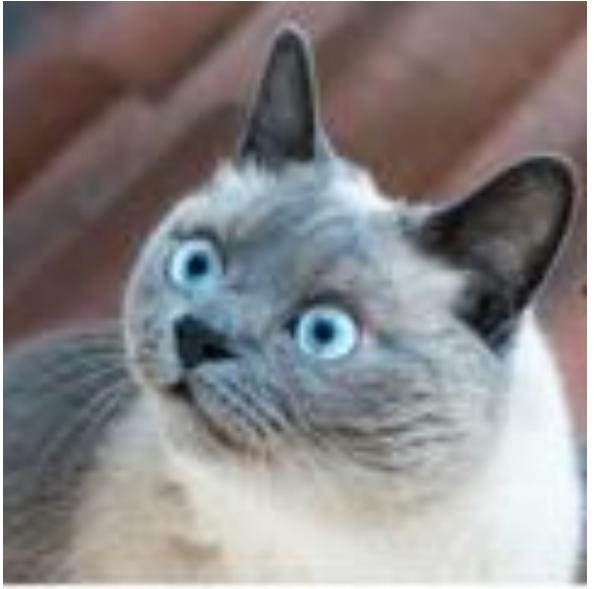


**Week 1**

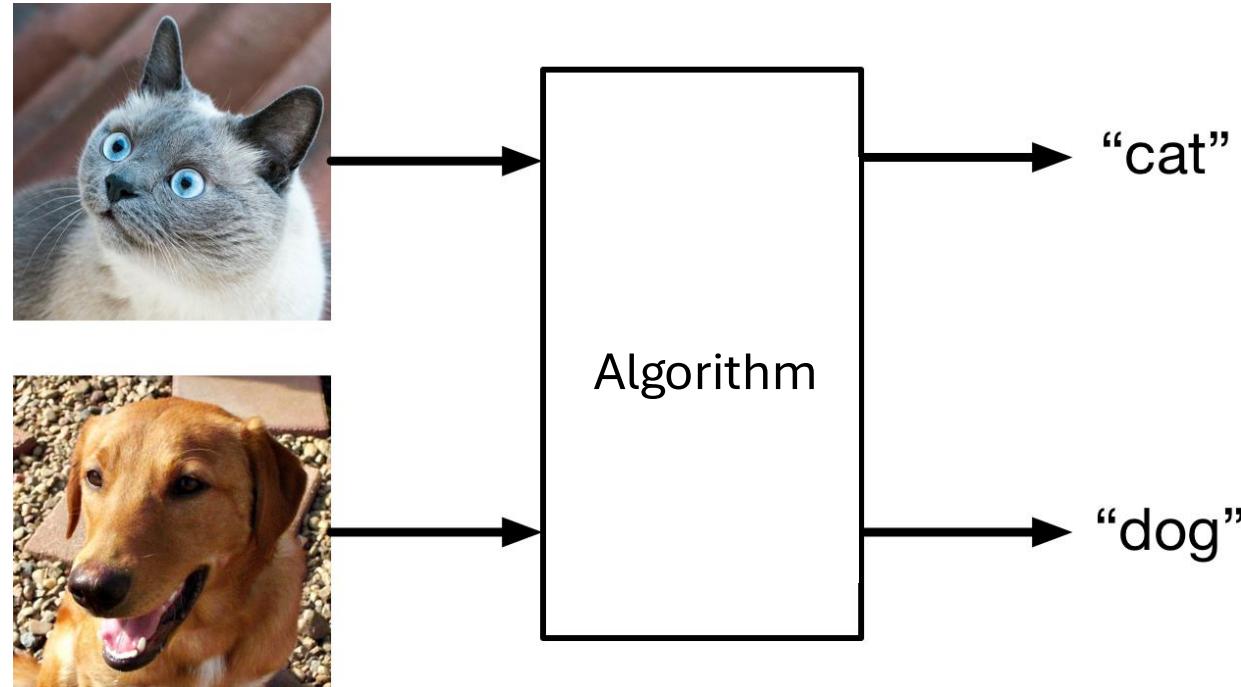
# Applied AI in Chemical and Process Engineering

DMMB Dissanayake



Can you write instructions to visually distinguish a cat from dog?

# 2012



*'AlexNet', Krizhevsky et al, ImageNet Classification with Deep Convolution Neural Networks, 2012, NeurIPS*

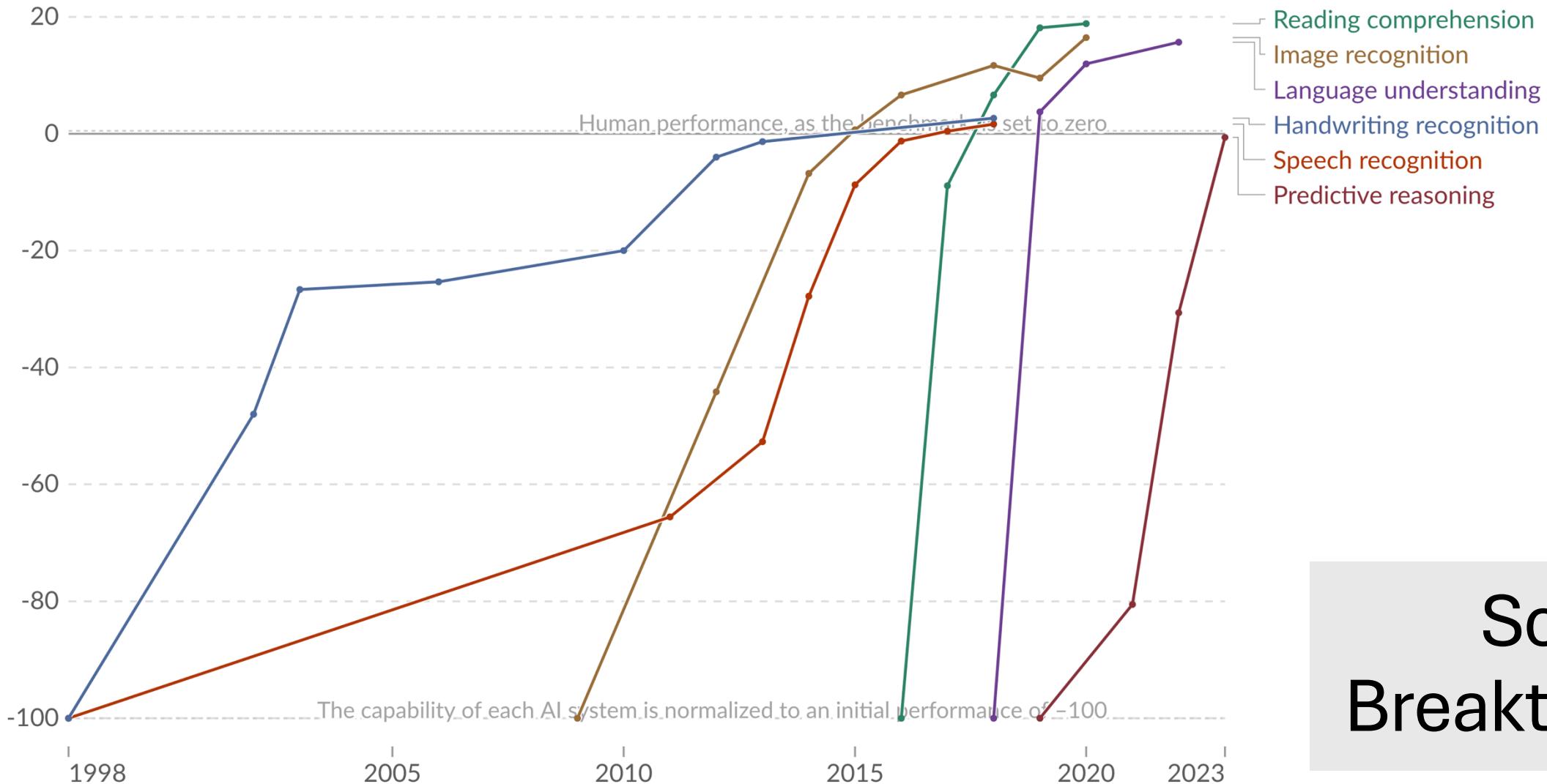
Nearly  
impossible to  
decode  
*'intelligence'*



Until now (?)

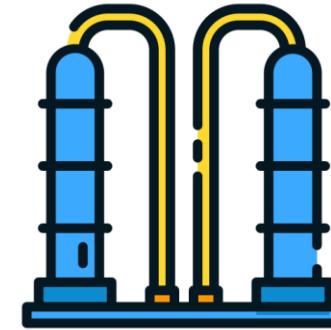
# Test scores of AI systems on various capabilities relative to human performance

Within each domain, the initial performance of the AI is set to -100. Human performance is used as a baseline, set to zero. When the AI's performance crosses the zero line, it scored more points than humans.



Some  
Breakthroughs

# From Tool to Agent



Help perform a function or a  
task, more efficiently

- Don't make decisions on their own
- Don't reason on their own
- Don't learn from past experience to adapt

but....

**Agentic AI Does**

# The Mother of Every Living Human

Human mitochondria hold a second genome, which is inherited from the mother



Mitochondrial Eve is  
the woman all living humans inherited their mitochondrial DNA from

She lived 200,000 years ago, and her mitochondrial lineage is called L0

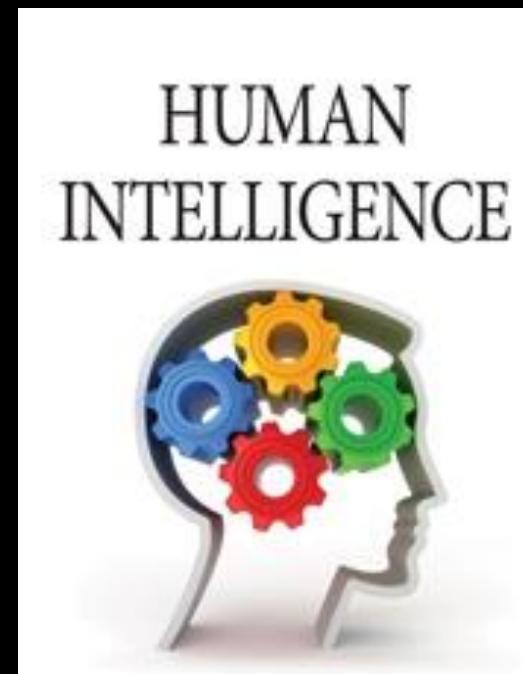






Sapiens Dominated

*Thanks to*



A close-up profile photograph of a woman's face, shown from the side and slightly from behind. Her hair is dark and pulled back. The lighting is dramatic, casting most of her face in deep shadow against a bright, featureless background. Her eyes are partially closed or heavily shadowed.

A digital species is emerging

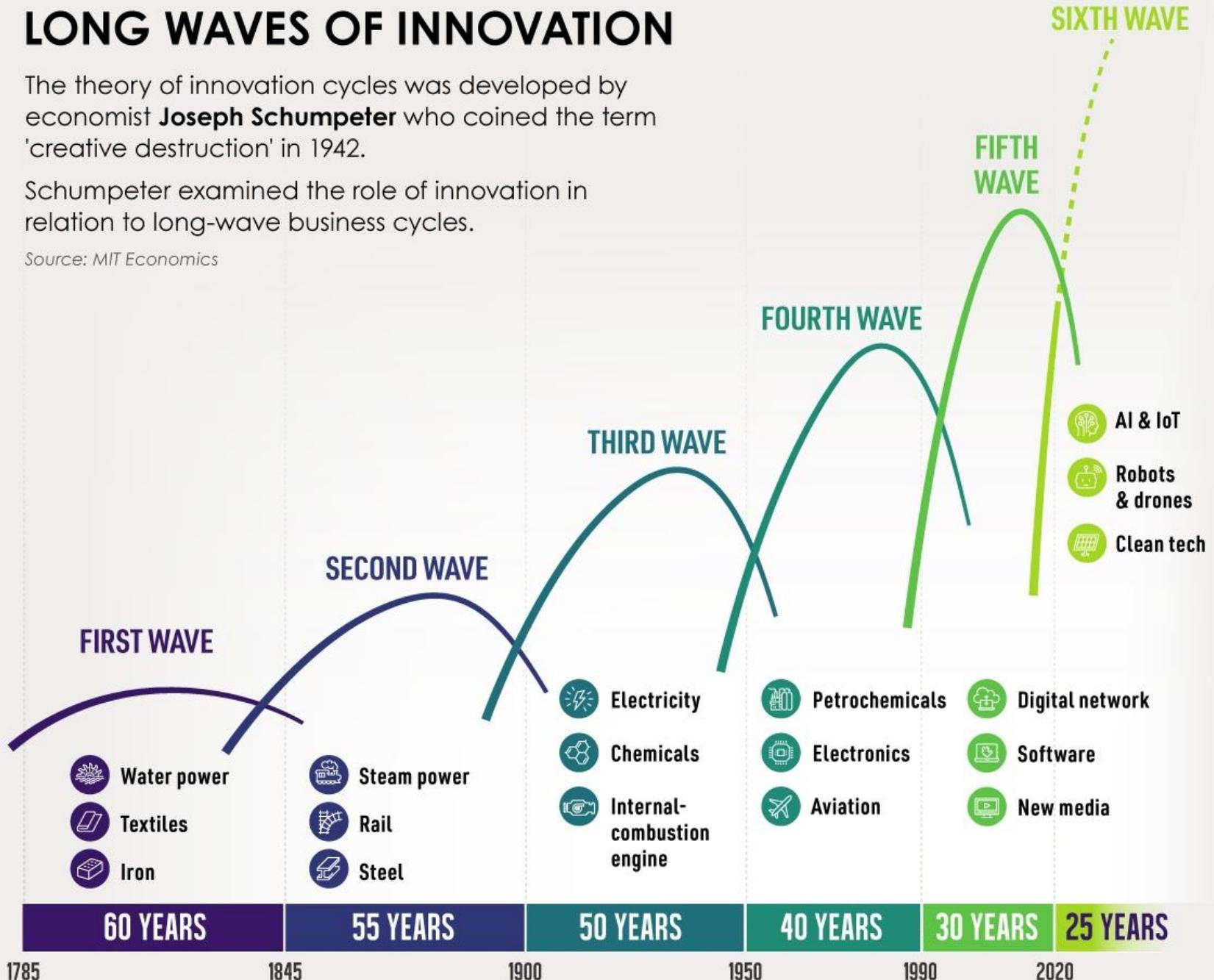
Reason 1

# LONG WAVES OF INNOVATION

The theory of innovation cycles was developed by economist **Joseph Schumpeter** who coined the term 'creative destruction' in 1942.

Schumpeter examined the role of innovation in relation to long-wave business cycles.

Source: MIT Economics



# 4.0 vs 5.0



## Human-Robot Co-working

Smart Society  
Sustainability  
Mass Personalization



## Power Source

Electrical power  
Renewable power sources



## Involved Technologies

Human Robot collaboration  
Sustainable Agricultural Production  
Bionics  
Renewable resources



## Involved Areas of Research

Agriculture  
Biology  
Waste Prevention  
Process Innovation and Improvement



bot nation



## Smart Manufacturing

Mass Production  
Global Competitiveness



## Power Source

Fossil-based fuels  
Electrical power  
Renewable power sources



## Involved Technologies

Internet of Things (IoT) Cloud Computing  
Big Data  
Robotics and Artificial Intelligence (AI)



## Involved Research Areas

Process Improvement and Innovation

# Digital Economy

## Reason 2





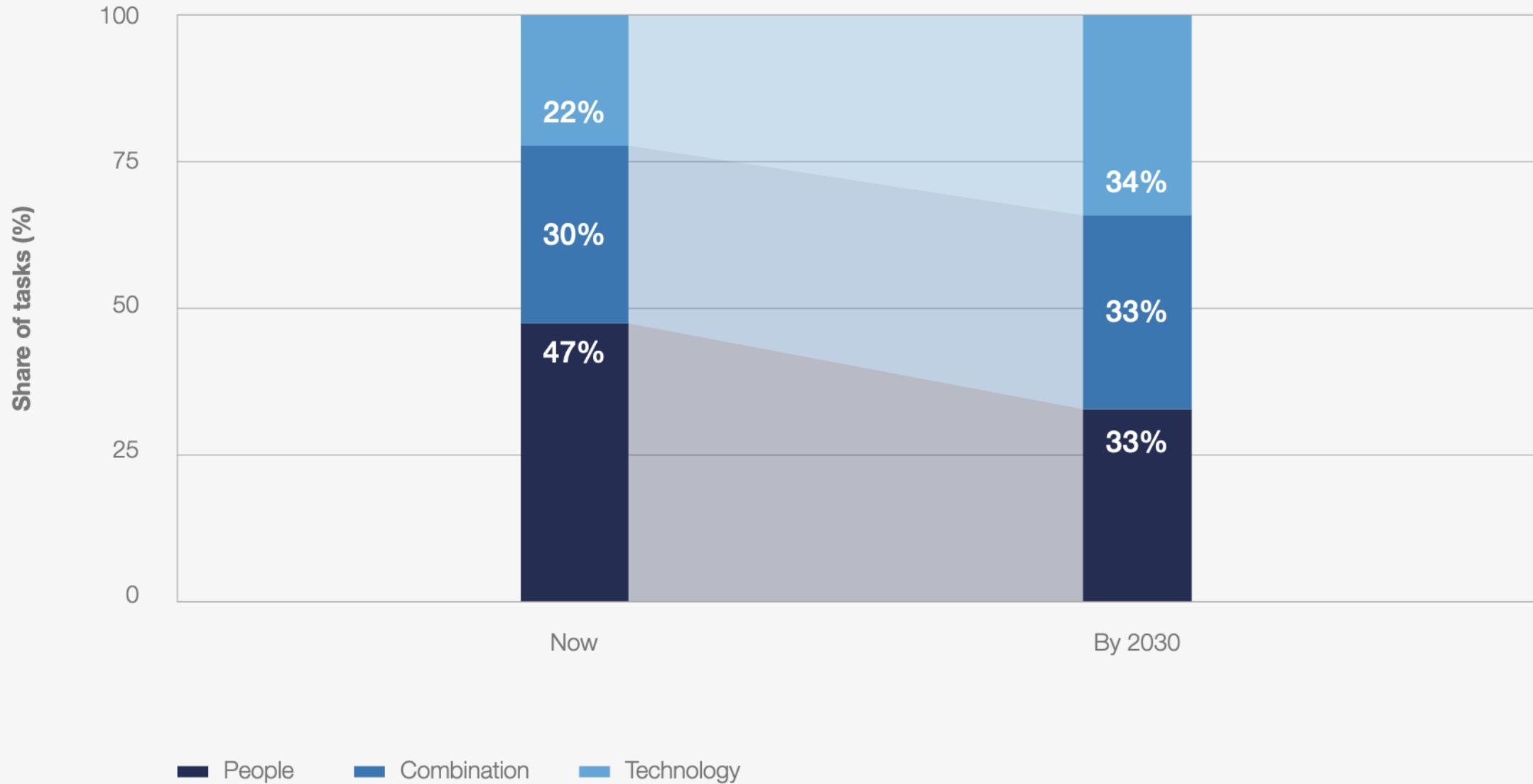
# Future of Jobs Report

## 2025

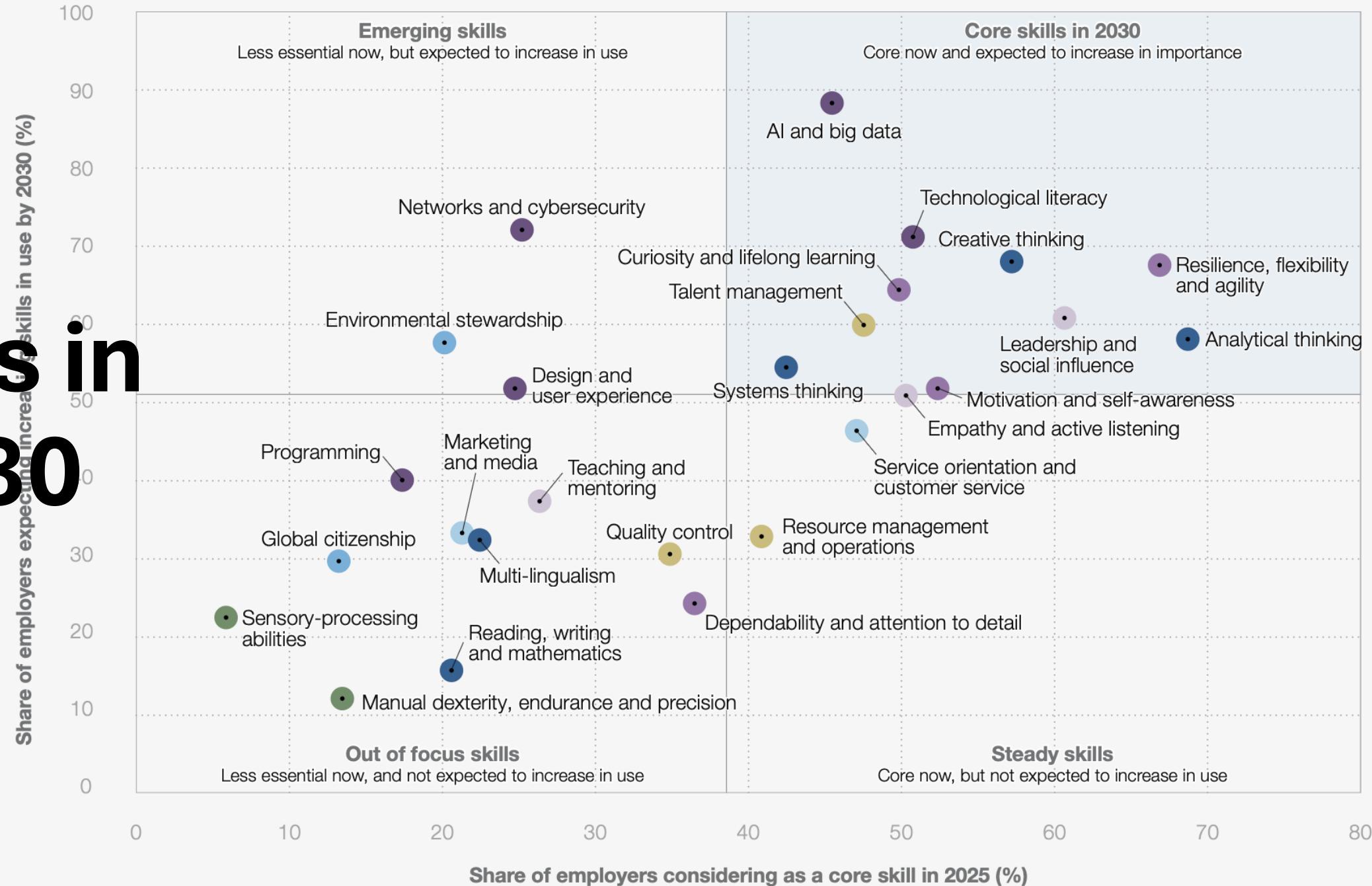
INSIGHT REPORT  
JANUARY 2025



# The shifting human-machine frontier: automation versus augmentation, 2025-2030



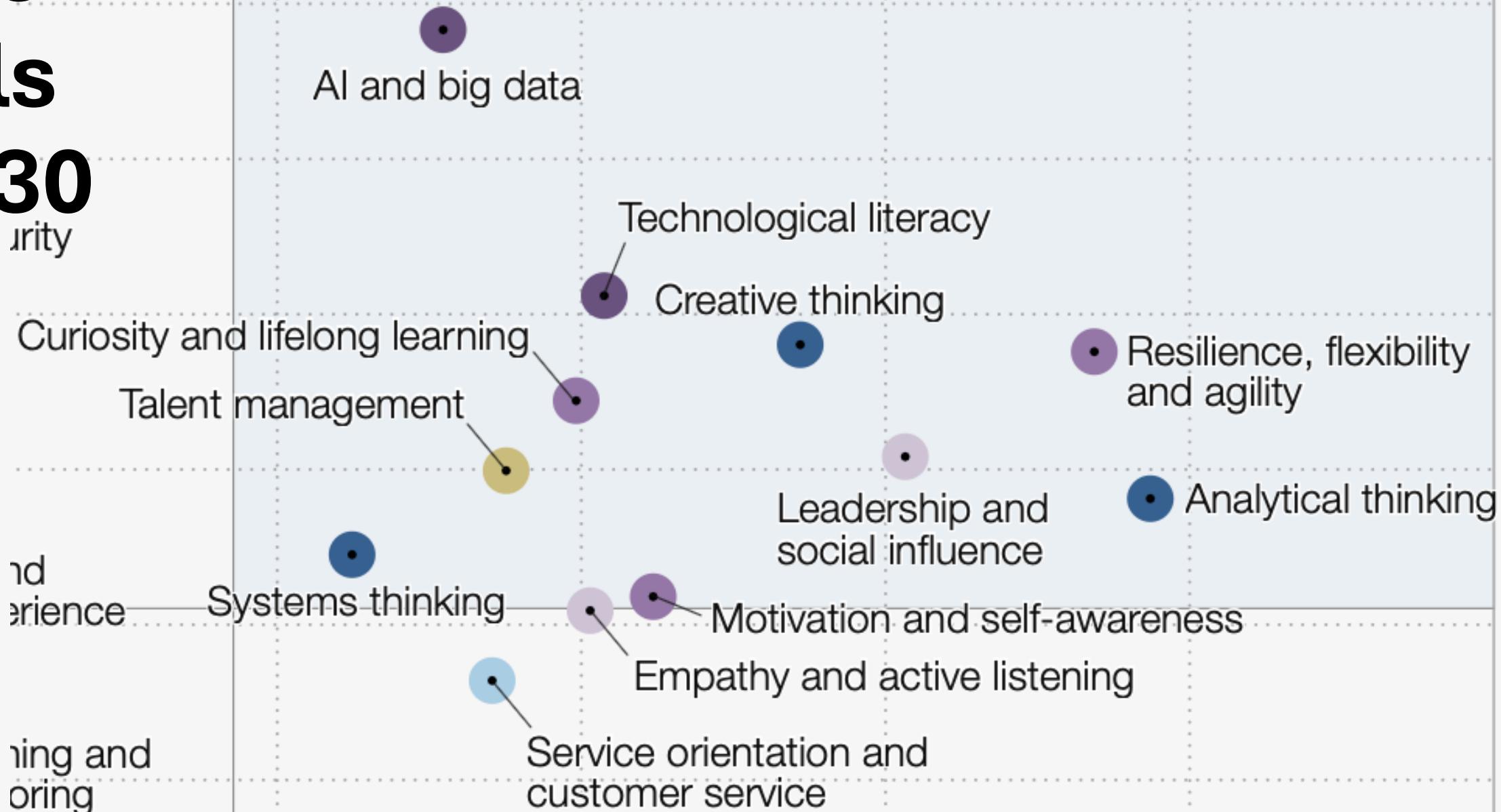
# Skills in 2030



# Core Skills in 2030

## Core skills in 2030

Core now and expected to increase in importance

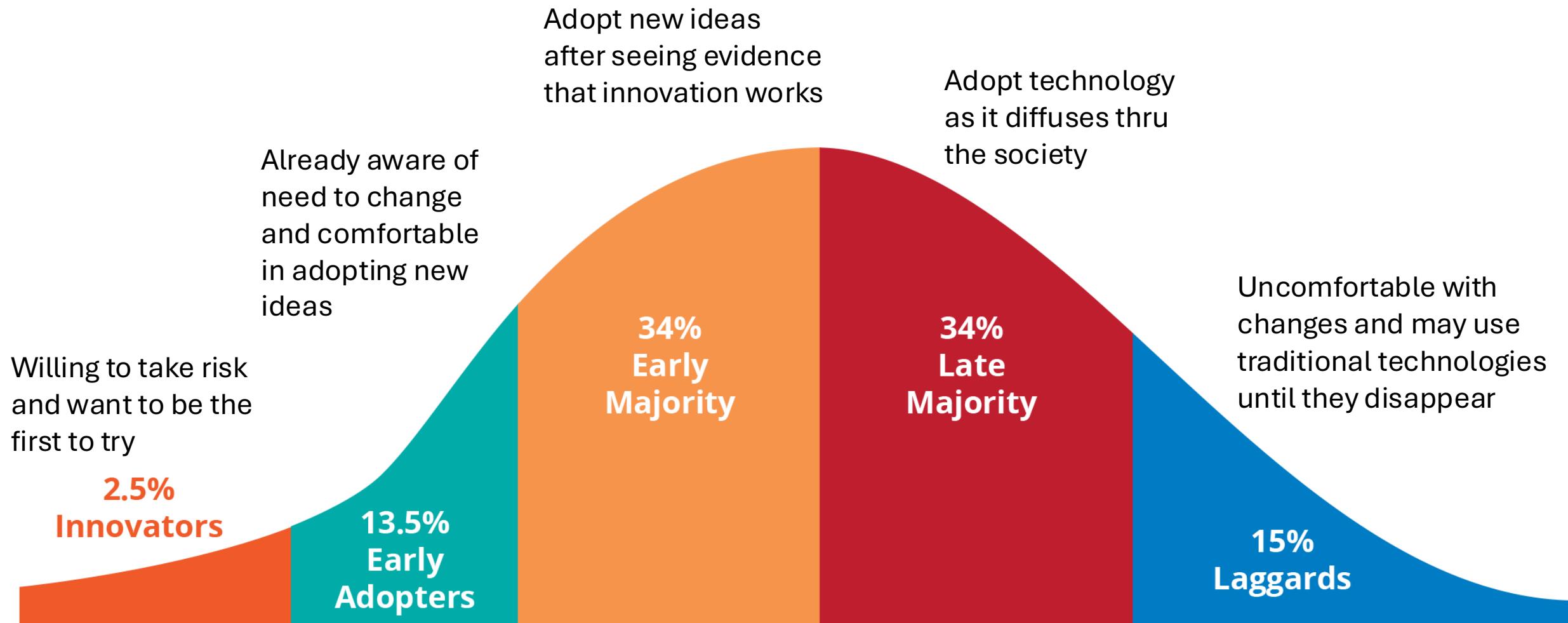


Demanding skills

**Reason 3**

AI is not an option

# Diffusion of Innovation



Who do you want to be?

DON'T YOU  
EVEN  
DARE  
TOUCH IT

IT'S MINE!!!



Foundational  
research in AI is  
multidisciplinary



Jeffery Hinton  
Experimental Psychology

Diverse founder  
background in  
leading AI  
companies



Daniela Amodei  
BA Literature, Politics, Music

Impact and  
applications are  
beyond technical  
fields

Finance, Health,  
Transportation, Military,  
Entertainment

AI benefits from  
interdisciplinary  
collaborations

SO

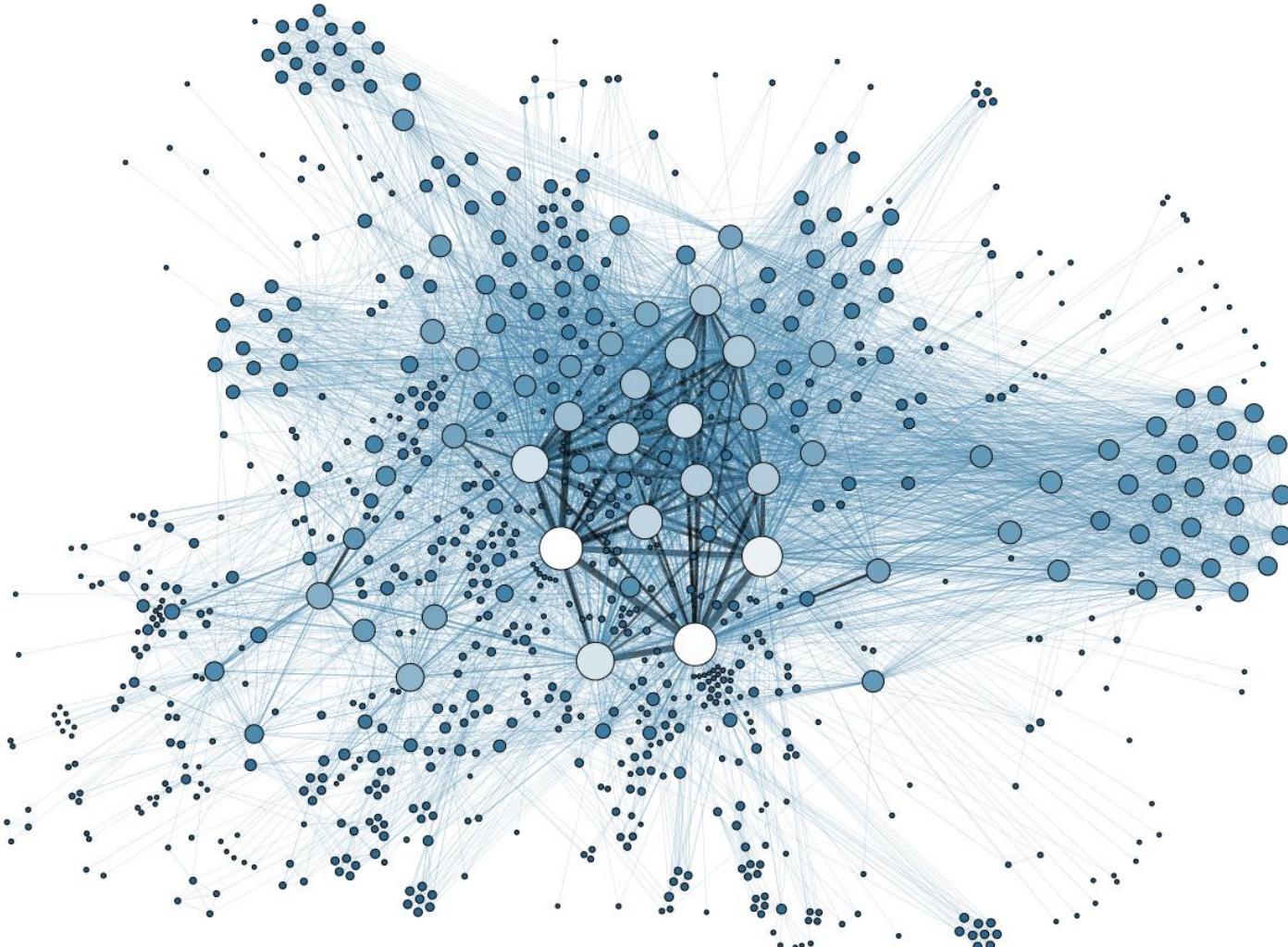
WHAT?

# Your Role

Design, Develop and Produce Products at a scale

Design, Develop and Optimize Industrial Processes

*Efficient, Quality, Safe, Cost-effective and  
Environmentally Compliant manner*



- Makes sense of complex data
- Identify patterns (hidden)
- Model complex systems

# AI can be used in

- Process Optimization
- Process Maintenance
- Sustainable Product Innovation
- Sustainable Process Development



Empower engineers/scientists to  
leverage ML/AI to solve problems

Engineers and Scientists with AI/ML skills



(or) the least

Help you learn not to misuse



What is the world record for crossing the English Channel entirely on foot?



According to the Guinness World Records, the fastest time for crossing the English Channel entirely on foot is 12 hours and 10 minutes. This record was set by George Reiff in 2016. The English Channel is a body of water that separates England from France, and is approximately 35 kilometers (22 miles) wide at its narrowest point. Many people attempt to cross the English Channel on foot as a endurance challenge, and the route is usually completed by either swimming or using a combination of swimming and wading.





Let's Learn AI  
Together

# What you'll learn

- Exploratory data analysis
- Machine learning
- Explainable AI
- Deep learning
- How to leverage LLM in academic/ research
- Risks

*Hands-on  
Case studies*

*No deep dive on methods, focus is application*



Is this an AI system?

Sinhala - detected

English

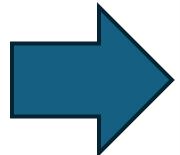
මට හොඳවම බඩගිනිය්



මචන් ....කන්න මොකුන්

නැද්ද

maṭa hoñdaṭama bađaginiy macan  
....kanna mokut nædda



I'm really hungry,  
man...is there  
anything to eat?



Is this an AI system?

# What is AI

Artificial intelligence refers to the capability of computational systems to perform tasks typically associated with human intelligence, such as ***learning, reasoning, problem-solving, perception, and decision-making***

# Types of AI

## Narrow AI

- Goal-oriented
- Designed to perform singular tasks
- Current state of art

*Search engines*

*Image recognition*

*Siri, Alexa*

*Manufacturing robots*

*Self-driving cars*

*Co-pilot*

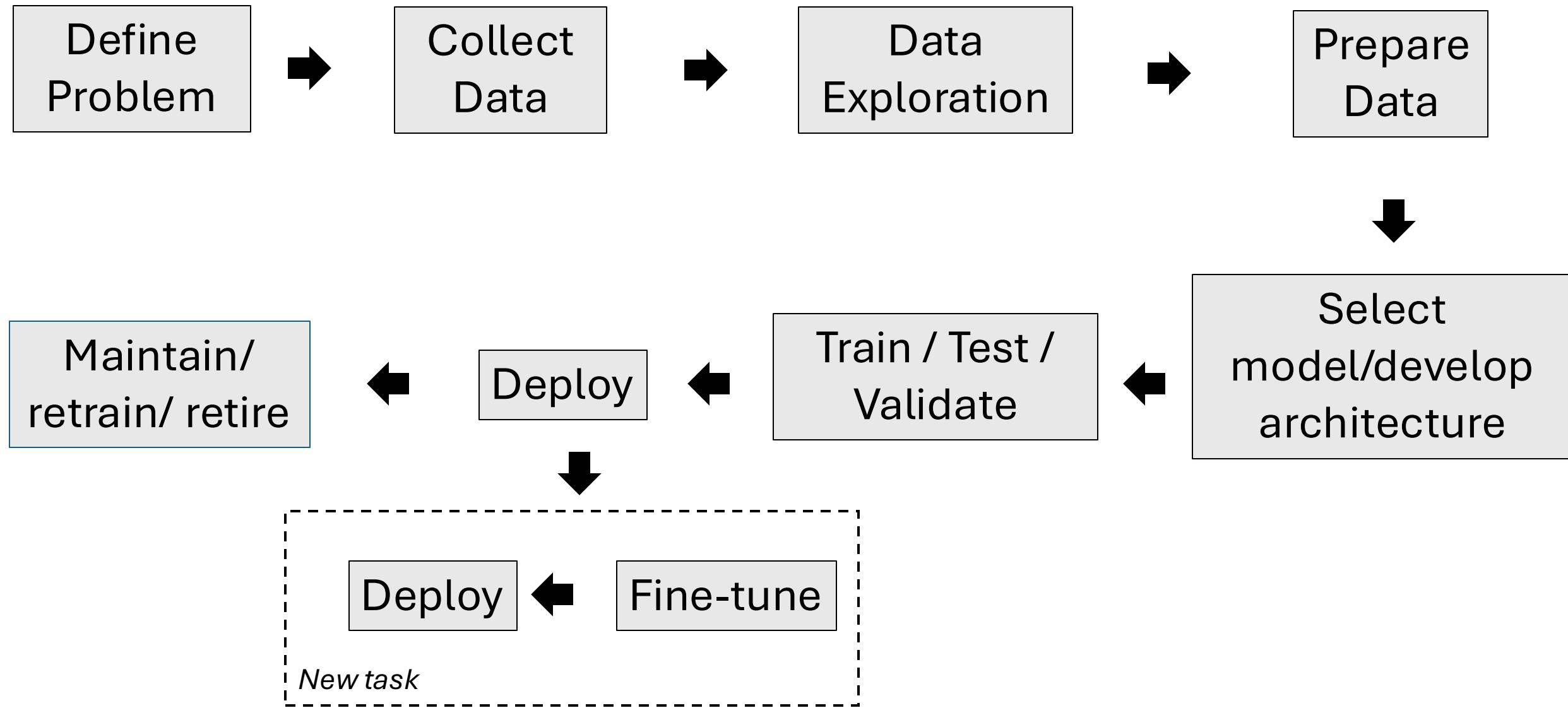
## General AI

- Mimics human intelligence
- Able to learn and apply its intelligence to solve any problem
- Research on-going

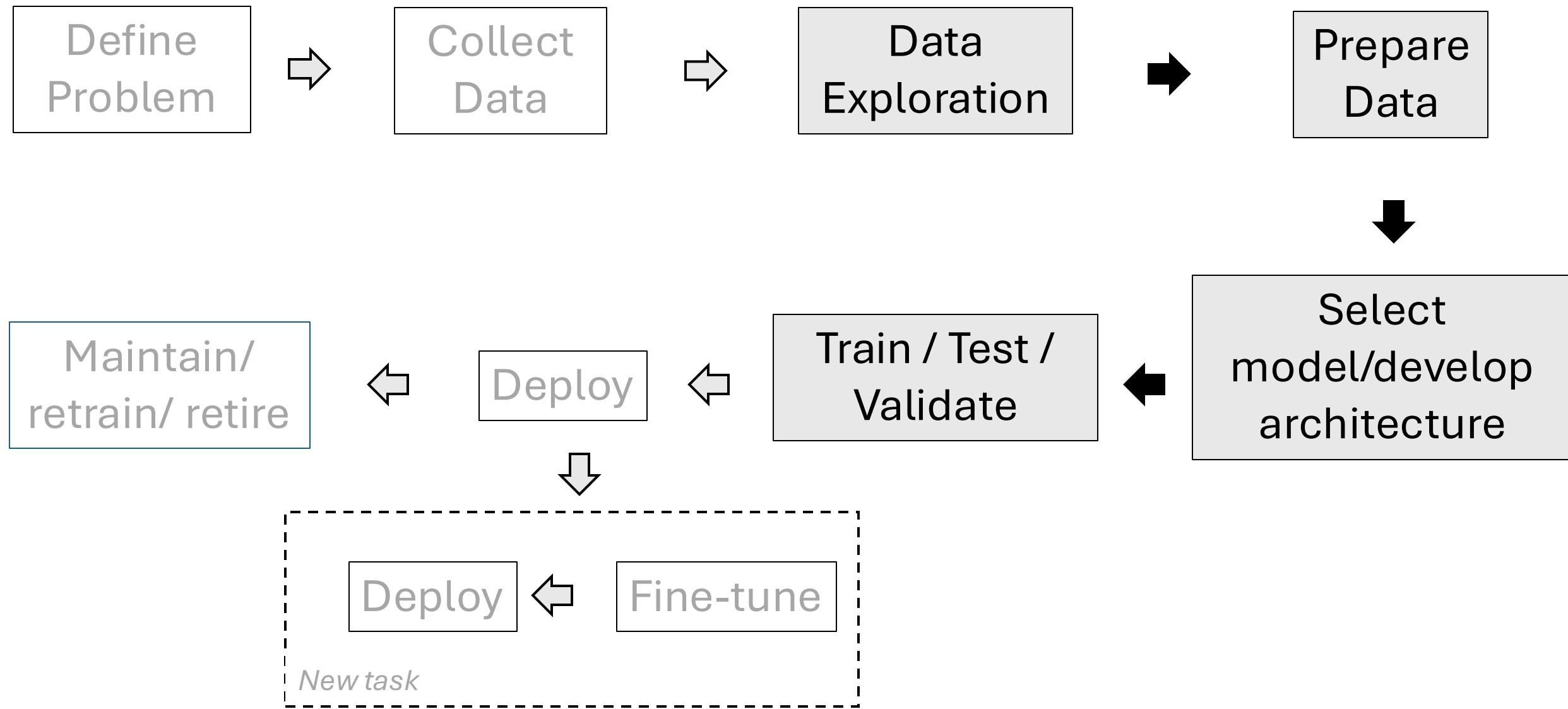
## Super AI

- Machines become self-aware
- Surpasses human abilities
- Conceptual

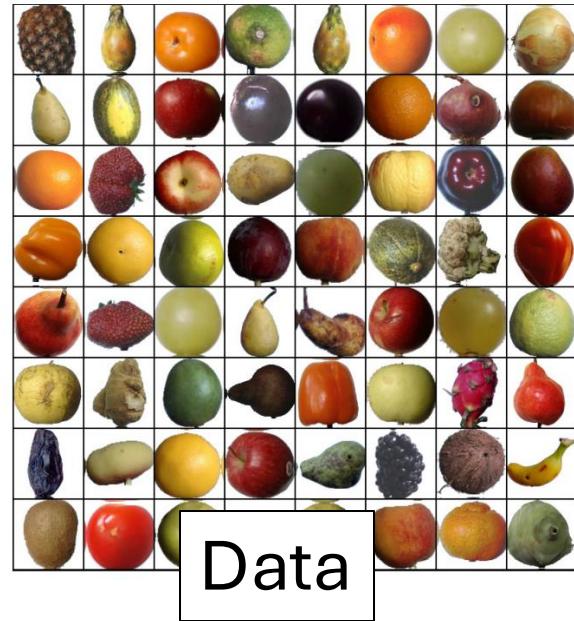
# Key steps of AI development



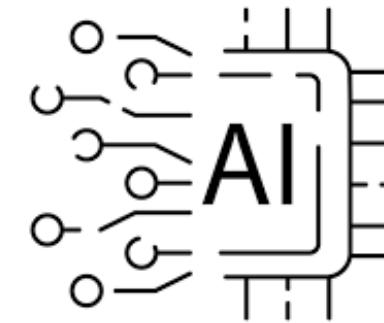
# Key steps of AI development



# Training



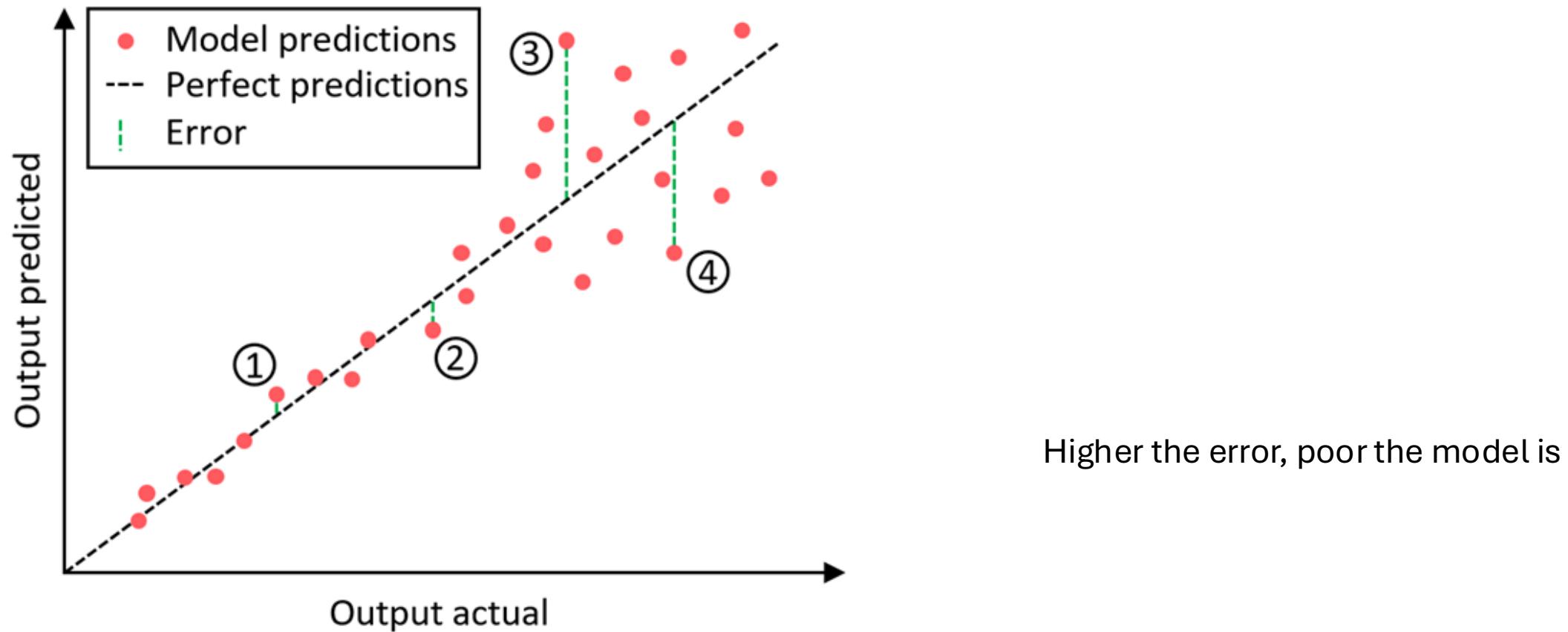
→ Training →



Trained AI Algorithm

***Training: Teaching an AI model with data***

# Testing/Validation

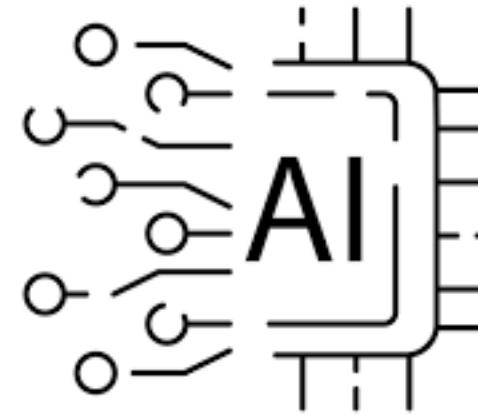


**Validation:** Ensure the model is accurate for the task

# Inference



New data



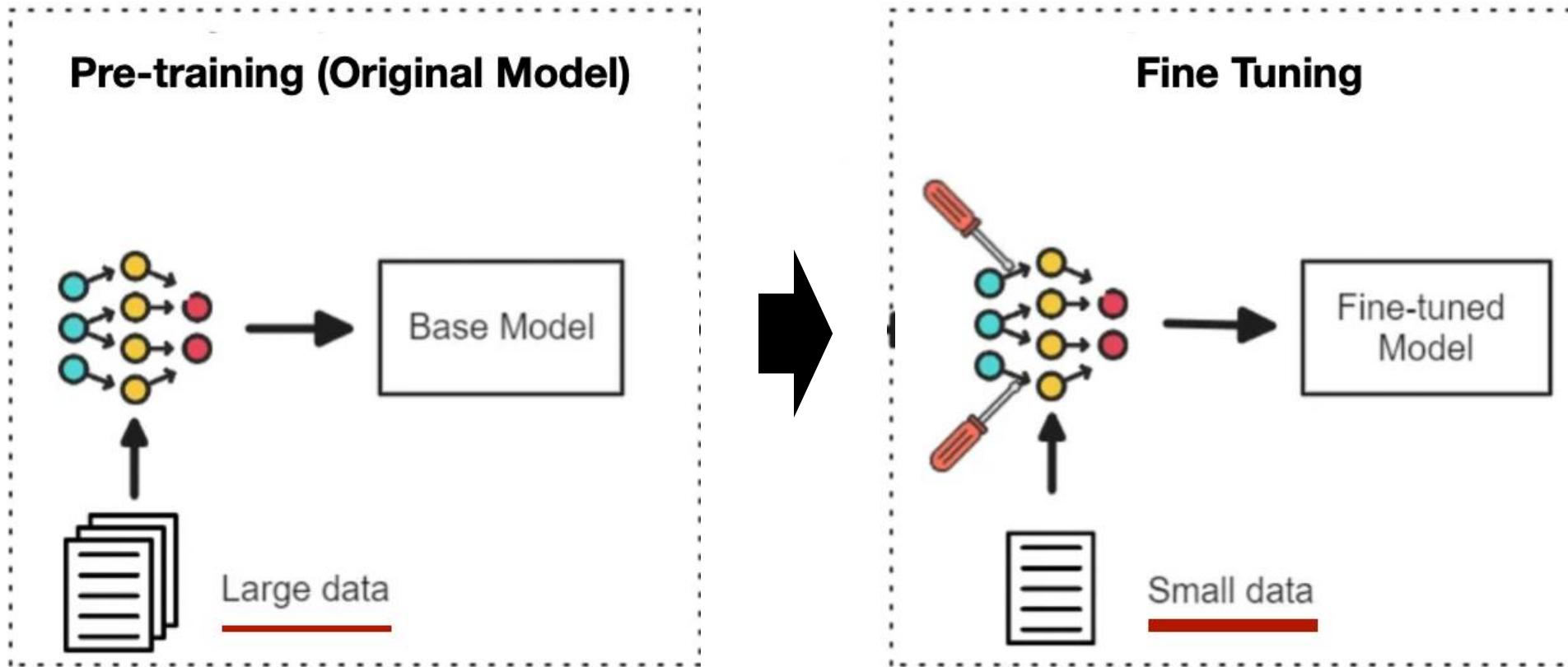
Trained AI Algorithm



Its Pineapple

***Inference:*** Use trained AI model to make predictions

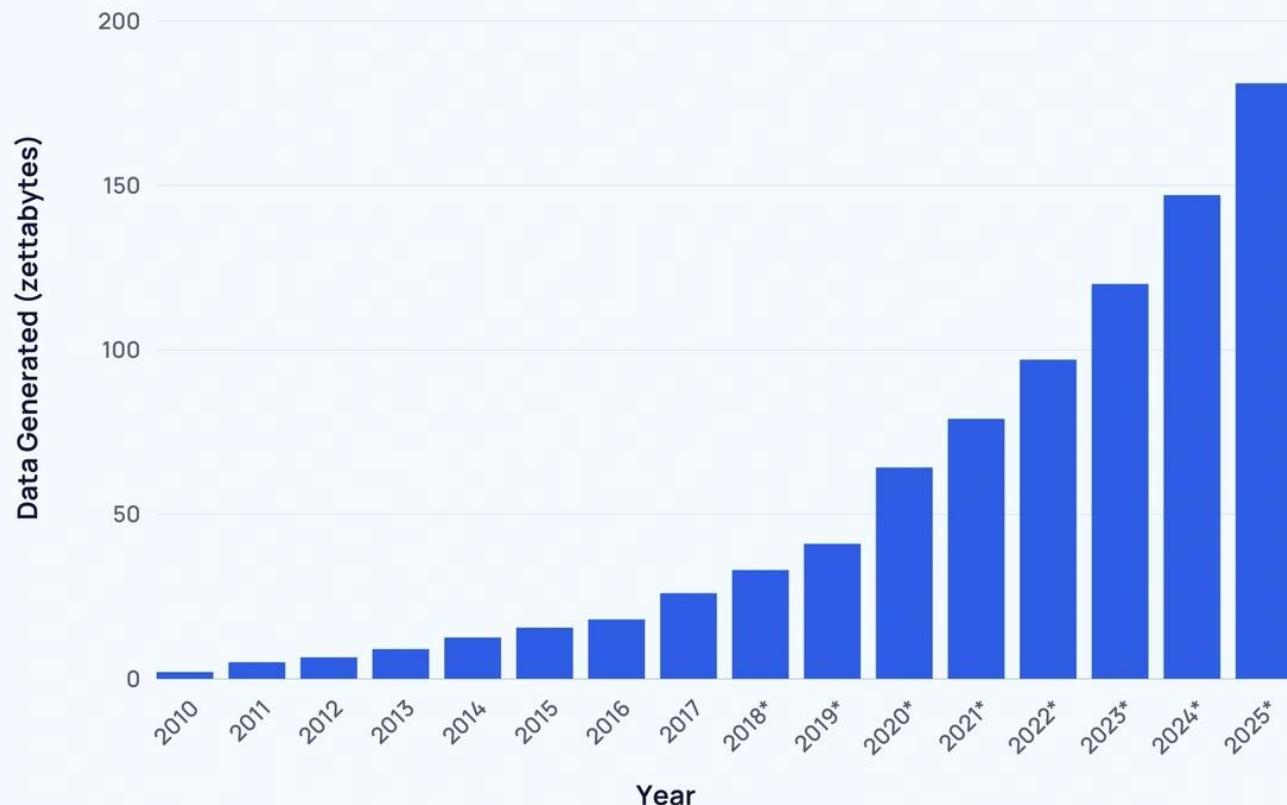
# Fine-tunning



**Fine tuning:** further training the pre-trained model on new data to improve task-specific performance.

# Data is the key for AI

## Global Data Generated Annually



# And computing

Classic ML → CPU

Deep Learning → GPU



# The Economist

MAY 6TH-12TH 2017

## The world's most valuable resource

Data and the new rules  
of competition

Crunch time in France

Ten years on: banking after the crisis

South Korea's unfinished revolution

Biology, but without the cells

# AI is data driven

- Do you have data?
- If not, how do you collect data?
- How much data you have?
- What is the quality of the data?

Remember: **Data is not cheap**

# Type of data

## Structured Data

- Numerical Data
- Categorical Data

## Unstructured Data

- Text Data
- Image Data
- Audio Data
- Video Data

# Structured Data - Examples

## Numerical data

### Continuous

- **Reactor temperature:** 70.1, 71.3
- **RPM of mixer:** 2005, 2009, 3001

### Discrete

- **Number of samples:** 10, 20, 50
- **Production vol of car company:** 10k, 25k, 100k

## Categorical data

### Ordinal

- Process safety risk level:** Low risk, Medium risk, High risk  
**Catalyst activity rating:** Low, Medium, High

### Nominal

- **QC:** pass or fail
- **Material classification:** Polymer, Metal, Ceramic, Composite

# Unstructured Data - Text data



Starbucks K-Cup Coffee Pods, Medium Roast Coffee, Pike Place Roast for Keurig Brewers, 100% Arabica, 4 boxes (96 pods total)

[Visit the Starbucks Store](#)

4.6 ★★★★☆ 75,672 ratings

Amazon's Choice

30K+ bought in past month



Scott E. High

★★★★☆ Good Taste But Not Strong Enough

Reviewed in the United States on August 19, 2025

Flavor Name: House Blend | Size: 75 Count (Pack of 1) | [Verified Purchase](#)

As always a good product from a great company. However, if you prefer stronger coffee in the morning, pick up some Death Wish Coffee or something similar for a more robust flavor and a stronger impact.

6 people found this helpful

[Helpful](#)

| Report



Karen D Tucker

★★★★☆ Taste is a little strong

Reviewed in the United States on August 11, 2025

Flavor Name: Decaf House | Size: 22 Count (Pack of 1) | [Verified Purchase](#)

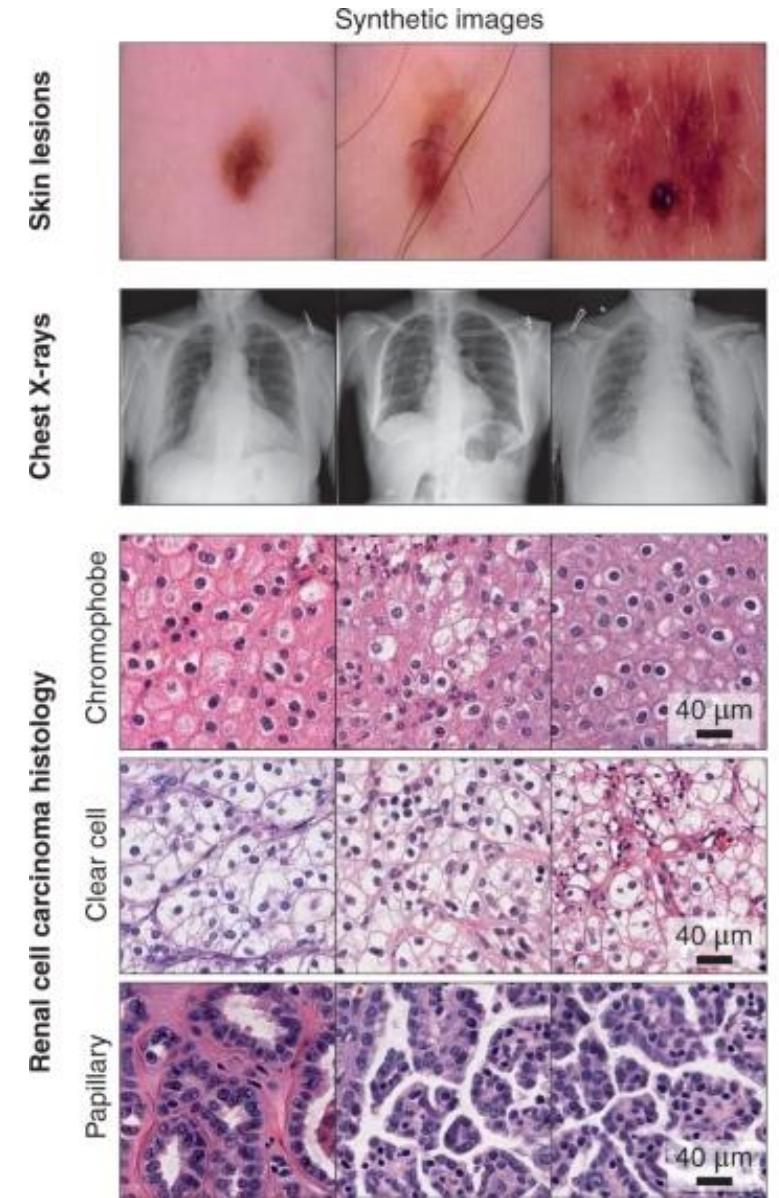
Its ok just trying to get use to the taste.

2 people found this helpful

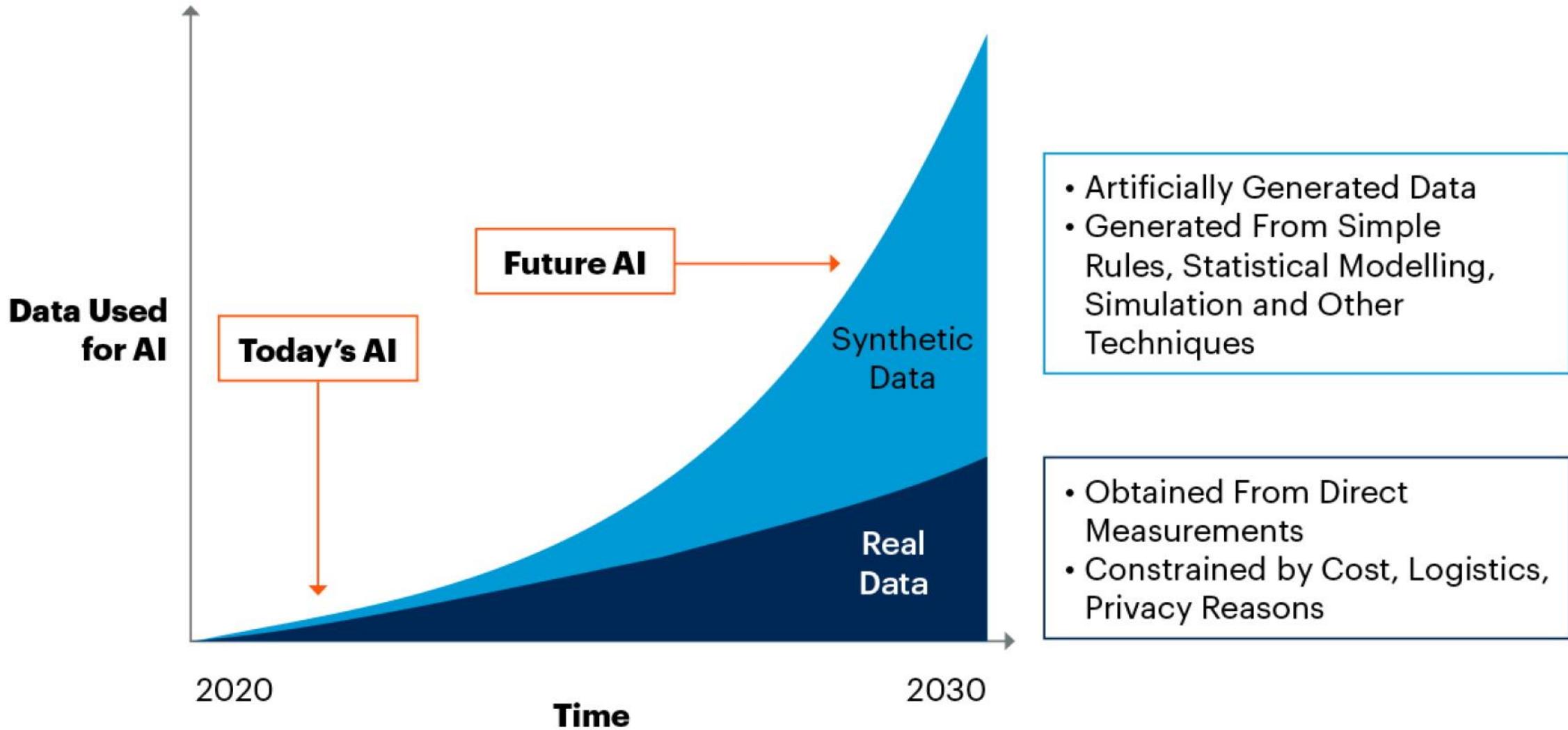
# Unstructured Data - Image data



# Synthetic data



# By 2030, Synthetic Data Will Completely Overshadow Real Data in AI Models



Source: Gartner

750175\_C

# Data Quality



+

Machine Learning

=



Data



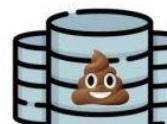
+

Artificial Intellifence

=



Data



+

Generative AI

=



Data



+

Agentic AI

=



Data



