Hottest Real-World Applications of Deep Learning

Mohammad Shokoohi-Yekta

AIXperience, Tehran 2022


CREATED WITH
AVATARIFY APP

Soon, we will be ashamed of telling our kids: we used to drive cars and we had to visit doctors to get monitored!

Outlines

What's up Deep Learning?

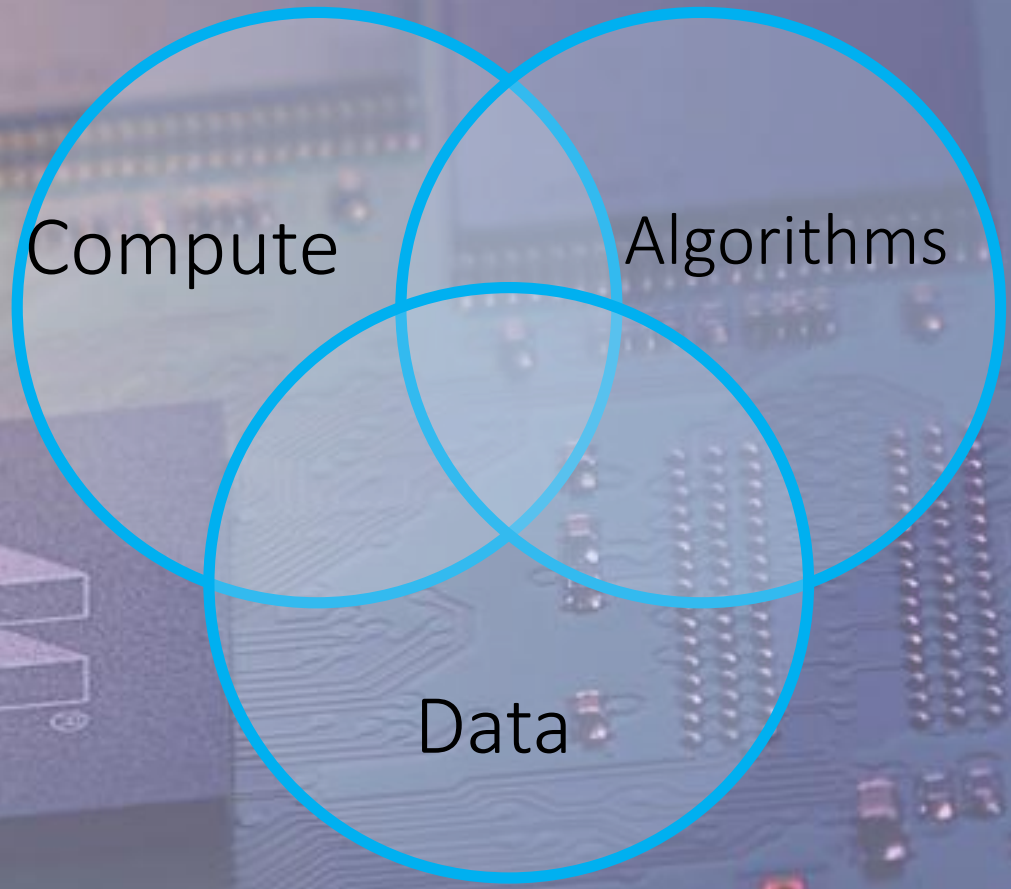
Deep Learning & Saving Lives

Deep Learning in Industry

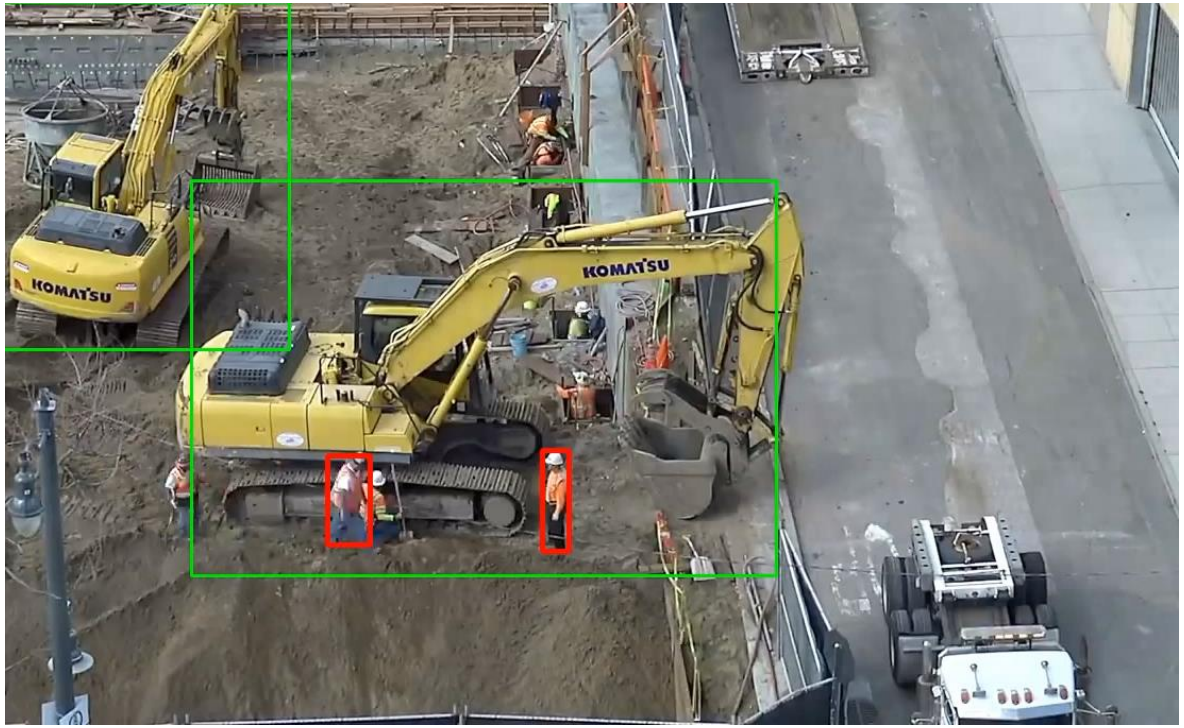
Next Trends & Challenges of Deep Learning

Industrial Takeaways

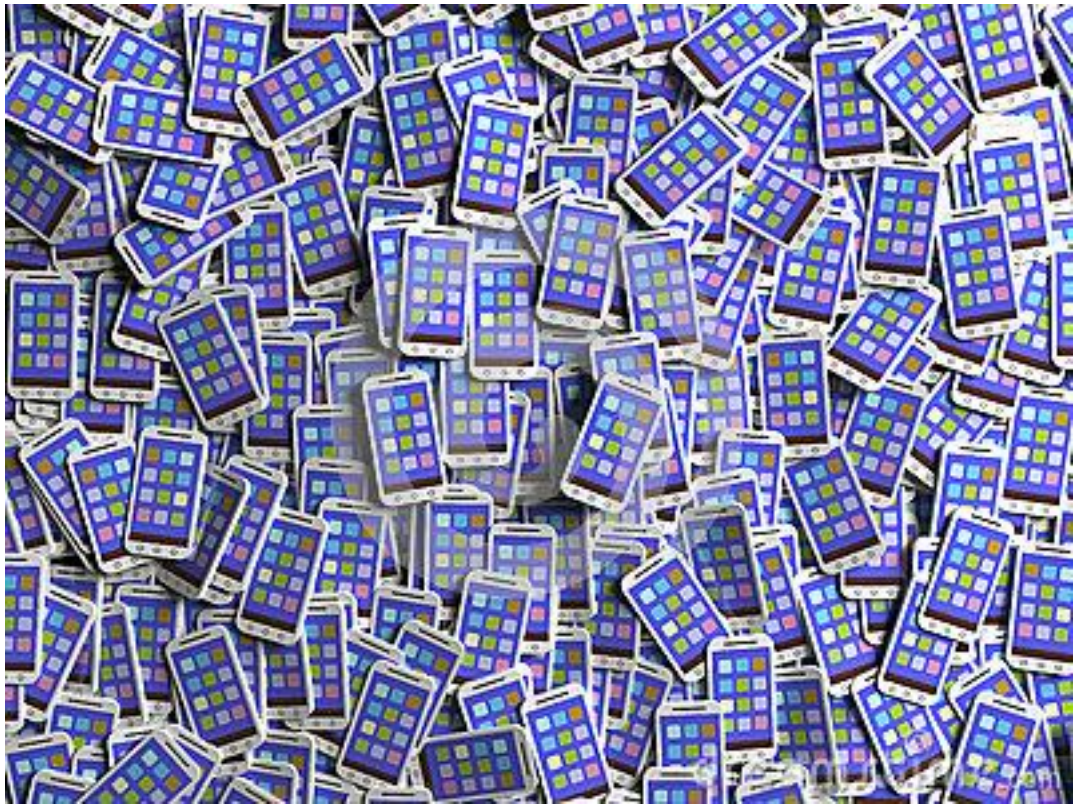
Trinity of Deep Learning



Safety Monitoring Applications of Deep Learning



Where Does Big Data Come From?



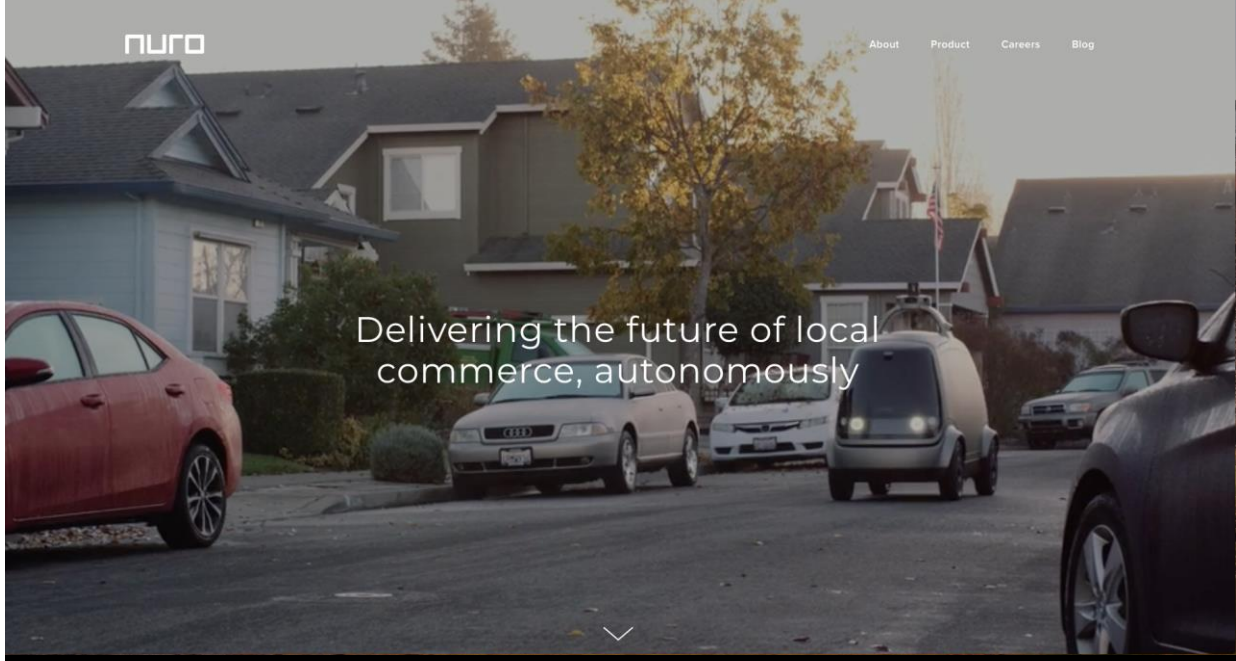
1 Autonomous Car = 2666 Internet Users

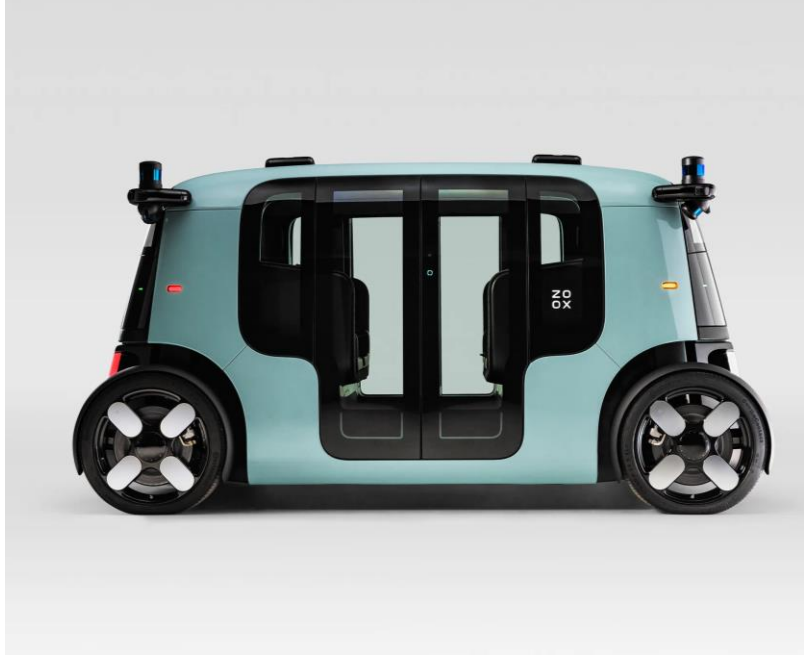
■ June 11, 2018, 4:00 AM PDT

Nuro's Driverless Cars Don't Have to Worry About Passenger Safety

● Delivering pizzas instead of people, this robot could make on-demand orders profitable.

By Mark Bergen




ZOOX


WAYMO


nuro

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Who Saves More Lives, Deep Learning or Doctors?

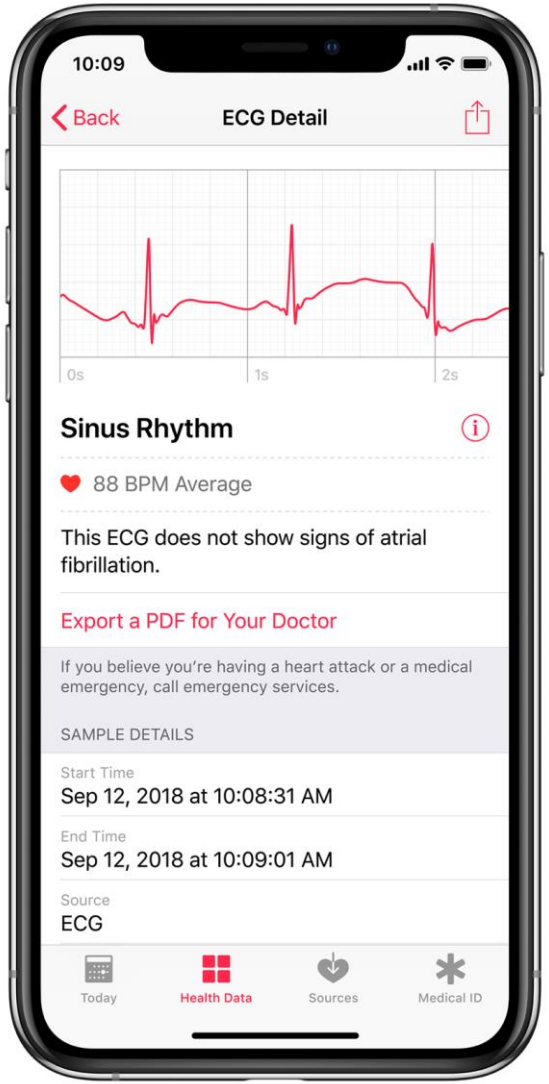
Prediction in Sensors Data

More than 1.2 million people die each year in car accidents!
Short term prediction can save many lives before an accident actually happens!

- M. Shokoohi-Yekta, et al. Discovery of Meaningful Rules in Time Series, SIGKDD 2015.
- Z. Yuan, et al. Hetero-ConvLSTM: A Deep Learning Approach to Traffic Accident Prediction on Heterogeneous Spatio-Tem, SIGKDD 2018.

We need to make our human bodies interesting … People know more about the air in their tires than about their blood pressure or sugar levels

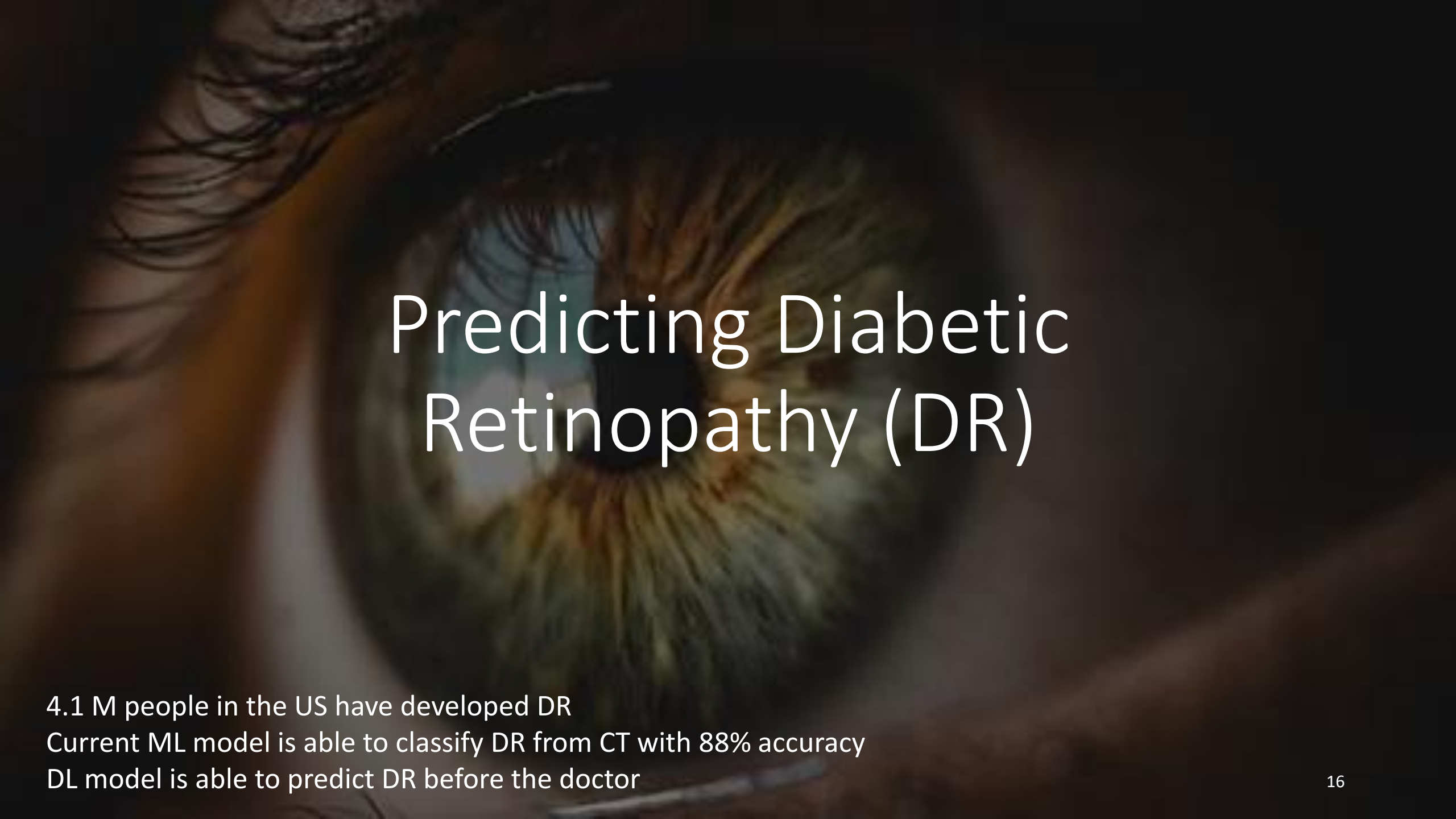
Bernard Tyson
CEO, Kaiser Permanente. *1959 - 2019*


10:09
Back
ECG Detail
0s
1s
2s
Sinus Rhythm
88 BPM Average
This ECG does not show signs of atrial fibrillation.
Export a PDF for Your Doctor
If you believe you're having a heart attack or a medical emergency, call emergency services.
SAMPLE DETAILS
Start Time
Sep 12, 2018 at 10:08:31 AM
End Time
Sep 12, 2018 at 10:09:01 AM
Source
ECG
Today
Health Data
Sources
Medical ID


Fall Safety 11:33 AM
MONITORING ON


dexcom
110


120
120
80
69



Predicting Diabetic Retinopathy (DR)

4.1 M people in the US have developed DR
Current ML model is able to classify DR from CT with 88% accuracy
DL model is able to predict DR before the doctor

Prevent Future Pandemics

Coming 2025

https://www.microsoft.com/en-us/research/project/project-premonition/

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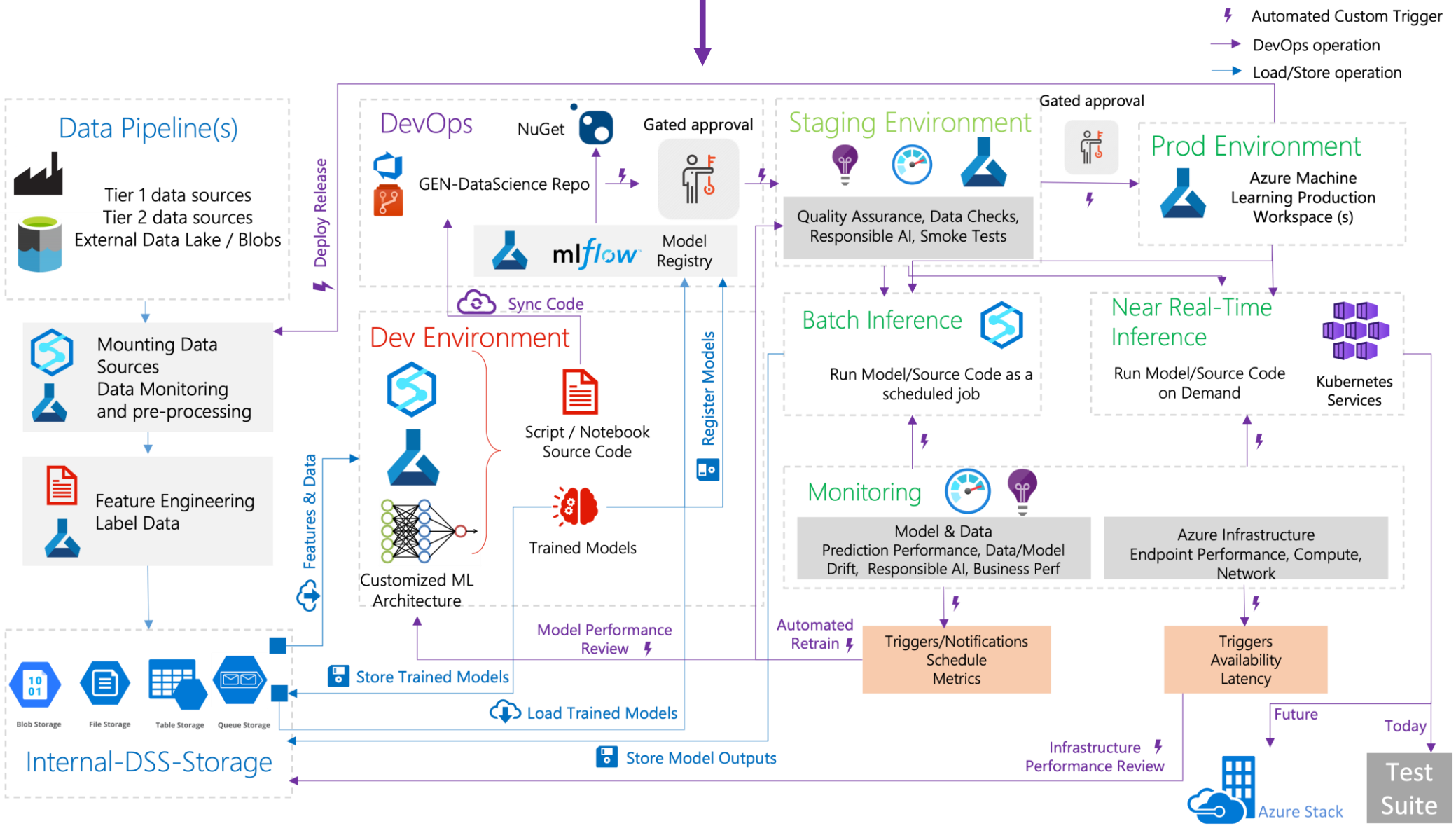
Industry vs Academia



Defining Computer Science

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Abstract

This paper explores the use and purpose of a definition of computer science from the perspective of an undergraduate student. In order to gain access to the topic, the nature and purpose of definitions are explored. Historical examples of computer science definitions are given. The paper concludes with an examination of how students define computer science and how we should use these definitions in computer science education.

1. Introduction

The debate over the definition of computer science is as old as our discipline itself. This paper tries to approach this subject from a point of view that has not been widely explored. Namely, what do our students think the definition of computer science is? The paper starts with an examination of the very nature of definitions.

2. Definitions

The first thing to remember when developing a definition is that definitions are a human invention. A definition is an arbitrary process that serves to include some cases and to exclude other cases [4]. In other words, a definition must not simply tell us what something is, it must also tell us what it is not. This dual function of a definition is difficult to achieve and there is often a struggle between a narrow definition and a broad definition. A narrow definition will be specific and make clear whether or not a case will be included in the concept. The problem with a narrow definition is that some legitimate cases of the concept may be excluded by the definition. On the other hand, a broad definition will include all relevant cases but might also include some concepts that are marginally legitimate at best.

An example of a narrow definition of computer science is one given by Edsger Dijkstra. In his definition, Dijkstra prefers to limit our discipline to an intellectual exercise. In 1967, he wrote "...the core challenge for computing science is hence a conceptual one: what (abstract) mechanisms we can conceive without getting lost in complexities of our own making." [3] The problem with Dijkstra's definition is that it ignores implementation issues. These issues are very important to many computer scientists.

A good example of a broad definition is the one given by Newell, Perlis, and Simon in 1967. Their definition simply states that "computer science is the study of computers." [8] While simple and elegant, this definition would include many cases that most people would not consider being computer science. The Computing Sciences Accreditation Board (CSAB) has tried to improve on this definition. CSAB defines computer science as "a discipline that involves the understanding and design of computers and computational processes." [1] However, this definition is also very broad and would allow many extraneous cases to fall within the umbrella of computer science.

Finally, an example that can be considered both narrow and broad is given by Long, et al. In their 1987 paper, they wrote that the central intellectual role of computer science is "the study and application of languages and methods for making precise and understandable descriptions of things." [7] It is narrow in the sense that it leaves out important computer science topics such as ethics in computing. It is broad in that it allows almost any topic from science to be included. What is science if not an attempt to use methods to make precise and understandable descriptions?

In addition to the function of a definition, there are many types of definitions. Some of the more common types are symbolization, similarity, spatial relations, temporal relations, and causation. *Symbolization* is when an object is defined by physically pointing to an example of the concept. If you are trying to define "apple" and you point to an apple, you are symbolically defining the term "apple." *Similarity* is when a concept is defined by examining similarities among objects. If you are trying to define "red" you might point to a red shirt, a red car, and a red house. When you use relations (spatial, temporal, or causation) you describe a concept by its relation to other concepts.

In an interim report from the ACM/IEEE-CS Curriculum 2001 task force, computer science is defined as "an integrated field of study that draws its foundations from mathematics, science, and engineering." [9] This is an example of a relational definition. It assumes that one can define mathematics, science and engineering and it implies that whenever these three disciplines intersect you have computer science. Another problem with this relational def-

Reviewed Papers

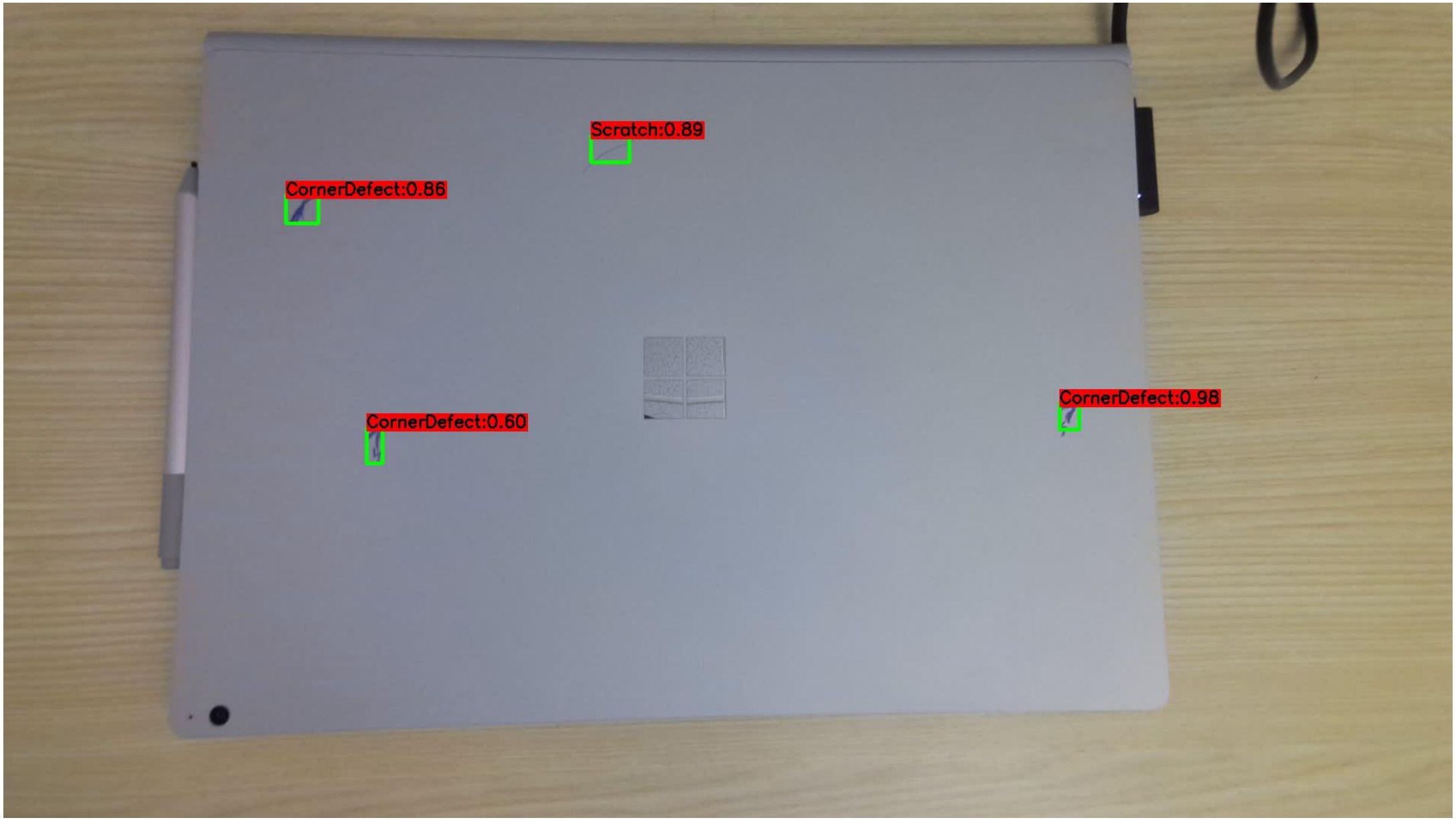
SIGCSE Bulletin — 74 — June 2000 Vol 32 No. 2

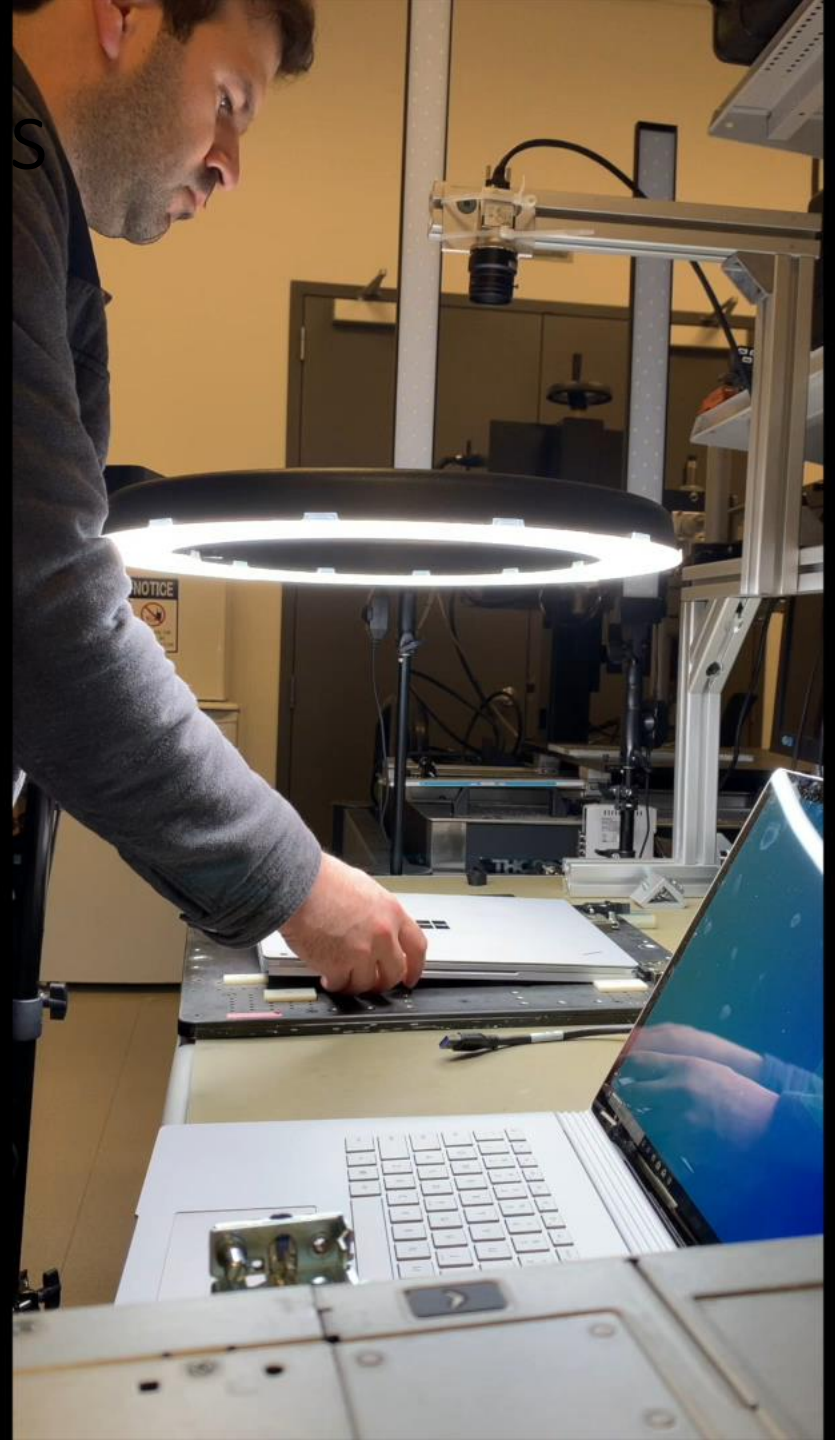
Automatic Optical Inspection

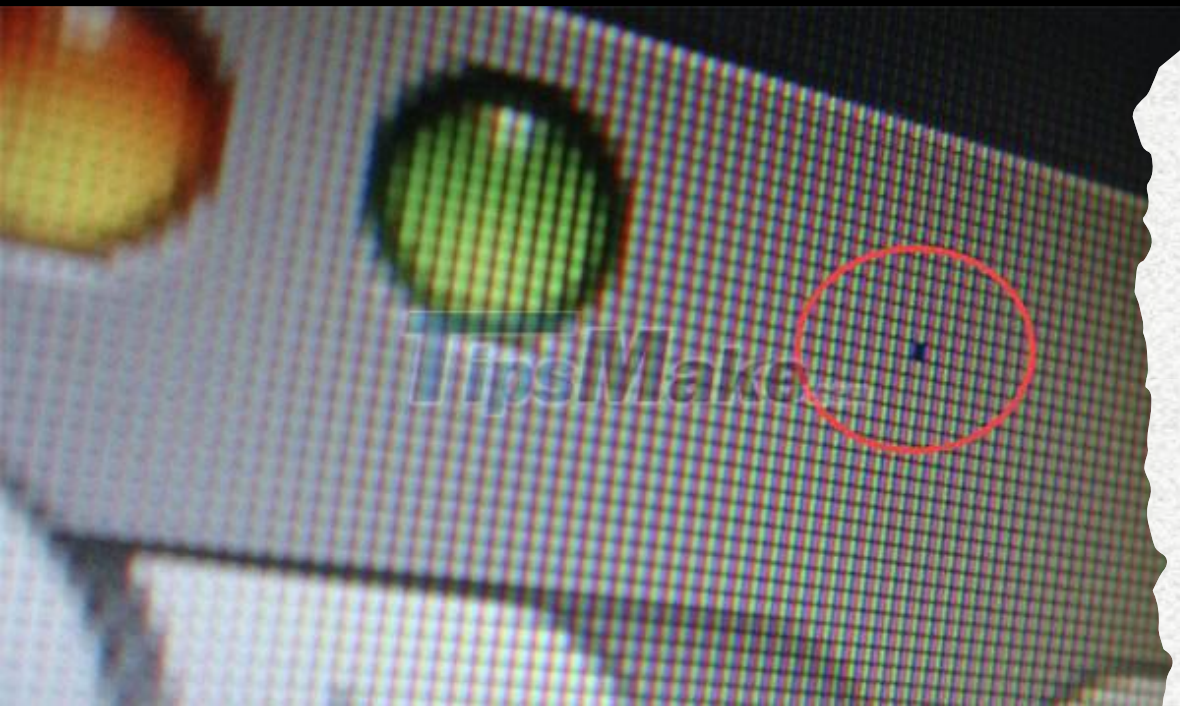
You Only ~~Live~~ Look Once

- more than 1000x faster than R-CNN
- 100x faster than Fast R-CNN

First AOI Demo




NOTICE



Automated Display Testing

- Inspect 12 different display defects
- A manual process done by 7 operators in a black tent
- Combination of DL and CV algorithms
- Resistance from partners
- Data Collection mode
- Turning point
- Running in production for the past year

Highlights

- ✓ Fully internal solution
- ✓ Uses state-of-the-art algorithms
- ✓ Models learn over time and become smarter
- ✓ Conveys the factory of the future

0%
Escapes

40%
Improved accuracy

90%
Reusability

12
CTXs covered

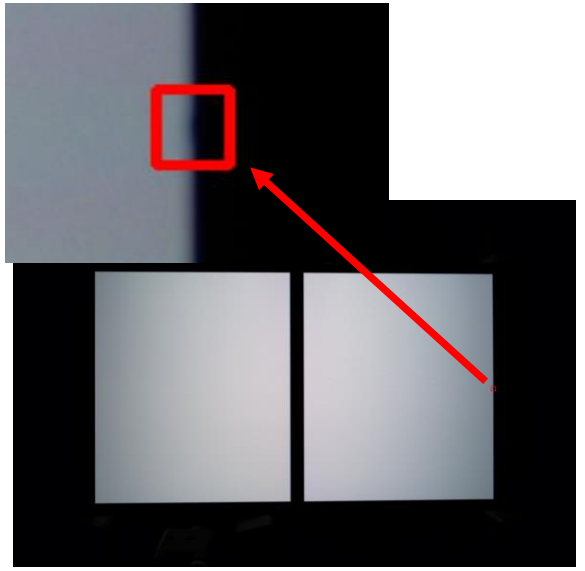
55%
Test Time Reduction

2M
Images Captured & Analyzed

5
Programs onboarded ADT

Future Testing Solution

Automated Display Testing (ADT)



Cosmetic AOI

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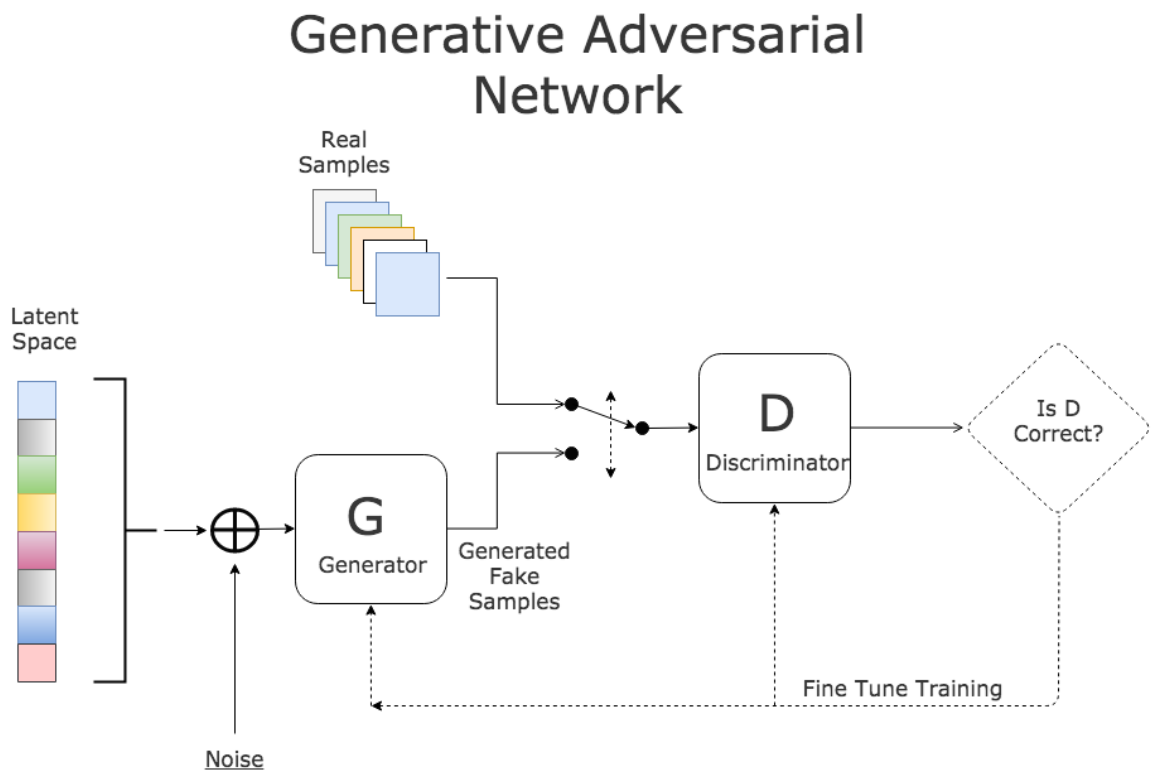


What are GANs?

- Deep learning GANs is one the biggest breakthrough technologies of 2018, as per MIT Technology Review's annual list of top 10 tech

GANs Rapidly Evolving

Deepfakes

10 YEARS AGO

Produced by studios

Dozens to
hundreds of hours

TODAY

Produced by *anyone*,
with widely-available
AI-based tools

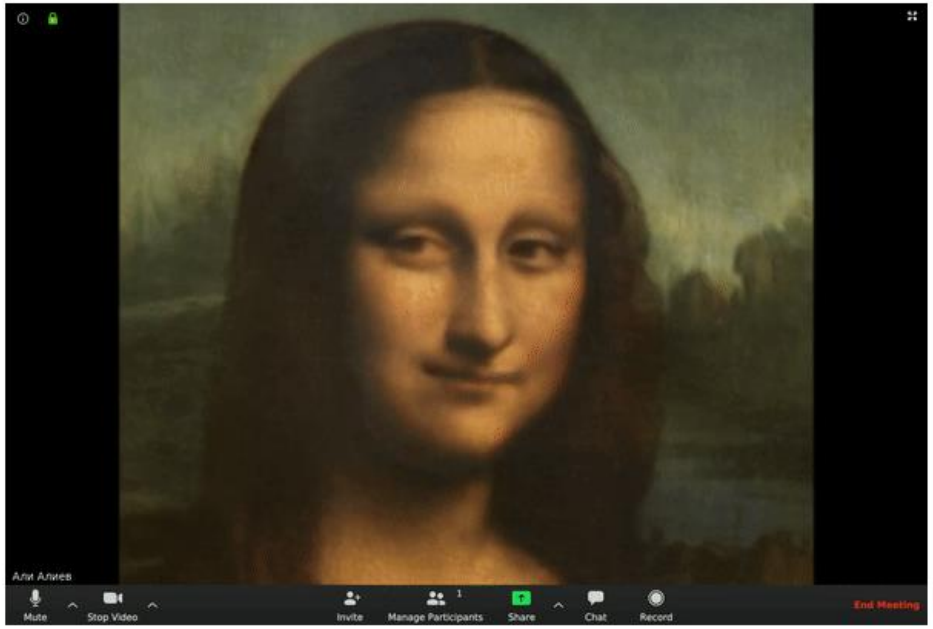
Minutes

Avatarify

vatarify

run_windows.bat remove cam opt

README.md



Open in Colab

slack join

Demo

AI-generated Elon Musk

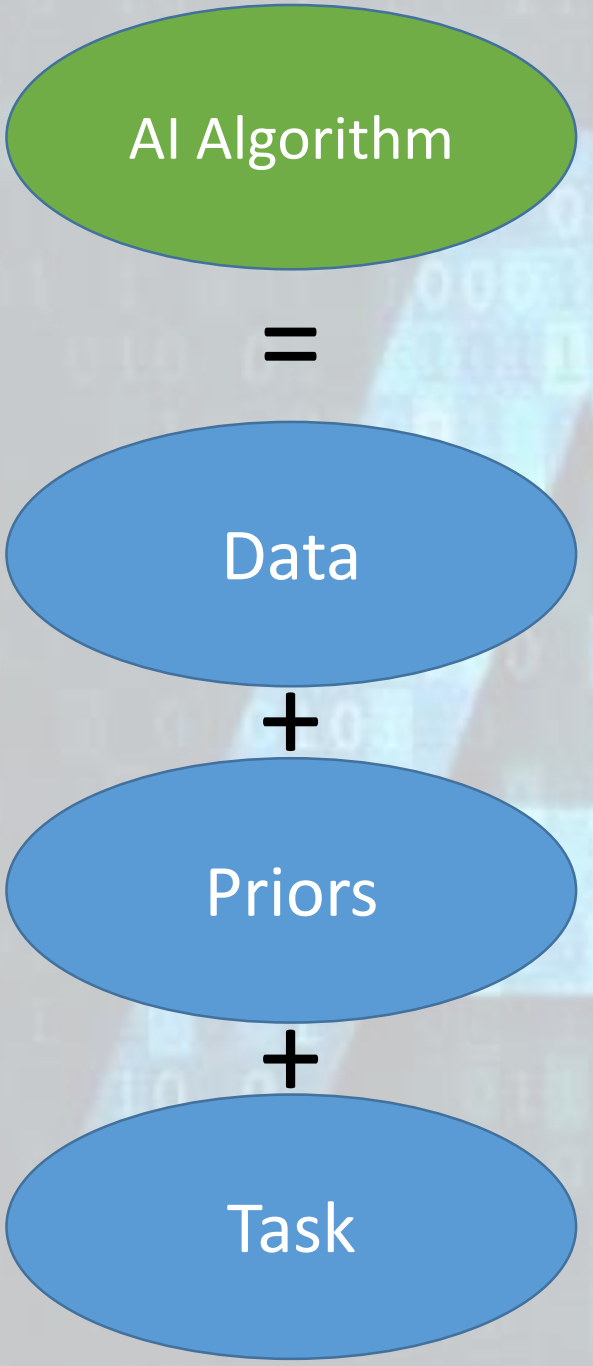
Avatarify

Photorealistic avatars for video-conferencing apps. Democratized.

Based on First Order Motion Model.

Created by: GitHub community.

Next Frontier in DL



Unsupervised: Concept Learning, Disentanglement Learning

Robust: Recurrent Feedback, Uncertainty Quantification

Adaptive: Multi Task & Domains, Life-Long Learning

* Slide adopted from Anima Anandkumar's talk

Ultimate of AI

- Learning with Limited Supervision
- Disentanglement Learning
- Concept Discovery
- Task Inference
- Learning to Compose
- Robustness to Noise

* Slide adopted from Anima Anandkumar's talk

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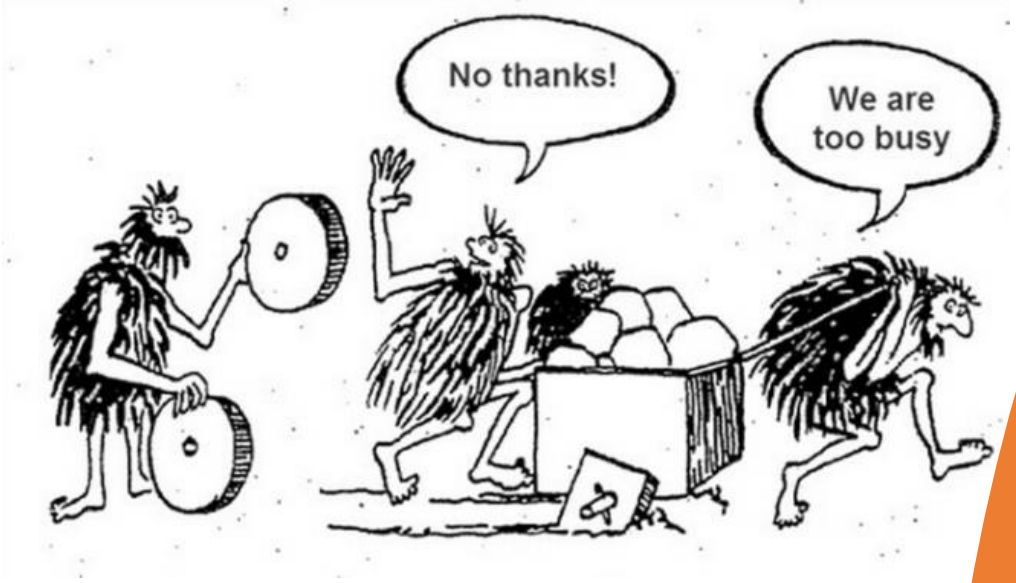
If you run in to Y challenges during the POC (Proof of Concept) phase, expect at least 10 x Y challenges in production/deployment

- Models throwing exceptions
- Growing failure rates over time
- Fine-tuning models over time
- Data collection for fine-tuning
- Educating manufacturing people on the m
- …



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Takeaways

- Try to avoid Deep Learning, if ML is an option
- The future of Deep Learning is unsupervised
- Disentanglement Learning is the next trend
- Academia and industry are VERY two different worlds
- Take advantage of all the great open source tools out there, don’t re-invent the wheel.

شكراً ,Obrigado, Tack , Thanks, متشكرم,
Gracias, Bedankt, धन्यवाद, σας
ευχαριστώ,谢谢, dziękuję

What the caterpillar calls the end of the world, the master calls a butterfly.

- Richard Bach