

# Deep Learning for Raiffeisenbank

Jiří Materna



Machine  
Learning  
College

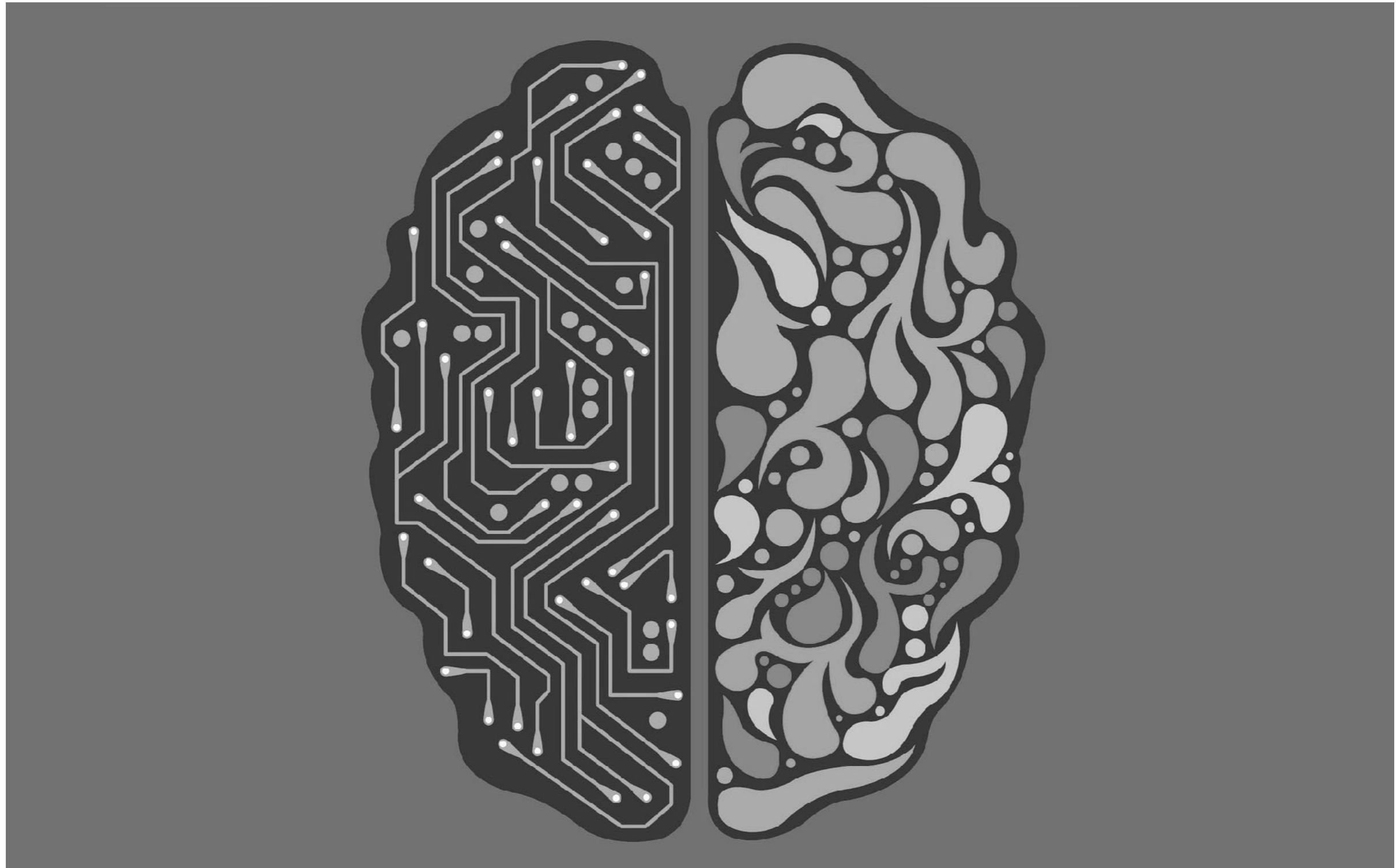
# About me

- Ph.D. in Natural Language Processing and Artificial Intelligence at Masaryk University
- 10 years at Seznam.cz (last 8 years as Head Of Research)
- Founder and co-organiser of ML Prague
- Mentor at StartupYard and Startup AI Incubator
- ML Freelancer and consultant

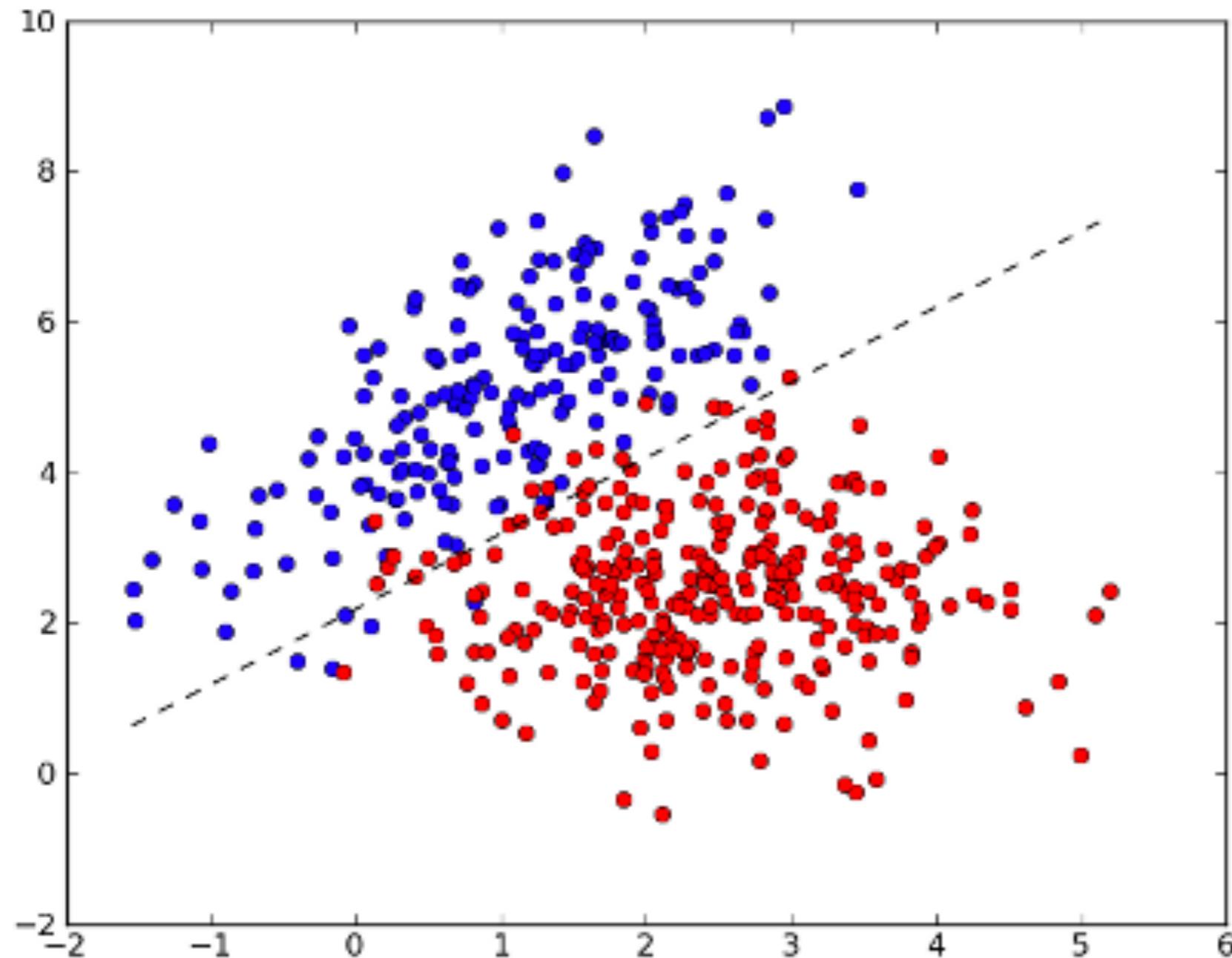
# Image processing

- Introduction to neural networks
- Activation functions for neural networks
- Multilayered neural networks
- Methods for training neural networks
- Keras tutorial
- Practical classification and regression tasks solved using neural networks
- ResNet
- Transfer learning and fine-tuning
- Image classification
- Image segmentation
- GANs and superresolution

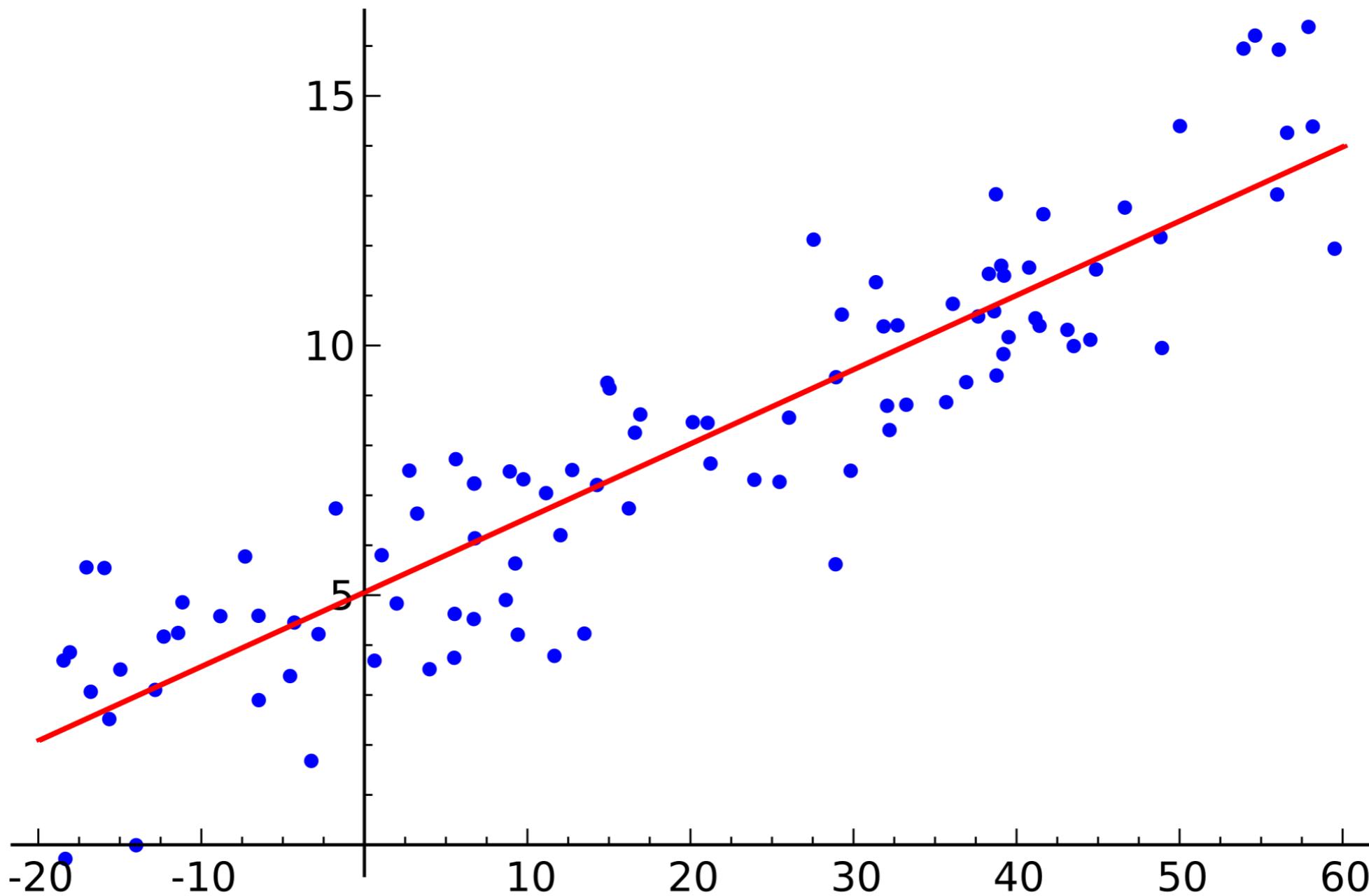
# What is (not) machine learning?



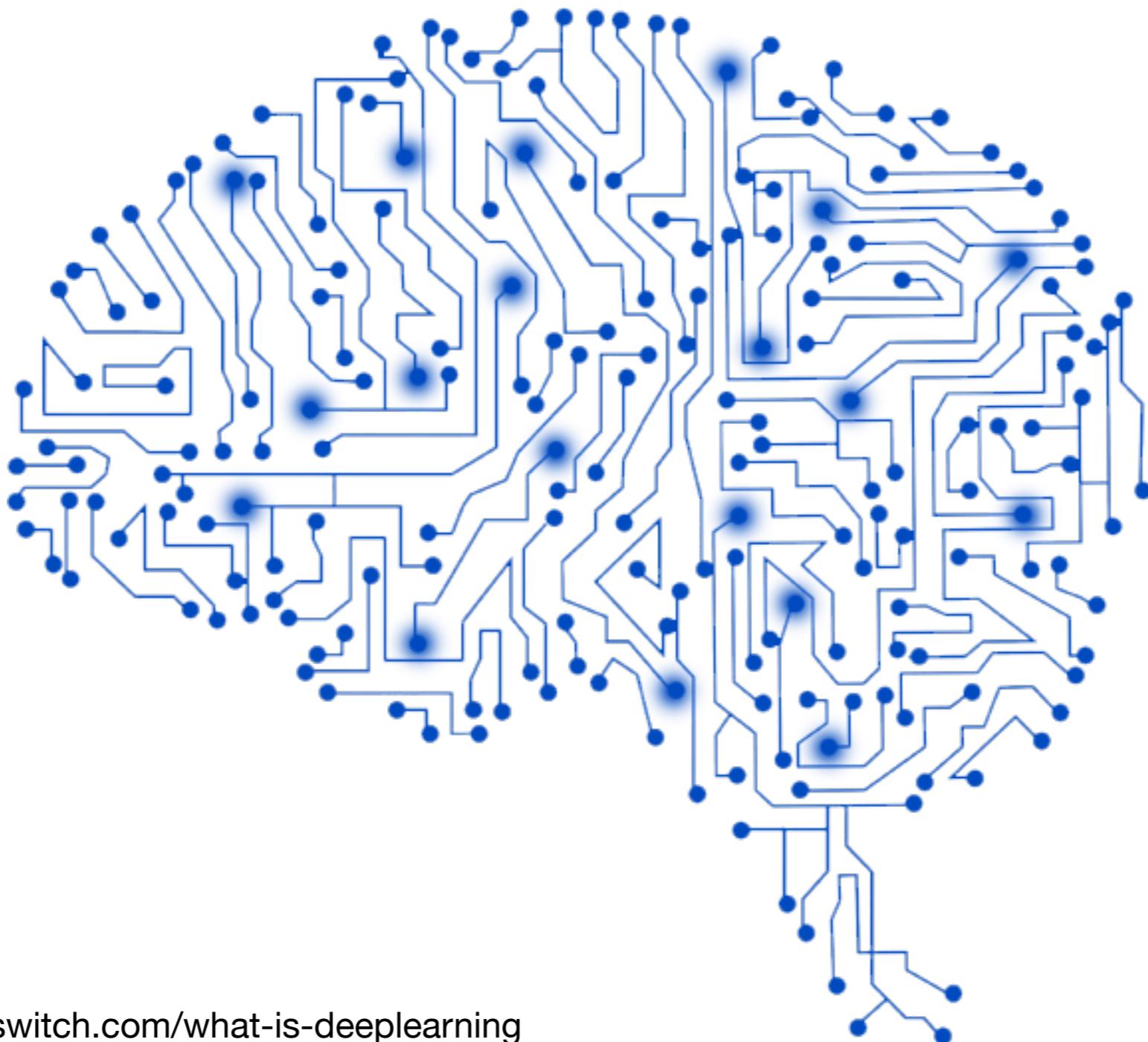
# Classification



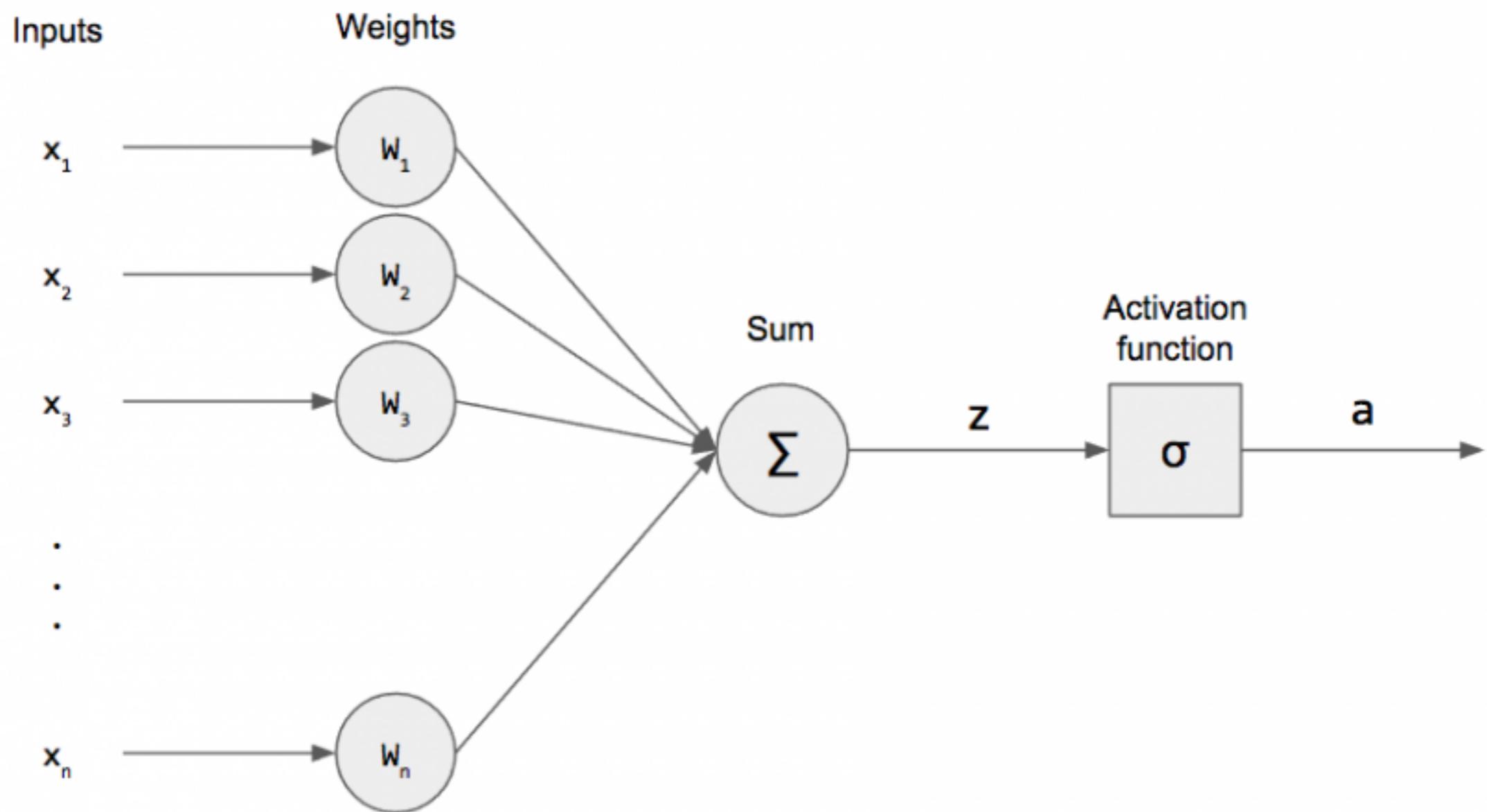
# Regression



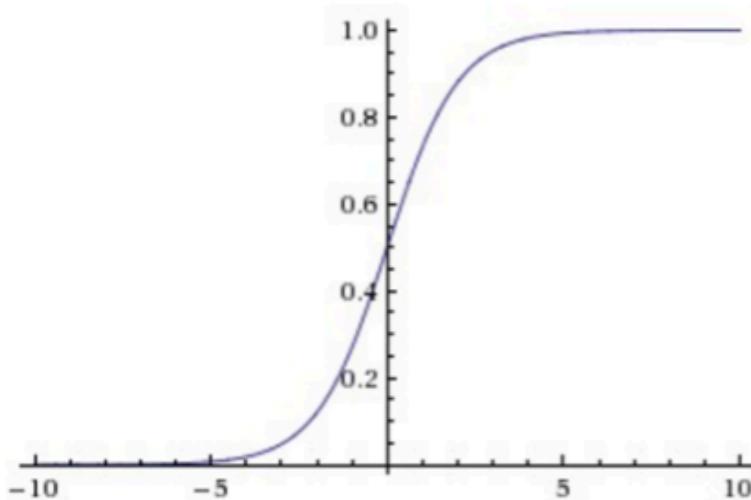
# Neural networks and deep learning



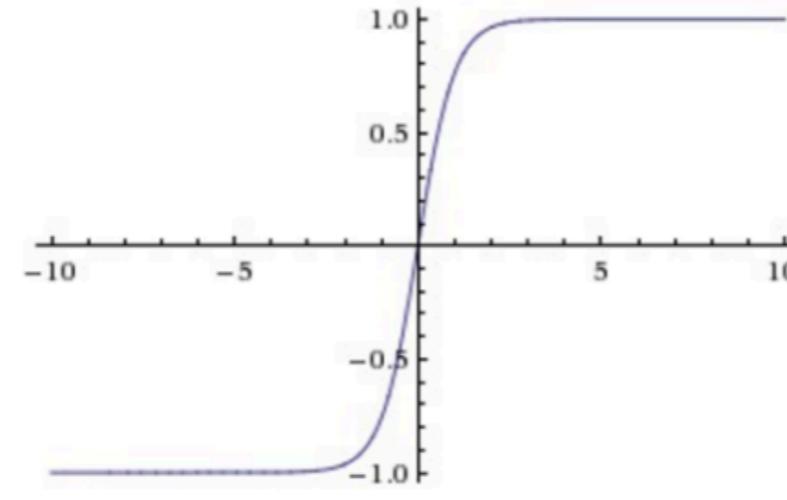
# Perceptron



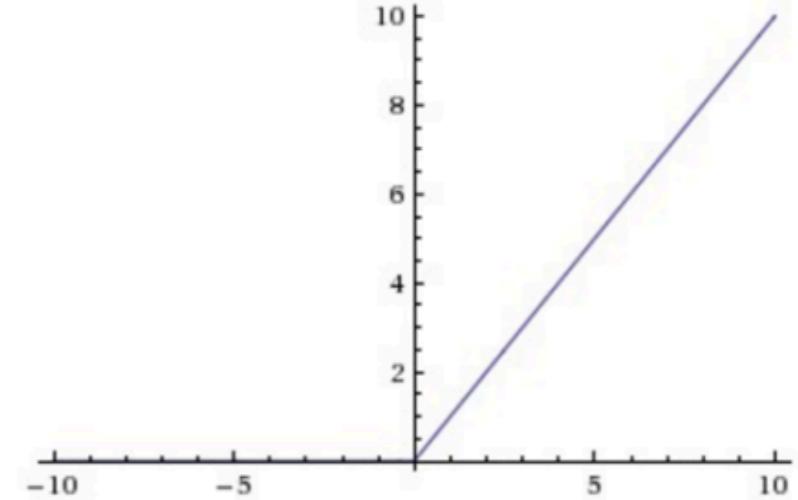
# Activation functions



Sigmoid



tanh

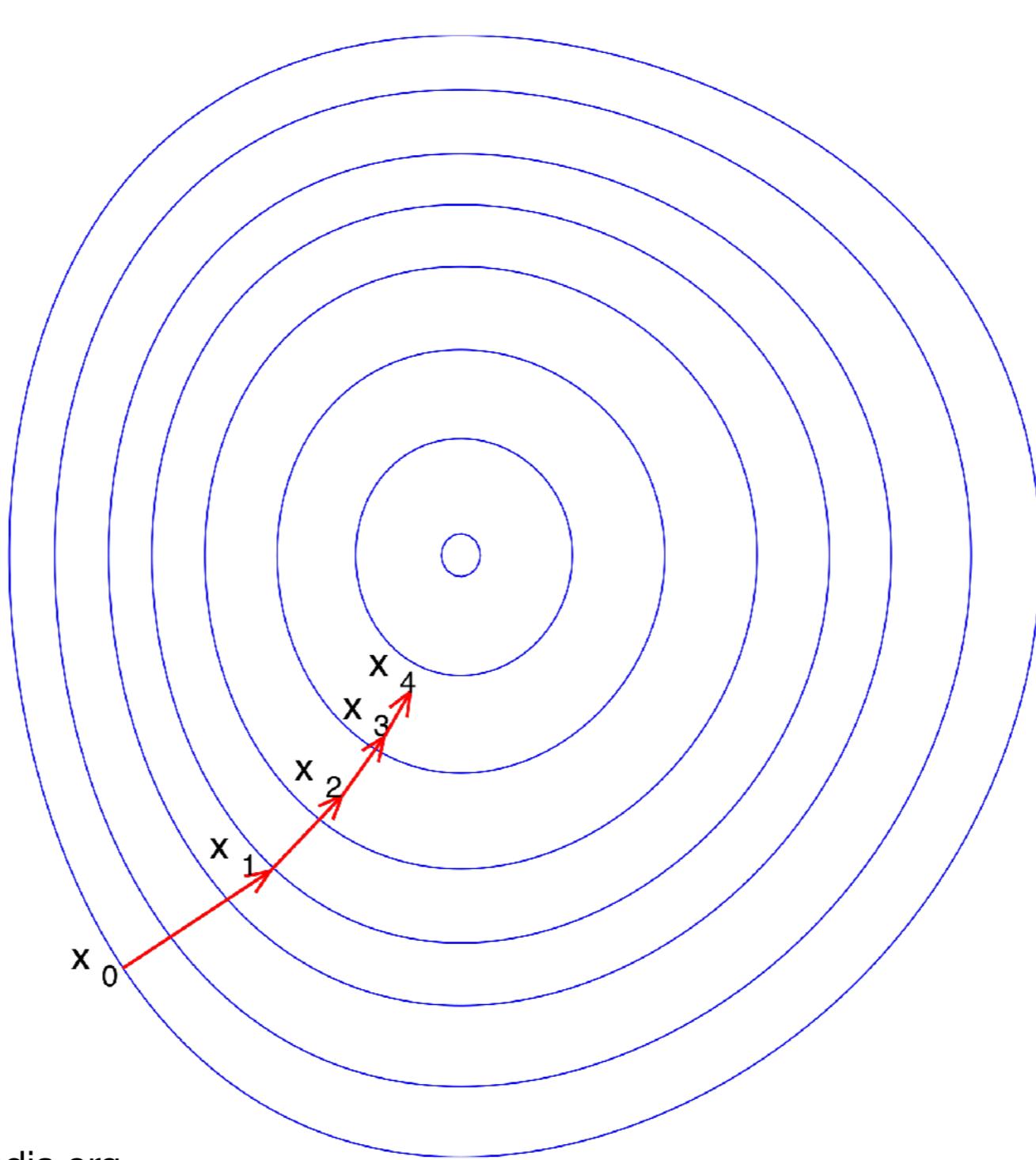


ReLU

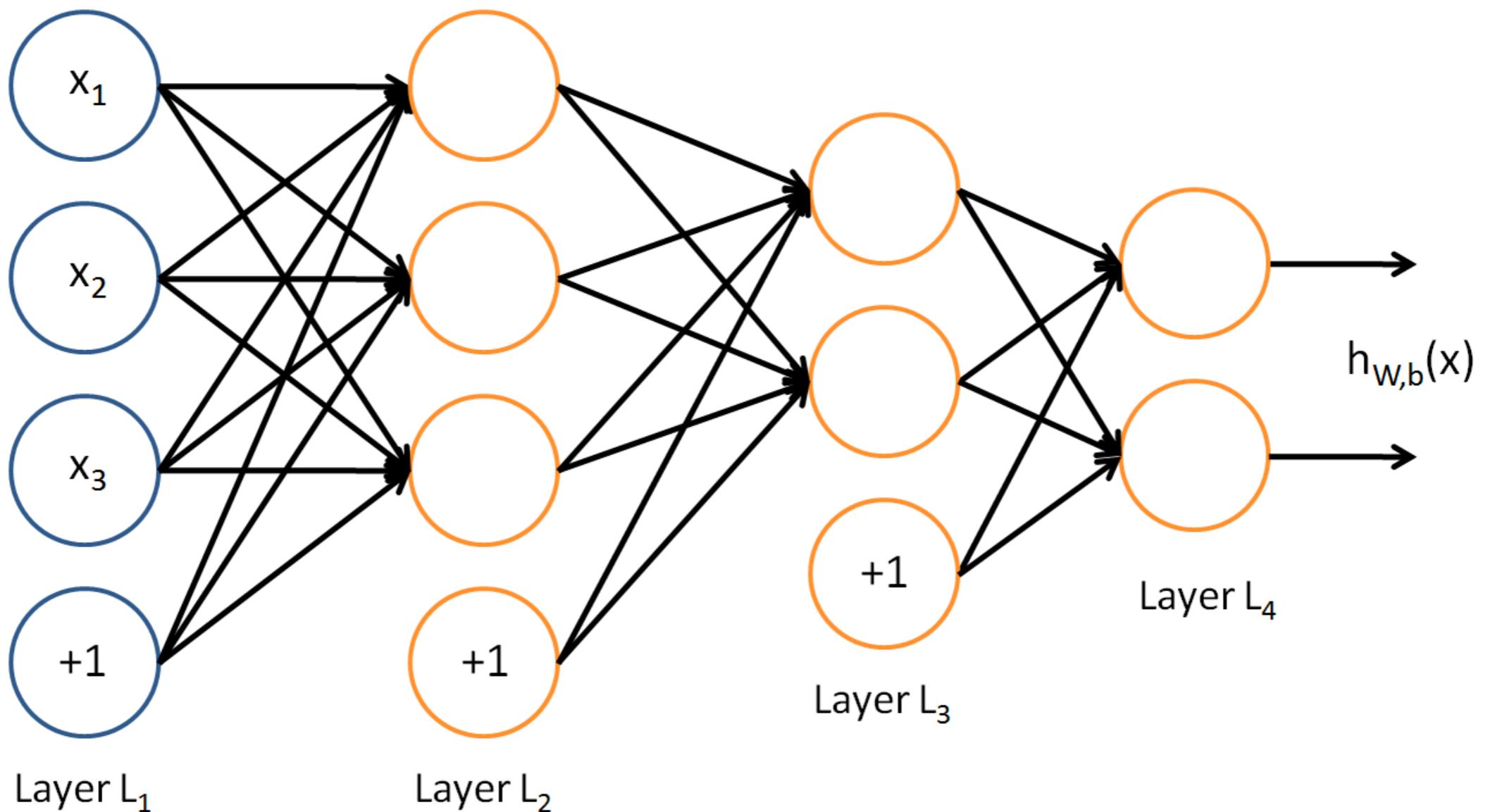
Softmax:

$$\sigma(\mathbf{z})_j = \frac{e^{z_j}}{\sum_{k=1}^K e^{z_k}}$$

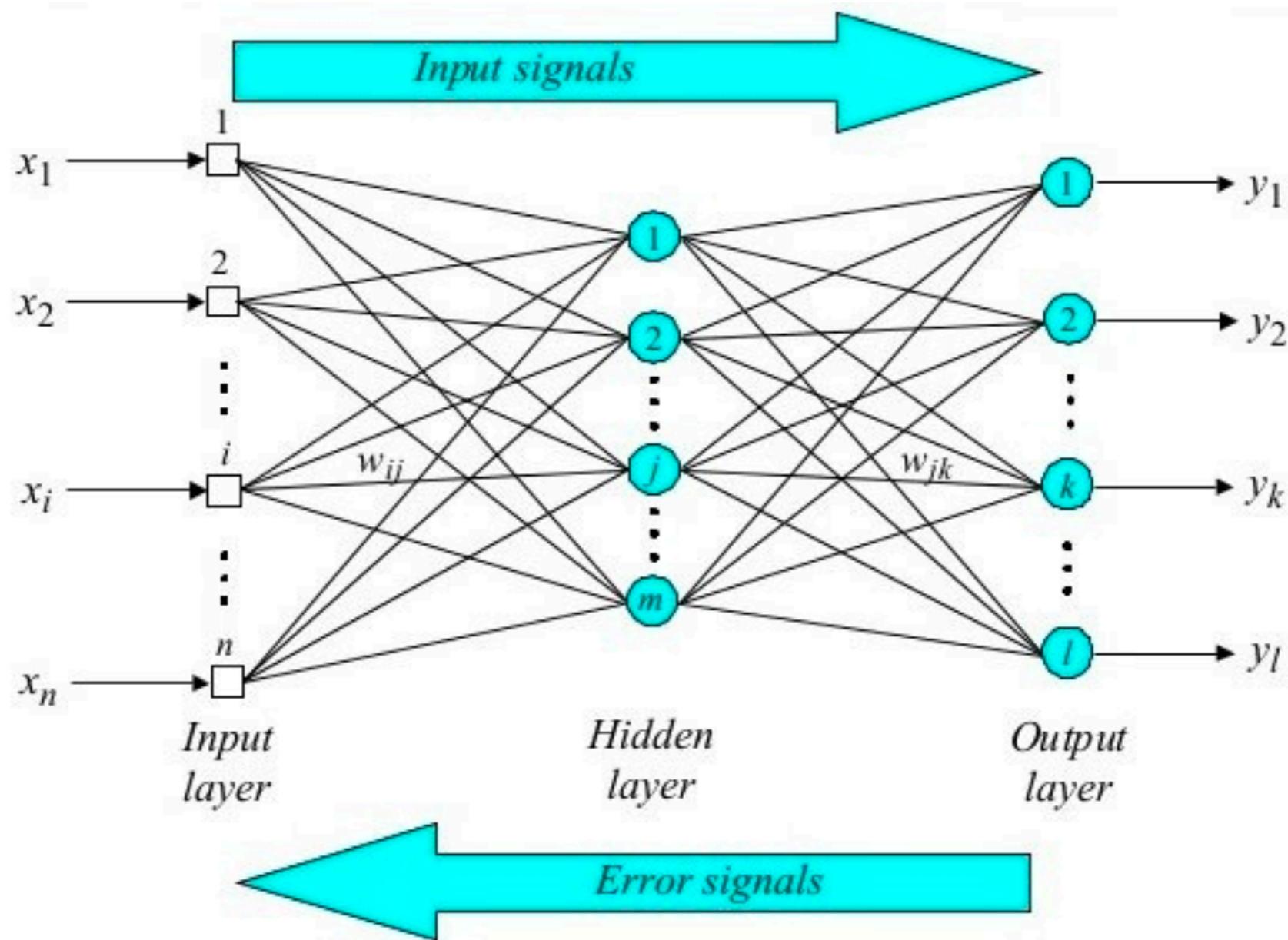
# Steepest gradient descent



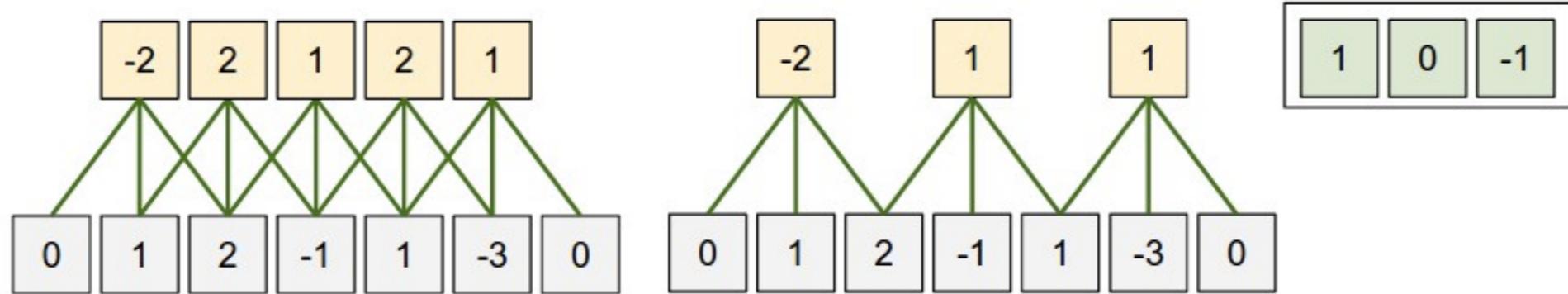
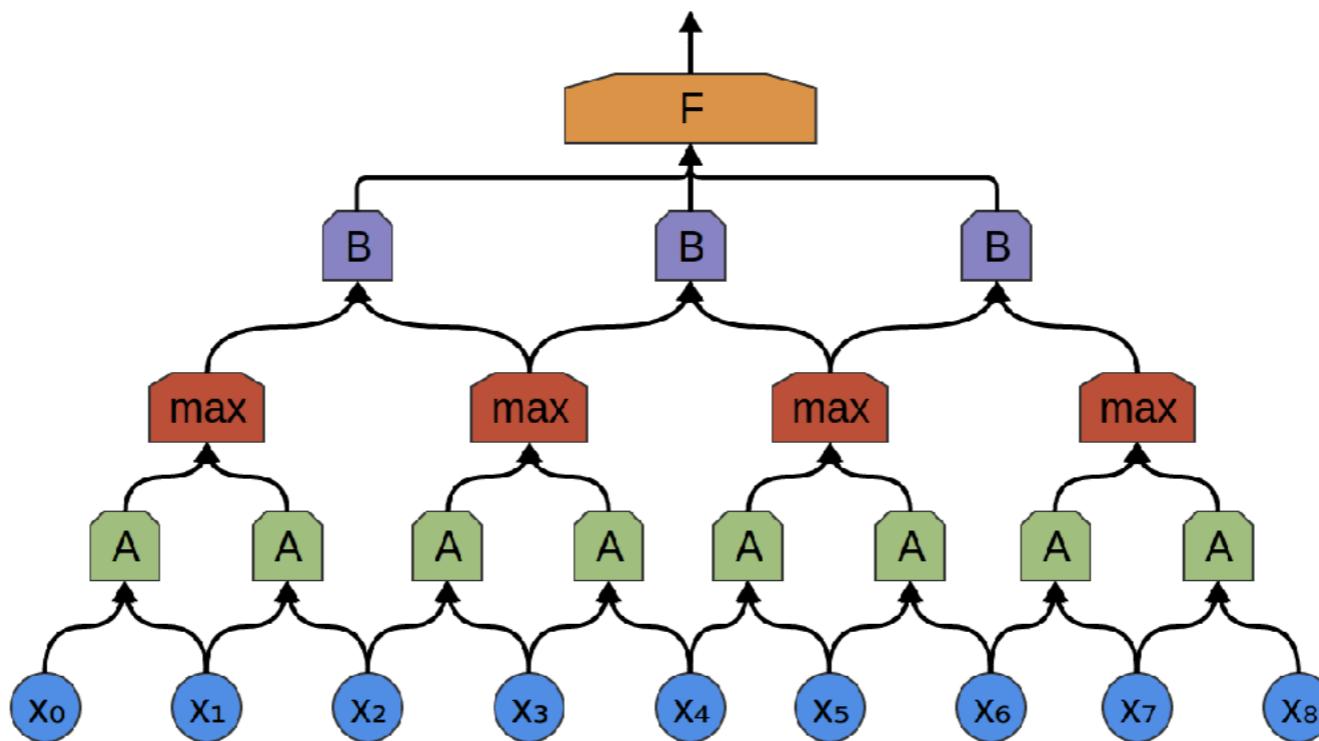
# Multilayer Neural Networks



# Back propagation



# Convolution



Source: <https://www.tensorflow.org>

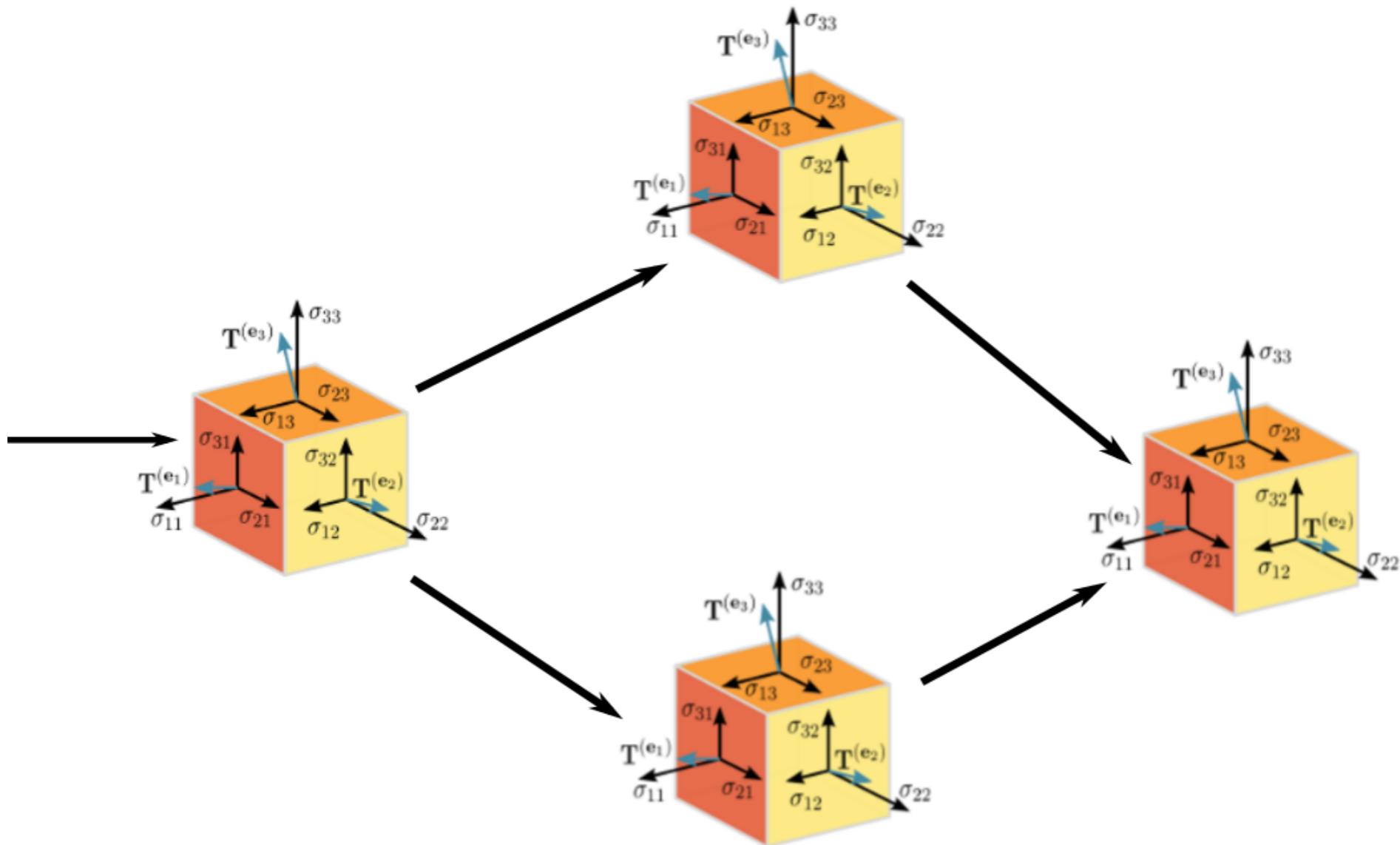
# Important terms

- deep learning
- stochastic gradient descent
- batch and mini-batch learning
- epoch
- dropout

# What is not TensorFlow



# What is TensorFlow?



# Keras tutorial

**01-Keras-introduction.ipynb**

# **Implementation of some classification and regression task using NN**

**02-Classification-nn-assignment.ipynb**

**03-Regression-nn-assignment.ipynb**

# ResNet



# Finetuning

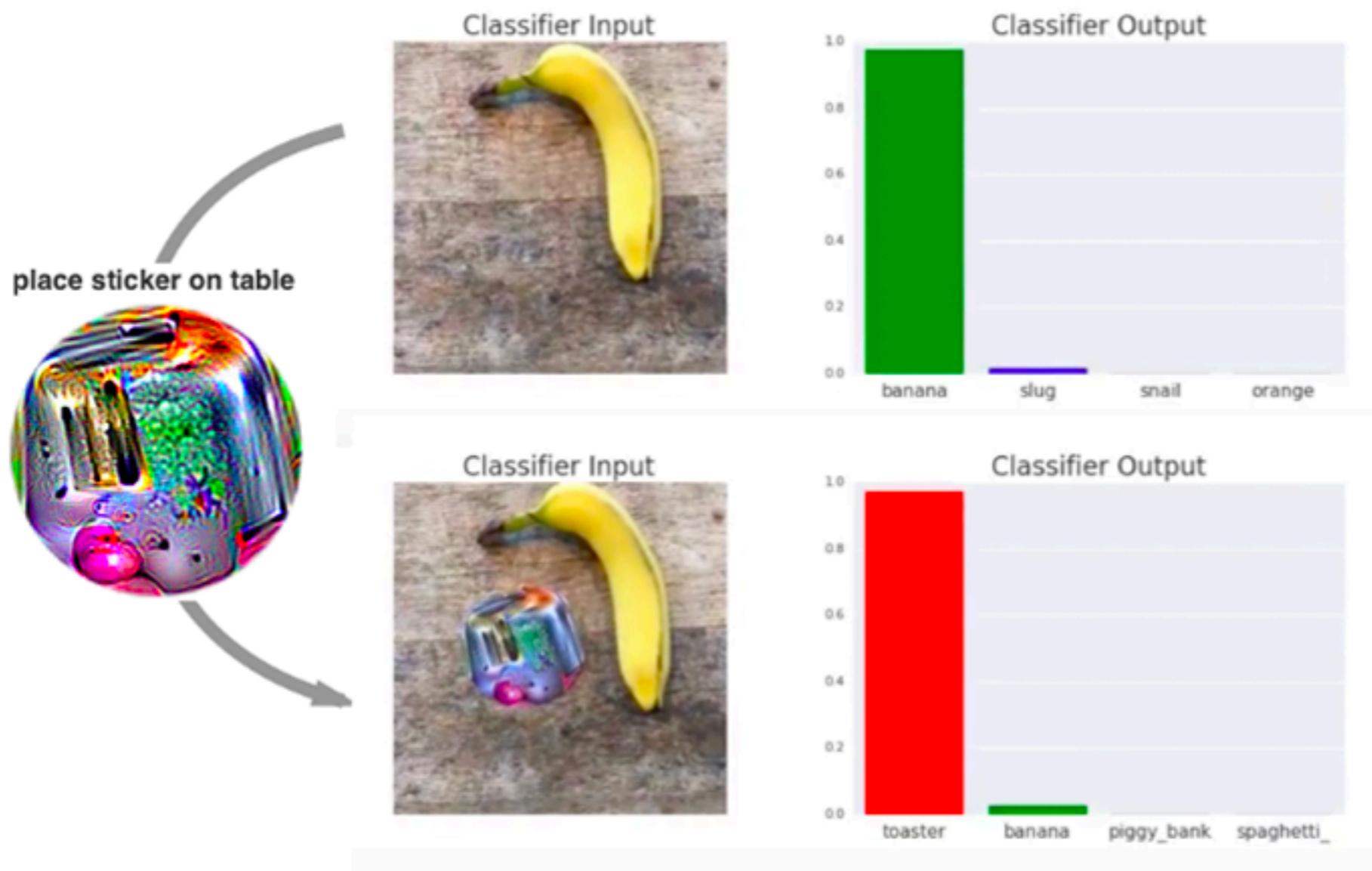
## Transfer Learning



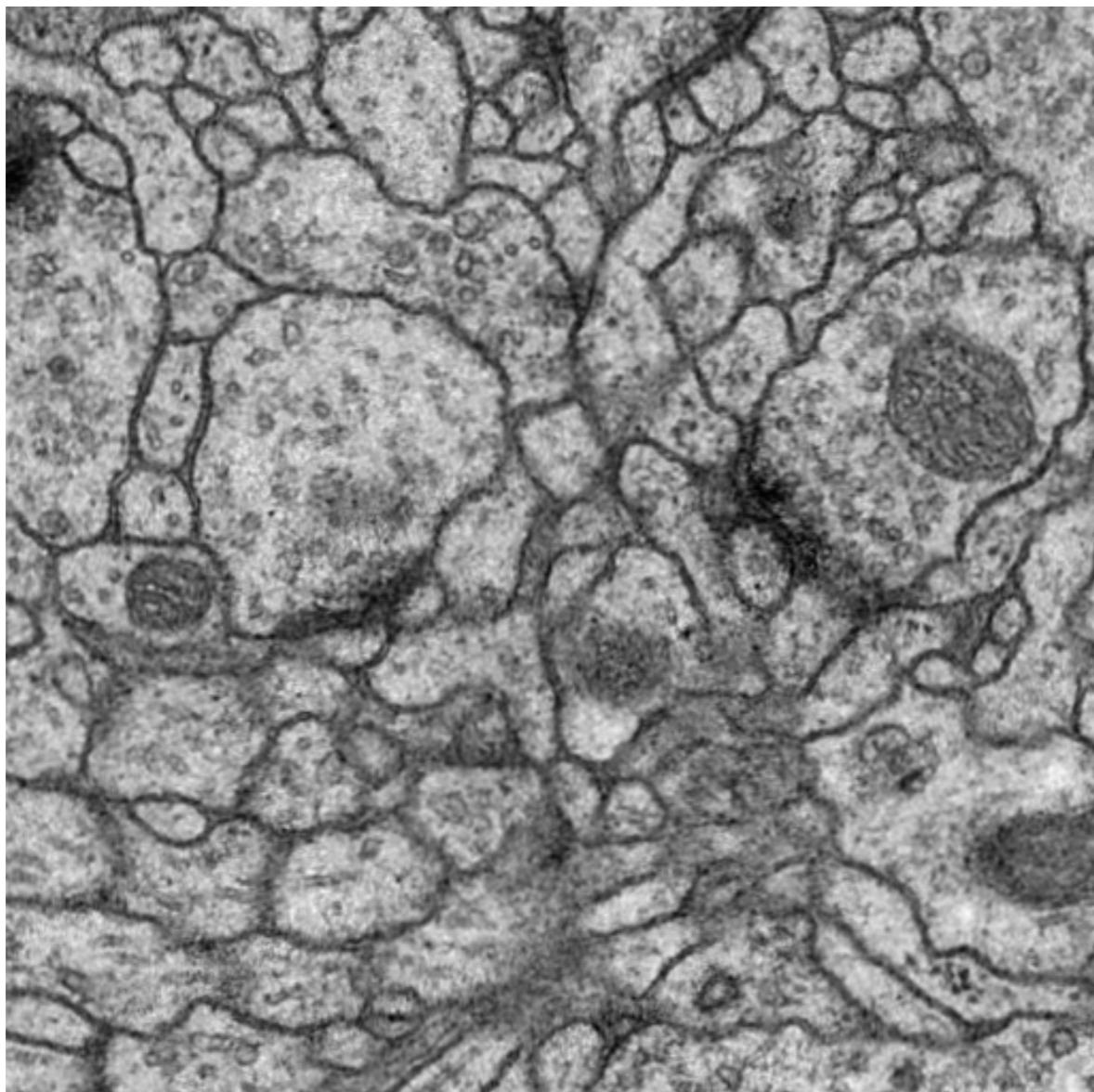
# **Transfer learning example**

**04-Transfer\_learning.ipynb**

# Adversarial Patch

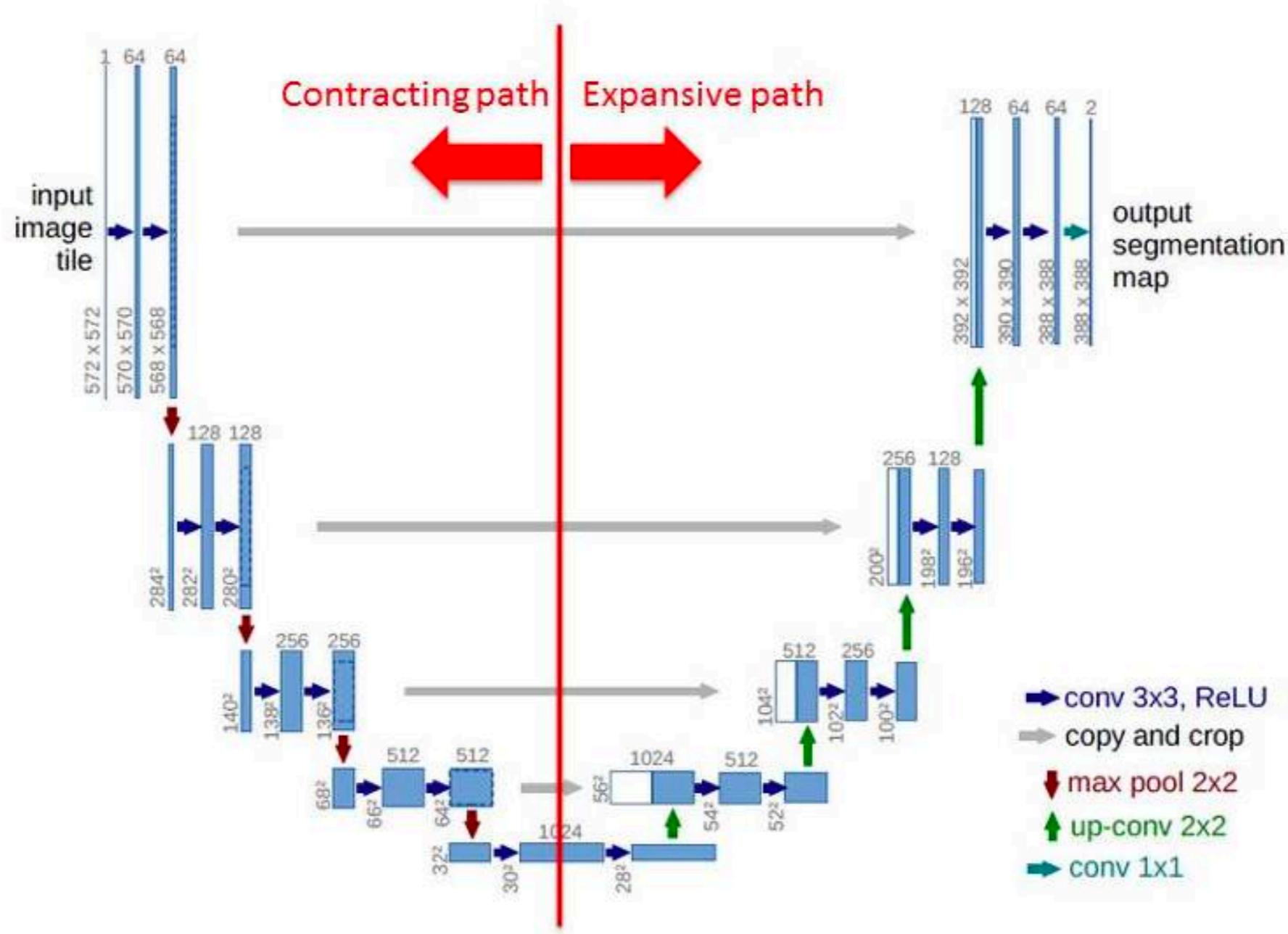


# Image segmentation

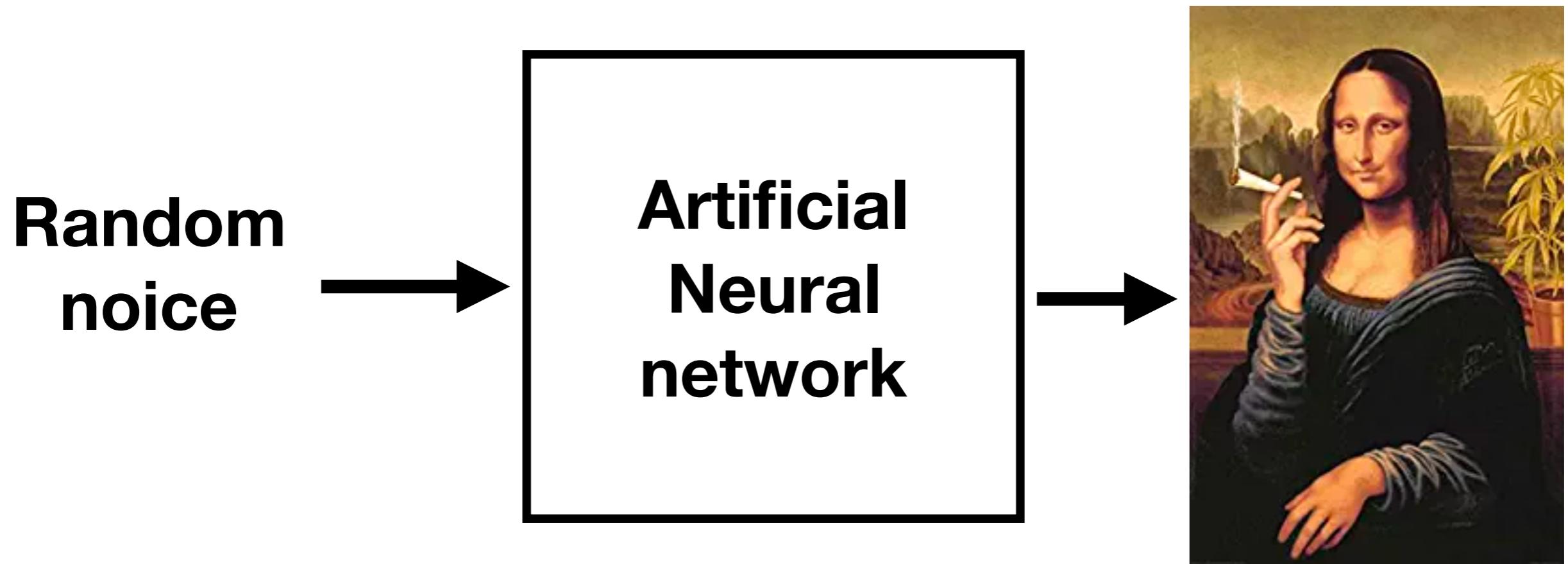


# U-Net

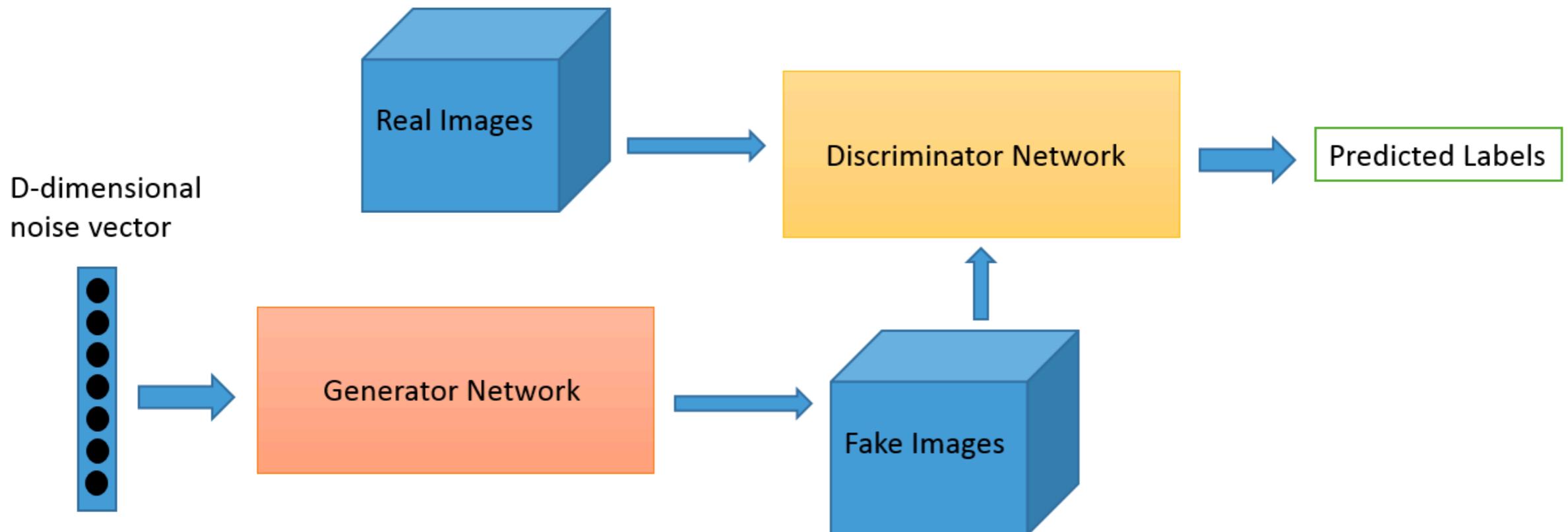
## Network Architecture



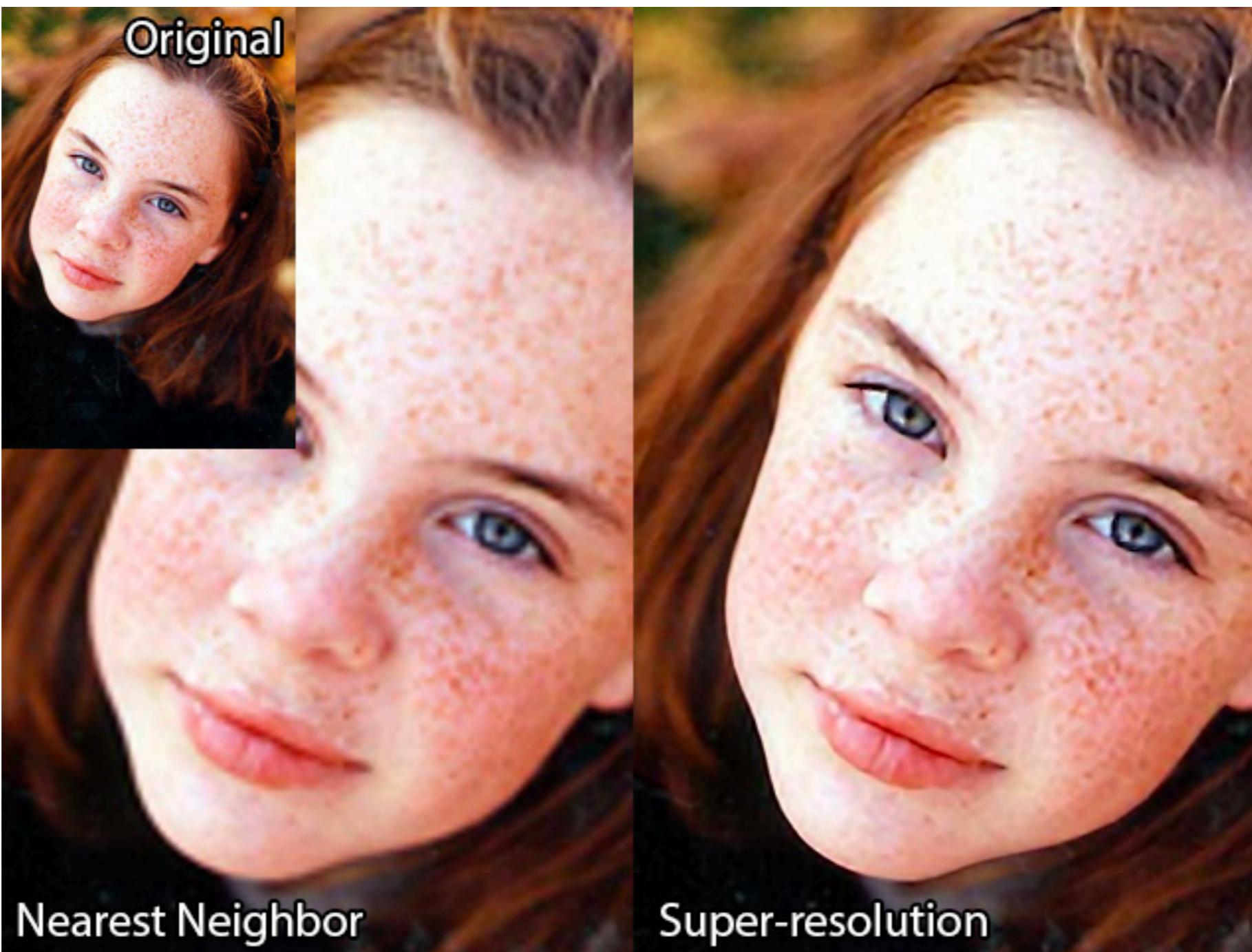
# Generative models with neural networks



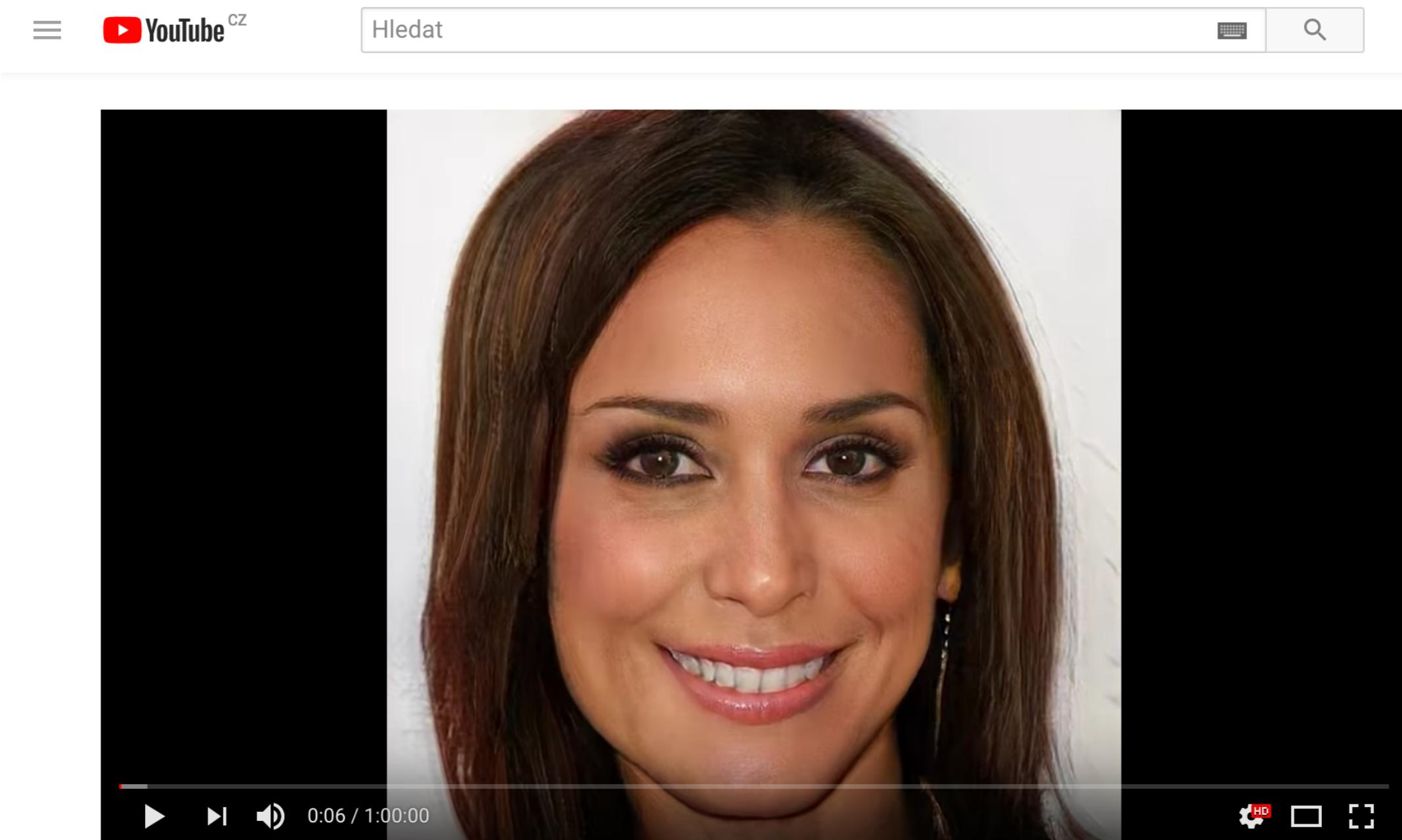
# Generative Adversarial Networks



# Superresolution



# Image synthesis



One hour of imaginary celebrities

95 832 zhlédnutí



TO SE MI LÍBÍ



NELÍBÍ SE

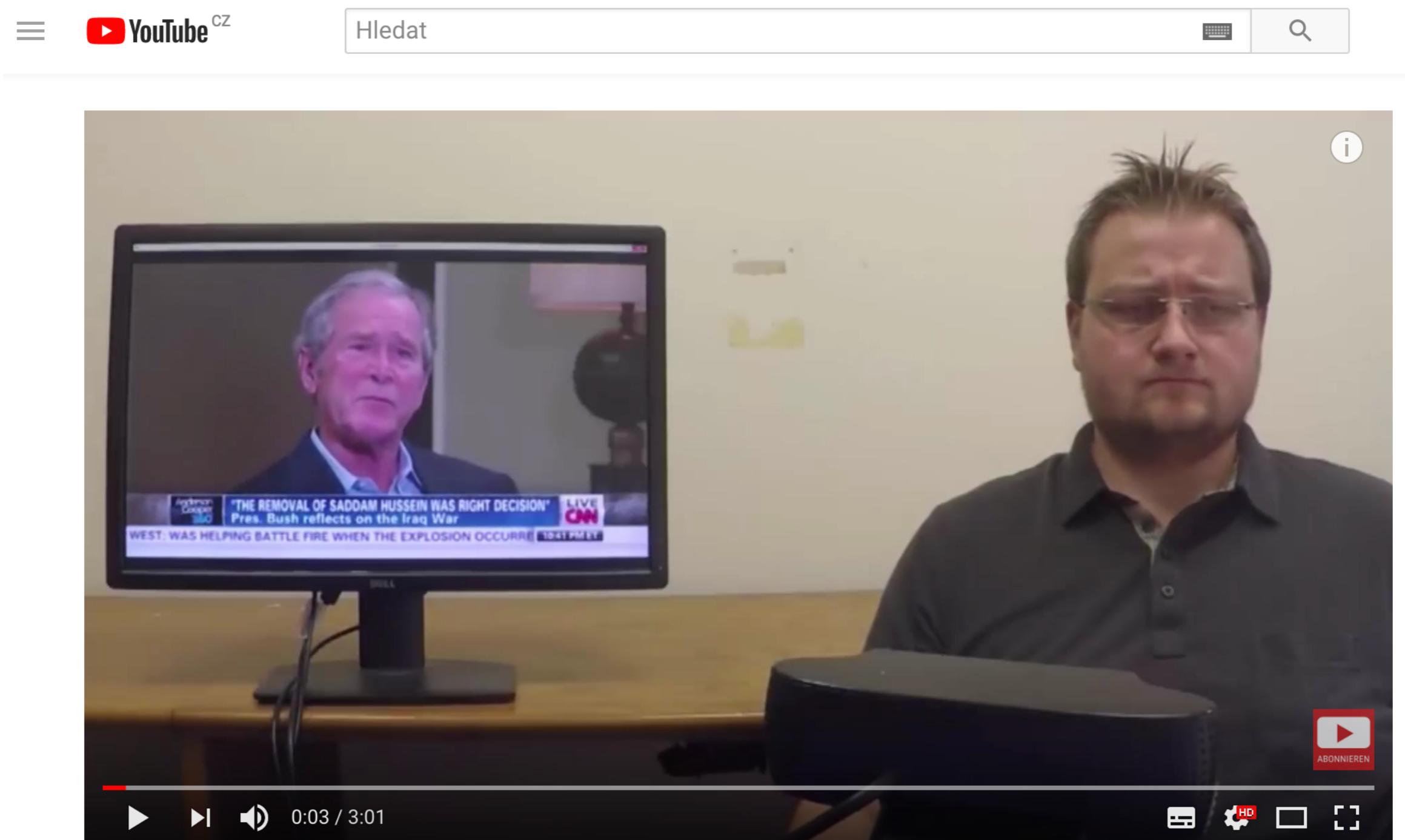


SDÍLET



...

# Image manipulation



How German scientists control Putin's face

3 540 zhlédnutí

117

1

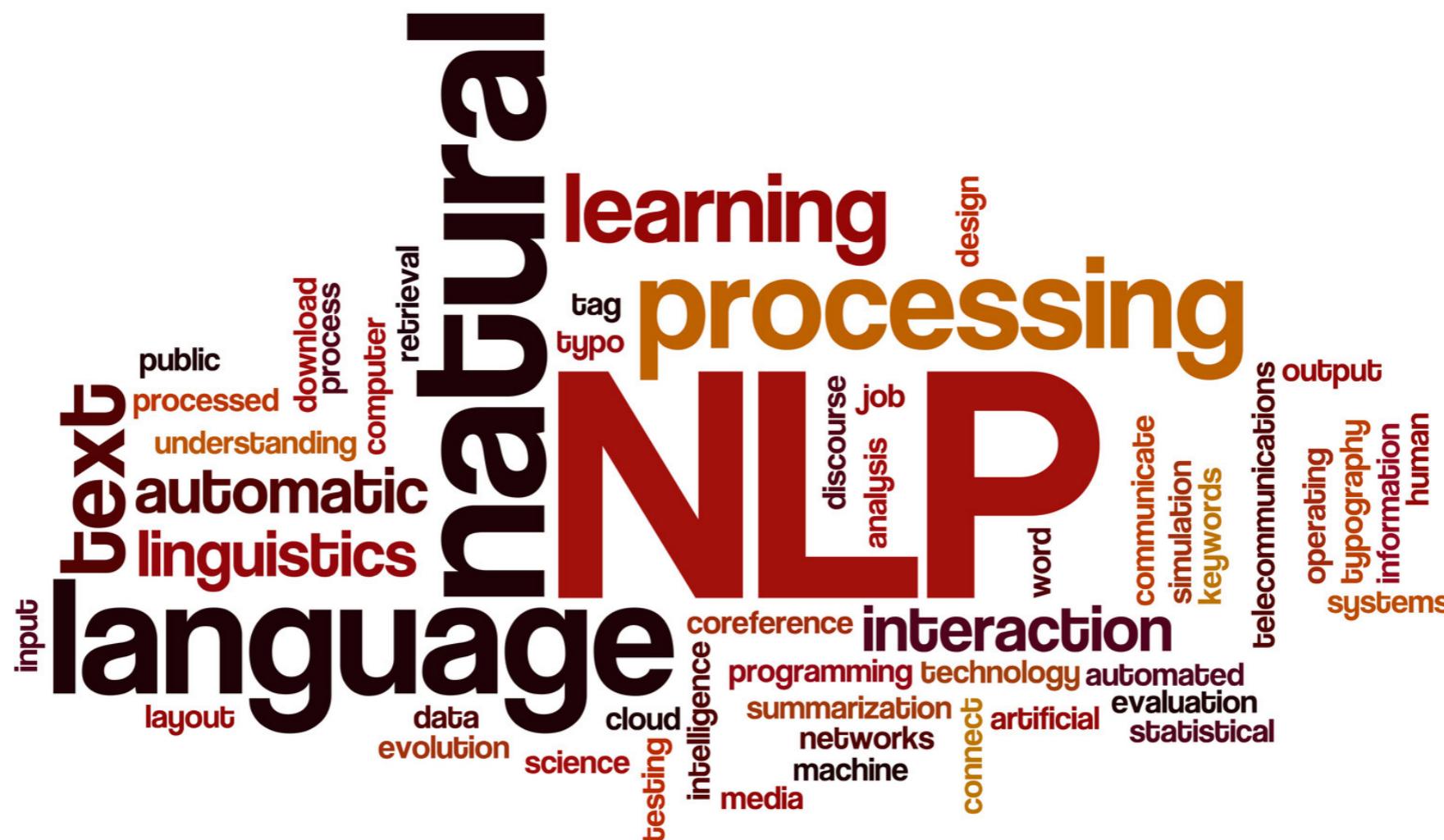
SDÍLET

...

# Generative Adversarial Networks

**06\_GANs.ipynb**

# Natural Language Processing



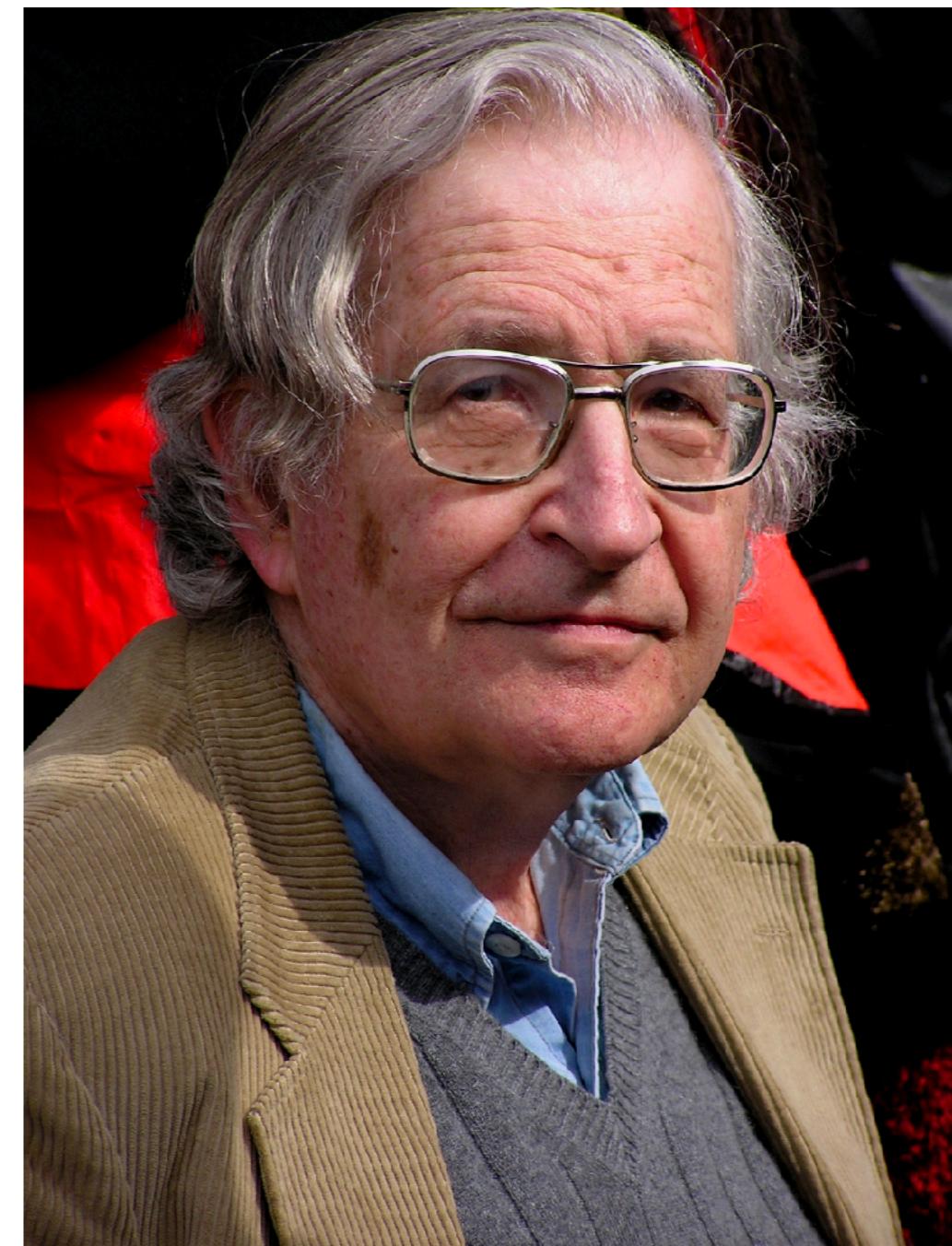
# Outline

- Introduction to natural language processing
- Computational linguistics
- Text document vectorization
- Practical document classification task
- Language modeling
- Practical tasks on language modeling
- Word embeddings
- Text generating
- Practical tasks on language modeling

# Norvig vs. Chomsky



source: <https://www.commarts.com>



source: <https://citaty.net>

# Text corpus



natural language   British National Corpus

Home

Search

Word list

Word sketch

Thesaurus

Sketch diff

Trends

Corpus info

My jobs

User guide ↗

Save

Make subcorpus

View options

KWIC

Sentence

Sort

Left

Right

Node

References

Shuffle

Sample

Query **natural, language** 255 (2.27 per million)

Page  of 13   |

J2K nature of deixis (see Chapter 2 below) in **natural languages**, for sentences like (II) are true or false only  
J2K of the simple but immensely important fact that **natural languages** are primarily designed, so to speak, for use in  
J2K . </p><p> The many facets of deixis are so pervasive in **natural languages**, and so deeply grammaticalized, that it is hard  
J2K the utterance, within the utterance itself. **Natural language** utterances are thus "anchored" directly to  
J2K semantics deals with certain **natural language** expressions. Suppose we identify the semantic  
J2K or self-referring expressions in **natural languages**, as in (12) and, arguably, in (13) (see Chapter 5  
J2K , is perhaps a philosophical red-herring. **Natural languages**, after all, just do have indexicals, and it is  
J2K . Semantics is then not concerned directly with **natural language** at all, but only with the abstract entities  
J2K to leave us with no term for all those aspects of **natural language** significance that are not in any way amenable to  
J2K of the deictic expressions that occur in **natural languages**, and we should now turn to consider linguistic  
J2K in familiar languages. </p><p> Deictic systems in **natural languages** are not arbitrarily organized around the  
J2K . But this has the consequence, as we noted, that **natural languages** will only have a syntax and a pragmatics, and no  
J2K more or less directly on fragments of **natural language** (as initiated by Montague, 1974) would make  
J2K The semanticist who takes the other tack, that **natural language** senses are protean, sloppy and variable, is  
J2K offers a way out, for it allows one to claim that **natural language** expressions do tend to have simple, stable and  
J2K radical differences between logic and **natural language** seem to fade away. We shall explore this below  
J2K on what can be a possible lexical item in **natural languages** . </p><p> Finally, the principles that generate  
J0V is meant any single document, or any stretch of **natural language** regarded as a self-contained unit for  
J53 recognition and those that can understand **natural languages**, such as English, are known by the collective  
HRK through a dialogue, which approaches a **natural language** dialogue, or via a menu. In figure 6.2, the users

Page  of 13   |

# Token & tokenization

This is a non-trivial English sentence: Ludolph's number is approx. 3.14.

**Python library:** <http://www.nltk.org/>

# Stemming & lemmatization

Original	Stemming	Lemmatization
compensation	compens	compensation
compensations	compens	compensation
mouse	mous	mouse
mice	mice	mouse

# Stemming & lemmatization

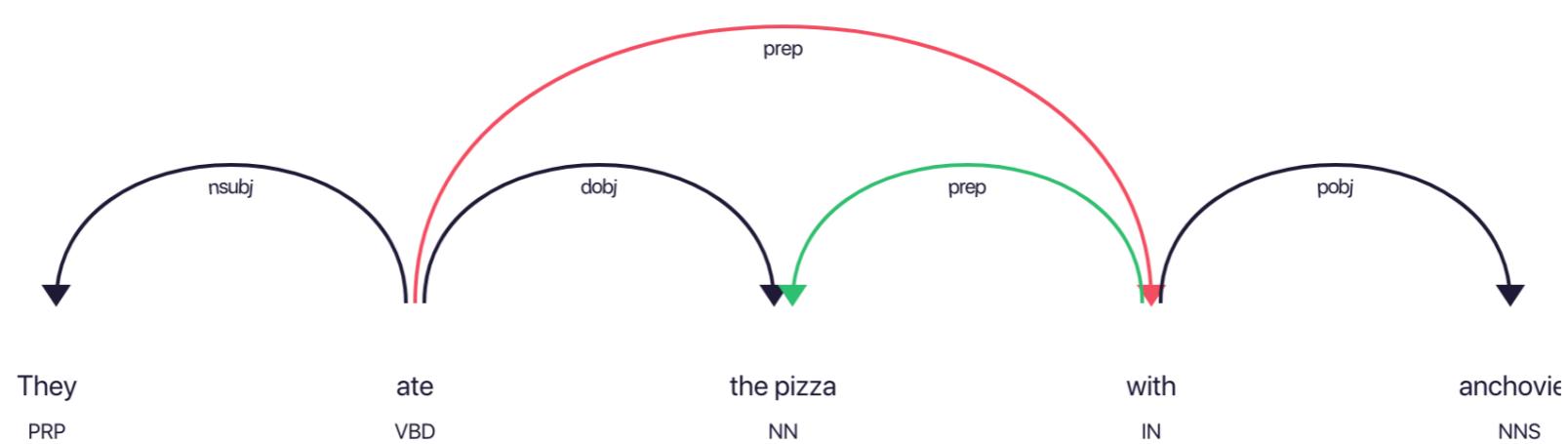
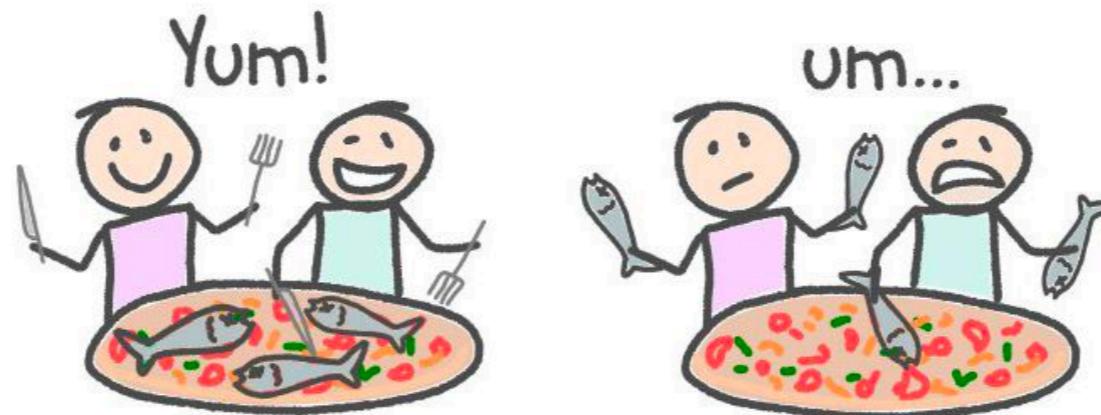
**English:**

<https://tartarus.org/martin/PorterStemmer/>

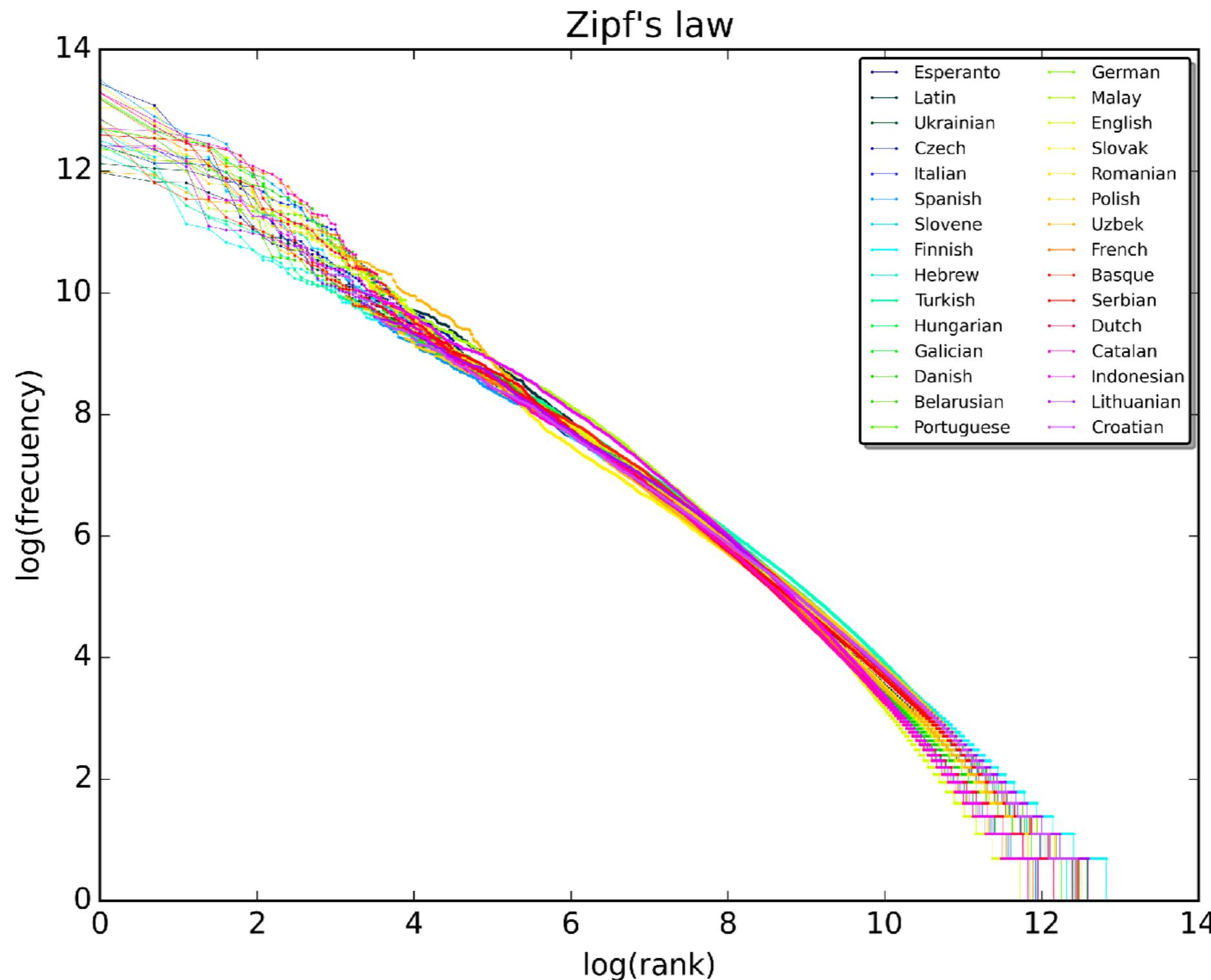
<http://www.cis.uni-muenchen.de/~schmid/tools/TreeTagger/>

# Parsing

They ate the pizza with anchovies



# Zipf's law & long tail



# Publicly available corpora

**British National Corpus:** <http://www.natcorp.ox.ac.uk/>

**Common Crawl:** <http://commoncrawl.org/the-data/get-started/>

**Wikipedia:** <https://dumps.wikimedia.org/>

# Feature extraction for NLP

1. *the man walked the dog*
2. *the man took the dog to the park*
3. *the dog went to the park*

[dog, man, park, the, to, took, walked, went]

1. [1, 1, 0, 1, 0, 0, 1, 0]
2. [1, 1, 1, 1, 1, 1, 0, 0]
3. [1, 0, 1, 1, 1, 0, 0, 1]

$$\text{idf}(t, D) = \log \frac{N}{|\{d \in D : t \in d\}|}$$

1. [1, 1, 0, 2, 0, 0, 1, 0]
2. [1, 1, 1, 3, 1, 1, 0, 0]
3. [1, 0, 1, 2, 1, 0, 0, 1]

1. [0, 0.18, 0, 0, 0, 0, 0.48, 0]
2. [0, 0.18, 0.18, 0, 0.18, 0.48, 0, 0]
3. [0, 0, 0.18, 0, 0.18, 0, 0, 0.48]

— . . .

# NLP Introduction task

**07-text-classification-introduction.ipynb**

# Language models

- spell checking
- speech recognition
- machine translation
- ...

# n-gram models – example

$P(< s >, \text{machine}, \text{learning}, \text{college}, </s>) =$

$P(\text{machine}|< s >)P(\text{learning} | \text{machine})P(\text{college} | \text{learning}).P(< s />|\text{college})$

$P(\text{learning} | \text{machine}) = \text{count}(\text{machine}, \text{learning})/\text{count}(\text{machine})$

# Language model smoothing

- Laplace smoothing (plus one)

$$P(w_i|w_{i-1}) = \frac{\text{count}(w_{i-1}, w_i) + 1}{\text{count}(w_{i-1}) + V}$$

- interpolation
- Good-Turing
- Witten-Bell
- ...

# Perplexity

$$PP(W) = P(w_1, w_2, \dots, w_N)^{-\frac{1}{N}}$$

$$= \sqrt[N]{\frac{1}{P(w_1, w_2, \dots, w_N)}}$$

$$= \sqrt[N]{\prod_{i=1}^N \frac{1}{P(w_i | w_1, \dots, w_{i-1})}}$$

$$= 2^{-\frac{1}{N} \sum_{i=1}^N \log_2 P(w_i | w_1, \dots, w_{i-1})}$$

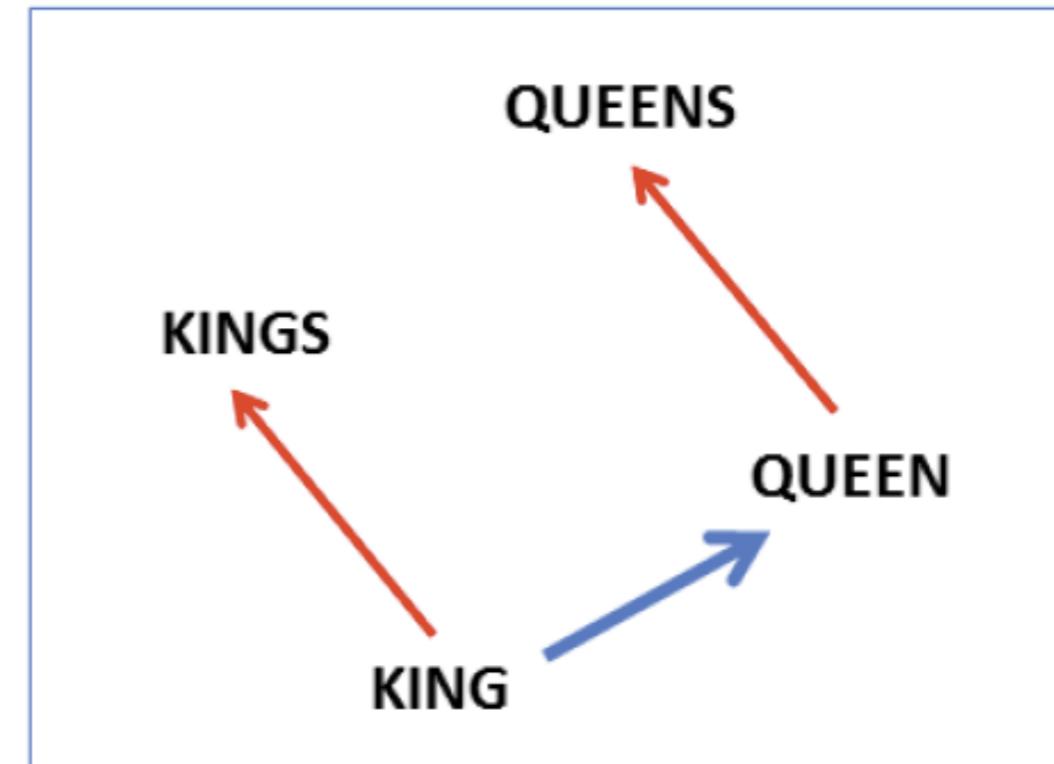
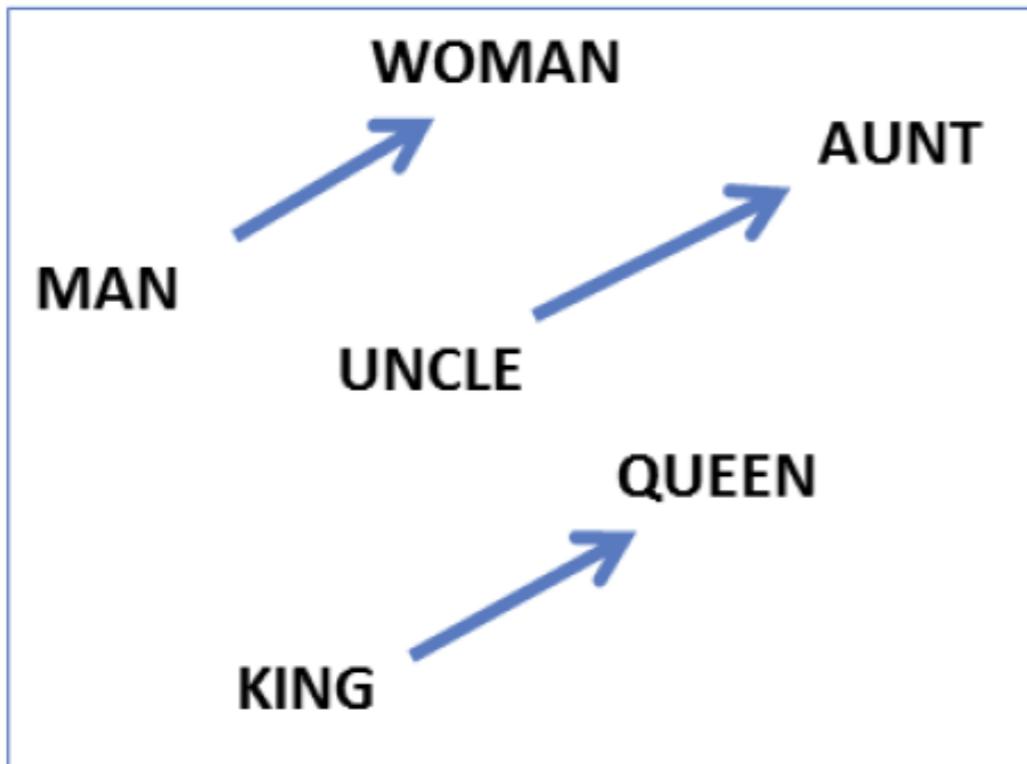
# Language detection using language models

[08-Language-detection-assignment.ipynb](#)

# Travel agency review classification

[\*\*09-Review-classification-assignment.ipynb\*\*](#)

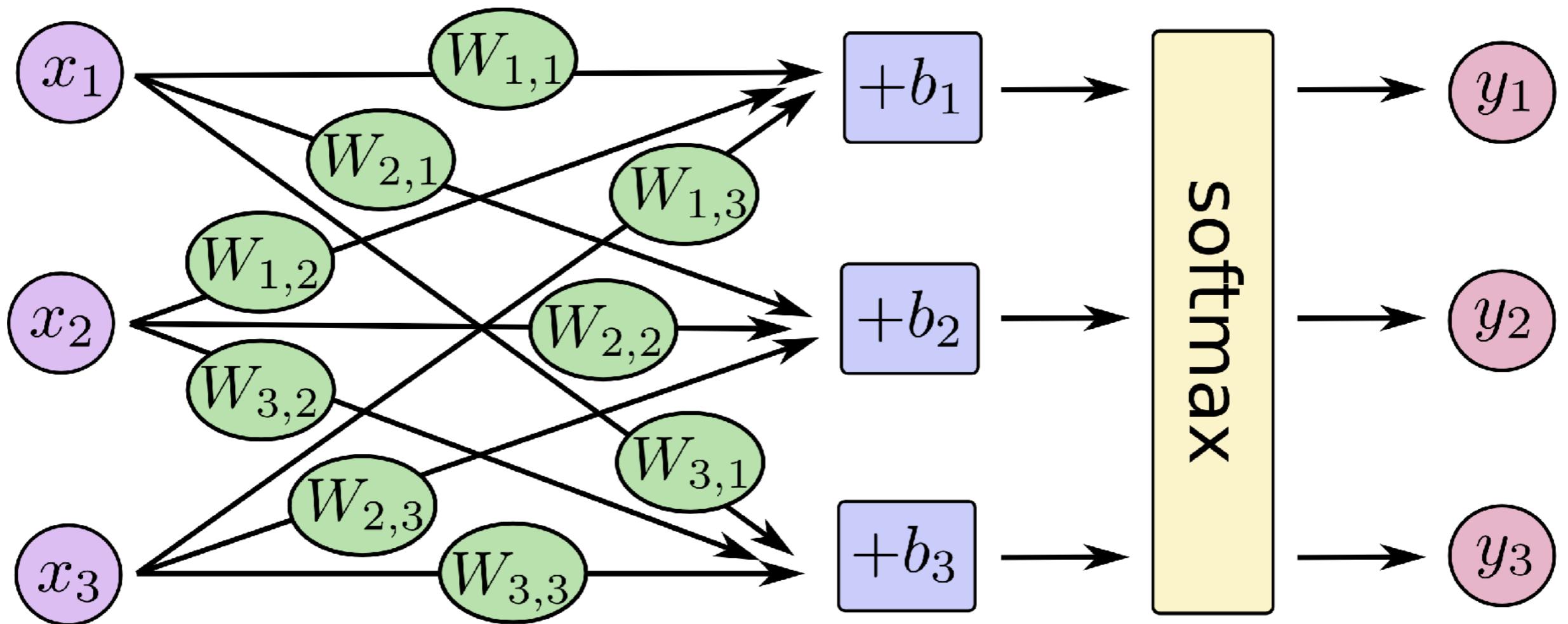
# word2vec



**king** is to **kings** as **queen** to ?.

$$v(\text{kings}) - v(\text{king}) = v(\text{queens}) - v(\text{queen})$$

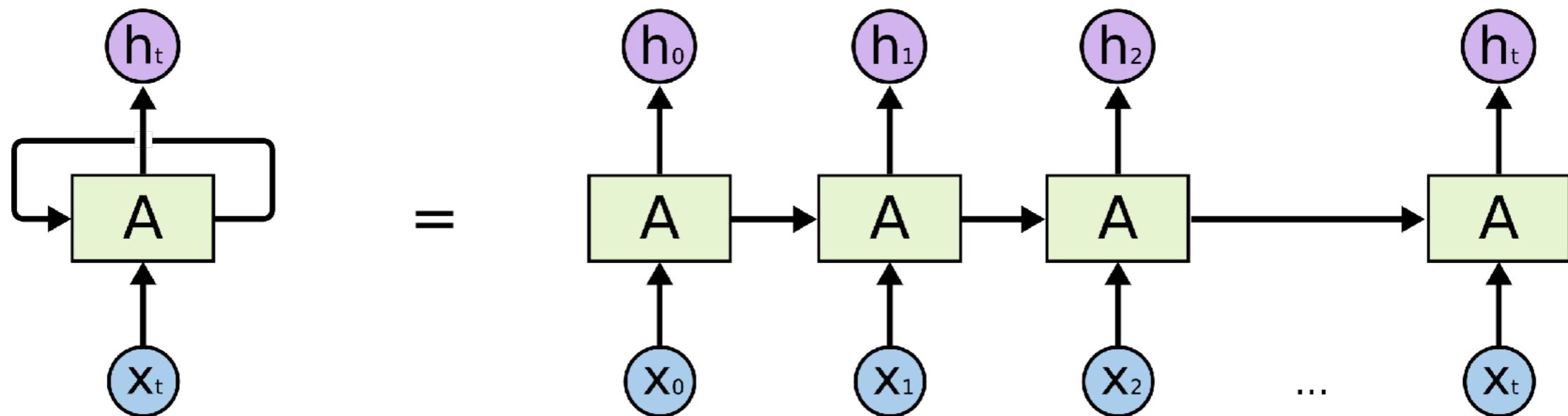
# Feed-Forward Neural Network



source: <https://www.tensorflow.org>

# Recurrent Neural networks

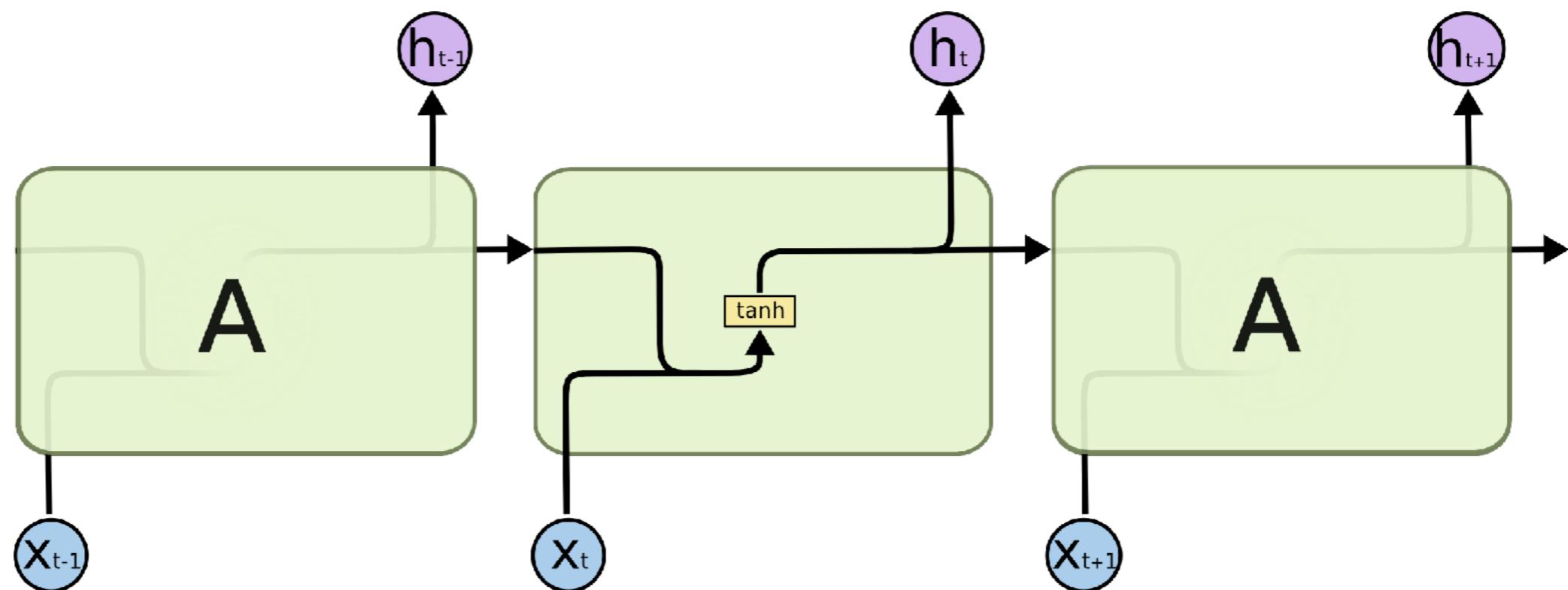
## 1/2



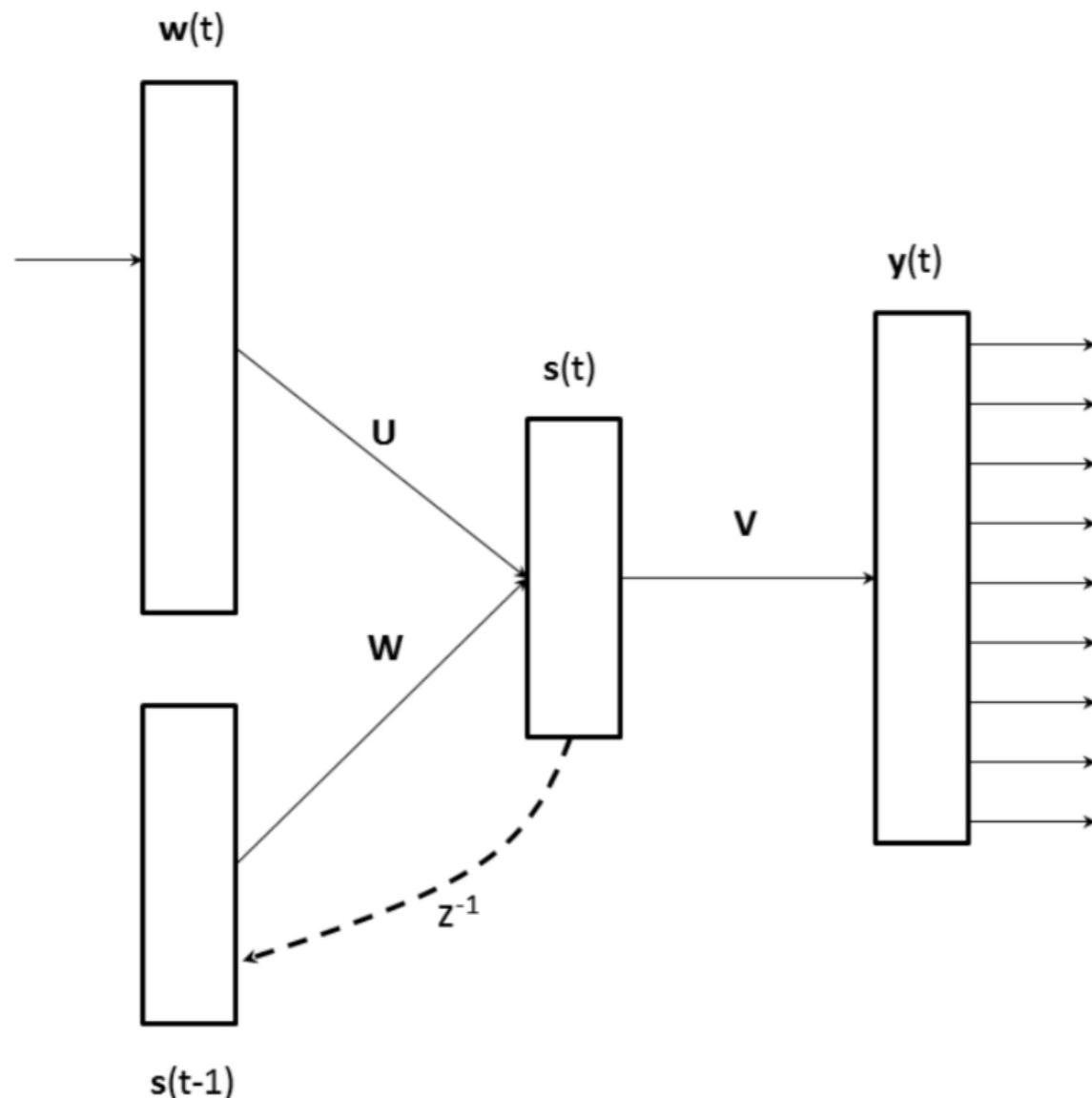
source: <http://colah.github.io/posts/2015-08-Understanding-LSTMs/>

# Recurrent Neural Networks

## 2/2



# Recurrent Neural Network Language Modeling Toolkit



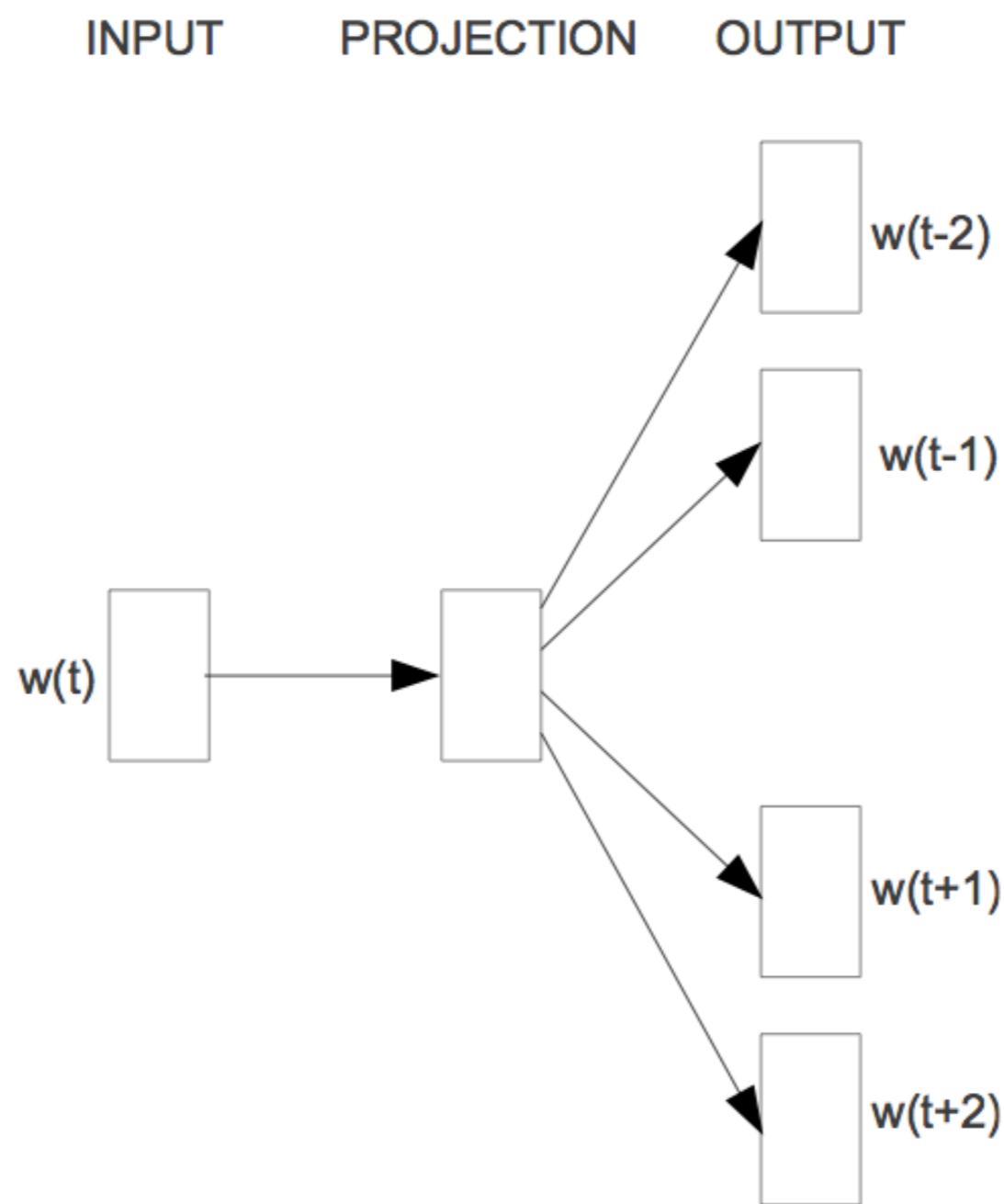
$$s(t) = f(\mathbf{U}w(t) + \mathbf{W}s(t-1))$$

$$y(t) = g(\mathbf{V}s(t)),$$

$$f(z) = \frac{1}{1 + e^{-z}}, \quad g(z_m) = \frac{e^{z_m}}{\sum_k e^{z_k}}.$$

source: <http://www.fit.vutbr.cz/~imikolov/rnnlm/>

# The skip-gram model



# **Experiments with word2vec**

**10-Word2vec-in-gensim.ipynb**

**11-Review-classification-w2v-assignment.ipynb**

# Language models for text generating

Nacházíte se: Úvod > Oddělení > Krásná literatura > Poezie > Česká a slovenská poezie > Elektronická kniha Poezie umělého světa



Poezie umělého světa [E-kniha]

Jiří Materna



 Hodnotilo 7 uživatelů, zatím žádné recenze, [napsat vlastní recenzi](#)

**Popis:** [Elektronická kniha](#), 50 stran, bez zabezpečení DRM,  ePUB,  Mobi,  PDF, česky - [více](#)



[Stáhnout](#)



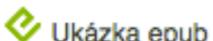
**Zdarma**

K dispozici pro **okamžité** stáhnutí

Ke stažení

Anotace

Všechny básně v této knize byly automaticky vygenerovány počítačem za pomocí umělých neuronových sítích. Neuronová síť sama o sobě nic neumí a je třeba ji natrénovat pro činnost, kterou má vykonávat.



## LISTOPAD

usínám, pláču, umírám, přemýšlím  
co cítíš ty?  
cítim tvou slabost  
a whisky

## NOVEMBER

I am falling asleep, crying, dying, thinking  
what do you feel?  
I feel your weakness  
and whisky

## SPRAVEDLNOST

na tvou dekadentní duši  
ráno i v poledne  
bůh má připravenou kuši

## JUSTICE

for your decadent soul  
in the morning, in the evening  
the god has prepared a crossbow

# Metaphores

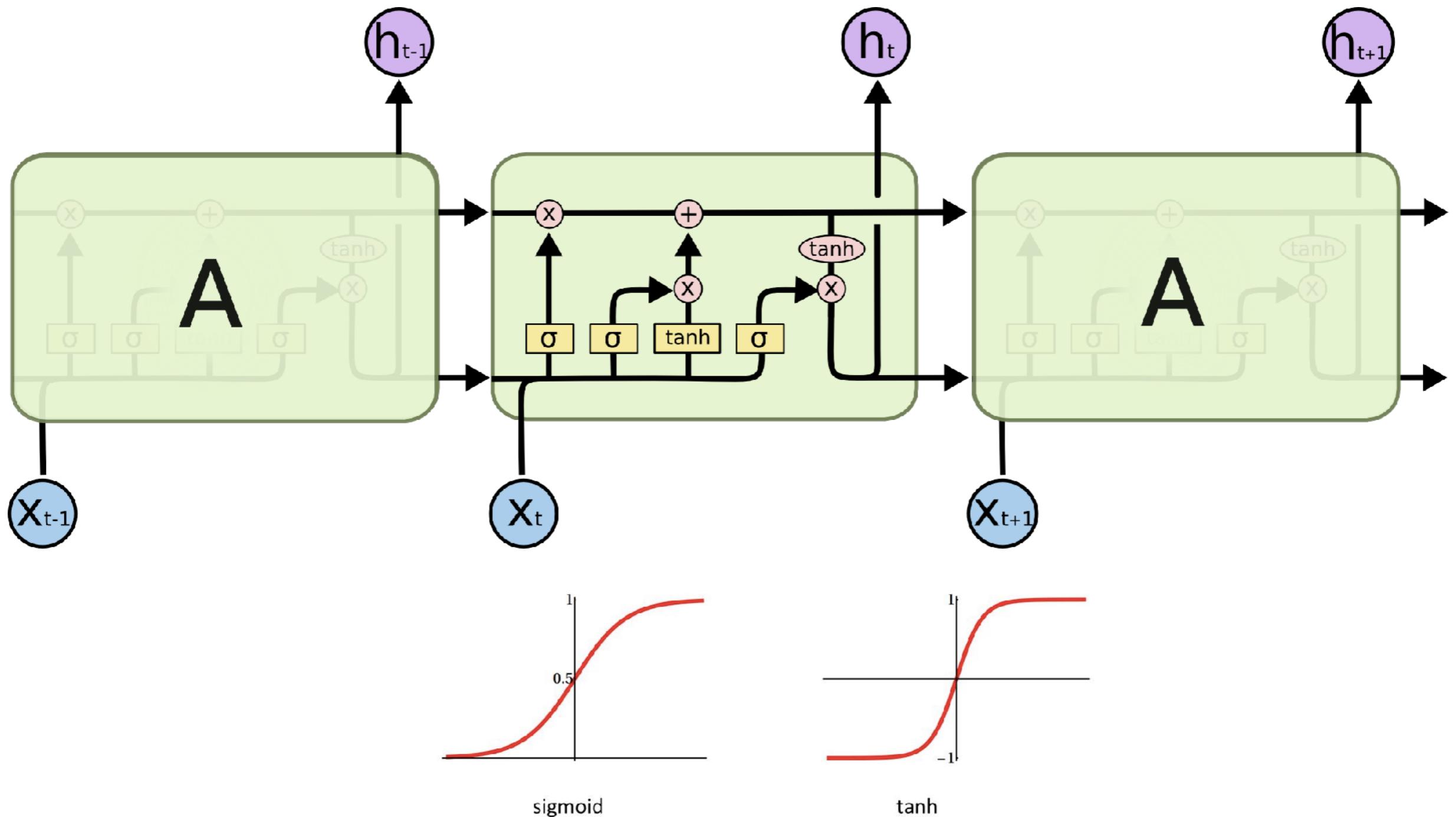
...tělo plné červánků...

...body full of blush of dawn...

...tak vzácný jako listí...

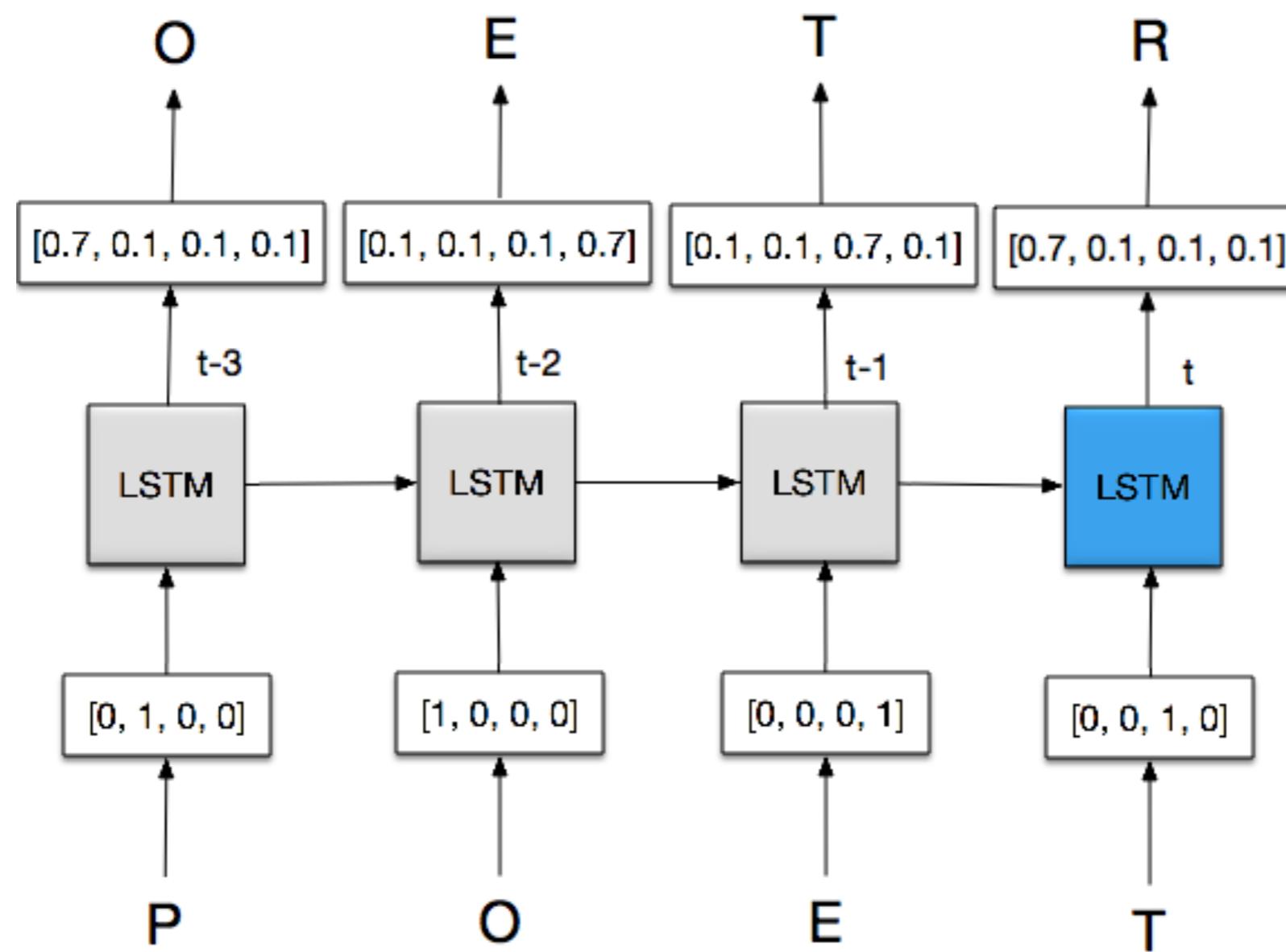
...as rare as leaves of trees...

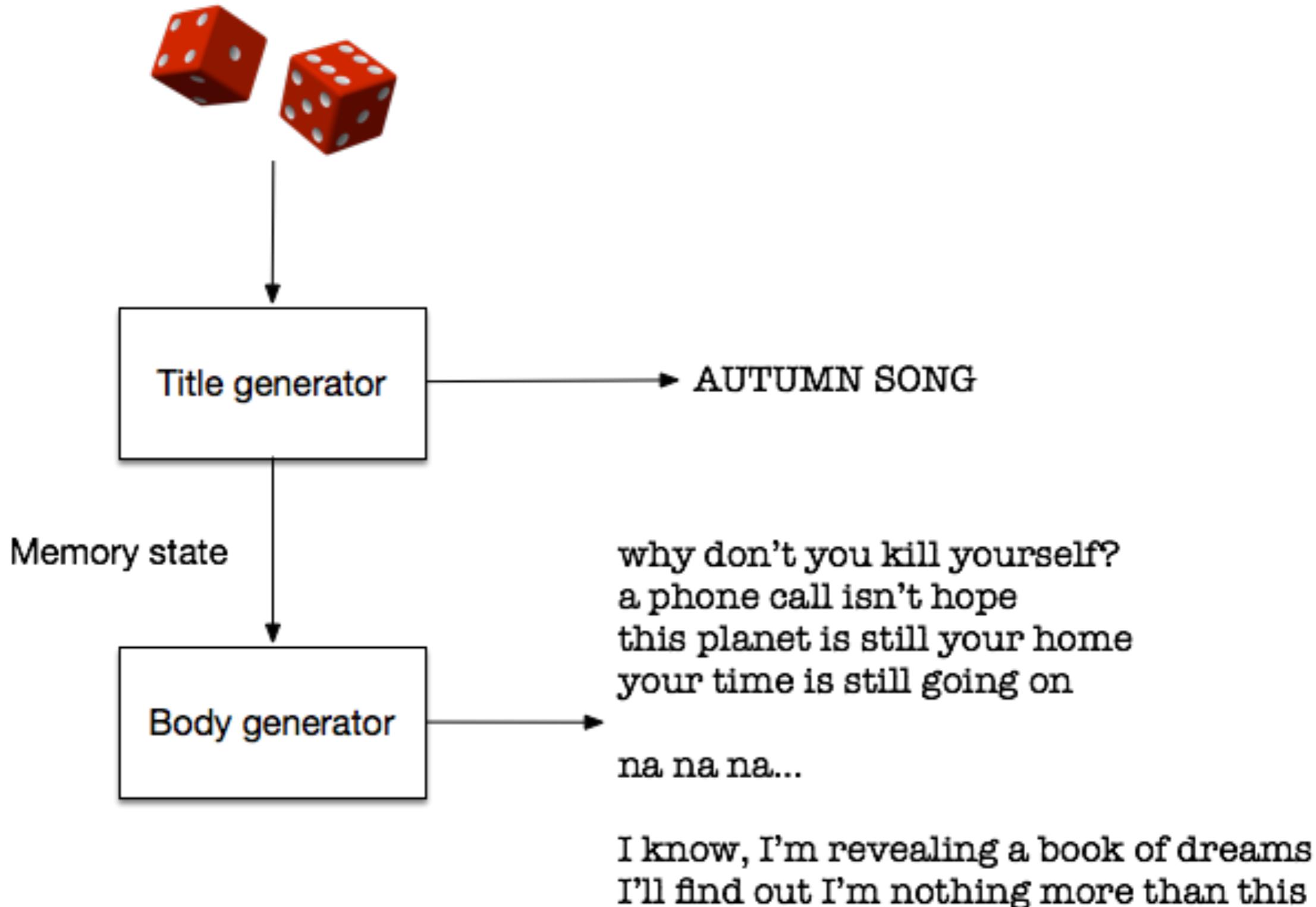
# Long Short-Term Memory



Source: <http://colah.github.io/posts/2015-08-Understanding-LSTMs/>

# LSTM language model

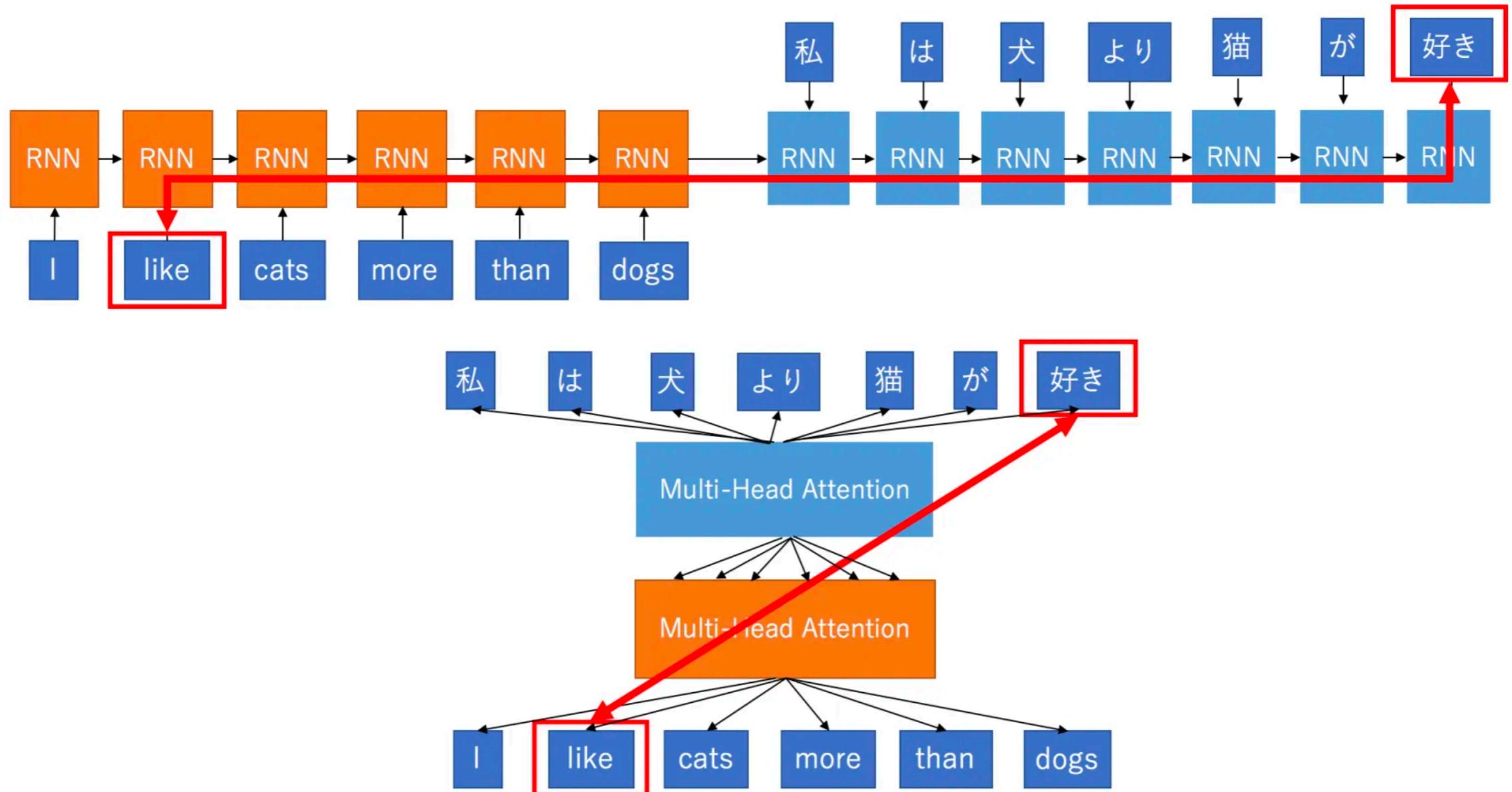




# LSTM review generator

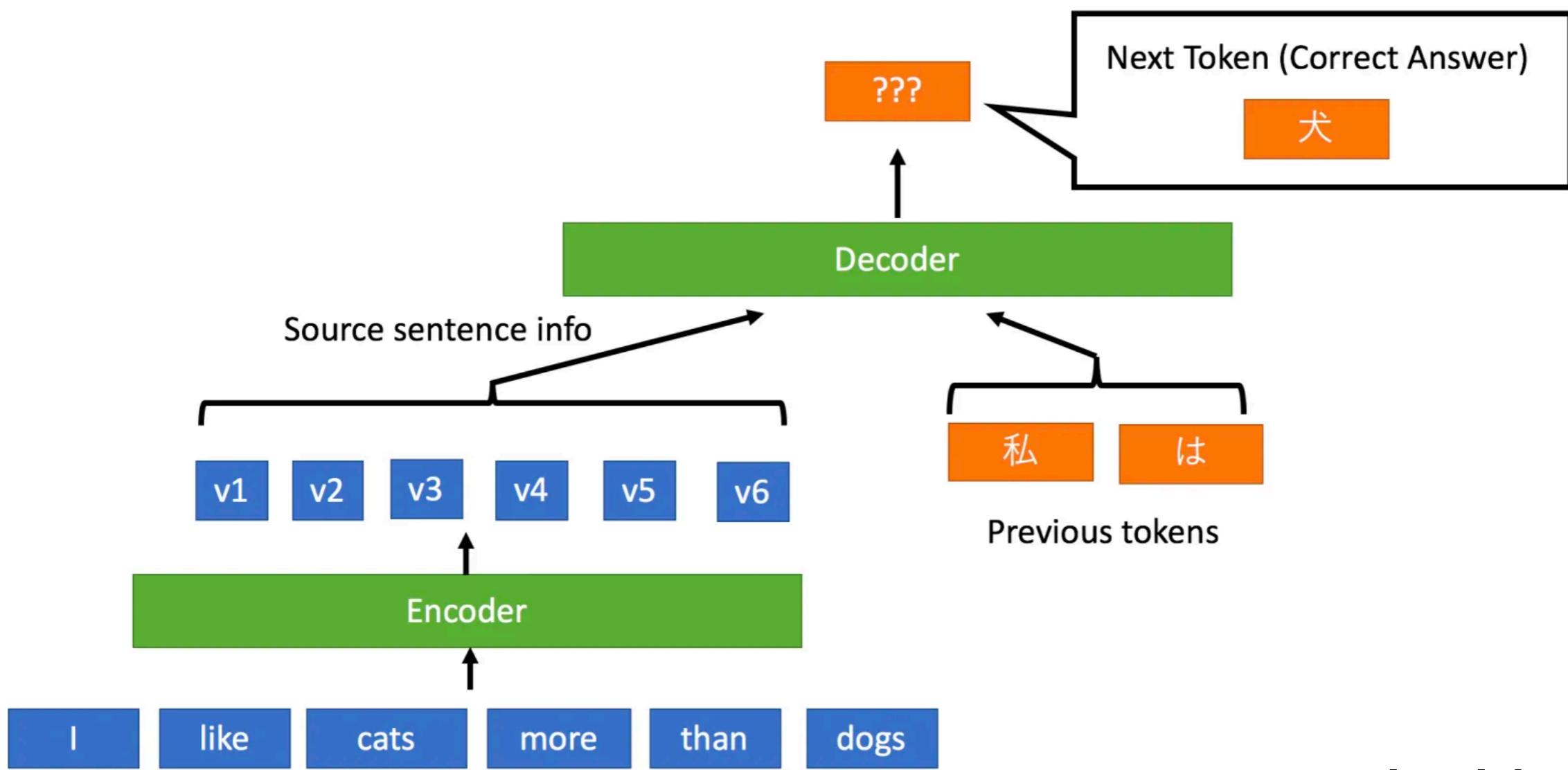
**12-Review-generator.ipynb**

# Transformer



source: [www.mlexplained.com](http://www.mlexplained.com)

# Translation with Transformers



# GPT-2 Language model

**Donald Trump told...**

Demo: <https://talktotransformer.com/>

# GPT-2 Language model

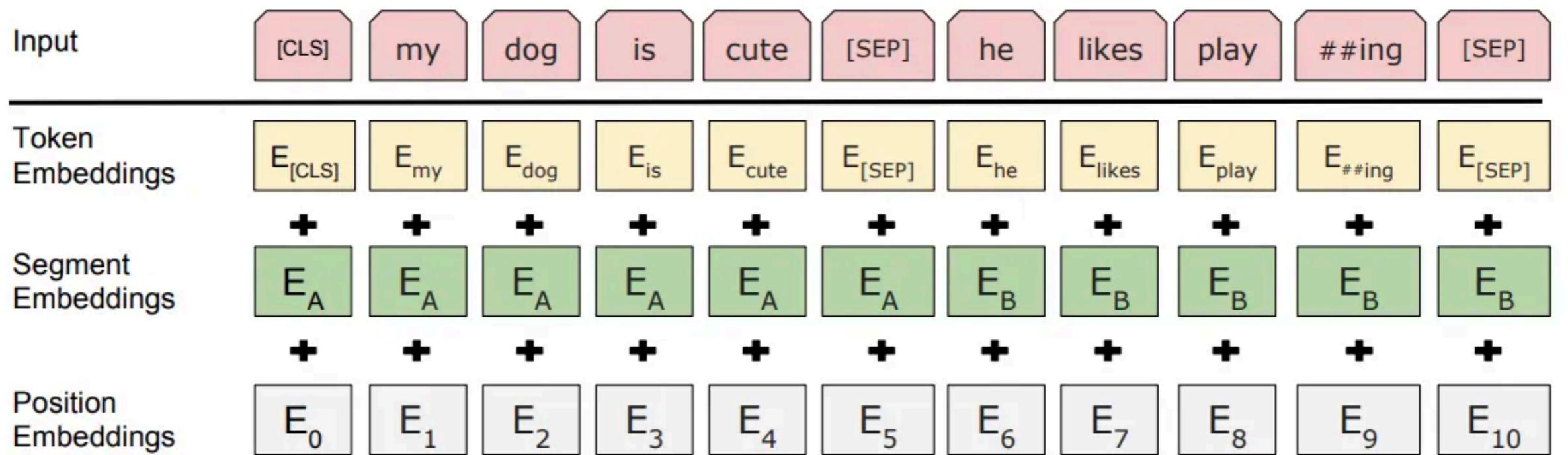
**Donald Trump told** the Times he is preparing a "major speech" on his economic plans, but did not provide details on what it will entail.

"I'm getting ready for the speech. And I will have a major speech on Tuesday." Trump said during an interview in the White House residence.

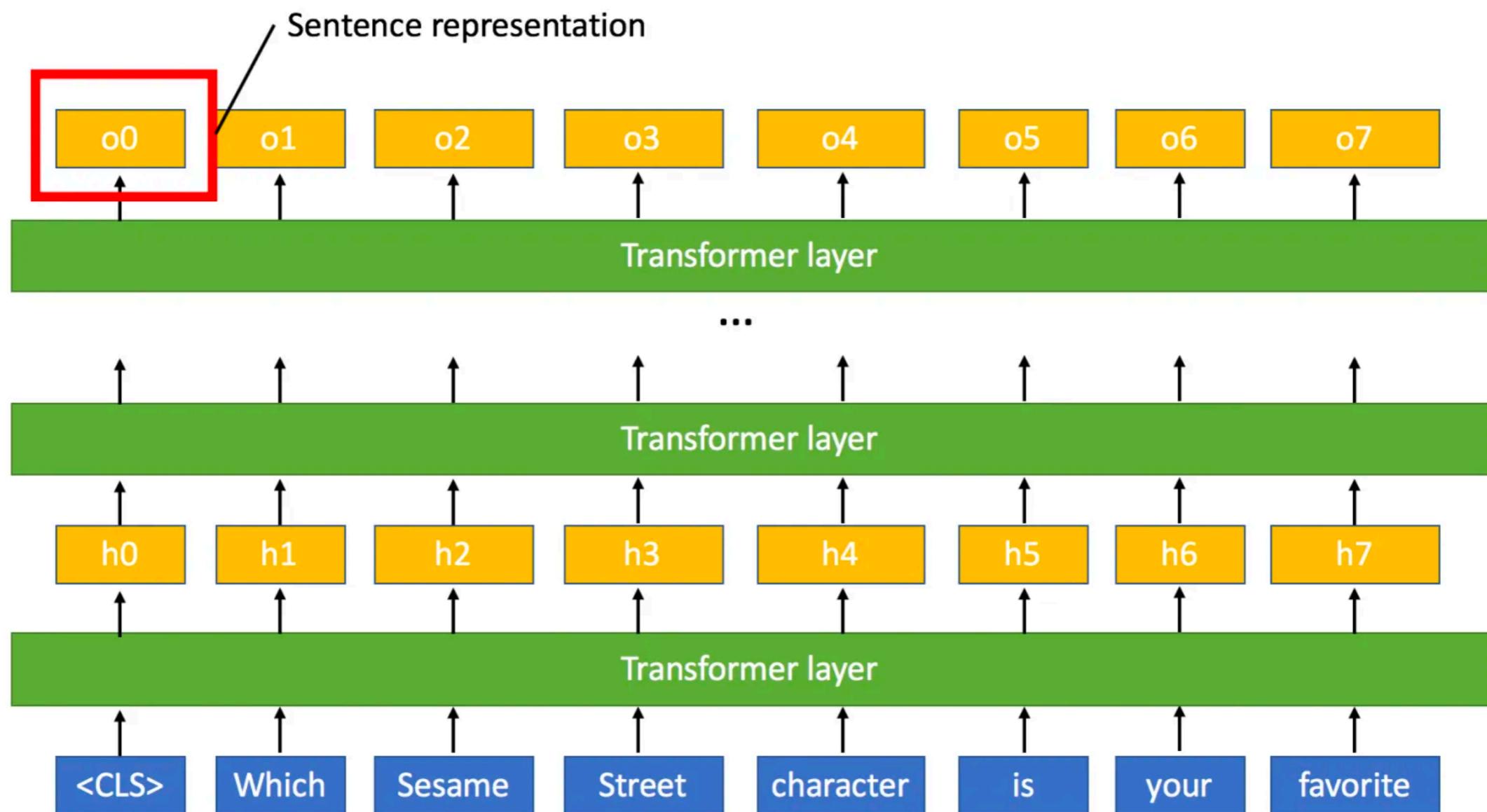
Demo: <https://talktotransformer.com/>

# BERT

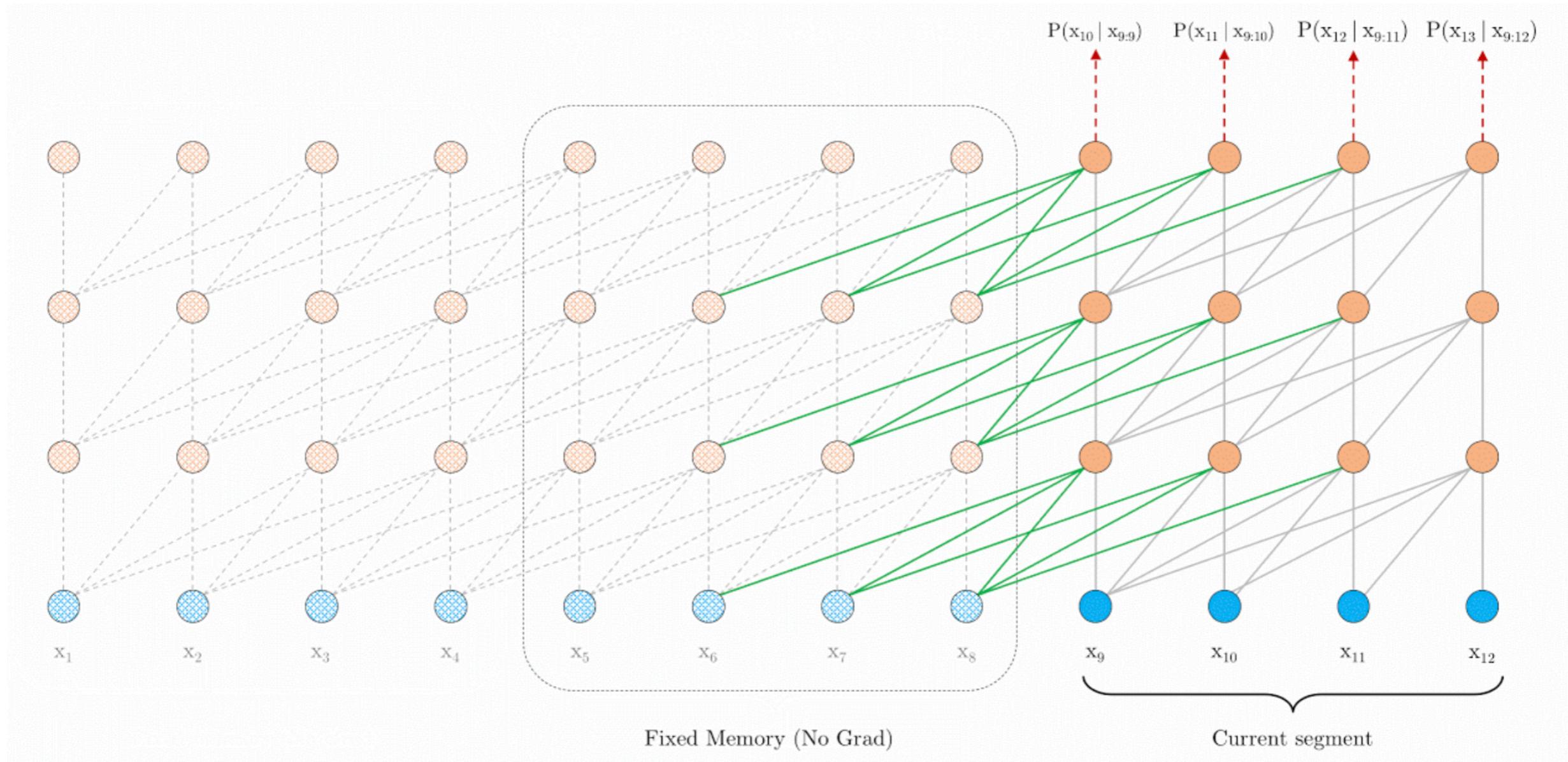
## (input encoding)



# BERT (classification)



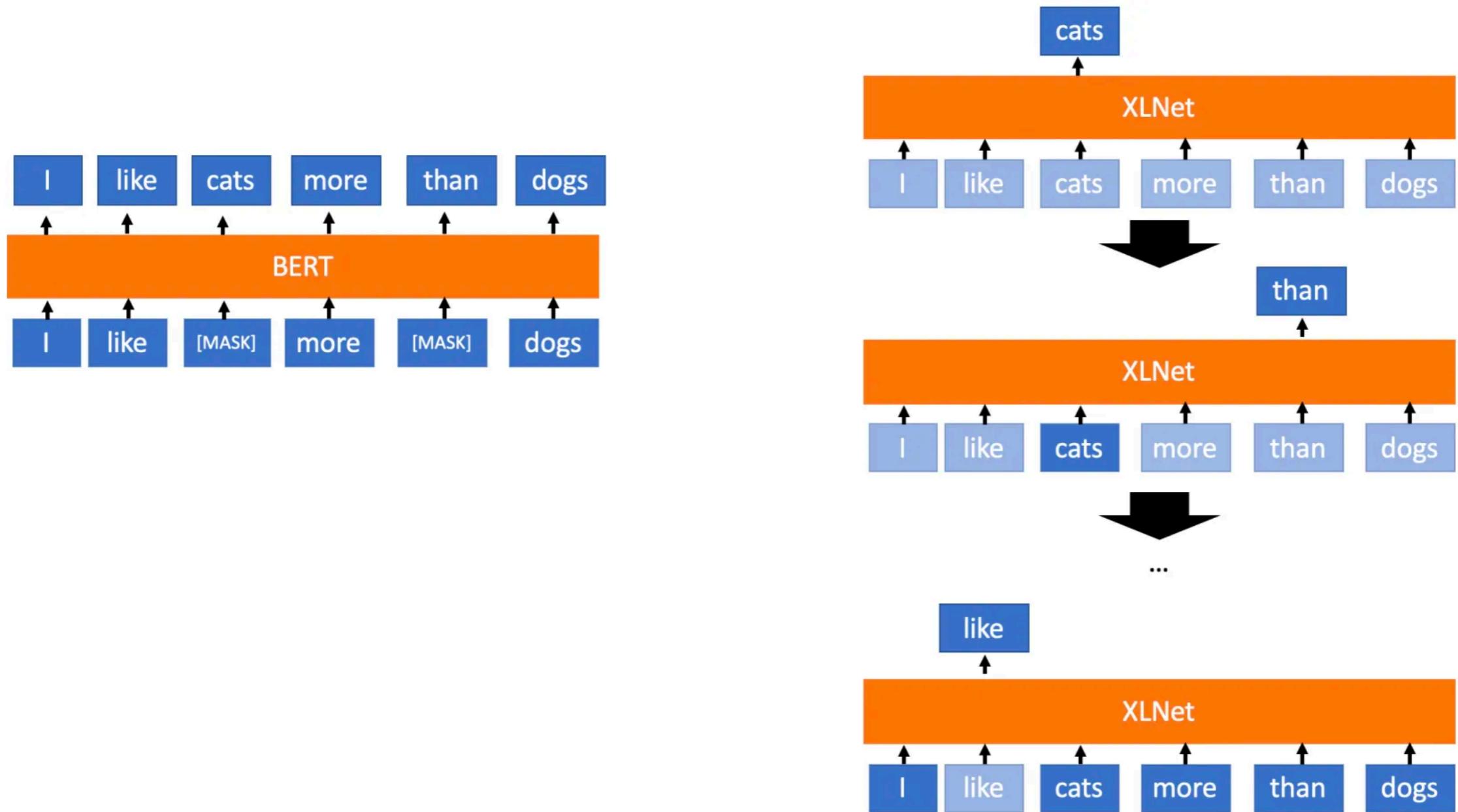
# Transformer XL



source: [ai.googleblog.com](https://ai.googleblog.com)

# XLNet

## (permutation language model)



# Thank you for your attention

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**Facebook:** <https://www.facebook.com/maternajiri>

**LinkedIn:** <https://www.linkedin.com/in/jirimaterna/>