



PyTorch for Beginners

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Welcome!

We're in the middle of an AI boom!

*How will **YOU** be a part of it?*





Business Opportunities in AI

"It is difficult to think of a major industry that AI will not transform. This includes healthcare, education, transportation, retail, communications, and agriculture.

*There are surprisingly clear paths for AI to make a big difference in **all of these industries**.*" - Andrew Ng,

Computer Scientist and Global Leader in AI

*"What all of us have to do is to make sure we are using AI in a way that is for the **benefit of humanity**, not to the detriment of humanity."* - Tim Cook, CEO of Apple

What industry are you in?





Careers in AI

Indeed Search June 6, 2021

indeed Find jobs Company reviews Find salaries

What Artificial Intelligence Where City, state, zip code, or "remote" Find jobs Advanced

Technology > Data & Database Occupations > Data Scientists & Statisticians

Date Posted ▾ Remote ▾ Salary Estimate ▾ Job Type ▾ Benefits ▾ Location ▾ Company ▾

Experience Level ▾

Artificial Intelligence jobs

Sort by: relevance - date

Page 1 of 20,291 jobs [?](#)

new

Artificial Intelligence Specialist
Barr Air Patrol, LLC 3.7 ★
Remote

Be the first to see new Artificial Intelligence jobs

Email address

4



What to Expect

My Promise: **Maximize your R.O.A.**

You should walk away good understanding of what PyTorch is, how it works, and how to use it

- Q&A Window - questions at end of section
- Attendee Chat Window - problems and feedback
- Breaks
- Surprise Bonuses
- Coding Exercises
- Beginners Level - Python, ML/DL
 - Part I - Getting Started
 - Part II - Tensors & Data
 - Part III - Deep Learning Model Training



About your instructor



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Email: jpapa@joepapa.ai

Joe Papa

- **Chief AI Engineer**, Mobile Insights
- **Author**, O'Reilly, [PyTorch Pocket Reference](#)
- **Master Trainer**, [PyTorchAcademy.com](#)
- MSEE, BSEE Rutgers University
- 25 Years in R&D: Verizon Wireless, Bell Labs, Booz Allen
- Led AI Teams, Career Manager
- 6000+ students on Udemy
- AI Edge Deployment & Signal Processing

“Tell me about yourself.”



Poll – What is your primary role?

Multiple-choice, Single Answer

- Researcher
- Developer
- Analyst
- Leader



Getting Started





What is PyTorch?

“PyTorch is an open source **machine learning framework** that accelerates the path from research prototyping to production deployment.” - pytorch.org

About PyTorch

- Top Deep Learning Framework
- Open sourced in 2018
- Primarily developed by Facebook AI Research (FAIR) w/ 1,870 Contributors
- Python API
- Popular: 60,000+ repos on Github, 55% PwC, 50-75% papers at Top Conferences





PyTorch Key Benefits

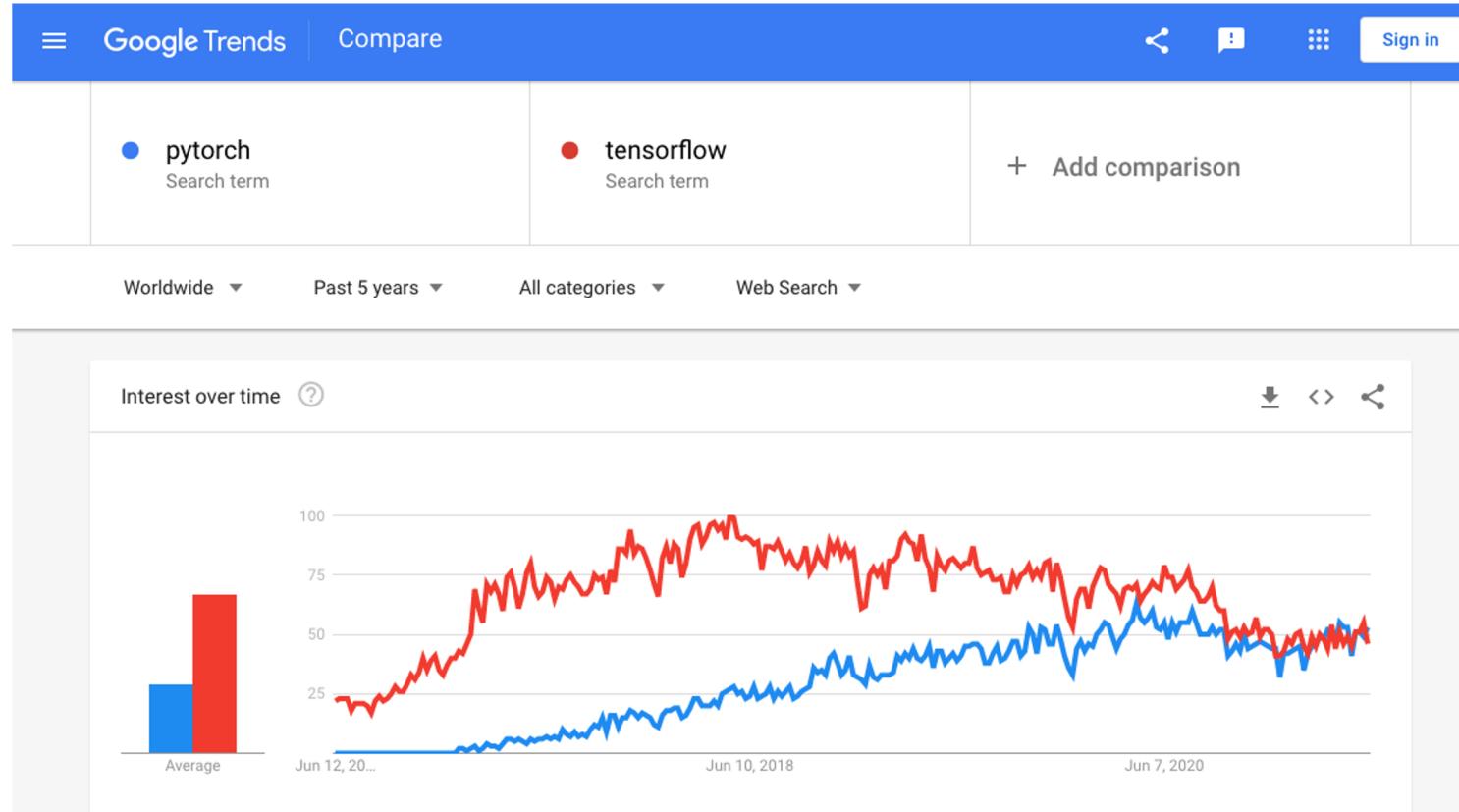
- Mature & stable (v1.8.1)
- Supported natively by cloud providers (AWS, GCP, Azure), Colab, & Kaggle
- Simple to use (Python API)
- Easy to install
- Customizable, pythonic
- Strong GPU support
- Flexibility through dynamic graphs
- Supports Parallel Processing & Distributed Training
- Supports Deployment to Production
- Beginning to support Mobile & Edge Deployment
- C++ Front End available
- Large User Community Forum
- Vast Ecosystem & Many Open Source Libraries





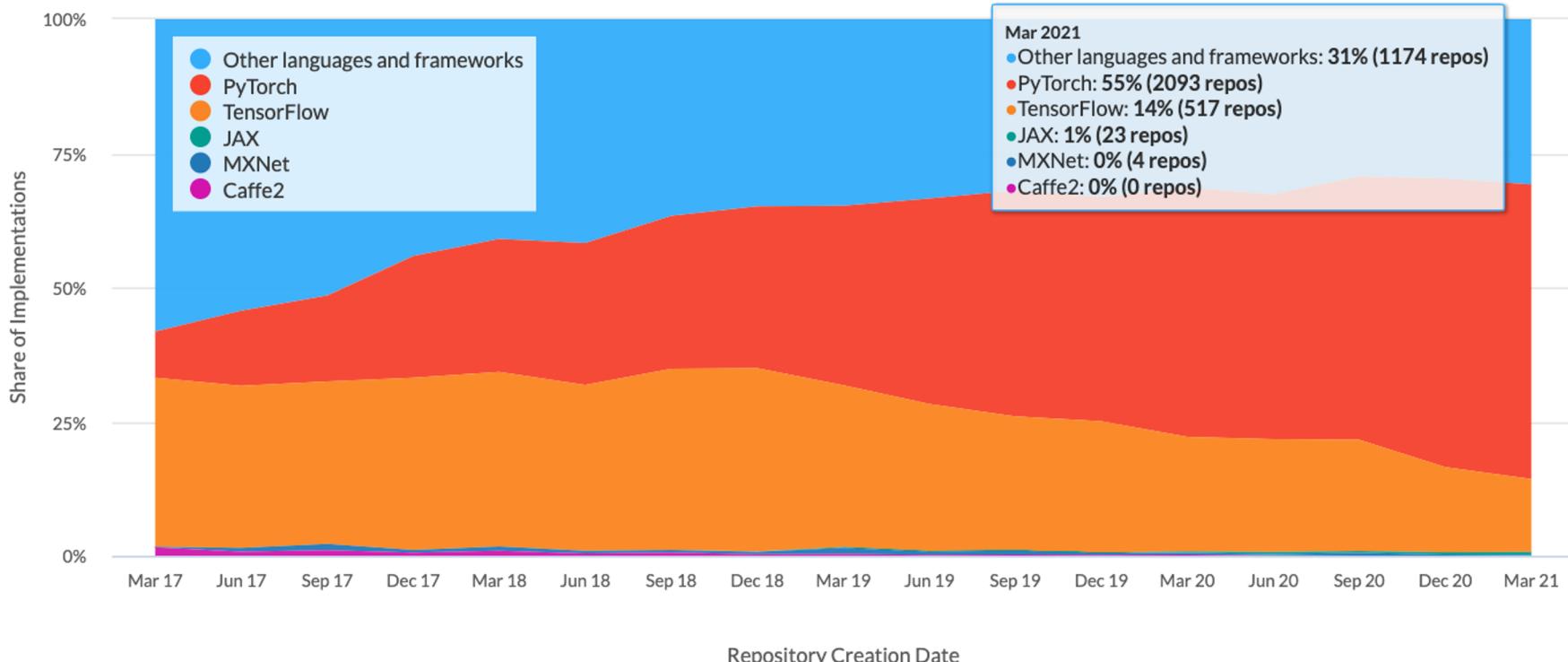
PyTorch vs Tensorflow

Google Trends – June 2016 – June 2021



PyTorch vs Tensorflow

Papers with Code 3/2017-4/2021





Why Learn PyTorch?

PyTorch can be used to ...

- Study Machine Learning
- Conduct DL research experiments
- Create, process, and analyze datasets
- Design & train NN models
- Create AI applications & tools
- Deploy AI to cloud platforms, mobile & edge devices

“How might you use PyTorch?”





Poll – How do you plan to use PyTorch?

Multiple-choice, Multiple Answer

- Study Machine Learning
- Conduct DL research experiments
- Create, process, and analyze datasets
- Design & train NN models
- Create AI applications & tools
- Deploy AI to cloud platforms,
- Deploy AI to mobile & edge devices



Q&A



PyTorch [Q & A]

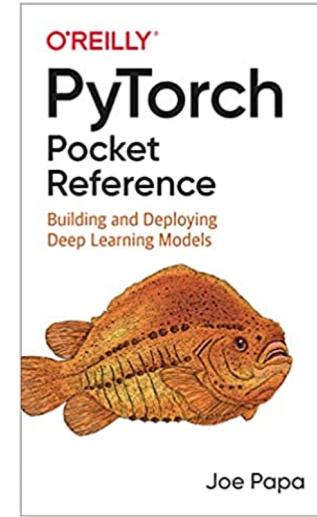


Surprise Bonus # 1

Free PyTorch Book (just pay S&H)

PyTorch Pocket Reference (May 2021)

1. Introduction to PyTorch
2. Tensors
3. Deep Learning with PyTorch
4. NN Development Reference
5. Customizing PyTorch
6. PyTorch Acceleration & Optimization
7. Deploying PyTorch to Production
8. PyTorch Ecosystem & Additional Resources



<https://pytorch.tips/free-book>

Free Signed Copy
(just pay \$7 for S&H)

After Break: Building an Image Classifier



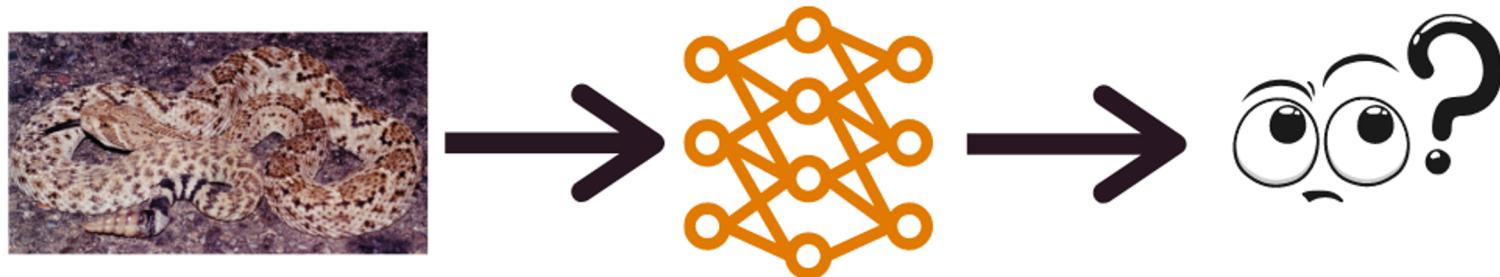
Break

Next: Building an Image Classifier



Let's Build an Image Classifier

What is this?



Model: *AlexNet* model (10 layers) pre-trained

Dataset: *ImageNet* Large Scale Visual Recognition
Challenge (ILSVRC) dataset (14 Million images, 1000 classes)



Installing PyTorch

3 Options

Google Colab

```
Exercise_1_Solution.ipynb
File Edit View Insert Runtime Tools Help
Comment Share
+ Code + Text Connect Editing
Example 1
[ ] 1 import torch
[ ] 1 torch.__version__
'1.8.1+cu101'
[ ] 1 from PIL import Image
2
3 img = Image.open('cup-of-coffee_528814833.jpeg')
PIL.JpegImagePlugin.JpegImageFile
[ ] 1 img
```

Local Machine



Cloud



Paperspace



Local Machine

pytorch.org

PyTorch

Get Started

Ecosystem

Mobile

Blog

Tutorials

Docs

Resources

GitHub



Shortcuts

Prerequisites

macOS Version

Python

Package Manager

Installation

Anaconda

pip

Verification

Building from source

Prerequisites

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, 1.9 builds that are generated nightly. Please ensure that you have **met the prerequisites below (e.g., numpy)**, depending on your package manager. Anaconda is our recommended package manager since it installs all dependencies. You can also [install previous versions of PyTorch](#). Note that LibTorch is only available for C++.

Additional support or warranty for some PyTorch Stable and LTS binaries are available through the [PyTorch Enterprise Support Program](#).

PyTorch Build	Stable (1.8.1)	Preview (Nightly)	LTS (1.8.1)
Your OS	Linux	Mac	Windows
Package	Conda	Pip	LibTorch Source
Language	Python	C++ / Java	
Compute Platform	CUDA 10.2	CUDA 11.1	ROCM 4.0 (beta) CPU
Run this Command:	<pre>conda install pytorch torchvision torchaudio -c pytorch</pre>		



Google Colab

Setting up your development environment

<https://colab.research.google.com>





Exercise 1: Image Classifier

Google Colab Walk-thru

`pytorch.tips/olt-ex-1`





Q&A



PyTorch [Q & A]



Tensors & Data





What is a Tensor?

Fundamental building block of PyTorch

- Multi-dimensional Array
- Contains numbers
- GPU support
- Gradient support (good for computing derivatives of computational graphs)

```
[1] 1 import torch  
      2 x = torch.rand(2,3,4))  
      2 x  
  
tensor([[[0.4192, 0.8142, 0.4676, 0.4339],  
        [0.4914, 0.7444, 0.1403, 0.9538],  
        [0.5356, 0.6300, 0.8804, 0.0405]],  
        [[0.9440, 0.9334, 0.8104, 0.8546],  
        [0.2348, 0.4871, 0.0631, 0.1839],  
        [0.2344, 0.2144, 0.7371, 0.0665]]])
```



Tensor Attributes & Operations

A robust data type

- Attributes
 - `.dtype`, `.device`,
`.shape`, `.ndim`
- Conversion
 - `to()`, `numpy()`
 - `x.detach().to('cpu')`
`.numpy()`
- Creating Tensors
 - `tensor()`
 - `empty()`, `zeros()`,
`ones()`
 - `empty_like()` ...
 - `rand()`, `randn()`,
`randint()`
 - `arange()`,
`linspace()`,
`logspace()`,
 - `eye()`, `full()`
 - `load()`, `save()`
- Indexing, Slicing,
Combining , & Splitting
 - `x[5]`, `y[:5,1]`, `x[x<5]`
 - `item()`, `t()`, `view()`
 - `stack()`, `unbind()`
 - `squeeze()`, `unsqueeze()`
 - `permute()`
- Math Operation
 - `+ - * / **`
 - `ceil()`, `floor()`,
`round()`
 - `abs()`, `angle()`, `conj()`
 - `cos()`, `sin()`, `tan()`,
`acos()`, `asin()`
 - `exp()`, `log()`, `log10()`
 - `logical_and()`,
`logical_not()`
 - `bitwise_and()`
`bitwise_not()`
- Reduction Operations
 - `mean()`, `median()`,
`mode()`, `std()`, `var()`
 - `argmax()`, `argmin()`,
`dist()`, `norm()`
 - `sum()`, `prod()`, `unique()`
- Comparison Operations
 - `== < <= > >= !=`
 - `isclose()`, `allclose()`
 - `max()`, `min()`, `sort()`,
`topk()`
- Linear Alg. Operations
 - `matmul()`, `addmm()`,
`eig()`, `det()`, `inverse()`,
`dot()`, `svd()`, `solve()`
- Other
 - `fft()`, `ifft()`
 - `histc()`, `flatten()`



Data - Loading, Preprocessing & Batching

PyTorch Built-in Classes

- **torch.utils.data.Dataset**
- **torch.utils.data.DataLoader**
- Torchvision Datasets

“What types of DATA do you
or could you process?”

TORCHVISION.DATASETS

All datasets are subclasses of `torch.utils.data.Dataset` i.e, they have `__getitem__` and `__len__` methods implemented. Hence, they can all be passed to a `torch.utils.data.DataLoader` which can load multiple samples in parallel using `torch.multiprocessing` workers. For example:

```
imagenet_data = torchvision.datasets.ImageNet('path/to/imagenet_root/')
data_loader = torch.utils.data.DataLoader(imagenet_data,
                                         batch_size=4,
                                         shuffle=True,
                                         num_workers=args.nThreads)
```

The following datasets are available:

Datasets

- [CelebA](#)
- [CIFAR](#)
- [Cityscapes](#)
- [COCO](#)
 - [Captions](#)
 - [Caption](#)

[torchvision.datasets](#)
[CelebA](#)
[CIFAR](#)
[Cityscapes](#)
+ [COCO](#)
[DatasetFolder](#)
[EMNIST](#)
[FakeData](#)
[Fashion-MNIST](#)
[Flickr](#)
[HMDB51](#)
[ImageFolder](#)
[ImageNet](#)
[Kinetics-400](#)
[KMNIST](#)
[LSUN](#)
[MNIST](#)
[Omniglot](#)
[PhotoTour](#)
[Places365](#)
[QMNIST](#)
[SBD](#)



Surprise Bonus # 2

Private Zoom Training

Private PyTorch Training (August 2021)

1. Tips & Tricks
2. Examples
3. LIVE Q&A
4. Limited attendance



<https://pytorch.tips/zoom>

**Register for
Private Session**

After Break: Data Walk-Thru & DL Training



Break

Next: Data Walk-thru &
Training a Deep Learning Model



Exercise 2: Tensors & Data

Google Colab Walk-thru

`pytorch.tips/olt-ex-2`

Q&A



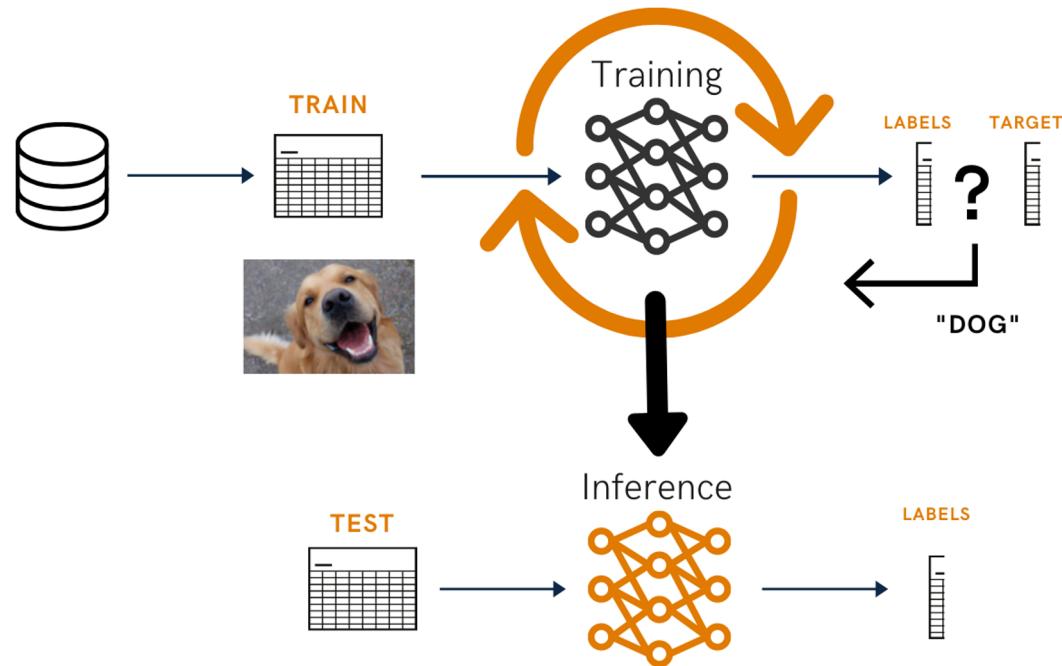


Brief Intro to Machine Learning

Supervised Learning - Classification

Types of Machine Learning

- **Supervised Learning**
 - Classification
 - Regression
- Unsupervised Learning
- Semi-supervised Learning
- Transfer Learning
- Reinforcement Learning
- Generative Learning
- What is Deep Learning?





Exercise 3: Training a Model

Google Colab Walk-thru

`pytorch.tips/olt-ex-3`



GPU Acceleration

Supervised Learning - Classification

```
1 device = "cuda" if torch.cuda.is_available() else "cpu"  
2 device  
  
'cuda'  
  
1 x = torch.rand((2,3,4))  
2 x.device  
  
device(type='cpu')  
  
1 x = x.to(device)  
2 x.device  
  
device(type='cuda', index=0)
```





Exercise 4: Training a Model (GPU)

Google Colab Walk-thru

`pytorch.tips/olt-ex-4`

Q&A





Recap

PyTorch for Beginners

Way to go! You learned a lot.

- What PyTorch is
- Why use PyTorch
- PyTorch Use Cases
- Setup & Installation
- Colab Development Environment
- Image Classifier
- Tensors
- Data Loading, Preprocessing & Batching
- Training a Deep Learning Model
- GPU Acceleration
- Next Steps



What's Next?

Your journey into PyTorch has just begun ...

Next steps:

- **Questions?** - email (jpapa@joepapa.ai) or linkedin (<https://linkedin.com/in/MrJoePapa>)
- **Free Signed Book** - (<https://pytorch.tips/free-book>)
- **Private Zoom Training** (<https://pytorch.tips/zoom>)
- Pytorch.org **Tutorials** (<https://pytorch.tips/tutorials>)
- Pytorch **Ecosystem** (<https://pytorch.tips/ecosystem>)
- **Papers with Code** (<https://paperswithcode.com>)
- Recommended **Books** -
 - A. Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow
 - I. Pointer, Programming PyTorch for Deep Learning
 - J. Howard, Deep Learning for Coders with Fastai and PyTorch



Thanks for attending ...

Go build something cool!



The background features a vibrant red-to-yellow gradient. Overlaid on this gradient are three large, semi-transparent white circles of varying sizes, creating a sense of depth and motion.

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