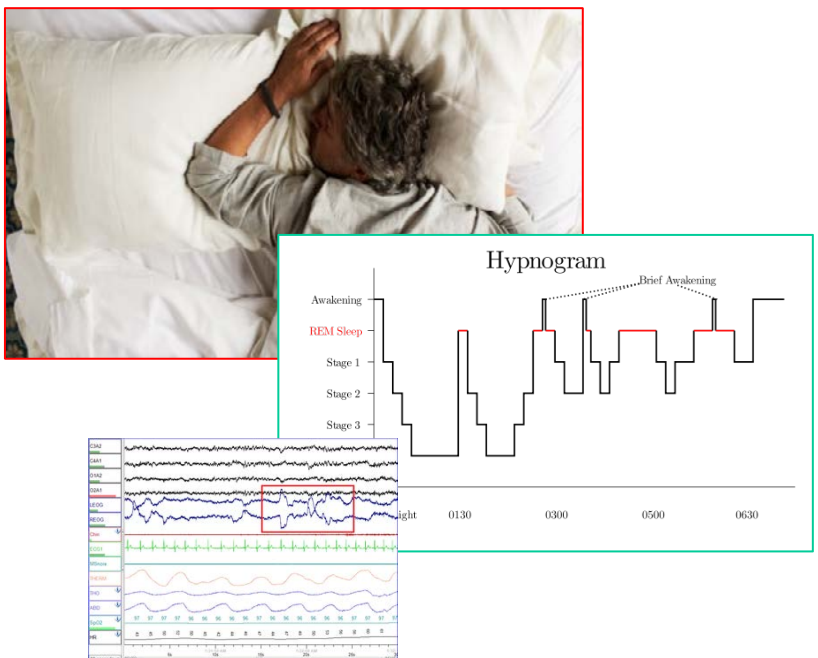
Hvad kan sundheds-AI gøre for dig og for fællesskabet? –respekt for privatlivet

AI: sansning, machine learning, handling & kommunikation



Hvordan har I sovet i nat?

AI og din sundhed

AI som sundheds-GPS - personlig baseline

... og fællesskabets

AI kan lære dimensionerne i velvære og sundhed

AI er lærende teknologi:

kan AI lære at respektere det private?

kunne du være data-donor?

Lars Kai Hansen – lkai@dtu.dk
Technical University of Denmark

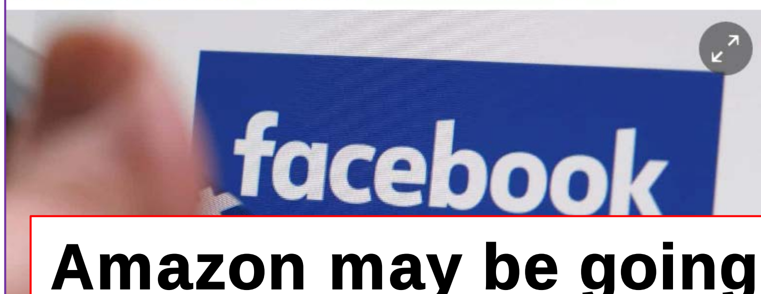
AI i dagens medicin… kan vi gøre det bedre?

How to use Apple Health on your iPhone: Everything you need to know

The Health app in iOS is a complex beast - here's how to get the best from it

Facebook posts $3.89bn quarterly profit, up 71% from last year

Shares hit record high after figure is much higher than expected, with total revenue climbing 44.8% thanks to increased mobile video ad sales



Google sees a future in wearable-free health monitoring

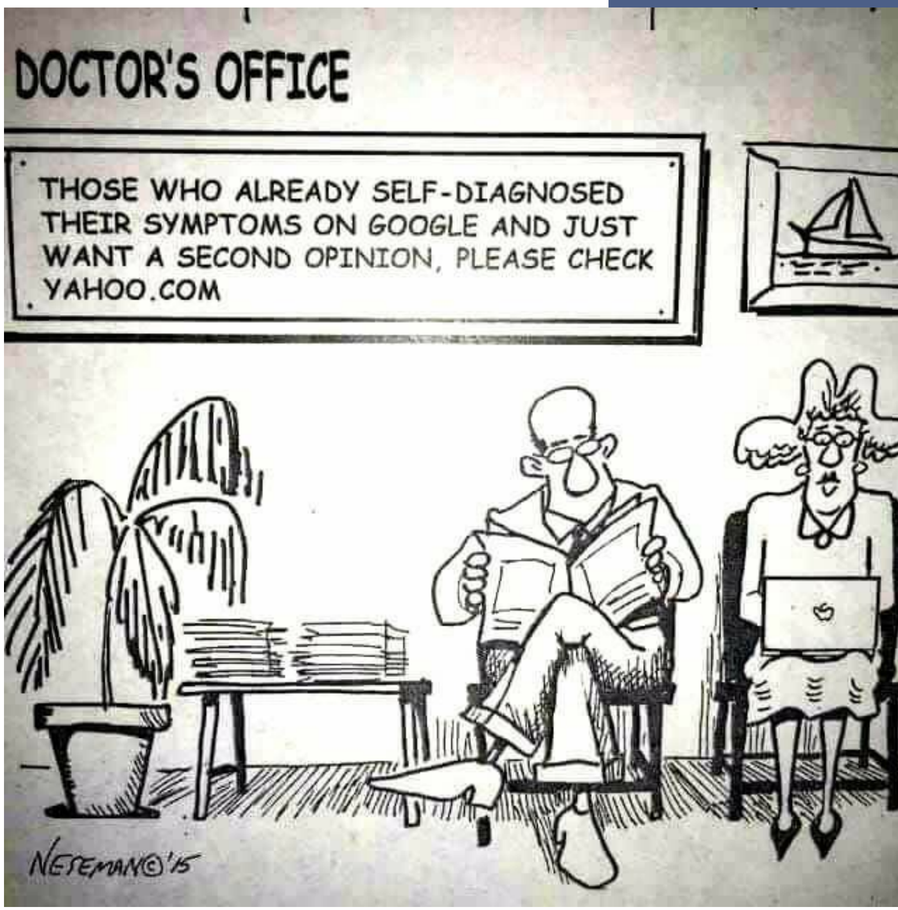
You might soon check your blood or your lungs with a mobile app.

Amazon may be going head-to-head with Microsoft in healthcare

The Guardian Juli 2017, Politiken Nov 2017,
http://www.zdnet.com/article/amazon-may-be-going-head-to-head-with-microsoft-in-healthcare/
https://www.wareable.com/apps/how-to-use-apple-health-iphone-fitness-app-960

Lars Kai Hansen – lkai@dtu.dk
Technical University of Denmark

AI påvirker allerede sundhed og well-being



The Guardian, Sep 19, 2017

Lars Kai Hansen – lkai@dtu.dk
Technical University of Denmark

Tidligere input til diskussionen af AI og sundhed

KRONIKEN
9. August 2013

Lad os demokratisere Big Data i en fart

LARS KAI HANSEN

TROR DU, DIT hjerteslag er et privat slag? Hmm, måske ikke så meget længere. Forskere på MIT, det tekniske universitet i Boston, viste sidste år, hvordan en video af dit ansigt kan bearbejdes, så man kan se pulsen med det blotte øje! Fremtidens videoovervågning vil aflæse dit kropssprog, dit ansigtsudtryk, og nu med denne opfindelse vil den også kunne tjekke din puls. På jobbet vil overvågningen måske genkende dig og sende dig en sms, hvis pulsen er for høj: Sæt dig ned og slap af. Eller i paskontrollen vil systemet måske advare personalet: Hold lidt ekstra

elle terrorister, men som det er fremgået af efterfølgende afsløringer, har myndighederne i en række lande ikke kunnet modstå den indlysende fristelse til at læse med på alle mulige andre borgeres tanker, heriblandt de spændende ting, der måtte foregå inden i toppolitikere og embedsmænd.

HER I DANMARK udsendte Forsvarets Efterretningstjeneste (FE) i slutningen af maj sin første offentlige beretning, der dækker perioden 2011-12. Beretningen er ganske åbenhjertig og detaljeret i beskri-

Allerede nu afslører smartphones, iPads, Fitbits, tweets, Facebook billeder og likes i minutiøse detaljer, hvor vi

og analysere vores adfærd og bogstaveligt talt vende vrangen ud på os og udnytte alle vore vaner til at forudsige os. Allerede den store psykolog William James indså, at menneskelig adfærd er stereotyp og vanebetonet og potentielt forudsigelig. Men

for fysiske bevægelser, men også mere kompleks adfærd, som hvad vi handler ind til aftensmaden, og hvad vi underh der os med. Og nu tilføjes også mange a dre aspekter af livet, som tidligere kun fandtes meget langt inden i os, som vo motivation og følelser. Ja, også vore føle ser kan sættes på formel. I 2011 underse te vi her på DTU, hvordan følelser kan a læses i de korte beskeder, vi sender til hinanden på Twitter, og vi fandt ud af, a følelserne i en tweet kan hjælpe med at forudsige, om den vil blive sendt videre om den bliver viral. Twitterbeskeder er

Videnskab.dk 2016: Kan en hjernechip gøre mig mere intelligent? Indimellem kunne man godt tænke sig ekstra hjernevindinger. Spørgsmålet er, om løsningen kan være at få indopereret en hjernechip, så intelligensen ryger i vejret?

Berlingske Tidende

Web 3.0 - internet der læser dine tanker

Af Lars Kai Hansen, Professor, Danmarks tekniske Universitet
Tirsdag den 19. december 2006, 03:30

Jyllandspostens kronik 12. november, 2005:

Stilhed før fremtiden

Af Lars Kai Hansen,
Danmarks Tekniske Universitet

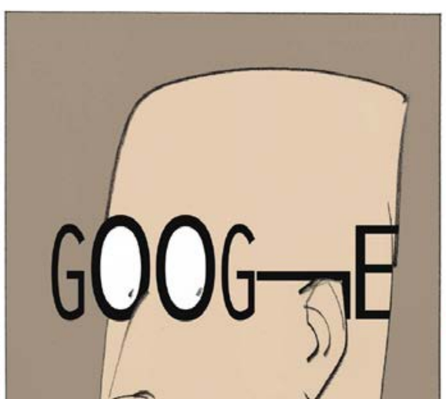
Computeren bliver så småt en del af os

Fremtidens computere og mobiltelefoner behøver ikke at ligge i tasker eller bukselommer. Om få år kan de sidde på armen, næsen og andre steder på kroppen eller ligefrem i tøjet, vurderer eksperter.

TEKNOLOGI

CHRISTIAN GRUNERT PEDERSEN

Vi forsøger hele tiden at forudsige, hvad der bliver det næste, brugeren gerne vil have
Christine Sørensen, Google Danmark



Ligesom vi har lært at slukke mobilen, vil vi nok også hurtigt lære, at der steder, hvor man

Maskinen søger - og finder

Kronik Mandag 12. november, 2001 Politiken

Lars Kai Hansen; Professor DTU

Google er søgemaskinen, der er tæt på menneskehedens forestilling om den store altvidende helhed, skriver kronikøren, der er professor ved Informatik og Matematisk Modellering på Danmarks Tekniske Universitet. Han understreger, at han hverken har økonomiske eller andre interesser i virksomheden.

Hjælp fra en kærlig storebror vs *big brother*

Hvorfor AI? Vore sanser og hjerner er ikke optimale …

Ambiguity effect	The tendency to avoid options for which missing information makes the probability seem "unknown."[8]
Anchoring or focalism	The tendency to rely too heavily, or "anchor," on one trait or piece of information when making decisions (usually the first piece of information that we acquire on that subject)[9][10]
Attentional bias	The tendency of our perception to be affected by our recurring thoughts.[11]
Availability heuristic	The tendency to overestimate the likelihood of events with greater "availability" in memory, which can be influenced by how recent the memories are or how unusual or emotionally charged they may be.[12]
Availability cascade	A self-reinforcing process in which a collective belief gains more and more plausibility through its increasing repetition in public discourse (or "repeat something long enough and it will become true").[13]
Backfire effect	When people react to disconfirming evidence by strengthening their beliefs.[14]
Bandwagon effect	The tendency to do (or believe) things because many other people do (or believe) the same. Related to groupthink and herd behavior.[15]
Base rate fallacy or base rate neglect	The tendency to ignore base rate information (generic, general information) and focus on specific information (information only pertaining to a certain case).[16]
Belief bias	An effect where someone's evaluation of the logical strength of an argument is biased by the believability of the conclusion.[17]
Bias blind spot	The tendency to see oneself as less biased than other people, or to be able to identify more cognitive biases in others than in oneself.[18]
Cheerleader effect	The tendency for people to appear more attractive in a group than in isolation.[19]

"*Kognitive systematiske fejl*"
list i Wikipedia

http://en.wikipedia.org/wiki/List_of_cognitive_biases

Lars Kai Hansen – lkai@dtu.dk
Technical University of Denmark

2017 – Hvor *storebror* er AI?

NATURE | LETTER

日本語要約

Dermatologist-level classification of skin cancer with deep neural networks

Andre Esteva, Brett Kuprel, Roberto A. Novoa, Justin Ko, Susan M. Swetter, Helen M. Blau & Sebastian Thrun

Affiliations | Contributions | Corresponding authors

Nature **542**, 115–118 (02 February 2017) | doi:10.1038/nature21056
Received 28 June 2016 | Accepted 14 December 2016 | Published online 25 January 2017
Corrigendum (June, 2017)

Full text | PDF | Citation | Rights & permissions | Article metrics

Status on human vs. machines

POSTED ON MARCH 15, 2015 UPDATED ON MARCH 17, 2017

Are computers beating humans. In mere simple number crunching yes, but also in more complex tasks.

Year	Domain	Description
2017	Poker (heads-up no-limits Texas Hold'em)	According to Andrew Ng "AI beats top humans", January 2017. Libratus, a reinforcement learning-based algorithm from Carnegie Mellon University, see Poker pros vs the machines.
2016	Lipreading	Lip Reading Sentences in the Wild writes "... we demonstrate lip reading performance that beats a professional lip reader on videos from BBC television."
2016	Conversational speech recognition	Microsoft Research reports past human performance on benchmark datasets in Achieving human parity in conversational speech recognition
2016	Geoguessing	Google's PlaNet: "In total, PlaNet won 28 of the 50 rounds with a median localization error of 1131.7 km, while the median human localization error was 2320.75 km" according to Google Unveils Neural Network with "Superhuman" Ability to Determine the Location of Almost Any Image
2016	Go	DeepMind's AlphaGo beats best European Go player reported in January Mastering the game of Go with deep neural networks and tree search
2015	Image classification	ImageNet classification by Microsoft Research researchers with deep neural network, see Delving Deep into Rectifiers: Surpassing Human-Level Performance on ImageNet Classification. Already in 2014 Google was close to human performance, see ImageNet Large Scale Visual Recognition Challenge. Human error rate in the ImageNet has been reported to be 5.1%, – and that was Andrej Karpathy, a dedicated human labeler. Microsoft reported in February 2015 4.94%. Google won one of the competitions in 2014 with "GoogLeNet" having a classification error on 6.66%. Baidu reported in January

https://finnaarupnielsen.wordpress.com/2015/03/15/status-on-human-vs-machines/

Hvorfor er AI og kvantitative målinger vigtige..?

J Autism Dev Disord (2016) 46:164–175
DOI 10.1007/s10803-015-2562-y

ORIGINAL PAPER

Do We Need Multiple Informants When Assessing Autistic Traits? The Degree of Report Bias on Offspring, Self, and Spouse Ratings

Esmé Möricke[1] · Jan K. Buitelaar[2,3] · Nanda N. J. Rommelse[1,3]

RESEARCH PAPER

Faking it: social desirability response bias in self-report research

DOI 10.1007/s10742-011-0069-3

Systematic self-report bias in health data: impact on estimating cross-sectional and treatment effects

Sebastian Bauhoff

...ikke nok at skrive **dagbog...** (egen-) rapportering er **problematisk** af mange grunde:

Systematiske fejl (biases): Sociale normer, etc...

Manglende viden / selvindsigt: Mange sundhedsproblemer er skjulte

Manglende evne til at kombinere begivenheder og forstå sundhedssignaler

Enorme individuelle forskelle – behov for en personlig baseline

Information: Genetik, adfærd, sociale netværk **-** genetik er et svagt signal

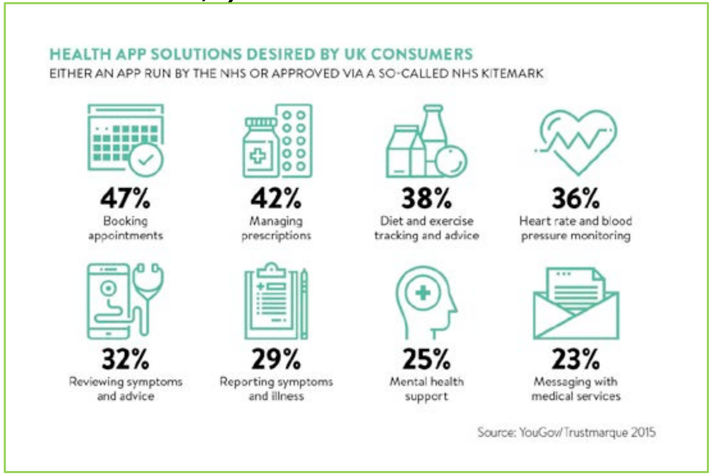
http://theconversation.com/the-key-to-your-health-could-be-in-your-zip-code-46304

AI og individ - AI kan blive din sundheds-GPS

Signalerne

- Smartphone/ur, wearables, IoT:

  Mobilitet/wifi, tale, eye-tracking, ansigtsgenkendelse /emotioner
- Medical devices – hearables, UNEEG Medical, Cure4You,..
- Remote sensing (camera, LIDAR, bluetooth / wifi trackers,)



Anvendelser

- Sundhed og fitness monitorering
- Markedsføring….

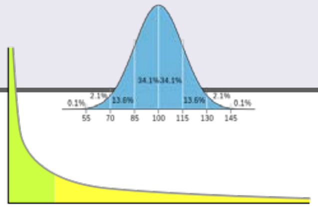
Visioner

- Navigation, konkret og abstract: GPS
- Nudging
- Høreapparat som sundheds-hub
- Automatisk dosering af medicin (fx. insulin)
- AI monitorering af medicinske risici og design af sundhedsinterventioner

Farrah J. Mateen, Massachusetts General Hospital

Lars Kai Hansen – lkai@dtu.dk
Technical University of Denmark

AI og individet: Præcisionsmedicin / personlig baseline



Human variabilitet … må håndteres med individualiserede modeller

- ”Unormale” fordelinger i adfærd (Song et al., 2010. *Limits of predictability in human mobility,* Science)
- Læring: *The Power law of practise* (Newell, A. and Rosenbloom, P.S., 1981. *Cognitive skills and their acquisition*, *1*:1-55)
- Standard medicin bygger på populationseffekter - brug for store populationer

  Behov for *science of the individual* - **personlig baseline**

Meget information om din adfærd er ”skjult” (inkl. for dig selv) => neuroteknologi

- Hjernen: Motivation, parathed, opmærksomhed
- Historien: Individuelle begrebsverdener, erfaringer
- Sociale dimensioner: Netværk, sensible DTU

2017 IEEE INTERNATIONAL WORKSHOP ON MACHINE LEARNING FOR SIGNAL PROCESSING, SEPT. 25–28, 2017, TOKYO, JAPAN

DEEP CONVOLUTIONAL NEURAL NETWORKS FOR INTERPRETABLE ANALYSIS OF EEG SLEEP STAGE SCORING

Albert Vilamala[1], Kristoffer H. Madsen[1,2] and Lars K. Hansen[1]

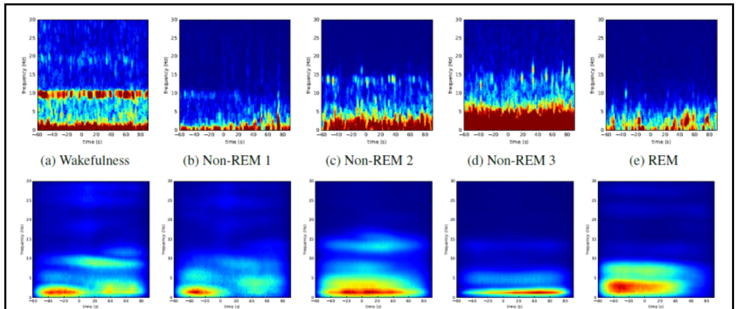


Fig. 1. Sensitivity analysis for subject 7. Top row shows characteristic sleep stage spectra; bottom row presents per-class sensitivity maps.

Research Articles, Behavioral/Cognitive

Baseline Levels of Rapid-Eye-Movement Sleep May Protect Against Excessive Activity in Fear-Related Neural Circuitry

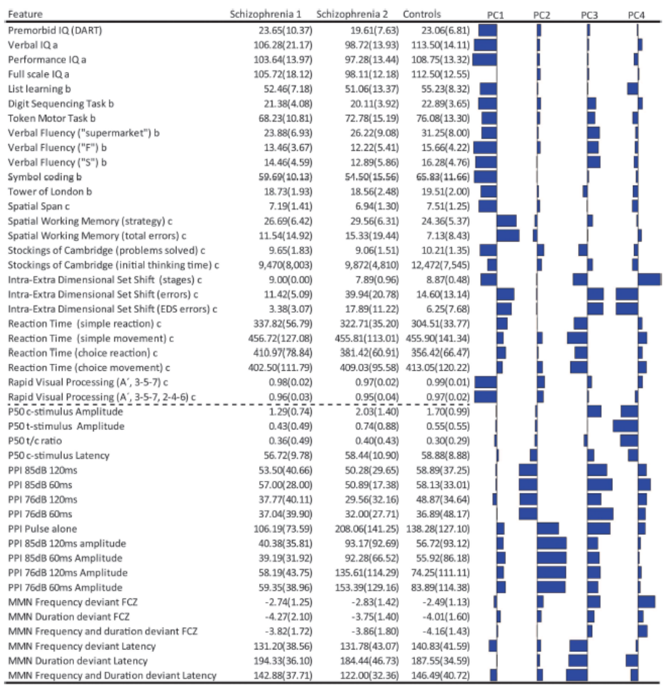
Itamar Lerner, Shira M. Lupkin, Neha Sinha, Alan Tsai, and Mark A. Gluck

Journal of Neuroscience 23 October 2017, 0578-17; DOI: https://doi.org/10.1523/JNEUROSCI.0578-17.2017

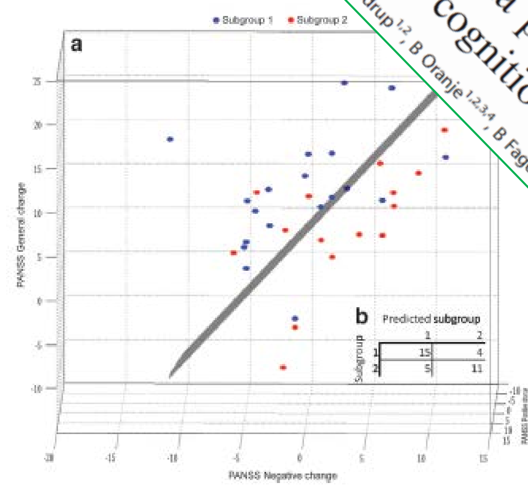
AI og fællesskabet: Bedre forståelse af sygdomme

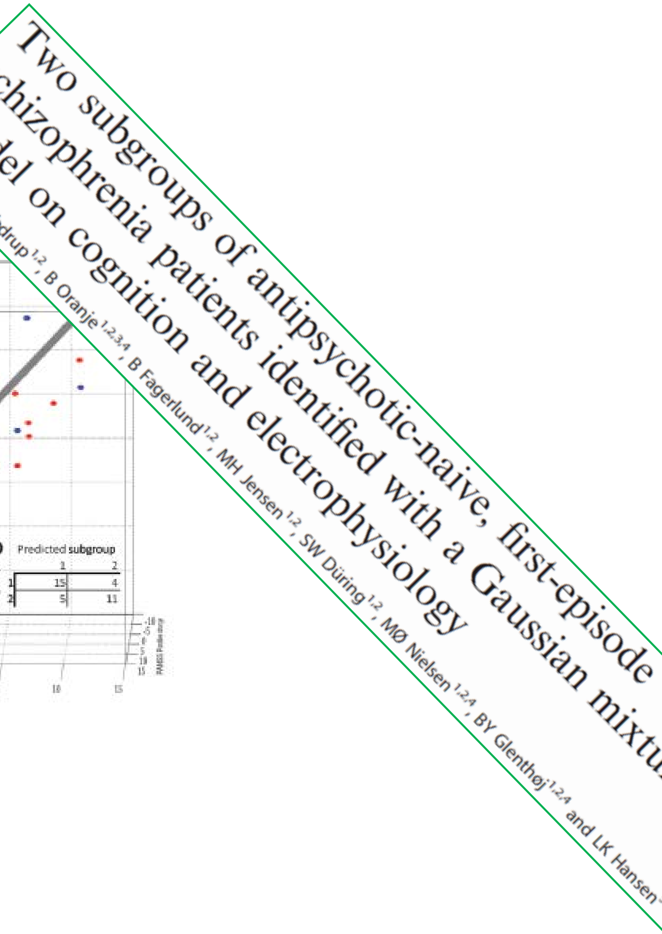
AI kan hjælpe med at forstå komplekse data sæt:

Der er (mindst) to typer schizofreni



Feature	Schizophrenia 1	Schizophrenia 2	Controls	PC1	PC2	PC3	PC4
Premorbid IQ (DART)	23.65(10.37)	19.61(7.63)	23.06(6.81)				
Verbal IQ a	106.28(21.17)	98.72(13.93)	113.50(14.11)				
Performance IQ a	103.64(13.97)	97.28(13.44)	108.75(13.32)				
Full scale IQ a	105.72(18.12)	98.11(12.18)	112.50(12.55)				
List learning b	52.46(7.18)	51.06(13.37)	55.23(8.32)				
Digit Sequencing Task b	21.38(4.08)	20.11(3.92)	22.89(3.65)				
Token Motor Task b	68.23(10.81)	72.78(15.19)	76.08(13.30)				
Verbal Fluency ("supermarket") b	23.88(6.93)	26.22(9.08)	31.25(8.00)				
Verbal Fluency ("F") b	13.46(3.67)	12.22(5.41)	15.66(4.22)				
Verbal Fluency ("S") b	14.46(4.59)	12.89(5.86)	16.28(4.76)				
Symbol coding b	59.69(10.13)	54.50(15.56)	65.83(11.66)				
Tower of London b	18.73(1.93)	18.56(2.48)	19.51(2.00)				
Spatial Span c	7.19(1.41)	6.94(1.30)	7.51(1.25)				
Spatial Working Memory (strategy) c	26.69(6.42)	29.56(6.31)	24.36(5.37)				
Spatial Working Memory (total errors) c	11.54(14.92)	15.33(19.44)	7.13(8.43)				
Stockings of Cambridge (problems solved) c	9.65(1.83)	9.06(1.51)	10.21(1.35)				
Stockings of Cambridge (initial thinking time) c	9,470(8,003)	9,872(4,810)	12,472(7,545)				
Intra-Extra Dimensional Set Shift (stages) c	9.00(0.00)	7.89(0.96)	8.87(0.48)				
Intra-Extra Dimensional Set Shift (errors) c	11.42(5.09)	39.94(20.78)	14.60(13.14)				
Intra-Extra Dimensional Set Shift (EDS errors) c	3.38(3.07)	17.89(11.22)	6.25(7.68)				
Reaction Time (simple reaction) c	337.82(56.79)	322.71(35.20)	304.51(33.77)				
Reaction Time (simple movement) c	456.72(127.08)	455.81(113.01)	455.90(141.34)				
Reaction Time (choice reaction) c	410.97(78.84)	381.42(60.91)	356.42(66.47)				
Reaction Time (choice movement) c	402.50(111.79)	409.03(95.58)	413.05(120.22)				
Rapid Visual Processing (A′, 3-5-7) c	0.98(0.02)	0.97(0.02)	0.99(0.01)				
Rapid Visual Processing (A′, 3-5-7, 2-4-6) c	0.96(0.03)	0.95(0.04)	0.97(0.02)				
P50 c-stimulus Amplitude	1.29(0.74)	2.03(1.40)	1.70(0.99)				
P50 t-stimulus Amplitude	0.43(0.49)	0.74(0.88)	0.55(0.55)				
P50 t/c ratio	0.36(0.49)	0.40(0.43)	0.30(0.29)				
P50 c-stimulus Latency	56.72(9.78)	58.44(10.90)	58.88(8.88)				
PPI 85dB 120ms	53.50(40.66)	50.28(29.65)	58.89(37.25)				
PPI 85dB 60ms	57.00(28.00)	50.89(17.38)	58.13(33.01)				
PPI 76dB 120ms	37.77(40.11)	29.56(32.16)	48.87(34.64)				
PPI 76dB 60ms	37.04(39.90)	32.00(27.71)	36.89(48.17)				
PPI Pulse alone	106.19(73.59)	208.06(141.25)	138.28(127.10)				
PPI 85dB 120ms amplitude	40.38(35.81)	93.17(92.69)	56.72(93.12)				
PPI 85dB 60ms Amplitude	39.19(31.92)	92.28(66.52)	55.92(86.18)				
PPI 76dB 120ms Amplitude	58.19(43.75)	135.61(114.29)	74.25(111.11)				
PPI 76dB 60ms Amplitude	59.35(38.96)	153.39(129.16)	83.89(114.38)				
MMN Frequency deviant FCZ	-2.74(1.25)	-2.83(1.42)	-2.49(1.13)				
MMN Duration deviant FCZ	-4.27(2.10)	-3.75(1.40)	-4.01(1.60)				
MMN Frequency and duration deviant FCZ	-3.82(1.72)	-3.86(1.80)	-4.16(1.43)				
MMN Frequency deviant Latency	131.20(38.56)	131.78(43.07)	140.83(41.59)				
MMN Duration deviant Latency	194.33(36.10)	184.44(46.73)	187.55(34.59)				
MMN Frequency and Duration deviant Latency	142.88(37.71)	122.00(32.36)	146.49(40.72)				





Enorm individuel variation: AI har brug for meget store data sæt – **data donorer!**

Lars Kai Hansen – lkai@dtu.dk
Technical University of Denmark

Bedre liv gennem ny viden

Citation: Transl Psychiatry (2017) **7**, e1087; doi:10.1038/tp.2017.59
www.nature.com/tp

AI er lærende teknologi *“machine learning”*
og AI kan lære at respektere det private

1) Machine learning med stærke garantier (homomorf kryptografi)
lovende og aktivt forskningsfelt, men stadigt for dyrt (tid/beregninger)

CryptoNets: Applying Neural Networks to Encrypted Data with High Throughput and Accuracy

Nathan Dowlin[1,2], Ran Gilad-Bachrach[1], Kim Laine[1], Kristin Lauter[1], Michael Naehrig[1], and John Wernsing[1]

[1]Microsoft Research, Redmond, USA
[2]Princeton University, New-Jersey, USA

February 24, 2016

2) Et praktisk alternativer med svagere garantier
– *differential privacy* og *federated computing*

Patienten deler ikke data.. Støjfyldte data henv. modelparametre

Apple starts collecting browsing data in Safari using its differential privacy tech

Posted Sep 25, 2017 by Brian Heater (@bheater)

ANDY GREENBERG SECURITY 09.15.17 09:28 AM
HOW ONE OF APPLE'S KEY PRIVACY SAFEGUARDS FALLS SHORT

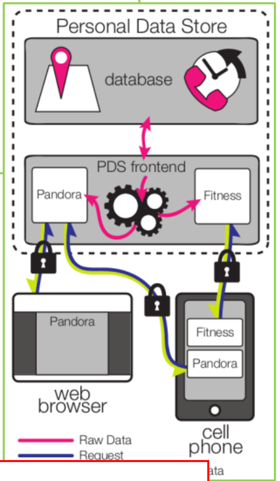
https://techcrunch.com
https://www.wired.com/story/apple-differential-privacy-shortcomings/

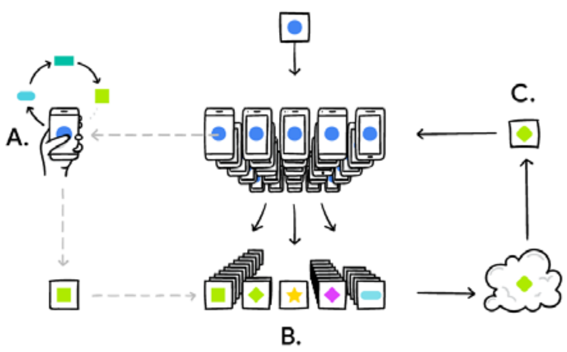
First attempt of machine learning in the fashion industry.

Fabrice Jossinet https://twitter.com/fjossinet

Realistiske tekniske muligheder for beskytte sundhedsdata

- Open Personal Data Storage modellen
- Privat netværks beregning, fx. Google's "federated computing"
- Autencitet: Sikre datavejen med blockchain





Privacy for Personal Neuroinformatics

Arkadiusz Stopczynski[1,2], Dazza Greenwood[2], Lars Kai Hansen[1], Alex Sandy Pentland[2]
1 Technical University of Denmark
2 MIT Media Lab
arks@dtu.dk, dazza@civics.com, lkai@dtu.dk, sandy@media.mit.edu

Your phone personalizes the model locally, based on your usage (A). Many users' updates are aggregated (B) to form a consensus change (C) to the shared model, after which the procedure is repeated.
https://research.googleblog.com/2017/04/federated-learning-collaborative.html

[...] example of **smart contract** utilization is in the music industry. In 2017, DJ Deadly Buda released the first DJ mix, "Rock the Blockchain" that pays the tracks and their artists contained within it via a cryptocurrency blockchain, Musicoin. Every time the dj mix is played, the smart contracts attached to the dj mix pays the artists almost instantly.
http://www.the-blockchain.com/2017/08/24/worlds-first-dj-mix-pays-artists-seconds-using-blockchain-technology/

Tag med hjem…

AI og din sundhed

AI kan blive en sundheds-GPS

Præcisionsmedicin er ikke løst med genetisk profil

skal lære den personlige baseline

…. fællesskabet

På grund af de enorme individuelle variationer bør sundhedsmodeller lære fra så mange som muligt: **data, data, data**

Vi må indrette et data-donorkorps – **vil du være data donor?**

AI er lærende teknologi og AI kan lære at respektere det private!

Lundbeck Foundation (CIMBI, CINS)
Novo Nordisk Foundation (BASICS project)
Innovation Foundation Denmark (NeuroTech 24/7)

DABAI

Lars Kai Hansen – lkai@dtu.dk
Technical University of Denmark

DTU