



FELIX (Friendly Enhanced LISA Information eXplorer).

An AI companion to navigate LISA's documents and tools

J.Martino



Mission Large de l'Agence Spatiale Européenne (ESA)

Budget global (financé): 2 milliards d'euros

Lancement: 2035

Objectif Scientifique: détecter des ondes gravitationnelles dans la bande du mHz

Objectif Technique: Mesurer des fluctuations de distance de l'ordre du pm sur une longueur de 2.5 millions de km



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Instrument = Constellation



FELIX

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⚠ Disclaimer: The information provided here is not public and must remain within the LISA Project.

Performance & Operations

> Document Corpus

What do you need to know about LISA today?

FELIX is your on-demand technical knowledge base for the LISA mission. Ask it anything about instrument performance, noise budgets, operational procedures, or system specifications, and get precise answers grounded in the mission's own documentation.

Always verify the answers before using them.

> Show Sources Used

Ask a question...





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Describe the brownian noise and provide formula. Is this noise stationary ?



Describe the brownian noise and provide formula. Is this noise stationary ?



Brownian noise (specifically Brownian force noise) in the LISA mission arises from the impacts of residual gas molecules colliding with the Test Mass (TM). It is a dominant noise source at **mHz** frequencies and is a function of the residual gas pressure around the Test Mass.

Physical Model and Formula

The Brownian noise can be described using a Model Based Estimate (MBE) or Current Best Estimate (CBE). The MBE value of $1.7 \text{ fm/s}^2/\text{Hz}^{1/2}$ is obtained directly from the following equation, assuming a residual pressure requirement of $p = 2 \text{ } \mu\text{Pa}$:

$$S_g^{Br} = \alpha_{Br} \left(1 + \frac{\pi}{8}\right) \frac{s_{TM}^2}{m_{TM}^2} p \left(\frac{512 m_0 k_B T}{\pi}\right)^{1/2} = \left[1.7 \text{ fm/s}^2/\text{Hz}^{1/2} \times \left(\frac{p}{2 \text{ } \mu\text{Pa H}_2\text{O}}\right)^{1/2}\right]^2 \quad (1)$$

Where:

- $\alpha_{Br} \approx 13$: Brownian noise geometrical amplification factor due to the proximity of the electrode housing (EH) surfaces to the TM.
- s_{TM} : Test Mass size.
- m_{TM} : Test Mass mass.
- p : Residual gas pressure.
- m_0 : Effective molecular weight of the gas species (likely water, H_2O).
- k_B : Boltzmann constant.
- T : GRS temperature.

Alternatively, the analytical model (MBE or CBE) is represented as: $\sqrt{\alpha_{noise} \times (1 + \pi/8) \times (TMsize/TMmass)^2 \times VacuumPressure \times \sqrt{512 \times H2Omo \times KB \times T_GRS/\pi}}$ (Source: LISA Constellation Performance Model, IRD2-GRS-04600)

Stationarity

The provided documents do not explicitly state whether this noise is stationary; however, they indicate that the noise level is expected to change over time.

The pressure (and thus the noise) is expected to decrease following a slow power law after the cruise time, specifically: $\sim (t -$

$t_{vent})^{-0.8}$ (observed in LPF) or $\sim (t - t_{vent})^{-0.5}$ (literature values) (Source: LISA Constellation Performance Description Document: ESA-



c'est quoi IRD2-IDS-09270 ?



c'est quoi IRD2-IDS-09270 ?



L'IRD2-IDS-09270 (**Line of Sight Alignment**) est une exigence relative à la contribution du sous-système IDS (Interferometric Detection Subsystem) à l'alignement de la ligne de visée (LoS).

Voici les détails techniques associés :

- **Description** : Cette exigence définit la contribution de l'IDS à l'angle entre le vecteur RX tel que construit (as-built) et la normale du Test Mass (TM) telle que construite, mesuré dans le référentiel de l'Optical Bench (OB)/OIRF/Telescope (TEL).
- **Valeurs limites** : Les composantes de cet angle doivent être inférieures à :
 - $R_y \leq \pm 75 \mu\text{rad}$
 - $R_z \leq \pm 75 \mu\text{rad}$
- **Justification (Rationale)** : L'Optical Bench (OB) contribue à l'alignement de la LoS. L'alignement total de la LoS considéré dans le modèle de performance est de $100 \mu\text{rad}$ dans le budget BGT-SYS-26100.
- **Note additionnelle** : Cette exigence contribue également au budget d'alignement angulaire OB-GRS (BGT-SYS-05100) à l'entrée BGT-SYS-05110.

Source: IDS IRD2: ESA-LISA-EST-IDS-RS-0002, IRD2-IDS-09270

 Not satisfied

Why ?

Usually it's a mess !

Where can I find reliable and up to date information ?

Usually it's a mess !

Where can I find reliable and up to date information ?



O5 Technical Design Report



IDS PDR datapack

Usually it's a mess !

Where can I find reliable and up to date information ?



O5 Technical Design Report

- > Everything in 959 pages
- > Not self consistent
- > rarely updated
- > Technical information mixed up with non relevant information



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IDS PDR datapack

- > Everything in 126 documents !
- > Information is scattered around and redundant (prone to error)
- > Multiple versions of each documents
- > Not easily understandable from outside the project.

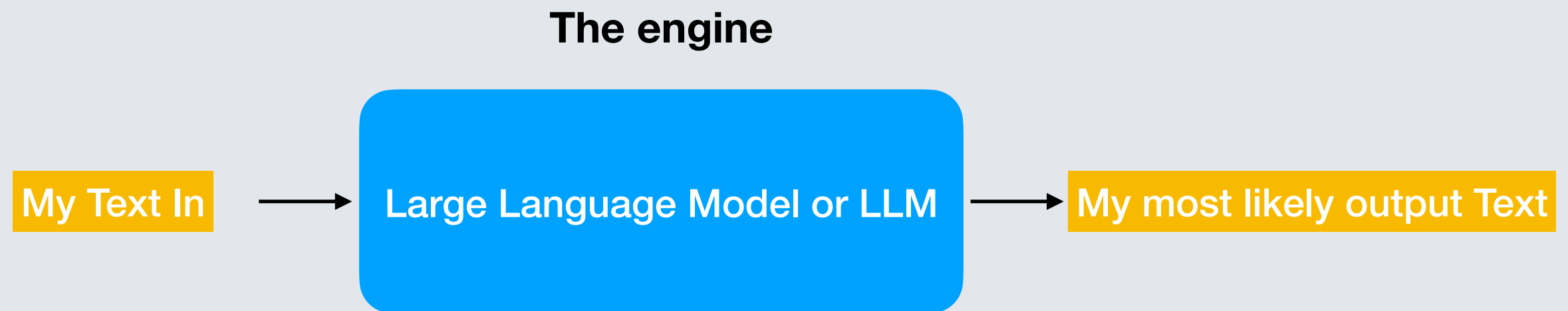
A LLM to answer the user query based
on Project Database

A LLM to answer the user query based on Project Database

The engine

Large Language Model or LLM

A LLM to answer the user query based on Project Database



A LLM to answer the user query based on Project Database

The engine

My Text In



Large Language Model or LLM

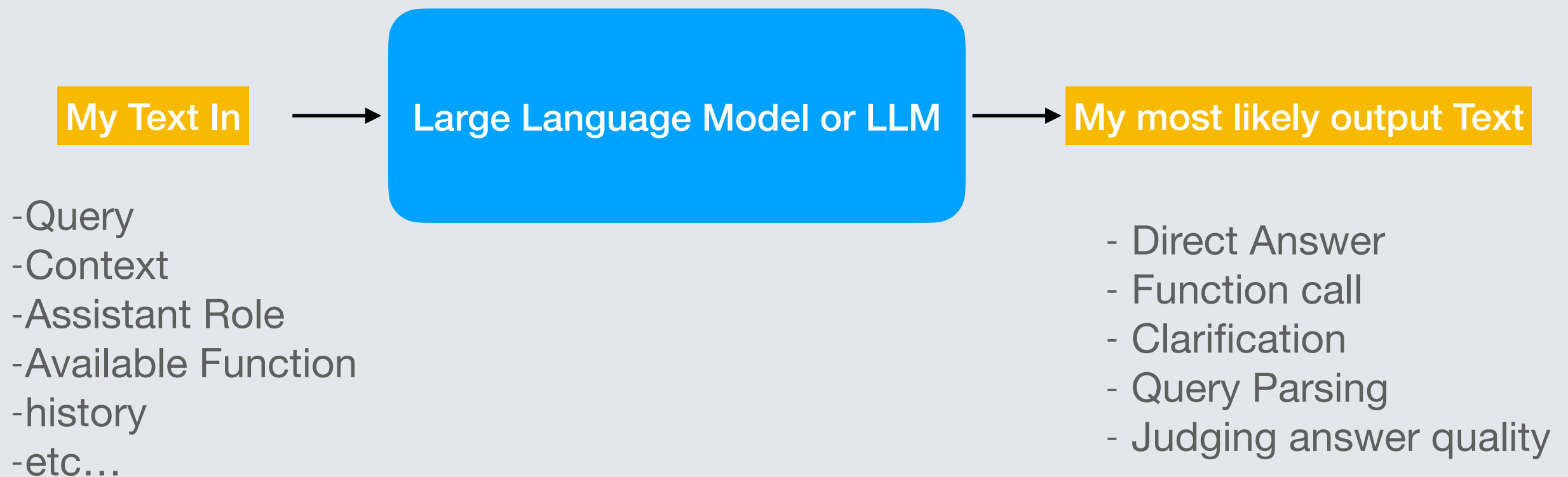


My most likely output Text

- Query
- Context
- Assistant Role
- Available Function
- history
- etc...

A LLM to answer the user query based on Project Database

The engine



A LLM to answer the user query based on Project Database

FELIX

The engine

My Text In

Large Language Model or LLM

My most likely output Text

- Query
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- etc...

- Direct Answer
- Function call
- Clarification
- Query Parsing
- Judging answer quality

Application	Underlying model(s)
Claude.ai	Claude Sonnet, Opus, Haiku...
ChatGPT	GPT-4o, GPT-4, o1...
Microsoft Copilot	GPT-4o (via Azure OpenAI)
Gemini (gemini.google.com)	Gemini 1.5 Pro/Flash...

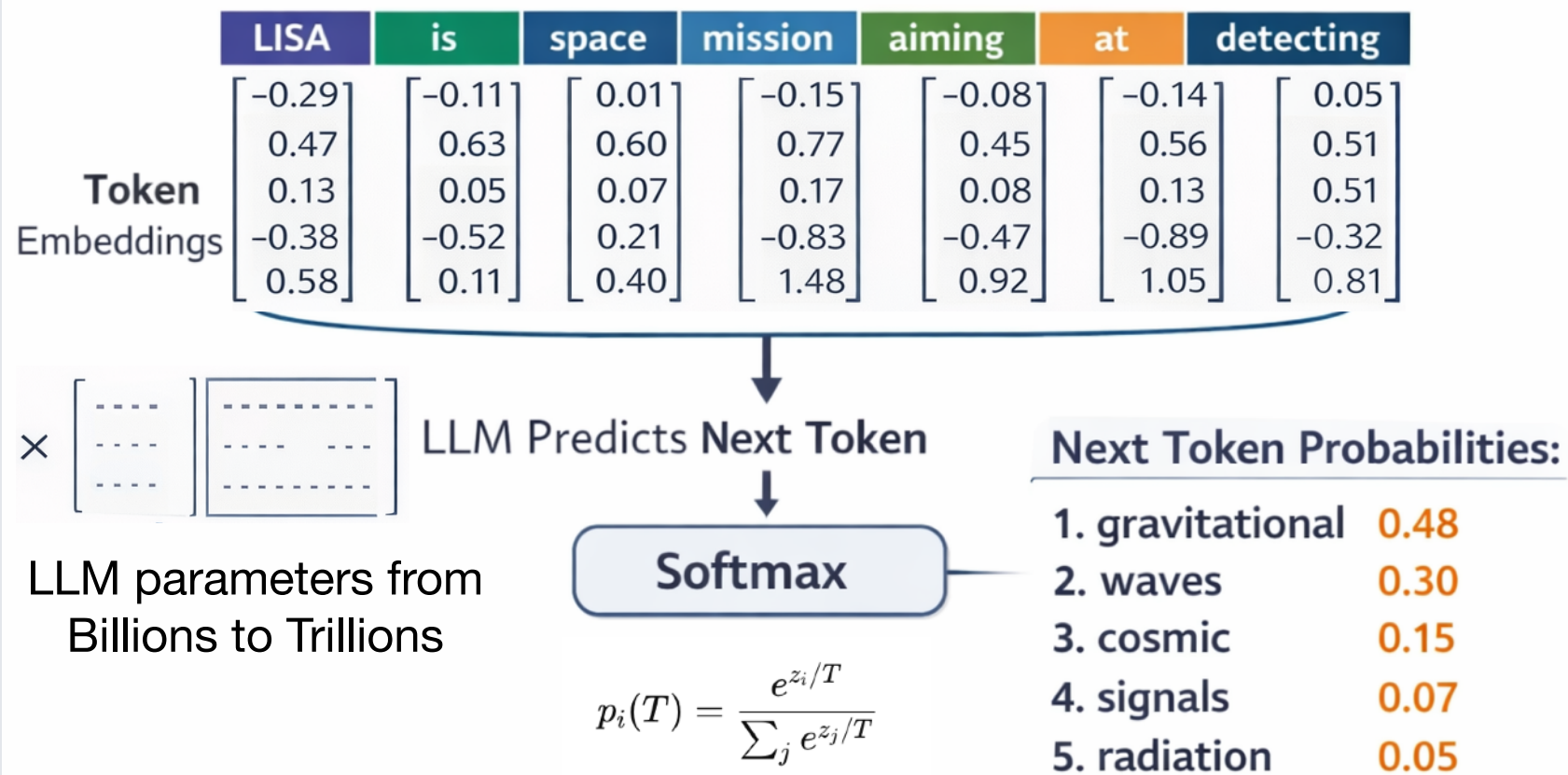
A statistical model trained to predict the next word (~ token) in a sequence

LISA is a space mission aiming at detecting ...?

	LISA	is	space	mission	aiming	at	detecting
Token Embeddings	$\begin{bmatrix} -0.29 \\ 0.47 \\ 0.13 \\ -0.38 \\ 0.58 \end{bmatrix}$	$\begin{bmatrix} -0.11 \\ 0.63 \\ 0.05 \\ -0.52 \\ 0.11 \end{bmatrix}$	$\begin{bmatrix} 0.01 \\ 0.60 \\ 0.07 \\ 0.21 \\ 0.40 \end{bmatrix}$	$\begin{bmatrix} -0.15 \\ 0.77 \\ 0.17 \\ -0.83 \\ 1.48 \end{bmatrix}$	$\begin{bmatrix} -0.08 \\ 0.45 \\ 0.08 \\ -0.47 \\ 0.92 \end{bmatrix}$	$\begin{bmatrix} -0.14 \\ 0.56 \\ 0.13 \\ -0.89 \\ 1.05 \end{bmatrix}$	$\begin{bmatrix} 0.05 \\ 0.51 \\ 0.51 \\ -0.32 \\ 0.81 \end{bmatrix}$

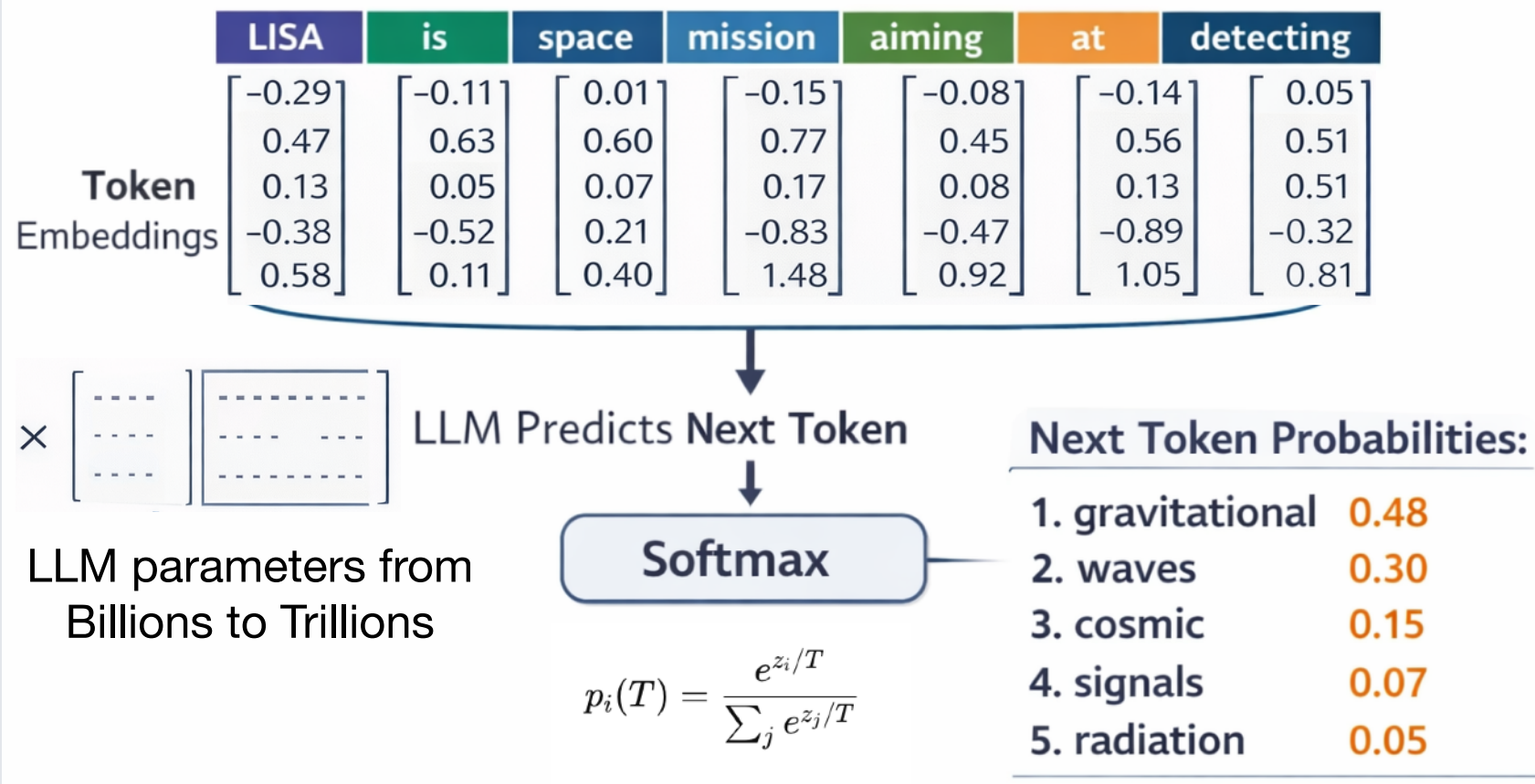
A statistical model trained to predict the next word (~ token) in a sequence

LISA is a space mission aiming at detecting ...?



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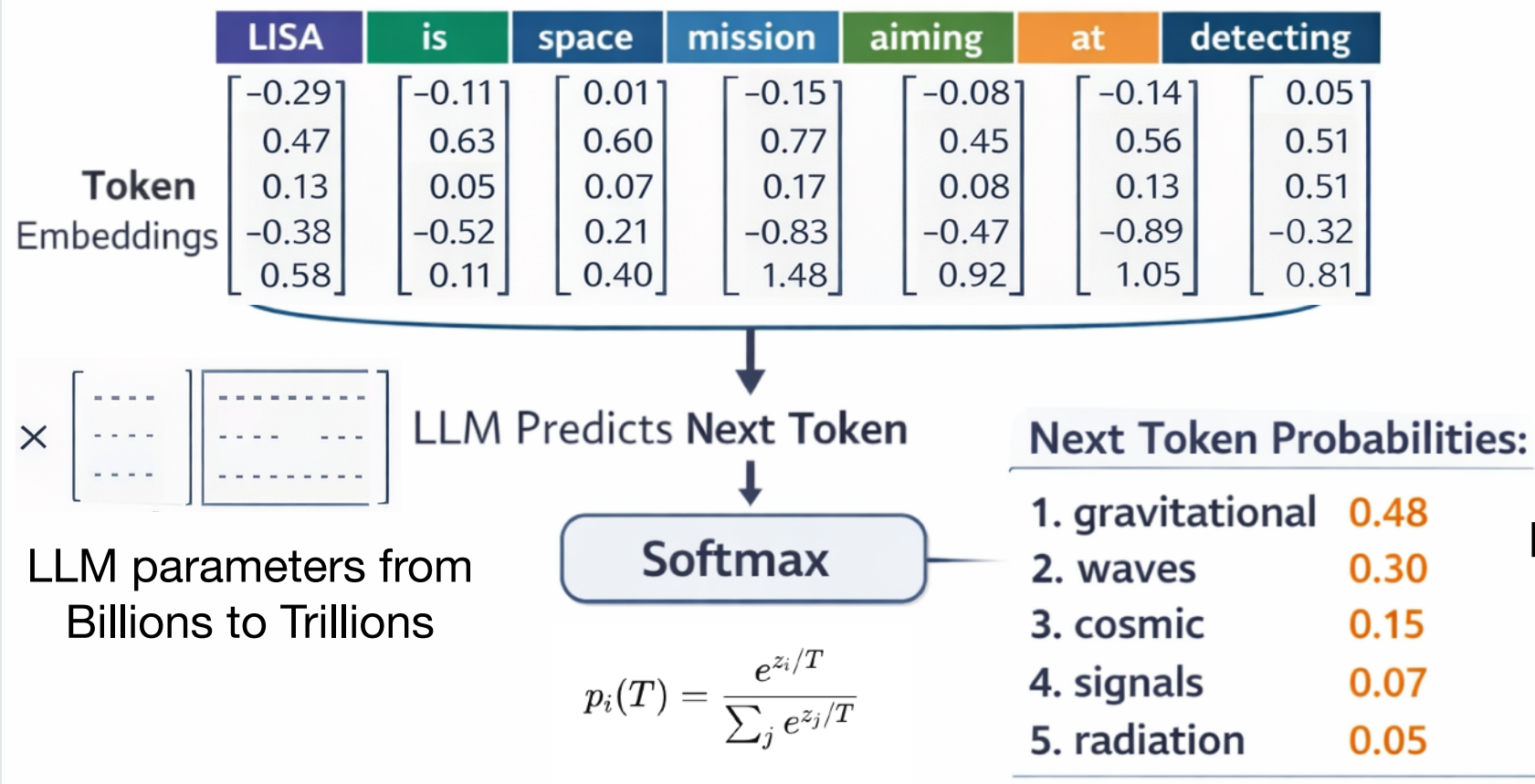
LISA is a space mission aiming at detecting ...?



LISA is a space mission aiming at detecting gravitational ...

A statistical model trained to predict the next word (~ token) in a sequence

LISA is a space mission aiming at detecting ...?



Key Properties

- Natural language understanding
- Intrinsically statistical
- Trained on a large corpus of « public » data.

LISA is a space mission aiming at detecting gravitational ...

- Not authoritative on LISA specific material

TDI -> Trouble Dissociatif de l'Identité

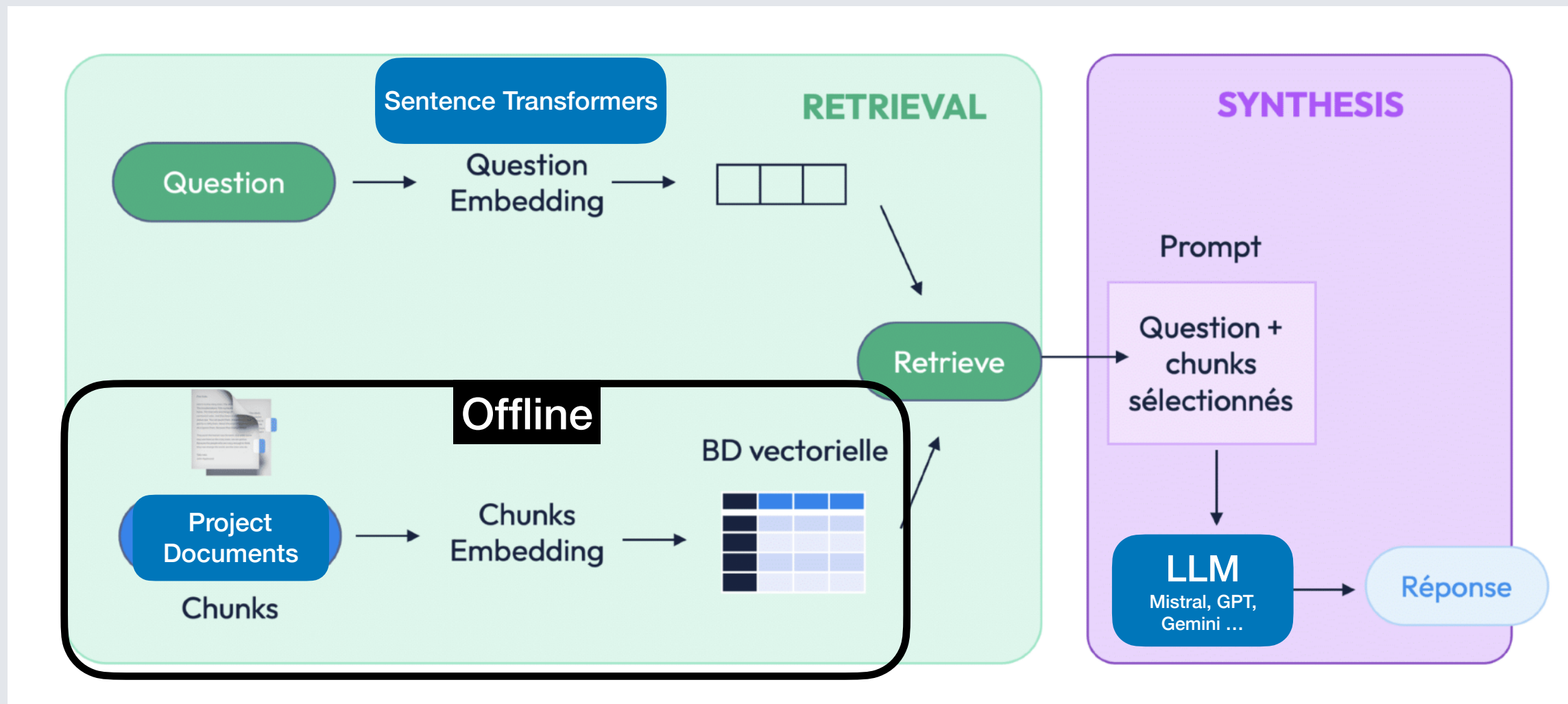
TDI -> Texas Department of Insurance

TDI -> Time Delay Interferometry

- No access to up-to-date project information (Models are too large to be trained continuously)
- Hallucination
- Poor traceability - Link to official documents.

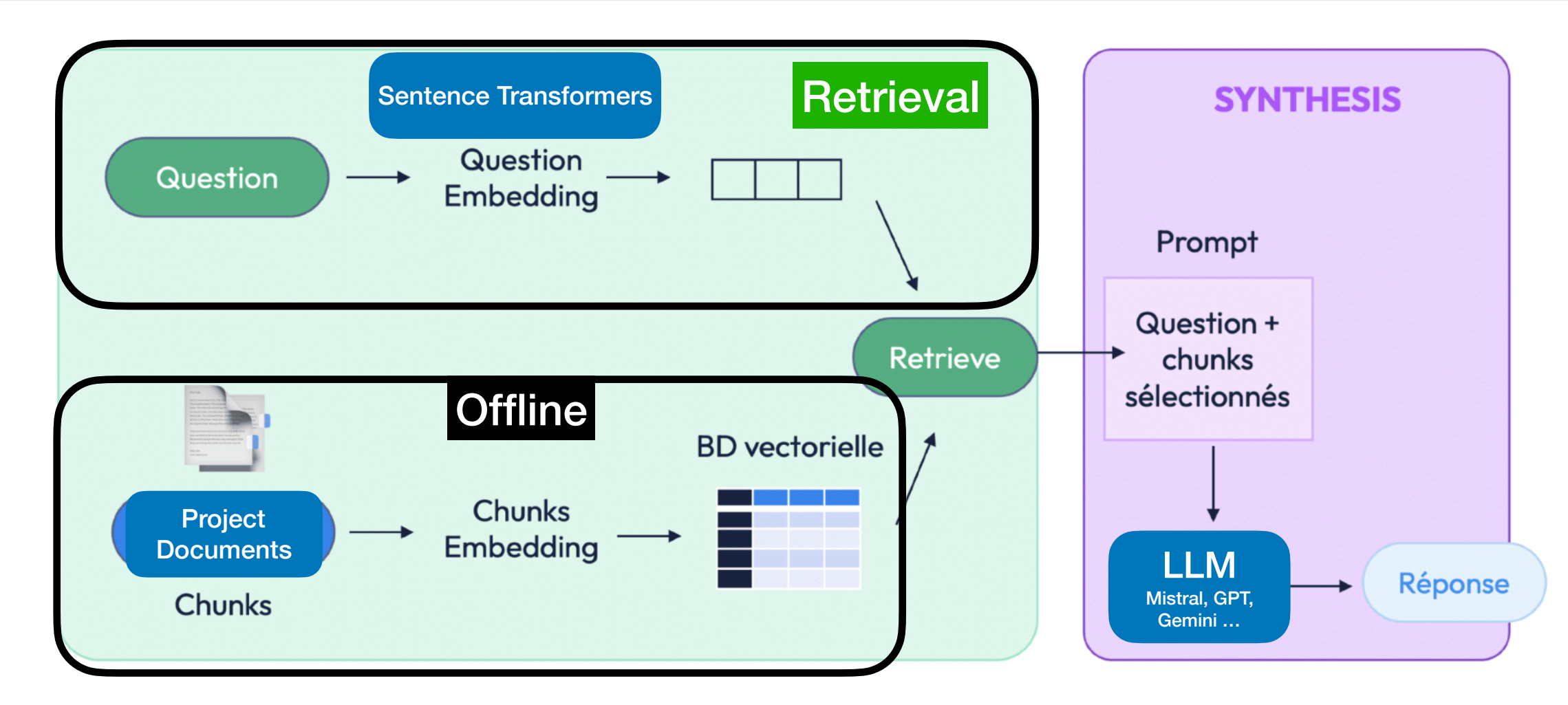
Core idea: Query to LLM + explicit access to curated documents

1. Retrieve relevant chunks of data from a corpus
2. Generate an answer grounded in those sources



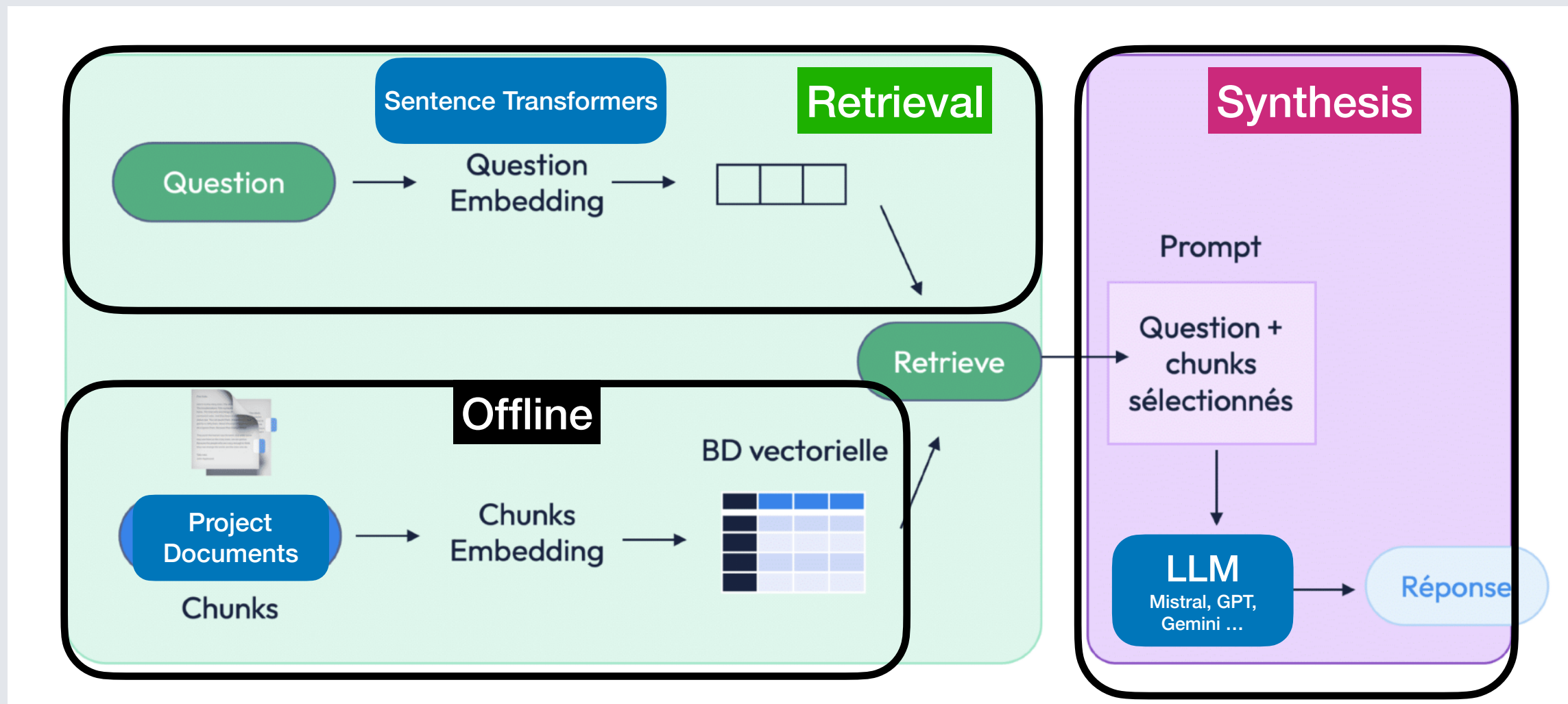
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- Example with ChatGPT 5.2

what is the BAM in LISA ?

In LISA (Laser Interferometer Space Antenna), the **BAM** is the **Backlink Assembly**.

What is the BAM?

The **Backlink Assembly (BAM)** is an **optical metrology system** inside each **LISA spacecraft** that measures the **relative phase (or optical pathlength)** between the two outgoing lasers sent to the *other two spacecraft*.

Each LISA spacecraft has **two optical benches**, each pointing toward a different distant spacecraft. The BAM links these two benches **internally**.

Type your question here:

what is the BAM in LISA?

> Show raw retrieved parameters

FELIX

Mistral Answer

The Beam Alignment Mechanism (BAM) in LISA is a mechanism that provides the capability to laterally shift the Transmit (Tx) and Receive (Rx) beams in two degrees-of-freedom. It is used to adjust the beams in order to introduce a Tilt-to-Length (TTL) coupling, which can be used to offset many of the inherent sources of Tilt-to-Length coupling across the LISA constellation. The BAM is primarily intended for calibration during the in-flight commissioning and calibration activities.

(Source: IDS Design Description: LISA-AEI-IDS-DD-0001, Version: v3.0 - 25/08/2025)

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- Intelligence is in the Corpus of Documents provided in Context
 - -> Good performance with smaller models.

Chat GPT 5.6 Luna

What is the BAM in LISA ?

If you mean **LISA (Laser Interferometer Space Antenna)**, **BAM** stands for **Back-Action Measurement** (often referred to as the **Back-Action Monitor**).

It is part of LISA's optical metrology system and is used to monitor **back-action effects**—tiny disturbances introduced by the measurement system itself that could affect the spacecraft's test masses.

If you mean **BAM in the context of LISA Pathfinder or a specific LISA instrument paper**, I can explain its optical setup and exactly what it measures.

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Claude got it right-> mainly citing Chinese paper

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Always verify the answers before using them.



What is the distance between Test Masses in LISA PATHfinder



Data not found



Not satisfied



What are the Suspension design in LIGO ?



Data not found



Keep Control over data privacy

Open Source « weight » Model with smaller number of parameters

- Mistral-small (French)
- **Gemma4 (Google) -> 26B (Mixture of Expert 4B)**
- Deepseek (Chinese)
- Llama (Facebook)
- Qwen (Alibaba)
- Granite (IBM)

Energy Efficient

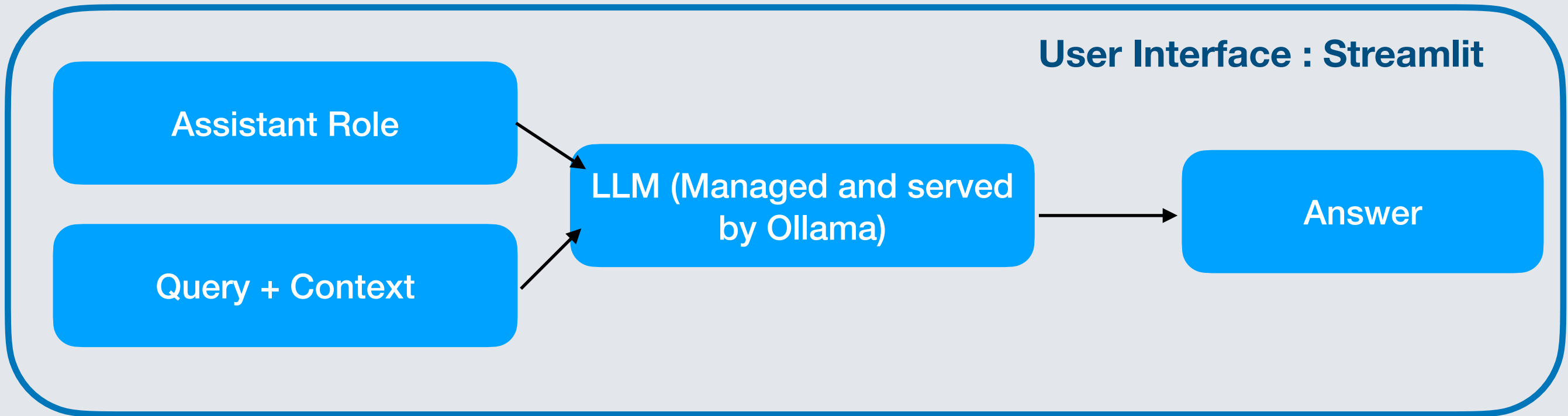
For domain specific questions: 7B models ~ 1T models

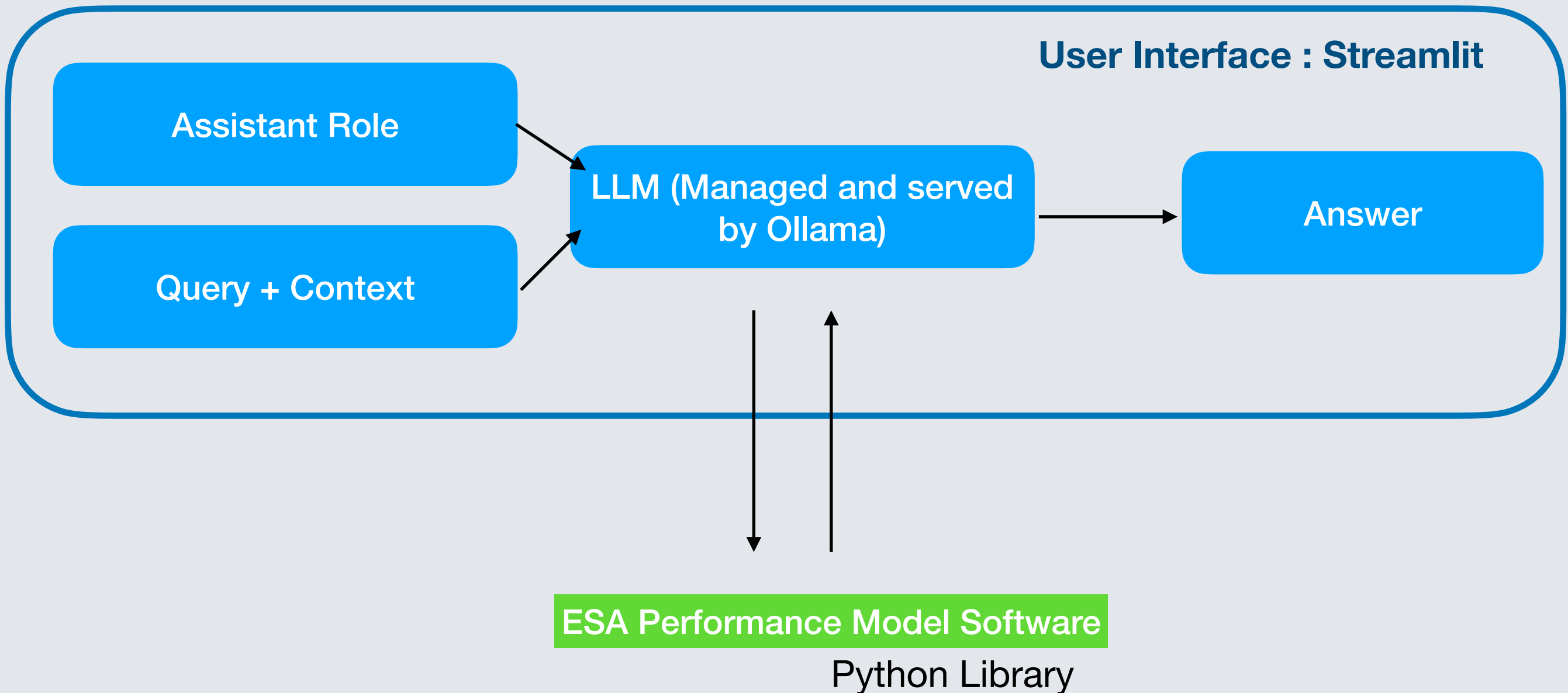
Simplistic rule of thumb if Energy ~ Nparams
-> 0.7% of the energy consumption.

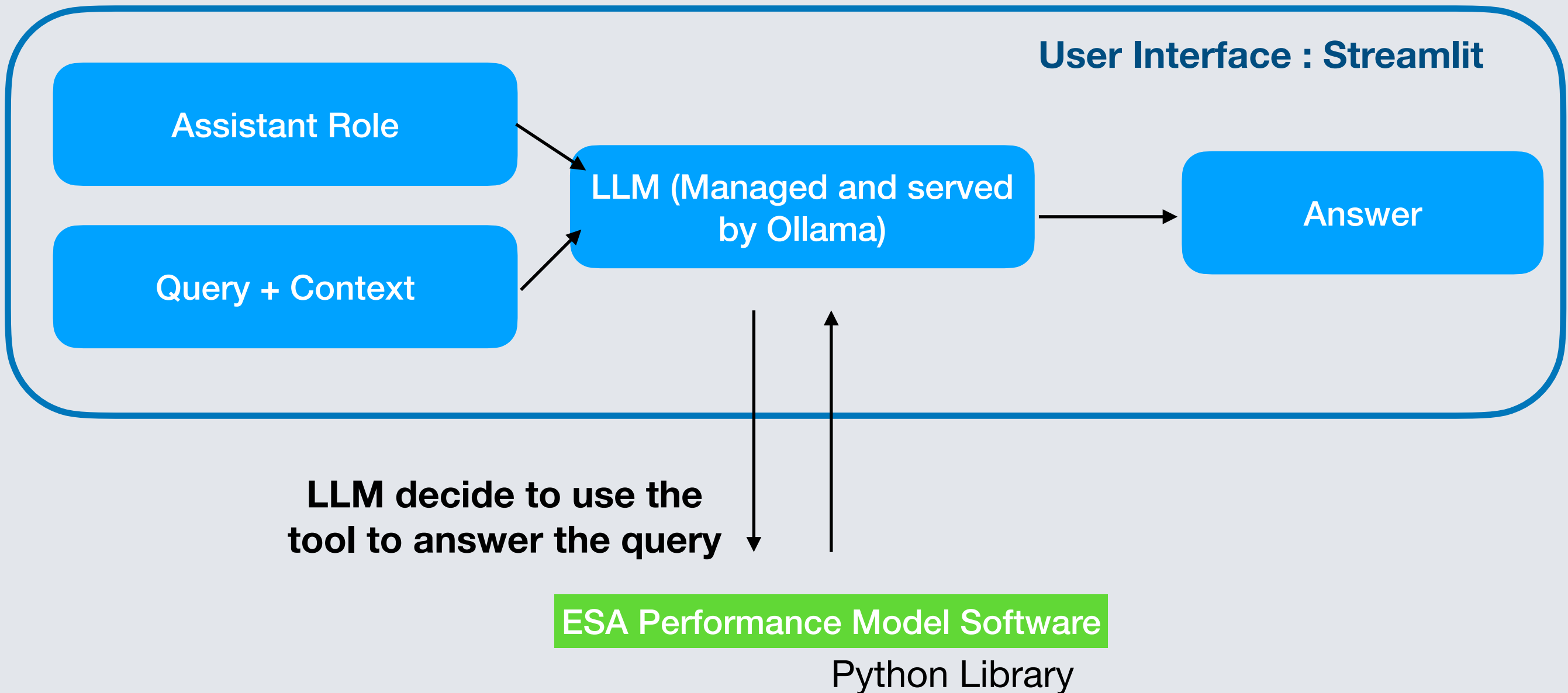
Best Performance

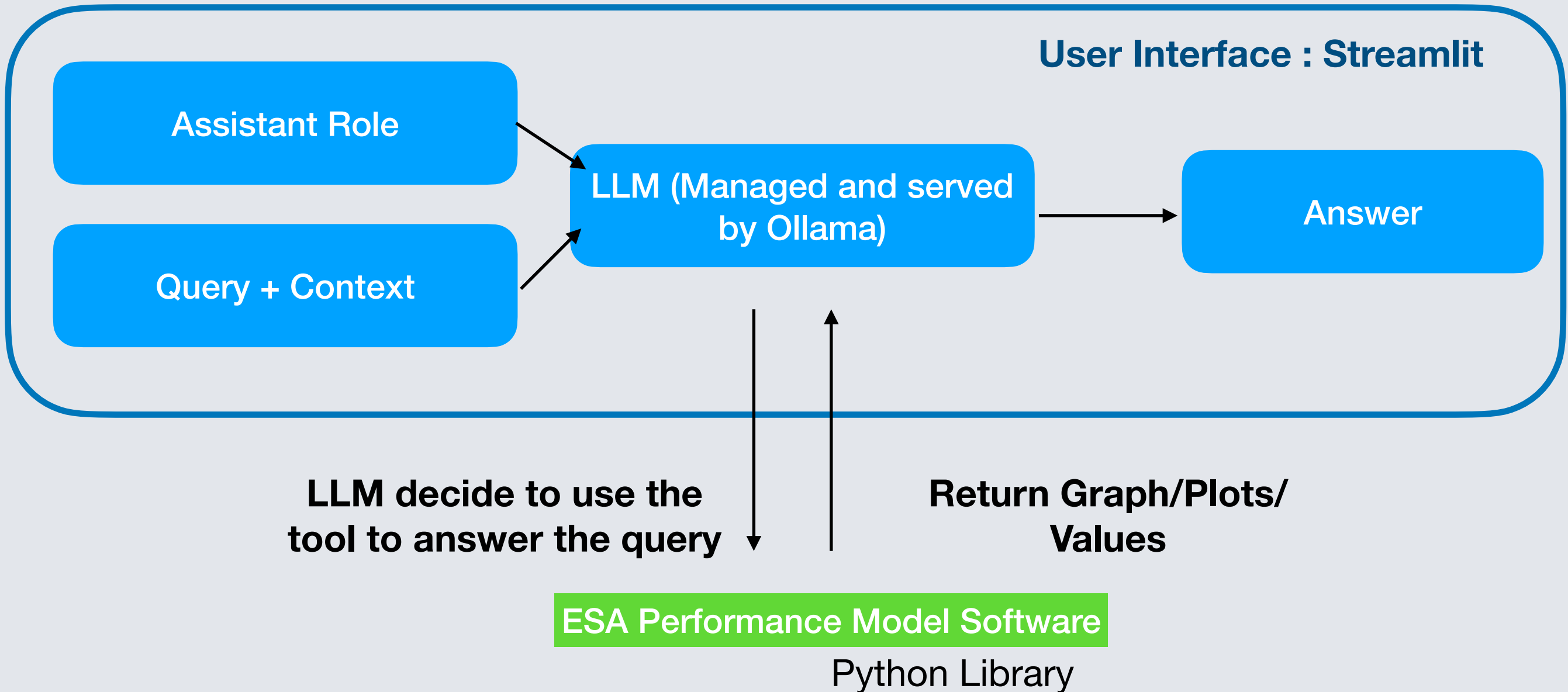
Narrow the scope, architecture design control tailored to our need and database.

Cost control











Graph of QPR noise in the SCI IFO at 10mHz



Graph of QPR noise in the SCI IFO at 10mHz



Graph of QPR noise in the SCI IFO at 10mHz



Graph of QPR noise in the SCI IFO at 10mHz



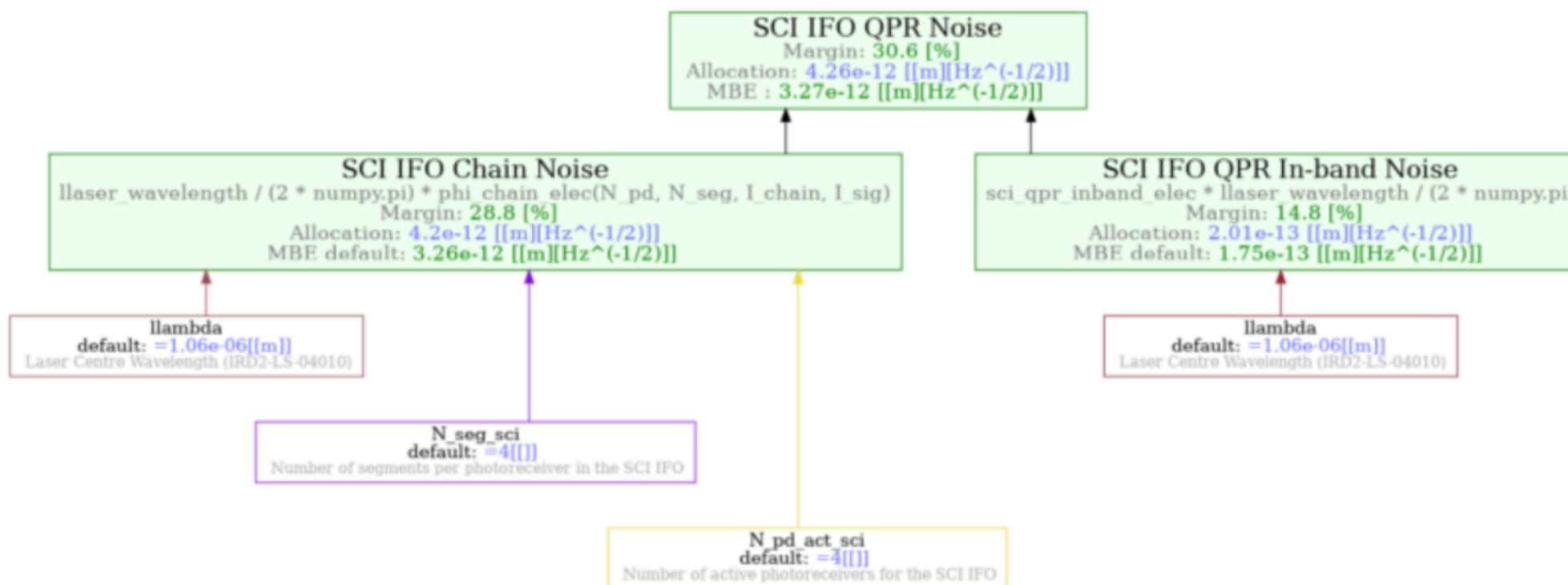
The SCI IFO QPR Noise, which represents the total phase noise from the Science Interferometer QPRs, is modeled as an uncorrelated sum of the SCI IFO Chain Noise and the SCI IFO QPR In-band Noise. The top-down performance allocation for this noise source is:

$$4.26 \times 10^{-12} \cdot \sqrt{1 + \left(\frac{2 \times 10^{-3}}{f}\right)^4} \text{ [m][Hz}^{-1/2}\text{]}$$

The graph shown below illustrates how the actual noise levels compare against this requirement across the frequency spectrum.

From Performance Model - SCI IFO QPR Noise

LCPM SCI IFO QPR Noise
generated with Python : Thu Apr 23 19:08:35 2026
Configuration: default
Evaluated at f = 0.01 Hz



 Is the Test Mass mass consistent across the documents ? Provide the answer in a report



Report on Test Mass (TM) Mass Consistency

An investigation of the provided documentation regarding the Test Mass (TM) mass reveals several different values and specifications depending on the nature of the entry (requirement, allocation, or physical model).

1. Physical Models and Estimates (MBE/CBE)

The following values represent physical models or best estimates:

- **LISA Constellation Performance Parameters:**
 - Nominal Value: 1.9328 kg
 - Minimum Value: 1
 - Maximum Value: 1.9428 kg
 - (Source: LISA Constellation Performance Parameters)
- **LISA Constellation Performance Model:**
 - Allocation: 1.92 kg
 - (Source: LISA Constellation Performance Model, requirement_id: IRD2-GRS-01210)

2. Requirements (Allocations)

The formal requirements specify the mass as follows:

- **GRS IRD2:**
 - The mass shall be 1933 g $\pm$ 10 grams.
 - (Source: GRS IRD2: ESA-LISA-EST-GRS-RS-0002, requirement_id: IRD2-GRS-01210)

Summary of Inconsistencies

The values are not strictly consistent across documents as they represent different types of data:

- **Requirements** specify a range of 1923 g to 1943 g (derived from 1933 g $\pm$ 10 g).
- **Allocations** (Performance Model) specify a lower value of 1.92 kg.
- **Physical Models** (Performance Parameters) provide a nominal value of 1.9328 kg, which falls within the requirement range, but the bounds (1.9228 to 1.9428 kg) also overlap with the requirement.



Provide a python implementation for Brownian noise



Provide a python implementation for Brownian noise



To implement the Brownian noise model in Python, you can use the mathematical expression provided in the **LISA Constellation Performance Model** (Source: LISA Constellation Performance Model).

The analytical model (MBE) for the Brownian noise is defined as: **Brownian Noise** =

$$\sqrt{\alpha_{\text{noise}} \times \left(1 + \frac{\pi}{8}\right) \times \left(\frac{TM_{\text{size}}}{TM_{\text{mass}}}\right)^2 \times \text{VacuumPressure} \times \sqrt{\frac{512 \times H_2 O_{\text{mo}} \times K_B \times T_{\text{GRS}}}{\pi}}}$$



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Below is the Python implementation:

```
import math

def calculate_brownian_noise(alpha_noise, tm_size, tm_mass, vacuum_pressure, h2o_mo, kb, t_grs):
    """
    Calculates the Brownian noise based on the MBE analytical model.

    Parameters:
    alpha_noise (float): Brownian noise amplification factor due to EH surfaces proximity
    tm_size (float): Test Mass (TM) size
    tm_mass (float): Test Mass (TM) mass
    vacuum_pressure (float): Residual Pressure around Test Mass
    h2o_mo (float): Molecular weight of water
    kb (float): Boltzmann constant
```

```
    Returns:
    float: Brownian noise in [m][s^-2][Hz^-1/2]
    """

    # term1: alpha_noise * (1 + pi/8)
    term1 = alpha_noise * (1 + math.pi / 8)

    # term2: (TMsize / TMmass)^2
    term2 = (tm_size / tm_mass)**2

    # term3: sqrt(512 * H2Omo * KB * T_GRS / pi)
    term3 = math.sqrt((512 * h2o_mo * kb * t_grs) / math.pi)

    # Combine all terms under the outer square root
    brownian_noise = math.sqrt(term1 * term2 * vacuum_pressure * term3)

    return brownian_noise
```

```
# Example usage with values from GRS Characteristics and Performance Model
if __name__ == "__main__":
    # Values derived from provided context
    alpha_noise_val = 13 # From ESA-LISA-EST-MIS-DD-0002
    tm_size_val = 0.044 # Example: Size in meters (Context implies TM size is a parameter)
    tm_mass_val = 2.0 # Example: Mass in kg
    vacuum_pressure_val = 2e-6 # 2 uPa from ESA-LISA-EST-MIS-DD-0002
    h2o_mo_val = 0.018 # Molecular weight of water in kg/mol
    kb_val = 1.38e-23 # Boltzmann constant
    t_grs_val = 293 # 293K from ESA-LISA-EST-MIS-DD-0002
```

```
noise = calculate_brownian_noise(
    alpha_noise_val, tm_size_val, tm_mass_val,
    vacuum_pressure_val, h2o_mo_val, kb_val, t_grs_val
)

print(f"Calculated Brownian Noise: {noise} m/s^2/Hz^1/2")
```

Notes on parameters:

- α_{Br} (or α_{noise}): Approximately 13 (Source: ESA-LISA-EST-MIS-DD-0002).
- T_{GRS} : 293 K (Source: ESA-LISA-EST-MIS-DD-0002).
- p (Vacuum Pressure): The model uses p as a driver; the requirement value used for MBE calculation is 2 μPa (Source: ESA-LISA-EST-MIS-DD-0002).

Prototype & Feasibility (Done): RAG prototype on Performance & Operations data completed.

Infrastructure (Done): Deployment of a dedicated GPU server (NVIDIA DGX GB10 Spark, 128GB unified memory), enabling local LLM inference.

Deployment of the prototype (Done): Deploy the service to a limited group of test users to evaluate real usage, performance, and stability.

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Deployment at ESA (ongoing)

ESA — — — — LAB

GPU Infrastructure

LLM Software

Access Control

New functionality

Documentation
management

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FELIX project started -> September 2025
Already Outdated

We need Frontier Model to test, explore and accelerate (x5 à x10) the deployment of our custom tools.

Risk Trade Off: What we give them should be considered Public or with a very short proprietary period

Conclusion

IA & LLM : 5 axes pour une politique d'institut



Nos données, un actif stratégique

Leur valeur est considérable. Enjeu : les structurer, les documenter et savoir les exploiter.



Bien spécifier... et bien tester

Développer avec les LLM exige des tests solides. Bien tester, c'est comprendre les données, donc rester proche du cas d'usage.



Moyens de calcul : quelle échelle ?

GPU : modèles frontières (type Claude) + modèles open déployés en interne pour les cas critiques. Mutualiser au labo, à l'institut, au CNRS, au-delà ? **Question ouverte.**



Vitesse : penser aussi bottom-up

L'IA évolue trop vite pour une politique uniquement descendante, vouée à être en retard. S'appuyer sur les initiatives du terrain.



Sécurité : former, pas contraindre

Une règle globale unique imposée à tous est contre-productive. Former les agents et adopter une approche granulaire.

*Un cadre institutionnel qui fixe les principes...
et fait confiance aux équipes au plus près des usages.*

PDF

Latex

XML
(performance
Model)

Jama (ESA
database for
Requirements)

Excel
(Parameters and

PDF

Latex

XML
(performance
Model)

Jama (ESA
database for
Requirements)

Excel
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Chunks + metadatas

PDF

Latex

XML
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Jama (ESA
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Excel
(Parameters and

Chunks + metadatas

Chunks embeddings (dim = 1024) by
sentence transformer (BGE M3)

Vector Database (ChromaDB)

PDF

Latex

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Chunks embeddings (dim = 1024) by
sentence transformer (BGE M3)

Vector Database (ChromaDB)

Lexical Database (BM25)

PDF

Latex

XML
(performance
Model)

Jama (ESA
database for
Requirements)

Excel
(Parameters and

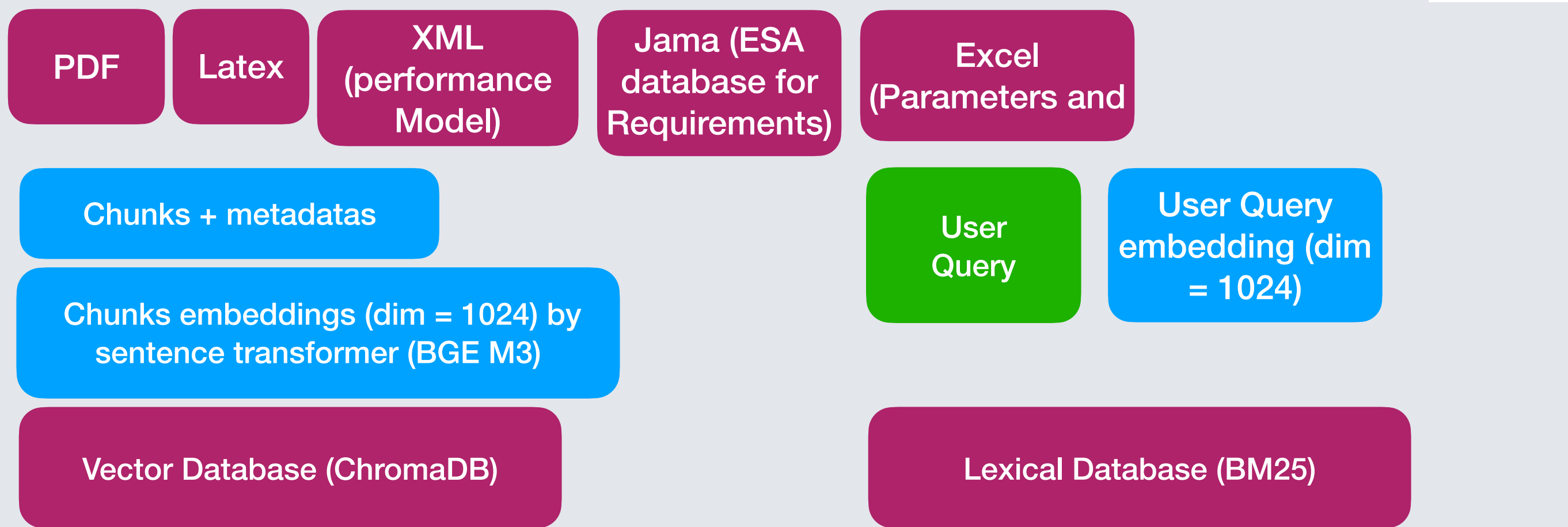
Chunks + metadatas

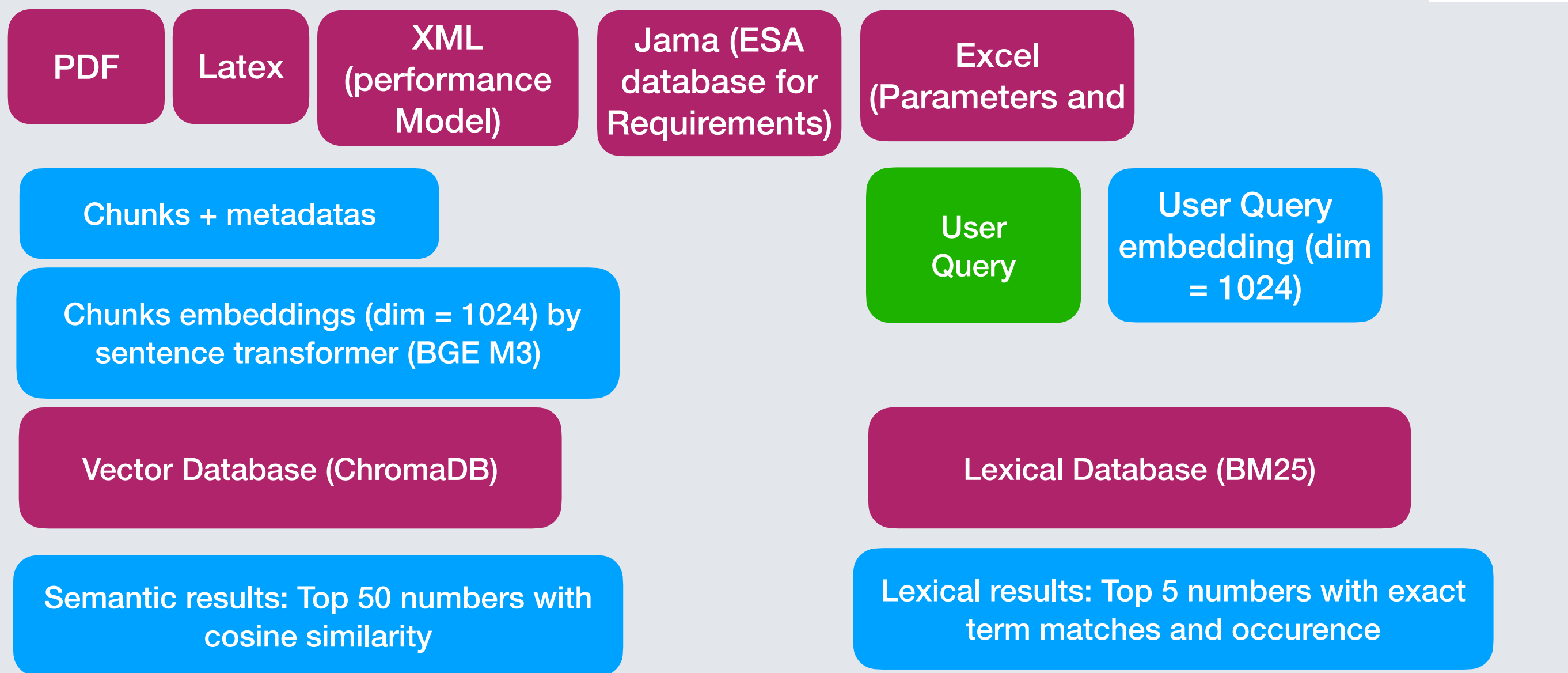
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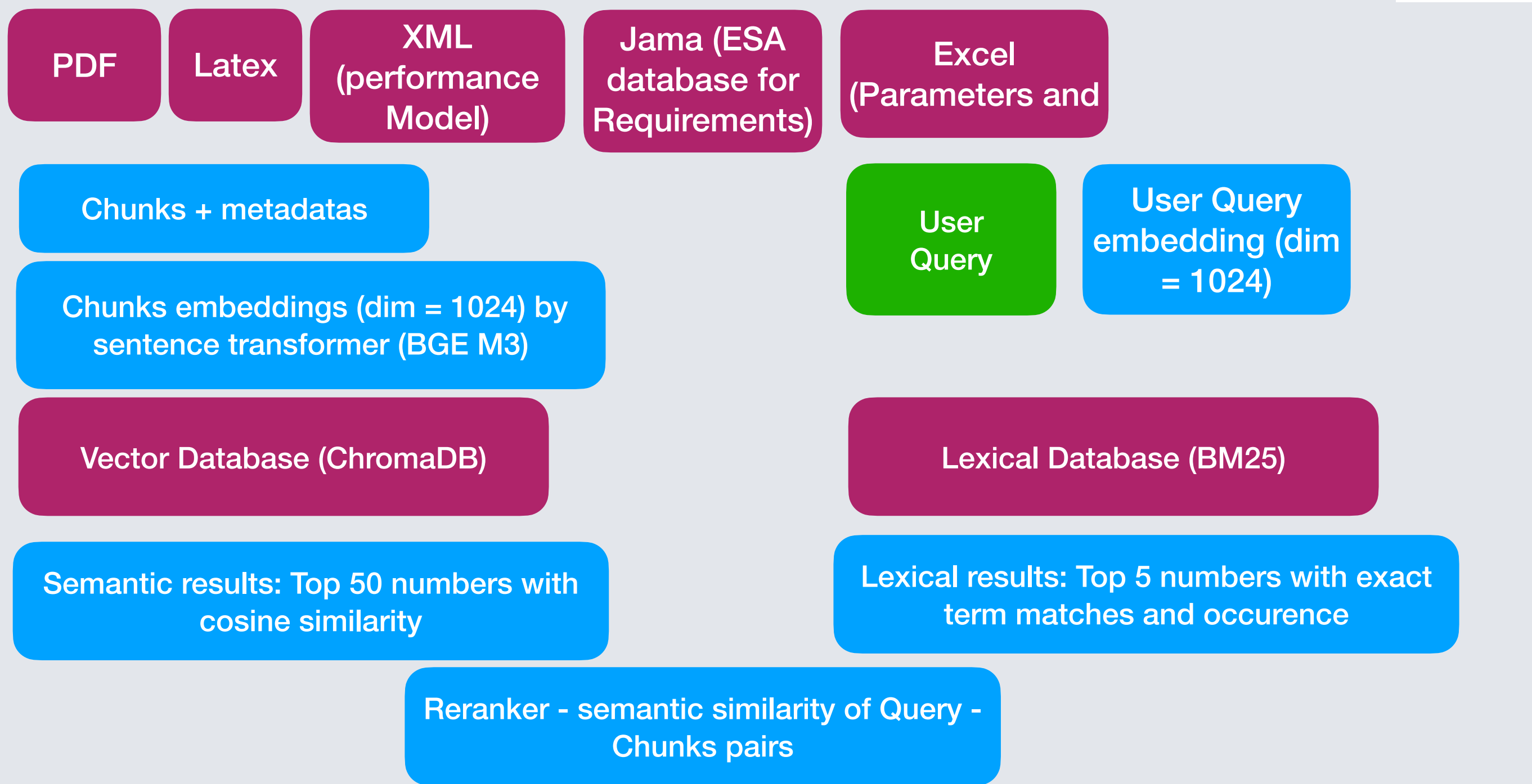
Vector Database (ChromaDB)

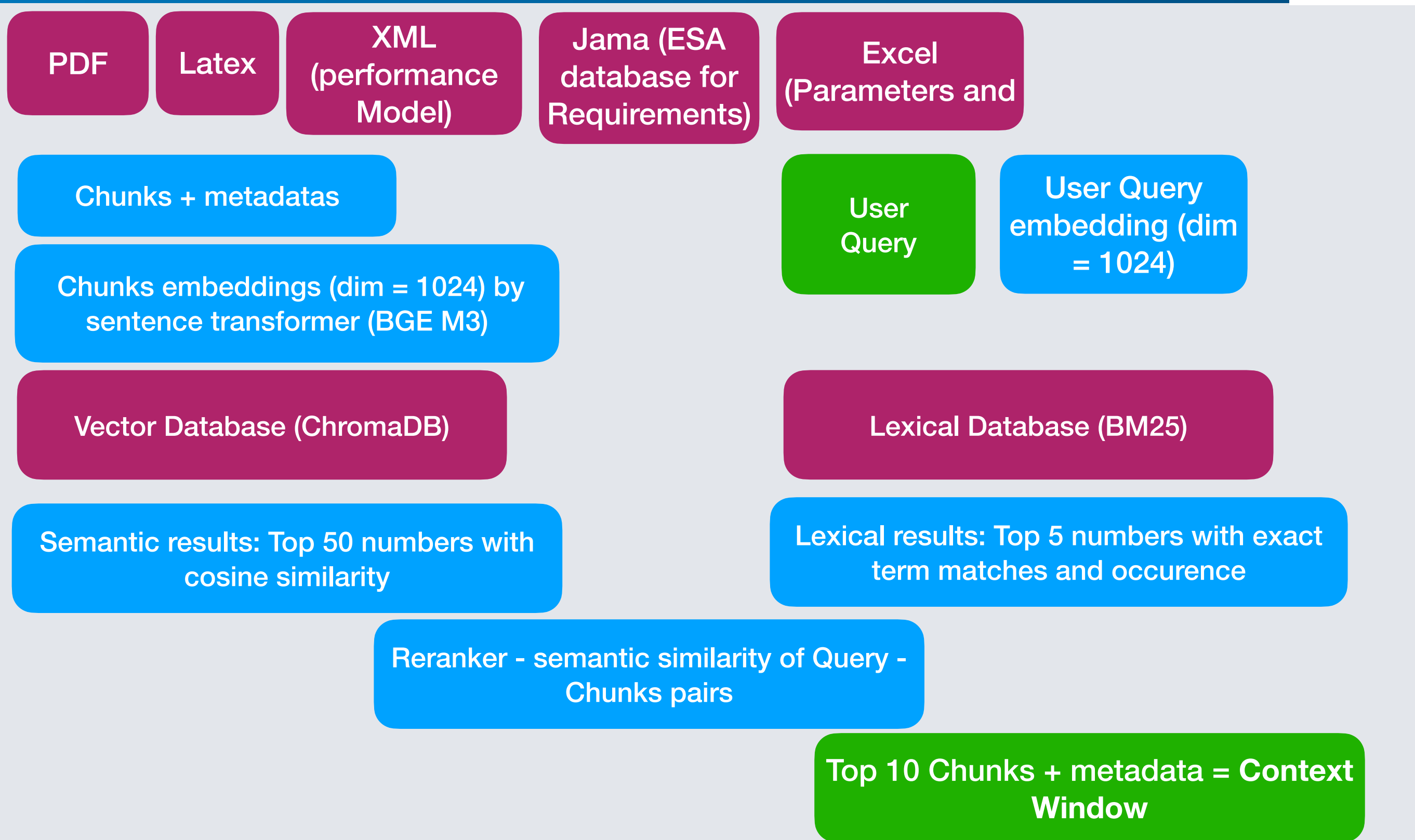
User
Query

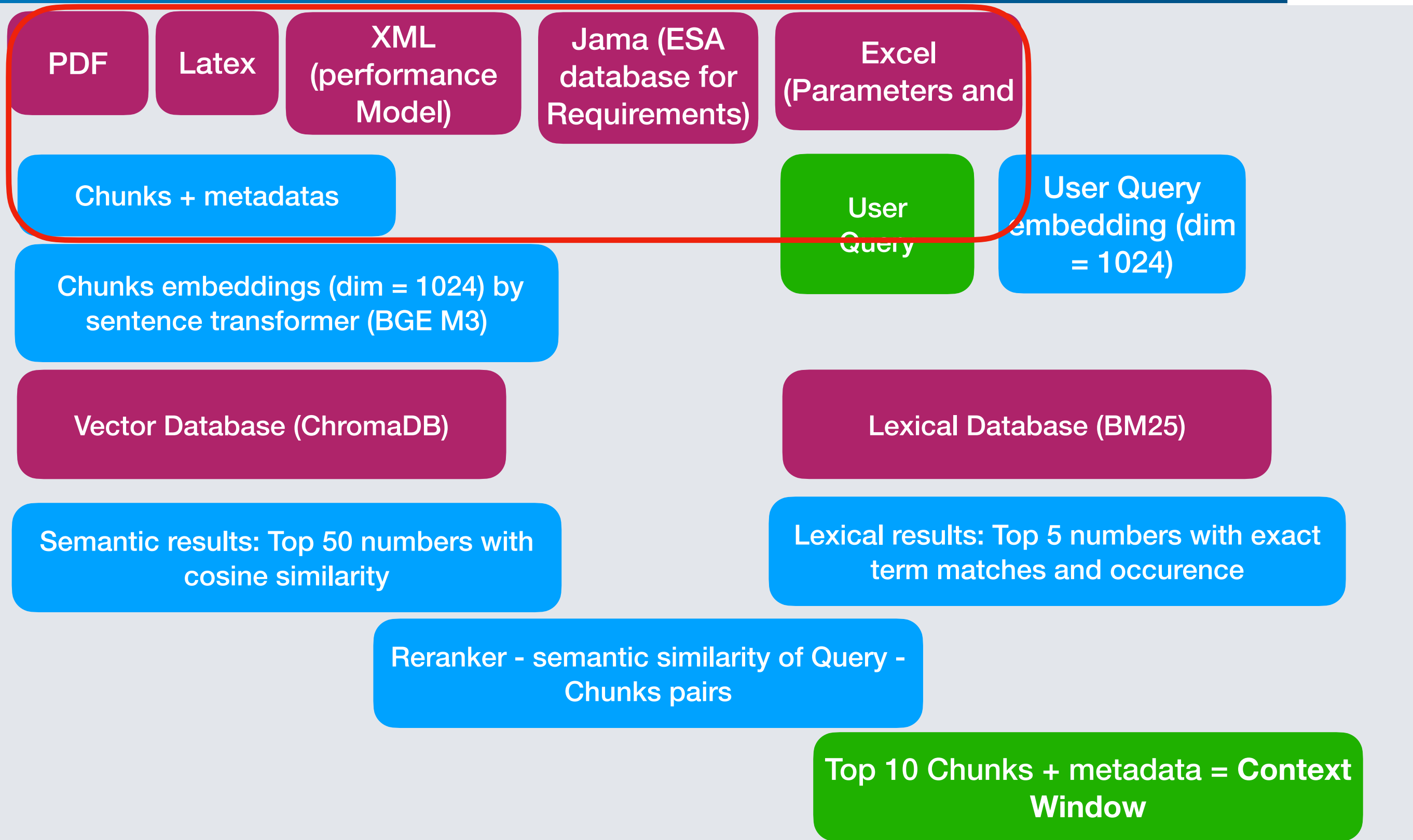
Lexical Database (BM25)











Query: how does the PAAM work ?

Interrogate P&O Documentation Corpus

- ☐ GRS IRD1: ESA-LISA-EST-GRS-RS-0001
- ☐ GRS IRD2: ESA-LISA-EST-GRS-RS-0002
- ☐ IDS Design Description: LISA-AEI-IDS-DD-0001
- ☐ IDS IRD1: ESA-LISA-EST-IDS-RS-0001
- ☐ IDS IRD2: ESA-LISA-EST-IDS-RS-0002
- ☐ LISA Constellation Description Document: ESA-LISA-EST-MIS-TN-0001
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- ☐ LISA Science Requirement Document: ESA-LISA-EST-SCI-RS-0001
- ☐ Laser IRD1: ESA-LISA-EST-LS-RS-0001
- ☐ Laser IRD2: ESA-LISA-EST-LS-RS-0002
- ☐ SIRD: ESA-LISA-ESAC-SGS-RS-001
- ☐ SRD: ESA-LISA-EST-SYS-RS-0001
- ☐ Telescope IRD1: ESA-LISA-EST-TEL-RS-0001
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☐ GRS IRD1: ESA-LISA-EST-GRS-RS-0001

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☐ LISA Constellation Description Document: ESA-LISA-EST-MIS-TN-0001

☒ LISA Constellation Performance Description Document: ESA-LISA-EST-MIS-DD-0002

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☐ LISA Constellation Performance Parameters

☒ LISA Definition Study Report

☐ LISA Mission Requirement Document: ESA-LISA-EST-MIS-RS-0001

☐ LISA Science Requirement Document: ESA-LISA-EST-SCI-RS-0001

☐ Laser IRD1: ESA-LISA-EST-LS-RS-0001

☐ Laser IRD2: ESA-LISA-EST-LS-RS-0002

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☐ IDS Design Description: LISA-AEI-IDS-DD-0001

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☐ IDS IRD2: ESA-LISA-EST-IDS-RS-0002

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☐ LISA Definition Study Report

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 ☐ Telescope IRD1: ESA-LISA-EST-TEL-RS-0001
 ☐ Telescope IRD2: ESA-LISA-EST-TEL-RS-0002

Retrieve top 10 chunks

Source: LISA Definition Study Report

Version: v1.0

section_parent: 5 The LISA Instrument > 5.3 Optical metrology interferometry i
 page: 90
 section_title: 5.3.2 Optical Bench
 Description: and (2) are detected by a pair of QPRs (QPR1/QPR1' and QPR2/QPR2', respectively.)
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 Fibre Switching Unit

 Source: LISA Constellation Performance Description Document: ESA-LISA-EST-MIS-
 Version: August 2025
 section_title: PAAM Piston
 parents: TDI and Post-Processing Noises > Thermo-mechanical noise
 Description: Time-Delay Interferometry (TDI) Transfer Function: H_2^{xx}
 The Point Ahead Angle Mechanism (PAAM) is required to correct for the variati

$$\tilde{s}_{\text{Therm,PAAM}} = \sqrt{2} \cdot \tilde{s}_{T_f}$$

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 , the coupling from temperature to piston of the PAAM mirror. The value used f

Query: how does the PAAM work ?

Interrogate P&O Documentation Corpus

☐ GRS IRD1: ESA-LISA-EST-GRS-RS-0001
 ☐ GRS IRD2: ESA-LISA-EST-GRS-RS-0002
 ☒ IDS Design Description: LISA-AEI-IDS-DD-0001
 ☐ IDS IRD1: ESA-LISA-EST-IDS-RS-0001
 ☐ IDS IRD2: ESA-LISA-EST-IDS-RS-0002
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 ☐ LISA Science Requirement Document: ESA-LISA-EST-SCI-RS-0001
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 ☐ Laser IRD2: ESA-LISA-EST-LS-RS-0002
 ☐ SIRD: ESA-LISA-ESAC-SGS-RS-001
 ☐ SRD: ESA-LISA-EST-SYS-RS-0001
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Source: LISA Constellation Performance Description Document: ESA-LISA-EST-MIS-

Version: August 2025

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Query: how does the PAAM work ?

Interrogate P&O Documentation Corpus

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Retrieve top 10 chunks

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Fibre Switching Unit

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Query: how does the PAAM work ?

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 ☒ IDS Design Description: LISA-AEI-IDS-DD-0001
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Retrieve top 10 chunks

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Query: how does the PAAM work ?

A (dim =1024)

$$\text{cosine similarity} = \cos(\theta) = \frac{A \cdot B}{\|A\| \|B\|}$$

Interrogate P&O Documentation Corpus

- ☐ GRS IRD1: ESA-LISA-EST-GRS-RS-0001
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Retrieve top 10 chunks

Source: LISA Definition Study Report

Version: 1.0

section_parent: 5 The LISA Instrument > 5.3 Optical metrology interferometry i

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metadatas

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Fibre Switching Unit

Query + Top 10 chunks -> LLM

-> Answer:

The Point-Ahead Angle Mechanism (PAAM) is a mechanism that adjusts the angle of the transmit (TX) beam to compensate for the change in position of the Spacecraft (SC) over the light-travel time, ensuring the beam is received by the distant spacecraft.

The PAAM works by steering the TX beam at an angle with the receive (RX) beam. The required angle is determined by orbital dynamics and appears due to the change of position of the Spacecraft (SC) over the light-travel time.

The PAAM needs to be adjusted at least once every few minutes with an accuracy of about 10 nrad to ensure the beam is received by the distant spacecraft. There will be one PAAM per Optical Bench (OB), with two piezo stacks and capacitive sensors for redundancy and closed-loop control. The PAAM will be controlled via a dedicated control unit commanded by the on-board computer (OBC).

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The PAAM shall operated in a step and stare mode, with a nominal operational step size of the PAAM shall be 15 nrad on the sky.

Further details about Point-Ahead Angle Mechanism (PAAM) operations can be found in [ESA-LISA-EST-MIS-TN-0005] and [LISA TTL STOP Model and Budget].

Source: LISA Definition Study Report, LISA Constellation Performance Description Document: ESA-LISA-EST-MIS-DD-0002, LISA Ground Segment Requirement: Point-Ahead Angle Mechanism (PAAM) Mode of Operations, LISA Constellation Description Document: ESA-LISA-EST-MIS-TN-0001, IDS IRD2: ESA-LISA-EST-IDS-RS-0002, LISA Ground Segment Requirement: Point-Ahead Angle Mechanism (PAAM) Operational Step Size.

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