NEXUS:
Neural Execution and Understanding System

Abstract

Abstract

Leveraging the power of Large Language Models (LLMs), like ChatGPT, our enhanced virtual assistant framework transforms user interactions with its advanced comprehension and dynamic response generation. These LLMs not only unravel the complexity of human queries but also adeptly generate code, enabling the virtual assistant to seamlessly integrate and execute tasks via APIs without manual intervention. Our approach is paving the way for virtual assistants that autonomously interpret and execute a broad spectrum of complex user requests, bridging the divide between human conversation and automated action — a pivotal stride towards truly intelligent digital assistants.

Agenda

01. Overview

02. Problem

03. Solution

04. System

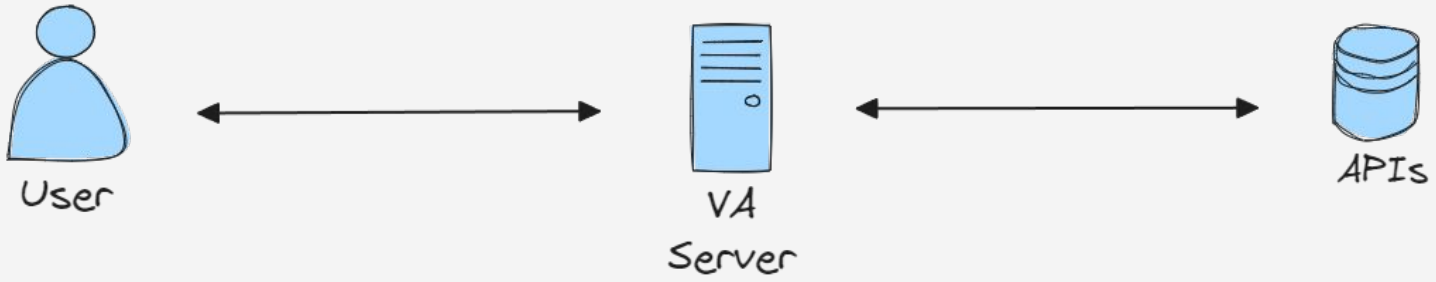
05. Future Works

06. Reference

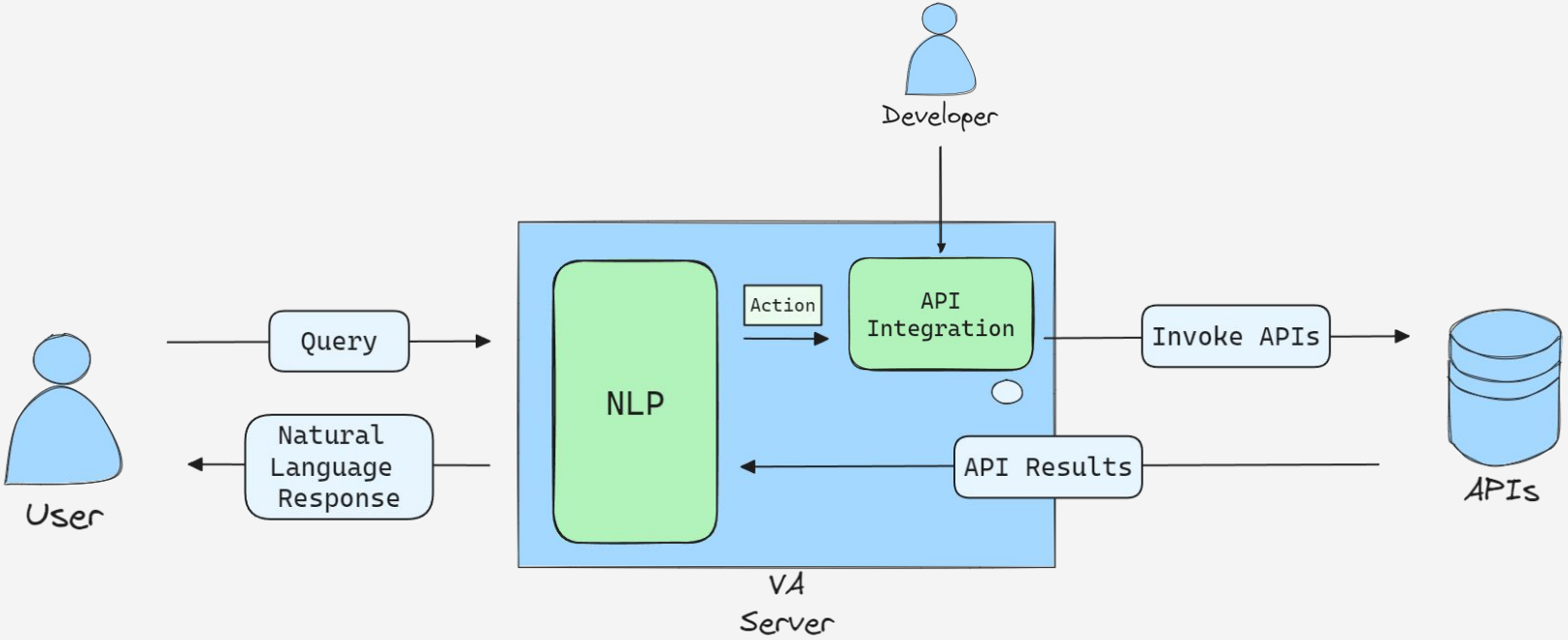
01.

Overview

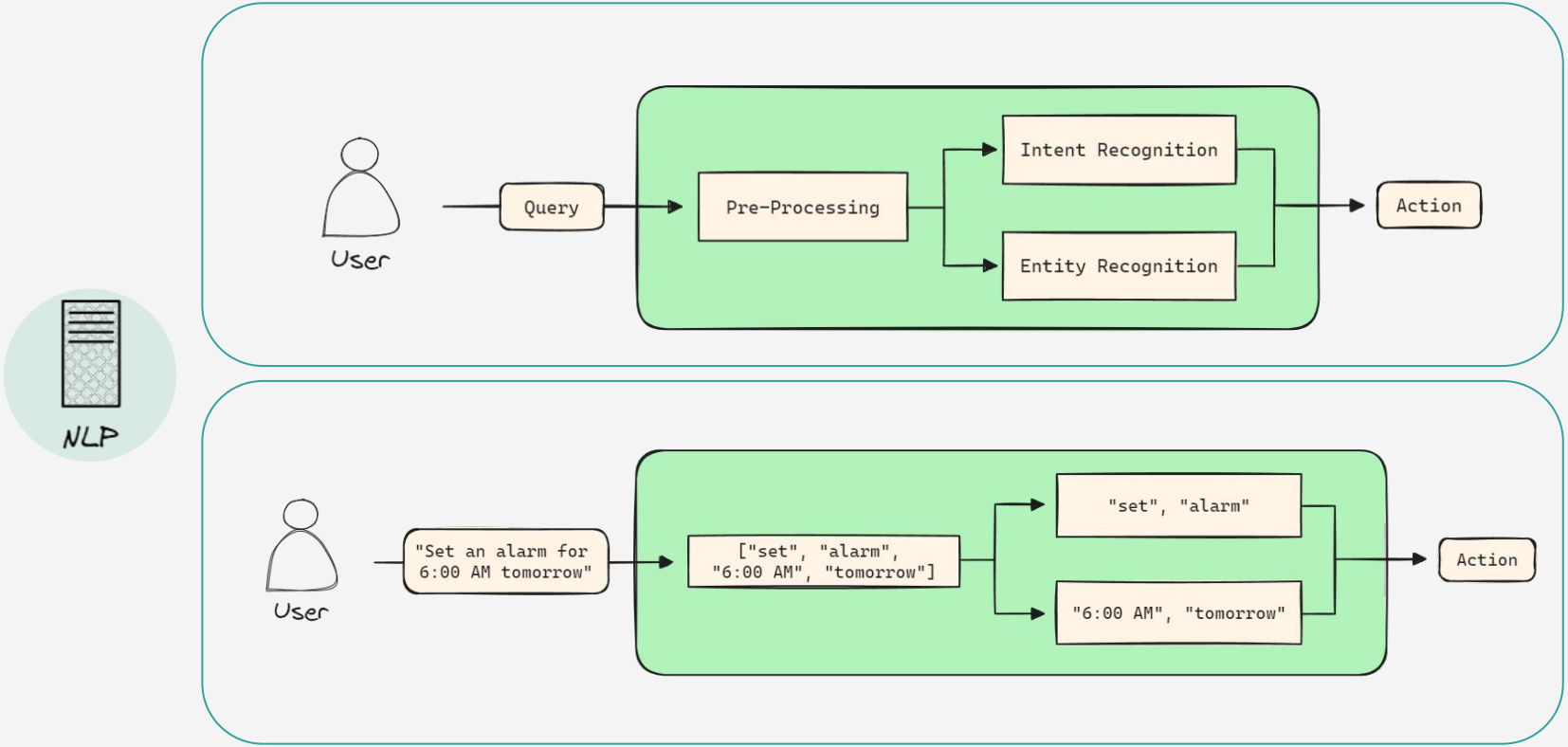
Virtual Assistants



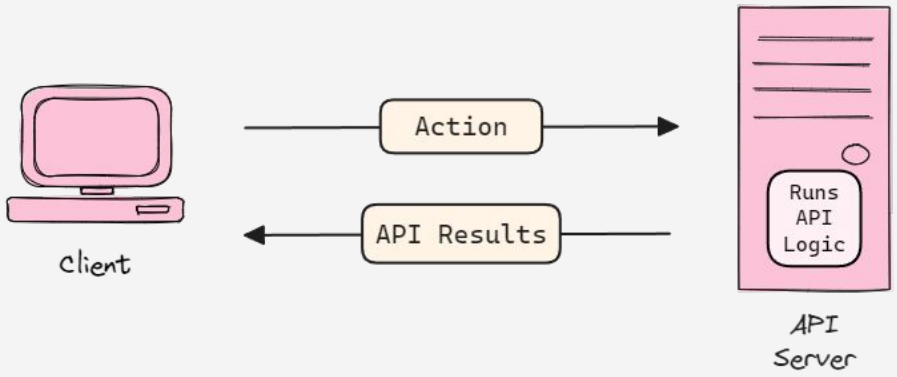
Virtual Assistants



Natural Language Processing (NLP)



Application Programming Interface (API)



- Google Maps
- Weather Apps
- Yelp
- Alarm
- etc.

02.

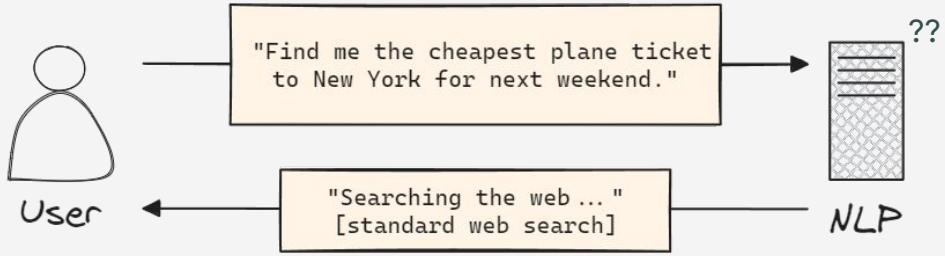
Problem

NLP - Limitation

- Poor contextual understanding
- Poor generalization
- Poor flexibility in response

API - Limitation

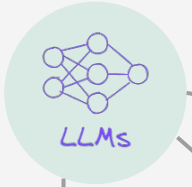
- Manual development integration
- Manual maintenance



03.

Solution

Large Language Models (LLMs)

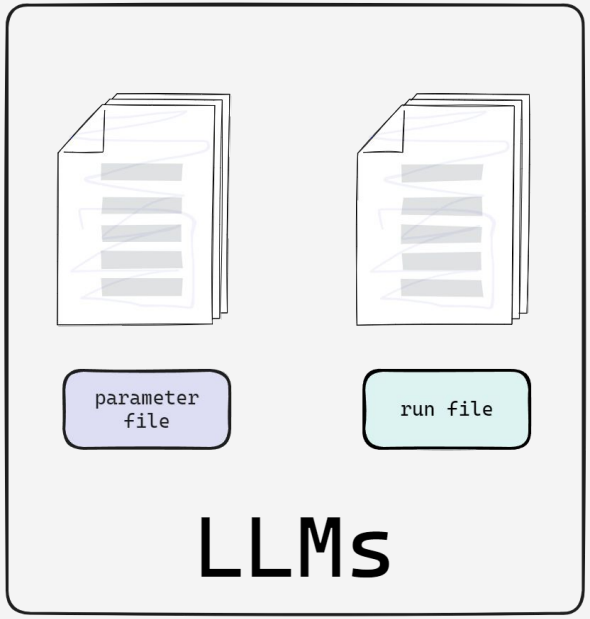


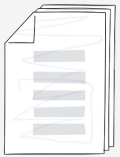
- Advanced machine learning models designed to understand, generate, and work with human language.

- Built on the transformer architecture.

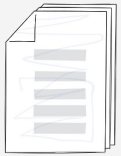
- Able to understand language structure and understand the full-context of given input data

Large Language Models (LLMs)





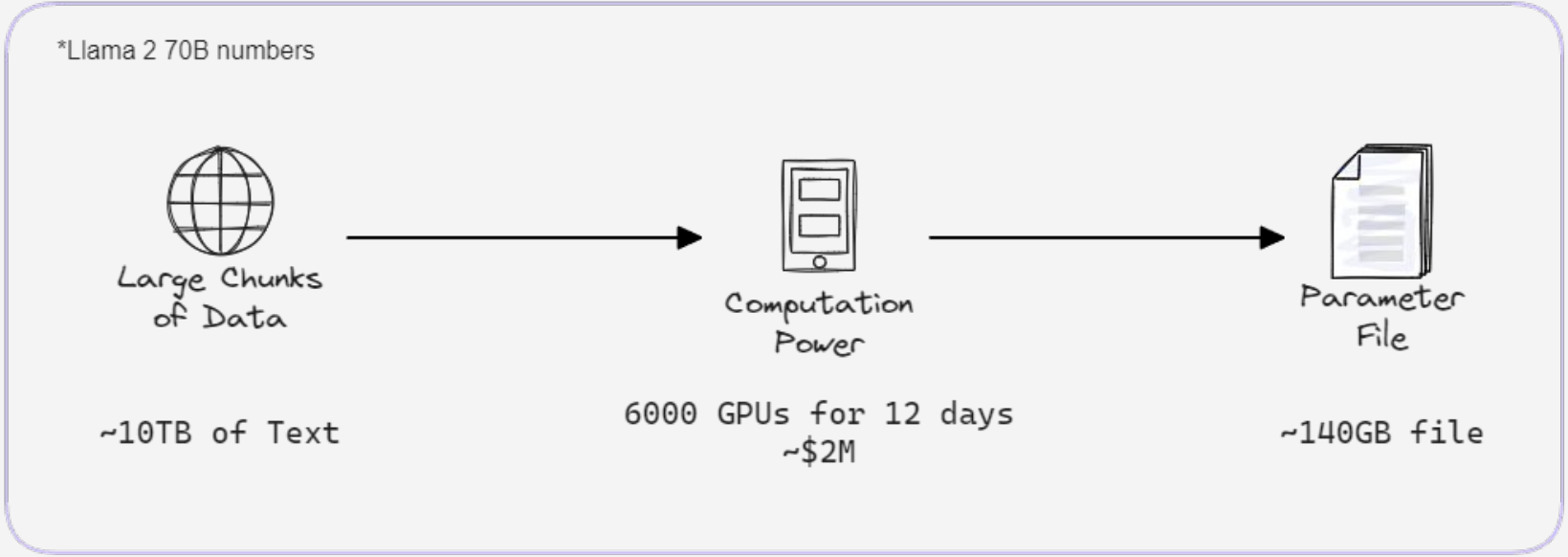
Contains weights or parameters of Neural Network that is language model



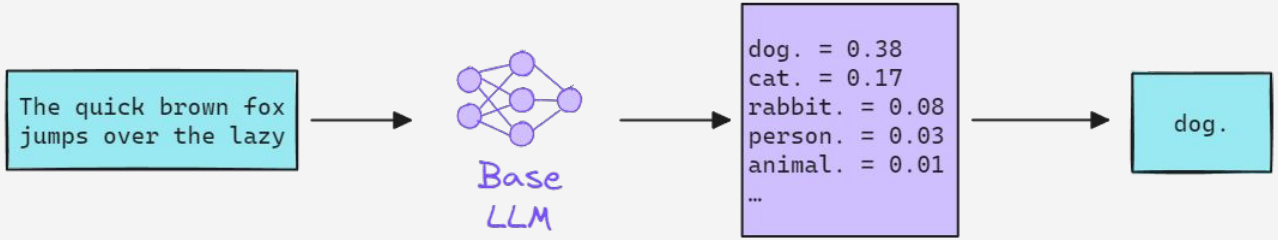
Runs the parameters (Neural Network) with no dependencies

LLMs - Training

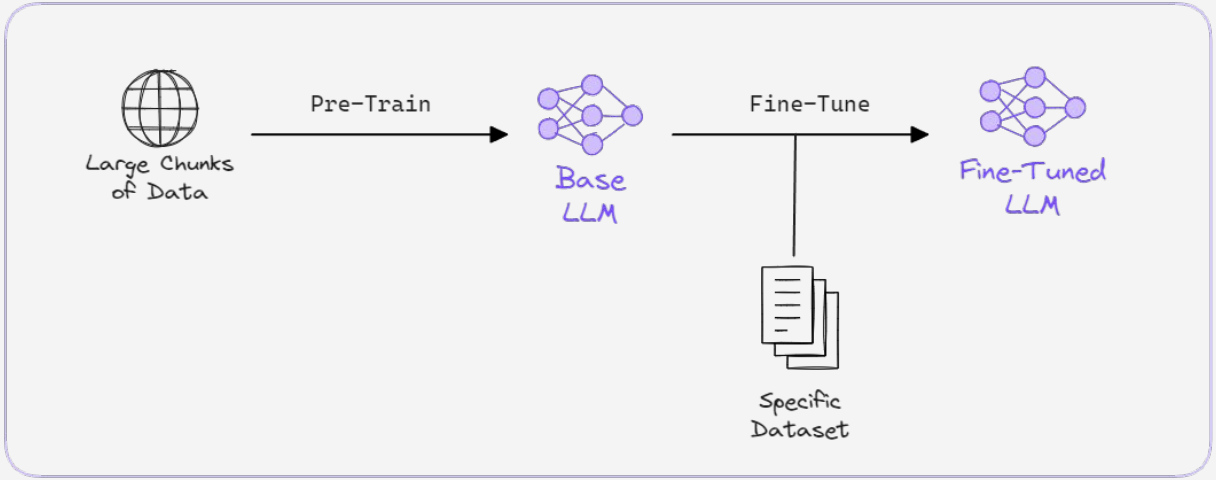
*Llama 2 70B numbers



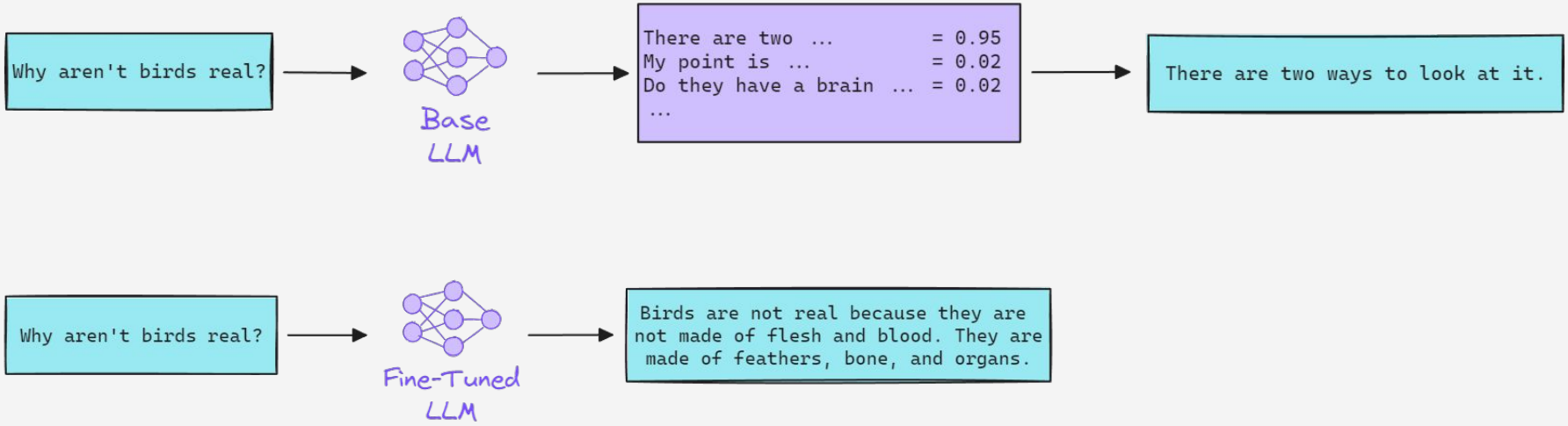
LLMs - Usage


The quick brown fox jumps over the lazy
Base LLM
dog. = 0.38
cat. = 0.17
rabbit. = 0.08
person. = 0.03
animal. = 0.01
…
dog.

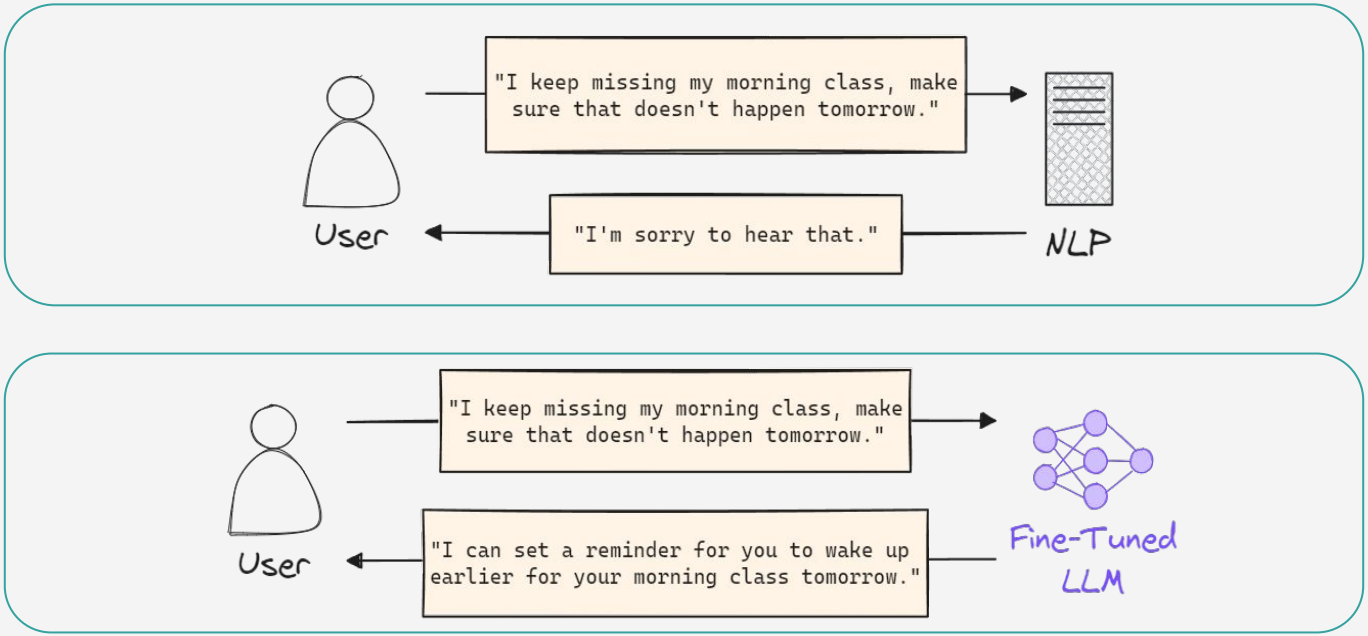
LLMs - Fine-Tuning



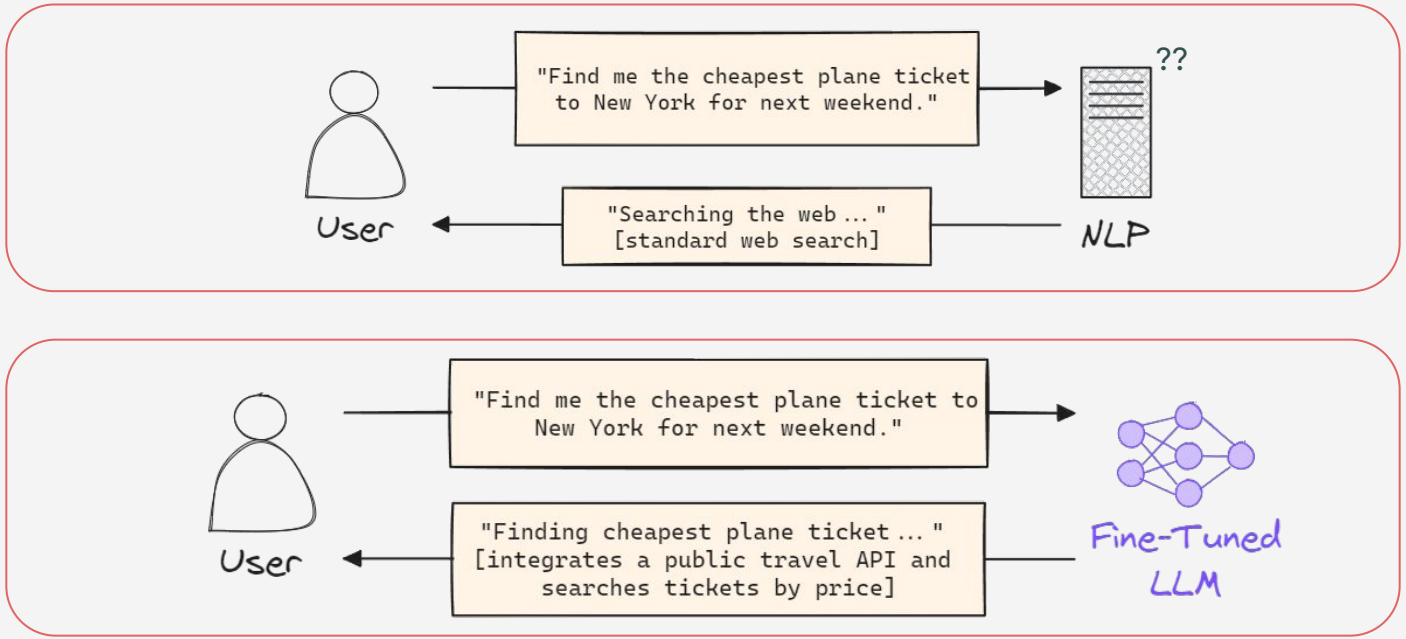
LLMs - Usage (Fine-Tuned)



LLMs - Virtual Assistant Usage



LLMs - Virtual Assistant Usage



ChatGPT

ChatGPT is a state-of-the-art large language model developed by OpenAI.

- It stands for "Chat Generative Pre-trained Transformer."
- Trained on large dataset of human language and fine-tuned on instructions and chat bot interactions.
- It is hosted by OpenAI and can be accessed through their commercial API.

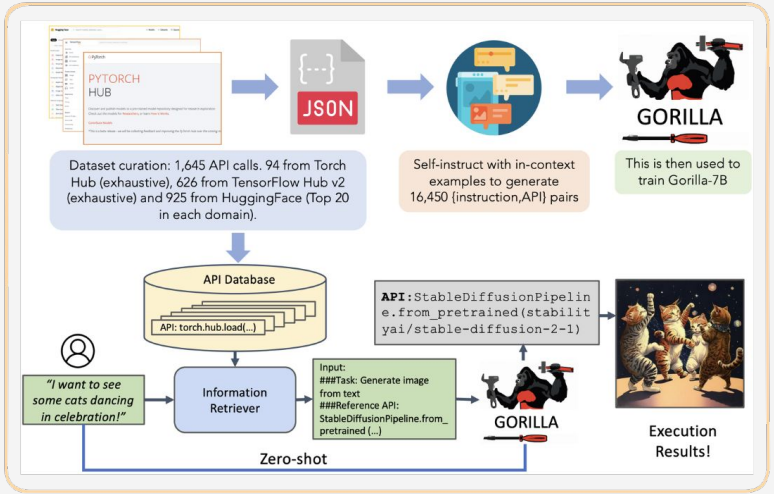
GPT-4 Turbo

Parameter	1 Trillion Parameters (2TB Parameter File)
Knowledge	Data up to April 2023

Related Works

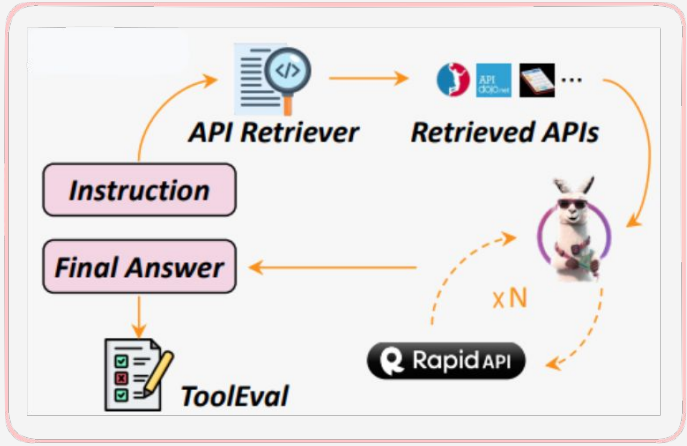
GorillaLLM

- Fine-Tuned LLM with API usage
- Code synthesis to call APIs
- APIs limited to other machine learning models



ToolLLM

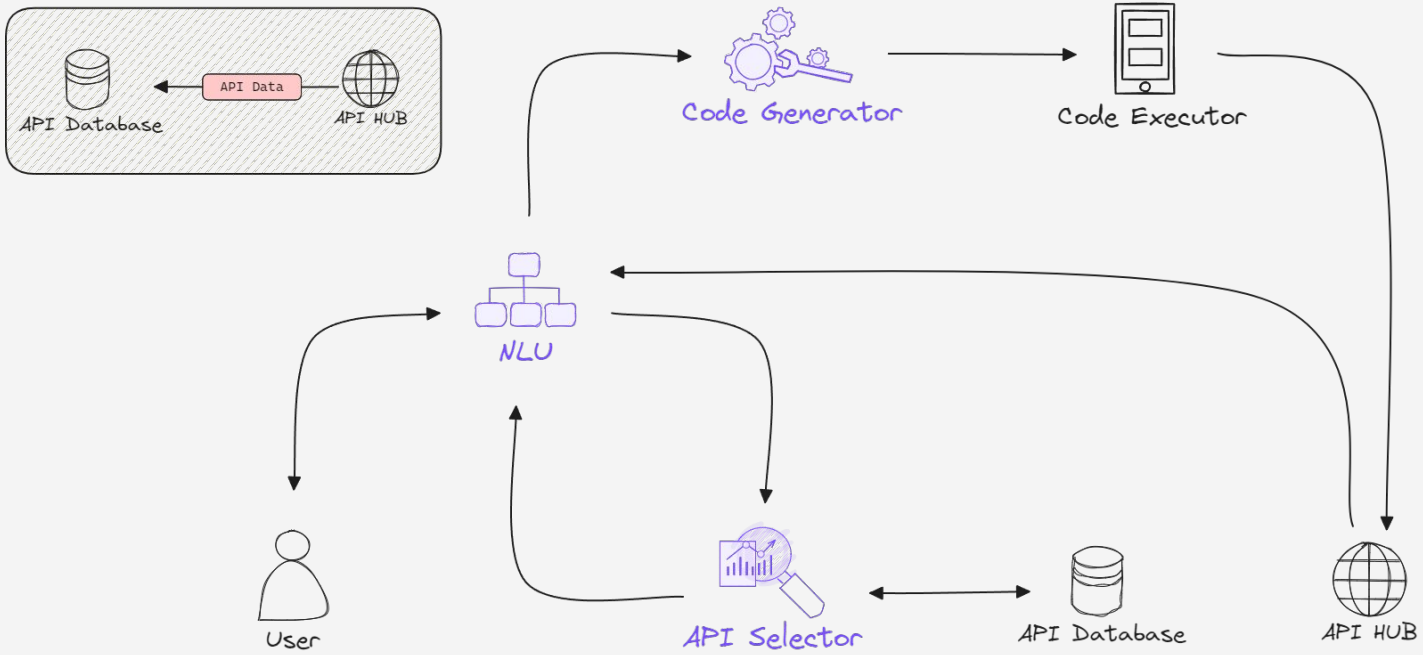
- Fine-Tuned LLM for API selection
- Allows for multiple API usage



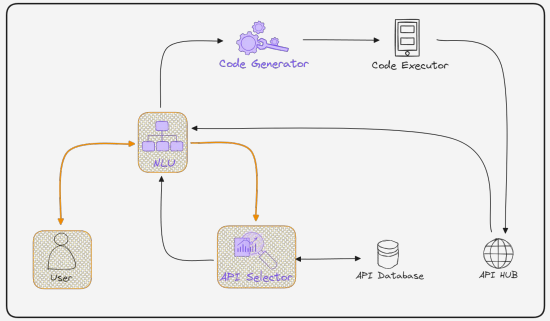
04.

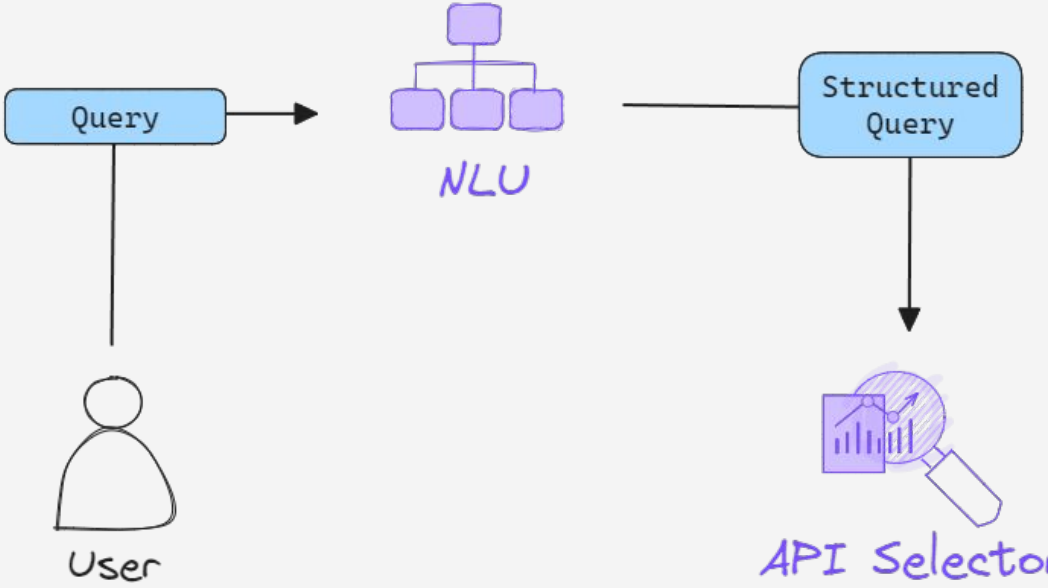
System

NEXUS

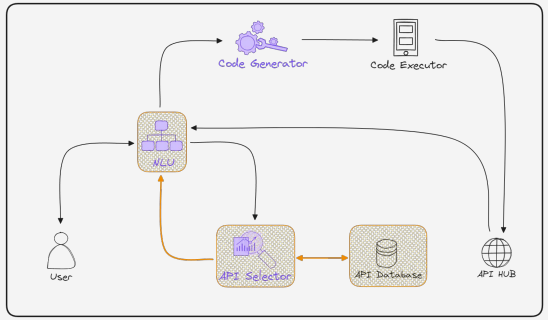

API Database
API Data
API HUB
Code Generator
Code Executor
NLU
User
API Selector
API Database
API HUB

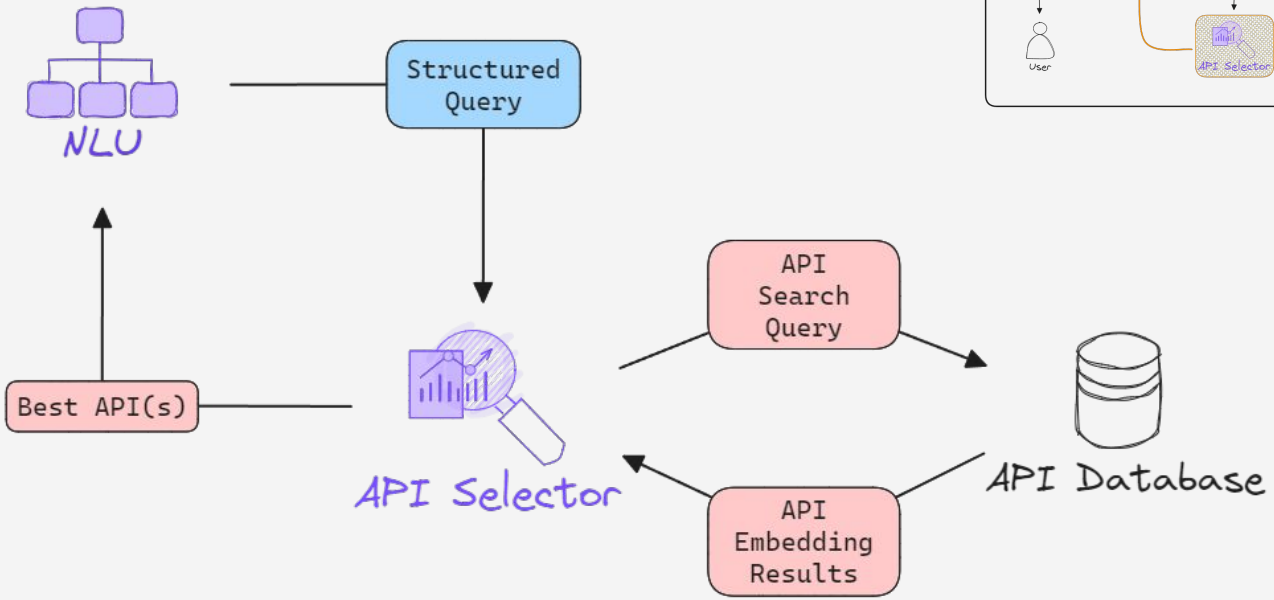
NEXUS - NLU


Code Generator
Code Executor
NLU
User
API Selector
API Database
API HUB

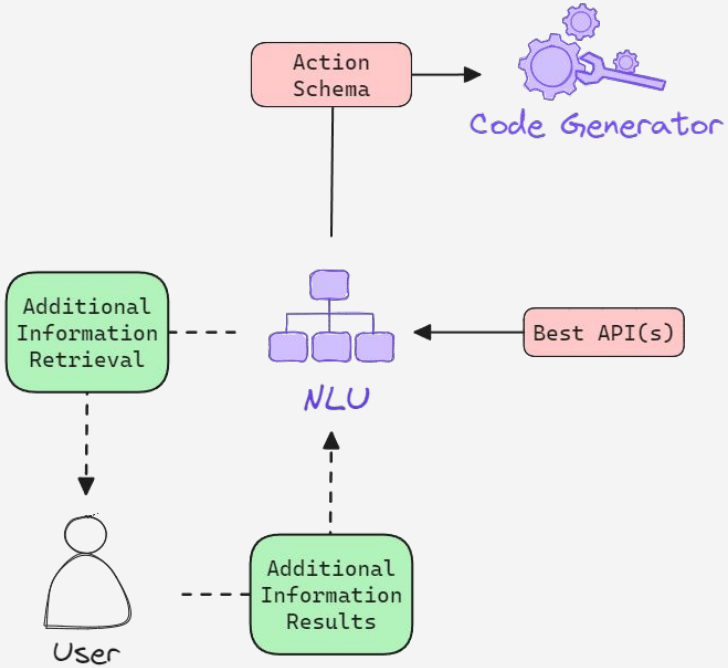

Query
NLU
Structured Query
User
API Selector

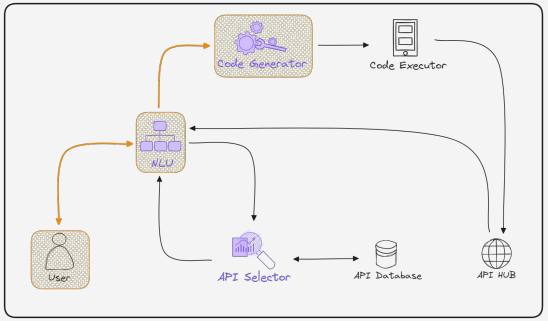
NEXUS - API Selector



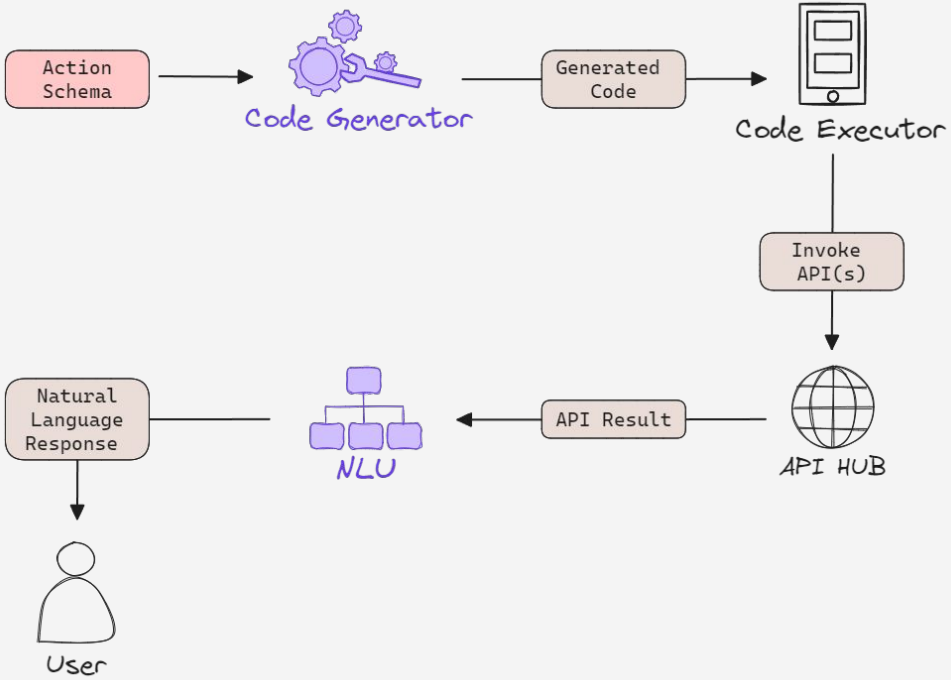


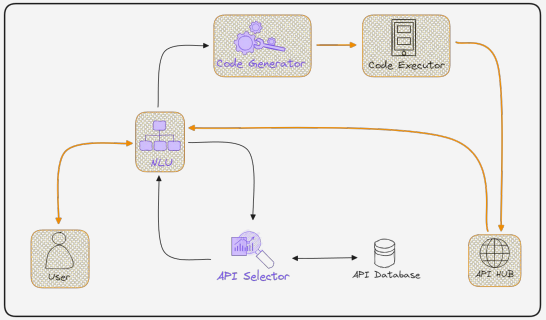
NEXUS - NLU


Action Schema
Code Generator
Additional Information Retrieval
NLU
Best API(s)
User
Additional Information Results

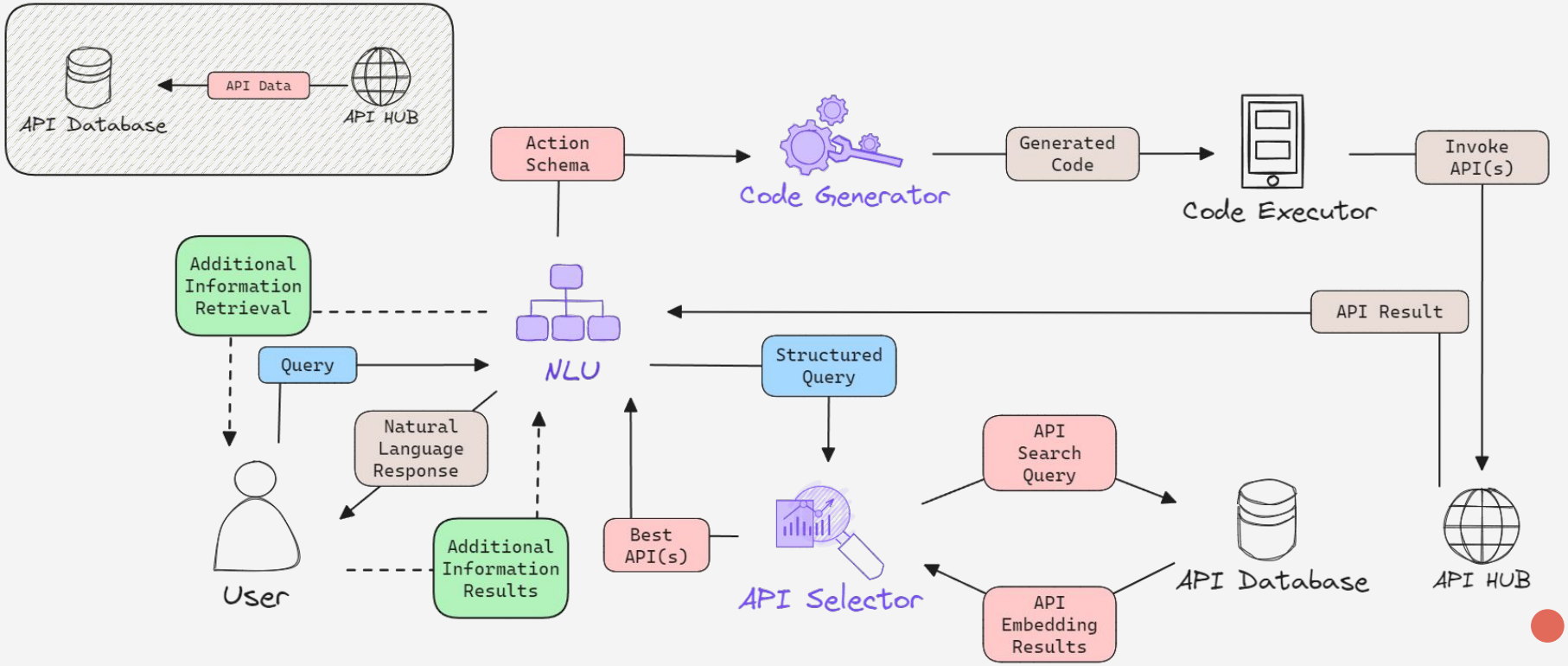

Code Generator
Code Executor
NLU
User
API Selector
API Database
API HUB

NEXUS - Code Generator

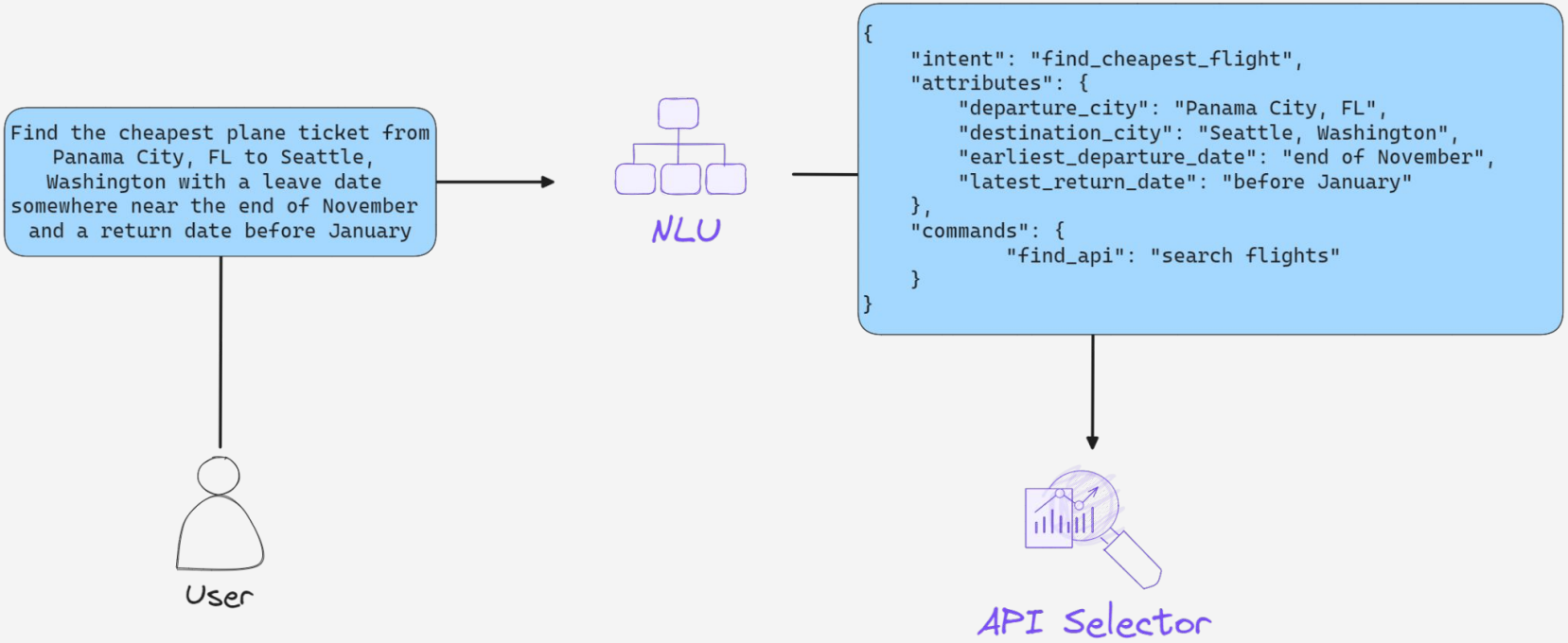




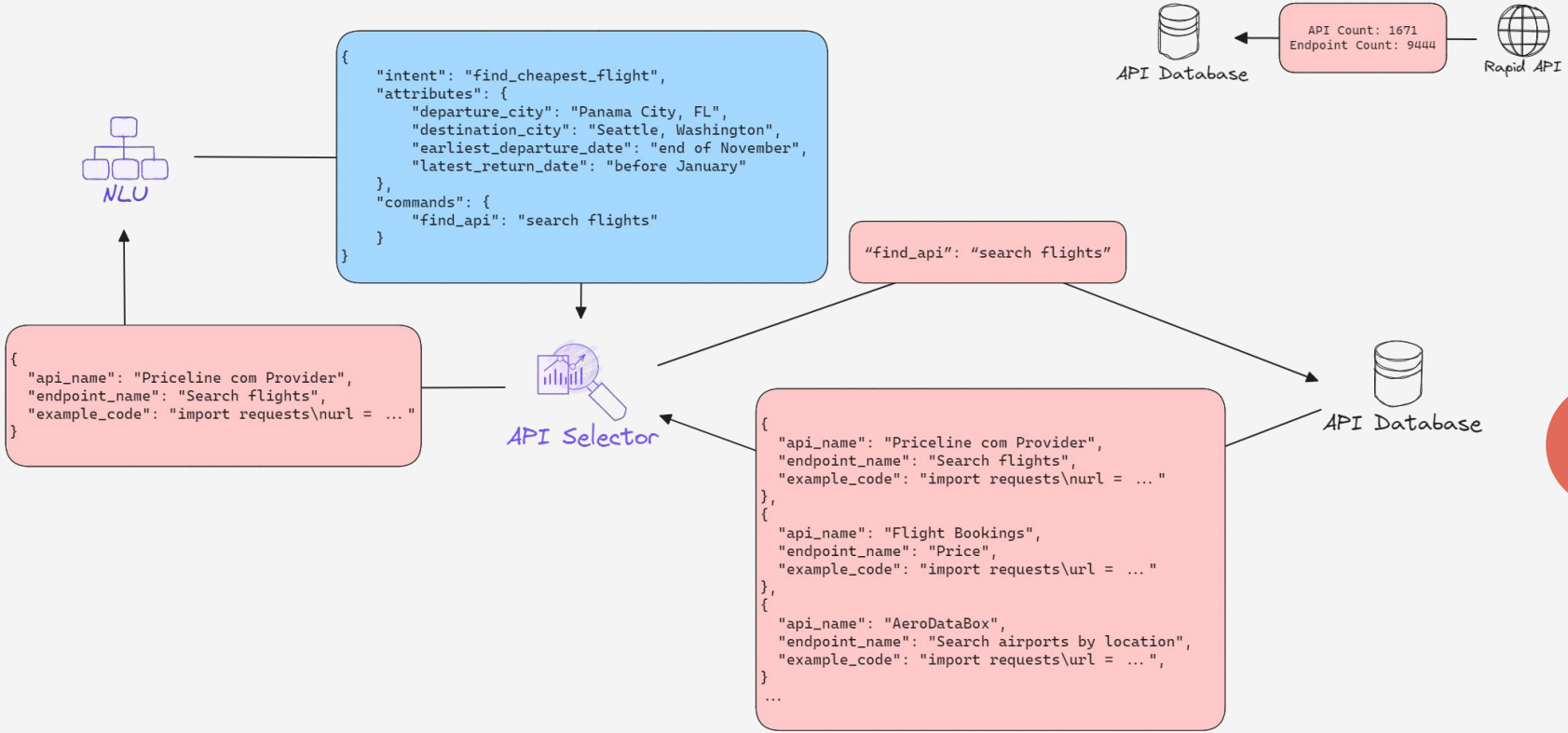
NEXUS


API Data
API Database
API HUB
Action Schema
Code Generator
Generated Code
Code Executor
Invoke API(s)
Additional Information Retrieval
NLU
API Result
Query
Structured Query
Natural Language Response
API Search Query
User
Additional Information Results
Best API(s)
API Selector
API Database
API HUB
API Embedding Results

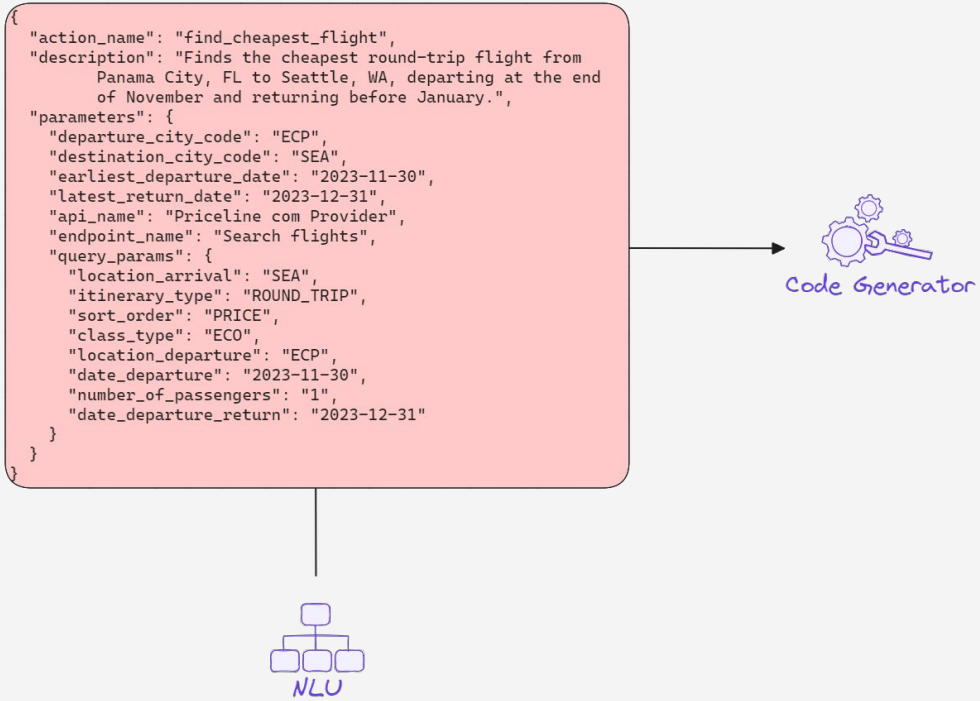
NEXUS - Sample



NEXUS - Sample



NEXUS - Sample



NEXUS - Sample

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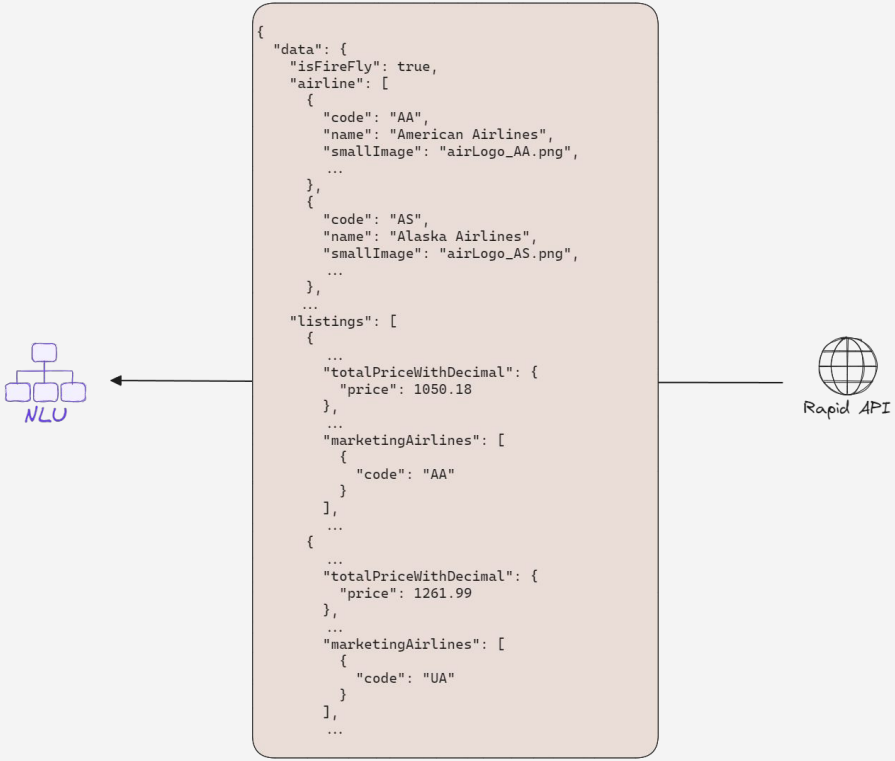

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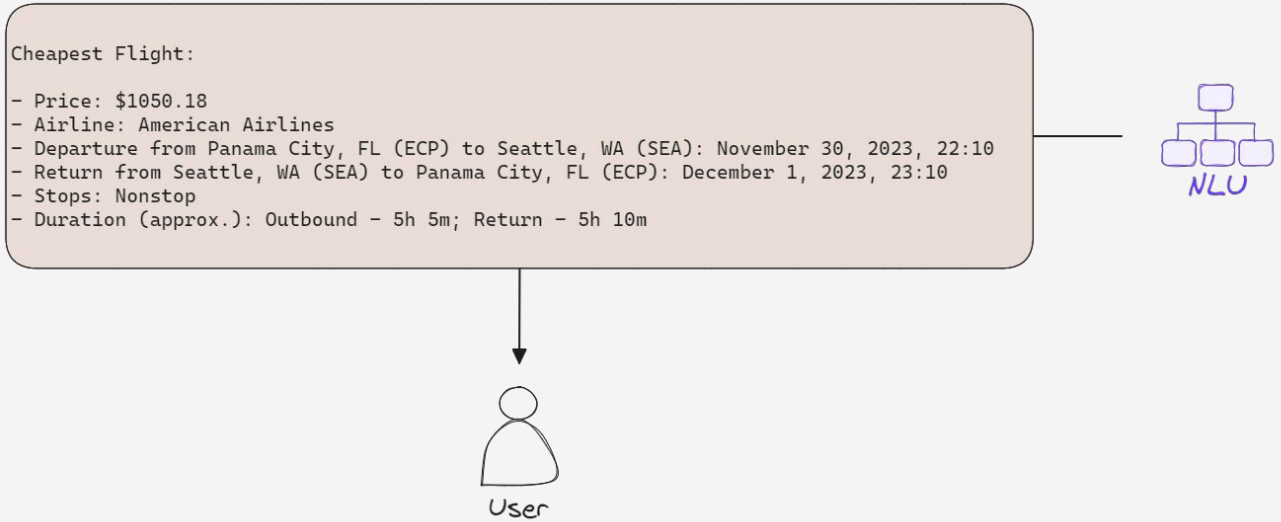
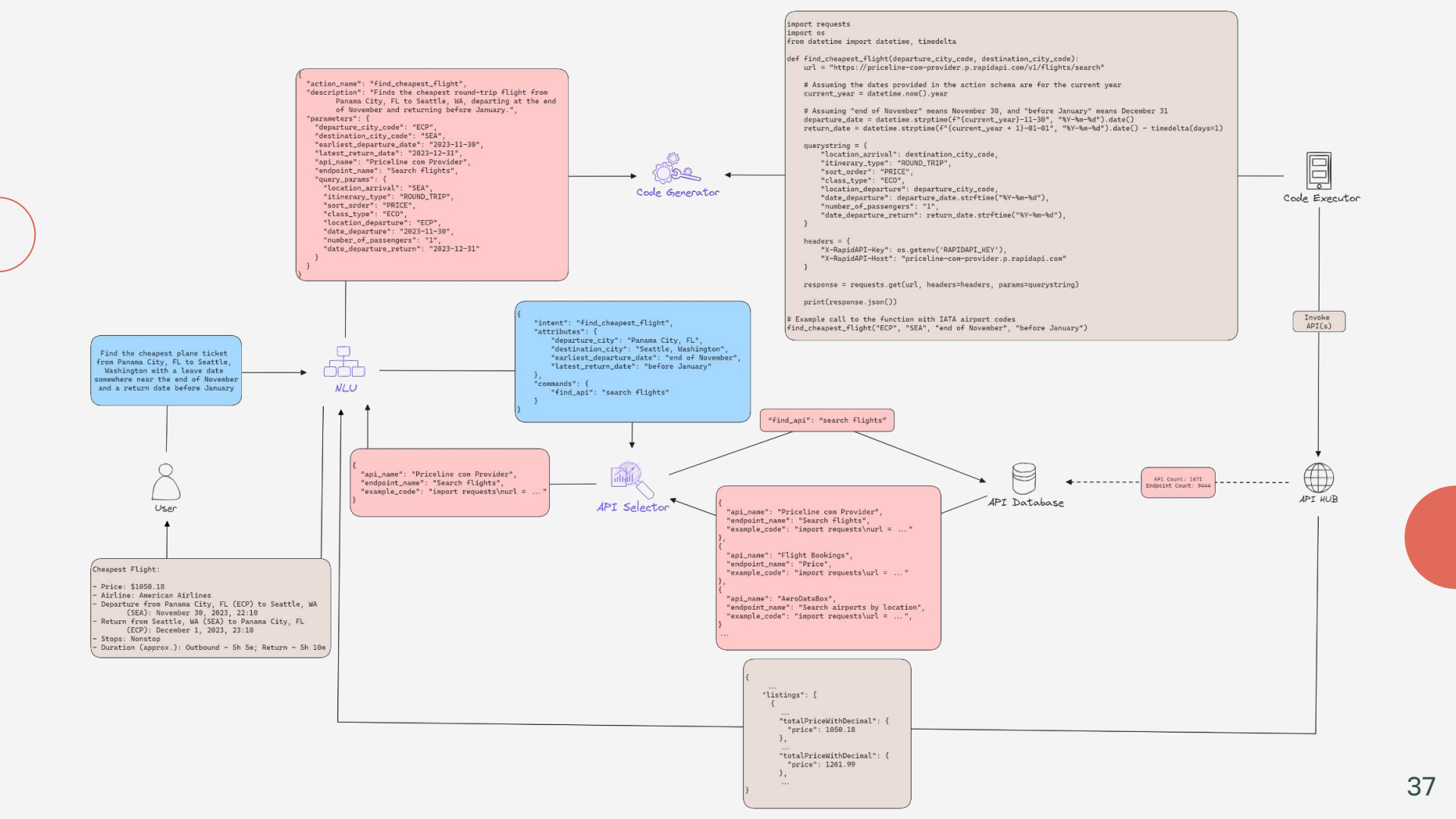


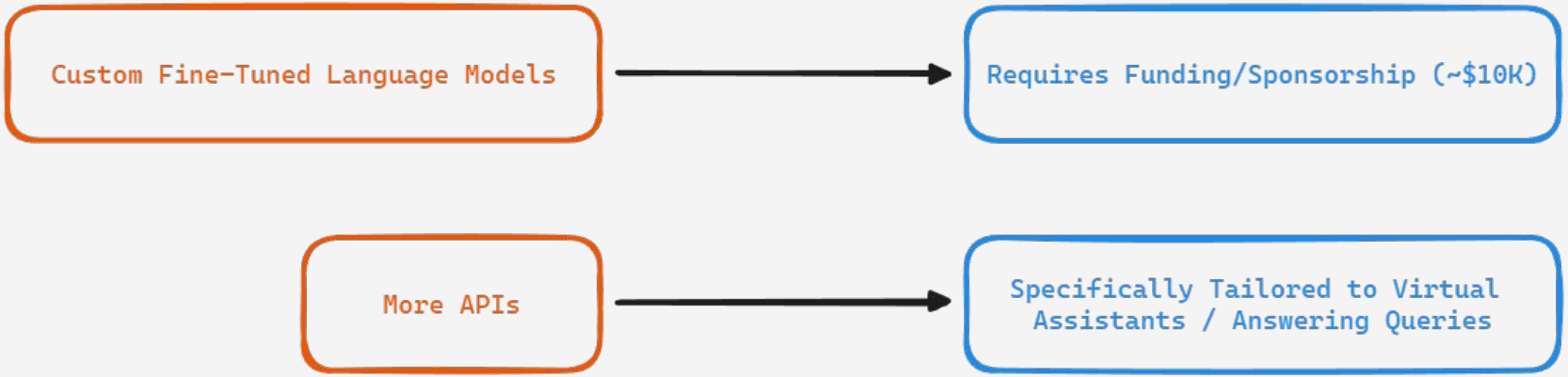

{
"action_name": "find_cheapest_flight",
"description": "Finds the cheapest round-trip flight from Panama City, FL to Seattle, WA, departing at the end of November and returning before January.",
"parameters": {
"departure_city_code": "ECP",
"destination_city_code": "SEA",
"earliest_departure_date": "2023-11-30",
"latest_return_date": "2023-12-31",
"api_name": "Priceline com Provider",
"endpoint_name": "Search flights",
"query_params": {
"location_arrival": "SEA",
"itinerary_type": "ROUND_TRIP",
"sort_order": "PRICE",
"class_type": "ECO",
"location_departure": "ECP",
"date_departure": "2023-11-30",
"number_of_passengers": "1",
"date_departure_return": "2023-12-31"
}
}
}
Code Generator
import requests
import os
from datetime import datetime, timedelta
def find_cheapest_flight(departure_city_code, destination_city_code):
url = "https://priceline-com-provider.p.rapidapi.com/v1/flights/search"
# Assuming the dates provided in the action schema are for the current year
current_year = datetime.now().year
# Assuming "end of November" means November 30, and "before January" means December 31
departure_date = datetime.strptime(f"{current_year}-11-30", "%Y-%m-%d").date()
return_date = datetime.strptime(f"{current_year + 1}-01-01", "%Y-%m-%d").date() - timedelta(days=1)
querystring = {
"location_arrival": destination_city_code,
"itinerary_type": "ROUND_TRIP",
"sort_order": "PRICE",
"class_type": "ECO",
"location_departure": departure_city_code,
"date_departure": departure_date.strftime("%Y-%m-%d"),
"number_of_passengers": "1",
"date_departure_return": return_date.strftime("%Y-%m-%d"),
}
headers = {
"X-RapidAPI-Key": os.getenv('RAPIDAPI_KEY'),
"X-RapidAPI-Host": "priceline-com-provider.p.rapidapi.com"
}
response = requests.get(url, headers=headers, params=querystring)
print(response.json())
# Example call to the function with IATA airport codes
find_cheapest_flight("ECP", "SEA", "end of November", "before January")
Code Executor
Invoke API(s)
Find the cheapest plane ticket from Panama City, FL to Seattle, Washington with a leave date somewhere near the end of November and a return date before January
NLU
{
"intent": "find_cheapest_flight",
"attributes": {
"departure_city": "Panama City, FL",
"destination_city": "Seattle, Washington",
"earliest_departure_date": "end of November",
"latest_return_date": "before January"
},
"commands": {
"find_api": "search flights"
}
}
User
{
"api_name": "Priceline com Provider",
"endpoint_name": "Search flights",
"example_code": "import requests\nurl = ..."
}
API Selector
"find_api": "search flights"
{
"api_name": "Priceline com Provider",
"endpoint_name": "Search flights",
"example_code": "import requests\nurl = ..."
},
{
"api_name": "Flight Bookings",
"endpoint_name": "Price",
"example_code": "import requests\nurl = ..."
},
{
"api_name": "AeroDataBox",
"endpoint_name": "Search airports by location",
"example_code": "import requests\nurl = ...",
}
...
API Database
API Count: 1671
Endpoint Count: 9144
API HUB
Cheapest Flight:
- Price: $1050.18
- Airline: American Airlines
- Departure from Panama City, FL (ECP) to Seattle, WA (SEA): November 30, 2023, 22:10
- Return from Seattle, WA (SEA) to Panama City, FL (ECP): December 1, 2023, 23:10
- Stops: Nonstop
- Duration (approx.): Outbound - 5h 5m; Return - 5h 10m
{
...
"listings": [
{
...
"totalPriceWithDecimal": {
"price": 1050.18
},
...
"totalPriceWithDecimal": {
"price": 1261.99
},
...
}

NEXUS - Demo

05.

Future Works

Future Works



06.

References

Reference

[1] S. G. Patil, T. Zhang, X. Wang, and J. E. Gonzalez, “Gorilla: Large Language Model Connected with Massive APIs,” arXiv.org, May 24, 2023. https://arxiv.org/abs/2305.15334

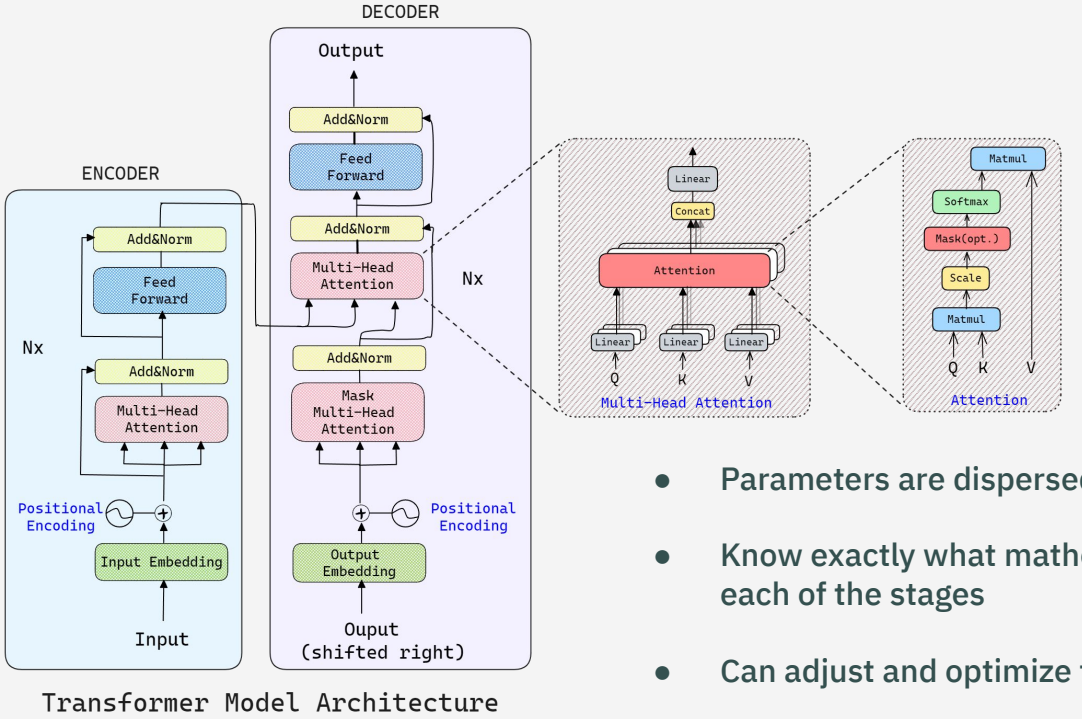
[2] Y. Qin et al., “ToolLLM: Facilitating Large Language Models to Master 16000+ Real-world APIs,” arXiv.org, Oct. 03, 2023. https://arxiv.org/abs/2307.16789

[3] A. Vaswani et al., “Attention Is All You Need,” arXiv.org, Jun. 12, 2017. https://arxiv.org/abs/1706.03762

[4] L. Ouyang et al., “Training language models to follow instructions with human feedback,” arXiv:2203.02155 [cs], Mar. 2022, Available: https://arxiv.org/abs/2203.02155

Thank You!

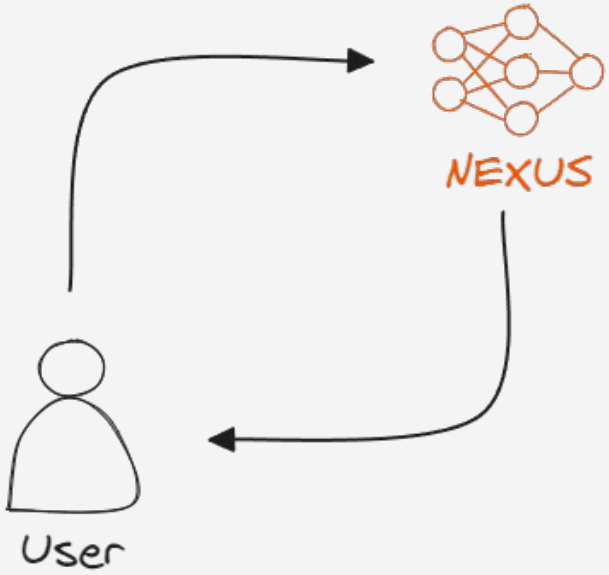
LLMs - Transformers



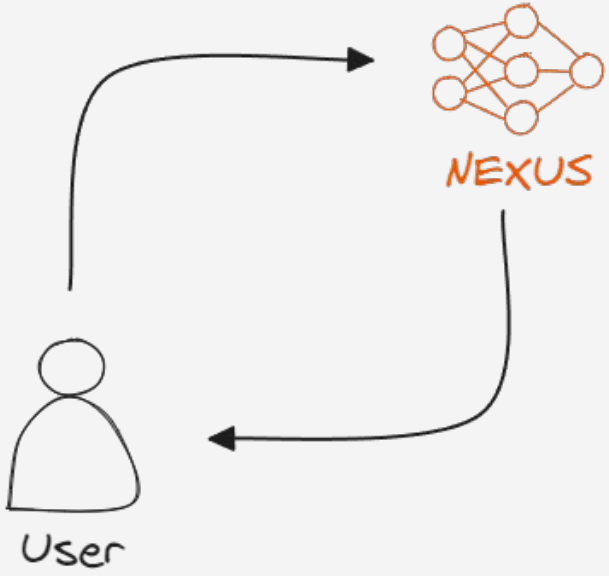
Transformer Model Architecture

- Parameters are dispersed throughout the network
- Know exactly what mathematical functions happen at each of the stages
- Can adjust and optimize the parameters iteratively

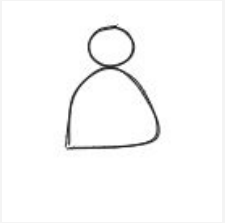
Overview



NEXUS



Shawn Hagler



Jaehyun Lee

Three ideas

Jupiter

Jupiter is a gas giant and the biggest planet in the Solar System. It’s the fourth-brightest object in the night sky and was named after the Roman god of the skies and lightning

Venus

Venus has a beautiful name and is the second planet from the Sun. It’s terribly hot and its atmosphere is poisonous. It’s the second-brightest natural object in the night sky

Saturn

Saturn is a gas giant and has several rings. It’s composed mostly of hydrogen and helium. Saturn is the sixth planet from the Sun and was named after the Roman god of wealth and agriculture

Three ideas

Jupiter

Jupiter is a gas giant and the biggest planet in the Solar System. It’s the fourth-brightest object in the night sky and was named after the Roman god of the skies and lightning

Venus

Venus has a beautiful name and is the second planet from the Sun. It’s terribly hot and its atmosphere is poisonous. It’s the second-brightest natural object in the night sky

Saturn

Saturn is a gas giant and has several rings. It’s composed mostly of hydrogen and helium. Saturn is the sixth planet from the Sun and was named after the Roman god of wealth and agriculture

Contents of this template

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Before we begin...

Do you know what helps you make your point clear? Lists like this one:

- They’re simple
- You can organize your ideas clearly
- You’ll never forget to buy milk!

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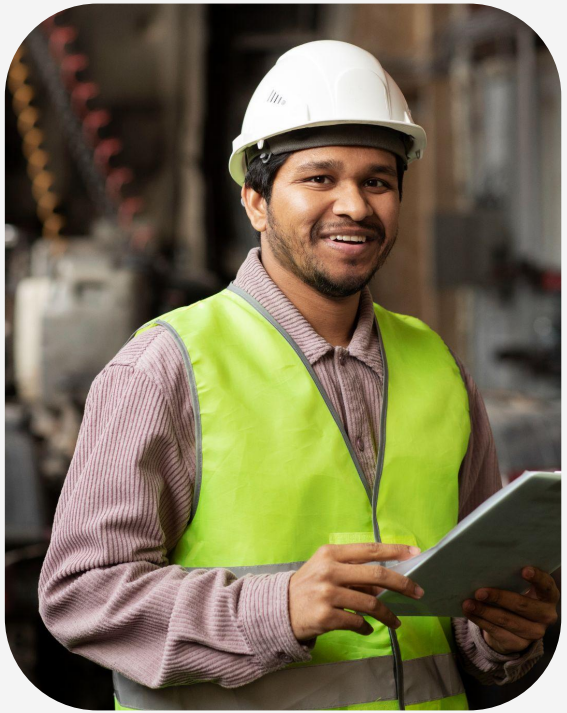

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Agenda

01. Overview

02. Problem

03. Solution

04. Related Works

05. Challenges

06. Name of the section

Four ideas

Mars

Despite being red, Mars is actually a cold place. It’s full of iron oxide dust, which gives the planet its reddish cast, and it’s made of basalt

Venus

Venus has a beautiful name and is the second planet from the Sun. It’s terribly hot and has an extremely poisonous atmosphere

Jupiter

Jupiter is a gas giant and the biggest planet in the Solar System. It’s the fourth-brightest object in the night sky and was named after a god

Saturn

Saturn is a gas giant and has several rings. This planet is composed mostly of hydrogen and helium. Saturn is the sixth planet from the Sun

Six ideas

Mars

Despite being red, Mars is actually a cold place. It’s full of iron oxide dust, which gives the planet its reddish cast

Venus

Venus has a beautiful name and is the second planet from the Sun. It’s terribly hot, even hotter than Mercury

Neptune

Neptune is the farthest planet from the Sun. It’s also the fourth-largest planet by diameter in the Solar System

Earth

Earth is the third planet from the Sun and the only one that harbors life in the Solar System. We all live on this planet

Saturn

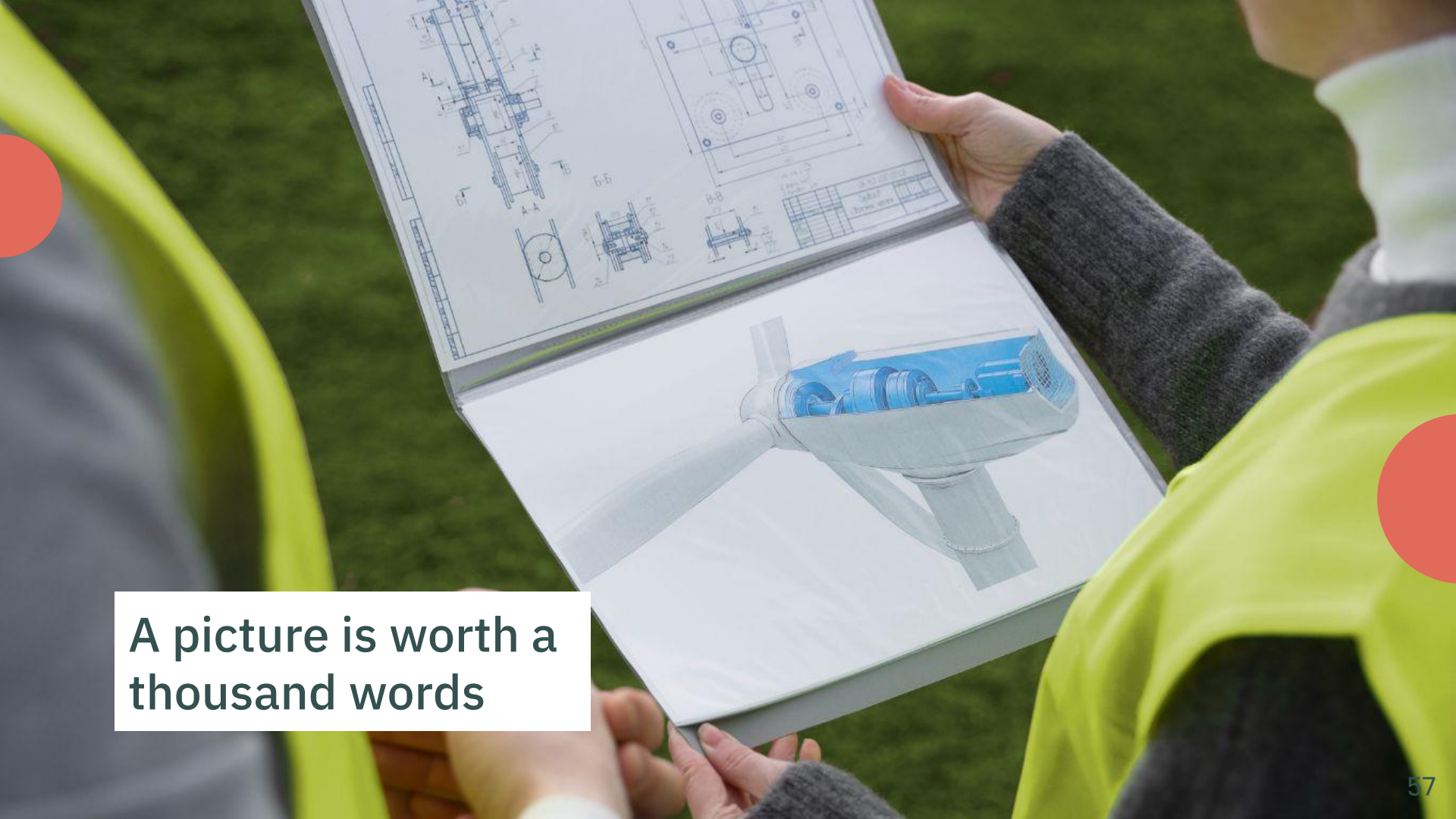
Saturn is a gas giant and has rings. It’s composed mostly of hydrogen and helium. It’s the sixth planet from the Sun

Jupiter

Jupiter is a gas giant and the biggest planet in the Solar System. It’s the fourth-brightest object in the night sky

4,498,300,000

Big numbers catch your audience’s attention



A picture is worth a thousand words

Pie chart

Q1

Mars is very cold

Q2

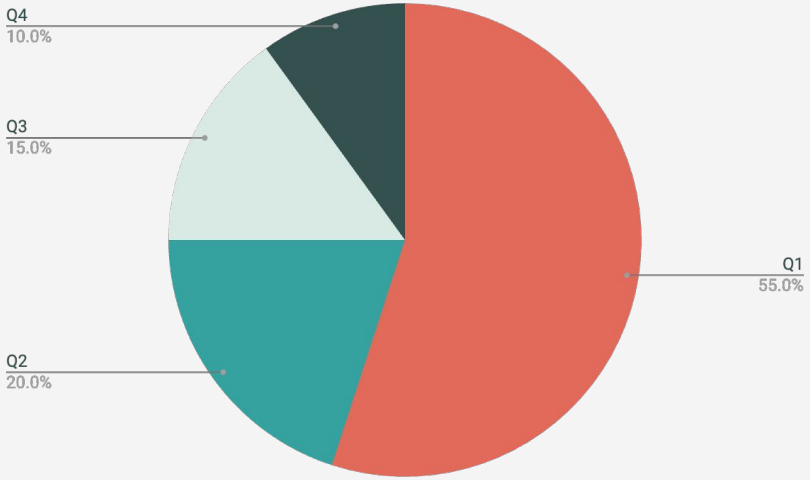
Mercury is small

Q3

Venus is very hot

Q4

Earth has life



Follow the link in the graph to modify its data and then paste the new one here. **For more info, click here**

Map

- Mercury is the closest planet to the Sun and the smallest of them all
- Venus has a beautiful name and is the second planet from the Sun
- Mars is full of iron oxide dust, which gives the planet its reddish cast

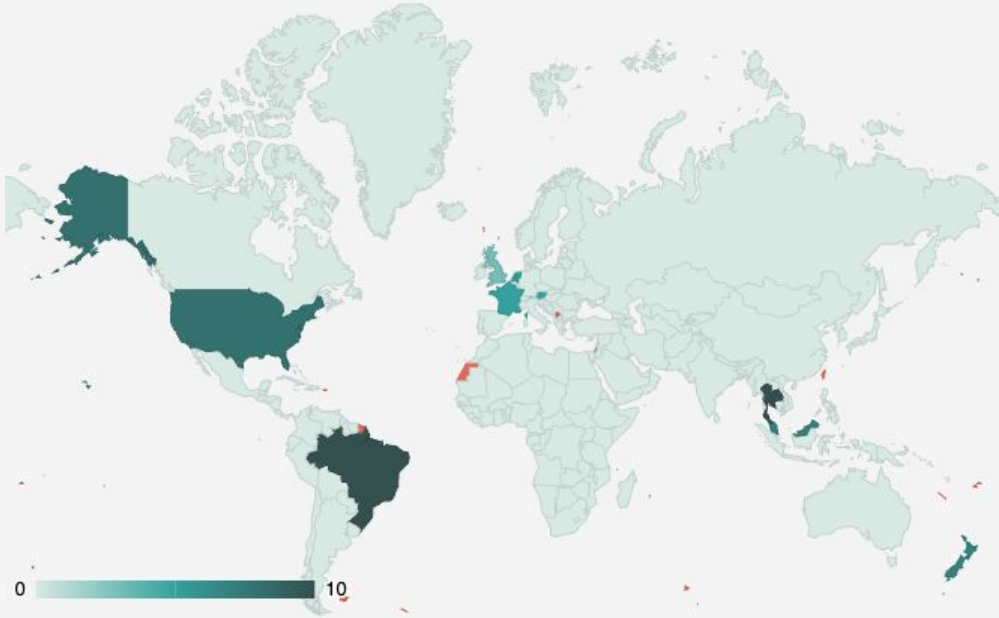


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Table

	Team A	Team B	Team C	Team D	Team E	Team F
Mercury	XX	XX	XX	XX	XX	XX
Mars	XX	XX	XX	XX	XX	XX
Saturn	XX	XX	XX	XX	XX	XX
Venus	XX	XX	XX	XX	XX	XX
Jupiter	XX	XX	XX	XX	XX	XX
Earth	XX	XX	XX	XX	XX	XX
Pluto	XX	XX	XX	XX	XX	XX

Timeline

Venus is a hot planet
Mercury is very small
Mars is very cold
Jupiter is a gas giant
Saturn has rings
Neptune is far from us
The Sun is a star
We live on the Earth

Target infographics

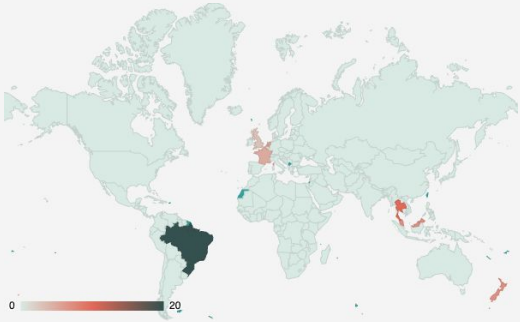
Demographics

Age	25-50 years old
Gender	Male and female
Occupation	Employees and students
Family Situation	Single and married people
Income	$50,000/year

Behavior

- Mercury is the closest planet to the Sun and the smallest one
- Venus has a beautiful name and is the second planet from the Sun
- Despite being red, Mars is actually a cold place. It’s full of iron oxide dust

Location



Region	Various
Area	Urban

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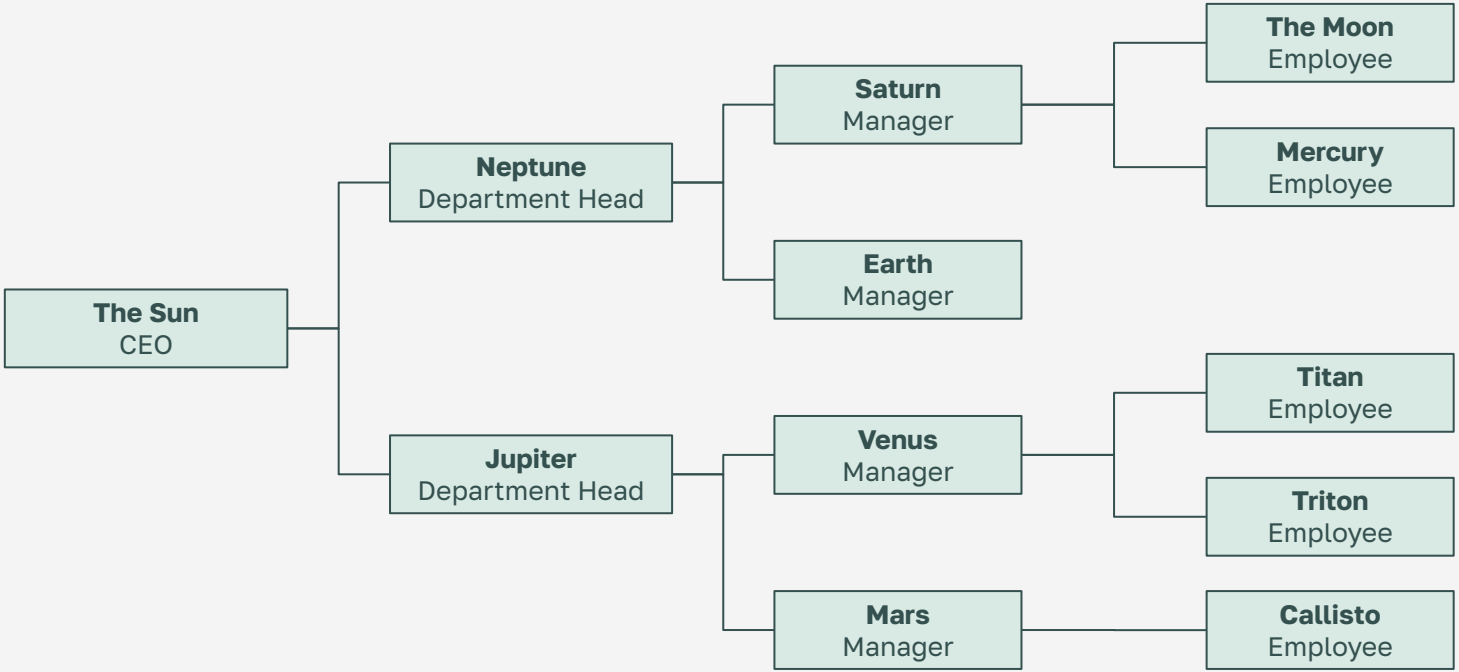
Organizational chart



Roadmap infographics

Initiative	Objective	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Venus is very hot	Venus has a beautiful name and is the second planet from the Sun												
Earth has life	Earth is the beautiful planet on which humans live												
Mars is very cold	Despite being red, Mars is actually a cold place												
Jupiter is huge	Jupiter is the biggest planet in the Solar System												
Saturn has rings	Saturn is a gas giant and has several rings												
Mercury is small	Mercury is the closest planet to the Sun and the smallest one												

Photo showcase

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Thanks!

Do you have any questions?
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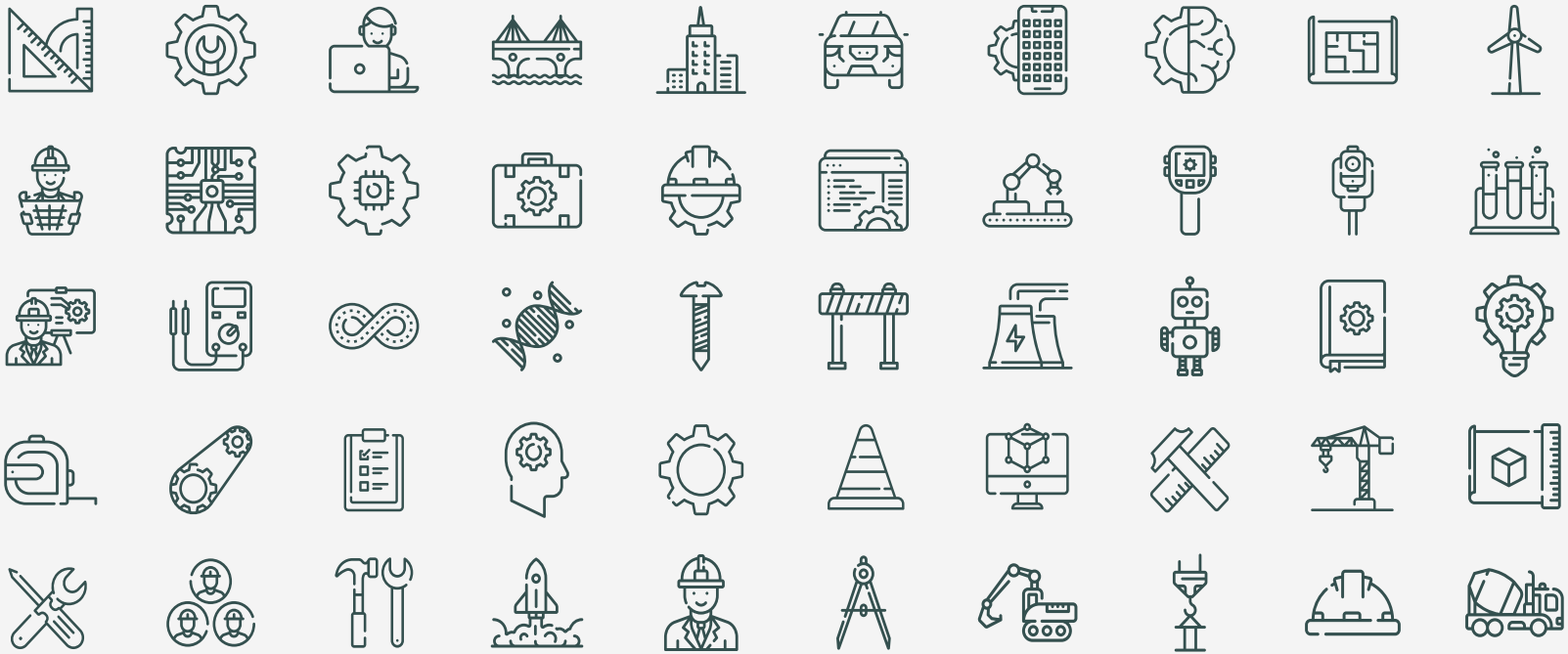

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Resources

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Photos:

- Medium shot smiley man wearing helmet
- Building and construction worker on the site with architect
- High angle engineers discussing plan
- Professional female driver operating forklift vehicle
- Safety goggles on drafts near laptop
- Medium shot smiley engineer with helmet

Icons:

- Icon Pack: Engineering | Lineal

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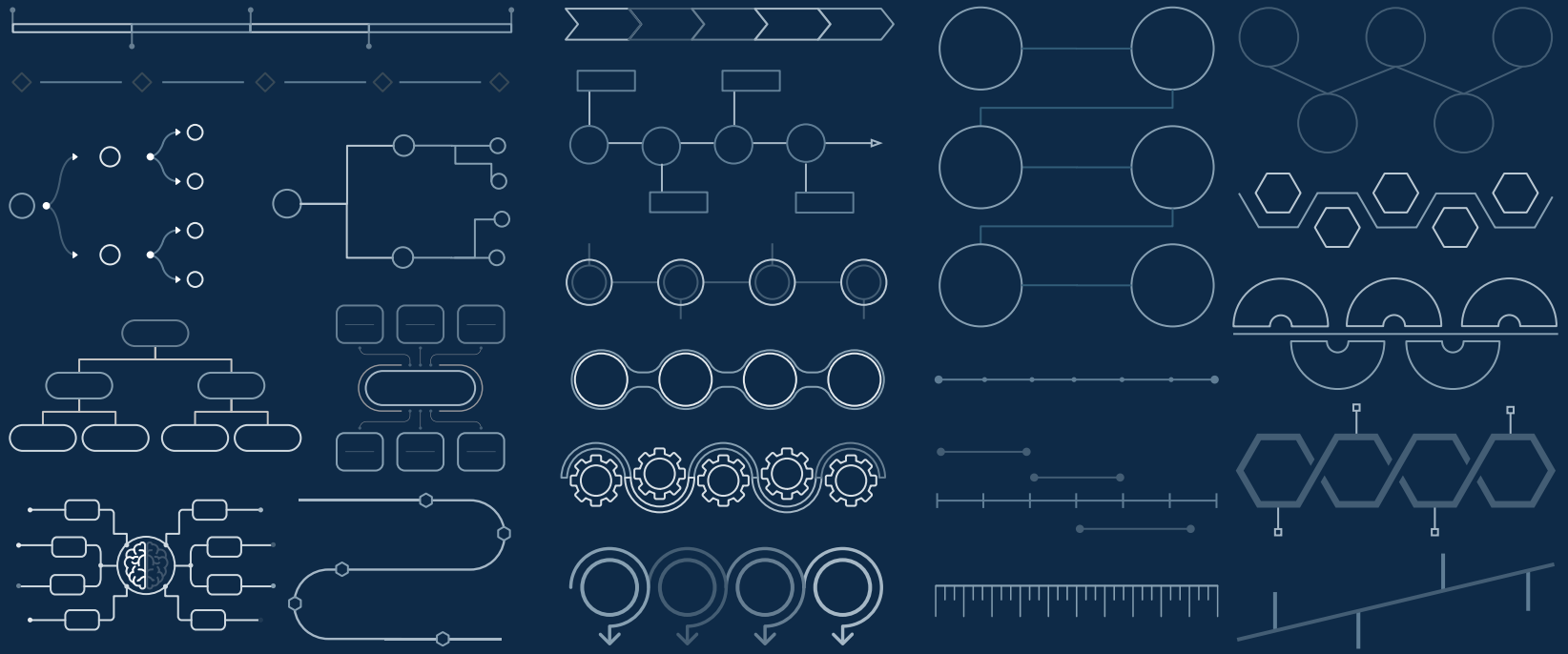

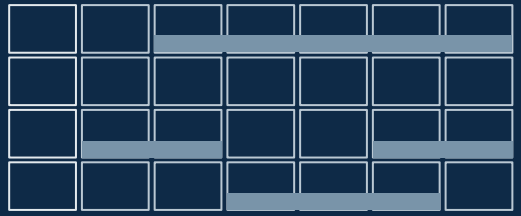

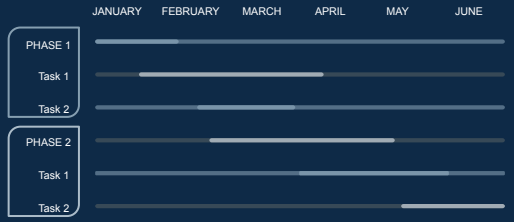
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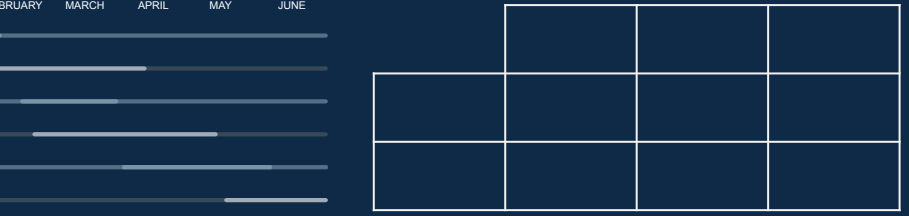

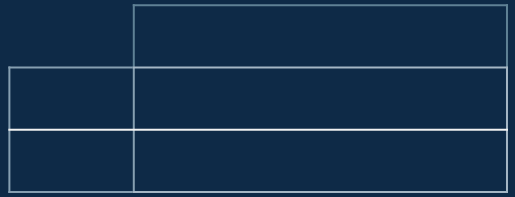

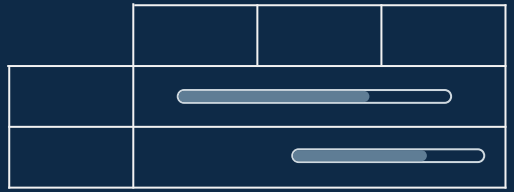

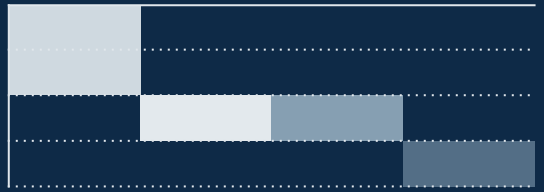

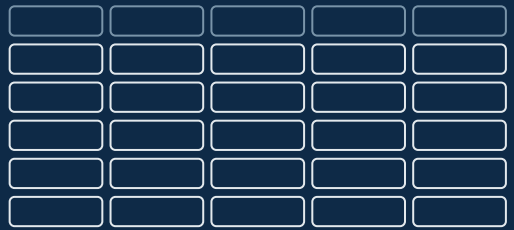

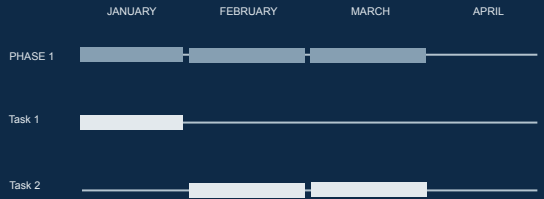
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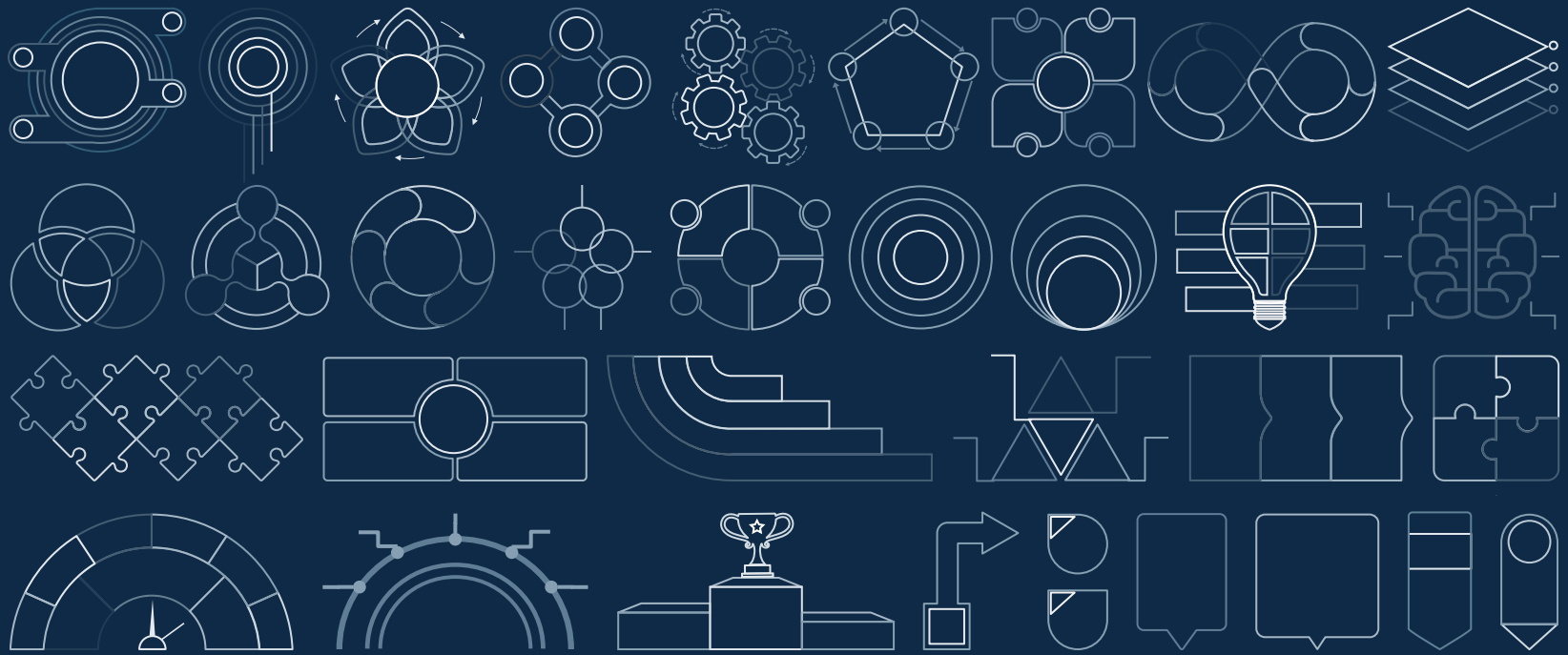
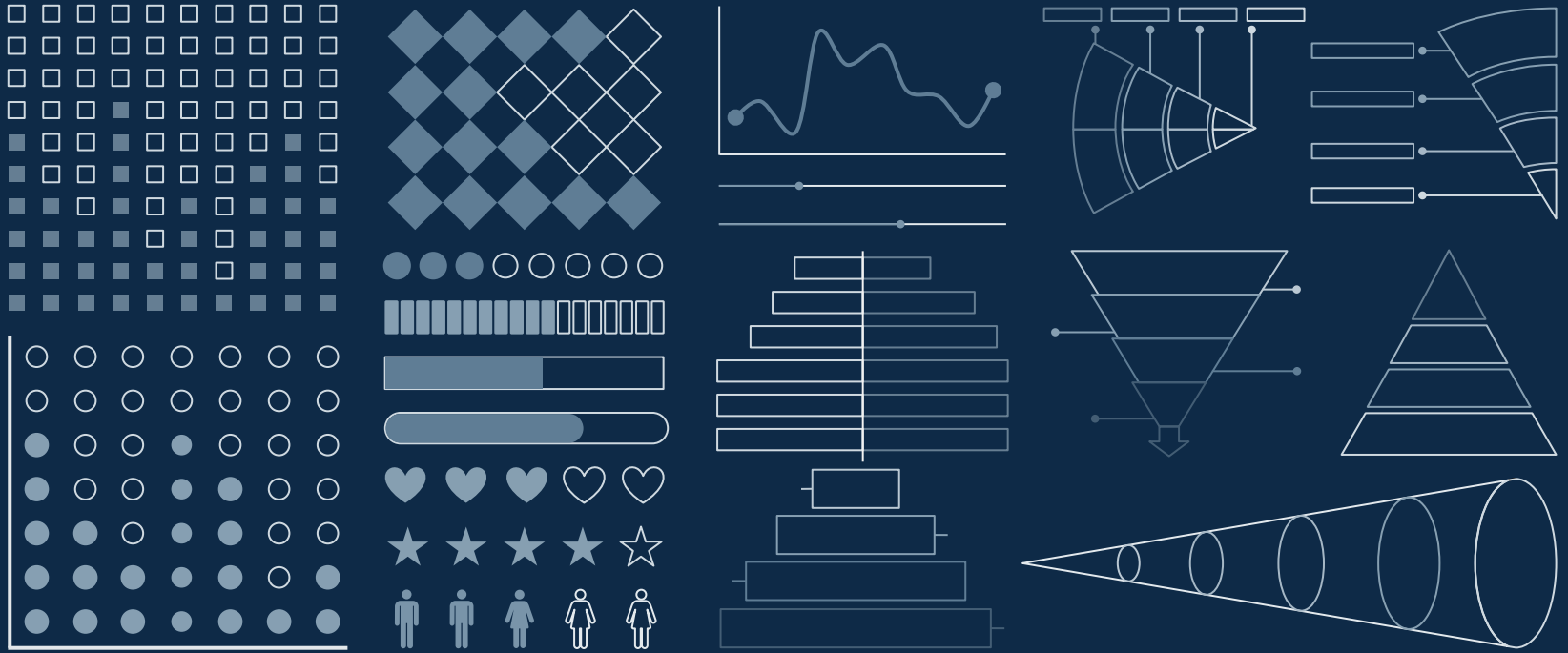
PHASE 1
Task 1
Task 2





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