# Keras vs Tensorflow vs Pytorch: Key Differences Among Deep Learning

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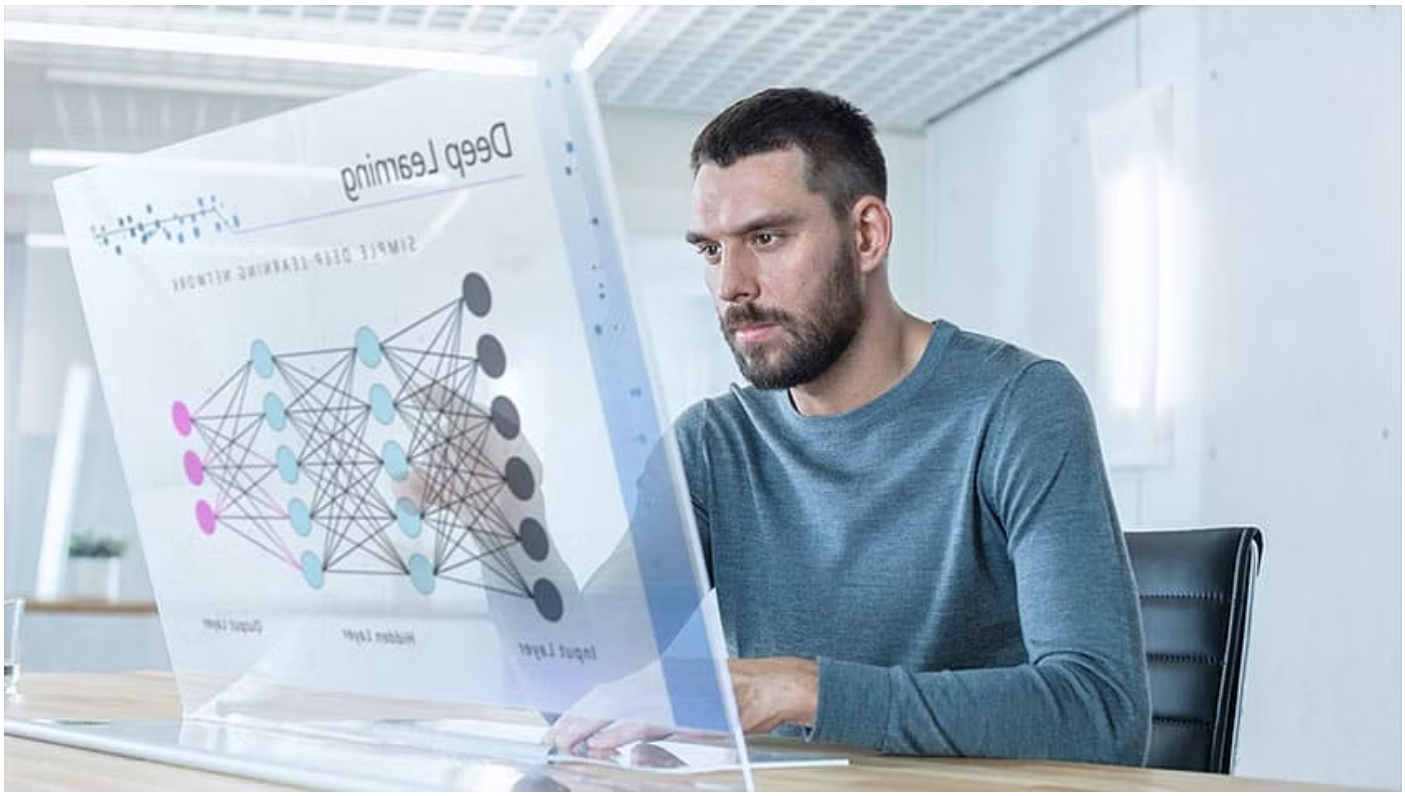


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Deep learning is a subset of Artificial Intelligence (AI), a field growing in popularity over the last several decades. Like any new concept, some questions and details need ironing out before employing it in real-world applications.

But before we explore the PyTorch vs TensorFlow vs Keras differences, let's take a moment to discuss and review deep learning.

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Have a look at the video below that will you help you have a better understanding of the differences between Keras vs Tensorflow vs Pytorch.

### What is Deep Learning?

It's common to hear the terms "deep learning," "machine learning," and "artificial intelligence" used interchangeably, and that leads to potential confusion. Deep learning and machine learning are part of the artificial intelligence family, though deep learning is also a subset of machine learning. Understanding the nuances of these concepts is essential for any discussion of Keras vs TensorFlow vs PyTorch.



Deep learning imitates the human brain's neural pathways in processing data, using it for decision-making, detecting objects, recognizing speech, and translating languages. It learns without human supervision or intervention, pulling from unstructured and unlabeled data.

Deep learning processes machine learning by using a hierarchical level of artificial neural networks, built like the human brain, with neuron nodes connecting in a web. While traditional machine learning programs work with data analysis linearly, deep learning's hierarchical function lets machines process data using a nonlinear approach.

Here are some resources that help you expand your knowledge in this fascinating field: a deep learning tutorial, a spotlight on deep learning frameworks, and a discussion of deep learning algorithms.

### What is Keras?

Keras is an effective high-level neural network Application Programming Interface (API) written in Python. This open-source neural network library is designed to provide fast experimentation with deep neural networks, and it can run on top of CNTK, TensorFlow, and Theano.

Keras focuses on being modular, user-friendly, and extensible. It doesn't handle low-level computations; instead, it hands them off to another library called the Backend.

Keras was adopted and integrated into TensorFlow in mid-2017. Users can access it via the tf.keras module. However, the Keras library can still operate separately and independently.

### What is PyTorch?

PyTorch is a relatively new deep learning framework based on Torch. Developed by Facebook's AI research group and open-sourced on GitHub in 2017, it's used for natural language processing applications. PyTorch has a reputation for simplicity, ease of use, flexibility, efficient memory usage, and dynamic computational graphs. It also feels native, making coding more manageable and increasing processing speed.

### What is TensorFlow?

TensorFlow is an end-to-end open-source deep learning framework developed by Google and released in 2015. It is known for documentation and training support, scalable production and deployment options, multiple abstraction levels, and support for different platforms, such as Android.

TensorFlow is a symbolic math library used for neural networks and is best suited for dataflow programming across a range of tasks. It offers multiple abstraction levels for building and training models.

A promising and fast-growing entry in the world of deep learning, TensorFlow offers a flexible, comprehensive ecosystem of community resources, libraries, and tools that facilitate building and deploying machine learning apps. Also, as mentioned before, TensorFlow has adopted Keras, which makes comparing the two seem problematic. Nevertheless, we will still compare the two frameworks for the sake of completeness, especially since Keras users don't necessarily have to use TensorFlow.

### Don't Forget Theano!

Although this article throws the spotlight on Keras vs TensorFlow vs PyTorch, we should take a moment to recognize Theano. Theano used to be one of the more popular deep learning libraries, an open-source project that lets programmers define, evaluate, and optimize mathematical expressions, including multi-dimensional arrays and matrix-valued expressions.



Theano was developed by the Universite de Montreal in 2007 and is a key foundational library used for deep learning in Python. It's considered the grandfather of deep learning frameworks and has fallen out of favor by most researchers outside academia.

Now, let us explore the PyTorch vs TensorFlow differences.

### PyTorch vs TensorFlow

Both TensorFlow and PyTorch offer useful abstractions that ease the development of models by reducing boilerplate code. They differ because PyTorch has a more "pythonic" approach and is object-oriented, while TensorFlow offers a variety of options.

PyTorch is used for many deep learning projects today, and its popularity is increasing among AI researchers, although of the three main frameworks, it is the least popular. Trends show that this may change soon.

When researchers want flexibility, debugging capabilities, and short training duration, they choose PyTorch. It runs on Linux, macOS, and Windows.

Thanks to its well-documented framework and abundance of trained models and tutorials, TensorFlow is the favorite tool of many industry professionals and researchers. TensorFlow offers better visualization, which allows developers to debug better and track the training process. PyTorch, however, provides only limited visualization.

TensorFlow also beats PyTorch in deploying trained models to production, thanks to the TensorFlow Serving framework. PyTorch offers no such framework, so developers need to use Django or Flask as a back-end server.

In the area of data parallelism, PyTorch gains optimal performance by relying on native support for asynchronous execution through Python. However, with TensorFlow, you must manually code and optimize every operation run on a specific device to allow distributed training. In summary, you can replicate everything from PyTorch in TensorFlow; you just need to work harder at it.

If you're just starting to explore deep learning, you should learn PyTorch first due to its popularity in the research community. However, if you're familiar with machine learning and deep learning and focused on getting a job in the industry as soon as possible, learn TensorFlow first.

Now let us look into the PyTorch vs Keras differences.

### PyTorch vs Keras

Both of these choices are good if you're just starting to work with deep learning frameworks. Mathematicians and experienced researchers will find PyTorch more to their liking. Keras is better suited for developers who want a plug-and-play framework that lets them build, train, and evaluate their models quickly. Keras also offers more deployment options and easier model export.

However, remember that PyTorch is faster than Keras and has better debugging capabilities.

Both platforms enjoy sufficient levels of popularity that they offer plenty of learning resources. Keras has excellent access to reusable code and tutorials, while PyTorch has outstanding community support and active development.

Keras is the best when working with small datasets, rapid prototyping, and multiple back-end support. It's the most popular framework thanks to its comparative simplicity. It runs on Linux, MacOS, and Windows.

### TensorFlow vs Keras

TensorFlow is an open-sourced end-to-end platform, a library for multiple machine learning tasks, while Keras is a high-level neural network library that runs on top of TensorFlow. Both provide high-level APIs used for easily building and training models, but Keras is more user-friendly because it's built-in Python.

Researchers turn to TensorFlow when working with large datasets and object detection and need excellent functionality and high performance. TensorFlow runs on Linux, MacOS, Windows, and Android. The framework was developed by Google Brain and currently used for Google's research and production needs.

The reader should bear in mind that comparing TensorFlow and Keras isn't the best way to approach the question since Keras functions as a wrapper to TensorFlow's framework. Thus, you can define a model with Keras' interface, which is easier to use, then drop down into TensorFlow when you need to use a feature that Keras doesn't have, or you're looking for specific TensorFlow functionality. Thus, you can place your TensorFlow code directly into the Keras training pipeline or model.

At the end of the day, use TensorFlow machine learning applications and Keras for deep neural networks.

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### Theano vs TensorFlow

Again, while the focus of this article is on Keras vs TensorFlow vs PyTorch, it makes sense to include Theano in the discussion. Theano brings fast computation to the table, and it specializes in training deep neural network algorithms. It's cross-platform and can run on both Central Processing Units (CPU) and Graphics Processing Units (GPU).

TensorFlow also runs on CPU and GPU. It is based on graph computation, allowing the developer to visualize the neural network's construction better using TensorBoard, making debugging easier.

### Which is Better PyTorch or TensorFlow or Keras?

Everyone's situation and needs are different, so it boils down to which features matter the most for your AI project. For easy reference, here's a chart that breaks down the features of Keras vs PyTorch vs TensorFlow.

| | Keras | PyTorch | TensorFlow |
|---|---|---|---|
| API Level | High | Low | High and Low |
| Architecture | Simple, concise, readable | Complex, less readable | Not easy to use |
| Datasets | Smaller datasets | Large datasets, high performance | Large datasets, high performance |
| Debugging | Simple network, so debugging is not often needed | Good debugging capabilities | Difficult to conduct debugging |
| Does It Have Trained Models? | Yes | Yes | Yes |
| Popularity | Most popular | Third most popular | Second most popular |
| Speed | Slow, low performance | Fast, high-performance | Fast, high-performance |
| Written In | Python | Lua | C++, CUDA, Python |

In the spirit of "there's no such thing as too much knowledge," try to learn how to use as many frameworks as possible. In other words, the Keras vs. PyTorch vs. TensorFlow debate should encourage you to get to know all three, how they overlap, and how they differ.

### Do You Want Additional Training in Tensorflow?

If you want to succeed in a career as either a data scientist or an AI engineer, then you need to master the different deep learning frameworks currently available. Simplilearn offers the Caltech Post Graduate Program in AI & ML course that can help you gain the skills you need to start a new

career or upskill your current situation.

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## FAQs

**1) Is TensorFlow better than PyTorch?**

TensorFlow shines in deploying AI models for production, while PyTorch is the go-to for academic research purposes.

**2) Is TensorFlow losing to PyTorch?**

The comparison between PyTorch and TensorFlow has typically been presented as TensorFlow excelling in production and PyTorch in research. Nevertheless, as of 2023, the situation is more nuanced, with both frameworks continually evolving.

**3) Is PyTorch replacing TensorFlow?**

Although PyTorch now offers options for mobile applications through PyTorch Live, TensorFlow combined with TFLite remains the current favored approach. Choosing the best framework for learning Deep Learning depends on your background, especially if you're interested in studying Deep Learning itself.

**4) Is TensorFlow faster than PyTorch?**

PyTorch enables faster prototyping, while TensorFlow might be more suitable when customized neural network features are required.

**5) Should I learn PyTorch or TensorFlow?**

For extensive projects with significant deployment requirements, TensorFlow is the preferred choice. However, if you're focused on prototyping for research or smaller-scale endeavors, PyTorch is the suitable option.

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John Terra lives in Nashua, New Hampshire and has been writing freelance since 1986. Besides his volume of work in the gaming industry, he has written articles for Inc.Magazine and Computer Shopp…

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