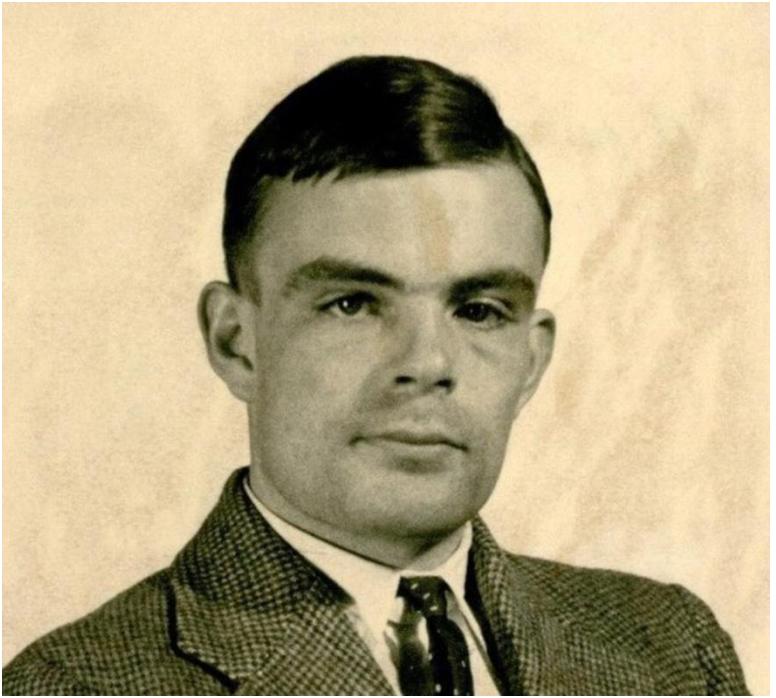


Macchine che apprendono: 75 anni dopo Alan Turing

Paolo Ferragina





Alan M. Turing (June 23, 1912)

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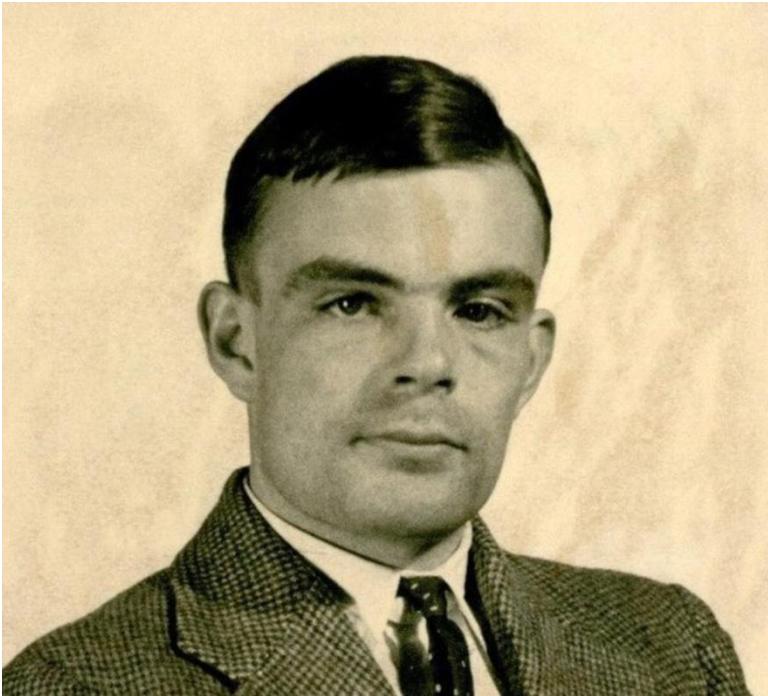
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Alan M. Turing Macchine calcolatrici e intelligenza

A cura di Diego Marconi



Io credo che la domanda iniziale, «Le macchine sono in grado di pensare?», sia troppo insensata perché valga la pena discuterne. E tuttavia, credo anche che alla fine di questo secolo l'uso delle parole e l'opinione diffusa delle persone colte avranno subito un cambiamento tale che si potrà parlare di macchine che pensano senza aspettarsi di essere contraddetti.



Alan M. Turing (June 23, 1912)

PENSARE = CONVERSARE

Alla domanda “Le macchine possono pensare” Turing preferì sostituire la domanda:

«Esistono macchine in grado di imitare l'uomo in una conversazione su qualunque argomento ?»

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«gioco dell'imitazione»

2014

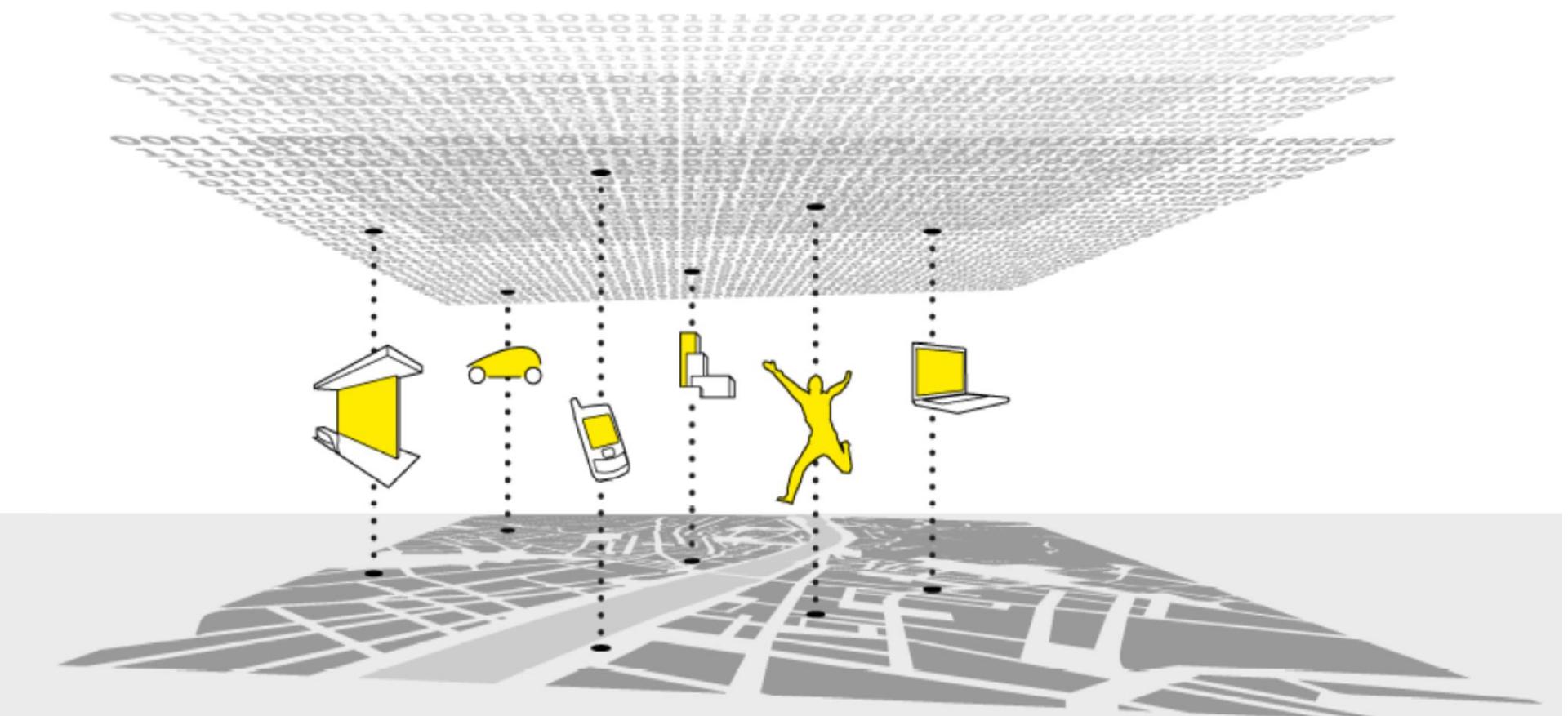


Dalla «società digitale» [HW]

alla «società algoritmica» [SW]

e, oggi, «società dell'IA» [Agenti]





Internet di bit e di persone

**Dalla «Società digitale»
alla «Società algoritmica»**

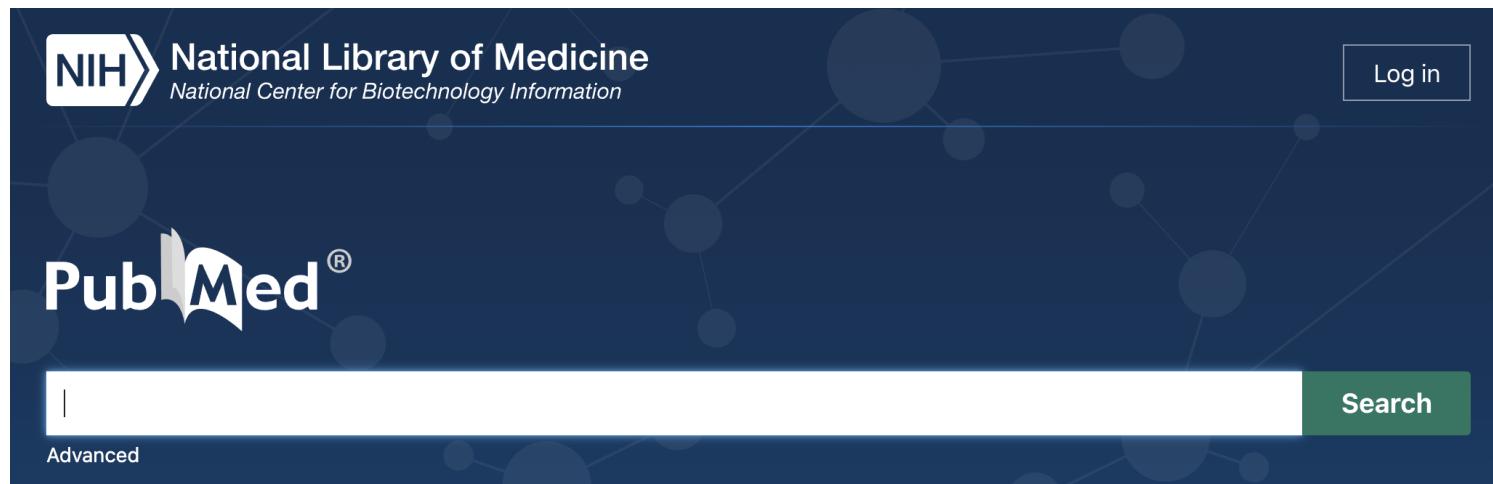
Cosa è un «algoritmo» ?



Sequenza finita di passi elementari

- **univocamente interpretabili**
- organizzati in un ordine logico
- e che, dato un input, producono un **output corretto**.

[Donald Knuth, '70]



Dalla «Società digitale»
alla «Società algoritmica»
e ora «Società dell'IA»

Cos'è l' «Intelligenza Artificiale» ?



Un **sistema automatizzato** progettato per funzionare con diversi **livelli di autonomia** e che può mostrare **capacità di adattamento** [... e], **deduce**, dagli input che riceve, come generare output quali **previsioni**, [...] **raccomandazioni o decisioni** [...].

[AI Act 2024]



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[The Lancet Digital Health](#)

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Benchmarking medical large language models

[Sadra Bakhshandeh](#) 

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Large language models encode clinical knowledge

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Medical large language models are vulnerable to data-poisoning attacks

[Daniel Alexander Alber](#)  [Zihao Yang](#), [Anton Alyakin](#), [Eunice Yang](#), [Sumedha Rai](#), [Aly A. Valliani](#), [Jeff Zhang](#), [Gabriel R. Rosenbaum](#), [Ashley K. Amend-Thomas](#), [David B. Kurland](#), [Caroline M. Kremer](#), [Alexander Eremiev](#), [Bruck Negash](#), [Daniel D. Wiggin](#), [Michelle A. Nakatsuka](#), [Karl L. Sangwon](#), [Sean N. Neifert](#), [Hammad A. Khan](#), [Akshay Vinod Save](#), [Adithi Palla](#), [Eric A. Grin](#), [Monika Hedman](#), [Mustafa Nasir-Moin](#), [Xujin Chris Liu](#), ... [Eric Karl Oermann](#)  [+ Show authors](#)

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Cosa è successo ?

Come è successo ?

Tre «momenti» tecnologici fondamentali

- ✓ Grafi della conoscenza
- ✓ Rappresentazioni vettoriali di dati multi-modali
- ✓ *IA Generativa*
- ✓ RAG, GraphRAG, agenti, ...

Maggio 2012

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The screenshot shows a network graph of interconnected nodes, primarily portraits of historical figures, set against a dark background. A large blue oval contains a portrait of Leonardo da Vinci. Other nodes include a portrait of a man with a red turban, a portrait of a man with a beard, and a portrait of a man with a red cap. A green oval node is visible in the upper right. A blue arrow points from the left towards the text 'The Knowledge Graph'.

The Knowledge Graph

Learn more about one of the key breakthroughs behind the future of search.

See it in action

Discover answers to questions you never thought to ask, powered by the Knowledge Graph.

Leonardo da Vinci

Leonardo di ser Piero da Vinci was an Italian Renaissance polymath: painter, sculptor, architect, musician, scientist, mathematician, engineer, inventor, anatomist, geologist, cartographer, botanist, ...

[Read more on en.wikipedia.org](#)

Born: April 15, 1452, Anchiano

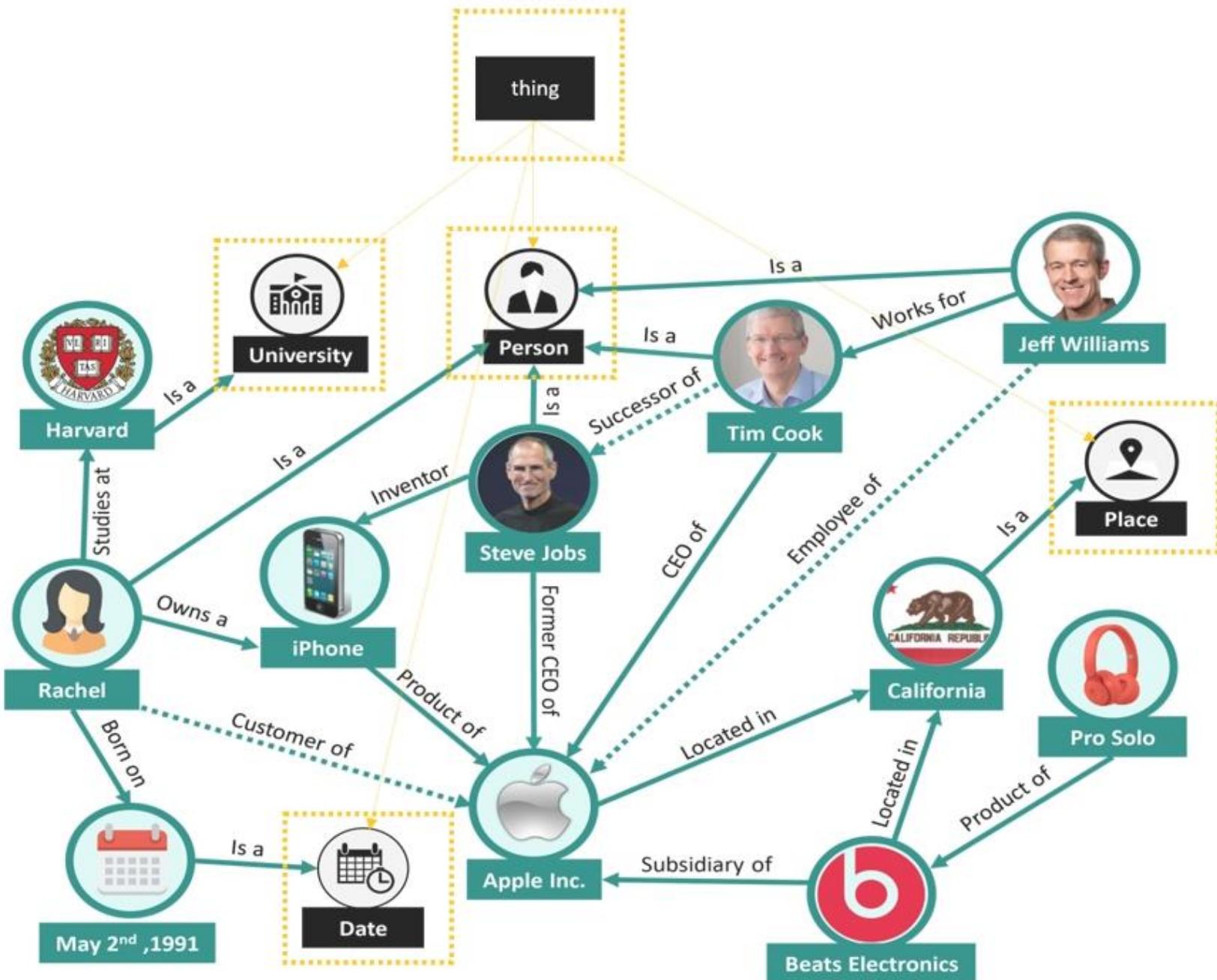
Died: May 2, 1519, Châtel

Buried: St. Piernin's Church

Inventions: Vitruvian Man, Double hull

Parents: Caterina da Vinci, Piero da Vinci

Thumbnail images of Leonardo da Vinci's works: Mona Lisa, The Last Supper, Virgin of the Rocks, Last Supper, and The Battle of Anghiari.



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Altre immagini

Galileo Galilei

Fisico

Galileo Galilei è stato un fisico, filosofo, astronomo e matematico italiano, considerato il padre della scienza moderna. [Wikipedia](#)

Data di nascita: 15 febbraio 1564, Pisa

Data di morte: 8 gennaio 1642, Arcetri

Luogo di sepoltura: Basilica di Santa Croce, Firenze

Scoperte: Callisto, Europa, Ganimede, Io

Figli: Virginia Galilei, Vincenzo Galilei, Livia Galilei

Ricevi aggiornamenti su Galileo Galilei

Tienimi aggiornato

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Galileo Galilei

Fisico

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--	---------------------------------	--	--	--	---	--	------------------------------	--	--

Ricerche correlate

	Niccolò Copernico		Isaac Newton		Giovanni Keplero		Aristotele		Albert Einstein
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Visualizza altri 15 elementi

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Building commonsense knowledge graphs to aid product recommendation

Using large language models to discern commonsense relationships can improve performance on downstream tasks by as much as 60%.

By [Changlong Yu, Zheng Li](#)

May 10, 2024

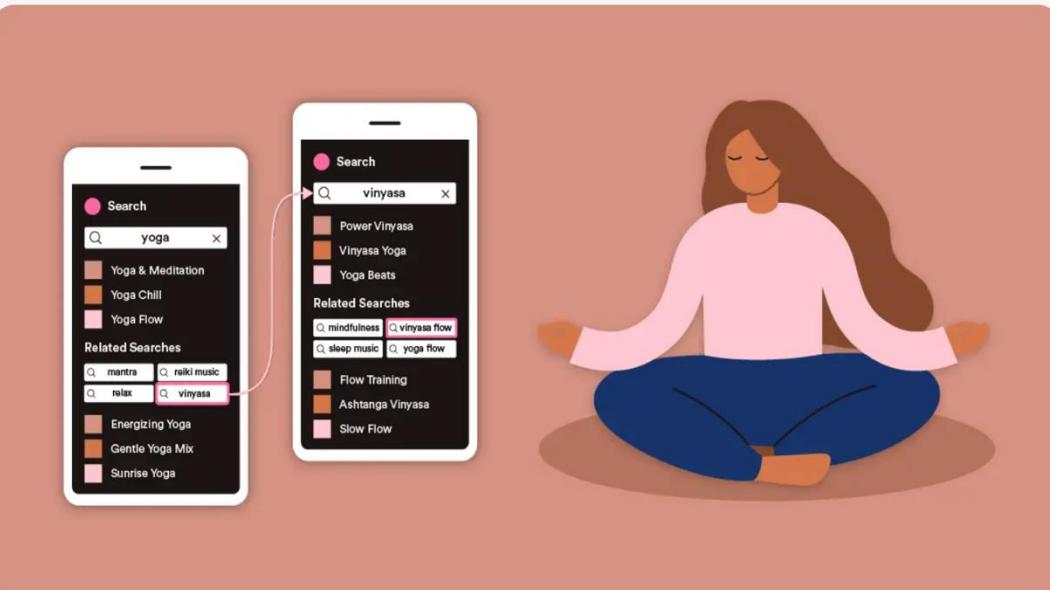
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Graph Learning for Exploratory Query Suggestions in an Instant Search System



The illustration shows a woman with long brown hair sitting in a meditative lotus pose. To her left are two smartphones. The phone on the left has a search bar with 'yoga' and a list of related searches including 'yoga & meditation', 'yoga chill', 'yoga flow', 'energizing yoga', 'gentle yoga mix', and 'sunrise yoga'. The phone on the right has a search bar with 'vinyasa' and a list of related searches including 'power vinyasa', 'vinyasa yoga', 'yoga beats', 'mindfulness', 'vinyasa flow', 'sleep music', 'yoga flow', 'flow training', 'ashtanga vinyasa', and 'slow flow'. Arrows point from the 'vinyasa' search term on the left phone to the 'vinyasa' search bar on the right phone, and from the 'vinyasa flow' related search on the right phone back to the 'vinyasa' search bar on the right phone, illustrating the concept of graph learning for exploratory query suggestions.

Oct 25, 2023

Published by Enrico Palumbo, Andreas Damianou, Francesco Fabbri, Hugues Bouchard, Mounia Lalmas

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Combining Knowledge Graphs with LLMs to Analyze Healthcare Data

Zeshan Ghory, Product Director

Oct 02, 2023

Data Descriptor | [Open access](#) | Published: 02 February 2023

Building a knowledge graph to enable precision medicine

[Payal Chandak](#), [Kexin Huang](#) & [Marin](#)[Scientific Data](#) 10, Article number: 6

- Harvard-MIT Program
- Department of Computer Science
- Broad Institute of MIT and Harvard

Pro:

- Modellazione esplicita della conoscenza
- Primi tentativi di «ragionamento» e di similarità «semantica» tra testi

Contro:

- Ampiezza e scalabilità
- Verifica della correttezza
- Solo concetti rilevanti

Rappresentazioni vettoriali (*embedding*)

- Strutturati: *tabelle*
- Non strutturati: *testi*
- Multi-modali: *img, video, audio*

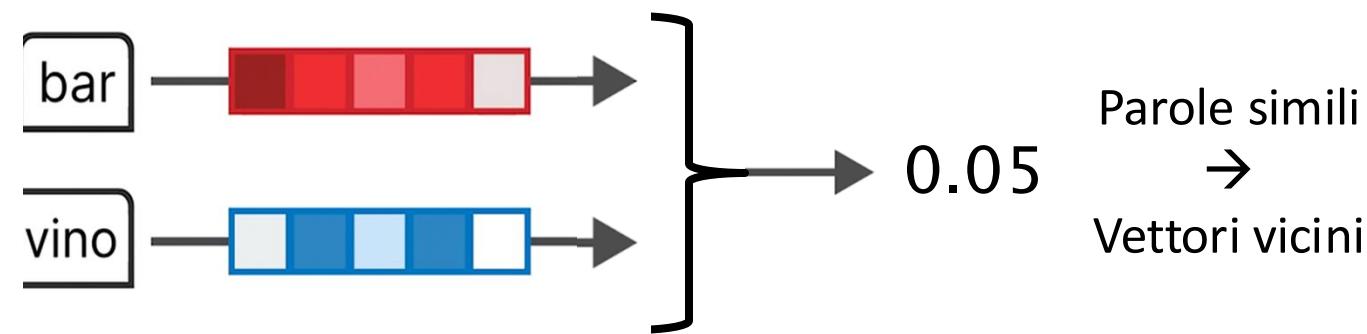


Rappresentazioni vettoriali (*embedding*)

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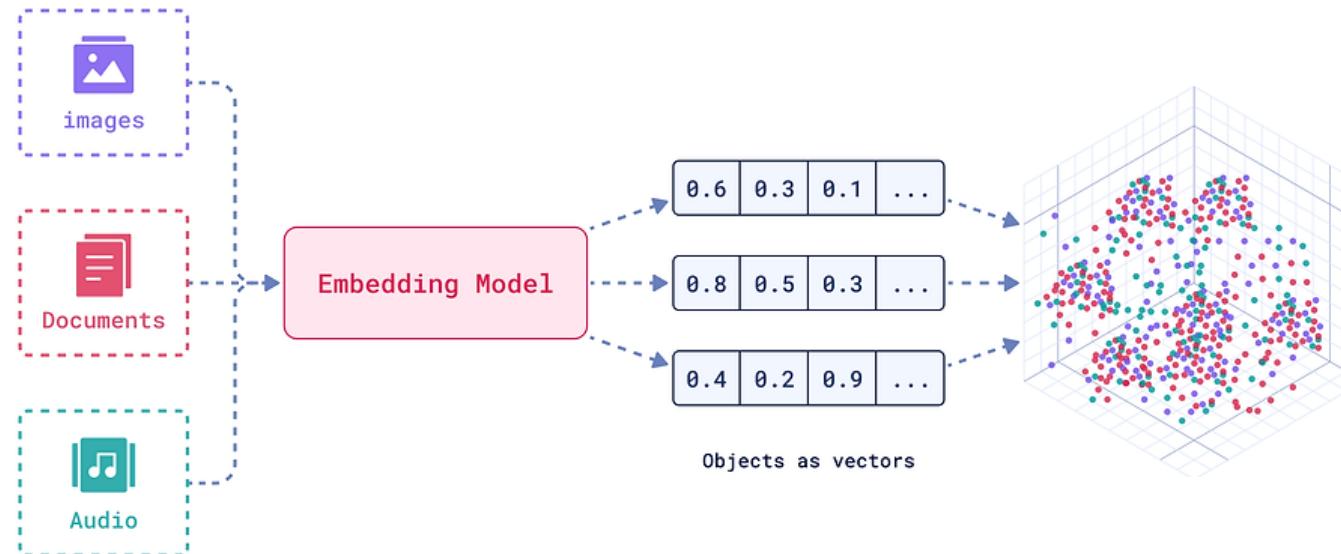


Parole \rightarrow vettori (embedding)



Rappresentazioni vettoriali (*embedding*)

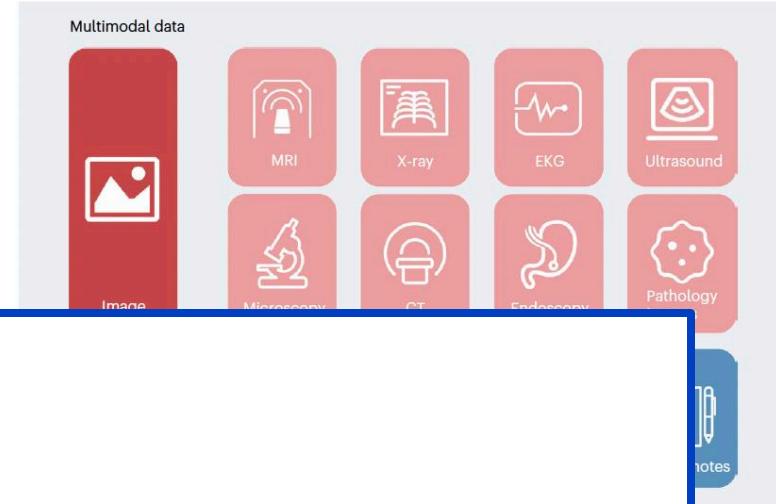
- Strutturati: *tabelle*
- Non strutturati: *testi*
- Multi-modali: *img, video, audio*



Rappresentazioni vettoriali (*embedding*)

- Strutturati: *tabelle*
- Non strutturati: *testi*

Multi-modali: *img, video, audio*



Pro:

- Supporto a dati multi-modali
- Match per «similarità semantica» anche di tipi di dato diversi
- Modellazione contestuale

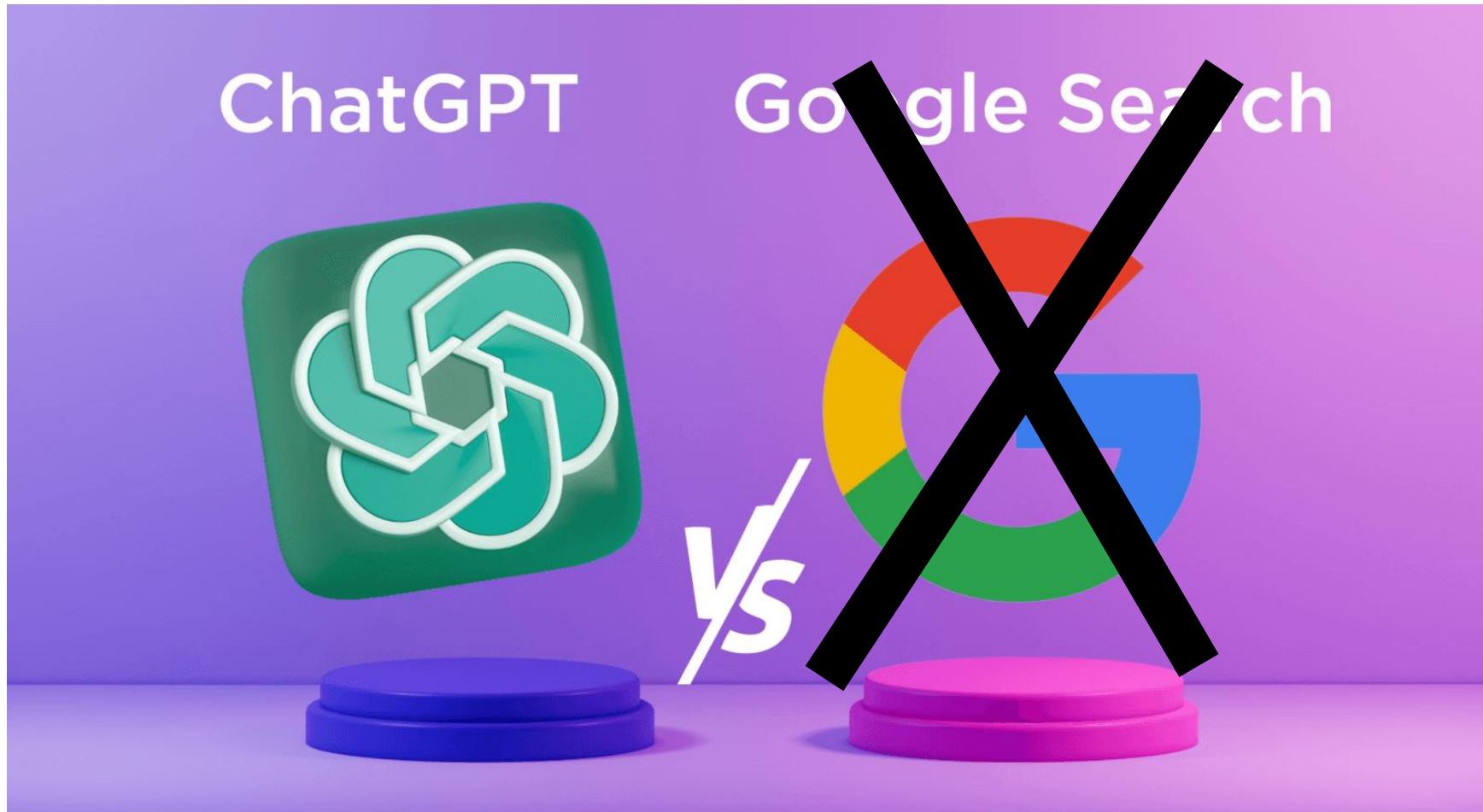
Contro:

- Modellazione implicita della conoscenza
- Big data per training
- Gestire grandi collezioni di vettori

Era il «lontano» 2022



Era il «lontano» 2022



L'era dell'IA Generativa



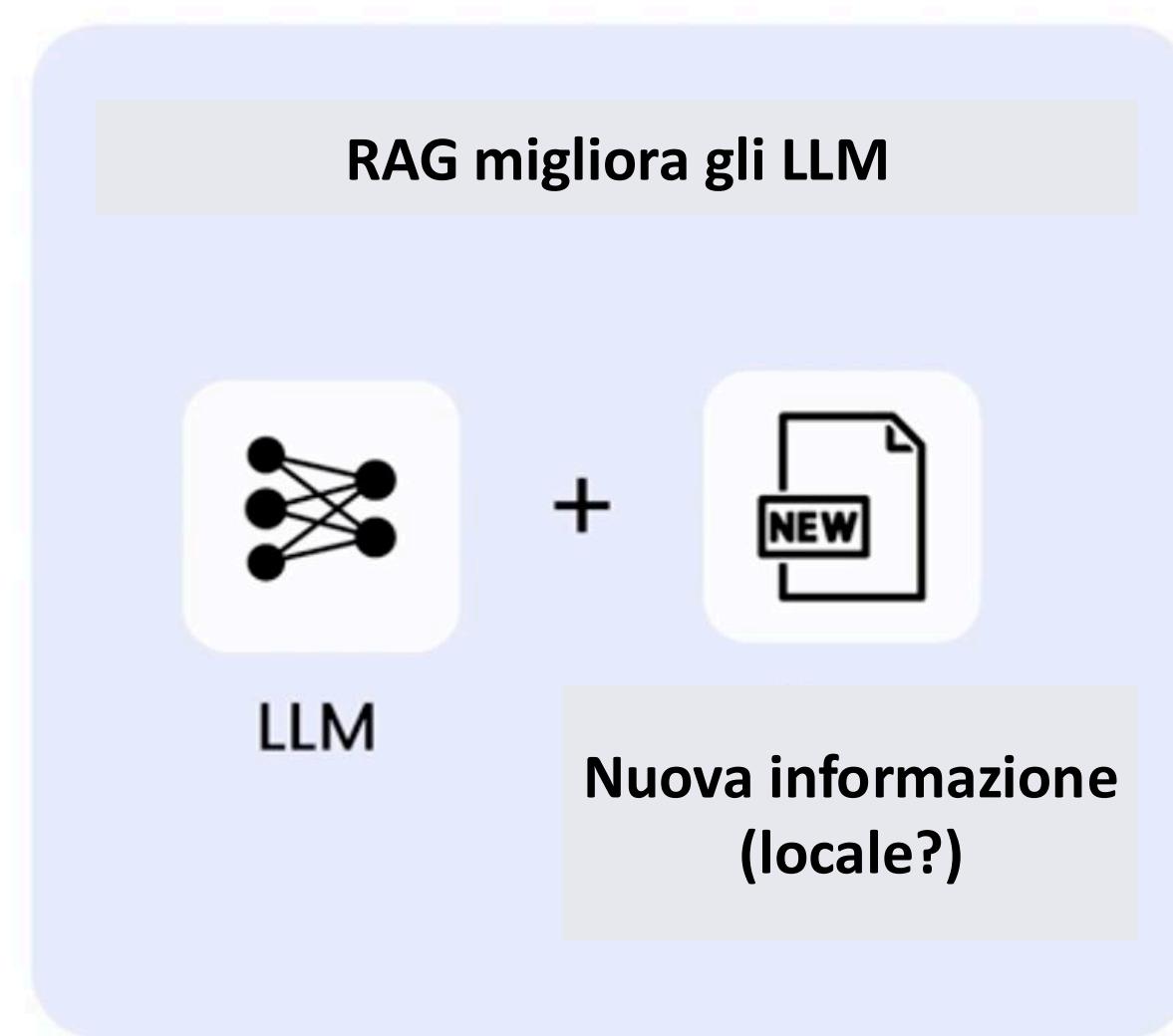
- Allucinazioni digitali
- Risultati non aggiornati
- Spiegabilità
- Interrogazioni specialistiche
- Velocità e costi di inferenza (vs costruzione)

L'era dell'IA Generativa

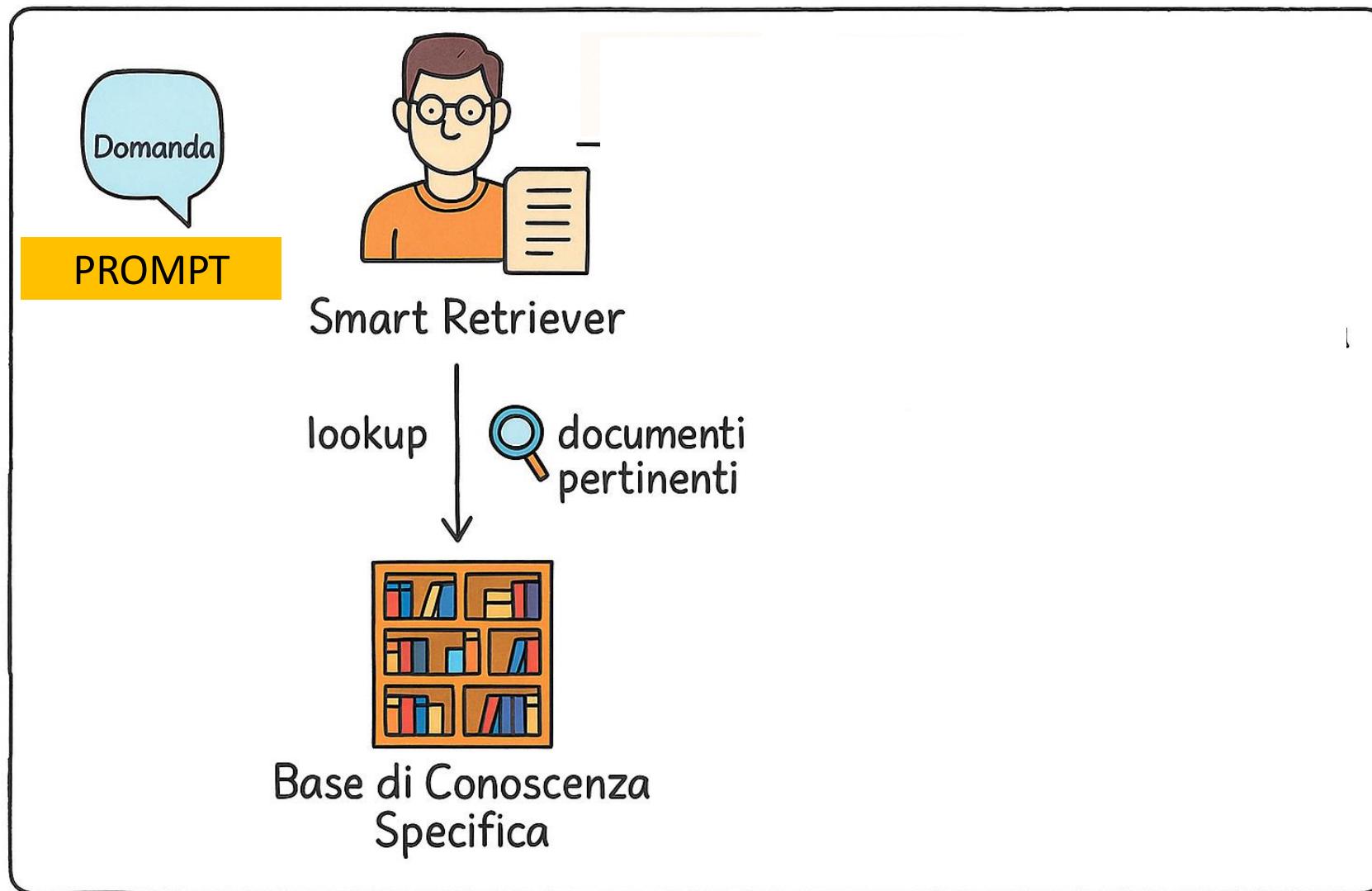


- Allucinazioni digitali
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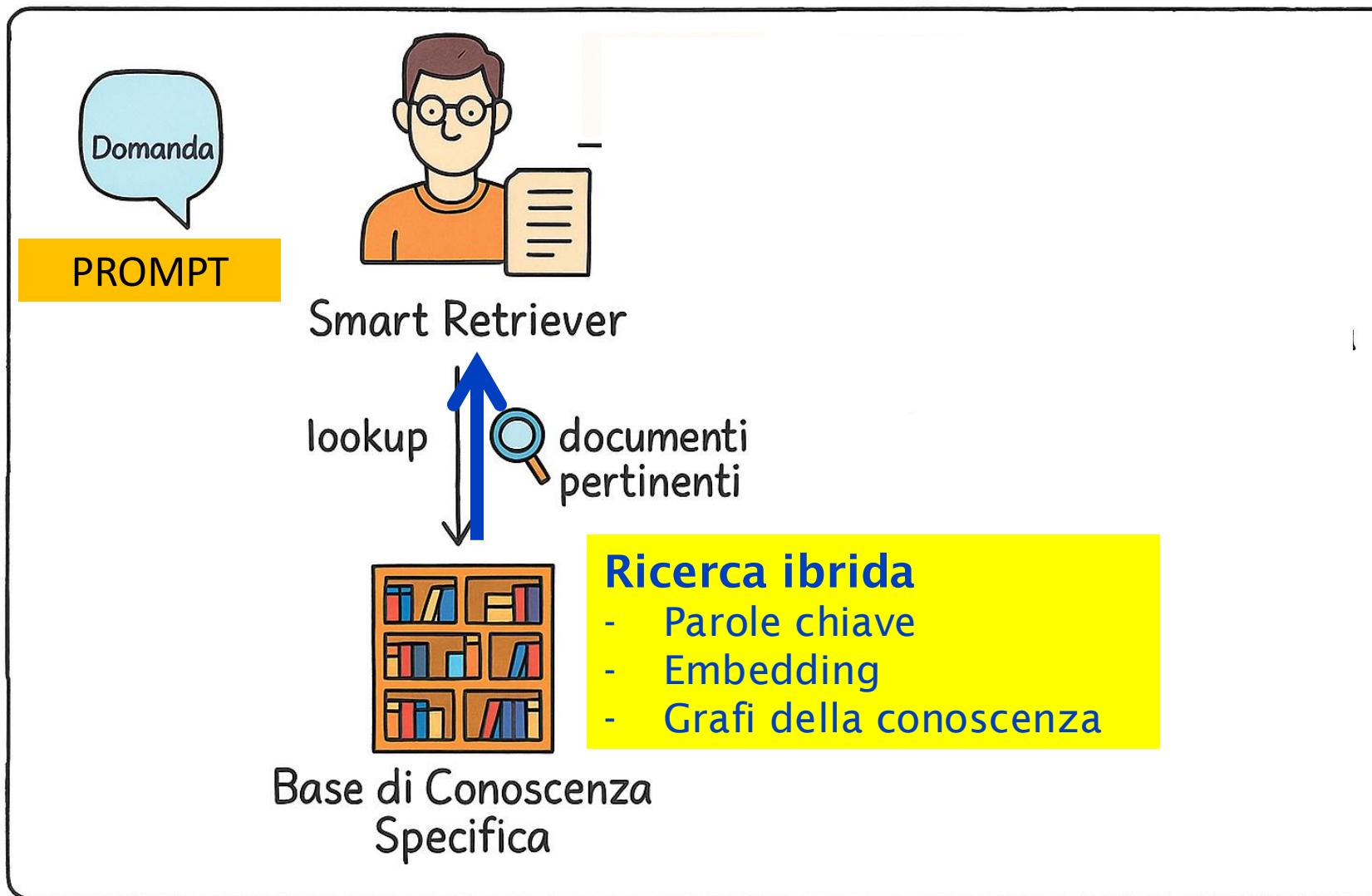
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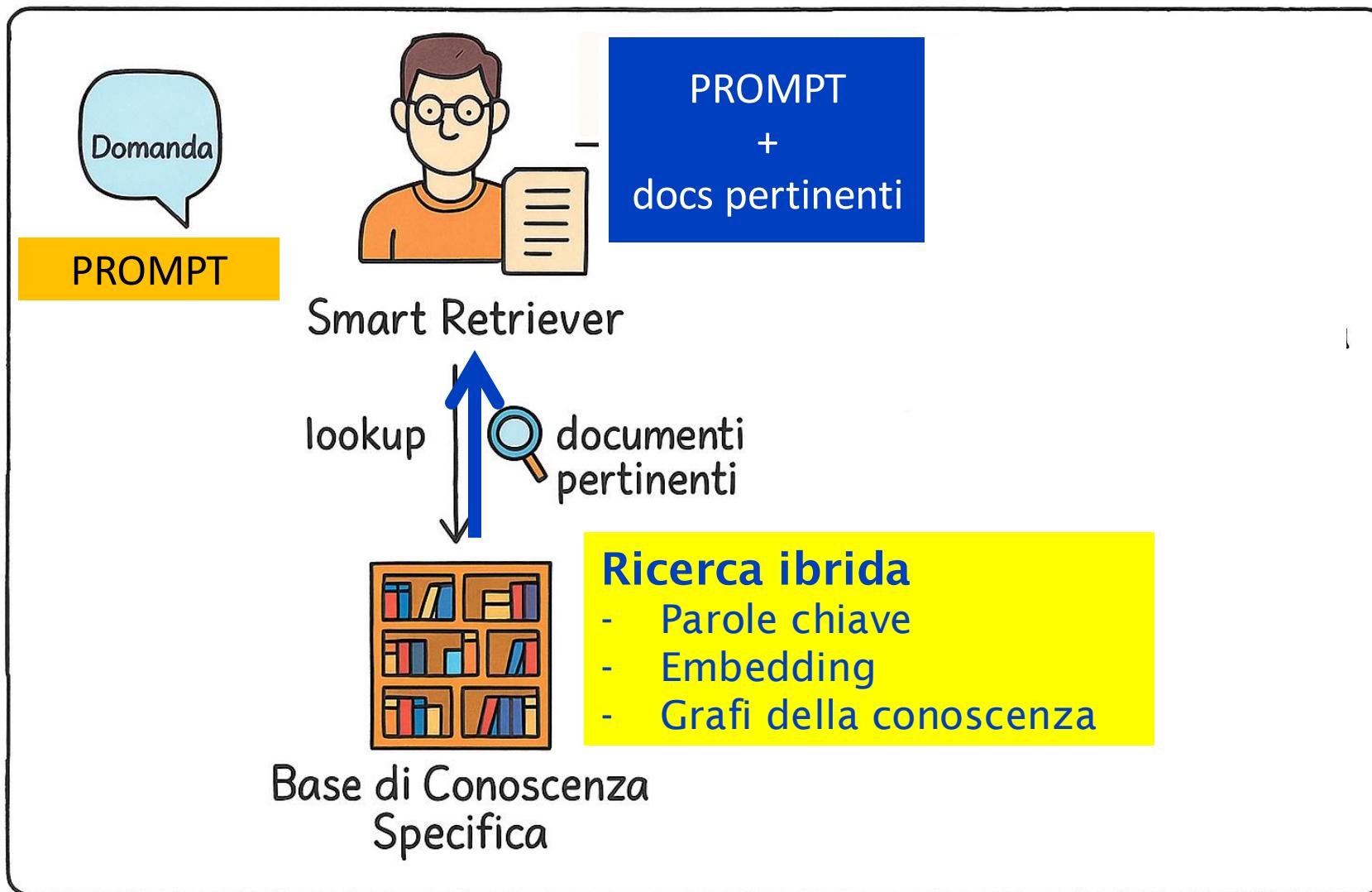
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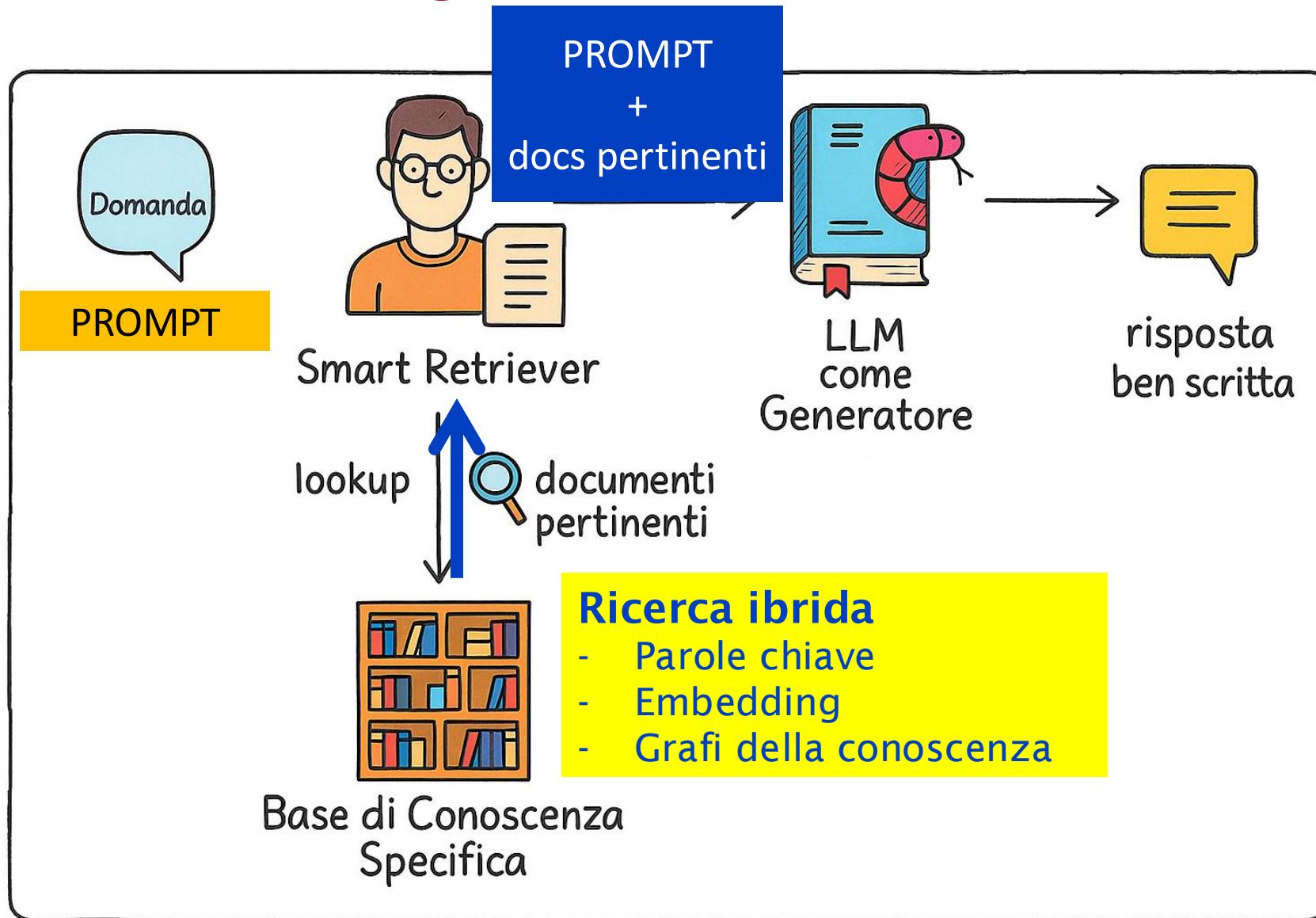
Retrieval Augmented Generation (RAG)



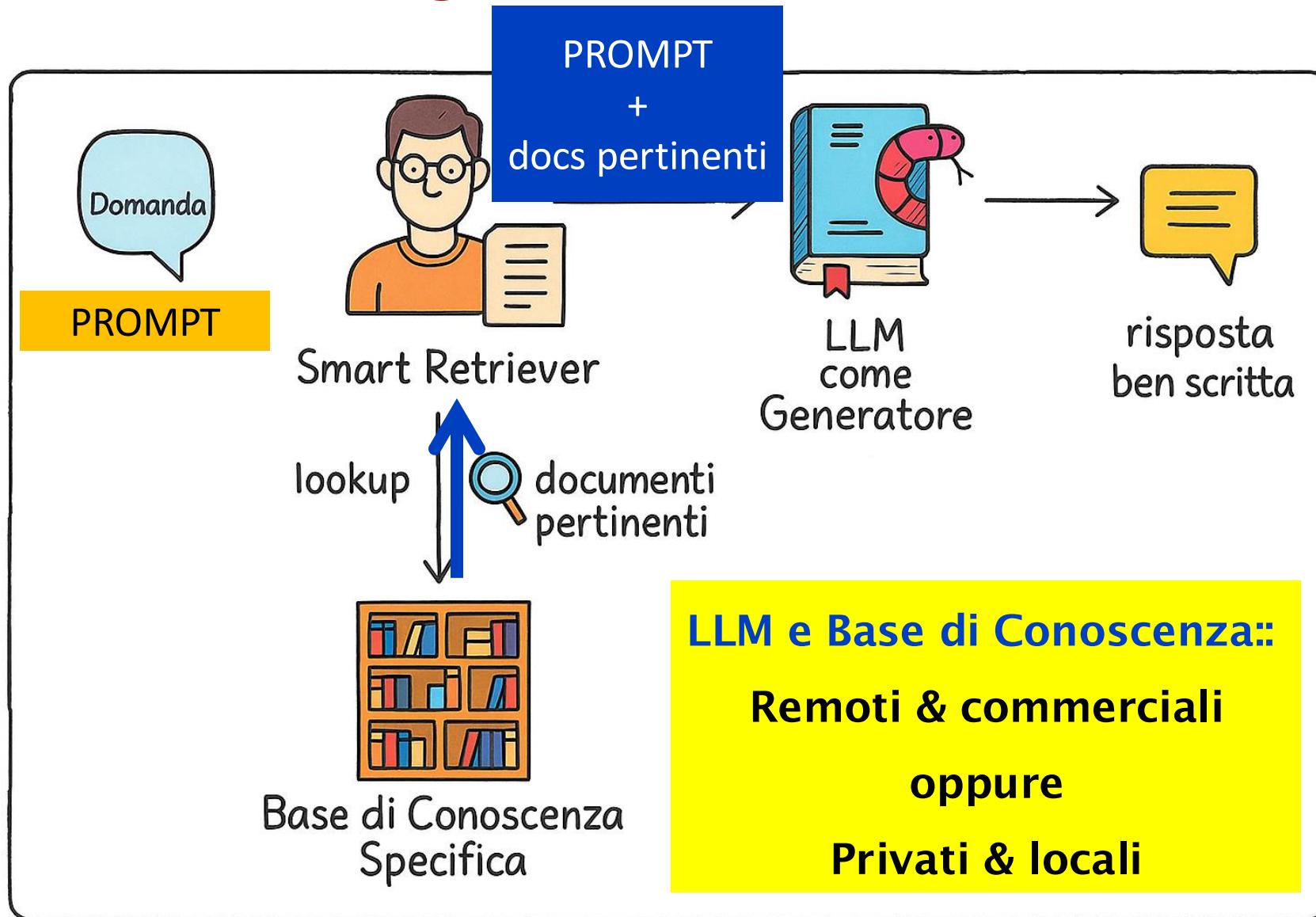
Retrieval Augmented Generation (RAG)



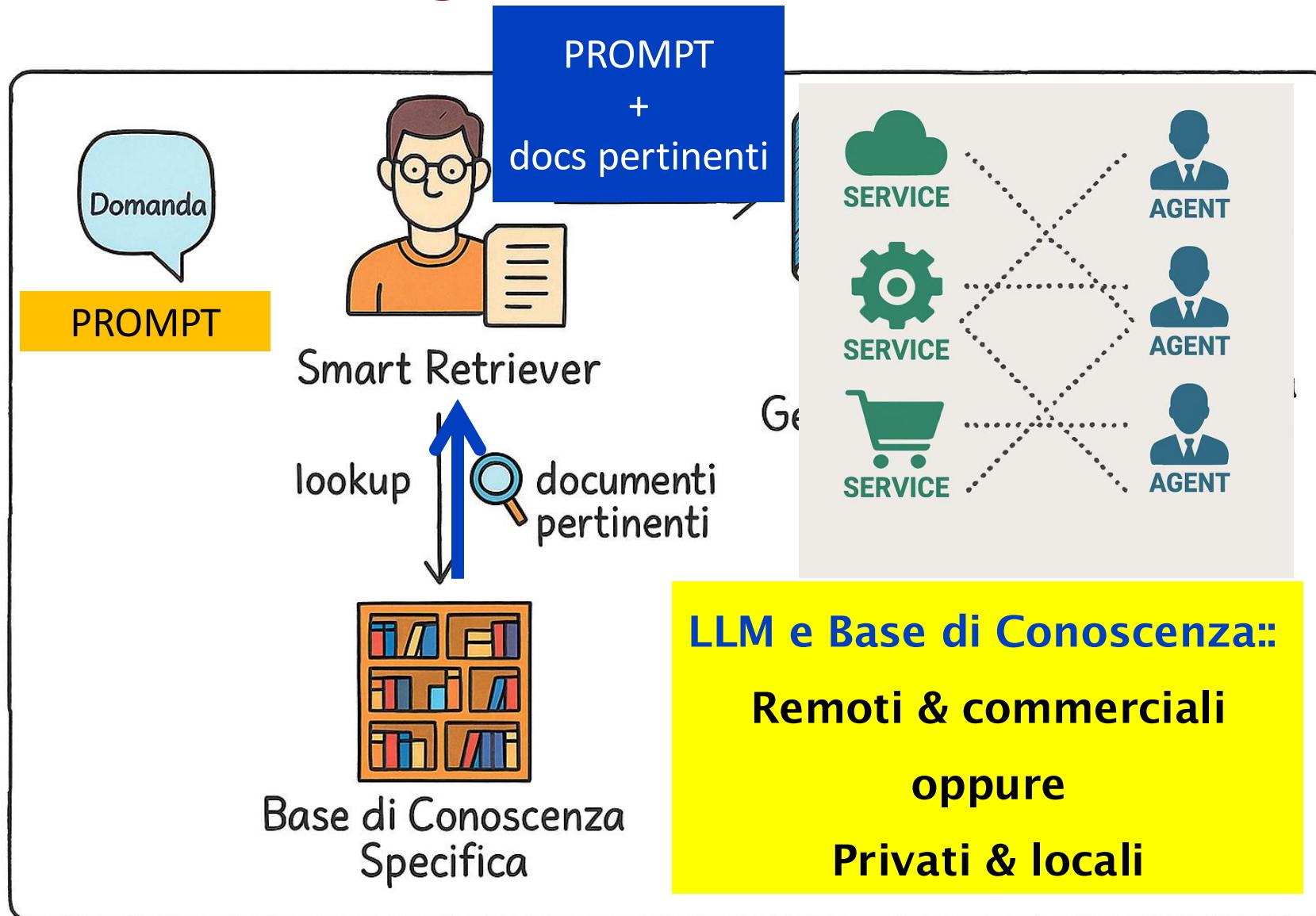
Retrieval Augmented Generation (RAG)



Retrieval Augmented Generation (RAG)



Retrieval Augmented Generation (RAG)



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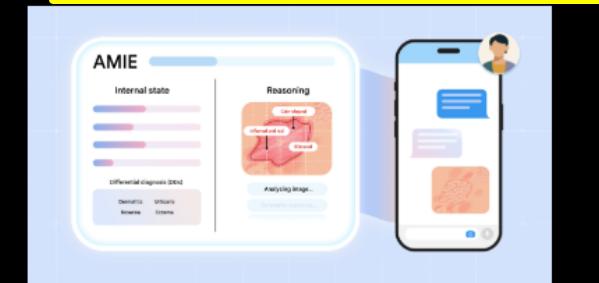
AMIE gains vision: A research AI agent for multimodal diagnostic dialogue

May 1, 2025 ·

Khaled Saab, Research Scientist, Google DeepMind, and Jan Freyberg, Software Engineer, Google Research

MedGemma

A Gemma 3 variant optimized for medical text and image comprehension

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- A **multimodal** framework that offers **history-based reasoning** that better emulates the structure of real-world clinical practice [Gemini 2.0 Flash].
- Evaluation sessions were performed through a **chat interface** where patient actors could upload multimodal artifacts

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STEVEN ROSENBUCH

Companies Are Struggling to Drive a Return on AI. It Doesn't Have to Be That Way.

Successful AI adoption begins with a targeted approach, and proceeds with careful orchestration and scaling across the organization



By [Steven Rosenbush](#) [Follow](#)

April 26, 2025 8:00 am ET

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HUMANS AND TECHNOLOGY

Finding value with AI automation

Rules-based policies and processes offer opportunities for enterprises to begin successful AI automation journeys.

By Lynn Comp

July 15, 2025

In un mondo dove fino al 90% dei Proof-of-Concept basati su AI ha fallito, ora è tempo di approcciare il loro progetto con estrema «cautela» [caution].

Why evaluating the impact of AI needs to start now

Oliver P. Hauser, Miriam Light, Lizzie Shelmerdine & Jack Blumenau

Artificial-intelligence technologies are being deployed rapidly across industries, yet most organizations lack even basic guidelines to assess the tools' effects.

Artificial intelligence (AI) has the potential to be a transformative force in science, society and the economy. However, much remains unknown about the broader implications of widespread AI use.

For instance, AI technologies can enhance as well as impede the performance of knowledge workers. They can boost productivity for routine tasks, such as ideageneration and writing, but might introduce bottlenecks and errors in more-complex tasks when AI advice is adopted blindly¹. Chatbots can aid individual people's creativity, yet overreliance on them might reduce the overall diversity of original ideas².

Understanding how users engage with the technology – and the outcomes that follow – requires careful, systematic study to differentiate between the positive and negative impacts. For instance, in education,