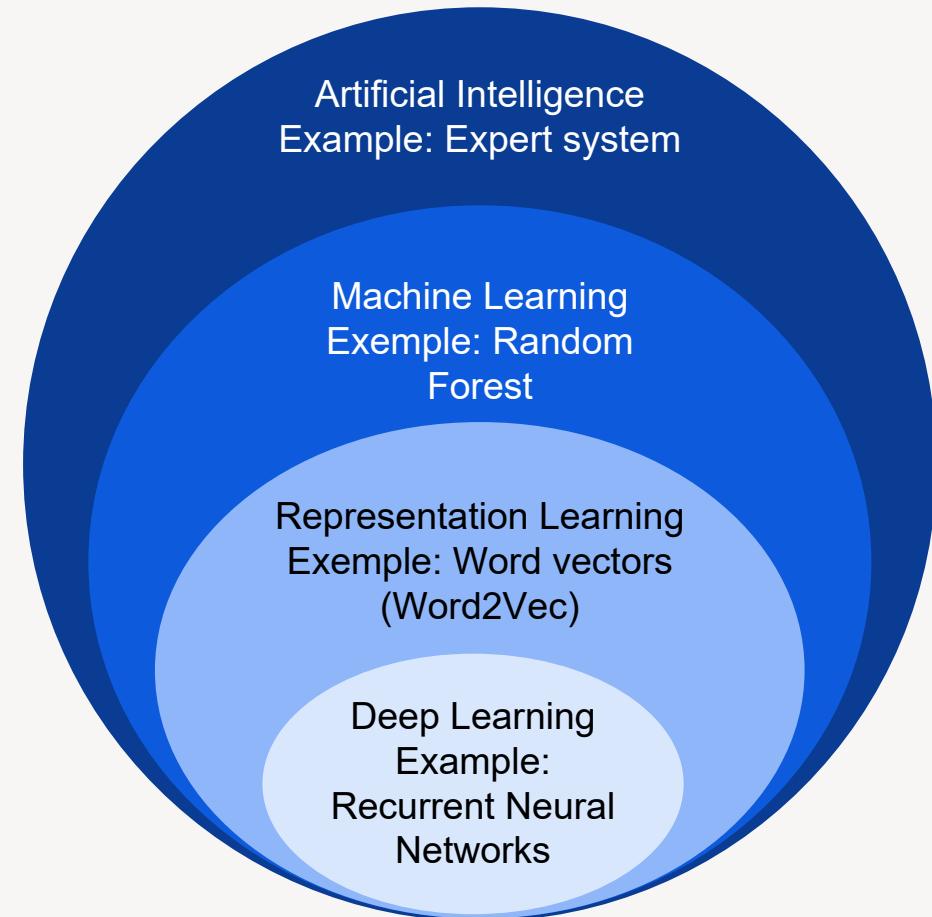


Image-generative AI

Erik Ylipää

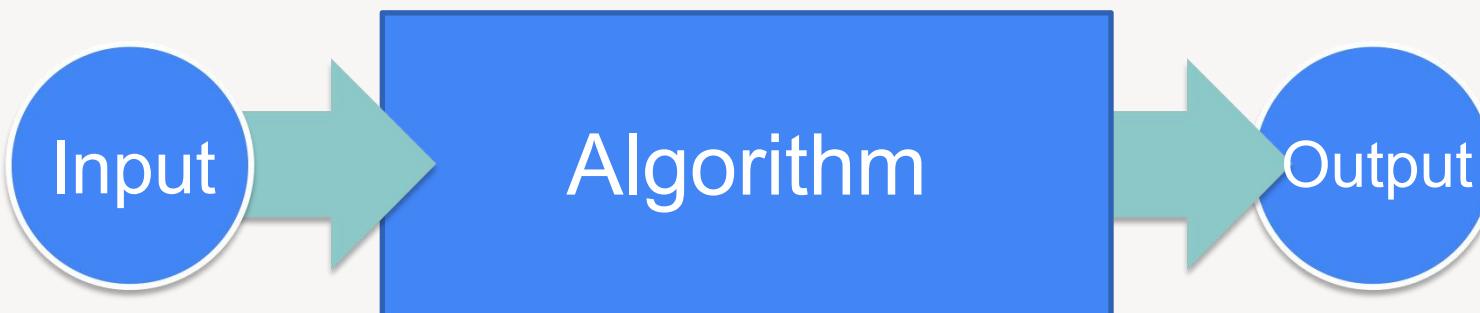
Artificial Intelligence (AI)

- AI studies machines which can solve problems which humans solve using intelligence (whatever that is)
- Not primarily about machines that learn and think like humans
- AI we hear about today is most often based on ***machine learning***



Bengio, Yoshua, Ian Goodfellow, and Aaron Courville. Deep learning. Vol. 1. MIT press, 2017.
<https://www.deeplearningbook.org/>

AI-systems are algorithmic problem solvers



$$\begin{array}{r} 0 \\ 7 \overline{)452} \\ -45 \\ \hline 2 \end{array}$$
$$\begin{array}{r} 06 \\ 7 \overline{)452} \\ -45 \\ \hline 32 \end{array}$$
$$\begin{array}{r} 064 \\ 7 \overline{)452} \\ -45 \\ \hline 32 \\ -32 \\ \hline 4 \end{array}$$

64 r4

Step 1: "How many times?"

Step 2: "Multiply"

Step 3: "Subtract"

Step 4: "Drop it down"

(repeat steps for each number, left to right)

Learning algorithms



Rule based algorithm

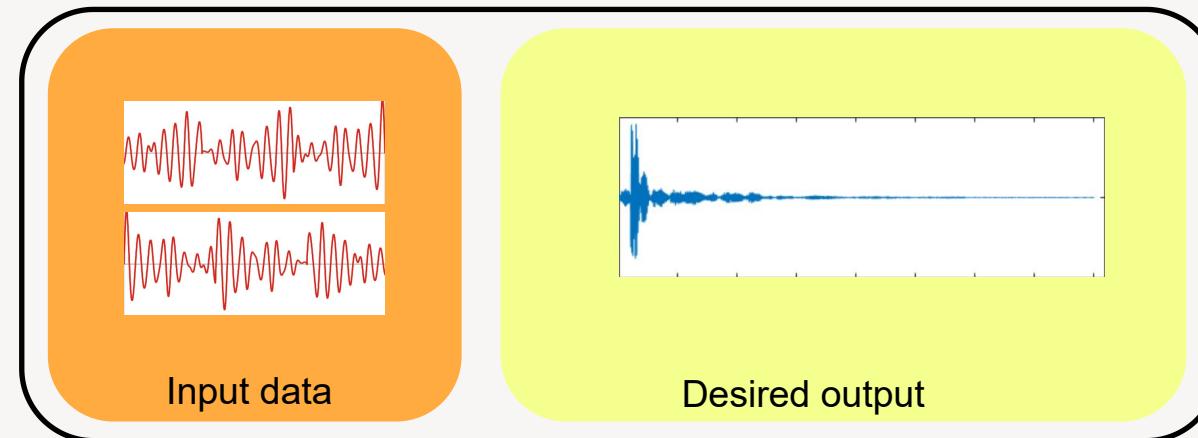
```
def fibonacci(n):
    terms = [0,1]
    i = 2
    while i<=n:
        terms.append(terms[i-1]+terms[i-2])
        i = i + 1
    return terms[n]
```

Learning algorithm



Ingredients of learning algorithms

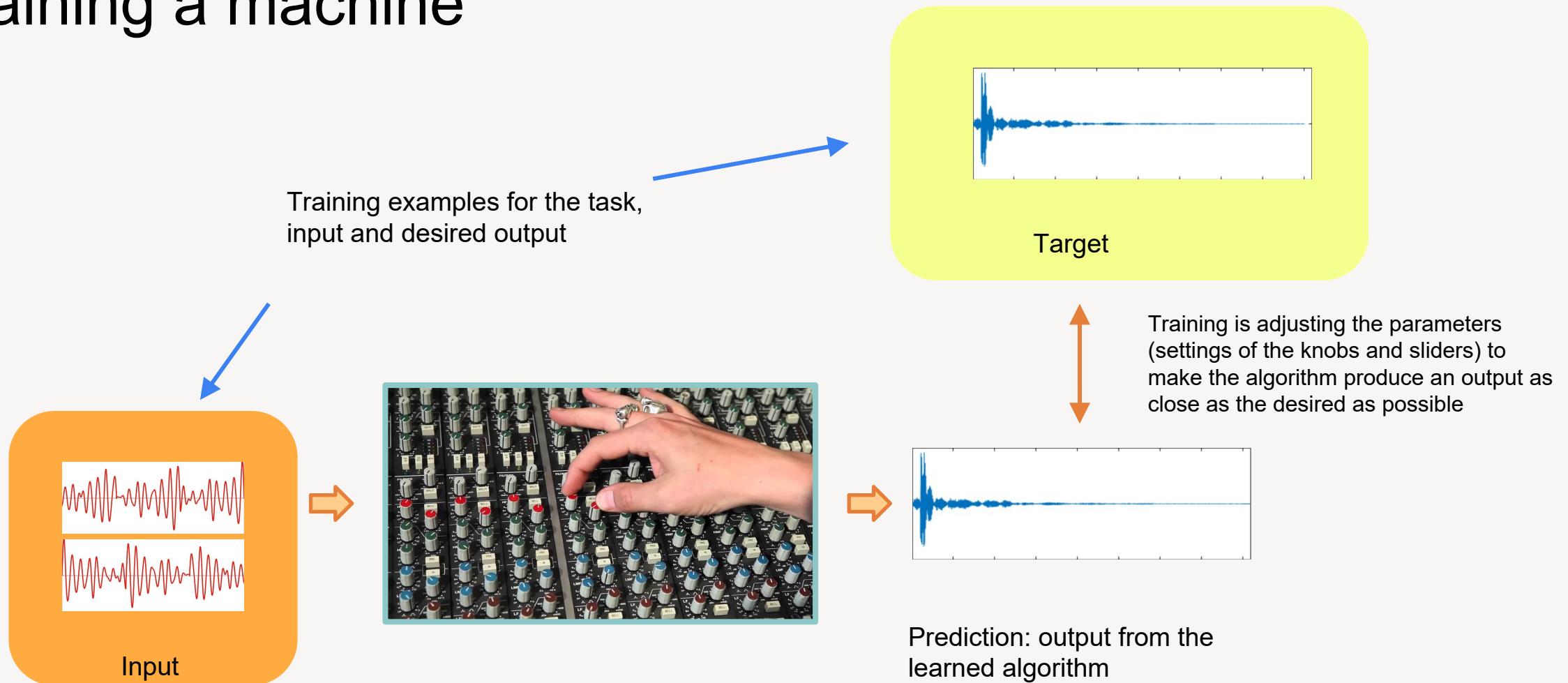
Data pair for training



Modell med fria parametrar

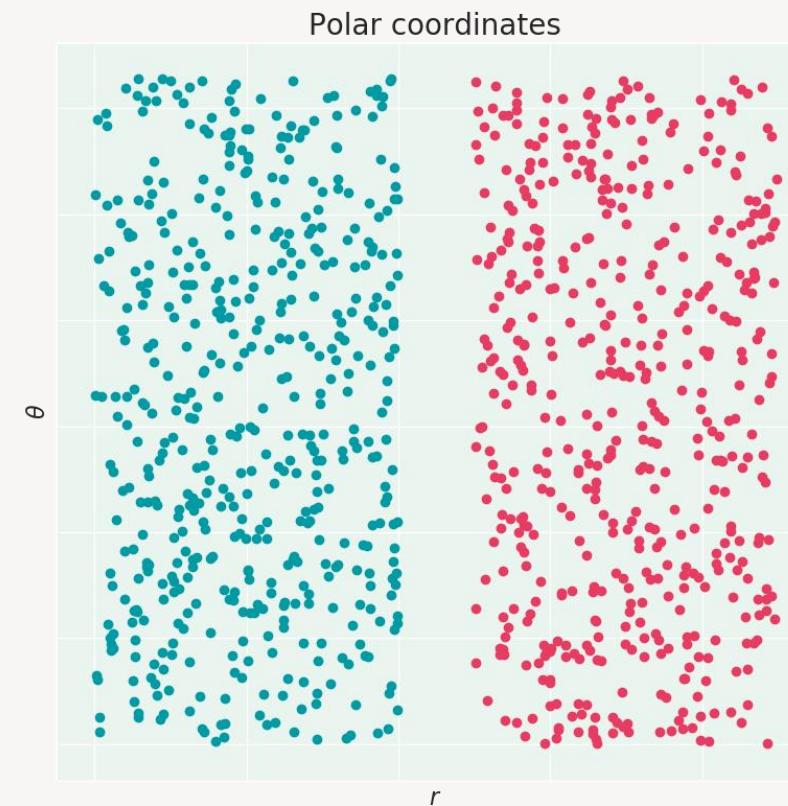
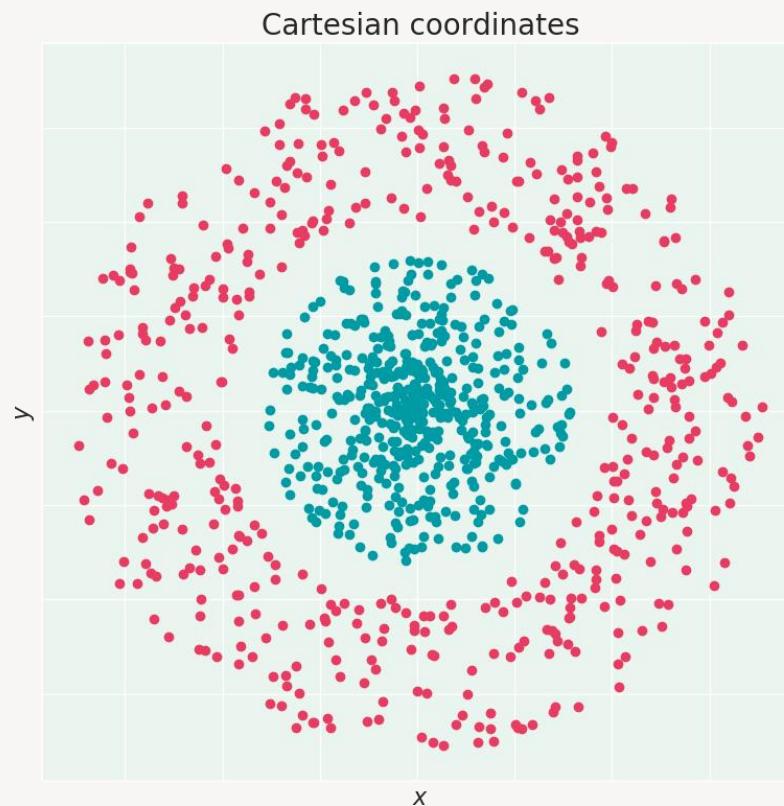


Training a machine

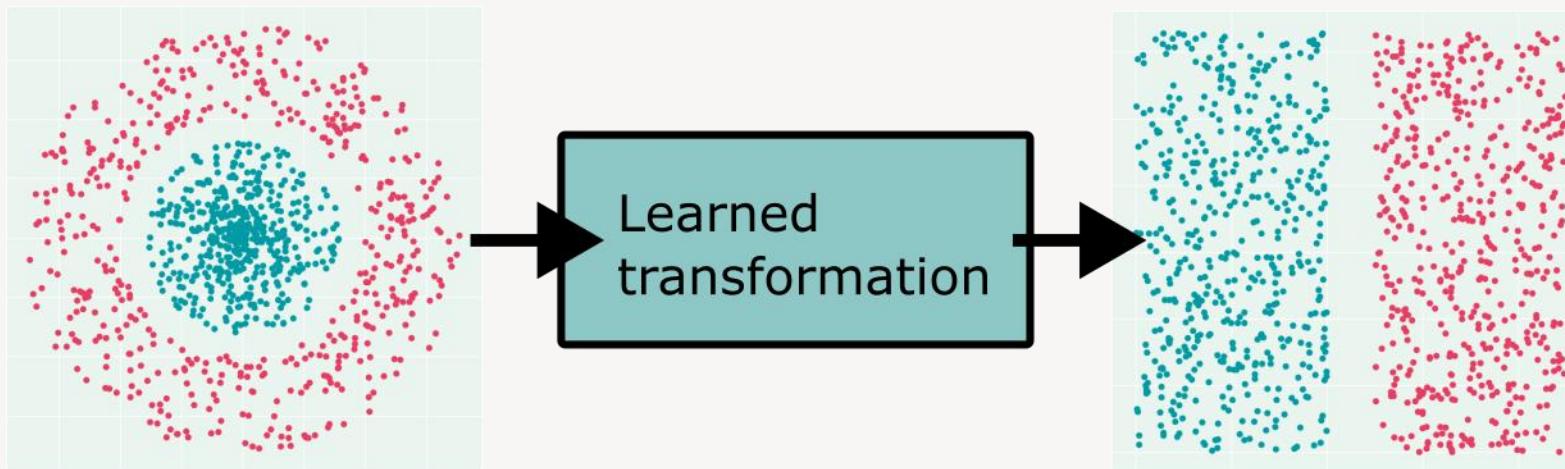


How do we represent a problem/data to make automated decision making simple?

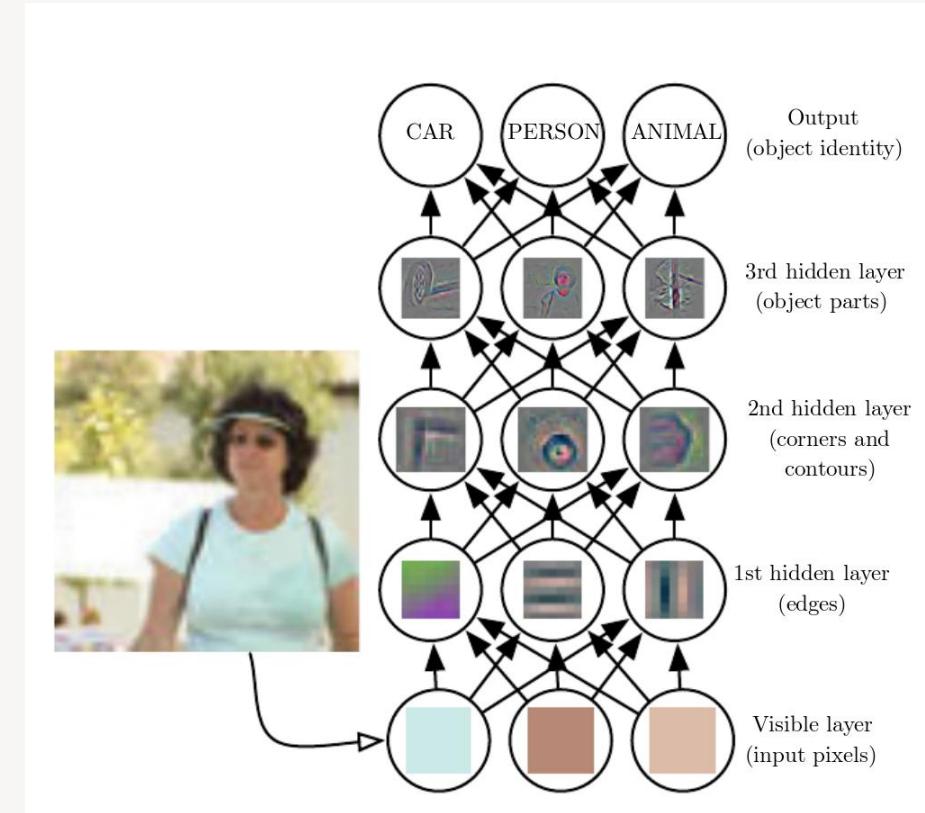
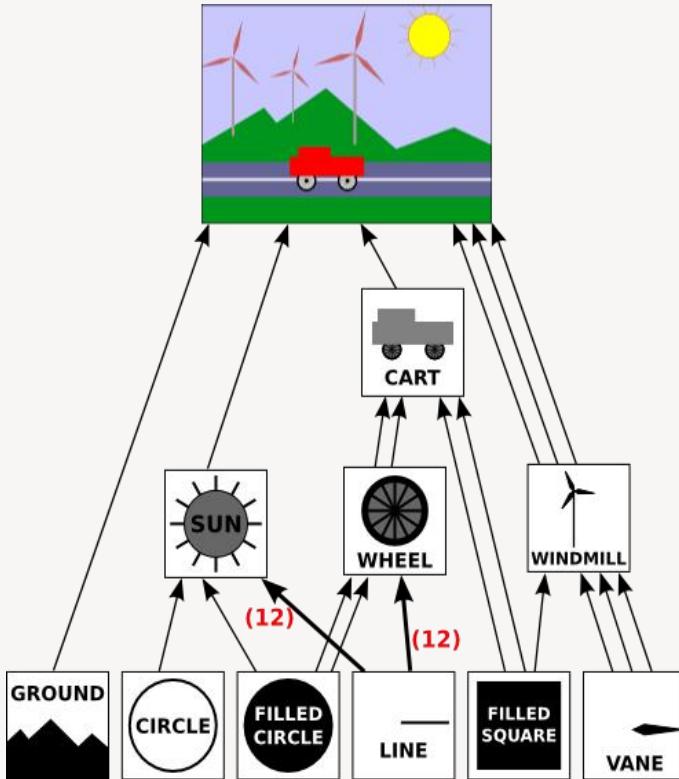
How to represent data?



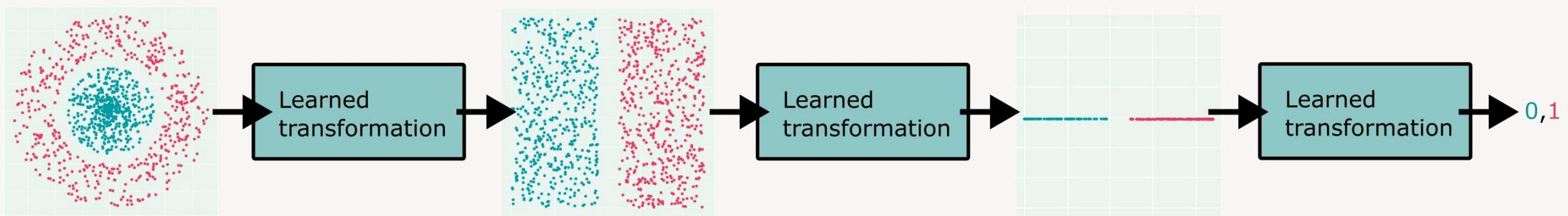
Learn the representation



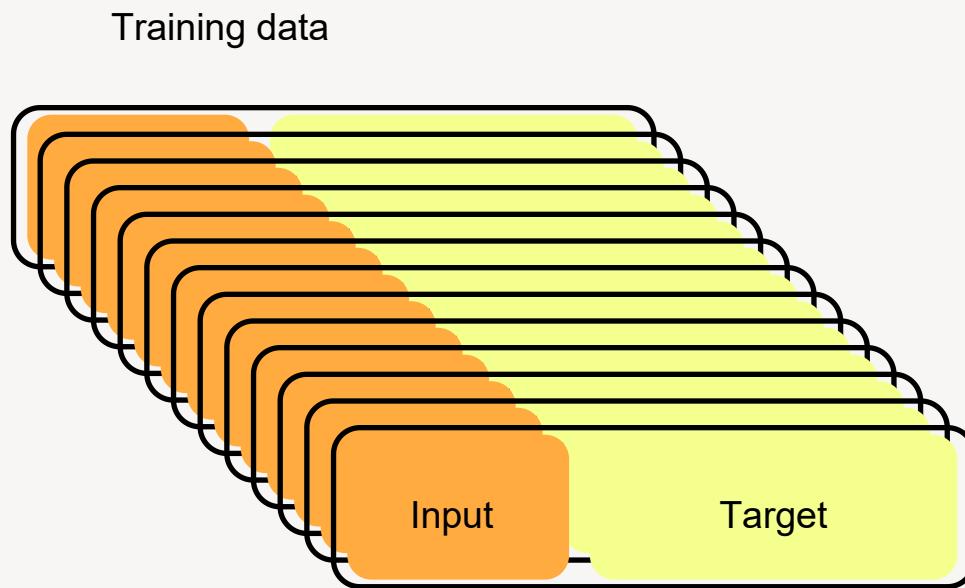
Deep learning



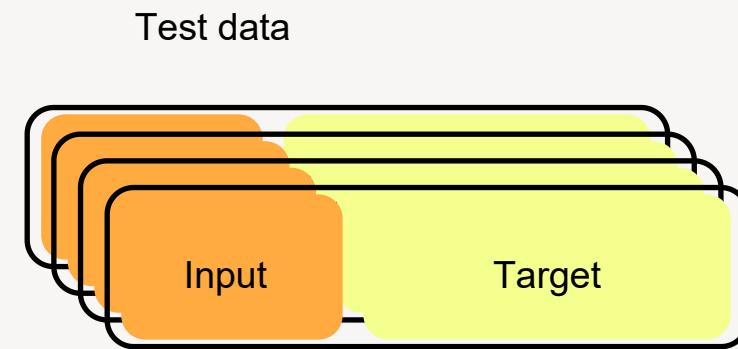
Representation learning with deep neural networks



Where do we get inputs and desired outputs which teaches the model good representations?

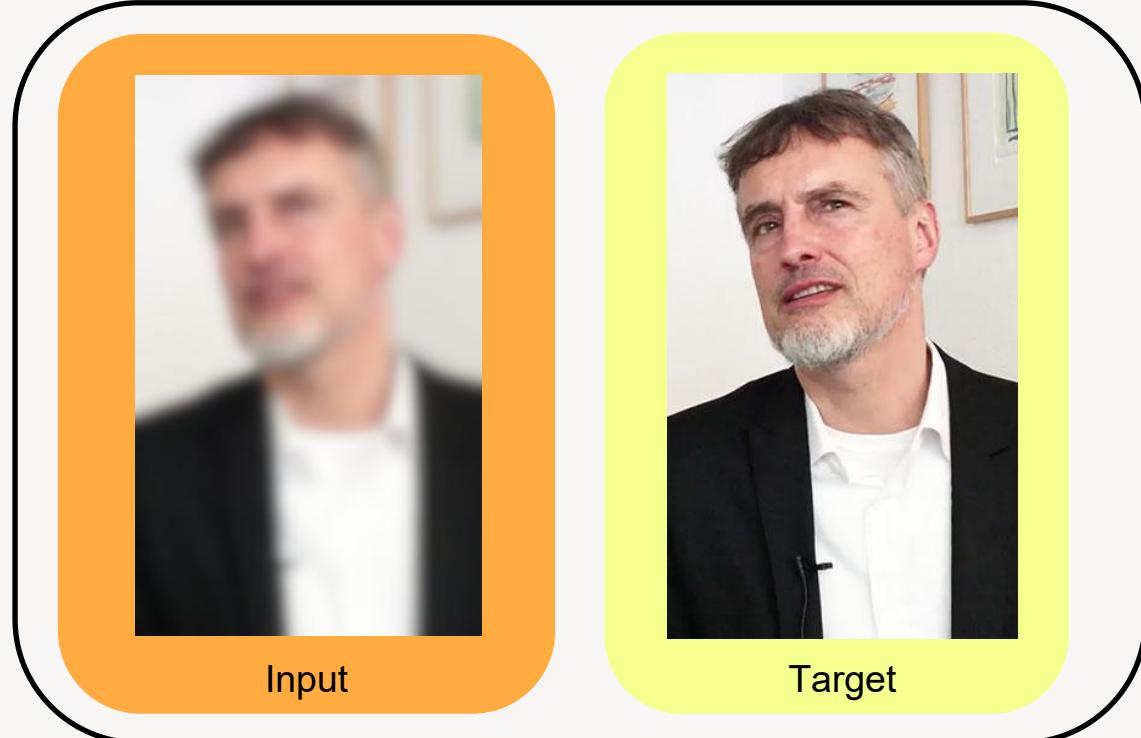


Lots of data to find parameters which works for many different inputs



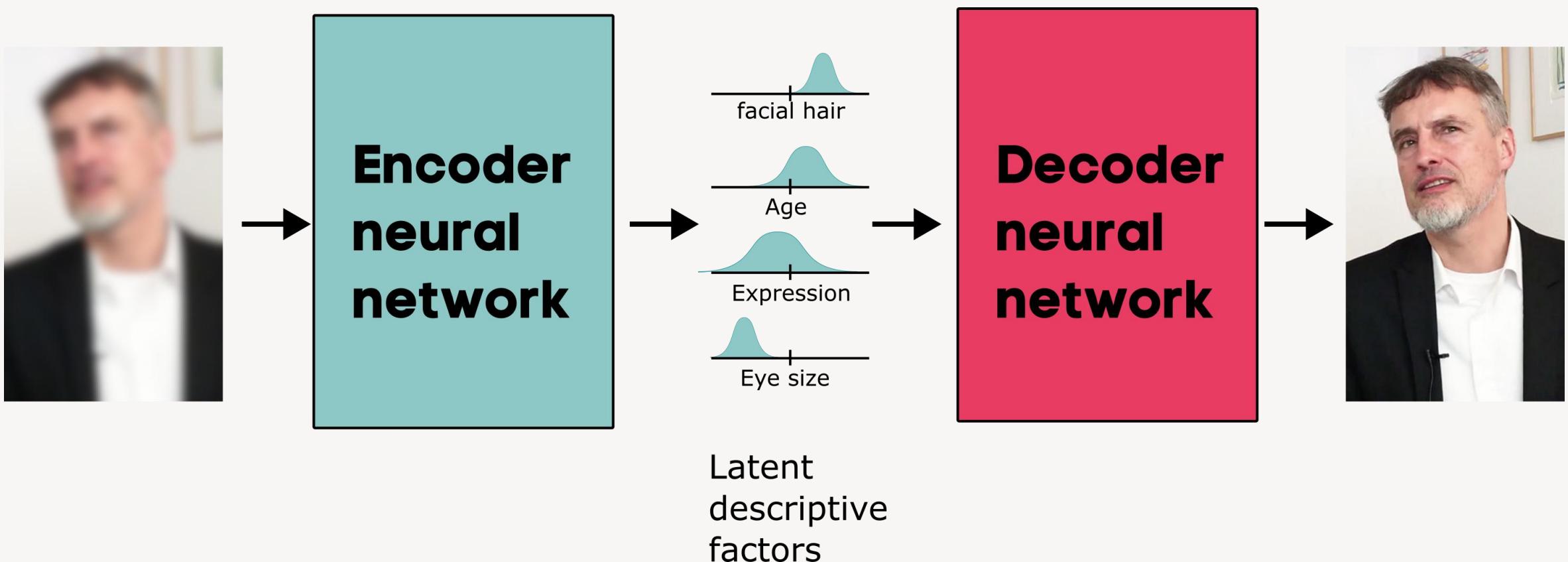
Enough test data to estimate performance on new data

Self-supervised learning - generate a desired output based on the data *itself*

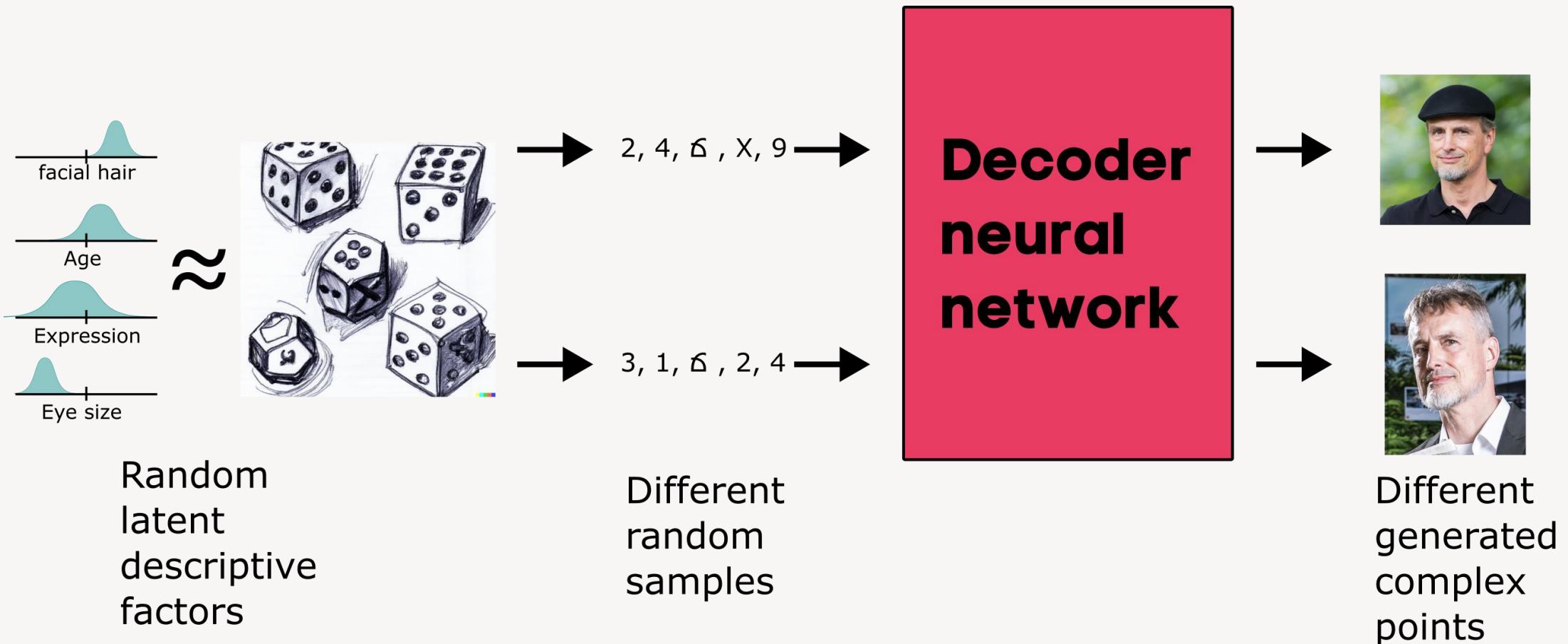


Modify the data and predict the unmodified version

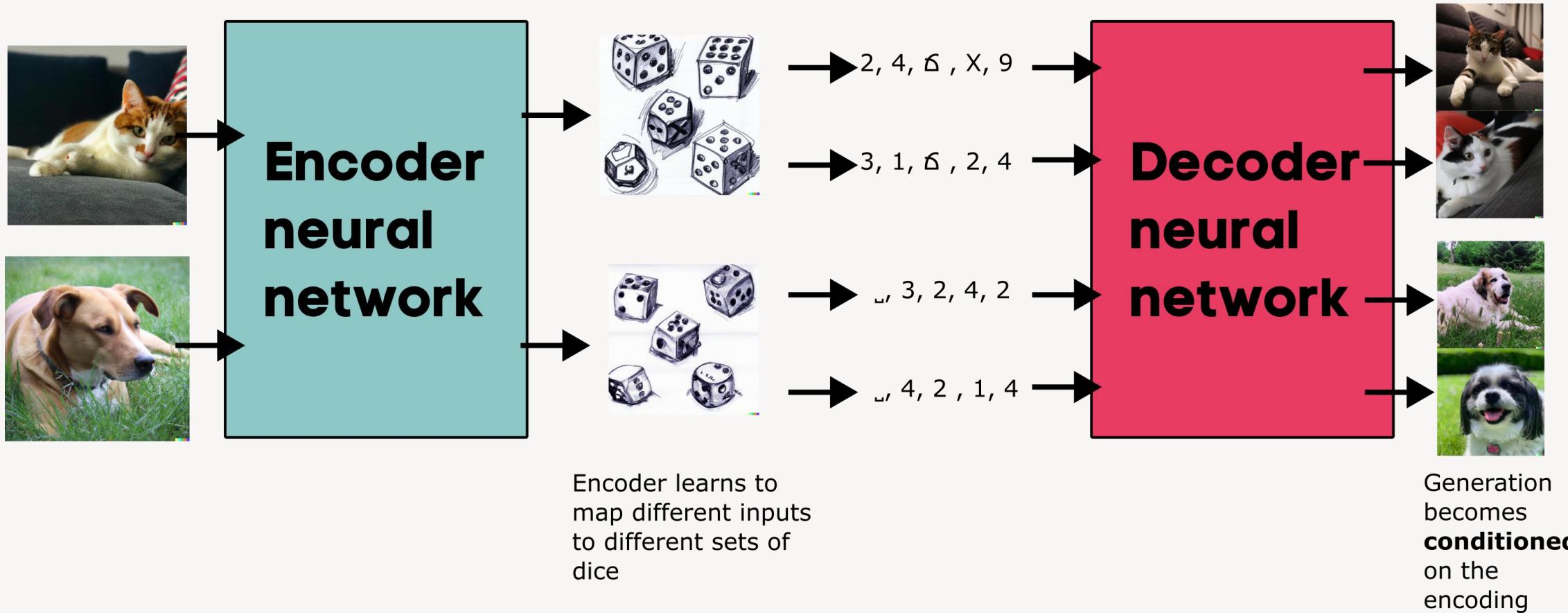
[Denoising] Auto Encoding



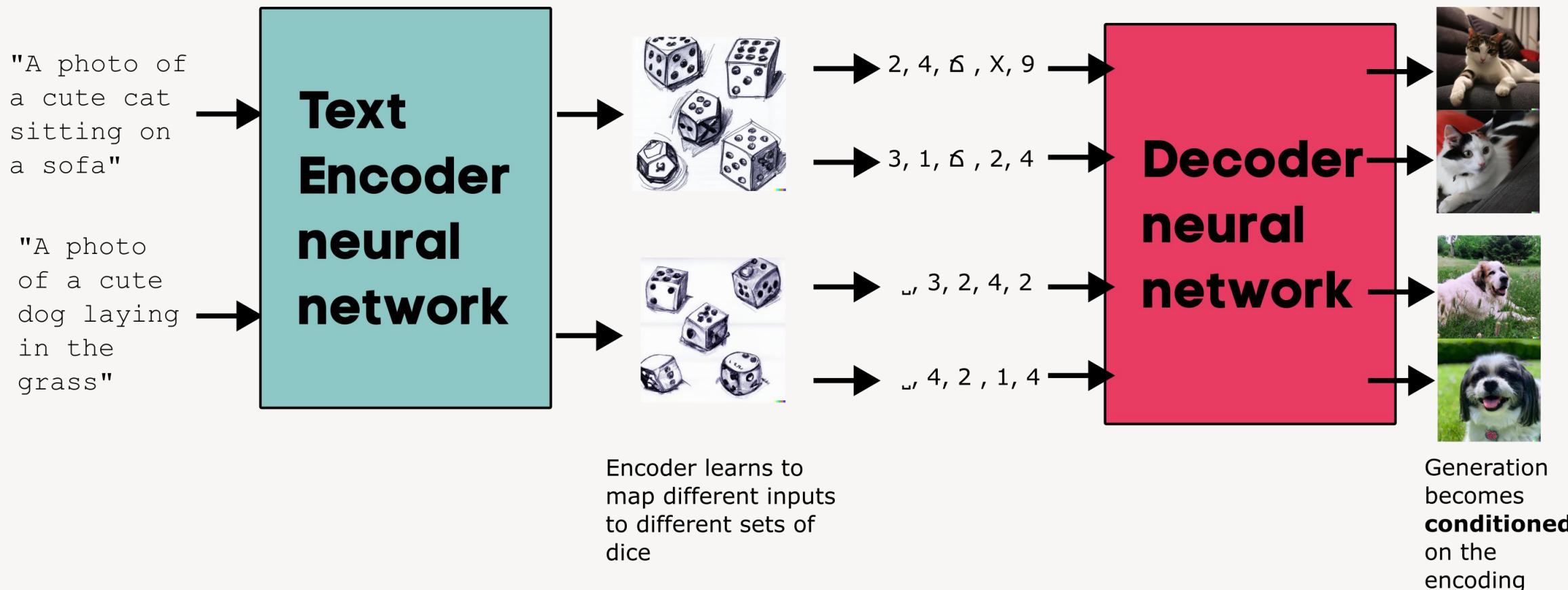
Generative models: maps random values to complex data



Conditional generation



DALL-E, Stable Diffusion, Midjourney, etc.



Training data is text-image pairs

“Portrait photograph of the AI researcher Jürgen Schmidhuber”

Input A



Input B

“Photo of a bumblebee”

Input A



Input B

Gathered from the internet

LAION



Large-scale Artificial Intelligence Open Network

TRULY OPEN AI. 100% NON-PROFIT. 100% FREE.

LAION, as a non-profit organization, provides datasets, tools and models to liberate machine learning research. By doing so, we encourage open public education and a more environment-friendly use of resources by reusing existing datasets and models.

[Join our community on discord!](#)

[Help building an Open Source ChatGPT!](#)

LAION-400M

An open dataset containing 400 million English image-text pairs.

LAION-5B

A dataset consisting of 5.85 billion multilingual CLIP-filtered image-text pairs.

Clip H/14

The largest CLIP (Contrastive Language-Image Pre-training) vision transformer model.

LAION-Aesthetics

A subset of LAION-5B filtered by a model trained to score aesthetically pleasing images.

DALL-E 3

DALL-E 3 understands significantly more nuance and detail than our previous systems, allowing you to easily translate your ideas into exceptionally accurate images.

[Read research paper ↗](#) [Try in ChatGPT ↗](#)

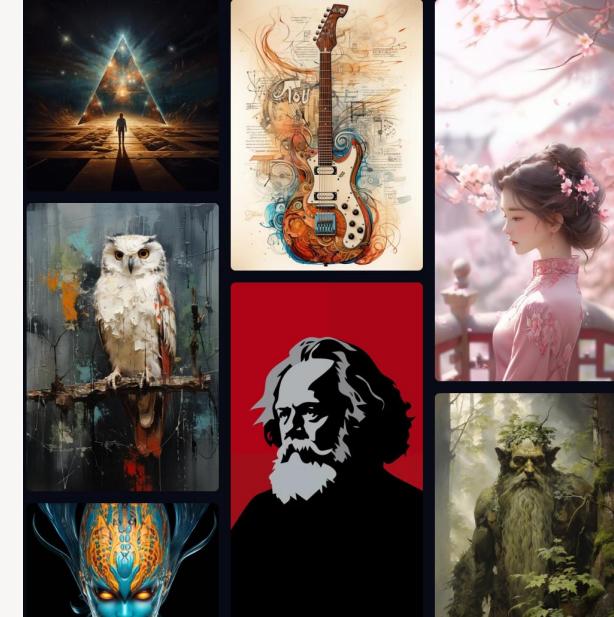
The sidewalks bustling
with **pedestrians** enjoying
the nightlife. —



At the corner stall, a **young woman** with fiery red hair, dressed in a signature velvet cloak, is **haggling with the grumpy old vendor.** —

The grumpy vendor, a **tall, sophisticated man**, is wearing a sharp suit, sports a **noteworthy moustache** and is animatedly conversing on his **steampunk telephone**.

Community Showcase



Stable Diffusion

stability.ai

Models ▾ Developers ▾ Enterprise Company ▾ News 日本語 Contact Us

Stable Diffusion XL

Create and inspire using the world's fastest-growing open source AI platform

With Stable Diffusion XL, you can create descriptive images with shorter prompts and generate words within images. The model is a significant advancement in image generation capabilities, offering enhanced image composition and face generation that results in stunning visuals and realistic aesthetics.

[Try on Clipdrop](#) [Download Code](#)



21

By AI developers - for AI developers

The screenshot shows the Hugging Face Diffusers documentation page for the `stable-diffusion-xl-base-1.0` model. It includes instructions for upgrading Diffusers, installing dependencies, and running the pipeline.

To use the whole base + refiner pipeline as an ensemble of experts you can run:

```
from diffusers import DiffusionPipeline
import torch

# load both base & refiner
base = DiffusionPipeline.from_pretrained(
    "stabilityai/stable-diffusion-xl-base-1.0", torch_dtype=torch.float16, variant="fp16"
)
base.to("cuda")
refiner = DiffusionPipeline.from_pretrained(
    "stabilityai/stable-diffusion-xl-refiner-1.0",
    text_encoder_2=base.text_encoder_2,
    vae=base.vae,
    torch_dtype=torch.float16,
    use_safetensors=True,
    variant="fp16",
)
refiner.to("cuda")

# Define how many steps and what % of steps to be run on each experts (80/20) here
n_steps = 40
high_noise_frac = 0.8

prompt = "A majestic lion jumping from a big stone at night"

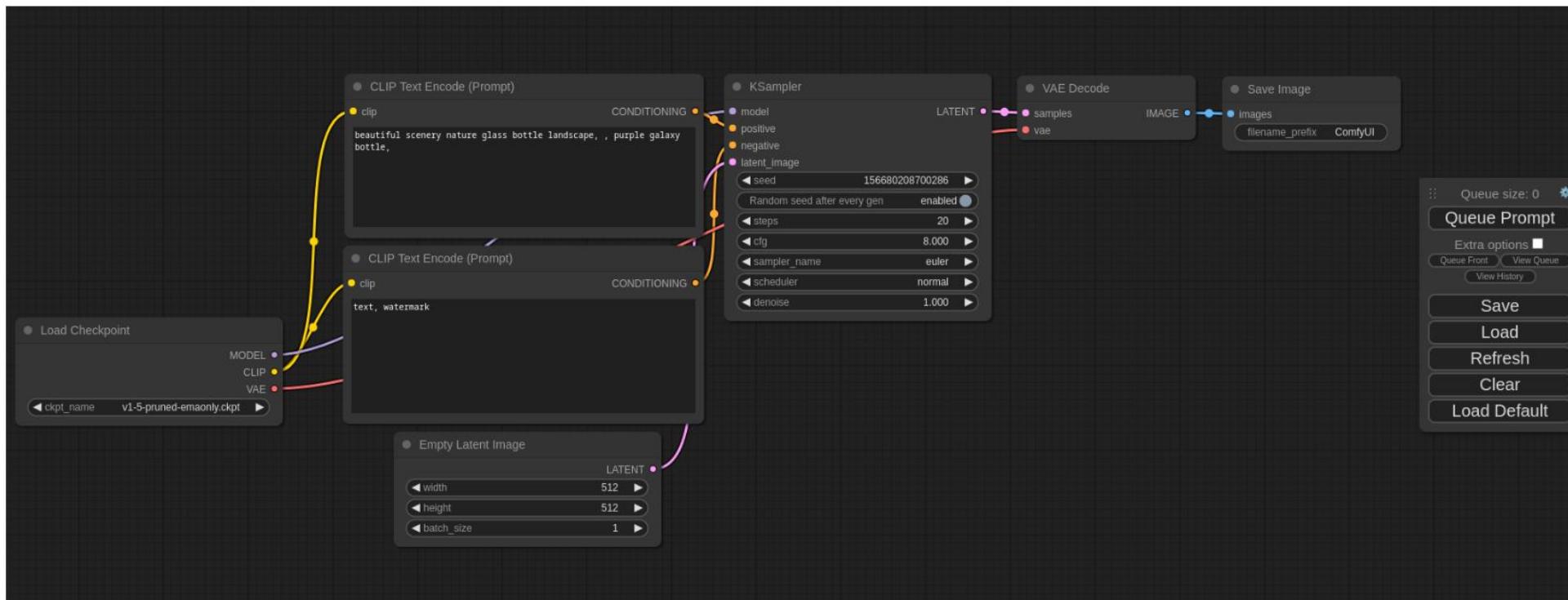
# run both experts
image = base(
    prompt=prompt,
    num_inference_steps=n_steps,
    denoising_end=high_noise_frac,
    output_type="latent",
).images
image = refiner(
    prompt=prompt,
    num_inference_steps=n_steps,
    denoising_start=high_noise_frac,
    image=image,
).images[0]
```

<https://huggingface.co/stabilityai/stable-diffusion-xl-base-1.0>

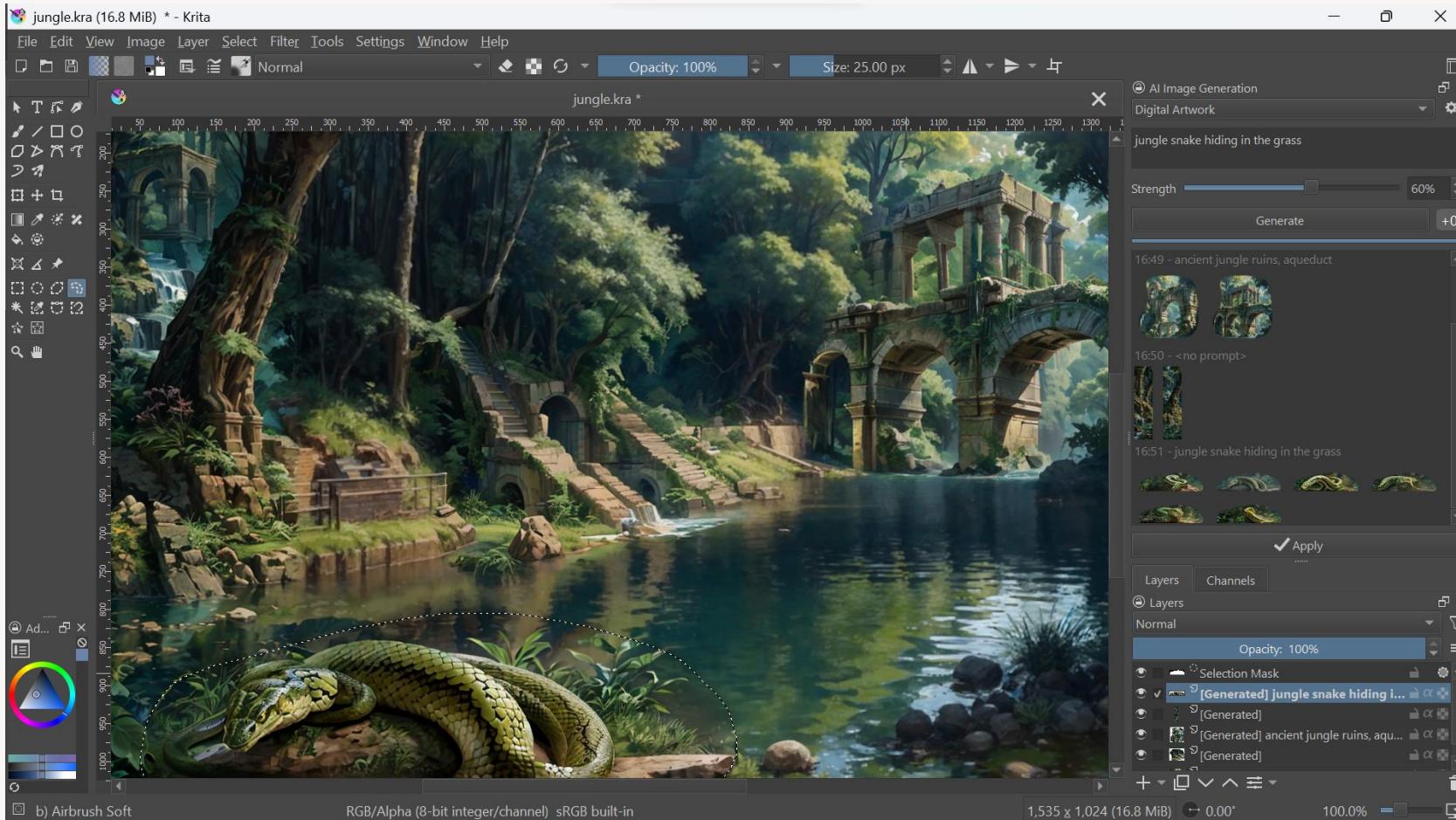
ComfyUI

☞ ComfyUI

The most powerful and modular stable diffusion GUI and backend.



Krita Diffusion



<https://github.com/Acly/krita-ai-diffusion>

This workshop - SDXL on Colab

Find the material at <https://github.com/jonandernovella/prompt-engineering>

Thank you!

erik.ylipaa@scilifelab.se

Wider implications

Controversies



TECH • ARTIFICIAL INTELLIGENCE

He Used AI to Publish a Children's Book in a Weekend. Artists Are Not Happy About It



Copyright and machine learning models

Data is scraped from the internet. Highly likely that the majority is protected under copyright.

Most copyright law considers copying (downloading digital files) as copyright infringement.

In the EU at least there are exemptions:

Under Article 5(1) of Directive 2001/29, an act of reproduction is exempted from the reproduction right provided for in Article 2 of that directive on condition that:

- it is temporary;
- it is transient or incidental;
- it is an integral and essential part of a technological process;
- its sole purpose is to enable a transmission in a network between third parties by an intermediary or a lawful use of a work or other subject-matter to be made, and
- it has no independent economic significance.

Whether the datasets used to train the machine learning models is exempt is yet to be determined.

The upcoming **EU AI Act** would likely introduce other legal obstacles for Large Language Models and the DALL-E like models (foundation models would likely be considered high risk).

Lawsuits

We've filed a lawsuit challenging Stable Diffusion, a 21st-century collage tool that violates the rights of artists.

Because AI needs to be fair & ethical for everyone.

JANUARY 13, 2023

Hello. This is [Matthew Butterick](#). I'm a writer, designer, programmer, and lawyer. In November 2022, I teamed up with the [amazingly excellent](#) class-action litigators [Joseph Saveri](#), [Cadio Zirpoli](#), and [Travis Manfredi](#) at the [Joseph Saveri Law Firm](#) to file a [lawsuit against GitHub Copilot](#) for its "unprecedented open-source software piracy". (That lawsuit is still [in progress](#).)



<https://stablediffusionlitigation.com/>

Are AI-created works copyrighted?

 **REUTERS®** World ▾ Business ▾ Legal ▾ Markets ▾ Breakingviews Technology ▾ Investigations More ▾

 Copyright Technology Intellectual Property Litigation Data Privacy



2 minute read · February 23, 2023 2:41 AM GMT+1 · Last Updated a day ago

AI-created images lose U.S. copyrights in test for new technology

By Blake Brittain



REUTERS/Andrew Kelly

Extracting training data



Original:



Generated:



Figure 3: Examples of the images that we extract from Stable Diffusion v1.4 using random sampling and our membership inference procedure. The top row shows the original images and the bottom row shows our extracted images.

Carlini, Nicholas, et al. "Extracting training data from diffusion models." arXiv preprint arXiv:2301.13188 (2023).

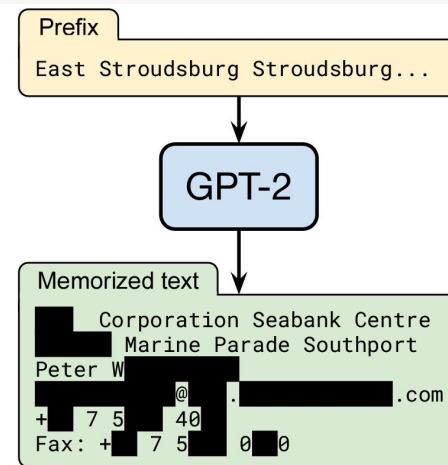


Figure 1: Our extraction attack. Given query access to a neural network language model, we extract an individual person's name, email address, phone number, fax number, and physical address. The example in this figure shows information that is all accurate so we redact it to protect privacy.

Carlini, Nicholas, et al. "Extracting Training Data from Large Language Models." USENIX Security Symposium. Vol. 6. 2021.

Category	Count
US and international news	109
Log files and error reports	79
License, terms of use, copyright notices	54
Lists of named items (games, countries, etc.)	54
Forum or Wiki entry	53
Valid URLs	50
Named individuals (non-news samples only)	46
Promotional content (products, subscriptions, etc.)	45
High entropy (UUIDs, base64 data)	35
Contact info (address, email, phone, twitter, etc.)	32
Code	31
Configuration files	30
Religious texts	25
Pseudonyms	15
Donald Trump tweets and quotes	12
Web forms (menu items, instructions, etc.)	11
Tech news	11
Lists of numbers (dates, sequences, etc.)	10

Table 1: Manual categorization of the 604 memorized training examples that we extract from GPT-2, along with a description of each category. Some samples correspond to multiple categories (e.g., a URL may contain base-64 data). Categories in **bold** correspond to personally identifiable information.

AI-Generated content

FORTUNE RANKINGS ▾ MAGAZINE NEWSLETTERS PODCASTS MORE ▾

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‘Out-of-hand’ flood of ChatGPT-like A.I.-generated stories forces prominent science fiction magazine to stop accepting submissions

BY PRARTHANA PRAKASH
February 22, 2023 at 1:51 PM GMT+1
Updated February 23, 2023 at 4:46 AM GMT+1



More people are using generative A.I. to explore creative avenues.
SOMPONG TOM—GETTY IMAGES

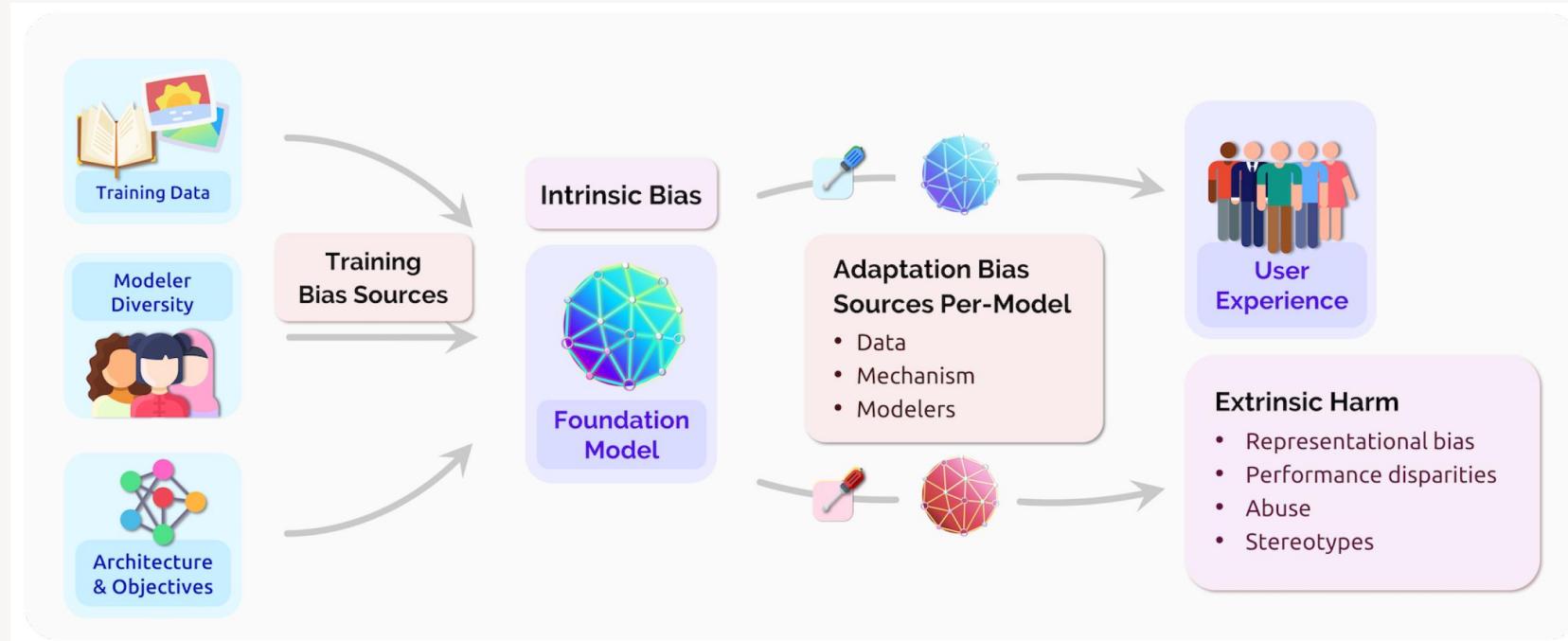
Most Popular

TECH
Google is asking staff to share with a 'desk partner' but they have to agree on tidiness and decorations

February 23, 2023

BY ELEANOR PRINGLE

Societal risks of foundation models

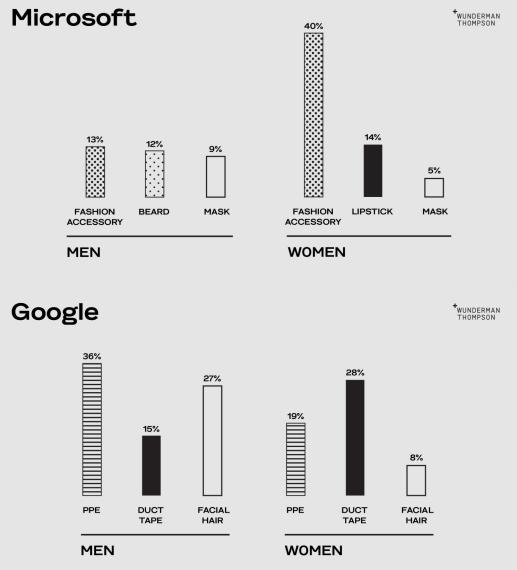


Bommasani, Rishi, et al. "On the opportunities and risks of foundation models." arXiv preprint arXiv:2108.07258 (2021).

Algorithmic Bias



Microsoft



<https://www.wundermanthompson.com/in-sight/ai-and-gender-bias>

Category	Screenshot 1 (2020-04-03)	Screenshot 2 (2020-04-02)
Hand	77%	72%
Gun	61%	60%
Monocular		60%

<https://algorithmwatch.org/en/story/computer-vision-police-discrimination/>

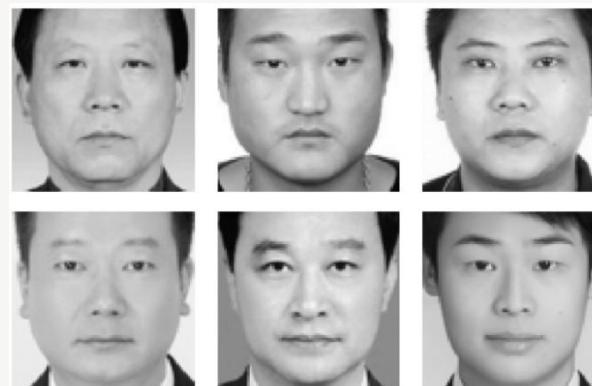


Figure 3. Wu and Zhang's "criminal" images (top) and "non-criminal" images (bottom). In the top images, the people are frowning. In the bottom, they are not. These types of superficial differences can be picked up by a deep learning system.

Blaise Agüera y Arcas, Margaret Mitchell and Alexander Todorov, Physiognomy's New Clothes, <https://medium.com/@blaisea/physiognomys-new-clothes-f2d4b59fdd6a>

Name suggestion	Company description	Distance
Magnus bilar	Bolaget ska bedriva verksamhet med bilar	0.028
Fredriks bilar	Bolaget ska bedriva verksamhet med bilar	0.038
Marias bilar	Bolaget ska bedriva verksamhet med bilar	0.044
Annas bilar	Bolaget ska bedriva verksamhet med bilar	0.075

Sahlgren, Magnus, and Fredrik Olsson. "Gender bias in pretrained Swedish embeddings." Proceedings of the 22nd Nordic Conference on Computational Linguistics. 2019.

Hungarian has no gender pronoun, so Google Translate makes some assumptions. https://www.reddit.com/r/europe/comments/m9uphb/hungarian_has_no_gendered_pronouns_so_google/?utm_source=share&utm_medium=web2x&context=3

What language is represented?



Bommasani, Rishi, et al. "On the opportunities and risks of foundation models." arXiv preprint arXiv:2108.07258 (2021).

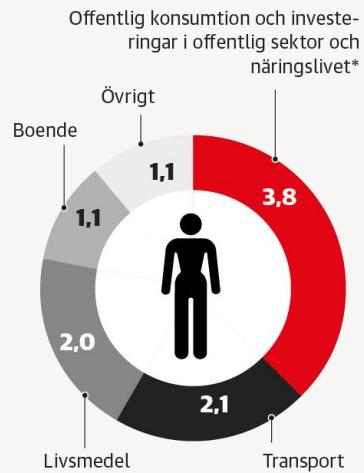
Economic impacts

"In summary, foundation models are poised to be an important general-purpose technology of our era. They have potential to increase living standards substantially, but also pose risks of increasing inequality and concentrating power. The economic implications of these technologies are not predetermined, but rather depend on how technologists, policymakers, managers, workers, and other stakeholders answer challenges such as:

- *How can we harness the potential of foundation models to boost productivity?*
- *Can we develop models that enhance creativity and boost the rate of innovation?*
- *Will the benefits and control rights be limited to a few or widely shared?"*

Bommasani, Rishi, et al. "On the opportunities and risks of foundation models." arXiv preprint arXiv:2108.07258 (2021).

Carbon emissions



Average per capita swedish metric tons of CO₂

<https://www.dn.se/nyheter/sverige/fakta-i-fragan-vilken-forandring-i-vardagen-gor-bast-nytta-for-klimatet/>

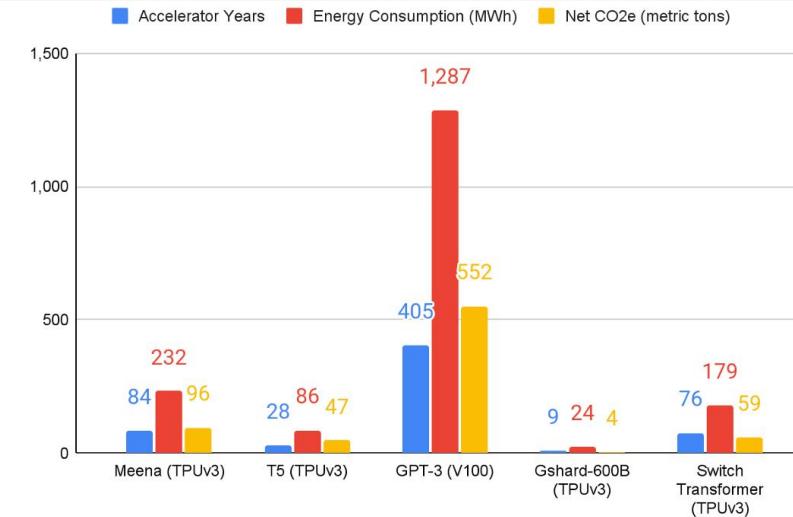
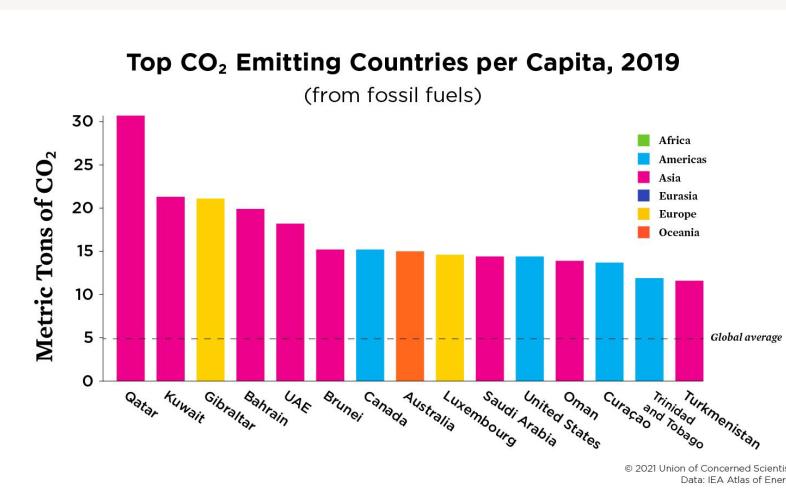


Figure 3. Accelerator years of computation, energy consumption, and CO₂e for five large NLP DNNs

Carbon Emissions and Large Neural Network Training. David Patterson, Joseph Gonzalez, Quoc V. Le, Chen Liang, Lluís-Miquel Munguía, D. Rothchild, David R. So, Maud Texier, J. Dean. 2021. From Google.



<https://www.ucsusa.org/resources/each-countrys-share-co2-emissions>

Science & Tech

A Photographer Submitted an A.I.-Generated Image to a Prestigious Art Competition to Be 'Cheeky.' It Won a Top Prize Anyway

Boris Eldagsen has refused the award, saying his submission was intended to start a discussion about the use of A.I. in photography.

Richard Whiddington, April 17, 2023



Boris Eldagsen, *The Electrician* (2022). Photo courtesy Boris Eldagsen.

<https://news.artnet.com/art-world/boris-eldagsen-photography-award-sony-ai-generated-images-dall-e-2286622>