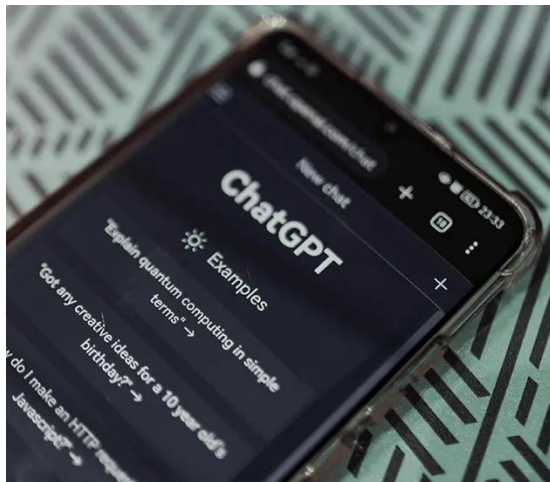




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# How AI Works

A/Prof Wolfgang Mayer  
Industrial AI Research Centre



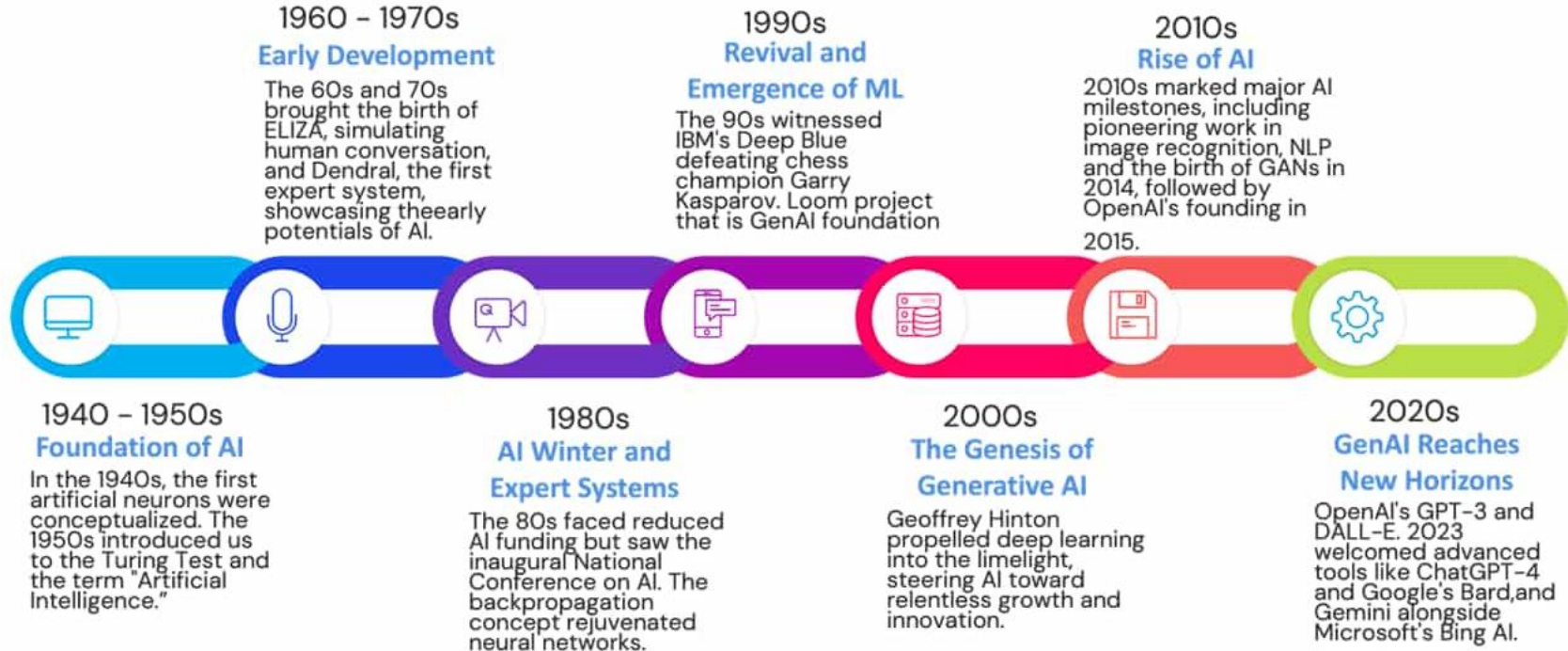
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# Traits of AI

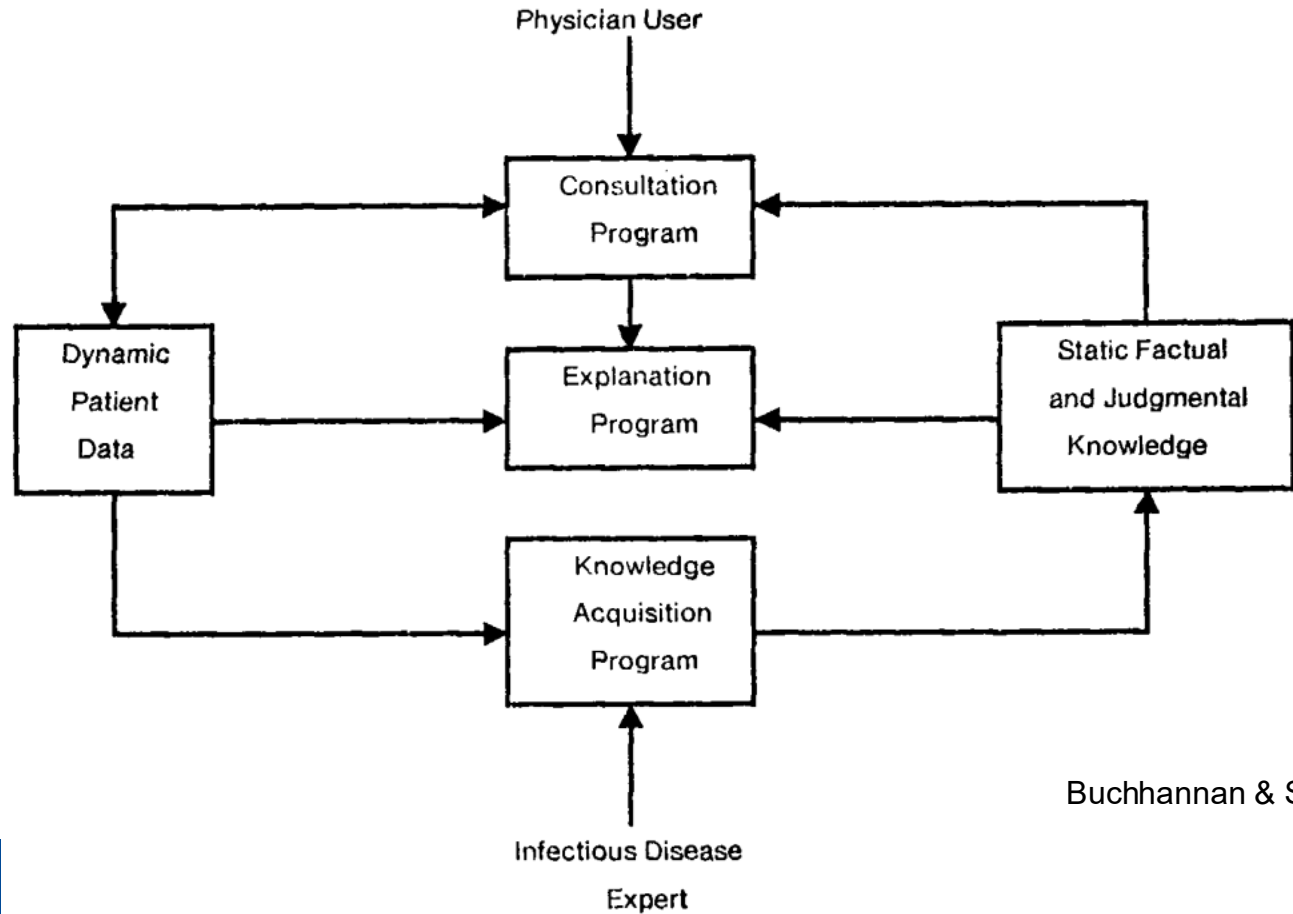
- Perception
- Manipulate Objects
- Natural Language Understanding
- Learning
- Planning
- Knowledge Representation
- Reasoning



# History of AI



# Mycin



Buchhannan & Shortliffe (1984)

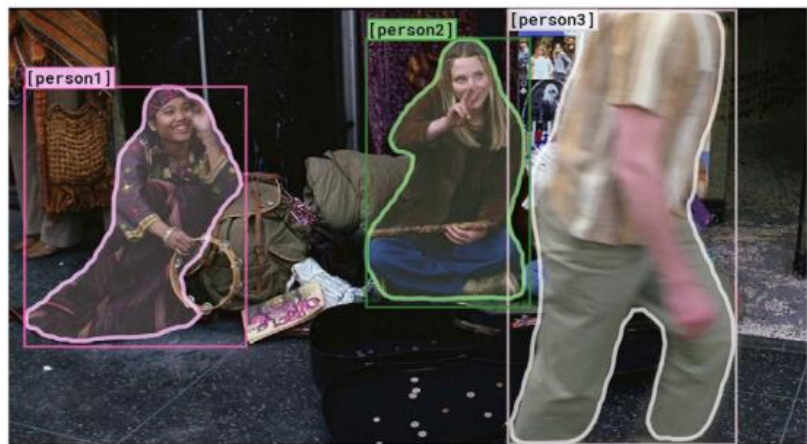


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# A Sample Question from the Visual Commonsense Reasoning (VCR) Challenge

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.

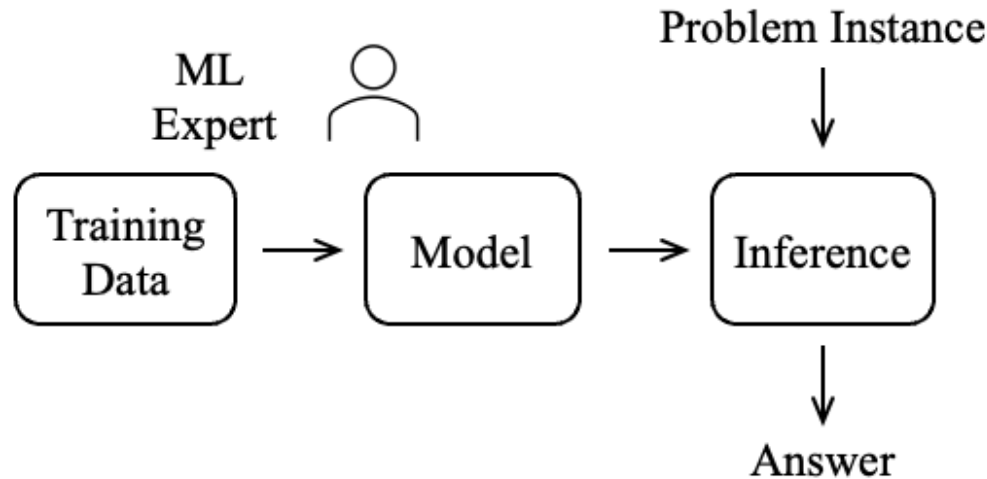
I chose b) because...

- 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

**Training**

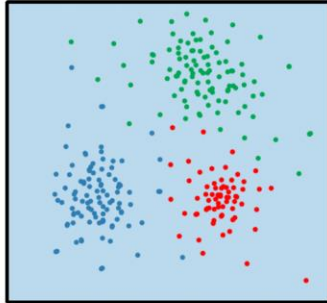
**Deployment**



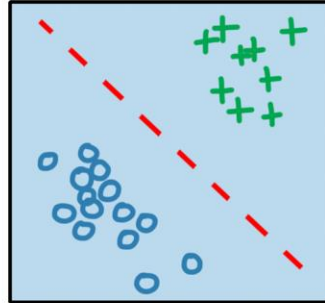
# Types of Learning

## machine learning

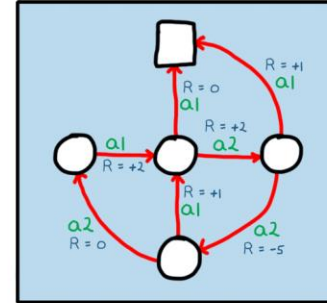
unsupervised  
learning



supervised  
learning

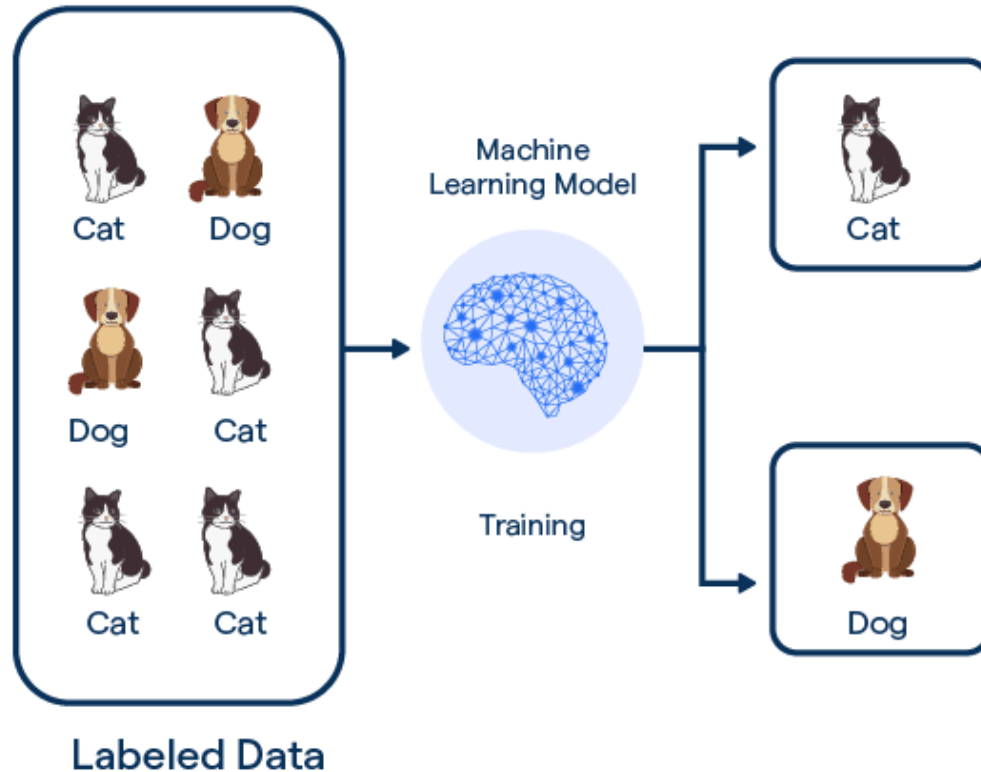


reinforcement  
learning

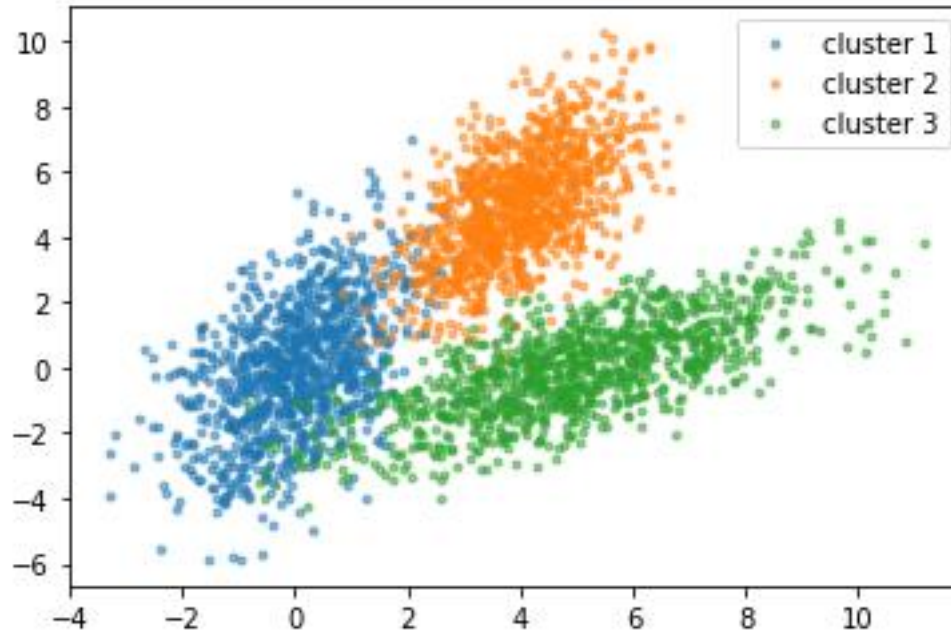




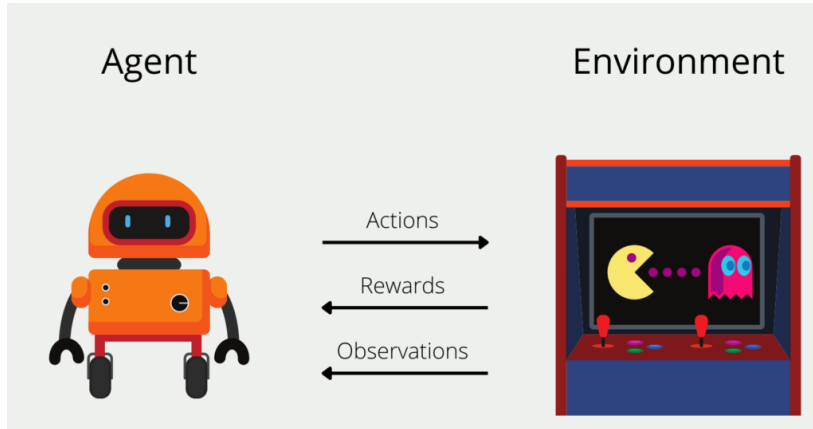
# Supervised Learning



# Unsupervised Learning



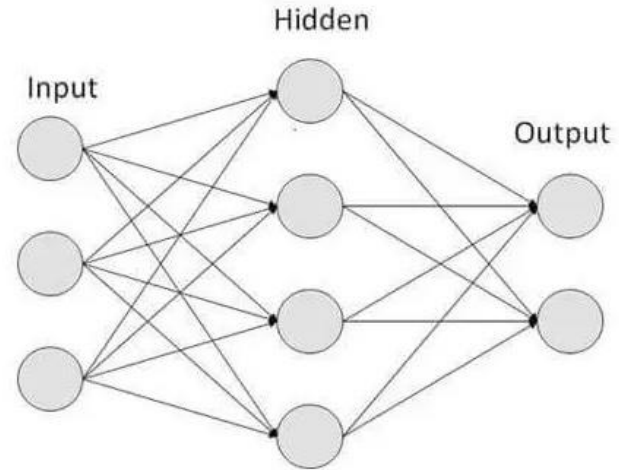
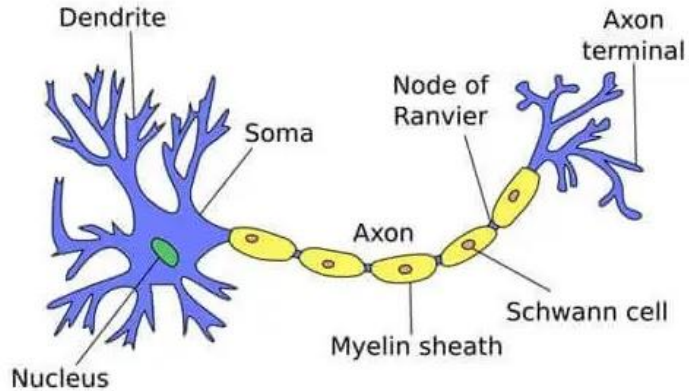
# Reinforcement Learning



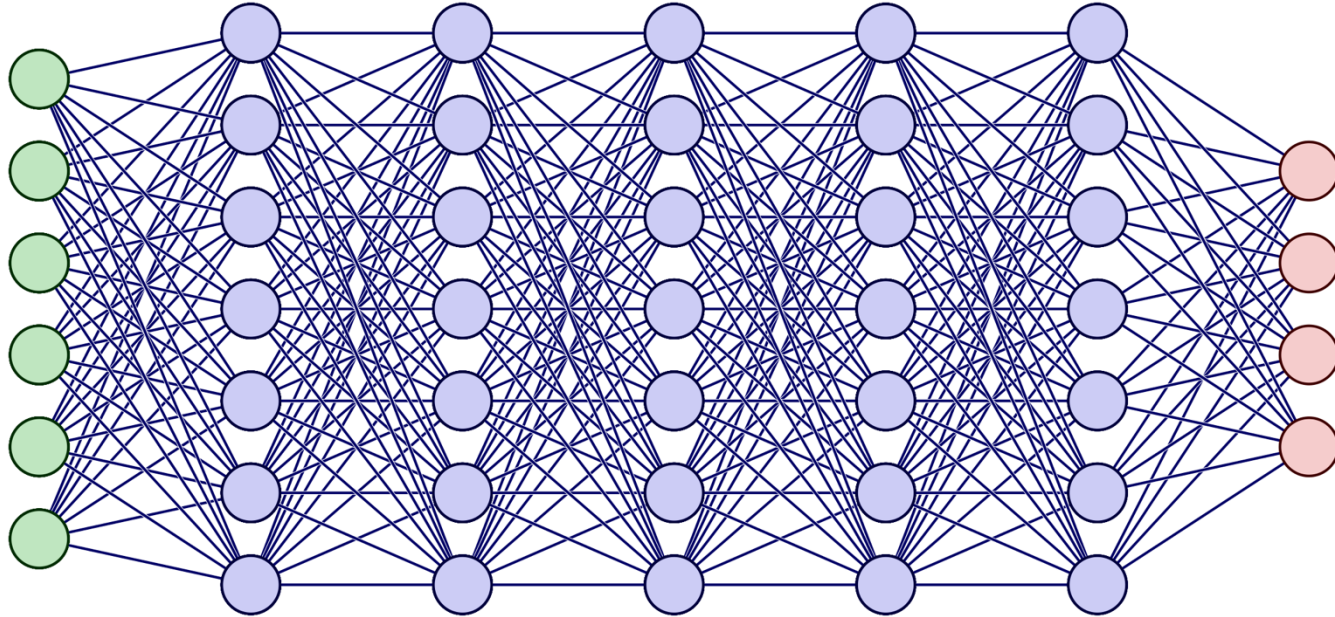
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<https://databasecamp.de/en/ml/reinforcement-learnings>

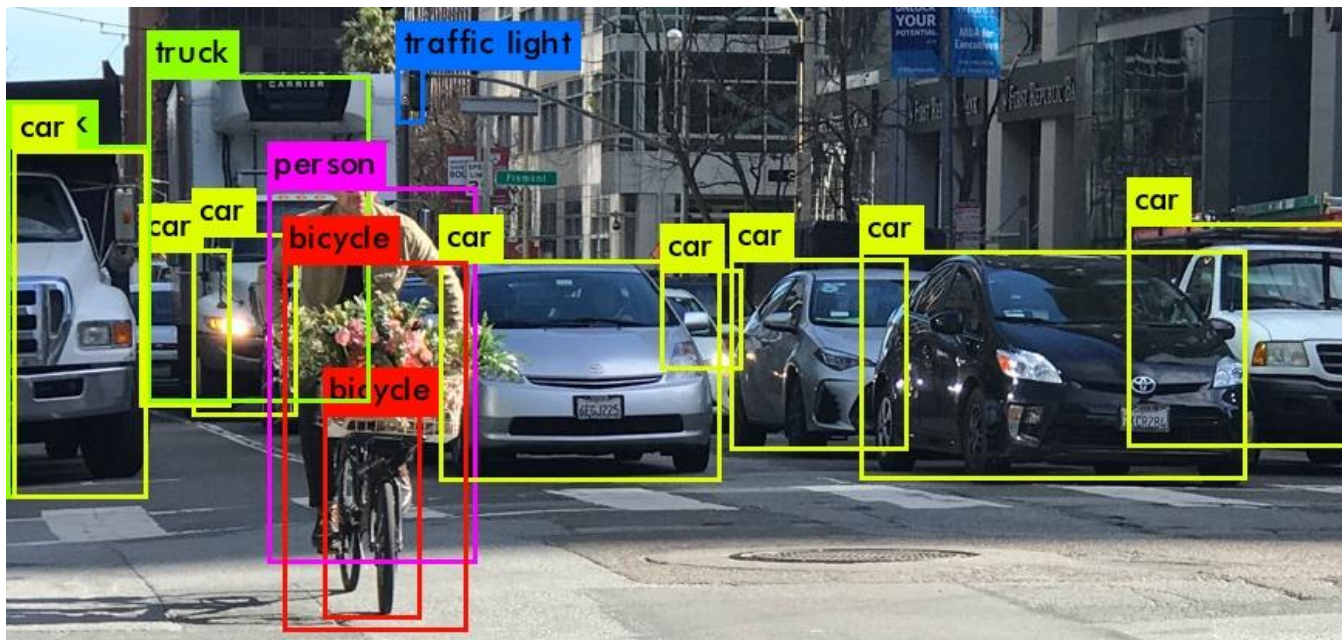
# Neural Networks



# Deep Neural Networks

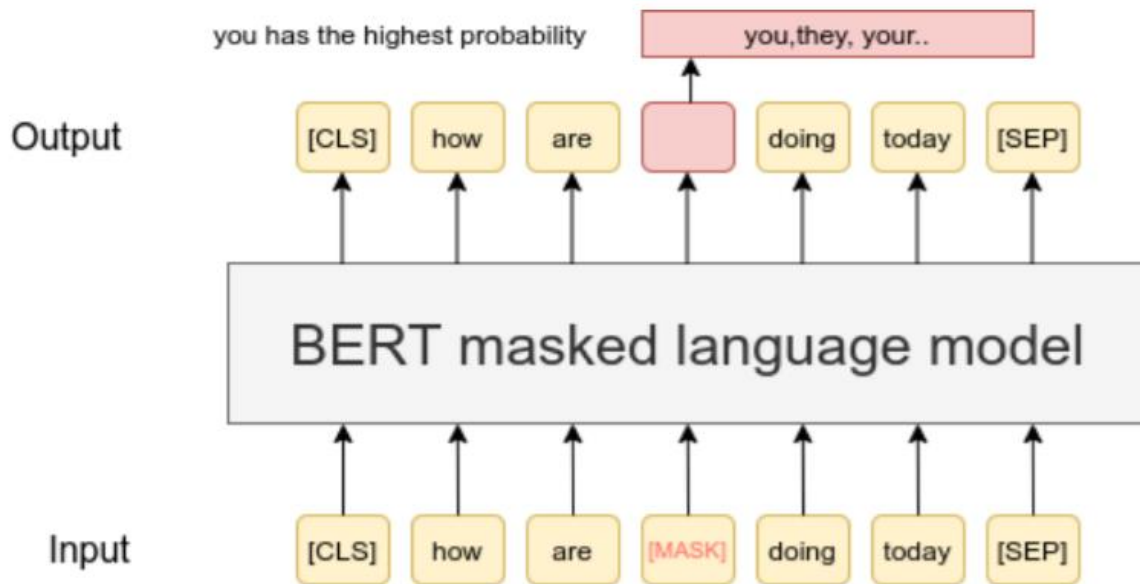


# Computer Vision





# Foundation (Language) Model



# Natural Language Processing

WM

describe what is a language model to a 5 year old.



Alright, imagine you have a super smart robot friend. This friend can talk and write just like you, but it's really good at it! It knows a lot of stories, answers to questions, and can even make up new stories that sound like they were written by a grown-up. This robot friend is a language model. It's like having a magical storyteller buddy who can help you learn new things and tell you all kinds of cool stuff!

WM

rephrase this for a college student.



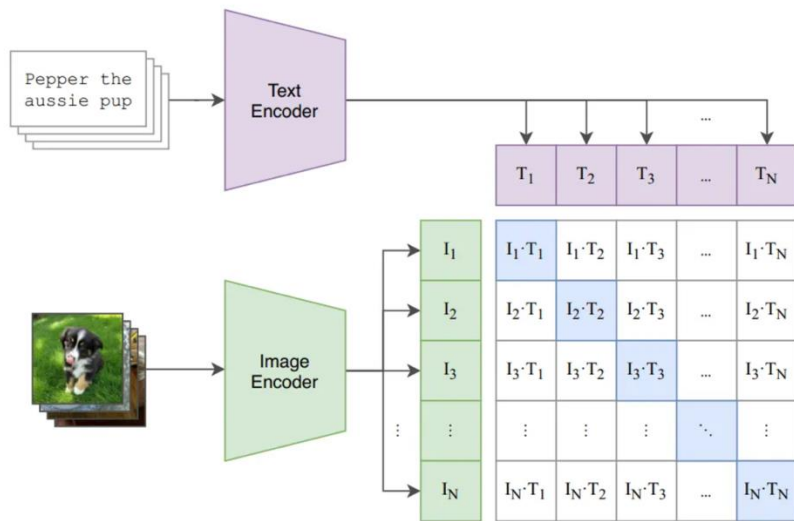
Sure thing! Think of a language model as a highly advanced computer program that's designed to understand and generate human-like language. It has been trained on massive amounts of text from books, articles, and websites, so it has learned the patterns and structures of how people talk and write. This allows the model to not only answer questions and provide information but also create new text that sounds like something a real person would say or write. It's like a virtual writing assistant that can help with a wide range of language-related tasks.



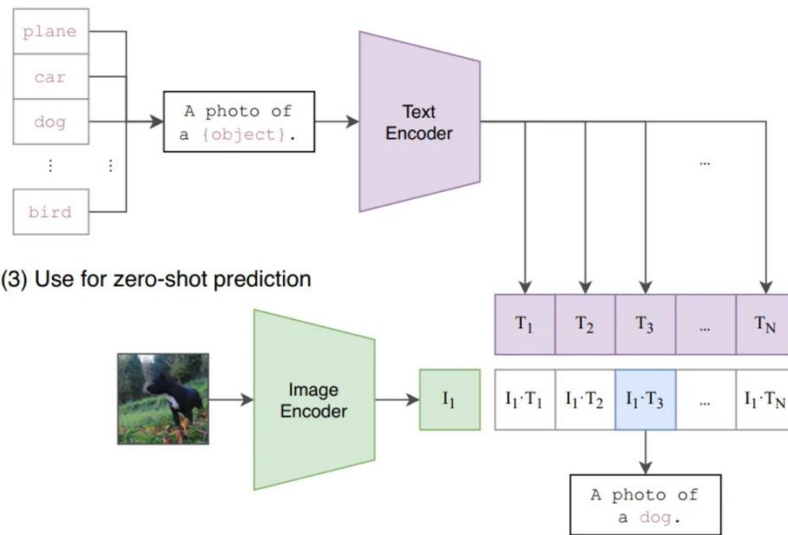
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# Multi-Modal Models

(1) Contrastive pre-training



(2) Create dataset classifier from label text

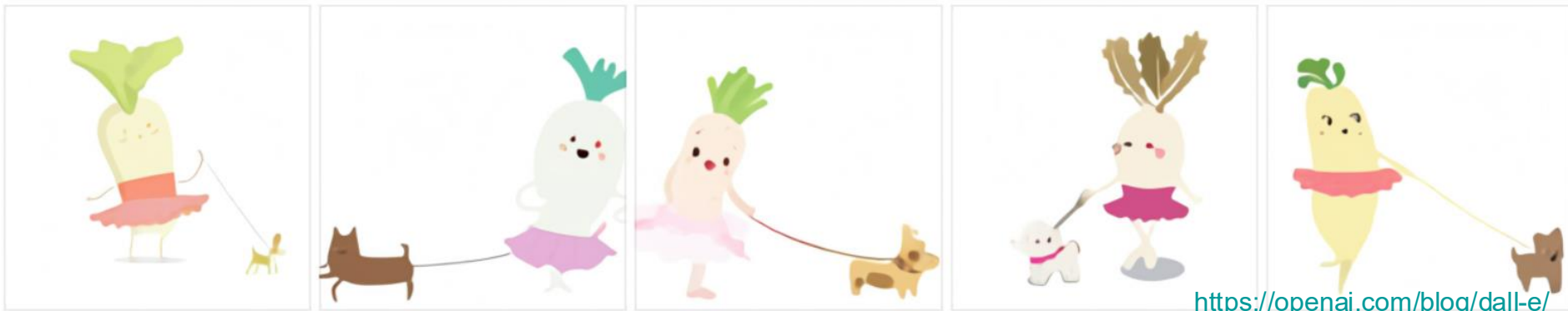


# Dall-E

## TEXT PROMPT

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

## AI-GENERATED IMAGES

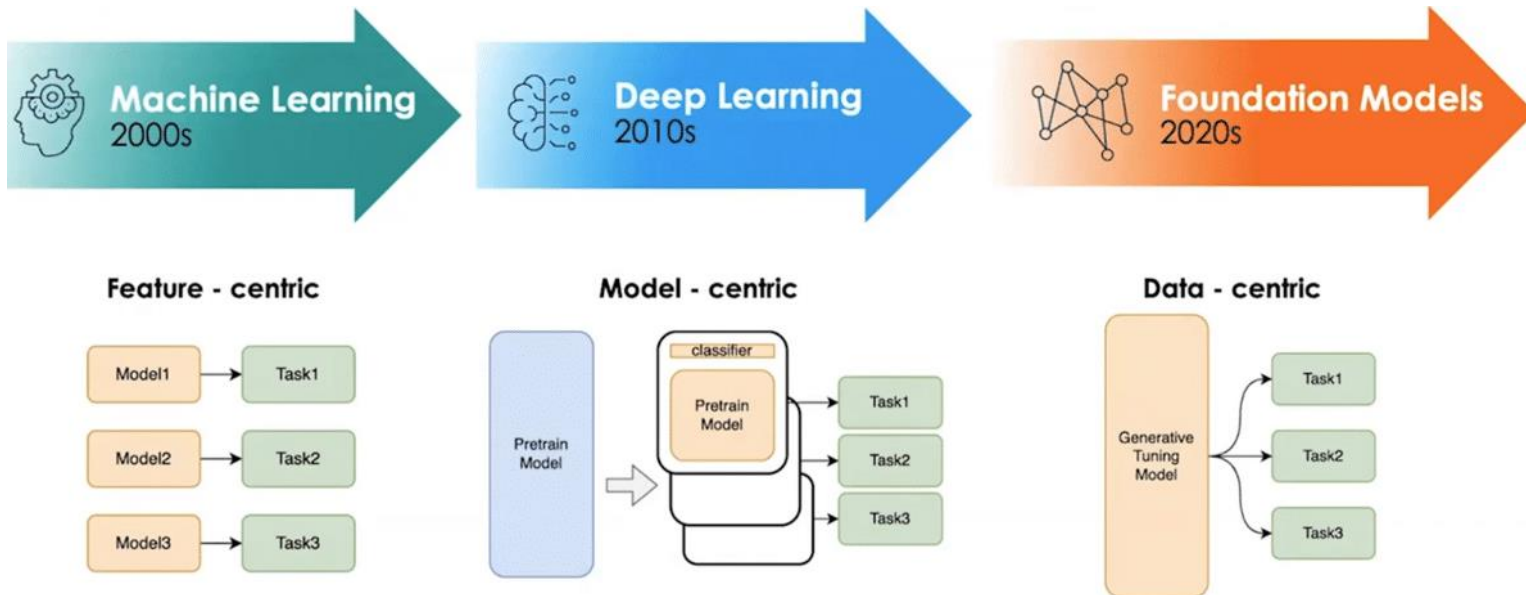


<https://openai.com/blog/dall-e/>



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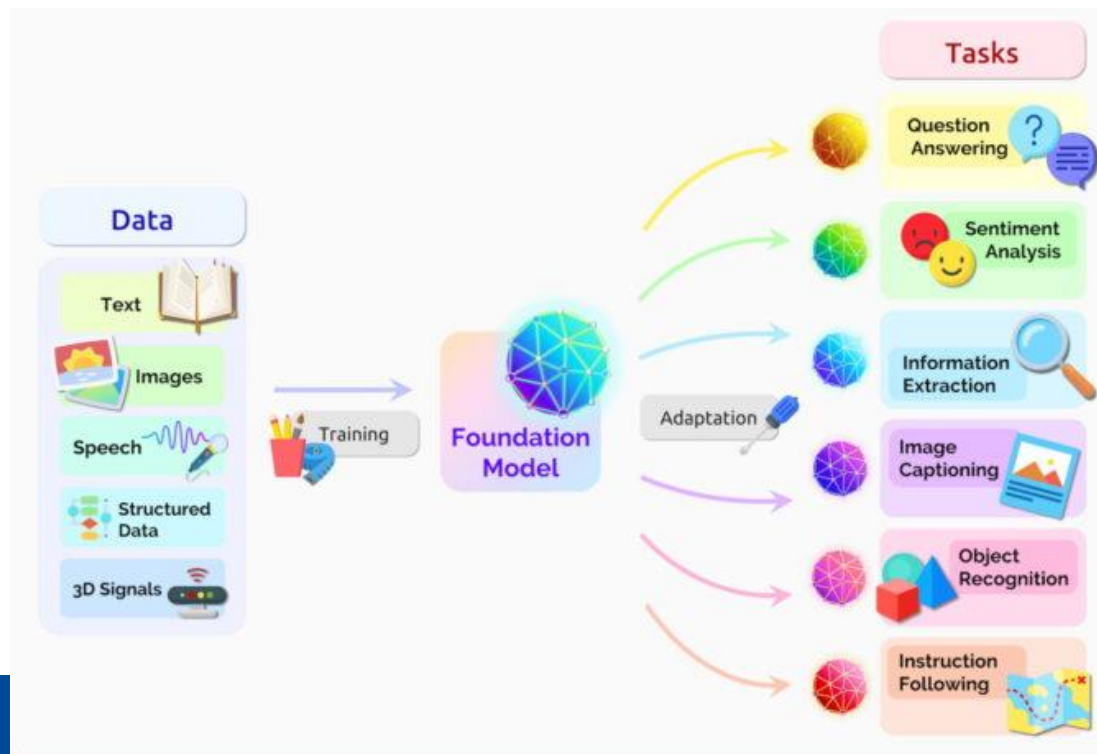
# ML Evolution



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



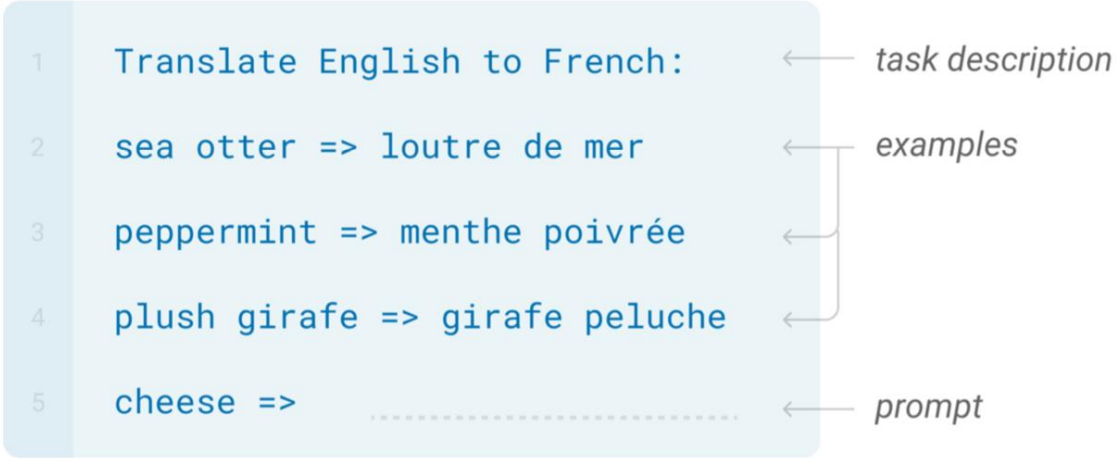
# A New Paradigm





# In-Context Learning

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

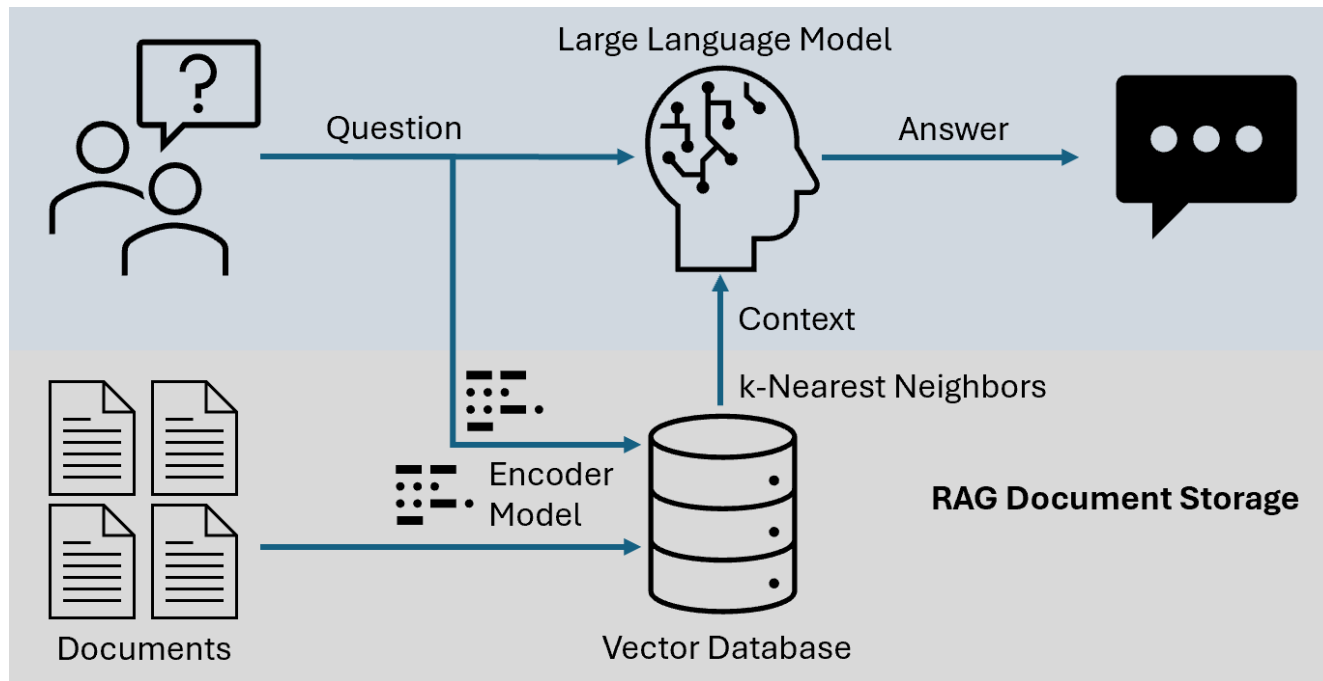


The diagram illustrates the structure of an in-context learning prompt. It consists of five lines of text, each preceded by a number in a light blue box. To the right of the text, arrows point from labels to specific parts of the prompt. The first line, '1 Translate English to French:', is labeled 'task description'. The next three lines, '2 sea otter => loutre de mer', '3 peppermint => menthe poivrée', and '4 plush girafe => girafe peluche', are grouped by a bracket and labeled 'examples'. The final line, '5 cheese => .....,', is labeled 'prompt'.

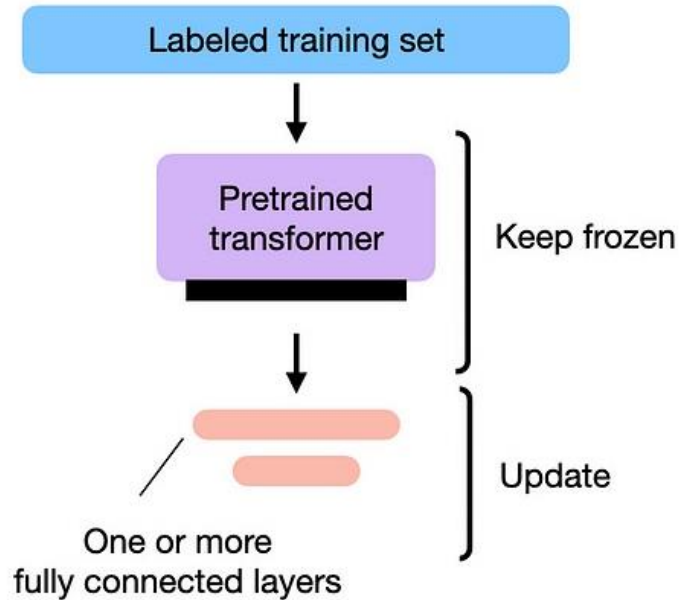
```
1 Translate English to French:
2 sea otter => loutre de mer
3 peppermint => menthe poivrée
4 plush girafe => girafe peluche
5 cheese => .....,
```



# RAG



# Finetuning I



# Finetuning II

## Reinforcement Learning from Human Feedback (RLHF)

x: "write me a poem about  
the history of jazz"



preference data

maximum  
likelihood

reward model

label rewards

LLM policy

sample completions

reinforcement learning

## Direct Preference Optimization (DPO)

x: "write me a poem about  
the history of jazz"



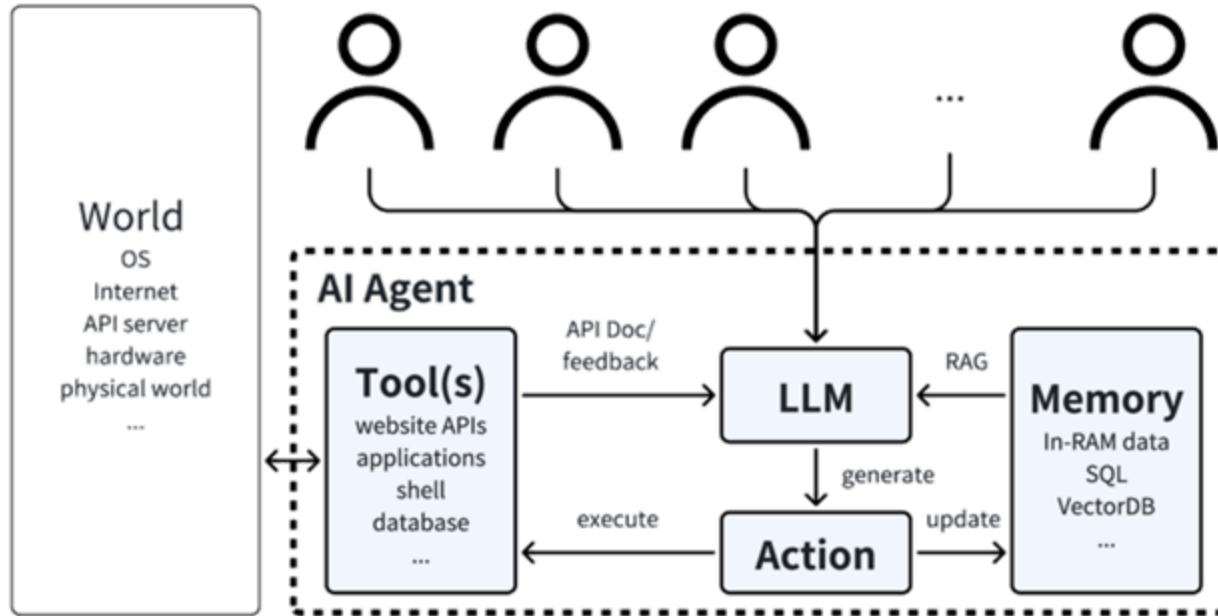
preference data

maximum  
likelihood

Final LLM



# LLM Agents



# 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

