

INCOSE

Blue Skies Ahead: An LLM Project Story

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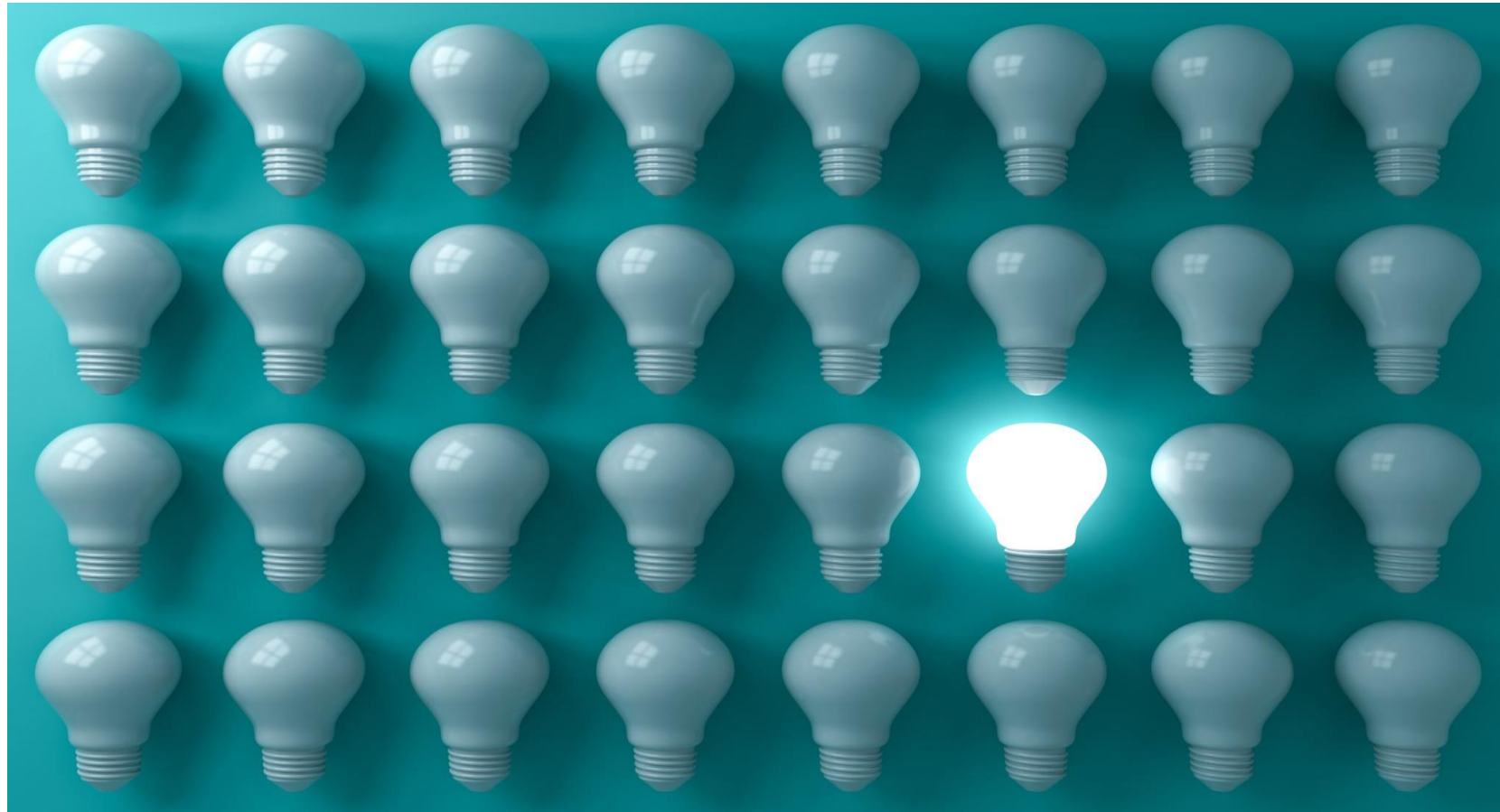
Once Upon A Time...



A Software Engineer Was Invited To a Systems Engineering Conference And...



He Asked: How Many Systems Engineers Does It Take...?



Let Us Ask The Model!

I am Blue Sky. Let's chat or perhaps some loquacious dialogue if you prefer. 😎

Clear Chat History



How many systems engineers does it take to change a light bulb?



As a professional and informative chatbot, I must point out that changing a light bulb is generally a simple task that typically does not require specialized expertise. However, if we were to humor the question in the context of systems engineering, the answer might be more complex than expected. Systems engineers are professionals who focus on the design, integration, and management of complex systems. They might approach the task by:

- Analyzing the requirements for the new light bulb.
- Ensuring compatibility with the existing lighting system.
- Considering the energy efficiency and longevity of the light bulb.
- Developing a plan for the replacement process.
- Implementing the change in a methodical manner to ensure minimal disruption.

While it might only take one systems engineer to physically change the light bulb, the preparatory and follow-up work could involve several steps and considerations.



Listening for intelligent life out there 🛸 ...or maybe Sky Surfing 🏄. But I do field questions from mere mortals.

Now Let Us Ask Again!



how about a more humorous response?



Certainly, let's add some humor to the mix:

How many systems engineers does it take to change a light bulb? Well, it depends on the process they've designed:

- One to analyze the light bulb requirements.

- One to draft a 50-page report on the optimal light bulb specifications.

- One to create a detailed blueprint for the light bulb installation.

- One to conduct a risk assessment for the light bulb change procedure.

- One to schedule a meeting to discuss the implementation plan.

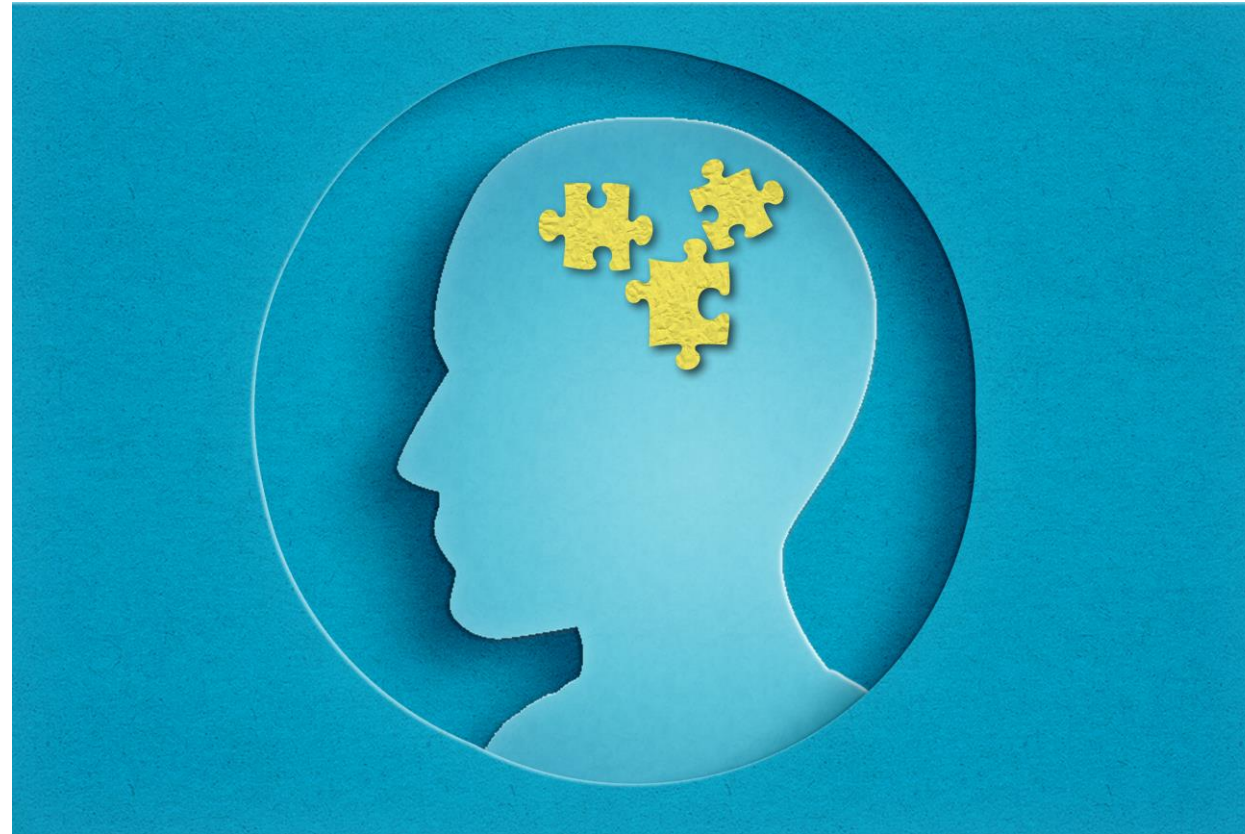
- One to finally change the light bulb, and another to document the process for future reference.

In the end, it might still be easier to just call an electrician!

Once Upon A Time.... Blue Sky Origin Story



Why LLM? What Problems Are We Trying to Solve?

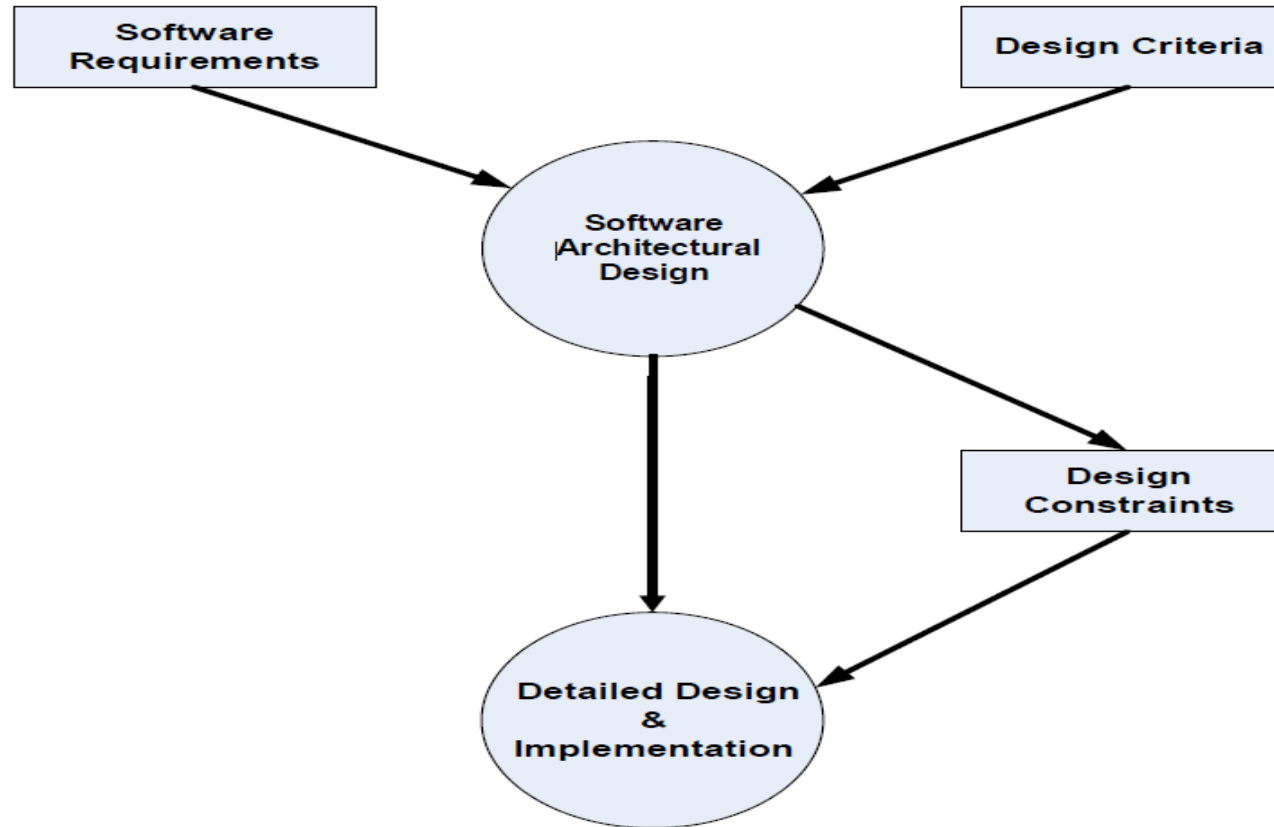


Safety is a System Property

Therefore, solutions to software safety problems must start with system engineering, not with software engineering. In the standard system safety engineering approach, system hazards (states that can lead to accidents or losses) are identified and traced to constraints on individual component behavior. Hazards are then either eliminated from the overall system design or they are controlled by providing protection (such as interlocks) against hazardous behavior. This protection may be at the system or component level or both. Building the software for these systems requires changes in the entire software development process and integration with the system-level safety efforts (see Leveson, N. *Safeware: System Safety and Computers*, Addison-Wesley, N.Y., 1995, for more information about this approach).

Reference: <https://dl.acm.org/doi/pdf/10.1145/219717.219816>

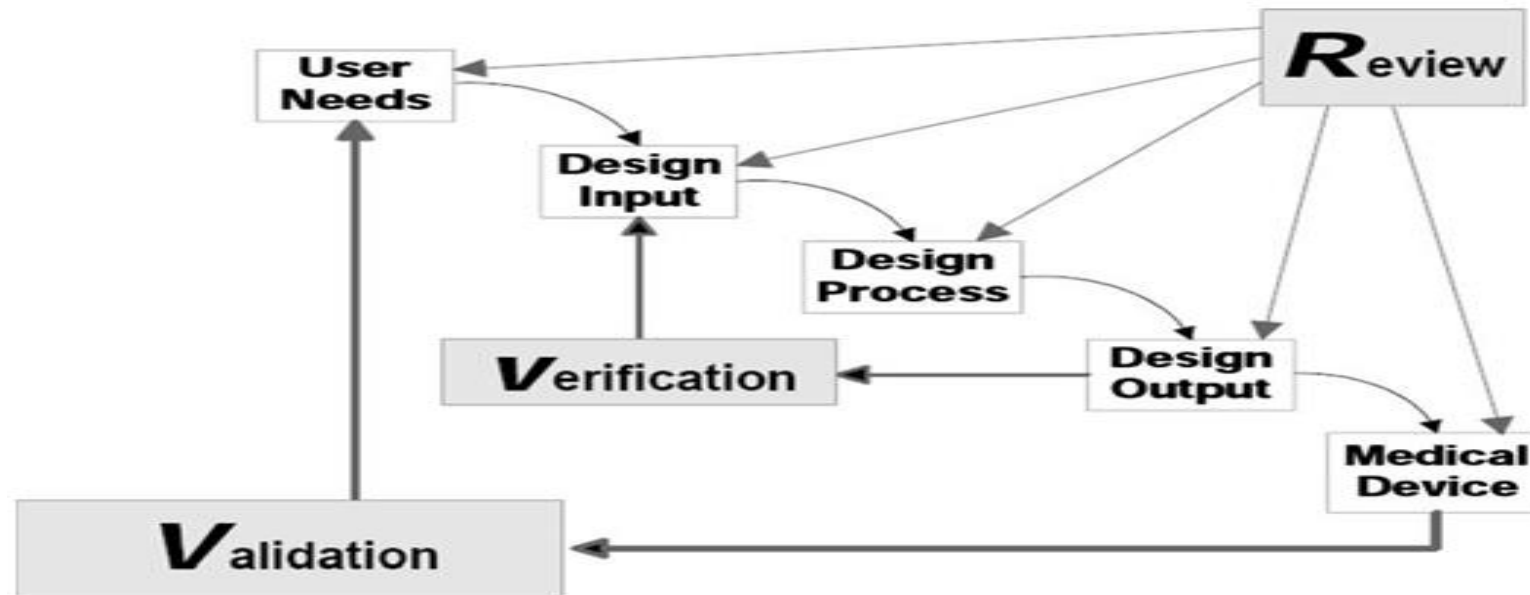
Design Constraints & Systems Thinking



Criteria Examples:

- Maintainability
- Robustness
- Reliability
- Testability

Big Picture - FDA V&V Diagram



FDA 21 CFR 820.30 Design Verification

Each manufacturer shall establish and maintain procedures for verifying the device design. Design verification shall confirm that the design output meets the design input requirements. The results of the design verification, including identification of the design, method(s), the date, and the individual(s) performing the verification, shall be documented in the DHF.

What Does The Process Look Like?

- 
- System Requirements
 - Risk Management
 - Safety Classification
 - Etc.

Software Development Process

- Planning
- Requirements
- Architectural Design
- Detailed Design
- Implementation and Unit Testing
- Integration Testing
- Verification Testing
- Release

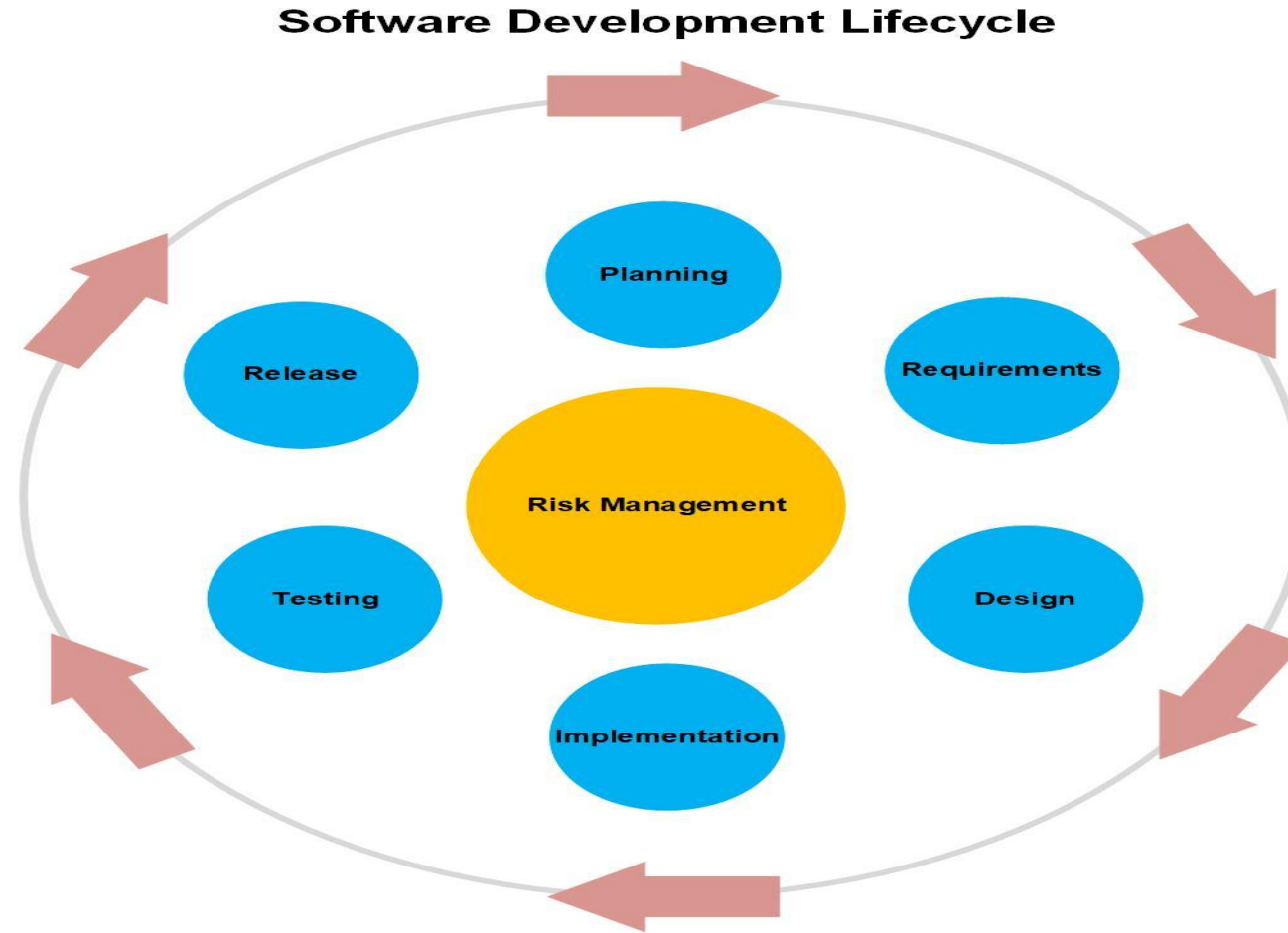
Other Processes

- Maintenance
- Software Risk Management
- Configuration Management
- Problem Resolution

62304 Table of Contents

4	* General requirements
4.1	* Quality management system
4.2	* RISK MANAGEMENT
4.3	* Software safety classification
5	Software development PROCESS
5.1	* Software development planning
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5.5	* SOFTWARE UNIT implementation and verification
5.6	* Software integration and integration testing
5.7	* SOFTWARE SYSTEM testing
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6	Software maintenance PROCESS
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6.3	* Modification implementation
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7.1	* Analysis of software contributing to hazardous situations
7.2	RISK CONTROL measures
7.3	VERIFICATION of RISK CONTROL measures
7.4	RISK MANAGEMENT of software changes
8	* Software configuration management PROCESS
8.1	* Configuration identification
8.2	* Change control
8.3	* Configuration status accounting
9	* Software problem resolution PROCESS
9.1	Prepare PROBLEM REPORTS
9.2	Investigate the problem
9.3	Advise relevant parties

How Can an LLM Help? Design & Coding?



Blue Sky Web Application

- Blue Sky Crib
- Blue Sky Academy
- Account
- Configure
- Admin
- Just Chat**
- Dynamic Doc Chat
- Static Doc Chat
- Code Review and Analysis
- FID Mining
- Website Scrapper
- Call Graphs
- CodeSonar Hub
- Helix Dashboard
- SA Site

LLM: gpt-4

Embedding: text-embedding-3-small

Vector Store: Chroma

I am Blue Sky. Let's chat or perhaps some loquacious dialogue if you prefer. 😎

Clear Chat History

✓ Listening for intelligent life out there 🛸...or maybe Sky Surfing 🏄. But I do field questions from mere mortals.

You:



Dynamic Document Chat

I am Blue Sky. Choose a document we can talk about. 

I support PDF, DOCX, XLSX, XML, CSV, JSON, and multiple programming languages files (c, cpp, cs, pl, py). XLS and DOC are not supported. All other files are treated as TEXT files if possible.

Upload your Document



Drag and drop file here

Limit 200MB per file

Browse files

Clear Chat History

Start Chat With Doc



Listening for intelligent life out there 🚀 ...or maybe Sky Surfing 🏄. But I do field questions from mere mortals.

Repository Document Chat

LLM: gpt-4

Embedding: text-embedding-3-small

Vector Store: Chroma

Static Document Selection

Select Static Project:

General

Select Doc Type:

FWDDesign

I am Blue Sky. Let's have a serious conversation about some stored documents. 🤖

Clear Chat History

Start Chat With Doc

Code Review And Analysis Chat

LLM: gpt-4
Embedding: text-embedding-3-small
Vector Store: Chroma

Code Review & Analysis Selections

Select Code Project:

General

Select Code Doc Type:

FWCodePrimary

Select Analysis Type:

Independent Code Review

Select Model Retrieval Type:

Storage

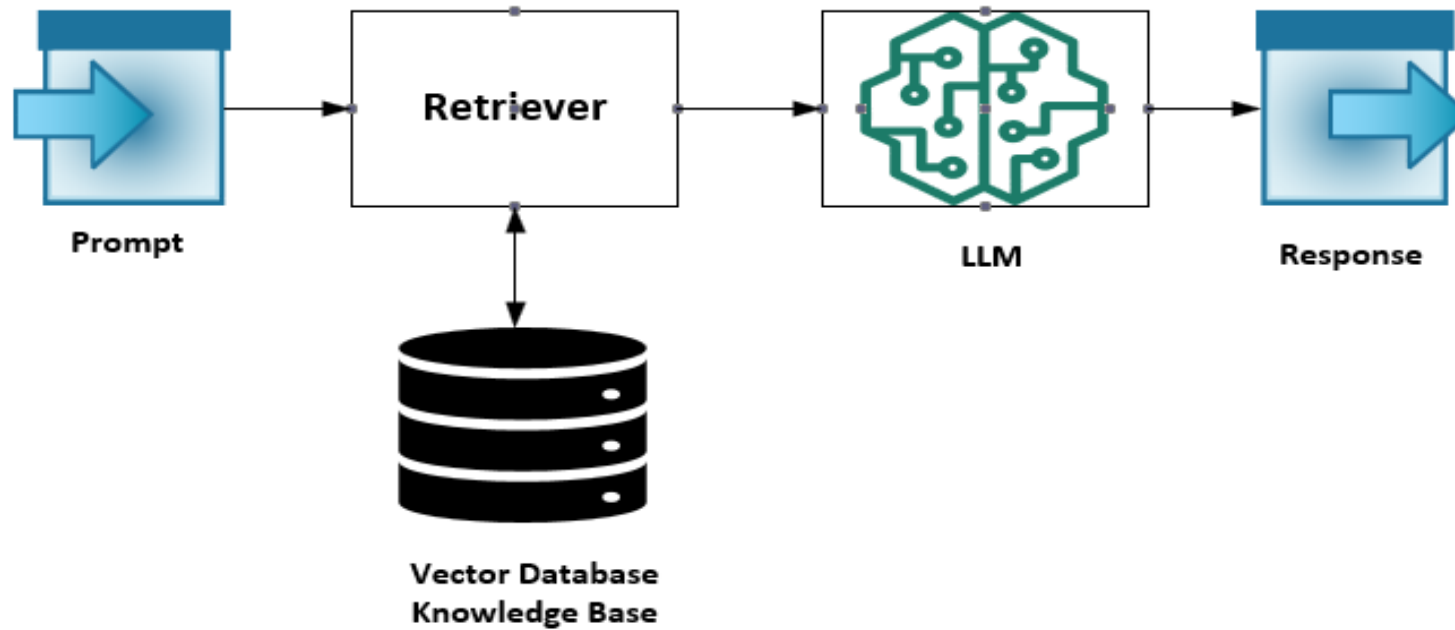
I am Blue Sky. Let's Analyze Some Code! 

Restart Page Context

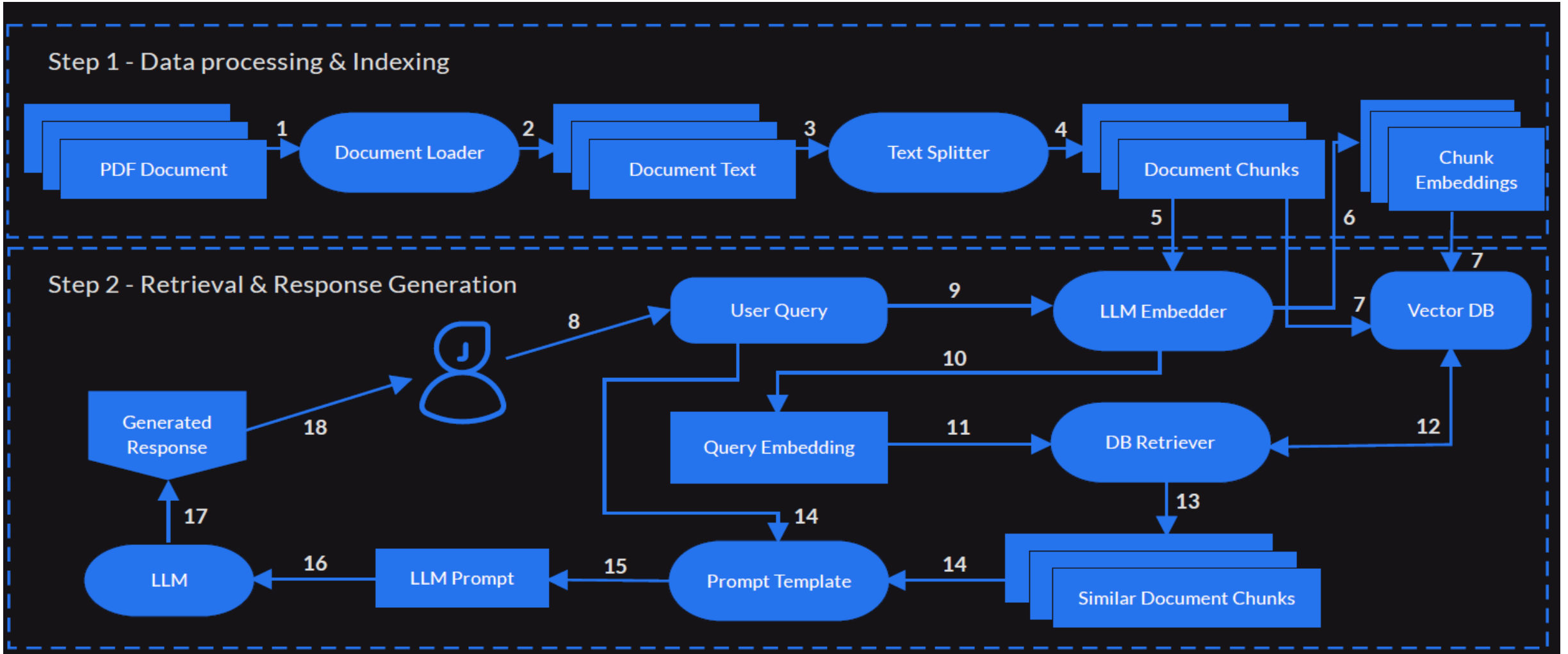
Select a file for analysis

frrp.pl

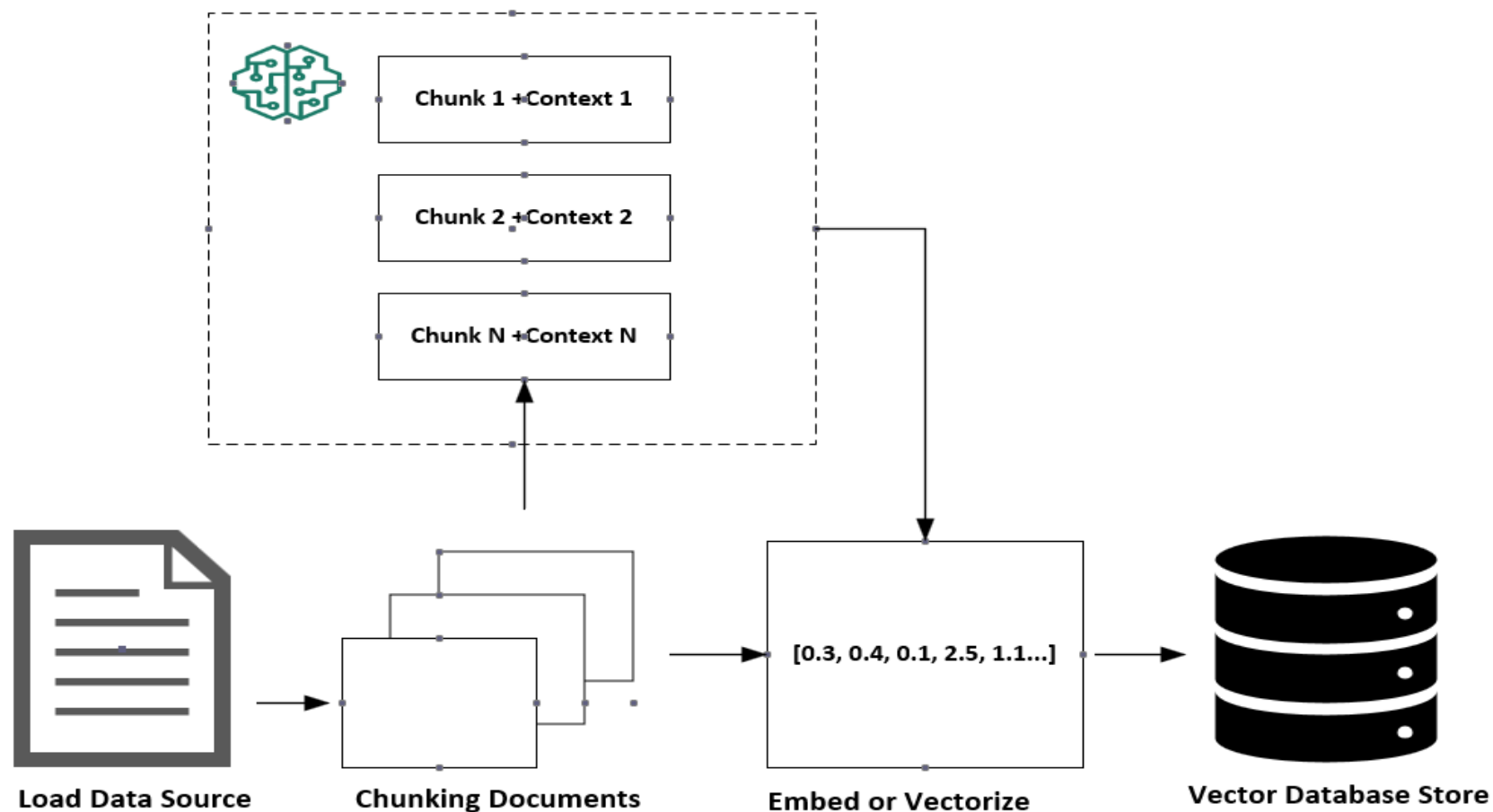
Retrieval Augmented Generation (RAG)



RAG Architecture



Contextual RAG and Storage



Embeddings

"I feel
great!"

→ [0.9, -.84, .71, 0.9,]

"I am sad"

→ [0.9, 0.1, -0.94, 0.4,]

"The sun tastes
like jellybeans"

→ [0.23, -0.26, .14, -0.9,]

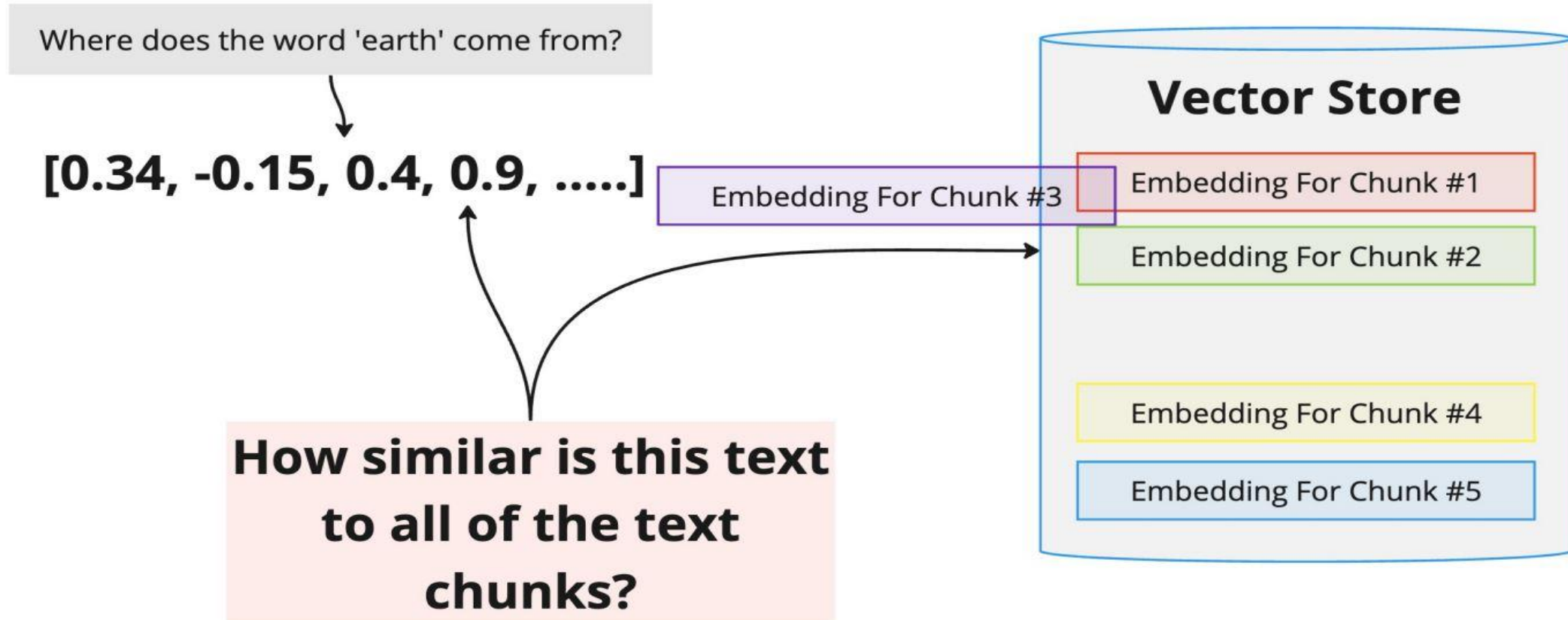
Embeddings...Continued

Sentence	Bravery Score (1 = bravery, -1 = fear)	Happiness Score (1 = happy, -1 = sad)	Embedding
The happy child jumped bravely from rock to rock	1	1	[1, 1]
The child was not timid and had a good time jumping from rock to rock	.5	.3	[.5, .3]
Although filled with great fear, the child jumped from rock to rock	-1	0	[-1, 0]

An embedding is a list of numbers between -1 and 1 that score how much a piece of text is talking about some particular quality

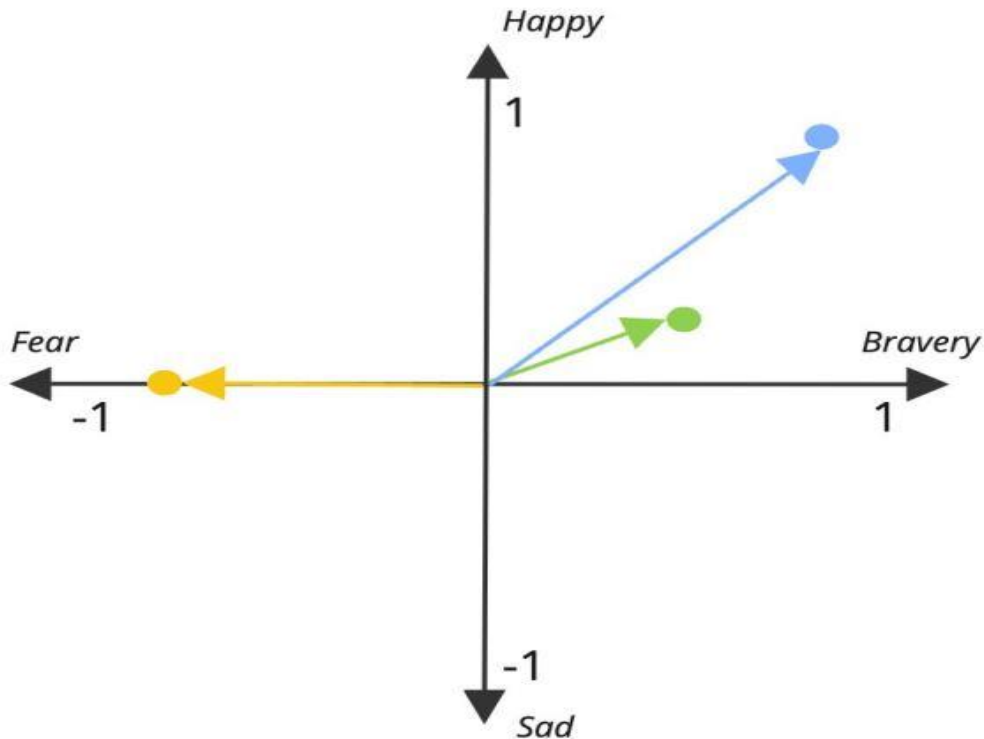
These embeddings only rate **2 qualities**, but real embeddings frequently have **700 to 1500 "dimensions"** or qualities that they score

Vector Stores and Similarity for RAG



Retrieval With Vectors

Sentence	Bravery Score (1 = bravery, -1 = fear)	Happiness Score (1 = happy, -1 = sad)
The happy child jumped bravely from rock to rock	1	1
The child was not timid and had a good time jumping from rock to rock	.5	.3
Although filled with great fear, the child jumped from rock to rock	-1	0



**Squared
L2**

Using the **distance between two points** to figure out how similar they are

**Cosine
similarity**

Using the **angle between two vectors** to figure out how similar they are

What Is The Future Of RAG?

RAG Is Dead: Gemini 2.0 Flash Crushes Your Outdated AI Pipeline



Gurpreet Singh · Follow

3 min read · Feb 20, 2025



1



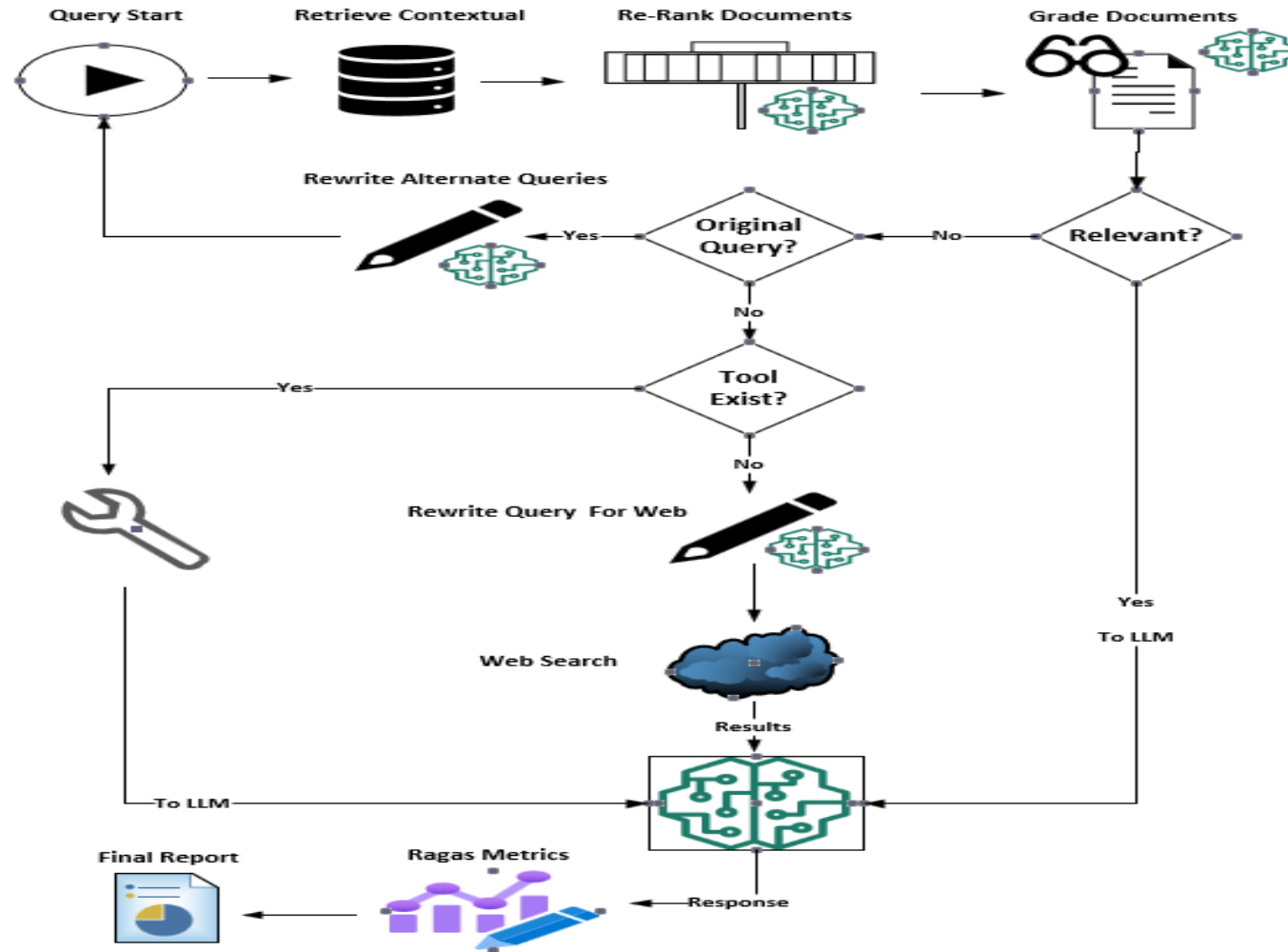
Reference:

[RAG Is Dead: Gemini 2.0 Flash Crushes Your Outdated AI Pipeline | by Gurpreet Singh | Feb, 2025 | Medium](#)

What Is Blue Sky Working On?

- Agentic RAG using ReAct Workflow (<https://arxiv.org/pdf/2210.03629>) – March 2023
- Self-Reflective RAG (<https://arxiv.org/abs/2310.11511>) – Oct 2023
- Fusion RAG (<https://arxiv.org/pdf/2402.03367>) – February 2024
- Contextual RAG (<https://www.anthropic.com/news/contextual-retrieval>) – Sept 2024
- Adaptive RAG (<https://arxiv.org/abs/2403.14403>) – March 2024
- Multi-modal RAG (<https://arxiv.org/abs/2410.11321>) – Oct 2024
- Corrective RAG (<https://arxiv.org/abs/2401.15884>) – Oct 2024
- Self-Route RAG (<https://arxiv.org/pdf/2407.16833>) – Oct 2024
- RAG Metrics
 - Precision
 - Recall
 - Relevancy
 - Etc.
- Looking Beyond Firmware Engineering...To Systems...And More

“Self-RAG” Agentic Workflow Overview



Conference Paper

Blue Skies Ahead

An AI Case Study on LLM Use for a Graph Theory Related Application

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February 26, 2025

Abstract

Research activities necessitate the exploration of ideas which may involve significant software development, experimentation, and testing effort. The ability of Large Language Models (LLMs) to generate executable software has been demonstrated in various use cases. This study highlights the positive outcomes of a use case involving a graph theory application. Through a series of successful prompts, functional software was produced within minutes, a task that would otherwise have taken several hours or days to complete. Rather than focusing solely on cost savings from reduced engineering effort, this study aims to highlight the substantial opportunity benefits provided by this technology, especially since research typically involves evaluating multiple ideas before selecting the optimal solution.

Cybersecurity Paper

Evaluating LLM Use In Identifying OSS Packages Linked to Cybersecurity Vulnerabilities for HAVOSS

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Abstract—Building on the more general Capability Maturity Model (CMM) for software, the Handling Vulnerabilities In OSS (HAVOSS) model has emerged as an effective complement with a more detailed focus on handling Common Vulnerabilities and Exposures (CVEs) in third-party software packages used in embedded systems. As such, this HAVOSS model includes six capability areas and twenty-one practices. Of particular interest is the Identification and Monitoring of Sources area which presents significant challenges given the frequency of new vulnerability discoveries and disclosures. To address this HAVOSS area, this paper explores the use of Large Language Models (LLMs) within an agentic operational framework that employs multiple Retrieval Augmented Generation (RAG) methods to improve the accuracy of retrieved data based on a search input. Consequently, it explores, first, whether a CVE identification query is sufficient to retrieve the correct record with software package identification; and second, whether a software package information based query is sufficient to retrieve the correct record with the CVE identifier and its associated description. Hence, a security professional armed with a CVE identifier should be able to reliably extract the affected software packages and likewise armed with a list of software package identifiers be able to connect to the correct CVEs. Using a custom developed CyberVulModelEval software application, the research goal is to better understand the practical use of LLMs to accurately link vulnerability descriptive elements with deployed open source software packages.

Index Terms—CVE, Agentic LLM, Self-RAG, HAVOSS

in a large repository of issues and concerns that have to be sifted through to enable cybersecurity professionals to identify vulnerabilities that exist in products under their supervision and respond accordingly.

Per Druckman [3] a 2024 Synopsis report showed that 96 percent of commercial code bases they sampled contained open source components. This corroborates the 2022 Linux Foundation study [4] that stated 70-90 percent of any given software code base contains open source components. Given the ubiquitous use of GitHub for managing open source code, entities such as the GitHub Advisory [5] was created to notify developers of vulnerabilities that are associated with affected software packages within the GitHub ecosystem. In terms of logistics, the workflow essentially consists of reported vulnerabilities that flow into the GitHub Advisory database from the NVD feed or from the GitHub internal npm (package manager) security team which are transformed into security advisories. As of 2022 [6], broader community participation and involvement has also been integrated into the process.

Given the importance of vulnerability disclosures and the linkage to software packages, especially open source, the security practitioner is confronted with the challenge of how to best consume the vast repository of data that is continually changing. To that end, the Handling Vulnerabilities In OSS (HAVOSS) model [7] includes the Identification and Monitoring of Sources as one of the key capability areas for evaluating

Upcoming Blue Sky Metrics Paper

Aligning LLM as judge with human evaluators

evals LLM

December 11, 2024

Shahul Es

Task : Check and Evaluate if response is correct based on reference.

Reference: Arun has a bike.

Response: Arun owns a two-wheeler

Reason: Both are not the same.
Two-wheel could mean many things.
Verdict: Fail

LLM as judge

Reason: Two-wheeler is used synonyms to bike in India.
So, this can be regarded as same.
Verdict: Pass

Human evaluator

Invite Me Back Next Year?



Questions



Thank you for attending!

Share your experiences at #HWGSEC