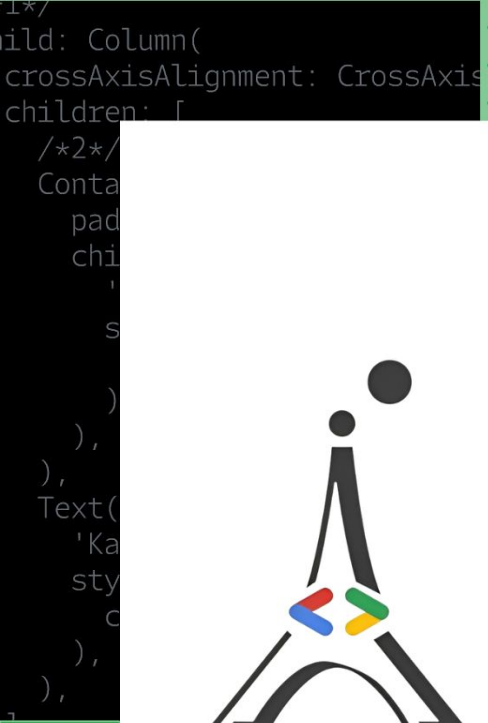

MASTERING AI WORKSHOP

Google Developer Student Clubs Paris-Saclay

Lucas J. Velôso

GDSC Lead

14/12/2023

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Agenda

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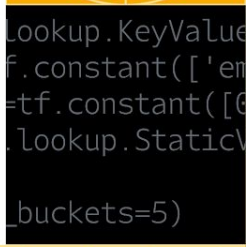
1. What are LLMs?
2. How LLMs work?
3. What is Fine-tuning?
4. What is Distillation?
5. What is **PEFT**?
6. What is **LoRA**
7. What is **QLoRA**?
8. Coding time...



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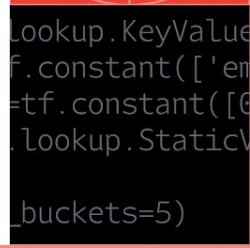
What are LLMs?



1. **Large Language Models (LLMs)** are advanced AI tools designed for processing and generating human-like text.

2. They **leverage vast amounts of data** to understand context, semantics, and language nuances.

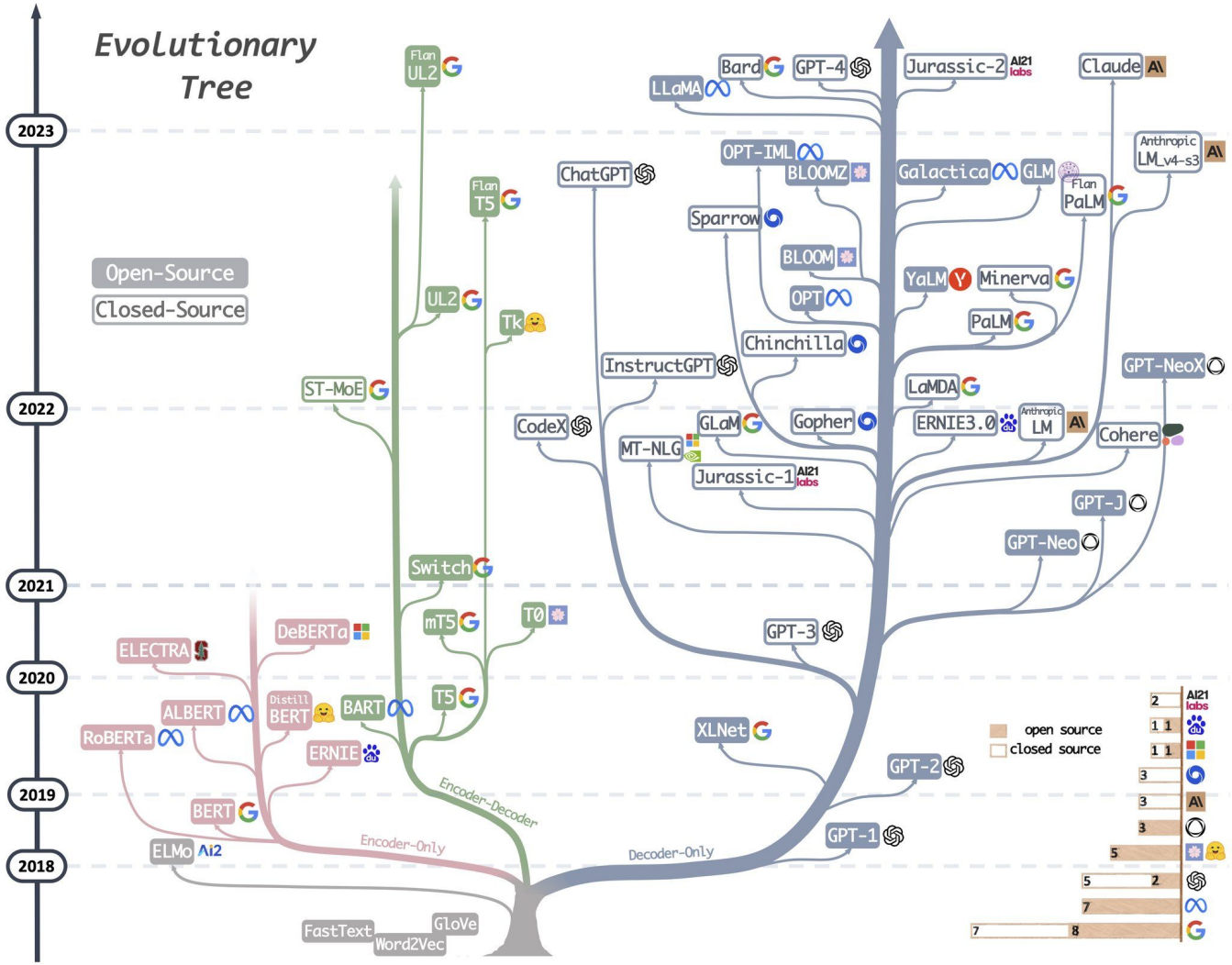
3. LLMs are used in various applications like **chatbots, content creation, and language translation**.

Gemini

LLaMA by Meta

Google Bard

Although various Large Language Models (LLMs) have existed since 2018, they only gained widespread popularity among the general public starting in 2022, with the advent of **ChatGPT**.



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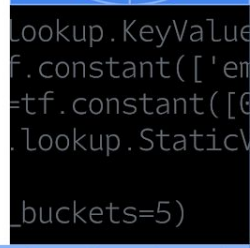
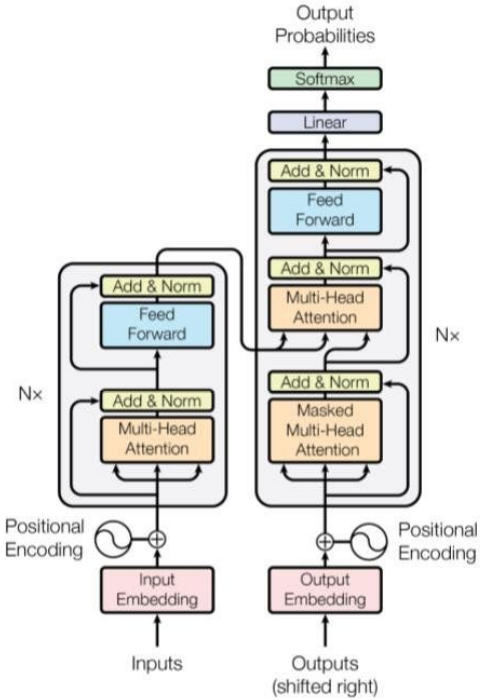
How LLMs work?

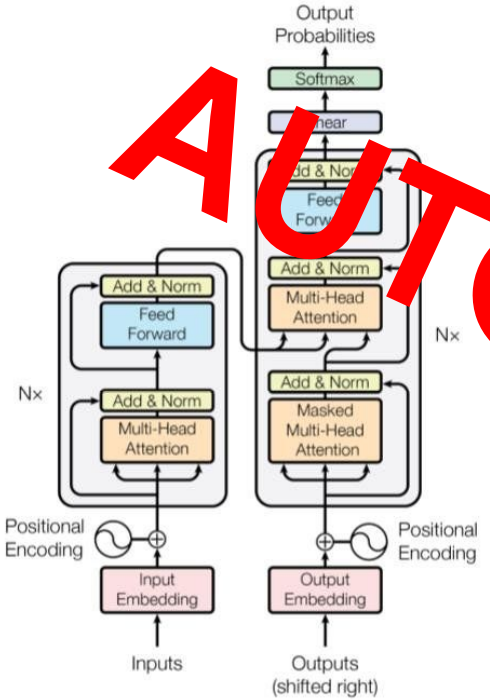




1. **Deep learning models**, primarily Transformers (Google 2017).

2. Multiple layers of processing (attention mechanisms, etc.)

3. Solves the task: **Given the phrase with is the next word?**



AUTOCOMPLETE

1. **Deep learning models**, primarily Transformers (Google 2017).
2. Multiple layers of processing (attention mechanisms, etc.)
3. Solves the task: **Given the phrase with is the next word?**

Stochastic Parrots

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What is Fine-Tuning?

Fine-Tuning

Gigantic web-scale dataset

Fine-Tuning

Gigantic web-scale dataset

Base LLM

Fine-Tuning

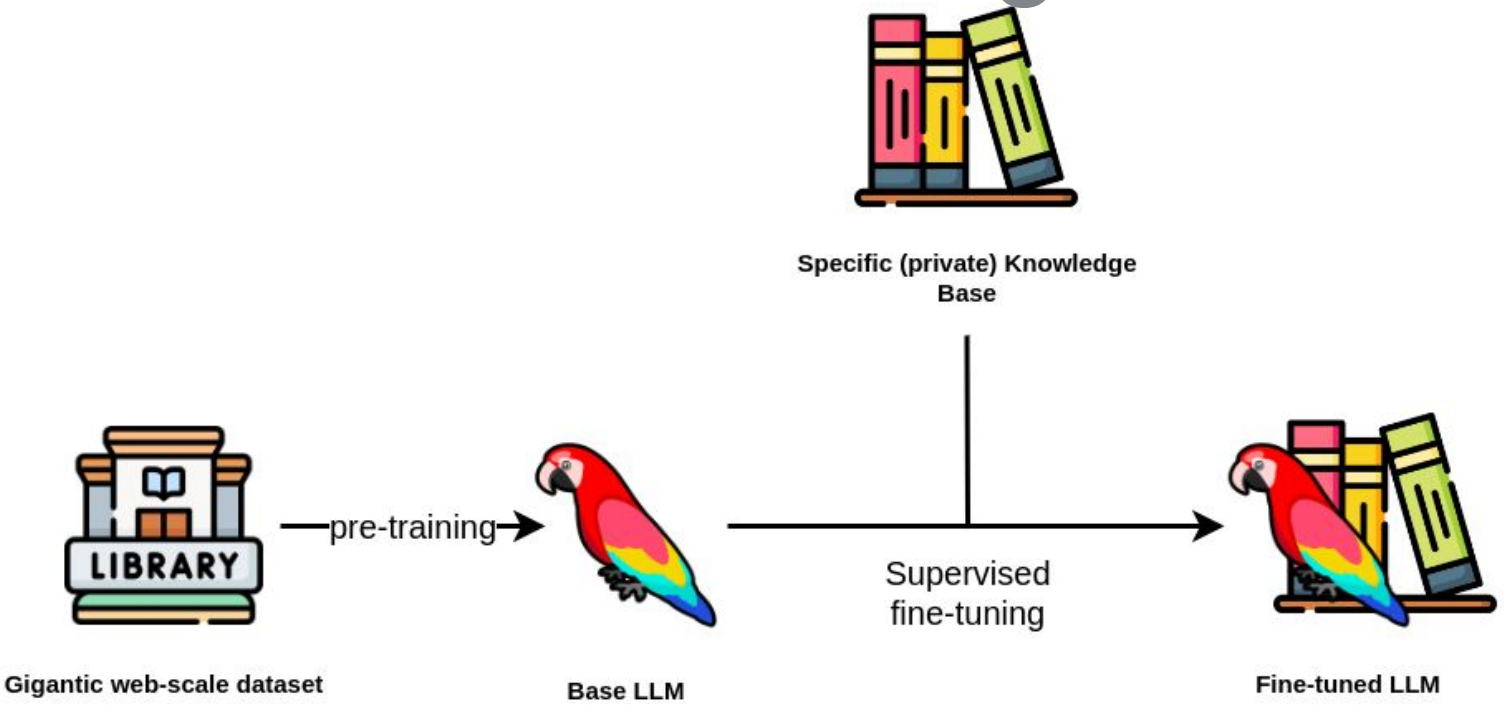
Specific (private) Knowledge Base

—pre-training→

Gigantic web-scale dataset

Base LLM

Fine-Tuning


Specific (private) Knowledge Base
LIBRARY
pre-training
Supervised fine-tuning
Gigantic web-scale dataset
Base LLM
Fine-tuned LLM

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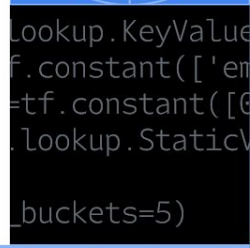
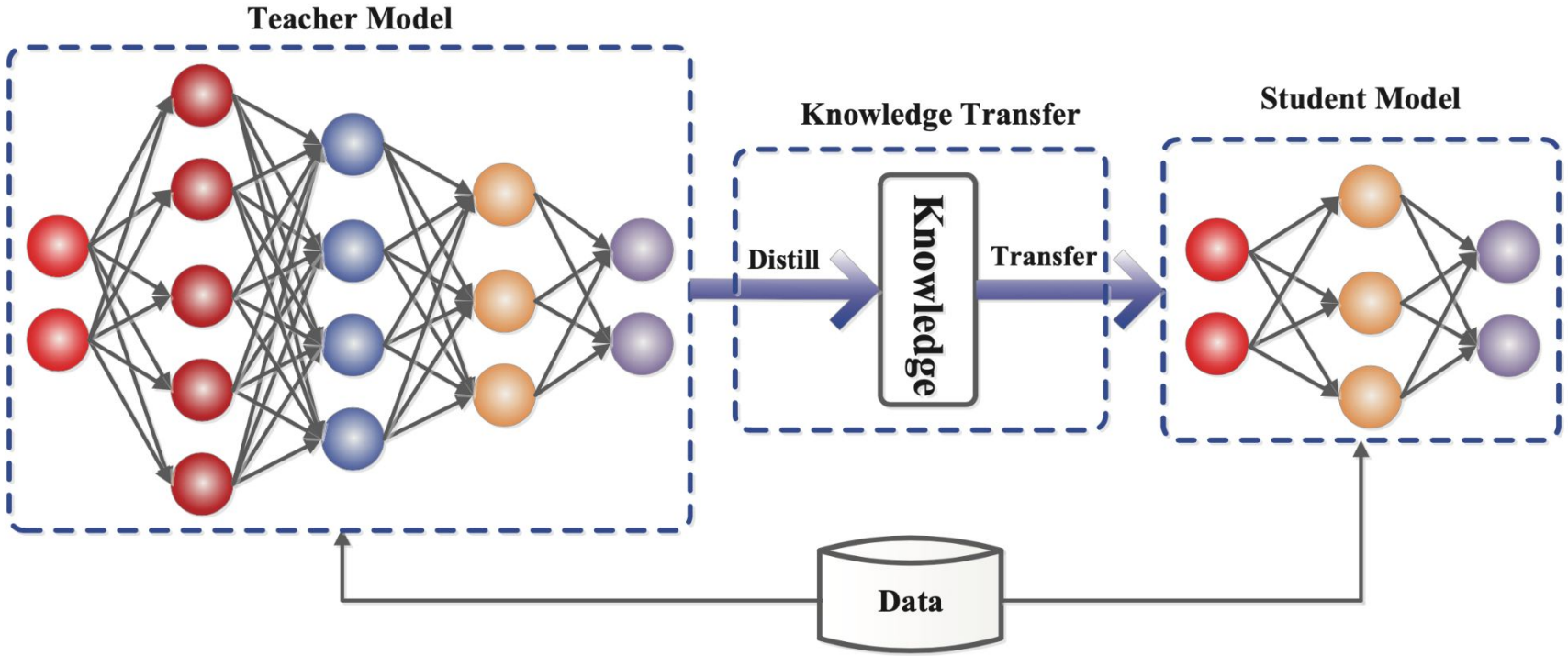
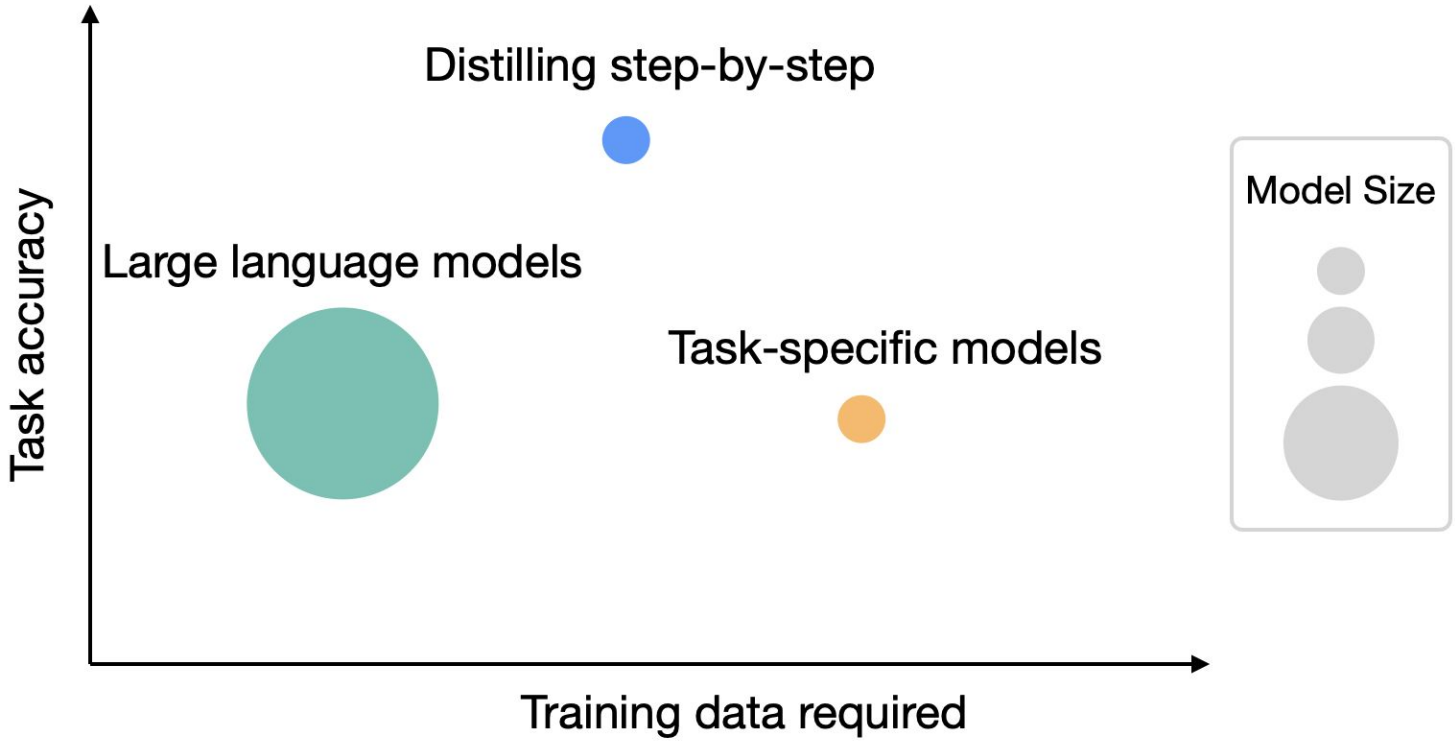
What is Distillation?




Teacher Model
Knowledge Transfer
Student Model
Distill
Knowledge
Transfer
Data


Distilling step-by-step
Large language models
Task-specific models
Task accuracy
Training data required
Model Size

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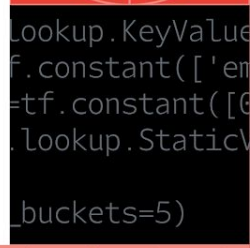
What is PEFT?



Parameter-Efficient Fine-Tuning (PEFT)

Parameter-Efficient Fine-Tuning (PEFT) by **Hugging Face** is a technique to adapt large models for specific tasks by **fine-tuning only a few parameters**, reducing computational and storage demands

Hugging Face

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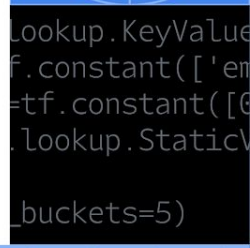
What is LoRA?



LoRA

Finetuned Weights

Weight Update

$$W_{\mathbf{ft}} = W_{\mathbf{pt}} + \Delta W$$

Pretrained Weights

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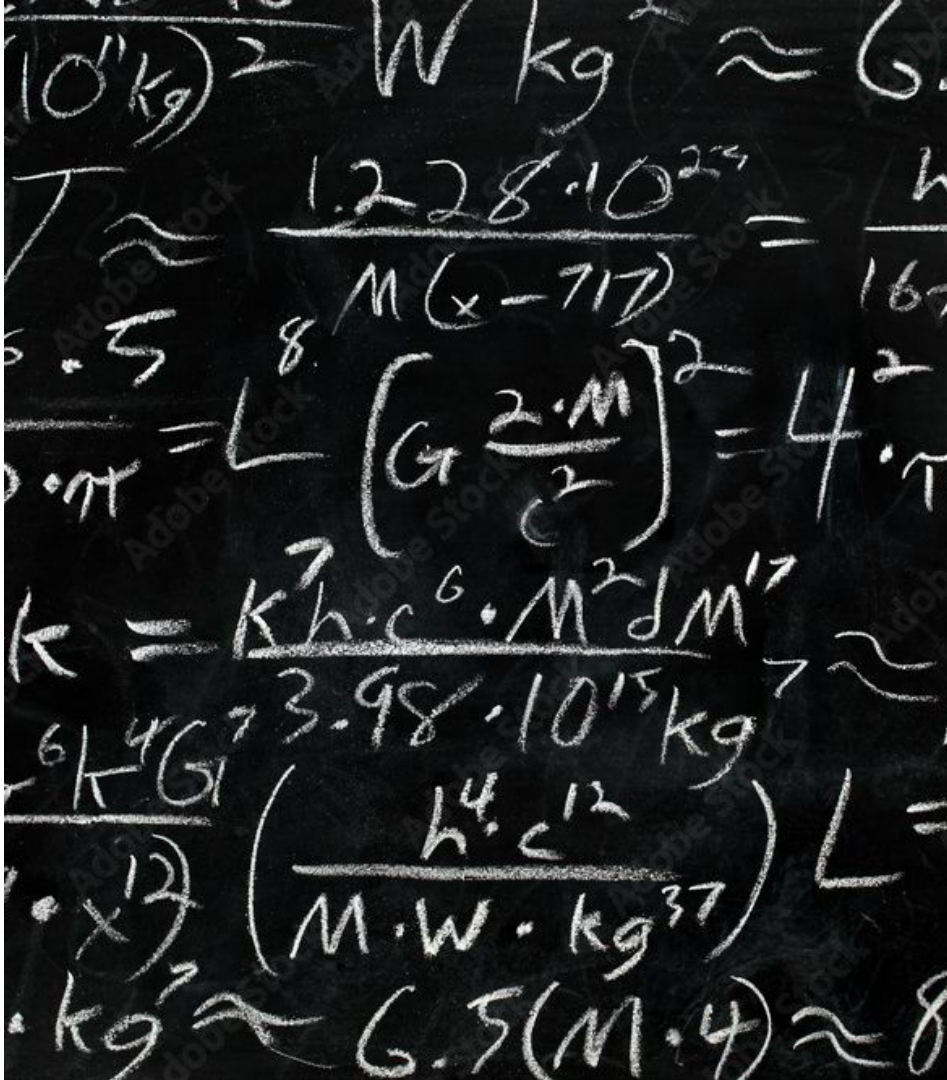
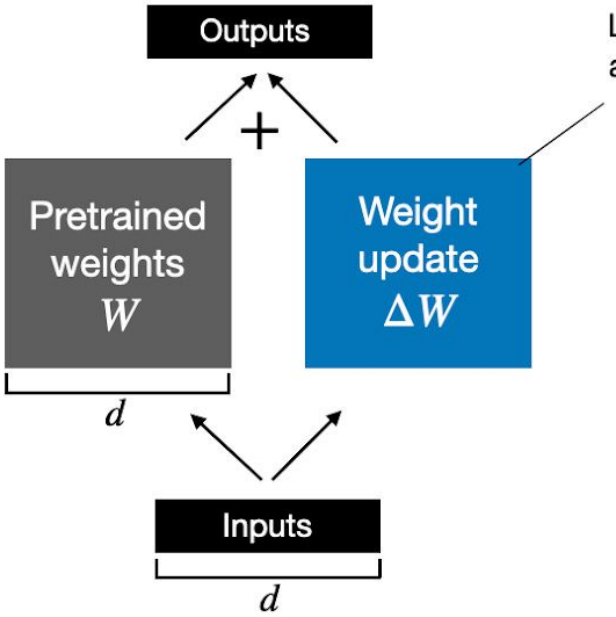
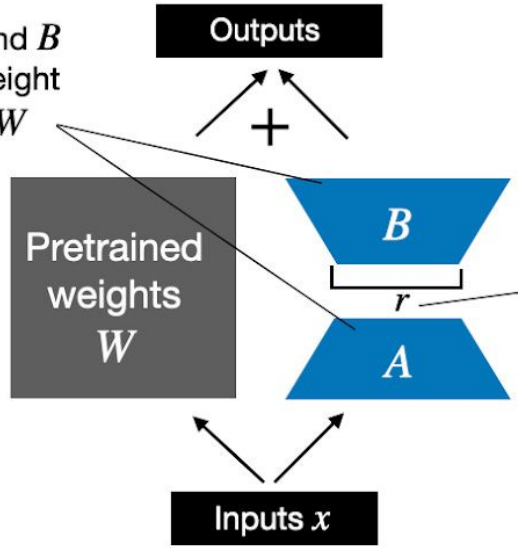


Weight update in regular finetuning



LoRA matrices A and B approximate the weight update matrix ΔW

Weight update in LoRA



The inner dimension r is a hyperparameter

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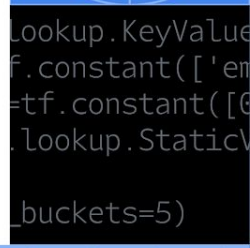
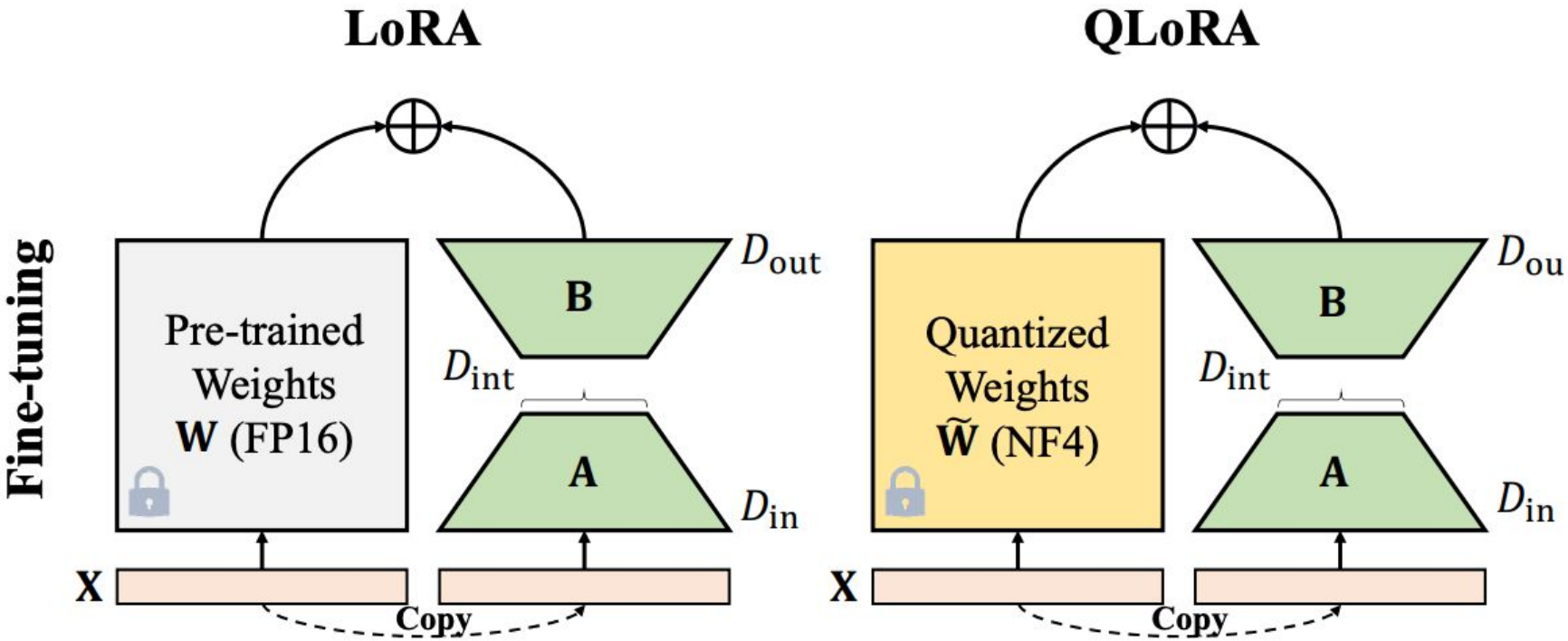
What is QLoRA?



QLoRA


LoRA
QLoRA
Fine-tuning
Pre-trained
Weights
W (FP16)
B
A
D_{out}
D_{int}
D_{in}
X
Copy
Quantized
Weights
$\widetilde{\mathbf{W}}$ (NF4)
B
A
D_{ou}
D_{int}
D_{in}
X
Copy

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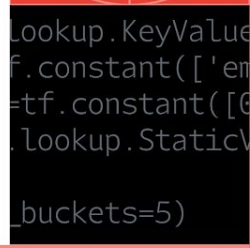
Coding Time...



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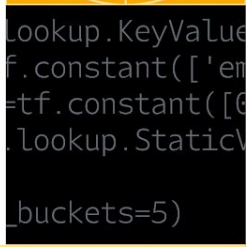
STARTUP CASE



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1. It **must** run in a cell phone!!

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1. It **must** run in a cell phone!!
2. It **must** run offline!!

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1. It **must** run in a cell phone!!
2. It **must** run offline!!
3. The cost must be at **maximum** $1

Thank you for joining!

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