

Pytorch

A quick tour to basics of Pytorch and auto differentiation

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University
of Glasgow

Which machine learning frameworks will be used in this course?

- (A) scikit-learn
- (B) TensorFlow
- (C) PyTorch

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Answer: **PyTorch**

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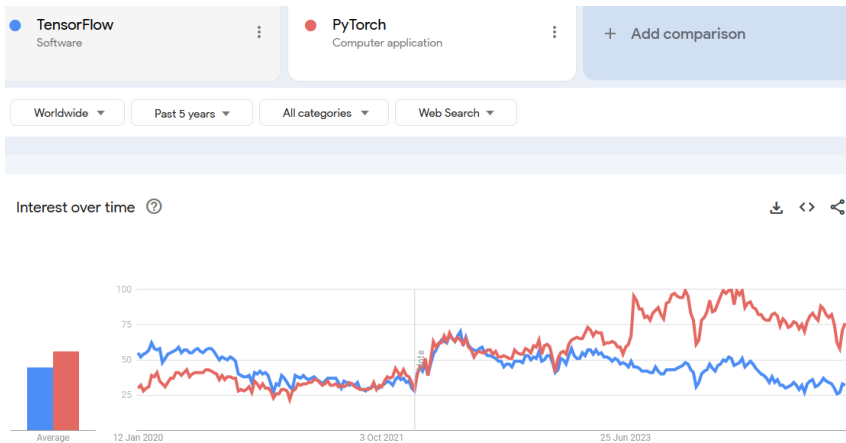
- (A) scikit-learn
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- (C) PyTorch

Answer: **PyTorch**

But why?

My job now is to convince you that we are going in the right direction.

PyTorch versus TensorFlow









































Google Trend: Click on Me!

PyTorch versus TensorFlow

Four tech companies.
Most notable company: Google









































List of companies using TensorFlow

Technology is any of TensorFlow		+ Add Filter		{ } API	Export
Company	Country	Industry	Employees	Revenue	Technologies
 Google	 United States	Software Development	300K	\$280B	 TensorFlow 
 EY	 United Kingdom	It Services And It Consulting	363K	\$45B	 TensorFlow 
 Amazon.com	 United States	Retail	10K	\$50M	 TensorFlow 
 JPMorgan Chase Bank, N.A.	 United States	Financial Services	76K	\$135M	 TensorFlow 
 myGwork - LGBTQ+ Business Community	 United Kingdom	Technology, Information And Internet	189		 TensorFlow 
 Walmart	 United States	Retail	2.3M	\$611B	 TensorFlow 
 Deloitte	Country flag	Business Consulting And Services	458K	\$59B	 TensorFlow 
 ritepros					 TensorFlow 
 SAP	 Germany	Software Development	126K	\$33B	 TensorFlow 
 General Motors	 United States	Motor Vehicle Manufacturing	167K	\$161B	 TensorFlow 

PyTorch versus TensorFlow

Mostly big tech companies
and research centers

List of companies using PyTorch

Technology is any of  PyTorch		+ Add Filter		{ } API		Export
Company	Country	Industry	Employees	Revenue	Technologies	
 Jobs via Dice <small>jobs via Dice</small>		Software Development	2		 PyTorch 	
 Apple <small>apple</small>	 United States	Computer Hardware Manufacturing	293K		 PyTorch 	
 Meta <small>meta</small>	 United States	Software Development	10K		 PyTorch 	
 TikTok <small>tiktok</small>	 United States	Entertainment Providers	70K	\$4.6B	 PyTorch 	
 Microsoft <small>microsoft</small>	 United States	Software Development	239K	\$198B	 PyTorch 	
 AMD <small>amd</small>	 United States	Semiconductor Manufacturing	35K	\$23B	 PyTorch 	
 ByteDance <small>bytedance</small>	 China	Software Development	43K	\$62B	 PyTorch 	
 Capital One <small>capital one</small>	 United States	Financial Services	58K	\$36B	 PyTorch 	
 IBM <small>ibm</small>	 United States	IT Services And It Consulting	329K	\$61B	 PyTorch 	
 Fraunhofer-Gesellschaft <small>fraunhofer</small>	 Germany	Non-Profit Organizations	10K	\$42M	 PyTorch 	

Discussion on Reddit. Click on Me!

Install PyTorch

Install PyTorch with conda (only CPU)

START LOCALLY

Select your preferences and run the install command. Stable represents the most currently tested and supported version of PyTorch. This should be suitable for many users. Preview is available if you want the latest, not fully tested and supported, builds that are generated nightly. Please ensure that you have **met the prerequisites below (e.g., numpy)**, depending on your package manager. You can also **install previous versions of PyTorch**. Note that LibTorch is only available for C++.

NOTE: Latest PyTorch requires Python 3.9 or later.

PyTorch Build	Stable (2.5.1)			Preview (Nightly)	
Your OS	Linux		Mac		Windows
Package	Conda		Pip		LibTorch Source
Language	Python			C++ / Java	
Compute Platform	CUDA 11.8	CUDA 12.1	CUDA 12.4	ROCm 6.2	CPU
Run this Command:	<code>conda install pytorch torchvision torchaudio cpuonly -c pytorch</code>				

Install PyTorch

Install PyTorch with conda (CPU + GPU)

START LOCALLY

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Package	Conda		Pip	LibTorch	Source
Language	Python			C++ / Java	
Compute Platform	CUDA 11.8	CUDA 12.1	CUDA 12.4	ROCm 6.2	CPU
Run this Command:	<pre>conda install pytorch torchvision torchaudio pytorch-cuda=12.4 -c pytorch -c nvidia</pre>				

Install PyTorch

Install PyTorch with pip (only CPU)

START LOCALLY

Select your preferences and run the install command. Stable represents the most currently tested and supported version of PyTorch. This should be suitable for many users. Preview is available if you want the latest, not fully tested and supported, builds that are generated nightly. Please ensure that you have **met the prerequisites below (e.g., numpy)**, depending on your package manager. You can also [install previous versions of PyTorch](#). Note that LibTorch is only available for C++.

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Package	Conda		Pip	LibTorch	Source
Language	Python			C++ / Java	
Compute Platform	CUDA 11.8	CUDA 12.1	CUDA 12.4	ROCm 6.2	CPU
Run this Command:	pip3 install torch torchvision torchaudio				

Install PyTorch

Install PyTorch with pip (CPU + GPU)

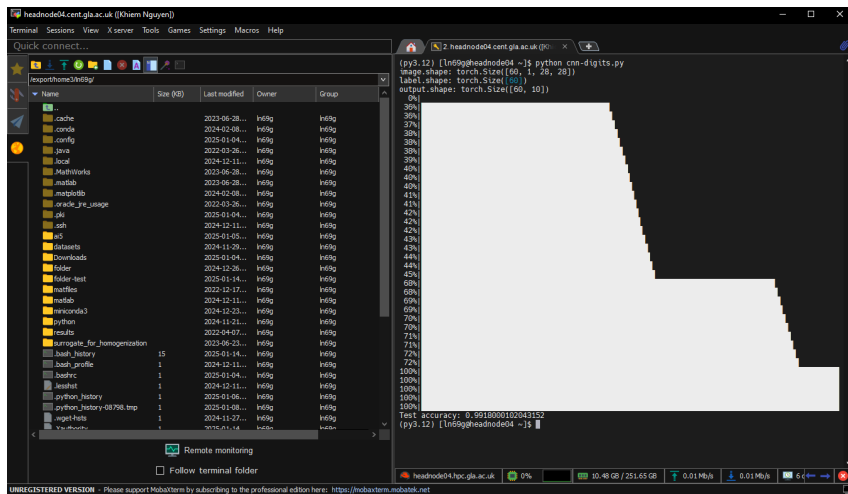
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Package	Conda	Pip		LibTorch
Language	Python		C++ / Java	
Compute Platform	CUDA 11.8	CUDA 12.1	CUDA 12.4	ROCm 6.2
Run this Command:	<pre>pip3 install torch torchvision torchaudio --index-url https://download.pytorch.org/whl/cu124</pre>			

Run Python code on HPC



The screenshot shows a MobaXterm window titled 'headnode04.cent.gla.ac.uk (Khien Nguyen)'. The left pane displays a file explorer view of the user's home directory, listing various folders like '.cache', '.conda', '.config', etc. The right pane is a terminal window where the command `python cnn-digits.py` has been executed. The output shows the shapes of tensors for image, label, and output, followed by a visualization of a handwritten digit '0' and the test accuracy: `Test accuracy: 0.9918000102043152`. The bottom status bar indicates system information like CPU usage (0%), memory usage (10.48 GB / 251.65 GB), and network speed.

```
(py3.12) [ln69g@headnode04 ~]$ python cnn-digits.py
image.shape: torch.Size([60, 1, 28, 28])
label.shape: torch.Size([60])
output.shape: torch.Size([60, 10])

0%
36%
39%
37%
38%
38%
38%
39%
40%
40%
40%
41%
41%
42%
42%
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69%
69%
70%
70%
71%
71%
72%
72%
100%
100%
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100%
Test accuracy: 0.9918000102043152
(py3.12) [ln69g@headnode04 ~]$
```

I walk you through this during the entire semester (even after my teaching session!)

Where to learn PyTorch

The screenshot shows the PyTorch website's navigation bar and a dropdown menu for 'Tutorials'. The navigation bar includes links for 'Learn', 'Ecosystem', 'Edge', 'Docs', 'Blogs & News', 'About', and 'Become a Member'. The 'Tutorials' dropdown menu is open, showing options: 'Get Started', 'Tutorials', 'Learn the Basics', 'PyTorch Recipes', and 'Intro to PyTorch - YouTube Series'. The 'Tutorials' option is highlighted in red. Below the dropdown, the 'PyTorch Tutorials' section is visible, featuring a 'Welcome to PyTorch Tutorials' message and a list of tutorial links. The 'PyTorch Recipes' section is also visible, featuring a 'Bite-size, ready-to-deploy PyTorch code examples' link and an 'Explore Recipes' button.

PyTorch

Learn ▾ Ecosystem ▾ Edge ▾ Docs ▾ Blogs & News ▾ About ▾ Become a Member

2.5.0+cu124

Search Docs

Google Search Classic Search

PyTorch Recipes [+]

Introduction to PyTorch [-]

[-] Learn the Basics

Quickstart

Tensors

Datasets & DataLoaders

Transforms

Build the Neural Network

Automatic Differentiation with torch.autograd

Optimizing Model Parameters

Save and Load the Model

[+] Introduction to PyTorch - YouTube Series

Learning PyTorch [+]

Image and Video [+]

Get Started

Run PyTorch locally or get started quickly with one of the supported cloud platforms

Tutorials

What's new in PyTorch tutorials

Learn the Basics

Familiarize yourself with PyTorch concepts and modules

PyTorch Recipes

Bite-size, ready-to-deploy PyTorch code examples

Intro to PyTorch - YouTube Series

Master PyTorch basics with our engaging YouTube tutorial series

PyTorch Tutorials

Welcome to PyTorch Tutorials

Additional Resources

PyTorch Recipes

Bite-size, ready-to-deploy PyTorch code examples.

Explore Recipes >

PyTorch documentation is unarguably the best source (at least in my opinion). [Click on Me!](#)


Where to learn PyTorch


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- **Learn the Basics** as the first place to start. **Click on Me!**
- The tutorial assumes you are quite competent at Machine Learning and Python.


Where to learn PyTorch

[Tutorials](#) > [Learn the Basics](#)

 [Run in Microsoft Learn](#)

 [Run in Google Colab](#)

 [Download Notebook](#)

 [View on GitHub](#)

[Learn the Basics](#) || [Quickstart](#) || [Tensors](#) || [Datasets & DataLoaders](#) || [Transforms](#) || [Build Model](#) || [Autograd](#) || [Optimization](#) || [Save & Load Model](#)

Learn the Basics

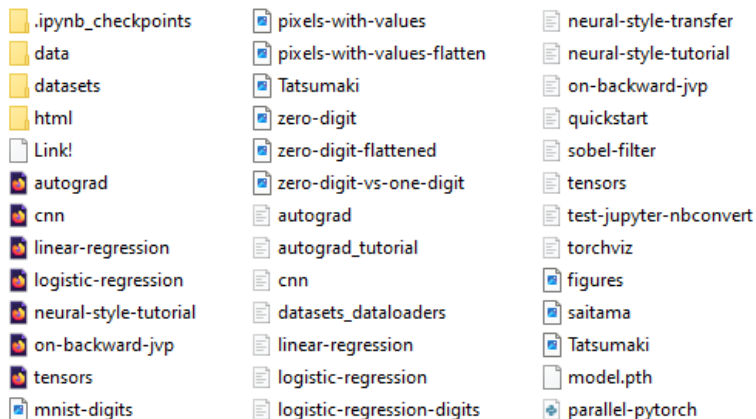
Created On: Feb 09, 2021 | Last Updated: Nov 04, 2024 | Last Verified: Nov 05, 2024

Some key components for building and training a deep neural network

- Tensors
- Datasets & DataLoaders
- Build Model
- Autograd
- Optimization

Where else to learn?

Where to learn PyTorch



From Moodle and Me!

Design principles of PyTorch

① Principle 1: Usability over Performance

- PyTorch's primary goal is usability
- A secondddary goal is to have reasonable performance

② Principle 2: Simple over Easy

- Simple/explicit (to understand, debug)
- Easy/implicit (to use)

③ Principle 3: Python First with Best In Class Language Interoperability

PyTorch is not a Python binding into a monolithic C++ framework. It is built to be deeply integrated into Python. You can use it naturally like you would use NumPy, SciPy, scikit-learn, or other Python libraries.

PyTorch Design Philosophy. Click on Me!

Let us get into business



Please bring out your laptop!!!