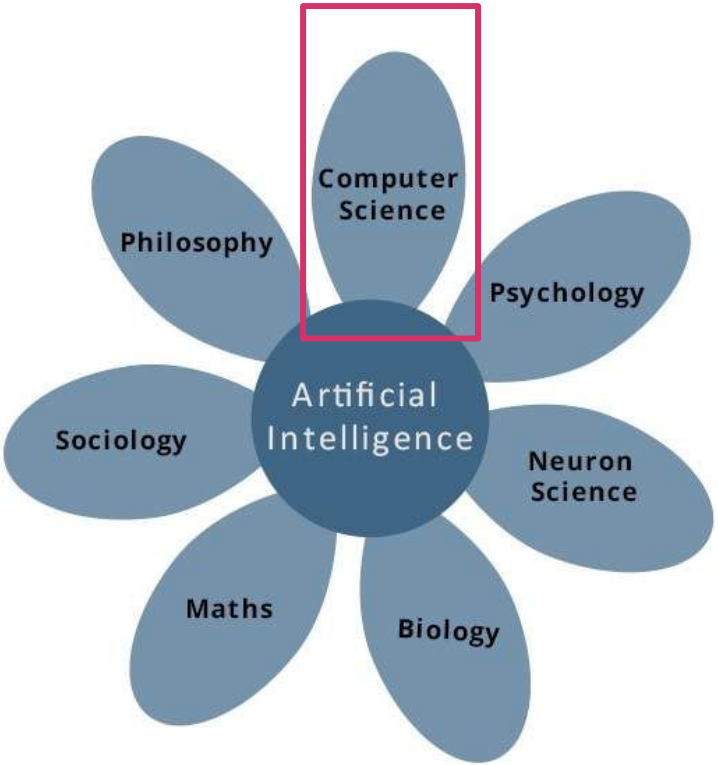
Artificial intelligence / machine learning

Kevin Schima

Spezielle Gebiete zum Software-Engineering
Sommersemester 2018
FH Bielefeld

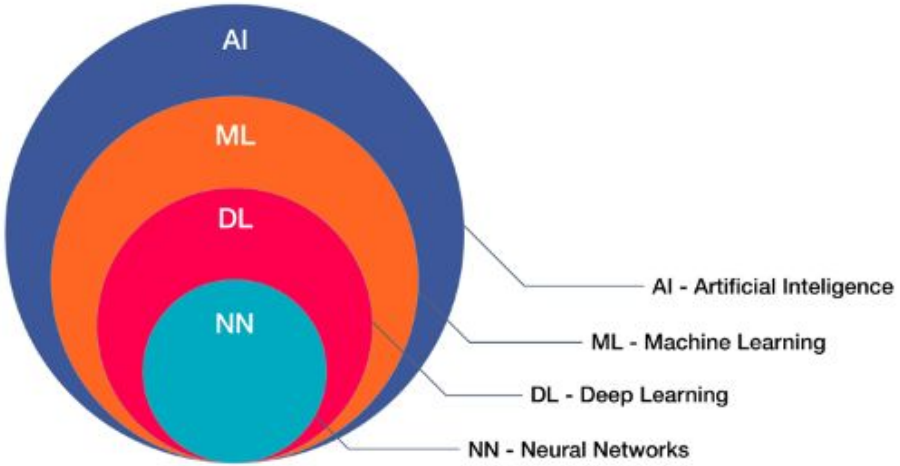
Kontext


Computer Science
Philosophy
Psychology
Artificial Intelligence
Sociology
Neuron Science
Maths
Biology

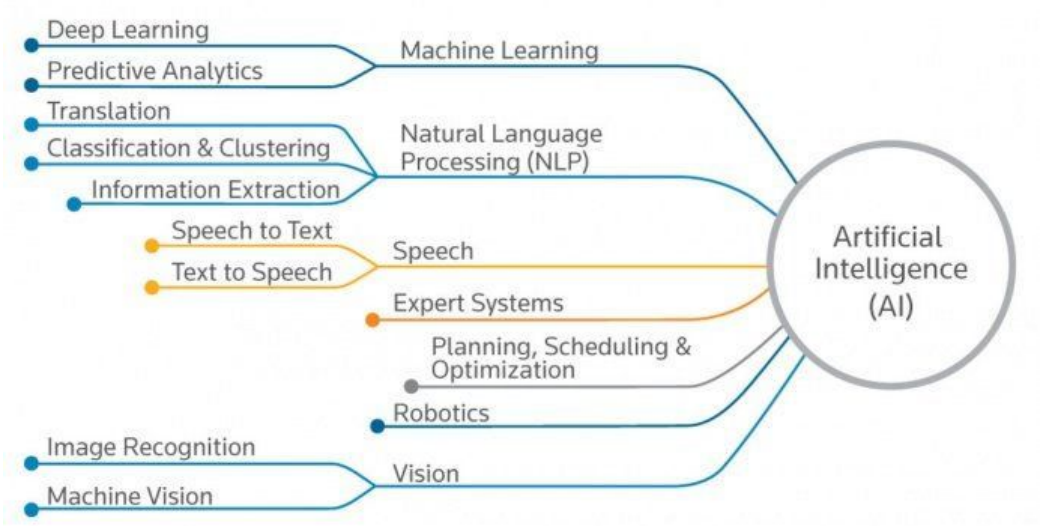
Agenda

Top down

- Artificial intelligence
- Machine learning
- Neural networks
- Deep learning



Künstliche Intelligenz (artificial intelligence)



Quelle: Michael Mills, Neota Logic

Machine learning

Aus Erfahrung lernen

"A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E."

- Tom M. Mitchell

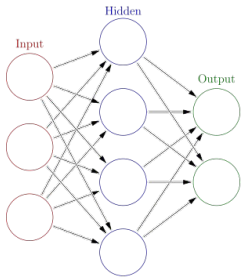
Machine learning

supervised learning

- Basis für neuronale Netze
- Training mit großer Menge vorklassifizierter Daten

  -> Generalisierung:

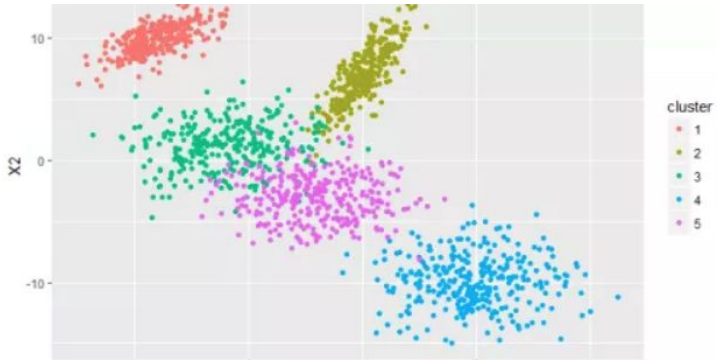
  Klassifizierung unbekannter Daten



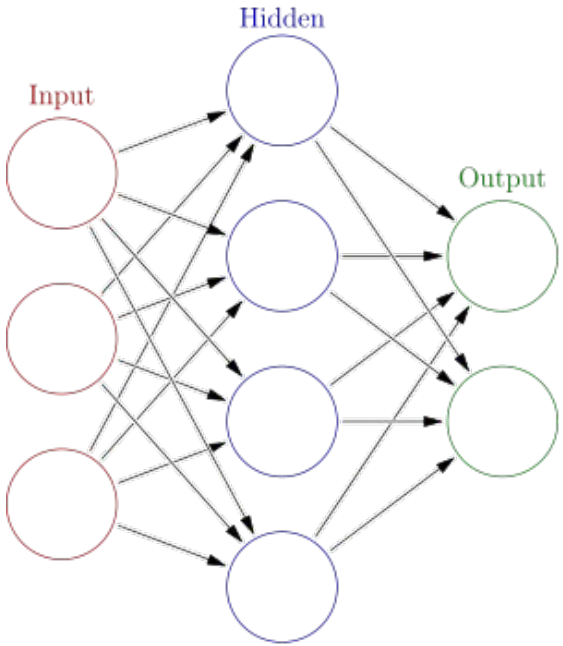
Quelle: https://en.wikipedia.org/wiki/Artificial_neural_network

unsupervised learning

- statistische Klassifizierung
- Clustering-Algorithmen:
  - k-means
  - Bildverarbeitung: Mustersegmentierung

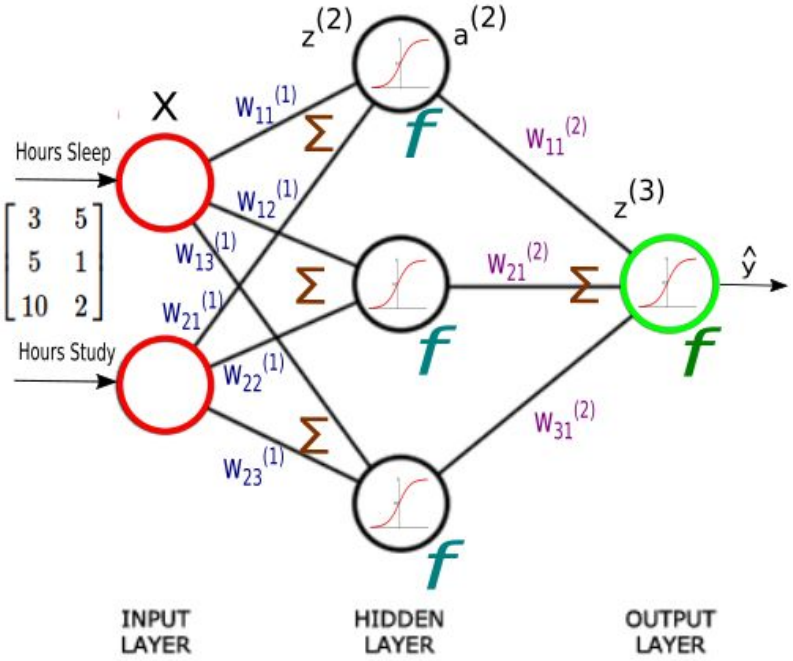


Neural networks



Quelle: https://en.wikipedia.org/wiki/Artificial_neural_network

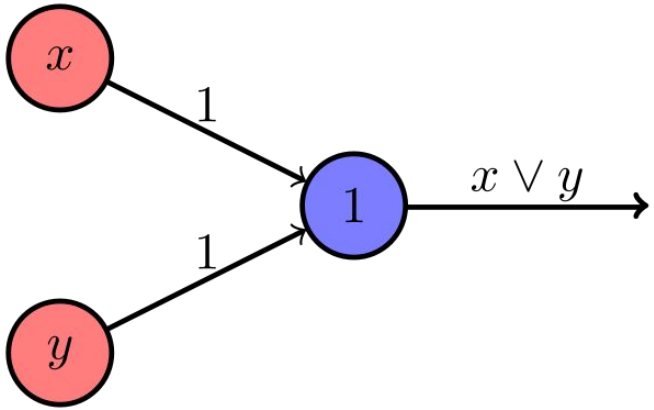
Neural networks



Quelle: http://www.bogotobogo.com/python/scikit-learn/Artificial-Neural-Network-ANN-1-Introduction.php

Perzeptron (Frank Rosenblatt 1958)

Der Grundbaustein neuronaler Netze



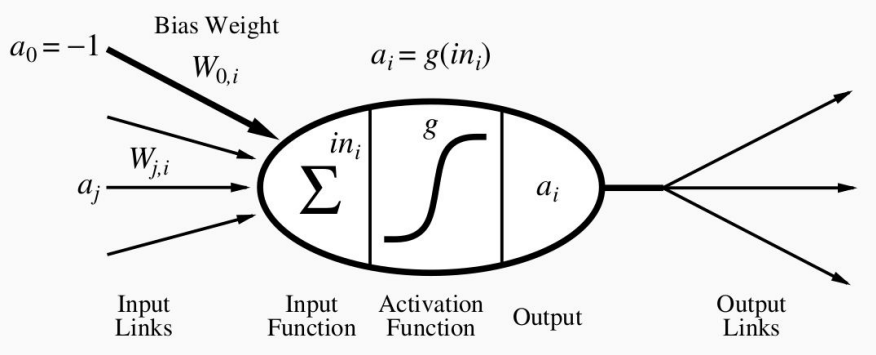
Quelle: https://de.wikipedia.org/wiki/Perzeptron

Einzelnes Perzeptron

- AND
- OR
- NOT

kein XOR :(

Perzeptron / künstl. Neuron

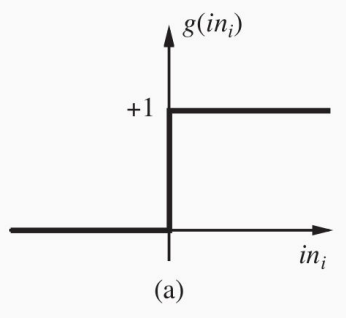


$$a_i = \begin{cases} 1 & \text{falls } a_1 w_{1,i} + a_2 w_{2,i} + \ldots + a_n w_{n,i} \geq w_{0,i} \\ 0 & \text{falls } a_1 w_{1,i} + a_2 w_{2,i} + \ldots + a_n w_{n,i} < w_{0,i} \end{cases}$$

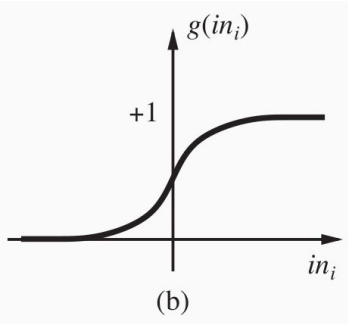
Quelle: Russell, Stuart J., and Peter Norvig. Artificial intelligence: a modern approach. Malaysia; Pearson Education Limited,, 2016.

Aktivierungsfunktionen

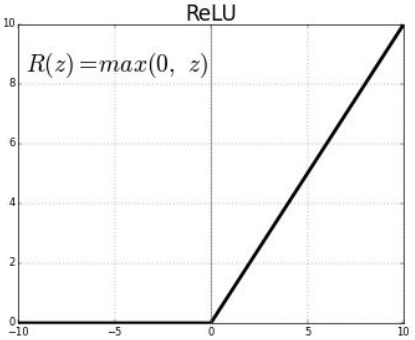
Sprungfunktion



Sigmoide Funktion



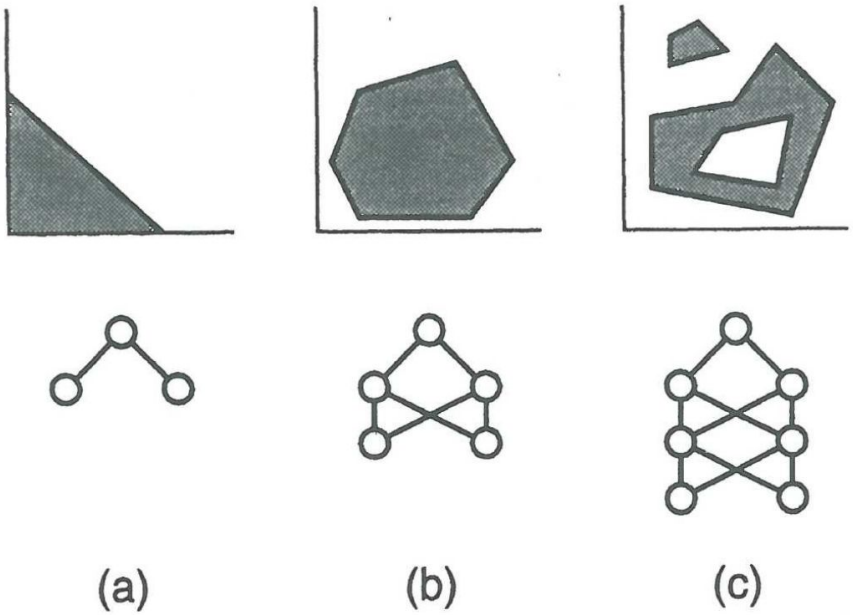
ReLU



Quelle: Russell, Stuart J., and Peter Norvig. Artificial intelligence: a modern approach. Malaysia; Pearson Education Limited,, 2016.

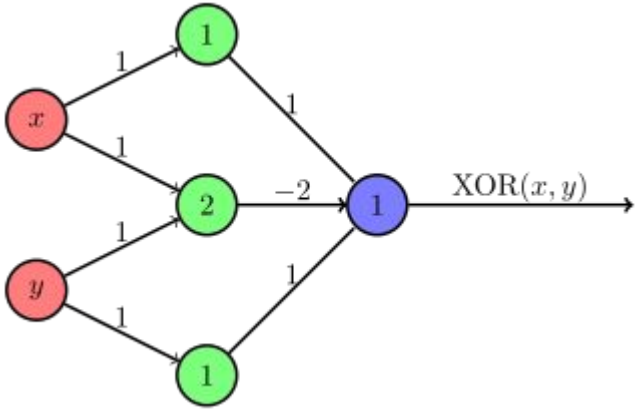
Perzeptron

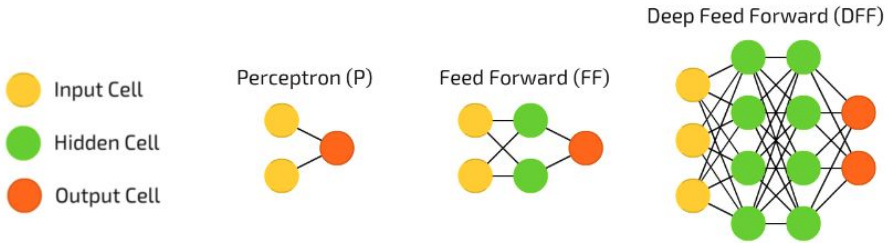
Limitierungen



Quelle: Russell, Stuart J., and Peter Norvig. Artificial intelligence: a modern approach. Malaysia; Pearson Education Limited,, 2016.

Mehrlagiges Perzeptron (NN)





Quellen: https://de.wikipedia.org/wiki/Perzeptron,
Fjodor van Veen, Asimov Institute

Fehlerfunktion

Einzelnes Neuron

$$E(\mathrm{w}) = \frac{1}{2}\sum_{d}(y^{(d)} - t^{(d)})^2$$

Über alle Neuronen summiert:

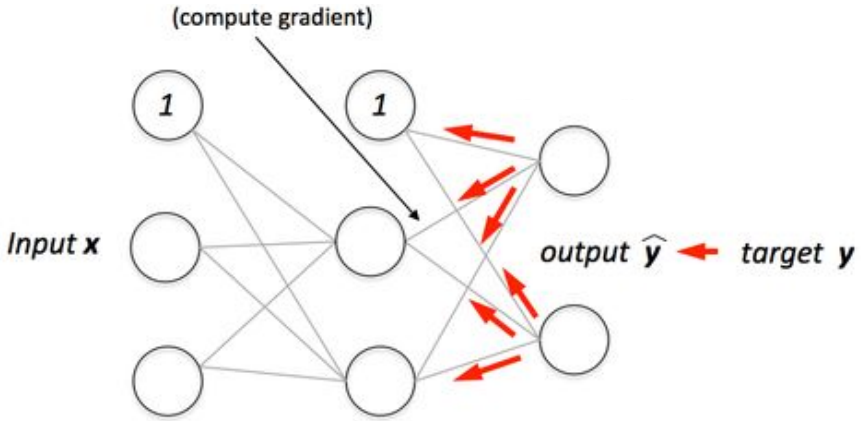
$$E = \sum_{d} E^{(d)}$$

d: Anzahl Trainingsbeispiele

y(d): Ausgabe des Neurons zu Trainingsbeispiel *d*

t(d): Erwarteter Wert zu Trainingsbeispiel *d*

Backpropagation (Fehlerrückführung)

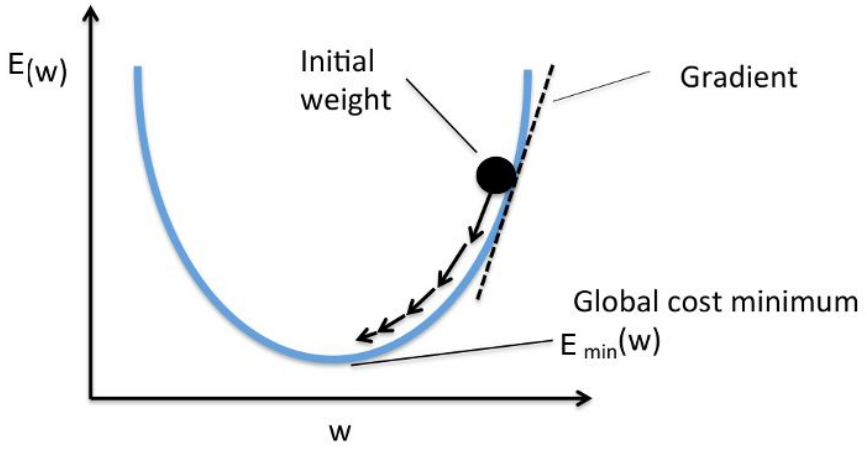


Quelle: https://sebastianraschka.com/faq/docs/visual-backpropagation.html

Gradientenabstieg

Differenzierung der Fehlerfunktion

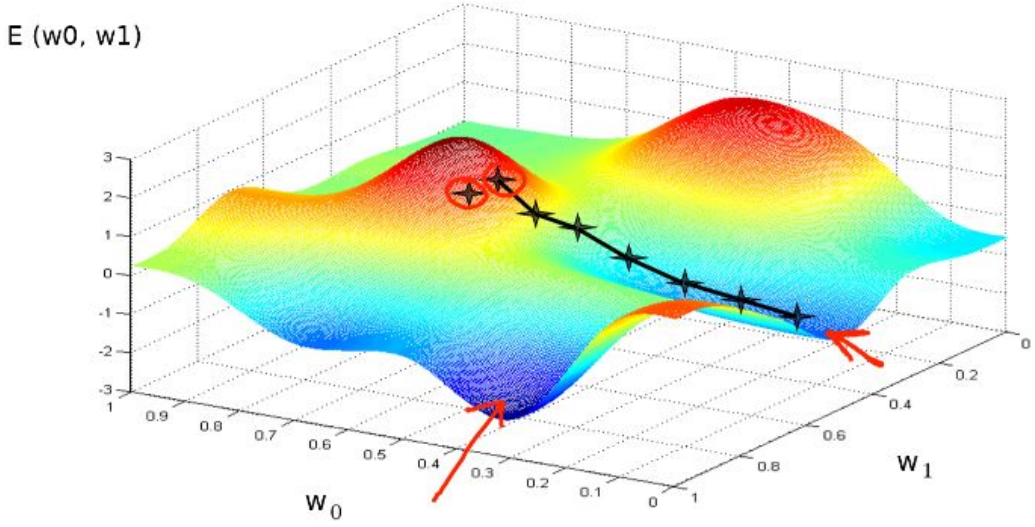
(Steigung)



Quelle: https://rasbt.github.io/mlxtend/user_guide/general_concepts/gradient-optimization/

Minimum finden

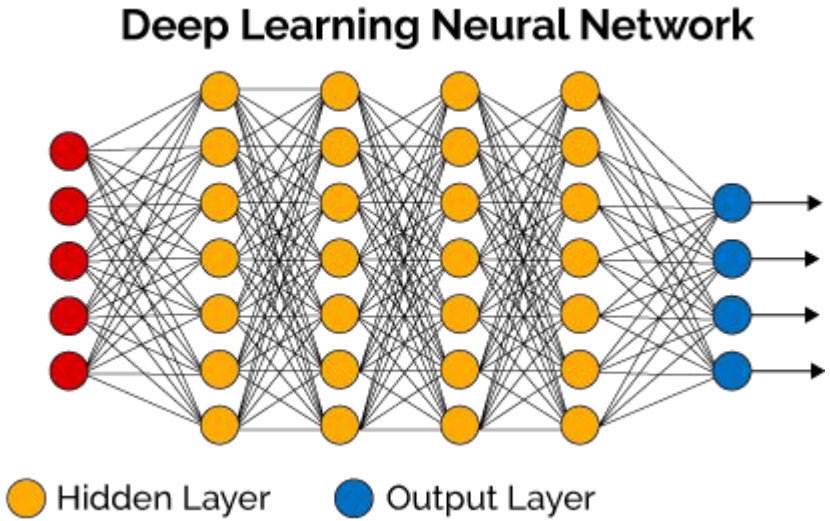
2 Gewichte -> 3 dimensionaler Ergebnisraum



Deep learning

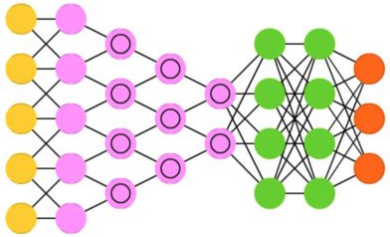
Was ist “deep” ?

Ab 2 hidden layer

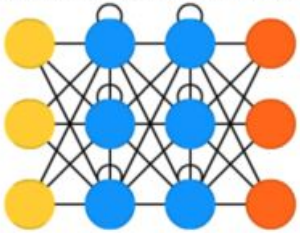


Deep neural networks

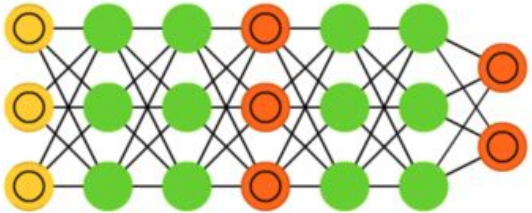
Deep Convolutional Network (DCN)



Recurrent Neural Network (RNN)



Generative Adversarial Network (GAN)

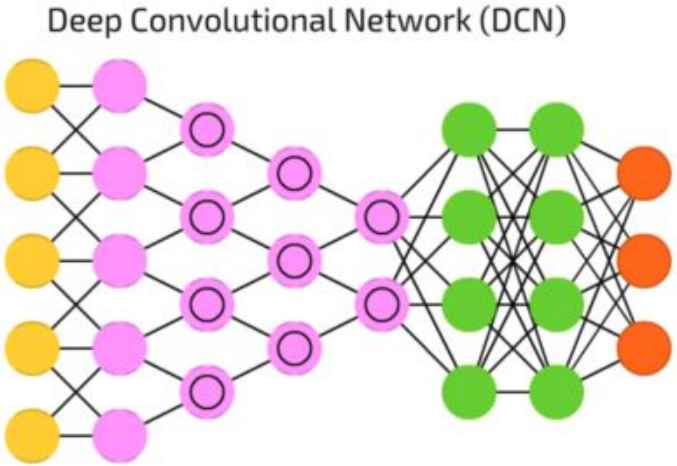


Quelle: Fjodor van Veen, Asimov Institute

Convolutional Neural Network (CNN / ConvNet)

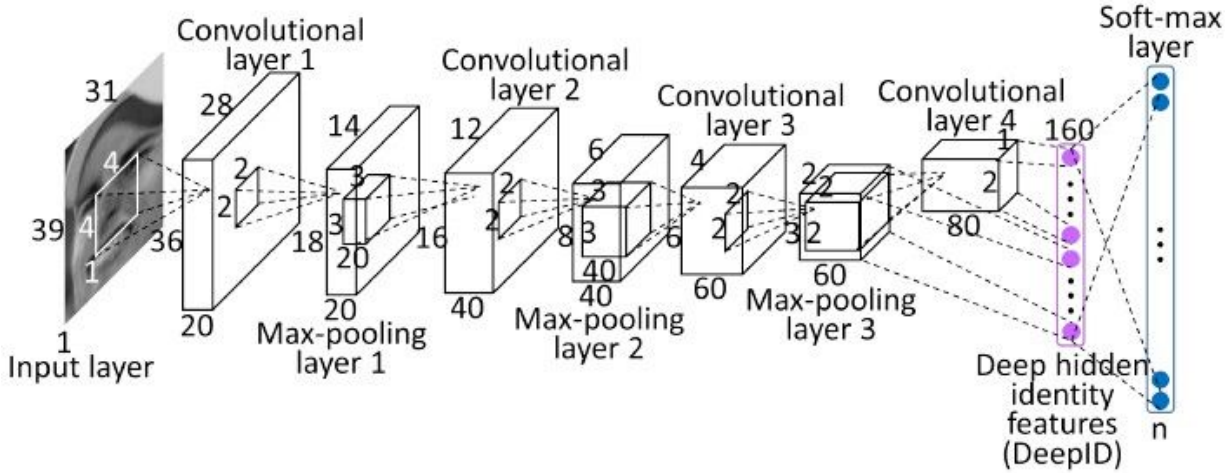
Bildverarbeitung / Mustererkennung

übersichtlich



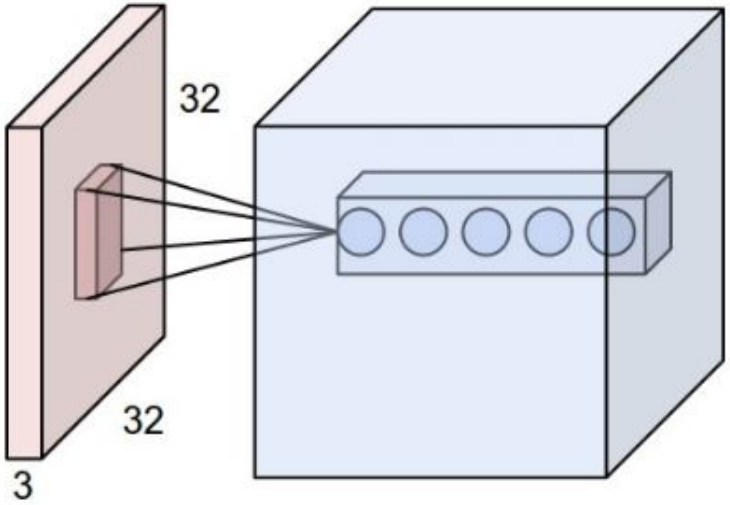
Quelle: Fjodor van Veen, Asimov Institute

CNN schematisch



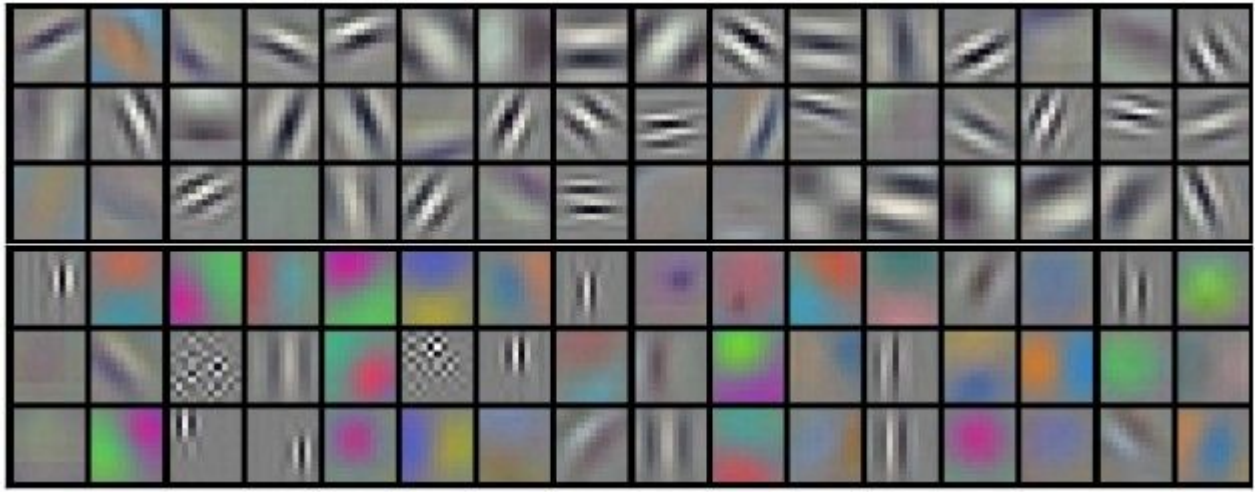
Quelle: Sun, Y., Wang, X., & Tang, X. (2014). Deep learning face representation from predicting 10,000 classes

CNN convolution layer



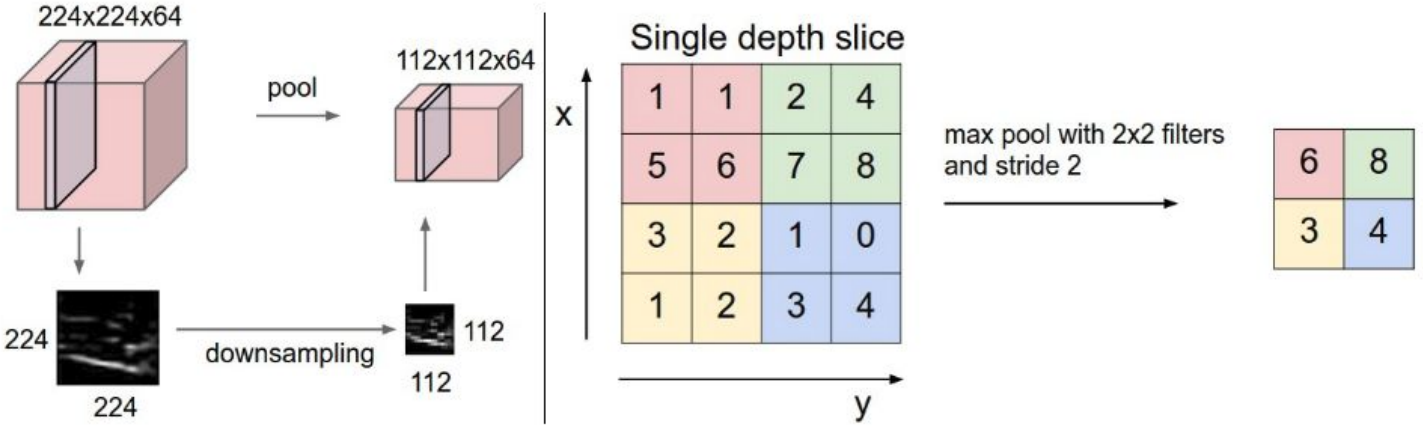
Quelle: http://cs231n.github.io/convolutional-networks/

CNN convolution layer - filter



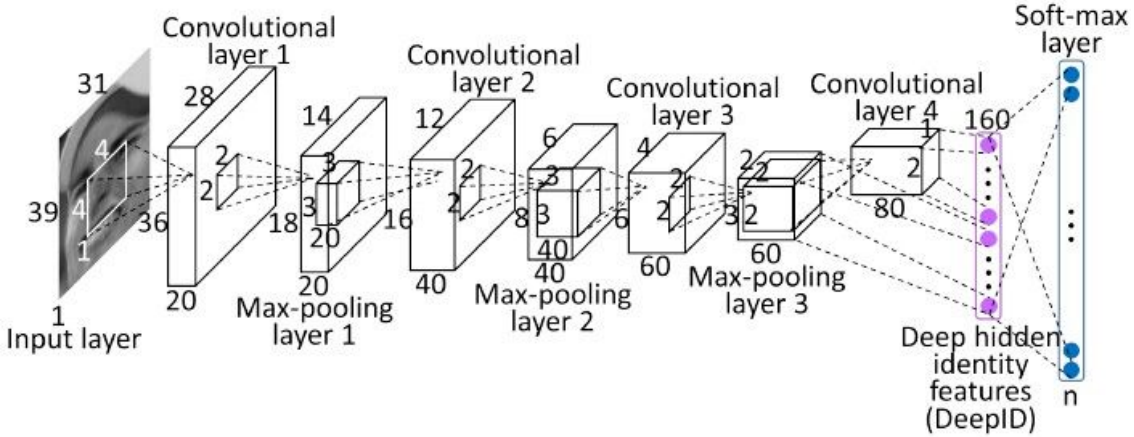
Quelle: http://cs231n.github.io/convolutional-networks/

CNN pooling layer



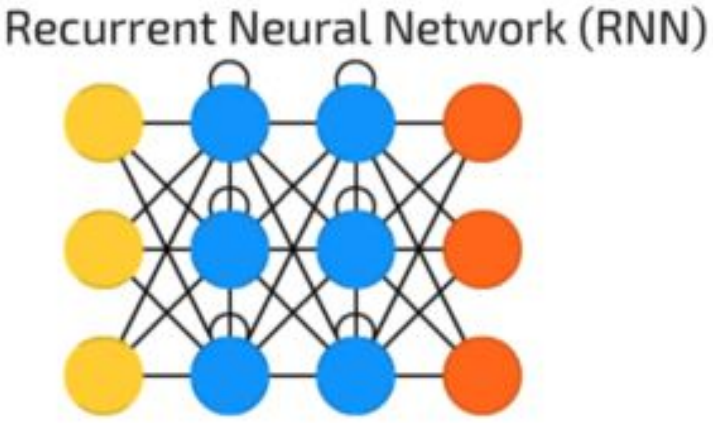
Quelle: http://cs231n.github.io/convolutional-networks/

CNN schematisch



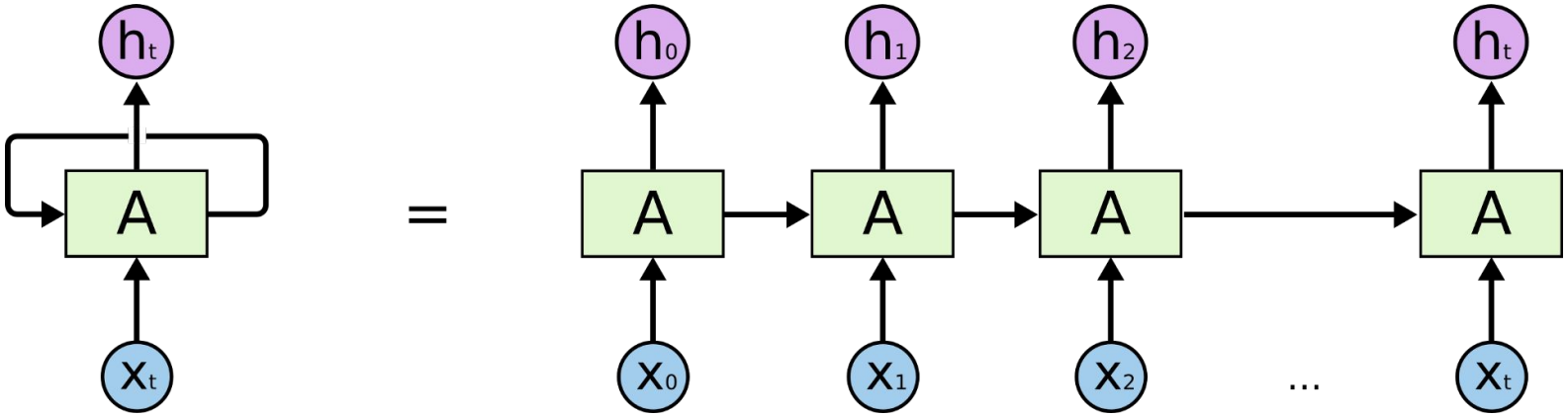
Quelle: Sun, Y., Wang, X., & Tang, X. (2014). Deep learning face representation from predicting 10,000 classes

Recurrent Neural Network (RNN)



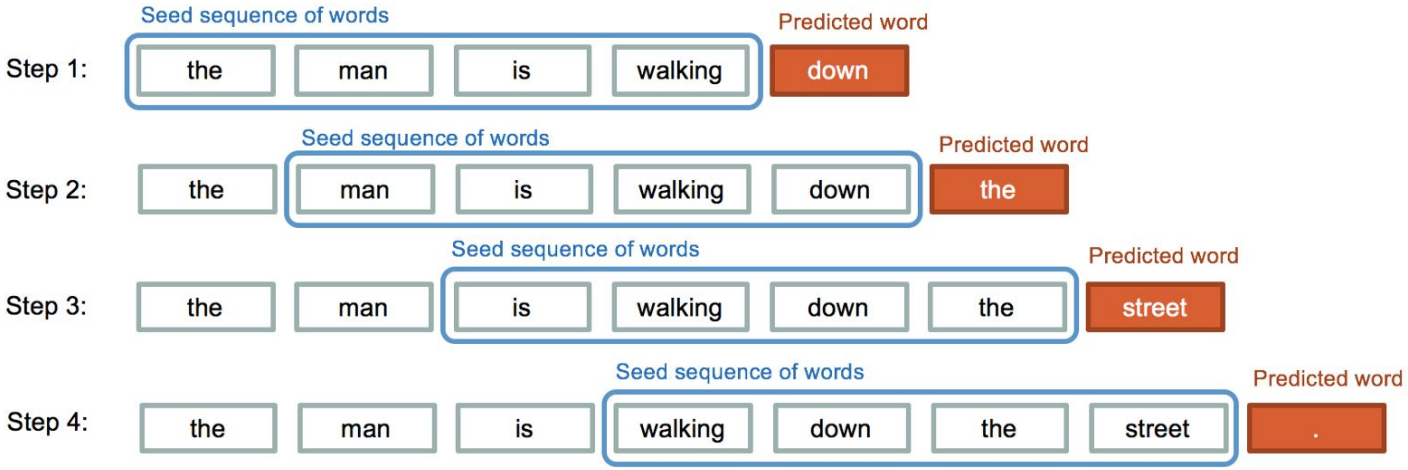
Quelle: Fjodor van Veen, Asimov Institute

RNN schematisch



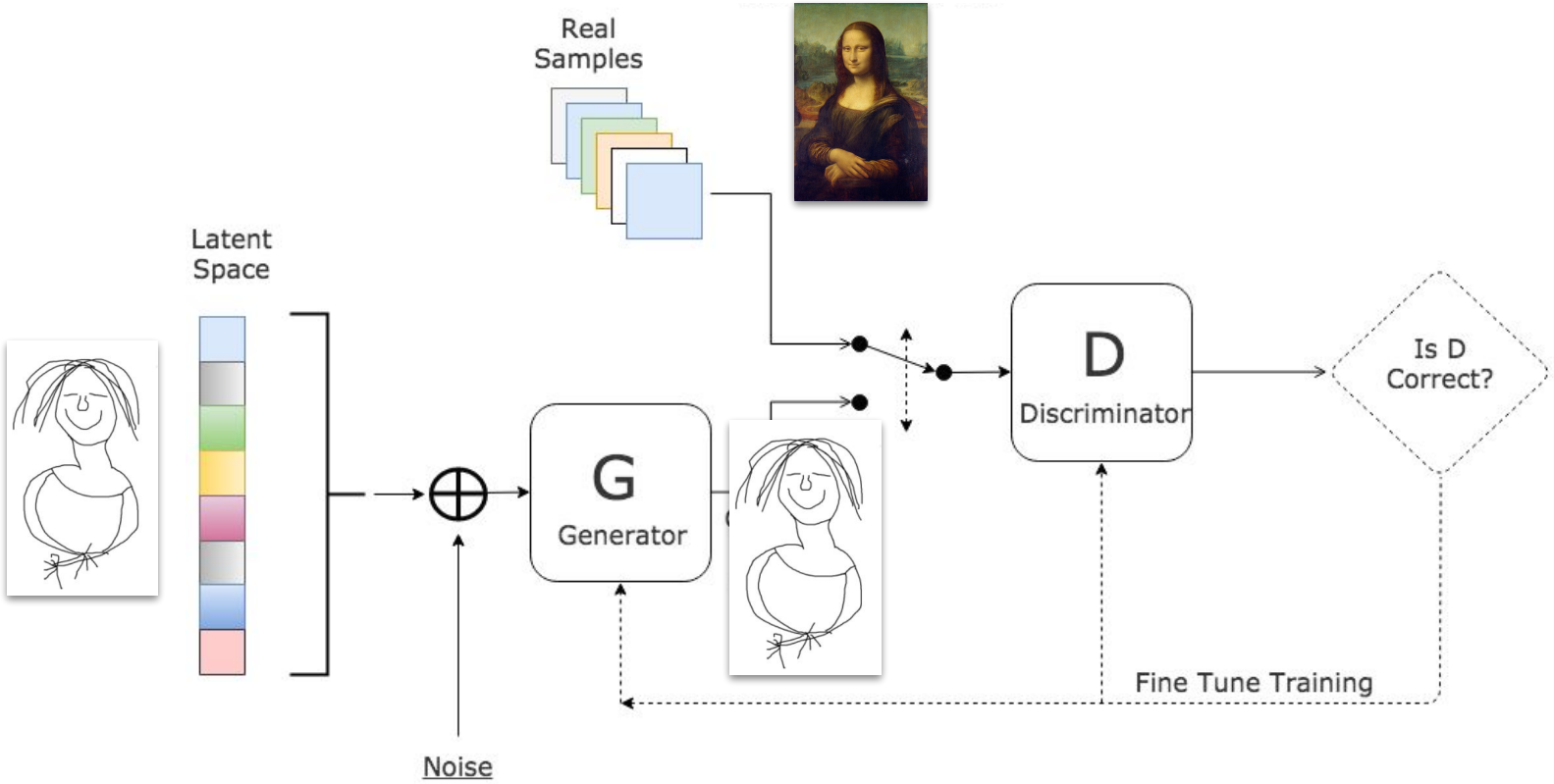
Quelle: https://towardsdatascience.com/introduction-to-recurrent-neural-network-27202c3945f3

RNN word prediction



Quelle:
https://medium.com/@david.campion/text-generation-using-bidirectional-lstm-and-doc2vec-models-1-3-8979eb65cb3a

Generative Adversarial Nets (GAN)



GANs Style transfer

1 Upload photo

The first picture defines the scene you would like to have painted.

2 Choose style

Choose among predefined styles or upload your own style image.

3 Submit

Our servers paint the image for you. You get an email when it's done.

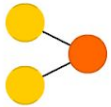
Quelle: deepart.io

A mostly complete chart of

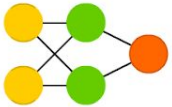
Neural Networks

- Backfed Input Cell
- Input Cell
- Noisy Input Cell
- Hidden Cell
- Probablistic Hidden Cell
- Spiking Hidden Cell
- Output Cell
- Match Input Output Cell
- Recurrent Cell
- Memory Cell
- Different Memory Cell
- Kernel
- Convolution or Pool

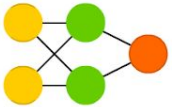
Perceptron (P)



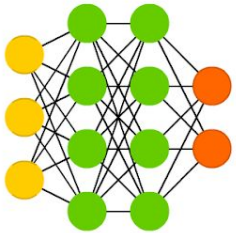
Feed Forward (FF)



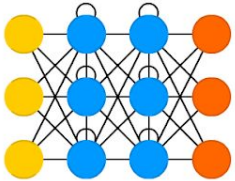
Radial Basis Network (RBF)



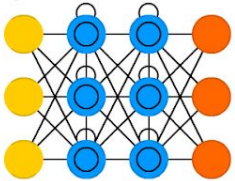
Deep Feed Forward (DFF)



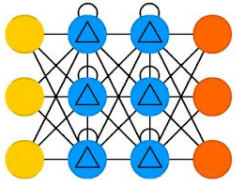
Recurrent Neural Network (RNN)



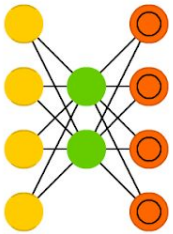
Long / Short Term Memory (LSTM)



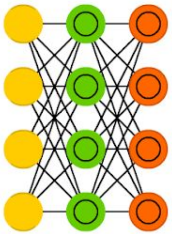
Gated Recurrent Unit (GRU)



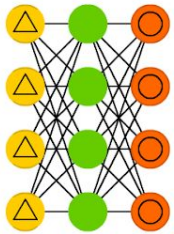
Auto Encoder (AE)



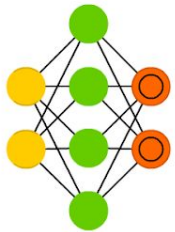
Variational AE (VAE)

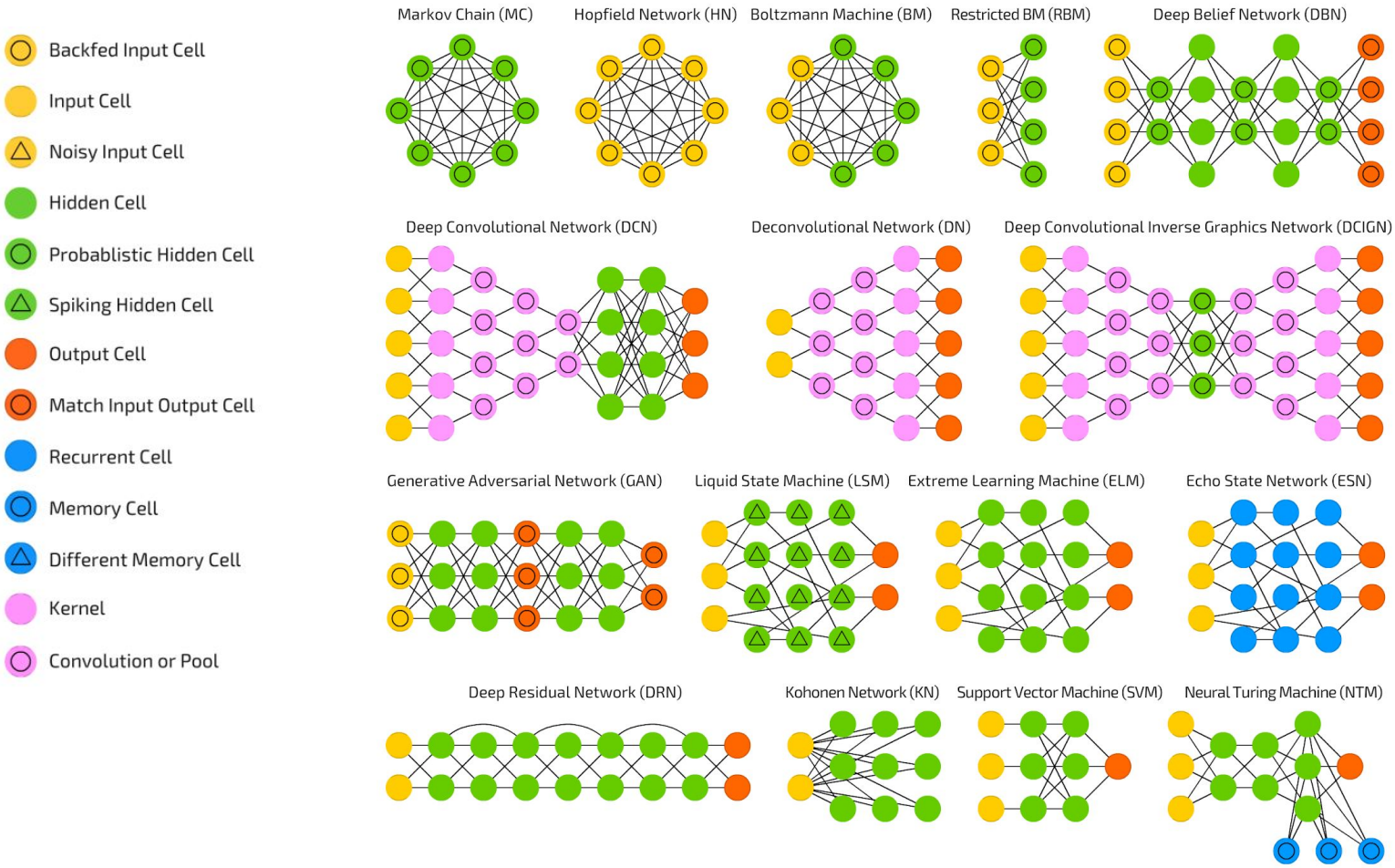


Denoising AE (DAE)



Sparse AE (SAE)




Backfed Input Cell
Input Cell
Noisy Input Cell
Hidden Cell
Probablistic Hidden Cell
Spiking Hidden Cell
Output Cell
Match Input Output Cell
Recurrent Cell
Memory Cell
Different Memory Cell
Kernel
Convolution or Pool
Markov Chain (MC)
Hopfield Network (HN)
Boltzmann Machine (BM)
Restricted BM (RBM)
Deep Belief Network (DBN)
Deep Convolutional Network (DCN)
Deconvolutional Network (DN)
Deep Convolutional Inverse Graphics Network (DCIGN)
Generative Adversarial Network (GAN)
Liquid State Machine (LSM)
Extreme Learning Machine (ELM)
Echo State Network (ESN)
Deep Residual Network (DRN)
Kohonen Network (KN)
Support Vector Machine (SVM)
Neural Turing Machine (NTM)

Machine Learning

Authors and titles for stat.ML in Jul 2018

[total of 53 entries: **1-25** | 26-50 | 51-53]
[showing 25 entries per page: fewer | more | all]

[1] **arXiv:1807.00002 [pdf, other]**

Single Index Latent Variable Models for Network Topology Inference
Jonathan Mei, José M.F. Moura
Comments: arXiv admin note: substantial text overlap with arXiv:1705.03536
Subjects: **Machine Learning (stat.ML)**; Machine Learning (cs.LG)

[2] **arXiv:1807.00042 [pdf, ps, other]**

Neural Networks Trained to Solve Differential Equations Learn General Representations
Martin Magill, Faisal Qureshi, Hendrick W. de Haan
Comments: 14 pages, 9 figures. Submitted to NIPS 2018
Subjects: **Machine Learning (stat.ML)**; Machine Learning (cs.LG); Computational Physics (physics.comp-ph)

[3] **arXiv:1807.00068 [pdf, other]**

Fully Nonparametric Bayesian Additive Regression Trees
Edward George, Prakash Laud, Brent Logan, Robert McCulloch, Rodney Sparapani
Subjects: **Machine Learning (stat.ML)**; Machine Learning (cs.LG)

[4] **arXiv:1807.00084 [pdf, other]**

A Learning Theory in Linear Systems under Compositional Models
Se Un Park
Subjects: **Machine Learning (stat.ML)**; Machine Learning (cs.LG)

Software Demo

Artificial intelligence / machine learning

Kevin Schima

Danke für die Aufmerksamkeit

Fragen?