

# Multimodal Large Language Models (LLMs)

## **Definition:**

*Multimodal Large Language Models* are advanced AI models capable of understanding, processing, and generating data across multiple modalities — such as text, images, audio, and video — rather than being limited to a single type of input (e.g., only text).

## **Key Characteristics:**

1. **Multiple Input Types:** They can handle text, images, speech, or even sensor data.
2. **Unified Representations:** These models create shared embeddings that link different data types in a common latent space, enabling cross-modal understanding.
3. **Contextual Understanding:** They can reason across modalities, e.g., describing an image in text or generating an image from a text prompt.
4. **Transfer Learning:** Often built on pretrained language models and adapted to multimodal tasks through fine-tuning.

## **Applications:**

- **Text-to-Image Generation:** Creating images based on descriptive text (e.g., DALL·E, Stable Diffusion).
- **Visual Question Answering (VQA):** Answering questions about images.
- **Speech-to-Text and Text-to-Speech:** Integrating audio and text processing.
- **Multimodal Search:** Searching for images using textual queries or vice versa.

## **Examples:**

- GPT-4 with vision capabilities
- CLIP (Contrastive Language-Image Pretraining)
- Flamingo by DeepMind

## **Advantages:**

- Better contextual reasoning using multiple modalities.
- Enables more interactive AI experiences.

*Reduces the need for separate models for each data type.*

# Databricks

## **Definition:**

*Databricks* is a unified data and AI platform built on **Apache Spark**. It provides a collaborative

*environment for data engineering, machine learning, and analytics, allowing organizations to process and analyze large-scale data efficiently.*

#### **Key Components:**

1. **Apache Spark Integration:** Distributed computing for large-scale data processing.
2. **Databricks Lakehouse:** Combines the benefits of data lakes (scalable storage) and data warehouses (structured analytics).
3. **Collaborative Workspace:** Supports notebooks, dashboards, and integration with popular IDEs for teams.
4. **MLflow Integration:** Built-in machine learning lifecycle management including experiment tracking, model deployment, and versioning.
5. **Delta Lake:** Provides ACID transactions on data lakes, enabling reliable data pipelines.

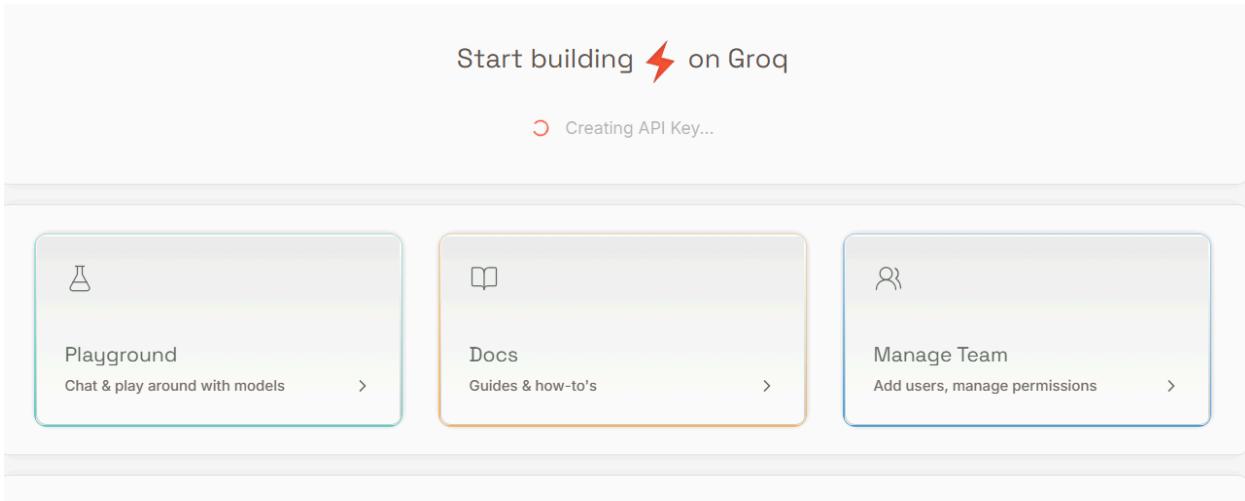
#### **Applications:**

- **Big Data Analytics:** Processing terabytes to petabytes of structured and unstructured data.
- **Machine Learning & AI:** Training and deploying ML models efficiently.
- **Data Engineering Pipelines:** ETL workflows, batch and streaming data processing.
- **Business Intelligence:** Creating dashboards and reports on unified datasets.

#### **Advantages:**

- Simplifies big data processing and AI workflows.
- Supports collaboration across data scientists, engineers, and analysts.
- Provides scalable, reliable, and high-performance data handling.

# Groq -Open AI Platform to generate API key



This screenshot shows the "Here's your API key!" section of the Groq platform. It displays the generated API key: "gsk\_7w57MmlvgUSmnXoKjq01WGdyb3FYYLfk8nuZxVZFyUuhSiskzxok". A red box highlights the copy icon next to the key. Below the key, there is a "Copy your key now. We will not display it again." button with a copy icon. Further down, instructions say "Run this in your terminal to make your first API request." followed by a "curl" command example. The command is as follows:

```
curl https://api.groq.com/openai/v1/chat/completions -s \
-H "Content-Type: application/json" \
-H "Authorization: Bearer gsk_7w57MmlvgUSmnXoKjq01WGdyb3FYYLfk8nuZx" \
-d '{
  "model": "openai/gpt-oss-120b",
  "messages": [
    {
      "role": "user",
      "content": "Please briefly explain the importance of fast AI in"
    }
}'
```

https://console.groq.com/playground?model=openai/gpt-oss-20b

**Playground** / Default Project

Playground API Keys Dashboard Docs

openai/gpt-oss-20b Hide code

Python

```
from groq import Groq

client = Groq()
completion = client.chat.completions.create(
    model="openai/gpt-oss-20b",
    messages=[
        {
            "role": "user",
            "content": [
                {
                    "type": "text",
                    "text": "Explain the role of deep learning in medical image analysis in simple terms."
                }
            ]
        },
        {
            "role": "assistant",
            "content": "***Deep learning in medical imaging: a quick-and-clear picture***\n\nWhat it is |"
        },
        {
            "role": "user",
            "content": ""
        }
    ]
)
```

SYSTEM Enter system message (Optional)

USER "Explain the role of deep learning in medical image analysis in simple terms."

ASSISTANT

- Reasoning
  - User wants simple explanation. Provide overview: deep learning = neural networks that can learn patterns from images, used for diagnosis, detection, segmentation. Mention convolutional neural networks. Use analogies, avoid heavy jargon. Provide examples.

**Deep learning in medical imaging: a quick-and-clear picture**

| What it is                             | How it works in plain language   | Why it matters in medicine   |
|--|--|--|
| A computer that "learns" from pictures | Think of a robot that watches thousands of X-rays, MRIs, CTs, or ultrasounds and keeps a mental note of the shapes, colors, and textures that belong to healthy tissue versus disease. After seeing enough examples, it can look at a new picture and say, | It can spot problems that a human eye might miss or take a long time to find |

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https://console.groq.com/playground?model=moonshotai/kimi-k2-instruct

Playground Chat Studio

Playground API Keys Dashboard Docs

moonshotai/kimi-k... Hide code

Python

```
from groq import Groq

client = Groq()
completion = client.chat.completions.create(
    model="moonshotai/kimi-k2-instruct",
    messages=[
        {
            "role": "user",
            "content": [
                {
                    "type": "text",
                    "text": "Explain the role of deep learning in medical image analysis in simple terms."
                }
            ]
        },
        {
            "role": "assistant",
            "content": "Think of a medical image as a very complicated \"Where's Waldo?\" picture.\n\n1. Old-style computer programs had to be told exactly what Waldo looked like (\"red-striped shirt, glasses, hat\").\n2. A deep-learning network is like giving the computer millions of pictures and saying, \"Here are 50 000 examples where someone circled Waldo. Figure out the pattern yourself.\"\n3. After looking at enough examples, the network builds its own idea of \"Waldo\" (a tumor, a fracture, a blood-vessel blockage).\n4. When a new image arrives, the network quickly spots the pattern it learned and marks the spot for the doctor.\n\nSo, deep learning is the computer's way of teaching itself to see the hidden clues in X-rays, CT, MRI, or microscope slides, helping doctors find diseases faster and more accurately."
        },
        {
            "role": "user",
            "content": ""
        }
    ]
)
```

USER Explain the role of deep learning in medical image analysis in simple terms.

ASSISTANT

- Old-style computer programs had to be told exactly what Waldo looked like ("red-striped shirt, glasses, hat").
- A deep-learning network is like giving the computer millions of pictures and saying, "Here are 50 000 examples where someone circled Waldo. Figure out the pattern yourself."
- After looking at enough examples, the network builds its own idea of "Waldo" (a tumor, a fracture, a blood-vessel blockage).
- When a new image arrives, the network quickly spots the pattern it learned and marks the spot for the doctor.

So, deep learning is the computer's way of teaching itself to see the hidden clues in X-rays, CT, MRI, or microscope slides, helping doctors find diseases faster and more accurately.

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Playground Chat Studio

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potential medical conditions or abnormalities.

**Role of Deep Learning in Medical Image Analysis:**

- **Automated Diagnosis:** Deep learning models can provide accurate and fast diagnoses, reducing the workload of medical professionals.
- **Object Detection:** Models can detect specific features or objects in medical images, such as tumors or blood vessels.
- **Decision Support:** Models can help doctors and medical professionals make informed decisions by providing them with relevant information and insights.
- **Predictive Analytics:** Deep learning models can analyze medical images to predict patient outcomes and disease progression.

Some examples of how deep learning has been used in medical image analysis include:

- Detection of diabetic retinopathy from retinal images
- Identification of breast cancer from mammography images
- Analysis of brain scans to diagnose neurological disorders

Deep learning is rapidly changing the way medical image analysis is performed, and it is becoming an essential tool in the field of medicine.

USER  
Enter user message...

```
from groq import Groq

client = Groq()
completion = client.chat.completions.create(
    model="llama-3.1-8b-instant",
    messages=[
        {
            "role": "user",
            "content": "Explain the role of deep learning in medical image analysis in simple terms."
        },
        {
            "role": "assistant",
            "content": "Deep learning is a subset of artificial intelligence (AI) that helps a computer learn from large amounts of data, like images. In medical image analysis, deep learning plays a vital role in interpreting and analyzing medical images such as X-rays, CT scans, MRI scans, and ultrasound images."
        },
        {
            "role": "user",
            "content": ""
        }
    ],
    temperature=1,
    max_completion_tokens=1024,
```

groq Personal / Default Project

Playground Chat Studio

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Explain the role of deep learning in medical image analysis in simple terms.

ASSISTANT  
Deep learning is a subset of artificial intelligence (AI) that helps a computer learn from large amounts of data, like images. In medical image analysis, deep learning plays a vital role in interpreting and analyzing medical images such as X-rays, CT scans, MRI scans, and ultrasound images.

Here's a simplified example of how deep learning works in medical image analysis:

**Step 1: Image Acquisition** A doctor or a medical professional takes medical images of a patient using special equipment.

**Step 2: Data Preparation** The medical images are then digitalized and stored in a large database.

**Step 3: Training a Model** A deep learning model is created and "trained" on the large database of medical images using a process called Supervised Learning. The model learns from the images and detects patterns and features that are associated with different medical conditions.

**Step 4: Model Application** The trained model is then applied to new medical images to identify potential medical conditions or abnormalities.

**Role of Deep Learning in Medical Image Analysis:**

- **Automated Diagnosis:** Deep learning models can provide accurate and fast diagnoses.

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```
from groq import Groq

client = Groq()
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        },
        {
            "role": "user",
            "content": ""
        }
    ],
    temperature=1,
    max_completion_tokens=1024,
    top_p=1,
```