{ DevFest }
Jakarta

Zero to Viral: Build TikTok-style Recommendation

linkedin.com/in/yodiaditya

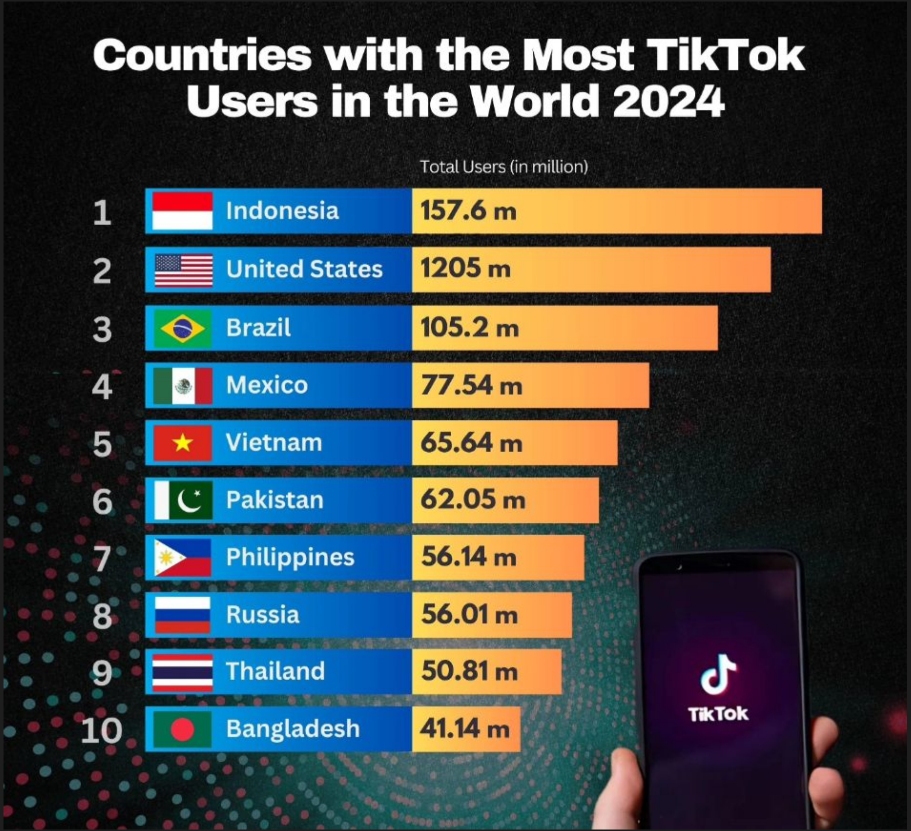
Google Developer Groups

AI
@DevFest

How do you build short videos recommendation when all have you just raw files with no metadata and nothing else ?

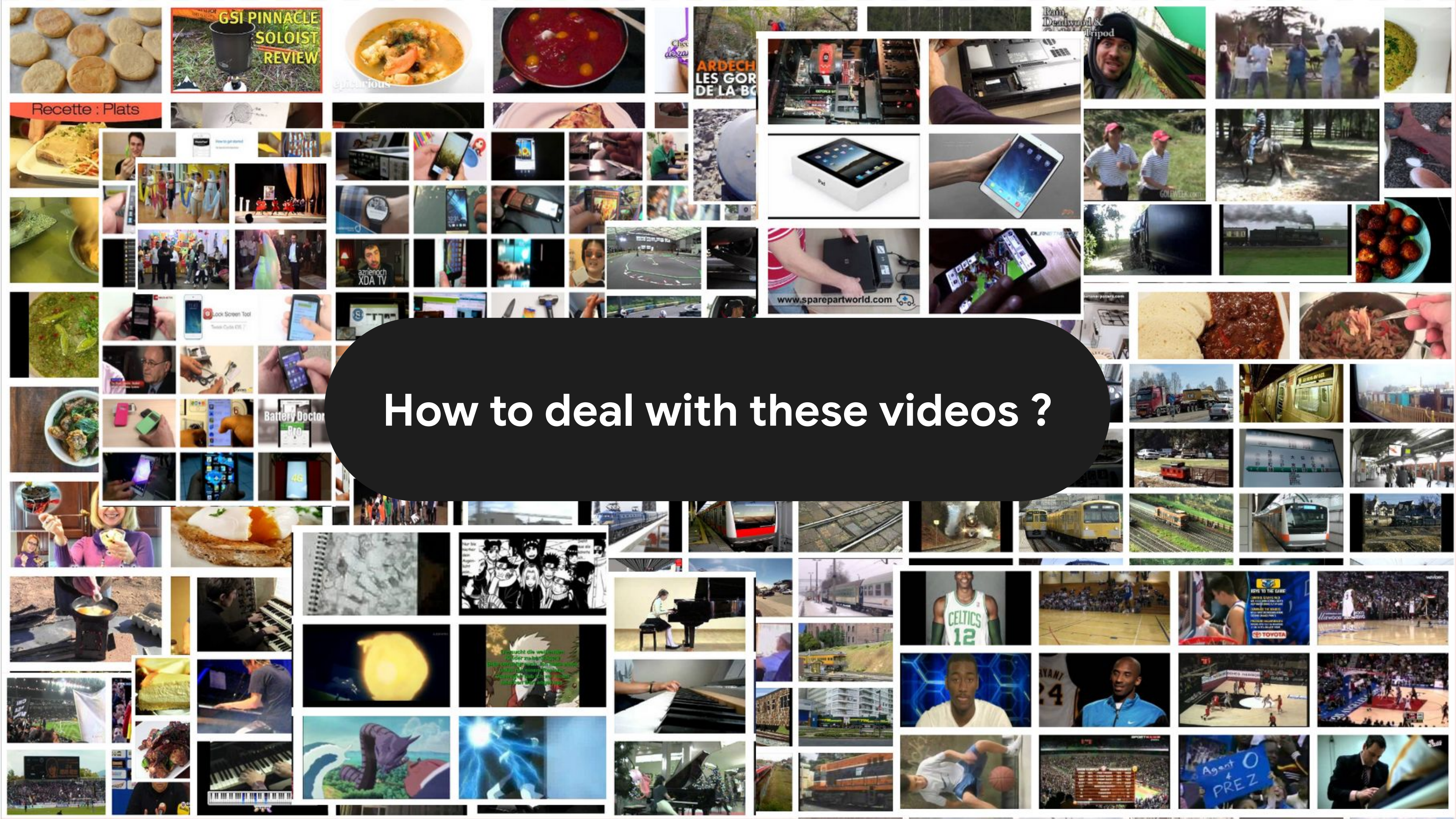
Google
Developer
Groups

Statistics



Estimated 1 Billion views per day

34 million TikTok videos are uploaded daily



How to deal with these videos ?

What you will get in next 17 minutes

1. Intro: Recommendation System
2. Architecture: Raw Dataset to Final Results
3. Code (Yes, its code!)
4. Tips to Scale

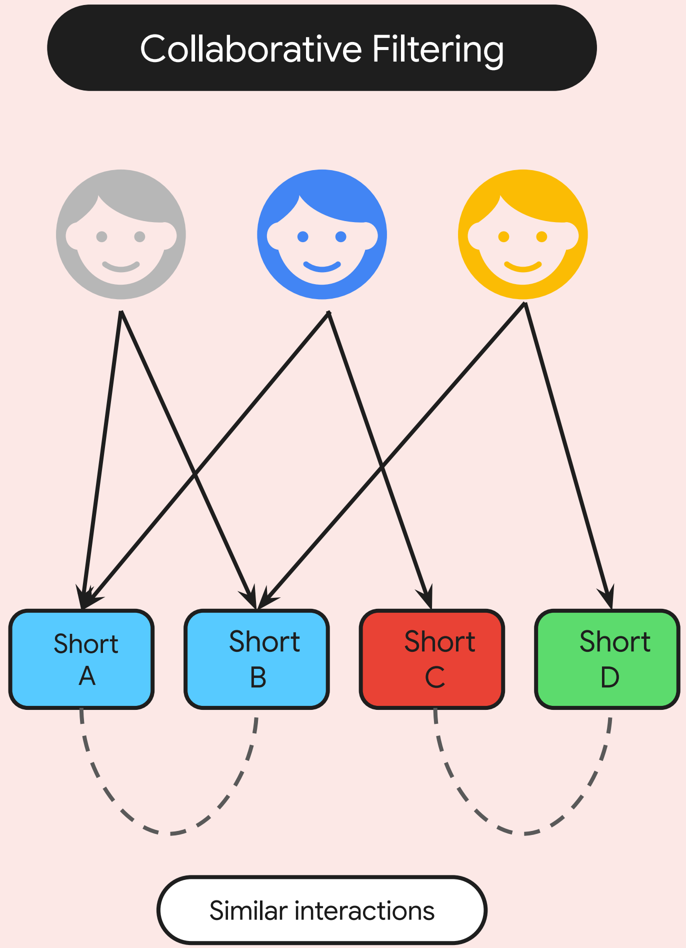
A bit about myself

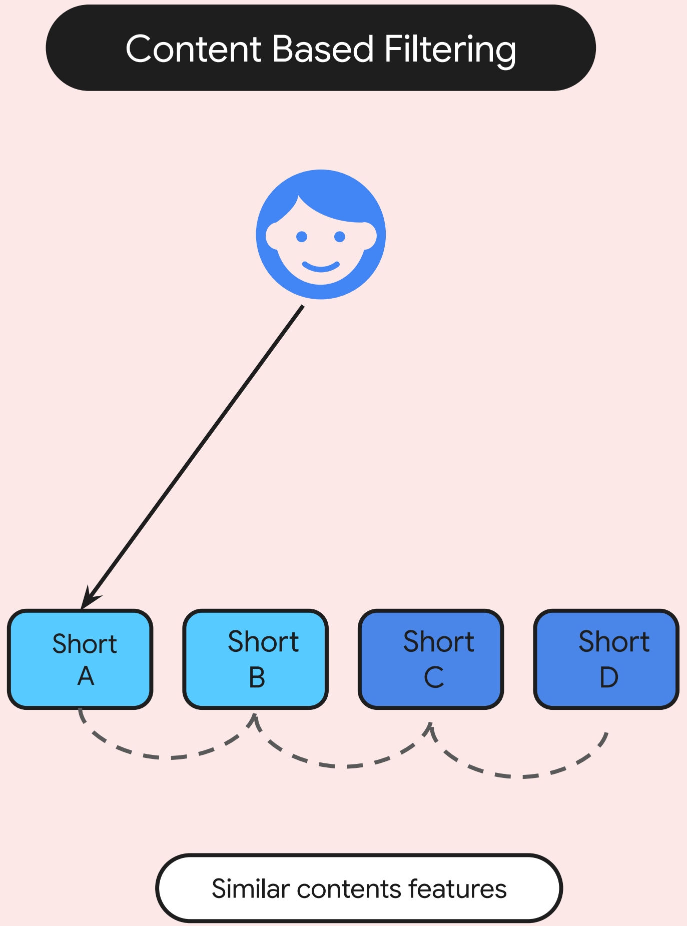
- Build short-videos recommendation at scale in production serving millions of users

- Certified Google Cloud Professional Machine Learning Engineer (PMLE).

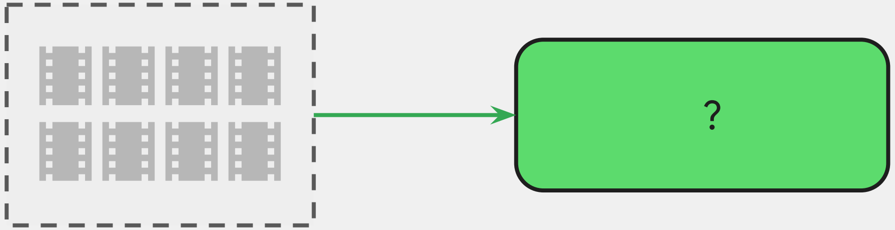
- 15 years working experience multi-domains and loves open-source !

https://github.com/yodiaditya

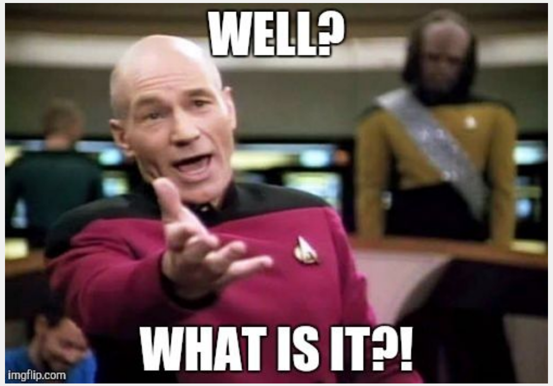

Collaborative Filtering
Short A
Short B
Short C
Short D
Similar interactions


Content Based Filtering
Short A
Short B
Short C
Short D
Similar contents features

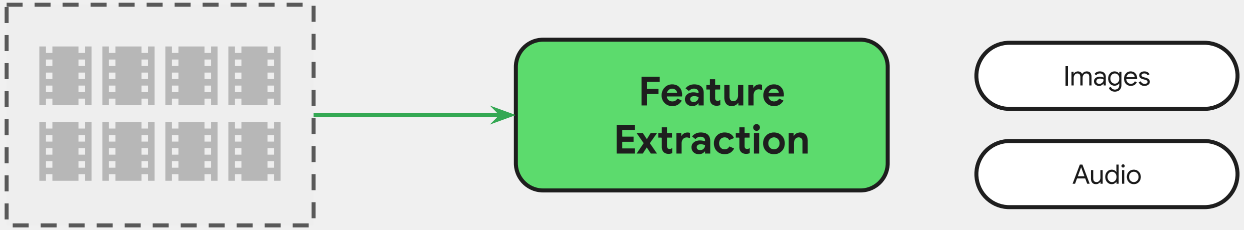
Users upload videos to server

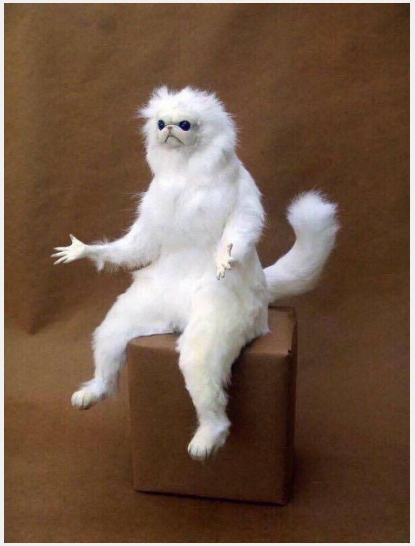


Shorts Videos
(Raw version)

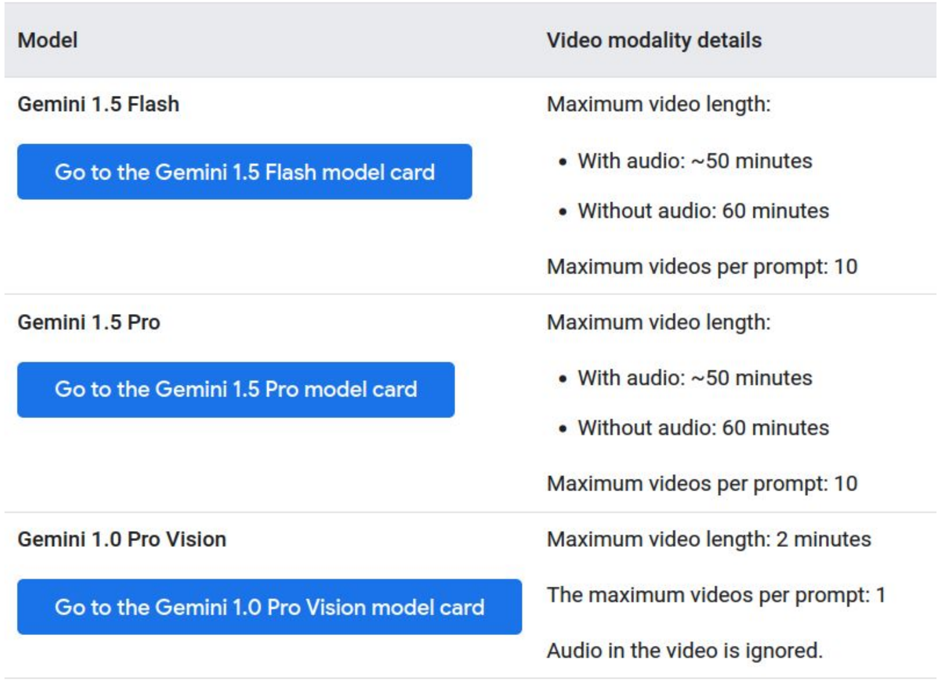


First step is to extract the information from the videos



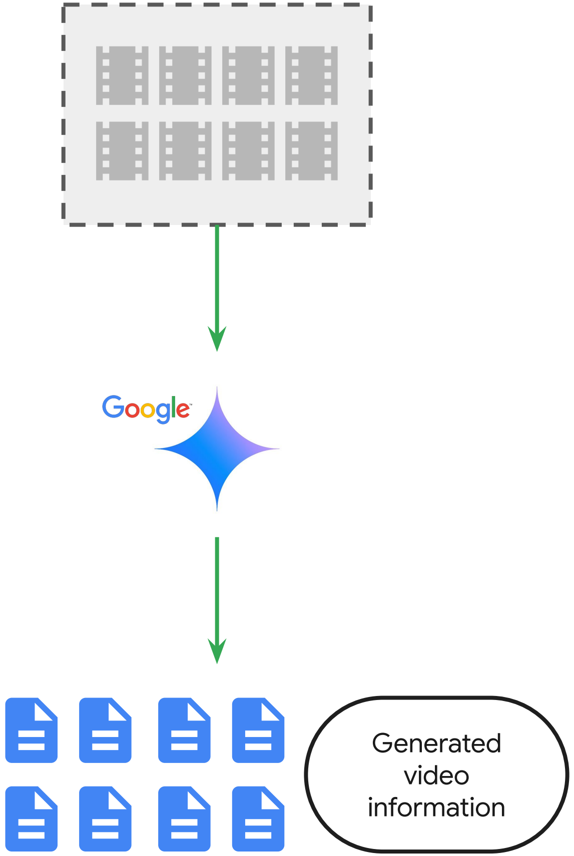


Gemini: Video Understanding

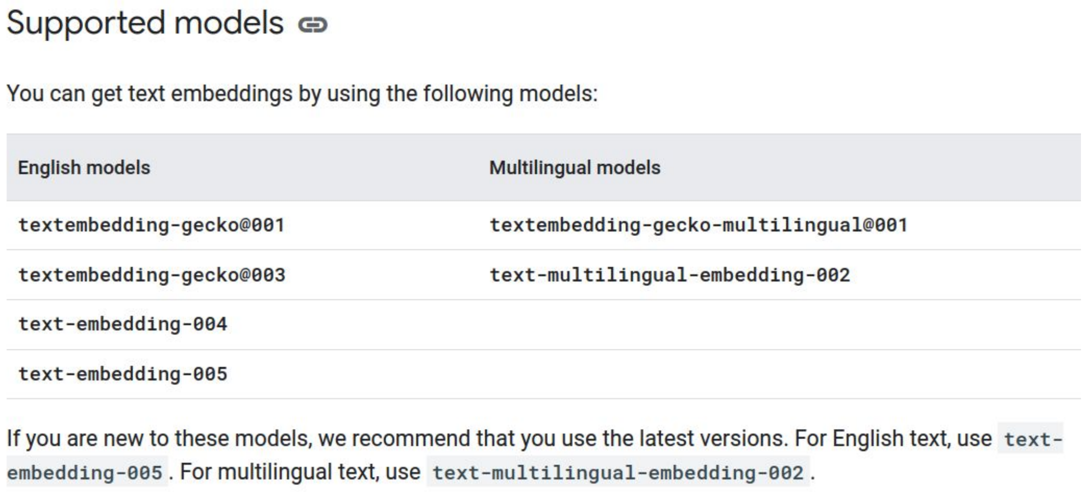


Model	Video modality details
Gemini 1.5 Flash Go to the Gemini 1.5 Flash model card	Maximum video length: • With audio: ~50 minutes • Without audio: 60 minutes Maximum videos per prompt: 10
Gemini 1.5 Pro Go to the Gemini 1.5 Pro model card	Maximum video length: • With audio: ~50 minutes • Without audio: 60 minutes Maximum videos per prompt: 10
Gemini 1.0 Pro Vision Go to the Gemini 1.0 Pro Vision model card	Maximum video length: 2 minutes The maximum videos per prompt: 1 Audio in the video is ignored.

https://cloud.google.com/vertex-ai/generative-ai/docs/multimodal/video-understanding



Next, Embedding Space

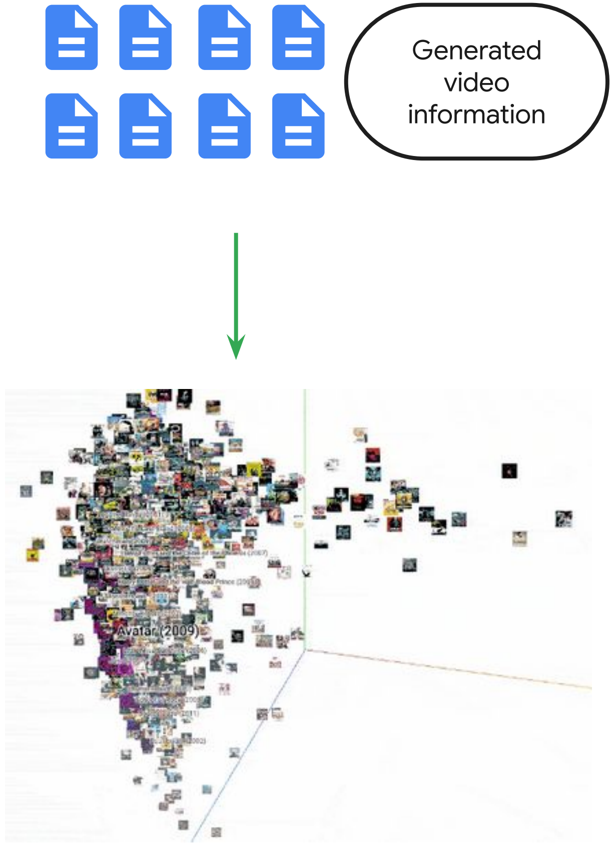


Supported models

You can get text embeddings by using the following models:

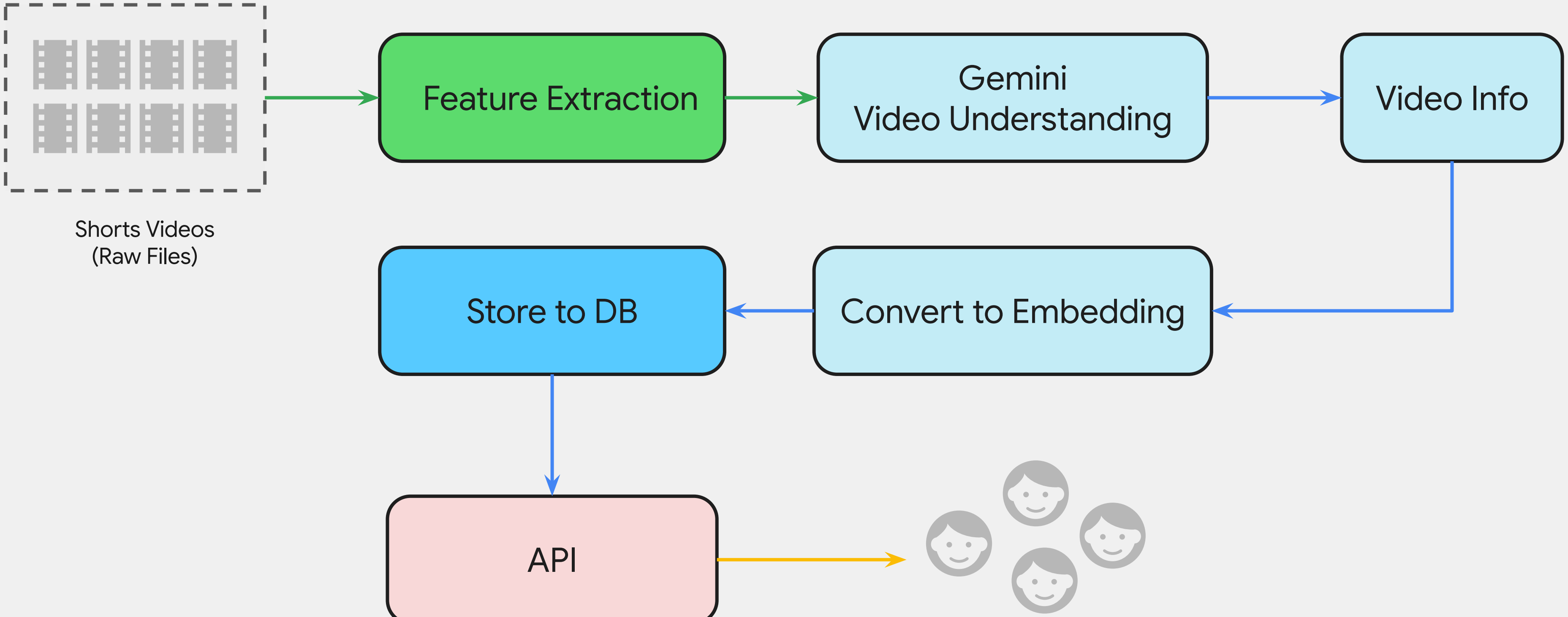
English models	Multilingual models
`textembedding-gecko@001`	`textembedding-gecko-multilingual@001`
`textembedding-gecko@003`	`text-multilingual-embedding-002`
`text-embedding-004`	
`text-embedding-005`	

If you are new to these models, we recommend that you use the latest versions. For English text, use `text-embedding-005`. For multilingual text, use `text-multilingual-embedding-002`.



https://cloud.google.com/vertex-ai/generative-ai/docs/embeddings/get-text-embeddings

Architecture Content-Based Raw Shorts Videos



Show me the code

```
import vertexai
from vertexai.generative_models import GenerativeModel, Part

PROJECT_ID = 'YOUR-PROJECT-ID'
vertexai.init(project=PROJECT_ID, location="us-central1")
vision_model = GenerativeModel("gemini-1.5-flash-002")

# Generate text
response = vision_model.generate_content(
  [
    Part.from_uri(
      "gs://shorts-hdr-dataset/videos/sdr/SDR_Animal_45j4.mp4", mime_type="video/mp4"
    ),
    "Watch each frame in video. Do not make up any information that is not part of the video. Generate title of video, genres, short description and taggings of content ",
  ]
)
print(response.text)
```

SFV+HDR Dataset
A large scale dataset containing YouTube Short form and HDR videos intended for video compression and quality assessment research.

https://media.withyoutube.com/sfv-hdr

Here's a breakdown of the video based on your request:

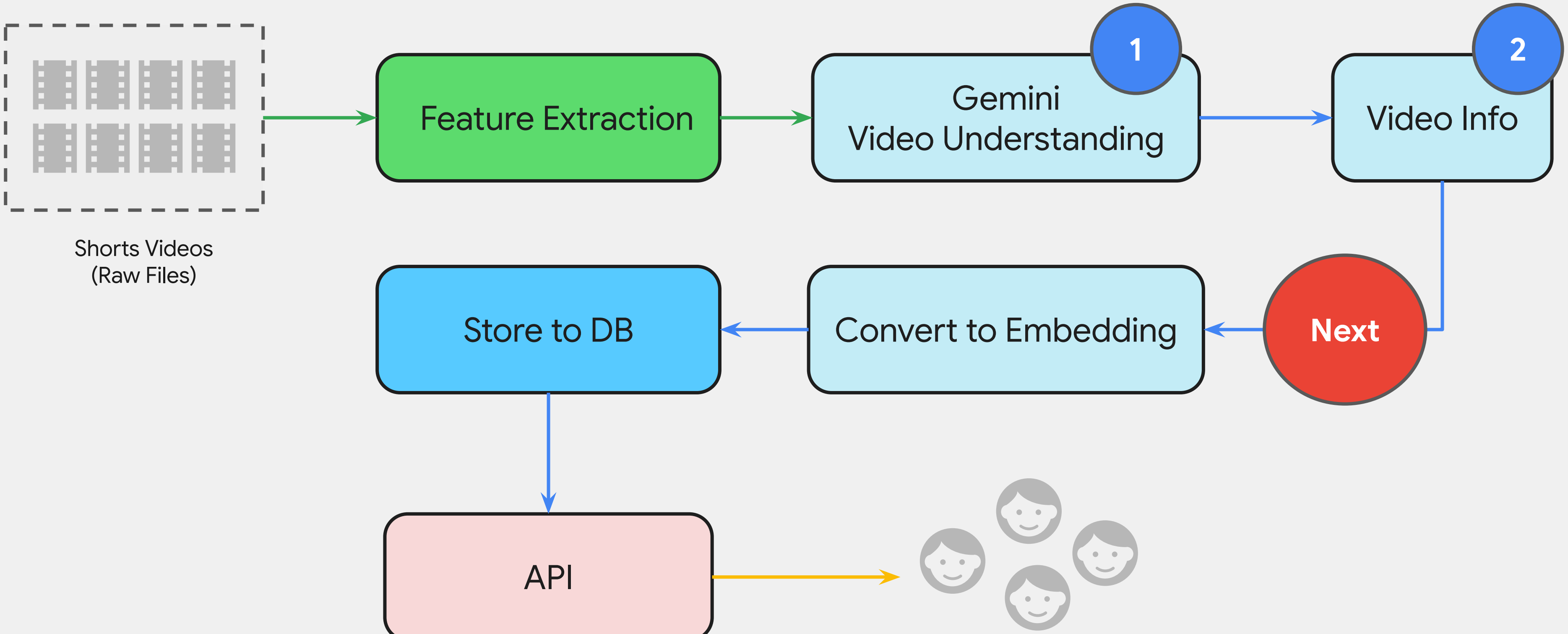
Title: Fluffy Persian Cat

Genres: Animals, Cats, Pets

Short Description: A beautiful fluffy Persian cat sits on a wooden pallet.

Taggings: Persian cat, fluffy cat, cat, kitten, pets, animals, cute, adorable, white cat, long hair cat

Architecture Content-Based Raw Shorts Videos

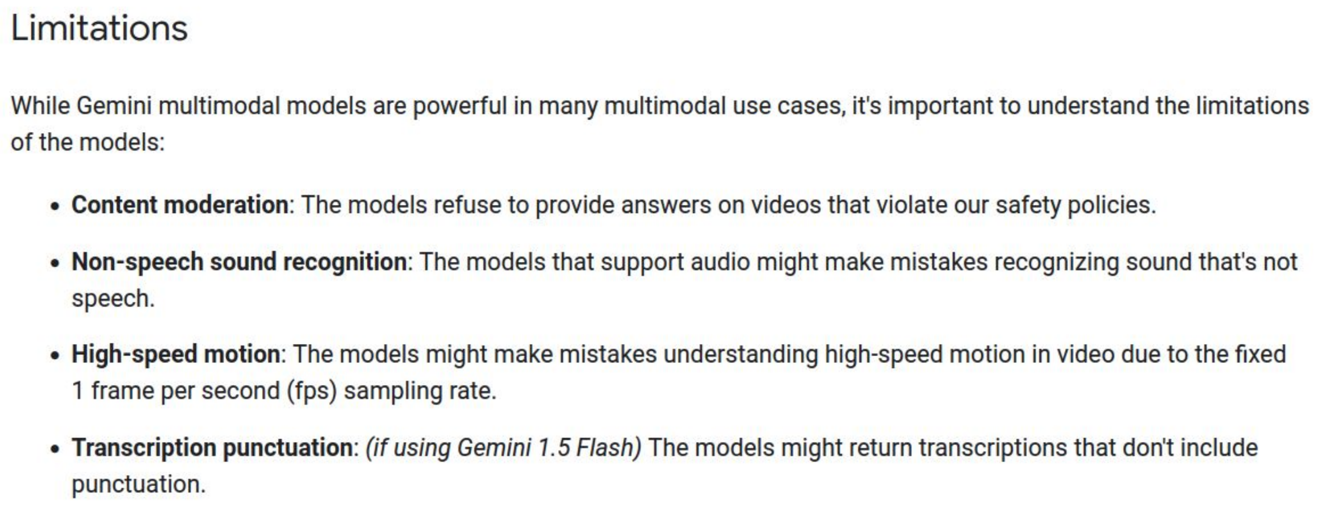


```python
import google.generativeai as genai
import os

genai.configure(api_key=os.environ["GEMINI_API_KEY"])

text = f"""
    *Title:**  Fluffy Persian Cat **Genres:** Animals, Cats, Pets
    **Short Description:** A beautiful fluffy Persian cat sits on a wooden pallet.
    **Taggings:** Persian cat, fluffy cat, cat, kitten, pets, animals, cute, adorable, white cat, long
hair cat"""

result = genai.embed_content(
    model="models/text-embedding-004",
    content=text)

print(str(result['embedding']))
```

```
[-0.07675823, 0.027660733, 0.049145754, -0.045824636, 0.061620172, 0.032313757,
-0.015517017, -0.03240082, 0.015460015, 0.062071748, -0.03166332, 0.036584534,
0.024837952, 0.009332091, 0.04251558, -0.029856514, 0.05006616, 0.073106274, -0.029902106,
-0.025679907, 0.084334895, -0.017889986, 0.059542187, 0.0013102485, -0.04699988,
-0.007112105, 0.055407282, 0.018771457, 0.07350461, -0.01813061, 0.04455579, 0.064248785,
0.00448263, 0.008756887, 0.047846865, -0.025803361, -0.019773666, 0.041618045,
0.051186264, -0.07005315, -0.033514354, -0.026876828, -0.0008525868, 0.08978644,
0.027724743, 0.010746625, -0.061409652, 0.026029717, -0.0034387638, 0.035402797,
0.007589881, -0.023214854, -0.019220363, 0.02619021, -0.026539033, 0.012508128,
0.0040561967, -0.028133305, -0.016629174, 0.020951482, 0.06473735, 0.034282178,
0.051744517, 0.019634075, -0.016341783, 0.021416675, -0.05009744, -0.0076771406,
-0.036871992, 0.095764354, -0.02469845, 0.025160229, -0.046339314, 0.024582243,
-0.008852839, -0.010245625, 0.011931524, 0.037149847, -0.027476897, 0.021095295,
-0.0048002778, 0.012314561, 0.09466355, -0.028999066, -0.010545491, 0.019936696,
-0.0075119766, 0.02987802, -0.08925607, 0.0030204963, 0.06398722, -0.005665603,
0.055336952, 0.031011213, 0.0803204, -0.046087332, -0.09462911, -0.029559113, 0.017180113,
0.035609562, -0.041688204, 0.016256401, -0.018201571, -0.06340068, 0.05076339,
0.00789683, -0.04663778, 0.003865695, -0.02993782, 0.05526901, -0.059481055, -0.08222241,
-0.044425923, 0.03254365, 0.052314047, 0.077546, 0.0024010574, 0.030455906, -0.017964754,
-0.03830613, 0.042473085, 0.021389754, 0.031468235, -0.0121501945, -0.010297442,
0.012780487, -0.0086625, -0.019988453, 0.017340286, -0.009815917, 0.068223, 0.02263392,
0.02600014, 0.03895912, -0.01126567, 0.03847954, 0.035594787, -0.08233705, 0.007975588,
-0.010537024, -0.042857118, -0.037623975, -0.04778282, 0.007993469, 0.0021377627,
-0.046956647, -0.019428788, 0.068178736, -0.002273978, 0.032764167, 0.022261541,
-0.050062243, -0.0049963817, -0.0493768, 0.027171357, 0.030386483, 0.035637327,
-0.026583953, -0.05276558, -0.051282965, 0.060191035, -0.03913675, 0.009324002,
-2.8839599e-05, -0.010929866, -0.0029119896, 0.013345155, -0.013394253, 0.006282062,
-0.029159687, -0.023629908, -0.04224124, -0.045065757, -0.023713488, -0.038271822,
0.046776716, -0.024885133, -0.05454553, -0.07411608, 0.02653326, 0.01615619, -0.017124163,
-0.03665412, -0.07935555, 0.034953605, -0.073878795, -0.035953894, -0.019765098,
0.004043873, 0.024911957, -0.005691729, -0.050333932, -0.000985027, -0.036075074,
0.011225469, -0.016764432, 0.09254729, -0.072244085, -0.037920788, 0.0124474, 0.041128416,
-0.018892227, 0.02873513, 0.03394367, 0.005887189, 0.04828047, -0.015023347, -0.010894143,
0.003211685, -0.042894274, -0.110083245, 0.013853838, 0.02313884, -0.072523855,
0.024407636, 0.02207754, 0.027719164, -0.01624695, 0.040581483, -0.039446704,
0.062565975, 0.014453987, 0.021910533, -0.019675337, 0.04837492, -0.011042686, -0.02570678,
-0.0035492862, -0.012308466, -0.020631982, -0.035574436, 0.042452924, 0.022002371,
-0.012221022, -0.039625946, 0.009512582, 0.0071309633, -0.01212419, -0.014330538,
0.06173416, -0.007517297, 0.016374068, 0.08243889, 0.0066845445, 0.053010326,
0.004689015, 0.027499422, 0.05117024, -0.06105194, -0.0407715, -0.006838235, 0.007643424,
-0.028924558, 0.031687874, -0.06336678, -0.01165728, -0.003804315, 0.04765609,
-0.008533617, 0.006844215, -0.026217818, -0.049941003, -0.010676516, -0.039658975,  ....
```

Tips to scale

Gemini: Video Understanding



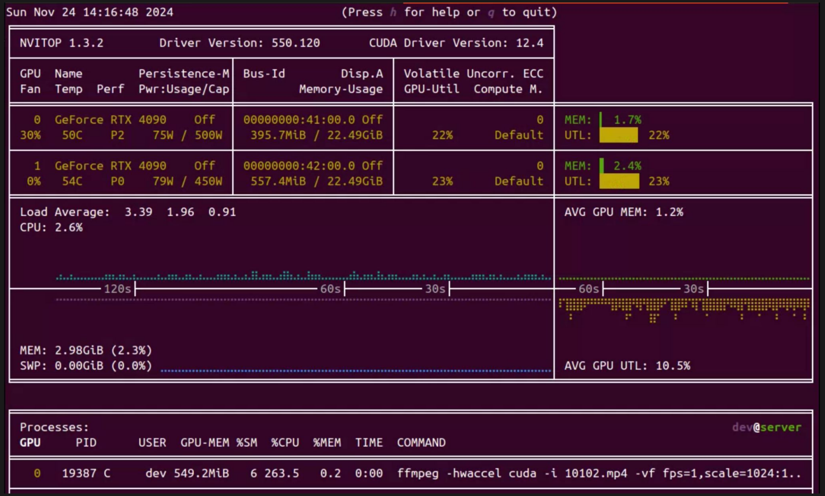
Limitations

While Gemini multimodal models are powerful in many multimodal use cases, it's important to understand the limitations of the models:

- **Content moderation**: The models refuse to provide answers on videos that violate our safety policies.
- **Non-speech sound recognition**: The models that support audio might make mistakes recognizing sound that's not speech.
- **High-speed motion**: The models might make mistakes understanding high-speed motion in video due to the fixed 1 frame per second (fps) sampling rate.
- **Transcription punctuation**: *(if using Gemini 1.5 Flash)* The models might return transcriptions that don't include punctuation.

https://cloud.google.com/vertex-ai/generative-ai/docs/multimodal/video-understanding

```bash
#!/bin/bash

# Create the output folder if it doesn't exist
mkdir -p small
files=(*.mp4)

for i in "${!files[@]}"; do
 file="${files[$i]}"
 filename=$(basename "$file" .mp4)
 output="small/${filename}.mp4"
 gpu=$((i % 2))

 CUDA_VISIBLE_DEVICES="$gpu" ffmpeg -hwaccel cuda -i "$file" -vf
"fps=1,scale=1024:1024:force_original_aspect_ratio=decrease,pad=1024:1024:(ow-iw)/2:(oh-ih)/2" \
  -c:v h264_nvenc -preset slow -cq 30 -c:a aac -b:a 96k -movflags +faststart "$output" &

 echo "Started processing: $file on GPU $gpu"
 # Wait for processes to complete every two files
 if ((i % 2 == 1)); then
  wait
 fi
done
```

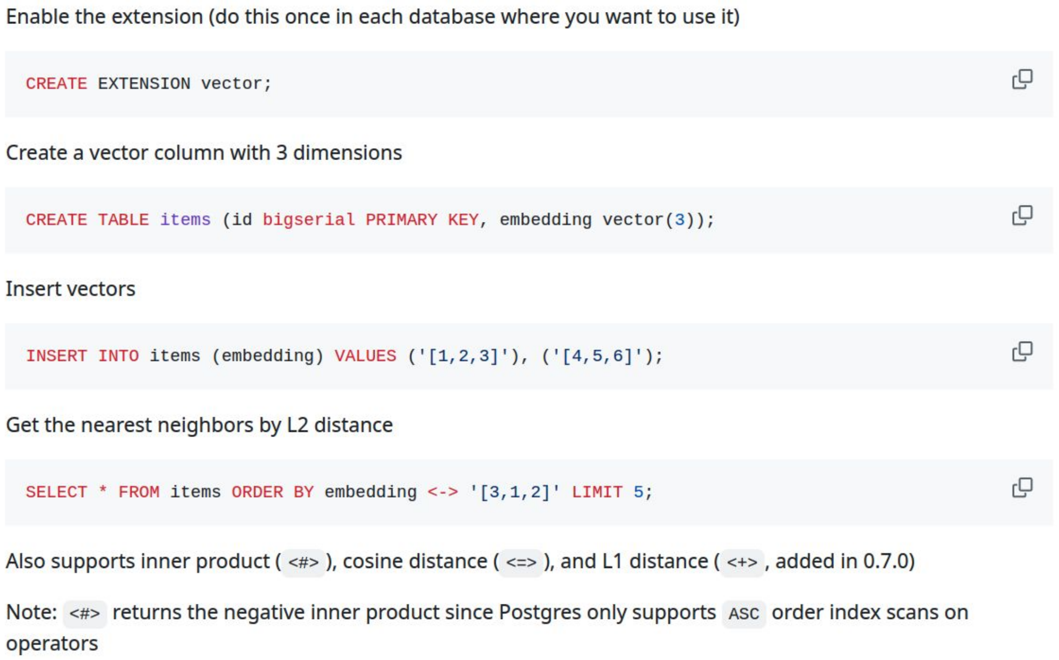


```
Sun Nov 24 14:16:48 2024                              (Press h for help or q to quit)
 NVITOP 1.3.2         Driver Version: 550.120        CUDA Driver Version: 12.4
 GPU  Name           Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC
 Fan  Temp  Perf     Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M.
   0  GeForce RTX 4090     Off    | 00000000:41:00.0 Off |                   0  MEM:    1.7%
 30%   50C    P2     75W / 500W   |  395.7MiB / 22.49GiB |     22%     Default  UTL:      22%
   1  GeForce RTX 4090     Off    | 00000000:42:00.0 Off |                   0  MEM:    2.4%
  0%   54C    P0     79W / 450W   |  557.4MiB / 22.49GiB |     23%     Default  UTL:      23%
 Load Average:  3.39  1.96  0.91                                               AVG GPU MEM: 1.2%
 CPU: 2.6%
            120s              60s          30s                                 60s          30s
 MEM: 2.98GiB (2.3%)
 SWP: 0.00GiB (0.0%)                                                           AVG GPU UTL: 10.5%

 Processes:                                                                           dev@server
 GPU      PID      USER  GPU-MEM %SM  %CPU  %MEM  TIME  COMMAND
   0   19387 C      dev 549.2MiB   6 263.5   0.2  0:00  ffmpeg -hwaccel cuda -i 10102.mp4 -vf fps=1,scale=1024:1..
```

1. Use FFMPEG-GPU NVIDIA
2. Reduce size and apply FPS 1

Process 2,6K videos: 31GB to 2.7GB (90% reduction) with FPS 1. 10x faster speed than CPU.

Use PostgreSQL and PGVector



Enable the extension (do this once in each database where you want to use it)

```
CREATE EXTENSION vector;
```

Create a vector column with 3 dimensions

```
CREATE TABLE items (id bigserial PRIMARY KEY, embedding vector(3));
```

Insert vectors

```
INSERT INTO items (embedding) VALUES ('[1,2,3]'), ('[4,5,6]');
```

Get the nearest neighbors by L2 distance

```
SELECT * FROM items ORDER BY embedding <-> '[3,1,2]' LIMIT 5;
```

Also supports inner product (`<#>`), cosine distance (`<=>`), and L1 distance (`<+>` , added in 0.7.0)

Note: `<#>` returns the negative inner product since Postgres only supports `ASC` order index scans on operators

https://github.com/pgvector/pgvector

Thank you!

Linkedin

linkedin.com/in/yodiaditya

Github

https://github.com/yodiaditya/shorts

Google Developer Groups