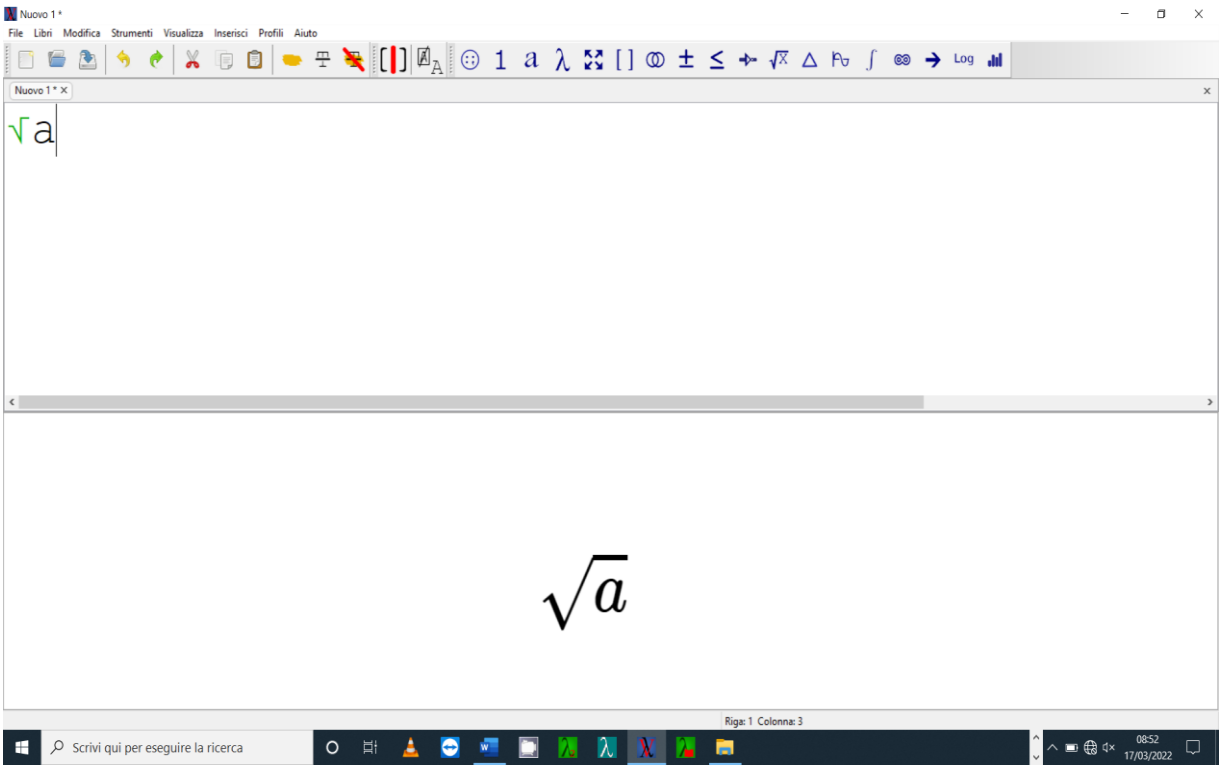
The three most common structures (fraction, square root and exponent) also have a

simple version in addition to the compound one.

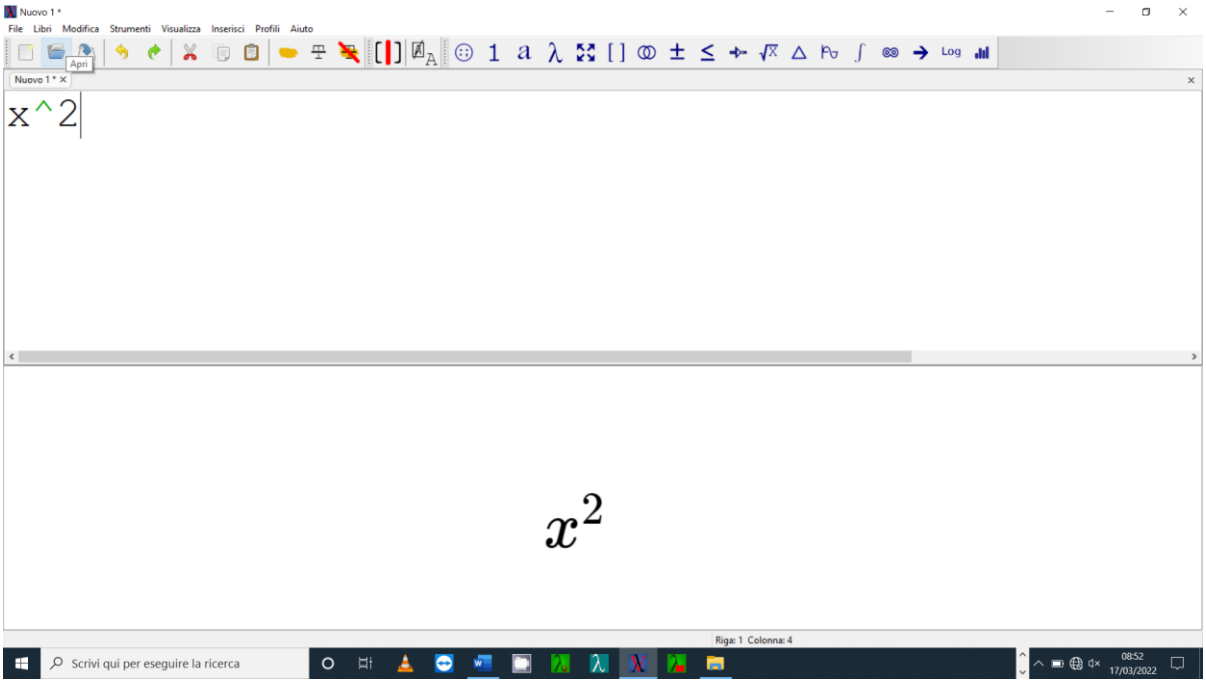
Simple fraction



Simple square root



Simple exponent

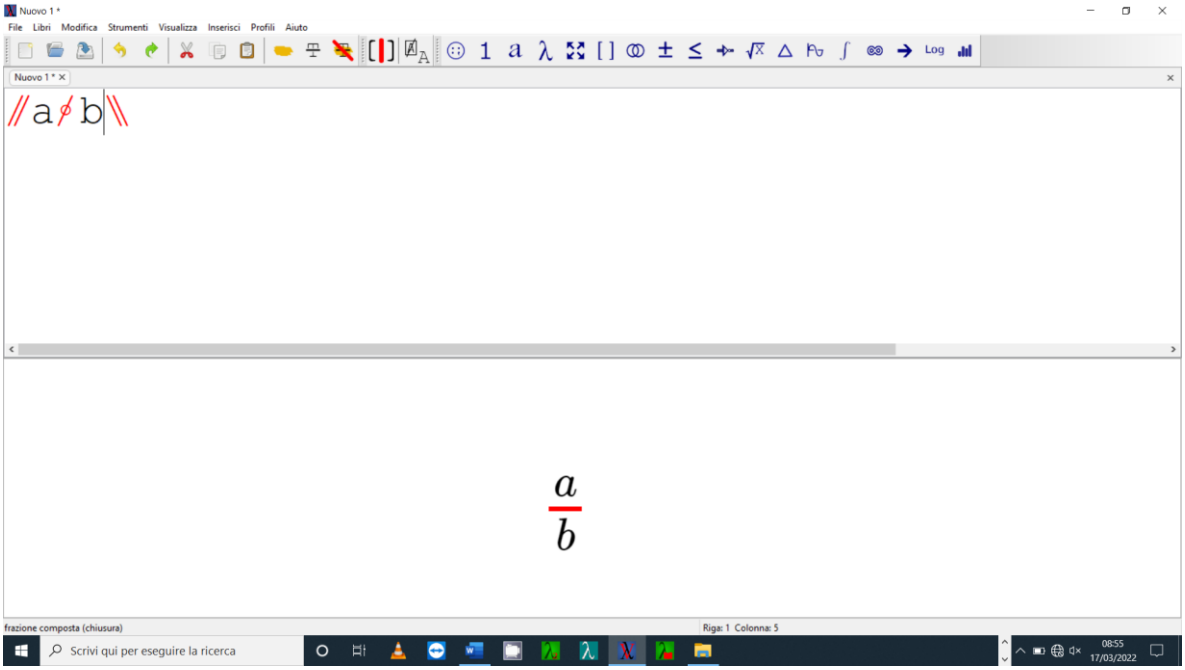


It is important to note that the markers of the simple versions are different from those of the corresponding compounds, as are the commands to be typed for entry.

When writing a fraction, a square root or a power you need to decide right away whether to use the simple form or the compound form.

The user who wishes can always use the compound form: he will have fewer symbols and commands to learn, but his mathematical text will be more wordy.

Nothing prevents, for example, that a simple fraction as it is written using the compound structure:



However, we will have a text of 5 characters instead of 3, as in simple notation, and this in an expression with many fractions can lead to a considerable expansion of the text.

9. Inserting symbols

To insert symbols not present in the keyboard, the LAMBDA editor offers four possibilities:

- a combination of hotkeys, some even on numeric keypad
- selection from the menu
- search in the list of elements
- selection from graphic buttons

9.1 Keyboard shortcuts

Each element has one or more keys associated with fast insertion, to be used in conjunction with the CTRL key.

For more frequently used elements, a second combination is provided in the numeric keypad so as to allow typing mainly with only the right hand, speeding up the entry of mathematical text. Numeric keypad combinations are associated with the CTRL key.

For the less used symbols, a pair of characters has been defined: the first letter indicates the group, the second the associated key.

For example, to enter the Greek letter α (lowercase alpha) you type CTRL g,a (that is: holding down CTRL you press the g key, release and then press a). All letters of the Greek alphabet will be entered in a similar way: CTRL g, associated Latin letter, uppercase or lowercase.

A particular type of hotkeys, particularly simple and intuitive, is used for elements represented in a textual way, such as trigonometric and logarithmic functions. In this case, just write the text in a normal way on the keyboard and the system will recognize the associated element. The keystroke needed, for example, to enter the element "cos" (cosine) will be just "cos".

The full list of keyboard shortcuts can be found in the index.

9.2 Insertion with the numeric keypad

Many users find it convenient to use the numeric keypad in writing, with the Numero Lock activated, because it can be managed with only the right hand speeding up mathematical writing.

Obviously the PC must be equipped with a numeric keypad or have connected via usb an external keypad.

With the LAMBDA editor it is possible to insert on the numeric keypad, in addition to numbers and arithmetic operators, also other mathematical elements of common use.

The following table shows the diagram of the numeric keypad organization.

normale

	separatore frazione semplice	*	-
7	8	9	+
4	5	6	
1	2	3	invio
0		.	

con CTRL

x		a	
		b	
(	[	{	
=			

Some keys are associated with editor functions that will be described later.

The complete list of keyboard shortcuts, including those associated with the numeric keypad, is also included in the index.

The use of the numeric keypad can also be customized by the user according to their needs.

9.3 Selection from menu

From the menu bar open the INSERT menu and select the group you are interested in. Then select the symbol you want to enter.

9.4 Search the list of items

With the F5 key, or the relative item in the insert menu, the complete list of all the elements opens, in alphabetical order.

By starting to write the name of the item to search for in the box at the top, the list is reduced by showing only the names of the elements that contain words that begin with the text entered. It only takes two or three characters to get a list compact enough that it can be easily consulted with the Windows lens (increase magnification: windows + keys; decrease magnification: windows keys -; to exit: windows esc keys).

9.5 Selection from graphical buttons

It is possible to insert the mathematical elements through a graphic menu with icons (tool bar).

The most common symbols include generic commands, and the one for inserting the intermediate marker are present in the toolbar of the elements (group on the left), with direct access.

The other elements are instead available in the mathematical toolbar by selecting the group first and then, in the new menu that opens, the chosen symbol.

The meaning of the symbols should be quite intuitive. In case of doubt, position the mouse pointer over it; a small explanation window appears accessible through the Windows lens.

The tool bar is fully active even if I am in the text section, obviously the corresponding math symbols will open and close if I am in the text field and vice versa.

10. Manipulating mathematical text

For a mathematical editor for school use it is not enough to be able to write an expression or an equation, it is also necessary to be able to process it to solve it adequately.

The Visual Lambda editor offers various tools to facilitate these manipulations.

10.1 Resolution by transformation

In many circumstances the easiest way to work on a mathematical text is to copy and paste the line and then intervene, with corrections, on the copy.

With an expression or equation to be solved with successive transformations, it is normal to perform many steps when transcribing a new line (calculations, simplifications...). It is much more effective to work for correction, that is, first copy the text and then read and process it.

Copying and pasting a line is an operation that can be done with the normal editing tools available in Visual Lambda, according to the usual procedures common to all writing programs.

For example,:

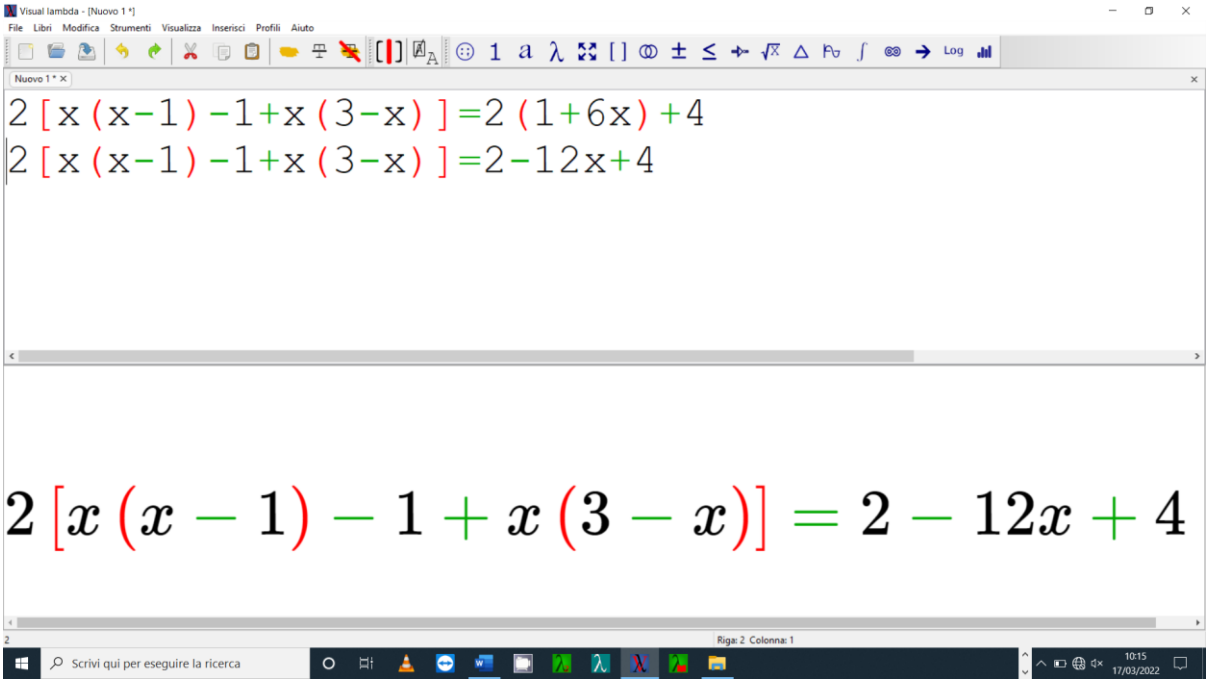
- go to the beginning of the line and type Shift End to select it all
- type CTRL C to copy it
- go down with the cursor and type CTRL V to copy the text to the new position.

10.2 Automatic row duplication

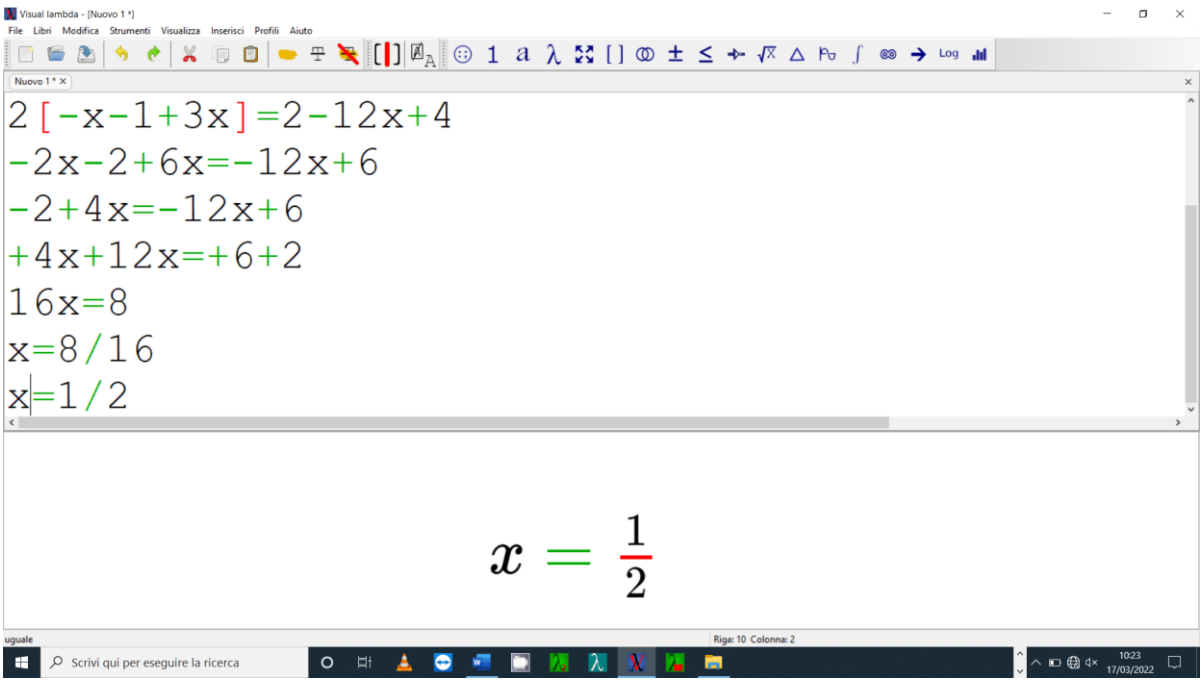
This variant of transformation resolution provides the ability to control steps taken through control lines, unmodified.

Corrections are made in overwriting (without insertion) so the overall structure of the expression remains unchanged.

Example:



Here is the complete solution from the previous example:



To view all the write operation, scroll up and down with the sidebar or arrow keys.

To view the whole operation in the graphic:

filespreferencesgraphicview single expressionchoose from the NOok drop-down menu; →→→→→

at this point you can see the whole operation by moving with the sidebars and horizontal.

The procedure may seem much longer than normal, in fact many operations are performed automatically very quickly.

It should be noted that in case of need it is possible to check the whole process in reverse, verifying the various steps.

The Visual Lambda Editor has a command (CTRL + D shortcut key) that automatically duplicates the line according to this method.

Specifically, CTRL+D performs these operations sequentially:

1 - you select the whole line on which the cursor is located (no need to go to the beginning)

2 - you copy once below the previous line;

3- at the end of the operation the cursor is positioned at the beginning of the lowest row (working line).

10.3 Selecting Blocks

It is possible to select, with a single command, all the mathematical block within which the cursor is placed. By "block" we mean the portion of text enclosed between a pair of open/closed markers, such as two parentheses, a compound root, or something else.

The command is activated from the menu (SELECTIONS/SELECT BLOCK) or with the shortcut combination CTRL B.

At the beginning you select the smallest block that contains the cursor; the selection can be extended, typing CTRL B again, and gradually include the outermost open/closed structures, up to the entire row. Similarly, you can later

reduce the selection back to the previous internal blocks, until you get to the starting selection (smaller block that contains the cursor).

Main commands:

Select block	CTRL B
Extend your selection	CTRL B
Reduce selection	Shift, CTRL, B

11. Alternative views of mathematical text

With the linear representation you lose a lot of structural information that in the normal graphic representation are instead evident even if, given the possibility of using the graphics always in evidence, there does not seem to be any misunderstandings in the identification of the various elements.

The problem mainly concerns complex mathematical objects, with many elements inserted one inside the other, on several levels (nesting).

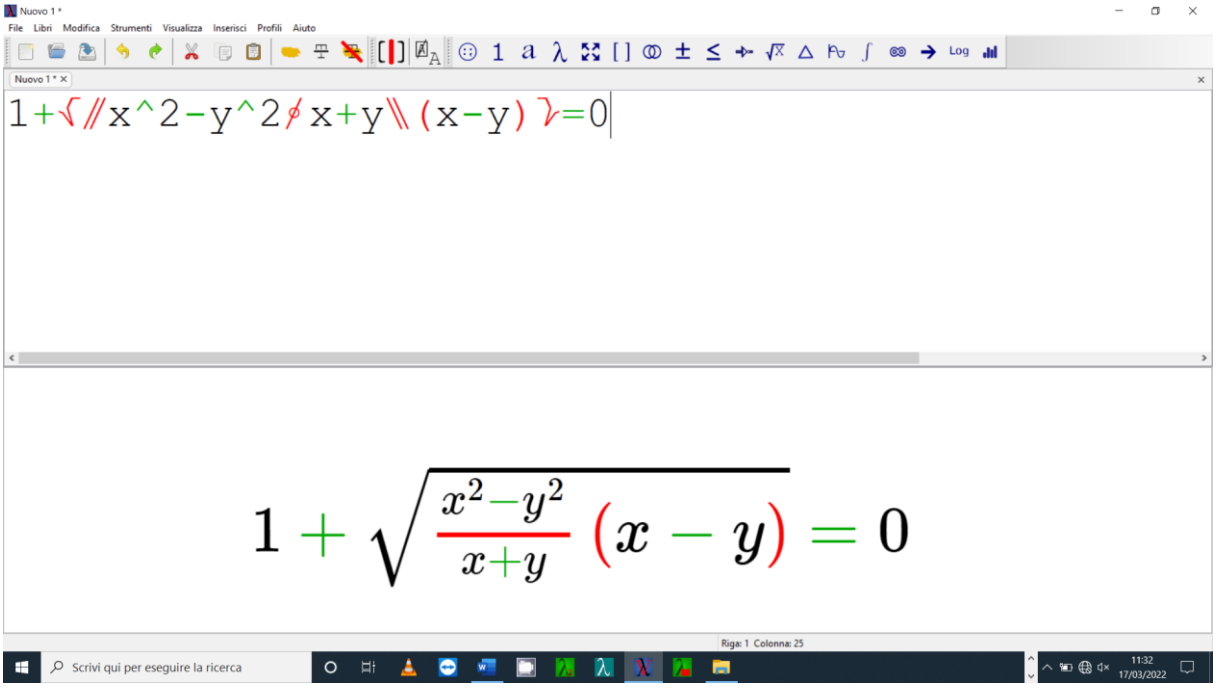
The Visual Lambda Editor has two alternate display modes designed to help you understand the structure of formulas and internal relationships by overcoming, as far as possible, the limitations of linear notation.

Being visualization tools, and not writing, inside them you can not edit the text but you can navigate freely by moving the cursor that, when you return to the normal window, will retain the new position.

11.1 Compressed structure

The "compressed structure" view shows the formula by emptying the contents of a block, from one marker to another. In this way it is clear which marker each block is associated with and on which part of the formula it acts.

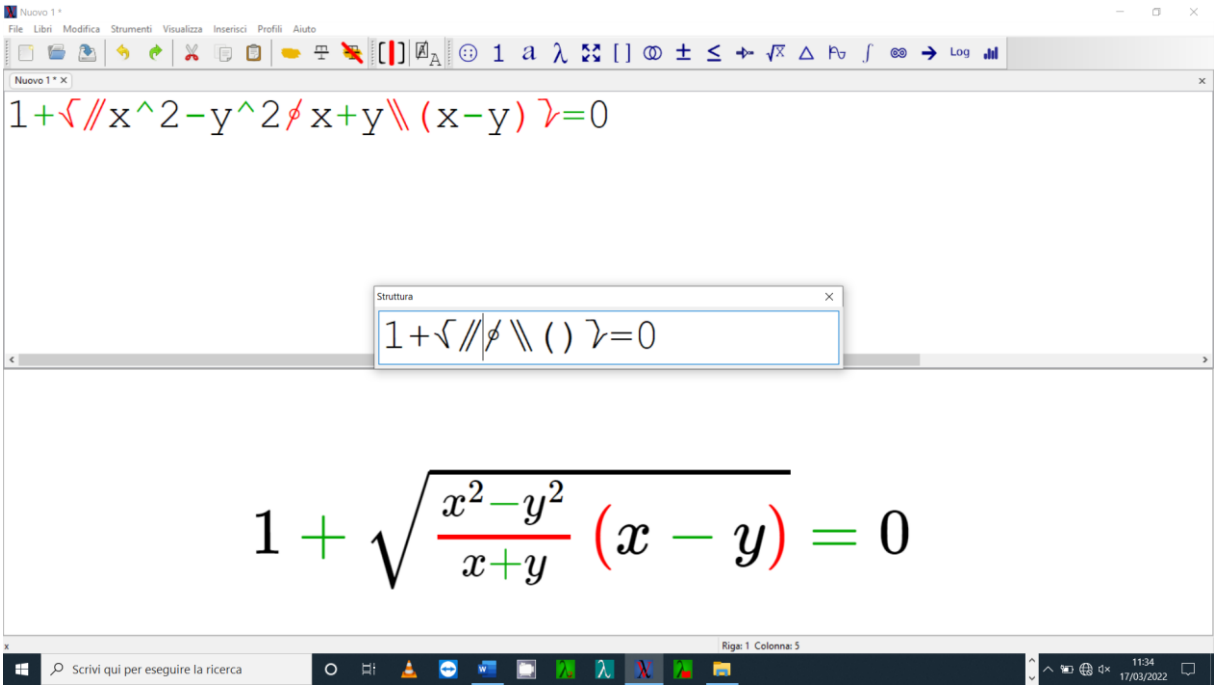
For example, the equation:



$$1+\sqrt{\frac{x^2-y^2}{x+y}}(x-y)=0$$

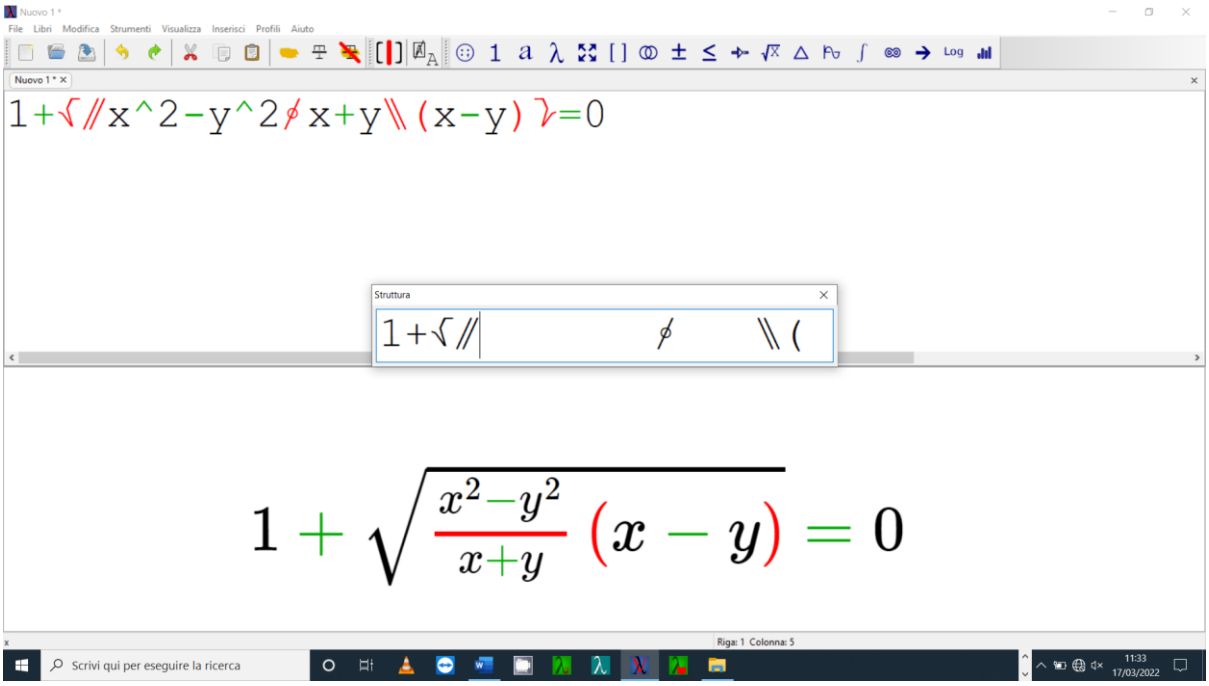
It is evident the loss of information, structure and relationship, that occurs with respect to the graphic representation.

The compressed structure of this formula will be, at the highest level, the following:



$$1+\sqrt{\frac{x^2-y^2}{x+y}}(x-y)=0$$

As you decrease the level, the other blocks become visible:



The initial level of compression depends on the position of the cursor (starting from the innermost complete block that contains it) and can be easily changed with the Pag buttons. next and Pag. back.

11.2 Expanded structure

The "expanded structure" view is similar to the previous one: hidden blocks are not deleted but replaced by spaces. The formula will be less compact but you have useful information about the size of the blocks. (see e.g. above)

Associated commands:

To enter the compressed design view	**F8**
To return to the normal window	**ESC**
To switch to expanded design view (F8 switches alternately from one tree to another)	**F8**
To reduce the display level	**Page back (pag su↑)**
To increase the display level	**Page Next (page down↓)**

12. Graphic display

The linear formula written with the Visual Lambda editor is displayed graphically in a window on the screen (bottom or side depending on the configuration you choose).

12.1 To print the graphics page

Place the mouse on the graphics window, right-click and choose: print. At this point you choose which printer to proceed with. If you choose to print the document directly, you will need to have a printer installed on your PC and click on that.

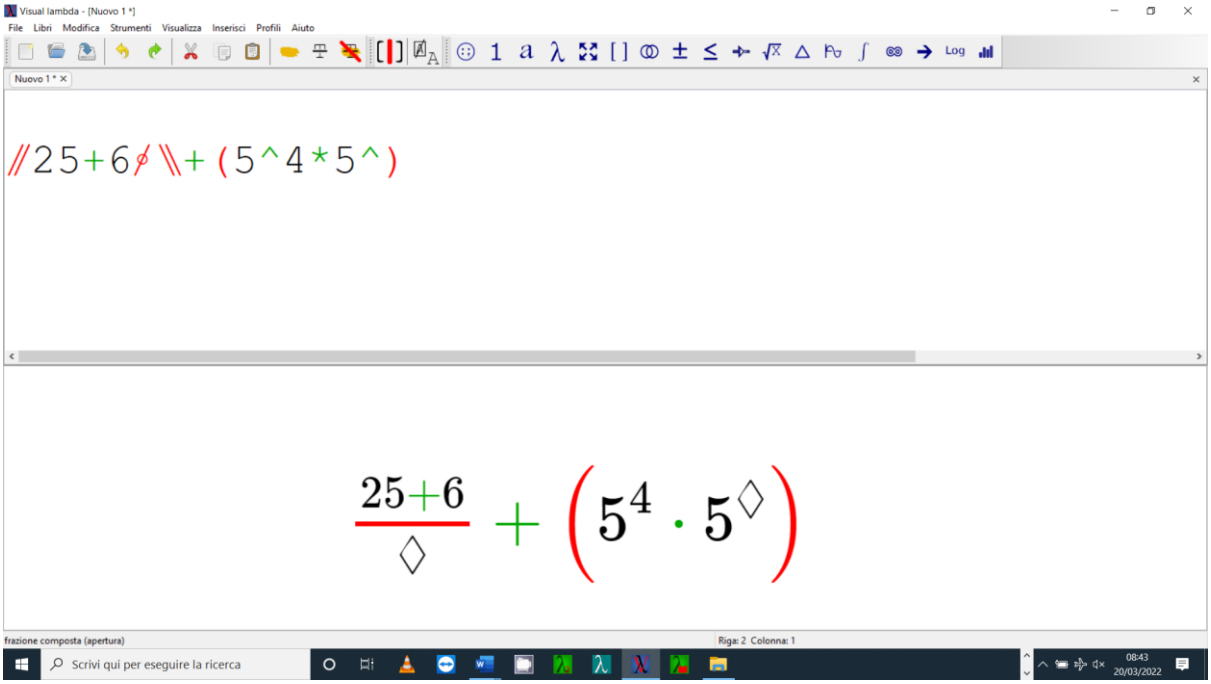
12.2 To save the graphic page in PDF

If you choose to save the file to be able to print it at another time, proceed as above until you choose the printer to use, at this point click on the PDF creation program on your PC.

The most direct way to save a PDF file is to use, always from the graphic window, right mouse button: open in external browser; a window will open in the browser with our graphic page. At this point save the file: right-click on the page, choose print and in the window that appears choose PDF.

12.3 If the formula is incorrect

Display is possible even if the formula is not recognized by Visual Lambda, such as due to compilation errors or forgetfulness. The graphics will appear as an example: the symbols ◊ will replace the missing data.



12.4 Appearance and content

Visual Lambda is a mathematical writing system oriented to the content of the document and its graphic appearance. The transformation into graphical view first passes through the conversion to MathML of content that is then displayed in graphical mode by the browser.

The formula displayed in the graphic retains the characteristics of the writing entered.

13. The calculator

Visual Lambda has a scientific calculator designed so that it can be easily used even with speech synthesis (although not fully accessible).
It can be used in two distinct ways: as a tool linked to the editor or as a stand-alone environment to be used in a separate window.

13.1 Calculator window

In this calculator, expressions are inserted into a text window and then calculated. The writing possibilities are significantly reduced compared to the VISUAL LAMBDA editor and this system should therefore be used mainly for simple calculations, which can be inserted mainly with the normal commands on the keyboard.
In addition to the numbers and the 4 operations (+,-,*,/) the toned brackets and the simple power sign ^.
Other more complex calculations can be performed through the Operations menu: roots, logarithms, trigonometric functions and more.
When you exit the calculator environment and return to the editor, you can copy the result of the last operation you performed anywhere on the page.

13.2 Calculator linked to the editor

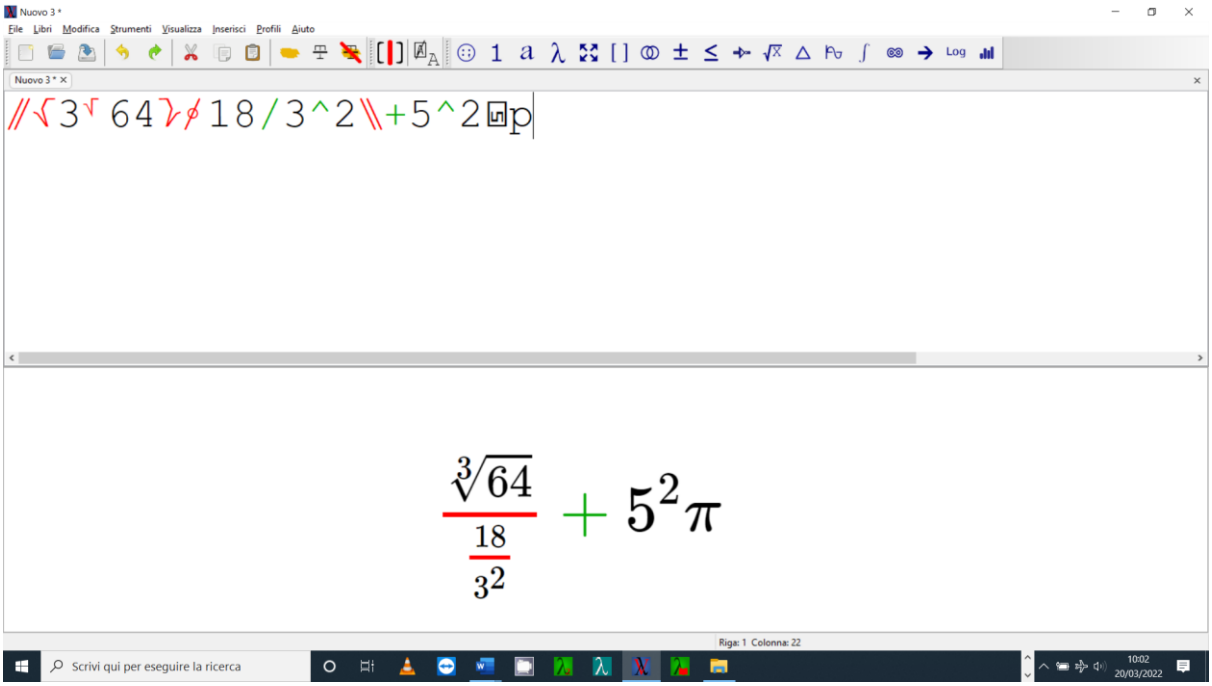
Calculations are performed directly on the editor or by activating the calculator. In order to use the calculator directly in the editor the calculations must be copied and pasted into a blank line, with the cursor at the end of the calculation type F9. Exit with the ESC key, select the calculation again, paste result (CTRL SHIFT F9).
If the magnification makes this phase too laborious, we can open an additional file that we will use for calculations. I move between the two files with (CTRL TAB).
We proceed as follows: copy the calculation or block (CTRL B; CTRL C); I move to the second file (CTRL TAB); paste (CTRL V); calculation (CTRL F9); ESC

exit; I move to the first file (CTRL TAB); paste result (CTRL SHIFT F9). Being still selected the block or the calculation I will replace the selection with the result without wasting time.

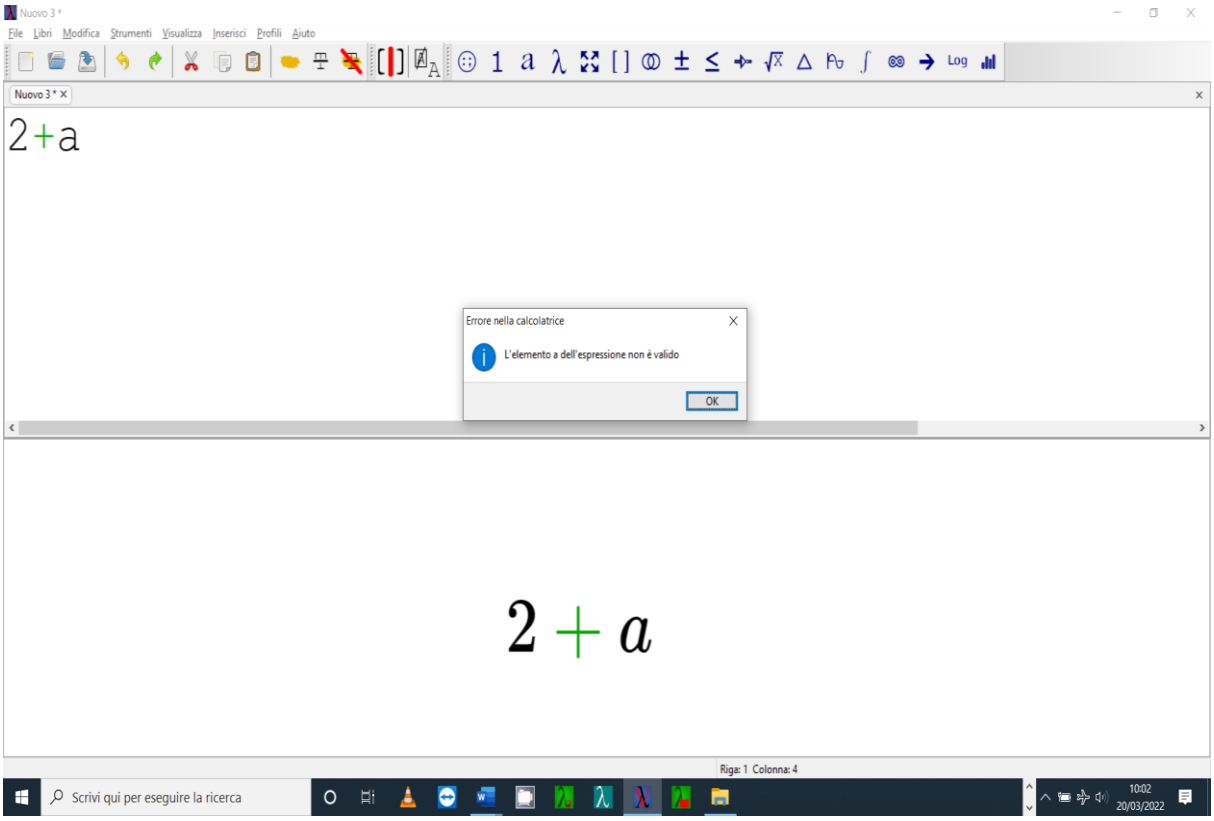
You can keep the result in memory and paste it later into the editor wherever and whenever you want.

The calculator can process any portion of text in a mathematical environment, even with subsequent and nested calculations, as long as the data consists only of numbers or known and defined constants.

Then, expressions such as



But not expressions that contain undefined variables, in this case an error message like this would appear:



To operate the calculator connected to the editor we have these commands (each of them can be activated, as well as with the hotkeys indicated here, with the relative item of the tools menu)

Calculator commands active from the editor (calculator closed)

Open calculator	**F9**
Calculate expression (copied and pasted into a blank line) and displays the expression with result	**CTRL F9**
Paste result (inserts the result of the last calculated expression in the current cursor position)	**CTRL Shift V**
Active calculator commands from the calculator window (calculator open)	
Calculates	**Dispatch**
Close calculator and return to the editor	**ESC or Alt F4**

13.3 Changing calculator settings

The settings are defined only in the calculator window but apply to both modes of use. Also to change the settings of the calculator connected to the editor you have to open the window of the other calculator.

They can be defined:

- the number of decimal places displayed (from 0 to 17);
- the angle measurement system, to be chosen between sexagesimal degrees, radians, gradients.

14. User profiles

The visual lambda editor can be adapted according to the user's needs.

In particular, it is possible to simplify the entry menu of mathematical elements by hiding those that are not used. You can hide an entire group (such as trigonometry) or one or more items by choosing them from those listed in the group.

It may be appropriate to hide even those used very often and that are usually inserted with direct keyboard commands. If their presence in the menus seems useless, it is advisable to remove them to make them more compact and quick to consult.

Each customization is called a profile and will be saved in a special file; the name of the active profile is shown on the status bar (last entry on the right).

In profiles, you can also change the keyboard shortcuts associated with the various mathematical elements.

The profiles can be built for the general needs of a student, i.e. for the type of studies followed and the class attended, but they can also vary according to special, specific or contingent needs. We can, for example, design profiles for set design, logic, trigonometry... in which to make access to the symbols or operators used very frequently more immediate, both through the menus (placing them in the first positions) and the hotkeys (they assign simpler and more compact combinations).

14.1 The prepared profiles

Some user profiles, already prepared, are provided with the program.

Primary: it is a profile suitable for elementary and middle school students; in addition to numbers, letters and basic operators, it contains the elements necessary for elementary algebra (parentheses, fractions, roots, powers), some attributes for characters and numbers and the main symbols of numerical sets.

Biennium: it is a profile suitable for students of the two-year period of secondary schools. The profile is obtained by extending the primary one with the elements of set theory and logic, binomial coefficients, matrices and all the symbols

necessary for these arguments (arrows, Greek characters). There are also some elements of algebra that were not foreseen in the primary profile such as the system of equations, summations and producers.

Three-year / University: it is the most complete profile, suitable for students of the three-year period of high schools and universities. All the mathematical elements of the VISUAL LAMBDA system are present. Compared to the two-year profile there are objects related to trigonometry, analysis, logarithms, with all the symbols necessary for the treatment of these topics.

15. List of LAMBDA editor keyboard shortcuts:

15.1 Standard Windows commands

	Alphanumeric keyboard
Open an existing document	**CTRL OR**
New document	**CTRL N**
Close a document	**CTRL F4**
Copy the selected text to the clipboard	**CTRL C**
Cut selected text on the clipboard	**CTRL X**
Paste the contents of the clipboard	**CTRL V**
Stop an operation	**ESC**
Cancel an operation performed	**CTRL Z**
Restore or repeat an operation	**CTRL Y**
Save	**CTRL S**
Press	**CTRL P**
Select all	**CTRL A**
Close the application (exit Lambda)	**ALT F4**

15.2 View or edit commands

	Alphanumeric keyboard	Numeric keypad
Displays the structure in expanded mode (typing F8 again - or CTRL 8 in the Numeric Keypad - switches to the compressed structure)	**F8**	**Ctrl 8**
Displays the structure in compressed mode (or with twice F8 - or CTRL in the t.n.- you enter expanded mode and immediately switch to the other)	**SHIFT F8**	
Active commands in view mode:		
Switch to the other view	**F8**	**Ctrl 8**
Increase the display level	**Pag. Come in**	
Reduce display level	**Pag. Back**	
Back to normal editor	**Esc**	
Select the block (from a corresponding open to indoor marker)	**CTRL B**	
Active commands with selected lock:		
Duplicate row (copy twice and remove spaces)	**CTRL D**	
Active commands with persistent blocks:		
Clear selected text	**DELETE**	
Active commands in the buffer window:		
Paste buffer displayed and exit	**CTRL V**	
Exit	**ESC**	

15.3 Commands for inserting symbols or markers

General	**Alphanumeric keyboard**	**Numeric keypad**
Opens the box for search and selection	**F5**	
Intermediate marker (inserts the intermediate marker)	**CTRL I**	
Inserts a text section block	**CTRL J**	
Most frequently used		
Compound fraction (opening marker)	**CTRL Q**	
Simple fraction (fraction sign)	**/**	**/**
Division (operator)	**Ctrl 7**	
Complex exponent (opening marker)	**CTRL ^**	
Simple exponent (operator)	**^**	
Yet another compound root (opening marker); - if the intermediate is missing, it is a compound square root	**CTRL SHIFT R**	
Simple square root (operator)	**CTRL R**	
Open round brackets (	**(**	**Ctrl 1**
Open square brackets [	**ALT GR [**	**Ctrl 2**
Open braces {	**ALT GR SHIFT [**	**Ctrl 3**
Equal (=)	**=**	**Ctrl 0**
Double characters		
Algebra / Analysis		
general prefix for Analysis and Algebra (should always be followed by another character)	**CTRL M**	

Natural logarithm	**CTRL M, L**	
Logarithm in generic base if the implied intermediate in base 10 is missing	**CTRL M, SHIFT L**	
Defined integral	**CTRL M, I**	
Integral double	**CTRL M, I I**	
Limit	**CTRL M, T**	
Summation	**CTRL M, S**	
Manufacturer	**CTRL M, P**	
Determining	**CTRL M, D**	
Sets		
general prefix for sets (should always be followed by another character)	**CTRL E**	
Empty set	**CTRL E, 0 (zero)**	
Belongs	**CTRL E, E**	
Intersection	**CTRL E, I**	
Union	**CTRL E, U**	
Logic		
general prefix for logic elements (should always be followed by another character)	**CTRL L**	
And	**CTRL L, A**	
Boolean sum	**CTRL L, B**	
Contradiction	**CTRL L, C**	
False	**CTRL L, F**	
For each	**CTRL L, P**	
Not	**CTRL L, N**	
Or	**CTRL L, OR**	
Tautology	**CTRL L, T**	

Exists	**CTRL L, E**	
True	**CTRL L, V**	
Geometry and trigonometry		
general prefix for geometry and trigonometry (should always be followed by another character)	**CTRL T**	
Angle	**CTRL T, A**	
Degrees	**CTRL T, G**	
Accident	**CTRL T, I**	
Parallel	**CTRL T, P**	
Vector	**CTRL T, V**	
Breast	**CTRL T, S**	
Cosine	**CTRL T, C**	
Tangent	**CTRL T, T**	
Greek letters		
general prefix for Greek letters	**CTRL G**	
Greek letters are obtained by following the CTRL prefix G with the associated Latin letter, uppercase or lowercase.		
Associations are generally easily identifiable; only the least obvious cases are reported here:		
Eta	**CTRL G, h**	
theta	**CTRL G, j**	
Ksi	CTRL G, x	
Khi	CTRL G, q	
psi	CTRL G, y	
omega	CTRL G, w	
Some examples:		
tiny delta	CTRL G, D	

uppercase delta	CTRL G, SHIFT D	
tiny omega	CTRL G, W	
omega capital letters	CTRL G, SHIFT W	

Displays the active array in two-dimensional (table) mode	**F10**
Commands that are active from the two-dimensional view (table)	
Close the two-dimensional view	**ESC or F4**

15.4 Arrays

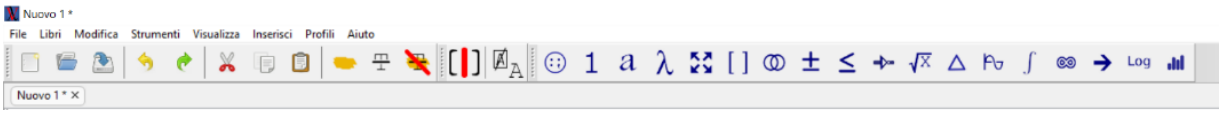
Active commands from the editor

15.5 Text section

Exit the text section (go to the top of the next math section)	CTRL TAB
Inserts mathematical section (or rather: divides the text section)	CTRL J

15.6 Selection with graphic buttons

The program offers the possibility to insert the mathematical elements through a graphic menu with icons (tool bar).



The most common symbols: the command for inserting the intermediate marker and the context change, are present in the toolbar of the elements (central group), with direct access.

The other elements are instead available in the mathematical toolbar (on the right and in blue color) by selecting the group first and then, in the new menu that opens, the chosen symbol.

The meaning of the symbols is quite intuitive. In case of doubt, position the mouse pointer over it; a small window of explanation appears.

The tool bar is fully active only in the mathematical section. In the text section the commands are still active but, when I choose a mathematical symbol, the program automatically opens and closes the mathematical section by inserting the chosen symbol inside.

15.7 Calculator

Calculator commands active from the editor (calculator closed)

Open calculator	**F9**
Calculate expression (copied and pasted into a blank line) and displays the expression with result	**CTRL F9**
Paste result (inserts the result of the last calculated expression in the current cursor position)	**CTRL Shift V**
Active calculator commands from the calculator window (calculator open)	
Calculates	**Dispatch**
Close calculator and return to the editor	**ESC or Alt F4**