Getting Started with Llama3.1

Lucas Soares

08-08-2024

Methodology Notes

Methodology Notes

1. Presentation Block

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2. Notebook Demo

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3. Quick Q&A + Summary

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4. Optional Exercise During Q&A

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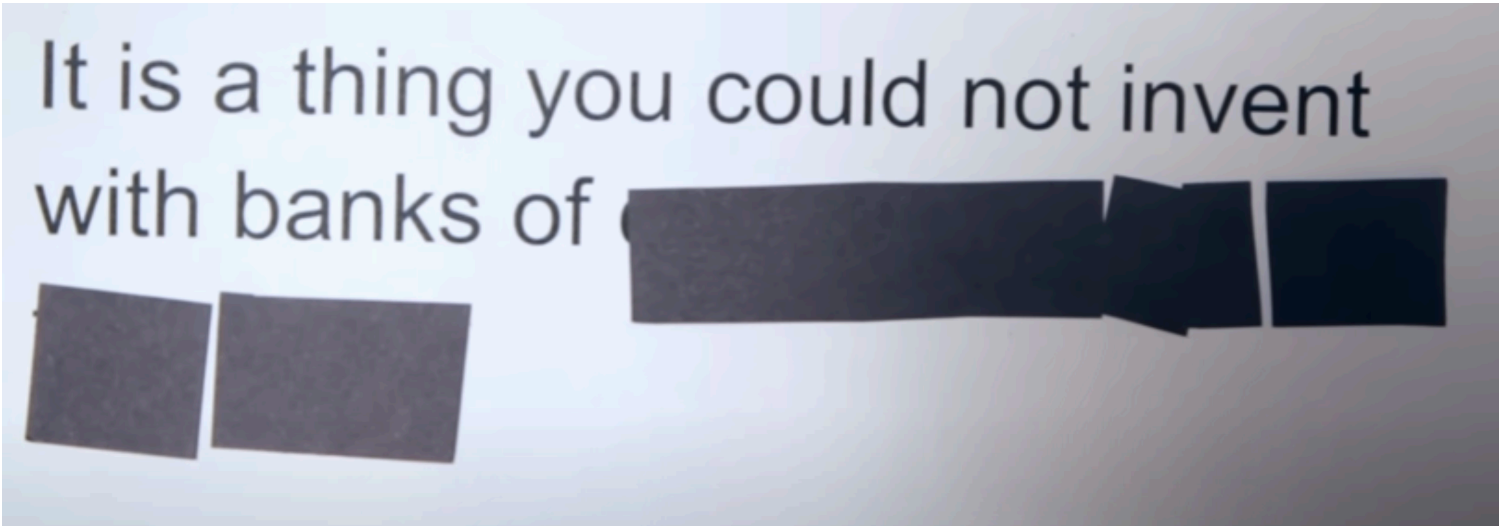
1. Presentation Block
2. Notebook Demo
3. Quick Q&A + Summary
4. Optional Exercise During Q&A
5. Repeat

LLMs Predict the Next Word



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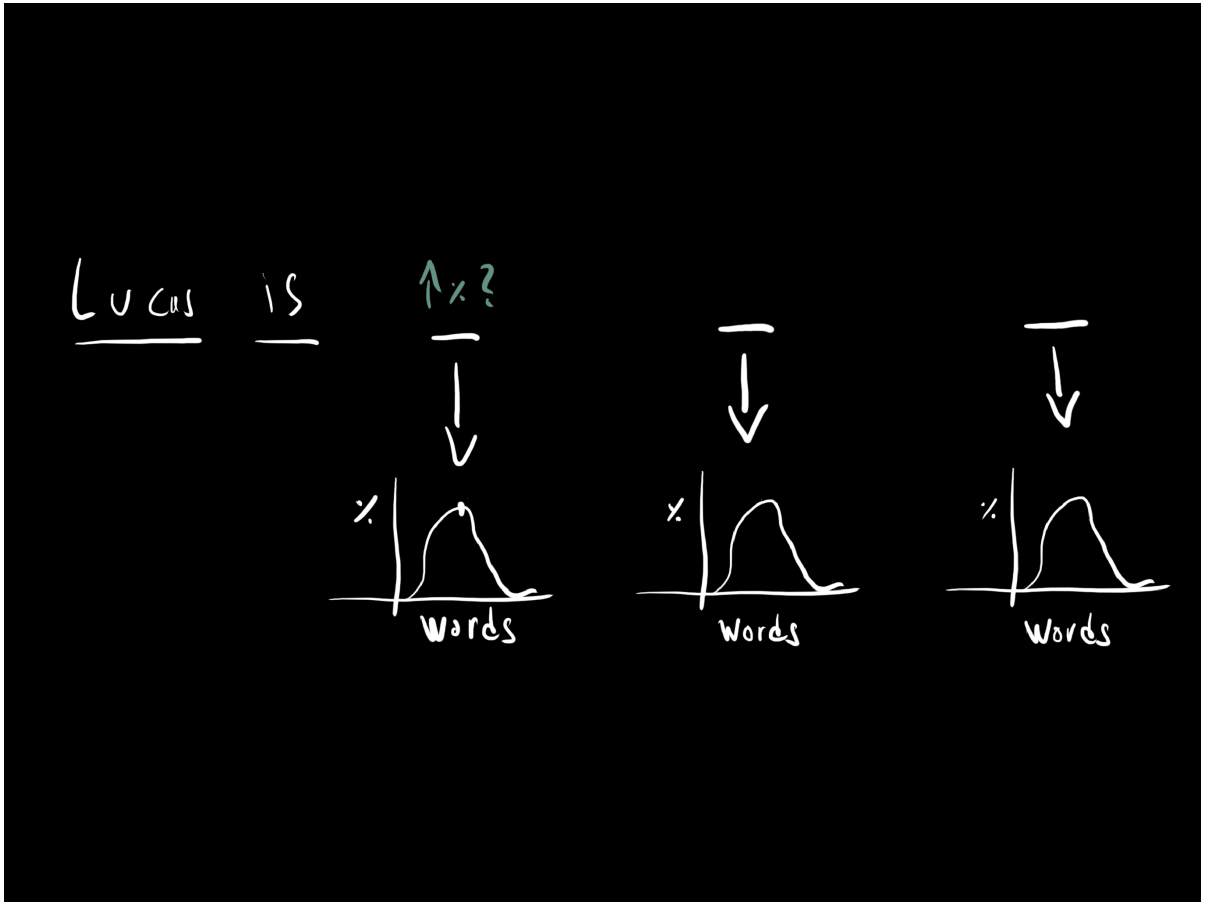

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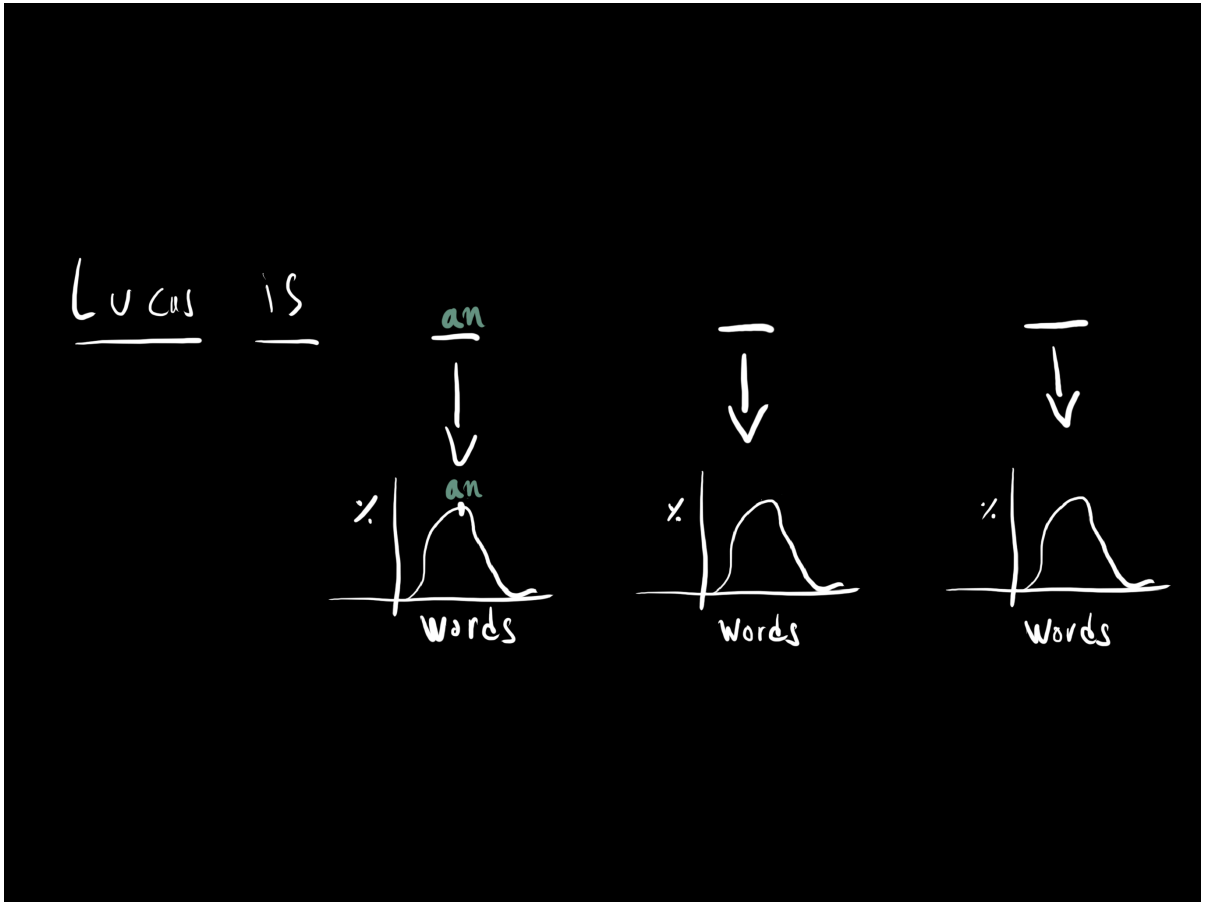

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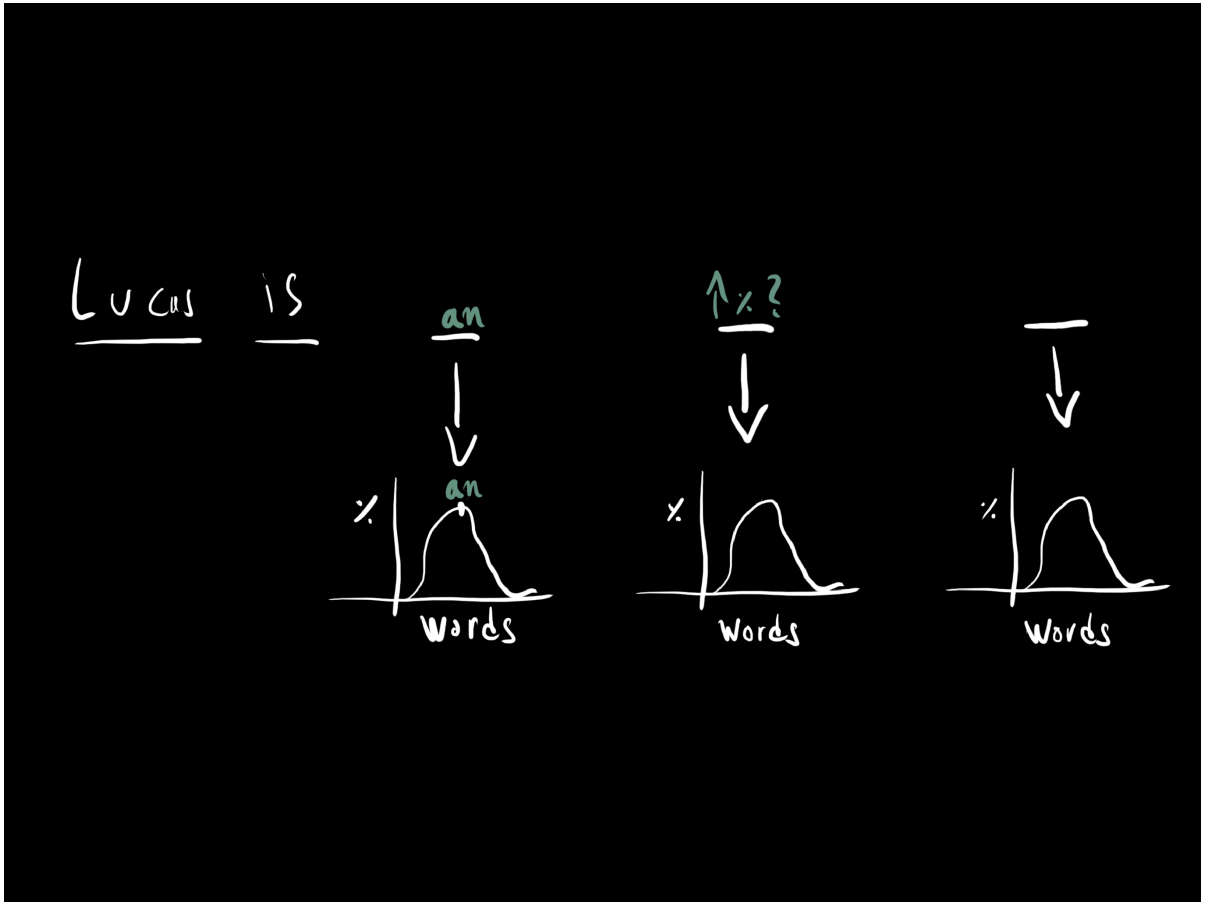
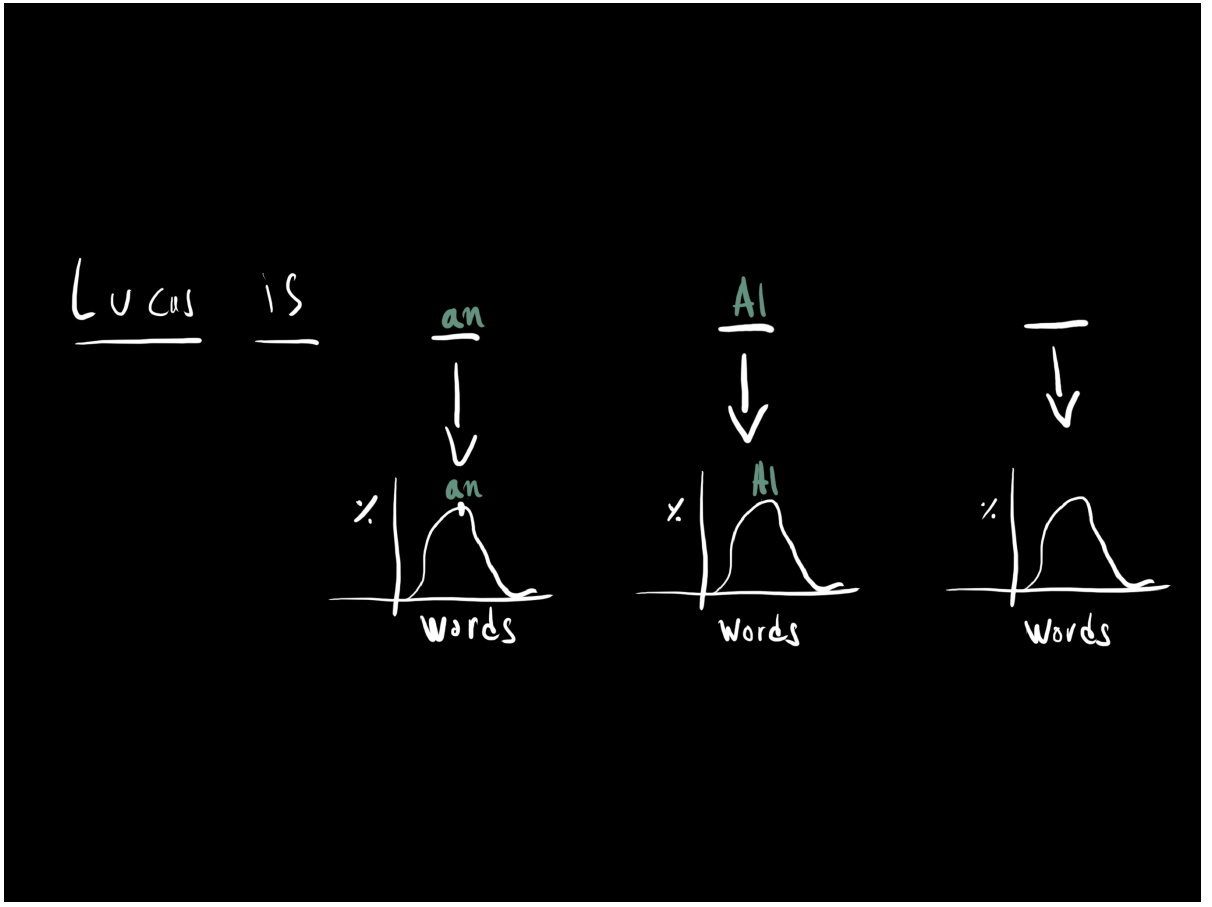
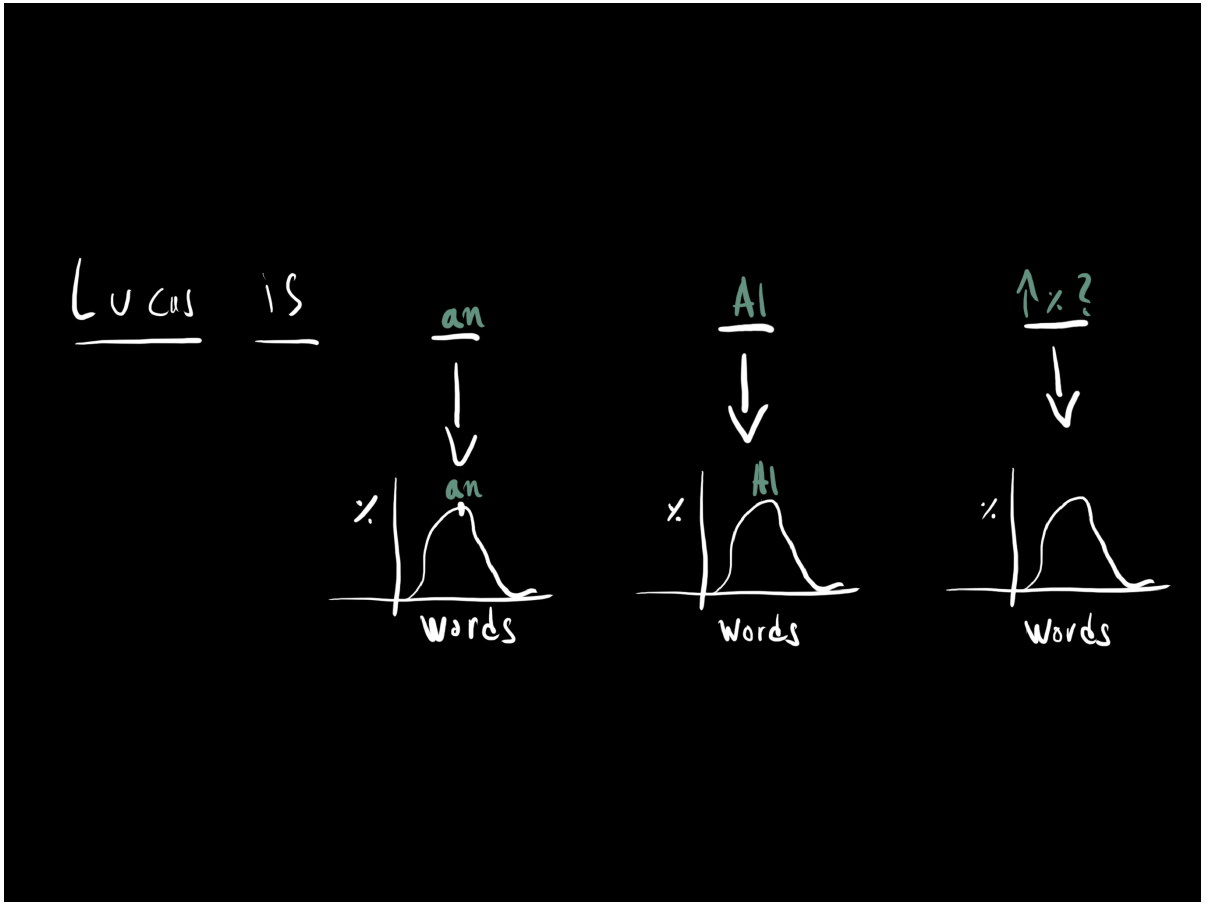


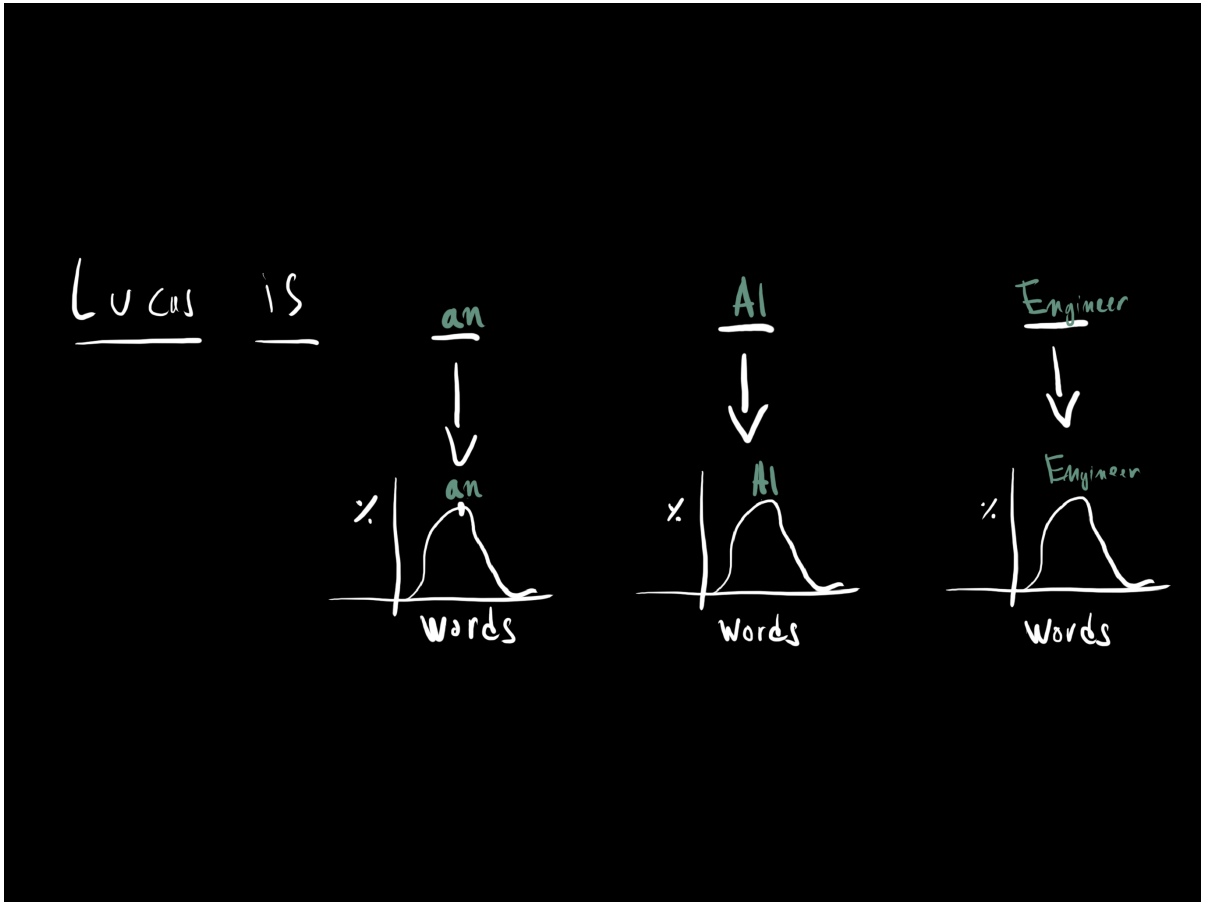
LLMs Predict the Next Word



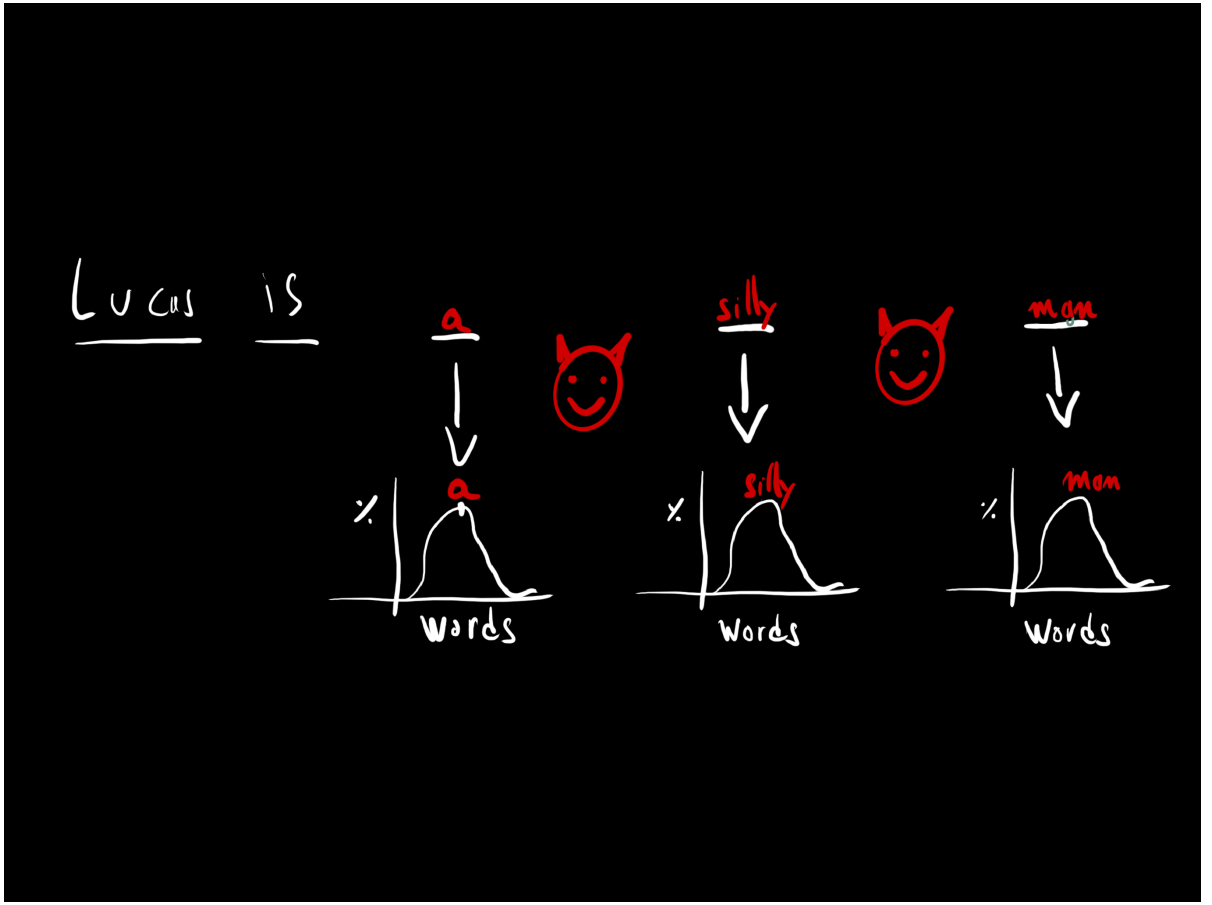
LLMs Predict the Next Word

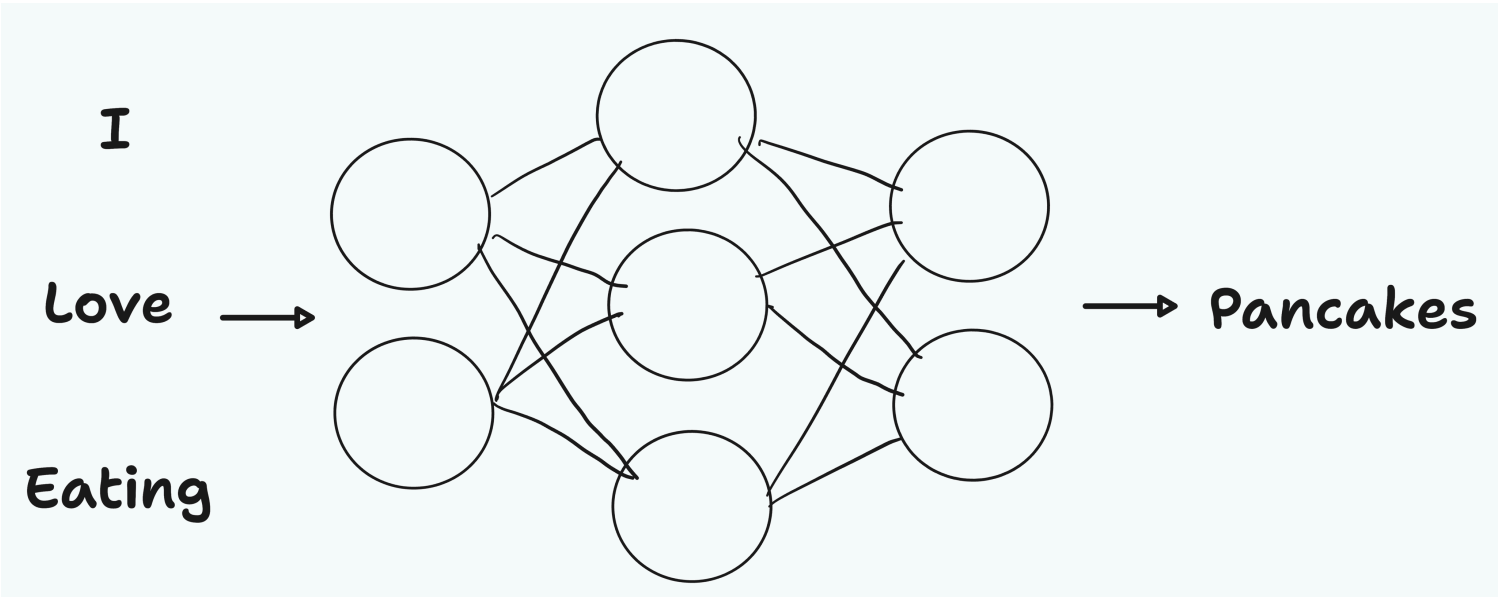


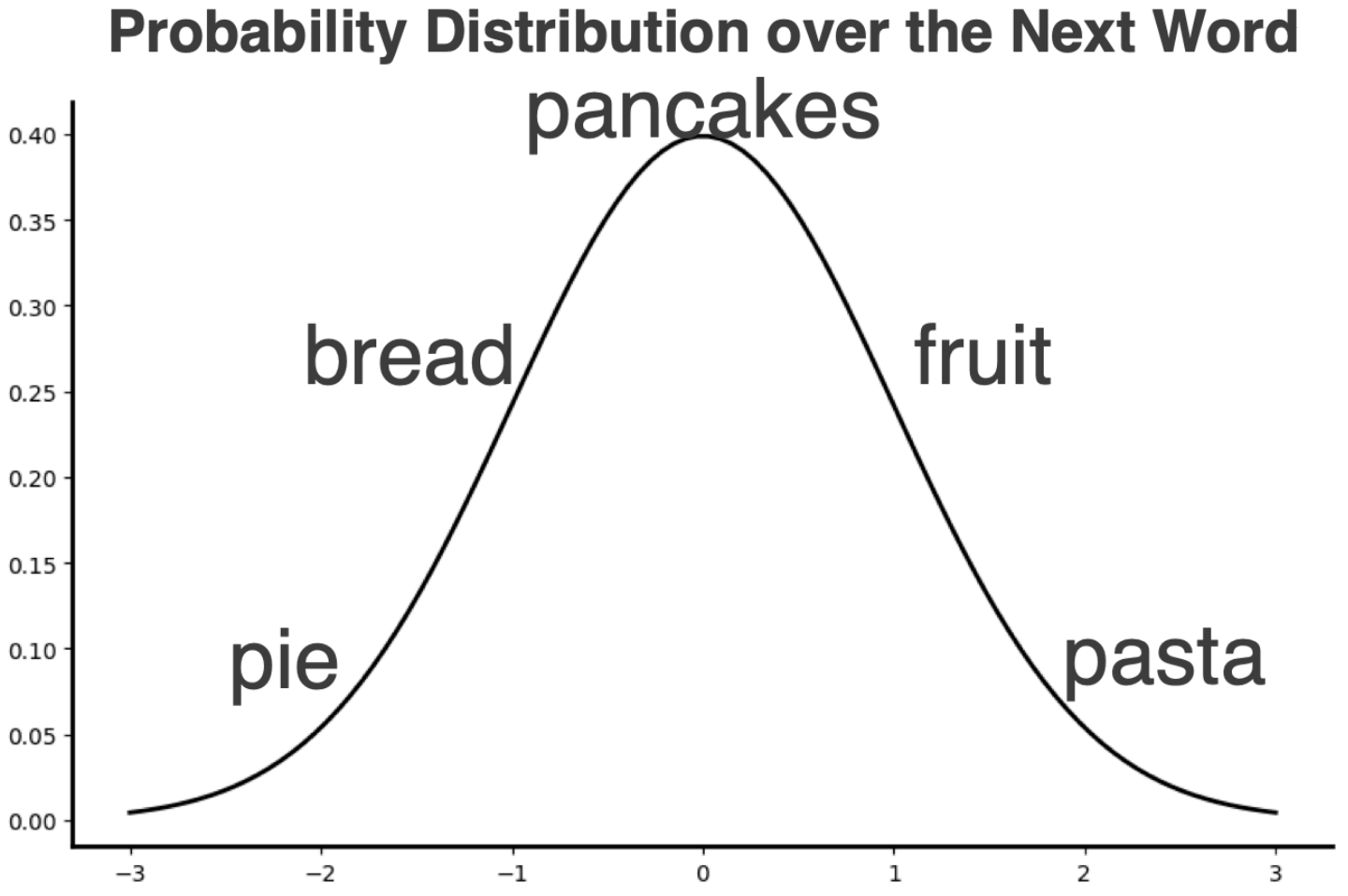
LLMs Predict the Next Word



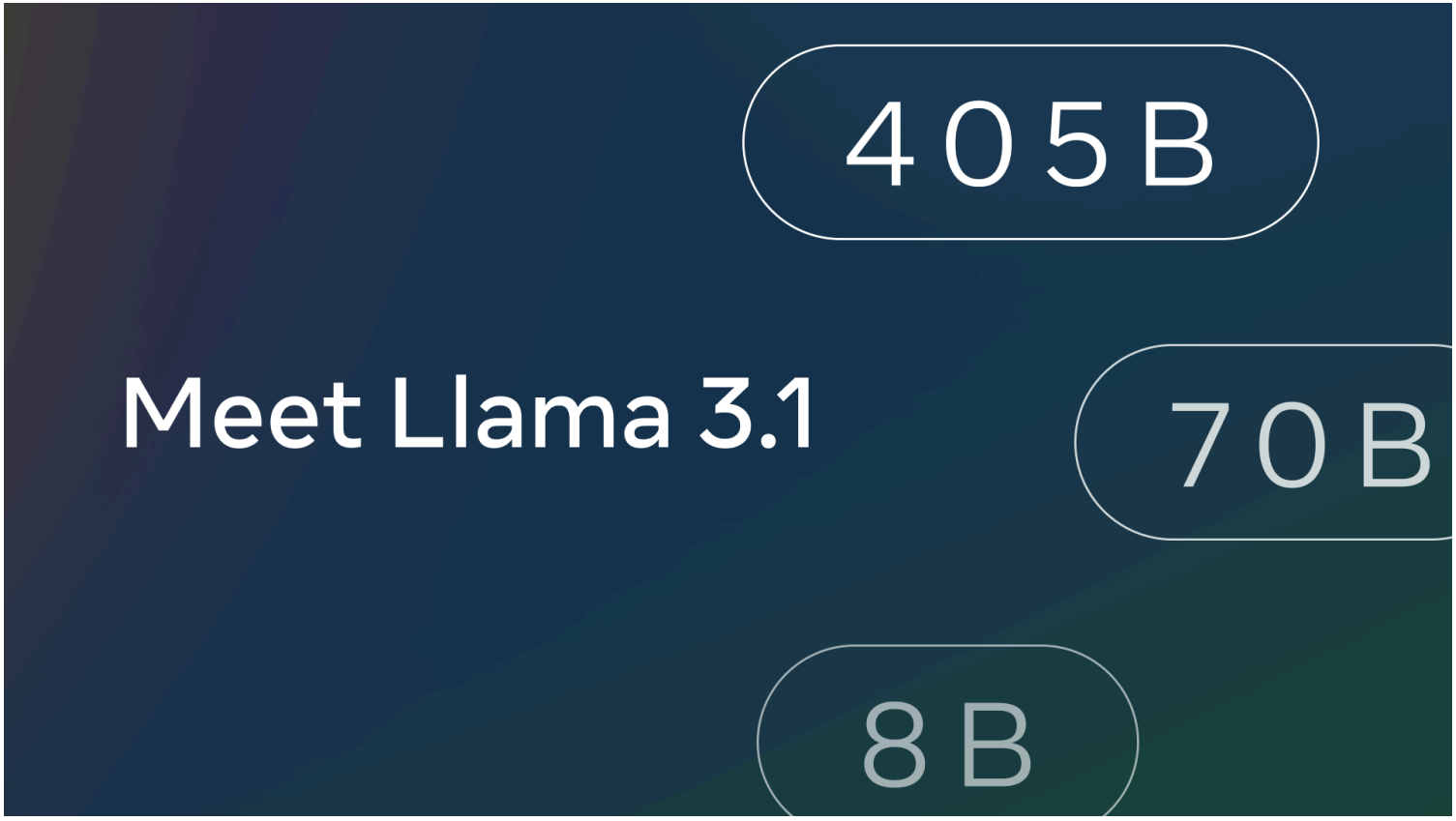
LLMs Predict the Next Word




I
Love
Eating
Pancakes


Probability Distribution over the Next Word
pancakes
bread
fruit
pie
pasta
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
−3
−2
−1
0
1
2
3

Introduction to Llama3



Llama3.1 Release

- LLM Released by Meta in July of 2024

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- LLM Released by Meta in July of 2024
- Open source with a Commercial license (just like Llama2 & Llama3)

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- Meta Llama3.1 Resources

Incredible Performance in 2 sizes

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- Llama3.1 is OPEN SOURCE

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- Released in 3 sizes: 8B, 70B & 405B parameters.

Incredible Performance in 2 sizes

- Llama3.1 is OPEN SOURCE
- Released in 3 sizes: 8B, 70B & 405B parameters.
- Incredible evaluation performances for all models.

Category Benchmark	Llama 3.1 8B	Gemma 2 9B IT	Mistral 7B Instruct	Llama 3.1 70B	Mixtral 8x22B Instruct	GPT 3.5 Turbo
General MMLU (0-shot, CoT)	**73.0**	72.3 (5-shot, non-CoT)	60.5	**86.0**	79.9	69.8
MMLU PRO (5-shot, CoT)	**48.3**	-	36.9	**66.4**	56.3	49.2
IFEval	**80.4**	73.6	57.6	**87.5**	72.7	69.9
Code HumanEval (0-shot)	**72.6**	54.3	40.2	**80.5**	75.6	68.0
MBPP EvalPlus (base) (0-shot)	**72.8**	71.7	49.5	**86.0**	78.6	82.0
Math GSM8K (8-shot, CoT)	**84.5**	76.7	53.2	**95.1**	88.2	81.6
MATH (0-shot, CoT)	**51.9**	44.3	13.0	**68.0**	54.1	43.1
Reasoning ARC Challenge (0-shot)	83.4	**87.6**	74.2	**94.8**	88.7	83.7
GPQA (0-shot, CoT)	**32.8**	-	28.8	**46.7**	33.3	30.8
Tool use BFCL	**76.1**	-	60.4	84.8	-	**85.9**
Nexus	**38.5**	30.0	24.7	**56.7**	48.5	37.2
Long context ZeroSCROLLS/QuALITY	81.0	-	-	90.5	-	-
InfiniteBench/En.MC	65.1	-	-	78.2	-	-
NIH/Multi-needle	98.8	-	-	97.5	-	-
Multilingual Multilingual MGSM (0-shot)	**68.9**	53.2	29.9	**86.9**	71.1	51.4

Llama 3.1 405B Rivals Closed Source Models

Category / Benchmark	Llama 3.1 405B	Nemotron 4 340B Instruct	GPT-4 (0125)	GPT-4 Omni	Claude 3.5 Sonnet
General MMLU (0-shot, CoT)	88.6	78.7 (non-CoT)	85.4	**88.7**	88.3
MMLU PRO (5-shot, CoT)	73.3	62.7	64.8	74.0	**77.0**
IFEval	**88.6**	85.1	84.3	85.6	88.0
Code HumanEval (0-shot)	89.0	73.2	86.6	90.2	**92.0**
MBPP EvalPlus (base) (0-shot)	88.6	72.8	83.6	87.8	**90.5**
Math GSM8K (8-shot, CoT)	**96.8**	92.3 (0-shot)	94.2	96.1	96.4 (0-shot)
MATH (0-shot, CoT)	73.8	41.1	64.5	**76.6**	71.1
Reasoning ARC Challenge (0-shot)	**96.9**	94.6	96.4	96.7	96.7
GPQA (0-shot, CoT)	51.1	-	41.4	53.6	**59.4**
Tool use BFCL	88.5	86.5	88.3	80.5	**90.2**
Nexus	**58.7**	-	50.3	56.1	45.7
Long context ZeroSCROLLS/QuALITY	**95.2**	-	**95.2**	90.5	90.5
InfiniteBench/En.MC	**83.4**	-	72.1	82.5	-
NIH/Multi-needle	98.1	-	**100.0**	**100.0**	90.8
Multilingual Multilingual MGSM (0-shot)	**91.6**	-	85.9	90.5	**91.6**

Llama3.1 Technical Details

- Data: Trained on over 15 trillion tokens of text data

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- Data: Trained on over 15 trillion tokens of text data
- Context length: 128k tokens
- System level approach for responsible development

Meta AI Llama3.1 Release Blog Post

Notebook Demo - Introduction to Llama3.1

Query Your Docs Locally with Llama3.1

- Need for LLMs with access to context-relevant data.

Query Your Docs Locall with Llama3.1

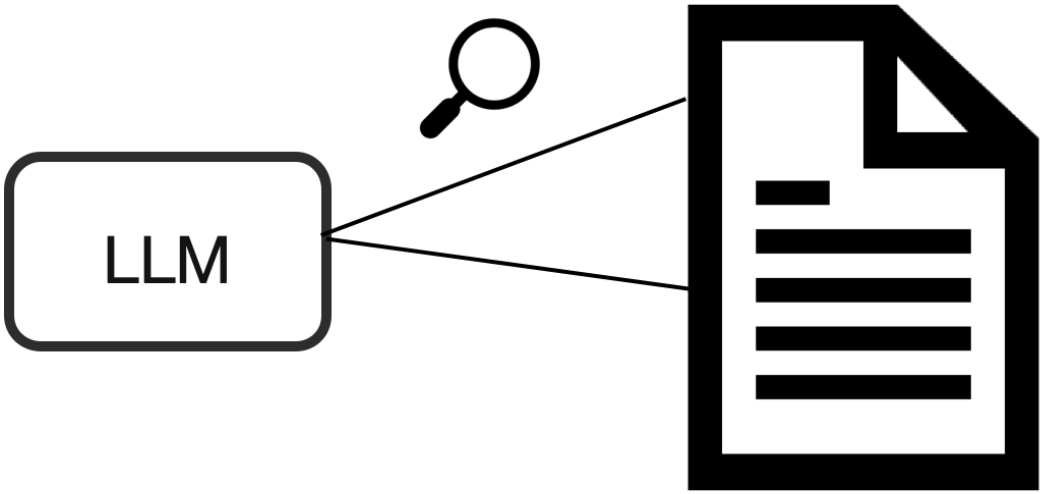
- Privacy concern with closed source LLMs.

Query Your Docs Locall with Llama3.1

- Solution? Llama3.1!

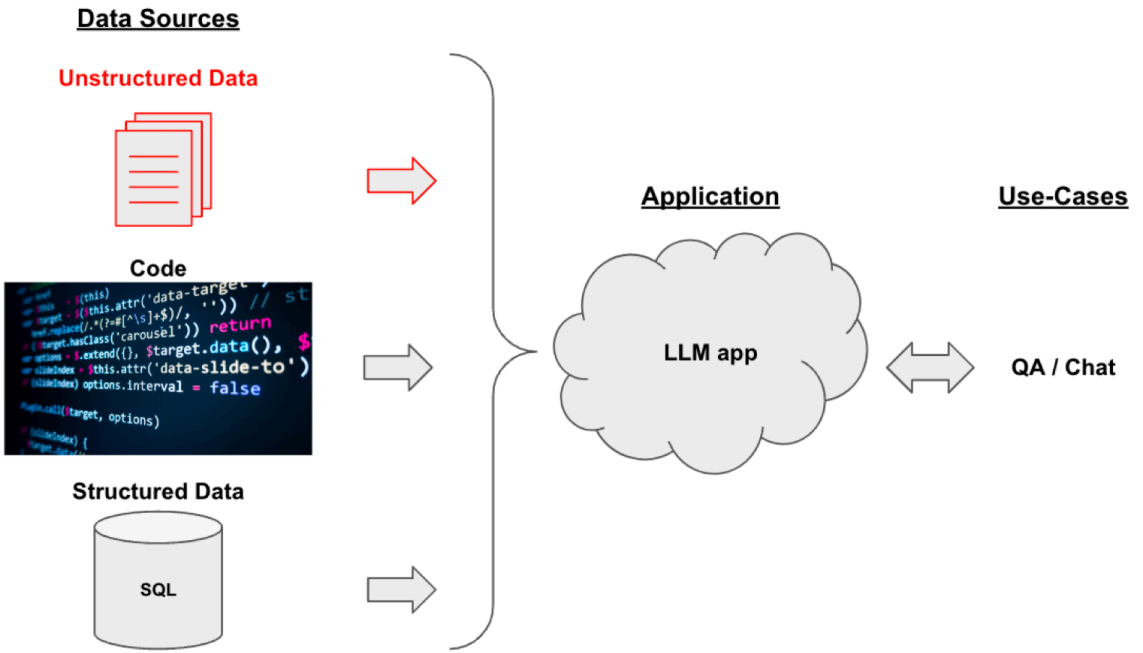
RAG with Llama3.1

- RAG - Retrieval Augmented Generation



RAG with Llama3.1

- LLMs have a limited context length

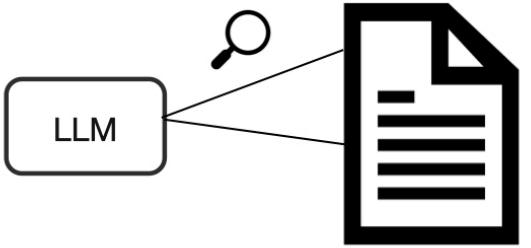


Q&A RAG Tech Friction of Access

- Framework for RAG Systems
- Friction of Access

Langchain Docs

RAG - Retrieval Augmented Generation



Langchain Docs

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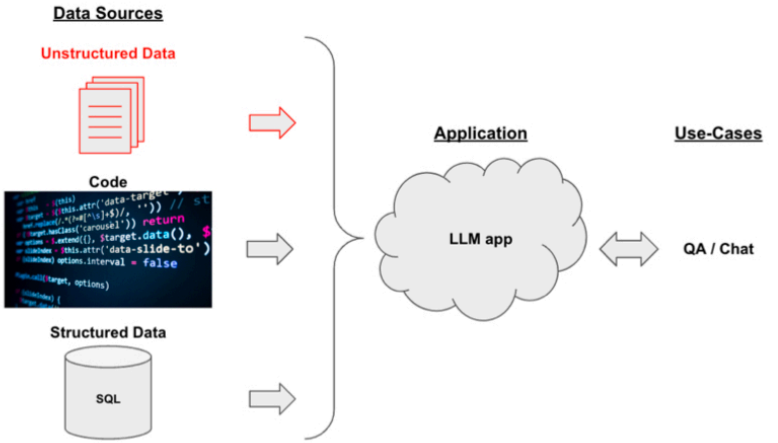

Langchain Docs

- RAG - Retrieval Augmented Generation
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Langchain Docs

- RAG - Retrieval Augmented Generation
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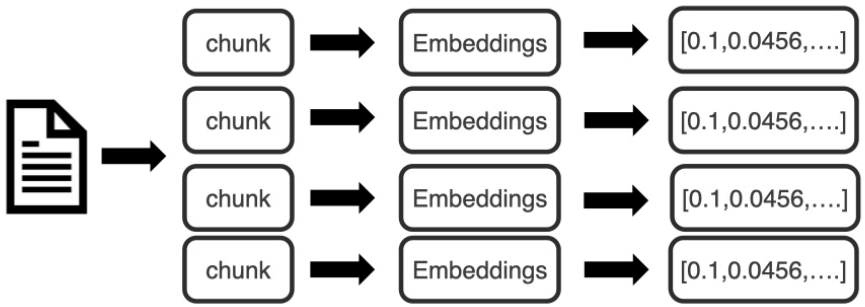
- **Embeddings**: capture content and meaning



Langchain Docs

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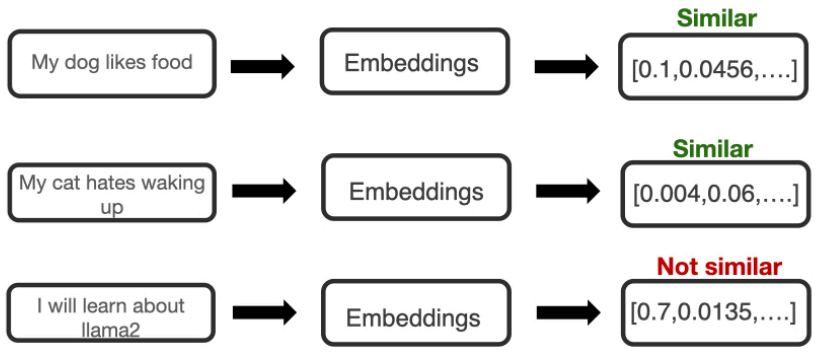

Langchain Docs

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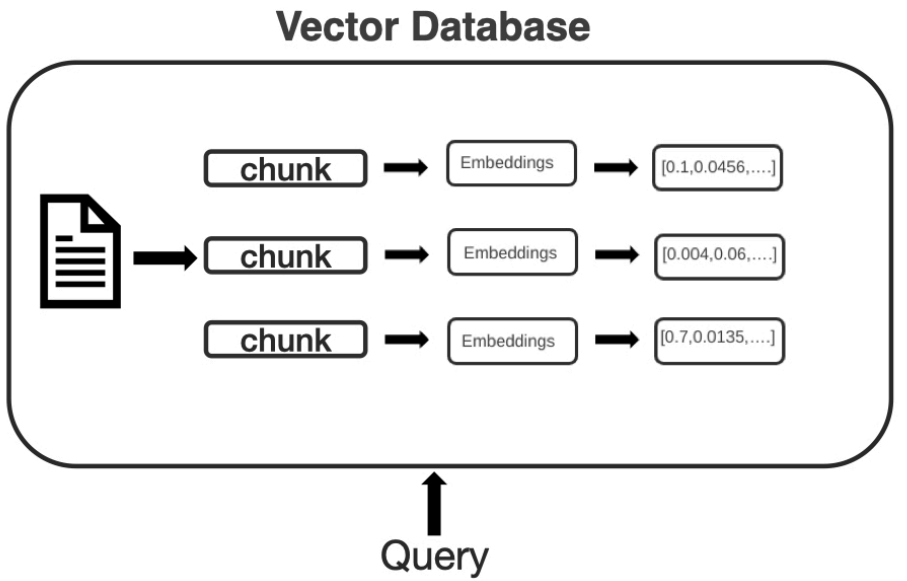
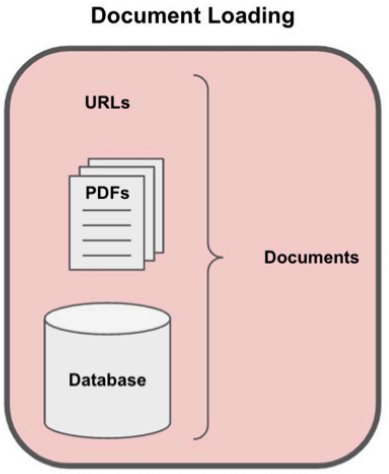


Langchain Docs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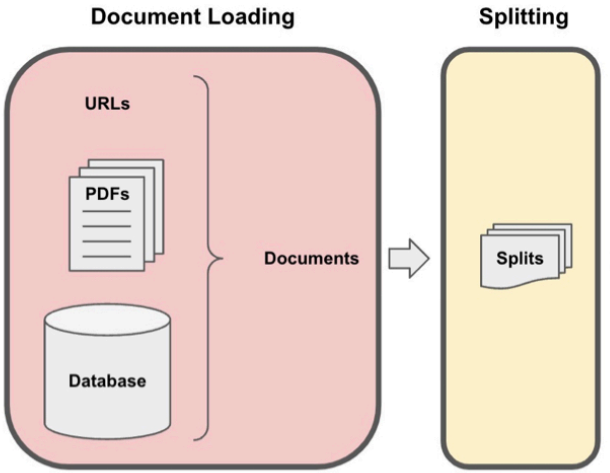
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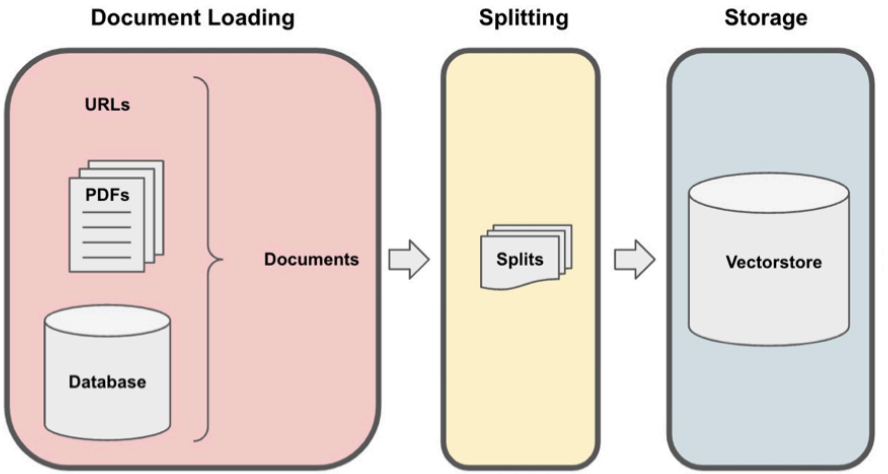
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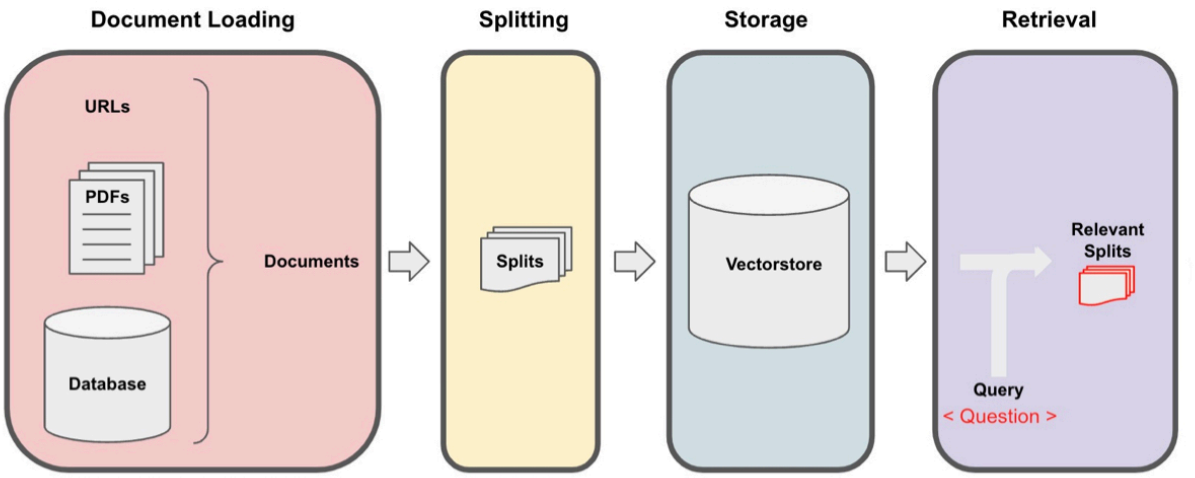
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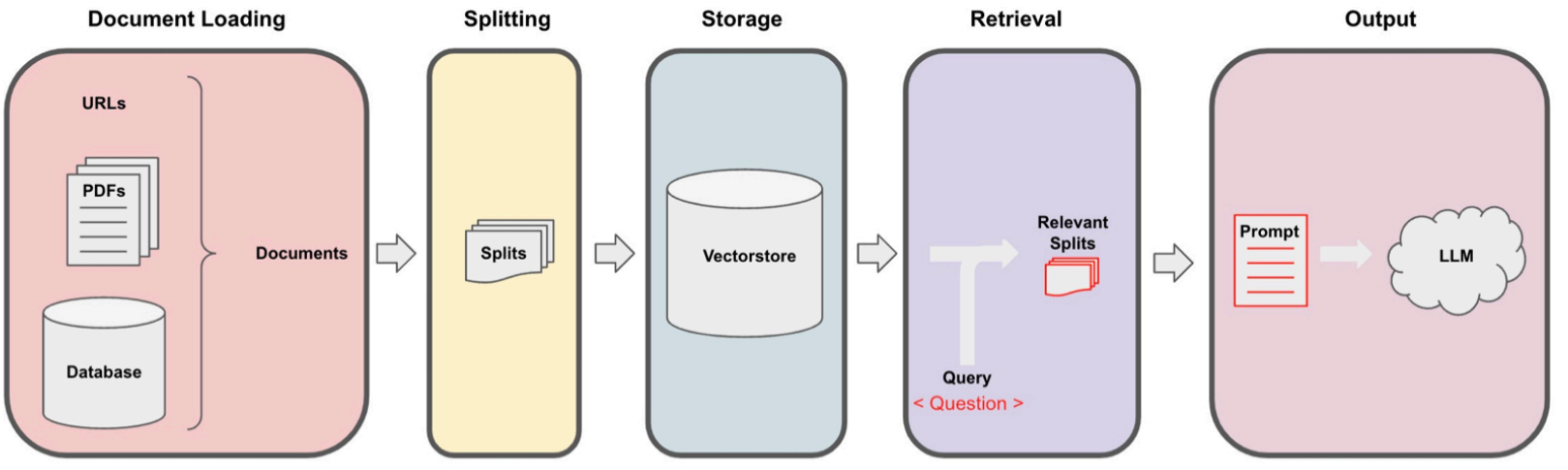
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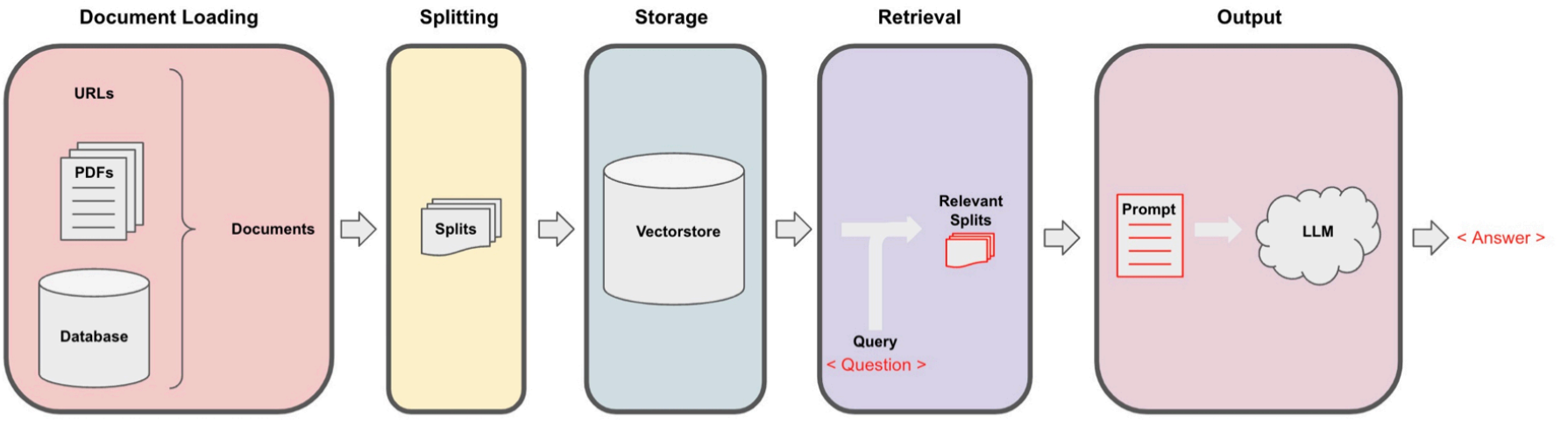
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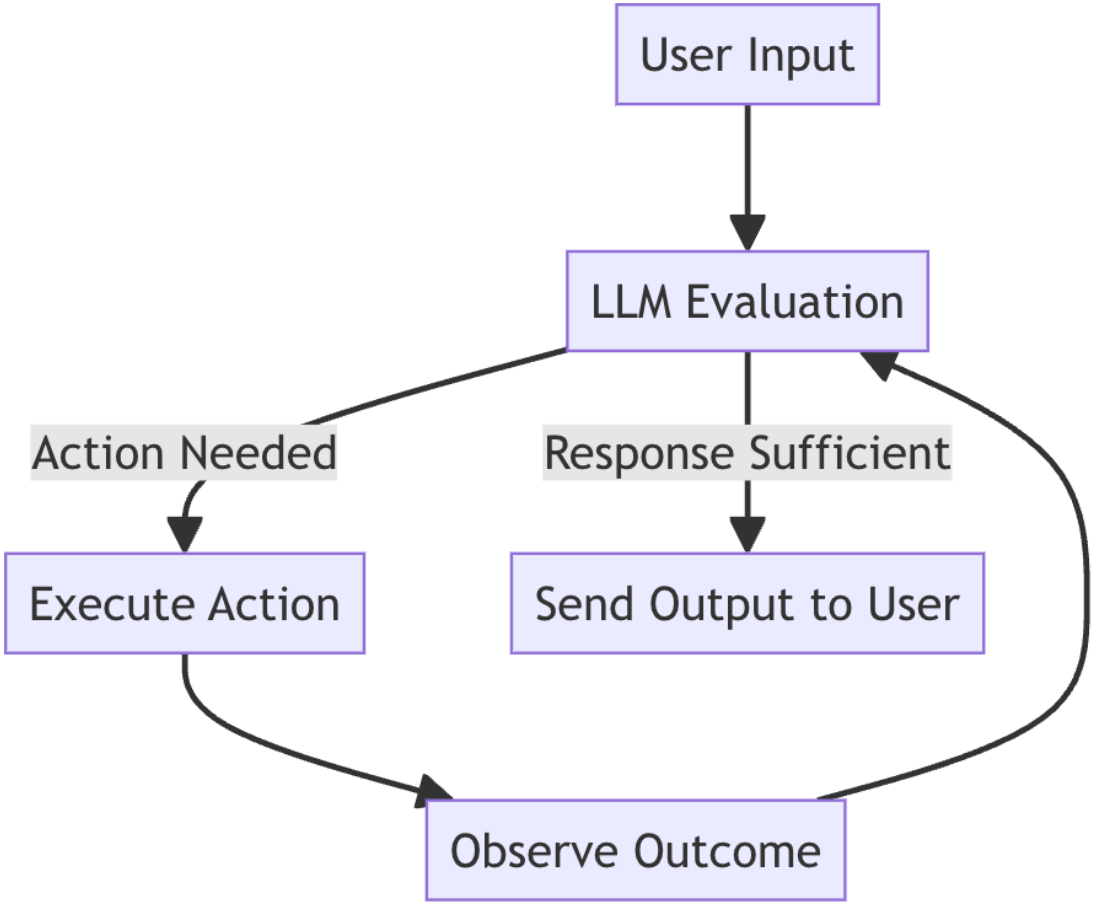
Notebook Demo - Local RAG with Llama 3.1

Q&A / Break

Local Agents with Llama 3.1

Local Agents with Llama 3.1



Explanation of the agent loop in cognitive architectures.

Practical Use Case: Customer Support Agent

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- **Scenario**: An LLM-powered customer support agent.

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- **User Input**: Customer asks about order status.

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- **LLM Decision**: Determines if it can provide the status directly or if it needs to fetch data from the database.

Practical Use Case: Customer Support Agent

- **Scenario**: An LLM-powered customer support agent.
- **User Input**: Customer asks about order status.
- **LLM Decision**: Determines if it can provide the status directly or if it needs to fetch data from the database.
- **Action Taken**: If data fetch is needed, the agent queries the database and updates the user with the order status.

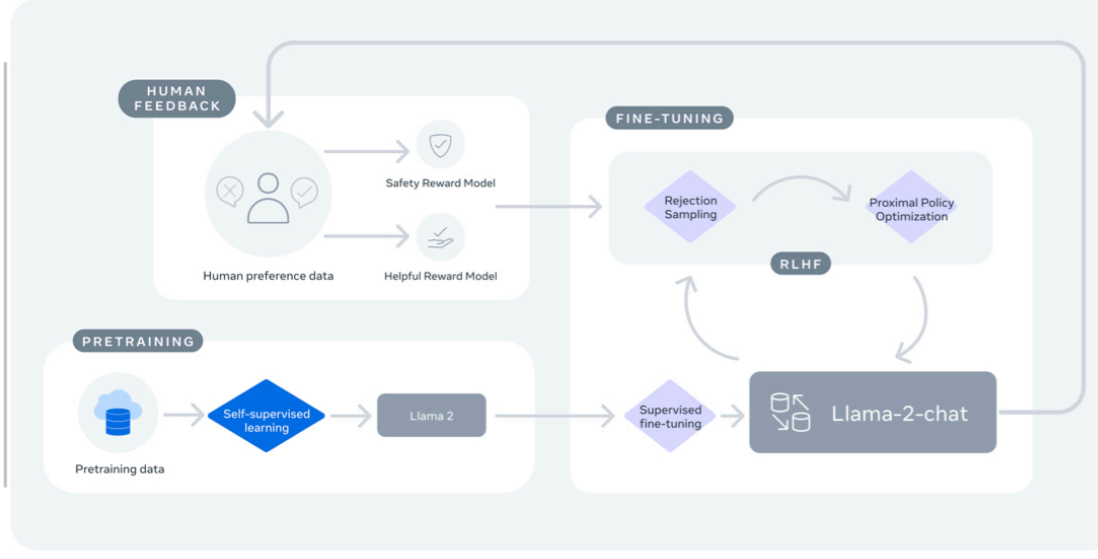
Practical use case of LLM agents in customer support.

Notebook Demo - Tool Calling and local agents with Llama 3.1

Q&A / Break

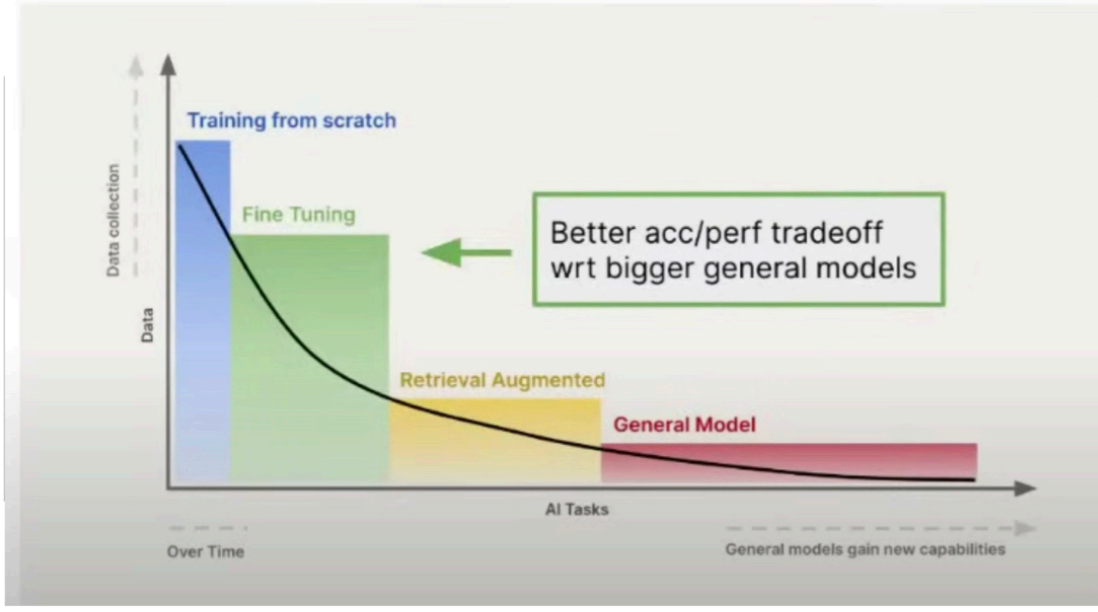
Fine Tunning Llama3.1

What is Fine Tuning?



LLama2 Paper

- What is Fine Tuning?
- Why Fine Tune?



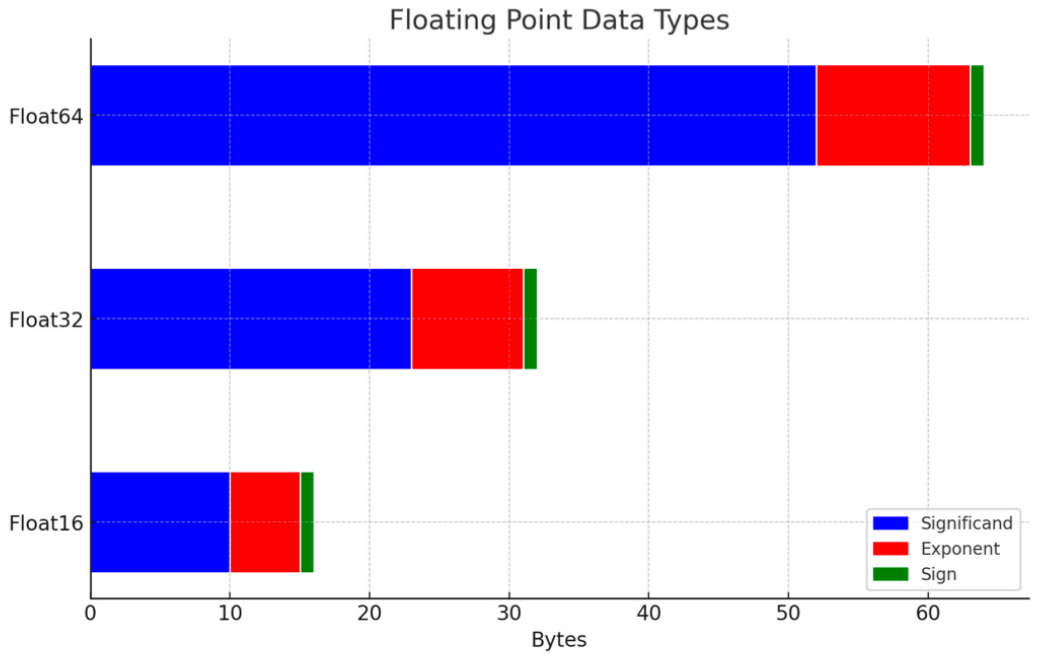
[Efficient Fine-Tuning for Llama-v2-7b on a Single GPU]

- What is Fine Tuning?
- Why Fine Tune?
- Memory cost of LLMs: parameters, gradients, optimiser states

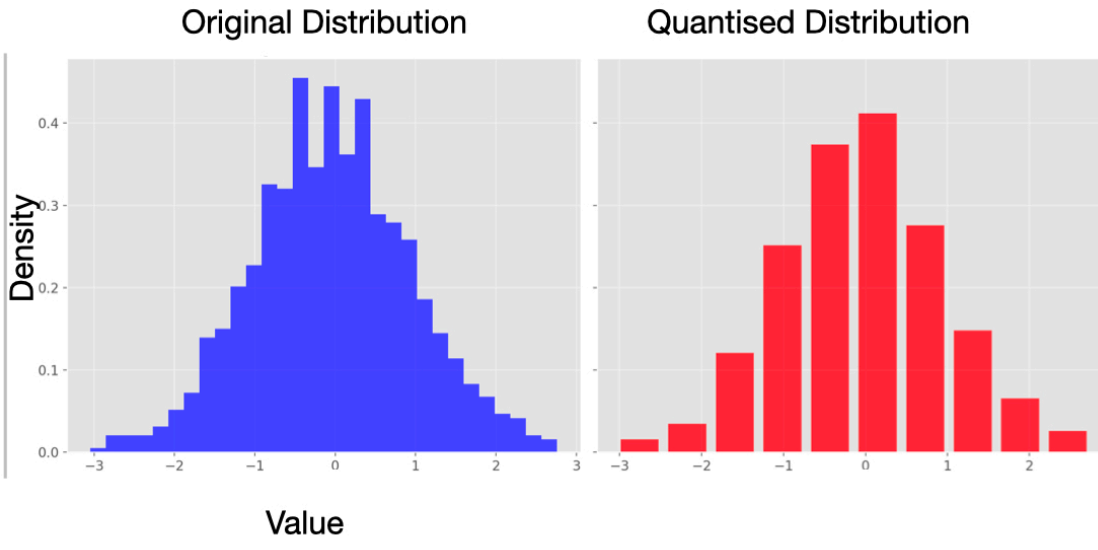
The Memory Bottleneck: GPU comparison

GPU	Tier	$ / hr (AWS)	VRAM (GiB)
H100	Enterprise	12.29	80
A100	Enterprise	5.12	80
V100	Enterprise	3.90	32
A10G	Enterprise	2.03	24
T4	Enterprise	0.98	16
RTX 4080	Consumer	N/A	16

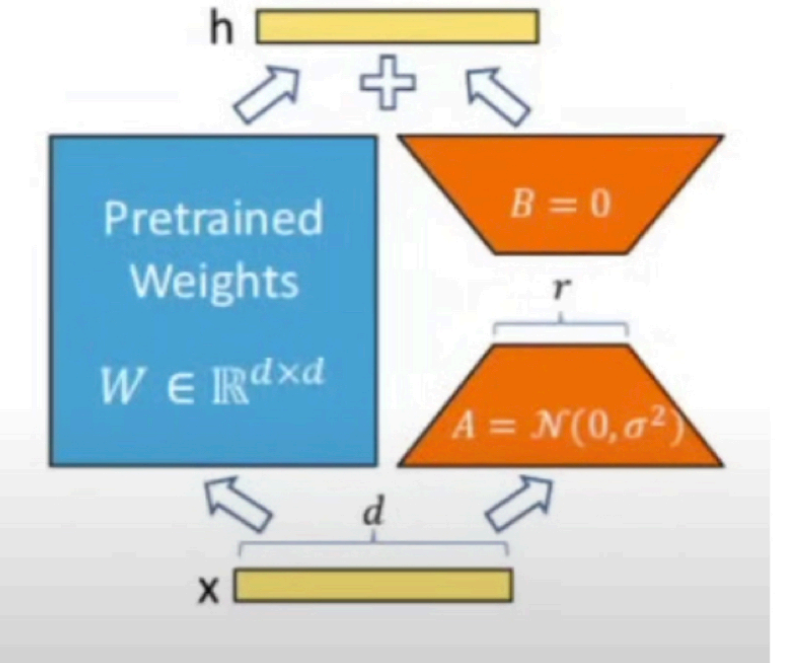
Problem - Loading Params
Solution - Half Precision



- Problem - Loading Params
  Solution - Half Precision
- Problem - Loading Gradients
  Solution - Quantization



- Problem - Loading Params
  Solution - Half Precision
- Problem - Loading Gradients
  Solution - Quantization
- Problem - Loading Optimizer States
  Solution - LoRA, QLora



Lora Paper

Notebook Demo - Fine-Tuning Llama3.1 - Walkthrough