

USER MANUAL

WELCOME

Welcome in the multi-environment, dynamic and interactive system of AlNuSet. The user manual describes all the functionalities available in AlNuSet which you will exploit to innovate and improve the teaching and learning of algebra, numerical sets and functions.

In this **user's manual** you will find a detailed description of the three environments composing AlNuSet: The Algebraic Line, The Manipulator and Functions.

This User manual is composed by 5 chapters:

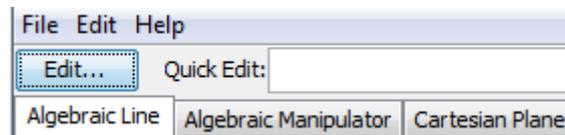
- The main menu of AlNuSet
- Algebraic editors
- Algebraic Line Component
- Algebraic Manipulator Component
- Function Component

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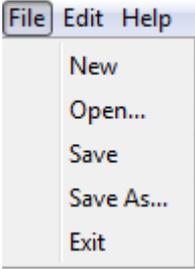
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THE MAIN MENU OF ALNUSET

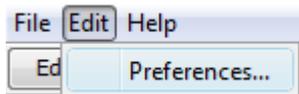


File

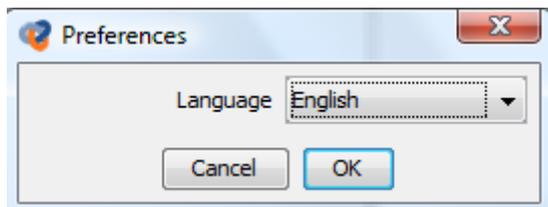
	<p>Use the File menu to:</p> <ul style="list-style-type: none">- Open a saved file- Save a file- Save file in a specific folder- Quit ALNUSET
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Note: file drop opportunity is available.

Edit



The user can select the language of the AlNuSet interface from Edit and the language in the pulldown menu.



ALGEBRAIC EDITORS

Two Algebraic Editors are available in Alnuset:

- Linear Editor
- Two-dimensional Editor

Linear Editor

In this space it is possible to edit expressions in linear form using the keyboard.

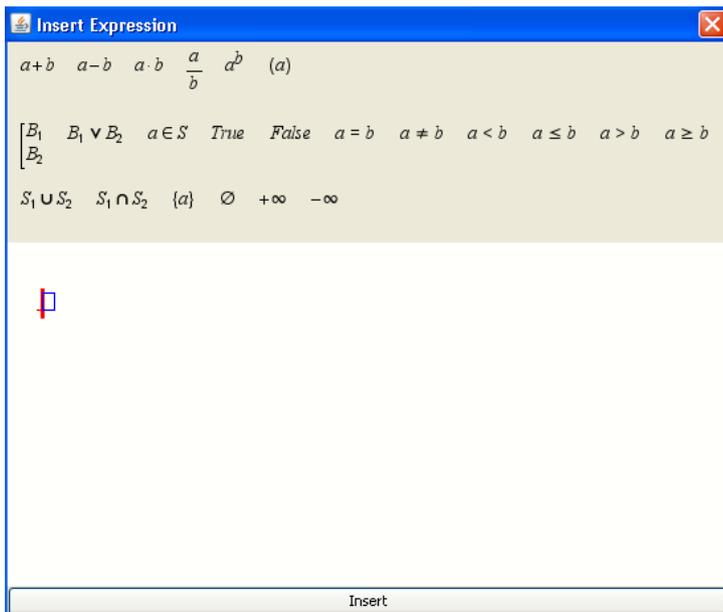
Quick Edit: $((3*x+1)^2)/(x+1)$

Two-dimensional Editor

Press button



To open the Two-dimensional Editor interface.



The interface is composed by:

- the list of commands that are available for the editing;
- the editing space.

How to Edit

Two modalities of editing are available:

1. using commands of the interface
2. using keyboard only.

These two modalities can be used in integrated way.

- Use the mouse to move the cursor on the expression
- It is possible to select a part of the edited expression in order to delete it or to apply on it a command of the interface
- Press the “Insert” button or the key “return” to use the edited expression.

Note that it is possible to construct an empty structure to be filled successively both using the key board and the commands of the interface.

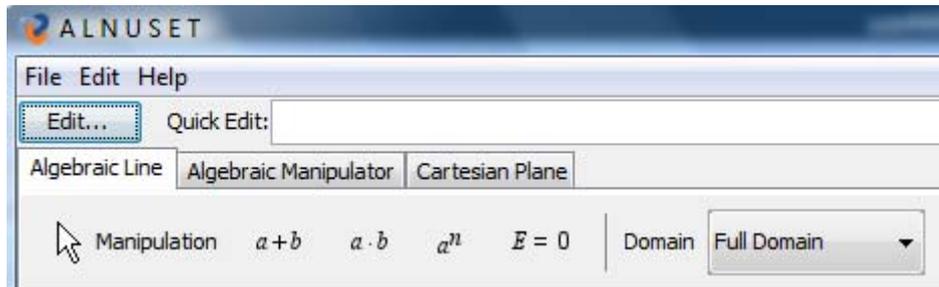
The diagram shows two mathematical expressions. The first is $\square + \square = \square \cdot \square$. The second is $\frac{\square}{\square \cdot \square} = \square \square$. In the second expression, a red vertical line with a small blue square at the top indicates a cursor positioned between the two \square terms on the right-hand side.

The following table reports the combination of the keys available to the user when the red cursor is on the left of the square 

0-9	numerical constants
a-z	Variables
Left Right Home End	move cursor without modifications
Backspace Delete	erase char to the left or right
Esc	clear the expression
+ - * / ^	insert numerical operator
()	Parentheses
[], {}	Subsets
T F	boolean constants

U I	union, intersection of sets
&	boolean and, or
0	empty set
M P	negative, positive infinity
> < = !	equations, comparisons
#	in set operator

ALGEBRAIC LINE COMPONENT



Main Menu of the Algebraic Line Component

General characteristics of Algebraic Line

Domain

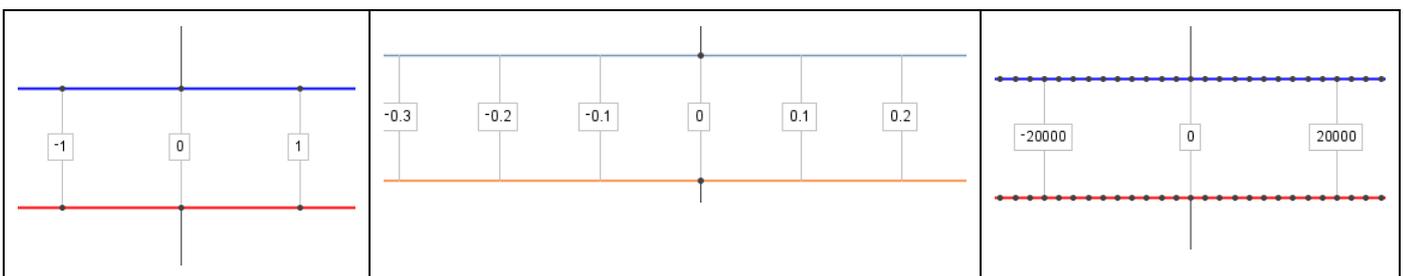
Use the Domain menu to choose the numerical set you want to operate on.

	<p>The choice of the numerical set modifies data display. For example, if the domain of natural integers is selected, only positive numbers are displayed on the algebraic line.</p> <p>Note: Full Range domain is the extension of Rational Numbers to rational powers</p>
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Zoom

Two different ways to modify the unit measure on the lines are available:

- drag any point corresponding to any integer number either on the blue or on the red line;
- use the mouse wheel.

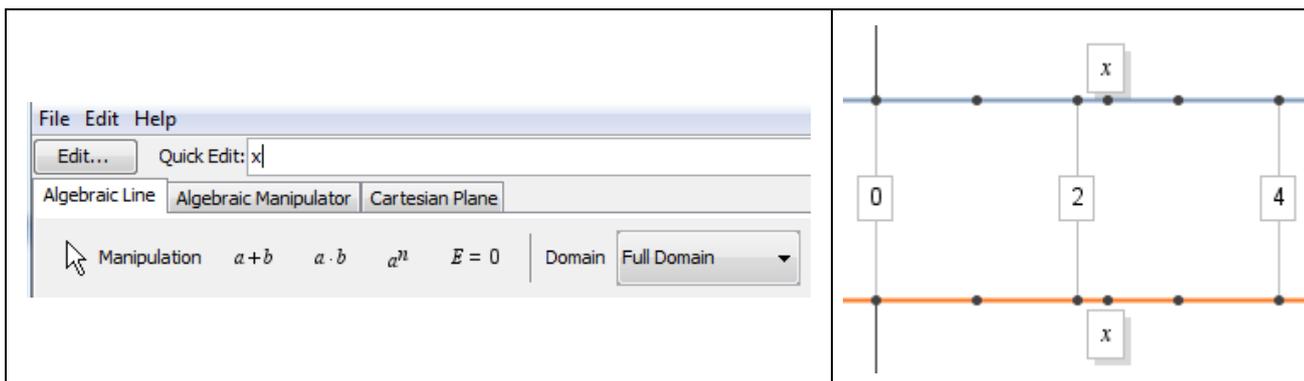


Scroll

Click and hold down the right mouse button to scroll the algebraic line either on the left or on the right along the screen.

Insertion of a mobile point on the line corresponding to an algebraic variable

Edit a letter in the Linear Editor or in the Two-dimensional Editor to insert a mobile point corresponding to a variable on the algebraic line.



Drag mobile points corresponding to algebraic variables

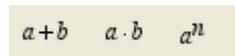
Mobile points can be dragged on the Algebraic Line in accordance with restraints imposed by the chosen numerical domain. By dragging a mobile point corresponding to a variable, all the expressions involving that variable move accordingly.

Geometrical editor

Three geometrical models are available to construct algebraic operations on the line: addition (subtraction), multiplication (division), integer power (rational power).

These algebraic models are based on the Thales theorem and on the parallelogram theorem. For this reason, in the Algebraic Line component there are two lines - a red line and a blu line.

The following three models are displayed clicking on the following icons:



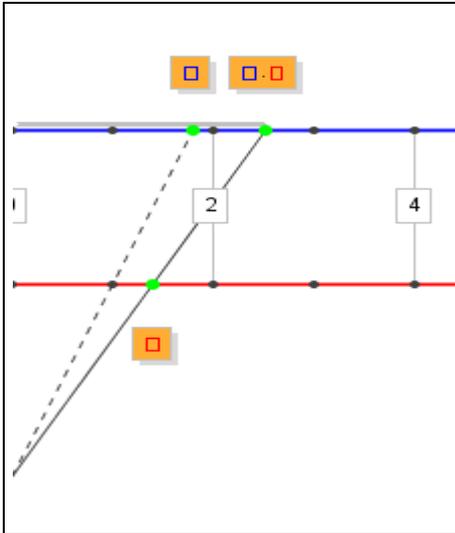
Addition/Subtraction $a + b$

	<p>To pass from addition to subtraction and vice-versa, click on the label $\square + \square$ or $\square - \square$ (or on their corresponding green points).</p>	
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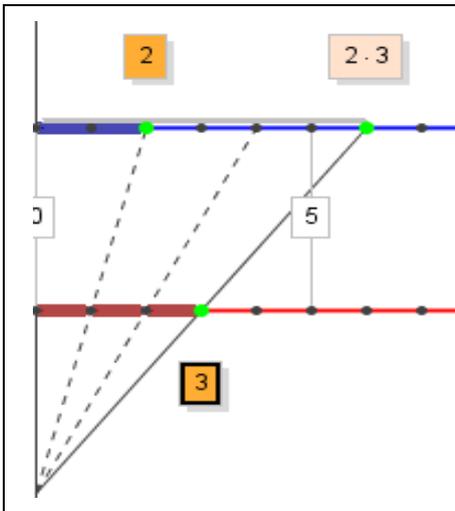
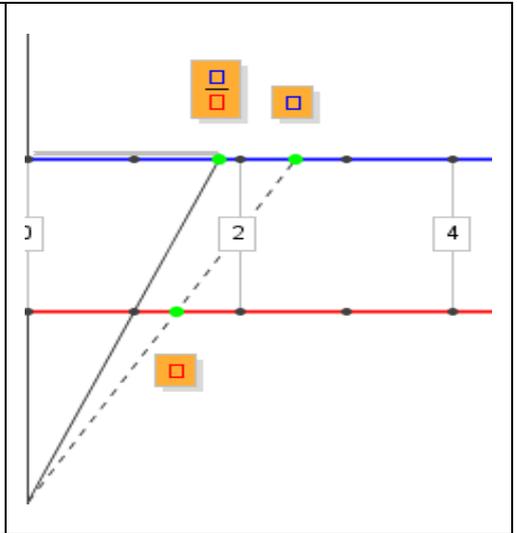
	<p>To instantiate the chosen operation, drag the two green points corresponding to the label \square and the label \square onto the two points of the line the values of which you want to</p>	
--	--	--

	add or subtract. Click on the label of the result to accept it.	
--	--	--

Multiplication/Division $a \cdot b$

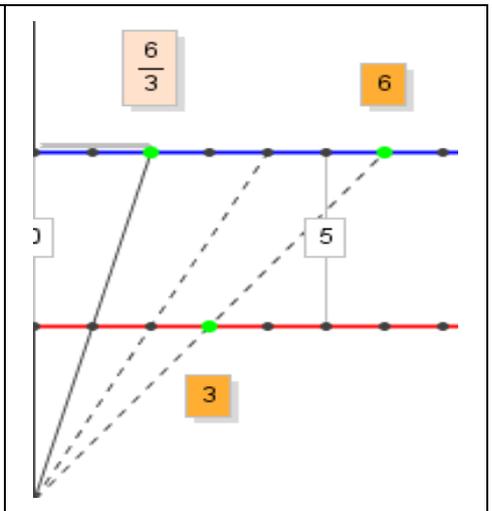


To pass from multiplication to division and vice-versa, click on the label \cdot or the label \div (or on their corresponding green points)

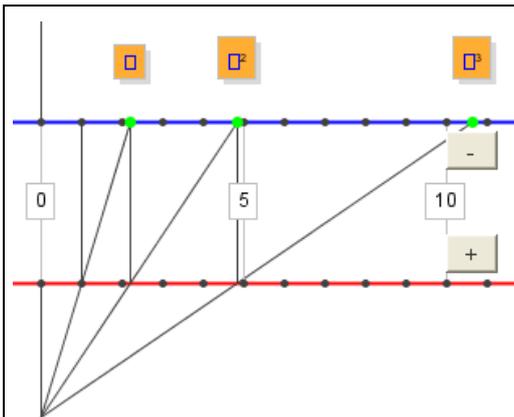


To instantiate the chosen operation, drag the two green points corresponding to the label \cdot and the label \div onto the two points of the line the corresponding variable of which you want to multiply or divide.

Click on the label of the result to accept it.

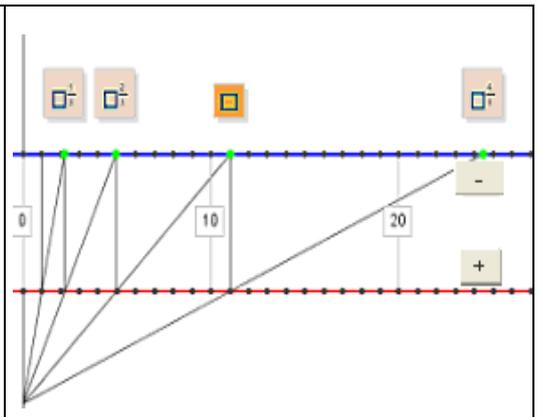


Integer Power/Rational Power a^n



Use the button $+$ or the button $-$ to increase or decrease the grade of the integer power.

to pass from integer power to rational power and vice-versa, click on the first label



	or any other labels (or on the corresponding points).	
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	<p>To instantiate the chosen operation, drag the green point corresponding to the label  onto the point of the line of which you want to compute the rational or integer power of the corresponding value.</p> <p>Click on the label of the result to accept it .</p>	
--	--	--

Visualize the constructed expressions

The expressions constructed on the Algebraic Line will be displayed also in the *Expressions* specific space

Clicking the right mouse button onto an expression (both on the line and on the Expressions space) different visualization functions are made available for that expression:

- Hide
- Start Tracking
- Show Construction
- Delete
- Insert in Manipulator
- Toggle Variable Display ▶

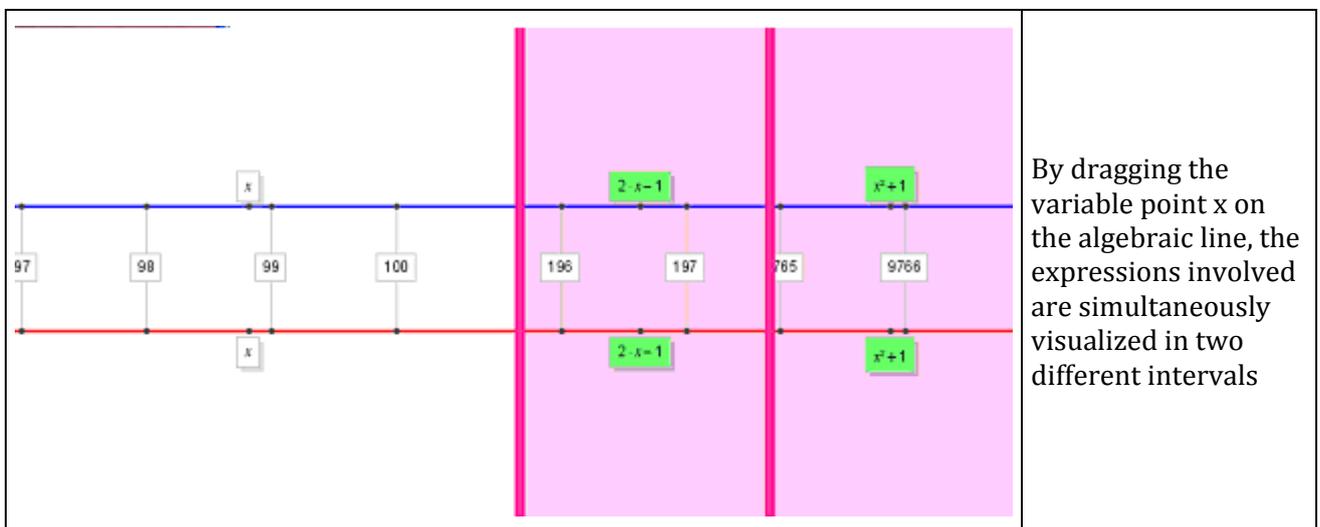
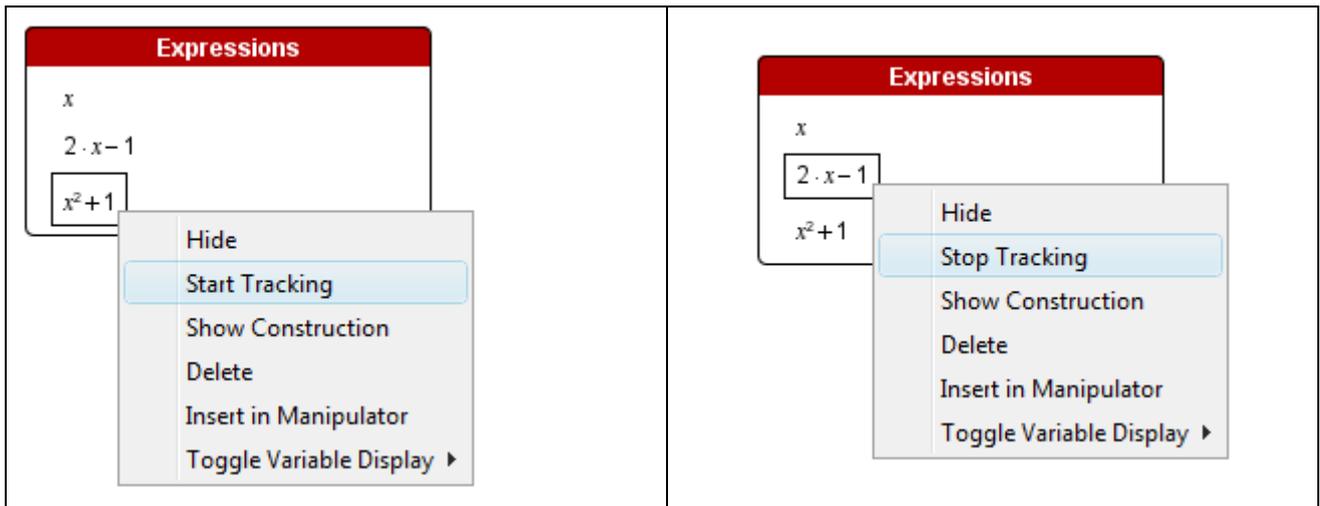
These functions will be described successively

Hide/Show

This function makes it possible to show or hide the point and the label corresponding to an expression on the Algebraic Line. The function Hide allows the user to maintain the expression into the *Expressions* window. To visualize again the point and the label on the line, the user has to click on the expression, with the right button of the mouse down, in the Expressions window and select the Show function.

Start/Stop Tracking

Use the Show Tracking function to maintain the visual control of the value assumed by an expression even if its corresponding point is displayed out of the screen. The expressions on which the Tracking function is applied (two at the most) are highlighted in green.



By dragging the variable point x on the algebraic line, the expressions involved are simultaneously visualized in two different intervals

Show/Hide construction

This function makes it possible to show or hide (default: hide) the geometrical construction of a point.

Delete

This function allows the user to delete the object constructed in this environment.

Send to manipulator

This function allows the user to send the selected expression to the Manipulator component.

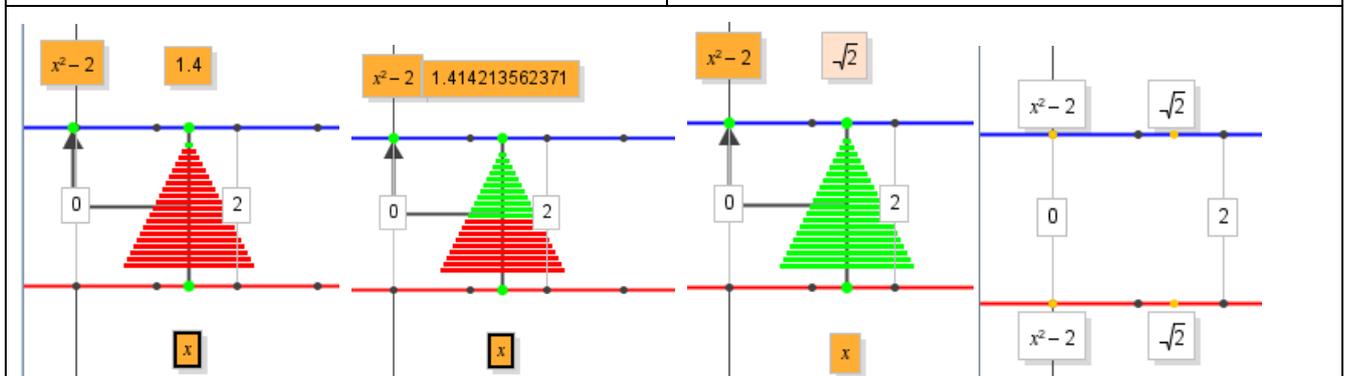
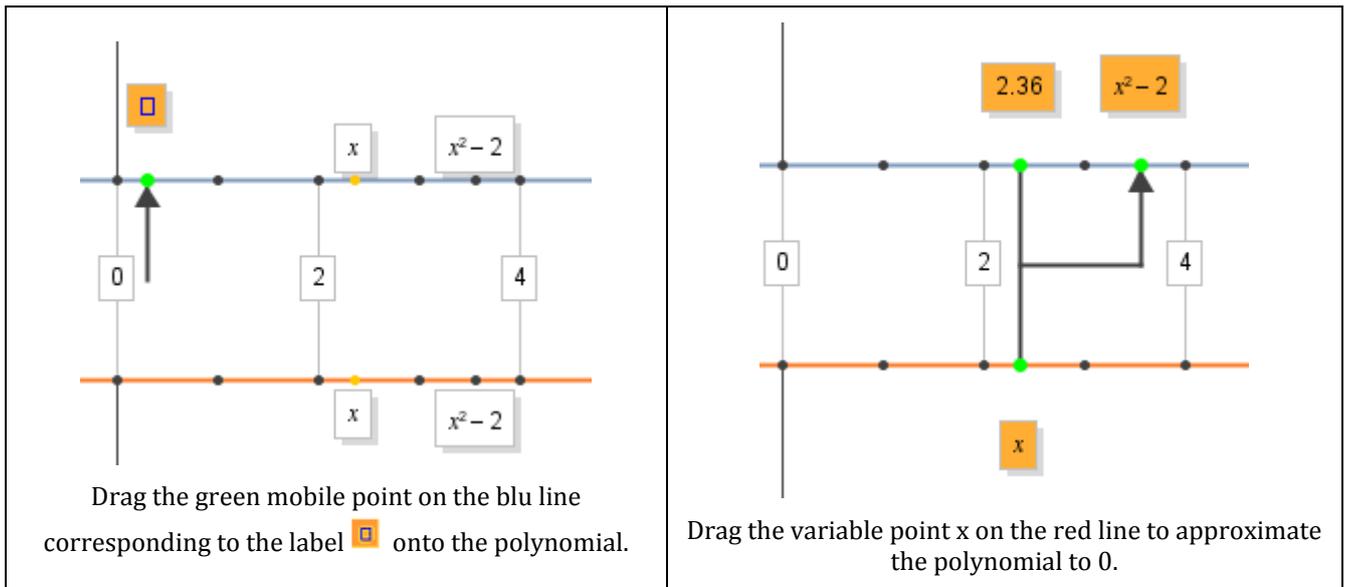
Show/Hide Graph

This function allows the user to represent the graph of the selected expression in the Cartesian Plane. This function requires to define the independent variable.

Polynomial Roots

The following command allows the user to find real roots of a polynomial with integer coefficients.

$$E = 0$$



A graphic animation (red triangle vs green triangle) indicates the automatic computation process performed by the system to determine numerical value of the root (each green bar corresponds to a decimal digits calculated by the system).

Note that:

- the polynomial root is presented as label associated to the x point on the blue line;
- click on the label to accept the result .

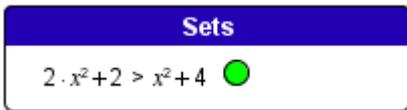
Once the result has been accepted the polynomial root is reported in the *Roots* window under the corresponding polynomial.

Roots
Roots of $Z^2 - 2$
$\sqrt{2} = 1.4142135623730951$
$-\sqrt{2} = -1.4142135623730951$

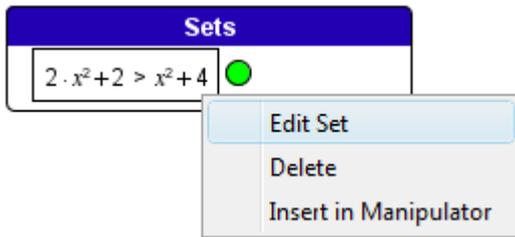
Truth set of algebraic proposition

The Algebraic Line component provides different opportunities to explore and define the truth set of algebraic propositions, i.e. the truth set of equations, inequalities or systems of inequalities/equations.

Editing a proposition in Algebraic Line component, it is automatically visualized into the *Sets* window.



To define the truth set of the algebraic proposition, the user has to click, with the right button of the mouse down, on that proposition and select the function *Edit Set*.



	<p>To define the truth set of the proposition, the user has to drag the variable on the point, already constructed on the line, which is root of the associated polynomial.</p>
	<p>In the case of inequalities, to define intervals composing the truth set of the proposition, the user has to select the parts of the red strip where the proposition is true. This definition is completely controlled by the mouse and it is displayed in green.</p>
<p>Click once on the button  to select the corresponding point and to include it in the truth set (a green point appears on the line), or twice to select the point without including it in the truth set (a red point appears on the line).</p>	

These actions (selection of points or intervals) are automatically translated into formal language by the system and visualized on the *Sets* window near the corresponding proposition.

Sets

$2 \cdot x^2 + 2 > x^2 + 4$ $x \in]-\infty, -\sqrt{2}[\cup]\sqrt{2}, +\infty[$

To close the function *Edit Set*, the user has to select the button  in the Menu bar.

The propositions and the truth sets contained in the *Sets* window are associated to a red or green marker.

With respect to the color of the markers associated to the propositions or to the truth sets, the system offers the following feedback.

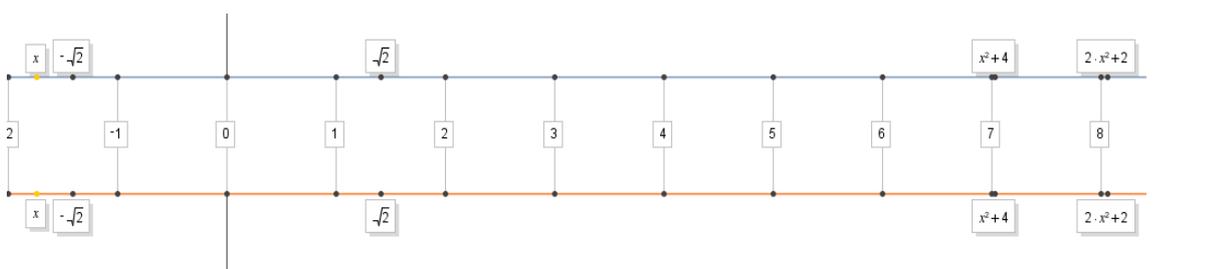
When the point corresponding to the variable is dragged onto the points where the proposition is true, the marker associated to that proposition becomes green. On the contrary, when the variable is dragged on points where proposition is false, the associated marker become red.

The marker associated to the set solution becomes green when the point corresponding to the variable is dragged on points that are contained in the edited set. It becomes red when the point corresponding to the variable is dragged on points which are not contained in the edited set.

The concordance of the color between the two markers when the variable point is dragged along the line, allows the user to evaluate the truth set constructed.

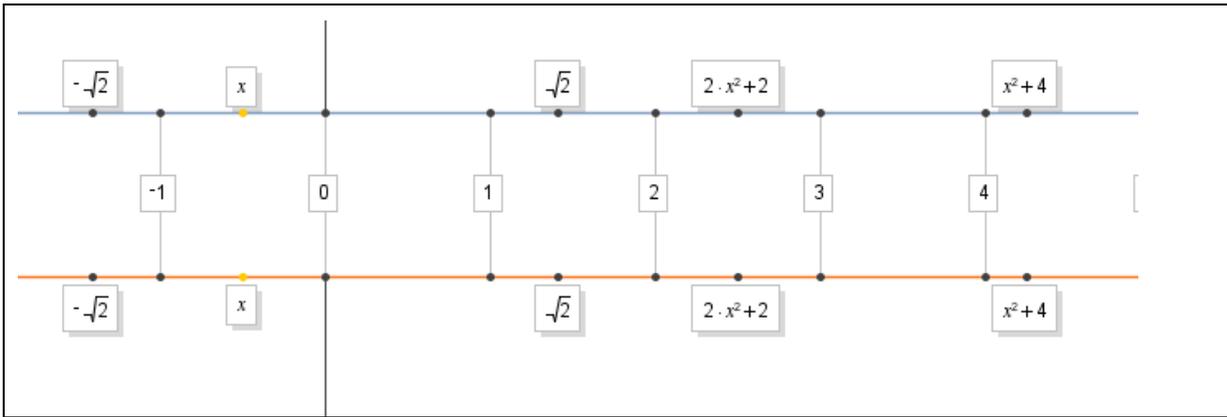
Sets

$2 \cdot x^2 + 2 > x^2 + 4$ ● $x \in]-\infty, -\sqrt{2}[\cup]\sqrt{2}, +\infty[$ ●

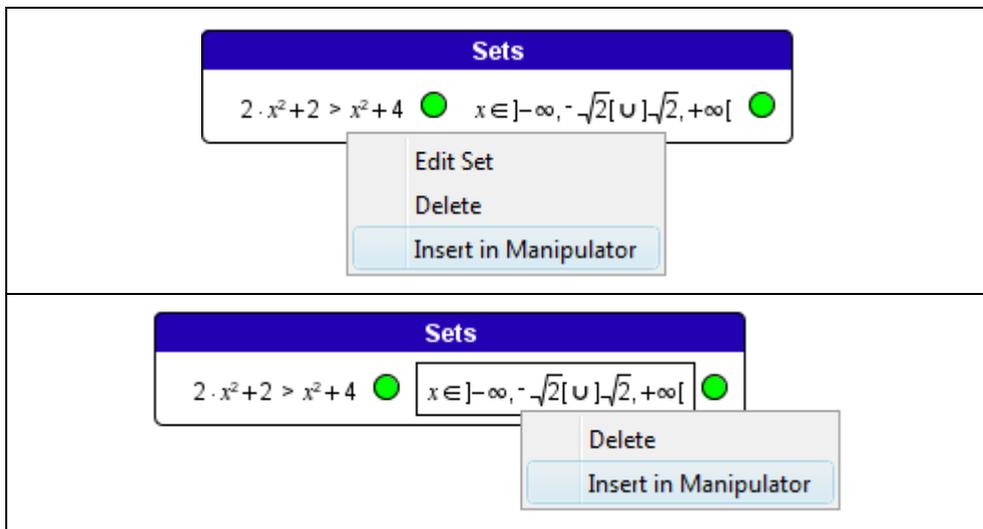


Sets

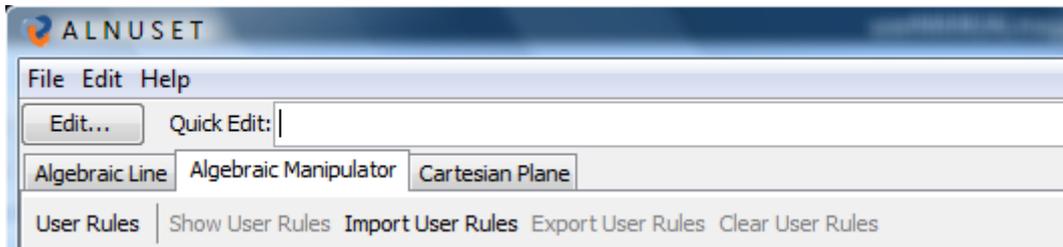
$2 \cdot x^2 + 2 > x^2 + 4$ ● $x \in]-\infty, -\sqrt{2}[\cup]\sqrt{2}, +\infty[$ ●



Clicking with the right mouse button down, on the proposition or on the set solution, it is possible to send the proposition or the set solution to the Algebraic Manipulator component.



ALGEBRAIC MANIPLULATOR COMPONENT



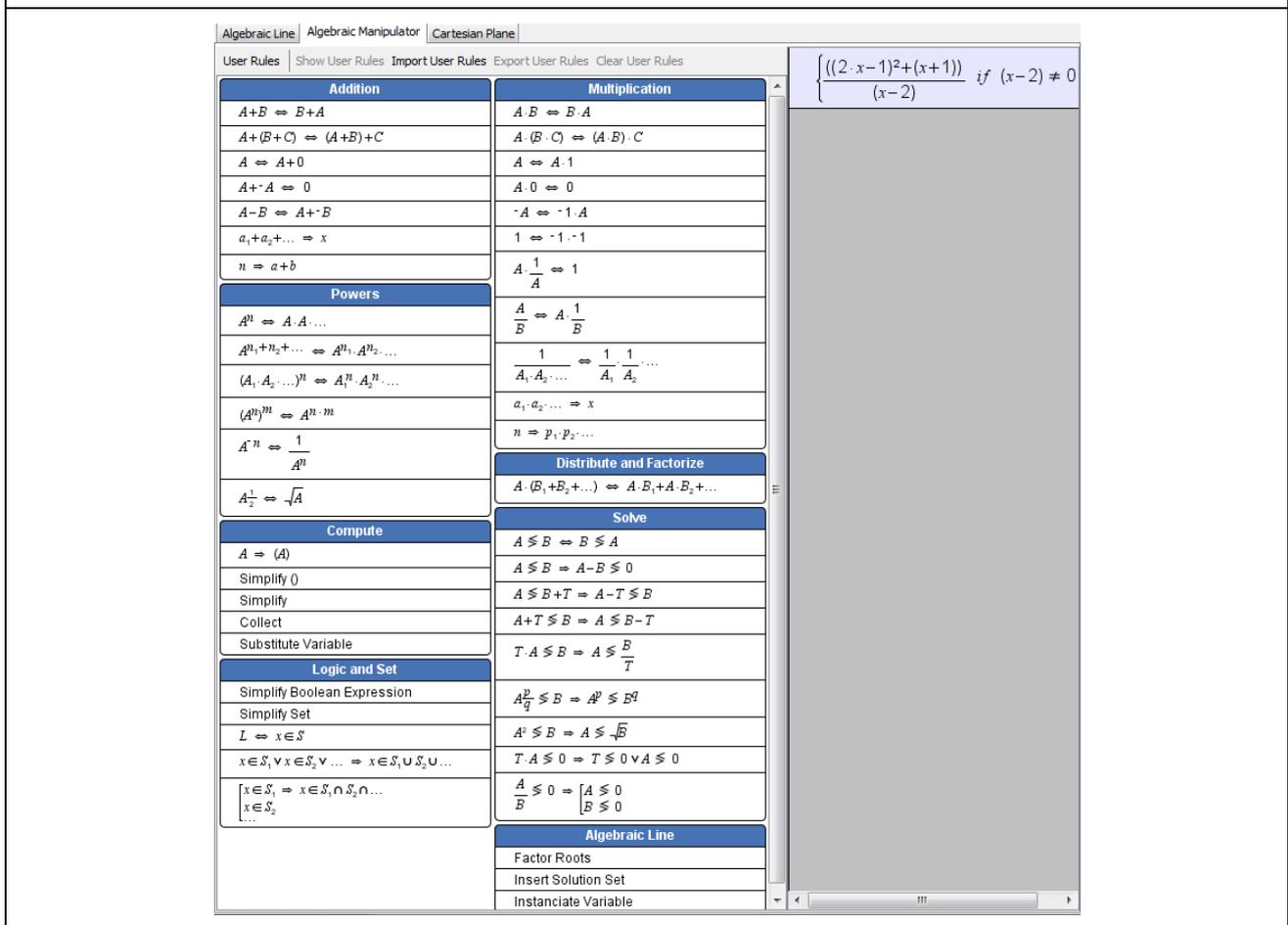
Main Menu bar of the Algebraic Manipulator component

General characteristics of Algebraic Manipulator

The interface makes available two kinds of commands:

- Basic commands for manipulation of algebraic expressions (see the following figure)
- Commands constructed by the user (see User Rules commands)

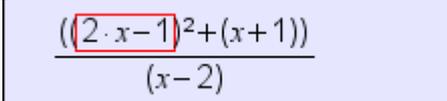
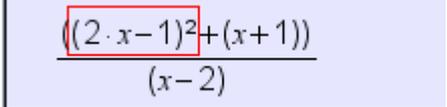
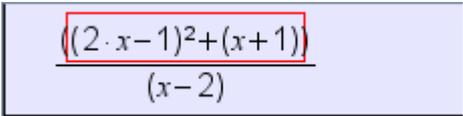
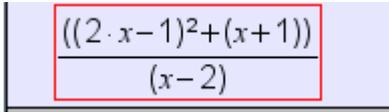
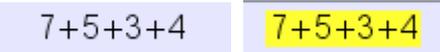
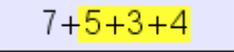
The figure below illustrates the interface of Algebraic Manipulator component containing an algebraic expression



Interaction

Selection of a part of expression

Operators, brackets and literal or numerical elements define the parts of the expression and their hierarchical organization. When the mouse pointer is positioned over any part of the expression, the system dynamically displays all the elements in the hierarchical structure of that part of expression. Hierarchical selection of a part of the expression corresponds to what mouse is pointing and the part of the expression selected is highlighted in yellow.

 <p>mouse points to the operator “-” of $2x-1$</p>	 <p>mouse points to the brackets of the following part of the expression $(2x-1)^2$</p>
 <p>mouse points to the operator “+” of $(2x-1)^2 + (x+1)$</p>	 <p>mouse points to the line fraction of the expression</p>
<p>If operators have the same hierarchical level, for instance the operator “+” in the following expression: $7+5+3+4$, the click of the mouse on the expression allows the user to select the whole expression</p> <p style="text-align: center;">  </p> <p>the selection of a part of the expression, for instance $5+3+4$, is performed by dragging the mouse, with the left button down, from the first to the last element of that part of the expression you want to select</p> <p style="text-align: center;">  </p>	

Commands for manipulation

In the following table the description and the action of each command for the algebraic manipulation is listed. Note that the list makes reference to the full range domain.

In other numerical domains, the list refers to the algebraic rules available in that domain.

Legend:

A, B, C, ...= structural elements of an algebraic expression;

a, b, c, ...= integer positive numbers.

<i>COMMANDS</i>	<i>DESCRIPTION</i>
ADDITION	
$A+B \Leftrightarrow B+A$	Commutative property of addition.
$A+(B+C) \Leftrightarrow (A+B)+C$	Associative property of the addition.

$A \Leftrightarrow A+0$	Neutral element of the addition.
$A+-A \Leftrightarrow 0$	Sum of two opposite elements.
$A-B \Leftrightarrow A+-B$	Relation between binary minus and unary minus.
$a_1 + a_2 + \dots \Rightarrow x$	Addition of positive integer numbers.
$n \Rightarrow a+b$	Decomposition of a positive integer number into an addition of two positive integer numbers. Note that input for “a” is requested
MULTIPLICATION	
$A*B \Leftrightarrow B*A$	Commutative property of multiplication.
$A*(B*C) \Leftrightarrow (A*B)*C$	Associative property of multiplication.
$A \Leftrightarrow A*1$	Neutral element of multiplication.
$A*0 \Leftrightarrow 0$	Zero-product property Note that selecting 0, input for A is requested
$-A \Leftrightarrow -1*A$	Relation between an expression and its opposite.
$1 \Leftrightarrow -1 * -1$	Rule of signs for multiplication
$A \cdot \frac{1}{A} \Leftrightarrow 1$	Product of two reciprocal expressions. Note that selecting 1, input for A is requested
$\frac{A}{B} \Leftrightarrow A \cdot \frac{1}{B}$	Fundamental property of fraction.
$\frac{1}{A_1 \cdot A_2 \cdot \dots} \Leftrightarrow \frac{1}{A_1} \cdot \frac{1}{A_2} \cdot \dots$	Multiplication of fractions with unitary numerator.
$a_1 * a_2 * \dots \Rightarrow x$	Multiplication of positive integer numbers

$n \Rightarrow p_1 * p_2 * \dots$	Factorization of an integer positive number in its prime factors.
DISTRIBUTE/FACTOR	
$A * (B_1 + B_2 + \dots) \Leftrightarrow A * B_1 + A * B_2 \dots$	Distributive property of multiplication over addition
POWERS	
$A^n \Leftrightarrow A * A * \dots$	Transform the integer power “n” of an expression into n products of its base, and vice-versa. If the rule is applied on an A, the output is A ¹ and vice-versa.
$A^{n_1 + n_2 + \dots} \Leftrightarrow A^{n_1} * A^{n_2} * \dots$	Rule of transformation involving product of powers with the same base
$(A_1 * A_2 * \dots)^n \Leftrightarrow A_1^n * A_2^n * \dots$	Rule of transformation involving the product of powers with the same exponent.
$(A^n)^m \Leftrightarrow A^{n*m}$	Rule of transformation of power of power
$A^{-n} \Leftrightarrow \frac{1}{A^n}$	Rule to transform a power with negative exponential
$A^{\frac{1}{n}} \Leftrightarrow \sqrt[n]{A}$	Passage from the exponential notation to root notation
COMPUTATION	
$A \Rightarrow (A)$	Insertion of the selected expression A into brackets
Simplify ()	Remove redundant brackets from the selected expression.

Simplify	Compute the result (integer or rational) of a numerical expression; Perform the selected polynomial computation and simplify the result.
Collect	Order the selected polynomial according to the variable assigned as input.
Substitute Variable	Eliminate a variable within a system assigning it the value present into the system.

SOLVING

<p>Legend:</p> <p>$\frac{>}{<}$: indicates any operator of comparison between two algebraic expressions.</p> <p>$A \frac{>}{<} B$: indicates a proposition (equation, inequation, inequality);</p>	
$A \lesseqgtr B \Leftrightarrow B \lesseqgtr A$	Transform a proposition into its symmetrical.
$A \lesseqgtr B \Rightarrow A - B \lesseqgtr 0$	Transform the comparison between two expressions into a comparison between their difference and zero
$A \lesseqgtr B + T \Rightarrow A - T \lesseqgtr B$	Move a structural element from the right side to the left side of the proposition
$A + T \lesseqgtr B \Rightarrow A \lesseqgtr B - T$	Move a structural element from the left side to the right side of the proposition
$T \cdot A \lesseqgtr B \Rightarrow A \lesseqgtr \frac{B}{T}$	Fundamental solving rule for any proposition
$A^{\frac{p}{q}} \lesseqgtr B \Rightarrow A^p \lesseqgtr B^q$	Solving rule for any irrational proposition
$A^2 \lesseqgtr B \Rightarrow A \lesseqgtr \sqrt{B}$	Solving rule for a pure second degree proposition
$T \cdot A \lesseqgtr 0 \Rightarrow T \lesseqgtr 0 \vee A \lesseqgtr 0$	Solving rule for propositions where the product of

	two factors is compared to zero
$\frac{A}{B} \leq 0 \Rightarrow \begin{cases} A \leq 0 \\ B \leq 0 \end{cases}$	Solving rule for propositions where the division of two expressions is compared with zero
LOGIC AND SET	
Simplify Boolean expression	
Simplify set	
$L \Leftrightarrow x \in S$	Transform a solution expressed in propositional form into a set form
$x \in S_1 \vee x \in S_2 \vee \dots \Rightarrow x \in S_1 \cup x \in S_2 \cup \dots$	Transform the logic “or” among two or more sets into their union
$\left. \begin{array}{l} x \in S_1 \Rightarrow x \in S_1 \cap x \in S_2 \cap \dots \\ x \in S_2 \\ \dots \end{array} \right\}$	Transform the logic “and” among two or more sets into their intersection
ALGEBRAIC LINE	
Factor roots	Factorize the selected polynomial (available only if the roots of the selected polynomial are previously found in Algebraic Line component)
Insert solution set	Insert the truth set of the selected proposition previously edited in the Algebraic Line (available only if the truth set is correct)
Instantiate variable	Assign the value assumed on the Algebraic Line to the selected variable

Application of the rule

The part of the expression selected for the manipulation comes under the system control. When a part of the symbolic representation is selected for manipulation, only commands that can be applied to that part are available.

The figure below illustrates the manipulation of an expression. Note that, in accordance with the current selection, only some commands are made available.

The screenshot shows a software interface with a menu of algebraic rules and a list of expressions. The rules are organized into several categories:

- Addition:**
 - $A+B \Leftrightarrow B+A$
 - $A+(B+C) \Leftrightarrow (A+B)+C$
 - $A \Leftrightarrow A+0$
 - $A+(-A) \Leftrightarrow 0$
 - $A-B \Leftrightarrow A+(-B)$
 - $a_1+a_2+\dots \Rightarrow x$
 - $n \Rightarrow a+b$
- Powers:**
 - $A^n \Leftrightarrow A \cdot A \dots$
 - $A^{n_1+n_2+\dots} \Leftrightarrow A^{n_1} \cdot A^{n_2} \dots$
 - $(A_1 \cdot A_2 \dots)^n \Leftrightarrow A_1^n \cdot A_2^n \dots$
 - $(A^n)^m \Leftrightarrow A^{n \cdot m}$
 - $A^{-n} \Leftrightarrow \frac{1}{A^n}$
 - $A^{\frac{1}{2}} \Leftrightarrow \sqrt{A}$
- Compute:**
 - $A \Rightarrow (A)$
 - Simplify ()
 - Simplify
 - Collect
 - Substitute Variable
- Logic and Set:**
 - Simplify Boolean Expression
 - Simplify Set
 - $L \Leftrightarrow x \in S$
 - $x \in S_1 \vee x \in S_2 \vee \dots \Rightarrow x \in S_1 \cup S_2 \cup \dots$
 - $\begin{cases} x \in S_1 \\ x \in S_2 \\ \dots \end{cases} \Rightarrow x \in S_1 \cap S_2 \cap \dots$
- Multiplication:**
 - $A \cdot B \Leftrightarrow B \cdot A$
 - $A \cdot (B \cdot C) \Leftrightarrow (A \cdot B) \cdot C$
 - $A \Leftrightarrow A \cdot 1$
 - $A \cdot 0 \Leftrightarrow 0$
 - $-A \Leftrightarrow -1 \cdot A$
 - $1 \Leftrightarrow -1 \cdot -1$
 - $A \cdot \frac{1}{A} \Leftrightarrow 1$
 - $\frac{A}{B} \Leftrightarrow A \cdot \frac{1}{B}$
 - $\frac{1}{A_1 \cdot A_2 \dots} \Leftrightarrow \frac{1}{A_1} \cdot \frac{1}{A_2} \dots$
 - $a_1 \cdot a_2 \dots \Rightarrow x$
 - $n \Rightarrow p_1 \cdot p_2 \dots$
- Distribute and Factorize:**
 - $A \cdot (B_1+B_2+\dots) \Leftrightarrow A \cdot B_1+A \cdot B_2+\dots$
- Solve:**
 - $A \leq B \Leftrightarrow B \geq A$
 - $A \leq B \Leftrightarrow A-B \leq 0$
 - $A \leq B+T \Leftrightarrow A-T \leq B$
 - $A+T \leq B \Leftrightarrow A \leq B-T$
 - $T \cdot A \leq B \Leftrightarrow A \leq \frac{B}{T}$
 - $A^{\frac{p}{q}} \leq B \Leftrightarrow A^p \leq B^q$
 - $A^2 \leq B \Leftrightarrow A \leq \sqrt{B}$
 - $T \cdot A \leq 0 \Leftrightarrow T \leq 0 \vee A \leq 0$
 - $\frac{A}{B} \leq 0 \Leftrightarrow \begin{cases} A \leq 0 \\ B \geq 0 \end{cases}$
- Algebraic Line:**
 - Factor Roots
 - Insert Solution Set
 - Instantiate Variable

On the right side, a list of expressions is shown, with the last one, $(x+1) \cdot (x+1)$, highlighted in blue. The expressions above it are: $x^2+2 \cdot x+1$, $x \cdot x+2 \cdot x+1$, $x \cdot x+(1+1) \cdot x+1$, $x \cdot x+x \cdot (1+1)+1$, $x \cdot x+x \cdot 1+x \cdot 1+1$, $x \cdot (x+1)+x \cdot 1+1$, $x \cdot (x+1)+x \cdot 1+1$, $x \cdot (x+1)+(x+1) \cdot 1$, and $x \cdot (x+1)+1 \cdot (x+1)$.

Clicking with the right mouse button down on an expression, different functions are available for that expression:

The context menu shows the following options:

- Duplicate
- Delete
- Insert User Rule
- Insert in Algebraic Line

These functions are described in the following.

Duplicate

This function allows to insert the selected expression at the end of the list of manipulations.

$x^2+2 \cdot x+1$	<div style="border: 1px solid gray; padding: 5px;"> Duplicate Delete Insert User Rule Insert in Algebraic Line </div>	$x^2+2 \cdot x+1$
$x \cdot x+2 \cdot x+1$		$x \cdot x+2 \cdot x+1$
$x \cdot x+(1+1) \cdot x+1$		$x \cdot x+(1+1) \cdot x+1$
$x \cdot x+1 \cdot x+1 \cdot x+1$		$x \cdot x+1 \cdot x+1 \cdot x+1$
$(x+1) \cdot x+1 \cdot x+1$		$(x+1) \cdot x+1 \cdot x+1$
$(x+1) \cdot x+1 \cdot x+1 \cdot 1$		$(x+1) \cdot x+1 \cdot x+1 \cdot 1$
$(x+1) \cdot x+1 \cdot (x+1)$		$(x+1) \cdot x+1 \cdot (x+1)$
$(x+1) \cdot x+(x+1) \cdot 1$		$(x+1) \cdot x+(x+1) \cdot 1$
$(x+1) \cdot (x+1)$		$(x+1) \cdot (x+1)$
$(x+1)^2$		
		$x^2+2 \cdot x+1$

Delete

This function allows the user to delete the expression selected.

Create User Rule

Once the algebraic manipulation has proved that expressions E is equivalent to expression F, the function "Create User Rule" allows the user to create a new symbolic manipulation command the rewriting rule $E \Leftrightarrow F$ is associated to.

The new command is immediately added to the list of the user-created commands in the User Rules space.

$x^2+2 \cdot x+1$	<div style="border: 1px solid gray; padding: 5px;"> Duplicate Delete Insert User Rule Insert in Algebraic Line </div>
$x \cdot x+2 \cdot x+1$	
$x \cdot x+(1+1) \cdot x+1$	
$x \cdot x+1 \cdot x+1 \cdot x+1$	
$(x+1) \cdot x+1 \cdot x+1$	
$(x+1) \cdot x+1 \cdot x+1 \cdot 1$	
$(x+1) \cdot x+1 \cdot (x+1)$	
$(x+1) \cdot x+(x+1) \cdot 1$	
$(x+1) \cdot (x+1)$	
$(x+1)^2$	

Algebraic Line Algebraic Manipulator Cartesian Plane

User Rules Hide Import User Rules Export User Rules Clear User Rules

TR: rules_user

$x^2 + 2 \cdot x + 1 \Leftrightarrow (x+1)^2$

- $x^2 + 2 \cdot x + 1$
- $x \cdot x + 2 \cdot x + 1$
- $x \cdot x + (1+1) \cdot x + 1$
- $x \cdot x + 1 \cdot x + 1 \cdot x + 1$
- $(x+1) \cdot x + 1 \cdot x + 1$
- $(x+1) \cdot x + 1 \cdot x + 1 \cdot 1$
- $(x+1) \cdot x + 1 \cdot (x+1)$
- $(x+1) \cdot x + (x+1) \cdot 1$
- $(x+1) \cdot (x+1)$
- $(x+1)^2$

By clicking on the button "Hide" the User Rules space is not visible.

User Rules Hide Import User Rules Export User Rules Clear User Rules

By clicking on the "Show" button the User Rules space is visible.

User Rules Show Import User Rules Export User Rules Clear User Rules

To make available the expression of user rules in a new working session, the user has to save it by means of the "Export User Rule" button

User Rules Hide Import User Rules Export User Rules Clear User Rules

"Import User rule" button allows the user to import the last user rule saved in a previous working session.

User Rules Hide Import User Rules Export User Rules Clear User Rules

To delete user rules from the interface the user has to click on the "Clear User Rule" button

User Rules Hide Import User Rules Export User Rules Clear User Rules

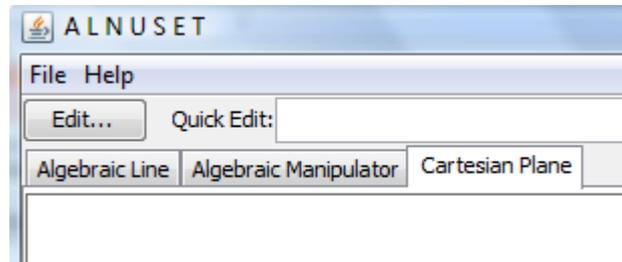
Send to Line

This function makes it possible to send a whole expression or proposition, or a part thereof, to the Algebraic Line component.

$$x^2+2 \cdot x+1$$

- Duplicate
- Delete
- Insert User Rule
- Insert in Algebraic Line

FUNCTION COMPONENT

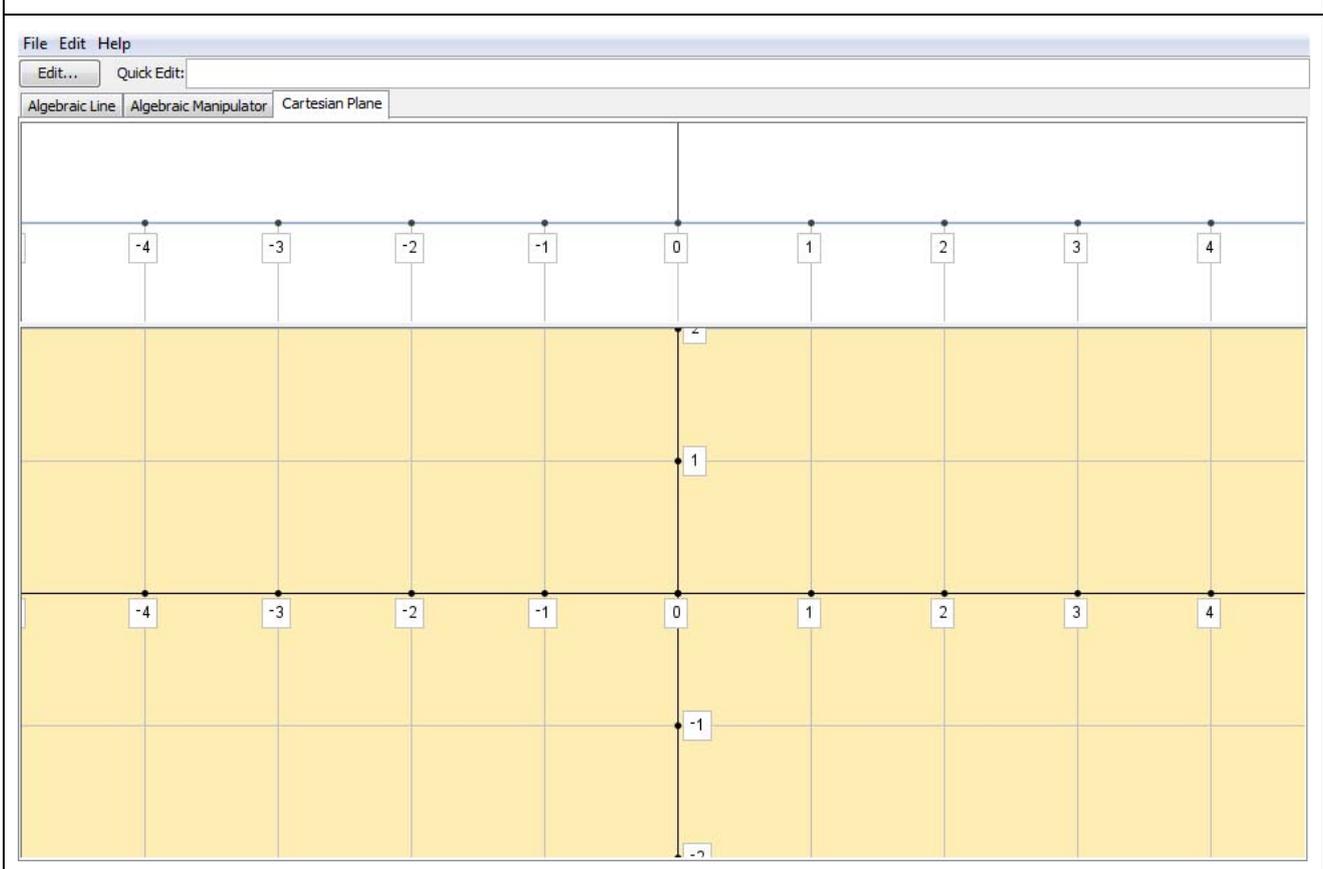


Main Menu of Function component

General characteristics of Function

The interface of the Function component is composed by an algebraic line and a Cartesian plane. The algebraic line contained in this component is a copy of the line of the Algebraic Line component.

The figure below shows the interface of the Function component



Zoom

To modify the unit measure in the Cartesian plane the user has to use the mouse wheel on the algebraic line. In this way, the unit measure of vertical axis is modified accordingly with that of horizontal axis.

To modify the unit measure of the vertical axis the user has to use the mouse wheel in the Cartesian plane.

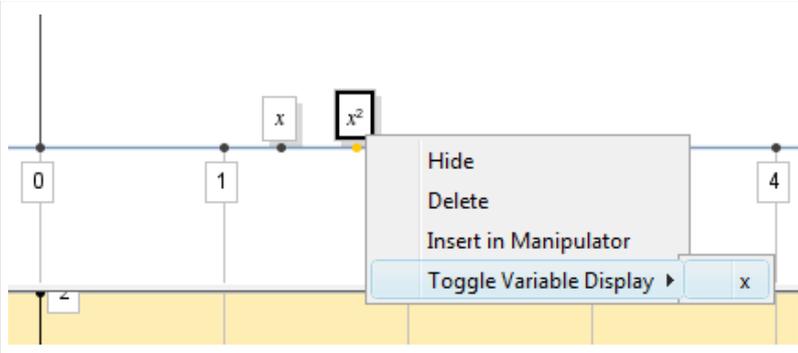
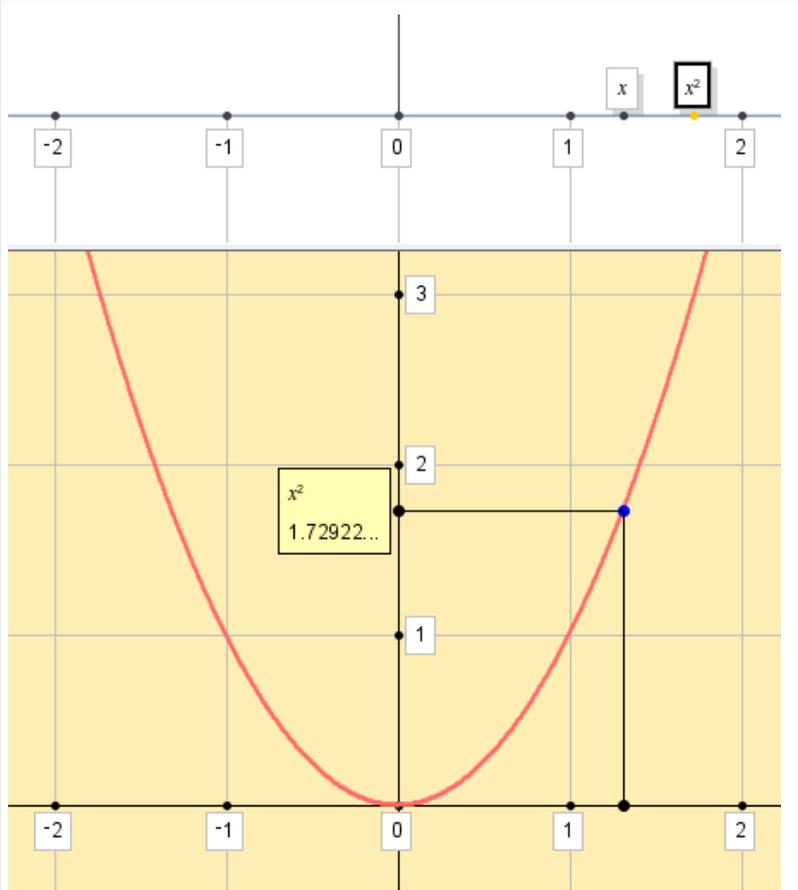
Scroll

Click the right mouse button down and drag the mouse to scroll the Cartesian Plane.

Interaction

Representation of Graphs

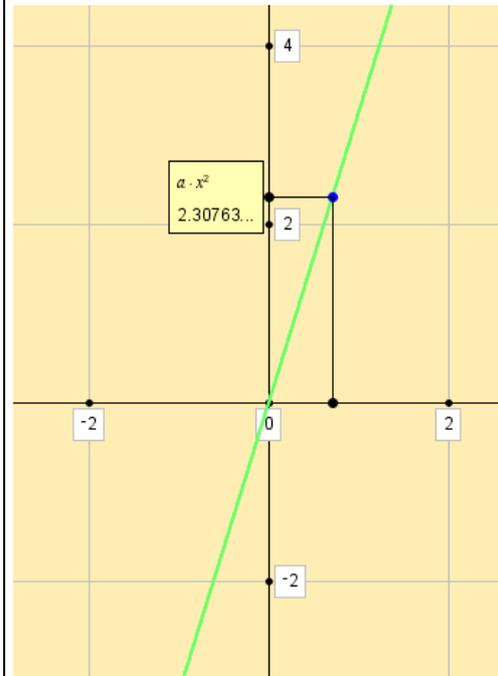
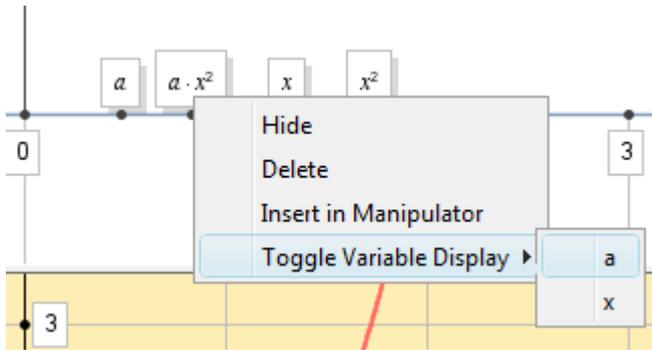
An expression visualized on the algebraic line can be represented as the graph of the corresponding function in the Cartesian plane through the “Show graph” function.

 A horizontal algebraic line with tick marks at 0, 1, and 4. Two expressions, 'x' and 'x^2', are placed on the line. A context menu is open over the 'x^2' expression, showing options: 'Hide', 'Delete', 'Insert in Manipulator', and 'Toggle Variable Display'. A blue arrow points from the 'Toggle Variable Display' option to a small box containing 'x'.	<p>By clicking on the expression with the right button of the mouse and selecting the function “Toggle Variable Display”, the graph of the corresponding function appears in the Cartesian plane.</p>
 A Cartesian coordinate system with x and y axes ranging from -2 to 2. A red parabola representing the function $y = x^2$ is plotted. A blue point is marked on the parabola at approximately $x = 1.72922$. A yellow box next to the point contains the text 'x^2' and '1.72922...'. The algebraic line from the previous screenshot is visible at the top of the graph area.	<p>By dragging the mobile point x along the algebraic line, the expression depending on x moves accordingly along the line. Moreover, the blue point defined by the pair (x, x^2) moves, accordingly with x, along the graph in the Cartesian plane.</p>

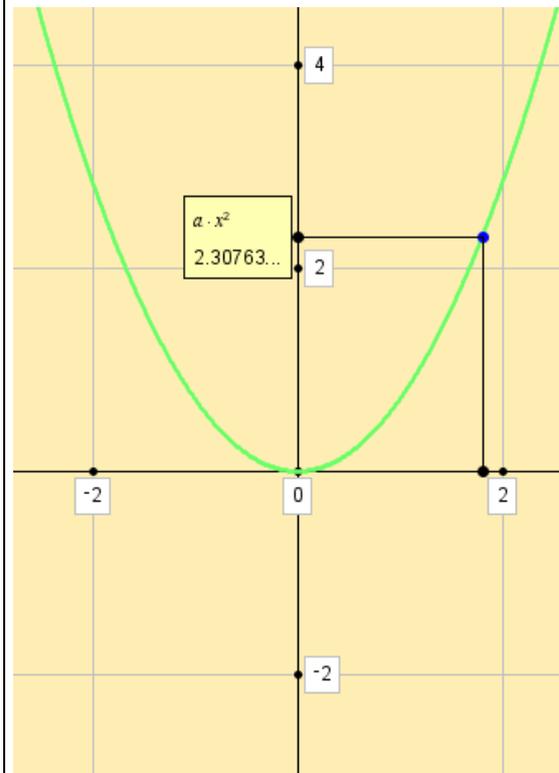
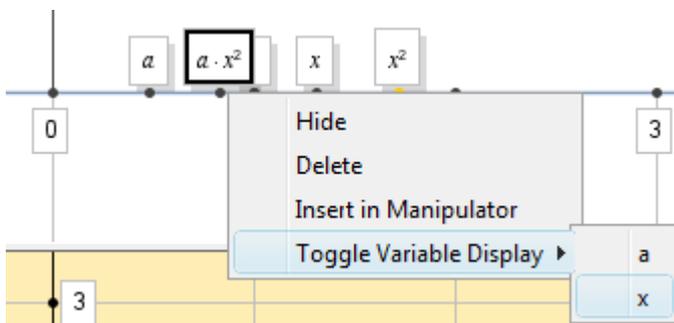
To delete a graph the user can click on the graph with the right mouse button down and select “clear”.

If the expression represented on the Algebraic Line contains more than one letter (i.e. $a \cdot x^2$), the user can choose what letter s/he wants to consider as independent variable. The other letters are considered as parameter.

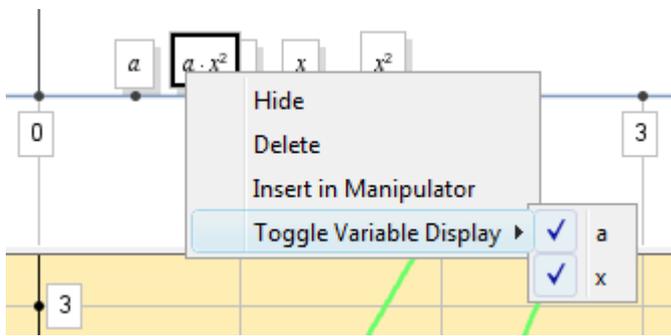
The letter "a" assumes the role of independent variable.



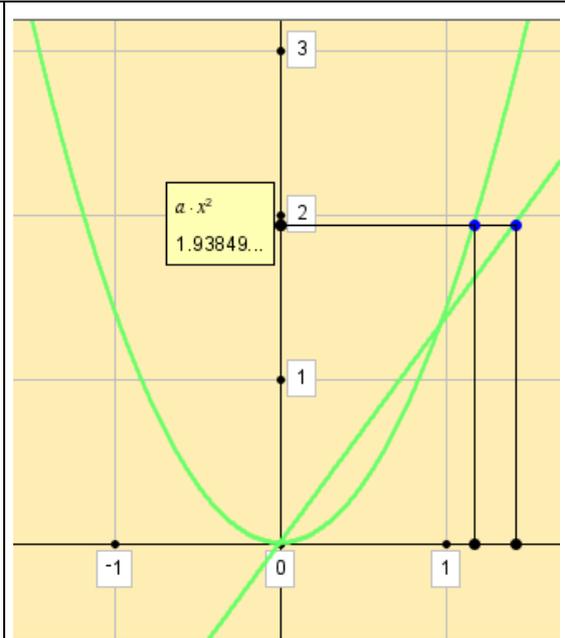
The letter "x" assumes the role of independent variable.



The two previous graphs can be visualized simultaneously in the Cartesian Plane.



Note that by dragging the “a” mobile point on the algebraic line, its role as parameter will modify the graph of the parable while its role as independent variable will modify the point on the graph of the line.



Drag mobile point corresponding to algebraic variable

A mobile point can be dragged on the Algebraic Line in accordance with the restraints imposed by the chosen numerical domain. By dragging a mobile point corresponding to an algebraic variable, both the expression involving that variable in the algebraic line and the point on the curb in the Cartesian plane move accordingly.