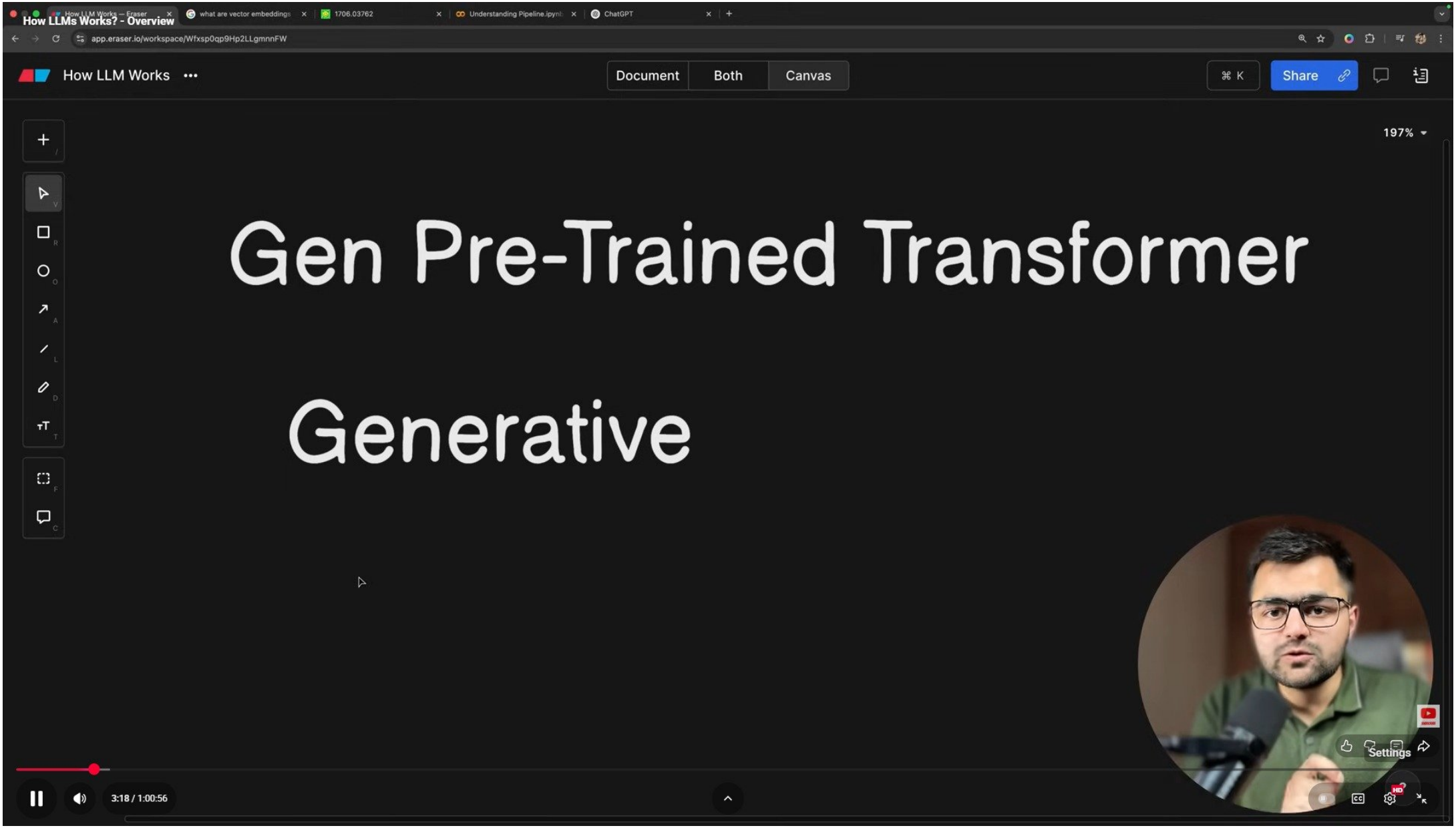
How LLMs Works? - Overview
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How LLM Works
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Gen Pre-Trained Transformer
Generative
3:18 / 1:00:56
Settings

Attention Is All You Need

Ashish Vaswani* Google Brain avaswani@google.com

Noam Shazeer* Google Brain noam@google.com

Niki Parmar* Google Research nikip@google.com

Jakob Uszkoreit* Google Research usz@google.com

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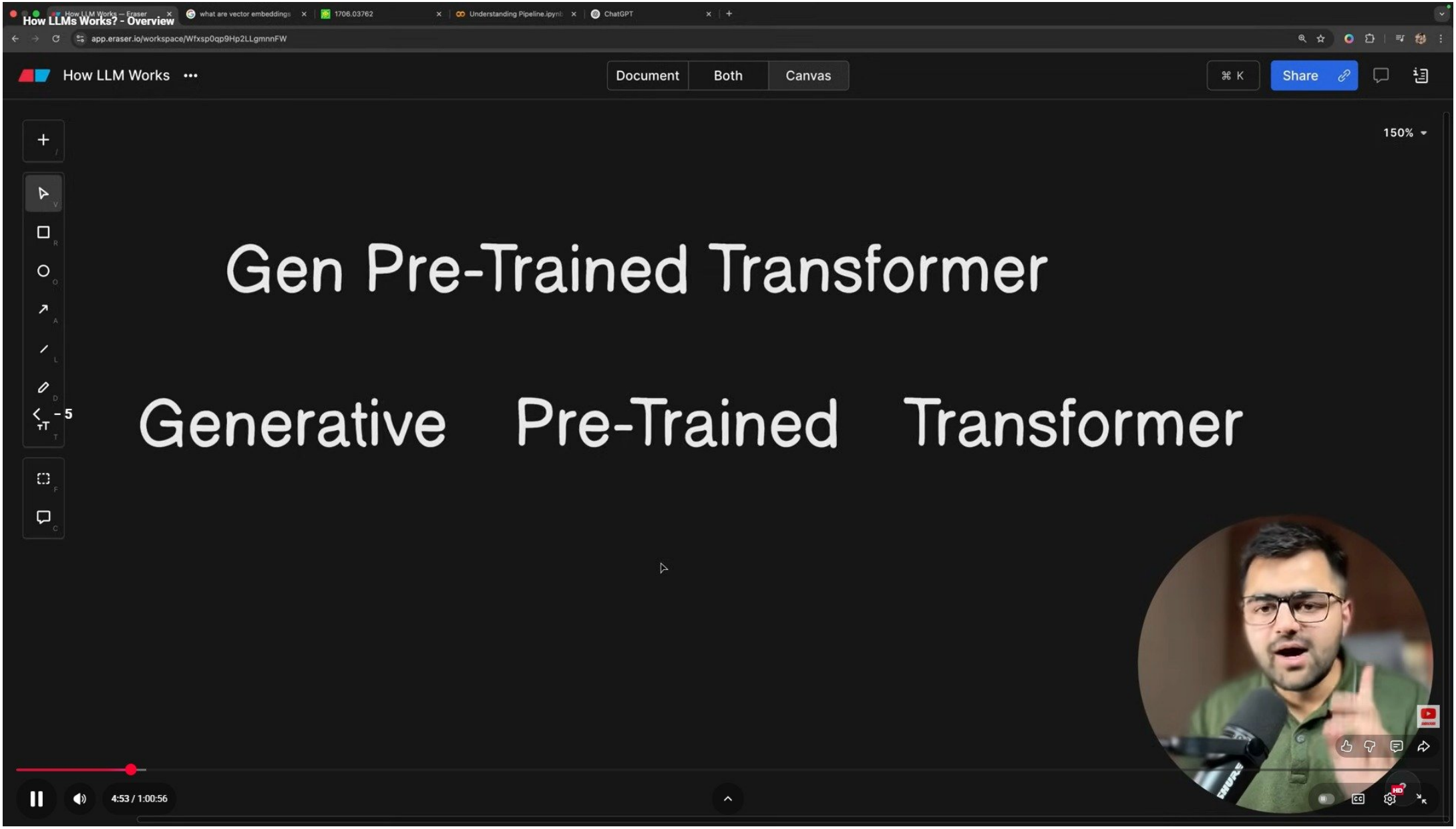
Illia Polosukhin* ‡ illia.polosukhin@gmail.com

Abstract

The dominant sequence transduction models are based on complex recurrent or convolutional neural networks that include an encoder and a decoder. The best performing models also connect the encoder and decoder through an attention mechanism. We propose a new simple network architecture, the Transformer, based solely on attention mechanisms, dispensing with recurrence and convolutions entirely. Experiments on two machine translation tasks show these models to be superior in quality while being more parallelizable and requiring significantly less time to train. Our model achieves 28.4 BLEU on the WMT 2014 English-to-German translation task, improving over the existing best results, including ensembles by over 2 BLEU. On the WMT 2014 English-to-French translation task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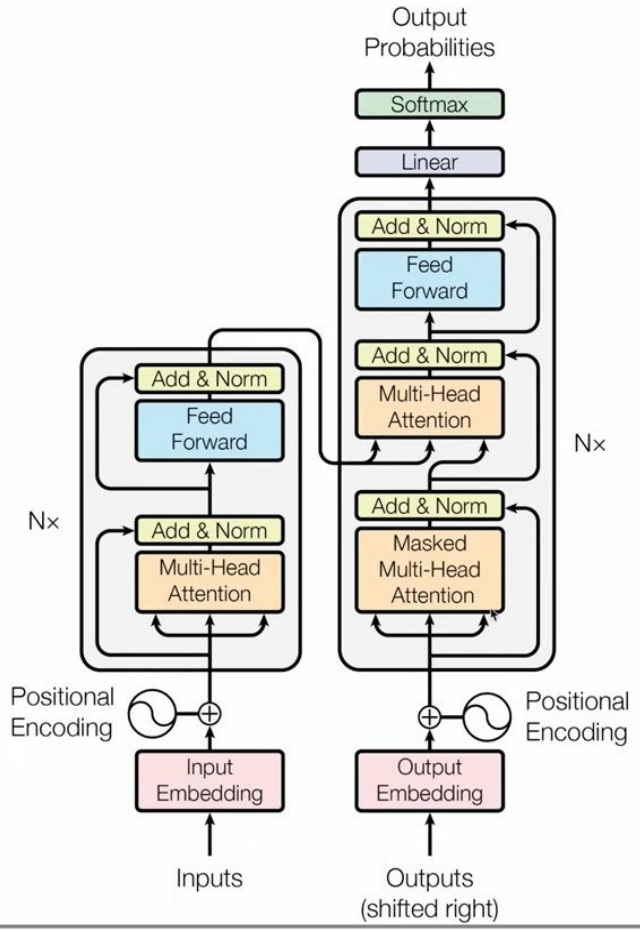
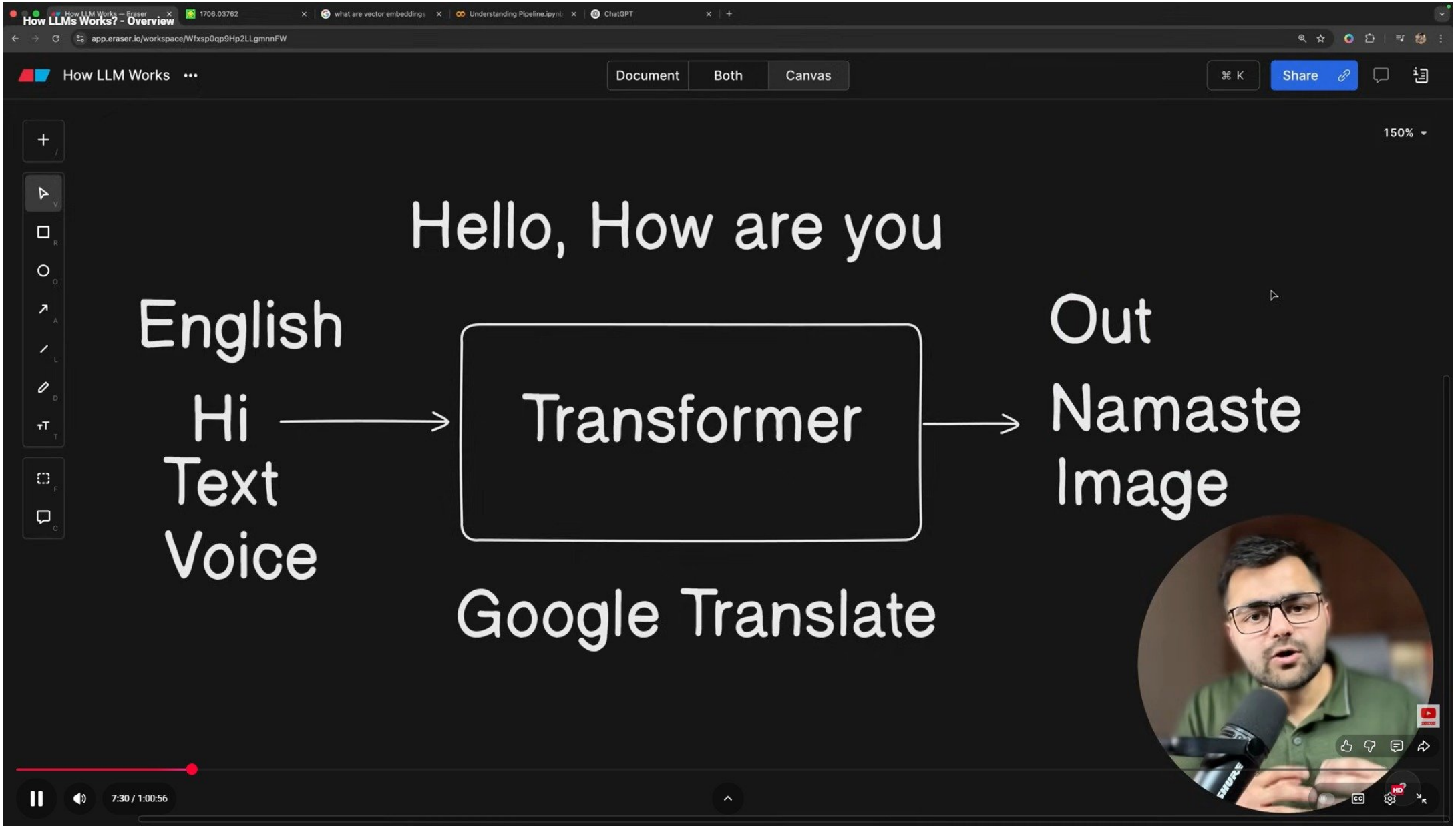


Figure 1: The Transformer - model architecture.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Google Translate
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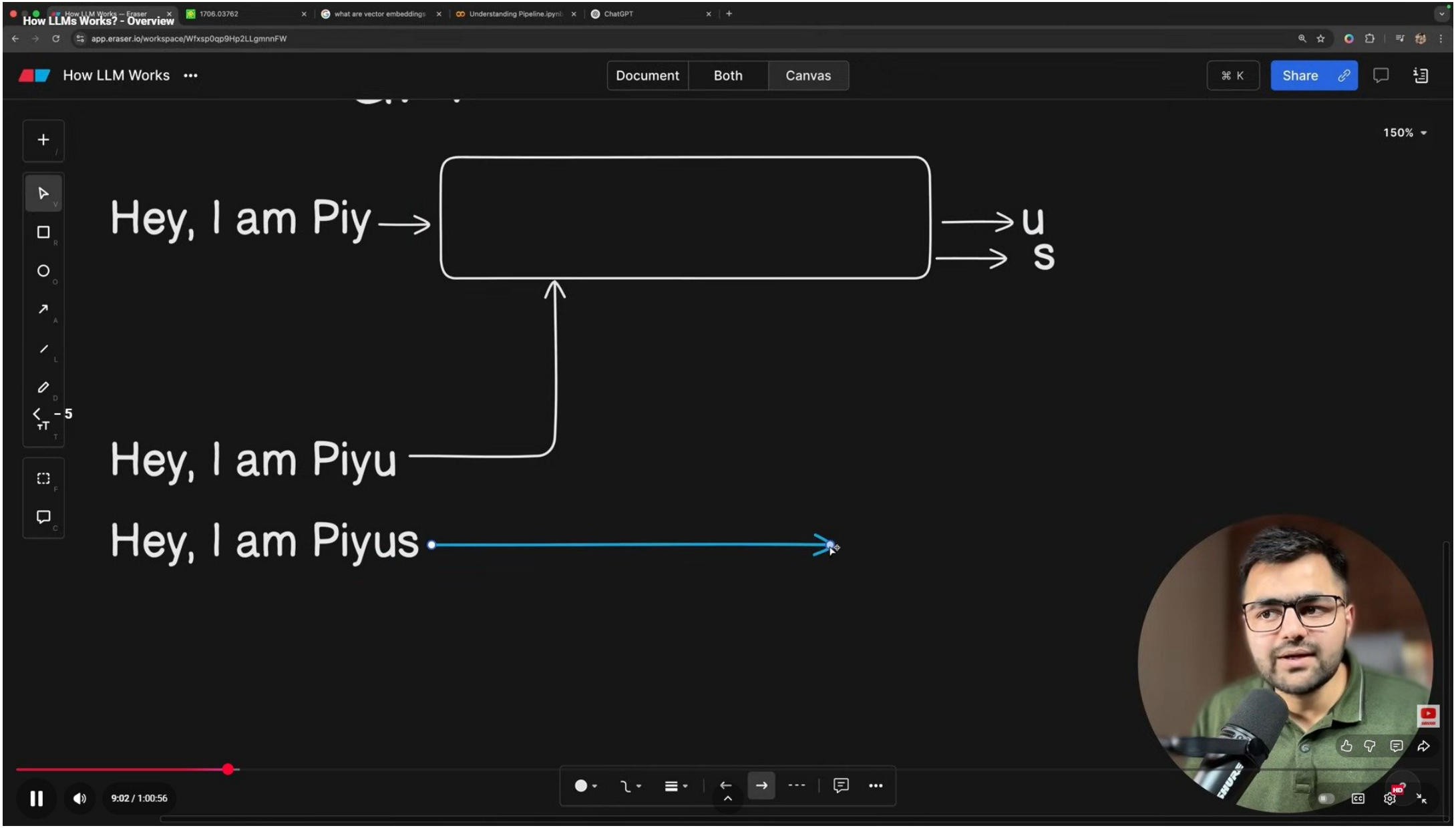
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Hey, I am Piyus
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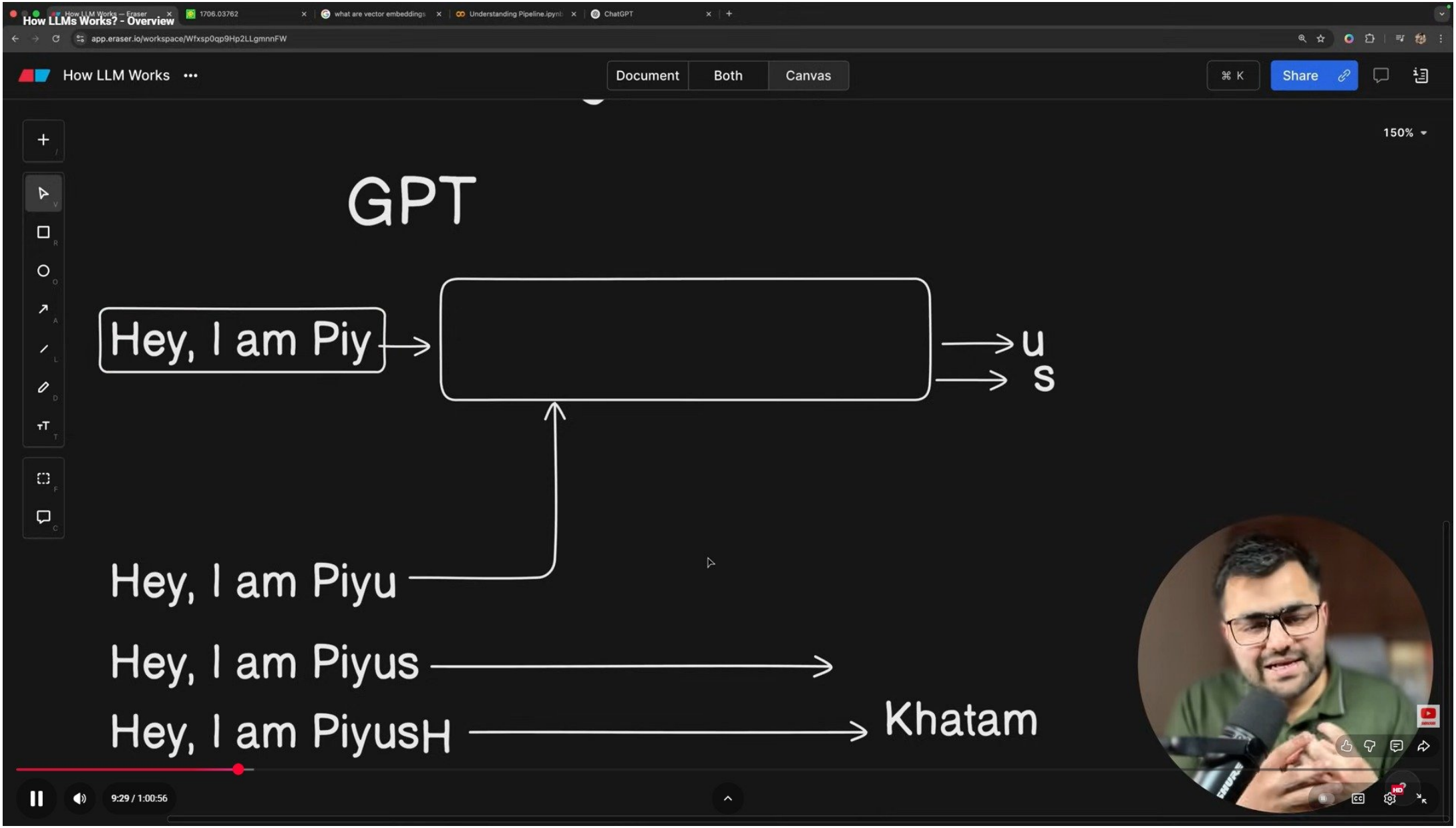
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Hey, I am PiyusH
Khatam
9:29 / 1:00:56

How LLMs Works? - Overview

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How LLM Works

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Hey, I am PiyusH → Khatam

a-1
b-2
c-3

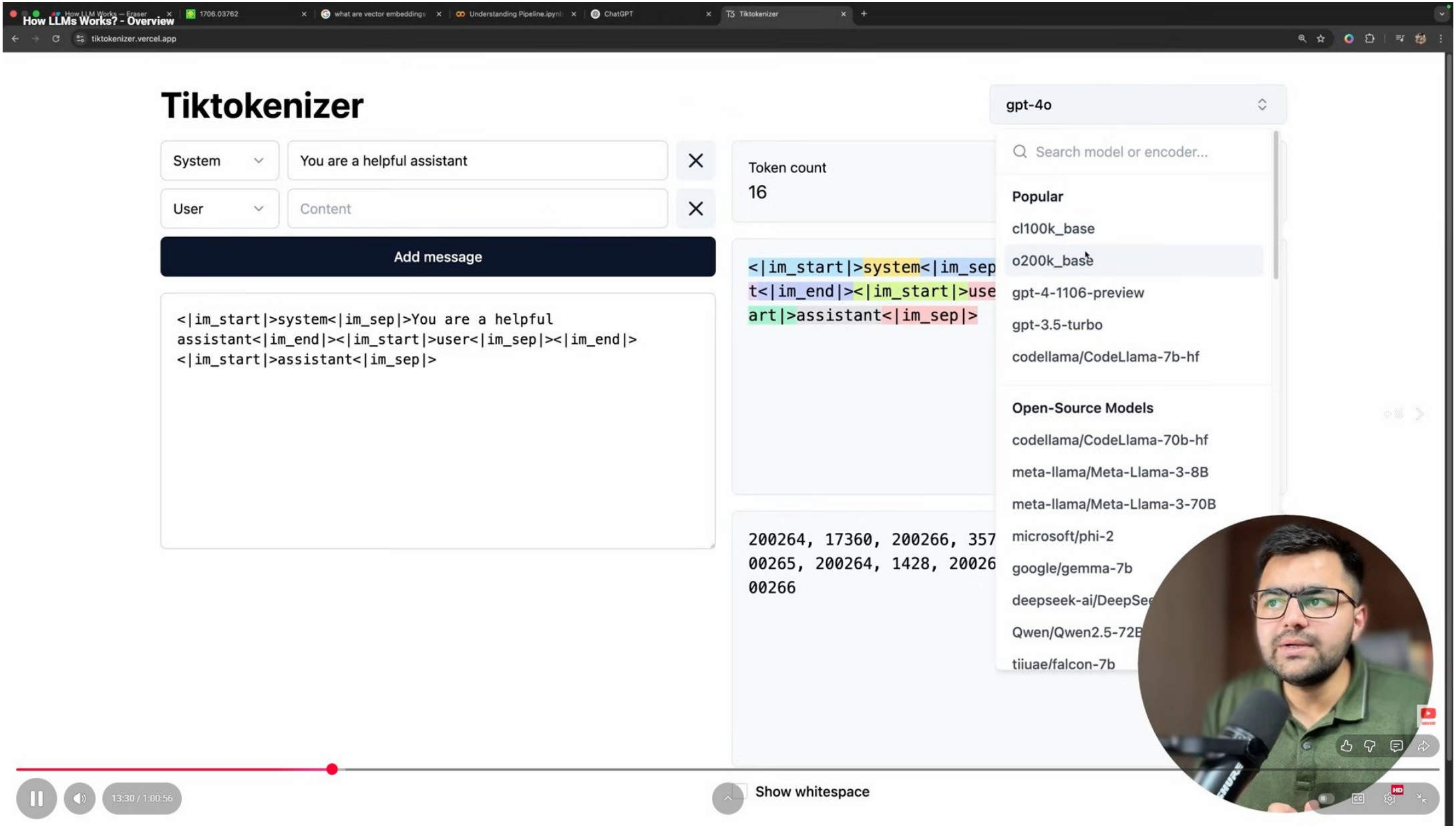
Dic
Hey - 10
There - 36

- 10

Step 1: Encoding → Hey There

Tokenize → 10 36

13:14 / 1:00:56


How LLMs Works? - Overview
tiktokenizer.vercel.app
Tiktokenizer
gpt-4o
System
You are a helpful assistant
User
Content
Add message
<|im_start|>system<|im_sep|>You are a helpful assistant<|im_end|><|im_start|>user<|im_sep|><|im_end|><|im_start|>assistant<|im_sep|>
Token count
16
<|im_start|>system<|im_sep
t<|im_end|><|im_start|>use
art|>assistant<|im_sep|>
200264, 17360, 200266, 357
00265, 200264, 1428, 20026
00266
Search model or encoder...
Popular
cl100k_base
o200k_base
gpt-4-1106-preview
gpt-3.5-turbo
codellama/CodeLlama-7b-hf
Open-Source Models
codellama/CodeLlama-70b-hf
meta-llama/Meta-Llama-3-8B
meta-llama/Meta-Llama-3-70B
microsoft/phi-2
google/gemma-7b
tiiuae/falcon-7b
13:30 / 1:00:56
Show whitespace

How LLMs Works? - Overview

tiktokenizer.vercel.app

Tiktokenizer

gpt-4o

User | Hey There

Add message

```
<|im_start|>user<|im_sep|>Hey There<|im_end|>
<|im_start|>assistant<|im_sep|>
```

Token count
9

```
<|im_start|>user<|im_sep|>Hey There<|im_end|><|im_star
t|>assistant<|im_sep|>
```

```
200264, 1428, 200266, 25216, 3274, 200265, 20026
781, 200266
```

14:04 / 1:00:56

Show whitespace

How LLMs Works? - Overview

colab.research.google.com/drive/1nY5N9G3iWTKZrhjOt5soXl2LD3FZ9GyY#scrollTo=1MOHKyPxPuHL

Understanding Pipeline.ipynb

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RAM Disk

```
import os

os.environ["HF_TOKEN"] = "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"
```

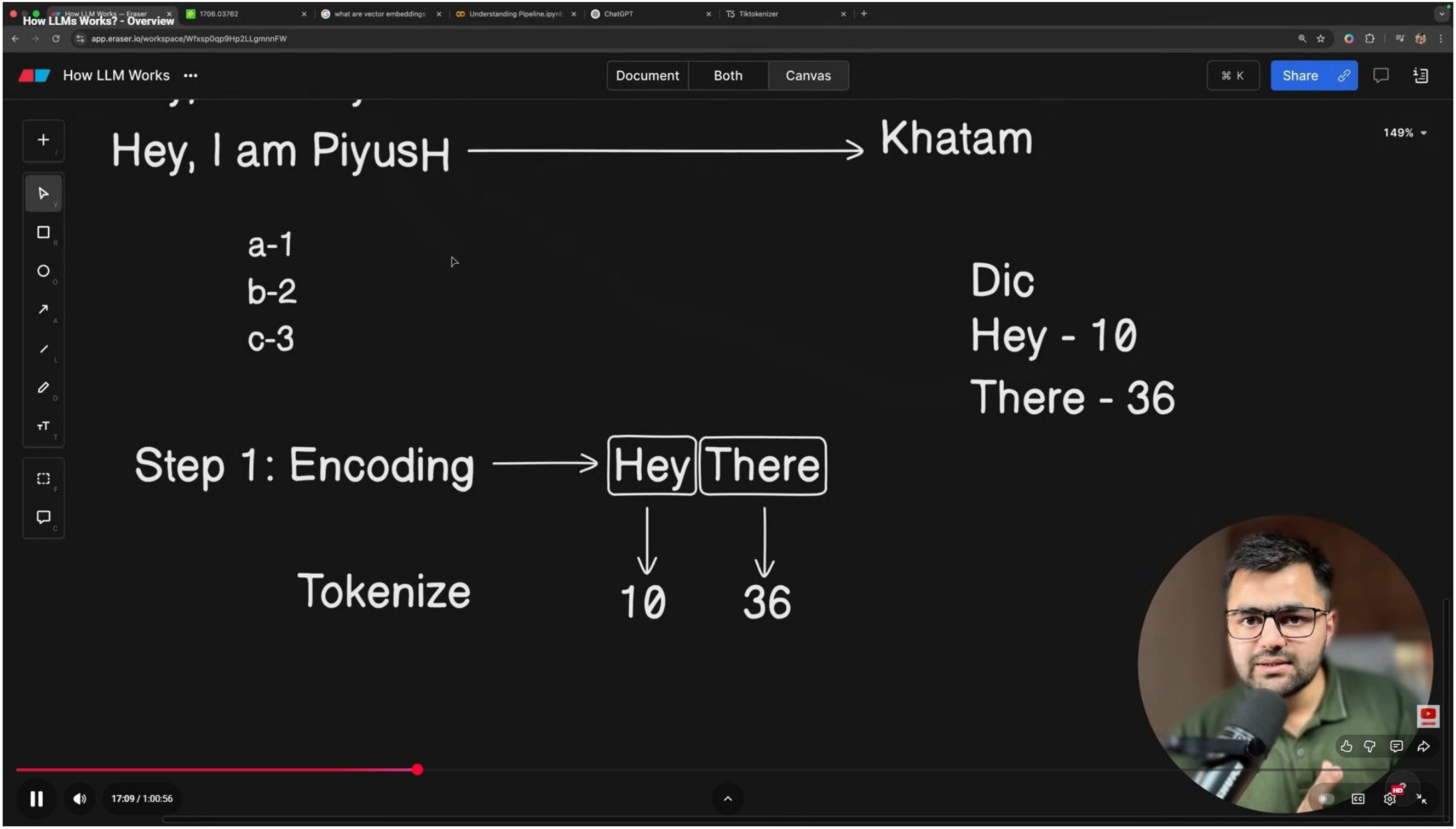
```
[4] from transformers import AutoTokenizer

    tokenizer = AutoTokenizer.from_pretrained("google/gemma-3-1b-it")
    tokenizer("Hey There!")
```

```
tokenizer_config.json: 100% 1.16M/1.16M [00:00<00:00, 6.19MB/s]
tokenizer.model: 100% 4.69M/4.69M [00:00<00:00, 14.7MB/s]
tokenizer.json: 100% 33.4M/33.4M [00:00<00:00, 80.9MB/s]
added_tokens.json: 100% 35.0/35.0 [00:00<00:00, 1.60kB/s]
special_tokens_map.json: 100% 662/662 [00:00<00:00, 16.9kB/s]
{'input_ids': [2, 17531, 2085, 236888], 'attention_mask': [1, 1, 1, 1]}
```

16:24 / 1:00:56

5s completed at 10:23


How LLMs Works? - Overview
app.eraser.io/workspace/Wfxsp0qp9Hp2LLgmnnFW
How LLM Works
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Hey, I am PiyusH
Khatam
149%
a-1
b-2
c-3
Dic
Hey - 10
There - 36
Step 1: Encoding
Hey
There
Tokenize
10
36
17:09 / 1:00:56

How LLMs Works? - Overview

what are vector embeddings

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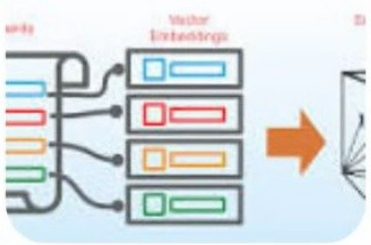
Vector embeddings are numerical representations of data, like words, images, or audio, that capture semantic relationships and meaning, allowing machine learning models to process and compare them efficiently.



Here's a more detailed explanation:

What they are:

Vector embeddings are essentially "fingerprints" or numerical representations of data

What are Vector

Vector embeddings

and other data into

Elastic

18:57 / 1:00:56

Show more

How LLMs Works? - Overview

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How LLM Works

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There - 36

149%

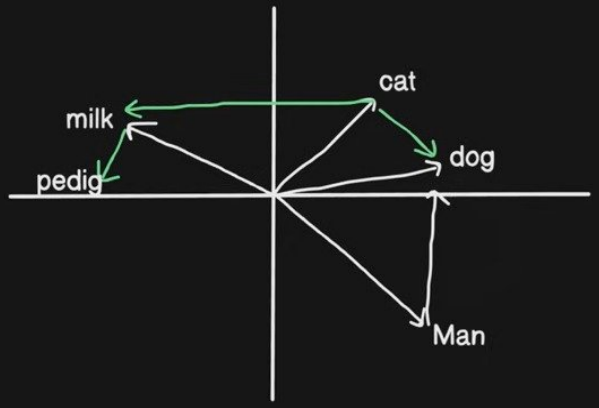
Step 1: Encoding → Hey There

Tokenize → 10 36

CAT - MILK
DOG - Pedig

+ 80

Vector Embeddings



CAT = 20
DOG = 80

21:51 / 1:00:56

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How LLM Works — Eraser | 1706.03762 | what are vector embeddings | Understanding Pipeline.ipynb | ChatGPT | Tiktokenizer

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149%

There - 36

Step 1: Encoding → Hey There

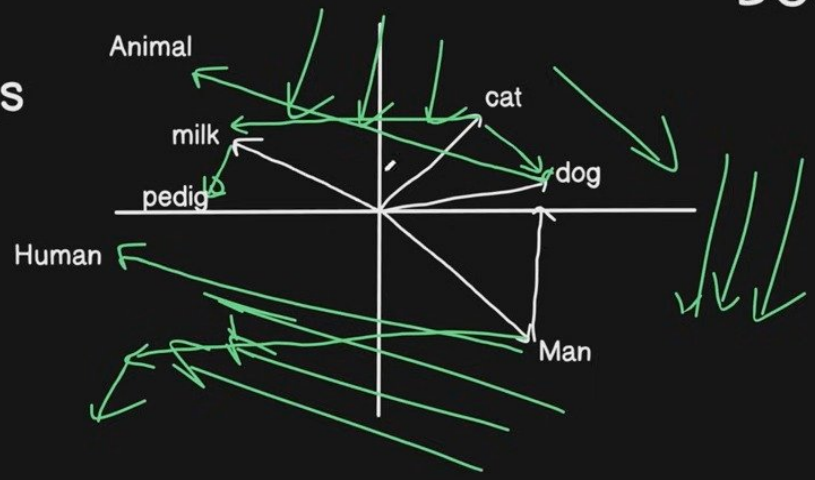
Tokenize → 10 36

CAT - MILK
DOG - Pedig

+ 30

Vector Embeddings

CAT = 20
DOG = 80



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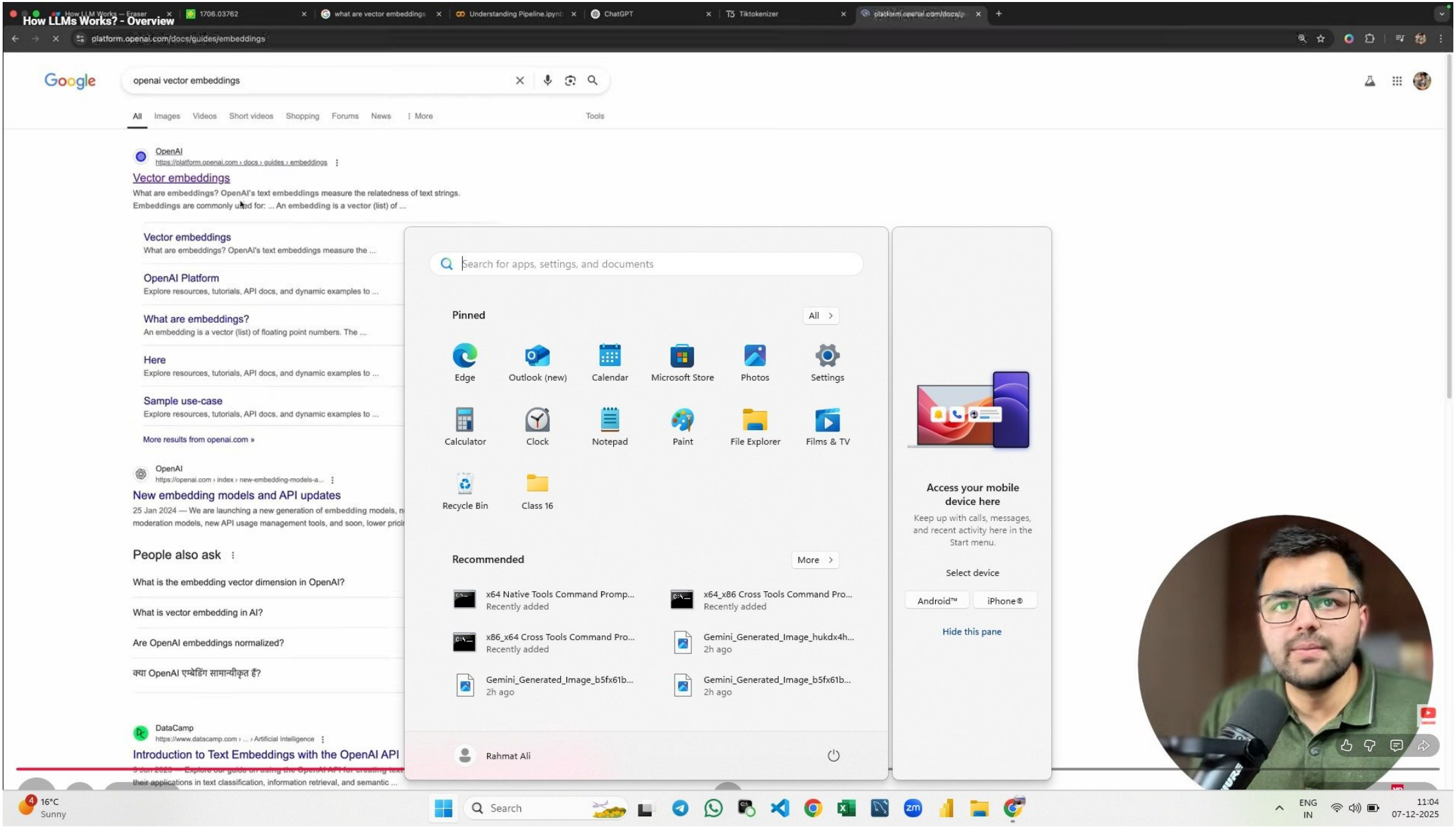
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platform.openai.com/docs/guides/embeddings
openai vector embeddings
All Images Videos Short videos Shopping Forums News More Tools
OpenAI
https://platform.openai.com › docs › guides › embeddings
Vector embeddings
What are embeddings? OpenAI's text embeddings measure the relatedness of text strings.
Embeddings are commonly used for: ... An embedding is a vector (list) of ...
Vector embeddings
What are embeddings? OpenAI's text embeddings measure the ...
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What are embeddings?
An embedding is a vector (list) of floating point numbers. The ...
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Explore resources, tutorials, API docs, and dynamic examples to ...
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25 Jan 2024 — We are launching a new generation of embedding models, n
moderation models, new API usage management tools, and soon, lower prici
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Rahmat Ali
Access your mobile device here
Keep up with calls, messages, and recent activity here in the Start menu.
Select device
Android™
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16°C
Sunny
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11:04
07-12-2025

- **Diversity measurement** (where similarity distributions are analyzed)
- **Classification** (where text strings are classified by their most similar label)

An embedding is a vector (list) of floating point numbers. The distance between two vectors measures their relatedness. Small distances suggest high relatedness and large distances suggest low relatedness.

Visit our pricing page to learn about embeddings pricing. Requests are billed based on the number of tokens in the input.

How to get embeddings

To get an embedding, send your text string to the embeddings API endpoint along with the embedding model name (e.g., `text-embedding-3-small`):

Example: Getting embeddings — python

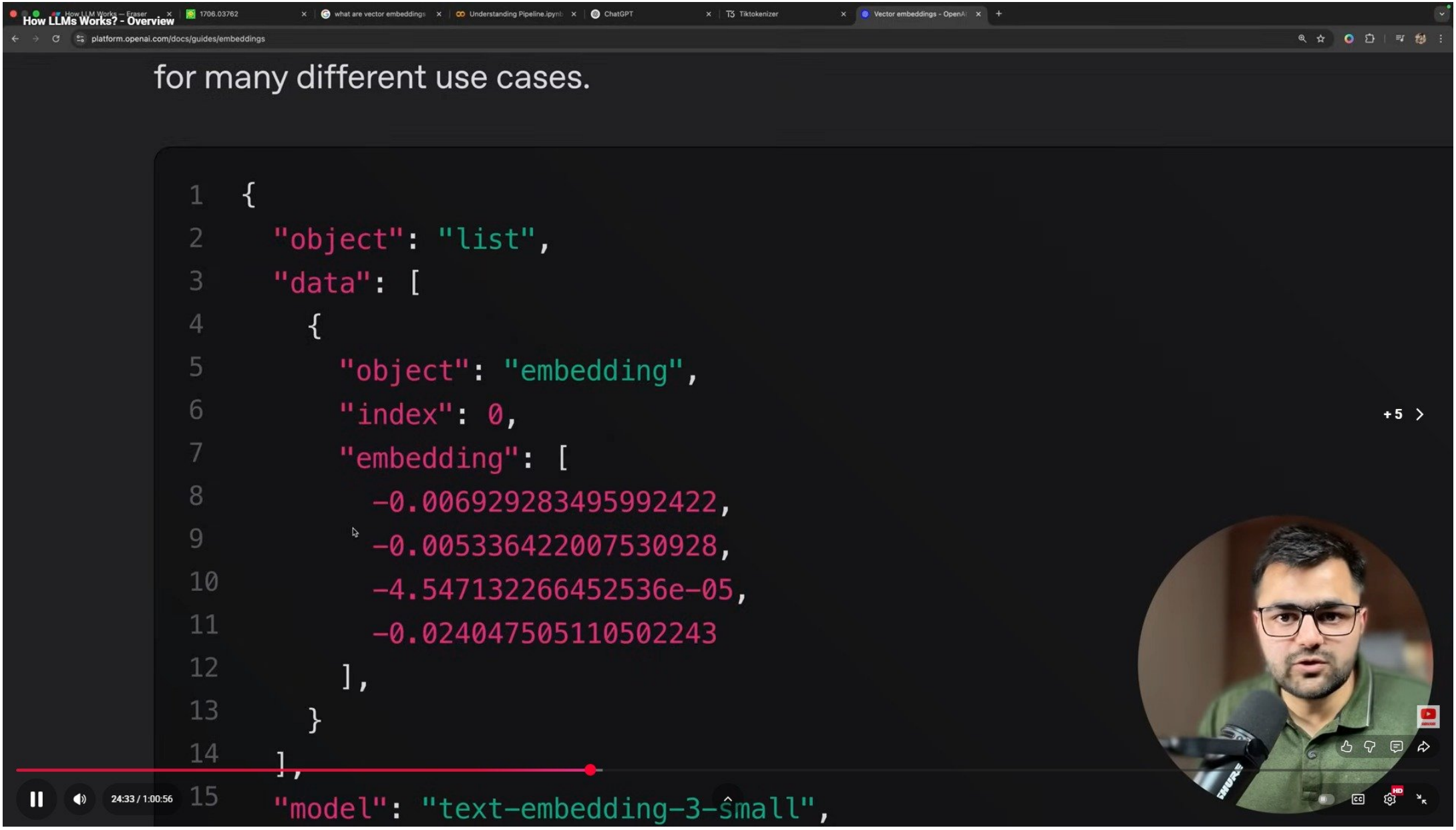
```python
from openai import OpenAI
client = OpenAI()

response = client.embeddings.create(
    input="Your text string goes here",
    model="text-embedding-3-small"
)

print(response.data[0].embedding)
```

The response contains the embedding vector (list of floating point numbers) along with some additional metadata. You can extract the embedding vector, save it in a vector database, and use for many different use cases.

```
{
```


How LLMs Works? - Overview
platform.openai.com/docs/guides/embeddings
for many different use cases.
{
"object": "list",
"data": [
{
"object": "embedding",
"index": 0,
"embedding": [
-0.006929283495992422,
-0.005336422007530928,
-4.547132266452536e-05,
-0.024047505110502243
],
}
],
"model": "text-embedding-3-small",
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How LLMs Works? - Overview

```
Requirement already satisfied: h11<0.15,>=0.13 in /usr/local/lib/python3.11/dist-packages (from httpcore=
Requirement already satisfied: annotated-types>=0.6.0 in /usr/local/lib/python3.11/dist-packages (from py
Requirement already satisfied: pydantic-core==2.27.2 in /usr/local/lib/python3.11/dist-packages (from pyd
```

```python
from openai import OpenAI
import os

client = OpenAI()

os.environ["OPENAI_API_KEY"] = "sk-proj-JJSk5dBf12JGy_4Giniq3UvbV7Xmbb7ezXRKhE_BDjqWeUY-2EHVGtbMzOOCeluMl

response = client.embeddings.create(
    input="Cat loves milk",
    model="text-embedding-3-small"
)

print(response.data[0].embedding)
```

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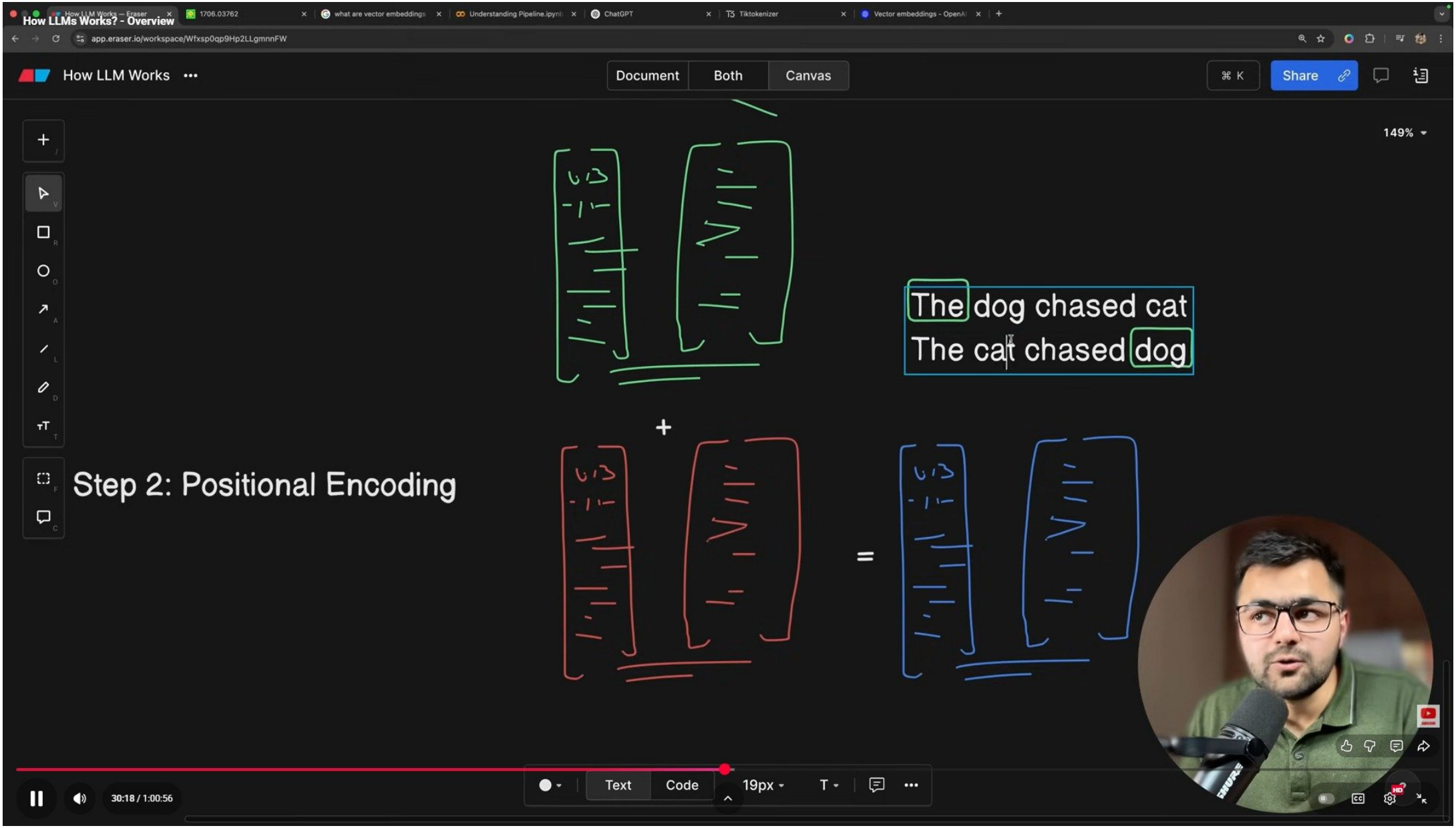
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The dog chased cat
The cat chased dog
Step 2: Positional Encoding
Text
Code
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		Operations	
Self-Attention	$O(n^2 \cdot d)$	$O(1)$	$O(1)$
Recurrent	$O(n \cdot d^2)$	$O(n)$	$O(n)$
Convolutional	$O(k \cdot n \cdot d^2)$	$O(1)$	$O(log_k(n))$
Self-Attention (restricted)	$O(r \cdot n \cdot d)$	$O(1)$	$O(n/r)$

3.5 Positional Encoding

Since our model contains no recurrence and no convolution, in order for the model to make use of the order of the sequence, we must inject some information about the relative or absolute position of the tokens in the sequence. To this end, we add "positional encodings" to the input embeddings at the bottoms of the encoder and decoder stacks. The positional encodings have the same dimension d_{model} as the embeddings, so that the two can be summed. There are many choices of positional encodings, learned and fixed [9].

In this work, we use sine and cosine functions of different frequencies:

$$PE_{(pos,2i)} = sin(pos/10000^{2i/d_{\text{model}}})$$
$$PE_{(pos,2i+1)} = cos(pos/10000^{2i/d_{\text{model}}})$$

where pos is the position and i is the dimension. That is, each dimension of the positional en corresponds to a sinusoid. The wavelengths form a geometric progression from 2π to $10000 \cdot 2$ chose this function because we hypothesized it would allow the model to easily learn to atten relative positions, since for any fixed offset k, PE_{pos+k} can be represented as a linear function PE_{pos}.

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Step 2: Positional Encoding

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Self Attension

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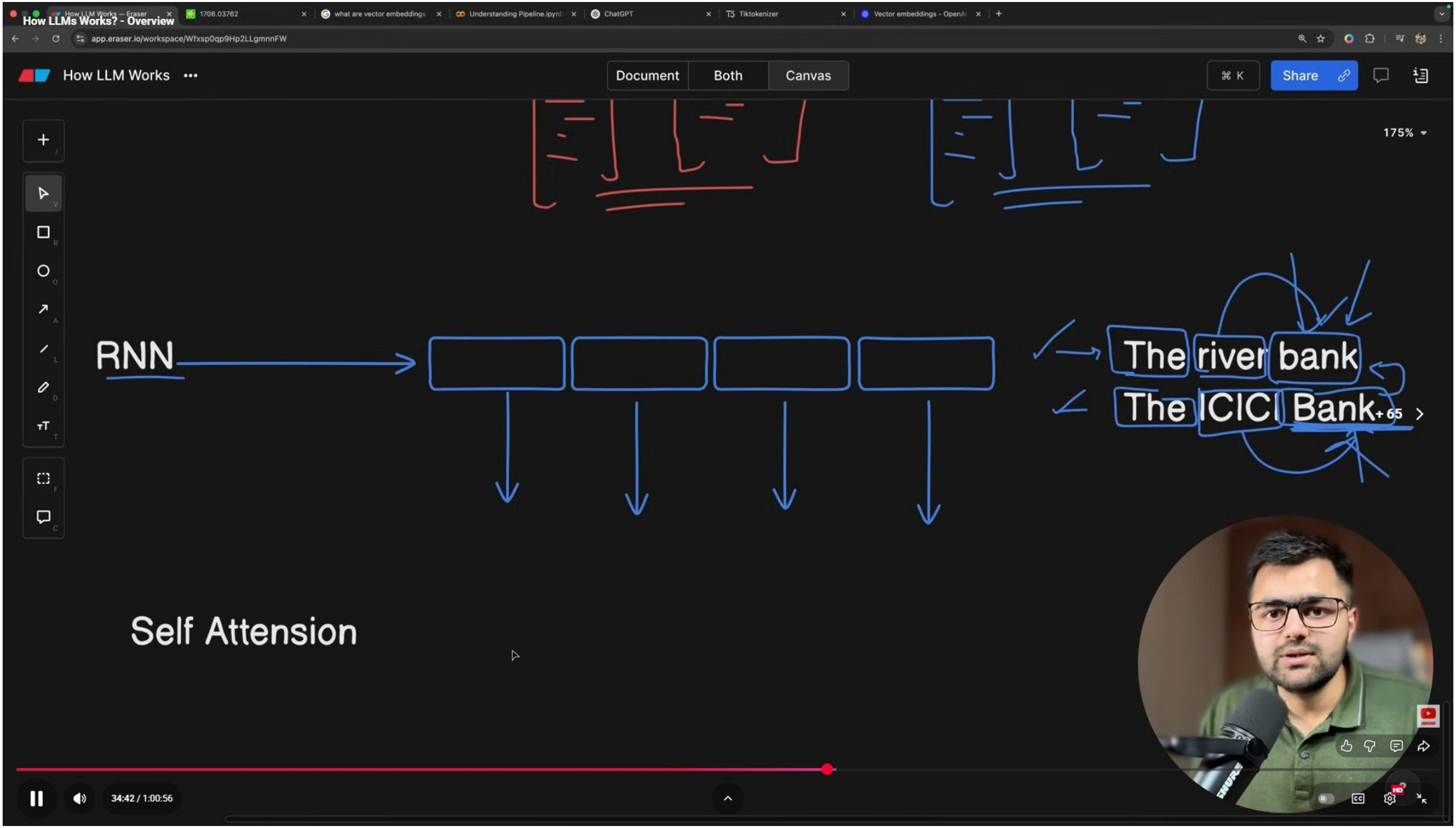
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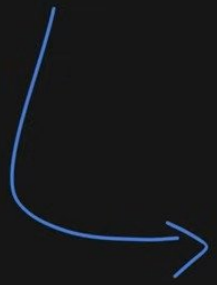
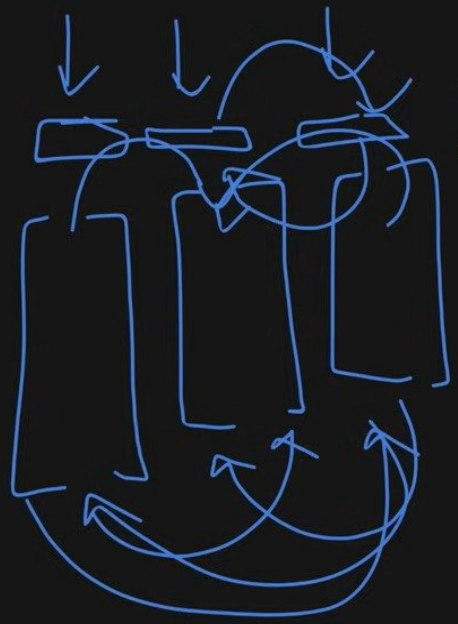
Self Attension

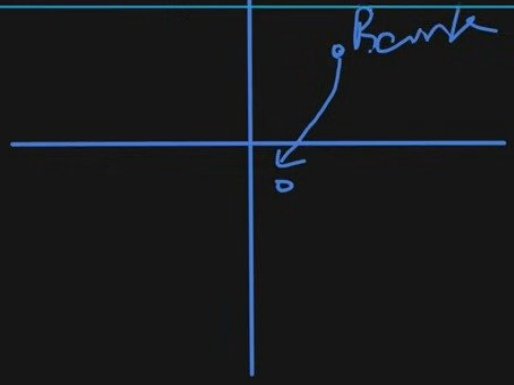


The river bank



Contex of the word is maintained

Relates words / token to each other



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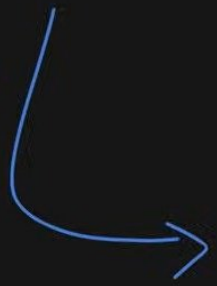
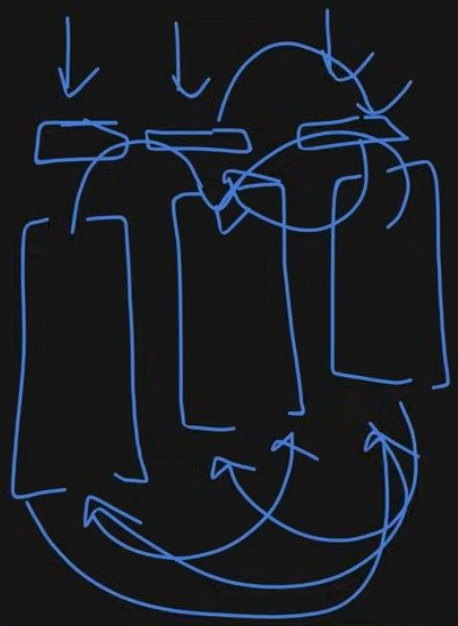
Self Attension



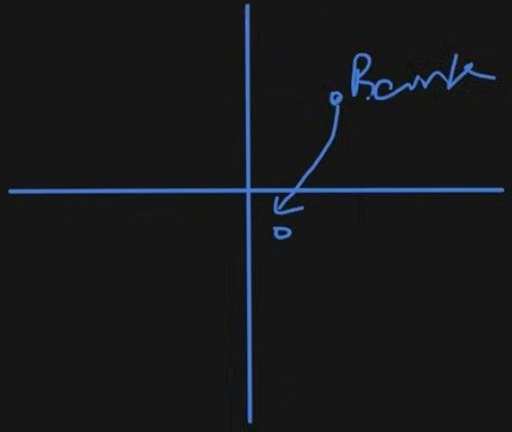
The river bank



Single Head Self Attension

Contex of the word is maintained

Relates words / token to each other



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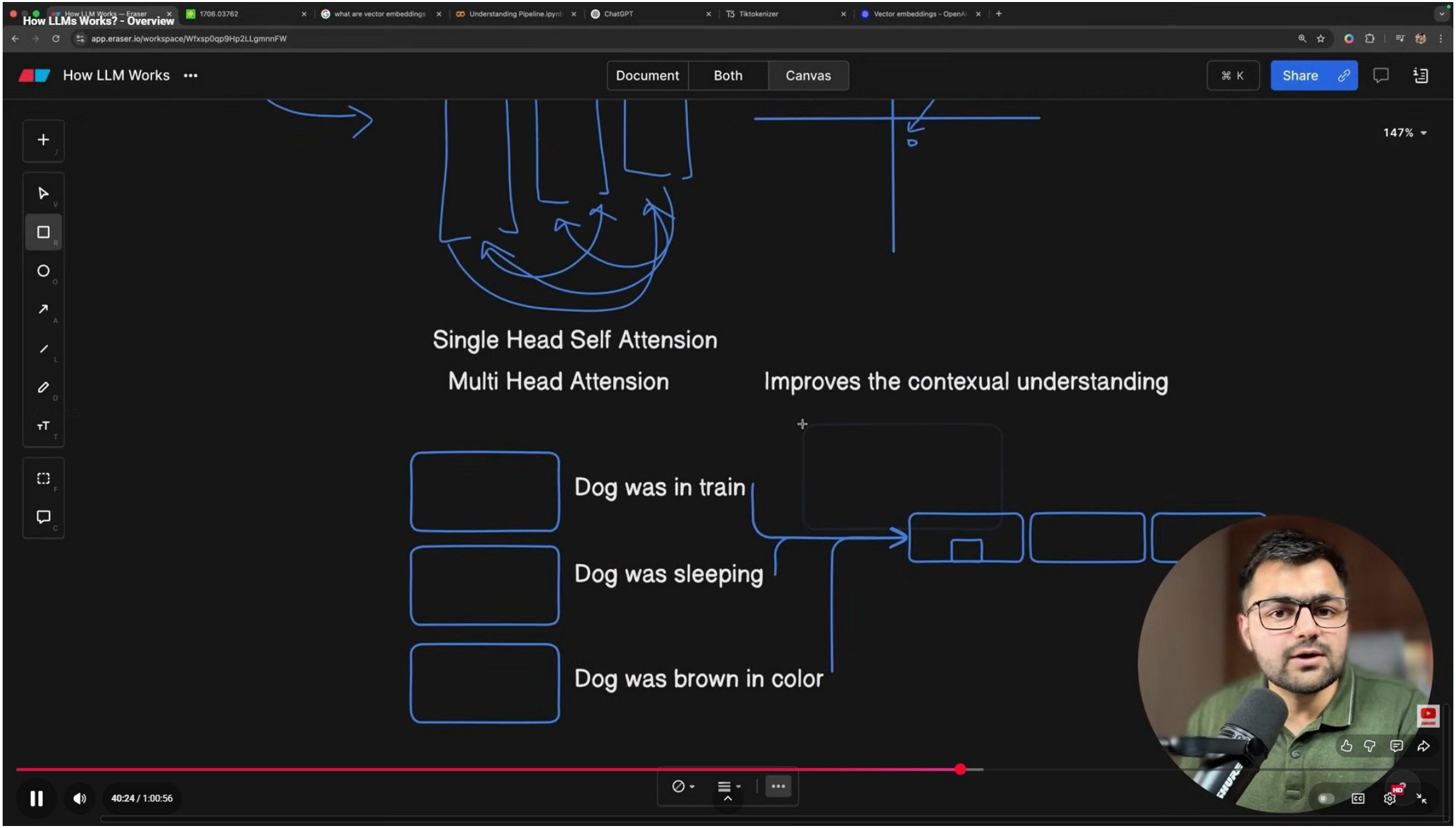
How LLMs Works? - Overview
app.eraser.io/workspace/Wfxsp0qp9Hp2LLgmnnFW
How LLM Works
Document
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Share
147%
Single Head Self Attension
Multi Head Attension
Improves the contexual understanding
Dog was in train
Dog was sleeping
Dog was brown in color
40:24 / 1:00:56

How LLMs Works? - Overview

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How LLM Works

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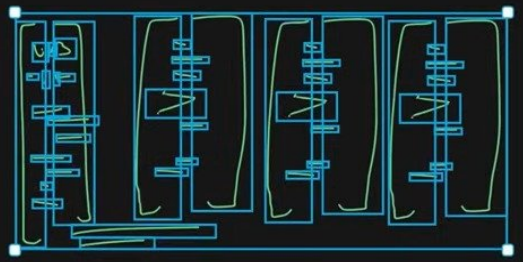
Dog was brown in color

94%

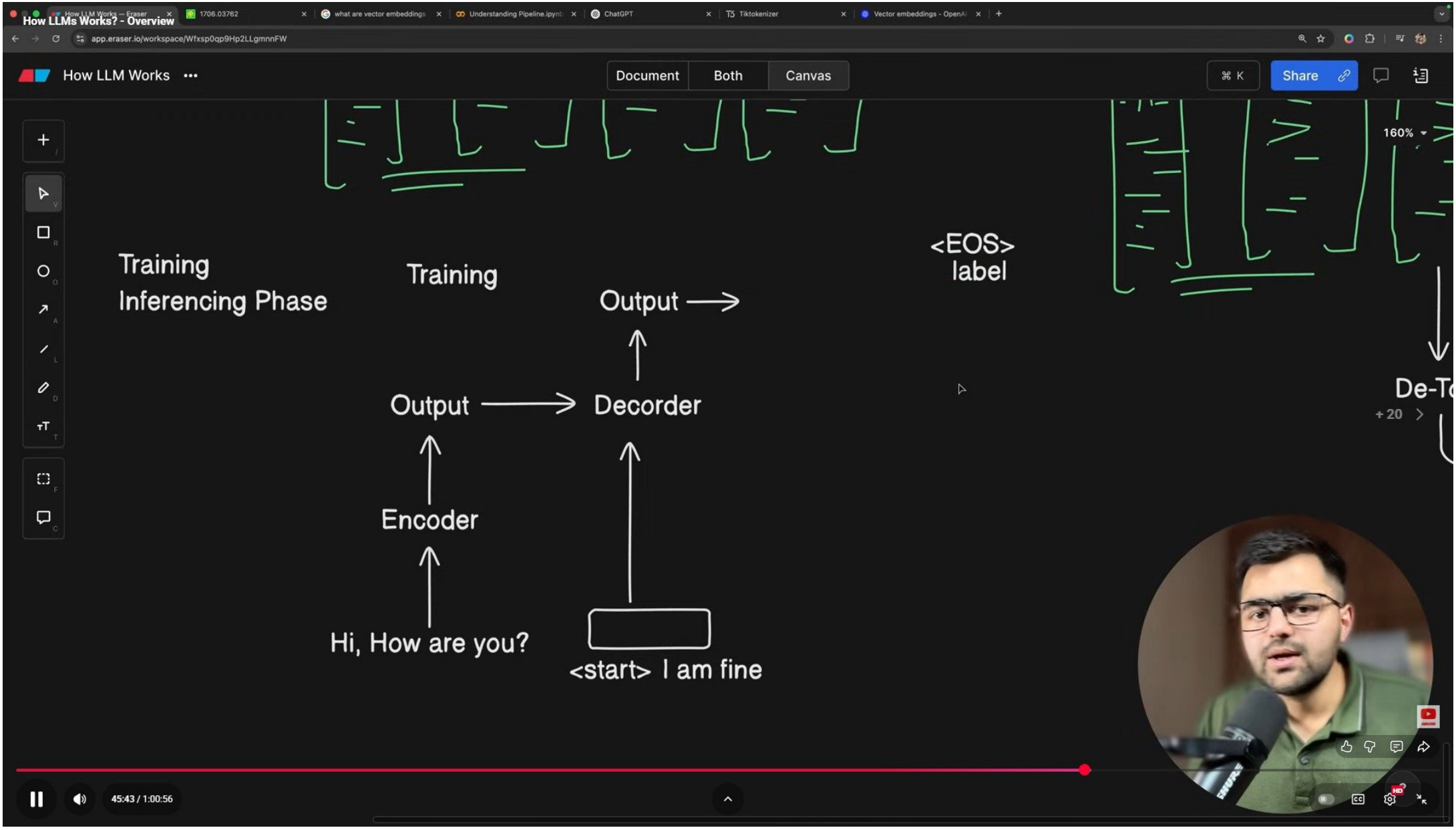
+ 60



De-Tokenize

Create Figure ⇧ F

42:31 / 1:00:56


How LLMs Works? - Overview
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How LLM Works
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Hi, How are you?
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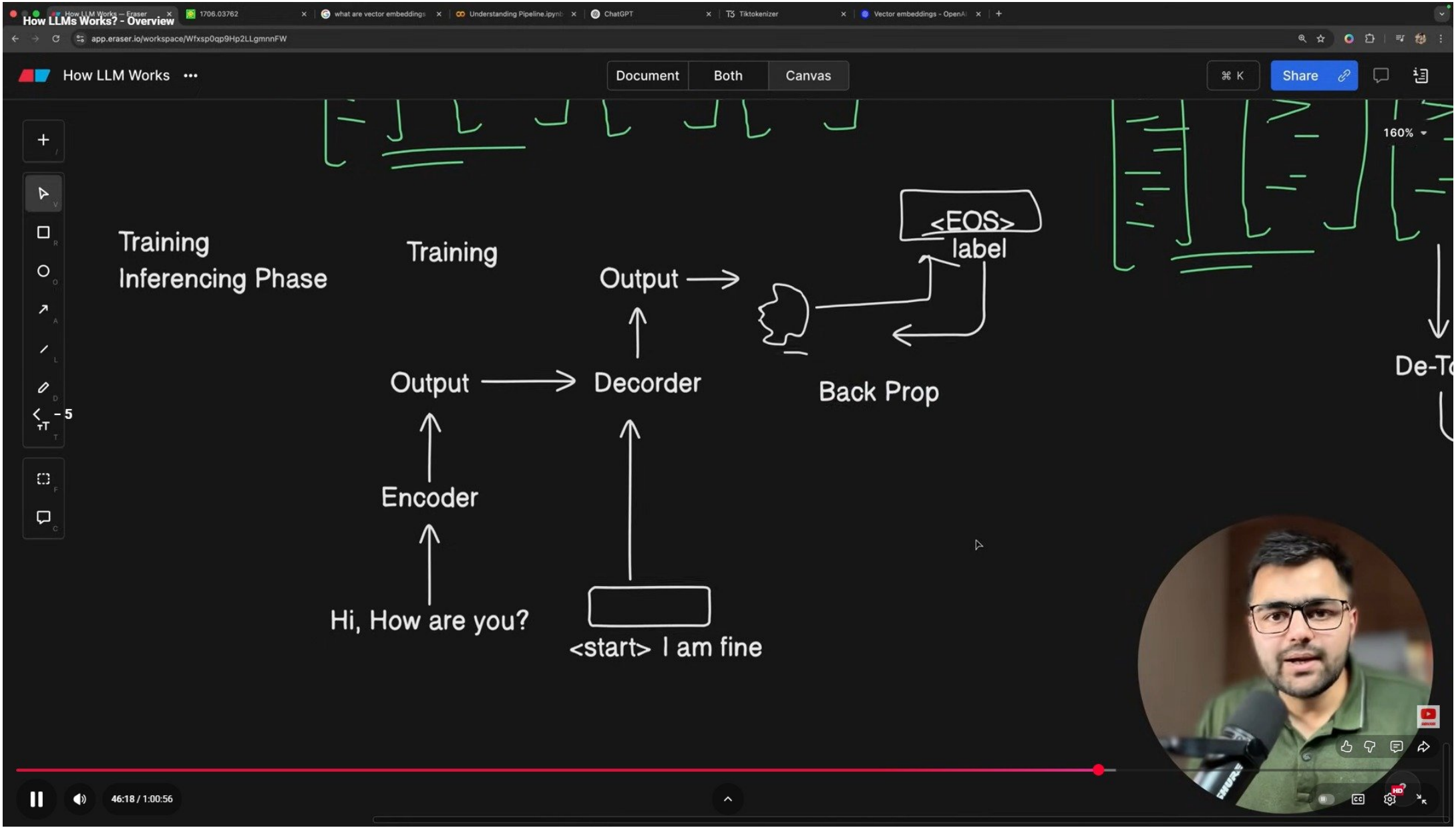
How LLMs Works? - Overview
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How LLM Works
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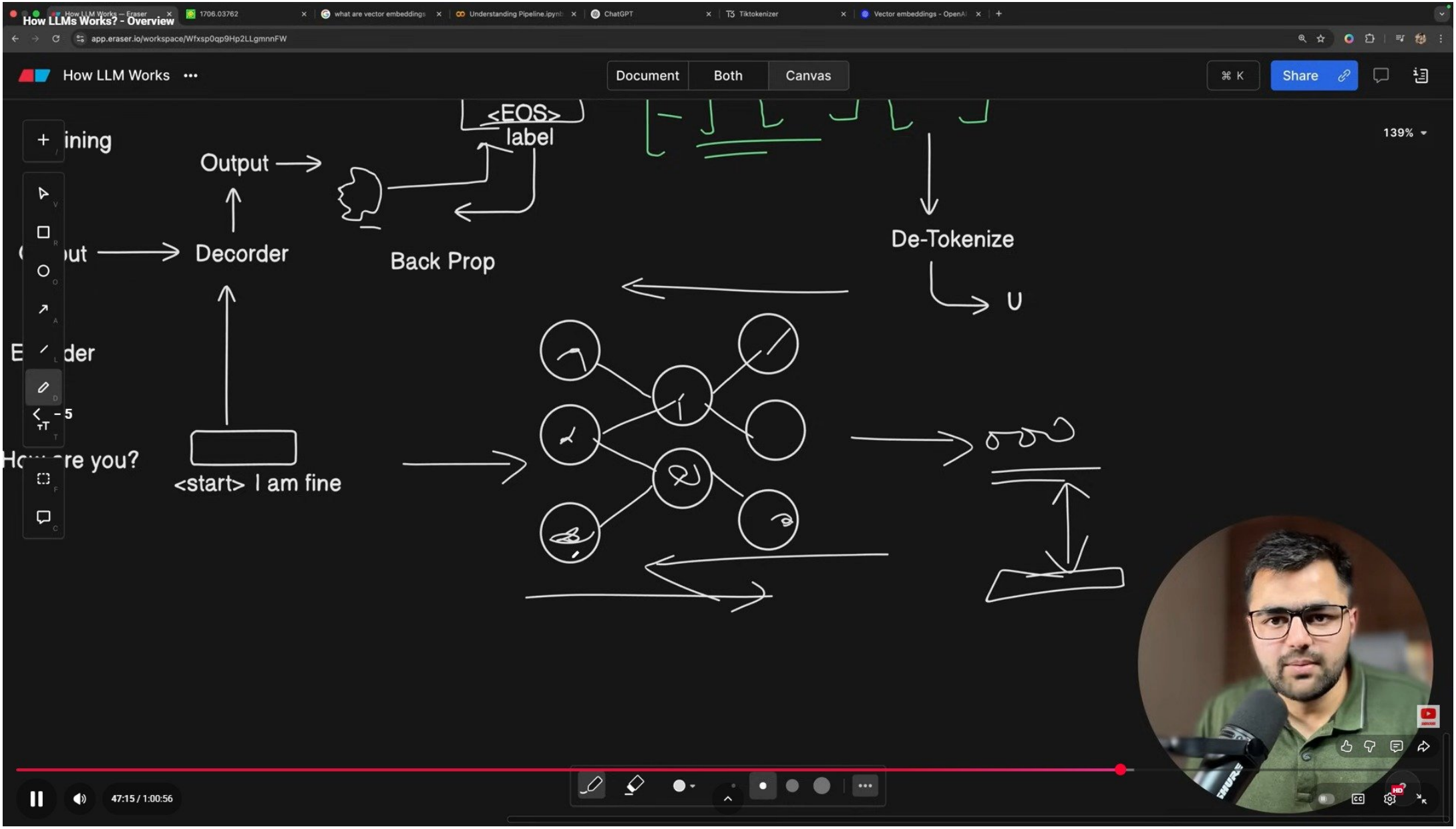
How LLMs Works? - Overview
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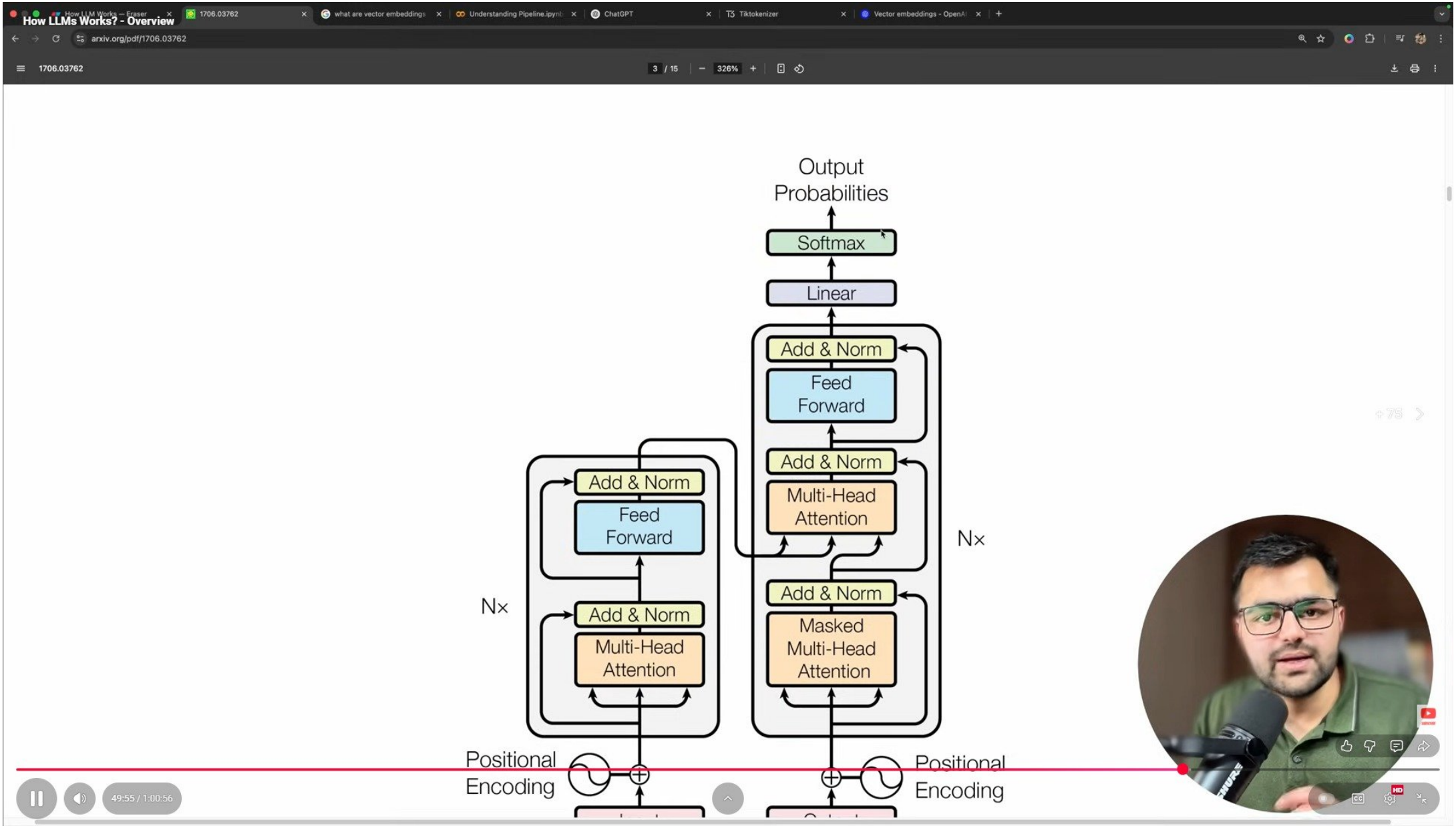
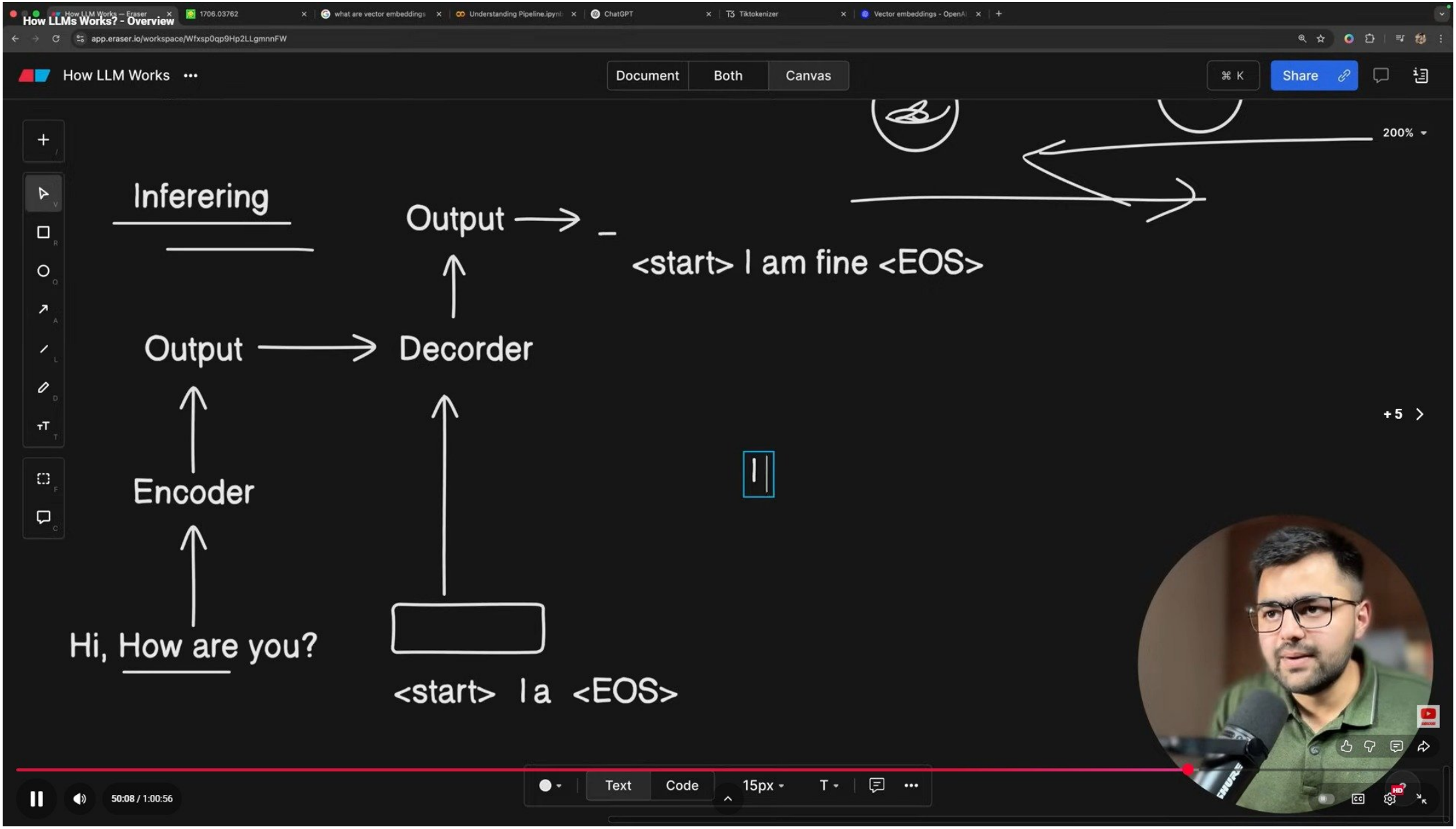
How LLMs Works? - Overview




How LLMs Works? - Overview
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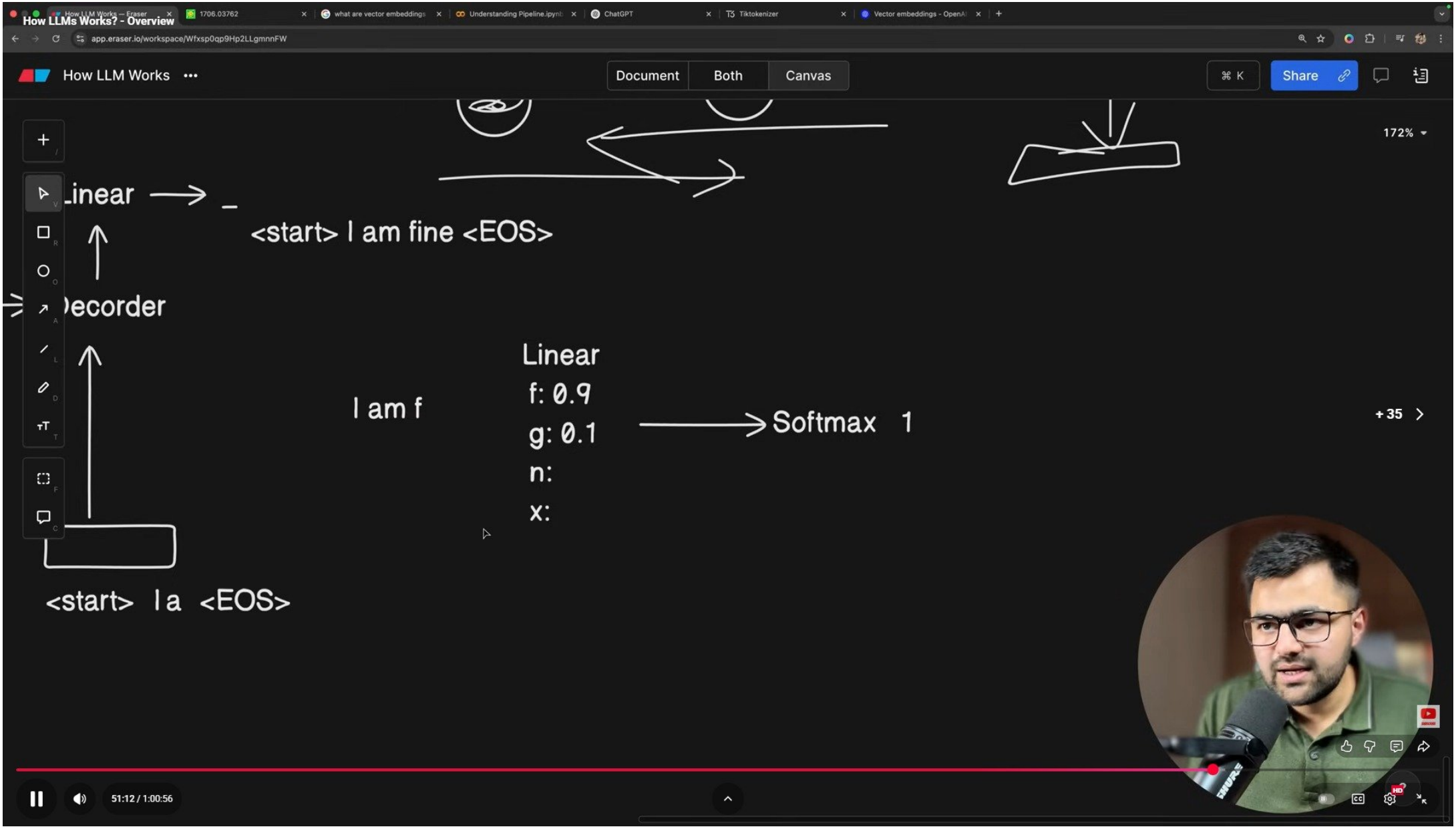
How LLMs Works? - Overview
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How LLMs Works? - Overview

colab.research.google.com/drive/1nY5N9G3iWTKZrhjOt5soXl2LD3FZ9GyY#scrollTo=9W_UO7THaQ8t

```
CausalLMOutputWithPast(loss=None, logits=tensor([[[-14.1875,  -1.1250,   4.6562,  ..., -14.6250, -14.6875, -14.6250],
         [-17.6250,  -0.6992,  -3.2500,  ..., -18.0000, -18.0000, -17.8750],
         [-12.1875,  -2.9844,  -4.9688,  ..., -13.4375, -13.4375, -13.3125],
         ...,
         [-14.8750,  -3.8750,  -2.4688,  ..., -16.6250, -16.6250, -16.5000],
         [-15.9375,  -3.1250,   1.3047,  ..., -18.0000, -18.0000, -17.8750],
         [-17.0000,  -2.3125,  -0.4629,  ..., -19.5000, -19.5000, -19.2500]]],
       dtype=torch.bfloat16, grad_fn=<UnsafeViewBackward0>), past_key_values=<transformers.cache_utils.HybridCache object
hidden_states=None, attentions=None)
```

13s

```
[18] gen_out = model.generate(input_ids=input_tokens["input_ids"])
     gen_out
```

```
tensor([[     2,   6974,    496,  23181,   3393,    573,   8009,   1156,   4945,
           107,   2717,   6719,    107,   2063,   1138, 236779,  34488, 236769,
        236781, 236764,    570,   1473,    107,    138,  12234, 174054,   1156,
          4945,   3075]])
```

+155

Start coding or generate with AI.

56:36 / 1:00:56

How LLMs Works? - Overview

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How LLM Works

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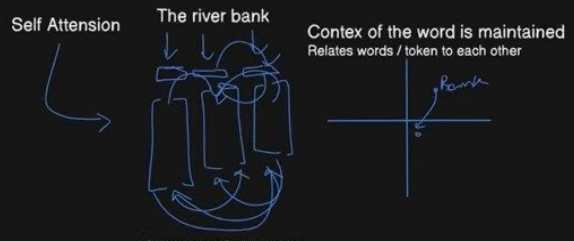

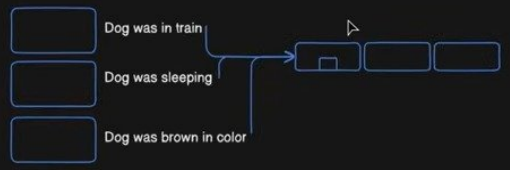

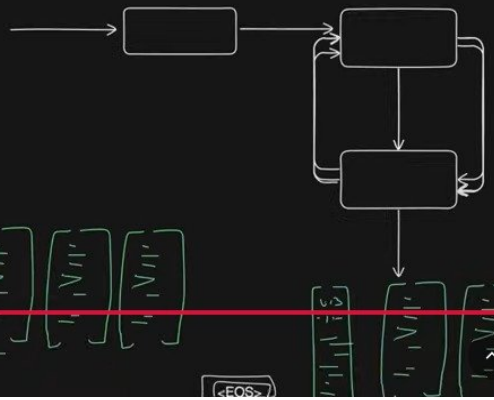

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How LLMs Works? - Overview

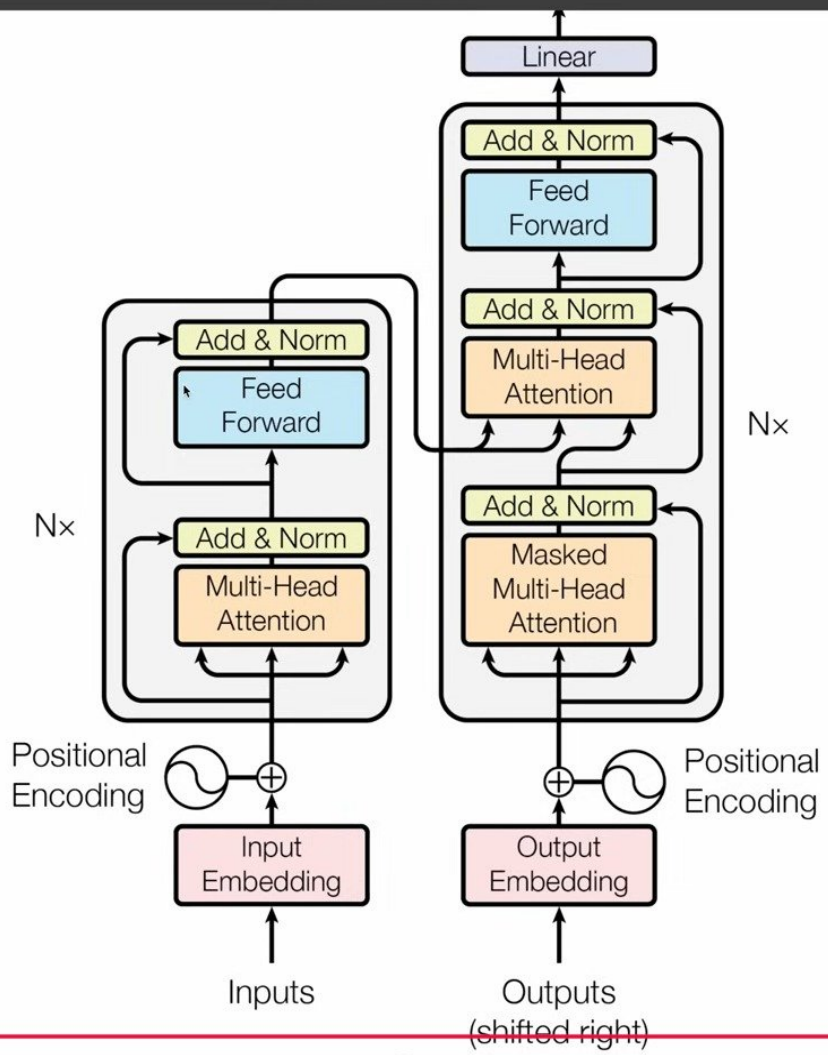
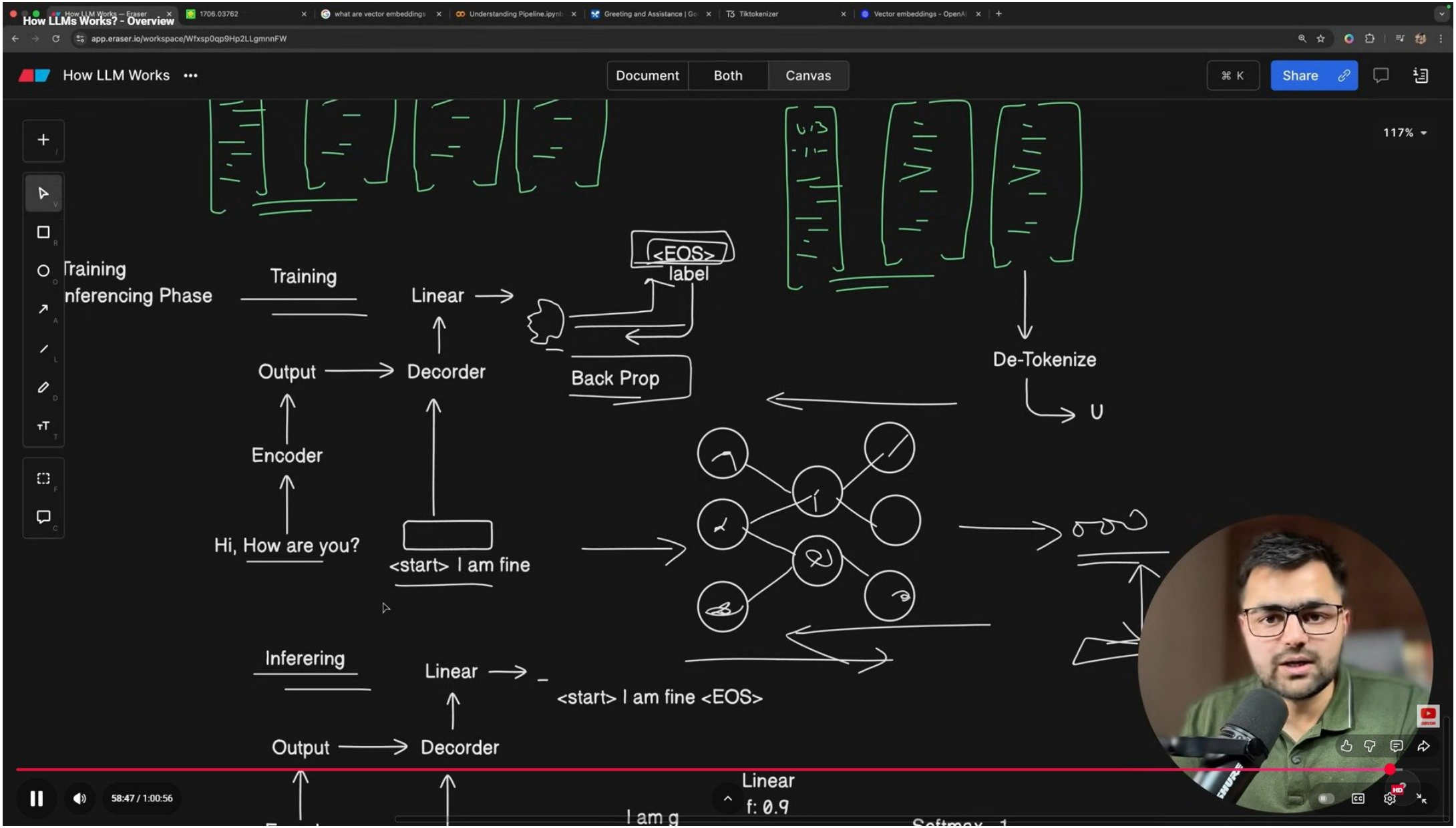


Figure 1: The Transformer - model architecture.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How LLM Works
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