# User-Testing

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Desenvolvi uma ferramenta interativa online para criar provas de dedução natural em forma de Àrvore que funciona para Logica Proposicional e Logica de Primeira Ordem.

## Briefing

2 O que se pretende não é avaliar o professor mas sim o sistema, quer em termos de usabilidade como a eficácia das mensagens de erros e feedback

You have been selected to test our online tool designed to help students practice natural deduction problems in both Propositional and First-Order Logic using a Gentzen-style tree format. During this test, you will not be evaluated. Instead, we aim to evaluate the system by measuring its usability and the effectiveness of the feedback system. We want to know how easy, intuitive, and interactive it is to build proofs, and how useful the error and feedback messages are.

The test consists of different activities, each designed to assess a specific aspect of the tool. While performing the tasks, you are encouraged to think out loud. Verbalize your thoughts, decisions, and reactions. This helps us collect qualitative data and better understand your experience. During the test, you are not allowed to click on the red buttons located on the left side of the screen, unless the task explicitly instructs you to do so.

The tool represents proofs using blocks. Each block corresponds to a part of the proof and can be connected to other blocks to form larger proof trees. The simplest block is a formula. More complex blocks involve inference rules and can contain multiple sub-blocks. Blocks can be nested inside other blocks or extracted to form independent subtrees. To move a block, you can drag or un-drag the conclusion of the block you want to reposition.

3 Para isso vamos realizar dois testes, um primeiro mais guiado cujo foco é avaliar quao intuitivo está o sistema e um segundo que vai ser mais livre onde pretendo que o professor construa uma prova e que cometa erros propositalmente

4 Queria que durante a realização dos testes o professor falasse em voz alta dos passos que está a pensar realizar para que o possa guiar caso se perca.

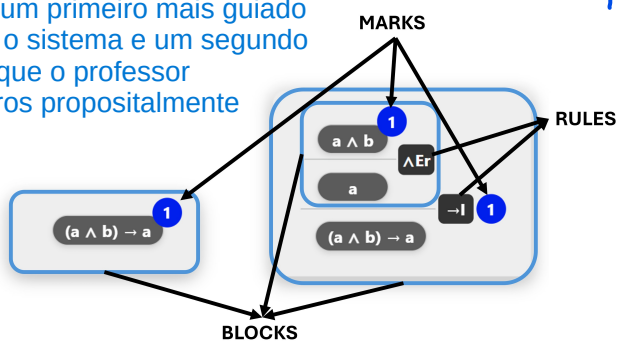



Figure 1: Proof components

# Tasks

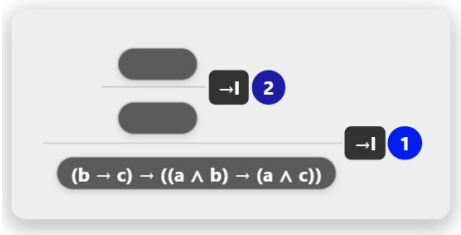
## First Task

The goal of this task is to prove the tautology:

$$\vdash (b \to c) \to ((a \wedge b) \to (a \wedge c))$$

We will divide the task into smaller steps: Aplicar as regras da introdução

- **Apply the introduction rules:** Start by identifying the main block with the final conclusion. Apply the Implication Introduction rule ($\to I$) to that block and assign the mark 1 to the rule. Then fill in the hypothesis. If you are unsure how the rule works, hover over the rule with your mouse (or tap the ? icon on touch devices) to see a tooltip explaining the rule. Repeat the same process for the new hypothesis, assigning the mark 2 to the second Implication Introduction. The result should look like this, but filled with formulas:




- **Prove $a$:** Add a new tree to the board and fill it with the formula $a$. Apply the Conjunction Elimination Right rule ($\wedge E_r$). Fill the new hypothesis with $a \wedge b$ and assign it mark 2. Then validate your proof by selecting it and clicking "Check proof". If everything is correct, a message saying "Valid proof" will appear. Provar a

- **Prove $c$:** Add another new tree and fill it with the formula $c$. Apply the Implication Elimination rule ($\to E$). In the first hypothesis, insert $b$. In the second, insert "b to c", do not use the auxiliary keyboard for this step. To prove $b$, apply the Conjunction Elimination Left rule ($\wedge E_l$) and add the hypothesis $a \wedge b$, marking it with 2. Validate the proof when finished. Provar c

- **Connect all trees:** Apply the Conjunction Introduction rule ($\wedge I$) to the hypothesis of the first tree. Drag the tree that concludes $a$ to the right hypothesis, and the one that concludes $c$ to the left hypothesis. Then check the full proof. Juntar as arvores de forma errada

- **Correct the errors:** Fix any remaining errors in the proof. After each correction, click "Check proof" again. If the message "Problem solved" appears, it means the proof is complete. If you followed the previous steps correctly, only minor fixes should be needed. Remember, you can extract or move blocks freely using the interface. Corrigir os erros

## Second Task (Student)

In this task, you will complete a proof on your own. Now that you know the basic steps, it's your turn to decide how to proceed. This exercise is very similar to the first one. Prove the following tautology:

$$\vdash (b \to c) \to ((a \wedge b) \to c)$$

Check your proof as many times as needed. Use the hints (yellow icons next to incorrect formulas) if you are unsure how to continue just click on them to generate a suggestion.

## Second Task (Teacher)

In this task, you will complete a proof independently. Now that you are familiar with the basic steps, it's up to you to decide how to proceed. Prove the following:

$$\{(a \vee b) \wedge (a \vee c)\} \vdash a \vee (b \wedge c)$$

$$\exists x \neg P(x) \to \neg \forall x \; P(x)$$

Check your proof as many times as needed. Try making intentional mistakes to explore the different types of errors and feedback messages the system provides. Click the third red button from the top to change the feedback level. There are 5 levels, and each click moves to the next one in a loop. You can also click the yellow hint icons next to incorrect formulas to view suggestions.

**Error suggestions:**

- Write incorrect formulas, for example: "$a \vee b \wedge c$" and "$a \vee (b \wedge c$"
- Apply rules incorrectly, using hypotheses that do not make sense
- Forget to use marks, or create conflicts by assigning different formulas to the same mark
- Deviate from the most direct solution path