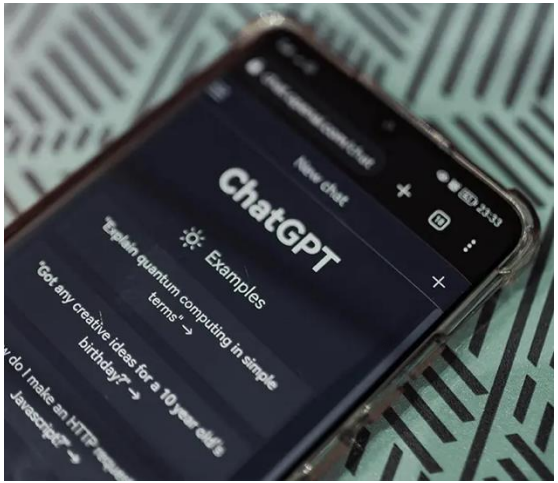
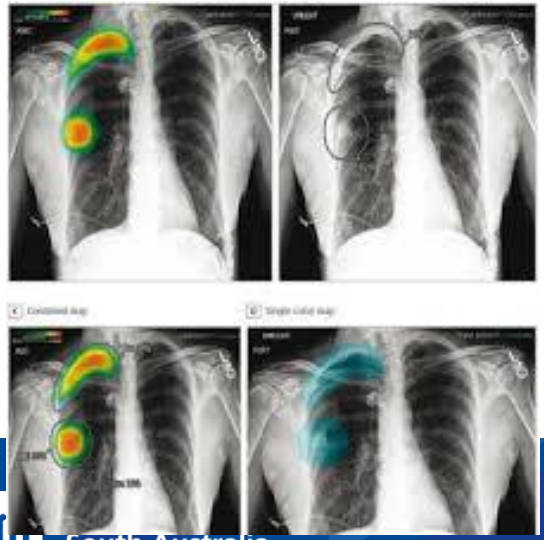
University of
South Australia

How AI Works

A/Prof Wolfgang Mayer
Industrial AI Research Centre


ChatGPT
Examples
Explain quantum computing in simple terms
Got any creative ideas for a 10 year old's birthday?

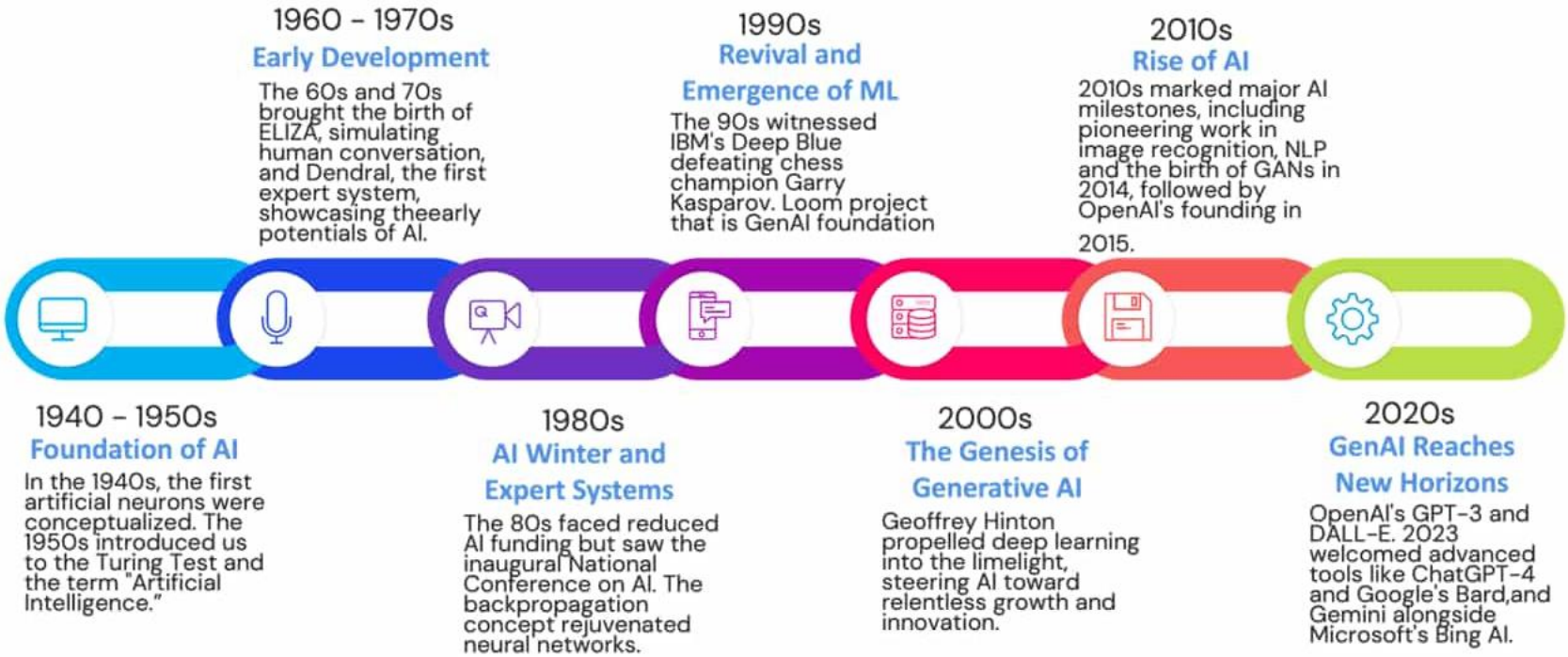



AlphaGo
Lee Sedol

Traits of AI

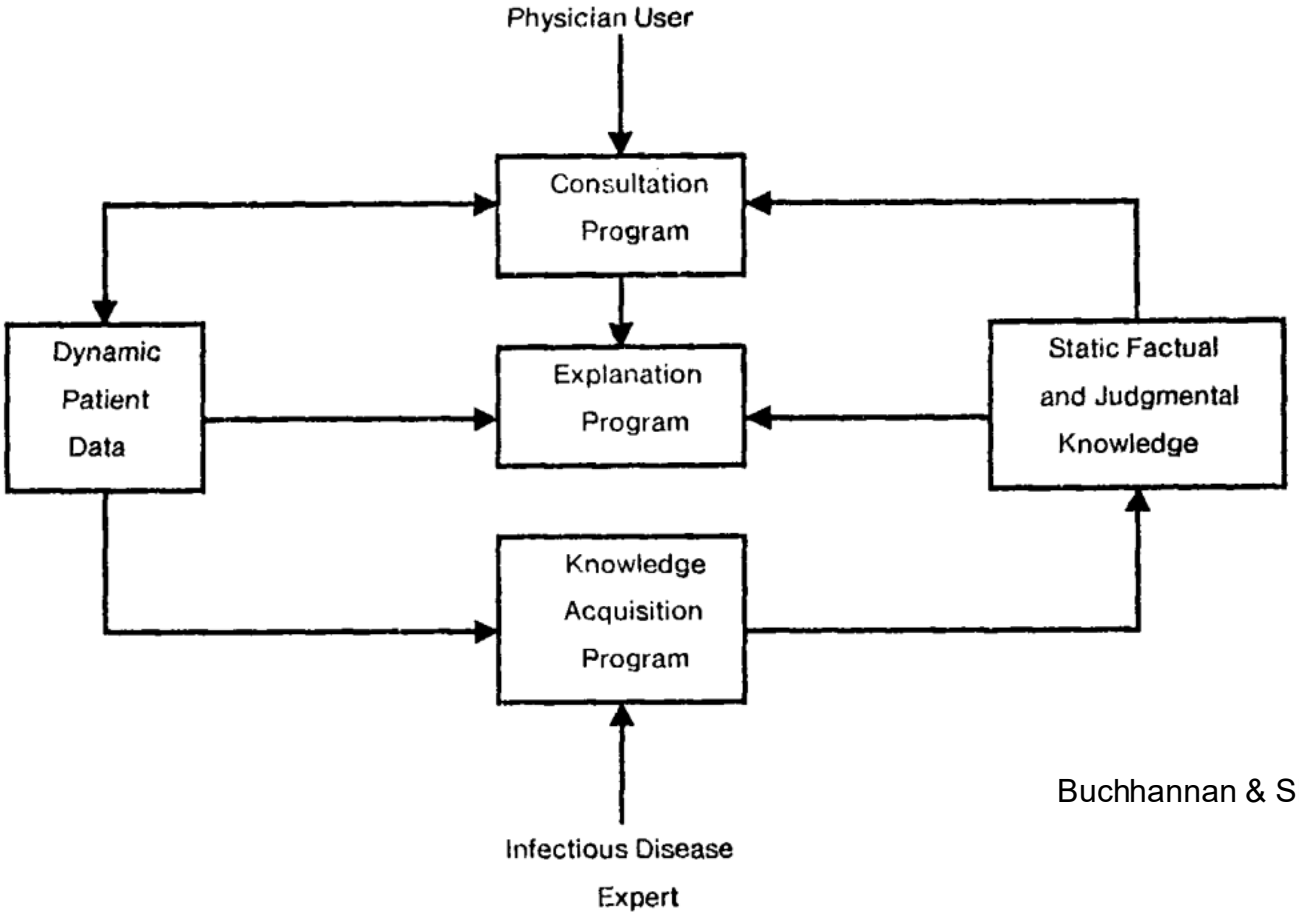
- Perception
- Manipulate Objects
- Natural Language Understanding
- Learning
- Planning
- Knowledge Representation
- Reasoning

History of AI



https://www.aibrilliance.com/blog/from-turing-to-today-a-brief-history-of-ai

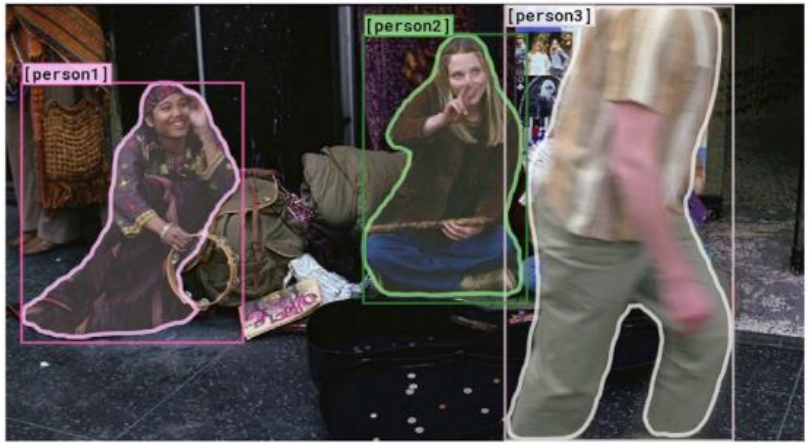
Mycin



Buchhannan & Shortliffe (1984)

A Sample Question from the Visual Commonsense Reasoning (VCR) Challenge

Source: Zellers et al., 2018



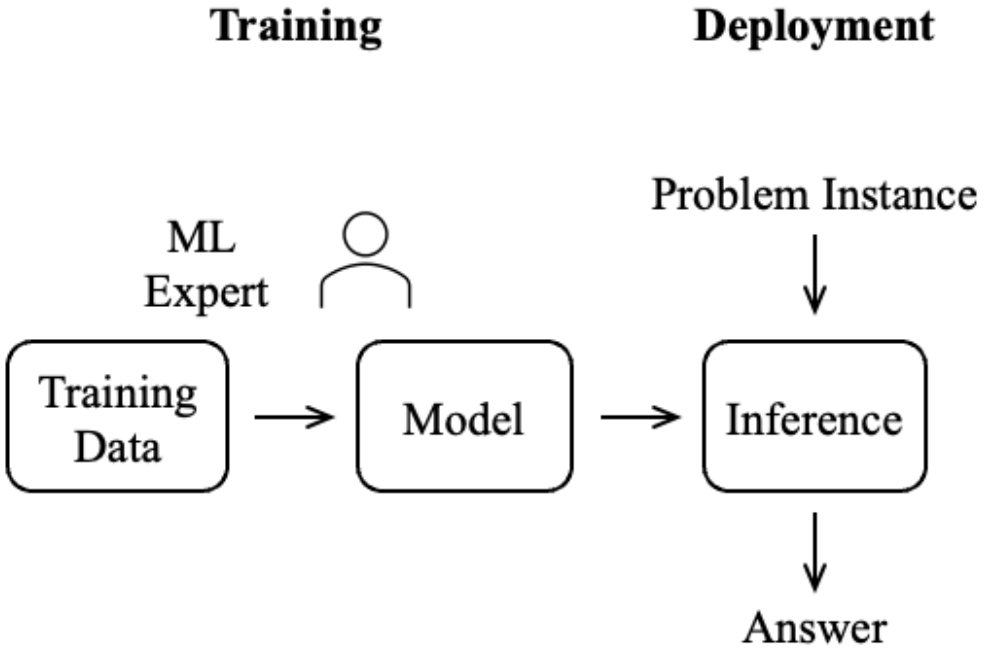
How did [person2] get the money that's in front of her?

a) [person2] is selling things on the street.
b) [person2] earned this money playing music.
c) She may work jobs for the mafia.
d) She won money playing poker.

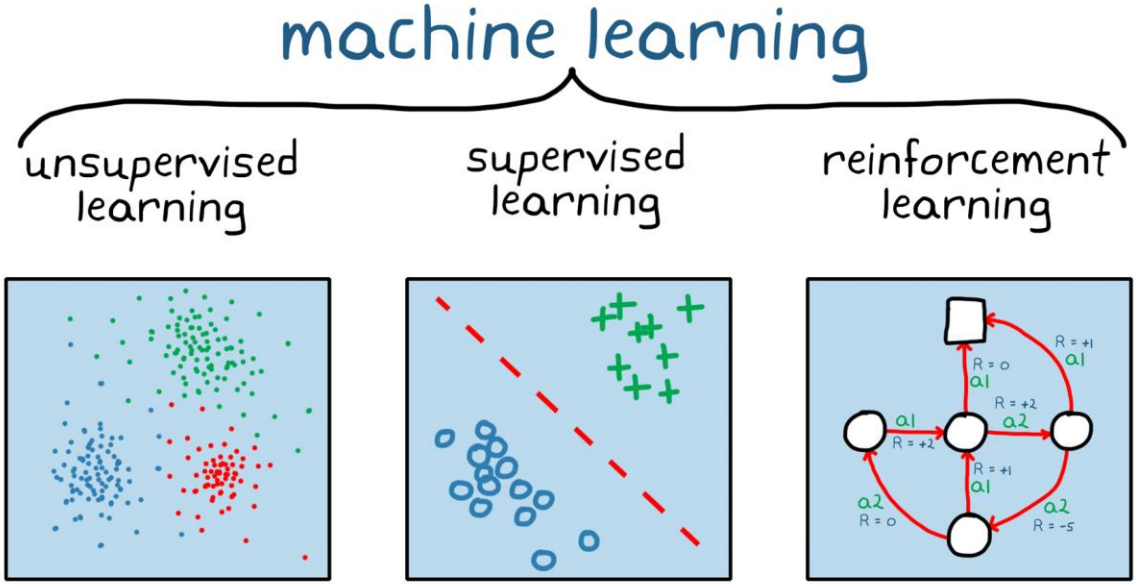
I chose **b)** because...

a) She is playing guitar for money.
b) [person2] is a professional musician in an orchestra.
c) [person2] and [person1] are both holding instruments, and were probably busking for that money.
d) [person1] is putting money in [person2]'s tip jar, while she plays music.

Learning From Data

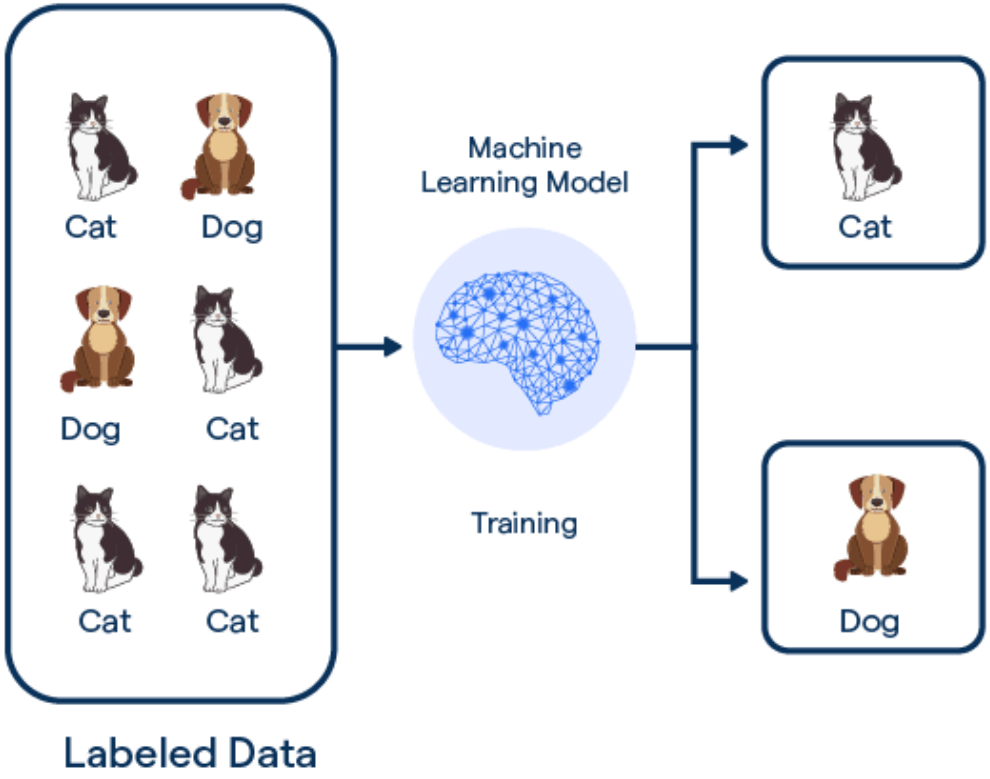


Types of Learning



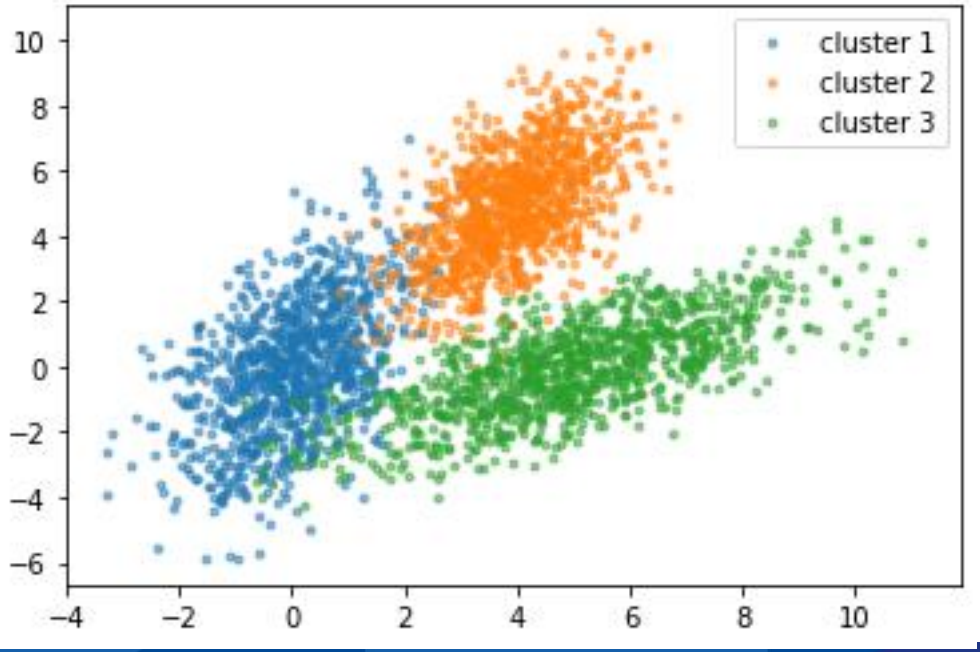
https://www.mathworks.com/discovery/reinforcement-learning.html

Supervised Learning

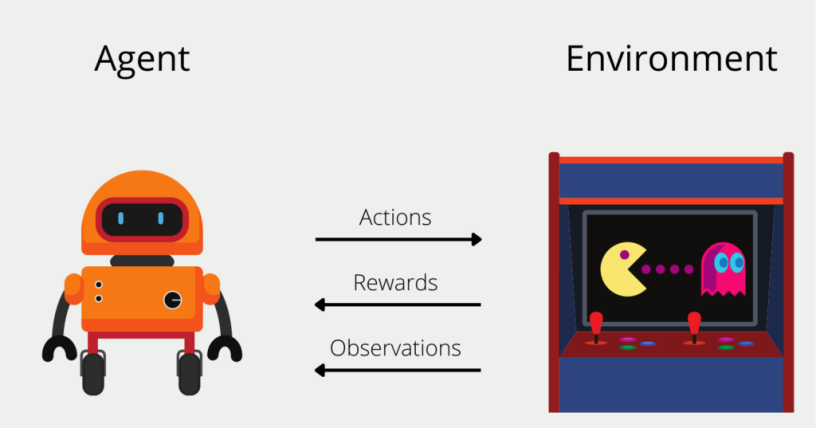


https://botpenguin.com/glossary/supervised-learning

Unsupervised Learning

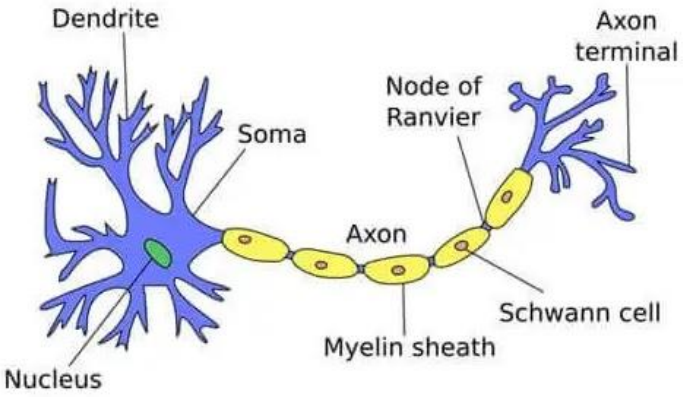


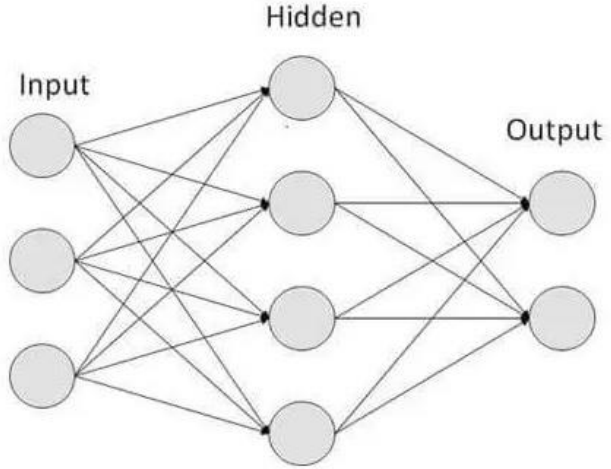
Reinforcement Learning



https://databasecamp.de/en/ml/reinforcement-learnings

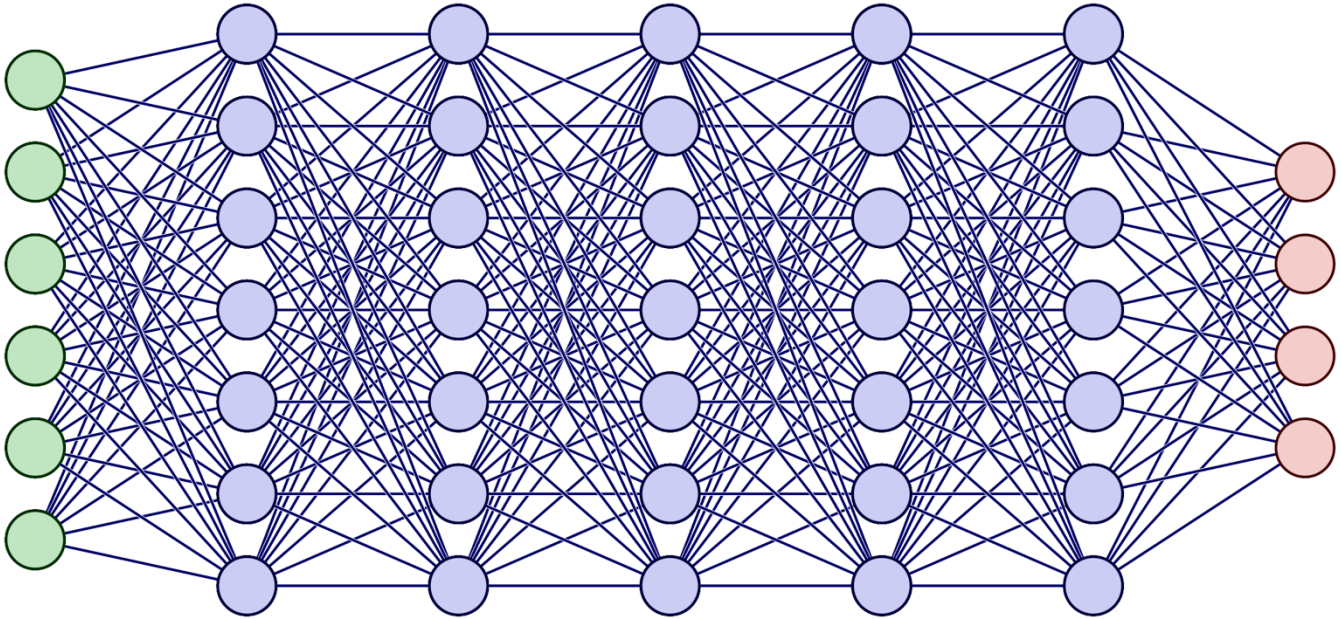
Neural Networks





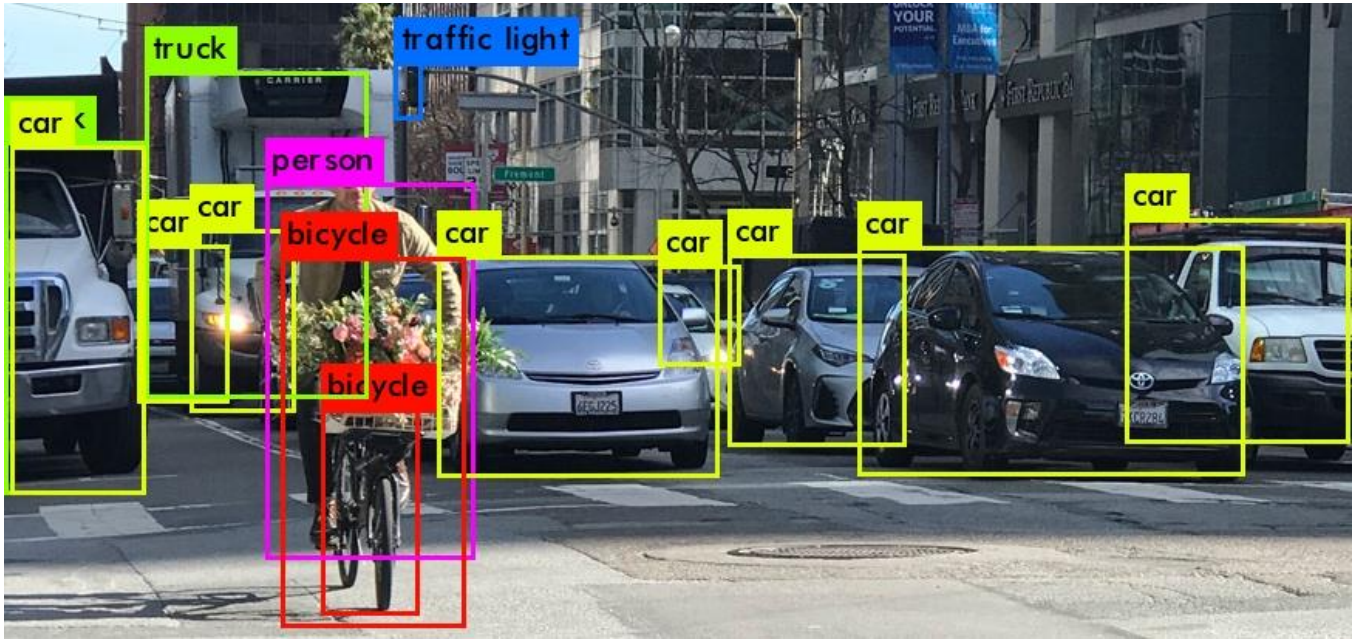
https://www.unaligned.io/p/neural-networks-simulating-human-brain-ai

Deep Neural Networks



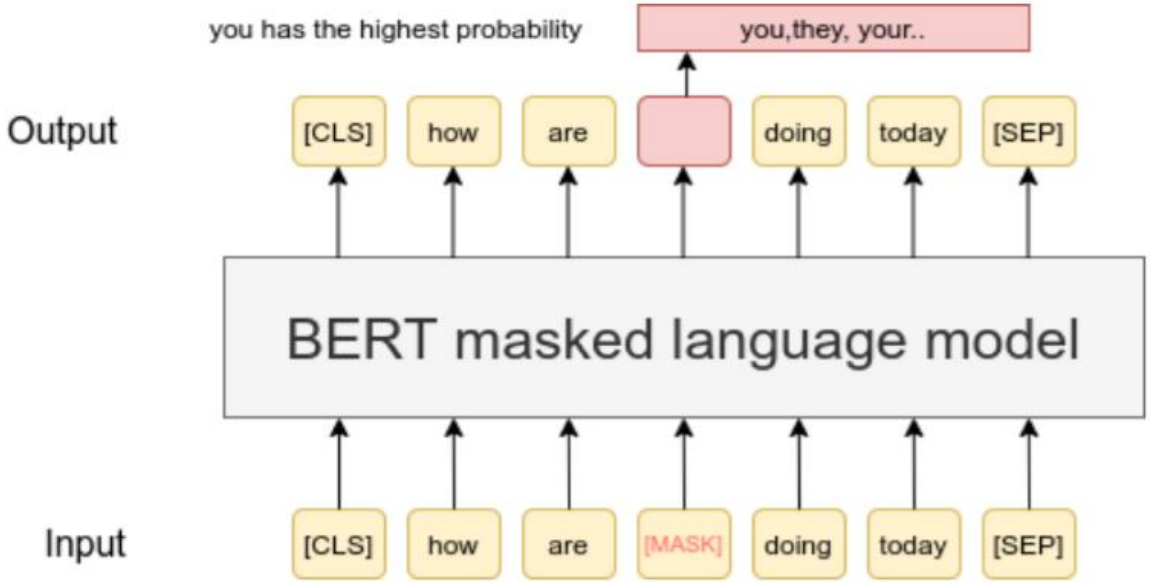
https://tikz.net/neural_networks/

Computer Vision



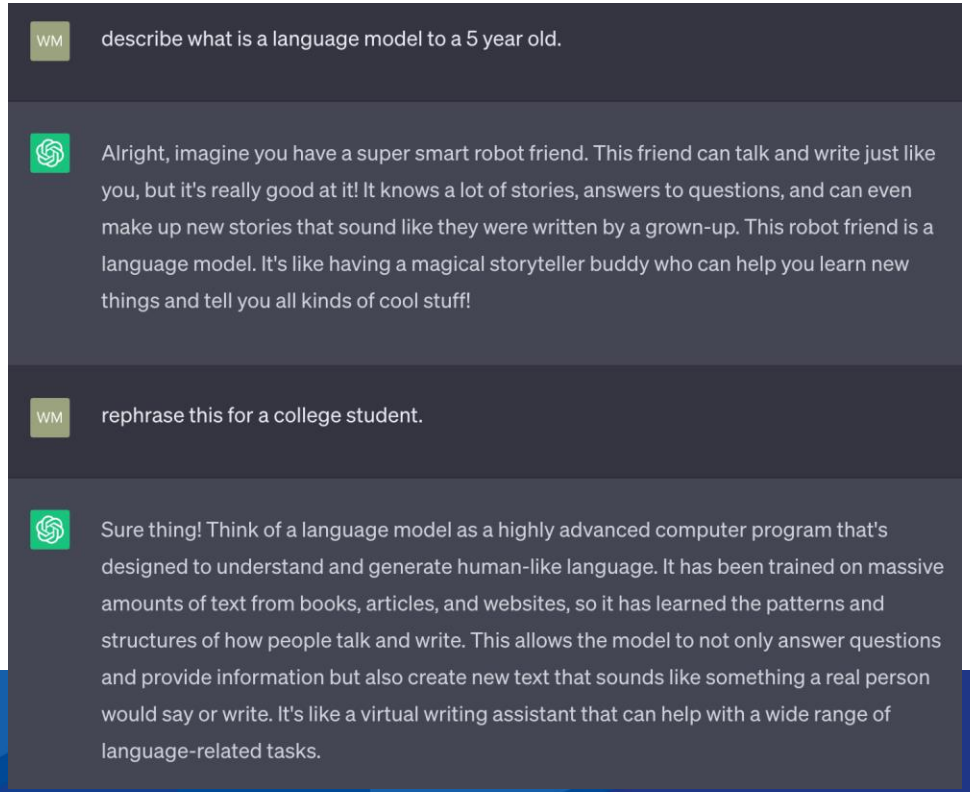
https://ai-pool.com/a/s/yolov3-and-yolov4-in-object-detection

Foundation (Language) Model

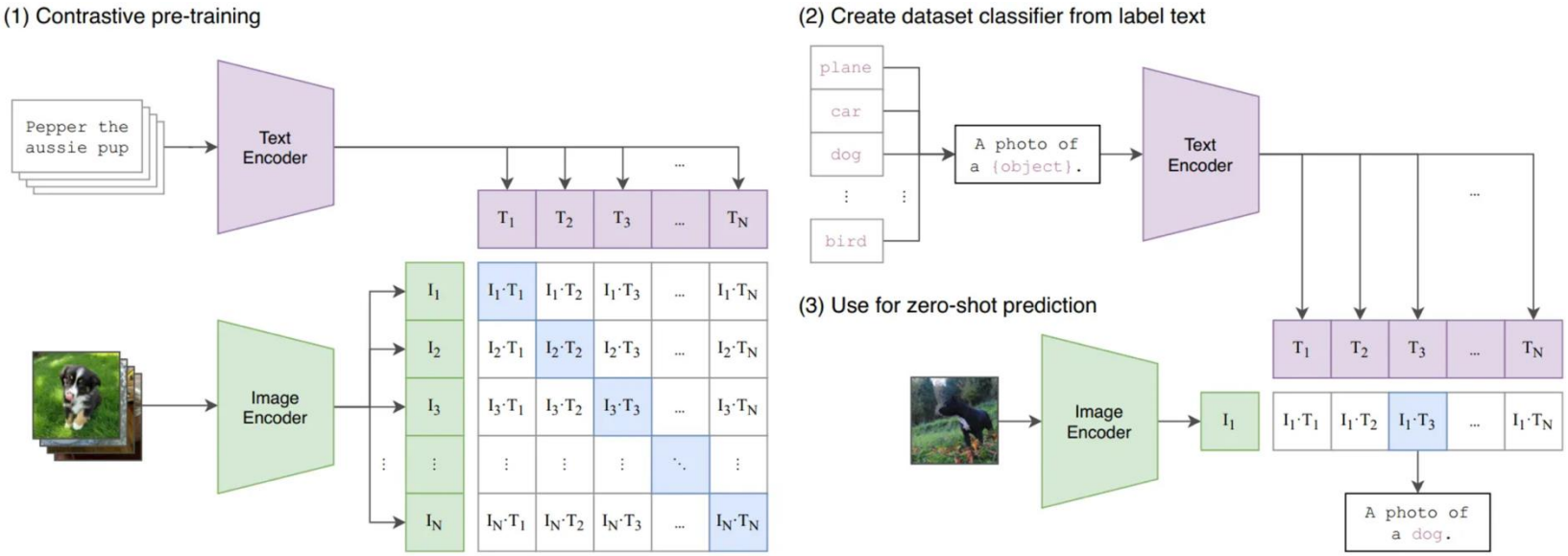


https://www.sbert.net/examples/unsupervised_learning/MLM/README.html

Natural Language Processing



Multi-Modal Models

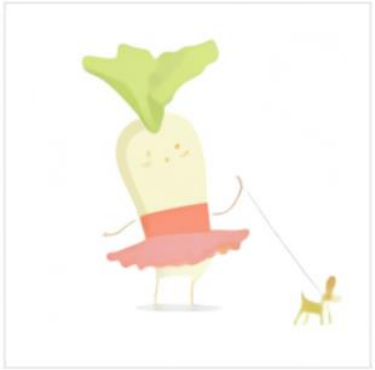


Dall-E

TEXT PROMPT

an illustration of a baby daikon radish in a tutu walking a dog

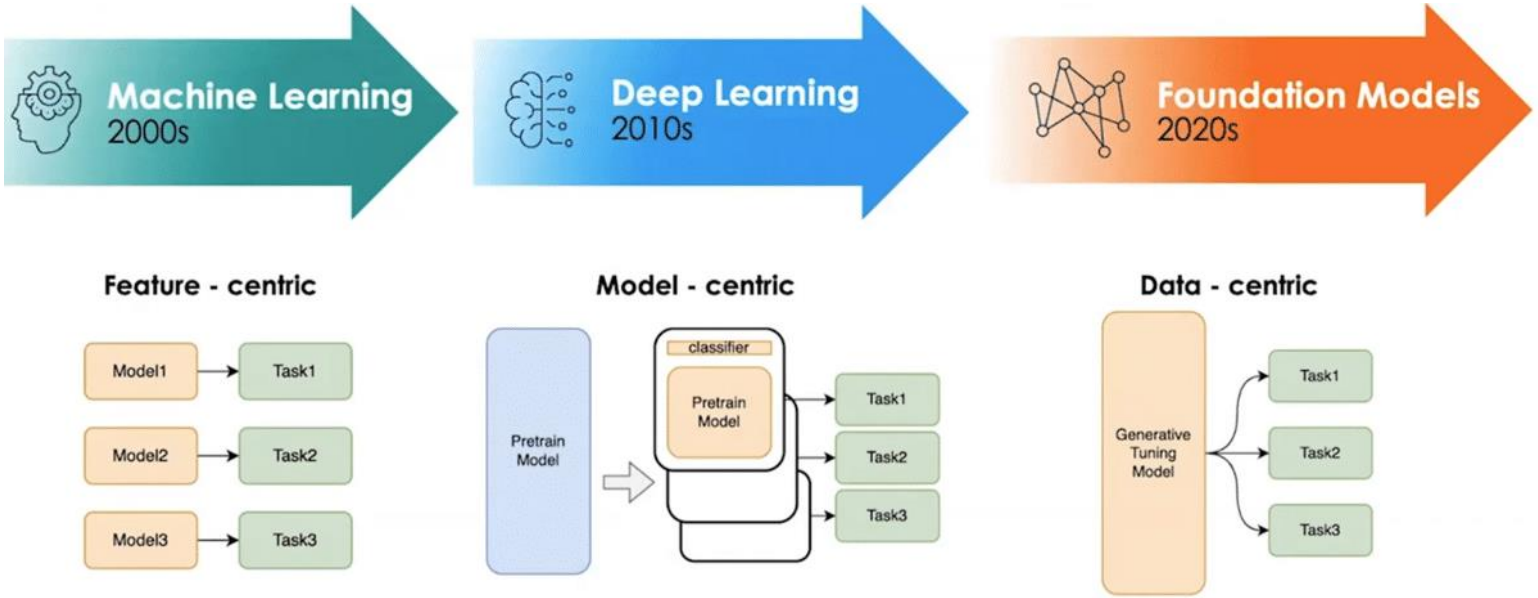
AI-GENERATED IMAGES





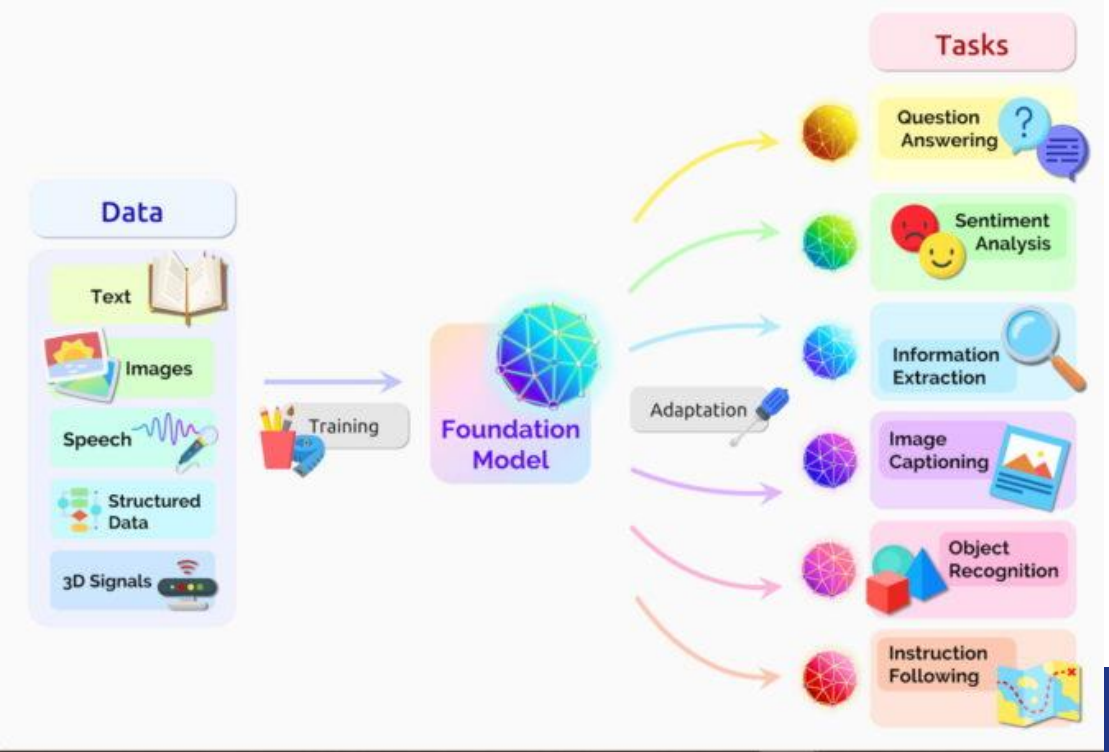
https://openai.com/blog/dall-e/

ML Evolution



https://snorkel.ai/sambanova-a-practical-approach-to-delivering-enterprise-value-with-foundation-models/

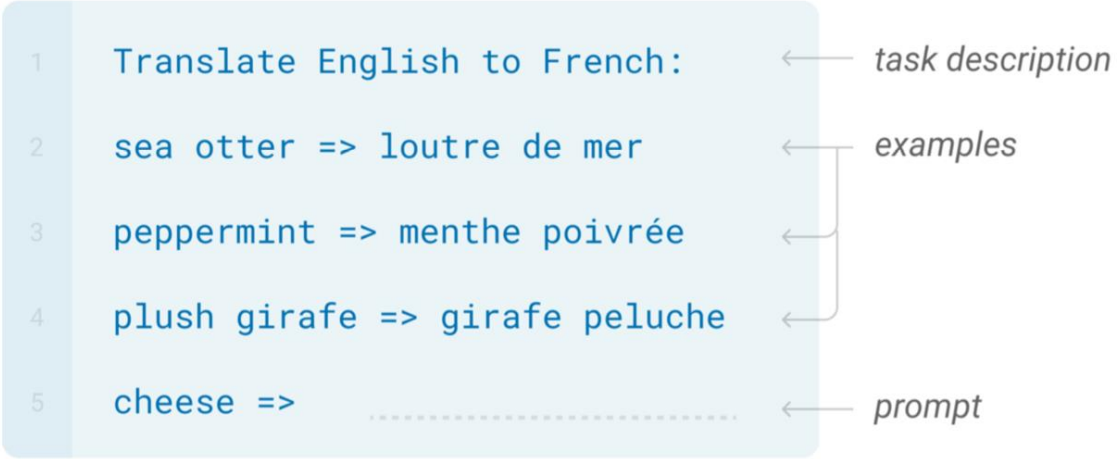
A New Paradigm



https://blogs.nvidia.com/blog/2023/03/13/what-are-foundation-models/

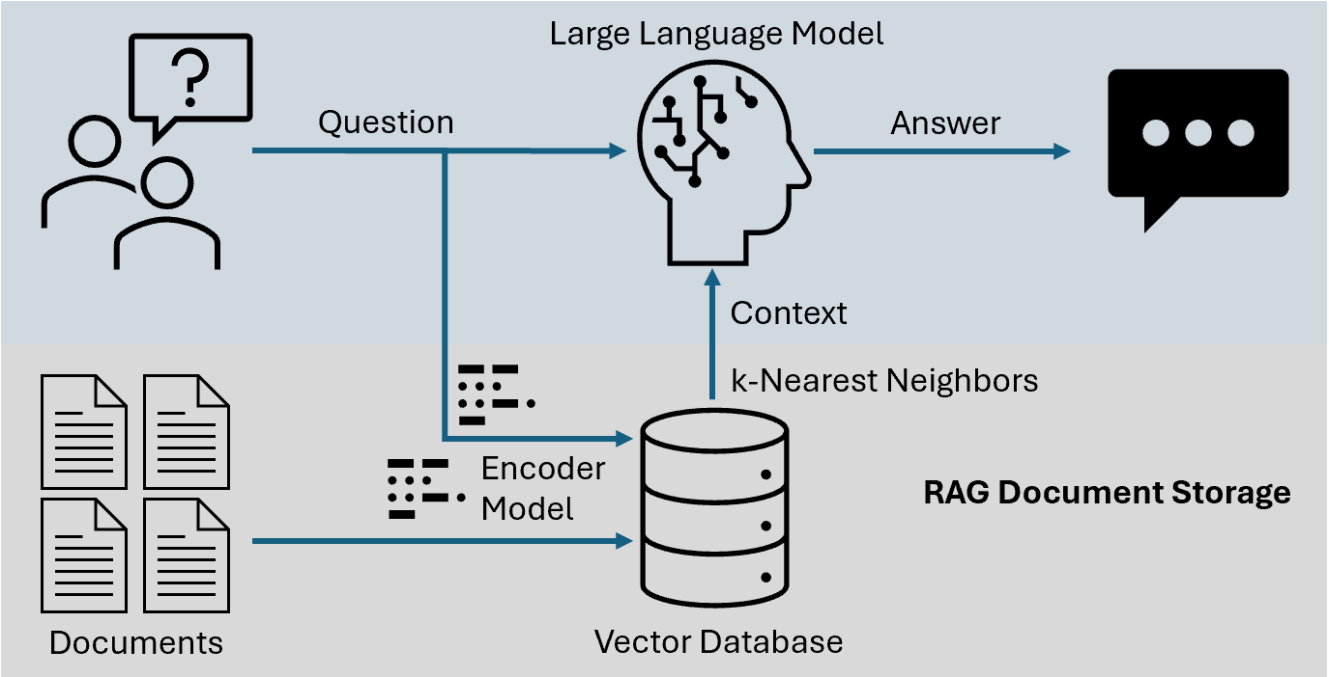
In-Context Learning

In addition to the task description, the model sees a few examples of the task. No gradient updates are performed.



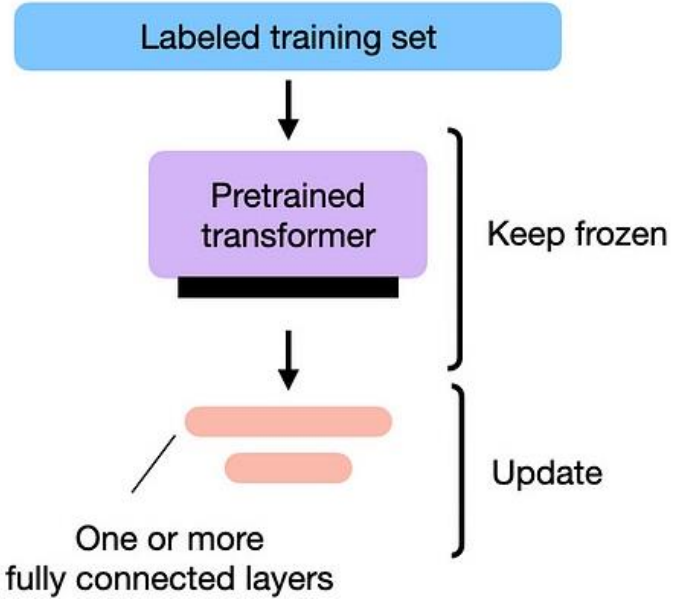
https://ai.stanford.edu/blog/in-context-learning/

RAG

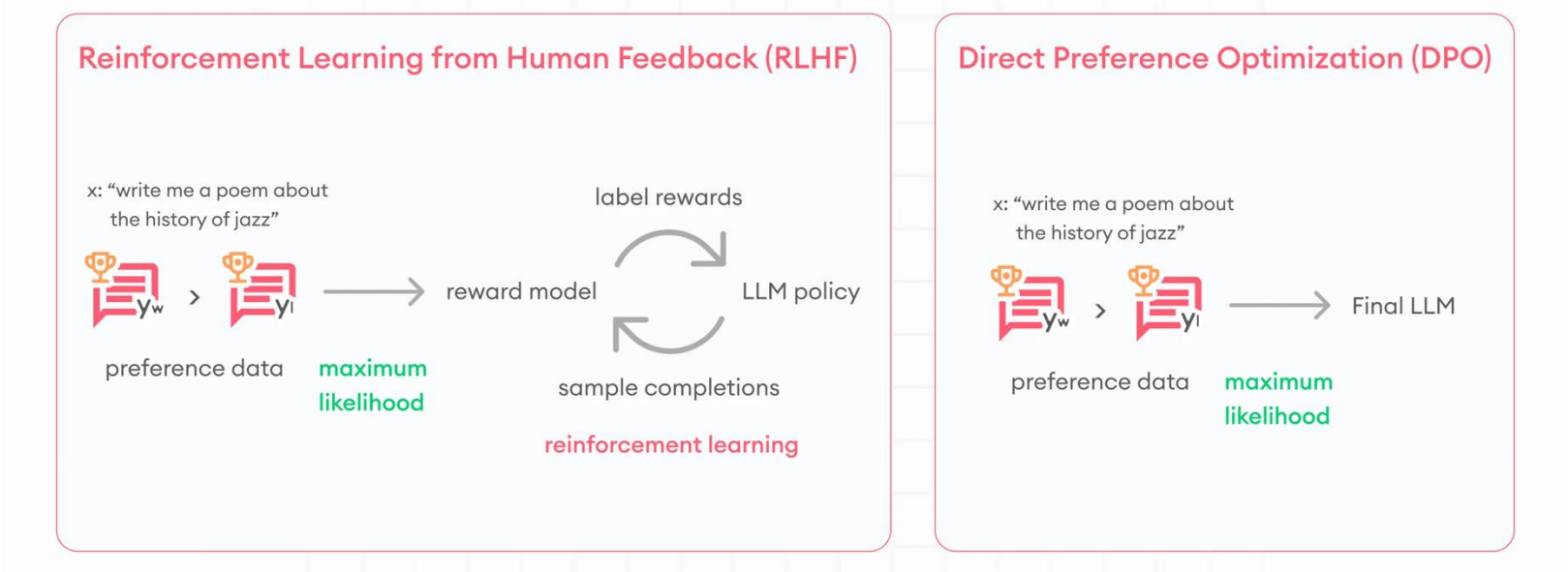


https://apmonitor.com/dde/index.php/Main/RAGLargeLanguageModel

Finetuning I

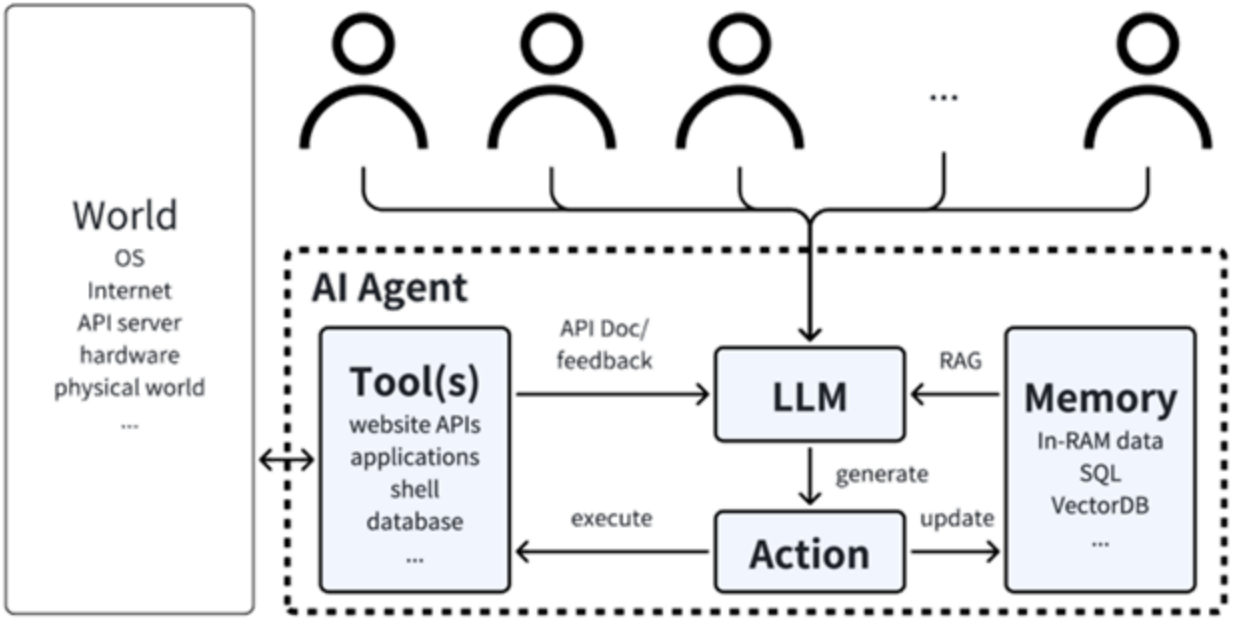


Finetuning II



https://www.superannotate.com/blog/direct-preference-optimization-dpo

LLM Agents



https://www.researchgate.net/figure/Overview-of-LLM-based-AI-agent_fig1_381404977

Summary

- AI simulates human intelligence through learning, reasoning, and perception.
- Deep learning powered breakthroughs in vision, speech, and language using layered neural networks.
- Foundation models have changed the field of AI & ML
- Not all problems are well-suited to AI
- AI must be designed as part of a Human-AI system