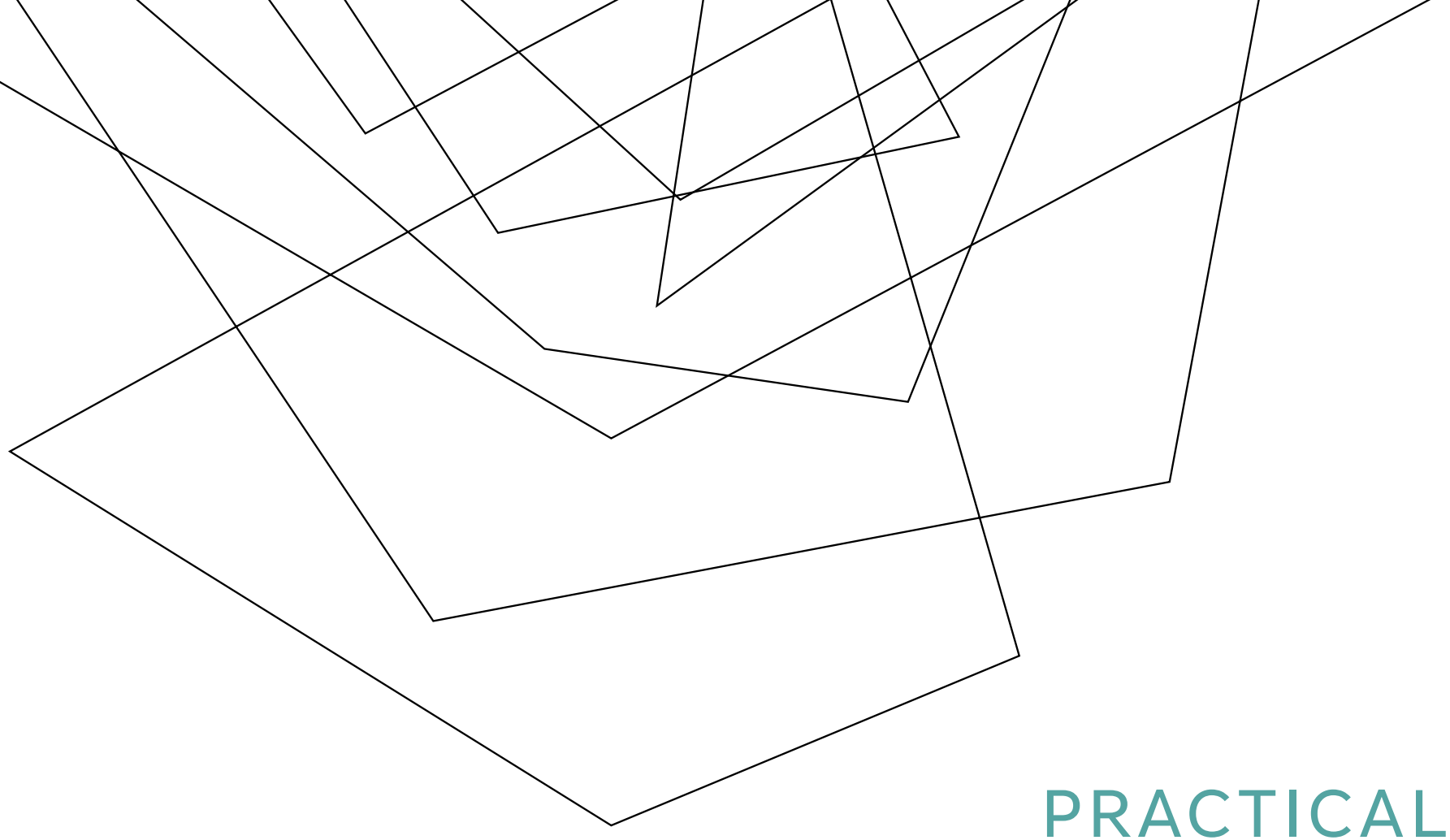


fast.ai

PRACTICAL DEEP LEARNING FOR CODERS

Lesson 1

Jeremy Howard

Practical Deep Learning for Coders

> Deep Learning for Coders with fastai and PyTorch: AI Applications Without a PhD - the book and the course

Table of Contents

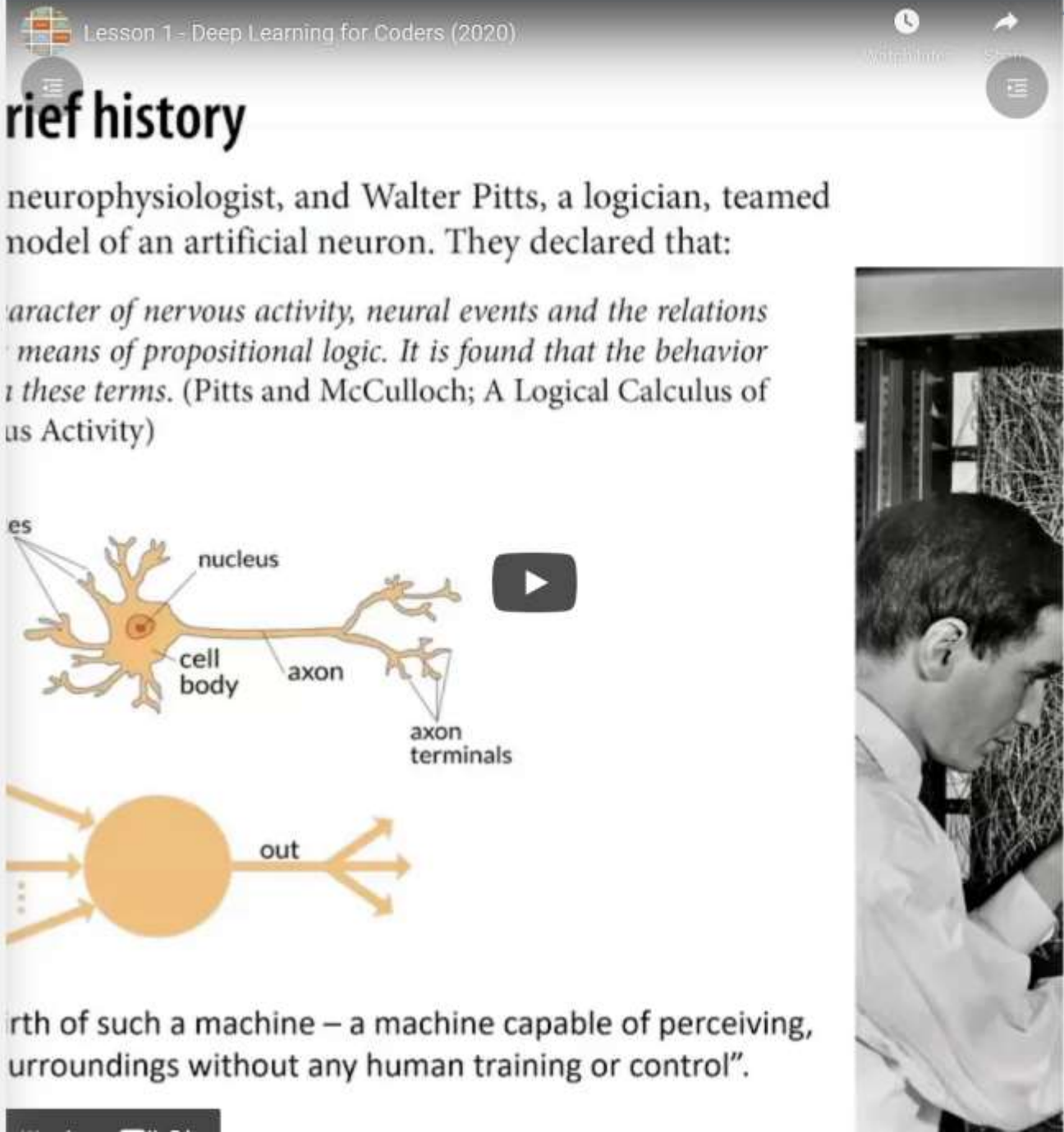
Welcome to *Practical Deep Learning for Coders*. This web site covers the book and the 2020 version of the course, which are designed to work closely together. If you haven't yet got the book, you can buy it here. It's also freely available as interactive Jupyter Notebooks; read on to learn how to access them..

How do I get started?

If you're ready to dive in right now, here's how to get started. If you want to know more about this course, read the next sections, and then come back here.

To watch the videos, click on the *Lessons* section in the navigation sidebar. The lessons all have searchable transcripts; click "Transcript Search" in the top right panel to search for a word or phrase, and then click it to jump straight to video at the time that appears in the transcript. The videos are all captioned and also translated into Chinese (简体中文) and Spanish; while watching the video click the "CC" button to turn them on and off, and the setting button to change the language.

Each video covers a chapter from the book. The entirety of every chapter of the book is available as an interactive Jupyter Notebook. Jupyter Notebook is the most popular tool for doing data science in Python, for good reason. It is powerful, flexible, and easy to use. We think you will love it! Since the most important thing for learning deep learning is writing code and experimenting, it's important that you have a great platform for experimenting with code.



Note: *you can collapse the sidebars on the left and right (i.e this notes pane, and the contents pane) by clicking the arrow icons at the top next to each of them.*

Welcome to Deep Learning for Coders! In this first lesson, we learn about what deep learning is, and how it's connected to machine learning, and regular computer programming. We get our GPU-powered deep learning server set up, and use it to train models across vision, NLP, tabular data, and collaborative filtering. We do this all in Jupyter Notebooks, using transfer learning from pretrained models for the vision and NLP training.

We discuss the important topics of test and validation sets, and how to create and use them to avoid over-fitting. We learn about some key jargon used in deep learning.

We also discuss how AI projects can fail, and techniques for avoiding failure.

Questionnaire

The questions below are the same as those in the book. For more, including detailed answers and links to the video timeline, have a look at Radek Osmulski's aiquizzes.

(If you're not sure of the answer to a question, try watching the next lesson and then coming back to this one, or read the first chapter of the book.)

1. Do you need these for deep learning?
    - Lots of math T / F
    - Lots of data T / F
    - Lots of expensive computers T / F
    - A PhD T / F

Quick Links
Course Home
fast.ai

Let’s create a bird recognizer!

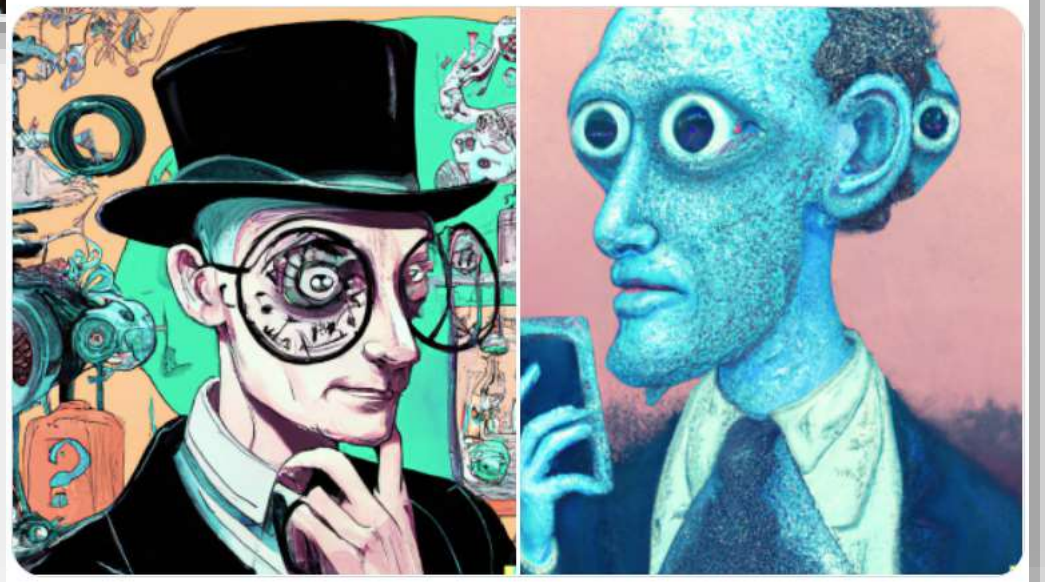
(Don’t try to follow along just yet – we’ll see the details in a moment.)

Nick
@nickcammarata

dall-e 2 illustrations of my friends' twitter bios

.@RomeoStevens76 commitments empathetic, psychedelic, philosophical

.@tszzl machine learning researchoor | technology brother | "prolific Twitter shitposter" ~ Vice News | “almost billionaire” - the Atlantic

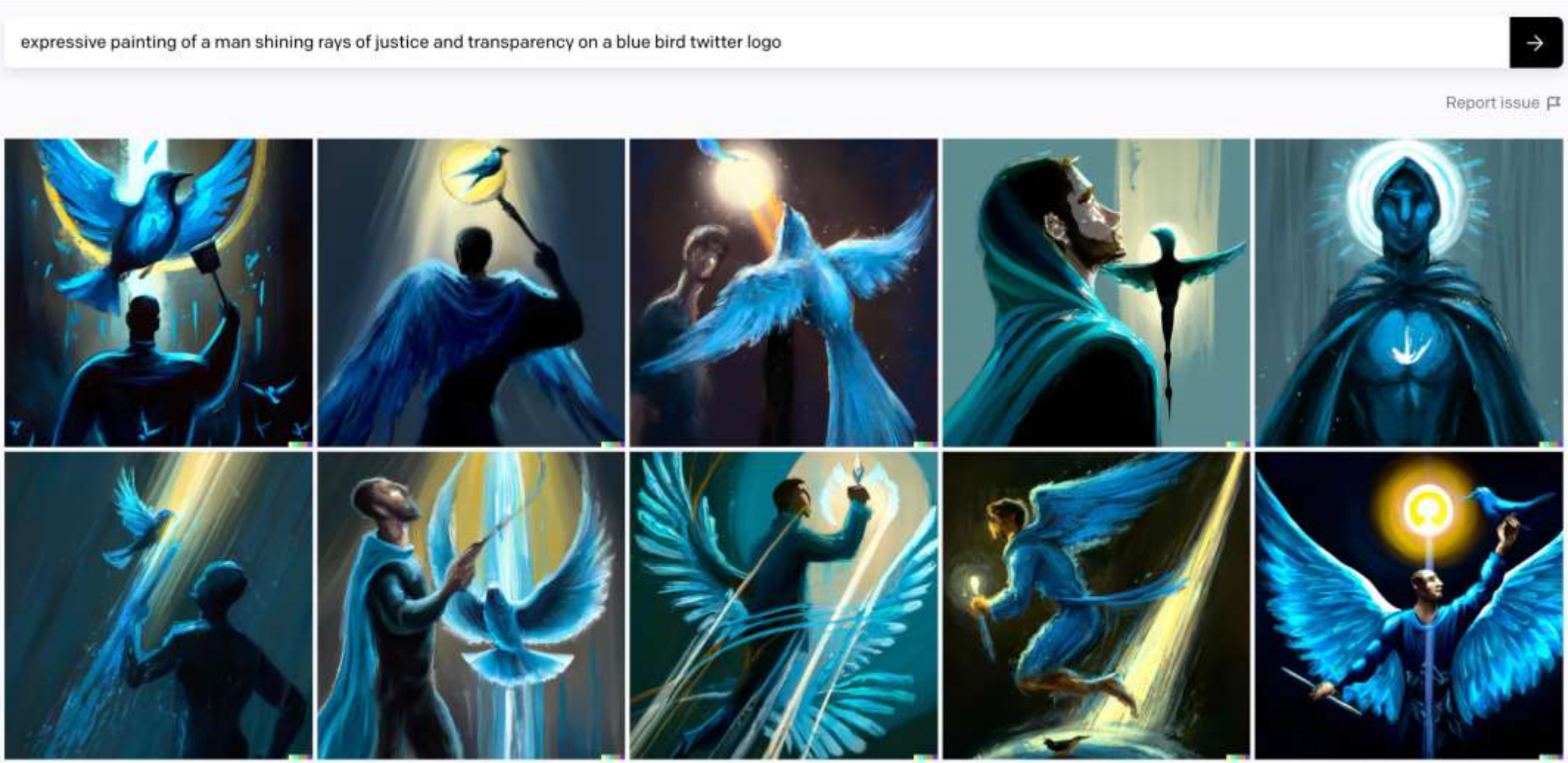


.@noampomsky bookbear

.@willwjack happy sisyphus

Nick
@nickcammarata

this is roughly what it's like to be the man-behind-the-machine. I enter something vaguely what I imagine and get 10 full paintings in about 18 seconds, do that a few times wiggling the prompt a bit as it comes up with new ideas and I like them, then pick one to post



Rivers Have Wings
@RiversHaveWings

"a female scientist with a laptop writing code, in a symbolic, meaningful, and vibrant style" #midjourney diffusion v2

Doron Adler
@Norod78

* An HD photo of a rare psychedelic pink elephant
* Cthulhu rises from the sea in a great storm
* A blind bat with big sunglasses is holding a walking stick in its hand

Xander Steenbrugge @xsteenbrugge · 22h

Caveat: all these pieces are the result of a tremendous amount (months) of code and parameter tuning, careful selection of initialization images, prompt engineering and cherry picking.

Xander Steenbrugge
@xsteenbrugge

"Framing reality"

Google AI Blo

The latest from Google Research

Pathways Language Model (PaLM
Parameters for Breakthrough Perf

Monday, April 4, 2022

Q: The cafeteria had 23 apples. If they used 20 to
ples

used
hey
. The

Explain

Input: Did you see that Go
whale for their TPU team?
communicate between two c
Model Output: TPUs are a
Google uses for deep learning. A "pod" is a group of TPUs. A "pod" is also a group of whales. The joke is that the whale is able to communicate between two groups of whales, but the speaker is pretending that the whale is able to communicate between two groups of TPUs.

Inference Chaining

Input: Shelley is from Virginia, but is visiting that city with that famous market where they throw the fish. Going home next Tuesday!
Question: Is it likely that Shelley will be near the Pacific Ocean this weekend?
Model Output: The city with the famous market where they throw the fish is Seattle, Washington. Seattle is on the Pacific Ocean. Shelley is visiting Seattle, so she will be near the Pacific Ocean this weekend. The answer is "yes", it is likely that Shelley will be near the Pacific Ocean this weekend.

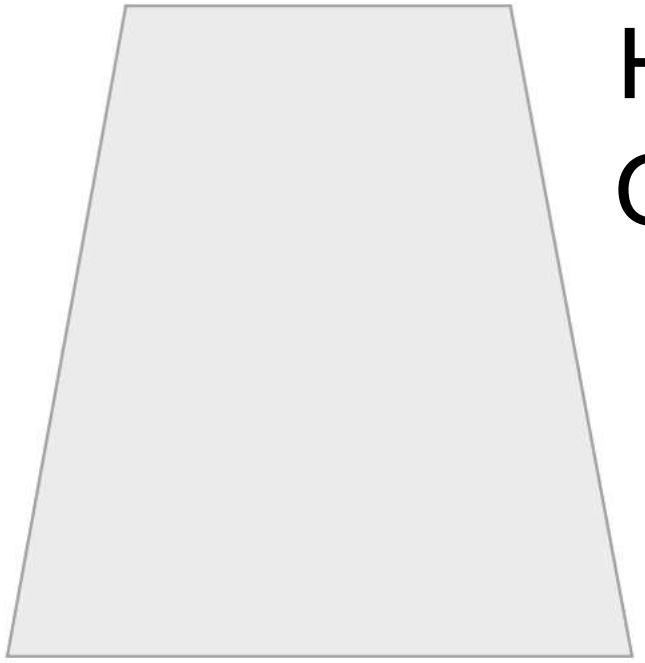
Practical Data Ethics

Data ethics covers an incredibly broad range of topics, many of which are urgent, making headlines daily, and causing harm to real people right now. A meta-analysis of over 100 syllabi on tech ethics, titled "What do we teach when we teach tech ethics?" found that there was huge variation in which topics are covered across tech ethics courses (law & policy, privacy & surveillance, philosophy, justice & human rights, environmental impact, civic responsibility, robots, disinformation, work & labor, design, cybersecurity, research ethics, and more– far more than any one course could cover). These courses were taught by professors from a variety of fields. The area where there was more unity was in outcomes, with abilities to critique, spot issues, and make arguments being some of the most common desired outcomes for tech ethics course.

In this course, we will focus on topics that are both urgent and practical. In keeping with my teaching philosophy, we will begin with two active, real-world areas (**disinformation** and **bias**) to provide context and motivation, before stepping back in Lesson 3 to dig into **foundations of data ethics** and **practical tools**. From there we will move on to additional subject areas: **privacy & surveillance**, the role of the Silicon Valley ecosystem (including **metrics, venture growth, & hypergrowth**), and **algorithmic colonialism**. I realize this course still just covers a slice of what is a sprawling field, and I hope that it will be a helpful entry point for continued exploration.

This class was originally taught in-person at the University of San Francisco Data Institute in January-February 2020, for a diverse mix of working professionals from a range of backgrounds (as an evening certificate courses). There are no prerequisites for the course. This course is in no way intended to be exhaustive, but hopefully will provide useful context about how data misuse is impacting society, as well as practice in critical thinking skills and questions to ask.

HOW ARE YOU GETTING ALONG?



Meta Learning: How To Learn Deep Learning And Thrive In The Digital World

by Radek Osmulski (Goodreads Author)

★★★★½ 4.57 · Rating details · 14 ratings · 3 reviews

"Meta Learning" documents the key lessons the author — Radek Osmulski — learned on his Deep Learning journey.

Green - I am comfortable with my understanding and pacing of the lesson

Yellow - I am working through my understanding, I would benefit from the teacher slowing down or revisiting the current concept

Red - STOP! I am not understanding and I have a question

Radek Osmulski
@radekosmulski

Today is my first day at @NVIDIAAI! 🥳

-From learning to code at 29
-through learning ML @fastdotai
-winning a @kaggle competition
-jobs at 🔥 startups
-moving continents thx to AI
-to joining the illustrious Merlin team ❤️

A Mathematician's Lament

How School Cheats Us
Out of Our Most Fascinating
and Imaginative Art Form

Paul Lockhart

BBC Your account Home News Sport Reel Worklife

TWO The Classroom Experiment

Home Episodes Clips

DAVID PERKINS

AUTHOR OF *THE EUREKA EFFECT*

MAKING LEARNING WHOLE

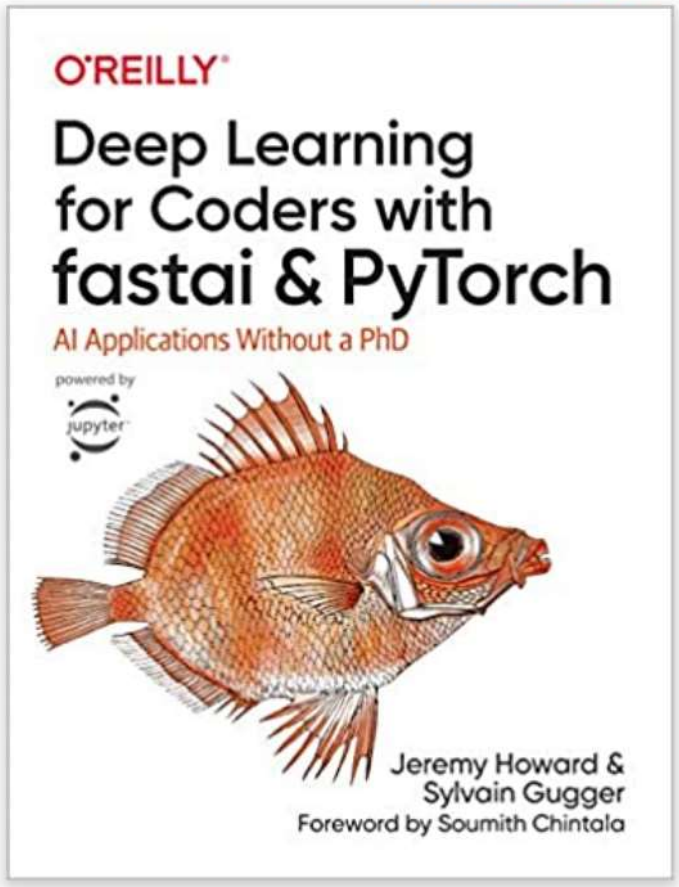
How SEVEN PRINCIPLES *of* TEACHING *can* TRANSFORM EDUCATION

Deep Learning for Coders with Fastai and PyTorch: AI Applications Without a PhD 1st Edition

by Jeremy Howard (Author), Sylvain Gugger (Author)

★★★★★ 294 ratings

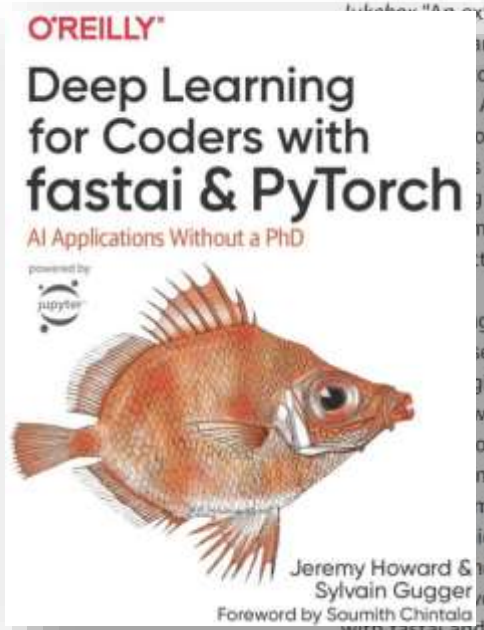
Look inside



The book does an impressive job of covering the key applications of deep learning in computer vision, natural language processing, and tabular data processing, but also covers key topics like data ethics that some other books miss. Altogether, ***this is one of the best*** *sources for a programmer to become proficient in deep learning* -- **Peter Norvig**, Director of Research, Google

As artificial intelligence has moved into the era of deep learning, it behooves all of us to learn as much as possible about how it works. Deep Learning for Coders provides a terrific way to initiate that, even for the uninitiated, ***achieving the feat*** *of simplifying what most of us would consider highly complex* -- **Eric Topol**, Author of Deep Medicine; Professor: Scripps Research

"If you are looking for a guide that starts at the ground floor and takes you to the cutting edge of research, this is the book for you. Don't let those PhDs have all the fun---you too can use deep learning to solve practical problems." -- **Hal Varian**, Emeritus Professor, UC Berkeley; Chief Economist, Google "As artificial intelligence has moved into the era of deep learning, it behooves all of us to learn as much as possible about how it works. Deep Learning for Coders provides a terrific way to initiate that, even for the uninitiated, achieving the feat of simplifying what most of us would consider highly complex" -- **Eric Topol**, Author of *Deep Medicine*; Professor: Scripps Research "Jeremy and Sylvain take you on an interactive--in the most literal sense as each line of code can be run in a notebook--journey through the loss valleys and performance peaks of deep learning. Peppered with thoughtful anecdotes and practical intuitions from years of developing and teaching machine learning, the book strikes the rare balance of communicating deeply technical concepts in a conversational and light-hearted way. In a faithful translation of fast.ai's award-winning online teaching philosophy, the book provides you with state-of-the-art practical tools and the real-world examples to put them to use. Whether you're a beginner or a veteran, this book will fast-track your deep learning journey and take you to new heights--and depths." -- **Sebastian Ruder**, Research Scientist, Deepmind "Jeremy Howard and Sylvain Gugger have authored a bravura of a book that successfully bridges the AI domain with the rest of the world. This work is a singularly substantive and insightful yet absolutely relatable primer on deep learning for anyone who is interested in this domain: a lodestar book amongst many in this genre." -- **Anthony Chang**, Chief Intelligence and Innovation Officer, Children's Hospital of Orange County "How can I 'get' deep learning without getting bogged down? How can I quickly learn the concepts, craft, and tricks-of-the-trade using examples and code? Right here. Don't miss the new locus classicus for hands-on deep learning" -- **Oren Etzioni**, Professor: University of Washington, CEO: Allen Institute for AI "This book is a rare gem- the product of carefully crafted and highly effective teaching, iterated and refined over several years resulting in thousands of happy students. I'm one of them. fast.ai changed my life in a wonderful way, and I'm convinced that they can do the same for you." -- **Jason Antic**, Creator of *DeOldify* "Deep Learning for Coders is an incredible resource. The book wastes no time and teaches how to use Deep Learning effectively in the first few chapters. It then covers the inner workings of ML models and frameworks in a thorough but accessible fashion, which will allow you to understand and build upon them. I wish there was a book like this when I started learning ML, it is an instant classic!" -- **Emmanuel Ameisen**, Author of *Building Machine Learning Powered Applications* ""Deep Learning is for everyone" we see in Chapter 1, Section 1 of this book, and while other books may make similar claims, this book delivers on the claim. The authors have extensive knowledge of the field but are able to describe it in a way that is perfectly suited for a reader with experience in programming but not in machine learning. The book shows examples first, and only covers theory in the context of concrete examples. For most people, this is the best way to learn.The book does an impressive job of covering the key applications of deep learning in computer vision, natural language processing, and tabular data processing, but also covers key topics like data ethics that some other books miss. Altogether, this is one of the best sources for a programmer to become proficient in deep learning." -- **Peter Norvig**, Director of Research, Google

"Gugger and Howard have created an ideal resource for anyone who has ever done even a little bit of coding. This book, and the fast.ai courses that go with it, simply and practically demystify deep learning using a hands on approach, with pre-written code that you can explore and re-use. No more slogging through theorems and proofs about abstract concepts. In Chapter 1 you will build your first deep learning model, and by the end of the book you will know how to read and understand the Methods section of any deep learning paper." -- **Curtis Langlotz**, Director, Center for Artificial Intelligence in Medicine and Imaging, Stanford University "This book demystifies the blackest of black boxes: Deep Learning. It enables quick code experimentations with a complete python notebook. It also dives into the ethical implication of Artificial Intelligence, and shows how to avoid it from becoming dystopian." -- **Guillaume Chaslot** , Fellow, Mozilla "As a pianist turned OpenAI researcher, I'm often asked for advice on getting into Deep Learning, and I always point to fastai. This book manages the seemingly impossible - it's a friendly guide to a complicated subject, and yet it's full of cutting-edge gems that even advanced practitioners will love." -- **Christine Payne**, Researcher, OpenAI; Creator of *Musenet* and


Jukebox "An extremely hands-on, accessible book to help anyone quickly get started on their deep learning project. It's a very clear, easy to follow and honest guide to practical deep learning. Helpful for beginners to managers alike. The guide I wished I had years ago!" -- **Carol Reiley**, Founding President and Chair, Drive.ai "Jeremy and Sylvain's expertise in deep learning, their practical approach to ML, and their many valuable contributions have made then key figures in the PyTorch community. This book, which continues the work that they and the fast.ai community are doing to make ML more accessible, will greatly benefit the AI." -- **Jerome Pesenti**, Vice President of AI, Facebook "Deep Learning is one of the most important technologies now, responsible for many amazing recent advances in AI. It used to be only for PhDs, but no book, based on a very popular fast.ai course, makes DL accessible to anyone with programming experience. This book teaches the "whole game", with excellent hands-on examples and a companion interactive will also learn a lot." -- **Gregory Piatetsky-Shapiro**, President, KDnuggets "An extension of the fast.ai course that I have consistently recommended for years, this book by Jeremy and Sylvain, two of the best experts today, will take you from beginner to qualified practitioner in a matter of months. Finally, something positive has come out of 2020!" -- **Louis Monier**, Founder of Altavista; former Head of Airbnb AI mmend this book! Deep Learning for Coders with fastai and PyTorch uses advanced frameworks to move quickly through concrete, real-world artificial intelligence or automation tasks. This leaves time to cover ted topics, like safely taking models to production and a much-needed chapter on data ethics." -- **John Mount and Nina Zumel**, Authors of *Practical Data Science with R*

g for Coders is much more than a book, as it is accompanied by fastai, a robust community and powerful machine learning framework built on pytorch. State of the art methods are provided out of the box with es, including tricks to make one competitive with top industrial research labs with only a fraction of the compute. The philosophies with respect to education and learning espoused in this book and companion given me the tools to accelerate my personal growth on many dimensions. Through fastai and this book, I have also learned valuable practices for software engineering, testing, iterative development, and works. Jeremy is an awe-inspiring individual who is not only among the top data scientists in the world but an impressive mental athlete who has mastered a wide variety of fields, and you get a glimpse into his ook. Finally, Jeremy and Sylvian are exceptional in that they teach with empathy at all times, which translates into the most approachable book you can buy on deep learning today." -- **Hamel Husain**, Machine neer: GitHub; Product Lead: CodeSearchNet "This book is "for Coders" and does not require a PhD. Now, I do have a PhD and I am no coder, so why have I been asked to review this book? Well, to tell you how me it really is! Within a couple of pages from Chapter 1 you'll figure out how to get a state-of-the-art network able to classify cat vs. dogs in 4 lines of code and less than 1 minute of computation. Then you land ich takes you from model to production, showing how you can serve a webapp in no time, without any HTML or JavaScript, without owning a server. I think of this book as an onion. A complete package that e best possible settings. Then, if some alterations are required, you can peel the outer layer. More tweaks? You can keep discarding shells. Even more? You can go as deep as using bare PyTorch. You'll have three oices accompanying you around your journey along this 500 page book, providing you guidance and individual perspective." -- **Alfredo Canziani**, Professor of Computer Science, NYU "Deep Learning for Coders with fastai and Pytorch is an approachable conversationally-driven book that uses the whole game approach to teaching deep learning concepts. The book focuses on getting your hands dirty right out of the gate with real examples and bringing the reader along with reference concepts only as needed. A practitioner may approach the world of deep learning in this book through hands-on examples in the first half, but will find themselves

Analytical Specialist, McKinsey & Co

Optimal Decisions Group

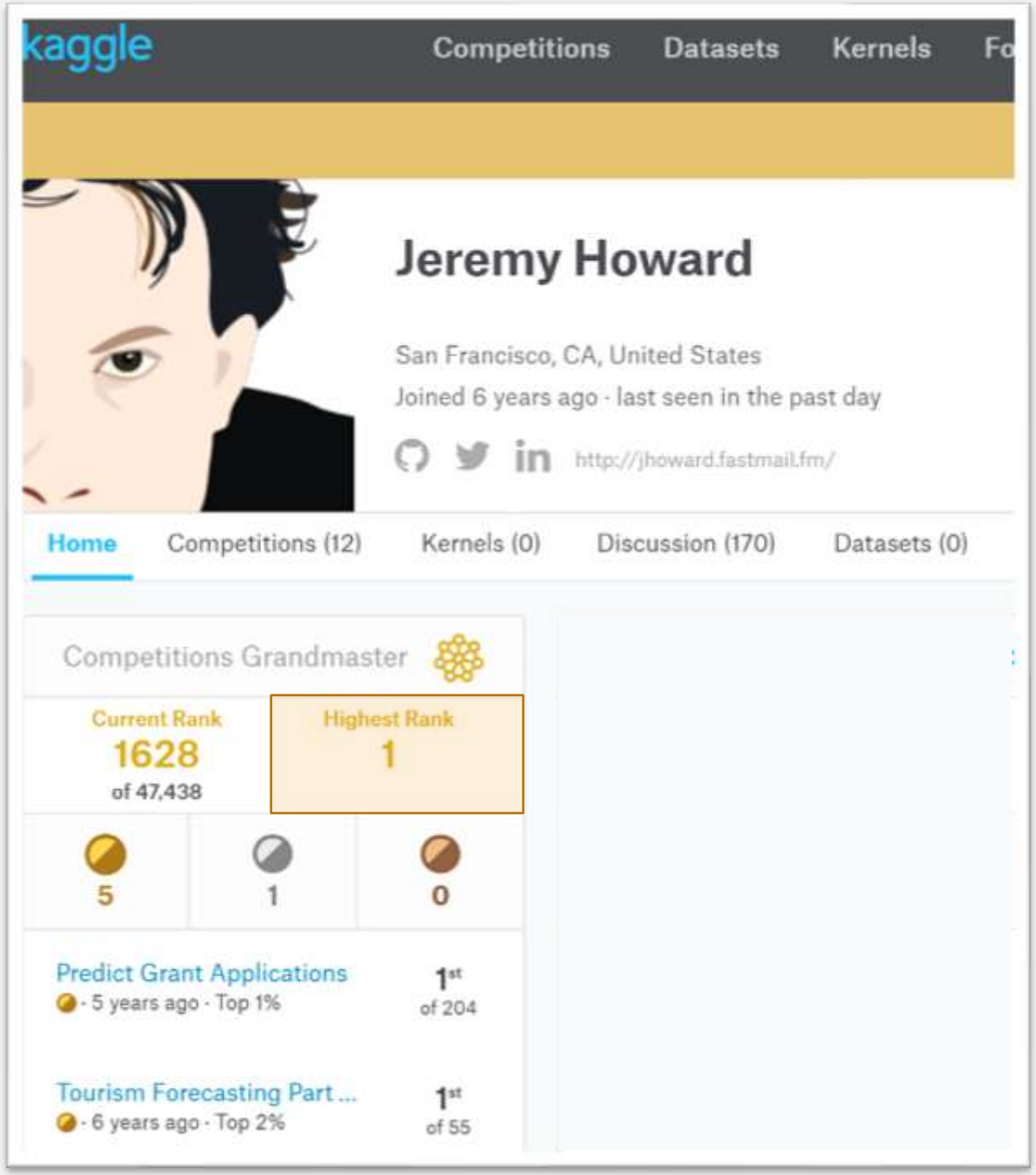
Kaggle #1; Founding president

Enlitic

University of San Francisco

fast.ai

University of Queensland



MIT Technology Review

50 Smartest Companies | The List | Years

50 Smartest Companies 2016

SORT BY

Rank

Name

Location

Years on List

1 Amazon
2 Baidu
3 Illumina
4 Tesla Motors
5 Aquion Energy
6 Mobileye
7 23andMe
8 Alphabet
9 Spark Therapeutics
10 Huawei
11 First Solar
12 Nvidia
13 Cellectis
14 Enlitic
15 Facebook
16 SpaceX

No PhD, no problem

New schemes teach the masses to build AI

The Economist

Artificial Intelligence Education Transforms The Developing World

Forbes

The startup diversifying the AI workforce beyond just "techies"

MIT Technology Review

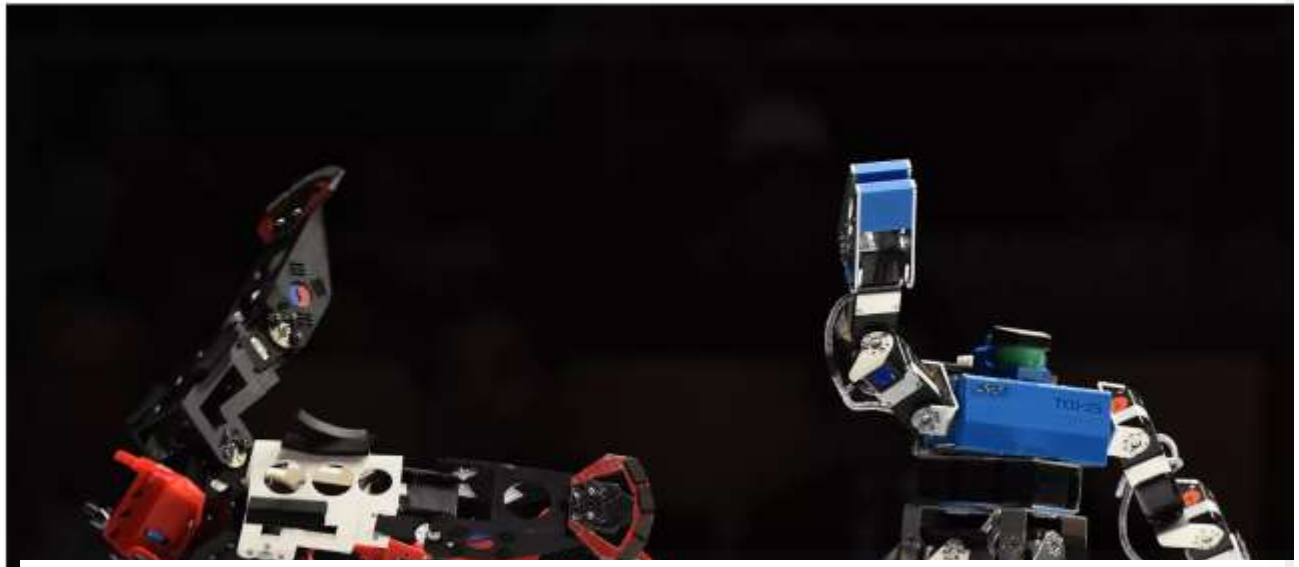
ZDNet

Fast.ai's software could radically democratize AI

An AI speed test shows clever coders can still beat tech giants like Google and Intel

By James Vincent | @jjvincent | May 7, 2018, 6:30am EDT

SHARE



Training Imagenet in 3 hours for $25; CIFAR10 for $0.26

Written: 30 Apr 2018 by *Jeremy Howard*

theverge.com/.../google-android-9-pie-review-gestures-ai-notifications

Intelligent Machines

A small team of student AI coders beats Google's machine-learning code

The success shows that advances in artificial intelligence aren't the sole domain of elite programmers.

Now anyone can train Imagenet in 18 minutes

Written: 10 Aug 2018 by *Jeremy Howard*

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NVIDIA Developer Blog

TOPICS

ARTIFICIAL INTELLIGENCE ACCELERATED COMPUTING

Volta Tensor Core GPU Achieves New AI Performan Milestones

By Loyd Case | May 7, 2018

Tags: Accelerated Computing, Deep Learning, featured, machine learning and AI, Tensor C

Artificial intelligence powered by deep learning now solves challenges once t such as computers understanding and conversing in natural speech and aut Inspired by the effectiveness of deep learning to solve a great many challeng exponentially growing complexity of algorithms has resulted in a voracious a computing. NVIDIA designed the Volta Tensor Core architecture to meet thes

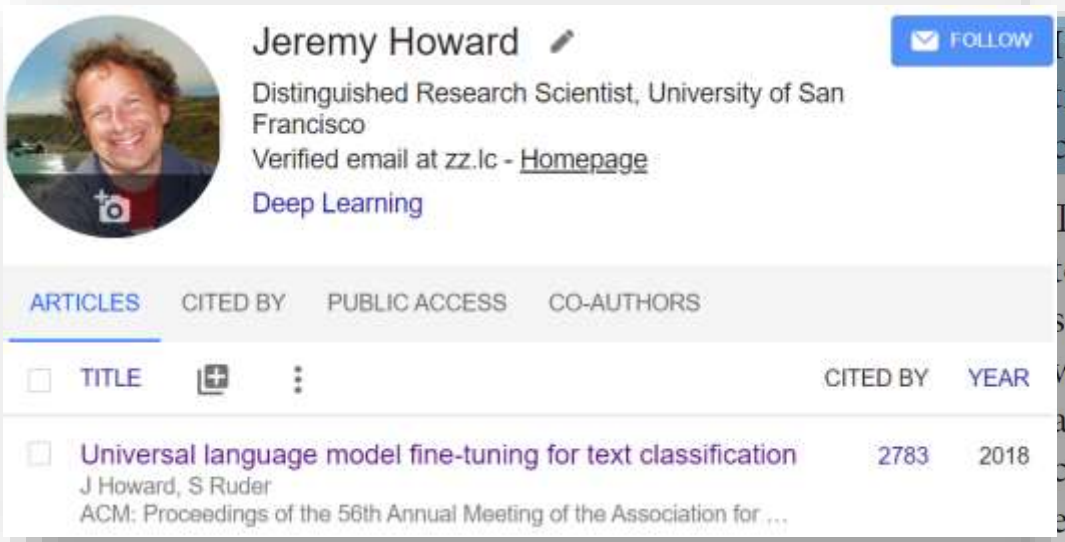
https://cloudplatform.googleblog.com/2018/06/Cloud-TPU-now-offers-preemptible-pricing-and-global-availability.htm

Preemptible Cloud TPUs make the Cloud TPU platform even more affordable. *You can now train ResNet-50 on ImageNet from scratch for just $7.50.* Preemptible Cloud TPUs allow fault-tolerant workloads to run more cost-effectively than ever before; these TPUs behave similarly to Preemptible VMs. And because TensorFlow has built-in support for saving and restoring from checkpoints, deadline-insensitive workloads can easily take advantage of preemptible pricing. This means you can train cutting-edge deep learning models to achieve DAWNBench-level accuracy for less than you might pay for lunch!

Select Open-Source Reference Models	Normal training cost (TF 1.8)	Preemptible training cost (TF 1.8)
ResNet-50 (with optimizations from fast.ai): Image classification	~$25	~$7.50
ResNet-50 (original implementation): Image classification	~$59	~$18
AmoebaNet: Image classification (model architecture evolved from scratch on TPUs to maximize accuracy)	~$49	~$15
RetinaNet: Object detection	~$40	~$12
Transformer: Neural machine translation	~$41	~$13
ASR Transformer: Speech recognition (transcribe speech to text)	~$86	~$27

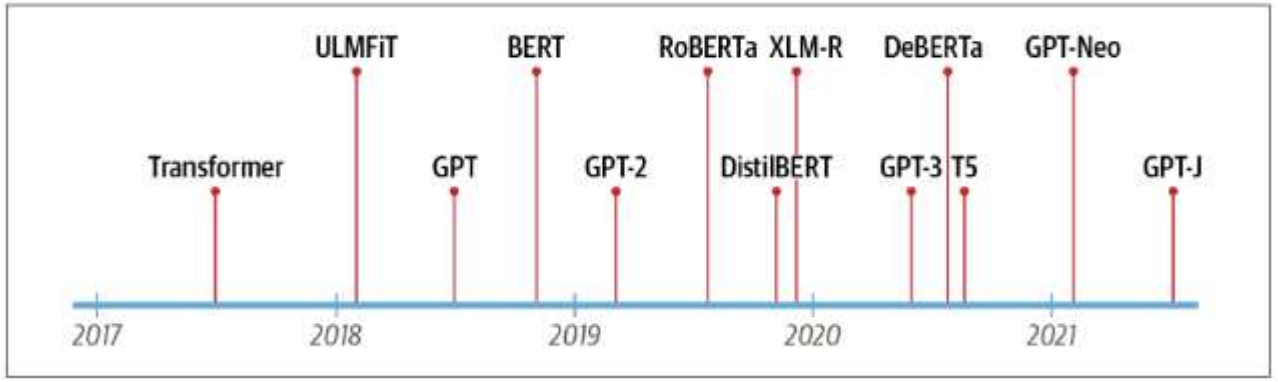
Natural Language Processing with Transformers

Building Language Applications with Hugging Face



CHAPTER 1

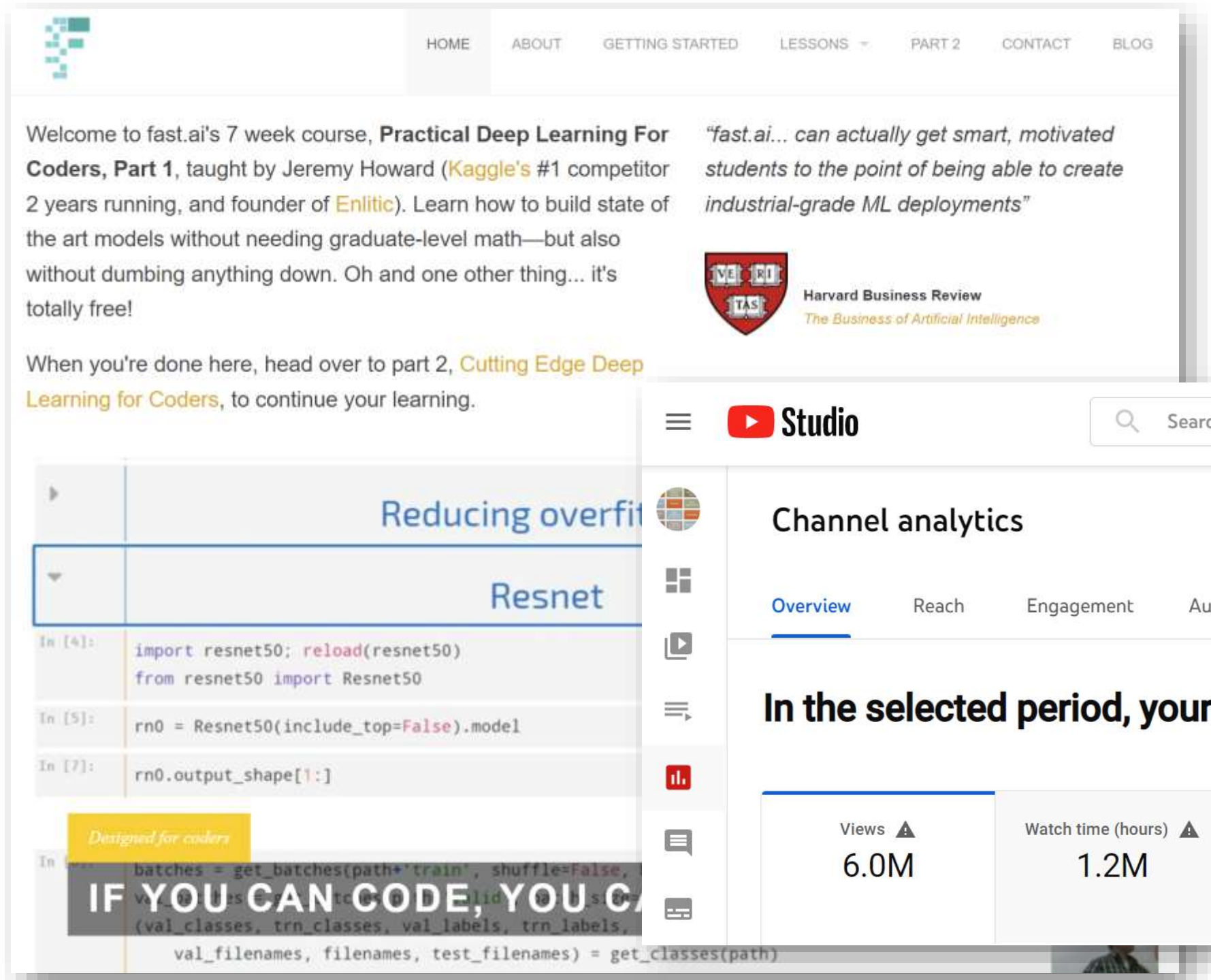
Hello Transformers



In 2017, researchers at Google published a paper[1] which proposed a novel neural network architecture for sequence modeling. Dubbed the *Transformer*, this architecture outperformed recurrent neural networks (RNNs) on machine translation tasks, both in terms of translation quality and training cost.

In parallel, an effective transfer learning method called ULMFiT[2] showed that pretraining Long-Short Term Memory (LSTM) networks on a very large and diverse corpus could produce state-of-the-art text classifiers with little labeled data.

These advances were the catalysts for two of the most well-known transformers today: Generative Pretrained Transformer (GPT)[3] and Bidirectional Encoder Representations from Transformers (BERT).[4] By combining the Transformer architecture with unsupervised learning, these models removed the need to train task-specific architectures from scratch, and broke almost every benchmark in NLP by a significant margin. Since the release of GPT and BERT, a zoo of transformer models has emerged, and a timeline of the most prominent ones is shown in Figure 1-1.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PART 2
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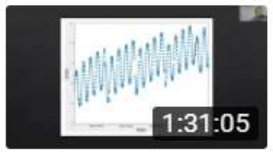
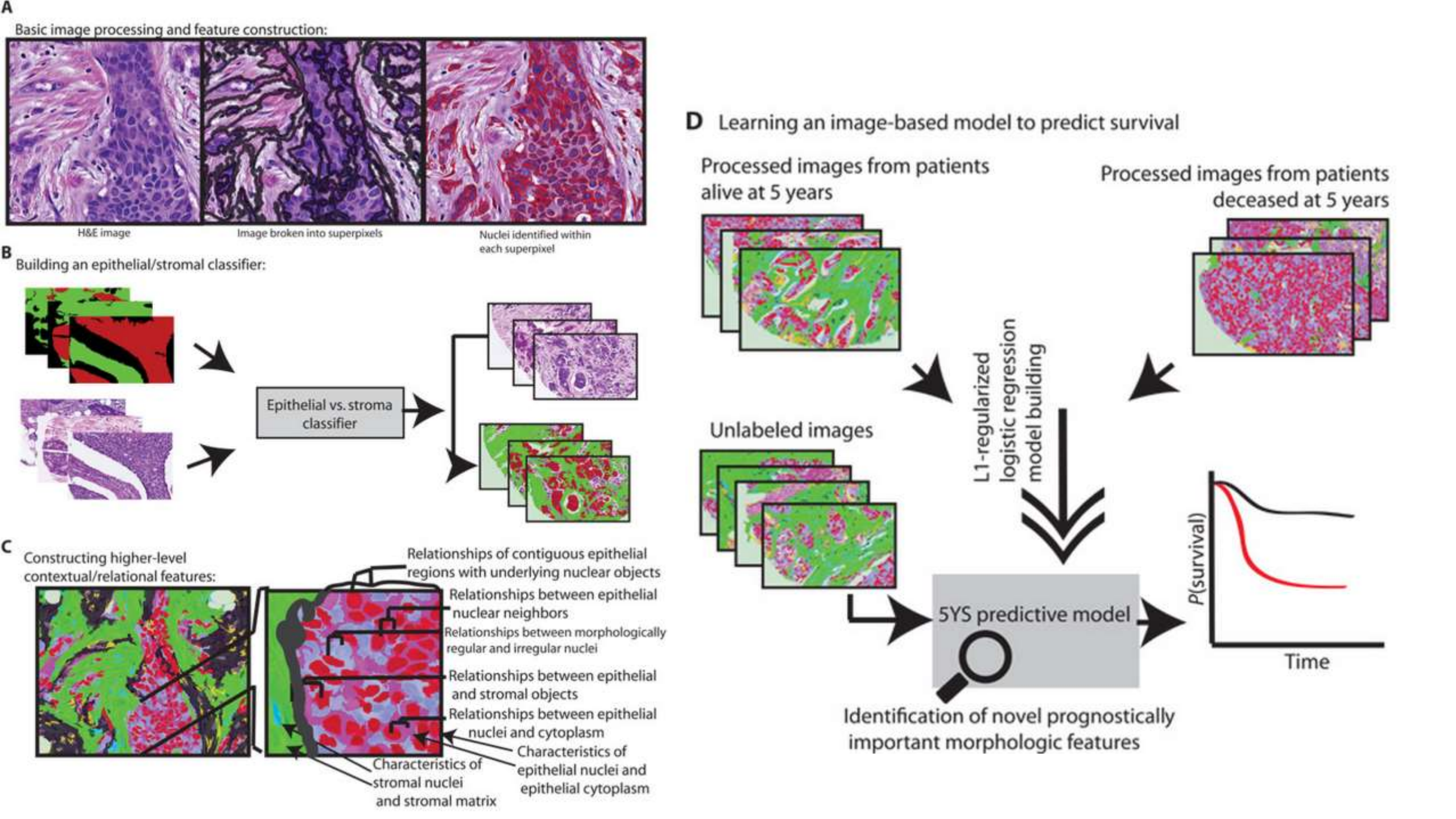
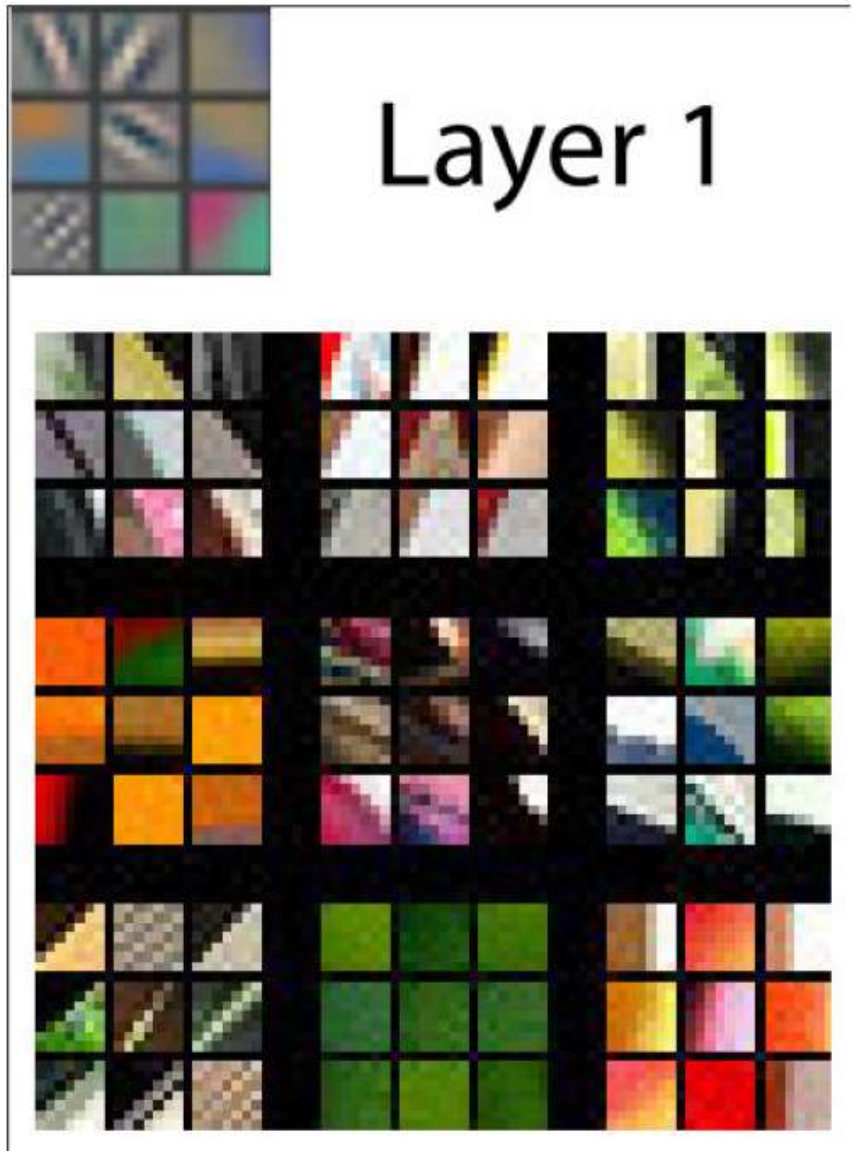
Welcome to fast.ai's 7 week course, **Practical Deep Learning For Coders, Part 1**, taught by Jeremy Howard (Kaggle's #1 competitor 2 years running, and founder of Enlitic). Learn how to build state of the art models without needing graduate-level math—but also without dumbing anything down. Oh and one other thing... it's totally free!
When you're done here, head over to part 2, Cutting Edge Deep Learning for Coders, to continue your learning.
"fast.ai... can actually get smart, motivated students to the point of being able to create industrial-grade ML deployments"
Harvard Business Review
The Business of Artificial Intelligence
Reducing overfit
Resnet
In [4]:
import resnet50; reload(resnet50)
from resnet50 import Resnet50
In [5]:
rn0 = Resnet50(include_top=False).model
In [7]:
rn0.output_shape[1:]
Designed for coders
IF YOU CAN CODE, YOU C
batches = get_batches(path+'train', shuffle=False,
(val_classes, trn_classes, val_labels, trn_labels,
val_filenames, filenames, test_filenames) = get_classes(path)

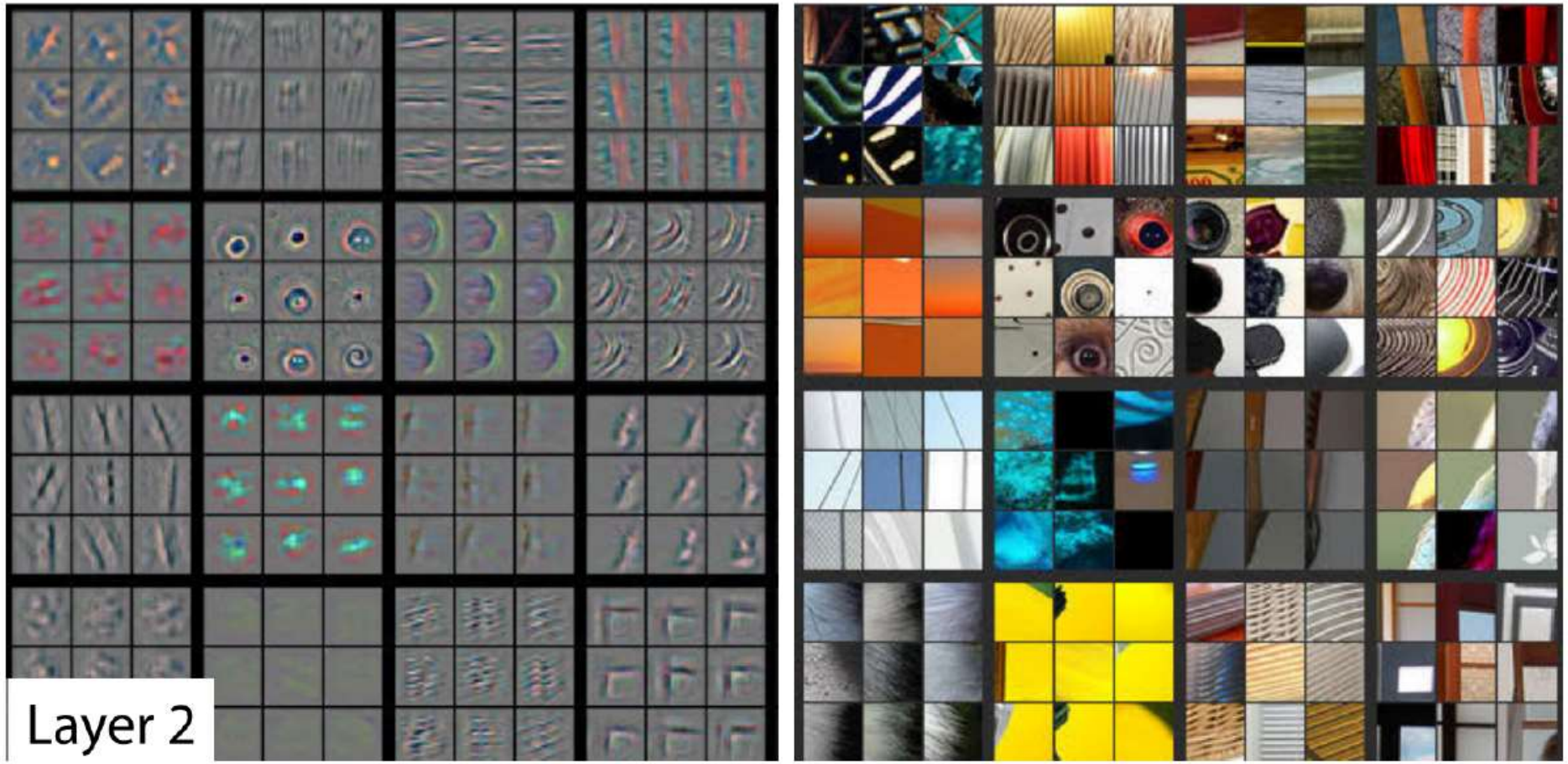
Studio
Search across your channel
Channel analytics
Overview
Reach
Engagement
Audience
Revenue
Research
In the selected period, your channel got 6,005,369 views
Views
6.0M
Watch time (hours)
1.2M
Subscribers
+58.7K
Your estimated revenue
$56.46

Video	Likes (vs. dislikes)
 Lesson 6 - Deep Learning for Coders (2020) NB: We recommend watching these videos through https://course.fast.ai rather than directly on YouTube,...	98.3% 352 likes
 Lesson 1 - Deep Learning for Coders (2020) Welcome to Deep Learning for Coders! Be sure to watch these videos through https://course.fast.ai to...	99.1% 3,960 likes
 Lesson 8 - Deep Learning for Coders (2020) NB: We recommend watching these videos through https://course.fast.ai rather than directly on YouTube,...	98.1% 311 likes
 Lesson 7 - Deep Learning for Coders (2020) NB: We recommend watching these videos through https://course.fast.ai rather than directly on YouTube,...	98.4% 307 likes
 Lesson 2 - Deep Learning for Coders (2020) NB: We recommend watching these videos through https://course.fast.ai rather than directly on YouTube,...	98.1% 1,217 likes
 Lesson 3 - Deep Learning for Coders (2020) NB: We recommend watching these videos through https://course.fast.ai rather than directly on YouTube,...	98.4% 749 likes
 An overview of fastai2 This was a presentation to the Swift for Tensorflow design meeting, describing the design of fastai2.	98.6% 360 likes

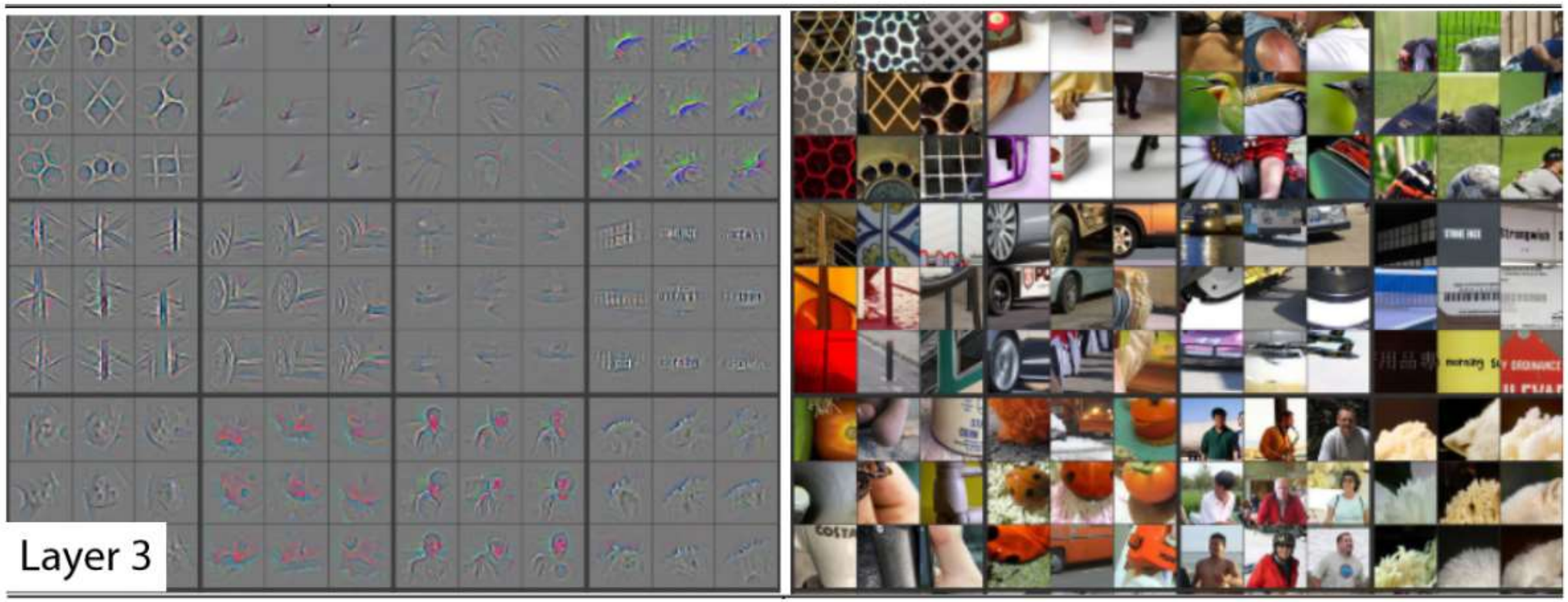

A
Basic image processing and feature construction:
H&E image
Image broken into superpixels
Nuclei identified within each superpixel
B
Building an epithelial/stromal classifier:
Epithelial vs. stroma classifier
C
Constructing higher-level contextual/relational features:
Relationships of contiguous epithelial regions with underlying nuclear objects
Relationships between epithelial nuclear neighbors
Relationships between morphologically regular and irregular nuclei
Relationships between epithelial and stromal objects
Relationships between epithelial nuclei and cytoplasm
Characteristics of epithelial nuclei and epithelial cytoplasm
Characteristics of stromal nuclei and stromal matrix
D
Learning an image-based model to predict survival
Processed images from patients alive at 5 years
Processed images from patients deceased at 5 years
Unlabeled images
L1-regularized logistic regression model building
5YS predictive model
P(survival)
Time
Identification of novel prognostically important morphologic features

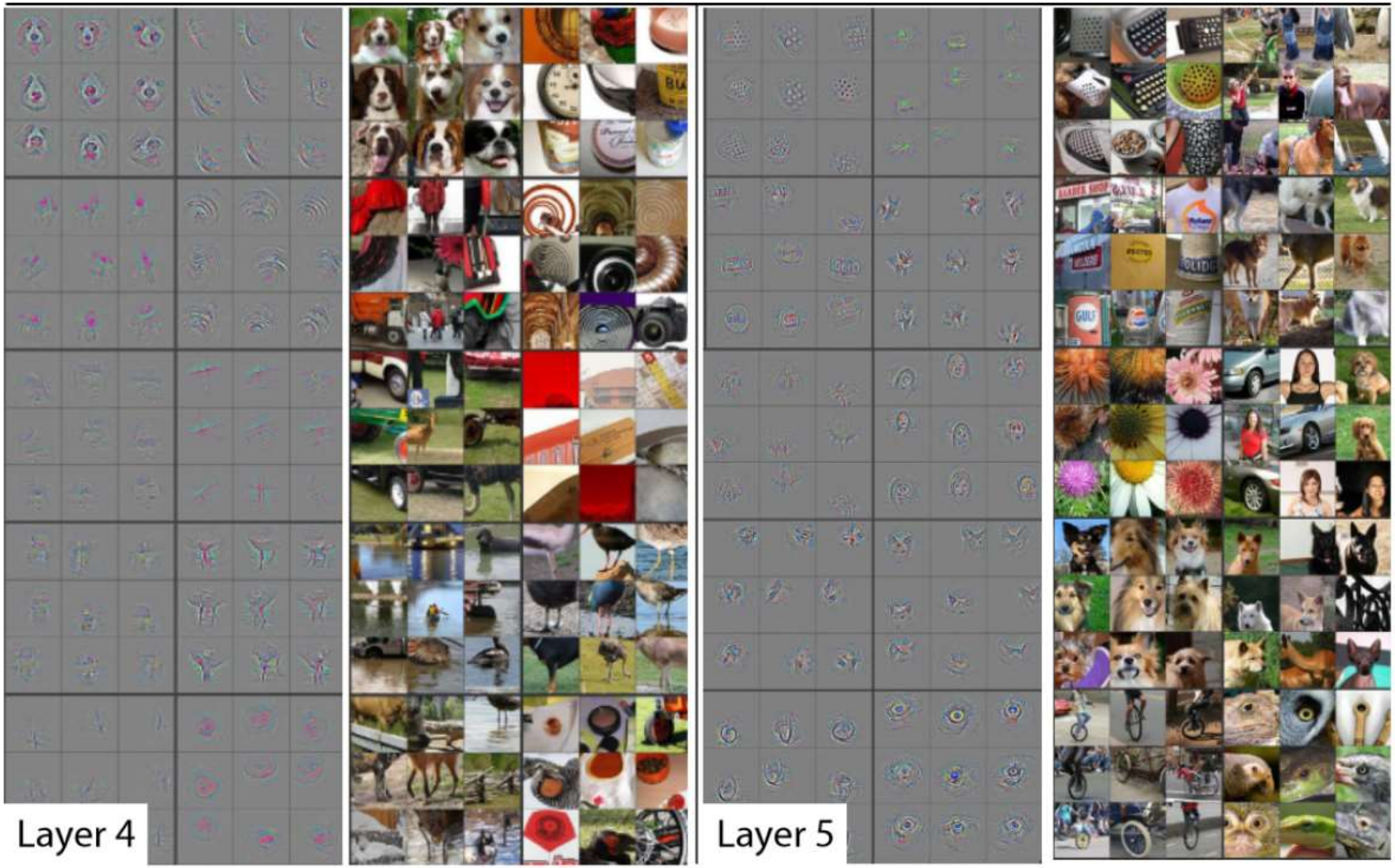


Images from Matthew D. Zeiler and Rob Fergus


Layer 2

fast.ai




Layer 4
Layer 5

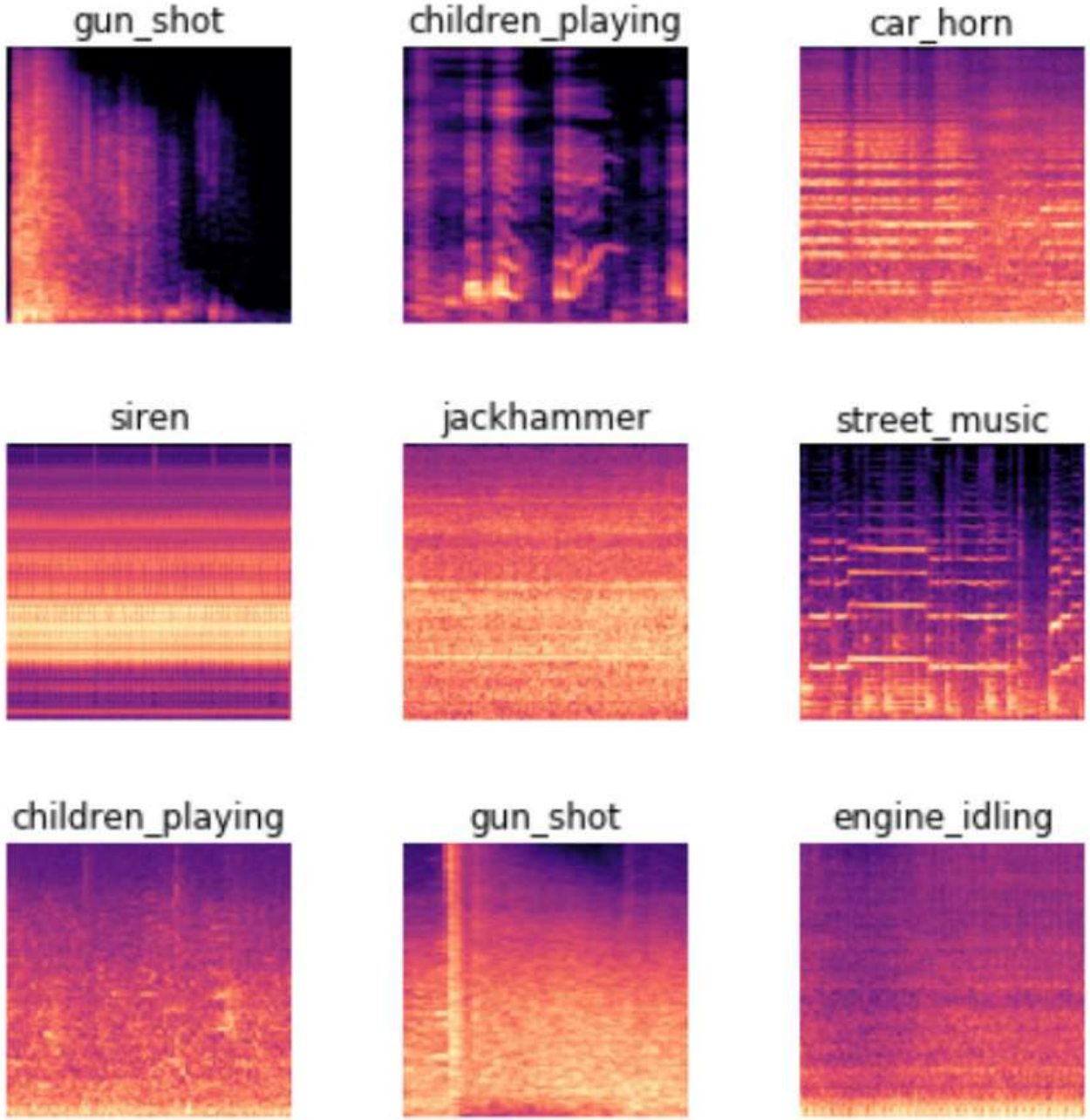
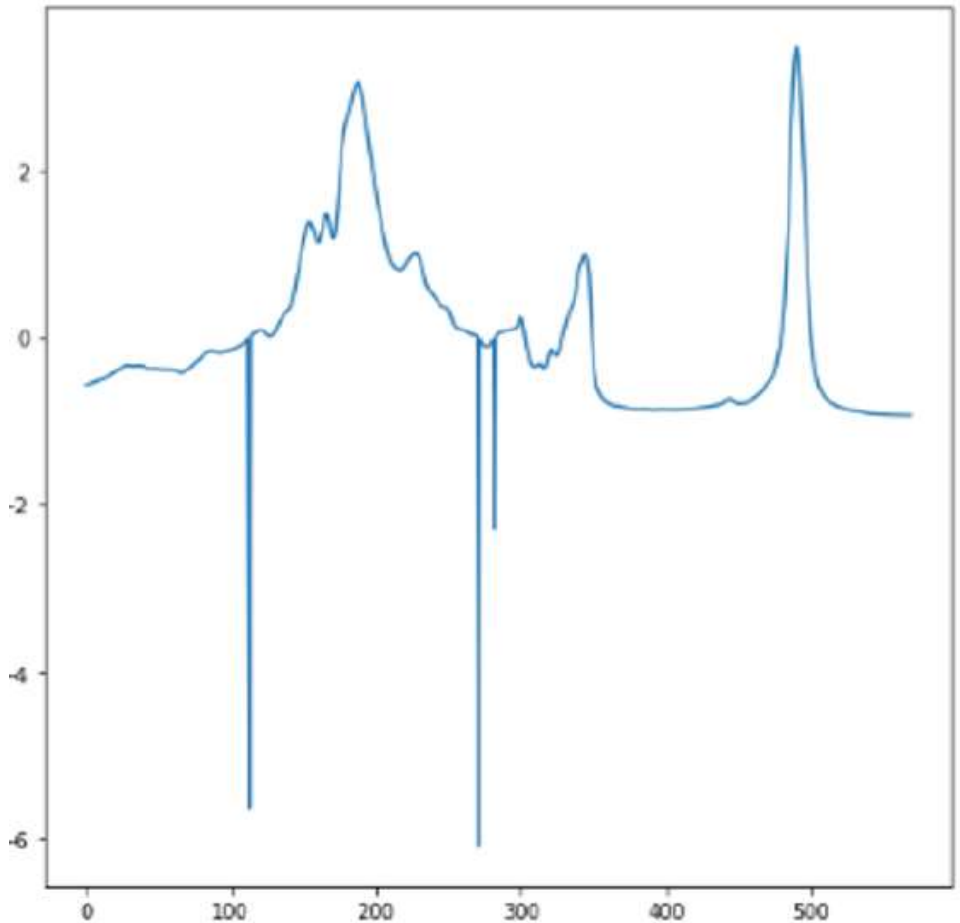


Image from Ethan Sutin



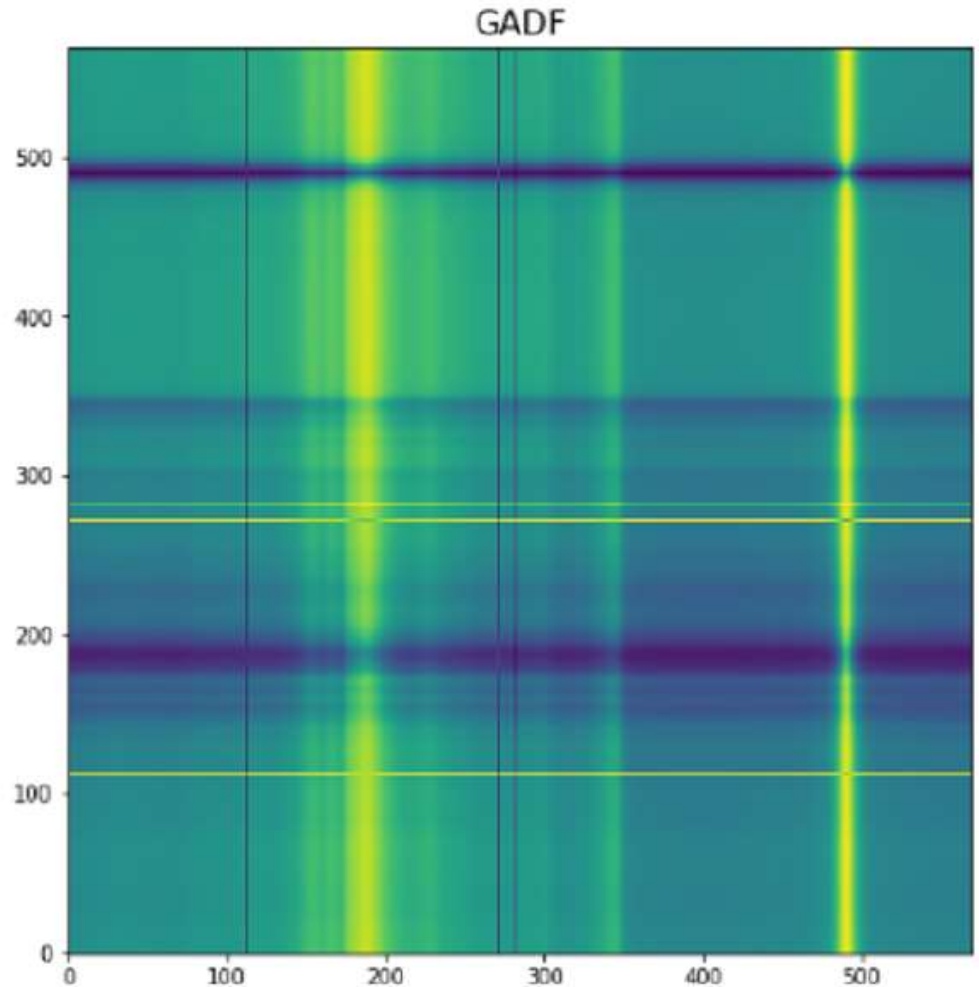


Image from Ignacio Oguiza

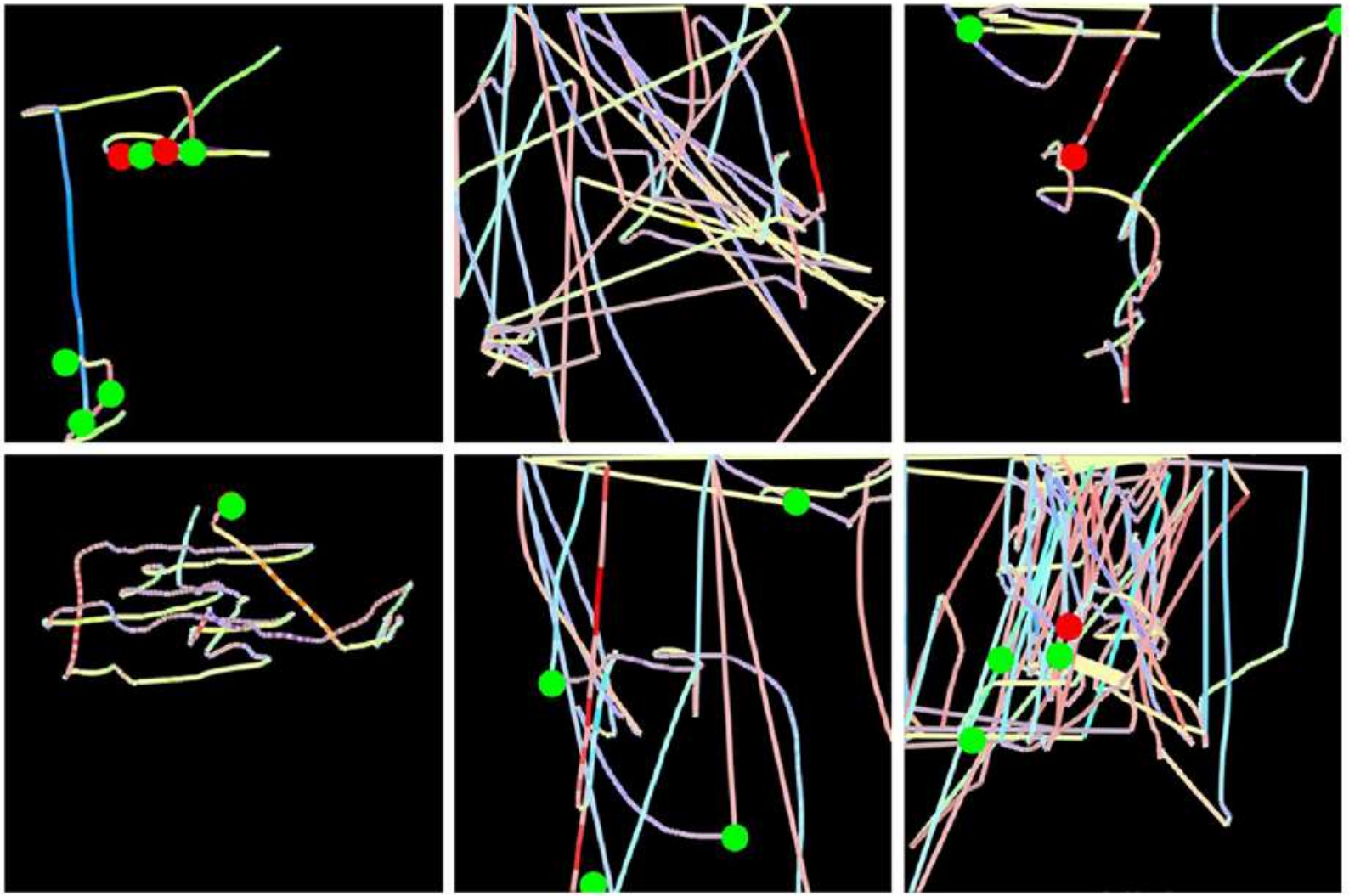


Image from Gleb Esman

Myth (don't need)	Truth
Lots of math	High school math is sufficient.
Lots of data	We've seen record-breaking results with <50 items of data.
Lots of expensive computers	You can get what you need for state-of-the-art work for free.

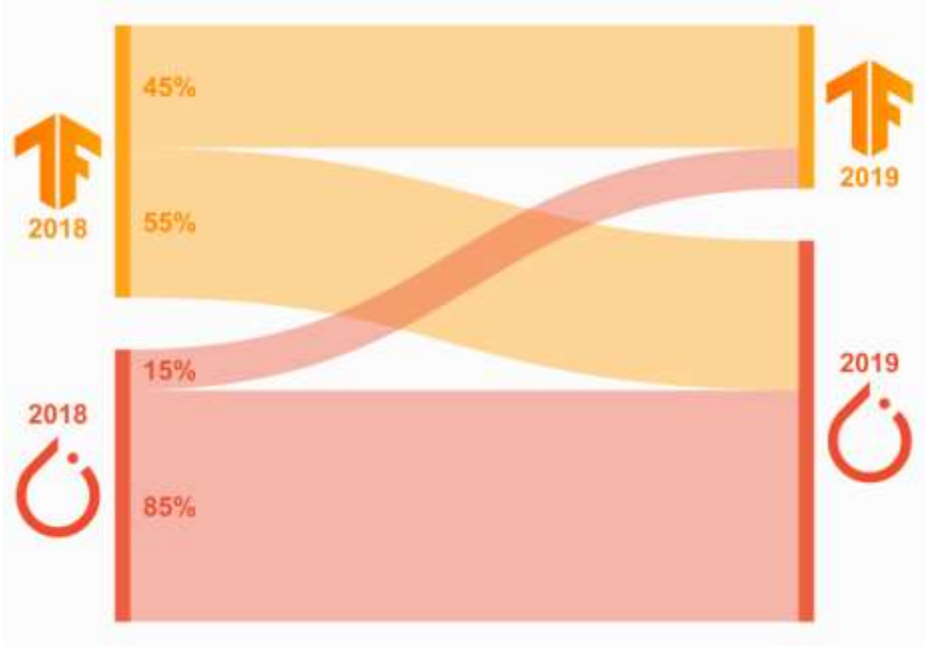
AssemblyAI Blog

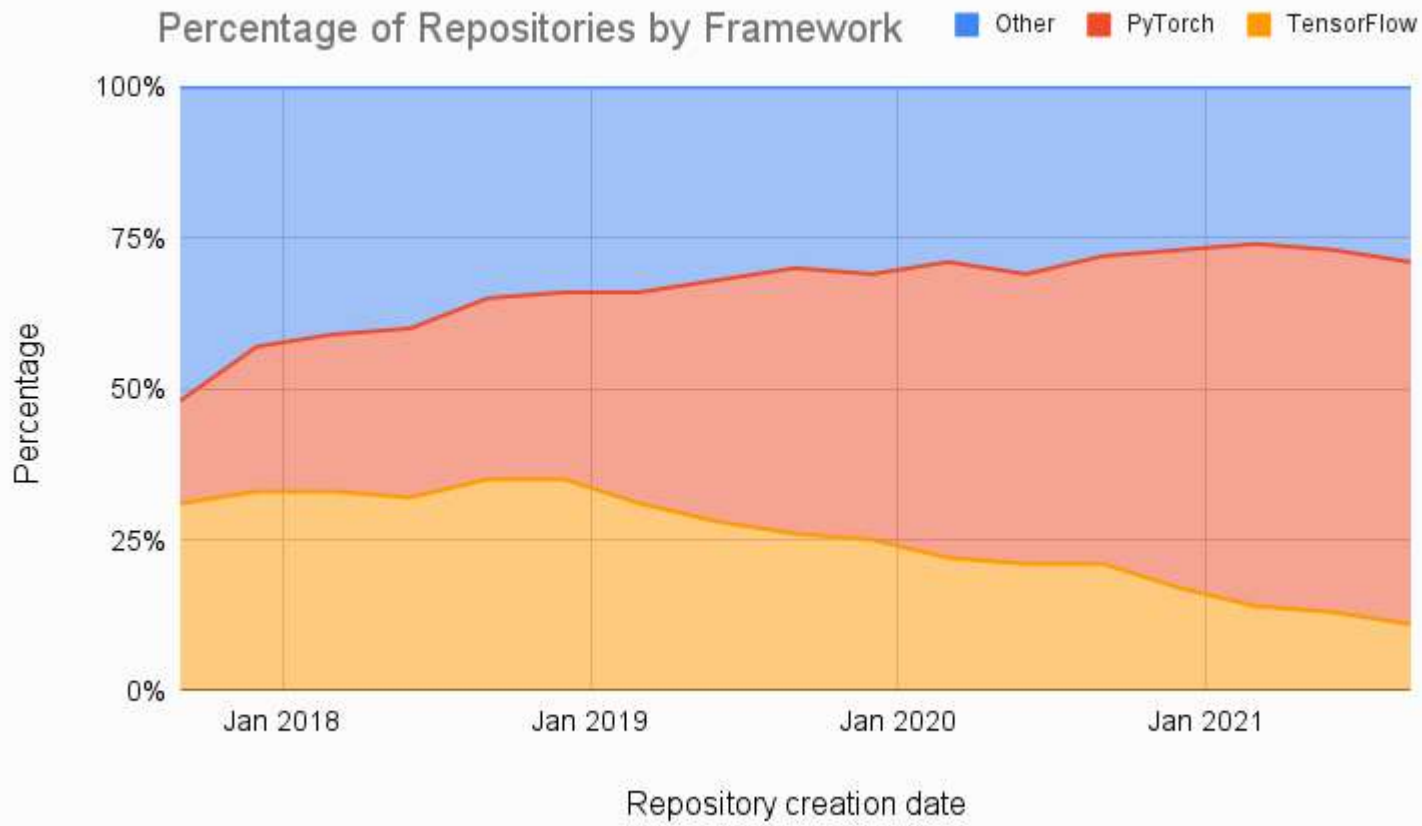
Industry Dec 14, 2021

PyTorch vs TensorFlow in 2022

Should you use PyTorch vs TensorFlow in 2022? This guide walks through the major pros and cons of PyTorch vs TensorFlow, and how you can pick the right framework.

Ryan O'Connor
Developer Educator





Here's AdamW's step in PyTorch.

```
loss = None
if closure is not None:
  loss = closure()

for group in self.param_groups:
  for p in group['params']:
    if p.grad is None:
      continue

    # Perform stepweight decay
    p.data.mul_(1 - group['lr'] * group['weight_decay'])

    # Perform optimization step
    grad = p.grad.data
    if grad.is_sparse:
      raise RuntimeError('Adam does not support sparse gradients, please consider SparseAdam instead')
    amsgrad = group['amsgrad']

    state = self.state[p]

    # State initialization
    if len(state) == 0:
      state['step'] = 0
      # Exponential moving average of gradient values
      state['exp_avg'] = torch.zeros_like(p.data)
      # Exponential moving average of squared gradient values
      state['exp_avg_sq'] = torch.zeros_like(p.data)
      if amsgrad:
        # Maintains max of all exp. moving avg. of sq. grad. values
        state['max_exp_avg_sq'] = torch.zeros_like(p.data)

    exp_avg, exp_avg_sq = state['exp_avg'], state['exp_avg_sq']
    if amsgrad:
      max_exp_avg_sq = state['max_exp_avg_sq']
    beta1, beta2 = group['betas']

    state['step'] += 1

    # Decay the first and second moment running average coefficient
    exp_avg.mul_(beta1).add_(1 - beta1, grad)
    exp_avg_sq.mul_(beta2).addcmul_(1 - beta2, grad, grad)
    if amsgrad:
      # Maintains the maximum of all 2nd moment running avg. till now
      torch.max(max_exp_avg_sq, exp_avg_sq, out=max_exp_avg_sq)
      # Use the max. for normalizing running avg. of gradient
      denom = max_exp_avg_sq.sqrt().add_(group['eps'])
    else:
      denom = exp_avg_sq.sqrt().add_(group['eps'])

    bias_correction1 = 1 - beta1 ** state['step']
    bias_correction2 = 1 - beta2 ** state['step']
    step_size = group['lr'] * math.sqrt(bias_correction2) / bias_correction1

    p.data.addcdiv_(-step_size, exp_avg, denom)

return loss
```

```
def weight_decay(p, lr, wd, do_wd=True, **kwargs):
    "Weight decay as decaying `p` with `lr*wd`"
    if do_wd: p.data.mul_(1 - lr*wd)
    return p
weight_decay.defaults = dict(wd=0.)
```

```
"A `Optimizer` for Adam with `lr`, `mom`, `sqr_mom`, `eps` and `params`"
steppers = [] if wd==0. else [weight_decay] if decouple_wd else [l2_reg]
steppers.append(adam_step)
stats = [partial(average_grad, dampening=True), average_sqr_grad, step_stat]
return Optimizer(params, steppers, stats=stats, lr=lr, mom=mom, sqr_mom=sqr_mom, eps=eps, wd=wd)
```

In fastai it's very different

01010
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CERTIFICATE
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Information **2020**, *11*(2), 108; doi:10.3390/info11020108

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TIME TO LEARN TO USE JUPYTER AND FASTAI...

...AND TIME TO TRAIN SOME MORE MODELS!

Here's a list of some of the thousands of tasks in different areas for which deep learning, or methods heavily using deep learning, is now the best in the world:

Natural language processing (NLP)
: Answering questions; speech recognition; summarizing documents; classifying documents; finding names, dates, etc. in documents; searching for articles mentioning a concept

Computer vision
: Satellite and drone imagery interpretation (e.g., for disaster resilience), face recognition, image captioning, reading traffic signs, locating pedestrians and vehicles in autonomous vehicles

Medicine
: Finding anomalies in radiology images, including CT, MRI, and X-ray images; counting features in pathology slides; measuring features in ultrasounds; diagnosing diabetic retinopathy

Biology
: Folding proteins; classifying proteins; many genomics tasks, such as tumor-normal sequencing and classifying clinically actionable genetic mutations; cell classification; analyzing protein/protein interactions

Image generation

Colorizing images, increasing image resolution, removing noise from images, converting images to art in the style of famous artists

Recommendation systems

Web search, product recommendations, home page layout

Playing games

Chess, Go, most Atari video games, and many real-time strategy games

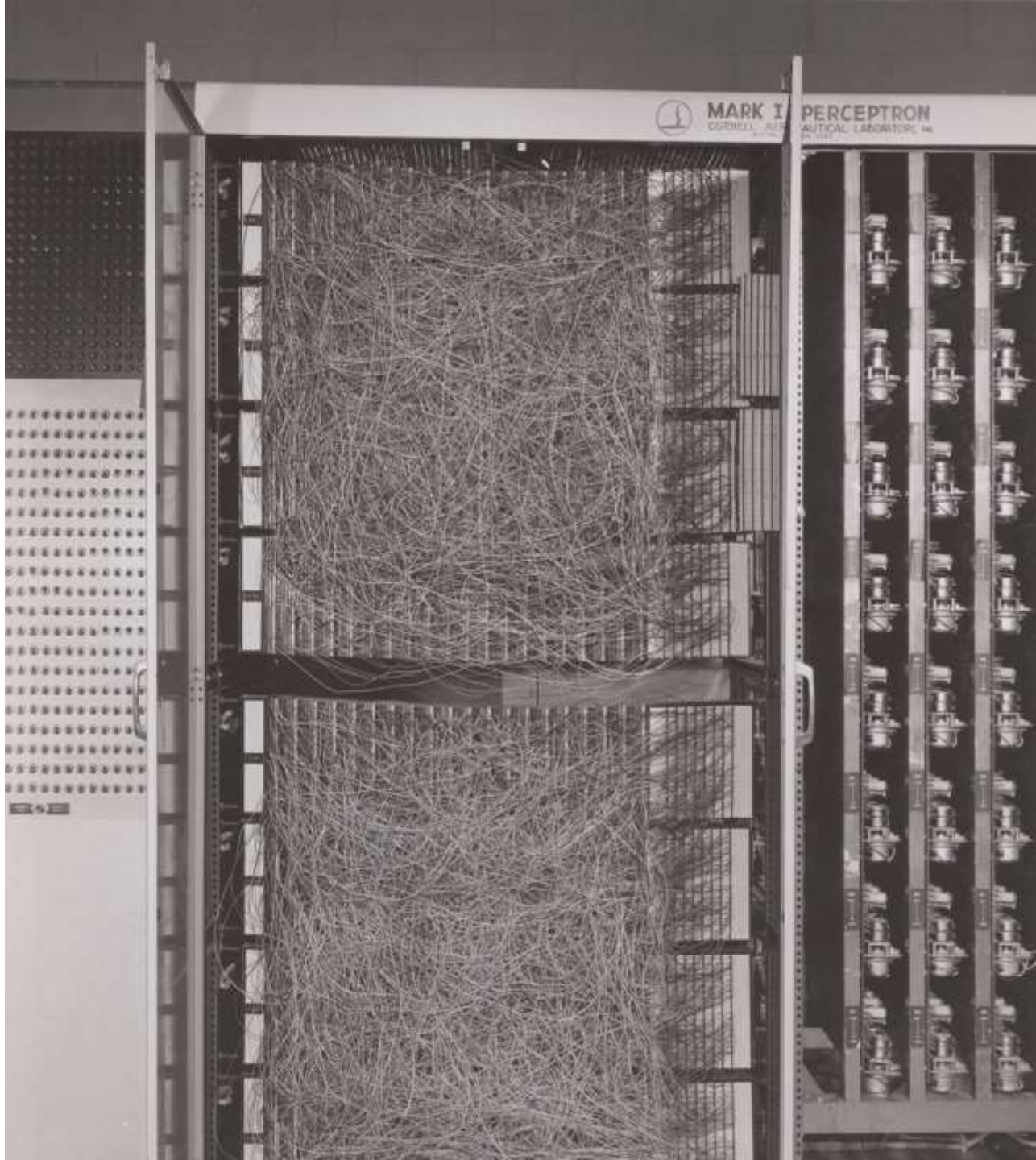
Robotics

Handling objects that are challenging to locate (e.g., transparent, shiny, lacking texture) or hard to pick up

Other applications

Financial and logistical forecasting, text to speech, and much, much more…

Mark I Perceptron at the Cornell Aeronautical Laboratory (1957)



Software

- To make these available to use quickly, reliably, and with minimal code

Education

- So that as many people as possible can use these

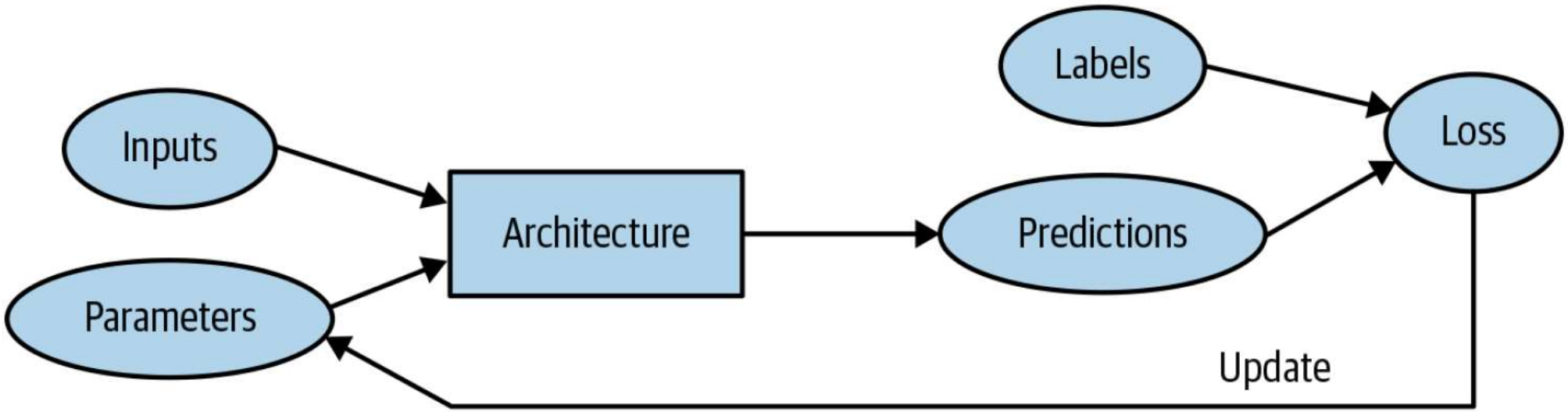
fast.ai:
Making Deep Learning Accessible

Research

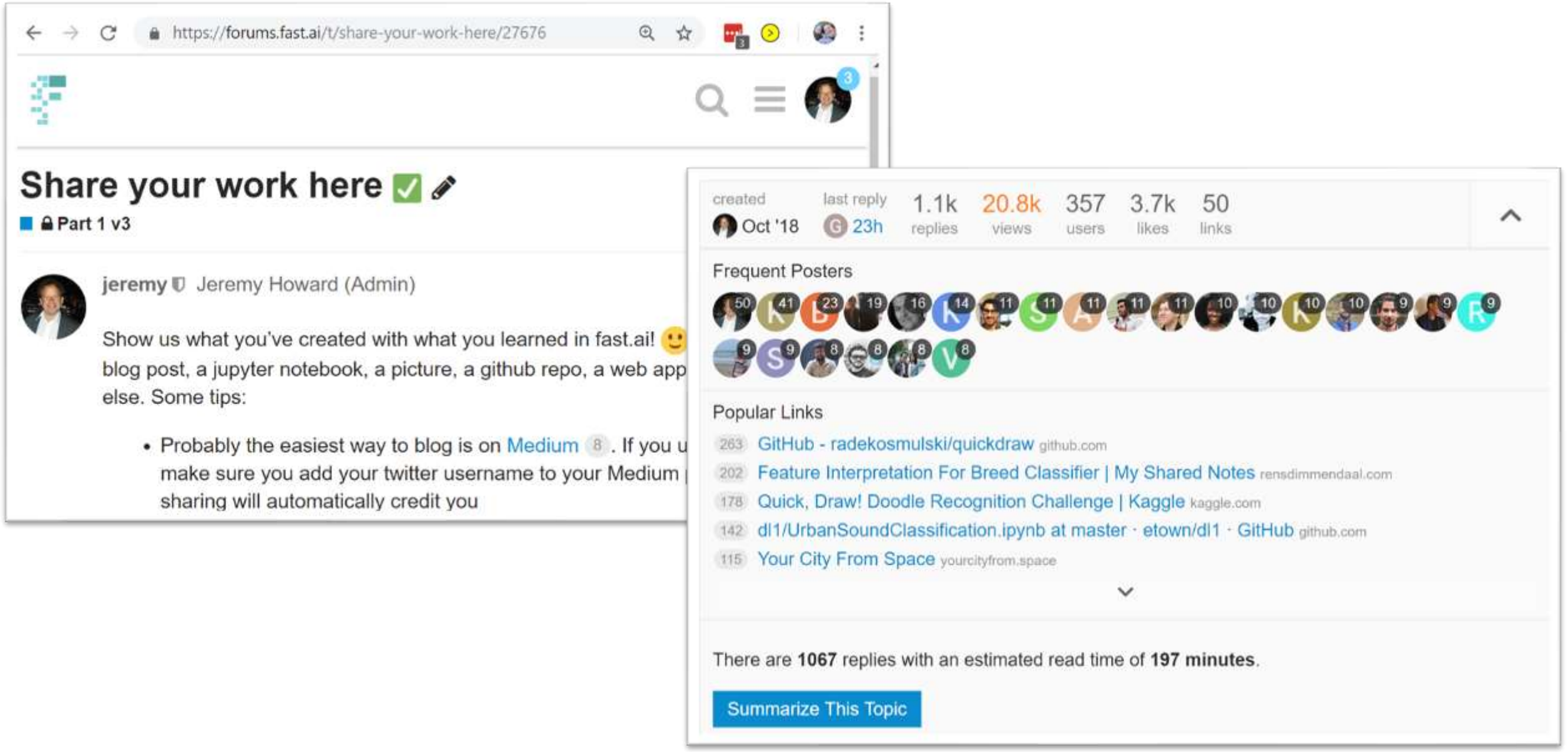
- Ways to make state of the art deep learning techniques more accessible

Community

- So that we can all help each other


Labels
Inputs
Loss
Architecture
Predictions
Parameters
Update

After 1st week of class…



Mauro

Hey everyone. I made an image cla
Panama city. The c
Metrobus. The acc
difference.

bus diablo rojo panar

bus metrobus panan

bus metrobus panan

cahya

I have s
attempt
is captu

It seems that this small datas
accuracy of 100% after just fe

```
In [33]: interp.plot_top_loss
```

B13/B13 / 0.07 / 1

B14/B14 / 0.06 / 1

B43/B43 / 0.05 / 1

daveluo 1 2h

Hi everyone!

I'm currently working on a project to segment & classify the condition of buildings seen on hi-res aerial (drone) imagery taken over Zanzibar island, Tanzania 1. As a step in the workflow, I trained a classifier based on lesson1 notebook to distinguish between 4 types/conditions of buildings on a variety of images (different sizes, ratios, blurriness):

(green = "Completed", yellow = "Incomplete", red = "Foundation")

y a resnet style

esnet34 (over 110 classes !!!) - here are

+Nicaragua/+Dem+Rep+of+Congo / 8.00 / 0.39

+Indonesia/+Colombia / 7.00 / 0.99

+China/+Canada / 6.71 / 0.74

Deep Convolutional Neural Networks and Data Augmentation for Environmental Sound Classification

Justin Salamon and Juan Pablo Bello

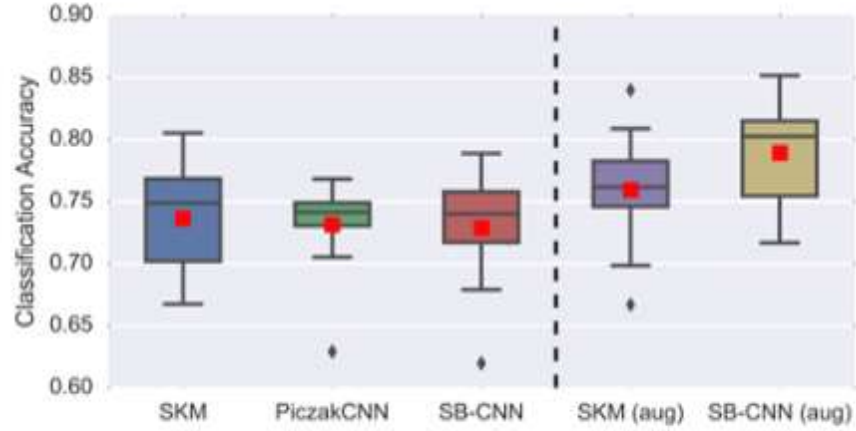
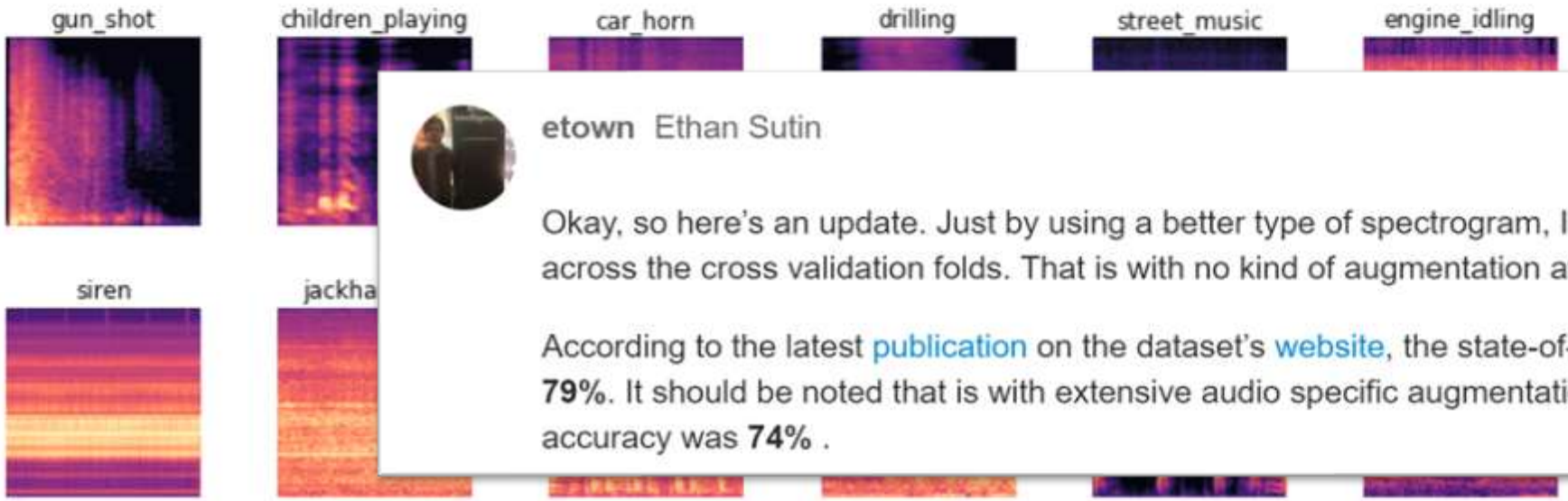


Fig. 1. Left of the dashed line: classification accuracy without augmentation – dictionary learning (SKM [7]), Piczak's CNN (PiczakCNN [11]) and the proposed model (SB-CNN). Right of the dashed line: classification accuracy for SKM and SB-CNN with augmentation.

```
data = ImageDataBunch.from_folder(data_directory/'1', ds_tfms=[], size=224)
data.normalize(imagenet_stats)
```

```
data.show_batch(rows=6, figsize=(12,12))
```



etown Ethan Sutin

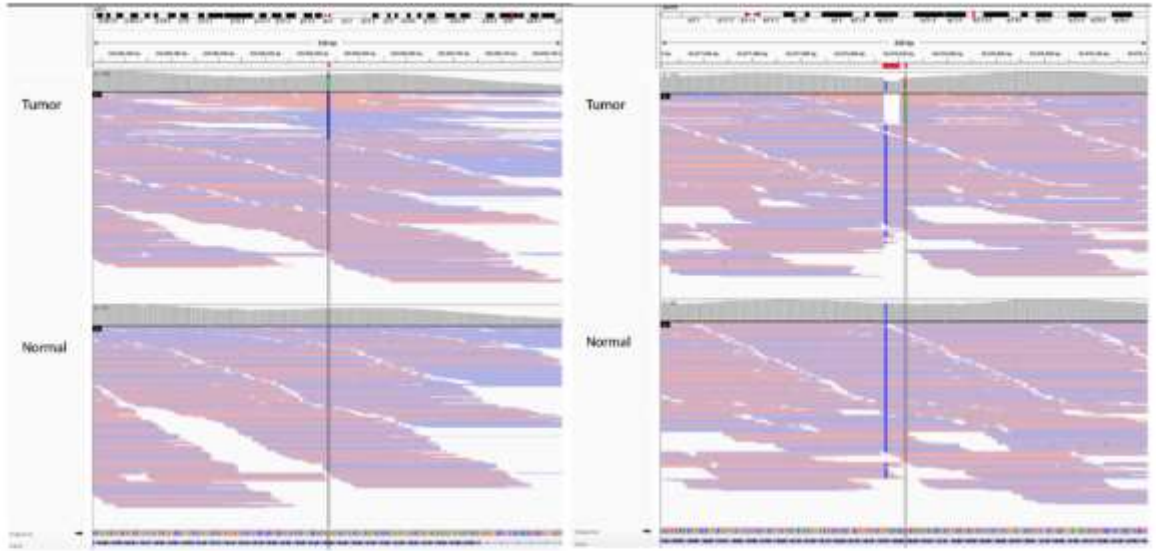
1 etown 1h

Okay, so here's an update. Just by using a better type of spectrogram, I was able to achieve **80.5%** accuracy across the cross validation folds. That is with no kind of augmentation at all.

According to the latest publication on the dataset's website, the state-of-the-art mean accuracy achieved was **79%**. It should be noted that is with extensive audio specific augmentation, and without augmentation their top accuracy was **74%** .

Alena Harley Follow
linkedin: https://www.linkedin.com/in/alena-harley-7700832; twitter @alenushka
Nov 5 · 4 min read

Tumor-normal sequencing: is this variant real?—deep learning and Fast.AI library to the rescue

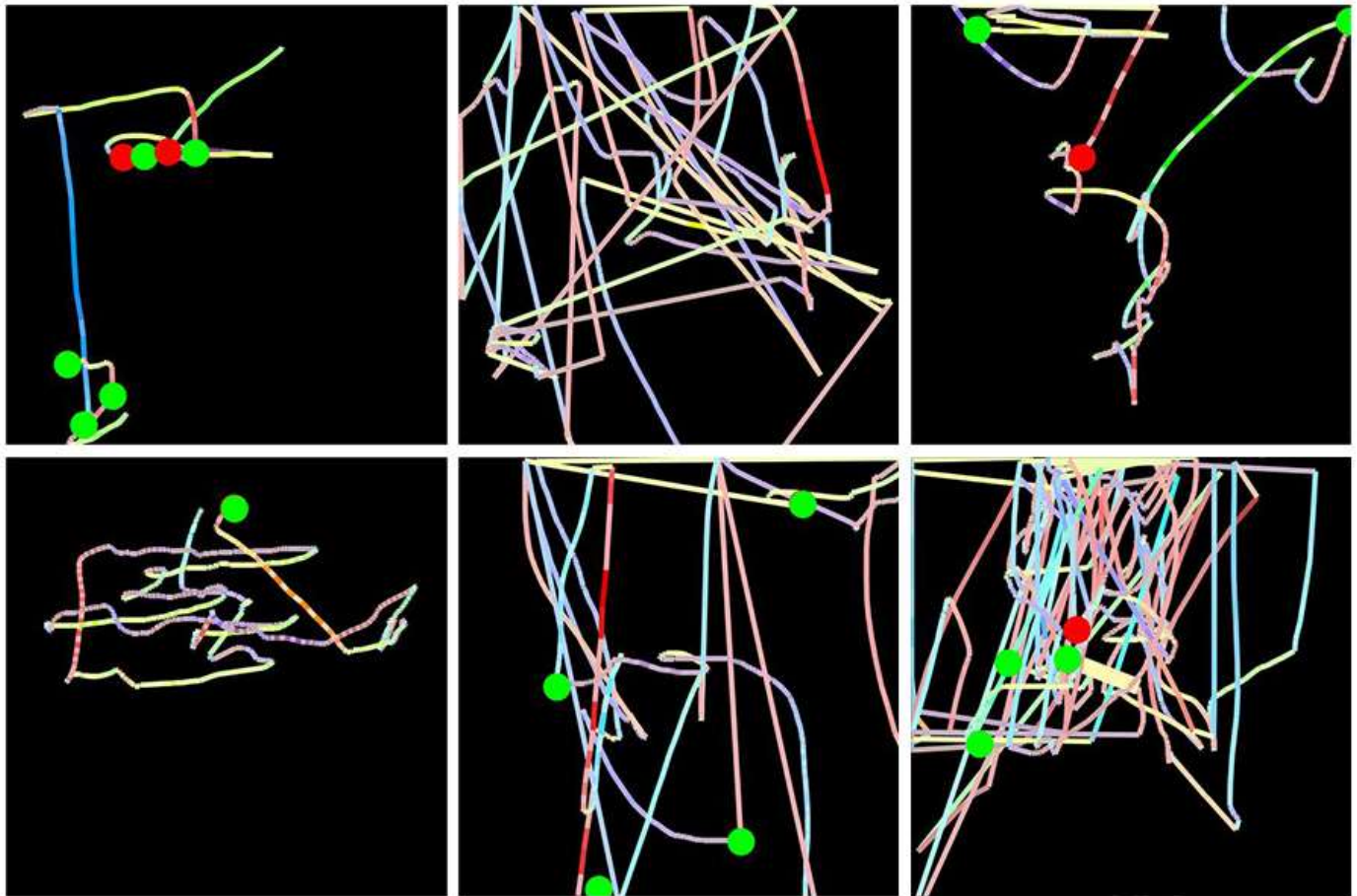


Example of a True variant detected by automated workflow is on the left. Example of a False variant detected is on the right (in this case proposed variant is two base pairs away from the "false" deletion over another variant that is present in the normal and tumor). Reads are colored by their orientation, variant examined is outlined by two black vertical lines. Reads are sorted by base pair. Bases and reads are vary in the saturation of color based on their quality. Reference sequence is also snap-shot-ed.

I used the data for **1,413** non-silent variants (variants affecting proteins) from a handful of tumor-normal pairs (70% was used for training, 30% was used for testing, employing stratified sampling). IGV snapshots, similar to the ones shown in the figure above, were generated. I labeled the data as true or false after looking at the snapshots (**1,010—true**, **403—false**, initial **false positive rate is 28%**).

Here are the 17 lines of code to train a deep learning network that uses transfer learning and achieves **93% accuracy.** This classifier greatly **reduces the false positive rate down to 4% at the expense of calling 3% of true variants false.**

Splunk and Tensorflow for Security: Catching the Fraudster with Behavior Biometrics



envision

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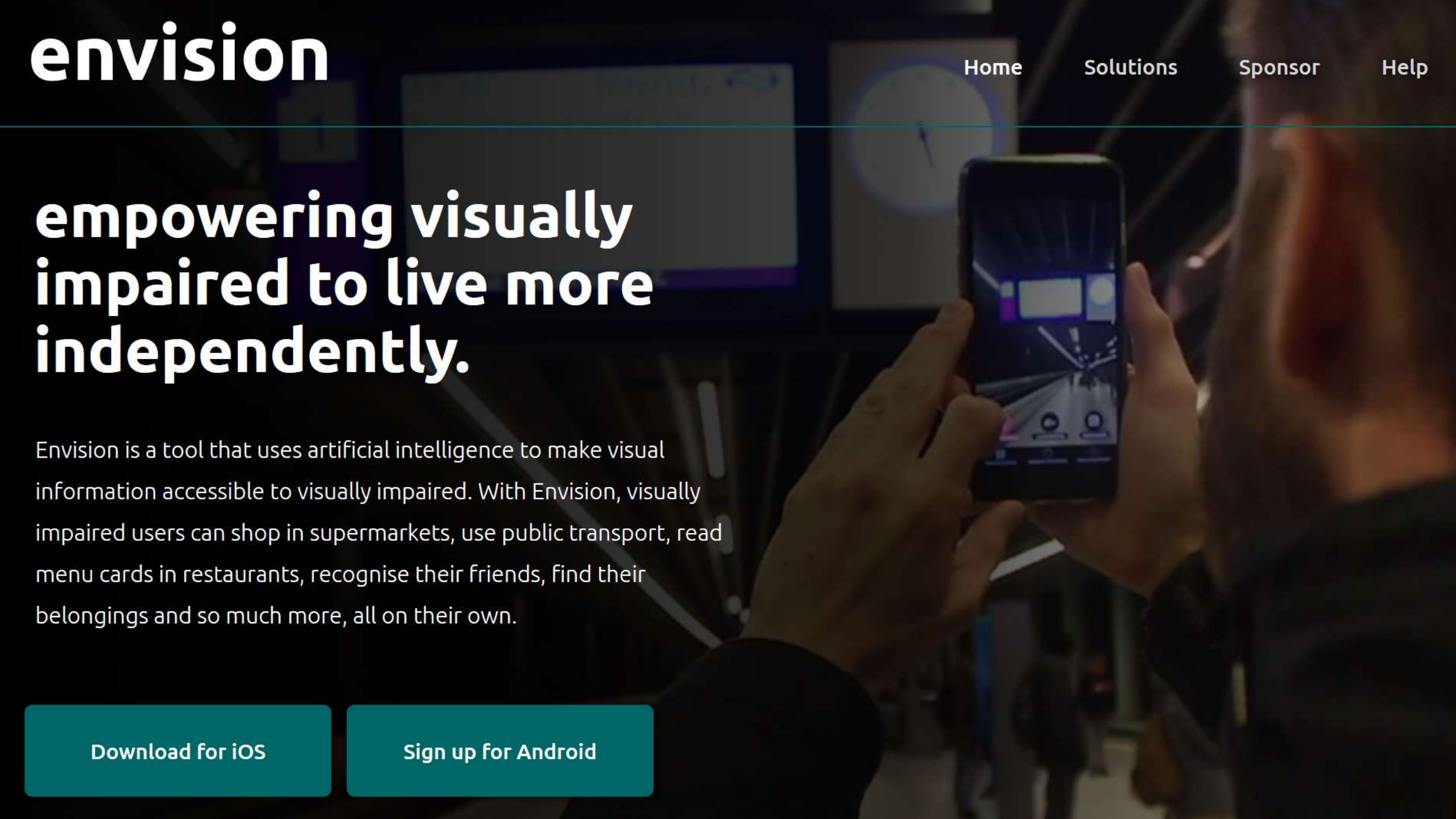
empowering visually impaired to live more independently.

Envision is a tool that uses artificial intelligence to make visual information accessible to visually impaired. With Envision, visually impaired users can shop in supermarkets, use public transport, read menu cards in restaurants, recognise their friends, find their belongings and so much more, all on their own.



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Category	Topics	Latest
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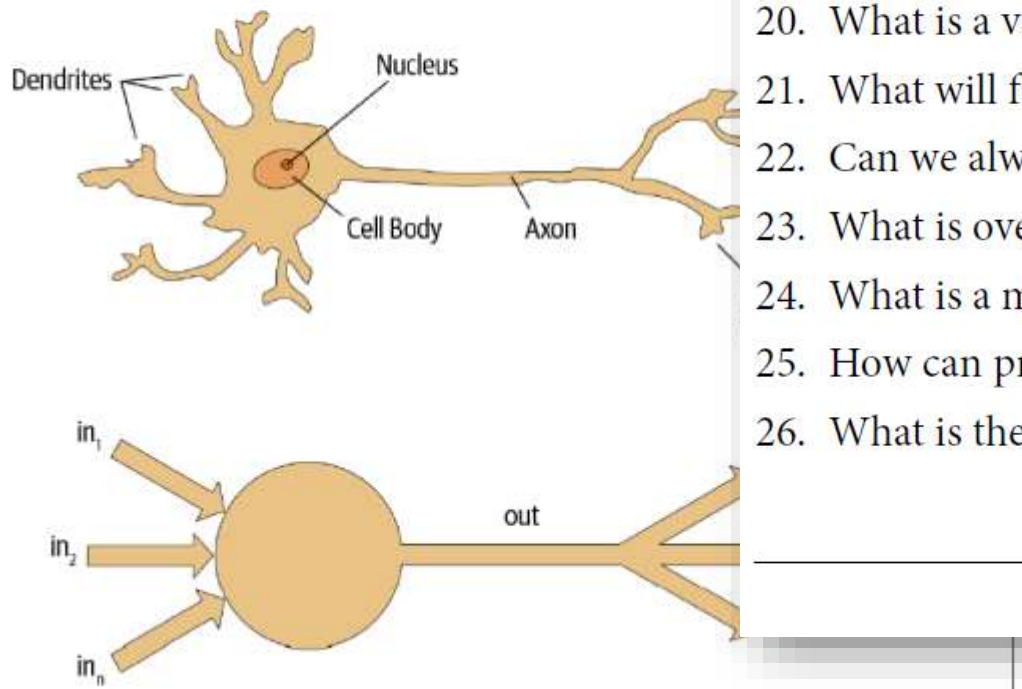
		General course chat Part 1 2022 16 · 5h
Part 1 2022 You can use this category to discuss the Part 1 (2022) Deep Learning course, whether attending through the University of Queensland, or as a fast.ai International Fellow.	10	Introduce yourself here ✅ Part 1 2022 100 · 7h
		Welcome to the 2022 fast.ai course! Part 1 2022 20 · 8h
Part 2 (2019) Welcome to part 2 (2019)! Please ensure that you've completed part 1 (2019) before the first lesson. If you haven't looked at the course for a while, I'd strongly suggest reviewing the lessons, since we'll be diving deep right from the first day of the course!	582 38 unread	Setup help ✅ Part 1 2022 17 · 10h

Neural Networks: A Brief History

In 1943 Warren McCulloch, a neurophysiologist, and Walter Pitts, a logician, teamed up to develop a mathematical model of an artificial neuron. In their paper "A Logical Calculus of the Ideas Immanent in Nervous Activity," they declared the following:

> Because of the "all-or-none" character of nervous activity, neural events and the relations among them can be treated by means of propositional logic. It is found that the behavior of every net can be described in these terms.

McCulloch and Pitts realized that a simplified model of a real neuron could be represented using simple addition and thresholding, as shown in Figure 1-1. Pitts was self-taught, and by age 12, had received an offer to study at Cambridge University with the great Bertrand Russell. He did not take up this invitation, and indeed throughout his life did not accept any offers of advanced degrees or positions of authority. Most of his famous work was done while he was homeless. Despite his
recognized position and increasing social isolation, his work w
influential and was taken up by a psychologist named Frank Rose



18. Do we always have to use 224×224-pixel images with the cat recognition model?
19. What is the difference between classification and regression?
20. What is a validation set? What is a test set? Why do we need them?
21. What will fastai do if you don't provide a validation set?
22. Can we always use a random sample for a validation set? Why or why not?
23. What is overfitting? Provide an example.
24. What is a metric? How does it differ from loss?
25. How can pretrained models help?
26. What is the "head" of a model?