

Eesti Teaduste Akadeemia üldkogu **23.04.2025**

Tehisararu

Prof. Jaak Vilo

#UniTartuCS



TARTU ÜLIKOOL
arvutiteaduse instituut



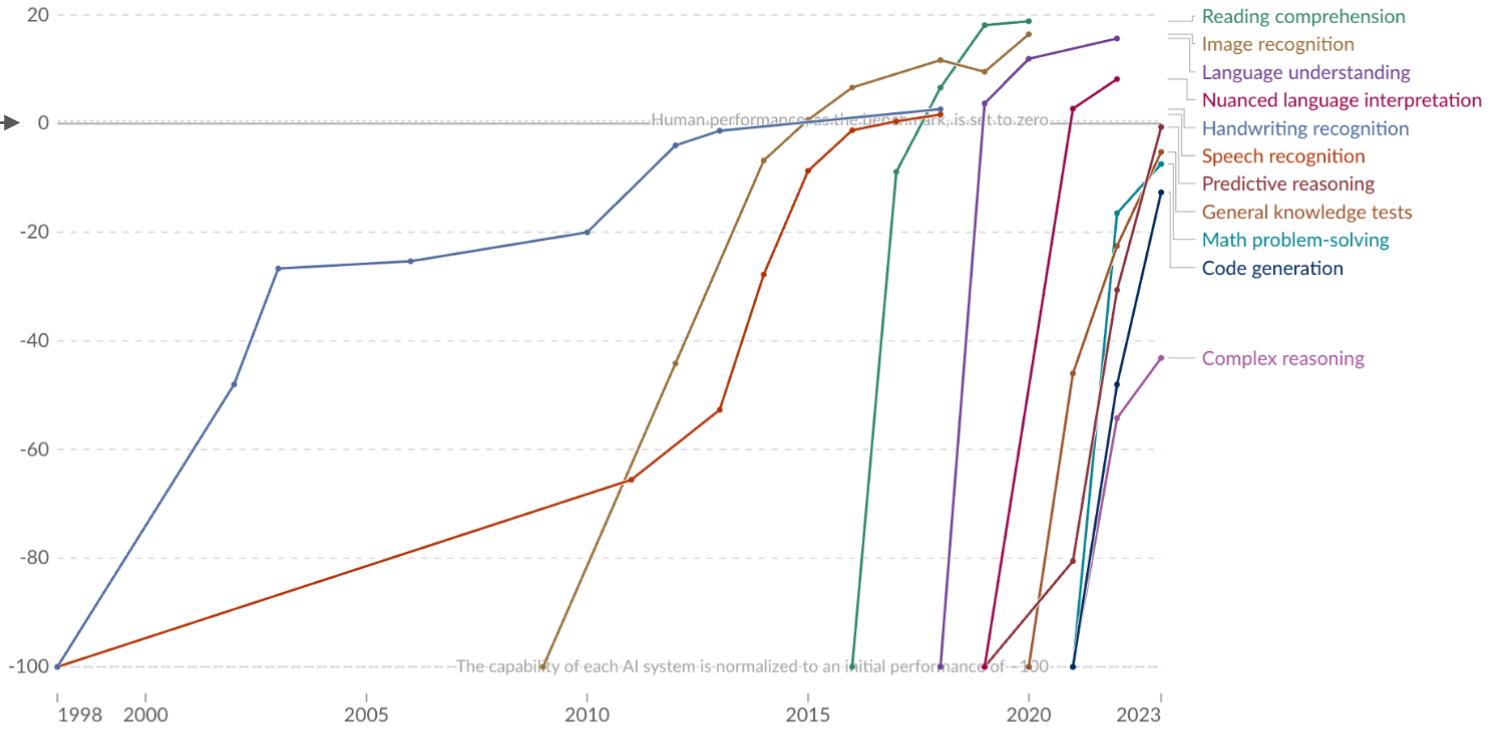
Test scores of AI systems on various capabilities relative to human performance

Within each domain, the initial performance of the AI is set to -100. Human performance is used as a baseline, set to zero. When the AI's performance crosses the zero line, it scored more points than humans.

Table Chart

Settings

Inimene →



Data source: Kiela et al. (2023) - [Learn more about this data](#)

Note: For each capability, the first year always shows a baseline of -100, even if better performance was recorded later that year.

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The U.S. Government's Bold \$500 Billion Investment in AI Infrastructure

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By Lidia Kurasińska · Contributor · Lidia Kurasińska covers Eastern European p... ⌵

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Nov 26, 2024, 03:27pm EST

Peter Sarlin makes substantial donation to strengthen AI research in Finland

The donation will support 13 new professorships at Finnish universities and the ELLIS Institute.

Nov 25, 2024

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CHINA

Inside China's State-Backed \$8.2 Billion AI Investment Strategy



CHRIS MCKAY

APRIL 11, 2025 · 2 MIN READ

PRESS RELEASE | Feb 11, 2025 | Paris | 3 min read

EU launches InvestAI initiative to mobilise €200 billion of investment in artificial intelligence*

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Quote(s)

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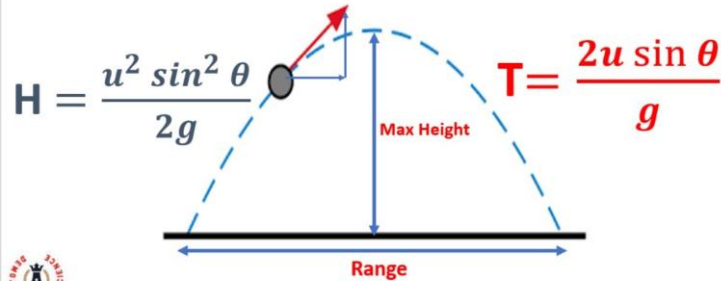
Today, at the Artificial Intelligence (AI) Action Summit in Paris, Commission President Ursula von der Leyen has launched InvestAI, an initiative to mobilise €200 billion for investment in AI, including a new European fund of €20 billion for AI gigafactories.

This large AI infrastructure is needed to allow open, collaborative development of the most complex AI models and to make Europe an AI continent.

Latvia has big plans for AI development

Matemaatika abil kirjeldame füüsika, keemia, bioloogia, jne reegleid

Projectile Motion



Vertical
Ascent

$$F_{\text{net}} = -W - D$$

$$a = -g - \frac{Cd A \rho V^2}{2m}$$

$$V = V_t \frac{V_0 - V_t \tan(t g / V_t)}{V_t + V_0 \tan(t g / V_t)}$$

$$y = \frac{V_t^2}{2g} \ln \left(\frac{V_0^2 + V_t^2}{V_t^2 + V_0^2} \right)$$

$$y_{\text{max}} = \frac{V_t^2}{2g} \ln \left(\frac{V_0^2 + V_t^2}{V_t^2} \right)$$

$$V_t = \sqrt{\frac{2mg}{Cd A \rho}}$$

$$t_{(v=0)} = \frac{V_t}{g} \tan^{-1} \left(\frac{V_0}{V_t} \right)$$

Horizontal: $F_{\text{net}} = -D$

$$a = -\frac{Cd A \rho U^2}{2m}$$

Vertical
Descent

$$F_{\text{net}} = -W + D = 0$$

$$a = 0$$

$$V = V_t$$

Horizontal:

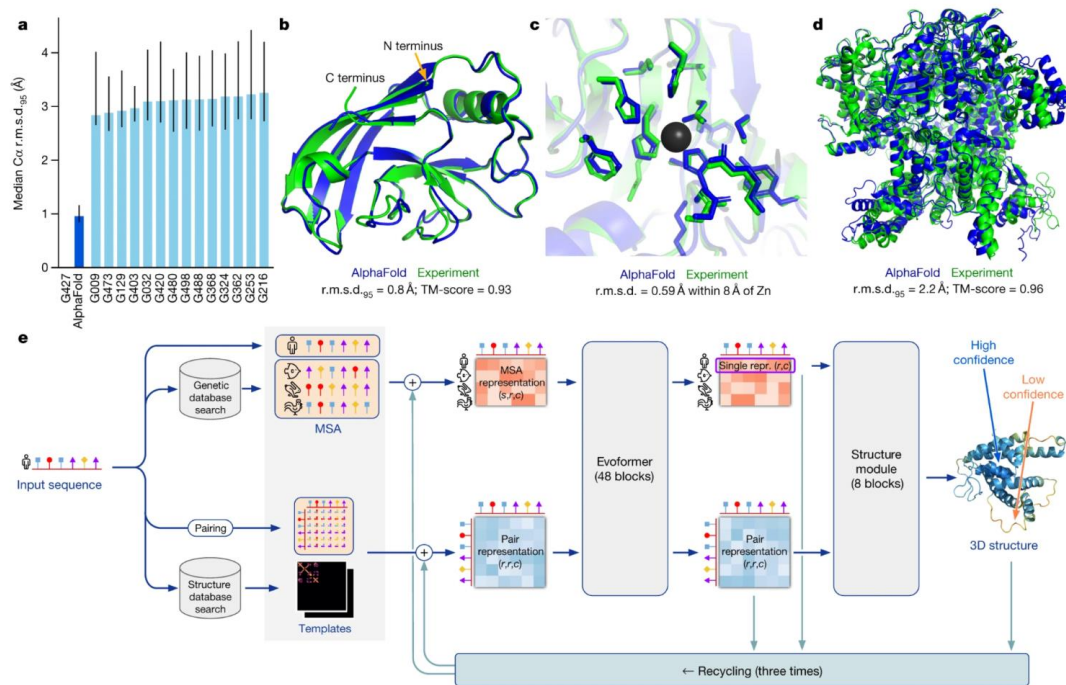
$$U = \frac{V_t^2 U_0}{V_t^2 + g U_0 t}$$

$$x = \frac{V_t^2}{g} \ln \left(\frac{V_t^2 + g U_0 t}{V_t^2} \right)$$



Fig. 1: AlphaFold produces highly accurate structures.

From: [Highly accurate protein structure prediction with AlphaFold](#)



a, The performance of AlphaFold on the CASP14 dataset ($n = 87$ protein domains) relative to the top-15 entries (out of 146 entries), group numbers correspond to the numbers assigned to entrants by CASP. Data are median and the 95% confidence interval of the median, estimated from 10,000 bootstrap samples. **b**, Our prediction of CASP14 target T1049 (PDB 6Y4F, blue) compared with the true (experimental) structure (green). Four residues in the C terminus of the crystal structure are β -factor outliers and are not depicted. **c**, CASP14 target T1056 (PDB 6Y1J). An example of a well-predicted zinc-binding site (AlphaFold has accurate side chains even though it does not explicitly predict the zinc ion). **d**, CASP target T1044 (PDB 6VR4)—a 2,180-residue single chain—was predicted with correct domain packing (the prediction was made after CASP using AlphaFold without intervention). **e**, Model architecture. Arrows show the information flow among the various components described in this paper. Array shapes are shown in parentheses with s , number of sequences (N_{seq} in the main text); r , number of residues (N_{res} in the main text); c , number of channels.

Through an enormous experimental effort, the structures of around **100,000 unique proteins** have been determined, but this represents a **small fraction of the billions of known protein sequences**. Structural coverage is bottlenecked by the months to years of painstaking effort required to determine a single protein structure. **Accurate computational approaches** are needed to address this gap and to enable large-scale structural bioinformatics.

Article | [Open access](#) | Published: 15 July 2021

Highly accurate protein structure prediction with AlphaFold

[John Jumper](#) , [Richard Evans](#), [Alexander Pritzel](#), [Tim Green](#), [Michael Figurnov](#), [Olaf Ronneberger](#), [Kathryn Tunyasuvunakool](#), [Russ Bates](#), [Augustin Židek](#), [Anna Potapenko](#), [Alex Bridgland](#), [Clemens Meyer](#), [Simon A. A. Kohl](#), [Andrew J. Ballard](#), [Andrew Cowie](#), [Bernardino Romera-Paredes](#), [Stanislav Nikolov](#), [Rishub Jain](#), [Jonas Adler](#), [Trevor Back](#), [Stig Petersen](#), [David Reiman](#), [Ellen Clancy](#), [Michał Zieliński](#), ... [Demis Hassabis](#)  + Show authors

[Nature](#) **596**, 583–589 (2021) | [Cite this article](#)

Science & technology | Future imperfect

Artificial intelligence is helping improve climate models

More accurate predictions will lead to better policy-making

The
Economist



PHOTOGRAPH: GETTY IMAGES

Nov 13th 2024

[Share](#)

Arvuti, sh ka tehisintellekti abil arvutame (f):

Input \xrightarrow{f} **Output**

Andmed (D)
tulemus (R)

mudel (M)



**Näited (D,R)
(M)**

masinõpe (ML)

mudel

Masinõpe,
treenimine:



- Juhendamata
- Juhendatud (klassifitseerimine, regressioon)
- Stimulõpe

Rakendamine - andmetel, mida ei ole varem näinud ...



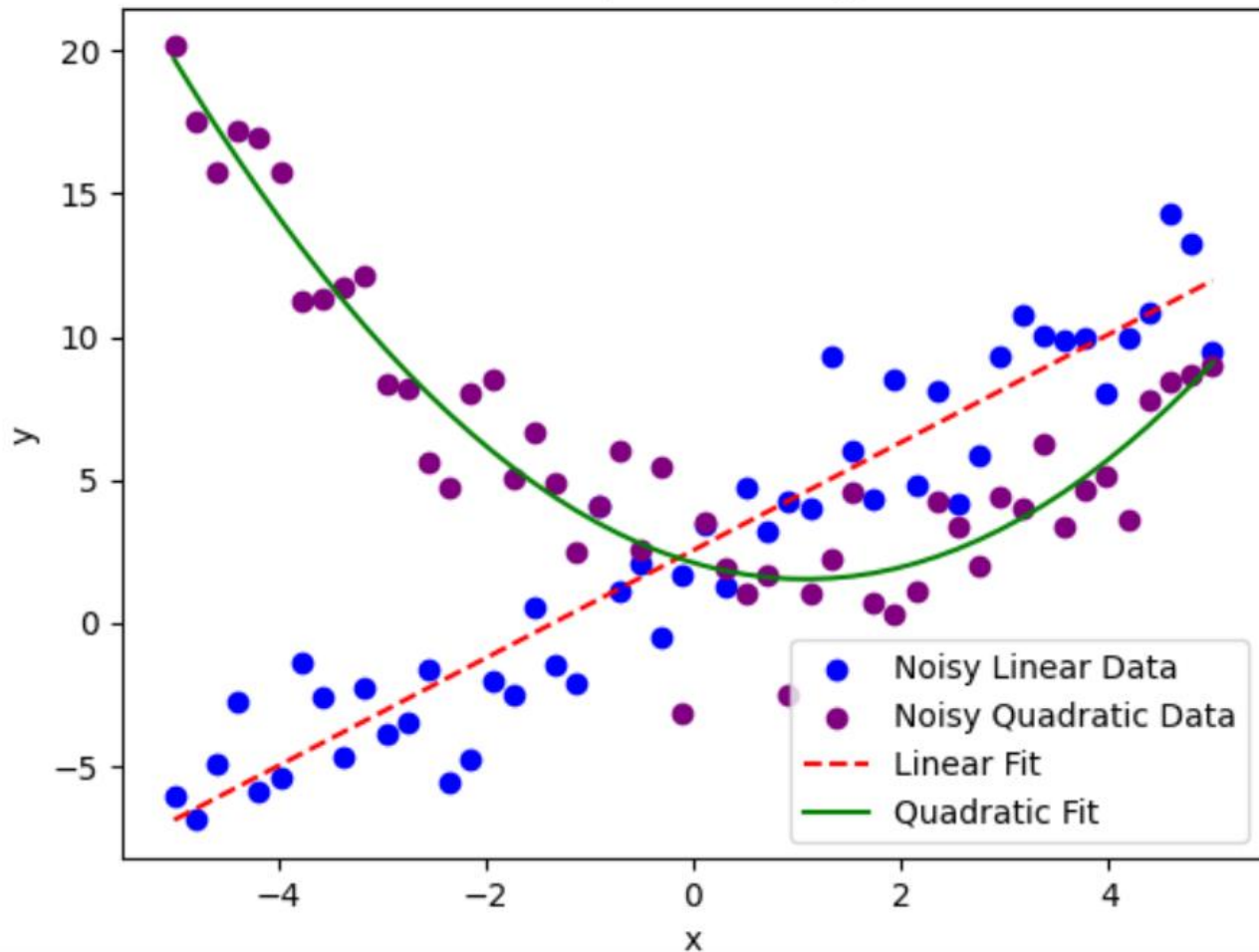
Linear vs. Quadratic Regression

Ennustame:

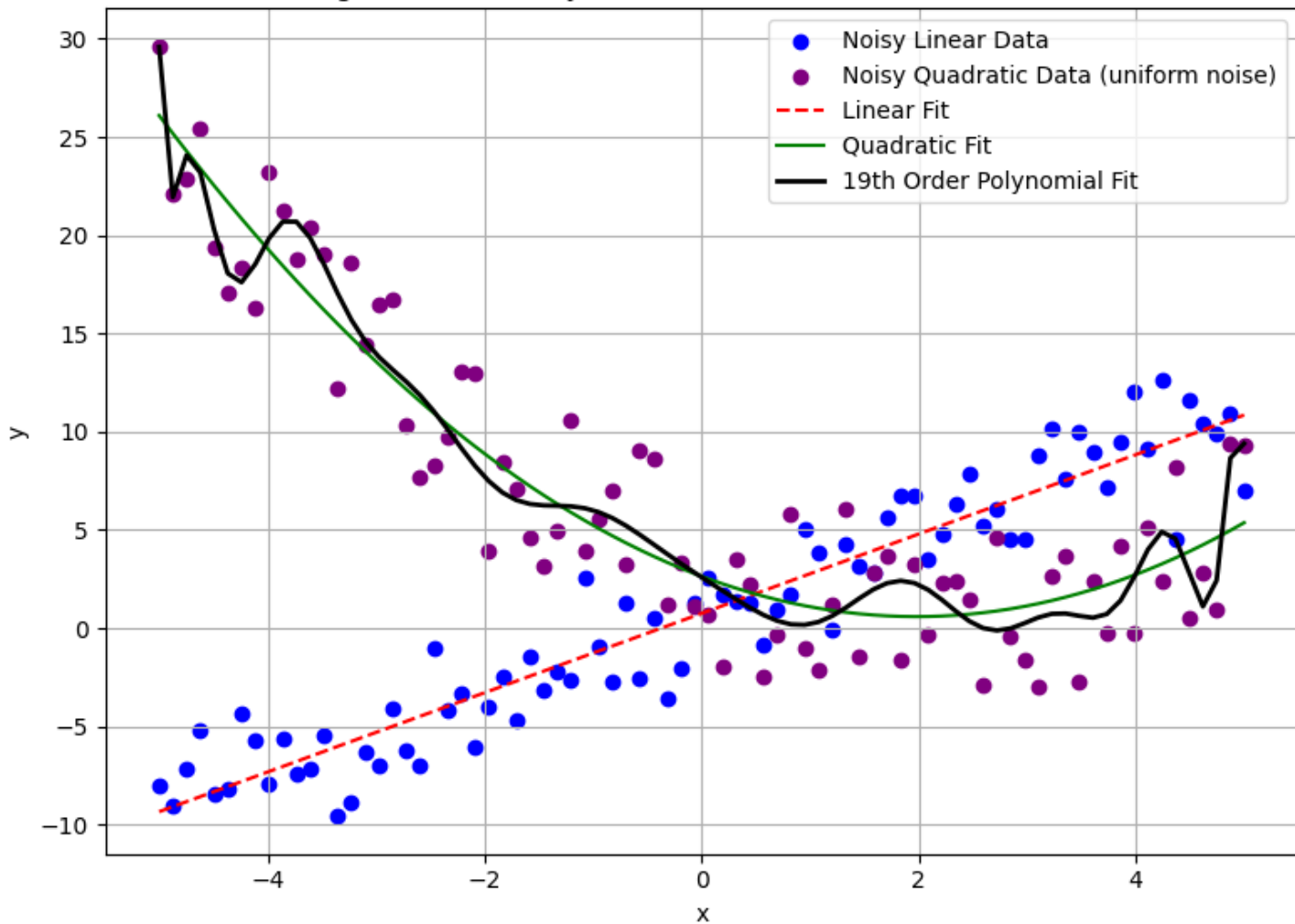
$X \rightarrow Y$

$aX + b = Y$

$aX^2 + bX + c = Y$



Regression on Noisy Data with Uniform and Normal Noise



```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import PolynomialFeatures
from sklearn.pipeline import make_pipeline

# Generate data
np.random.seed(42)
x = np.linspace(-5, 5, 88)
x = x[:, np.newaxis]

# Linear data + normal noise
y_linear = 2 * x.flatten() + 1 + np.random.normal(0, 2, size=x.shape[0])

# Quadratic data + uniform noise
y_quad = 0.5 * x.flatten()**2 - 2 * x.flatten() + 3 + np.random.uniform(-5, 5, size=x.shape[0])

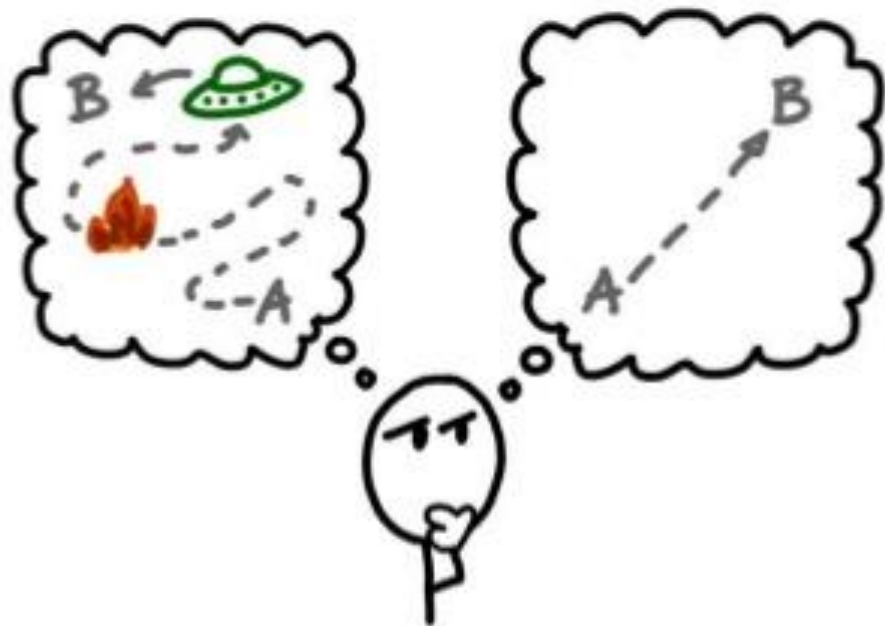
# Linear regression fit
lin_reg = LinearRegression()
lin_reg.fit(x, y_linear)
y_linear_pred = lin_reg.predict(x)

# Quadratic regression fit (true model)
quad_model = make_pipeline(PolynomialFeatures(2), LinearRegression())
quad_model.fit(x, y_quad)
y_quad_pred = quad_model.predict(x)

# 19th-order polynomial fit over the quadratic data
poly9_model = make_pipeline(PolynomialFeatures(19), LinearRegression())
poly9_model.fit(x, y_quad)
y_poly9_pred = poly9_model.predict(x)

# Plot
plt.figure(figsize=(8, 6))
plt.scatter(x, y_linear, color='blue', label='Noisy Linear Data')
plt.scatter(x, y_quad, color='purple', label='Noisy Quadratic Data (uniform noise)')
plt.plot(x, y_linear_pred, 'r--', label='Linear Fit')
plt.plot(x, y_quad_pred, 'g-', label='Quadratic Fit')
plt.plot(x, y_poly9_pred, color='black', linewidth=2, label='19th Order Polynomial Fit')
plt.title('Regression on Noisy Data with Uniform and Normal Noise')
plt.xlabel("x")
plt.ylabel("y")
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```

Occam's Razor



“When faced with two equally good hypotheses, always choose the simpler.”

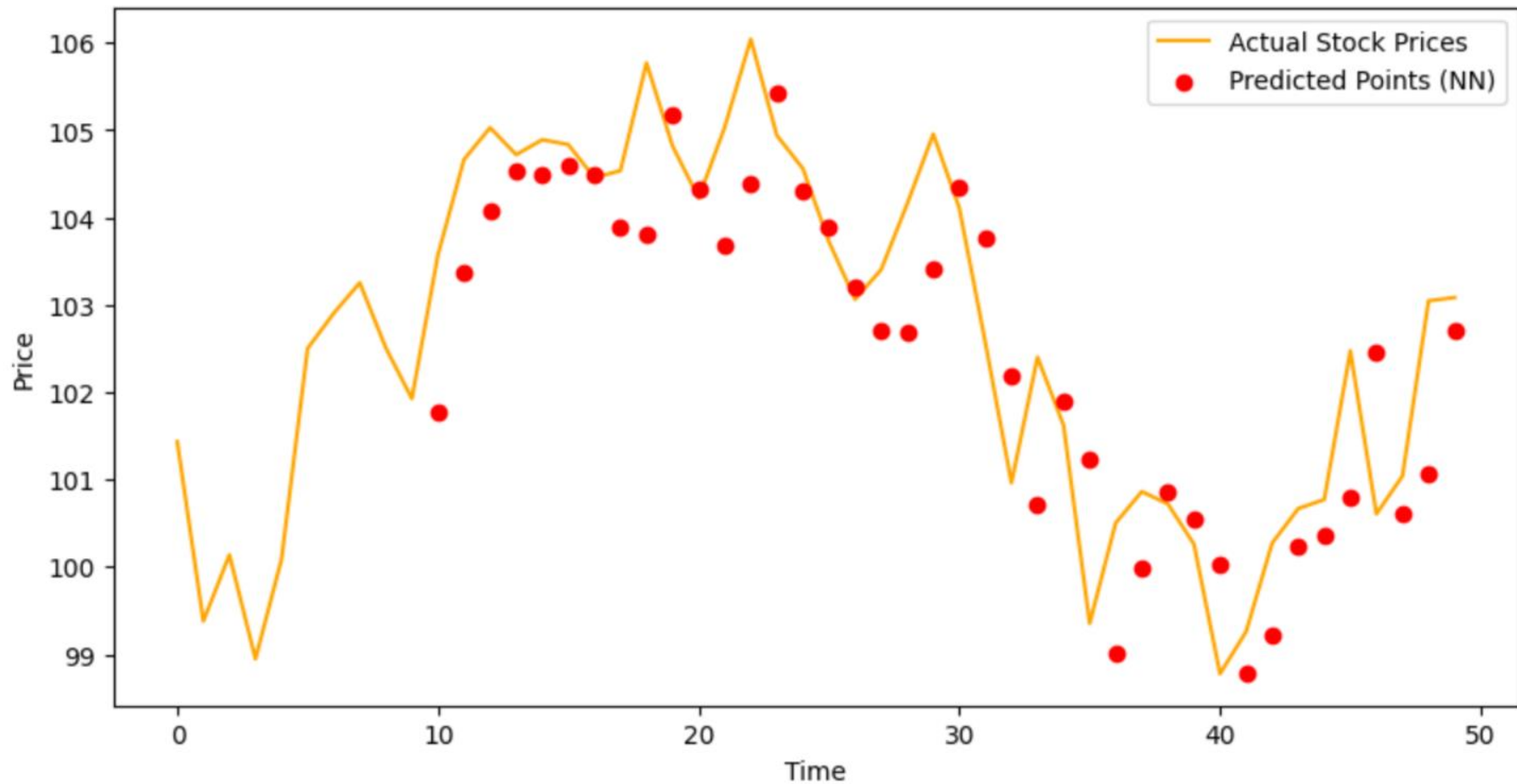
Jätka kollast joont ...

Milline kolmest punasest ennustusest on täpseim?

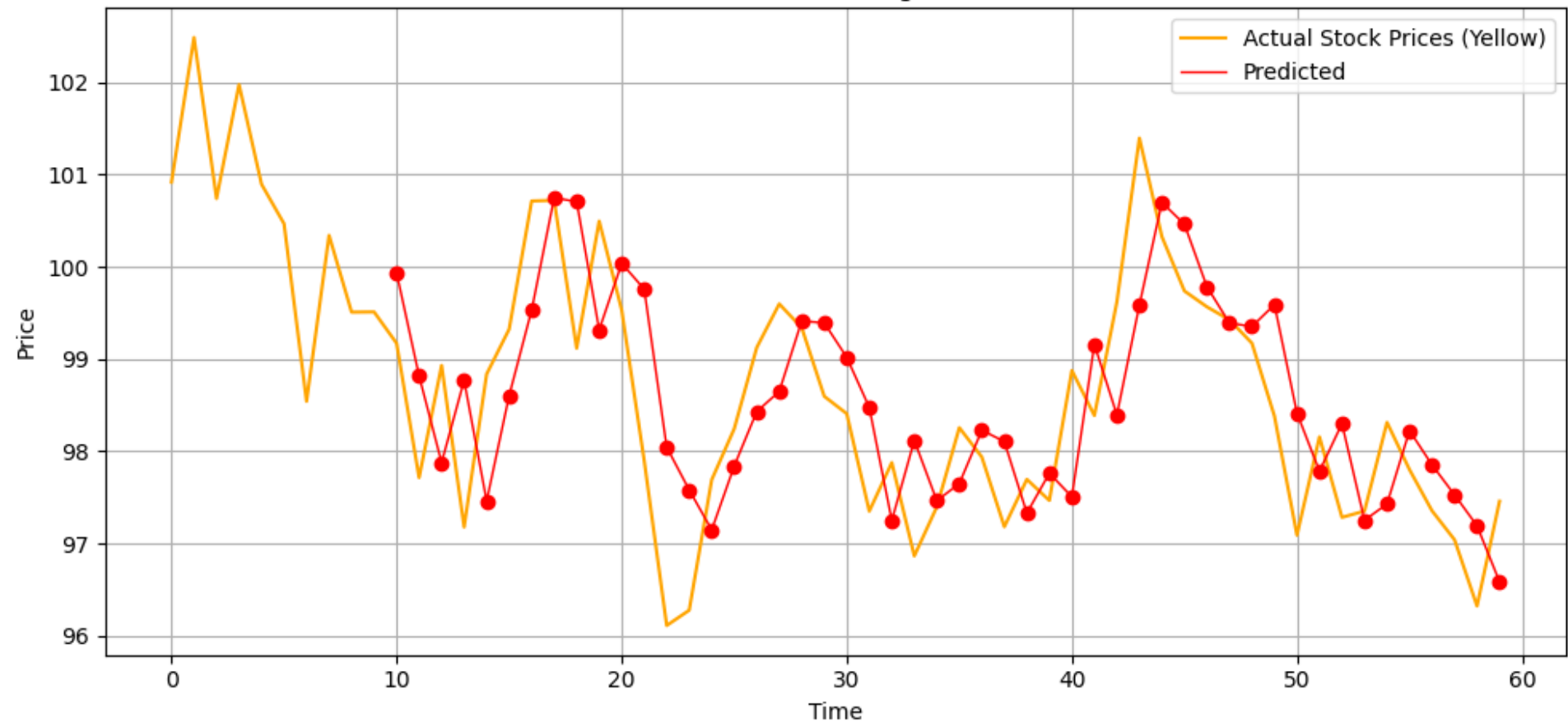


Sum of Squared Errors (SSE): 46.77844796247822

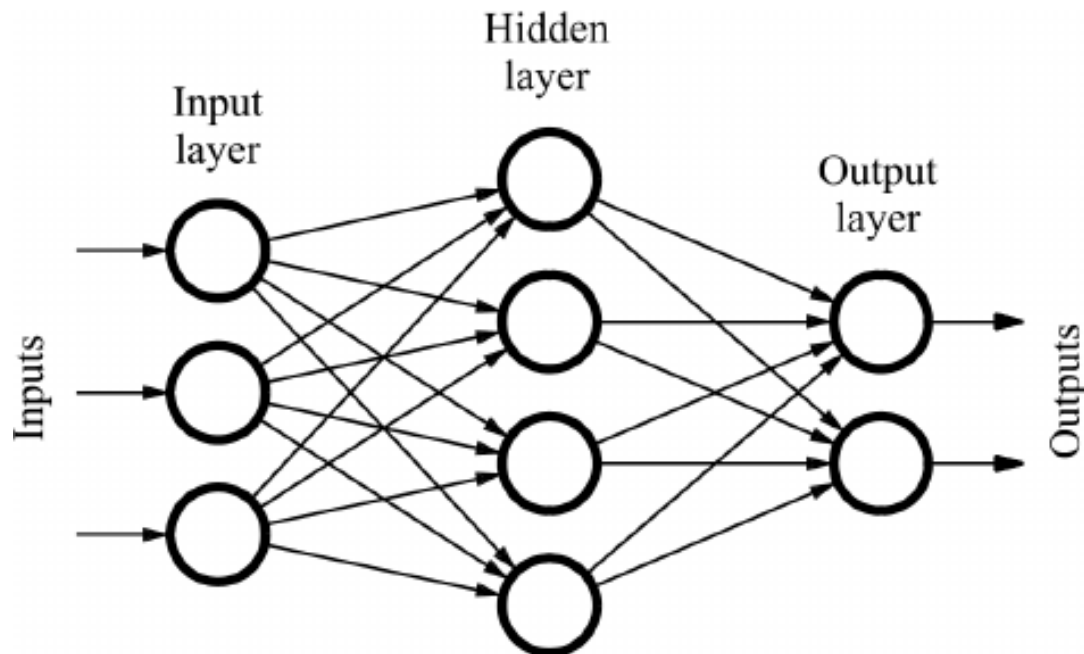
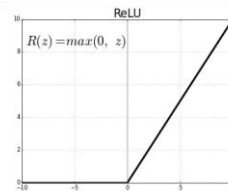
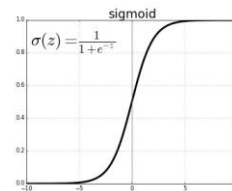
Test Stock Price Time Series with Neural Network Predictions



Model Prediction vs Actual on a Single Stock-like Time Series



Tehisnärvivõrk, igas neuronis: $f(\mathbf{w} \cdot \mathbf{x})$



$$4(3+1)=16$$

$$2(4+1)=10$$

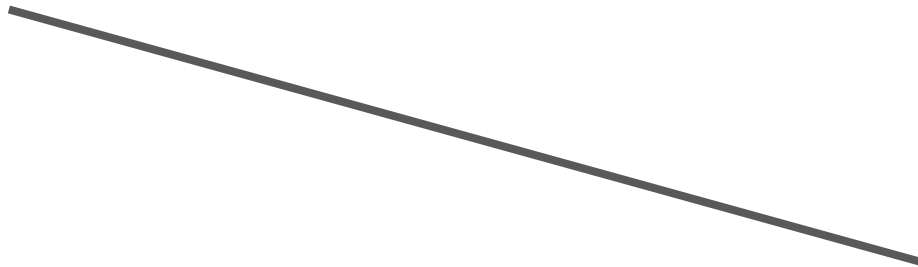
26 parameetrit

2D $f(\mathbf{w} \cdot \mathbf{x})$

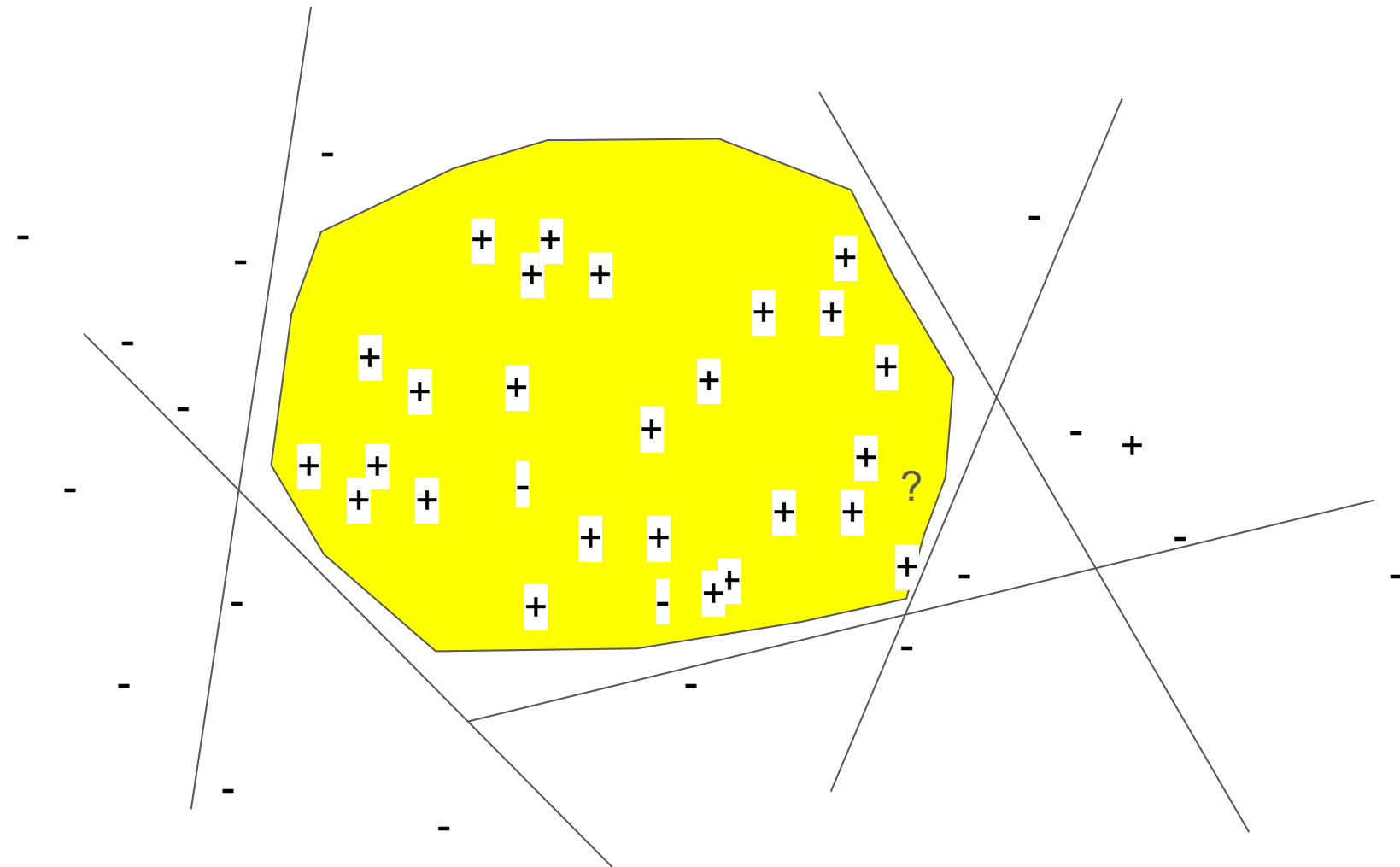
(x,y)

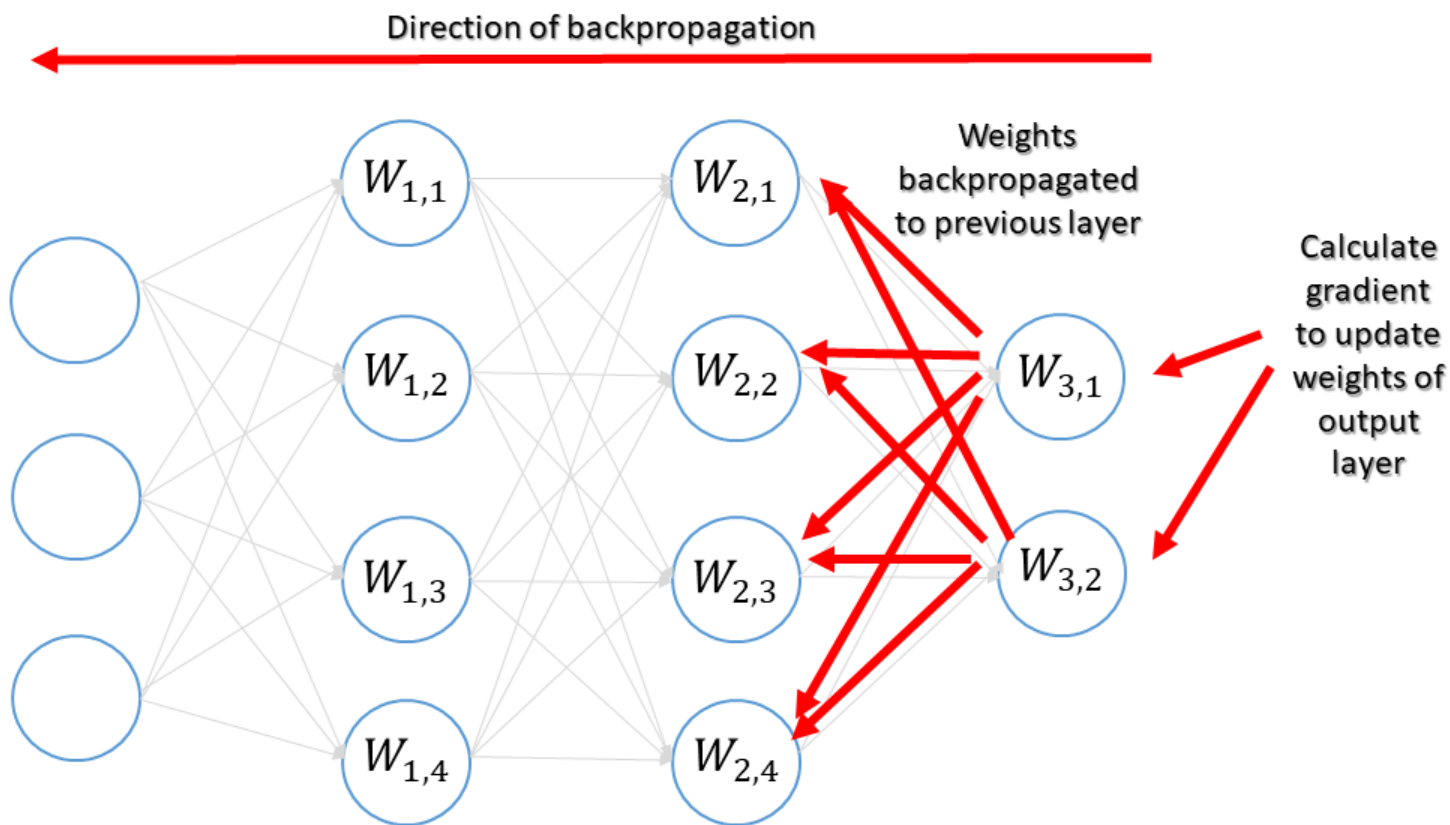


$$aX + bY + c = 0$$

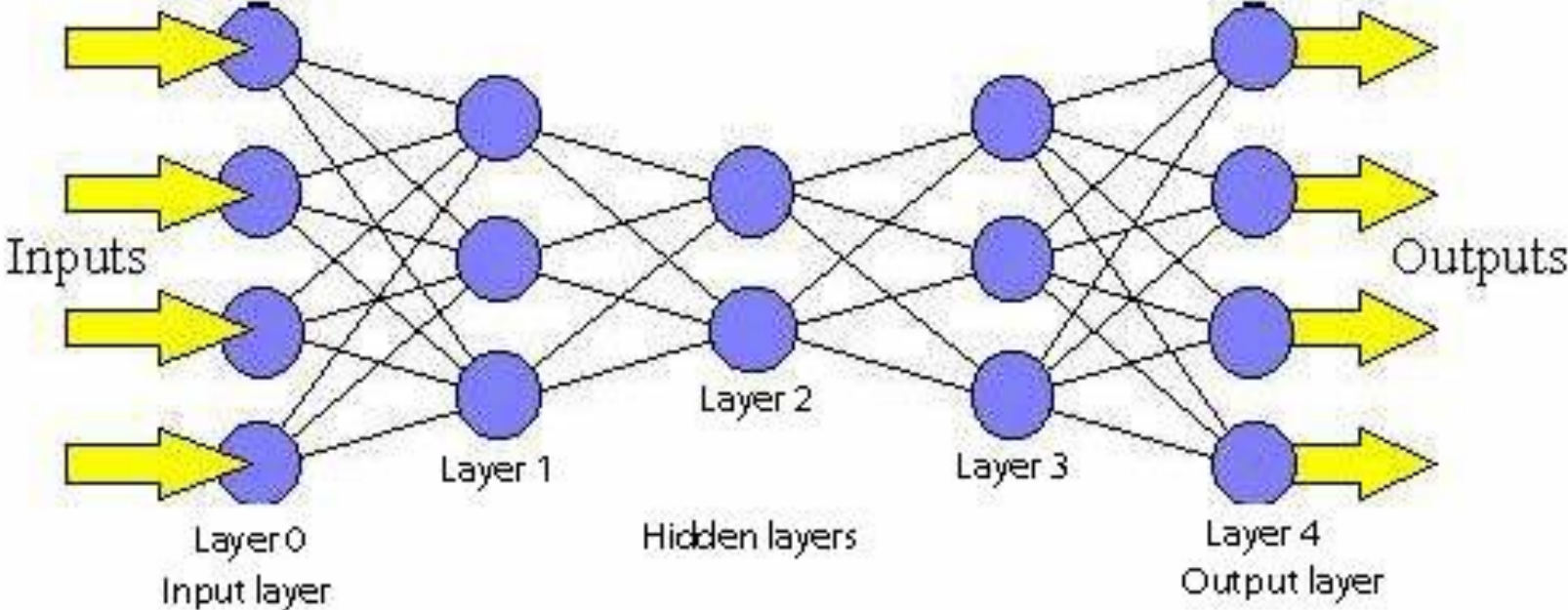


a	b	c
x	y	1



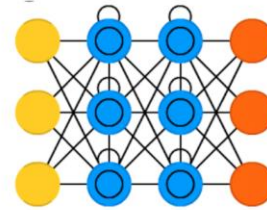
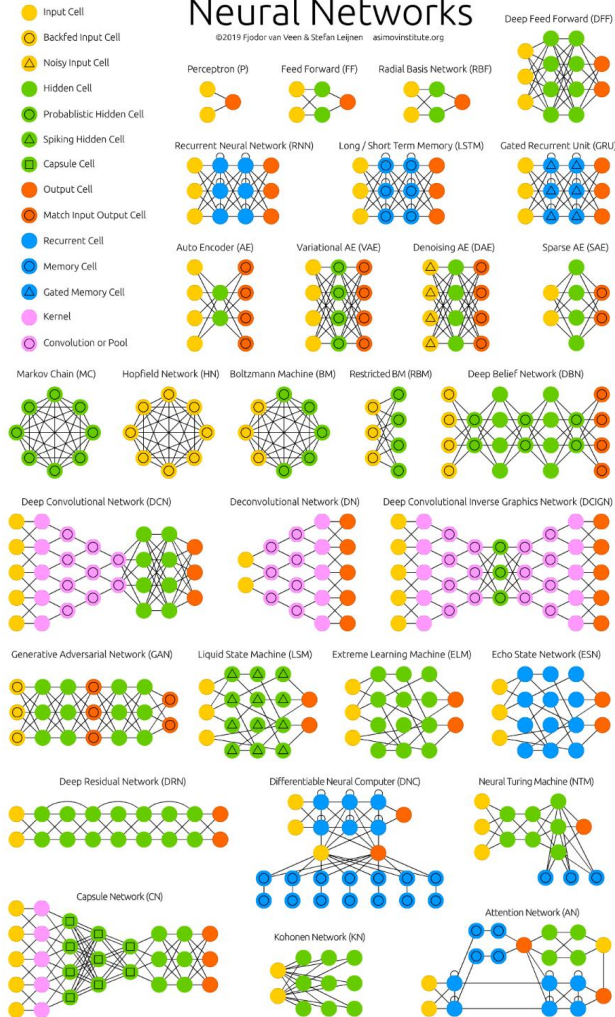


Erinevaid NN arhitektuure on pakutud välja väga palju



A mostly complete chart of Neural Networks

©2019 Fjodor van Veen & Stefan Lejnen asimovinstitute.org

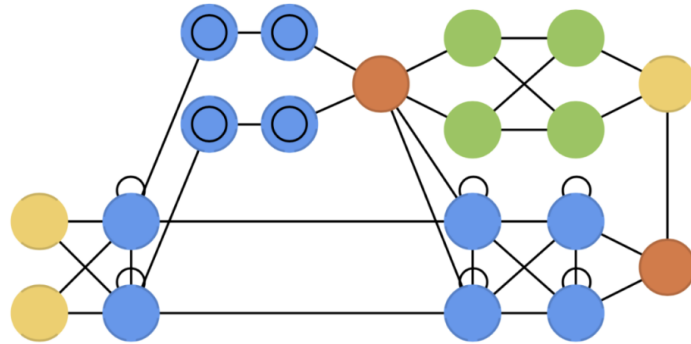


Long / short term memory (LSTM) networks try to combat the vanishing / exploding gradient problem by introducing gates and an explicitly defined memory cell. These are inspired mostly by circuitry, not so much biology. Each neuron has a memory cell and three gates: input, output and forget. The function of these gates is to safeguard the information by stopping or allowing the flow of it. The input gate determines how much of the information from the previous layer gets stored in the cell. The output layer takes the job on the other end and determines how much of the next layer gets to know about the state of this cell. The forget gate seems like an odd inclusion at first but sometimes it's good to forget: if it's learning a book and a new chapter begins, it may be necessary for the network to forget some characters from the previous chapter. LSTMs have been shown to be able to learn complex sequences, such as writing like Shakespeare or composing primitive music. Note that each of these gates has a weight to a cell in the previous neuron, so they typically require more resources to run.

Hochreiter, Sepp, and Jürgen Schmidhuber. "Long short-term memory." Neural computation 9.8 (1997): 1735-1780.

[Original Paper PDF](#)

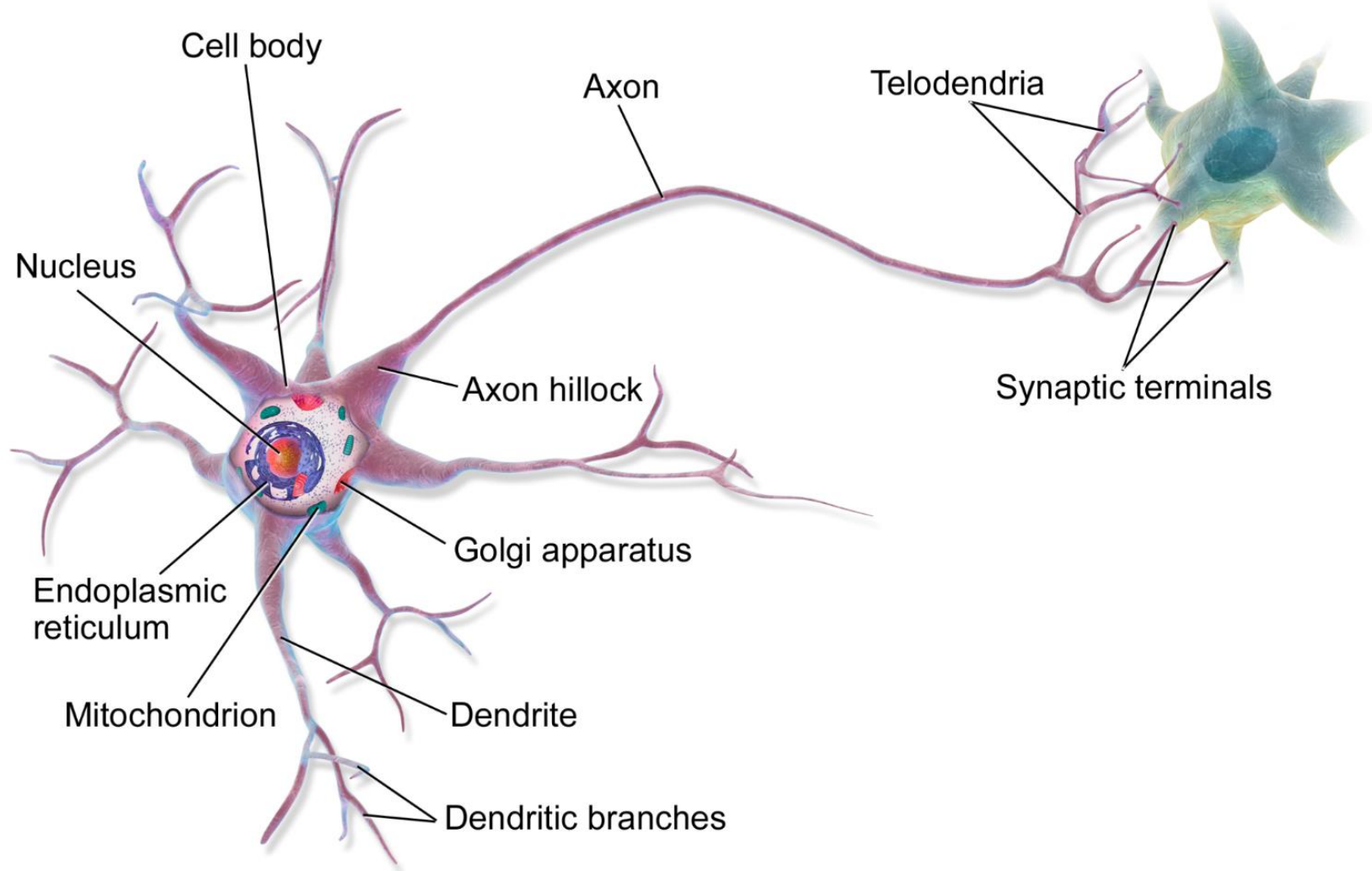
<https://www.asimovinstitute.org/neural-network-zoo/>

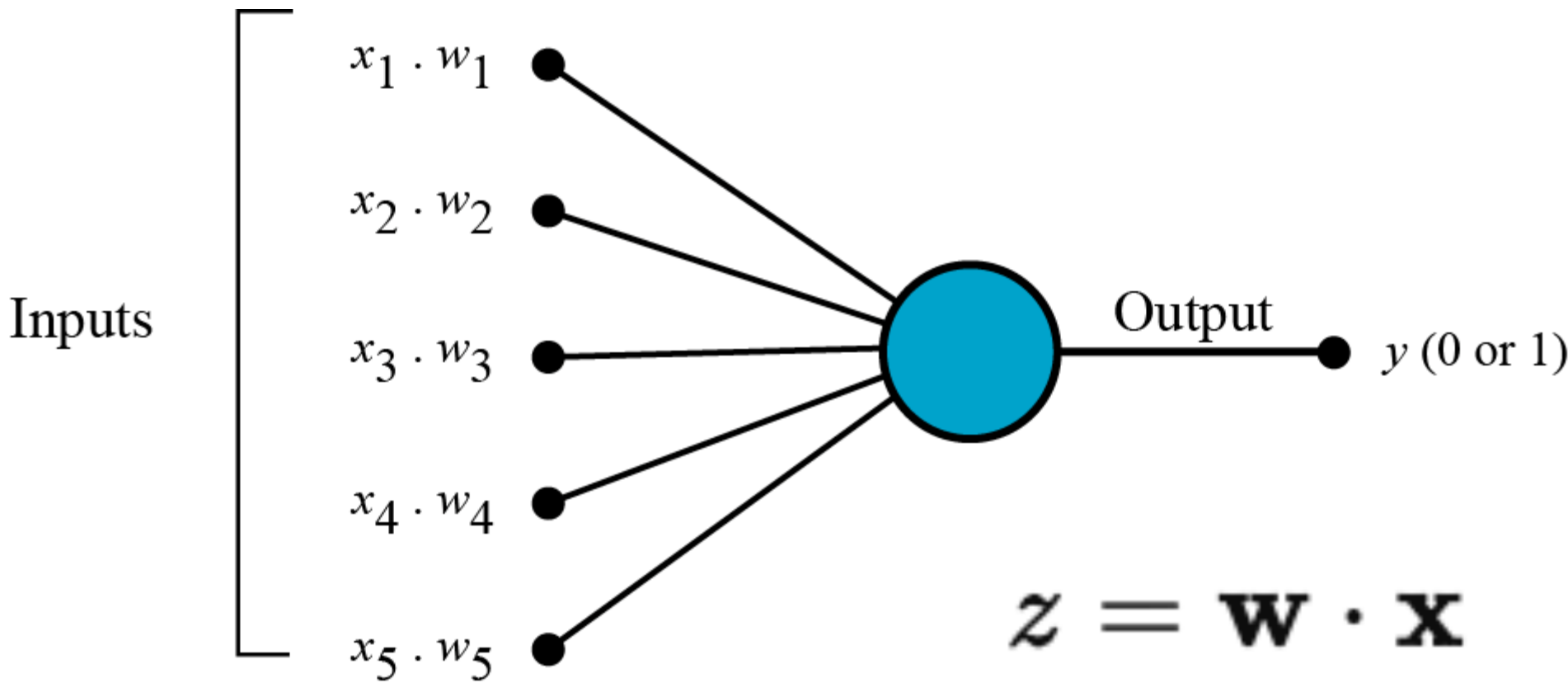


Attention networks (AN) can be considered a class of networks, which includes the Transformer architecture. They use an attention mechanism to combat information decay by separately storing previous network states and switching attention between the states. The hidden states of each iteration in the encoding layers are stored in memory cells. The decoding layers are connected to the encoding layers, but it also receives data from the memory cells filtered by an attention context. This filtering step adds context for the decoding layers stressing the importance of particular features. The attention network producing this context is trained using the error signal from the output of decoding layer. Moreover, the attention context can be visualized giving valuable insight into which input features correspond with what output features.

Jaderberg, Max, et al. "Spatial Transformer Networks." In Advances in neural information processing systems (2015): 2017-2025.

[Original Paper PDF](#)







Epoch
001,907

Learning rate
0.03

Activation
Tanh

Regularization
None

Regularization rate
0

Problem type
Classification

DATA

Which dataset do you want to use?



Ratio of training to test data: 50%



Noise: 0



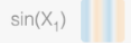
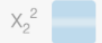
Batch size: 10



REGENERATE

FEATURES

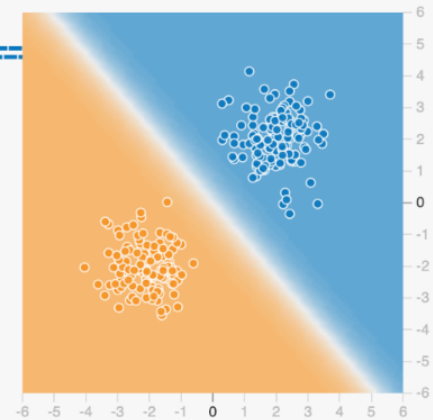
Which properties do you want to feed in?



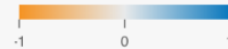
+ - 0 HIDDEN LAYERS

OUTPUT

Test loss 0.000
Training loss 0.000



Colors shows data, neuron and weight values.



Show test data

Discretize output

<https://playground.tensorflow.org/>



Tinker With a **Neural Network** Right Here in Your Browser.

Don't Worry, You Can't Break It. We Promise.



Epoch
000,752

Learning rate
0.03

Activation
Tanh

Regularization
None

Regularization rate
0

Problem type
Classification

Run/Pause

DATA

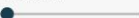
Which dataset do you want to use?



Ratio of training to test data: 50%



Noise: 0



Batch size: 10



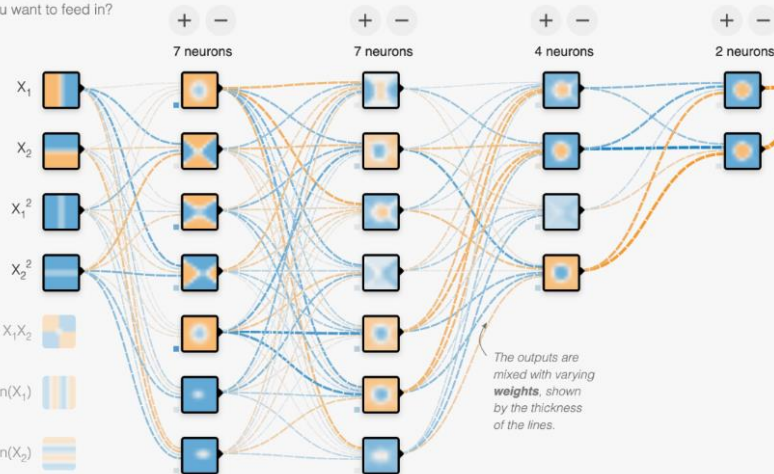
REGENERATE

FEATURES

Which properties do you want to feed in?

- X_1
- X_2
- X_1^2
- X_2^2
- $X_1 X_2$
- $\sin(X_1)$
- $\sin(X_2)$

4 HIDDEN LAYERS

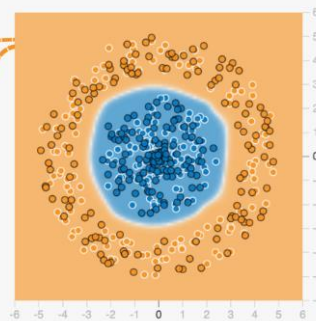


The outputs are mixed with varying **weights**, shown by the thickness of the lines.

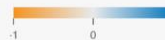
This is the output from one **neuron**. Hover to see it larger.

OUTPUT

Test loss 0.000
Training loss 0.000



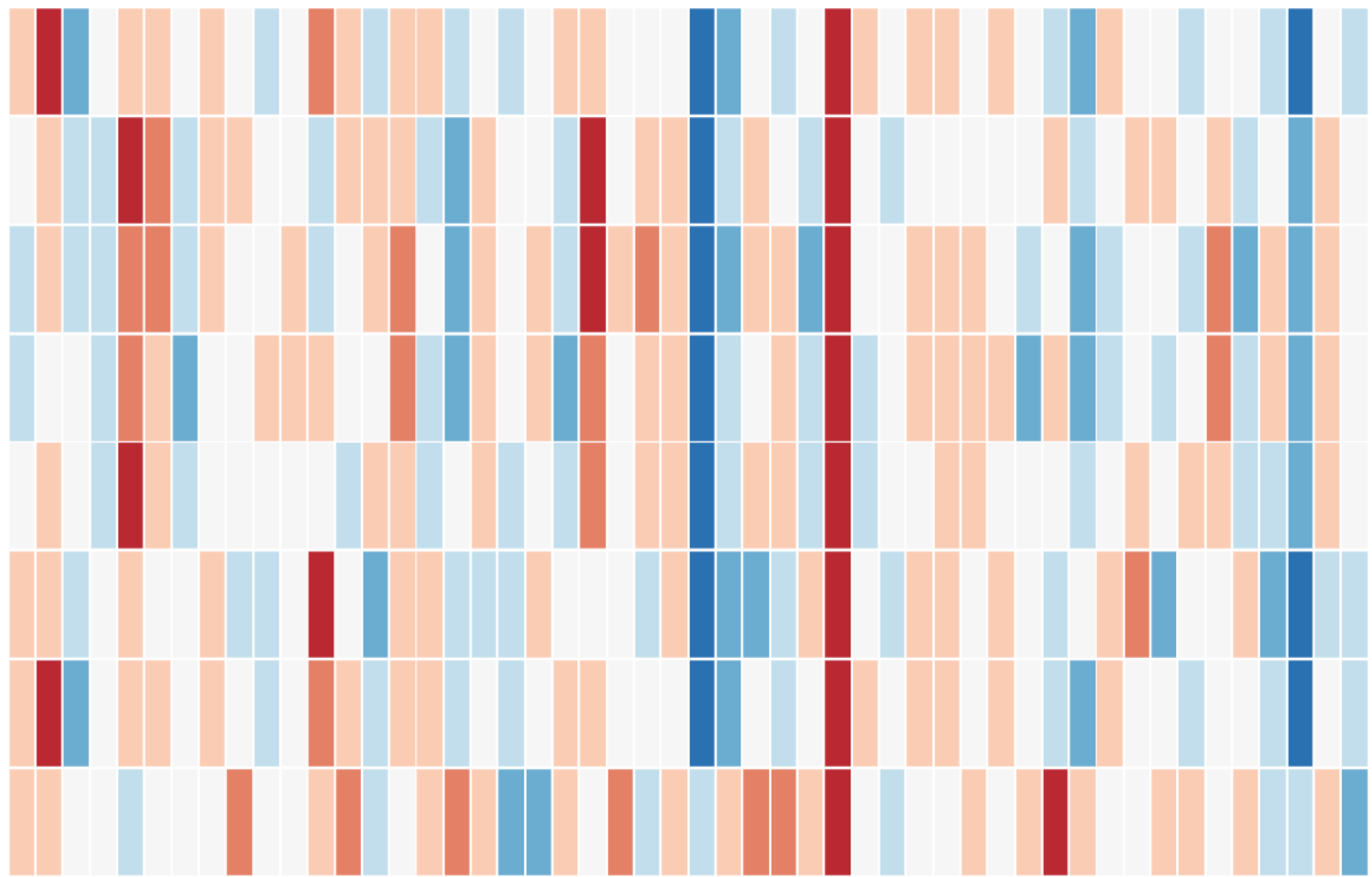
Colors shows data, neuron and weight values.



Show test data Discretize output

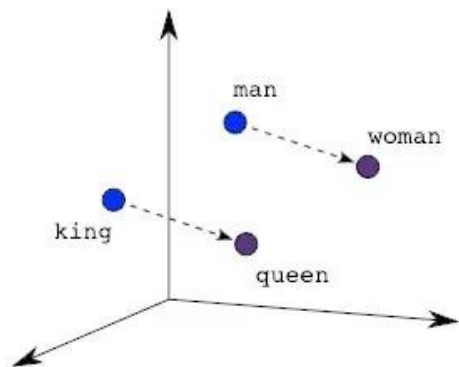


queen
woman
girl
boy
man
king
queen
water

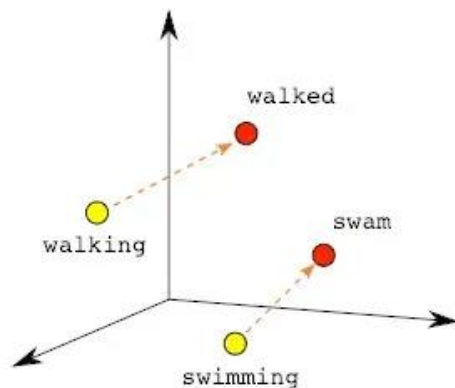


<https://jalammar.github.io/illustrated-word2vec/>

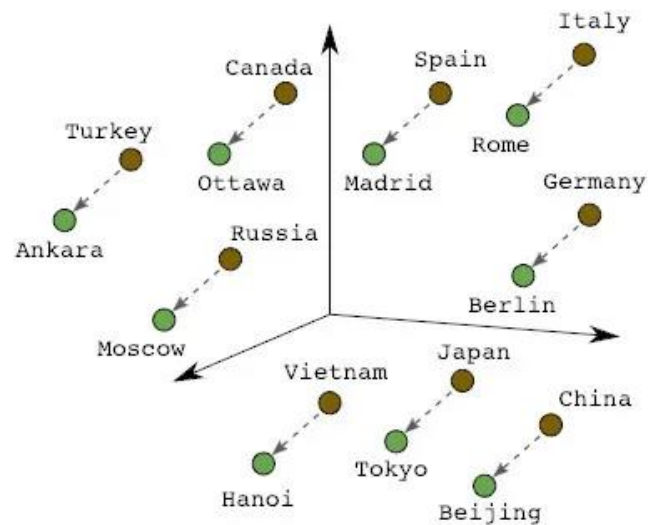
Keele mudelid - word2vec



Male-Female



Verb Tense



Country-Capital

2013, Google

Sõnal on kontekst!

palk

kõrge palk

palk kukkus varbale

paistes maks

maks

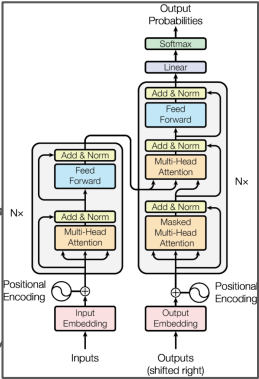
kõrgem maks

terav valu

valu

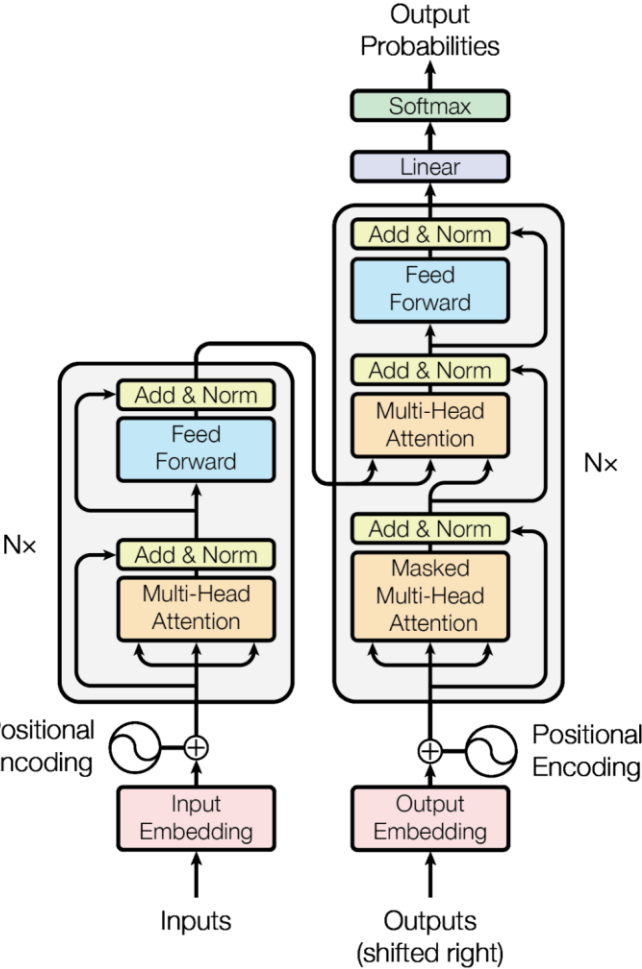
raua valu

GPT - eeltreenitud



Kui Arno isaga koolimajja jõudis, olid

???



Mis on suur keelemudel (i.k LLM)?

Statistiline mudel, mis ennustab järgmist tähte/sõnaosa

kaebused: väsimus, nõrkus, iiveldus, oks???

0.24 0.45 0.43 0.40 0.27 0.27 0.62 0.49 0.37
0.89 0.12 0.98 0.28 0.62 0.11 0.19 0.47 0.95
0.59 0.31 0.95 0.83 0.33 0.76 0.38 0.39 0.28
0.89 0.12 0.98 0.28 0.62 0.11 0.19 0.47 0.95
0.37 0.56 0.54 0.57 0.80 0.95 0.20 0.45 0.09
0.81 0.15 0.75 0.61 0.33 0.55 0.06 0.35 0.54
0.89 0.12 0.98 0.28 0.62 0.11 0.19 0.47 0.95
0.09 0.58 0.91 0.60 0.87 0.35 0.85 0.40 0.30
0.61 0.09 0.61 0.23 0.61 0.69 0.82 0.98 0.18
0.12 0.26 0.25 0.47 0.70 0.50 0.94 0.15 0.88
0.21 0.16 0.85 0.70 0.98 0.24 0.54 0.85 0.74



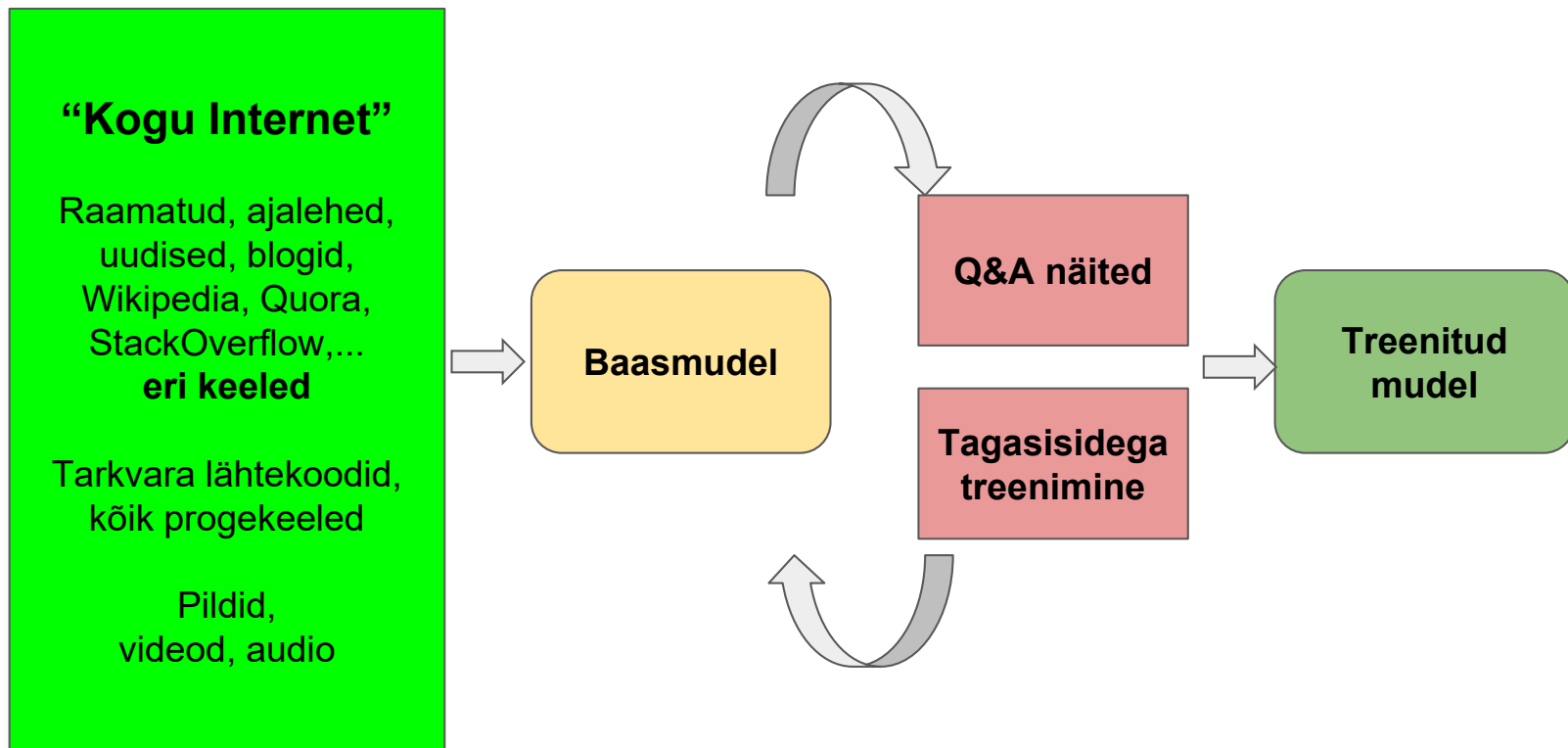
Suur keelemudel:
Funktsioon miljonite-miljardite
parameetritega

Järgmine sõnaosa	Tõenäosus
endamine	0.8
e	0.1
ja	0.02
,	0.01
...	

Treenimisel kohandatakse parameetreid nii, et mudel suudaks anda **kõrgemad tõenäosused tegelikes tekstides esinevatele järjestustele.**

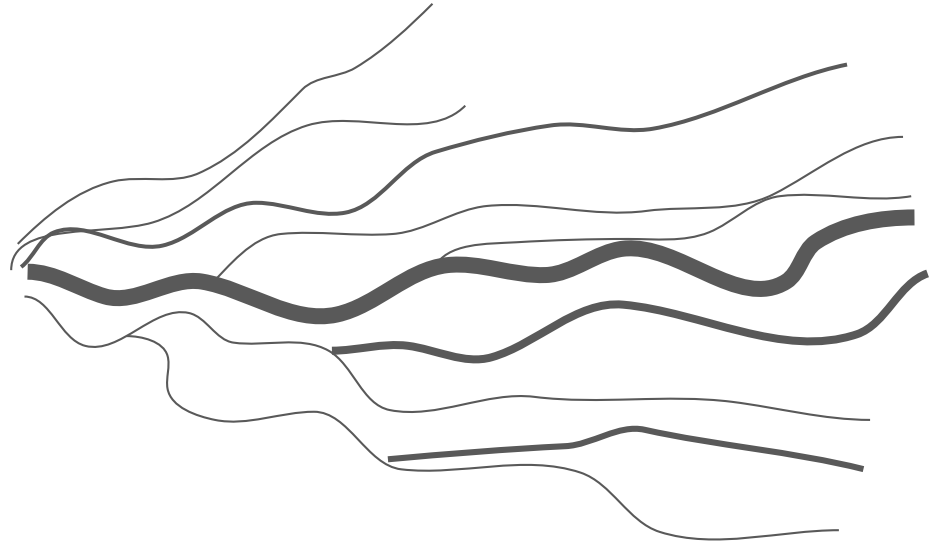
Nähes treenimisel väga palju tekste, õpib mudel üha abstraktsemaid kontseptsioone

Treenimine



**Vali juhuslikult mitu võimalikku jätku,
tõenäolisemate hulgast “õigem” vastus**

Kirjelda tehisnärvivõrku. ???



Kokkuvõte

1. Baasmudeli treenimine

Õppida keelemustreid

Suuremahuline internetitekst (nt artiklid, raamatud, foorumid)

2. Juhiste järgi häälestamine

Õpetada, kuidas reageerida kasutaja küsimustele ja juhistele

Inimeste loodud küsimus-vastus paarid

3. Inimtagasisidega tugevdamine (RLHF)

Parandada vastuste kvaliteeti, selgust ja ohutust

Inimeste hinnangud mitmele vastusevariandile

Kokkuvõte: Kuidas GPT-d koolitatakse

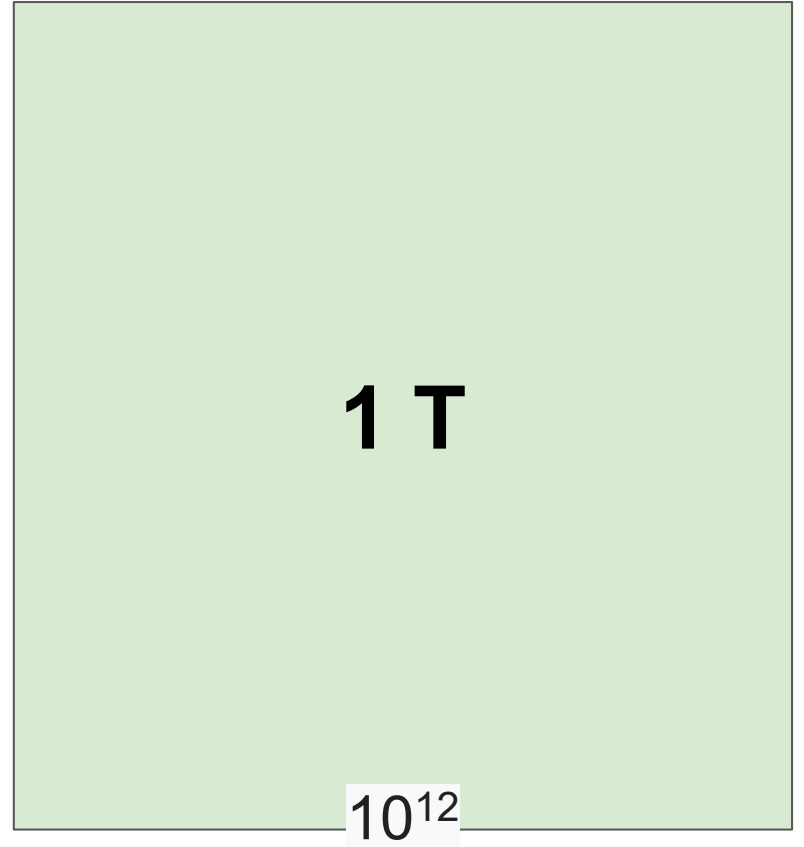
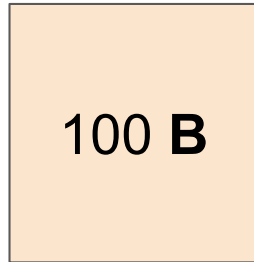
	Eesmärk	Andmeallikas
1. Baasmudeli treenimine	Õppida keelemustreit	Suuremahuline internetitekst (nt artiklid, raamatud, foorumid)
2. Juhiste järgi häälestamine	Õpetada, kuidas reageerida kasutaja küsimustele ja juhistele	Inimeste loodud küsimus-vastus paarid
3. Inimtagasisidega tugevdamine (RLHF)	Parandada vastuste kvaliteeti, selgust ja ohutust	Inimeste hinnangud mitmele vastusevariandile

Kokkuvõte: Kuidas GPT-d koolitatakse

Etapp	Eesmärk	Andmeallikas
1. Baasmudeli treenimine	Õppida keelemustreid	Suuremahuline internetitekst (nt artiklid, raamatud, foorumid)
2. Juhiste järgi häälestamine	Õpetada, kuidas reageerida kasutaja küsimustele ja juhistele	Inimeste loodud küsimus-vastus paarid
3. Inimtagasisidega tugevdamine (RLHF)	Parandada vastuste kvaliteeti, selgust ja ohutust	Inimeste hinnangud mitmele vastusevariandile

Suurem mudel on parem?

■
1 miljard



Mudeli suurus

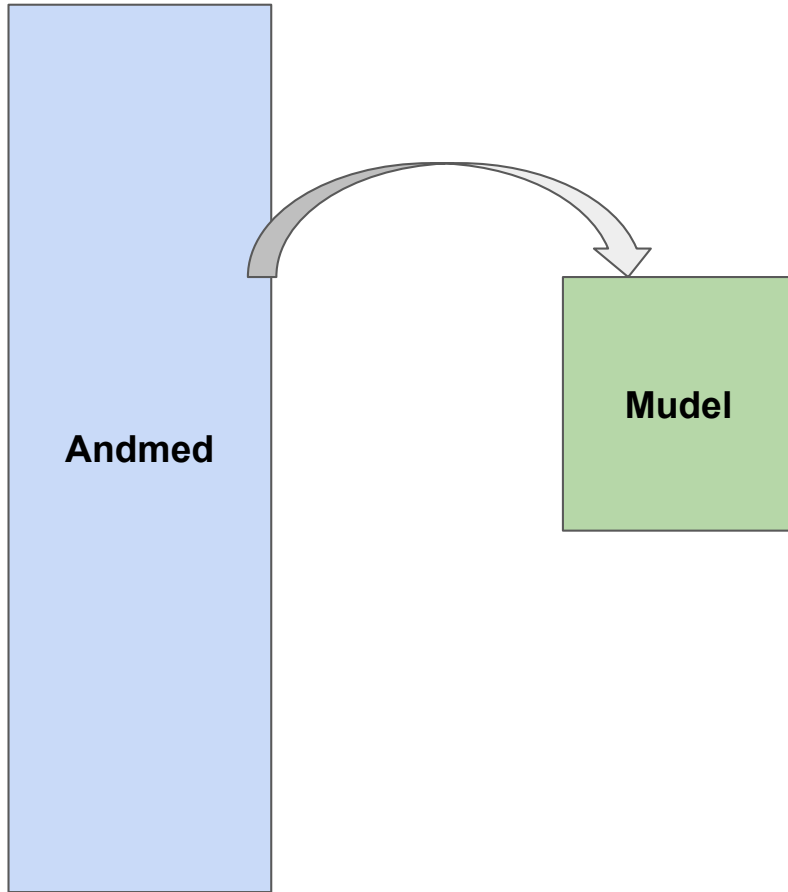
Parameetrite arv

Hõredus - kui palju parameetreid nullid, saab neid ignoreerida

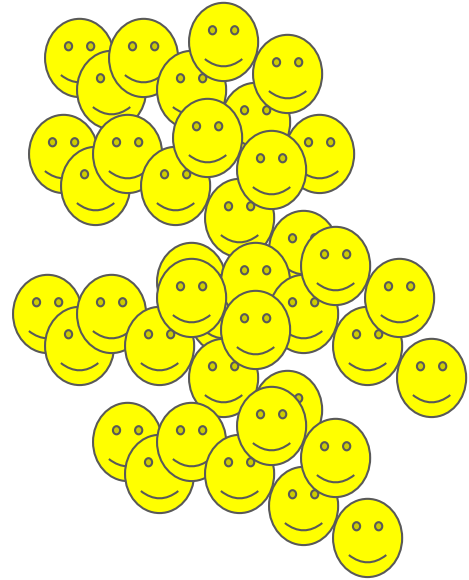
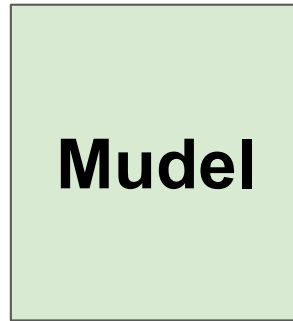
Reaalarvu täpsus: 64, 32, 16, 8, 4 bitti

Väga suure mudeli kasutamine väiksema häälestamiseks (andmed)

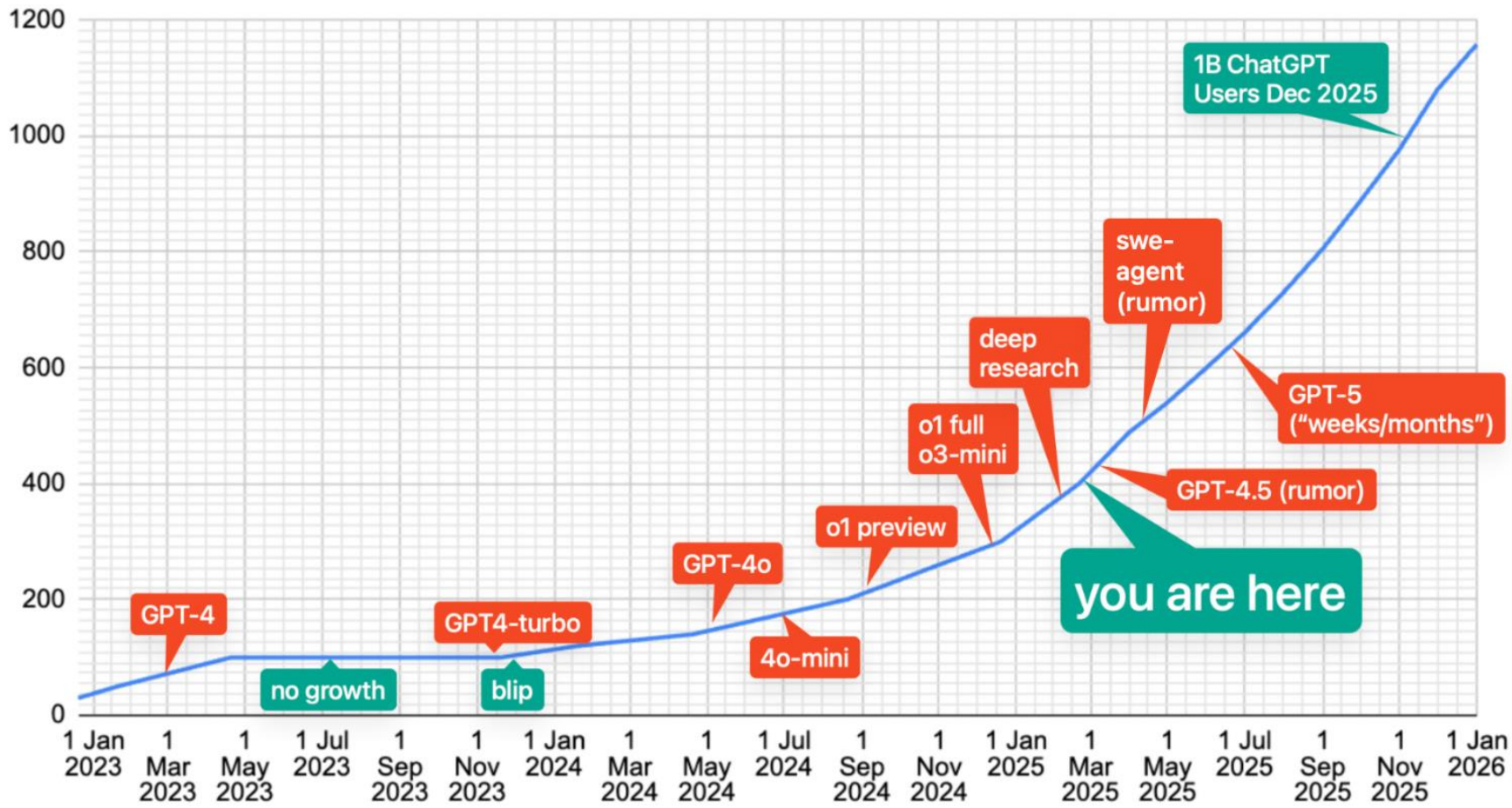
Mudel vajab palju andmeid, **treenimine on väga kulukas**



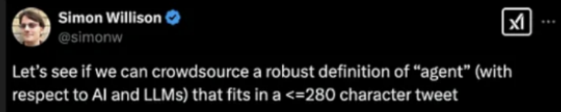
Kasutamine on kulukam(?): arvutid, rakendused/kasutajad



ChatGPT's Path to 1B Weekly Active Users



First thing in discussing agents, we have to do the simple task of **defining agents**.



Encoded Intent

"An agent is a system that can pursue a goal-oriented behavior, adapt along the way to achieve its goals."

Long-Running Memory

"An AI system that's capable of carrying out and completing long running, open ended tasks in the real world." - @Dan_Jeffries1

Multi-Step Planning

"An AI system component that performs non-trivial, multi-step operations that previously would have required a human." - @DanielMiessler

Delegated Authority

"a system that is trusted to make impactful decisions on behalf of me"

LLM Control Flow

"The more agentic an application is, the more an LLM decides the control flow of the application" - @hwchase17

Tool-using LLMs

"agent = llm + memory + planning + tools + while loop" - swyx

Metaphors

"control system for future states" - @plinz

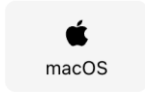
Reductiveness

"LLM calls in a for loop"

Specific Examples

Code Interpreter
Deep Research
Operator

Download Ollama



Linux



Windows

Download for macOS

Requires macOS 11 Big Sur or later

2. ollama run gemma3:27b

3. >>> mida rääkida AI-st ehitusinseneridele?

```
$ ollama run gemma3:27b
pulling manifest
pulling e796792eba26... 100%
pulling e9a42594d892... 100%
pulling d6094c7972a3... 100%
pulling 3116c5225075... 100%
pulling f838f848d368... 100%
verifying sha256 digest
writing manifest
success
>>> mida rääkida AI-st ehitusinseneridele?
AI-st ehitusinseneridele rääkimine on tohutu teema, sest võimalused on palju. Siin on mõned punktid, mida võiks käsitleda, jaotatuna teemade kaupa. Proovin ka anda näiteid ja mõtlema, mis on ehitusinseneride jaoks kõige olulisem.

**1. AI põhitõed ja kontseptsioonid (lühike osa)**

* **Mis on AI?** Selgitage, et AI on laialdane mõiste, mis hõlmab masinõpet, süvaõpet, loodusliku keele töötlemist (NLP) jne.
* **Masinõpe (ML):** Selgitage, et ML võimaldab arvutitel õppida andmetest ilma selgesõnulise programmeerimiseta. Näiteks: Andmete põhjal prognoosida ehitusprojekteid kulu.
* **Süvaõpe (DL):** ML alaliik, mis kasutab kunstlikke närvivõrke keerukamate mudeliteid õppimiseks.
* **AI tüübid:**
  * **Reaktiivsed masinad:** Põhinevad lihtsalt praegusel olukorral (nt lihtsad robotid). Ei ole ehitusinsenerile nii oluline.
  * **Piiratud mälu masinad:** Saavad eelmise sündmuste põhjal otsuseid teha (nt hoone energiasüsteem).
  * **Teooria ja eneseteadvusega masinad:** Praegu veel teoreetilised.

**2. AI rakendused ehitusinseneris (peamine osa)**

See on koht, kus peate keskenduma konkreetsetele näitele.

* **Projekti planeerimine ja eelarvestamine:**
  * **Kuluprognosimine:** ML-algoritmid saavad analüüsida ajaloolisi projektikuluseid, materjalihindu, tööpäevakuluseid ja muid tegureid, et täpsemalt prognoosida uute projektide kulu.
  * **Ajagraafiku optimeerimine:** AI võib aidata leida optimaalse ajakava projekti lõpetamiseks, arvestades ressursse, sõltuvusi ja riske.
  * **Hussurside juhtimine:** AI võib aidata jaotada ressursse (inimressursid, materjalid, seadmed) tõhusalt.
* **Kujundus ja projekteerimine:**
  * **Generatiivne kujundus (Generative Design):** AI genereerib mitmeid disainilahendusi, mis vastavad määratud kriteeriumidele (nt maksimaalne tugevus, minimaalne kaal, madalad kulud). Insener saab seejärel valida parima lahenduse. Näide: Optimaalne teraskonstruktsiooni kuju leidmine.
  * **BIM (Building Information Modeling) automatiseerimine:** AI võib aidata automatiseerida BIM-mudelite loomist ja haldamist.
* **Struktuurianalüüs:** AI võib aidata kiiremini ja täpsemalt analüüsida struktuuride tugevust ja stabiilsust.
* **Ehitusplatsi juhtimine:**
  * **Progress Monitoring (Ehituse jälgimine):** Droonid ja kaamerad koguvad andmeid ehitusplatsilt, misjärel AI analüüsib pilte ja videoid, et jälgida ehituse edenemist.
  * **Ohtude tagamine:** AI-põhised süsteemid võivad tuvastada ohtusriske ehitusplatsil (nt töötaja ilma turvavarustuse, takistused).
  * **Kvaliteedikontroll:** AI võib analüüsida fotosid ja videoid, et tuvastada ehitusvigu ja puudusi.
  * **Seadmete jälgimine ja hooldamine:** IoT-andurid ja AI võivad jälgida ehitusseadmete seisundit ja prognoosida hooldusvajadust.
* **Hoone kasutamine ja hooldus:**
  * **Energiaefektiivsus:** AI võib analüüsida andmeid hoone energiasüsteemidest, et optimeerida energiatarbimist.
  * **Ennustav hooldus:** AI võib prognoosida hoone komponentide rikkeid ja planeerida hooldust ette.
  * **Hoone haldamine:** AI-põhised süsteemid võivad automatiseerida hoone haldamist, nagu valgustus, ventilatsioon ja turvalisus.
  * **Digitaalsed kaksikud (Digital Twins):** Hoone virtuaalne mudel, mida AI pidevalt värskendab realse maailma andmetega.

**3. Vahendid ja tehnoloogiad**

* **Pilvteenused:** AWS, Azure, Google Cloud pakuvad AI/ML teenuseid.
* **ML raamistikud:** TensorFlow, PyTorch, scikit-learn.
* **BIM tarkvara:** Autodesk Revit, Bentley AECOsim.
* **Robotika ja automatiseerimine.**

**4. Väljakutsed ja kaalutlused**

* **Andmete kvaliteet ja kättesaadavus:** AI nõuab palju kvaliteetset andmestikku.
* **Kulud:** AI-põhiste lahenduste juurutamine võib olla kallid.
* **Muutuste vastuvõtlikkus:** Insenerid peavad olema valmis õppima uusi tehnoloogiasid ja muutama oma töömeetodeid.
* **Eetilised kaalutlused:** Näiteks, AI-põhiste süsteemide poolt tehtud otsuste vastutus.
* **Töökohtade mõju:** AI võib automatiseerida mõningaid ülesandeid, mis võivad mõjutada töökohtade arvu.

**Kuidas see kõik edasi anda?

* **Konkreetsed näited:** Kasutage näiteid, mis on ehitusinseneridele tuttavad.
* **Visuaalne esitus:** Kasutage pilte, videoid ja graafikuid.
* **Interaktiivne seans:** Julgustage küsima küsimusi ja arutama teemasid.
* **Pilotprojektid:** Soovitage väikesed pilotprojektid, et katsetada AI-põhiseid lahendusi.

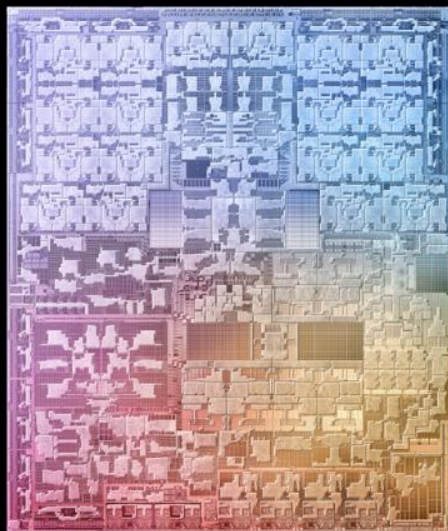
Loodan, et see annab teile hea aluse, et rääkida AI-st ehitusinseneridele. Olge paindlik ja kohandage oma esitust vastavalt publiku vajadustele ja huvidele.

>>> Mooda message (/? far.hel)
```

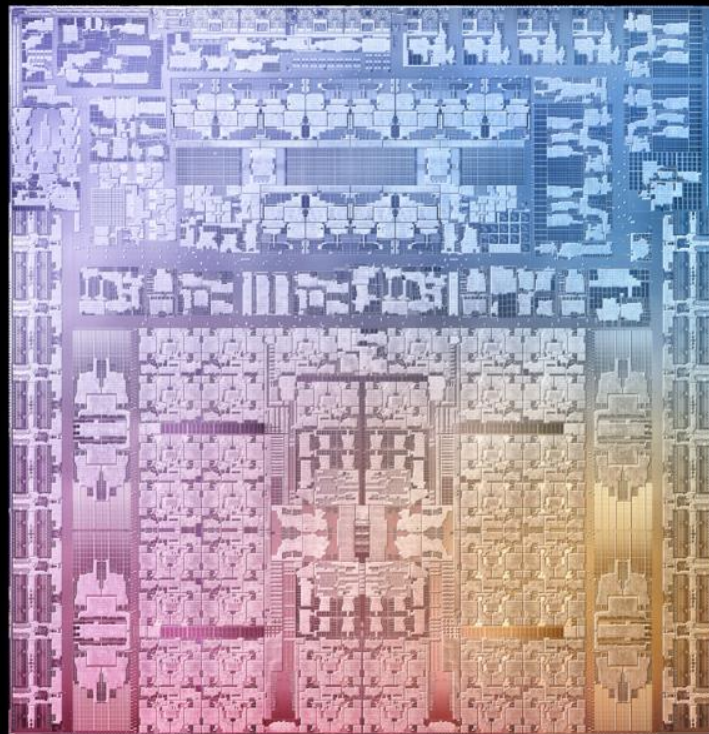
M3 Max pushes the transistor count up to **92 billion** and takes pro performance to the next level. The 40-core GPU is up to 50 percent faster than M1 Max, and support for up to 128GB of unified memory allows AI developers to work with even larger transformer models with billions of parameters. Oct 30, 2023



Apple M3

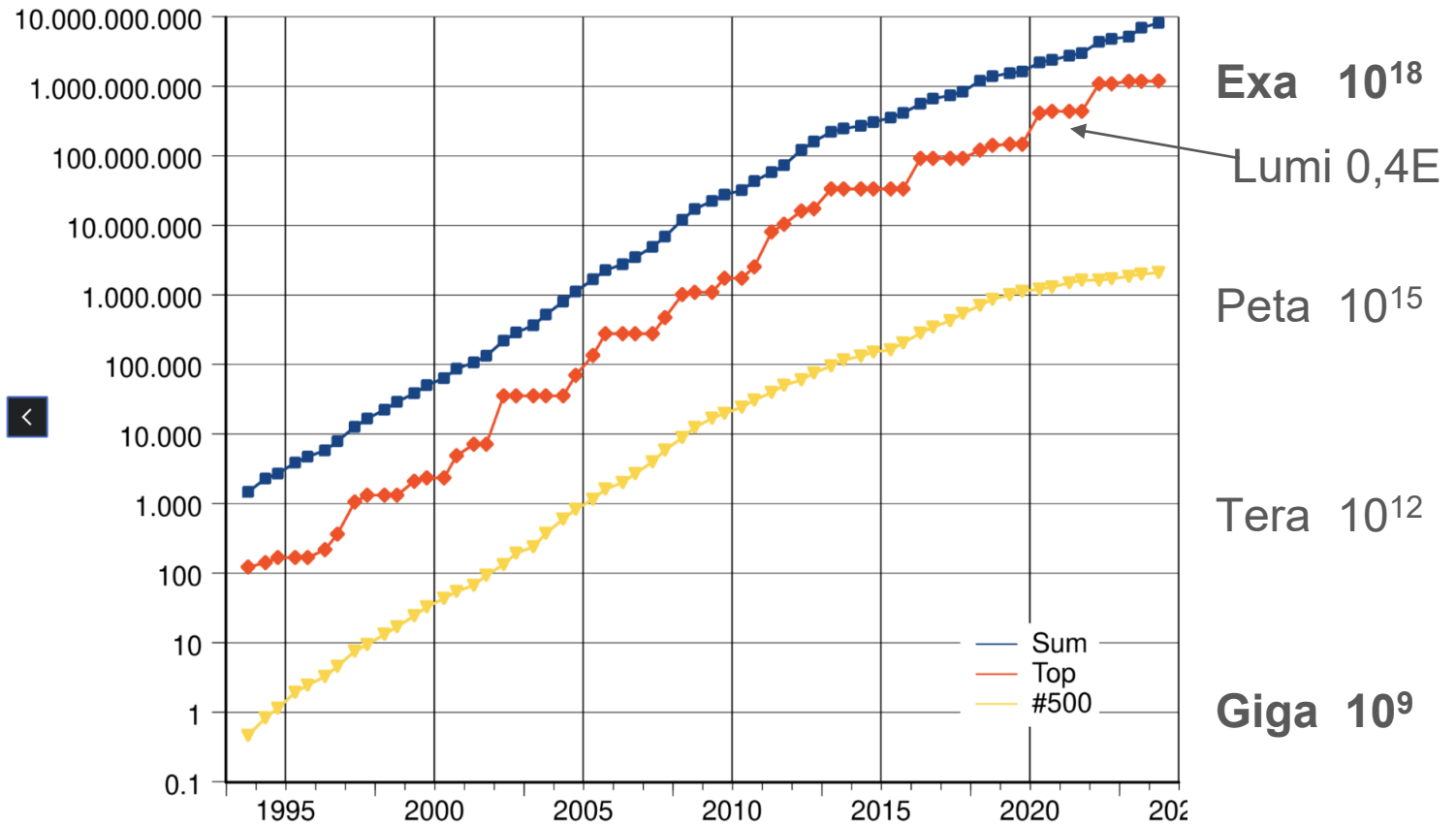


Apple M3 Pro



Apple M3 Max





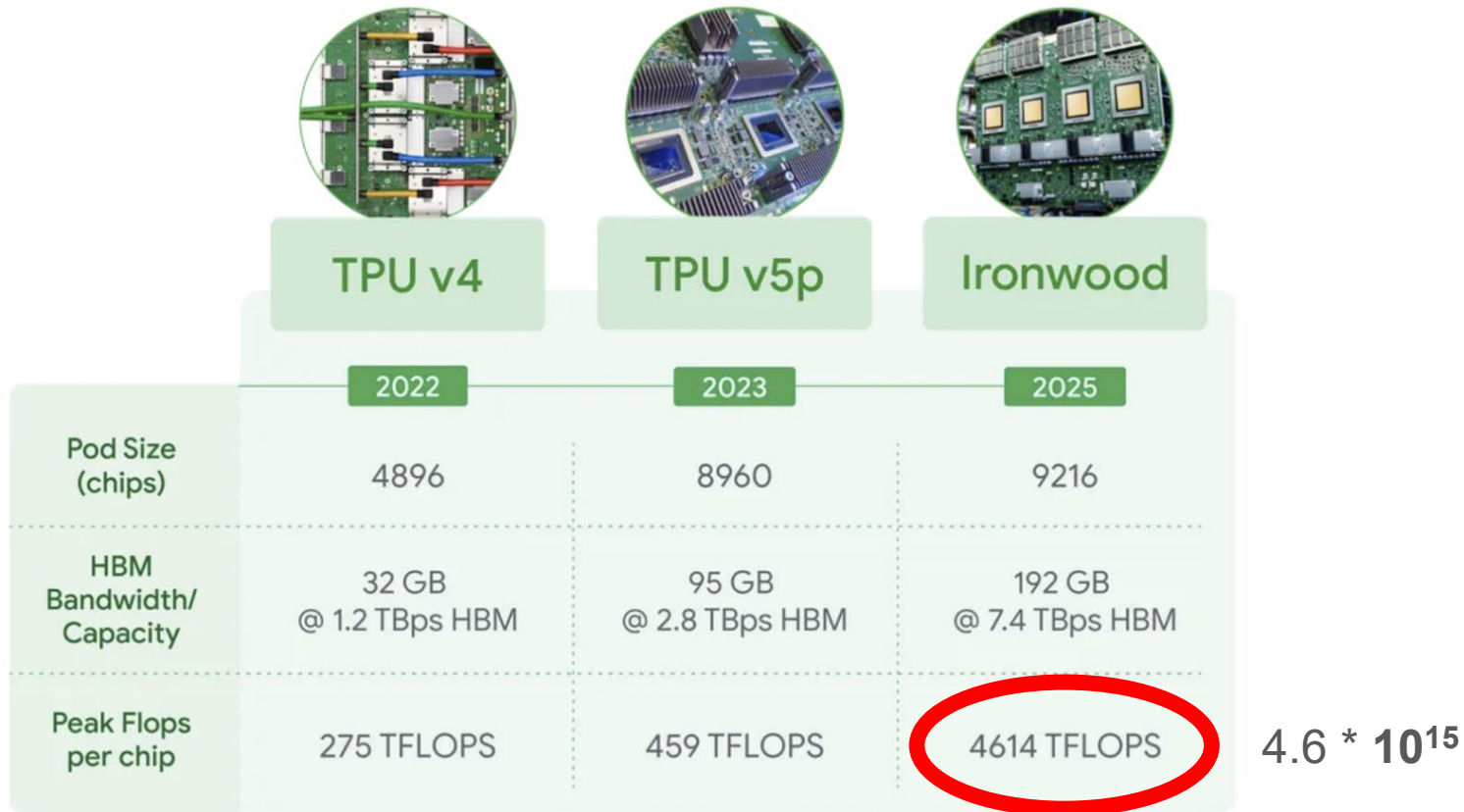
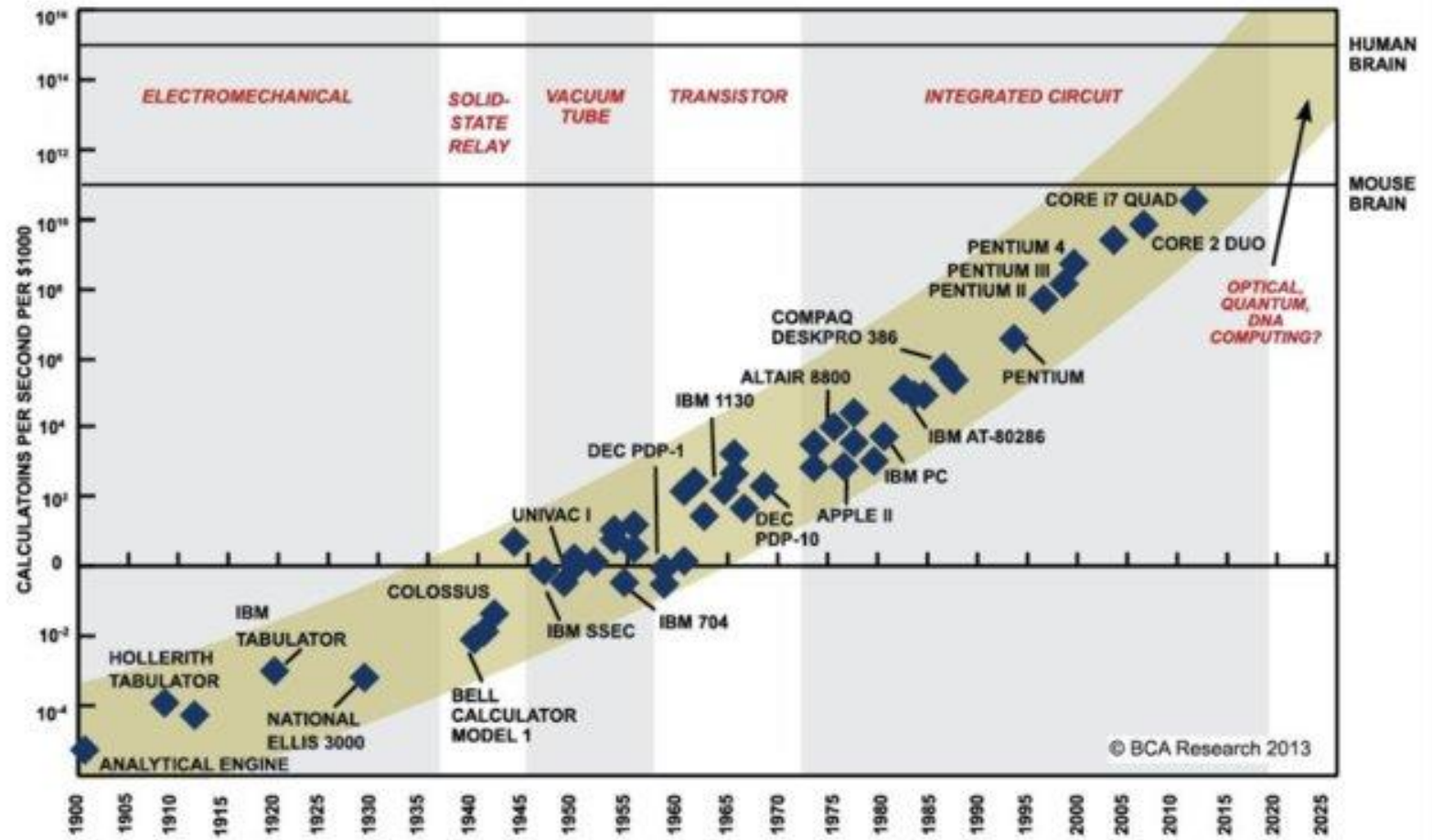


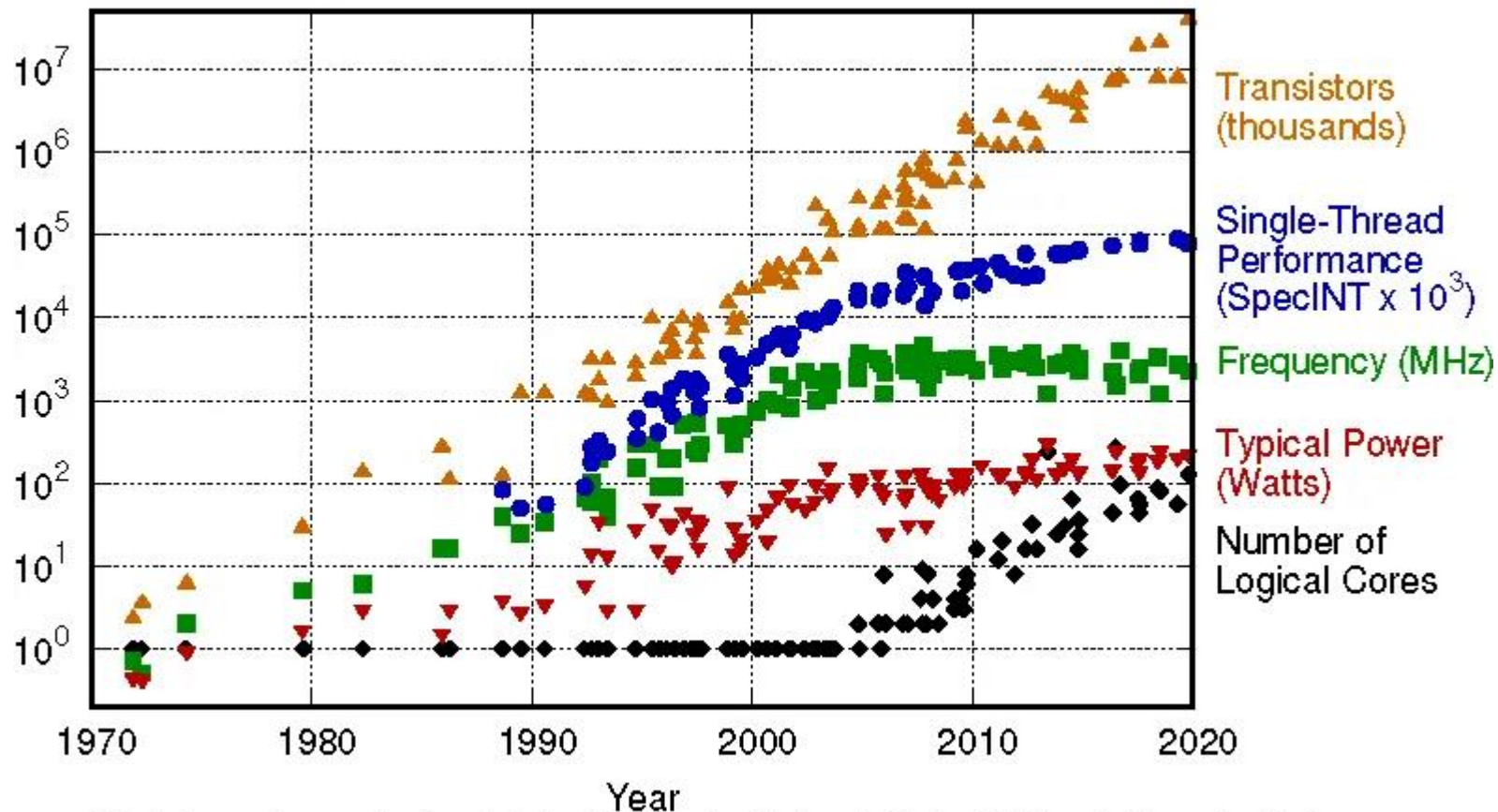
Figure 2. Side by side comparison of technical specifications of the 3D torus version of Cloud TPU products including the latest generation Ironwood. FP8 peak TFlops emulated for v4 and v5p, but natively supported for Ironwood.

10¹⁵



SOURCE: RAY KURZWEIL, "THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCEND BIOLOGY", P.67, THE VIKING PRESS, 2006. DATAPOINTS BETWEEN 2000 AND 2012 REPRESENT BCA ESTIMATES.

48 Years of Microprocessor Trend Data



Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten
New plot and data collected for 2010-2019 by K. Rupp



Raspberry Pi **Compute Module 5**

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Compute Module 5 is a powerful and scalable system on module with a 64-bit Arm processor @ 2.4GHz, an I/O controller, video and PCIe interfaces, and a range of wireless, SDRAM and eMMC options.

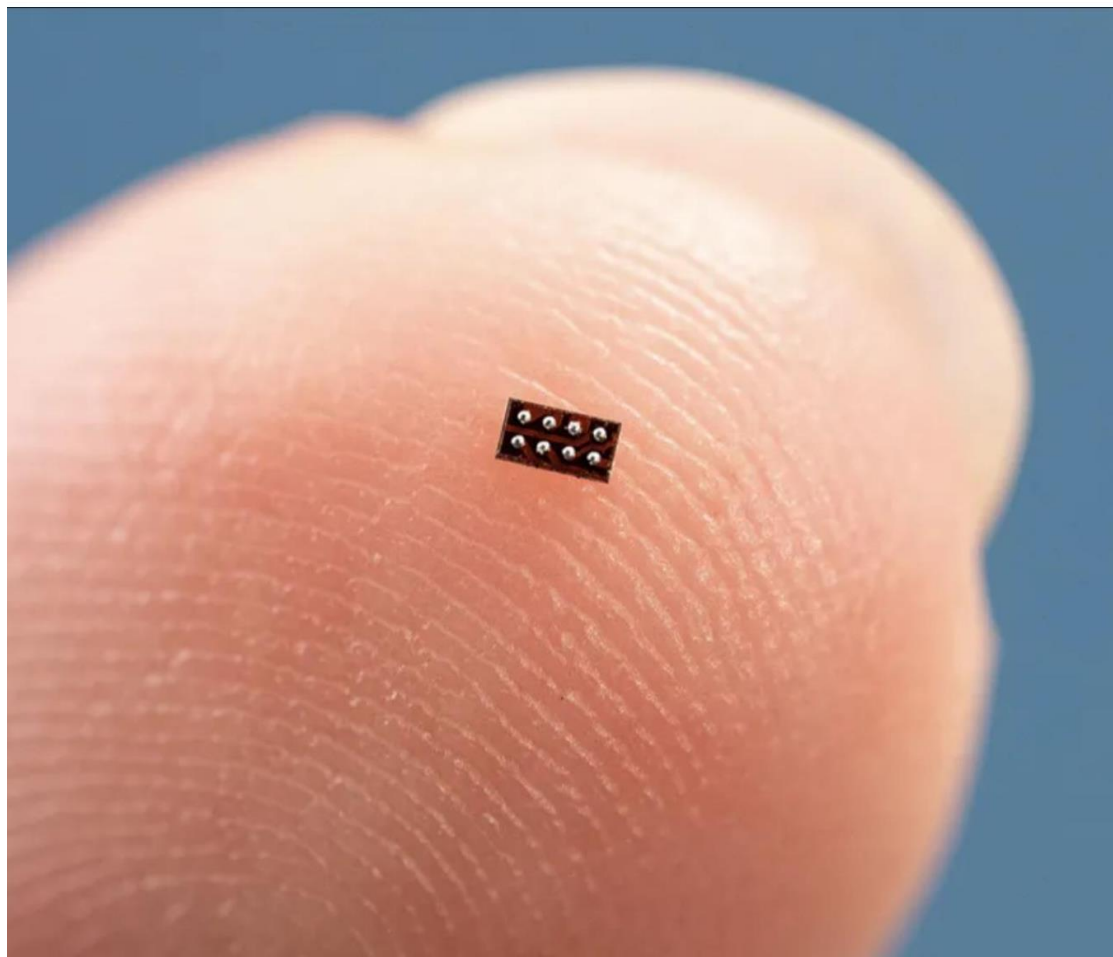
Wireless Bluetooth and Wi-Fi®

SDRAM 2GB, 4GB, 8GB, or 16GB

eMMC 0GB, 16GB, 32GB, or 64GB

Texas Instruments unveiled the world's smallest microcontroller.

It has a fully functional Arm 32-bit Cortex-M0+ CPU core running at a towering 24 MHz. It also has 16 KB of flash memory and 1 KB of SRAM.



Kulu Eesti kontekstis?

Andmed - suures koguses (kvaliteetseid) andmeid

1-2 M eur / aastas

Arvutid - treenimine, **kasutamine**

5-10M eur / aastas

Inimesed - kasutamine, uued rakendused, juurutus/haldus, edasiarendus

Z*100

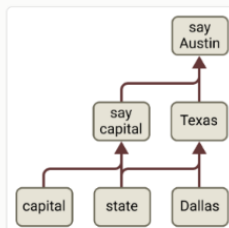
X*10,000

100-200

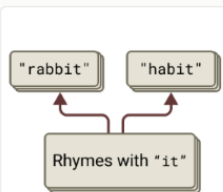
Y*100

On the Biology of a Large Language Model

We investigate the internal mechanisms used by Claude 3.5 Haiku — Anthropic's lightweight production model — in a variety of contexts, using our circuit tracing methodology.



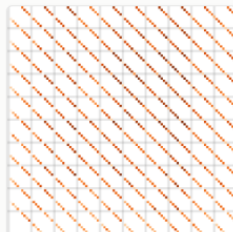
Introductory Example:
Multi-step Reasoning



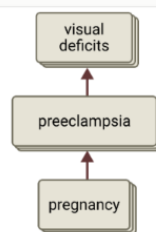
Planning in Poems



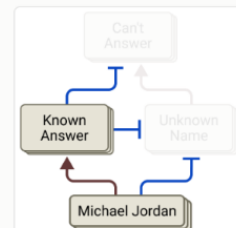
Multilingual Circuits



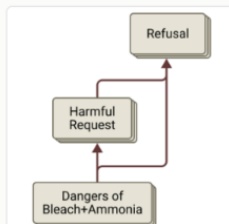
Addition



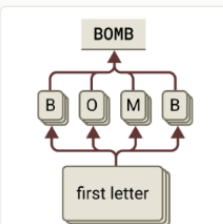
Medical Diagnoses



Entity Recognition and
Hallucinations



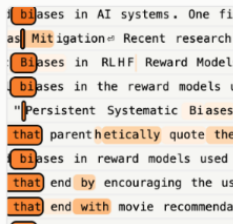
Refusals



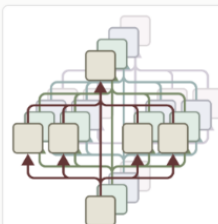
Life of a Jailbreak



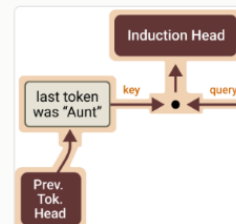
Chain-of-thought
Faithfulness



Uncovering Hidden
Goals in a Misaligned
Model



Commonly Observed
Circuit Components
and Structure



Limitations

THE NOBEL PRIZE IN PHYSICS 2024

Illustrations: Niklas Elmehed



John J. Hopfield

Geoffrey E. Hinton

"for foundational discoveries and inventions
that enable machine learning
with artificial neural networks"

THE ROYAL SWEDISH ACADEMY OF SCIENCES

THE NOBEL PRIZE IN CHEMISTRY 2024



Illustrations: Niklas Elmehed

David
Baker

“for computational
protein design”

Demis
Hassabis

“for protein structure prediction”

John M.
Jumper

Suured küsimused

Kas mudelid saavad **seniste andmete** pealt järjest võimekamateks?

- Kuidas muuta mudelid pidevalt arenevaks?

Mis juhtub töö(kohtade)ga, näiteks disainerid, programmeerijad, tõlgid, ...

Mis juhtub õppimisega kui assistent “teab vastuseid”?



UNIVERSITY OF TARTU
Institute of Computer Science

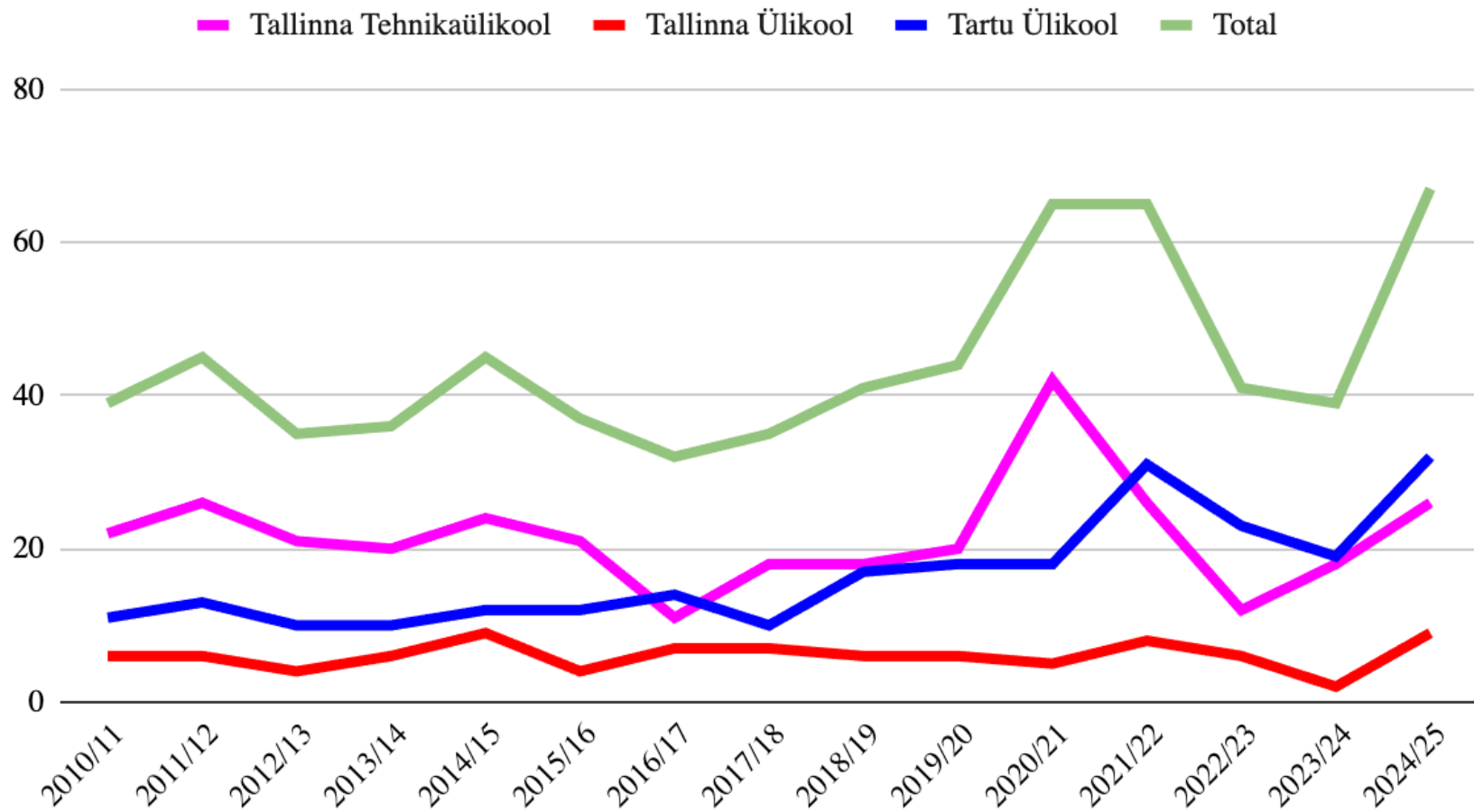
Tänan!

cs.ut.ee

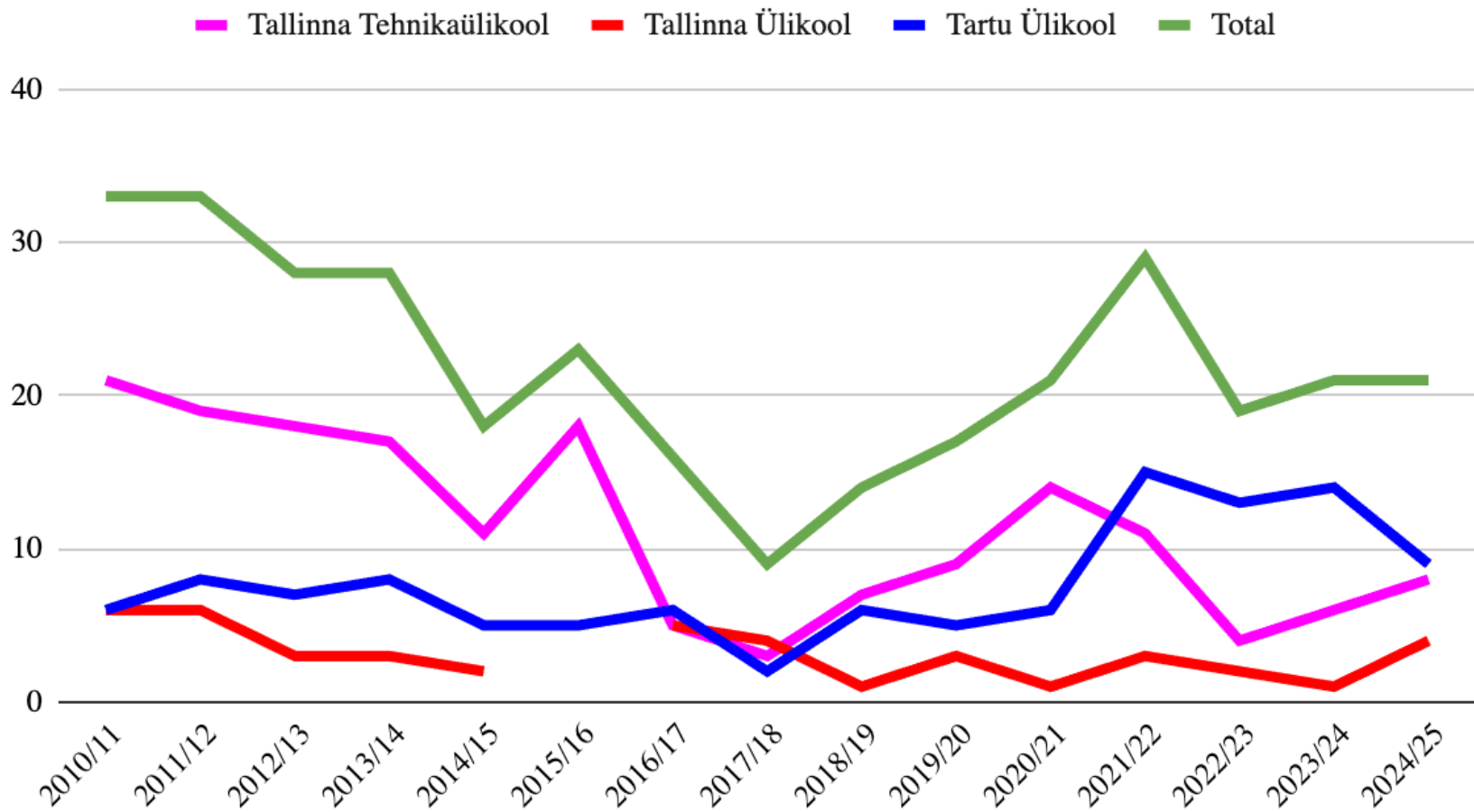
vilo@ut.ee



PhD IKT vastuvõtt, kõik koos



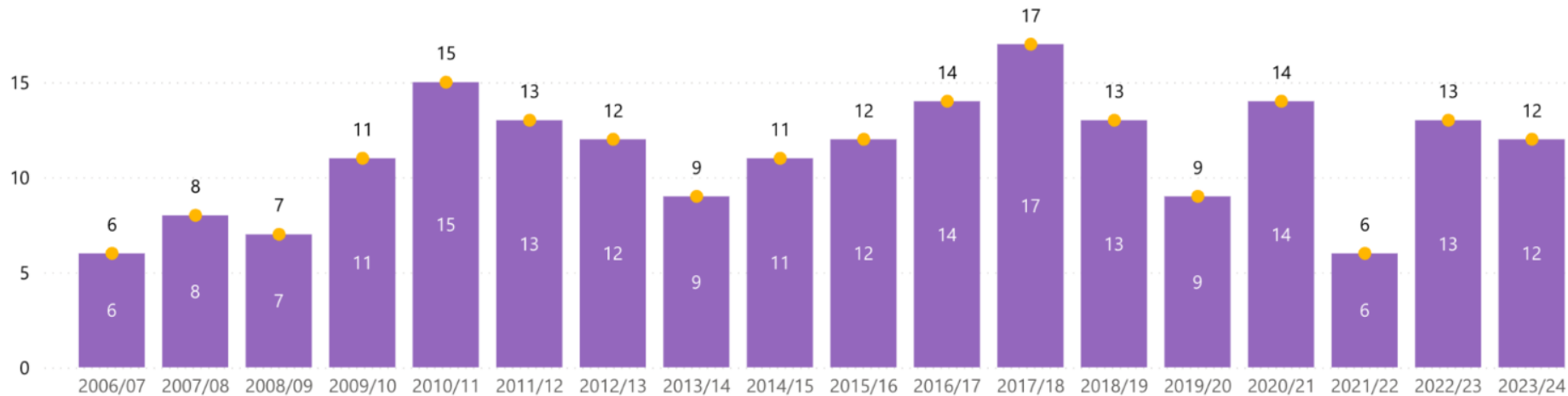
Eesti IKT PhD vastuvõtud - Eesti kodanikud



PhD lõpetamine IKT valdkonnas, Eesti kodanikud

Lõpetajate arv õppevaldkondade lõikes

% 123



● IKT ● lõpetajate arv kokku

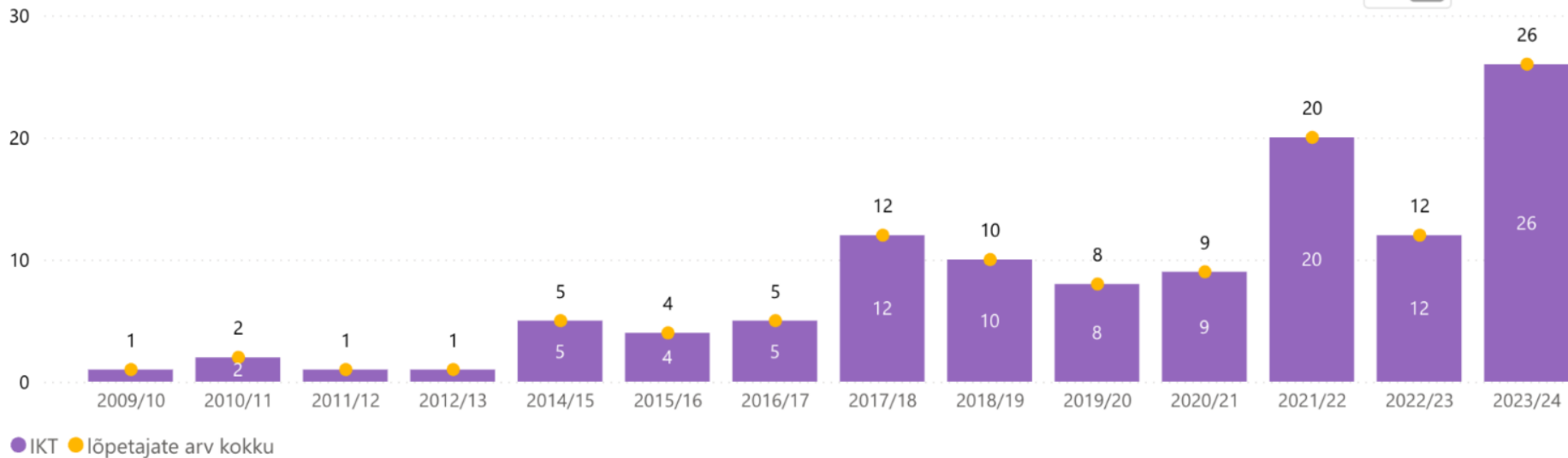
Lõpetajad õppeasutuste lõikes

Õppeasutus	5/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Tallinna Tehnikaülikool	10	7	12	8	7	8	2	8	6
Tallinna Ülikool		1	3				2	3	
Tartu Ülikool	2	6	2	5	2	6	2	2	6

PhD lõpetamine IKT valdkonnas, väliskodanikud

Lõpetajate arv õppevaldkondade lõikes

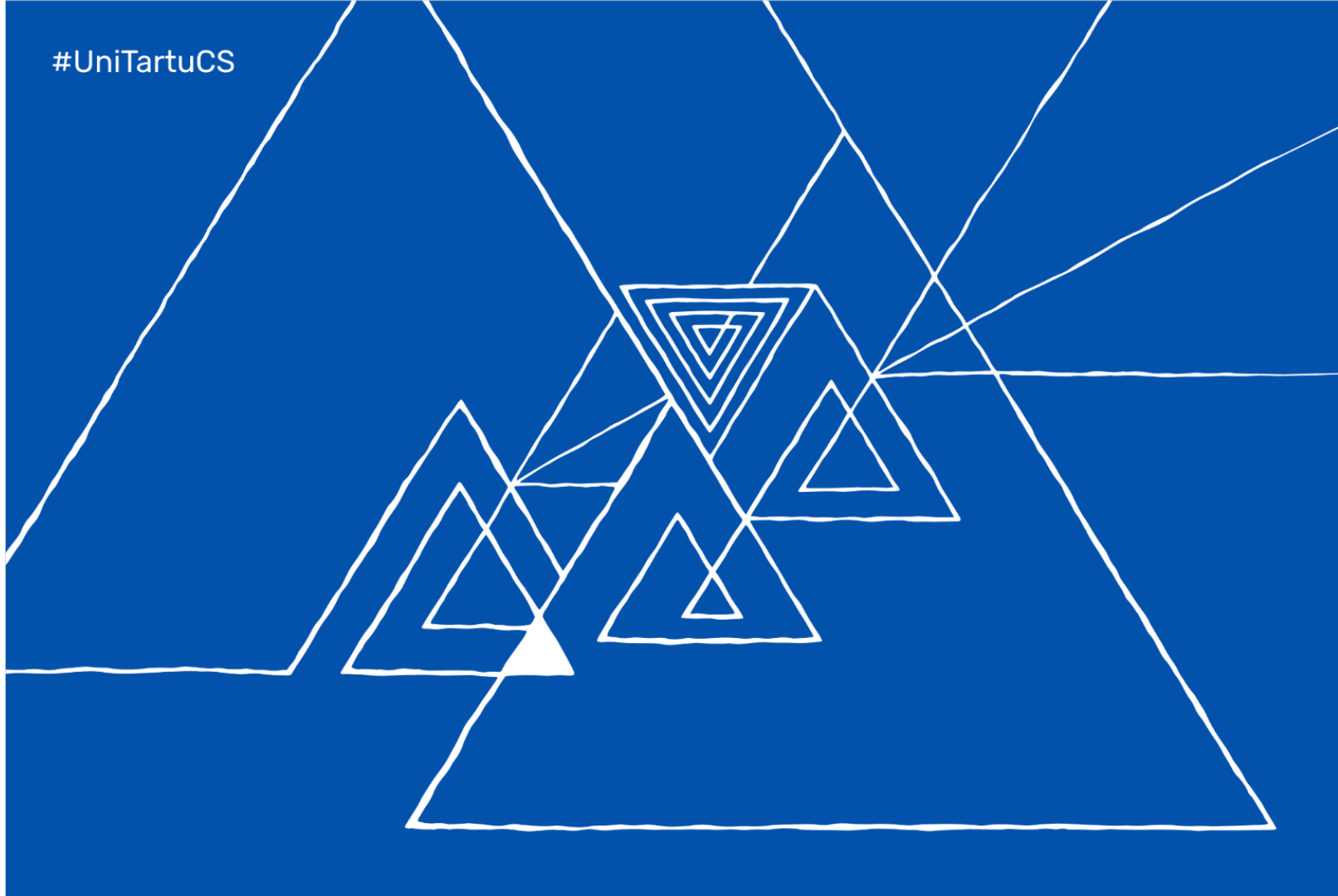
% 123



Lõpetajad õppeasutuste lõikes

Õppeasutus	5/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Tallinna Tehnikaülikool	3	3	5	4	1	5	13	5	19
Tallinna Ülikool			6		2	1	2	2	1
Tartu Ülikool	1	2	1	6	5	3	5	5	6

#UniTartuCS



Velvet
Kärt
Jaak
Maria