

Intelligent Information Systems Lab

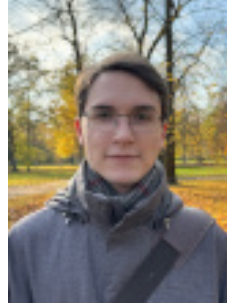
Winter Term 2026

Course Information

Instructors



Martin Potthast



Tim Hagen



Ben Gerhards

Contact

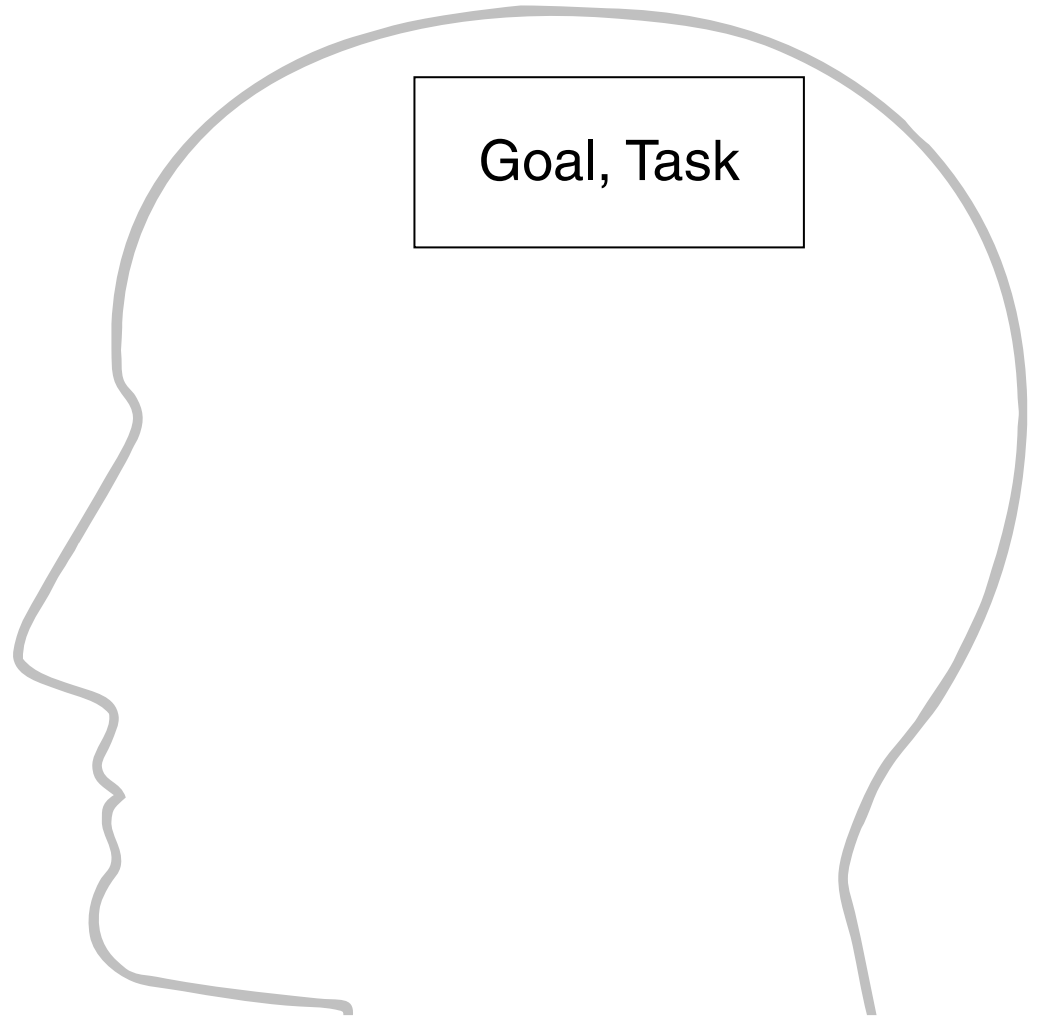
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- ❑ Office hours: by appointment
- ❑ Web: temir.org > Teaching > Intelligent Information Systems Lab

Intelligent Information Systems

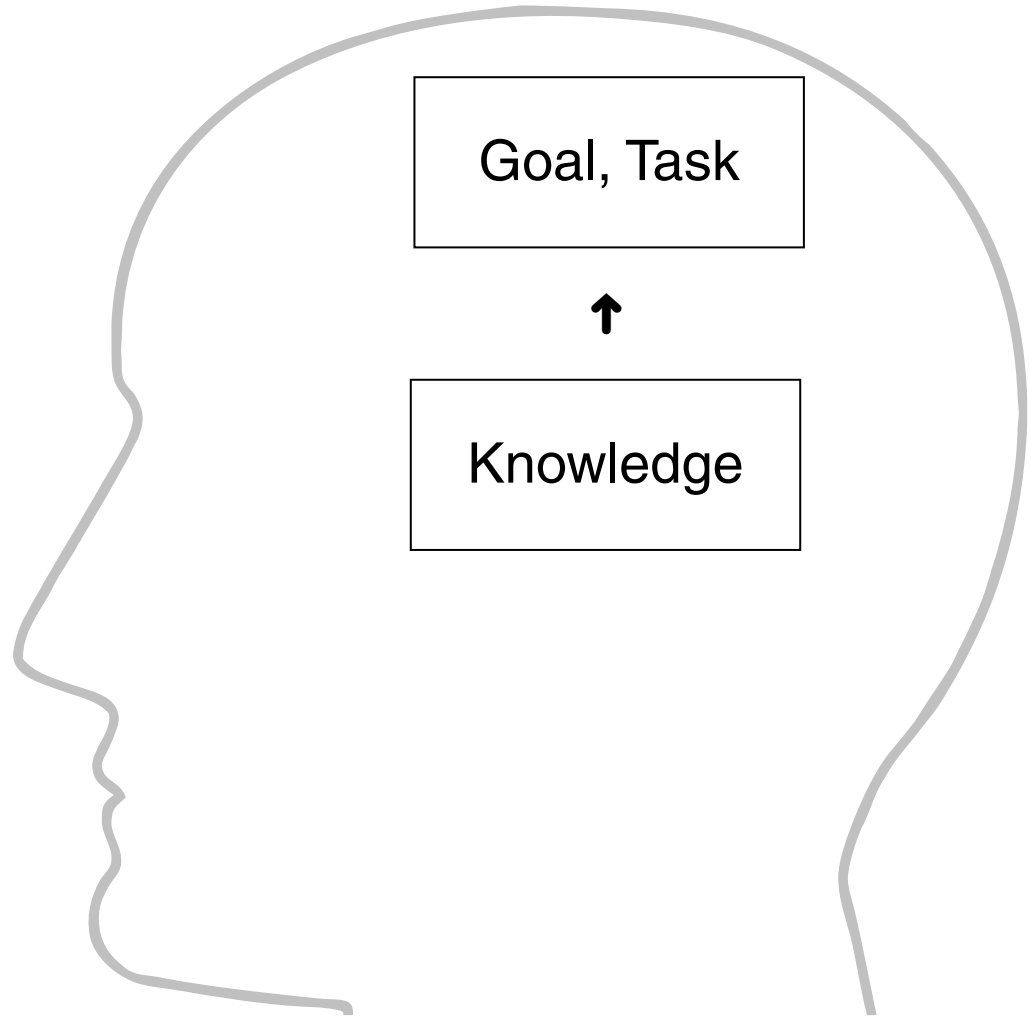
Information systems are those that help people satisfy information needs by finding, organizing, interpreting, and presenting relevant information.

- ❑ Help humans satisfy their information need efficiently and effectively
- ❑ Examples
 - Search engines
 - Translation systems
 - Dialog and conversation systems
 - AI Agents
 - Argumentation systems
 - ...
- ❑ Research subject of NLP and IR fields
- ❑ Rely on ML, and especially Deep Learning techniques

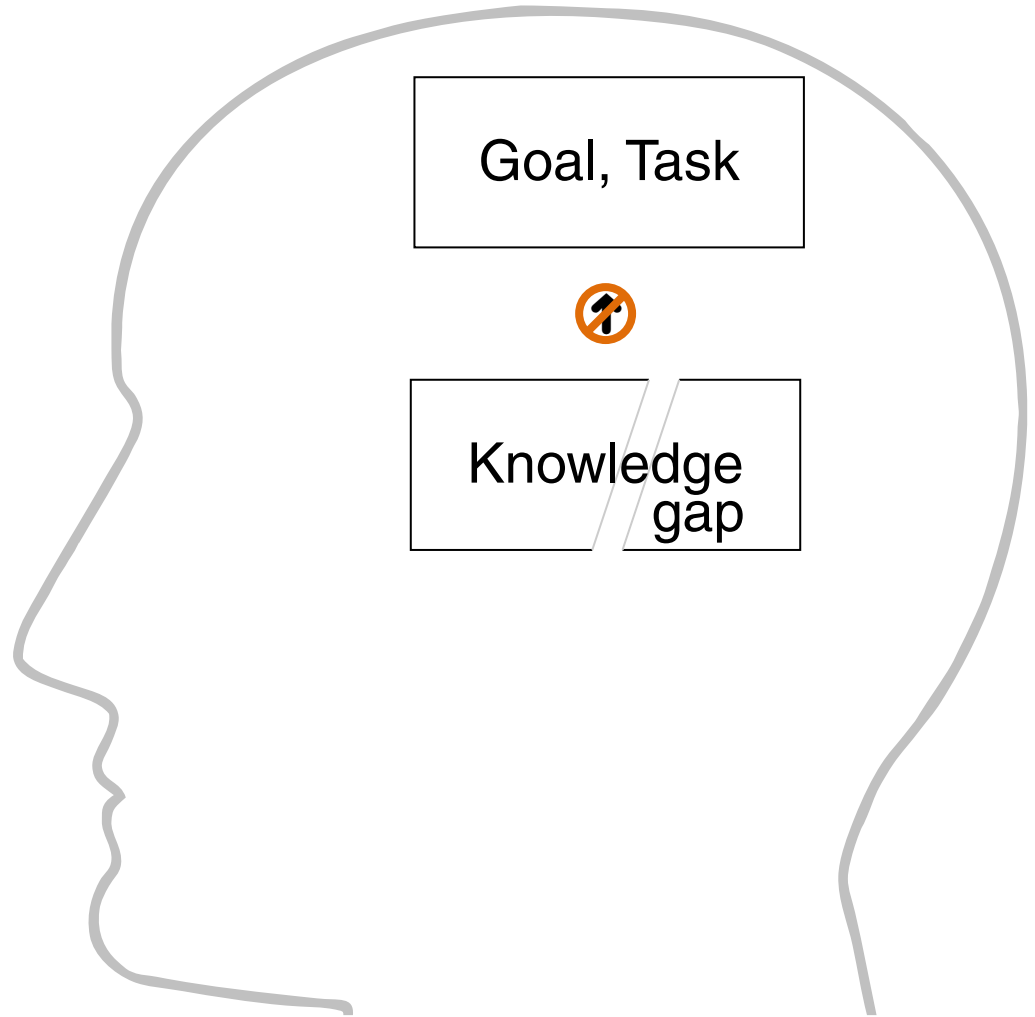
Information Retrieval



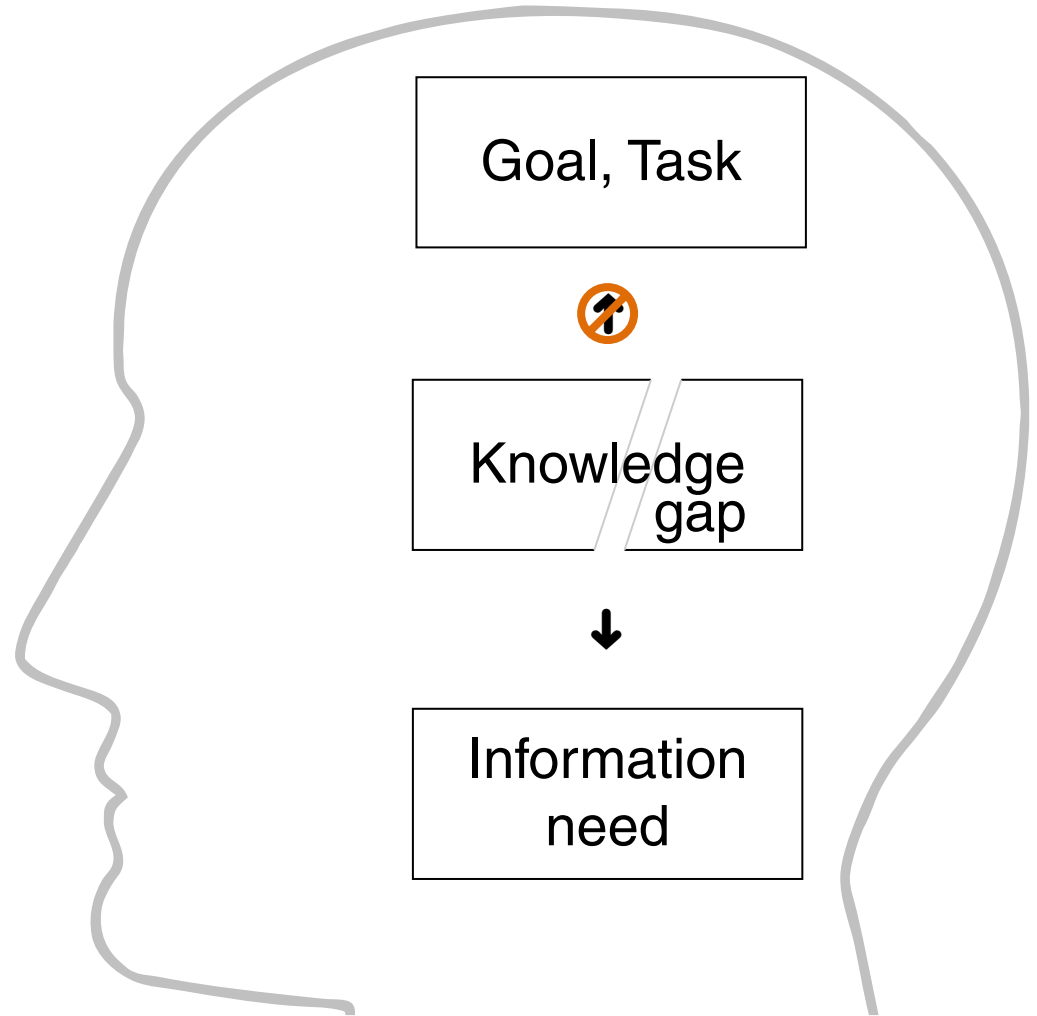
Information Retrieval



Information Retrieval



Information Retrieval



Information Retrieval

Data as documents



Information system

User

Goal, Task

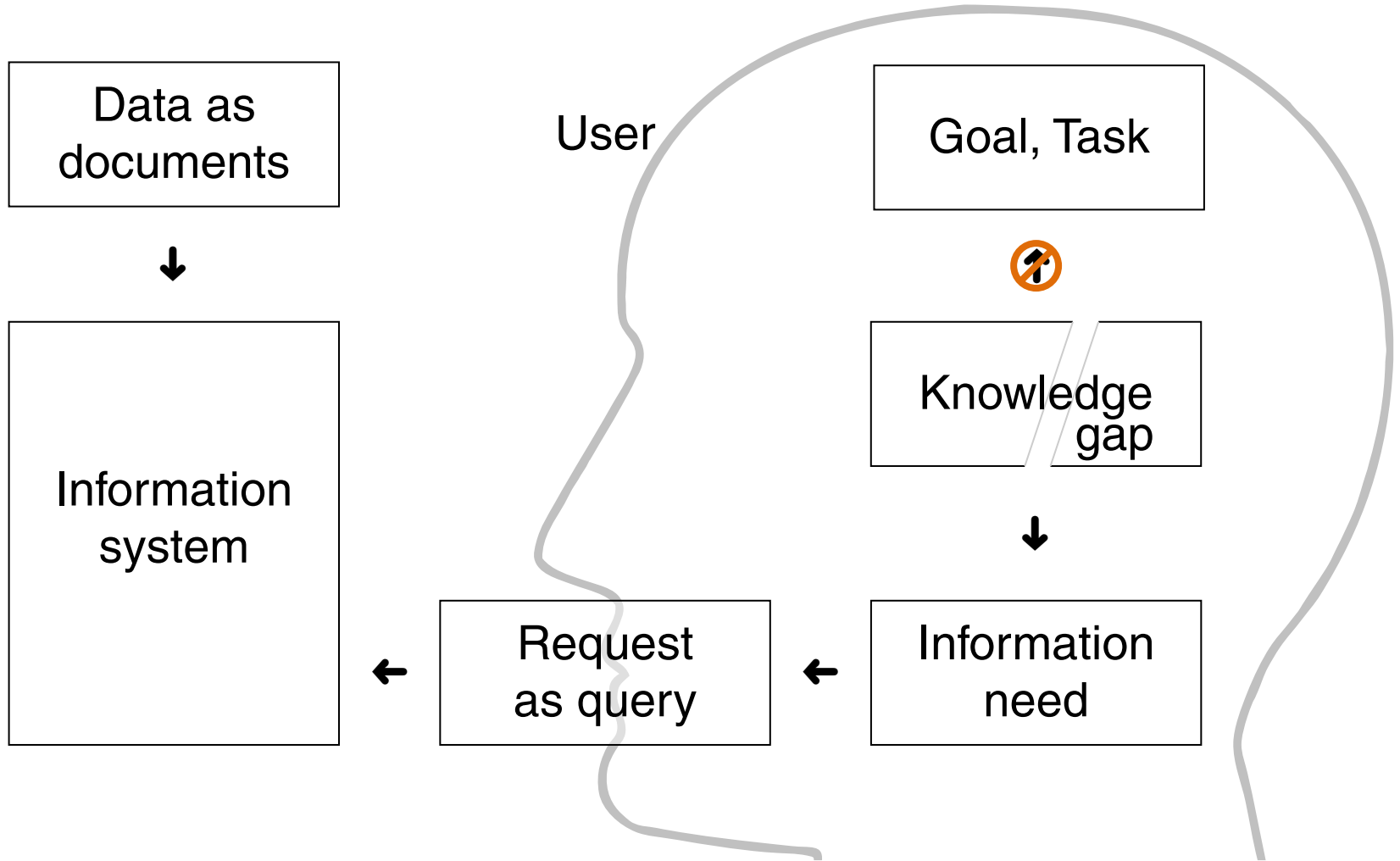


Knowledge gap

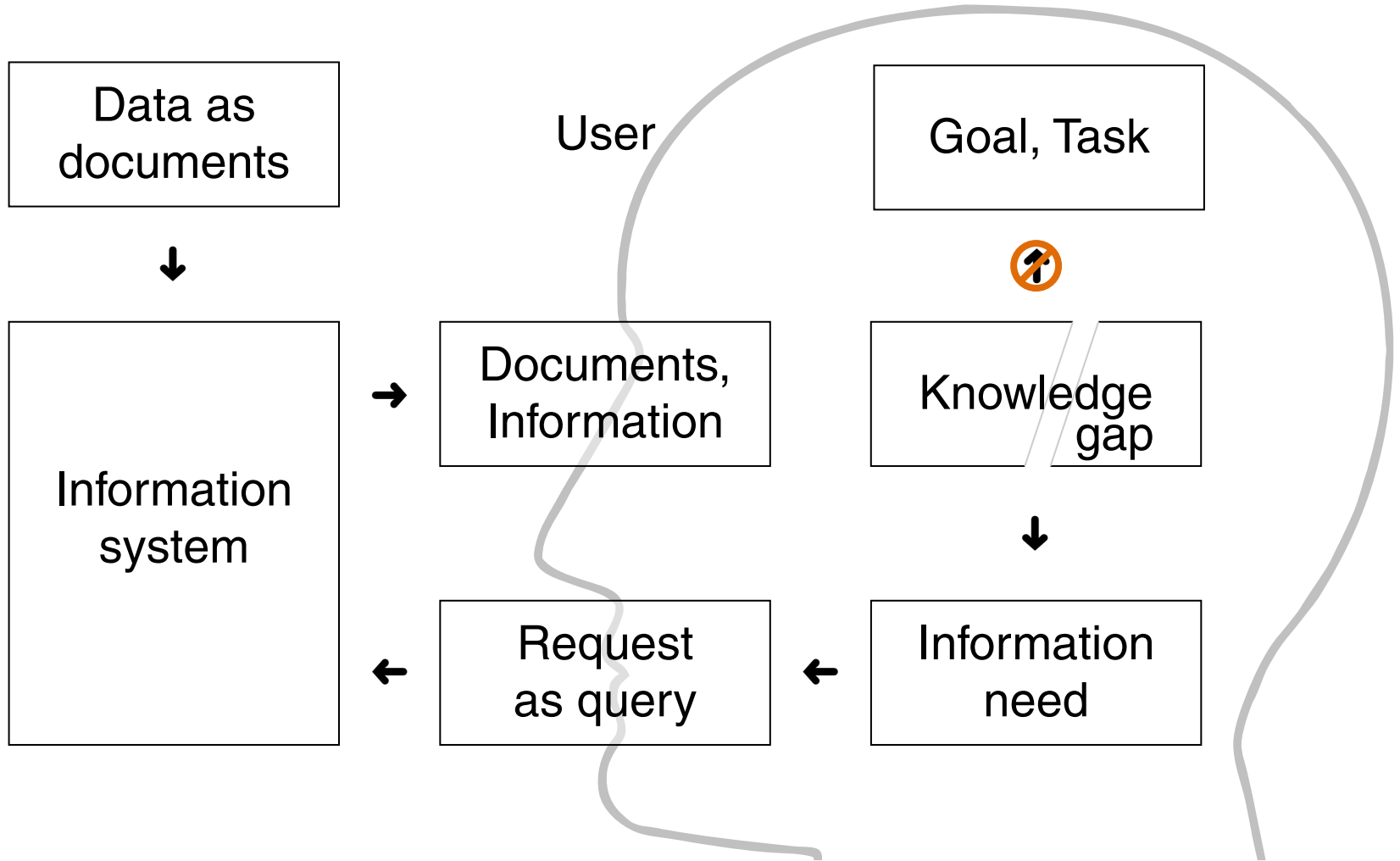


Information need

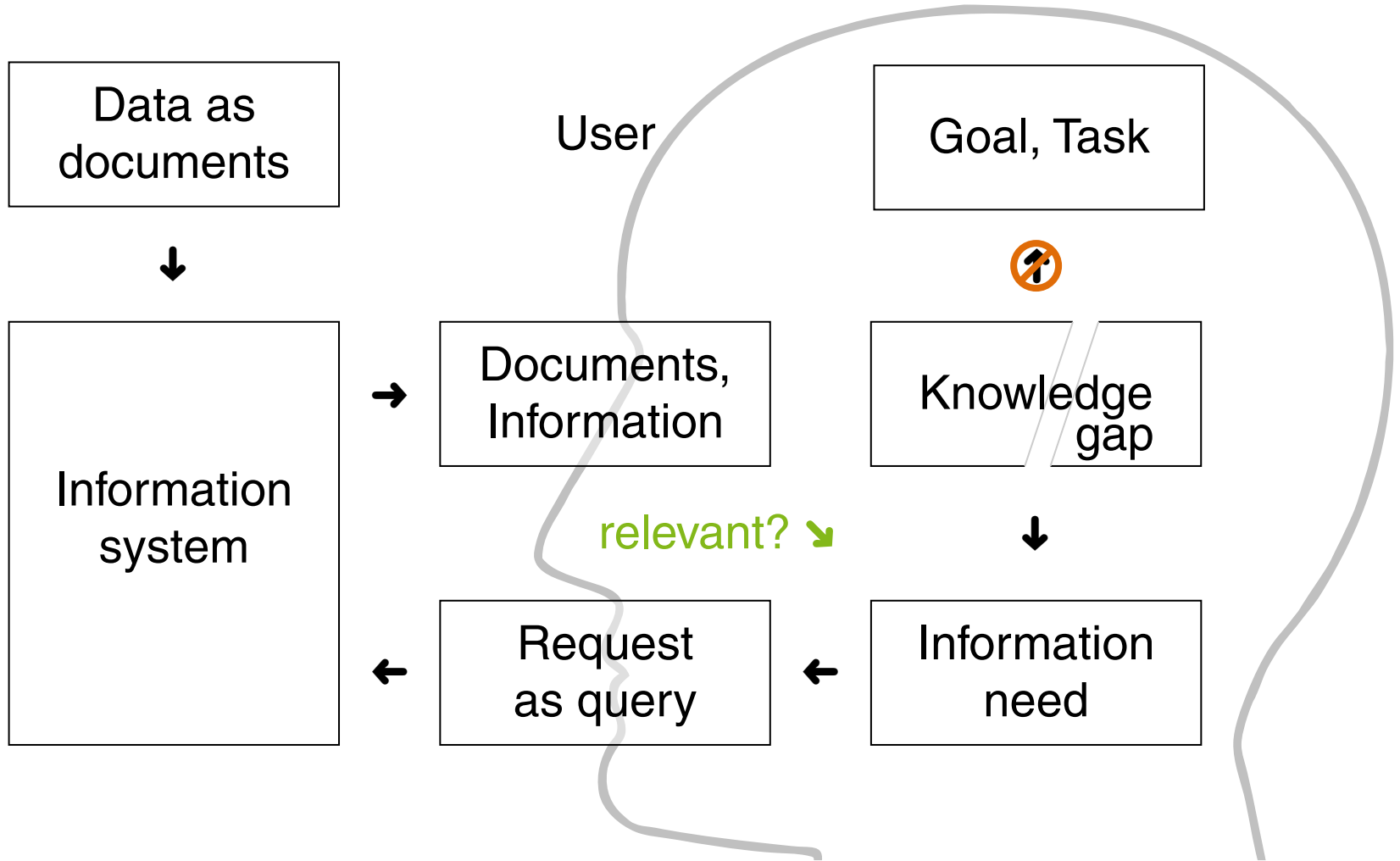
Information Retrieval



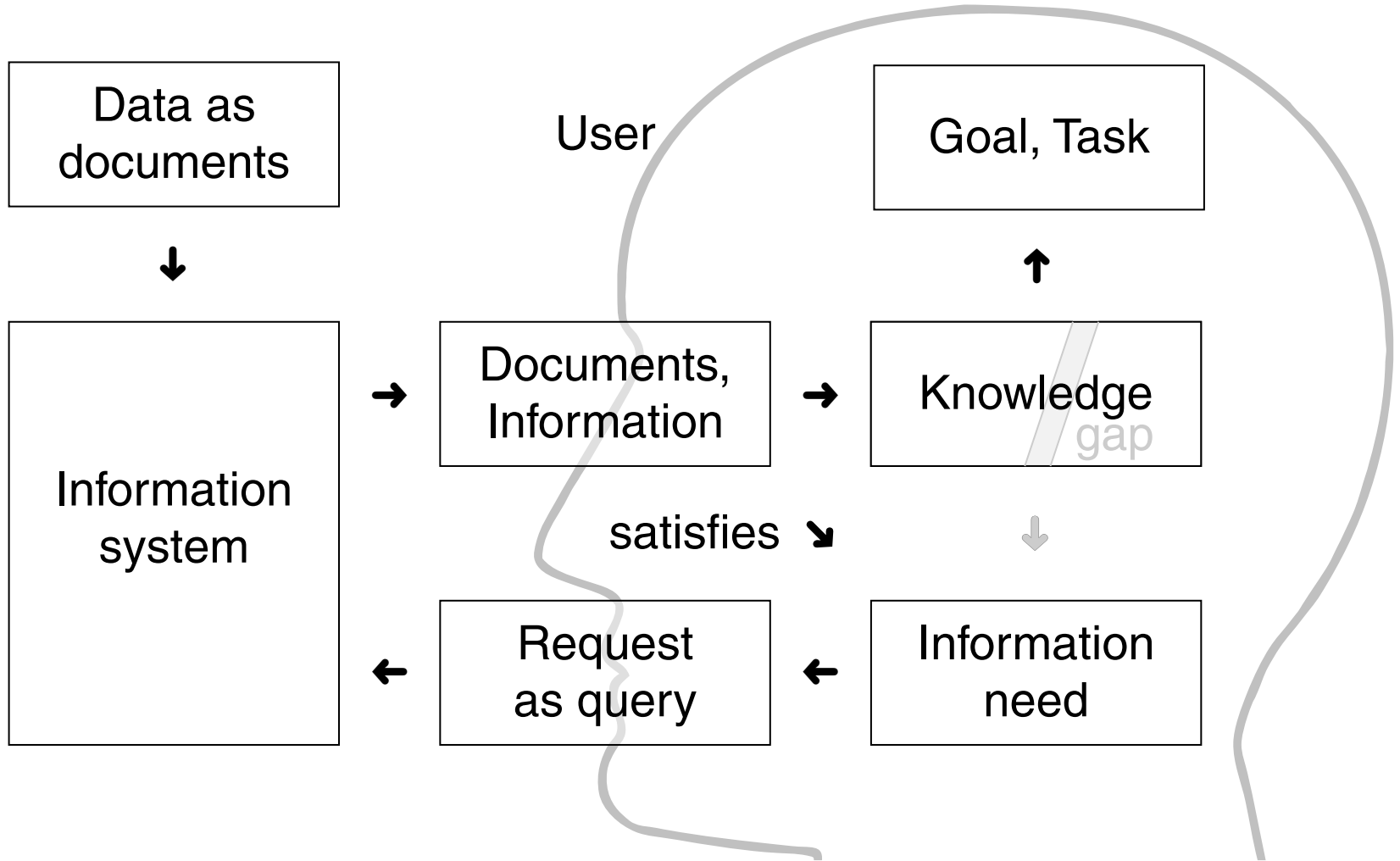
Information Retrieval



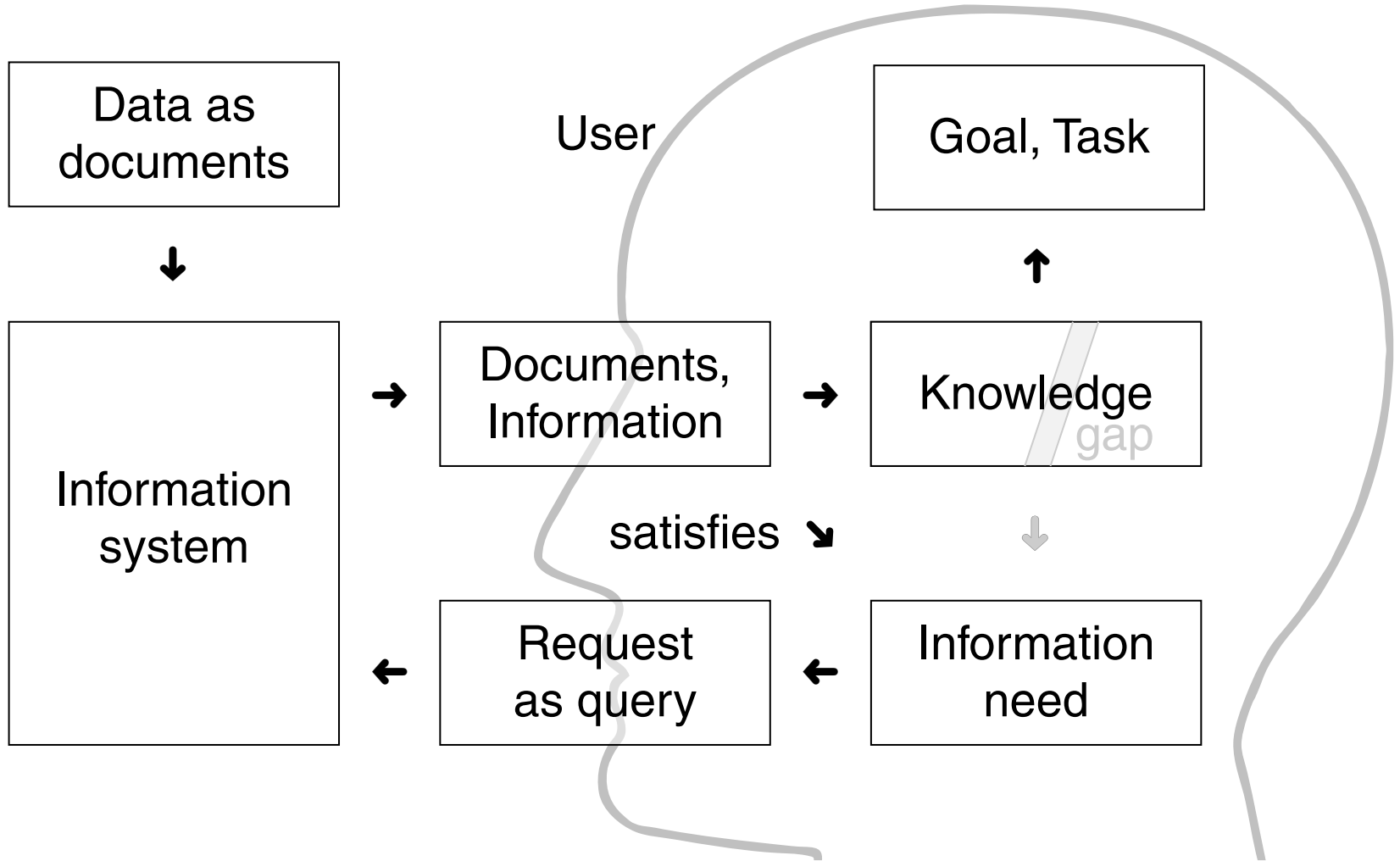
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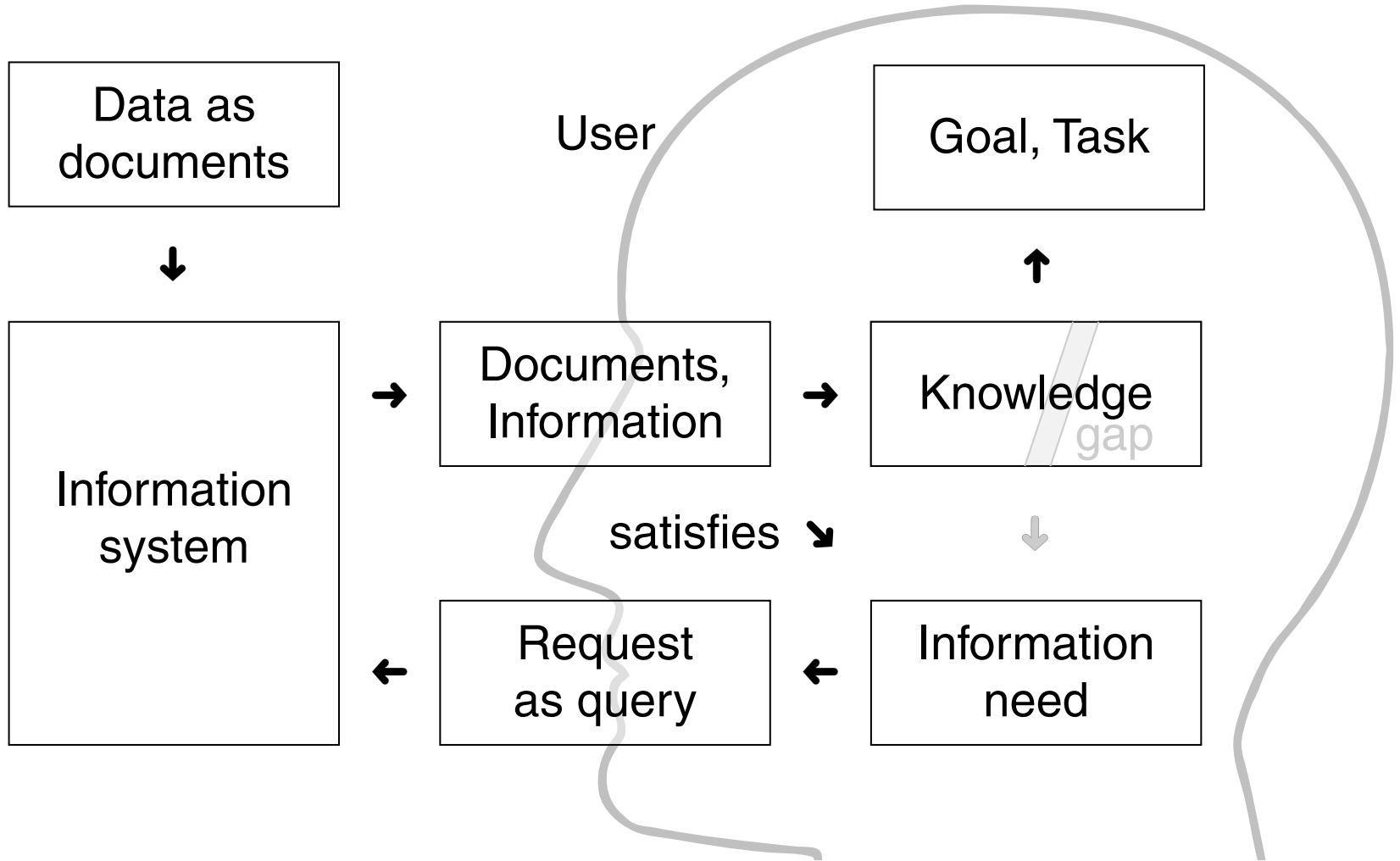


Information Retrieval



What search engines do you know?

Information Retrieval



What search engines do you know?

Google/Bing/... (Web Search), Library Index, Generative Models (e.g., GPT), Netflix

Search behavior is changing

Provide the answer instead of “10 blue links”



Birthplace abraham lincoln

Alle

Bilder

Videos

Nachrichten

Karten

Einkaufen

Chat

Settings

Immer privat

Deutschland

Abgesicherte Suche: moderat

Irgendwann

https://www.nps.gov/abli/index.htm

Abraham Lincoln Birthplace National Historical Park (U.S. National ...
16. Apr. 2024 · For over a century people from around the world have come to rural Central Kentucky to honor the humble beginnings of our 16th president, **Abraham Lincoln**. His early life on Kentucky's frontier shaped his character and prepared him to lead the nation through Civil War.

Info
About 200,000 people per year make the journey to visit the birthplace of th...

Alerts
Alerts - Abraham Lincoln Birthplace National Historical Park (U.S. National...

Maps
Maps - Abraham Lincoln Birthplace National Historical Park (U.S. National...

Calendar
Calendar - Abraham Lincoln Birthplace National Historical Park (U.S. National...

W https://en.wikipedia.org/wiki/Abraham_Lincoln

Abraham Lincoln - Wikipedia
Abraham Lincoln was born on February 12, 1809, the second child of Thomas Lincoln and Nancy Hanks Lincoln, in a log cabin on Sinking Spring Farm near Hodgenville, Kentucky. [2] He was a descendant of Samuel Lincoln, an Englishman who migrated from Hingham, Norfolk, to its namesake, Hingham,...

Bilder für Birthplace abraham lincoln



VS.

Where was Abraham Lincoln born?



Abraham Lincoln was born in a log cabin on February 12, 1809, in Hodgenville, which was then part of Hardin County, Kentucky (now known as LaRue County). His birthplace is now preserved as the Abraham Lincoln Birthplace National Historical Park.

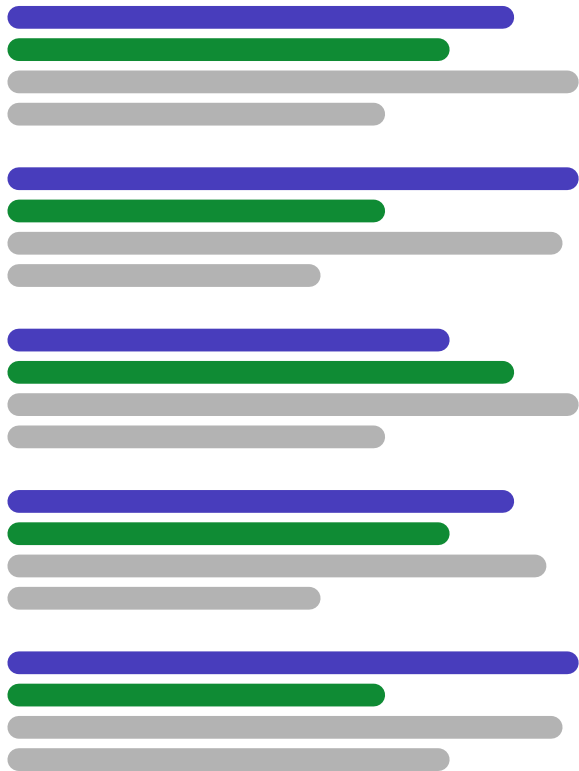
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Retrieval-Augmented Generation

How to satisfy an information need:

Query



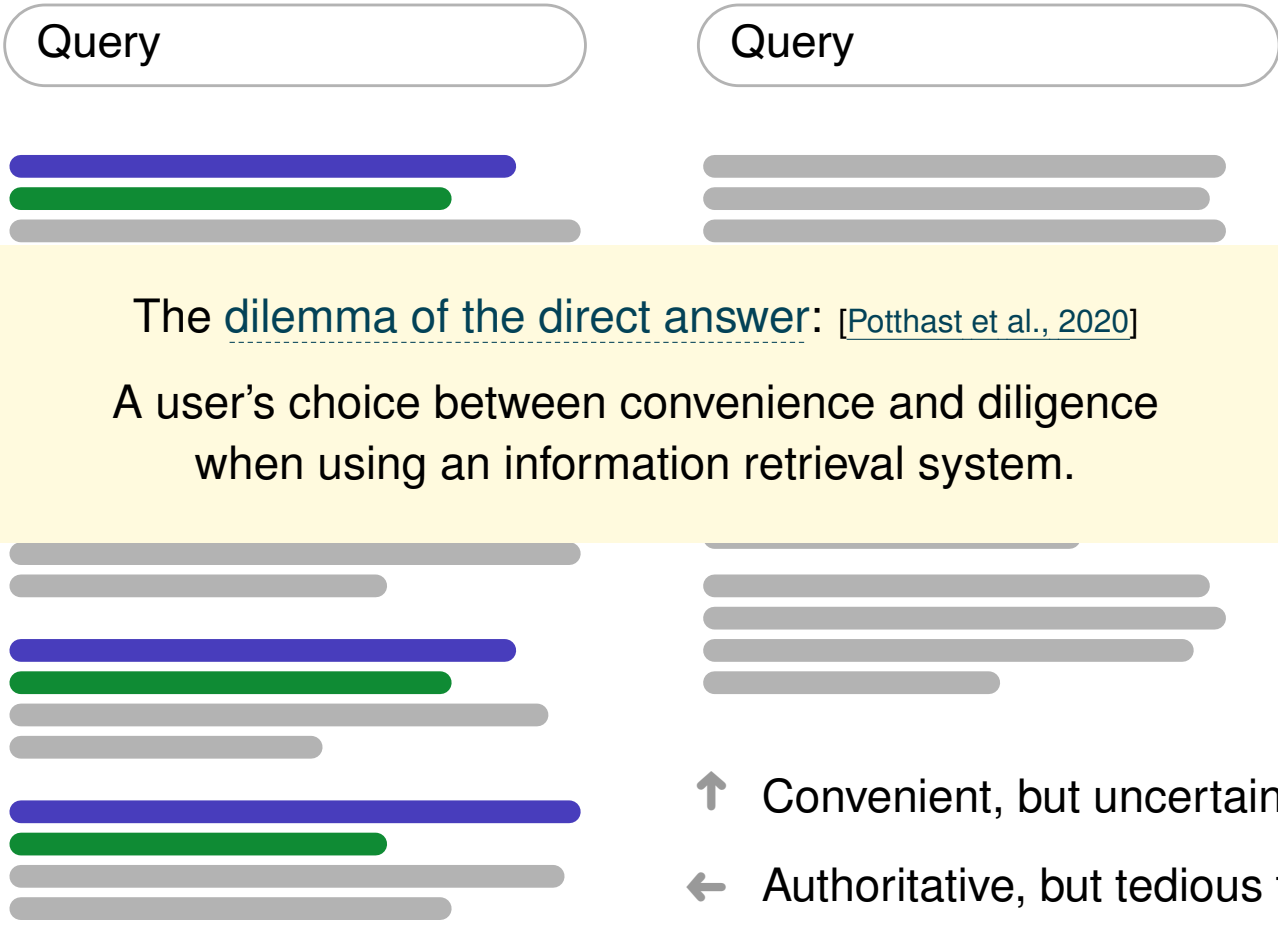
Query



- ↑ Convenient, but uncertain veracity
- ← Authoritative, but tedious to analyze

Retrieval-Augmented Generation

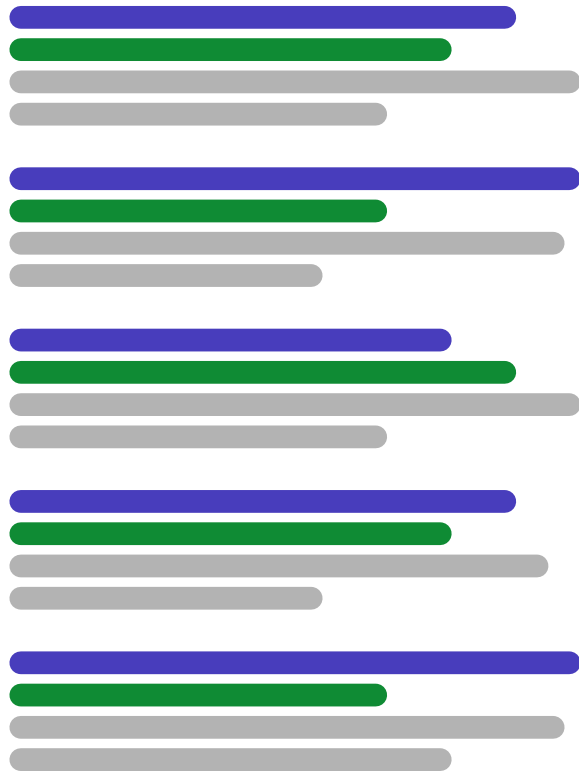
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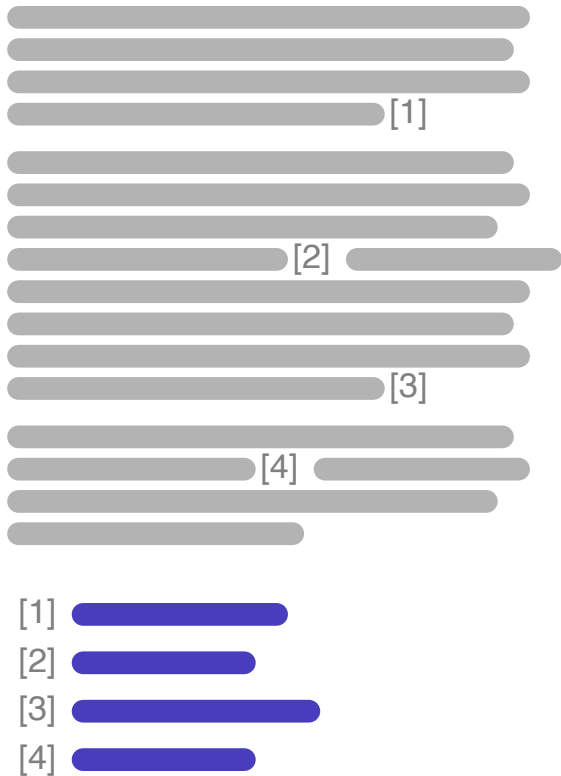
Retrieval-Augmented Generation

How to satisfy an information need:

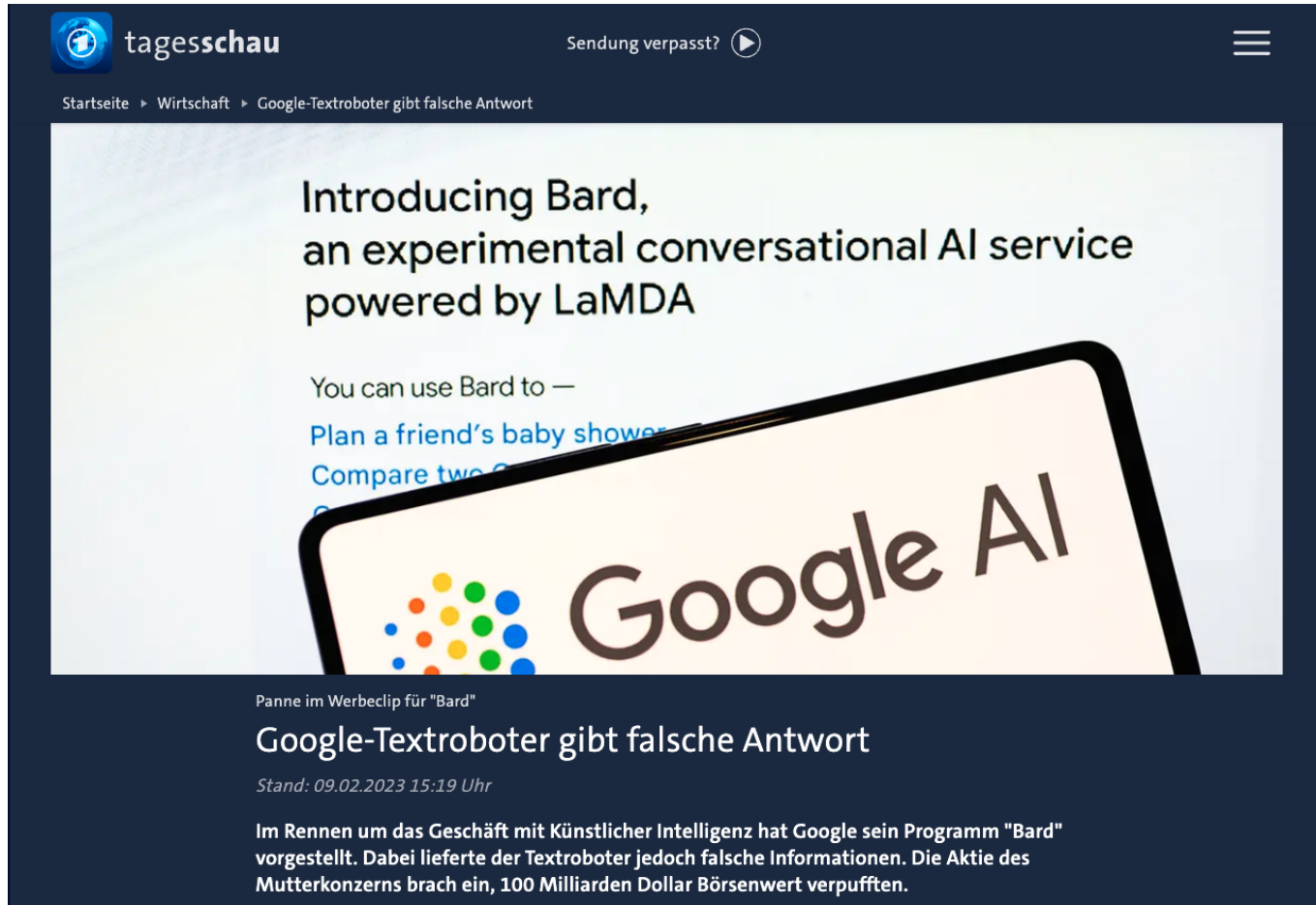
Query



Query



To err is “human”



[[tagesschau.de](https://www.tagesschau.de)]

→ It is important to give good answers

What makes a good response?

What makes a good response?

How tall is the Empire State Building?

A tabby cat is distinguished by its unique coat patterns, which typically include the classic “M” shape on the forehead, stripes, dots, or swirling patterns on the body, and ring-like markings on the legs and tail. The four primary tabby patterns are classic, mackerel, spotted, and ticked. Tabby cats also have agouti hairs, which are hairs that have multiple colors along their length, contributing to their mottled appearance. Their coat can come in a variety of colors such as brown, grey, and orange.

The Empire State Building stands at 381 meters without the antenna and reaches 443 meters when the antenna is included.

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Quality aspects:

1. **Relevance:** The user’s information need must be addressed

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1. Relevance: The user's information need must be addressed
2. Grounding: The response must be verifiable from sources

What makes a good response?

How tall is the Empire State Building?

Ah, an inquiry regarding the towering vertical majesty that is the Empire State Building! Well, let us first dissect this marvel of architectural splendor by considering its height in two distinct forms. If one is to contemplate the structural essence of the building sans antenna, it reaches an elevation of precisely 381 meters—yes, 381, that rather specific number which seems to land with elegant finality. However, if one dares to include the soaring antenna that crowns this iconic skyscraper, a further extension of the structure's grandeur is achieved, bringing its total height to a dizzying 443 meters! Indeed, a height that challenges one's very perception of the skyward limit. Thus, the Empire State Building, in its duality of heights, stands either at 381 meters in a minimalist contemplation of its mass or at 443 meters when fully embracing its towering ambition.

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Quality aspects:

1. **Relevance:** The user's information need must be addressed
2. **Grounding:** The response must be verifiable from sources
3. **Presentation:** The response must be readable

Which response is better?

How do I tell that I have a virus?

You might have a virus if your computer is slow or crashes often. Look for unexpected pop-ups and missing files. Strange behavior, like settings changing on their own, can also indicate a virus. Finally, check for unusual network activity.

To determine if you have a virus, watch for symptoms like fever, cough, fatigue, muscle aches, sore throat, headache, runny or stuffy nose, nausea, or diarrhea. If you experience multiple symptoms, especially if they worsen, consult a healthcare professional for diagnosis and testing.

Quality aspects:

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Which response is better?

What society issues did goth rock address?

Gothic rock delves into a variety of thought-provoking topics, focusing on societal issues such as racism, war, and group hatred. The music often presents a unique perspective on life, seeking to find beauty in life, pain, and death [0].

[0] <https://www.example.org/a.html>

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Quality aspects:

1. Relevance: The user's information need must be addressed
2. Grounding: The response must be verifiable from sources
3. Presentation: The response must be readable

Which response is better?

How do I divide two fractions?

To divide fractions, multiply the dividend by the reciprocal of the divisor.

To divide fractions, flip the second fraction upside down and then multiply it with the first fraction. After multiplying, simplify the answer.

Quality aspects:

1. Relevance: The user's information need must be addressed
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3. Presentation: The response must be readable

Agentic Search

- ❑ Retrieval Augmented Generation (RAG): Given a query, retrieve relevant documents. Synthesize an answer based on the query and the documents
- ❑ What queries cannot be answered by a RAG system?

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Which university did Microsoft's founder attend?
 - Exploratory queries (need high recall)
What scientific work is there on agentic search in NLP and IR?
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How does SLURM compare to HTC Conda?

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 - Comparative queries
How does SLURM compare to HTC Conda?
- ➔ Agentic Search: a language model repeatedly issues queries, analyzes results, and synthesizes an answer

Topic

Agentic Search on the IR Anthology

- ❑ Help researchers find answers in the [IR Anthology](#)
- ❑ Corpus: Scientific publications on information retrieval (as PDF files)
- ❑ Goal: Answer complex user queries with verifiable citations
- ❑ The agent retrieves iteratively, follows evidence, and decides when to stop
- ❑ How to efficiently search and index PDF files? [[Architecture of a Search Engine](#)]
What software can we use to do it for us?
- ❑ How to present sources and citations to the user?
- ❑ When to stop searching?
What if the answer is not out there?

Tasks

Develop and evaluate an agentic search system for the IR Anthology.

- ❑ Extract document content and metadata and index it
- ❑ Implement a retrieval and a RAG system on top of the index
- ❑ Develop a search agent that answers a users stated information need
- ❑ Expose a REST API for the search agent and develop a web interface
- ❑ Evaluate relevance, grounding, presentation, and efficiency

Learning Objectives

- ❑ Work in a structured and self-supervised manner
- ❑ Apply current research in language technologies
- ❑ Develop and carry out experiments at scale
- ❑ Work with large corpora via state-of-the-art infrastructure
- ❑ Collaborate effectively in a group
- ❑ Scientific writing and presentation
- ❑ Create demonstrable software solutions

Labor: Intelligent Information Systems

Organization

- ❑ **Workload:** 4 SWS
- ❑ **Schedule:** Wednesday, 10:00 c.t. – 12:00
- ❑ **Location:** Room 1114; individual appointments online
- ❑ **Communication:** Email, Discord



- ❑ **Materials:** Slides, papers, and resources on the [course website](#)

Deliverables

- ❑ Code/Demo
- ❑ Report (template will be provided)
- ❑ Presentation

Details on the deliverables will be provided later.

Getting to Know Each Other

What experience do you have in the following subjects?

- ☐ Information Retrieval

Hint: we also have an [IR Lecture](#); its not required for this course though

- ☐ Machine learning, deep learning
- ☐ Programming in Python
- ☐ Web development (particularly Svelte)
- ☐ Software architecture
- ☐ Git
- ☐ SSH
- ☐ Continuous Integration (CI)
- ☐ Kubernetes

Introductory Exercise

- ❑ Send me your Student E-Mail addresses via Discord and I will create an account at our GitLab for you
- ❑ We provide a short Jupyter Notebook that instructs you to write a simple RAG system; complete it and write down any thoughts or inspirations you have regarding this lab [\[notebook\]](#)
- ❑ Brainstorm regarding possible architectures and pitfalls
- ❑ Search for frameworks and prior work
- ❑ Find prior work on agentic search
What can we take away from it?
- ❑ Prepare short 5–10 min presentations
Present your architectural ideas, pitfalls, relevant prior work, and other general thoughts. Don't present how you solved the Notebook

Submit your Notebooks and slides until Tuesday evening to

tim.hagen@uni-kassel.de.