

# LogEX: user manual

## Global description

With the LogEX-application you can practice three kinds of exercises.

- *rewrite a logic expression into a disjunctive normalform*  
In each next step one rule is applied to rewrite the logical expression into the disjunctive normalform.
- *rewrite a logic expression into a conjunctive normalform*  
In each next step one rule is applied to rewrite the logical expression into the conjunctive normalform.
- *proof logic equivalence*  
By performing a sequence of valid logic rewrite rules to the left or right hand side of the equivalence you should create two identical formulas and thereby proof the logical equivalence.

The components of the userinterface of LogEX are described in the short manual. Beyond that you can find a list of all valid rules that you can apply and the hotkeys that you can use in LogEX.

LogEQ can be used with all recent versions of Firefox, Chrome, Safari and Internet Explorer 11 or higher.

## Interface

In the table below you can find a description of all functional elements of the exercise window.  
You can find a screenshot of the windows below the table.

Table 1: Description of the Interface	
1	Using the three tabs you can start one of the three exercises.
2	The language button can be used to change the language to "Dutch" or "English".
3	General help (this document)
4	Back to the log in screen, to enter another student number (the current exercise will be closed).
5	Here you can start a new exercise. You can choose between "easy", "normal" and "difficult" or manual input.
6a	With this switch you can turn the rule combobox on or off (only with conjunctive and disjunctive normal forms).
6b	With this switch you can turn validation per step on or off.
7	You can change the formula using the toolbar or by using the hotkeys (see table 3).
8	The hint button will provide support for the next rewrite step you can perform.
9	By pressing the "Show step" button, the application will automatically add the next rewrite step to the proof.
10	Select the rewrite rule you have applied. See table 2 for all valid rewrite rules.
11	By using the X you can undo a previous step.
12	With the OK button you will add the step to the proof. This button can only be used after you changed the formula. The formula should have a correct syntax. If the option to specify rules is turned ON a rule has to be selected.
13	With the "Show complete proof" button the application will automatically complete the entire proof of the equivalence.
14	If you believe the proof has been completed, you can verify this by clicking this button.
15	Buttons to choose between a top-down or a bottom-up step (these buttons are shown when proving logical equivalence only)
16	This number shows the number of steps that remain until the proof is complete (only shown when proving logic equivalence)

## Conjunctive and disjunctive normalform

The screenshot shows the LogEX interface for Conjunctive and Disjunctive Normal Form exercises. The interface is divided into several sections:

- Header Bar:** Contains the text "Ideas - LogEX" and navigation links for "NL", "EN", "Help", and "Logout".
- Navigation Tabs:** Three tabs are visible: "Convert to disjunctive normal form" (1), "Convert to conjunctive normal form", and "Proof logical equivalence".
- Toolbar:** Includes a "New exercise" button (5), a "Rule Justification" section with an "ON" switch (6a), and a "Correction per step" section with an "ON" switch (6b).
- Formula Input Area:** Displays the formula  $\neg r \rightarrow (T \wedge p)$ . A text input field (7) also contains the same formula. A "Show step" button (9) is located next to the input field.
- Rule Selection:** A dropdown menu labeled "Regel.." (10) is used to select a rewrite rule.
- Buttons:** A "Send" button (12) is located next to the rule selection dropdown. A "Show complete derivation" button (13) is at the bottom left. A "Check if derivation is complete" button (14) is at the bottom right.
- Numbered Callouts:** Yellow circles with numbers 1 through 14 point to specific UI elements as described in the table.

## Logic Equivalence

The window that is shown when proving a logic equivalence looks very similar.

The switch (6) for turning the rule combobox on or off is missing.

Apart from that you must choose for a top-down or a bottom-up step (15). You can always choose to do the next step in a different direction.

New exercise

Correction per step ON

$(p \rightarrow q) \vee \neg p$

15 Add top-down step

15 Add bottom-up step

$(p \rightarrow q) \vee q$

The input field for editing a formula (7) is only shown after deciding for a top-down or a bottom-up step.

New exercise

Correction per step ON

$(p \rightarrow q) \vee \neg p$

Implication definition 4 16

11

Rule..

7

15 Add bottom-up step

$(p \rightarrow q) \vee q$

<b>Table2</b> : Valid rewrite rules	
<i>Rule</i>	<i>Example</i>
Absorption	$(p \wedge q) \vee q \Leftrightarrow q$ of $p \wedge (p \vee q) \Leftrightarrow p$
Commutativity	$p \vee q \Leftrightarrow q \vee p$ of $p \wedge q \Leftrightarrow q \wedge p$
De Morgan	$\neg(p \vee q) \Leftrightarrow \neg p \wedge \neg q$ of $\neg(p \wedge q) \Leftrightarrow \neg p \vee \neg q$
Distribution	$r \wedge (p \vee q) \Leftrightarrow (r \wedge p) \vee (r \wedge q)$ of $r \vee (p \wedge q) \Leftrightarrow (r \vee p) \wedge (r \vee q)$
Double negation	$\neg\neg q \Leftrightarrow q$
Equivalence definition	$p \Leftrightarrow q \Leftrightarrow (p \wedge q) \vee (\neg p \wedge \neg q)$
F-rule conjunction	$p \wedge F \Leftrightarrow F$
F-rule complement	$p \wedge \neg p \Leftrightarrow F$
F-rule not T	$\neg T \Leftrightarrow F$
F-rule disjunction	$p \vee F \Leftrightarrow p$
Idempotency	$q \vee q \Leftrightarrow q$ of $q \wedge q \Leftrightarrow q$
Implication definition	$p \rightarrow q \Leftrightarrow \neg p \vee q$
T-rule conjunction	$q \wedge T \Leftrightarrow q$
T-rule complement	$p \vee \neg p \Leftrightarrow T$
T-rule not F	$\neg F \Leftrightarrow T$
T-rule disjunction	$p \vee T \Leftrightarrow T$
<p>Please note: Commutative variants of absorption, distribution and the T and F rules are also allowed. The implicit use of associativity of the disjunction and the conjunction is always allowed, but you can only replace or remove parentheses in disjunctions or conjunctions together with the application of one of the rules from the table. Generalisations of distribution [e.g. <math>r \wedge (p \vee q \vee s) \Leftrightarrow (r \wedge p) \vee (r \wedge q) \vee (r \wedge s)</math>] or DeMorgan [e.g. <math>\neg(p \wedge q \wedge s) \Leftrightarrow \neg p \vee \neg q \vee \neg s</math>] mag u ook gebruiken.</p>	

Table3 : entering formulas   list of hotkeys	
The input of T, F, p, q, r, s, ( and ) can be done with or without using the shift key.	
<i>input</i>	<i>hotkey</i>
$\neg$	$\neg, \sim, n$
$\wedge$	a, &
$\vee$	o, v
$\rightarrow$	i, >
$\leftrightarrow$	e, =
<i>action</i>	<i>hotkey</i>
Hide alerts	esc
undo	u
hint	/, ?
Switch input field	tab, shift-tab
OK	enter
Selecte rule	arrow up/down, ctrl-1 t/m ctrl-=
Show step	ctrl-enter
Show proof	ctrl-shift-enter
Proof completed?	ctrl-?, ctrl-/
New exercise normal	ctrl-n, ctrl-y
New exercise easy	ctrl-b
New exercise difficult	ctrl-m
New exercise manual input	ctrl-shift-n, ctrl-shift-y
Remove top step	ctrl-up, alt-up, ctrl-e
Remove bottom step	ctrl-down, alt-down, ctrl-e