Meilenstein 4: Klassifikation von Tieren

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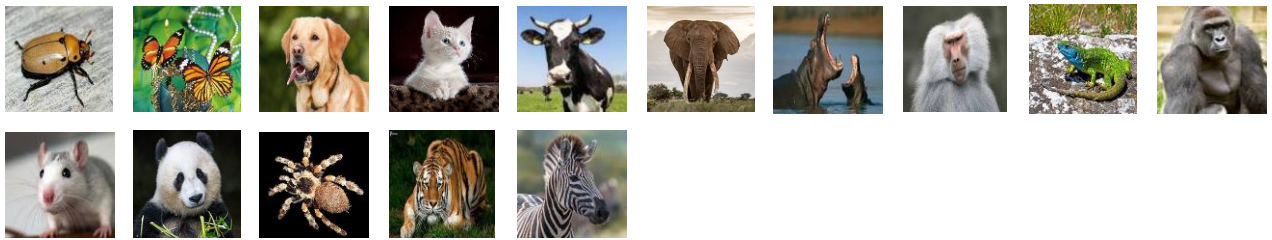
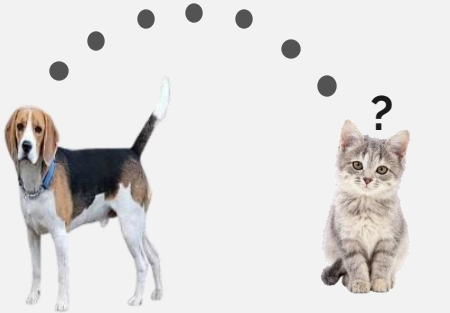
Rückblick - Datensatz

- 15 verschiedene Klassen
- 2000 Trainingsbilder pro Klasse
- 100-200 Validierungsbilder pro Klasse
- 100-200 Testbilder pro Klasse
- Normalisiert mit Auflösung 256 x 256

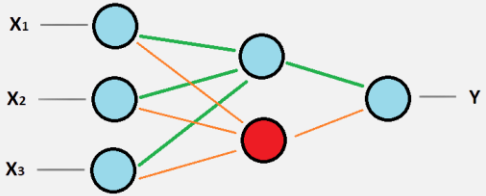


Eingesetzte Techniken

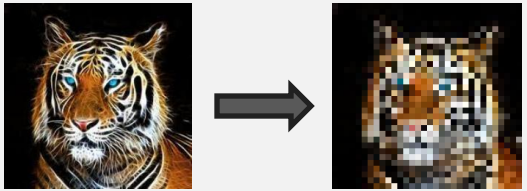
Knowledge Distillation



Pruning



Quantisierung



Knowledge Distillation

Loss Funktion:

$$\mathcal{L}_{Total} = \alpha * \mathcal{L}_{Student} + (1 - \alpha) * \mathcal{L}_{Dist}$$

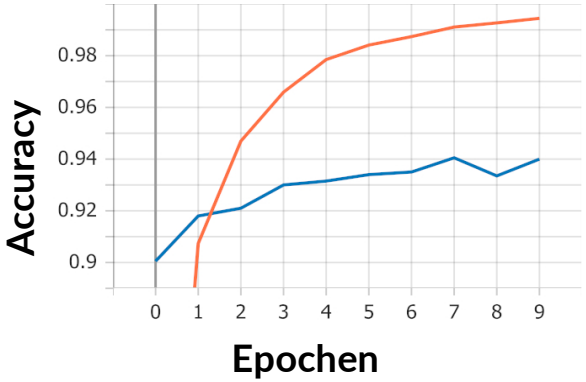
Params	
Student Loss	SparseCategoricalCrossentropy
Distillation Loss	KLDivergence
α	0.1
Temp	10

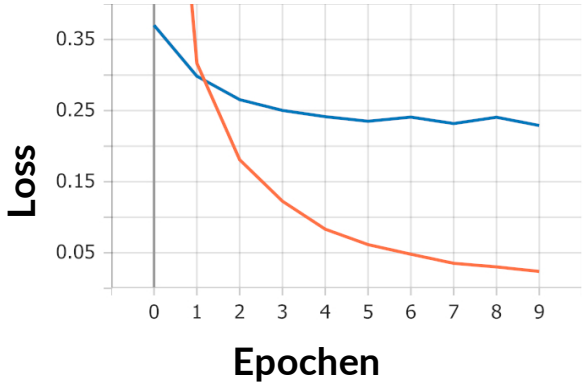
Teacher Model – Architektur & Parameter

- ResNet-50
- Layer: Flatten
- Layer: Batch Normalization
- Layer: Dense (Size: 256, Activation: Relu)
- Layer: Dropout (Value: 0.4)
- Layer: Dense (Size: 128, Activation: Relu)
- Layer: Dropout (Value: 0.1)
- Layer: Dense (Size: 15, Activation: Softmax)

- Anzahl der Epochen: **15**
- Augmentierung der Daten: **Nein**
- Bildauflösungen: **256**
- Learning Rates: **0.0001**
- Learning Rate Decay: **Nein**
- Weight Decay: **L2**

Teacher





Validierungsdaten
Result: 0.94

Trainingsdaten
Result: 0.9945

Validierungsdaten
Result: 0.2291

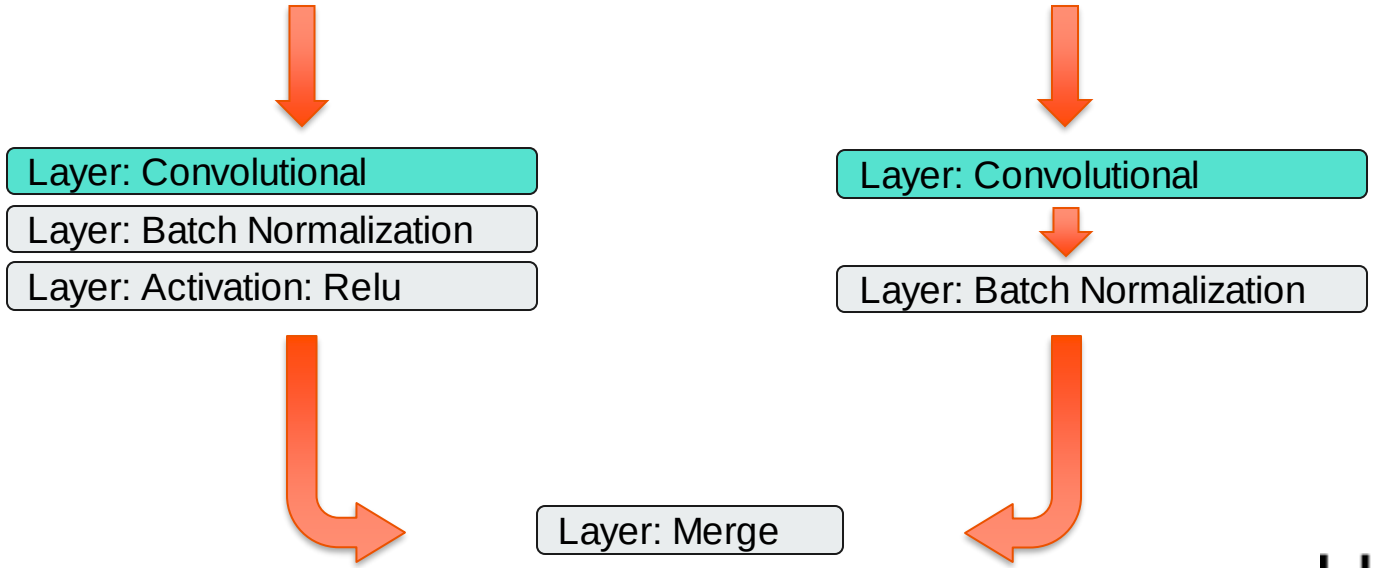
Trainingsdaten
Result: 0.02374

Ergebnis Testdaten:

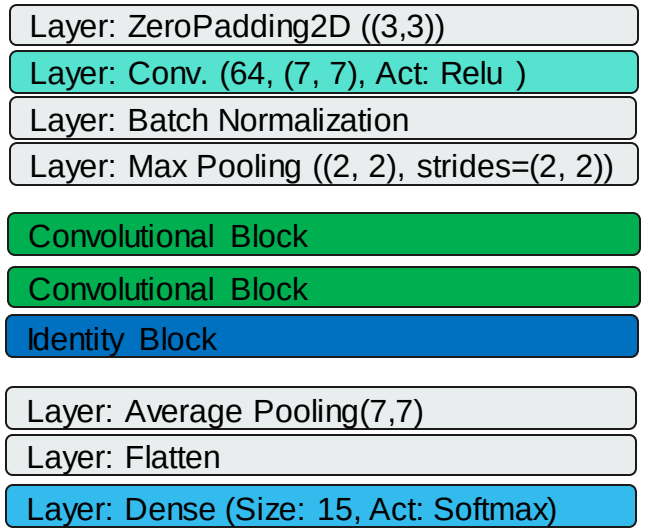
Accuracy: **0.9042**

Loss: **0.3498**

Student Model #1 - Block Architektur

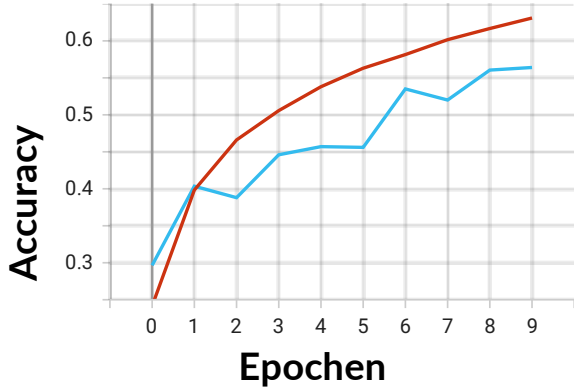


Student Model #1 – Architektur & Parameter



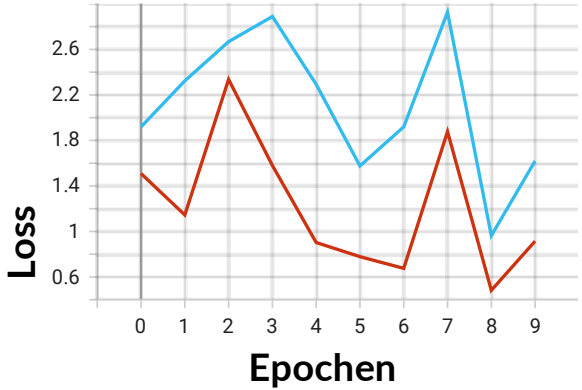
- Anzahl der Epochen: **10**
- Augmentierung der Daten: **Nein**
- Bildauflösungen: **256**
- Learning Rates: **0.001**
- Learning Rate Decay: **Nein**

Student Model #1 – Ergebnisse



Validierungsdaten
Result: 0.564

Trainingsdaten
Result: 0.6309



Validierungsdaten
Result: 1.62

Trainingsdaten
Result: 0.9147

Ergebnis Testdaten:

Accuracy: **0.5419**

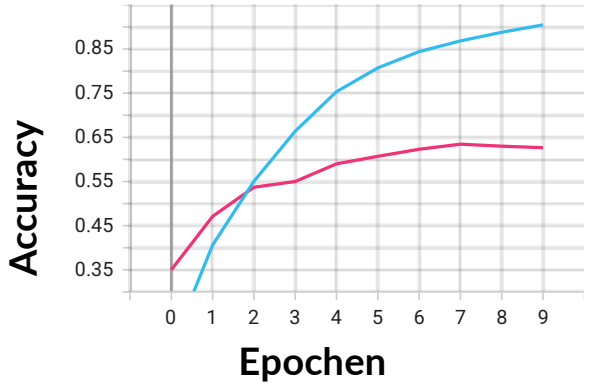
Loss: **2.7261**

Student Model #2 – Architektur & Parameter

- Layer: Batch Normalization
- Layer: Conv. (32, (3, 3), Act: Relu)
- Layer: Max Pooling ((2, 2), strides=(2, 2))
- Layer: Batch Normalization
- Layer: Conv. (64, (3, 3), Act: Relu)
- Layer: Conv. (128, (3, 3), Act: Relu)
- Layer: Max Pooling ((2, 2), strides=(2, 2))
- Layer: Flatten
- Layer: Dense (Size: 256, Act: Relu)
- Layer: Dropout (Value: 0.5)
- Layer: Dense (Size: 128, Act: Relu)
- Layer: Flatten
- Layer: Dense (Size: 15, Act: Softmax)

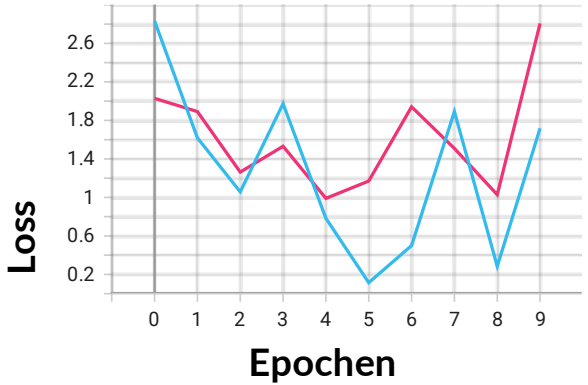
- Anzahl der Epochen: **10**
- Augmentierung der Daten: **Nein**
- Bildauflösungen: **256**
- Learning Rates: **0.001**
- Learning Rate Decay: **Ja**
  - Decay Steps **1500**
  - Decay Rate **0.96**

Student Model #2 – Ergebnisse



Validierungsdaten
Result: 0.6265

Trainingsdaten
Result: 0.9047



Validierungsdaten
Result: 2.807

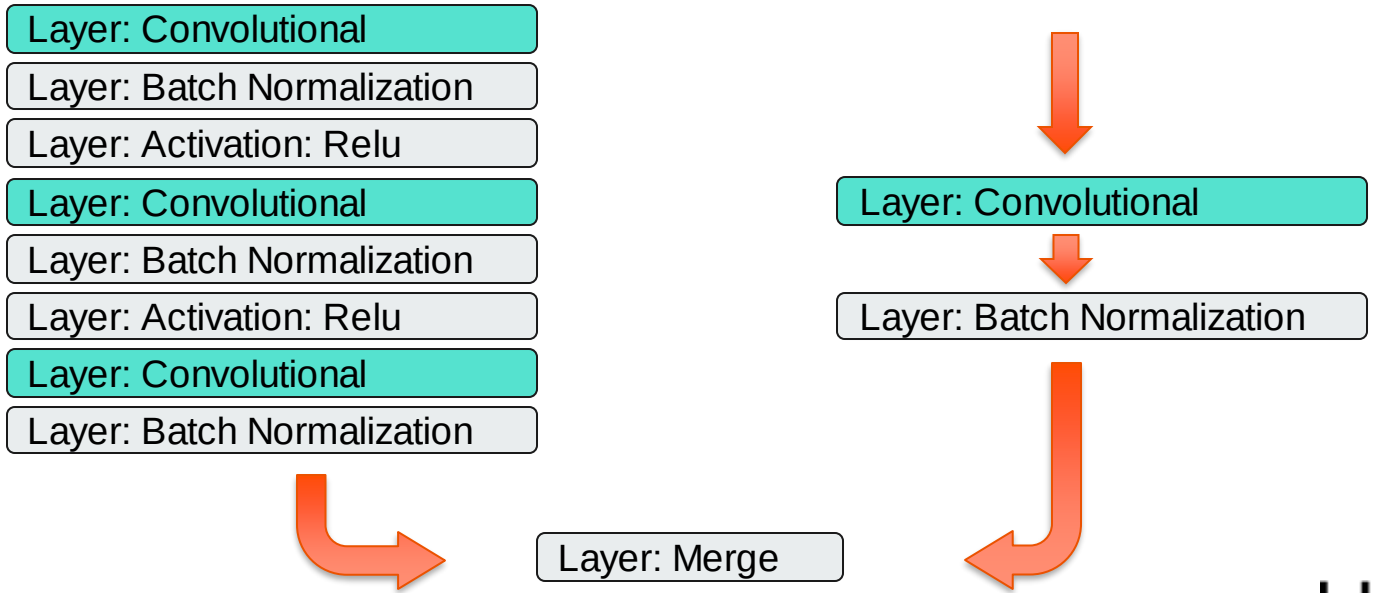
Trainingsdaten
Result: 1.718

Ergebnis Testdaten:

Accuracy: **0.5654**

Loss: **1.368**

Student Model #3 - Block Architektur



Student Model #3 – Architektur & Parameter

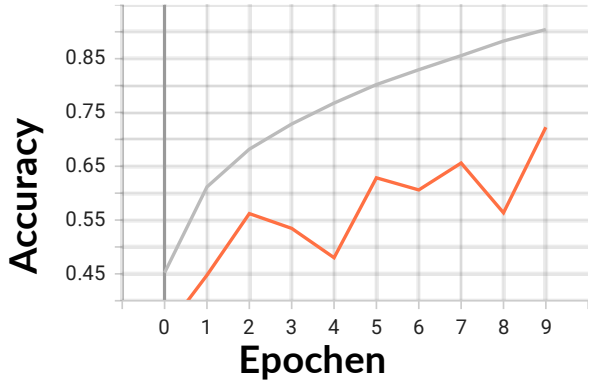
- Layer: Zero Padding
- Layer: Conv. (64, (7, 7), strides=(2,2))
- Layer: Batch Normalization
- Layer: Activation: Relu
- Layer: Max Pooling ((3, 3), strides=(2, 2))

- Convolutional Block
- Identity Block

- Layer: Flatten
- Layer: Dense (Size: 256, Act: Relu)
- Layer: Average Pooling(7,7)
- Layer: Flatten
- Layer: Dense (Size: 15, Act: Softmax)

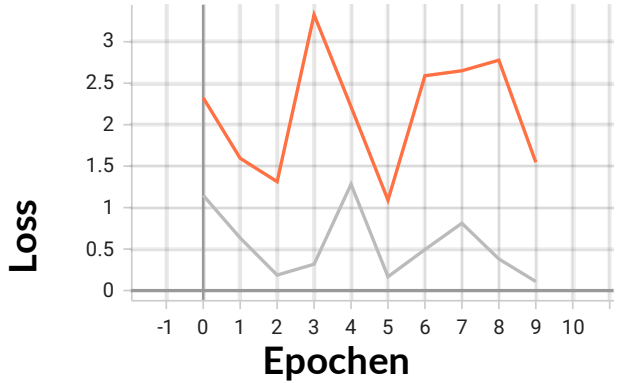
- Anzahl der Epochen: **20**
- Augmentierung der Daten: **Nein**
- Bildauflösungen: **256**
- Learning Rates: **0.001**
- Learning Rate Decay: **Ja**
  - Decay Steps **1500**
  - Decay Rate **0.96**

Student Model #3 (Epochen 1 bis 10) - Ergebnisse



Validierungsdaten
Result: **0.7225**

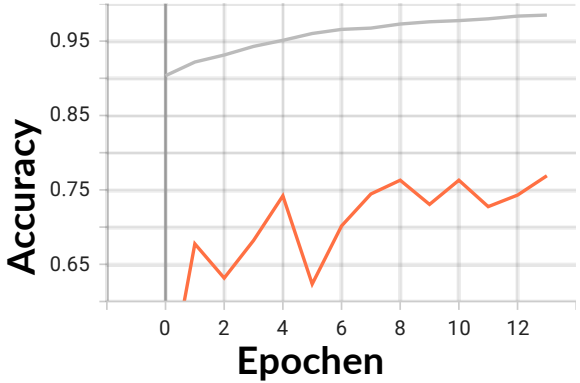
Trainingsdaten
Result: **0.9042**



Validierungsdaten
Result: **1.546**

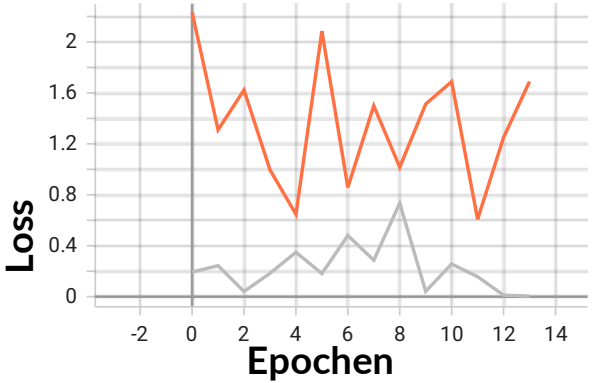
Trainingsdaten
Result: **0.1086**

Student Model #3 (Epochen 11 bis 24) - Ergebnisse



Validierungsdaten
Result: **0.769**

Trainingsdaten
Result: **0.985**



Validierungsdaten
Result: **1.689**

Trainingsdaten
Result: **0.0048**

Ergebnis Testdaten:

Accuracy: **0.7537**

Loss: **0.9764**

Performancevergleich Teacher/Student

	Teacher	Student
Test Accuracy	0.9042	0.7537
Test Loss	0.3498	0.9764
Runtime	43.844 s	13.536 s

Teacher Klassifikation

Echte Klassen

	Beetle	Butterfly	Cat	Cow	Dog	Elephant	Gorilla	Hippo	Lizard	Monkey	Mouse	Panda	Spider	Tiger	Zebra
Beetle	89	5	0	0	0	0	0	0	1	1	0	0	4	0	0
Butterfly	1	90	1	0	0	0	0	0	1	0	1	0	5	0	1
Cat	0	0	318	7	8	1	4	0	2	4	29	0	1	5	0
Cow	0	0	0	161	2	1	1	2	0	0	3	3	1	0	0
Dog	0	0	0	1	79	1	2	0	0	4	0	0	0	0	0
Elephant	0	0	0	9	0	274	9	5	0	1	0	0	0	1	0
Gorilla	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0
Hippo	0	0	0	1	0	1	0	55	0	0	0	0	0	0	0
Lizard	0	2	1	0	0	0	0	0	86	1	1	0	2	0	0
Monkey	0	0	3	1	0	0	6	0	0	172	0	0	0	1	0
Mouse	3	0	6	1	0	0	0	0	2	3	71	1	2	4	0
Panda	0	0	0	2	1	0	1	1	0	7	1	220	0	0	0
Spider	2	3	2	0	0	0	0	1	2	0	4	2	79	2	1
Tiger	0	0	0	1	0	3	0	0	1	0	0	0	0	153	2
Zebra	0	0	1	0	0	1	0	0	0	1	0	0	0	5	255

Beste Student Klassifikation

Echte Klassen

	Beetle	Butterfly	Cat	Cow	Dog	Elephant	Gorilla	Hippo	Lizard	Monkey	Mouse	Panda	Spider	Tiger	Zebra
Beetle	80	4	1	0	0	0	0	1	5	2	1	0	4	2	0
Butterfly	10	69	2	0	0	0	0	0	8	1	2	0	4	3	1
Cat	2	5	283	1	15	1	4	2	1	11	37	5	5	6	1
Cow	2	1	10	83	23	3	5	10	2	11	8	3	2	6	5
Dog	0	0	7	3	61	2	5	0	1	6	0	0	0	2	0
Elephant	3	2	5	8	10	199	11	17	5	11	6	0	1	9	12
Gorilla	0	0	2	0	0	0	25	0	0	1	0	0	0	0	0
Hippo	1	0	0	0	1	3	6	36	0	3	1	1	0	4	1
Lizard	3	6	2	1	2	0	1	0	66	1	3	0	2	4	2
Monkey	7	1	8	2	6	0	9	1	3	131	12	0	1	1	1
Mouse	0	0	5	2	2	0	3	1	2	5	68	0	2	3	0
Panda	1	0	1	2	1	0	1	1	1	15	3	202	3	2	0
Spider	11	6	2	1	1	0	1	0	6	7	2	0	54	6	1
Tiger	1	2	1	0	0	0	0	1	0	4	0	0	0	148	3
Zebra	0	0	0	0	0	0	1	2	1	0	1	0	0	3	255

Größenvergleich Teacher/Student

Teacher

- Total Params: 57.701.519
- Trainable Params: 33.851.663
- Size: 482 MB

Student

- Total Params: 1.340.150
- Trainable Params:
- 671.119
- Size 3.19 MB

	Total Params	Trainable Params	Disk Size
Ersparnis	**97,67 %**	**98.01 %**	**99,38 %**




Live Demo




Fragen?

Link zum Github Repo