

Artificiell intelligens – möjligheter och utmaningar

Caj Södergård

Innehåll

- **Vad** är AI system & hur **vuxit fram** ?
- **Hur** fungerar AI teknik ?
- Vilka **möjligheter** ger AI teknik ?
- Vilka **utmaningar** har AI teknik ?
- Hur kan AI tekniken **styras** ?

Nobelpris 2024

NextAI



Fysik



Kemi

Vad är AI system ?

AI = maskinbaserade system, som

- opererar *autonomt*
- utifrån målsättningar
- *anpassar* sig till situationer.

Källor

- EU AI High Level Expert Group, 2019
- Elements of AI, 2024
- EU AI Act 2024

AI vetenskap

Maskinell inlärning

- Inkl. Djup inlärning

Maskinellt resonemang

- Planering
- Representation av kunskap & resonemang
- Sökning & optimering
- Multi-agent system

Varseblivning & interaktion

- Tal- och bildigenkänning
- System för konversation
- Generativ AI
- Behandling av naturliga språk (NLP)
- Robotik

Hur AI tekniken vuxit fram



Dartmouth AI conference 1956

Överoptimism

"In from **three to eight years** we will have a machine with the general intelligence of an average human being".

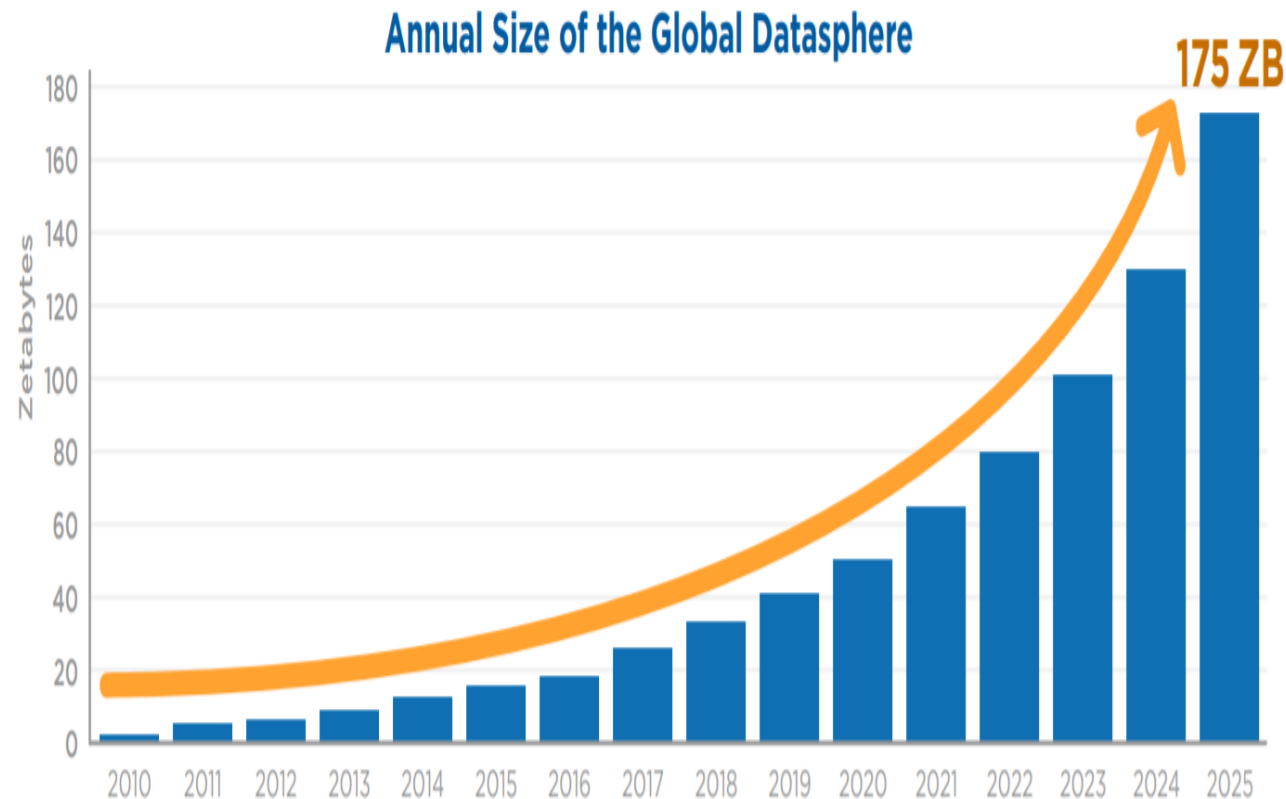


Marvin Minsky, 1970

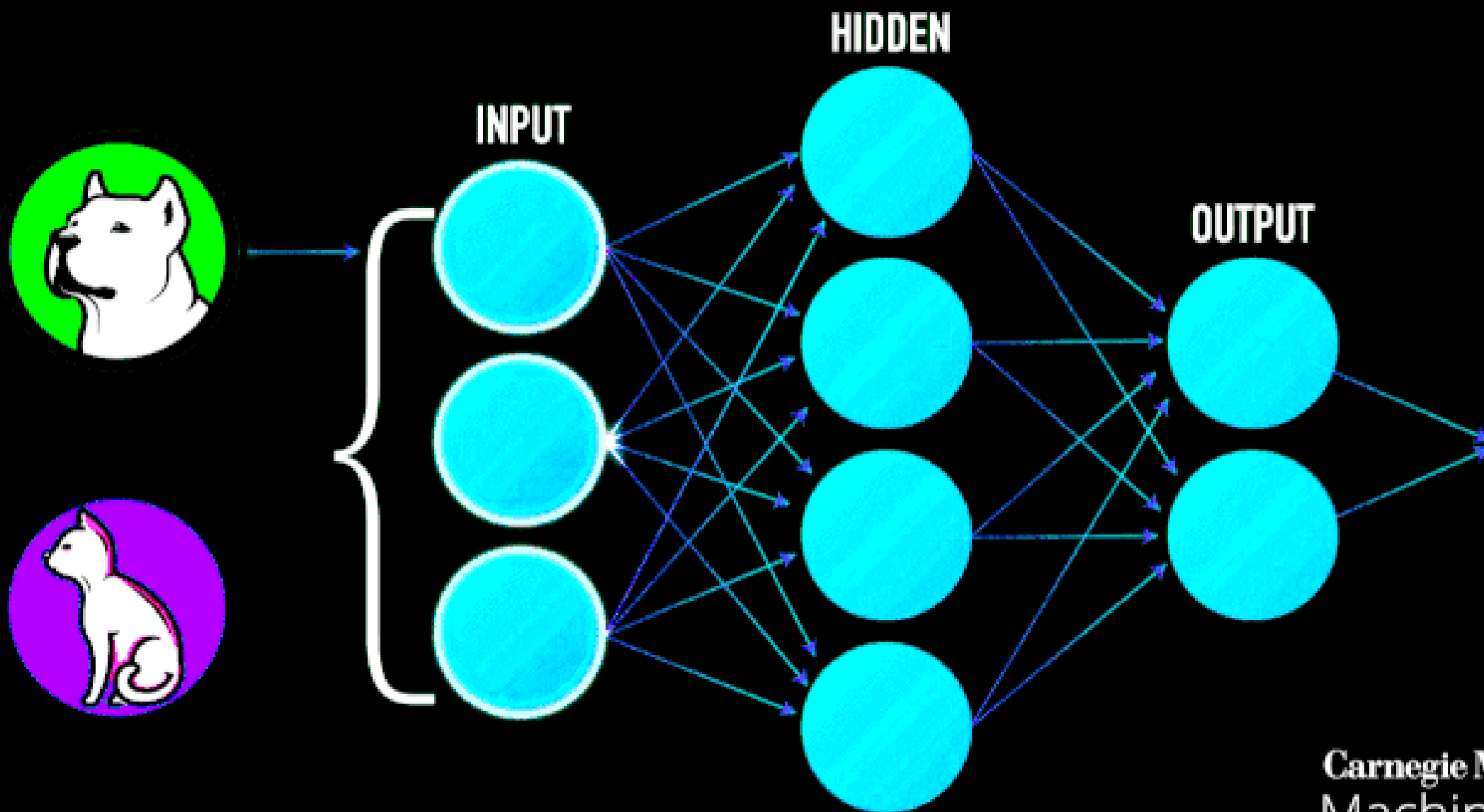
- **Våg 1.** Modellera mänskligt resonerande i expert system (1956 – 1990)
- **Våg 2.** Inläarning från stora datamängder (1990 - 2011). Jeopardy 2011
- **Våg 3.** Artificiella neuralnätverk (2012-) ImageNet 2012, AlphaGo 2016

Hur fungerar AI system?

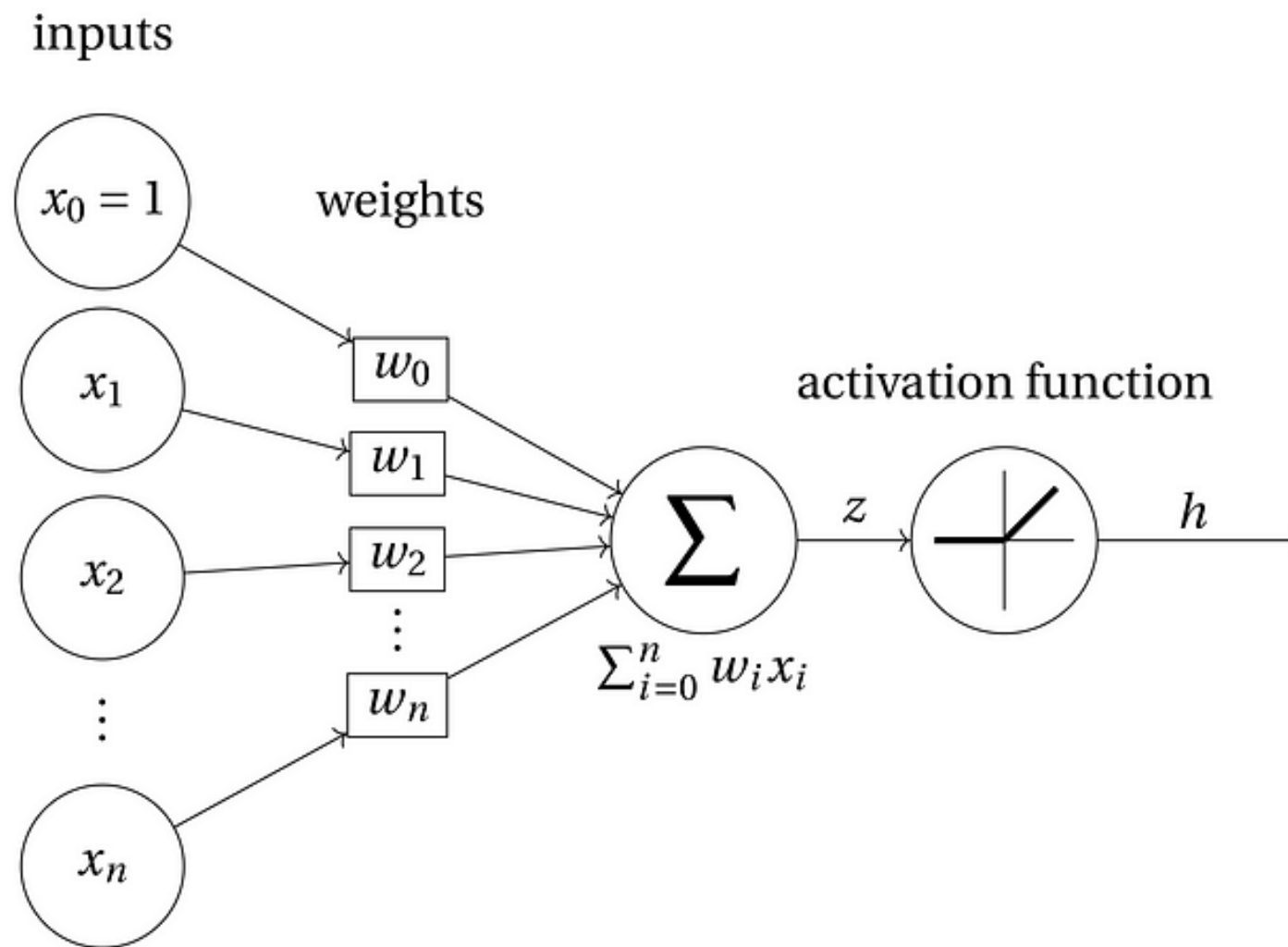
- Drivkrafter
 - Tillväxt i datorkraft
 - Dataexplosionen
- Artificiella neurala nätverk dominerar



Source: Data Age 2025, sponsored by Seagate with data from IDC Global DataSphere, Nov 2018



Hur artificiella neuroner räknar och lär ?



Stora språkmodeller är enorma

- Open AI:s Chat GPT-4
 - 1,7 **triljoner** parametrar
 - 120 lager
 - 13 **triljoner** ord (tokens)
 - Träning:
 - 25 000 GPUs
 - 3 månader,
 - kostnad 63 M\$.
- Chat GPT-5 **100X** kraftigare



Hur genererar språkmodellerna innehåll ? **NextAI**

”Gissar” följande ord

Pargas IF spelar	innebandy	10 %
	fotboll	55 %
	handboll	35 %

Generativ AI kan producera bild, video och tal (podcast)



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- Vilka **möjligheter** ger AI teknik ?

Möjligheter?

- Stor potential
- Kan bidra till FN:s hållbara utvecklingsmål
 - Miljö
 - Hälsa
 - Utbildning
- Höjer produktiviteten



Utveckling av nya material med AI hjälp

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communications materials

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Article | [Open access](#) | Published: 14 August 2024

Material engineering and application of hybrid biomimetic-de novo designed elastin-like polypeptides

[Zhuoran Geng](#), [Timo Laakko](#), [Ari Hokkanen](#), [Caj Södergård](#), [Ilari Maasilta](#) & [Pezhman Mohammadi](#) ✉

[Communications Materials](#) 5, Article number: 152 (2024) | [Cite this article](#)

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Abstract

The global concern over environmental consequences of petrochemical-derived plastics underscores the urgent need for sustainable and biodegradable polymers. In this context, elastin-like polypeptides emerge as a promising solution, offering multiple advantages, including remarkable mechanical properties, biocompatibility, customizable functionalities,

ADVANCED MATERIALS

Research Article | [Open Access](#) | [CC BY](#)

Accelerated Engineering of ELP-Based Materials through Hybrid Biomimetic-De Novo Predictive Molecular Design

[Timo Laakko](#), [Antti Korkealaakso](#), [Burcu Firatligil Yildirim](#), [Piotr Batys](#), [Ville Liljeström](#), [Ari Hokkanen](#), [Nonappa](#), [Merja Penttilä](#), [Anssi Laukkanen](#), [Ali Miserez](#), [Caj Södergård](#), [Pezhman Mohammadi](#) ✉

First published: 06 May 2024 | <https://doi.org/10.1002/adma.202312299> | Citations: 3

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Abstract

Efforts to engineer high-performance protein-based materials inspired by nature have mostly focused on altering naturally occurring sequences to confer the desired functionalities, whereas de novo design lags significantly behind and calls for unconventional innovative approaches. Here, using partially disordered elastin-like polypeptides (ELPs) as initial building blocks this work shows that de novo engineering of protein materials can be accelerated through hybrid biomimetic design, which this work achieves by integrating computational modeling, deep neural network, and recombinant

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Volume 36, Issue 28
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Figures References Related Information

Recommended
Innovative Engineering Nation

AI Empowered Material Scientist (AIMS)

Designing superior materials in minutes
instead of years

The problem

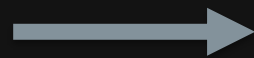
AIMS

VTT



Unsustainable fossil-based materials

Weak materials



Help from Nature

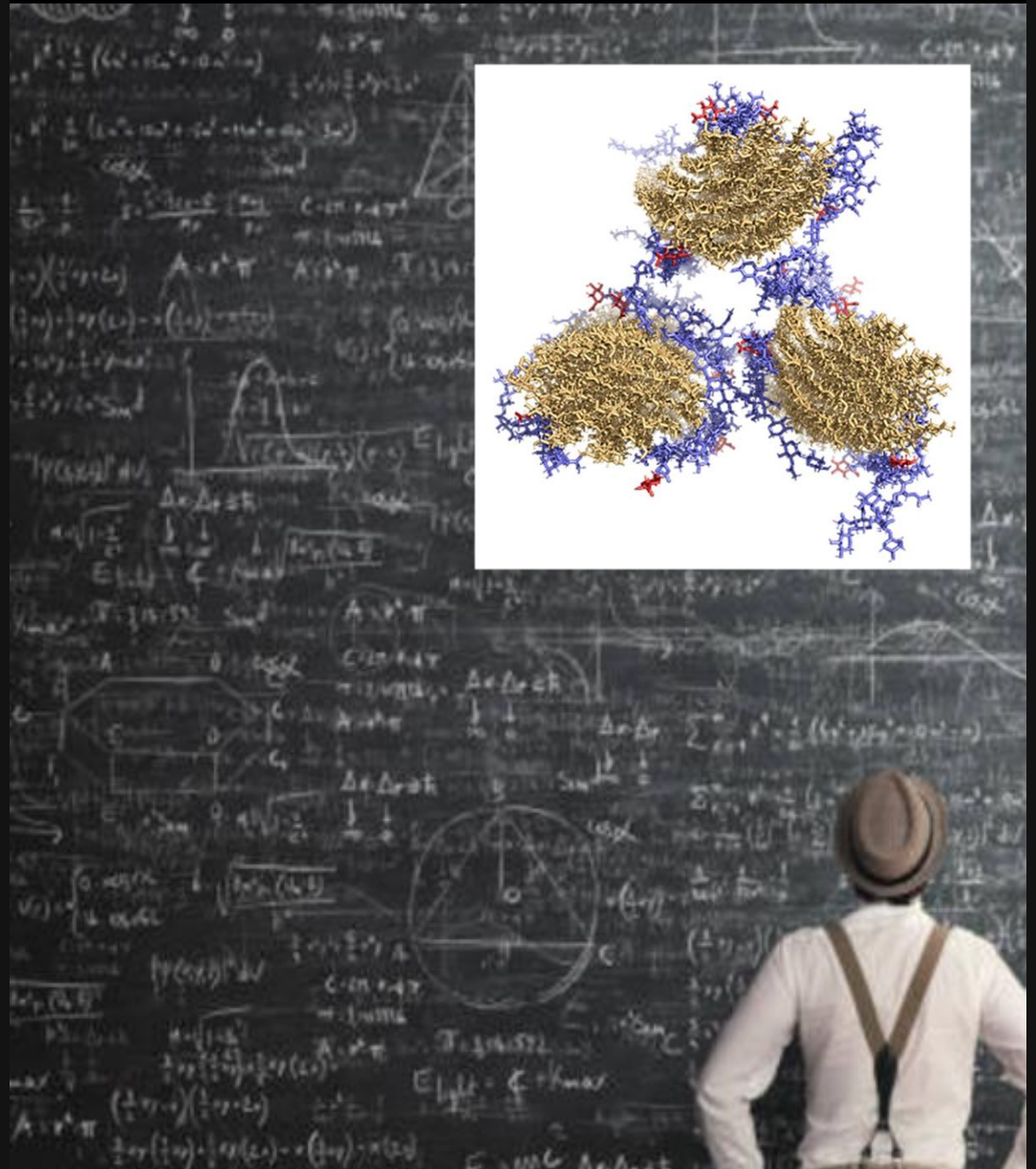
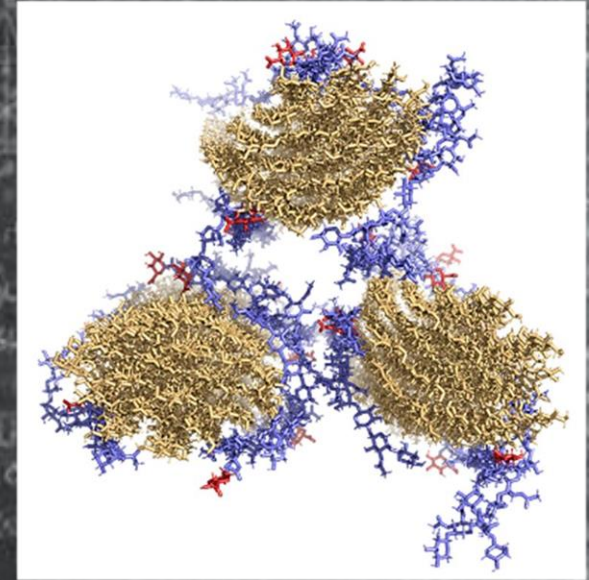
Need for renewable materials



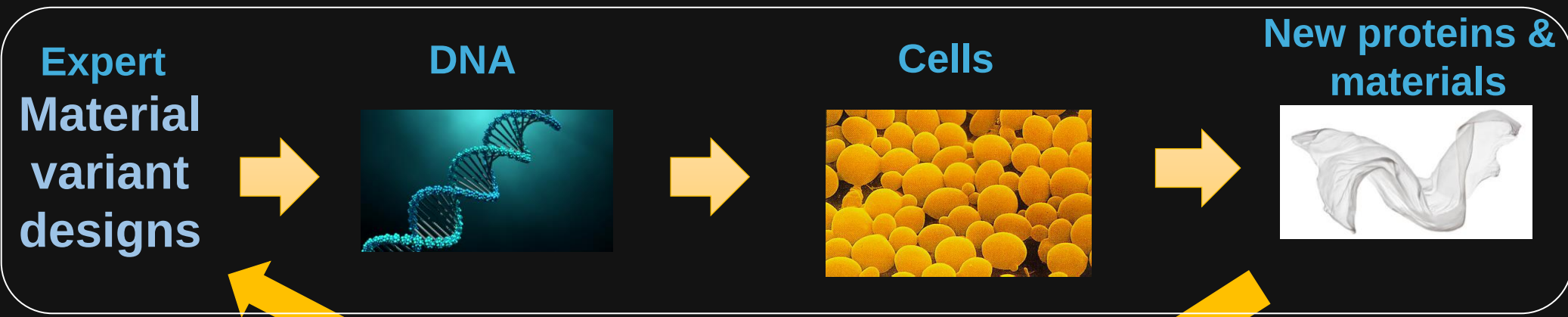
Need for extreme performance

Challenges

- ✓ Trial and error
 - ✓ Years to develop
 - ✓ Massive costs
- ✓ Complexity beyond human reach



**Synbio
Lab**



AIMS

Trial & Error

Data on properties

AI support speeds up invention

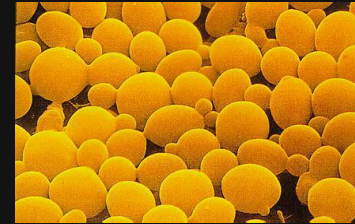
AIMS

New proteins & materials

Cells

DNA

Expert
Material
variant
designs



Finalists

Data on properties

Protein
databases

Generate novel
candidates

Predict properties of
candidates

Deep learning,
Generative algorithms

**AI-
aid**

**Synbio
Lab**

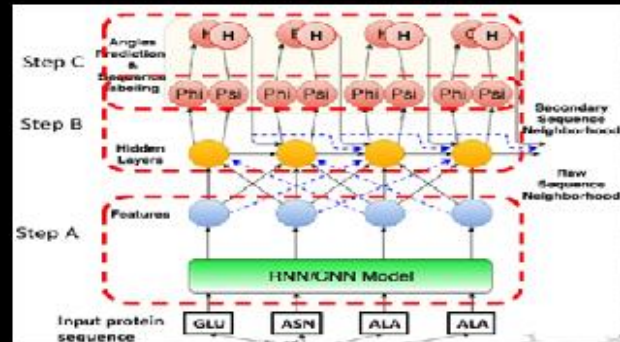
AI Predicts properties from DNA sequence

VTT

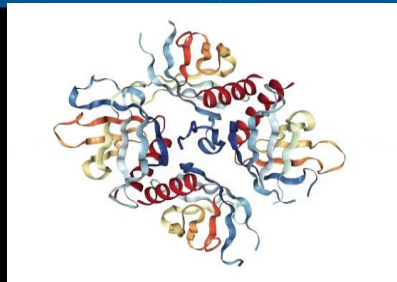


Amino acids

Learn
Predict

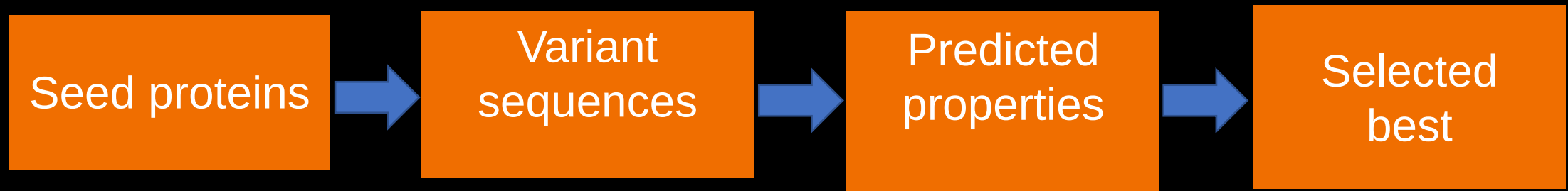


Artificial neural
network



3D protein structure

AI invents *never-seen* proteins



Complexity Challenge:

An amino acid sequence of length 10:

$20^{10} = 10\,240\,000\,000\,000$ combinations

Result: 10 novel validated protein materials

VTT

AI

- 1800 digital proteins proposed by AIMS AI



- 144 novel & stable proteins filtered by AI

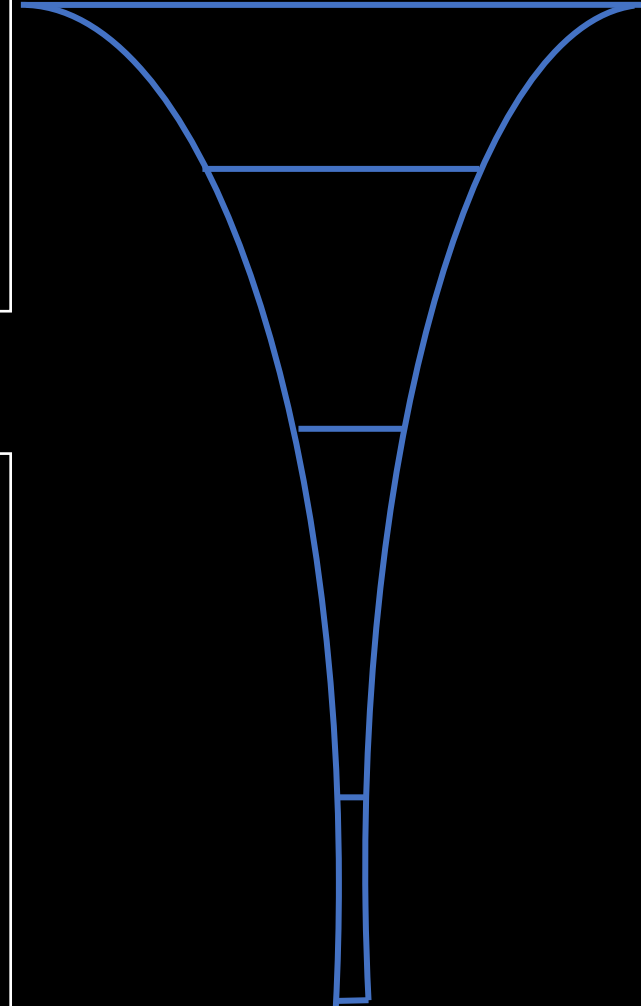


- 27 diverse protein sequences handpicked by Synbio expert & synthesized



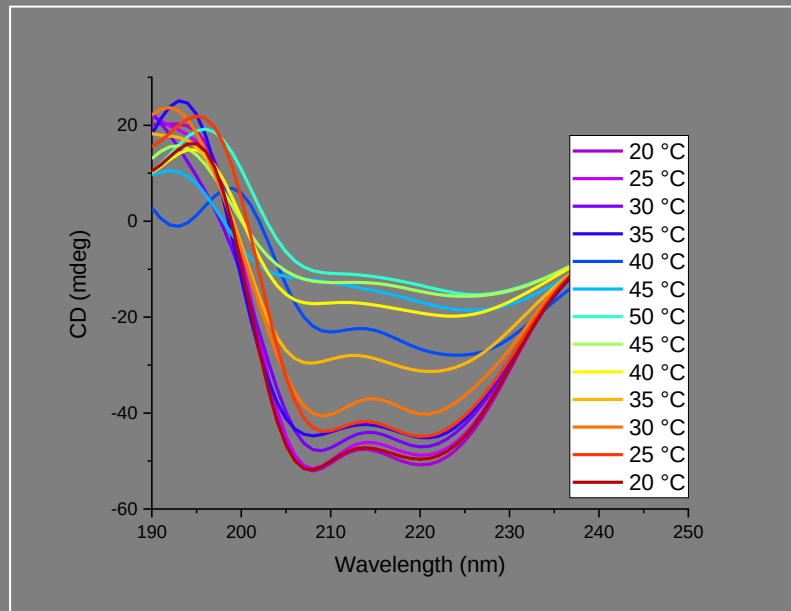
- 10 novel protein materials validated in Lab with good results

Human



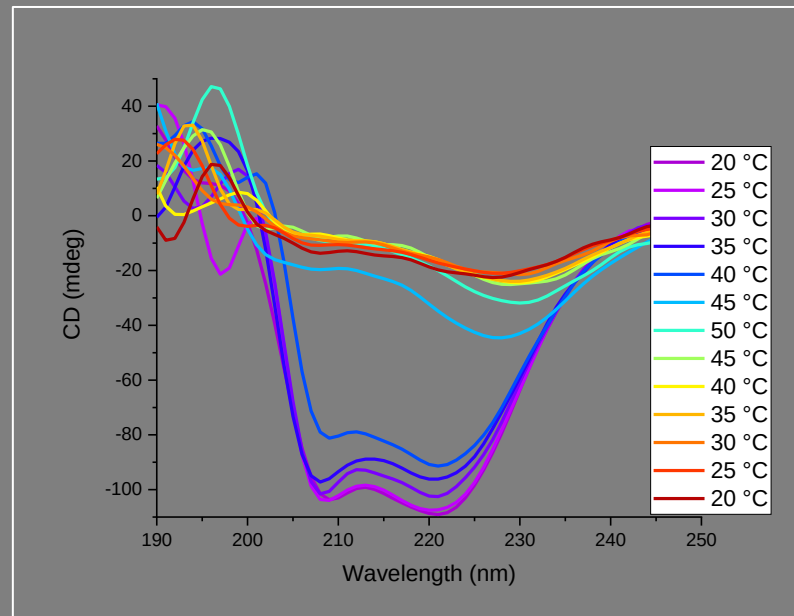
Our AI-invented proteins have superior stability

Reversible = stable



AI+human-designed ELP*

Irreversible



Human-designed ELP



*ELP = Elastine Like Polypeptides

Source: Pezhman Mohammadi

Medicin och hälsa

- Hjälper till att hitta nya mediciner (t.ex. antibiotika för resistenta bakterier)
- AI används redan nu bl.a. för att upptäcka sjukdomar
- 70 kliniska AI verktyg godkända i USA
- AI system kan analysera EKG bättre än kardiologer, men tolkningen svår

NextAI

Over a million ECG's give New Insights

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AI can predict if you'll die soon – but we've no idea how it works

TECHNOLOGY 11 November 2019
By Donna Lu



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Artificial intelligence can predict a person's chances of dying within a year by looking at heart test results – even when they look normal to doctors. How it does so is a mystery.

Brandon Formwalt at healthcare provider Geisinger in Pennsylvania, US and colleagues tasked an AI with examining 1.77 million electrocardiogram (ECG) results from nearly 400,000 people to predict who was at a higher risk of dying within the next year.

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Letter | Published: 11 May 2020

Prediction of mortality from 12-lead electrocardiogram voltage data using a deep neural network

Sushravya Raghunath, Alvaro E. Ulloa Cerna, Linyuan Jing, David P. vanMaanen, Joshua Stough, Dustin N. Hartzel, Joseph B. Leader, H. Lester Kirchner, Martin C. Stumpe, Ashraf Hafez, Arun Nemani, Tanner Carbonati, Kipp W. Johnson, Katelyn Young, Christopher W. Good, John M. Pfeiffer, Aalpen A. Patel, Brian P. Delisle, Amro Alsaïd, Dominik Beer, Christopher M. Haggerty & Brandon K. Formwalt

Nature Medicine (2020) | Cite this article
1528 Accesses | 48 Altmetric | Metrics

Abstract

The electrocardiogram (ECG) is a widely used medical test, consisting of voltage versus time traces collected from surface recordings over the heart¹. Here we hypothesized that a deep neural network (DNN) can predict an important future clinical event, 1-year all-cause mortality, from ECG voltage–time traces. By using ECGs collected over a 34-year period in a large regional health system, we trained a DNN with 1,169,662 12-lead resting ECGs obtained from 253,397 patients, in which 99,371 events occurred. The model achieved an area under the curve (AUC) of 0.88 on a held-out test set of 168,914 patients, in which 14,207 events occurred. Even within the large subset of patients ($n = 45,285$) with ECGs interpreted as 'normal' by a physician, the performance of the model in predicting 1-year mortality remained high (AUC = 0.85). A blinded survey of cardiologists demonstrated that many of the discriminating features of these normal ECGs were not apparent to expert reviewers. Finally, a Cox proportional-hazard model revealed a hazard ratio of 0.5 ($P < 0.005$) for the two

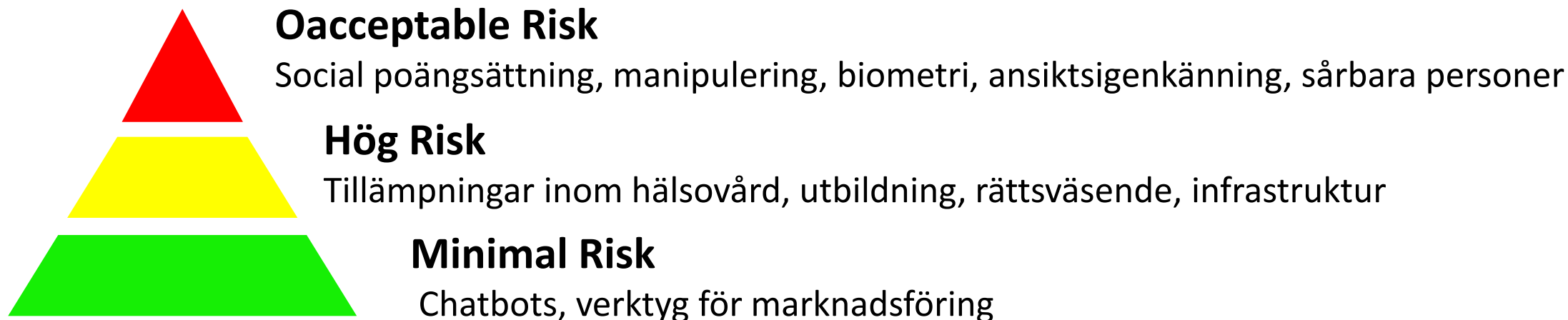
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- Vilka **utmaningar** har AI teknik ?

Utmaningar

- Fungerar inte alltid (hallucinationer)
- Förlust av *jobb*
- Inbyggd *diskriminering* & bristande *transparens* i beslutssystem
- Skydd av rättigheter till *innehåll* & egen *integritet*
- *Desinformation*, bedrägerier, hot mot demokrati
- *Maktkoncentration*, sårbarhet
- Autonoma *vapen*
- *Energiförbrukning*

EU AI förordningen – världens första AI lag



- **General Purpose** AI system (t.ex. språkmodeller) : Måste dokumenteras och eventuellt testas
- Leverantörerna måste demonstrera *överensstämmelse före* and övervaka *efter* ibruktagande
- Böter upp till 35 miljoner € eller 7% av omsättning. EU AI Office övervakar
- Trädde i kraft 1.8.2024 och tillämpningen börjar 2.8.2026

- Nuvarande AI system är smala, men blir allt kraftfullare
- Enligt vissa forskare kan det leda till generellt intelligenta system (AGI), t.o.m. superintelligens (ASI)
- Dagens system känner igen mönster, men är långt från generell intelligens
- De nuvarande system hjälper till att förbättra vår vardag
- AI lagen i Europa säkrar att AI systemen fungerar etiskt och ansvarsfullt

Tack för er uppmärksamhet!