AI ARTIFICIAL INTELLIGENCE AN INTRODUCTION

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ARTIFICIAL INTELLIGENCE

Introduction

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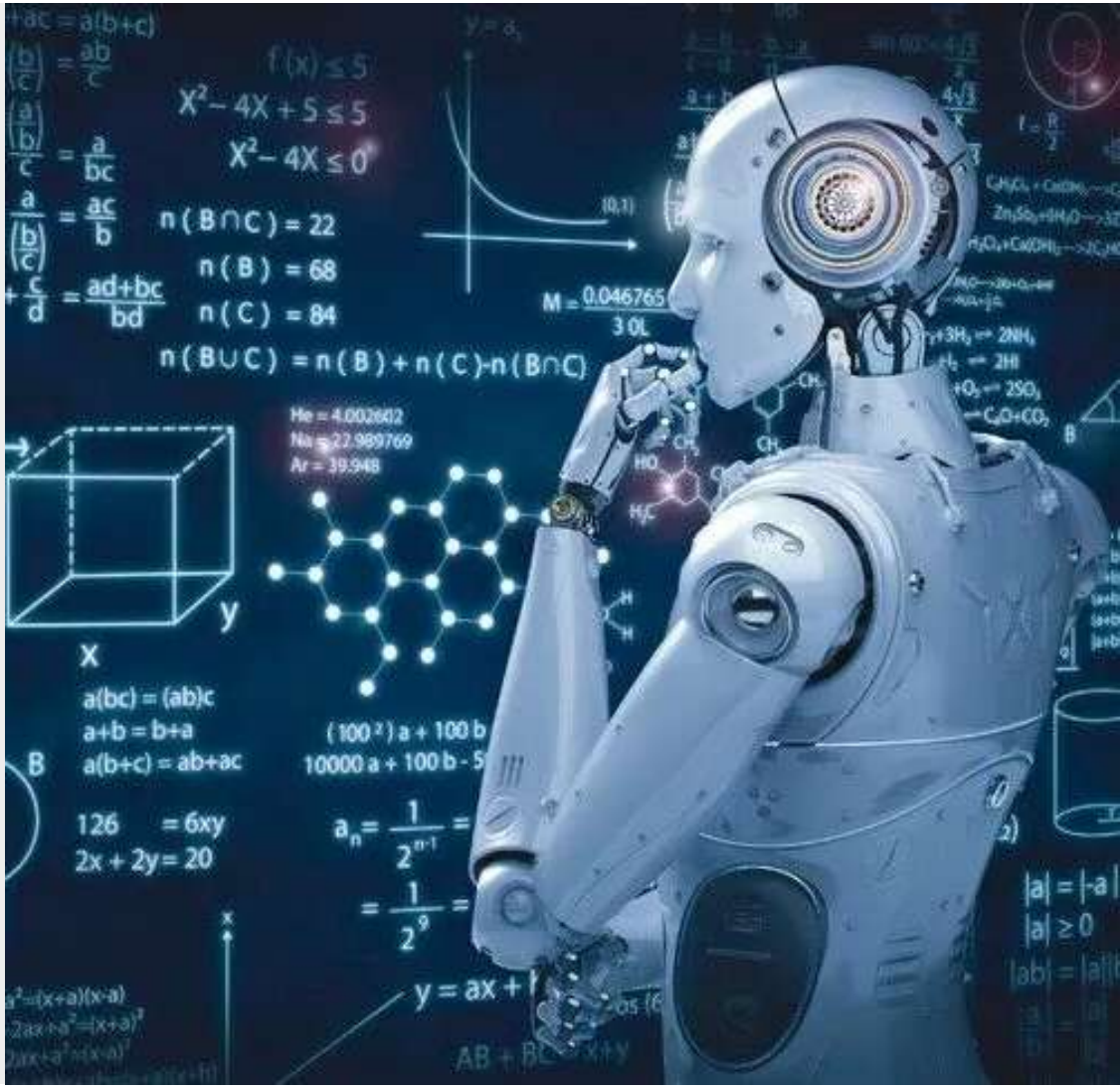

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DEFINITION OF INTELLIGENCE

Introduction to Artificial Intelligence

Definition of intelligence: Intelligence is a complex property of a living being that allows it to acquire, understand and apply knowledge, solve problems and learn from experience.

Definition of artificial intelligence: Artificial intelligence refers to the ability of machines to perform tasks that normally require human intelligence.

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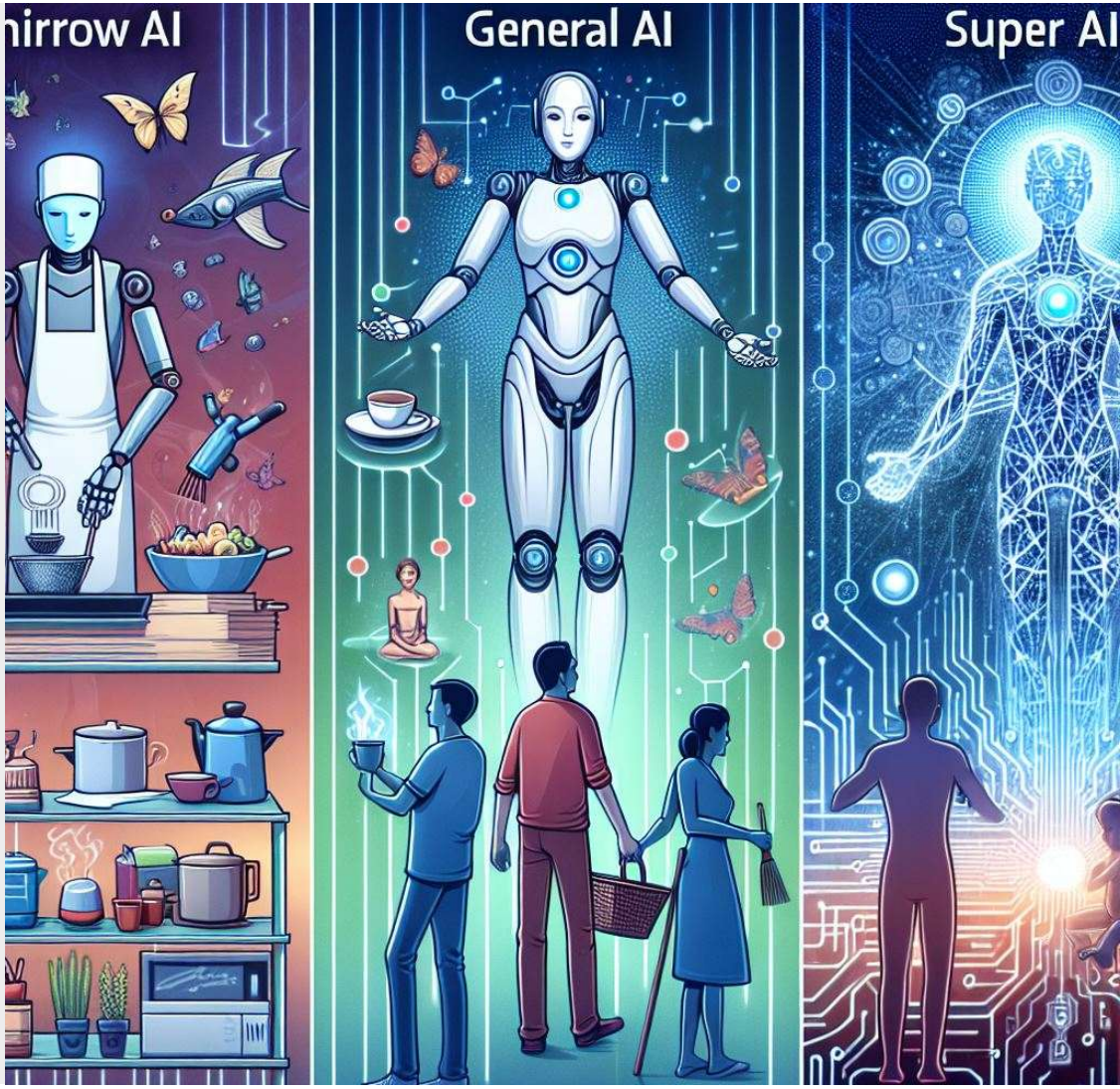
TYPES OF AI

Introduction to Artificial Intelligence

Weak AI: Also known as narrow AI, it focuses on specific tasks, such as speech recognition, image processing, and Chatpots.

Strong or general AI: Abilities correspond to those of the human mind. It could learn and understand independently and react intelligently to different situations.

Superintelligence: Outperforms human intelligence in almost all areas.



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ORIGINS AND EARLY DEVELOPMENTS

History of Artificial Intelligence

17th century: René Descartes speculates on mechanical thinking machines.

1842: Ada Lovelace recognises the potential of computers for more than just arithmetic tasks.

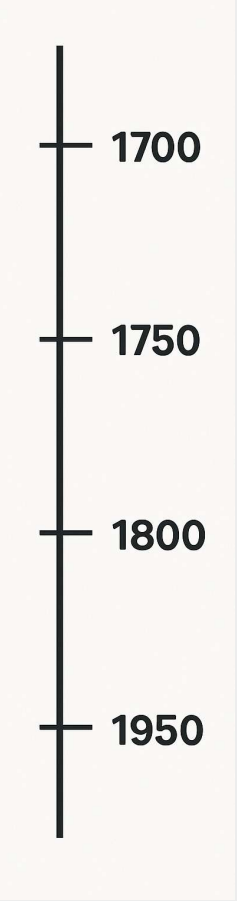
1860s: George Boole develops Boolean algebra, a basis for logical machines.

1914: Leonardo Torres Quevedo builds an electromechanical chess machine.

1936: Alan Turing describes the "Turing machine" – a theoretical model for calculations.

1943: McCulloch & Pitts develop the first model of artificial neurons.

1949: Donald Hebb describes Hebb's rule of learning ("Neurons that fire together, wire together").



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EARLY AI DEVELOPMENT (1950ER–1990ER)

History of Artificial Intelligence

1950: Alan Turing introduces the "Turing Test".

1956: Dartmouth Conference – Birth of AI as a field of research.

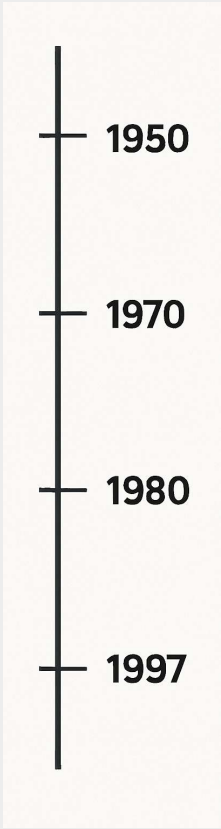
1966: ELIZA – first AI-powered chat program.

1970s: First "AI winter" – lack of progress leads to less funding.

1980s: Development of expert systems and neural networks.

1987: Second "AI winter" due to limited computing power.

1997 – IBM Deep Blue defeats World Chess Champion Garry Kasparov.



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MILESTONES IN AI DEVELOPMENT

History of Artificial Intelligence

Data-driven AI (2000s–2010s)

2011: IBM Watson wins "Jeopardy!".

2012: AlexNet revolutionises deep learning with Convolutional Neural Networks (CNNs).

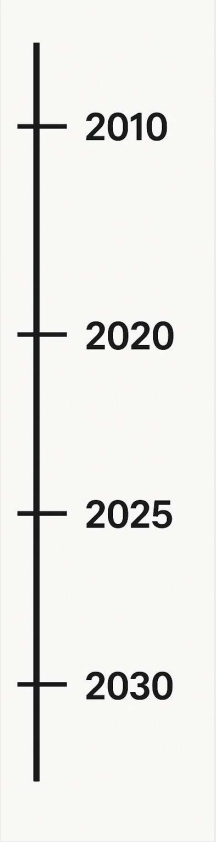
2016: AlphaGo by DeepMind defeats Go master Lee Sedol.

Modern AI Era (2020s)

2020: GPT-3 revolutionises natural language processing.

2022: ChatGPT and DALL· E bring AI-generated content into the mainstream.

2023+: Autonomous AI systems, AI-assisted medicine, and generative models continue to evolve.



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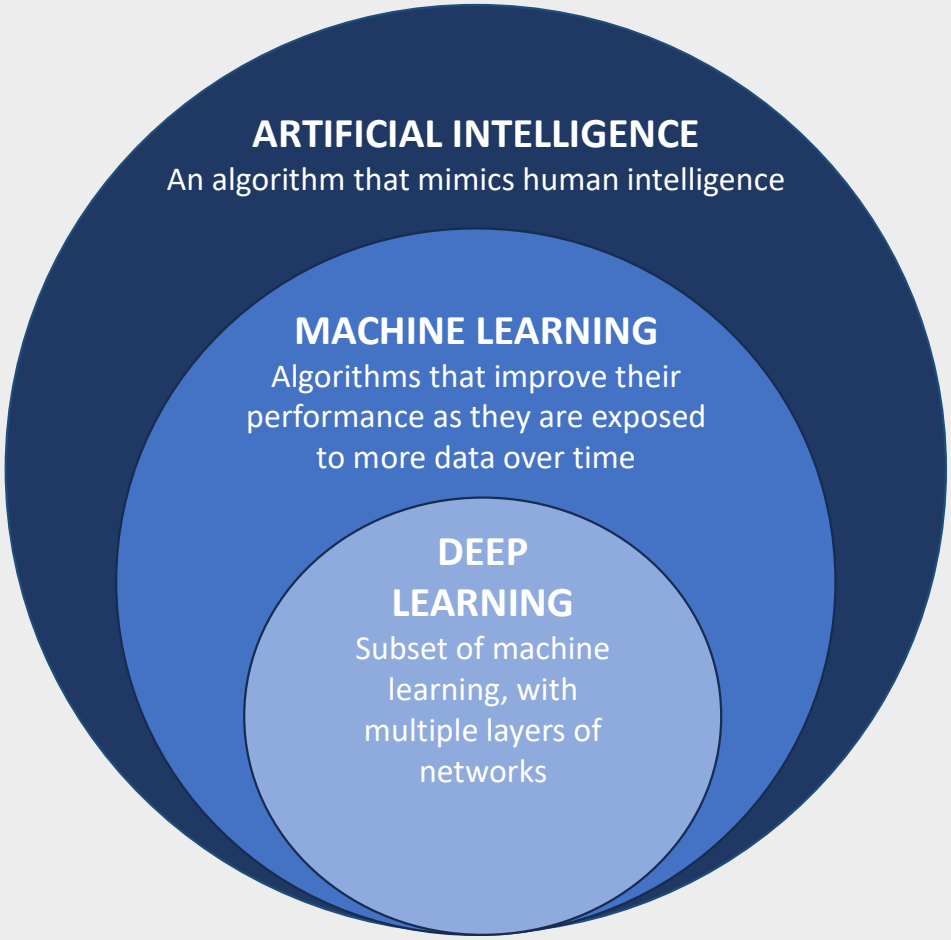
MACHINE LEARNING VS. DEEP LEARNING

Basics of Artificial Intelligence

Machine learning belongs to the category of artificial intelligence.

Deep learning is a specific variant of machine learning.

Application examples: Identification of objects in images and natural language processing.



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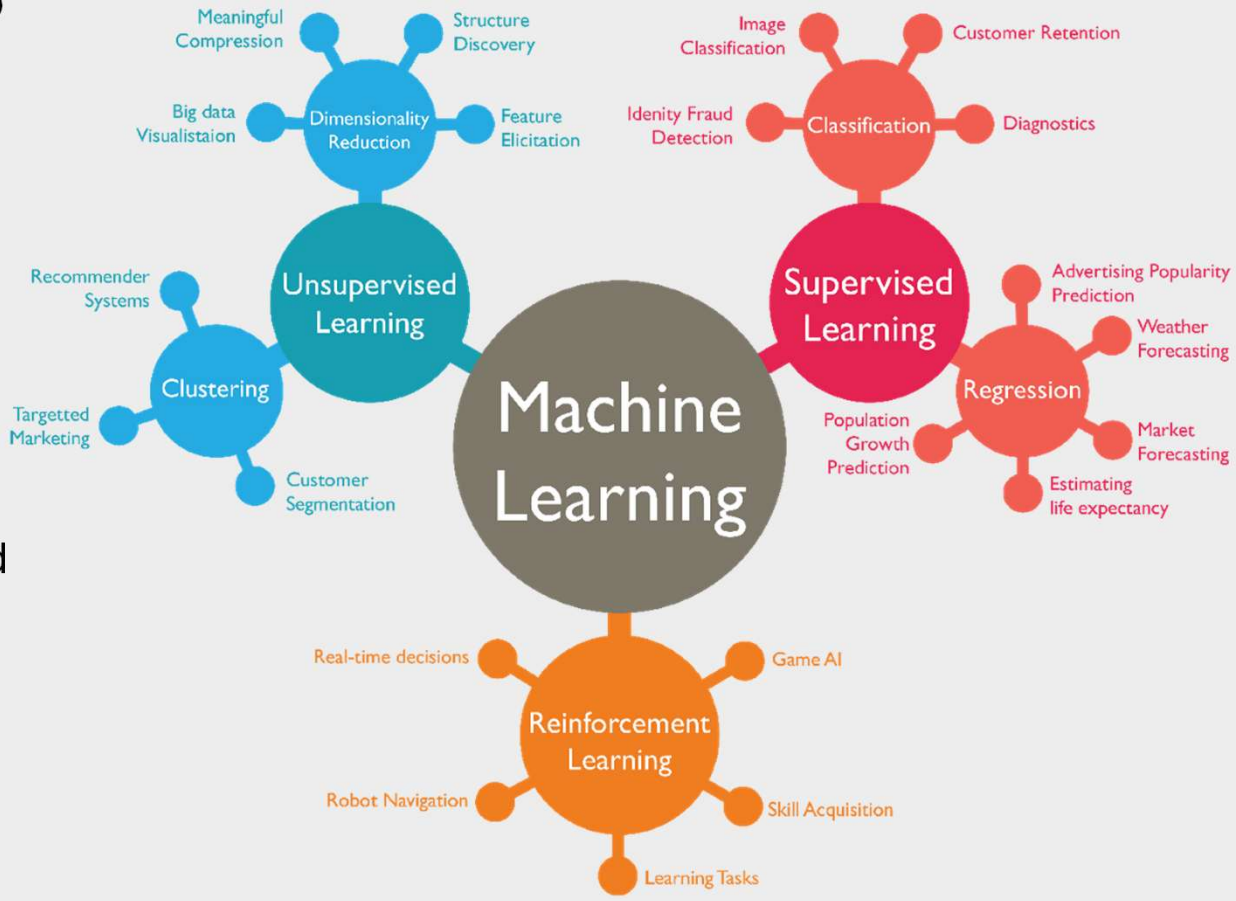
TYPES OF LEARNINGS

Basics of Artificial Intelligence

Supervised learning uses labelled data where both the inputs and the associated outputs are known.

Unsupervised learning works with unlabelled data where the outputs are unknown.

Reinforcement learning, through trial and error and interaction with the environment.



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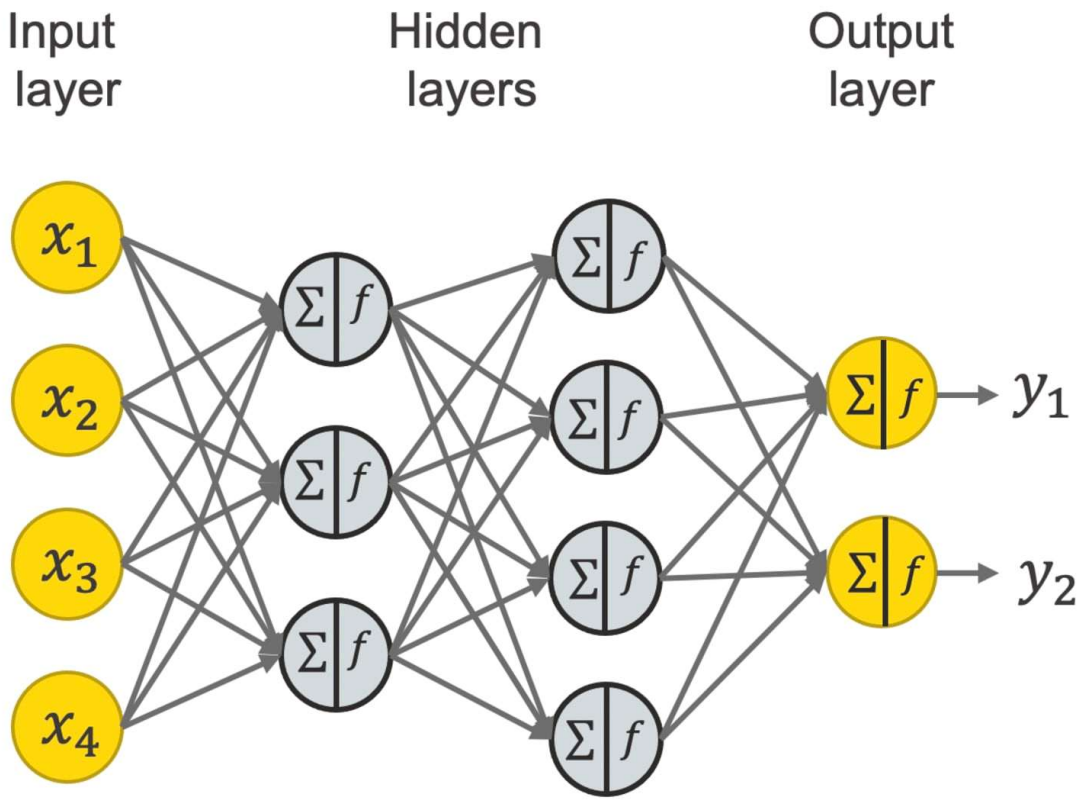
NEURAL NETWORKS AND HOW THEY WORK

Basics of Artificial Intelligence

Input layer takes the input data and passes it on to the next layer.

Hidden layers processing of input data, can consist of several layers.

Output layer provides the end result of the network, based on the processing in the hidden layers.



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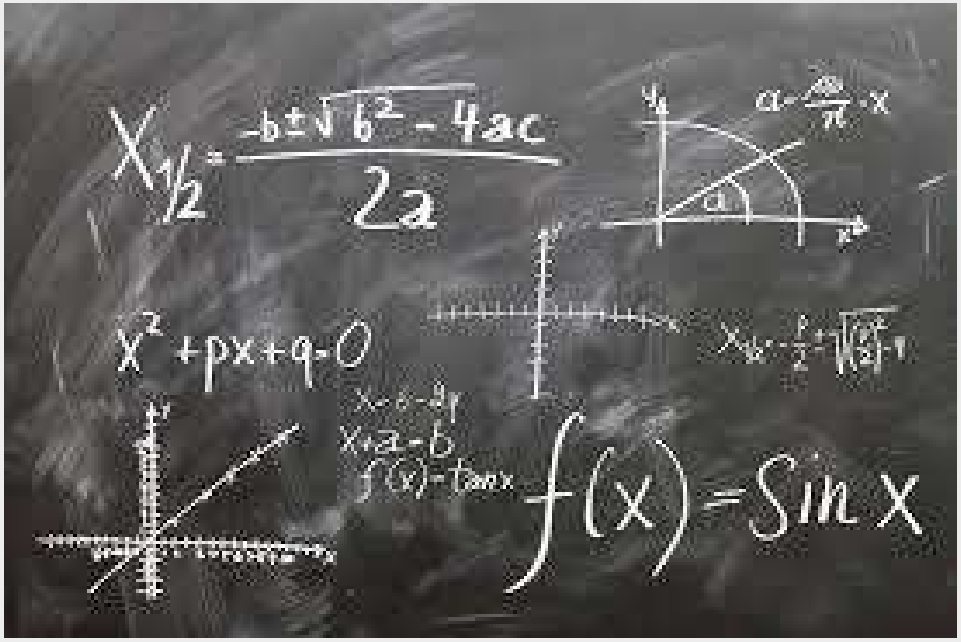
PROBABILITY CALCULATION AND STATISTICS

Mathematical Foundations of Artificial Intelligence

Linear algebra and matrices: Storage and processing of data, matrix multiplication is a commonly used operation.

Probability and statistics: Important for pattern recognition and model performance evaluation.

Optimisation algorithms: Finding the best parameters for a model.



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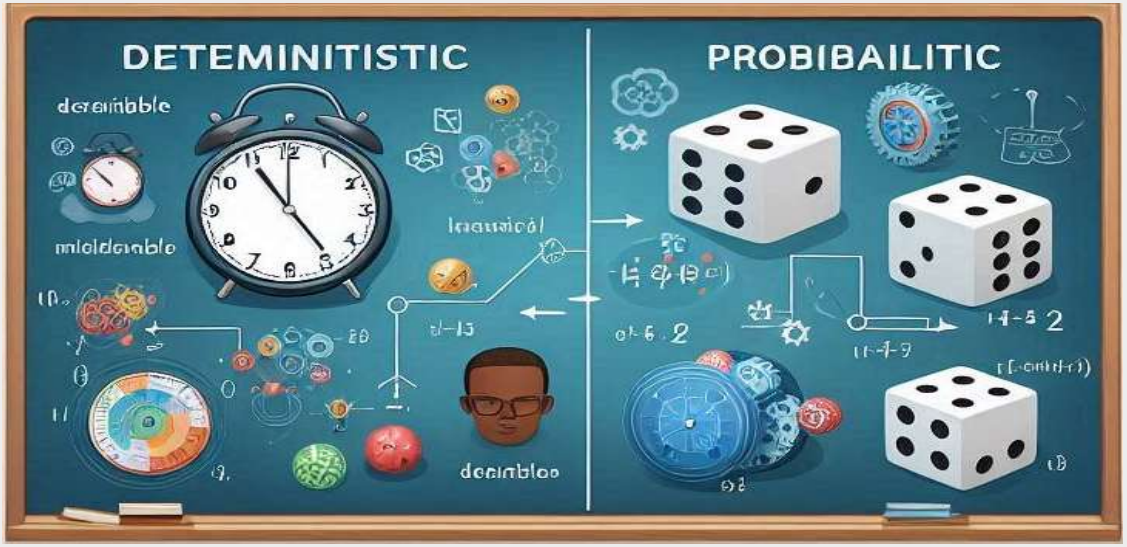
DETERMINISM VERSUS PROBABILISTICS

Mathematical Foundations of Artificial Intelligence

Deterministic models always produce the same output for a given input. They work according to fixed rules and algorithms.

Probabilistic models account for the uncertainties in data and outcomes by using probabilities. For predictions where not all variables are known.



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XAI

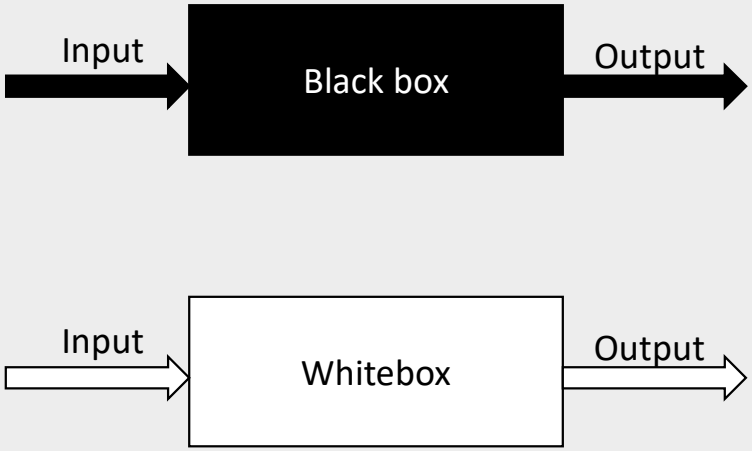
Basics of Artificial Intelligence

Explainable Artificial Intelligence (XAI) is a field of artificial intelligence that aims to make the decision-making processes of AI systems transparent and comprehensible.

Black box, unknown, unexplainable solution

Whitebox, explainable model

Example: Credit scoring model, melanoma detection



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EXAMPLE OF SUPERVISED LEARNING

Problem: Predicting a student's final grade based on their previous grades

Final grade = average value from the partial grades

$$Final\ Grade = \frac{Grade1+Grade\ 2+Gra \quad 3}{3}$$

```python
import numpy as np
from sklearn.linear_model import LinearRegression

# Erweiterte Eingabedaten
X = np.array([
    [7,7,7],
    [9,5,8],
    [10,8,9],
    [6,5,6],
    [8,9,7],
    [6,8,4],
    [5,5,6]
])

# Zielwerte (Abschlussnoten)
y = np.array([7,7.33,9,5.67,8,6,5.33])

# Modell erstellen und trainieren
model = LinearRegression()
model.fit(X, y)

a = int(input("1. Note: "))
b = int(input("2. Note: "))
c = int(input("3. Note: "))
# Neue Daten für Vorhersage
new_data = np.array([[a,b,c]])
predicted_grade = model.predict(new_data)

print(f"Die mathematisch berechnete Abschlußnote ist: {round((a+b+c)/3, ndigits=4)}")
print(f"Die vorhergesagte Abschlussnote ist: {round(predicted_grade[0], ndigits=4)}")
```


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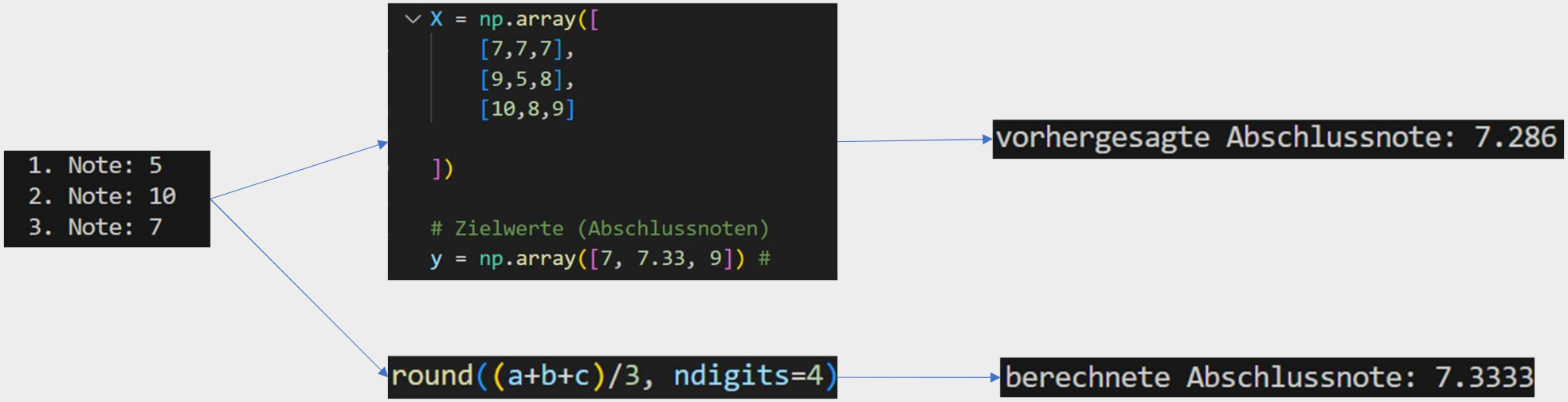
TRAINING SET 1

Example of school grades



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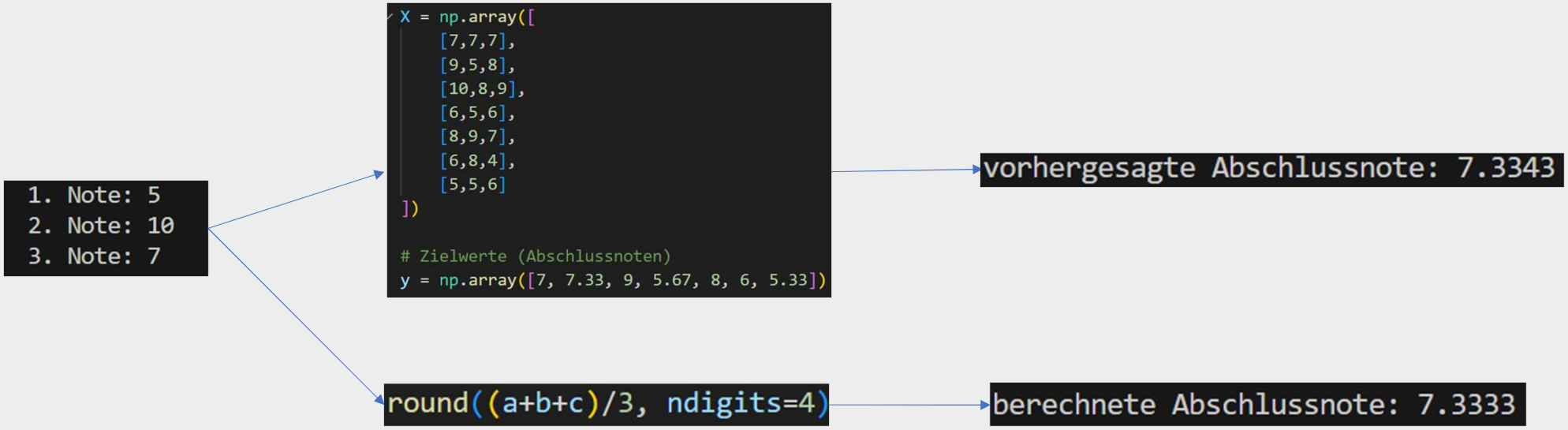
TRAINING SET 2

Example of school grades



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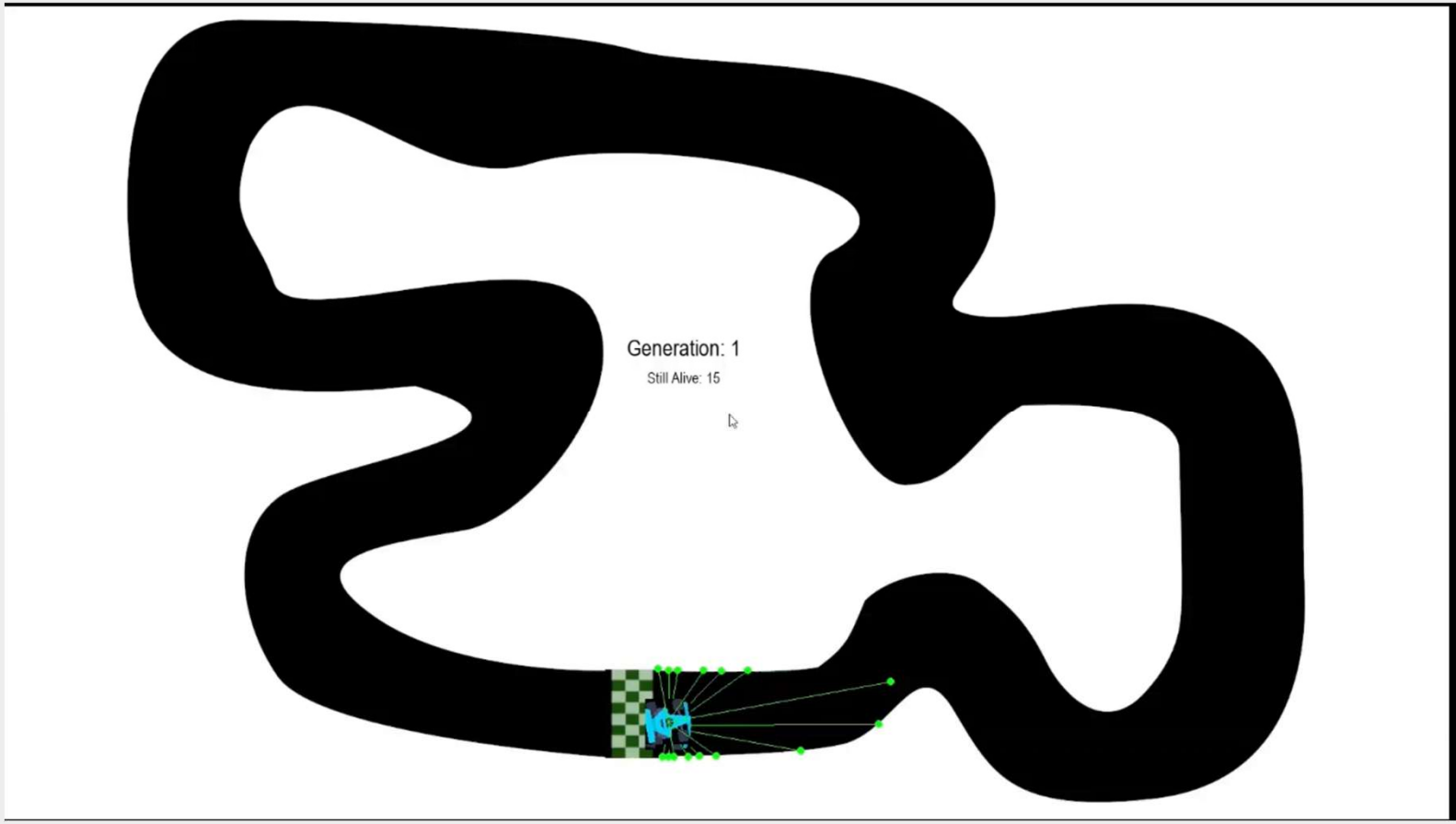
REINFORCED LEARNING

Example

Racing car to find its way on the track

Try & Error

Reward



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POTENTIALS AND ADVANTAGES OF AI

Opportunities and risks of artificial intelligence

Increased efficiency: AI can automate repetitive tasks, saving time and resources.

Innovation: AI opens up new possibilities, for example in the development of autonomous vehicles or advanced medical diagnostic tools.

Personalisation: In areas such as marketing or education, AI can tailor content and recommendations to individual users.

Increased productivity: Companies can use AI to optimise their workflows and increase productivity.

Improved decision-making: By analysing large amounts of data, AI can support informed decisions.

Quality of life: In medicine, for example, AI can help to detect and treat diseases more quickly.

ETHICAL AND SOCIETAL CHALLENGES

Opportunities and risks of artificial intelligence

Bias in data: AI can reinforce existing biases in the data, which can lead to discriminatory results.

Transparency: Many AI systems are difficult to understand ("black box"), which can reduce trust.

Responsibility: It is often unclear who is responsible for wrong decisions – developers, users or the AI?

Labour market: Automation could endanger jobs.

Privacy: The use of AI often requires large amounts of personal data, which raises concerns about surveillance and copyrights.

Inequality: AI could deepen the digital divide because not everyone has access to the same technologies.

SECURITY ASPECTS AND DATA PROTECTION

Opportunities and risks of artificial intelligence

Cybersecurity: AI systems are vulnerable to cyberattacks. Hackers could try to manipulate models or steal data used for training.

Responsibility for errors: Wrong decisions due to faulty algorithms can have serious consequences, especially in safety-critical areas such as medicine or autonomous vehicles.

Abuse: AI can be used for harmful purposes, such as creating deepfakes or automating cyberattacks.

Data collection: AI applications often require large amounts of personal data that could potentially be misused.

Transparency: Users often do not have a clear view of how their data is being used or stored.

Regulations: There is often a lack of clear, international standards to regulate the handling of AI and personal data.

VARIOUS APPLICATIONS

Possible applications of artificial intelligence

Generative KI: Chat GPT and co.

Voice assistants: Siri, Alexa.

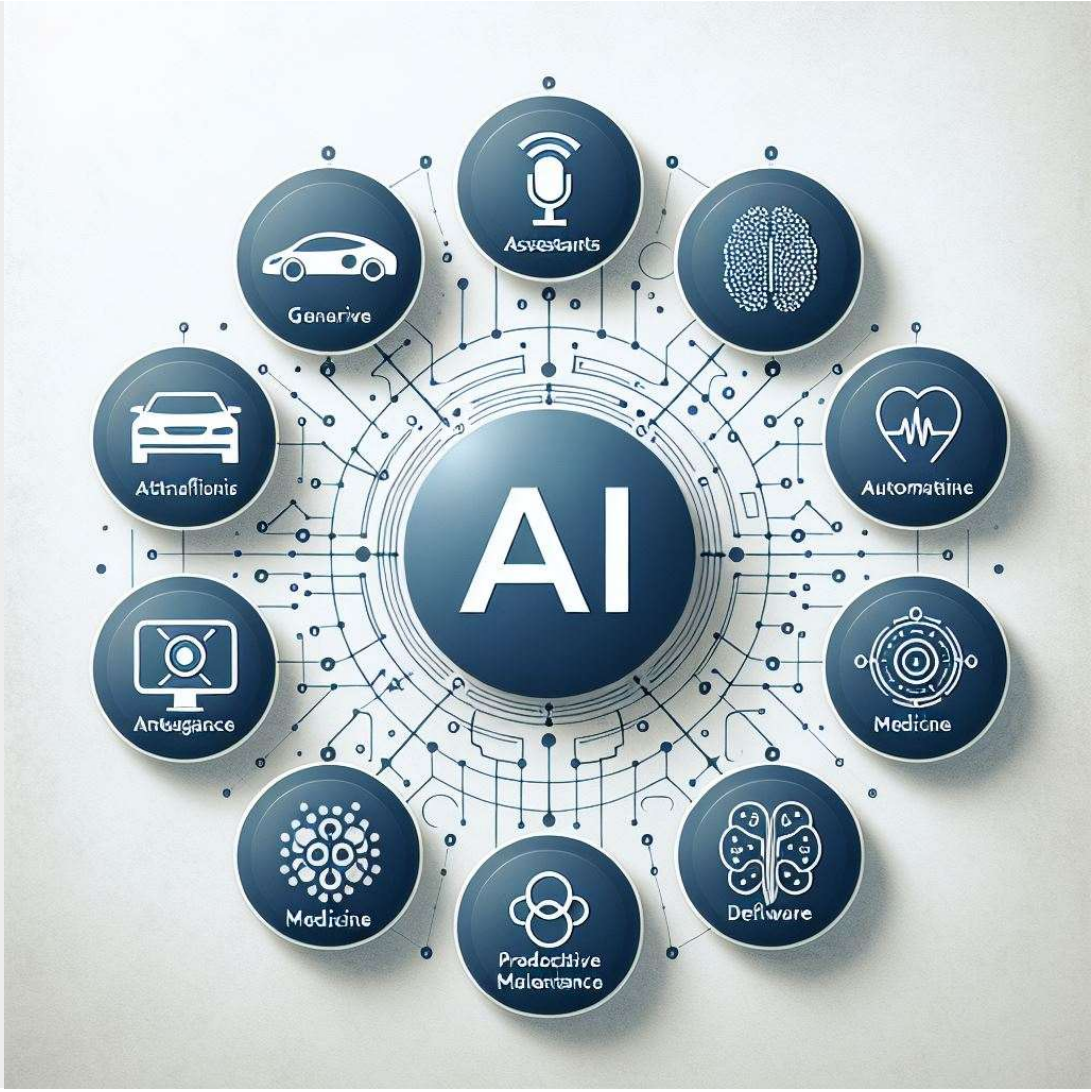
Autonomous driving

Medicine: diagnosis and treatment, personalised medicine.

Automation of production processes: increased efficiency, cost reduction.

Predictive maintenance: Maintenance of machines.

Software development



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USE OF AI IN ROPEWAYS

Possible applications of artificial intelligence

Autonomous operations management

Visual rope inspection

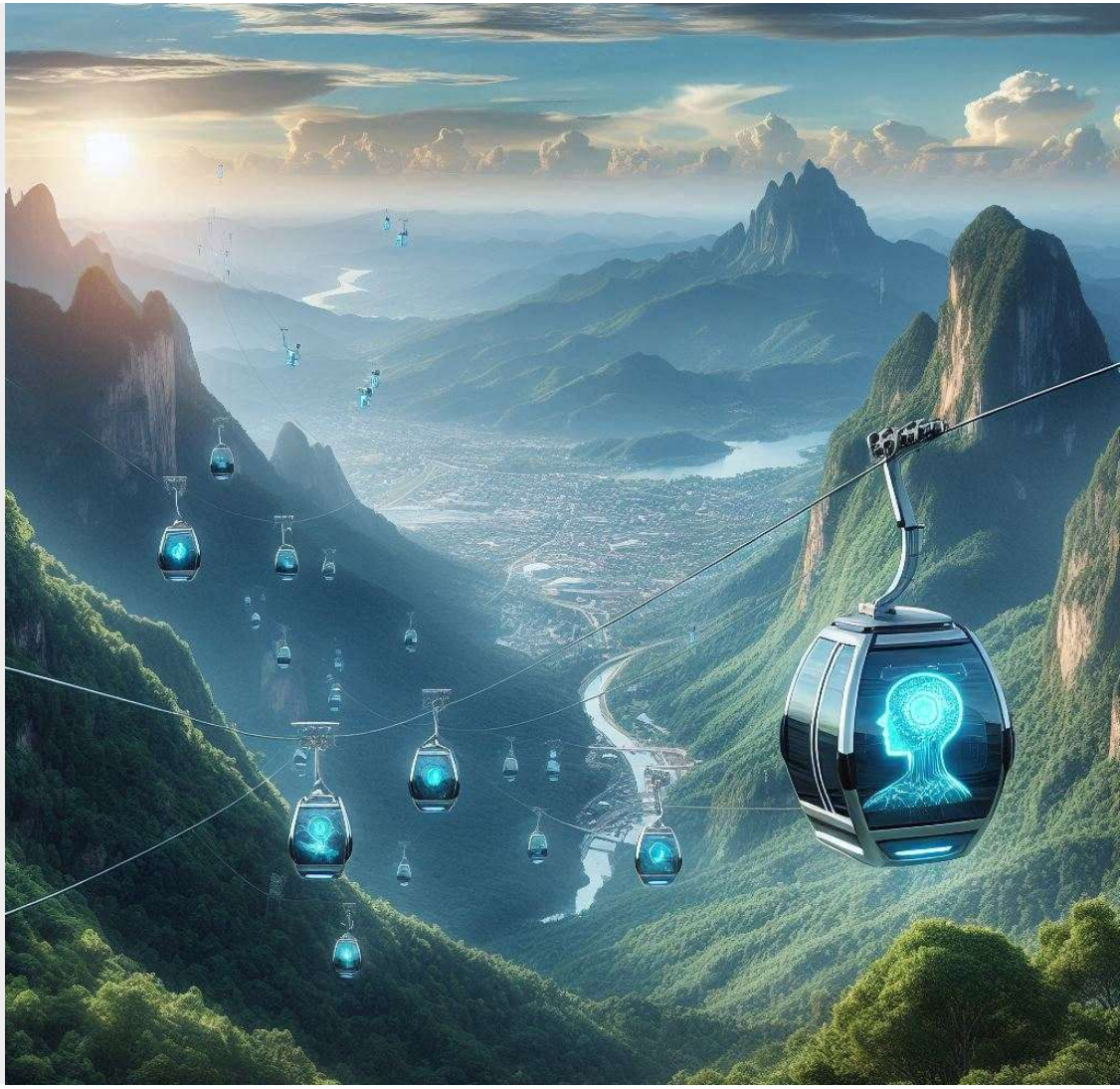
Predictive Maintenance

Operational optimisation

Energy saving

Automated data evaluation

Security



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REGULATIONS OF AI IN ROPEWAYS

EU AI ACT Regulation (EU) 2024/1689

Article 6: Classification rules for high-risk AI systems

Regardless of whether an AI system is placed on the market or put into service independently of the products referred to in points (a) and (b), that AI system shall be considered high-risk if both of the following conditions are met:

(a) the AI system is intended for use as a safety component of a product, or the AI system is itself a product covered by the Union harmonisation legislation listed **in Annex I;**

(b) the product whose safety component referred to in point (a) is the AI system, or the AI system itself as a product, must be subject to a conformity assessment by a third party in order for that product to be placed on the market or put into service in accordance with the Union harmonisation legislation listed **in Annex I.**

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CURRENT DEVELOPMENTS AND TRENDS

Agentic AI

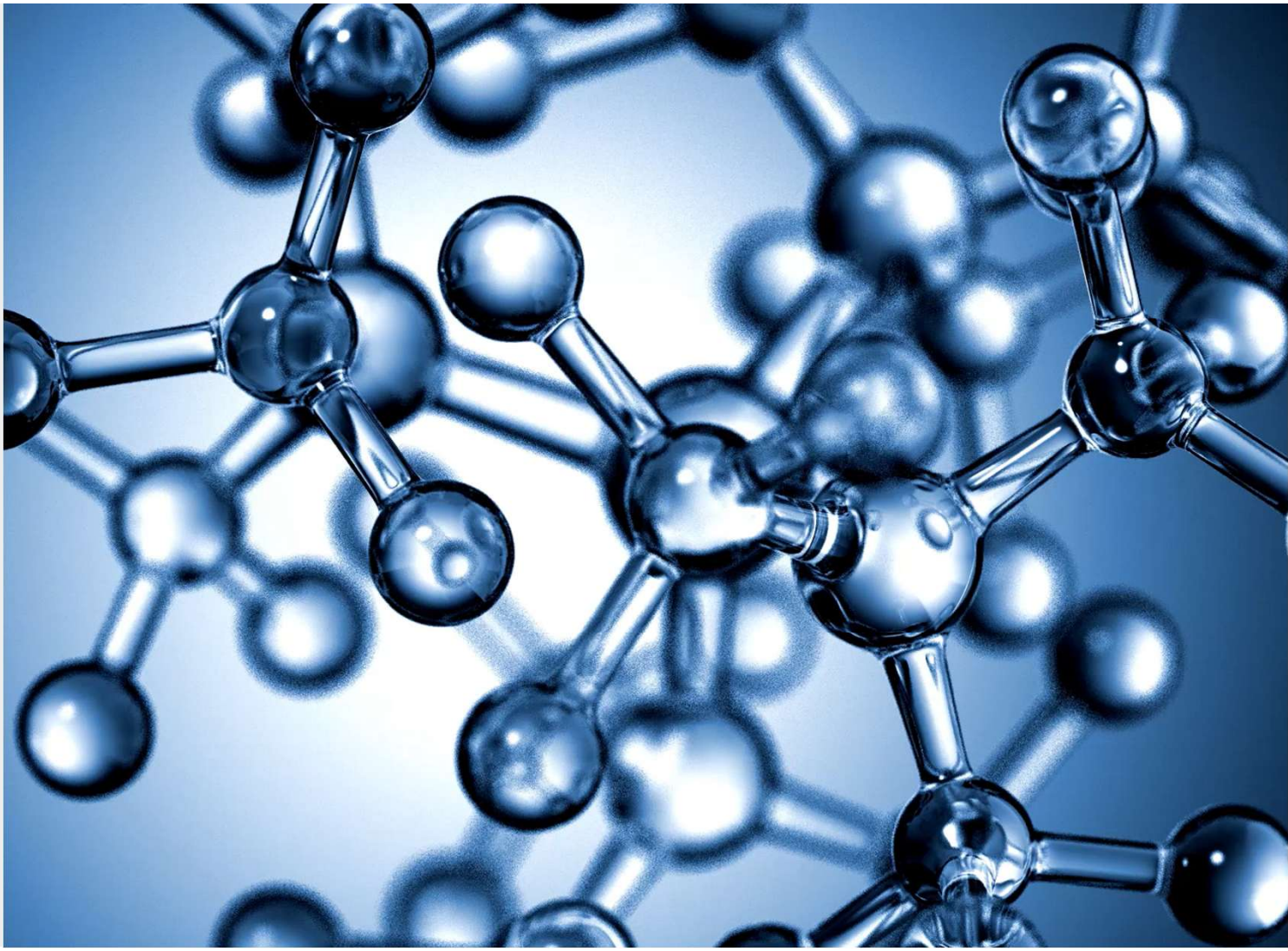
Generative KI

Edge computing and smaller models

Multimodal AI

Regulation and Ethics

Internet search



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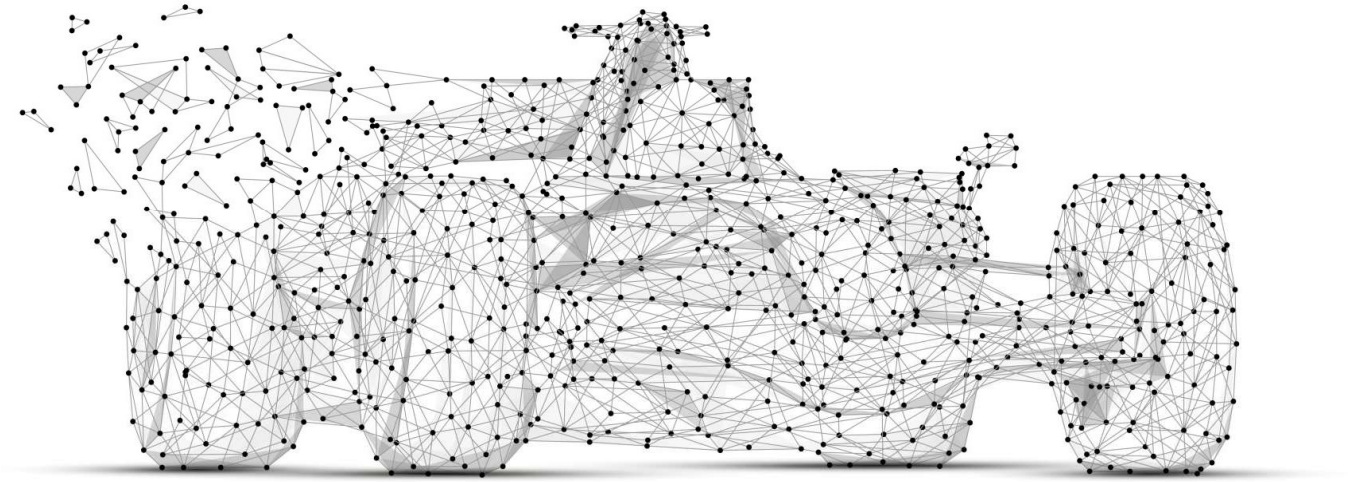
POTENTIAL BREAKTHROUGHS AND INNOVATIONS

Future Outlook of Artificial Intelligence

Quantum computing and AI: Performing complex calculations faster

Autonomous systems: self-driving cars, drones, weapons

Strong AI: AI equivalent to humans



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SUMMARY

It will not happen as quickly as many predict or fear.

AI is not a new invention, but has been around for a long time.

One must not be deceived by designations and by what one thinks to understand by them.

AI will have an impact on our lives and it will lead to a new form of cooperation between humans and machines.

Computers will not replace us (at least not soon).

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