

# Lean and Education

*by Johan Commelin*

# Three talks

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- Lean and Education I

Medley of projects and tools

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- Liquid Tensor Experiment

Intermezzo on epistemology of proof

# Three talks

- Lean and Education I

Medley of projects and tools

- Liquid Tensor Experiment

Intermezzo on epistemology of proof

- Lean and Education II

Finale ...

# This talk

- Demo
- Community website + chat
- Online options
- Natural Number Game + Game server
- Widgets
- Tutorials
- Velleman's "How to prove it with Lean"
- List of Lean courses around the world
- Macbeth's course
- Massot's lean-verbose and informalization

# Demo

<https://lean.math.hhu.de>

# Community website + chat

<https://leanprover-community.github.io>

<https://leanprover.zulipchat.com>



# Online options

- Web editor: `https://lean.math.hhu.de`
- Gitpod
- Codespaces

# Natural Number Game

- `https://www.ma.imperial.ac.uk/~buzzard/xena/natural_number_game/`
- In Lean 3 by Kevin Buzzard and Mohammad Pedramfar
- Revamped into a generic game server in Lean 4 by Patrick Massot and later Jon Eugster and Alexander Bentkamp (see next slide)

# Game server

- <https://adam.math.hhu.de>  
Live demo server
- <https://github.com/leanprover-community/lean4game>  
Game server
- <https://github.com/hhu-adam/NNG4>  
Game data for the Natural Number Game

# Widgets

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- Widgets: use javascript for extra interaction!
- Basics: type info + goal diffs

# Widgets demos

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`Mathlib4/test/CommDiag.lean`



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- Rubik's cube

`https://github.com/kendfrey/rubiks-cube-group`

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- Sudoku

`https://github.com/TwoFX/sudoku`

# Tutorials

□ See “Learning resources” on community website

□ “Mathematics in Lean”

`https://leanprover-community.github.io/mathematics\_in\_lean`

WIP book by several authors

already usable as solid intro

targets mathematicians (no focus on types or logic)

# Velleman's "How to prove it with Lean"

- <https://djvelleman.github.io/HTPIwL/>
- Companion to the book "How to prove it"

# Lean courses around the world

- [https://math.commelin.net/files/lean\\_teaching.html](https://math.commelin.net/files/lean_teaching.html)
- Soon integrated in community website

# Macbeth's course: Mechanics of proofs

- <https://github.com/hrmacbeth/math2001>
- Online lecture notes
- Fully parallel: English and Lean
- “custom tactics which perform exactly one step of reasoning”  
“It lets you off the hook in grading – you can just say  
‘that’s not enough detail – Lean wouldn’t accept it!’ ”

lean-verbose and informalization



# lean-verbose and informalization

- <https://github.com/PatrickMassot/lean-verbose>  
Controlled natural language Lean tactics  
by Patrick Massot

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Controlled natural language Lean tactics  
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- [tinyurl.com/LeanIpam](http://tinyurl.com/LeanIpam)  
Mechanic informalization of Lean to English  
by Patrick Massot and Kyle Miller