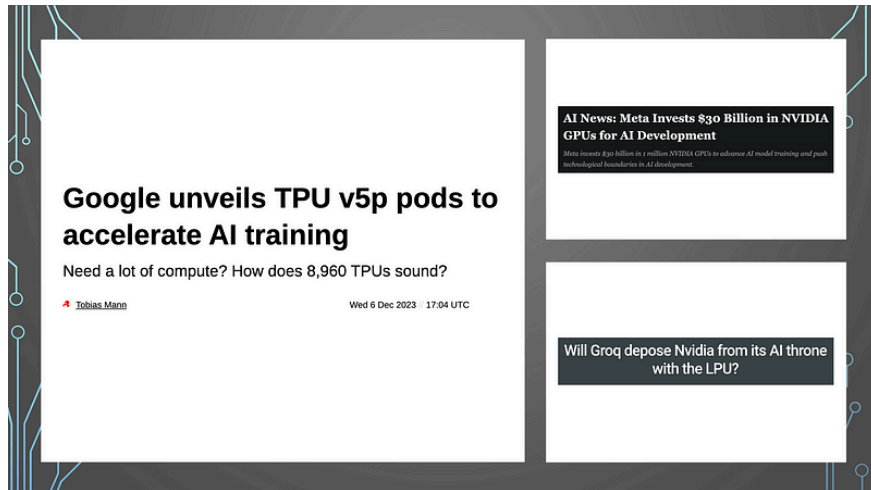# A Beginner's guide to AI Processors: CPUs, GPUs, TPUs and LPUs



Author generated from news and articles on Google search

As Artificial Intelligence (AI) technology continues to evolve, need for understanding the role of specialised hardware that power AI applications is important. From training machine learning models to processing big data, the choice of processor impacts the efficiency and performance of AI tasks. Whether you are a developer, data scientist, or tech enthusiast, this guide will help you to understand the most common types of AI hardware: CPUs, GPUs, TPUs, and LPUs.

**CPU: All-Rounder**

C entral Processing Unit (CPU) is the traditional heart of a computer, capable of handling a variety of tasks from basic calculations to complex software operations.

*Examples : Intel Core processors and Apple M1/M2 chips*

- **Best for:** General-purpose computing, smaller datasets, or tasks requiring complex logic where data processing needs are sequential.

- **Application:** Running data preprocessing or light machine learning models like linear/logistic regression on a dataset with less number of data points

**GPU: Speedster**

G raphics Processing Units (GPUs) are known for their ability to handle multiple operations simultaneously in parallel, making them ideal for graphics rendering in Games and AI computations.

*Examples: Nvidia Tesla and Nvidia Drive PX*

- **Best for:** Large-scale machine learning tasks that requires handling of massive datasets with millions of data points or running complex deep learning models.

- **Application:** Training a convolutional neural network on a dataset with millions of images. A task that could take days on a CPU might only take hours on a GPU due to its parallel processing capabilities.

*Difference between CPU and GPU:*
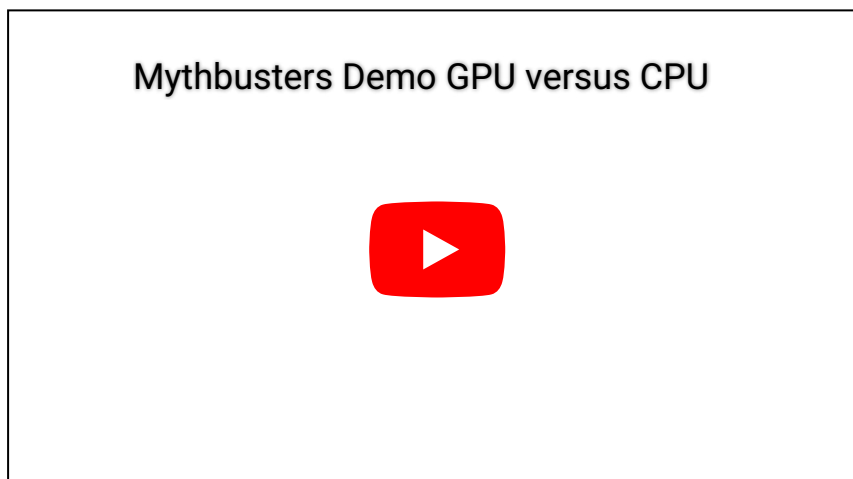


Credits to creators

```python
import numpy as np
import cupy as cp
import time

# Larger matrices for more complex computation
def cpu_matrix_multiplication():
    x = np.random.random((10000, 10000))
    y = np.random.random((10000, 10000))
    start_time = time.time()
    result = np.dot(x, y)
    end_time = time.time()
    print("CPU time: {:.5f} seconds".format(end_time - start_time))

def gpu_matrix_multiplication():
    x = cp.random.random((10000, 10000))
    y = cp.random.random((10000, 10000))
    start_time = time.time()
    result = cp.dot(x, y)
    cp.cuda.Stream.null.synchronize()
    end_time = time.time()
    print("GPU time: {:.5f} seconds".format(end_time - start_time))

cpu_matrix_multiplication()
gpu_matrix_multiplication()
```

```
CPU time: 37.36517 seconds
GPU time: 8.65761 seconds
```

Running a matrix multiplication using CPU and GPU

### TPU: Accelerator

Tensor Processing Units (TPUs) are Application Specific Integrated Circuits (ASIC), developed by Google, designed to accelerate TensorFlow, a popular machine learning framework.

*Examples: Apple neural engine and Intel's Gaudi AI processor*

- **Best for:** TPUs are built to enhance the speed and efficiency of TensorFlow applications, making them particularly suitable for tasks that can leverage this specific framework.

- Application: TPUs are commonly used in advanced Google services like Google Search and Google Photos, where rapid data processing and model improvements are continously required.

### LPU: Language Expert

Language Processing Units (LPUs) are specialised processors designed to excel in natural language tasks such as translation and sentiment analysis.

*Groq, a new player, in the AI hardware industry, is pioneering the development of LPUs*

- **Best for:** LPUs are suitable for applications that require processing complex language data efficiently.

- **Example:** LPUs power advanced chatbots, enabling them to understand and respond to human queries quickly and accurately, improving user interactions in customer service settings.
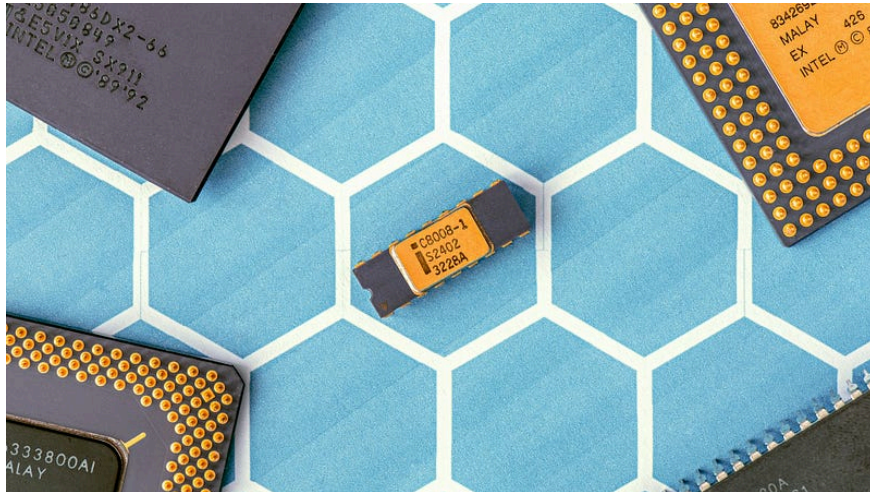
## Choosing the right processor:



Photo by Jonas Svidras on Unsplash

Selecting the right AI hardware depends on your specific needs:

- **CPUs** are suitable for general-purpose computing and less complex AI tasks.

- **GPUs** are the go-to for large-scale data processing and deep learning.

- **TPUs** offer the best performance for TensorFlow-based applications.

- **LPUs** excel in handling optical data for imaging and real-time analysis.

By carefully selecting your hardware based on your project specific needs, you can significantly enhance efficiency and bring innovation in your AI initiatives. A deep understanding of these hardware options enables you to make a right choice that can significantly impact the performance and success of your AI technologies.