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Deep Learning part 1

08.11.18

Legchikov Dmitry

Course plan

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- Artificial Neural Networks
- Deep Learning
- MNIST (Image recognition practice)
- Image classification (Transfer Learning practice)
- Reinforcement Learning (OpenAI Gym practice)

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Simple task

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Labradoodle or fried chicken?

Puppy or bagel?

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Sheepdog or mop?

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and one more

Chihuahua or muffin?

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We human actually lose!

A demo that shows we, human, lose, on the classification task

https://cs.stanford.edu/people/karpathy/ilsvrc/

We human lose on Go!

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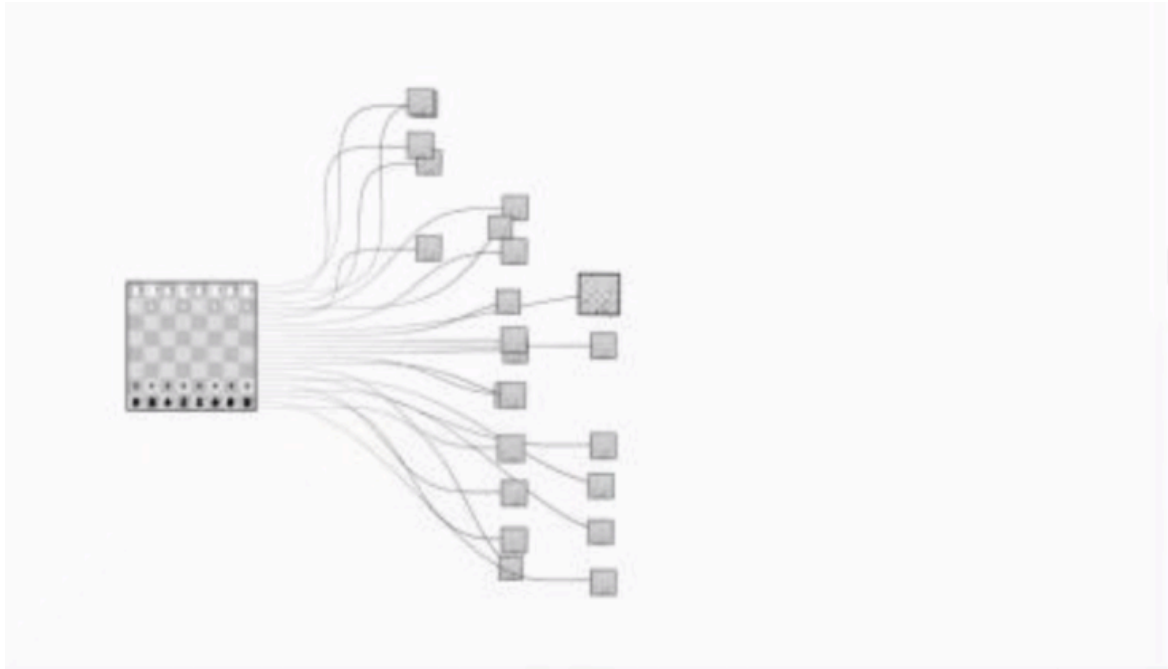
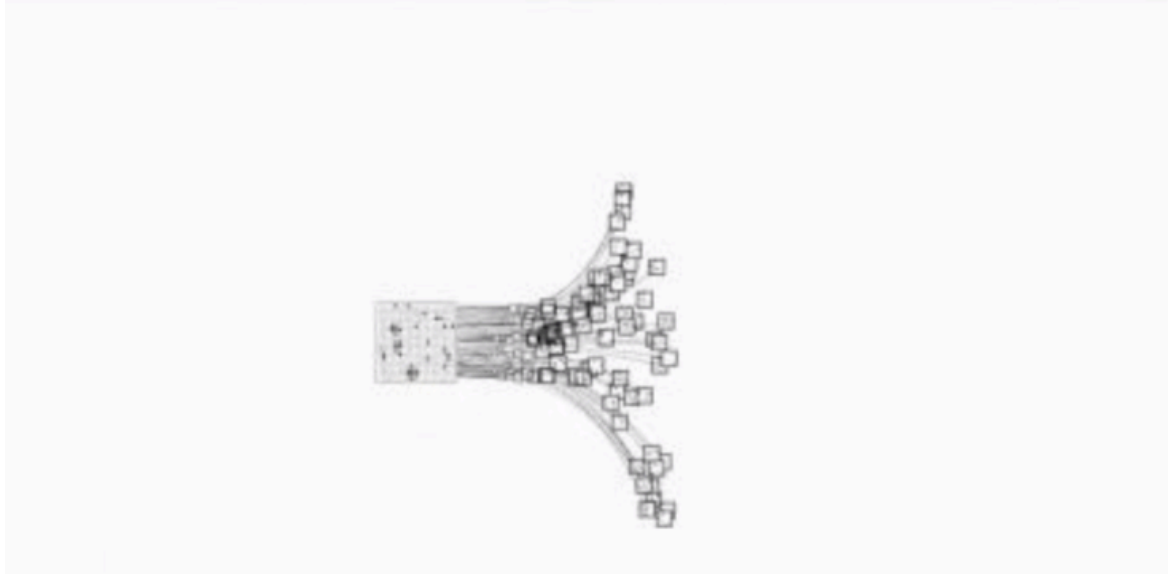


Chess: 10^{47}

Deep Blue, Feb 10, 1996



Go: 10^{170}

AlphaGo, March, 2016

We (will) lose on many specific tasks!

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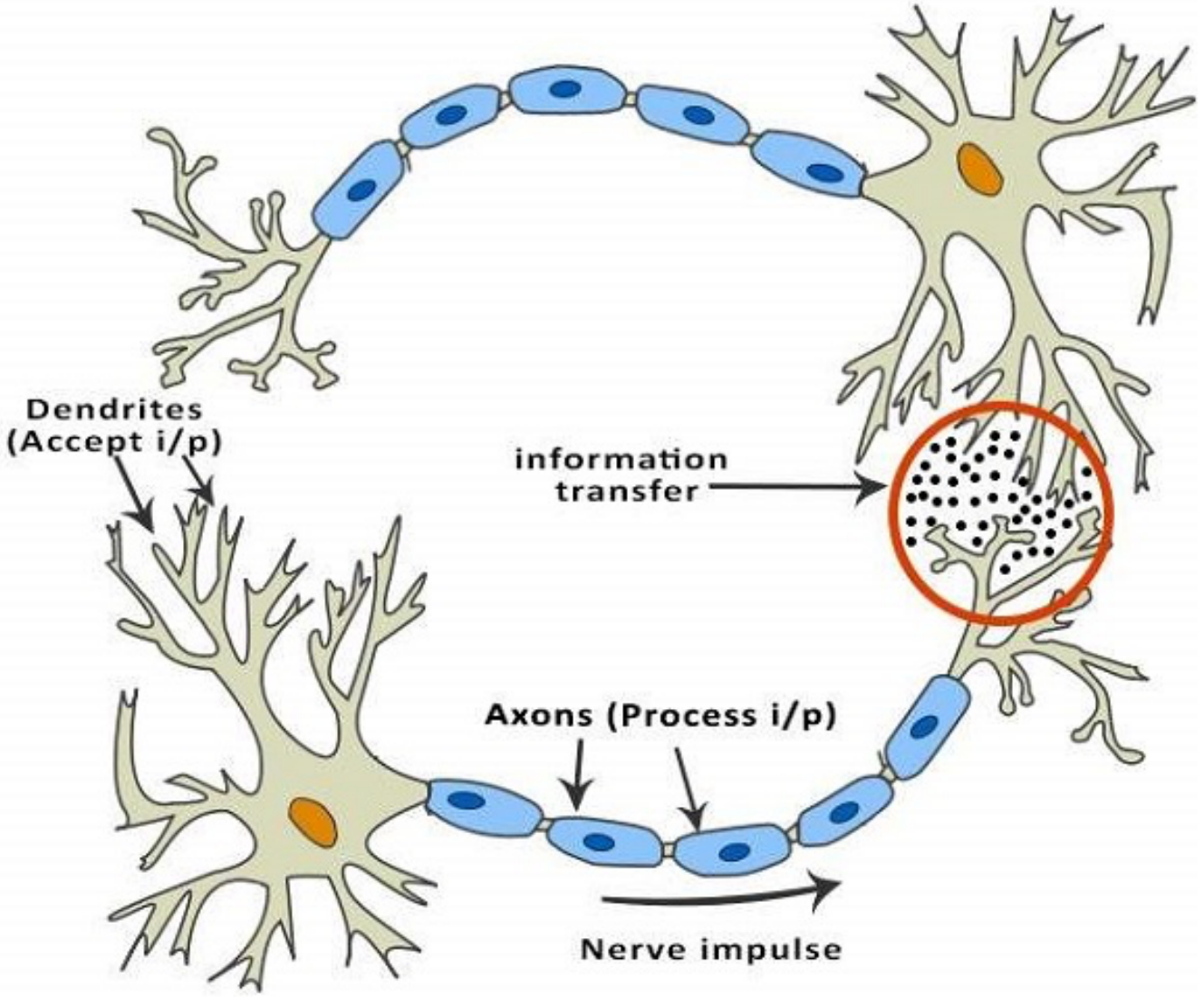
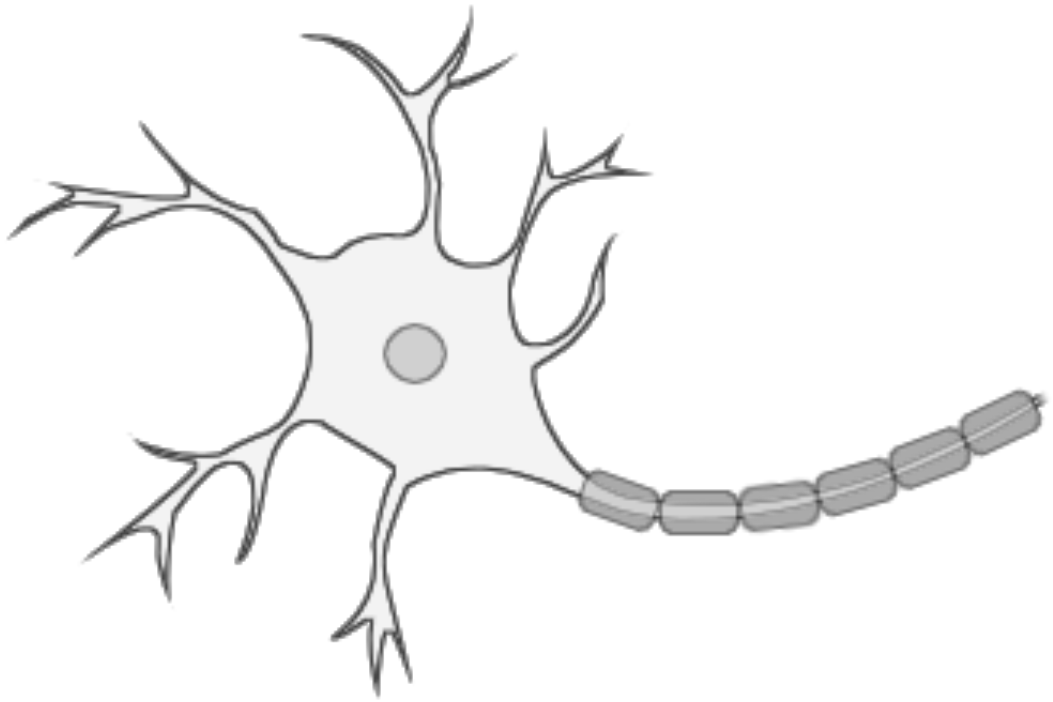
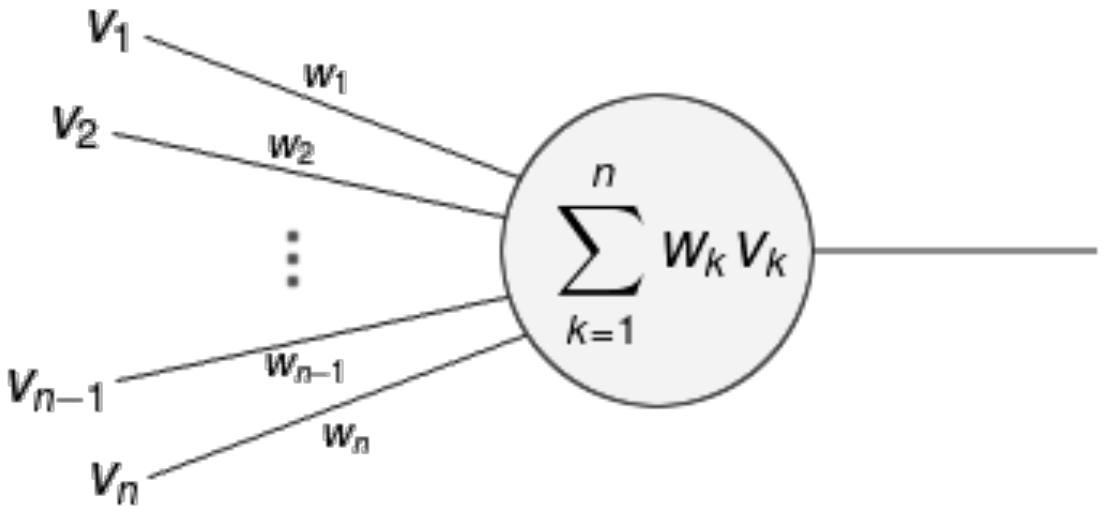
- Image classifier with deep learning (with fewest lines of code)
- Multi-label classification and different kinds of images (e.g. satellite images)
- Structured data (e.g. sales forecasting)
- Language: NLP classifier (e.g. movie review classification)
- Collaborative filtering (e.g. recommendation engine)
- Generative language model

Biological neuron

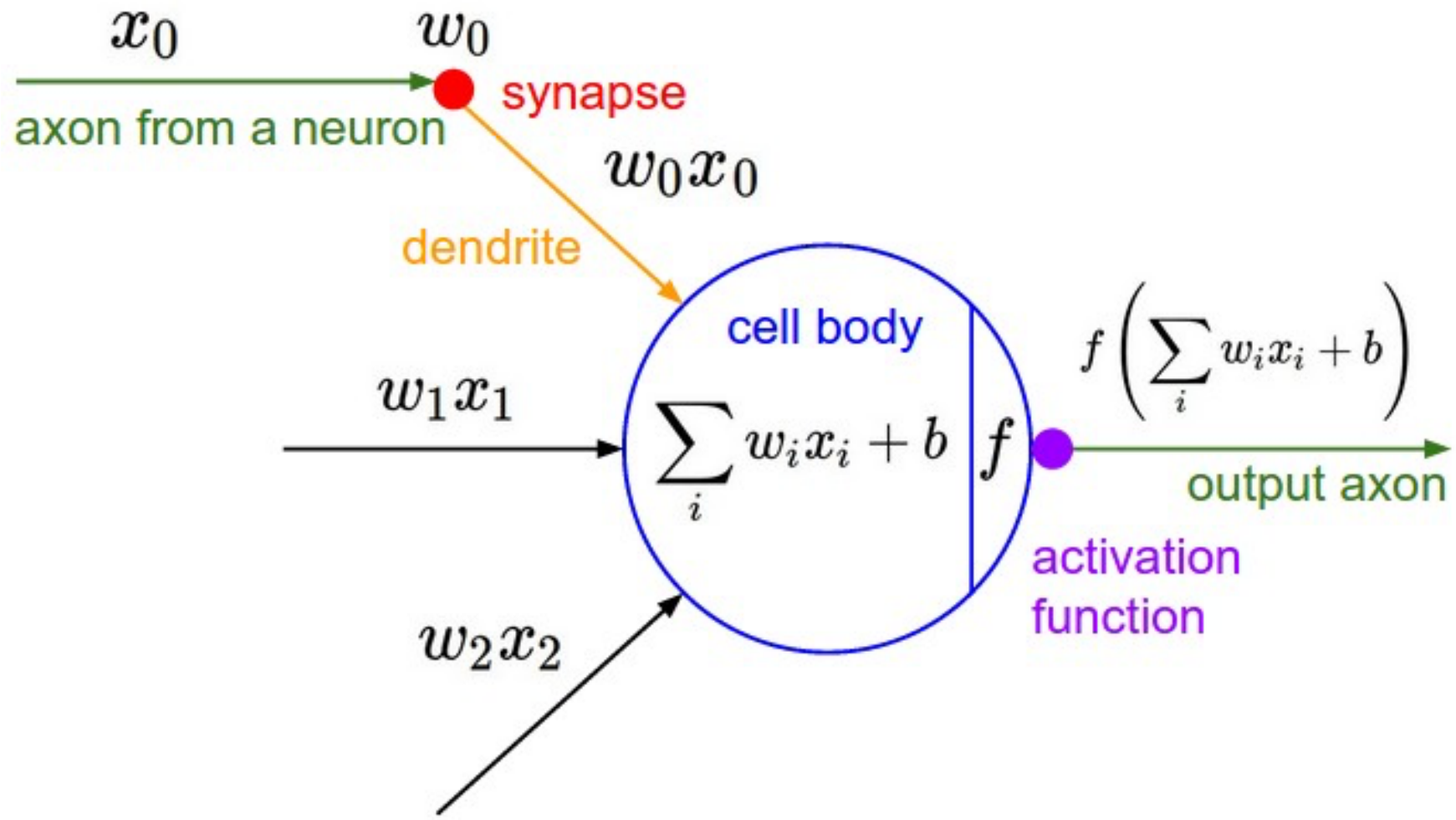


Artificial neuron

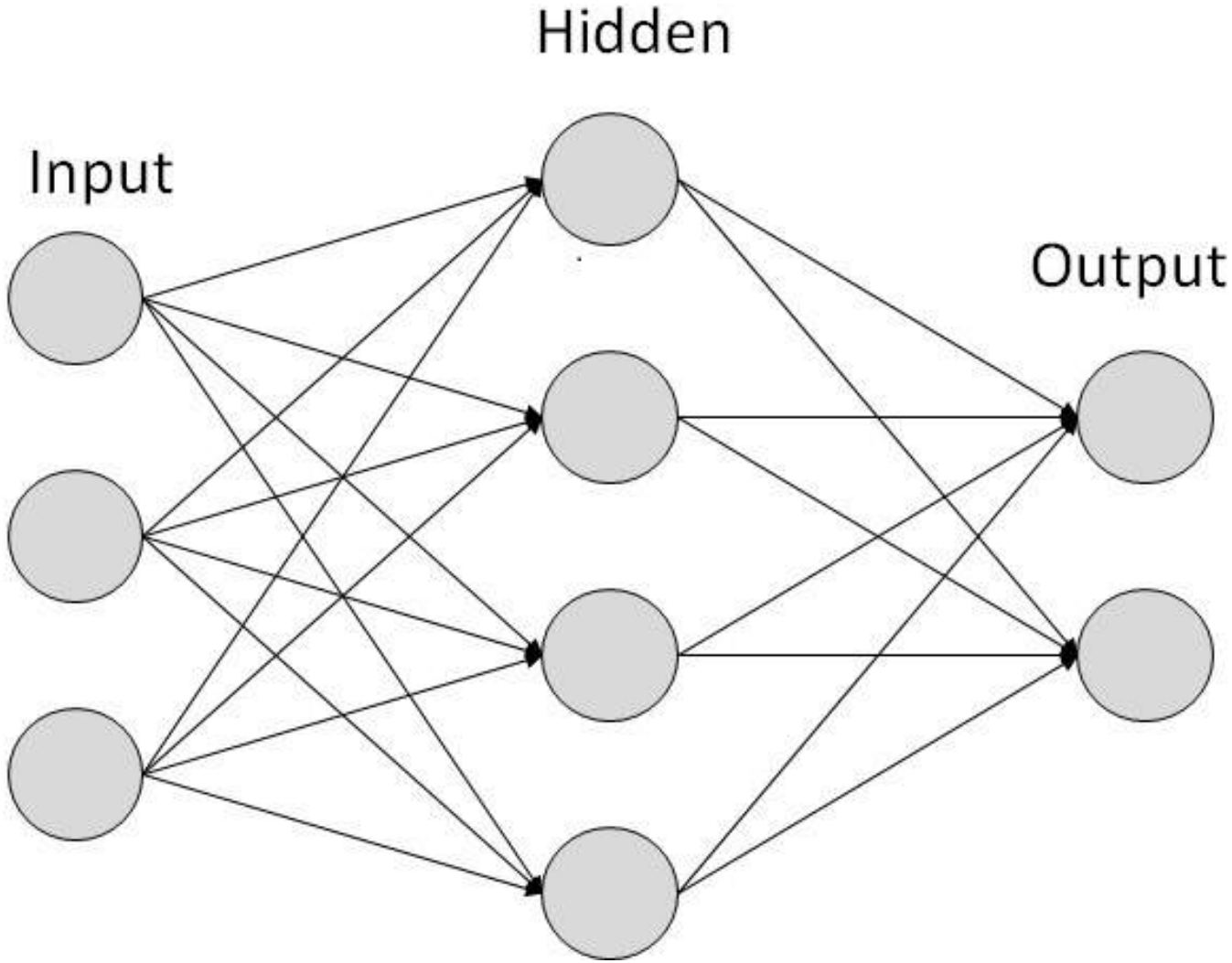




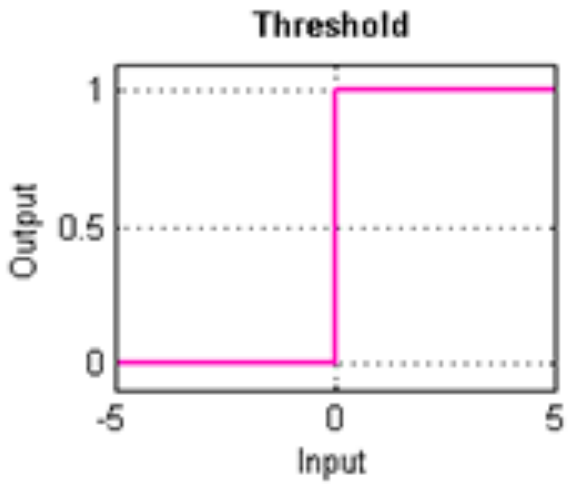
Artificial neuron



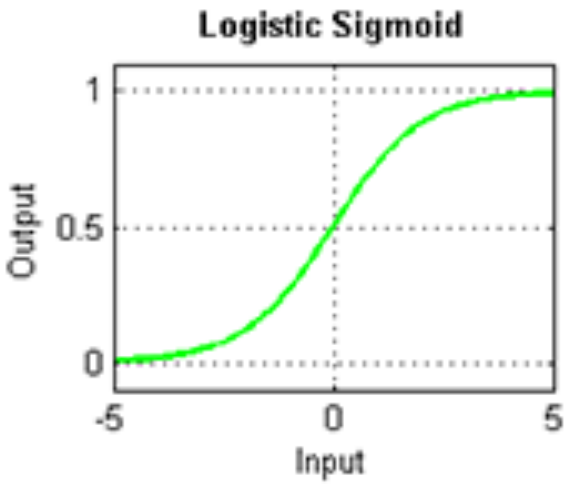
Artificial neural network (ANN)

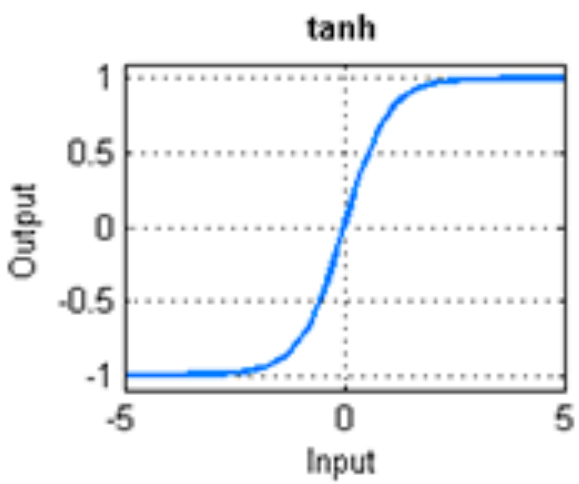


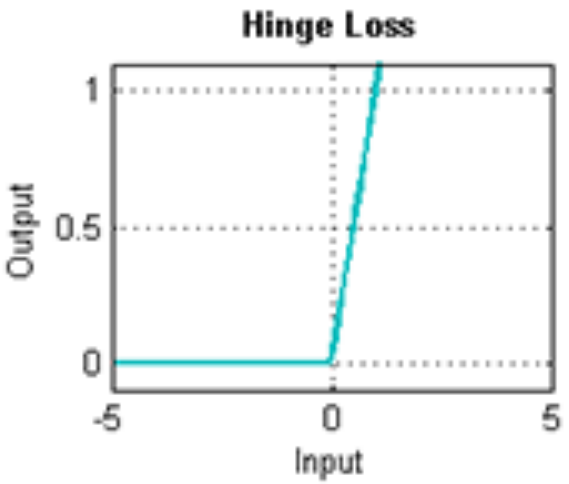
Activation function



Undefined gradient
Cant be used







New default activation

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but “AI Winter” was started

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but “AI Winter” was started

- No theoretical base

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but “AI Winter” was started

- No theoretical base
- How to teach ANN?

- Universal approximation theorem

"A feedforward network with a single layer is sufficient to represent any function, but the layer may be infeasibly large and may fail to learn and generalize correctly."

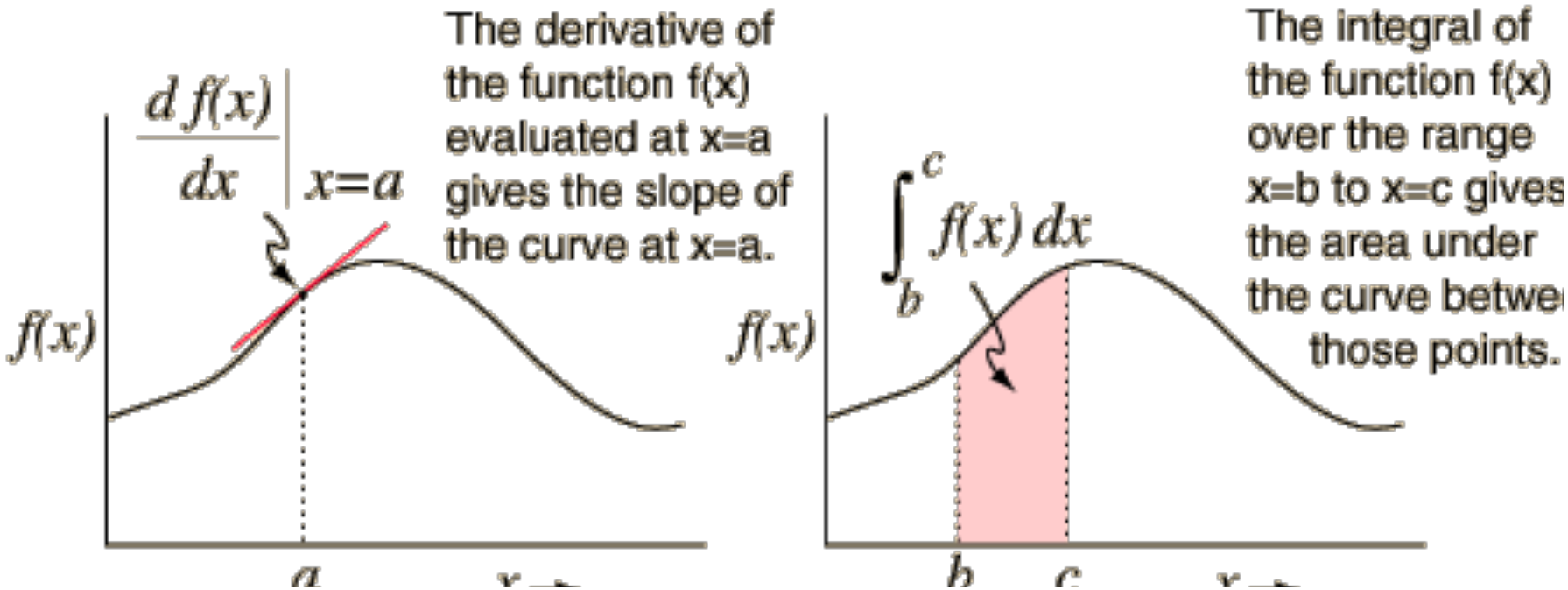
- Backpropagation algorithm

Derivative

$$\frac{d\,f(x)}{dx}$$

Integral

$$\int f(x)\,dx$$



What if N-dimensional?

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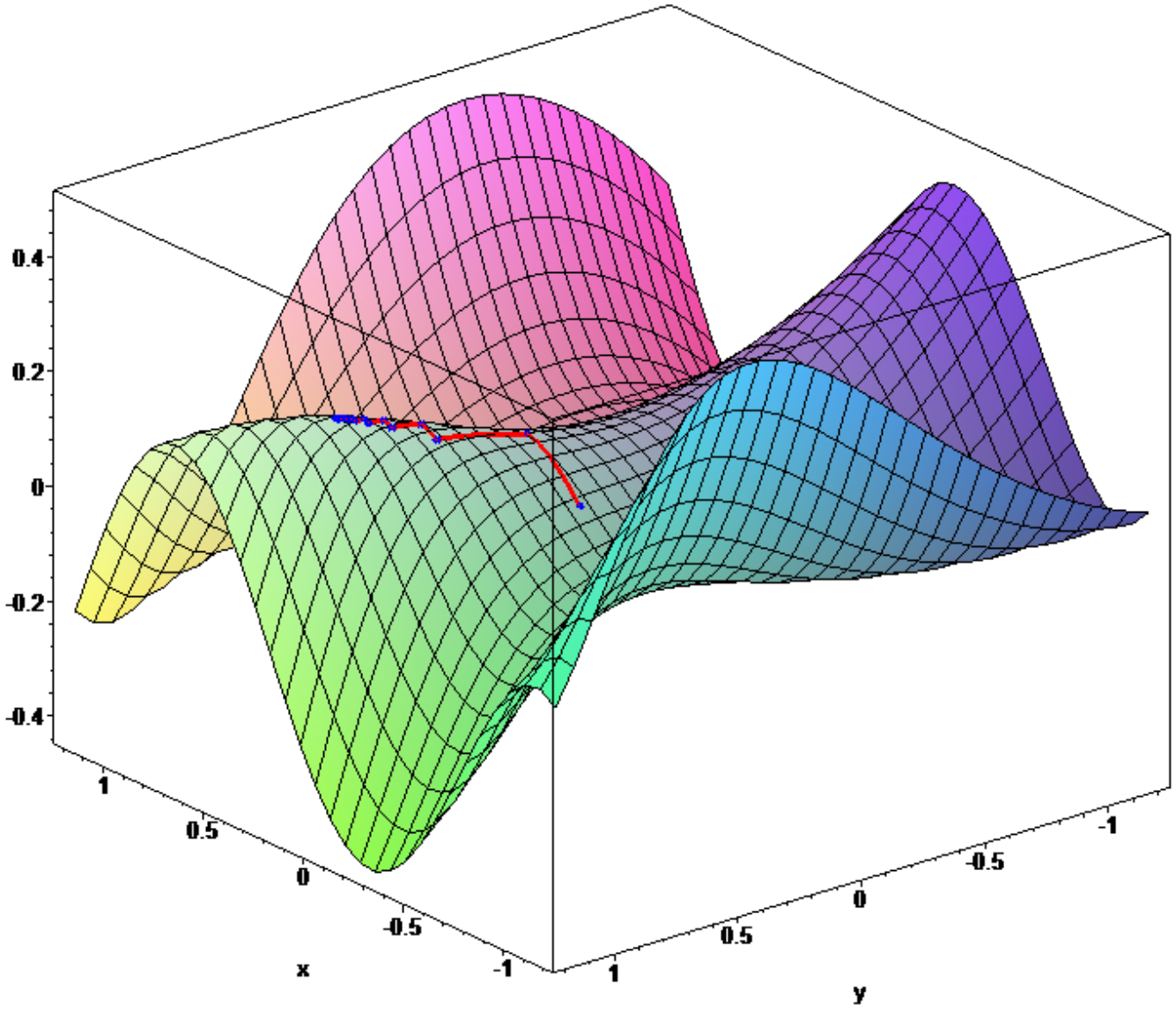

Gradient Descent

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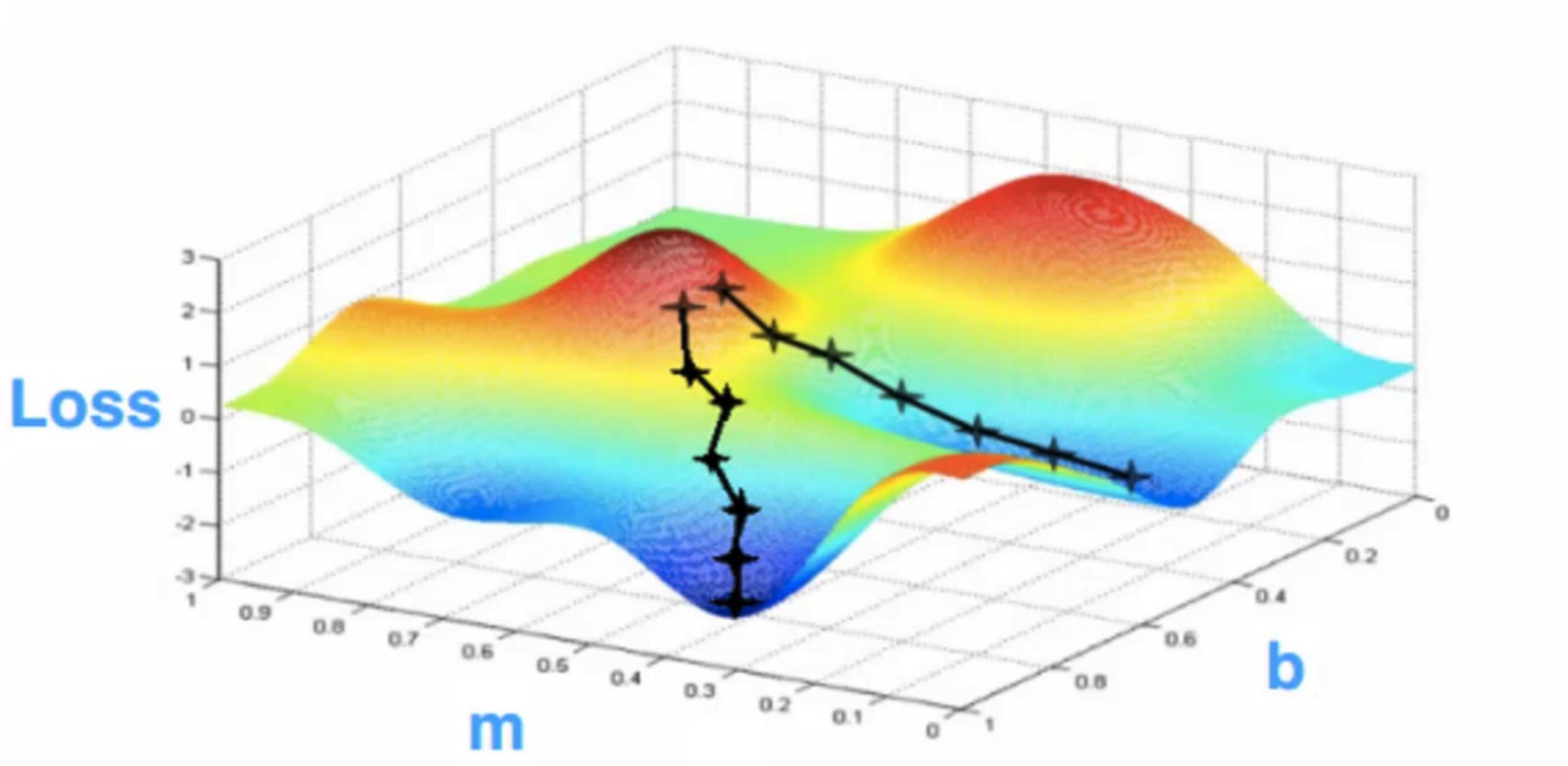
$f(x)$ = nonlinear function of x



Backpropagation

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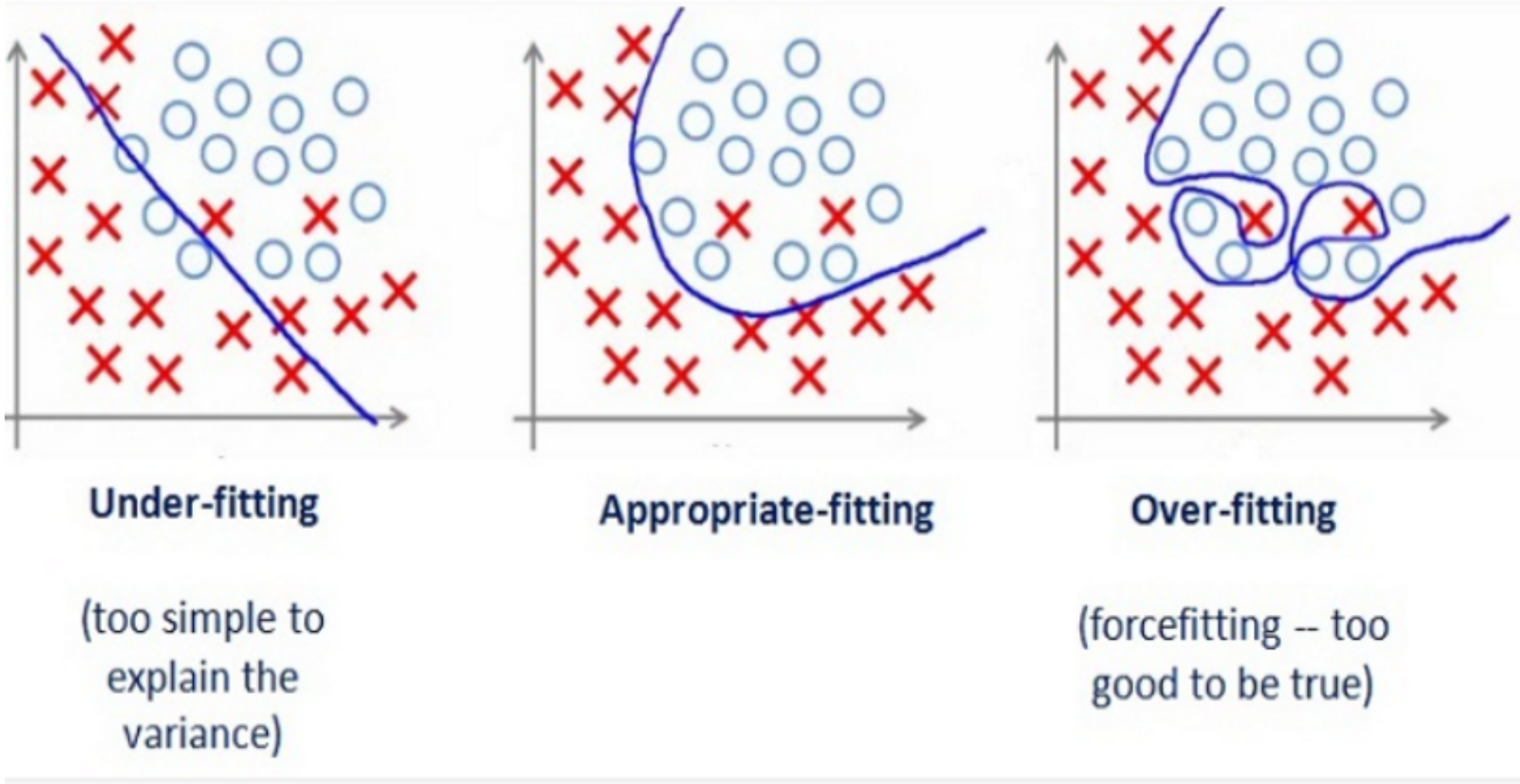
LIVE DEMO

https://google-developers.appspot.com/machine-learning/crash-course/backprop-scroll/

Overfitting



Artificial neural network (ANN)

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LIVE DEMO

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Deep Learning

Deep Neural Networks (DNN)

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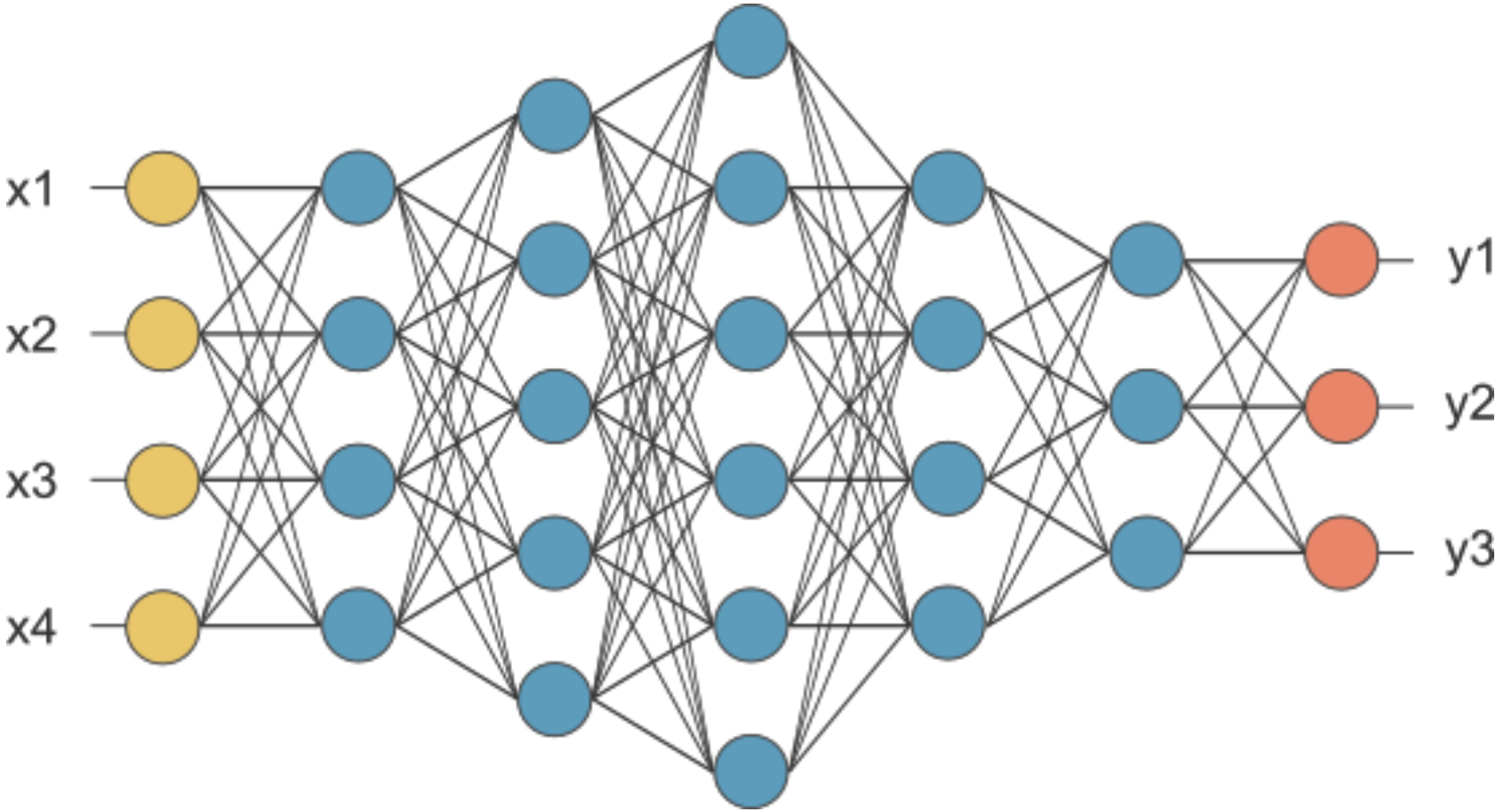

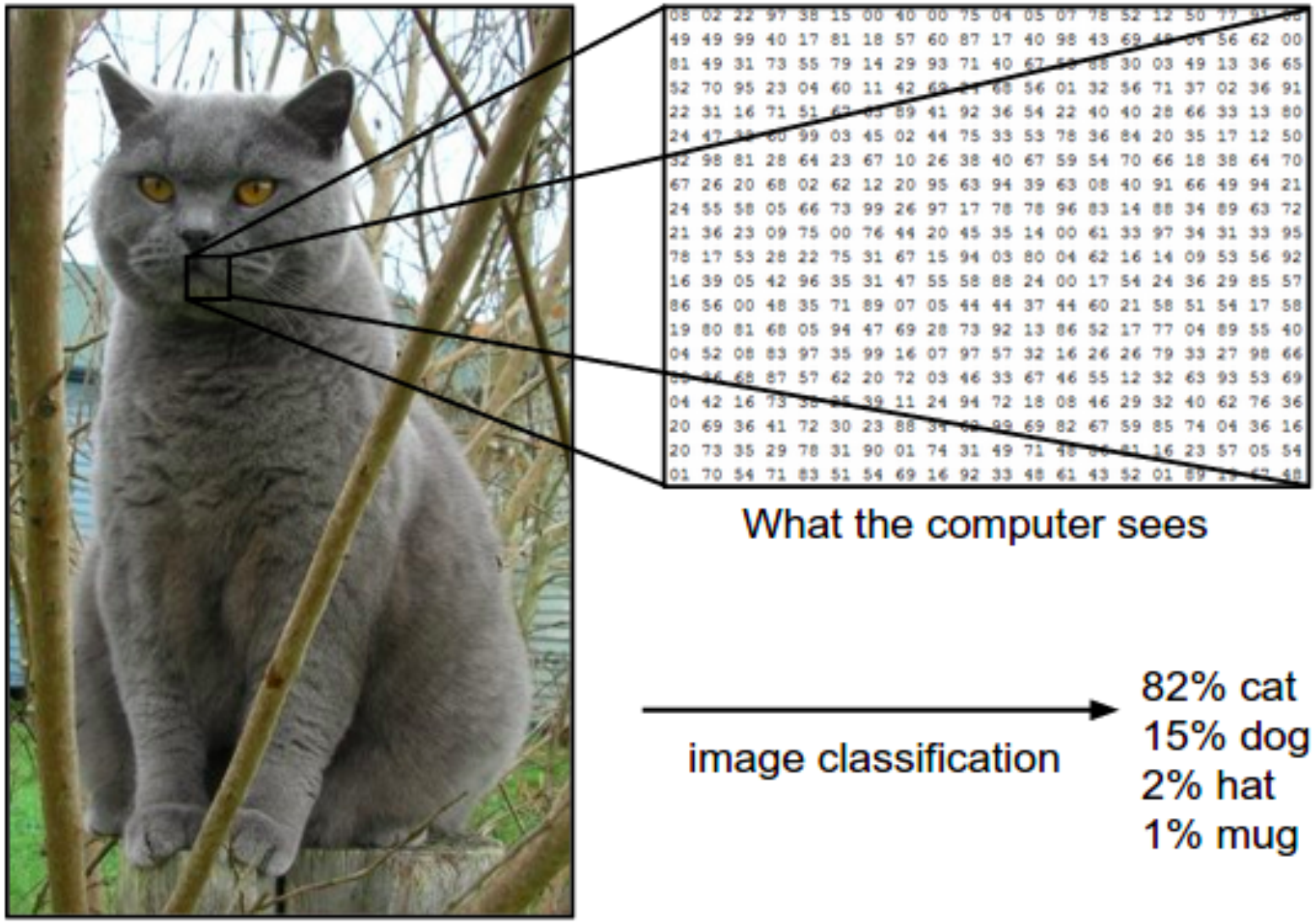
What the computer sees
image classification
82% cat
15% dog
2% hat
1% mug

Convolution layer

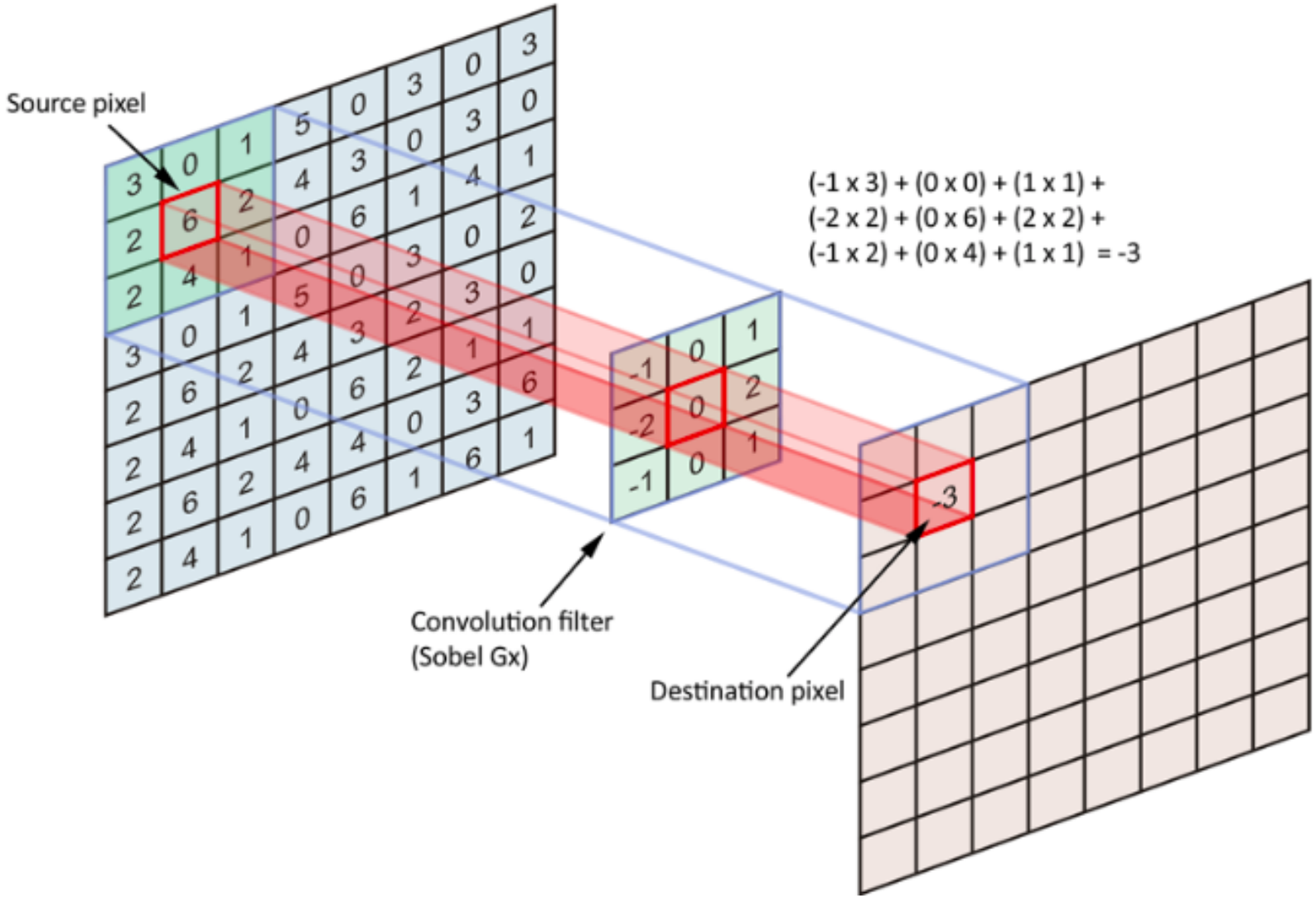

Image Kernel Visualisation

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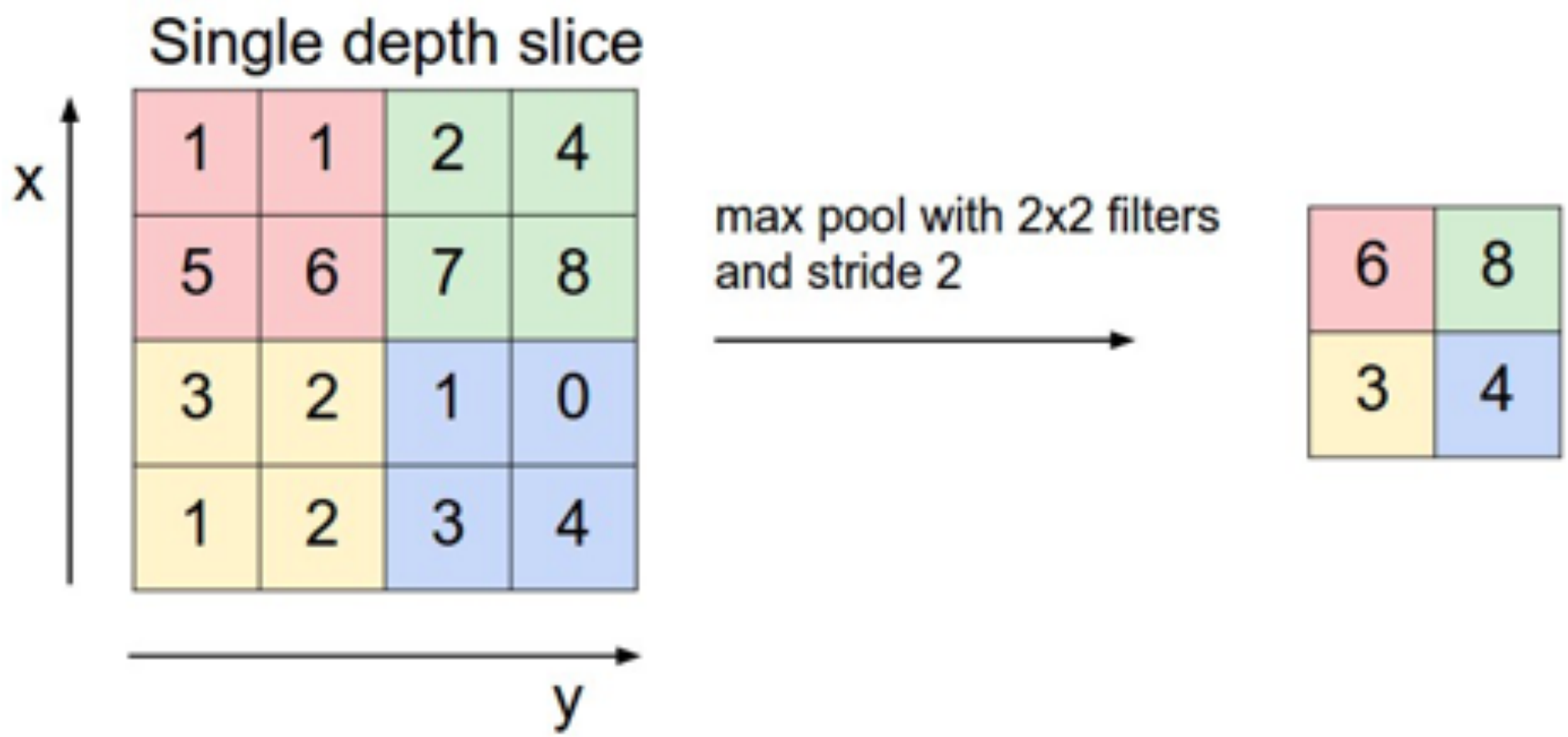
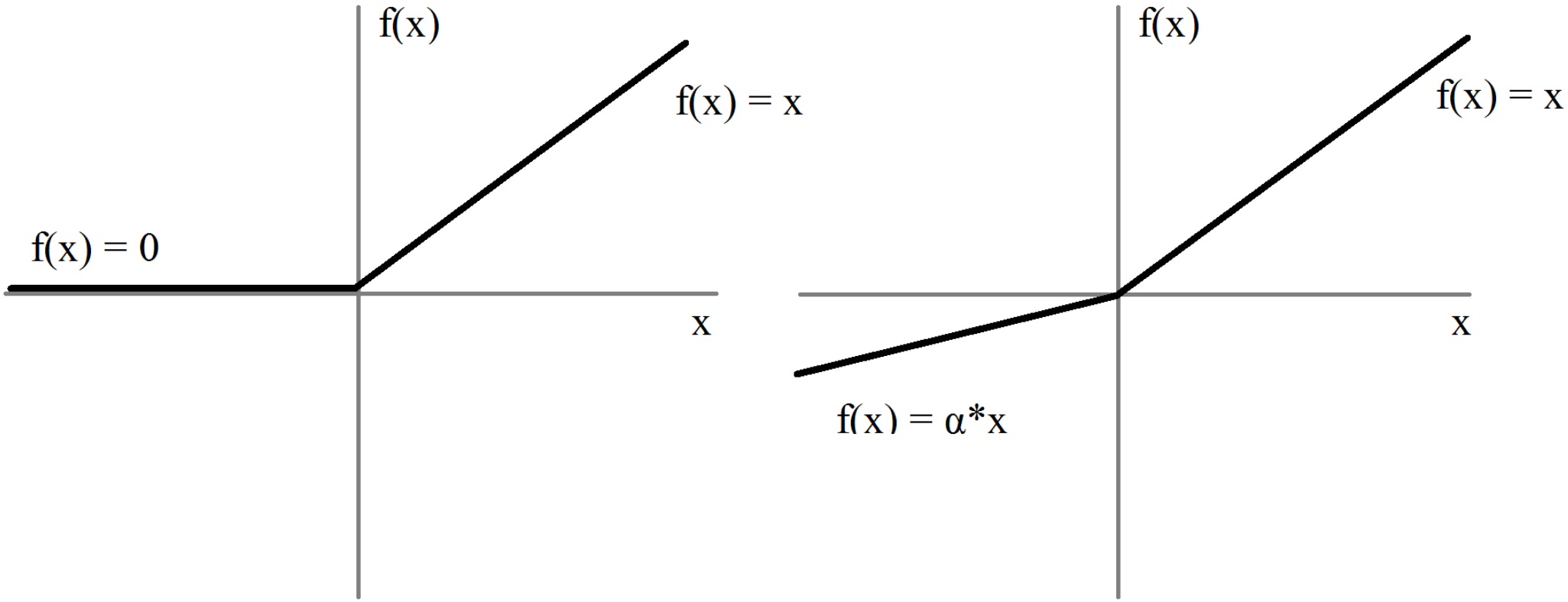
http://setosa.io/ev/image-kernels/

Max pooling layer



ReLU layer



Convolution Neural Networks (CNN)

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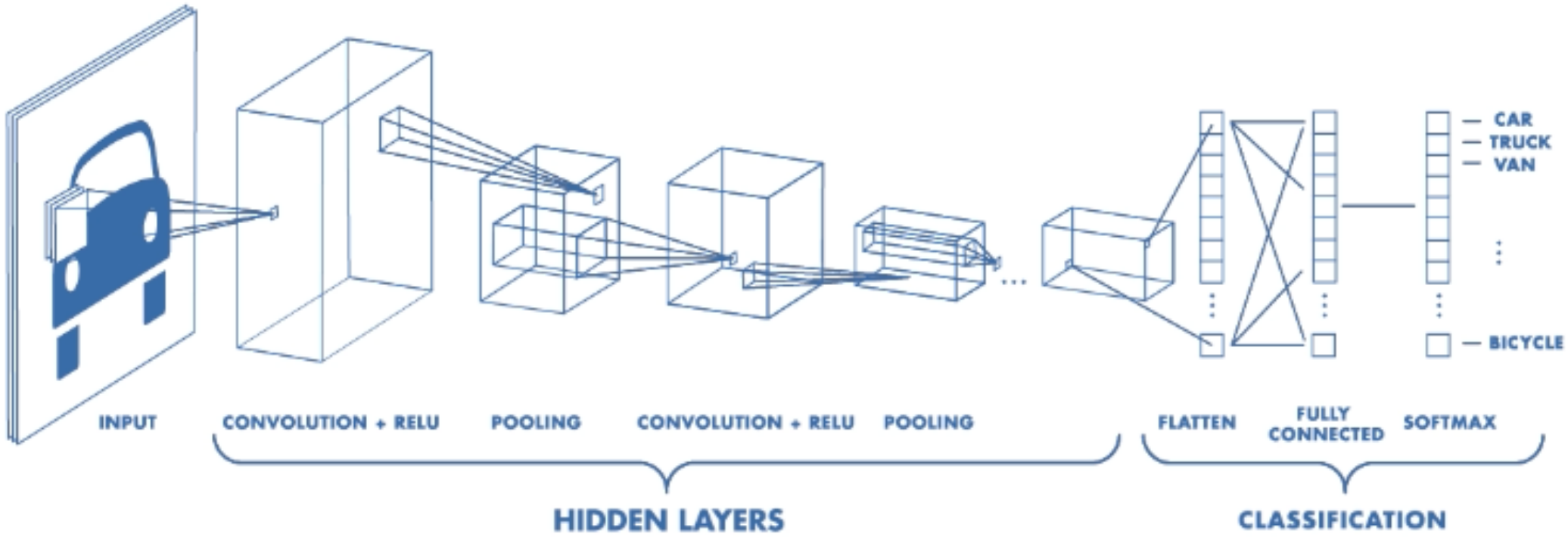

Convolution Neural Networks

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Visualisation

https://www.youtube.com/watch?time_continue=267&v=Oqm9vsf_hvU

Summary

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- Artificial Neural Networks
- Backpropagation Algoritm
- Deep Neural Networks
- Convolution Neural Networks

Books

Deep Learning

By Ian Goodfellow, Yoshua Bengio and Aaron Courville

https://www.deeplearningbook.org/

Deep Learning: Methods and Applications

By Li Deng and Dong Yu

Neural Networks and Learning Machines (3rd edition)

By Simon Haykin

Online courses

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Deep Learning Specialization

https://www.coursera.org/specializations/deep-learning/

Deep Learning For Coders

http://course.fast.ai/

CS231n: Convolutional Neural Networks for Visual Recognition

http://cs231n.stanford.edu/

Next time

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- Deep Neural Network Architectures
- Kaggle competition
- MNIST classification (practice)

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Thank you!