

Kunstig intelligens og bildegenkjenning i hjernehorskning

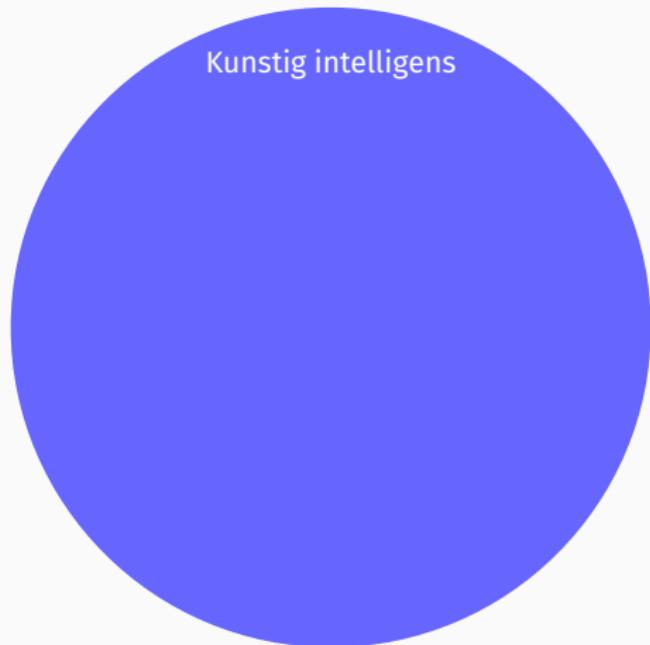
Esten H. Leonardsen

22.09.23



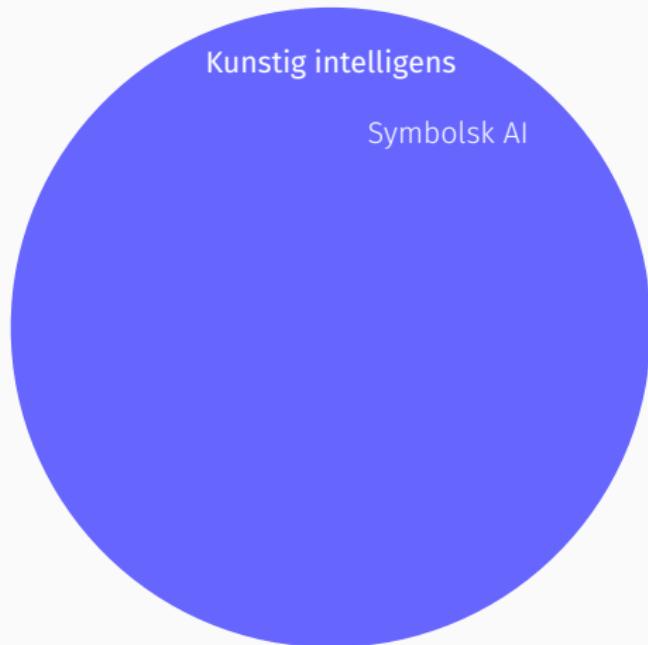
Kunstig intelligens

Terminologi: Taksonomi



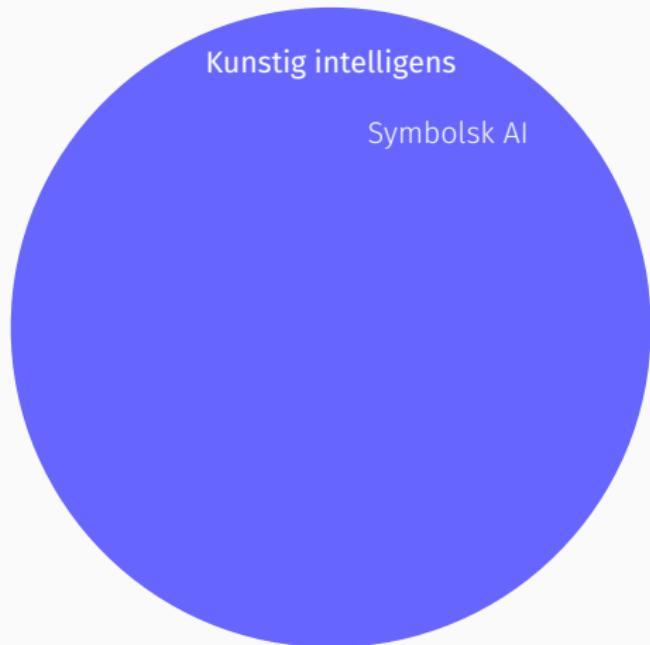
Kunstig intelligens:
Maskiner som løser oppgaver
som krever intelligens

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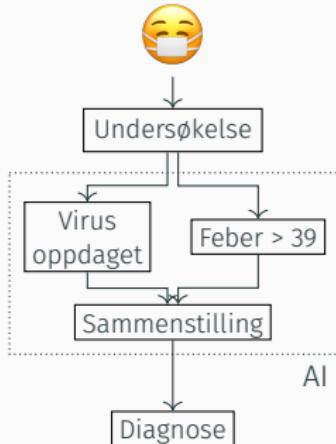
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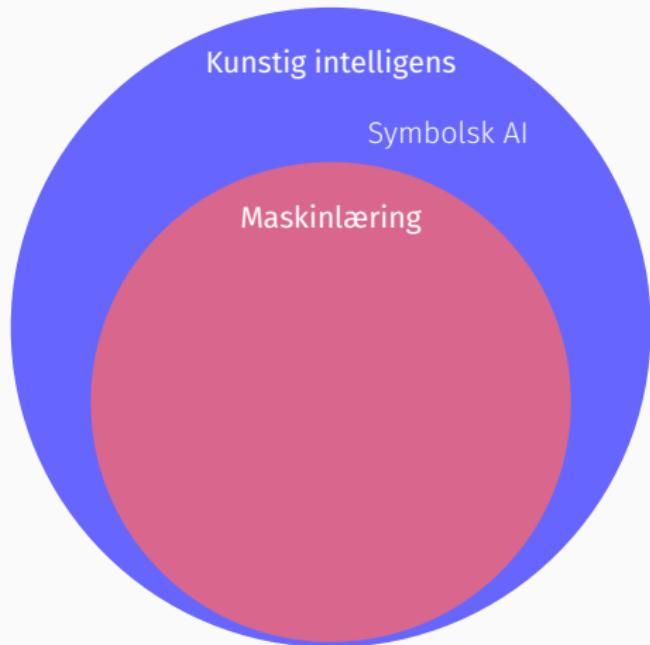


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Symbolsk AI

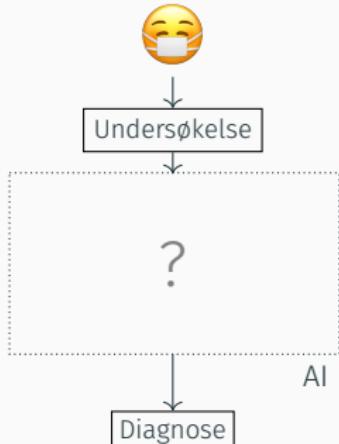


Terminologi: Taksonomi

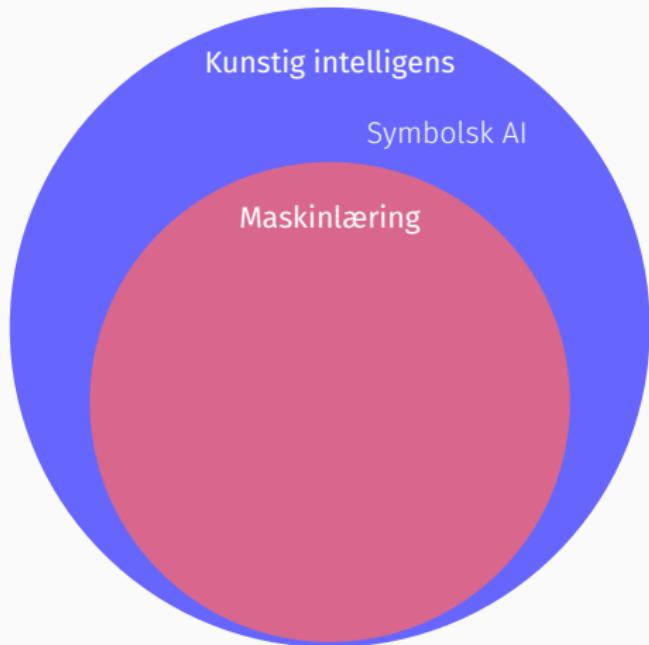


Kunstig intelligens:
Maskiner som løser oppgaver
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Maskinlæring



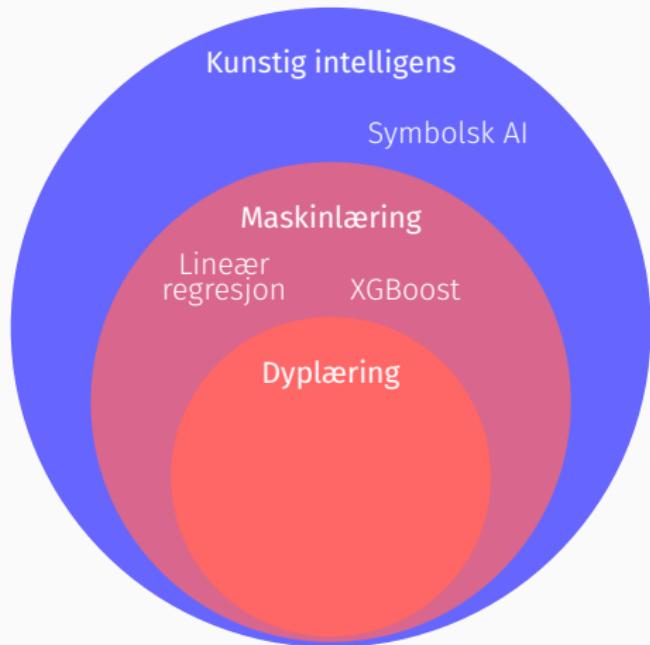
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Kunstig intelligens:
Maskiner som løser oppgaver som krever intelligens

Maskinlæring:
Modeller som lærer å løse oppgaver gjennom å finne mønster i data

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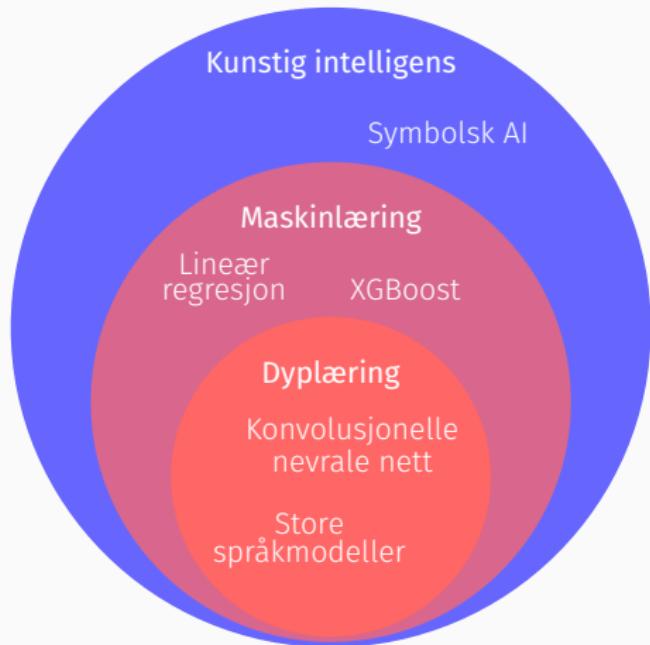


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Dyplæring:
Maskinlæringsmodeller som er lagvis organisert (\approx dype nevrale nett) for å lære mer effektive representasjoner av data

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Konvolusjonelle nevrale nett:
Nevrale nett som løser problemer i bildedata

Store språkmodeller:
Nevrale nett som løser problemer i naturlig språk (ChatGPT)

Terminologi: Veiledet vs ikke-veiledet læring

Veiledet læring
(Supervised learning)



→ Katt



→ Hund



→ Katt



→ Hund

Ikke-veiledet læring
(Unsupervised learning)

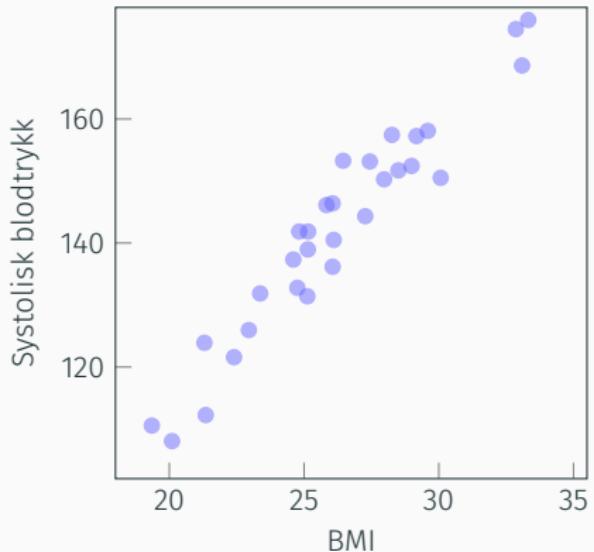


Maskinlæring

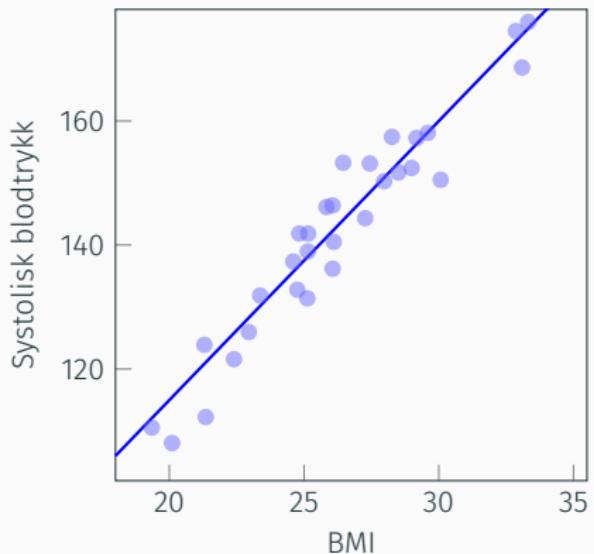
Maskinlæring: Lineær regresjon

BMI	Systolisk blodtrykk
28.99	152.43
26.45	153.27
29.59	158.09
33.09	168.63
26.06	146.40
26.06	136.18
33.32	175.97
30.07	150.52
25.12	131.41
29.17	157.25
25.15	141.85
25.14	138.97
27.97	150.28
19.35	110.56
20.10	108.06
24.75	132.78
22.95	125.97
28.26	157.44
23.37	131.87
21.35	112.26

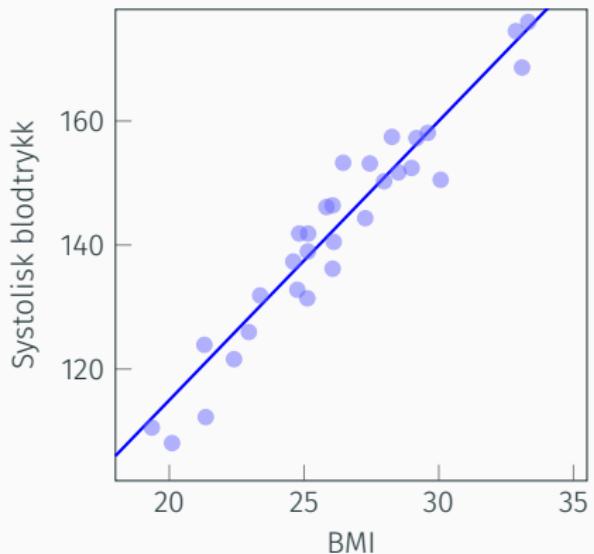
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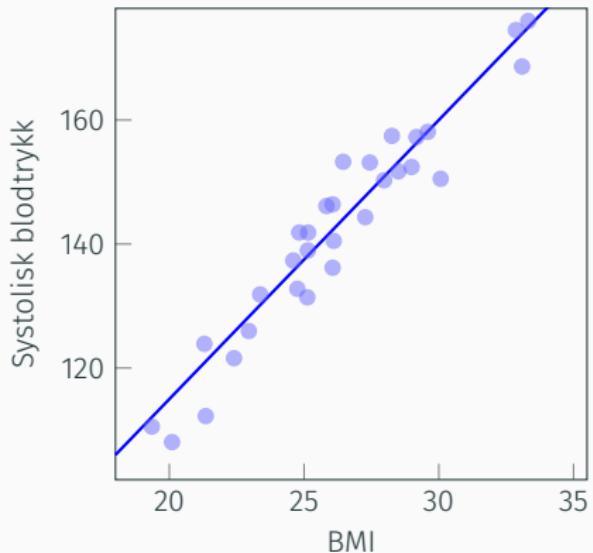


Maskinlæring: Lineær regresjon

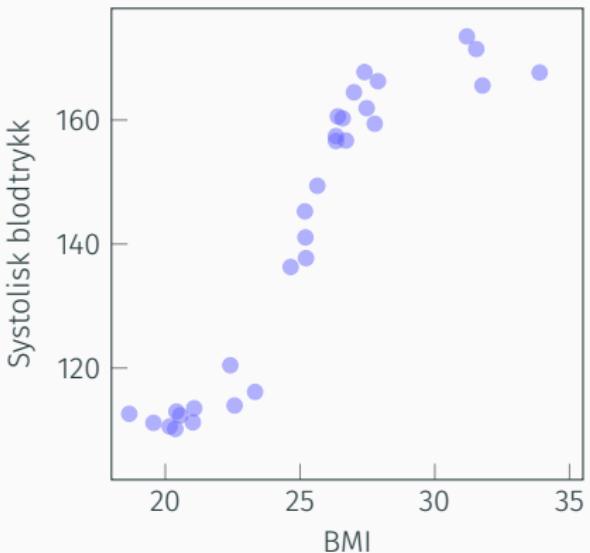


$$SBP = 25 + 4.5 * BMI$$

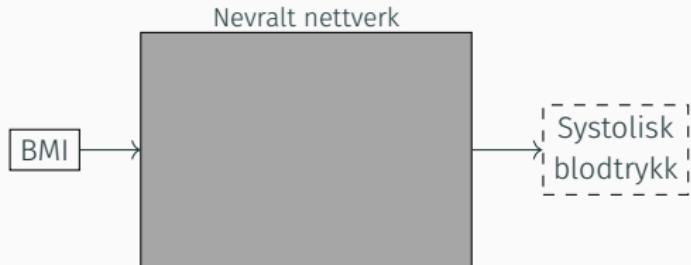
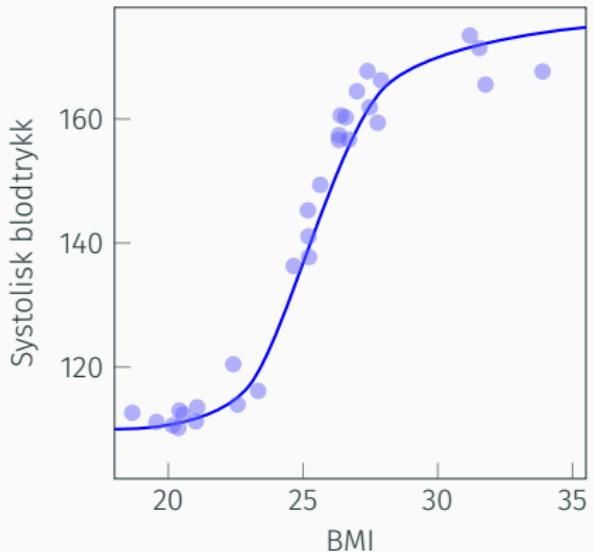
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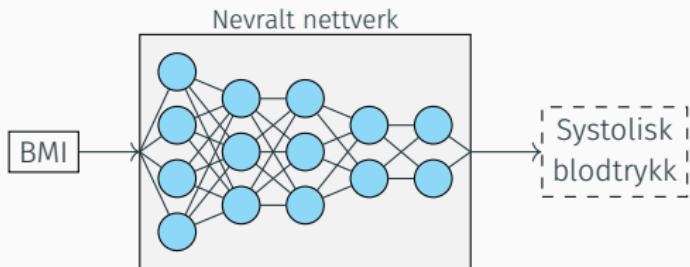
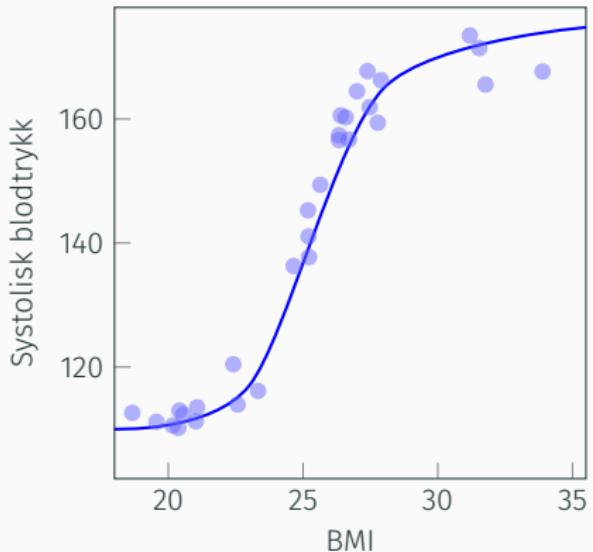
Maskinlæring: Dype nevrale nettverk



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Maskinlæring: Dype nevrale nettverk



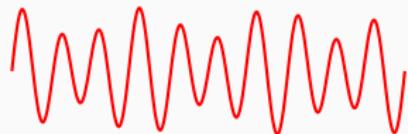
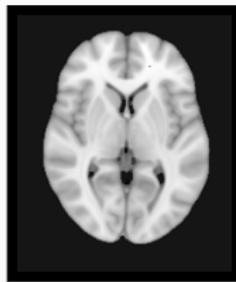
Maskinlæring: Ustrukturert data

Strukturert data

Alder	Kjønn	BMI	SBP
54	M	28.99	152
32	K	26.45	110
41	K	21.59	91
72	M	25.52	130

Ustrukturert data

"Pasienten opplever smerter i brystet og har høyt blodtrykk."



Kunstig intelligens: Oppsummering

- Kunstig intelligens er et fagfelt som handler om å lage maskiner som løser vanskelige oppgaver som tidligere var reservert for mennesker.
- Maskinlæring er en teknikk der en maskin lærer å løse et problem gjennom å finne mønster i data.
- Nevrale nett er en type maskinlæringsmodell inspirert av hjernen, der prediksjonen skjer via et nettverk av kunstige nevroner.
 - + Kan modellere komplekse, ikke-lineære sammenhenger.
 - + Er i stand til å håndtere ikke-strukturert data (e.g. bilder).
 - Reglene som modellen lærer er ikke nødvendigvis forståelig for mennesker.
 - Krever mye data og regnekraft.
 - Kan være sluttet på menneskeheten(?)

Bildegenkjenning

Bildegjenkjenning



Katt



Solsikke

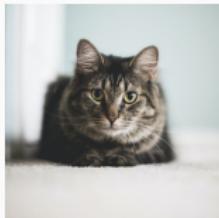


Hvithai



Fly

Bildegjenkjenning



Katt



Solsikke



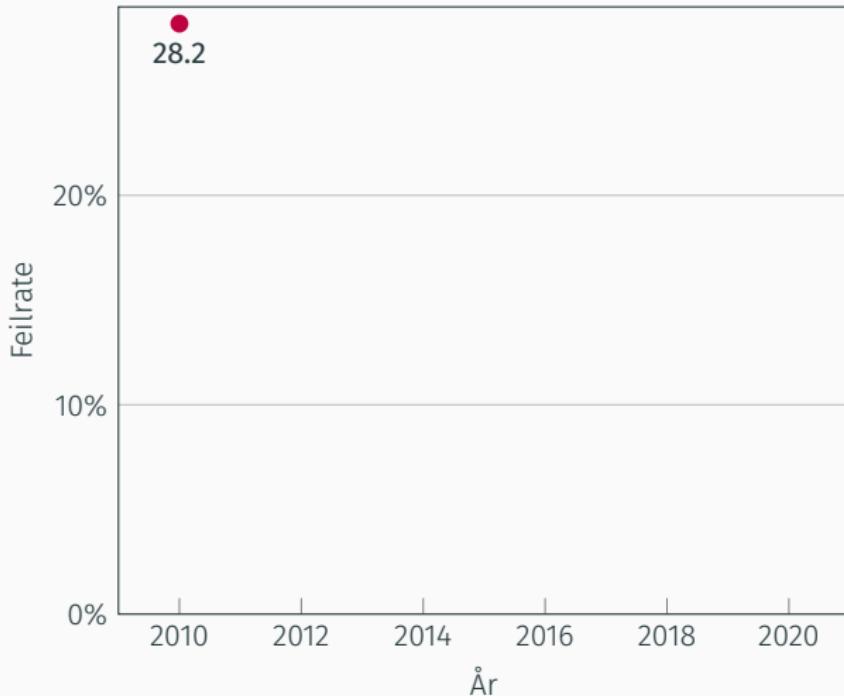
Hvithai



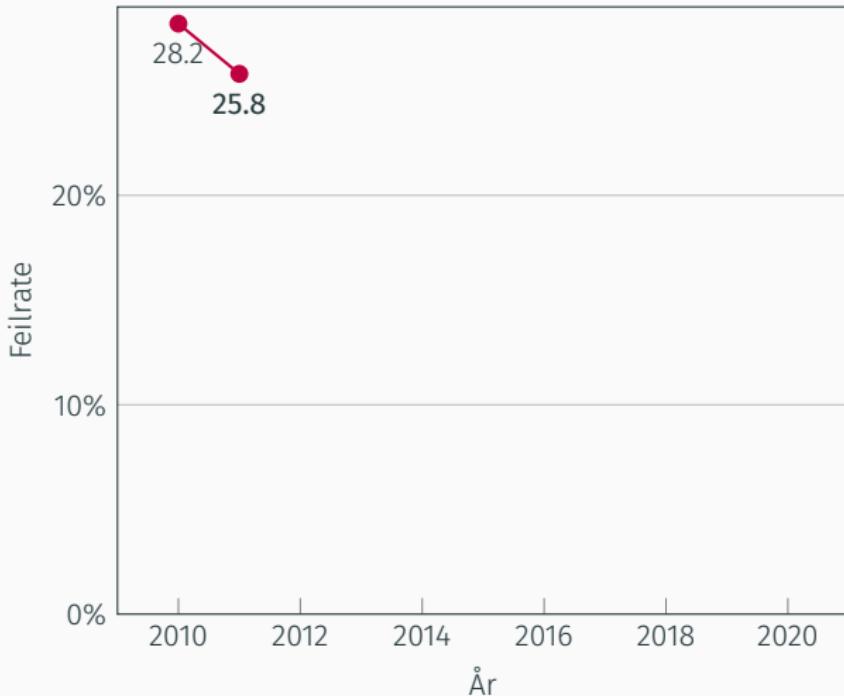
Fly

ImageNet: ~14 millioner bilder, 1000 kategorier

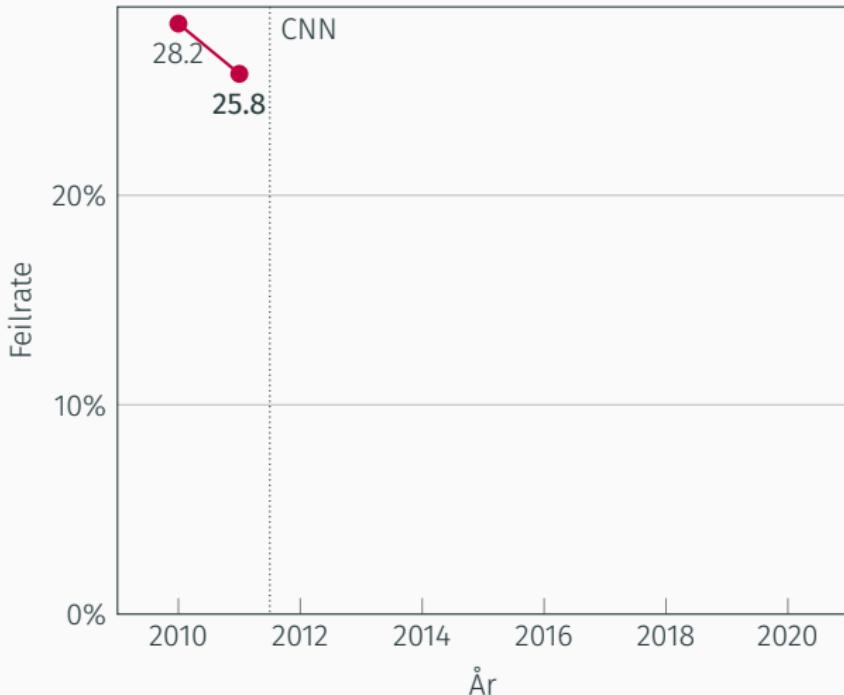
Bildegjenkjenning: Historikk



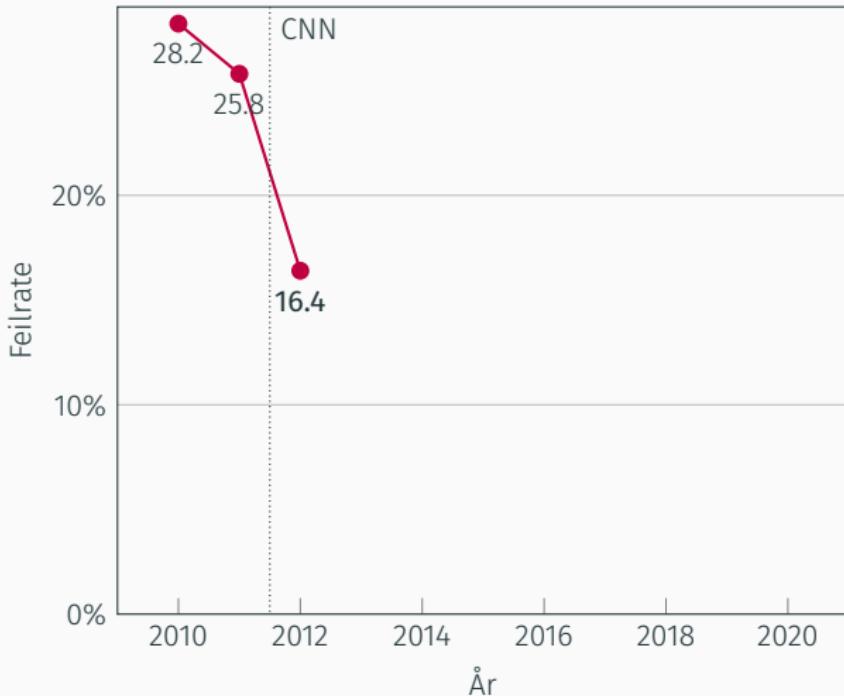
Bildegjenkjenning: Historikk



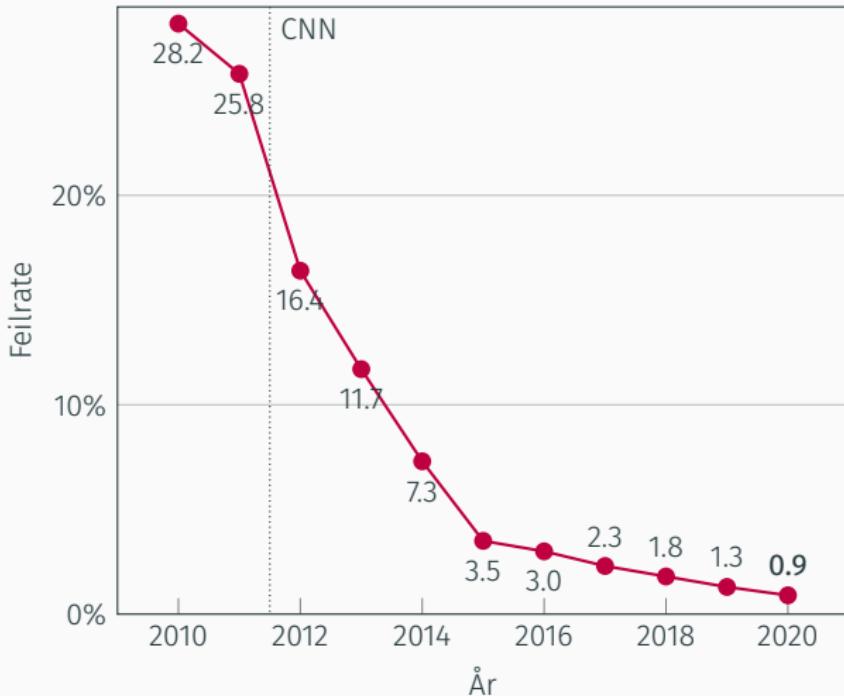
Bildegenkjenning: Historikk



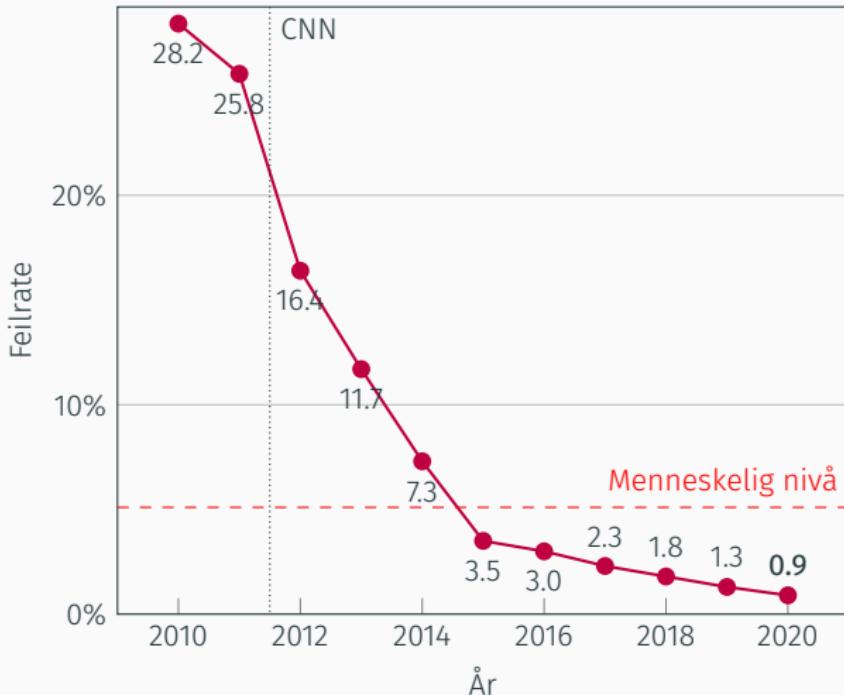
Bildekjenning: Historikk



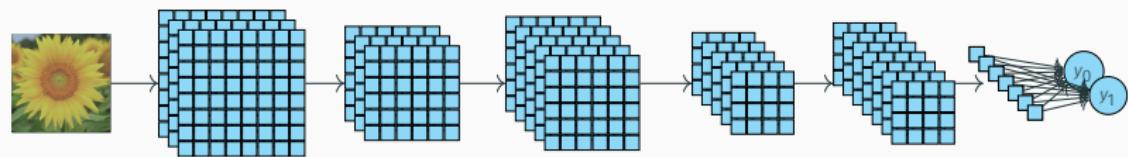
Bildekjenning: Historikk



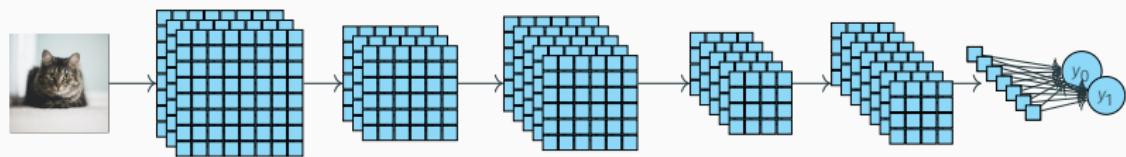
Bildegenkjenning: Historikk



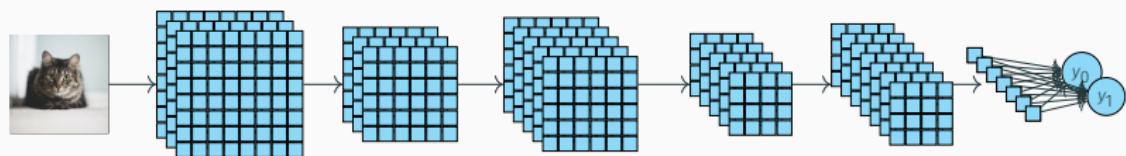
Bildegjenkjenning: Konvolusjonelle nevrale nettverk



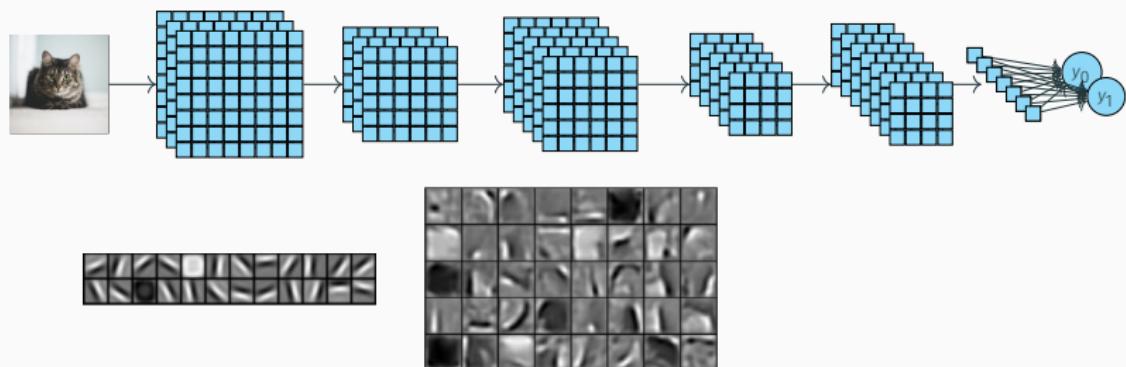
Bildegjenkjenning: Konvolusjonelle nevrale nettverk



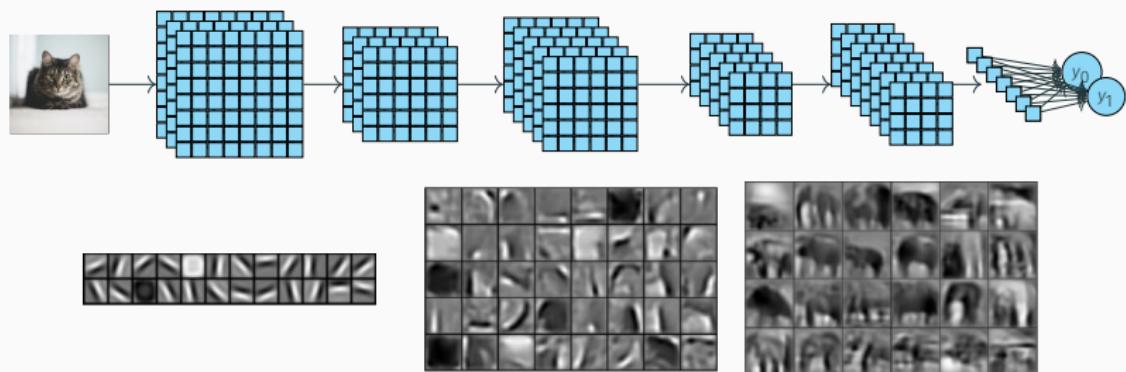
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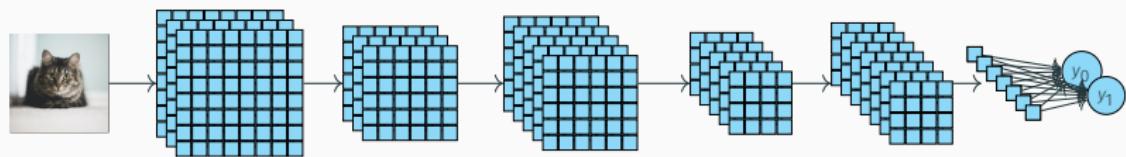
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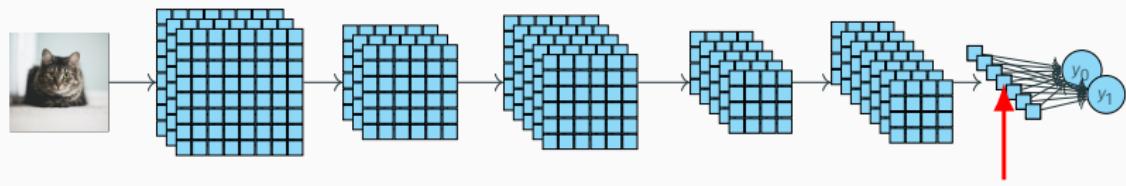
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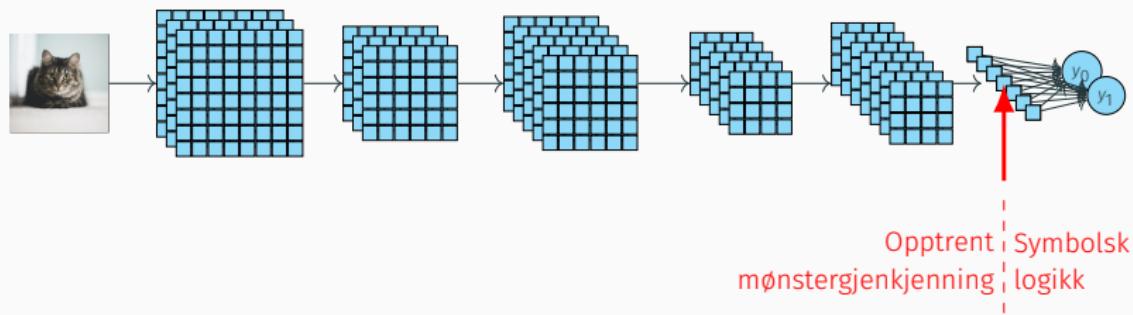
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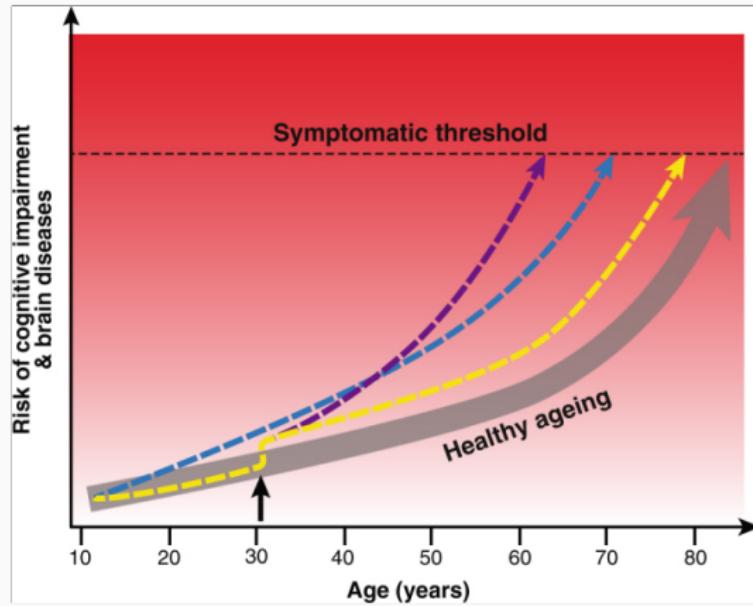
Bildegjenkjenning: Konvolusjonelle nevrale nettverk



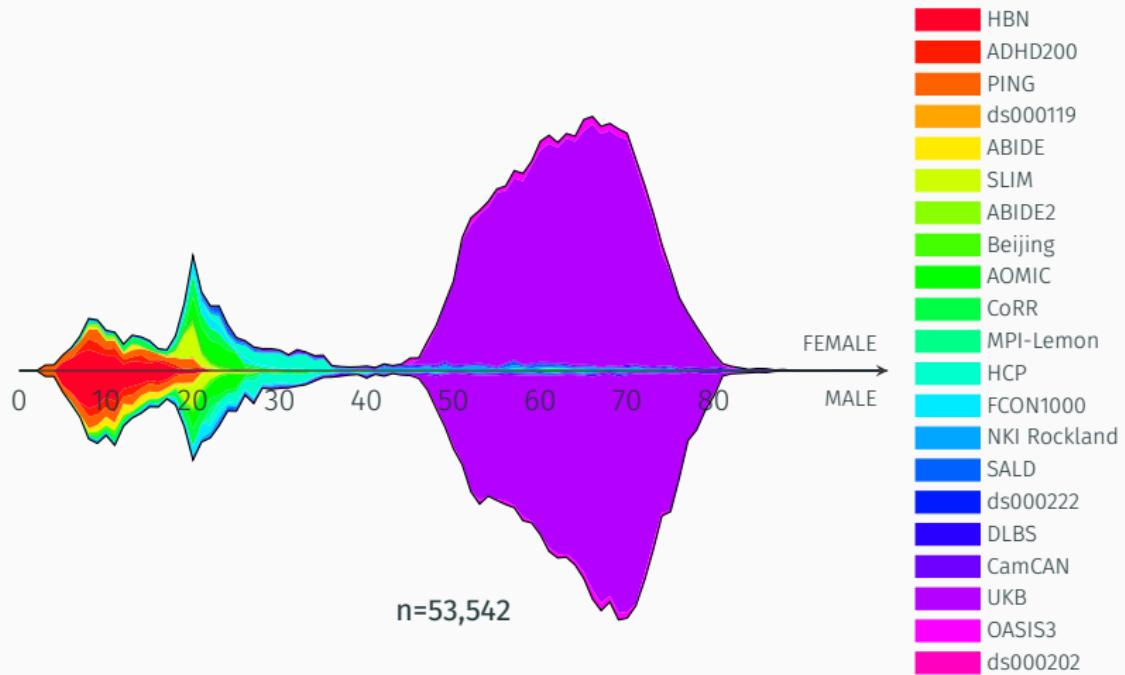
Bildegjenkjenning: Oppsummering

- Moderne bildegjenkjenning gjøres ved hjelp av konvolusjonelle nevrale nettverk.
- Konvolusjonelle nevrale nettverk løser oppgaver ved å lære seg å kjenne igjen mønstre i bilder.
- Jo lenger inn i nettverket man kommer, jo mer abstrakte og konseptuelle er mønstrene.

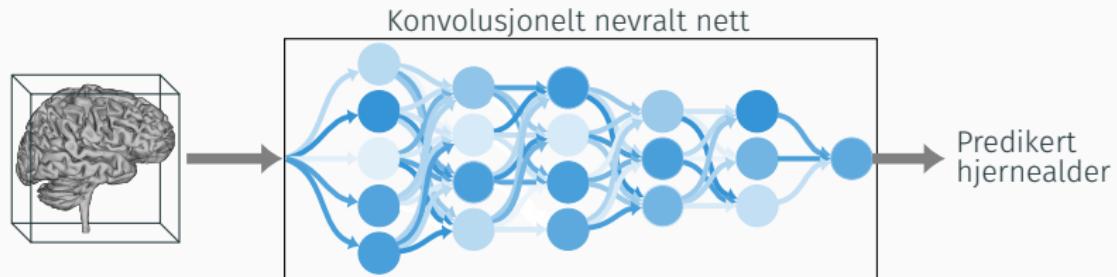
Bildegjenkjenning i hjerneforskning



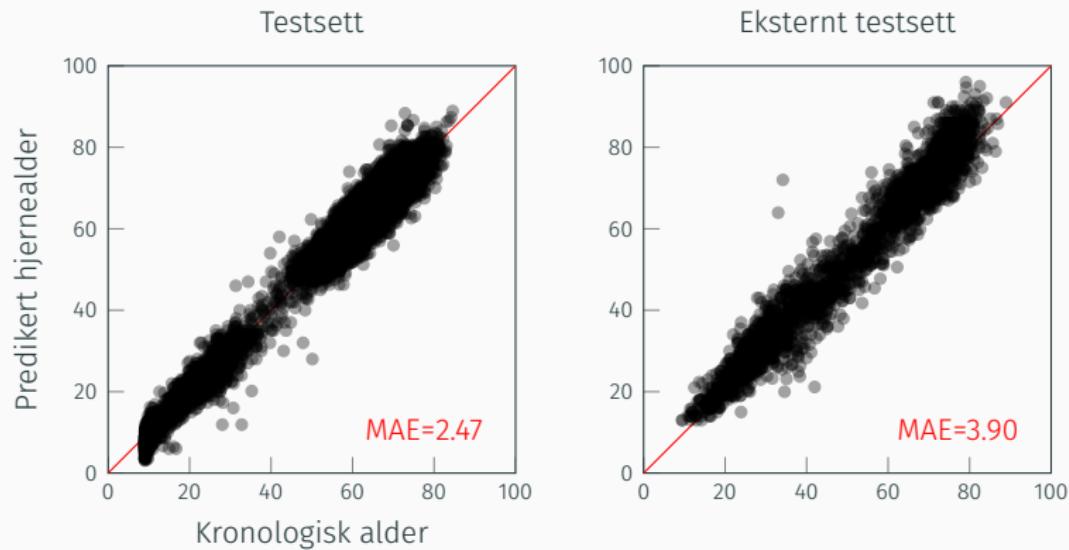
Hjernealder: Datasett



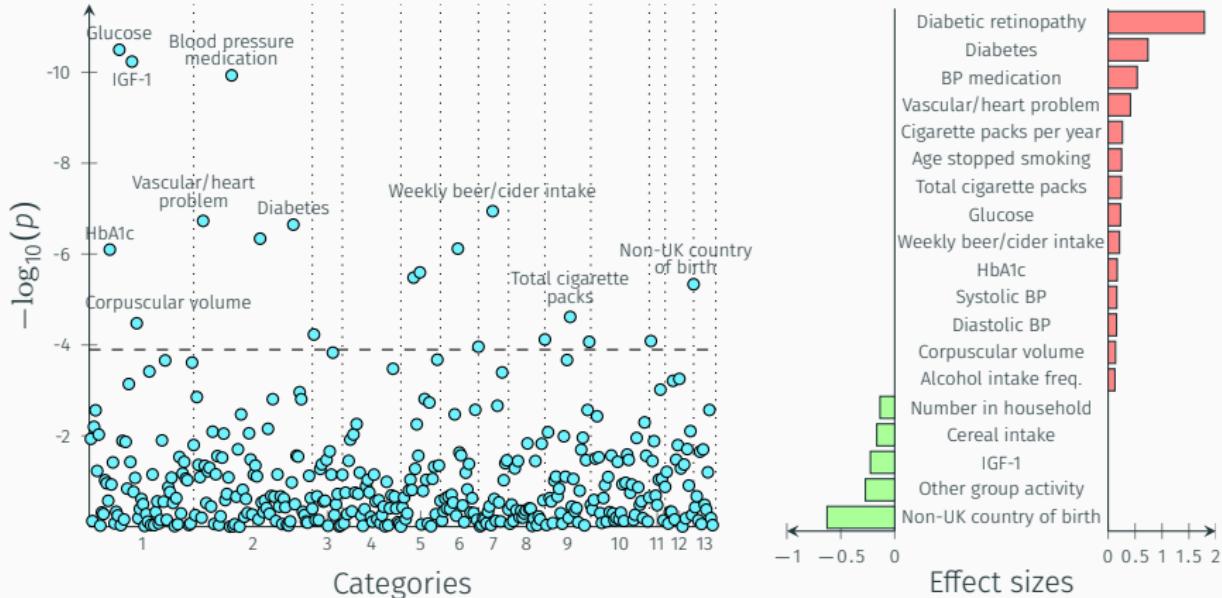
Hjernealder: Modellering



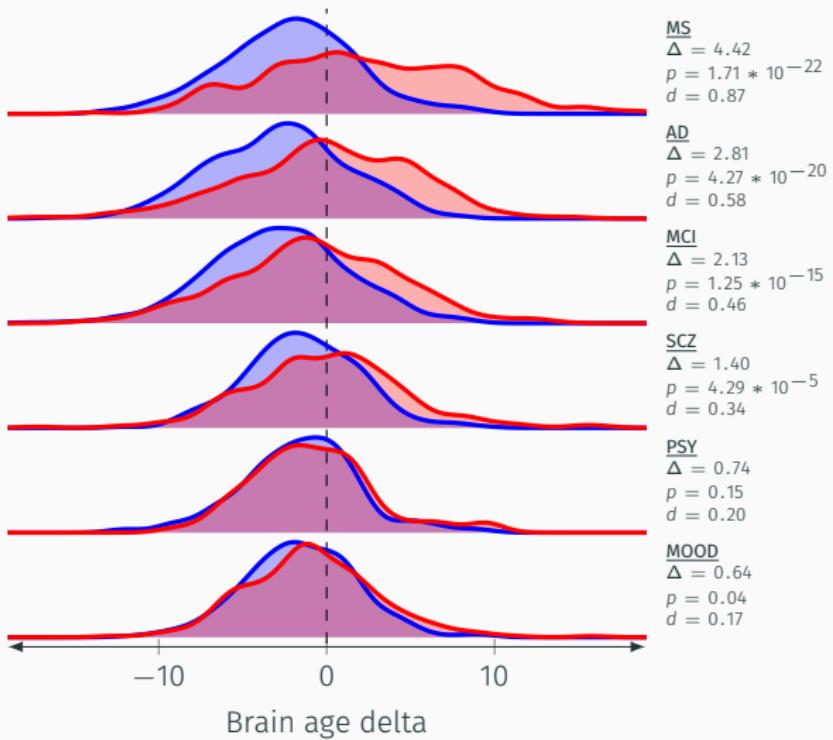
Hjernealder: Treffsikkerhet



Hjernealder: Assosiasjoner

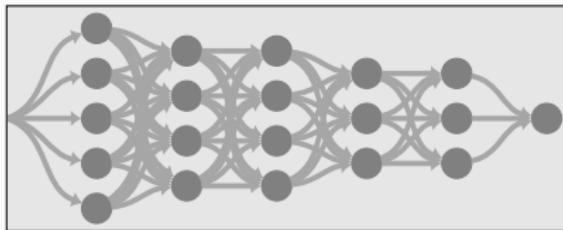


Hjernealder: Pasientgrupper

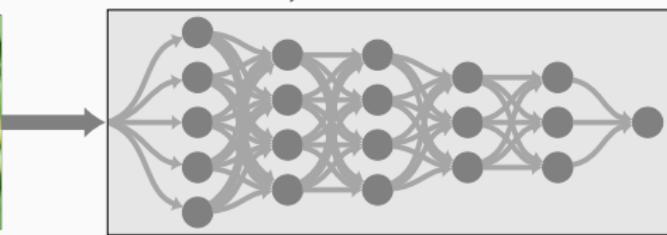


Forklarbar AI: Layerwise relevance propagation

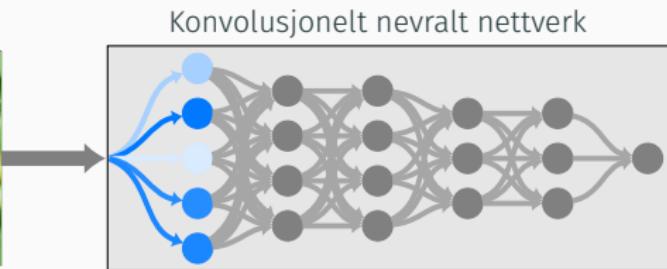
Konvolusjonelt nevralgt nettverk



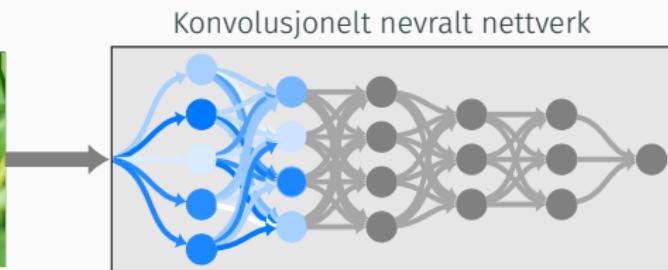
Forklarbar AI: Layerwise relevance propagation



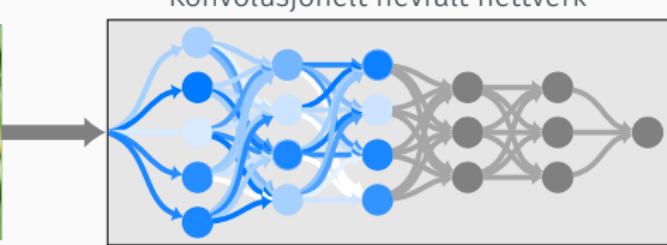
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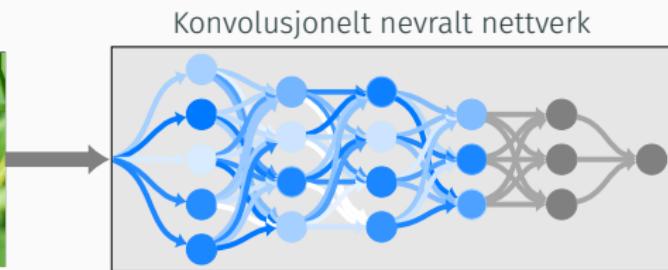
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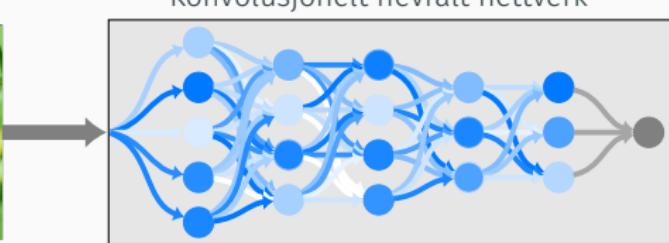
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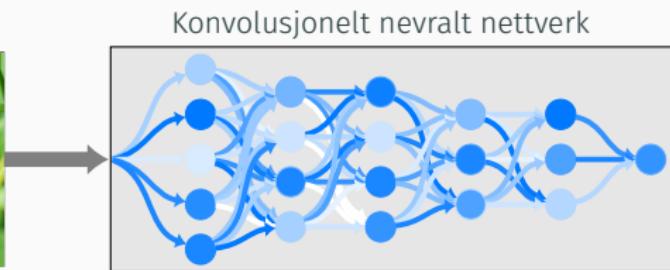
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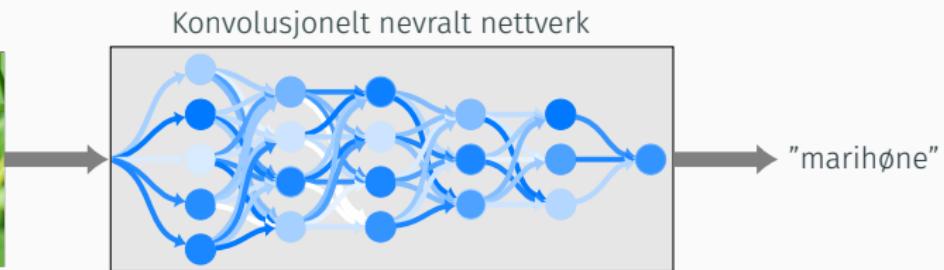
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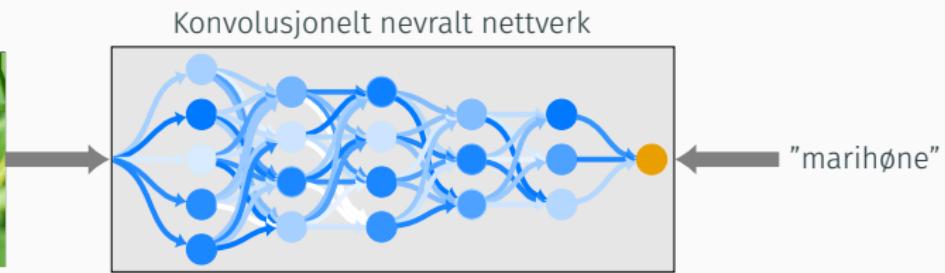
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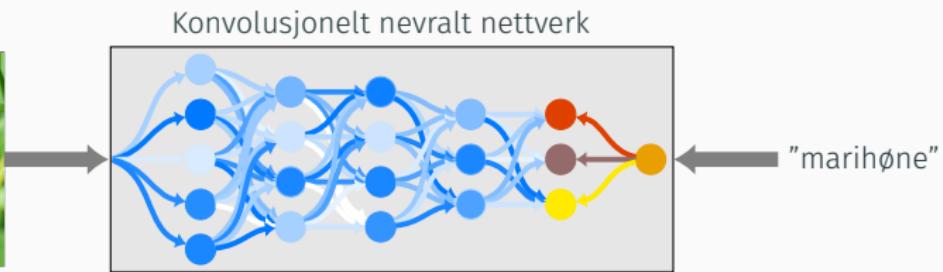
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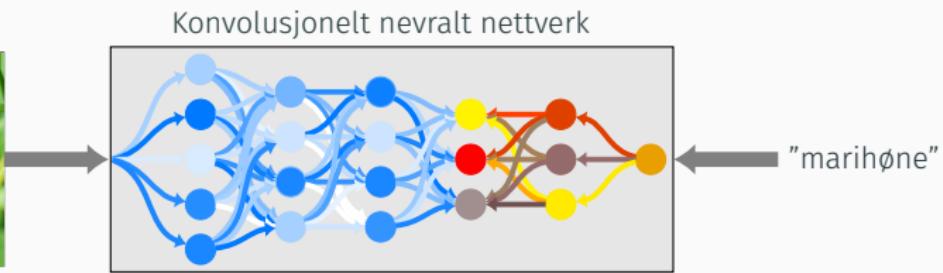
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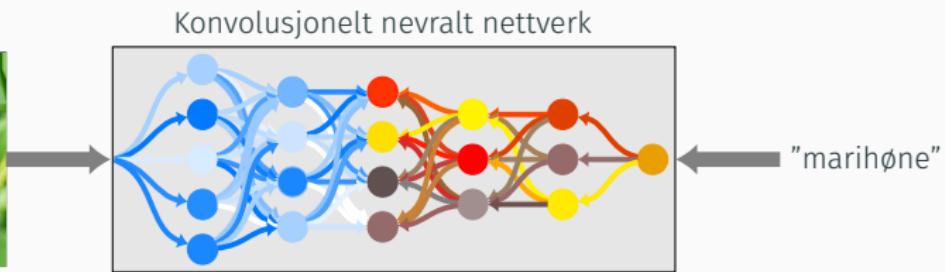


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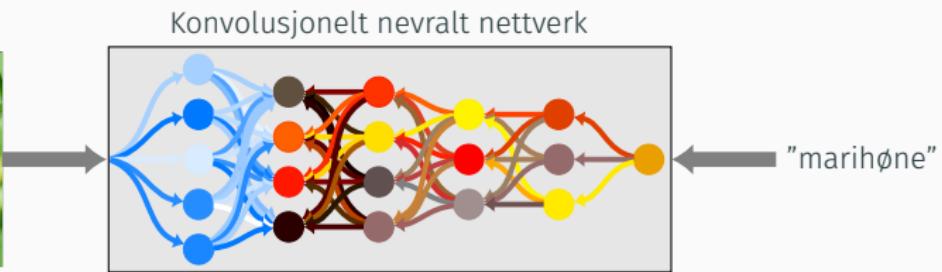


"marihøne"

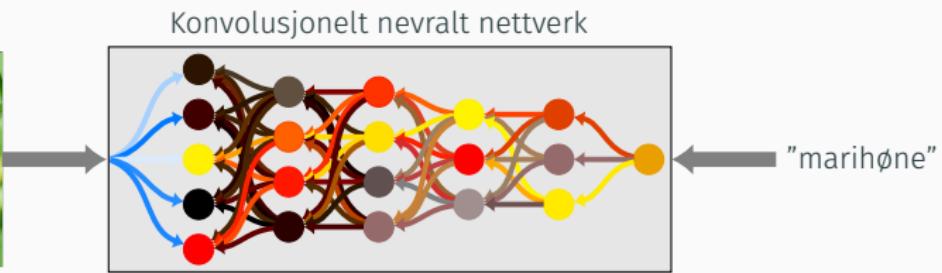
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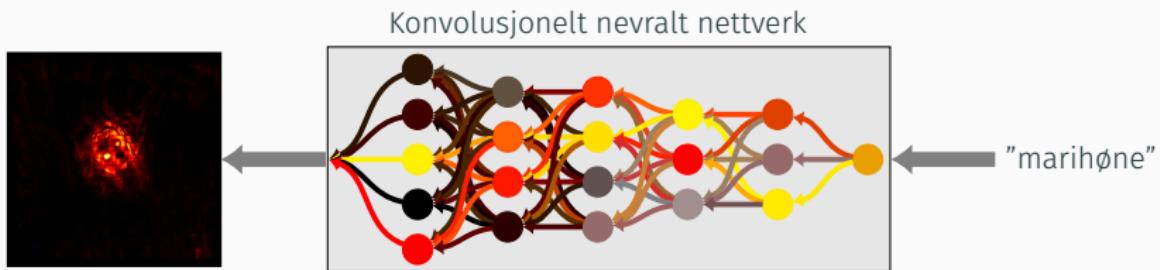
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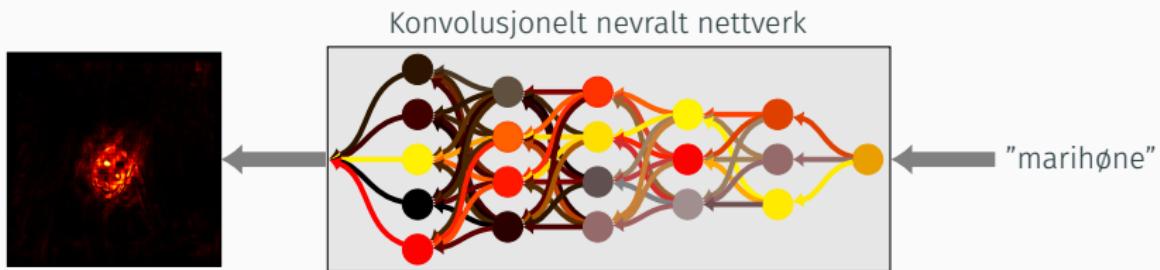
Forklarbar AI: Layerwise relevance propagation



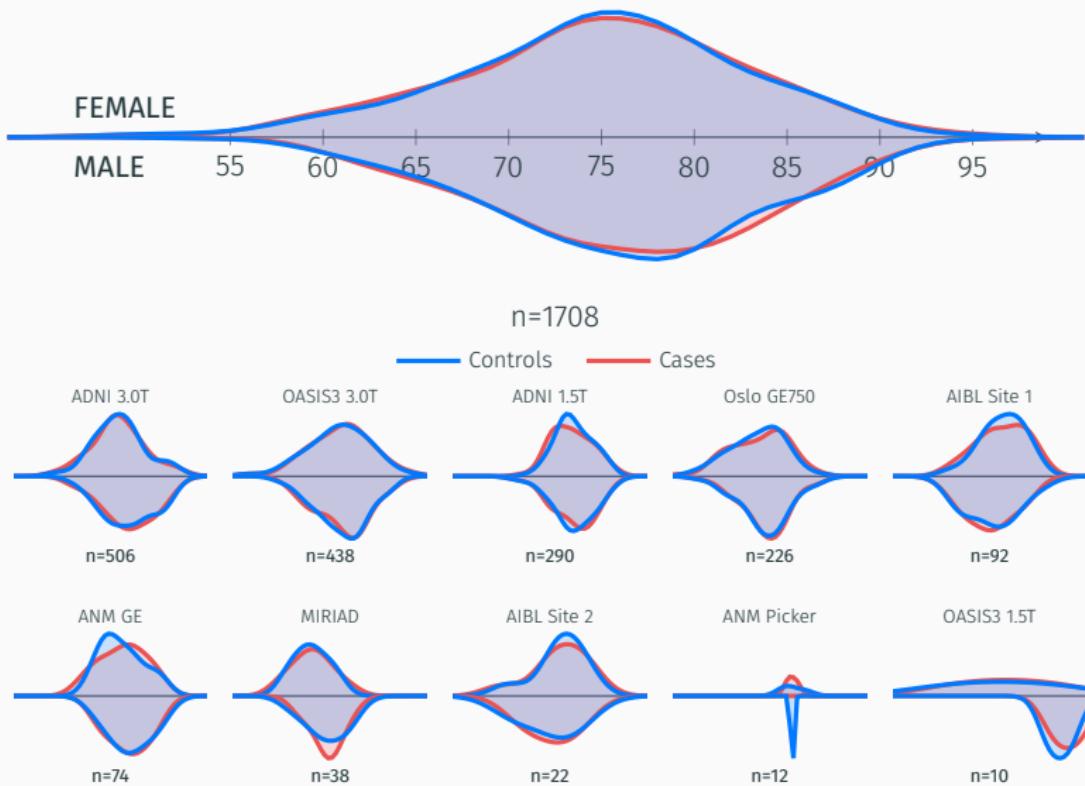
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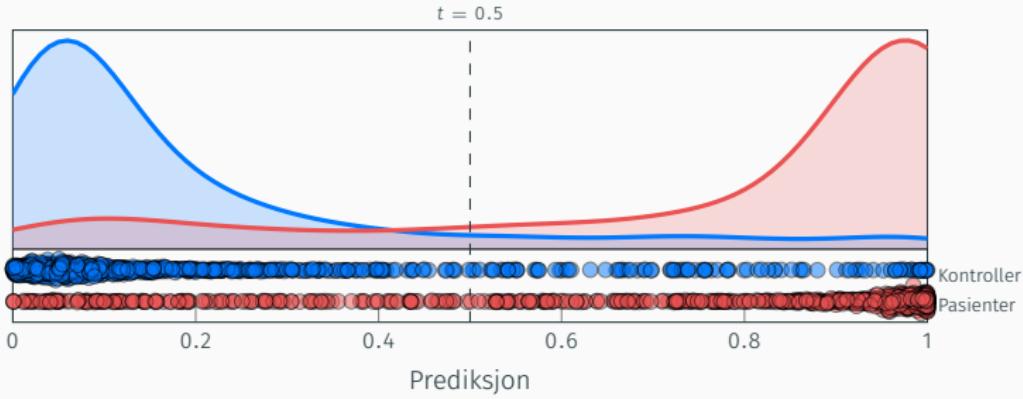
Forklarbar AI: Layerwise relevance propagation



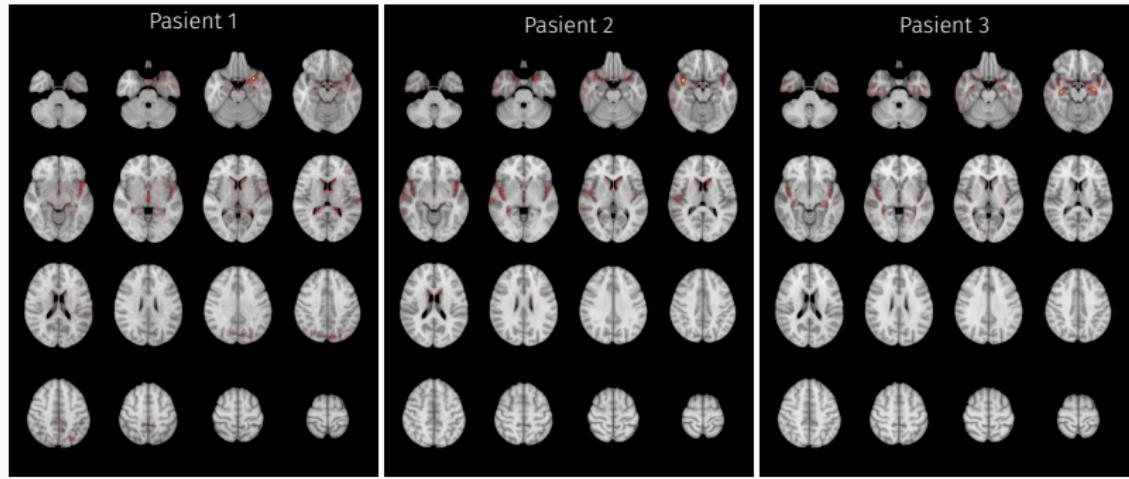
Forklarbar demens-prediksjon: Datasett



Forklarbar demens-prediksjon: Prediksjoner

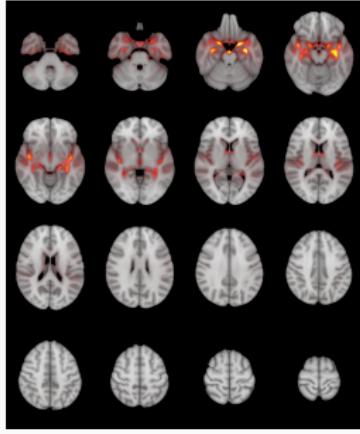


Forklarbar demens-prediksjon: Forklaringer



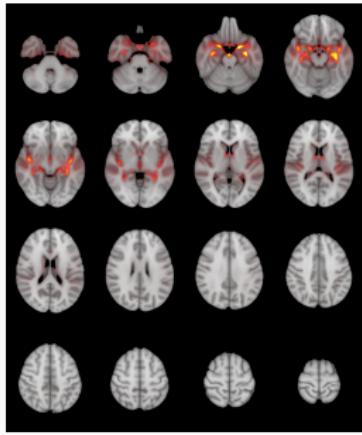
Forklarbar demens-prediksjon: Validering

LRP

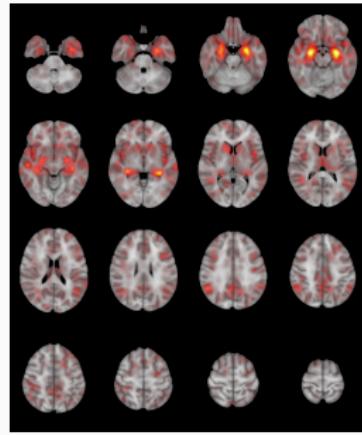


Forklarbar demens-prediksjon: Validering

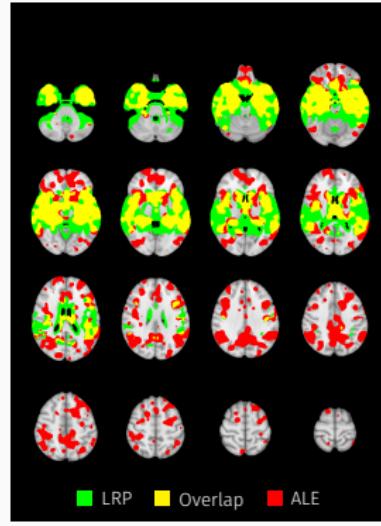
LRP



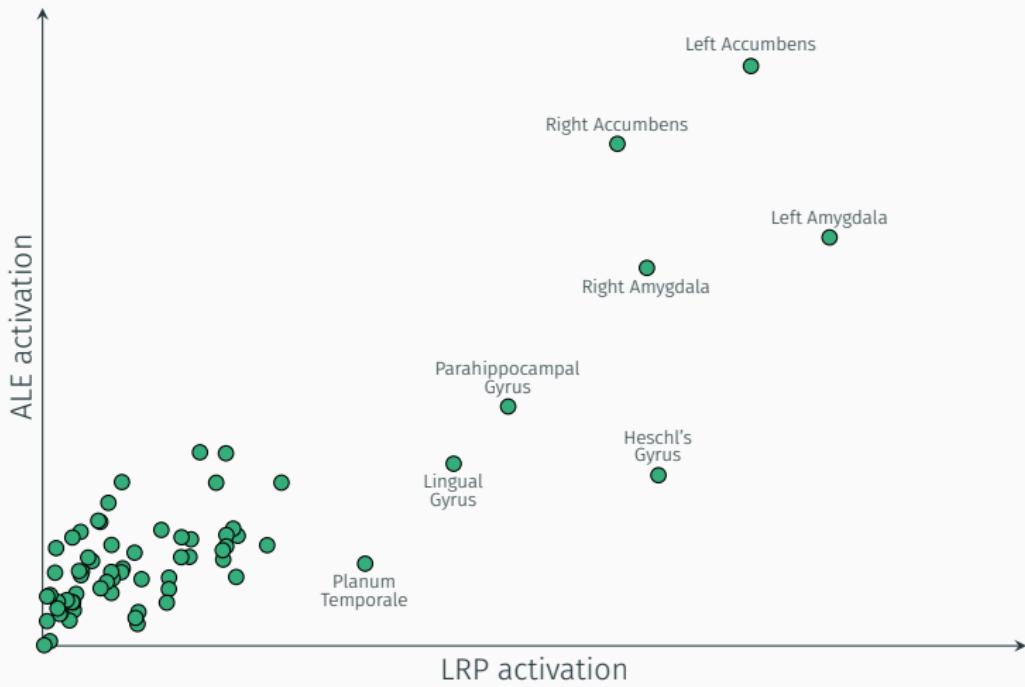
GingerALE



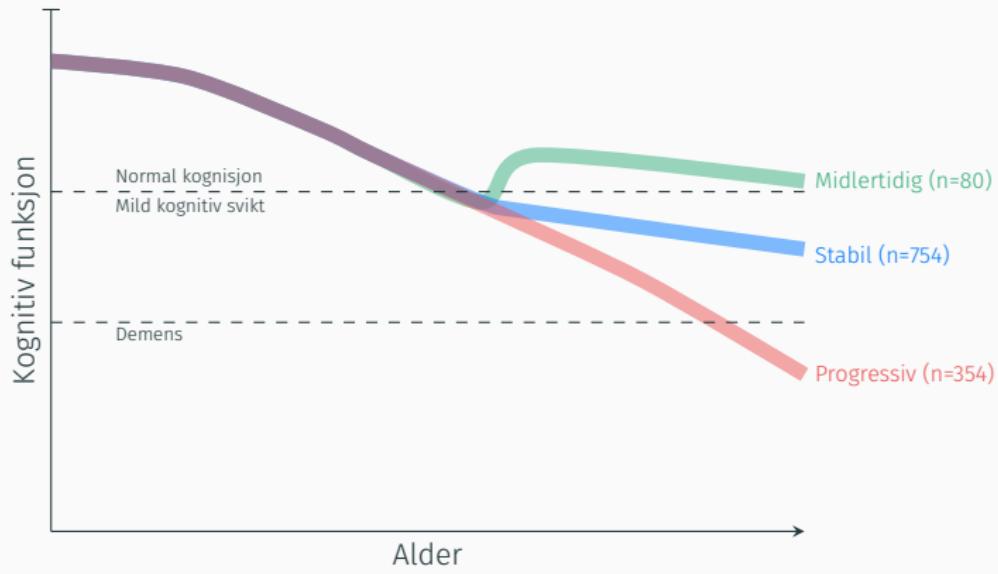
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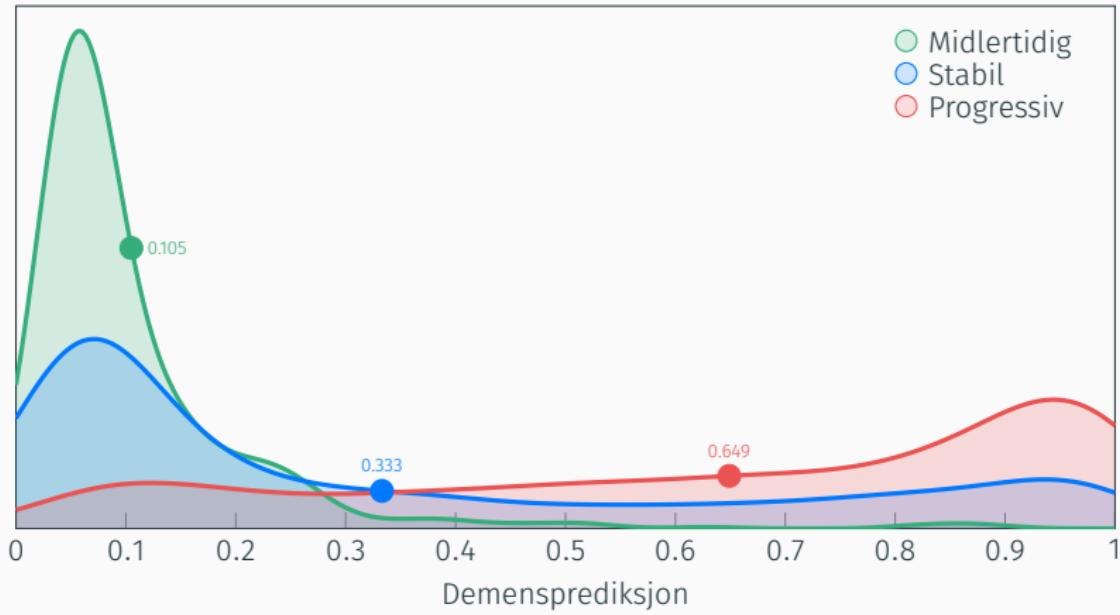
Forklarbar demens-prediksjon: Validering



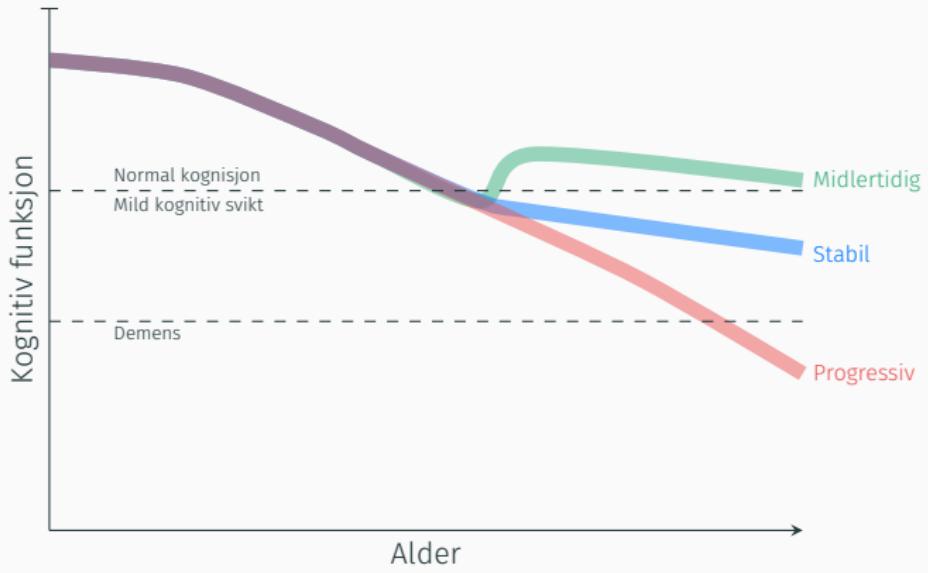
Forklarbar demens-prediksjon: Klinisk usecase



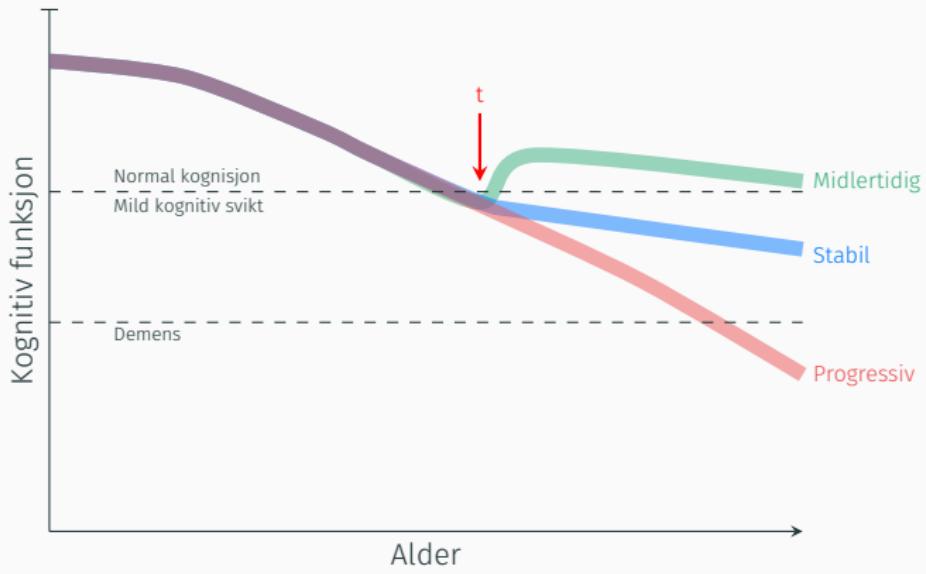
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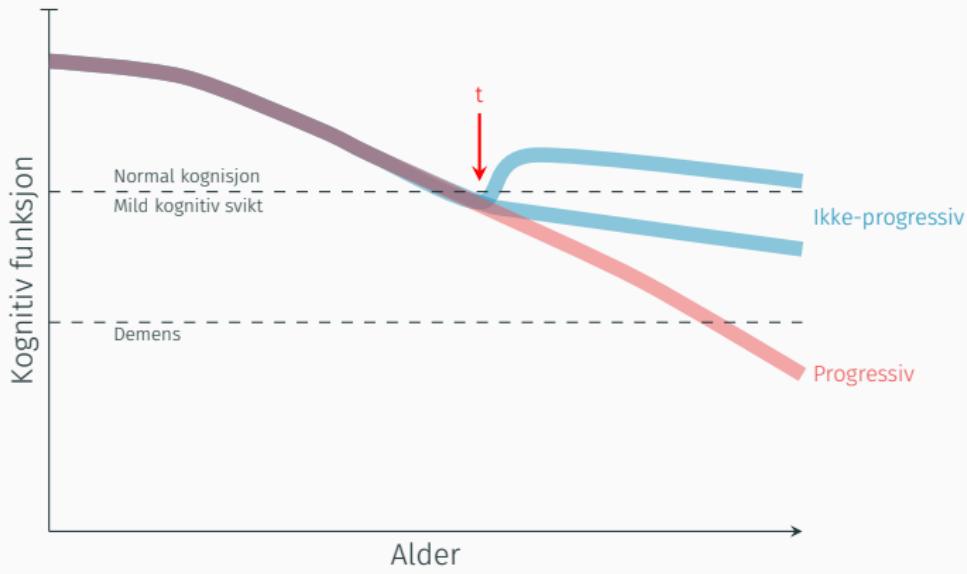
Forklarbar demens-prediksjon: Klinisk usecase



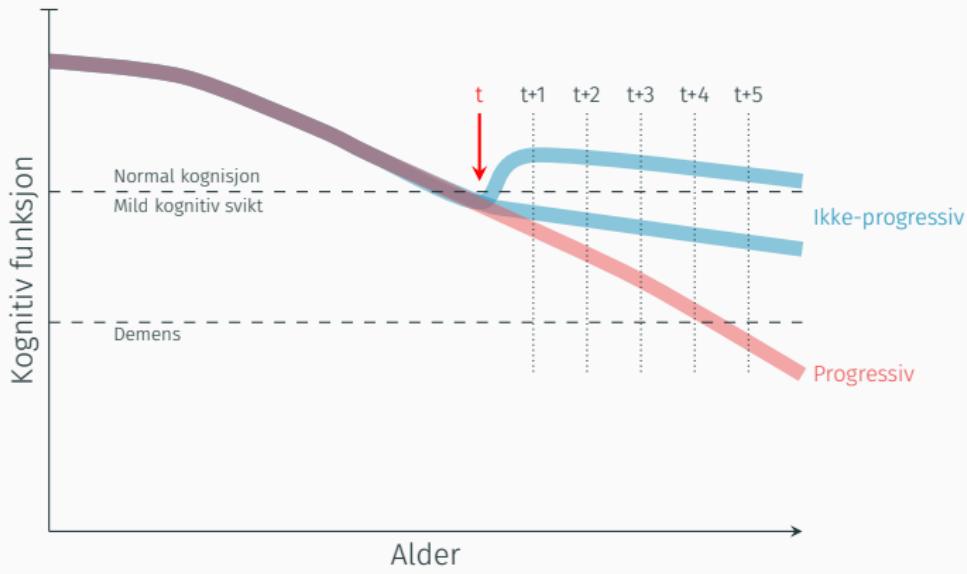
Forklarbar demens-prediksjon: Klinisk usecase



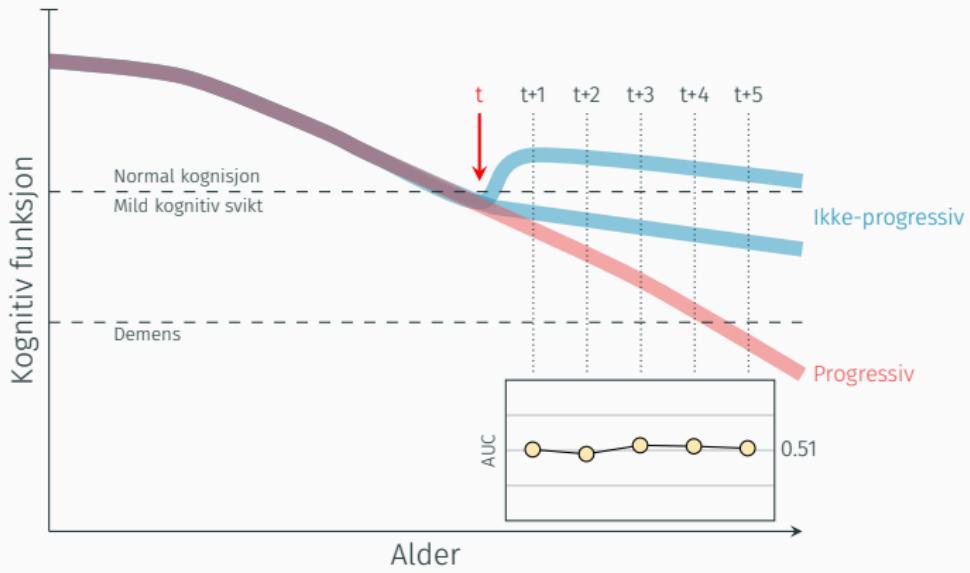
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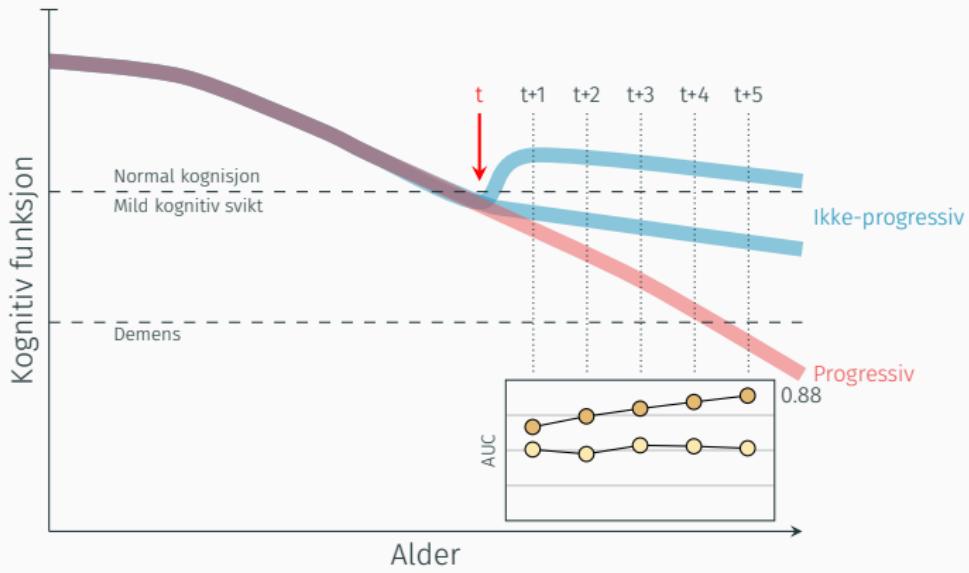
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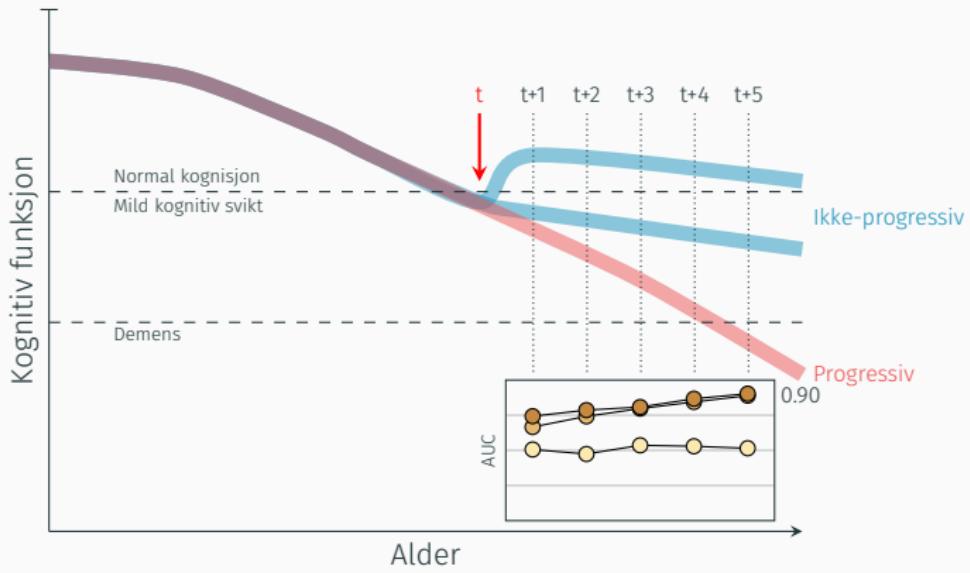
Forklarbar demens-prediksjon: Klinisk usecase



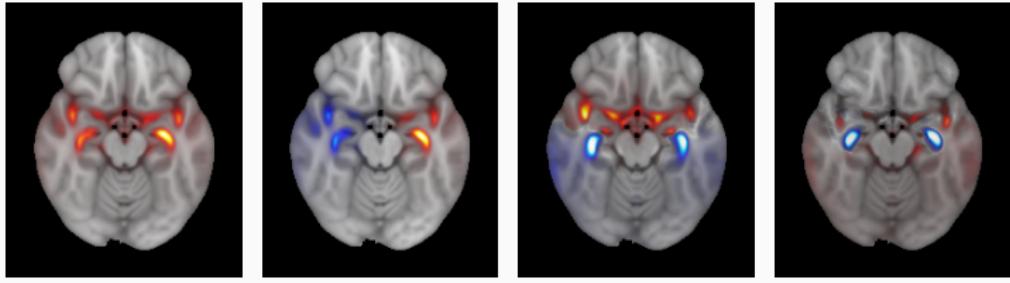
Forklarbar demens-prediksjon: Klinisk usecase



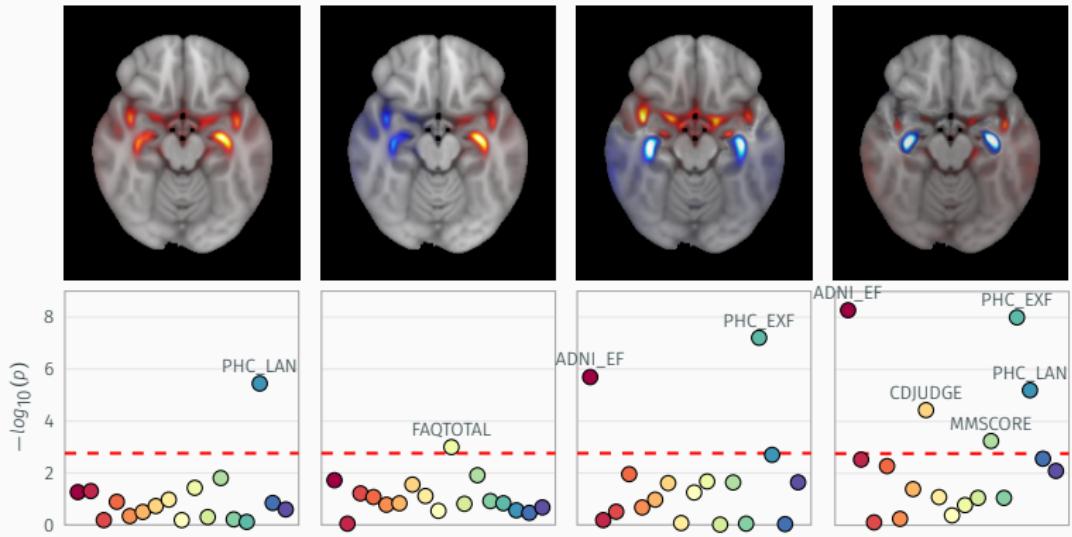
Forklarbar demens-prediksjon: Klinisk usecase



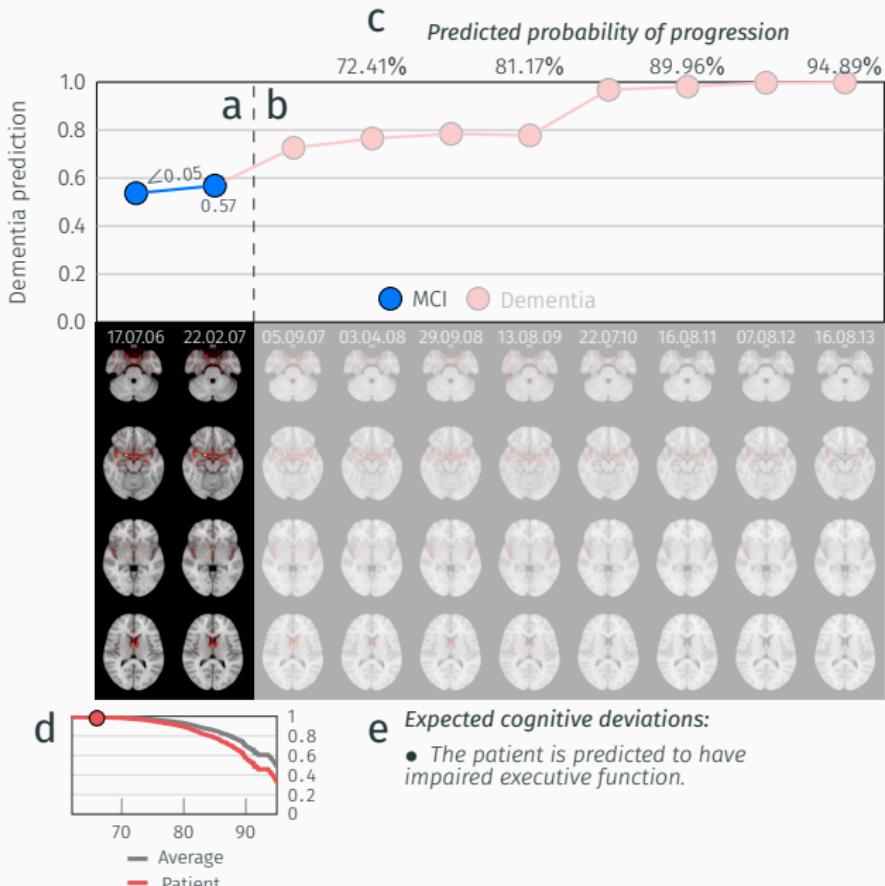
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Takk for meg!



Yunpeng Wang



Lars T. Westlye



Thomas Wolfers



Hjernealder



Forklarbar AI