INTRODUCTION TO ARTIFICIAL INTELLIGENCE

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01
History

History

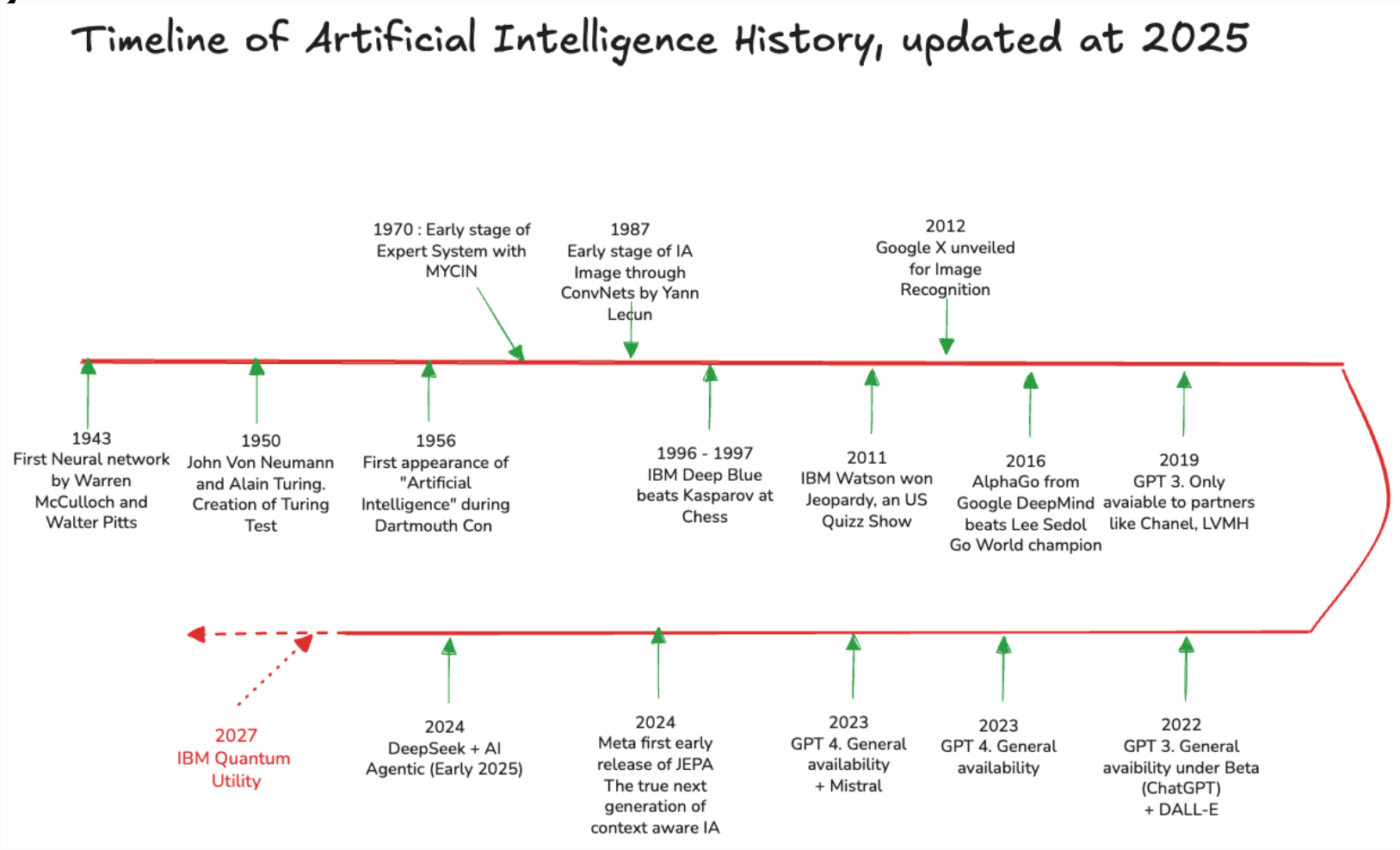


Figure 1: History of Artificial Intelligence

History

“The science and engineering of making intelligent machine. The creation of machine that learn, reason, make decision and mimic human-like intelligence to solve problems. (John McCarthy, 1955)”

History

i | Definition : Artificial Intelligence

Just a set of toolbox that a computer can use to perform some complexes tasks.

Basically, if we write a tool for a specific field, we can assume that AI is better than Humans for that specific field, since it is designed for it.

i | Example : Kasparov at Chess ♔

Around the 1990, an AI was made (Deep Blue) to perform the following task : to play a chess game.

Since we have an AI tailored for chess, we can assume that AI is simply better than Kasparov !

Movie you can watch : *Game Over : Kasparov and the Machine (2003)*

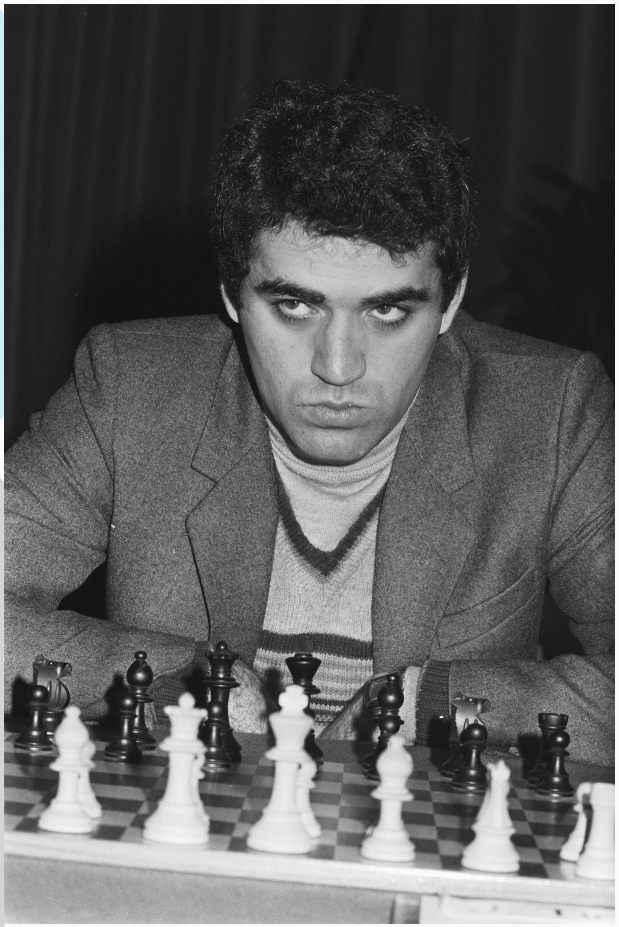


Figure 2: *Garry Kasparov*

History

i | Definition : Artificial Intelligence from the European commission Perspective

*A set of systems that **perceive their environment, collect and interpret data, reason over inferred knowledge, make decisions, and take actions** to achieve a goal.*

History

Artificial Intelligence grew as a specialized field within computer Science, the discipline that powers everything from :

- Hardware
- Programming Language
- Operating Systems
- Algorithms

History

At the same time (still at 1990), researchers dropped logical AI to get back to statistical AI. Because a major tech breakdown occurred : **Internet Access + Big Data !**

What happens if we have too large data ? We simply do statistics ! :

The following statistics tools appeared, and you might heard them before such as :

- Machine Learning
- Deep Learning (1990-2000)
- Generative AI(from 2017)

History

- Regarding Deep Learning, it became popular starting from 2012 with AlexNet.
- The first wave of IA was Perception (Recognize information and to understand it)
- The Second Wave, is Generative AI, which is known by everyone.
  - *It is multimodal, meaning that an IA was able to learn both images and language. Like DALL-E, StableDiffusion, Suna.*
- A new wave of IA has started : **Agentic IA**. Local motion, meaning the ability to use tools. Robotics IA will profit most of it in the next year.

History

⚠ | Warning

Generative AI are an evolution of statistical IA, with the capacity of handling a much more amount of data.

Therefore, as we advance from Machine Learning towards Generative IA, there is a significant different size of data to be processed.

Strictly, there is **no revolution made** in the AI field in 2022 for general public with ChatGPT. The correct wording is an evolution of processing a much larger amount of data.

We can still say there is a revolution, it is about the usages : **the prompting**

History

i | Definition : Prompting

The ability to speak in natural language for an Artificial Intelligence without any background associated to it.

It means, we no longer need to know math, coding to interact with AI about anything that comes into your mind.

100M User (January 2023) Chat GPT 3,5 users

- **It means that it is the fastest new tech adoption in the history !**
- **Prompting made public user easier about onboarding the use of AI through ChatGPT, with natural language.**
- It can be used to anything, wich is great, but can also be dangerous, because it can be used to anything (Such as Starter pack generation which can sometimes be useless)

History

Wait ■ : If we are staying strictly into the Mathematics, AI began in the 1600's with Pascal. As early as the 1600s, Blaise Pascal built the Pascaline, a machine capable of performing addition and subtraction—often considered an early form of mechanical intelligence.

AI are just tools than can be perceived as intelligent, based the the field it was made for.

- It is easy to think of something that can be perceived as intelligent by doing a certain thing at Greece (for example)

Figure 3: Pascaline

History

- The future trend : Artificial General Intelligence.

> **i | Definition : Artificial General Intelligence**
>
> A type of generic IA, that can do anything, anytime, alone, much better than humans.

Most of the people worshiping Artificial General Intelligence are saying it will come.

- *Truth is, AGI may not be possible using current mathematical approach*
- *It means, the AGI, will not tell you anything that is 100% accurate, such as weather in the next two month, the next heatwave, next airplanes crash, etc..*
- *It might come with quantum, since the quantum is based on physics.*

History

The difference between quantum and maths, one is based on physics, the latter is an approximation of the physics. (We are trying to describe the world however we can, but it will not be the reality of that).

- Huge remainder : **In Statistic, the quantity 100% is impossible ! Being perfect is inexistent**

Therefore, speaking about AGI, is just like speaking about being perfect, which is nonsense

History

i | Example : Level 5 Automatic drive

Level 5 is a car that is capable of driving from A to B, without causing any damage to tiers, without human intervention at any given time. **It will never exist**

Proof : Level 4 will exist, it can be compared to taxi-robot that you might have seen in Los Angeles with Google Waymo.

1. **They limited in a geographics area, therefore excluding level 5**
2. **The amount of taxi-robots are limited to each city, it means it can be remote controlled in case of an major issue.** *If any humans intervention occurs to the car, it is no longer level 5.*

History

i | Example : Level 5 Automatic drive

3. **In 2018, Waymo open sourced 10M Miles in order to achieve Level 4 in YouTube**. In one the video, at Mountain View (Google), the cars stop briefly before restarting it course a few time for a few meters.

It made no sense, the issue was, two guys at the sidewalk have a Stop Sign. Humans will not stop because it will know that trolling.

But the cars will see every time a stop sign, therefore stopping every time it is near the sign.

We have an infinite number of case, therefore, Genericity will not work.

Agentic IA

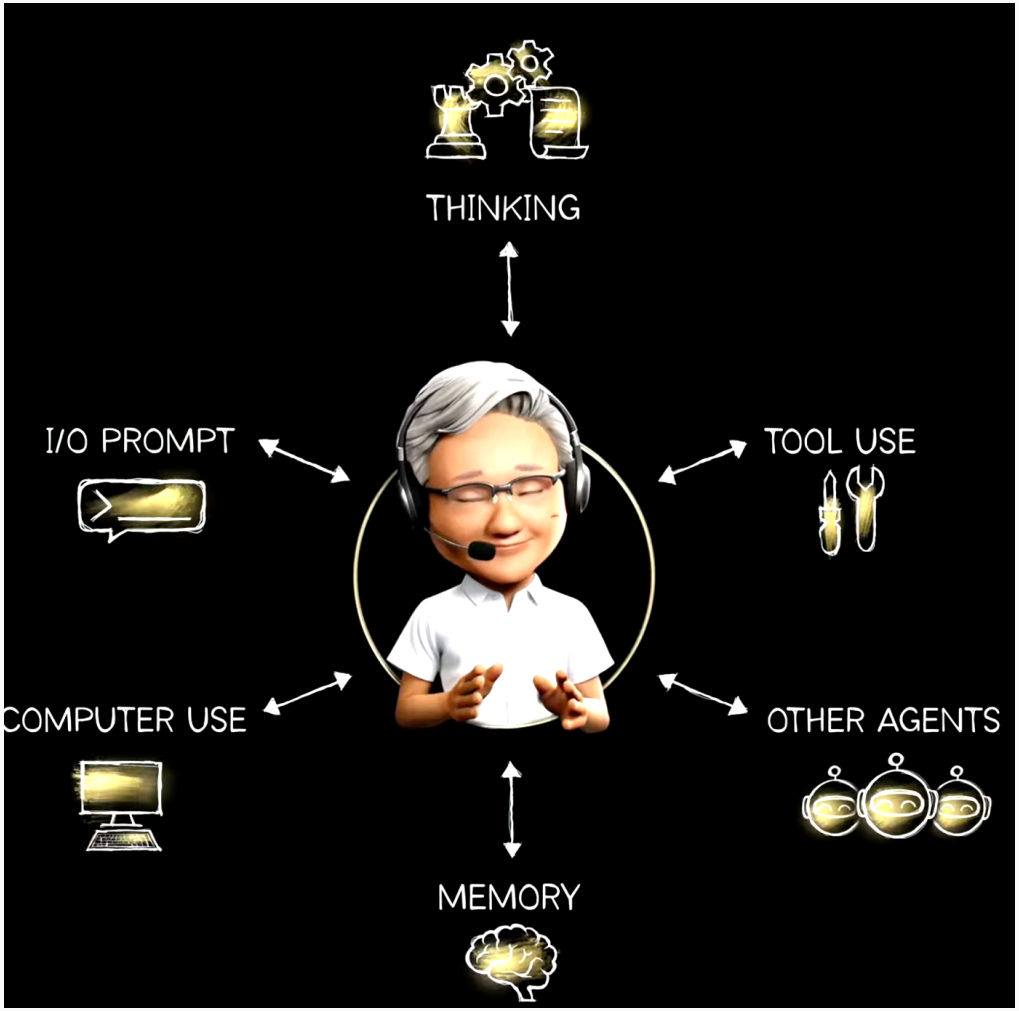
AI Agent are digital assistants. Based on a prompt, they reason through and break down problems into multi-step plans.

They use the proper tools, work with other agents, and use context from memory to properly execute the job on GPU accelerated system.

Demo for Perplexity :

https://www.youtube.com/live/X9cHONwKkn4?si=8EKeh9MqKIbCeMfy&t=3450

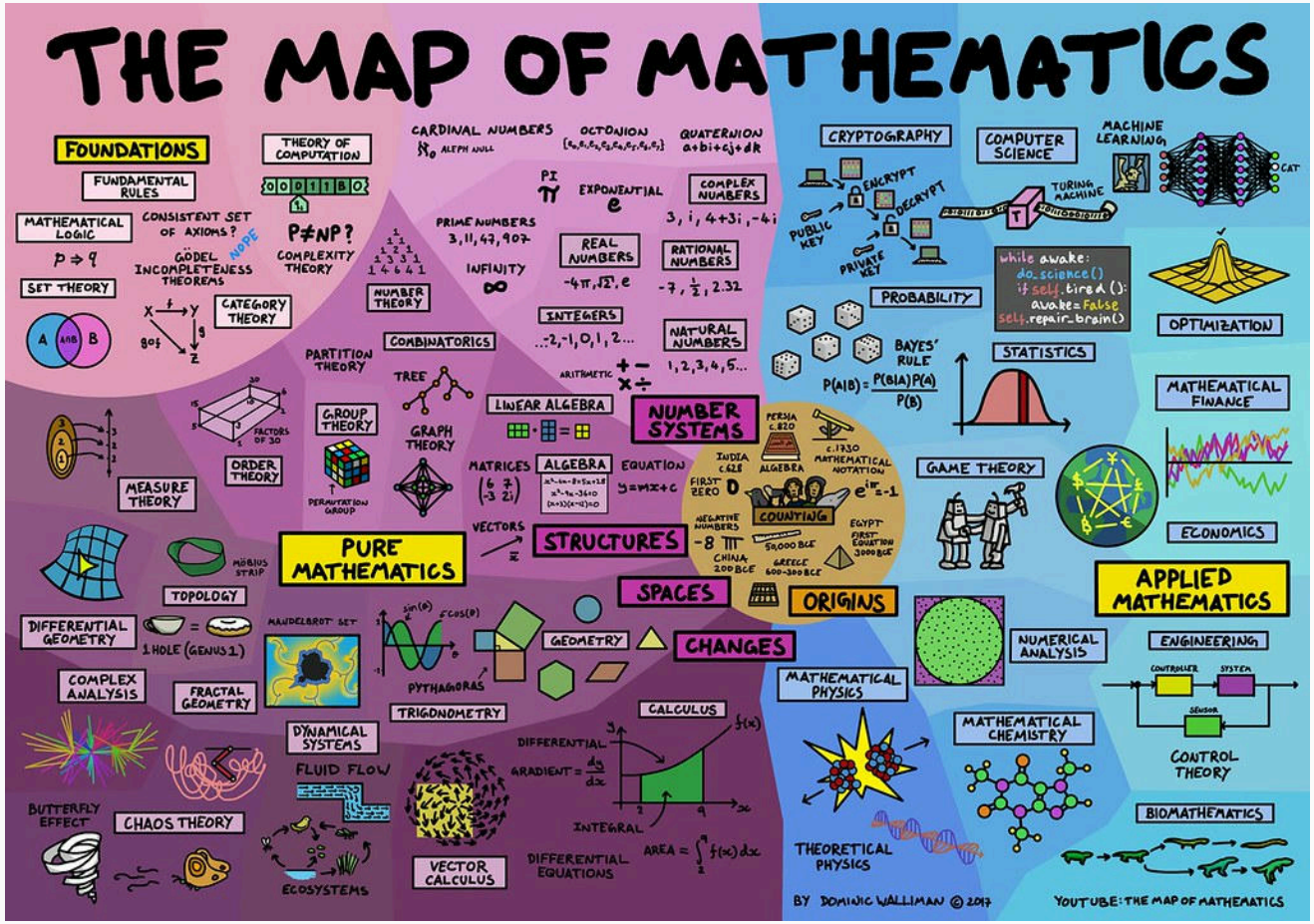
(From Nvidia GTC Paris 2025 at Vivatech 2025)



02
Artificial Intelligence breakdown

Artificial Intelligence breakdown

Remember when I said AI is Mathematics ? Let's check the map of mathematics



- **Algebra** : Symbolic manipulation, neural net weight
- **Calculus** : Optimization (gradient descent)
- **Probability** : Uncertainty modeling
- **Statistic** : Learning from data
- **Linear Algebra** : Data representation (vector/matrix)
- **Information Theory** : Compression, Entropy, Learning.

Artificial Intelligence breakdown

- Linear Algebra lets us represent images, sounds, and texts as numbers (vectors & matrices).
- Calculus lets us adjust our model to minimize errors (e.g., by following gradients)
  - *More on that during Deep Learning Lecture*.
- Probability Theory helps models deal with uncertainty (e.g., weather forecasts).
- Statistics allows generalization: "*We saw this before, so it's likely again.*"

03
Machine Learning

Machine Learning

Machine learning allows systems to learn from the past and make decision.

Two keys task in machine learning :

> 𝐢 | Definition : **Prediction**
>
> Predictions help forecast futures events like high-precision weather forecasting

> 𝐢 | Definition : **Inference**
>
> Inferences focus on determining an outcome based on existing data. Like recommending a book based on your past preferences.
>
> **DISCLAIMER :** Inference can also mean to predict something while in a production environment !

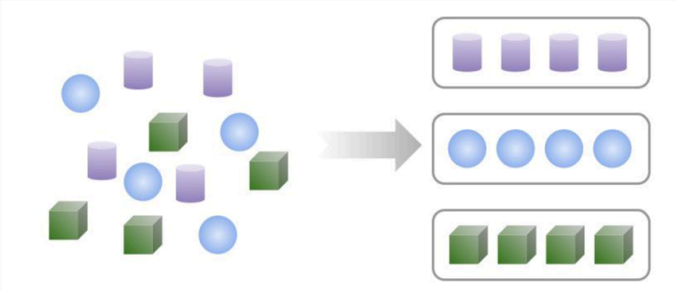
AI excels at pattern recognition, which involves analyzing data to identify trends and make informed decisions.

Machine Learning

We have clustering techniques that help business to segments customers into groups with **similar behavior**, making it easier to tailor marketing strategies.

- In security and finance, anomaly detection spots unusual transaction or activities that might indicate fraud.

It can also be used to **determine the fastest routes, supports energy grids in operating** efficiently, and enable travel companies to set dynamic pricing strategy to maximize revenue.



This field is what we call **Unsupervised Learning**

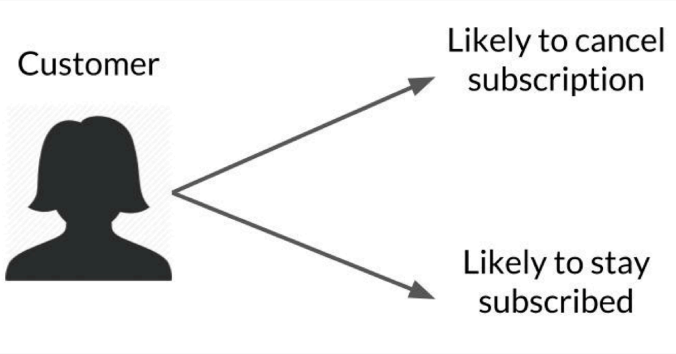
Think of the following, I have a set of flowers, and I need to discover the number of species .

Machine Learning

Retailers and brands also use machine learning to plan discount campaigns that drive sales by analyzing customer behavior.

It can also be predicting the correct outcome based on historical event. It is implied that we already know the final answer, but need to automate this through IA.

> **i | Example :**
>
> Based on the client communication history, we would like to know if our client will likely to cancel a mobile subscription or likely to stay subscribed...



This field is what we call **Supervised learning**

Think of the following, it like proposing a anwser to a friend, and that friend tells me if my answer is correct or not

Machine Learning

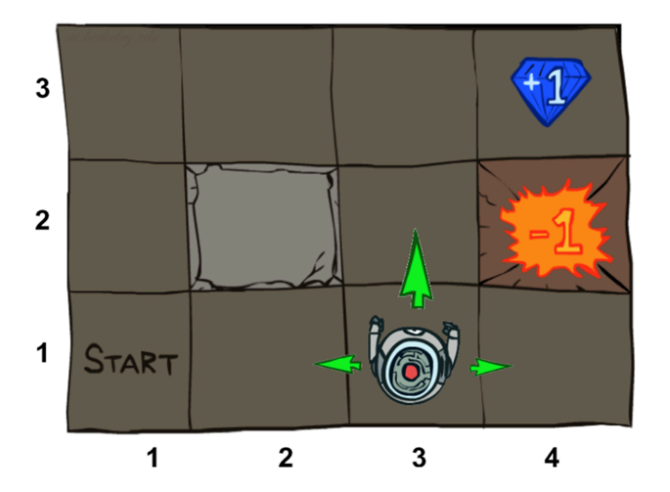
Another key application is automation, where machines follow predefined rules to complete tasks independently by improving efficiency.

i | Example : Chess

Let's recall the chess Deep Blue model we talked earlier. This model need a lot of sets of finished games of Chess.

Each action taken is based on the chess rule, in which we can calculate either it immediate reward, or the long term reward. We already know the outcome of the game which are either Win, Loose or Draw.

In the following figure, we have a lineworld. Our agent need to find the quickest way to finish the game.



This field is what we call **Reinforcement Learning**

Hungry for more ? CON#2 about Machine Learning will come tomorrow

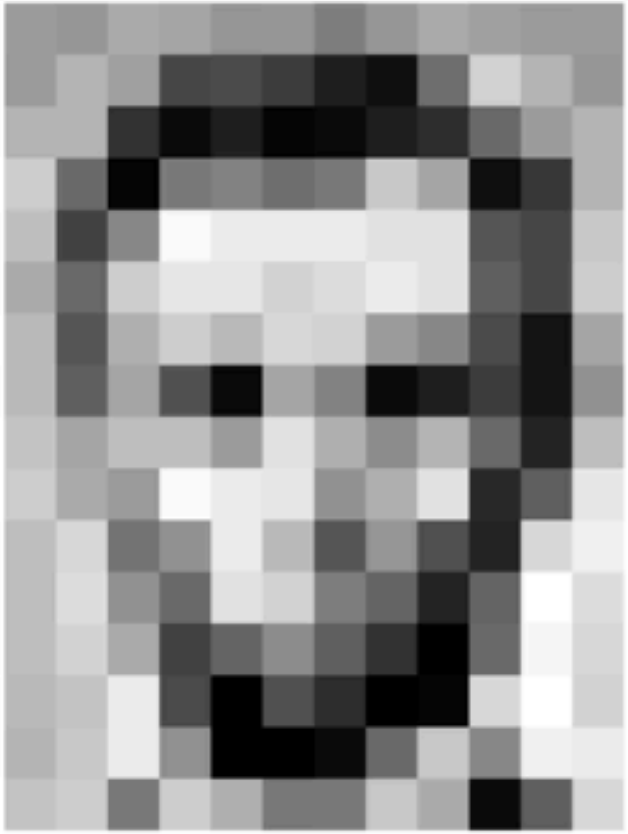
04
Deep Learning

Deep Learning

Remember that running an AI needs data. What happens when there is too much data for our Machine Learning tasks ? **Training time will become slower.**

Deep Learning

Let’s tackle an example : We want to identify this picture.

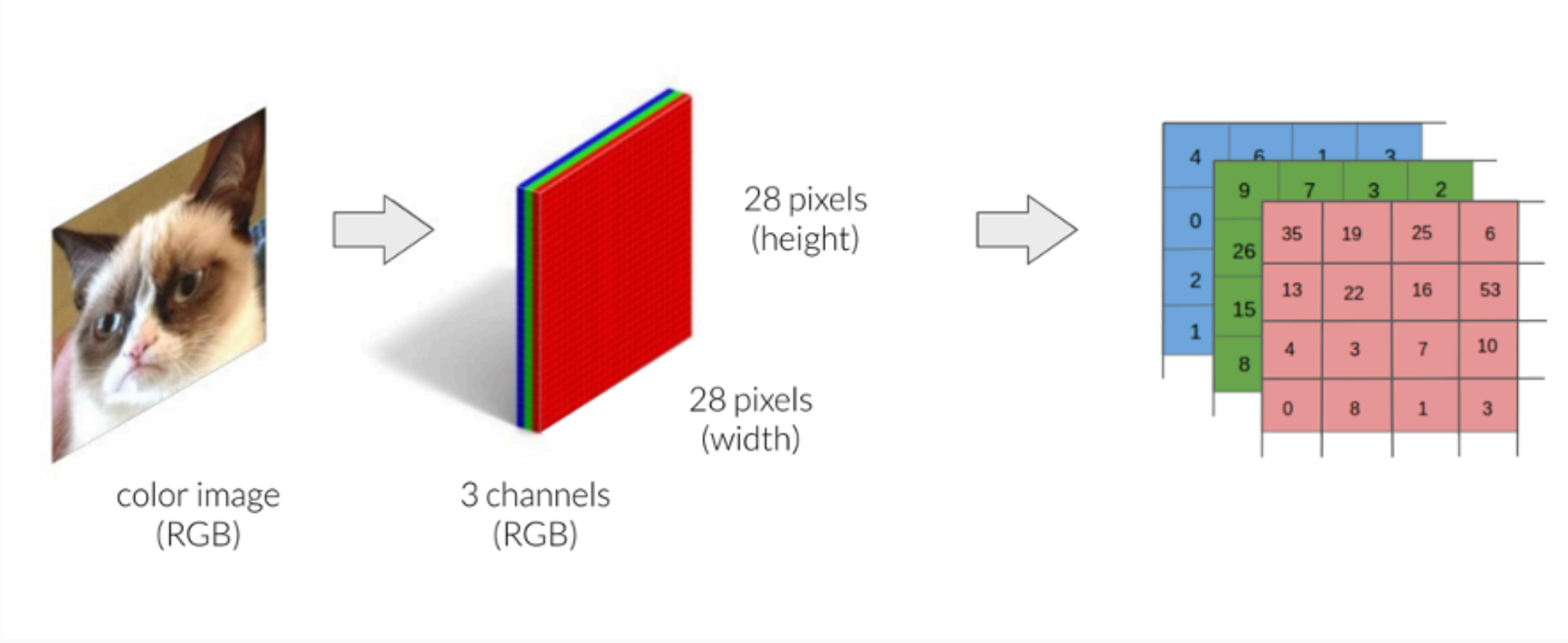


157	153	174	168	150	152	129	151	172	161	155	156
155	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	87	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
190	214	173	66	103	143	96	50	2	109	249	215
187	196	235	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

157	153	174	168	150	152	129	151	172	161	155	156
155	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	87	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
190	214	173	66	103	143	96	50	2	109	249	215
187	196	235	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

This text is 16x12 matrice, which is equivalent to 192+1 columns to be trained. Which is a lot !

Deep Learning

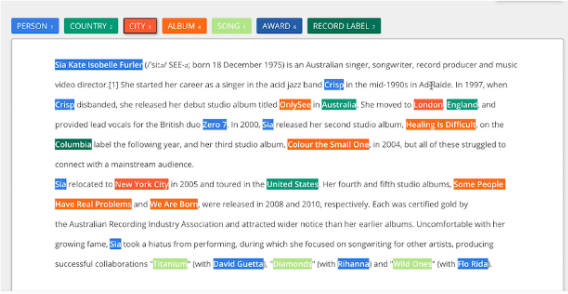


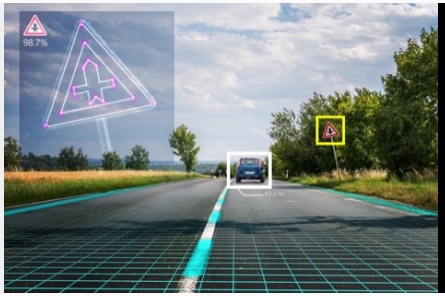
This is a 28x28x3 data for colored picture, which is a lot more !

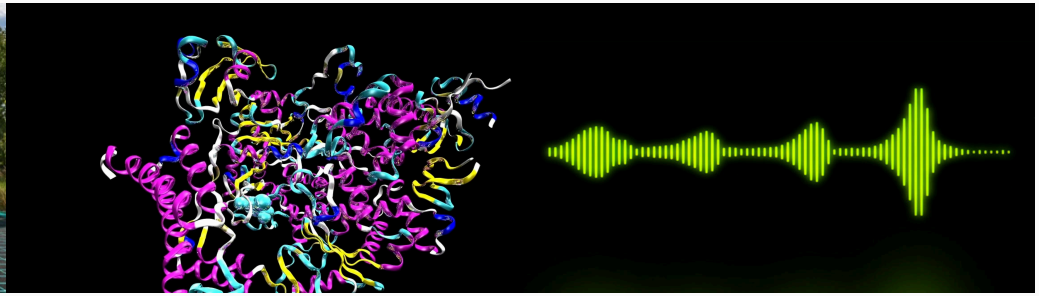
Deep Learning

We use Deep Learning when the amount of data to be trained on exceed the computing.

We can use deep learning for the following tasks (not exhaustive)







Natural Language processing

Image recognition

Drug discovery

Audio Processing

05
Natural language processing

Natural language processing

The Natural Language Processing is a sub-field of Deep Learning where the tasks are tailored for Language comprehension. It’s like giving computing a way to understand the human language !

Natural language processing

But first, we'll need a bag of word. It will count every occurrence of a word.

It is a period of civil war. Rebel spaceships, striking from a hidden base, have won their first victory against the evil Galactic Empire.

During the battle, Rebel spies managed to steal secret plans to the Empire's ultimate weapon, the DEATH STAR, an armored space station with enough power to destroy an entire planet.

Pursued by the Empire's sinister agents, Princess Leia races home aboard her starship, custodian of the stolen plans that can save her people and restore freedom to the galaxy....

the	7
to	4
rebel	2
plans	2
of	2
her	2
empire's	2
an	2
...	...

Natural language processing

Let's suppose we have the following sentences :

- *U2 is a great band*
- *Queen is a great band*

We can have the following contents after generating our bag of words.

U2 is a great band

Word	Count
U2	1
Queen	0
is	1
a	1
great	1
band	1

Queen is a great band

Word	Count
U2	0
Queen	1
is	1
a	1
great	1
band	1

Natural language processing

Let's reconsider with a negative input.

That book is not great

Word	Count
That	1
book	1
is	1
not	1
great	1

2-gram (bi-gram)

Word	Count
That book	1
book is	1
is not	1
not great	1

Analyzing the following is tricky, great is a positive word. By putting the "not", it becomes a negative word. In order to fix that, we'll have a bag of 2 words, known as 2-grams !

Natural language processing

But we have some limitations

- Counting words will not take into account the definition and it synonym of the words.

> i | Example : Blue
>
> - Aqua
> - Ceruluan
> - Turquoise

06
Generative Artificial Intelligence

Artificial General Intelligence

The concept of Artificial General Intelligence (AGI), represents a level of AI that could match or surpass human intelligence across a wide range of tasks such as:

- Scope of knowledge
- Reasoning across domain
- Social skills
- Creative Thinking
- Other cognitive competencies (vision, language)

Today, we talking about **Artificial Narrow Intelligence** that excels at specifics problems.

AGI would possess the ability to think, reason and adapt like a human.

Artificial General Intelligence

Some AI Systems can simulate human intelligence in certain tasks, but none have exceeded like

- Voice assistants
- Face recognition
- Self-driving car
- GPT models

they demonstrate remarkable capabilities, but they remain specialized rather than truly general intelligence.

AGI will use patterns in existing data (such as text, images or music) to create new content.

Artificial General Intelligence

Immense pros

- Productivity
- Research progress
- Engineering Solutions
- Companionship and wisdom

i | Example : Nvidia GTC Paris 2025 Feedback about microchip conception

Artificial General Intelligence

Cons

- Negative Economic disruption
- Malicious use
- Value alignment problems
- Existential Catastrophe

Artificial General Intelligence

The Safety debate

AGI can empower

AGI can have negative consequences

Artificial General Intelligence

Controlling AGI outcomes

Requirements for aligning AGI and humain values:

- Clear rules and expectations
- Constructive feedback

1. Hard constraints
2. Alignment strategies
3. Government intervention

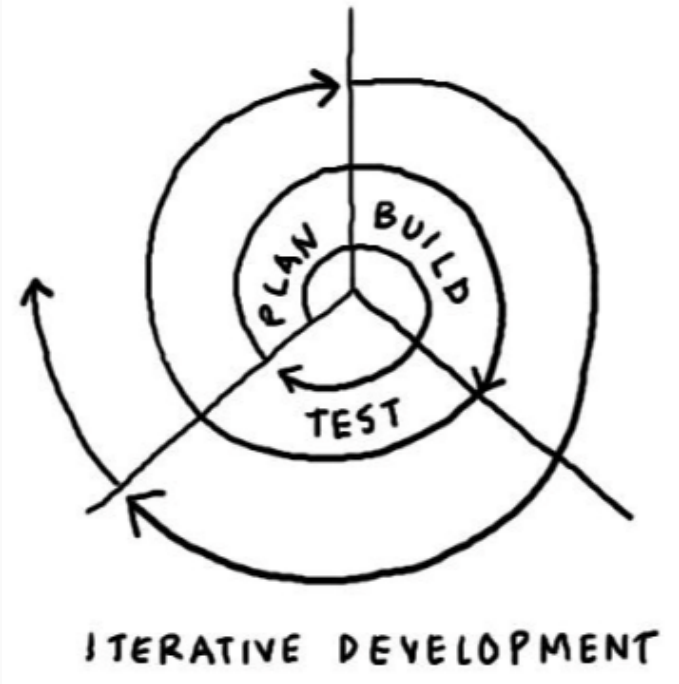
Artificial General Intelligence

1. **Boxing** restrict access to their wider world
2. **Interruptibility** add a stop or off switch

Artificial General Intelligence

Alignment strategies

- Iterative development
- Constitutional AI
- Multi-stakeholder engagement



07
Wrapping up

Wrapping up

- AI is a tool, not magic.
- AI is still in it's early days, with incredible potential for the future.
- It excels in narrow domains, struggles with generality.
- **The revolution is in usability (prompting), not the math.**
- **AGI is more philosophy than reality (for now).**
- If you are interested into researching generative IA, please look into JEPA models backed by Yann Lecun (Meta)
- Otherwise, you can still check for open sourced like Mistral, Llama, DeepSeek and Qwen which are Large Language Models.

Questions ?

Thank you for attention
Coming up shortly : Excel Automation

Have a nice day and enjoy your stay at Paris.