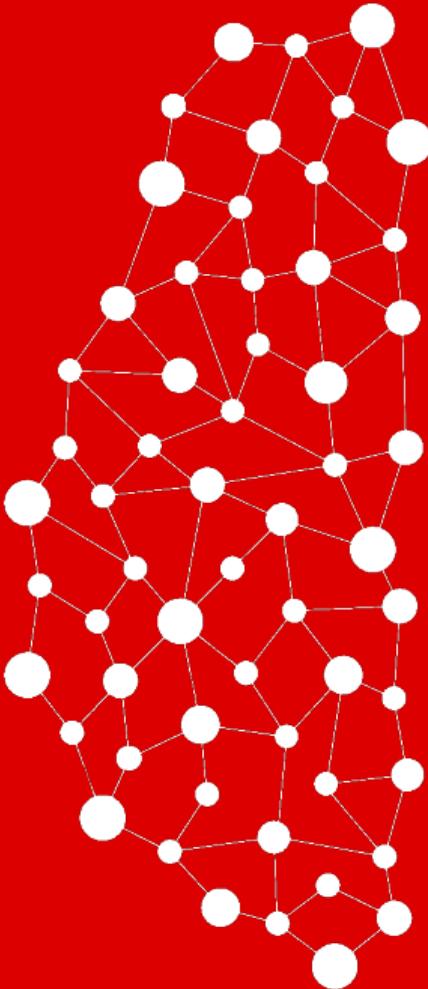


Bridging the translational gap for artificial intelligence in clinical neuroimaging



Esten H. Leonardsen

Post-doctoral research fellow at the
Department of Psychology, University of Oslo
Chief Scientific Officer, baba.vision



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What is artificial intelligence?

What is AI?

Artificial Intelligence (AI) is the field of computer science devoted to creating systems that can perform tasks that typically require human intelligence. These tasks include perception (e.g., recognizing images or speech), reasoning (e.g., solving problems, making decisions), learning (e.g., adapting from data and experience), and interaction (e.g., understanding natural language, generating responses, collaborating with humans).

At a high level, AI can be divided into:

- Symbolic AI (knowledge-based, rule-based, expert systems): Uses explicit rules, logic, and symbolic representations to encode reasoning.
- Machine Learning (data-driven): Learns patterns from data, with subfields like deep learning, reinforcement learning, and probabilistic modeling.

AI is not a single method but a spectrum of approaches for replicating or augmenting cognitive functions in machines.

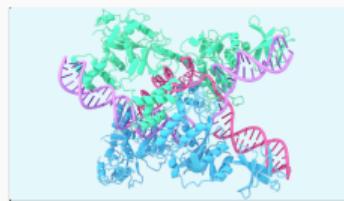
Would you like me to give you a concise working definition (one sentence) or a taxonomy of types of AI (narrow, general, superintelligence, etc.)?

Ask anything

ChatGPT



Spot



AlphaFold

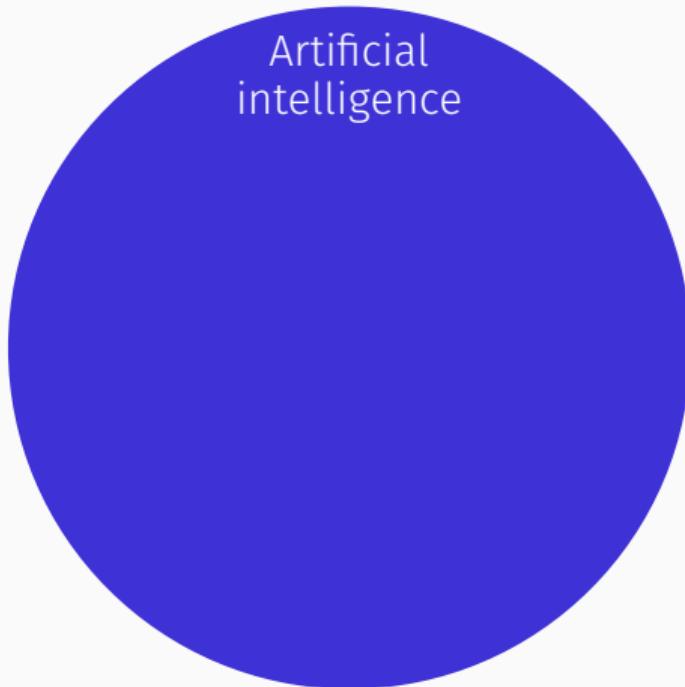


IX Neo



AlphaZero

What is artificial intelligence?

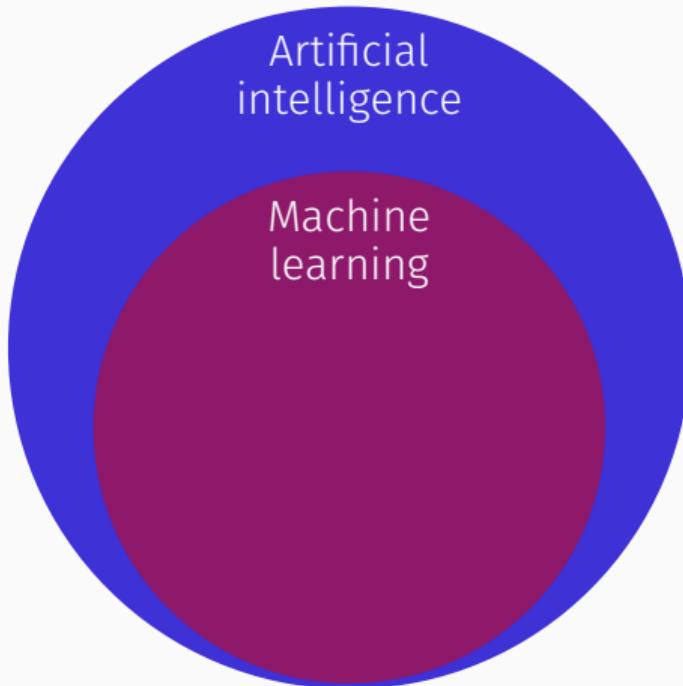


Artificial intelligence:

Machines that solve tasks requiring some kind of (often human-like) intelligence.



What is artificial intelligence?



Artificial intelligence:

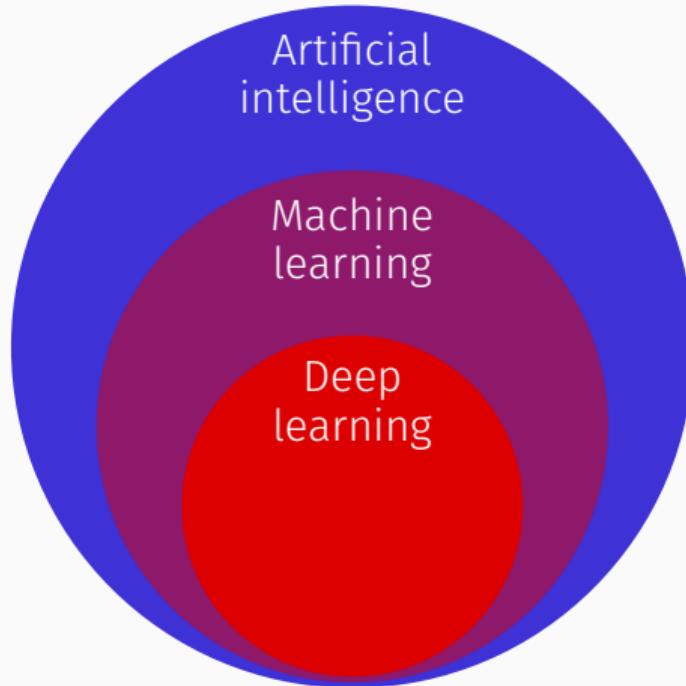
Machines that solve tasks requiring some kind of (often human-like) intelligence.

Machine learning:

Machines that learn to solve tasks by learning patterns from data



What is artificial intelligence?



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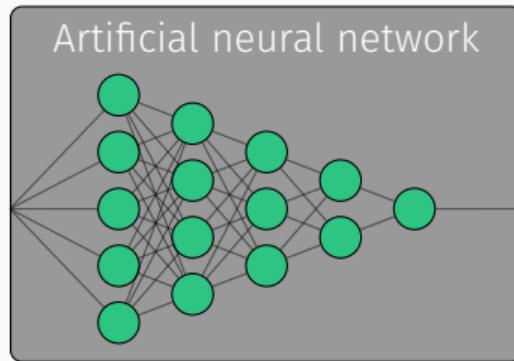
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Machines that learn to solve tasks by learning patterns from data

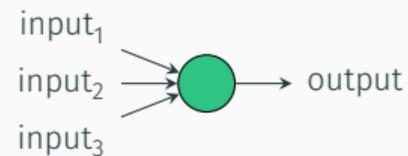
Deep learning:

Machine learning approaches relying on artificial neural networks (inspired by the human brain)

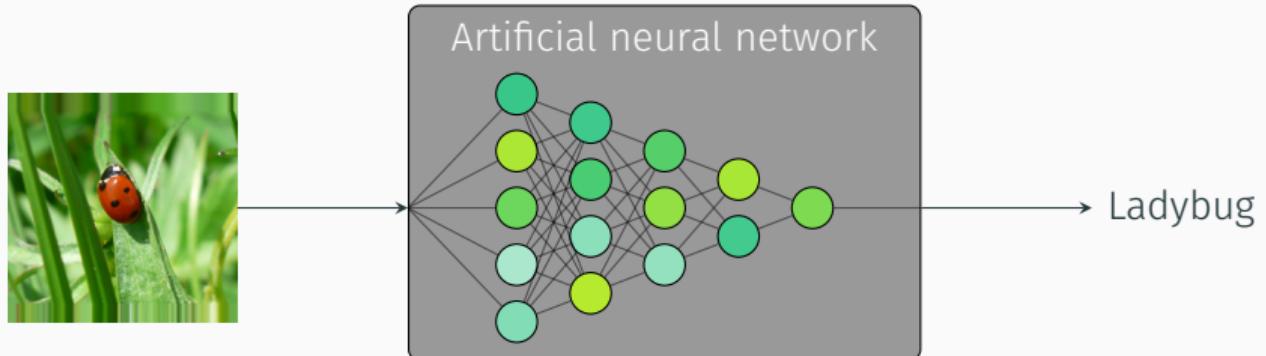
What is artificial intelligence?



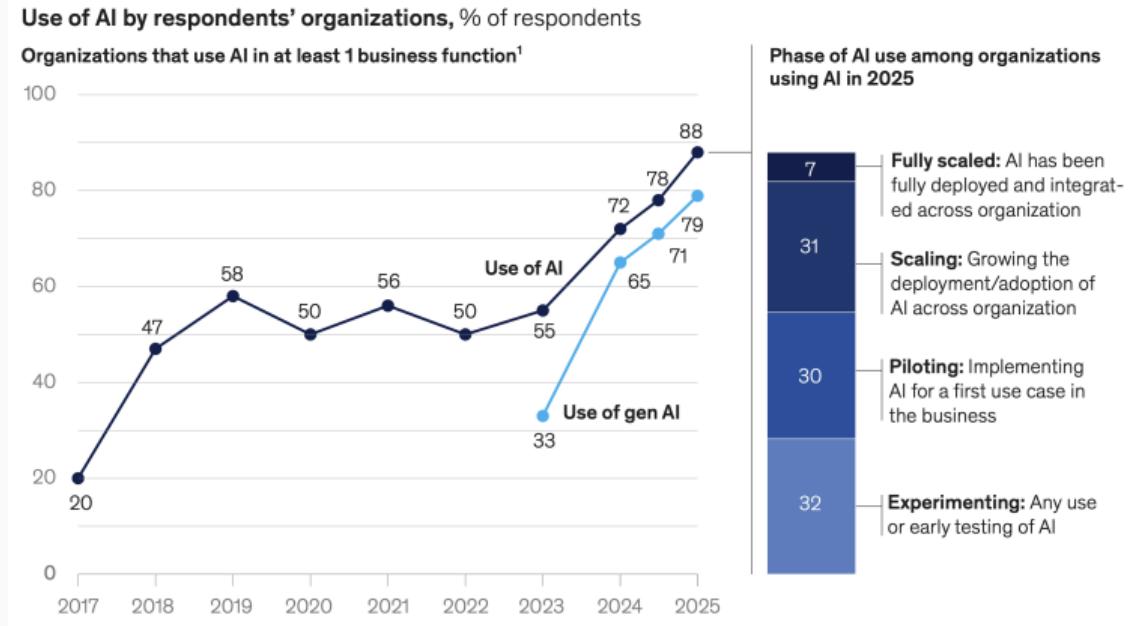
Artificial neuron



What is artificial intelligence?



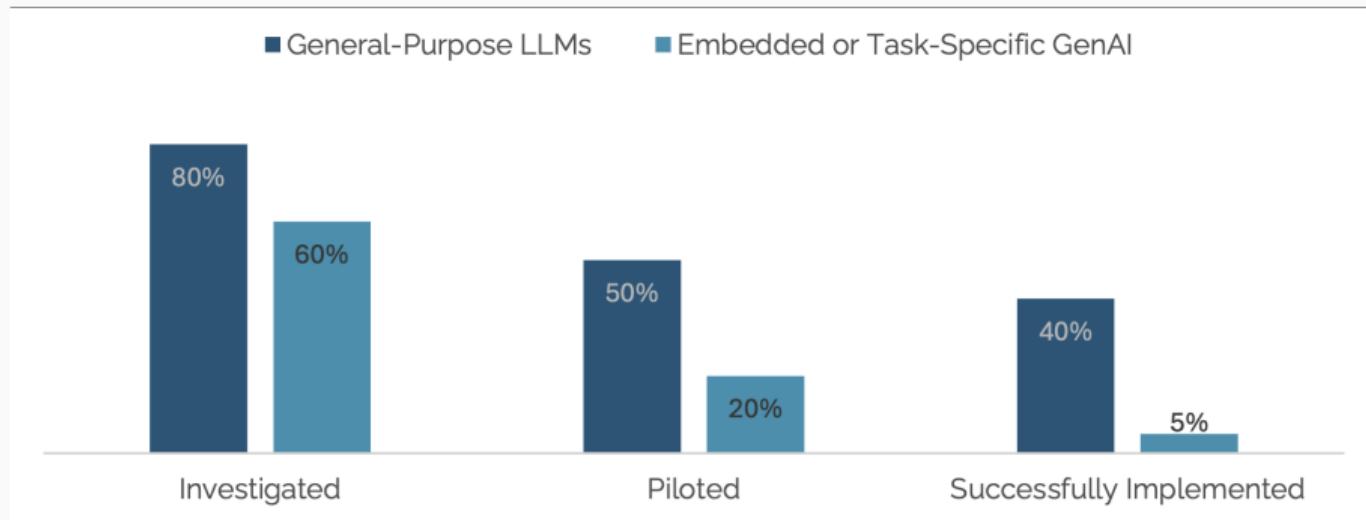
Artificial intelligence and clinical neuroimaging



The state of AI 2025, McKinsey & Company



Artificial intelligence and clinical neuroimaging



NANDA, MIT (2025). State of AI in Business 2025. Preprint at
https://www.artificialintelligence-news.com/wp-content/uploads/2025/08/ai_report_2025.pdf



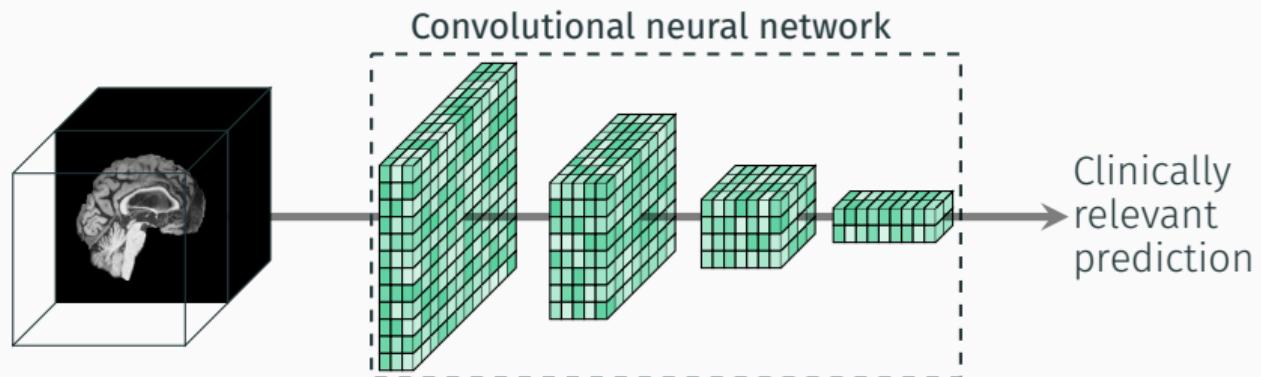
Artificial intelligence and clinical neuroimaging



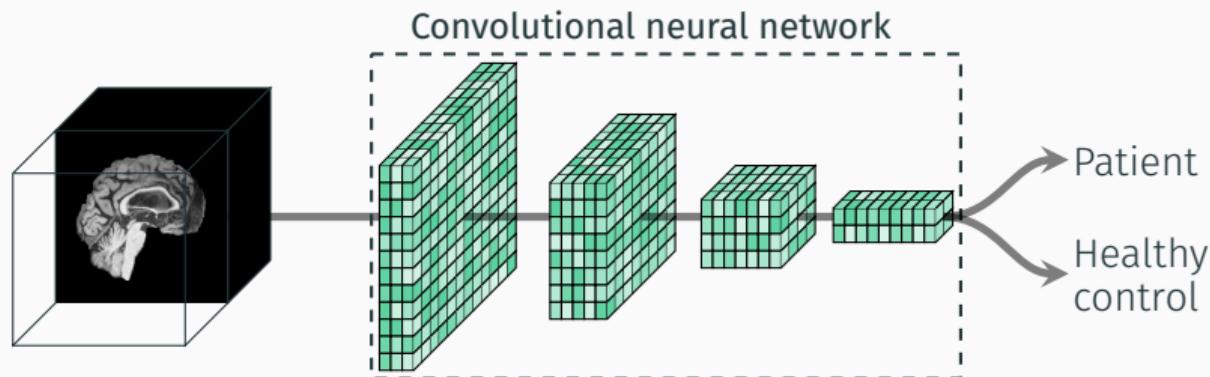
Publications containing "(neuroimaging OR clinical neuroscience) AND (artificial intelligence OR deep learning)"
from <https://pubmed.ncbi.nlm.nih.gov>



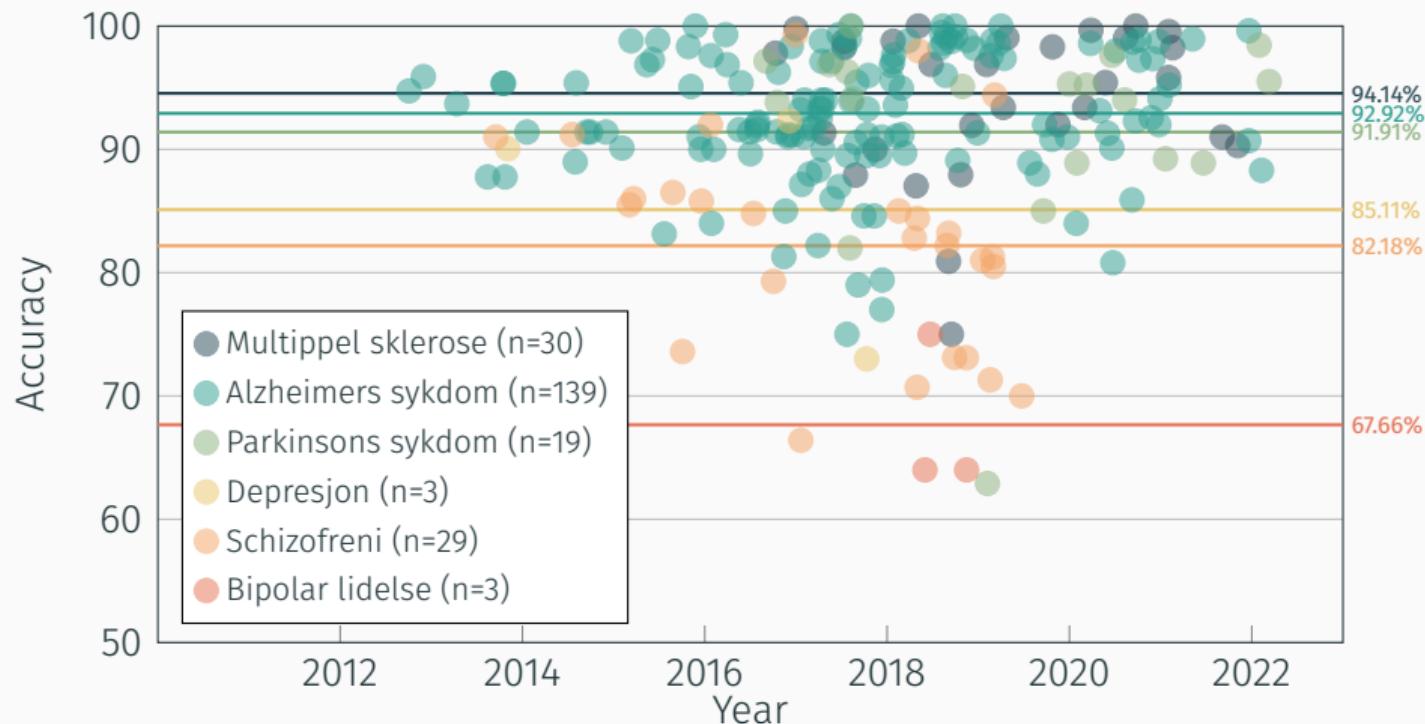
Artificial intelligence and clinical neuroimaging



Artificial intelligence and clinical neuroimaging



Artificial intelligence and clinical neuroimaging

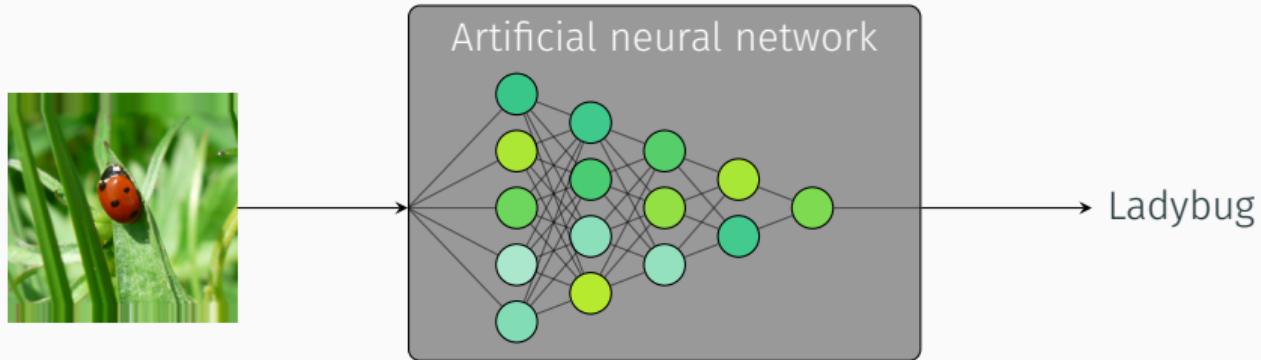


The black-box problem of artificial neural networks

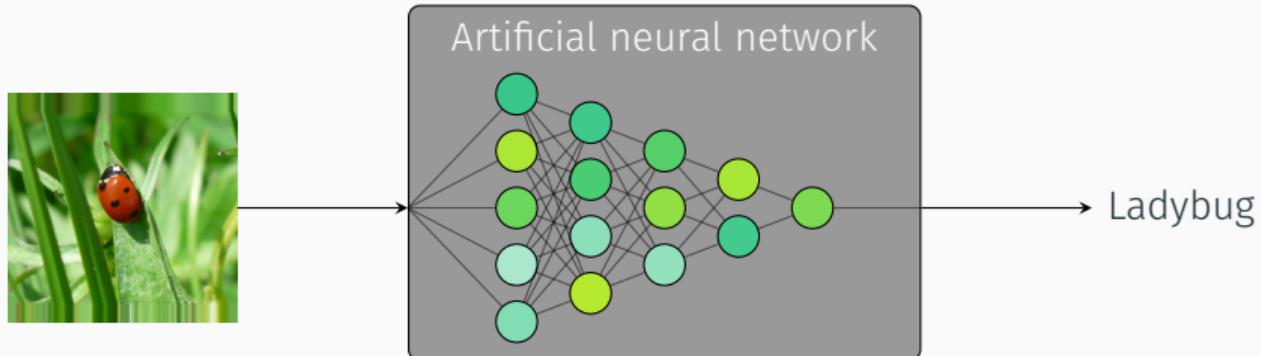


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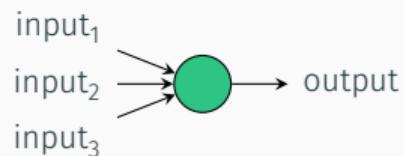
Understanding artificial neural networks



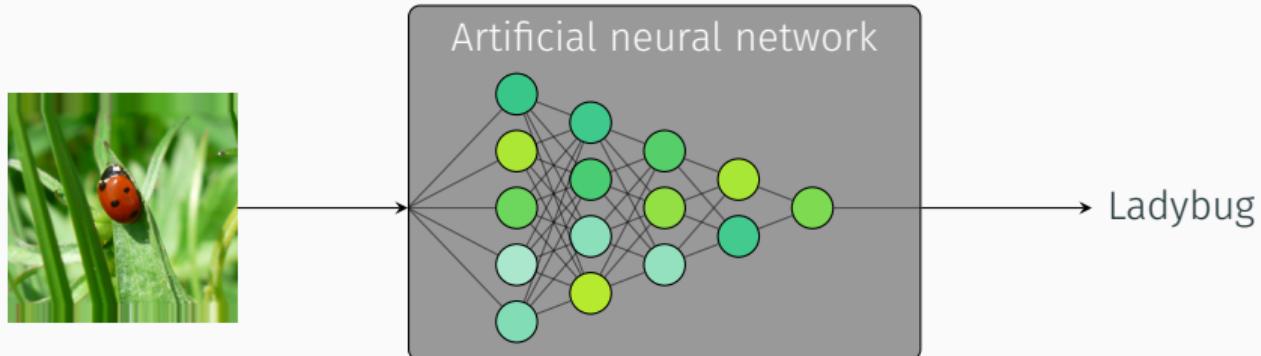
Understanding artificial neural networks



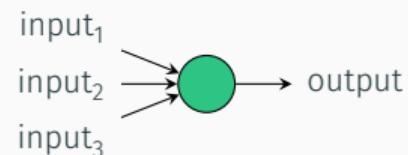
Artificial neuron



Understanding artificial neural networks



Artificial neuron



$$\text{output} = \max(0, b + w_1 * \text{input}_1 + w_2 * \text{input}_2 + w_3 * \text{input}_3)$$



Understanding artificial neural networks



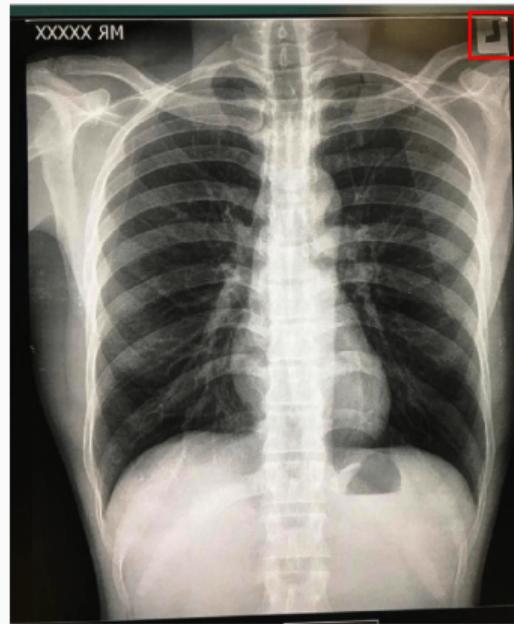
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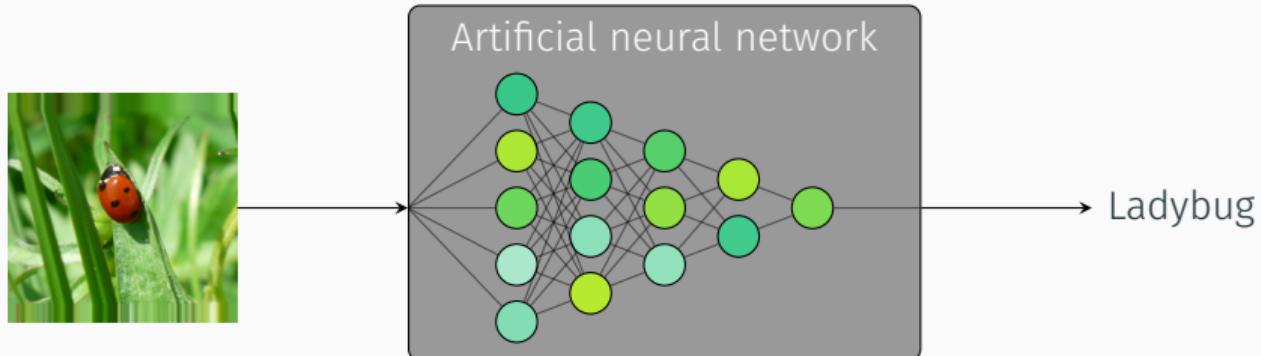
Understanding artificial neural networks



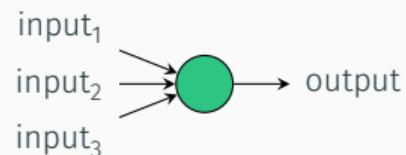
Banerjee, I., Bhattacharjee, K., Burns, J. L., Trivedi, H., Purkayastha, S., Seyyed-Kalantari, L., ... & Gichoya, J. (2023). "Shortcuts" causing bias in radiology artificial intelligence: causes, evaluation, and mitigation. *Journal of the American College of Radiology*, 20(9), 842-851.



Understanding artificial neural networks



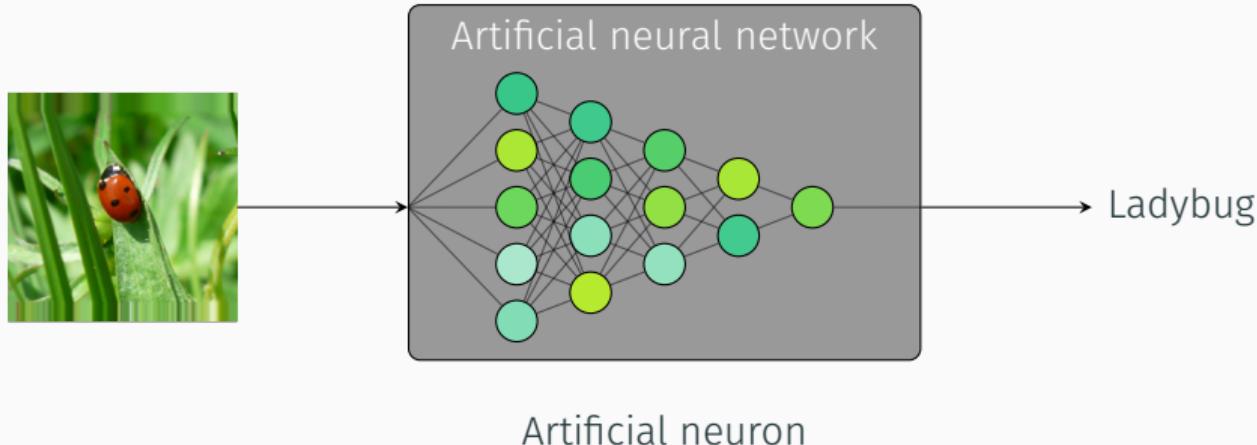
Artificial neuron



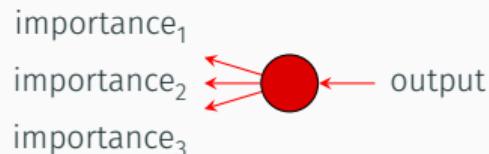
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Understanding artificial neural networks



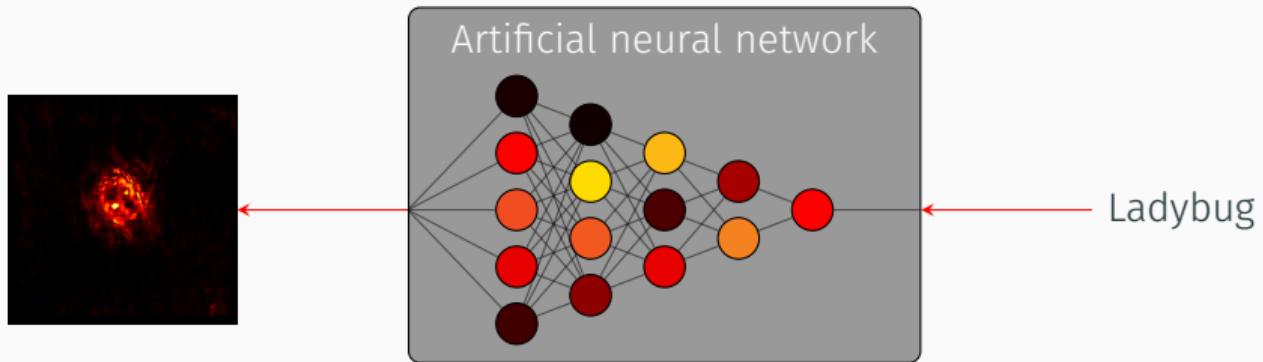
Artificial neuron



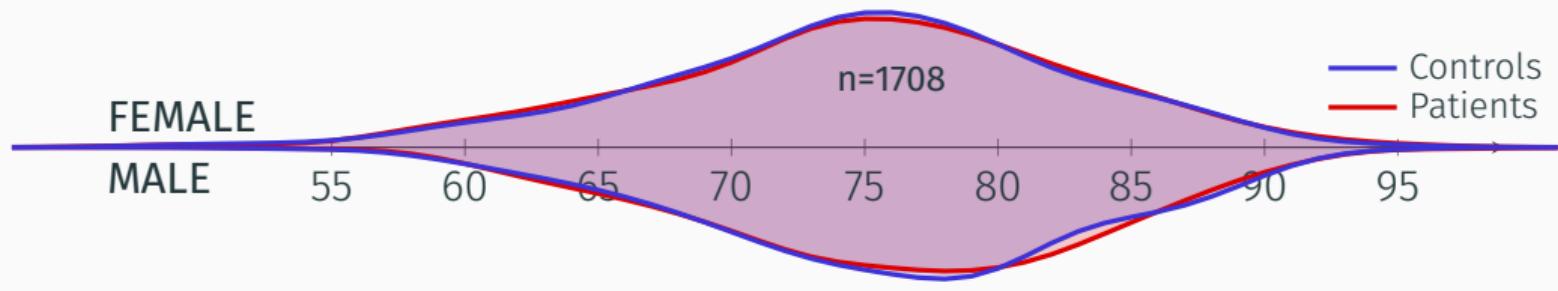
$$\text{importance}_i = \frac{\text{input}_i * w_i}{\sum \text{input}_j * w_j} * \text{output}$$



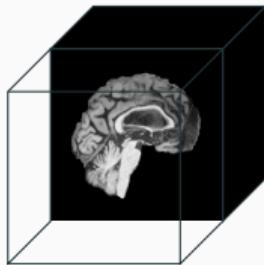
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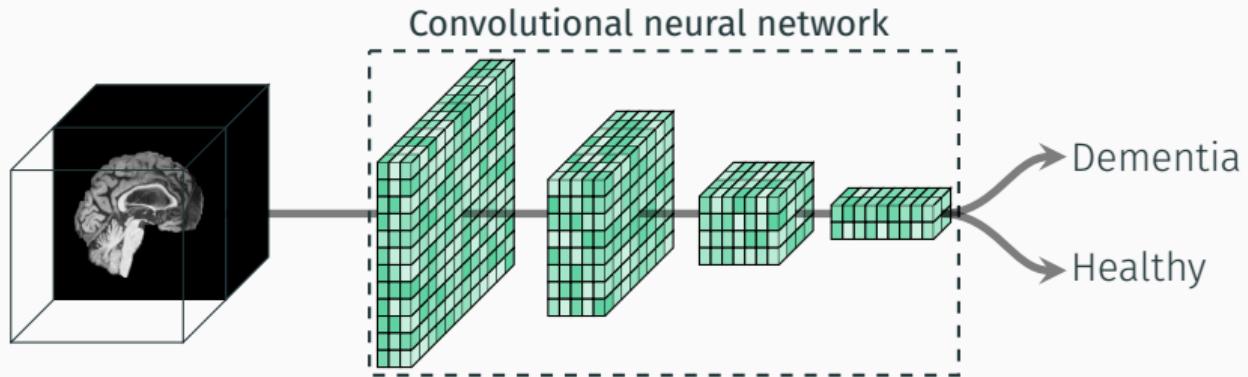
Explainable artificial intelligence and dementia



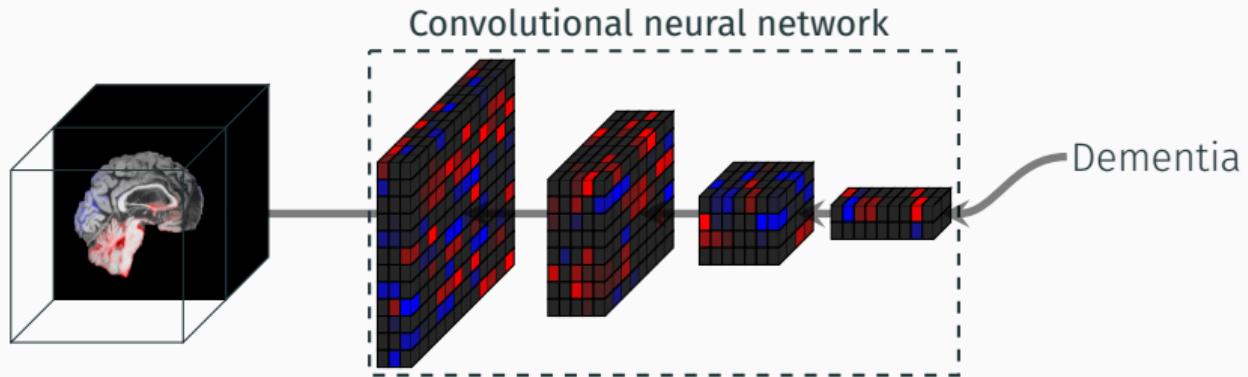
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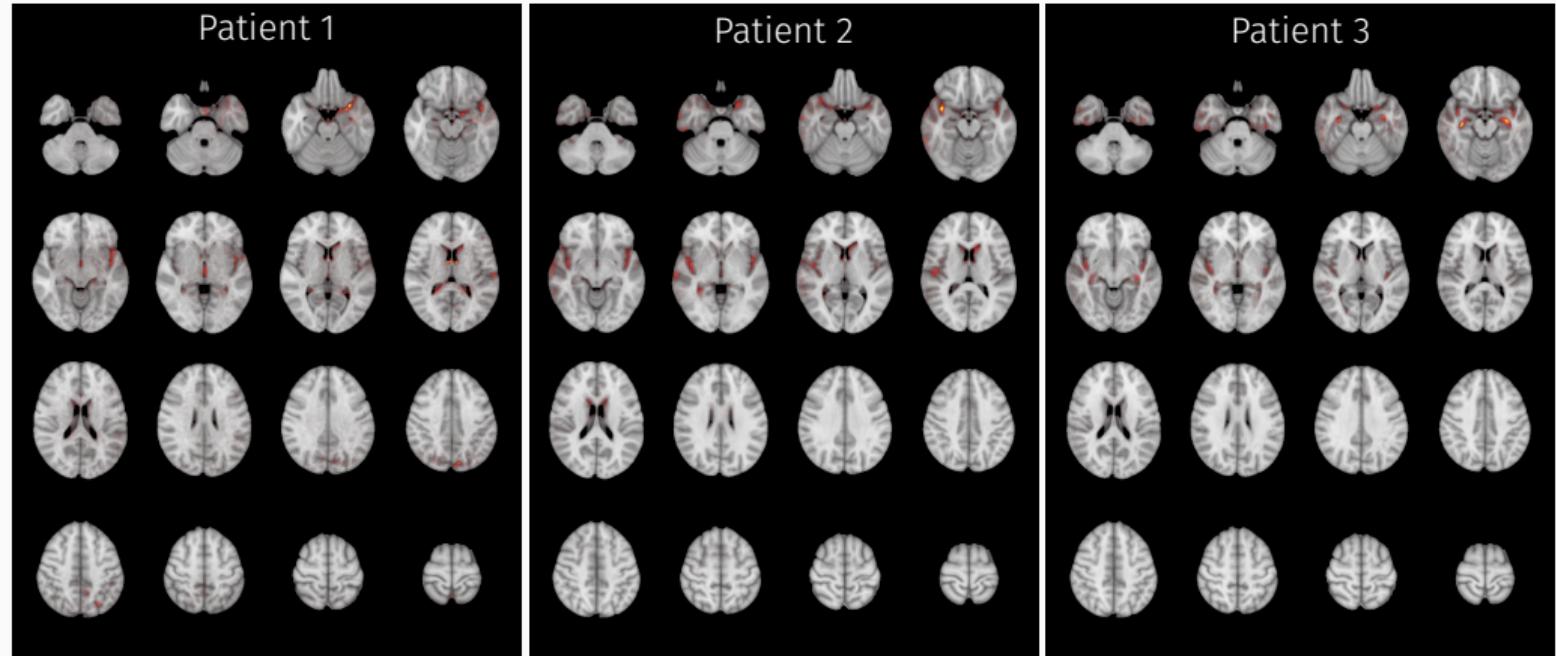
Explainable artificial intelligence and dementia



Explainable artificial intelligence and dementia

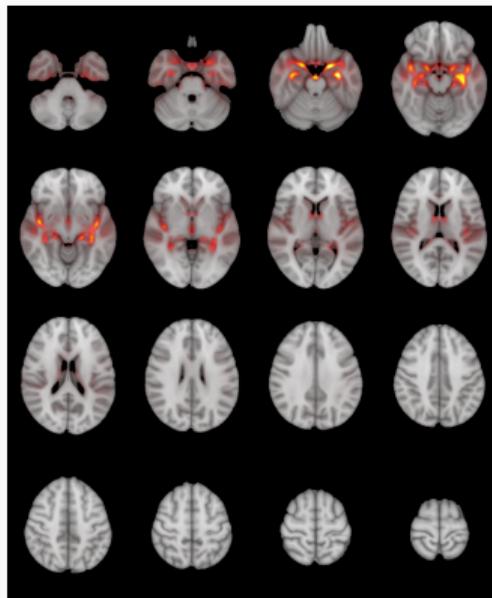


Explainable artificial intelligence and dementia



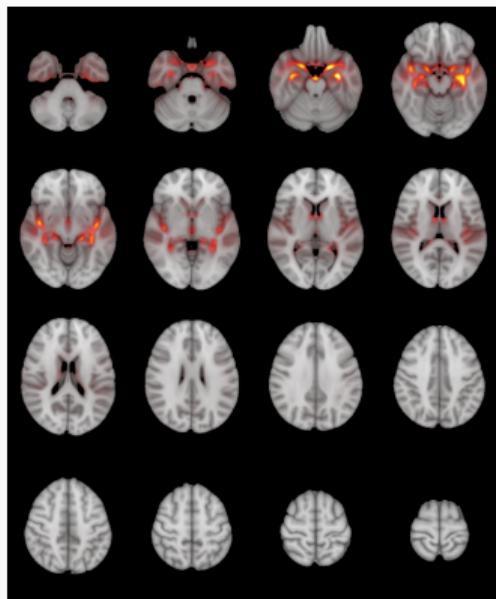
Explainable artificial intelligence and dementia

Explainable AI

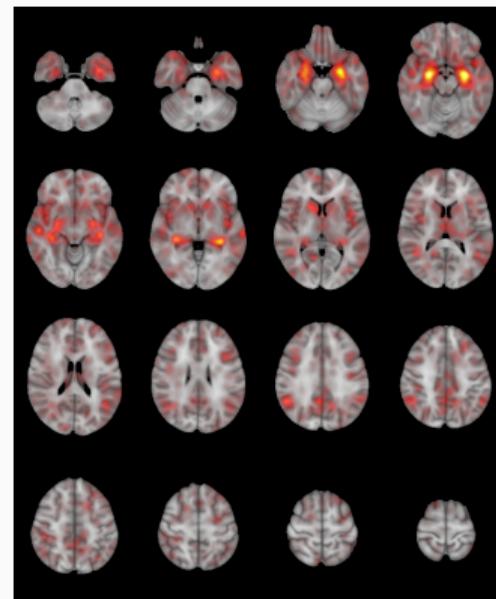


Explainable artificial intelligence and dementia

Explainable AI



Human researchers



The black-box problem of artificial intelligence

Although artificial neural networks very often result in accurate predictions, their opaque nature makes it hard to understand their underlying decision processes.

- Shortcutting the problem by relying on superficial cues rather than genuine understanding can give rise to "Clever Hans"-predictors.
- Explainable artificial intelligence provides methodology for probing how these models work, building trust and potentially enabling clinical use.



The availability of neuroimaging data



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The size of neuroimaging datasets

Dataset	Size	Description
MNIST	~70K	Handwritten digits
CIFAR	~60K	Natural images
COCO	~330K	Contextualized objects
ImageNet (21k)	~14M	Natural images
CLIP	~400M	Image-caption pairs from the internet
JFT-3B	~3B	Image-caption pairs from the internet
LAION-5B	~2.3B	Image-caption pairs from the internet



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ADNI	2,729	Clinical MRI data
TOP	2,222	Clinical MRI data
HBN	1,365	Population MRI data
QTIM	1,201	Population MRI data
PING	1,176	Population MRI data
CoRR	1,156	Population MRI data
HCP	1,113	Population MRI data
OASIS3	1,062	Clinical MRI data



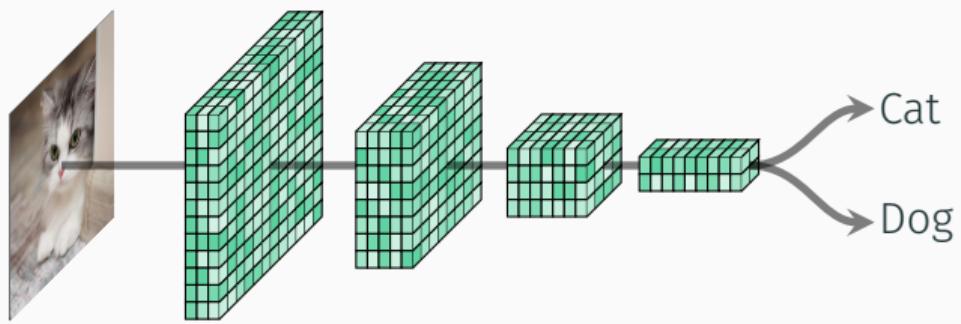
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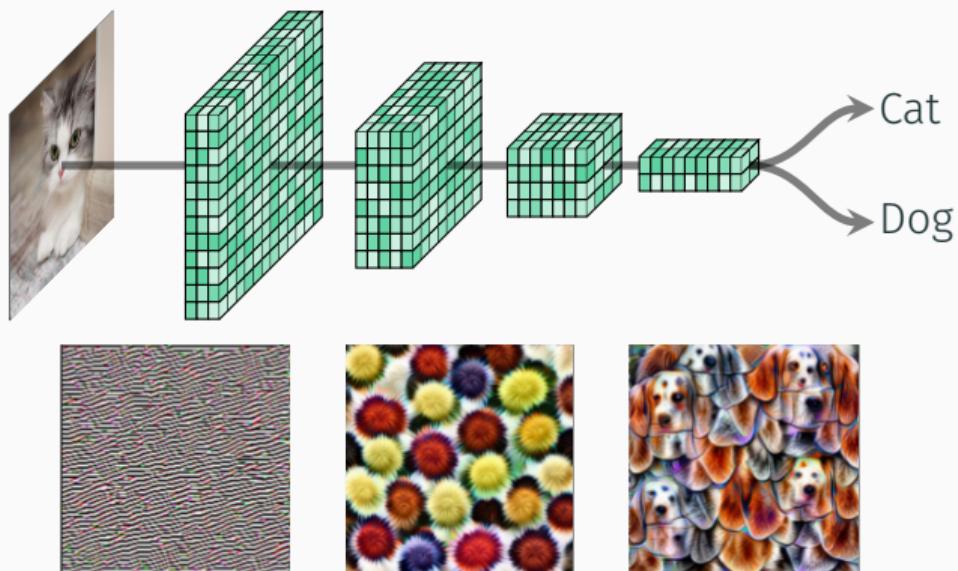
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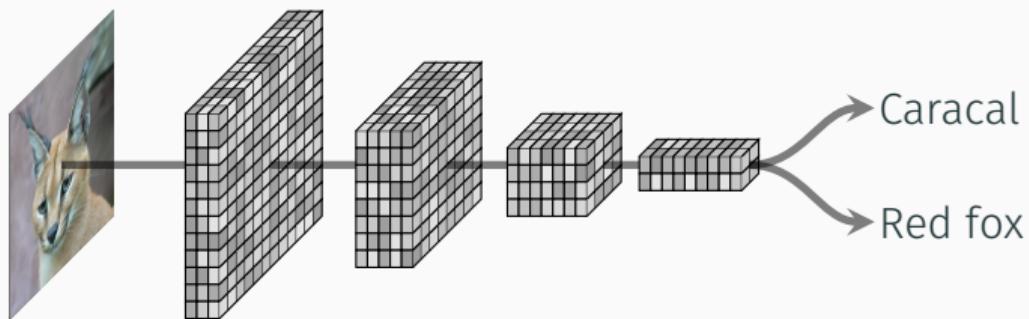
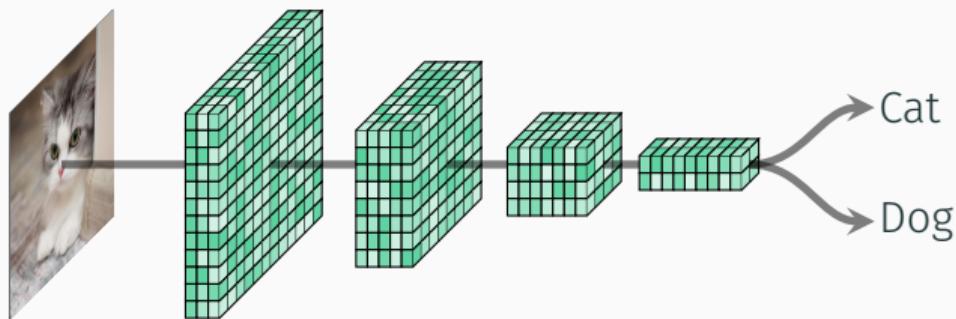
Transfer learning



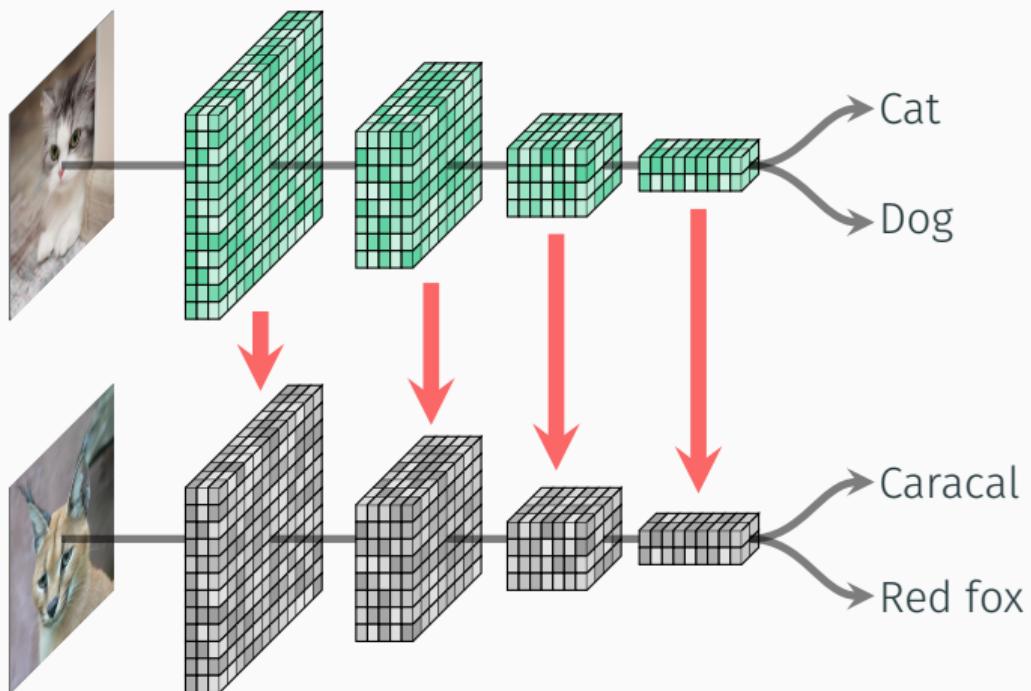
Transfer learning



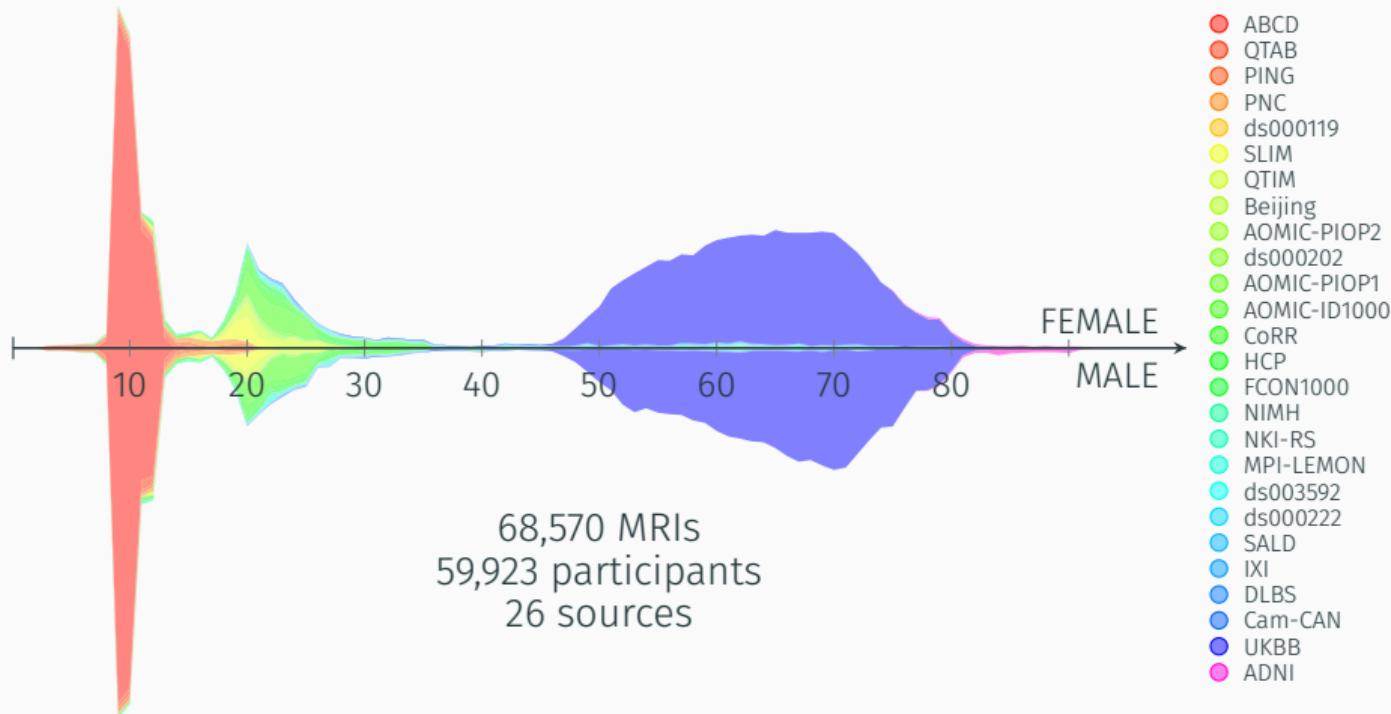
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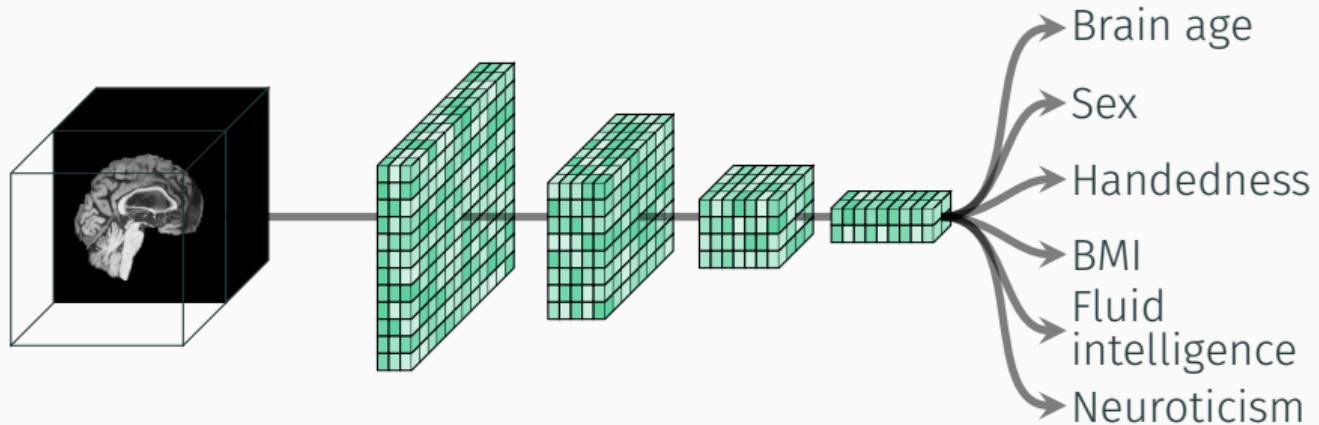
Transfer learning



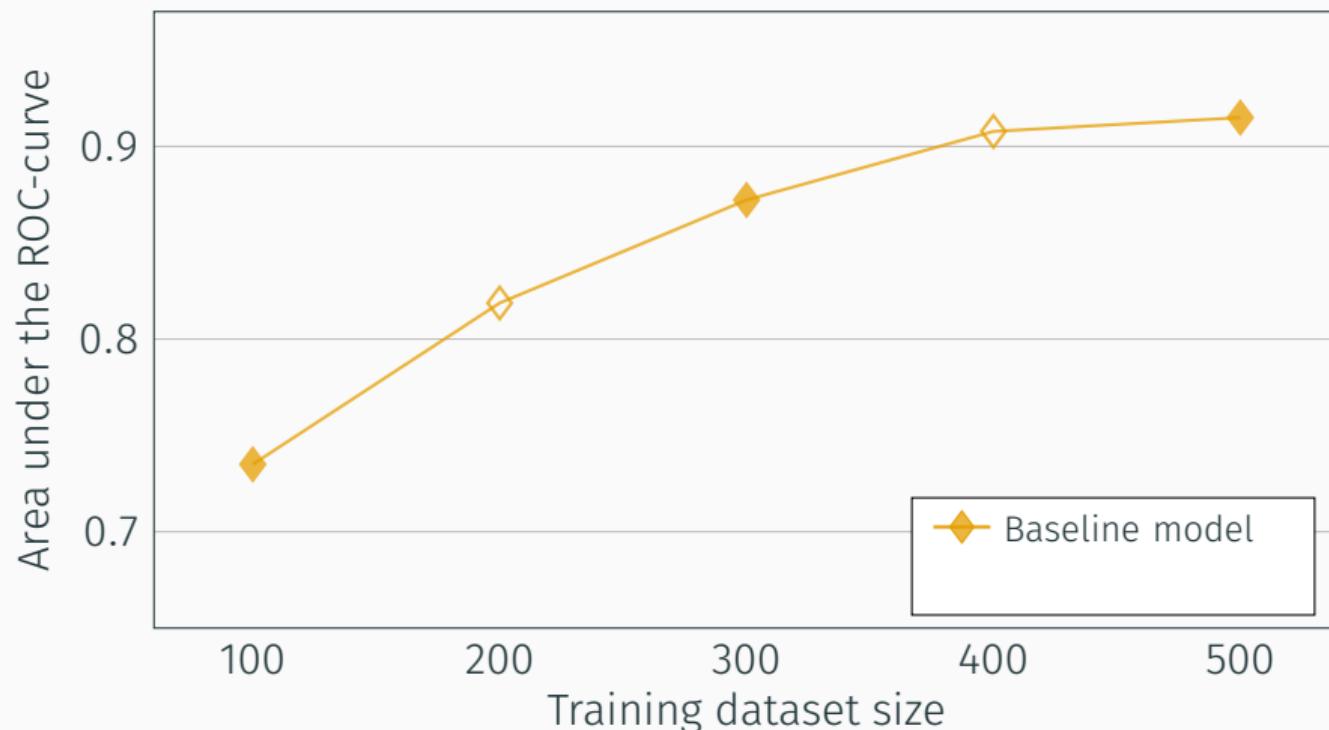
Transfer learning on neuroimaging data



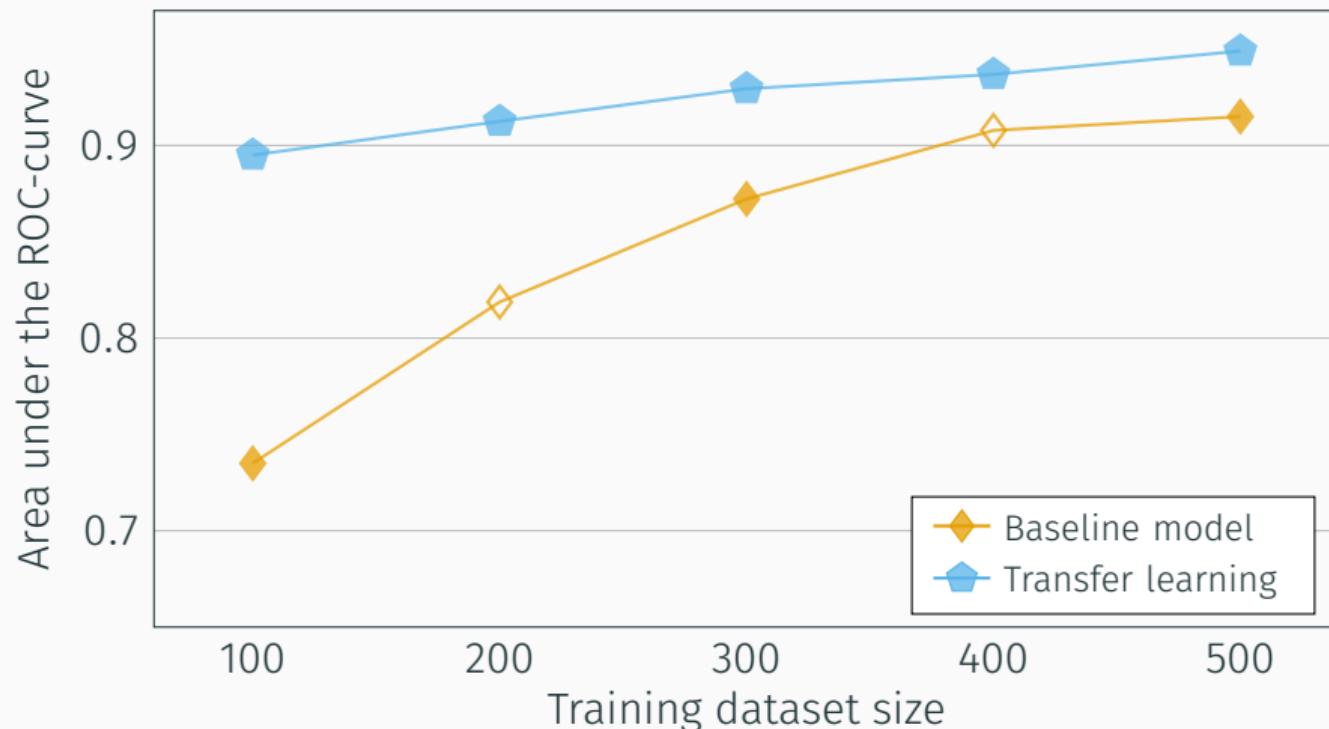
Transfer learning on neuroimaging data



Transfer learning on neuroimaging data



Transfer learning on neuroimaging data



The availability of neuroimaging data

Training modern artificial neural networks require *really* large datasets (millions or billions of training examples).

- Existing neuroimaging datasets are relatively small (tens of thousands of participants), a problem further exacerbated in clinical datasets (thousands of participants).
- Transfer learning represents a promising approach for training complex models with limited data.

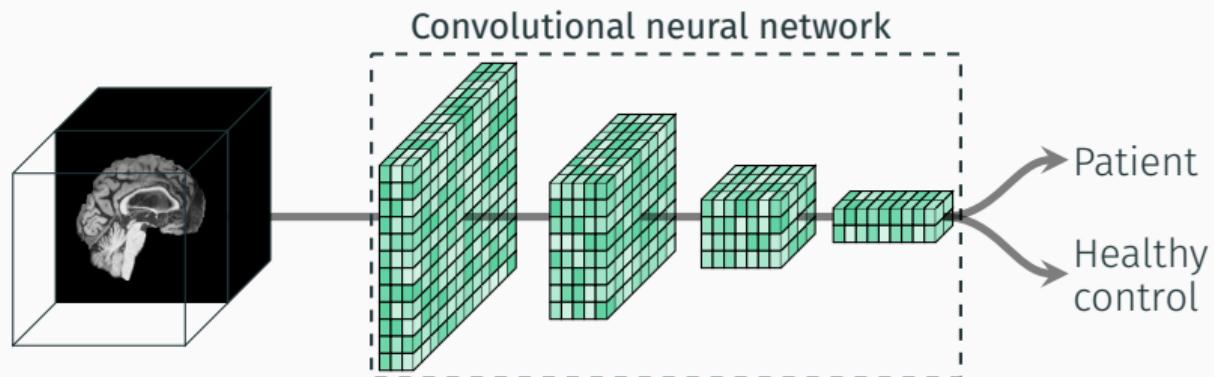


The applicability of research models

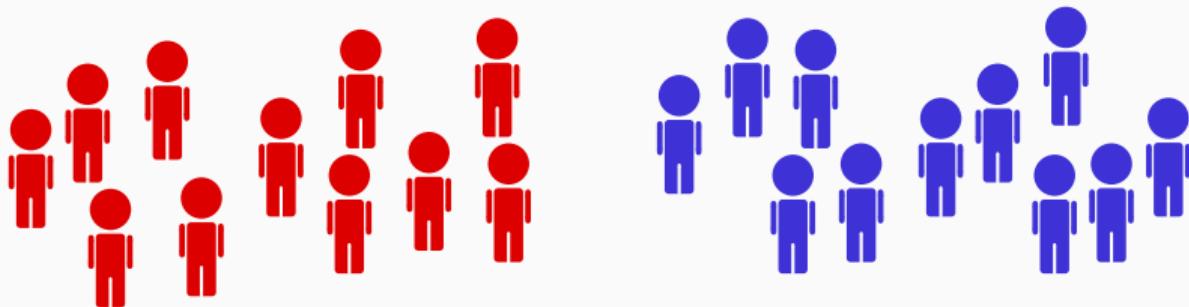


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Use-cases in neuroimaging research



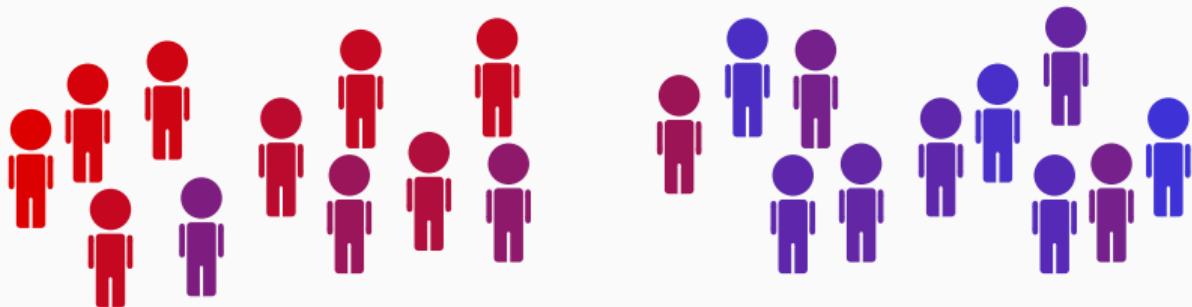
Use-cases in neuroimaging research



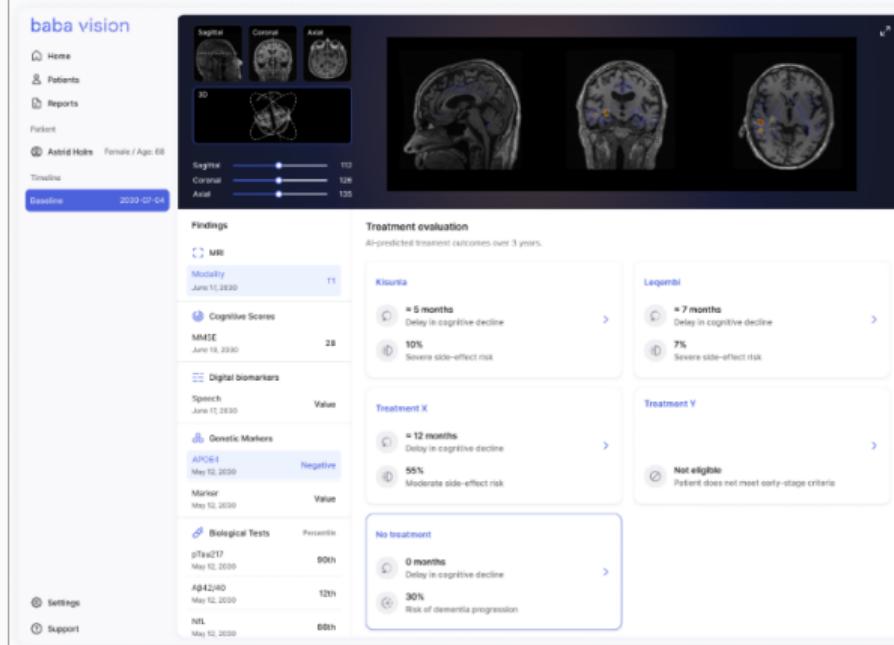
Use-cases in neuroimaging research



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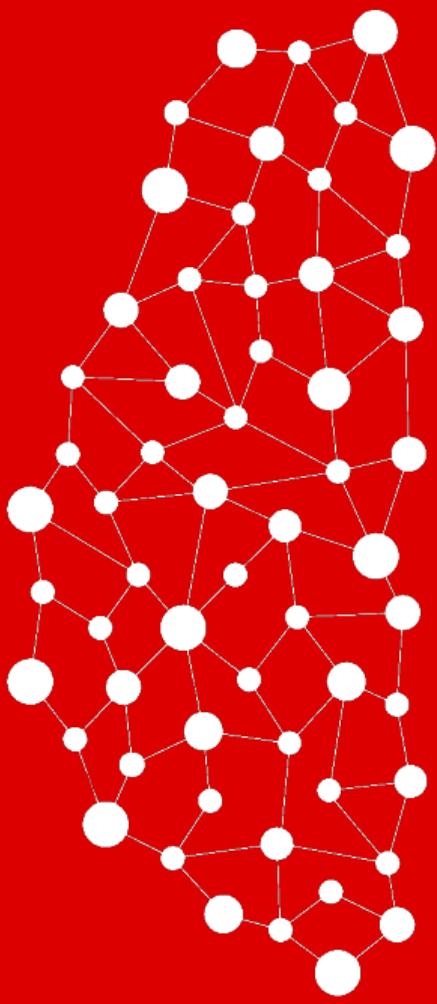
The applicability of research models

Most models trained for research are technological proof-of-concepts relying on simplified views of reality and sanitized data.

- Training models for more appropriate use-cases requires clinical insights and access to clinical data.
- **More collaboration between technologists and clinical experts are crucial.**



Thank you for your attention!
estenhl@ui.no



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