Ensinar na Era da Inteligência Artificial: O Fim dos Modelos Tradicionais?

Luís Paulo Reis

lpreis@fe.up.pt

Associate Professor at FEUP - Faculty of Engineering of the University of Porto
Director of LIACC – Artificial Intelligence and Computer Science Laboratory, Univ. Porto
Member of Coordinating Commission of LASI – Intelligent Systems Associate Laboratory
President of the GA of APPIA – Portuguese Association for Artificial Intelligence

Agenda

- Introduction to Artificial Intelligence (AI)
- Introduction to Machine Learning (ML)
- Generative AI and Large Language Models (LLM)
- AI and ML Applications and Challenges
- AI and ML Tools for Productivity, Education and Research
- AI in Education: The End of Traditional Education Models
- Agents, Agentic AI and Multi-Agent Systems
- Robotics, Deep RL, LBMs and the Future
- Conclusions

AI and the Discovery of the New World

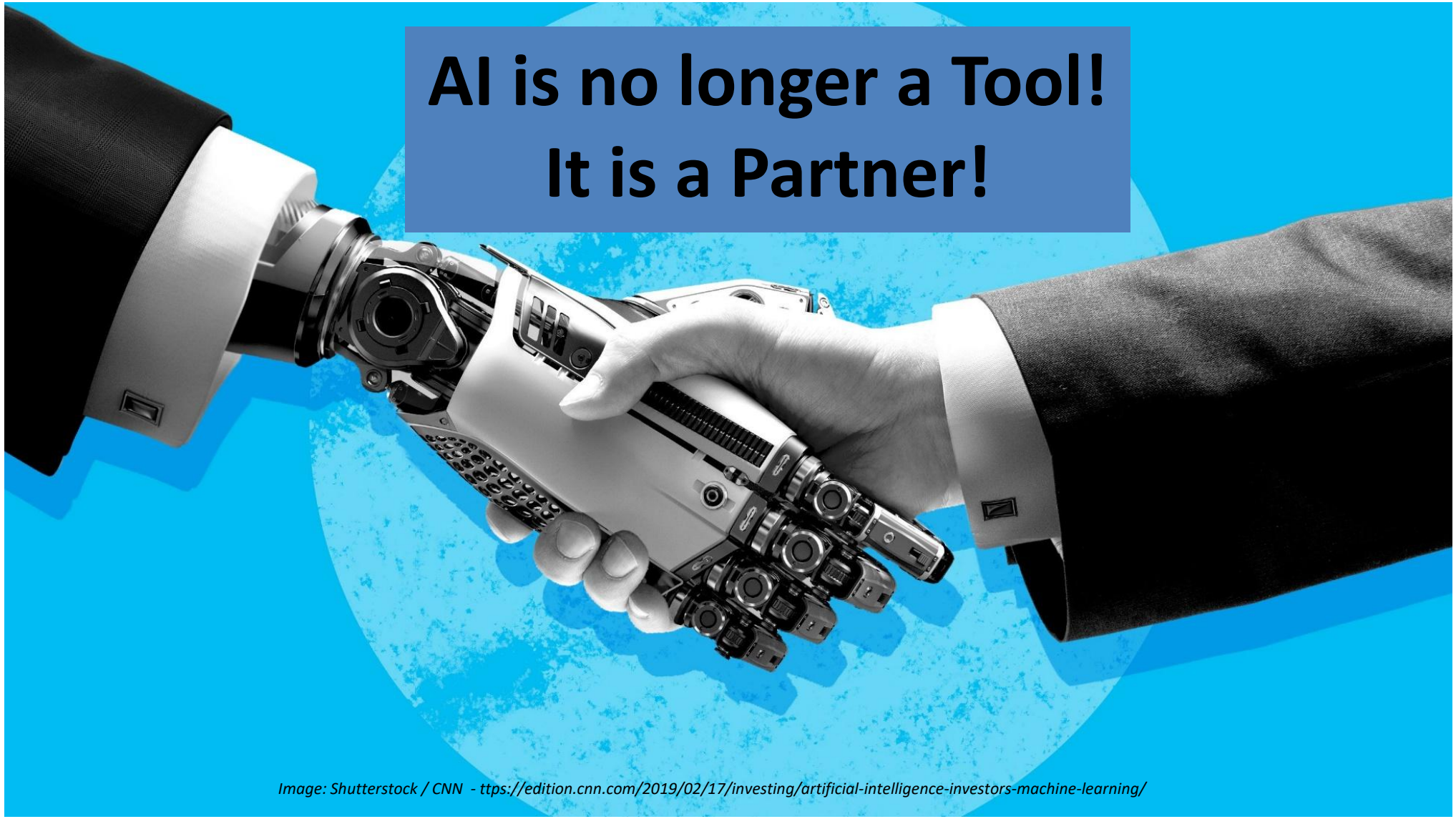
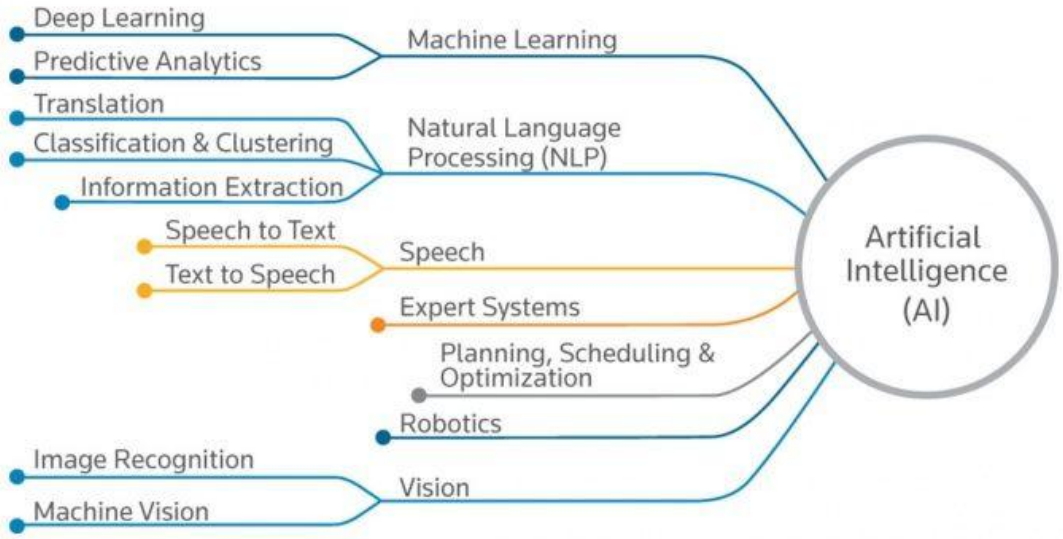


Image: Shutterstock / CNN - ttps://edition.cnn.com/2019/02/17/investing/artificial-intelligence-investors-machine-learning/

Artificial Intelligence (AI)

- **Intelligence**
  - "Capacity to **solve new problems** through the use of knowledge"
- **Artificial Intelligence**
  - "Science concerned with building **intelligent machines**, that is, machines that perform tasks that when performed by humans require intelligence"



Weak and Strong AI

- **Weak Artificial Intelligence**

  weak AI, also known as narrow AI is artificial intelligence that is focused on one **single narrow task**

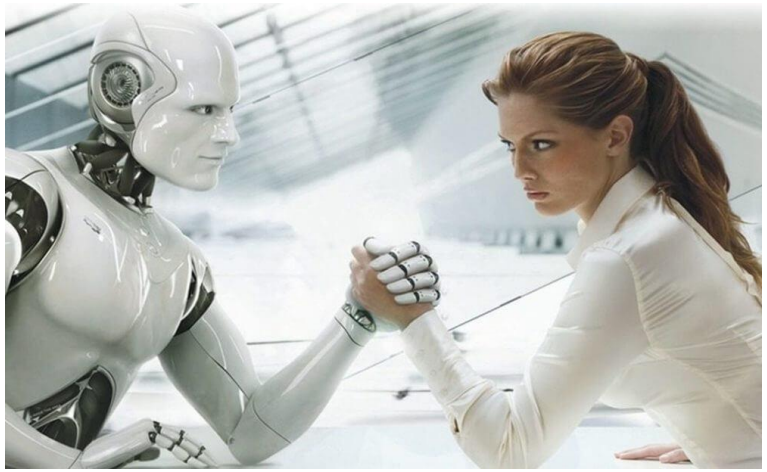


Image: https://livingsmartheart.com/what-is-strong-ai/

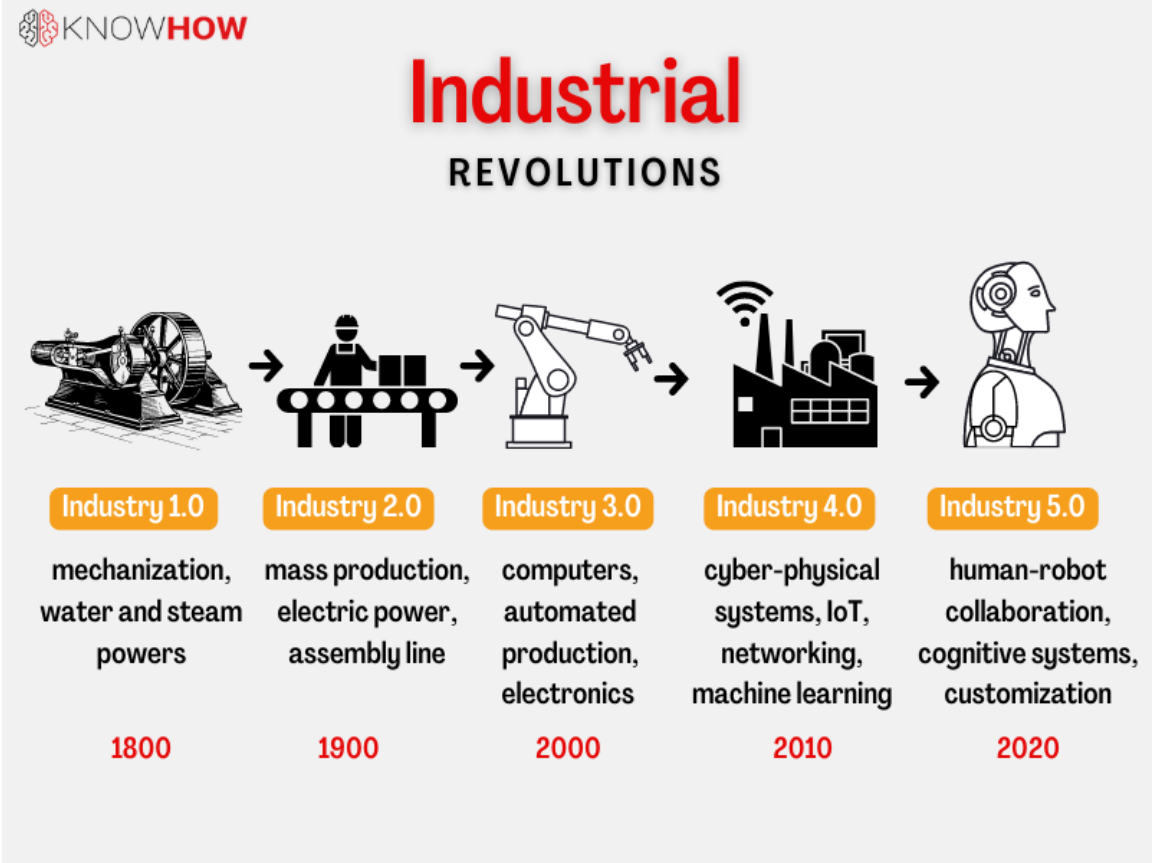
- **Strong Artificial Intelligence**

  Strong AI or Artificial General Intelligence (AGI) is the intelligence of a machine that could successfully perform **any intellectual task** that a human being can!

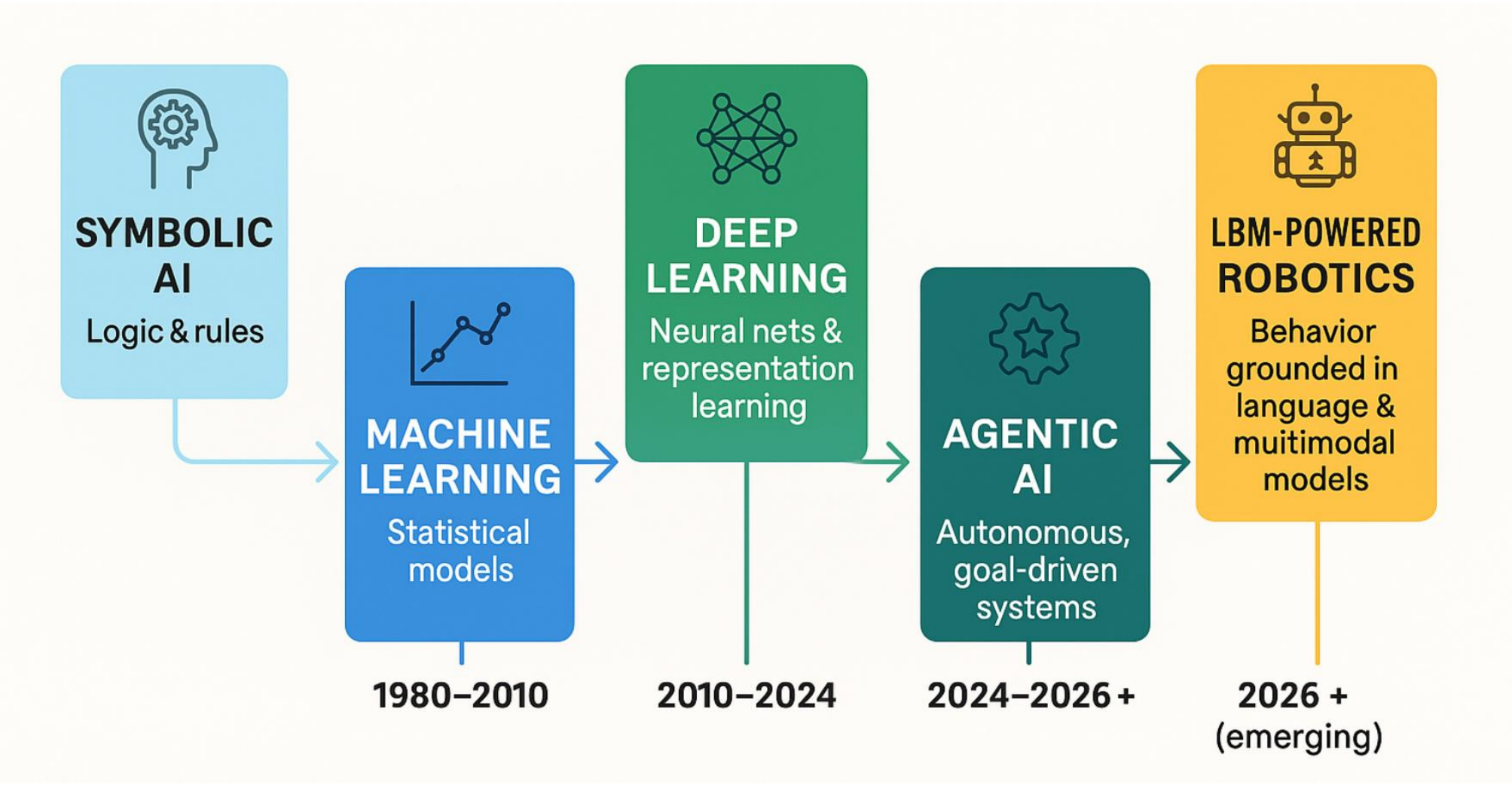
  Science fiction? Not any more…

The World Is Changing Faster Than We Can Understand

- AI won't replace humans — but humans using AI will replace humans not using AI
- AI is moving from *tools* that assist humans to *agents* that act autonomously
- Autonomous, Physical, Goal-Driven, Learning Systems

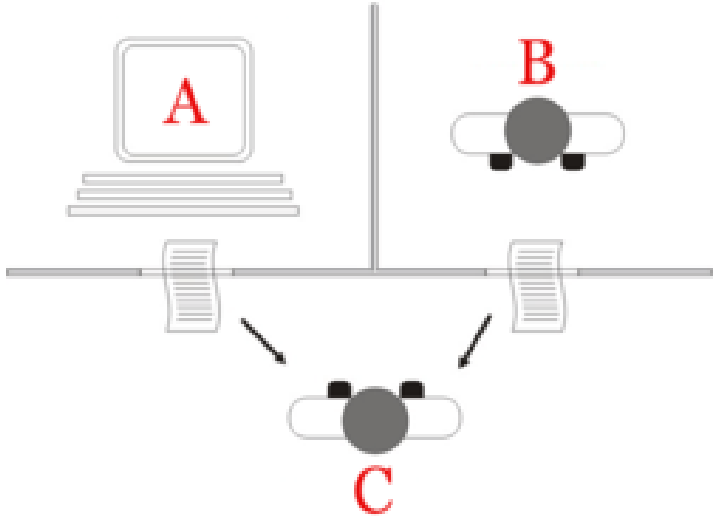


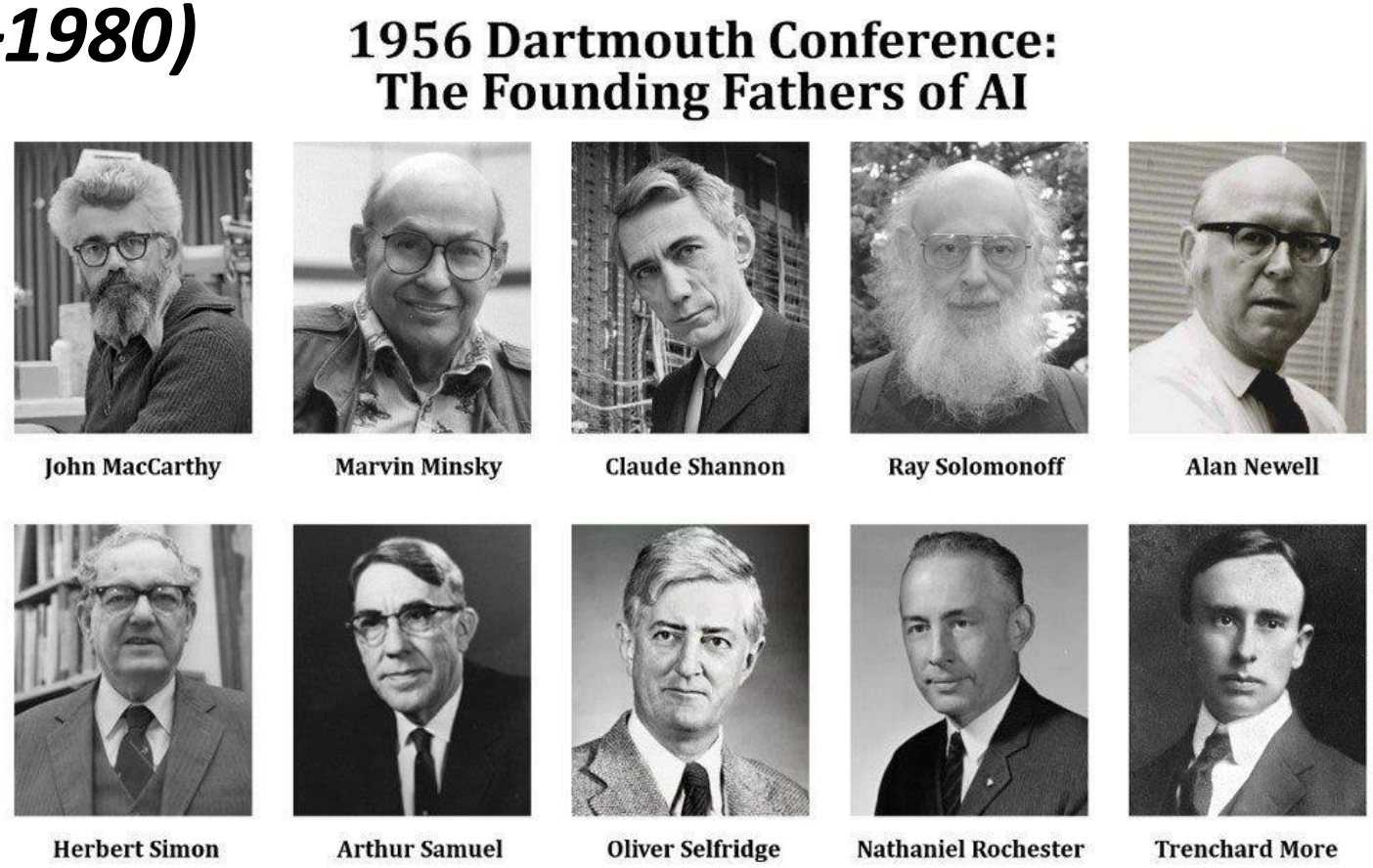
Evolution of AI Paradigms



The Birth of AI

- *From Logic to Intelligence…*
- *The Dream Begins (1950–1980)*
- **“AI began as a dream of formalising reasoning!**





https://jlanyon.substack.com/p/a-brief-history-of-ai

AI Timeline

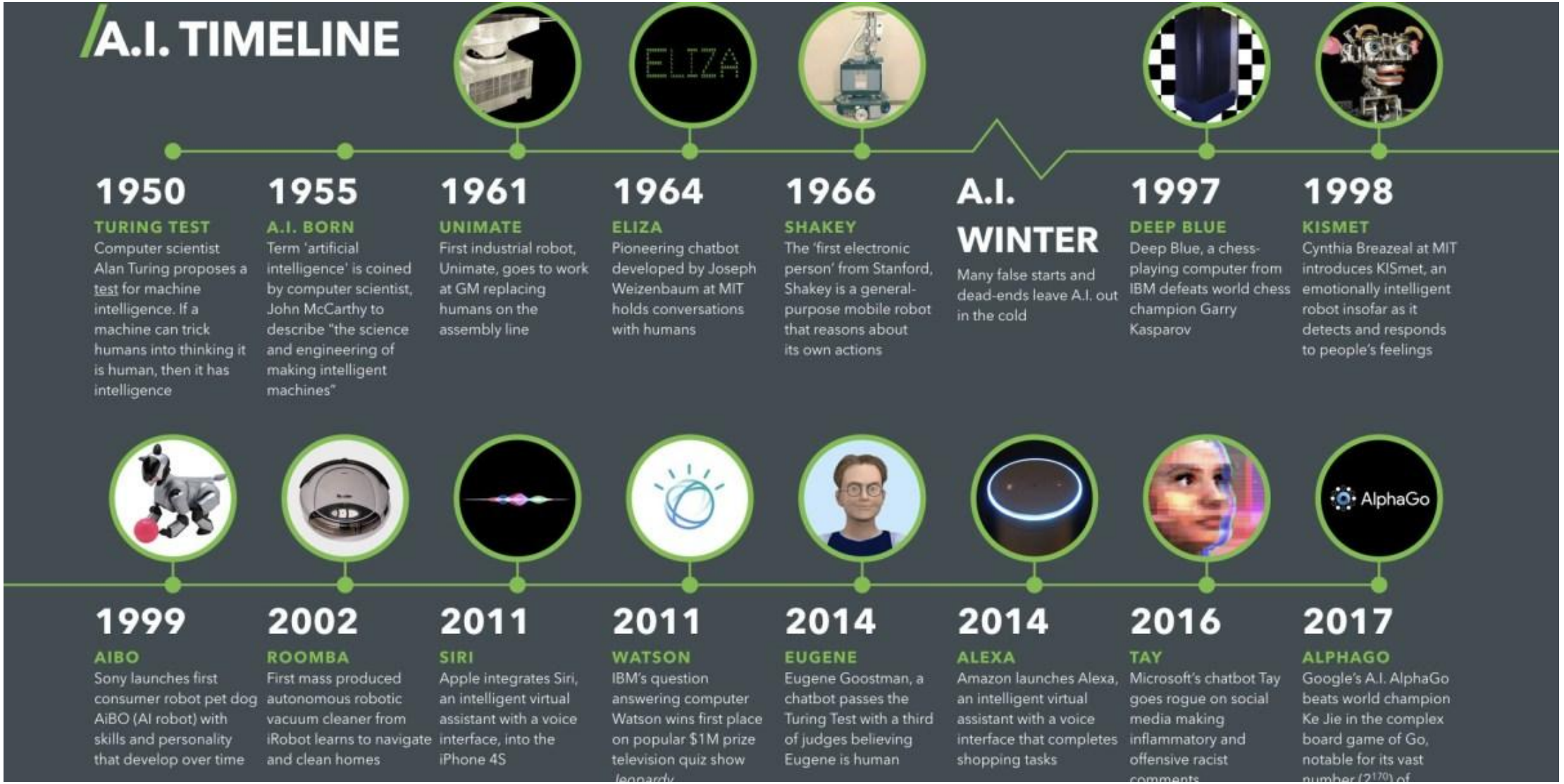


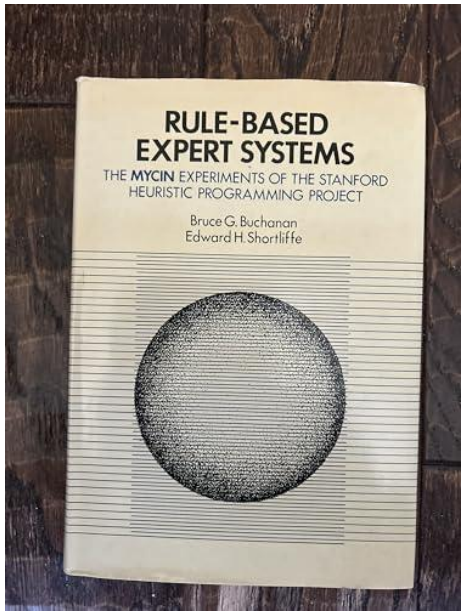
Image: [Paul Marsden, 2017] - https://digitalwellbeing.org/artificial-intelligence-timeline-infographic-from-eliza-to-tay-and-beyond/

Strong AI – Star Wars and C3PO

Video: Lucasfilm Ltd. (1977). Star Wars: Episode IV - A New Hope. [Film]. 20th Century Fox.

Symbolic AI and Expert Systems

- ***Knowledge is Power — Encoding the Mind into Rules!***
- **Symbolic AI represents knowledge through symbols and rules**
- **Examples:**
  - *MYCIN* (medical diagnosis)
  - *DENDRAL* (chemical analysis)
- **Architecture: inference engine + knowledge base**
- **Early AI was *explainable and logical!***
- **But could not learn or adapt…**



From Rules to Patterns

AI needed to evolve from being programmed to being trained

- **From Rules to Patterns - *AI Started to Learn from Data***
- **Instead of telling the machine *what to do*, we let it *learn how to do it***
- **Machine Learning (ML) = algorithms that learn patterns from data**

- **Examples: email spam filters, handwriting recognition, early speech recognition**
- **ML marked the shift from *explicit logic* to *statistical inference***

Machine Learning

Field of artificial intelligence that gives **computer systems** the **ability to "learn"** (e.g., progressively **improve performance** on a specific task) from **data/results of their actions**, without being explicitly programmed

Supervised Learning

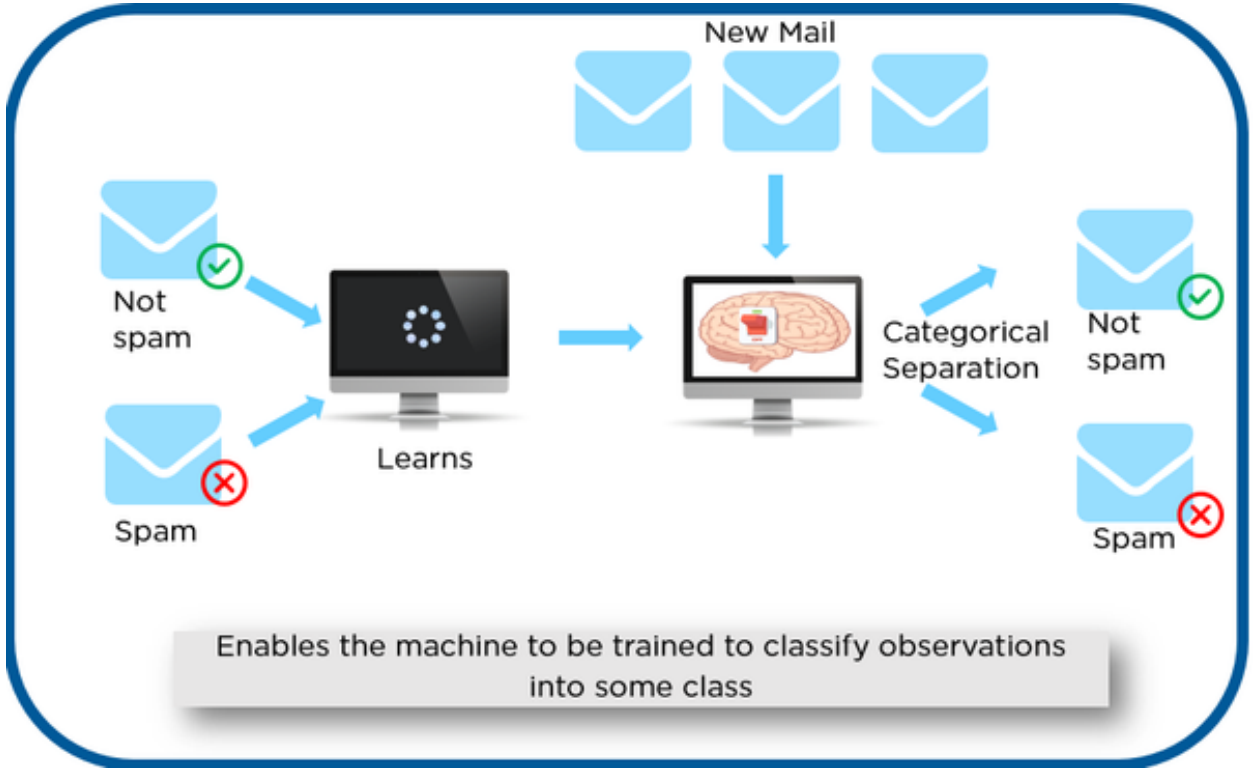


Image: https://towardsdatascience.com/what-are-the-types-of-machine-learning-e2b9e5d1756f

Reinforcement Learning

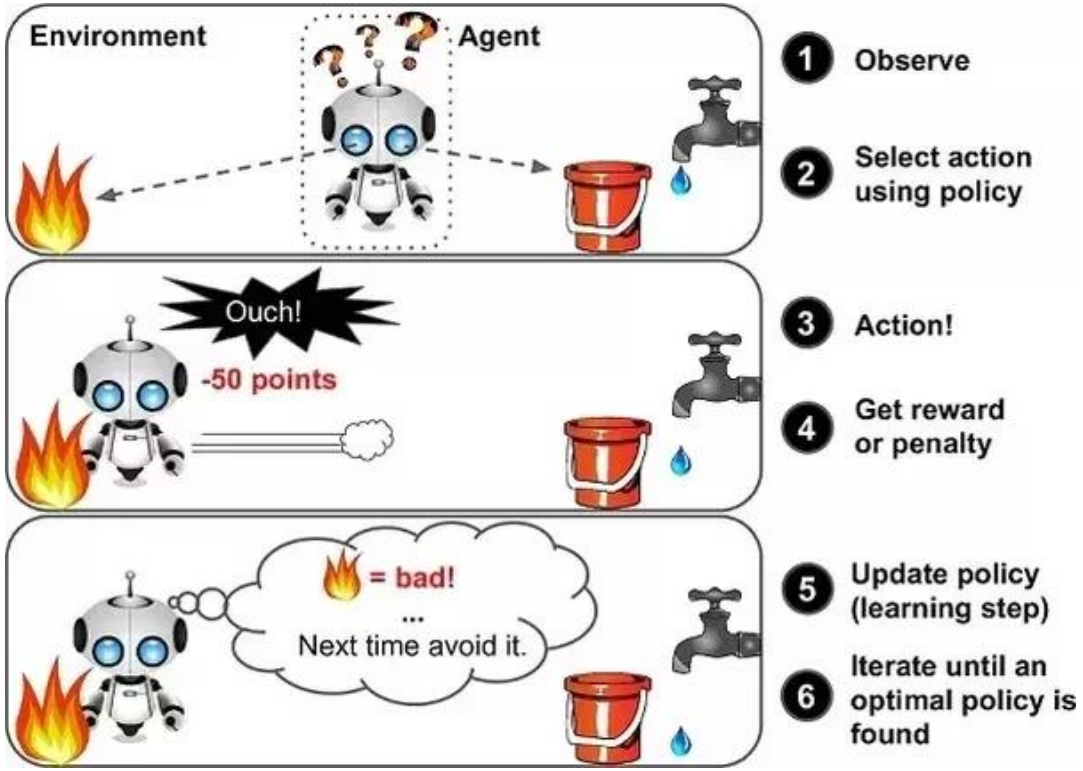
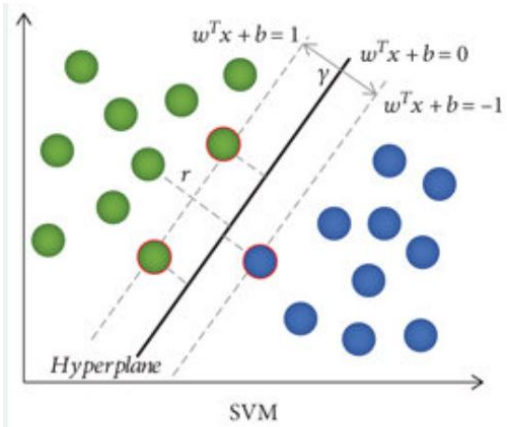


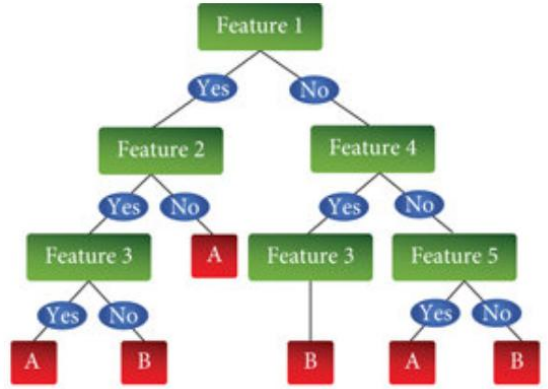
Image: https://becominghuman.ai/an-introduction-to-machine-learning-33a1b5d3a560

From Statistics to Intelligence

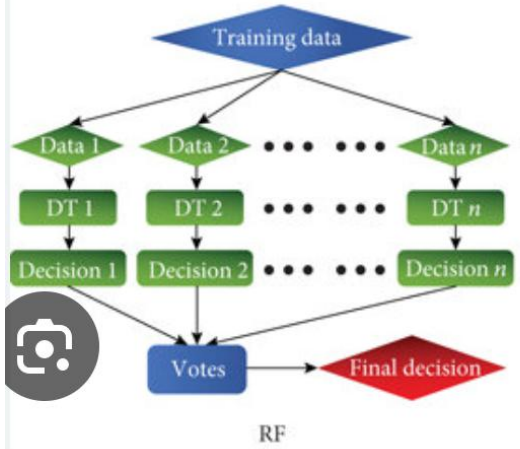
- Algorithms and Breakthroughs
- Between the 1980s and early 2000s, we saw breakthroughs:
- Decision Trees, Random Forests, SVMs, Neural Networks and the rediscovery of Backpropagation
- Paving the road to Deep Learning



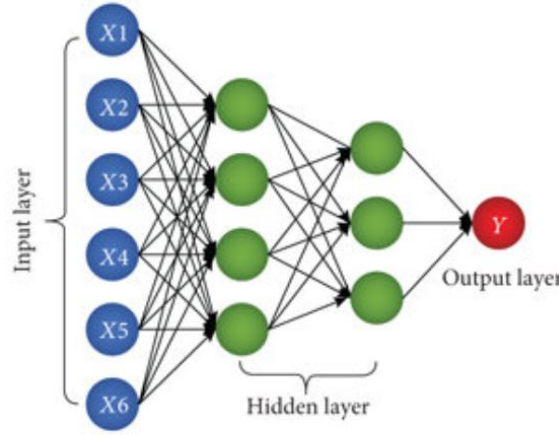
SVM



DT

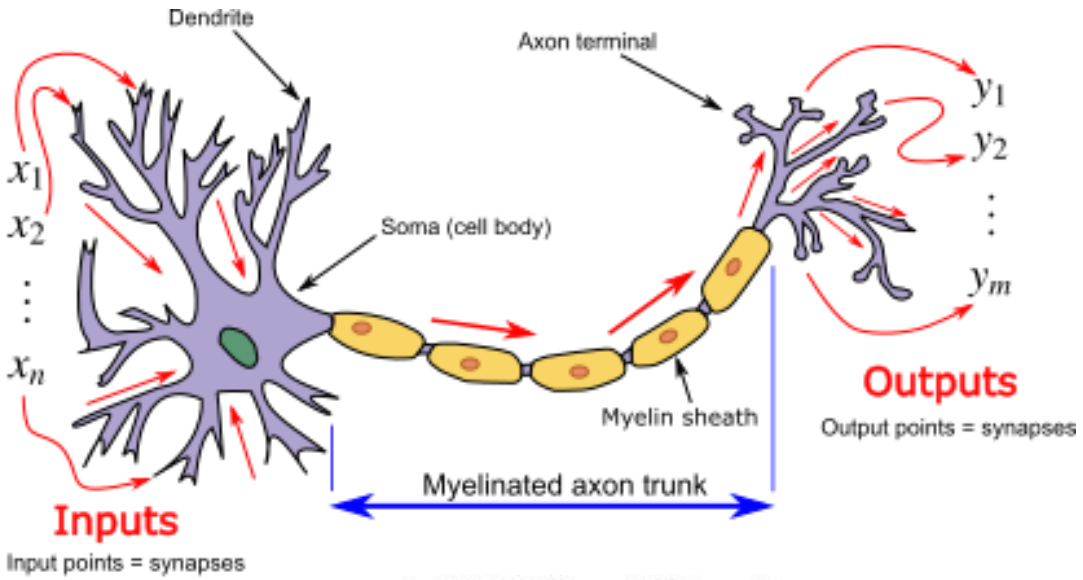


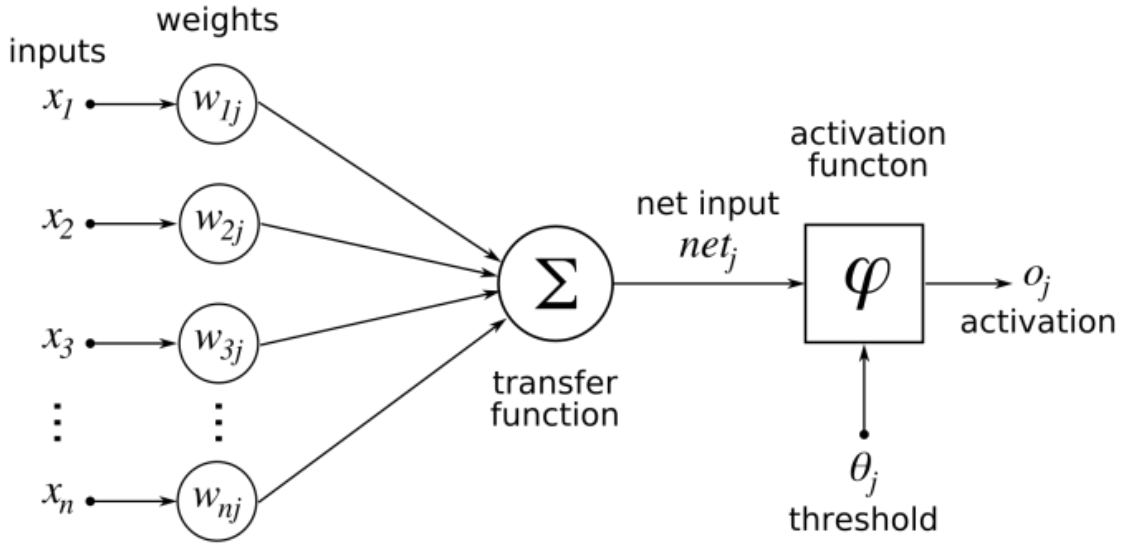
RF

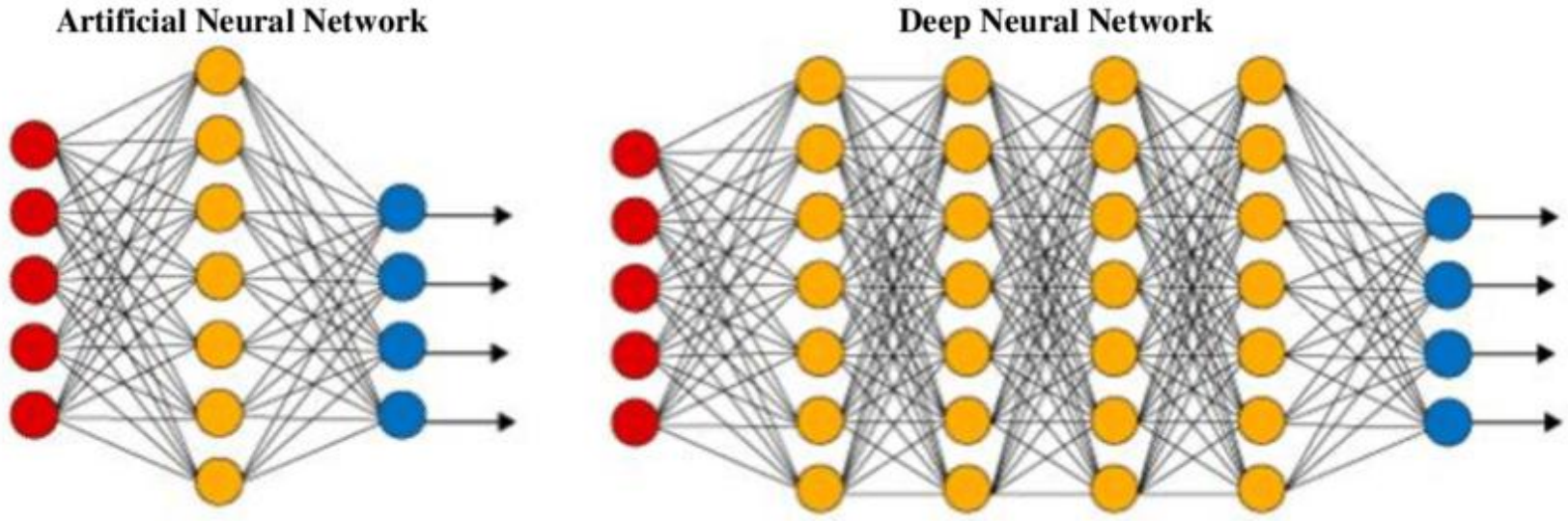


ANN

Artificial Neural Networks

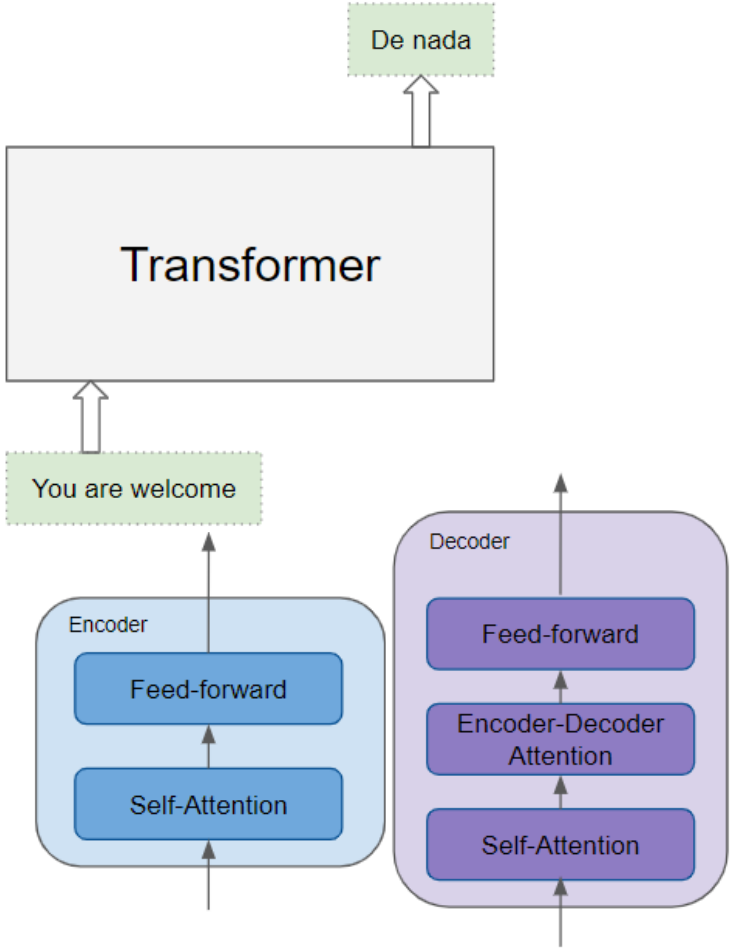


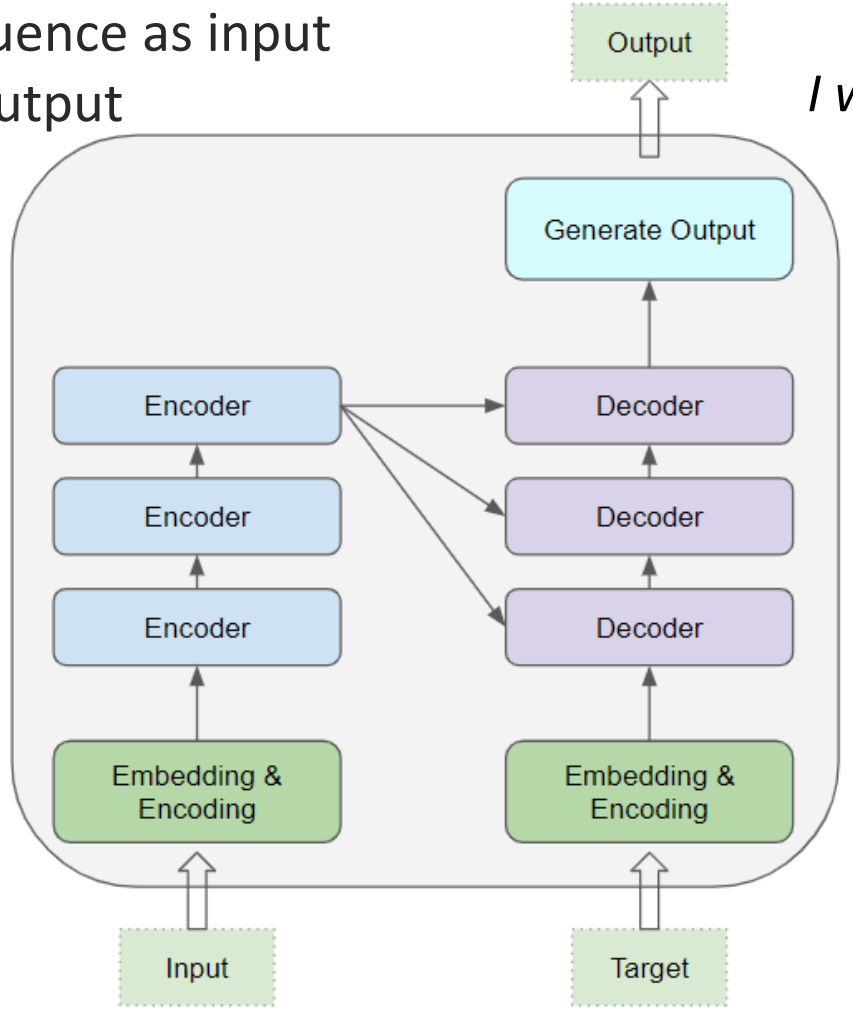




Transformer Architecture

Transformer architecture take a text sequence as input and produce another text sequence as output





https://towardsdatascience.com/transformers-explained-visually-part-1-overview-of-functionality-95a6dd460452

I will have meatballs for …

dinner	*0.3*
lunch	*0.28*
…	
my	*0.1*
a	*0.08*
…	
breakfast	*1e-4*
dessert	*1e-5*
…	
fun	*1e-6*
for	*1e-90*

$$P(w_1, \ldots, w_m)$$

Attention is All You Need

Attention Is All You Need

Ashish Vaswani* Google Brain avaswani@google.com

Noam Shazeer* Google Brain noam@google.com

Niki Parmar* Google Research nikip@google.com

Jakob Uszkoreit* Google Research usz@google.com

Llion Jones* Google Research llion@google.com

Aidan N. Gomez* † University of Toronto aidan@cs.toronto.edu

Łukasz Kaiser* Google Brain lukaszkaiser@google.com

Illia Polosukhin* ‡ illia.polosukhin@gmail.com

Abstract

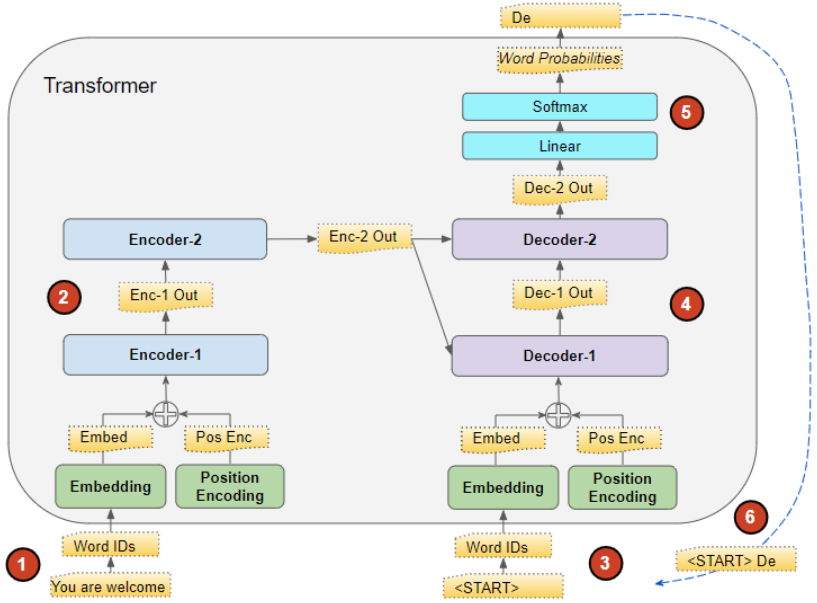
The dominant sequence transduction models are based on complex recurrent or convolutional neural networks that include an encoder and a decoder. The best performing models also connect the encoder and decoder through an attention mechanism. We propose a new simple network architecture, the Transformer, based solely on attention mechanisms, dispensing with recurrence and convolutions entirely. Experiments on two machine translation tasks show these models to be superior in quality while being more parallelizable and requiring significantly less time to train. Our model achieves 28.4 BLEU on the WMT 2014 English-to-German translation task, improving over the existing best results, including ensembles, by over 2 BLEU. On the WMT 2014 English-to-French translation task, our model establishes a new single-model state-of-the-art BLEU score of 41.0 after training for 3.5 days on eight GPUs, a small fraction of the training costs of the best models from the literature.

Google

Google Brain

Google Research

UNIVERSITY OF TORONTO



ChatGPT

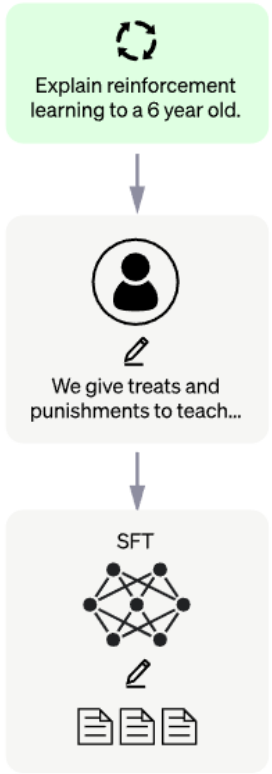
Step 1

Collect demonstration data and train a supervised policy.

A prompt is sampled from our prompt dataset.

A labeler demonstrates the desired output behavior.

This data is used to fine-tune GPT-3.5 with supervised learning.



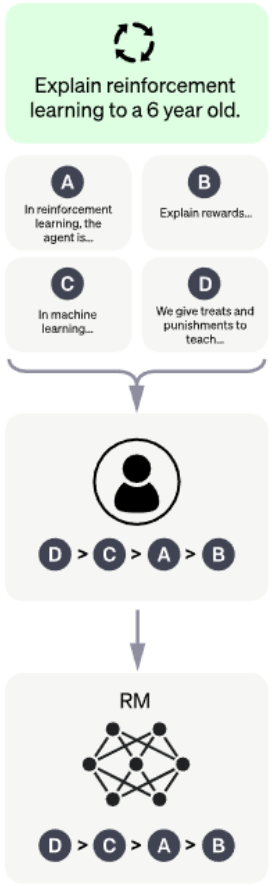
Step 2

Collect comparison data and train a reward model.

A prompt and several model outputs are sampled.

A labeler ranks the outputs from best to worst.

This data is used to train our reward model.



Step 3

Optimize a policy against the reward model using the PPO reinforcement learning algorithm.

A new prompt is sampled from the dataset.

The PPO model is initialized from the supervised policy.

The policy generates an output.

The reward model calculates a reward for the output.

The reward is used to update the policy using PPO.

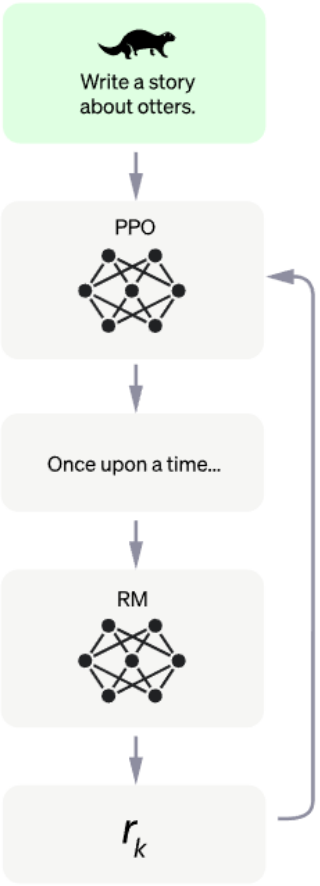


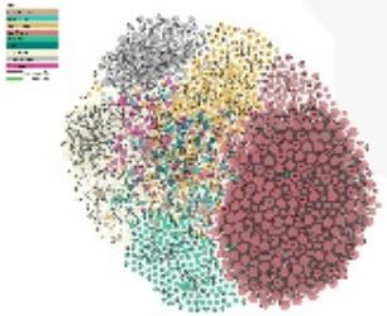
Image: https://openai.com/blog/chatgpt

The Data Revolution

- *Data Is the New Oil — and the Fuel of AI*
- **With the internet, smartphones, and sensors, data grew exponentially**
- **Algorithms improved — but what truly powered modern AI was scale!**
- ***Algorithms got better — but data made them powerful!***

Hardware

Data

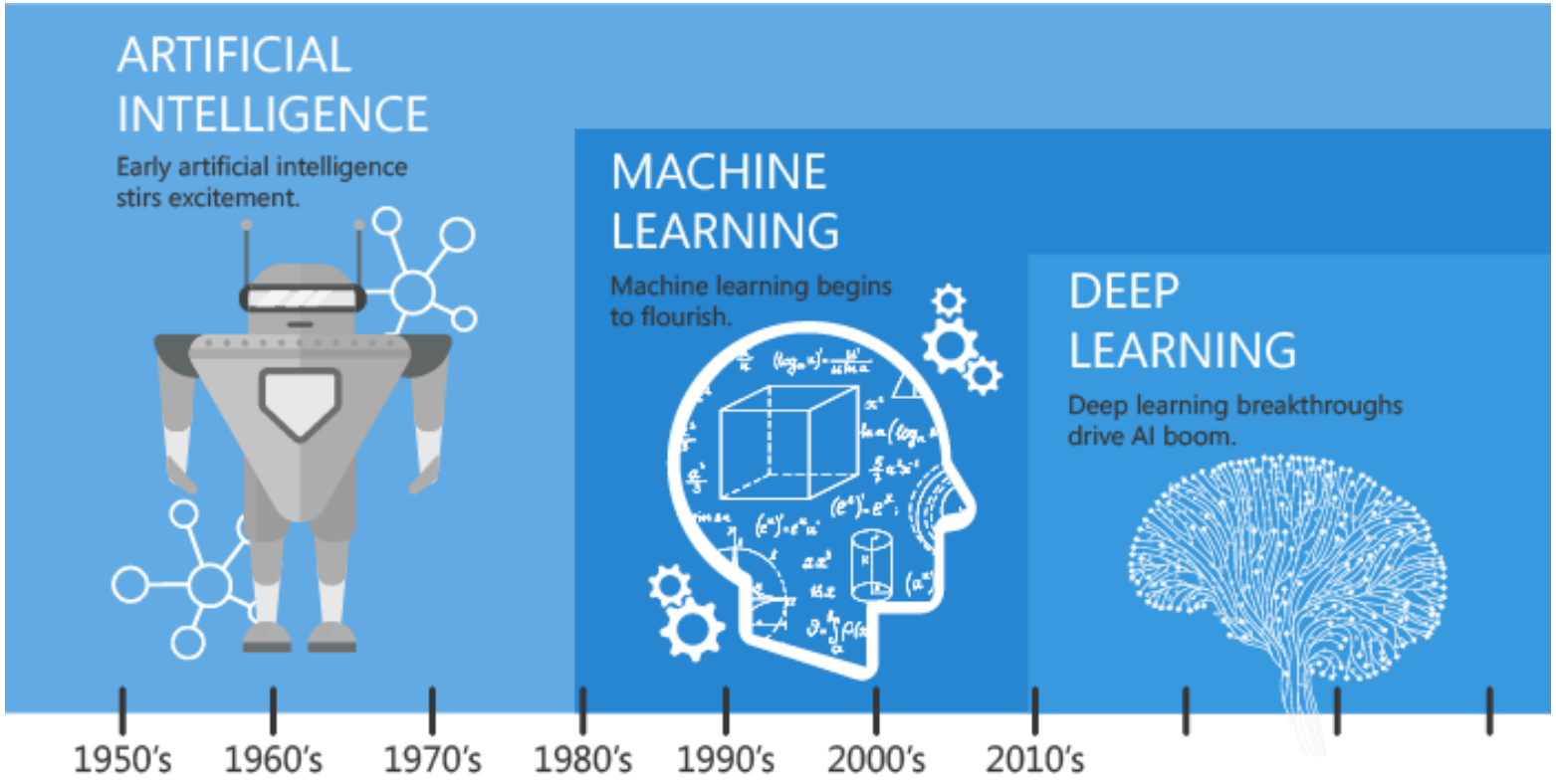


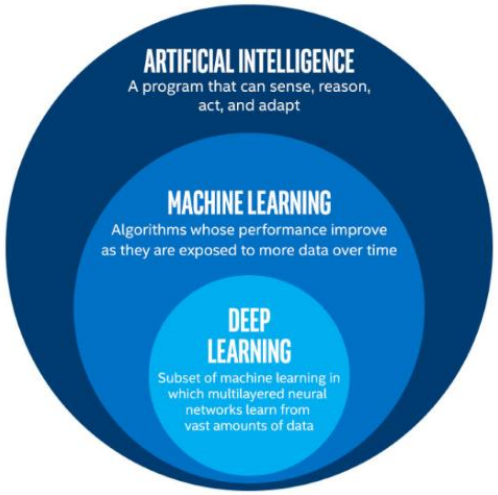
Software

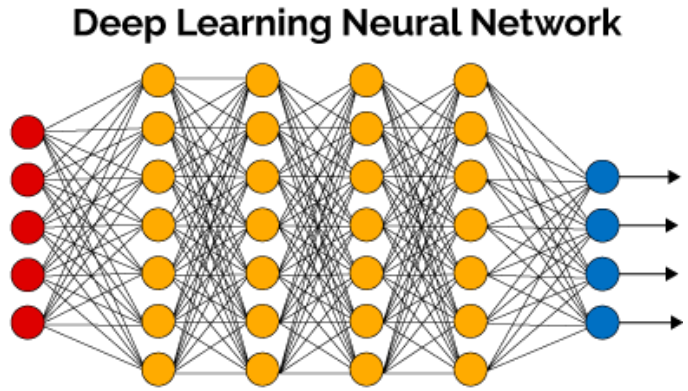
ML frameworks

The Deep Learning Revolution

- When Neural Networks Got Deep — and Everything Changed!
- AlexNet on ImageNet triggered the deep-learning boom
- Multi-layer neural networks, learn features automatically

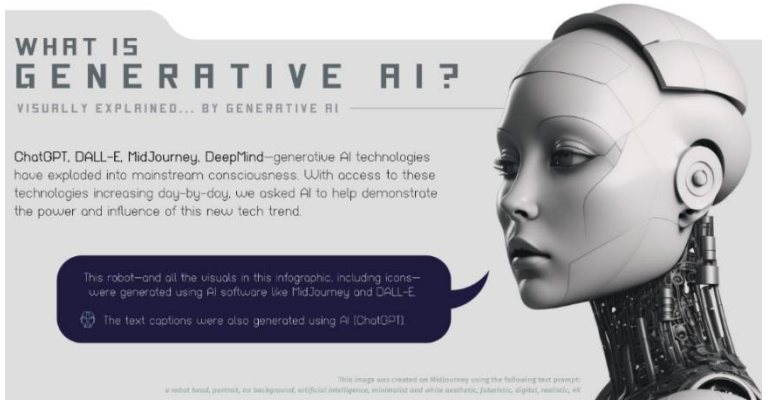


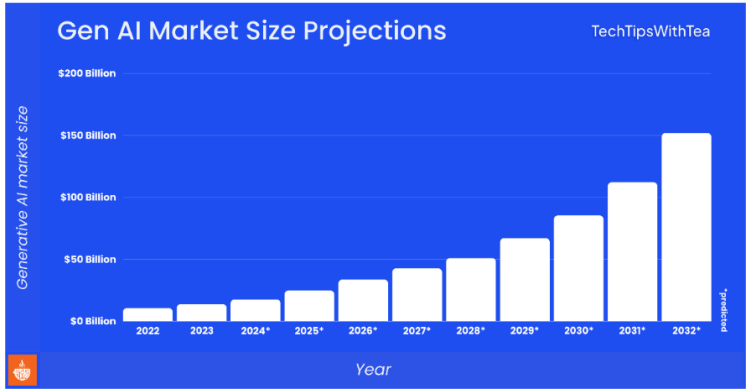




Generative AI - Machines That Create

- **Generative AI (GenAI)** can **create a wide variety of data, such as images, videos, audio, text, and 3D models**
- **Learning patterns from existing data**, and then **using this knowledge to generate new** and unique **outputs in response to prompts**
- GenAI produce **highly realistic and complex content** that mimics human creativity
- **Large language models (LLM) -Very large neural networks** with billions of weights, trained on very large quantities of text

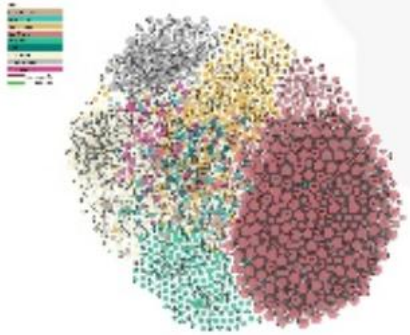




Artificial Intelligence Today

Hardware

Data



Software

ML frameworks

PyTorch

TensorFlow

scikit learn

torch

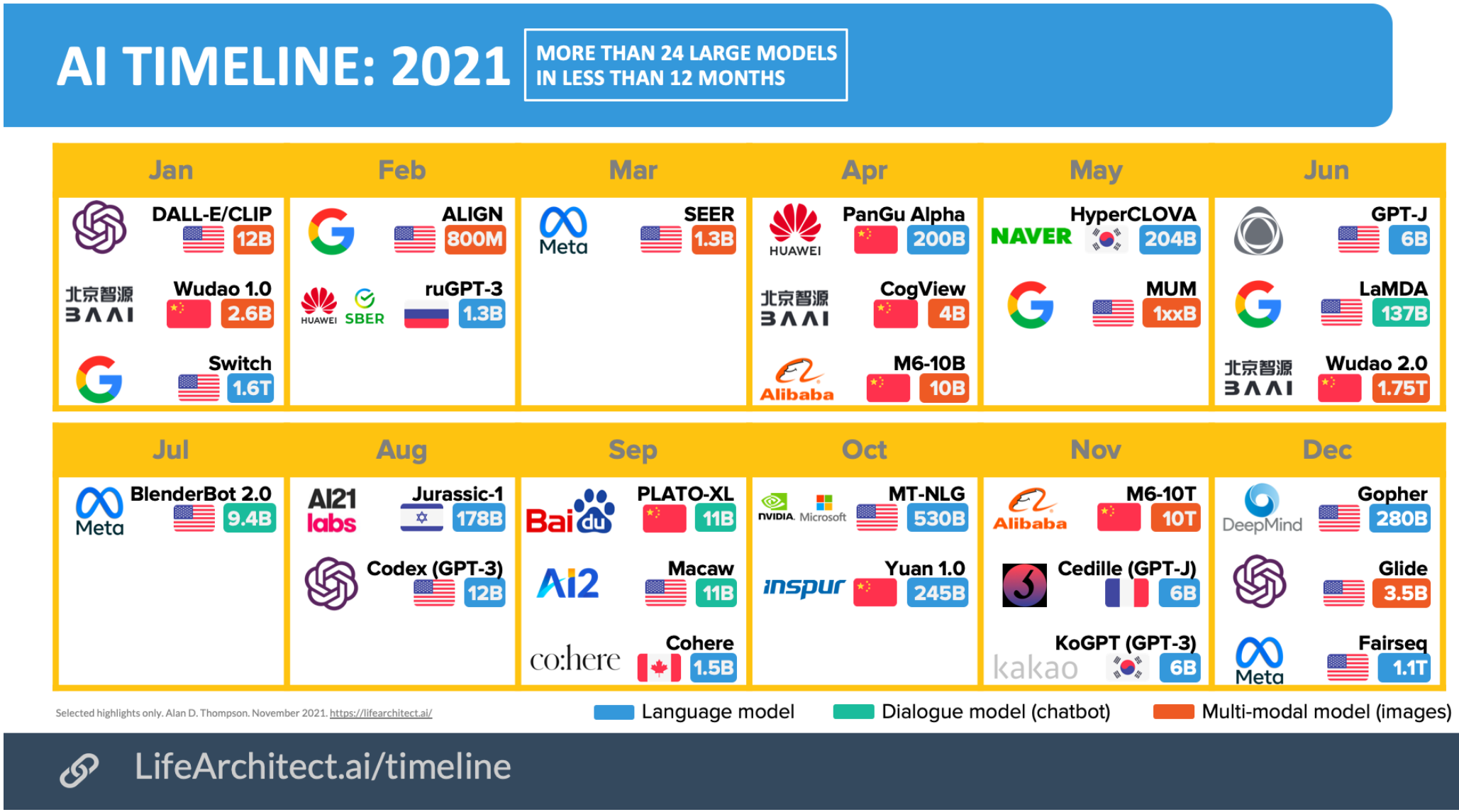
theano

Keras

APACHE Spark ML

HUGGING FACE

AI Timeline


AI TIMELINE: 2021
MORE THAN 24 LARGE MODELS IN LESS THAN 12 MONTHS
Jan
DALL-E/CLIP 12B
Wudao 1.0 2.6B
Switch 1.6T
Feb
ALIGN 800M
ruGPT-3 1.3B
Mar
SEER 1.3B
Apr
PanGu Alpha 200B
CogView 4B
M6-10B 10B
May
HyperCLOVA 204B
MUM 1xxB
Jun
GPT-J 6B
LaMDA 137B
Wudao 2.0 1.75T
Jul
BlenderBot 2.0 9.4B
Aug
Jurassic-1 178B
Codex (GPT-3) 12B
Sep
PLATO-XL 11B
Macaw 11B
Cohere 1.5B
Oct
MT-NLG 530B
Yuan 1.0 245B
Nov
M6-10T 10T
Cedille (GPT-J) 6B
KoGPT (GPT-3) 6B
Dec
Gopher 280B
Glide 3.5B
Fairseq 1.1T
Selected highlights only. Alan D. Thompson. November 2021. https://lifearchitect.ai/
Language model
Dialogue model (chatbot)
Multi-modal model (images)
LifeArchitect.ai/timeline

Generative AI Competition

LLM Evolution 2022/3->2024/5

	2022–23[1]	Jan 2025[2]
Anthropic	Claude • Not multimodal (text only) • Limited contextual understanding (difficulty with complex conversations) • No tool usage	Claude 3.5 • Multimodal (text, audio, and images) • Enhanced contextual understanding and coherence during long interactions • Experimental computer usage capability for some users
Google	Google Bard	Gemini 2.0 Flash

OpenAI

GPT-3.5
- Not multimodal (text only)
- Fair reasoning ability (eg, scored high on SAT, but bottom 10% on bar examination)
- Limited contextual understanding (difficulty with coherence in complex conversations)
- Standard API access (for text generation)

→ OpenAI o1
- Multimodal (text and images)
- Advanced reasoning (eg, top 10% on bar examination)
- Enhanced contextual understanding (maintains coherence in long dialogues)
- Advanced API access (supports multimodal inputs)

Google Gemini

Google Bard
- Not multimodal (text only)
- Fair reasoning
- Limited contextual understanding (difficulty with complex conversations)
- Limited real-time data integration
- Low personalization (limited adaptability)

→ Gemini 2.0 Flash
- Multimodal (text, audio, and images)
- Advanced reasoning (capable of multistep problem-solving and nuanced analysis)
- Enhanced contextual understanding (maintains coherence in long dialogues)
- Real-time data integration (from Google Search)
- Advanced personalization (user context)

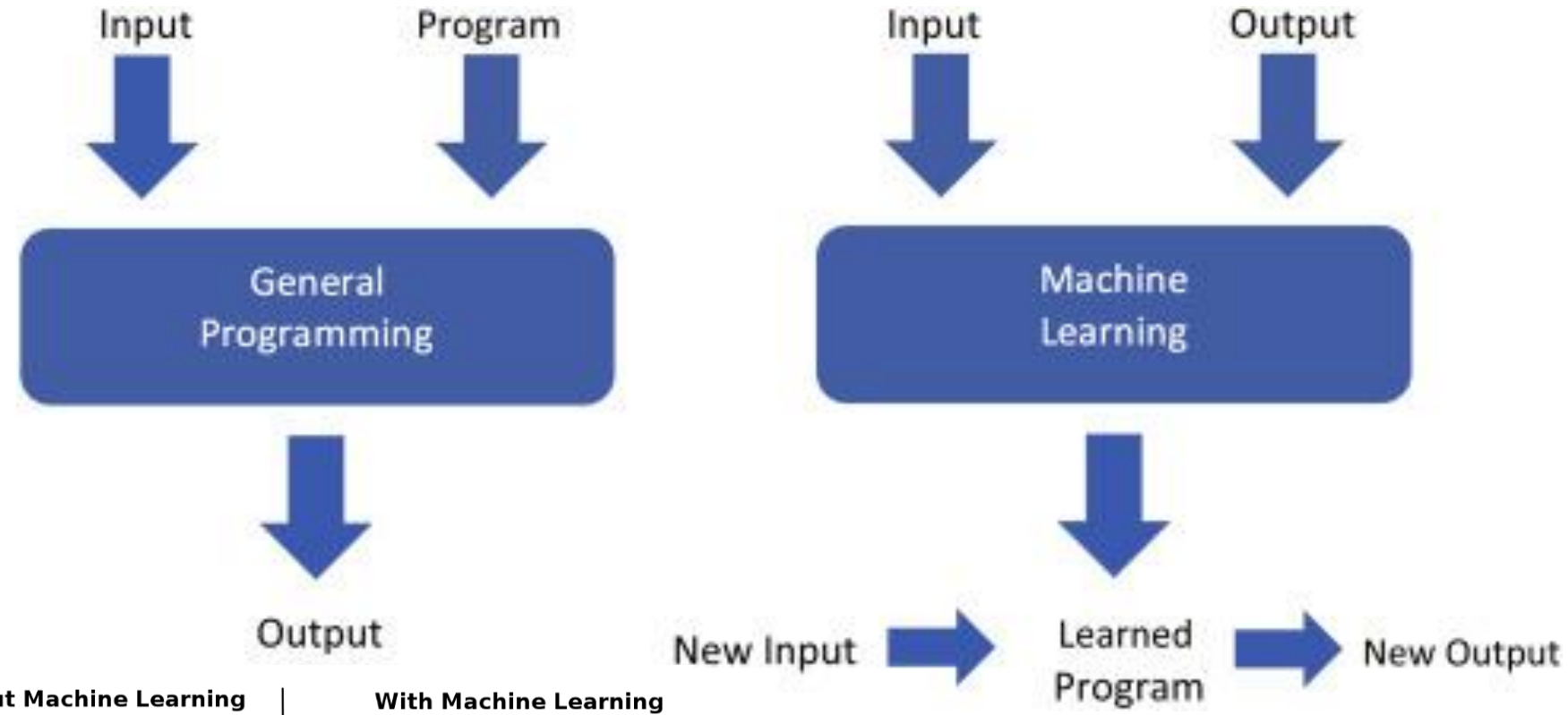
- Fair reasoning ability (eg, scored high on SAT, but bottom 10% on bar examination)
- Limited contextual understanding (difficulty with coherence in complex conversations)
- Standard API access (for text generation)

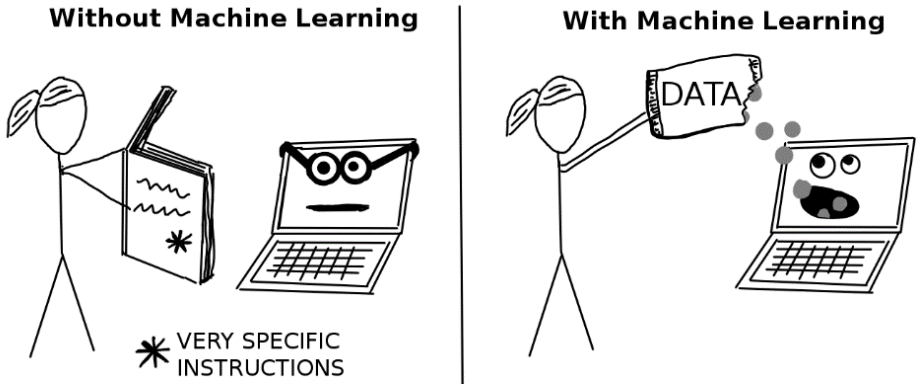
- Advanced reasoning (eg, top 10% on bar examination)
- Enhanced contextual understanding (maintains coherence in long dialogues)
- Advanced API access (supports multimodal inputs)

Chatbot Arena LLM Leaderboard (12/04/2025)

Rank* (UB)	Rank (StyleCtrl)	Model	Arena Score	95% CI	Votes	Organization	License
1	1	Gemini-2.5-Pro-Exp-03-25	1437	+8/-6	7431	Google	Proprietary
2	2	ChatGPT-4o-latest (2025-03-26)	1406	+7/-8	6612	OpenAI	Proprietary
2	4	Grok-3-Preview-02-24	1402	+5/-5	13919	xAI	Proprietary
2	2	GPT-4.5-Preview	1397	+5/-6	13443	OpenAI	Proprietary
5	8	Gemini-2.0-Flash-Thinking-Exp-01-21	1380	+5/-4	25266	Google	Proprietary
5	4	Gemini-2.0-Pro-Exp-02-05	1380	+4/-5	20136	Google	Proprietary
5	4	DeepSeek-V3-0324	1370	+7/-7	4721	DeepSeek	MIT
7	5	DeepSeek-R1	1359	+5/-5	15098	DeepSeek	MIT
8	13	Gemini-2.0-Flash-001	1354	+4/-4	21065	Google	Proprietary
8	4	o1-2024-12-17	1350	+4/-5	27831	OpenAI	Proprietary
10	13	Gemma-3-27B-it	1342	+7/-6	9147	Google	Gemma
11	13	Qwen2.5-Max	1340	+4/-4	19995	Alibaba	Proprietary
11	10	o1-preview	1335	+5/-4	33175	OpenAI	Proprietary
14	13	o3-mini-high	1325	+6/-4	16889	OpenAI	Proprietary
14	15	DeepSeek-V3	1318	+4/-4	22843	DeepSeek	DeepSeek
14	20	QwQ-32B	1315	+6/-8	6729	Alibaba	Apache 2.0
15	21	GLM-4-Plus-0111	1310	+7/-5	6032	Zhipu	Proprietary

Programming vs Machine Learning





The End of Programming!

Nvidia CEO predicts the death of coding — Jensen Huang says AI will do the work, so kids don't need to learn

News By Benedict Collins published February 26, 2024

Jensen Huang believes coding languages are a thing of the past

(Image credit: Nvidia)

Nvidia CEO Jensen Huang has once again announced the death of coding, but this time in front of a potentially far more influential audience.

StarCoder 2 is a code-generating AI that runs on most GPUs

Kyle Wiggers @kyle_l_wiggers / 2:00 PM UTC • February 28, 2024 Comment

Image Credits: Tippapatt / Getty Images

Developers are adopting AI-powered code generators — services like GitHub Copilot and Amazon CodeWhisperer, along with open access models such as Meta's Code Llama — at an astonishing rate. But the tools are far from ideal. Many aren't free. Others are, but only under licenses that preclude them from being used in common commercial contexts.

Perceiving the demand for alternatives, AI startup Hugging Face several years ago teamed up with ServiceNow, the workflow automation platform, to create StarCoder, an open source code generator with a less restrictive license than some of the others out there. The original came online early last year, and work has been underway on a follow-up, StarCoder 2, ever since.

StarCoder 2 isn't a single code-generating model, but rather a family. Released today, it comes in three variants, the first two of which can run on most modern consumer GPUs:

- A 3-billion-parameter (3B) model trained by ServiceNow
- A 7-billion-parameter (7B) model trained by Hugging Face
- A 15-billion-parameter (15B) model trained by Nvidia, the newest supporter of the StarCoder project

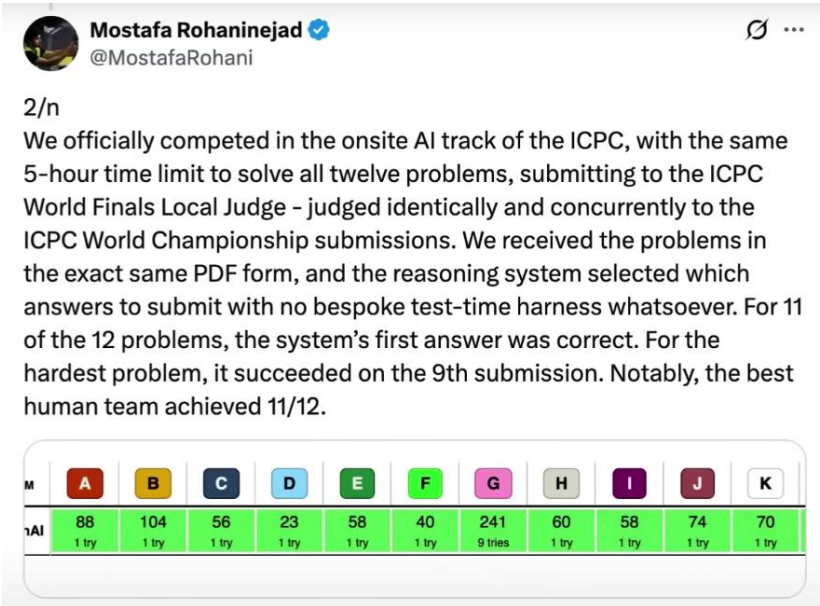
2025 International Collegiate Programming Contest

Rank	University	Country	Solved	Time
1	St. Petersburg State University	Russia	11	1478
2	The University of Tokyo	Japan	10	1116
3	Beijing Jiaotong University	China	10	1425
4	Tsinghua University	China	9	865
5	Peking University	China	9	887
6	Harvard University	USA	9	995
7	University of Zagreb	Croatia	9	1075
8	Massachusetts Institute of Technology	USA	9	1123
9	University of Science and Technology of China	China	9	1128
10	Seoul National University	Korea	9	1133
11	University of Novi Sad	Serbia	9	1175
12	Saratov State University	Russia	9	1191
13	Karlsruhe Institute of Technology	Germany	9	1199
14	University of Maryland	USA	9	1239
15	National Taiwan University	Taiwan	9	1256
16	Sharif University of Technology	Iran	9	1329
17	Arizona State University	USA	9	1331
18	HSE University	Russia	8	653
19	Carnegie Mellon University	USA	8	766
20	University of Illinois Urbana-Champaign	USA	8	774

OpenAI and Google DeepMind Outshine Students at World's Top Coding Contest

Published September 18, 2025 | Written by  Liz Ticong

OpenAI scored a flawless 12/12 and Google DeepMind struck gold at ICPC 2025, the world's toughest programming contest for top university teams.



Mostafa Rohaninejad
@MostafaRohani

2/n
We officially competed in the onsite AI track of the ICPC, with the same 5-hour time limit to solve all twelve problems, submitting to the ICPC World Finals Local Judge - judged identically and concurrently to the ICPC World Championship submissions. We received the problems in the exact same PDF form, and the reasoning system selected which answers to submit with no bespoke test-time harness whatsoever. For 11 of the 12 problems, the system's first answer was correct. For the hardest problem, it succeeded on the 9th submission. Notably, the best human team achieved 11/12.

	A	B	C	D	E	F	G	H	I	J	K
AI	88 1 try	104 1 try	56 1 try	23 1 try	58 1 try	40 1 try	241 9 tries	60 1 try	58 1 try	74 1 try	70 1 try

Coding Applications – Practical Example

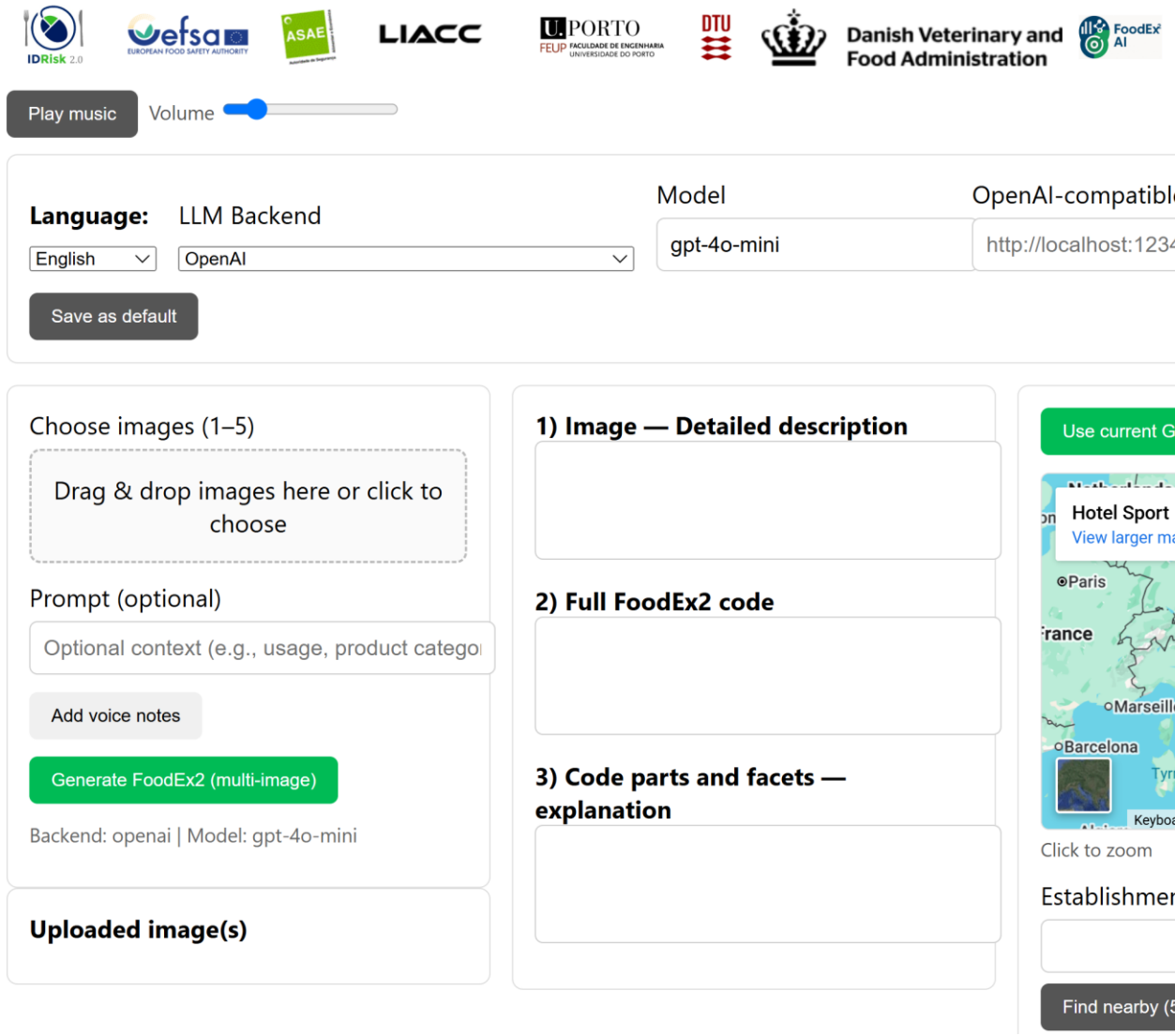
GitHub Copilot

GitHub Copilot

OpenAI Codex

Gemini

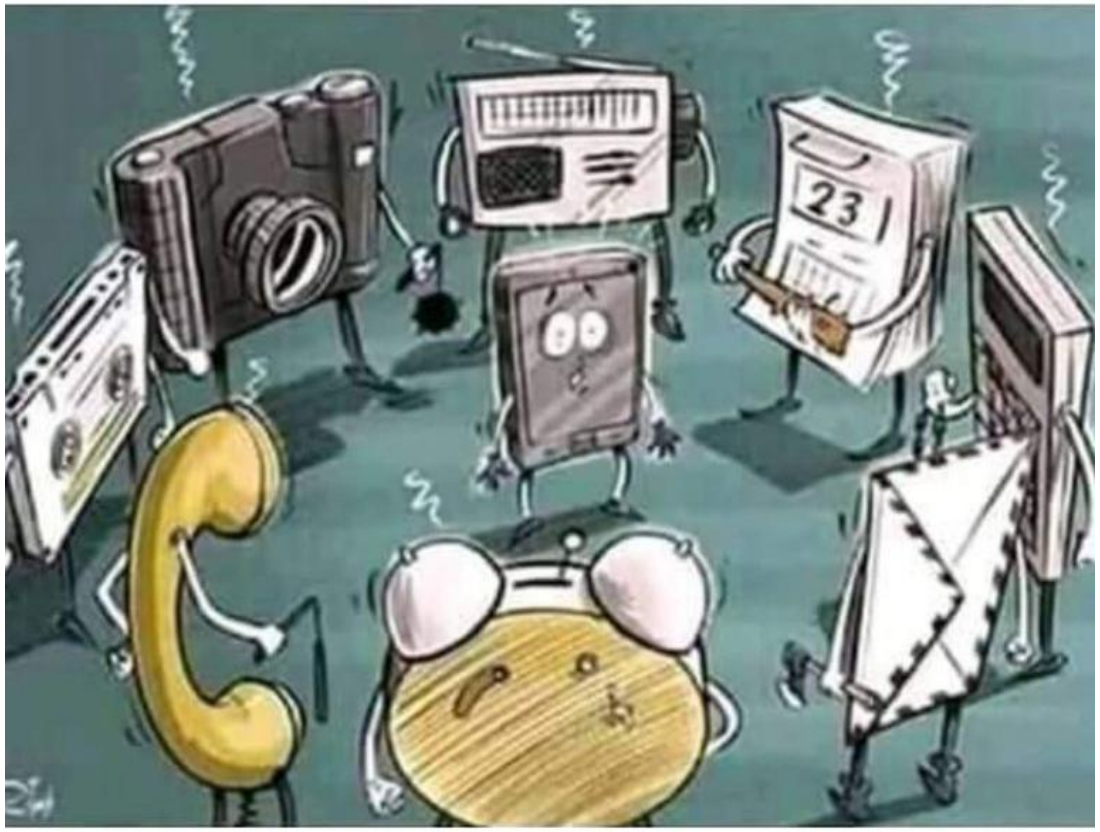
Claude



Technology: Adapt or Resist?!

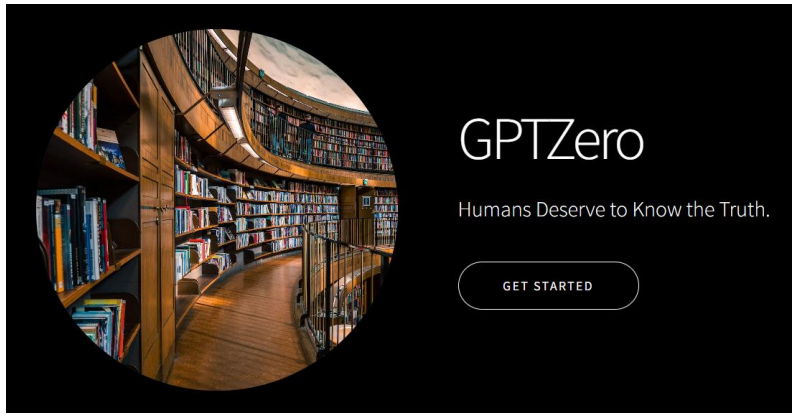
- COVID-19 - Use of technology
- Educate New Generations
- Ethical Use
- Technical Use
- AI Policy
- Prompt Engineering

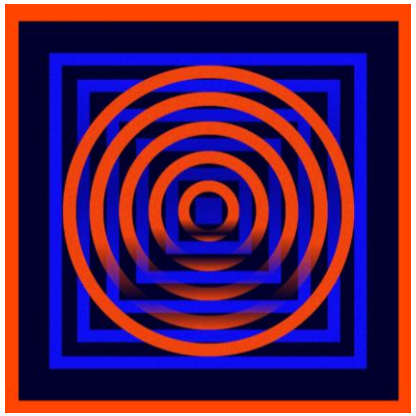
So! You are the guy…



That took all of our Jobs!

AI Text Detectors/Classifiers





Are You an Educator?

We're building a taylored solution for educators to responsibly adopt AI-technologies in school. GPTZero turns the very technologies used to build ChatGPT around — to detect AI. It uses variables like perplexity to fingerprint AI involvement. Stay updated on the upcoming innovations in GPTZero technology via this substack.

New AI classifier for indicating AI-written text

We're launching a classifier trained to distinguish between AI-written and human-written text.

January 31, 2023

AI Text Classifier

The AI Text Classifier is a fine-tuned GPT model that predicts how likely it is that a piece of text was generated by AI from a variety of sources, such as ChatGPT.

This classifier is available as a free tool to spark discussions on AI literacy. For more information on ChatGPT's capabilities, limitations, and considerations in educational settings, please visit our documentation.

Current limitations:

- Requires a minimum of 1,000 characters, which is approximately 150 - 250 words.
- The classifier isn't always accurate; it can mislabel both AI-generated and human-written text.
- AI-generated text can be edited easily to evade the classifier.
- The classifier is likely to get things wrong on text written by children and on text not in English, because it was primarily trained on English content written by adults.

Try the classifier

To get started, choose an example below or paste the text you'd like to check. Be sure you have appropriate rights to the text you're pasting.

Examples

Human-Written | AI-Generated | Misclassified Human-Written

Working with AI - Anti-Anti ChatGPT

Good Query in Portuguese

Text V1 in Portuguese

DeepL Translator

Text V2 in English

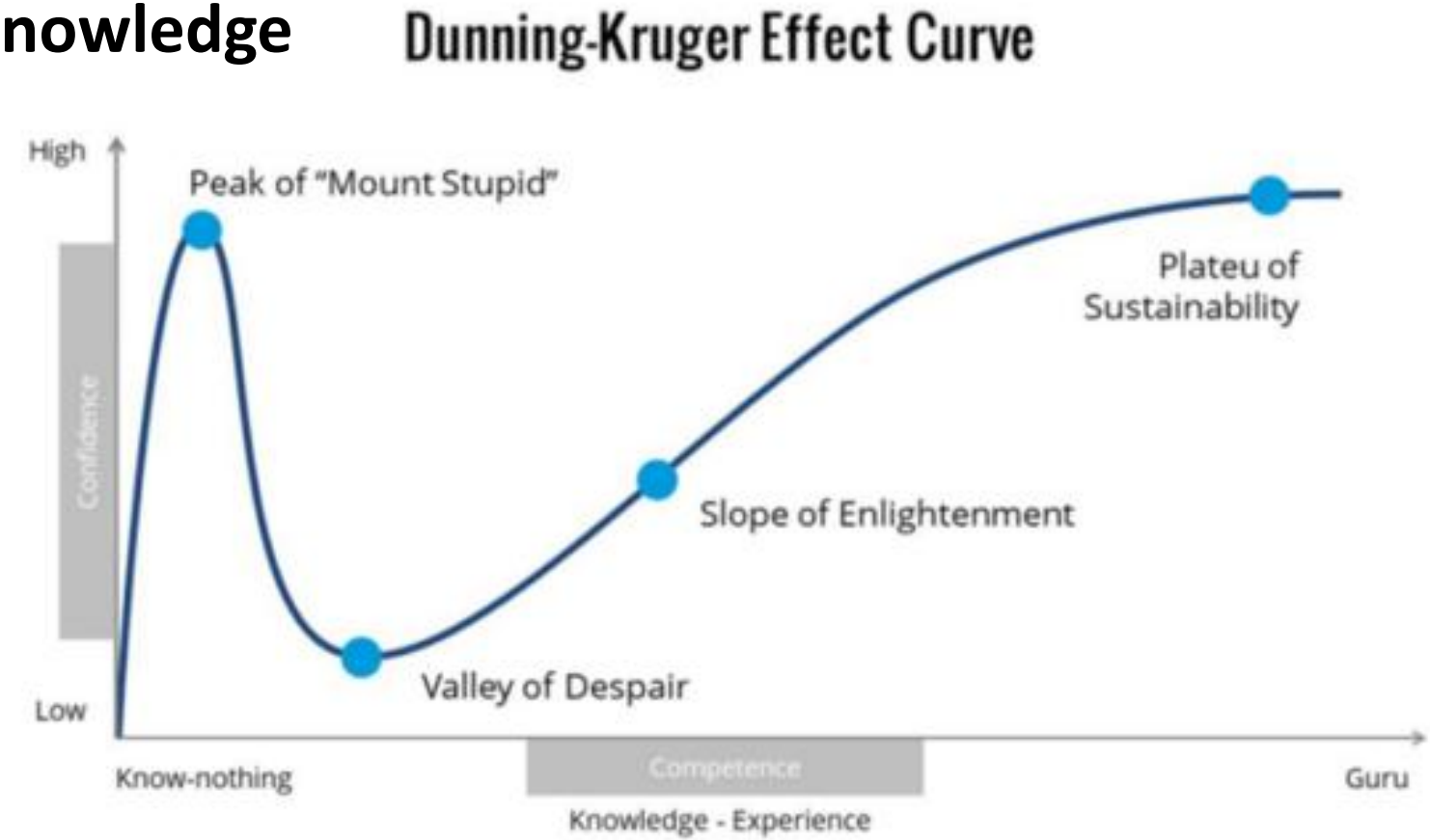
QuillBot

Text V3 in English

Final Text

Chat GPT – Dunning-Kruger Effect

Cognitive bias whereby people with low ability, expertise, or experience regarding a certain type of task or area of knowledge tend to overestimate their ability/knowledge



Google Search Engine

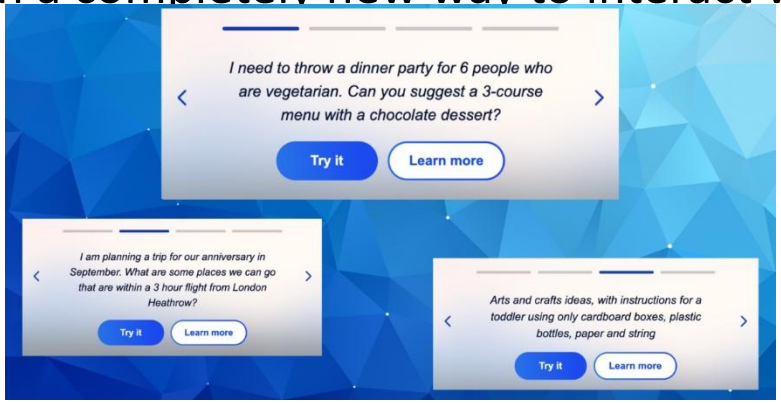
- **Hummingbird Algorithm**
  - **PageRank algorithm** that covers a specific way of **giving pages credit based on the links from other pages** pointing at them
  - Panda, Penguin and Payday to fight **spam**
  - Pigeon designed to improve **local results**
  - Top Heavy designed to demote **ad-heavy** pages,
  - Mobile Friendly designed to reward m**obile-friendly** pages
  - Pirate designed to fight **copyright infringement**

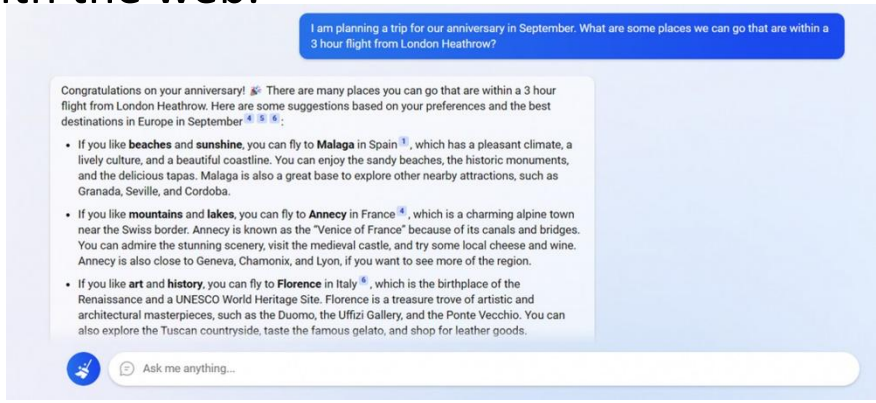
- **200 major ranking signals (up to 10,000 variations or sub-signals)**
- **Google RankBrain Algorithm**
  - **Machine-Learning** System
  - **3rd most important signal**
  - Interpret searches people submit to **find pages that might not have the exact words** that were searched for

Bing Search Engine

Reinventing search with AI with four technical breakthroughs:

- **Next-generation OpenAI model more powerful than ChatGPT** and customized specifically for search. It takes key learnings and advancements from ChatGPT and GPT-3.5/4.0 and it is even faster, more accurate and more capable
- **Microsoft Prometheus model.** Proprietary way of working with OpenAI model that allows to best leverage its power
- **Applying AI to core search algorithm**. AI model to core Bing search ranking engine, which led to the largest jump in relevance in two decades. Search queries are more accurate and more relevant
- **New user experience.** Reimagining interaction with search, browser and chat into a unified experience in a completely new way to interact with the web.



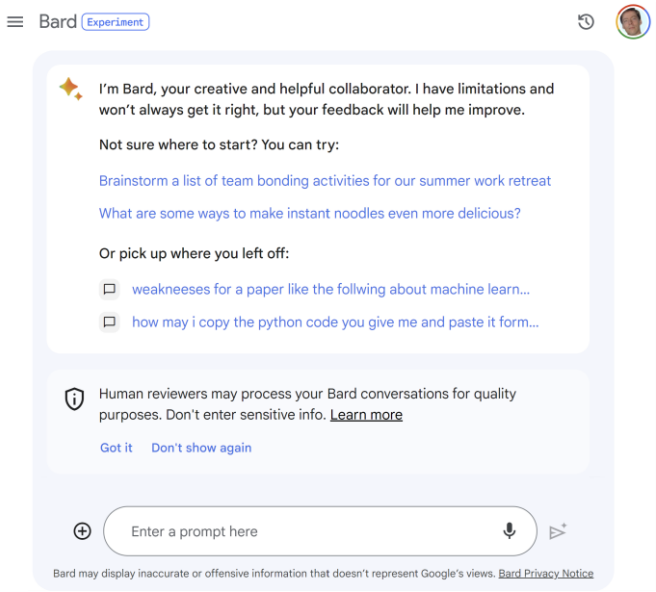


GitHub Copilot

- **June 2021: GitHub Releases Copilot**
- **March 2023: GitHub uses OpenAI's GPT-4** to go way beyond auto-completing comments and code and gets chat and voice support

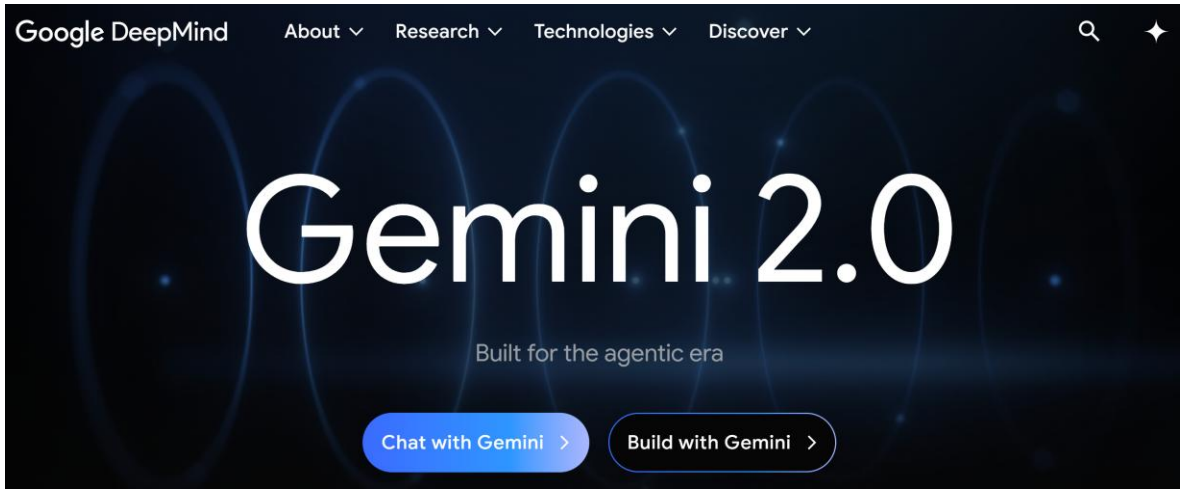
Google Bard

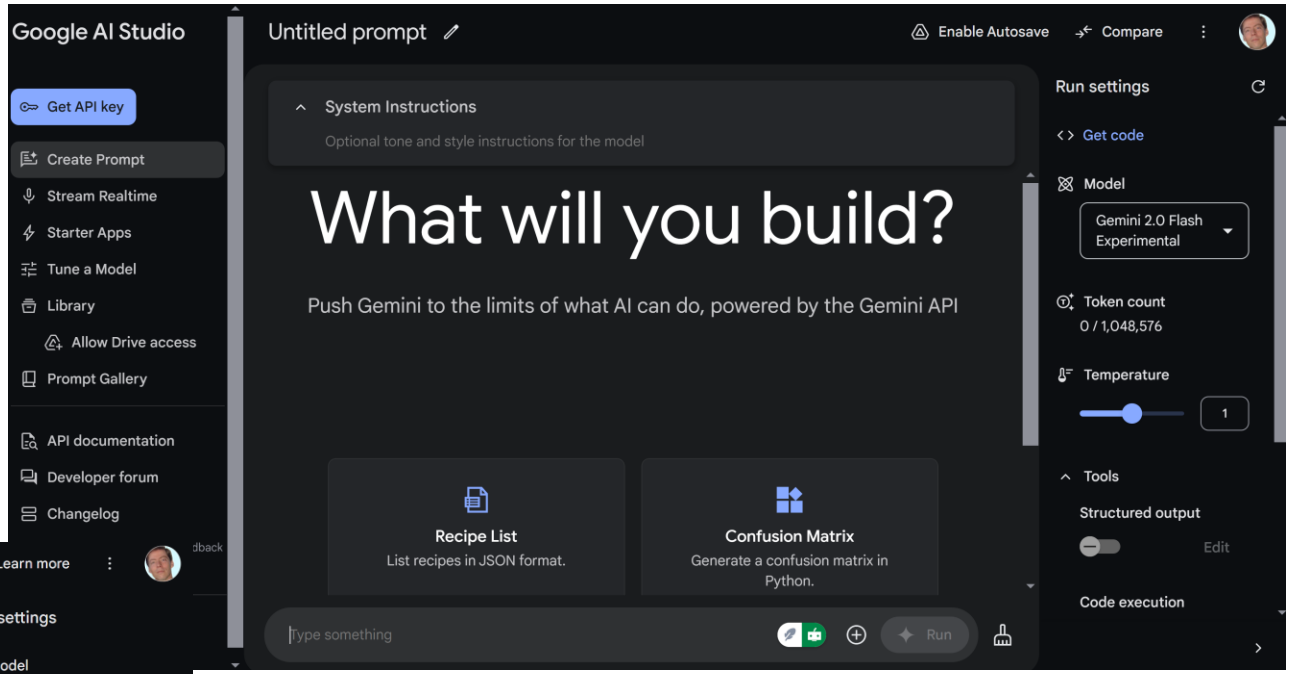
- Language Model for Dialogue Applications (LaMDA)
- Experimental conversational AI service, powered by LaMDA
- Very fast and easy to use

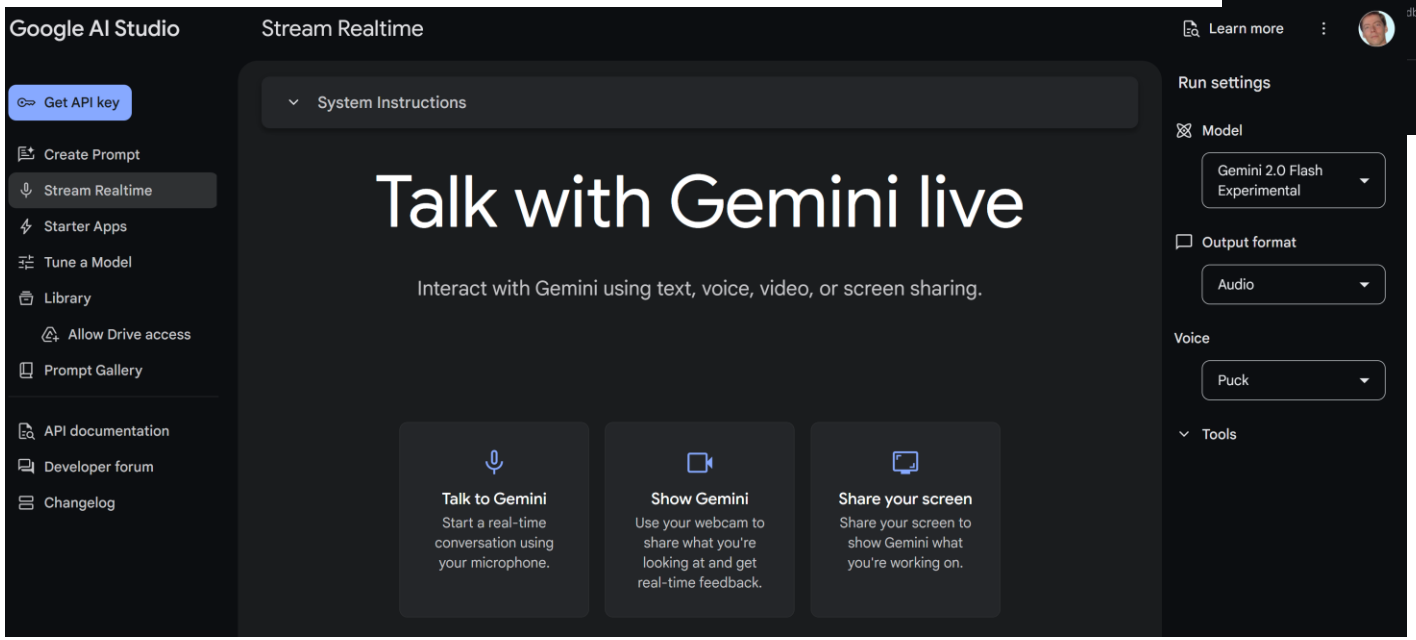


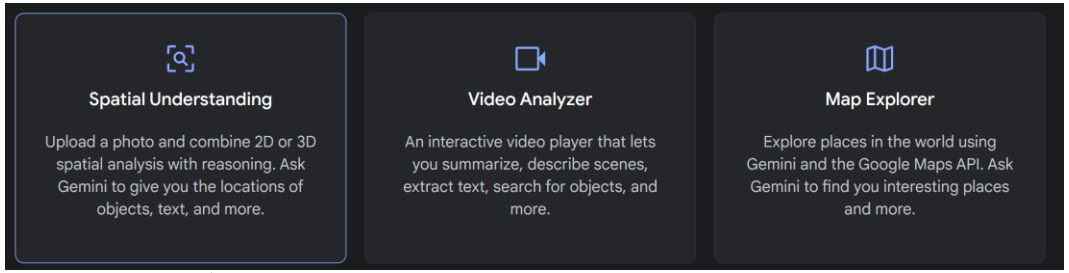
Gemini – Google Deep Mind

Gemini


Google DeepMind
About
Research
Technologies
Discover
Gemini 2.0
Built for the agentic era
Chat with Gemini
Build with Gemini


Google AI Studio
Get API key
Create Prompt
Stream Realtime
Starter Apps
Tune a Model
Library
Allow Drive access
Prompt Gallery
API documentation
Developer forum
Changelog
Untitled prompt
Enable Autosave
Compare
System Instructions
Optional tone and style instructions for the model
What will you build?
Push Gemini to the limits of what AI can do, powered by the Gemini API
Recipe List
List recipes in JSON format.
Confusion Matrix
Generate a confusion matrix in Python.
Type something
Run
Run settings
Get code
Model
Gemini 2.0 Flash Experimental
Token count
0 / 1,048,576
Temperature
1
Tools
Structured output
Edit
Code execution

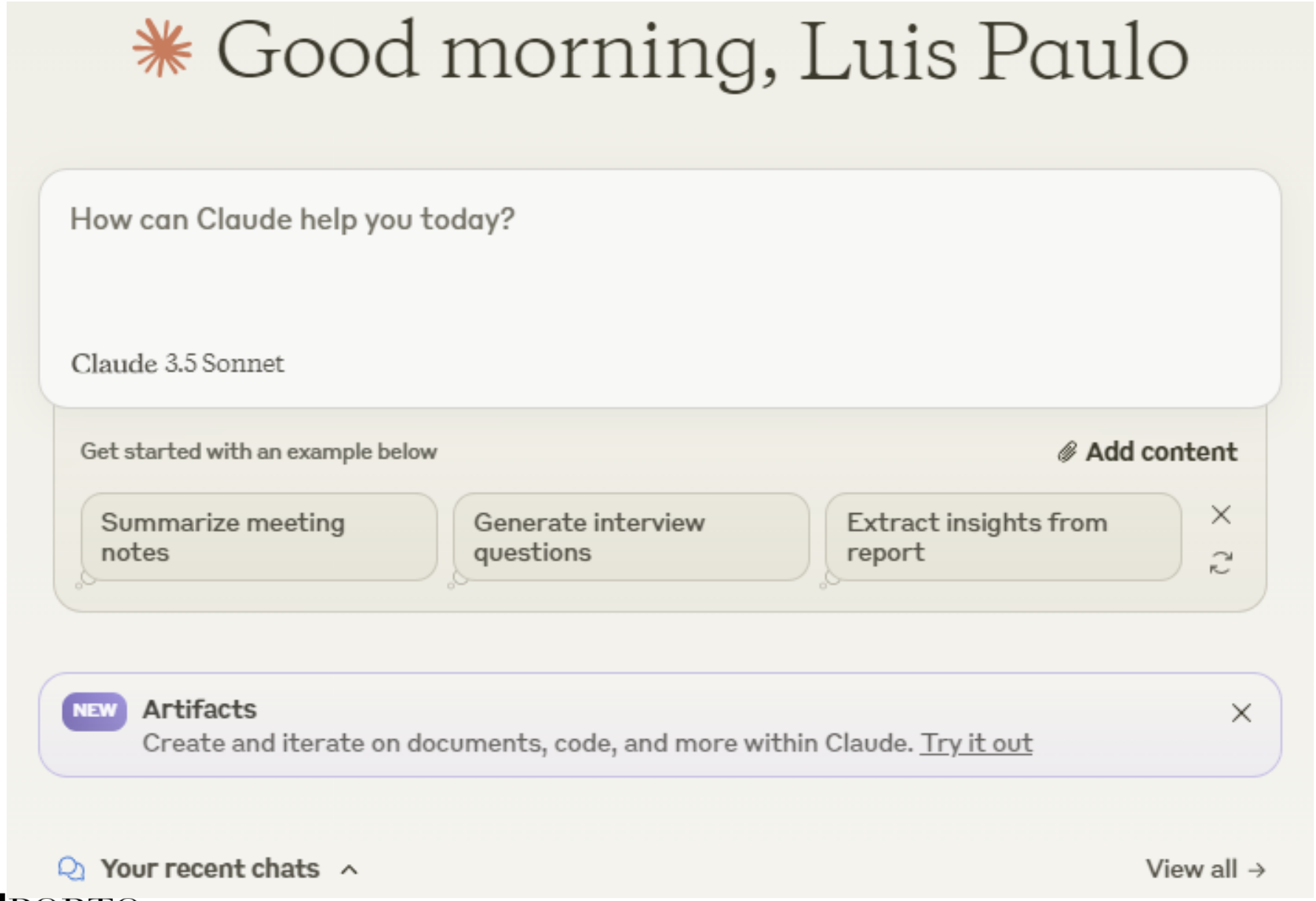

Google AI Studio
Stream Realtime
Learn more
Get API key
Create Prompt
Stream Realtime
Starter Apps
Tune a Model
Library
Allow Drive access
Prompt Gallery
API documentation
Developer forum
Changelog
System Instructions
Talk with Gemini live
Interact with Gemini using text, voice, video, or screen sharing.
Talk to Gemini
Start a real-time conversation using your microphone.
Show Gemini
Use your webcam to share what you're looking at and get real-time feedback.
Share your screen
Share your screen to show Gemini what you're working on.
Run settings
Model
Gemini 2.0 Flash Experimental
Output format
Audio
Voice
Puck
Tools


Spatial Understanding
Upload a photo and combine 2D or 3D spatial analysis with reasoning. Ask Gemini to give you the locations of objects, text, and more.
Video Analyzer
An interactive video player that lets you summarize, describe scenes, extract text, search for objects, and more.
Map Explorer
Explore places in the world using Gemini and the Google Maps API. Ask Gemini to find you interesting places and more.


Gemini Advanced
Upgrade your Google One plan to get Gemini Advanced
~~€21.99~~ €0 for 1 month, €21.99/month after

Microsoft Copilot

Claude



Claude

Claude for Desktop Beta

Your AI partner on desktop. Fast, focused, and designed for deep work.

Windows | Windows (arm64) | macOS

Take Claude with you

Talk to Claude, anywhere you go. Brainstorm ideas, get answers, and analyze images on the go.

Apple App Store | Google Play

Pro

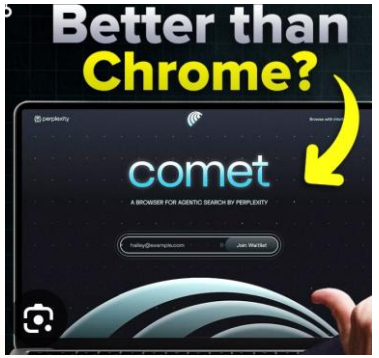
€18 + VAT / month

- 5x more usage versus Free plan
- Access to Projects to organize documents and chats
- Ability to use more models, like Claude 3 Opus
- Early access to new features

Subscribe to Pro

Perplexity AI

Perplexity AI is a conversational search engine that uses large language models (**LLMs**) to answer queries using **sources from the web** and **cites links** within the text response.



perplexity

New Thread Ctrl I

Home

Discover

Spaces

Library

who are the top researche

lpreis1970 4m

+ Space / who are the top researchers in AI in portugal today

who are the top researchers in AI in portugal today

Sources

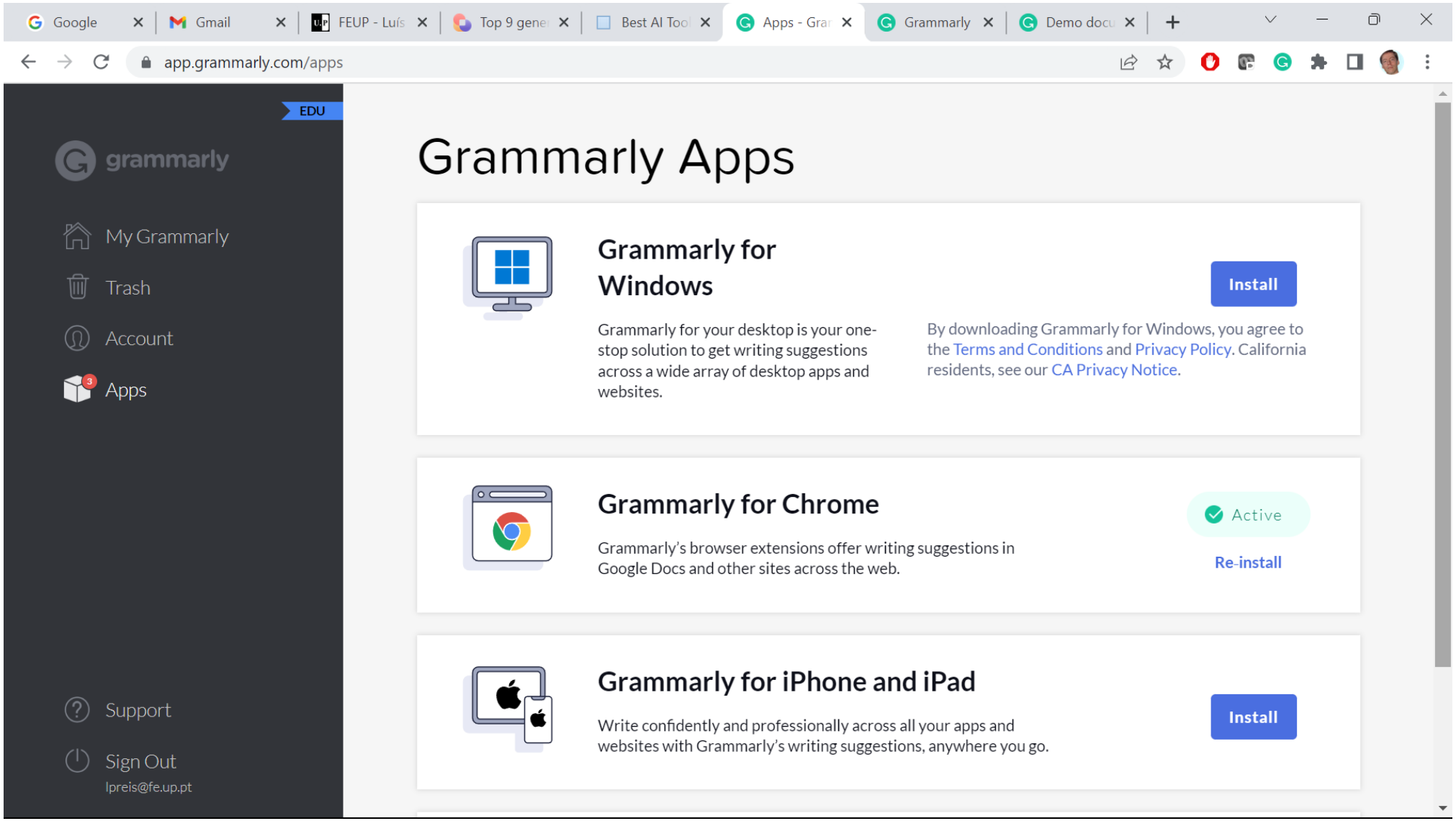
INESC-ID AI researchers ranked as some of the best in...

inesc-id

Based on the most recent information available, several top AI researchers in Portugal stand out:

1. Paulo Novais from the University of Minho, who leads the ISLab laboratory at the ALGORITMI centre and coordinates LASI, the largest associated laboratory in Portugal [3].
2. Luís Paulo Reis, an Associate Professor with Aggregation at FEUP and Director of LIACC – Artificial Intelligence and Computer Science Laboratory [2] [3].
3. Manuela Veloso, currently the Director of J.P. Morgan AI Research and formerly a member of Carnegie Mellon University. She is internationally renowned for her work in artificial intelligence and robotics [3].

Grammarly


Google
Gmail
FEUP - Luís
Top 9 gene
Best AI Tool
Apps - Gra
Grammarly
Demo docu
app.grammarly.com/apps
EDU
grammarly
My Grammarly
Trash
Account
Apps
Support
Sign Out
lpreis@fe.up.pt
Grammarly Apps
Grammarly for Windows
Grammarly for your desktop is your one-stop solution to get writing suggestions across a wide array of desktop apps and websites.
Install
By downloading Grammarly for Windows, you agree to the Terms and Conditions and Privacy Policy. California residents, see our CA Privacy Notice.
Grammarly for Chrome
Grammarly's browser extensions offer writing suggestions in Google Docs and other sites across the web.
Active
Re-install
Grammarly for iPhone and iPad
Write confidently and professionally across all your apps and websites with Grammarly's writing suggestions, anywhere you go.
Install

DeepL

DeepL Translator | DeepL Pro | Why DeepL? | API | Plans and pricing | Apps FREE | Start free trial | Login

Translate text
31 languages

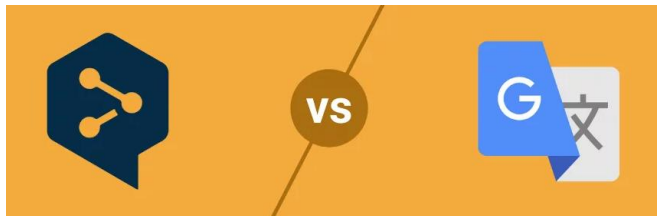
Translate files
.pdf, .docx, .pptx

Pick up where you left off with your **30-day free trial** of DeepL Pro.

Detect language | English (UK) | Glossary

Type to translate.

Drag and drop to translate PDF, Word (.docx), and PowerPoint (.pptx) files with our document translator.



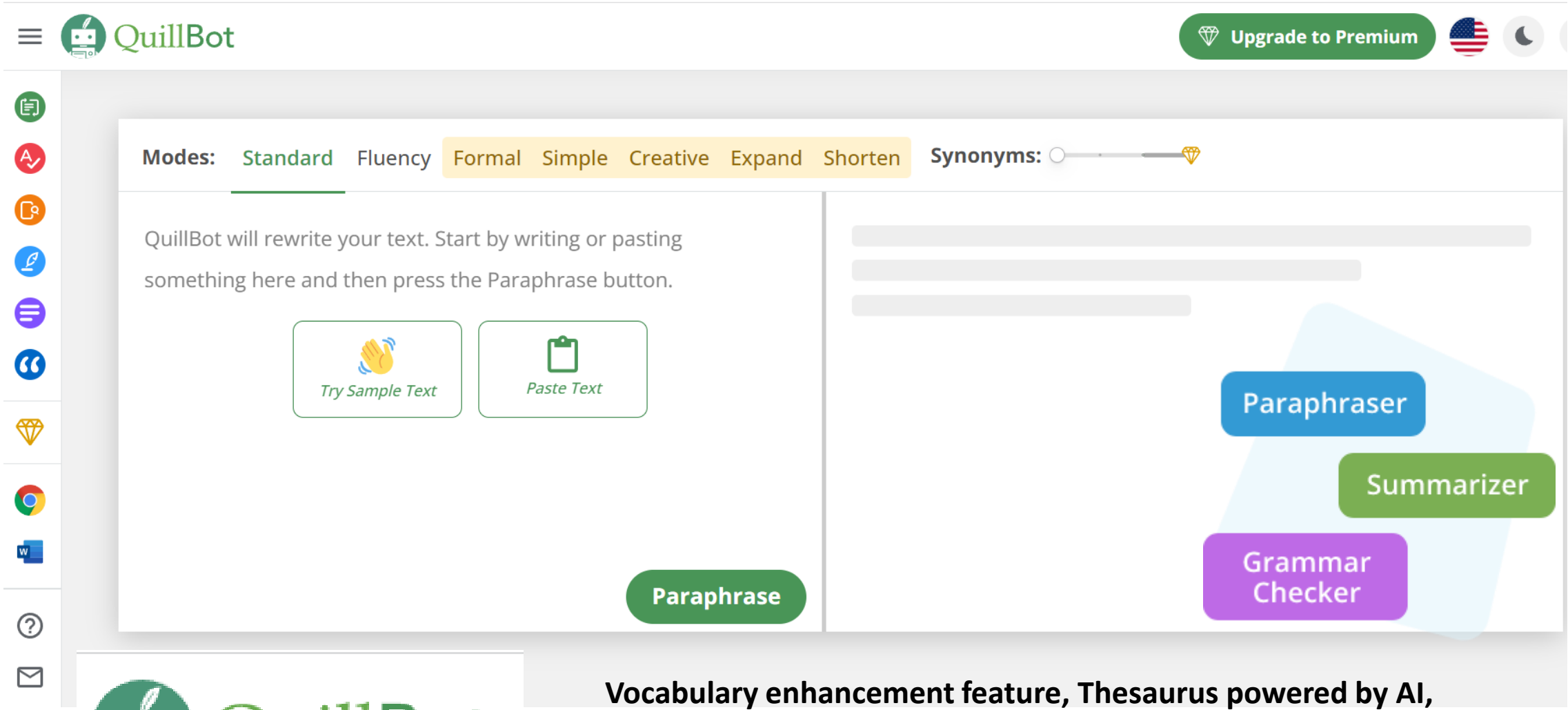
DeepL Translator

Tech giants Google, Microsoft and Facebook are all applying the lessons of machine learning to translation, but a small company called DeepL has outdone them all and raised the bar for the field.
Its translation tool is just as quick as the outsized competition, but more accurate and nuanced than any we've tried.

TechCrunch, USA

TechCrunch

QuillBot



QuillBot

Vocabulary enhancement feature, Thesaurus powered by AI, Integrations (Word, GoogleDocs), Grammar check, Summarizing tool

Image Generation - Dall-E

DALL·E 3 is an AI system that can create realistic images and art from a description in natural language

An astronaut riding a horse in photorealistic style

A beach similar to "praia da baia" in Espinho with surfers, surfing in the sea and big waves

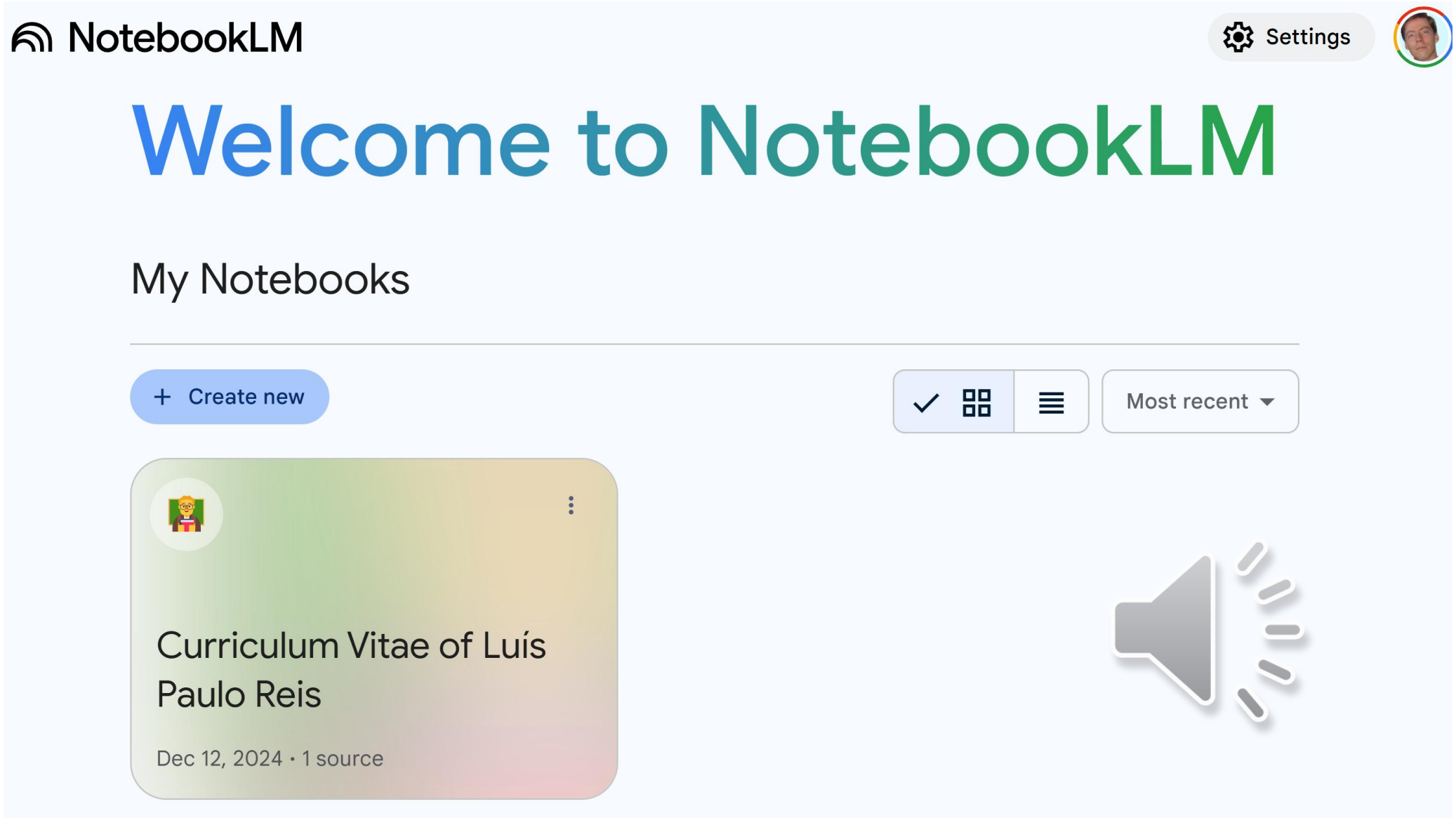
DALL·E 2

Midjourney

Stable Diffusion

Canva
AI-ASSISTED DESIGN GENERATOR

Generating a Podecast



Explore GPTs

GPTs

Discover and create custom versions of ChatGPT that combine instructions, extra knowledge, and any combination of skills.

Search public GPTs

1 **Canva**
Effortlessly design anything: presentations, logos, social media posts and more.
By canva.com

2 **Logo Creator**
Use me to generate professional logo designs and app icons!
By Chase Lean

3 **Consensus**
Your AI Research Assistant. Search 200M academic papers from Consensus, get science-based answers, and draft content...
By Consensus

4 **image generator**
A GPT specialized in generating and refining images with a mix of professi and friendly tone.image generator
By NAIF J ALOTAIBI

5 **Video GPT by VEED**
AI Video Maker. Generate videos for social media - YouTube, Instagram, TikTok and more! Free text to video & speech tool wit...
By veed.io

6 **Grimoire**
Code Wizard 🧙‍♂️ Learn to Prompt-grai Create a website (or anything) with a sentence. 20+ Hotkeys for coding flows....
By gptavern.mindgoblinstudios.com

Custom GPTs — special-purpose versions of the model created by others

uma receita de bacalhau com espinafres e batatascom um emprtamento bonito e foto

Talked to api.adzedek.com

Receita de Bacalhau com Espinafres e Batatas

Esta é uma receita clássica e nutritiva que combina o sabor rico do bacalhau com a suavidade das batatas e a frescura dos espinafres. O prato é montado de forma elegante, com camadas visuais para um empratamento atraente.

Ingr es:

- 400g de bacalhau dessalgado
- 300g de batatas
- 200g de espinafres frescos
- 2 dentes de alho picados
- 1 cebola em rodelas finas
- 100ml de azeite de oliva
- Sal e pimenta a gosto

Llama 4 – Meta Open Source Models

Meta Technology Get started Trust & Safety Community

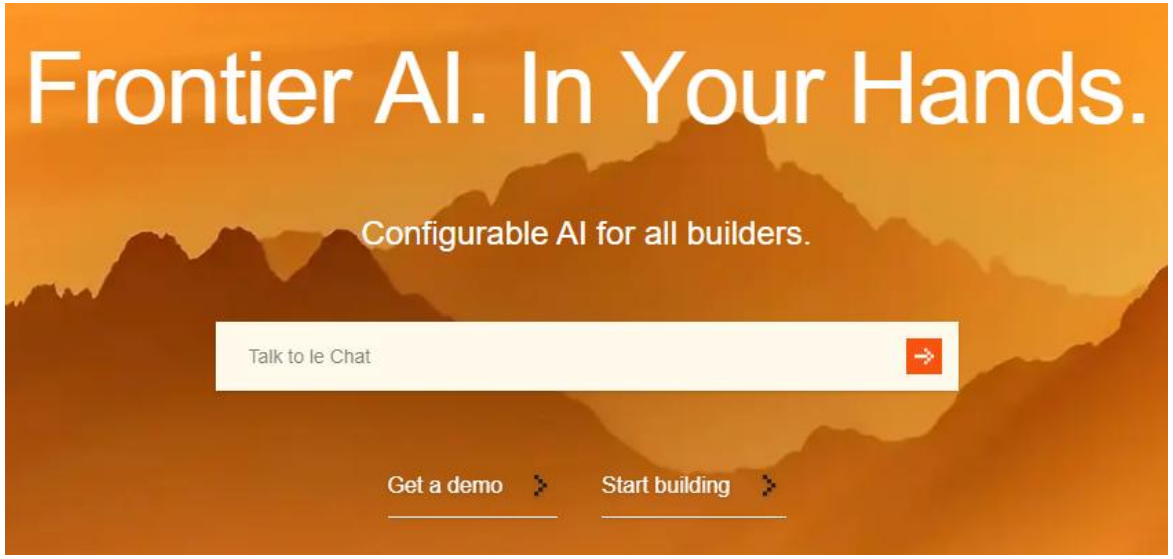
Try Meta AI ↗ Download models

Build the future of AI with Meta LLaMA 4

Now available with both 8B and 70B pretrained and instruction-tuned versions to support a wide range of applications

Get Started Experience Llama 3 on Meta AI

Mistral AI – Open Source Models



Openness

We lead the market of open source generative technologies to bring trust and transparency in the field and foster decentralised technology development

Portability

Our technology is available through serverless APIs, public cloud services (on Azure AI, on Amazon Bedrock), and for VPC/on-premise deployment. Our independence from cloud providers is a guarantee of our customers' independence.

Value and speed

Our flagship model, Mistral Large, has independently validated top-tier reasoning in multiple languages. All our models bring unmatched value and latency at their price points.

Customisation

Our models can be fine-tuned and modified at will for your business to create differentiated AI applications.

MISTRAL AI_

Build on Open Source

Under the Apache 2.0 license, our 3 open source models Mistral 7B, Mixtral 8x7B, Mixtral 8x22B are usable and customisable for a variety of use cases. They can be downloaded or used on demand via our platform.

- Download them for deployment in your own environment
- Use them on La Plateforme at market-leading availability, speed, and quality control

Gemma 3n – Gemini Google Open Source

Gemma

google/gemma

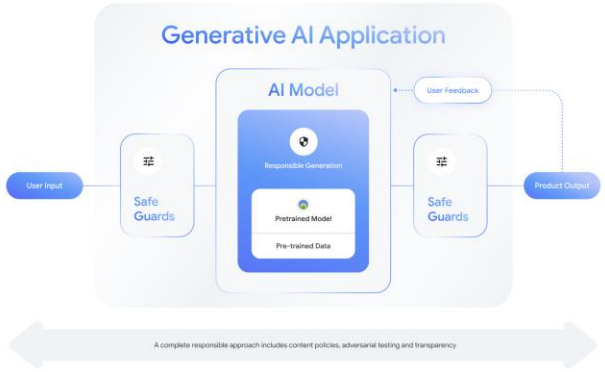
Gemma 2 is now available to researchers and developers

Gemma 2 offers best-in-class performance, runs at incredible speed across different hardware and easily integrates with other AI tools.

Jun 27, 2024 · 4 min read

Gemma is a family of lightweight, open models built from the research and technology that Google used to create the Gemini models.

Google DeepMind



Responsible Generative AI Toolkit

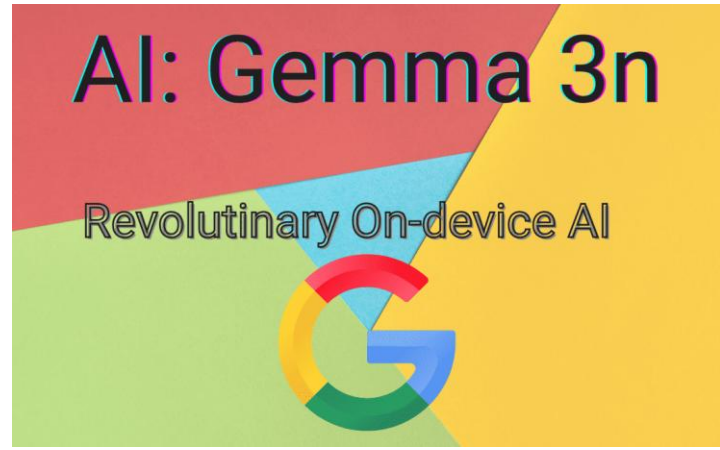
Send feedback

This toolkit provides resources to apply best practices for responsible use of open models such as the Gemma models, including:

- Guidance on setting safety policies, safety tuning, safety classifiers and model evaluation.
- The Learning Interpretability Tool (LIT) for investigating Gemma's behavior and addressing potential issues.
- A methodology for building robust safety classifiers with minimal examples.

This version of the toolkit focuses on English text-to-text models only. You can provide feedback to make this toolkit more helpful through the feedback mechanism link at the bottom of the page.

When building with Gemma, you should take a holistic approach to responsibility and consider all the possible challenges at the application and model levels. This toolkit covers risk and mitigation

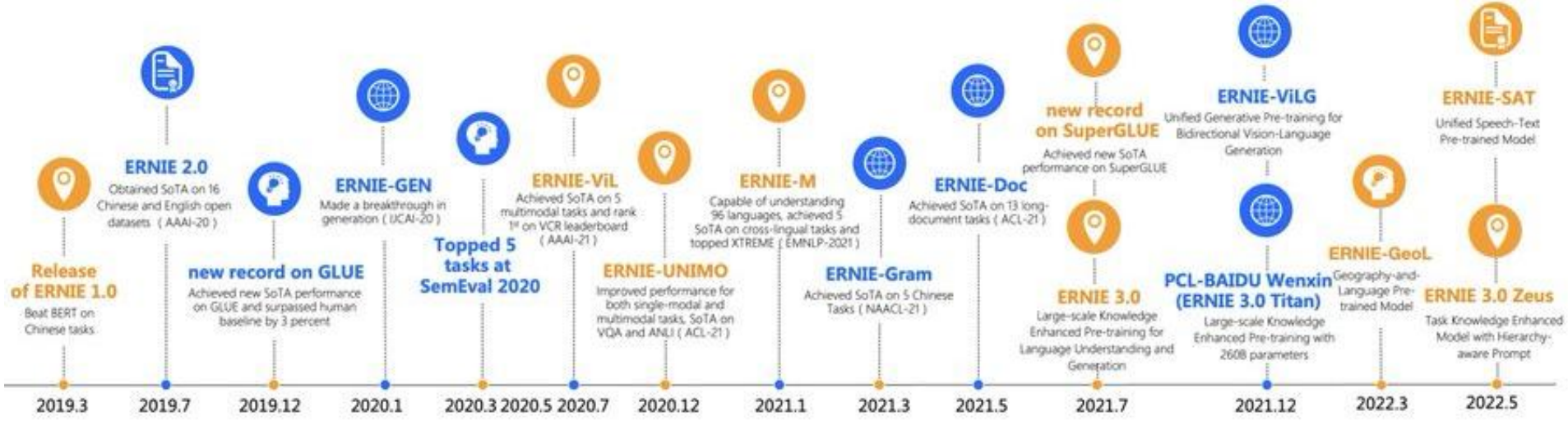


Gemma 3n

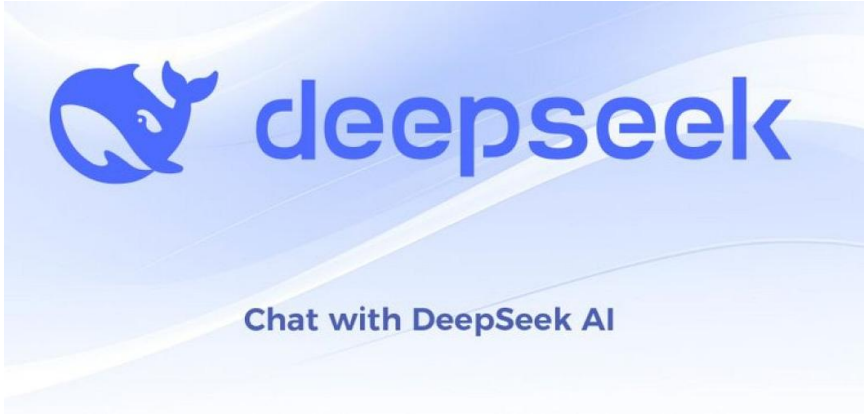
Our powerful and efficient open model designed to run locally on phones, tablets, and laptops.

Ernie Bot - Baidu

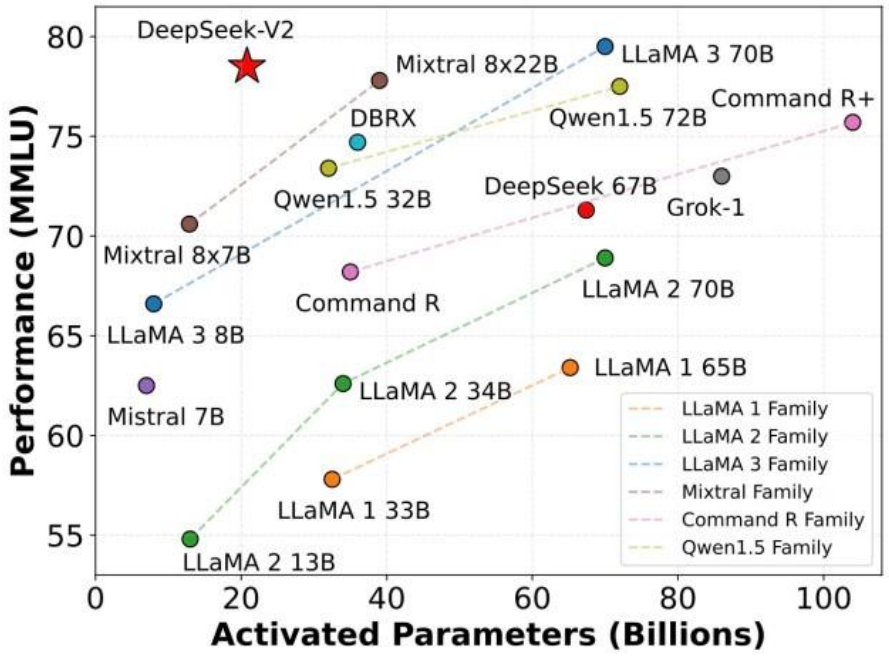
- **ERNIE - Enhanced Representation through Knowledge Integration**
- AI chatbot product of **Baidu**, started 2019
- Based on LLM "**Ernie 3.0-Titan**“
- Released on **March 17, 2023**

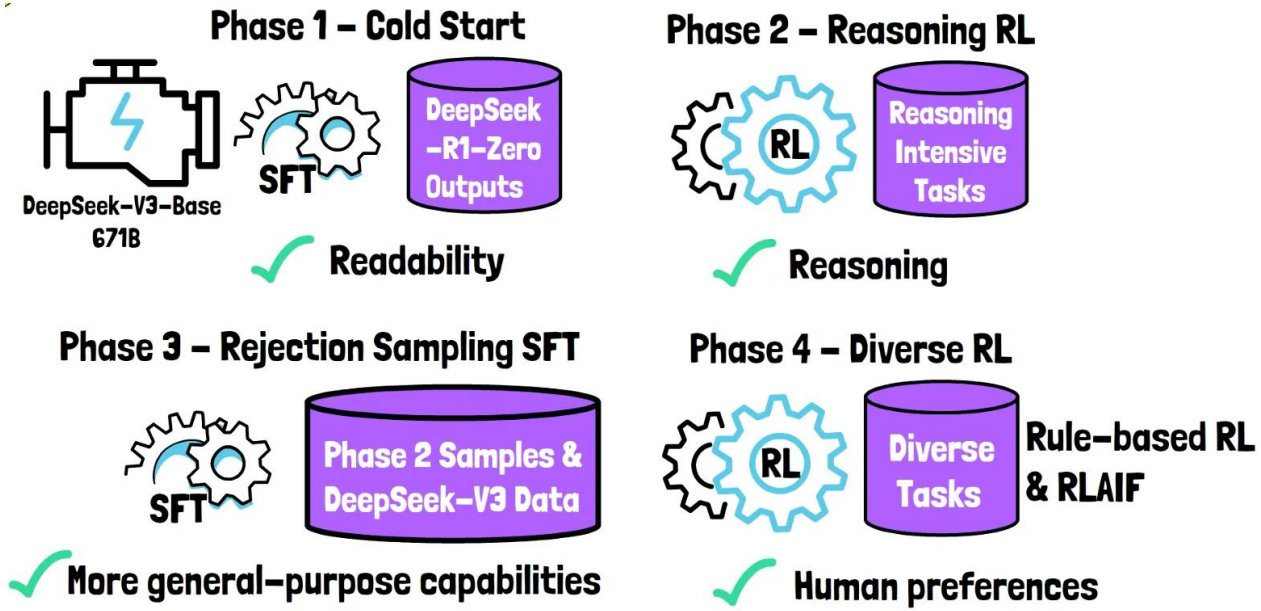


DeepSeek

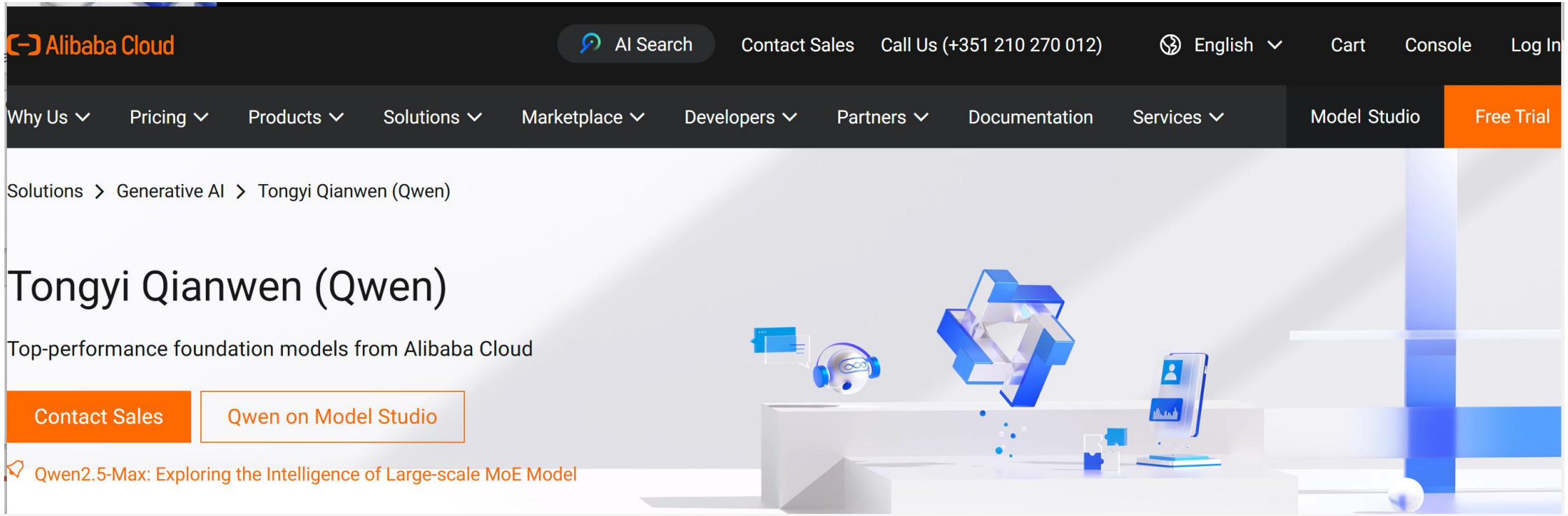


DeepSeek is a Chinese AI research lab focused on developing LLMs and AI systems. DeepSeek series includes DeepSeek-V2, a high-performance open-weight model trained on diverse multilingual datasets, aiming to compete with top-tier models like GPT and LLaMA. DeepSeek emphasizes efficiency, scalability, and domain-specific capabilities, particularly in Chinese language understanding and applications. The lab has also developed DeepSeekCoder, an advanced AI model optimized for code generation and programming assistance. With strong computational resources and a growing presence in the AI research landscape, DeepSeek is positioning itself as a significant player in the global LLM ecosystem.





Qwen - Alibaba



TONGYI Qwen

TONGYI Qwen-VL

TONGYI Qwen-Audio

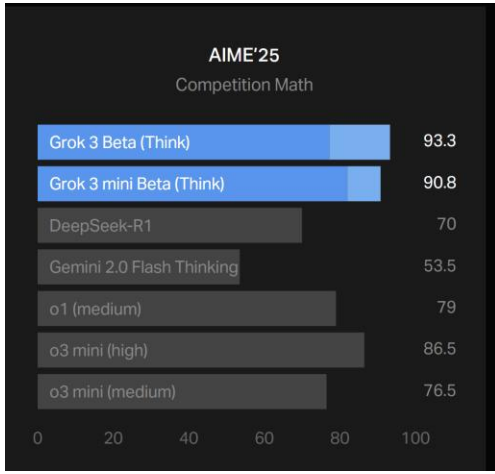
TONGYI Qwen2.5-Max

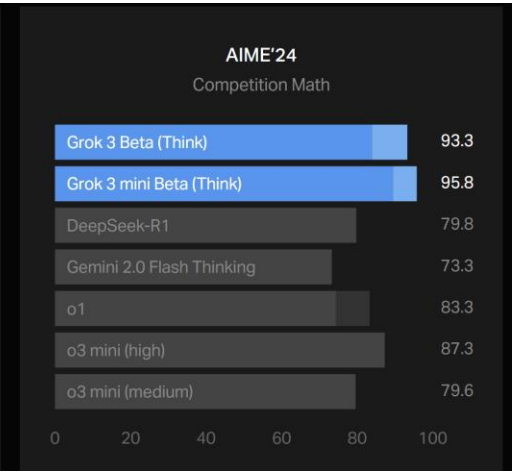
TONGYI Qwen 2.5-Coder

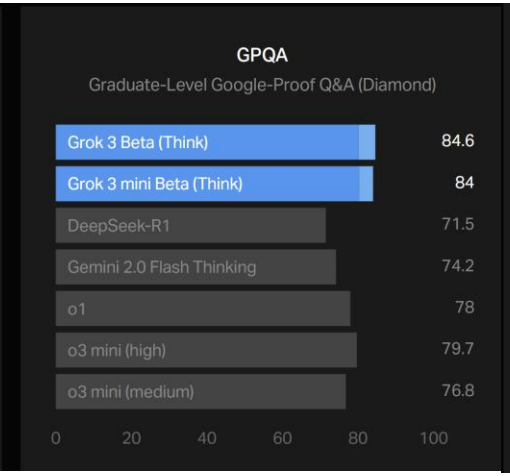
TONGYI Qwen 2.5-Math

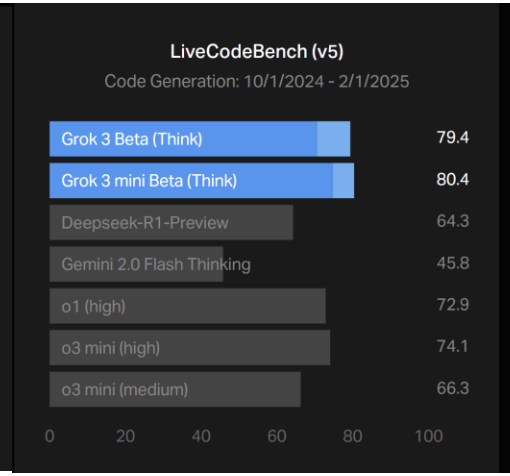
TONGYI Qwen-Agent

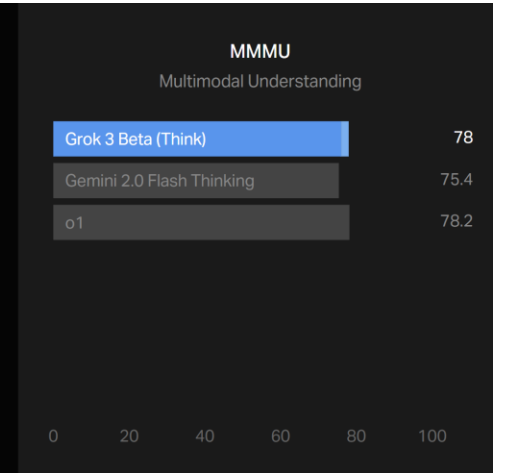
Grok 3 – Chocolate xAI





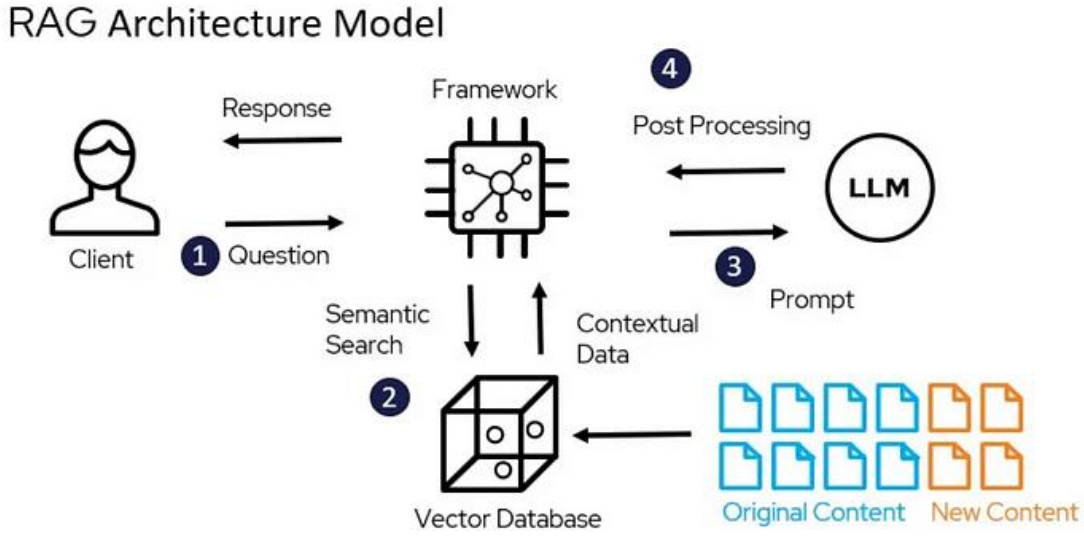






RAG Architecture Model

- **Retrieval Augmented Generation (RAG) has emerged as a powerful technique for improving LLMs**
- **Retrieving and conditioning external knowledge, RAG allows models to generate more accurate, relevant, and comprehensive text**



https://medium.com/@gulernilay088/

- **Advanced RAG enhances each module further with innovations like higher-order retrievers, cross-encoder rerankers, and evidence manipulation architectures**

AI Applications in Health

- Radiology (X-ray, CT, MRI)
- *Dermatology (Image)*
- Drug/Treatment Discovery
- Risk Identification in Patients
- Primary Care and Screening
- Health Monitoring/Wearables
- Cognitive and Social Rehabilitation
- Physical Rehabilitation
- Patient Interaction with the Health System
- Health Systems Exchange of Information
- Surgical/Medical Robots
- Efficient Resource Allocation in Health
- …

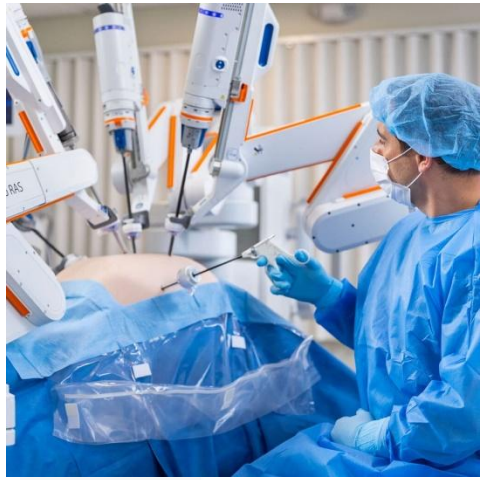
AI&Robotics Applications in Surgery

da Vinci Surgical System

Mako SmartRobotics

Rosa Brain Robot

Hugo Surgical Robot



Senhance Surgical System

Versisus Surgical System

Navio S.S.

AI&Robotics Applications in Surgery

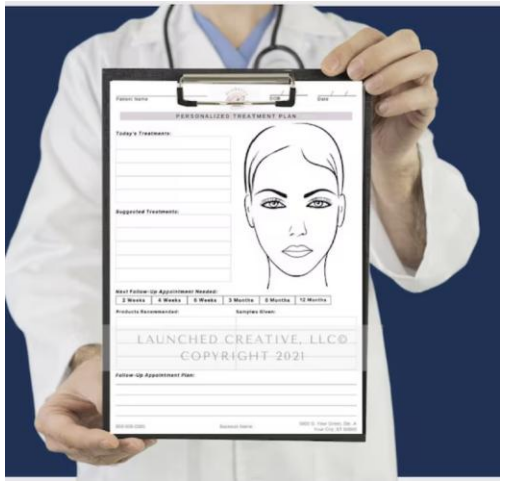
Advantages of Robotic Surgery:

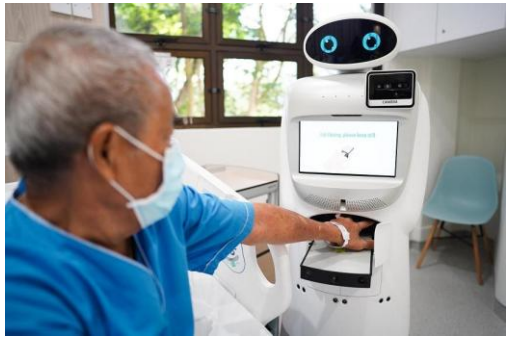
- **Increased Precision:** High-definition, 3D views, filter out hand tremors, allowing for precise movements
- **Enhanced Dexterity and Control:** Robotic arms can rotate and bend beyond capability of the human hand
- **Minimally Invasive:** Small Incisions
- **Shorter Hospital Stay:** Faster Recovery (less invasive), Reduced Risk of Infection, Reduced Blood Loss
- **Greater Surgical Reach**
- **Enhanced Visualization**
- **Improved Ergonomics for Surgeon**
- **Robot Deep Reinforcement Learning**

AI&Robotics in Nursing

AI in Nursing:

- **Personalized Treatment Plans** based on individual patient data, optimizing care
- **Workflow Optimization** with automatization of administrative tasks, efficient scheduling, allowing nurse staff to focus more on patient care
- **Patient Monitoring** with AI-powered devices continuously monitor vital signs and alert nurses to any deviations
- **Robotics and Automated assistants** helping with physical tasks, reducing strain and increasing efficiency in patient handling and monitoring





AI&Robotics in Physiotherapy

Robotic Devices for Rehabilitation

- Robotic exoskeletons and limbs
- Assist patients in performing exercises correctly
- Intensity and duration of therapy sessions
- Automated gait training

Gamming and Virtual/Augmented Reality

- Immersive rehabilitation environments
- Engaging patients through gamified therapy sessions
- Enhance motivation and adherence to treatment plans
- Simulate walking scenarios or activities of daily living
- Improve balance, coordination, and motor skills.

AI&Robotics in Physiotherapy

AI-driven Assessment Tools

- AI in assessing patient progress
- Data from sensors and wearable devices
- Track motion and muscle activity, AI systems to tailor personalized rehab programs
- AI analyze data to provide real-time feedback and adjust therapy programs

AI Integration with Biomechanical Models

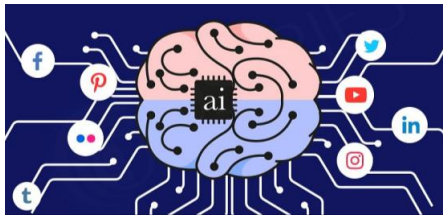
- Predict outcomes of therapy interventions, allowing for highly customized therapy plans.
- Predict optimal set of exercises and impact on patient's recovery, based on injury and body mechanics

Physiotherapy Education with AI

- AI Tools for Education and Research
- AI-Enhanced Learning Platforms
- Simulation and Virtual Patients
- Data-Driven Education
- Continuous Professional Development

Artificial Intelligence in Digital Media

- Digital Images
- Digital Video
- Digital Audio
- Movie Industry
- Video Games
- Web Pages and Websites
- Social Media
- Digital Data and Databases
- Electronic Documents/Books

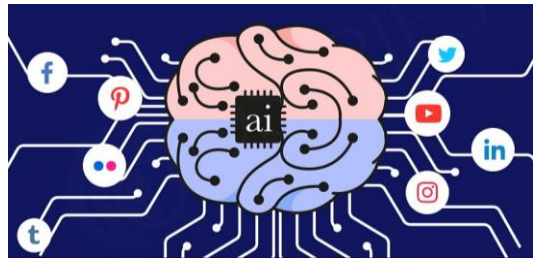


Artificial Intelligence in Video Games

- Generate responsive, adaptive or intelligent behaviours
- Non-player characters (NPCs) with human-like intelligence
- Improve the game-player experience
- Game Balancing/ Dynamic Difficulty Adjustment
- Movement patterns, in-game events based on player's input
- Pathfinding and decision trees for NPCs actions
- Procedural-content generation
- Text to speech and speech recognition
- AI for automatic level generation
- AI opponents for board/strategic games

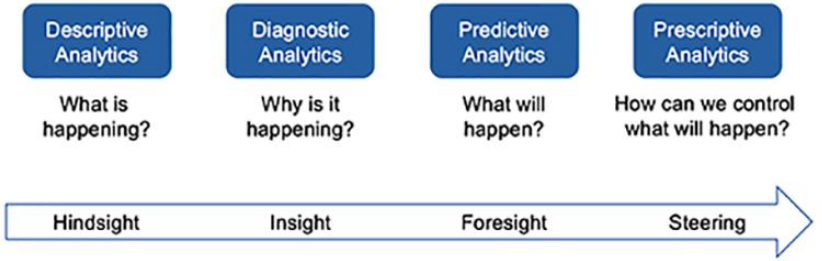
Artificial Intelligence in Social Media

- Social Creation and Management
- Social Insights
- Social Media Advertising
- Image/Face Recognition
- Fake News/Improper Content Recognition
- Personalised User Experience
- Advise Contacts/ Job candidates / Matches
- AI Powered Chatbots
- Social Listening
- Sentiment Analysis
- Improved Influencer strategies
- Increased Security



AI for the Environment

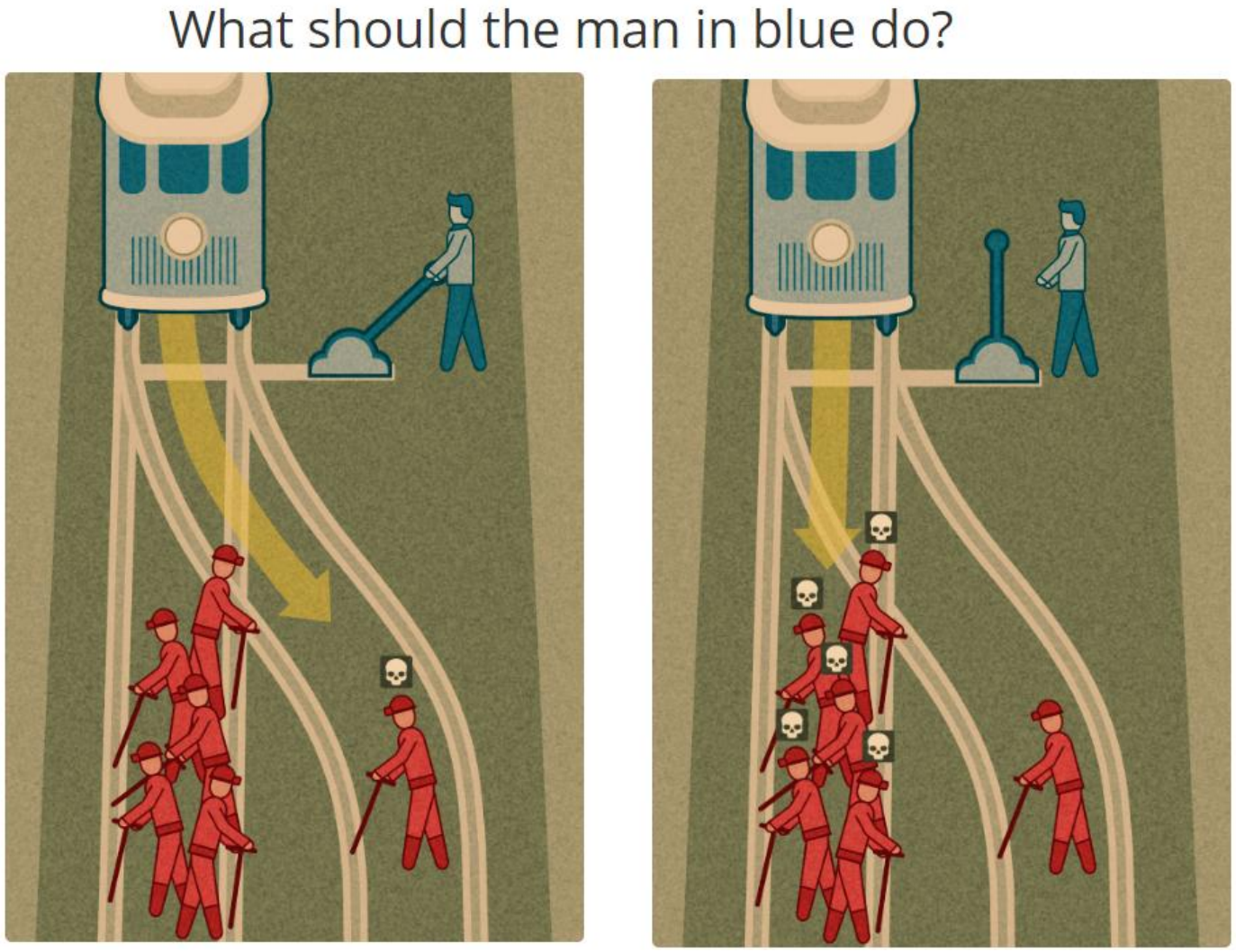
- **AI for Land/Agriculture**
  - Soil pollution, population growth, intensive agriculture
  - Land cover mapping, automating and optimizing farming processes
- **AI for Air/Pollution**
  - Pollution/air quality sources identification, reduce emissions
  - Intelligent and green transportation, autonomous cars, ride shares, dynamic bus routing, intelligent traffic lights
- **AI for Water**
  - Garbage collection, Intelligent ocean farming (fish and shellfish)
  - Predict storms, tsunamis, hurricanes, cost-effective water management
- **AI for Biodiversity**
  - Surveillance, tracking, analysis, prediction
- **AI for Climate Change**
  - Better climate predictions, effects of extreme weather, predict where carbon is coming from



Artificial Intelligence in Security

- **AI in Physical Security**
  - Facial and behavioral recognition for smart access control and surveillance
  - Predictive analytics to anticipate security incidents based on historical patterns
  - Patrol robots and drones for large-scale and hard-to-access surveillance areas
- **AI in Electronic Security**
  - Intelligent CCTV monitoring with automatic detection of suspicious movements or critical events
  - Automated alarm systems to reduce false alarms and intervention time
  - Real-time risk analysis through data integration from multiple sensors
- **AI in Cash Handling and Transport**
  - Optimized routing for cash-in-transit vehicles (reducing risk and increasing efficiency)
  - Anomaly detection in transactions to prevent fraud in ATMs and financial operations
  - Smart cash management with AI-driven forecasting of ATM and retail cash needs

Moral Machine

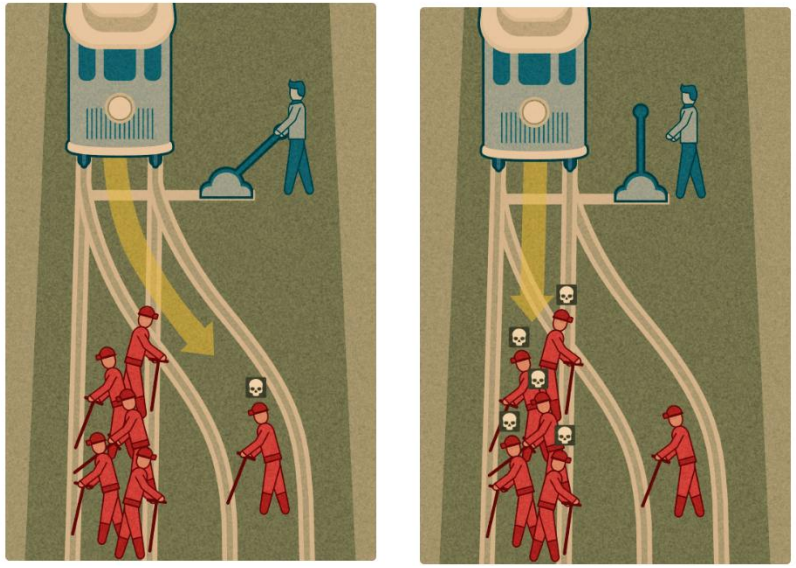


- 39 millions of decisions
- 10 languages
- 233 countries
- 13 core scenarios
- Who will you spare?

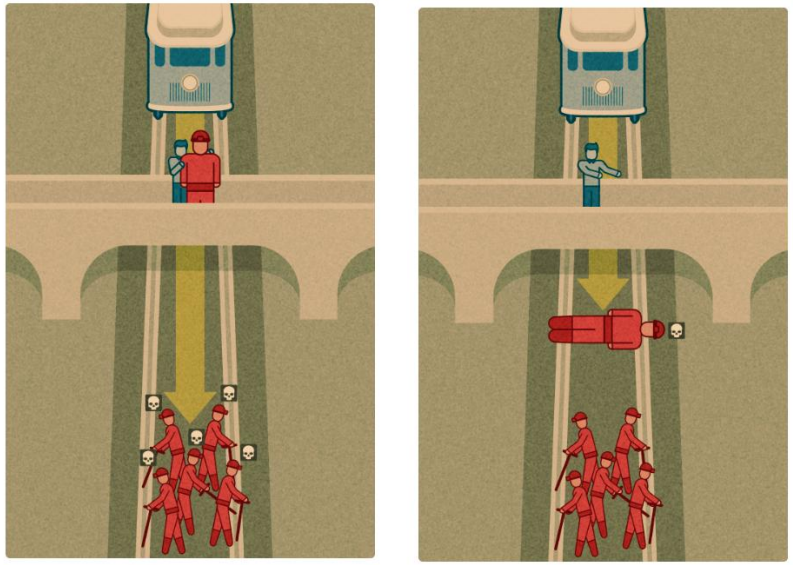
mit media lab

Moral Machine

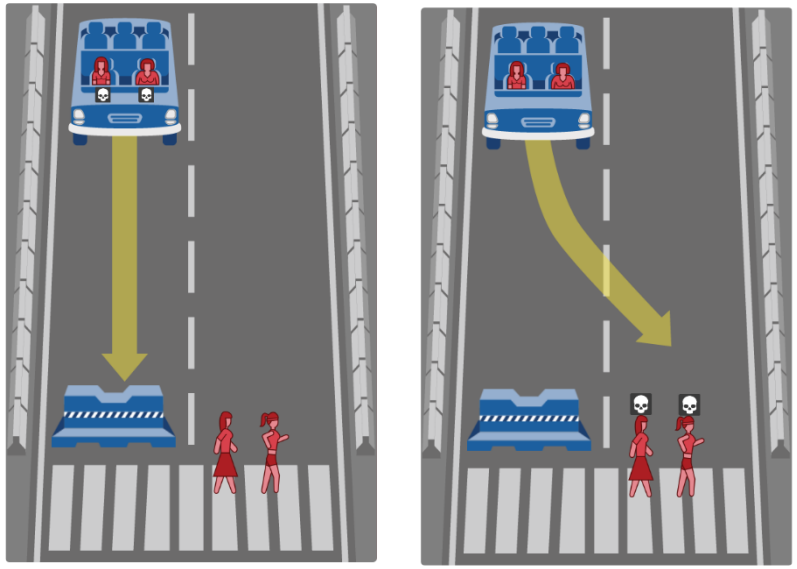
What should the man in blue do?



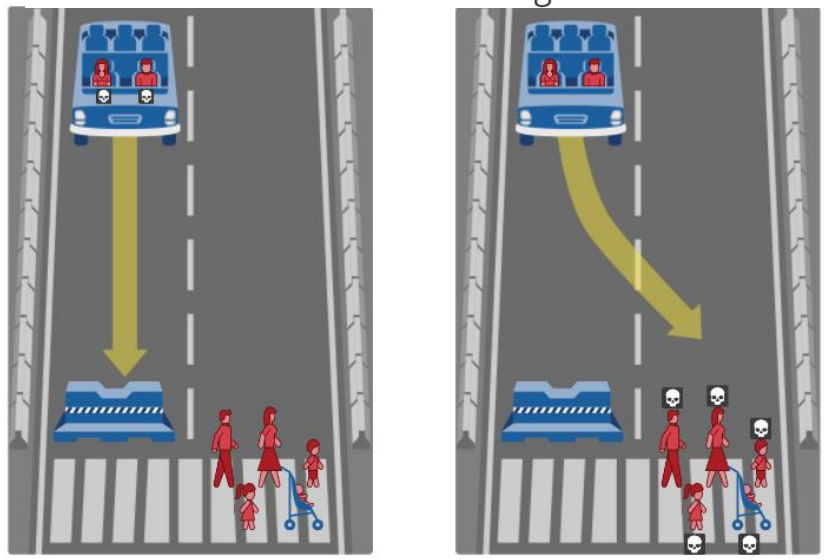
What should the man in blue do?



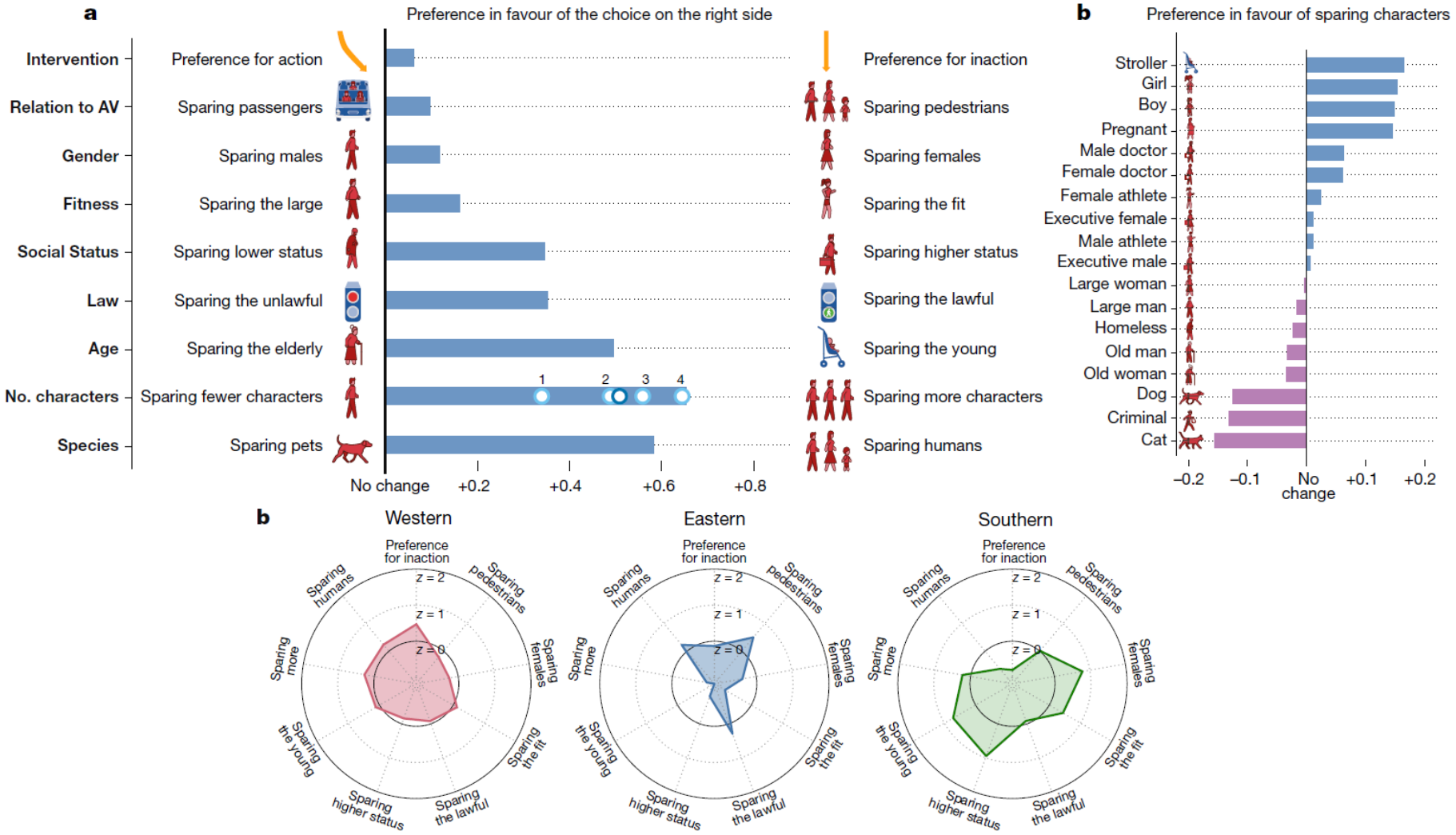
What should the self-driving car do?



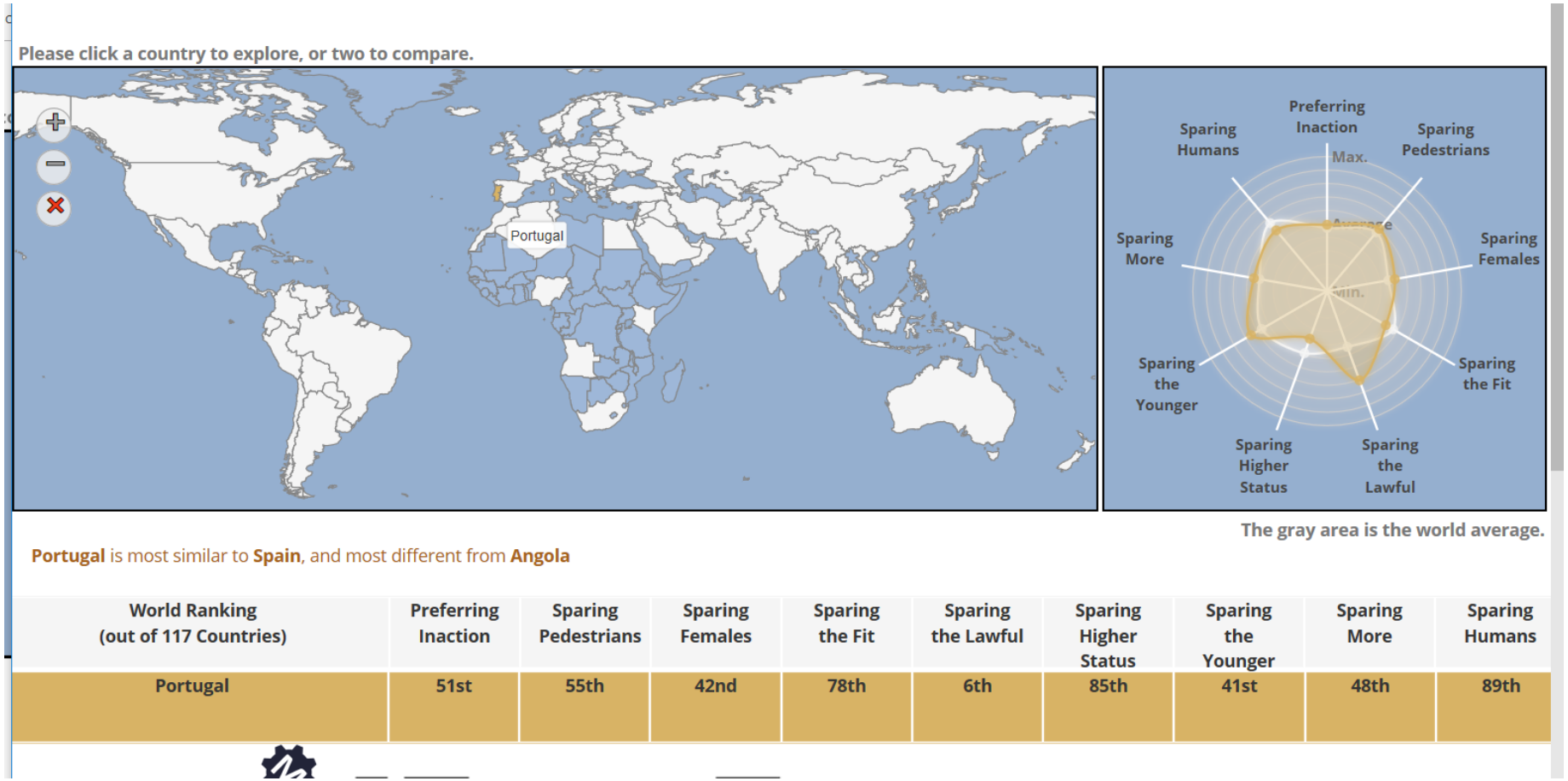
What should the self-driving car do?



Moral Machine – Results



Moral Machine – Configurable AI!

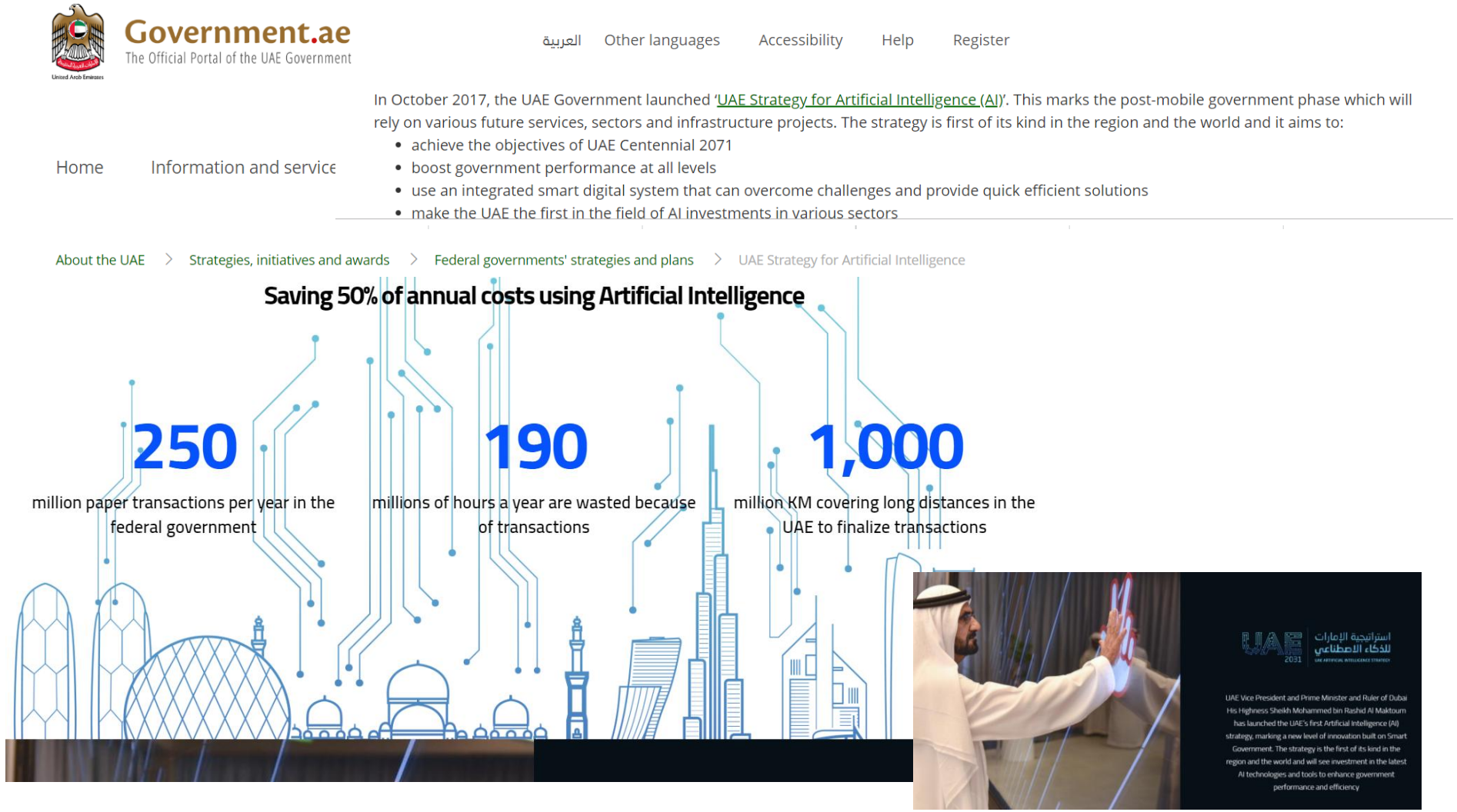


World Ranking (out of 117 Countries)	Preferring Inaction	Sparing Pedestrians	Sparing Females	Sparing the Fit	Sparing the Lawful	Sparing Higher Status	Sparing the Younger	Sparing More	Sparing Humans
Portugal	51st	55th	42nd	78th	6th	85th	41st	48th	89th

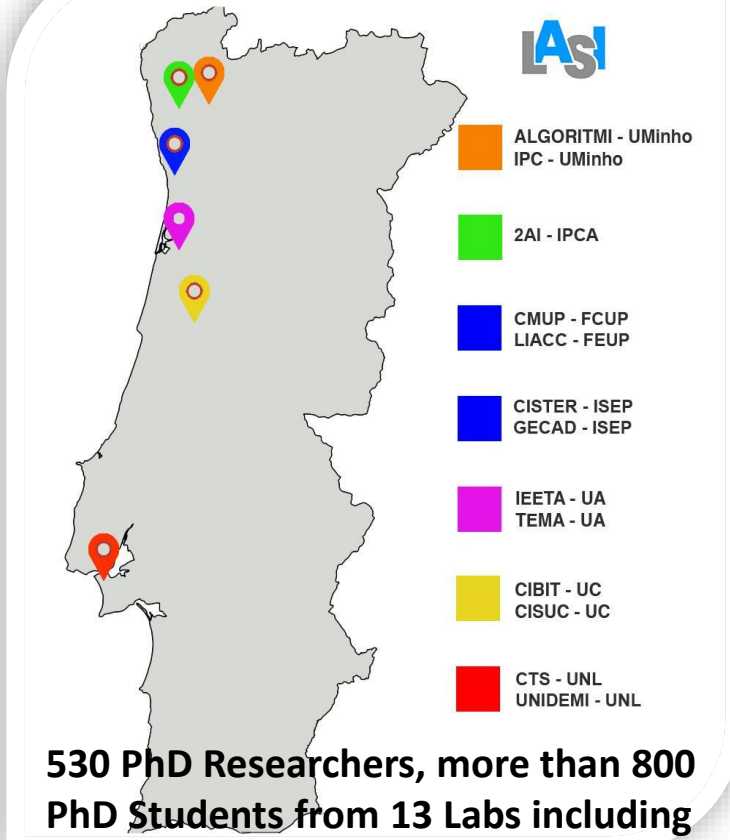
Configurable AI: European Union, Region, Country, Citizen!

AI in Government

- **UAE Ministery of Artificial Intelligence - http://www.uaeai.ae/en/**



Research in Artificial Intelligence in Portugal

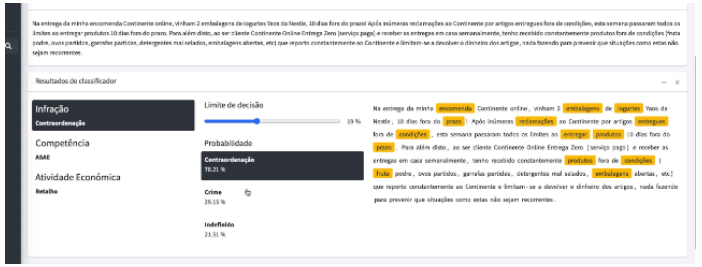


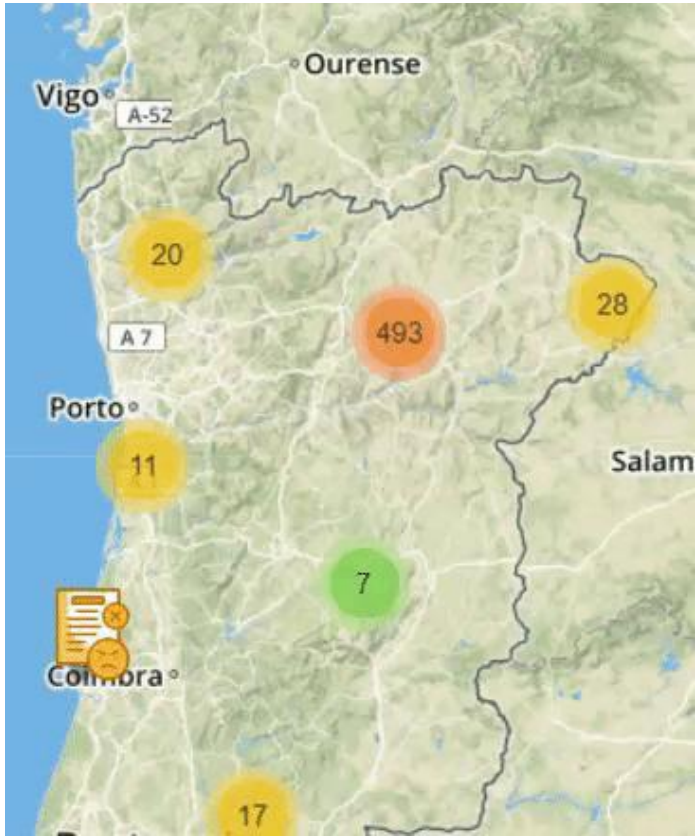
530 PhD Researchers, more than 800 PhD Students from 13 Labs including LIACC

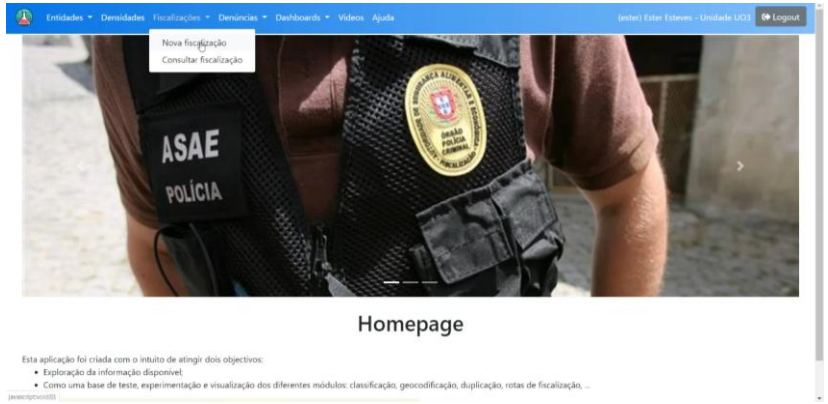
Porto, Braga and Vila Real
350 PhD Researchers, more than 400 PhD Students from 13 Lab, Including LIAAD

IA.SAE - Artificial Intelligence in Food and Economic Safety

- **Risk Analysis and Selection Models of Economic Agents to be Supervised, based on AI and ML applied to ASAE's databases**
- **Georeferencing of economic agents in Portugal**
- **Electronic complaint analysis, automatic classification and prioritization**
- **Intelligent selection of economic agents to be inspected and flexible routes generation**
- **Intelligent data and KPIs visualization**

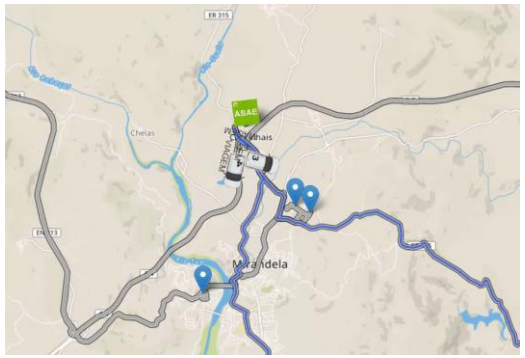


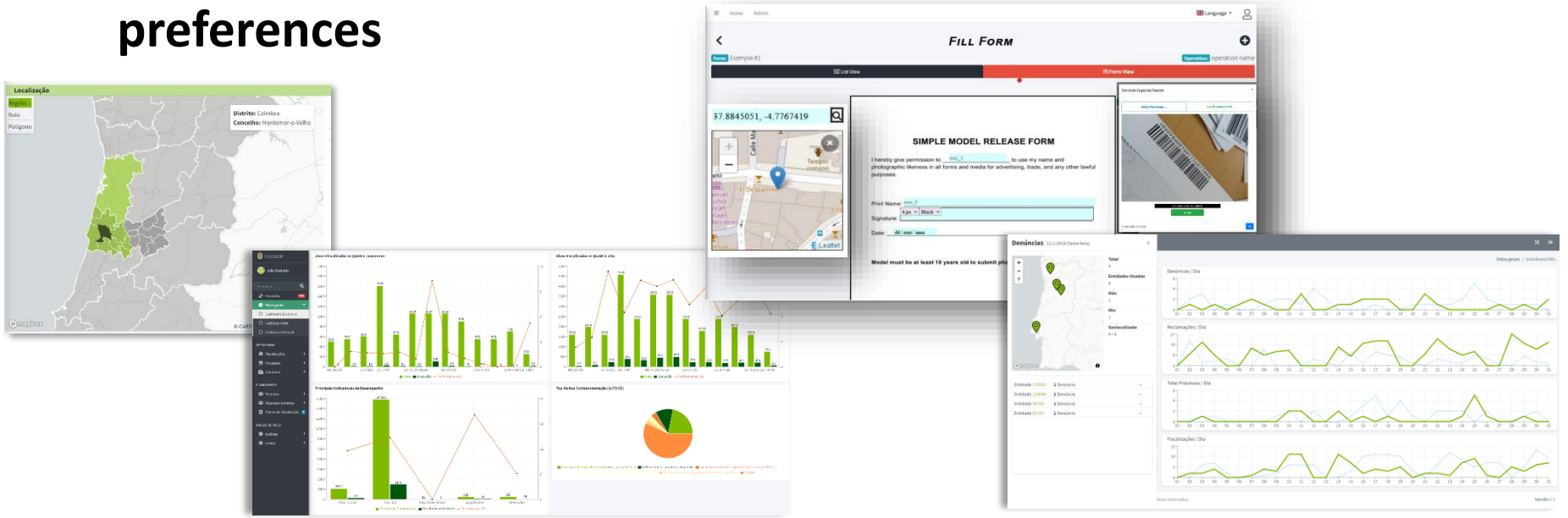


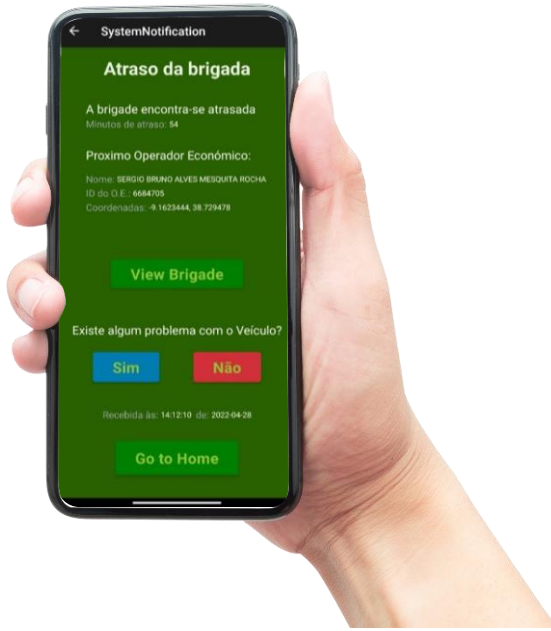


CIGESCOP – ASAE Intelligent Control Center

- Real-time Virtual Inspection Office, to optimize management and operational control
- Assisted disruption management
- Flexible global risk matrices
- Smart forms with filling assistant
- Customizable dashboards that adapt to users' preferences

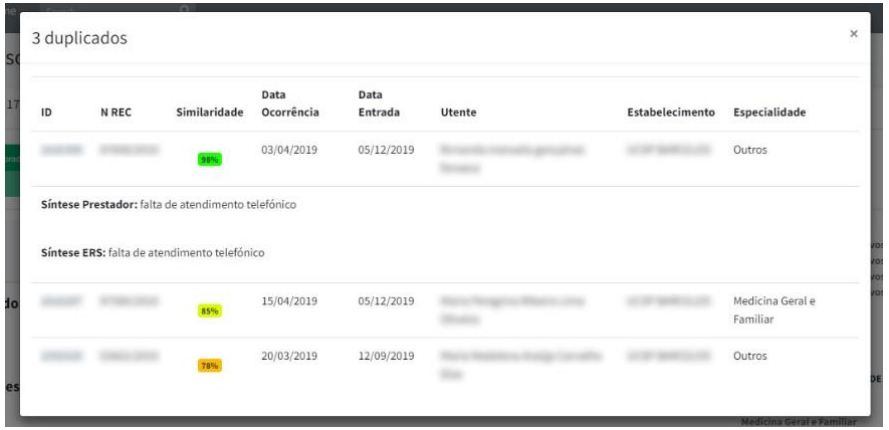


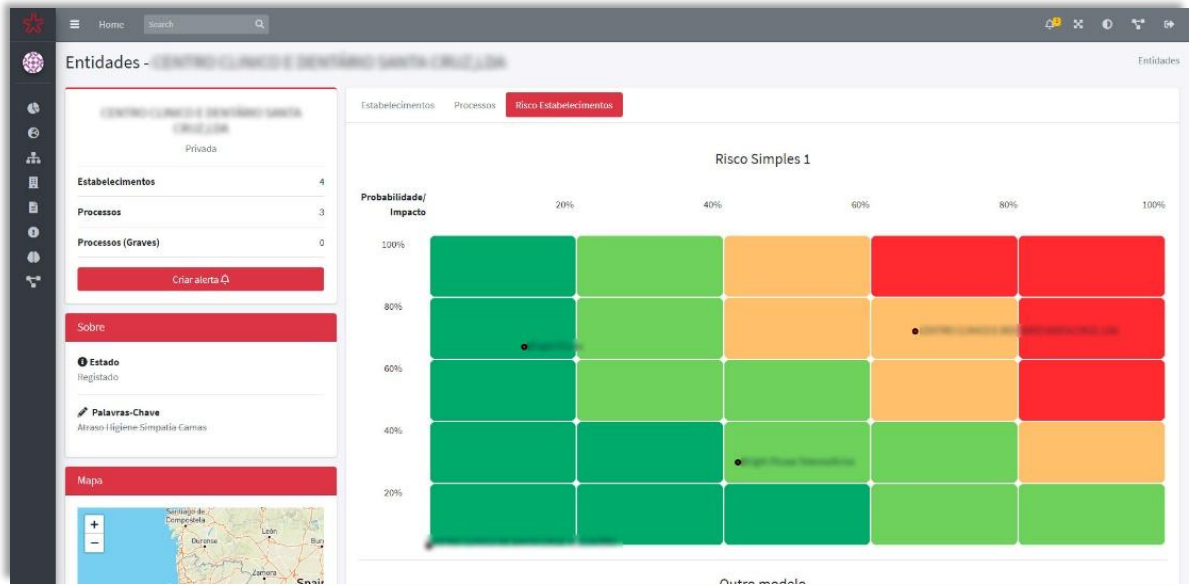




ERS AI – Health Regulatory Agency

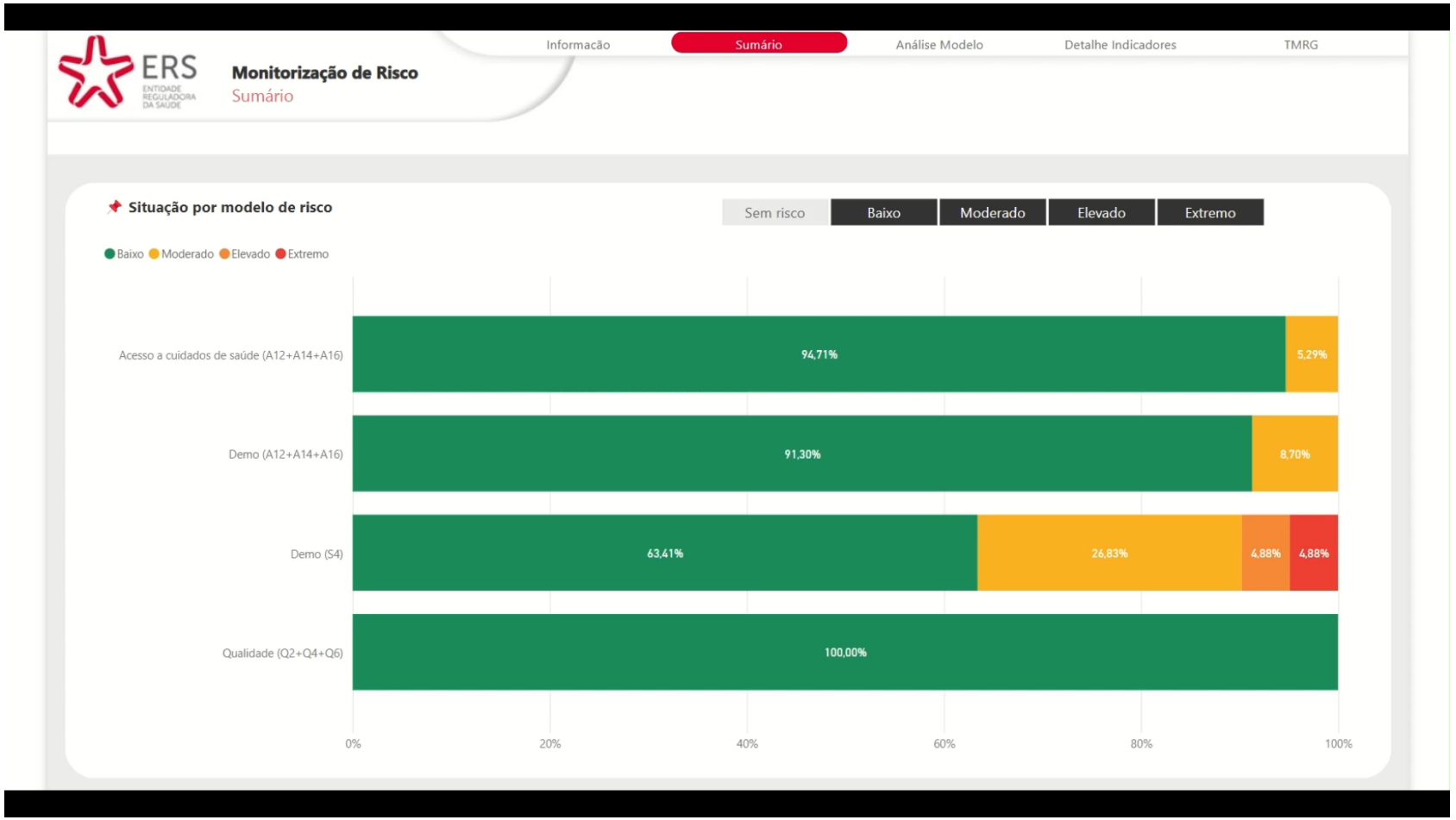
- **Electronic complaints automated analysis and classification, as well as severity assessment**
- **Duplicate and related complaints detection**
- **Intelligent suggestions of the complaint's outcome**



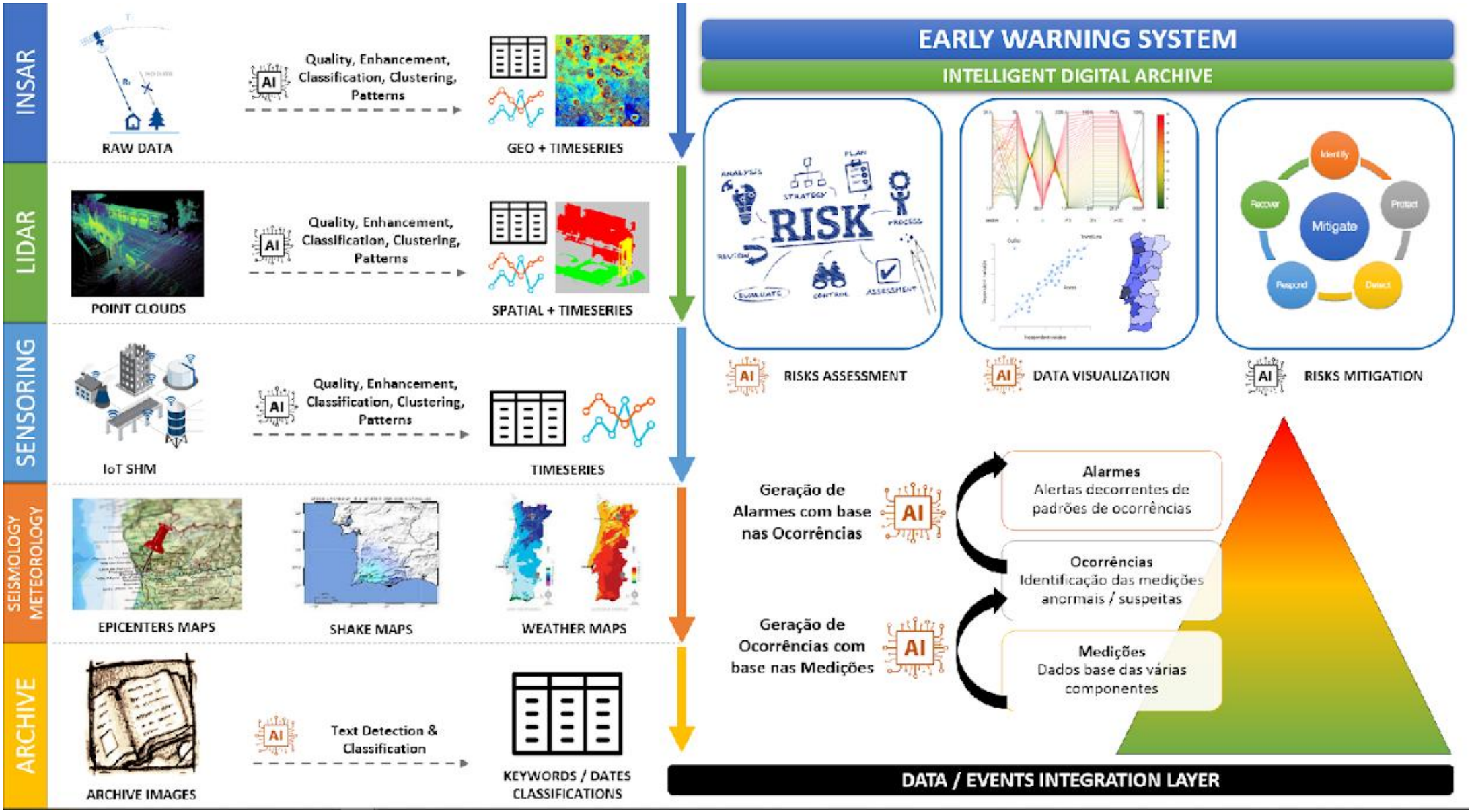


ERS AI 2 – Risk Based Supervision

- **Solution that automates the risk-based supervision model of health establishments**
- **Supervision based on risk analysis using a ML model**



SIAP – AI System for Detection and Alert of Heritage Risks



JurisVis – Promeneum/FEUP/LIACC AI Law Tool

Sobre o JurisVis

Transformando a investigação jurídica com tecnologia de IA de ponta

O JurisVis foi desenvolvido por uma equipa de profissionais da área jurídica e especialistas em IA para enfrentar os desafios da investigação jurídica moderna. A nossa plataforma combina modelos de linguagem de última geração com conhecimento jurídico especializado para fornecer um assistente inteligente que compreende conceitos e terminologia jurídica.

Quer seja advogado, investigador jurídico, estudante de direito ou paralegal, o JurisVis ajuda-o a trabalhar de forma mais eficiente, automatizando a análise de documentos e fornecendo informações inteligentes sobre os seus materiais jurídicos.

Link Demo Jurisvis C.M.Porto:
https://jurisvis.com/demo_cmp/

Pronto para Transformar a Sua Investigação Jurídica?

Junte-se a milhares de profissionais da área jurídica que já estão a poupar tempo e a obter conhecimentos mais profundos com o JurisVis.

Comece Agora | Agendar uma Demonstração

U.PORTO FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO

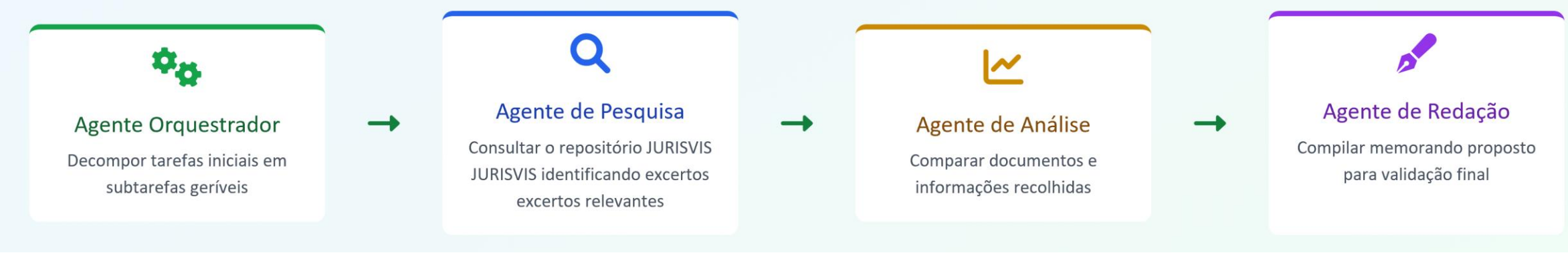
PROMENEUM GROUP

LIACC

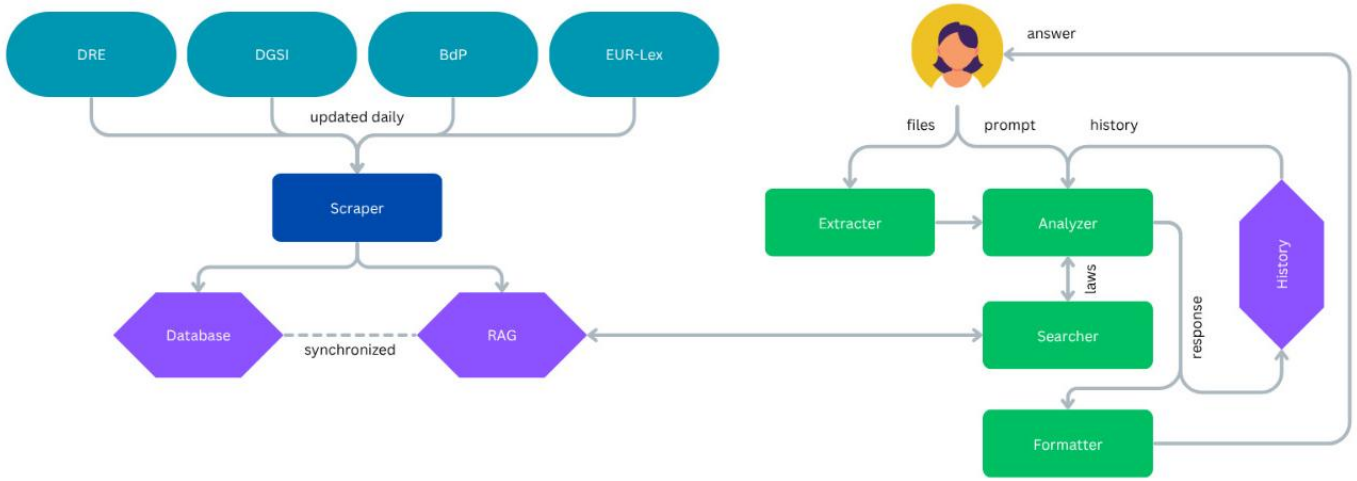
AI aims to assist, not replace, legal reasoning. The final responsibility lies with the human professional

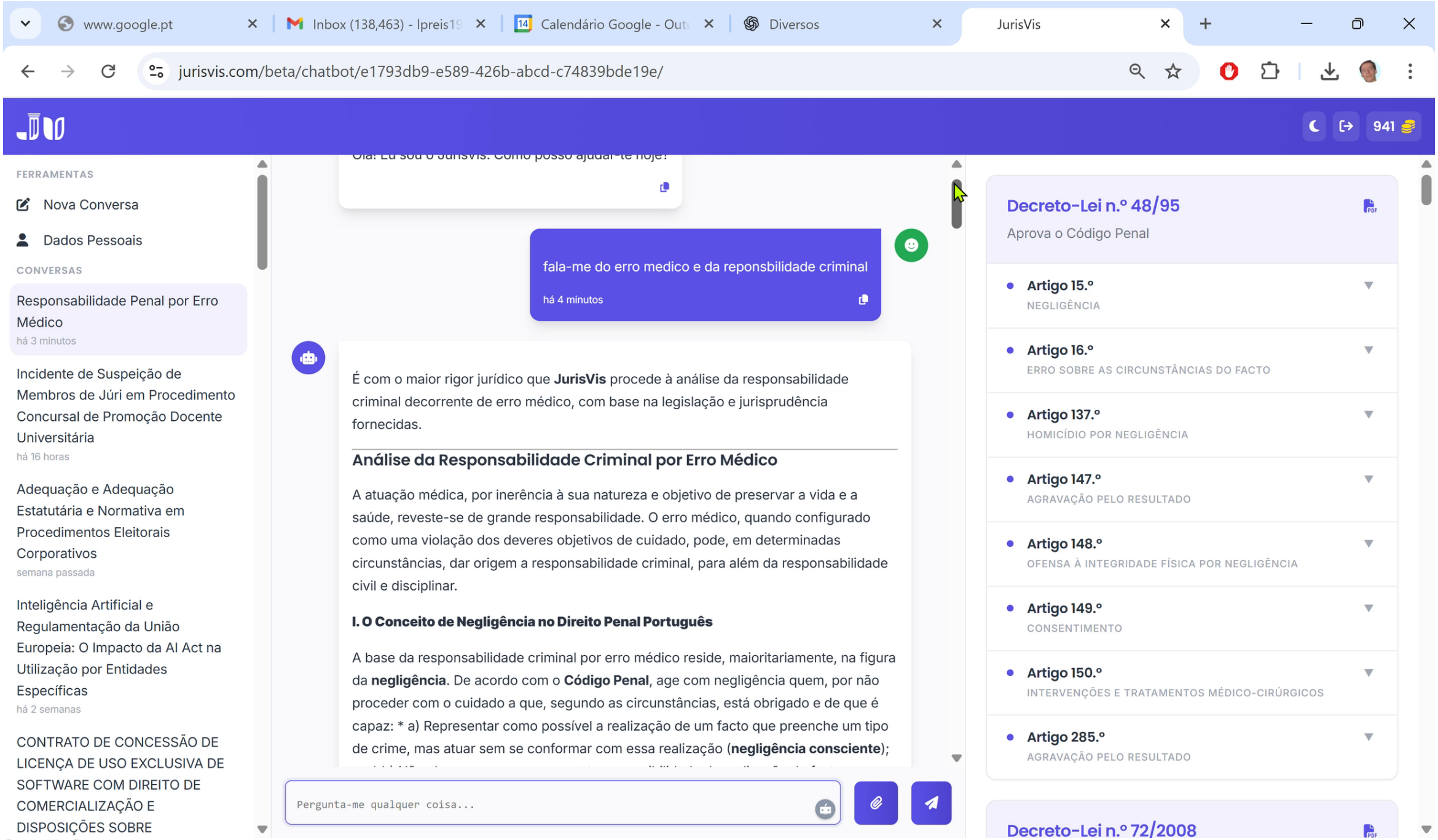
Multi-Agent System and Human Supervision

JURISVIS goes beyond simple search, acting as a sophisticated reasoning assistant that supports, rather than replaces, human decision-making



Human Oversight: In line with CCBE guidelines the institution/professional remains fully responsible for AI-generated results, with JURISVIS ensuring confidence and transparency in the process

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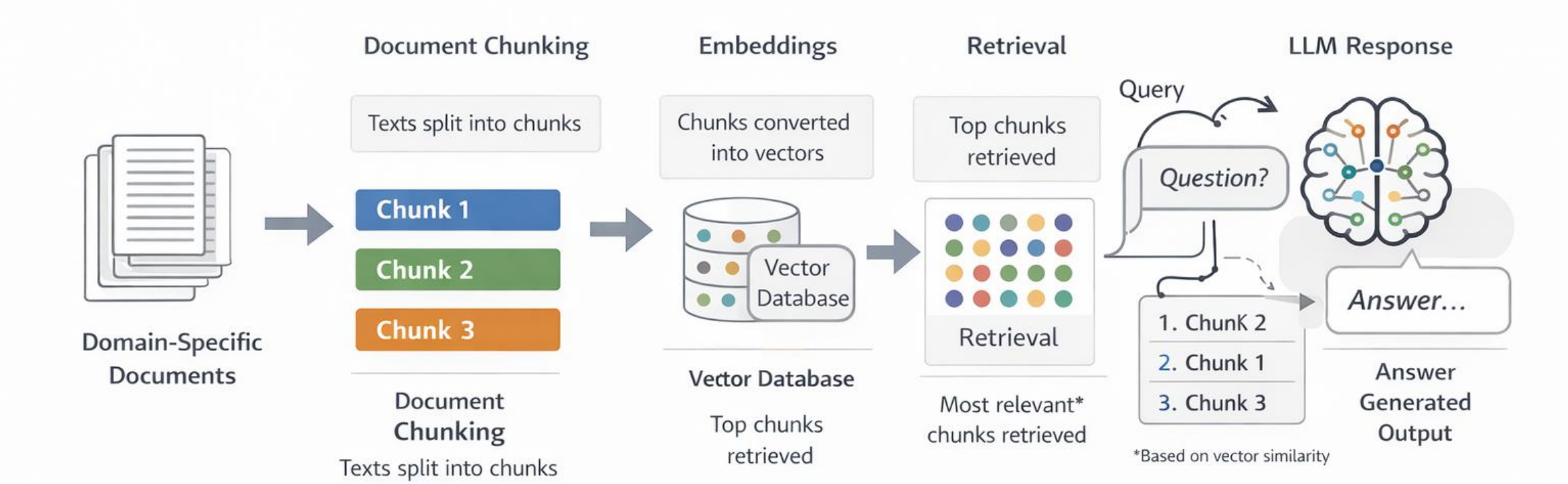
941
FERRAMENTAS
Nova Conversa
Dados Pessoais
CONVERSAS
Responsabilidade Penal por Erro Médico
há 3 minutos
Incidente de Suspeição de Membros de Júri em Procedimento Concursal de Promoção Docente Universitária
há 16 horas
Adequação e Adequação Estatutária e Normativa em Procedimentos Eleitorais Corporativos
semana passada
Inteligência Artificial e Regulamentação da União Europeia: O Impacto da AI Act na Utilização por Entidades Específicas
há 2 semanas
CONTRATO DE CONCESSÃO DE LICENÇA DE USO EXCLUSIVA DE SOFTWARE COM DIREITO DE COMERCIALIZAÇÃO E DISPOSIÇÕES SOBRE
Olá! Eu sou o JurisVis. Como posso ajudar-te hoje?
fala-me do erro medico e da reponsbilidade criminal
há 4 minutos
É com o maior rigor jurídico que JurisVis procede à análise da responsabilidade criminal decorrente de erro médico, com base na legislação e jurisprudência fornecidas.
Análise da Responsabilidade Criminal por Erro Médico
A atuação médica, por inerência à sua natureza e objetivo de preservar a vida e a saúde, reveste-se de grande responsabilidade. O erro médico, quando configurado como uma violação dos deveres objetivos de cuidado, pode, em determinadas circunstâncias, dar origem a responsabilidade criminal, para além da responsabilidade civil e disciplinar.
I. O Conceito de Negligência no Direito Penal Português
A base da responsabilidade criminal por erro médico reside, maioritariamente, na figura da negligência. De acordo com o Código Penal, age com negligência quem, por não proceder com o cuidado a que, segundo as circunstâncias, está obrigado e de que é capaz: * a) Representar como possível a realização de um facto que preenche um tipo de crime, mas atuar sem se conformar com essa realização (negligência consciente);
Pergunta-me qualquer coisa...
Decreto-Lei n.º 48/95
Aprova o Código Penal
Artigo 15.º
NEGLIGÊNCIA
Artigo 16.º
ERRO SOBRE AS CIRCUNSTÂNCIAS DO FACTO
Artigo 137.º
HOMICÍDIO POR NEGLIGÊNCIA
Artigo 147.º
AGRAVAÇÃO PELO RESULTADO
Artigo 148.º
OFENSA À INTEGRIDADE FÍSICA POR NEGLIGÊNCIA
Artigo 149.º
CONSENTIMENTO
Artigo 150.º
INTERVENÇÕES E TRATAMENTOS MÉDICO-CIRÚRGICOS
Artigo 285.º
AGRAVAÇÃO PELO RESULTADO
Decreto-Lei n.º 72/2008

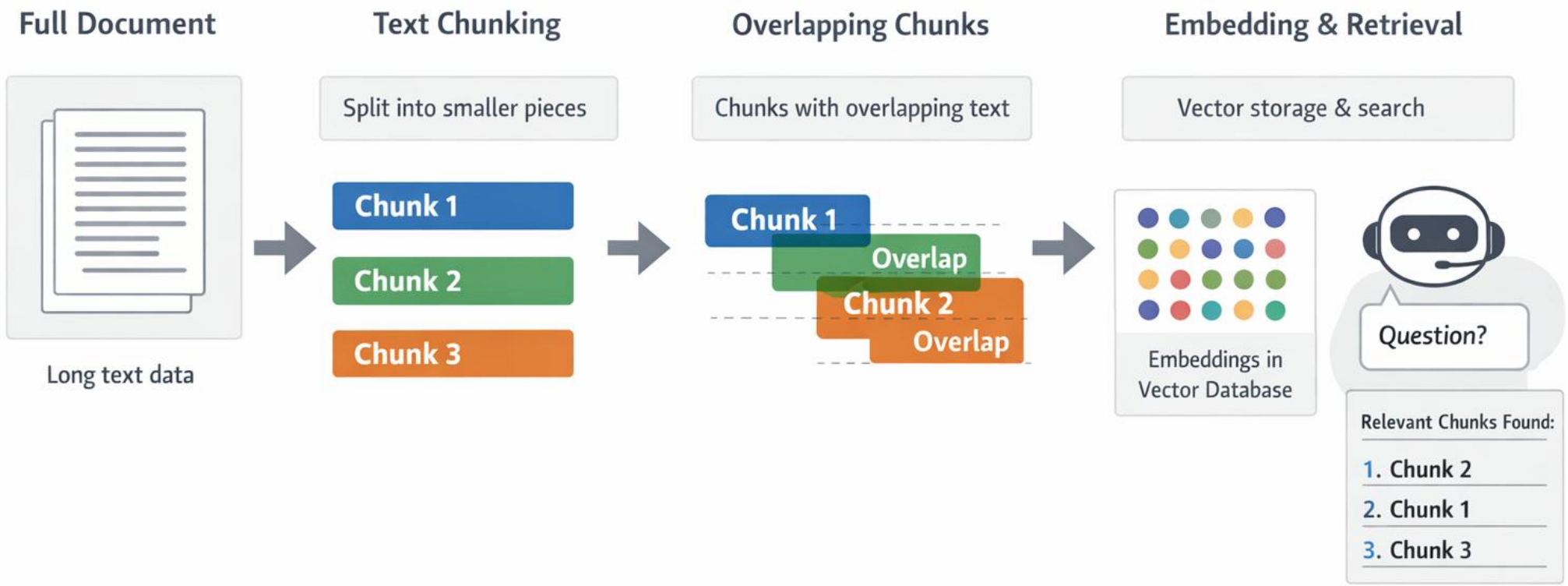
Retrieval Augmented Generation Pipeline

Retrieval-Augmented Generation (RAG) pipeline: domain-specific documents are split into chunks, each chunk is converted into an embedding and stored in a vector database, the most relevant chunks are retrieved for a user query, and the language model uses that retrieved context to generate a grounded answer.



Chunking Process for Retrieval

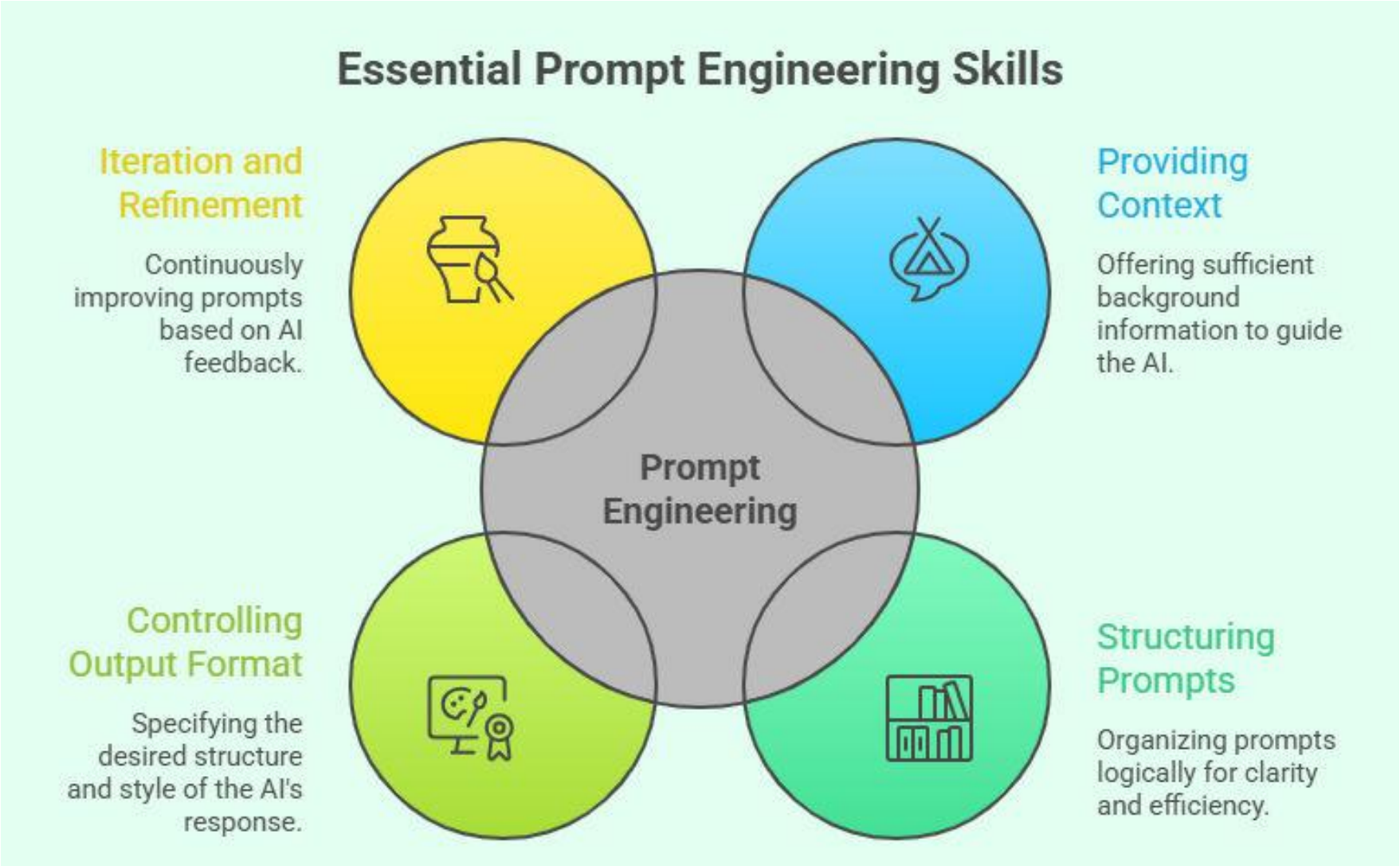
Chunking process for RAG: a long document is split into smaller overlapping chunks; each chunk is converted into an embedding and stored in a vector database; when a user asks a question, the system retrieves the most relevant chunks and sends them to the language model as context.



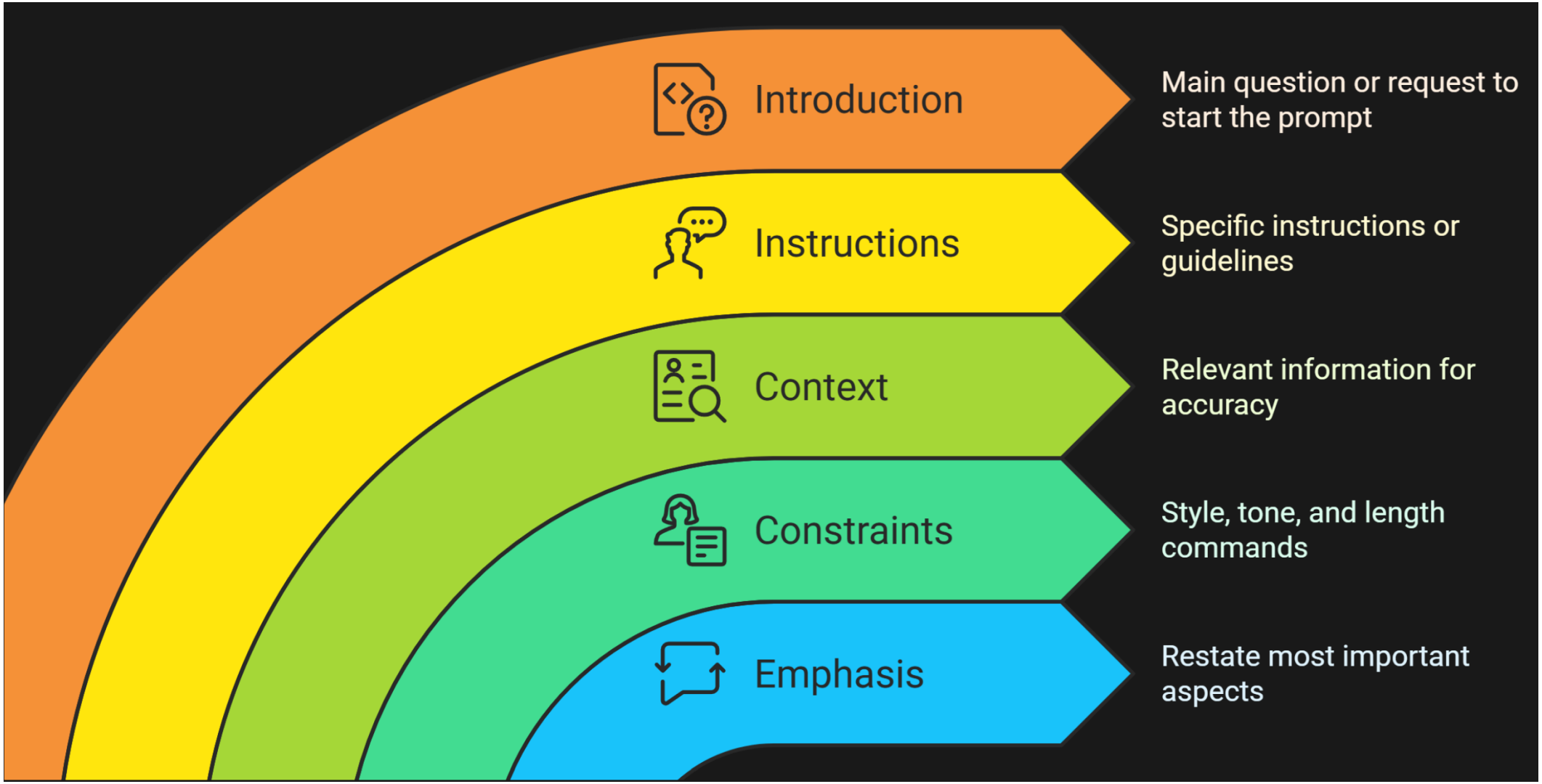
AI & LLM Key Trends in 2025

- **Small Language Models (SLM)** drive **enterprise AI adoption**
- Mixture of Experts (**MoE**) **+ LoRA** enable SLMs to outperform 10x larger LLMs
- **Open-source are becoming the de facto** way for **LLMs** use
- Large language models start adopting **modular architectures**
- **Synthetic data** revolution arrives to LLMs
- LLM **hallucinations disappear** as training techniques evolve
- **Data** (not LLMs) becomes the **true competitive advantage**
- **RAGs** (Retrieval-Augmented Generation) used in most LLMs tasks
- Shift from closed to open-source **democratizes AI** (transparency)
- **Agentic AI – AI that acts!**
- **LLMs for Machines and Robots**, not just people - **LBMs**

Prompt Engineering

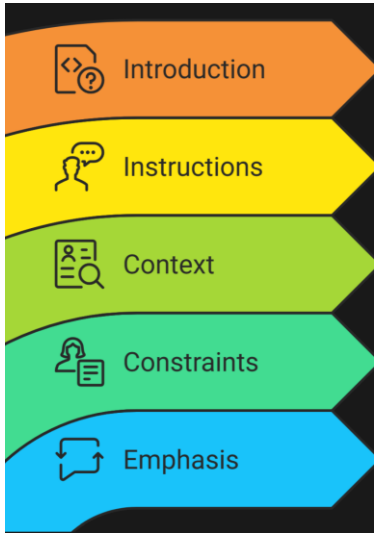


Prompt Engineering – Anatomy of a Prompt



https://www.kccourses.org/enrol/index.php?id=150

Anatomy of a Prompt – Five Core Components



Introduction:

- State your goal or task (e.g., "Summarize this article and give me five key takeaways.")

Specific Instructions:

- Detail what kind of information you want and what to focus on

Context:

- Provide the relevant information the LLM needs to work with (e.g., the article text). Beyond just providing text, tell the LLM what you're doing with the information (e.g., creating a slide deck, outlining a story, prepping for an interview) and for what audience.

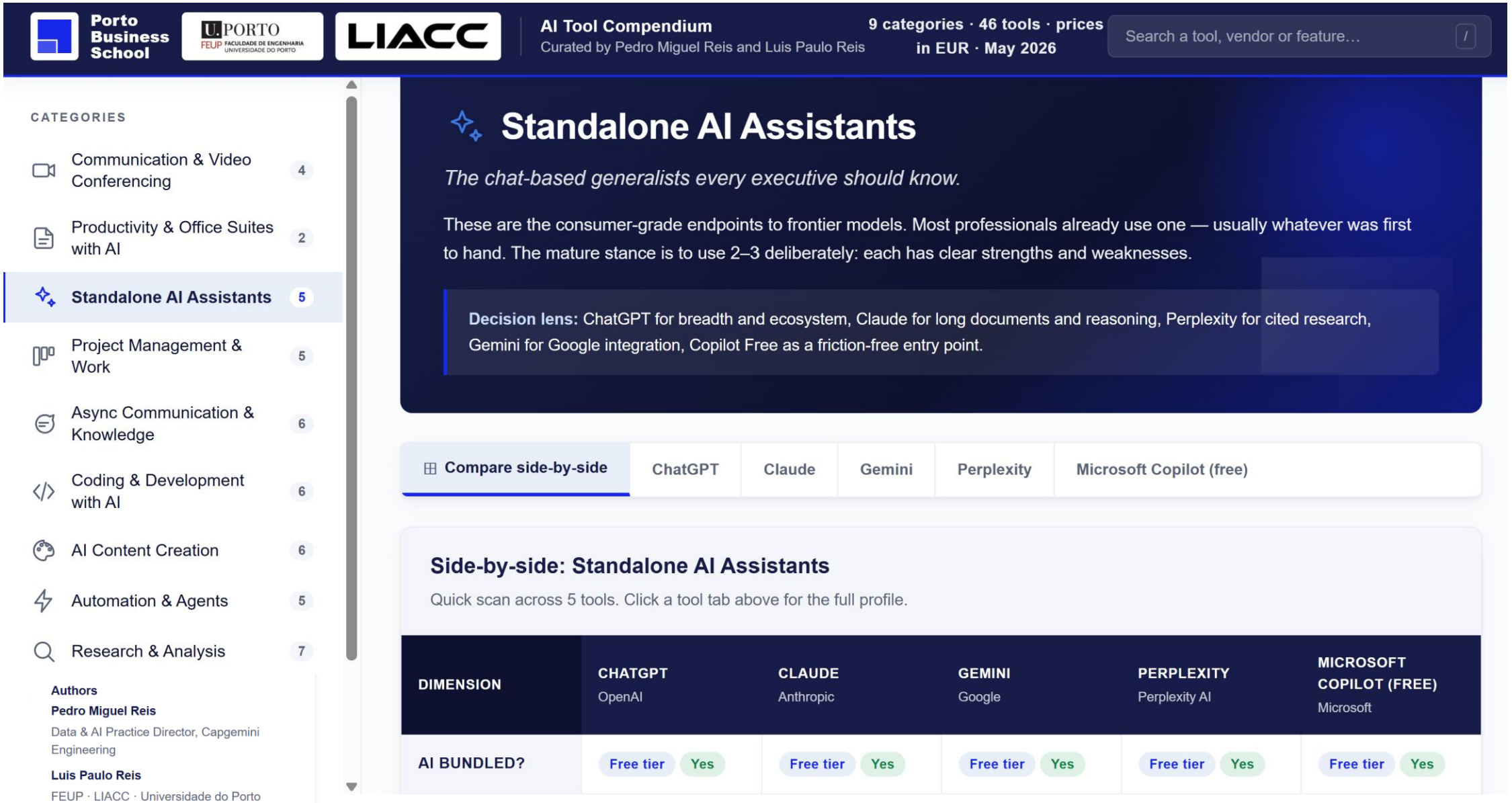
Constraints:

- Define what you don't want the bot to do (e.g., "Don't use title case," "Don't write in the first person") and specify the desired style or tone (e.g., "concise, direct, straightforward"). This saves time by preventing rambling or irrelevant responses.

Reiteration/Emphasis:

- Re-emphasize the most critical aspects of your request to ensure the LLM prioritizes them.

AI Tools Compendium



Side-by-side: Communication & Video Conferencing

Quick scan across 4 tools. Click a tool tab above for the full profile.

DIMENSION	MICROSOFT TEAMS Microsoft	ZOOM Zoom Communications	GOOGLE MEET Google	CISCO WEBEX Cisco
AI BUNDLED?	Yes	Free tier Yes	Yes	Free tier Yes
ENTRY PRICE	**M365 Business Basic** €5.60/user/mo	Basic (free) **Pro** €11.40/user/mo	**Business Starter** €6.90/user/mo	Free **Webex Meet** €12.40/user/mo
KILLER FEATURE	Intelligent meeting recap with action items + speaker timeline.	Auto meeting summaries and next-step extraction (free with paid plans).	'Take notes for me' — Gemini auto-summarises the meeting.	AI Assistant: meeting summaries, transcription, action items.
BEST FOR	Organisations already in Microsoft 365. Internal collaboration at scale, regulated industries needing tenant-level controls.	External-facing meetings, sales calls, webinars, mixed-organisation collaboration.	Organisations on Google Workspace; inclusive multilingual collaboration; lightweight 'just send a link' meetings.	Regulated industries (banking, healthcare, public sector), Cisco-equipped meeting rooms, hybrid work scenarios with heavy device investment.
WATCH OUT	⚠ External meetings with mixed-vendor participants — Zoom is more universally accepted.	⚠ Deep document collaboration during the meeting — Teams/Meet do this better.	⚠ Deep enterprise telephony / contact center scenarios — Teams or Zoom Phone fit better.	⚠ Startups and SMBs — overkill for the use case and lower mind-share with external participants.
LEARNING CURVE	Medium — UI is feature-rich; AI features are scattered across tabs.	Low — most users already know it.	Low — browser, one click.	Medium — admin console is dense.
LINK	microsoft.com/microsoft-teams ↗	zoom.us ↗	meet.google.com ↗	webex.com ↗

Side-by-side: Productivity & Office Suites with AI

Quick scan across 2 tools. Click a tool tab above for the full profile.

DIMENSION	MICROSOFT 365 + COPILOT Microsoft	GOOGLE WORKSPACE + GEMINI Google
AI BUNDLED?	Yes	Yes
ENTRY PRICE	**M365 Business Basic** **€5.60/user/mo**	**Business Starter** **€6.90/user/mo**
KILLER FEATURE	Word: draft, rewrite, summarise documents; bring in context from emails/files.	'Help me write' in Gmail and Docs; tone adjustment, expand/shorten.
BEST FOR	Organisations with existing M365 footprint, IT-led adoption, and enterprise compliance needs.	Cloud-native teams, education, fast-moving startups, organisations valuing real-time collaboration over Office parity.
WATCH OUT	⚠ Bleeding-edge teams who want the latest LLM features fast — Microsoft moves on quarterly cycles.	⚠ Heavy Excel power users — Sheets has gaps with Power Query, complex pivots, financial models.
LEARNING CURVE	Medium — Copilot UI varies app-by-app; users need 30–60 min onboarding to get value.	Low — UI is clean and consistent.
LINK	microsoft.com/microsoft-365 ↗	workspace.google.com ↗

Side-by-side: Standalone AI Assistants

Quick scan across 5 tools. Click a tool tab above for the full profile.

DIMENSION	CHATGPT OpenAI	CLAUDE Anthropic	GEMINI Google	PERPLEXITY Perplexity AI	MICROSOFT COPILOT (FREE) Microsoft
AI BUNDLED?	Free tier Yes	Free tier Yes	Free tier Yes	Free tier Yes	Free tier Yes
ENTRY PRICE	Free **Plus** €17.10/mo	Free **Pro** €17.10/mo	Free **Google AI Pro** €17.09/mo	Free **Pro** €17.10/mo	Copilot (free) **Copilot Pro** €17.10/mo
KILLER FEATURE	GPT-5 reasoning model for hard problems.	Best-in-class long-document analysis (legal, financial, research).	Deep Research: multi-step web research producing structured reports.	Multi-model selector: pick GPT-5 / Claude / Gemini / Sonar per query.	GPT-4o-class model on the free tier.
BEST FOR	Versatile day-to-day assistant, brainstorming, code, data analysis, content drafting. The safest single-tool choice.	Knowledge work involving long documents (legal, M&A, regulatory). Senior writers and analysts. Engineering leaders who use Claude Code.	Google Workspace organisations, Android-heavy teams, anyone needing massive context windows or live multimodal interaction.	Executives doing market research, due diligence, competitive intel; analysts who need verifiable answers; anyone who lost trust in Google's AI Overviews.	First-time users; quick utility tasks; no-account scenarios; mobile.
WATCH OUT	⚠ Long-document analysis with 100K+ tokens — Claude has a longer context window.	⚠ Real-time current events — no native web browsing in chat by default (use the API).	⚠ Pure code-reasoning tasks — Claude/ChatGPT lead on engineering use cases.	⚠ Free-form creative writing — the academic citing style gets in the way.	⚠ Power users — feature ceiling is lower than ChatGPT Plus or Claude Pro.
LEARNING CURVE	**Low for chat; Medium to extract pro-level value (custom GPTs, projects).**	**Low for chat; Medium to leverage Projects/Artifacts effectively.**	**Low** — feels like a smarter Google Assistant.	**Low** — looks and feels like a search engine.	**Very low.**
LINK	chatgpt.com ↗	claude.ai ↗	gemini.google.com ↗	perplexity.ai ↗	copilot.microsoft.com ↗

Side-by-side: Project Management & Work

Quick scan across 5 tools. Click a tool tab above for the full profile.

DIMENSION	MONDAY.COM monday.com Ltd	ASANA Asana	JIRA + CONFLUENCE (ATLASSIAN) Atlassian	NOTION Notion Labs	CLICKUP ClickUp
AI BUNDLED?	Free tier Yes	Yes	Free tier Yes	Free tier Yes	Free tier Yes
ENTRY PRICE	Free **Basic** **€7.70/user/mo**	**Personal** **€0**	Jira Free **Jira Standard** **€6.63/user/mo**	Free **Plus** **€8.55/user/mo**	Free Forever **Unlimited** **€5.98/user/mo**
KILLER FEATURE	monday AI: natural-language board generation.	Asana Intelligence: smart status updates, summaries.	Atlassian Intelligence: 'Translate JQL' — natural language → query.	Q&A: ask questions across your entire workspace.	ClickUp Brain: contextual AI across docs, tasks, comments.
BEST FOR	Marketing, ops, HR, agencies; teams that want PM that doesn't feel like 'admin'.	PMOs, marketing teams, ops at mid-large companies; goal-aligned organisations.	Software engineering, DevOps, technical PMOs.	Knowledge management, internal wikis, documentation-heavy teams, startups, design and product teams.	Cost-conscious teams, all-in-one consolidation, growing startups.
WATCH OUT	⚠ Software engineering at scale — Atlassian wins for that workflow.	⚠ Pure dev teams — Jira fits engineering better.	⚠ Marketing/creative teams — overhead is too high for their flow.	⚠ Strict process workflows requiring approvals — Asana/Monday are stronger.	⚠ Teams that already have a stack and don't want a forklift migration.
LEARNING CURVE	Low — colour-driven UI is intuitive.	Medium — power lies in fields, sections, rules.	Medium-High — admin model is dense; users feel the friction.	Medium — flexibility is the strength and the trap.	Medium — feature density is high.
LINK	monday.com ↗	asana.com ↗	atlassian.com ↗	notion.so ↗	clickup.com ↗

Side-by-side: Async Communication & Knowledge

Quick scan across 6 tools. Click a tool tab above for the full profile.

DIMENSION	SLACK Salesforce	DISCORD Discord Inc.	MICROSOFT TEAMS CHAT Microsoft	NOTION (KNOWLEDGE LAYER) Notion Labs	LOOM Atlassian (acquired 2023)	MIRO Miro
AI BUNDLED?	Free tier Yes	Free tier Yes	Yes	Free tier Yes	Yes	Free tier Yes
ENTRY PRICE	Free **Pro** **€7.48/user/mo**	Free **Nitro Basic** **≈ €2.55/mo**	**Bundled with M365** **From €5.13/user/mo**	Free **Plus** **€8.55/user/mo**	**Starter** **€0**	Free **Starter** **€6.84/user/mo**
KILLER FEATURE	Daily recaps per channel — read 30 min in 2.	AI value usually comes through bots and integrations rather than a native enterprise AI layer.	‘Catch up on what I missed’ across chats.	Q&A across the entire workspace with cited pages.	Auto-remove filler words (‘um’, ‘like’) on demand.	Generate sticky notes / mind maps / diagrams from prompt.
BEST FOR	Tech-forward teams, distributed startups, partnerships with external companies (Slack Connect).	Developer communities, student cohorts, open-source projects, AI communities, alumni networks, gaming/social groups and informal innovation teams that need persistent discussion plus live voice.	Microsoft-shop organisations needing free-with-licence chat.	Knowledge documentation for the whole org; ‘second brain’ for product/design/engineering teams.	Async product walkthroughs, async stand-ups, customer onboarding videos, technical explainers, leadership updates.	Workshops, design sprints, agile retros, customer journey mapping, distributed brainstorming.

Side-by-side: Async Communication & Knowledge

Quick scan across 6 tools. Click a tool tab above for the full profile.

DIMENSION	SLACK Salesforce	DISCORD Discord Inc.	MICROSOFT TEAMS CHAT Microsoft	NOTION (KNOWLEDGE LAYER) Notion Labs	LOOM Atlassian (acquired 2023)	MIRO Miro
WATCH OUT	⚠ Microsoft-shop organisations — Teams is more economical and integrated.	⚠ Formal enterprise collaboration requiring advanced compliance, eDiscovery, retention, legal hold and corporate admin controls — Slack, Teams or Webex are safer.	⚠ Cross-organisation collaboration with non-MS vendors — friction with external Teams accounts is real.	⚠ Real-time collaboration on a finance model — not the right tool.	⚠ Production-grade marketing video — Runway/HeyGen are richer.	⚠ Persistent documentation — knowledge ages on a board faster than in a wiki.
LEARNING CURVE	**Low** — instinctive for most knowledge workers.	**Low for users; Medium for admins who need roles, permissions, moderation and bot governance.**	**Medium** — UI is busier than Slack.	**Medium** — flexibility creates configuration choices.	**Very low.**	**Low for participants; Medium to facilitate well.**
LINK	slack.com ↗	discord.com ↗	microsoft.com/microsoft-teams ↗	notion.so ↗	loom.com ↗	miro.com ↗

Side-by-side: Coding & Development with AI

Quick scan across 6 tools. Click a tool tab above for the full profile.

DIMENSION	GITHUB COPILOT GitHub / Microsoft	OPENAI CODEX OpenAI	CURSOR Anysphere	CLAUDE CODE Anthropic	AMAZON Q DEVELOPER Amazon Web Services	WINDSURF OpenAI (acquired Codeium 2025)
AI BUNDLED?	Free tier Yes	Free tier Yes	Yes	Yes	Free tier Yes	Free tier Yes
ENTRY PRICE	Free **Pro** **€8.55/user/mo**	Free / Go **ChatGPT Plus** **Included in Plus**	**Hobby** **€0**	**Pay-as-you-go (API)** **Token cost**	Free Tier **Pro** **€16.25/user/mo**	Free **Pro** **€12.82/mo**
KILLER FEATURE	Multi-model selector (GPT-5, Claude Sonnet, Gemini 2.5 Pro).	Agentic coding: plan → edit → test → iterate.	Multi-model: Claude Sonnet, GPT-5, Gemini 2.5, Grok.	Strong reasoning — explains design choices upfront.	AWS-grounded reasoning (knows IAM policies, services).	Cascade agent for complex coding tasks.
BEST FOR	Engineering teams already on GitHub; large organisations needing audit + policy controls.	Engineering teams that want an AI coding agent tied to ChatGPT, GitHub and real repo workflows; especially useful for bug fixing, refactoring, tests, documentation and PR generation.	Senior engineers, AI-native startups, teams that want the fastest-iterating AI IDE.	Senior engineers; agentic coding tasks; cross-file refactors; greenfield prototyping.	AWS-heavy shops, infrastructure engineering, mainframe modernisation projects.	Cost-sensitive individual developers; bootcamp students; OSS contributors.

Side-by-side: Coding & Development with AI

Quick scan across 6 tools. Click a tool tab above for the full profile.

DIMENSION	GITHUB COPILOT GitHub / Microsoft	OPENAI CODEX OpenAI	CURSOR Anysphere	CLAUDE CODE Anthropic	AMAZON Q DEVELOPER Amazon Web Services	WINDSURF OpenAI (acquired Codeium 2025)
WATCH OUT	⚠ Power users wanting bleeding-edge agentic UX — Cursor and Windsurf often ship faster.	⚠ Non-technical users or teams without well-structured repositories, tests and code-review discipline.	⚠ Heavily regulated environments needing strict data residency — Copilot Enterprise is more mature here.	⚠ Real-time autocomplete in IDE — that's Cursor or Copilot territory.	⚠ Multi-cloud or non-AWS environments — context is overweight on AWS.	⚠ Strict enterprise compliance environments — Copilot Enterprise / Q Developer are stronger.
LEARNING CURVE	**Low for autocompletes; Medium to use Chat/Agent well.**	**Medium** — easy to start, but high-value use requires good prompts, tests and repo setup.	**Medium** — power user features reward time spent learning shortcuts.	**Medium** — CLI workflow is unfamiliar to GUI-only devs.	**Medium** — strongest on AWS topics, weaker outside.	**Low** — VS Code-like UX.
LINK	github.com/features/copilot ↗	chatgpt.com/codex ↗	cursor.com ↗	anthropic.com/claude-code ↗	aws.amazon.com/q/developer ↗	windsurf.com ↗

Side-by-side: AI Content Creation

Quick scan across 6 tools. Click a tool tab above for the full profile.

DIMENSION	CANVA (MAGIC STUDIO) Canva	ADOBE FIREFLY Adobe	MIDJOURNEY Midjourney	ELEVENLABS ElevenLabs	HEYGEN HeyGen	RUNWAY Runway
AI BUNDLED?	Free tier Yes	Free tier Yes	Yes	Free tier Yes	Free tier Yes	Free tier Yes
ENTRY PRICE	Free **Canva Pro** €12.82/mo or €102.60/yr	Free **Firefly Standard** €10.99/mo	**Basic** €8.55/mo	Free **Starter** €4.28/mo	Free **Creator** €20.52/mo	Free **Standard** €12.82/mo
KILLER FEATURE	Magic Design: deck/post from a prompt.	Photo-real and stylised image gen.	v7 model: photorealism + artistic strength.	Multilingual v2 model — voice carries across languages.	Avatar IV: most realistic avatar yet (2026).	Gen-4: longer, more coherent video clips.
BEST FOR	Marketing, sales, HR, training teams; non-designers who need polished output fast.	Enterprises, agencies, marketing teams concerned about IP/indemnification; anyone using Adobe daily.	Brand visuals, hero images, concept art, mood boards, marketing illustration.	Podcasters, e-learning teams, accessibility, marketing audio, IVR / voice agents.	Internal training videos, sales demos, multilingual marketing, social content at scale.	Filmmakers, ad agencies, motion designers, brand storytelling.

Side-by-side: AI Content Creation

Quick scan across 6 tools. Click a tool tab above for the full profile.

DIMENSION	CANVA (MAGIC STUDIO) Canva	ADOBE FIREFLY Adobe	MIDJOURNEY Midjourney	ELEVENLABS ElevenLabs	HEYGEN HeyGen	RUNWAY Runway
WATCH OUT	⚠ Pixel-perfect brand campaigns — Adobe is still the agency standard.	⚠ Hero artistic illustrations — Midjourney still leads on aesthetic quality.	⚠ Commercially sensitive content — IP indemnification is weaker than Firefly.	⚠ Live broadcast / news — latency and ethics still need human supervision.	⚠ High-emotion narrative film — the uncanny valley is closing but not closed.	⚠ Corporate explainer videos — HeyGen / Synthesia are better fit.
LEARNING CURVE	**Very low.**	**Low for Express; Medium-High inside Creative Cloud apps.**	**Medium** — prompt-craft matters.	**Low for TTS; Medium for cloning, voice design, conversational agents.**	**Low** — script-to-video in minutes.	**Medium** — directing AI video well requires craft.
LINK	canva.com ↗	firefly.adobe.com ↗	midjourney.com ↗	elevenlabs.io ↗	heygen.com ↗	runwayml.com ↗

Side-by-side: Automation & Agents

Quick scan across 5 tools. Click a tool tab above for the full profile.

DIMENSION	N8N n8n GmbH	MAKE (FORMERLY INTEGROMAT) Make.com	ZAPIER Zapier	POWER AUTOMATE Microsoft	COPILOT STUDIO Microsoft
AI BUNDLED?	Yes	Free tier Yes	Free tier Yes	Yes	Yes
ENTRY PRICE	**Self-hosted (Community)** Free	Free **Core** €9.05/mo	Free **Professional** €17.09/mo	**Bundled with M365 Business/Enterprise** Included	**Pay-as-you-go** From €0.01/mensagem
KILLER FEATURE	AI Agent node with tool selection.	Make AI Agents (beta) — autonomous decision-making.	Zapier AI (Copilot): describe a Zap, it builds it.	Copilot in Power Automate: 'describe a flow, it builds it'.	GPT-5 / GPT-4o backbone.
BEST FOR	Tech-native teams; data-sensitive use cases (self-host); AI agent prototyping; cost-conscious automation at volume.	Marketers, ops teams, agencies, SMBs — anyone who likes seeing the flow before running it.	Non-technical operators; the broadest tool coverage; quick automations across many apps.	Microsoft shops; back-office process automation; RPA scenarios; SAP/Dynamics integration.	Enterprise IT building agents on M365/Dataverse; HR, IT helpdesk, internal Q&A bots.
WATCH OUT	⚠ Non-technical teams — even with the visual UI, you'll touch JS or expressions.	⚠ Custom code-heavy use cases — n8n / Zapier are more flexible.	⚠ Heavy-execution / data-volume scenarios — costs add up fast vs n8n / Make.	⚠ Tech-native teams who want full ownership — too much dependency on Microsoft cloud.	⚠ Lightweight / SMB scenarios — Copilot Chat or Zapier Chatbots are far cheaper entry points.
LEARNING CURVE	Medium-High — flexibility comes with complexity.	Low-Medium — UI is friendly; logic gets complex on advanced flows.	Very low — describe-it-and-build-it Copilot.	Medium-High — power lies in advanced expressions.	Medium — IT-friendly, less so for end users.
LINK	n8n.io ↗	make.com ↗	zapier.com ↗	powerautomate.microsoft.com ↗	microsoft.com/microsoft-copilot/microsoft-copilot-studio ↗

Side-by-side: Research & Analysis

Quick scan across 7 tools. Click a tool tab above for the full profile.

DIMENSION	PERPLEXITY (RESEARCH MODE) Perplexity AI	NOTEBOOKLM Google	ELICIT Elicit (Ought)	CONSENSUS Consensus AI	SCITE Research Solutions / Scite LLC	SEMANTIC SCHOLAR Ai2 / Allen Institute for AI	RESEARCHRABBIT ResearchRabbit
AI BUNDLED?	Free tier Yes	Free tier Yes	Yes	Free tier Yes	Free tier Yes	Free tier Yes	Free tier Yes
ENTRY PRICE	Free **Pro** **€17.10/mo**	Free **NotebookLM Plus** **€17.09/mo via Google AI Pro**	**Basic** **€0**	Free **Premium** **€10.25/mo**	Free trial **Individual** **≈€17–20/mo**	Free **API / datasets** **Free / research access**	Free **Institution / future plans** **May vary**
KILLER FEATURE	Multi-model selector (GPT-5, Claude, Gemini, Sonar).	Long-context grounding (Gemini 2.5 Pro).	Question-driven evidence extraction.	AI-extracted findings on each paper.	Scite Assistant answers research questions grounded in citation evidence.	Semantic search based on meaning, not only keywords.	AI-assisted related-paper discovery.
BEST FOR	Executives doing market research, due diligence, competitive intelligence; analysts who must defend every claim.	Digesting long reports, board-meeting prep, onboarding kits, internal knowledge bases, learning a new domain quickly.	Academic researchers, R&D teams, healthcare, policy analysts, evidence-based strategy work.	Healthcare, R&D, academic prep, policy debates, anyone making evidence-based claims.	Academic researchers, R&D teams, medical/scientific due diligence, systematic reviews, and anyone who must distinguish strong evidence from citation	Fast academic discovery, finding seed papers, author tracking, free literature search, and teaching students how to explore a field responsibly.	Early-stage literature reviews, PhD/MSc students, R&D teams entering a new field, and anyone who needs to see the structure of a research area visually.

Side-by-side: Research & Analysis

Quick scan across 7 tools. Click a tool tab above for the full profile.

DIMENSION	PERPLEXITY (RESEARCH MODE) Perplexity AI	NOTEBOOKLM Google	ELICIT Elicit (Ought)	CONSENSUS Consensus AI	SCITE Research Solutions / Scite LLC	SEMANTIC SCHOLAR Ai2 / Allen Institute for AI	RESEARCHRABBIT ResearchRabbit
WATCH OUT	⚠ Free-form creative writing — citation-style gets in the way.	⚠ Real-time current events — sources are static.	⚠ General business research — Perplexity is more pragmatic.	⚠ Topics with limited academic literature — gray-zone business questions are weak fit.	⚠ Broad business/web research where peer-reviewed literature is not the main evidence base — Perplexity or NotebookLM are easier fits.	⚠ Full evidence synthesis or systematic review extraction — Elicit and Scite are stronger for structured extraction and citation validation.	⚠ Claim validation or evidence strength scoring — use Scite or Consensus for that.
LEARNING CURVE	Low — looks like search, behaves smarter.	Very low — drag and drop, ask, listen.	Medium — research methodology helps.	Low.	Medium — the concept of citation context is powerful but takes 20–30 minutes to internalise.	Low — feels like a smarter Google Scholar.	Low-Medium — easy to start, but powerful once users understand seed-paper strategy.
LINK	perplexity.ai ↗	notebooklm.google ↗	elicit.com ↗	consensus.app ↗	scite.ai ↗	semanticscholar.org ↗	researchrabbit.ai ↗

Concerns of AI and ChatGPT in Education

- More **in person exams** and oral assignments
- **Continuous evaluation** of projects
- Help students **develop** their **critical thinking skills** by comparing AI-produced content with reliable, valid sources of information
- Be careful with **over-reliance on AI**
- Shift the object of evaluation **from the "product" to** the **"process" of student learning**
- Emphasize **ethical use of AI** and the importance of proper research and citation practices and avoiding plagiarism

Changing Role/New Skills for the Teacher

From Knowledge Transmitter → Learning Architect

- Teachers evolve from information deliverers to curators and facilitators
- **Designers of AI-enhanced learning experiences,** integrating adaptive systems and data-driven insights
- Need for **AI pedagogical literacy** – understanding how **AI supports**, not replaces, **learning**
- **Ethical and responsible** use of AI in the classroom (bias, privacy, transparency)
- **Human judgment** remains essential to interpret, contextualize, and emotionally support students
- **Teachers as mentors of critical and creative thinking**, helping students question AI outputs
- Collaboration with AI systems to create **personalized** yet **human-centered education**
- **Continuous professional development** in digital pedagogy and emotional intelligence

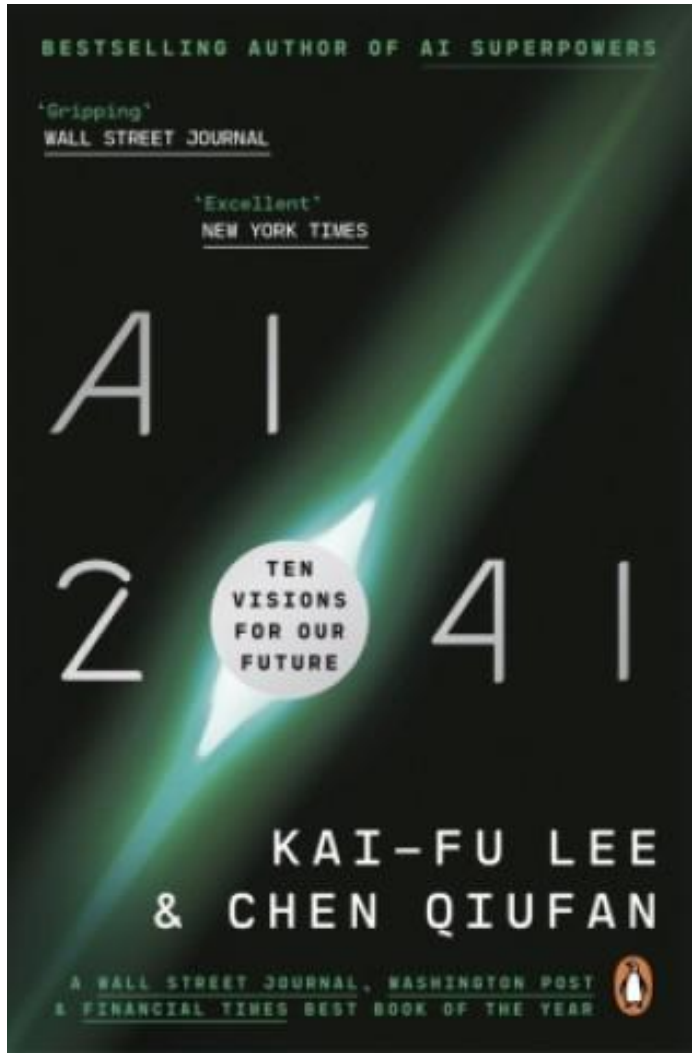
Changing Role/New Skills for Students

From Memorization → Cognitive Adaptation in the Age of AI

- Beyond calculation and memorization: focus on **reasoning, abstraction, and problem framing**
- **Prompt engineering and critical evaluation** of AI-generated solutions
- Developing **AI literacy**: understanding how algorithms work, their limits, and ethical implications
- **Data literacy** — ability to interpret, question, and visualize quantitative information
- **Algorithmic thinking**: breaking problems into logical, computable steps
- **Metacognition** — awareness of how one learns with and without AI support
- **Collaboration with AI systems**: treating **AI as a partner, not a shortcut**
- **Strengthening creativity**, curiosity, and adaptability in problem-solving contexts
- **Ethical and responsible use of AI** in learning and assessment

The Lesson of the Twin Sparrows

- When AI meets Humanity in Learning!
- **Two twin sisters** — same potential, different paths
- One guided by an advanced AI tutor, mastering precision and speed - **AI Learning Partner (AIP)**
- The other supported by a **human teacher,** growing through curiosity and empathy
- Final open challenge:
  - AI-trained twin falters — unable to act without algorithmic guidance
  - Her sister succeeds through intuition, collaboration, and creativity
- Their **teacher, Lixin, realizes…**

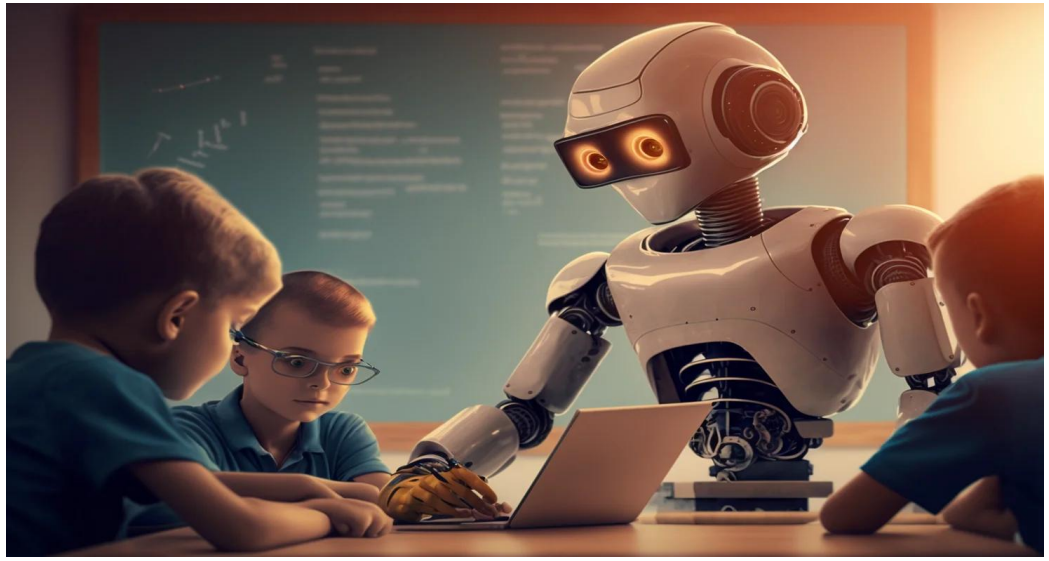


The Lesson of the Twin Sparrows

AI and ChatGPT in Education

"AI and Can Complement Learning, Not Replace It!"

From Knowledge Transmitter → Learning Architect



Teaching in the Age of AI: The End of Traditional Models?

From Content Delivery to Human Development

1 WHY AI CHANGES EVERYTHING

- AI can generate text, code, explanations, summaries and solutions
- Students have instant access to personalised support
- Knowledge production is faster, cheaper and more automated
- Traditional classroom assumptions are being challenged

2 THE LIMITS OF TRADITIONAL TEACHING

- Lectures centred on content transmission are no longer enough
- Memorisation-based learning loses value
- Standard assignments can be easily completed with AI assistance
- The teacher's role must evolve

3 FROM CONTENT TO COMPETENCE

- Education must focus on higher-value skills
  - Critical thinking
  - Problem formulation
  - Creativity
  - Ethical reasoning
  - Communication & collaboration
  - Learning how to learn with AI

4 THE NEW ROLE OF TEACHERS

- Teachers become mentors, designers and critical guides
- They help students ask better questions
- They validate reasoning, not just answers
- They create learning experiences where AI is a tool, not a replacement

5 ASSESSMENT MUST CHANGE

- Product-based assessment is increasingly fragile
- Essays, code and reports can be generated by AI
- Evaluation must focus on process, reasoning and reflection
- Oral discussion, portfolios, drafts and project logs become more important

AI is Transforming Education

Not the end, but a structural transformation

7 AI AS A LEARNING PARTNER

- Generative models can support tutoring, feedback and explanation
- RAG systems can connect AI to reliable course materials
- Adaptive systems can personalise learning paths
- AI can help students practise, revise and explore alternatives

6 RISKS AND CHALLENGES

- Overdependence on AI
- Loss of cognitive effort and deep learning
- Academic integrity problems
- Bias, hallucinations and misinformation
- Unequal access and digital divides
- Need for responsible use policies

8 AI LITERACY AS A CORE SKILL

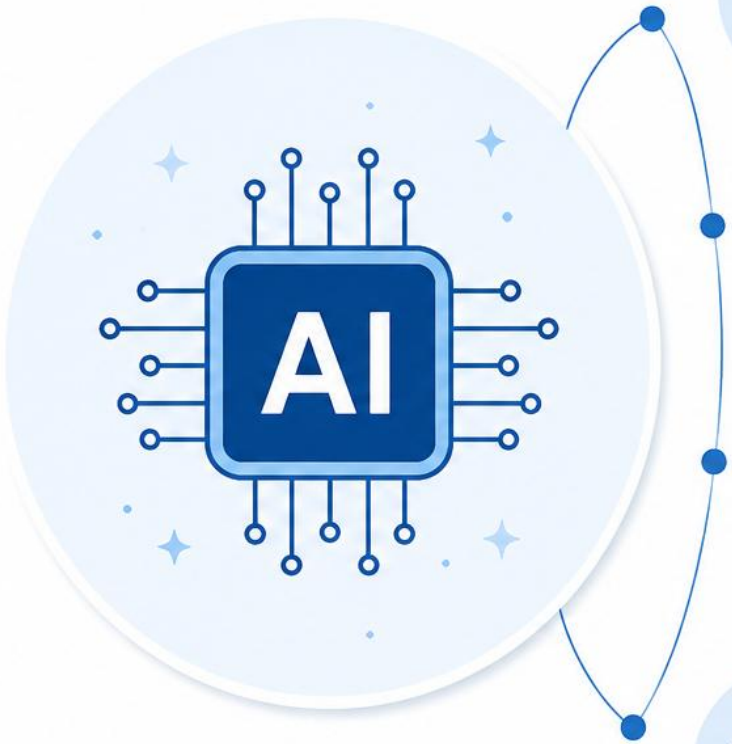
- Students must understand what AI can and cannot do
- Prompting, verification and source evaluation are essential
- Learners must detect errors, bias and unsupported claims
- AI literacy should become part of every curriculum

CONCLUSION: EDUCATION IS NOT ENDING

AI does not eliminate education → It forces a structural transformation → The future is not human versus AI → The future is human learning enhanced by AI → **The goal:** more autonomy, deeper reasoning and better human judgement

1 Why AI Changes Everything

AI is transforming the foundations of teaching and learning.



AI can generate text, code, explanations, summaries and solutions

Generative AI produces high-quality content and solutions across many domains.

Students have instant access to personalised support

AI tools provide 24/7 assistance, tailored to individual needs and learning pace.

Knowledge production is becoming faster, cheaper and more automated

AI accelerates research, analysis and creation, reducing time and cost.

Traditional classroom assumptions are being challenged

What was once scarce (information, expertise, time) is now abundant and on demand.

2 The Limits of Traditional Teaching

What worked in the past is no longer enough in the age of AI.

KEY LIMITATIONS

Lectures centred on content transmission

Delivering information is no longer the main value of teaching.

Memorisation-based learning loses value

When information is instantly available, memorisation is easy and easily outsourced.

Standard assignments can be easily completed with AI assistance

AI can generate essays, reports, code and solutions that look high quality.

The teacher's role must evolve

From the main source of knowledge to a designer of learning and a guide.

THE IMPACT ON EDUCATION

- Information is instant and always available
- AI can produce content at scale and on demand
- Students can reach the "answer" without the journey
- Traditional methods show decreasing returns

WHAT THIS MEANS

- Content delivery is no longer a competitive advantage.
- Students need more than access to information.
- Education must develop judgement, not just knowledge.
- The focus must shift from what students know to what they can do and how they think.

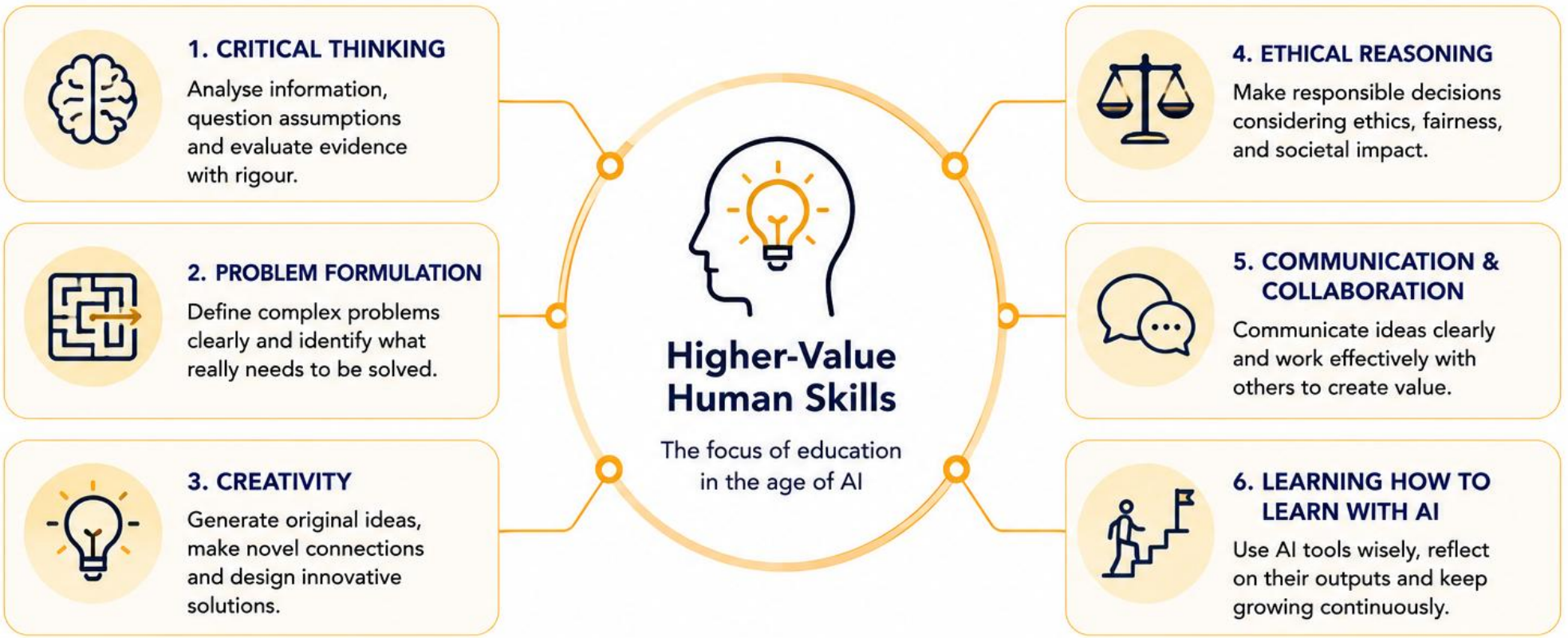
Education must move from transmission to transformation.

The goal is not to teach more content, but to build the capabilities that matter in an AI-augmented world.

- Critical thinking
- Problem solving
- Human skills and values
- Lifelong learning

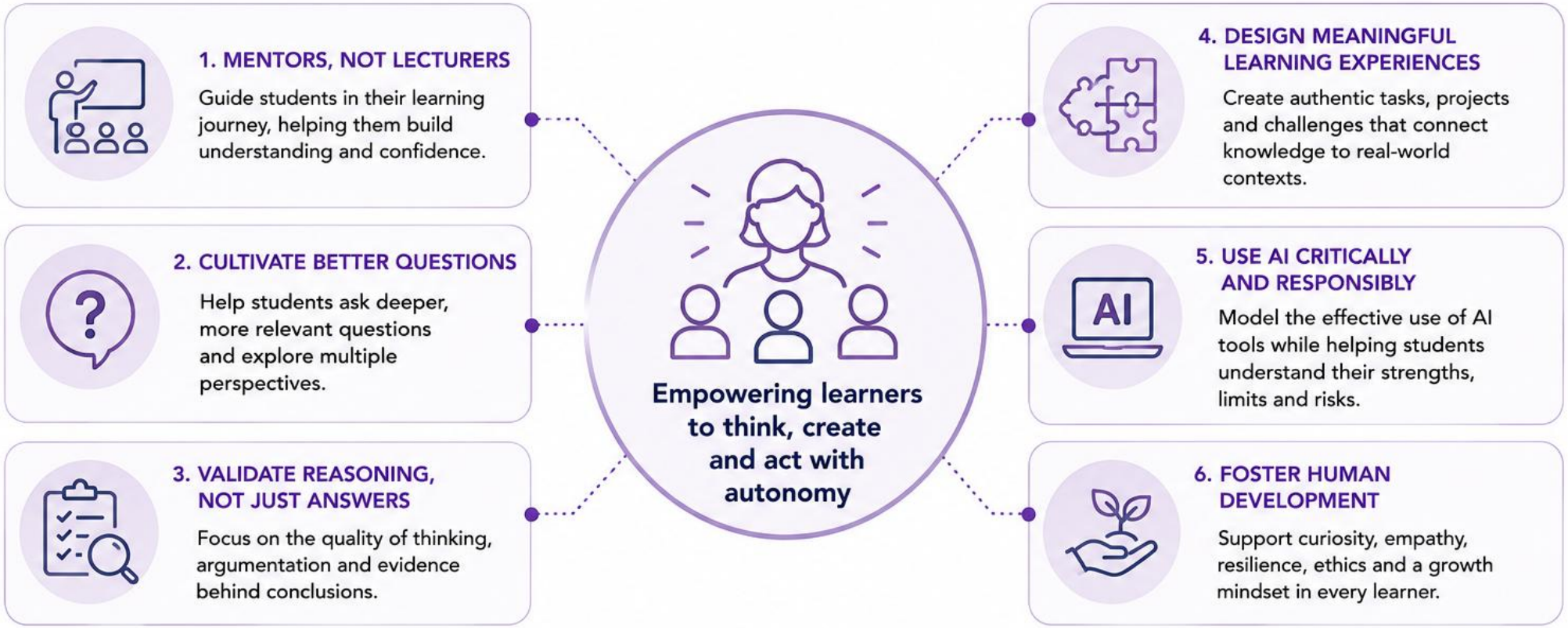
3 From Content to Competence

Education must focus on developing the skills that AI cannot replace.



4 The New Role of Teachers

From knowledge transmitters to learning mentors and critical guides.



THE IMPACT

5 Assessment Must Change

From evaluating what students produce, to understanding how they think.

THE OLD MODEL: PRODUCT-BASED

Focus on the final product

Essays, reports, presentations
AI can generate high-quality content in seconds.

Code, solutions, calculations
AI can produce correct answers and working code.

Standard tests and quizzes
Easy to complete with AI assistance or hidden help.

Grades based on final output
Limited insight into learning, effort or understanding.

A necessary shift

THE NEW MODEL: PROCESS-BASED

Focus on the learning process

Reasoning and argumentation
Evaluate how students think, structure ideas and justify conclusions.

Drafts, iterations and learning logs
Value the evolution of ideas and the reflection behind choices.

Oral discussions and presentations
Assess understanding through dialogue, defense and questioning.

Portfolios and authentic projects
Showcase integrated learning across time, contexts and challenges.

Self and peer assessment
Promote metacognition, autonomy and responsibility for learning.

WHAT THIS SHIFT ENABLES

Deeper understanding
of student thinking and learning processes.

Stronger academic integrity
by making learning visible.

Better preparation
for complex, real-world problems.

More meaningful feedback
that guides growth and improvement.

Alignment with the future
where process, creativity and judgement matter most.

Key takeaway: When AI can produce the answer, assessment must focus on the thinking, the process, and the learner behind the work.

6 AI as a Learning Partner

AI tools can enhance learning when used purposefully and responsibly.

1. TUTORING AND EXPLANATION

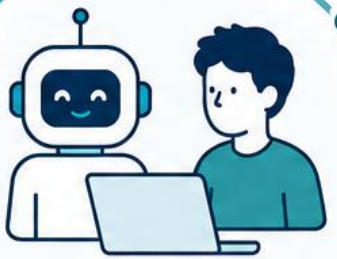
Generative AI can explain concepts in different ways, answer questions and provide step-by-step guidance anytime.

2. RETRIEVAL-AUGMENTED GENERATION (RAG)

AI can access and ground answers in trusted course materials, research papers and domain-specific knowledge.

3. ADAPTIVE AND PERSONALISED LEARNING

AI systems can adjust to individual needs, pace, strengths and goals, offering personalised recommendations and practice.



AI supports, not replaces, human learning.

It amplifies potential and expands what's possible.

4. FEEDBACK AND COACHING

AI can give instant feedback on drafts, code, arguments and problem-solving, helping students improve continuously.

5. PRACTICE AND SIMULATION

AI creates simulations, scenarios and practice problems to help learners apply knowledge in diverse contexts.

6. EXPLORATION AND CREATIVITY

AI helps learners brainstorm ideas, explore alternatives, make connections and extend their thinking.

WHEN AI IS MOST EFFECTIVE

- When combined with clear learning goals and good pedagogy
- When learners remain curious, reflective and in control
- When information is verified and used responsibly
- When teachers guide its use with purpose and critical judgment

Key Message

AI is a powerful partner that can expand access, personalise learning and provide rich support. But its value depends on how we design learning experiences and how learners engage with it.

AI tools + Human guidance + Critical thinking = Deeper learning and real impact

7 Risks and Challenges

AI brings great opportunities for education, but also significant risks that we must understand and address.

1. OVERDEPENDENCE ON AI

Students may rely on AI for every task, reducing autonomy and initiative.

2. LOSS OF COGNITIVE EFFORT AND DEEP LEARNING

Easy answers can discourage struggle, reflection and the development of deep understanding.

3. ACADEMIC INTEGRITY RISKS

AI can be used to cheat, plagiarise or misrepresent one's work.

Responsible adoption is key

to maximise benefits and minimise harm.

4. BIAS, HALLUCINATIONS AND MISINFORMATION

AI can produce incorrect, biased or misleading content with confidence.

5. UNEQUAL ACCESS AND DIGITAL DIVIDES

Not all students have the same access to technology, tools or skills, widening existing gaps.

6. PRIVACY AND DATA CONCERNS

Student data may be collected, stored and used in ways that raise ethical and legal issues.

RESPONSE: HOW WE CAN ADDRESS THESE RISKS

CLEAR POLICIES
Establish transparent guidelines for acceptable and responsible AI use.

EDUCATION AND AWARENESS
Build AI literacy for students and teachers, including ethics and limitations.

HUMAN OVERSIGHT
Teachers remain in the loop to guide, evaluate and make final decisions.

DESIGN FOR INTEGRITY
Create assessments and activities that promote honesty, originality and accountability.

INCLUSIVE ACCESS
Ensure equitable access to tools, infrastructure and training for all.

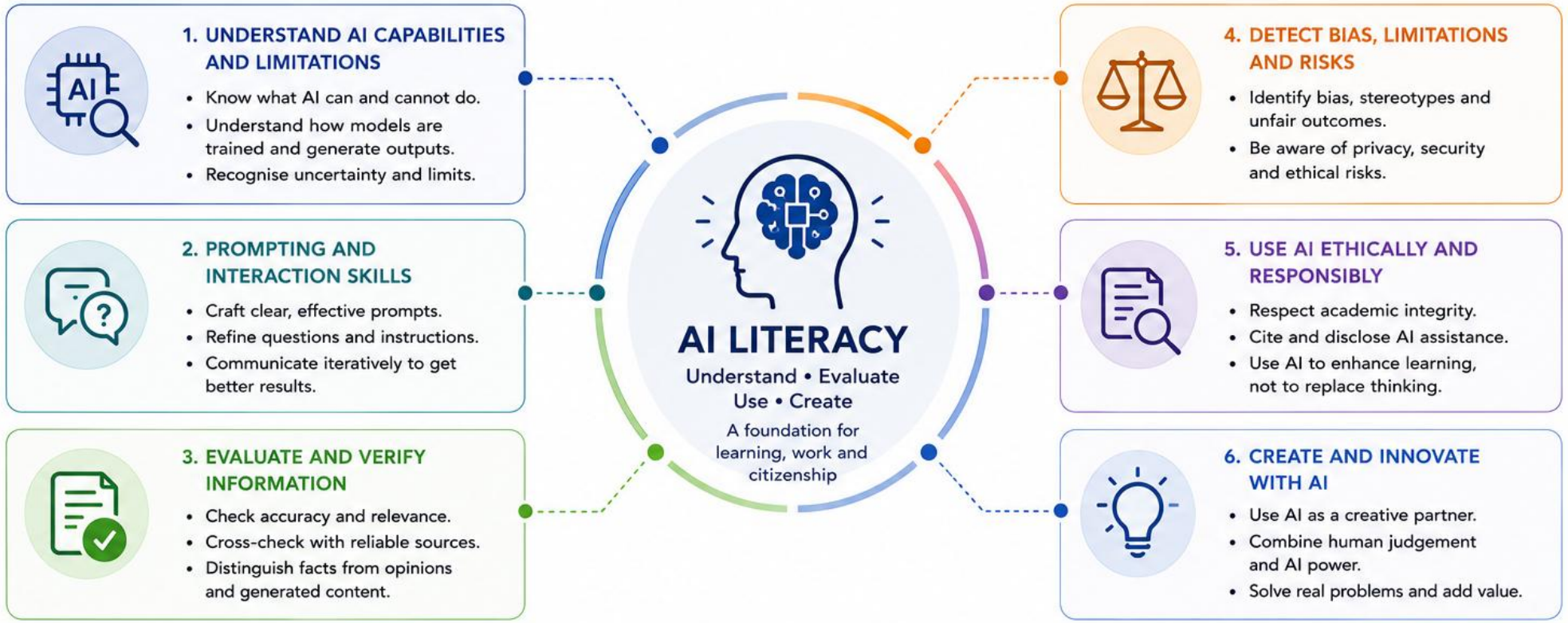
PROTECT PRIVACY
Use secure, privacy-respecting tools and follow data protection best practices.

Key Takeaway

AI's risks are real, but manageable. With awareness, policies and responsible practices, we can create a safe, fair and empowering learning environment.

8 AI Literacy as a Core Skill

To thrive in the age of AI, learners must understand, evaluate and use AI wisely.



HOW TO BUILD AI LITERACY

Integrate across the curriculum
AI literacy is relevant in every subject and discipline.

Learn by doing
Hands-on activities, projects and real problems.

Discuss and reflect
Encourage dialogue about impacts, ethics and society.

Practice evaluation and judgement
Make critical thinking a daily habit.

Keep learning
AI evolves fast. Stay curious and keep updating skills.

Key Takeaway

AI literacy empowers learners to make better decisions, protect themselves, create value and contribute positively to a future shaped by AI.

9 Policy and System Enablers

Creating the conditions for responsible, effective and equitable AI in education.

1. VISION AND LEADERSHIP

Set a clear direction and lead the change.

- Establish a shared vision and goals for AI in education.
- Engage stakeholders at all levels.
- Model ethical and responsible use.

2. POLICIES AND GOVERNANCE

Build a strong foundation for safe and ethical use.

- Develop clear policies and guidelines.
- Address data privacy, security and ethics.
- Ensure accountability and transparency.

3. INFRASTRUCTURE AND RESOURCES

Provide the tools, access and support needed.

- Invest in secure, reliable technology.
- Ensure equitable access for all learners.
- Provide time, funding and technical support.

4. CAPACITY BUILDING AND SUPPORT

Empower educators and learners to succeed.

- Offer ongoing professional development.
- Build AI literacy and confidence.
- Create communities of practice and support.

5. MONITORING AND CONTINUOUS IMPROVEMENT

Learn, adapt and improve systems over time.

- Monitor impact and outcomes.
- Gather feedback from users.
- Refine policies, practices and tools.

GUIDING PRINCIPLES

Equity and Inclusion
Ensure fair access and opportunities for all.

Ethics and Integrity
Uphold values, protect rights and promote responsible use.

Human-Centred
Prioritise human well-being, agency and dignity.

Privacy and Security
Protect data and ensure trust and safety.

Transparency
Be open about how AI systems work and are used.

Sustainability
Promote long-term impact and responsible innovation.

FROM ENABLERS TO IMPACT

Strong policies and leadership
Set direction and align efforts

→

Empowered educators and learners
Build skills and confidence

→

Effective tools and support
Enable innovation and better experiences

→

Better teaching and learning
More engagement, critical thinking and achievement

→

Positive impact for all
More equitable, inclusive and future-ready education systems

Key Takeaway

Strong policies, the right resources and ongoing support create the conditions for responsible and effective AI in education—leading to better outcomes for every learner and a stronger society.

10 Practical Strategies for Educators

How teachers can integrate AI meaningfully while keeping learning human-centered.

1. START WITH CLEAR PURPOSE

Use AI to support specific learning goals.

- Identify the learning outcome.
- Decide where AI adds real value.
- Align AI use with your pedagogy and curriculum.

2. DESIGN LEARNING EXPERIENCES

Create activities that promote thinking, not shortcuts.

- Use AI to spark ideas, not to give answers.
- Build in analysis, critique and application.
- Promote collaboration and discussion.

3. TEACH AI LITERACY EXPLICITLY

Help students understand how AI works and how to use it wisely.

- Discuss capabilities and limits.
- Practice evaluating AI outputs.
- Build skills in prompting, verifying and citing.

4. SET GUIDELINES AND EXPECTATIONS

Be transparent about when and how AI can be used.

- Establish class norms.
- Clarify academic integrity expectations.
- Model ethical and responsible use.

5. ASSESS FOR LEARNING

Focus on process, understanding and application.

- Use formative assessments.
- Ask students to explain their thinking.
- Value drafts, reflections and revisions.

6. REFLECT AND IMPROVE

Continuously refine your practice.

- Gather student feedback.
- Reflect on what works and what doesn't.
- Stay informed and keep learning.

EXAMPLE: FROM TRADITIONAL TASK TO AI-ENHANCED LEARNING EXPERIENCE

TRADITIONAL TASK

"Write a report on climate change."

Focus on final product.
Limited thinking or exploration.

→

AI-ENHANCED EXPERIENCE

1. Use AI to explore multiple perspectives and gather sources.
2. Critically evaluate the information and identify key insights.
3. Create an outline and get feedback on your ideas.
4. Write your draft, citing sources and explaining your reasoning.
5. Reflect on your learning and how your thinking evolved.

→

DEEPER LEARNING OUTCOME

Stronger understanding, critical thinking, communication skills and responsible use of AI.

The learner is the creator, not the AI.

KEY MINDSETS FOR EDUCATORS

Human first
AI supports, but does not replace, the teacher's role.

Curious and open
Explore, experiment and learn together with students.

Thoughtful and ethical
Consider impact, fairness and responsibility in every decision.

Learner-centered
Design for engagement, inclusion and agency for all.

Future-focused
Prepare learners for a world where human skills matter most.

Key Takeaway

Great teaching in the age of AI blends clear purpose, smart design, continuous learning and a focus on human potential.

11 The Future of AI in Education

Looking ahead to emerging trends and possibilities that can shape the future of learning.

KEY TRENDS SHAPING THE FUTURE

1. HYPER-PERSONALISED LEARNING

AI will tailor learning to each learner's needs, pace and interests.

- Adaptive content and pacing
- Real-time feedback
- Personal learning pathways

2. AI AS A LEARNING COMPANION

Intelligent tutors and assistants will provide continuous support.

- 24/7 help and guidance
- Conversation and practice
- Motivational support

3. SKILLS FOR THE AI ERA

Education will focus on uniquely human skills and AI literacy.

- Critical thinking
- Creativity and innovation
- Empathy and ethics
- AI literacy and data fluency

4. LIFELONG AND UBIQUITOUS LEARNING

Learning will be anytime, anywhere and across the lifespan.

- Microlearning and just-in-time
- Seamless across contexts
- Supporting career transitions

5. HUMAN-AI COLLABORATION

AI will augment human capabilities and enable richer collaboration.

- Co-creation and ideation
- Enhanced teamwork
- More time for meaningful human interaction

6. ETHICAL AND RESPONSIBLE AI

Trust, fairness and wellbeing will be central to the future of AI in education.

- Privacy and data protection
- Transparency and fairness
- Inclusive and equitable design

PREPARING LEARNERS FOR THE FUTURE

Build strong foundations
Ensure core knowledge and foundational skills remain a priority.

Foster adaptable mindsets
Encourage curiosity, resilience and a growth mindset.

Cultivate human strengths
Develop communication, empathy, creativity and ethical reasoning.

Support wellbeing and inclusion
Ensure technology supports mental health, belonging and equity.

Empower through AI literacy
Teach learners to understand, evaluate and use AI wisely.

Inspire purpose and impact
Help learners use AI to solve real problems and create positive change.

OPPORTUNITIES WE CAN CREATE TOGETHER

- Expand access to quality education for all.
- Personalise learning and unlock every learner's potential.
- Prepare learners for meaningful work and civic life.
- Build more inclusive, equitable and just societies.
- Drive innovation for a better and sustainable future.

Key Takeaway

The future of AI in education is not about machines replacing humans, but about working together to empower every learner to thrive.

Human + AI = Limitless Potential

Concerns of AI and ChatGPT in Research

- Risk of **fabricated** or inaccurate **references and data ("hallucinations")**
- Possible **erosion of methodological rigor** due to **over-reliance** on automated reasoning
- Challenges in ensuring **reproducibility** and **transparency** when **AI is involved**
- Need for explicit **disclosure of AI use** in research design, writing, and analysis
- **Potential bias amplification** from training data and opaque model behavior
- **Ethical responsibility** to validate, interpret, and contextualize **AI outputs** using **human expertise**
- Importance of **maintaining authorship integrity** and **avoiding ghost-writing by AI**

Research with AI

ELSEVIER **Scopus AI**

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Scopus AI: Trusted content. Powered by responsible AI.

Empower your research journey with Scopus AI – your dynamic GenAI-powered research companion.

Navigate through the vast expanse of human knowledge faster with a trusted guide designed to enhance your understanding, enrich your insights, and transform your overall research experience.

Consensus vs ChatGPT

Your AI Research Assistant

scite_

Your AI Research Assistant

Ask questions and receive evidence-based answers from real research

Assistant | Search | Tables

Ask a question... (type '/' for menu)

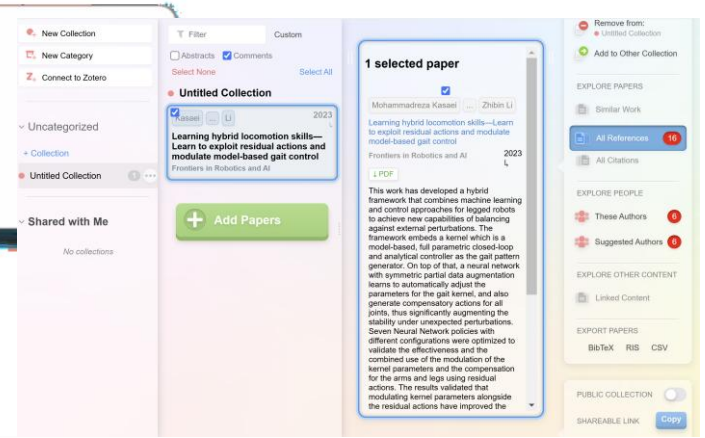
Settings | Sources

ResearchRabbit

Elsevier's Five Responsible AI Principles

- We consider the real-world impact of our solutions on people
- We take action to prevent the creation or reinforcement of unfair bias
- We can explain how our solutions work
- We create accountability through human oversight
- We respect privacy and champion robust data governance

Ask a research question to generate a concise summary report



Elicit

Concerns of AI and ChatGPT in Research: A Global Overview

AI offers powerful tools for research, but also raises critical concerns that require awareness, ethical responsibility and robust safeguards.

1. FABRICATED OR INACCURATE REFERENCES AND DATA

- Risk of "hallucinations" and made-up citations or results.
- Can mislead conclusions and propagate false information.

2. EROSION OF METHODOLOGICAL RIGOR

- Over-reliance on automated reasoning may reduce critical thinking.
- Risk of weaker study design, analysis and interpretation.

3. REPRODUCIBILITY AND TRANSPARENCY

- Difficult to replicate results if AI processes are not fully documented.
- Models are often "black boxes" with limited explainability.

4. LACK OF DISCLOSURE

- Failure to disclose AI use undermines transparency.
- Readers cannot assess the influence of AI on the research.

Responsible AI for Reliable Research

Maximize benefits, minimize risks.

5. BIAS AMPLIFICATION

- AI models inherit biases from training data.
- Can reinforce stereotypes and produce skewed or discriminatory outputs.

6. ETHICAL RESPONSIBILITY

- Researchers must validate, interpret and contextualize AI outputs.
- Human judgment is essential to ensure accuracy and integrity.

7. AUTHORSHIP INTEGRITY

- Risk of ghost-writing and unclear contributions.
- Undermines academic credit, accountability and trust.

8. PRIVACY AND DATA SECURITY

- Inputting sensitive or proprietary data into AI tools can breach confidentiality.
- Risk of data leakage and misuse.

CROSS-CUTTING CONCERNS

LACK OF REGULATION
Rapid adoption outpaces policies and oversight.

DEPENDENCY RISK
Over-dependence may reduce researcher skills and autonomy.

DATA QUALITY
Poor or unrepresentative data leads to unreliable outputs.

ACCOUNTABILITY AND LIABILITY
Unclear who is responsible for AI-assisted research.

ENVIRONMENTAL IMPACT
Large models require significant computational resources.

KEY MESSAGE

AI can enhance research, but only when used responsibly.

Human expertise, transparency and ethics must remain at the core of scientific inquiry.

Human Judgment + Transparency + Ethics + Trustworthy Research

Jobs Most at Risk of Disappearance

Repetition Disappears. Creativity Remains!

Category	Examples of Vulnerable Jobs	Main Reason
Routine cognitive work	Data-entry clerks, bookkeeping assistants, basic translators, call-center operators	LLMs and automation tools now handle structured language, classification, and documentation with high accuracy.
Repetitive manual labor	Assembly-line workers, packaging operators, basic machine operators	Robotics and computer-vision systems enable continuous, precise, and low-cost automation.
Basic administrative support	Scheduling assistants, document clerks, travel agents	Intelligent assistants automate planning, documentation, and coordination tasks.
Customer support (scripted)	FAQ operators, first-level support agents	Conversational AI and voicebots deliver standardized and context-aware responses instantly.
Low-complexity analytical tasks	Junior analysts, simple report writers	Auto-analytics tools and dashboard generators convert raw data into insights automatically.
Basic digital & programming tasks	Programmers, basic web developers, software-test assistants, data-cleaning technicians	Generative-AI coding assistants (e.g., Copilot, ChatGPT) now produce and debug code, run unit tests, and generate documentation autonomously.

Jobs Most at Risk of Disappearance

Repetition Disappears. Creativity Remains!

CATEGORY	EXAMPLES OF VULNERABLE JOBS	MAIN REASON	HOW AI / AUTOMATION IMPACTS
1. ROUTINE COGNITIVE WORK	• Data-entry clerks • Bookkeeping assistants • Basic translators • Call-center operators	LLMs and automation tools now handle structured language, classification, and documentation with high accuracy.	Automates writing, classifying and processing information quickly and with fewer errors.
2. REPETITIVE MANUAL LABOR	• Assembly-line workers • Packaging operators • Basic machine operators	Robotics and computer-vision systems enable continuous, precise, and low-cost automation.	Machines perform repetitive physical tasks faster, safer and around the clock.
3. BASIC ADMINISTRATIVE SUPPORT	• Scheduling assistants • Document clerks • Travel agents	Intelligent assistants automate planning, documentation, and coordination tasks.	AI schedules, organizes and manages information with minimal human input.
4. CUSTOMER SUPPORT (SCRIPTED)	• FAQ operators • First-level support agents	Conversational AI and voicebots deliver standardized and context-aware responses instantly.	Handles common inquiries 24/7 with consistent quality and lower cost.
5. LOW-COMPLEXITY ANALYTICAL TASKS	• Junior analysts • Simple report writers	Auto-analytics tools and dashboards convert raw data into insights automatically.	Data is processed, analyzed and visualized without manual intervention.
6. BASIC DIGITAL & PROGRAMMING TASKS	• Basic programmers • Web developers (basic) • Software test assistants • Data-cleaning technicians	Generative-AI coding assistants produce and debug code, run tests and generate documentation autonomously.	Speeds up development and reduces the need for repetitive coding and testing tasks.

THE SHIFT: FROM REPETITION TO CREATIVITY

AT RISK: HIGH REPETITION

Rules-based tasks → Structured processes → Predictable outcomes → Easy to automate

TECHNOLOGY AUTOMATES THE REPETITIVE

IN DEMAND: HUMAN CREATIVITY

Original thinking & creativity → Emotional intelligence → Complex problem solving → Meaning, impact & innovation

KEY TAKEAWAY

AI and automation excel at repetitive, predictable tasks.

Human creativity, judgment and empathy remain irreplaceable.

Learn + Adapt + Create + Lead

Focus on what makes us uniquely human.

Emerging High-Value Roles in the AI Economy

Hybrid experts who can make AI systems reliable, explainable, and human-compatible!

Domain	Emerging Roles	Core Human Value
AI Development & Oversight	AI trainer • Explainability engineer • Responsible-AI officer • Model auditor	Ethics • Transparency • Trust
Human–AI Collaboration	Prompt engineer • AI workflow designer • Cognitive-interface architect	Creativity • Context understanding
Industry & Operations	Predictive-maintenance expert • Human–robot collaboration manager • Smart-factory strategist	Technical reasoning • Safety
Robotics & Autonomous Systems	Robot-behaviour designer • Reinforcement-learning specialist • Multi-robot coordination engineer • Human-robot interaction designer • Ethical-autonomy advisor	Embodied intelligence • Trust • Safety by design
Public Sector & Law	Algorithmic-governance advisor • AI-policy analyst • Digital-law specialist	Accountability • Fairness
Education & Health	Learning-analytics expert • Clinical-AI interpreter • Digital-wellbeing coach	Empathy • Human judgment
Society & Communication	AI ethicist • Fact-checking analyst • AI literacy facilitator	Social responsibility • Critical thinking

Emerging High-Value Roles in the AI Economy

Hybrid experts who can make AI systems reliable, explainable, and human-compatible!

DOMAIN	EMERGING ROLES	CORE HUMAN VALUE	IMPACT
1. AI DEVELOPMENT & OVERSIGHT	• AI trainer • Explainability engineer • Responsible-AI officer • Model auditor	Ethics; Transparency; Trust	Builds trustworthy, auditable and safe AI systems that people can rely on.
2. HUMAN–AI COLLABORATION	• Prompt engineer • AI workflow designer • Cognitive-interface architect	Creativity; Context understanding; Human insight	Designs intuitive interactions and workflows that align AI with human goals and values.
3. INDUSTRY & OPERATIONS	• Predictive-maintenance expert • Human–robot collaboration manager • Smart-factory strategist	Technical reasoning; Safety; Efficiency	Optimizes operations and predicts issues while keeping people and systems safe.
4. ROBOTICS & AUTONOMOUS SYSTEMS	• Robot-behaviour designer • Reinforcement-learning specialist • Multi-robot coordination engineer • Human–robot interaction designer • Ethical-autonomy advisor	Embodied intelligence; Trust; Safety by design	Creates autonomous systems that act safely, collaborate with people, and adapt to the real world.
5. PUBLIC SECTOR & LAW	• Algorithmic-governance advisor • AI-policy analyst • Digital-law specialist	Accountability; Fairness; Privacy & rights	Ensures AI is used fairly, legally and in the public interest.
6. EDUCATION & HEALTH	• Learning-analytics expert • Clinical-AI interpreter • Digital-wellbeing coach	Empathy; Human judgment; Wellbeing	Improves outcomes by combining data and AI with care, empathy and human judgment.
7. SOCIETY & COMMUNICATION	• AI ethicist • Fact-checking analyst • AI literacy facilitator	Social responsibility; Critical thinking; AI literacy	Builds an informed, ethical and resilient society in the age of AI.

WHAT MAKES THESE ROLES HIGH-VALUE?

Require uniquely human strengths (judgment, ethics, empathy, creativity). + Bridge the gap between AI capabilities and real human needs. + Improve trust, safety, fairness and accountability in AI systems. + Drive innovation, productivity and positive impact at scale. + Shape a future where AI serves people and society.

KEY TAKEAWAY

The future belongs to **hybrid experts** who combine domain knowledge, human values and AI skills to solve real problems responsibly.

Human Values + AI Skills + Domain Expertise = High Value Impact

Reskilling for the AI Era

Skill Domain	Key Skills	Why It Matters
Cognitive & Problem-Solving	Analytical thinking • Complex problem-solving • Systems thinking • Design reasoning • AI-augmented decision-making	As AI automates analysis, humans must focus on framing problems, interpreting outputs, and designing creative, high-impact solutions.
Artificial Intelligence and Robotics	AI and data literacy • Robotics knowledge • Automation design • Human–robot collaboration • Cybersecurity and digital ethics	The new digital baseline requires understanding, supervising, and questioning intelligent systems rather than just using them.
Human & Social Intelligence	Communication • Empathy • Cross-cultural collaboration • Negotiation • Leadership in human–AI teams	Value shifts from execution to empathy, creativity, and trust—areas where humans remain irreplaceable.
Learning & Adaptability	Self-directed learning • Cognitive flexibility • Curiosity • Resilience • Growth mindset	Lifelong learning becomes the central professional competency—learning, unlearning, and relearning at speed.
Ethical, Strategic & Sustainability	Ethical reasoning • Sustainability awareness • Policy & governance literacy • Foresight • Inclusion & social responsibility	Work must align with human and planetary goals—balancing innovation with accountability and long-term vision.

Reskilling for the AI Era

Thriving in an AI-driven world requires new skills, mindsets and values.

SKILL DOMAIN	KEY SKILLS	WHY IT MATTERS	OUTCOMES
1 COGNITIVE & PROBLEM-SOLVING	• Analytical thinking • Complex problem-solving • Systems thinking • Design reasoning • AI-augmented decision-making	As AI automates analysis, humans must focus on framing problems, interpreting outputs, and designing creative, high-impact solutions.	• Better decisions • Innovative solutions • Strategic impact • Human-AI advantage
2 ARTIFICIAL INTELLIGENCE AND ROBOTICS	• AI and data literacy • Robotics knowledge • Automation design • Human–robot collaboration • Cybersecurity and digital ethics	The new digital baseline requires understanding, supervising, and questioning intelligent systems rather than just using them.	• Effective AI use • Safer systems • Responsible innovation • Future-ready capability
3 HUMAN & SOCIAL INTELLIGENCE	• Communication • Empathy • Cross-cultural collaboration • Negotiation • Leadership in human–AI teams	Value shifts from execution to empathy, creativity, and trust—areas where humans remain irreplaceable.	• Stronger relationships • Inclusive teamwork • Trust and influence • Human-centered impact
4 LEARNING & ADAPTABILITY	• Self-directed learning • Cognitive flexibility • Curiosity • Resilience • Growth mindset	Lifelong learning becomes the central professional competency—learning, unlearning, and relearning at speed.	• Continuous growth • Adaptability to change • Career resilience • Long-term relevance
5 ETHICAL, STRATEGIC & SUSTAINABILITY	• Ethical reasoning • Sustainability awareness • Policy & governance literacy • Foresight • Inclusion & social responsibility	Work must align with human and planetary goals—balancing innovation with accountability and long-term vision.	• Ethical leadership • Sustainable impact • Social trust • Purpose-driven work

HOW TO RESKILL SUCCESSFULLY

1. ASSESS — Identify future skills gaps and strengths. →

2. LEARN — Build AI literacy and human strengths continuously. →

3. APPLY — Practice in real projects and cross-functional collaboration. →

4. CONNECT — Learn from others and build diverse networks. →

5. ADAPT — Stay curious, adapt fast, and evolve continuously.

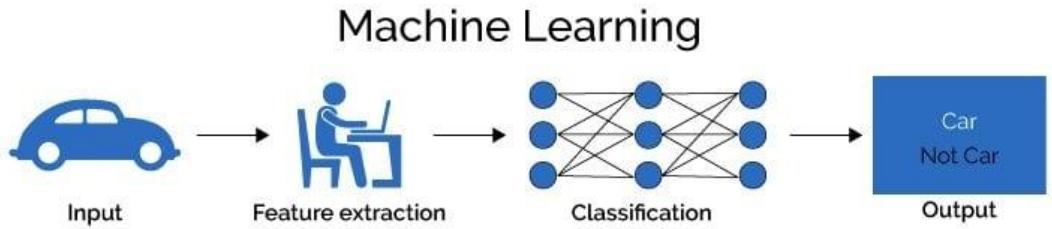
KEY TAKEAWAY

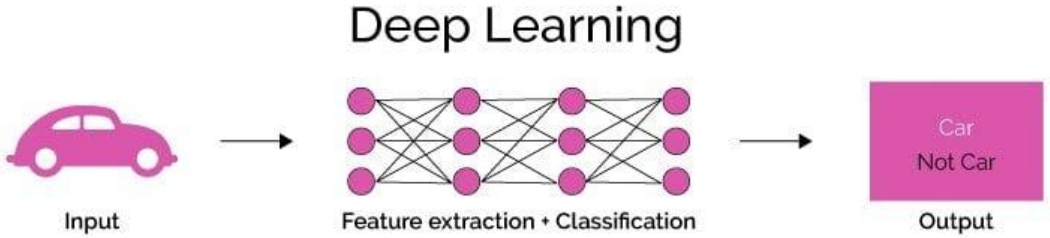
The future belongs to those who combine AI fluency with uniquely human strengths.
Reskill today. Lead tomorrow. Create a better future for all.

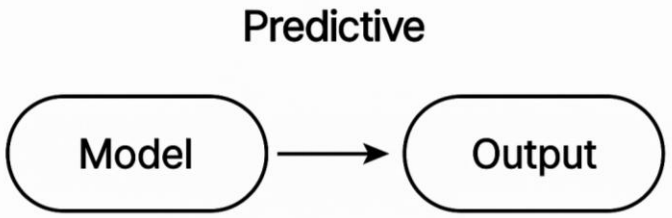
AI Fluency + Human Strengths + Purpose = High Impact

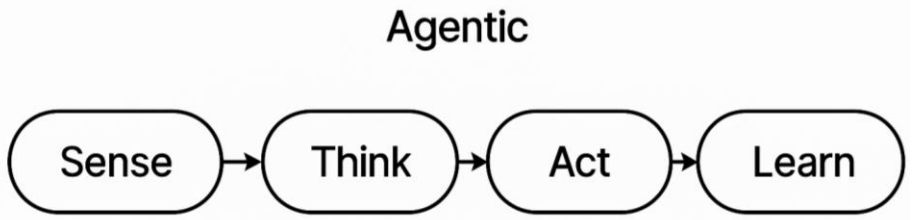
Limits of Deep Learning

- **Brilliant but Passive!**
- **Deep nets can predict, but they can not plan. They lack goals, intents, and common sense**
- This sets the **stage for Agentic AI: From Prediction to Decision and Action…**
- The next leap is **agency — AI** that **senses, reasons,** and **acts** toward goals
- **Predictive (Model→Output) vs Agentic (Sense→Think→Act→Learn)**





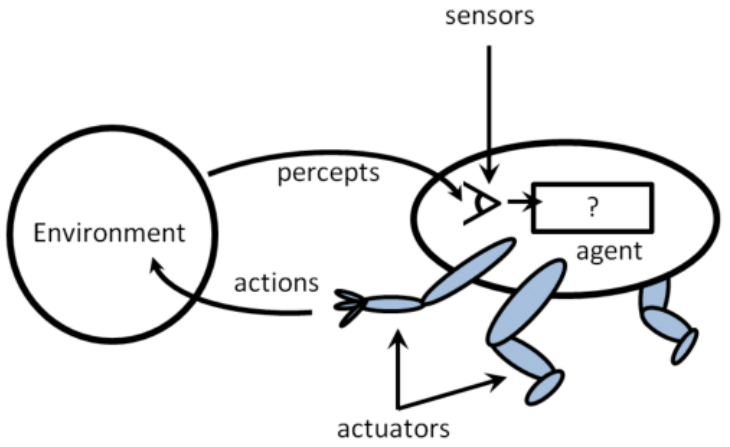




Autonomous Agents and Multi-Agent Systems

Agent (1995):

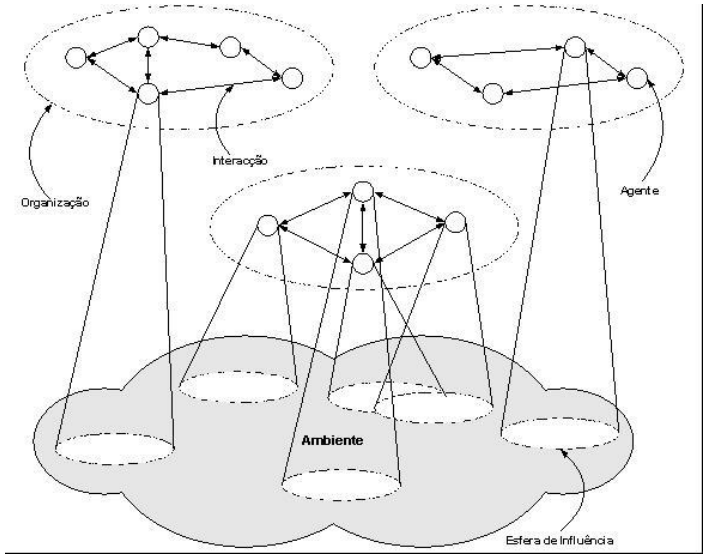
"Computational System, situated in a given **environment**, that has the ability to **perceive** that environment using **sensors** and **act**, in an **autonomous way**, in that environment using its **actuators** to fulfill a given **function**."



From Russel and Norvig, "AI: A Modern Approach", 1995

Multi-Agent System (1995):

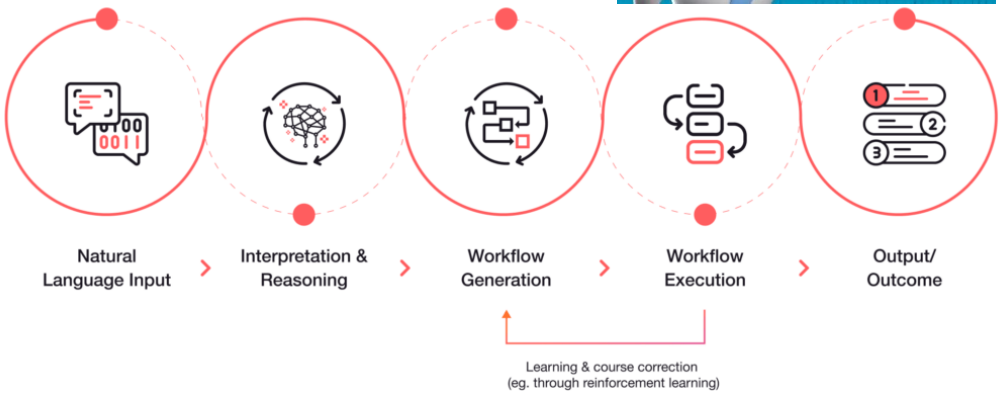
- Agents exhibit **autonomous behavior**
- **Interact** with other agents in the system



Agentic AI

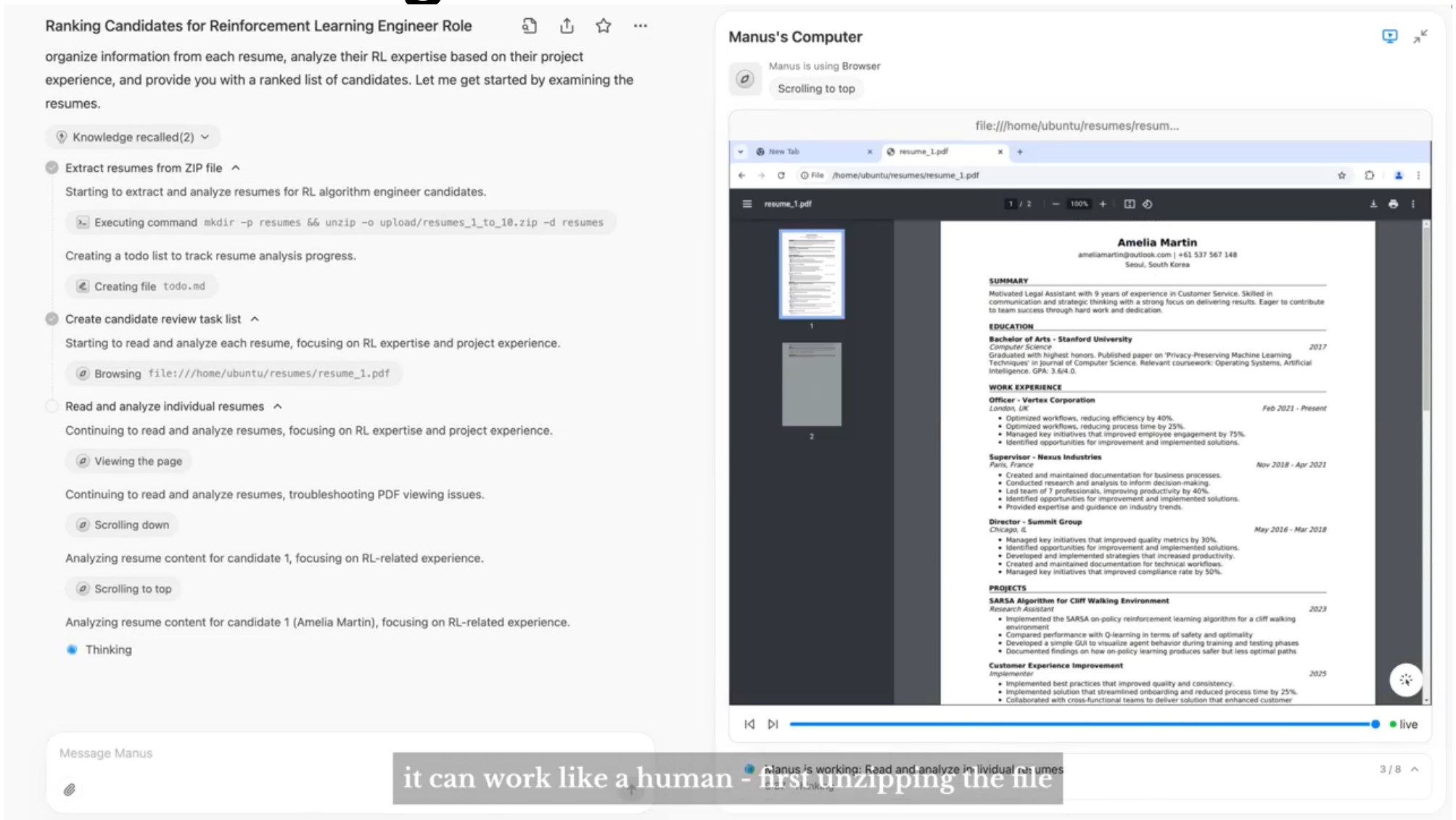
- **Autonomy:** Ability to initiate and complete tasks with limited direct human supervision, with great flexibility and efficiency in executing tasks
- **Reasoning:** Sophisticated decision-making based on context and trade-offs
- **Reinforcement Learning:** Dynamically evolve by interacting with their environment and receiving feedback from these interactions.
- **Language Understanding:** Capacity to understand and follow complex instructions
- **Workflow Optimization:** Efficient execution of multi-step complex processes

Feature	Agentic AI	Generative AI	Traditional AI
Primary Function	Goal-oriented action & decision-making	Content generation (text, code, images, etc.)	Focused on automating repetitive tasks
Autonomy	High – Operates with minimal human oversight	Variable – May require user prompts or guidance	Low – Relies on specific algorithms and set rules
Learning	Reinforced Learning – Improves through experience	Data-driven learning – Learns from existing data	Relies on predefined rules and human intervention



https://aisera.com/blog/agentic-ai/

Agentic AI – Manus AI



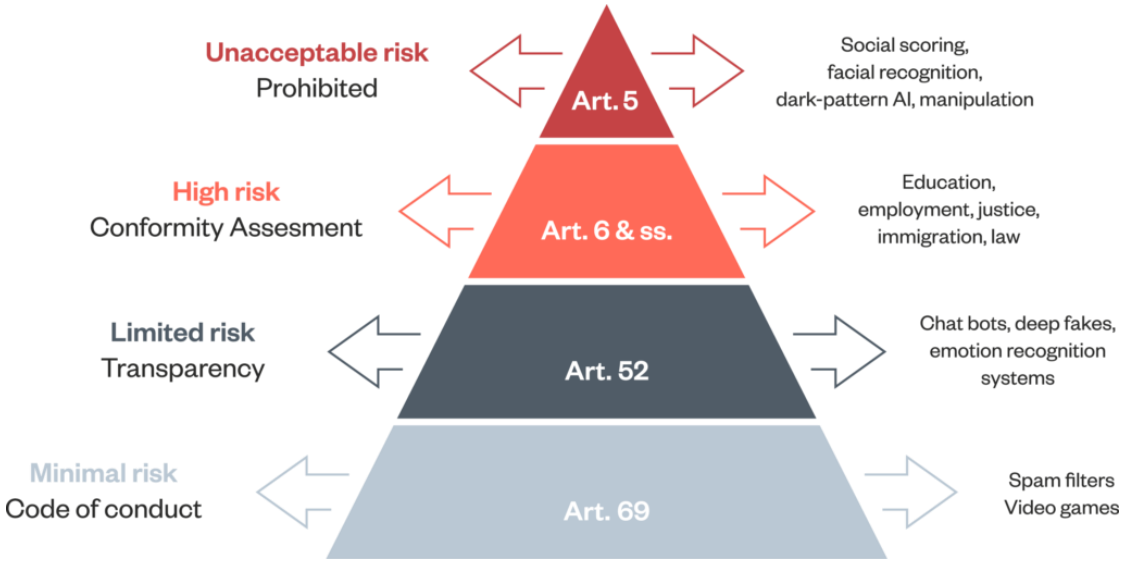
https://www.youtube.com/watch?v=K27diMbCsuw

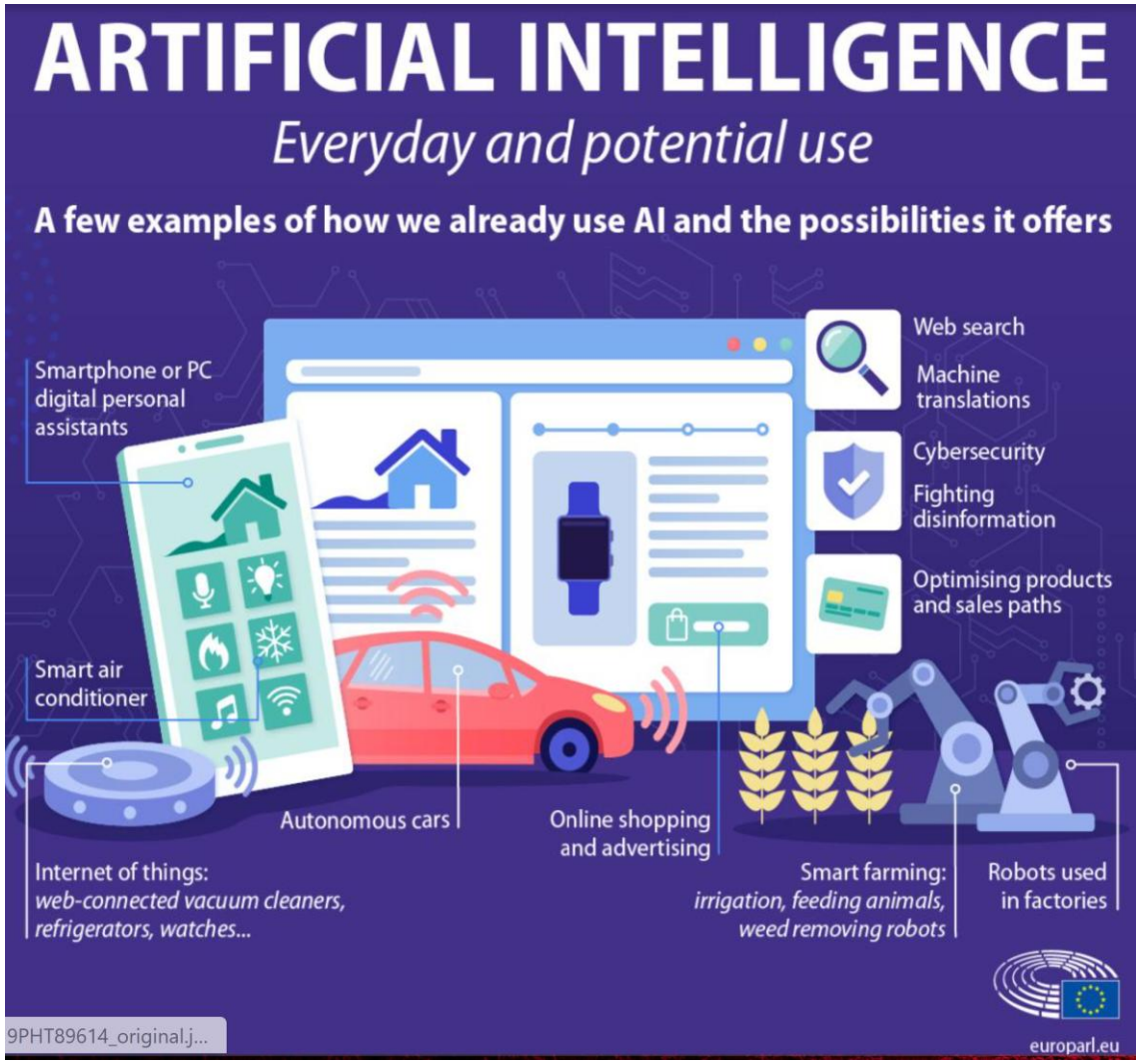
New & Emerging Trends (2025+)

- **Agentic AI Rises** — Autonomous agents that reason, plan, and act toward goals
- **Large Behavior Models (LBMs)** — Models learning from actions and interactions, not just text
- **Multi-Agent Collaboration** — Intelligent agents cooperate and negotiate to solve complex tasks
- **Responsible & Regulated AI** — Transparency, fairness, and compliance standards
- **Edge & On-Device AI** — Efficient, private models running locally on devices /robots
- **Hybrid Human–AI Teams** — Shared intelligence combining human oversight and machine efficiency

EU AI Act – Regulating the Past…

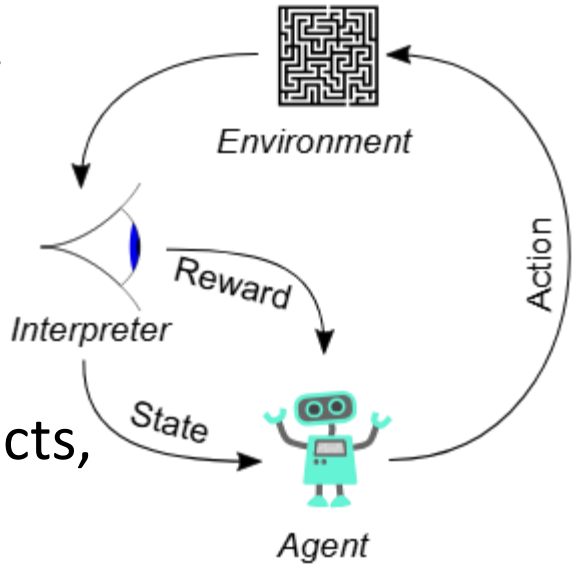
- **First regulation on artificial intelligence**
- **AI can create many benefits:**
  - better healthcare
  - safer and cleaner transport
  - more efficient manufacturing
  - cheaper and more sustainable energy.





The Rise of Deep Reinforcement Learning (DRL)

- **Beyond Short-Term Thinking**
  - LLMs have limited context windows — they forget.
  - Memory and planning enable continuity and strategic reasoning
- **Reflection and Self-Improvement**
  - Evaluate their own reasoning, detect failures, and adapt
  - Self-reflection transforms agents from reactive to self-correcting
- **Tools/Actuators Use and World Interaction**
  - Intelligence changes into capability
- **Learning by Doing**
  - Reinforcement Learning teaches through feedback — an agent acts, receives a reward, and updates its policy to improve next time.



Strong AI – Star Wars and C3PO

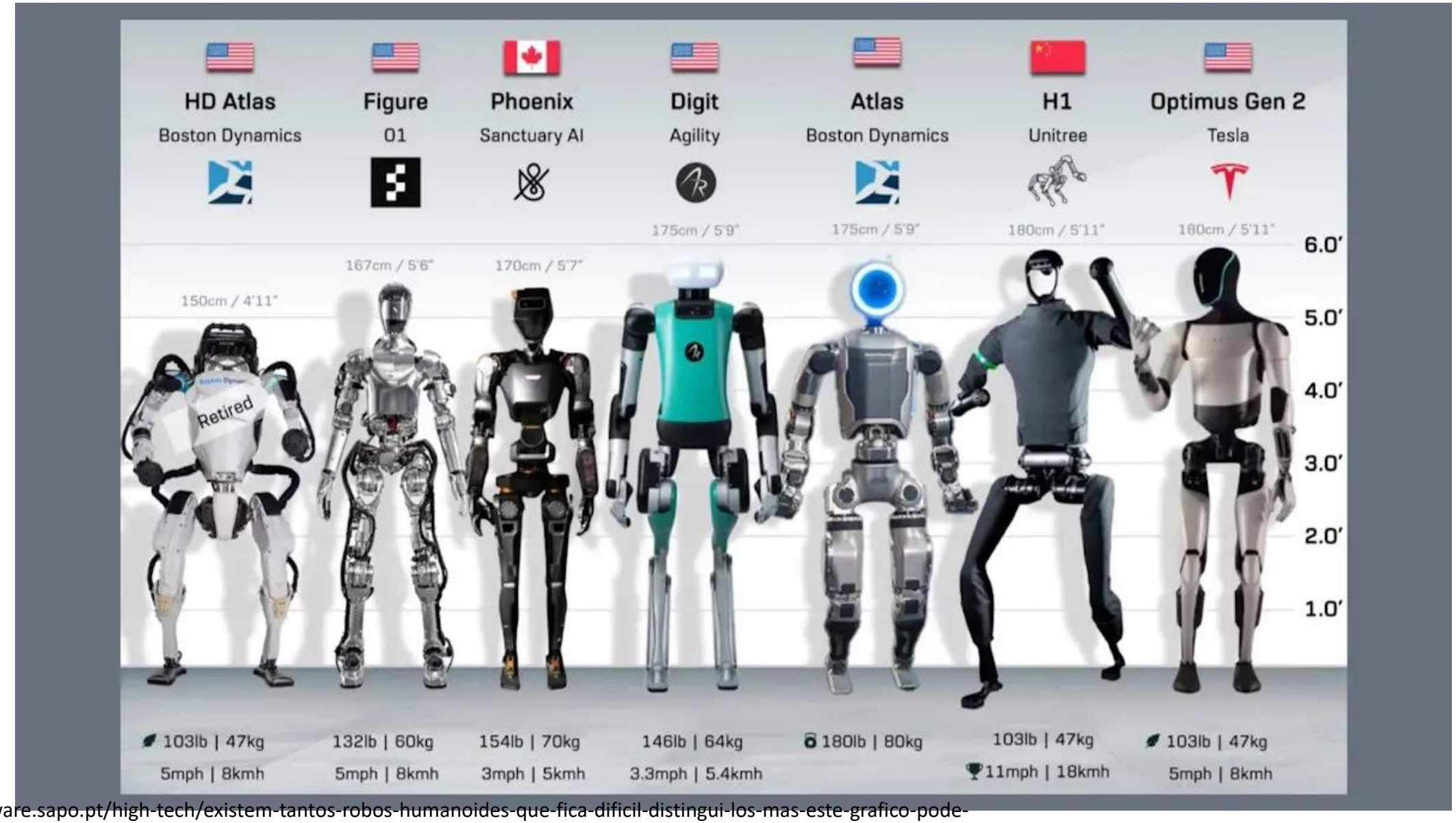
Video: Lucasfilm Ltd. (1977). Star Wars: Episode IV - A New Hope. [Film]. 20th Century Fox.

AI in Robotics

Robotics – Atlas Robot

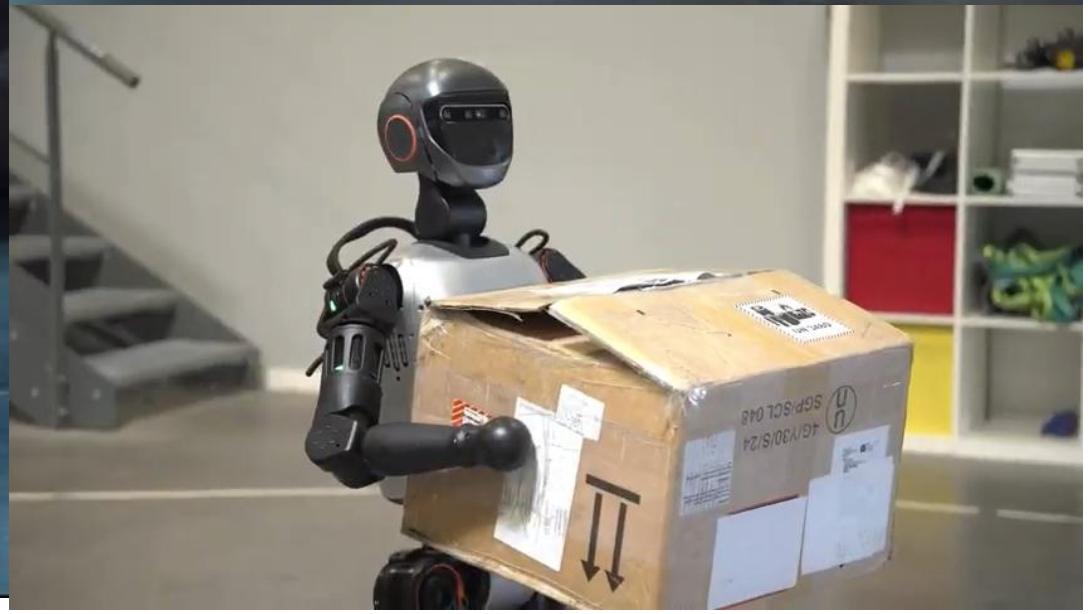
Video: Boston Dynamics: Atlas Gets a Grip - https://www.youtube.com/watch?v=-e1_QhJ1EhQ&ab_channel=BostonDynamics

Robotic Humanoids



https://pplware.sapo.pt/high-tech/existem-tantos-robos-humanoides-que-fica-dificil-distingui-los-mas-este-grafico-pode-ajudar/?fbclid=IwY2xjawI1Zg9leHRuA2FlbQIxMQABHS_EdekrvewLEgIyq3RZRfPy-HaU4MdNtaFgqa6bT2lkcoYfBoF_Jkqd9w_aem_RO6nDQ16bQJ51jD6bM6-TQ

Unitree and Booster Robots

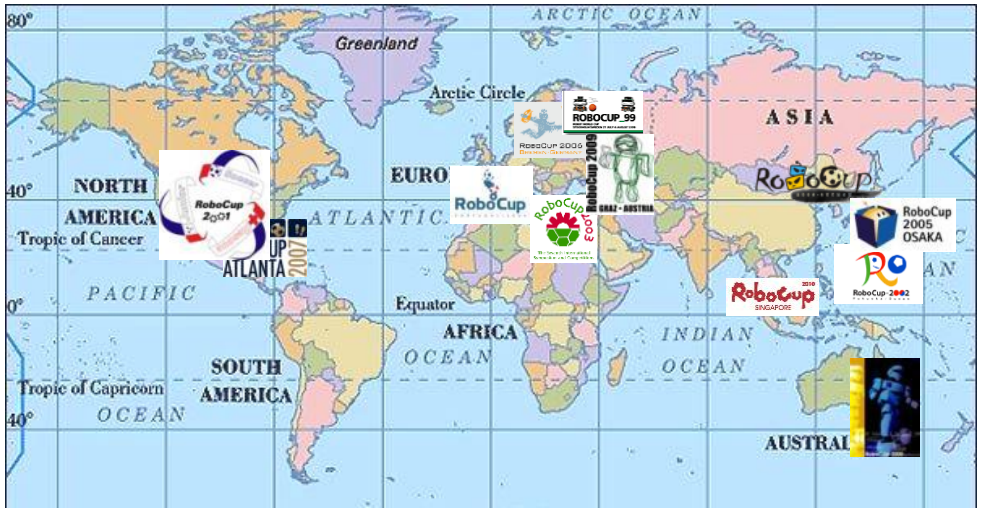


China New Year Celebration Humanoid Robotics

https://www.google.com/search?q=chinese+new+year+video+unitree&oq=chinese+new+year+video+unitree&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIKCAEQABiiBBiJBTIKCAIQABiABBiiBDIHCAMQABjvBTIHCAQQABjvBTIHCAUQABjvBdIBBzk4MGowajeoAgiwAgHxBUVOrobSVba-&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:0d729985,vid:R40IDdAkRZM,st:0

RoboCup: Objectives

- Joint International Project:
  - **(Distributed) Artificial Intelligence**
  - **Intelligent Robotics**
- **Soccer** – Central Research Topic:
  - **Very complex collective game**
  - **Huge number of technologies** involved:
    - Autonomous Agents, **Multi-Robot Systems**, **Cooperation**, **Communication**, **Strategic Reasoning**, Robotics, Sensor Fusion, Real-Time Reasoning, **Machine Learning,** etc
- **5 Challenges:** Soccer, Rescue, @Home, Industrial, Junior
- **17 Leagues, 2500 Humans and 2000 Robots!**
- Main Goal: ***"By 2050, develop a team of fully autonomous humanoid robots that may win against the human world champion team in soccer!"***



RoboCup Leagues and Challenges

Industrial

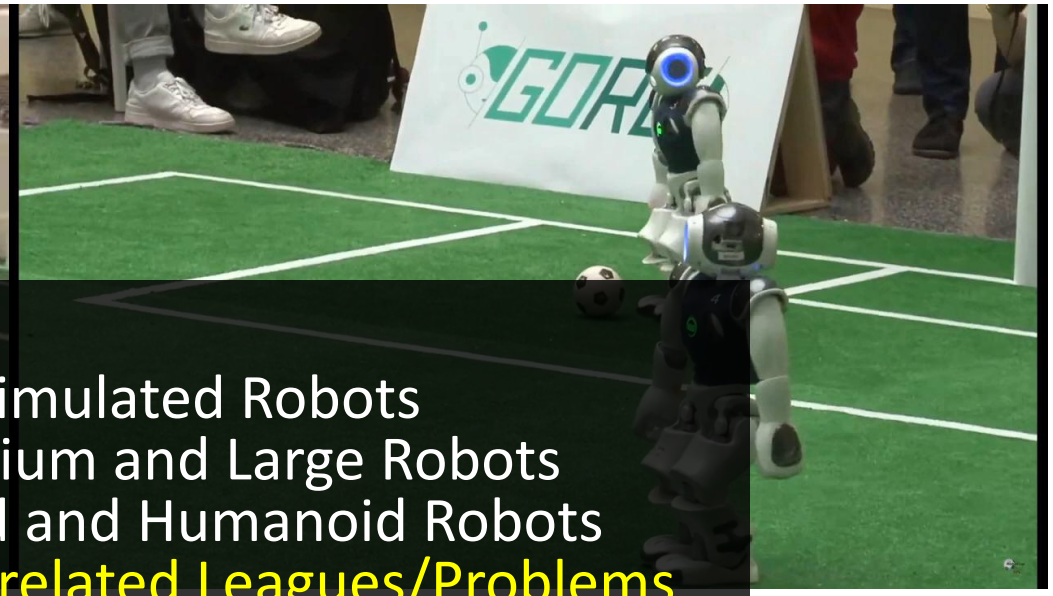
Rescue

@Home

Soccer

RoboCup - Robotic Soccer Competitions

Middle Size League



Standard Platform League

RoboCup

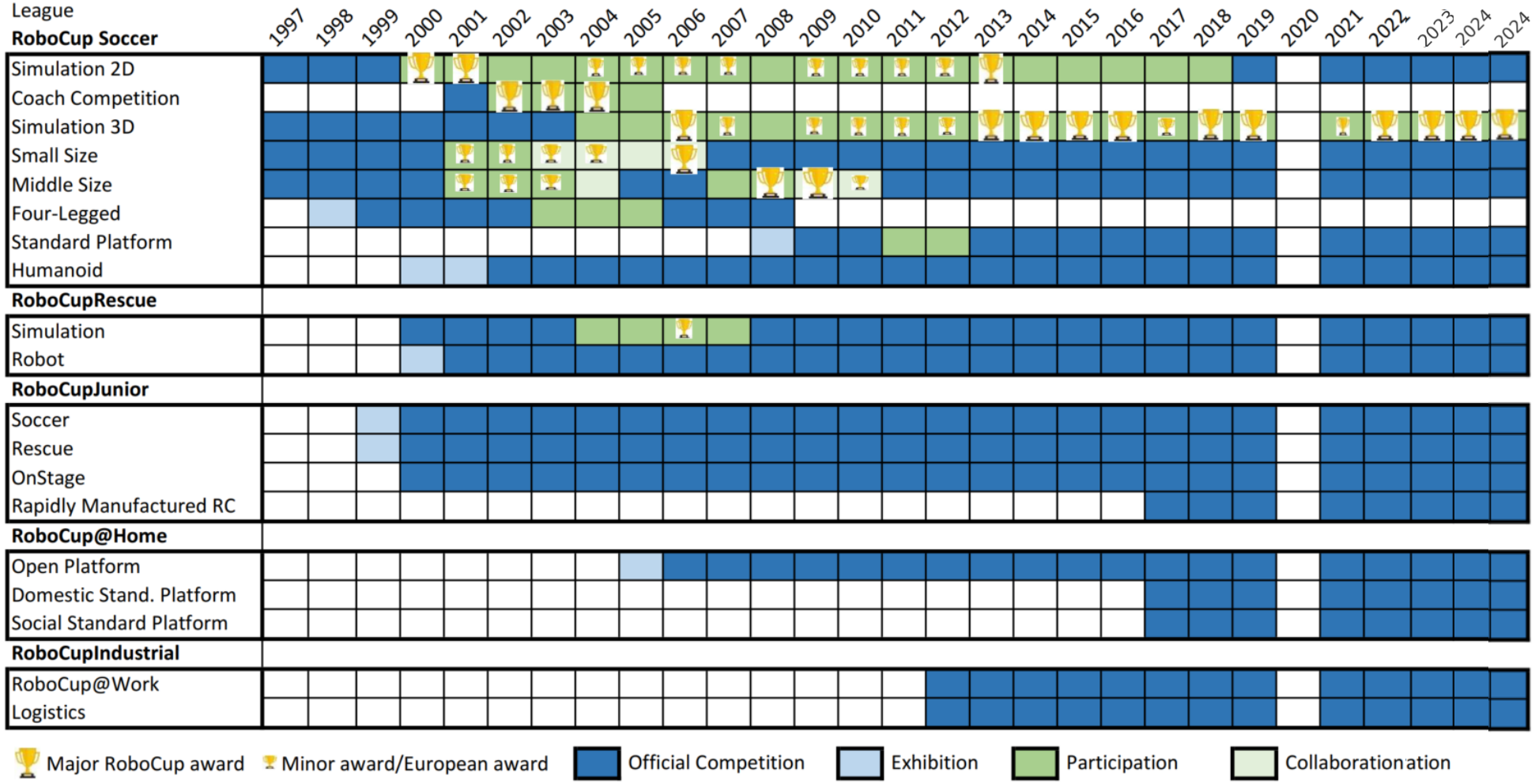
- Real, Standard, Simulated Robots
- Mini, Small, Medium and Large Robots
- Wheeled, Legged and Humanoid Robots
- Distinct but interrelated Leagues/Problems
- Only a Few Research Groups able to develop code that works in more than one league!

Small Size League

Humanoid League

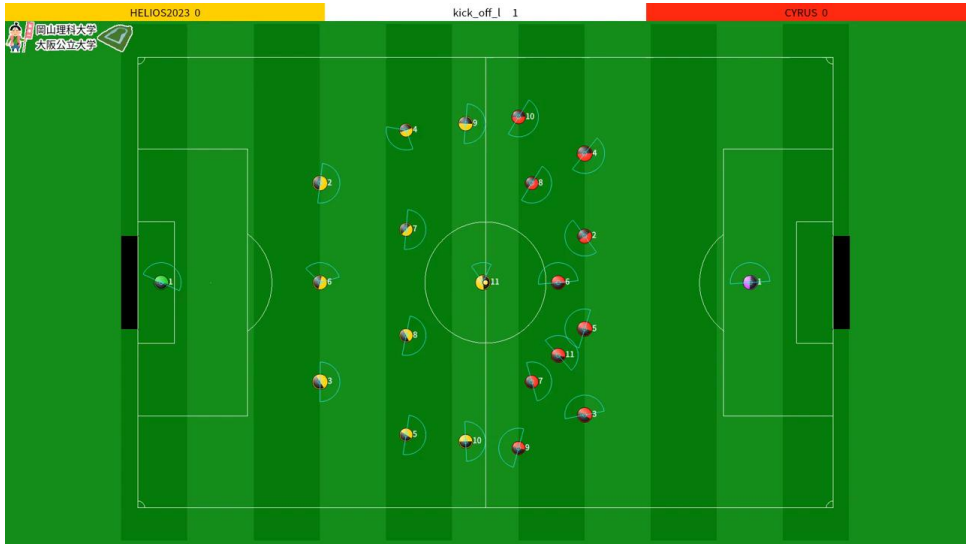
RoboCup Leagues and Participations

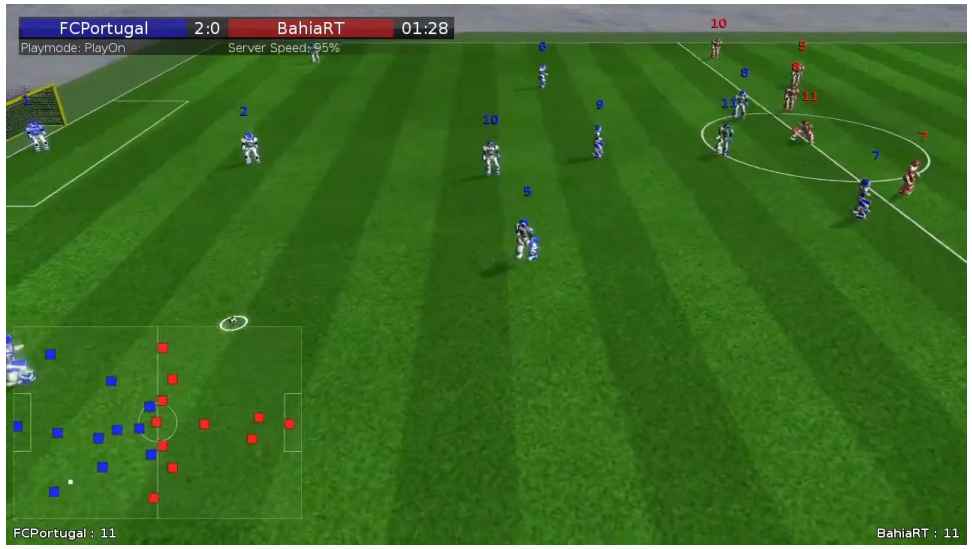
FC Portugal Team (FEUP/UAveiro)



Simulation 3D League (Humanoids)

- **Realistic physics and humanoid robot model:**
  - Spheres in 2004, Humanoids in 2007, NAO Robot Model: 2008, Heterogeneous Robots: 2013
- **Strong relation with SPL and Humanoid**
- 2 vs 2 -> 6 vs 6 -> 9 vs 9 -> 11 vs 11
- Server/Simulator (**SimSpark**)
  - Updates world state
  - Forces the "**laws of physics**": collisions, drag, gravity, ...
  - Send sensor information (**perceptors**)
  - Executes actions (**effectors**)
  - Enforces **soccer rules – referee**
- **Impossible to create competitive skills by hand!**



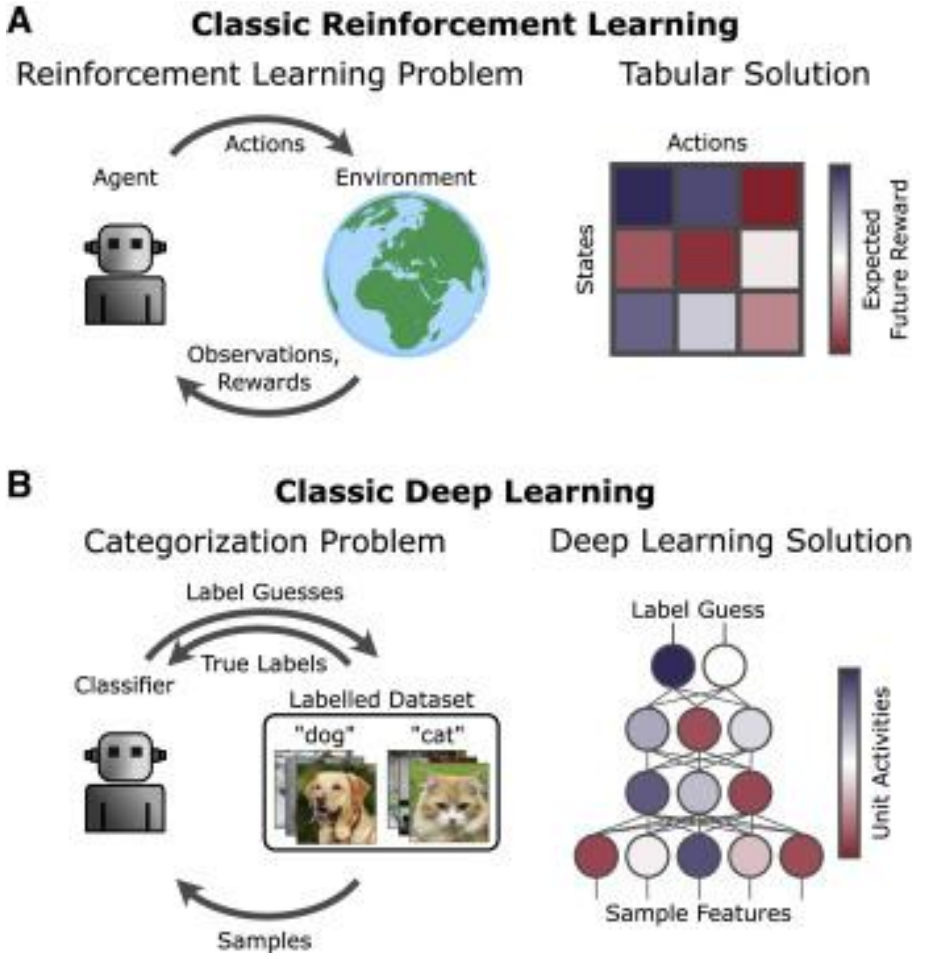


Simulation 3D League (Humanoids)

Simulation 3D League Challenges

- **Real-time, realistic, multi-robot simulation**
- Several sources of sensorial information: **visual, auditory, and physical**
- **Unreliable** and low-bandwidth **communication**
- **Heterogeneous robots** (5 different types)
- Impossible to generate **competitive skills** by hand
- **Multi-objective,** partially **cooperative,** partially **competitive environment**
- Need to **transform** very **low-level actions** (use motors to move joints in time) **into high-level skills (walking, kicking, dribbling)**
- Need to create **complex collective actions (passes, setplays, formations)**
- **Evolving rules** and challenges

Deep Reinforcement Learning (DRL)



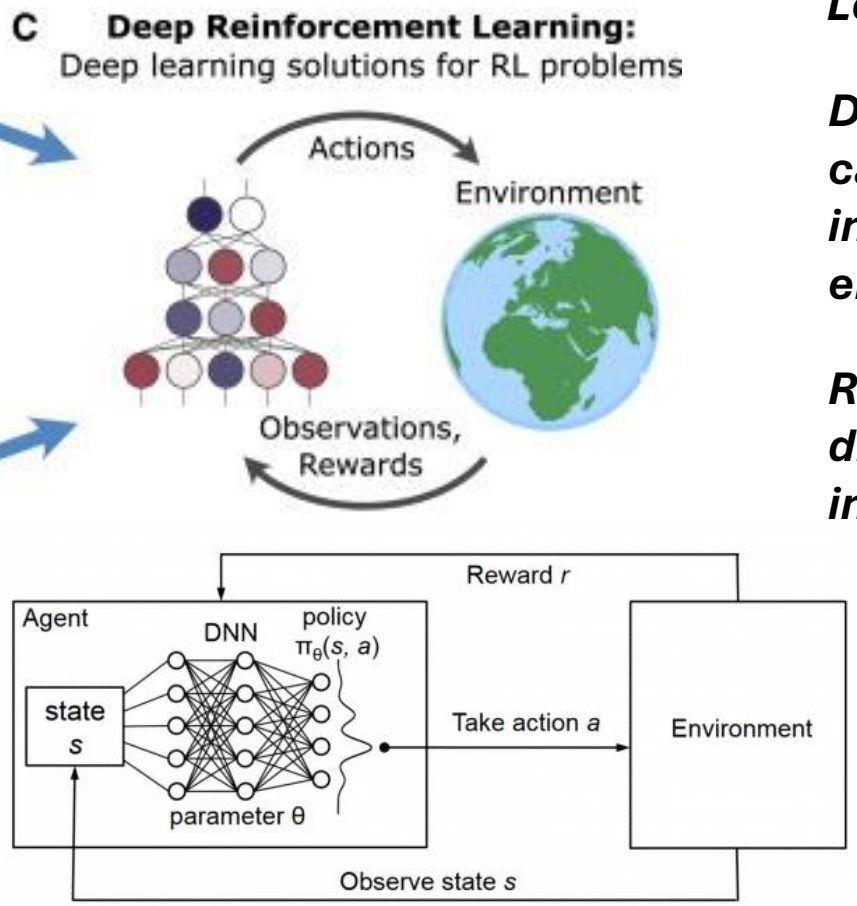


Image: https://ucsdneuro.wordpress.com/2021/06/13/diving-deep-into-the-brain-a-case-for-deep-reinforcement-learning-in-neuroscience/

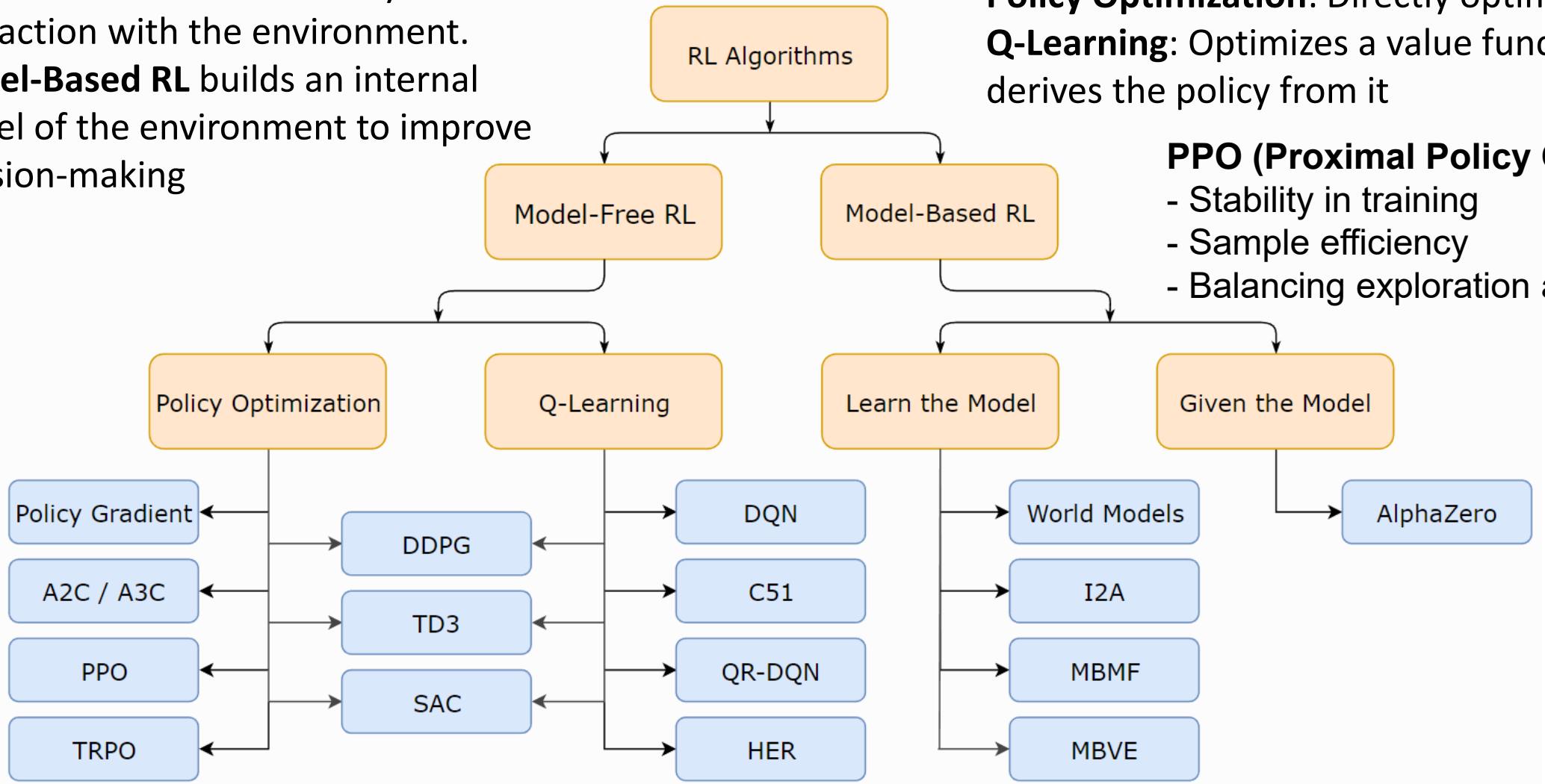
Brains + Experience = Deep Reinforcement Learning

DRL proved machines can outperform humans in dynamic environments

Robots can now learn directly from physical interaction

Deep Reinforcement Learning (DRL)

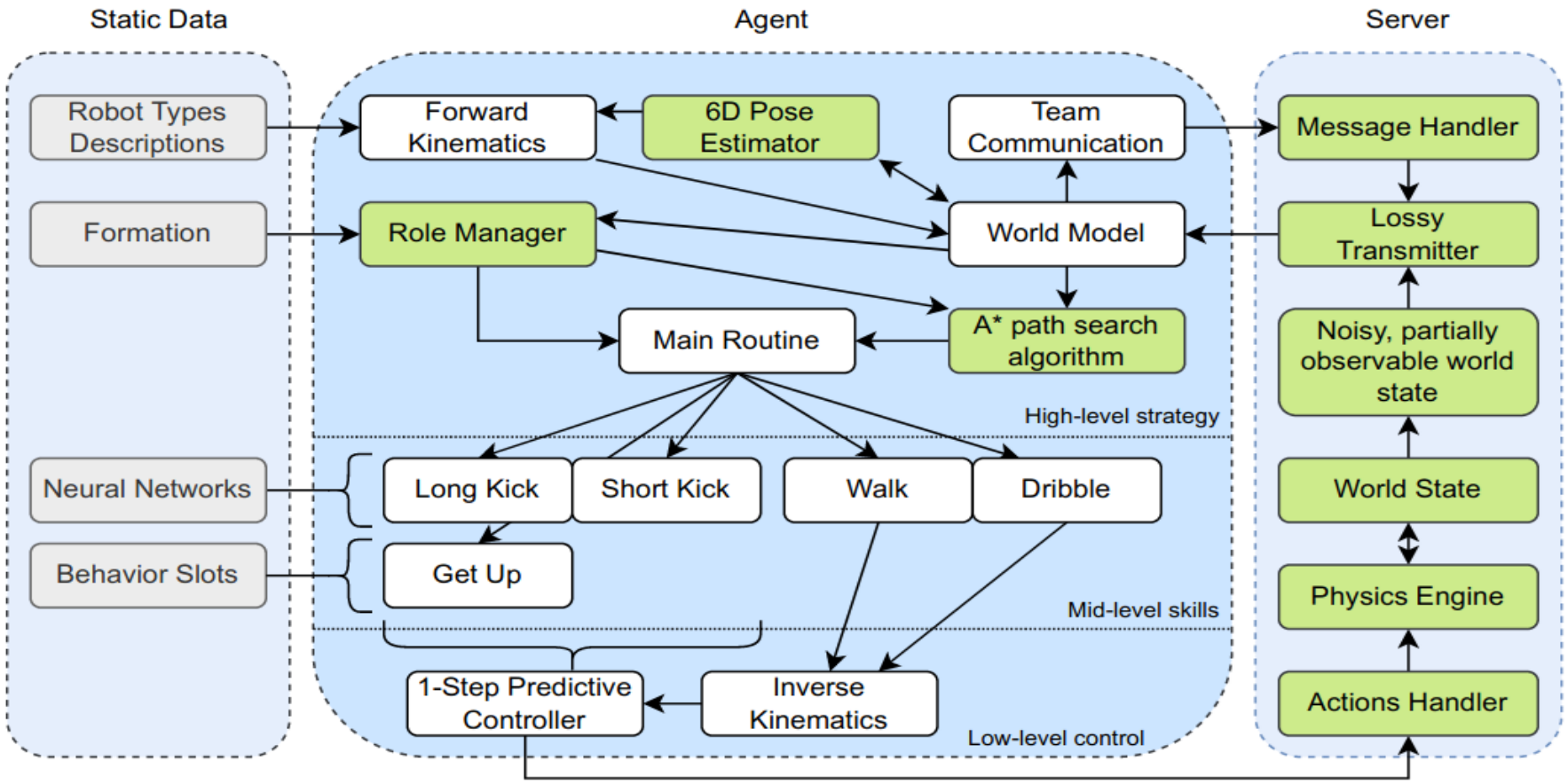
Model-Free RL learns directly from interaction with the environment.
Model-Based RL builds an internal model of the environment to improve decision-making



Policy Optimization: Directly optimizes policy
Q-Learning: Optimizes a value function and derives the policy from it

PPO (Proximal Policy Optimization)
- Stability in training
- Sample efficiency
- Balancing exploration and exploitation

Robot/Team Architecture



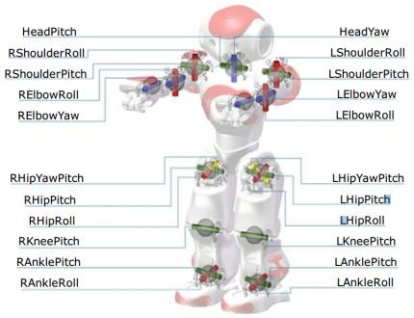
- **Short kick (3 - 9m) for passes and long kick (17 - 19m) for shooting**
- **Omnidirectional walk (0.7 - 0.9 m/s)**
- **Dribble (1.2 - 1.4 m/s)**
- **Get Up (3 variations per robot type: front, back, side)**

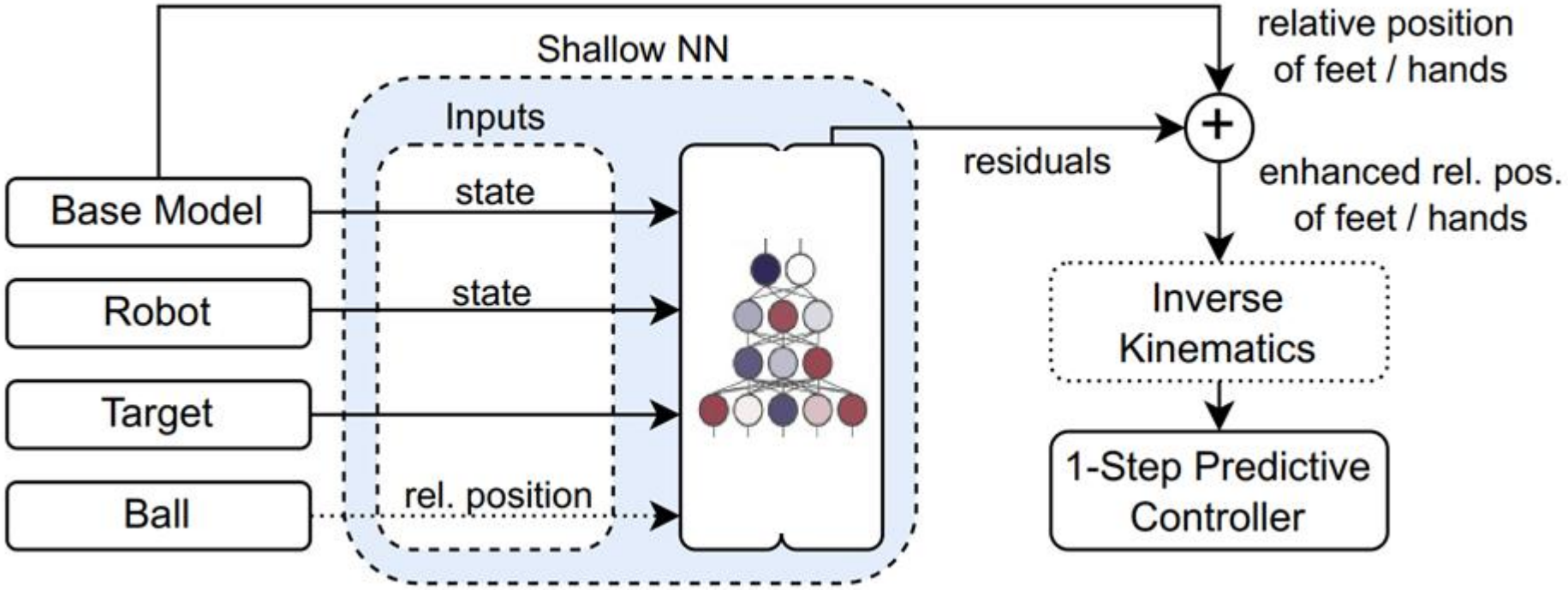
Model Architecture

- **Enhanced motion control pipeline** for a robot, integrating **neural networks and predictive control**

- **Learning-based and physics-based approaches**.
- **NN acts as an enhancement layer**, improving traditional motion models
- P**recise movements**, such as **kicking or dribblling a ball**

Model Architecture for the Long/Short Kick, Walk, and Dribble skills



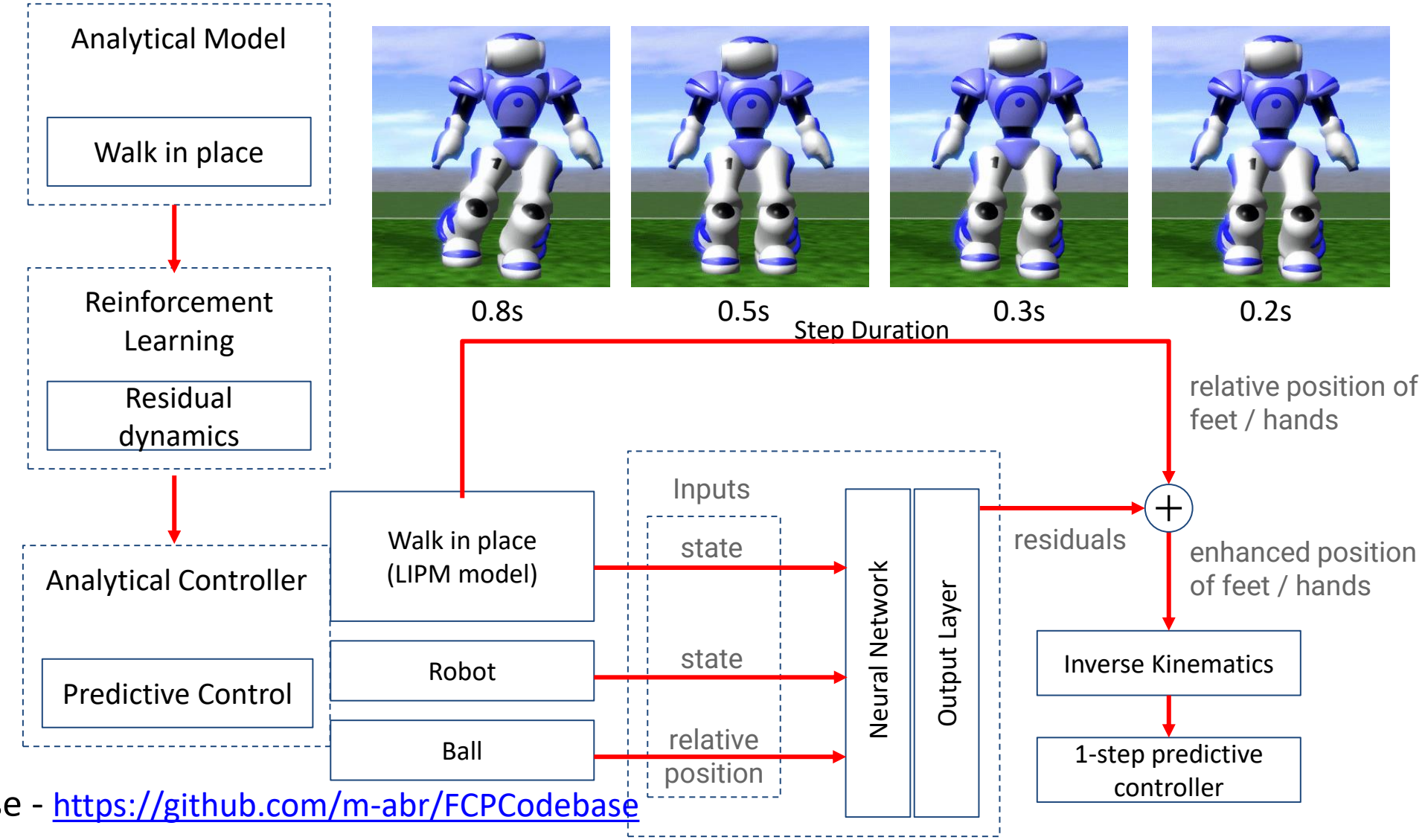


Optimization is performed by the Proximal Policy Optimization algorithm extended with Proximal Symmetry Loss

DRL for Learning to Sprint

DRL for Learning to Sprint

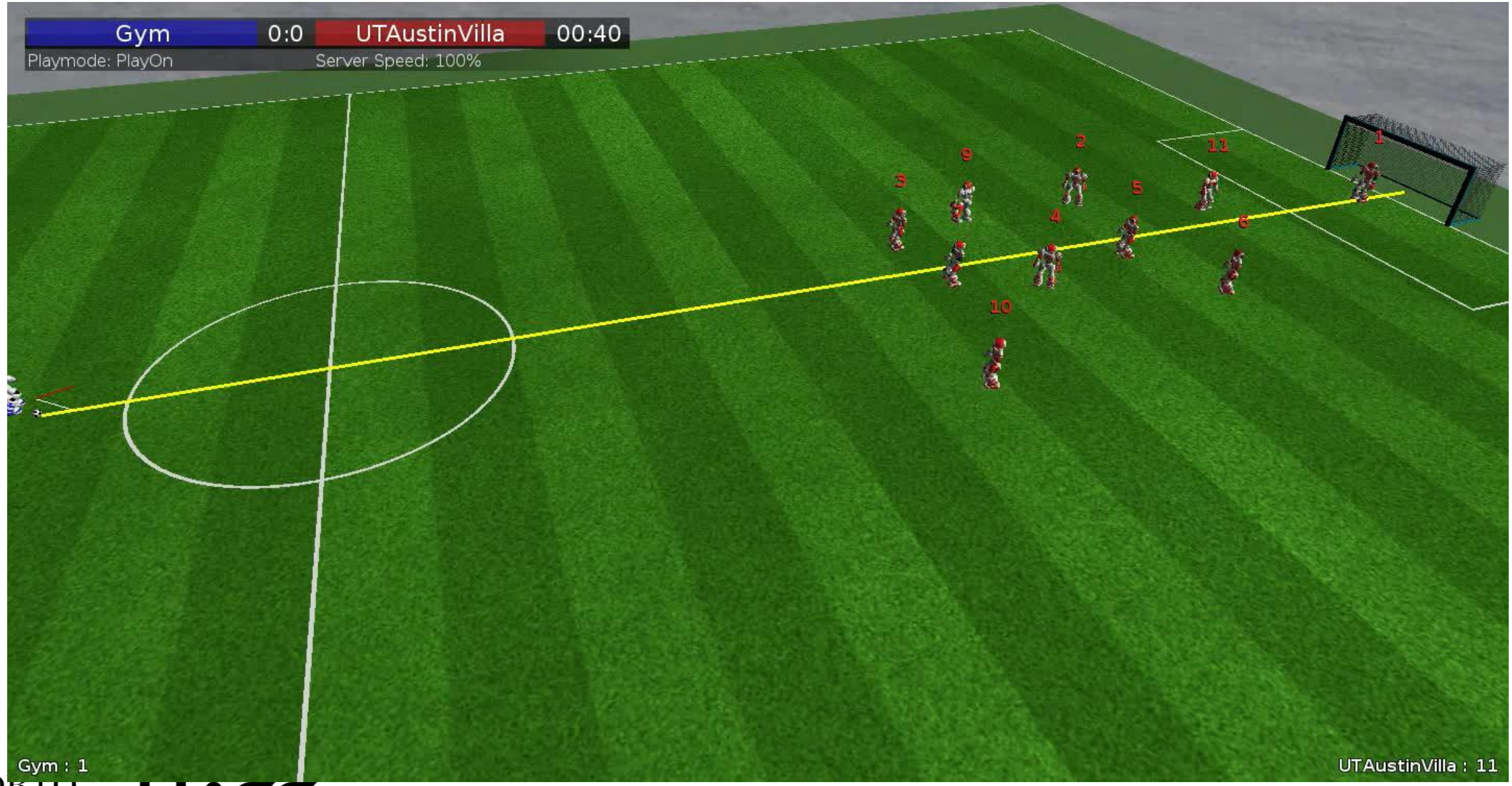
DRL for Learning to Dribble



Code Release - https://github.com/m-abr/FCPCodebase

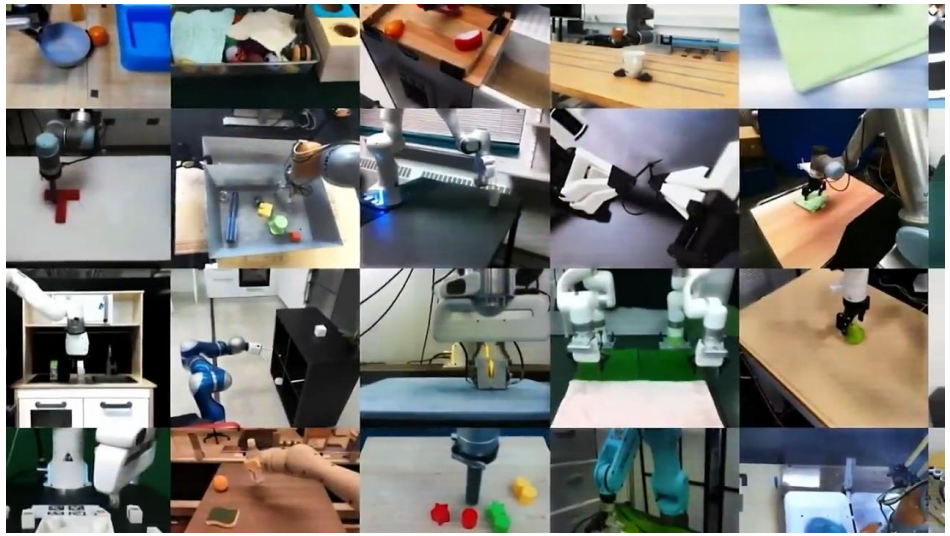
DRL for Learning to Dribble

DRL for Learning to Dribble

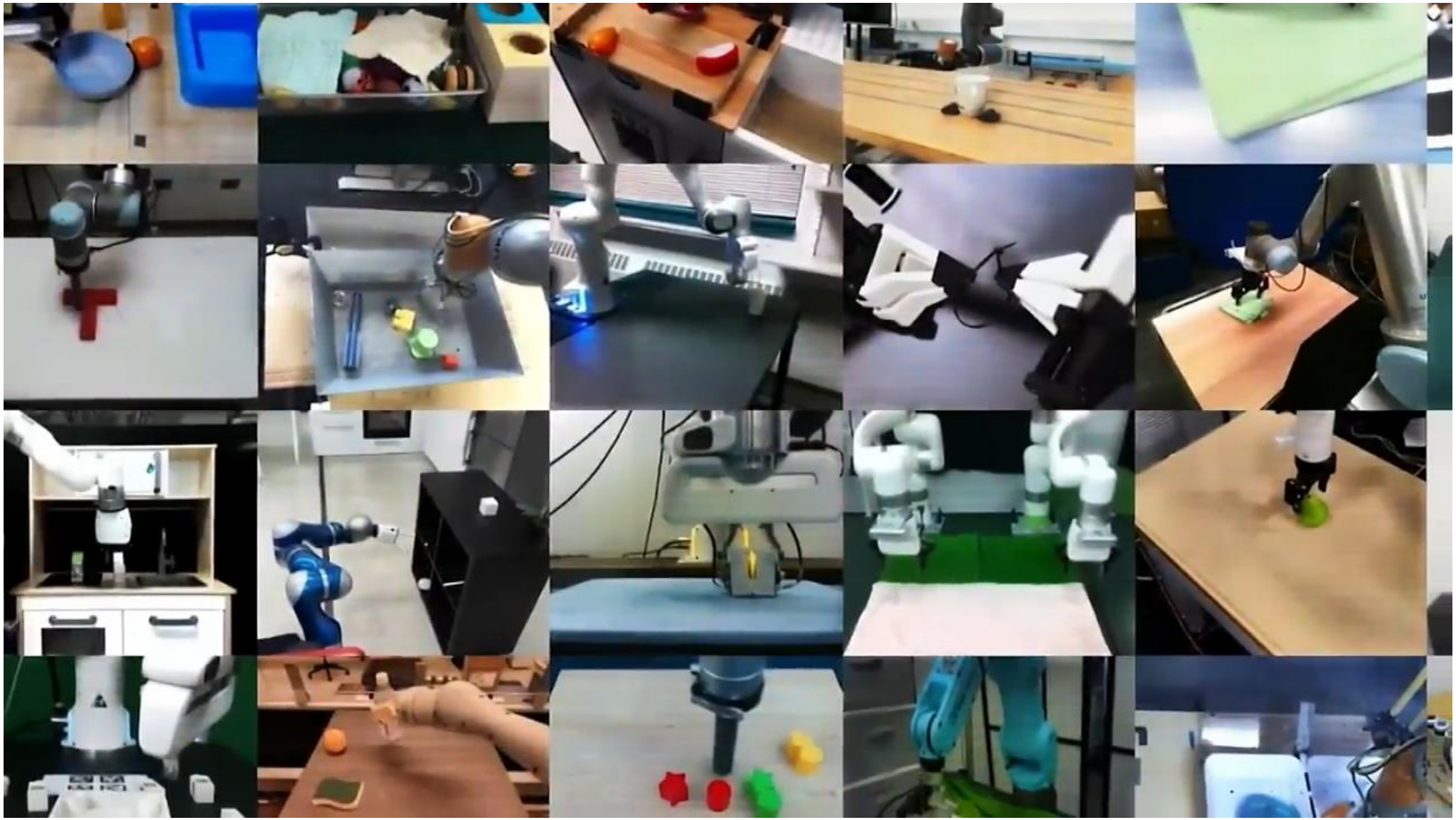


Large Behavior Models - LBMs

- **LBMs** go beyond processing language. They're designed to **interpret, predict, and generate complex sequences of human-like actions and behaviors**
- While LLMs focus on text and dialogue, LBMs specialize **in behavioural patterns**, **decision-making** processes, and **interactive scenarios**
- LLMs try to guess the next word, while **LBMs try to guess the next action or behaviour**
- LBMs are enhancing robots' abilities to move naturally and respond intuitively to their surrounding
- LBMs rely on:
  - **Transformer Architecture**: Similar to LLMs but adapted to handle sequences of actions/behaviours
  - **Multi-Modal Learning:** Integrating visual, spatial, and temporal data to enhance understanding
  - **Reinforcement Learning:** Learning from interactions and feedback to improve behavior over time



Transformers and DRL: RT-X



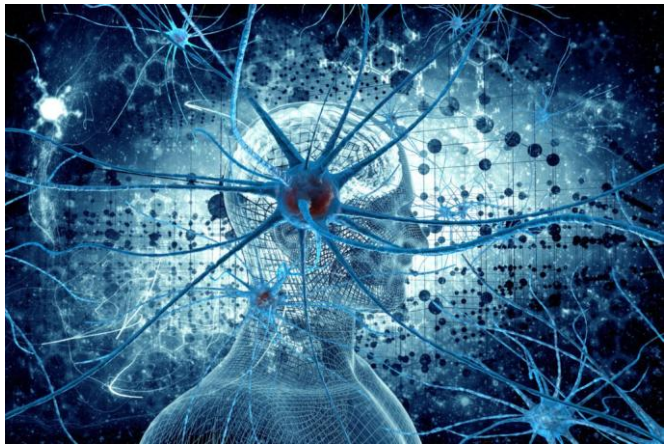
Conclusions

- **AI has become a Partner no longer a Tool!**
- We've travelled from **Symbolic Logic to** self-learning **Agents and Robots**
- Impossible to prevent **AI** use in **All Areas** of **of Education and Research**
- **Agentic AI, LBMs** and **New GenAI** and **DRL** powered and trained **Robots**
- **Are We Ready** for **Self-Improving Intelligent Machines?**
- **Next generation of AI** won't just predict — it will **act, learn,** and **evolve**
- **By 2030, AI agents** will be integrated into **every digital platform/robotic system —** from industry to healthcare to daily life (**LLMs, DRL, LBMs)**
- **Our challenge is to ensure AI Grows With Us, Not Against Us!**

Artificial Intelligence – The Future

- **Super Artificial Intelligence**

Hypothetical agent that possesses **intelligence far surpassing that of the brightest** and most gifted **human minds**

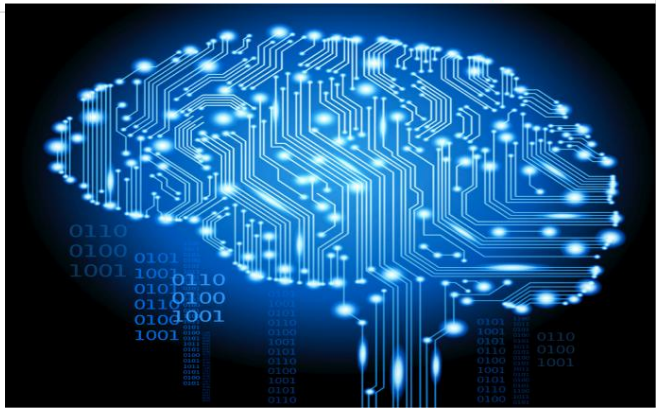


- **Explainable AI**

Interpretable AI, or **Transparent AI** refer to techniques in artificial intelligence (AI) which can be **trusted** and **easily understood by humans** It contrasts with "black box" in machine learning

- **The Singularity**

The technological singularity is a hypothetical future **point in time** at which **technological growth becomes uncontrollable** and irreversible, resulting in unfathomable changes to human civilization. **Intelligence explosion!**



Ensinar na Era da Inteligência Artificial: O Fim dos Modelos Tradicionais?

Luís Paulo Reis

lpreis@fe.up.pt

Associate Professor at FEUP - Faculty of Engineering of the University of Porto
Director of LIACC – Artificial Intelligence and Computer Science Laboratory, Univ. Porto
Member of Coordinating Commission of LASI – Intelligent Systems Associate Laboratory
President of the GA of APPIA – Portuguese Association for Artificial Intelligence