to Fine-tune *or* Prompt *or* RAG

Using LLMs in business

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LLMs in Business

LLMs are trained on internet scale data & have knowledge of the world. But these LLMs do not understand your business or domain data.

Using LLMs to solve your own business problems can be challenging. Take for example a Law Firm which wants to create a Knowledge extraction chatbot using its knowledge and data. This can be hard despite available tools and frameworks. There is no one-stop shop for this. Here is a framework on how to adapt LLMs to solve business problems you care about.

Law Firm

International Law firm *(multiple countries, jurisdictions, business domains)* wants to use LLMs to prepare draft case documents, compare previous cases, new employee Q&A

LLM

Foundation Model

- **Understand language**
- **Have knowledge of the world**
- **Have reasoning capability**

- **Lack law & legal domain knowledge**

Framework to extend model knowledge and adapt to your task

LLM

How to unlock the full potential of LLMs to solve business problems

Track 1

Use model as-is.
Model is not modified.

Prompt Engineering

Few-shot
Zero-Shot
Chain-of-Thought

Used for simple use cases like extractive Q+A or rapid prototyping

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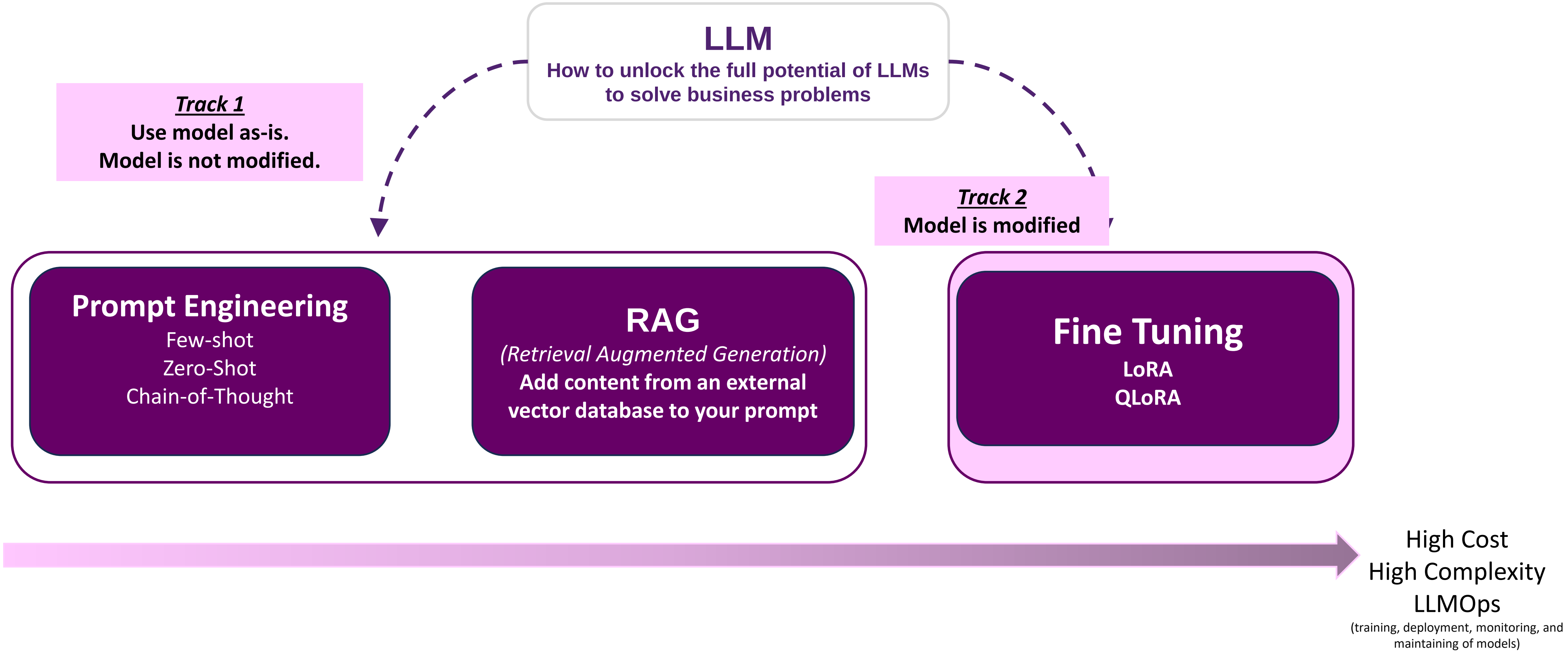
RAG
(Retrieval Augmented Generation)
Add content from an external vector database to your prompt

High Cost
High Complexity

Framework to extend model knowledge and adapt to your task



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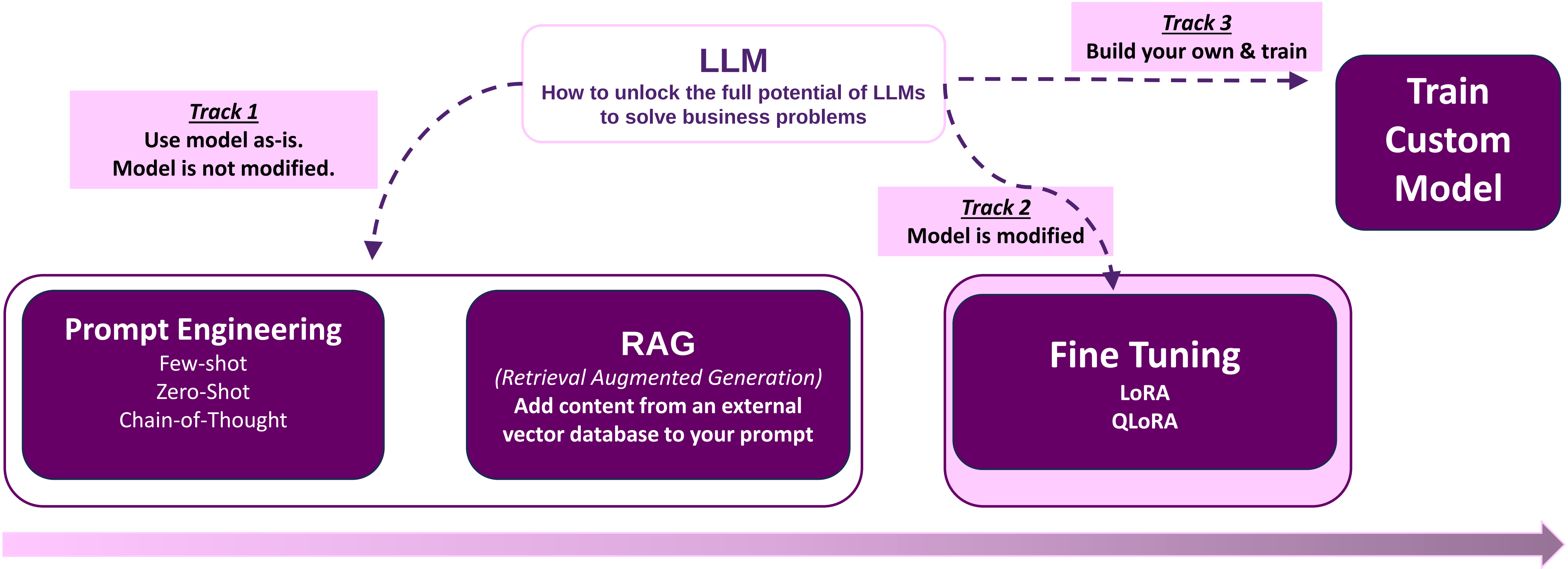

High Cost
High Complexity
LLMOps needed
(training, deployment, monitoring, and maintaining of models)

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(Track 1) Prompt Engineering

Prompt engineering is the process of carefully designing and refining the input (the "prompt") given to an AI model to achieve the desired output.

What is a Prompt? A prompt is a combination of requirements, instructions, guardrails combined with data to be acted upon by the LLM.

Anatomy of a Prompt

Style & Tone	Guardrails
Requirement	Instructions
Output Format	Examples

Types of Prompts

Zero-Shot

The model predicts the answer given only a natural language prompt with no examples

<u>Use cases</u>

Language Translation
Content moderation
Sentiment analysis

One-Shot

Is a technique where a model leverages a single example to understand and execute a task

<u>Use cases</u>

Automated content generation
Document summarization
Email drafting

Few-Shot

Add few examples to the prompt. The model will adapt results based with in-context learning

<u>Use cases</u>

Customer support automation
Content generation
Data cleaning
JSON extraction

CoT(Chain-of-Thought)

Guides a model to solve complex problems by explicitly prompting it to follow a step-by-step reasoning process.

<u>Use Cases</u>

Mathematical problem solving
Data analysis

Few-shot prompt

SA **You**

You are a bank customer service bot.

Style & Tone

Your task is to assess customer intent and categorize customer inquiry after into one of the following predefined categories:

Requirement

change pin
lost card
exchange rate
country support
charge dispute

If the customer inquiry doesn't fit into any of the above categories, classify it as: customer service.

Instructions

You will only respond with the predefined category. Do not provide explanations or notes.

Output Format

Here are some examples:

Inquiry: When will my credit card arrive? I'm going on a vacation and will not be able to check my mails for few days in first week of May

Examples

Category: card arrival
Inquiry: I am planning an international trip to Mexico. Does the card work there ?Category: Country support Inquiry: I forget pin of my credit card. Can you help me reset it ?
Category: Change pin
For the below question coming from a customer what is the service category "My wallet got stolen. It was in my bag at a conference. It had my credit card. What should i do?"

‹ 8 / 8 ›

ChatGPT

lost card

Output Format

Chain-of-thought prompt

SA **You**

Karen went to the grocery store. She saw mangoes were on Sale and she bought a dozen. She already had 5 mangoes at home. Later that evening her father came to her home and gave her half-a-dozen mangoes. How many mangoes does she have in total. Don't show any code. Lets work this step-by-step

‹ 2 / 2 ›

ChatGPT

Sure, let's calculate how many mangoes Karen has now, step by step.

1. Karen initially had 5 mangoes.
2. She bought a dozen mangoes. A dozen equals 12.
3. Her father gave her half a dozen mangoes later, which equals 6.

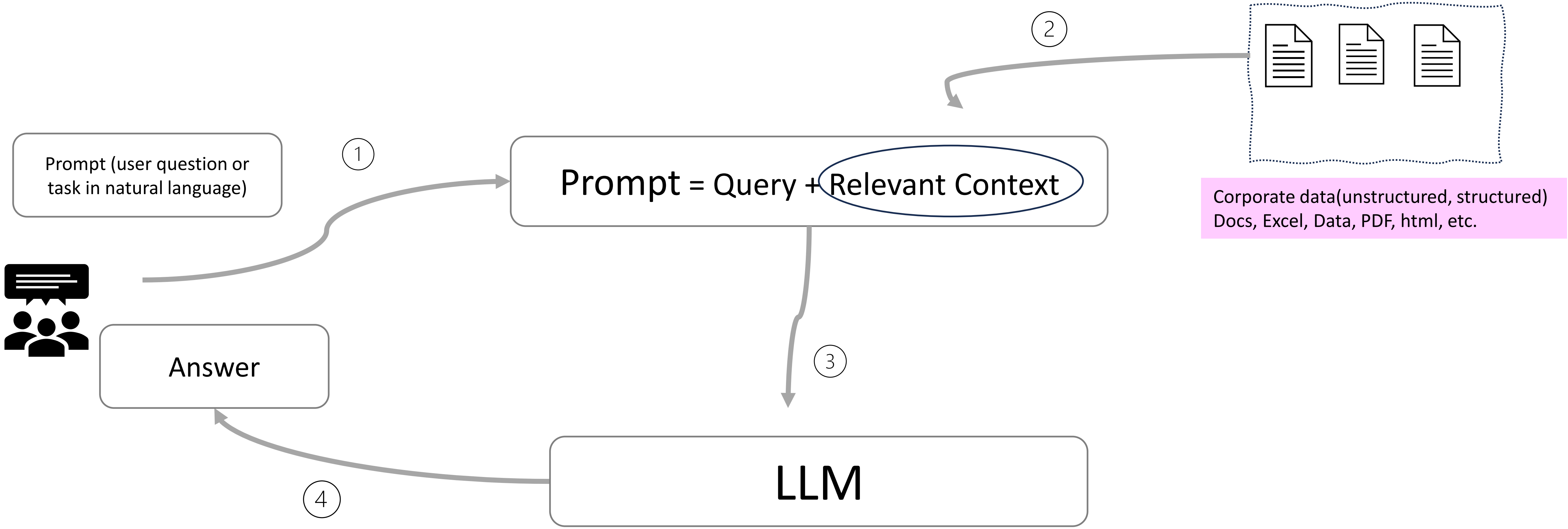
Now, let's add all these together:

- Start with the 5 mangoes she already had.
- Add the 12 mangoes she bought.
- Add the 6 mangoes her father gave her.

That makes a total of 23 mangoes.

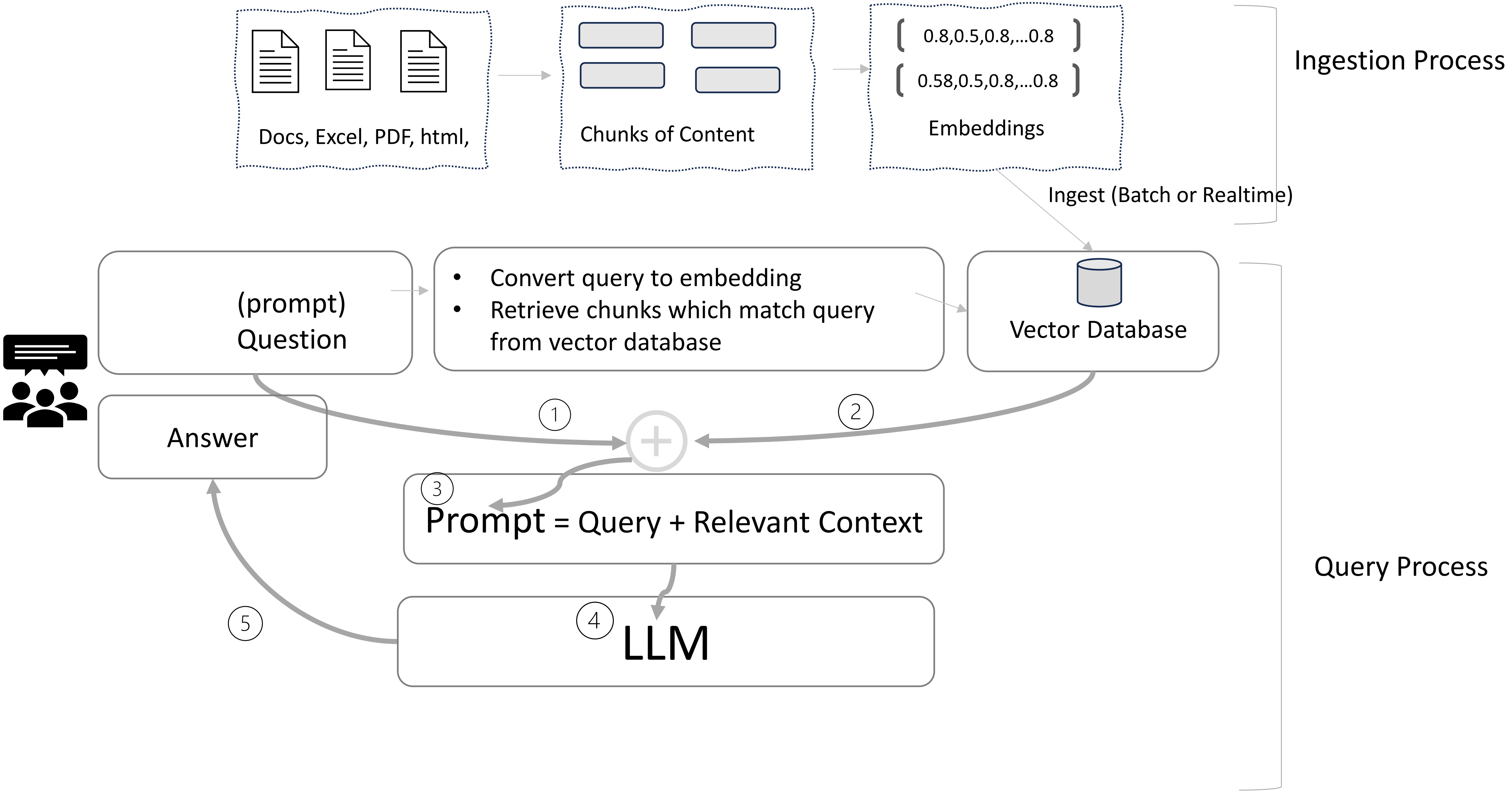
RAG (Retrieval Augmented Generation)

In simple words, RAG is a technique where you combine external content like (business knowledge/data) with a prompt before sending it to the LLM. The LLM then acts & reasons on that to provide you with results. Essentially you are using the AI power of a LLM on your custom knowledge/data.



Watch my video on RAG for more details and a demo

RAG Application Architecture



Framework to extend model knowledge and adapt to your task

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Track 2
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Build your own & train

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Fine Tuning
LoRA
QLoRA

Custom Model
Train

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(track 2): Fine Tuning

Fine tuning is a method to train a foundation model with your own business data or domain knowledge. During the training process, the weights are adjusted. After fine-tuning, you can use the custom model it to build applications that are specific to your organization and use cases.

For example, **Boeing** wants to build an AI Assistant which helps train new employees on Aeronautical Engineering.

LLM
Foundation Model

*Has **NO** knowledge about Aeronautical Engineering*

Fine Tuning
(PEFT, LoRA, QLoRA)

(Aircraft Engineering)
Domain specific data

LLM
Custom Model

Now *Has knowledge about Aircraft Engineering*

This is a new model. Weights have been adjusted. Can be used to build domain specific AI applications.

Aeronautical engineering is a field of engineering that focuses on designing, developing, testing and producing aircraft.

FineTuning

Challenges of Fine-Tuning

Fine-tuning a large foundation model changes the model's weights and can be computationally intensive, expensive and time consuming, making it out of reach for many business.

PEFT (parameter efficient fine-tuning)

Addresses the challenges of full fine-tuning

Parameter Efficient Fine-Tuning (PEFT) refers to a range of techniques used to adapt large pre-trained models to specific tasks with **minimal updates** to the model parameters. The goal is to retain the benefits of the pre-trained model while customizing it for a particular dataset or task without the need for extensive re-training, which can be costly in terms of computational resources and time. Here we will talk about two such techniques:

1. LoRA (Low-Rank Adaptation)
2. QLoRA (Quantized Low-Rank Adaptation) are two such techniques.

LoRA: Low-Rank Adaptation

Is a type of efficient fine-tuning technique

Problem statement:

The default (fine-tuning: full weight) for LLMs tends to be expensive, compute-intensive & slow. This becomes a major obstacle for companies to adapt these models for their business use.

How does LoRA it solve it :

LoRA reduces the number of trainable parameters for downstream tasks by freezing the weights of the model and inserting a smaller number of new weights into the model. This makes training with LoRA faster, memory-efficient and less costly. All while maintaining the quality of the model outputs..

LoRA (Freeze weights & insert small number of trainable weights)

Preprocessor: "gemma_causal_lm_preprocessor_1"

Tokenizer (type)	Vocab #
gemma_tokenizer (GemmaTokenizer)	256,000

Model: "gemma_causal_lm_1"

Layer (type)	Output Shape	Param #	Connected to
padding_mask (InputLayer)	(None, None)	0	-
token_ids (InputLayer)	(None, None)	0	-
gemma_backbone (GemmaBackbone)	(None, None, 2048)	2,506,172,416	padding_mask[0][0], token_ids[0][0]
token_embedding (ReversibleEmbedding)	(None, None, 256000)	524,288,000	gemma_backbone[0][0]

Total params: 2,506,172,416 (4.67 GB)
Trainable params: 2,506,172,416 (4.67 GB)
Non-trainable params: 0 (0.00 B)

- Freeze weights
- Insert small number of trainable weights

Model: "gemma_causal_lm_1"

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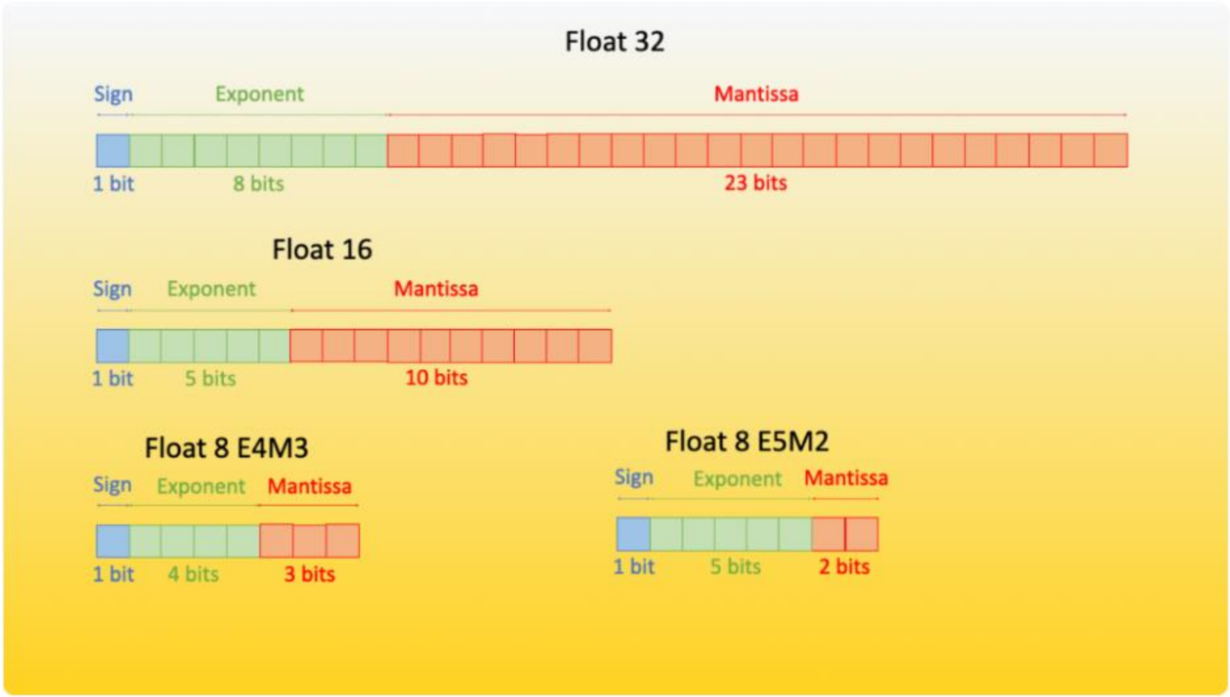
token_embedding (ReversibleEmbedding)	(None, None, 256000)	524,288,000	gemma_backbone[0][0]

Total params: 2,507,536,384 (4.67 GB)
Trainable params: 1,363,968 (2.60 MB)
Non-trainable params: 2,506,172,416 (4.67

QLoRA (Quantized Low-Rank Adaption)

Building on LoRA, QLoRA incorporates quantization into the adaptation process. It uses techniques like 4-bit quantization to further reduce the memory and computational requirements. This quantization applies not just to the low-rank matrices but potentially also to other parts of the model, making the storage and processing of model weights more efficient



Overview of Floating Point 8 (FP8) format. Source: Original content from sgugger

huggingface.co/blog/4bit-transformers-bitsandbytes

(track 3): Custom Model

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