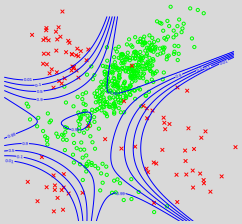
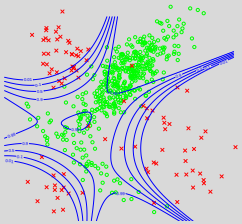


KIBlock Introduction

Lecture *Machine Learning* vom 23.3.2022

Lars Gabriel, Felix Becker, Mario Stanke
Institut für Mathematik und Informatik
Universität Greifswald

Lars Gabriel, Felix Becker, Mario Stanke



Administratives

- Time frame: 9:00-16:00 from march 23rd to 25th
- Lunch break: ∼12:00-13:00
- Course material (slides, code, data sets, ...):
  - `https://github.com/mslehre/KI-Block`
  - `https://moodle.uni-greifswald.de/course/view.php?id=5405`
- Questions and feedback outside of the course (moodle forum):
  - `https://moodle.uni-greifswald.de/mod/forum/view.php?id=146549`
- JupytherHub Uni Greifswald:
  - `https://jupyterhub.wolke.uni-greifswald.de/hub/login`
- Course instructors: Felix Becker, Lars Gabriel, Stefan Simm

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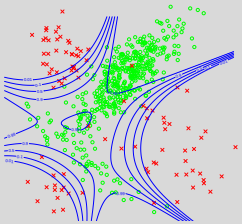

Prerequisites

- Connection to the network of the University of Greifswald
- Basic programming skills in any language
- Basic calculus and linear algebra (derivation, matrix multiplication)

$$\nabla E(\theta) = \left(\frac{\partial E(\theta)}{\partial \theta_0}, \cdots, \frac{\partial E(\theta)}{\partial \theta_n}\right)^T, \quad \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix} \cdot \begin{pmatrix} 3 & 2 & 1 \\ 4 & 1 & 0 \end{pmatrix} = \begin{pmatrix} 11 & 4 & 1 \\ 25 & 10 & 3 \\ 39 & 16 & 5 \end{pmatrix}$$

- Familiarity with numpy syntax

```
[1]: import numpy as np

[3]: A = np.array([[1,2],[3,4],[5,6]])
     B = np.array([[3,2,1],[4,1,0]])
     C = np.matmul(A,B)
     C

[3]: array([[11,  4,  1],
            [25, 10,  3],
            [39, 16,  5]])
```

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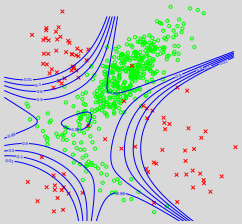
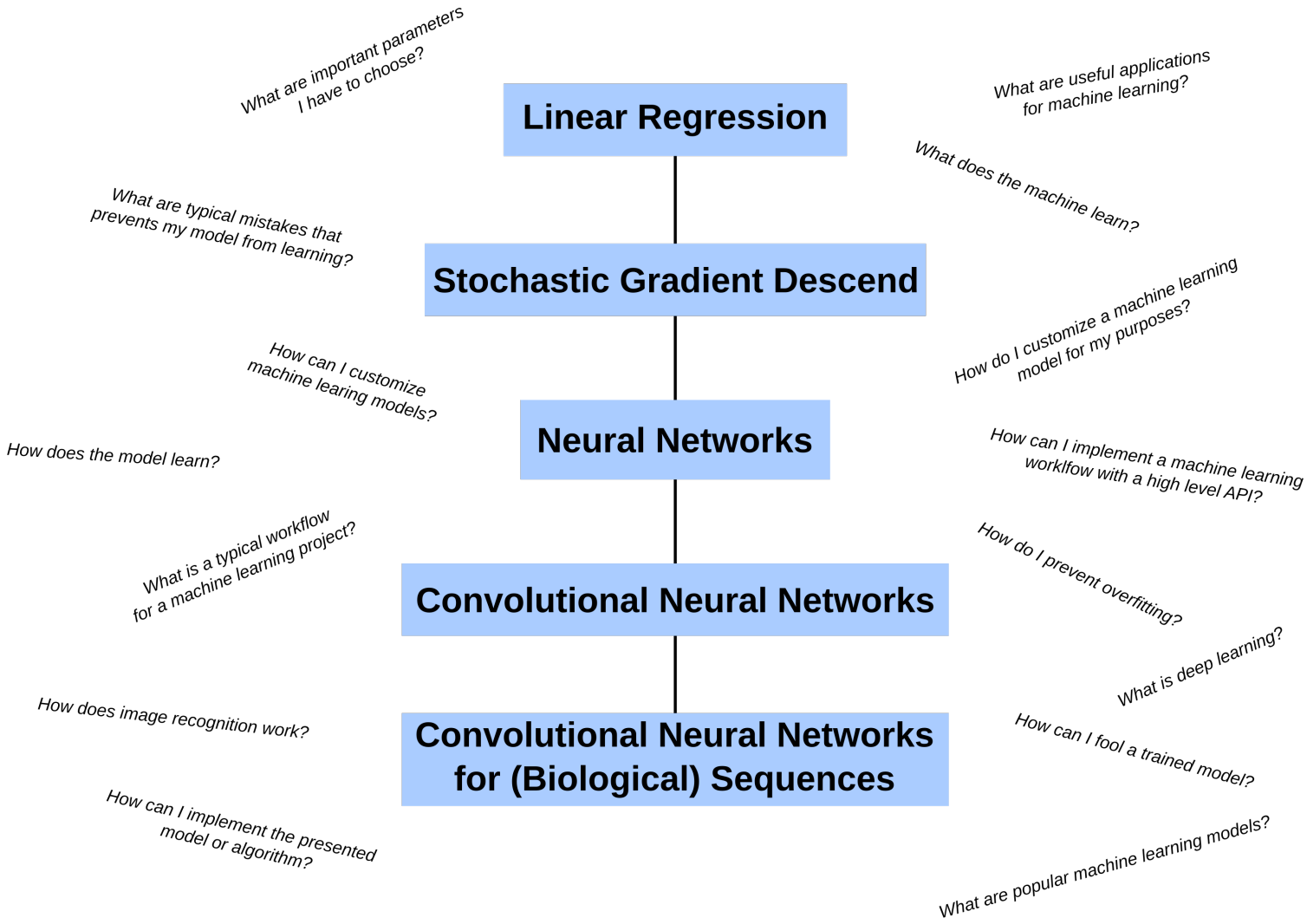


KI-Block 2022 - Overview



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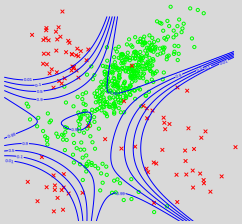
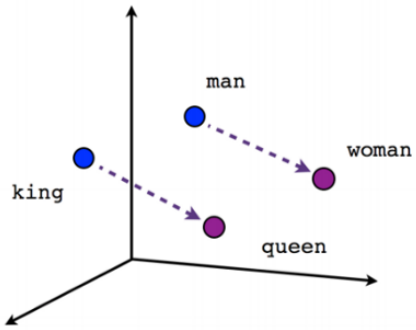
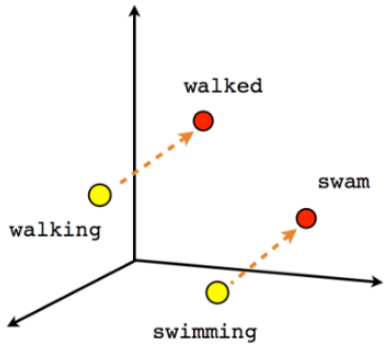


Natural Language Processing

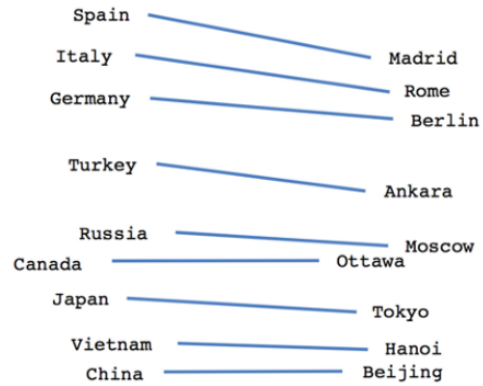
- *GPT-3*[1]: Task-agnostic language model with 175 billion parameters
- Can be used for many purposes e.g. translation, text generation and interpretation
- word embeddings:



Male-Female



Verb tense



Country-Capital

[1] Language Models are Few-Shot Learners, Brown et al., 2020

[2] towardsdatascience.com/creating-word-embeddings-coding-the-word2vec-algorithm-in-python-using-deep-learning

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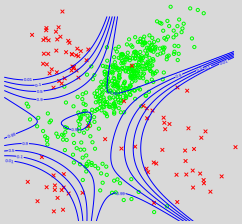
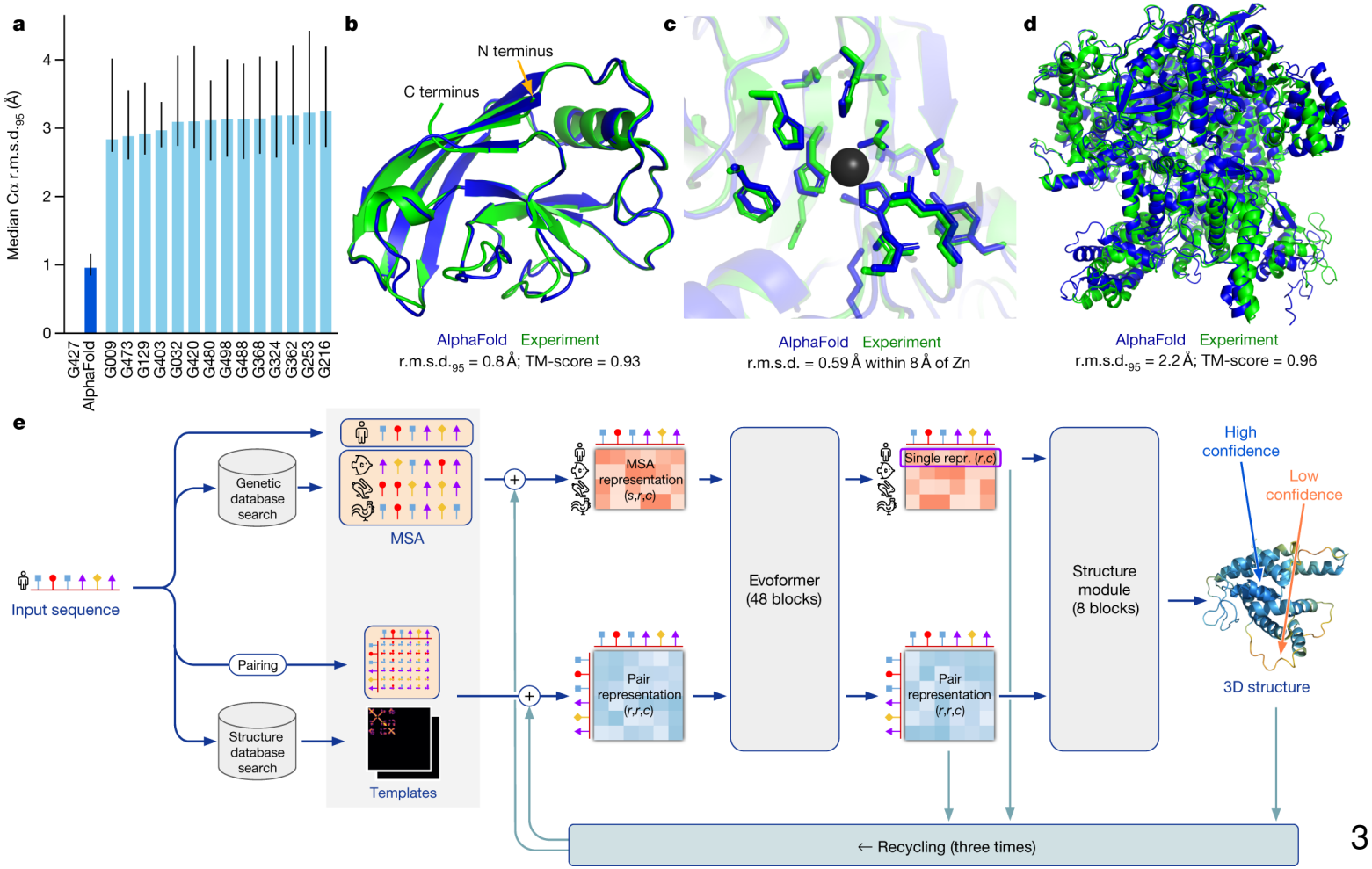


AlphaFold



[3]Highly accurate protein structure prediction with AlphaFold, Brown Mann Ryder Subbiah et al., 2020

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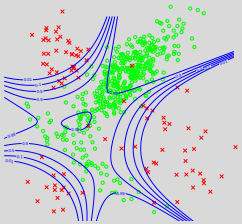
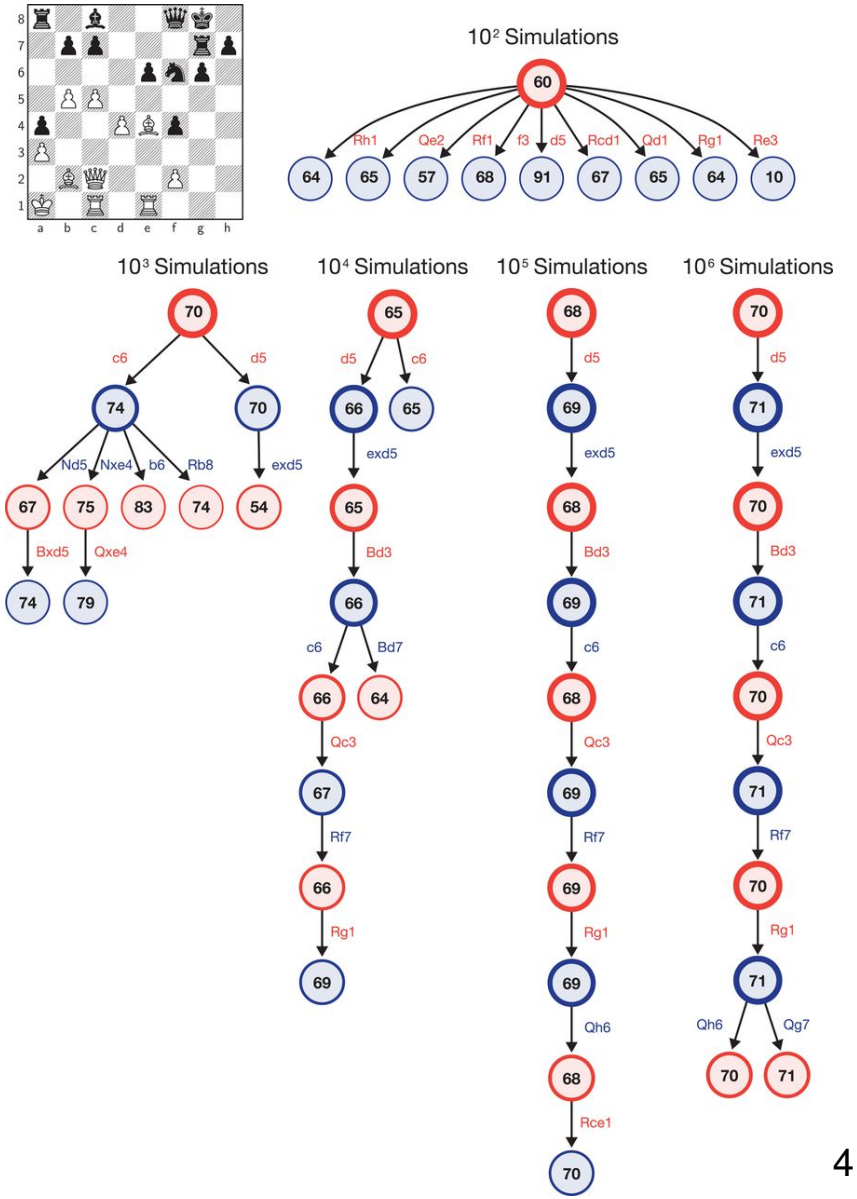


Reinforcement Learning

- Self-playing symmetric games millions of times in parallel
- AlphaZero: Beat the top ranked Go player in the world ("superhuman")
- Uses neural networks to make an educated guess on the best actions (policy) and their expected outcome



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[4] A general reinforcement learning algorithm that masters chess, shogi, and Go through self-play, Silver et al., 2018

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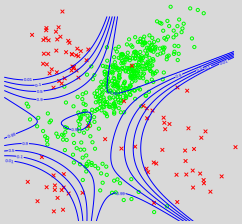
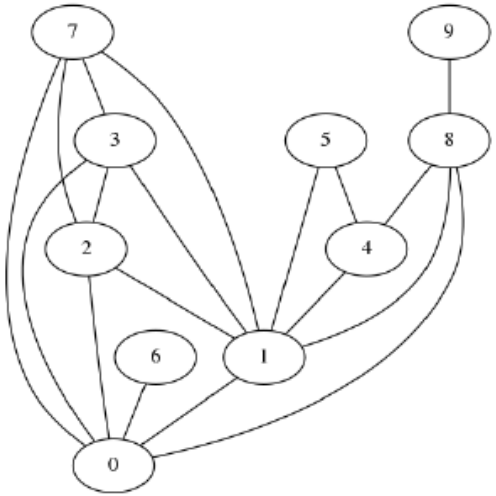
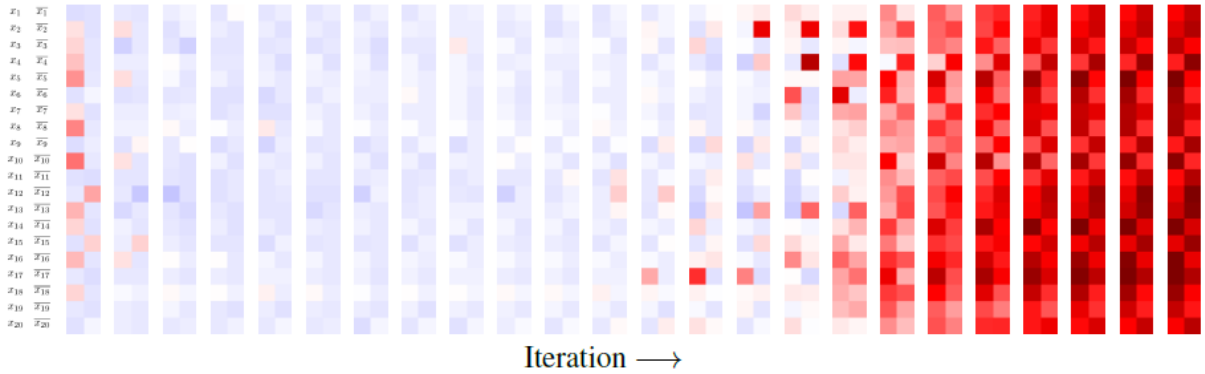


Graph Neural Networks

- Input can have any graph-like structure
- Solve problems by passing messages between nodes of the graph over several iterations





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[5] Learning a SAT solver from single-bit supervision, Selsam et al., 2019

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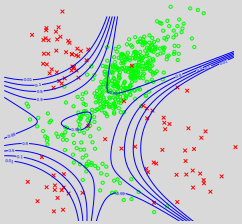
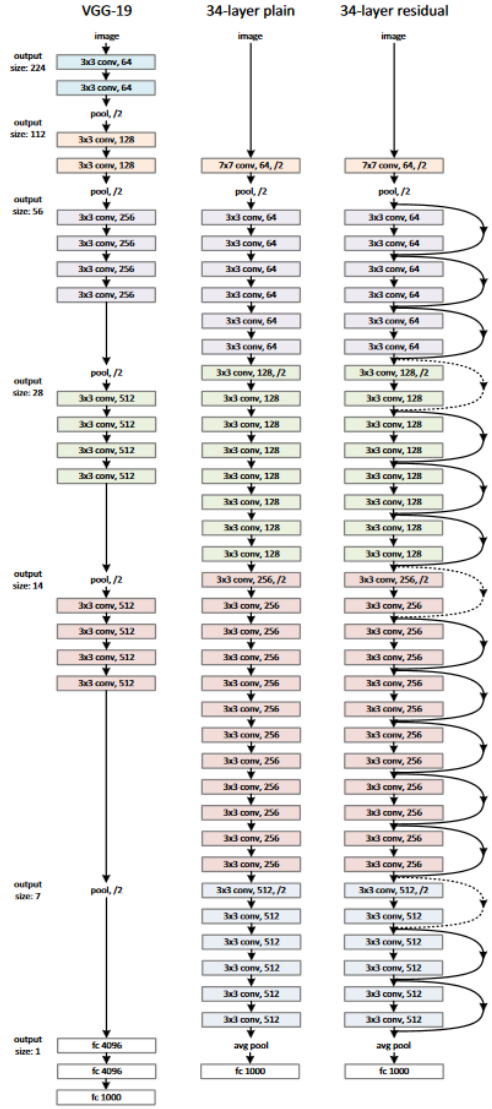


ResNet

- ResNet [6]are very deep networks with great performance in image classification
- Introduced a very useful trick (residual connections) for stable training with large numbers of layers



[5]Deep residual learning for image recognition, He et al., 2016