Jupyter Notebooks for Education

Computational Thinking in practice

Patrick Jermann, Cécile Hardebolle, Pierre-Olivier Vallès
EPFL Center for Digital Education
cecile.hardebolle@epfl.ch

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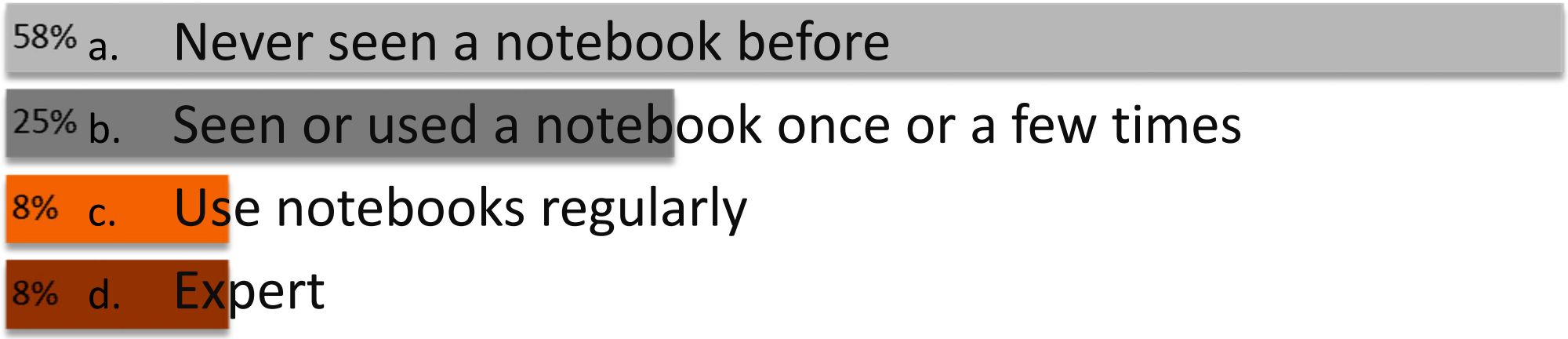
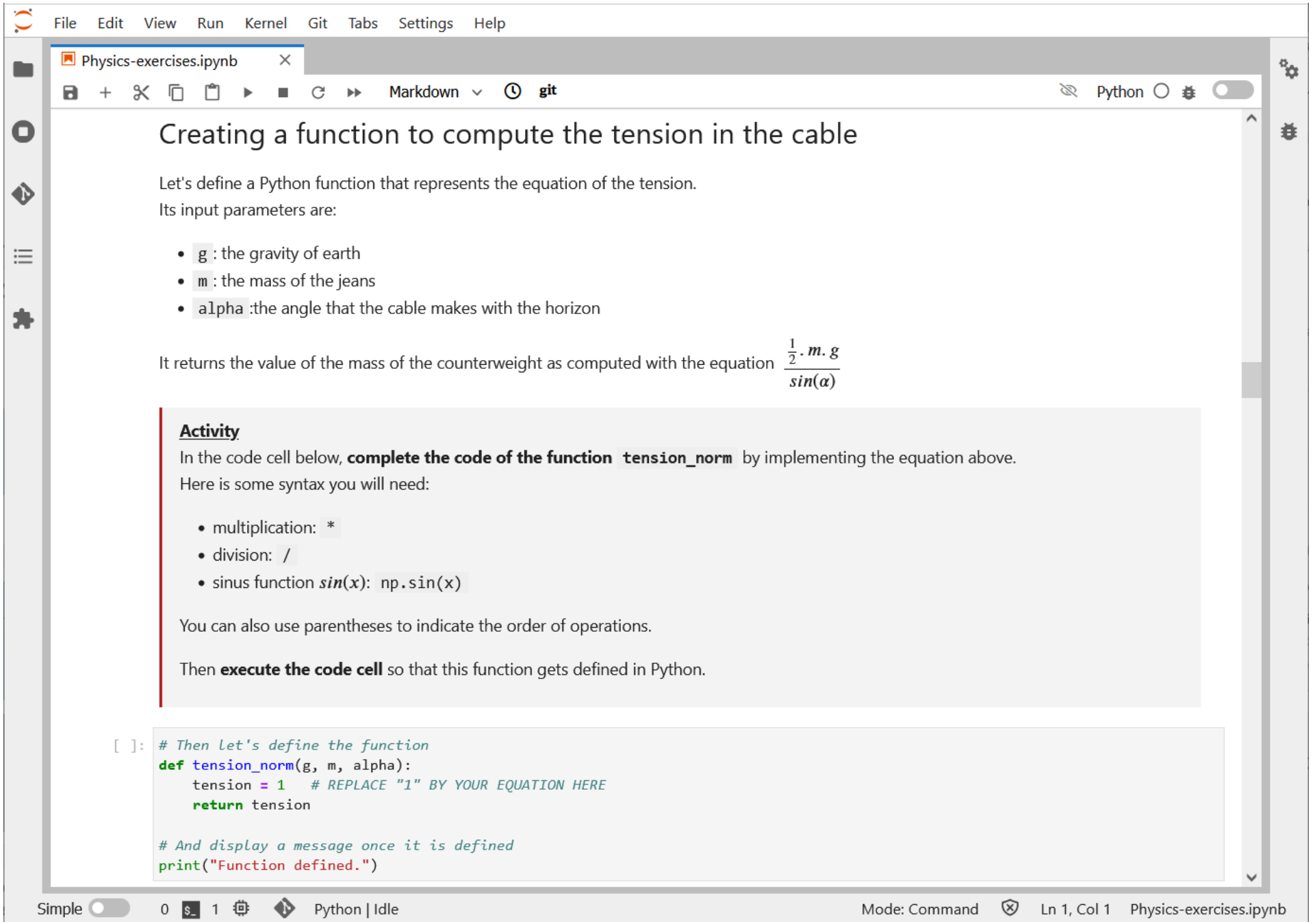
How familiar are you with Jupyter Notebooks?

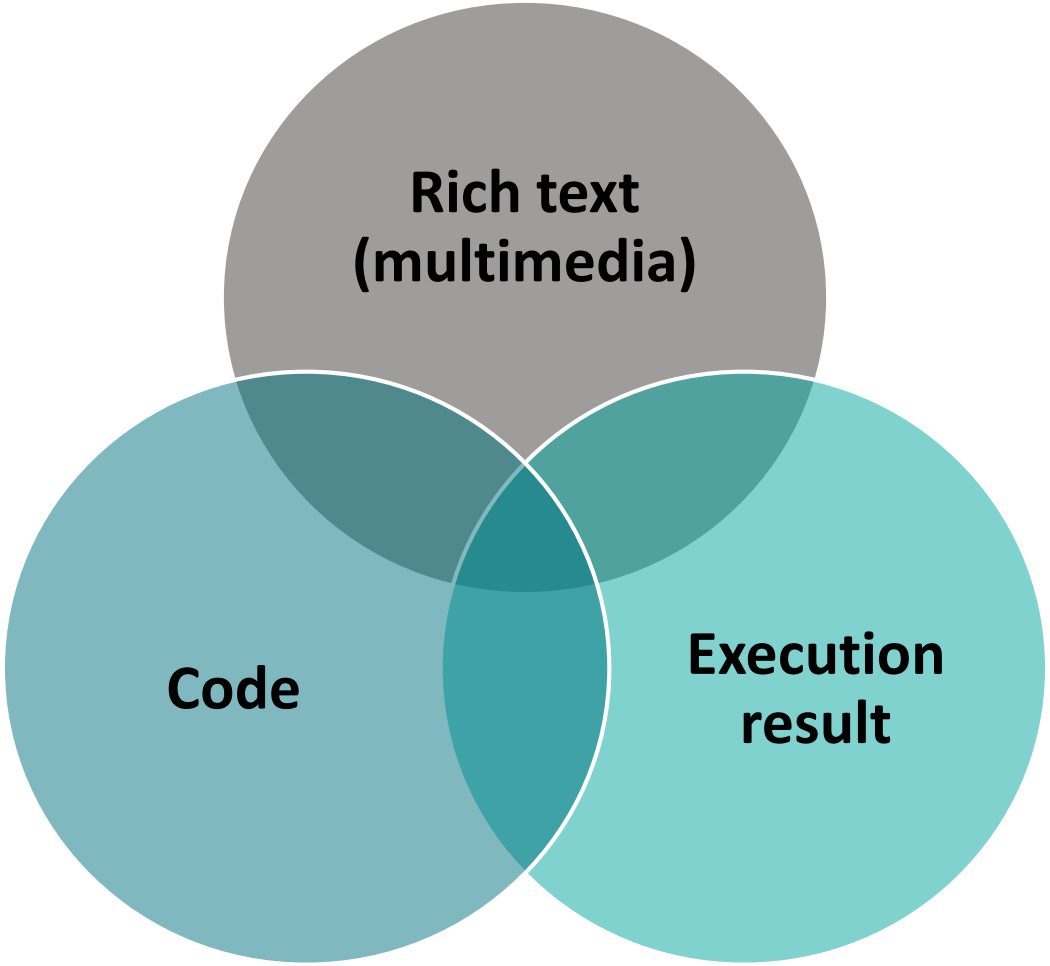
URL: http://ttpoll.eu
Session ID: noto



Demo


File Edit View Run Kernel Git Tabs Settings Help
Physics-exercises.ipynb
Markdown
git
Python
Creating a function to compute the tension in the cable
Let's define a Python function that represents the equation of the tension.
Its input parameters are:
g : the gravity of earth
m : the mass of the jeans
alpha :the angle that the cable makes with the horizon
It returns the value of the mass of the counterweight as computed with the equation $\frac{1}{2}.m.g / sin(\alpha)$
Activity
In the code cell below, complete the code of the function tension_norm by implementing the equation above.
Here is some syntax you will need:
multiplication: *
division: /
sinus function $sin(x)$: np.sin(x)
You can also use parentheses to indicate the order of operations.
Then execute the code cell so that this function gets defined in Python.
[ ]:
# Then let's define the function
def tension_norm(g, m, alpha):
tension = 1 # REPLACE "1" BY YOUR EQUATION HERE
return tension
# And display a message once it is defined
print("Function defined.")
Simple
0 1
Python | Idle
Mode: Command
Ln 1, Col 1
Physics-exercises.ipynb

Why focus on Jupyter Notebooks?



Thinking

Computational

Expert thinking in the form of problem solving or scientific investigation **narrative** including equations, diagrams, etc.

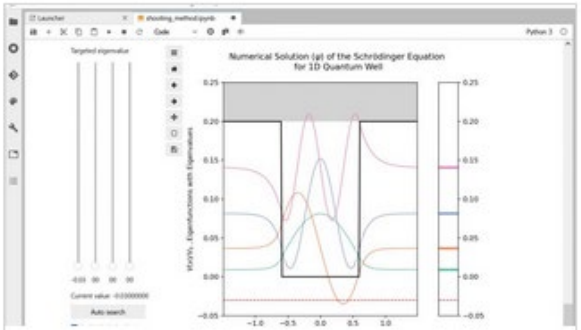
+

Code & output as **interactive illustrations** and **activities**

[Knuth, 1984 ; Granger & Pérez, 2021]

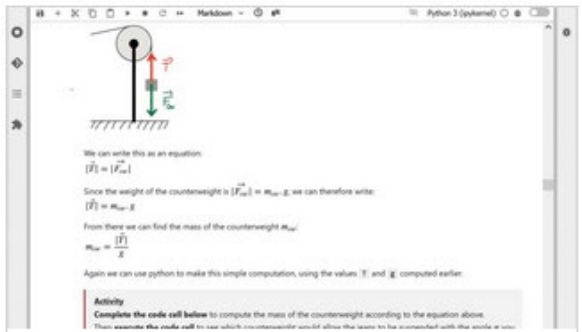
When / for what to use notebooks?

Assignments



Demonstrations

Interactive textbooks



Exercise worksheets

Projects and labs

Active learning & Control by student

[Freeman, 2014; Hattie, 2009]

Educational notebooks for all disciplines

Contact	Discipline	Use case	Language	Repository	Execute on noto
Cécile Hébert	General Physics: Mechanics	Demonstrations in class	Python	https://github.com/c-hebert/MecaDRIL	https://go.epfl.ch/mecadril
Guillaume Anciaux	Numerical Modelling of Solids and Structures	Exercise worksheets	Python	https://c4science.ch/source/mnss-notebook-demo	https://go.epfl.ch/MNSS-demo
Paolo Prandoni	Signal Processing for Communications	Interactive textbook	Python	https://github.com/prandoni/COM303	https://go.epfl.ch/COM303-noto
Pol del Aguila Pla, Daniel Sage	Image Processing	Assignments (automatically graded)	JavaScript,Python, SoS		
Alexandre Alahi	Machine Learning for Engineers	Exercise worksheets Assignments (automatically graded)	Python	https://github.com/vita-epfl/introML-2021	https://go.epfl.ch/introML-noto
Giovanni Pizzi, Dou Du	Quantum Mechanics and Materials Science	Demonstrations in class	Python	https://github.com/osscar-org/quantum-mechanics	https://go.epfl.ch/quantum-noto
Oleg Yazyev	Solid State Physics	Demonstrations in class	Python	https://github.com/oyazyev/SoliDRIL	https://go.epfl.ch/SoliDRIL-noto
Simone Deparis	Numerical Analysis	Exercise worksheets	Python	https://c4science.ch/source/PubNumAnalysisIpynb/	https://go.epfl.ch/NumAnalysis-noto
Giulia Tagliabue	Heat and Mass Transfer	Interactive textbook	Python	https://c4science.ch/source/Convection/	https://go.epfl.ch/Convection-noto
Martin Jaggi	Machine Learning	Exercise worksheets	Python	https://github.com/epfml/ML_course	https://go.epfl.ch/ML_course-noto
Martin Jaggi	Optimization for Machine Learning	Exercise worksheets	Python	https://github.com/epfml/OptML_course	https://go.epfl.ch/OptML-noto
Simon Dürr, Ursula Röthlisberger	Electronic Structure Methods	Interactive textbook Exercise worksheets	Python	https://lcbc-epfl.github.io/iesm-public/intro.html	https://go.epfl.ch/IESM-noto
Johanni Brea	Machine Learning for Bioengineers	Interactive textbook Exercise worksheets	R	https://c4science.ch/diffusion/9511/notebooks-bio322.git	https://go.epfl.ch/bio322-noto
Philip Moll	Probability and Statistics for Materials Science	Demonstrations in class Exercise worksheets	R	https://c4science.ch/source/MSE-213/	https://go.epfl.ch/MSE213-noto
Pierre Vandergheynst, Michaël Defferrard	Network Science and Learning with Graphs	Interactive textbook Assignments	Python	https://github.com/mdeff/ntds_2019	https://go.epfl.ch/ntds-noto
John Kolinski	Continuum Mechanics	Assignments Labs, projects	Python	https://gitlab.epfl.ch/kolinski/ME_201	https://go.epfl.ch/ME201-noto
Orane Jecker, Simone Deparis	Linear Algebra	Interactive textbook	Python	https://c4science.ch/source/jupyter_notebooks_AL/	https://go.epfl.ch/AL-noto
Felix Naef	Dynamical Systems in Biology	Demonstrations in class	Python	https://github.com/MMCBEPFL/supplementary_examples	https://go.epfl.ch/BIO341-noto
Karl Aberer	Distributed Information Systems	Exercise worksheets Assignments	Python	https://github.com/LSIR/DIS	
Alexander Mathis	Projects in Informatics for Life Sciences	Exercise worksheets Labs, projects	Python	https://github.com/amathislab/EPFL-BIO-210	

Technical support

Test new software, develop and maintain the platform, **integrate** with other tools

Pedagogical support

Accompany teaching teams, develop resources with an evidence-based and data-driven approach

Jupyter Notebooks for Education @ EPFL

Provide an **online, standard and scalable JupyterLab platform** to teachers and students

Infrastructure

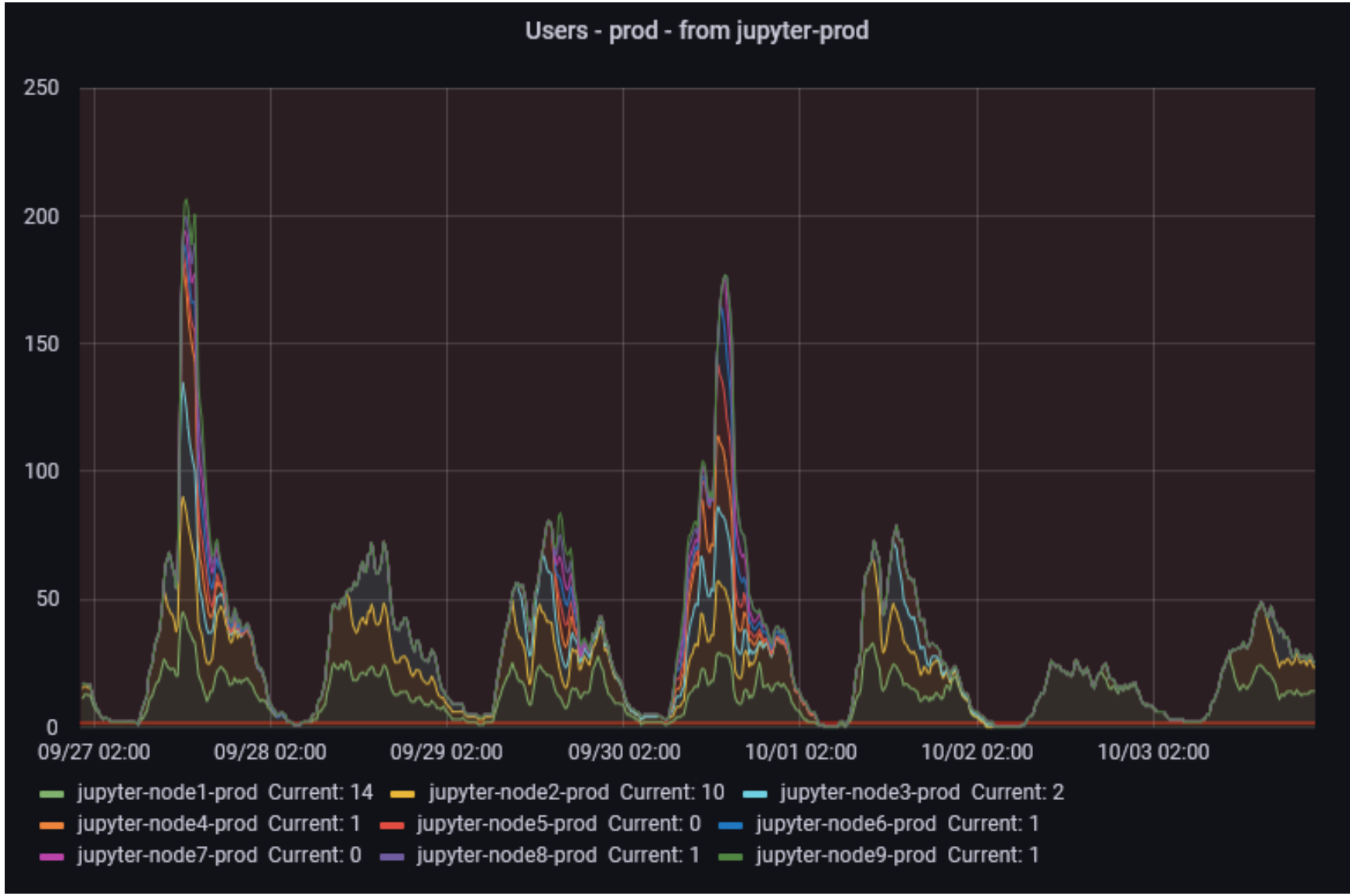
Make **resources** available for teachers to develop **digital material and tools**

DRIL fund

Noto
ノート
(nōto)

https://noto.epfl.ch

5 392 cumulated users since launch (autumn 2019)



Conclusion and perspectives

Want to learn more?
https://go.epfl.ch/notebooks

Virtual demonstrations in physics

Virtual demonstrations help students visualize the different variables involved in experiments in Cécile Hébert's Jupyter Notebooks.

Read the story

Interactive signal processing textbook

Music is a central element in the interactive textbook designed by Paolo Prandoni to teach signal processing with Jupyter Notebooks.

Read the story

Structure modeling exercises

Guillaume Anciaux uses Jupyter Notebooks as exercise worksheets to help students learn about civil engineering.

Read the story

Automatically graded image processing assignments

Pol del Aguila Pla uses automated grading in image processing labs based on Jupyter Notebooks.

Read the story

Our P8 2021-2024 project:

- Other ways to develop computational thinking in disciplines
- Introduce **responsible use of data** and responsible computational systems