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# Introduction to Deep Learning

— Tuan Nguyen - AI4E —

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# Introduction

- Tuan <https://nttuan8.com/>, founder: AI For Everyone (AI4E).
- The author of deep learning series, GAN series.
- The author of e-book deep learning,  
<https://nttuan8.com/sach-deep-learning-co-ban/>
- Deep learning, python teachers.

# Outline

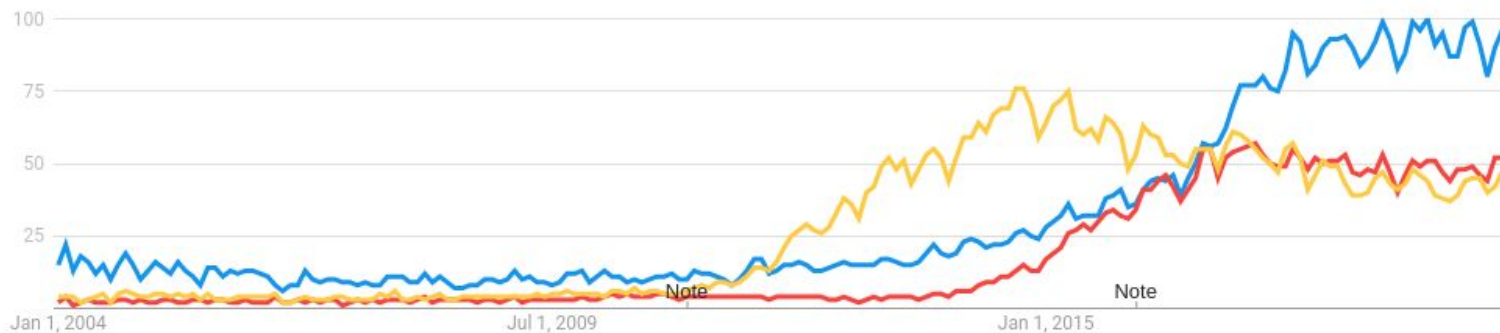
- What is Machine Learning?
- Types of Machine Learning
- Deep Learning
- Machine Learning vs Deep Learning
- Deep Learning history
- Why Deep Learning now?
- Deep Learning Framework
- Keras is awesome

# Machine Learning trends

● machine learning  
Search term

● IoT  
Search term

● Big data  
Search term



# What is Machine Learning?

The acquisition of knowledge or skills through experience, study, or by being taught



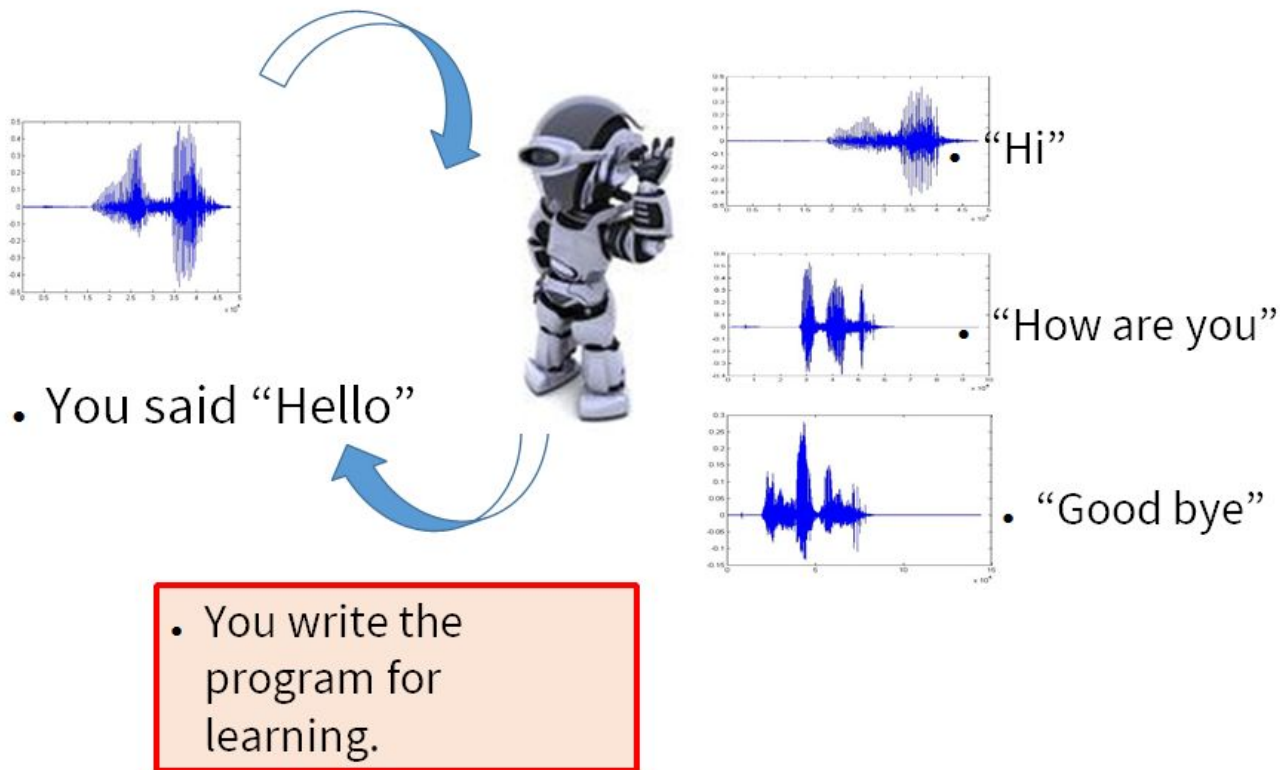
# What is Machine Learning?



# What is Machine Learning?

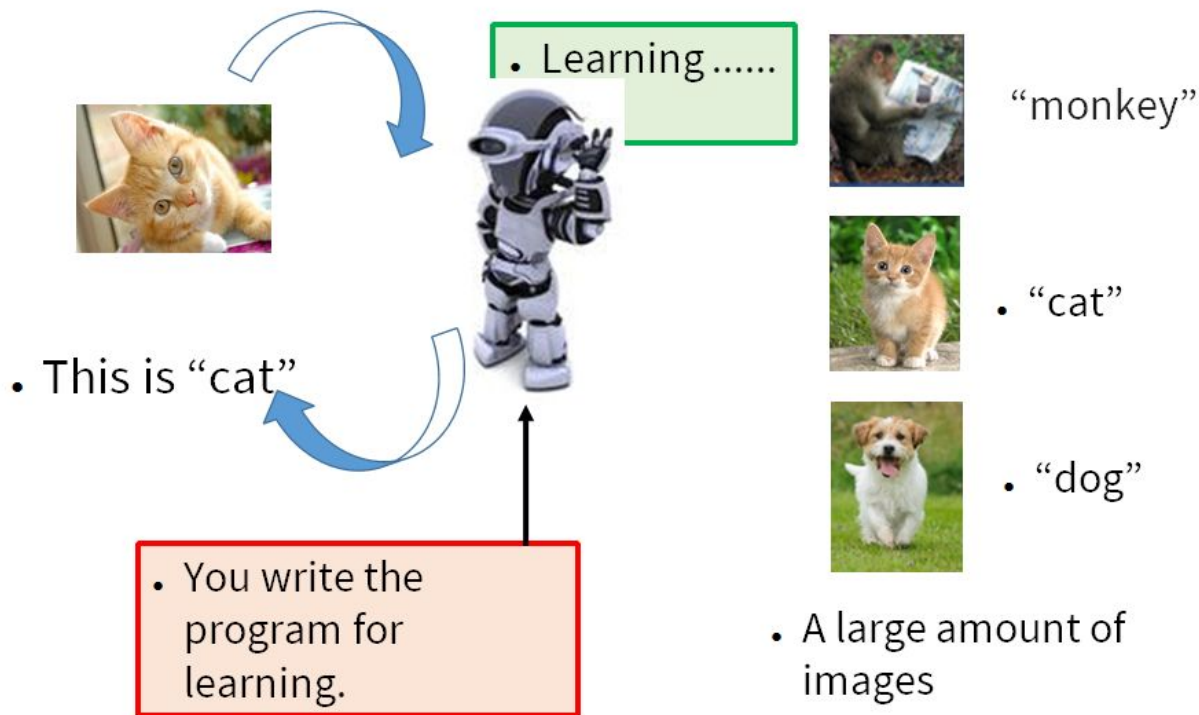
- [Arthur Samuel, 1959] Field of study that gives computers the ability to learn without being explicitly programmed
- [Kevin Murphy] algorithms that automatically detect patterns in data use the uncovered patterns to predict future data or other outcomes of interest
- [Tom Mitchell] algorithms that improve their performance (P) at some task (T) with experience (E)

# What is Machine Learning?



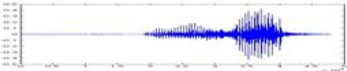


# What is Machine Learning



# Machine Learning $\approx$ Looking for a Function


- Speech Recognition

$$f(\text{  }) = \text{"How are you"}$$

- Image Recognition

$$f(\text{  }) = \text{"Cat"}$$

- Playing Go

$$f(\text{  }) = \text{"5-5"}_{\text{(next move)}}$$

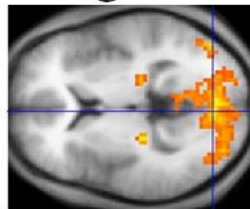
- Dialogue System

$$f(\text{ "Hi" }) = \text{ "Hello" }$$

(what the user said)      (system response)

# Machine Learning in Action


## Decoding thoughts from brain scans



• Rob a bank ...

[Home](#) » [Health & Wellness](#)

### Brain Scans: Are You a Criminal?

Published February 07, 2007 by:  
 [Andrea Okrentowich](#)  
[View Profile](#) | [Follow](#) | [Add to Favorites](#)

Adjust font-size: [+](#) [-](#)

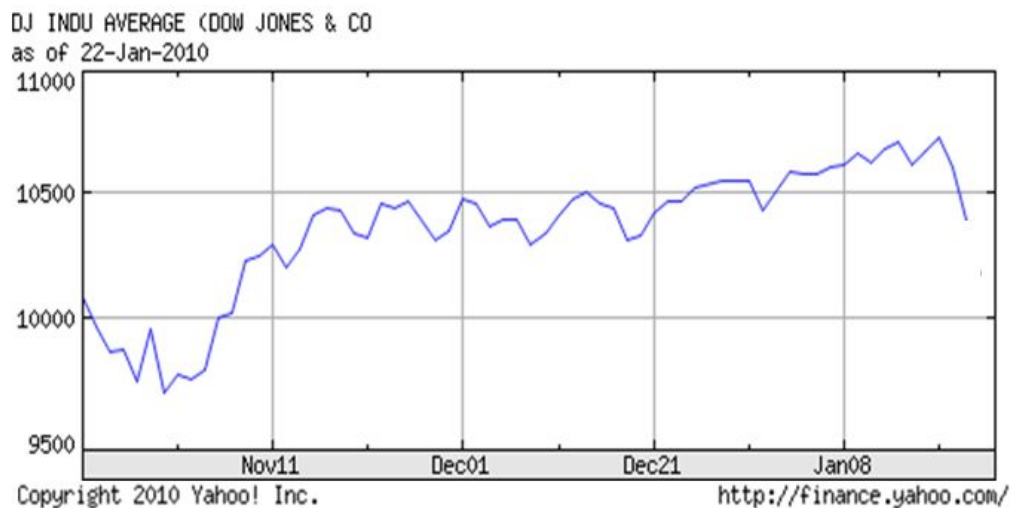
**More:** [Brain Scans](#) | [Brain Scan](#) | [Disposition](#) | [Defendant](#) | [Criminal Behavior](#)

#### MRI Scans as Courtroom Evidence

The average Joe's MRI scan can show a brain abnormality, do we proceed to check him into the nearest mental institution or prison? That would make about as much sense as trying to prove a defendant innocent of a violent ...

# Machine Learning in Action

## Stock Market Prediction



# Machine Learning in Action

Document classification



Sports  
Science  
News

# Machine Learning in Action

## Spam filtering

### Welcome to New Media Installation: Art that Learns

☆ Carlos Guestrin to 10615-announce, Osman, Miche [show details](#) 3:15 PM (8 hours ago) [↩ Reply](#) ▼

Hi everyone,

Welcome to New Media Installation:Art that Learns

The class will start tomorrow.

\*\*\*Make sure you attend the first class, even if you are on the Wait List.\*\*\*

The classes are held in Doherty Hall C316, and will be Tue, Thu 01:30-4:20 PM.

By now, you should be subscribed to our course mailing list: [10615-announce@cs.cmu.edu](mailto:10615-announce@cs.cmu.edu).

You can contact the instructors by emailing: [10615-instructors@cs.cmu.edu](mailto:10615-instructors@cs.cmu.edu)

**Natural \_LoseWeight SuperFood Endorsed by Oprah Winfrey, Free Trial 1 bottle, pay only \$5.95 for shipping mfw rlk** [Spam](#) | [X](#)

☆ Jaquelyn Halley to nherlein, bcc: thehorney, bcc: ang [show details](#) 9:52 PM (1 hour ago) [↩ Reply](#) ▼

=== Natural WeightLOSS Solution ===

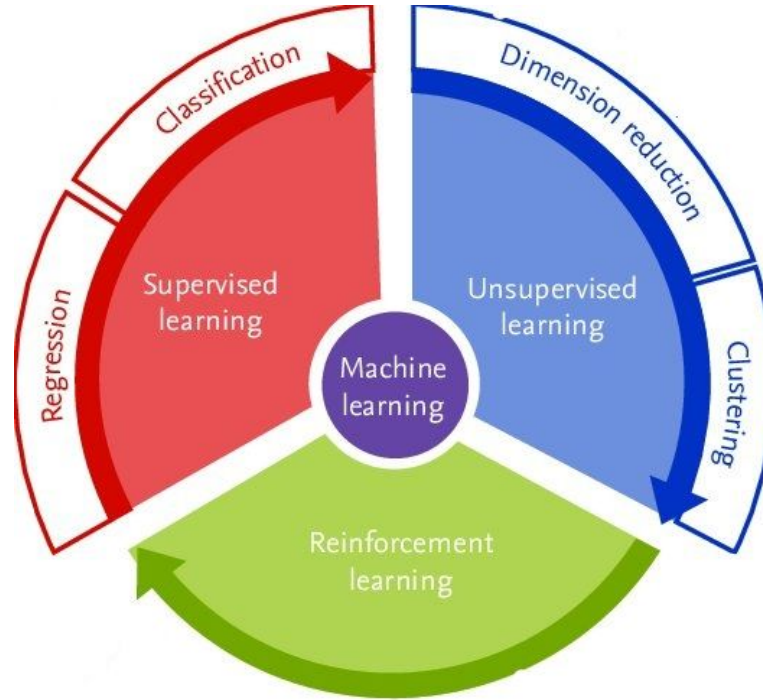
Vital Acai is a natural WeightLOSS product that Enables people to lose wieght and cleansing their bodies faster than most other products on the market.

Here are some of the benefits of Vital Acai that You might not be aware of. These benefits have helped people who have been using Vital Acai daily to Achieve goals and reach new heights in there dieting that they never thought they could.

- \* Rapid WeightLOSS
- \* Increased metabolism - BurnFat & calories easily!
- \* Better Mood and Attitude

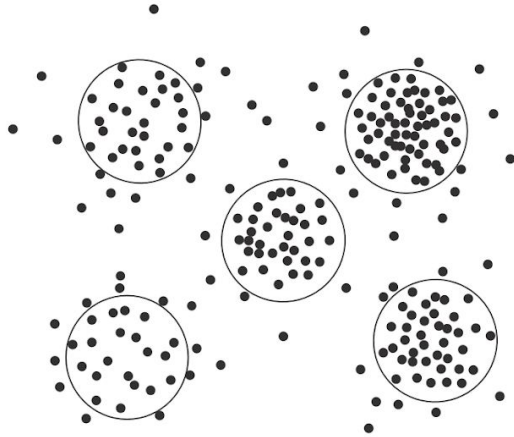
Spam/  
Not spam

# Types of Machine Learning

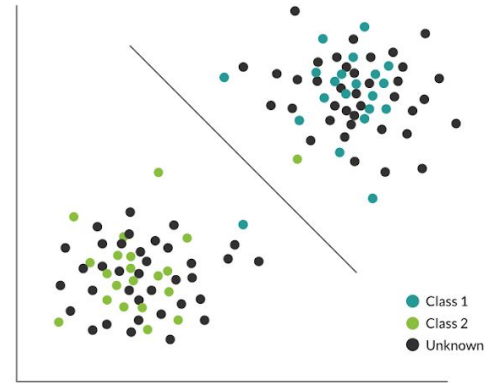


# Supervised vs Unsupervised Learning

Unsupervised



Supervised





# Supervised Learning

Feature Space  $\mathcal{X}$

Words in a document



Label Space  $\mathcal{Y}$

“Sports”  
“News”  
“Science”  
...



Share Price  
“\$ 24.50”



**Task:** Given  $X \in \mathcal{X}$ , predict  $Y \in \mathcal{Y}$ .

# Supervised Learning - Classification

Feature Space  $\mathcal{X}$

Words in a document



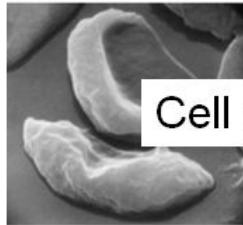
Label Space  $\mathcal{Y}$

“Sports”

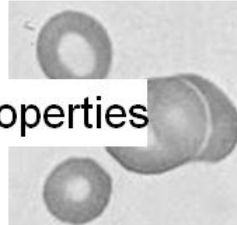
“News”

“Science”

...



Cell properties



“Anemic cell”

“Healthy cell”



Discrete Labels

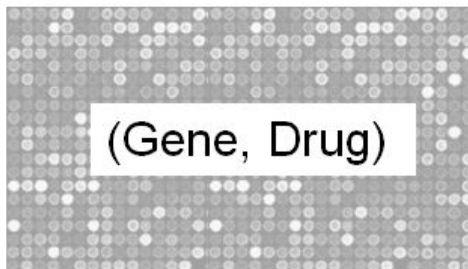
# Supervised Learning - Regression

Feature Space  $\mathcal{X}$

Label Space  $\mathcal{Y}$



Share Price  
"\$ 24.50"

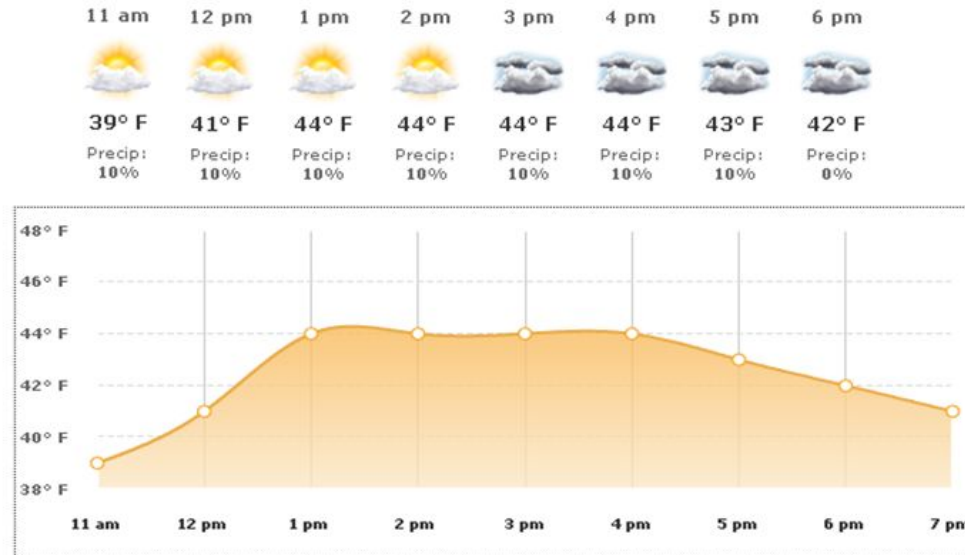


Expression level  
"0.01"

Continuous Labels

# Supervised Learning problems

Features?   Labels?   Classification/Regression?



**Temperature/Weather prediction**

# Supervised Learning problems

Features?   Labels?   Classification/Regression?



**Environmental Mapping**

# Unsupervised Learning

Aka “learning without a teacher”

Feature Space  $\mathcal{X}$



Words in a document



Word distribution  
(Probability of a word)

**Task:** Given  $X \in \mathcal{X}$ , learn  $f(X)$ .

# Unsupervised Learning – clustering web search

The screenshot shows the Clusty web search interface. At the top, there's a navigation bar with links for web, news, images, wikipedia, blogs, jobs, and more. The search bar contains the word "race". Below the search bar, there's a section titled "Cluster Human contains 8 documents." On the left side, there's a sidebar with a list of clusters. The "Human" cluster is selected, showing a list of sub-topics: "Classification Of Human", "Statement, Evolved", and "Other Topics". The main content area displays a list of search results for the term "race".

web news images wikipedia blogs jobs more »

Clusty

race Search advanced preferences

clusters sources sites

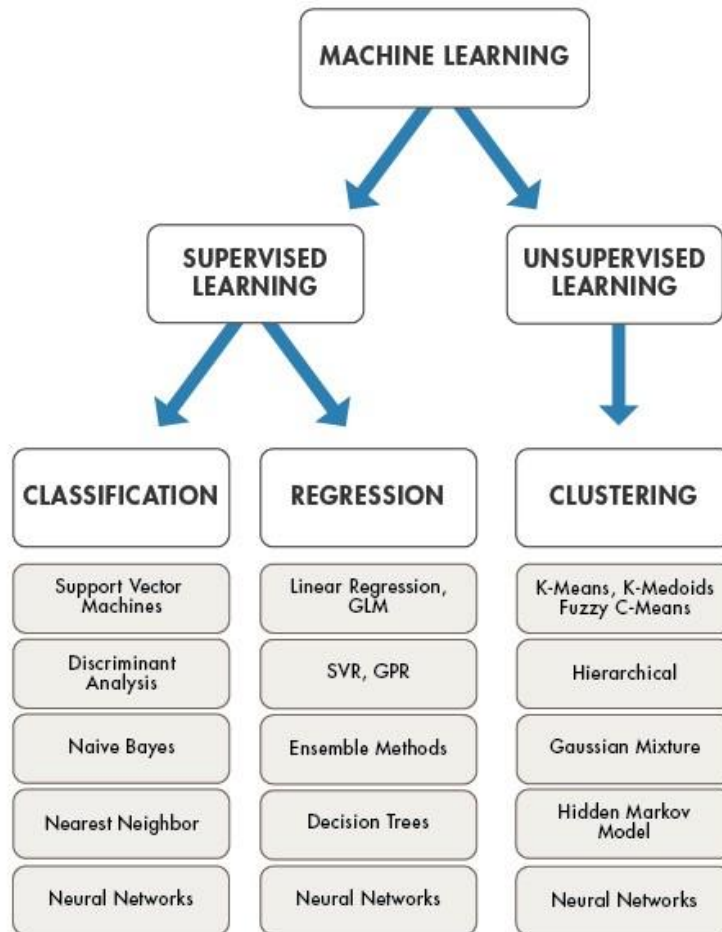
All Results (238) remix

- Car (28)
  - Race cars (7)
  - Photos, Races Scheduled (5)
  - Game (4)
  - Track (3)
  - Nascar (2)
  - Equipment And Safety (2)
  - Other Topics (7)
- Photos (22)
- Game (14)
- Definition (13)
- Team (18)
- Human (8)**
  - Classification Of Human (2)
  - Statement, Evolved (2)
  - Other Topics (4)
- Weekend (8)
- Ethnicity And Race (7)
- Race for the Cure (8)

Cluster Human contains 8 documents.

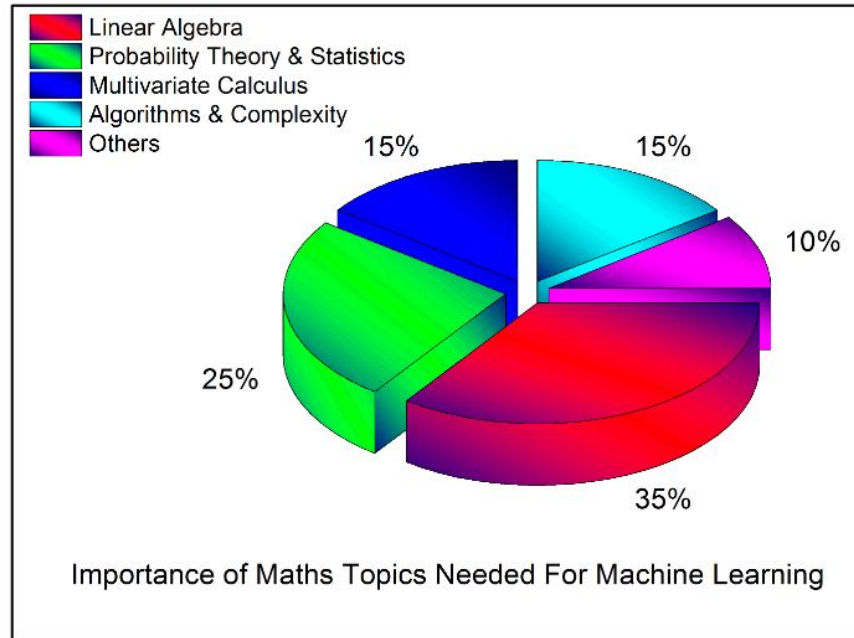
- [Race \(classification of human beings\) - Wikipedia, the free ...](#)  
The term **race** or racial group usually refers to the concept of dividing **humans** into populations or groups on the ba categories are based on visible traits (especially skin color, cranial or facial features and hair texture), and self-ident by culture and over time, and are often controversial for scientific as well as social and political reasons. History · Mx en.wikipedia.org/wiki/Race\_(classification\_of\_human\_beings) - [cache] - Live, Ask
- [Race - Wikipedia, the free encyclopedia](#)  
General. **Racing** competitions The **Race** (yachting **race**), or La course du millénaire, a no-rules round-the-world sai of **human beings**) **Race** and ethnicity in the United States Census, official definitions of "**race**" used by the US Cen genetics. Historical definitions of **race**; **Race** (bearing), the inner and outer rings of a rolling-element bearing. **RACE** Literature · Video games en.wikipedia.org/wiki/Race - [cache] - Live, Ask
- [Publications | Human Rights Watch](#)  
The use of torture, unlawful rendition, secret prisons, unfair trials, ... Risks to Migrants, Refugees, and Asylum Seek ... www.hrw.org/backgrounder/usa/race - [cache] - Ask
- [Amazon.com: Race: The Reality Of Human Differences: Vincent Sarich ...](#)  
Amazon.com: **Race: The Reality Of Human Differences: Vincent Sarich, Frank Miele: Books ...** From Publishers W www.amazon.com/Race-Reality-Differences-Vincent-Sarich/dp/0813340861 - [cache] - Live
- [AAPA Statement on Biological Aspects of Race](#)  
AAPA Statement on Biological Aspects of **Race** ... Published in the American Journal of Physical Anthropology, vol. evolution and variation, ... www.physanth.org/positions/race.html - [cache] - Ask
- [race: Definition from Answers.com](#)  
**race** n. A local geographic or global **human** population distinguished as a more or less distinct group by genetically www.answers.com/topic/race-1 - [cache] - Live

# ML Algorithms

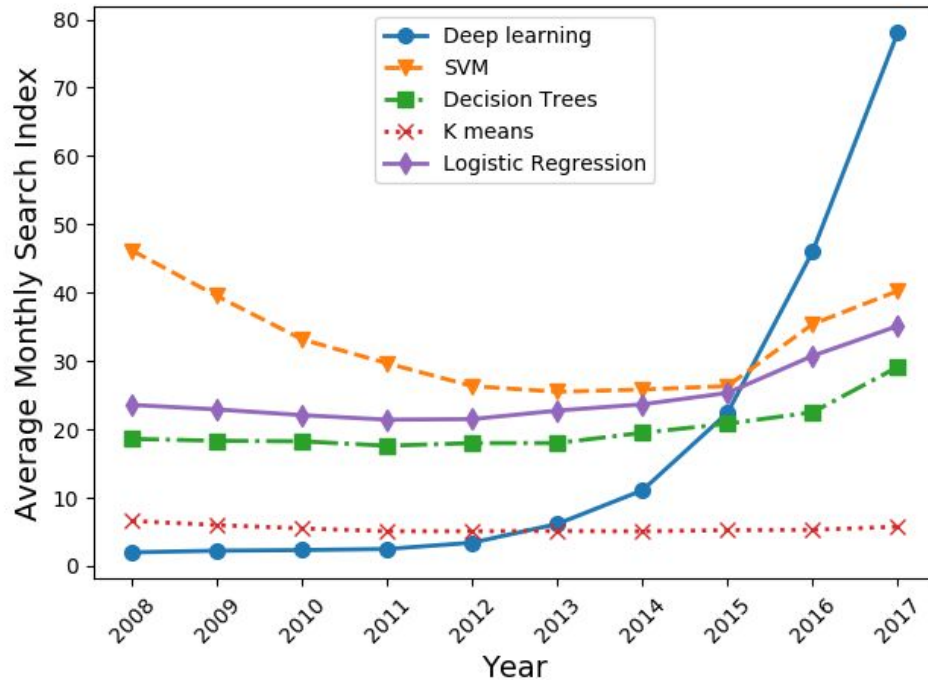




# Math for Machine Learning



# Google trends



# Hype or reality?



I have worked all my life in Machine Learning, and I've never seen one algorithm knock over benchmarks like Deep Learning

– Andrew Ng (Stanford & Baidu)



Deep Learning is an algorithm which has no theoretical limitations of what it can learn; the more data you give and the more computational time you provide, the better it is

– Geoffrey Hinton (Google)



Human-level artificial intelligence has the potential to help humanity thrive more than any invention that has come before it

– Dileep George  
(Co-Founder Vicarious)

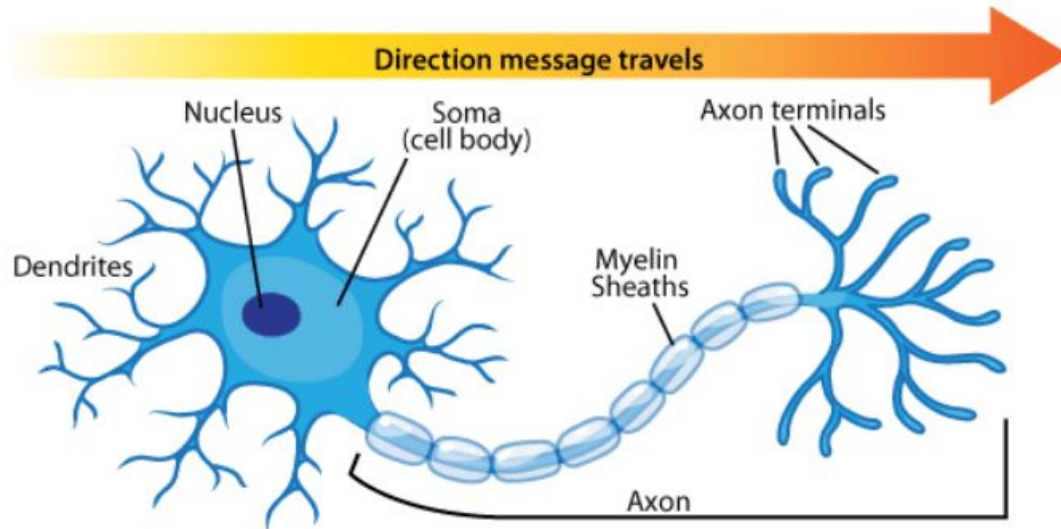


For a very long time it will be a complementary tool that human scientists and human experts can use to help them with the things that humans are not naturally good at

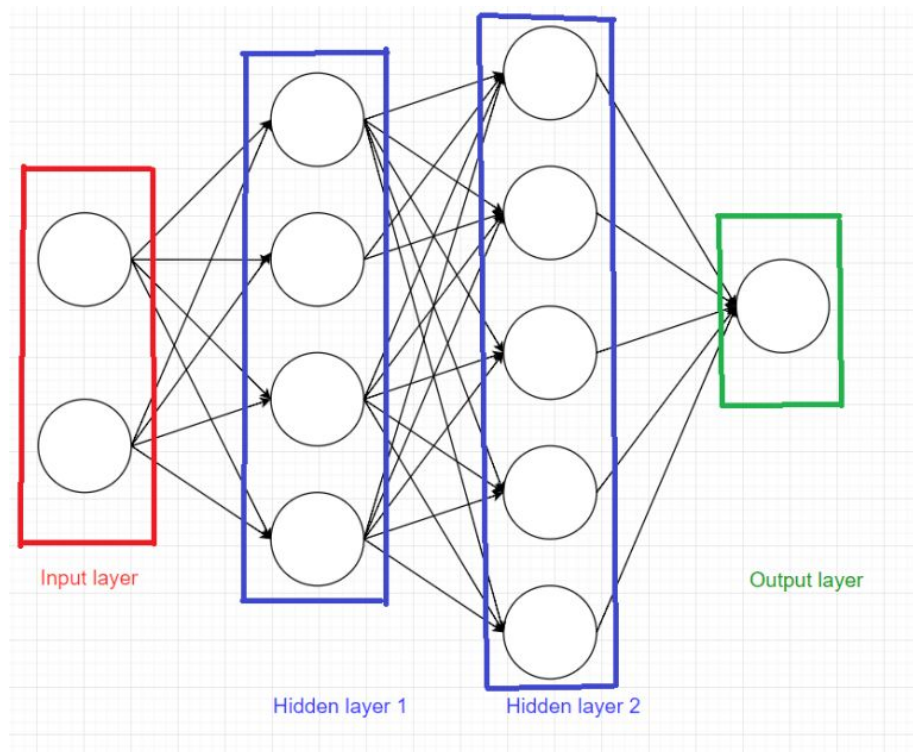
– Demis Hassabis (Co-Founder DeepMind)

# Brain

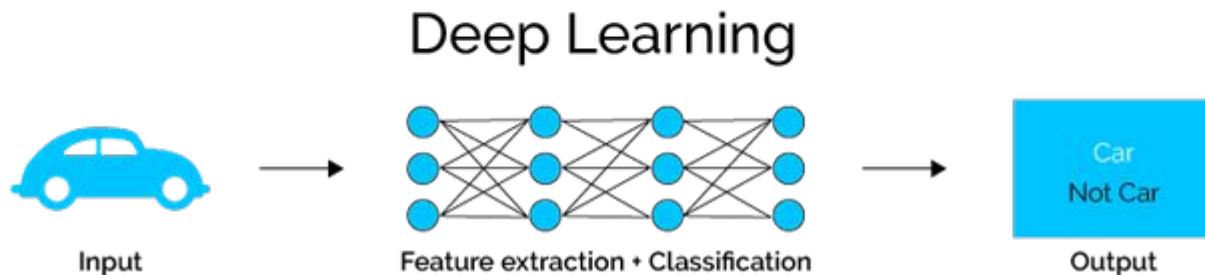
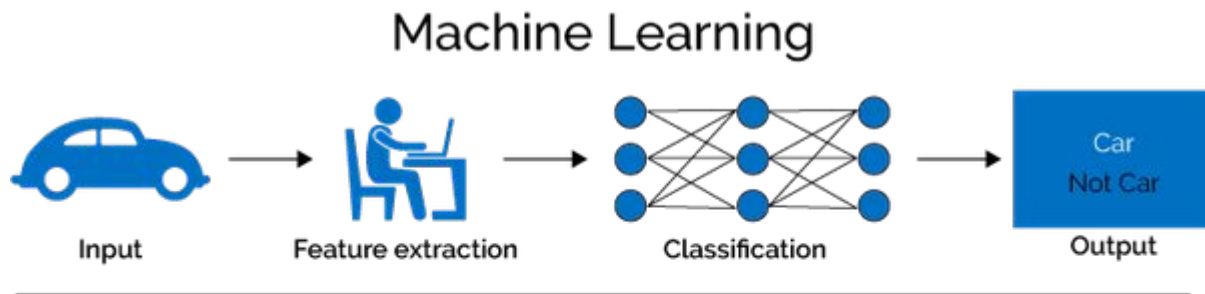
## Neuron Anatomy



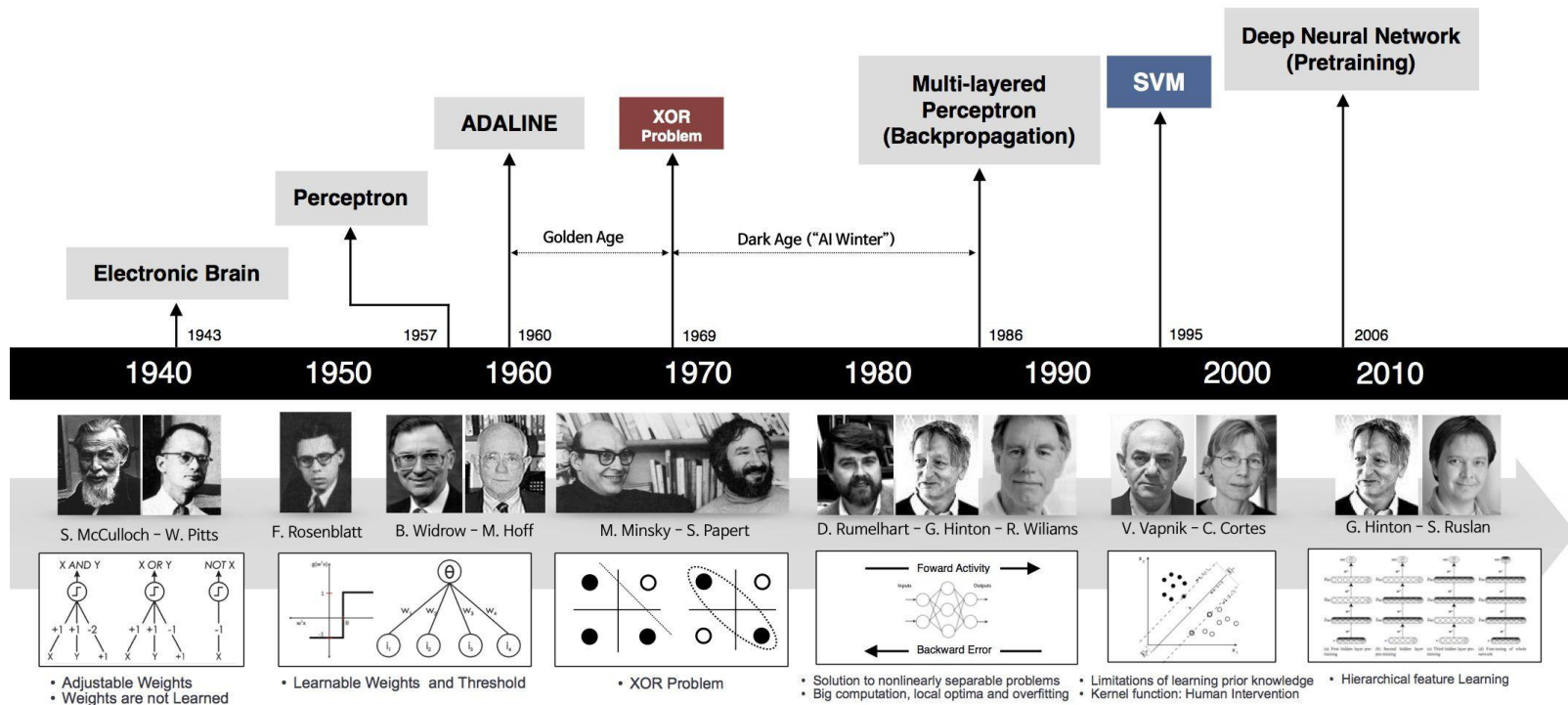
# Neural Network



# Machine Learning vs Deep Learning



# A long history



# ImageNet Challenge





# Why deep learning?

## Why is Deep Learning Hot **Now**?

### Big Data Availability

**facebook**

350 millions  
images uploaded  
per day

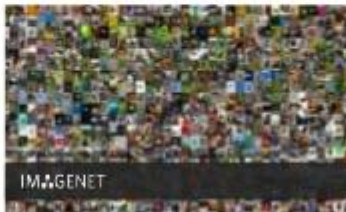
**Walmart** ✱

2.5 Petabytes of  
customer data  
hourly

**You Tube**

300 hours of video  
uploaded every  
minute

### New ML Techniques



### GPU Acceleration



# Data

## Eric Schmidt: Every 2 Days We Create As Much Information As We Did Up To 2003

MG Siegler

Aug 4, 2010

Like 1K

Buzz 522

Tweet 1,878

1

digg

62 Comments



Today at the **Technomy** conference in Lake Tahoe, CA, the first panel featured Google CEO **Eric Schmidt**. As moderator David Kirkpatrick was introducing him, he rattled off a massive stat.

# Source of data?

## Web/Mobile

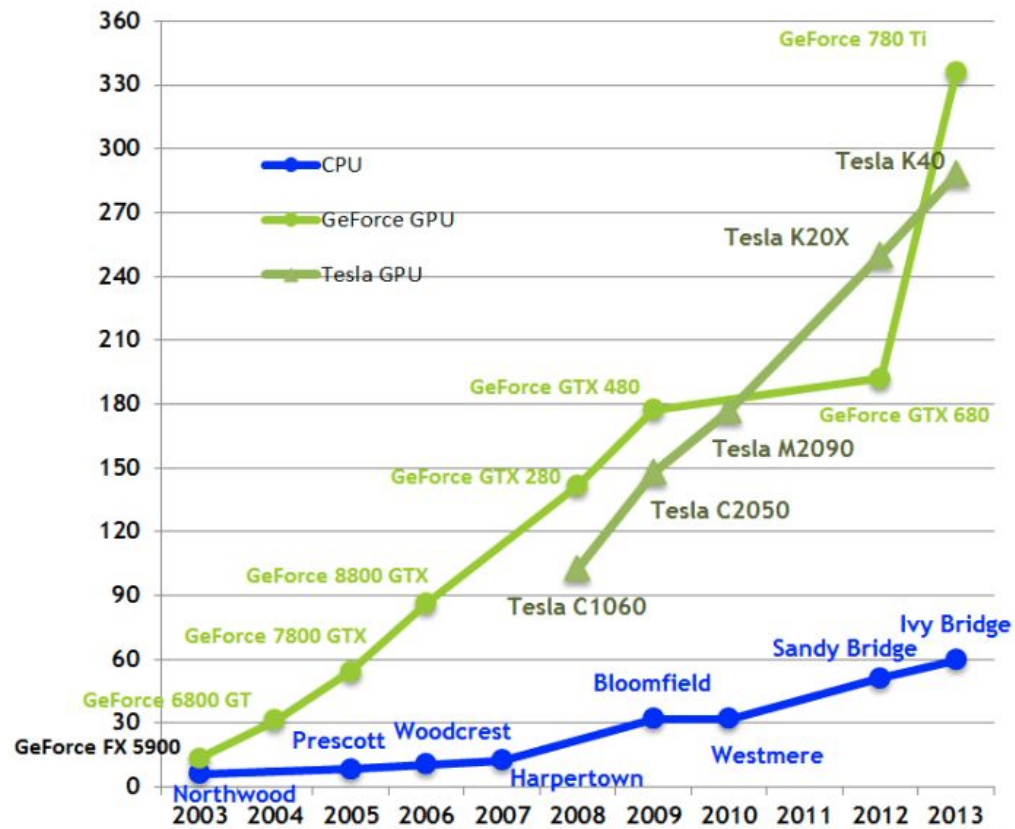


## IoT/M2M

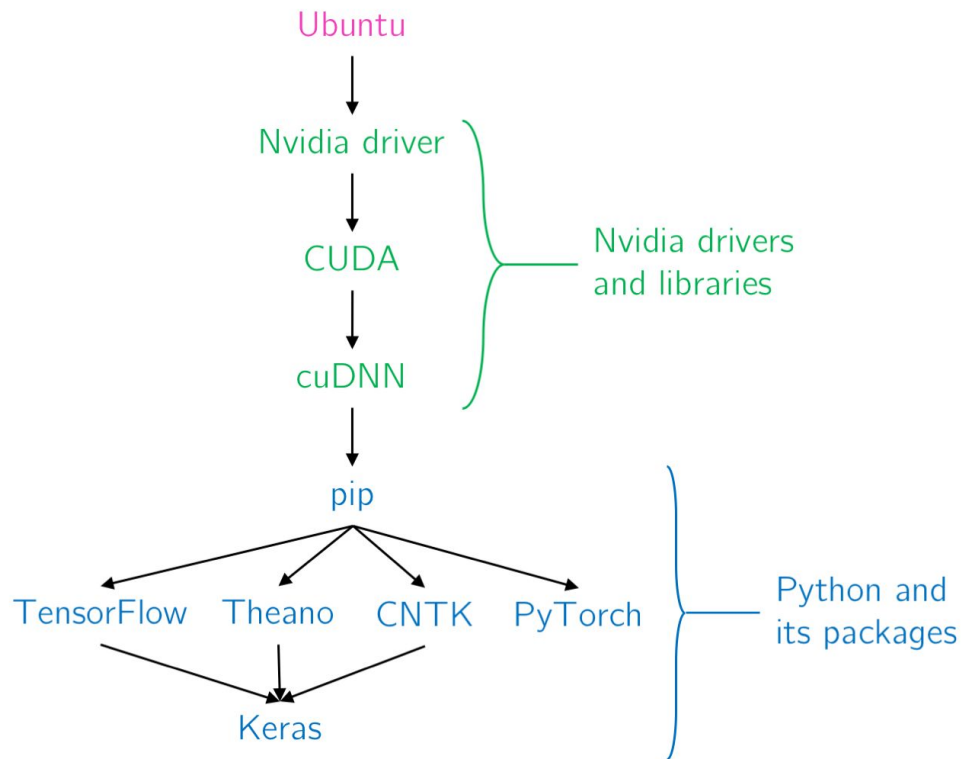


# GPU

Theoretical GB/s

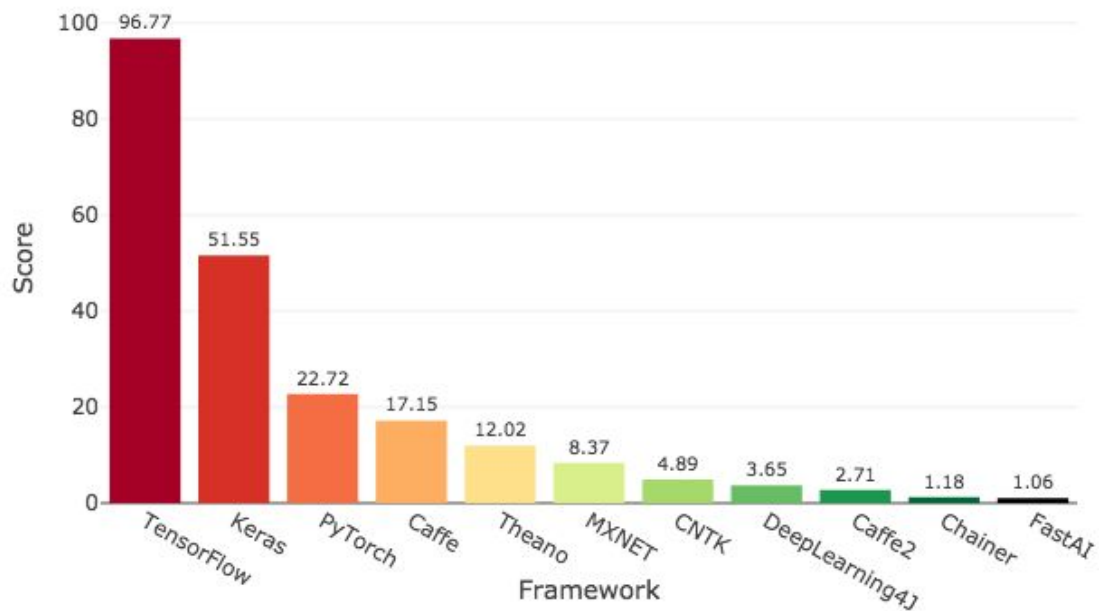


# Structure



# DL Framework

Deep Learning Framework Power Scores 2018



# Why Keras?

## Keras Overview

16/04/2017

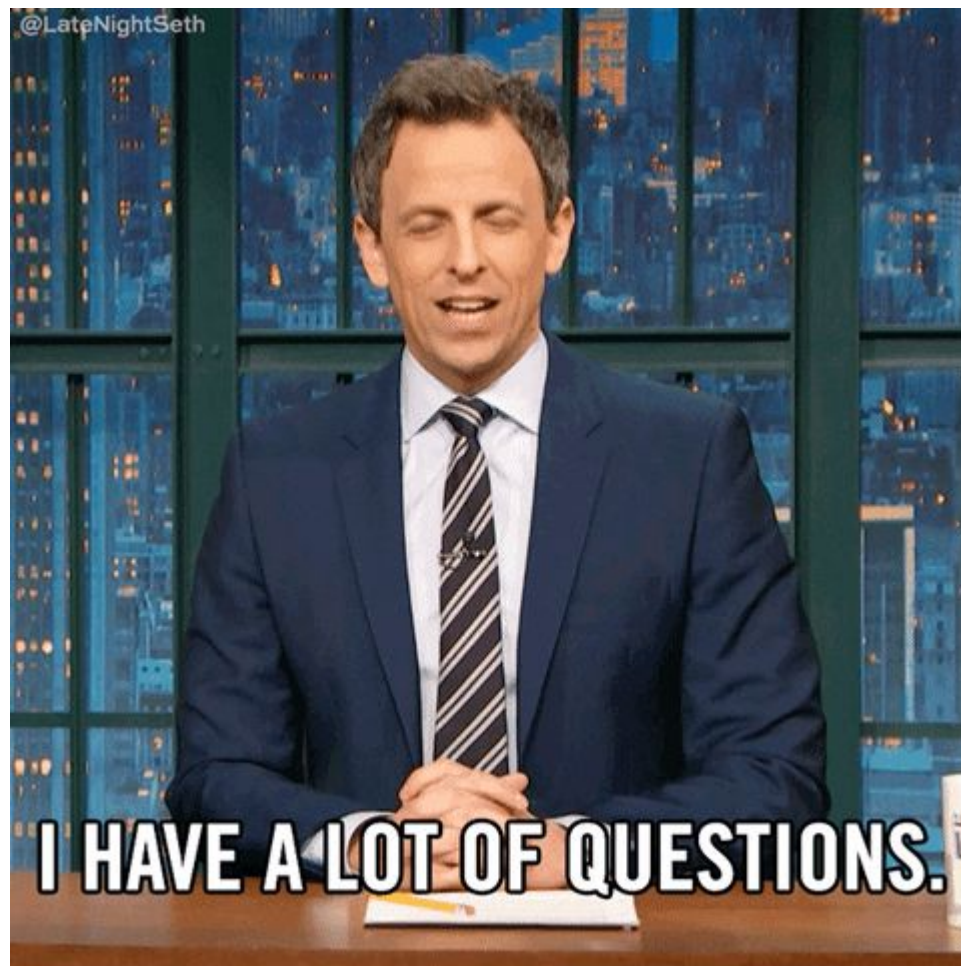
### What is Keras?

- Neural Network library written in python
- Design to be simple and straightforward
- Built on top of different deep learning libraries such as Tensorflow, Theano and CNTK

### Why Keras?

- Simple
- Highly modular
- Deep enough to build models

# Q&A





# The end

