

En introduksjon til kunstig intelligens og dets rolle i medisinsk forskning

Esten H. Leonardsen

26.10.23



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1. Historikk
2. Hva er egentlig kunstig intelligens (og maskinlæring)?
3. Kunstig intelligens i hjerneforskning
4. Kunstig intelligens i kreftforskning



Turing
(1950)



Alan Turing

Turing
(1950)

MIND
A QUARTERLY REVIEW
OF
PSYCHOLOGY AND PHILOSOPHY

I.—COMPUTING MACHINERY AND
INTELLIGENCE

By A. M. TURING

1. *The Imitation Game.*

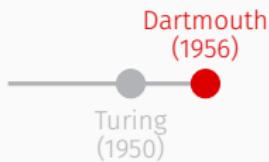
I PROPOSE to consider the question, ‘Can machines think?’ This should begin with definitions of the meaning of the terms ‘machine’ and ‘think’. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words ‘machine’ and ‘think’ are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, ‘Can machines think?’ is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.





Turing
(1950)

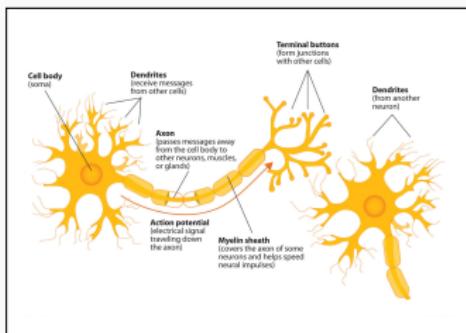
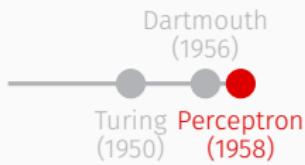




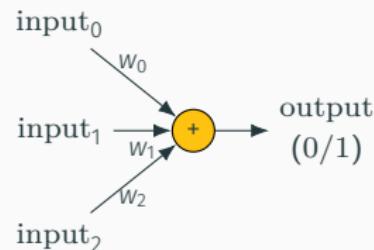
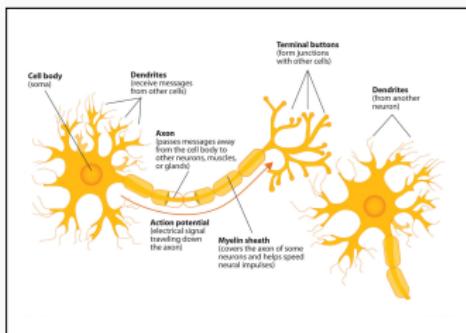
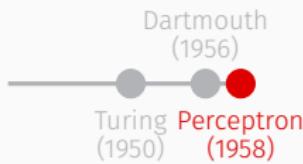
"We propose that a 2-month, 10-man study of artificial intelligence be carried out [...]. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in [...] a summer."

- Proposal, Dartmouth summer school (1956)

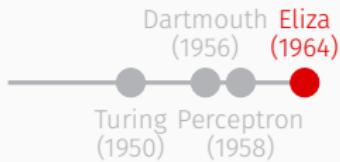
Historikk



Historikk



Historikk



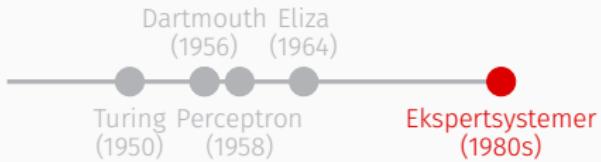
Talk to Eliza by typing your questions and answers in the input box.

```
* I'm feeling kind of sad today
> Do you believe it is normal to be feeling kind of sad today?
* No, I would prefer to be happy
> Are you sure?
* Yes
> Are you sure about that?
* Yes
> Okay, now you're repeating yourself. That is not moving us forward.
* You started
> Oh... Let's move on to something else for a bit. started?
```

TYPE HERE

<https://web.njit.edu/~fonkowit/eliza.html>





1) Patient's name: (first-last)
** FRED BRAUN
2) Sex:
** M
3) Age:
** 55
4) Are there any cultures for Fred Braun which may be related to the present illness, and
from which organisms have been grown successfully in the microbiology laboratory?
** y

(background patient data)

-----CULTURE-1-----
5) From what site was the specimen for CULTURE-1 taken?
** BLOOD
*BLOOD
6) Please give the date and time when CULTURE-1 was obtained. (mo/day/year time)
** JUN 20, 1977
The first organism isolated from the blood culture of 20-JUN-77 (CULTURE-1) will be
referred to as:

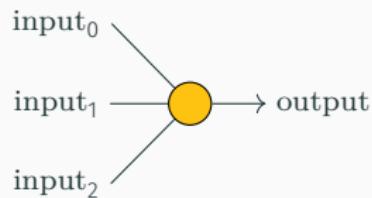
-----ORGANISM-1-----
7) Enter the laboratory-reported identity of ORGANISM-1:
** UNKNOWN
8) The stain (Gram or Ziehl-Neelsen acid-fast) of ORGANISM-1:
** NEG
9) Is ORGANISM-1 a rod or coccus (etc.)?
** ROD
10) What is the form of the individual organisms (e.g. Lancelet-shaped
for cocci, fusiform for rods, etc.)?
** FUSIFORM

{...more questions follow in order to gather sufficient information
to infer the identity and significance of the infecting organisms...}

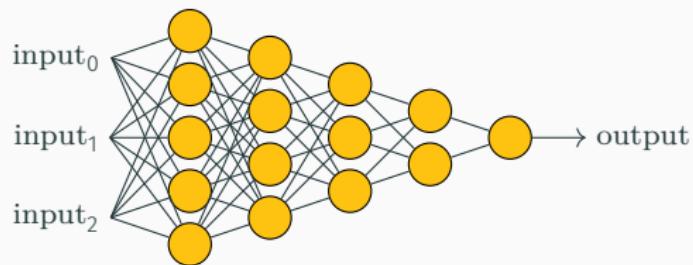
MYCIN (1972)



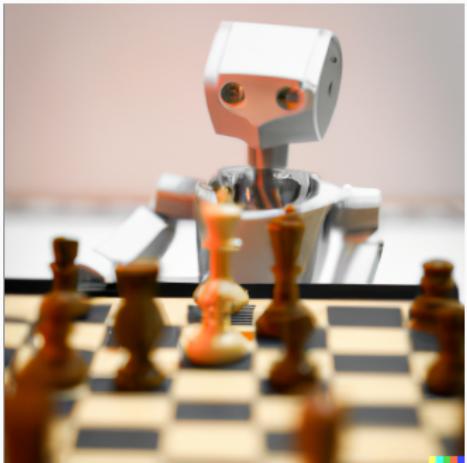
Historikk



Historikk



Historikk



DALL-E: "A robot playing chess"

- IBMs Deep Blue ble den første datamaskinen som slo sittende verdensmester i sjakk.
- Deep blue vant med $3\frac{1}{2}$ poeng mot Garry Kasparovs $2\frac{1}{2}$ etter seks spill.
- Kasparov har uttalt at "Deep Blue was intelligent the way your programmable alarm clock is intelligent."
- En kombinasjon av maskinlæring og preprogrammert kunnskap fra sjakkeeksperter.

Historikk



Katt



Historikk



Solsikke



Marihøne



Katt



Fly

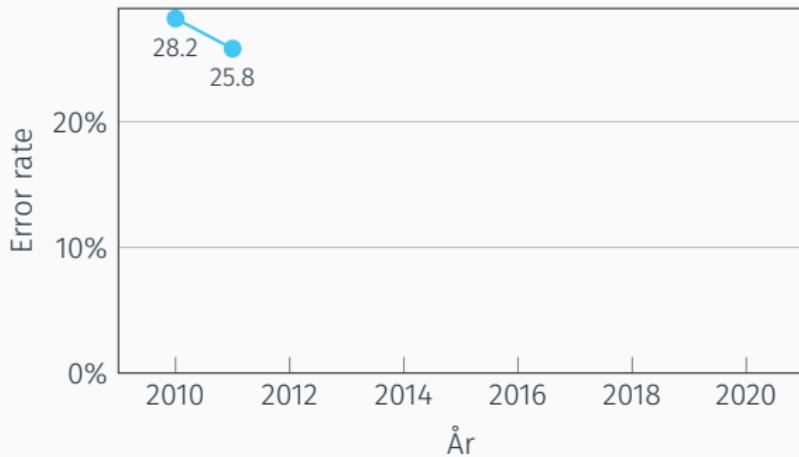


Hvithai

ImageNet: ~14m bilder fra ~22k kategorier



Historikk



Historikk

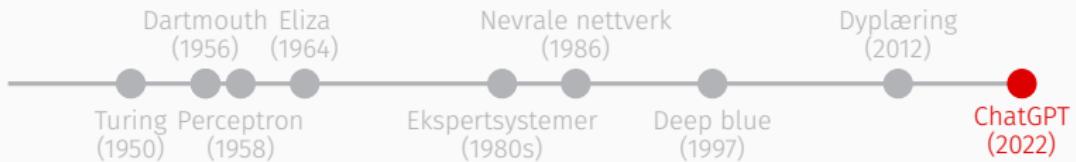


Historikk



Historikk





You
Can you help me describe some high-level commonalities between the usage of AI in cognitive neuroscience and cancer research?

ChatGPT
Absolutely, the use of Artificial Intelligence (AI) in both cognitive neuroscience and cancer research, though applied in distinct fields, shares several high-level commonalities:

- Data Analysis and Pattern Recognition:** Both fields generate massive amounts of complex data. In cognitive neuroscience, this might be functional MRI scans or EEG data, while in cancer research, it could be genomic sequences or cell imaging data. AI excels in identifying patterns and correlations within these large datasets, which might be too subtle or complex for traditional analysis methods.
- Predictive Modeling:** AI is used to develop models that can predict outcomes. In cognitive neuroscience, this might involve predicting cognitive abilities or the progression of neurological diseases based on brain imaging data. In cancer research, AI models predict disease progression, response to therapies, or patient prognosis based on genetic, cellular, or clinical data.
- Personalized Medicine:** Both fields benefit from AI's ability to tailor medical approaches to individual patients. In cognitive neuroscience, this could mean personalized treatment plans for neurological disorders. In cancer research, it facilitates the development of personalized therapy regimens based on the specific genetic makeup of a patient's tumor.
- Improving Diagnostic Accuracy:** AI algorithms can augment the diagnostic process by providing more accurate interpretations of medical imaging or laboratory results, whether it's identifying subtle changes in brain scans that might signal the onset of a disorder or detecting early signs of cancer in imaging or biopsy data.



Hva er egentlig kunstig intelligens (og maskinlæring)?



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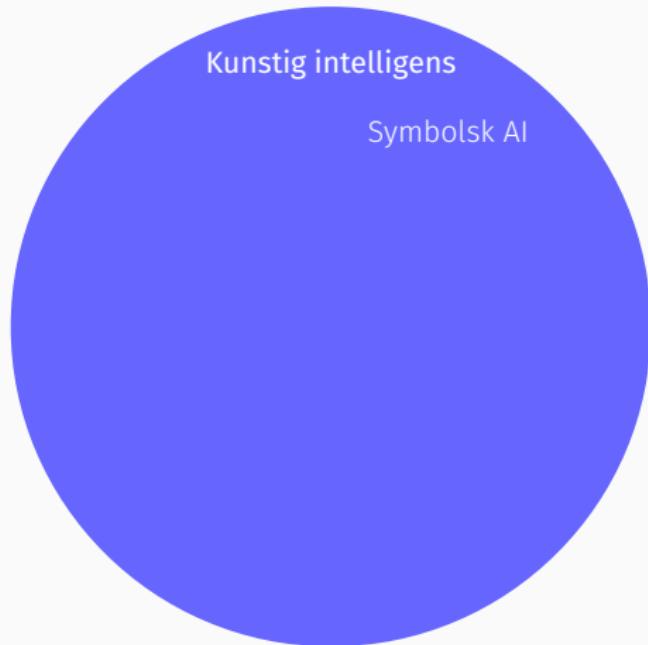
Hva er kunstig intelligens?



Kunstig intelligens (AI):
Maskiner som løser problemer
som krever intelligens



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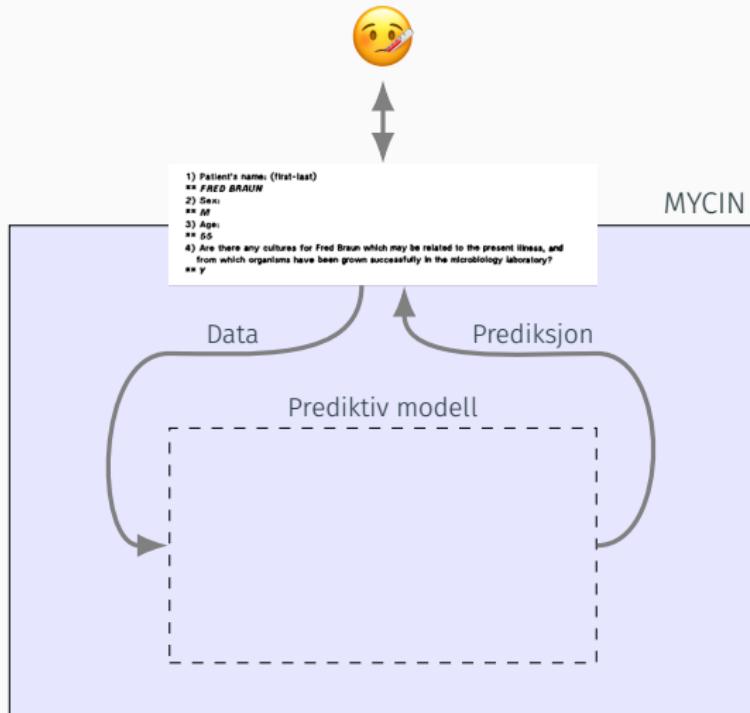


1) Patient's name: (first-last)
** FRED BRAUN
2) Sex:
** M
3) Age:
** 65
4) Are there any cultures for Fred Braun which may be related to the present illness, and from which organisms have been grown successfully in the microbiology laboratory?
** Y

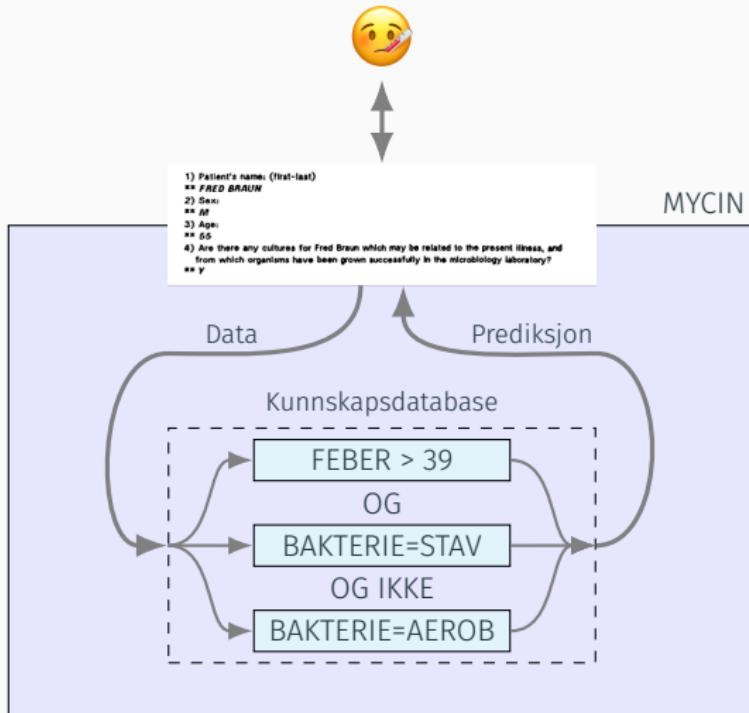
MYCIN



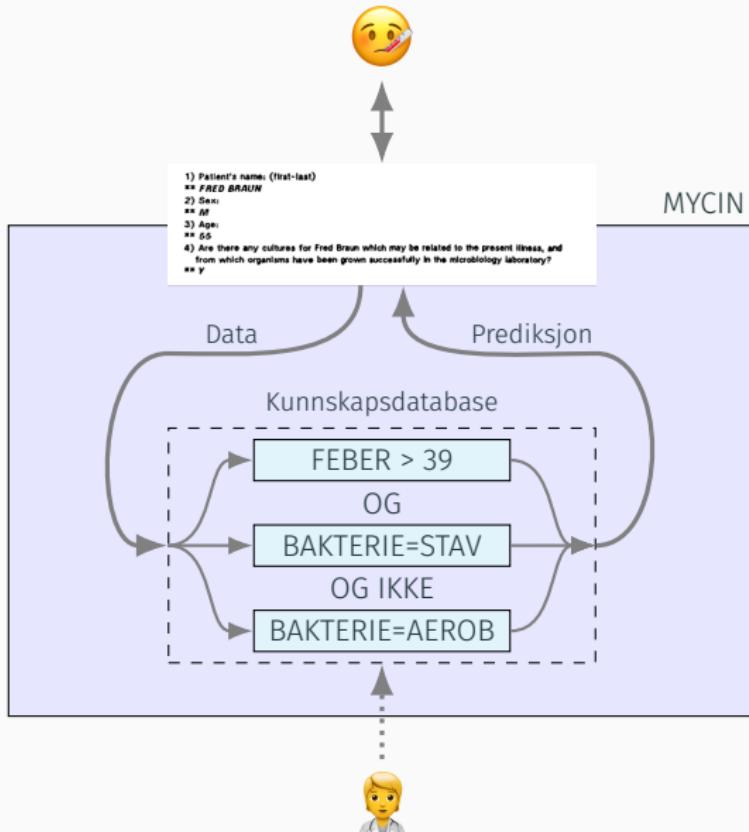
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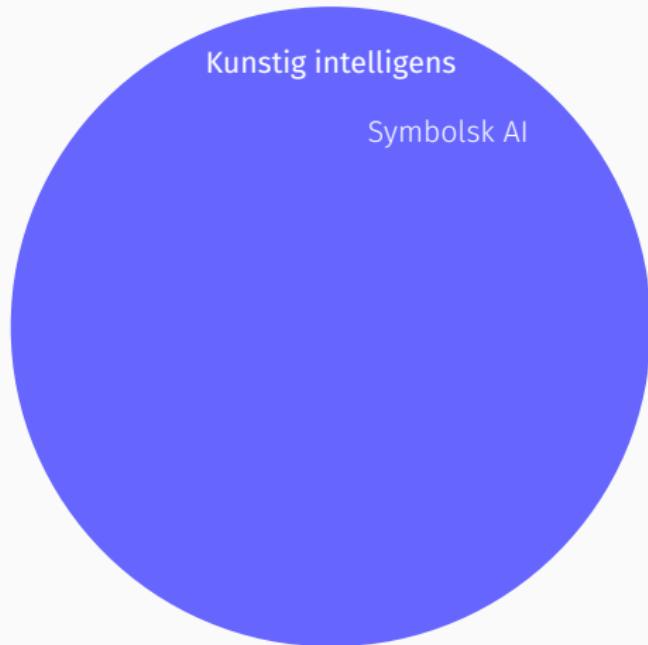
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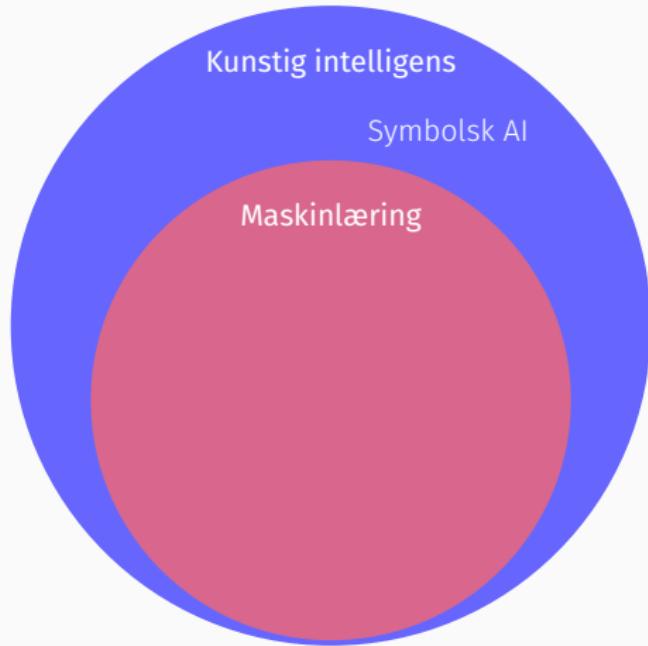
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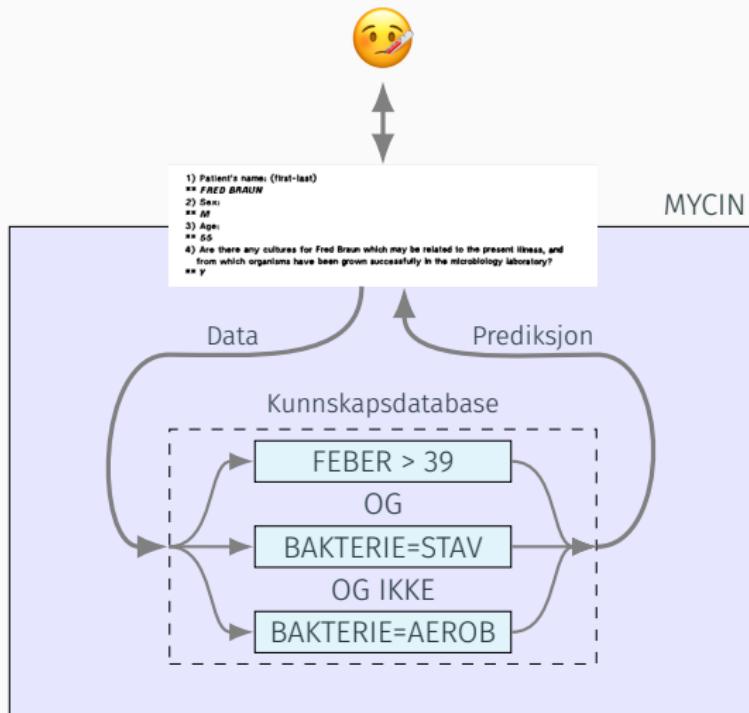


Kunstig intelligens (AI):
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Maskinlæring:
Maskiner som lærer å løse problemer
gjennom å finne mønster i data



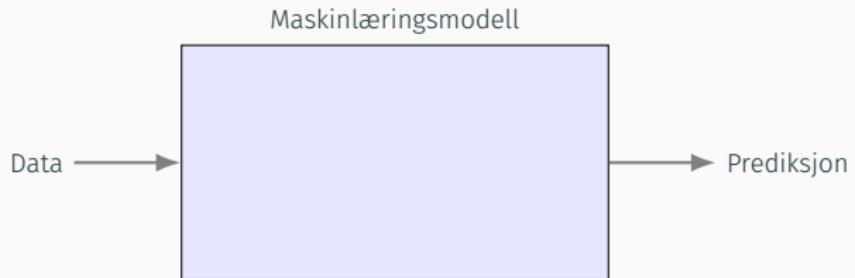
Hva er kunstig intelligens?



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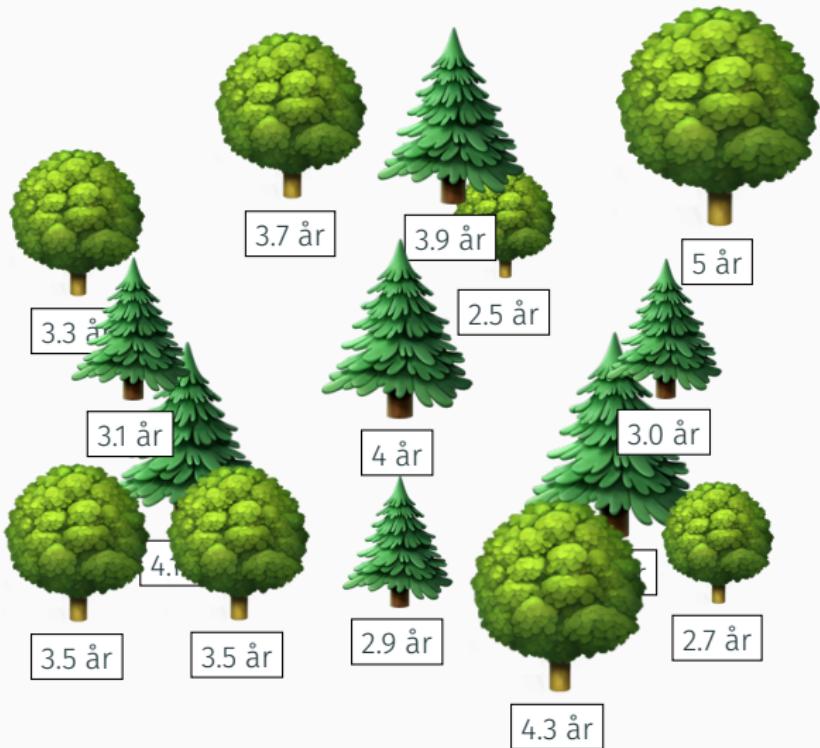
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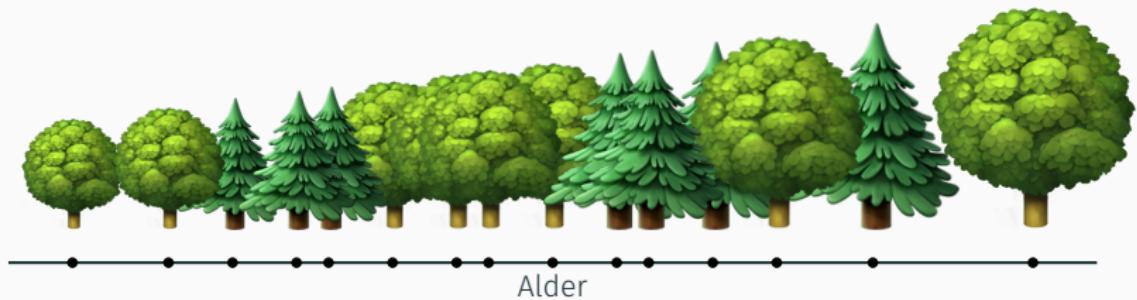
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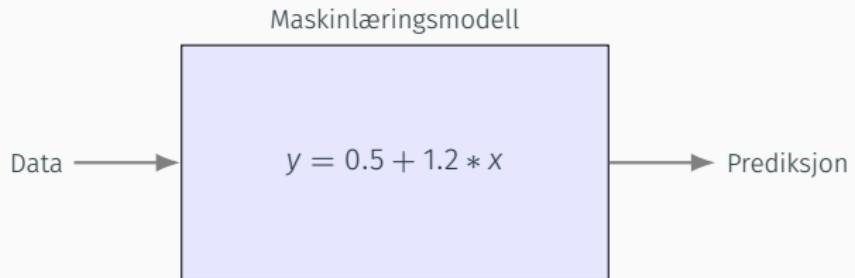
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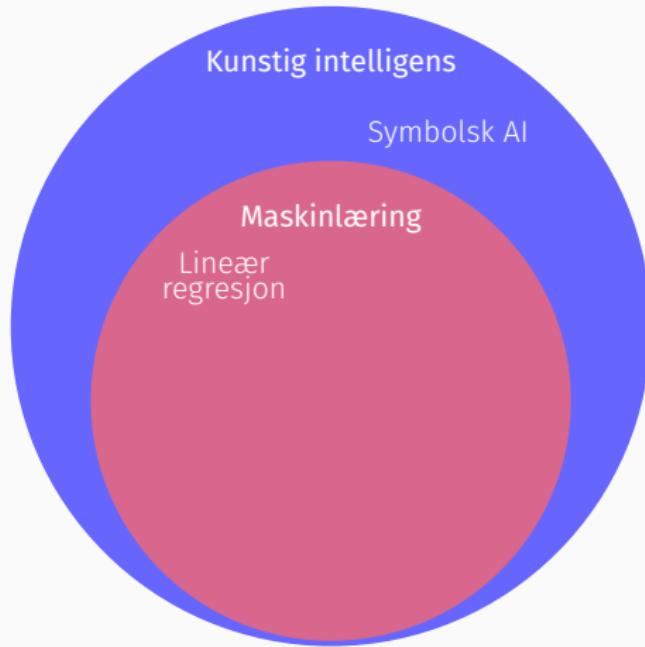
$$høyde = 0.5 + 1.2 \cdot alder$$



Hva er kunstig intelligens?



Hva er kunstig intelligens?

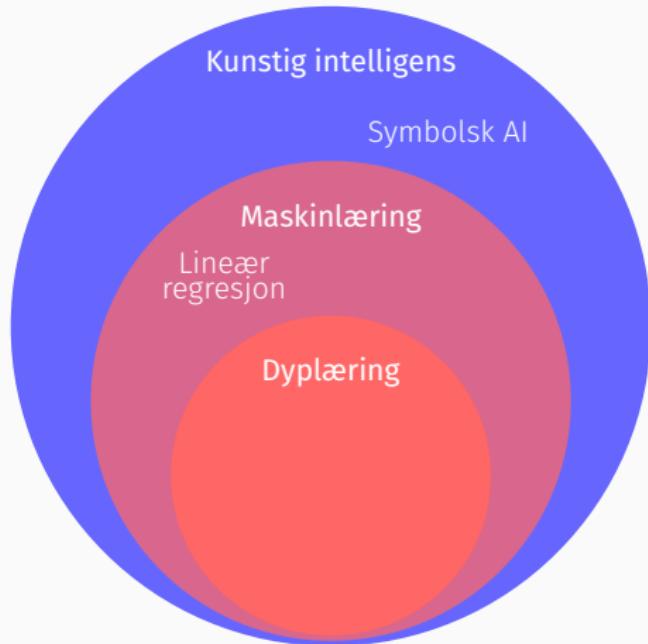


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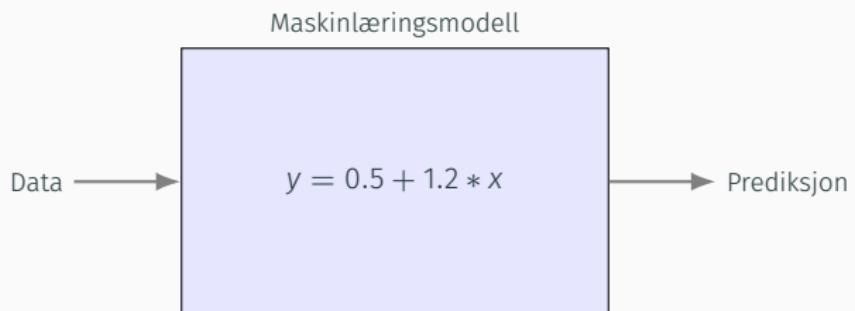
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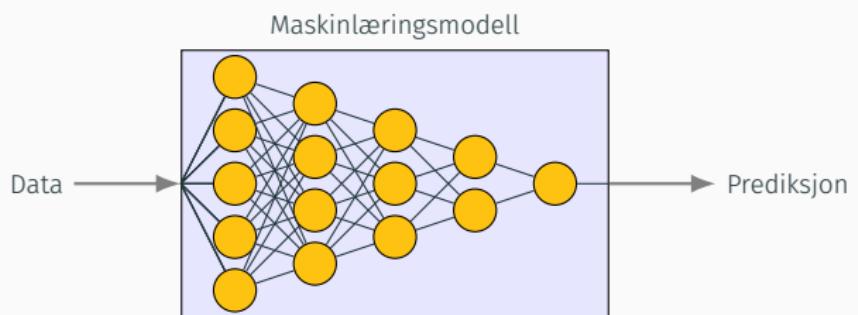
Dyplæring:
Maskinlæringsmodeller som er hierarkisk organisert (\approx dype nevrale nettverk), inspirert av hjernens struktur



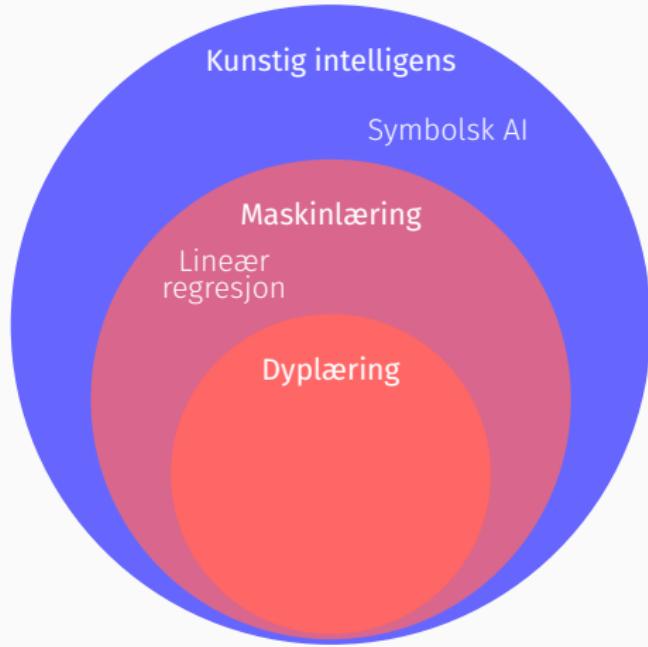
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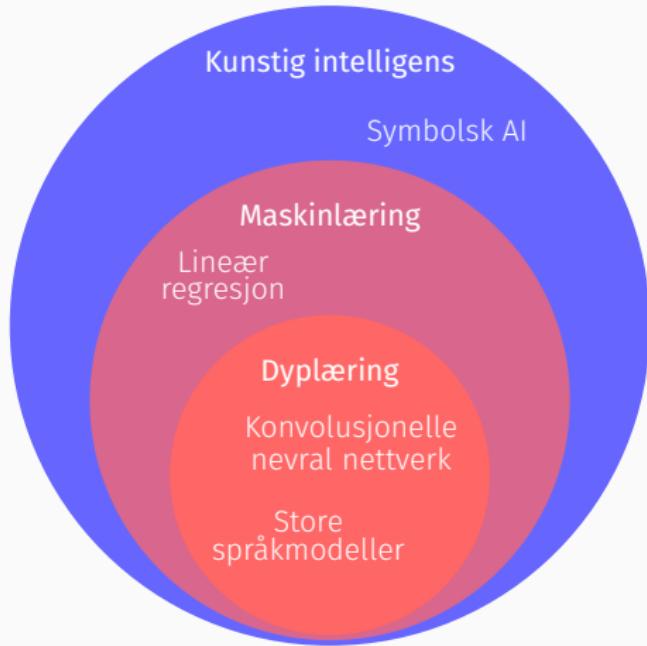


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Konvolusjonelle nevrale nettverk:
Nevrale nettverk for prosessering av bildedata

Store språkmodeller:
(Store) nevrale nettverk for språkprosessering (ChatGPT)



Terminologi: Veiledet vs ikke-veiledet læring

Veiledet læring
(Supervised learning)



→ Katt



→ Hund

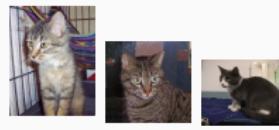


→ Katt



→ Hund

Ikke-veiledet læring
(Unsupervised learning)



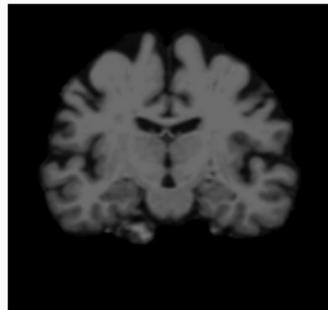
Kunstig intelligens i medisinsk forskning



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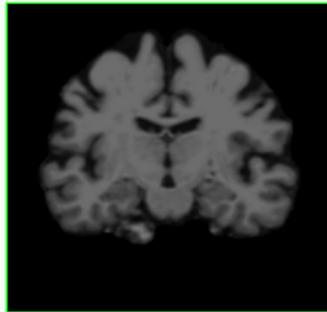
AI i hjernehjerneforskning: Presisjonsdiagnostikk



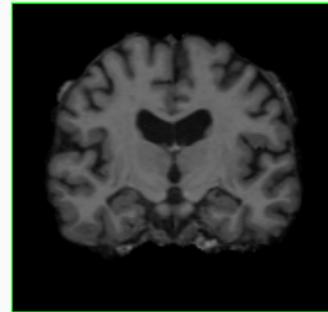
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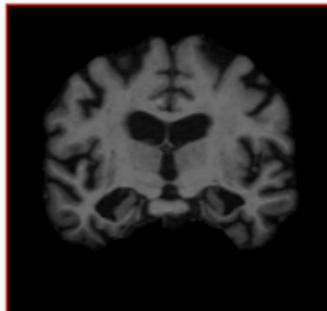
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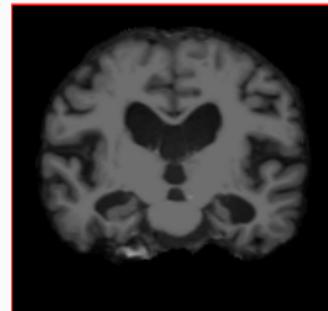
Frisk



Frisk



Pasient

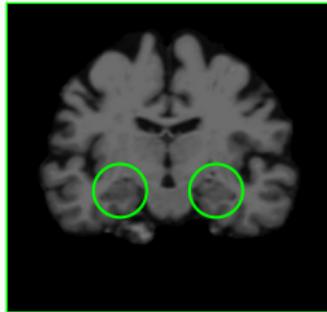


Pasient

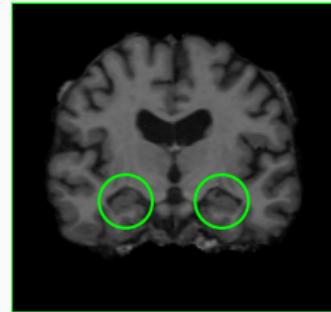
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AI i hjernehjerneforskning: Presisjonsdiagnostikk



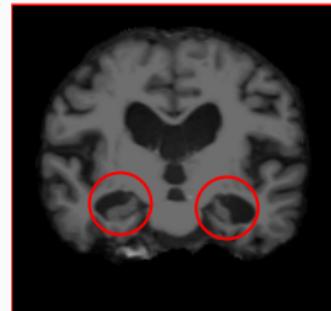
Frisk



Frisk



Pasient

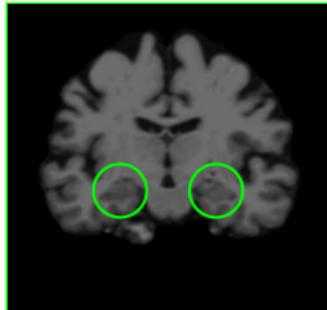


Pasient

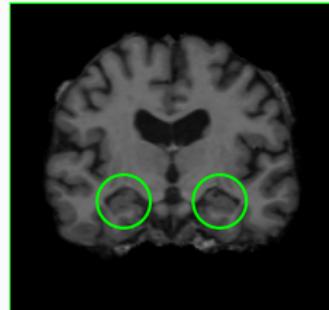
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AI i hjernehjerneforskning: Presisjonsdiagnostikk



Frisk



Frisk



Ikke effektivt
Talevansker
Pasient

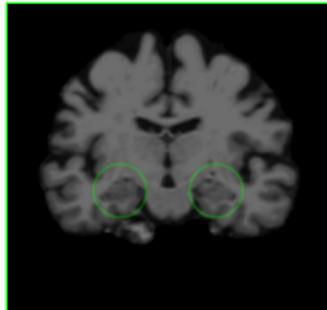


Effektivt
Hukommelsessvikt
Pasient

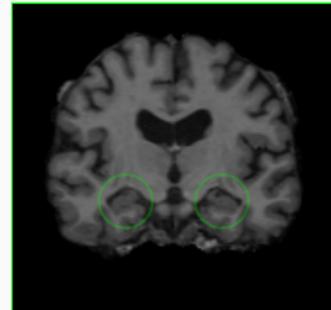
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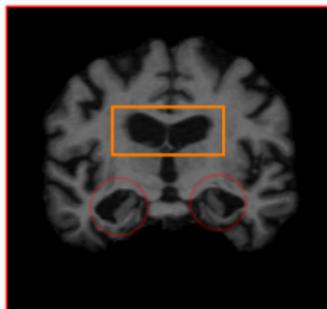
AI i hjernehjerneforskning: Presisjonsdiagnostikk



Frisk



Frisk



Ikke effektivt
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Pasient

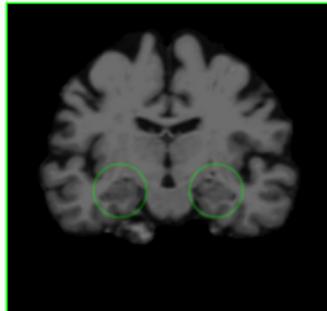


Effektiv
Hukommelsesssvikt
Pasient

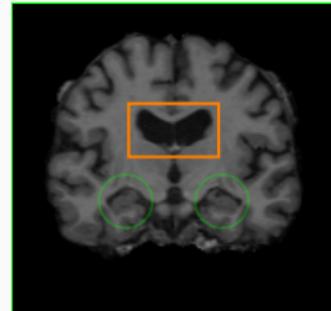
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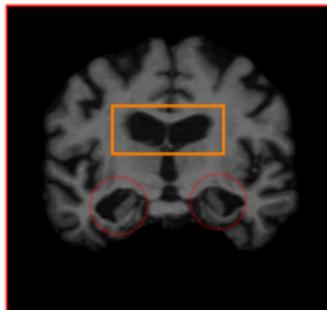
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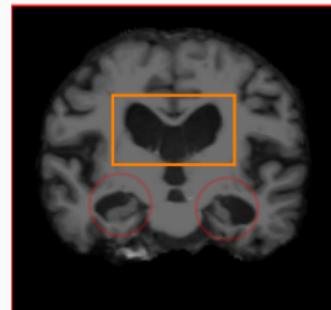
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Frisk



Ikke effektiv
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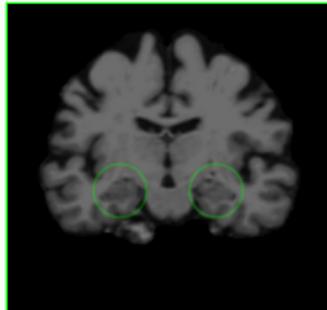


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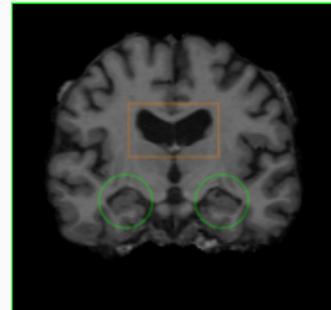
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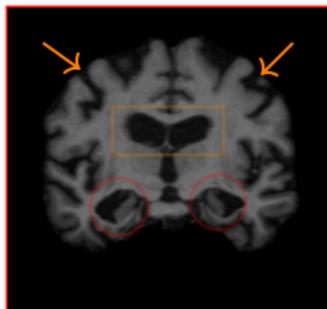
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Frisk



Frisk



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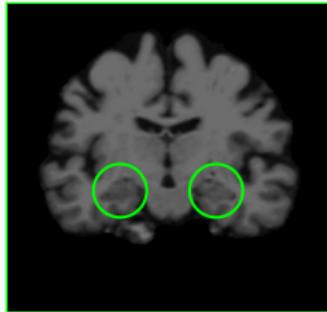


Effektiv
Hukommelsessvikt
Pasient

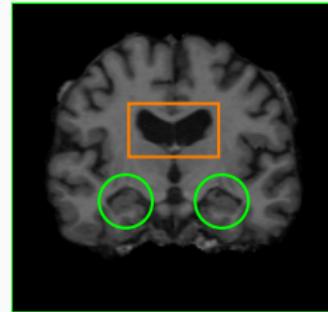
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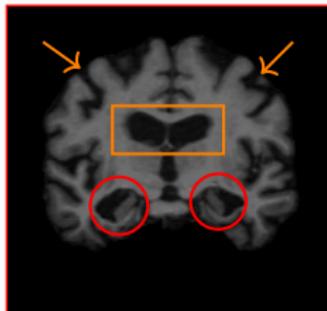
AI i hjernehjerneforskning: Presisjonsdiagnostikk



74 år
Kvinne
Frisk



75 år
Mann
Frisk



84 år
Mann
Ikke effektivt
Talevansker
Pasient



81 år
Kvinne
Effektivt
Hukommelsessvikt
Pasient

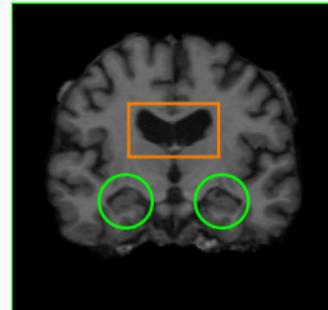
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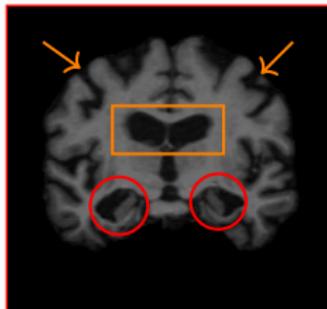
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74 år
Kvinne
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75 år
Mann
Frisk



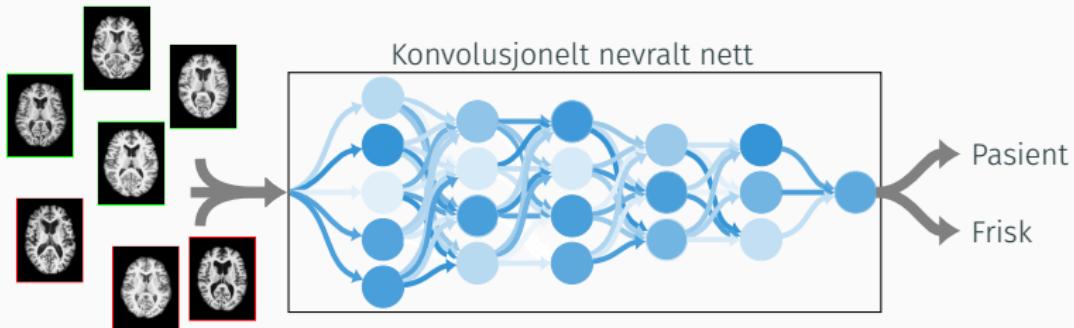
84 år
Mann
Ikke effektivt
Talevansker
Pasient

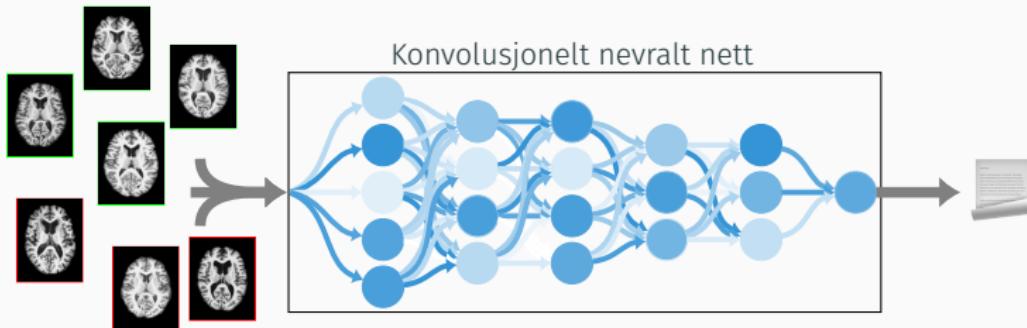


81 år
Kvinne
Effektivt
Hukommelsessvikt
Pasient

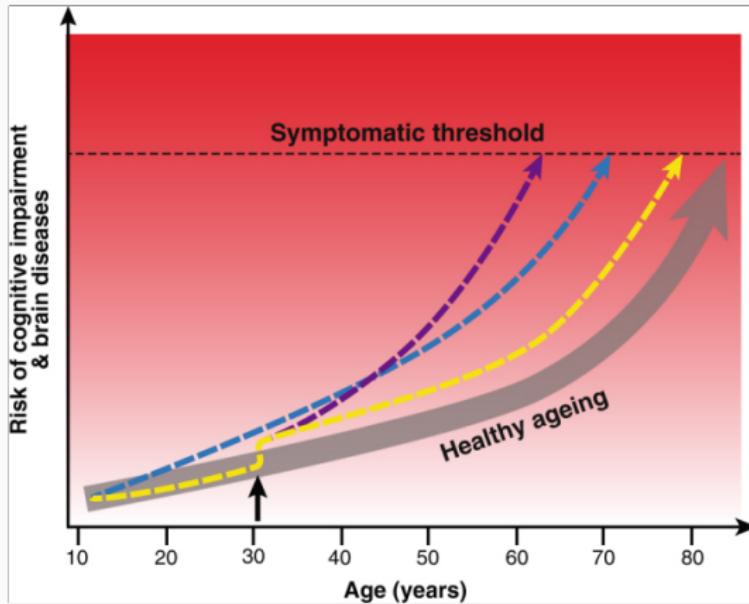
Data fra Open Access Series of Imaging Studies 3 (OASIS-3)







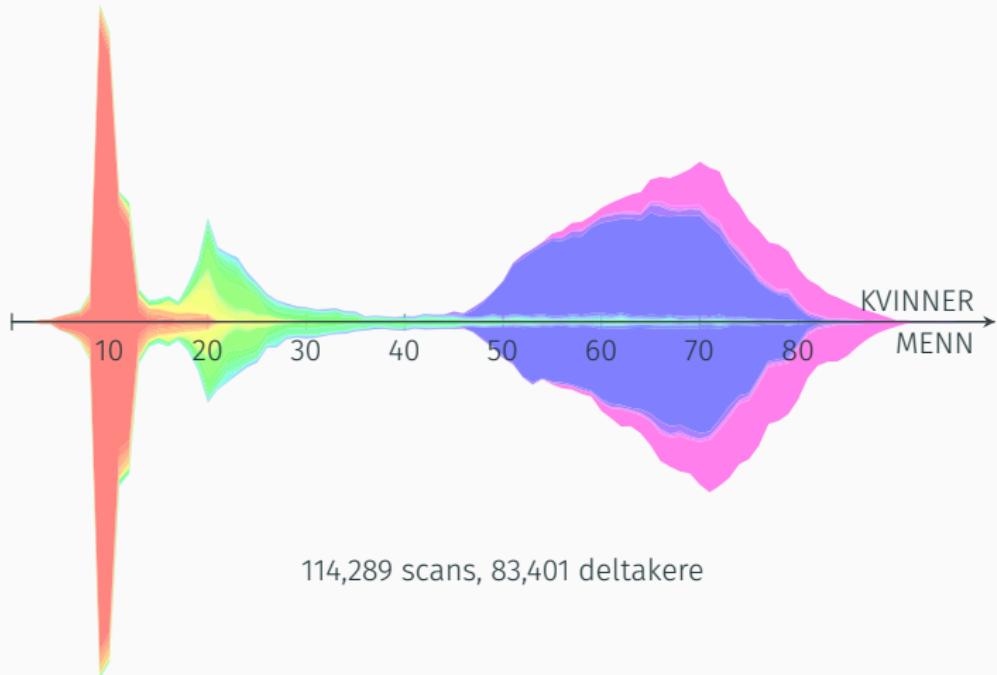


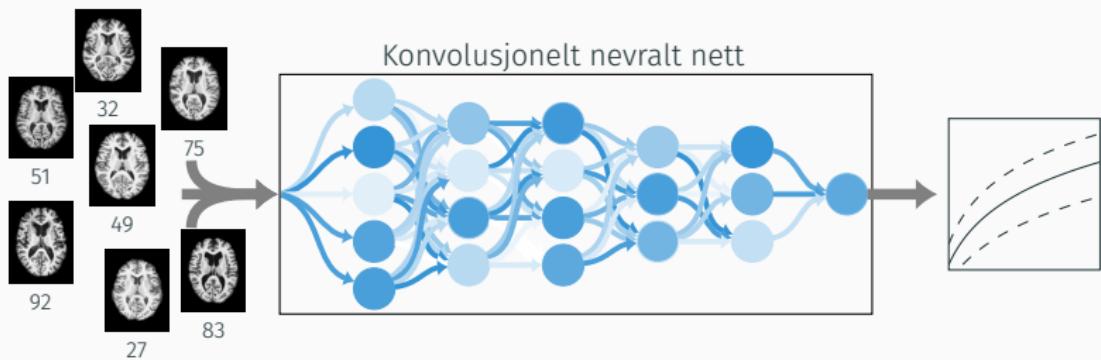


Brain age and other bodily 'ages': implications for neuropsychiatry

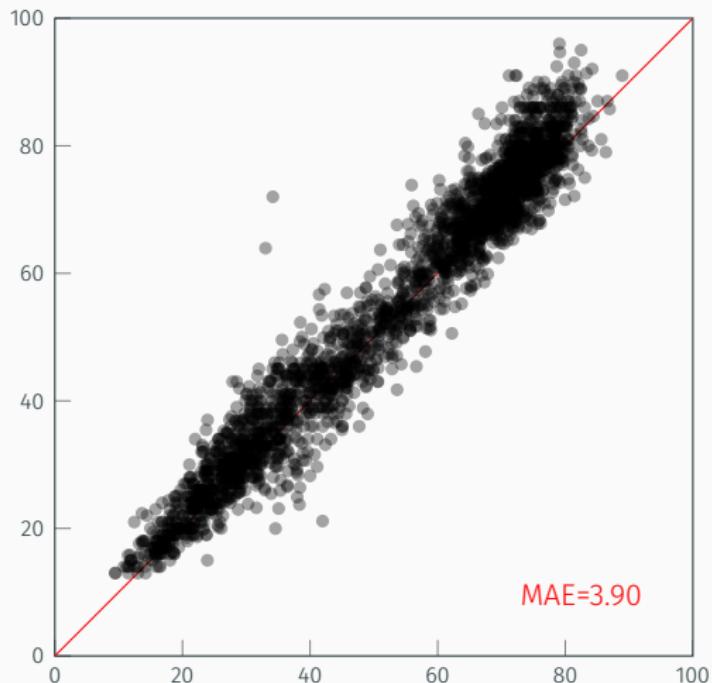
Cole et al., *Molecular Psychiatry* (2019)

AI i hjernehforskning: Hjernealder

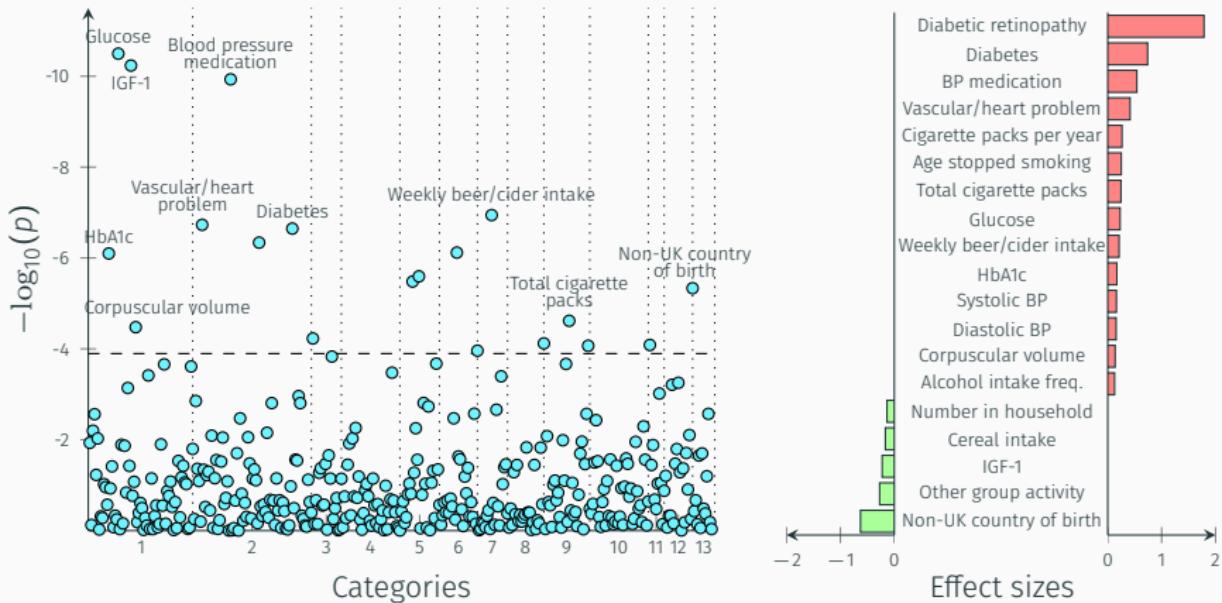




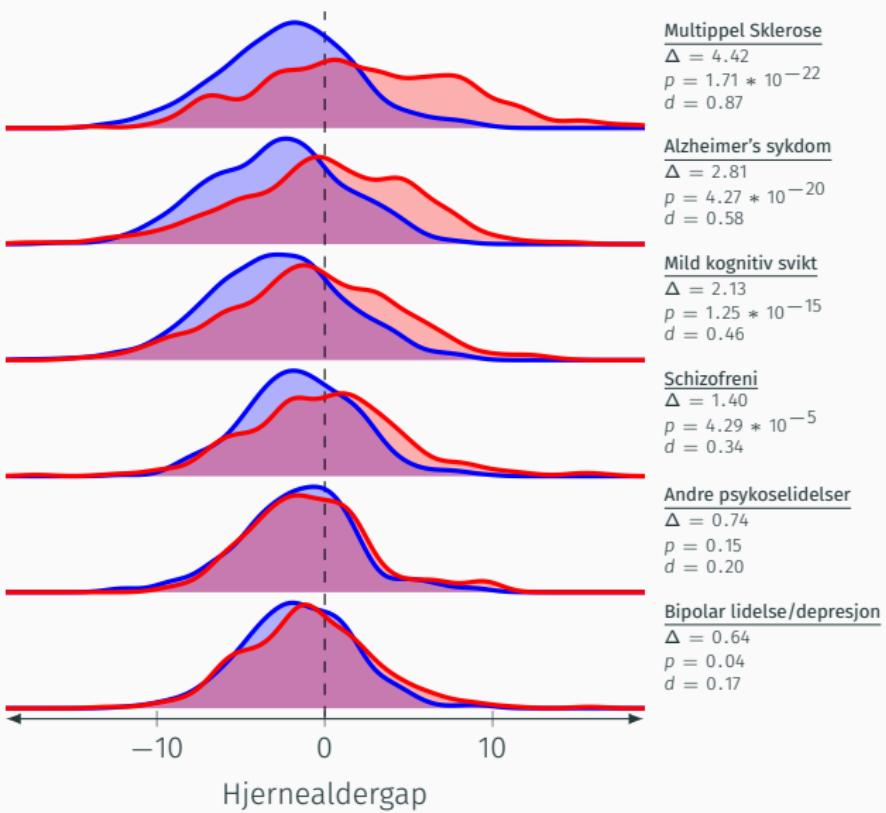
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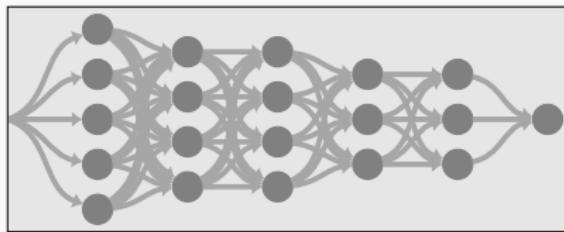
AI i hjernehalskning: Hjernealder



AI i hjernehelseforskning: Hjernealder

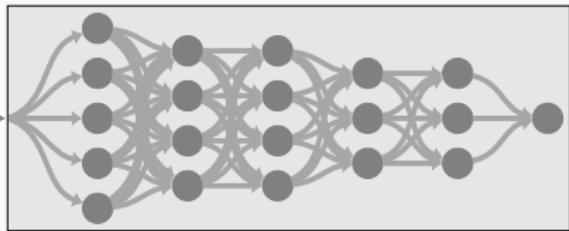


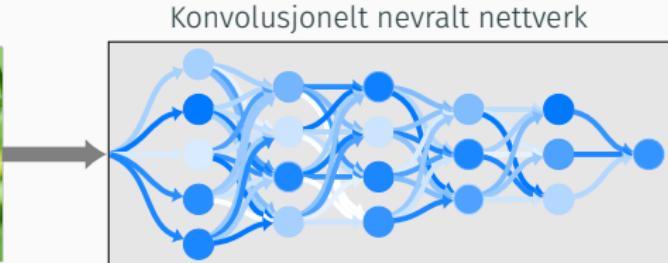
Konvolusjonelt nevralgt nettverk

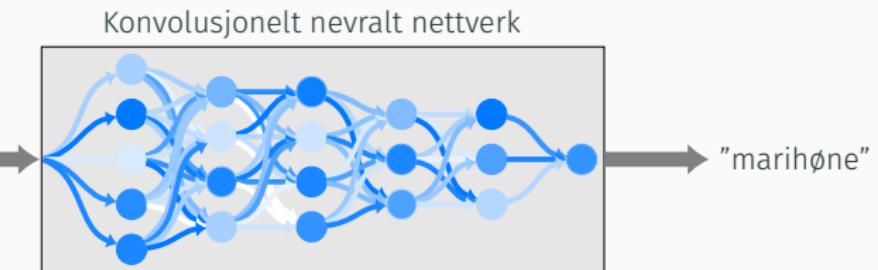


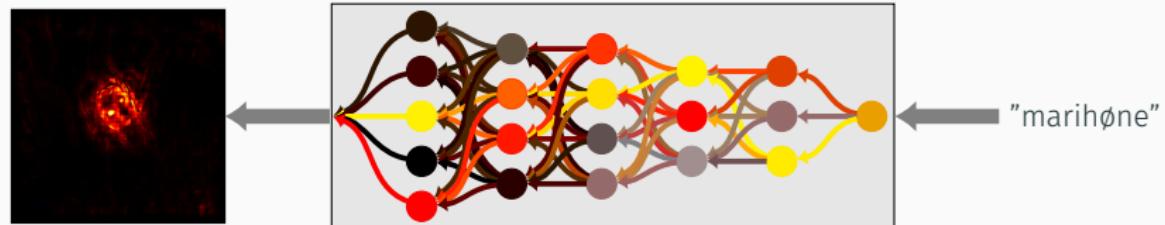


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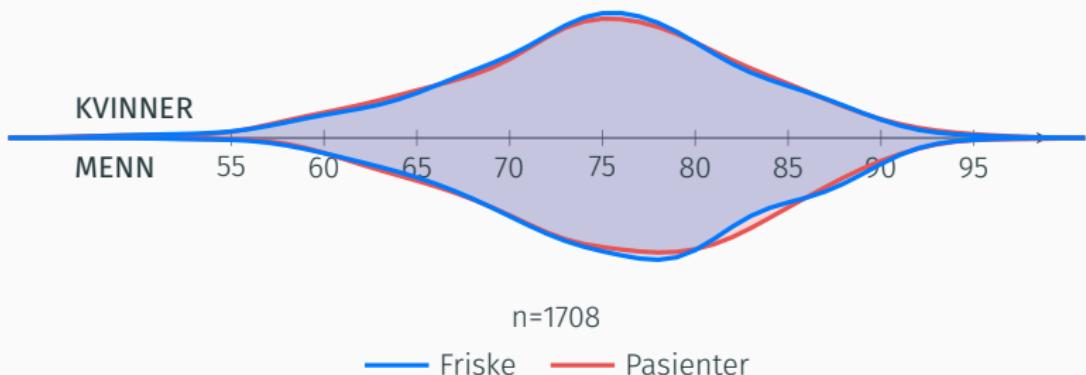


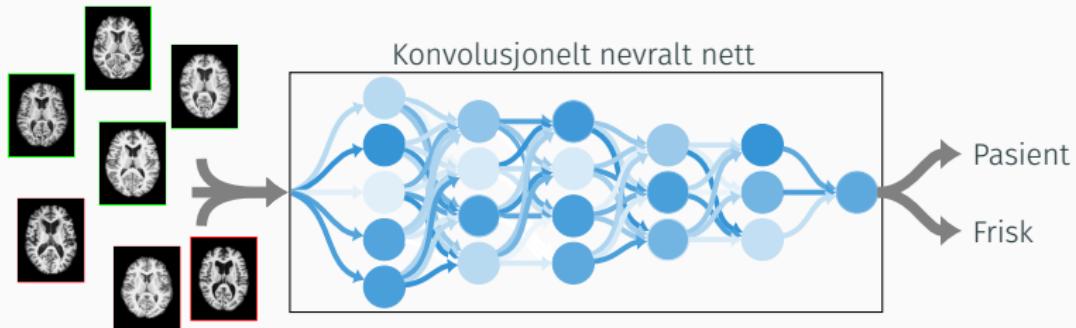




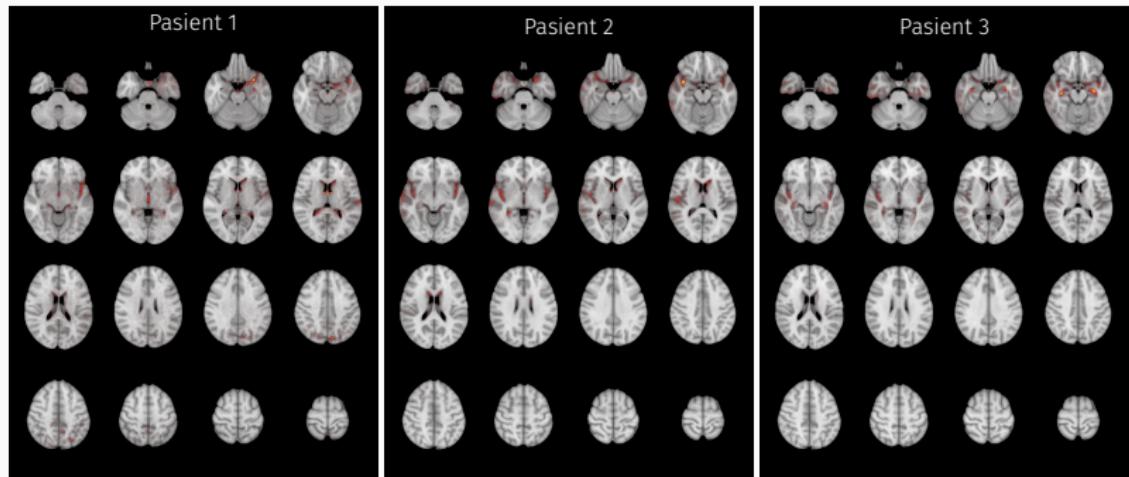


AI i hjernehjerneforskning: Forklarbarhet

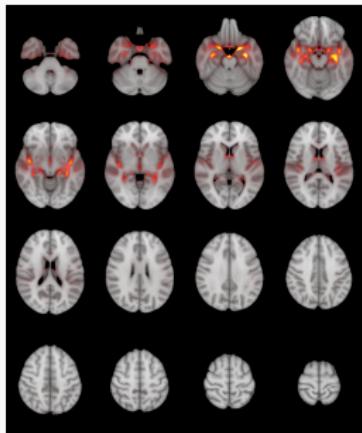




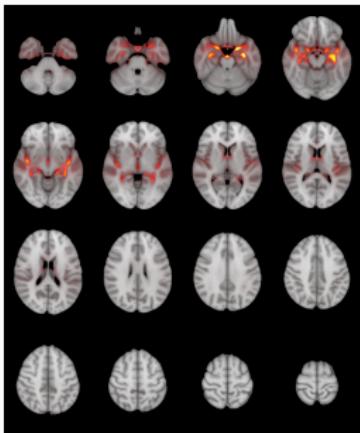
AI i hjernehjerneforskning: Forklarbarhet



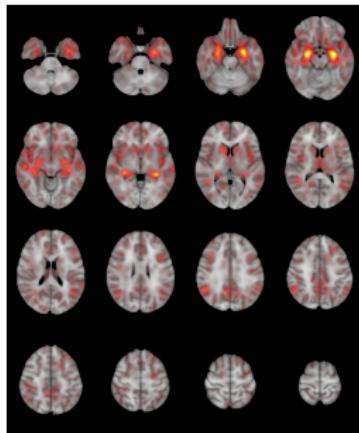
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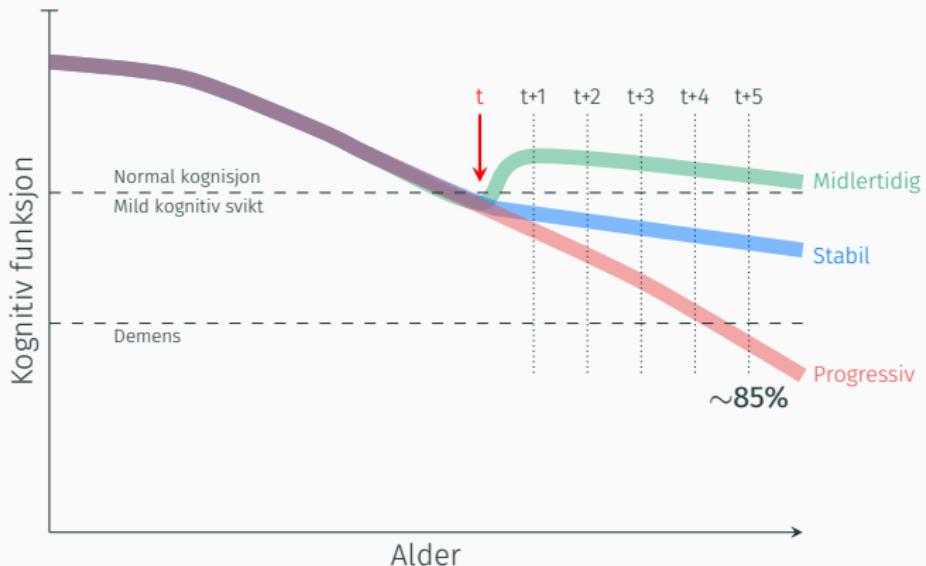
AI



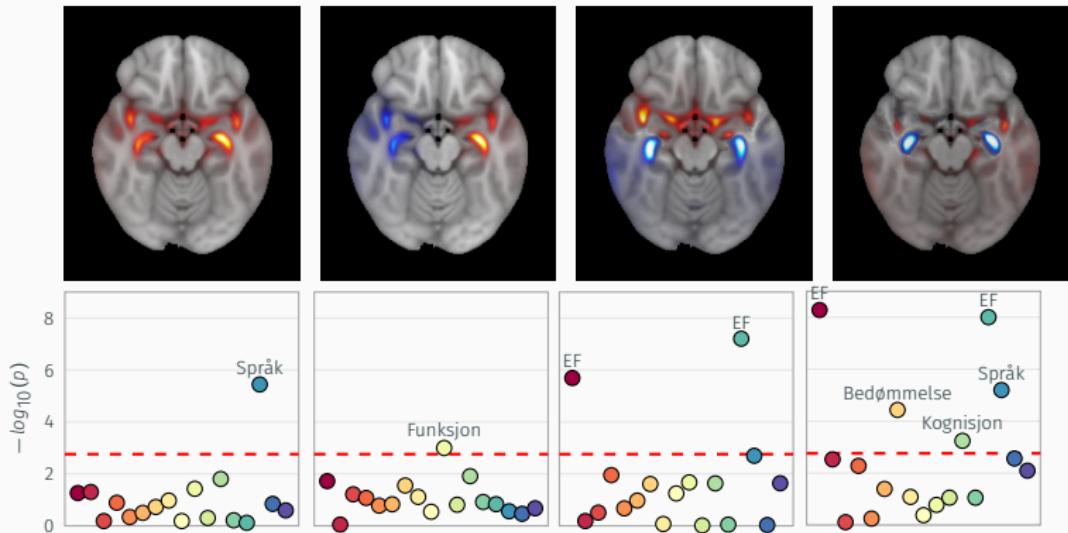
Mennesker

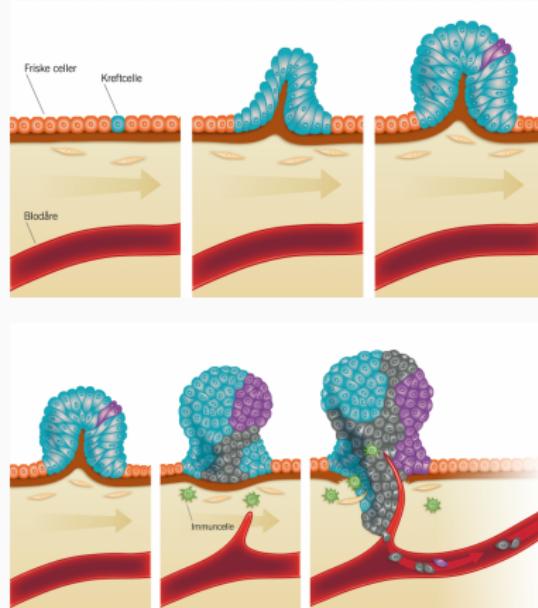


AI i hjernehjerneforskning: Forklarbarhet



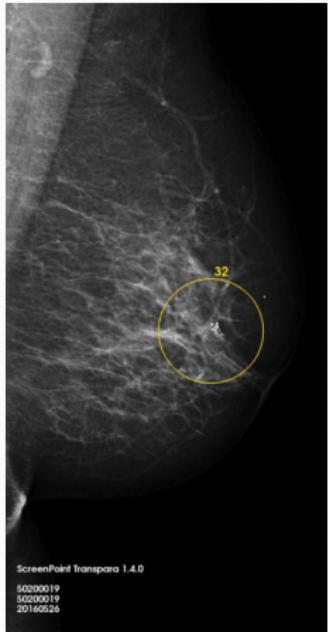
AI i hjernehorskning: Forklarbarhet





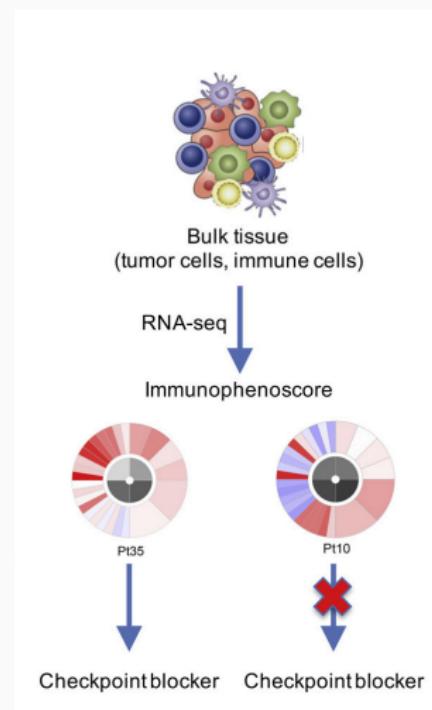
www.kreftforeningen.no





MASAI-studien (Sverige, 2023)

- Screening av 80,000 mammografier
- AI-støtte med hjelp fra Transpara (CE-merket, FDA-godkjent)
- 20% flere svulster oppdaget med hjelp fra AI
- 45% færre undersøkelser med hjelp fra AI



AI i kreftforskning: Presisjonsdiagnostikk

