

Lean Tutoraat cheat sheet

Tactics

Tactic	Usage	Example
<code>rfl</code>	Prove equalities that hold <i>by definition</i> .	<code>example : 1 + 2 = 3 := by rfl</code>
<code>numbers</code>	Prove (in)equalities between purely numerical expressions.	<code>example : 5 ^ 3 < 2 ^ 7 := by numbers</code>
<code>algebra</code>	Prove algebraic identities.	<code>example (x y : ℝ) : (x + y) * (x - y) = x ^ 2 - y ^ 2 := by algebra</code>
<code>rewrite [h]</code>	If hypothesis <code>h</code> is of the form <code>a = b</code> , replace <code>a</code> with <code>b</code> in the goal.	<code>example (x : ℚ) (h : x = 2) : x ^ 2 = 4 := by rewrite [h]; numbers</code>
<code>rewrite [←h]</code>	If hypothesis <code>h</code> is of the form <code>a = b</code> , replace <code>b</code> with <code>a</code> in the goal.	<code>example (x y : ℚ) (h : x + 1 = y) : x = y - 1 := by rewrite [←h]; algebra</code>
<code>positivity</code>	Prove goals of the form <code>a > 0</code> or <code>a ≥ 0</code> .	<code>example (x : ℝ) : x ^ 2 ≥ 0 := by positivity</code>
<code>extra</code>	Prove inequalities of the form <code>a + e > a</code> or <code>a + e ≥ a</code> .	<code>example (a b : ℤ) (h : a ≥ 0) : a + b ≥ b := by extra</code>
<code>rel [h]</code>	Use inequality <code>h</code> to prove a directly related inequality.	<code>example (a b : ℝ) (h : a ≥ b) : a + 1 ≥ b + 1 := by rel [h]</code>
<code>linarith</code>	A powerful tactic to automatically prove linear inequalities from linear (in)equalities in the hypotheses.	<code>example (a b : ℝ) (h1 : a > 2) (h2 : a + b < 3) : b < 1 := by linarith</code>
<code>calc</code>	Chain (in)equalities together to prove an (in)equality.	<code>example (x y : ℝ) : x ^ 2 + y ^ 2 - 2 * x * y ≥ 0 := by calc x ^ 2 + y ^ 2 - 2 * x * y = (x - y) ^ 2 := by algebra _ ≥ 0 := by positivity</code>
<code>use</code>	Start proving an existential statement (\exists) by providing the value that you will use.	<code>example : ∃ n : ℕ, 81 * n = 2025 := by use 25 numbers</code>
<code>intro</code>	Start proving a universal statement (\forall) by introducing an arbitrary variable.	<code>example : ∀ x : ℝ, x ^ 2 ≥ 0 := by intro x positivity</code>

Typing mathematical symbols

Symbol	Type	Description
\mathbb{N}	<code>\N</code>	natural numbers
\mathbb{Z}	<code>\Z</code>	integers
\mathbb{Q}	<code>\Q</code>	rational numbers
\mathbb{R}	<code>\R</code>	real numbers
\leq	<code>\le</code>	less than or equal to
\geq	<code>\ge</code>	greater than or equal to
π	<code>\pi</code>	pi
\leftarrow	<code>\l</code>	used in <code>rewrite</code> [<code>\leftarrow h</code>]
a^{-1}	<code>\inv</code>	inverse
\forall	<code>\forall</code>	for all
\exists	<code>\exists</code>	exists
\cdot	<code>\cdot</code>	bullet (used for induction cases)