
SOFTWARE-ENTWICKLUNG
CIIT

CIIT

SOFTWARE-ENTWICKLUNG

Einführung ins Machine Learning

WIEN 26.September 2024

Ziel dieser Präsentation

00

Ziel dieser Präsentation?

- Allgemeines Verständnis
- Grundkonzepte von Machine Learning
- Machine Learning Algorithmen
- Mögliche Einsatzmöglichkeiten
- Herausforderungen

Einführung in Machine Learning.

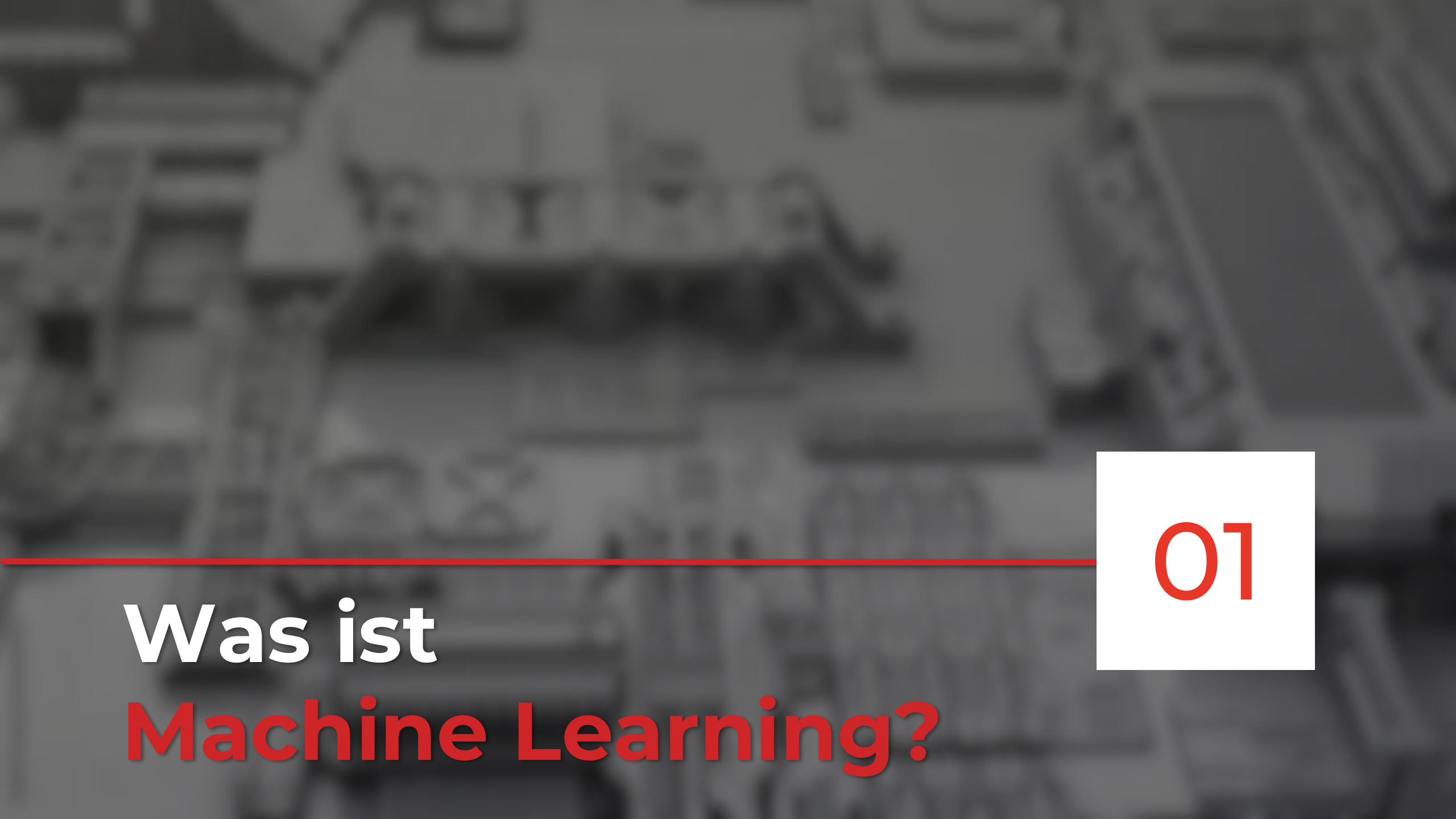
01 **Was ist Machine Learning?**

02 Supervised Learning

03 Unsupervised Learning

04 **Reinforcement Learning**

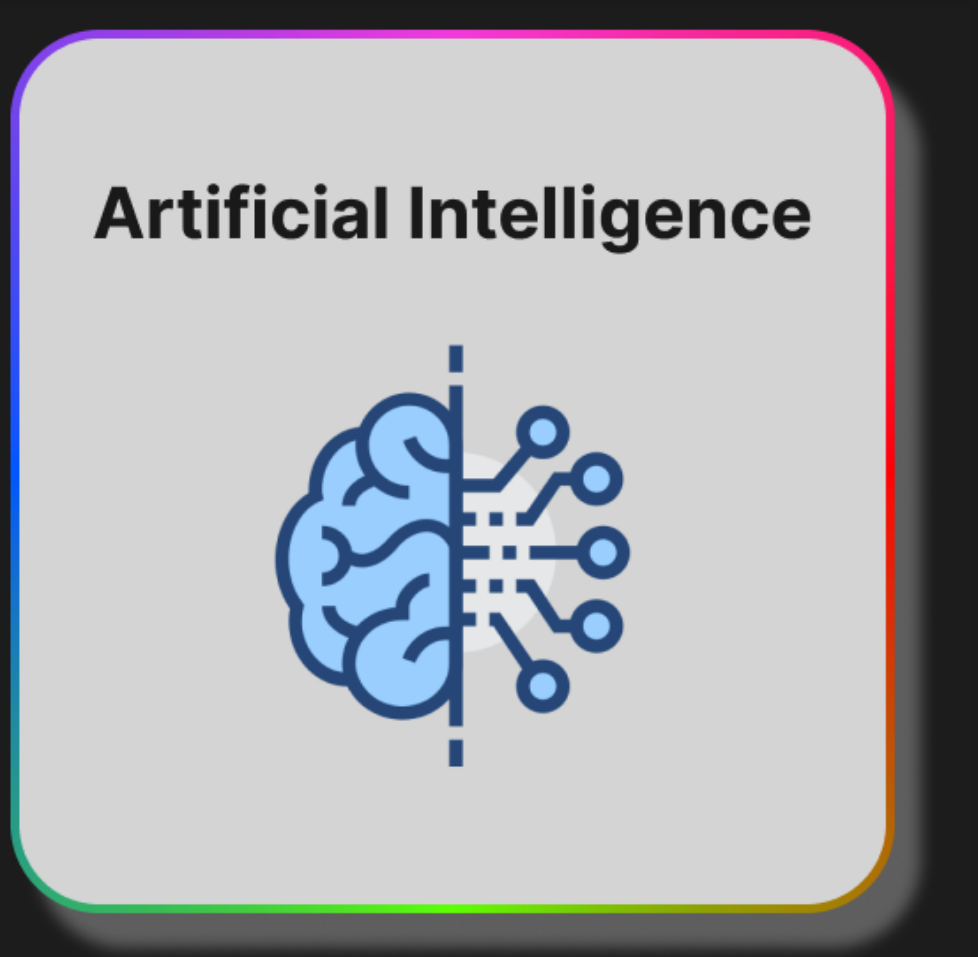
05 Zusammenfassung



01

Was ist Machine Learning?

Was ist Machine Learning?



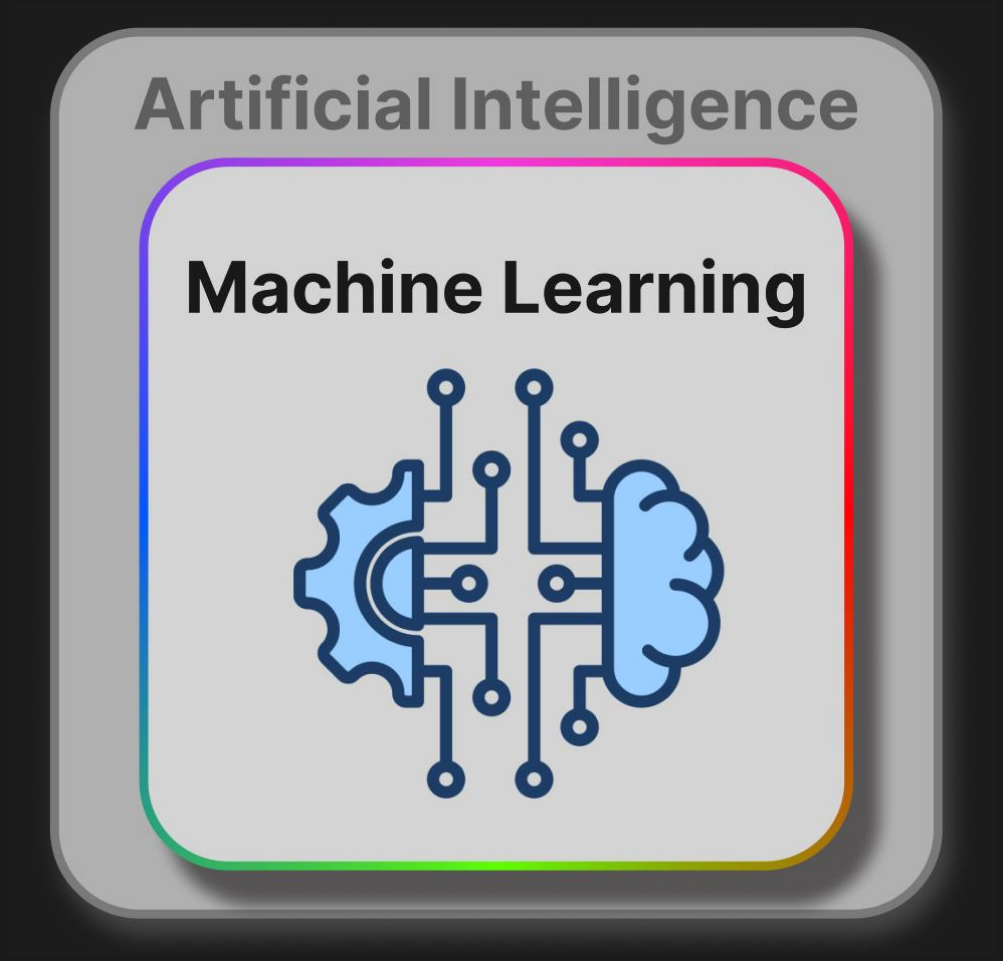
Artificial Intelligence

- Imitiert menschliche Intelligenz
- Lösung von komplexen Problemen

Beispiele

- Sortieralgorithmen
- Logikbasierte Chatbots
- Heuristikbasierte Systeme

Was ist Machine Learning?



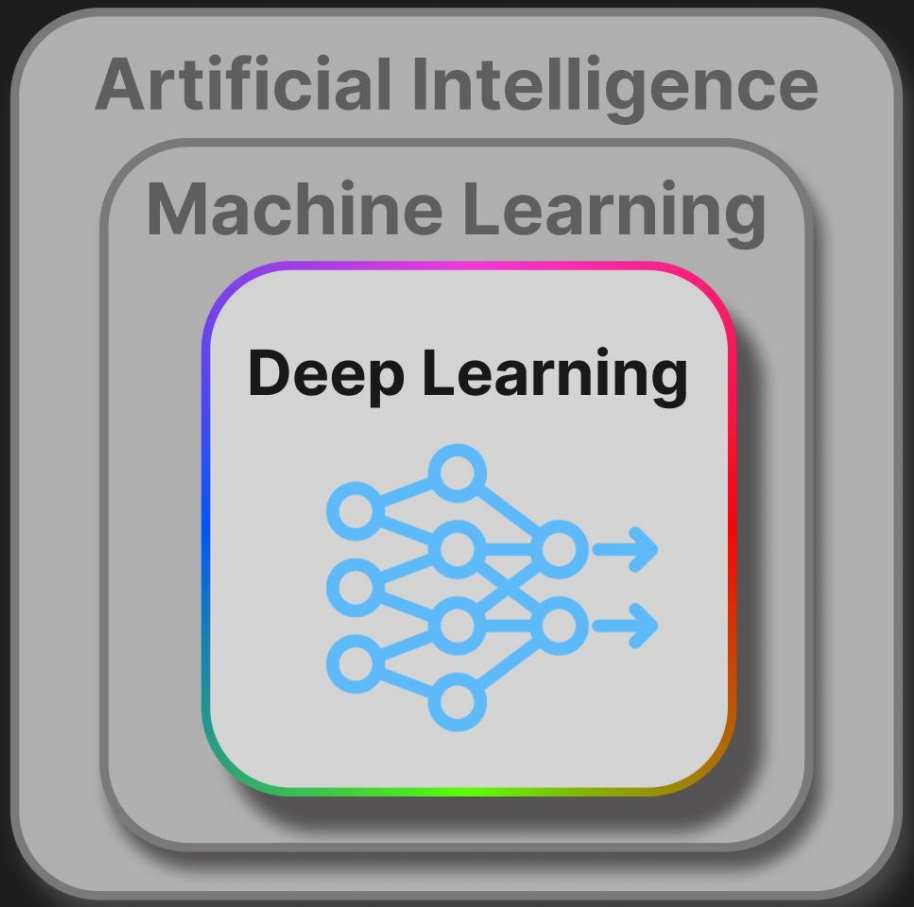
Machine Learning

- Teil von Artificial Intelligence
- Lernen und optimieren durch Erfahrungen

Beispiele

- Spam-Filter
- Risikoanalyse
- Personalisierte Werbung

Was ist Machine Learning?



Deep Learning

- Teil von Machine Learning
- Neuronale Netze mit mehrere Schichten

Beispiele

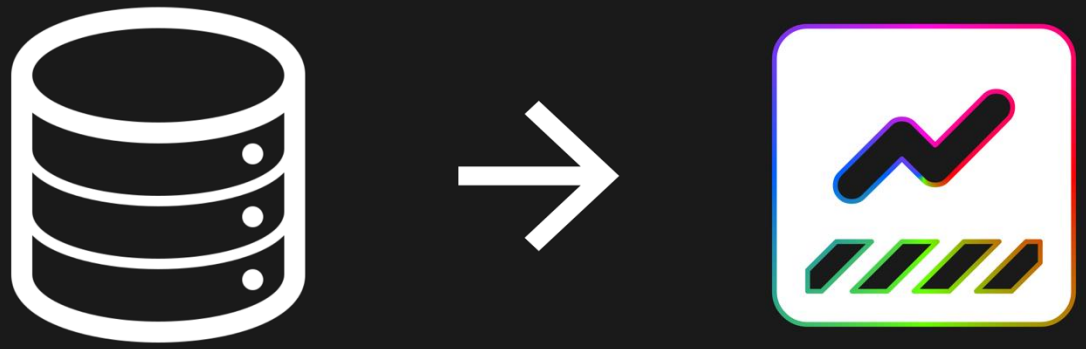
- Bilderkennung
- Sprachverarbeitung
- Large Language Models

Was ist Machine Learning?
Phase 1: Training

Daten

Was ist Machine Learning?

Phase 1: Training



Daten

ML Modell

Was ist Machine Learning?

Phase 1: Training

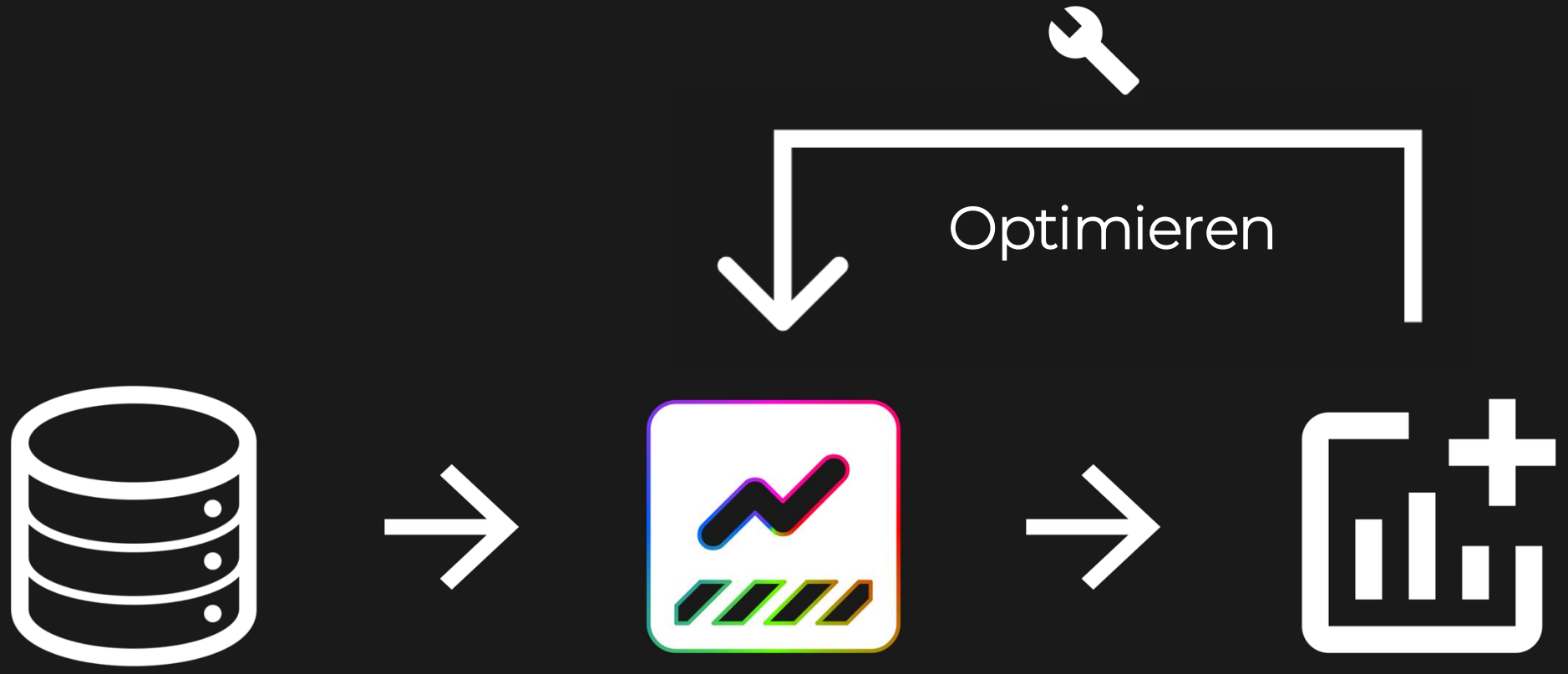
Daten

ML Modell

Evaluieren

Was ist Machine Learning?

Phase 1: Training

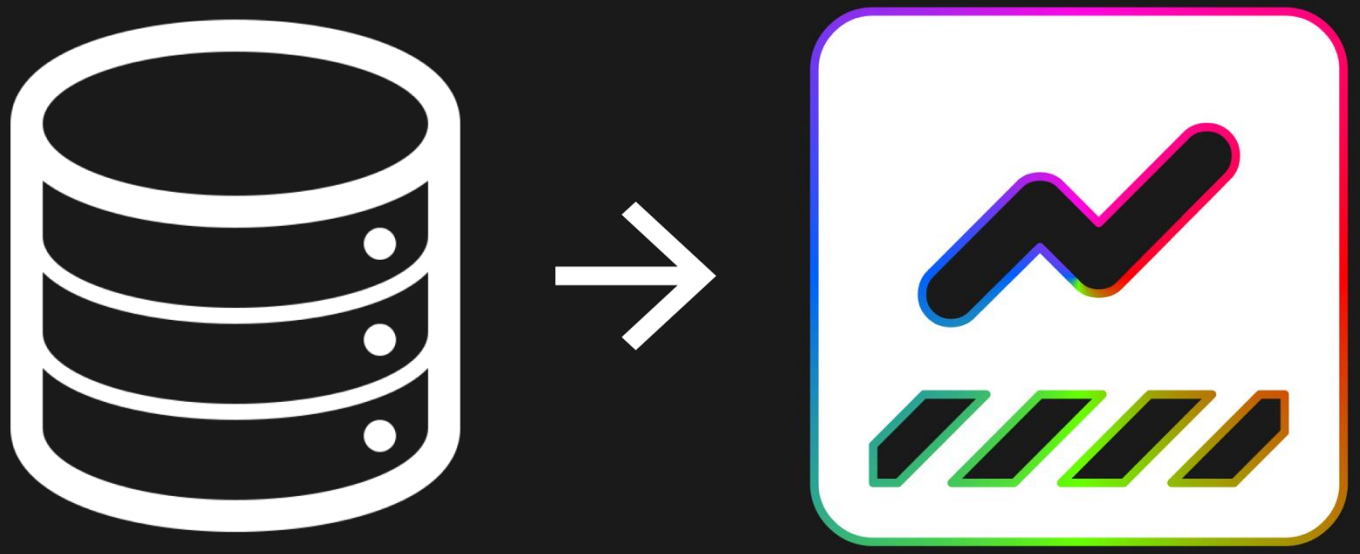


Was ist Machine Learning?
Phase 2: Production

Daten

Was ist Machine Learning?

Phase 2: Production



Daten

ML Modell

Was ist Machine Learning?

Phase 2: Production

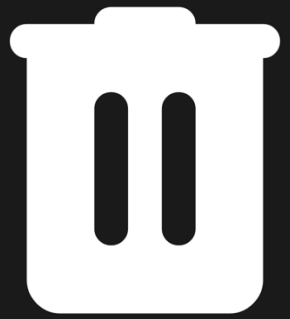
Daten ML Modell Vorhersage

Was ist Machine Learning?

Machine Learning Modelle

- Phase 1 liefert immer ein Modell
- Qualität variiert
- Nie zu 100% genau

Was ist Machine Learning?



Garbage in

Was ist Machine Learning?

Garbage in

Garbage out

Typen von ML

Supervised Learning

Daten: Eingabe - Ausgabe Paare

Lernprozess: Überwacht - Feedback über Korrektheit

Ziel: Vorhersagen neuer Eingaben

Unsupervised learning

Reinforcement Learning

Typen von ML

Supervised Learning

Unsupervised Learning

Daten: Unbeschriftete Daten

Lernprozess: Unüberwacht - Ohne Anweisungen

Ziel: Muster und Strukturen in Daten finden

Reinforcement Learning

Typen von ML

Supervised Learning

Unsupervised Learning

Reinforcement Learning

Daten:	Umgebung
Lernprozess:	Belohnung und Bestrafung nach Interaktion
Ziel:	Strategie mit höchster Belohnung

Einführung in Machine Learning.

01

Was ist Machine Learning?

02

Supervised Learning

03

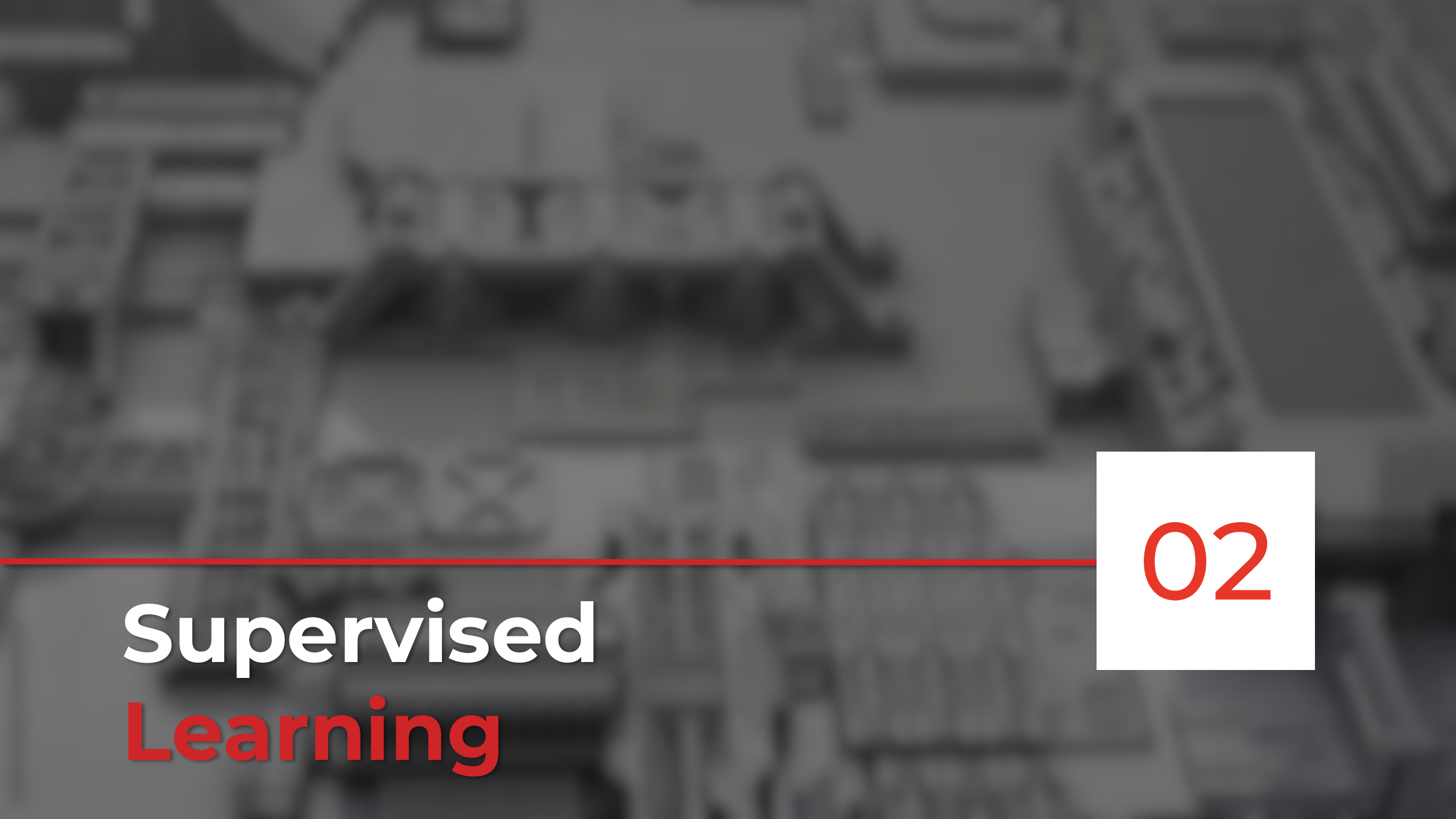
Unsupervised Learning

04

Reinforcement Learning

05

Zusammenfassung



02

Supervised Learning

Supervised Learning

Regression

Classification

Supervised Learning

Regression

Supervised Learning

Regression

Supervised Learning

Regression

# Hours Studied Numeric	# Previous Scores Numeric	# Sleep Hours Numeric	# Performance Ind... Target Variable
7	99	9	91.0
4	82	4	65.0
8	51	7	45.0
5	52	5	36.0
7	75	8	66.0

Supervised Learning

Regression

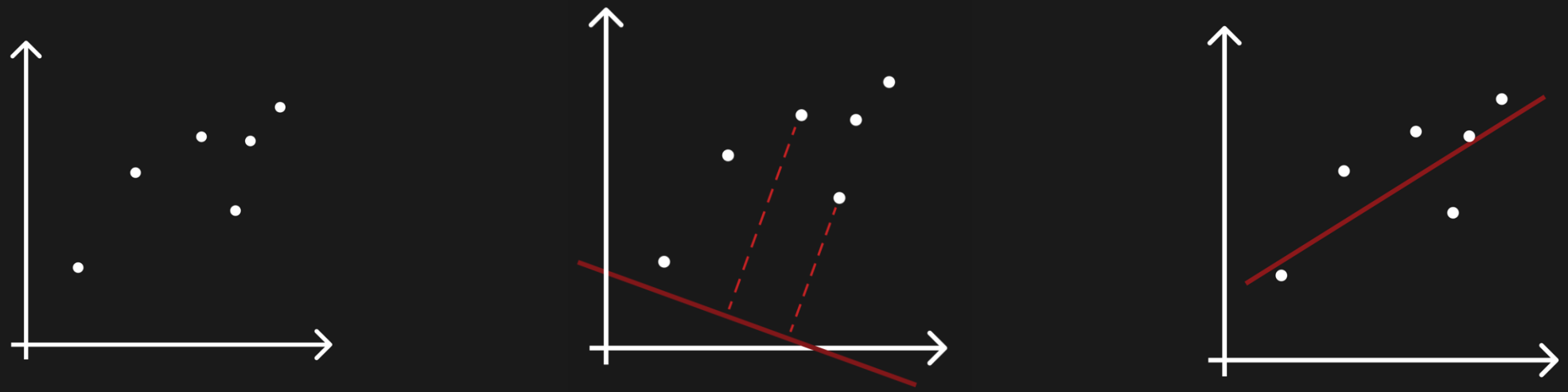
Beispiele

- Temperatur / Wetter
- Immobilienpreise
- Aktienkurse

Supervised Learning

Regression

Linear Regression



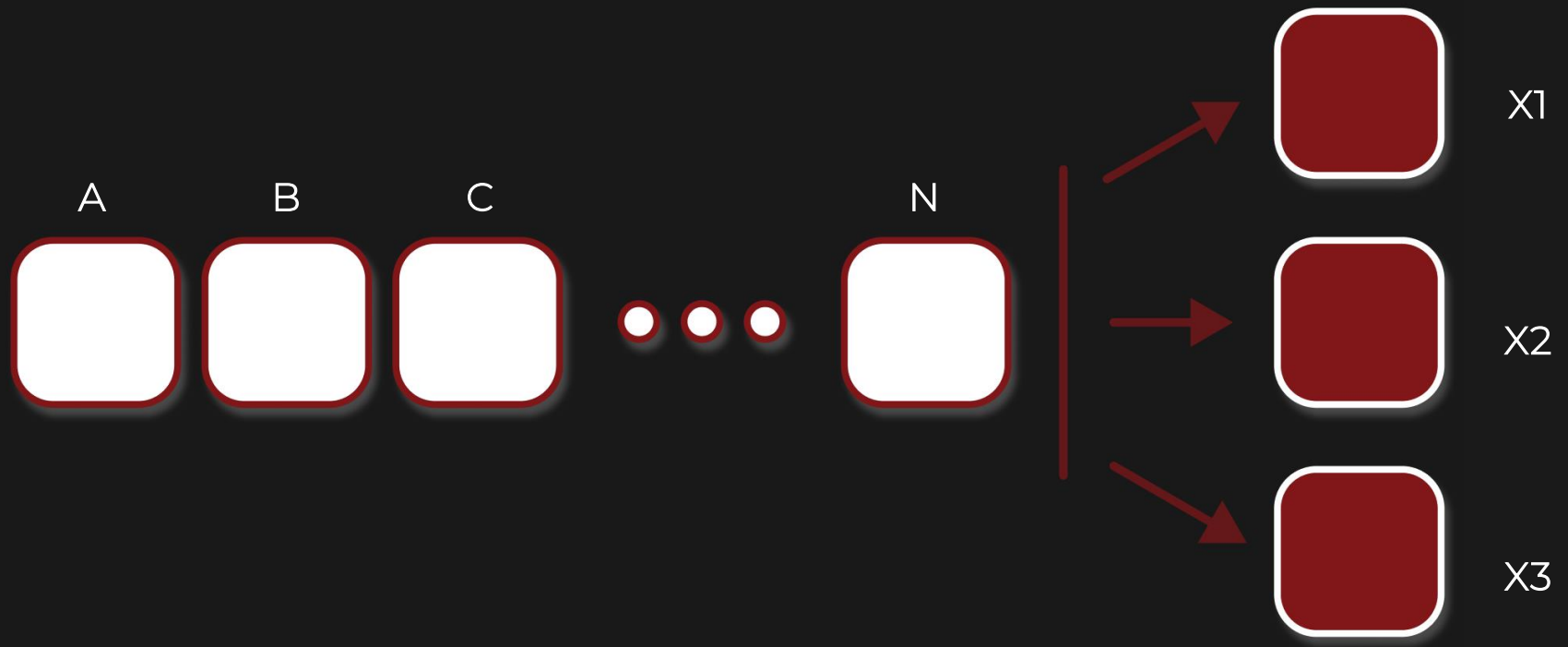
$$y = a * x + b + \epsilon$$

Supervised Learning

Classification

Supervised Learning

Classification



Supervised Learning

Classification

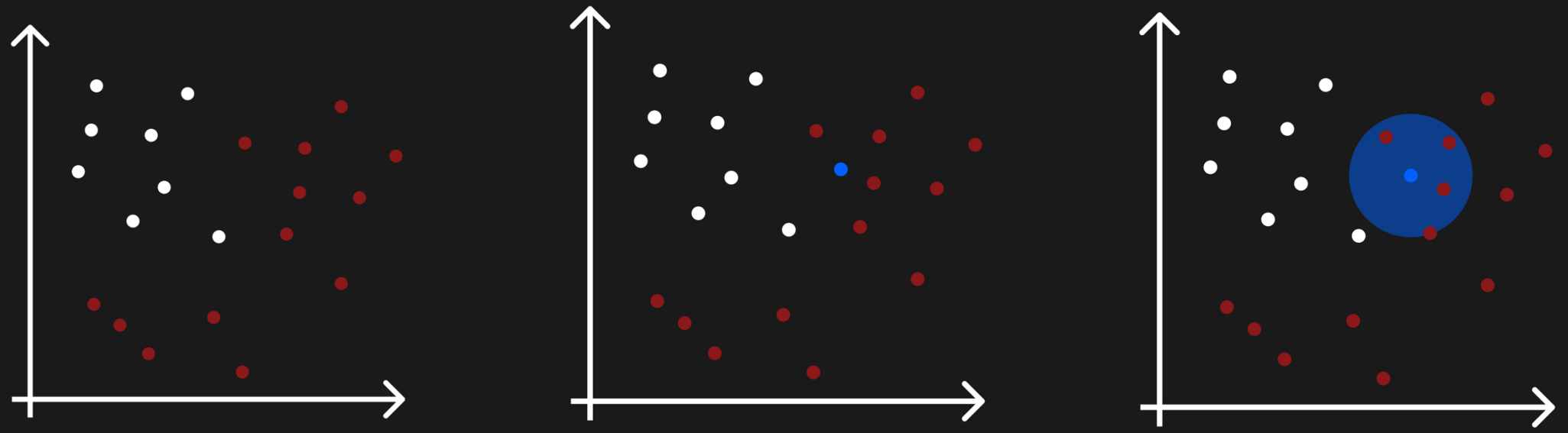
Gender	Age	GPA	Major	Projects	Python	SQL	Java
Male	21	3.5	Computer Science	Chatbot Development	Strong	Strong	Weak
Female	20	3.2	Computer Science	Data Analytics	Average	Strong	Weak
Male	22	3.8	Computer Science	E-commerce Website	Strong	Strong	Average
Female	21	3.7	Computer Science	Full-Stack Web App	Weak	Strong	Strong
Male	23	3.4	Computer Science	Network Security	Average	Weak	Strong

Future Career
Machine Learning Researcher
Data Scientist
Software Engineer
Web Developer
Information Security Analyst

Supervised Learning

Classification

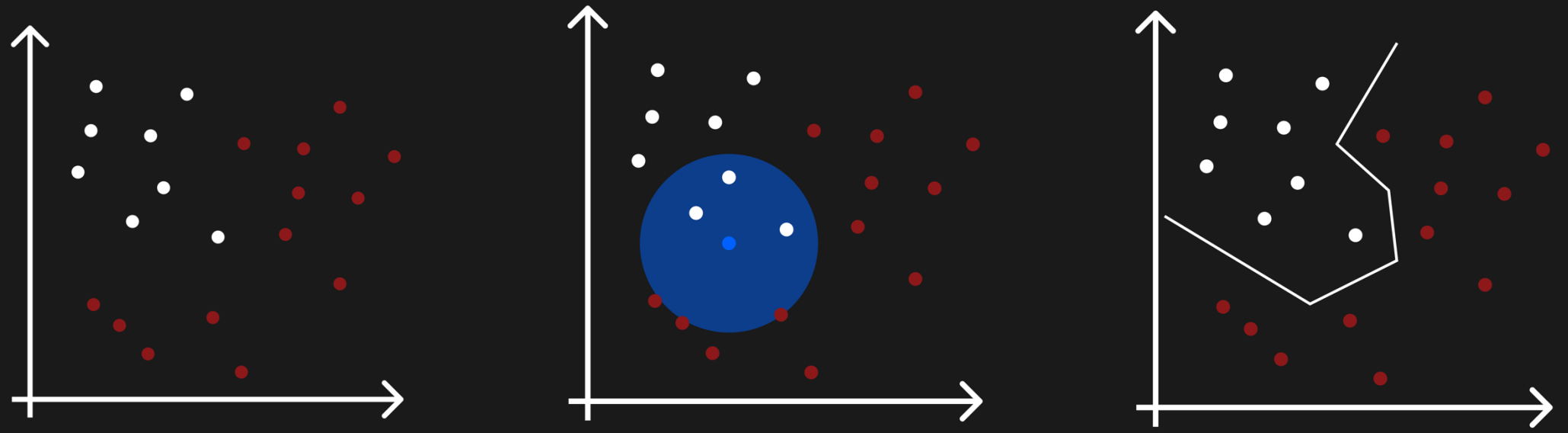
K - Nearest Neighbour (k-NN)



Supervised Learning

Classification

K - Nearest Neighbour (k-NN)



Supervised Learning

Classification

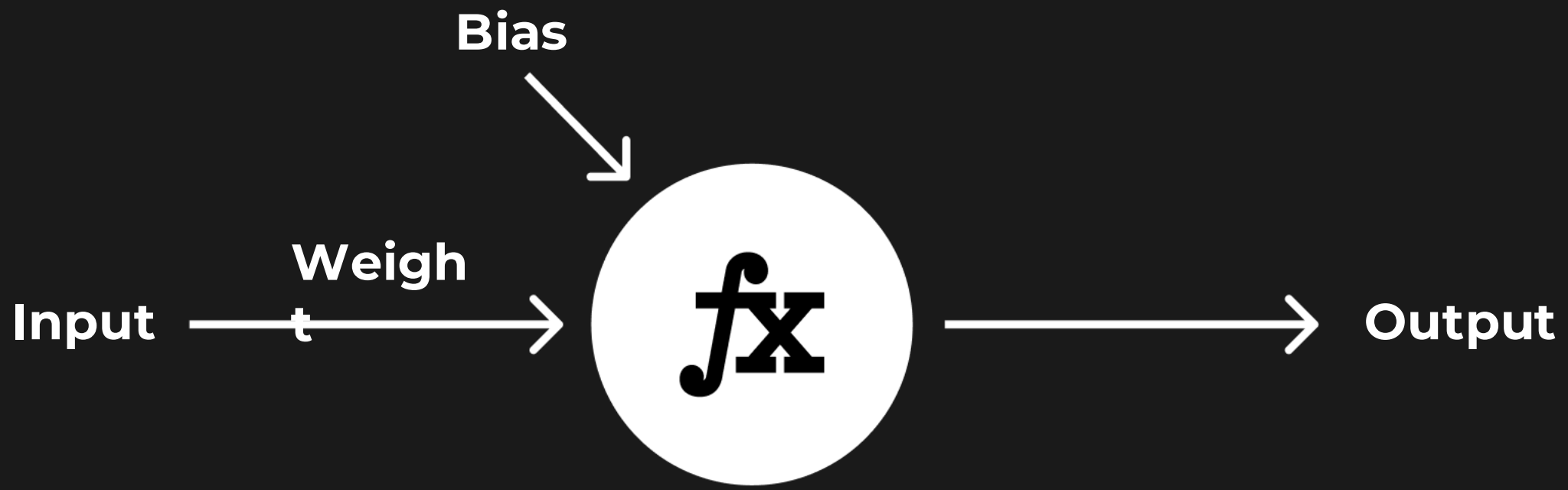
Beispiele

- Spam Filter
- Musik Genre
- Bild- & Spracherkennung

Supervised Learning

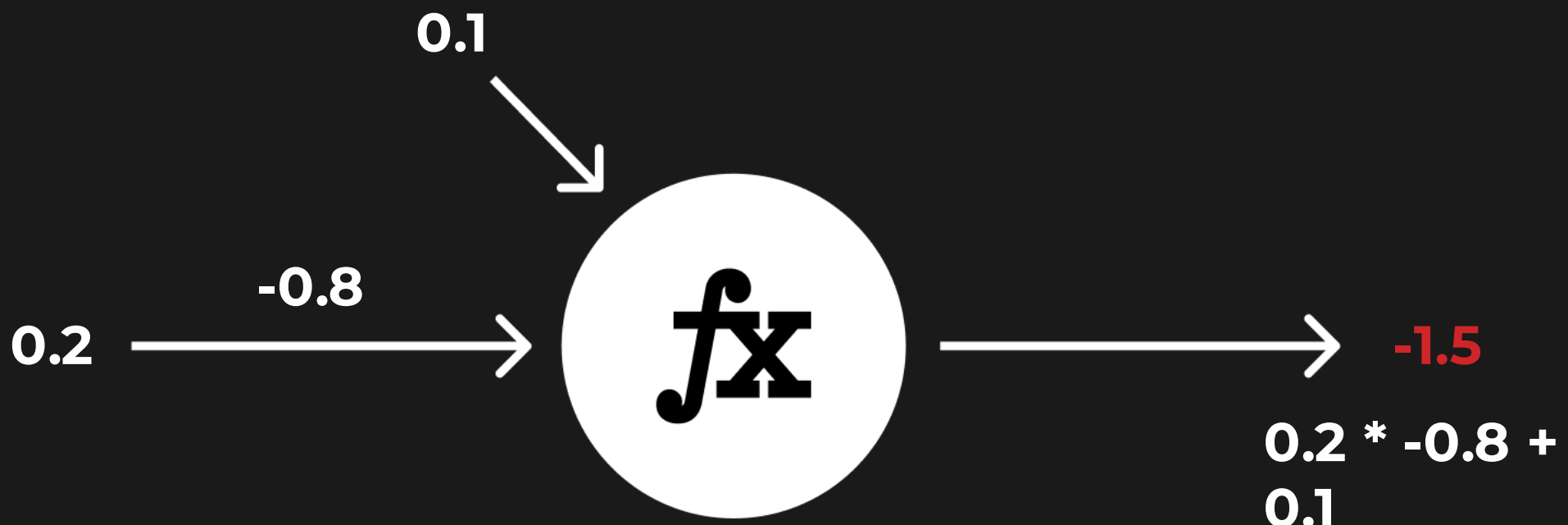
Neural Network

Supervised Learning
Neural Network



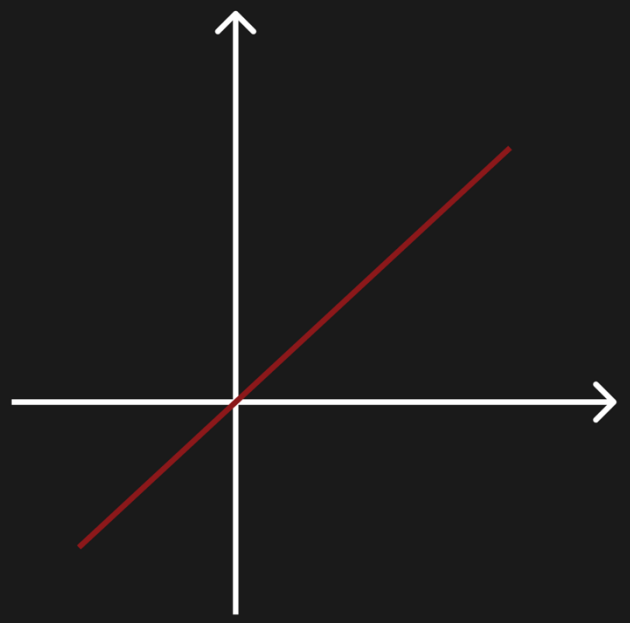
Perceptro
n

Supervised Learning
Neural Network

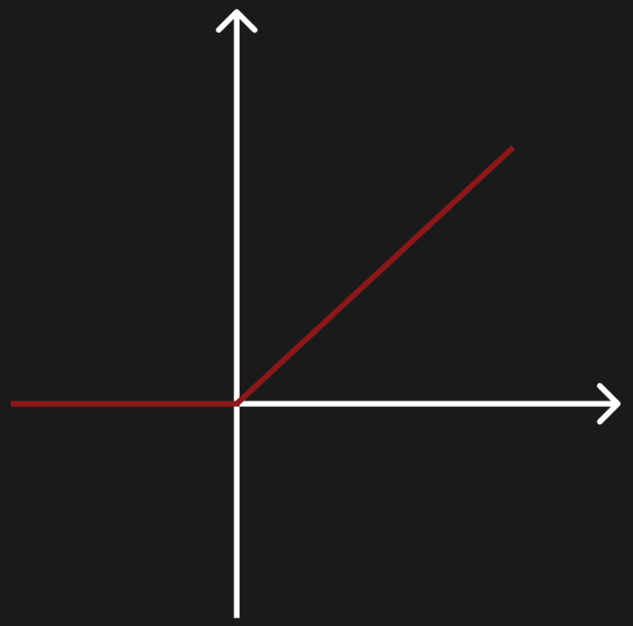


$$f(x) = x$$

Supervised Learning
Neural Network

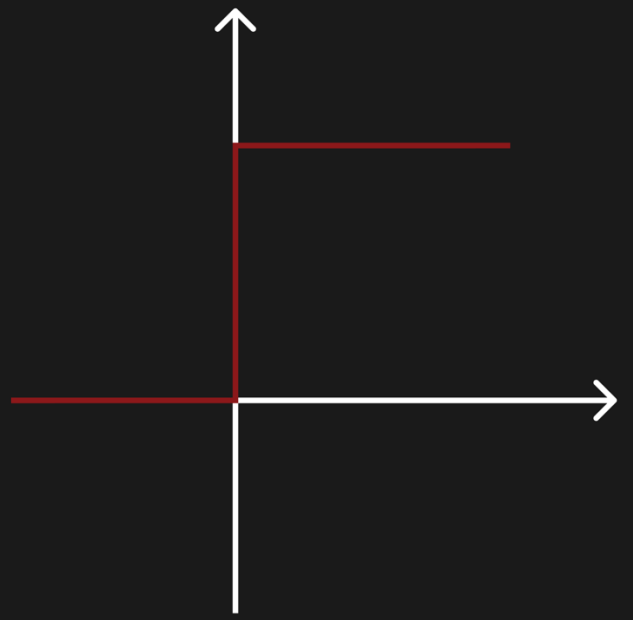


Linear



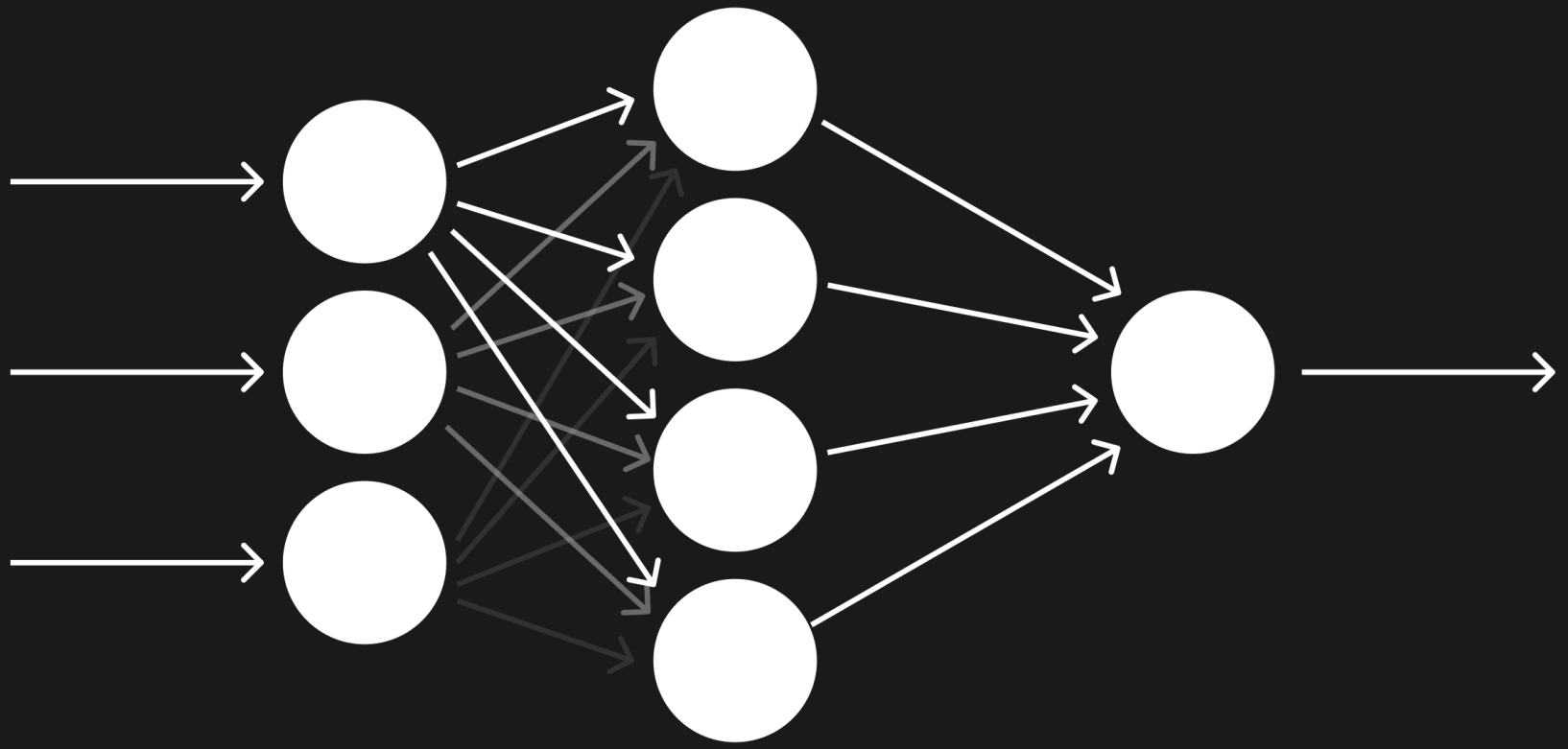
ReLU

Rectified Linear Unit



Unit Step

Supervised Learning
Neural Network

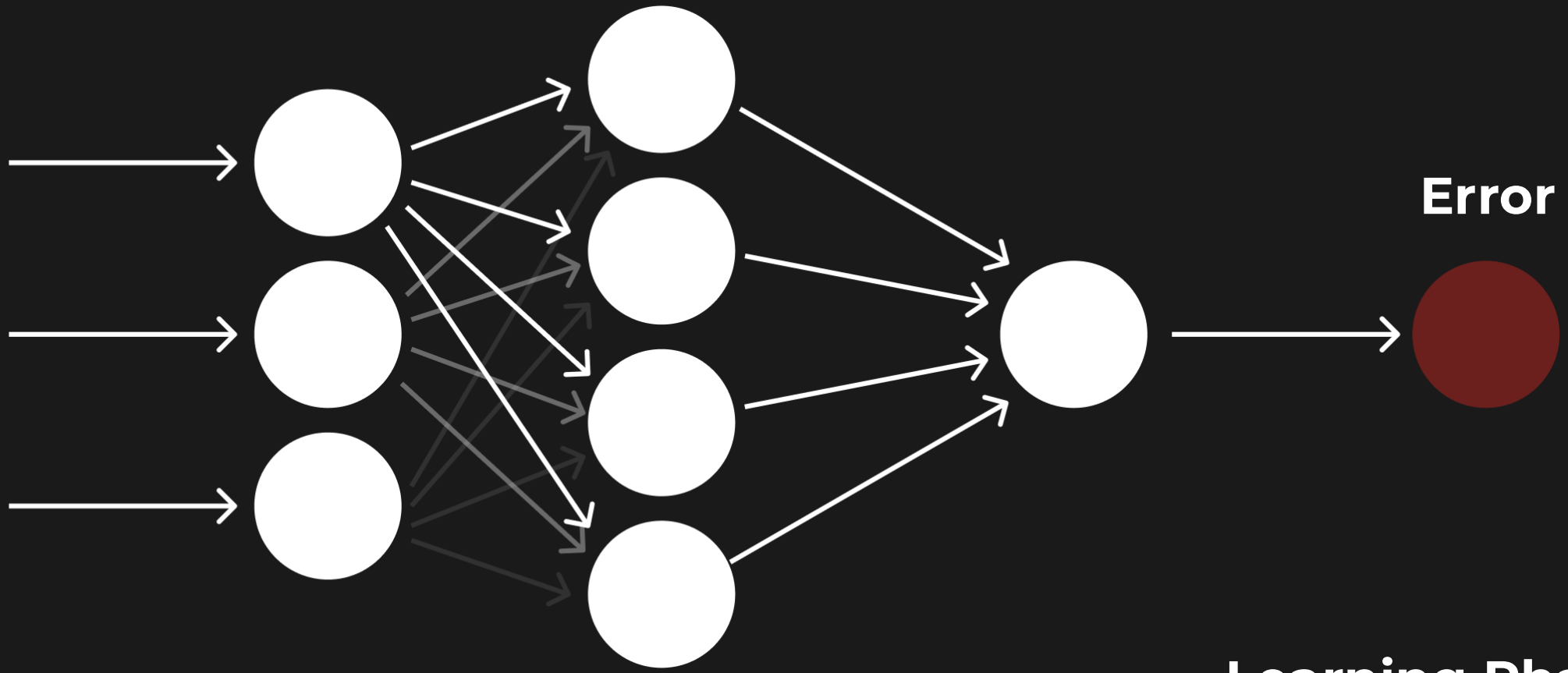


Input Layer

Hidden Layer

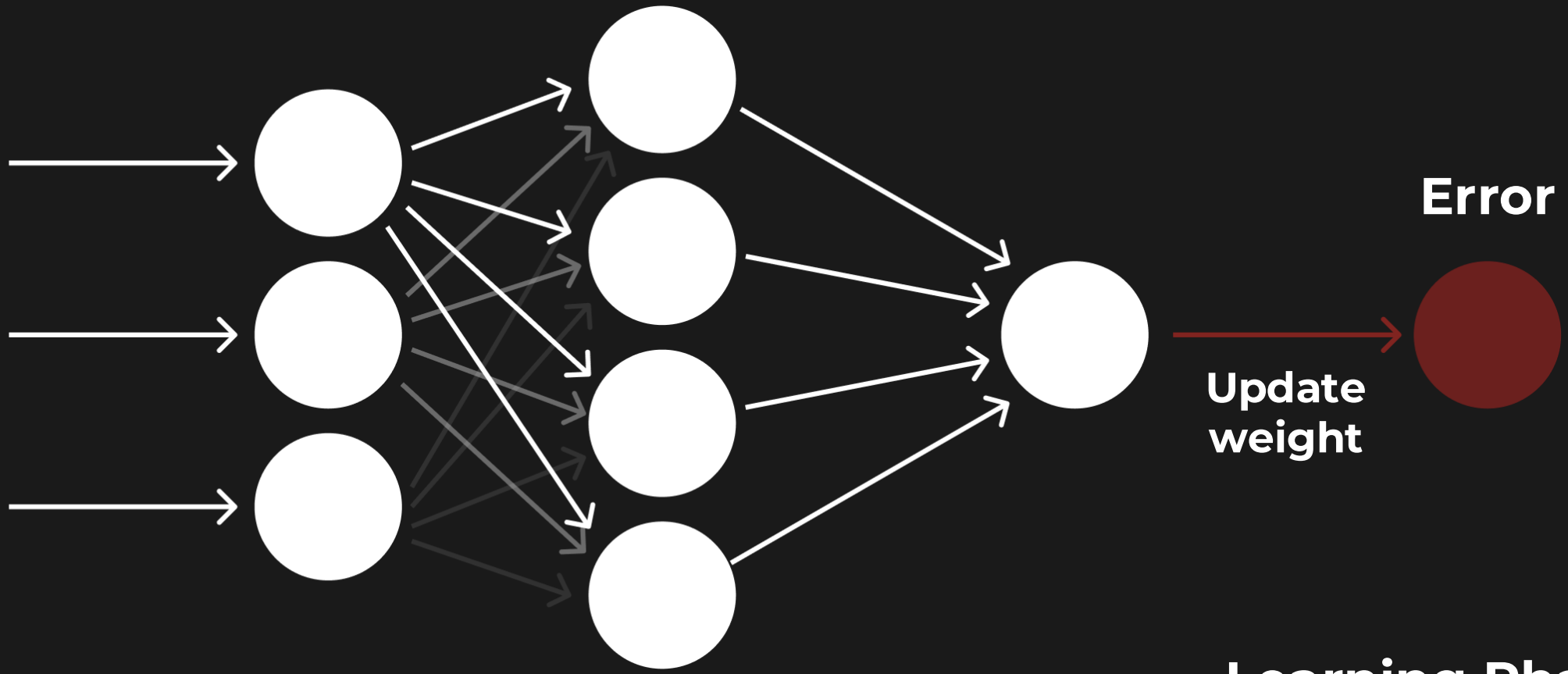
Output Layer

Supervised Learning
Neural Network



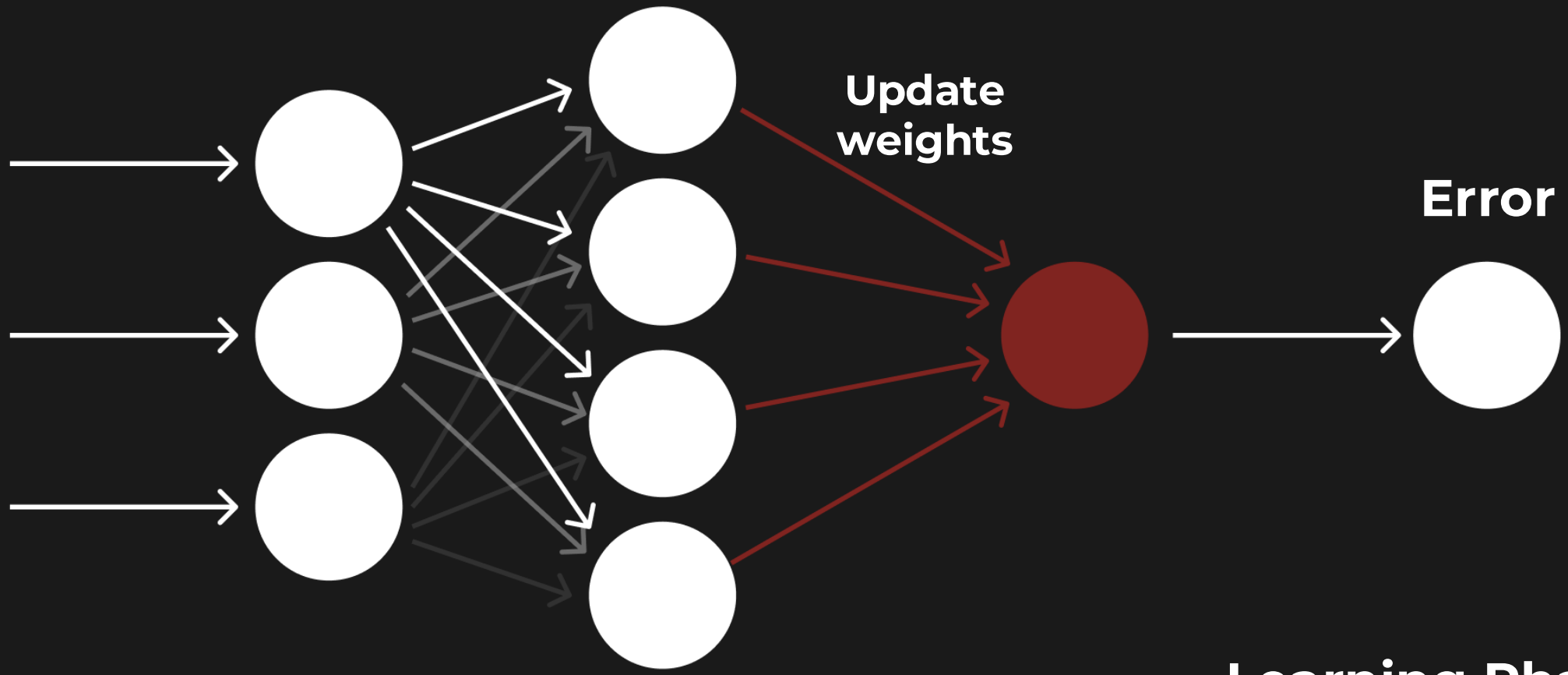
Learning Phase

Supervised Learning
Neural Network



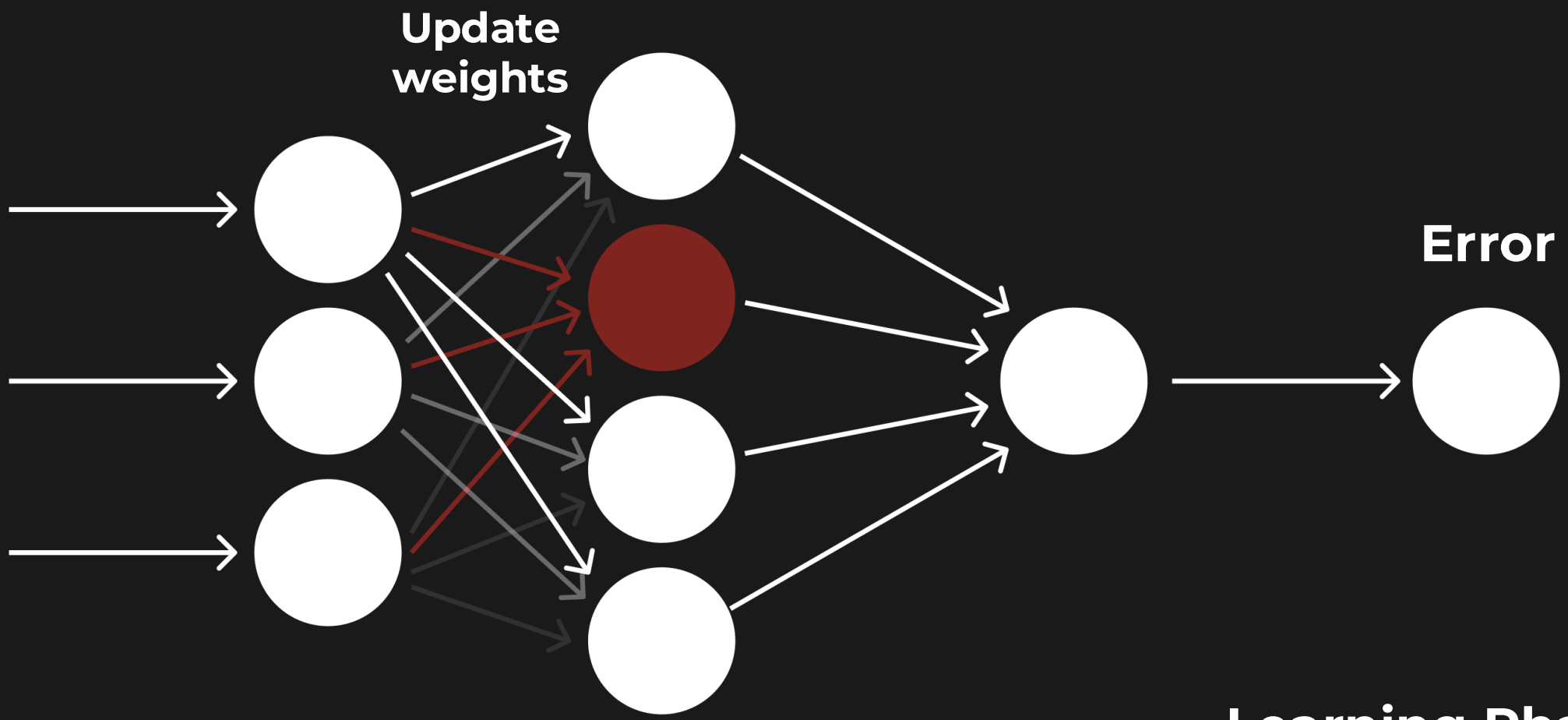
Learning Phase

Supervised Learning
Neural Network



Learning Phase

Supervised Learning
Neural Network



Learning Phase

Supervised Learning
Neural Network

Deep Learning = **Neural Network** + **2x Hidden Layer**

Supervised Learning
Neural Network

Vorteile

- Komplexe nicht-lineare Beziehungen
- Skalierbarkeit und Leistung bei großen Datensätzen
- Vielseitig - Regression / Classification / (Un-)Supervised / Reinforcement Learning

Supervised Learning
Neural Network

Nachteile

- Ressourcenintensiv - Hardware und Rechenzeit
- Blackbox - Kaum Erklärbar
- Wahl der Parameter

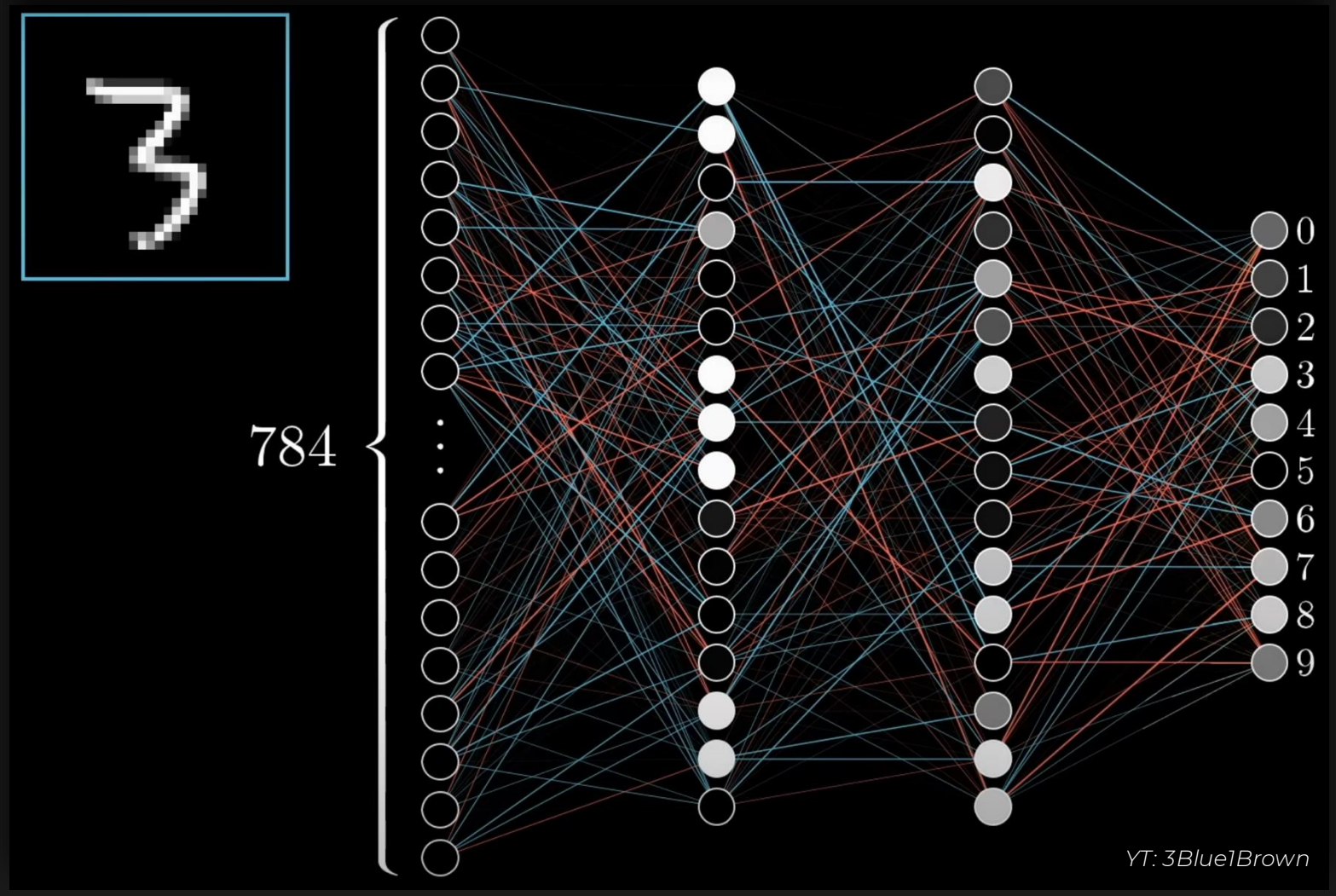
Supervised Learning
Neural Network

Fragen

- Wie viele Hidden Layers?
- Wie viele Neuronen pro Layer?
- Welche Aktivitätsfunktion?

Supervised Learning

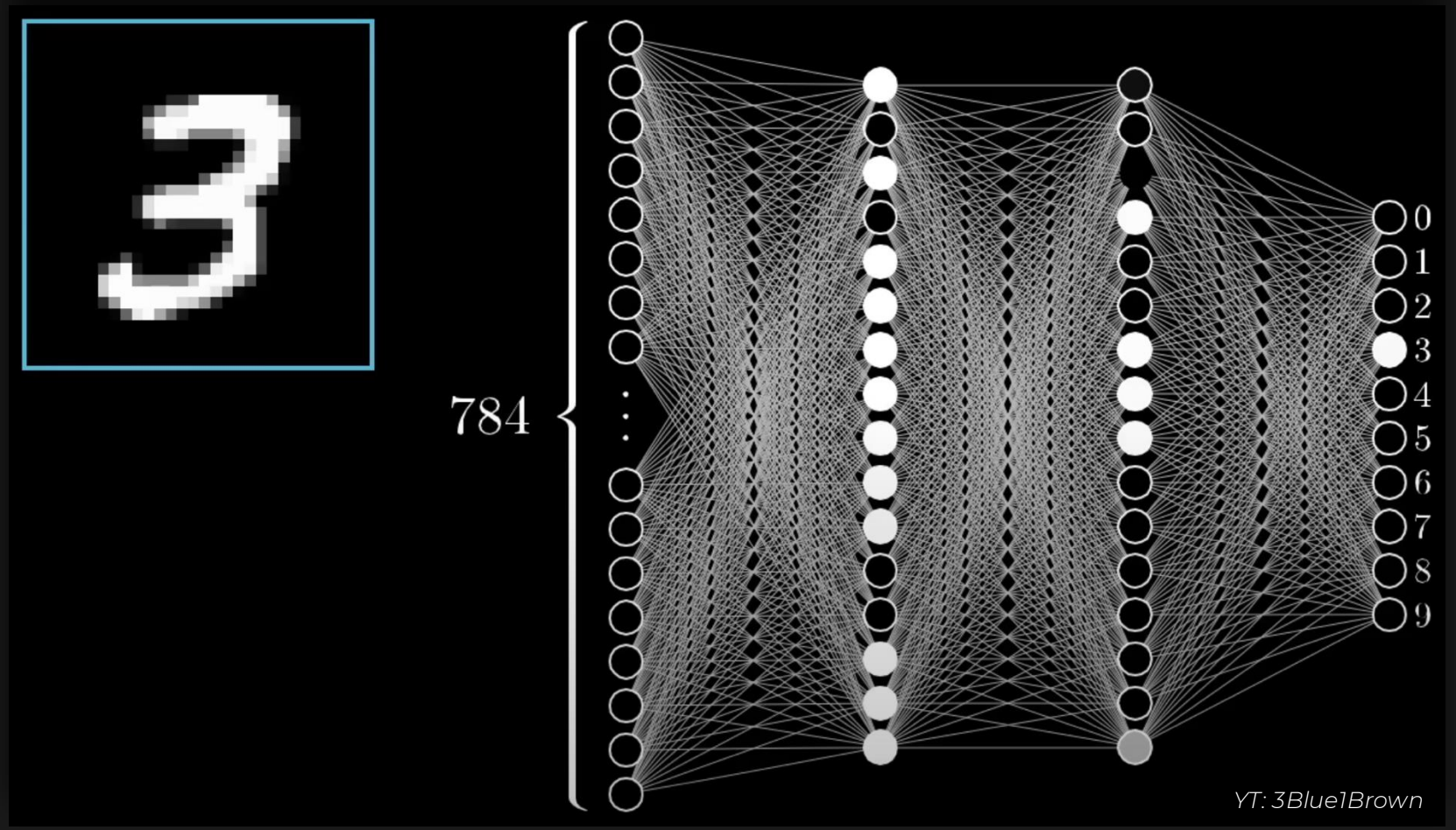
Neural Network



Bilderkennung

Beispiele

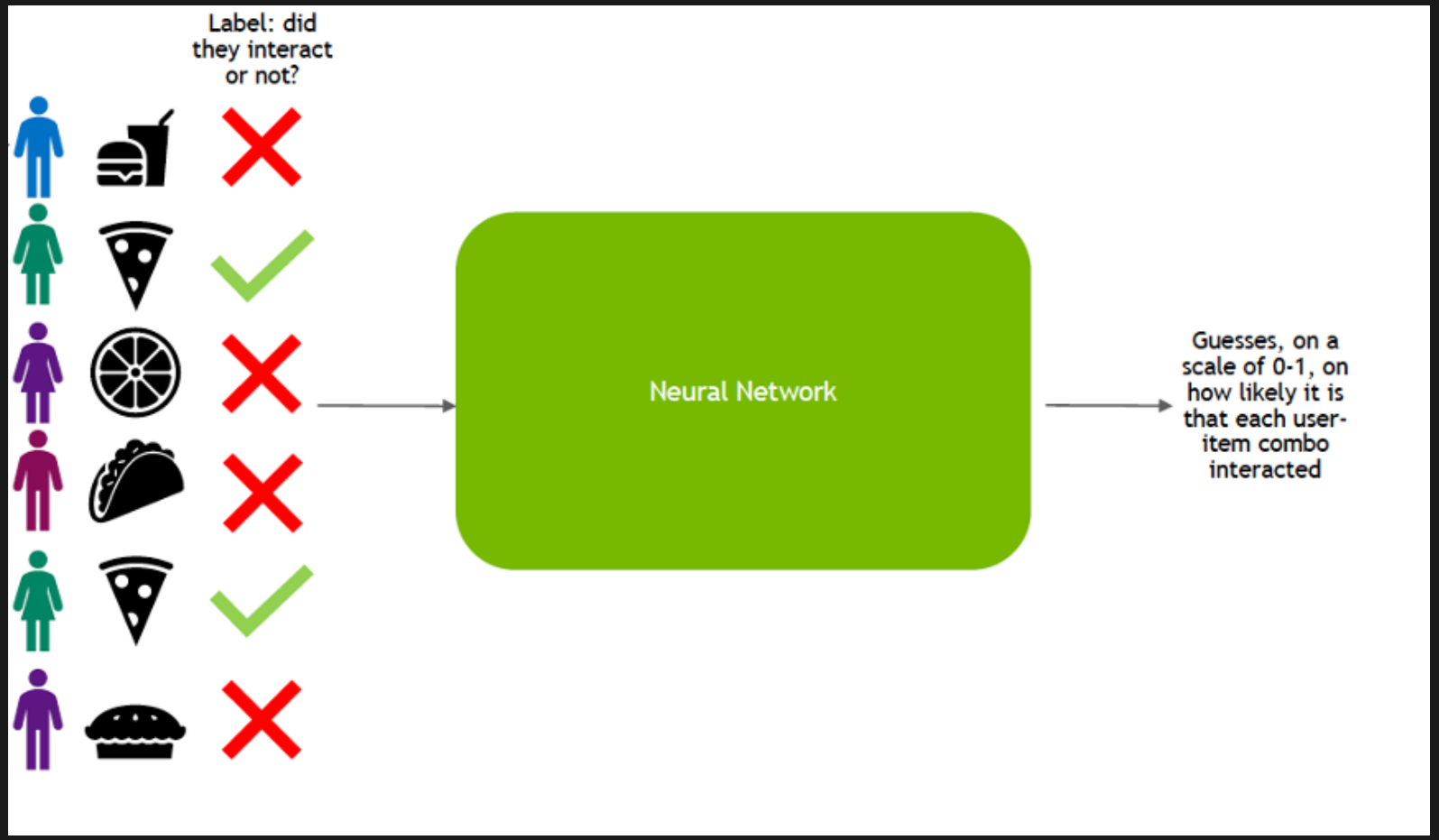
Supervised Learning
Neural Network



Bilderkennung

Beispiele

Supervised Learning
Neural Network

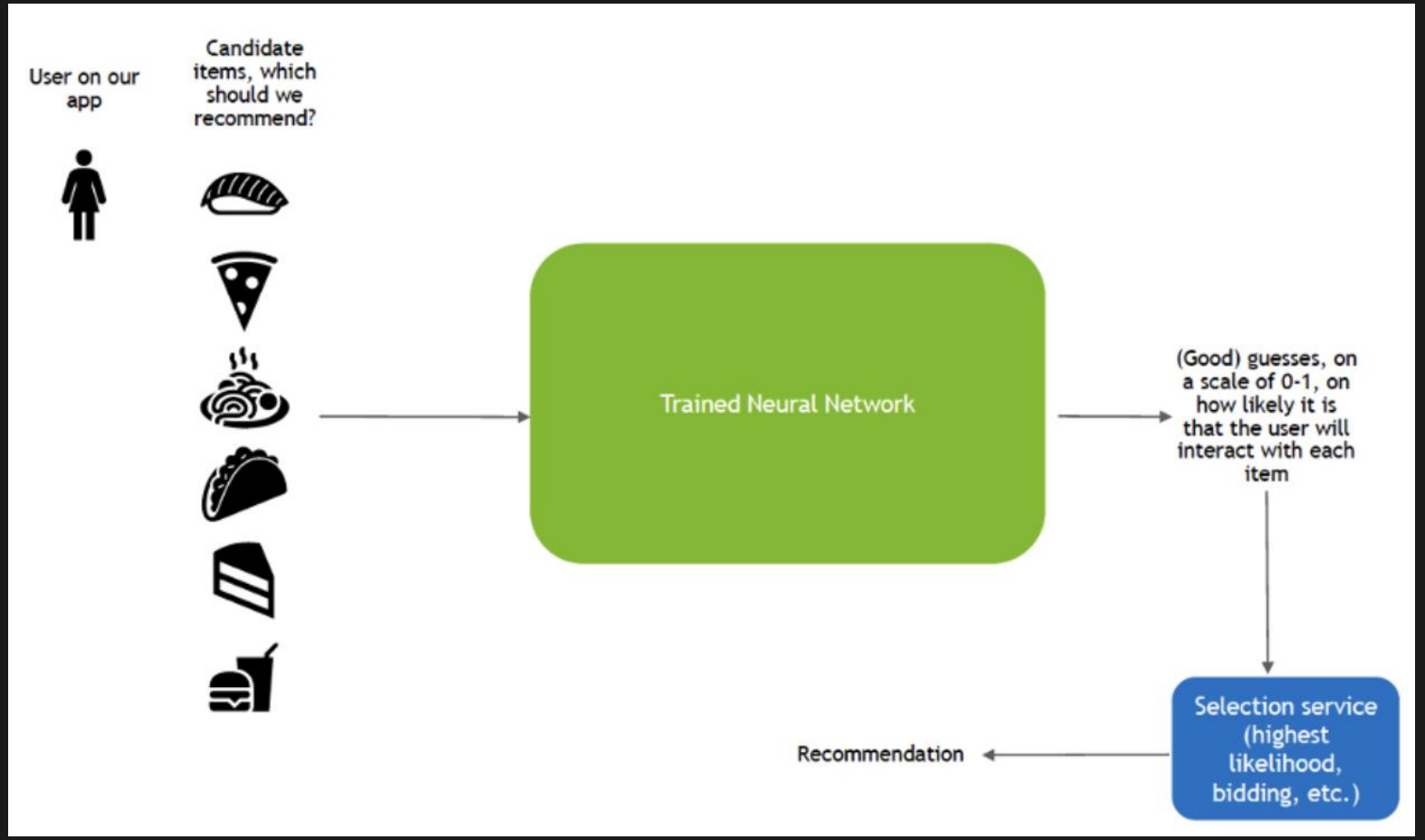


NVIDIA Developer Blog

Personenbezogenes Empfehlungssystem

Beispiele

Supervised Learning
Neural Network



NVIDIA Developer Blog

Personenbezogenes Empfehlungssystem

Beispiele

Supervised Learning
Other Examples

Support Vector Machine (SVM)

Logistic Regression

Decision Tree

Gradient Boosting Machines (GBM)

Naive Bayes

Random Forest

Einführung in Machine Learning.

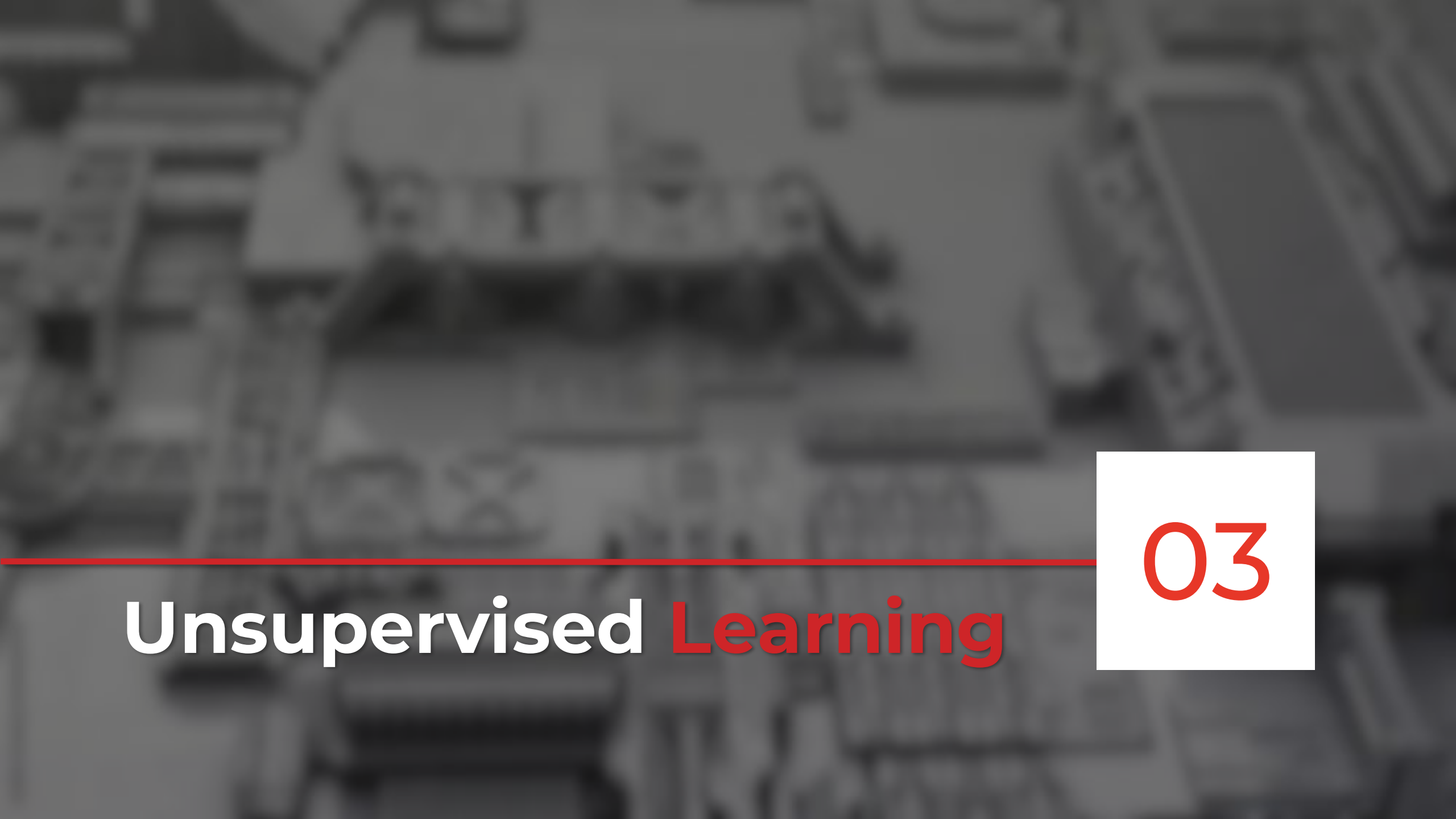
01 **Was ist Machine Learning?**

02 Supervised Learning

03 Unsupervised Learning

04 **Reinforcement Learning**

05 Zusammenfassung



Unsupervised Learning

03

Unsupervised Learning

Clustering

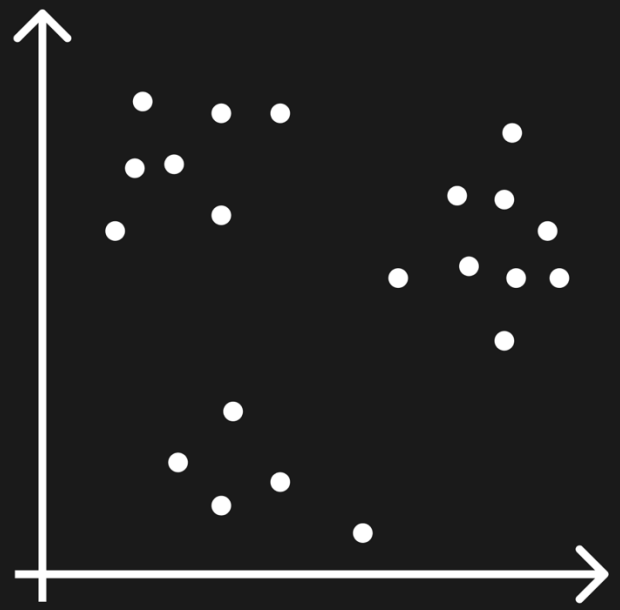
Association

Dimensionality Reduction

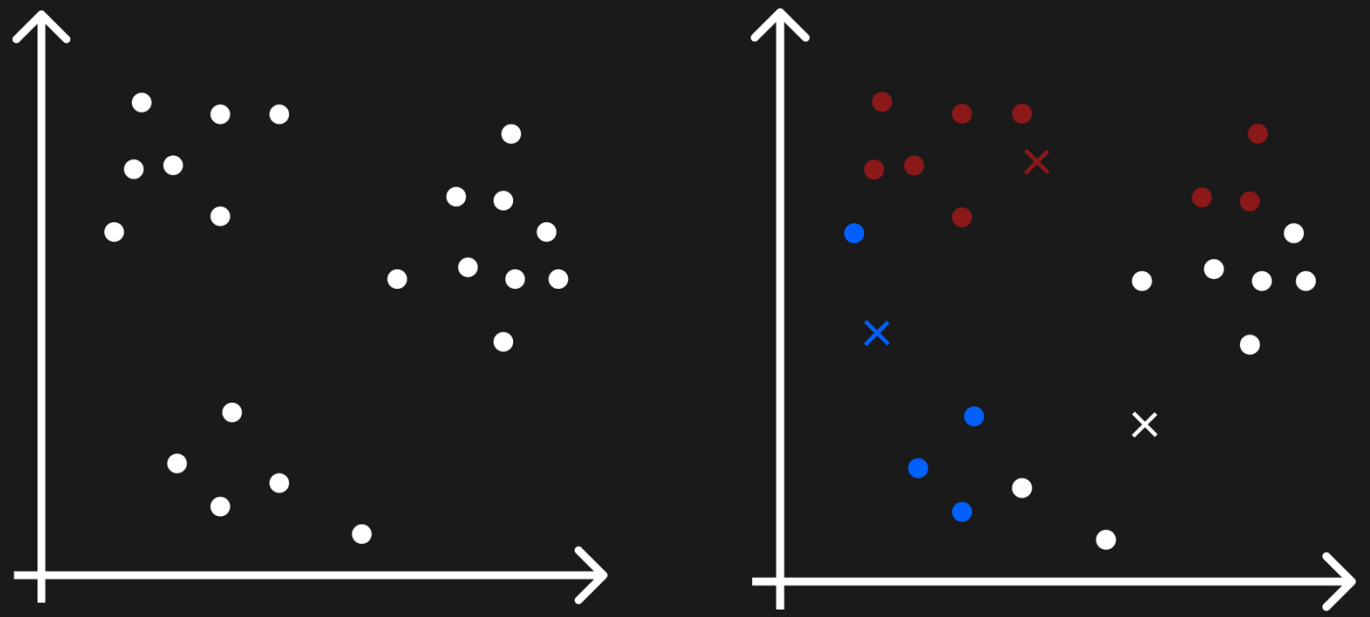
Unsupervised Learning

Clustering

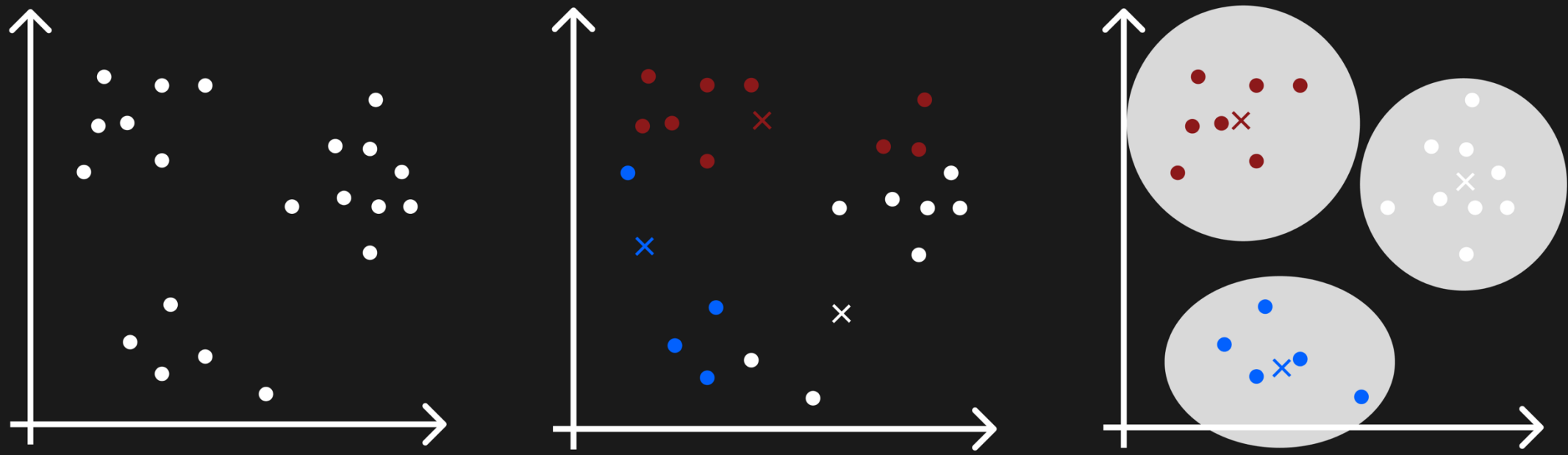
Unsupervised Learning
Clustering



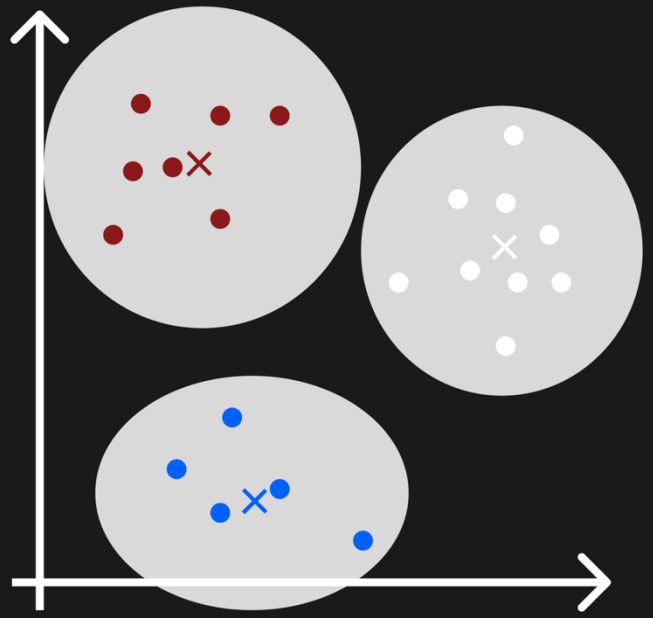
Unsupervised Learning
Clustering



Unsupervised Learning
Clustering



Unsupervised Learning
Clustering



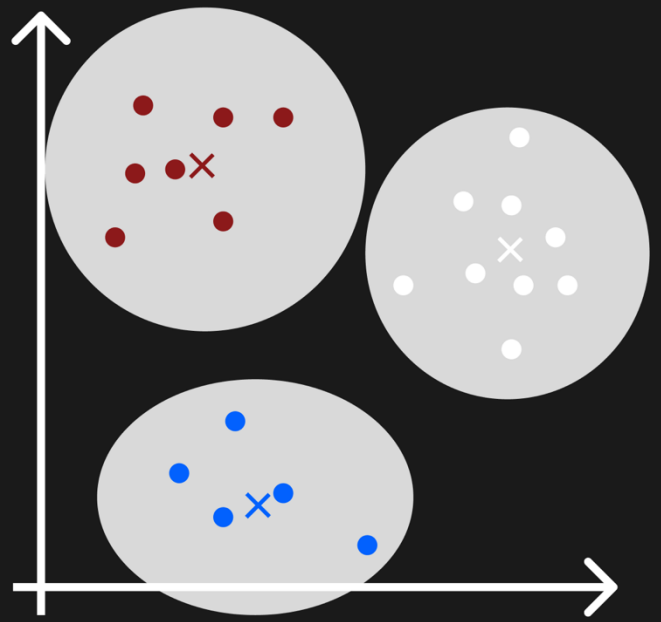
K-mean Clustering

- Zufällig K Zentren definieren
- Datenpunkte zu Zentren zuordnen
- Zentren anhand von Schwerpunkten neu positionieren
- Wiederholen bis Schwerpunkte konvergieren

Unsupervised Learning
Clustering

Cluster gefunden: Was nun?

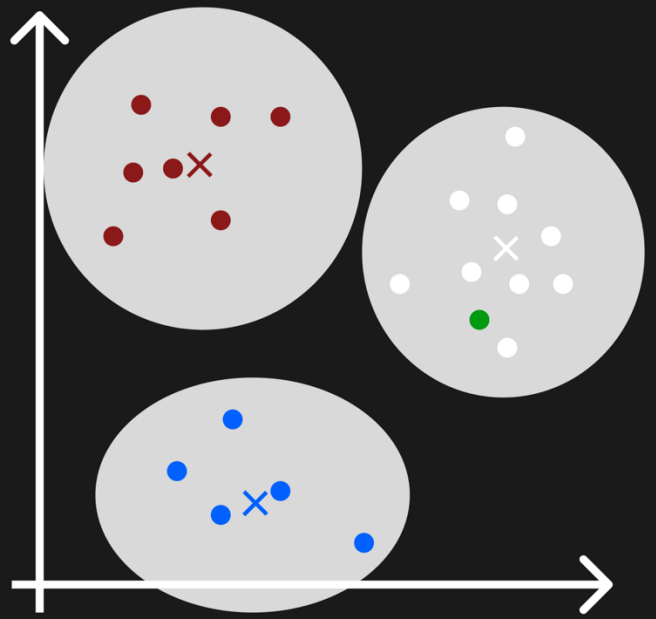
Unsupervised Learning
Clustering



Gruppierungen finden

Cluster gefunden: Was nun?

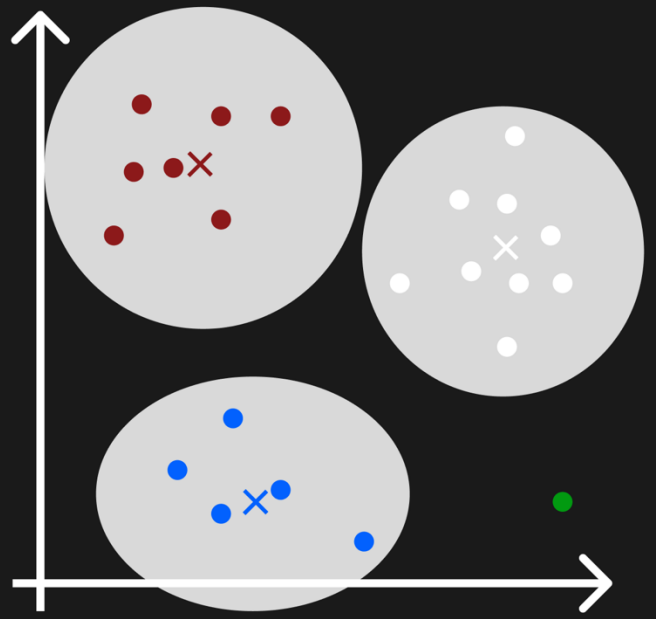
Unsupervised Learning
Clustering



Neue Datenpunkte schneller zuweisen

Cluster gefunden: Was nun?

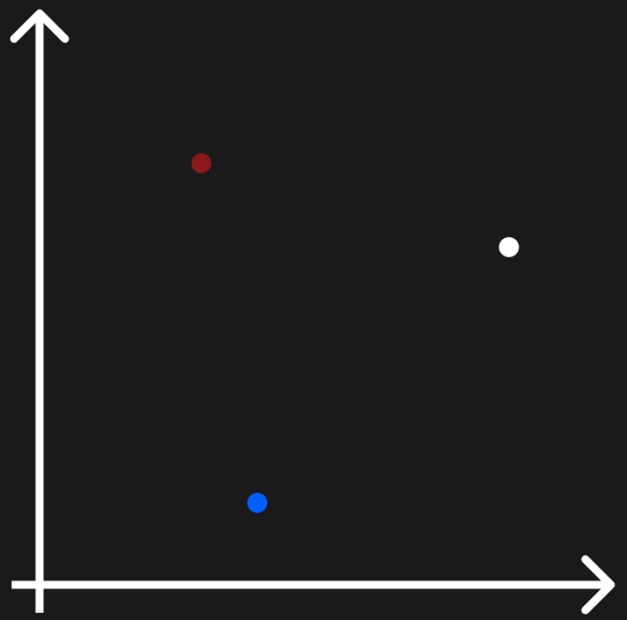
Unsupervised Learning
Clustering



Anomalien erkennen

Cluster gefunden: Was nun?

Unsupervised Learning
Clustering



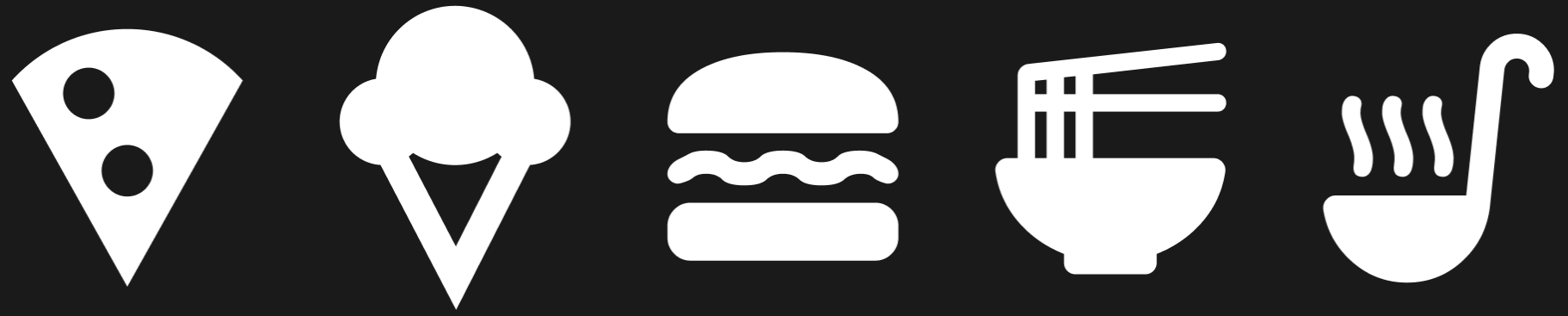
Daten komprimieren

Cluster gefunden: Was nun?

Unsupervised Learning

Association

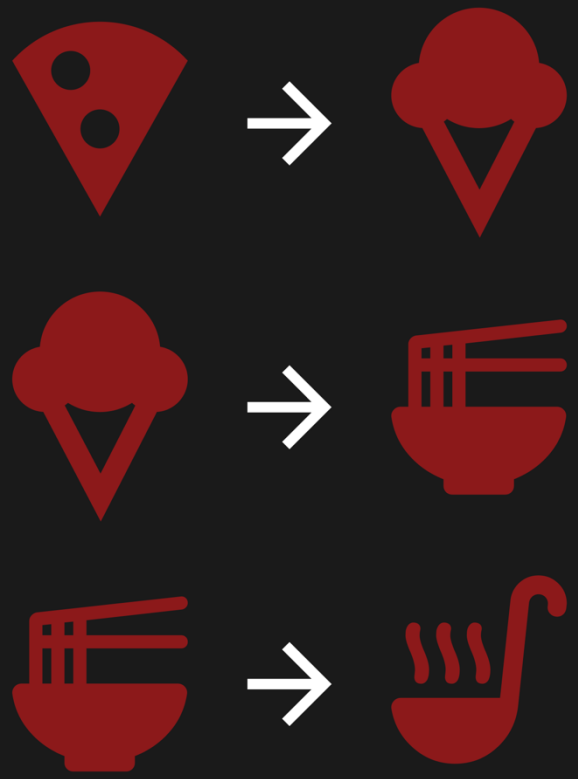
Unsupervised Learning
Association



Unsupervised Learning

Association

Unsupervised Learning
Association



Assoziationsregeln

- Support - Vorkommnisse im Datensatz
- Confidence - Genauigkeit im Datensatz
- Lift - Wahrscheinlichkeit in Relation zum Zufall

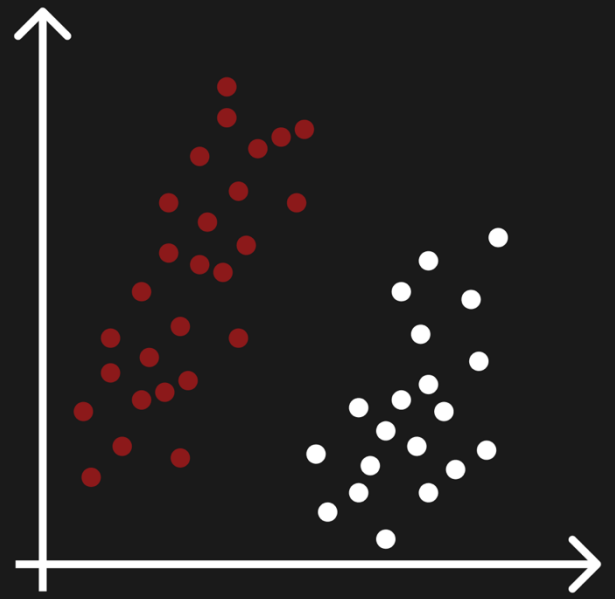
Unsupervised Learning
Association

Support: 50%
Confidence: 100%
Lift: 1.33

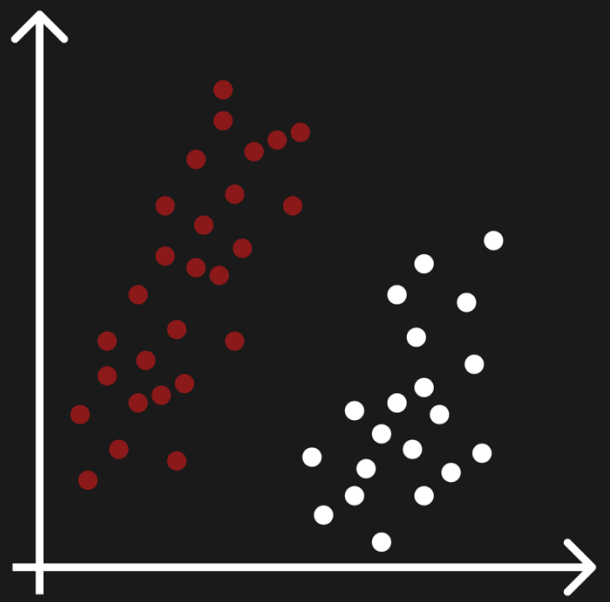
Unsupervised Learning

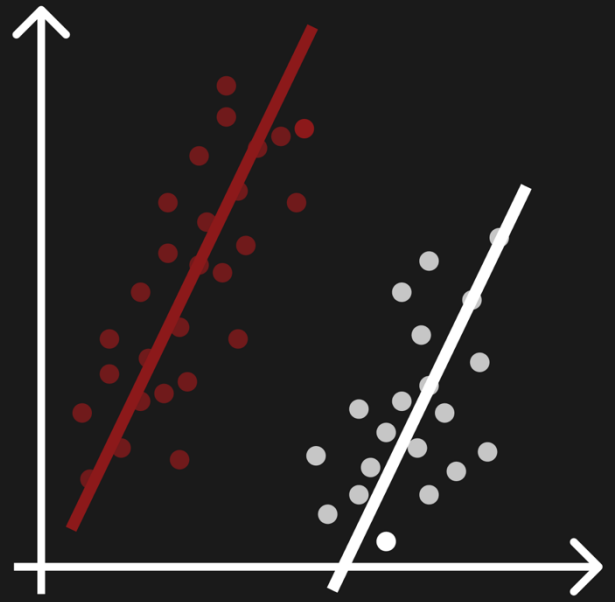
Dimensionality Reduction

Unsupervised Learning
Dimensionality Reduction



Unsupervised Learning
Dimensionality Reduction

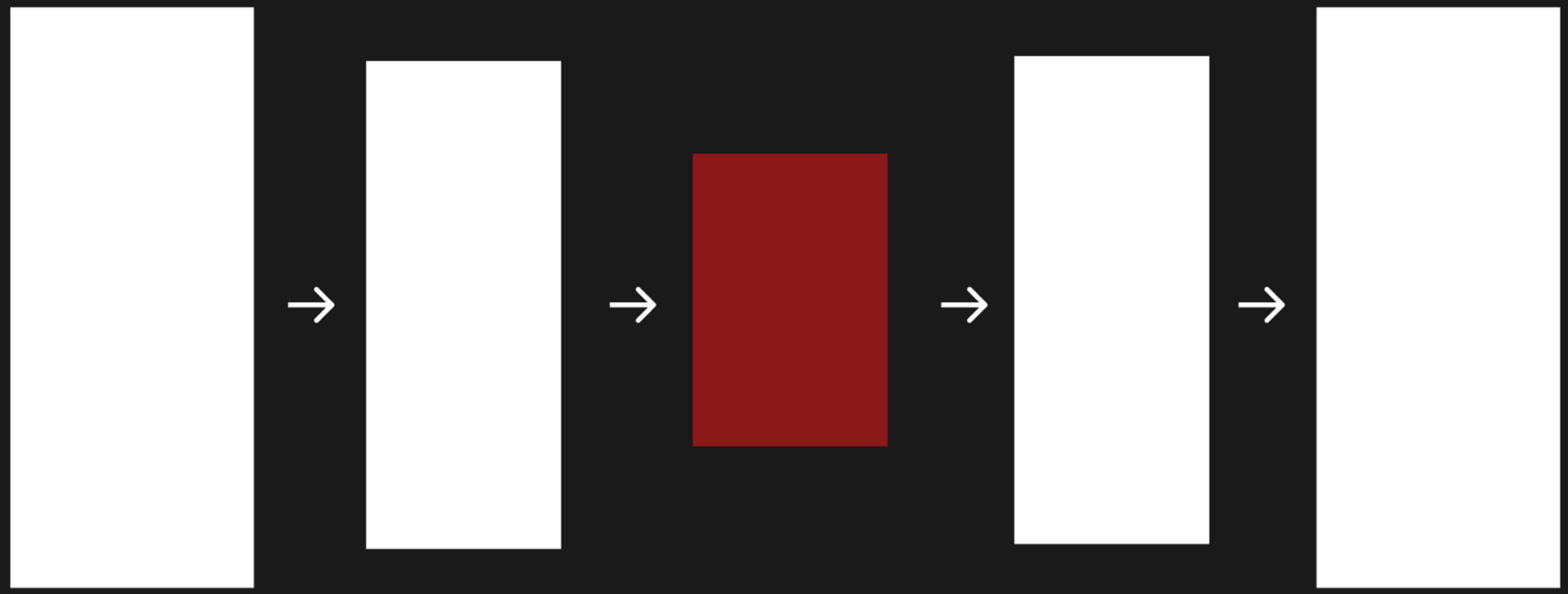




Unsupervised Learning
Dimensionality Reduction

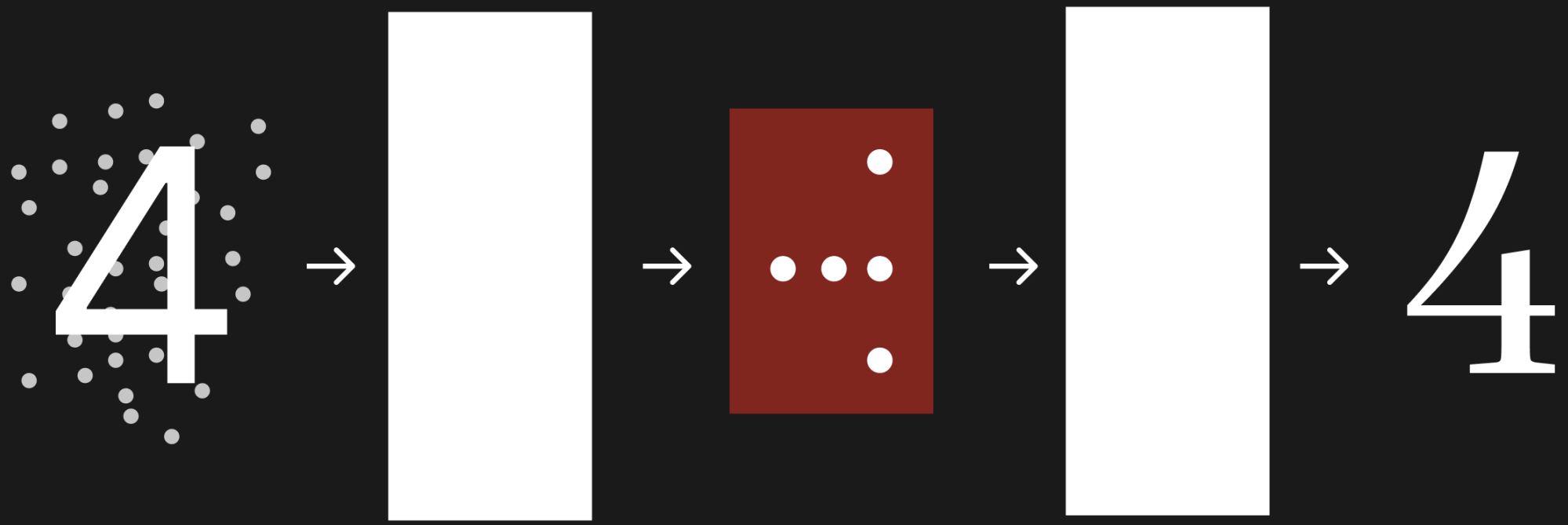
Autoencoder

Unsupervised Learning
Dimensionality Reduction



Autoencoder

Unsupervised Learning
Dimensionality Reduction



Autoencoder

Unsupervised Learning
Dimensionality Reduction

Einsatzgebiete

- Rauschreduzierung
- Bildkomprimierung
- Datenvorverarbeitung - Effizienteres Lernen
- Sprachverarbeitung

Unsupervised Learning
Dimensionality Reduction

Nachteile

- Informationen gehen verloren
- Hoher Rechenaufwand

Einführung in Machine Learning.

01 **Was ist Machine Learning?**

02 Supervised Learning

03 Unsupervised Learning

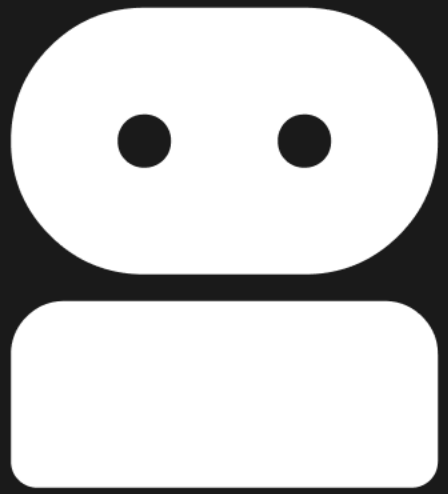
04 **Reinforcement Learning**

05 Zusammenfassung

Reinforcement Learning

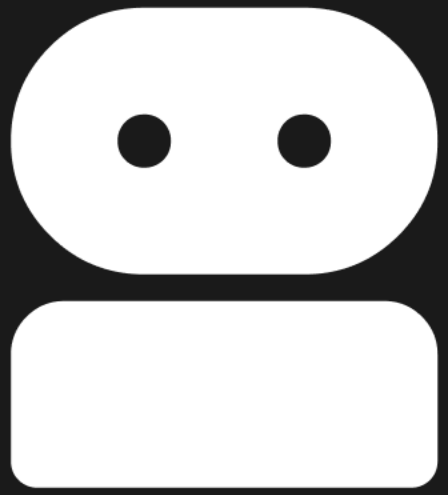
04

Reinforcement Learning

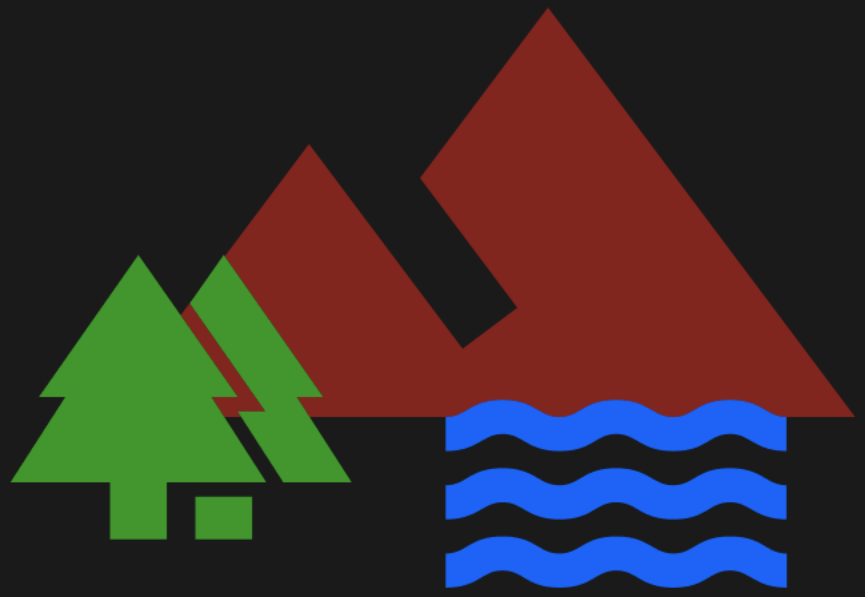


Agent

Reinforcement Learning

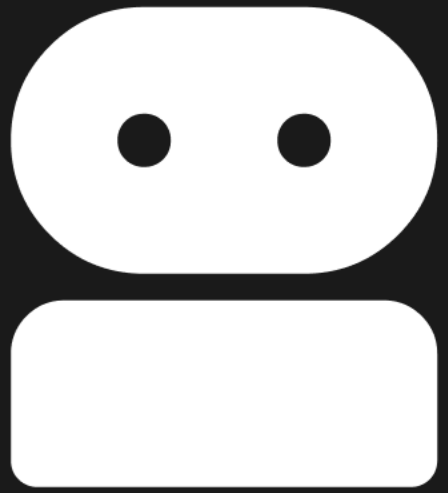


Agent



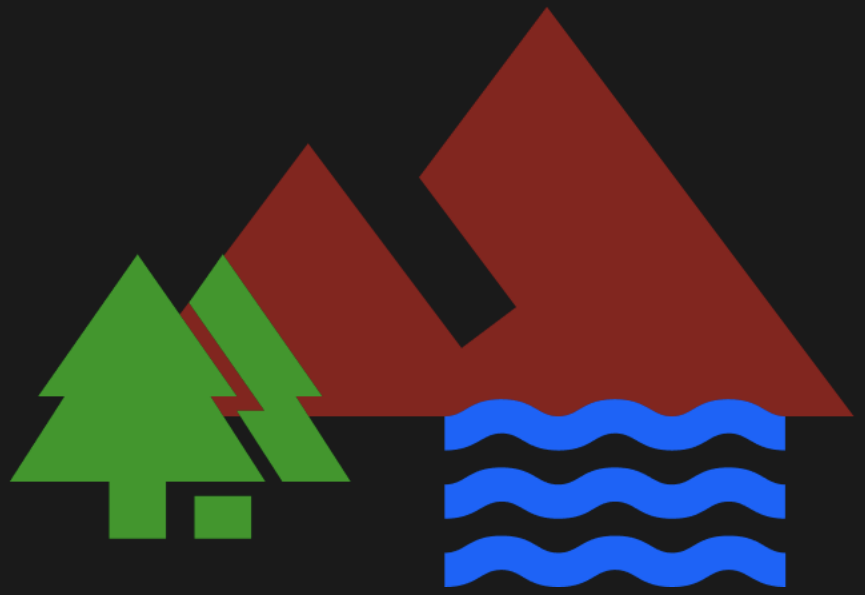
Environment

Reinforcement Learning



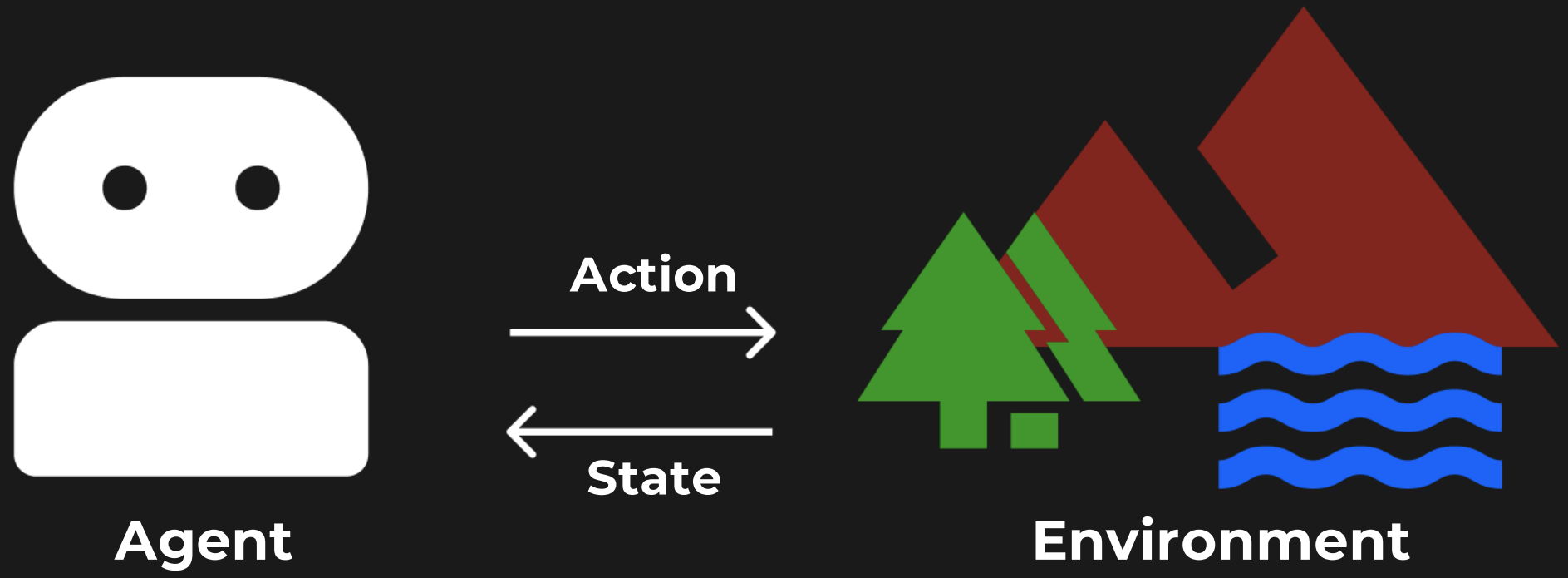
Agent

State

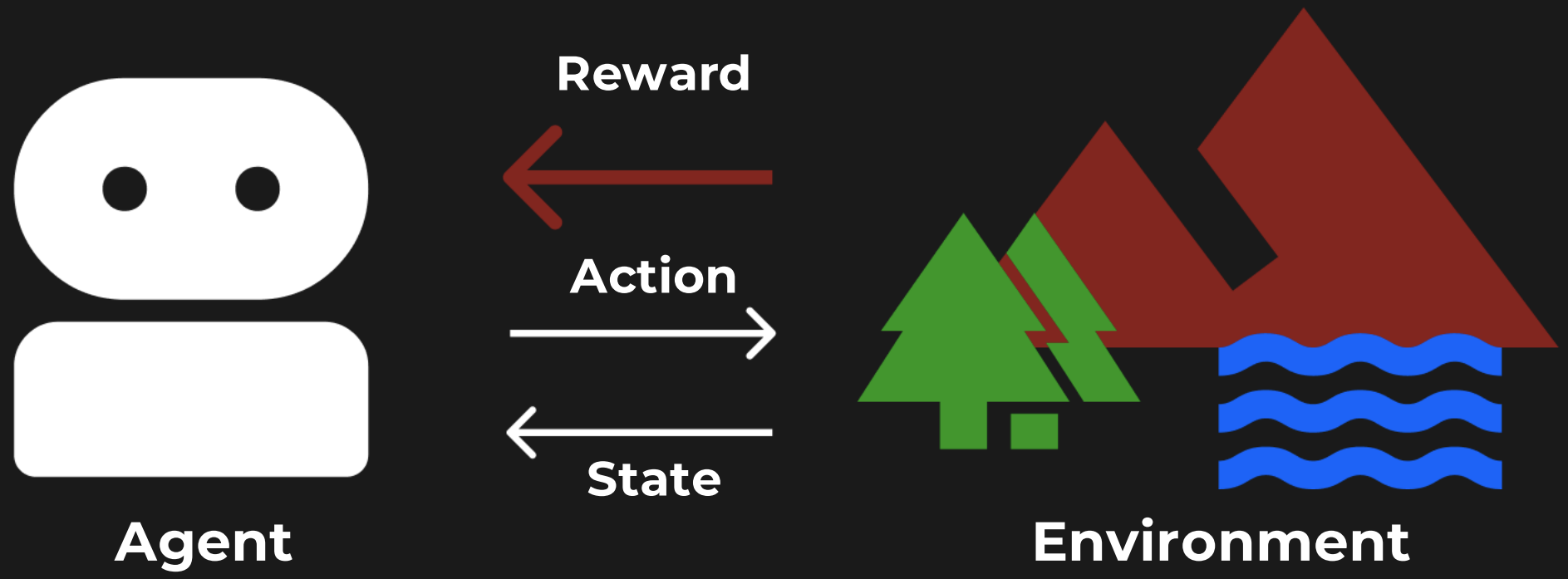


Environment

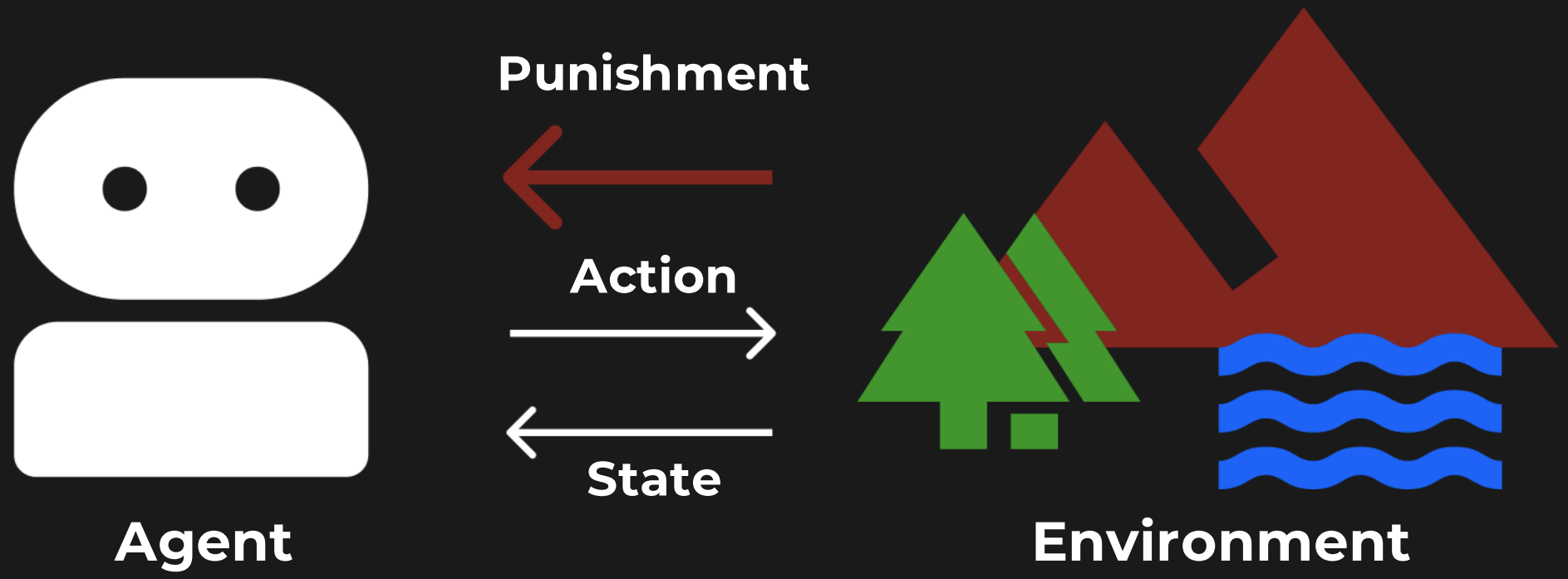
Reinforcement Learning



Reinforcement Learning



Reinforcement Learning

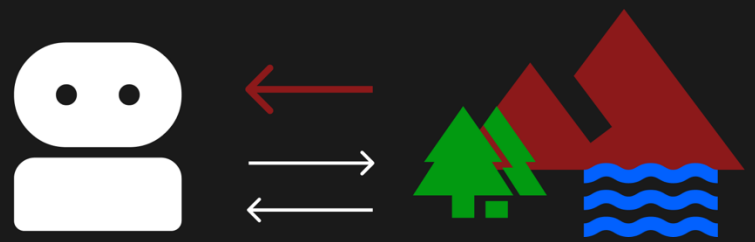


Reinforcement Learning

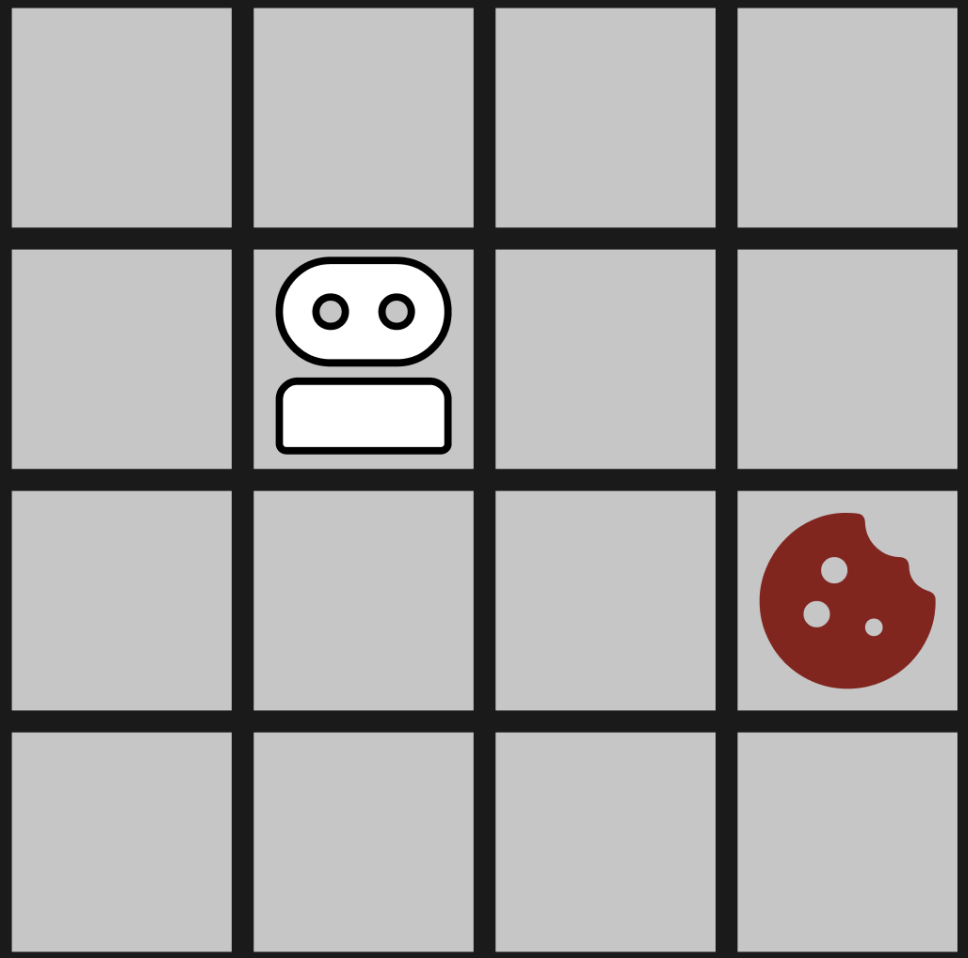
Maximiere die Belohnung

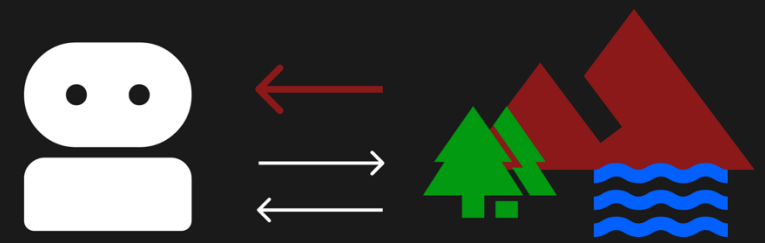
Reinforcement Learning

Trail and error

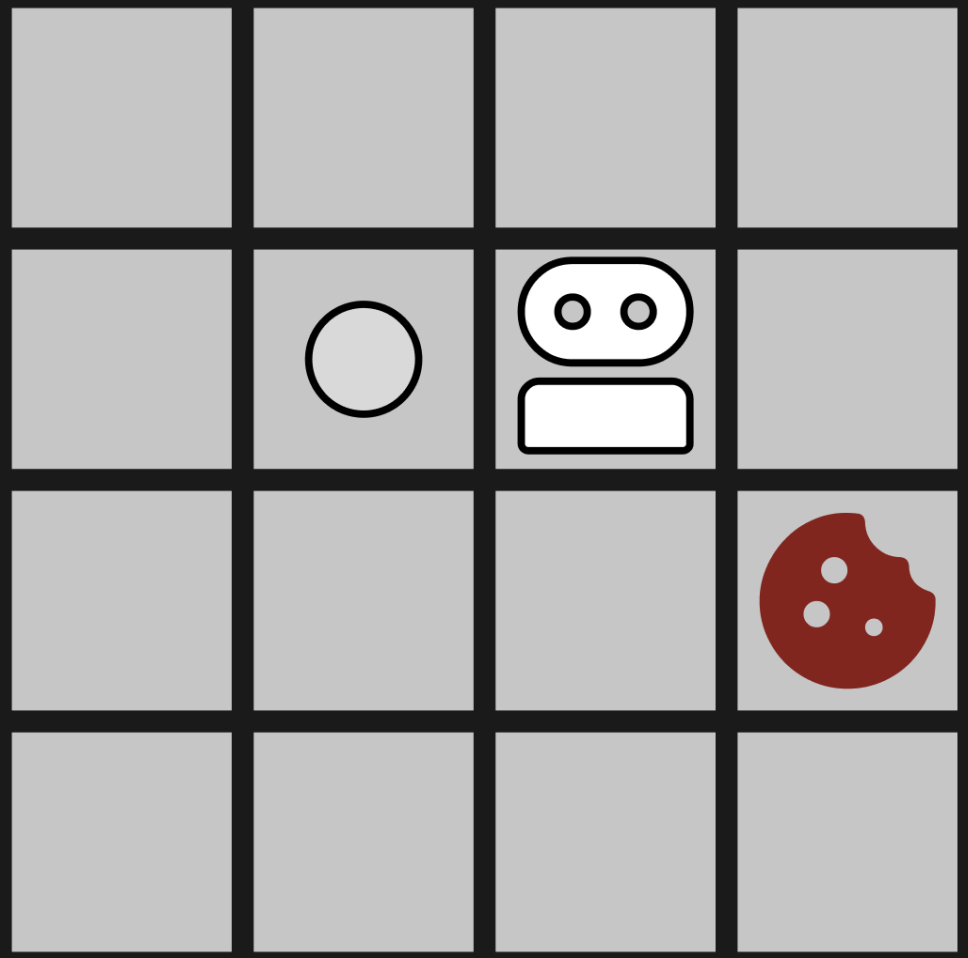


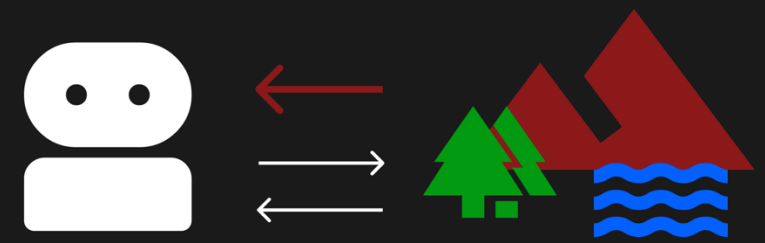
Reinforcement Learning



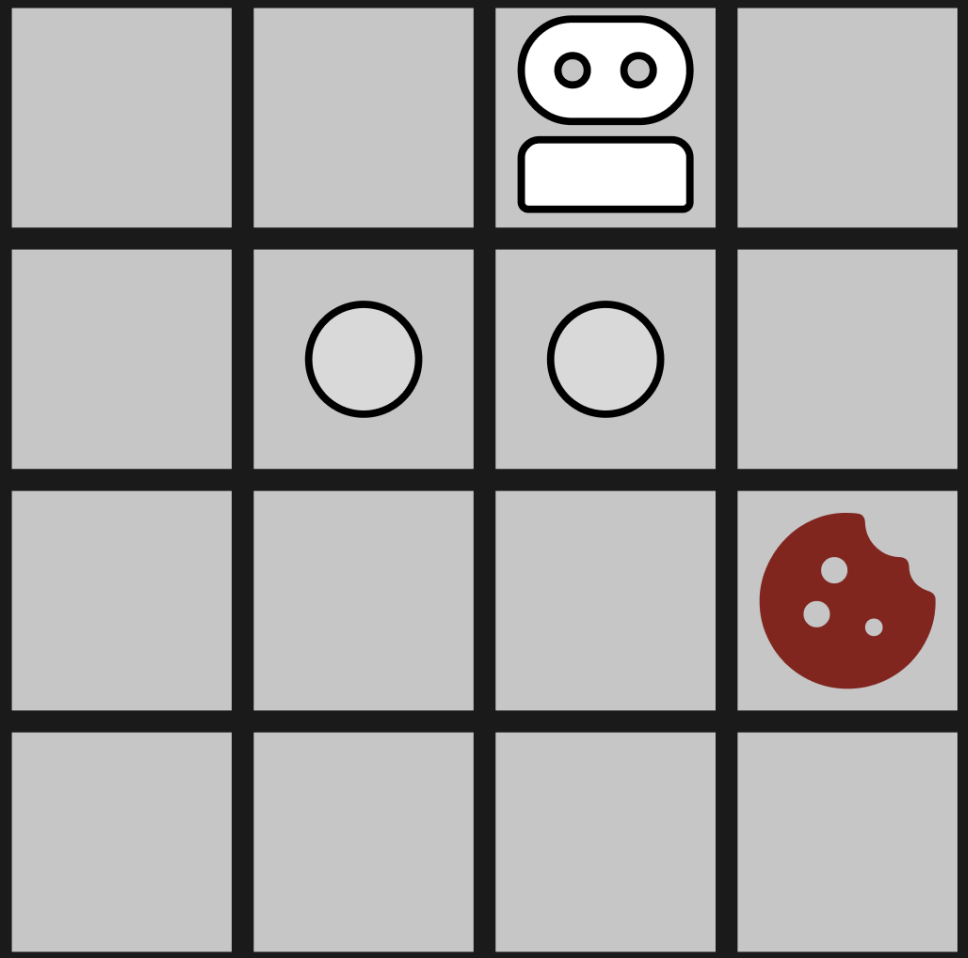


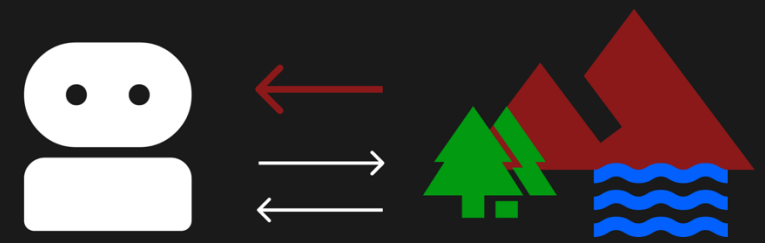
Reinforcement Learning



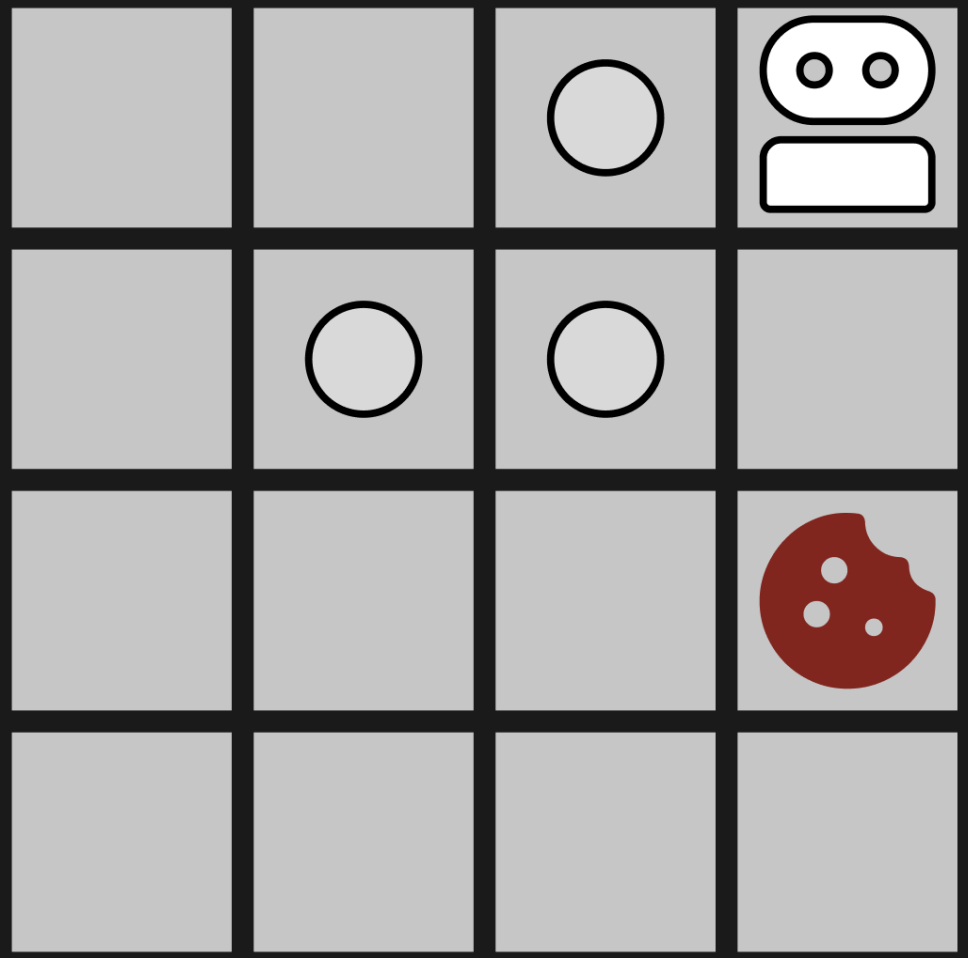


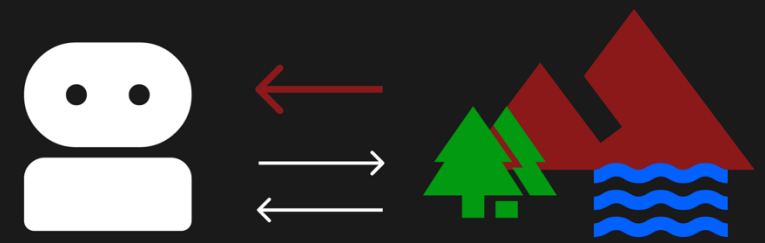
Reinforcement Learning



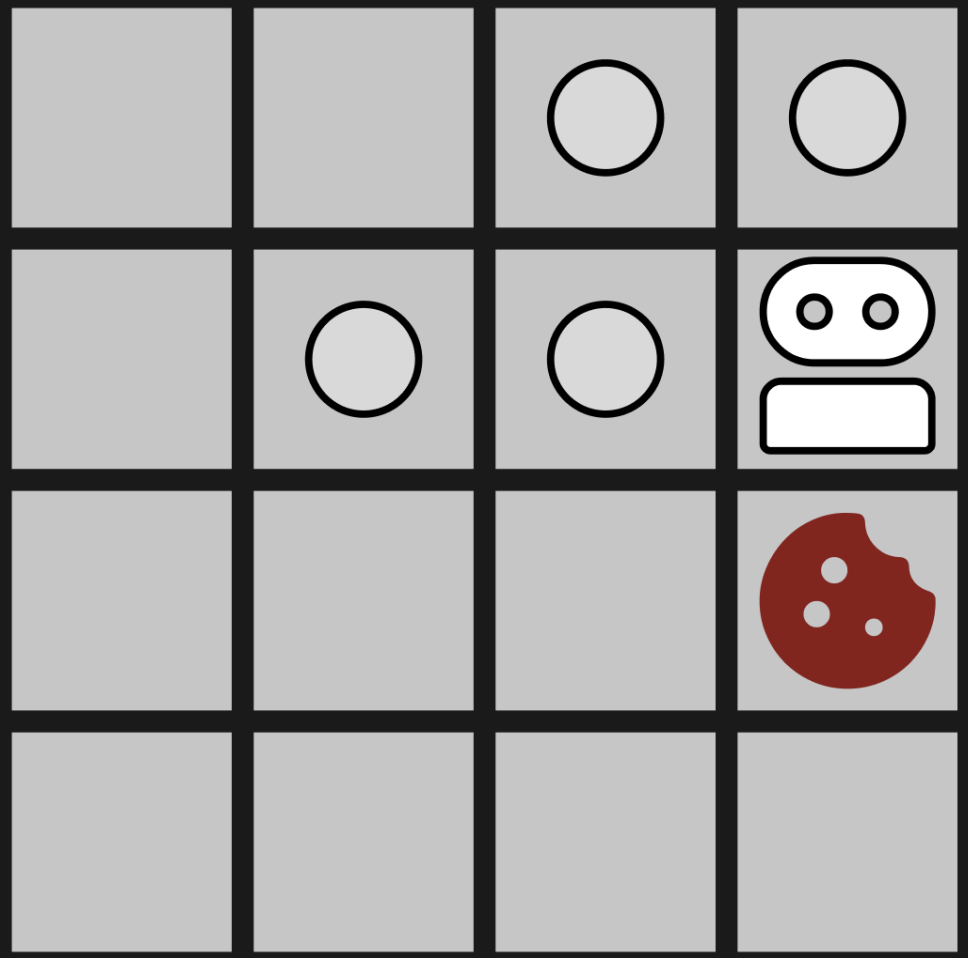


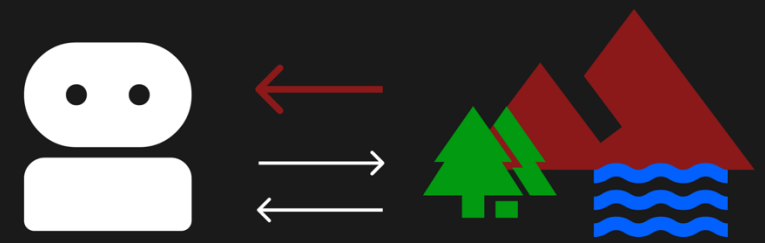
Reinforcement Learning



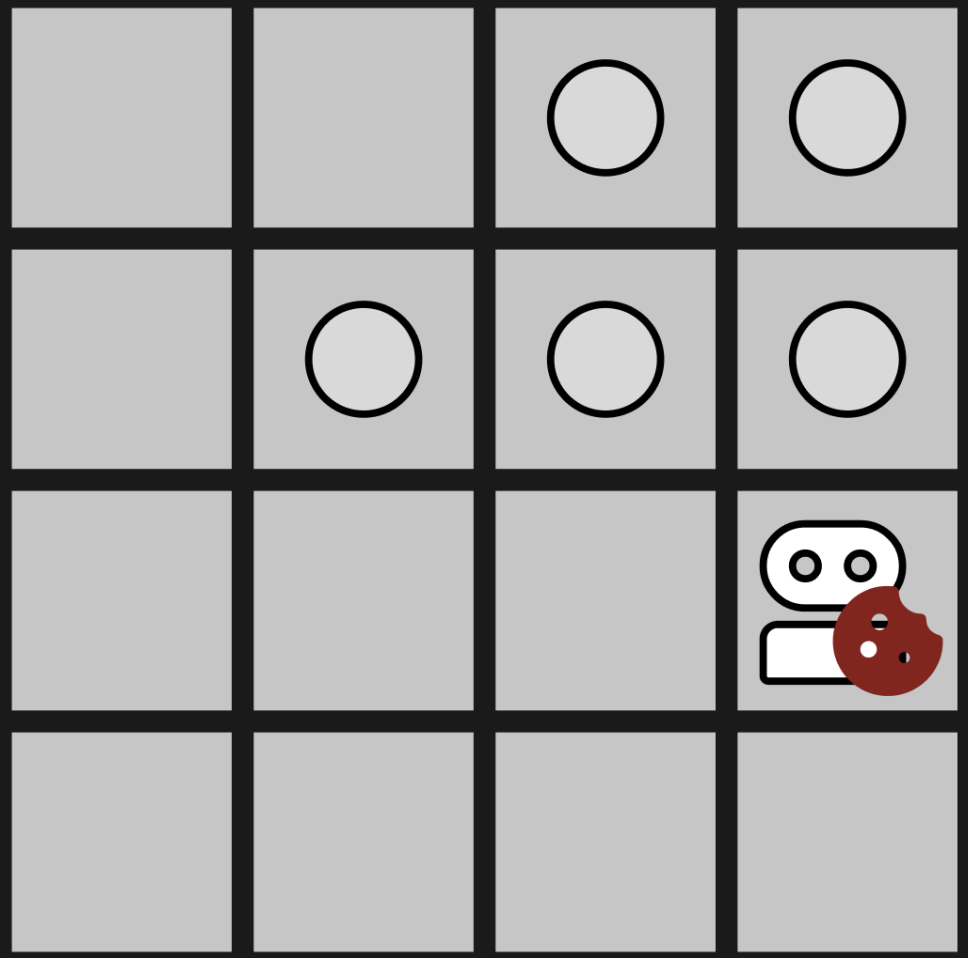


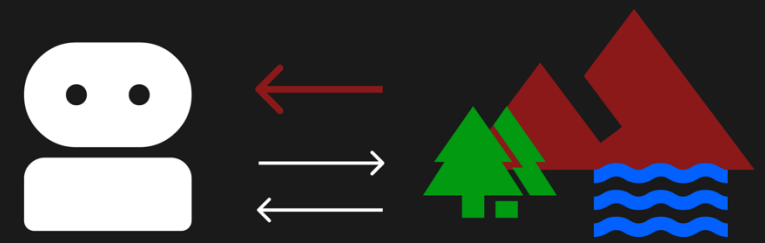
Reinforcement Learning



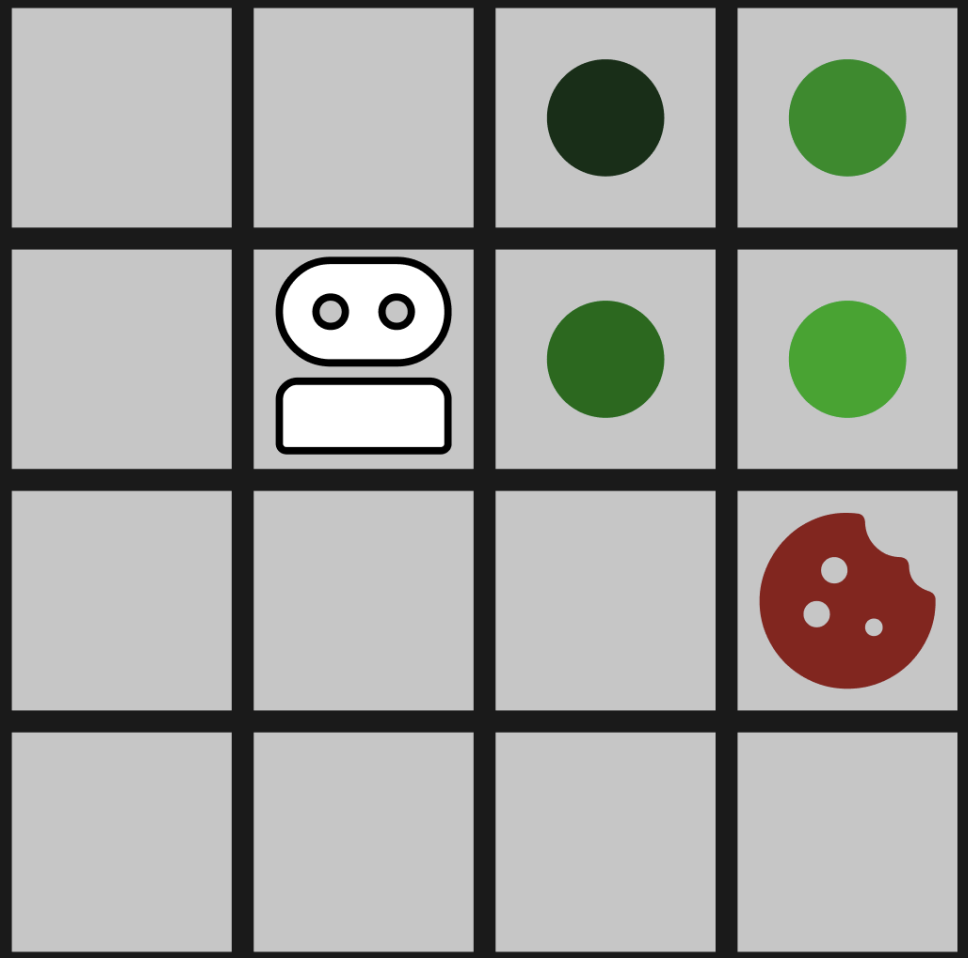


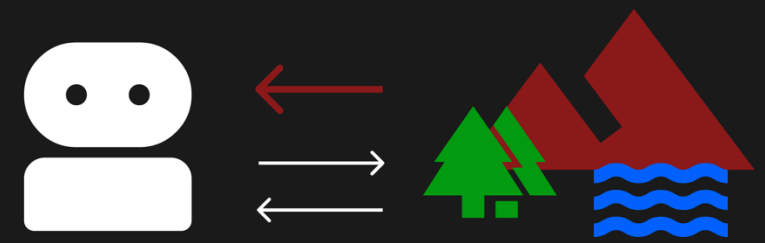
Reinforcement Learning



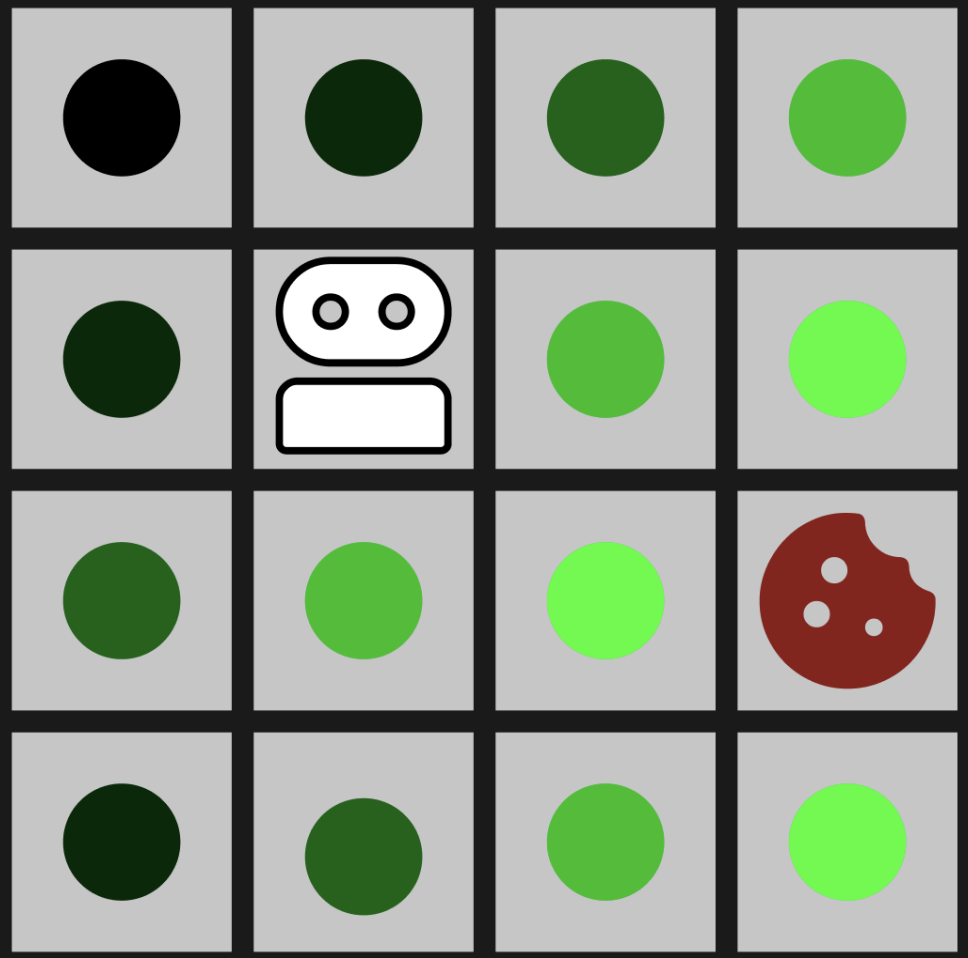


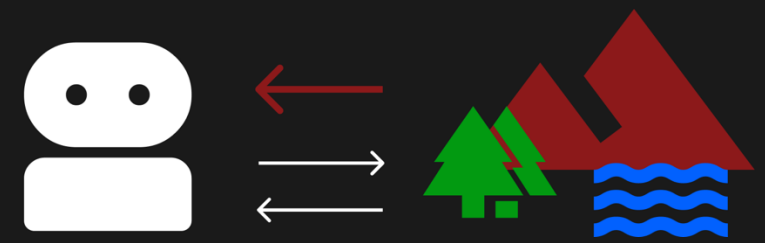
Reinforcement Learning



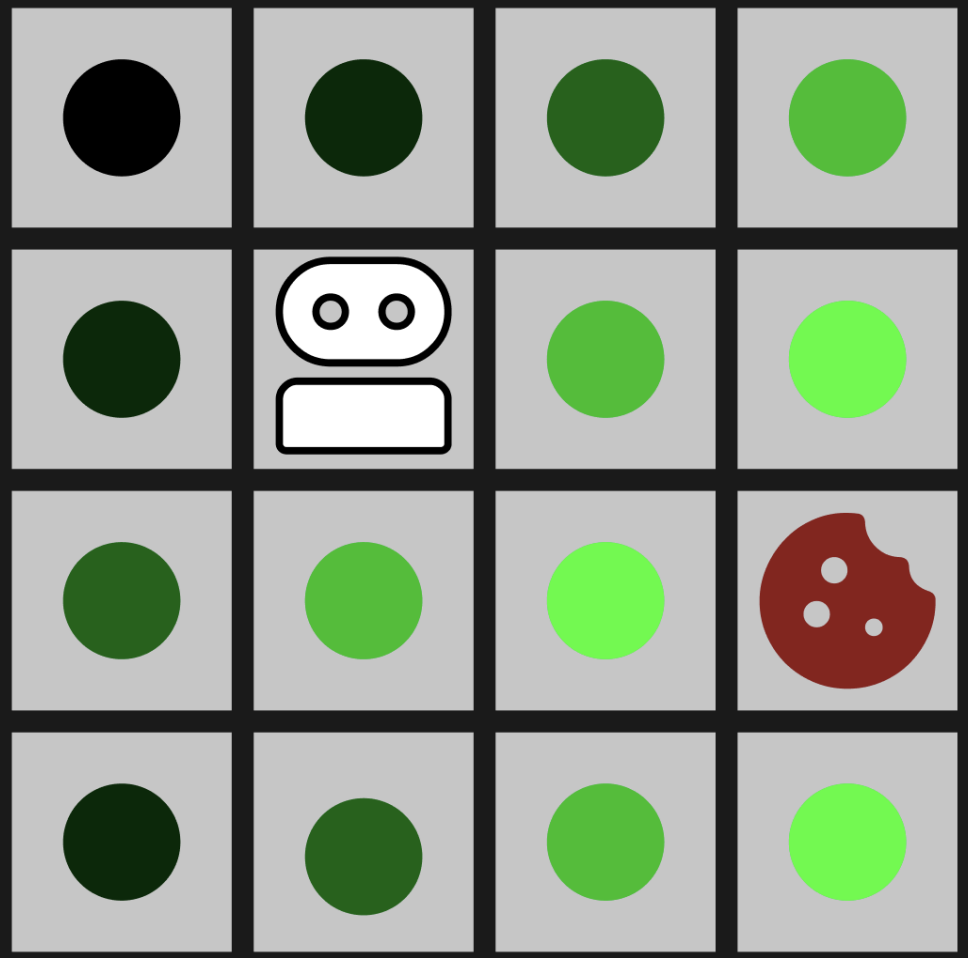


Reinforcement Learning



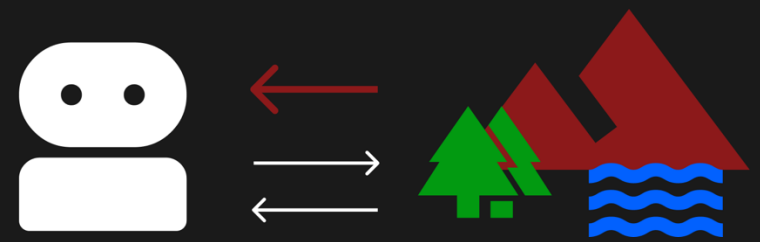


Reinforcement Learning



Policy

- Q-Table
- Deep-Q-Learning



Reinforcement Learning

Einsatzgebiete

- Autonomes Fahren
- NPCs
- Automatisierung von Robotern
- Trading-Strategien

Einführung in Machine Learning.

01 **Was ist Machine Learning?**

02 Supervised Learning

03 Unsupervised Learning

04 **Reinforcement Learning**

05 Zusammenfassung

Zusammenfassung

05

Zusammenfassung

- Was ist AI? Was ist ML? Was ist DL?
- Supervised Learning
  - Regression vs. Classification
- Unsupervised Learning
  - Clustering
  - Association
  - Dimensionality Reduction
- Reinforcement Learning

Weiterführende Literatur

https://blogs.nvidia.com/blog/tag/machine-learning/

https://www.3blue1brown.com/topics/neural-networks

https://www.ibm.com/topics/artificial-intelligence

https://scikit-learn.org/stable/user_guide.html

Machine Learning - Tom M. Mitchell, 1997

Deep Learning - Ian Goodfellow & Yoshua Bengio & Aaron Courville, 2016

Reinforcement Learning - An Introduction second edition - Richard S. Sutton & Andrew G. Barto, 2020

VIELEN DANK!