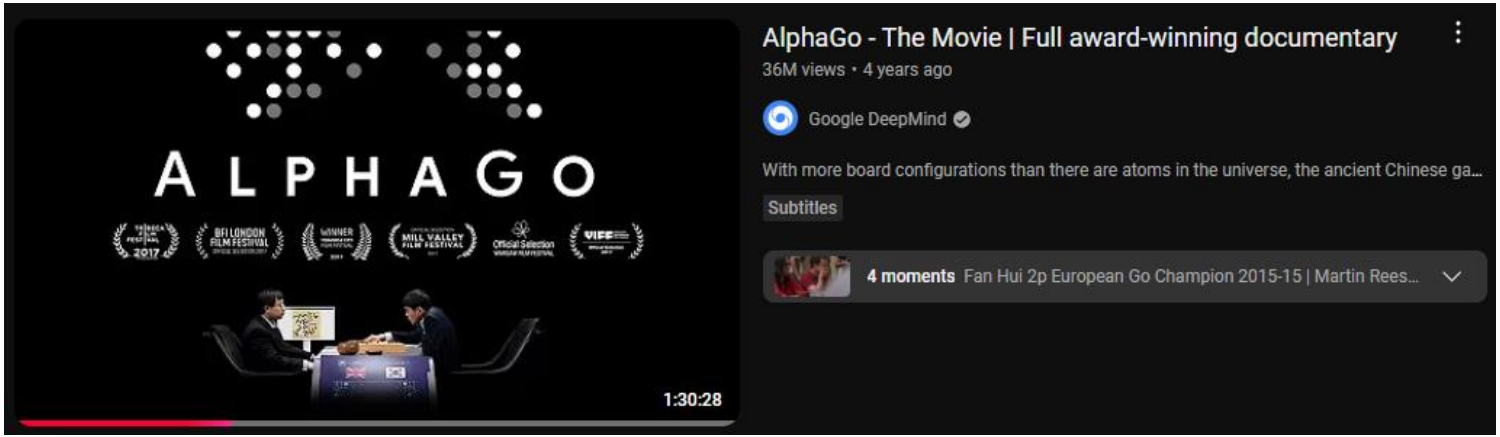
# Unlocking AI: The Basic Smart Technology

**Aditya Firman Ihsan**

# Let’s watch together (first 15 min)

**https://www.youtube.com/watch?v=WXuK6gekU1Y**



# What is exactly (artificial) intelligence?

# Problem of Intelligence

- Can the reasoning process be formally formulated?
- How is the "mind" awakened from physical organs?
- Where does knowledge come from?
- How does knowledge entrust action?

# Question 1: Can a discourse conclusion be formally formulated?

- Laws of Thought
  - Law of Identity
  - Law of non-Contradiction
  - Law of Excluded Middle
- Structured reasoning -> Ponen mode, Tolen mode, Sylogism, etc
- The reasoning of "uncertainty"? -> Statistics and Probability

# Prob 2: How is the "mind" awakened from the physical organs?

- Dualism vs Materialism
  - Materialism: There is a component of the mind that applies under the laws of physics (laws of physics constitute the mind)
  - Dualism: There are two components of reasoning, which follow the laws of physics and those that do not; The part that is independent of the laws of physics entrusts free will. (René Descartes)
- Ideas and designs of the "Mechanical Brain“
  - Leonardo da Vinci (mechanical calculator design)
  - Blaise Pascal (Postcaline Machine)
  - Gottfried W. Leibniz
  - Thomas Hobbes (in his book, Leviathan)

# Prob 3: Where does knowledge come from?

- Empiricism (Bacon, Locke)
  - *Nothing is in the understanding, which was not first in the senses*
- Principle of Induction (Hume)
  - Generalization of reasoning is taken based on the observation of inter-element relationships.
- Logical Positivism (Analytic Philosophy and the Vienna Circle)
  - Knowledge = logical theories associated with senseable statements
- Confirmation Theory (Carnap, Hempel)
  - Knowledge acquisition can be measured by the degree of trust; how connected a logical statement is to observation.

# Prob 4: How does knowledge dictate action?

- Aristotle: Nicomachean Ethics
  - The logical relationship between the purpose of an action and knowledge of the consequences of an action.
  - Become the inspiration for the design of the General Problem Solver
- Utilitarianism (Bentham, J.S. Mill)
  - Rational decision-making is based on maximum use value.
  - Right and wrong an action is determined from the expectations of its output.
- Deontological Ethics (Side)
  - Wrong and right of an action is determined from the universal social law

# Prob 4: How does knowledge dictate action?

- How to reason decision-making preferences?
  - How to rationalize the decision-making process when the other party disagrees?
  - How to reason the decision-making process if the benefits are not directly obtained?

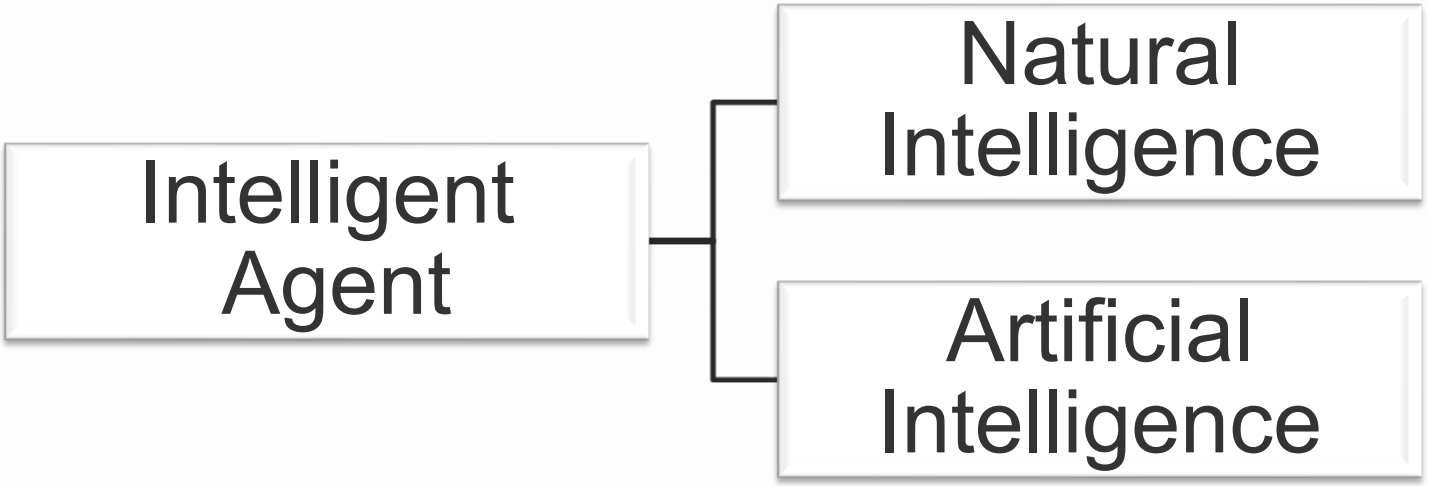
# (Other) Problems of Intelligence

| Mathematics | Economics |
| --- | --- |
| • *What are the formal rules to draw valid conclusions?*<br>• *What can be computed?*<br>• *How do we reason with uncertain information?* | • *How should we make decisions so as to maximize payoff?*<br>• *How should we do this when others may not go along?*<br>• *How should we do this when the payoff may be far in the future?* |

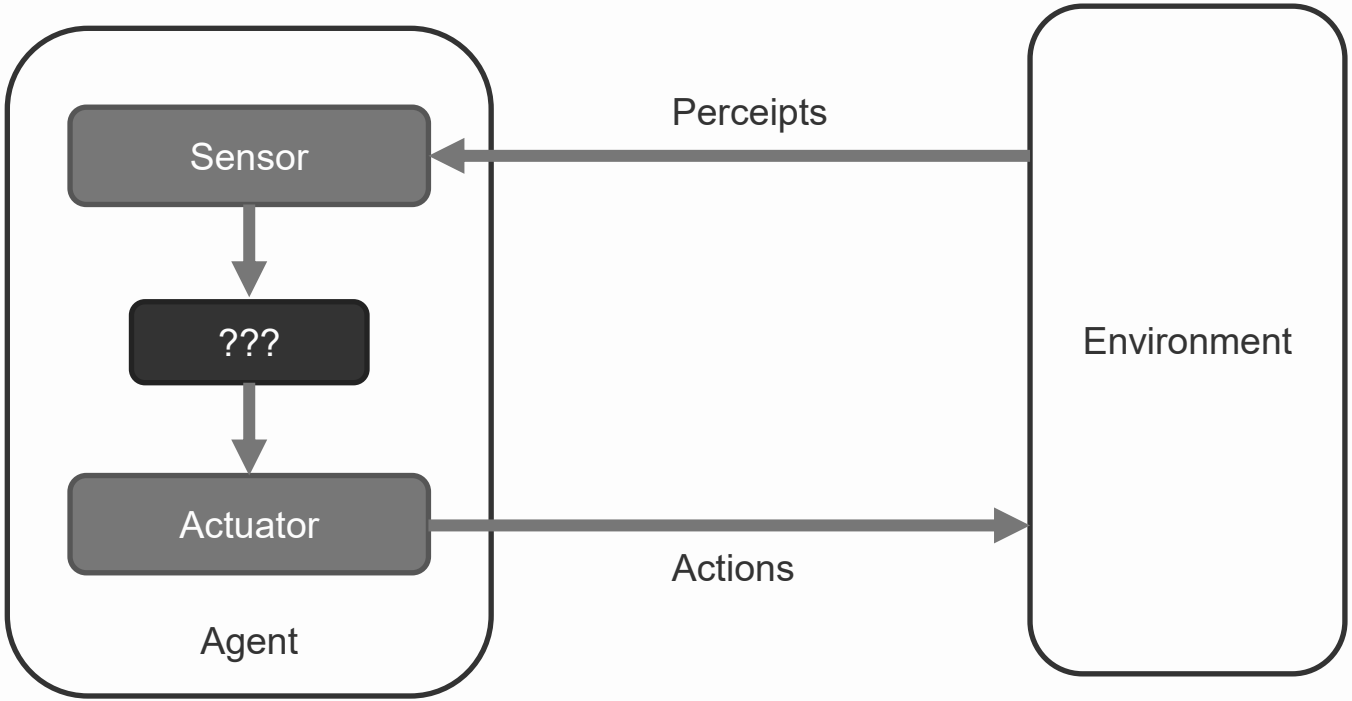
# (Other) Problems of Intelligence

- **Neuroscience:** *How do brains process information?*
- **Psychology:** *How do humans and animals think and act?*
- **Computer Engineering:** *How can we build an efficient computer?*
- **Control Theory and Cybernetics:** *How do brains process information?*
- **Linguistics:** *How does language relate to thought?*

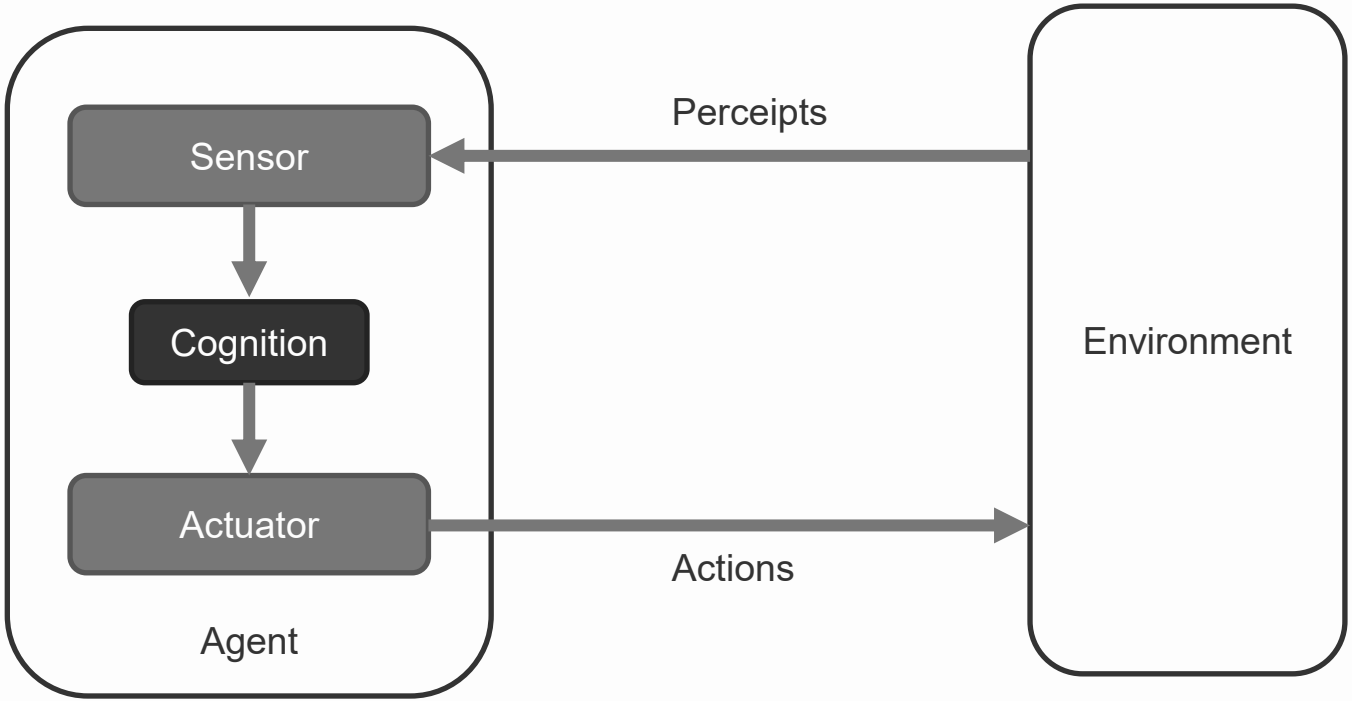
# INTELLIGENT AGENT



# INTELLIGENT AGENT



# INTELLIGENT AGENT



# ASPECT OF COGNITION

## KNOWLEDGE REPRESENTATION

Store what it knows

## AUTOMATED REASONING

Answer and decide best conclusion

## LEARNING AND DEVELOPMENT

Self-improve specific performance

## SELF-CONSCIOUSNESS

Aware of the existence of itself

# ASPECT OF COGNITION

## KNOWLEDGE REPRESENTATION

Store what it knows

## AUTOMATED REASONING

Answer and decide best conclusion

## LEARNING AND DEVELOPMENT

Self-improve specific performance

## SELF-CONSCIOUSNESS

Aware of the existence of itself

# Definition of Artificial Intelligence (AI)

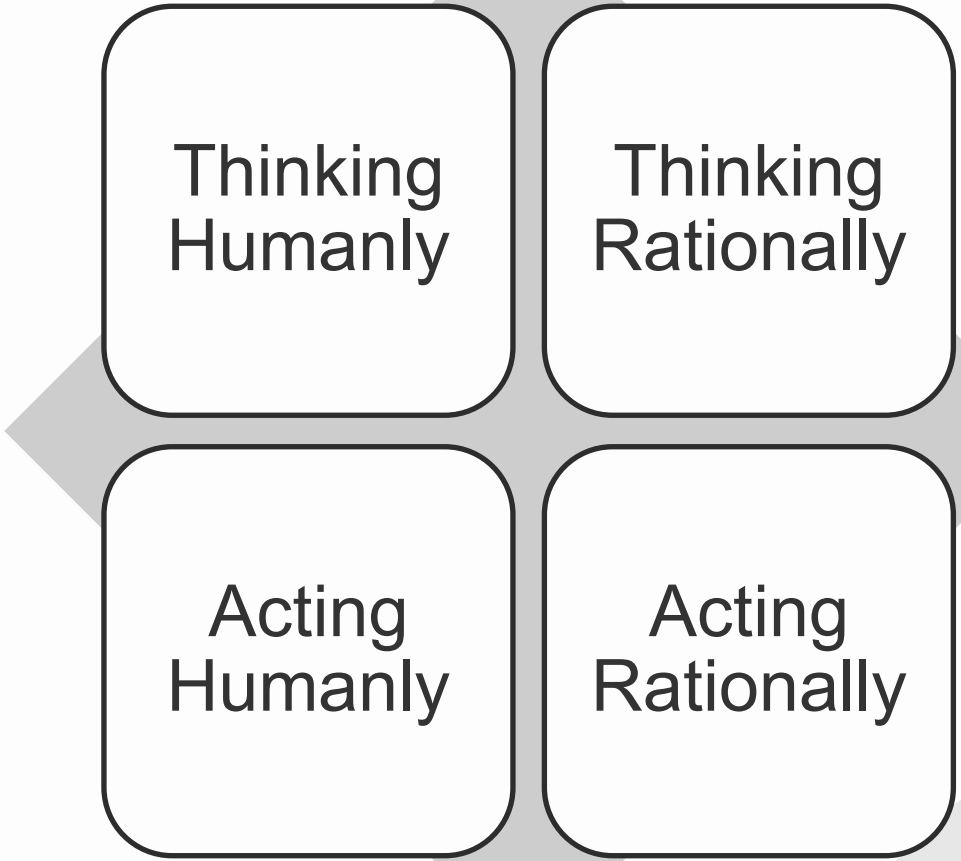
- Kaplan & Haenlein (2019): "AI is a system capable of interpreting data, learning from data, and adapting to achieve goals."
- Poole & Mackworth (2010): "AI is a field of study of intelligently acting computational agents, capable of:
  - acting in accordance with conditions and objectives;
  - adapting to the environment and changing goals;
  - learning from experience (data); and
  - make decisions according to the limitations of perception and computation."

# Definition of Artificial Intelligence (AI)

- **Stanford Emerging Technology Review 2025:**
  - AI is defined as a computing system that can perform tasks that typically require human intelligence, such as problem-solving, decision-making, learning from data, and adapting to new environments.
  - AI not only focuses on automation, but also acts as a tool that complements and enhances human capabilities in various sectors, including healthcare, business, education, and cybersecurity.

## Various Paradigms of Artificial Intelligence (Standard Model)

- Introspective Approach
  - Acting Humanly
  - Thinking Humanly
- Formal Approach
  - Thinking Rationally
  - Acting Rationally



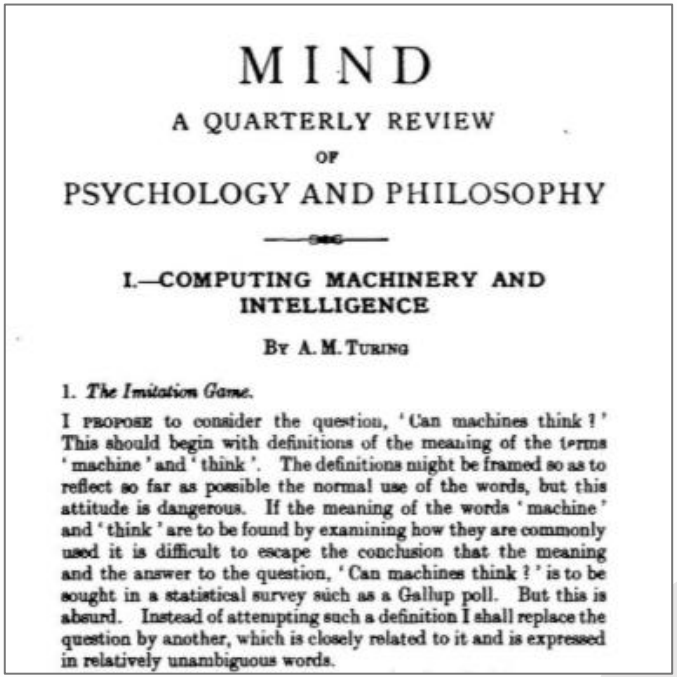
# Various Paradigms of Artificial Intelligence (Standard Model)

| | |
|---|---|
| **Thinking Humanly**<br>“The exciting new effort to make computers think … machines with minds, in the full and literal sense.” (Haugeland, 1985)<br>“[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning …” (Bellman, 1978) | **Thinking Rationally**<br>“The study of mental faculties through the use of computational models.” (Charniak and McDermott, 1985)<br><br>“The study of the computations that make it possible to perceive, reason, and act.” (Winston, 1992) |
| **Action Humanly**<br>“The art of creating machines that perform functions that require intelligence when performed by people.” (Kurzweil, 1990)<br>“The study of how to make computers do things at which, at the moment, people are better.” (Rich and Knight, 1991) | **Action Rationally**<br>“Computational Intelligence is the study of the design of intelligent agents.” (Poole et al., 1998)<br><br>“AI … is concerned with intelligent behavior in artifacts.” (Nilsson, 1998) |

# History of AI

## Early Era (1940s – 1950s): The Foundations of AI

•1943 – Warren McCulloch & Walter Pitts publish a paper on artificial neural networks, which form the basis for AI modeling.
•1950 – Alan Turing introduces the Turing Test in his paper "Computing Machinery and Intelligence", which becomes the benchmark for machine intelligence.
•1956 – The Dartmouth Conference (led by John McCarthy) marks the formal birth of the field of AI research. McCarthy also coined the term Artificial Intelligence.



MIND

A QUARTERLY REVIEW

OF

PSYCHOLOGY AND PHILOSOPHY

I.—COMPUTING MACHINERY AND INTELLIGENCE

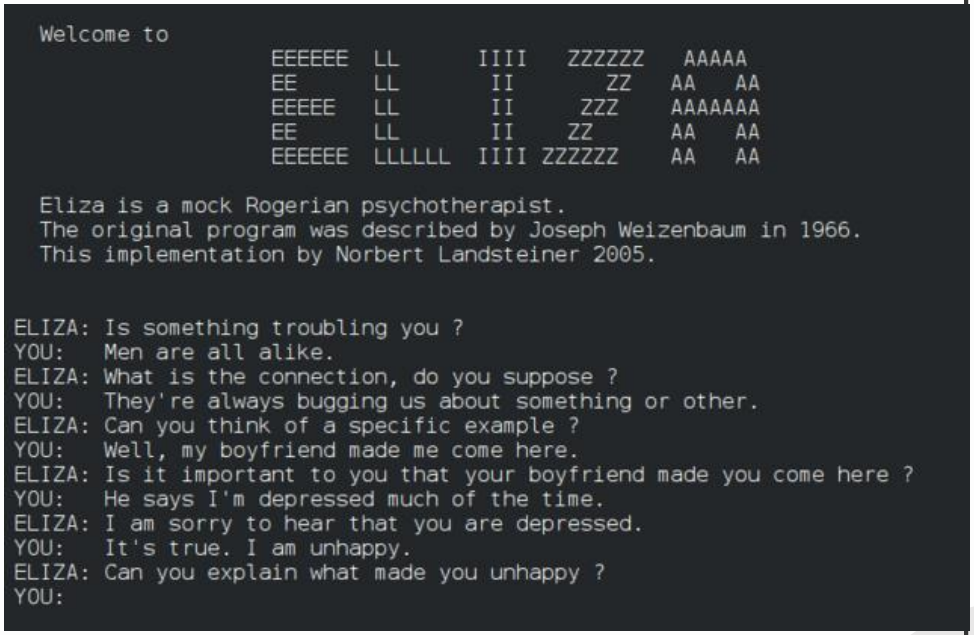
By A. M. Turing

1. *The Imitation Game.*

I propose to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words 'machine' and 'think' are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, 'Can machines think?' is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

# The Era of Optimism and Exploration (1956 – 1970s): Early Development

- 1958 – John McCarthy develops the LISP programming language, which is widely used in AI research.
- 1966 – The ELIZA program, the first chatbot, is developed by Joseph Weizenbaum at MIT.
- 1969 – The first expert system, DENDRAL, is developed to analyze chemical data.
- 1973 – The first AI Winter occurs due to AI's failure to meet high expectations, leading to a reduction in research funding.

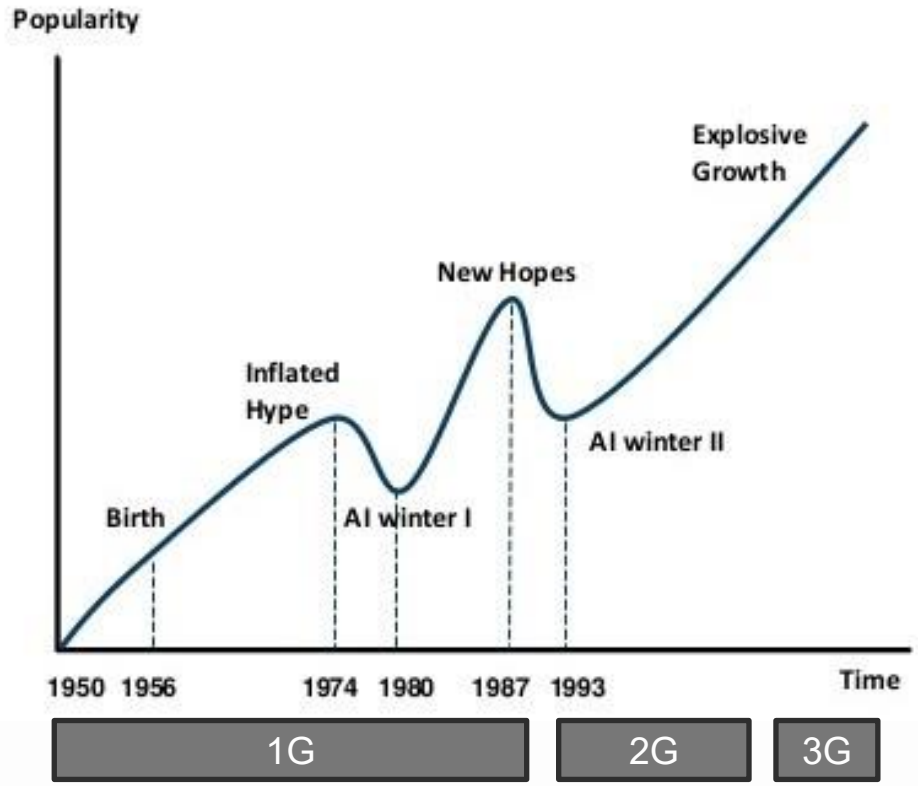


## Revival (1980s – 1990s): Expert Systems and Neural Networks

- 1980 – Expert systems begin to gain popularity, used in a variety of industries for decision-making.
- 1986 – Geoffrey Hinton and his colleagues develop a backpropagation algorithm, which improves the performance of artificial neural networks.
- 1997 – IBM's Deep Blue defeats chess world champion Garry Kasparov, demonstrating the great potential of AI in decision-making.

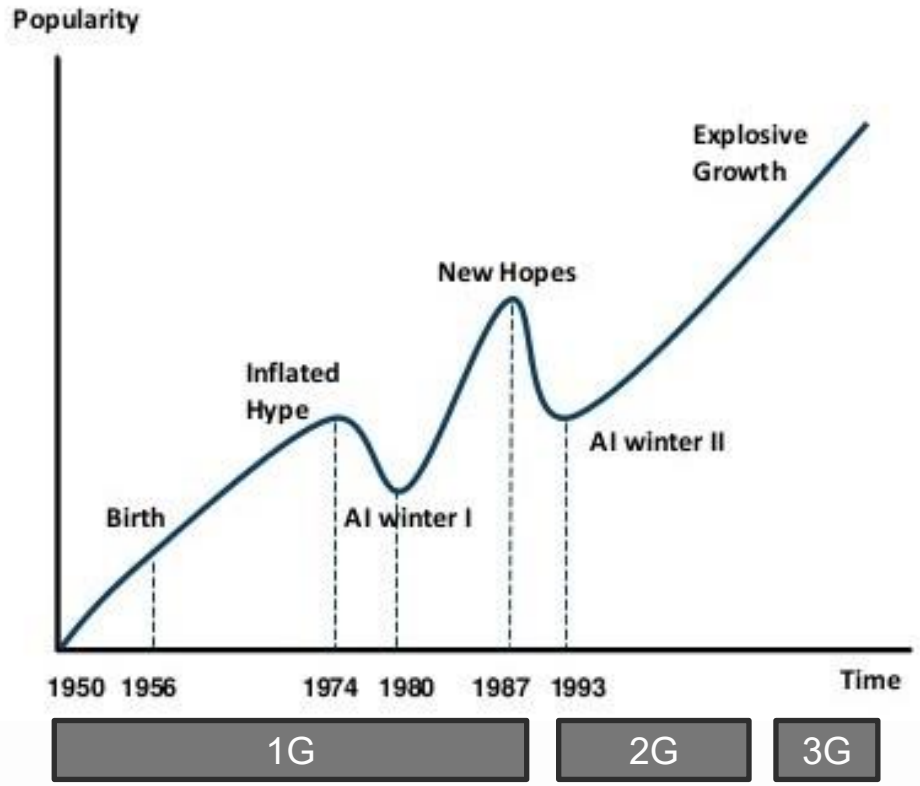
## The Modern Era (2000s – 2020s): Generative AI and Machine Learning

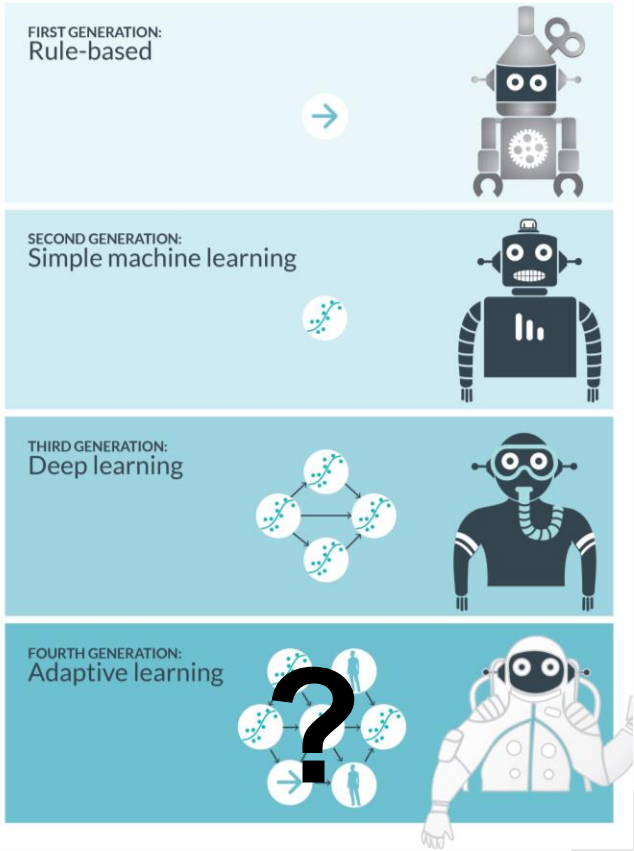
- 2011 – Apple introduces Siri, the first AI-based virtual assistant on mobile devices.
- 2012 – The Deep Learning revolution begins with the Hinton team's victory in the ImageNet Challenge, proving the effectiveness of neural networks in computer vision.
- 2016 – DeepMind's AlphaGo defeats world champion Go, a game that is much more complex than chess.
- 2020 – OpenAI's GPT-3 is released, marking the era of generative AI capable of generating human text.
- 2022-2023 – Generative AI is growing with the arrival of ChatGPT, DALL· E, and other multimodal AI models.




**Timeline of AI Development**

- **1950s-1960s**: First AI boom - the age of reasoning, prototype AI developed
- **1970s**: AI winter I
- **1980s-1990s**: Second AI boom: the age of Knowledge representation (appearance of expert systems capable of reproducing human decision-making)
- **1990s**: AI winter II
- **1997**: Deep Blue beats Gary Kasparov
- **2006**: University of Toronto develops Deep Learning
- **2011**: IBM's Watson won Jeopardy
- **2016**: Go software based on Deep Learning beats world's champions


Popularity
Explosive Growth
New Hopes
Inflated Hype
AI winter II
Birth
AI winter I
1950 1956 1974 1980 1987 1993
Time
1G
2G
3G


FIRST GENERATION:
Rule-based
SECOND GENERATION:
Simple machine learning
THIRD GENERATION:
Deep learning
FOURTH GENERATION:
Adaptive learning
?

**1st Generation is actually rule-based: Logic, deduction, etc**

**What about second generation?**

# Computational Theory of Mind

**Artificial Intelligence**
(*Computational Theory of Mind*)

## *Symbolic AI*
(*Physical Symbol System Hypothesis*)
***Deductive***

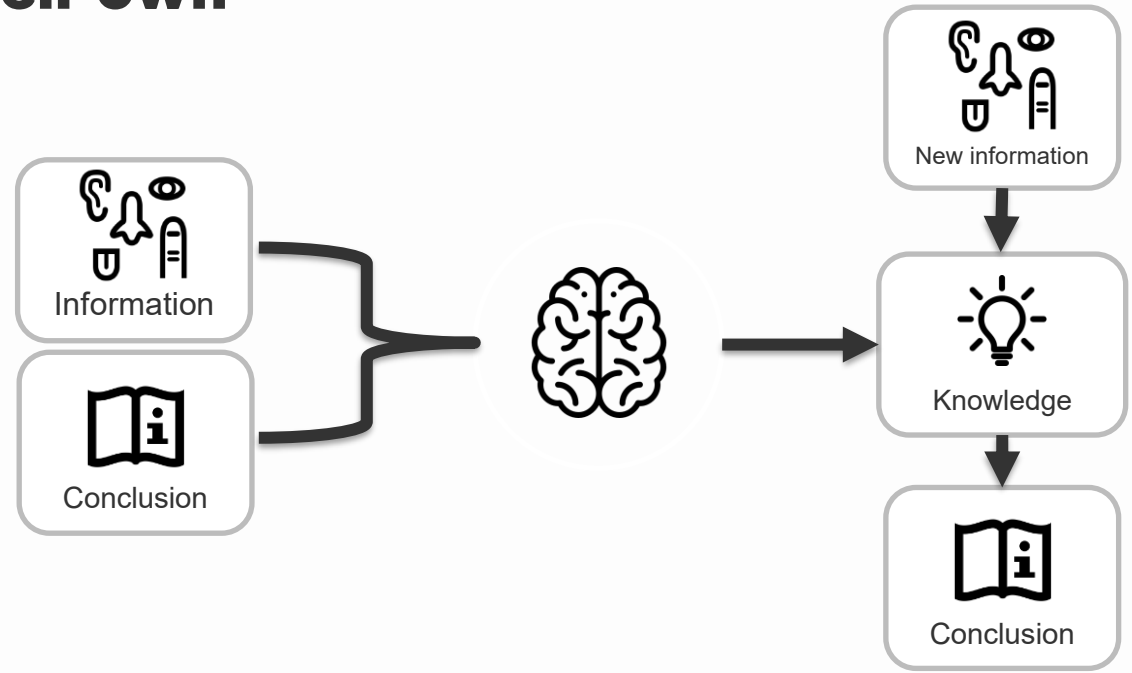
If it rains today, then the streets are wet $P \rightarrow Q$
Today it rains $P$
In conclusion, the streets are wet $\therefore Q$

Thinking can be fully represented by the rules of formal logic.

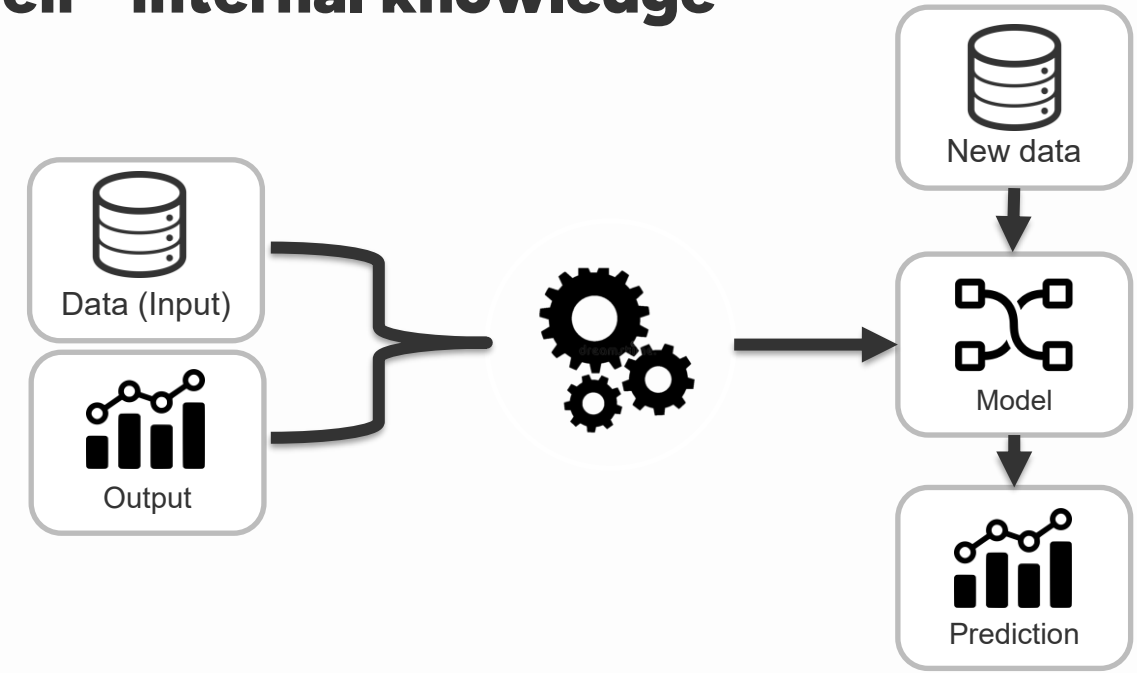
## *Data-based AI*
(*Connectionism*)
***Inductive***

Information/knowledge is represented by the interaction and interconnection between unit of data or information

# Humans can develop their internal knowledge so that when given new information, they can conclude on their own



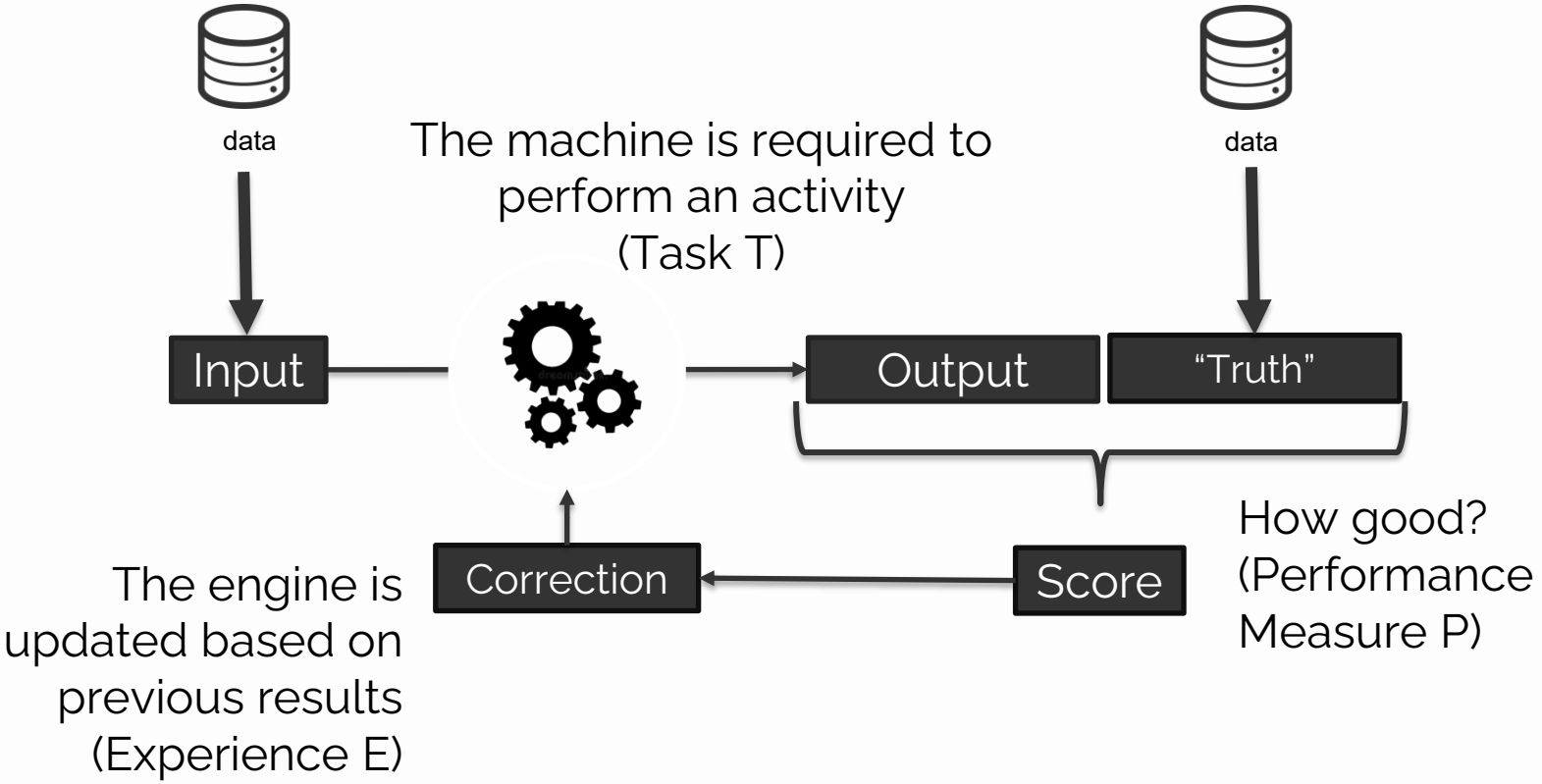
# Likewise, if we want to make machines "learn", machines must be able to develop their "internal knowledge"

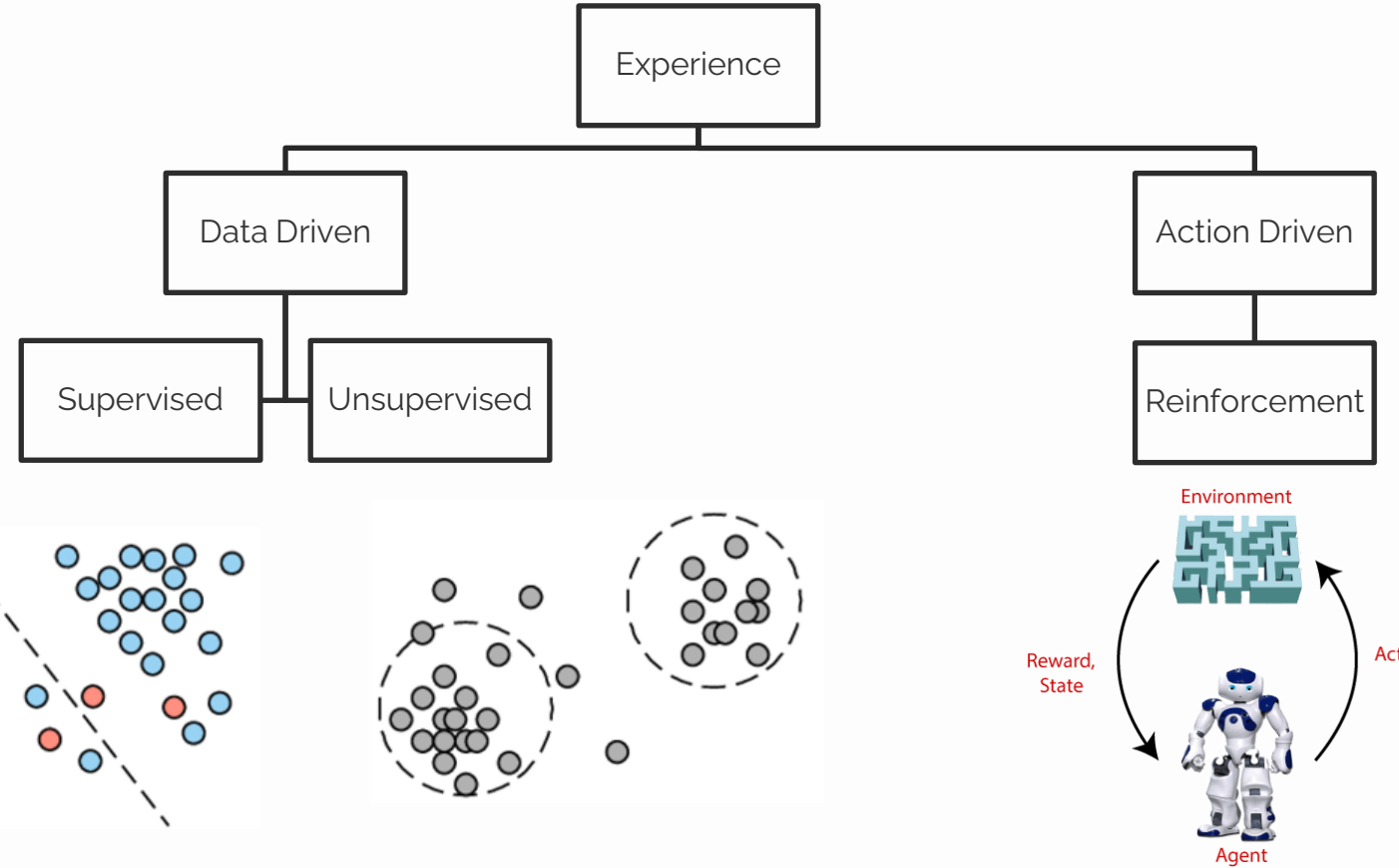


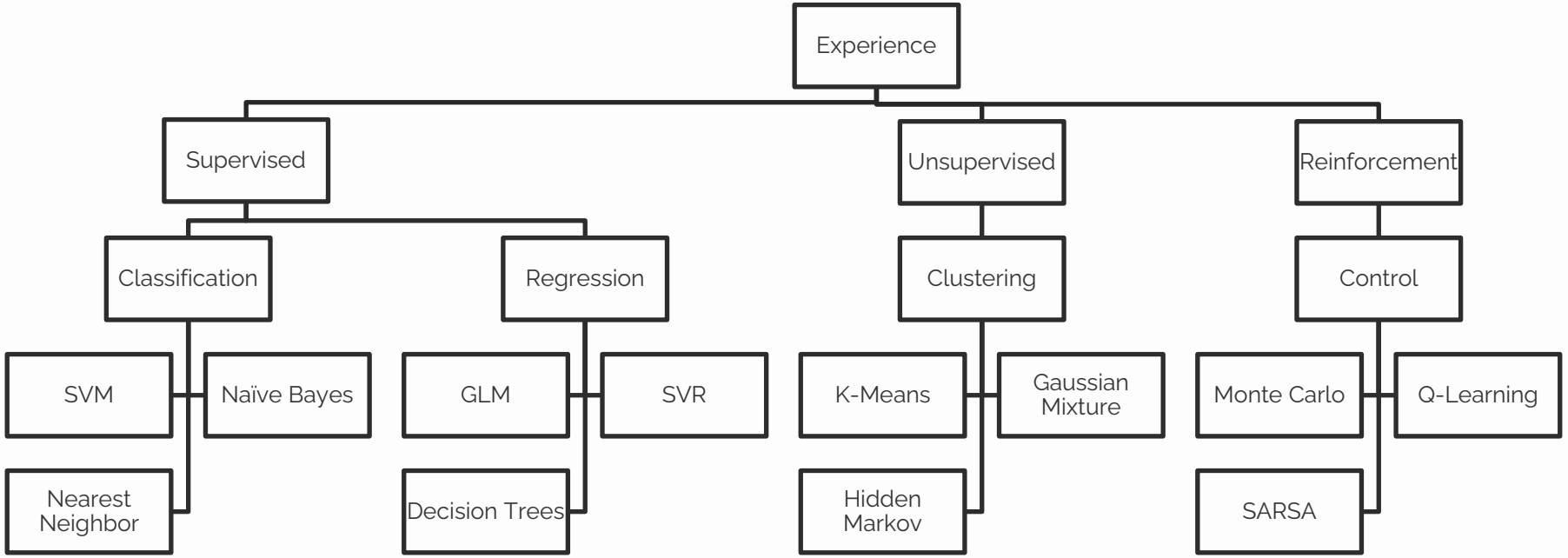
# Machine Learning

*“A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P , if its performance at tasks in T, as measured by P, improves with experience E.”*

[FMH - 2025]


data
The machine is required to perform an activity (Task T)
data
Input
Output
"Truth"
How good? (Performance Measure P)
Score
Correction
The engine is updated based on previous results (Experience E)


Experience
Data Driven
Action Driven
Supervised
Unsupervised
Reinforcement
Environment
Reward,
State
Actions
Agent

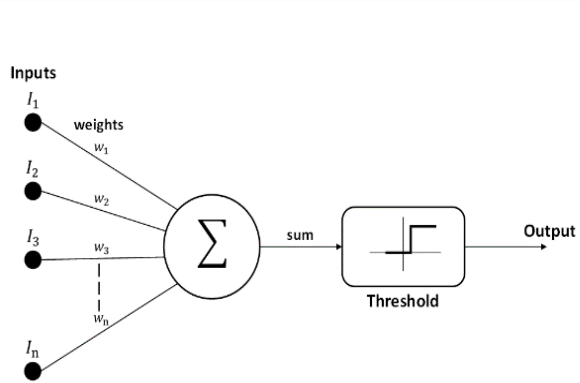

Experience
Supervised
Unsupervised
Reinforcement
Classification
Regression
Clustering
Control
SVM
Naïve Bayes
GLM
SVR
K-Means
Gaussian Mixture
Monte Carlo
Q-Learning
Nearest Neighbor
Decision Trees
Hidden Markov
SARSA

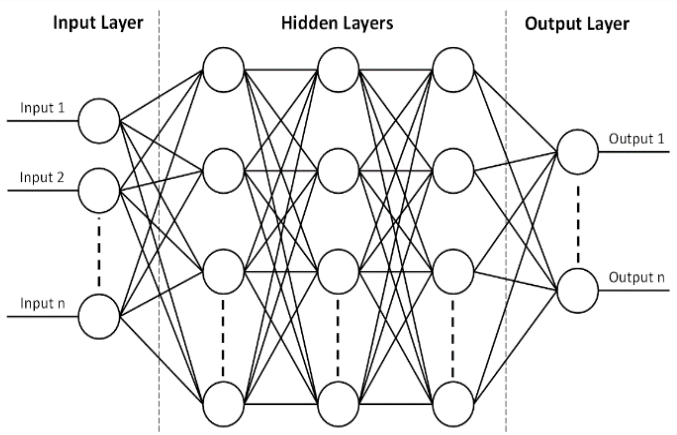
[FMH - 2025]

# Okay, what about third Generation?

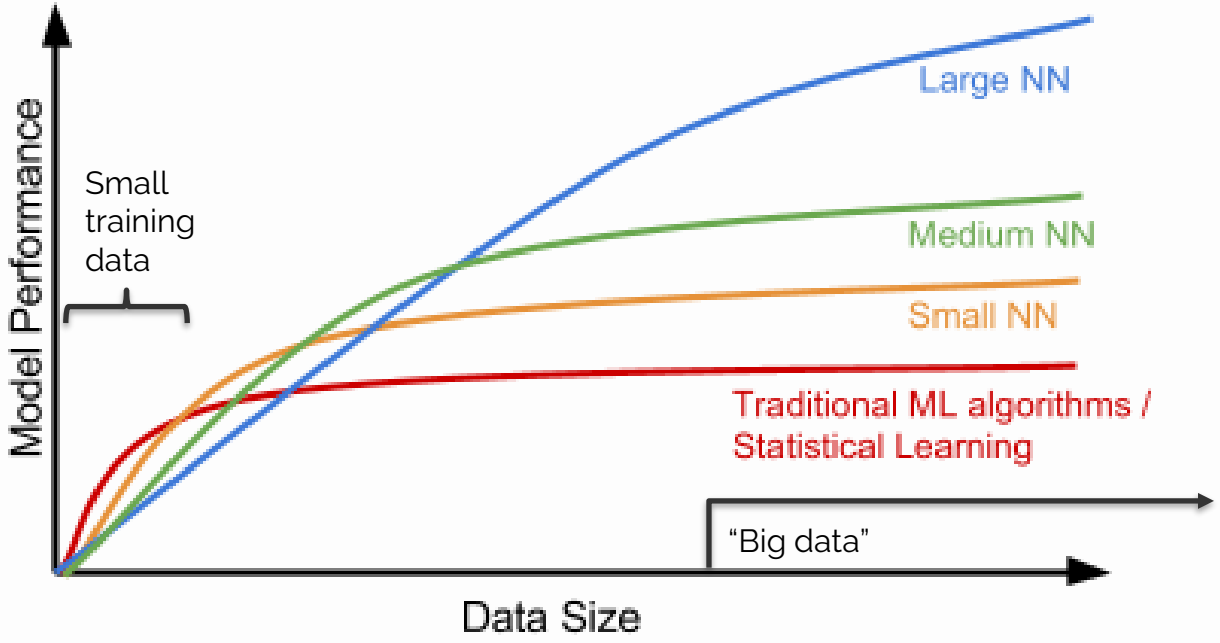
# Connectionism

- Replicates a model of a human neuron.
- Connectionism knowledge is encoded in the weights and threshold of a neuron unit.
- Advantages: can "learn" from data (induction)
- Disadvantages: requires a lot of data why connectionism wasn't popular in the early years of AI.
- The AI paradigm is popular now

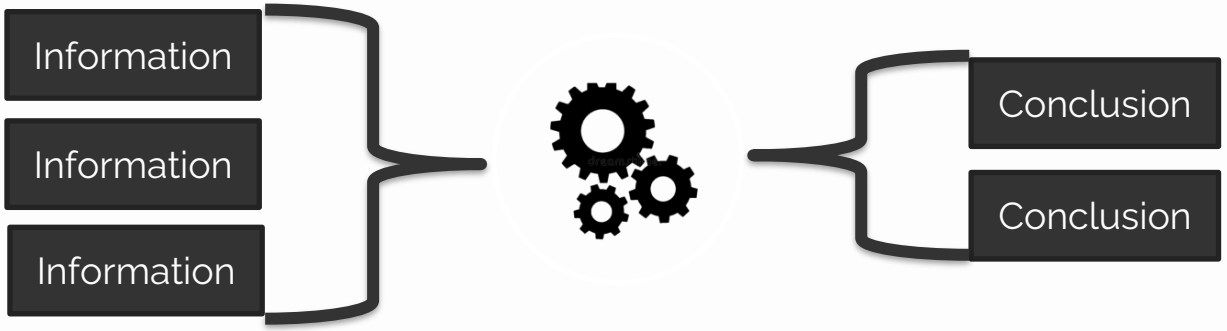


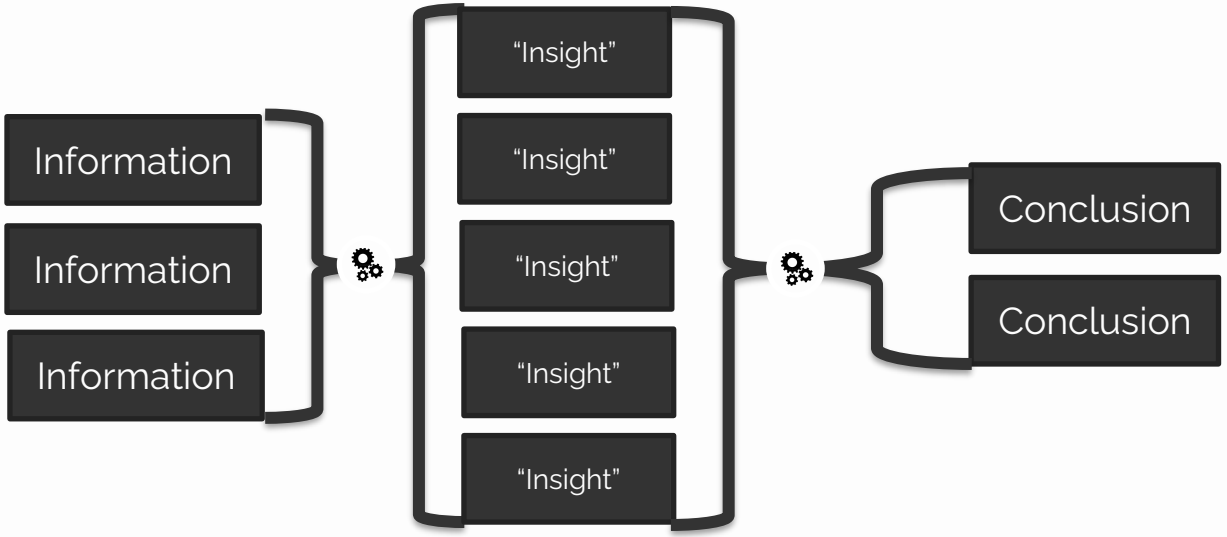
# Why Neural Network (NN)?



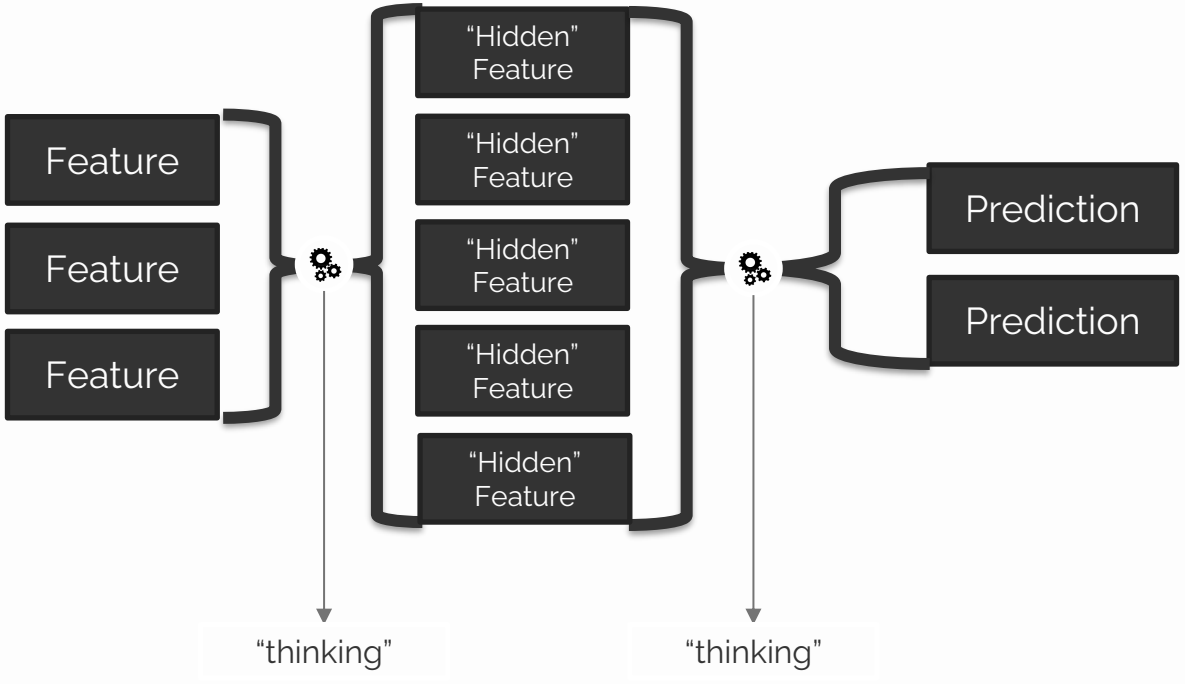
# What does NN do?



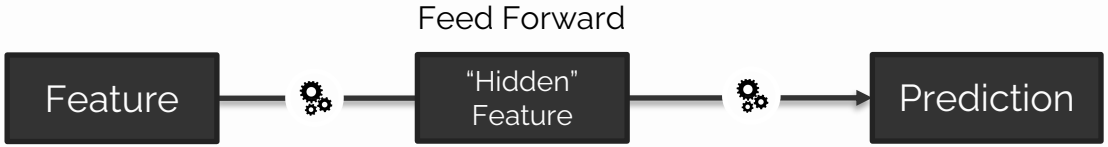
# What does NN do?



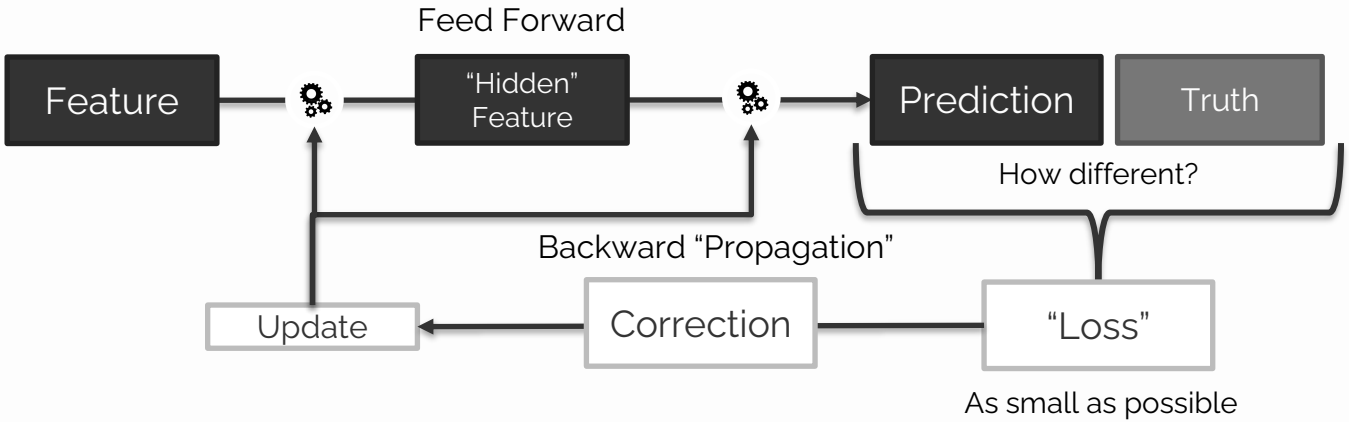
# Apa yang dilakukan NN?



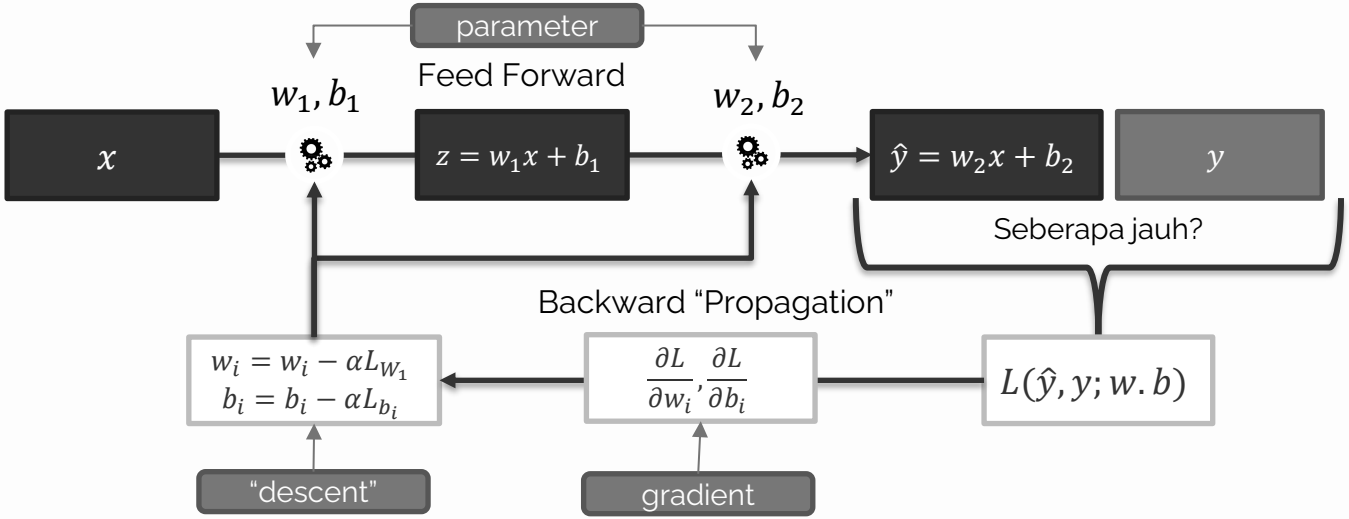
# What does NN do?



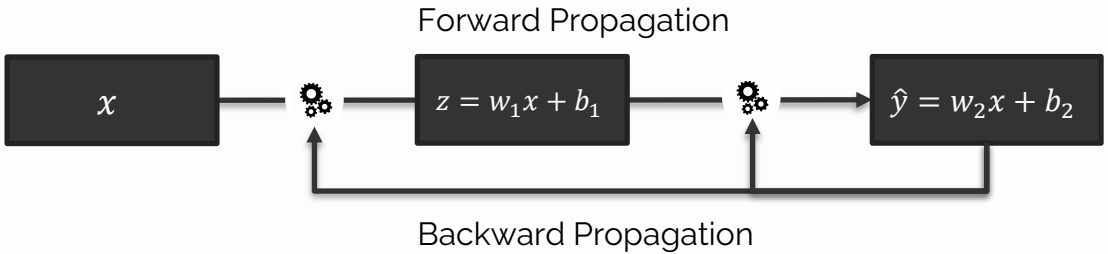
# What does NN do?



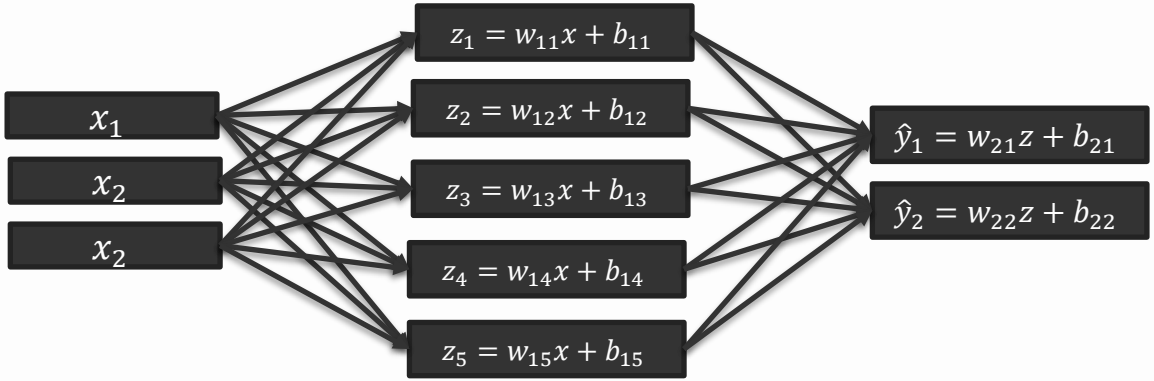
# What does NN do?

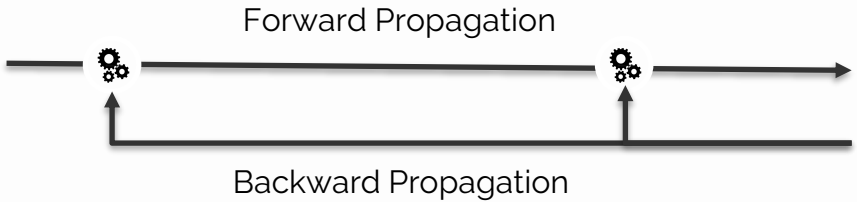


# What does NN do?



# What does NN do?



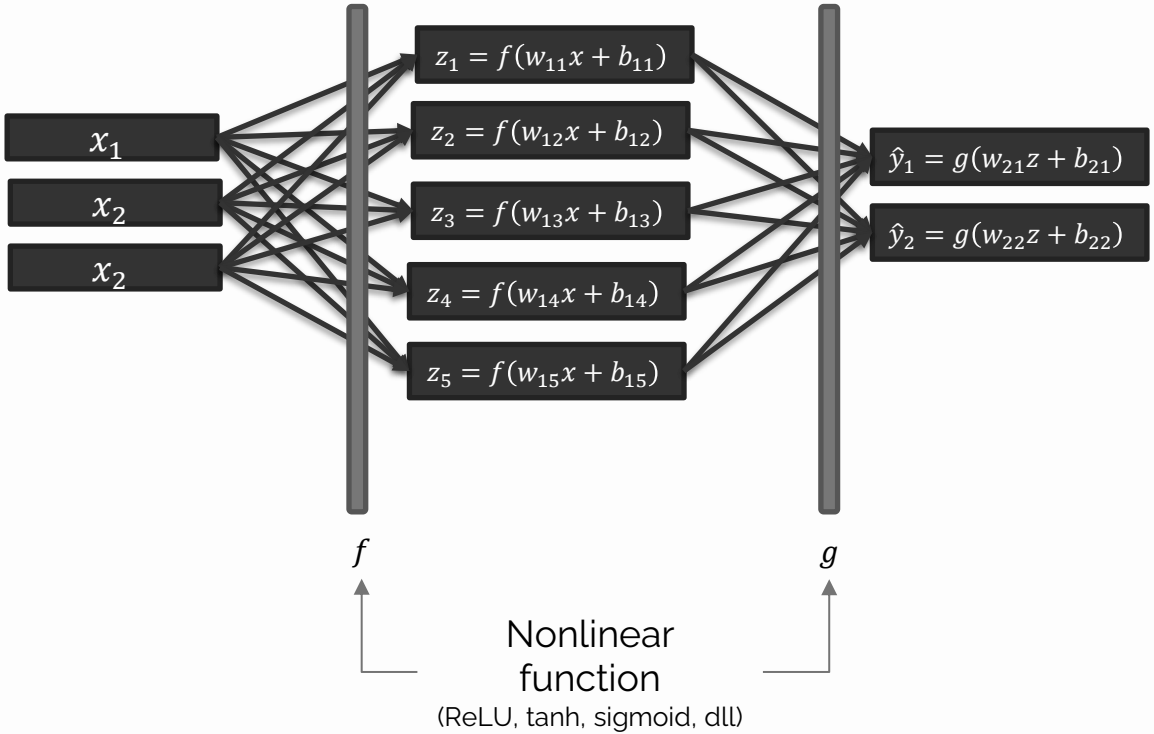



# However, the linear stack will remain linear

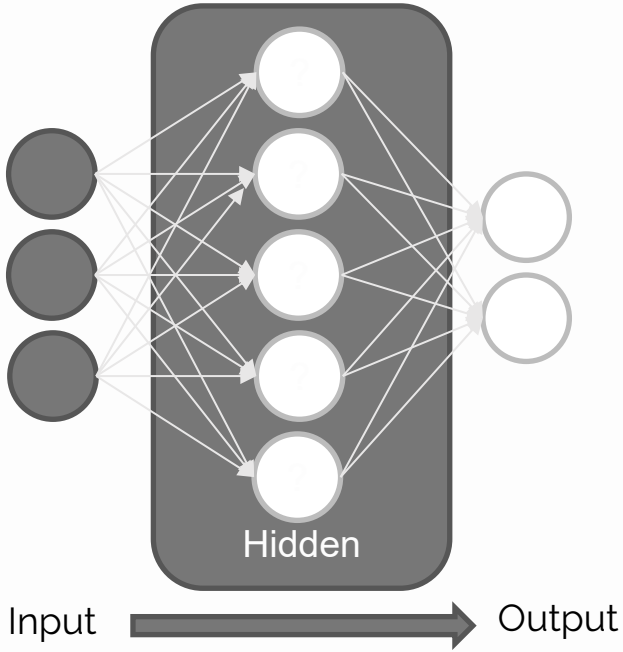
$$z = w_1 x + b_1$$

$$\hat{y} = w_2 z + b_2 = w_2(w_1 x + b_1) + b_2$$
$$= (w_2 w_1)x + (w_2 b_1 + b_2)$$

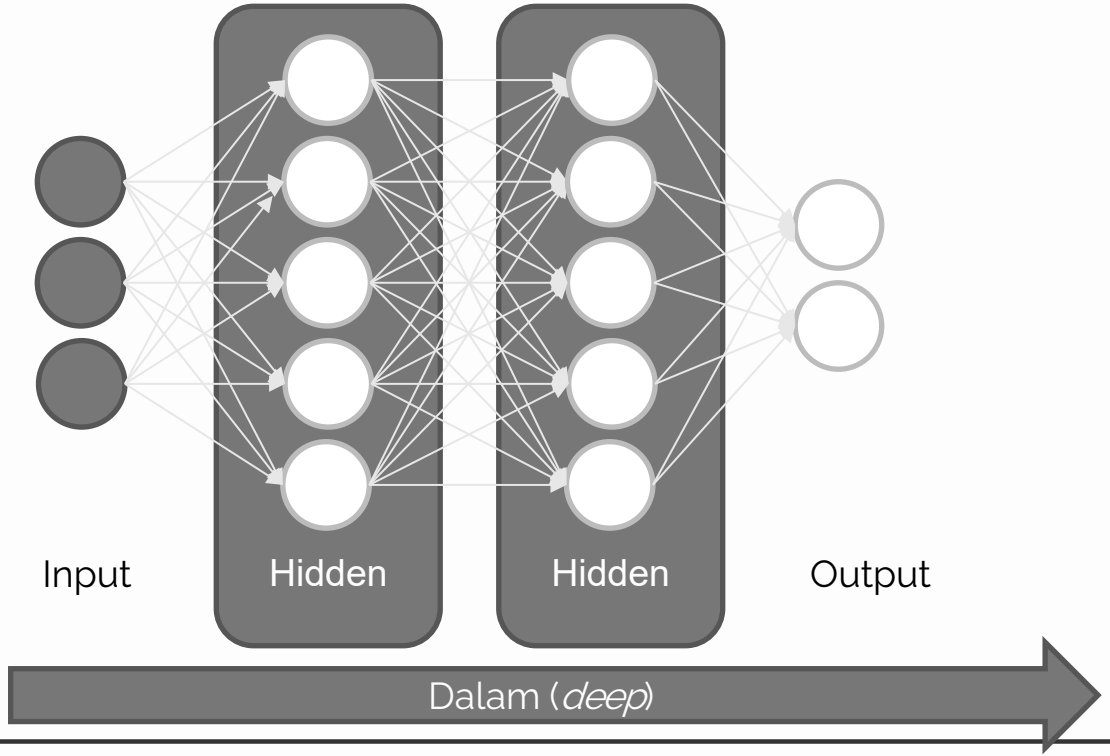
# What does NN do?



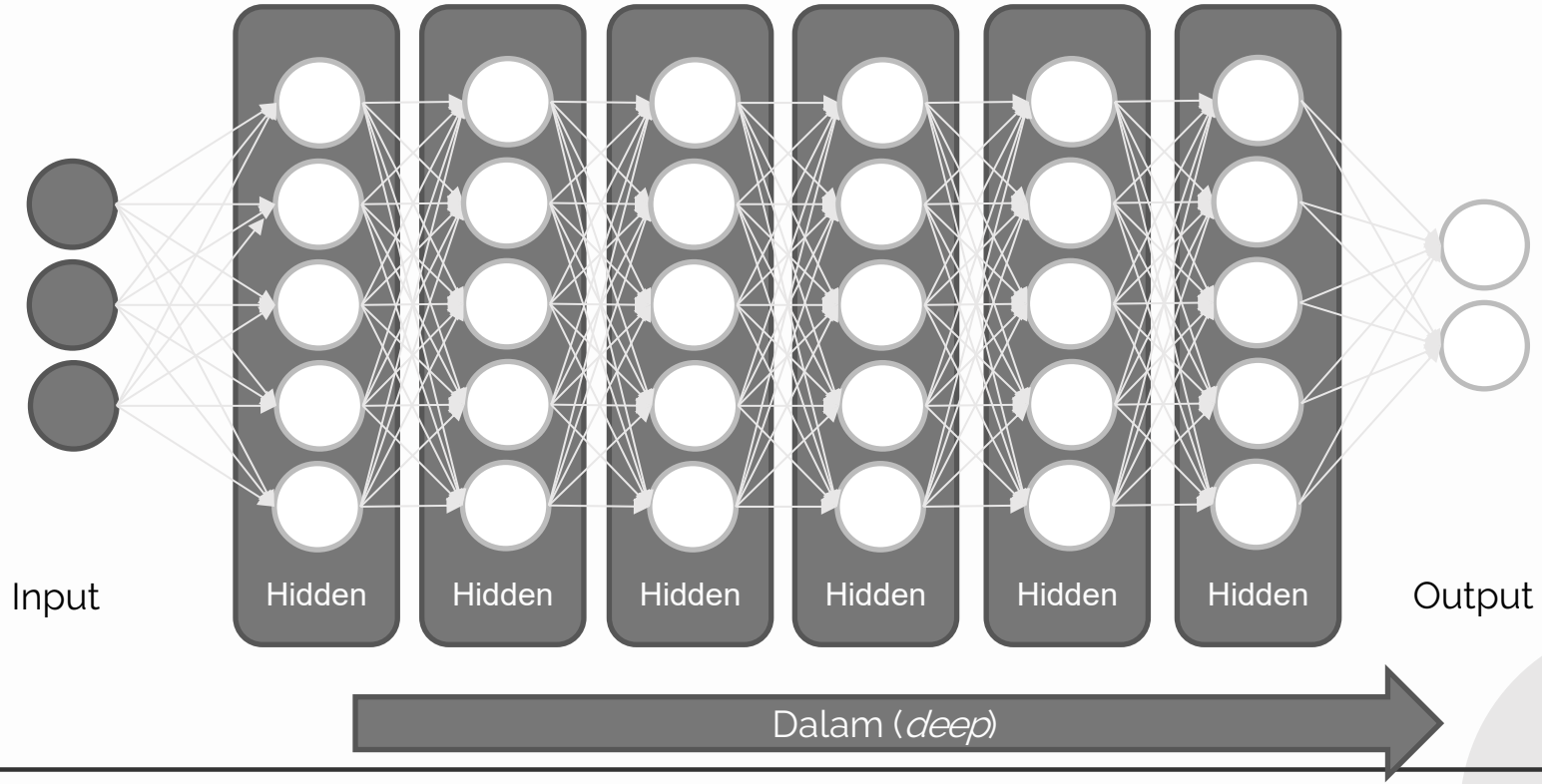
# Let’s just simplify it as follows



# What if the abstract information is learned gradually?

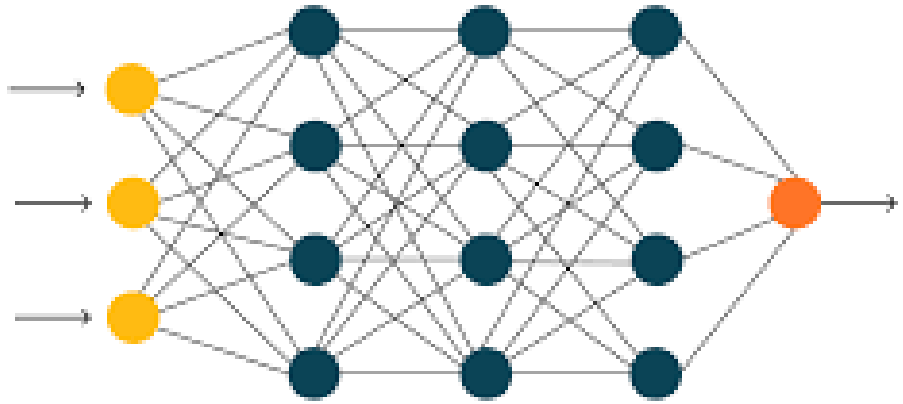


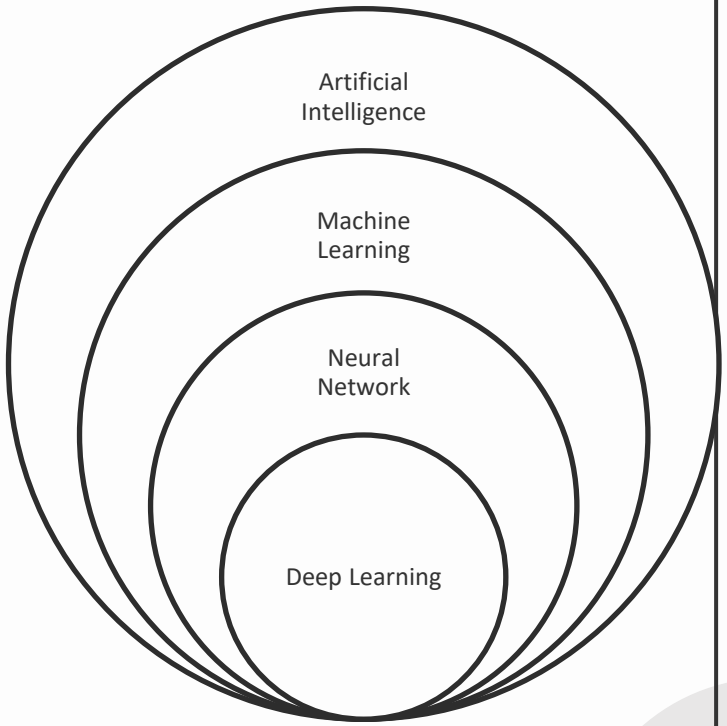
# How deep should machines learn?



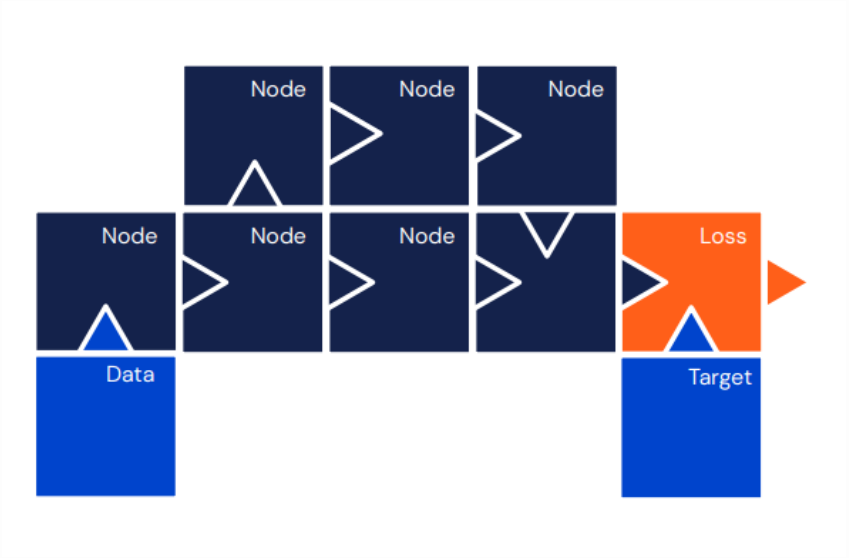
# Neural Network as Modern ML

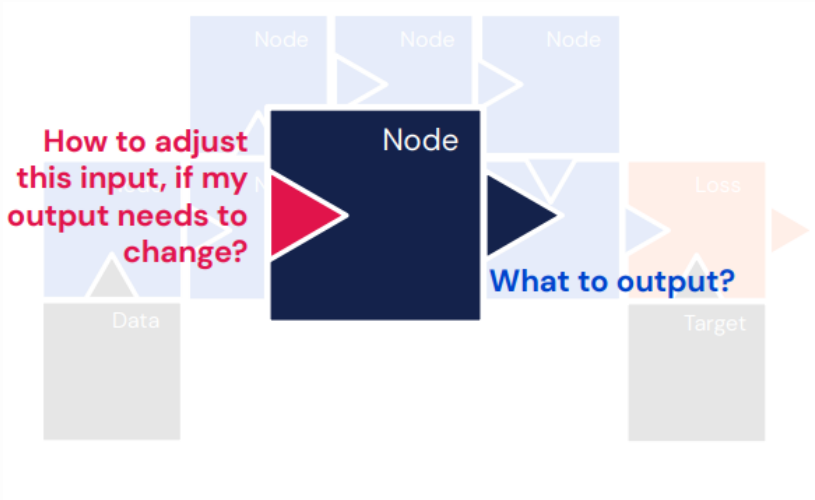
Neural Network becomes the bridge to new paradigm of ML, called deep learning



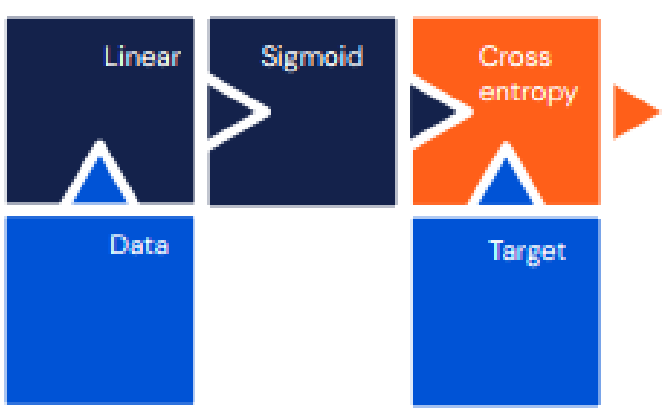


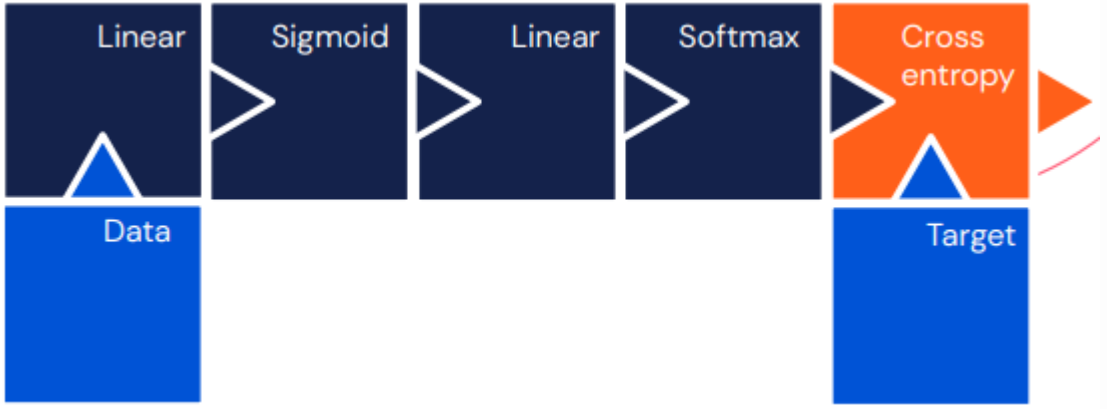
# Deep Learning “Puzzle”



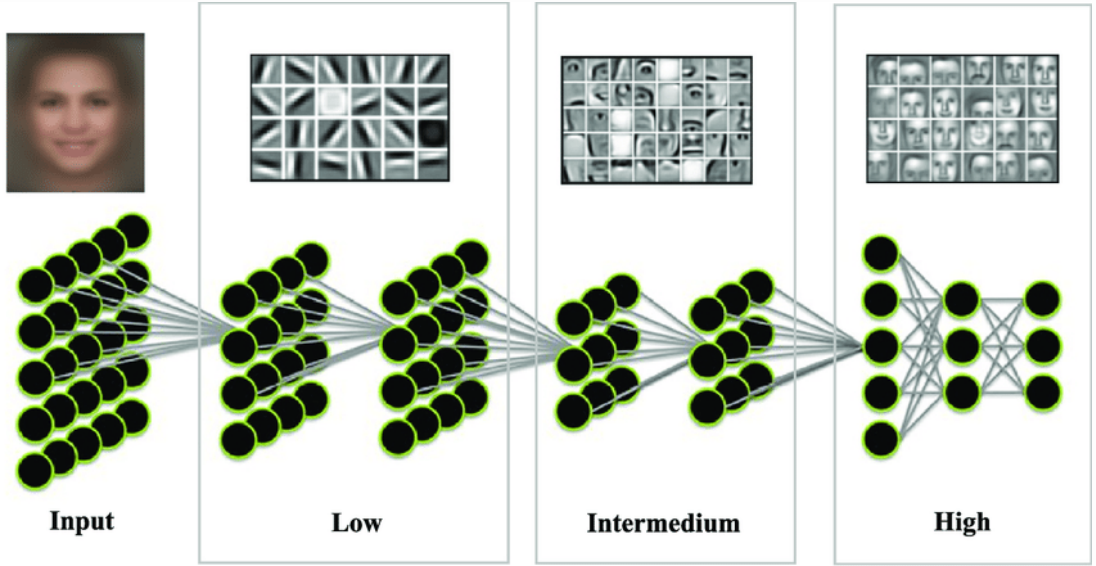



# Deep Learning “Puzzle”



# *Connectionism* and Visual Perception



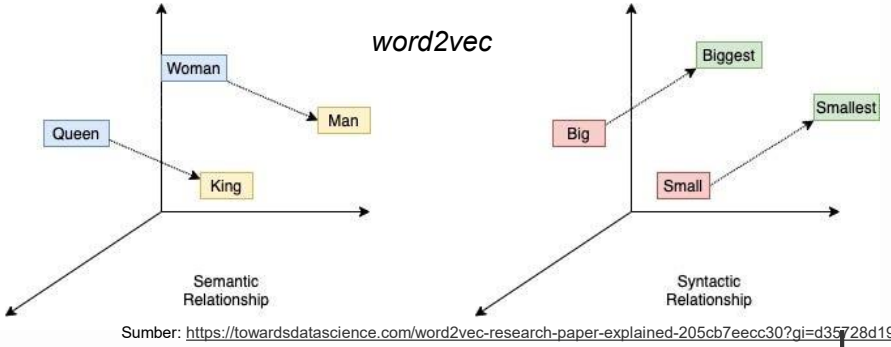

Sumber: https://www.researchgate.net/figure/A-convolutional-neural-network-for-a-facial-recognition-application_fig10_330373042

- The image is used as a pixel to be the input of the Artificial Neural Network.
- Use "feature extraction" to be able to recognize the object in question.
- Hierarchical pattern:
- Pixel -> edges -> pattern -> object
-

# *Connectionism* **and** *Natural Language Processing* **(NLP)**

*The best thing about AI is its ability to*

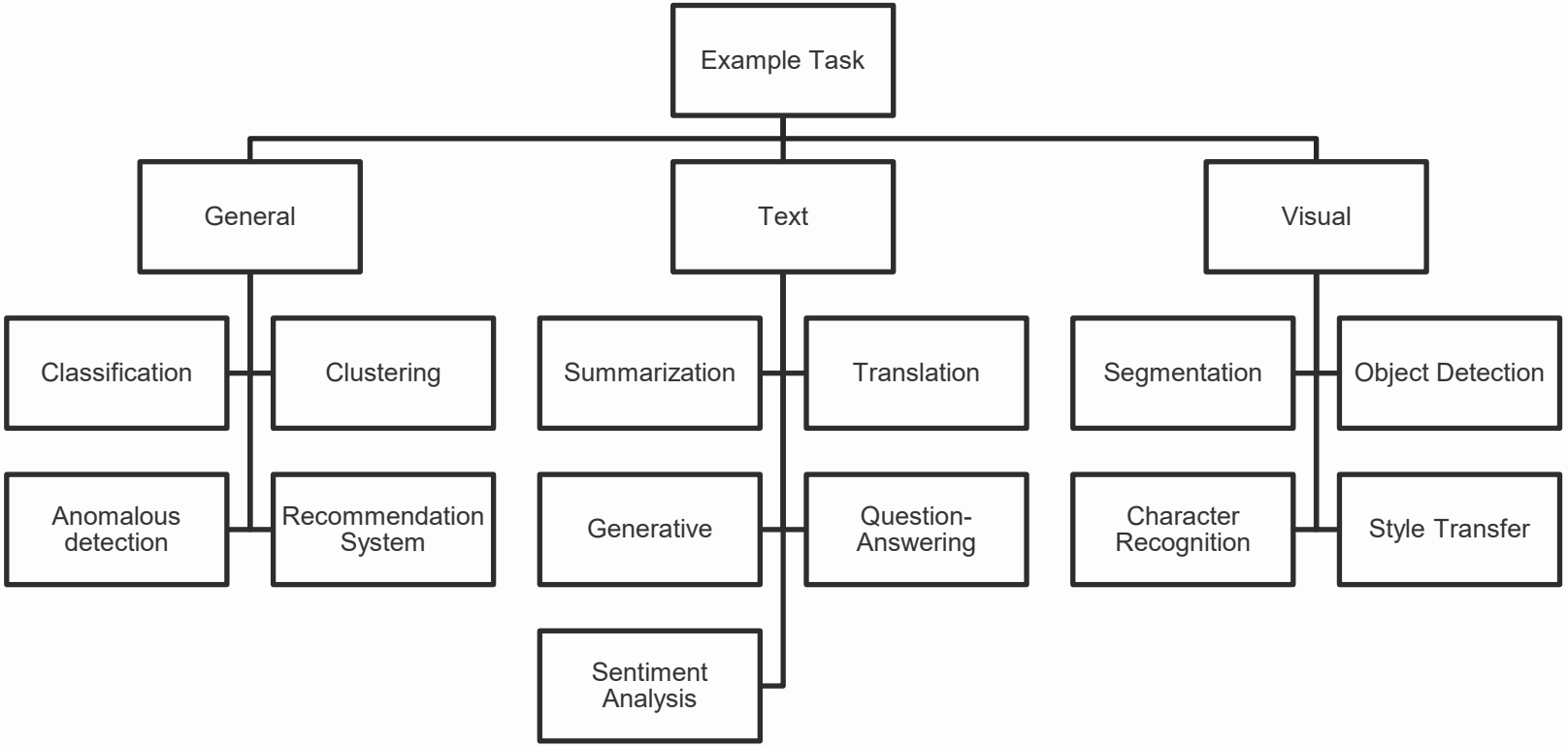
| | |
|---|---|
| learn | 4.5% |
| predict | 3.5% |
| make | 3.2% |
| understand | 3.1% |
| do | 2.9% |




Sumber: https://towardsdatascience.com/word2vec-research-paper-explained-205cb7eecc30?gi=d35728d19

- The probability is obtained from a large text dataset.
- Each word is used as a vector to be ANN's input.
- Vectors are not only for words, but they can also be for word sequences!

**Man** to **woman** is like **king** to ___(**queen**)

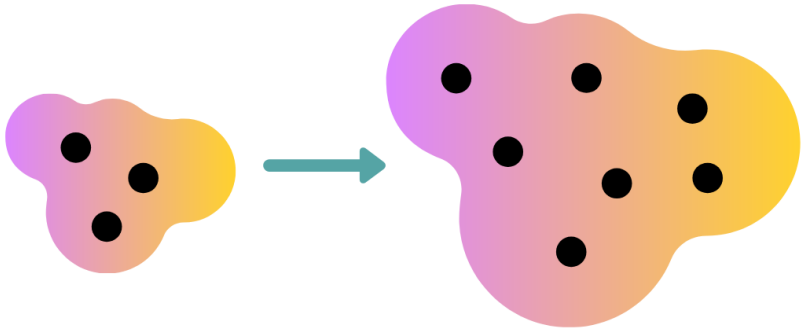

Example Task
General
Text
Visual
Classification
Clustering
Anomalous detection
Recommendation System
Summarization
Translation
Generative
Question-Answering
Sentiment Analysis
Segmentation
Object Detection
Character Recognition
Style Transfer

[FMH - 2025]

# What’s next?

# Generative AI

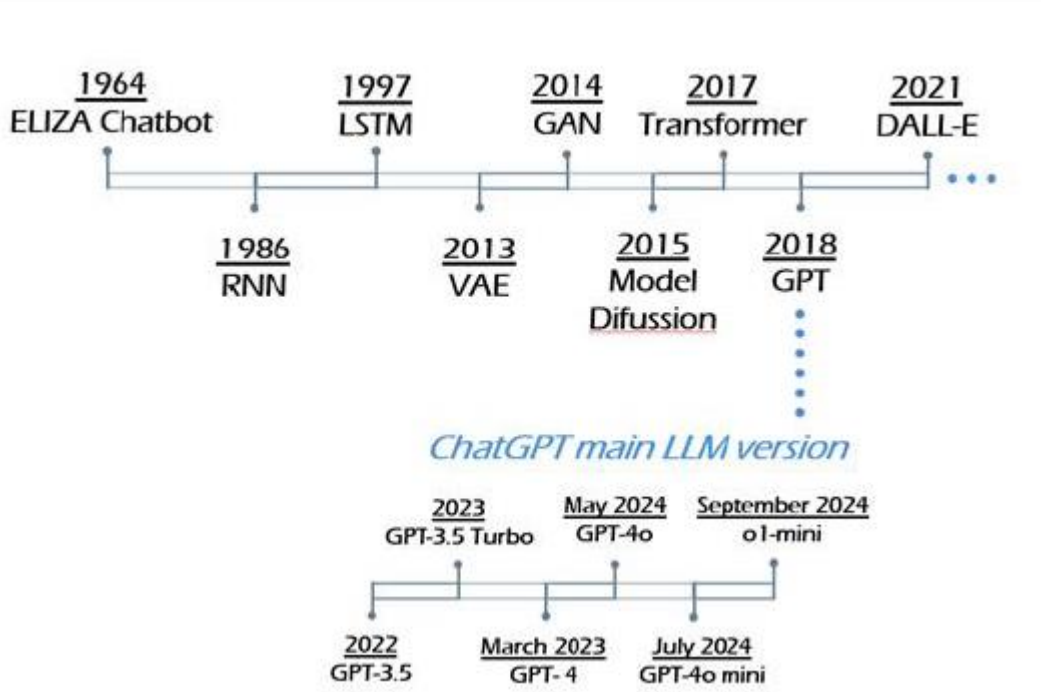
- Prediction paradigm can be modified to “predict a new data” based on existing information
- This kind of prediction actually create a new forms of AI model, called generative model.



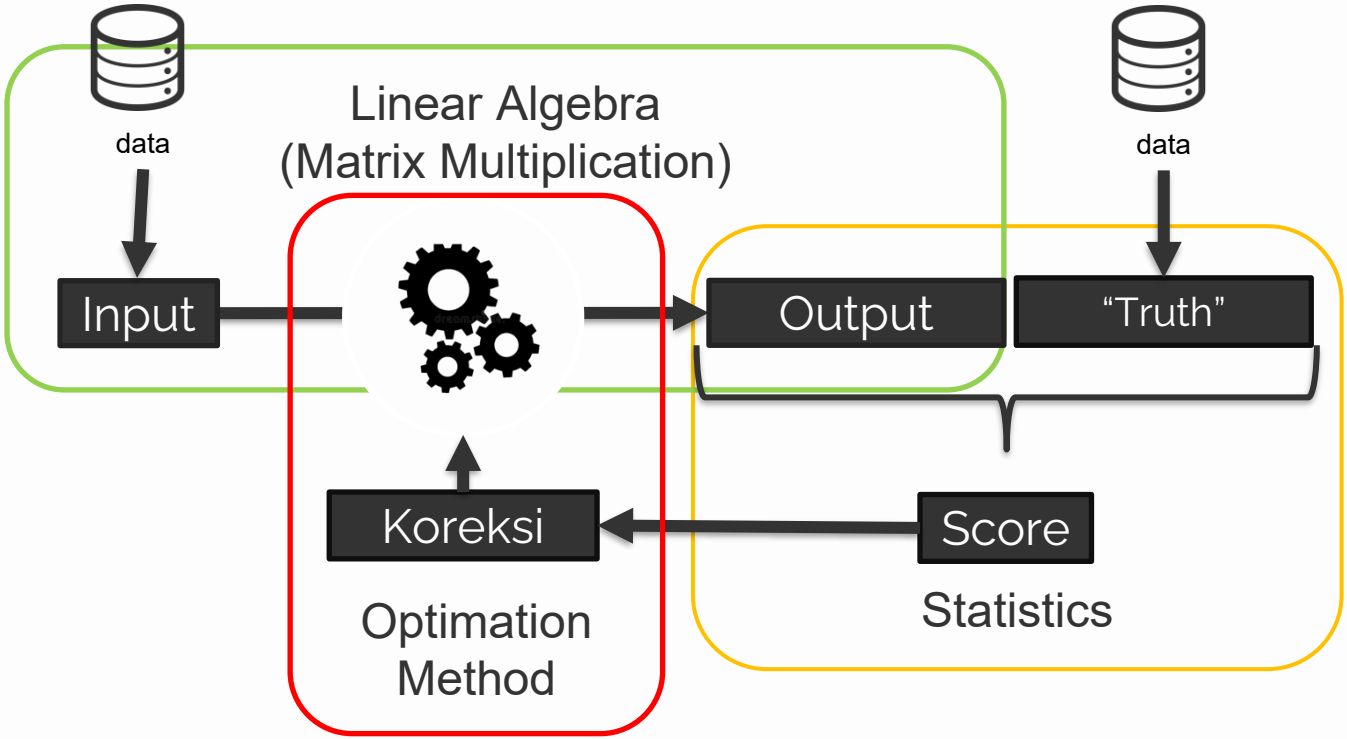
Generating new data using past data

# Generative AI

**Generative model:**
Deep learing model that can create a new content in the form of text, video, images, or others outside of the triaining data provided in the algorithm development process.



# Deep Learning "Puzzle"




The overall framework is the same:

- How to "encode" the input and output
- How to design the "puzzle" to obtain desired output.
- How to define the correct score
- How to optimize the model iteratively.

[FMH - 2025]


why ML engineers always have a calculator ?
WHY?
because ML is just MATRIX MULTIPLICATION

# Example of Generative Models: Transformer

## Embedding

Input tokens are transformed into vectors. 12288
Example: dog → [0.3,−0.7,...,0.10]. 12,288 dimensions

## Positional Encoding

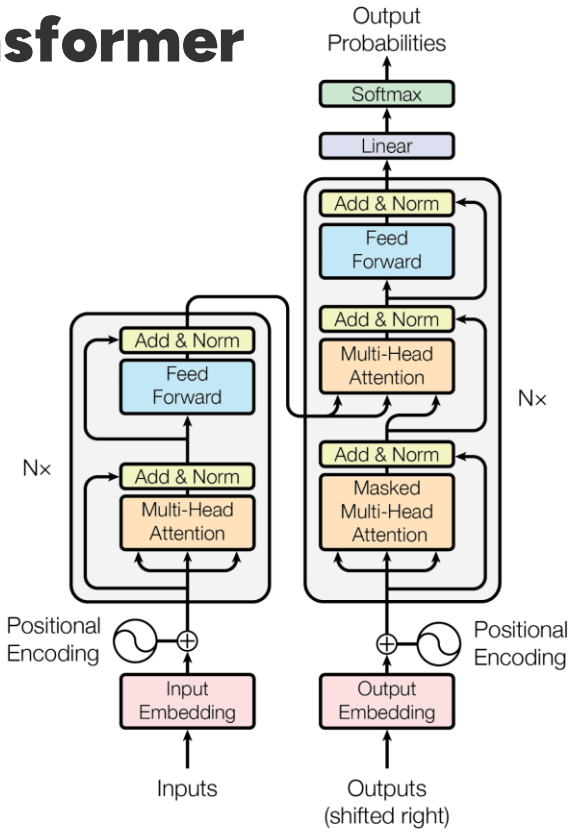
Positional information of each token is added, since Transformers process inputs in parallel.
Example: (1st, 2nd, ...).

## Attention Module

Each token decides how important other tokens are and integrates that information accordingly. Multiple attention heads allow the model to capture different contextual perspectives.

## Fully Connected Layer

The output from the attention layer is further processed through a non-linear feedforward network.



# Large Language Model

A neural network model designed to handle natural language, trained on extremely large datasets with a massive number of parameters.

- Large

Composed of billions to trillions of parameters (e.g., 175 billion in GPT-3, over 1 trillion in GPT-4). Trained on hundreds of gigabytes to tens of terabytes of text data

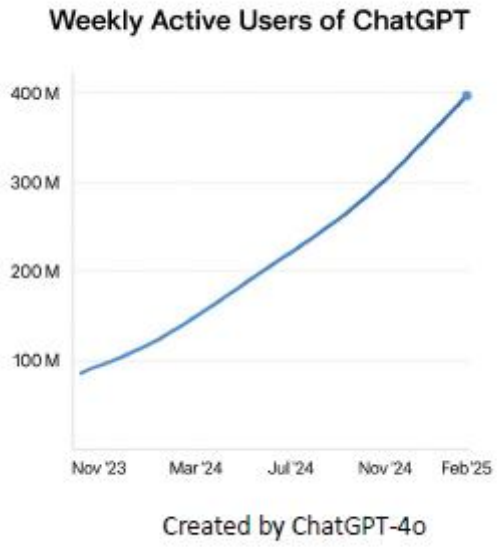
- Language

Mainly targets natural languages, but includes programming languages and structured data. Models grammar, meaning, context, and dialogue flow through predictive learning

- Model

Based on a multi-layer Transformer architecture. Trained using self-supervised learning, where the model learns to predict the next word or token

# Large Language Model




## How widely are LLMs used?

• 400 million
Weekly active users of ChatGPT as of February 2025.
• Over 1 billion
Number of queries ChatGPT processes per day.

## Scale of LLMs

• Number of parameters in GPT-4:
1.8 trillion
• Training duration for GPT-4:
3 months
• Number of NVIDIA A100 GPUs used for training GPT-4 :
25,000 units
• Text data used for GPT-3 training:
45 TB (unfiltered) / 570 GB (filtered: only 1.2%)

# Evolutionary AI (Swarm Intelligence)

Adopt how biological system works (emergence principle)

Learning by many agents

# Fourth Generation of AI (4G AI)?

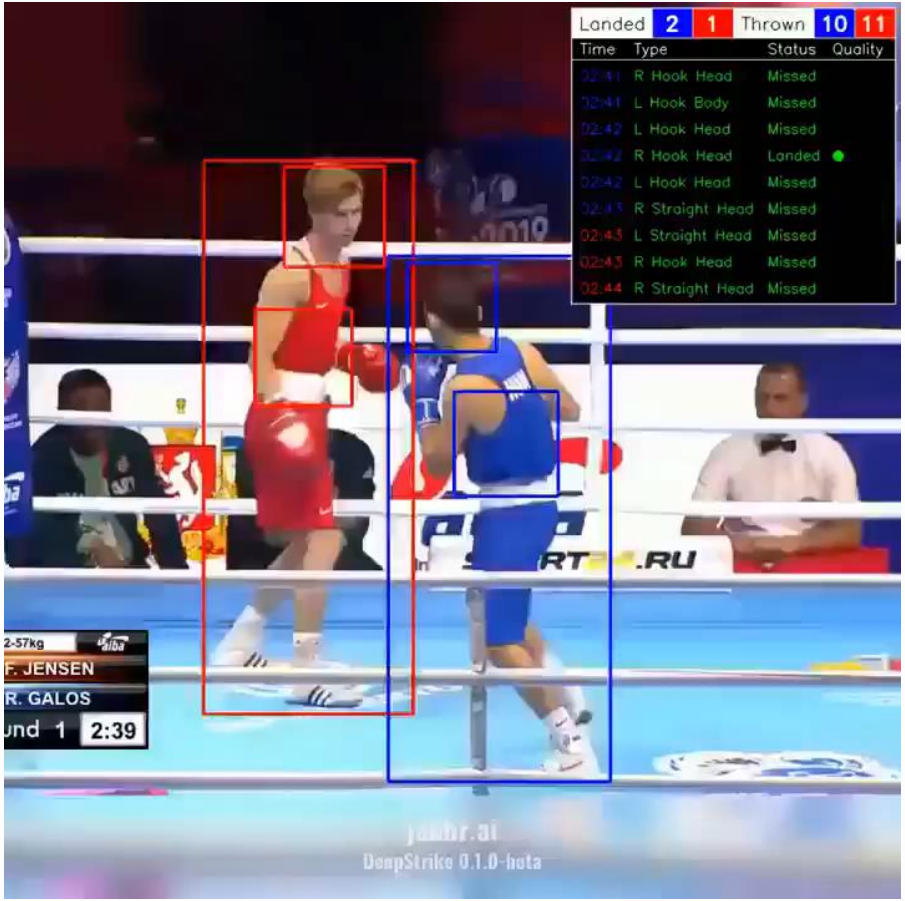
1. Adaptive Learning
2. Federated Learning
3. Self-supervised Learning
4. Hybrid Symbolic AI + Deep Learning
5. Transformers
6. **Evolutionary Artificial Intelligence**

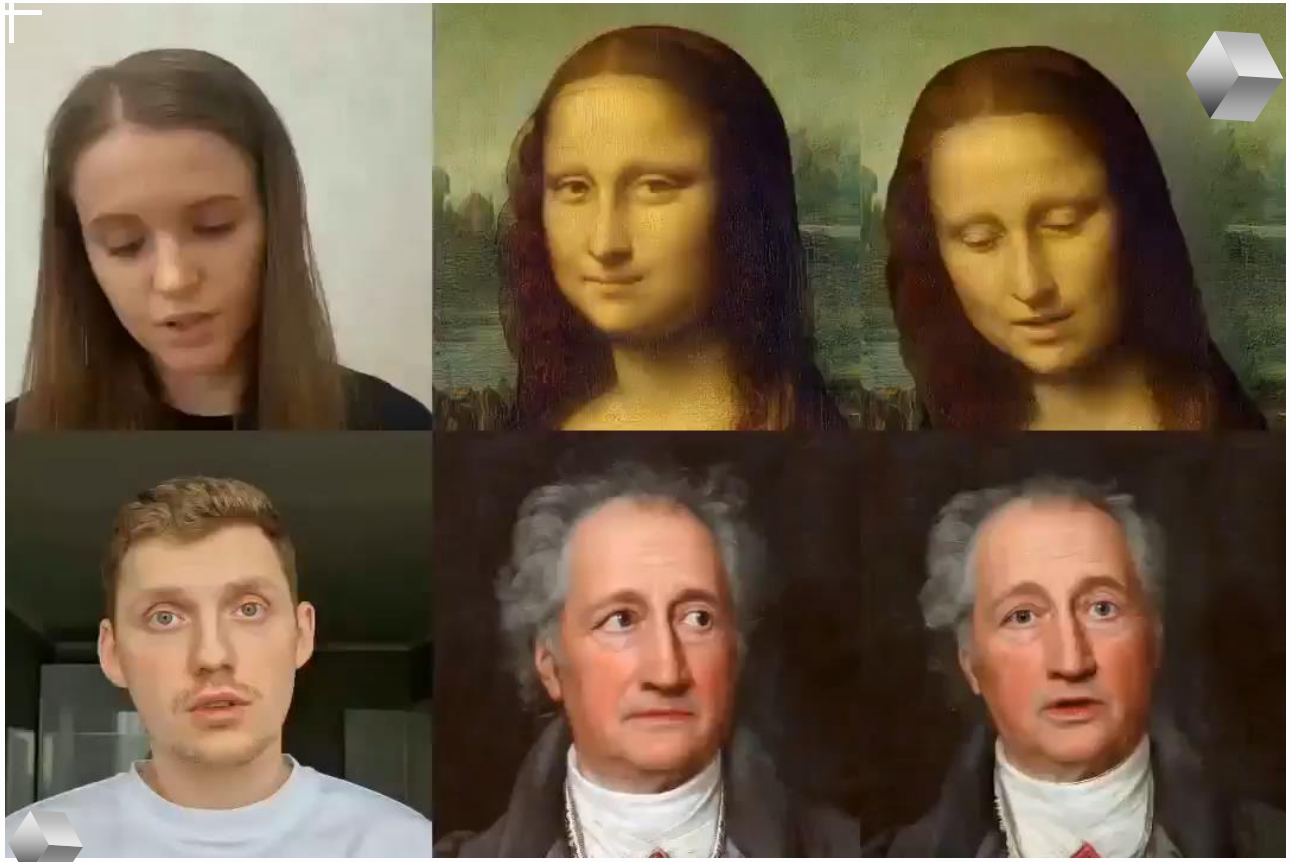
# Evolutionary AI (Swarm Intelligence)

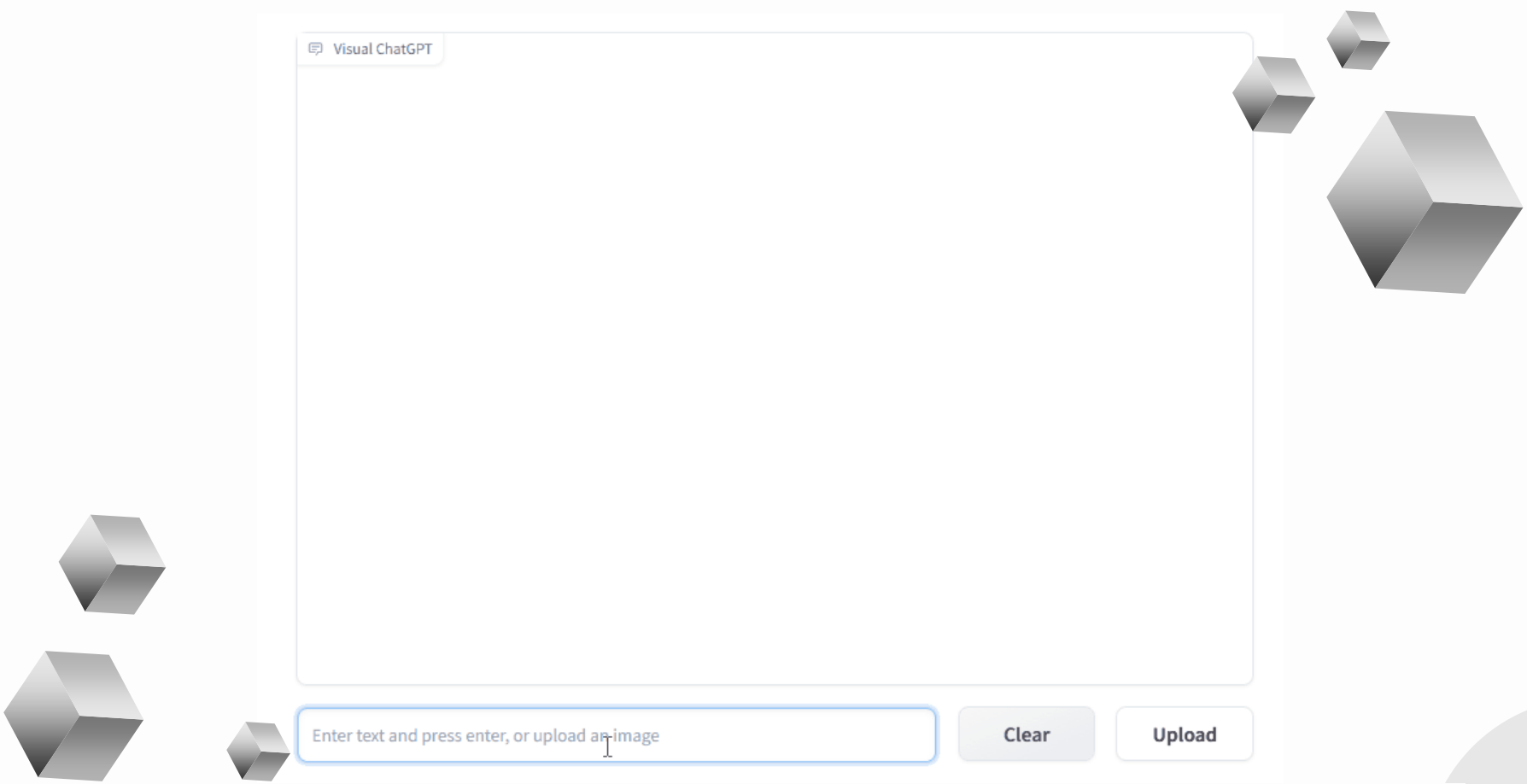
Adopt how biological system works (emergence principle)

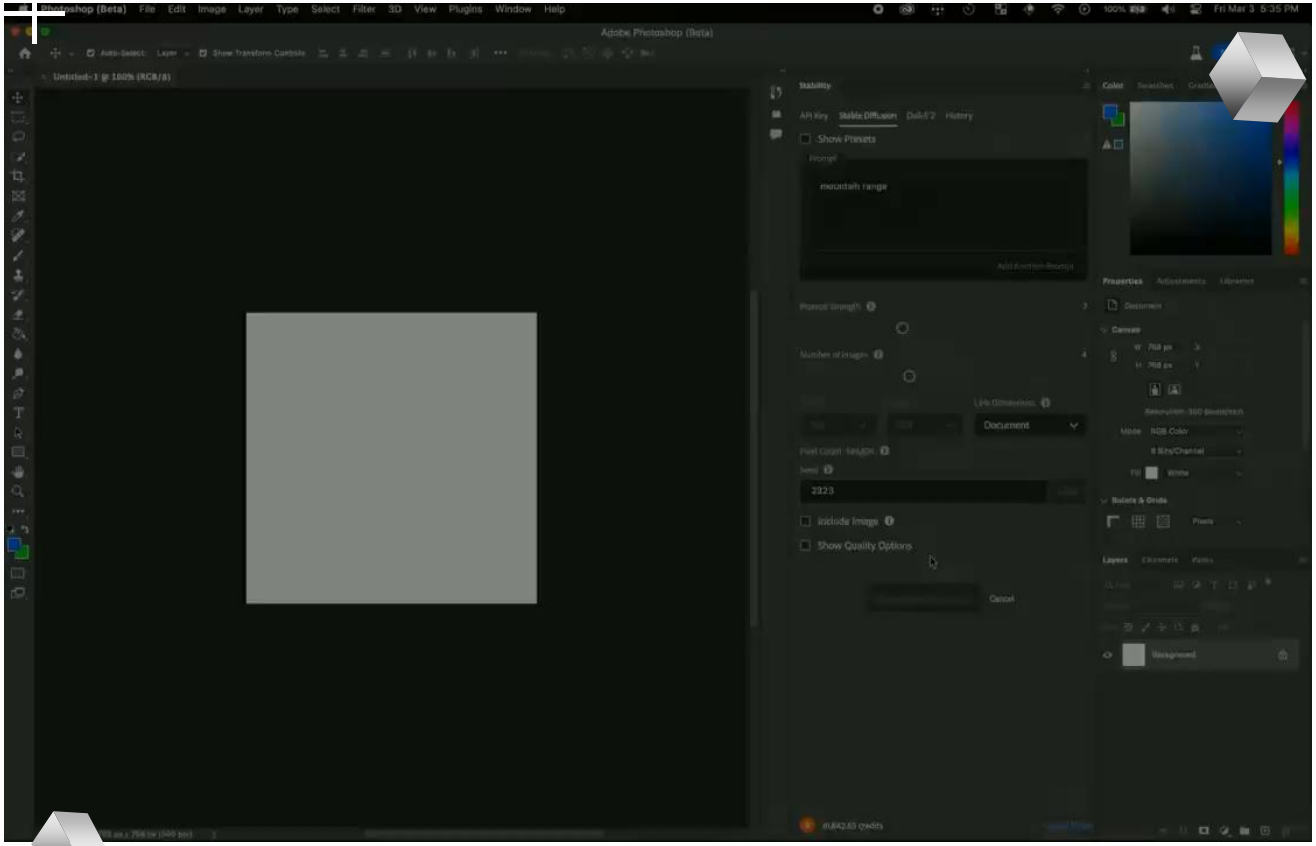
Learning of many agents

Different than neurons (each agent is independent)


Landed 2 1 Thrown 10 11
Time Type Status Quality
R Hook Head Missed
L Hook Body Missed
L Hook Head Missed
R Hook Head Landed
L Hook Head Missed
R Straight Head Missed
L Straight Head Missed
R Hook Head Missed
R Straight Head Missed
F. JENSEN
R. GALOS
2:39
DeepStrike 0.1.0-beta




Visual ChatGPT
Enter text and press enter, or upload an image
Clear
Upload


Adobe Photoshop (Beta)
Stability
Show Presets
mountain range
Document
2323
Include Image
Show Quality Options
Cancel


Insilico
Medicine


© The Leg Laboratory

# What’s the Problem?


The New York Times

# AI Art at Christie's Sells for $432,500

Give this article

"Edmond de Belamy, from La Famille de Belamy," by the French art collective Obvious, was sold on Thursday at Christie's New York. Christie's

ABC NEWS Just In For You Politics World More

# Legal expert warns patients' medical data at risk as GPs adopt AI scribes

By Anna McGuinness | ABC Central Victoria | Artificial Intelligence

Thu 6 Mar

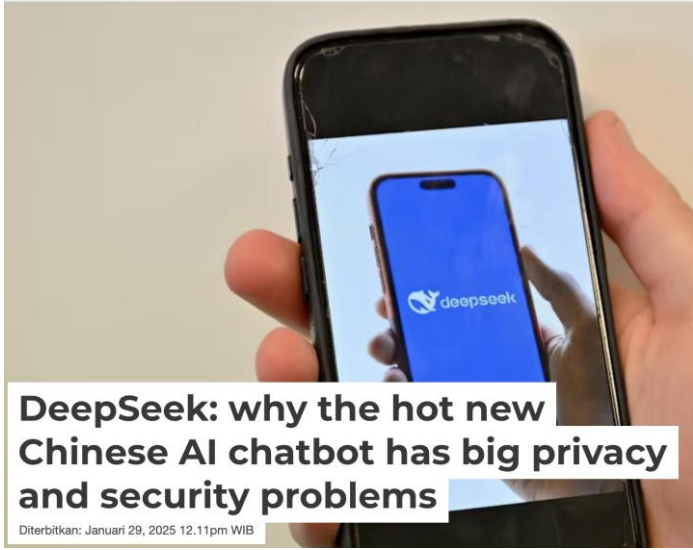
# A Huge Amount of Doctors Are Already Using AI in Medical Care

HEALTH 05 November 2024 By MARK SUJAN, THE CONVERSATION

THE CONVERSATION

Disiplin ilmiah, gaya jurnalistik

Ekonomi Isu Anak Muda Kesehatan Lingkungan Pendidikan + Budaya Politik + Masyarakat Sains + Teknologi




# DeepSeek: why the hot new Chinese AI chatbot has big privacy and security problems

Diterbitkan: Januari 29, 2025 12.11pm WIB

euronews. Latest Europe World EU Policy Business Travel Next Culture

Next > Tech News

# What are the data privacy issues plaguing Chinese AI DeepSeek in the EU?

SRI LANKA Guardian SINCE 2007
Beyond The Island

anka Editorials Defence Business World Essays New Books Old Site

ARTIFICIAL INTELLIGENCE

# AGI: A Growing Debate in the AI World

**The road to AGI is filled with uncertainties, but for now, its balloon continues to inflate—buoyed by both technological advancements and a growing sense of urgency among policymakers and researchers alike.**

by Sri Lanka Guardian · March 12, 2025 · 2 mins read

The Gradient

ETTER PODCAST SUBSCRIBE WRITE SUPPORT

Why transformative artificial intelligence is really, really hard to achieve

26.JUN.2023 . 20 MIN READ

Tech Xplore Topics Week's top Latest news

Home / Machine learning & AI

69 Tweet Share Email

SEPTEMBER 30, 2024 Editors' notes

## Don't believe the hype: Artificial general intelligence is far from inevitable, researchers say

by Radboud University Nijmegen


Forbes

INNOVATION

# There Could Never Be An Artificial General Intelligence

By Richie Etwaru , Former Forbes Councils Member.
for Forbes Technology Council, COUNCIL POST | Membership (fee-based)

Jul 01, 2024, 09:45am EDT

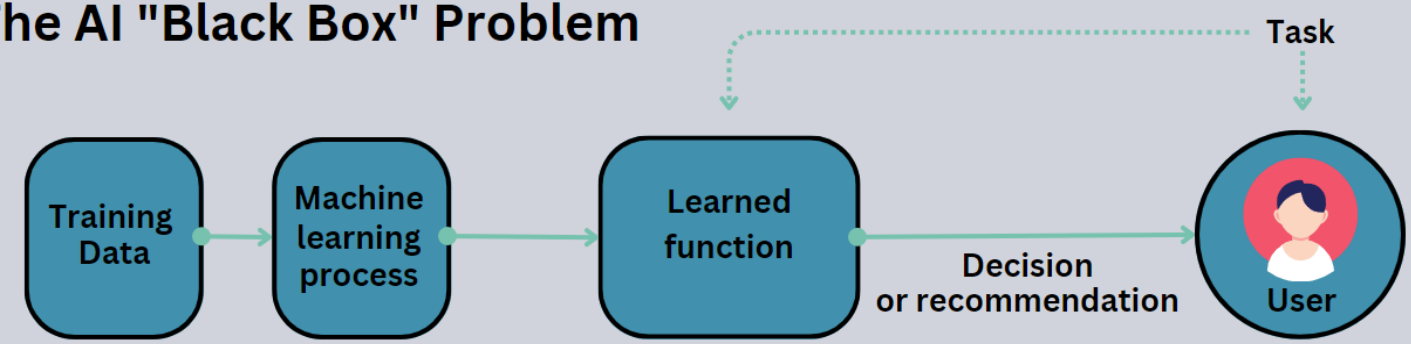
Share Save

*Richie Etwaru is Co-founder & CEO at Mobeus. He's also a former CTO, CDO & CIO at Fortune 500 firms in Financial Services and Healthcare.*

NOW PLAYING:

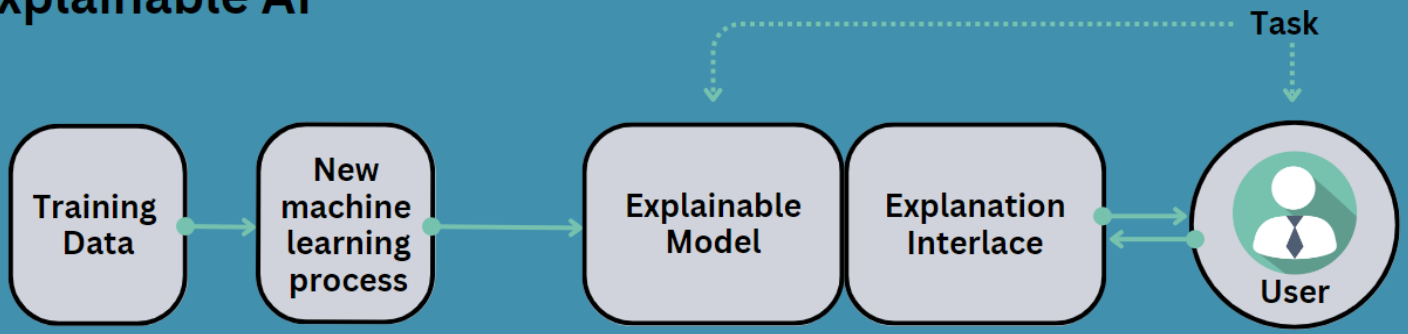
[FMH - 2025]

# The AI "Black Box" Problem



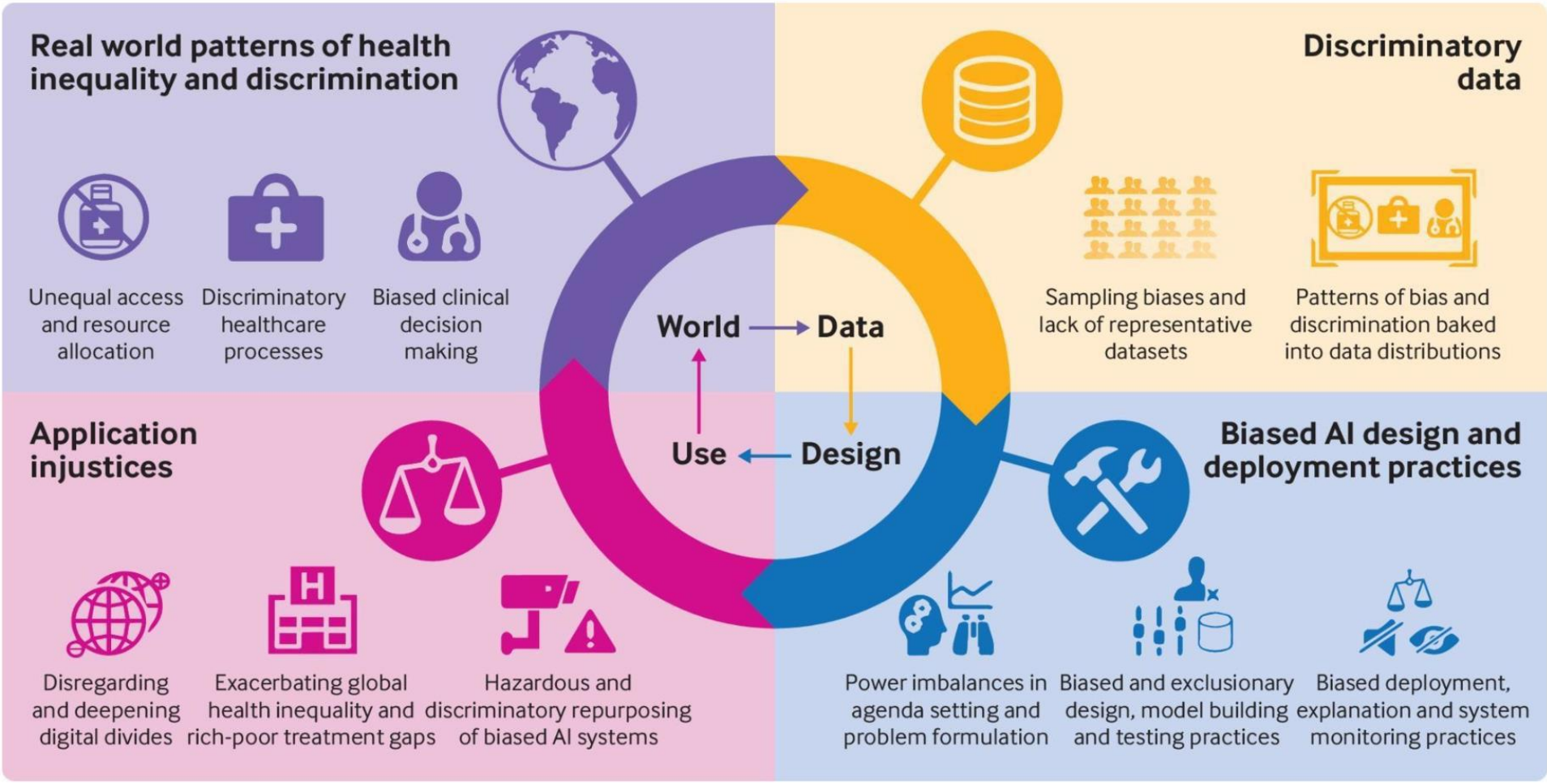

- Why did you do that?
- Why not something else?
- When do you succeed?
- When do you fail?
- When can I trust you?
- How do I correct an error?

# Explainable AI




- I understand why
- I understand why not
- I know when you succeed
- I know when you fail
- I know when to trust you
- I know when you're wrong

https://renaissancerachel.com




Ridding AI and machine learning of bias involves taking their many uses into consideration

Image: British Medical Journal

# Issues Raised Related to AI

- **Bias and Discrimination**
  - Problem: AI can inherit biases that exist in the data used to train it, which can lead to discrimination against certain groups.
  - Example: An AI-based employee recruitment system that is biased towards a particular gender or race.

# Issues Raised Related to AI

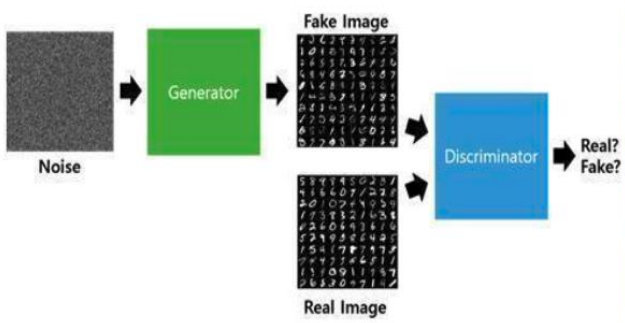
- **Remember "Machine Learning"?**
  - Computers can learn. Computers learn from data.
    Computers learn from mistakes.
  - Machine Learning is an AI product that is currently Trending!
  - Thus, AI relies heavily on Data
    AI is "steered" by Data
    The good and bad of AI depends on the data used to learn
    Bias in AI is very likely!

# Issues Raised Related to AI

- **Transparency and Accountability**
  - Problem: Many AI systems, especially those based on deep learning, are "black boxes" that are difficult to understand.
  - That is, the user only provides data, then leaves the AI to make his decision, without any explanation or reasoning related to the decision; And the user will just accept it.
  - Example: Difficulty in explaining the decisions made by the AI is unclear as to the reason for the decision who is responsible and how to account for it?

# Issues Raised Related to AI

- **Ethics and Morals**
  - Problem: AI can be used for unethical purposes, such as mass surveillance or autonomous weapons.
  - Example: The use of AI in autonomous weapons that can make life-and-death decisions without human intervention.
  - This issue is also related to the ownership of the rights to a copyrighted work.




**GAN and First AI Artwork Portrait of Edmond de Belamy**

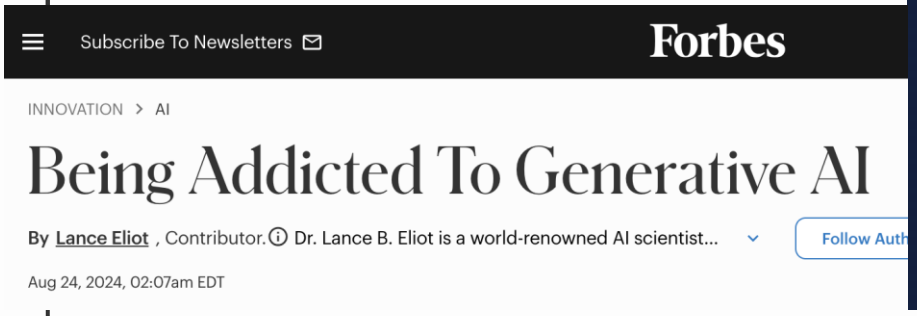
Source:
- https://wikidocs.net/146217
- https://en.wikipedia.org/wiki/Edmond_de_Belamy

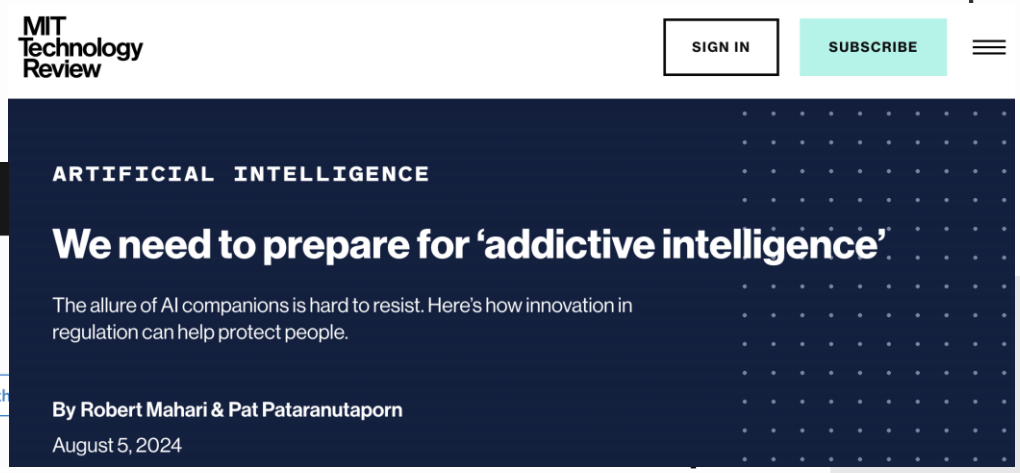
# Issues Raised Related to AI

- **Impact on Work**
  - Problem: AI-powered automation can replace human work, causing unemployment.
  - Example: The use of robots in Manufacturing that replaces human workers.

# Issues Raised Related to AI

- **Dependability and Reliability**
  - Problem: Over-reliance on AI can be risky if the system fails or is hacked.
  - Example: Failure of an AI system in an autonomous vehicle that causes an accident.



# Issues Raised Related to AI

- **Data Privacy and Security**
  - Problem: AI often requires large amounts of data, which can threaten an individual's privacy.
  - Example: Misuse of personal data by technology companies.

# Issues Raised Related to AI

- **Cyber Security**
  - Problem: AI systems are vulnerable to cyberattacks that can be leveraged for malicious purposes.
  - Example: A cyberattack on an AI system that controls critical infrastructure.

# Issues Raised Related to AI

- **Responsibility**
  - Problem: Who can be blamed in the failure of an automatics system?
  - Example: Crash of an autonomous vehicle.

# Problem of Responsibility

- If an accident occurs while the car is still in automatic control, who will be responsible?
- The driver is not in control, not even asked to do so. The automatic control technology works as it should. Is the company responsible?
- What if the Company has done everything possible to prevent accidents, but accidents still occur?

# Problem of Responsibility

- Moral Responsibility Versus Liability
    - Legal responsibility must be proven in court.
    - Evidence needs to be presented in court through a legal process.
    - By following this legal process, those who made mistakes can be held accountable, and those at fault can be punished.

# Problem of Responsibility

- "Strict liability" is that a company or person can also be held accountable even if they have not committed any wrongdoing in a narrow sense.
- For example, if a person owns a cat, and the cat causes damage to someone else's property, then the owner will be liable in this sense.
- Product liability occurs if a company or one of its employees causes losses to others due to neglecting their duties, then the company will be held liable.

# Problem of Responsibility

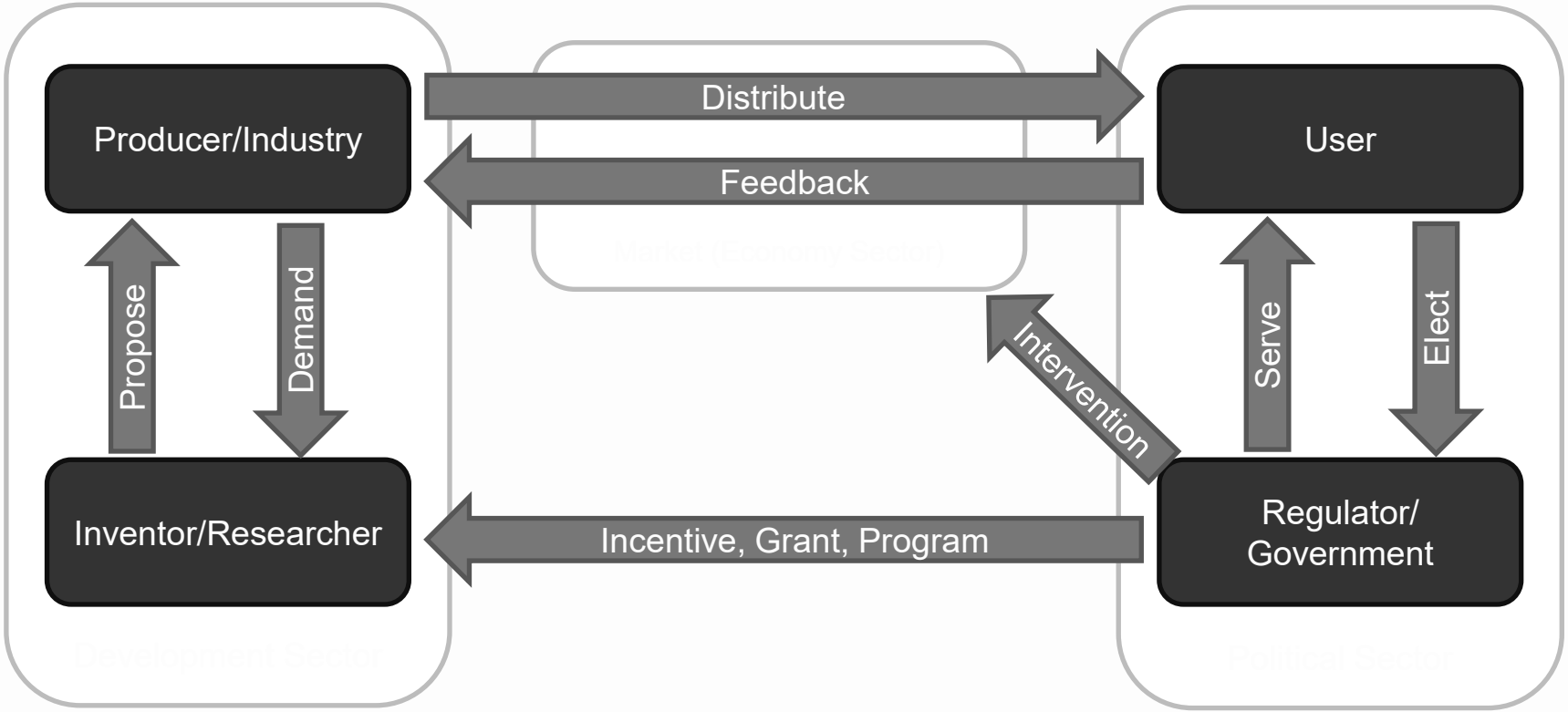
- In the case of automatic vehicles, there is a shift of the person in charge from the driver or vehicle owner to the company that makes the vehicle, if possible to the company that operates or makes the software.
- This shift occurred due to adjustments from the Vienna Convention on Road Traffic. Update from the 1968 version to the 2014 version (United Nations 1968).
- The German Ethics Code for Automated and Connected Driving (Luetge 2017), also explicitly states. The consequence is that there must be a kind of black box in the car like an airplane that monitors who controls the car every second.

# Challenge: Problem of Many Hands

Stakeholder AI:

- Professionals
- Society
- research organisations,
- companies and government.

# Every stakeholder has role.




[FMH - 2025]

# Thanks