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› Introduction to Deep Learning in Practice with pytorch

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> Objective of this class

Overview of deep learning architectures
and applications, using **pytorch** as the
support library

> Objective of this class

- At the end of the class, you should know
 - Deep Learning architectures suited to different problems
 - Problems for which DL is suited, and problems for which it is not
 - Basic usage of pytorch and a few other DL libraries
 - Where to find and how to use large pre-trained models
 - Keywords to perform further research/reading

> Outline

- Existential questions: who am I, why are we here?
- Current state of the field: why deep learning, why pytorch?
- (Tentative) Planning for the class

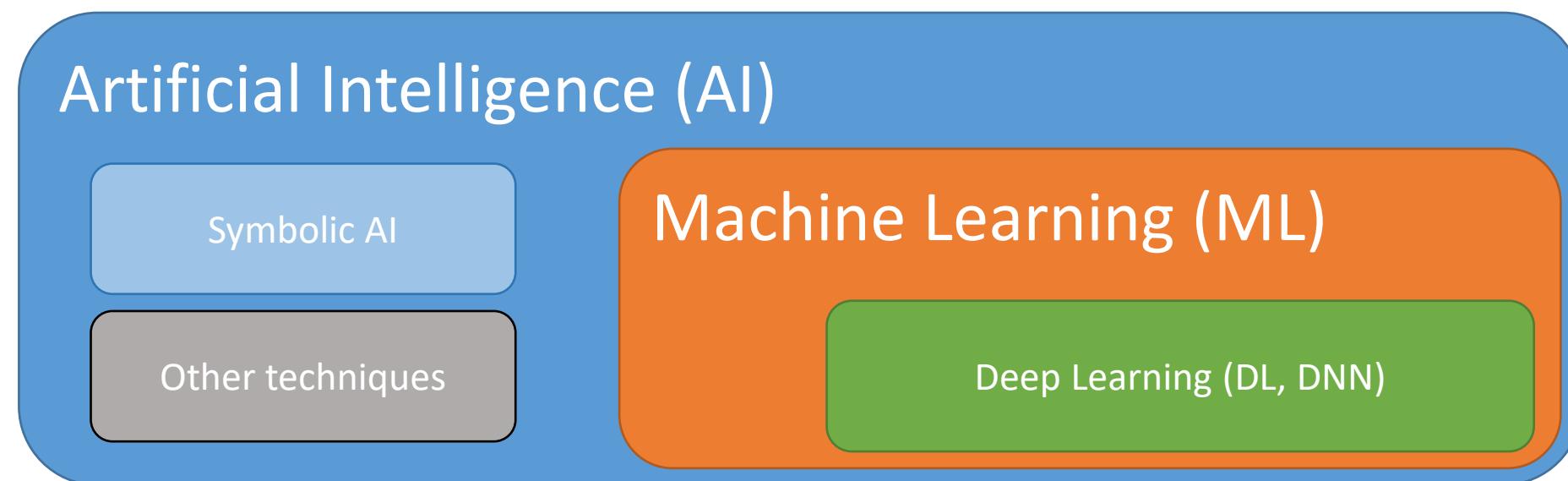
> Who am I?

- Career
 - Bachelor and Master in Computer Science Engineering
 - Ph.D. from Politecnico di Torino, Italy, in 2011
 - Permanent researcher in France since late 2012 (INRAE)
 - Senior researcher (DR) since 2023
- Research interests
 - Stochastic multi-objective optimization
 - Machine learning (explainable AI)
 - Biological/agri-food problems



> What is *deep learning*?

- One technique among many in Machine Learning
- Rebranding of Artificial Neural Networks
- Currently extremely successful



> Why is this subject relevant now?

- Artificial Intelligence achieved important goals in last decade
 - Human-competitive* play in difficult games
 - Improvement in state of the art for image/video classification
 - Generation of images, text, and sound
- Availability of data and computing (phones)
- Attempts at commercial use of AI
 - Self-driving vehicles
 - Assistants for text and code generation
 - Prediction of protein structures
 - ...

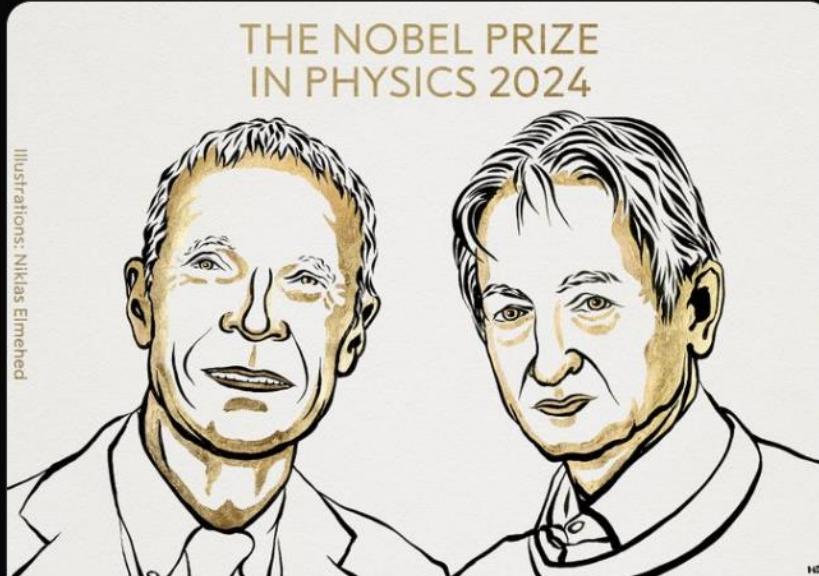


> Why is this subject relevant now?

The Nobel Prize @NobelPrize · Oct 8

BREAKING NEWS

The Royal Swedish Academy of Sciences has decided to award the 2024 #NobelPrize in Physics to John J. Hopfield and Geoffrey E. Hinton "for foundational discoveries and inventions that enable machine learning with artificial neural networks."



THE NOBEL PRIZE IN PHYSICS 2024

Illustrations: Niklas Elmehed

John J. Hopfield **Geoffrey E. Hinton**

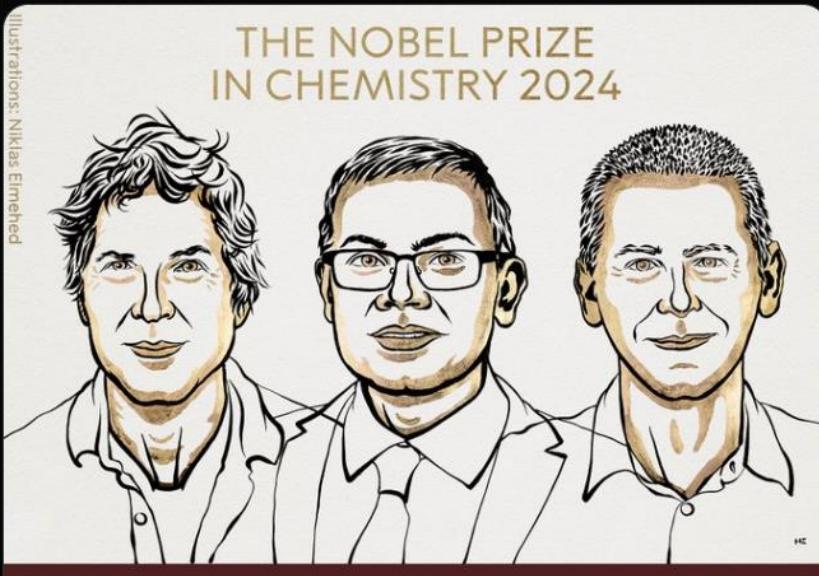
"for foundational discoveries and inventions that enable machine learning with artificial neural networks"

THE ROYAL SWEDISH ACADEMY OF SCIENCES

The Nobel Prize @NobelPrize · Oct 9

BREAKING NEWS

The Royal Swedish Academy of Sciences has decided to award the 2024 #NobelPrize in Chemistry with one half to David Baker "for computational protein design" and the other half jointly to Demis Hassabis and John M. Jumper "for protein structure prediction."



THE NOBEL PRIZE IN CHEMISTRY 2024

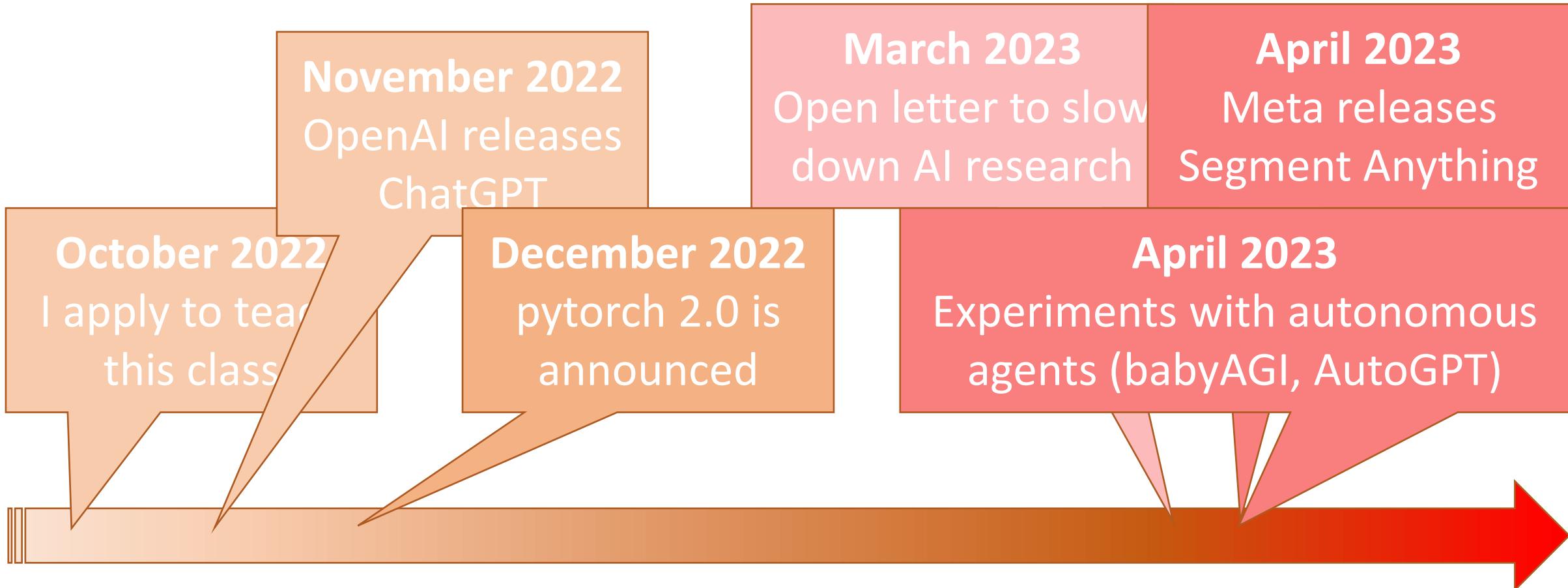
Illustrations: Niklas Elmehed

David Baker **Demis Hassabis** **John M. Jumper**

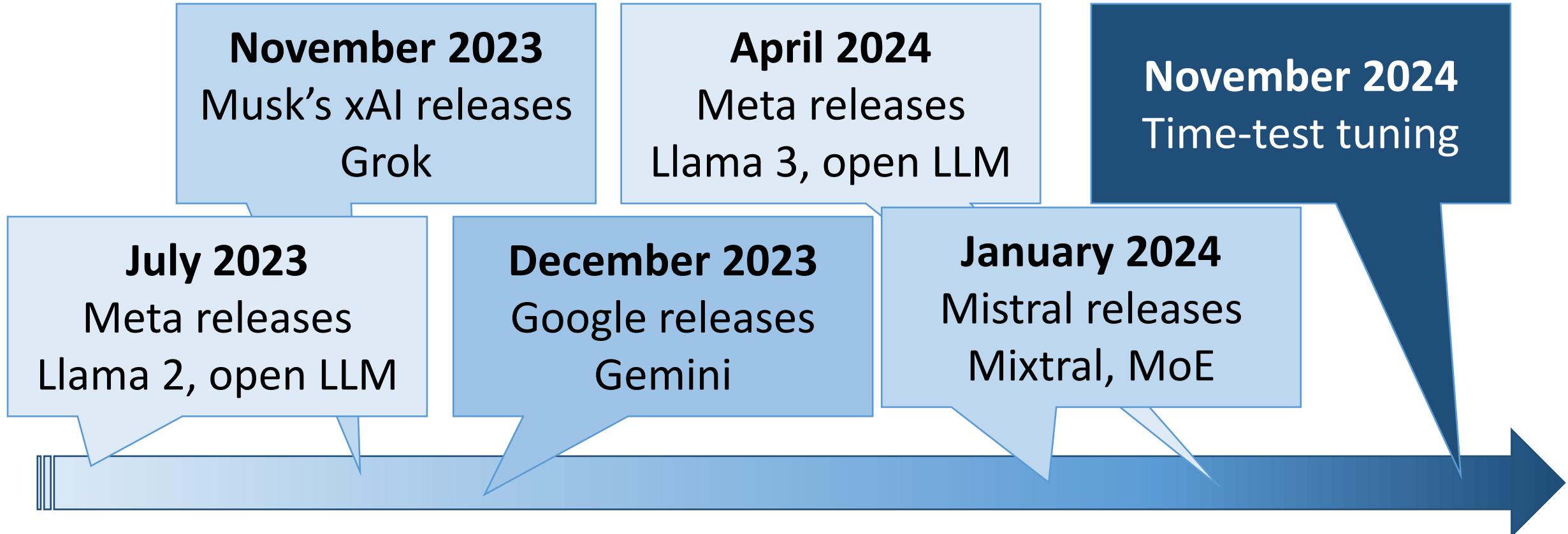
"for computational protein design" "for protein structure prediction"

THE ROYAL SWEDISH ACADEMY OF SCIENCES

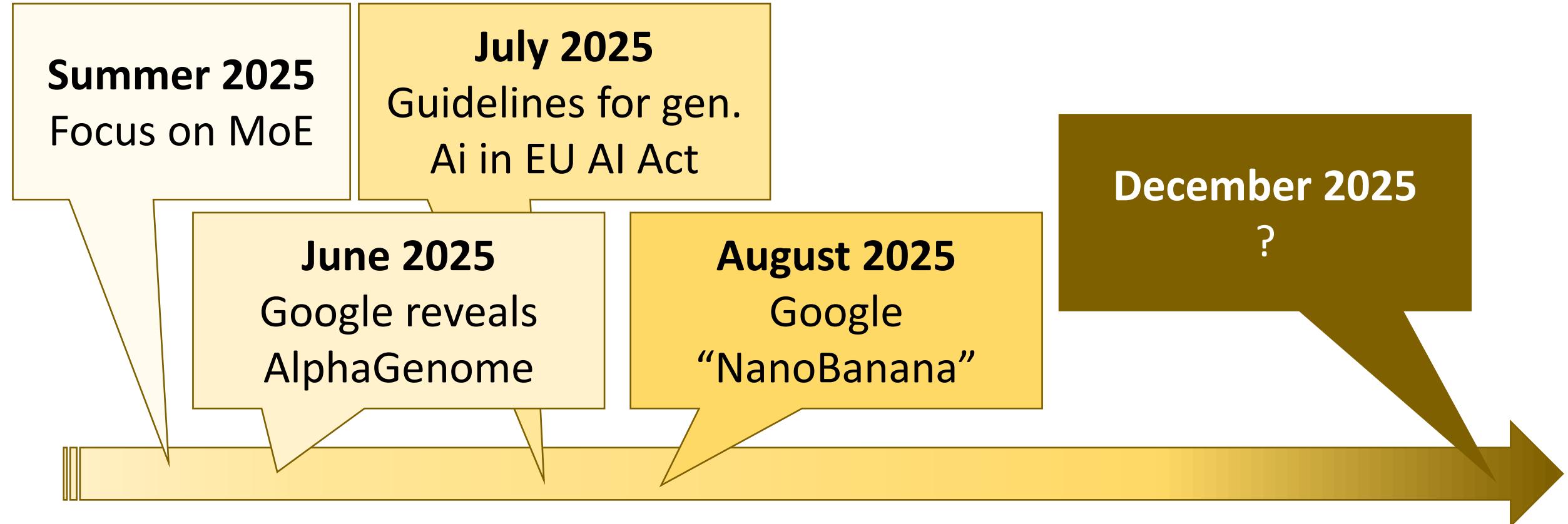
> Current state of the field



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> Current state of the field

- Large availability of open-*ish* source tools
 - The open source movement in computer science is strong
 - It's useful for companies to have other people use their code
 - For deep learning, it started with Tensorflow, 2017 (Google)
- General Purpose Graphic Processing Units (GPGPUs)
 - GPUs originally created for gaming, lots of processors (low-spec)
 - Great for *massive parallelization* of simple computations

> Current state of the field

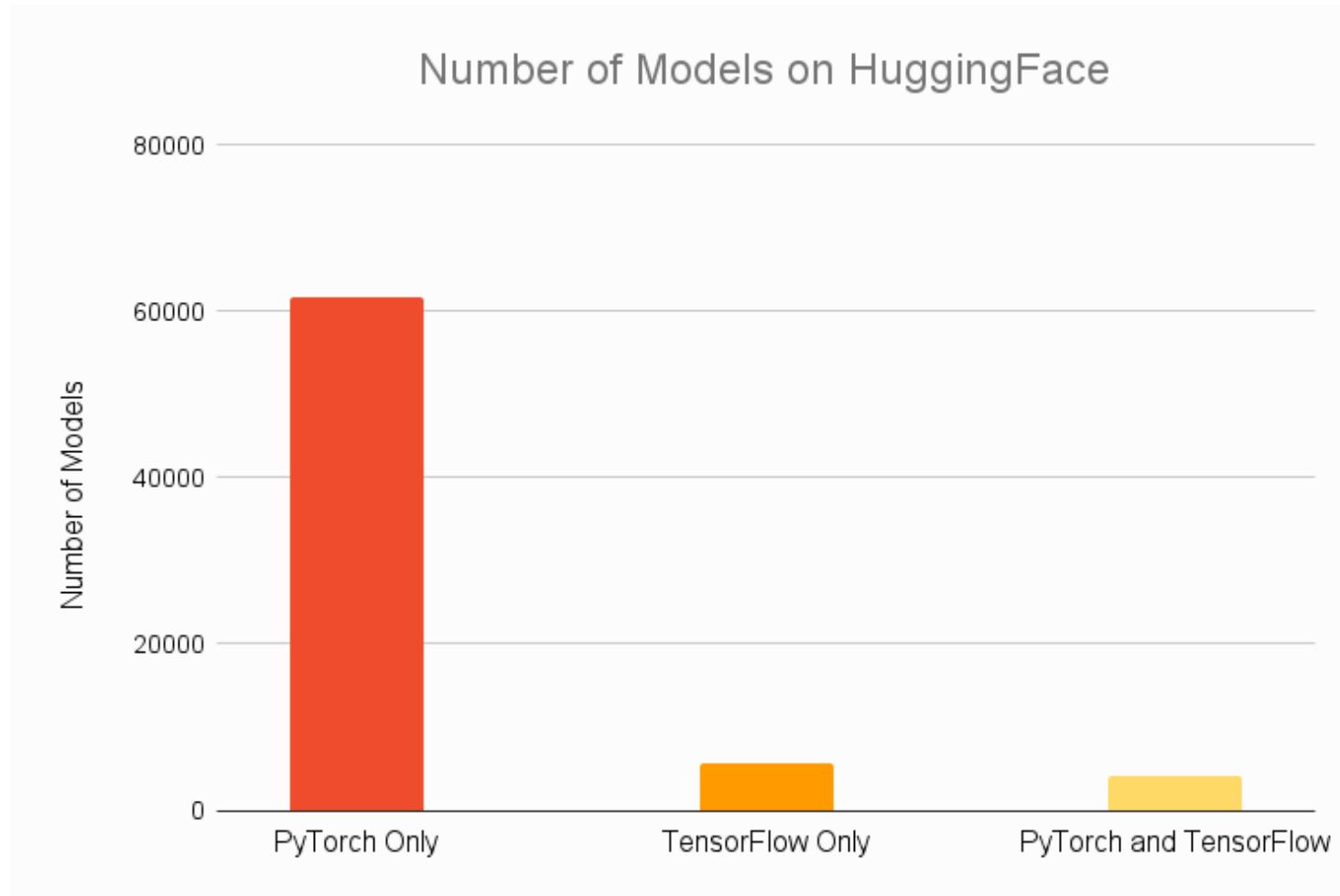
- A vast (unreasonable?) amount of *enthusiasm*!
- Why is that?
 - **Competition** between large companies (Microsoft, Meta, Google)
 - **Tools** that are relatively accessible to non-experts
 - Considerable amount of **passionate practitioners**
 - Communities *obsessed* with AI (existential risk, accelerationists, ...)
 - Charismatic influencers (Sam Altman, Eliezer Yudkowsky, Yann Le Cunn, Gary Marcus, ...)

> Why pytorch?

- Several competing libraries
 - keras, pytorch, theano, ...
- pytorch (currently) most popular
 - Eager execution, for rapid prototyping
 - Analysis step by step
 - Availability of models



> Why pytorch?



> HuggingFace?

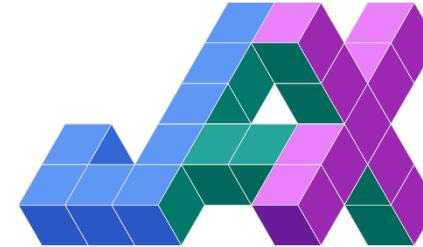
- French-American company
- Weird name (IMHO), but $4.5 \cdot 10^9 \$$ evaluation
- Library for deep neural networks (*transformers* and others)
- Hub, to share and discuss trained models
 - Extremely successful, several useful models
 - Users can download, fine-tune, change and share
 - Relatively easy to use, loved by practitioners



> Competition



Keras 3:
Keras for JAX, TensorFlow,
and PyTorch



neural network library in JAX

> (Tentative) Planning

December 01
Introduction,
ML summary,
Basics of deep
neural networks

09h45,
Amphi II

December 03
Convolutional
Neural
Networks

09h30,
Amphi IV

December 04
Recurrent
Neural
Networks,
Embeddings,
Autoencoders

09h30,
Amphi VI

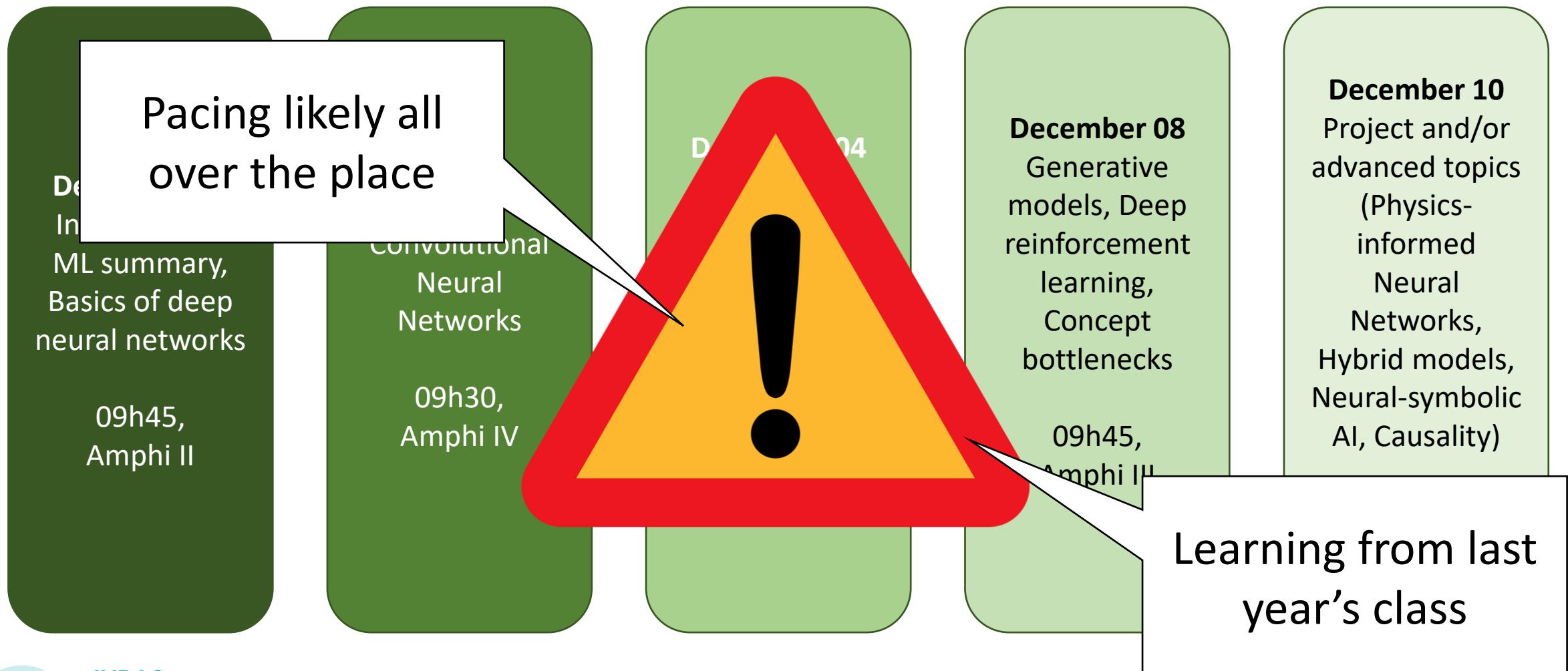
December 08
Generative
models, Deep
reinforcement
learning,
Concept
bottlenecks

09h45,
Amphi III

December 10
Project and/or
advanced topics
(Physics-
informed
Neural
Networks,
Hybrid models,
Neural-symbolic
AI, Causality)

09h30,
Amphi III

> (Tentative) Planning



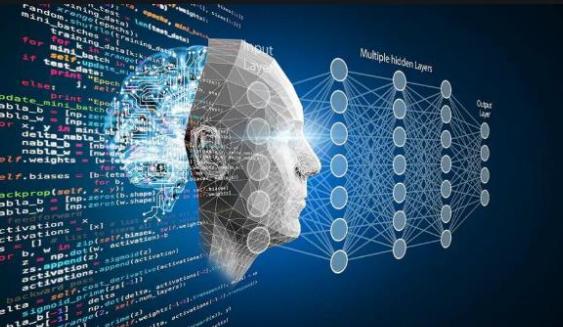
> Class material

<https://albertotonda.github.io>

Alberto Tonda

Bio News Research Projects Publications Teaching Experience

Teaching



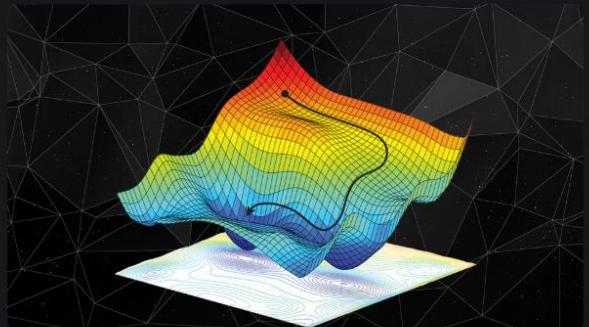
A diagram illustrating a deep learning neural network. It features a profile of a human head facing right, with a complex web of lines extending from its brain area to a series of circular nodes representing hidden layers. The text "Input Layer", "Multiple hidden layers", and "Output Layer" is overlaid on the diagram. To the left of the diagram, there is a block of Python code.

DEEP LEARNING

Deep learning in practice with pytorch

Class on deep learning for Ph.D. students enrolled in Université Paris-Saclay, taught in English

Apr 7, 2025



A 3D surface plot showing a landscape of hills and valleys, representing an optimization function. The surface is colored with a gradient from blue to red, indicating varying values across the search space. The plot is set against a dark background with a grid.

OPTIMIZATION

Optimization algorithms for artificial intelligence

Class on optimization for Ph.D. students enrolled in Université Paris-Saclay, taught in English

Apr 7, 2025

> References

“When you are copying from one source, it’s *plagiarism*; when you are copying from multiple sources, it’s **research**. ”

-- Prof. Notestein, Yale, 1929



Prof. **Vincent Guigue**, AgroParisTech & Sorbonne University,
here depicted with cool sunglasses, <https://vguigue.github.io/>

- “Practical deep learning”, <https://jxmo.io/deep-learning-workshop/>
- “Understanding deep learning”, <https://udlbook.github.io/udlbook/>
- “Deep learning with pytorch”, <https://github.com/deep-learning-with-pytorch/>

