

# Building LLM-based Systems & Products at Paranal

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*Engineering with prompts, rather than prompt engineering*

Cristóbal Alcázar  
MSc in Finance & (not yet) MSc in Data Science



# Cristóbal Alcázar

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- ❑ MSc (not yet) in Data Science @U. de Chile
- ❑ Current research: diffusion generative models, RLHF. Supervised by Felipe Tobar.
- ❑ MDS7203 Deep Generative Models: Teaching assistant.
- ❑ Hugging Face student ambassador program.
- ❑ Finance and Economic background.
- ❑ Work Experience: 3 years in Macroeconomic Statistics area at the Central Bank of Chile. 2 years at a Fintech joint venture on payments (currently the payment subsidiary of BancoEstado).
- ❑ Currently at @ ESO Paranal Software group (winter-internship 2023).

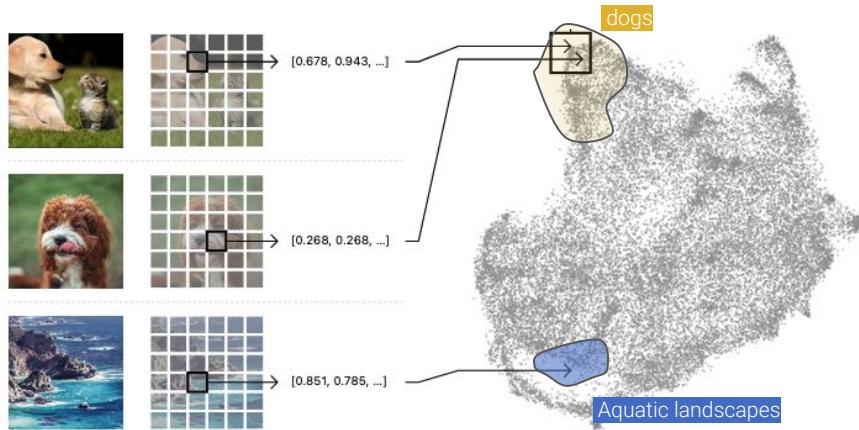


# Context

LLM, embeddings, generative models, context window

# Neural Networks and Representation Learning

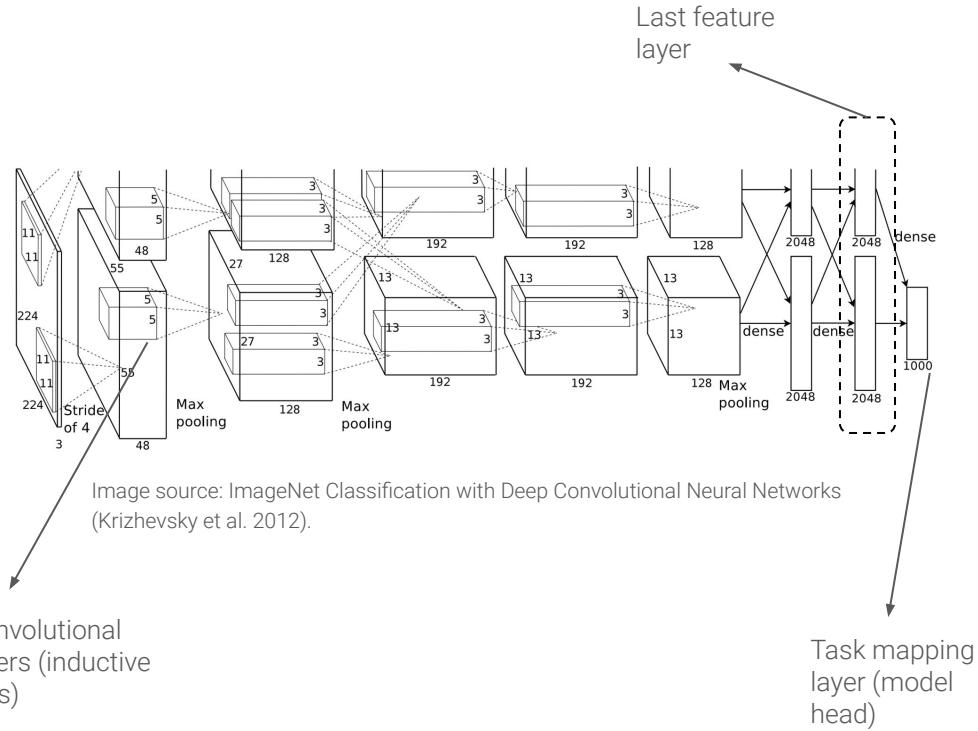
Learning a simplified numerical representation of complex data



- ❑ **Embeddings:** Vectors representing complex data in a numerical and dense format.
- ❑ **Vector space representation:** Imagine a space where data resides. Within this space, dogs cluster together, forming a distinct neighborhood than cats, but both classes lives in a different district than humans.
- ❑ **Embeddings as a features:** These vectors serve as a foundation for constructing various systems (object recognition, scene detection).

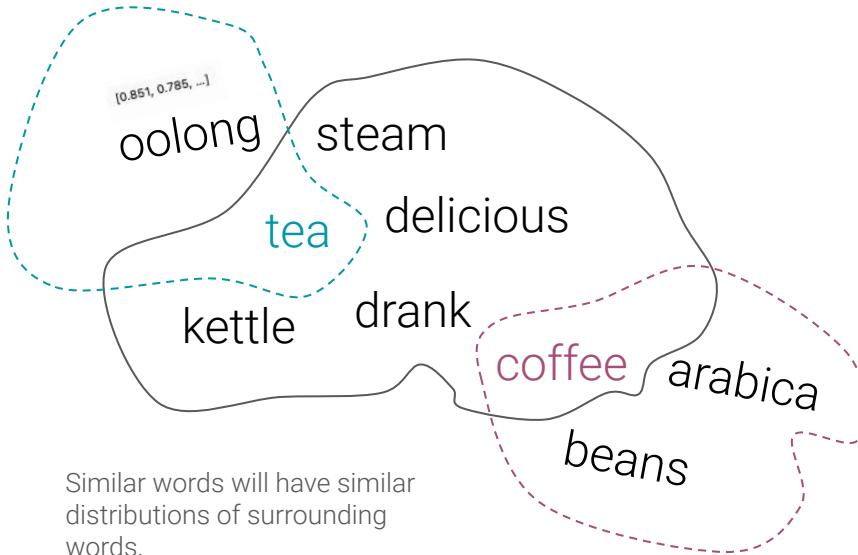
# Neural Networks and Representation Learning

End-to-end system, from raw data to task mapping layers.



# Vector Semantics and Embeddings

"You shall know a word by the company it keeps". - Firth, 1957



- **Distributional hypothesis:** the meaning of a word can be derived from the distribution of contexts in which it appears.
- **Contextual embeddings:** to capture the semantic of a word or token, context is critical. It's necessary a way to resignify a fix embedding given their context.
- **More about sequence models:** [Sequence Models with Transformers. A Journey Through Language Models. Current Insights, and Practical Applications at Paranal Observatory \(Carvajal, Alcázar 2023\)](#)

# 2023 NeurIPS Test of Time Award

Distributed Representations of Words and Phrases and their Compositionality (word2vec)

Jeff Dean (@JeffDean)  @JeffDean

On behalf of our co-authors Tomáš Mikolov, @ilyasut and Kai Chen, @greg\_corrado and I were delighted to accept the #NeurIPS2023 Test of Time Award for the "word2vec" paper ([arxiv.org/abs/1310.4546](https://arxiv.org/abs/1310.4546)). Thanks to the @NeurIPSConf test of time committee for honoring us with this award!

This work started as an earlier ICLR 2013 workshop paper ([arxiv.org/abs/1301.3781](https://arxiv.org/abs/1301.3781)) that explored a few different self-supervised techniques for learning word embeddings. The skip-gram approach worked better than others, and we scaled that and explored various alternative loss functions in the NeurIPS paper.

The geometric relationships contained in the trained word embeddings were one thing about this work that I think people found interesting (see images from our talk below).

[Traducir post](#)

We are honored to receive this award

- Thanks to the committee that selected our work! We're honored!
- Thanks to our co-authors who couldn't be here today!

Distributed Representations of Words and Phrases and their Compositionality

Tomáš Mikolov, Greg Corrado, Boen Perozzi, Jeff Dean

5. Words as n-dimensional vectors

Expression	Named token
Police + man - woman	man
logger + log - cold	colder
Japan - Japan + Germany	Germany
China - China + India	India
Windows - Microsoft + Google	Android

2d PCA visualization of embeddings: Syntactic relationships expressed geometrically

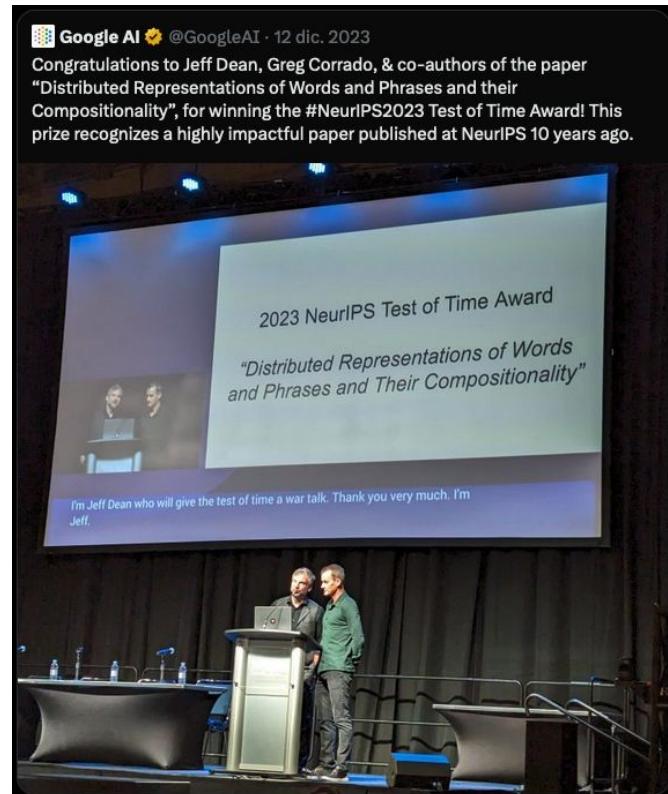
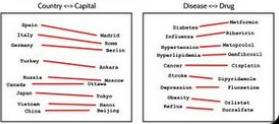
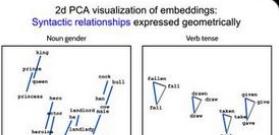
Noun gender

Verb tense

5. Semantic relationships expressed geometrically

Country <=> Capital

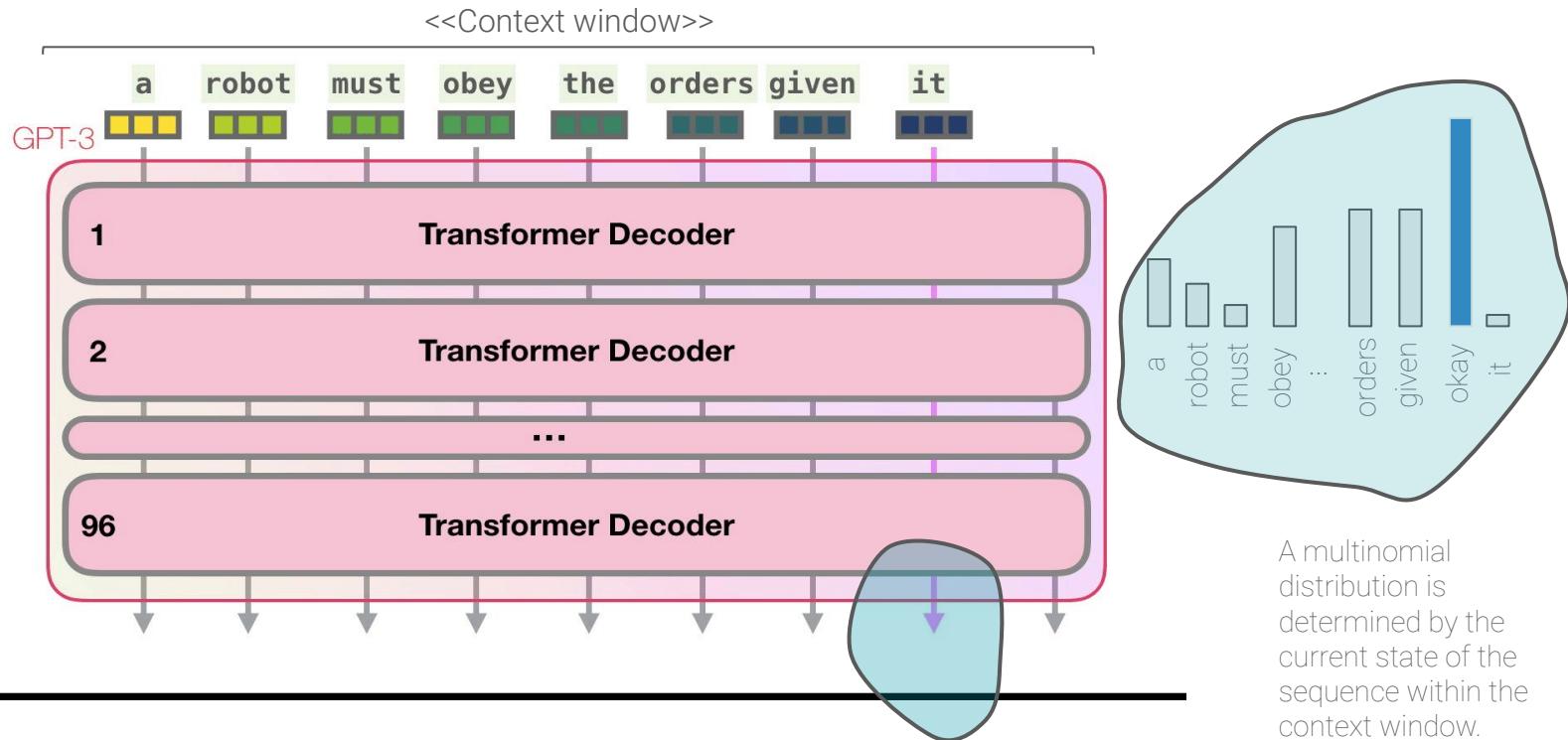
Disease <=> Drug



# A Neural Network to predict the next token in the sequence

Embeddings are recalibrated based on the distributional hypothesis established by the context window.

Generative Pre-trained Transformer (GPT)



# How to Achieve a ChatGPTish Model?

Involved at least 2 training stages and result in a lossy compression about 5 order of magnitude



every  
~year

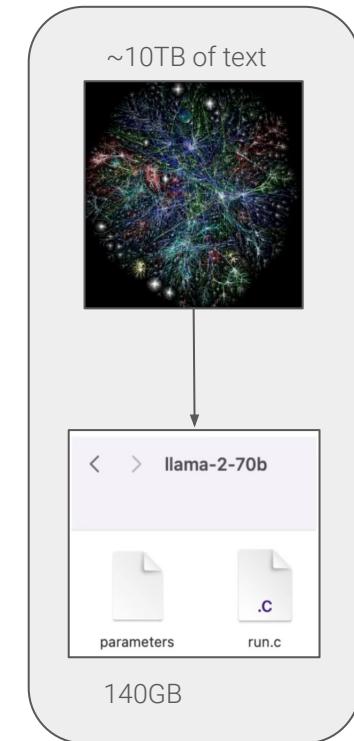
## Stage 1: Pretraining

1. Download ~10TB of text.
2. Get a cluster of ~6,000 GPUs.
3. Compress the text into a neural network, pay ~\$2M, wait ~12 days.
4. Obtain **base model**.

every  
~week

## Stage 2: Finetuning

1. Write labeling instructions
2. Hire people (or use [scale.ai](#)!), collect 100K high quality ideal Q&A responses, and/or comparisons.
3. Finetune base model on this data, wait ~1 day.
4. Obtain **assistant model**.
5. Run a lot of evaluations.
6. Deploy.
7. Monitor, collect misbehaviors, go to step 1.



Source: [Intro to Large Language Models \(Karpathy 2023\)](#)

Resource - [Llama 2: Open Foundation and Fine-Tuned Chat Models \(paper\)](#)



# Zero-shot prompt

Just feed the task text to the model and ask for results.

**Text:** i'll bet the video game is a lot more fun than the film.  
**Sentiment:** [MODEL COMPLETION]

# Few-shot prompt

High-quality task demonstrations, showcasing input-output pairs. **Pros:** enhance comprehension of human intent and expected answer criteria. **Cons:** increase token consumption and context length limitations.

**Text:** (lawrence bounces) all over the stage, dancing, running, sweating, mopping his face and generally displaying the wacky talent that brought him fame in the first place.

**Sentiment:** positive

**Text:** despite all evidence to the contrary, this clunker has somehow managed to pose as an actual feature movie, the kind that charges full admission and gets hyped on tv and purports to amuse small children and ostensible adults.

**Sentiment:** negative

**Text:** i'll bet the video game is a lot more fun than the film.

**Sentiment:** [MODEL COMPLETION]

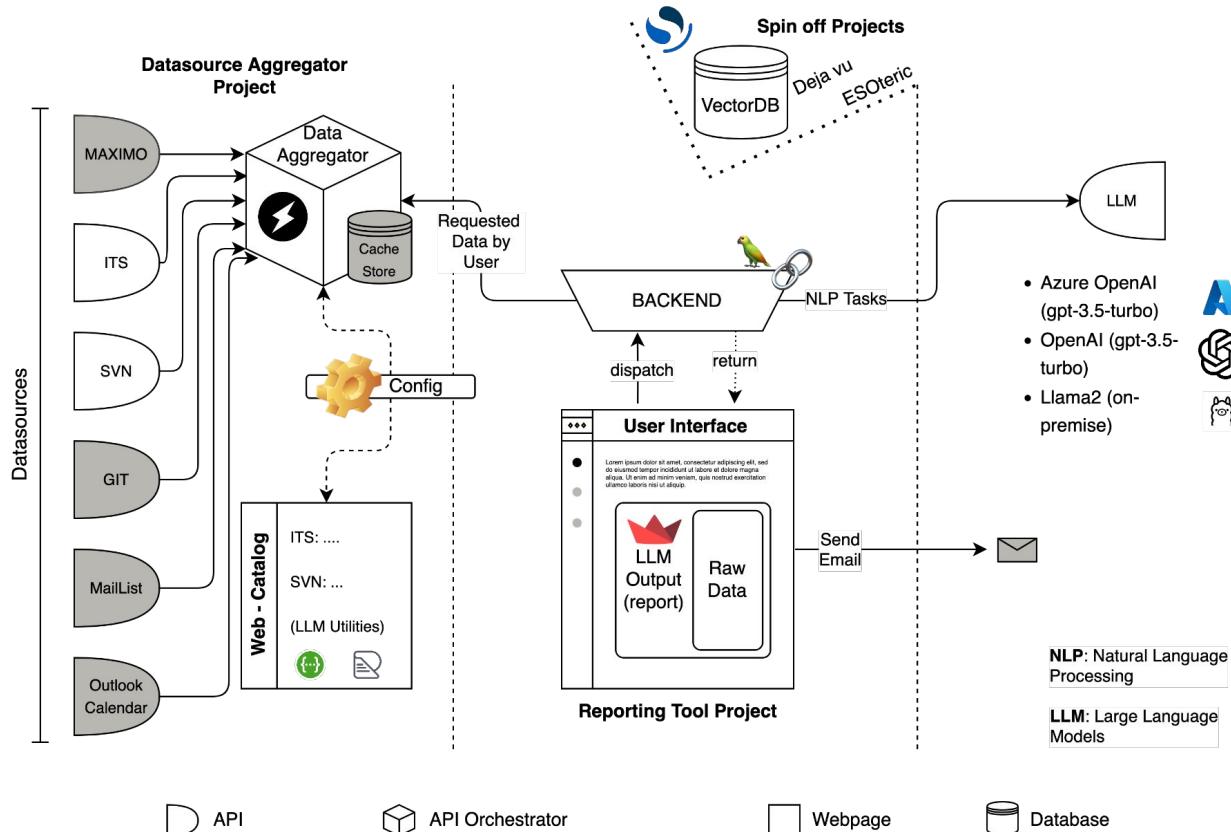


# The Internship

In a nutshell

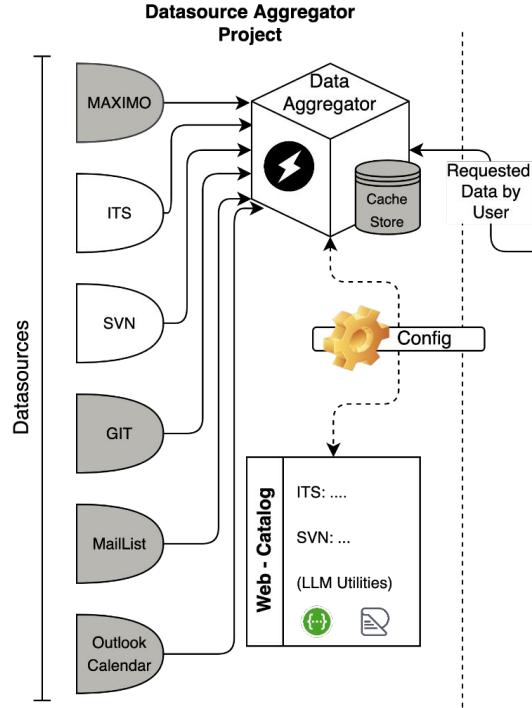
# Internship Overview

Datasource Aggregator - Reporting Tool - Spin off Projects



# Datasource Aggregator

A comprehensive API featuring various endpoints for retrieving specific data from diverse sources



- ❑ **Aggregator:** connecting different data sources.
- ❑ Specific interaction with **data sources** (e.g., obtaining a ticket for a user).
- ❑ Independent project; Reporting Tool is the first service...

## Get Issues By User Between

Returns issues related to a specific ITS (Jira) user within a time range between from\_date and to\_date.

Parameters:

- `jira_user` (str): The ITS (Jira) user to retrieve issues for.
- `from_date` (str): The date to retrieve issues from. Format: YYYY-MM-DD.
- `to_date` (str): The date to retrieve issues to. Format: YYYY-MM-DD or 'HEAD' for the current date.

Returns:

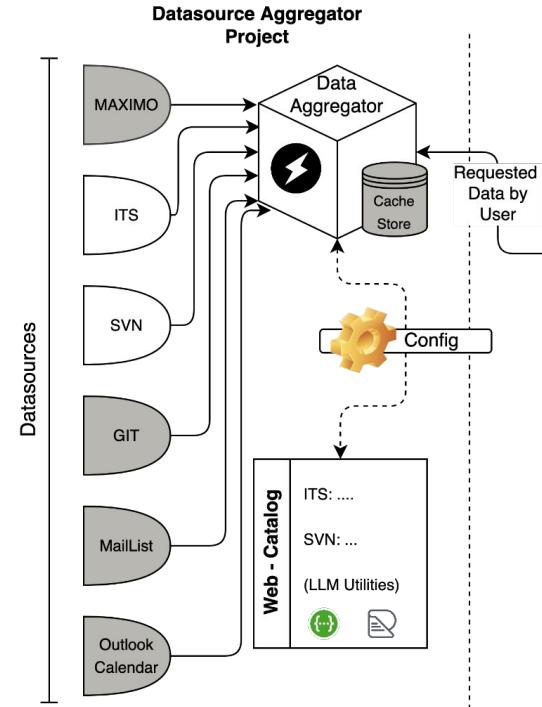
- `List[JiraIssue]` : A list of parsed ITS (Jira) issues.

### QUERY PARAMETERS

<code>jira_user</code>	string (Jira User) Default: "jaraneda"	The ITS (Jira) user to retrieve issues for.
<code>from_date</code>	string (From Date) Default: "2023-11-25"	The date to retrieve issues from.
<code>to_date</code>	string (To Date) Default: "2023-12-25"	The date to retrieve issues to. You can use 'HEAD' to retrieve issues up to the current date.

### Responses

> 200 Successful Response



API

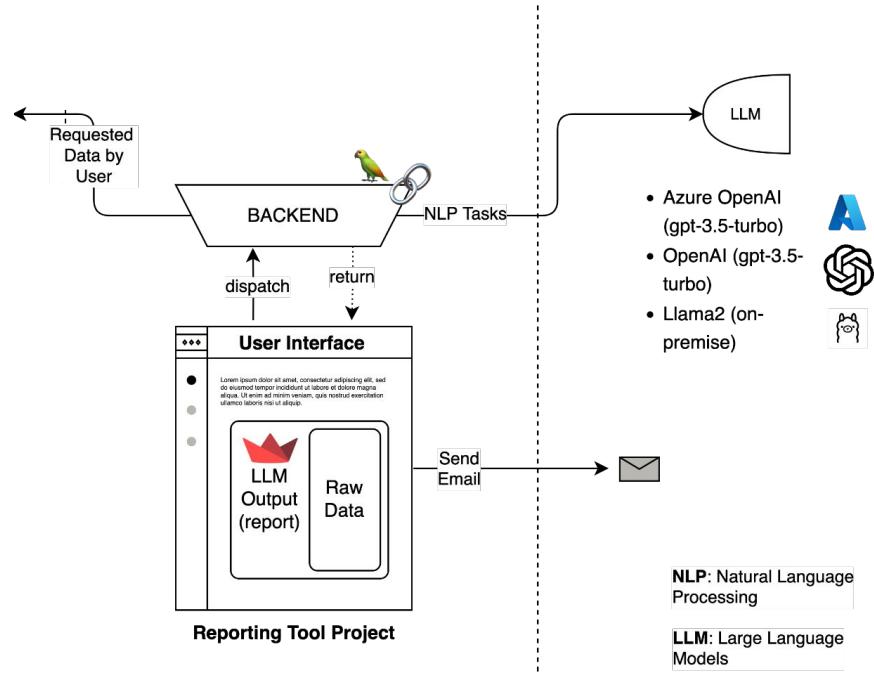


API Orchestrator

# Reporting Tool

Application to Generate Reports Automatically

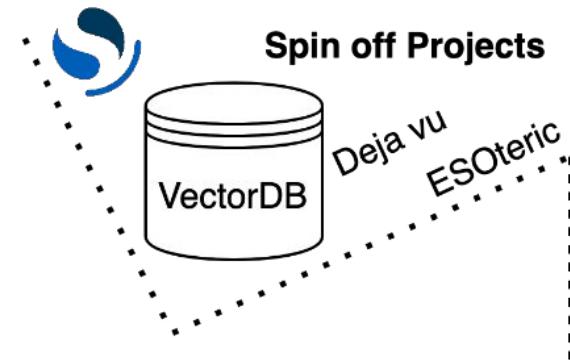
- ❑ Automatic generation of reports through summarization using LLM.
- ❑ Builds the domain of information requested by the user.
- ❑ User serves as an editor with the option to edit and remove the information to be used by the LLM (augmented tool).



# Spin off Projects

Vector Similarity Search & Retrieval Augmented Generation

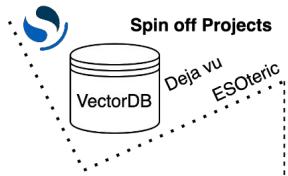
- ❑ **ESOteric**: a “talk with your files” chatbot.
- ❑ **DejaVu** (by NMI).
- ❑ Two core concepts behind these spin off projects.
  - ❑ Vector Similarity Search
  - ❑ Retrieval Augmented Generation (RAG)





# ESoteric: a “Talk with your Files” Q&A

Retrieval Augmented Generation (RAG) Pattern



The screenshot shows the ESoteric application interface. On the left, there's a sidebar with a decorative image of a robot reading books in a futuristic setting, followed by an "About" section describing the project's goal of demonstrating LLM utilization for a RAG system. Below that is a list of technologies used: Streamlit, LangChain, and OpenAI. The main area features the ESoteric logo with a crystal ball icon. A prominent heading asks, "Why read when you can communicate directly with your files?". Below it, a message encourages users to upload PDFs from Project Gutenberg. A file upload interface shows a "pride-and-prejudice.pdf" file successfully uploaded at 28.3MB. A success message confirms the upload. At the bottom, a question is asked about Mr. Darcy and Miss Elizabeth Bennet, with a placeholder text box for a response.

**About**

The objective of this project is to demonstrate the utilization of a Large Language Model (LLM) in constructing a straightforward Retrieve-based Question & Answer System.

This app was built using:

- Streamlit
- LangChain 🦜🔗
- OpenAI

**ESoteric** 🌟

*Why read when you can communicate directly with your files?*

You need some inspiration? Try a pdf from the [Project Gutenberg frequently downloaded ebooks \(totally legal!\)](#)

Upload a PDF file

Drag and drop file here  
Limit 200MB per file • PDF

Browse files

pride-and-prejudice.pdf 28.3MB X

Your document pride-and-prejudice was successfully uploaded!

Embeddings loaded from disk

Ask me anything! 🤖 (related to the document of course...)

Do you really believe Miss Elizabeth Bennet was in love with Mr. Darcy? Can you provide an example?

<https://gitlab.eso.org/calcazar/esoteric-qa>

# ESoteric: a “Talk with your Files” Q&A

Retrieval Augmented Generation (RAG) Pattern

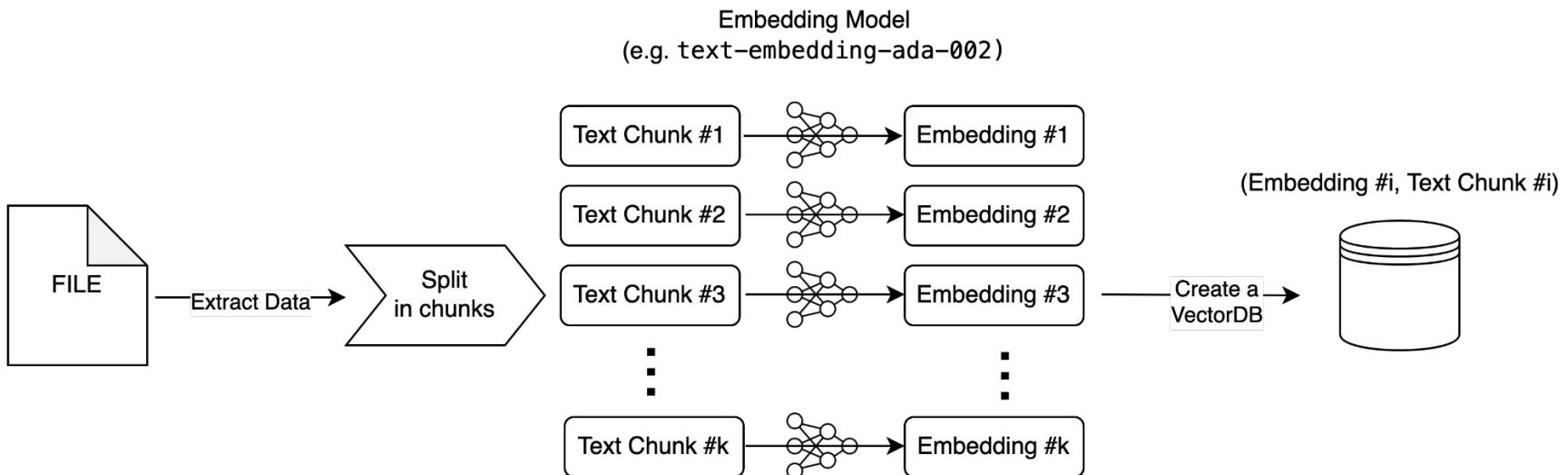


<https://gitlab.eso.org/calazar/esoteric-qa>

- ❑ A reader assistant agent via Question & Answering (QA) to interact with pdf documents such as Pride and Prejudice.
- ❑ A retrieve-based QA System:
  1. A large document, or a collection of documents, is transform into a knowledge base using embeddings.
  2. User ask questions that retrieve information from the knowledge data using a large language model.

# How to Create a Vector Database?

A simple split-apply pattern to create a vector database

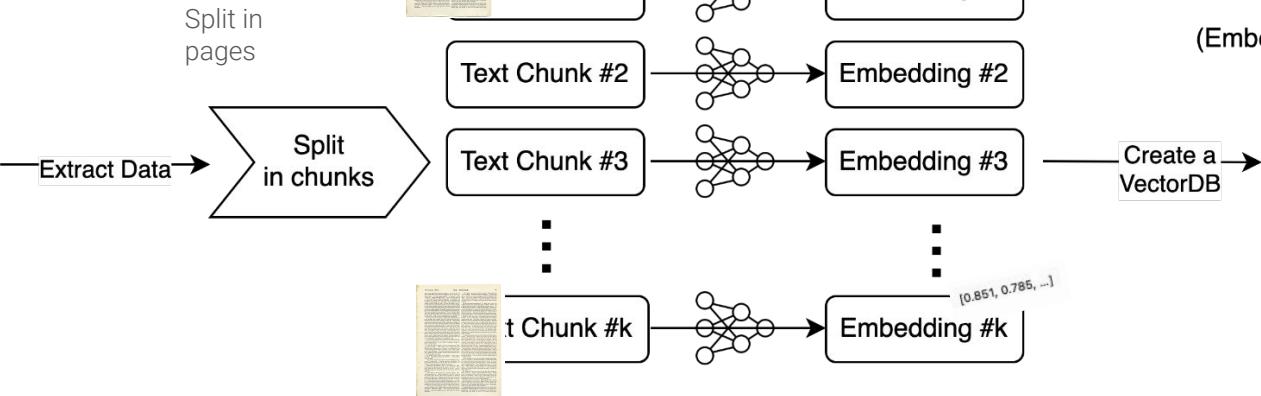
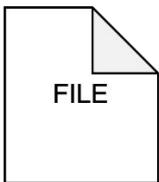


Create your own vector database with OpenSearch  
<https://gitlab.eso.org/calcazar/langchain-series/-/tree/main/examples/embedder>

# How to Create a Vector Database?

A simple split-apply pattern to create a key, value database

Get a book in a readable format

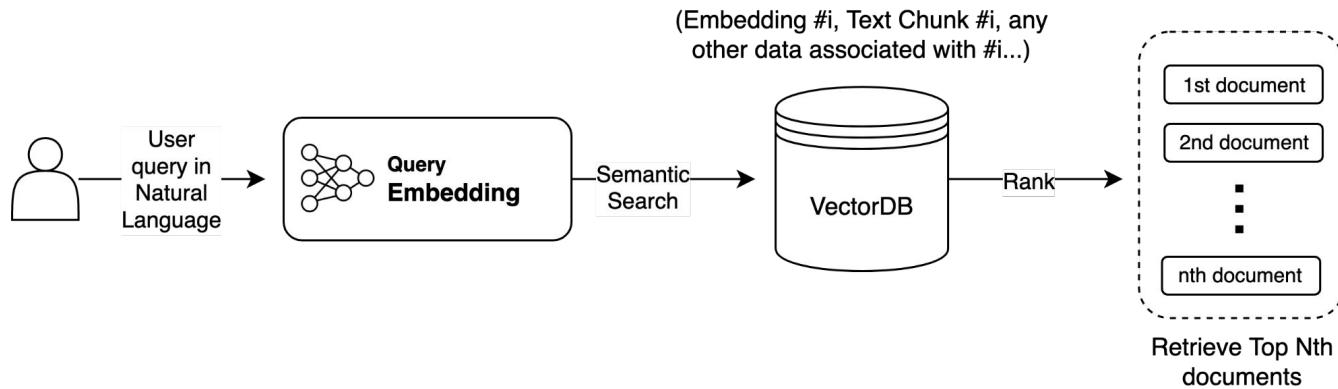


A Pride & Prejudice  
"knowledge database"

Create your own vector database with OpenSearch  
<https://gitlab.eso.org/calcazar/langchain-series/-/tree/main/examples/embedder>

# Retrieve Documents using Natural Language

Embeddings deliver similarity metrics, while the remainder involves ranking and retrieval



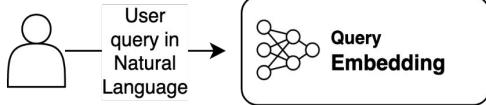
Create your own vector database with OpenSearch  
<https://gitlab.eso.org/calcazar/langchain-series/-/tree/main/examples/embedder>

Deja vu  
ESoteric

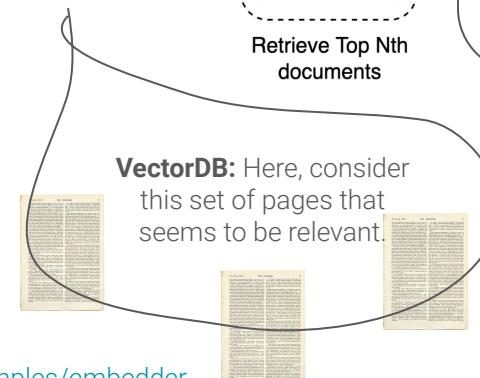
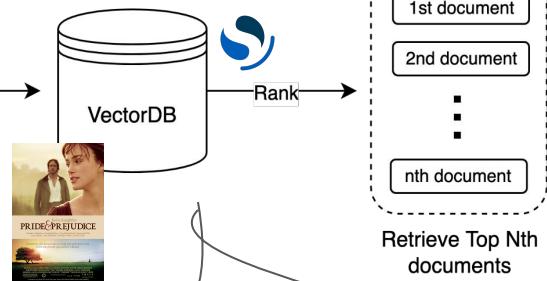
# Retrieval Augmented Generation

Improve LLM input by retrieving and incorporating pertinent data from a vectorDB

**User:** Do you really believe Miss Elizabeth Bennet was in love with Mr. Darcy? Can you provide an example?



A Pride & Prejudice "knowledge database"  
(Embedding #i, Text Chunk #i, any other data associated with #i...)



**LLM**  
Input - Prompt

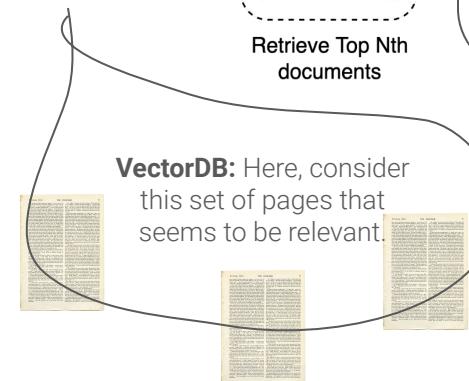
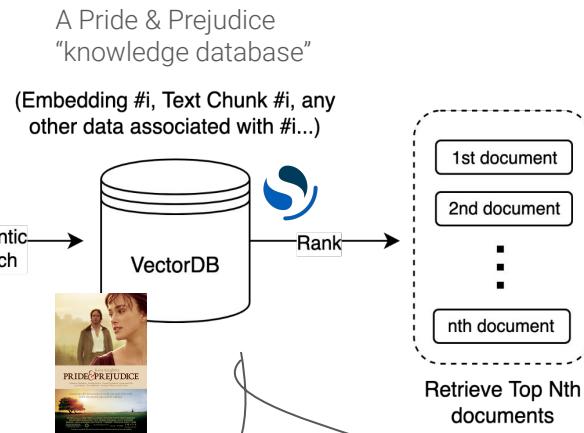
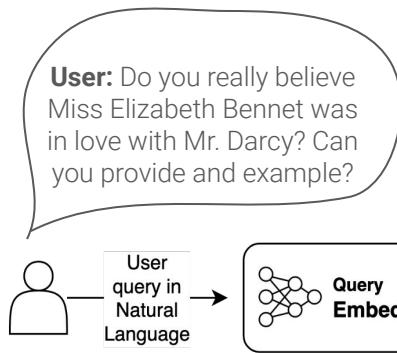
Respond to **{USER QUESTION}** using **{CONTEXT FROM VECTOR DB}**. Only provide factual information; if the answer is unavailable, reply with "I don't know."



**LLM:** Yes, I believe Miss Elizabeth Bennet was in love with Mr. Darcy... ❤️

Create your own vector database with OpenSearch

<https://gitlab.eso.org/calazar/langchain-series/-/tree/main/examples/embedder>



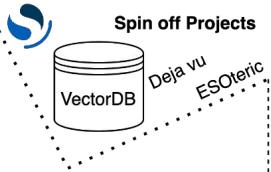
**VectorDB:** Here, consider this set of pages that seems to be relevant.

**LLM**  
**Input - Prompt**

Respond to **{USER QUESTION}** using **{CONTEXT FROM VECTOR DB}**. Only provide factual information; if the answer is unavailable, reply with "I don't know."



**LLM:** Yes, I believe Miss Elizabeth Bennet was in love with Mr. Darcy... ❤️



# ESoteric sample responses

Ask me anything! 😊 (related to the document of course...)

Do you really believe Miss Elizabeth Bennet was in love with Mr. Darcy? Can you provide an example?

Do you really believe Miss Elizabeth Bennet was in love with Mr. Darcy? Can you provide an example?

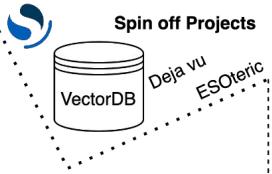
Yes, I believe Miss Elizabeth Bennet was in love with Mr. Darcy. An example of this is when Mr. Darcy tells Miss Bingley that Miss Elizabeth Bennet is his favorite lady, and Miss Bingley is surprised by this revelation.

Ask me anything! 😊 (related to the document of course...)

Why is Lizzy Mr. Bennet's favorite daughter?

Why is Lizzy Mr. Bennet's favorite daughter?

Based on the given context, it is not explicitly stated why Lizzy is Mr. Bennet's favorite daughter.



# DejaVu: A Vector Similarity Search for ITS Issues

A practical and clean application of vectorDB, by NMI

The screenshot shows a web browser window with the URL `wgsdlab3.pl.eso.org:8501`. The page has a dark theme with a sidebar on the left and a main content area on the right.

**Left Sidebar:**

- User Interface:** Shows a person icon and the text "Use query Natural Language".
- How Does it Work?**: Describes DejaVu as a similarity search in a database of embedding vectors from Jira issues.
- Embeddings Database Info**: States it is connected to an issue embeddings database at `wgsdlab3.pl.eso.org:9244`.

**Main Content Area:**

- DejaVu**: The title of the application.
- Have I seen this issue before...?**: A question asking if the user has seen a similar issue before.
- Tool for retrieving the top n most similar issues.**: A descriptive text about the tool's purpose.
- Enter the issue key or URL (e.g. "PR-174576" or "<https://wits.pl.eso.org/browse/PR-111311>")**: A text input field for entering a query.
- Number of issues to retrieve**: A dropdown menu set to 5, with minus and plus buttons for adjustment.
- Document**: A dashed-line box containing several document icons.
- Top Nth documents**: A dashed-line box containing text related to the retrieved documents.



# Automate Report Generation

How we build a system that take relevant information, categorize, and summarize from the users' perspective?



# Reporting Tool

Application to Generate Reports Automatically

Enter your username

Select the period of the report:

Last X days  
 Start/End date

Select the number of days to retrieve the last information

 - +

Select the display style for JIRA summaries:

Verbose  
Minimalist

Hide SVN commits that has these keywords (separated by comma)

Automatic\_backup, Autom:

Max number of lines changed to display for each SVN commit

 - +

Model Temperature

0.00  
0.00 1.50

## Reporting Tool

Devouringly digest your ITS tickets like fast food 🍔🍟🍕🍔🍟, but with the nourishment of a wholesome breakfast 🥧. Save your valuable time for what truly matters ✨...

ITS tickets	Start Date	End Date
31	2024-01-12	2024-01-25

SVN commits
22

ITS Tickets related to the following components: PIONIER, GRAVITY, VLTI, MATISSE, ESPRESSO

ITS Ticket ids: PR-187090, PR-187087, CCB-1003164, PR-187102, ER-183983, PR-186711, PR-187106, PR-187140, PR-184737, PR-187086, ER-183979, ER-183980, ER-183814, ER-183121, PR-187135, PR-187136, PR-187112, PR-184847, PR-186284, PR-187133, WR-1, CCB-1003237, CCB-1003260, ER-183927, ER-183977, ER-183976, ER-183975, ER-183974, ER-183973, ER-183929, ER-183928

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End of Turn Help ?

### 1 Your ITS Tickets since 2024-01-12

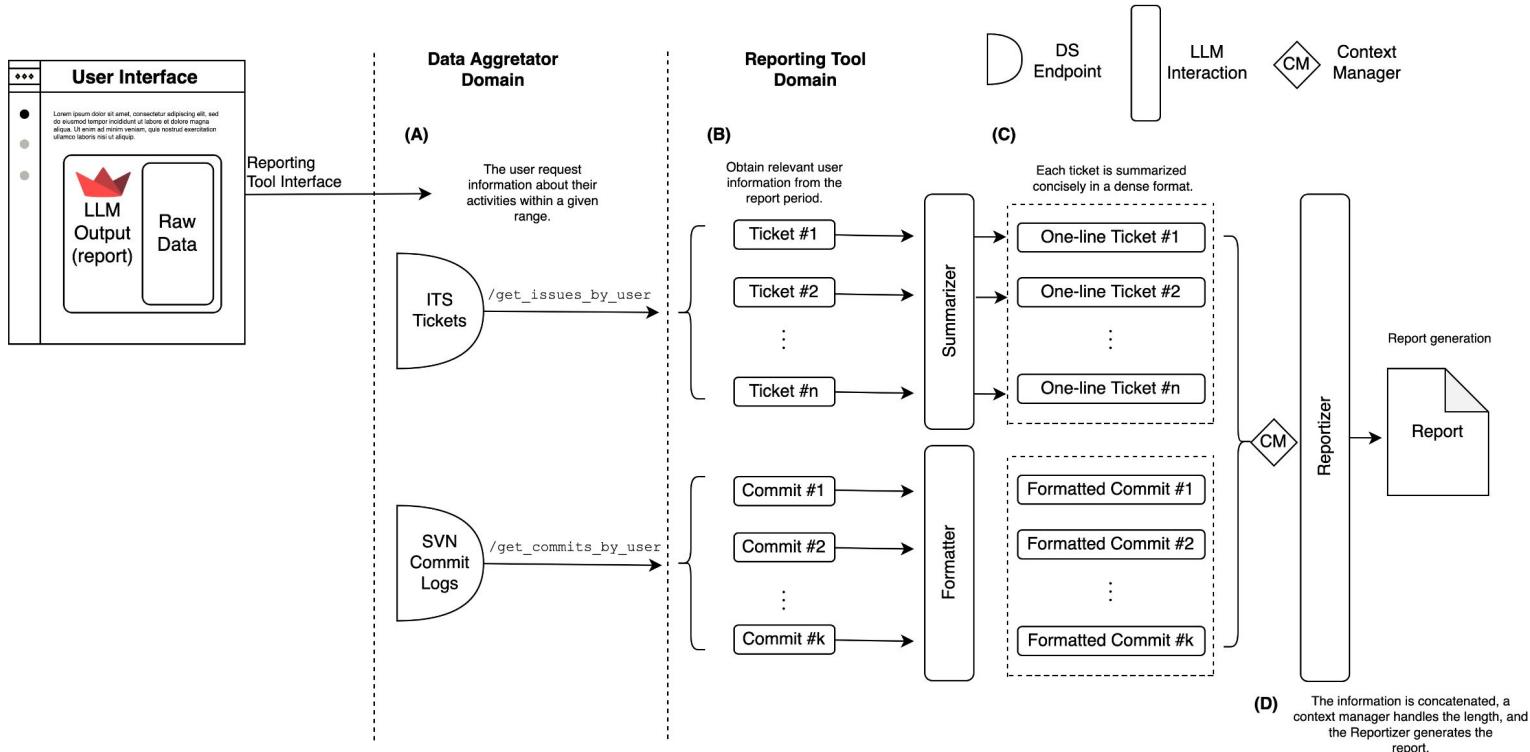
You can revise the summary and metadata generated from your recent JIRA tickets. Add any missing information or correct impressions. Once done, click 'Generate EoT Report' for your updated report.

Ticket: PR-187090 | Status: Resolved | Type: Problem | Components: ESPRESSO | Location: ICCF | Assignee: jgil | Reporter: egarro

Source: <https://scgitlab.sc.eso.org/psw/projects/reporting-tool>

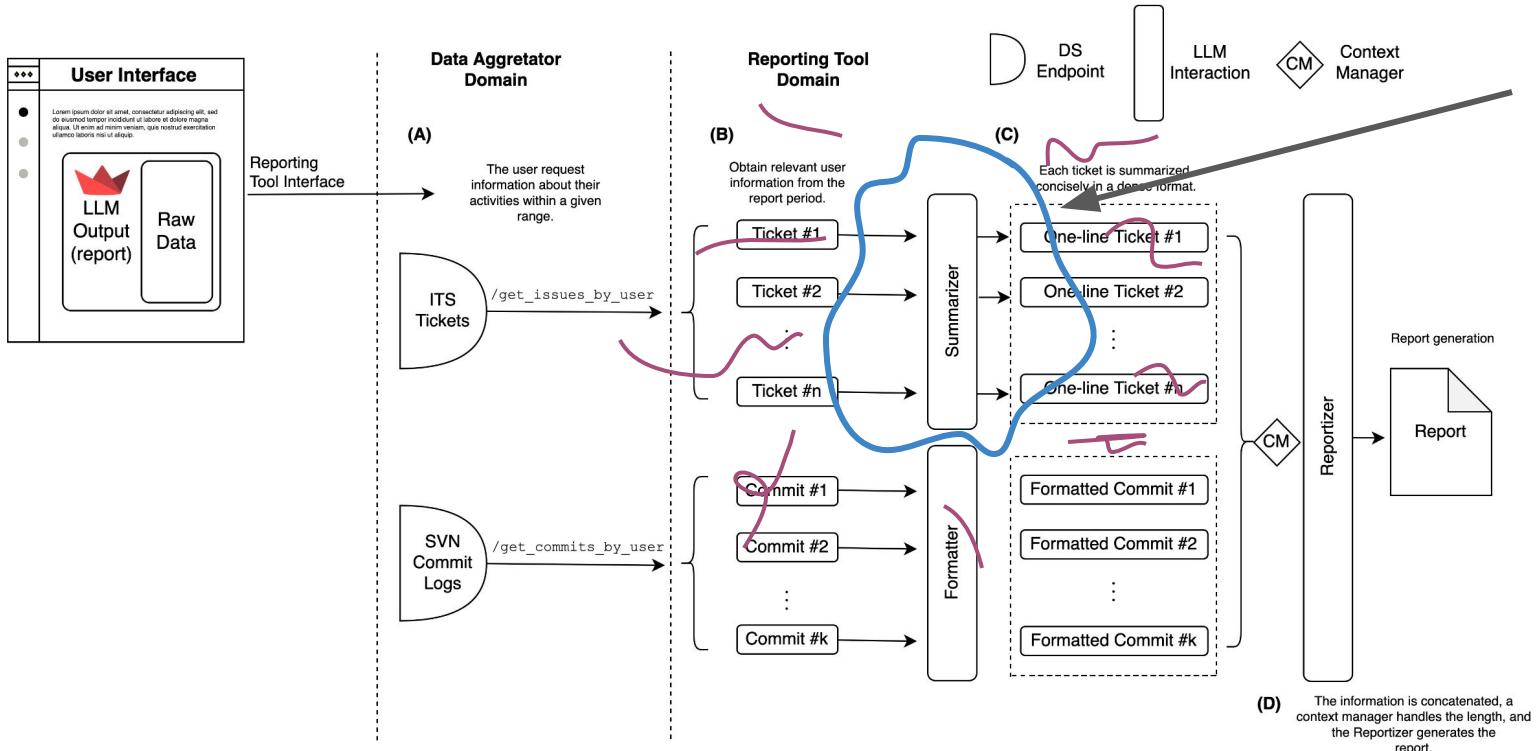
# Report Generation

## User Domain Information & Impersonation



# How does the LLM Interaction Work?

Let's Break Down the Summarizer...

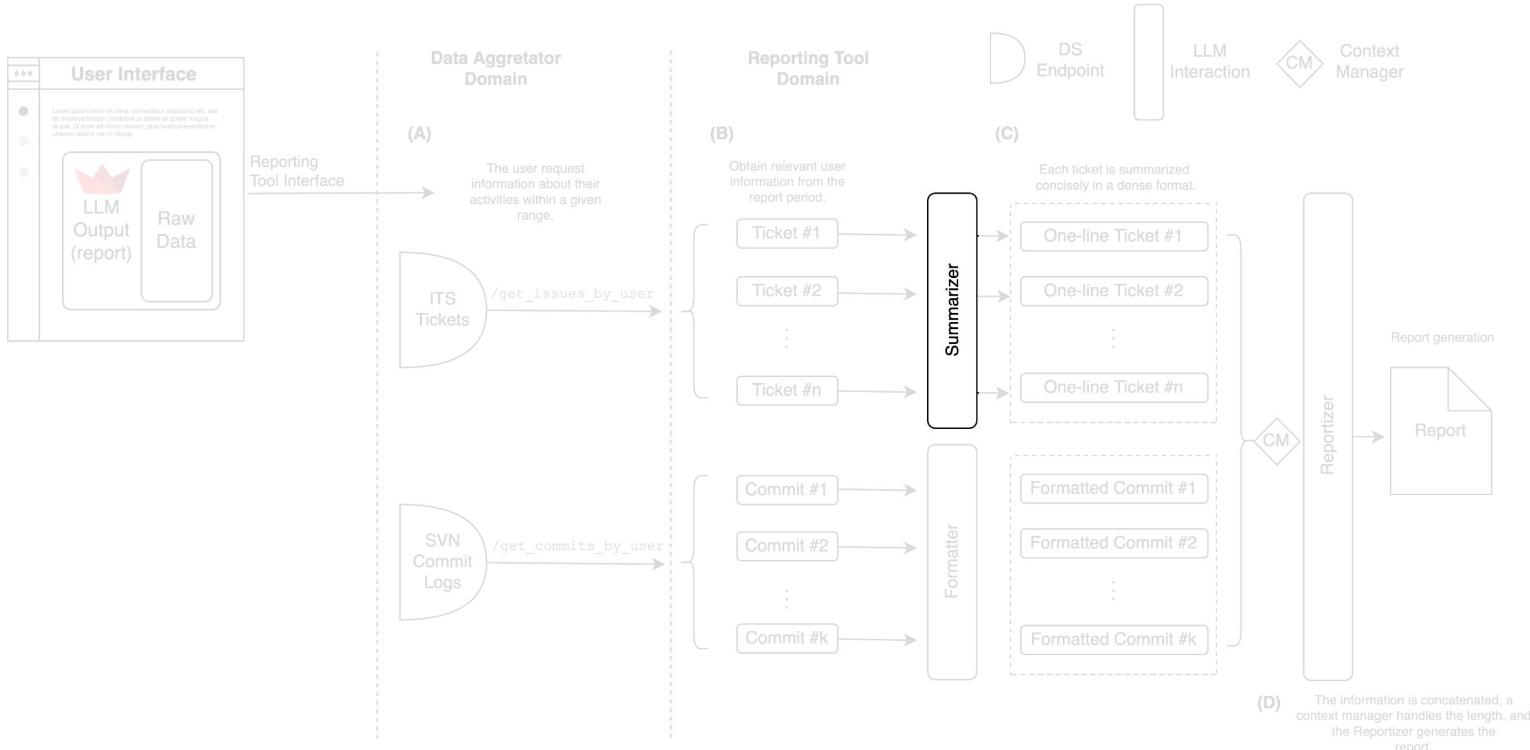


Here comes the "AI", or rather, the **stochastic parrot** !



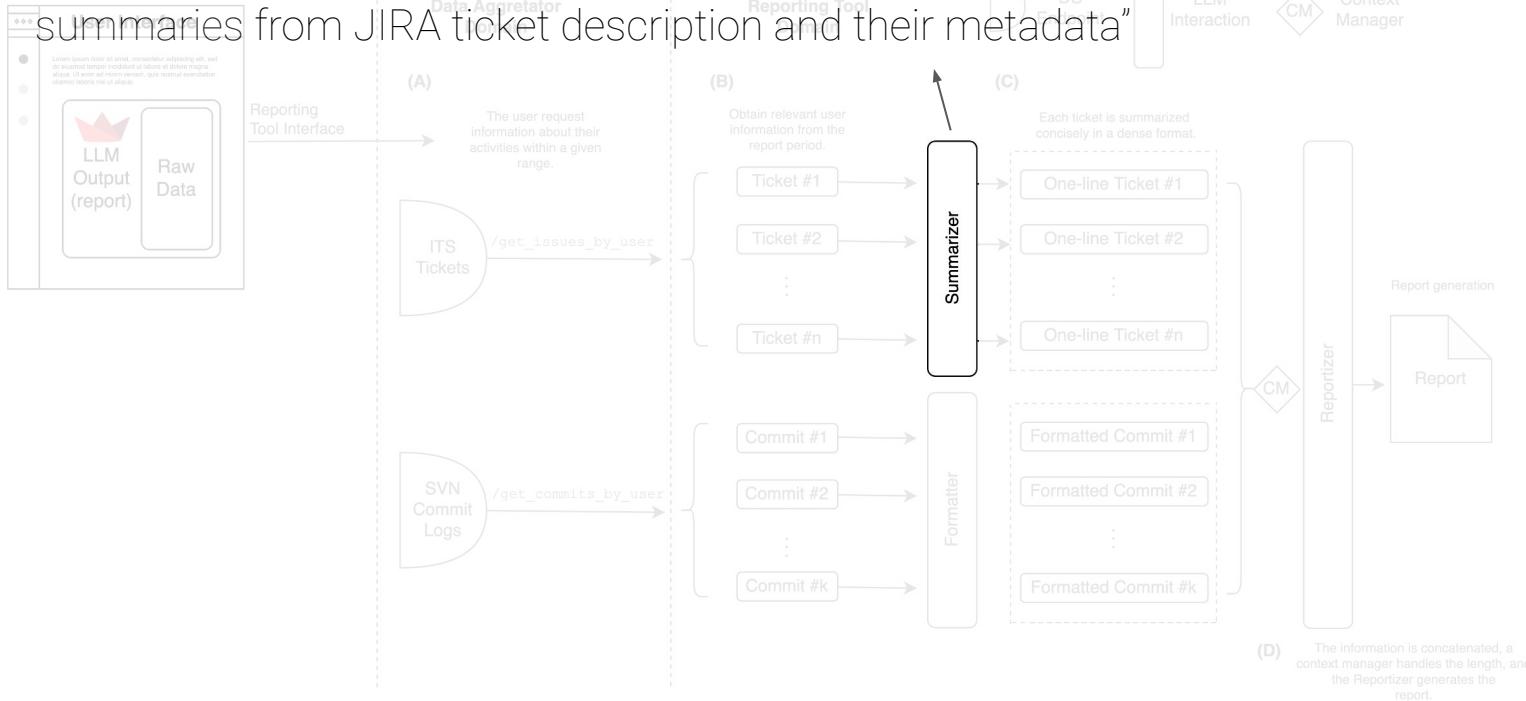
# How does the LLM Interaction Work?

Let's Break Down the Summarizer...



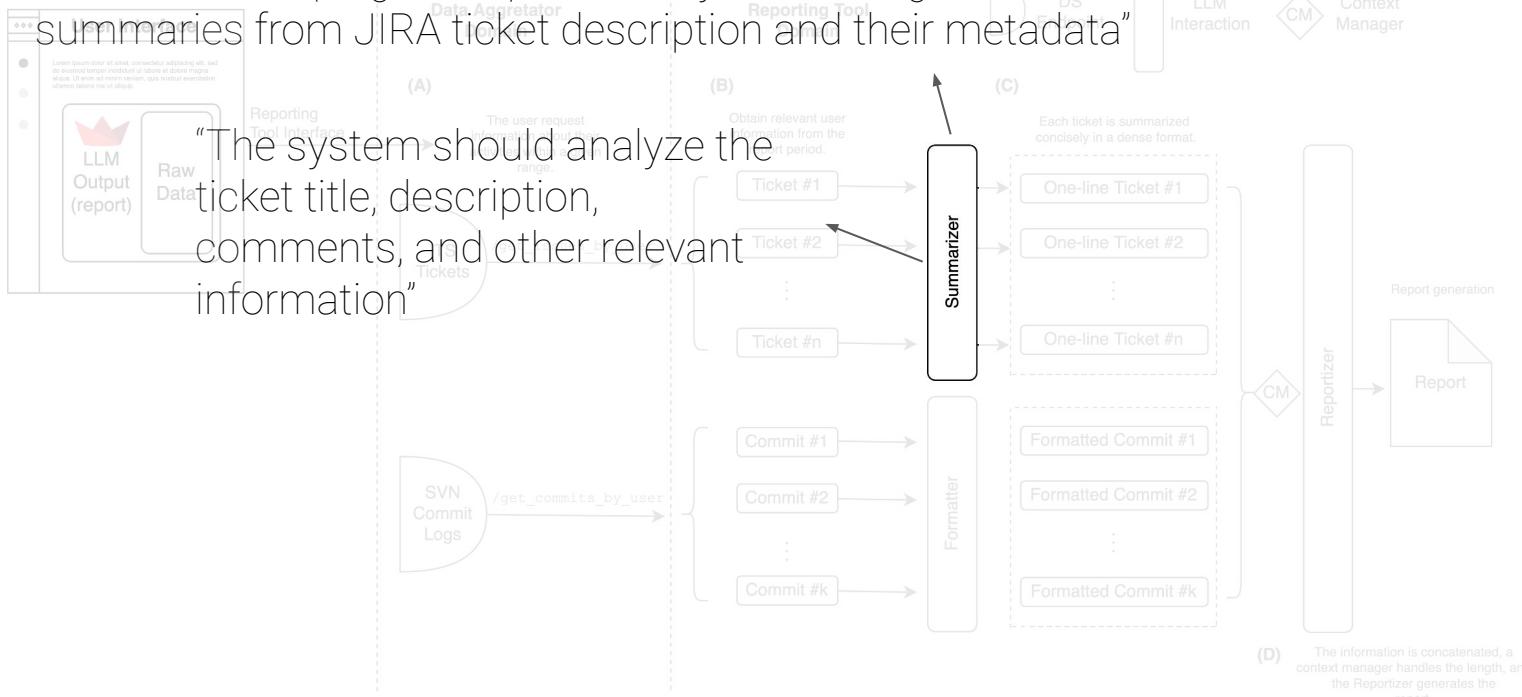
# The Summarizer Goal is Conditioning via the System Prompt

"You are developing an AI-powered system that generates concise and valuable summaries from JIRA ticket description and their metadata"



# The Summarizer Goal is Conditioning via the System Prompt

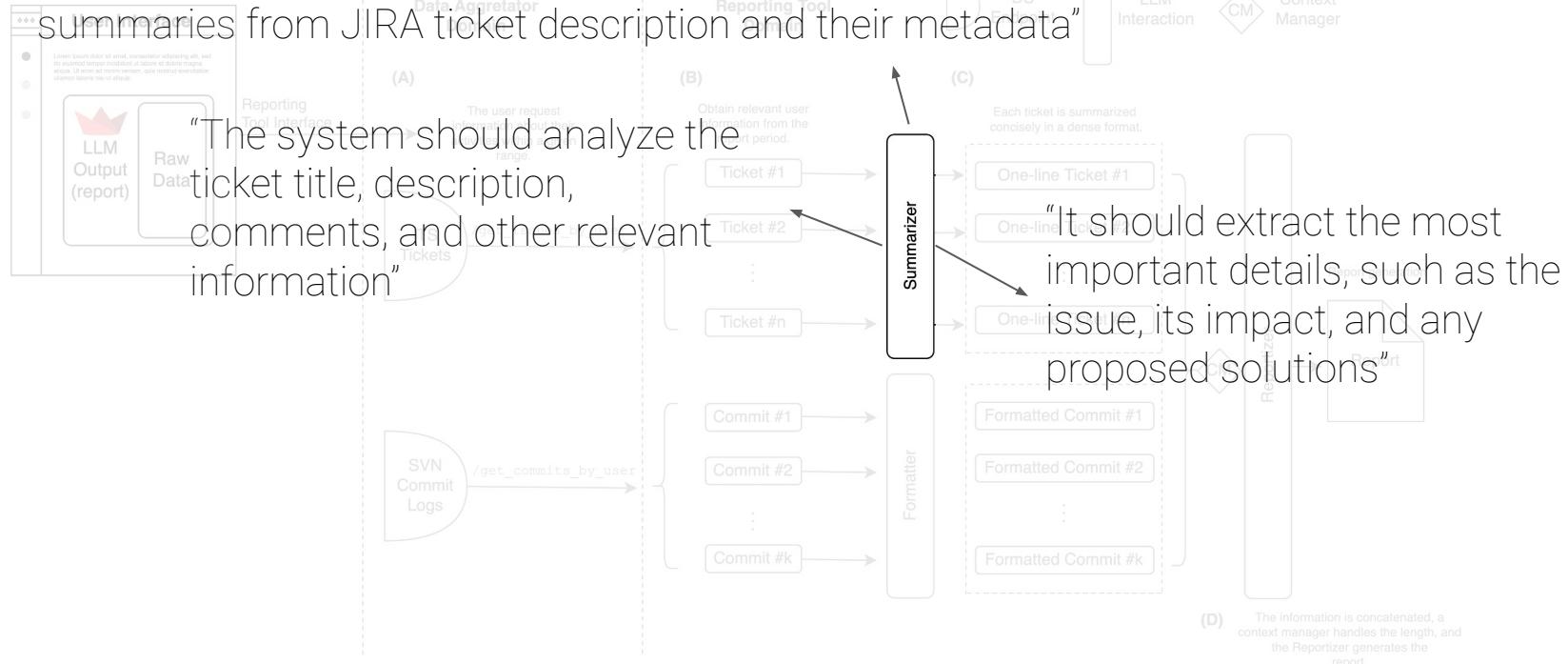
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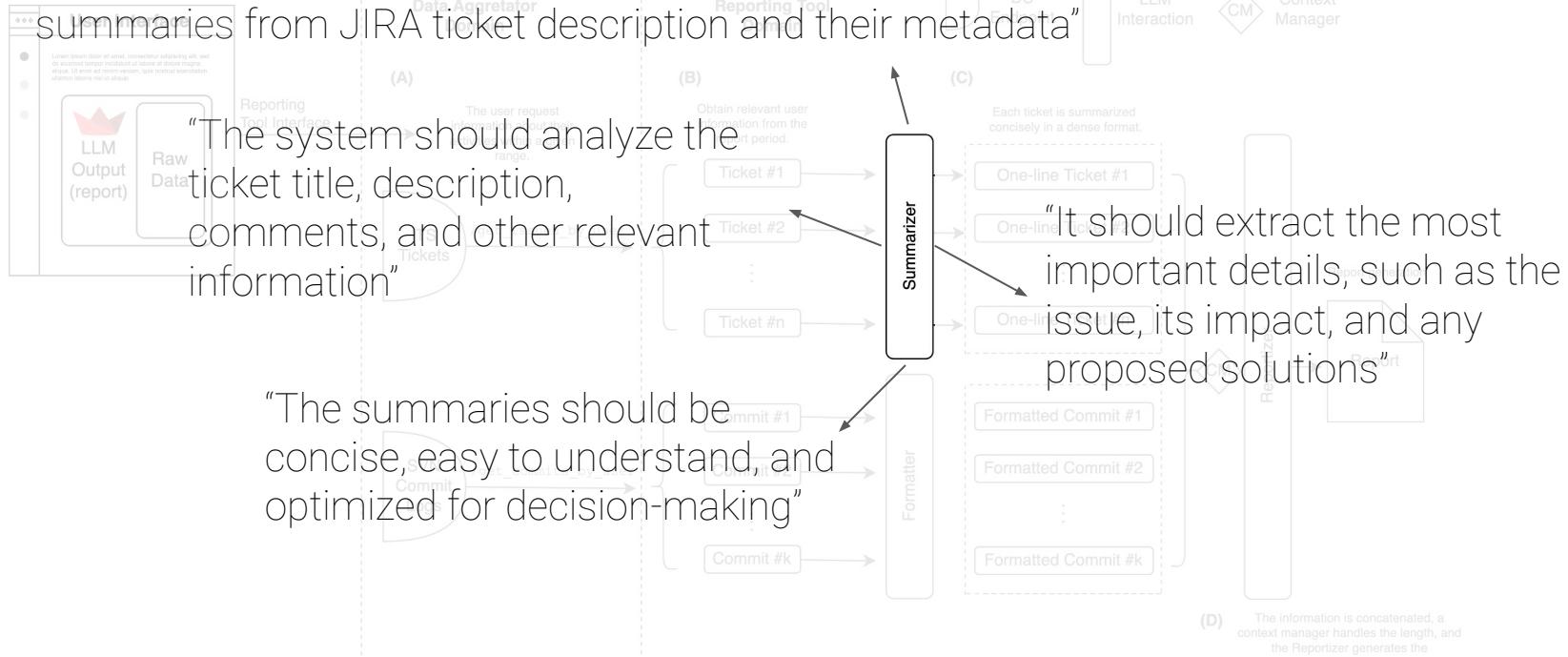


“You are developing an AI-powered system that generates concise and valuable summaries from JIRA ticket description and their metadata”



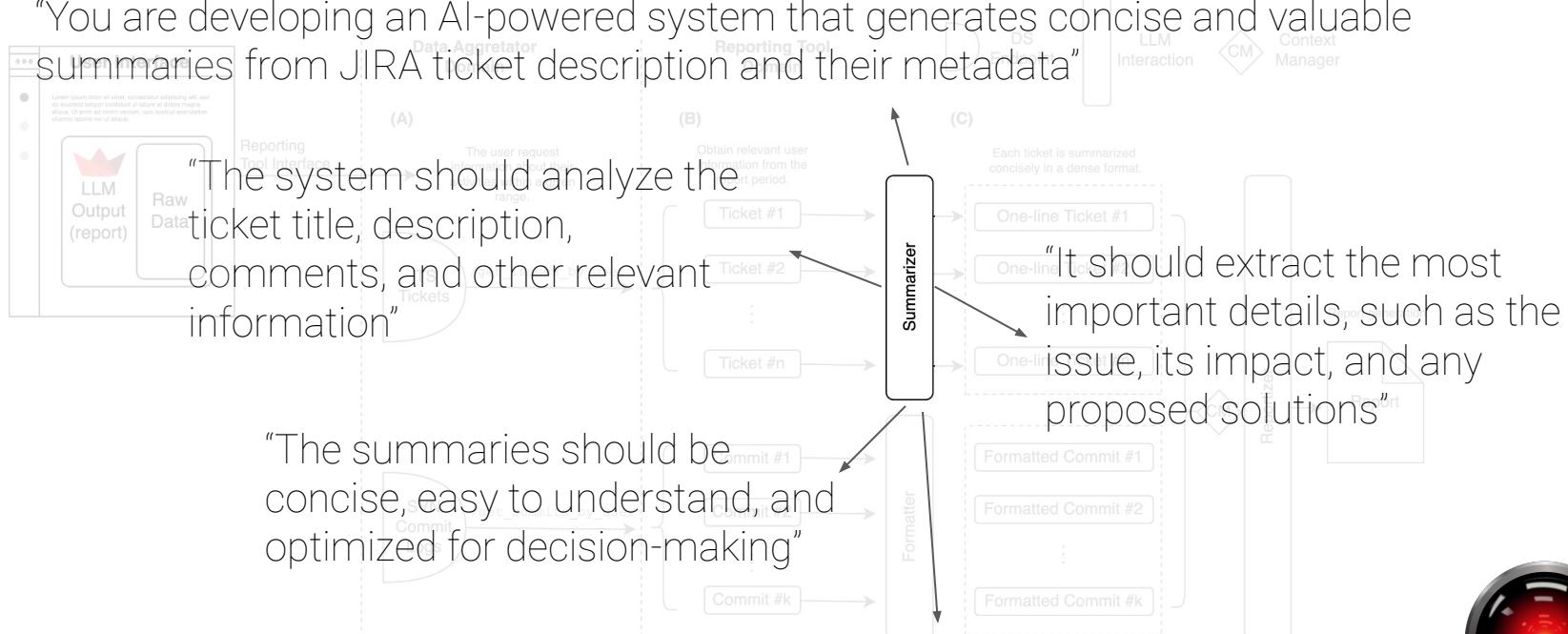
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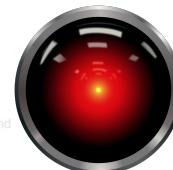
"You are developing an AI-powered system that generates concise and valuable summaries from JIRA ticket description and their metadata"



"The summaries should be concise, easy to understand, and optimized for decision-making"

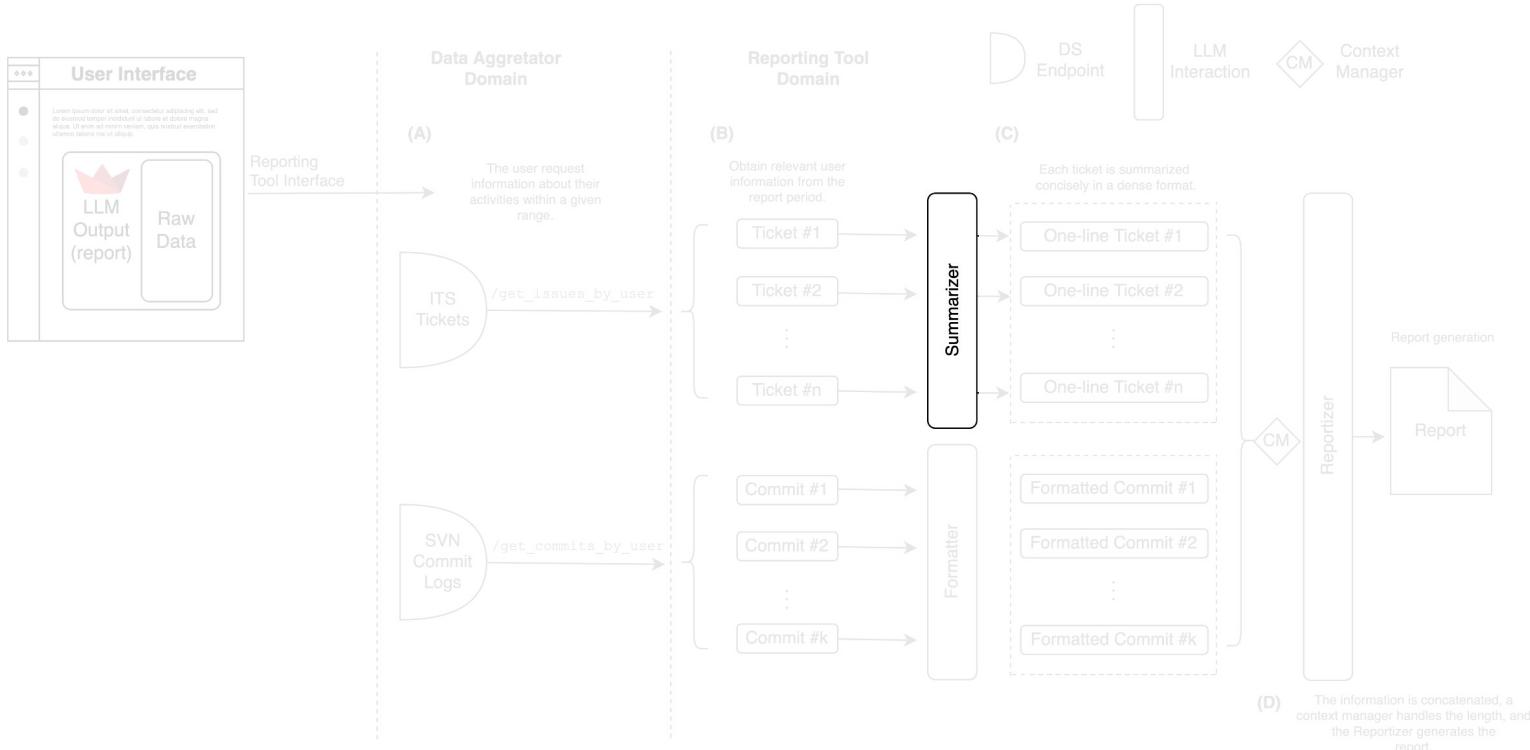
"Your goal is to create a system that helps users quickly grasp the key information from JIRA tickets, enabling efficient collaboration and problem-solving."

"It should extract the most important details, such as the issue, its impact, and any proposed solutions"



"The information is concatenated, a Context manager handles the length, and the Reporter generates the report."

# Now how the Summarize perform their task...summarize!



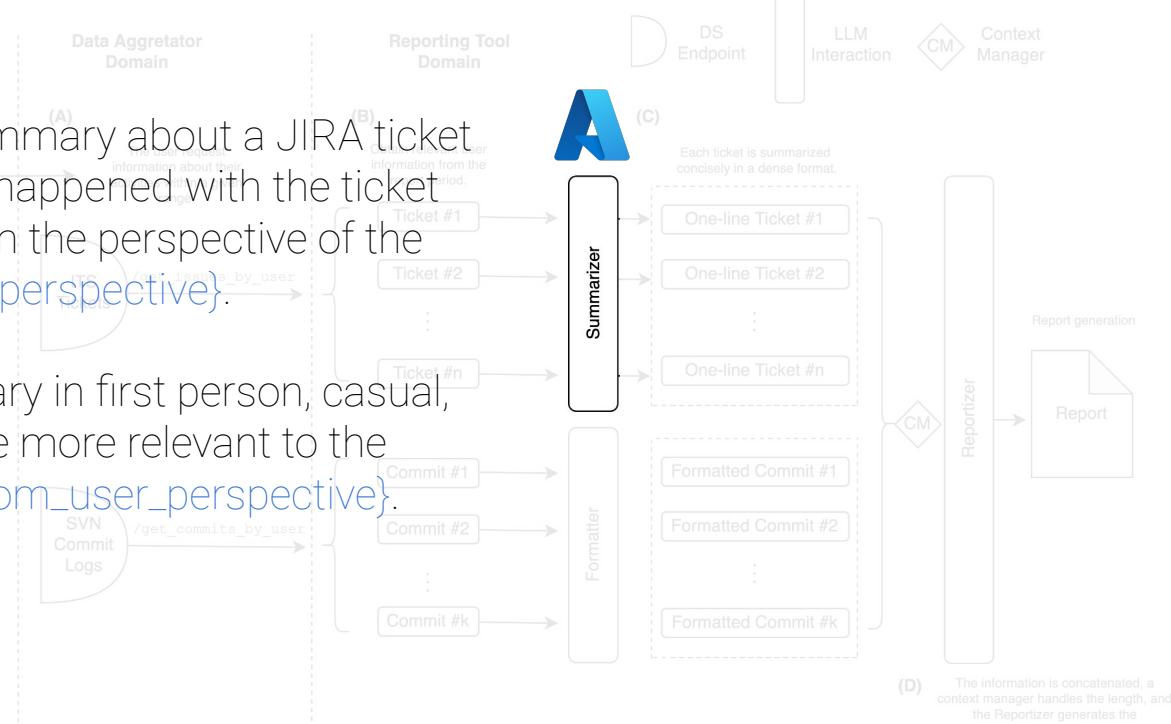
# Now how the Summarize perform their task...summarize!

1



Write a short-summary about a JIRA ticket answering what happened with the ticket recently, and from the perspective of the user `{from_user_perspective}`.

Write the summary in first person, casual, and concise. Give more relevant to the comments of `{from_user_perspective}`.



# Now how the Summarize perform their task...summarize!

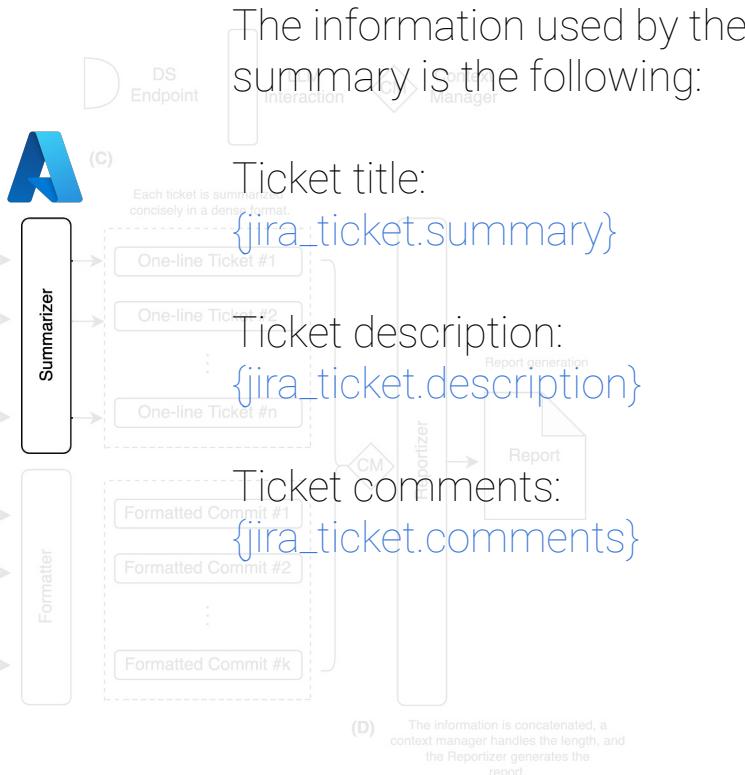
1



Write a short-summary about a JIRA ticket answering what happened with the ticket recently, and from the perspective of the user `{from_user_perspective}`.



Write the summary in first person, casual, and concise. Give more relevant to the comments of `{from_user_perspective}`.



The information used by the summary is the following:

Ticket title:  
`{jira_ticket.summary}`

Ticket description:  
`{jira_ticket.description}`

Ticket comments:  
`{jira_ticket.comments}`

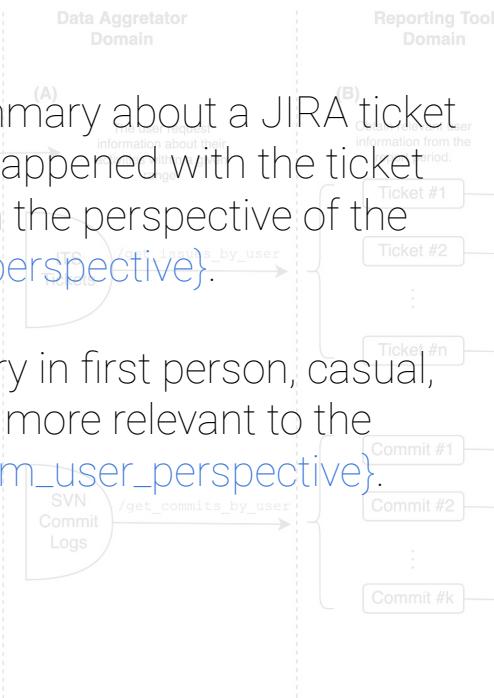
# Now how the Summarize perform their task...summarize!

2

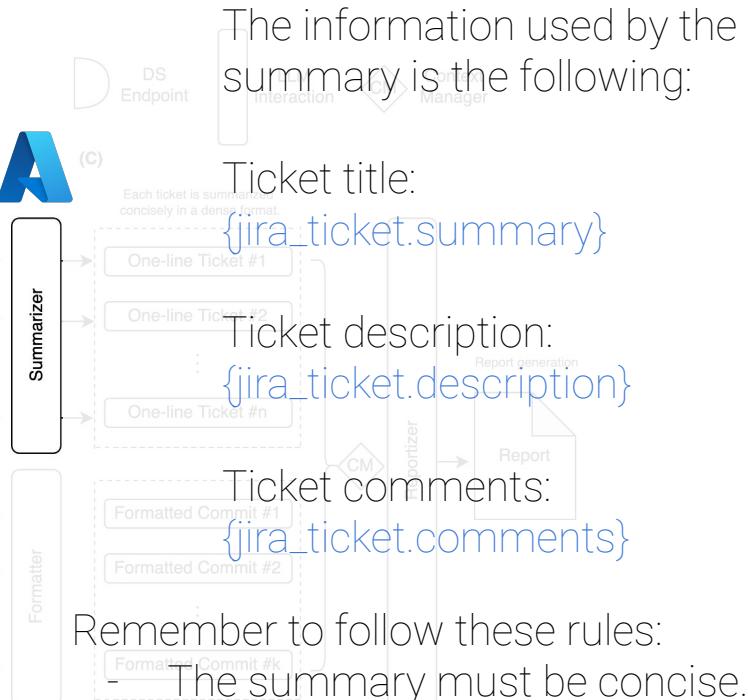
1



Write a short-summary about a JIRA ticket answering what happened with the ticket recently, and from the perspective of the user `{from_user_perspective}`.



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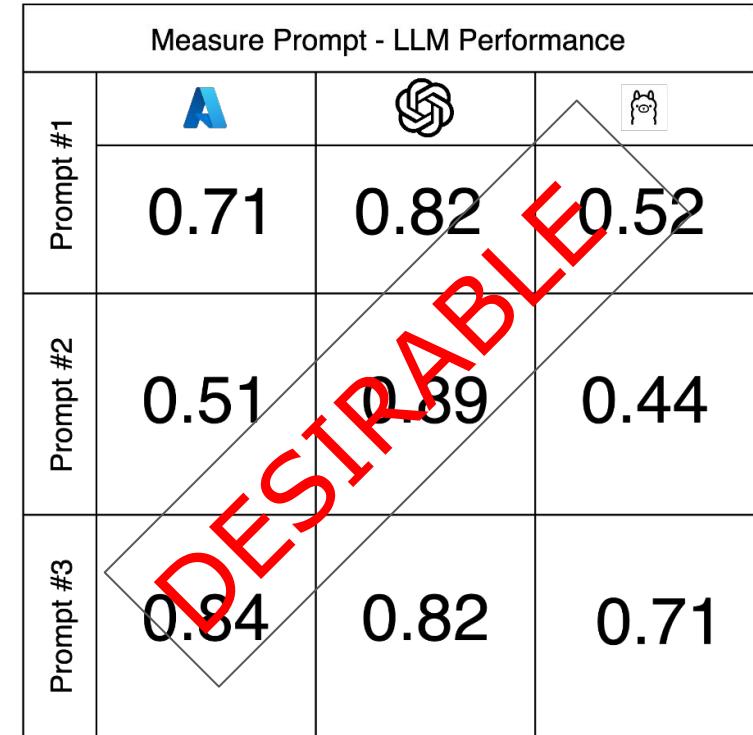
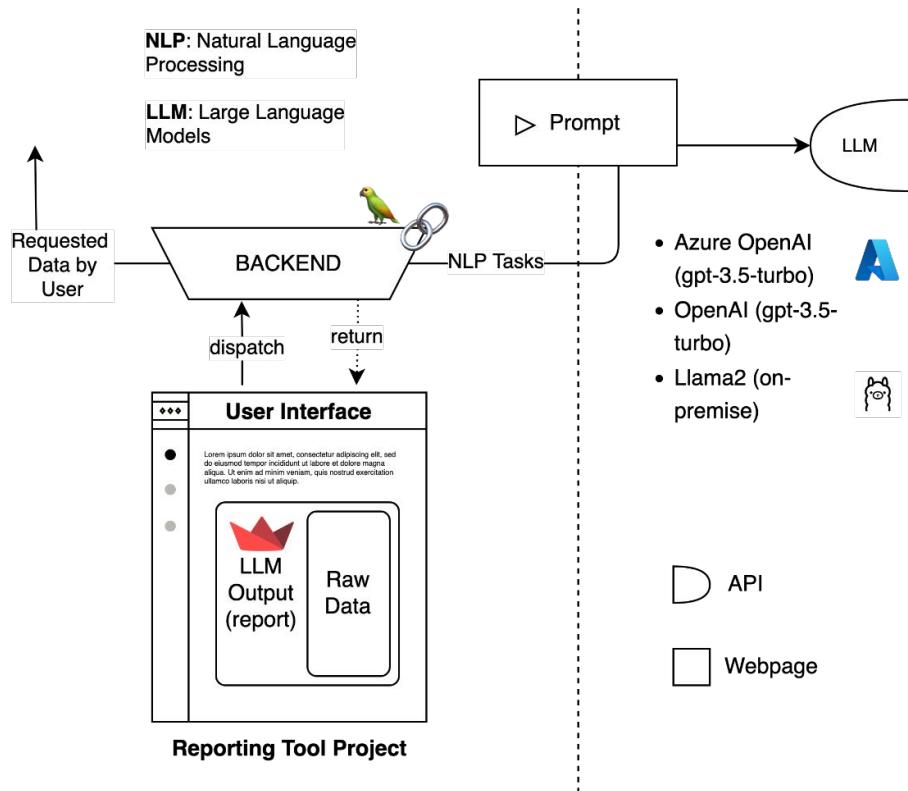
Remember to follow these rules:

- The summary must be concise.
- Avoid mentioning the `{from_user_perspective}` name in the summary (e.g. use "I" instead of "I, jgil,")

3

# Reporting Tool Challenges

Measure and Evaluate Performance



# Reporting Tool Challenges

Proprietary versus In-house models

- ❑ **Fine-tuning:** Adjusting the models parameters with their own data.
  - a. Pros: privacy and more control about the model.
  - b. Cons: requires infrastructure and demand dedicated expertise.
- ❑ **LoRA:** The idea is to represent the finetuned weight as a multiplication of two matrices that use a low rank decomposition. Only finetune a fraction of the model.

The diagram shows the decomposition of finetuned weights into Low-Rank Adaptation (LoRA) components. It features a green box containing text and mathematical symbols. The text includes "Finetuned Weights" with two orange gears, "LoRA", and a matrix equation. The equation is 
$$\begin{pmatrix} \Delta w_{11} & \Delta w_{12} & \Delta w_{13} \\ \Delta w_{21} & \Delta w_{22} & \Delta w_{23} \\ \Delta w_{31} & \Delta w_{32} & \Delta w_{33} \end{pmatrix} = \Delta W = \beta A \quad d \times k \quad (d \times r)(r \times k)$$
. Below the green box, the text "Low-Rank Adaptation" is written in orange.

LoRA: Low-Rank Adaptation of Large Language Models (Hu et al. 2021)





# Other Projects

Non-LLM

# MSE Ops Role Assignment

(MORA)



- ❑ **Rostering Problem:** Use a constraint programming solver (by ORTools) to solve the operational role assignment (i.e. TCO, VLTI).

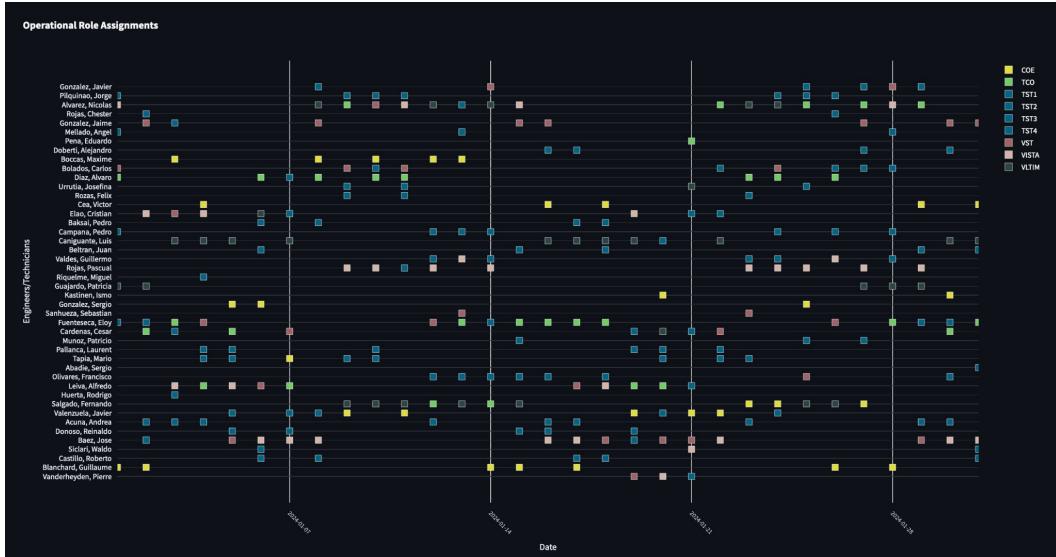
- a. `_set_one_engineer_per_role_assigned` ✓
  - b. `_set_at_most_one_assignment_per_day` ✓
  - c. `_set_availability_and_certification_constraints` ✓
  - d. `_set_consecutive_days_constraint` !
  - e. `_set_no_last_day_assignment_constraint` !
  - f. `_set_mandatory_role_constraint` !
  - g. `_set_balance_objective` !

- ❑ **Format & Report results:** automate the report with the assignment results.

Source: 'Op Roles' sheet, from P112.xlsx

# MSE Ops Role Assigntation

User interface with Streamlit



Source: <https://gitlab.eso.org/calcazar/mse-planning>

**Pretty Print the Results**

Select a month to format      Describe sheet name to read

1      Op Roles

Upload your PXXX excel file for pretty print (.xlsx)

Drag and drop file here  
Limit 200MB per file • XLSX      Browse files

P112 MSE 1.xlsx 1.9MB

	P12000000	2023-10-01 00:00:00	2023-10-02 00:00:00	2023-10-03 00:00:00	2023-10-04 00:00:00
3	Boccas, Maxime	0	0	0	0
4	Acuna, Andrea	0	8ANF	8ANF	8ANF
5	Sansgasset, Pierre	PAO\	0	0	0
6	Blanchard, Guillaume	0	0	0	0
7	Aguilera, Gregorio	PAO\	0	L	L
8	Bolados, Carlos	0	TU+	VSTM	VSTM
9	Bourget, Pierre	PoC	PoC\	0	
11	Dauvin, Louise	PAO	PAO\	0	
12	Dubost, Nicolas	0	PAO+	PAO	PAO
13	Gonzalez, Jaime	PAO\	0	0	0

Column name "P12000000" matches the pattern of the Op Roles sheet format. The period file from which is obtain the staff member column is P112 MSE 1.xlsx.

The last row of the excel contains a staff member name: Del Rosario, Andrea. However, ensure that this name is the last one in the staff member list.

The selected month 1 is within the available months in the P12000000 file.

**Download the formatted file**   **Copy/Paste**

Download the pretty print as an excel file

Engineer	Role
Blanchard, Guill	COE
Kastinen, Ismo	
Gonzalez, Sergio	
Valenzuela, Javi	
Boccas, Maxime	
Blanchard, Guill	
Cea, Victor	
Tapia, Mario	
Boccas, Maxime	
Cea, Victor	



# PSW Scheduling Tool

Collaborate and Test

A	B	EY	EZ	FA	FB	FC	FD	FE	FF	FG	FH	FI	FK	FL	FM	FN	FO	FP	FQ	FR	FS	FT	FU	FV	FW	FX	FY	FZ	GA	GB	GC	GD			
		<b>Mar-24</b>																																	
		30-09-23																																	
	<b>Software</b>	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon		
IKA	Kastinen, Ismo	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO\																										
SAE	Aedo, Sebastián	GHQ																																	
JPA	Araneo, Juan Pablo																																		
PBA	Baksai, Pedro	PAO	PAO	PAO	PAO\																														
PBU	Burgos, Pedro	SS	PAO	PAO	PAO	PAO\																													
JPG	Gil, Juan Pablo		Fv																																
CHE	Herrera, Christian	PAO	PAO	PAO	OSS	PAO																													
VLI	Lizana, Vicente	GHQ																																	
NMI	Miranda, Nicolas																																		
IMU	Munoz, Ivan	PAO	OSS	OSS	PAO	PAO\																													
EPE	Pena, Eduardo	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO	PAO				
S&A	Jurarock, Stejvan																																		
RSC	Schmutzler, Ricardo																																		
JUR	Urrutia, Josefina																																		
GVA	Valdes, Guillermo	GHQ																																	
		<b>TRs / Activities</b>																																	
IMU GV	112.0009 UTA Nasmith B Adapter Rd																																		
IKA	112.0011 ASM VLT SW upgrade: wasr																																		
JPG	112.0012 Alignment of all modules in																																		
JPG	112.0013 GRAVITY upgrade to VLT SW																																		
JPG	112.0014 Linux RMN recorder commi																																		
JUR	112.0015 HAWKI upgrade to VLT2022																																		
EPE	112.0016 SPHERS upgrade to VLT20																																		
(blank)	112.0017 UTA M1/M3 recoating	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)				
PBU	112.0018 GALACSI RTC BOX Science																																		
PBU	112.0019 ESPRESSO upgrade to VLTS																																		
PBU CHE	112.0020 NAOMI upgrade VLT20																																		
PBU CHE	112.0021 Implementation and testing																																		
oss	112.0022 ERIS AO improvements																																		
(blank)	112.0023 Functional verification and																																		
JPG PBU	112.0025 GRAVITY+: October commis																																		
JPG PBU	112.0026 GRAVITY+: March commis																																		
GVA	112.0027 4LGSF Maintenance 2023																																		
		X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)					

# Internship Memoirs

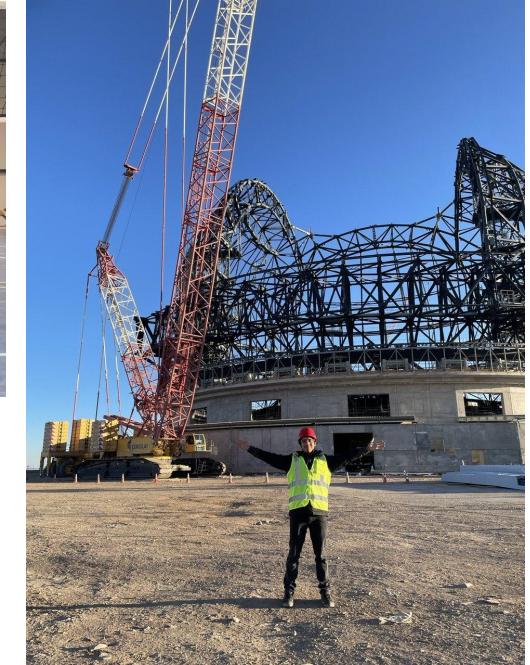
- ❑ Friends and camaraderie! ❤️
- ❑ The sunset at the platform  
☀️!
- ❑ Volleyball 🏐!
- ❑ Mind 🧘 & body 💪
- ❑ The desert 🌵 and dessert  
🍨!
- ❑ The nostalgic short dose  
when you arrive at the airport  
✈️
- ❑ Thanks to PSW! and JPG for  
being excellent advisors!
- ❑ And everyone I know and  
shared moments with, there  
was a pleasure!



An excellent and lovely group of people



Practicing jump serve with Nico!



Me visiting the ELT (thanks Matteo!)

# Thank you!

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*Engineering with prompts, rather than prompt engineering*

Cristóbal Alcázar  
MSc in Finance & (not yet) MSc in Data Science