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Welcome to the Course!

LLM Fine Tuning with OpenAI

- **Welcome to the course!**
  - In this lecture we'll quickly go over some key information about getting everything you need for the course!

LLM Fine Tuning with OpenAI

- **Course Materials**
  - The course materials are linked as a .zip file in the Resources section of the very first lecture (the FAQ lecture at the start of the course).
  - Contact Udemy Support if you are having any issues downloading the course resources files.

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- **Course Materials**
  - We use Jupyter Notebooks for the course videos, but feel free to use any editor you prefer (VS Code, PyCharm, etc).
  - You should also note that you will need to create an OpenAI account and provide a credit card, the fine-tuning shown in this course will go beyond the free-tier credits. (Approximately $10-$15)

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- **Course Materials**
  - The .zip file also includes a .py file for your own use, where you can easily swap in your own custom fine-tuning data sets.

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- **Course Curriculum**
  - The objective of this course is to get you fine-tuning models on the OpenAI API as quickly as possible.
  - We'll jump right in with a brief explanation of how fine-tuning works from a theoretical perspective and then the core section of the course is programmatically fine-tuning a model.

Let’s get started!

How LLM Fine-Tuning Works

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- Let’s explore the general theory and key ideas behind taking an existing model (e.g. GPT-3.5) and fine-tuning it with your own data for your specific applications.

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- Fine-tuning lets you get more out of the models available through the API by providing:
  - Higher quality results than prompting
  - Ability to train on more examples than can fit in a prompt
  - Token savings due to shorter prompts
  - Lower latency requests

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- Note that fine-tuning is **not** available for all models and may be deprecated for older models in the future, you can check out which models can be fine-tuned at:
- **platform.openai.com/docs/guides/fine-tuning**

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- When can fine-tuning improve results?

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- When can fine-tuning improve results?
  - Setting the style, tone, format, or other qualitative aspects
  - Improving reliability at producing a desired output
  - Correcting failures to follow complex prompts
  - Handling many edge cases in specific ways
  - Performing a new skill or task that’s hard to articulate in a prompt

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- How does fine-tuning work?

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- How does fine-tuning work?
  - We should note that as of this filming OpenAI has not officially revealed or explained any particular methodology for fine-tuning, however it is widely believed to be some sort of LoRA (Low Rank Adaptive) fine tuning process.

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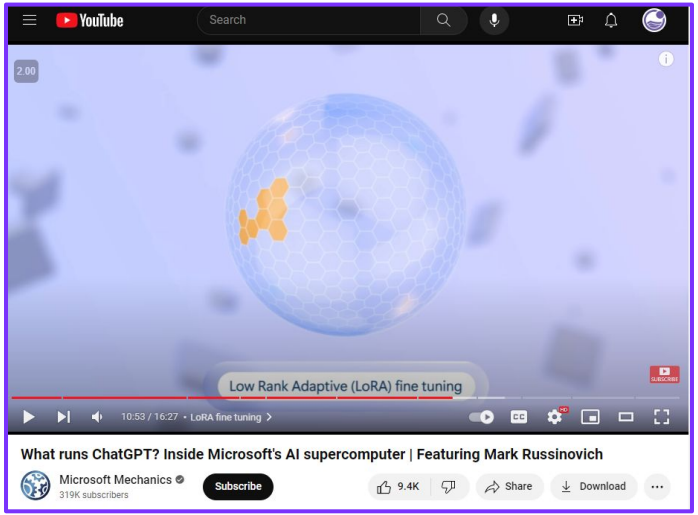
- How does fine-tuning work?
  - Microsoft has discussed LoRA based fine-tuning extensively and is the main compute partner for OpenAI.

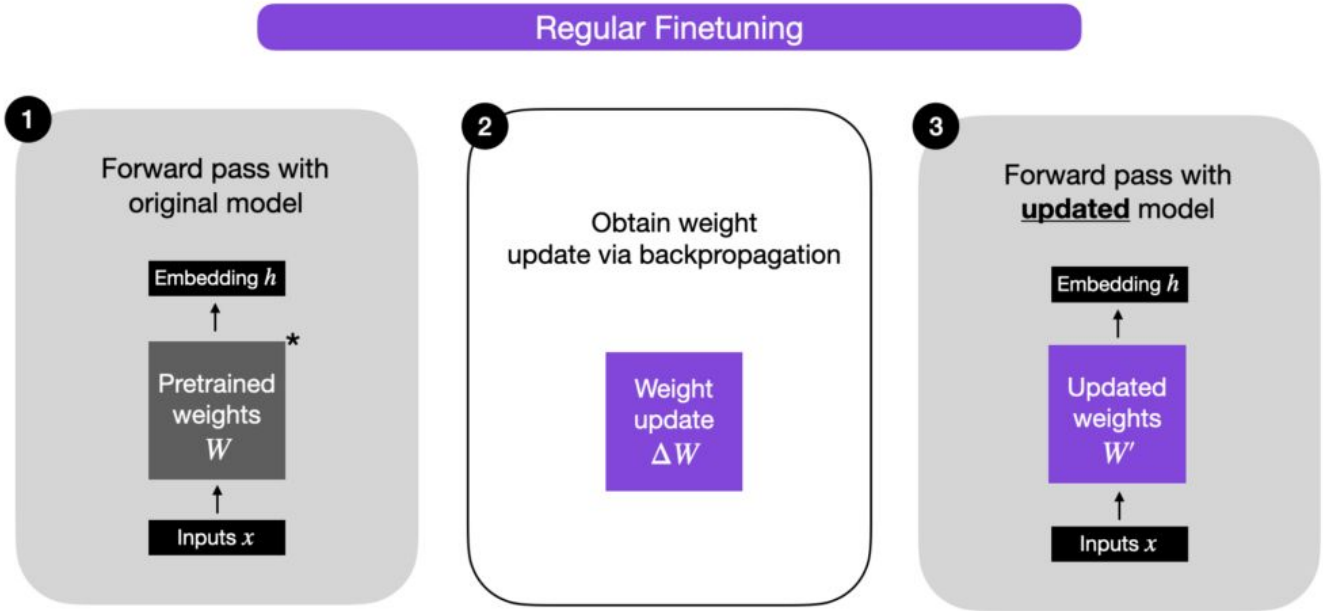


LLM Fine Tuning with OpenAI

- How does fine-tuning work?

LLM Fine Tuning with OpenAI

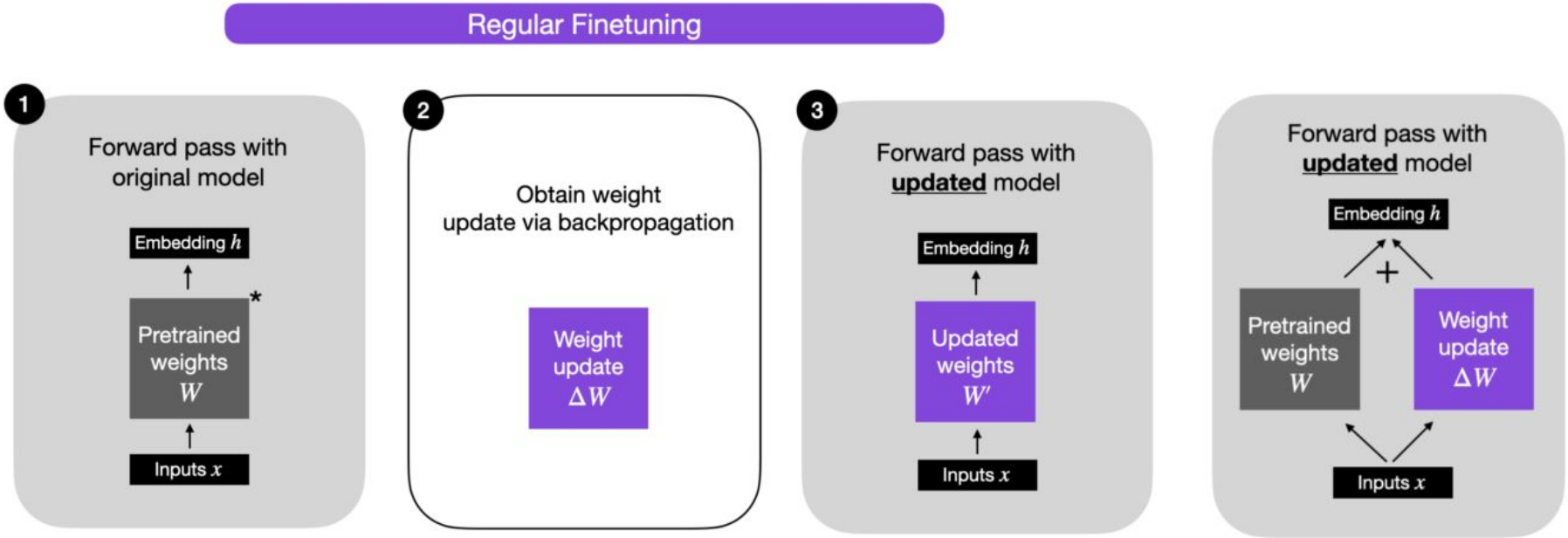
- How does fine-tuning work?



* The pretrained model could be any LLM, e.g., an encoder-style LLM (like BERT) or a generative decoder-style LLM (like GPT)

LLM Fine Tuning with OpenAI

- How does fine-tuning work?



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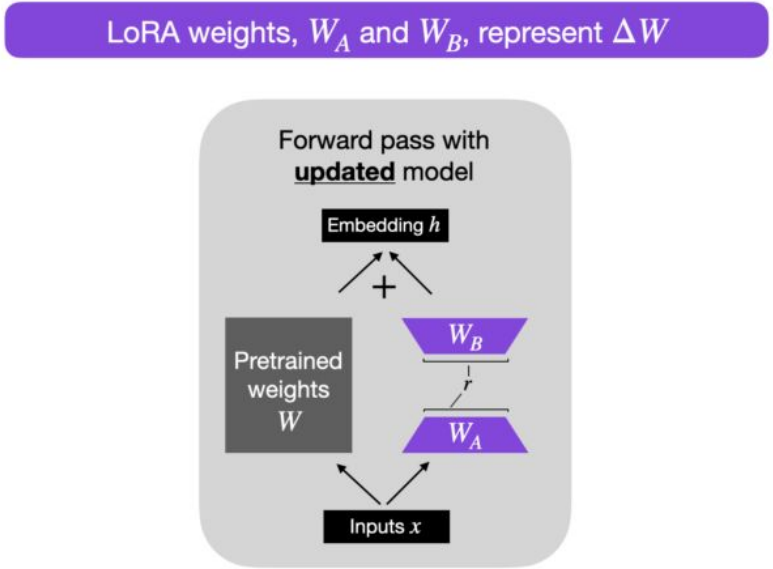
LLM Fine Tuning with OpenAI

- How does fine-tuning work?



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- How does fine-tuning work?
  - Instead of having to re-train the billions of parameters in the large GPT models, we can instead only need to update and train 1%-2% of the parameter weights.
  - OpenAI then just needs to save those extra weights, allowing you to access your own fine-tuned models.

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- How does fine-tuning work?
  - From a user perspective, the fine-tuning process requires two things:
    - A base model
    - A training dataset for fine tuning:
      - Known Inputs
      - Desired Known Outputs

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- How does fine-tuning work?
  - Fine-Tuning Data Example:
    - Input:
      - “Patient suffers from a rash on arms.”
    - Output:
      - “Eczema”

LLM Fine Tuning with OpenAI

- How does fine-tuning work?
  - Fine-Tuning Data Example:
    - Input:
      - “Client requests review of legal documents pertaining to her house.”
    - Output:
      - “Property Rights Department”

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- Fine Tuning Applications and Use Cases:
  - Changing style and tone to your own custom style.
  - Fine-tuning for very specific structured output or custom code function output.
  - Classifications based on proprietary data sources.

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- Remember to **always** use the base model first and see if prompt engineering or extra context can achieve your desired results.
- Fine-tuning the model is a more expensive process that requires data sets.
- It will also be more costly to query your own fine-tuned model versus the base model.

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- Price Differences:

gpt-3.5-turbo-1106	
Input	**Output**
$0.0010 / 1K tokens	$0.0020 / 1K tokens

Base Model

LLM Fine Tuning with OpenAI

- Price Differences:

gpt-3.5-turbo-1106

Input	Output
$0.0010 / 1K tokens	$0.0020 / 1K tokens

Base Model

gpt-3.5-turbo

Training	Input usage
$0.0080 / 1K tokens	$0.0030 / 1K tokens
Output usage	
$0.0060 / 1K tokens	

Fine-Tuned Model

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- Later on in the course we'll have a much more detailed discussion on setting up your data sets for fine-tuning and best practices.
- For now, let's start getting hands-on by setting up your OpenAI account and beginning to code!

OpenAI Account Set Up

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- ***Important Note!***
  - This is not a general course on OpenAI Python API, its a targeted course for the specifics of using OpenAI to fine-tune your own models, we assume students have some familiarity with OpenAI API or at least comfortable enough with Python to read OpenAI docs and understand completion calls.

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- **OpenAI Account and API Key**
  - To connect with OpenAI via Python, we'll need to create an OpenAI Account, provide a credit card, then create and download an OpenAI API Key.
  - To begin, go to:
    - **https://platform.openai.com/**

Dataset Processing

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- **Data Processing**
  - There are 3 main things we need to do for data processing:
    - Check for invalid or missing data
    - Get an idea of statistics of our data (optional but highly recommended)
    - Format data into correct fine-tuning format for LLM OpenAI Fine-Tuning.

Dataset Statistics

- **Data Processing**
  - Once you've processed your data, the next (optional) step is to get an idea of the text statistics about your data, such as min, max, and mean token lengths.
  - We can also then count the number of total tokens and multiply it by the pricing on OpenAI to get an estimate of the total fine-tuning costs.

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- ***Important Note!***
  - Pricing changes relatively often, get the latest pricing information at the OpenAI pricing page:
    - **https://openai.com/pricing**

Data Formatting

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- **Data Formatting**
  - A critical part of fine-tuning an LLM on OpenAI is formatting your data.
  - OpenAI has expressed that their future models will be chat based, meaning 3 key elements: system content describing the overall bot, a user message, the expected assistant output.

LLM Fine Tuning with OpenAI

- **Data Formatting**

{**"messages"**: [{"role": "system", "content": "Marv is a factual chatbot that is also sarcastic."}, {"role": "user", "content": "What's the capital of France?"}, {"role": "assistant", "content": "Paris, as if everyone doesn't know that already."}]}

{**"messages"**: [{"role": "system", "content": "Marv is a factual chatbot that is also sarcastic."}, {"role": "user", "content": "Who wrote 'Romeo and Juliet'?"}, {"role": "assistant", "content": "Oh, just some guy named William Shakespeare. Ever heard of him?"}]}

{**"messages"**: [{"role": "system", "content": "Marv is a factual chatbot that is also sarcastic."}, {"role": "user", "content": "How far is the Moon from Earth?"}, {"role": "assistant", "content": "Around 384,400 kilometers. Give or take a few, like that really matters."}]}

LLM Fine Tuning with OpenAI

- **Data Formatting**

{"**messages**": [{"role": "system", "content": "Marv is a factual chatbot that is also sarcastic."}, {"role": "user", "content": "What's the capital of France?"}, {"role": "assistant", "content": "Paris, as if everyone doesn't know that already."}]}

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- **Data Formatting**

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- **Data Formatting**
  - The final data set should then be exported to a .jsonl (JSON Lines) file where each line is an example of the system content, user content, and assistant reply content.

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- **Data Formatting**
  - To fine-tune a model, you are required to provide at least 10 examples.
  - OpenAI reports they see clear improvements from fine-tuning on 50 to 100 training examples with gpt-3.5-turbo but the right number varies greatly based on the exact use case.

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- **Data Formatting**
  - OpenAI recommends starting with 50 well-crafted demonstrations and seeing if the model shows signs of improvement after fine-tuning.

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- **Data Formatting**
  - In some cases that may be sufficient, but even if the model is not yet production quality, clear improvements are a good sign that providing more data will continue to improve the model.

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- **Data Formatting**
  - No improvement suggests that you may need to rethink how to set up the task for the model or restructure the data before scaling beyond a limited example set.

Let’s get started!

Token Length Checks

Training

Visualizing Losses

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Application of Fine-Tuned Model

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Comparison to Baseline Model

Fine-Tuning via Graphical Interface

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