

Kunstig intelligens som et verktøy for å forstå hjernesykdommer - med fokus på psykiatri

Esten H. Leonardsen

26.10.23



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1. Historien bak kunstig intelligens
2. Hva er kunstig intelligens (og maskinlæring)
3. Kunstig intelligens i hjerneforskning



Historien bak kunstig intelligens



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Turing
(1950)



Alan Turing



Turing
(1950)

MIND
A QUARTERLY REVIEW
OF
PSYCHOLOGY AND PHILOSOPHY

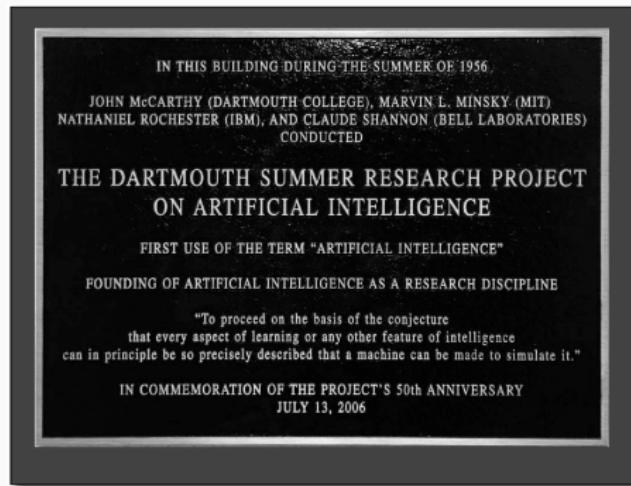
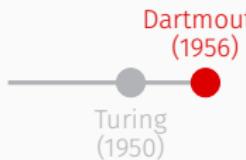
I.—COMPUTING MACHINERY AND
INTELLIGENCE

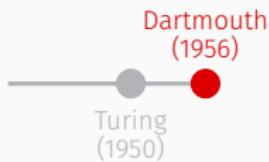
By A. M. TURING

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.



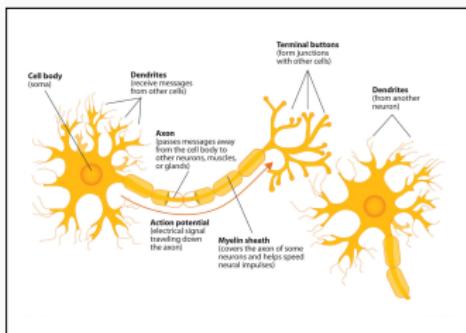
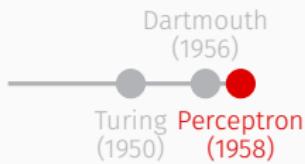




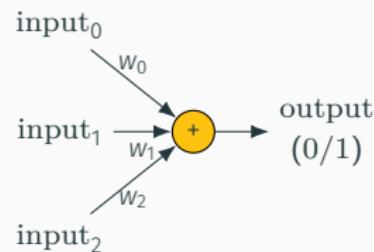
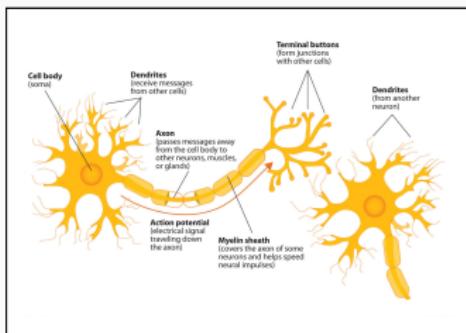
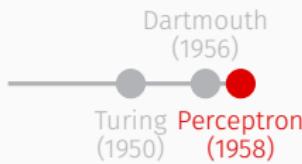
"We propose that a 2-month, 10-man study of artificial intelligence be carried out [...]. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can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

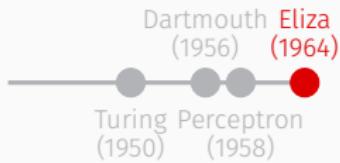
- Proposal, Dartmouth summer school (1956)

Historikk



Historikk





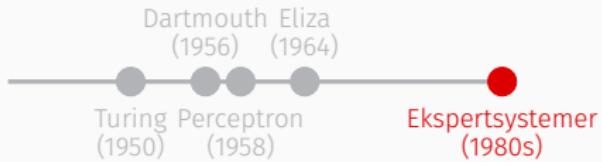
Talk to Eliza by typing your questions and answers in the input box.

```
* 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>



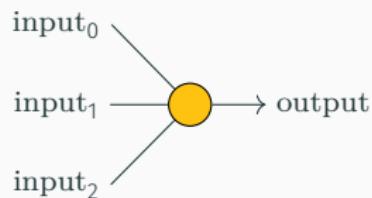
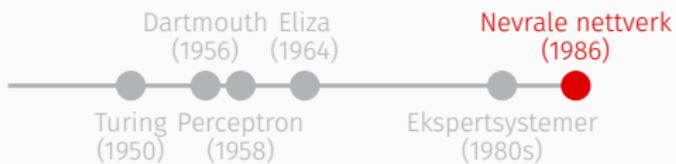


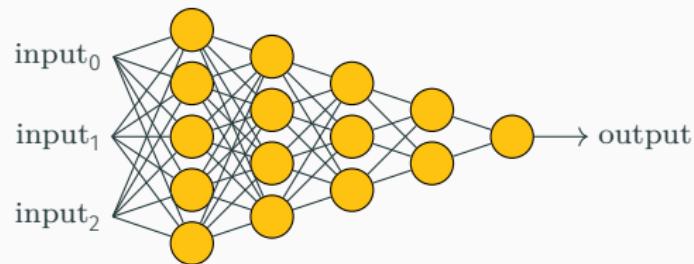
1) Patient's name: (first-last) ** FRED BRAUN	(background patient data)
2) Sex: ** M	
3) Age: ** 55	
4) Are there any cultures for Fred Braun which may be related to the present illness, and from which organisms have been grown successfully in the microbiology laboratory? ** y	
 -----CULTURE-1-----	
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	(typically identity is not yet known)
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...}	

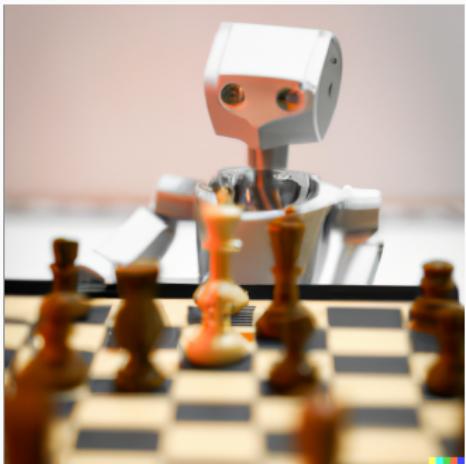
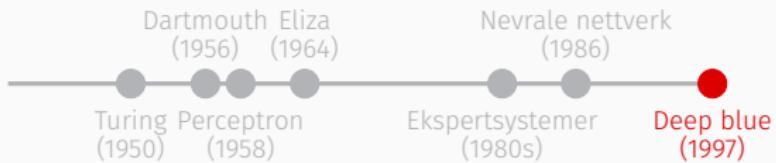
MYCIN (1972)



Historikk







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."
- Avanserte søkealgoritmer og preprogrammert kunnskap fra sjakkekspertene.

Historikk



Katt



Historikk



Solsikke



Marihøne



Katt



Fly

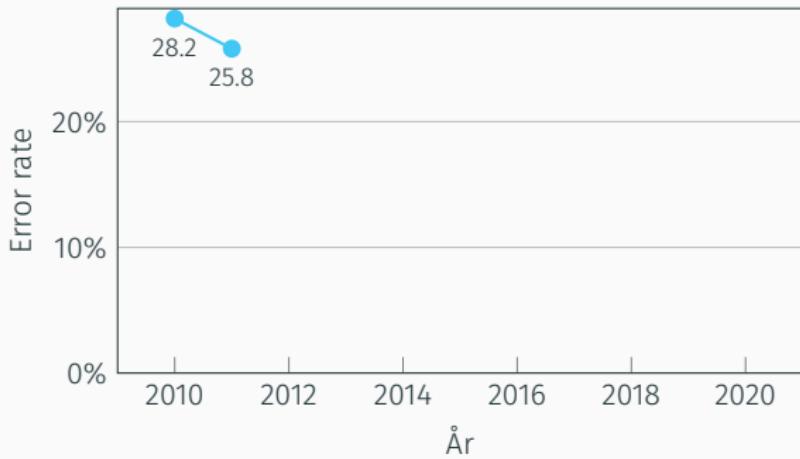


Hvithai

ImageNet: ~14m bilder fra ~22k kategorier



Historikk



Historikk



Historikk



Historikk





You
What is the best angle to approach to explain how deep learning works to psychiatrists in an intuitive manner?

ChatGPT
Explaining deep learning to psychiatrists in an intuitive manner can be achieved by drawing parallels between deep learning and concepts familiar to them, such as the human brain's functioning and psychological theories. Here are some strategies:

1. Analogy to the Human Brain

- **Neural Networks:** Start by explaining that deep learning models, particularly neural networks, are inspired by the human brain. Just as the brain consists of neurons interconnected to process information, neural networks use artificial neurons (or nodes) arranged in layers to process data.
- **Learning Process:** Emphasize how these artificial neurons adjust their connections (weights) based on experience, analogous to how synaptic connections in the brain strengthen or weaken over time through learning and experience.

2. Pattern Recognition and Decision Making

- **Similarity to Cognitive Processes:** Highlight how deep learning involves recognizing patterns and making decisions based on data, similar to how the human brain processes sensory inputs and experiences to understand the world and make decisions.
- **Examples from Psychiatry:** Relate to diagnostic processes in psychiatry, where patterns in patient behavior, speech, and history are analyzed to diagnose mental health conditions.



Hva er egentlig kunstig intelligens (og maskinlæring)?



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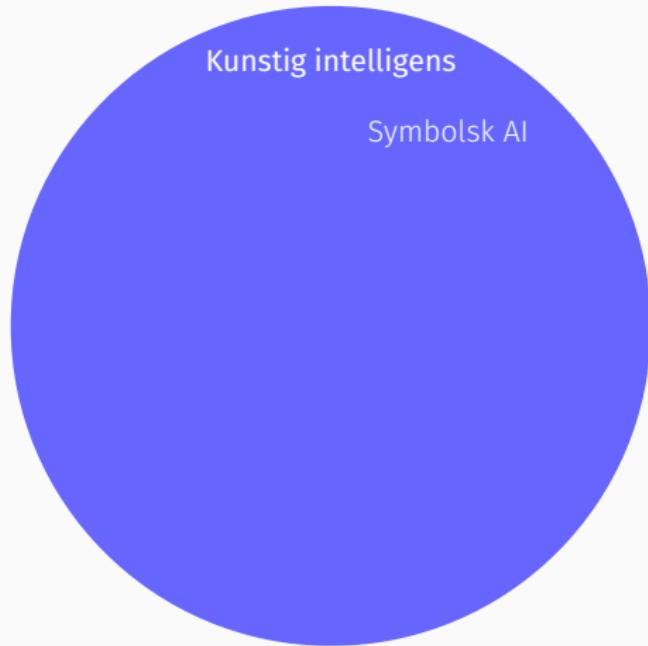
Hva er kunstig intelligens?



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



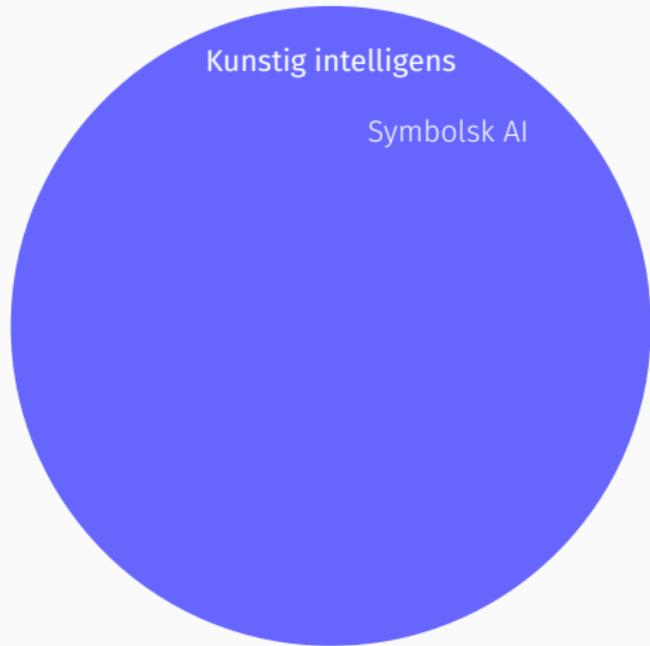
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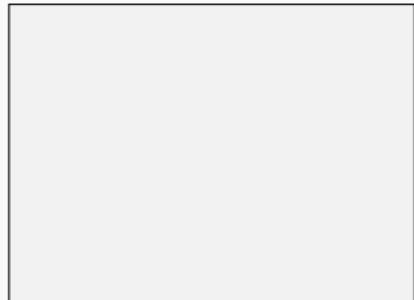
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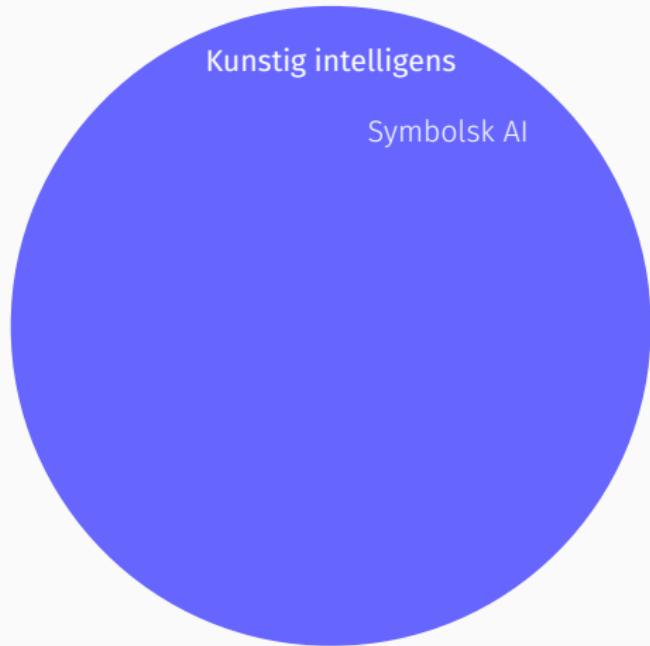
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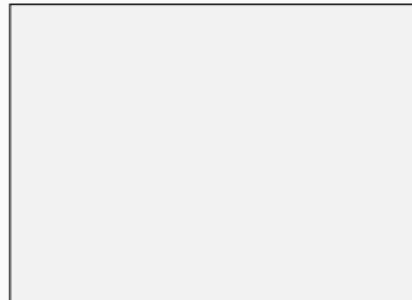
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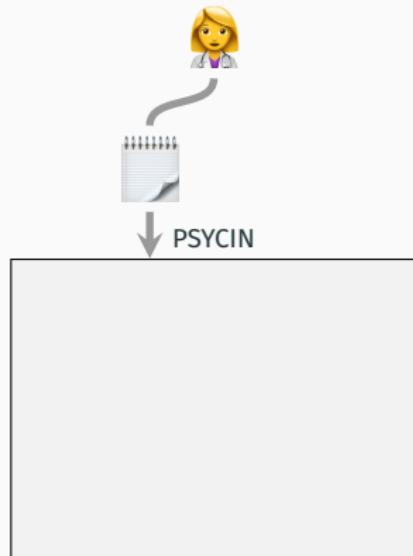
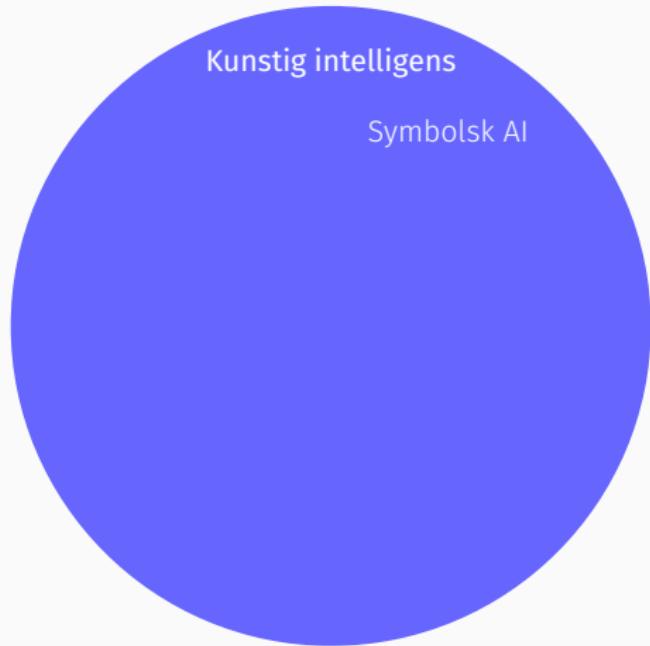
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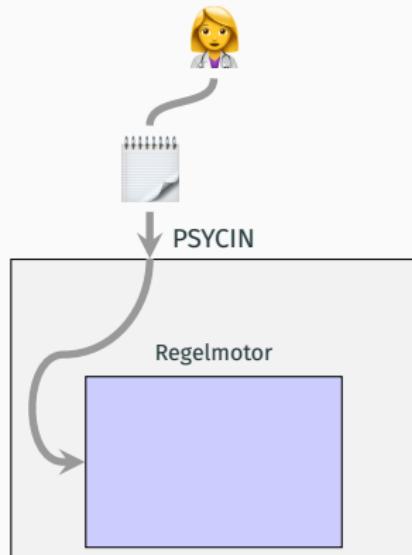
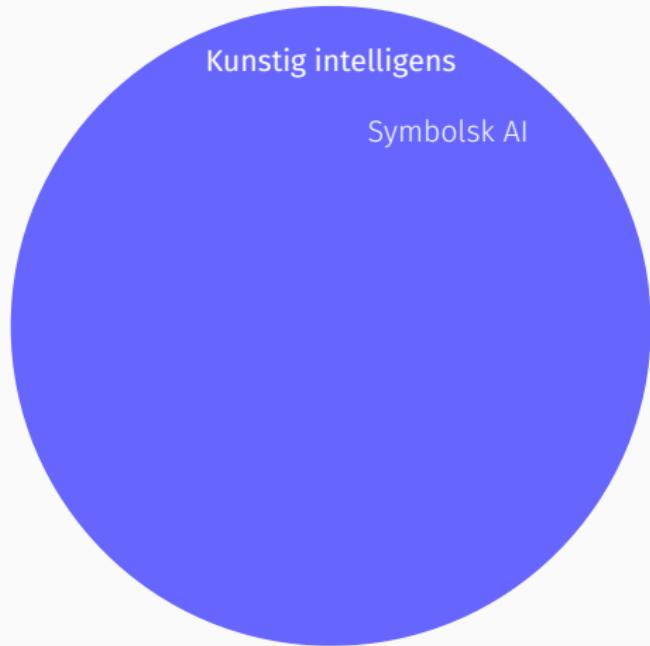
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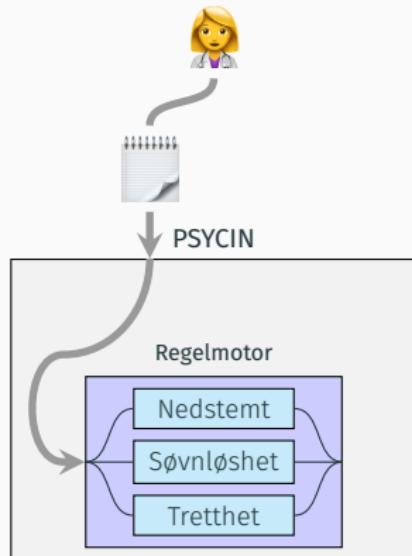
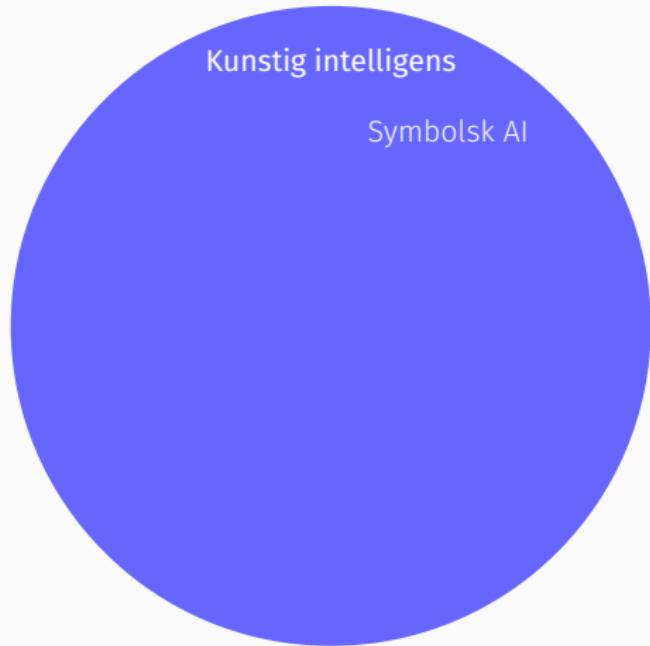
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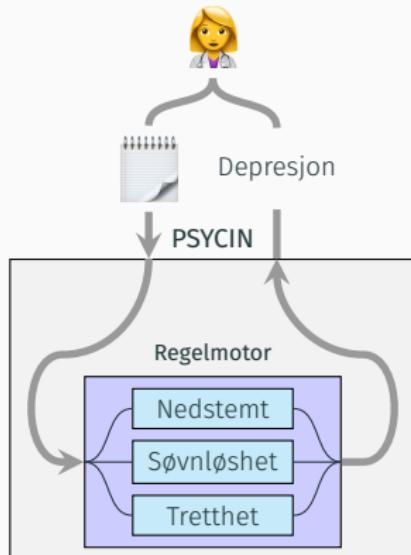
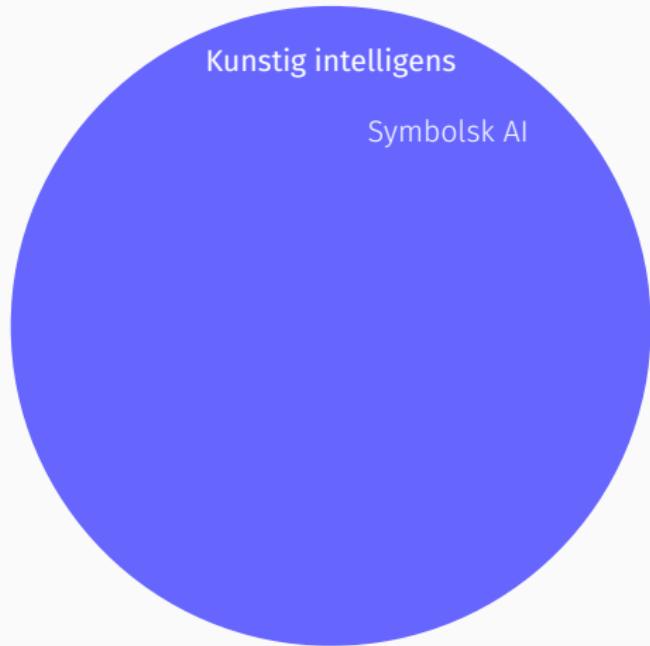
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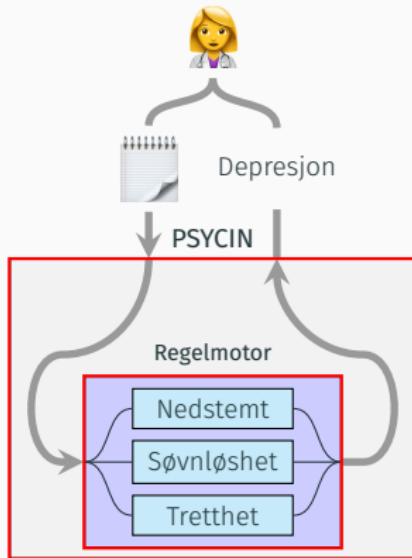
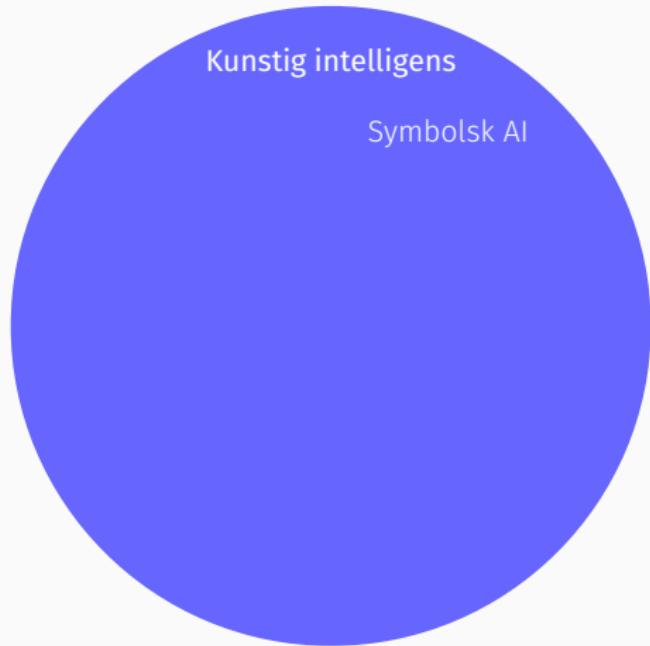
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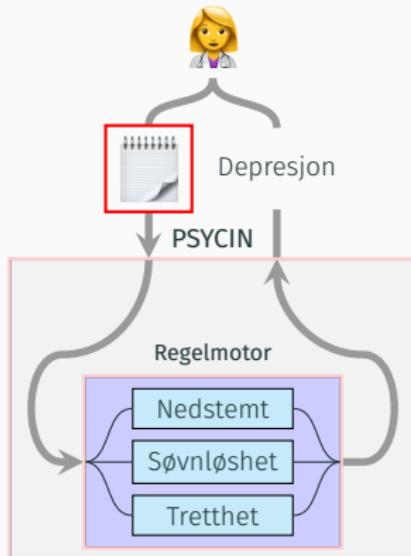
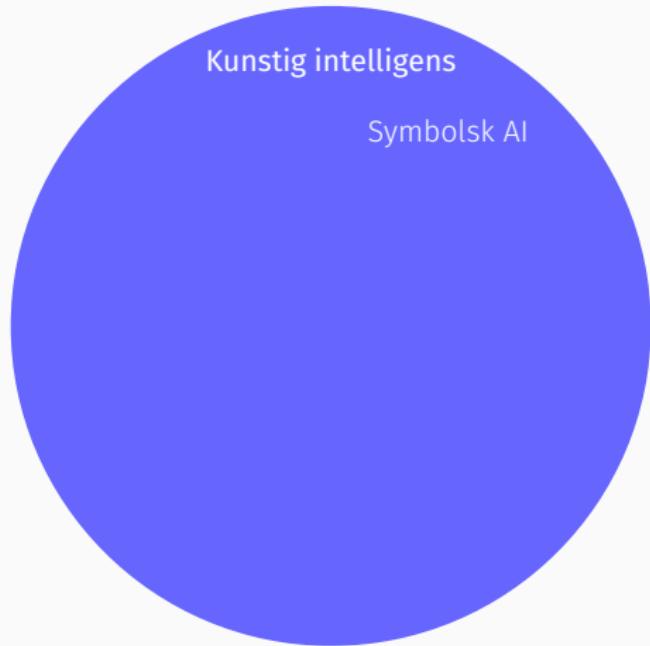
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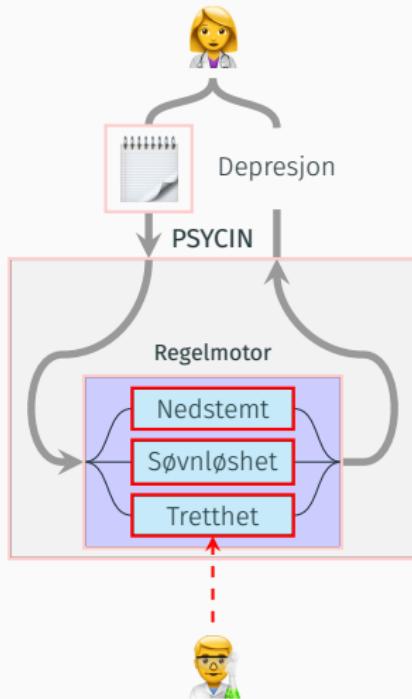
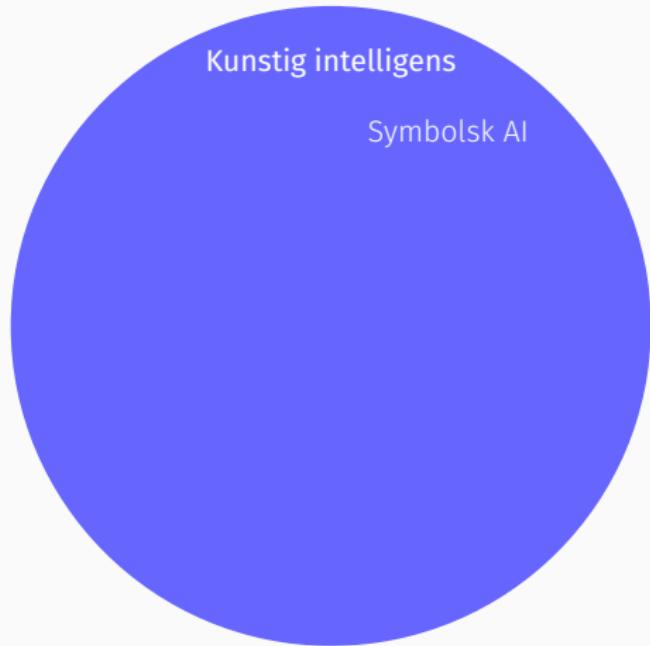
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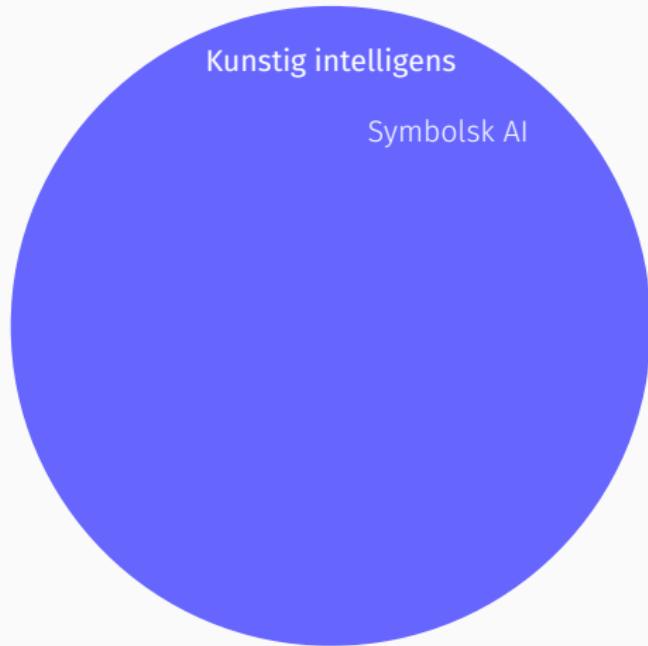
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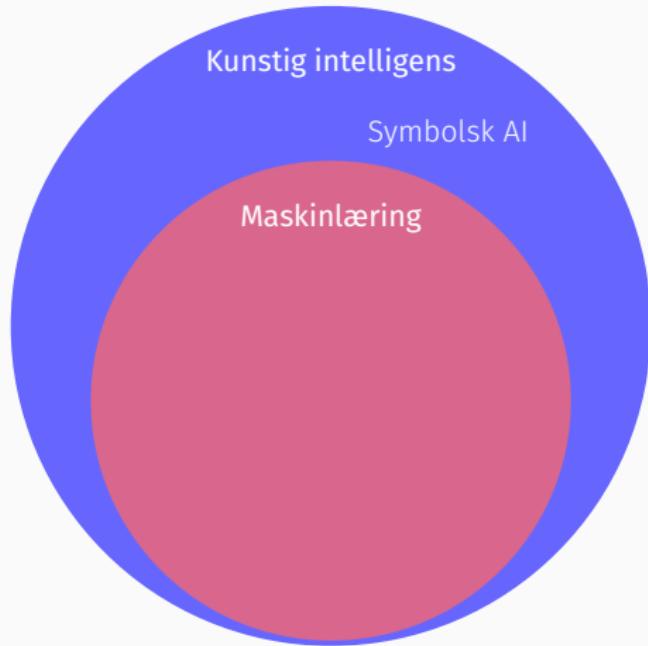
Hva er kunstig intelligens?



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

Symbolisk AI:
Tradisjonell AI der problemer
løses gjennom oppslag mot regler,
gjerne definert av menneskelige
eksperter

Hva er kunstig intelligens?

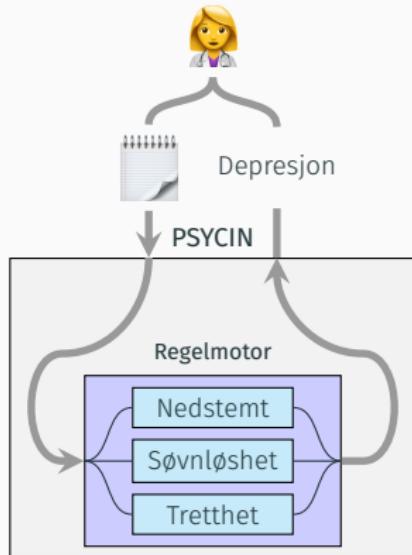
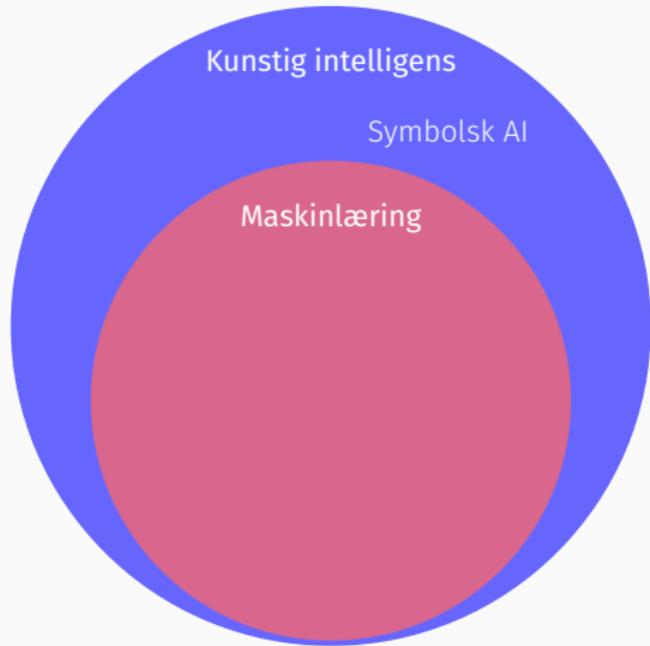


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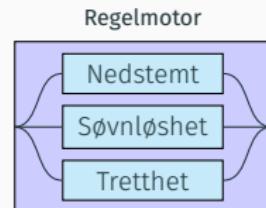
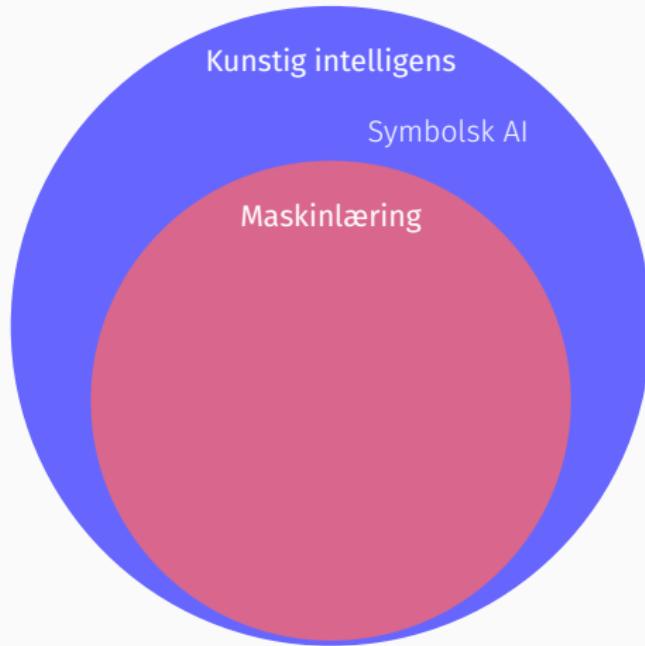
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Maskiner som lærer å løse problemer gjennom å finne mønster i data på egenhånd



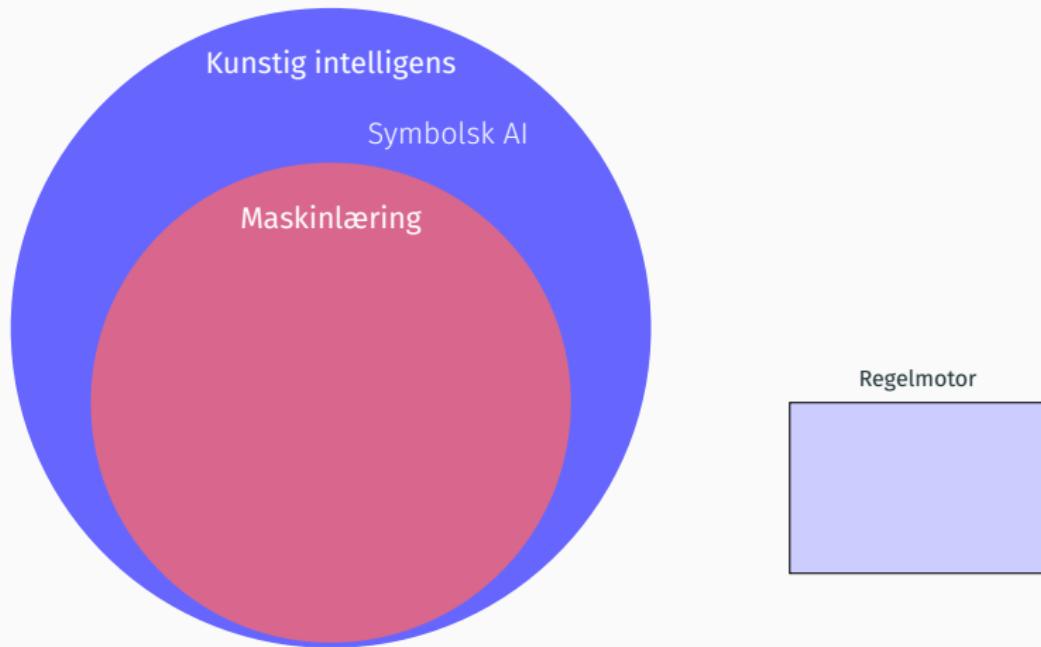
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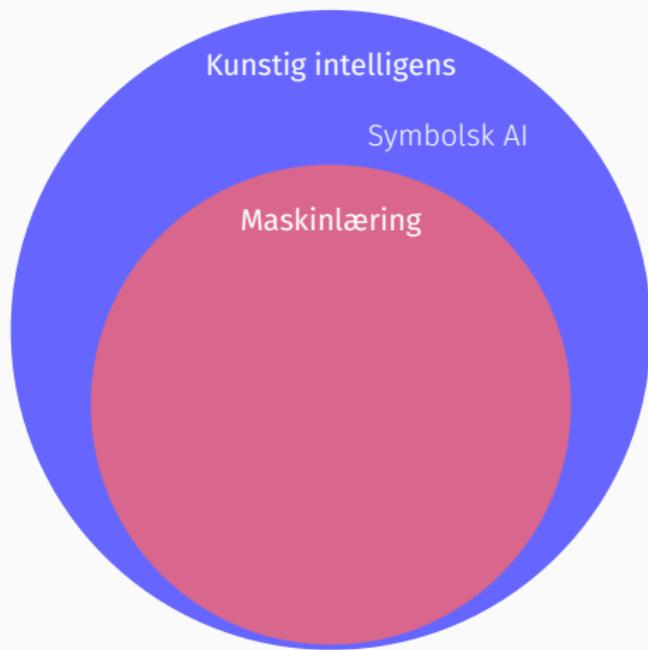
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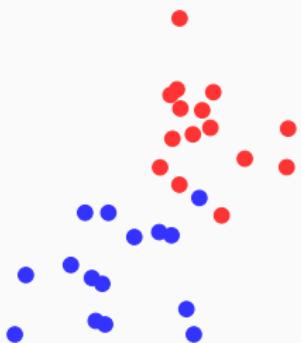
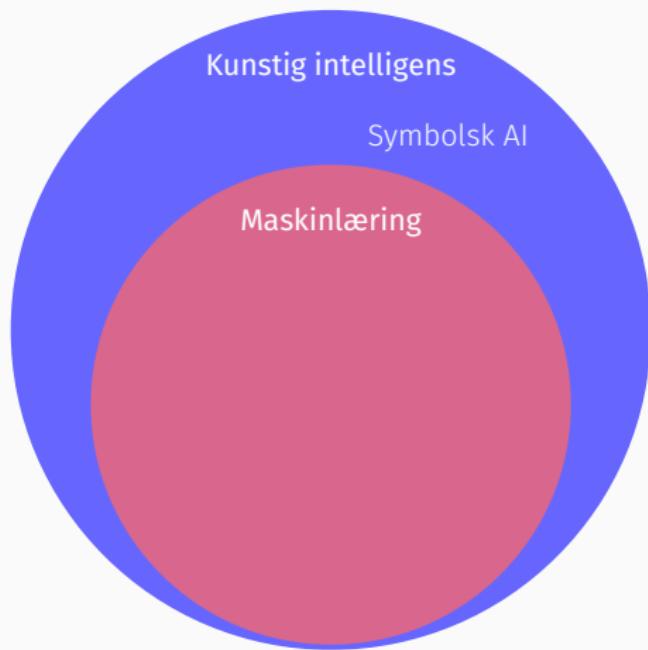
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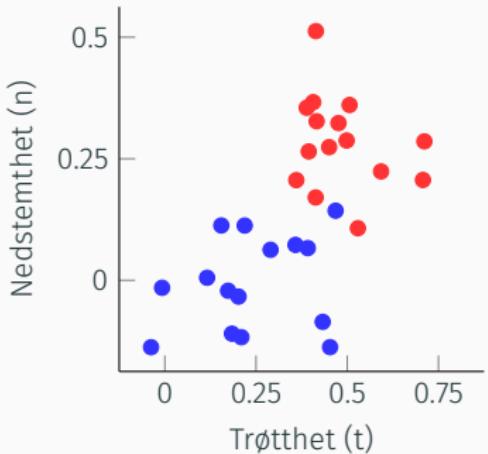
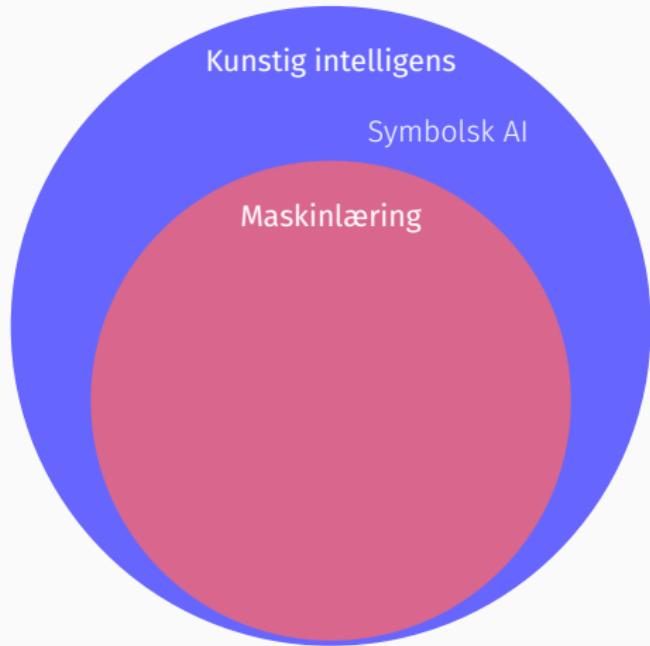
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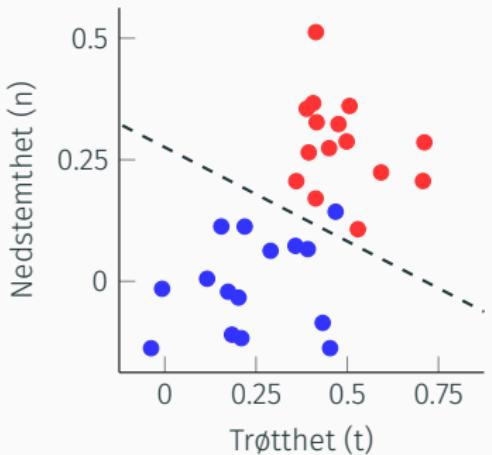
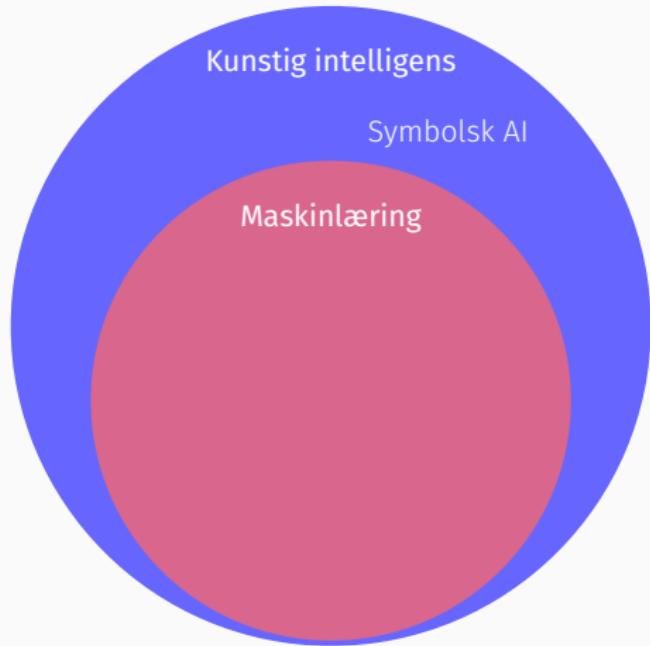
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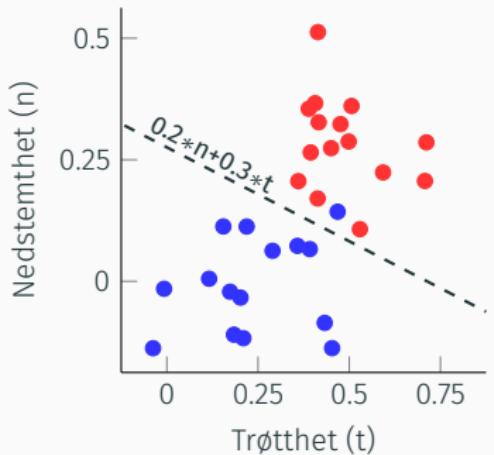
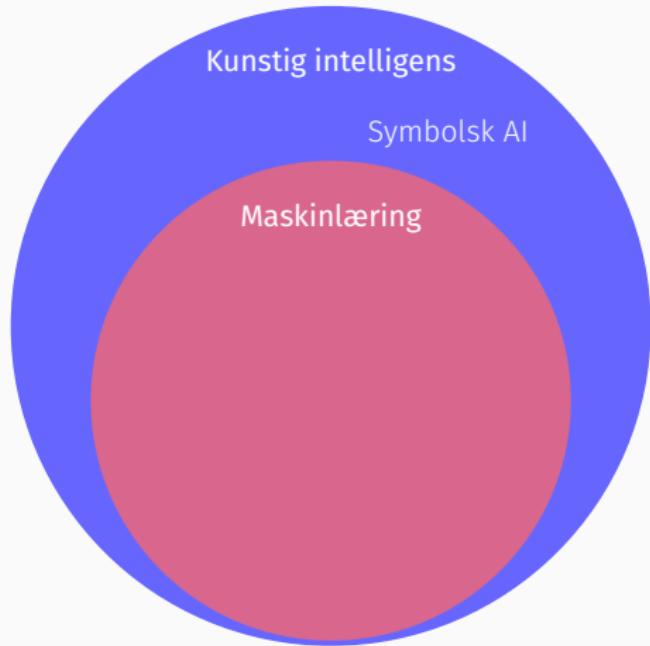
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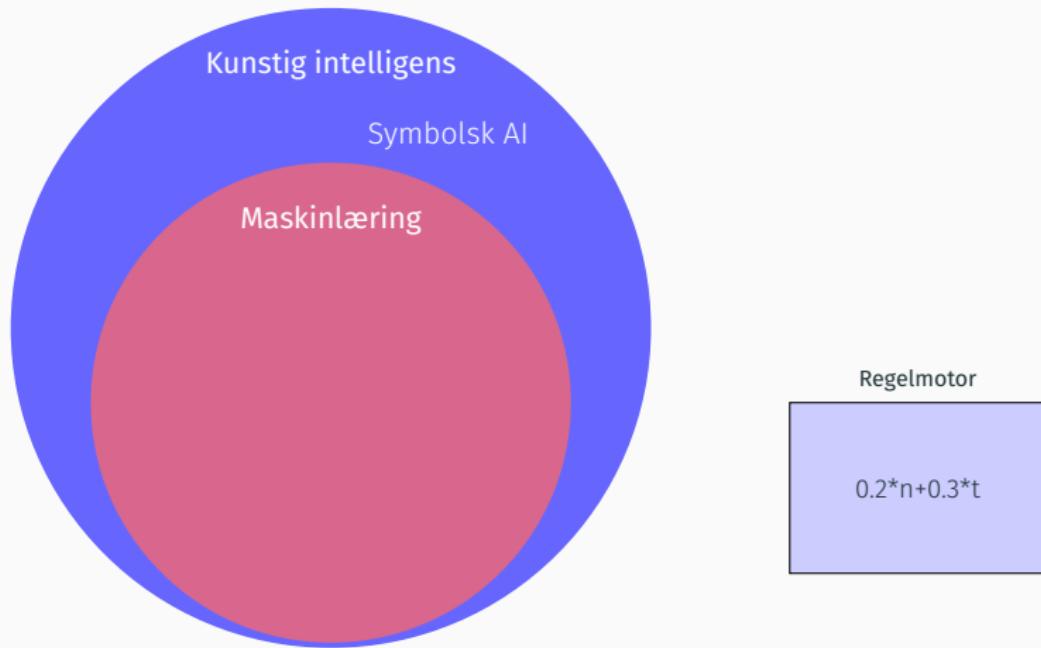
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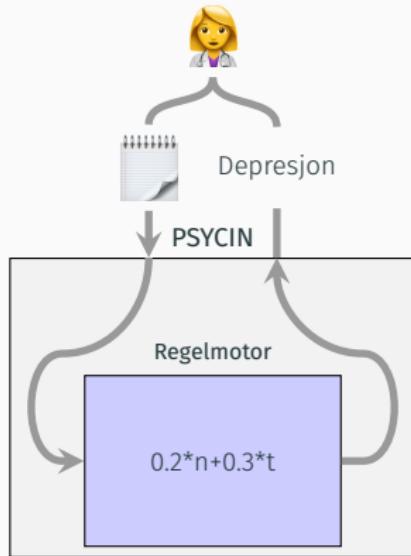
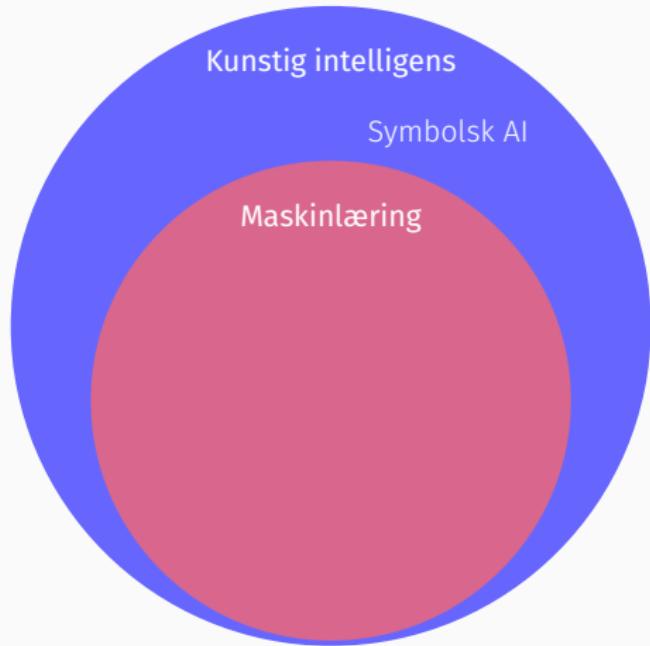
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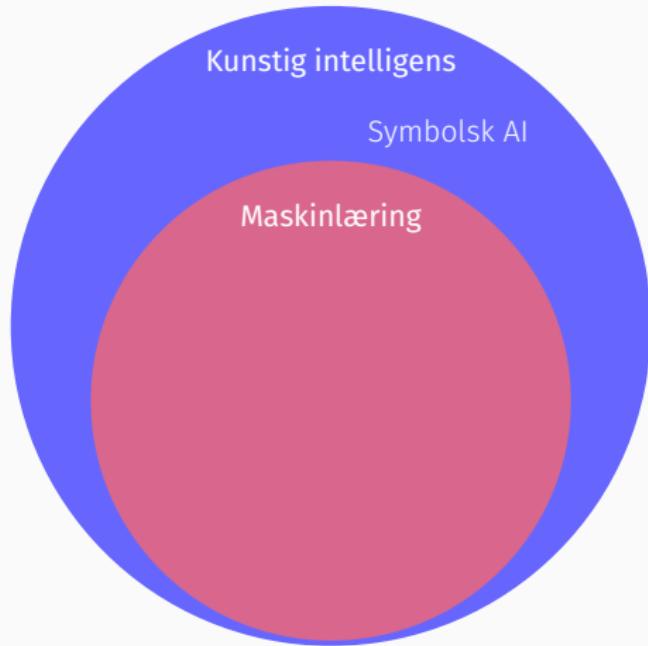
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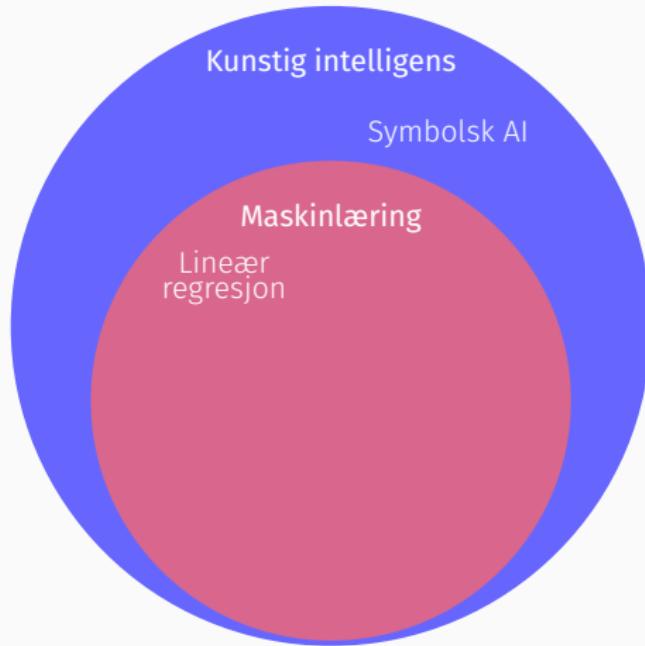


Kunstig intelligens (AI):
Maskiner som løser problemer som krever intelligens

Maskinlæring:
Maskiner som lærer å løse problemer gjennom å finne mønster i data på egenhånd



Hva er kunstig intelligens?

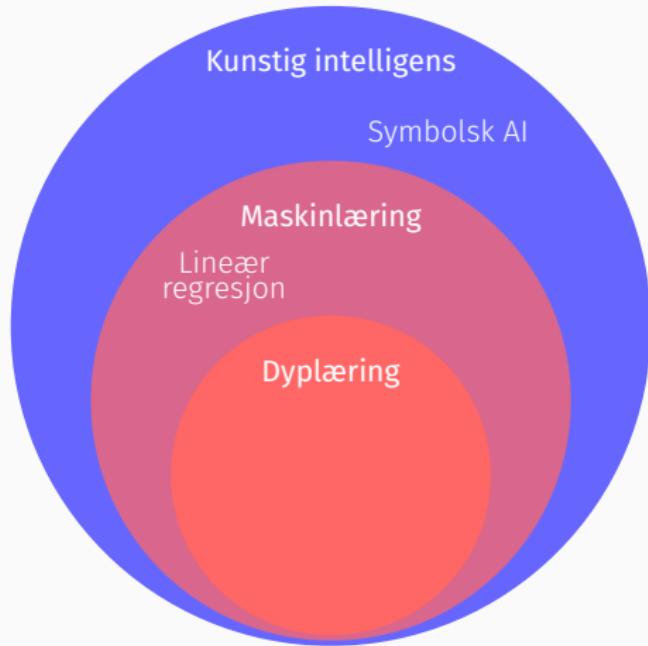


Kunstig intelligens (AI):
Maskiner som løser problemer som krever intelligens

Maskinlæring (ML):
Maskiner som lærer å løse problemer gjennom å finne mønster i data på egenhånd

Lineær regresjon:
Maskinlæringsmodeller som finner lineære (m.a.o. enkle) mønstre

Hva er kunstig intelligens?



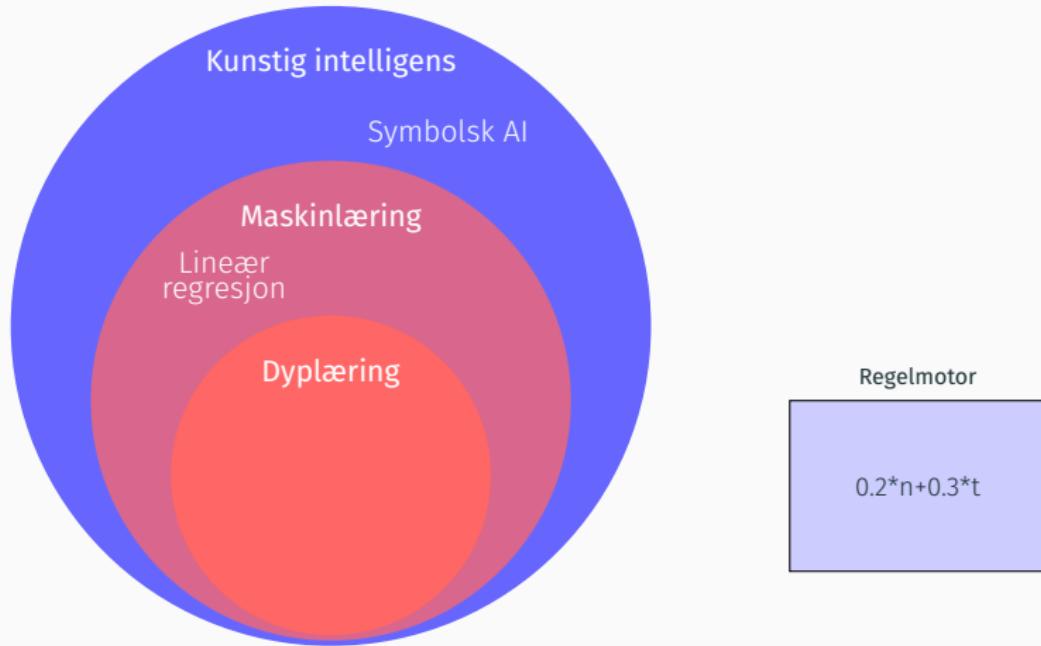
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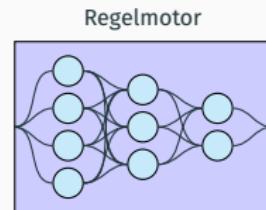
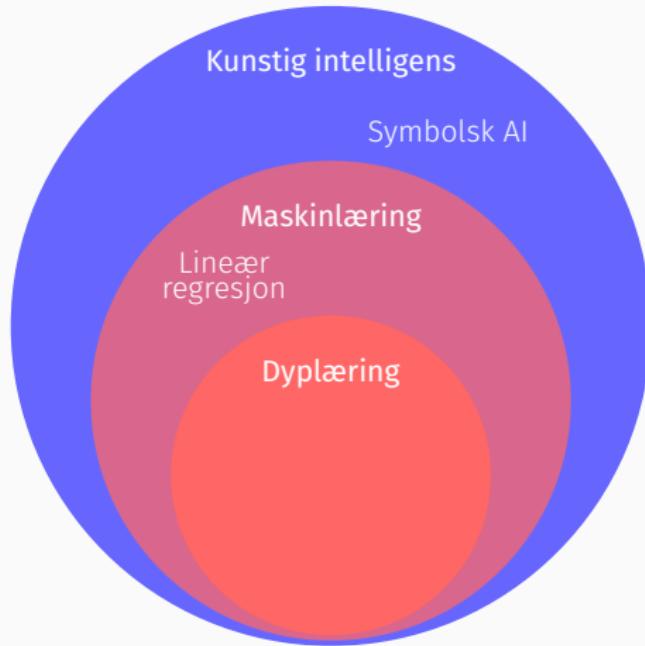
Dyplæring:
Maskinlæringsmodeller som er hierarkisk organisert (\approx dype nevrale nettverk), inspirert av hjernens struktur



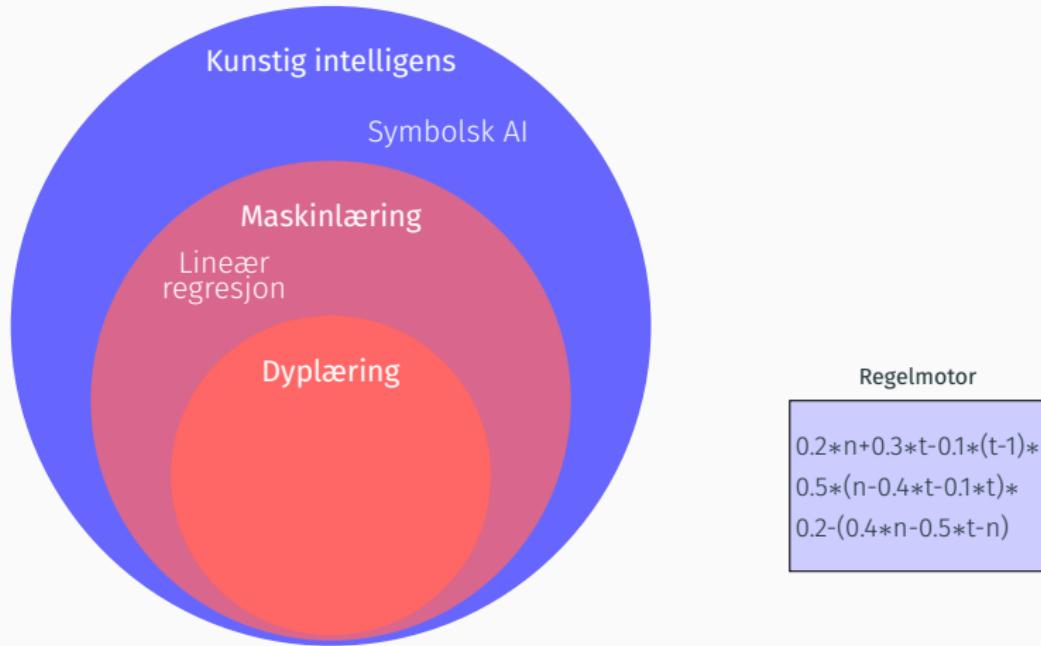
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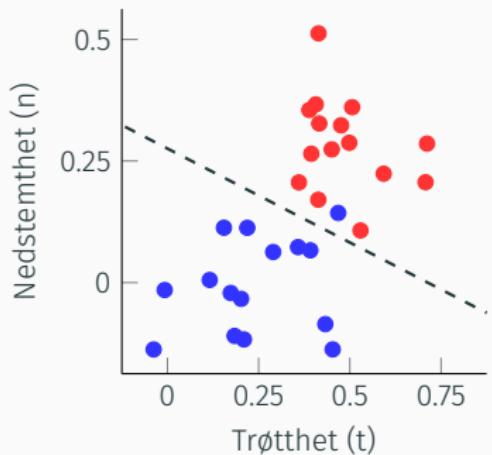
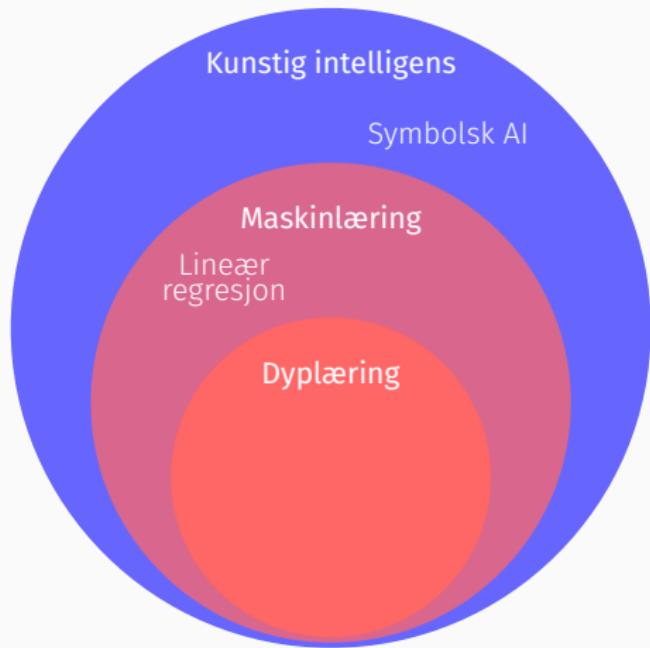
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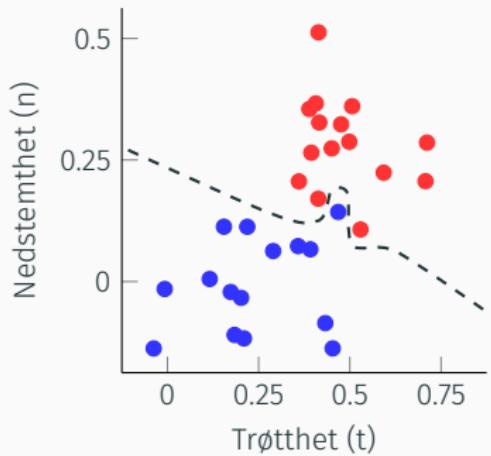
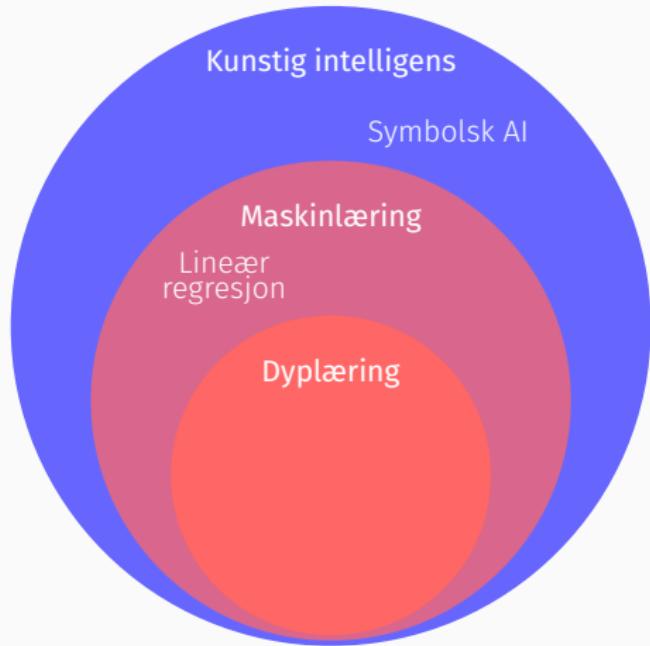
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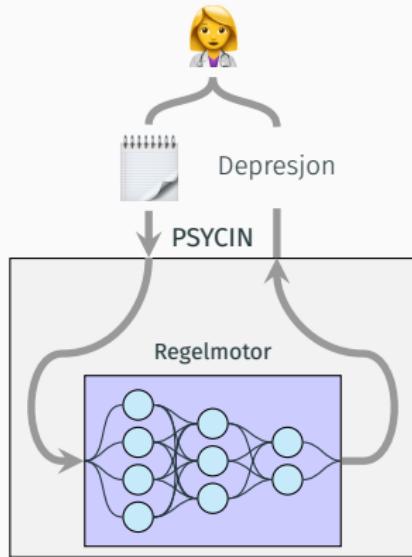
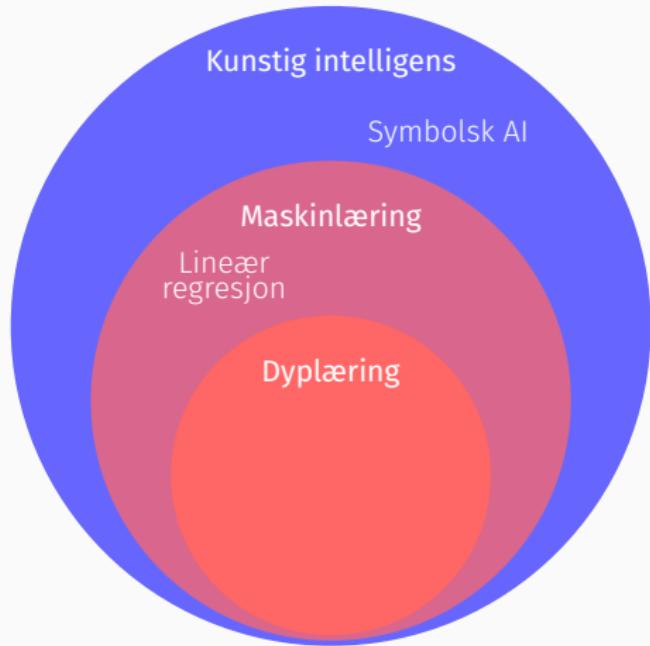
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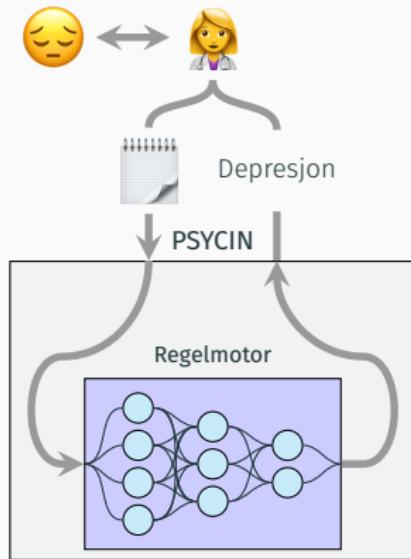
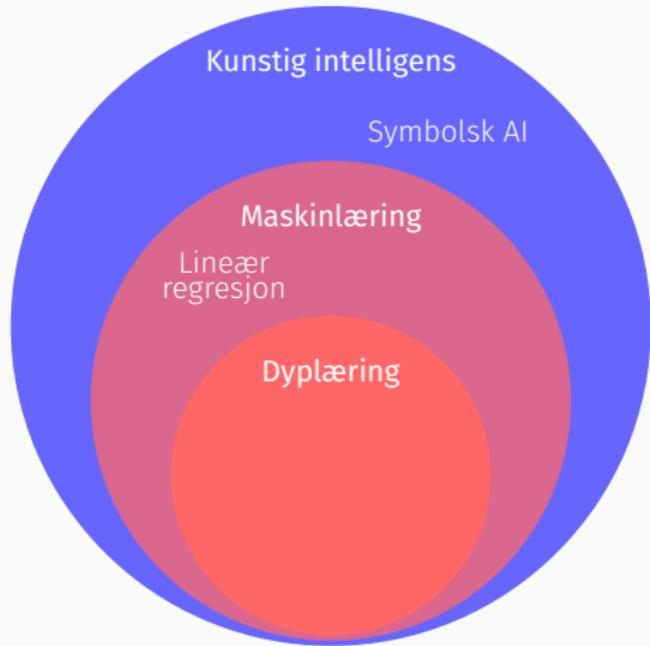
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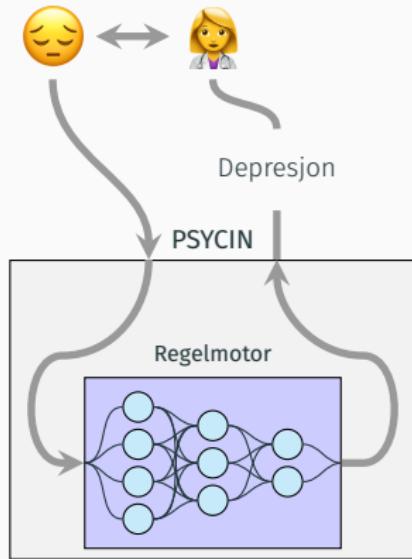
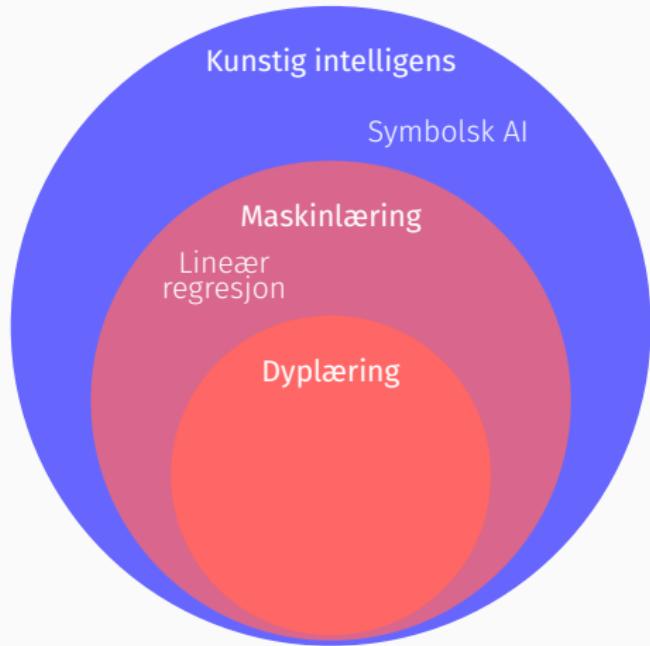
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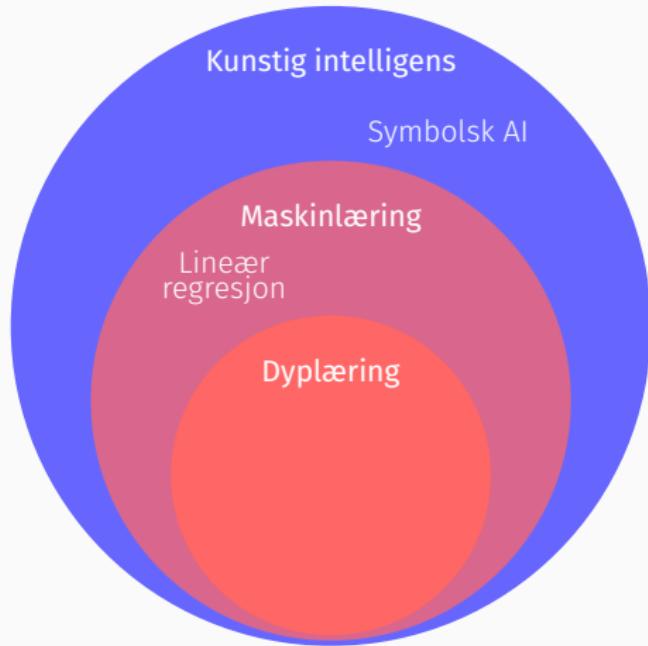
Hva er kunstig intelligens?



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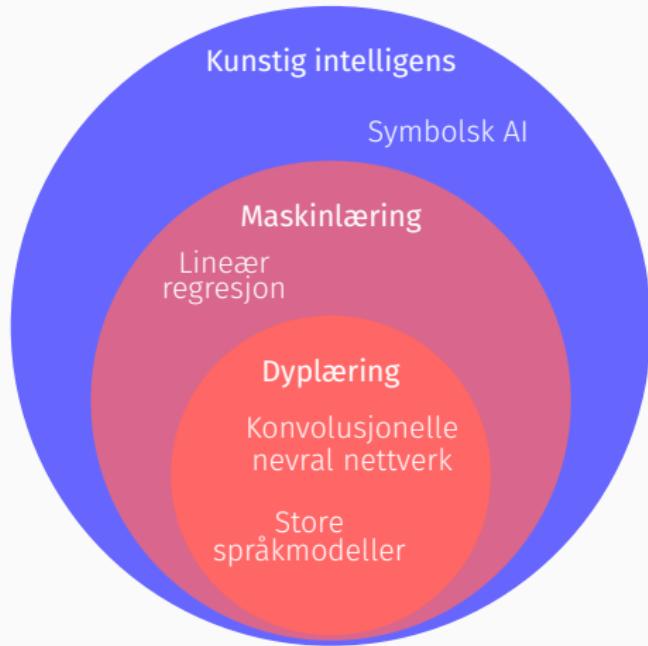
Kunstig intelligens (AI):
Maskiner som løser problemer som krever intelligens

Maskinlæring (ML):
Maskiner som lærer å løse problemer gjennom å finne mønster i data på egenhånd

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



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Konvolusjonelle nevrale nettverk:
Nevrale nettverk for prosessering av bildedata

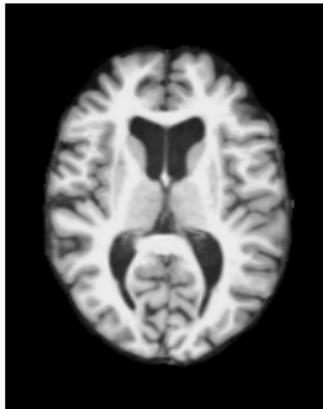
Store språkmodeller:
(Store) nevrale nettverk for språkprosessering (f.eks. ChatGPT)

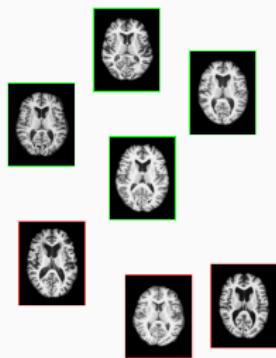


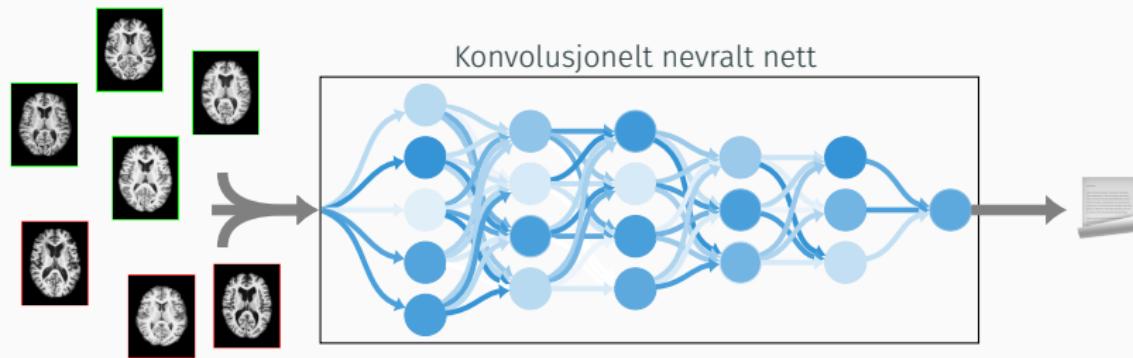
Kunstig intelligens i hjerneforskning



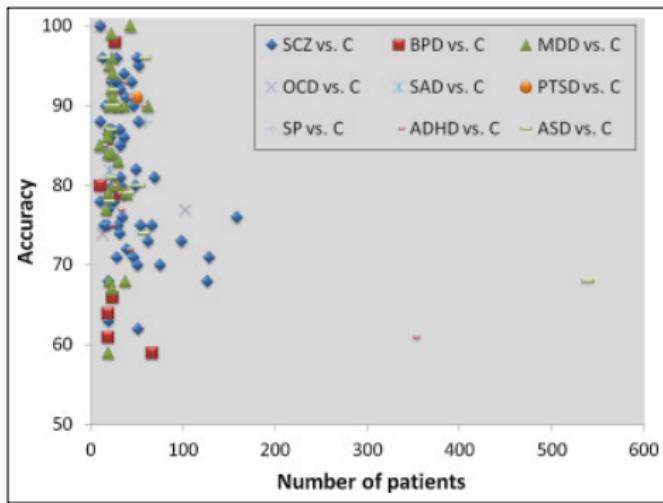
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I OSLO

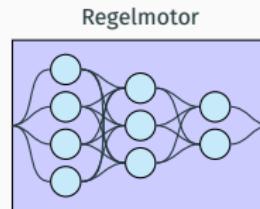
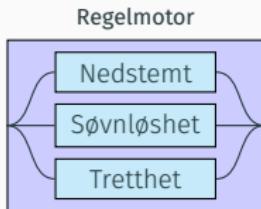




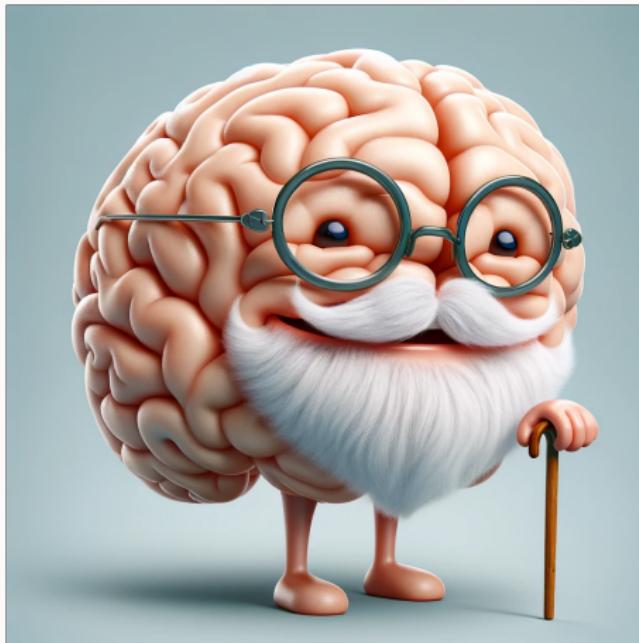








AI i hjernehorskning: Hjernealder

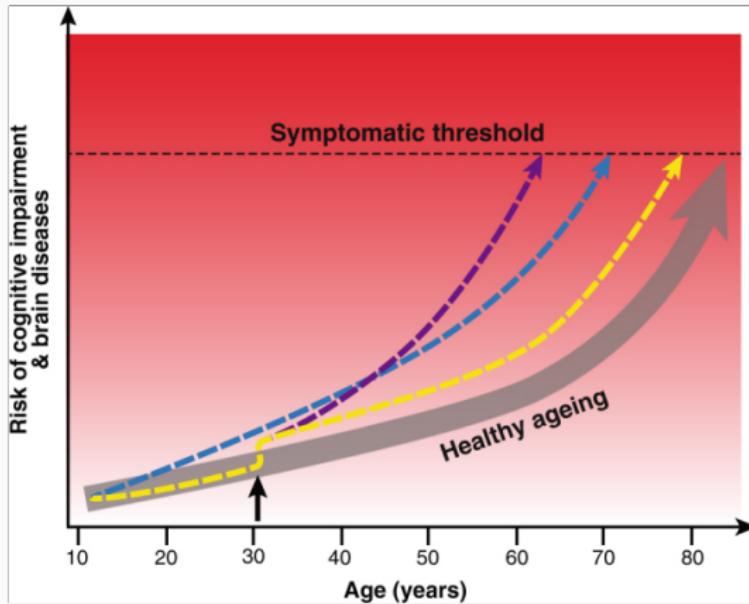


Generert av DALL-E 3 med prompt:

"Draw me a cartoon of a brain that looks like an old man"



AI i hjernehforskning: Hjernealder

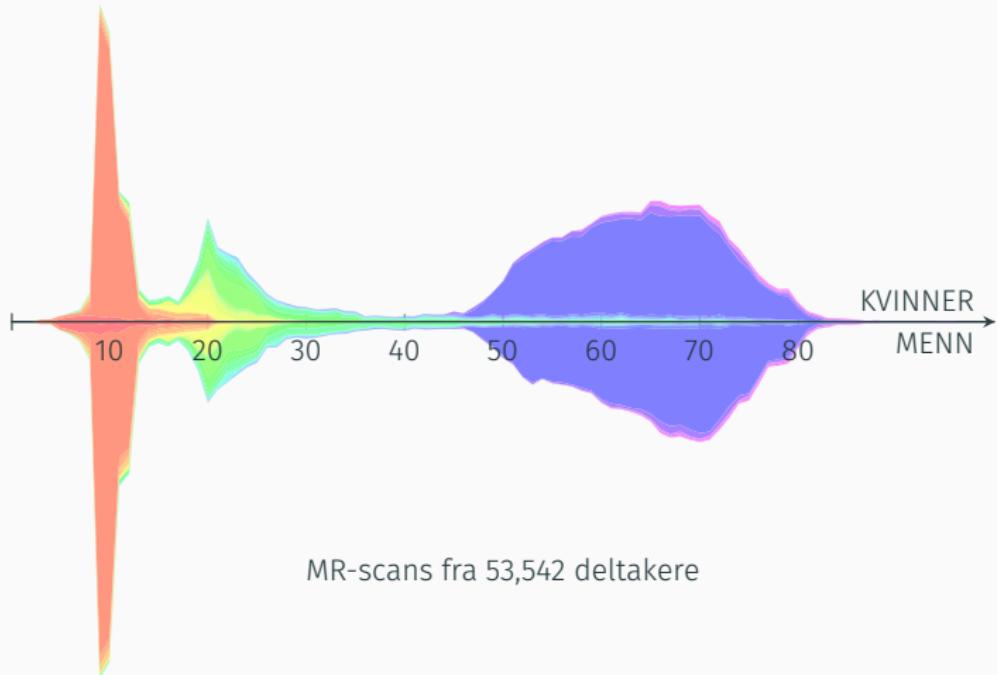


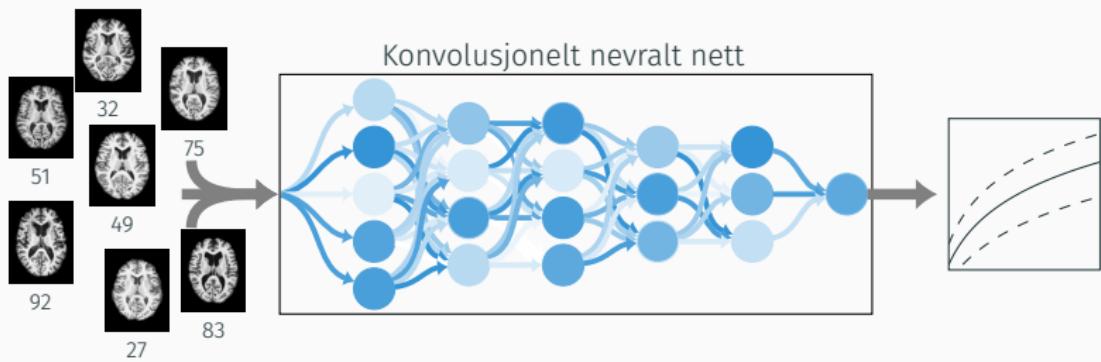
Brain age and other bodily 'ages': implications for neuropsychiatry

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

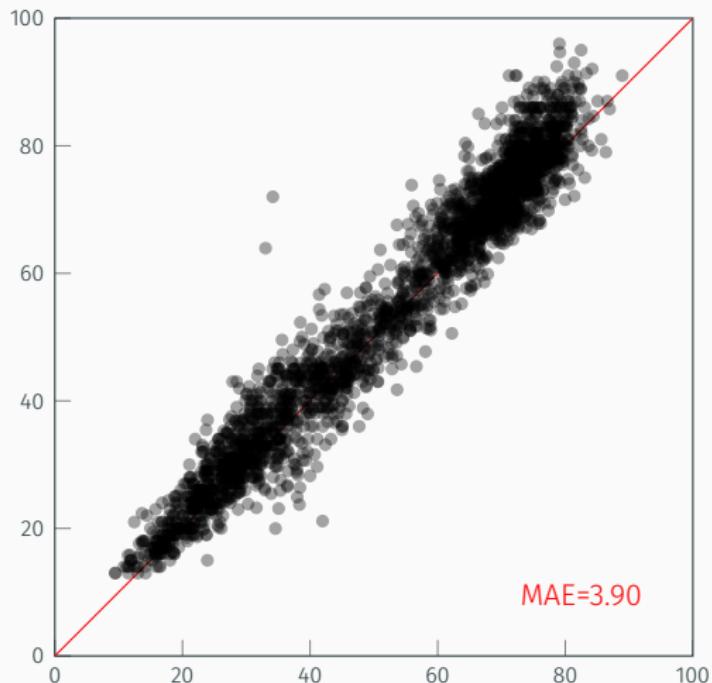


AI i hjernehforskning: Hjernealder

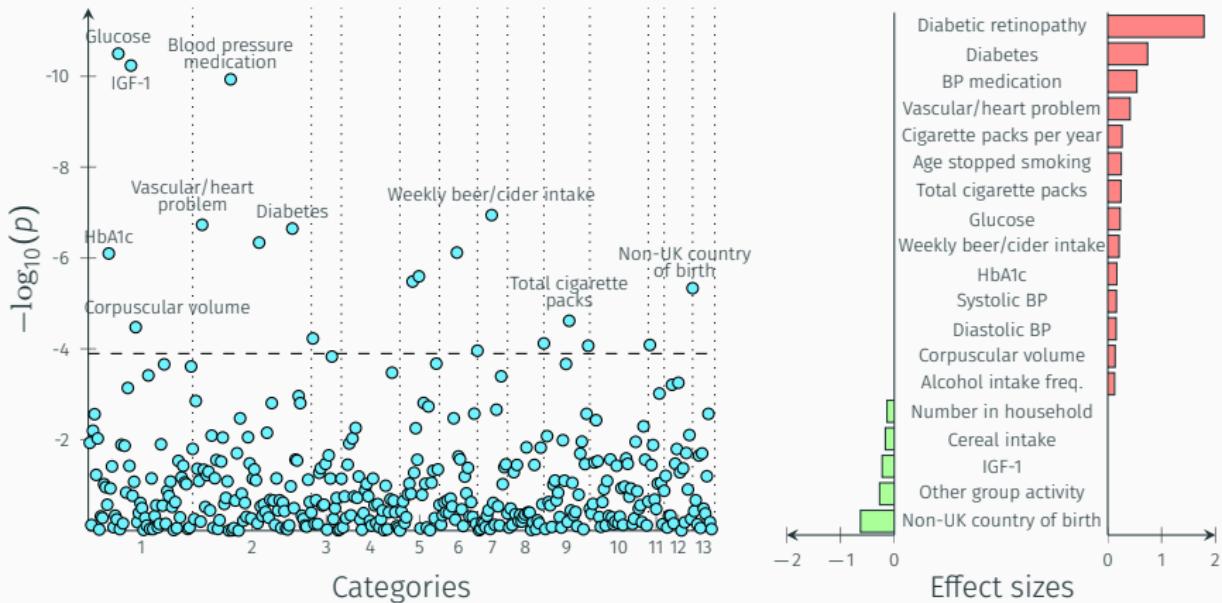




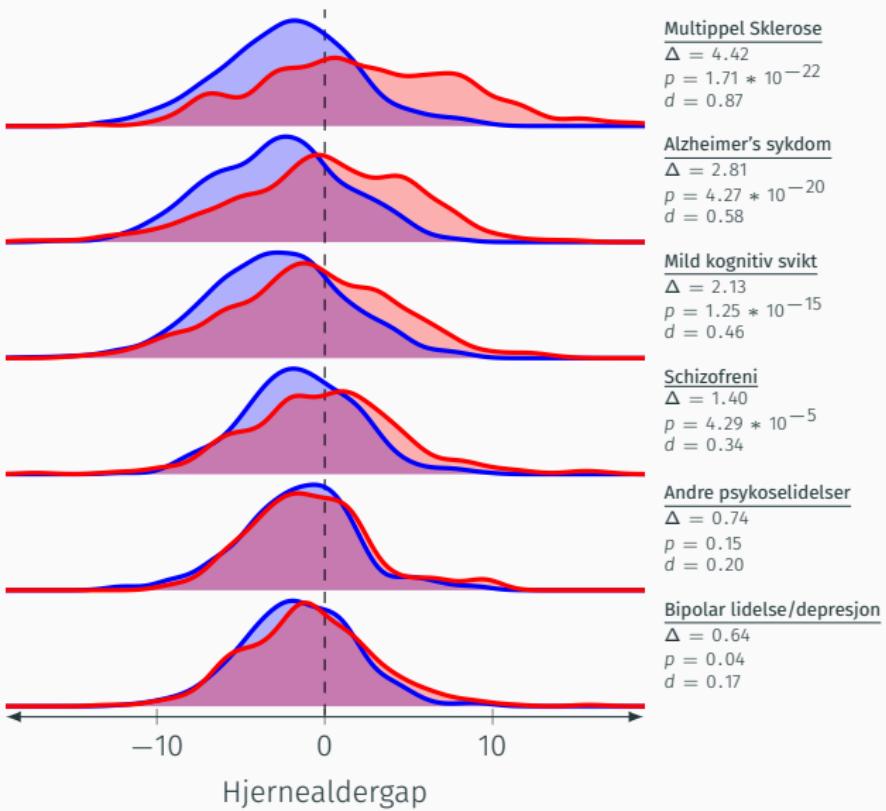
AI i hjernehforskning: Hjernealder



AI i hjernehforskning: Hjernealder



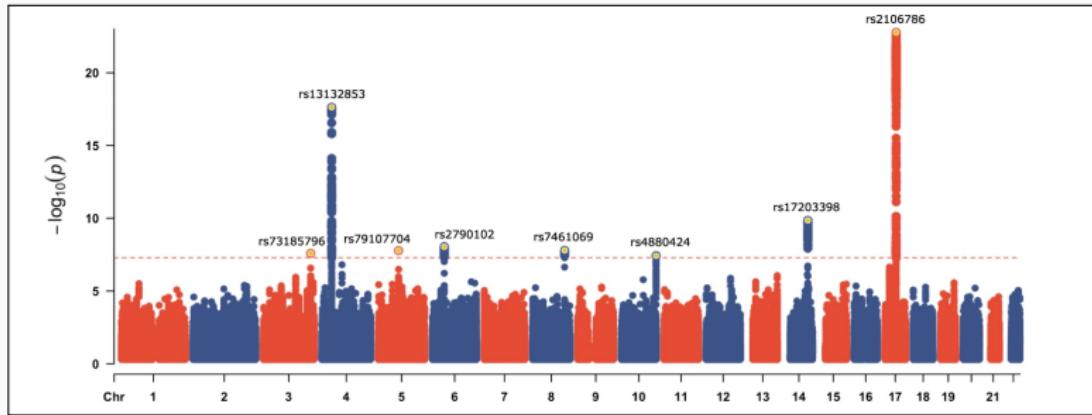
AI i hjernehelseforskning: Hjernealder



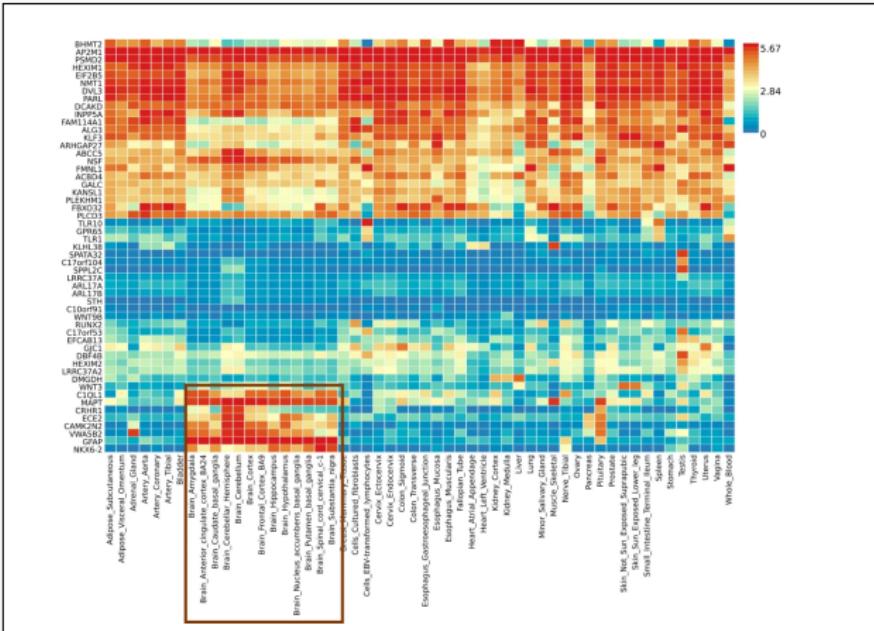
1. Hvordan henger hjernealder sammen med psykiske lidelser?
2. Hva er hjernealder egentlig?

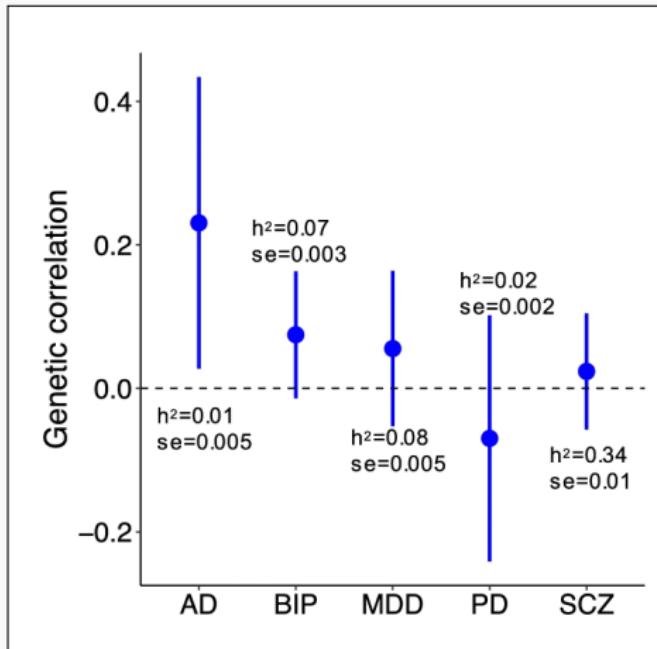


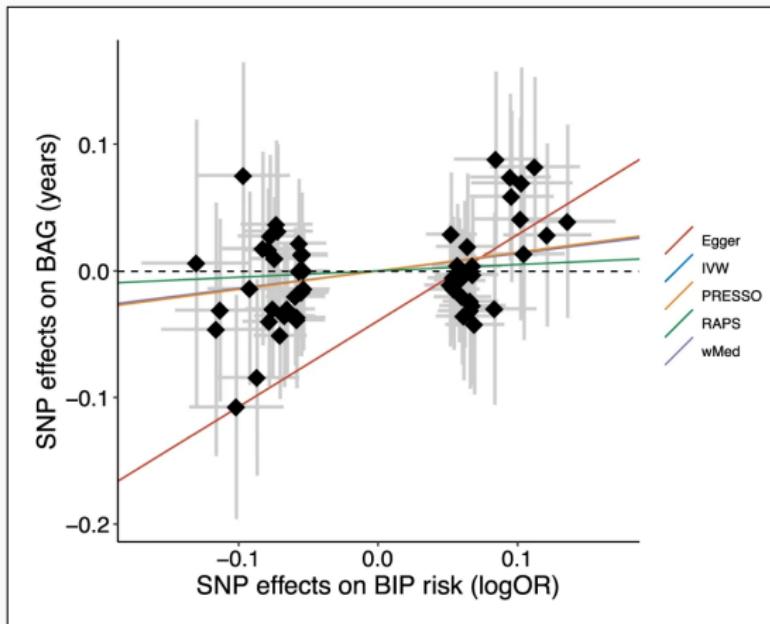
AI i hjernehforskning: Genetikk, hjernealder og psykiatri



AI i hjernehforskning: Genetikk, hjernealder og psykiatri







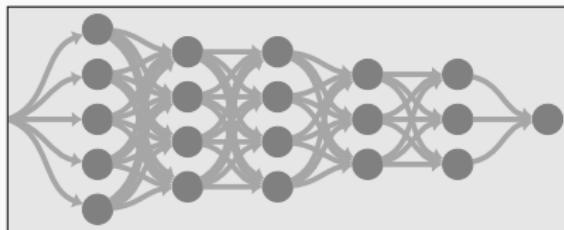
1. Hvordan henger hjernealder sammen med psykiske lidelser?

Foreløpig uklart

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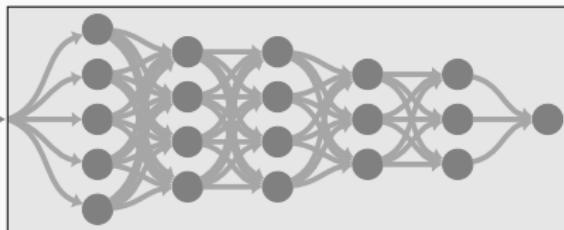


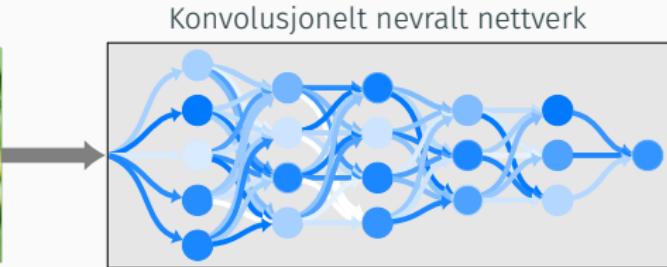
Konvolusjonelt nevralgt nettverk





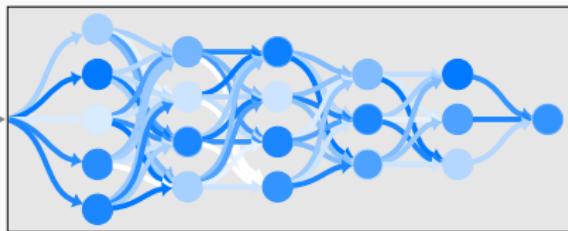
Konvolusjonelt nevralgt nettverk





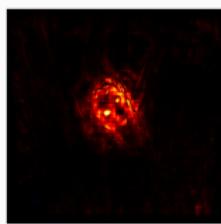


Konvolusjonelt nevralgt nettverk

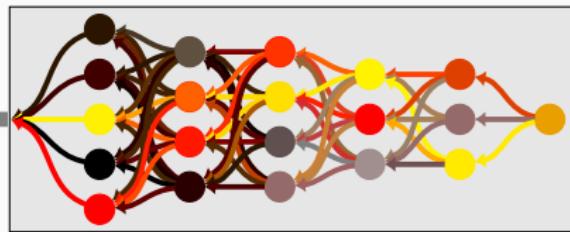


"marihøne"





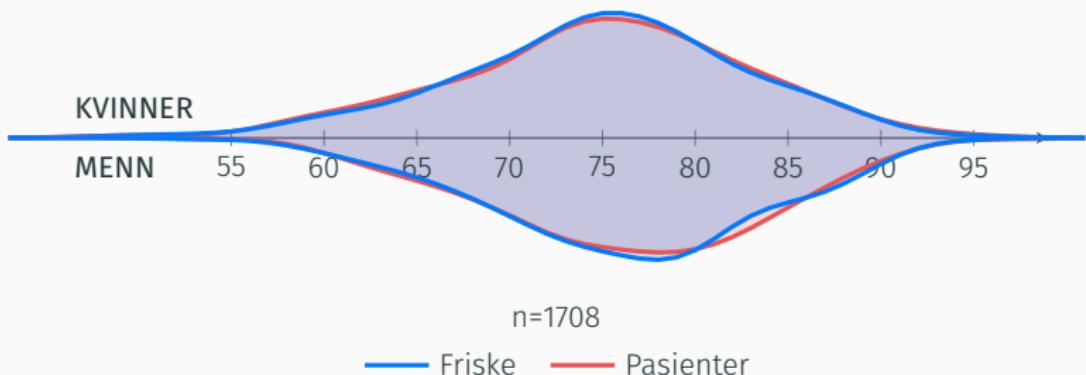
Konvolusjonelt nevralgt nettverk

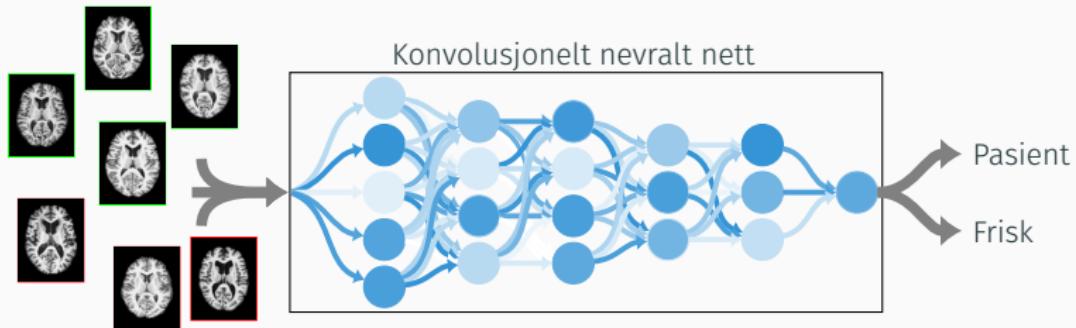


"marihøne"

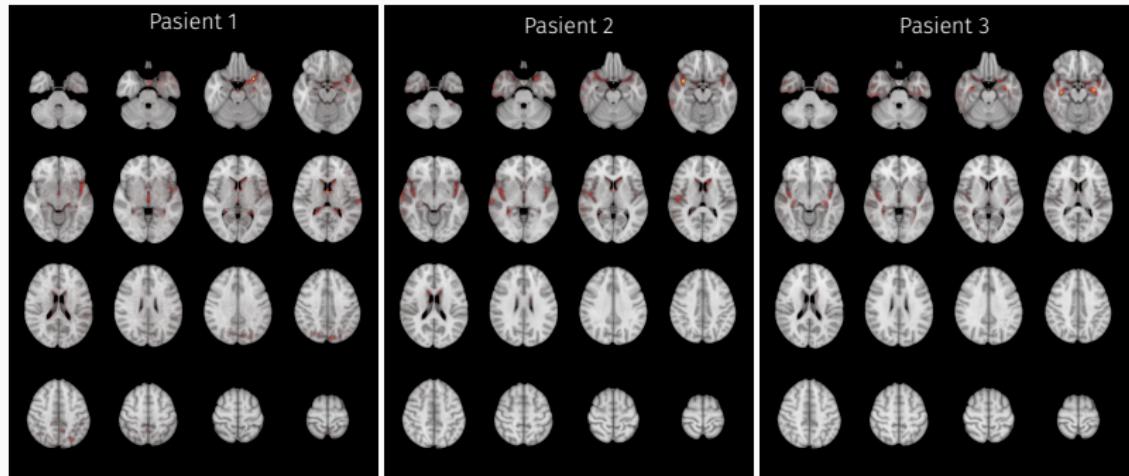


AI i hjernehforskning: Forklarbarhet

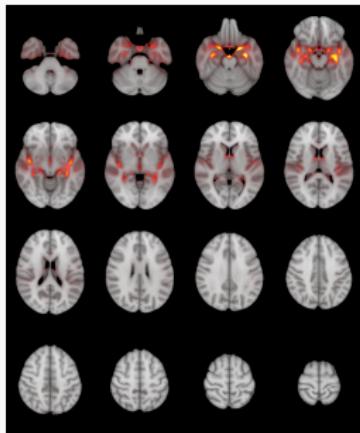




AI i hjernehorskning: Forklarbarhet

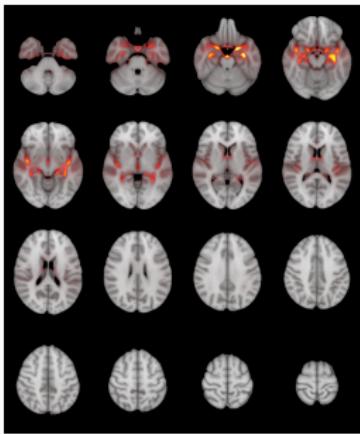


AI i hjernehorskning: Forklarbarhet

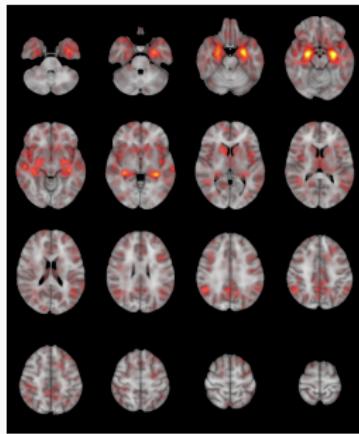


AI i hjernehorskning: Forklarbarhet

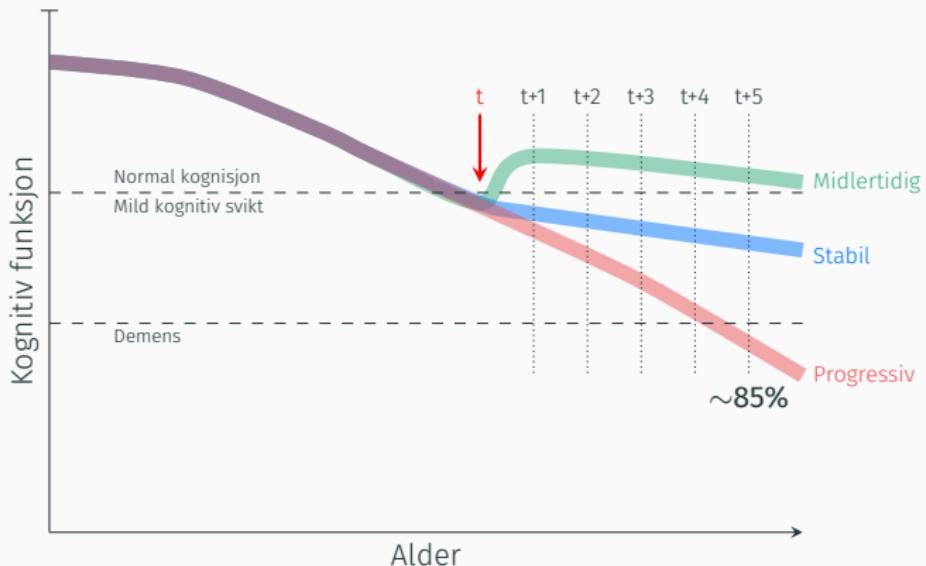
AI



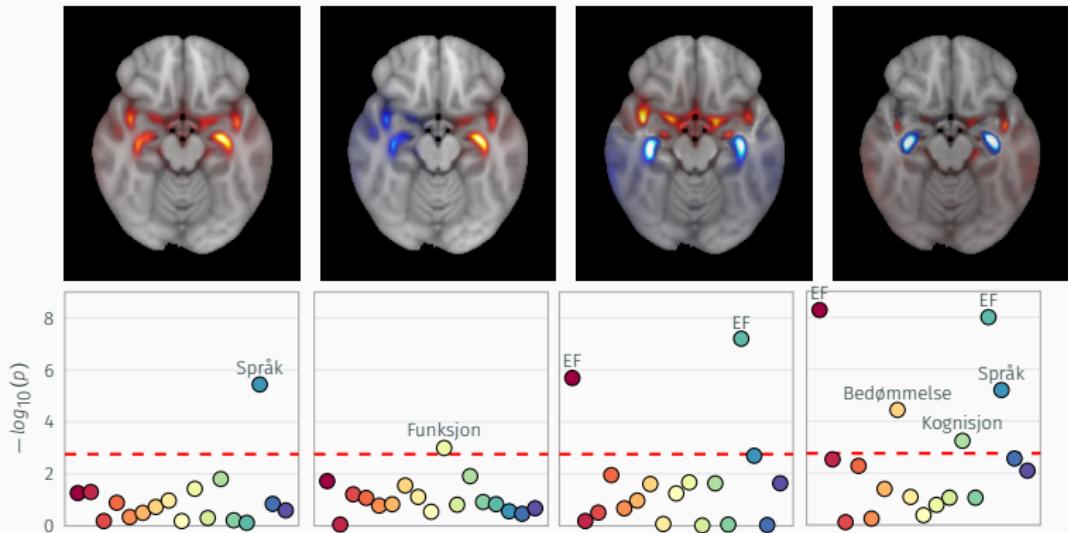
Mennesker



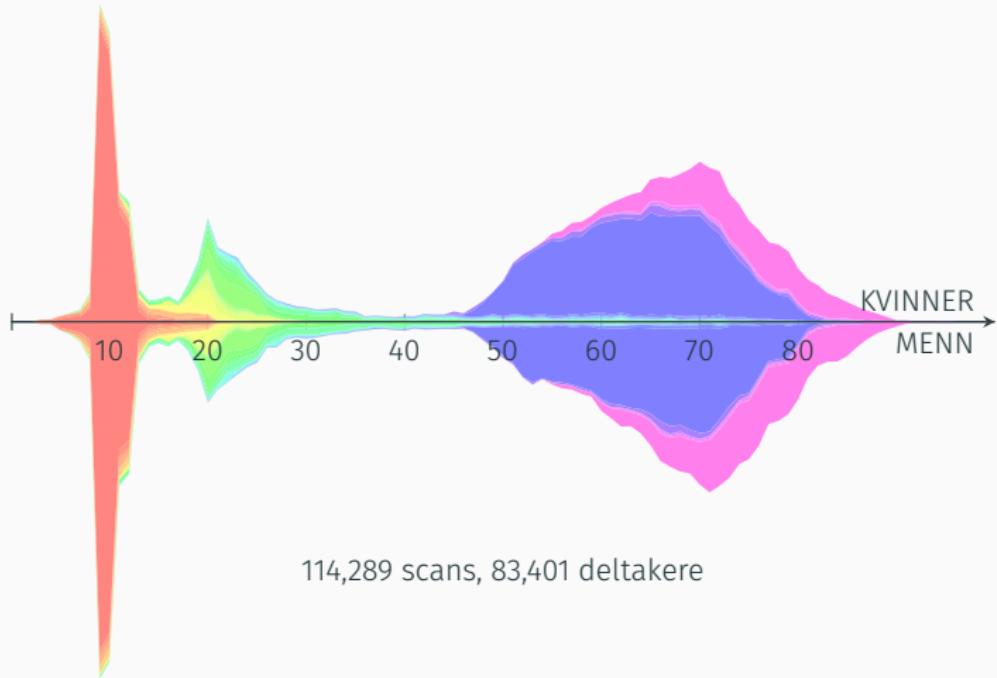
AI i hjernehorskning: Forklarbarhet



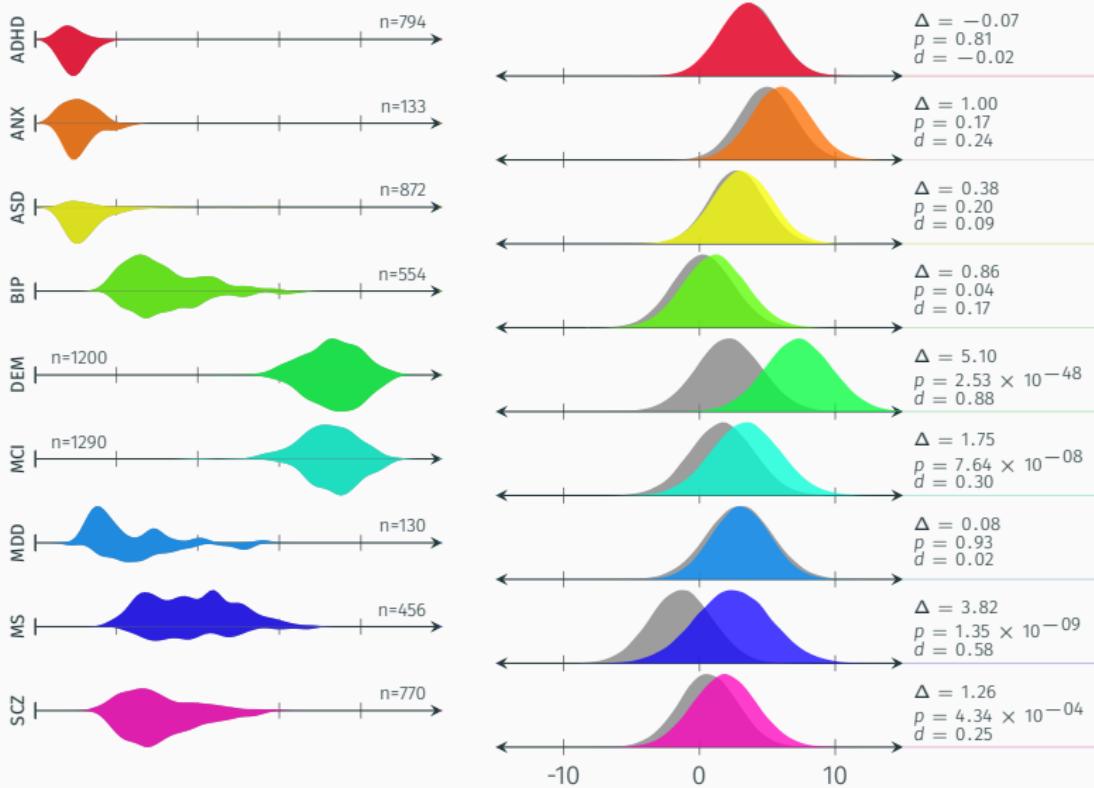
AI i hjernehorskning: Forklarbarhet



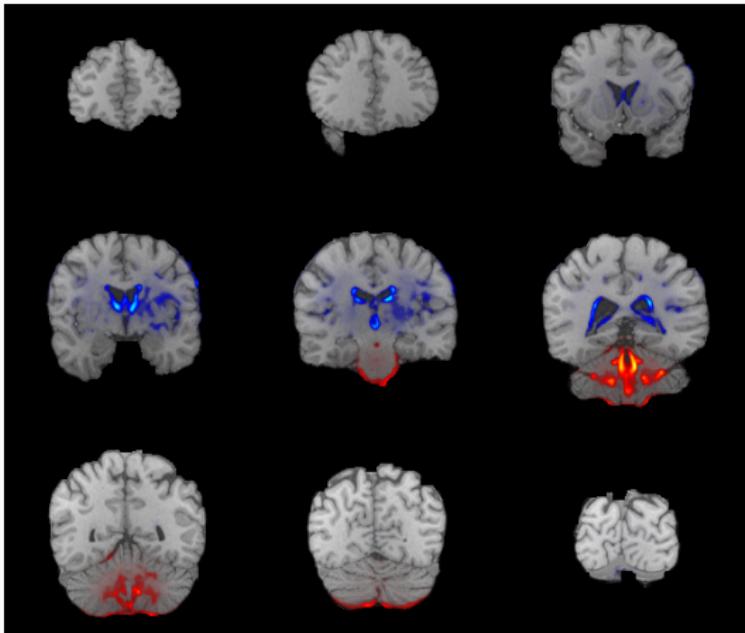
AI i hjernehorskning: Forklarbarhet



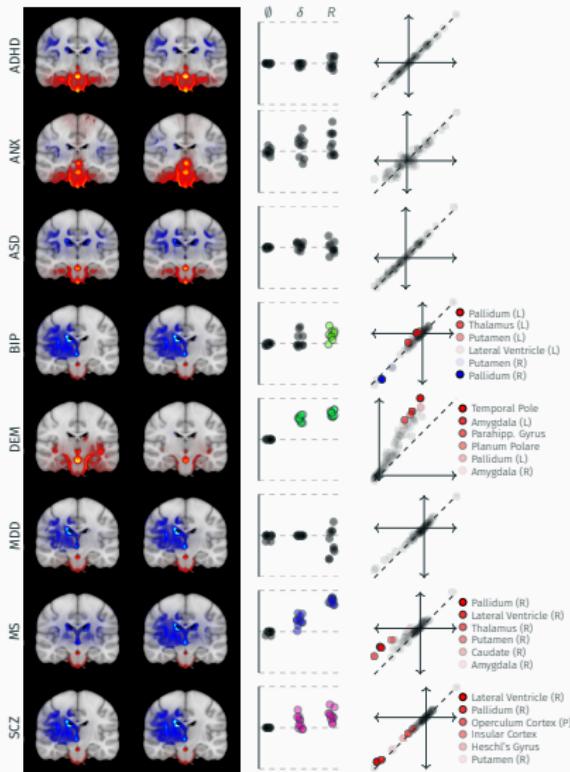
AI i hjernehforskning: Forklarbarhet



AI i hjernehorskning: Forklarbarhet



AI i hjernehjerneforskning: Forklarbarhet



1. Hvordan henger hjernealder sammen med psykiske lidelser?

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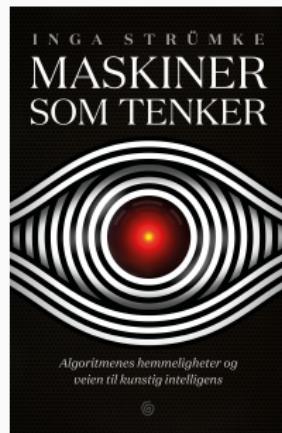
Det er komplisert



- Vi kan predikere psykiske lidelser basert på MR-bilder med kunstig intelligens bedre enn tilfeldig, men ikke så bra at det er meningsfullt på individ-nivå.
- Hjernealder er et lovende mål på generell hjernehelse som er (noenlunde) tolkbart, estimert av kunstig intelligens
 - Samvarierer med psykiske lidelser
 - Har et bredt genetisk grunnlag
- Forklarbar kunstig intelligens gir muligheter for å oppdage og beskrive kompliserte sammenhenger mellom hjernestruktur og psykiske lidelser
 - Avdekker at kunstig intelligens bruker de samme mønstrene som menneskelige eksperter (for å gjenkjenne demens)
 - Viser at høyoppløselige kart over hjernehorskjeller er mer prediktive enn singulære risiko-scorer



Boktips!



Takk for meg!

