

# Algorithms and AI systems demystified

UNDERSTANDING ARTIFICIAL INTELLIGENCE



Iván Palomares Carrascosa

Senior Data Science & AI Manager

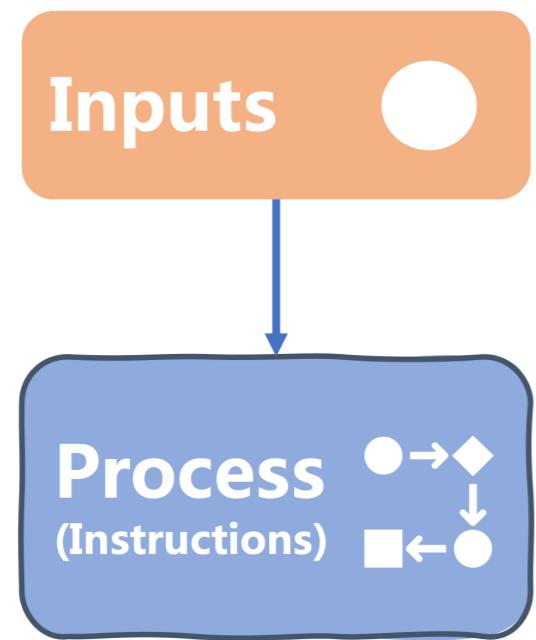
# What is an algorithm?

**Algorithm:** a set of (computer) instructions to solve a problem or perform an action.

Inputs

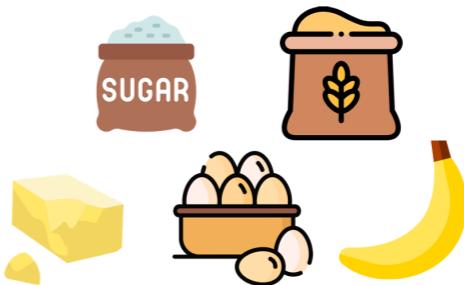
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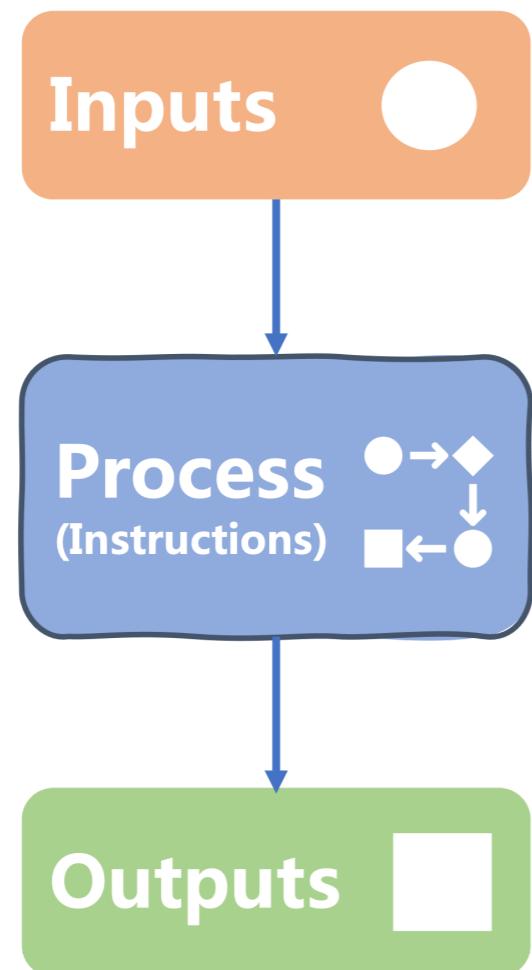


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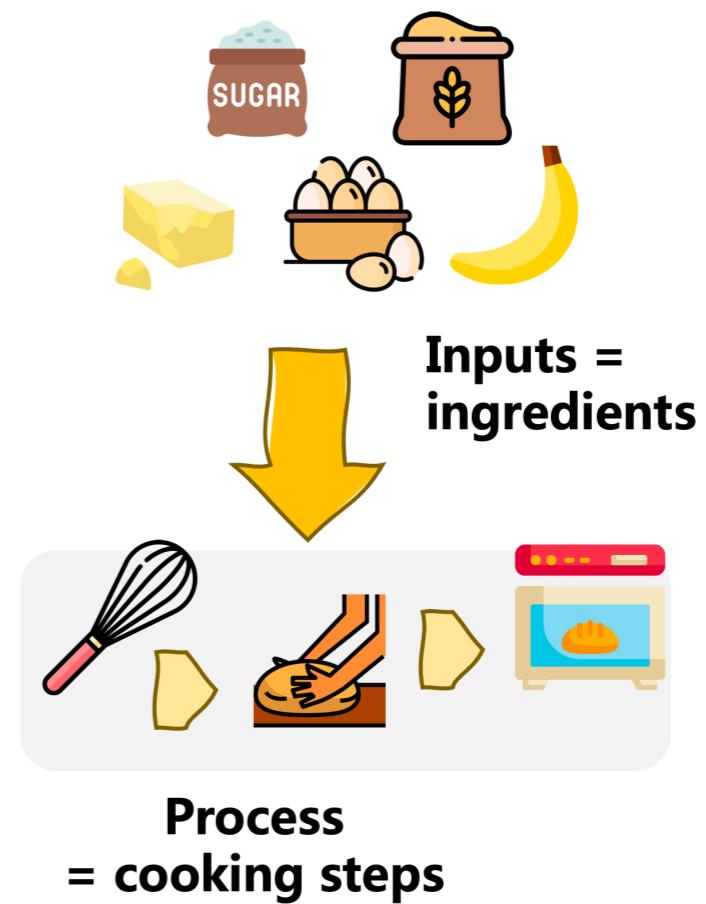
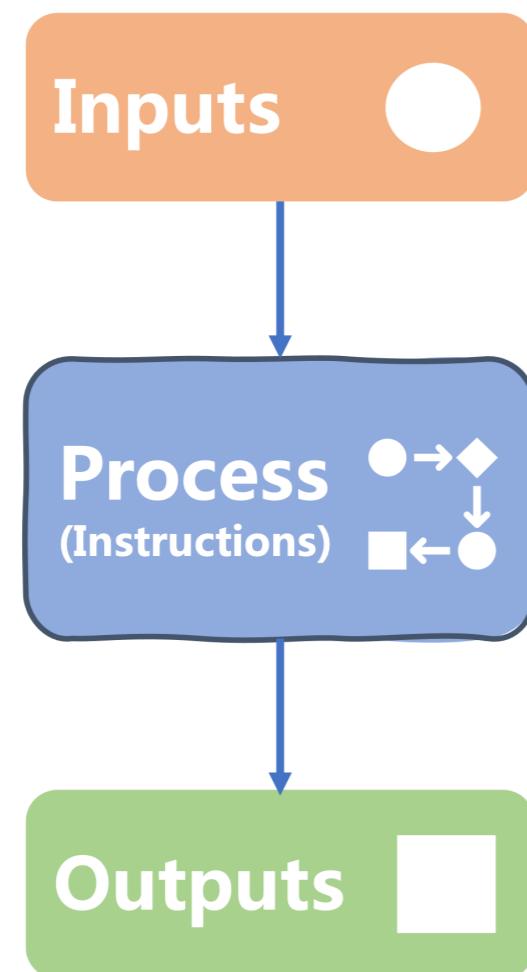


**Inputs = ingredients**



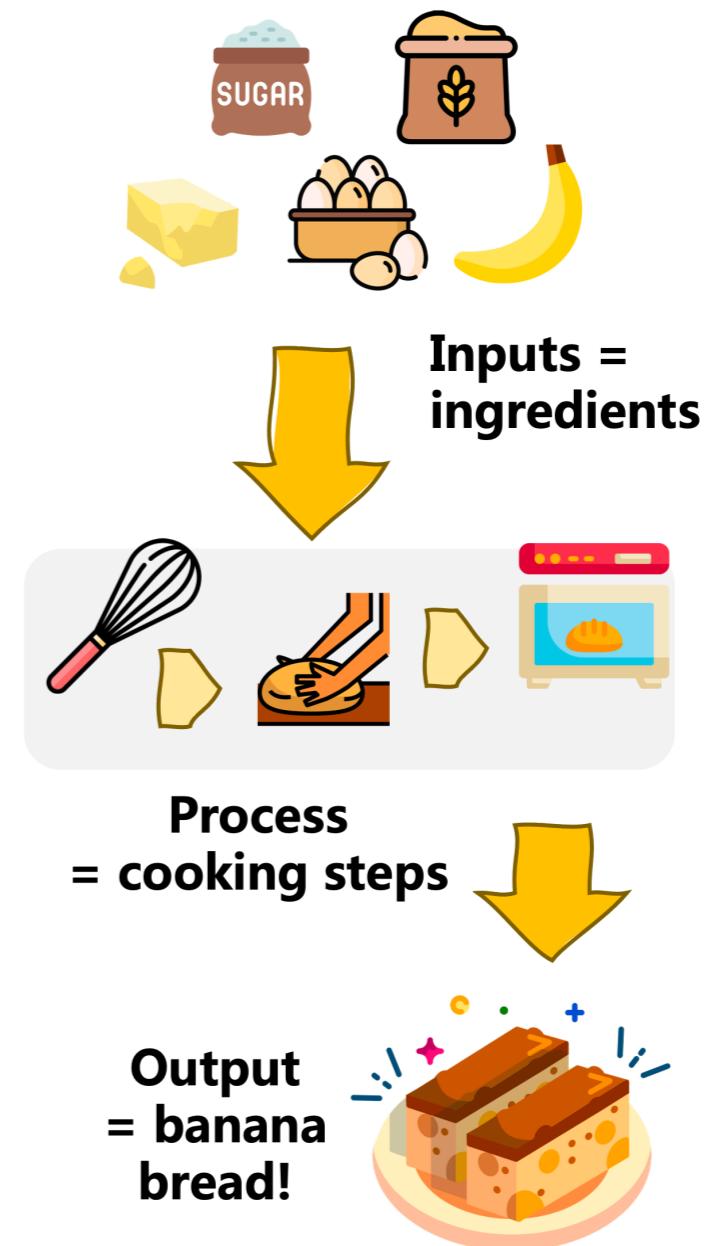
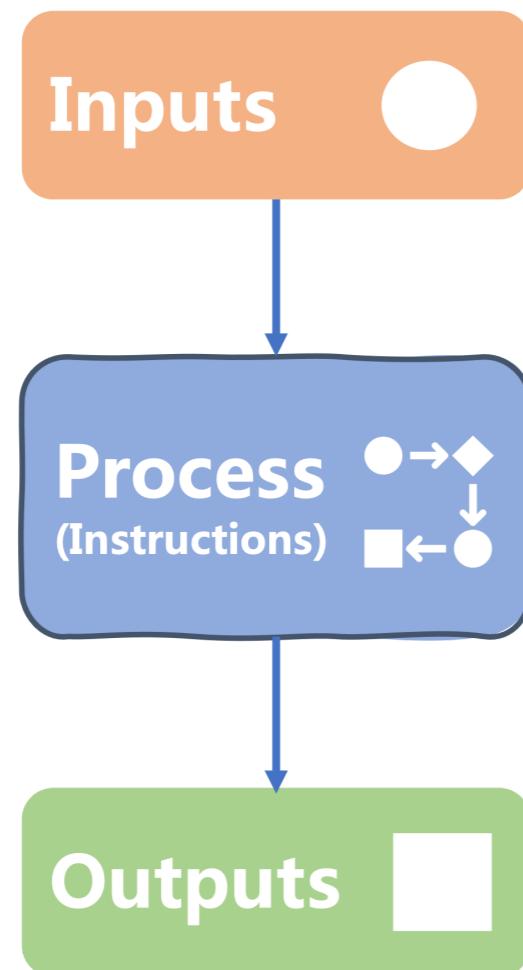
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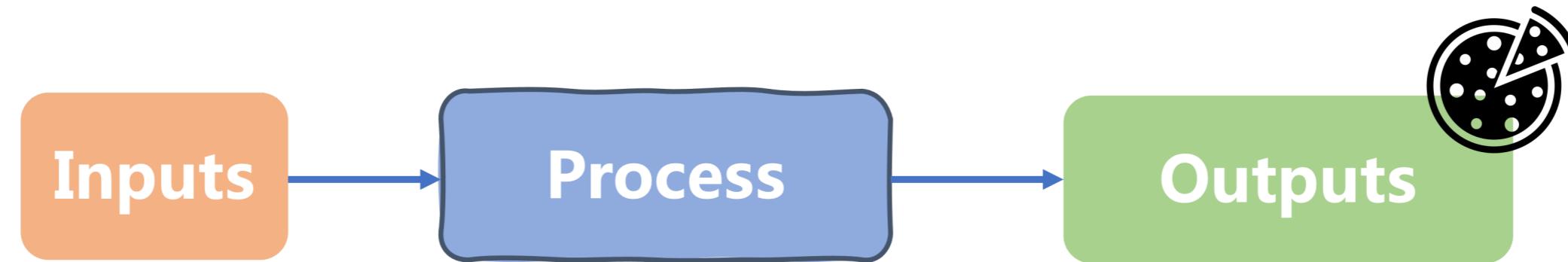


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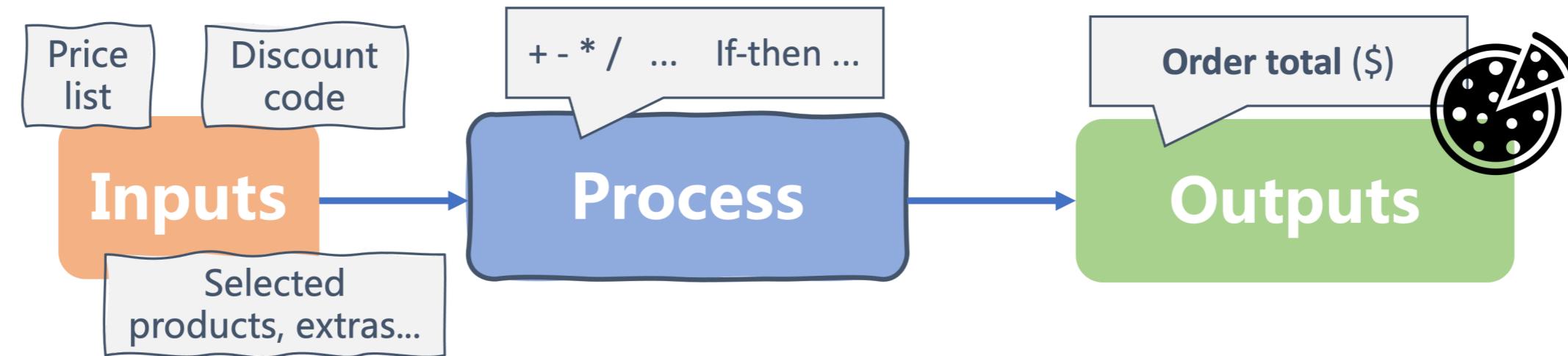
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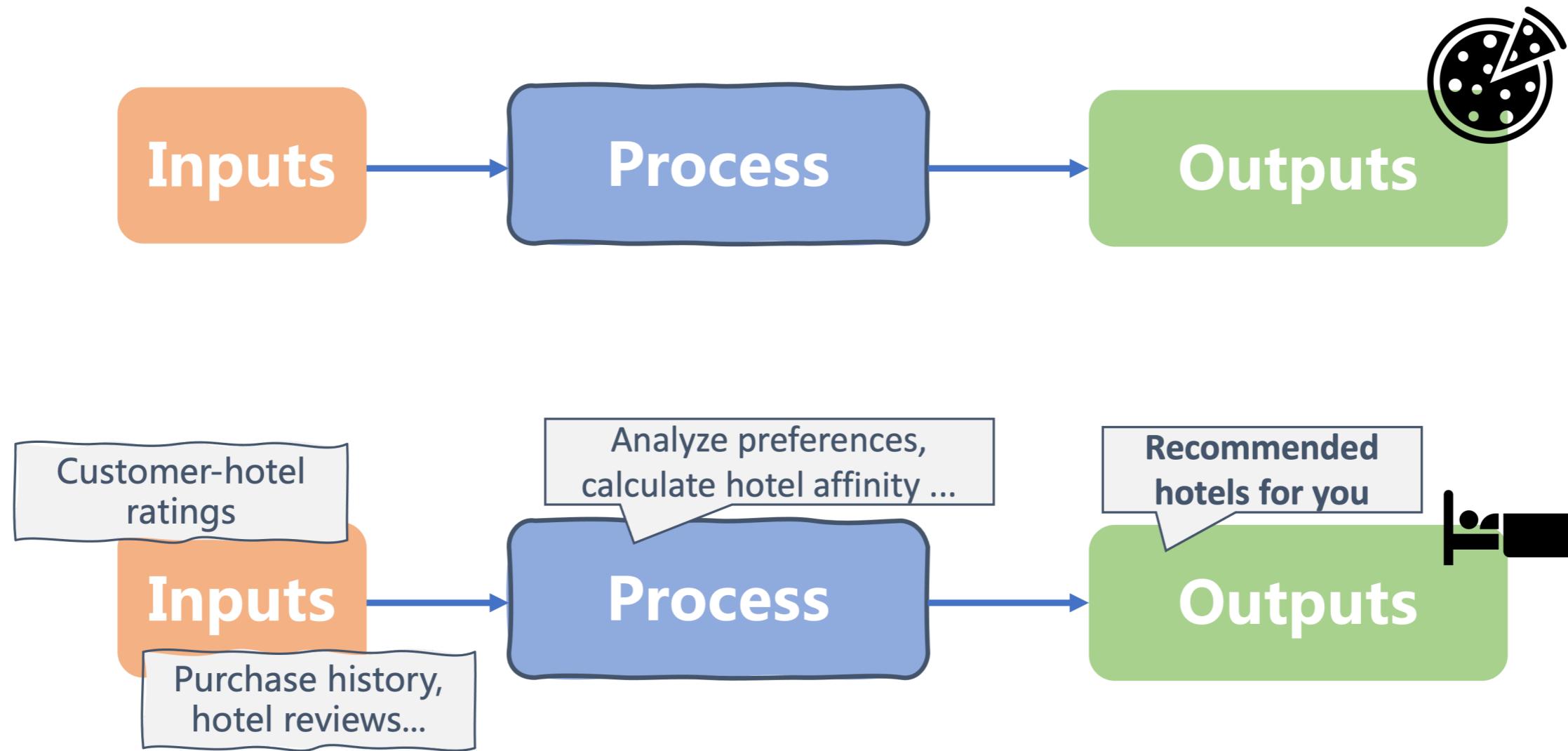
# Algorithms in Computer Science vs AI algorithms



# Algorithms in Computer Science vs AI algorithms



# Algorithms in Computer Science vs AI algorithms



- **AI algorithms:** learn by themselves to produce better outputs or processes from input data

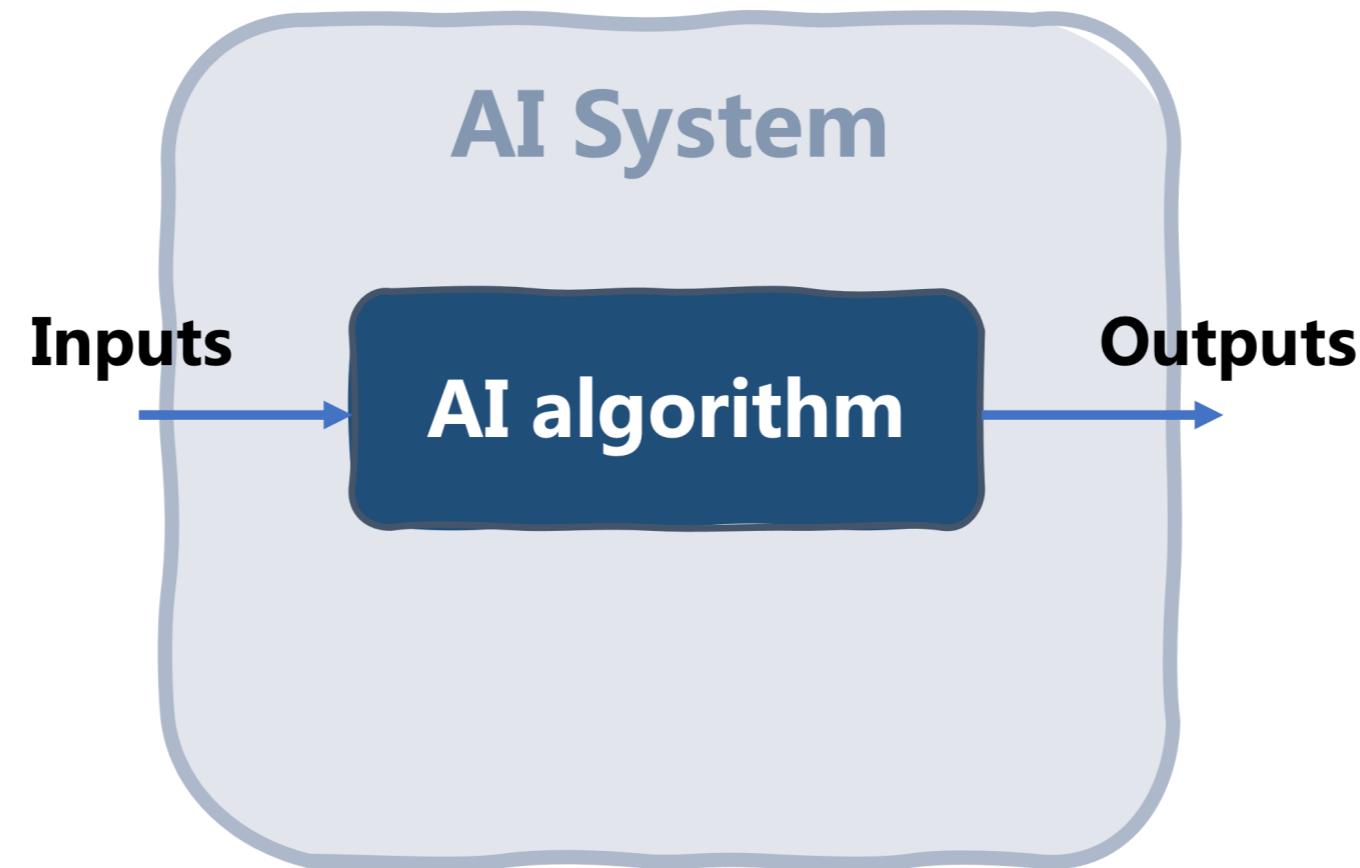
# What is an AI system?

**AI system:** infrastructure and components needed to implement and deploy AI algorithms in the real world



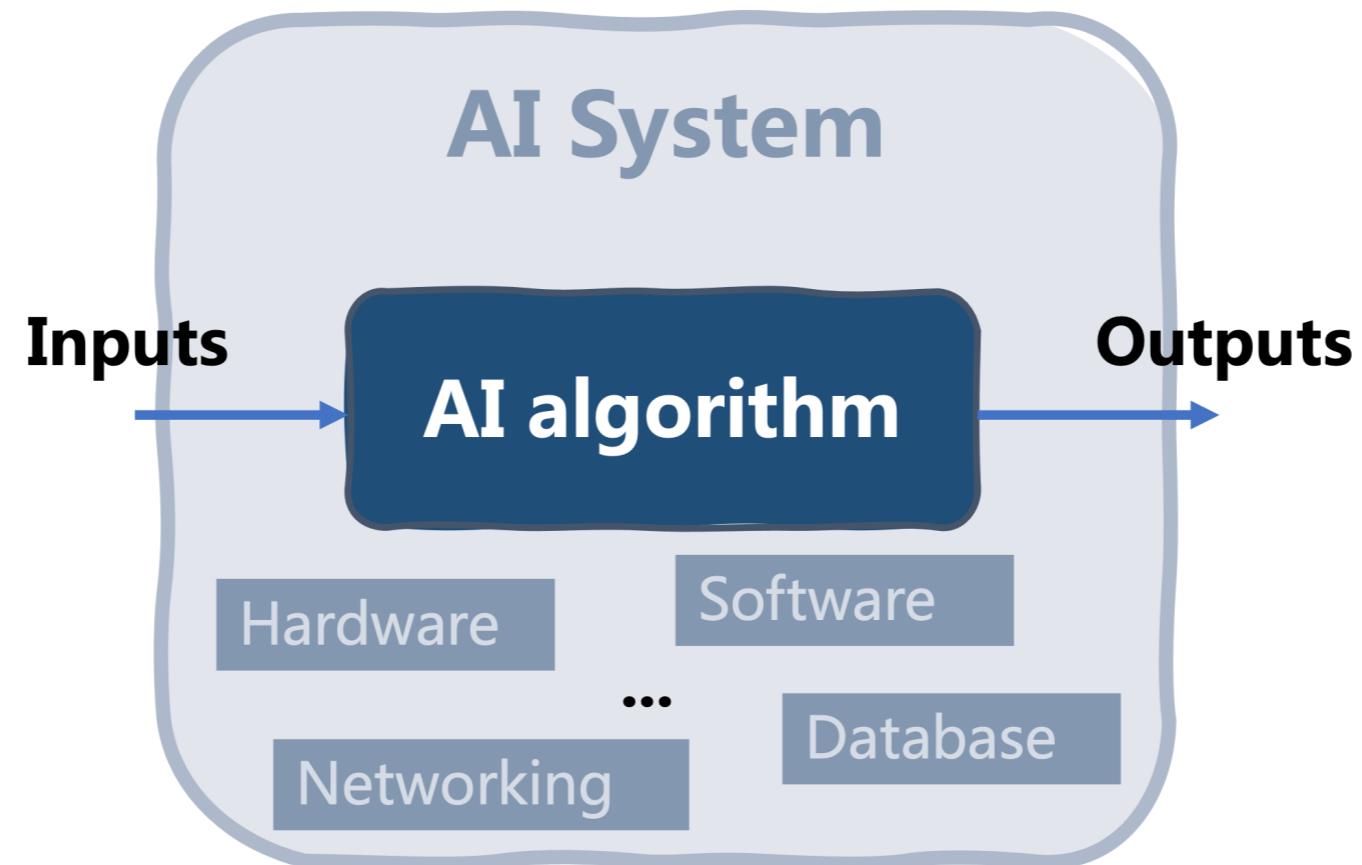
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# **Let's practice!**

**UNDERSTANDING ARTIFICIAL INTELLIGENCE**

# Acquiring data

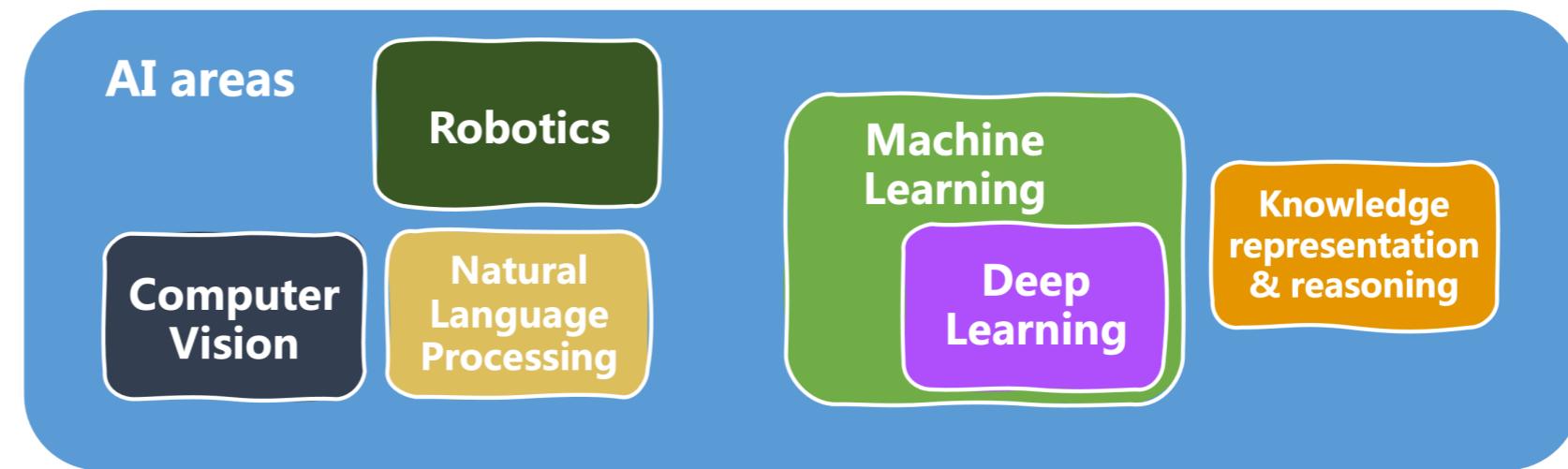
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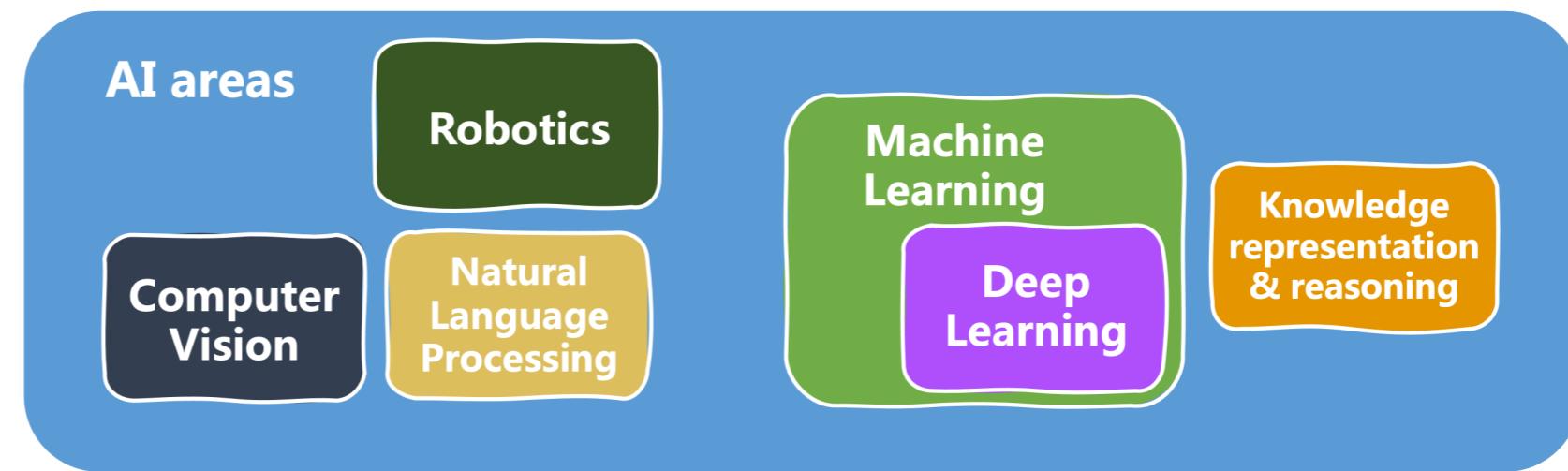
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# AI functions and areas involved



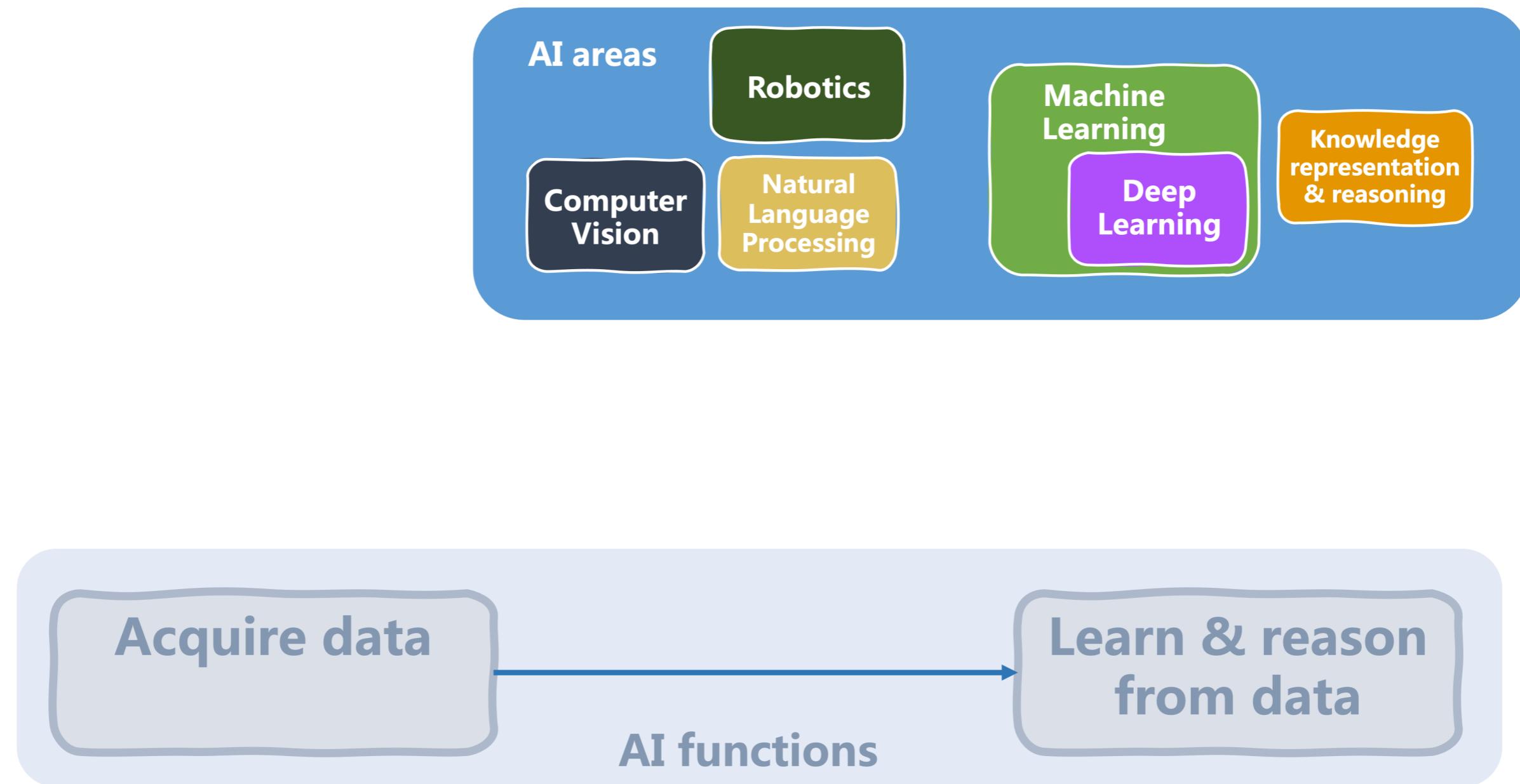
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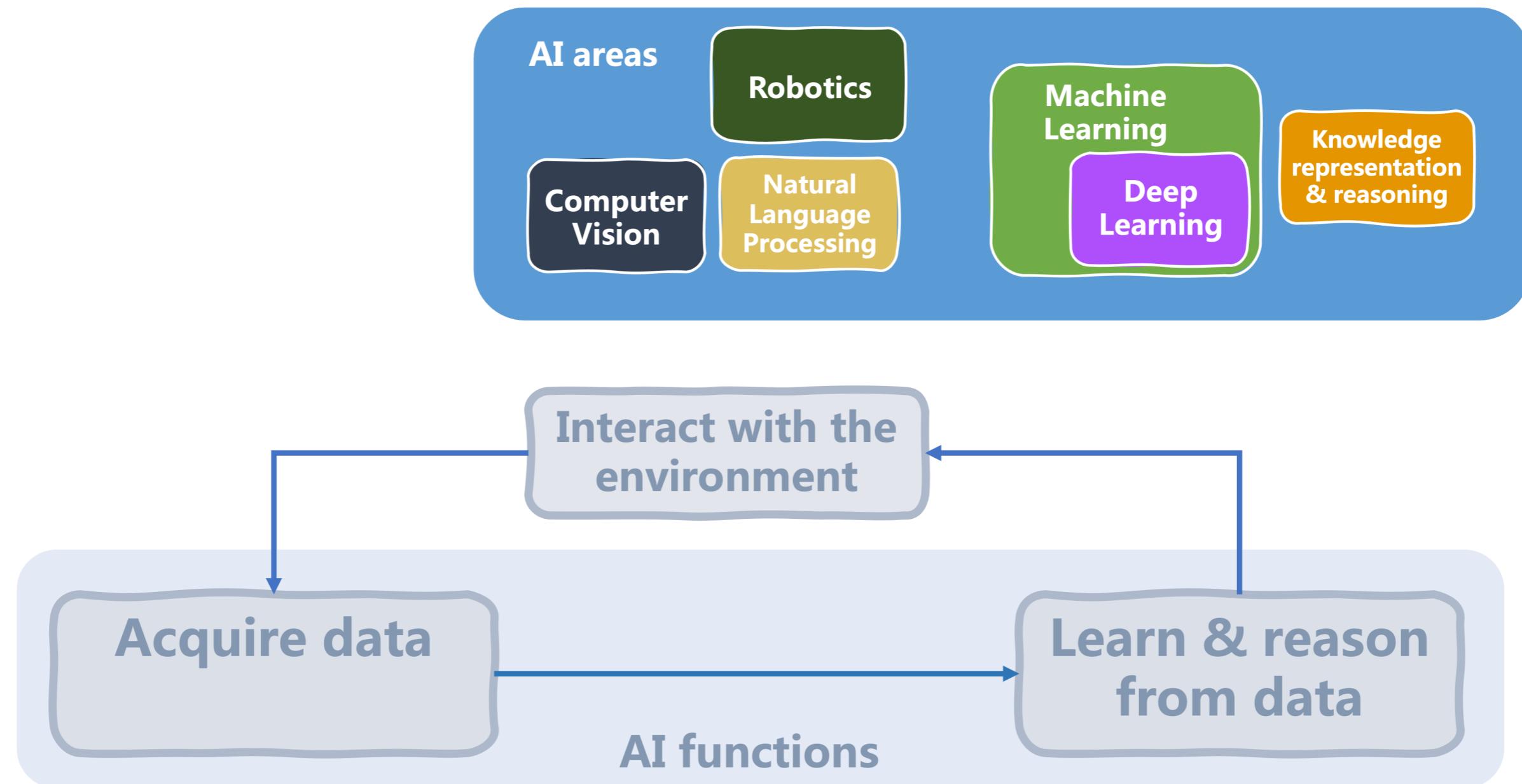
Acquire data

AI functions

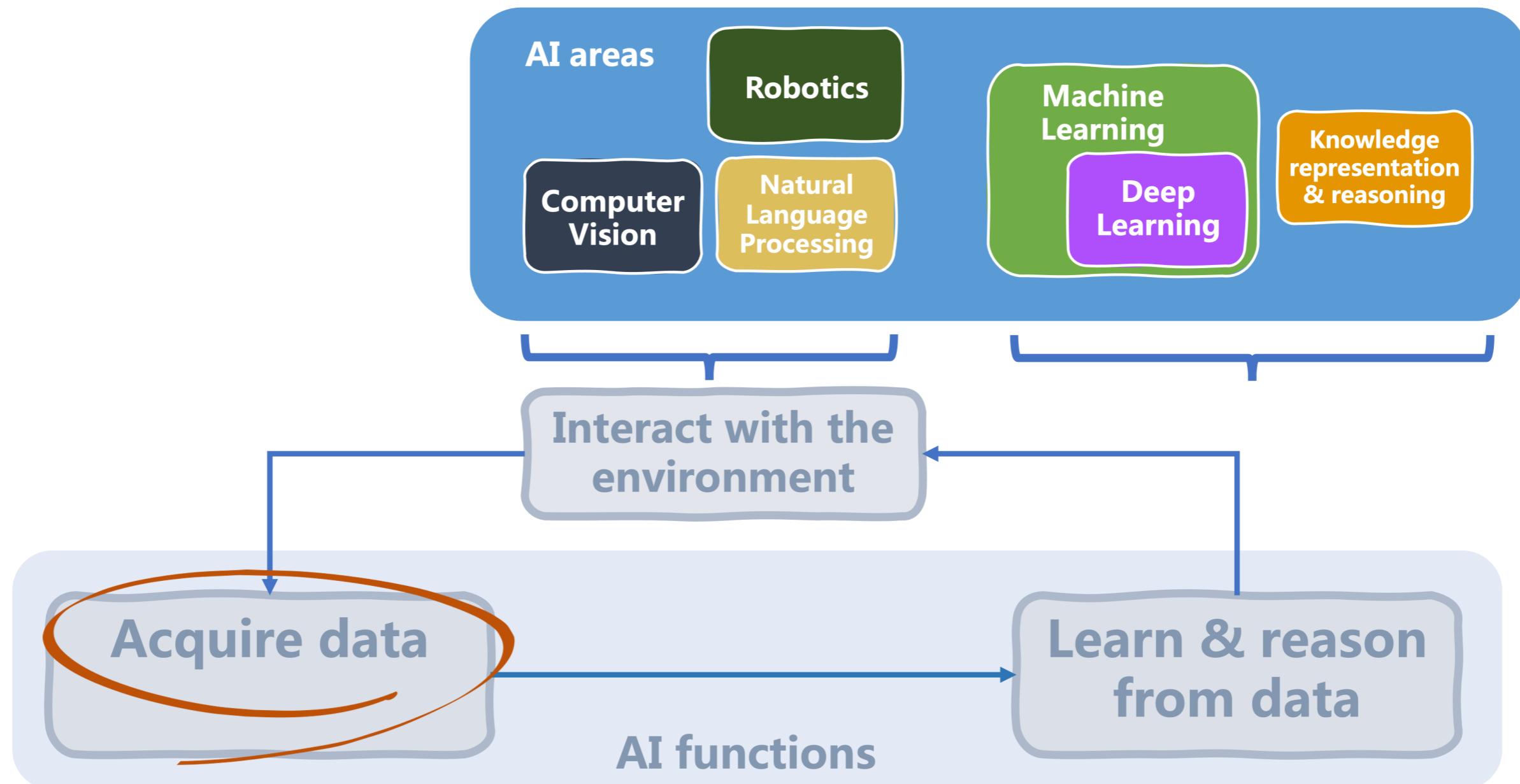
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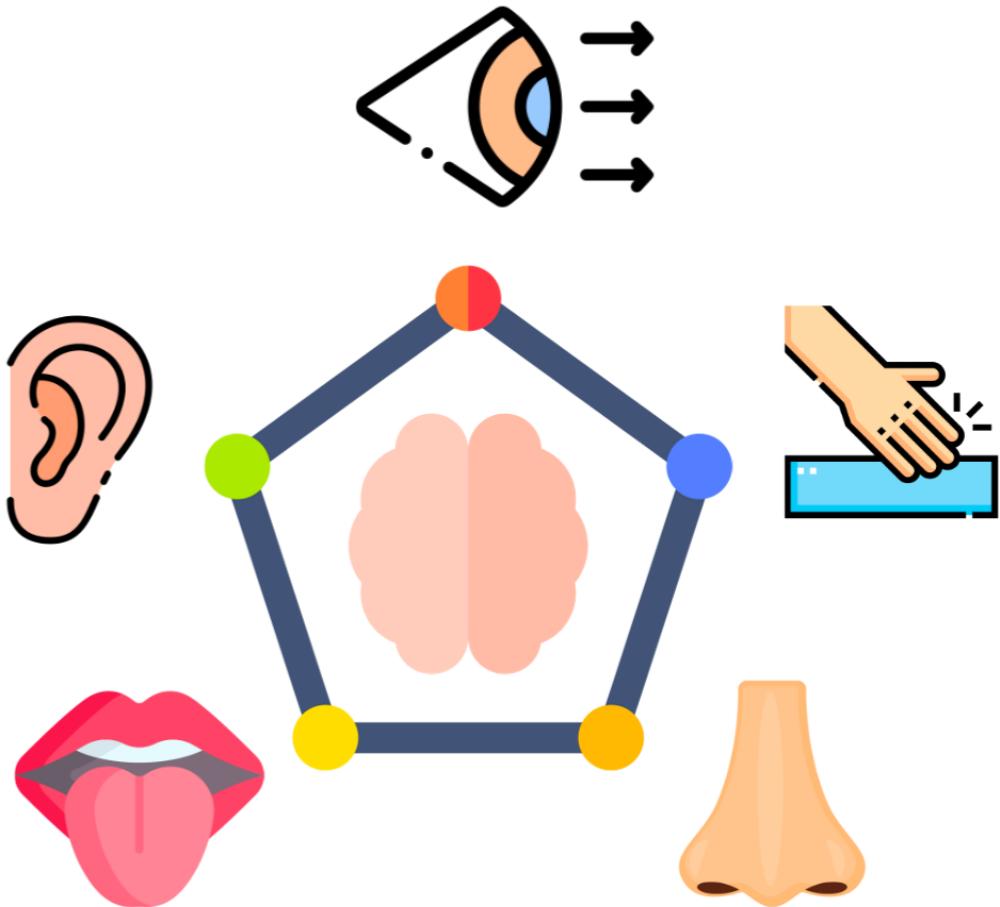
# Data acquisition: sensing the environment

Collect outside sensory information through **sensors**: mimic human senses

Transform perceptions into **data**

Occurs in:

- **NLP and audio**: capturing speech, sounds.
- **Computer Vision**: satellite images, fingerprint, etc.
- **Robotics and sensors**: temperature, touch, motion, gravity, etc.



# Data acquisition: datasets

Dataset collection of data: data samples or instances of a given type of data

- **Structured:** tabular format, spreadsheets
- **Unstructured:** images, audio, videos, text, ...

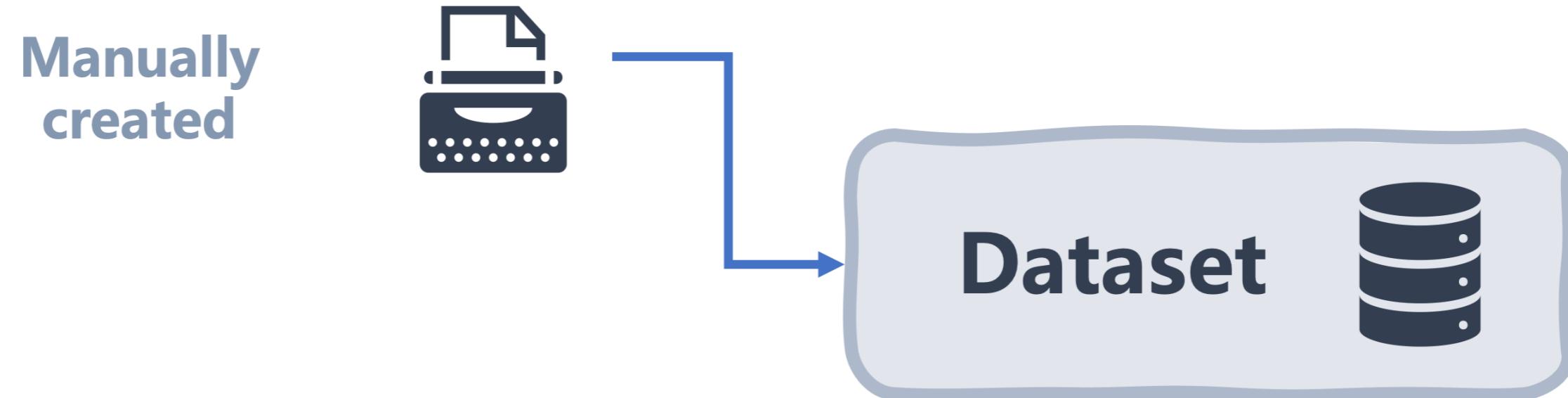
Dataset



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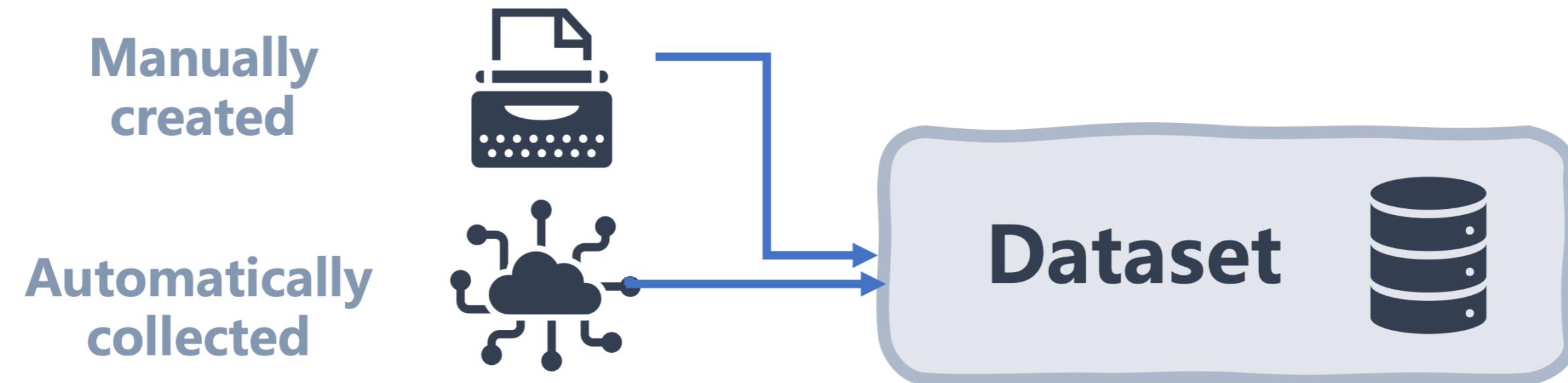
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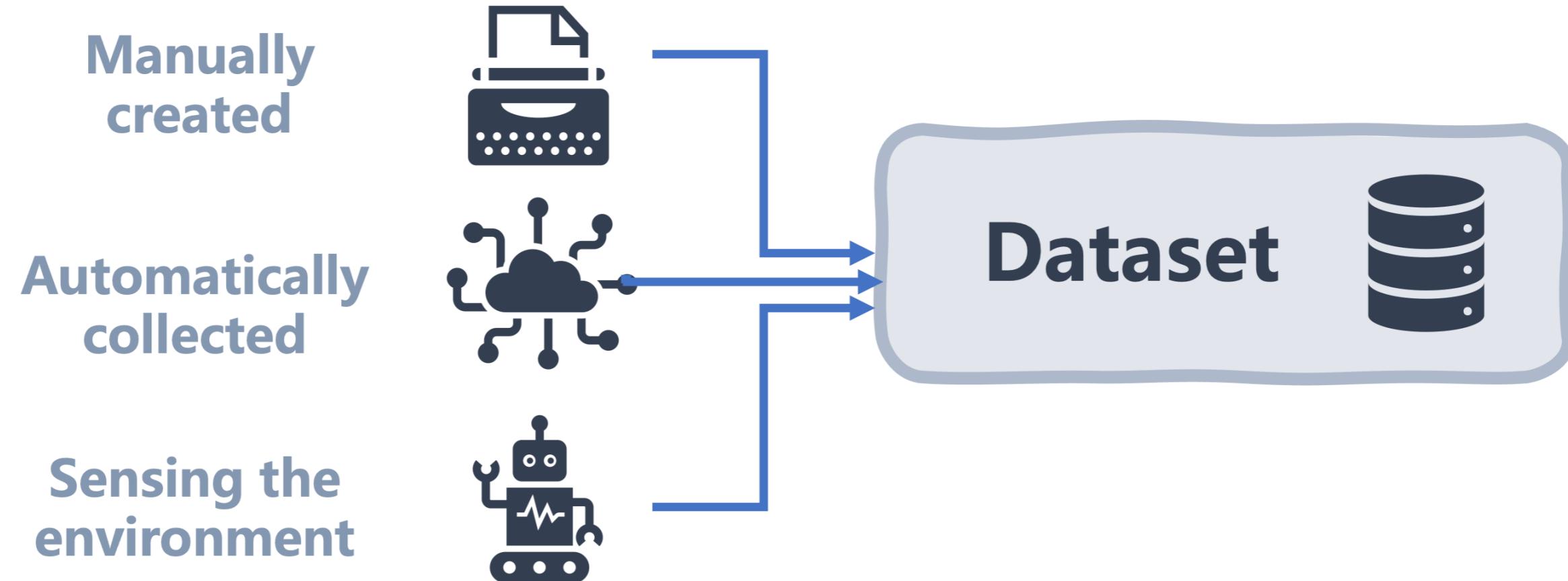
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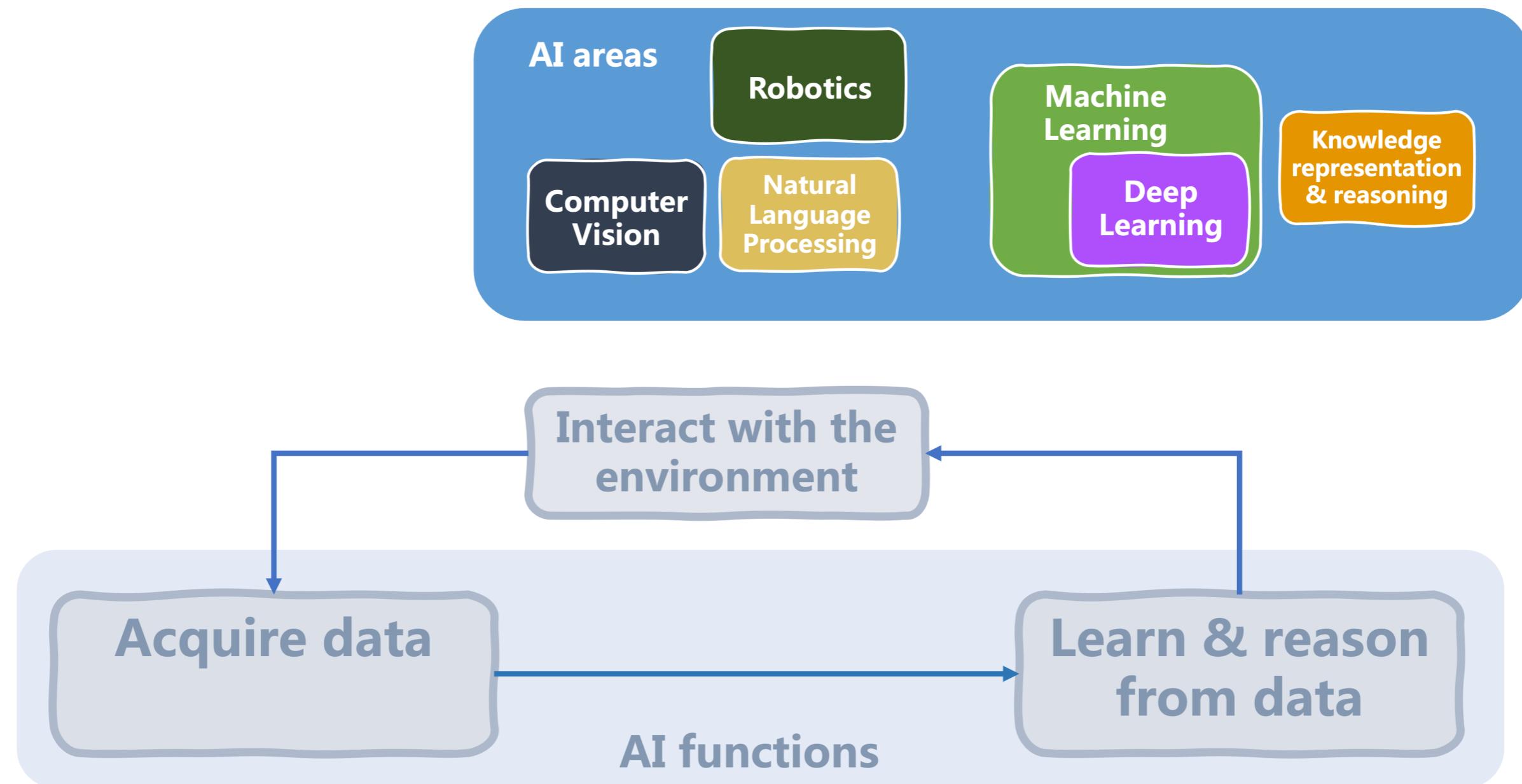
# Learning from data

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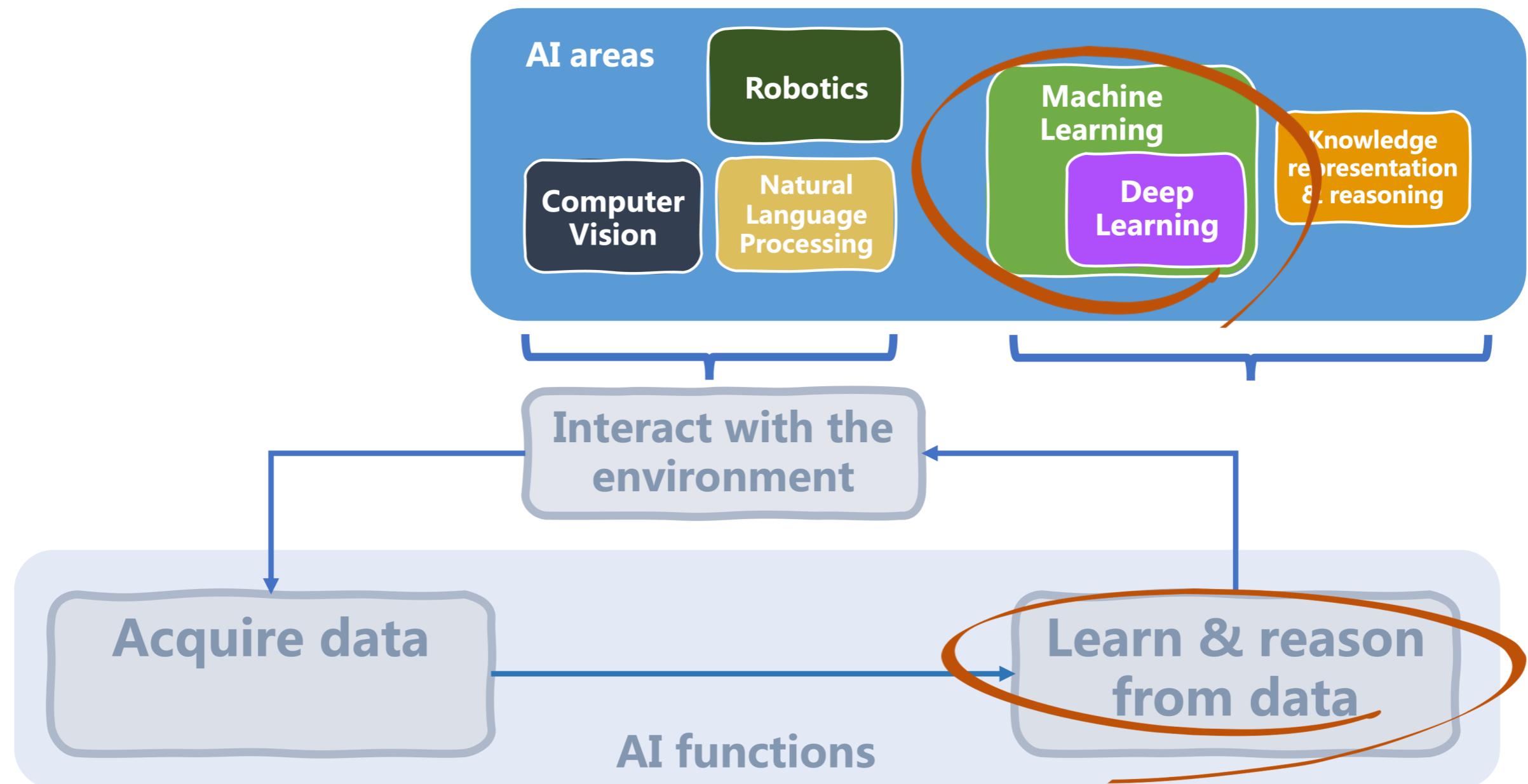


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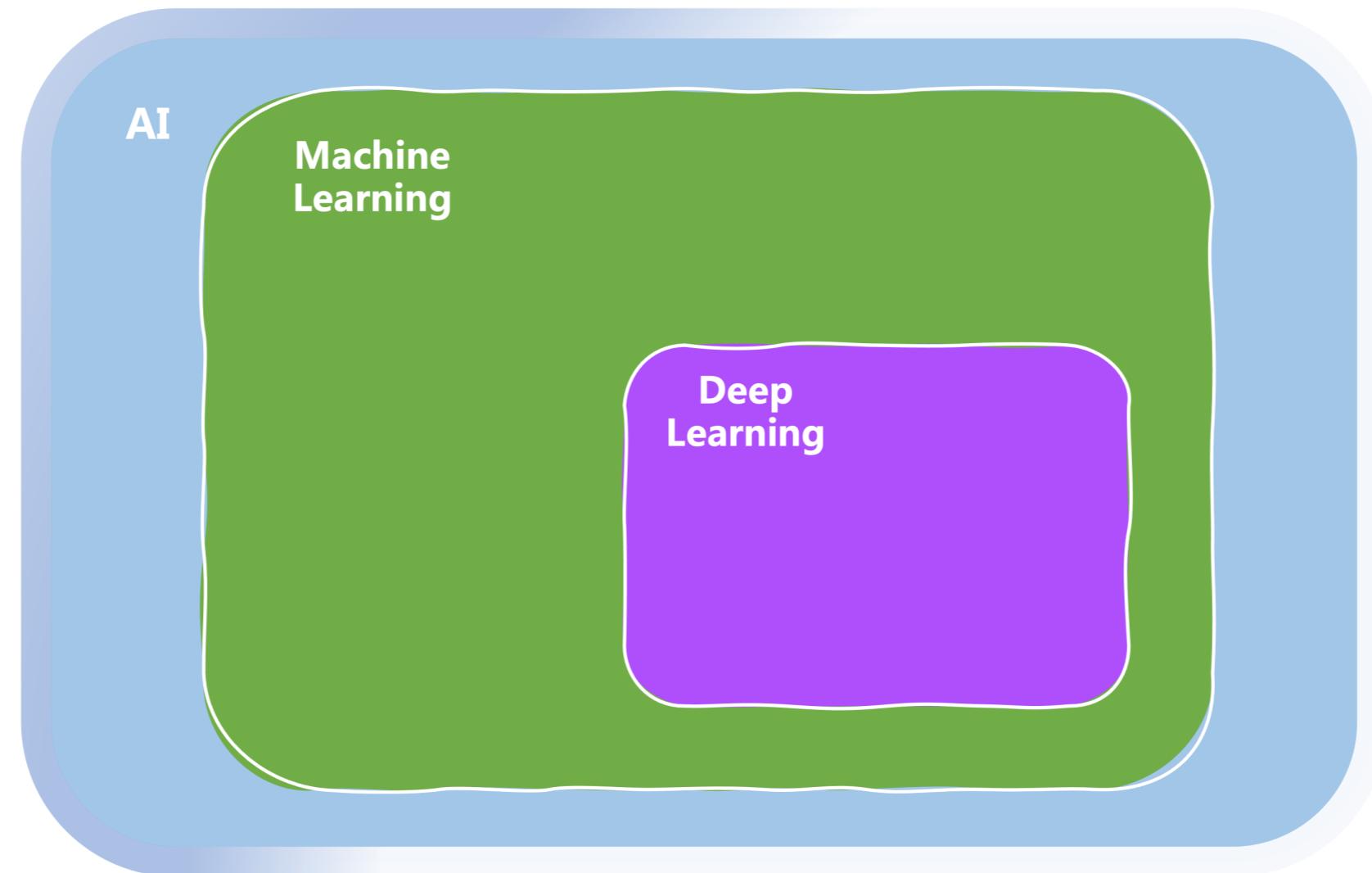


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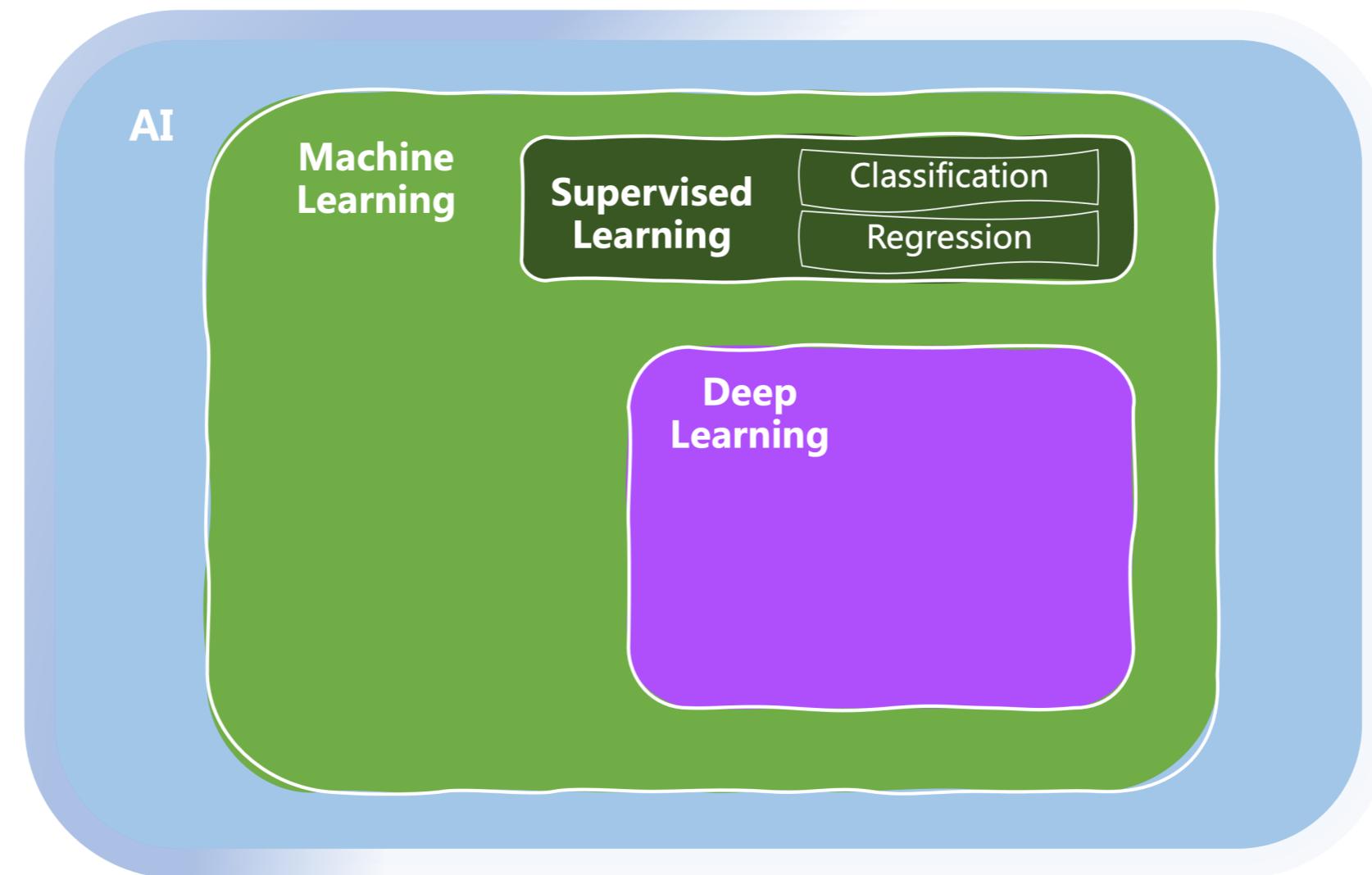
# Enter Machine Learning (ML)

**Machine Learning:** learn from data and identify patterns to perform inference tasks:  
predictions, classifications, clustering, ...



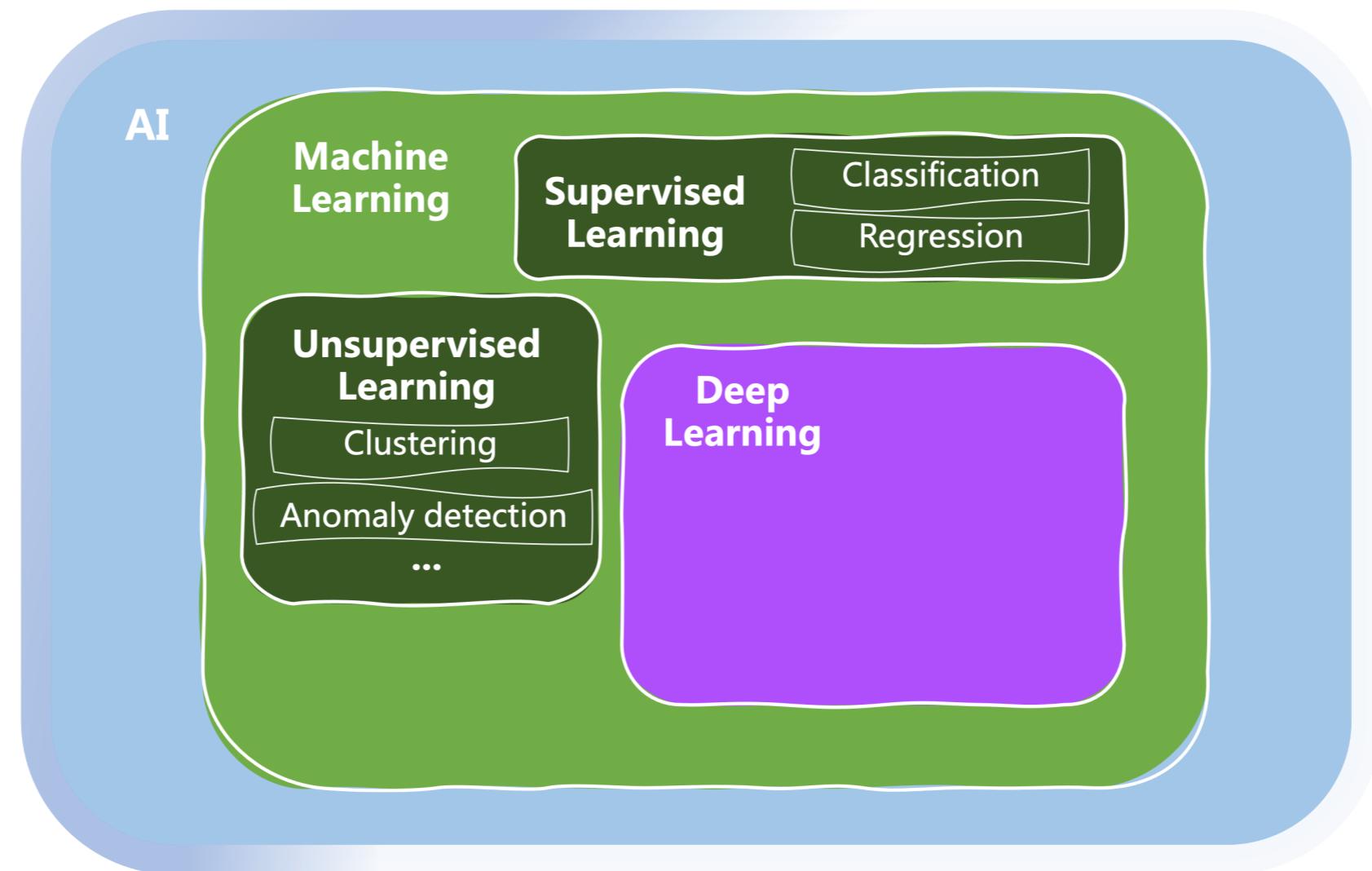
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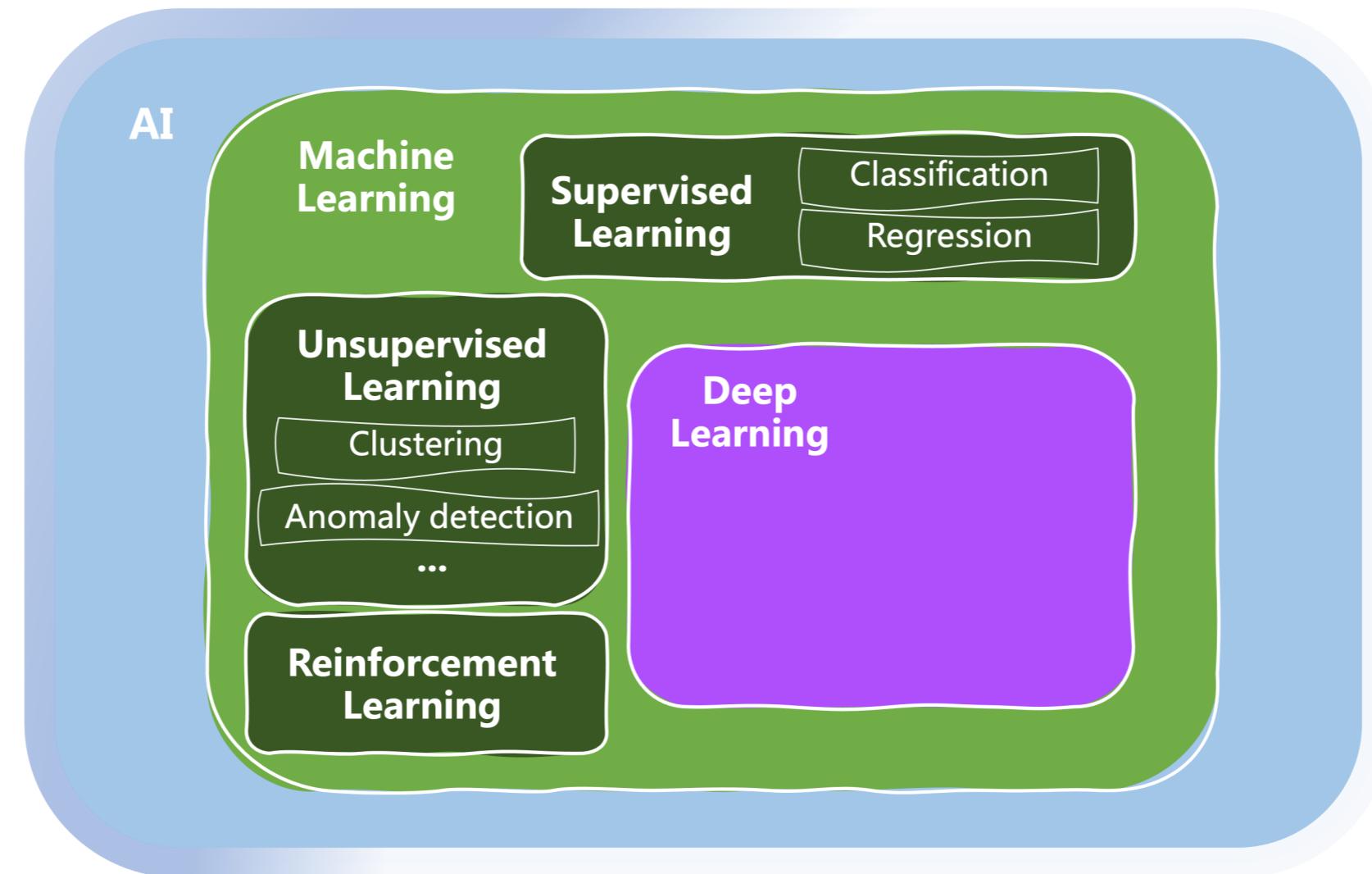
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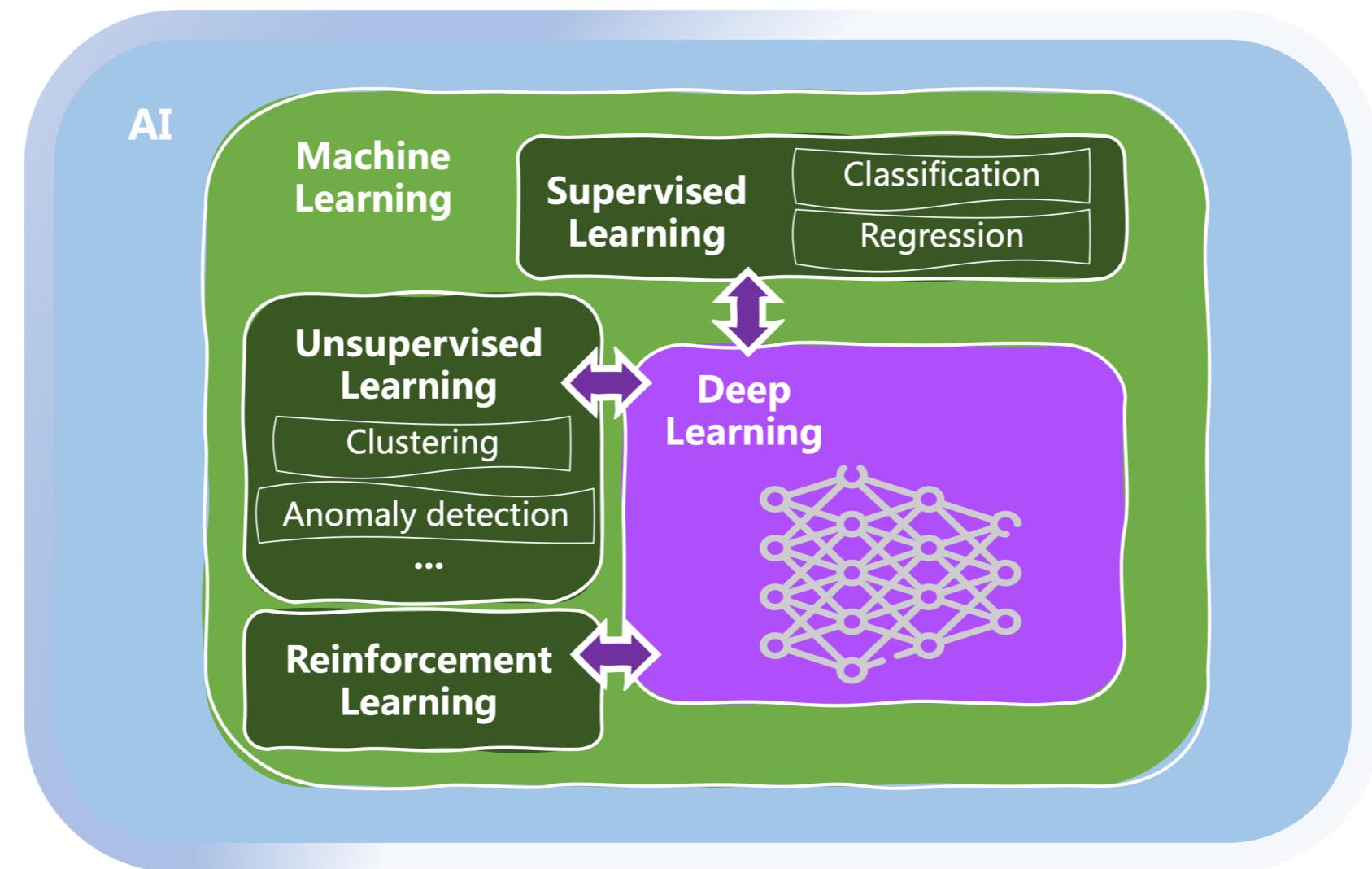
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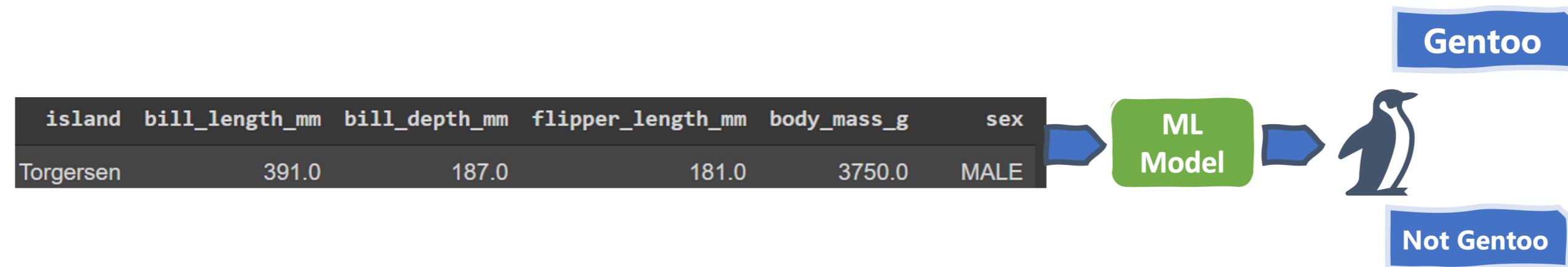
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# Supervised Learning: classification

**Classification:** assign each data observation the category (*class*) it may belong to

- **Binary classification:** two classes, e.g. positive/negative, male/female, etc.

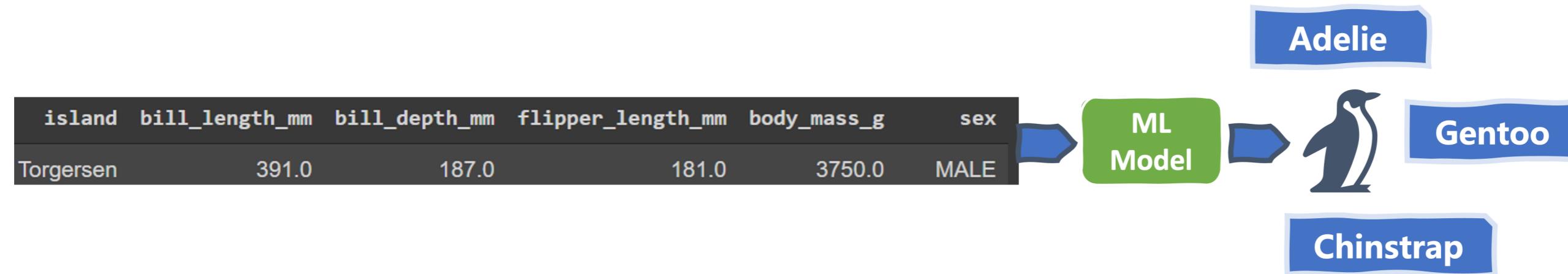


# Supervised Learning: classification

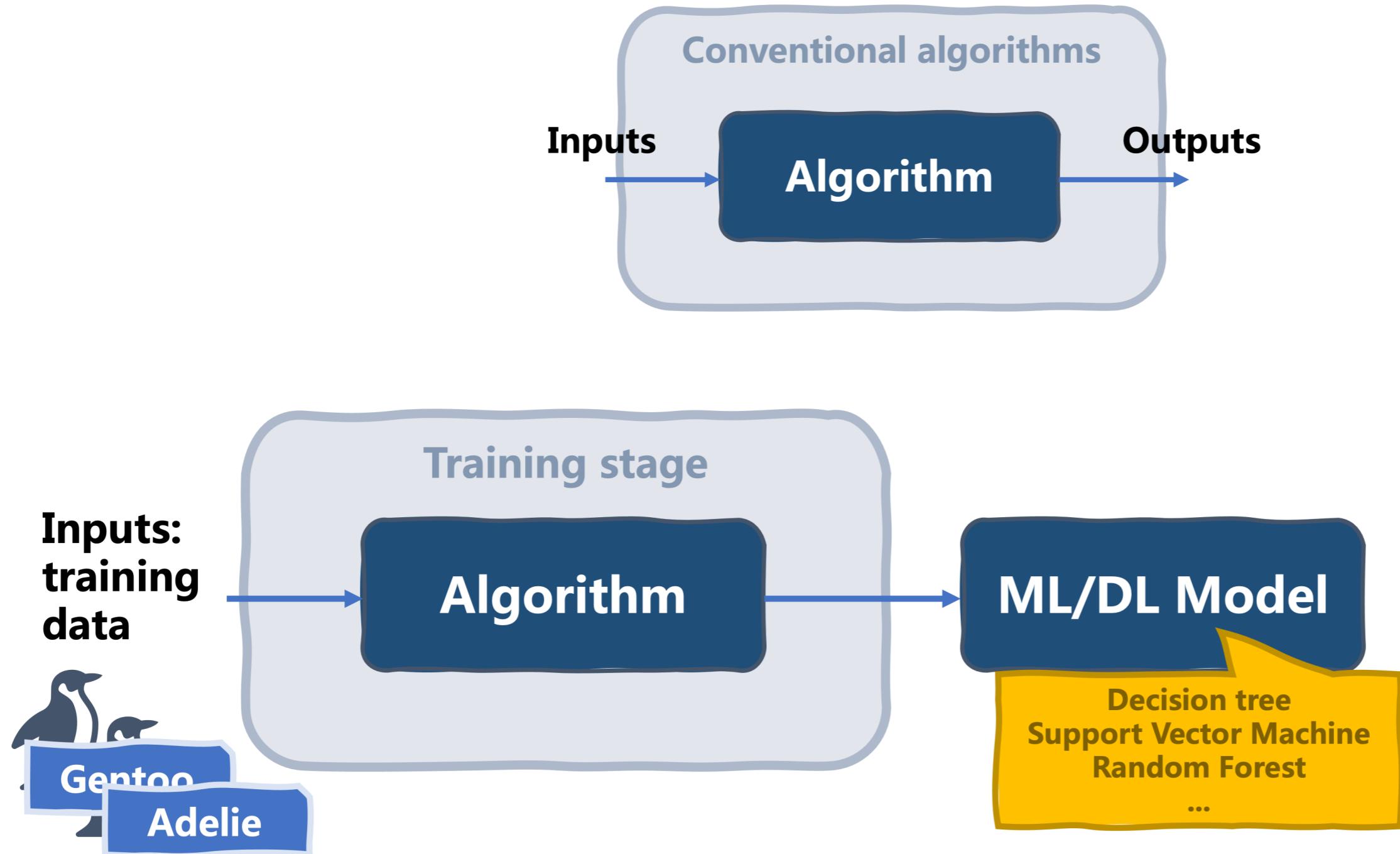
**Classification:** assign each data observation the category (*class*) it may belong to

- **Binary classification:** two classes, e.g. positive/negative, male/female, etc.
- **Multi-class classification:** several mutually exclusive classes, e.g. multiple species

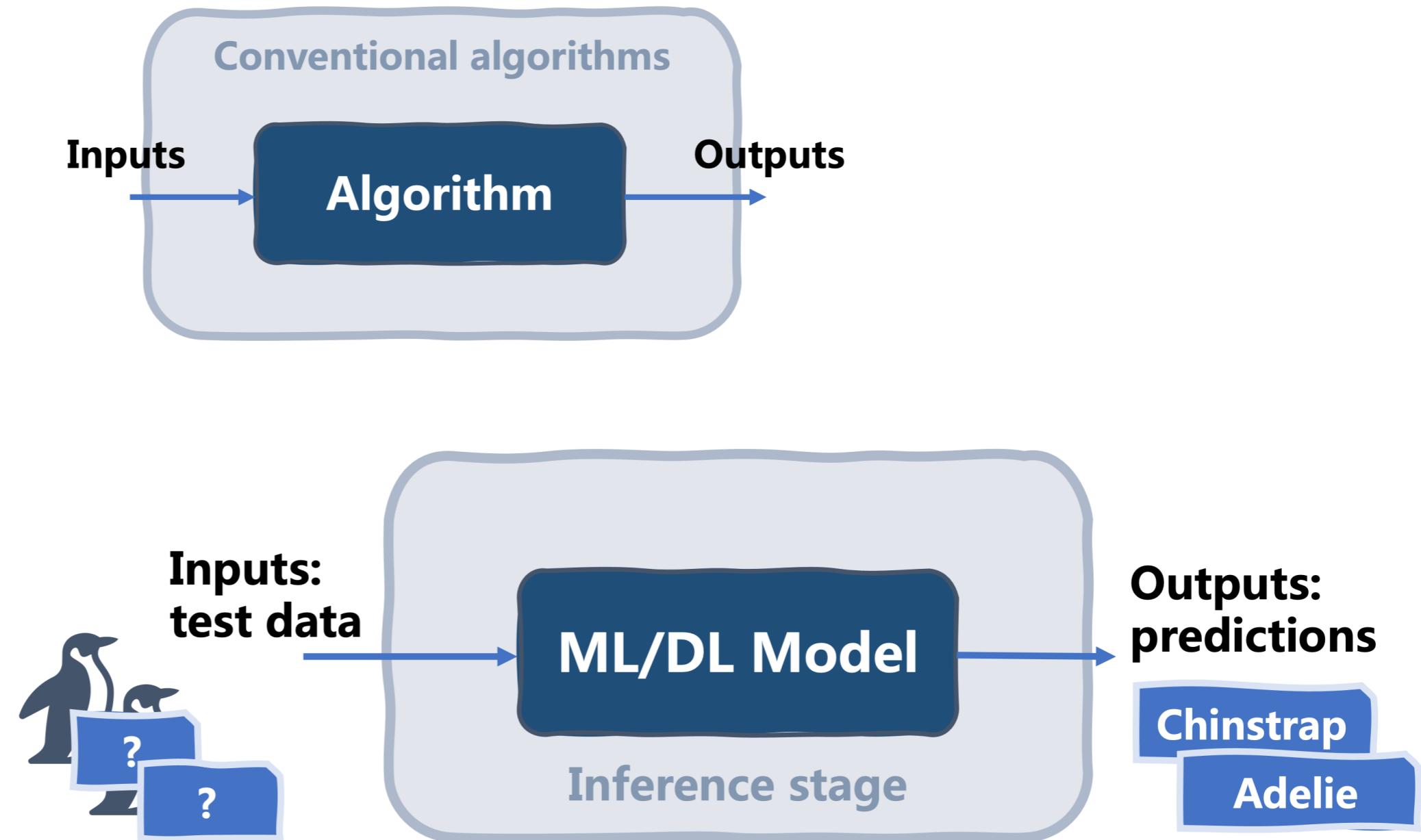
**Supervised learning:** *Data annotation* (getting labelled observations with *known class a priori*) needed to learn/train a **model** capable of making inference



# Machine Learning algorithm vs Model

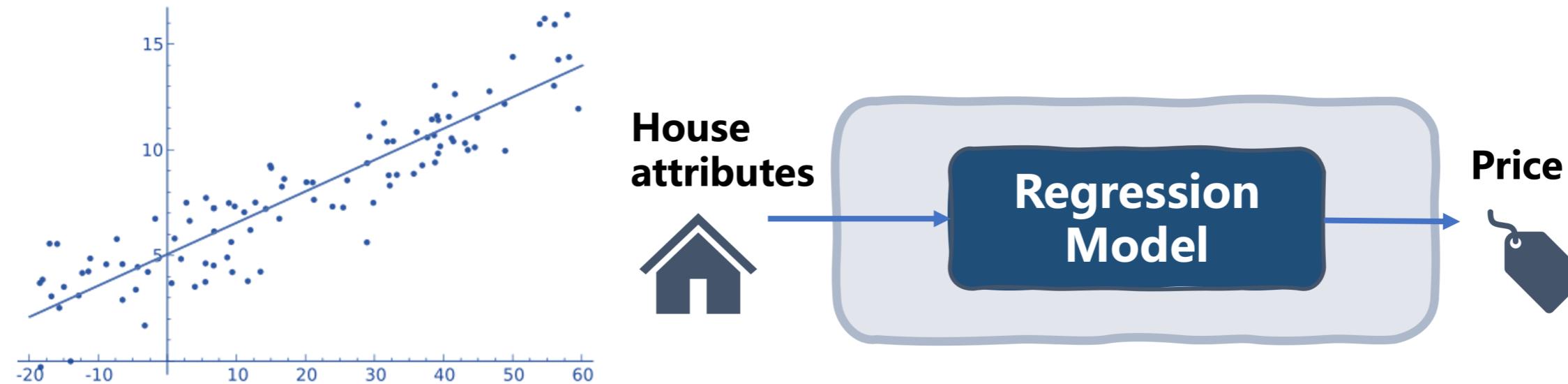


# Machine Learning algorithm vs Model

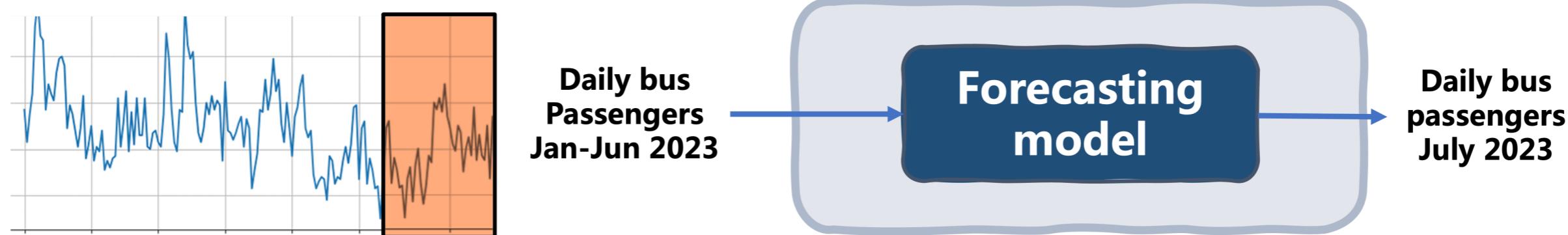


# Supervised Learning: regression and forecasting

Regression: assign each data observation a numerical output or *label* based on its inputs

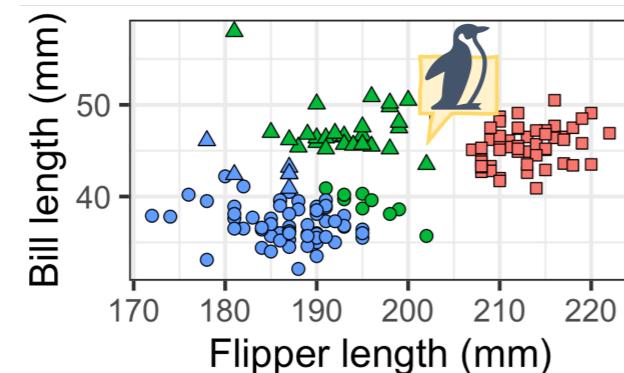


Time series forecasting: predict future values of variable, based on its past behavior

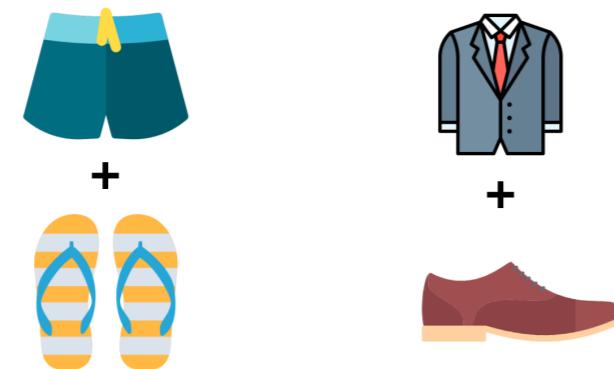


# Unsupervised and reinforcement learning

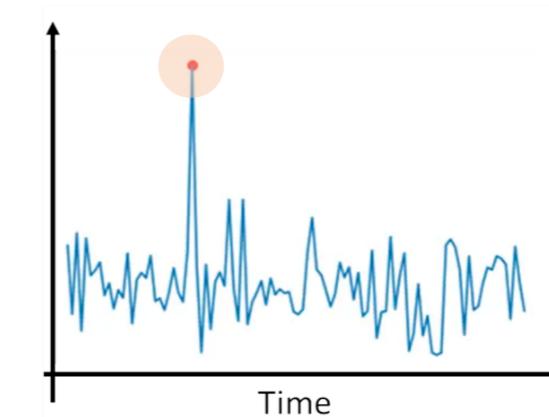
**Clustering:** find subgroups of data with *similar* characteristics (e.g. *k-means* algorithm)



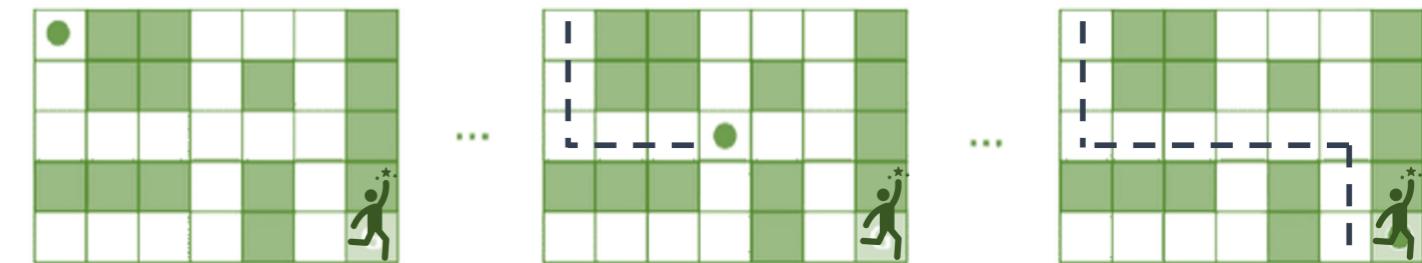
**Association rule discovery:** find common co-occurrences of items in transaction data



**Anomaly detection:** detecting *abnormal* data observations e.g. unusual card transactions



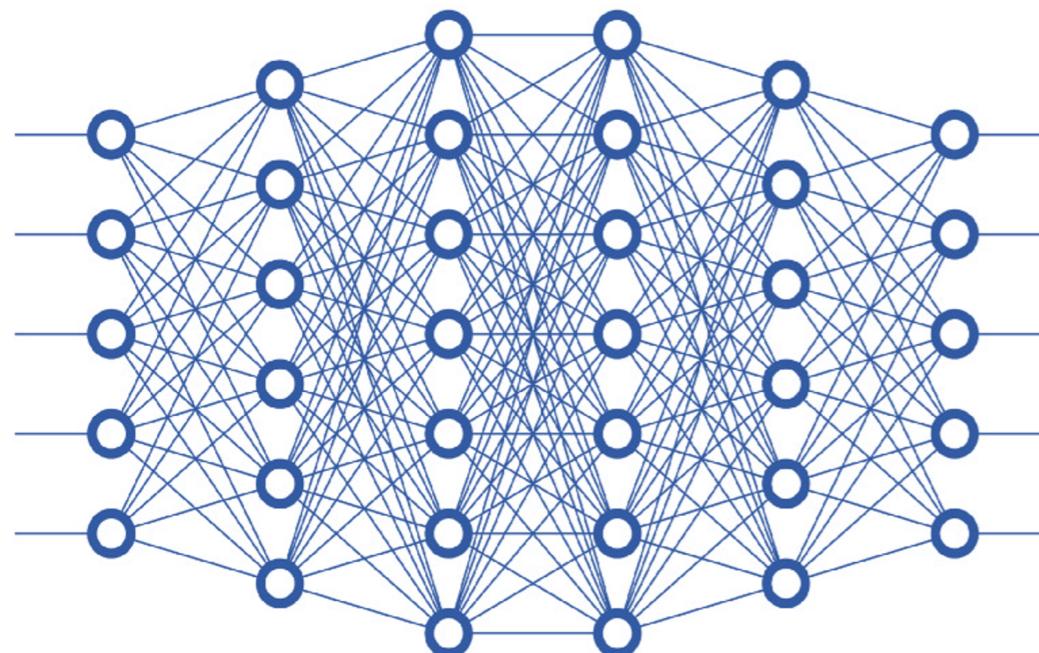
**Reinforcement learning:** learn by *experience* (trial and error) to master a complex task



# How about Deep Learning?

Highly sophisticated models based on **deep neural networks**: solve very challenging tasks where classical ML models become limited.

Need a lot of data to learn: sometimes *millions* of observations.



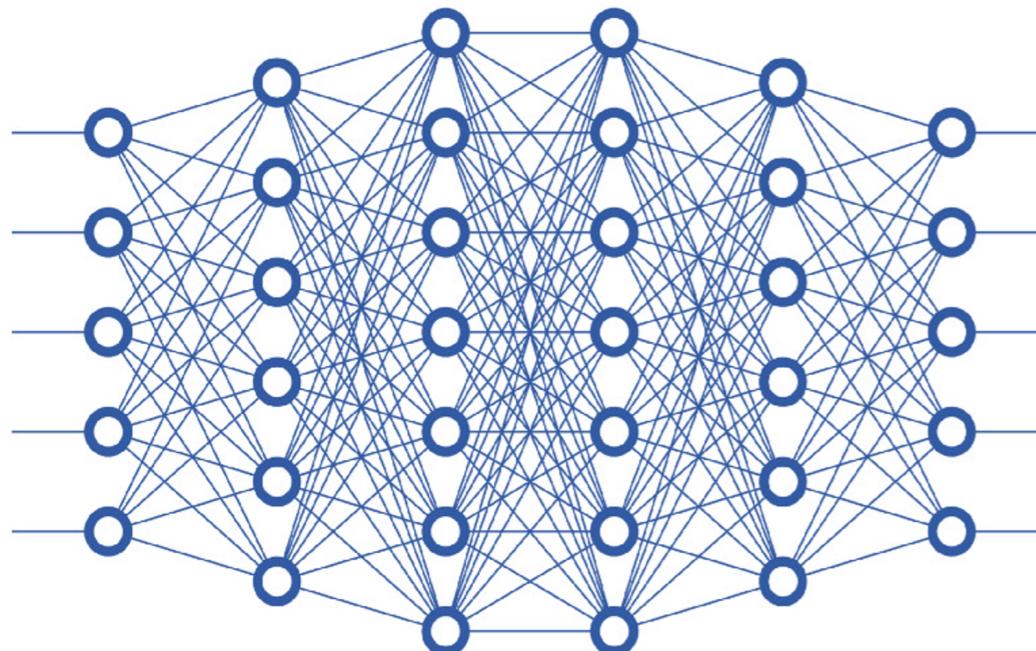
## Some tasks Deep Learning can do

- Classification
- Regression
- Forecasting
- Clustering
- Anomaly detection
- ...

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## Some tasks Deep Learning can do

Classification  
Regression  
Forecasting  
Clustering  
Anomaly detection  
...

Recognize objects in images/video

Translation, summarization, ...

**Generative AI:** Large Language Models, image and music generation, ...



你好  
→ Hola

men tropical shirt with blue and yellow motifs



# **Let's practice!**

**UNDERSTANDING ARTIFICIAL INTELLIGENCE**

# Interacting with the Environment

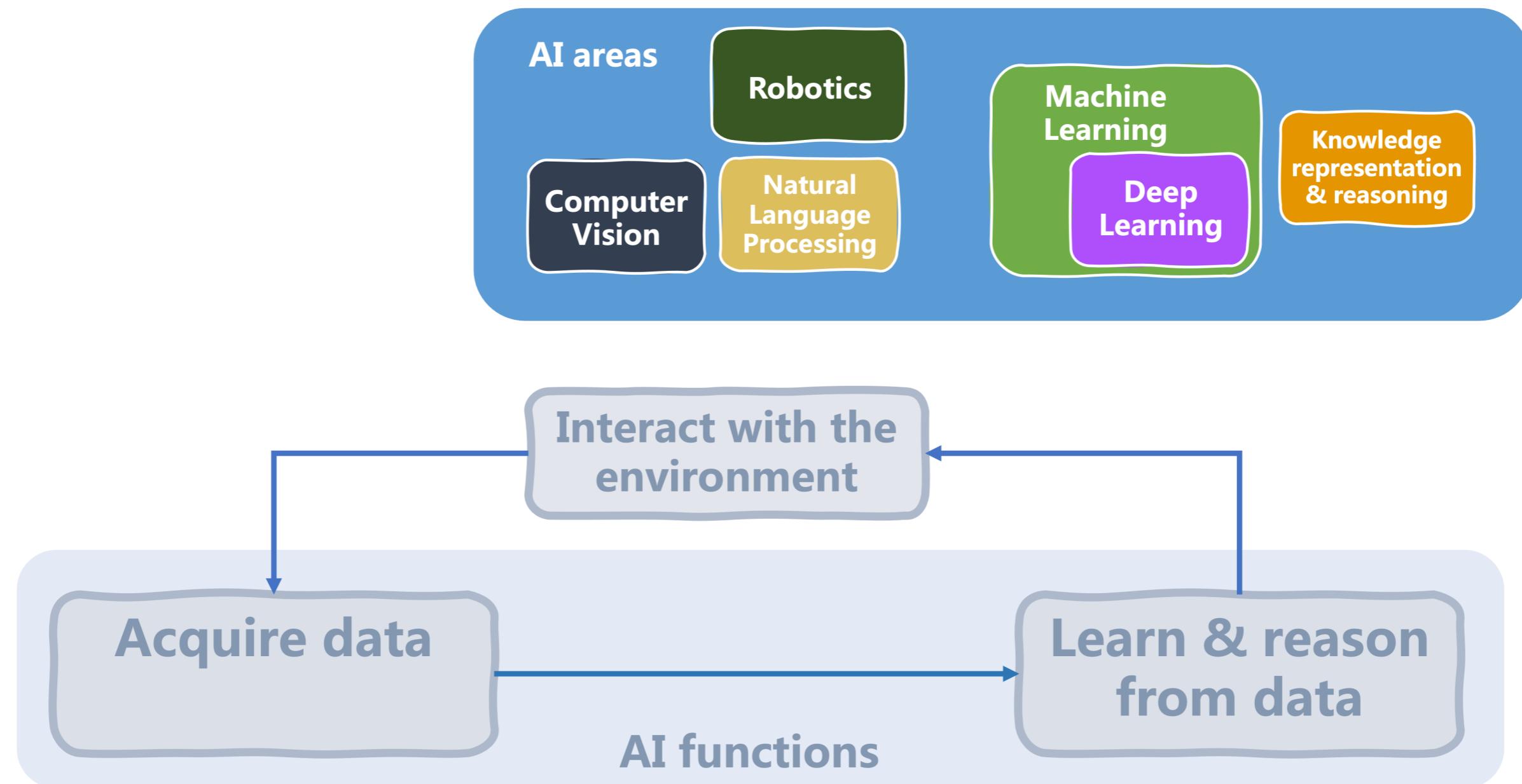
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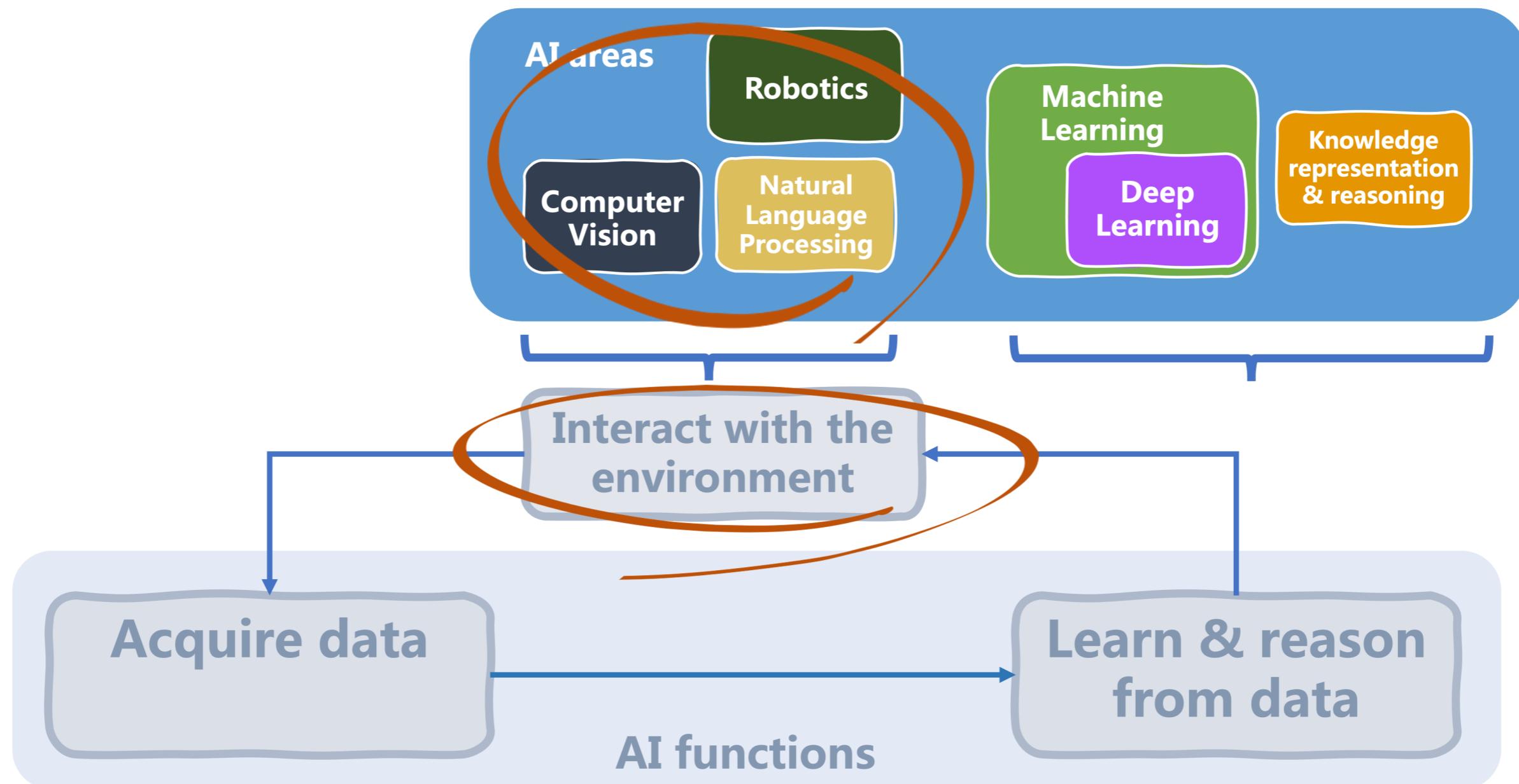
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# AI functions and areas involved

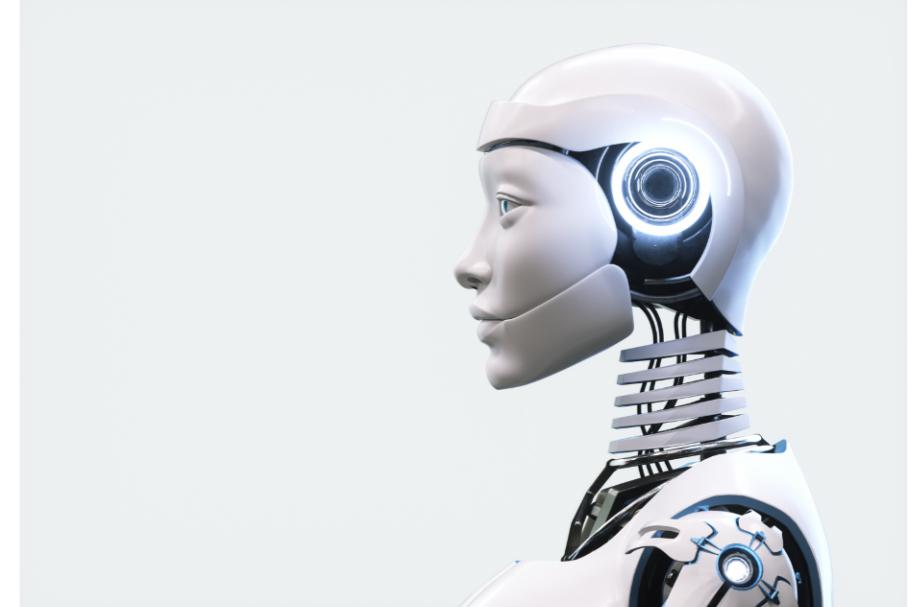


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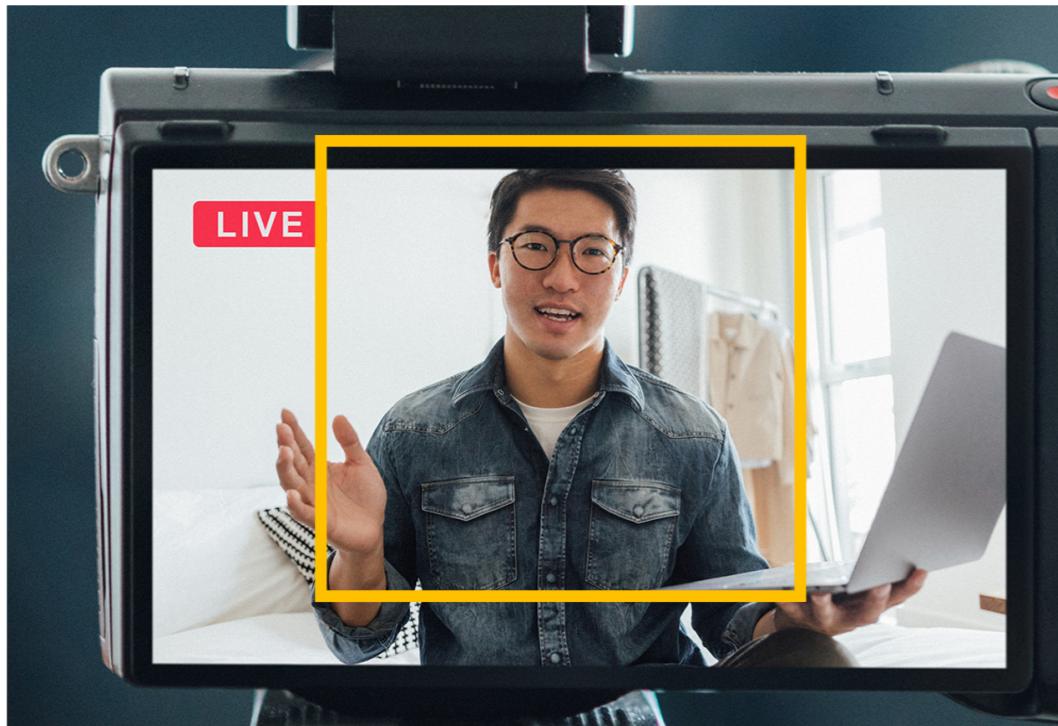
# Robotics

- **Sensing and perception:** collecting data or perceiving signals
- **Mobility:** moving in the environment guided by perceptions of surroundings
- **Manipulation:** the robot modifies its environment
- **Human-robot interaction:** e.g. conversational robots endowed with NLP



# Computer Vision

- **Image processing:** intelligently enhance images and video
- **Object detection:** identify subjects in images/video for surveillance, logistics, etc.
- **Motion analysis:** extract motion information like speed and direction of objects
- **Image and video generation:** create realistic visual data from human text

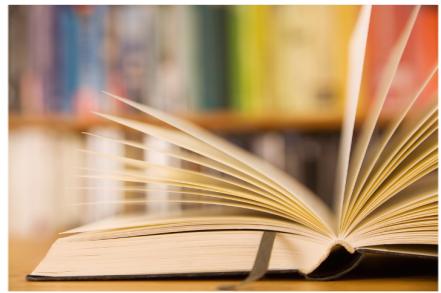


men tropical  
shirt with  
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# Natural Language Processing (NLP)

- **Text-based**
  - **Text classification**
  - **Sentiment analysis:** extract positive and negative feelings in text, e.g. customer reviews.
  - **Question answering (chatbots)**
  - **Text summarization**
- **Speech-based**
  - **Text-to-speech**
  - **Speech-to-text**



你好  
↓  
Hola



# Chapter summary

Takeaways from this chapter:

- **Algorithms** are the building blocks of **AI systems**, along with data, hardware and other components
- **Acquiring data, learning and reasoning from data, and interacting with the environment**, are three key functions in AI systems
- **Data collection** into **datasets** are the fuel of most AI systems, especially those guided by **Machine Learning and Deep Learning**

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