

Introduction to Deep Learning

Part III: Practical application

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Jena

A large, high-resolution image of the Earth from space occupies the right half of the slide. It shows a curved horizon of the planet with a deep blue atmosphere. The visible surface includes white polar ice caps, swirling white clouds, and green landmasses. The text "Knowledge for Tomorrow" is overlaid in white on the lower right portion of the Earth image.

Knowledge for Tomorrow

Curriculum

A: Theoretical introduction – Morning

I. Introduction and basics

II. Advanced concepts

III. Practical application

B. Hands-on seminar – Afternoon

Run prepared Jupyter Notebooks online on Binder, or locally on your own computer.



Curriculum

III. Practical application

- The PyTorch Framework
- Code & knowledge sources
- First Steps with PyTorch: Example Notebook

** Inspired by lectures from MIT; images taken from these, if not noted otherwise*



Frameworks



Frameworks



PyTorch

- Developed by Facebook
- Based on Torch (Lua)
- “Autograd” module for differentiation
- Dynamic graph – easy debugging
- User-friendly, easy parallelization
- Used by Facebook, Microsoft, Salesforce, ...
- Implemented in Python and C++
- Supports Python, C++
- BSD license



Frameworks

What do DL frameworks like PyTorch offer?

- **Tensor algebra**

In [5]:

```
1 import torch
2
3 x= torch.tensor([[1,2,3],[4,5,6]])
4 y= torch.tensor([[7,8,9],[10,11,12]])
5
6 f= 2*x + y
7 print(f)
```

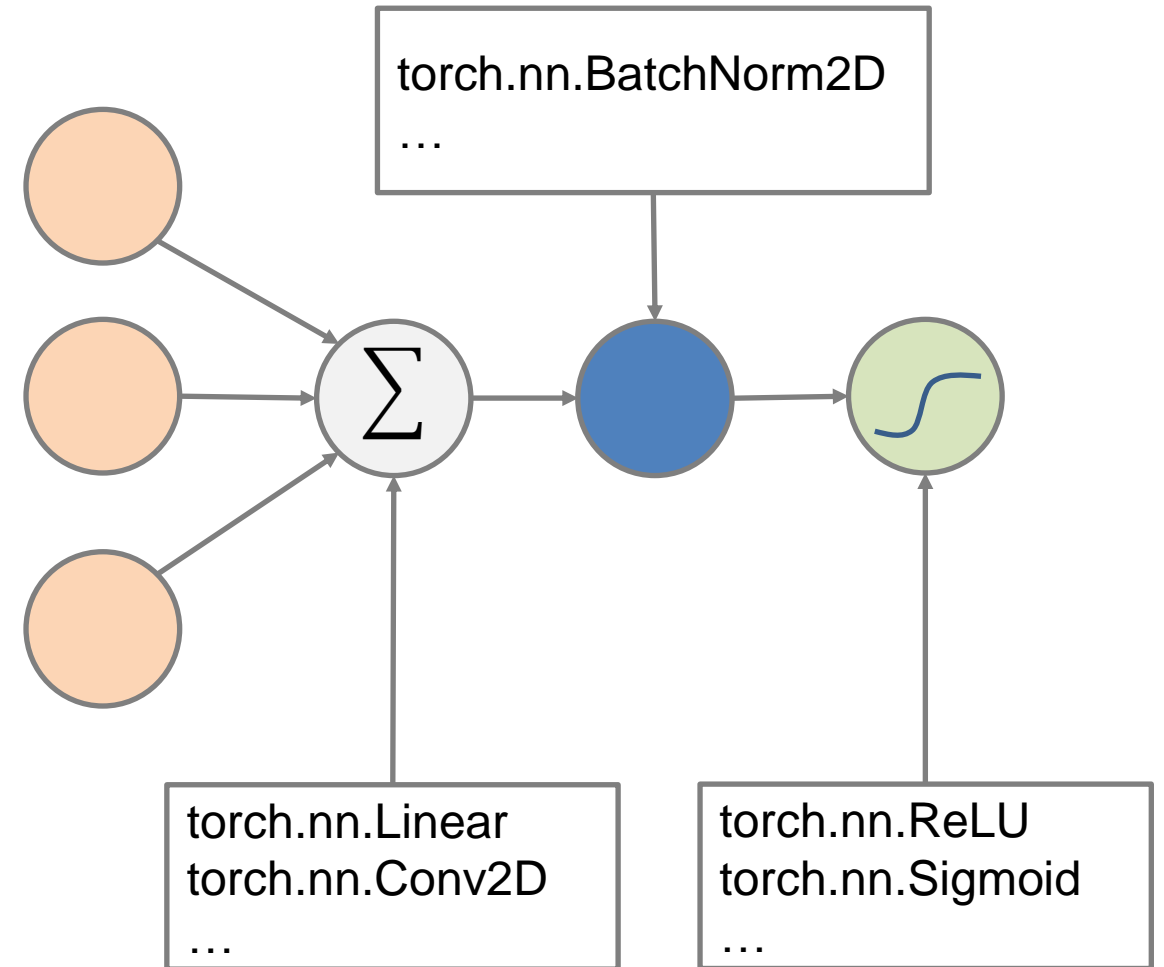
```
tensor([[ 9, 12, 15],
        [18, 21, 24]])
```

<https://subscription.packtpub.com/book/web-development/9781789534092/1/ch01lv1sec04/basic-pytorch-operations>

Frameworks

What do DL frameworks like PyTorch offer?

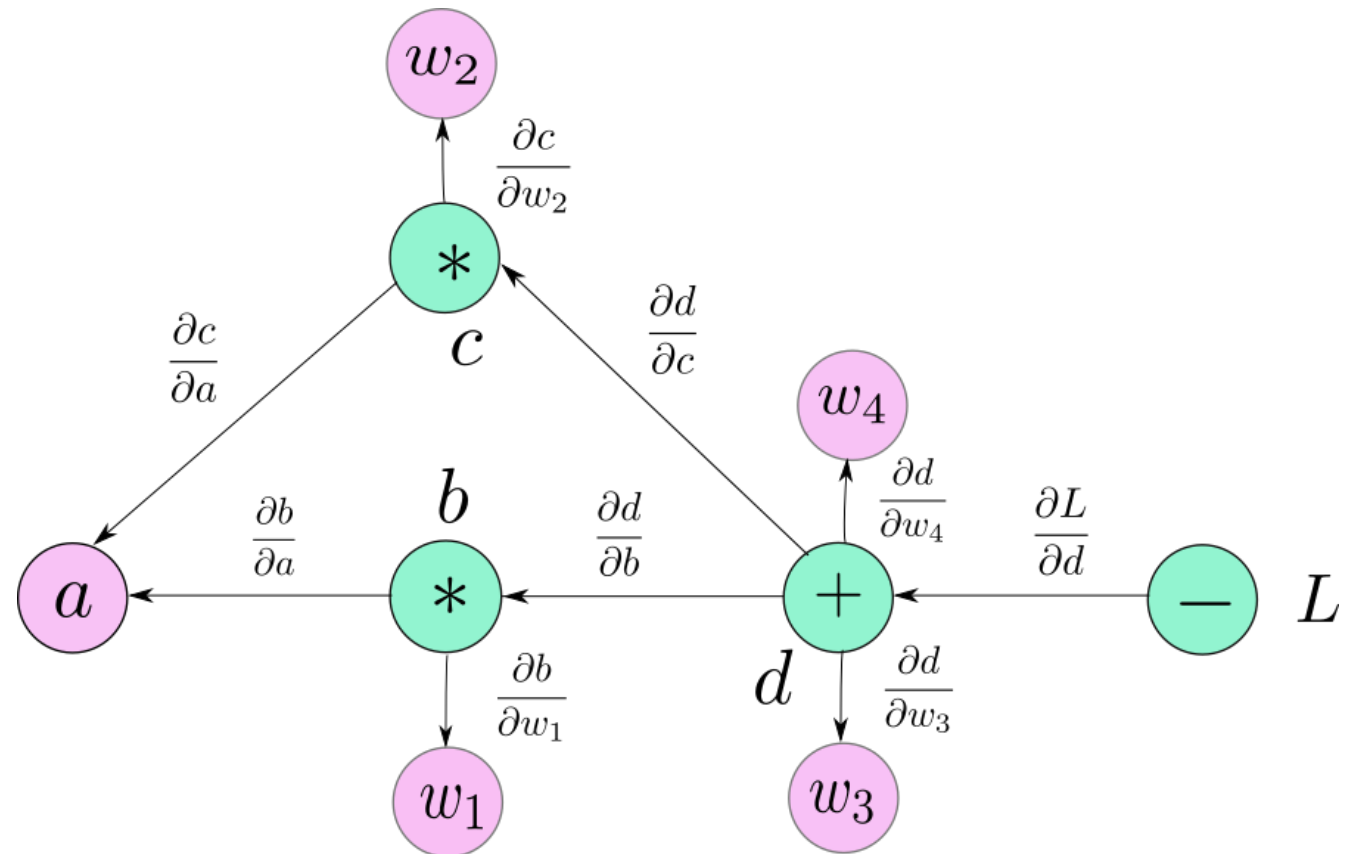
- Tensor algebra
- **Pre-defined components**



Frameworks

What do DL frameworks like PyTorch offer?

- Tensor algebra
- Pre-defined components
- **Computation graph and automatic differentiation**

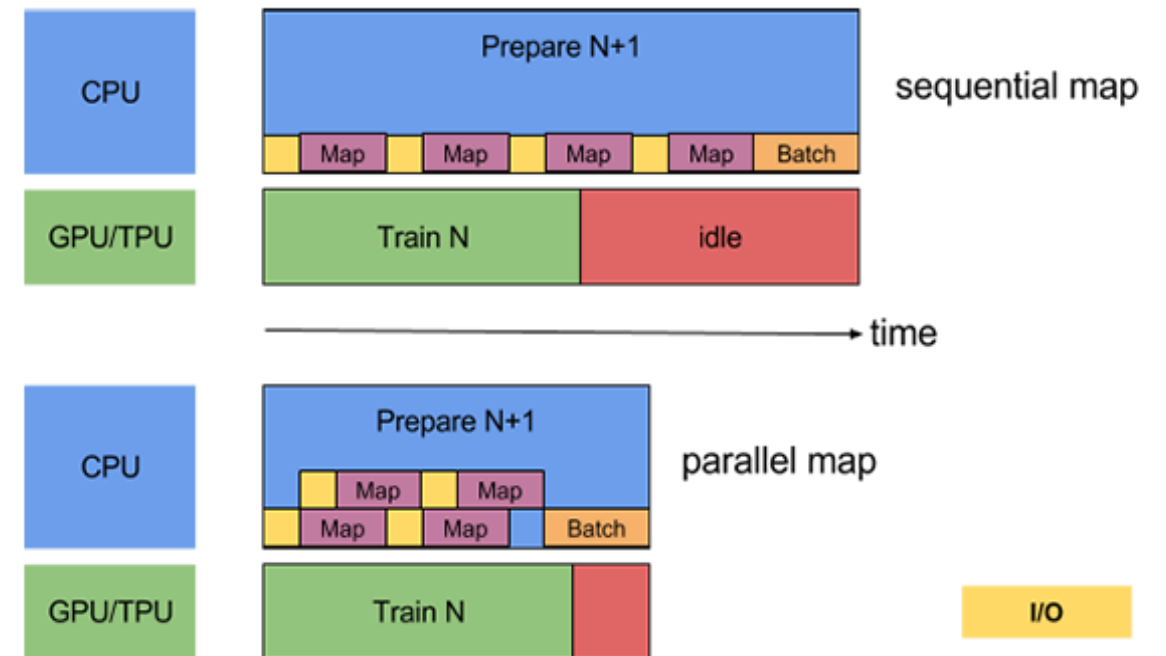


<https://blog.paperspace.com/pytorch-101-understanding-graphs-and-automatic-differentiation/>

Frameworks

What do DL frameworks like PyTorch offer?

- Tensor algebra
- Pre-defined components
- Computation graph and automatic differentiation
- **Algorithmic optimization, parallelization, computation on GPU (CUDA)**

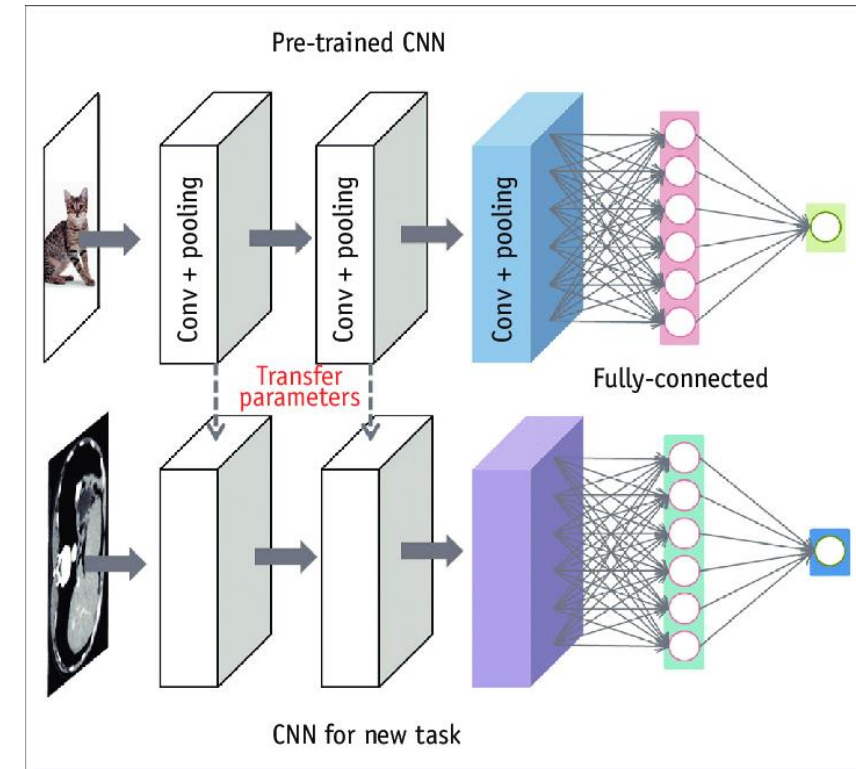


https://www.tensorflow.org/guide/data_performance

Frameworks

What do DL frameworks like PyTorch offer?

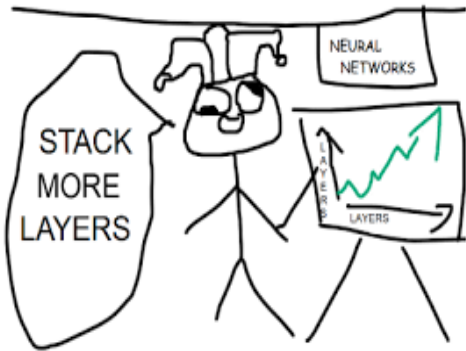
- Tensor algebra
- Pre-defined components
- Computation graph and automatic differentiation
- Algorithmic optimization, parallelization, computation on GPU (CUDA)
- **Pretrained networks (for finetuning on your own task)**



Do, Synho, Kyoung Doo Song, and Joo Won Chung. "Basics of deep learning: a radiologist's guide to understanding published radiology articles on deep learning." *Korean journal of radiology* 21.1 (2020): 33-41.

Frameworks

What do DL frameworks like PyTorch offer?



Flexibility for new experiments

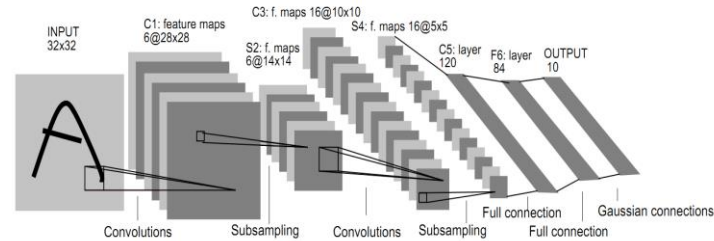


Fig. 2. Architecture of LeNet-5, a Convolutional Neural Network, here for digits recognition. Each plane is a feature map, i.e. a set of units whose weights are constrained to be identical.

Non-linear execution
(graphs)



Language usually Python

Code & knowledge sources



Code

&

Knowledge



Code

&

Knowledge

GitHub

www.github.com

Free implementations of
multiple methods.



Code

&

Knowledge

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Free implementations of
multiple methods.

Online Courses

<https://pytorch.org/tutorials/>

<https://www.coursera.org/>

<https://datacamp.com/>

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Blogs

<https://towardsdatascience.com>
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Intuitive descriptions and explanations



Code

&

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Free implementations of multiple methods.

Conferences

Hybrid or fully virtual

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Journals and Books

<http://www.deeplearningbook.org/>

Bishop: Pattern Recognition with Machine Learning

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...

Blogs

<https://towardsdatascience.com>
<https://medium.com/>

...

Intuitive descriptions and explanations

Available Preprints

www.arxiv.com

Now often the first point of publication for DL papers.

Not peer-reviewed!

Curriculum

III. Practical application

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- Code & knowledge sources
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Code & knowledge sources

Code: Github

- Many free of popular and implementationsnew methods
- Many conferences now require public code for reproducibility
- Usually a good first step for testing and adapting a new method

keras-yolo3

license MIT

Introduction

A Keras Implementation of YOLOv3 (Tensorflow backend) Inspired by [allanzelener/YAD2K](#).

Quick Start

1. Download YOLOv3 weights from [YOLO website](#).
2. Convert the Darknet YOLO model to a Keras model.
3. Run YOLO detection.

```
wget https://pjreddie.com/media/files/yolov3.weights
python convert.py yolov3.cfg yolov3.weights model_data/yolo.h5
python yolo_video.py [OPTIONS...] --image, for image detection mode, OR
python yolo_video.py [video_path] [output_path (optional)]
```

For Tiny YOLOv3, just do in a similar way, just specify model path and anchor path with `--model model_file` and `--anchors anchor_file`.

Usage

Use `--help` to see usage of `yolo_video.py`:

```
usage: yolo_video.py [-h] [--model MODEL] [--anchors ANCHORS]
                    [--classes CLASSES] [--gpu_num GPU_NUM] [--image]
                    [--input] [--output]
```




Code & knowledge sources

Knowledge: arXiv

- Now often the first point of publication for DL papers (sometimes the only one)
- Not peer-reviewed!
- Helpful tool:

<http://www.arxiv-sanity.com/>


Cornell University

We gratefully acknowledge support from the Simons Foundation and member institutions.

arXiv.org > cs > arXiv:1506.02640

All Fields

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Computer Science > Computer Vision and Pattern Recognition

You Only Look Once: Unified, Real-Time Object Detection

[Joseph Redmon](#), [Santosh Divvala](#), [Ross Girshick](#), [Ali Farhadi](#)

(Submitted on 8 Jun 2015 (v1), last revised 9 May 2016 (this version, v5))

We present YOLO, a new approach to object detection. Prior work on object detection repurposes classifiers to perform detection. Instead, we frame object detection as a regression problem to spatially separated bounding boxes and associated class probabilities. A single neural network predicts bounding boxes and class probabilities directly from full images in one evaluation. Since the whole detection pipeline is a single network, it can be optimized end-to-end directly on detection performance.

Our unified architecture is extremely fast. Our base YOLO model processes images in real-time at 45 frames per second. A smaller version of the network, Fast YOLO, processes an astounding 155 frames per second while still achieving double the mAP of other real-time detectors. Compared to state-of-the-art detection systems, YOLO makes more localization errors but is far less likely to predict false detections where nothing exists. Finally, YOLO learns very general representations of objects. It outperforms all other detection methods, including DPM and R-CNN, by a wide margin when generalizing from natural images to artwork on both the Picasso Dataset and the People-Art Dataset.

Subjects: **Computer Vision and Pattern Recognition (cs.CV)**

Cite as: [arXiv:1506.02640](#) [cs.CV]
(or [arXiv:1506.02640v5](#) [cs.CV] for this version)

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[\[v1\]](#) Mon, 8 Jun 2015 19:52:52 UTC (5,267 KB)

[\[v2\]](#) Tue, 9 Jun 2015 07:51:14 UTC (5,267 KB)

[\[v3\]](#) Thu, 11 Jun 2015 19:21:47 UTC (5,267 KB)

[\[v4\]](#) Thu, 12 Nov 2015 22:53:44 UTC (4,483 KB)

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Code & knowledge sources


Knowledge: Blogs




The Tensor



The Loss Function




The Autograd



The nn Module


How PyTorch lets you build and experiment with a neural net

We show, an example of building a classifier neural network in PyTorch and highlight how easy it is to experiment with advanced ideas.

 Tirthajyoti Sarkar in Towards Data Science
Nov 27 · 10 min read ★

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<https://medium.com/topic/artificial-intelligence>

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Real-time Object Detection with YOLO, YOLOv2 and now YOLOv3



Jonathan Hui [Follow](#)
Mar 18, 2018 · 18 min read



You only look once (YOLO) is an object detection system targeted for real-time processing. We will introduce YOLO, YOLOv2 and YOLO9000 in this article. For those only interested in YOLOv3, please forward to the [bottom of the article](#). Here is the accuracy and speed comparison provided by the YOLO web site.

Model	Train	Test	mAP	FLOPS	FPS
SSD300	COCO trainval	test-dev	41.2	-	46
SSD500	COCO trainval	test-dev	46.5	-	19
YOLOv2 608x608	COCO trainval	test-dev	48.1	62.94 Bn	40
Tiny YOLO	COCO trainval	-	-	7.07 Bn	200
SSD321	COCO trainval	test-dev	45.4	-	16
DSSD321	COCO trainval	test-dev	46.1	-	12
R-FCN	COCO trainval	test-dev	51.9	-	12
SSD513	COCO trainval	test-dev	50.4	-	8
DSSD513	COCO trainval	test-dev	53.3	-	6
FPN FRCN	COCO trainval	test-dev	59.1	-	6
RefineNet 50 500	COCO trainval	test-dev	59.9	-	14

Code & knowledge sources

Knowledge: Conferences (selection)

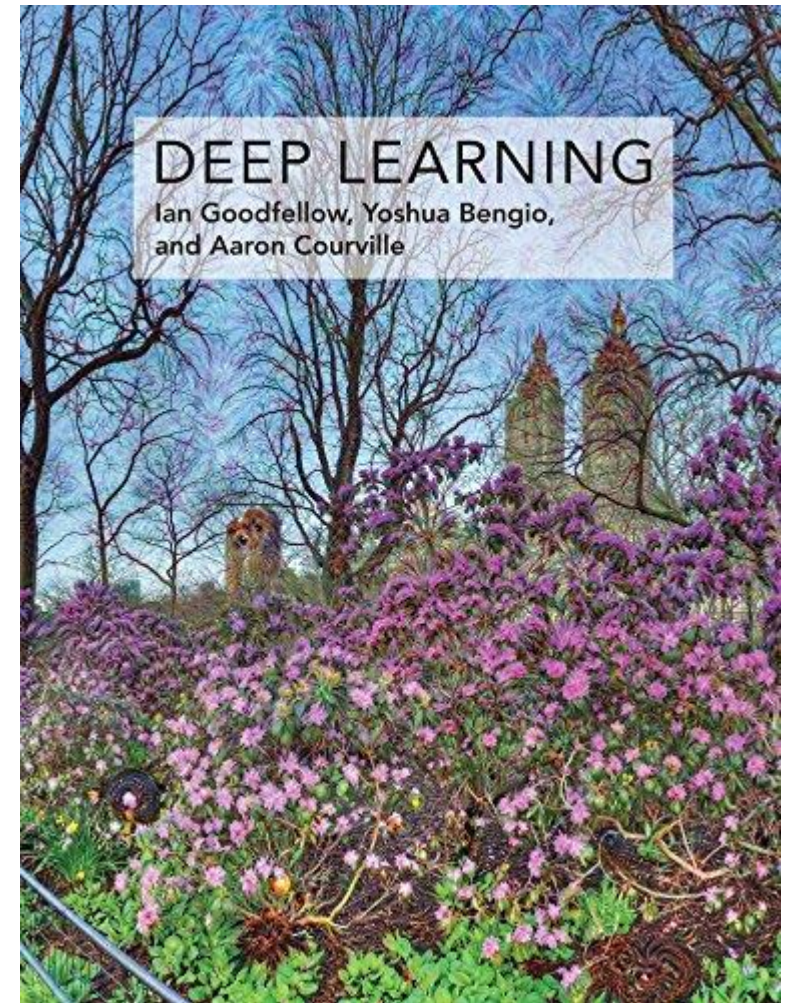
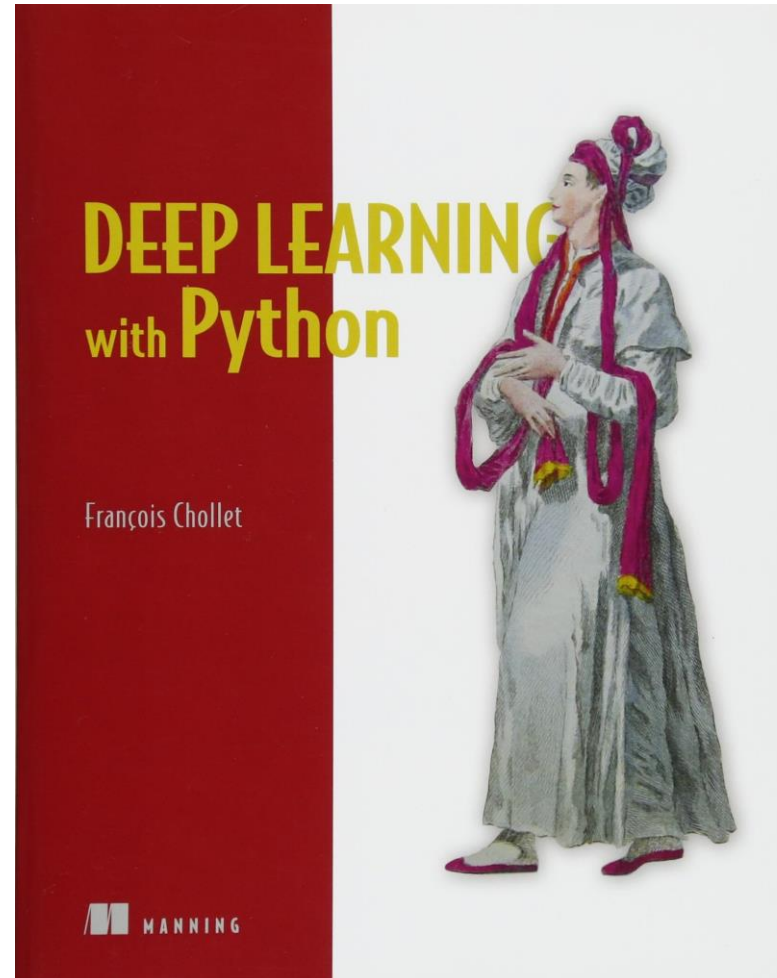
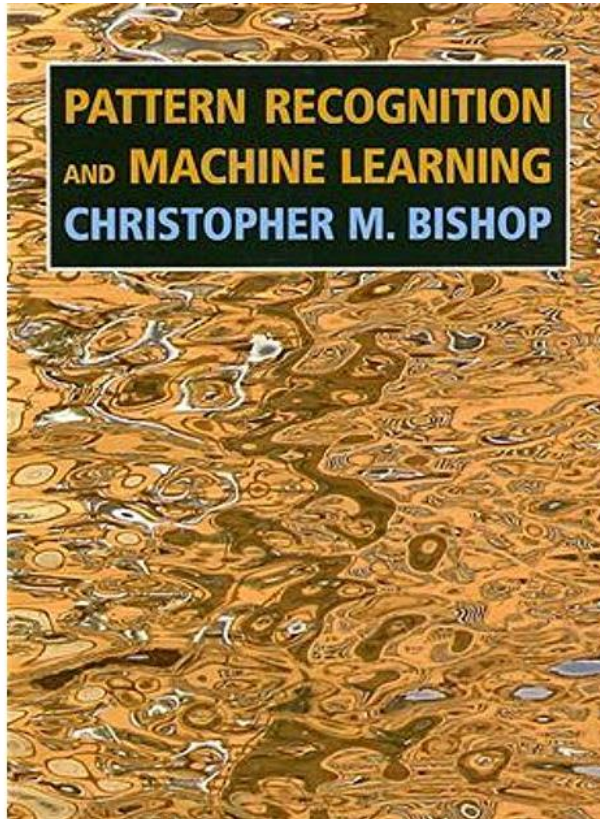


...and of course many domain-specific conferences



Code & knowledge sources

Knowledge: Books



<http://www.deeplearningbook.org/>

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