

Deep Learning mit Keras und TensorFlow

- Einführung Deep Learning
- Ein Neuronales Netz trainieren (Keras und TensorFlow)
- Selbststudium ermöglichen



Motivation

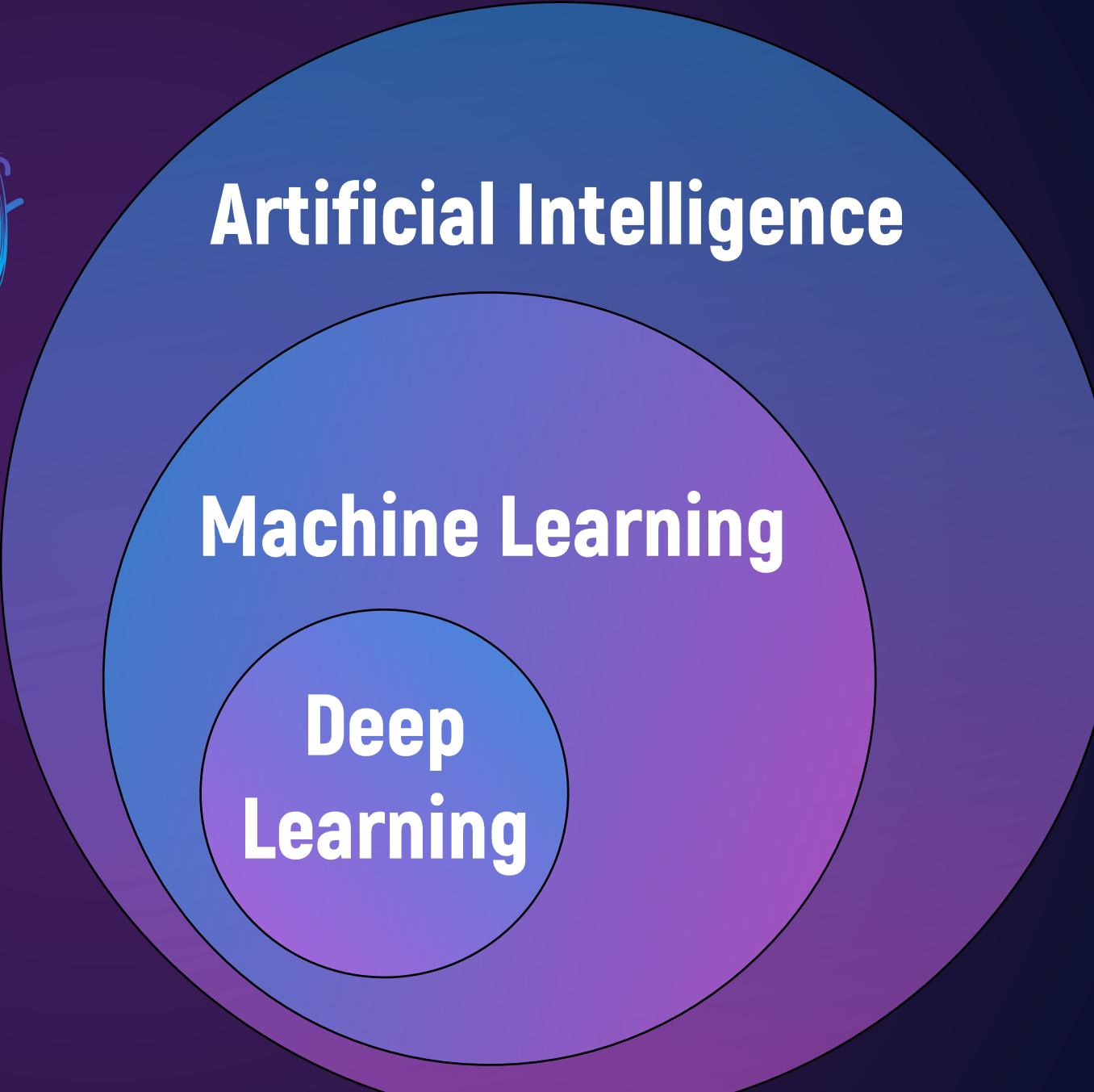


Anhalt

- Deep Learning
- Neuronales Netze
- Keras und TensorFlow (Python)
- Google Colab (Jupyter Notebook)

Deep Learning

Was ist
Deep Learning



Artificial Intelligence

Machine Learning

Deep
Learning

Deep Learning

Warum brauchen wir Deep Learning

<https://hackernoon.com/>



Deep Learning

Typische

Deep Learning

Probleme

Classification



<https://praxistipps.focus.de>

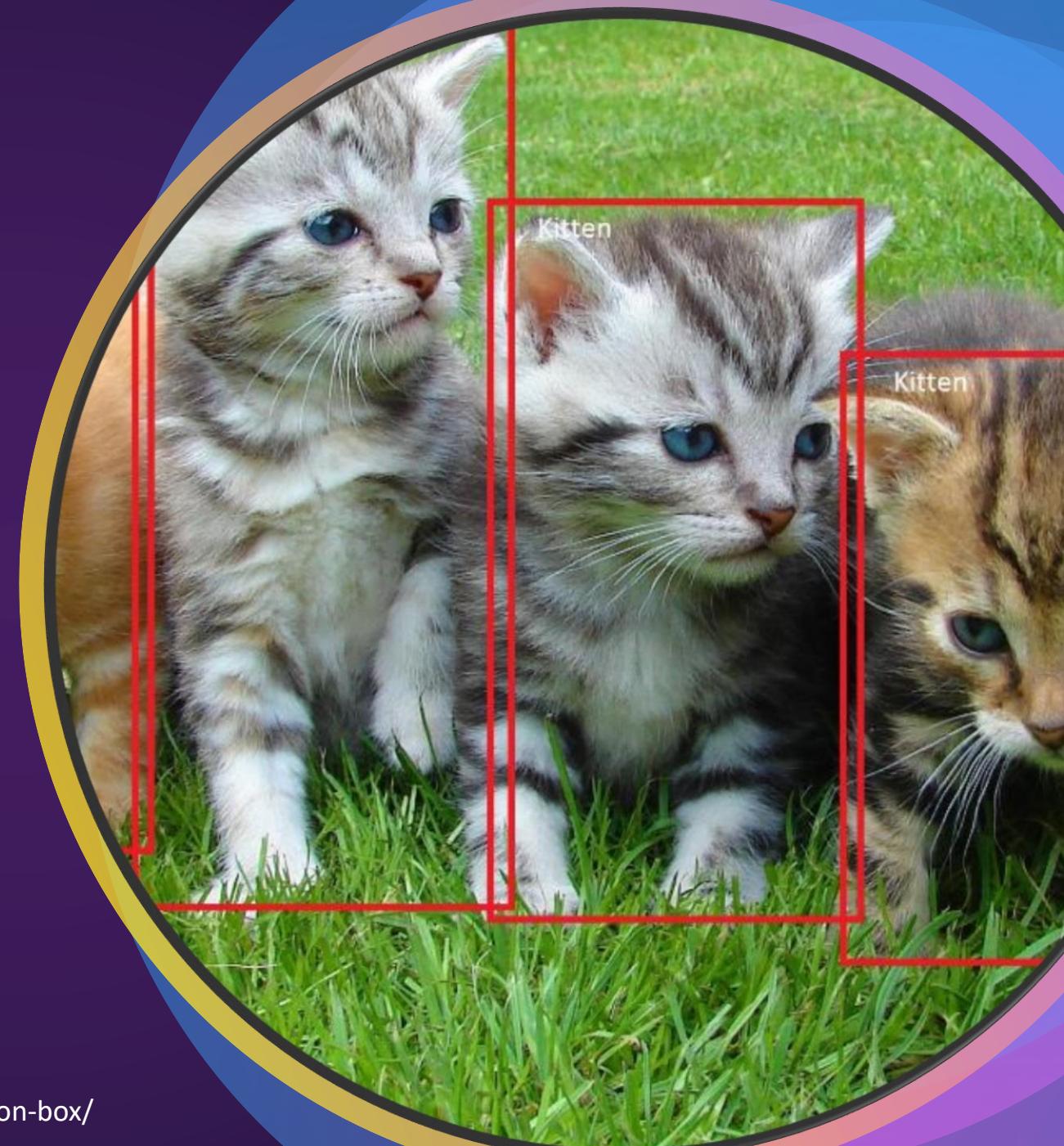


<https://www.zooroyal.de>

Deep Learning

Typische Deep Learning Probleme

Object Detection



Deep Learning

Typische

Deep Learning Probleme

Natural Language Processing



Hey Alexa...

Deep Learning

Typische Deep Learning Probleme

Regression



Deep Learning

Typische

Deep Learning

Probleme

Clustering



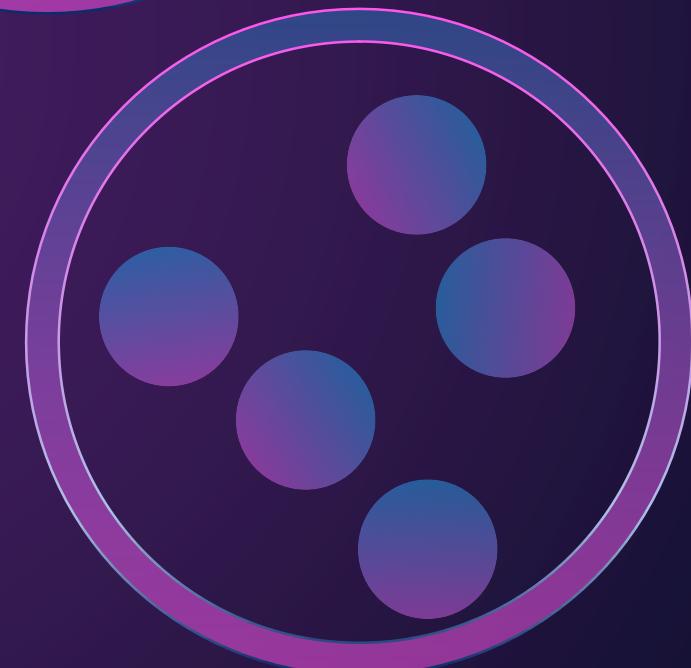
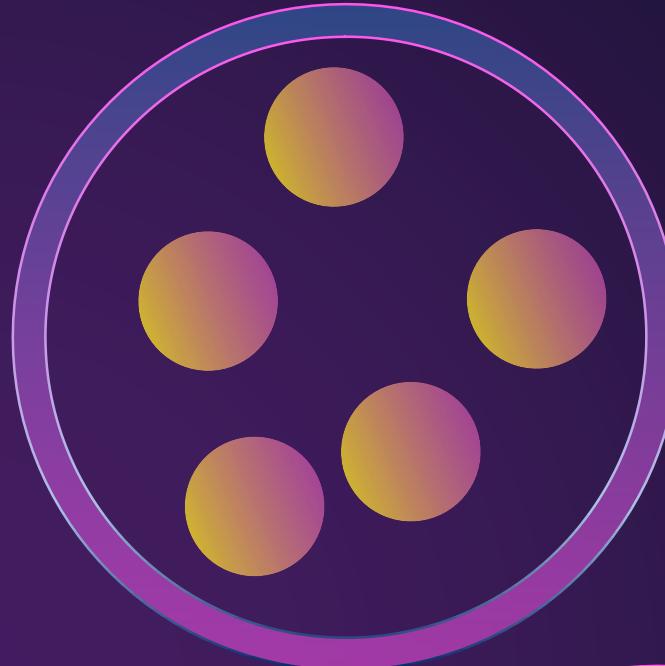
Deep Learning

Typische

Deep Learning

Probleme

Clustering



Deep Learning

Typische

Deep Learning

Probleme

Games



<https://www.fotocommunity.de>



<https://www.heikovaneckert.de>

Deep Learning

Wie funktioniert
Deep Learning

Deep Learning

Wie funktioniert
Deep Learning

Problem



<https://theleadershipnetwork.com/>

Deep Learning

Wie funktioniert
Deep Learning

Problem



<https://theleadershipnetwork.com/>

Daten

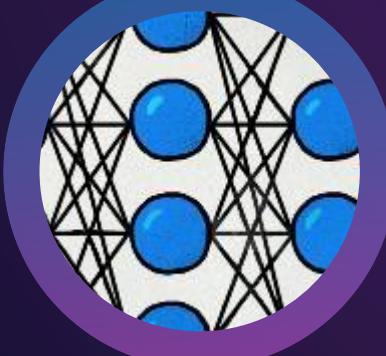


<http://farefwd.com/>

Deep Learning

Wie funktioniert
Deep Learning

Model



<https://medium.com/@datamonsters/>

Problem



<https://theleadershipnetwork.com/>

Daten



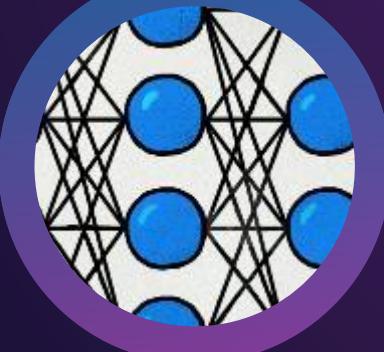
<http://farefwd.com/>

Deep Learning

Wie funktioniert

Deep Learning

Model



<https://medium.com/@datamonsters/>

Problem



<https://theleadershipnetwork.com/>

Daten



<http://farefwd.com/>

Algorithmus



<https://oupeitglobalblog.com/2018/03/27/>

Deep Learning

Wie funktioniert

Deep Learning

Model



<https://medium.com/@datamonsters/>

Problem



<https://theleadershipnetwork.com/>

Daten



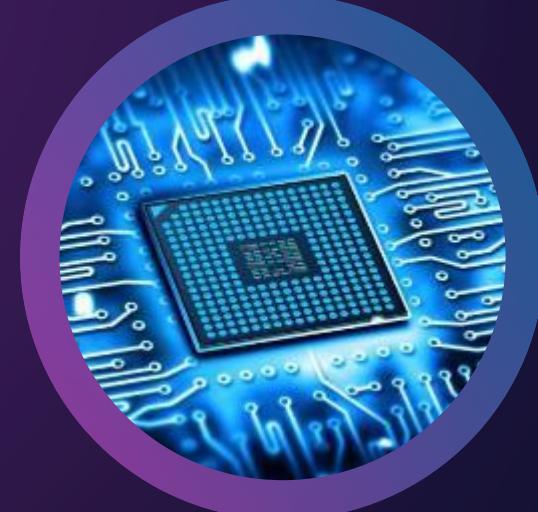
<http://farefwd.com/>

Algorithmus



<https://oupeitglobalblog.com/2018/03/27/>

Rechenzeit und Leistung



<https://www.pc-magazin.de/>

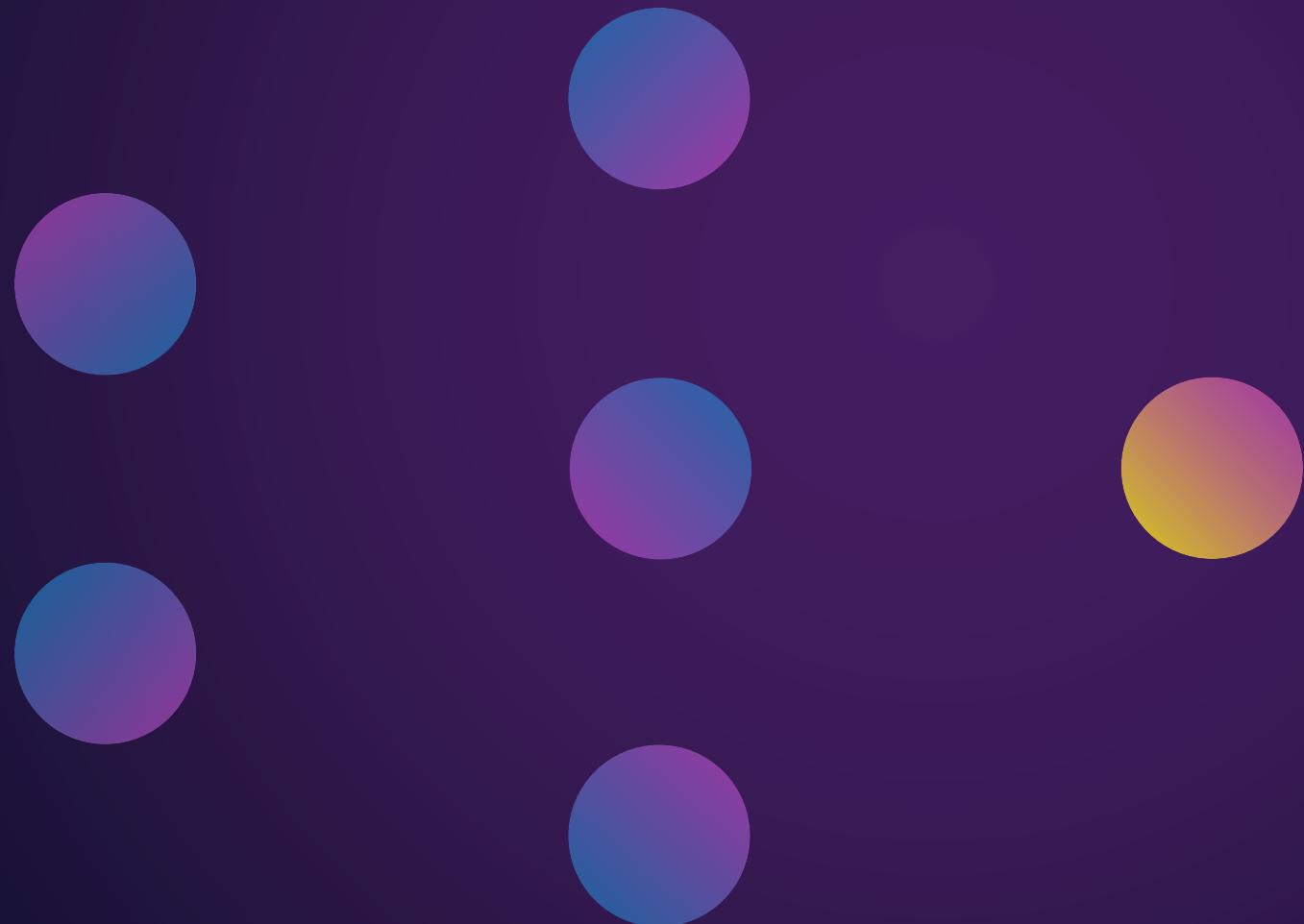


Neuronale Netze

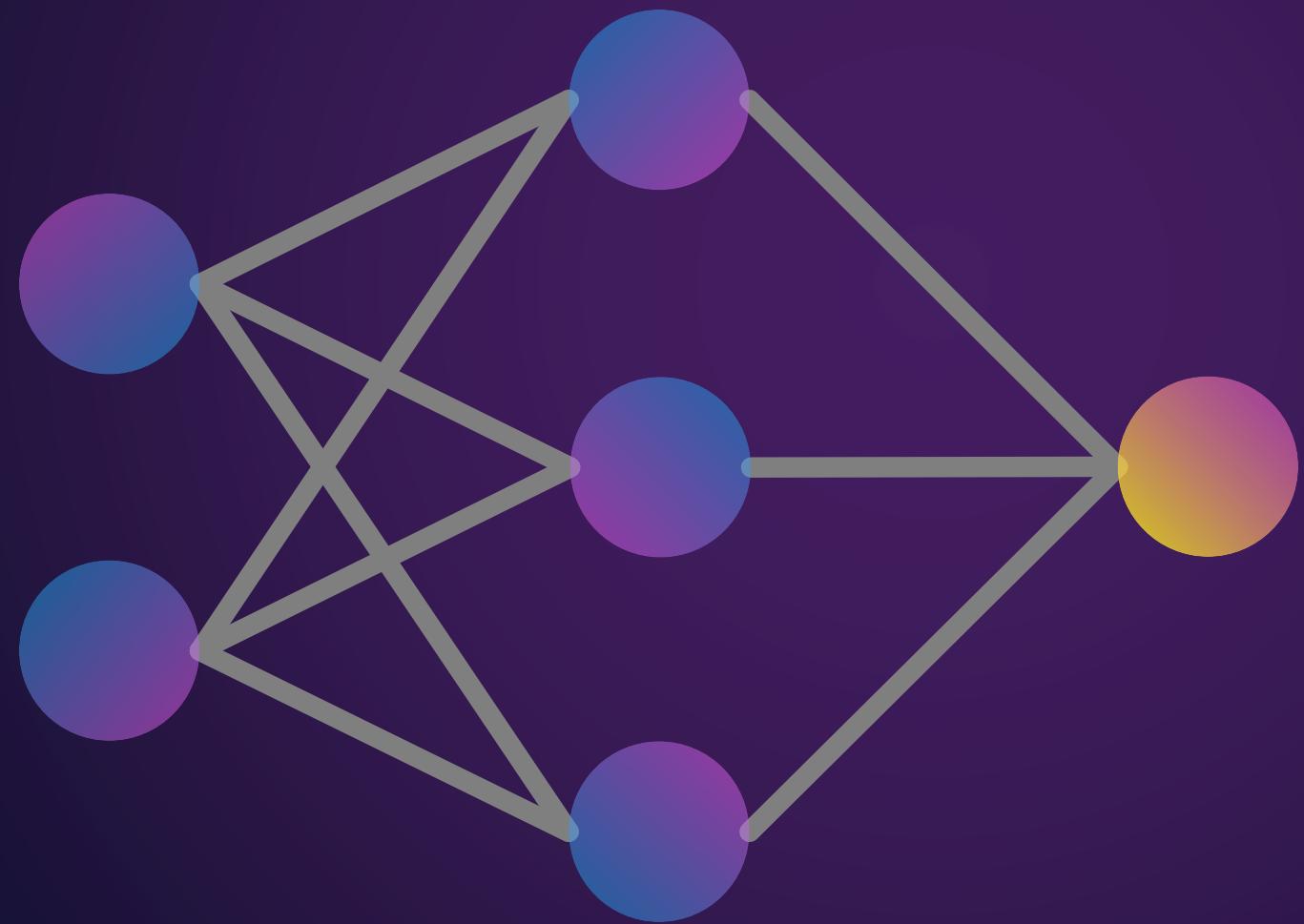
Und ihre Geschichte

- Approximation beliebiger Funktion
 - 1943: Mathematisches Modell
 - 1986: Stabiler Lernalgorithmus
- 'loosely modeled after the human brain'
 - Vielzahl an Architecturen

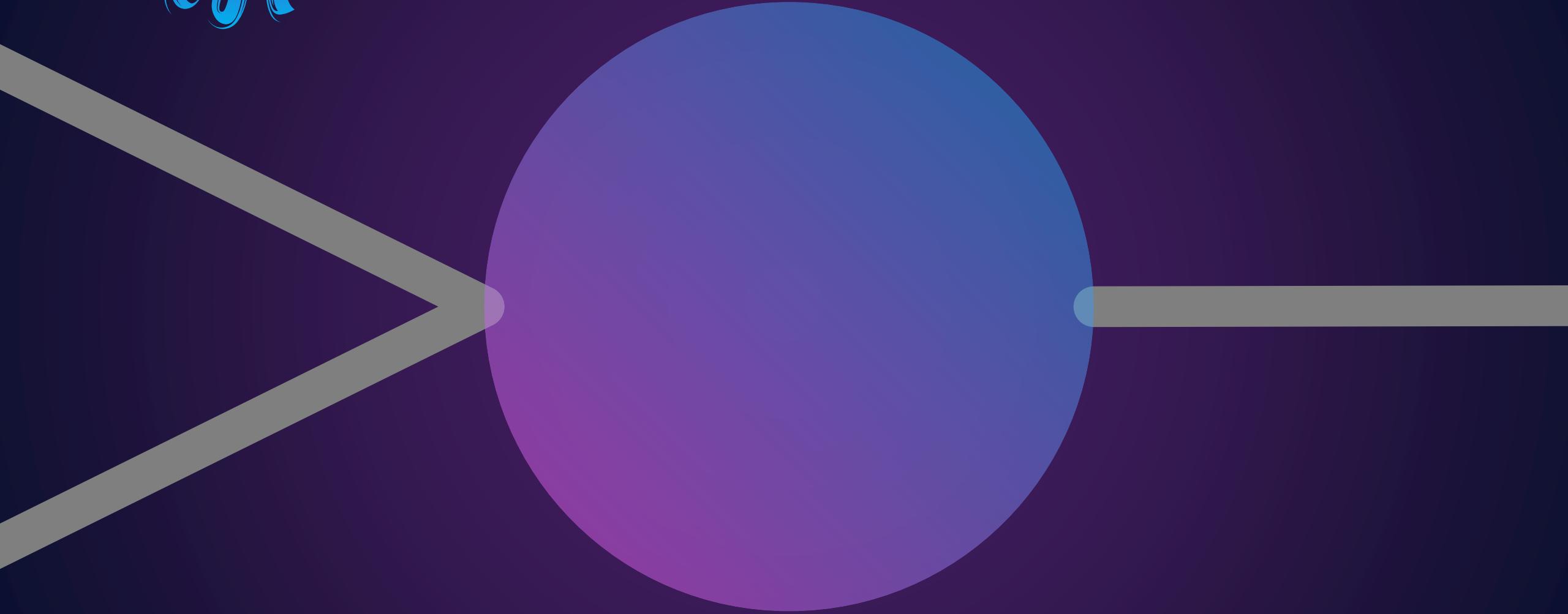
Neuronale Netze



Neuronale Netze



Newton



Newton

w_1

w_2



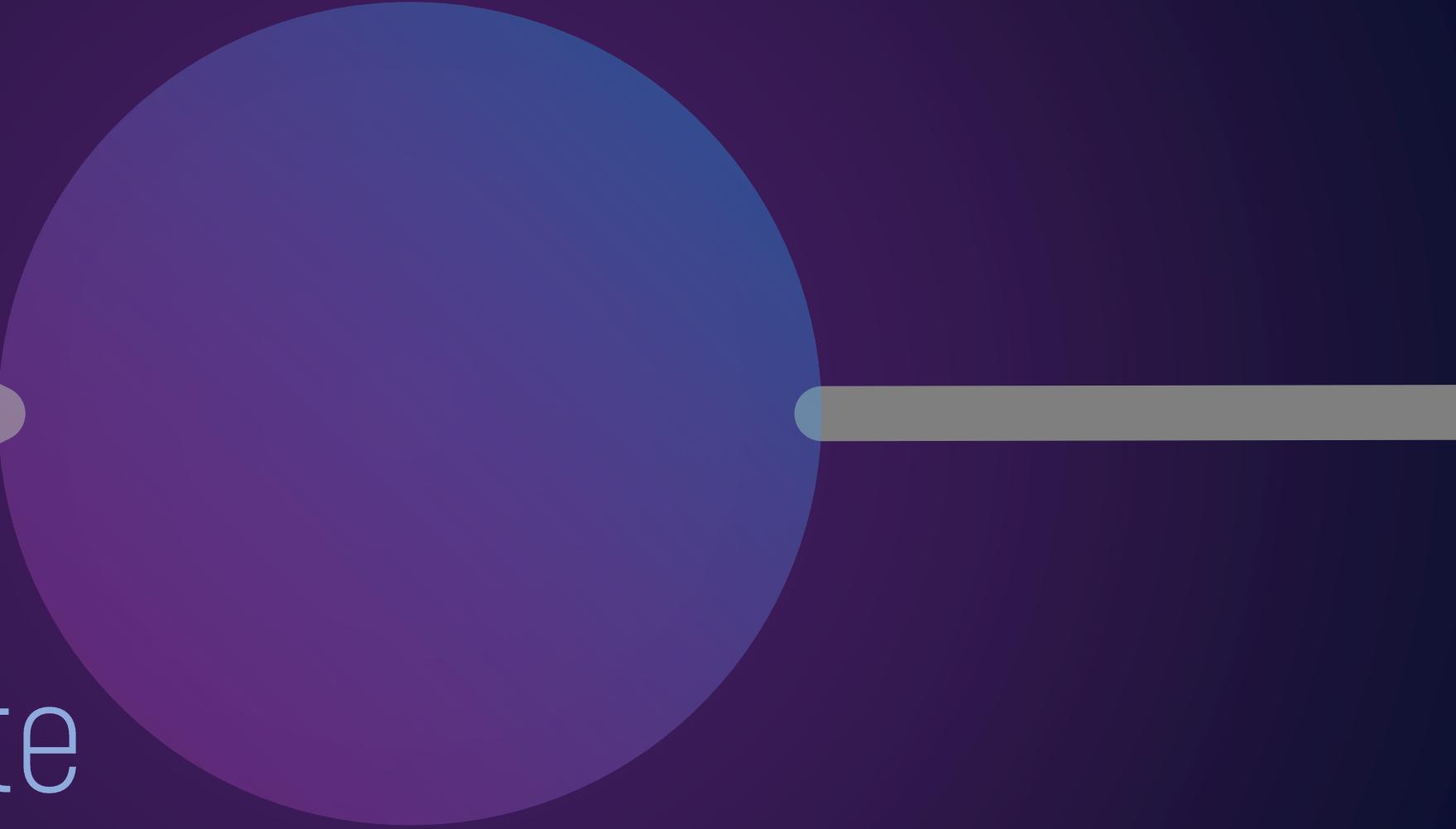
Neuron

w_1

w_2

Gewichte

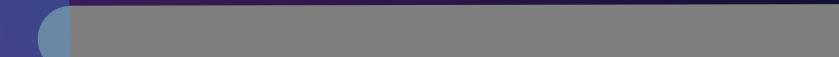
weights



Newton

w_1

w_2



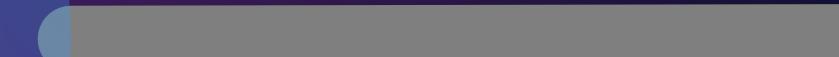
Newton

x_1

w_1

w_2

x_2



Newton

$$z = \begin{matrix} x_1 w_1 \\ + x_2 w_2 \end{matrix}$$

Newton

$$z = \sum_i w_i x_i$$

Newton

$$z = \sum_i w_i x_i$$

Newton

$$z = \sum_i w_i x_i$$

$$a = f()$$

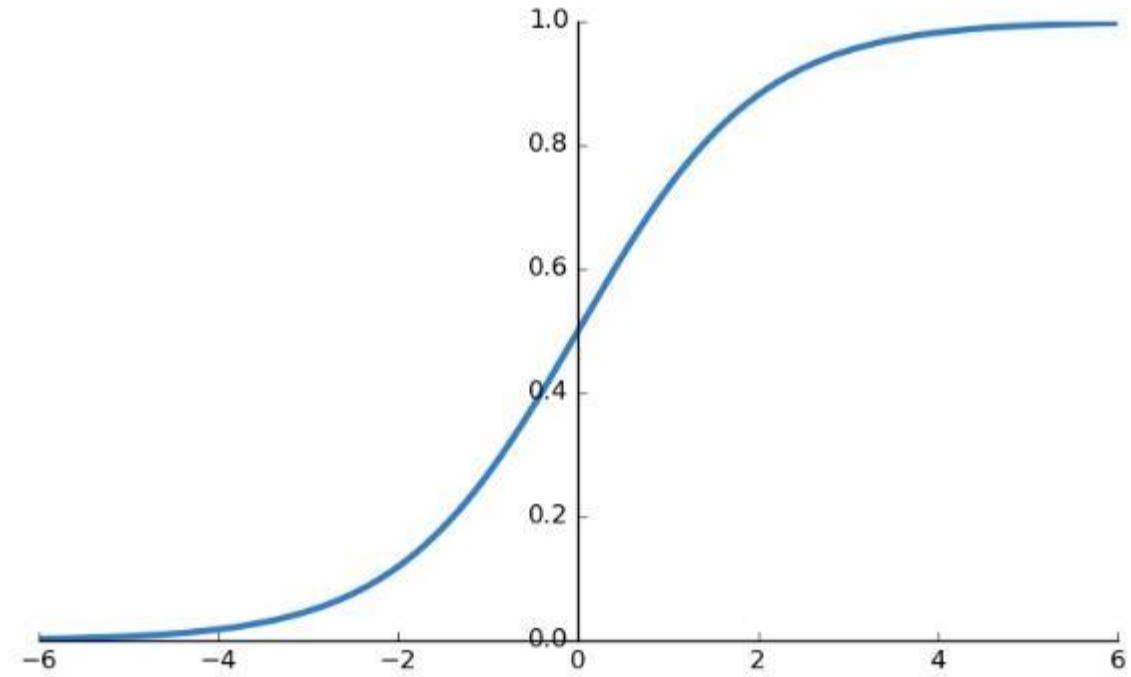
Newton

$$z = \sum_i w_i x_i$$

$$a = f(z)$$

$$a = f(z)$$

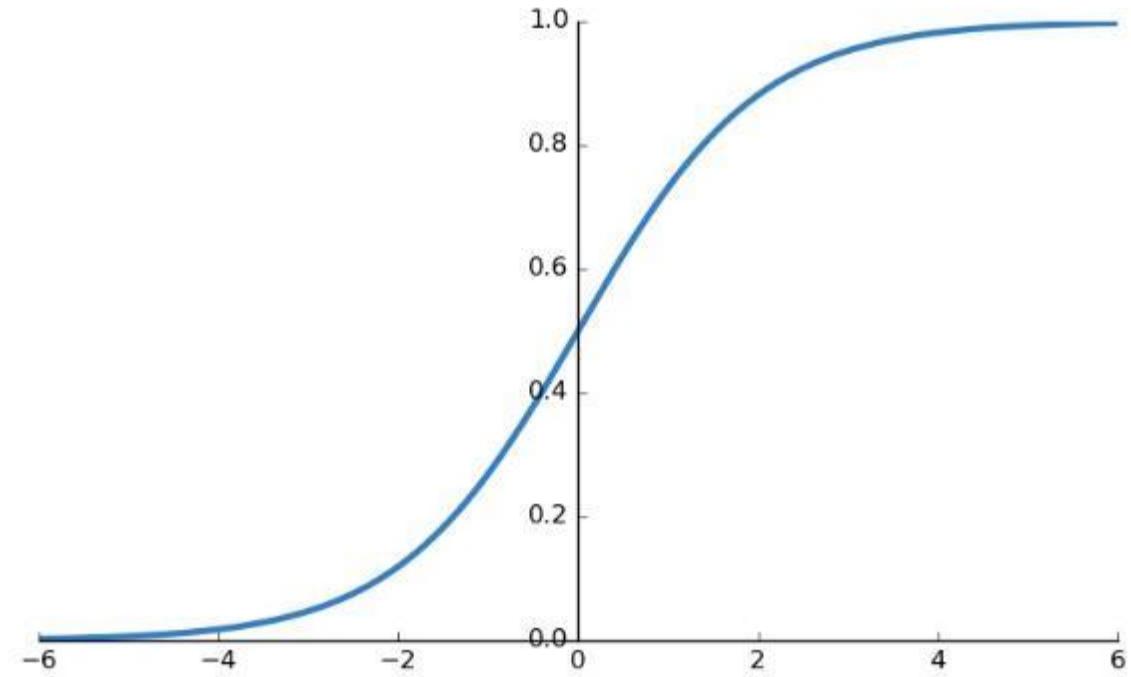
Aktivierungs
funktion



http://ronny.rest/blog/post_2017_08_10_sigmoid/

$$a = f(z)$$

Aktivierungs
funktion



http://ronny.rest/blog/post_2017_08_10_sigmoid/

$$f(x) = \frac{1}{1 + e^{-x}}$$

Newton

$$z = \sum_i w_i x_i$$

$$a = f(z)$$

Newton

$$z = \sum_i w_i x_i$$

$$a = f(z)$$

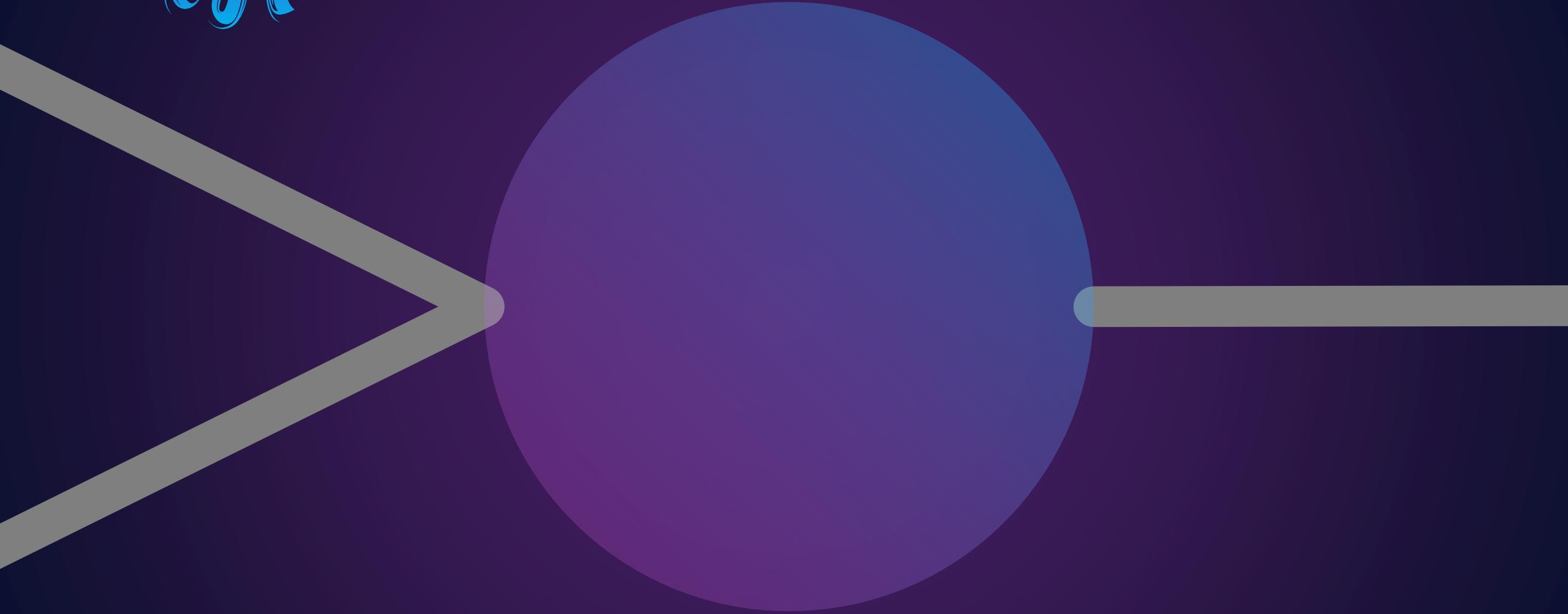
$$a \cdot w_3$$

Newton

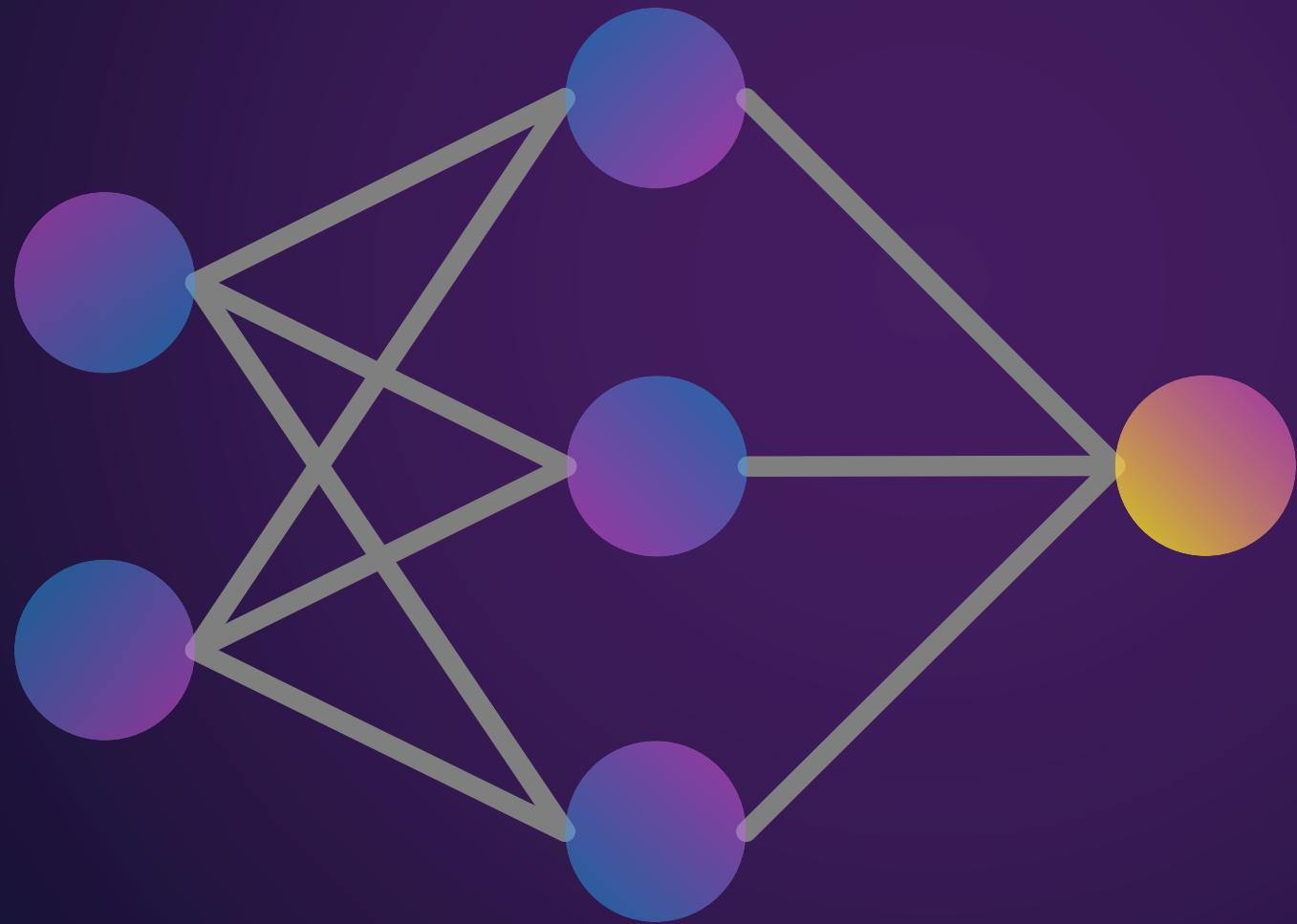
$$z = \sum_i w_i x_i$$

$$a = f(z)$$

Newton

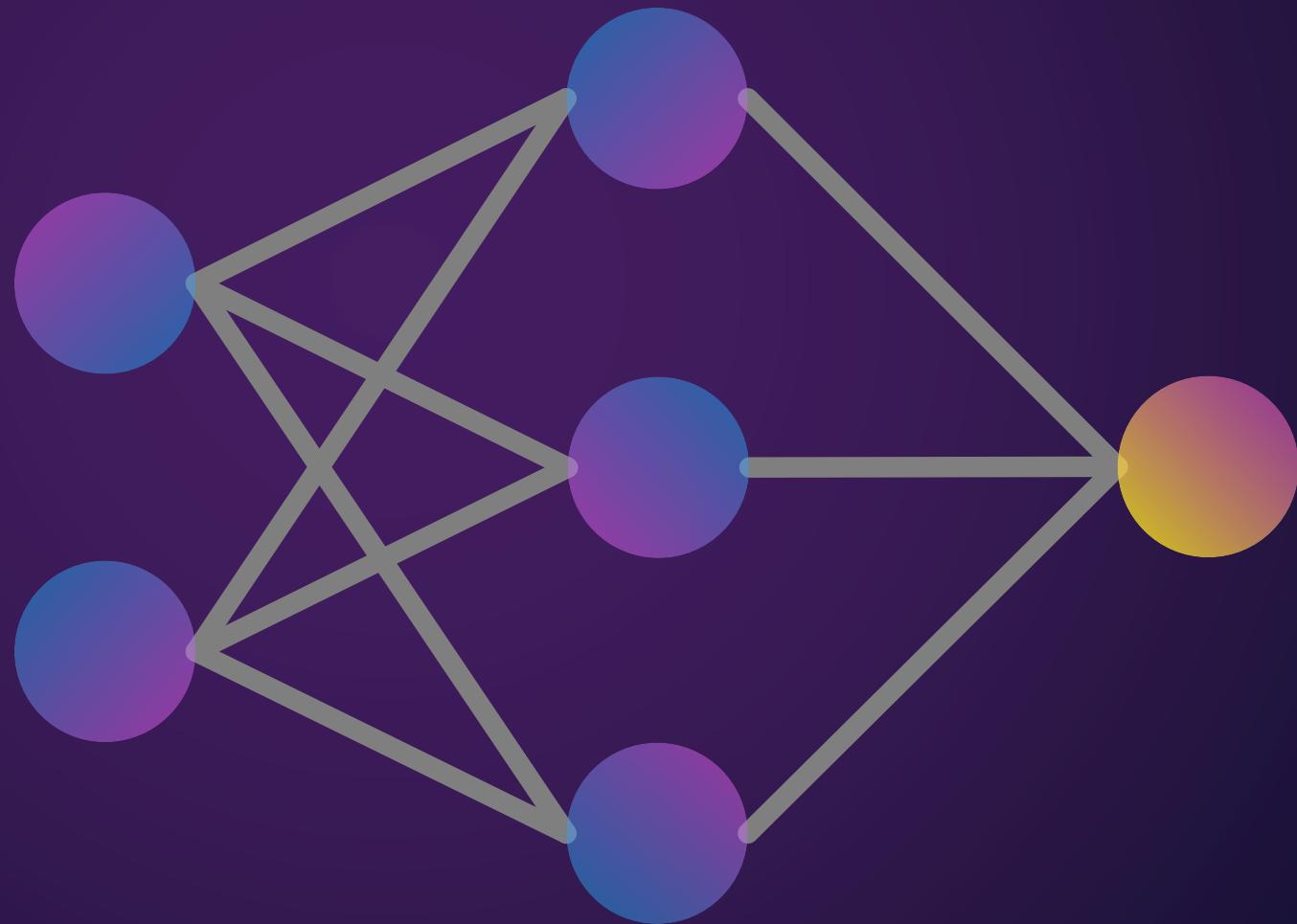


Neuronale Netze



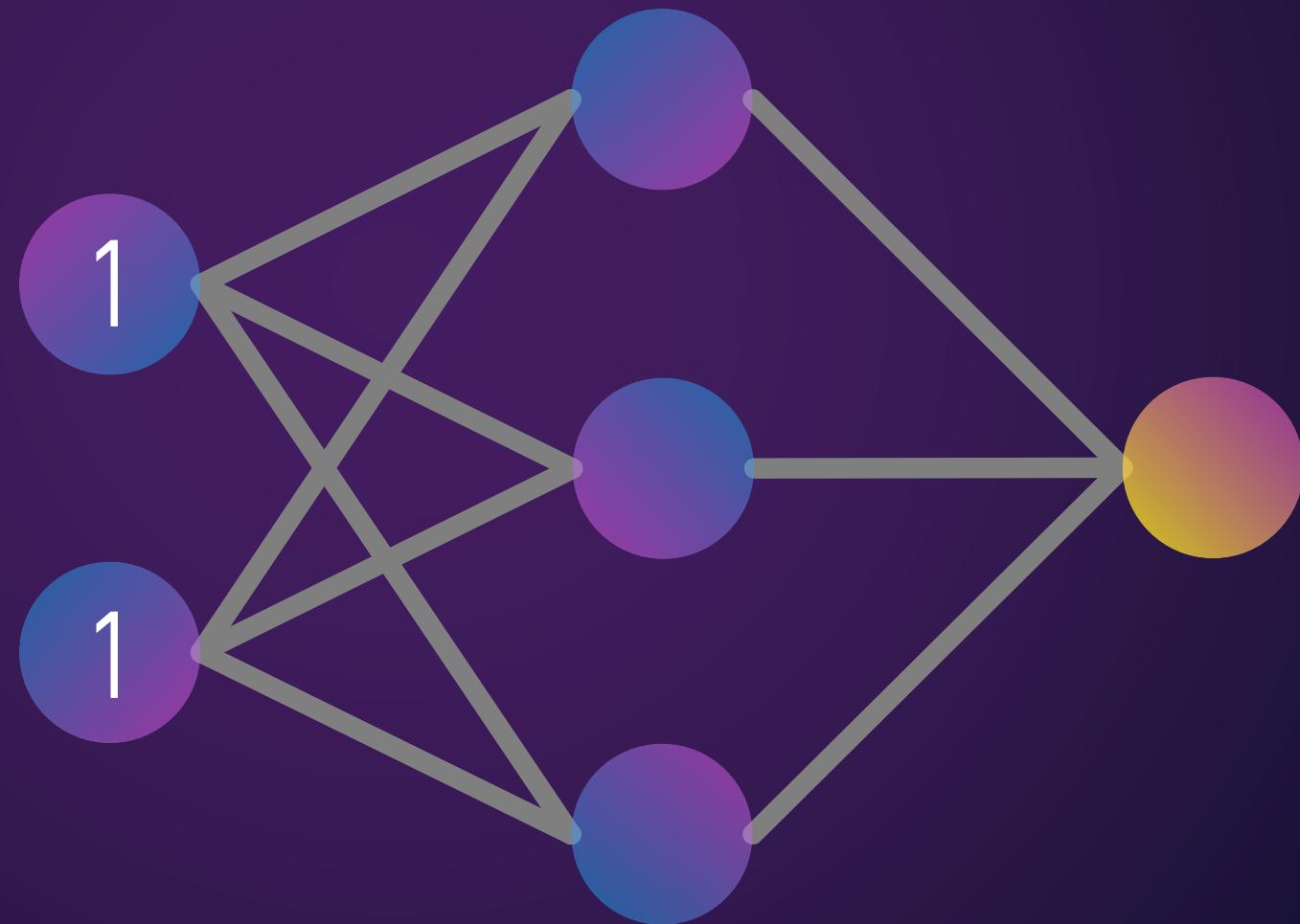
Lernalgorithmen

**Supervised
Learning**



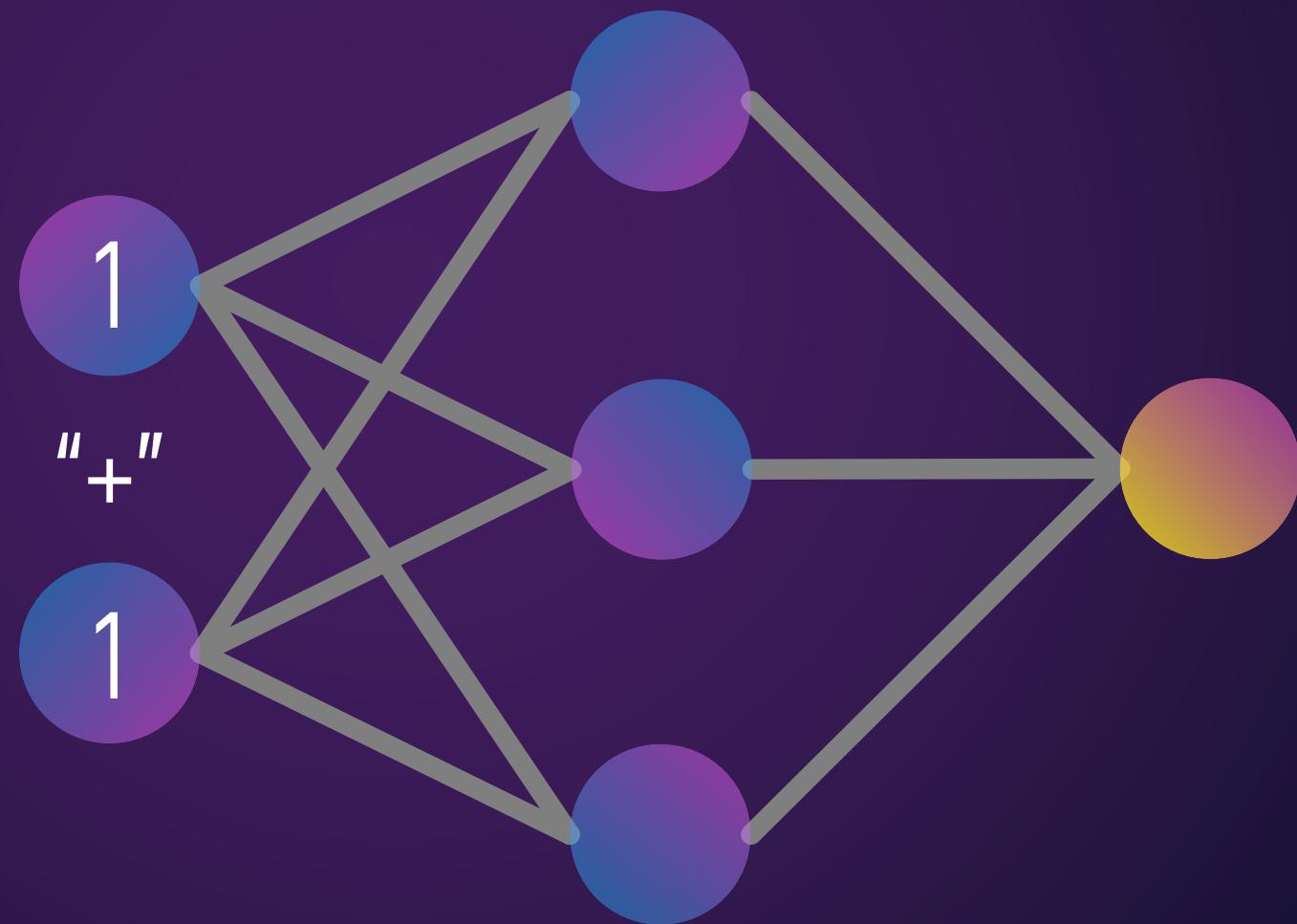
Lernalgorithmen

Supervised
Learning



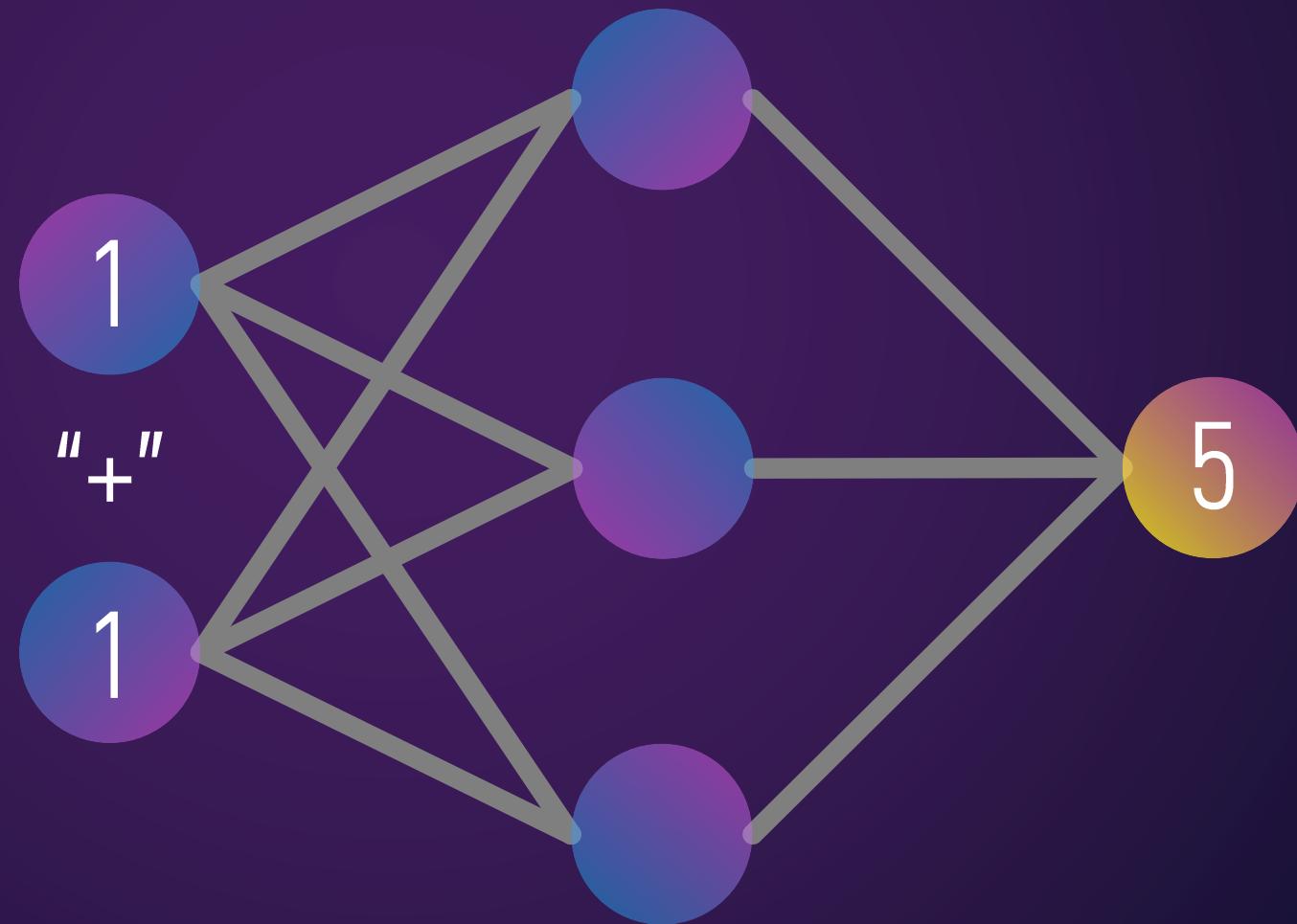
Lernalgorithmen

Supervised
Learning



Lernalgorithmen

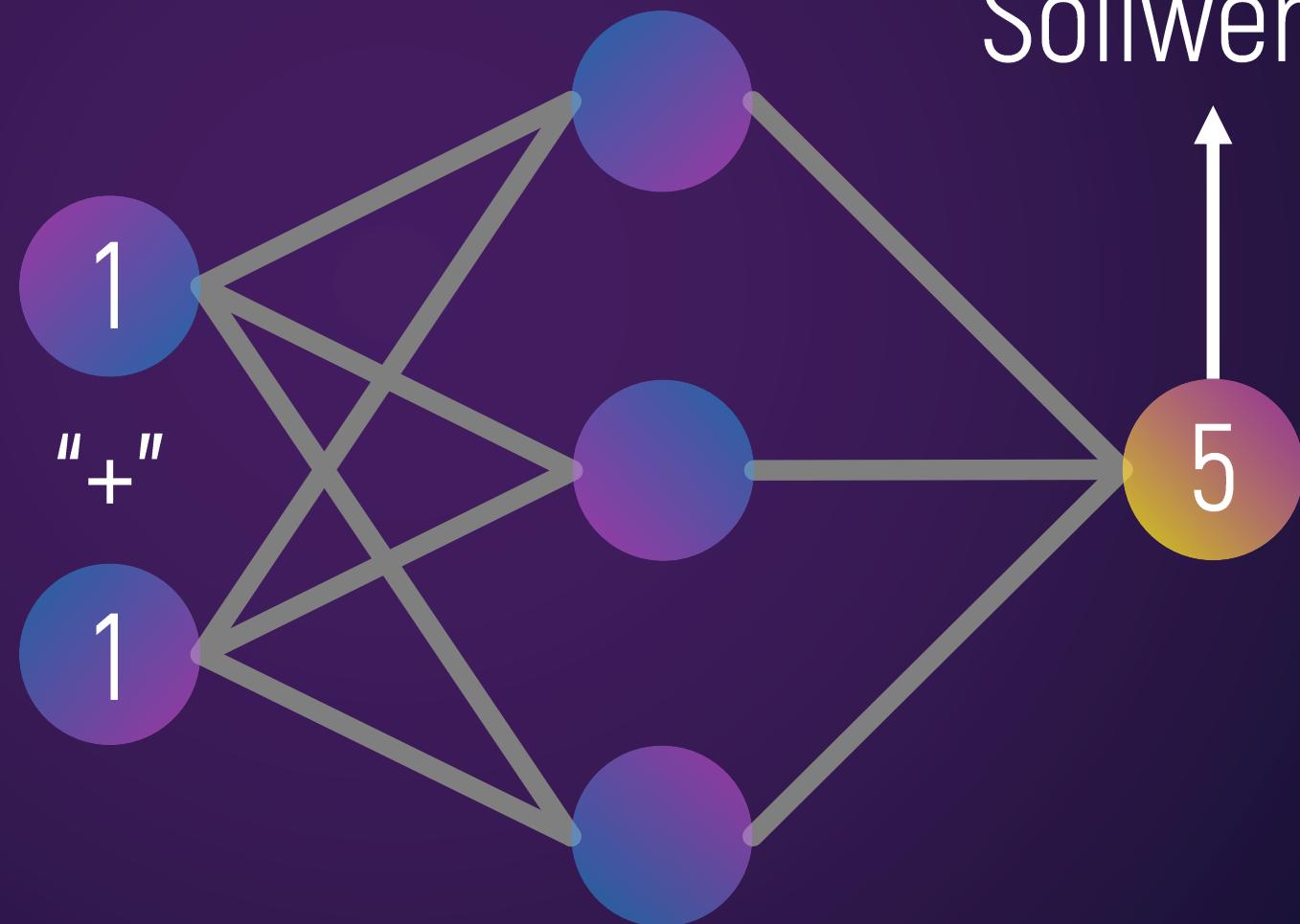
Supervised
Learning



Lernalgorithmen

Supervised
Learning

Istwert: 5
Sollwert: 2



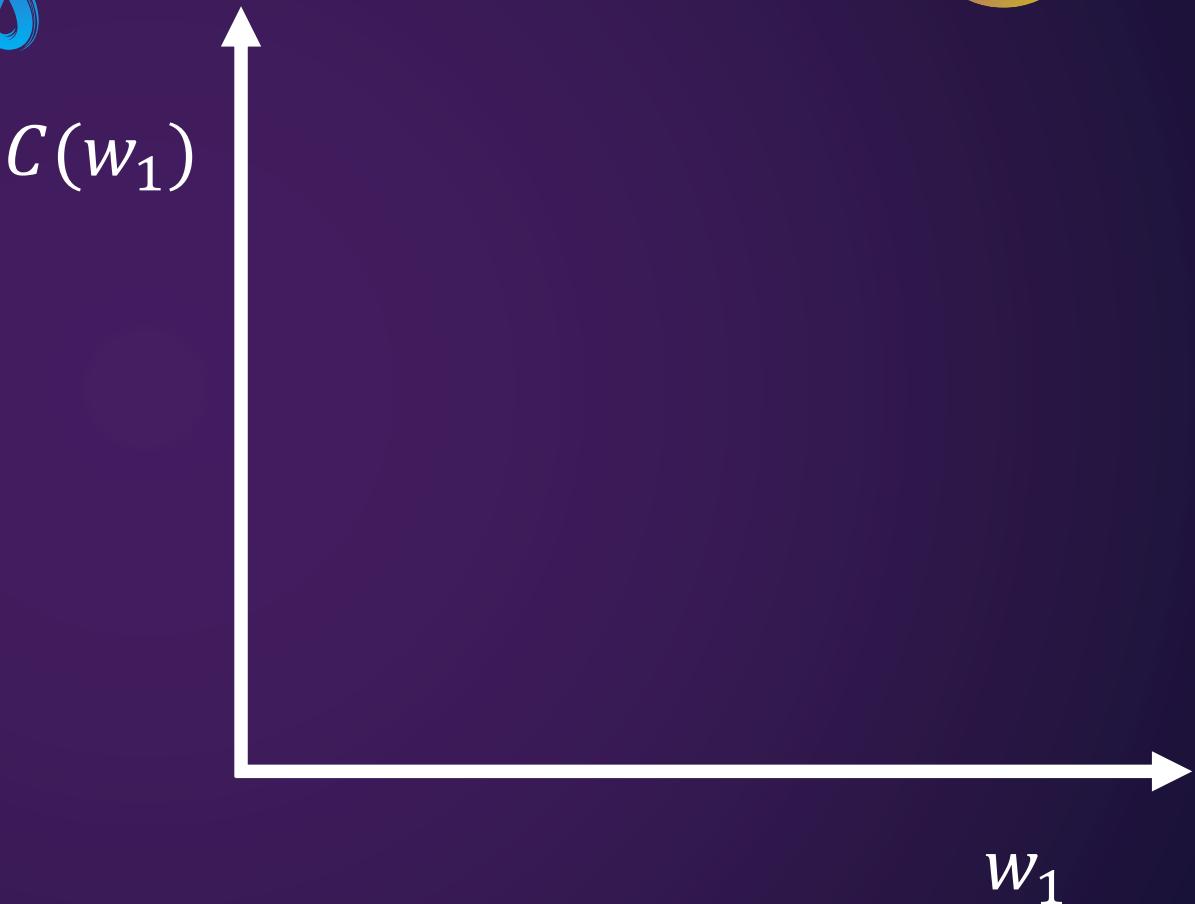
Lernalgorithmen



Gradient Descent

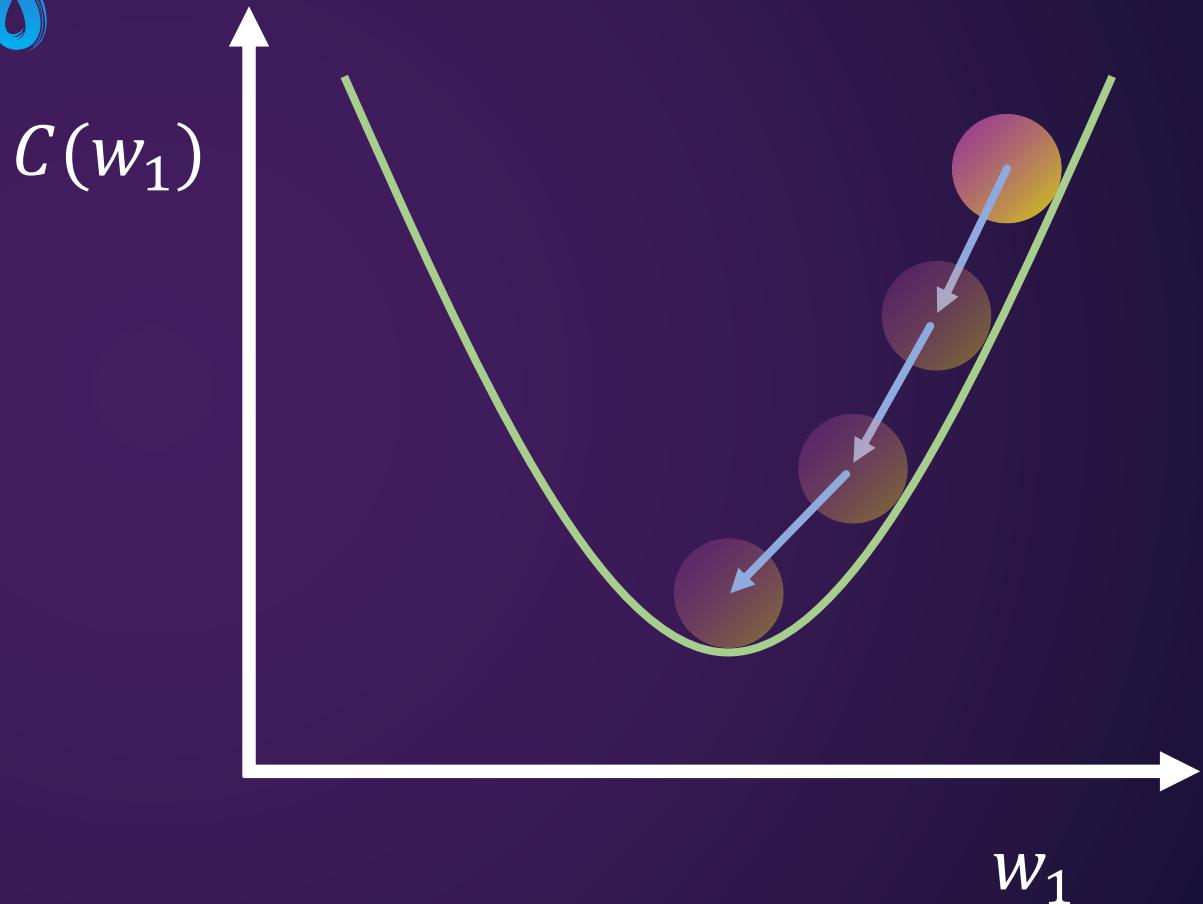
Lernalgorithmus

Gradient
Descent



Lernalgorithmen

Gradient Descent



The background features a central yellow circle surrounded by several concentric rings in shades of blue, purple, and pink. The word "Daten" is written in a large, stylized, cursive font that follows the color gradient of the rings.

Daten



Training



Test

Leeralgorithmen

Hyper-
Parameter



Lernalgorithmen

Hyper- Parameter

Lernalgorithmus

Hyper-
Parameter



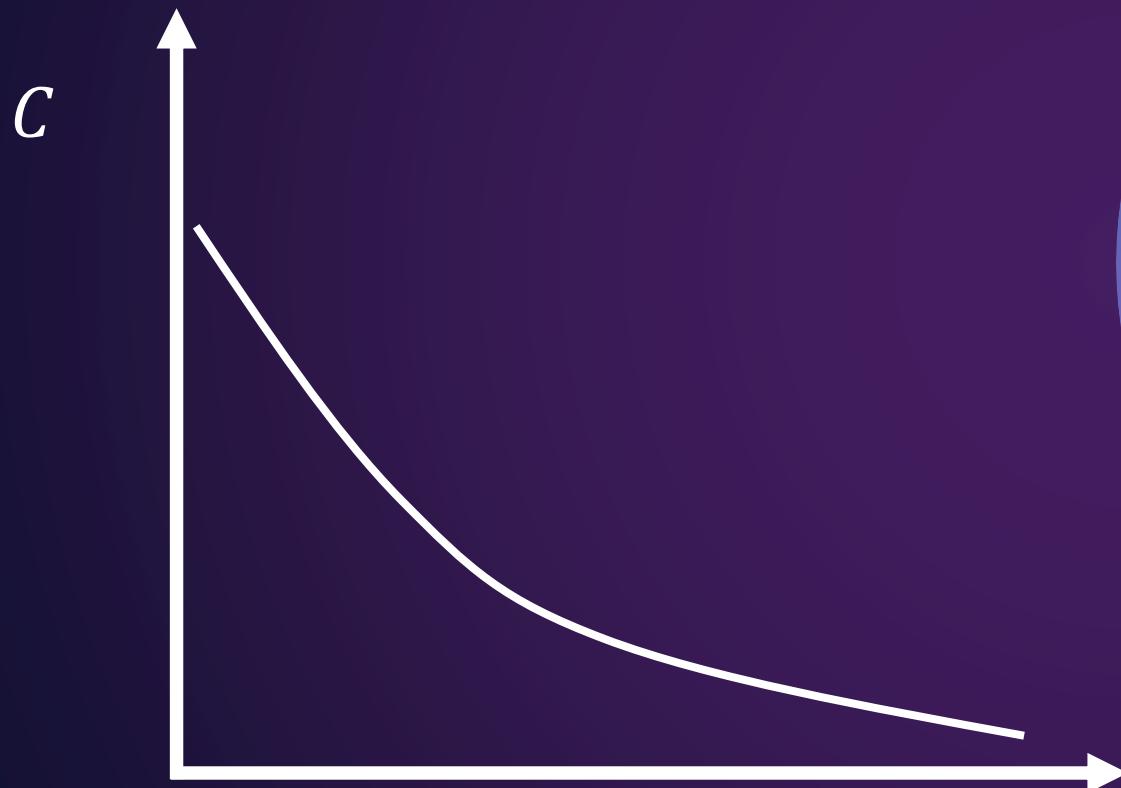
Epochen

Lernalgorithmus



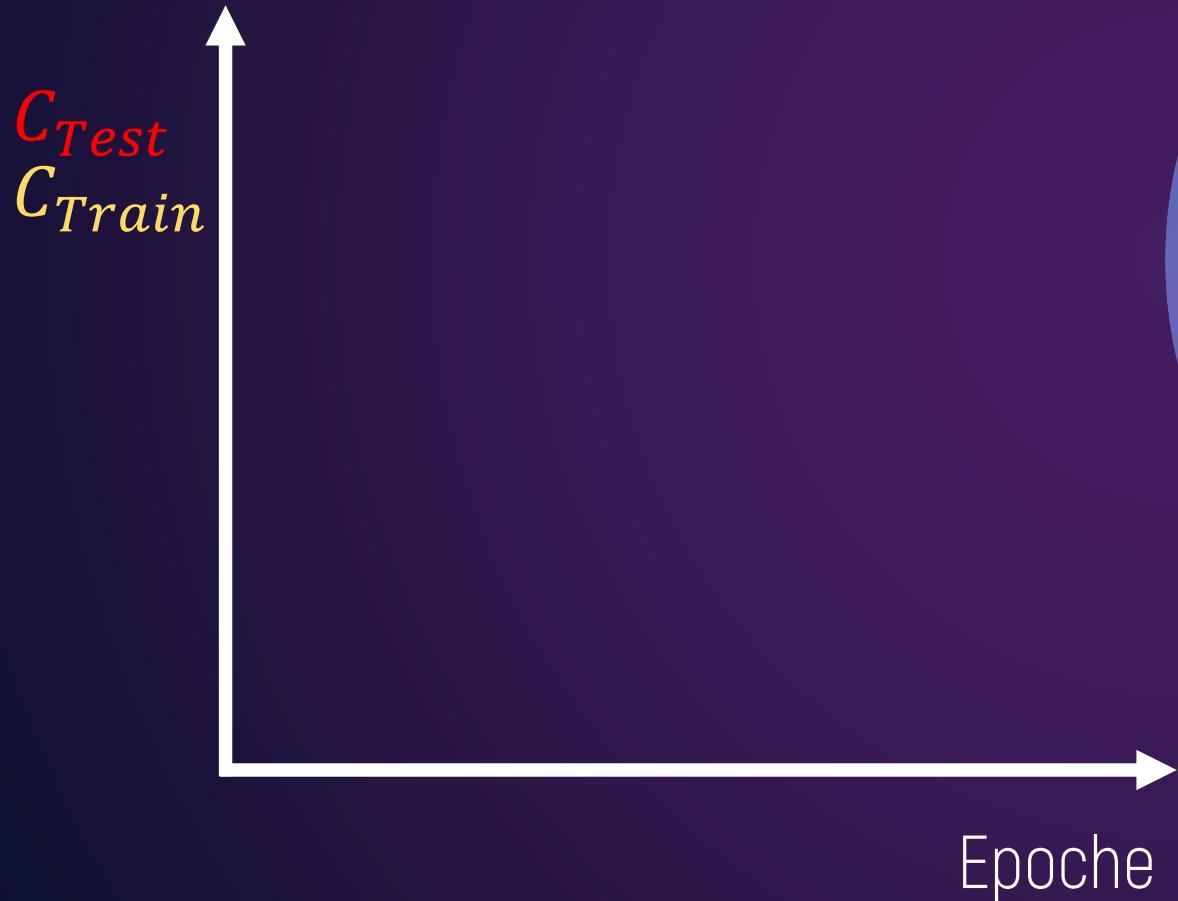
Epochen

Lernalgorithmus



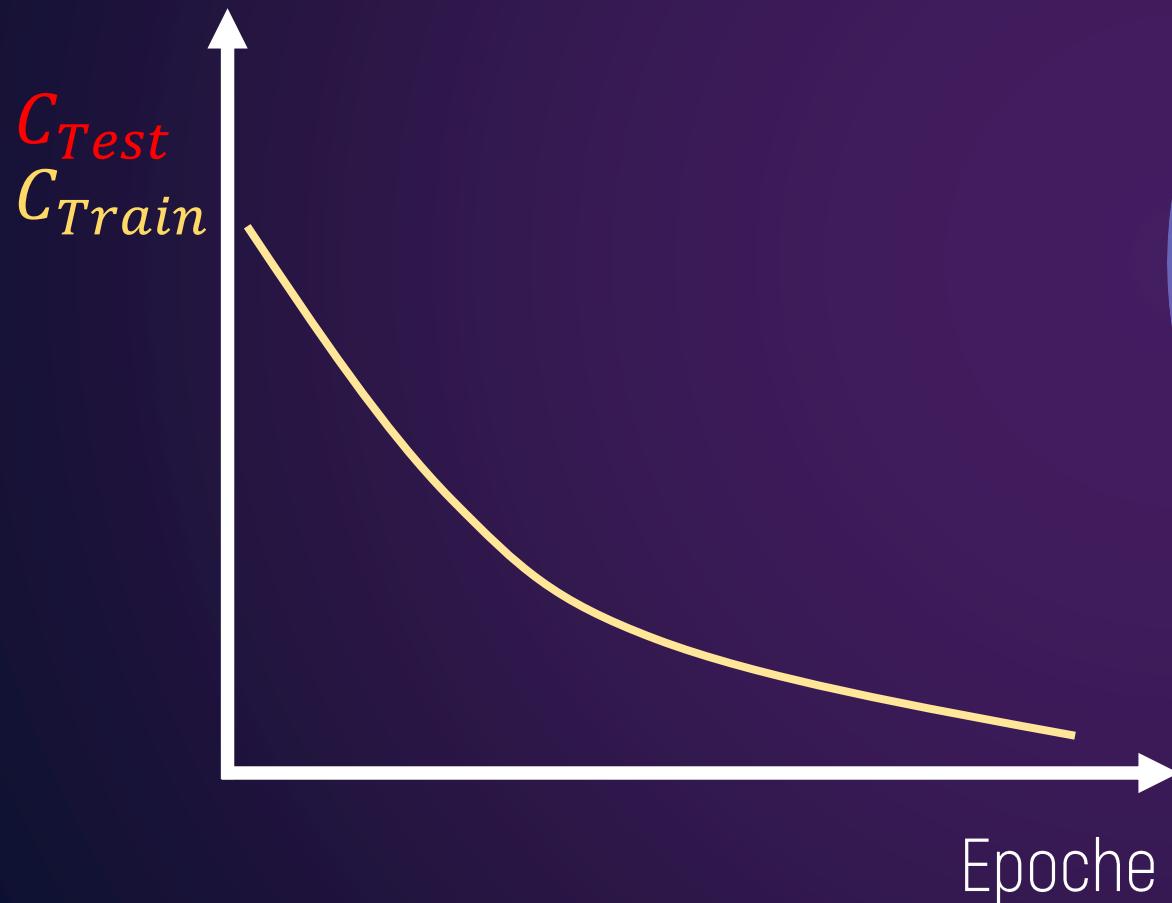
Epochen

Lernalgorithmus



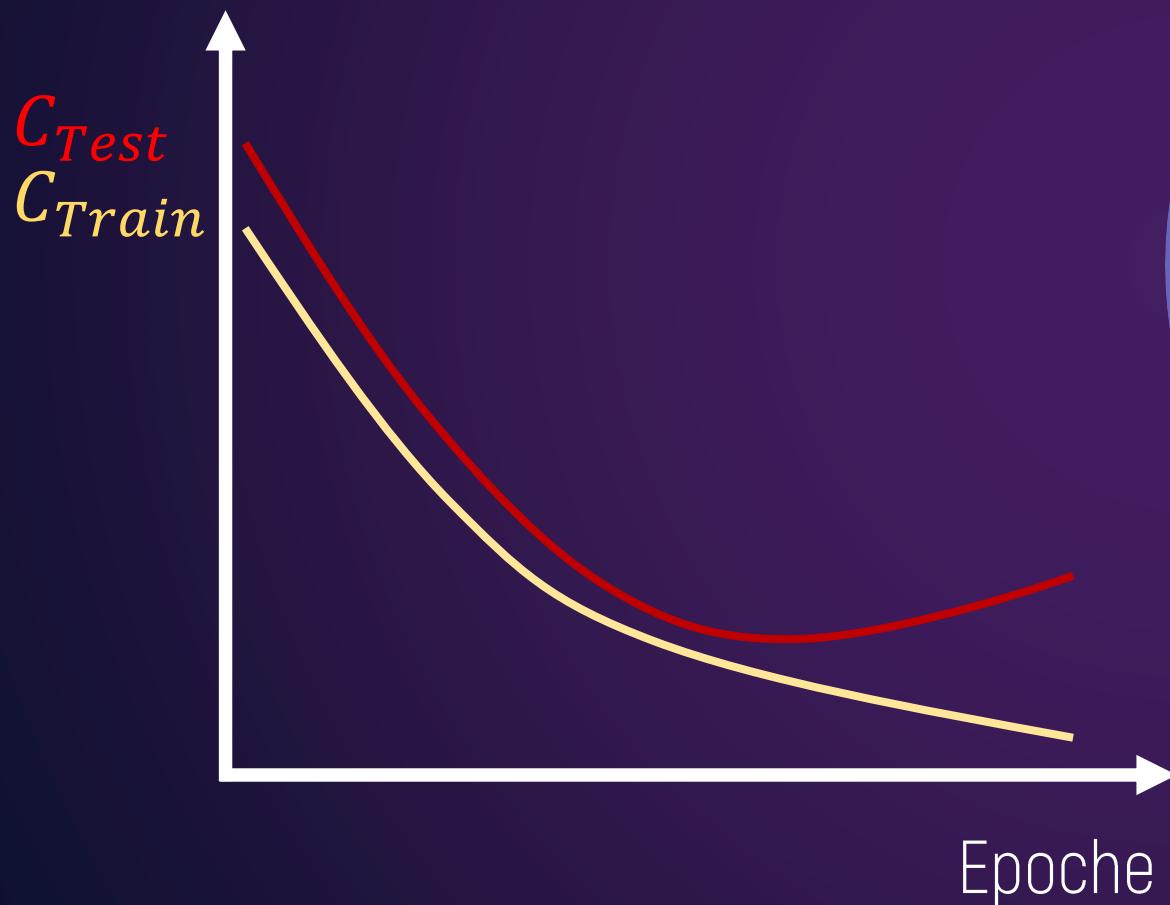
Epochen

Lernalgorithmus



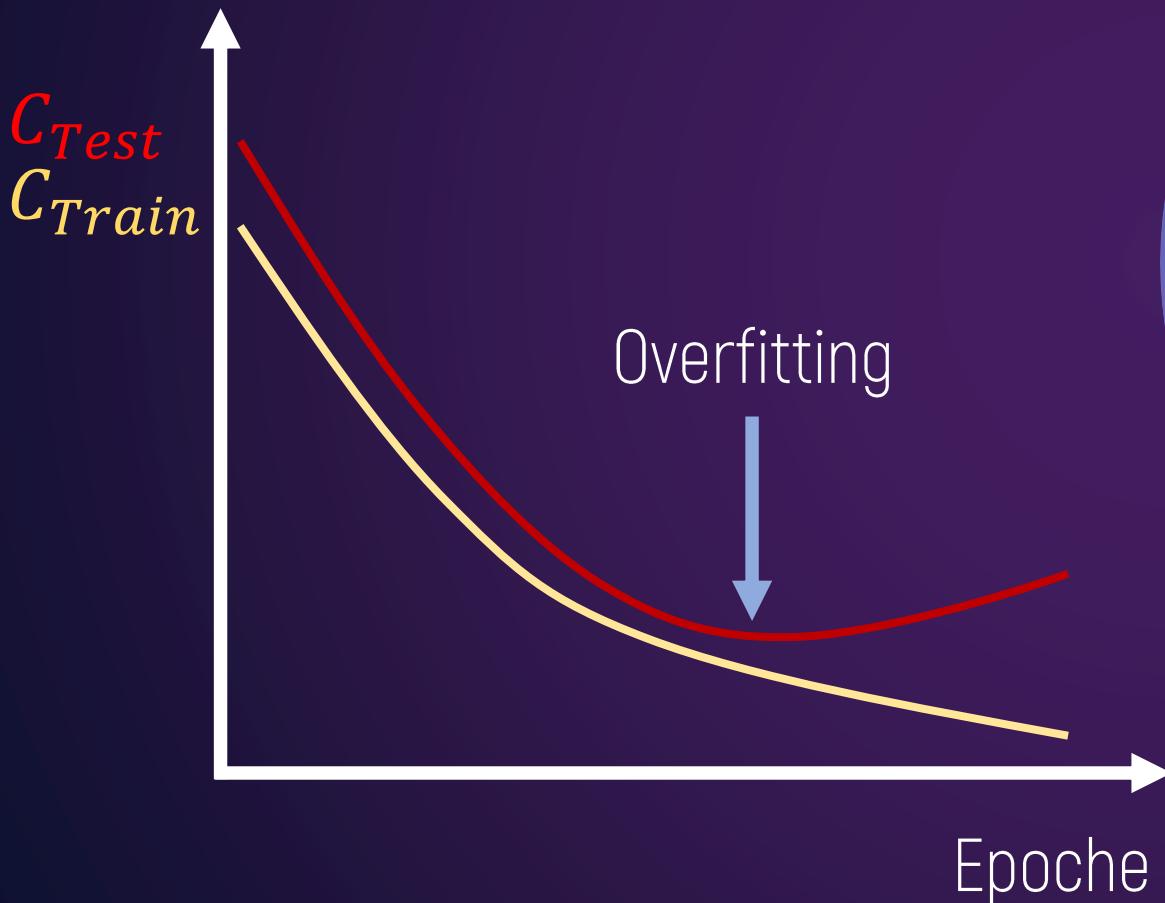
Epochen

Lernalgorithmus



Epochen

Lernalgorithmus



Epochen

Lernalgorithmus

Hyper-
Parameter



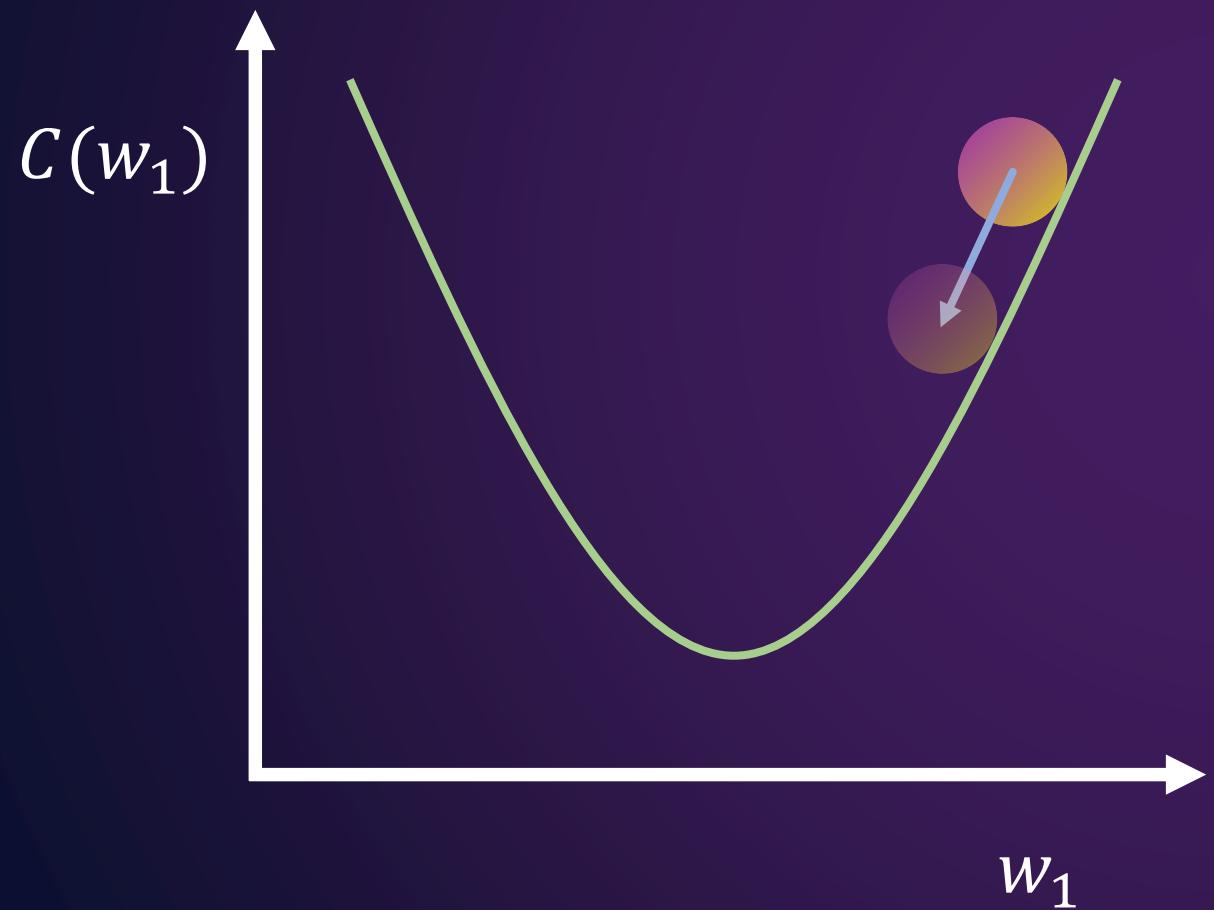
Epochen

Lernalgorithmus

Hyper-
Parameter

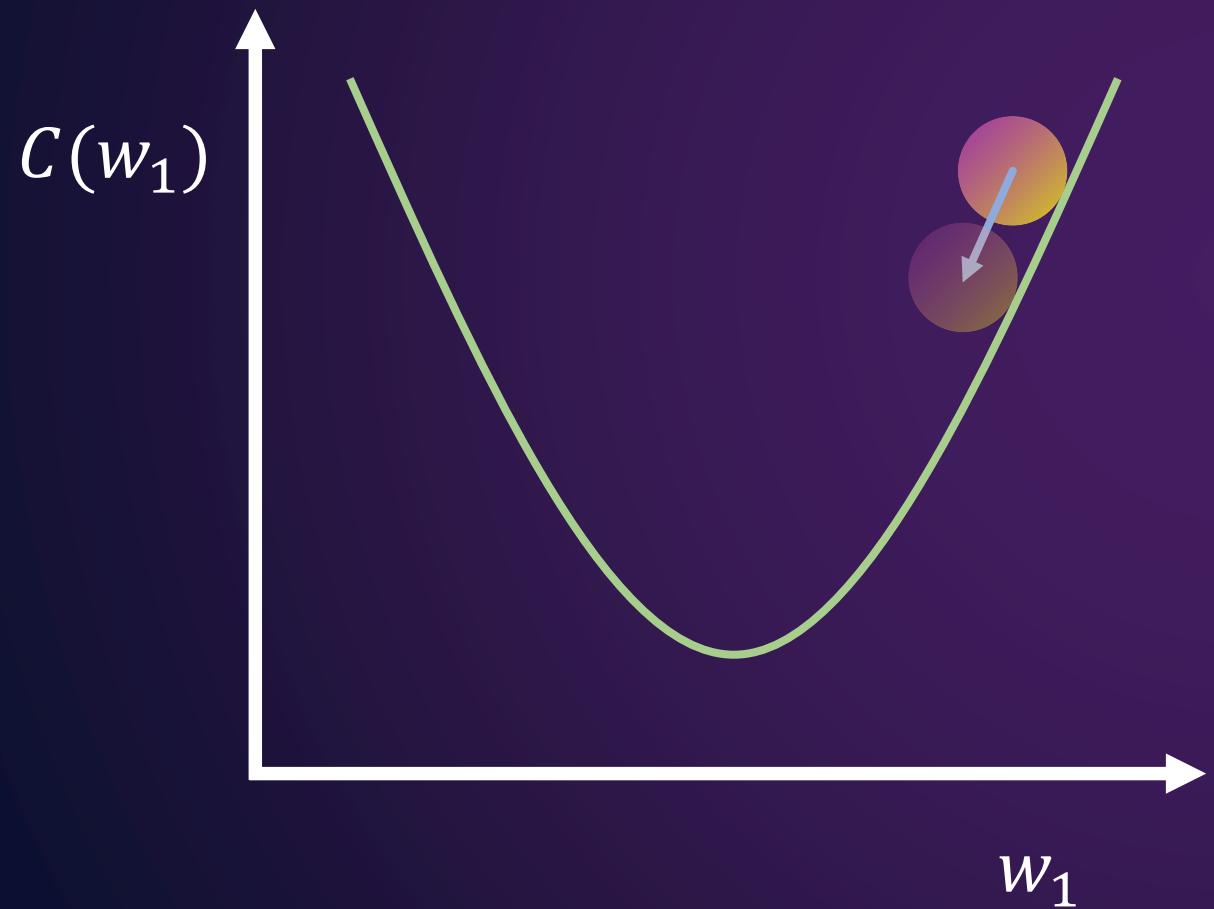
Lernrate

Lernalgorithmus



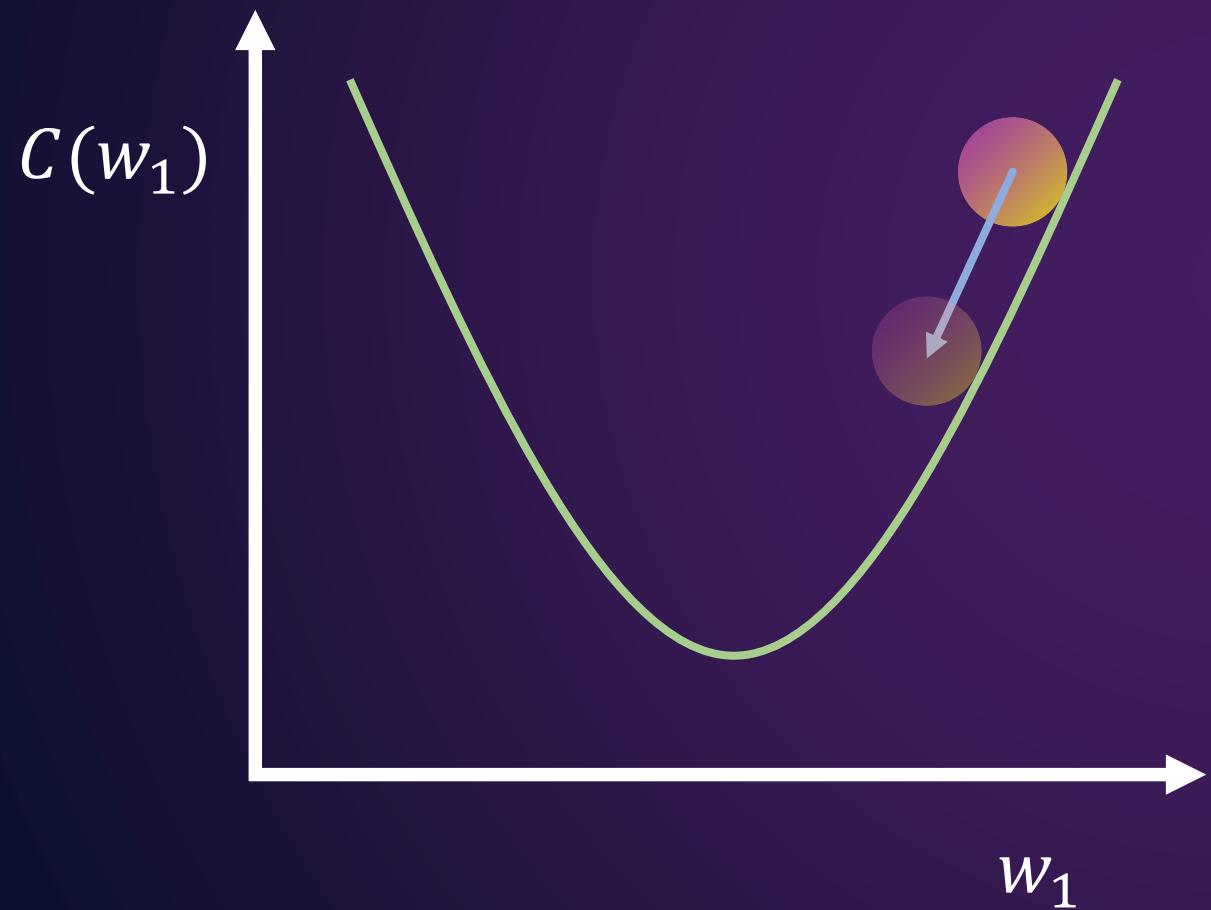
Lernrate

Lernalgorithmus



Lernrate

Lernalgorithmus



Lernrate

Lernalgorithmus

Hyper-
Parameter

Lernrate

Lernalgorithmen

Hyper-
Parameter



Batch Size

Lernalgorithmen



Batch Size

Lernalgorithmus

Daten

Batch Size

Lernalgorithmen

Batch



Batch Size

Lernalgorithmen

Hyper-
Parameter



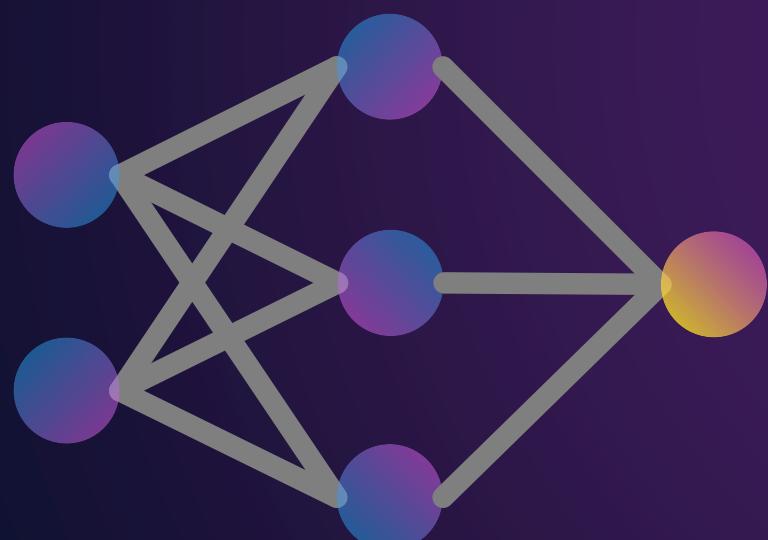
Batch Size

Lernalgorithmus

Hyper-
Parameter

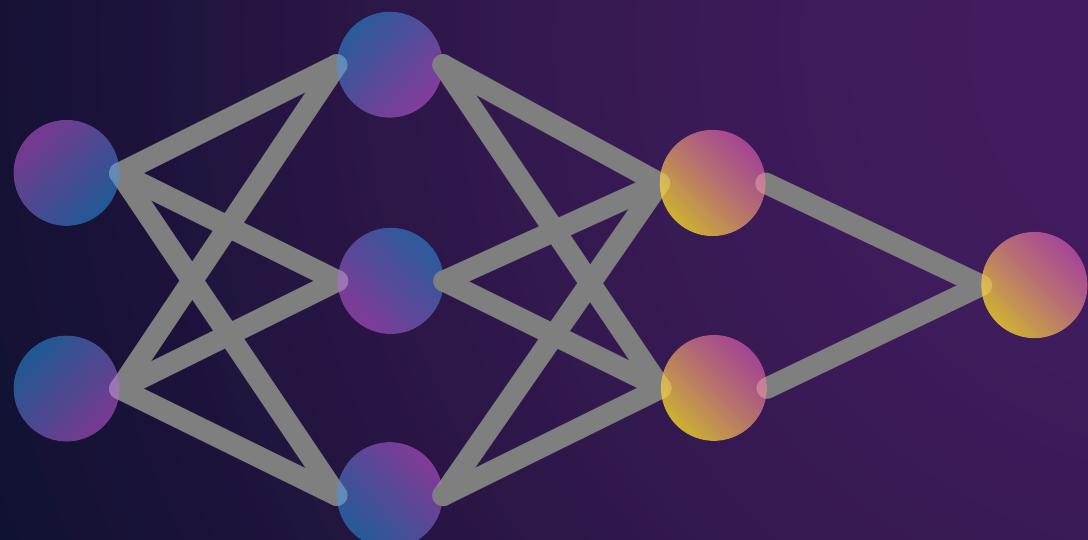
Anzahl der
Schichten

Lernalgorithmus



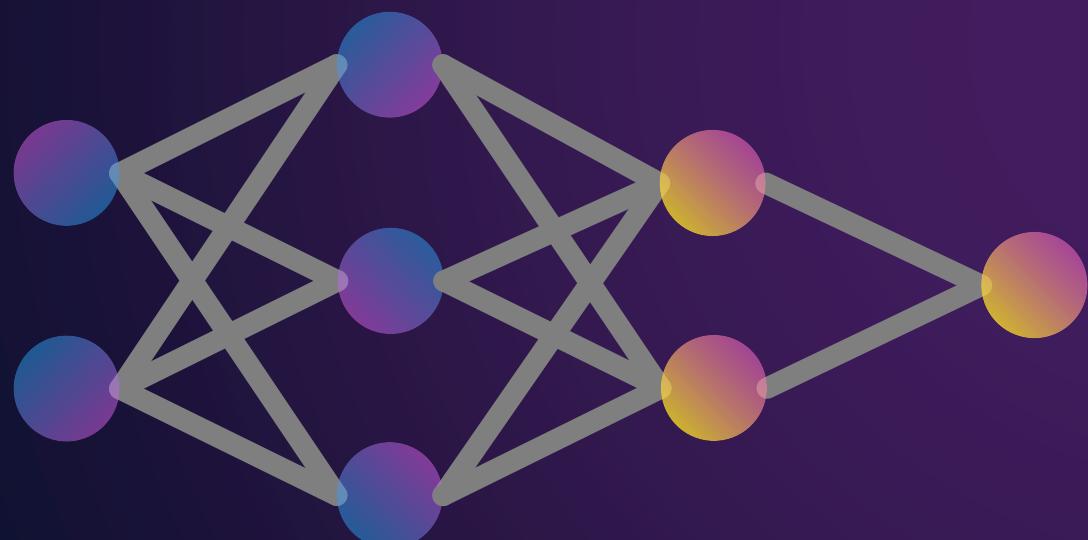
Anzahl der
Schichten

Lernalgorithmen



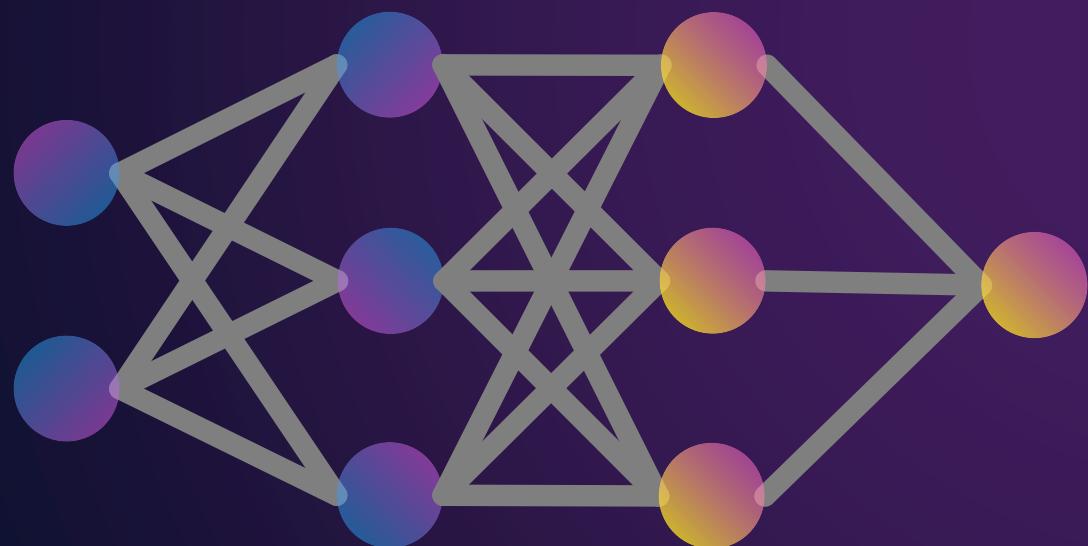
Anzahl der
Schichten

Lernalgorithmus



Anzahl der
Neuronen

Lernalgorithmen



Anzahl der
Neuronen

Lernalgorithmus

Hyper-
Parameter

Anzahl der
Neuronen

Leeralgorithmen

Hyper-
Parameter





Tension
Flow



Tension



Flow

Was ist ein Tensor



Tensor

Was ist ein Tensor

Eine Zahl

$$s = a$$



Tensorⁿ

Was ist ein Tensor

Ein Vektor

$$\vec{v} = \begin{bmatrix} a \\ b \\ c \end{bmatrix}$$



Tensorⁿ

Was ist ein Tensor

Eine Matrix

$$M = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$$



Tensorⁿ

Was ist ein Tensor

N-Dimensional

$$T = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$$



Tensor¹



Tension



Flow



Tension



Flow



Flow

Wie fließen
Tensor

Tensor Operation

Wie fließen
Tensor



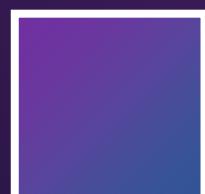
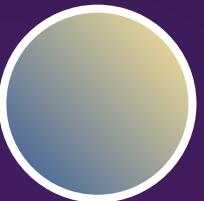
flow



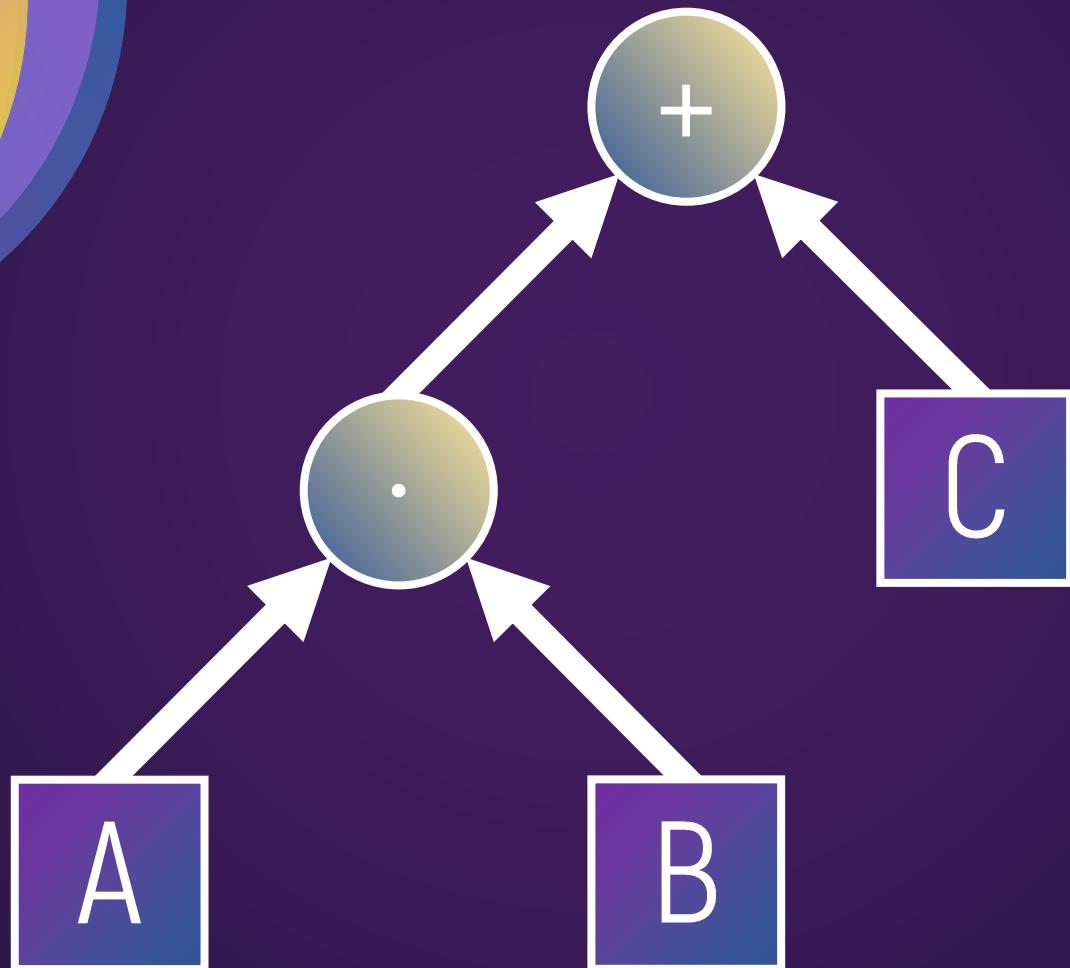


Flow

Wie fließen
Tensor



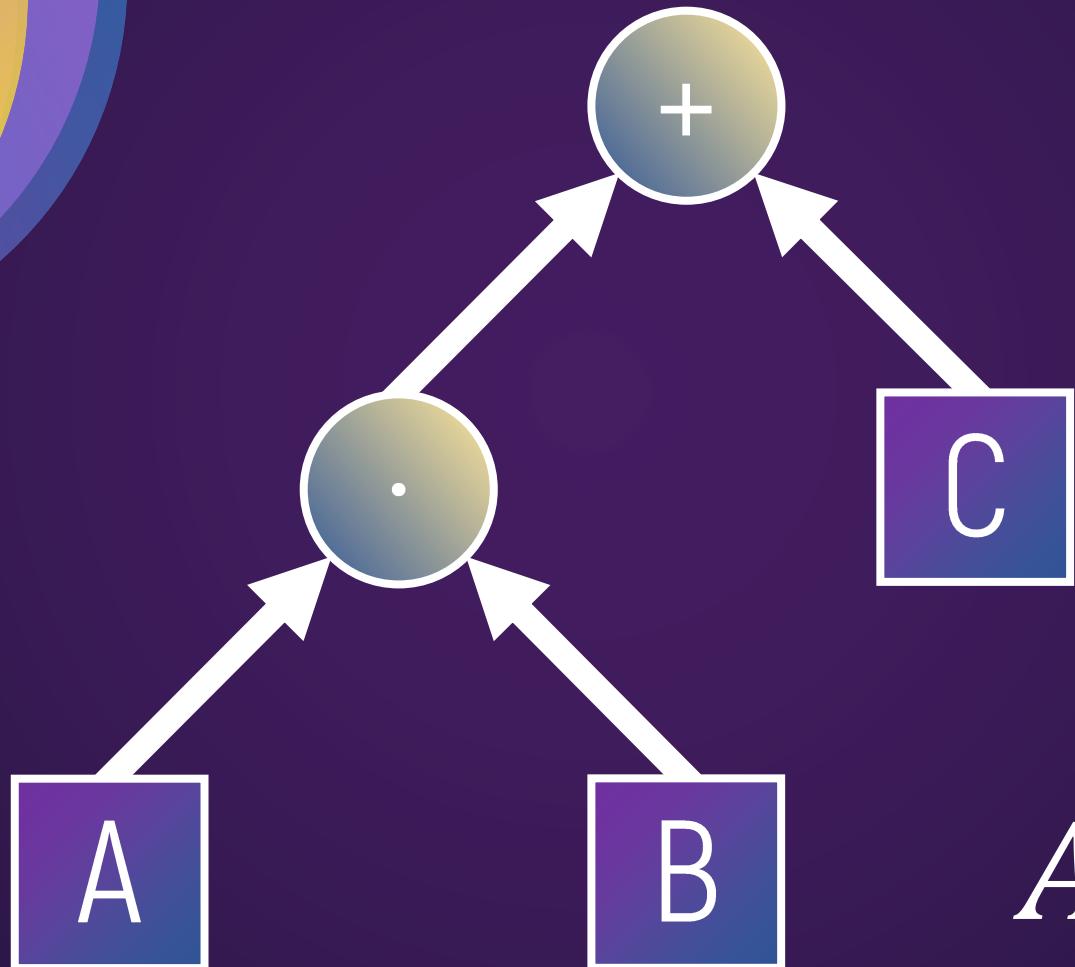
Wie fließen Tensor



flow



flow



Wie fließen
Tensor

$$A \cdot B + C$$



Tensor

Was
Tensoren



Flow

Wie
Operationen



Tensor

Was
Tensoren



Flow

Wie
Operationen



Keras

The TensorFlow logo is displayed on a large, semi-transparent circular background. The background has concentric rings in shades of yellow, orange, pink, and purple. The text "TensorFlow" is written in a bold, black, sans-serif font.

TensorFlow

The Keras logo is displayed on a large, semi-transparent circular background. The background has concentric rings in shades of blue, purple, pink, orange, and yellow. The text "Keras" is written in a bold, black, sans-serif font.

Keras

Tensor
Flow

Keras

Tensor
Flow



Keras

Tensor
Flow



Keras

Tensor
Flow



Keras



Tensor
Flow

Versus



Keras

- + Schneller
- + Flexibler

- + Leserlicher
- + Abstrakter

In der Sprache Python

- Neuronales Netz
- Quellcode der das Netz erzeugt und trainiert
- Vergleich von Keras und TensorFlow Code

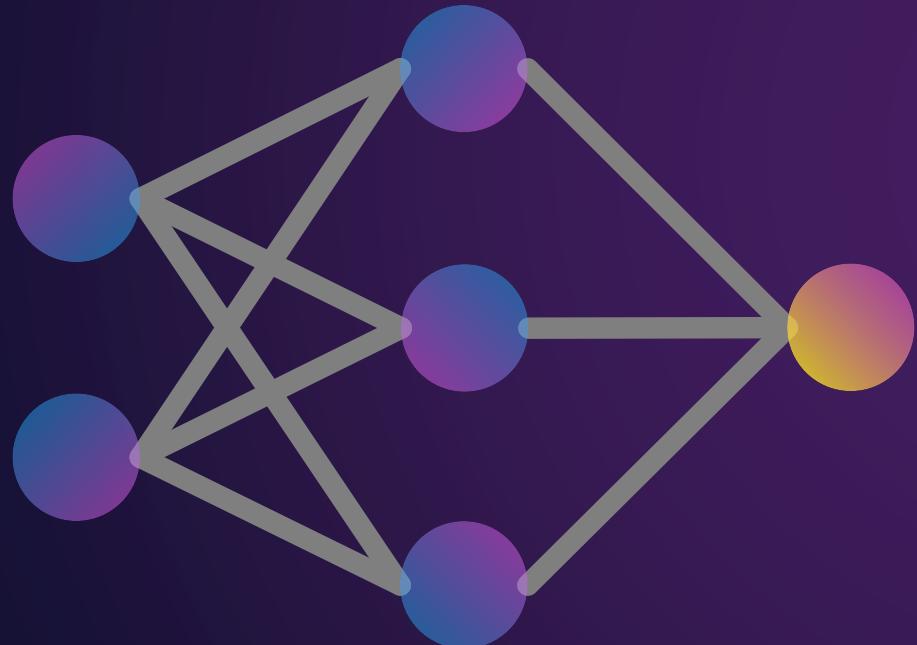


Umsetzung

Modell

Keras

Modell



Keras

Modell

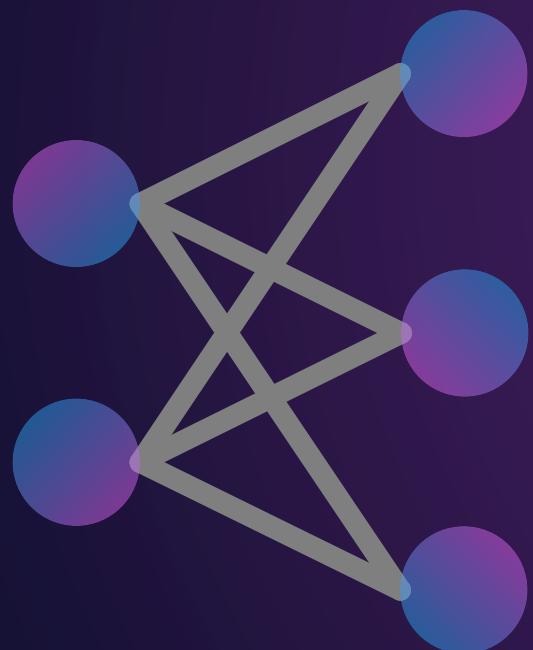
Keras

Modell

Keras

```
model = Sequential()
```

Modell

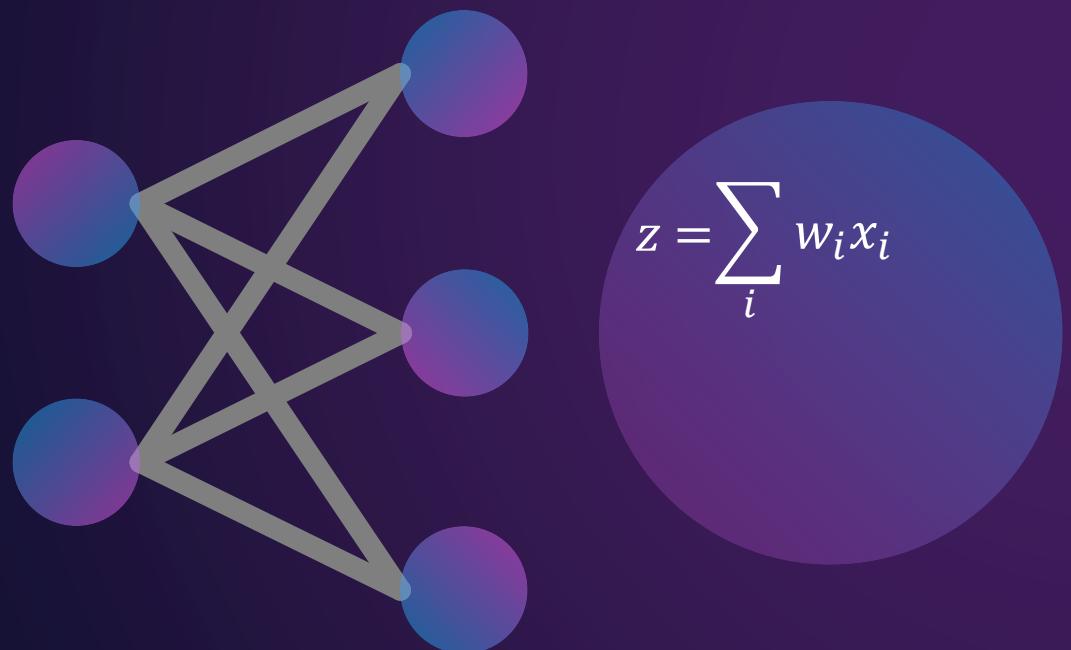


Keras

```
model = Sequential()
```

```
model.add(Dense(3, input_dim=2))
```

Modell

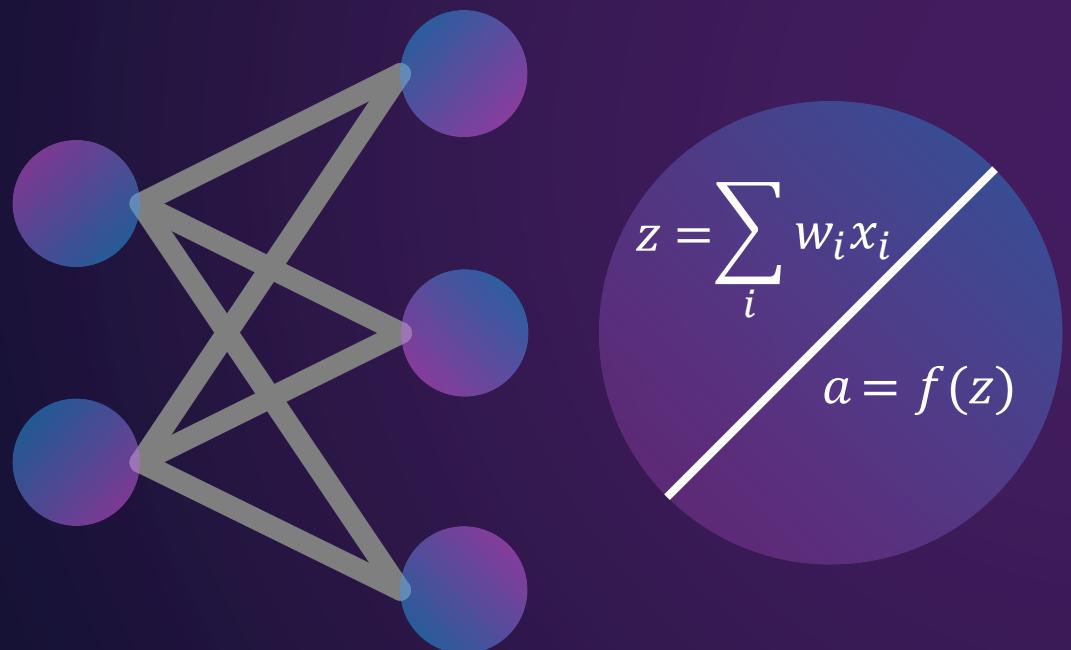


Keras

```
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```

```
model.add(Dense(3, input_dim=2))
```

Modell

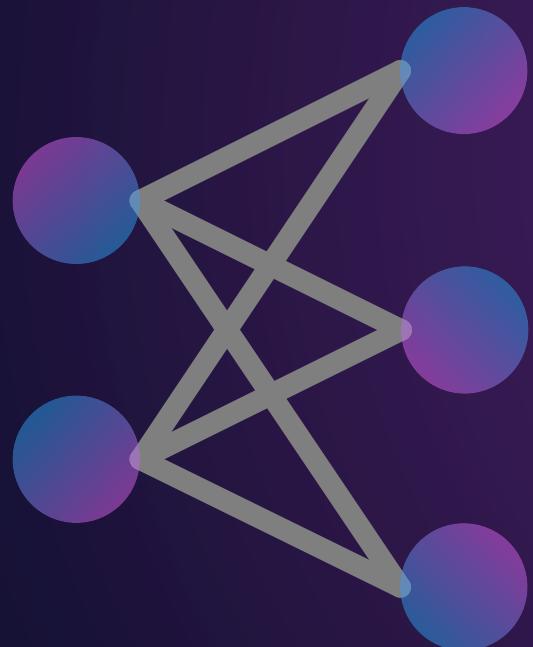


Keras

```
model = Sequential()
```

```
model.add(Dense(3, input_dim=2))  
model.add(Activation('sigmoid'))
```

Modell

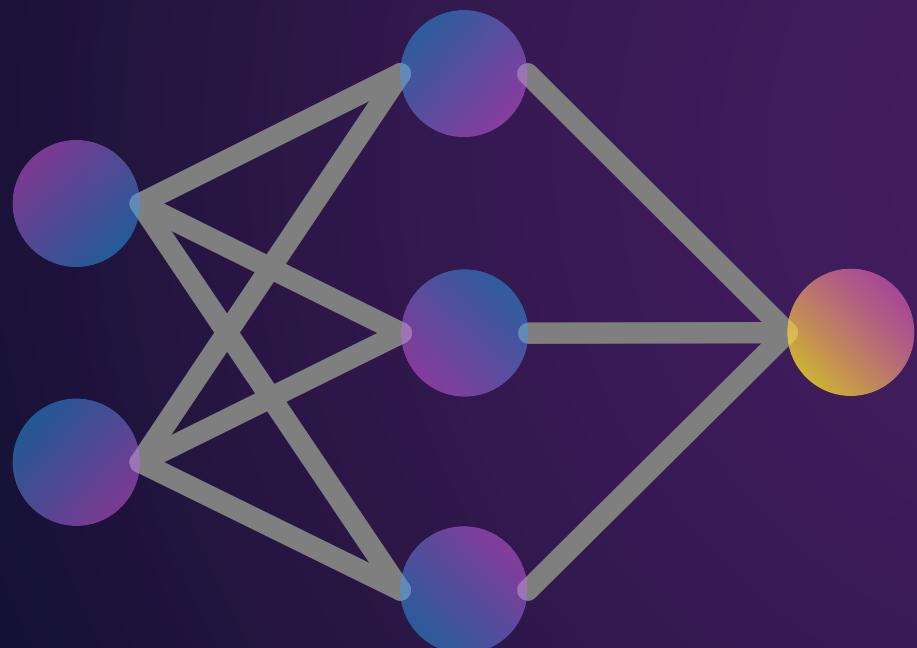


Keras

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model.add(Dense(3, input_dim=2))  
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```

Modell



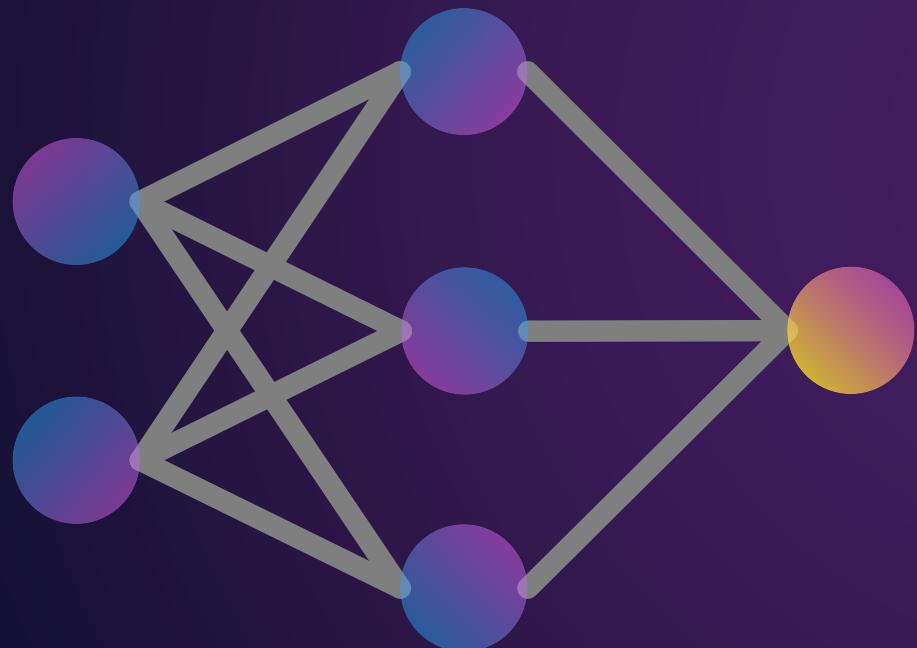
Keras

```
model = Sequential()
```

```
model.add(Dense(3, input_dim=2))  
model.add(Activation('sigmoid'))
```

```
model.add(Dense(1))
```

Modell



Keras

```
model = Sequential()
```

```
model.add(Dense(3, input_dim=2))  
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```

```
model.add(Dense(1))  
model.add(Activation('sigmoid'))
```

Keras

```
model = Sequential()
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```

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```

TensorFlow

Keras

```
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model.add(Dense(3, input_dim=2))  
model.add(Activation('sigmoid'))  
  
model.add(Dense(1))  
model.add(Activation('sigmoid'))
```

TensorFlow

```
x = tf.placeholder(  
    shape=[None, 2],  
    dtype=tf.float32)
```

Keras

```
model = Sequential()  
  
model.add(Dense(3, input_dim=2))  
model.add(Activation('sigmoid'))  
  
model.add(Dense(1))  
model.add(Activation('sigmoid'))
```

TensorFlow

```
x = tf.placeholder(  
    shape=[None, 2],  
    dtype=tf.float32)  
  
l1 = tf.layers.dense(x, 3,  
    activation=tf.nn.sigmoid)
```

Keras

```
model = Sequential()  
  
model.add(Dense(3, input_dim=2))  
model.add(Activation('sigmoid'))  
  
model.add(Dense(1))  
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```

TensorFlow

```
x = tf.placeholder(  
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l1 = tf.layers.dense(x, 3,  
    activation=tf.nn.sigmoid)  
  
l2 = tf.layers.dense(l1, 1,  
    activation=tf.nn.sigmoid)
```

Keras

```
model = Sequential()  
  
model.add(Dense(3, input_dim=2))  
model.add(Activation('sigmoid'))  
  
model.add(Dense(1))  
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```

TensorFlow

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```

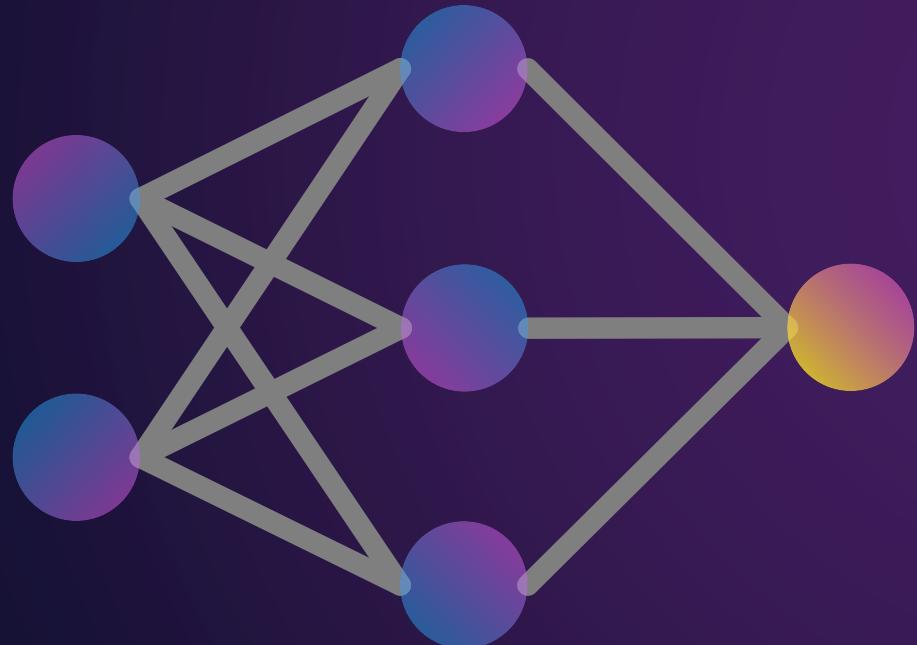
TensorFlow

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l2 = tf.layers.dense(l1, 1,  
    activation=tf.nn.sigmoid)
```

Keras

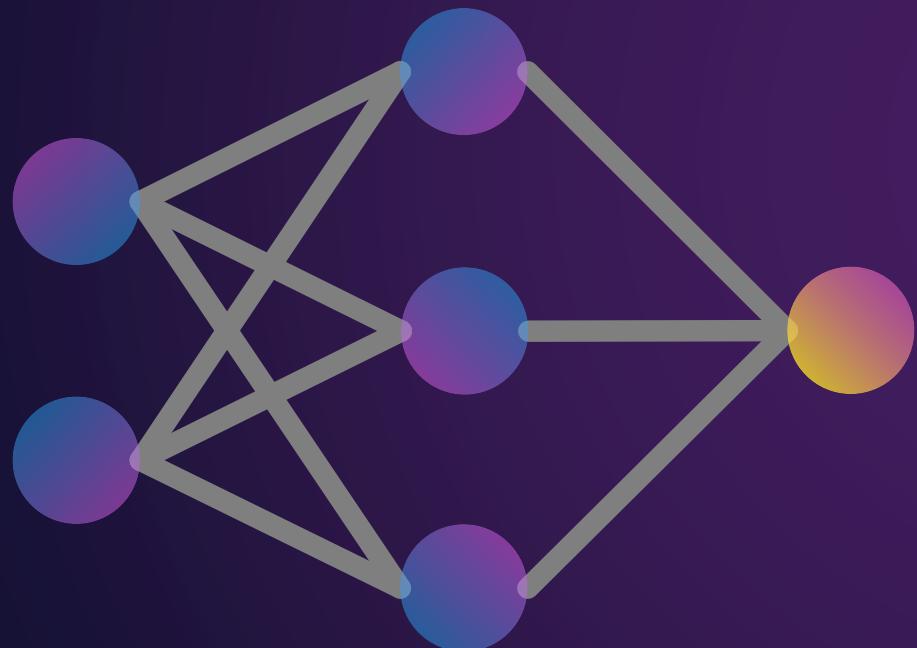
TensorFlow

Modell



Keras

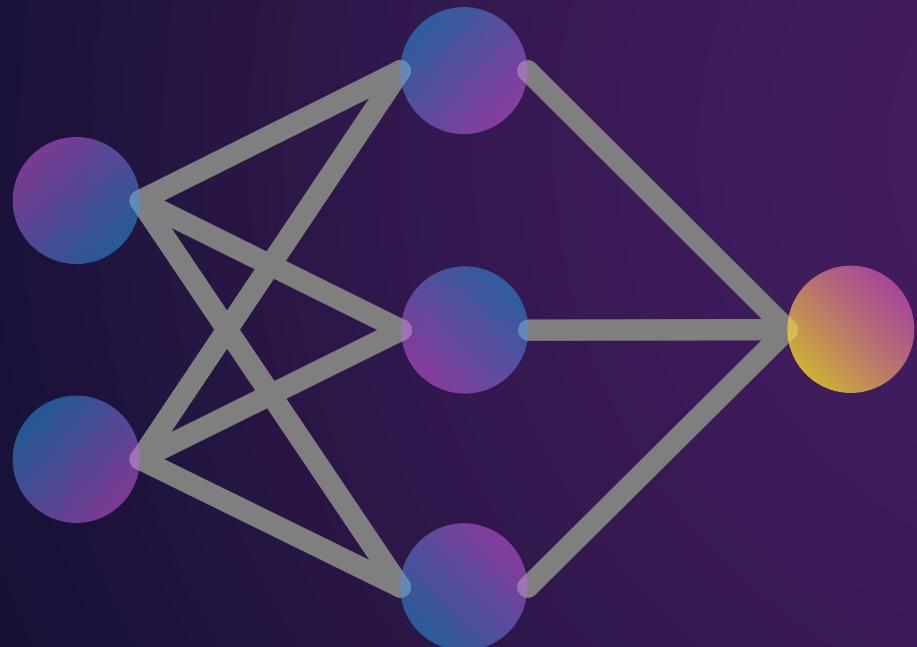
Modell



Keras

```
model.compile(loss='mse',  
              optimizer=adam(lr=0.001),  
              metrics=['accuracy'])
```

Modell

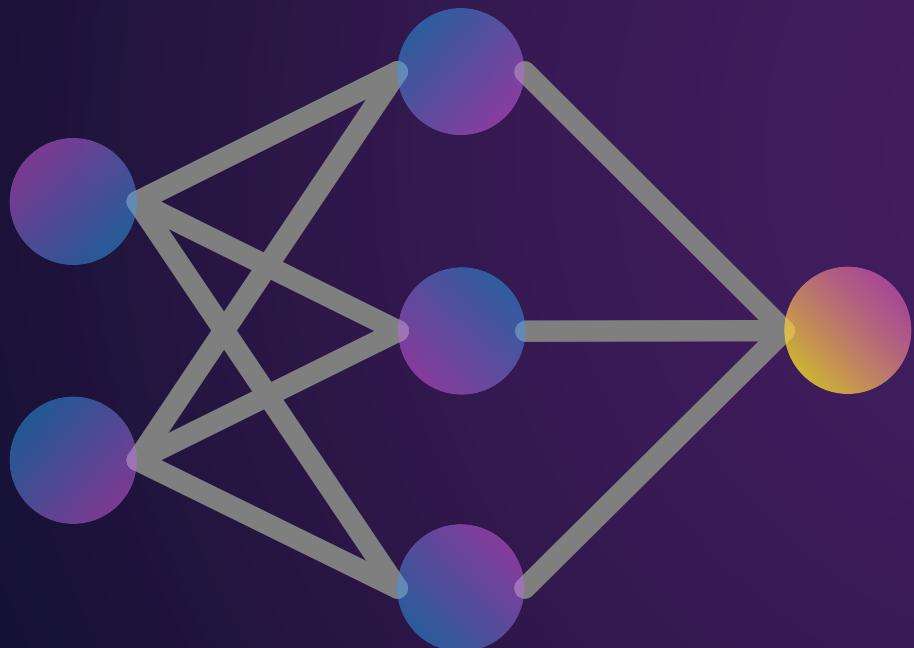


Keras

```
model.compile(loss='mse',
               optimizer=adam(lr=0.001),
               metrics=['accuracy'])
```

```
model.fit(x=x_train, y=y_train,
           batch_size=128,
           epochs=10)
```

Modell



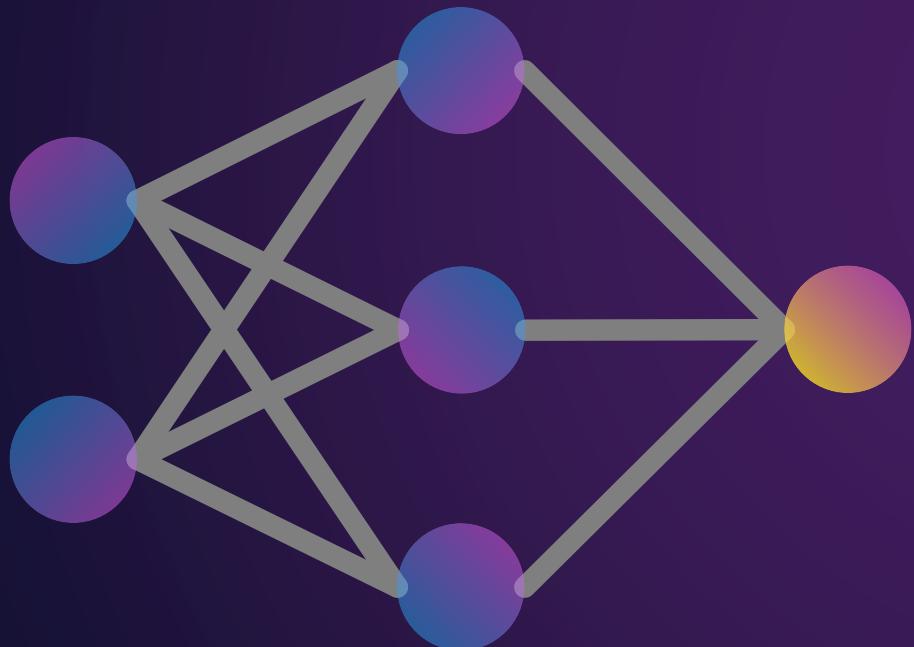
Keras

```
model.compile(loss='mse',
               optimizer=adam(lr=0.001),
               metrics=['accuracy'])

model.fit(x=x_train, y=y_train,
          batch_size=128,
          epochs=10)

model.evaluate(x=x_test, y=y_test)
```

Modell



Keras

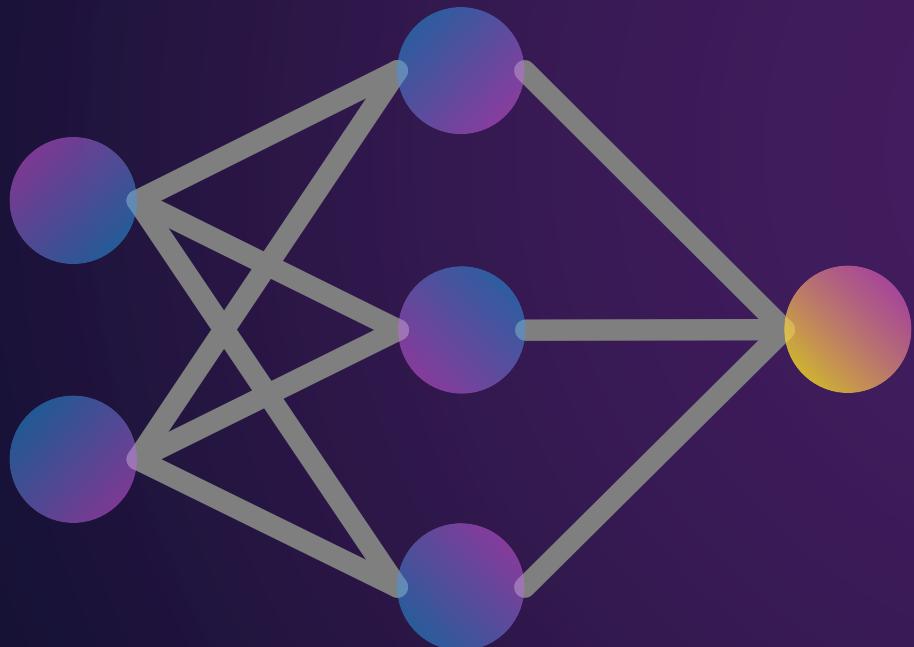
```
model.compile(loss='mse',
               optimizer=adam(lr=0.001),
               metrics=['accuracy'])

model.fit(x=x_train, y=y_train,
          batch_size=128,
          epochs=10)

model.evaluate(x=x_test, y=y_test)

model.predict(x=x_new)
```

Modell



Keras

```
model.compile(loss='mse',  
              optimizer=adam(lr=0.001),  
              metrics=['accuracy'])
```

```
model.fit(x=x_train, y=y_train,  
          batch_size=128,  
          epochs=10)
```



Problem

Handgeschriebene
Zahlen
klassifizieren

0 1 2 3 4
5 6 7 8 9

0

1

2

3

4

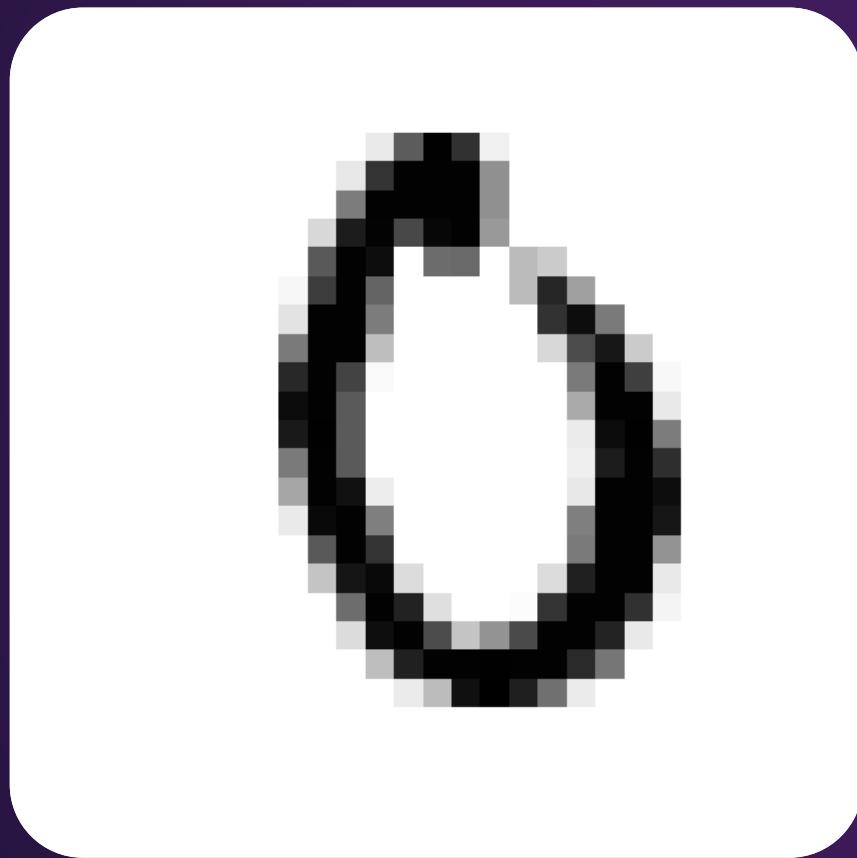
5

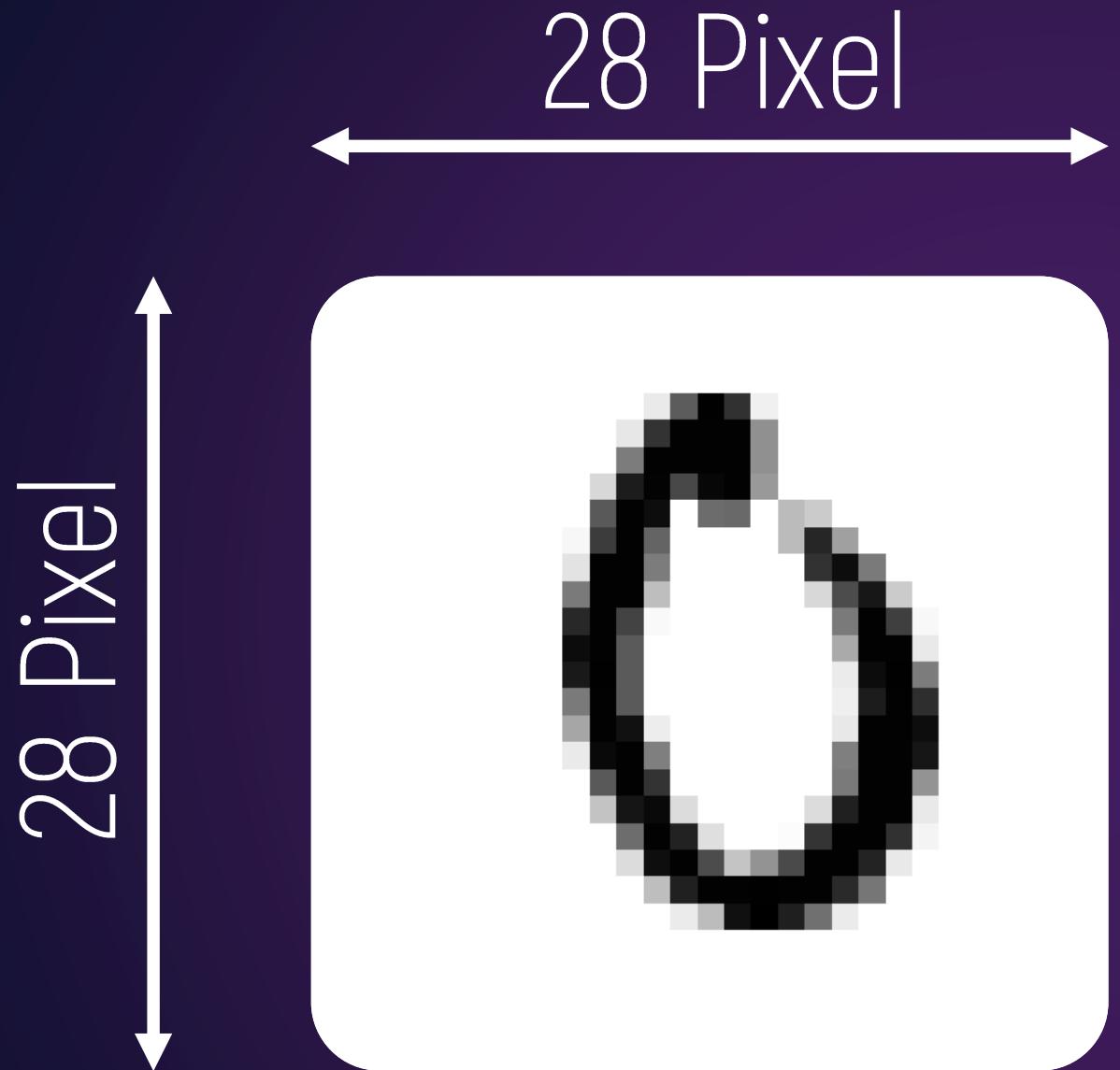
6

7

8

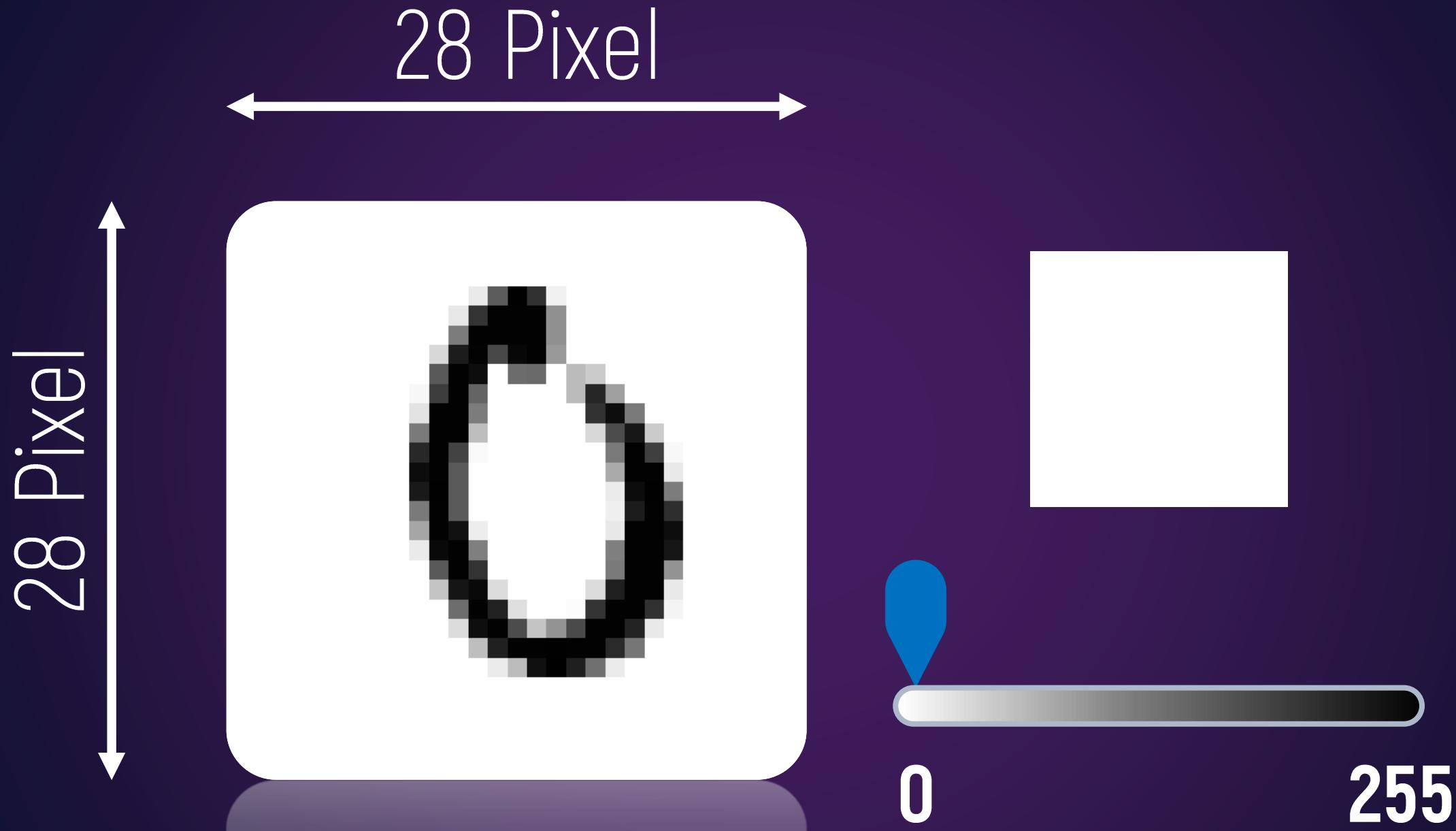
9

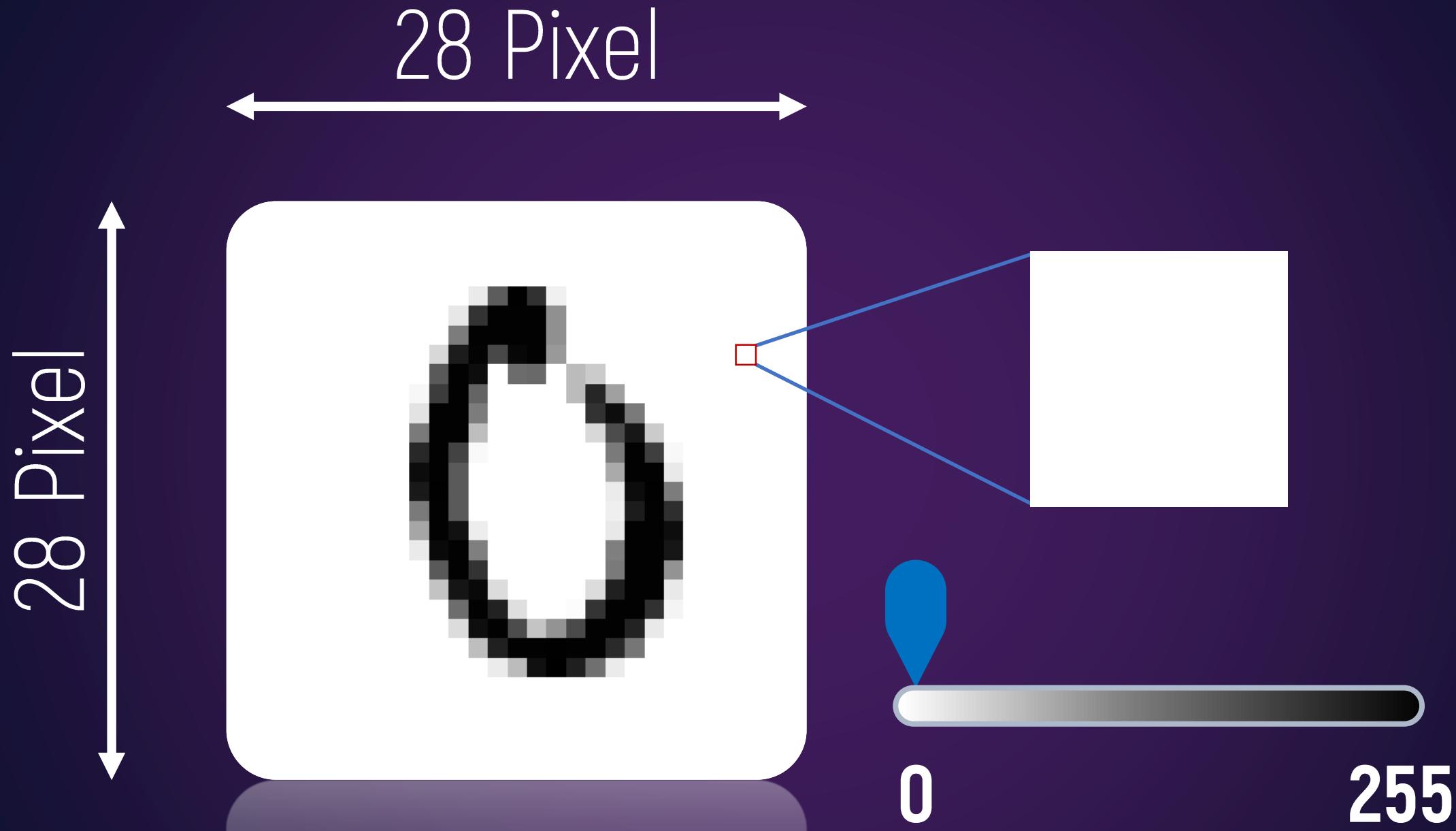


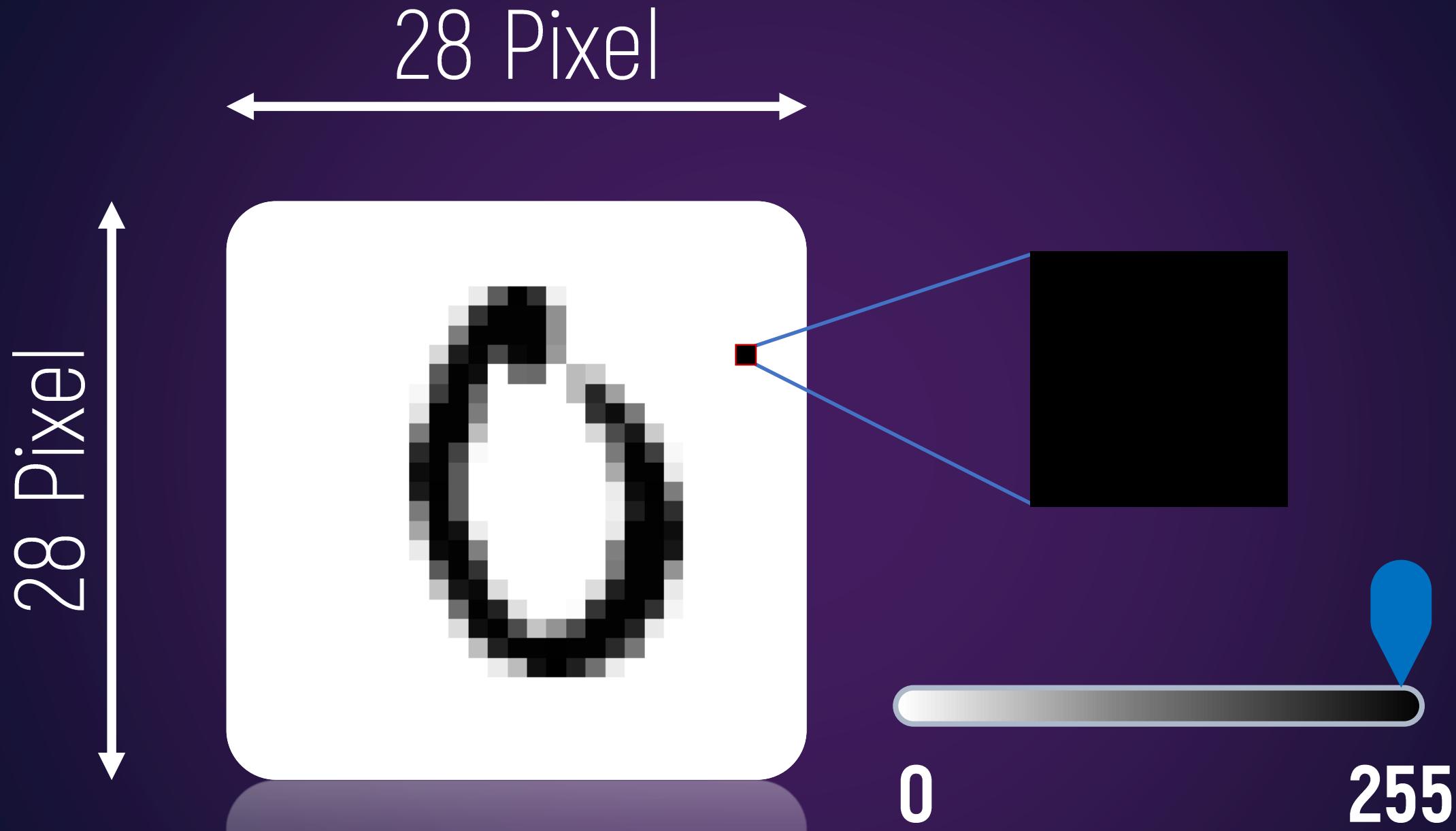


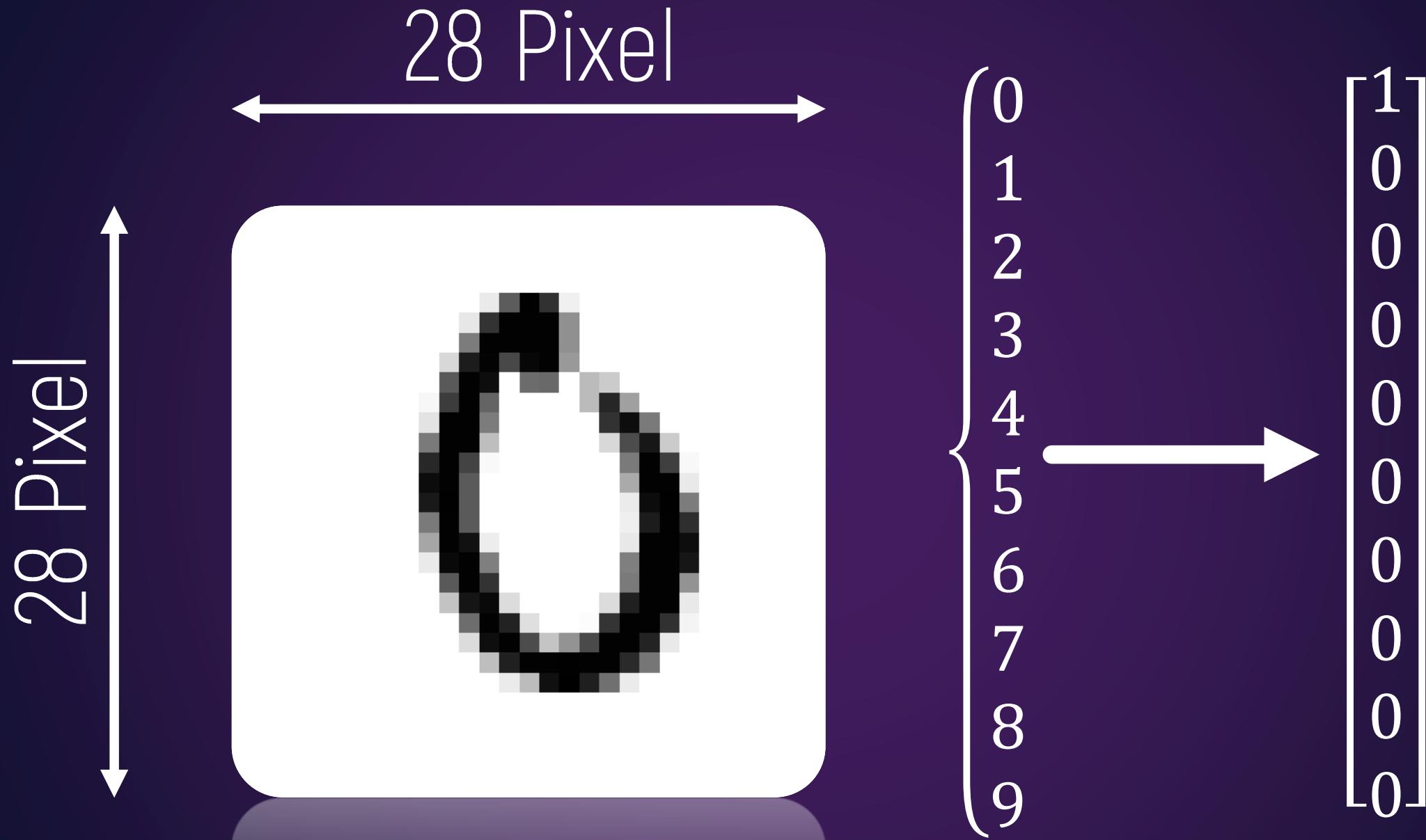
28 Pixel

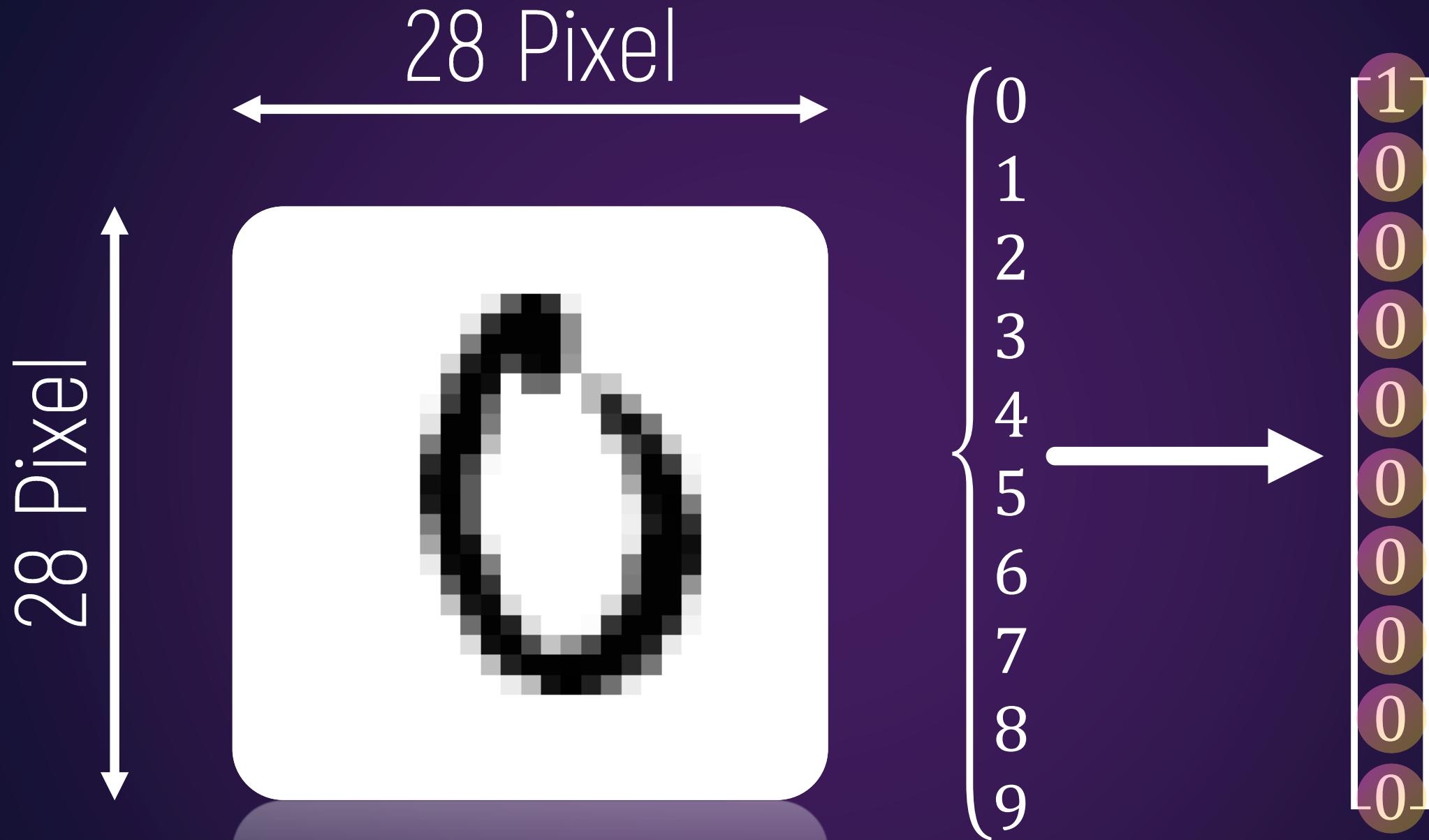
28 Pixel

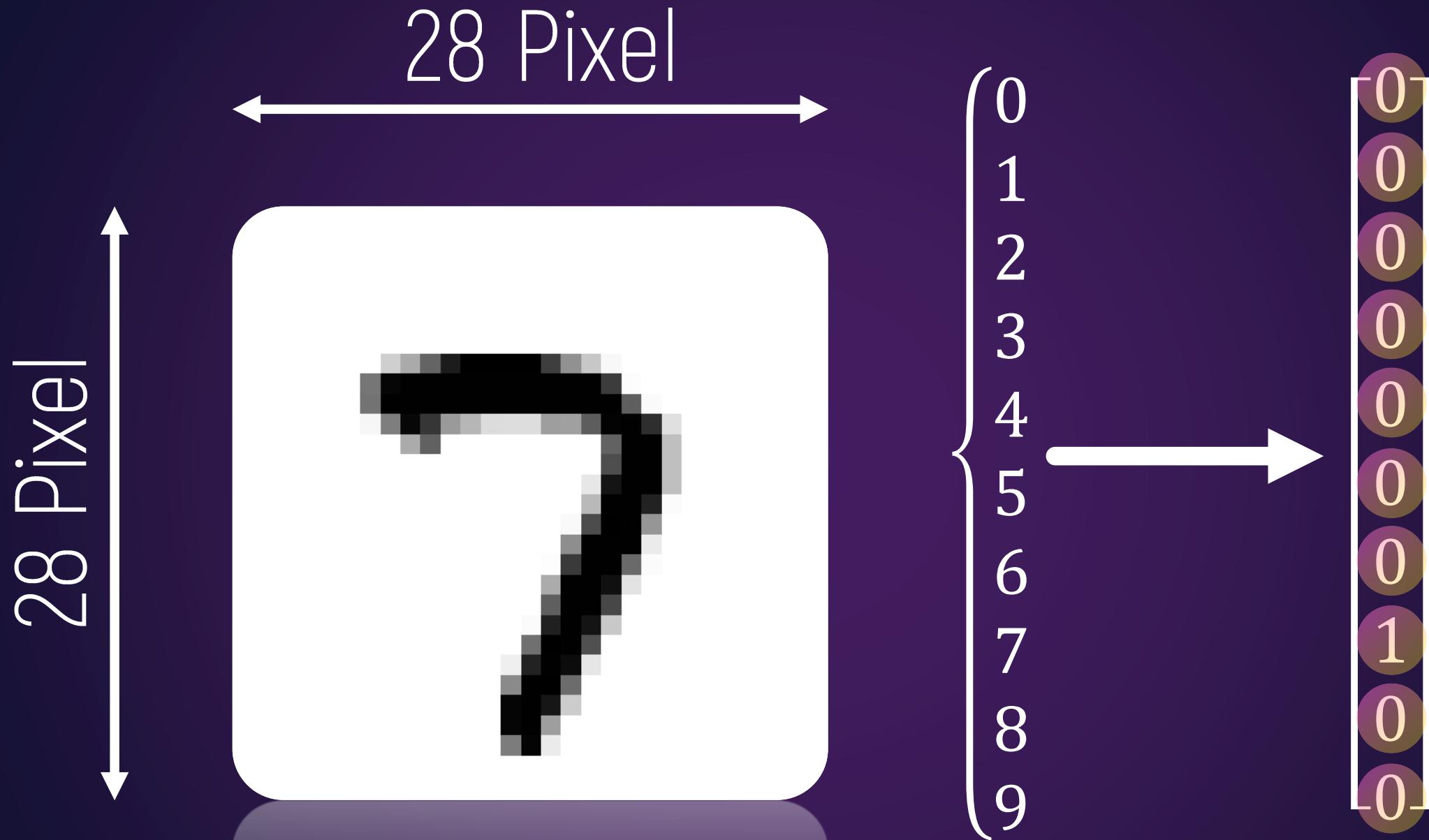


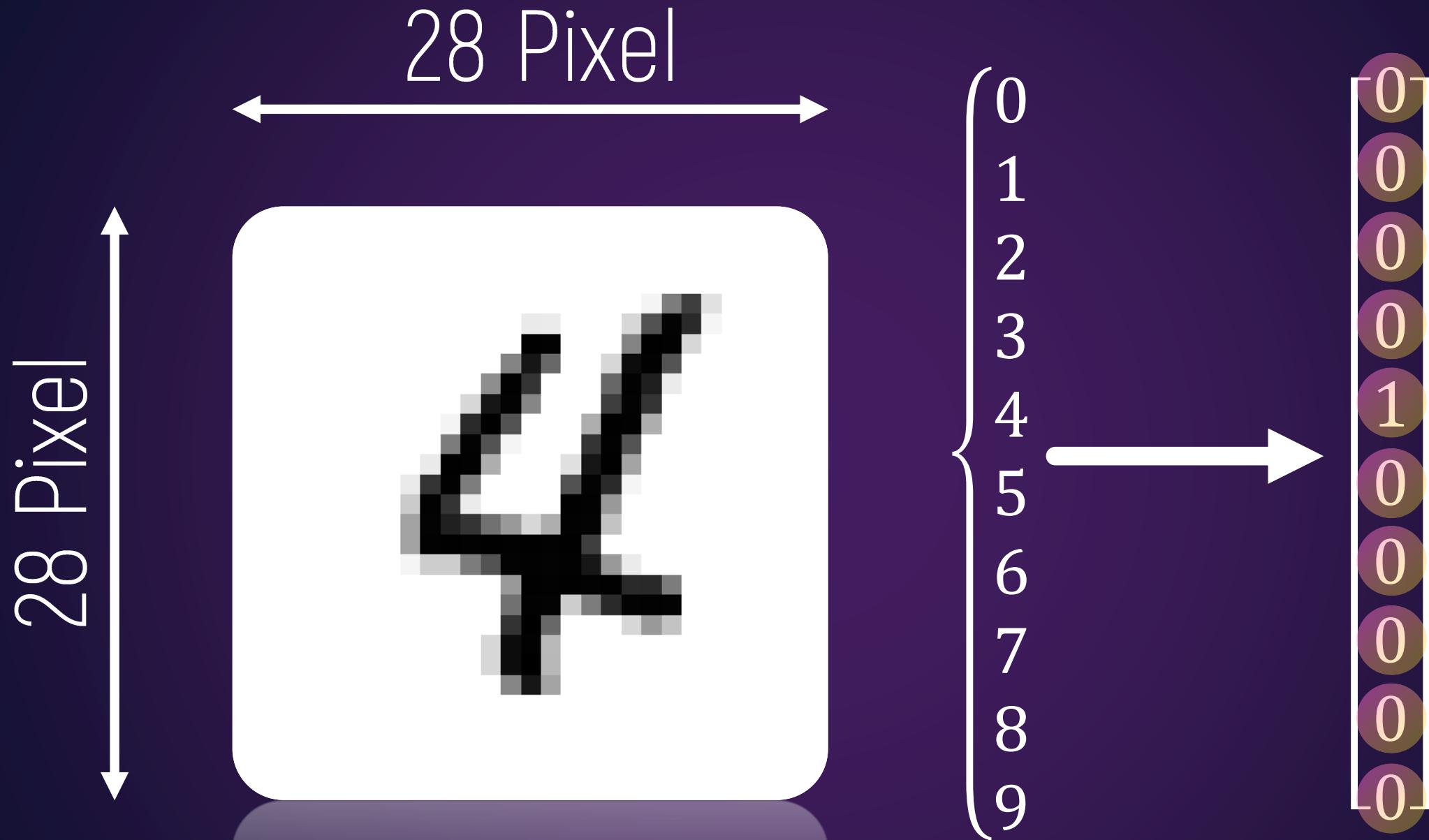














Live Demo

Deep Learning

- Was ist Deep Learning
- Warum brauchen wir Deep Learning
- Typische Deep Learning Probleme
- Wie funktioniert Deep Learning



Summary

Neuronales Netze

- Geschichte
- Aufbau
 - Schichten
 - Neuronen



Summary

Lernalgorithmus

- Supervised Learning
- Gradient Descent
- Hyperparameter



Summary

Keras und TensorFlow

- TensorFlow - Namensgebung
- Keras baut auf TensorFlow auf
- Vor- und Nachteile von Keras und TensorFlow



Summary

Programmieren einer KI in Keras

- Quellcode
- Keras und TensorFlow Codevergleich
- Neuronales Netz in Keras trainieren



Summary

Inhalt

- Resourcen für Selbststudium
- Das eben gezeigt Jupyter Notebook
- Diese Präsentation im PDF-Format



Fragen



