From Data Analysis to Artificial Intelligence

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Universidad Politécnica de Madrid

The Data Revolution: Big Data

May 5, 2016 | 931 views

Big Data At Sprint: Turning Mobile Network Data Into Business Value

Thanks to its huge network of users, Sprint has access to vast amounts of user data. Three years ago it established subsidiary Pinsight Media to investigate ways of capitalizing on that data. Since then it has gone from serving zero to six billion ad impressions per months, based on “authenticated […]

Apr 19, 2016 | 20,645 views

How Big Data And Analytics Are Transforming The Construction Industry

Apr 22, 2016 | 14,793 views

How Big Data And Analytics Are Transforming Supply Chain Management

FEB 16, 2016 @ 02:54 AM 15,945 VIEWS

How Big Data Is Transforming Medicine

Apr 28, 2016 | 9,109 views

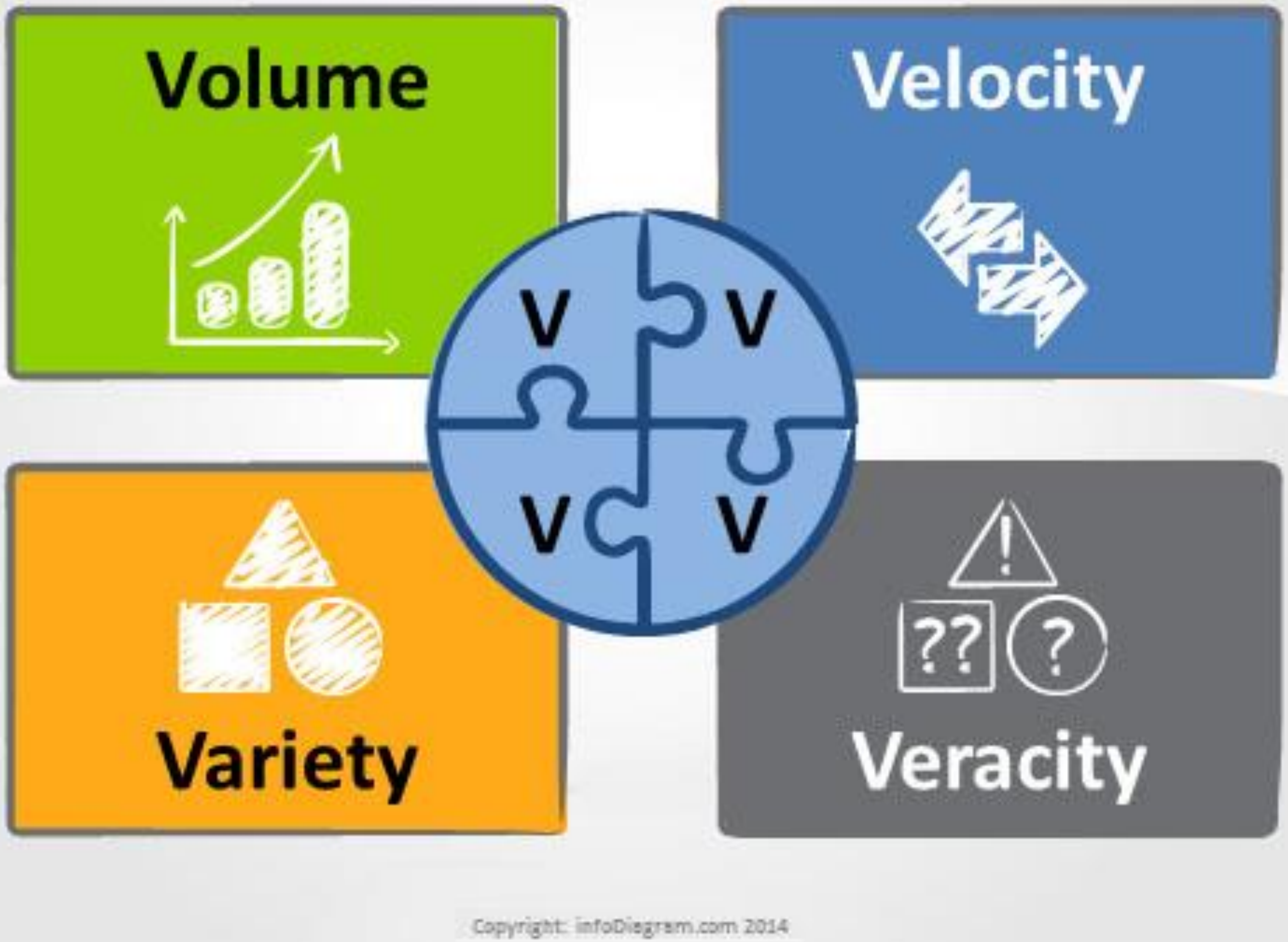
Big Data Overload: Why Most Companies Can't Deal With The Data Explosion

Forbes / Tech

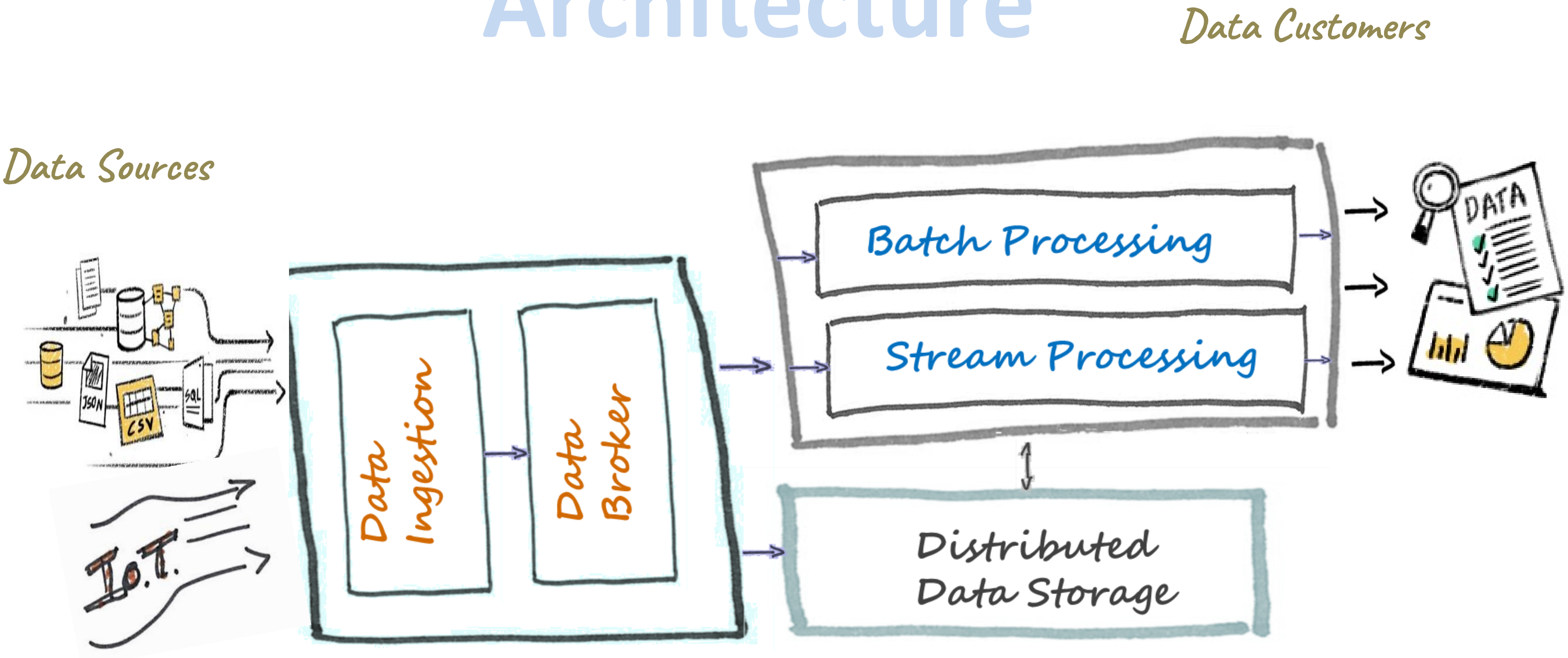
SEP 8, 2015 @ 02:26 AM 131,676 VIEWS

4 Ways Big Data Will Change Every Business

Big Data: 4V definition

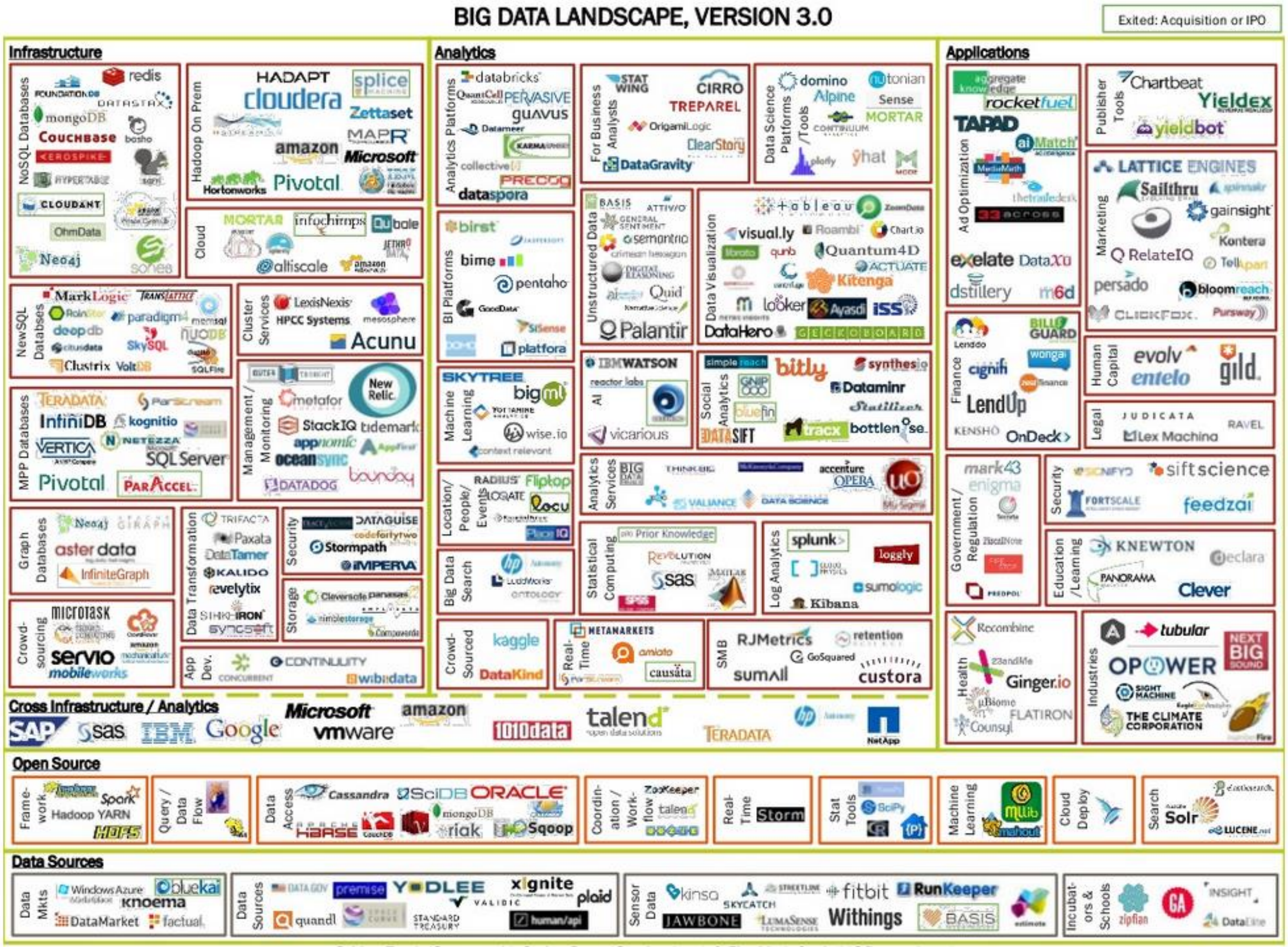


Big Data Architecture



- Business Intelligence
- Visualization
- Analytics

BIG DATA LANDSCAPE, VERSION 3.0



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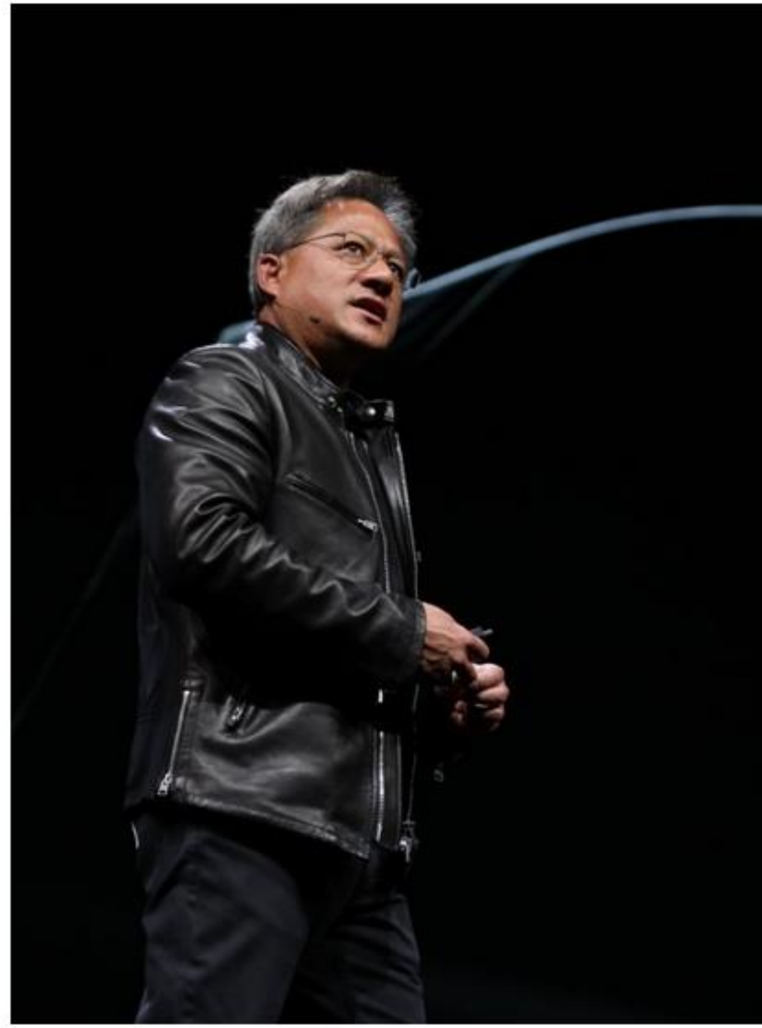
Intelligent Machines

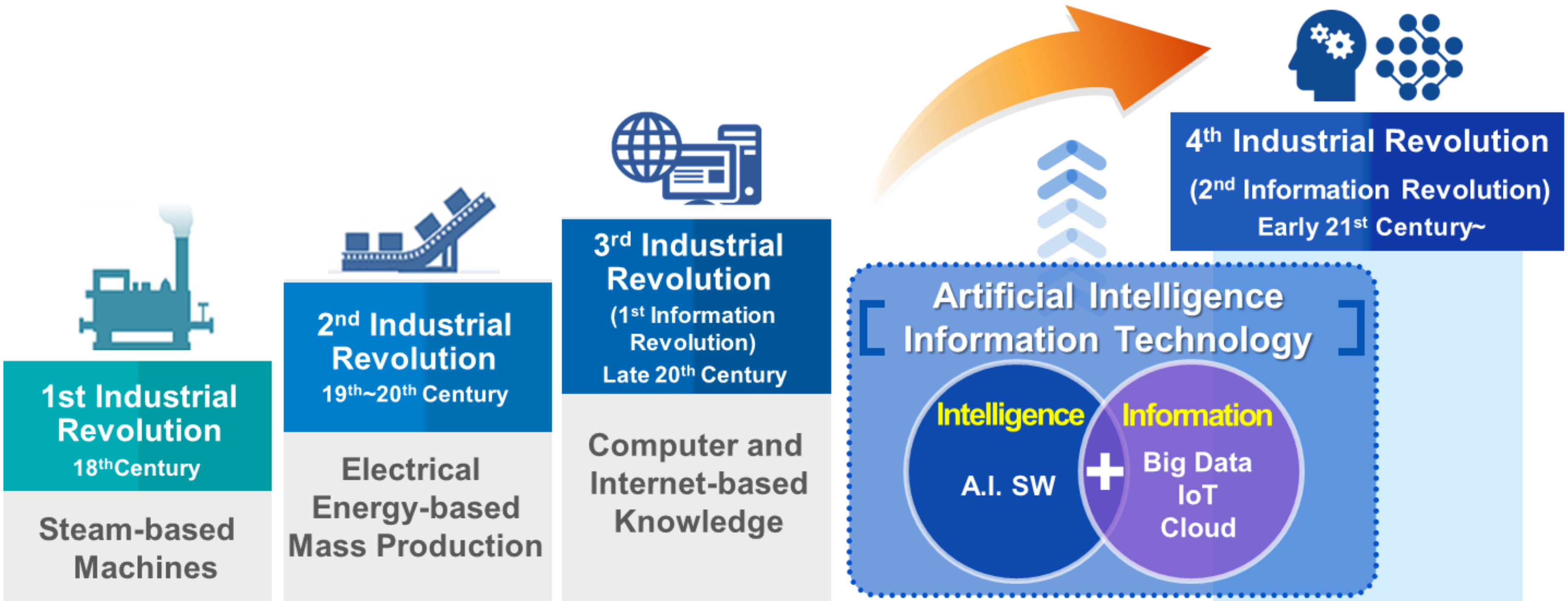
Nvidia CEO: Software Is Eating the World, but AI Is Going to Eat Software

Jensen Huang predicts that health care and autos are going to be transformed by artificial intelligence.

by Tom Simonite May 12, 2017



Nvidia CEO Jensen Huang at the company's developer conference in San Jose, California.

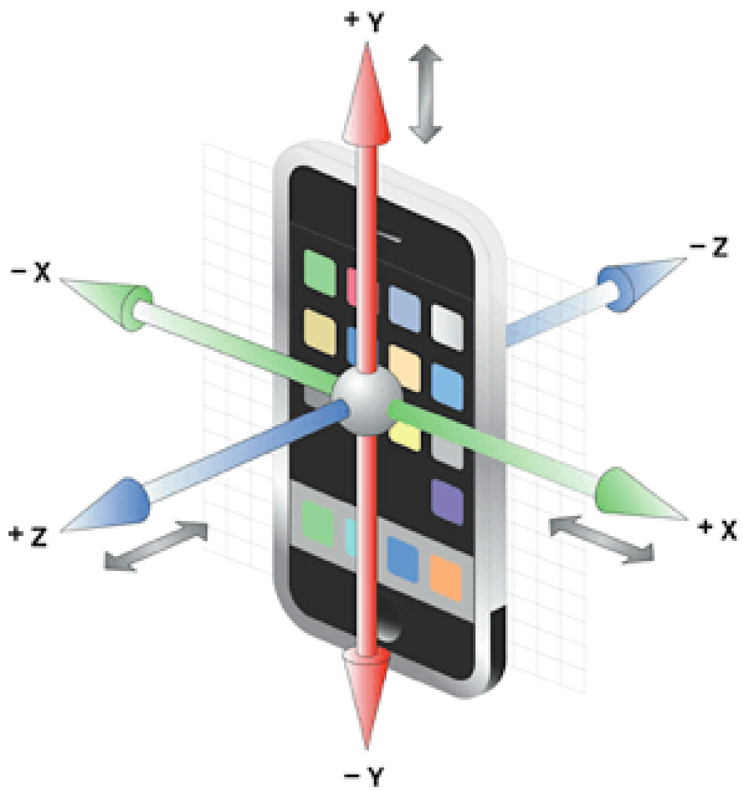

1st Industrial Revolution
18thCentury
Steam-based Machines
2nd Industrial Revolution
19th~20th Century
Electrical Energy-based Mass Production
3rd Industrial Revolution
(1st Information Revolution)
Late 20th Century
Computer and Internet-based Knowledge
4th Industrial Revolution
(2nd Information Revolution)
Early 21st Century~
Artificial Intelligence
Information Technology
Intelligence
A.I. SW
Information
Big Data
IoT
Cloud

FROM : *humans*

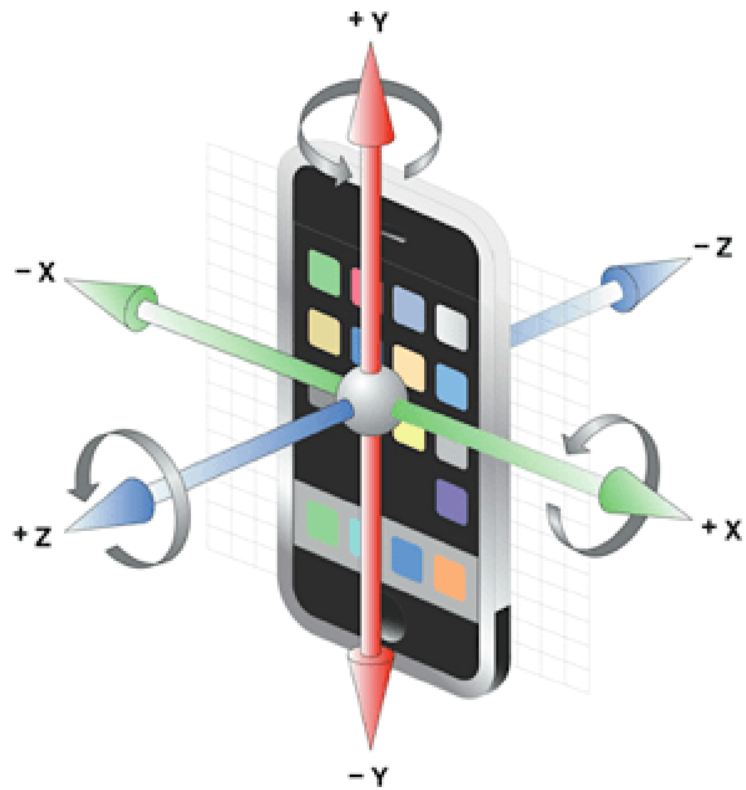
- **to *machines***
- **to Artificial Intelligence (AI)**

Drivies use case:

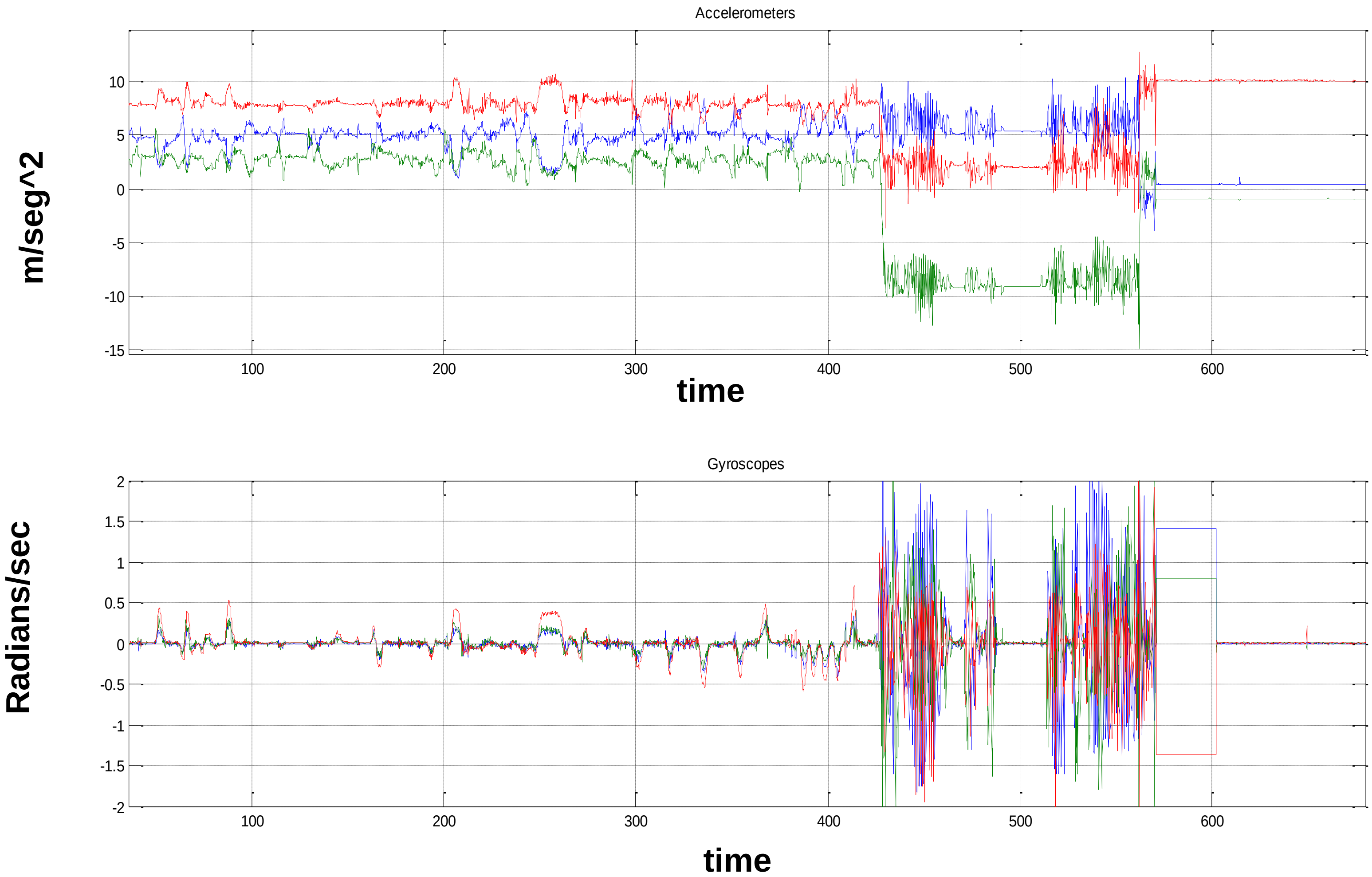
www.driviesapp.com



Accelerometer



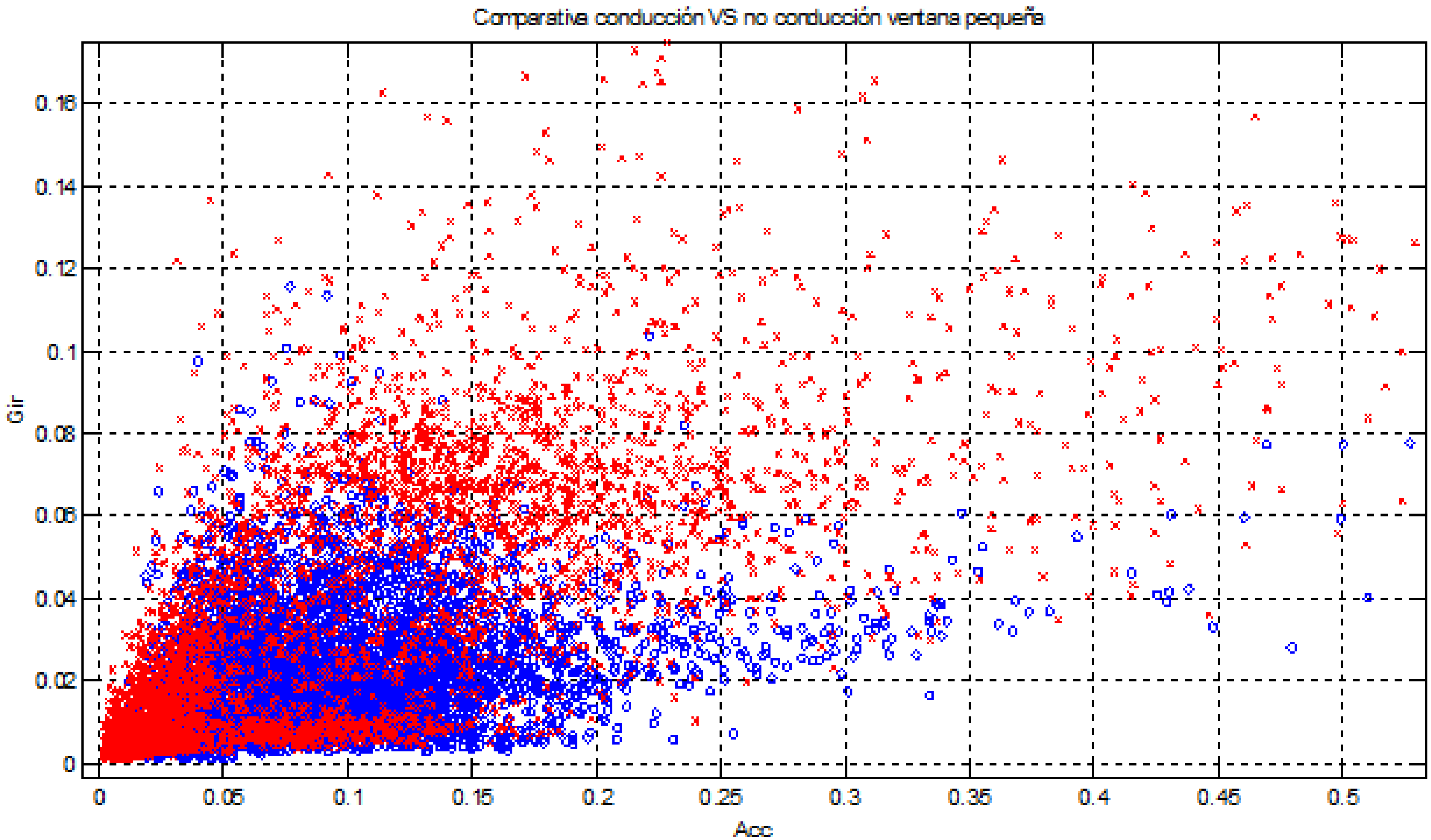
Gyroscope


Accelerometers
m/seg^2
time
Gyroscopes
Radians/sec
time

From manual - linear classifiers TO Neural Networks

Gyroscopes Energy

x_2

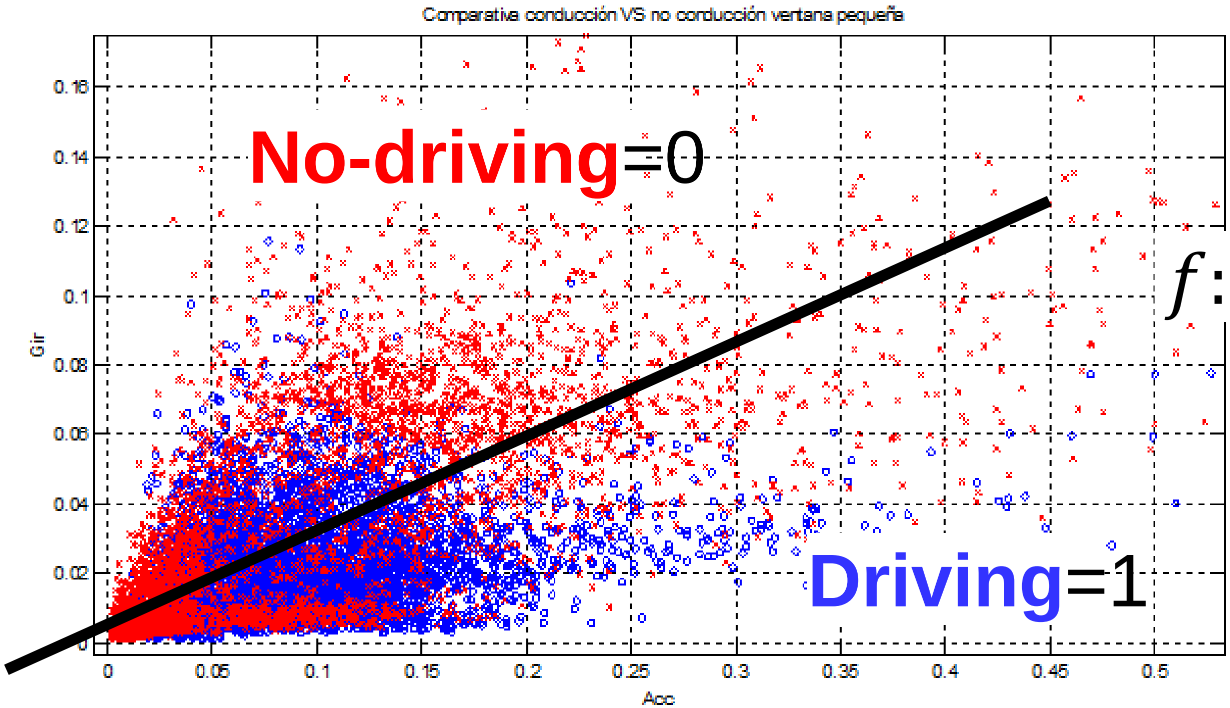


x_1 : **Accelerometers Energy**

Driving detection (yes/no)
= define a **decision function**

Gyroscopes Energy

x_2



$f: R^K \rightarrow R$

x_1 **(Accelerometers Energy)**

Logitravel Group

LOGITRAVEL.com

traveltool MÉXICO

Smyrooms global bed bank

Smyhotels

bluekiri

Roomdi.com Same hotel, better price

traveltino

Alitravel

Smyland

7ideas

24 HOURS

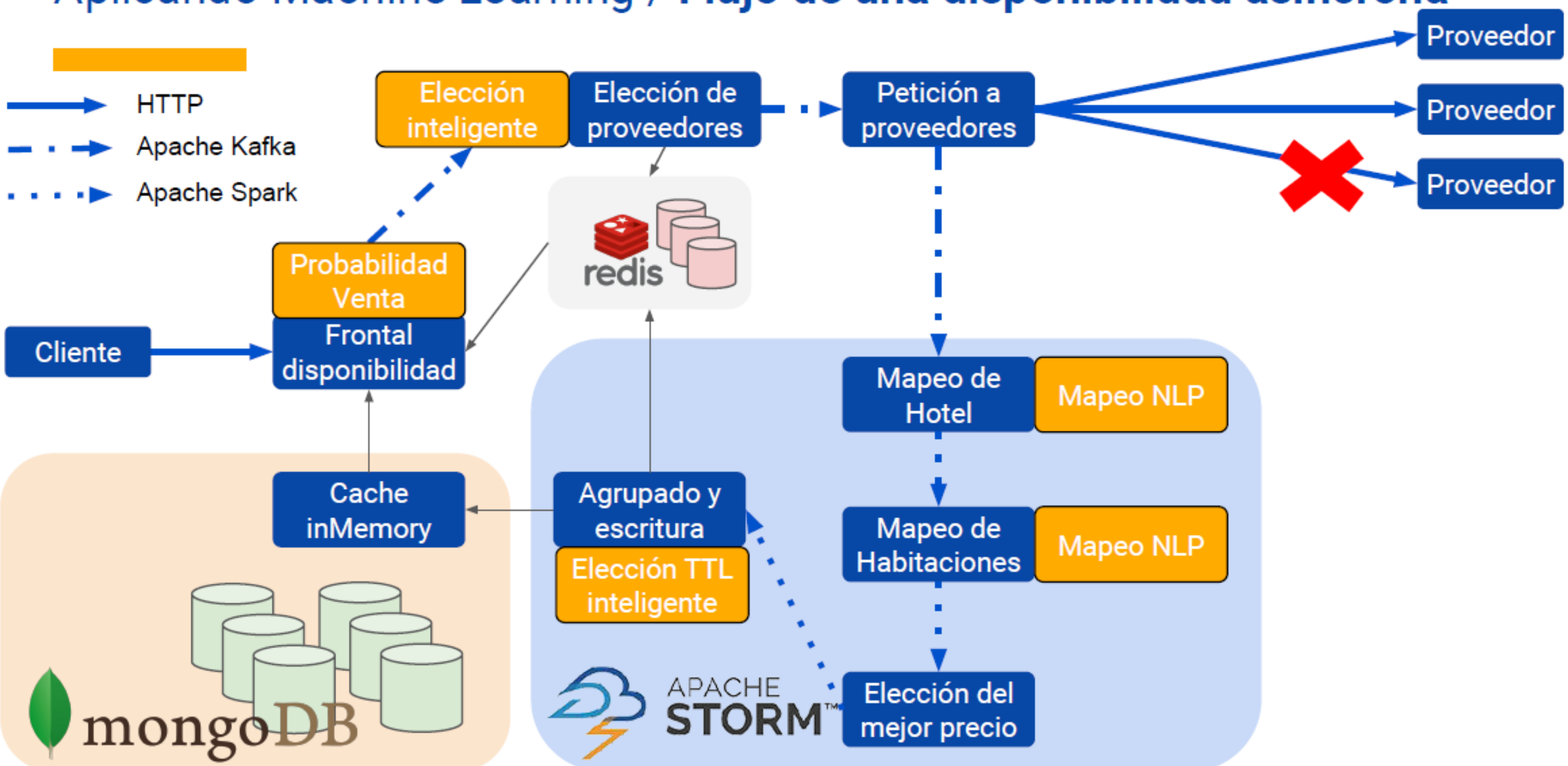
7 DAYS A WEEK

365 DAYS A YEAR

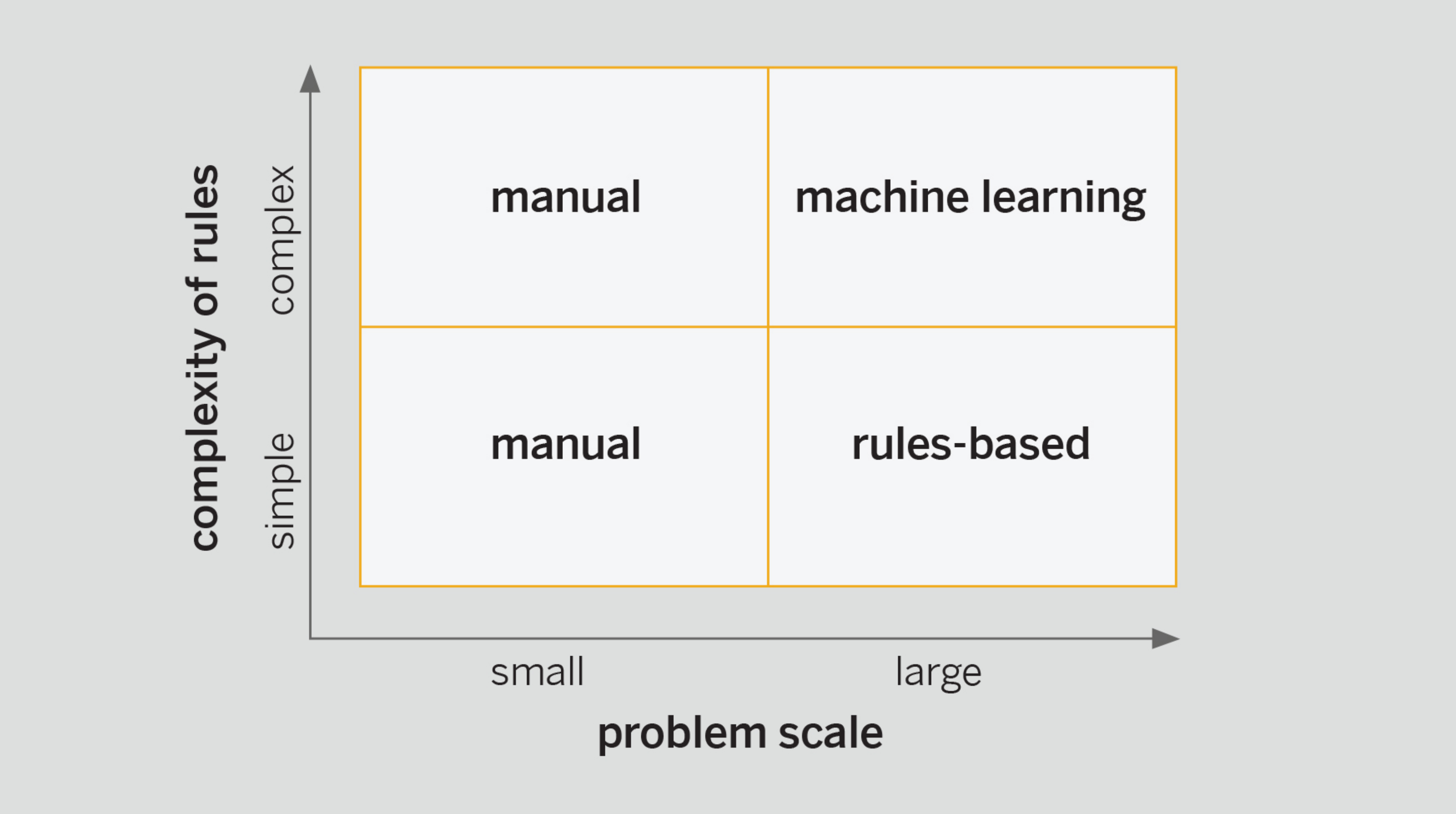
@sukiweb

SSR

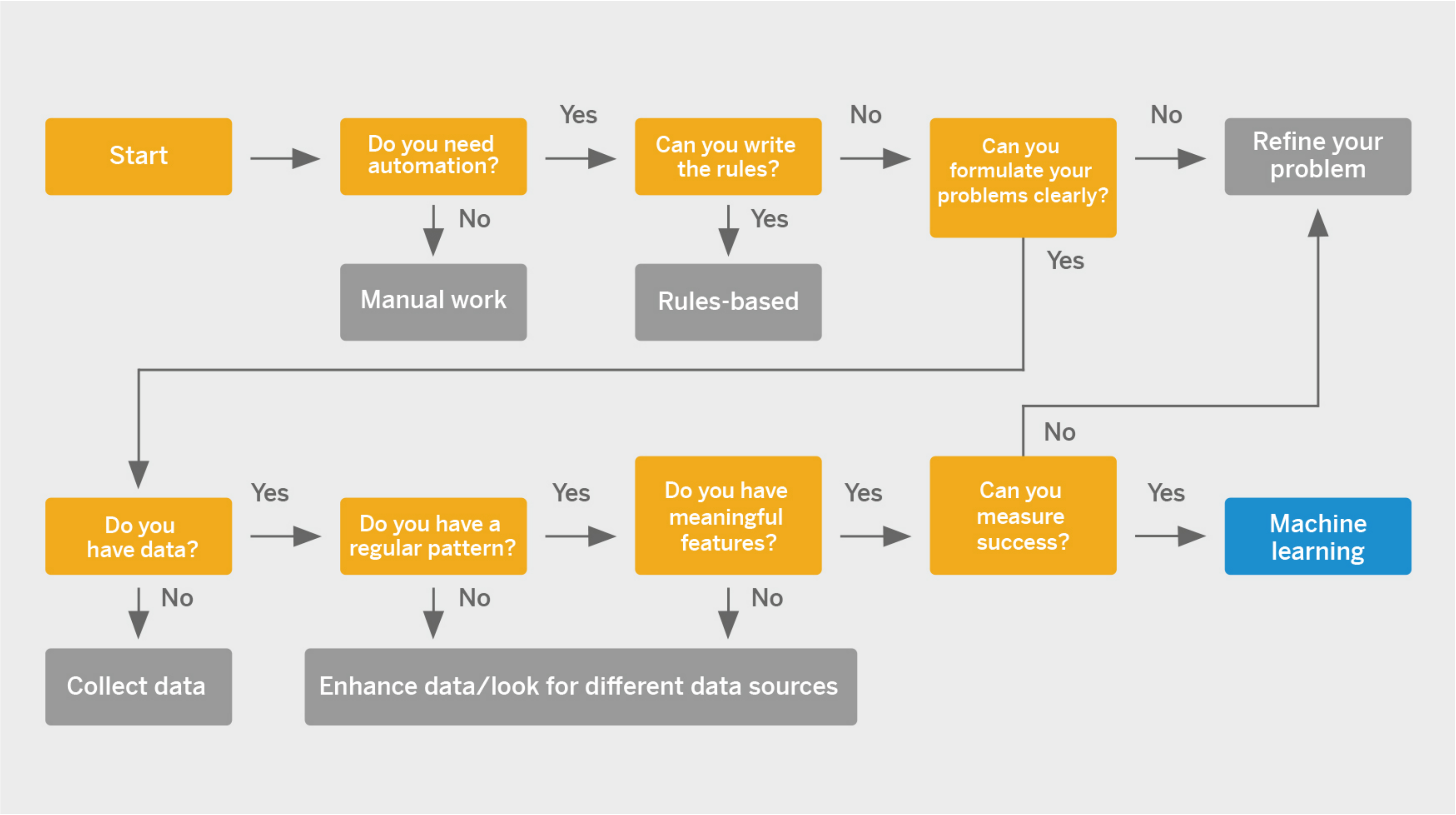
Aplicando Machine Learning / **Flujo de una disponibilidad asíncrona**



Logitravel Group


manual
machine learning
manual
rules-based
complexity of rules
complex
simple
small
large
problem scale

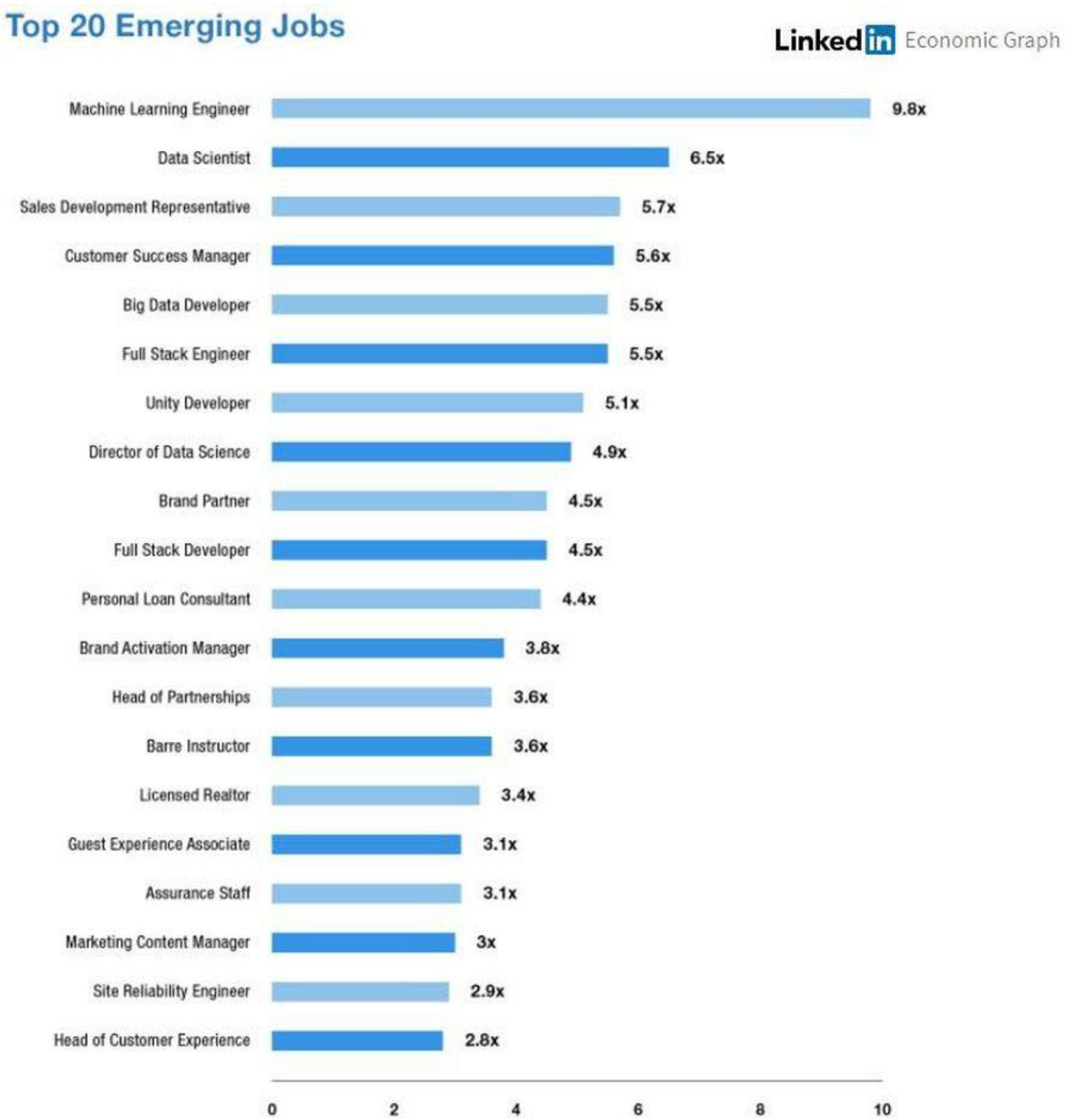
Why Machine Learning and Why Now?



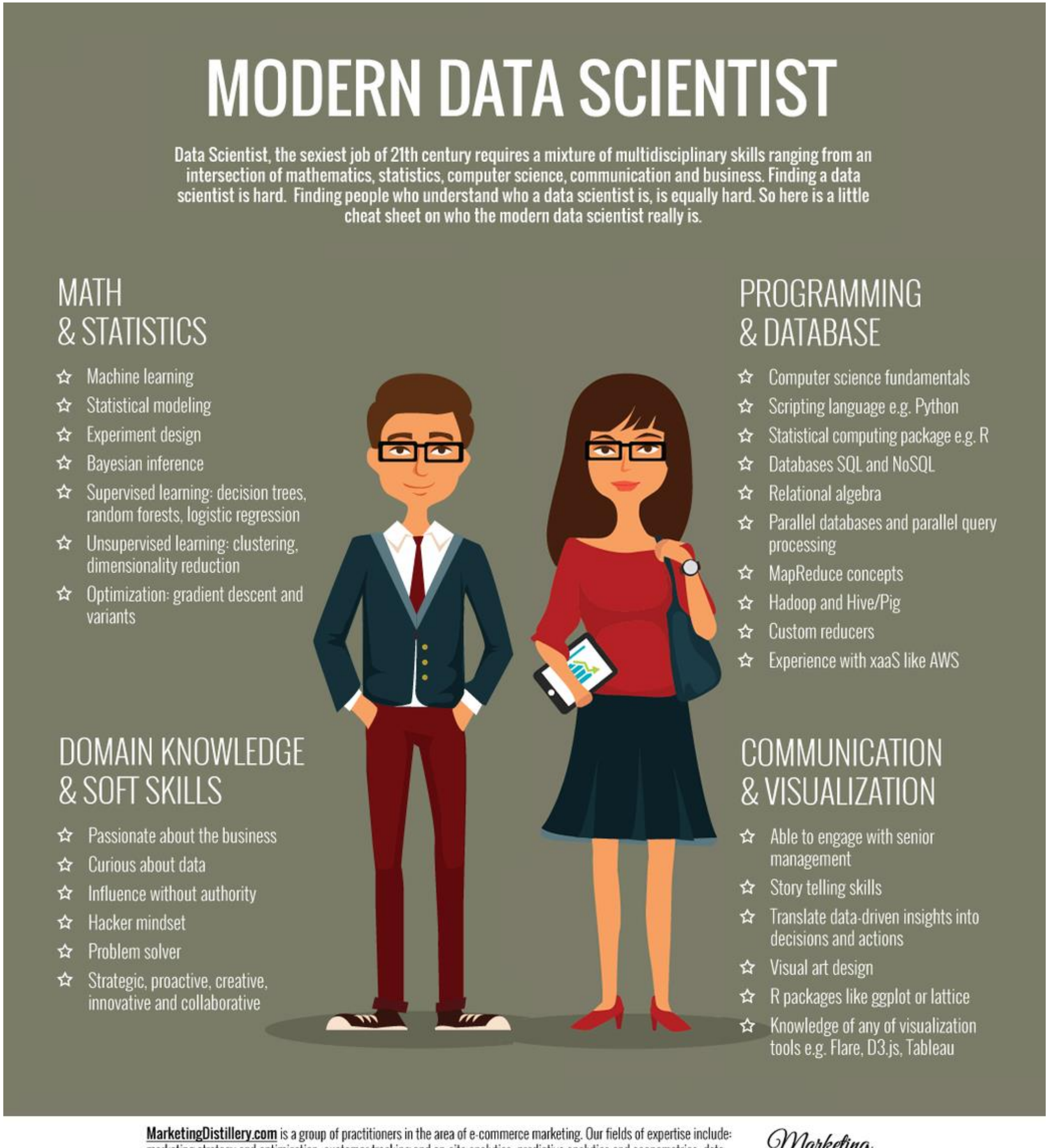
Process optimization

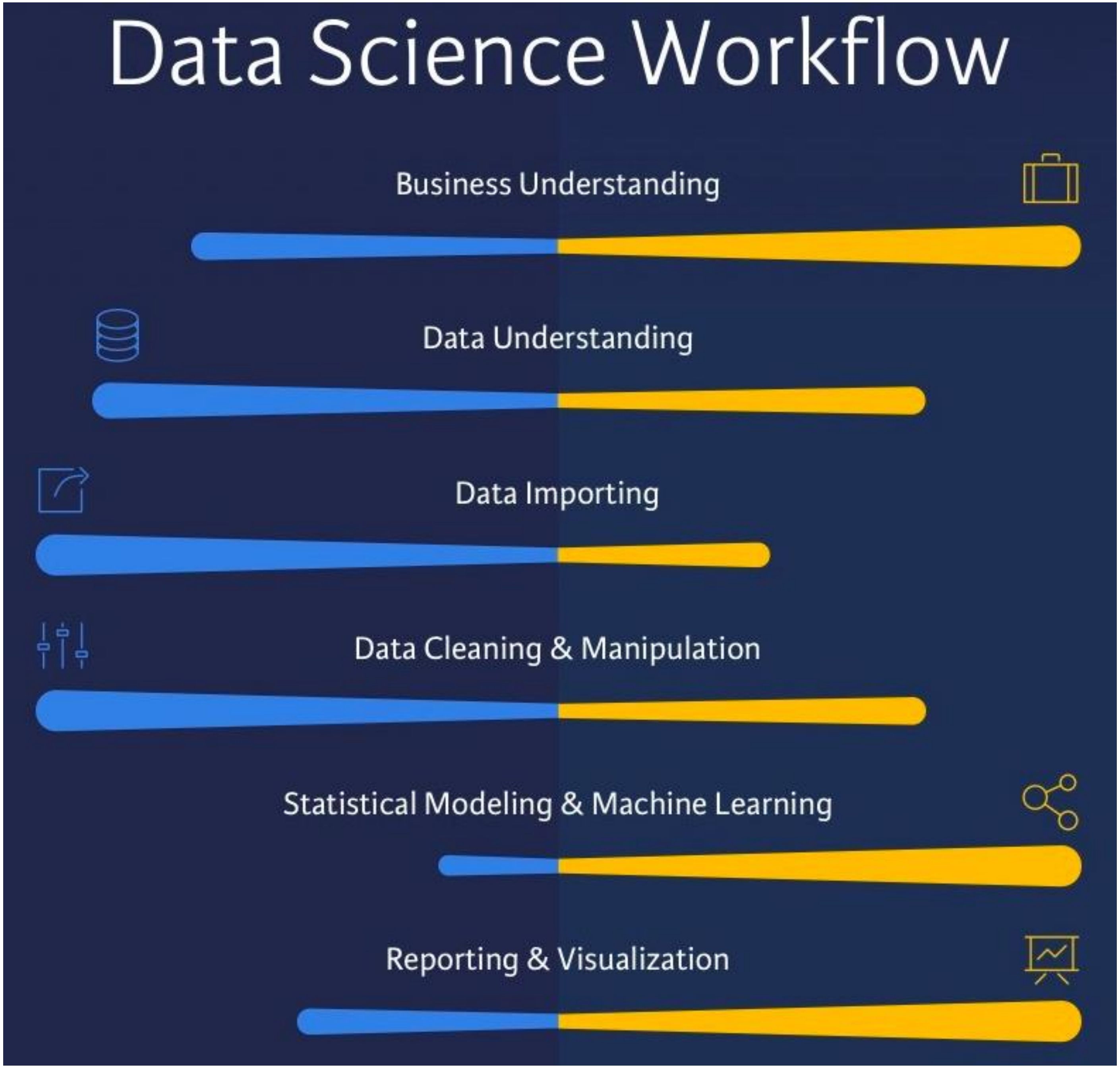

Don't fire people.
Rent their avatars
"EL BULLI" OF
DIGITAL
TRANSFORMATION
Our professional career has been a unique experiment chasing the Frontier of Knowledge.
We have challenged every single process that has settled in the industry. And we have injected our own style, academically rigorous, to transformation. Both, industry and academia have prized our approaches.
SCI THE WORLD

LinkedIn's Fastest-Growing Jobs Today Are In Data Science And Machine Learning




DATA
Engineer
DataCamp
Learn Data Science By Doing
DATA
Scientist
Develops, constructs, tests, and maintains architectures. Such as databases and large-scale processing systems.
Cleans, massages and organizes (big) data. Performs descriptive statistics and analysis to develop insights, build models and solve a business need.


MODERN DATA SCIENTIST
Data Scientist, the sexiest job of 21th century requires a mixture of multidisciplinary skills ranging from an intersection of mathematics, statistics, computer science, communication and business. Finding a data scientist is hard. Finding people who understand who a data scientist is, is equally hard. So here is a little cheat sheet on who the modern data scientist really is.
MATH & STATISTICS
Machine learning
Statistical modeling
Experiment design
Bayesian inference
Supervised learning: decision trees, random forests, logistic regression
Unsupervised learning: clustering, dimensionality reduction
Optimization: gradient descent and variants
PROGRAMMING & DATABASE
Computer science fundamentals
Scripting language e.g. Python
Statistical computing package e.g. R
Databases SQL and NoSQL
Relational algebra
Parallel databases and parallel query processing
MapReduce concepts
Hadoop and Hive/Pig
Custom reducers
Experience with xaaS like AWS
DOMAIN KNOWLEDGE & SOFT SKILLS
Passionate about the business
Curious about data
Influence without authority
Hacker mindset
Problem solver
Strategic, proactive, creative, innovative and collaborative
COMMUNICATION & VISUALIZATION
Able to engage with senior management
Story telling skills
Translate data-driven insights into decisions and actions
Visual art design
R packages like ggplot or lattice
Knowledge of any of visualization tools e.g. Flare, D3.js, Tableau
MarketingDistillery.com is a group of practitioners in the area of e-commerce marketing. Our fields of expertise include:


Data Science Workflow
Business Understanding
Data Understanding
Data Importing
Data Cleaning & Manipulation
Statistical Modeling & Machine Learning
Reporting & Visualization

LUCA

Telefónica DATA UNIT

Machine Learning:

automatic methods of data analysis

- What is the best prediction about the future given some past data?
- What is the best model to explain some data?
- What action should be performed next?

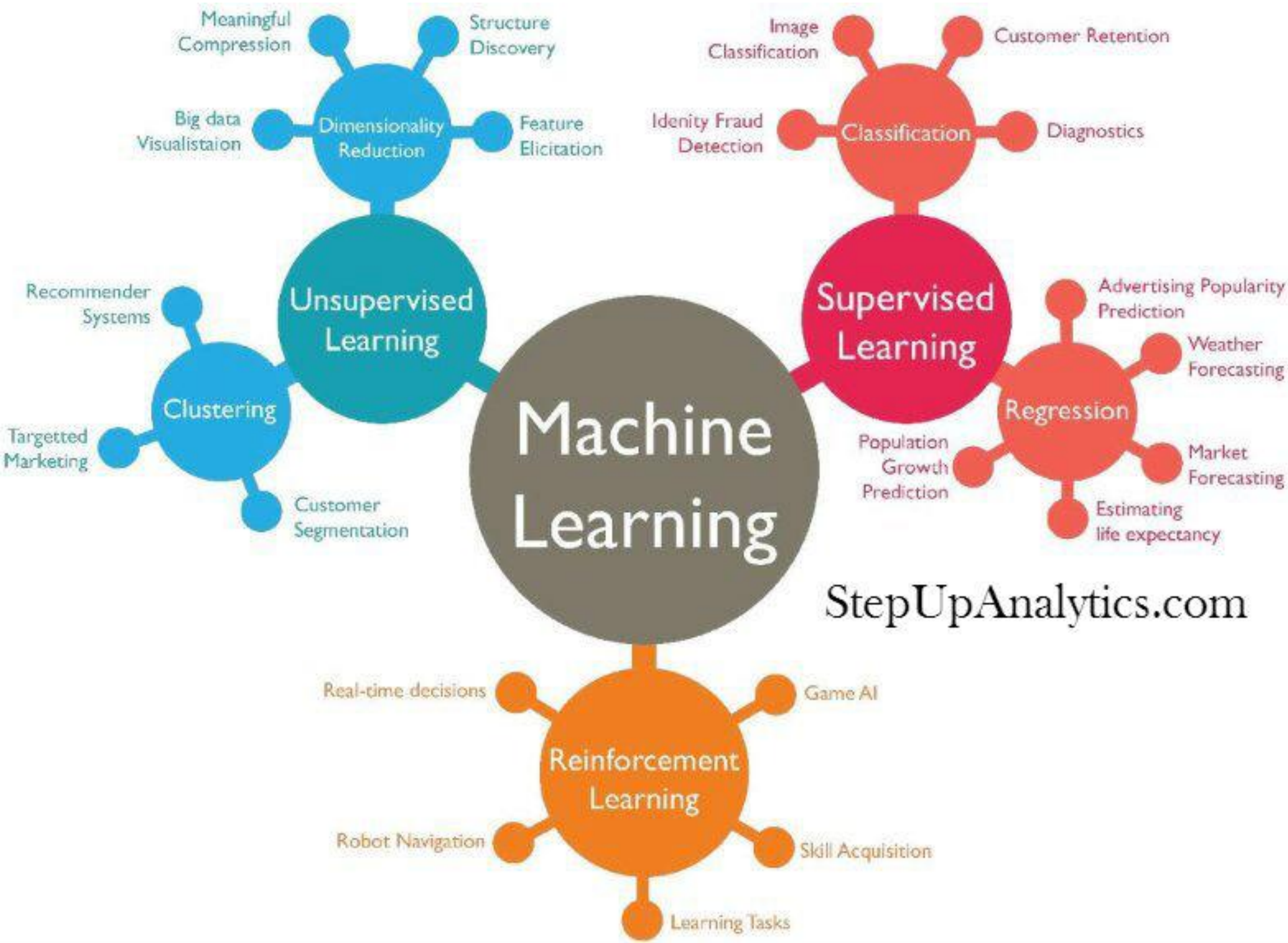
MANY DIFFERENT FIELDS & APPLICATION DOMAINS

Music Recommendation systems

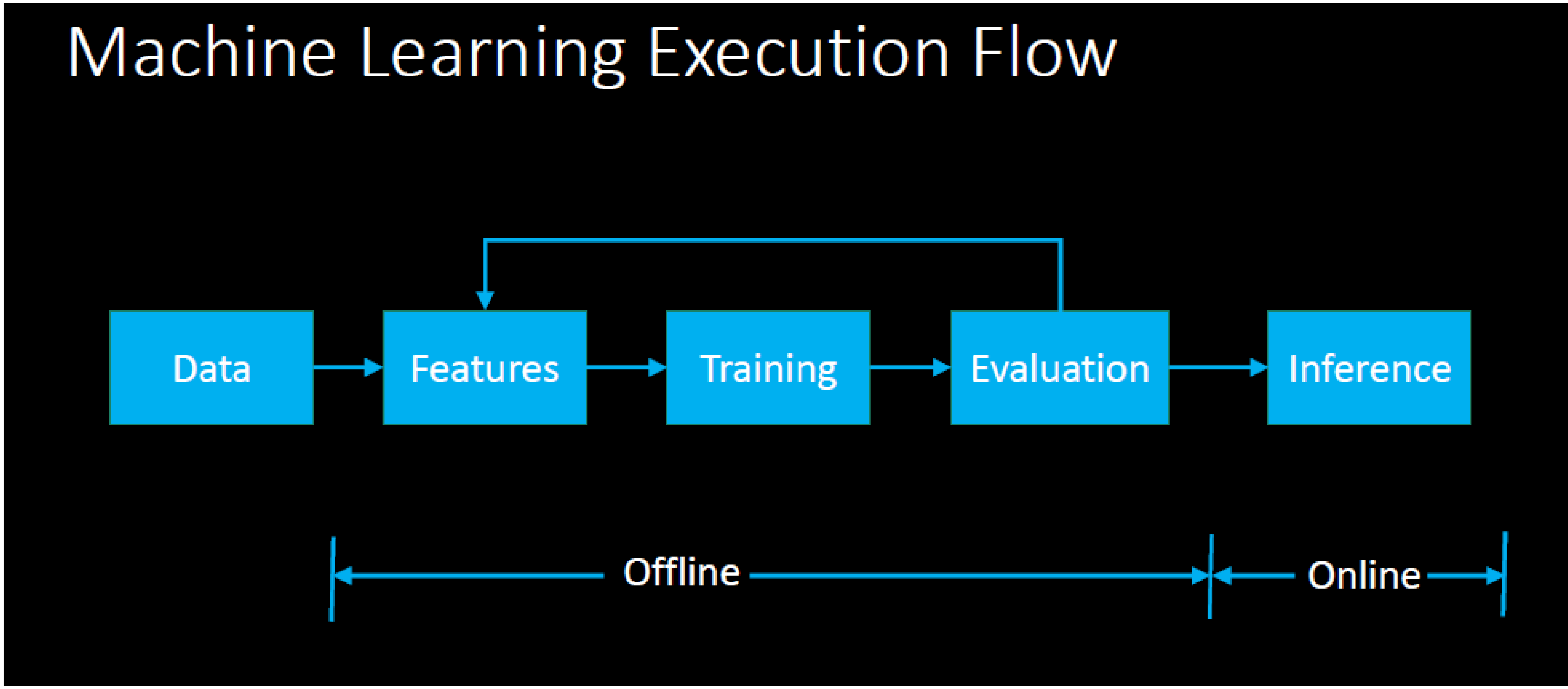
- Is this song similar to that one?
- When can this song become a hit?
- Should I recommend this song?

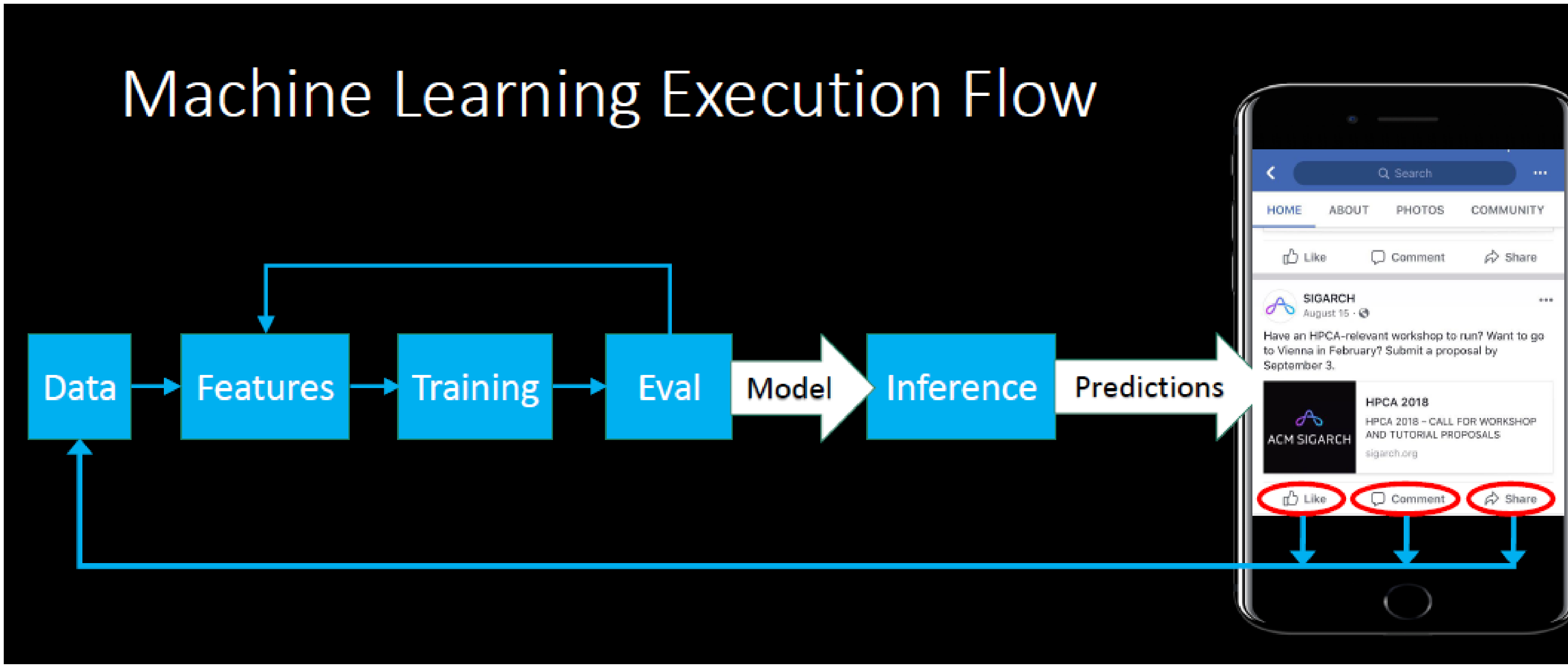
Predictive Maintenance of machinery

- Is that behavior normal?
- When the machine is going to fail?
- Should I add this machine to the review list?


Machine Learning
Unsupervised Learning
Dimensionality Reduction
Meaningful Compression
Structure Discovery
Big data Visualistaion
Feature Elicitation
Clustering
Recommender Systems
Targetted Marketing
Customer Segmentation
Supervised Learning
Classification
Image Classification
Customer Retention
Idenity Fraud Detection
Diagnostics
Regression
Advertising Popularity Prediction
Weather Forecasting
Population Growth Prediction
Market Forecasting
Estimating life expectancy
Reinforcement Learning
Real-time decisions
Game AI
Robot Navigation
Skill Acquisition
Learning Tasks
StepUpAnalytics.com

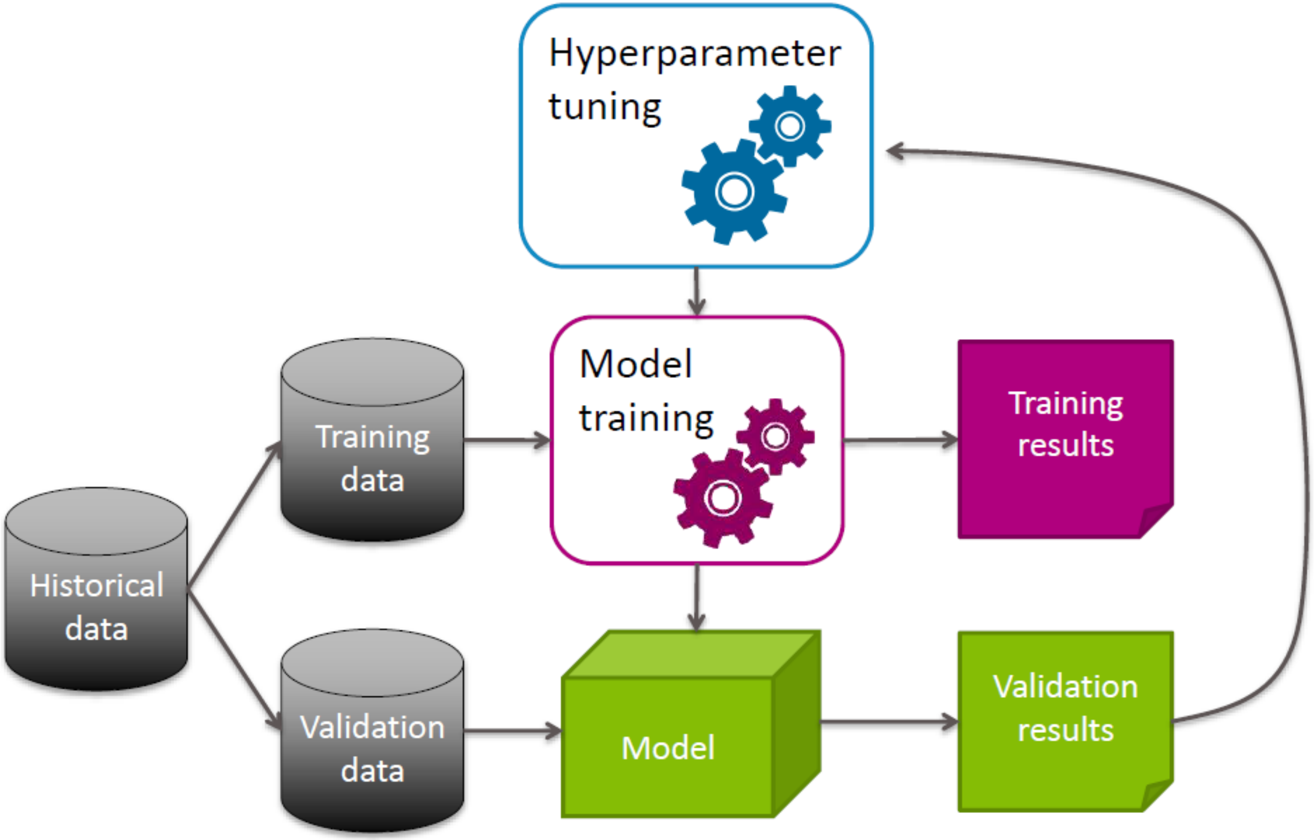

ML at Facebook:
An Infrastructure View
Yangqing Jia
Director, Facebook AI Infra


Machine Learning Execution Flow
Data
Features
Training
Evaluation
Inference
Offline
Online

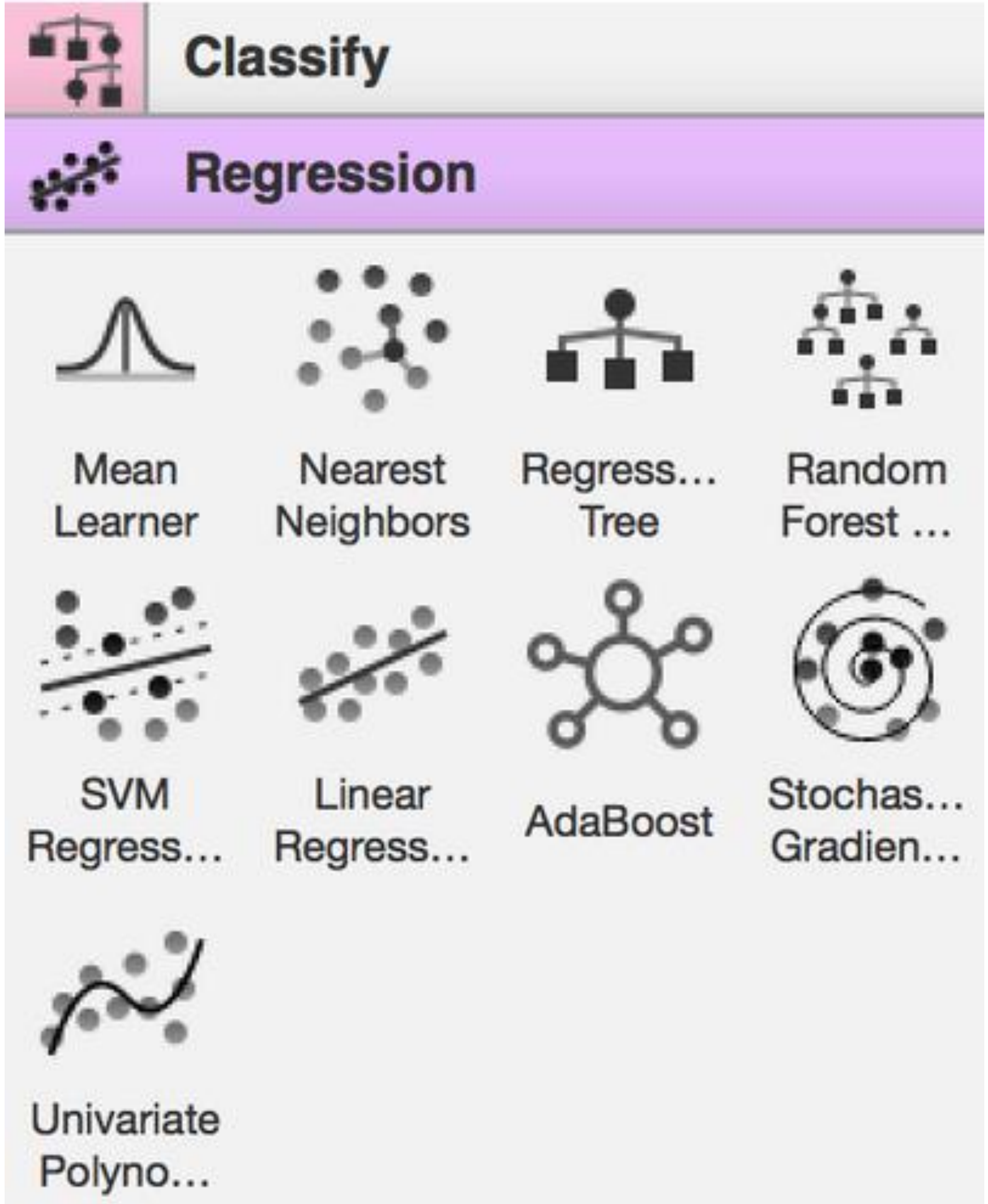


Machine Learning Execution Flow
Data
Features
Training
Eval
Model
Inference
Predictions
Search
HOME
ABOUT
PHOTOS
COMMUNITY
Like
Comment
Share
SIGARCH
August 15
Have an HPCA-relevant workshop to run? Want to go to Vienna in February? Submit a proposal by September 3.
ACM SIGARCH
HPCA 2018
HPCA 2018 – CALL FOR WORKSHOP AND TUTORIAL PROPOSALS
sigarch.org
Like
Comment
Share

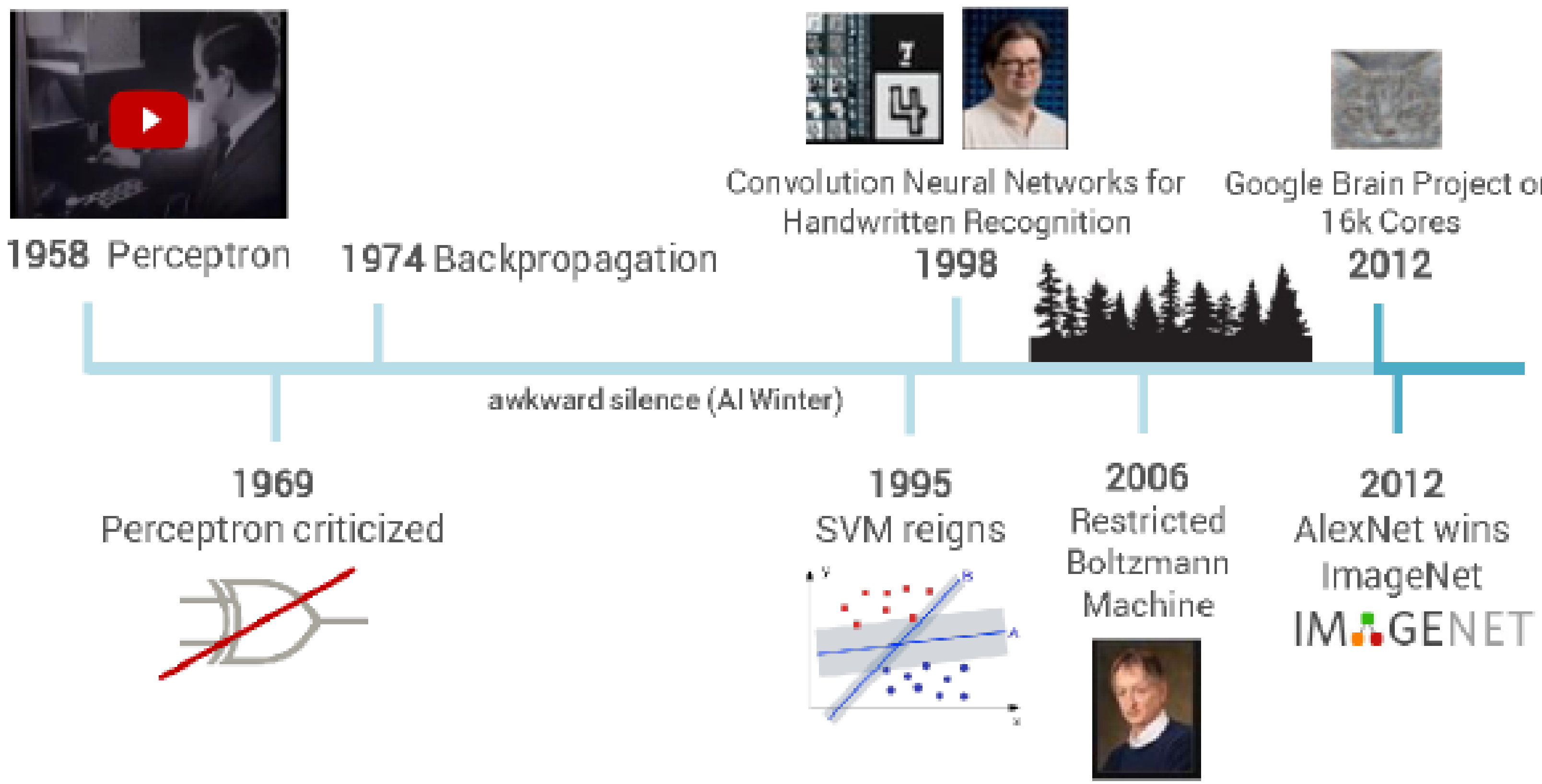
Model Selection and Tuning



Evaluating Machine Learning Models – A Beginner's Guide
Alice Zheng, Dato

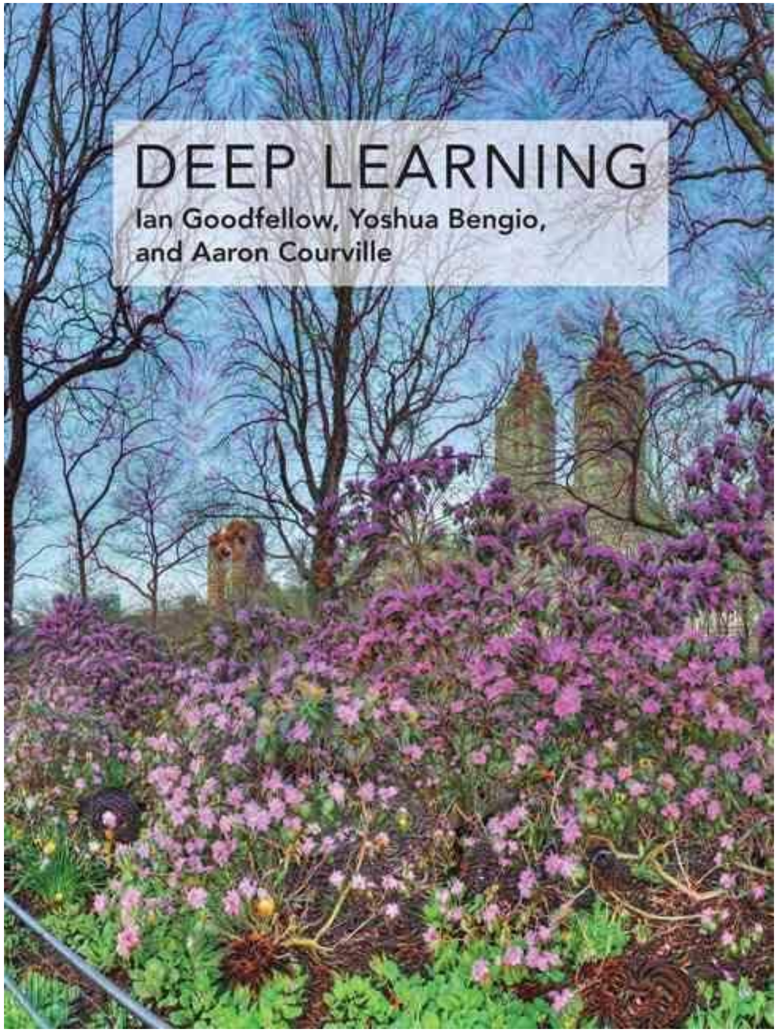

Classify
Regression
Mean Learner
Nearest Neighbors
Regress... Tree
Random Forest ...
SVM Regress...
Linear Regress...
AdaBoost
Stochas... Gradien...
Univariate Polyno...

A Brief History



Deep Learning: Hype or Reality?

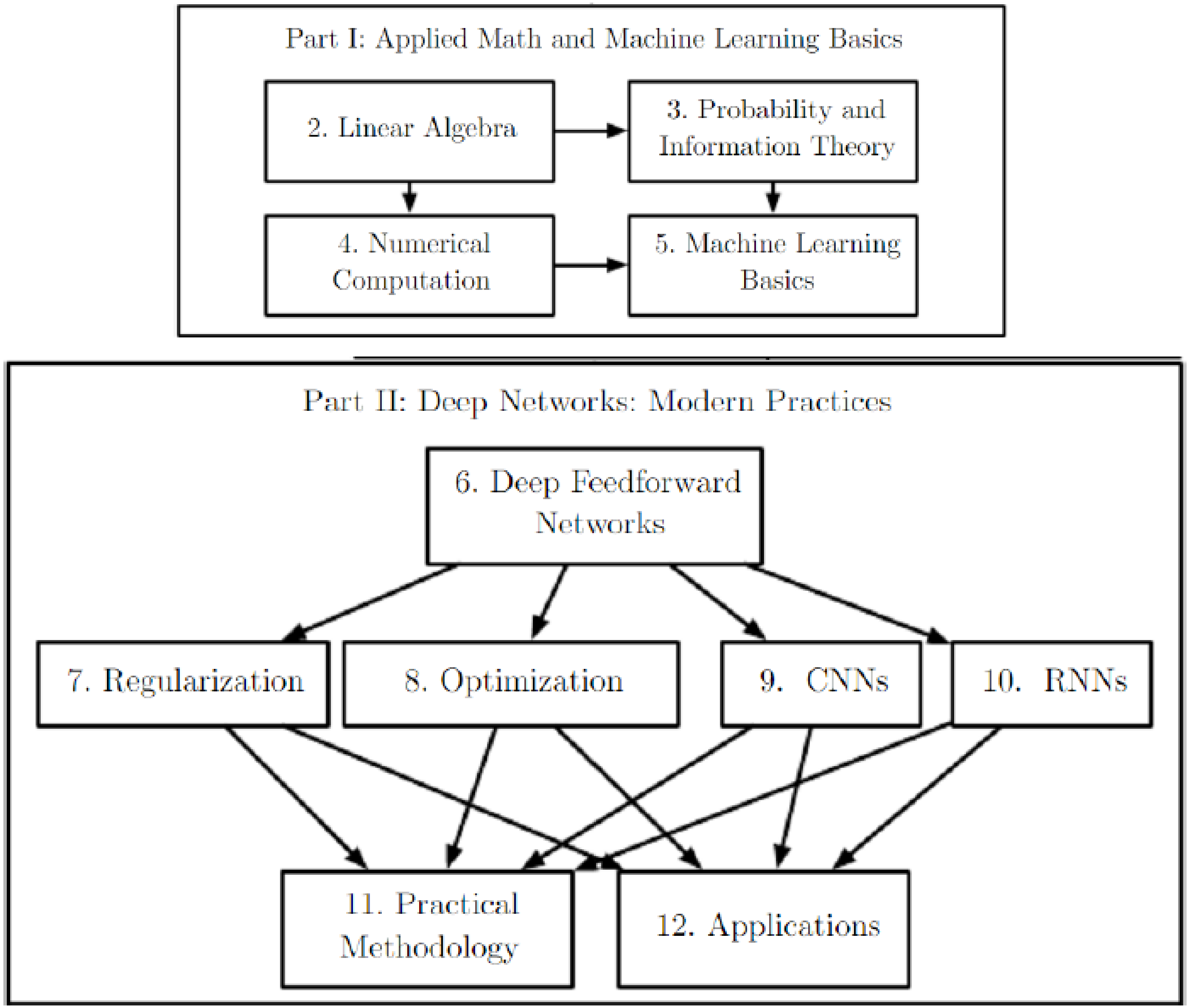
Learn the whole Machine Learning context



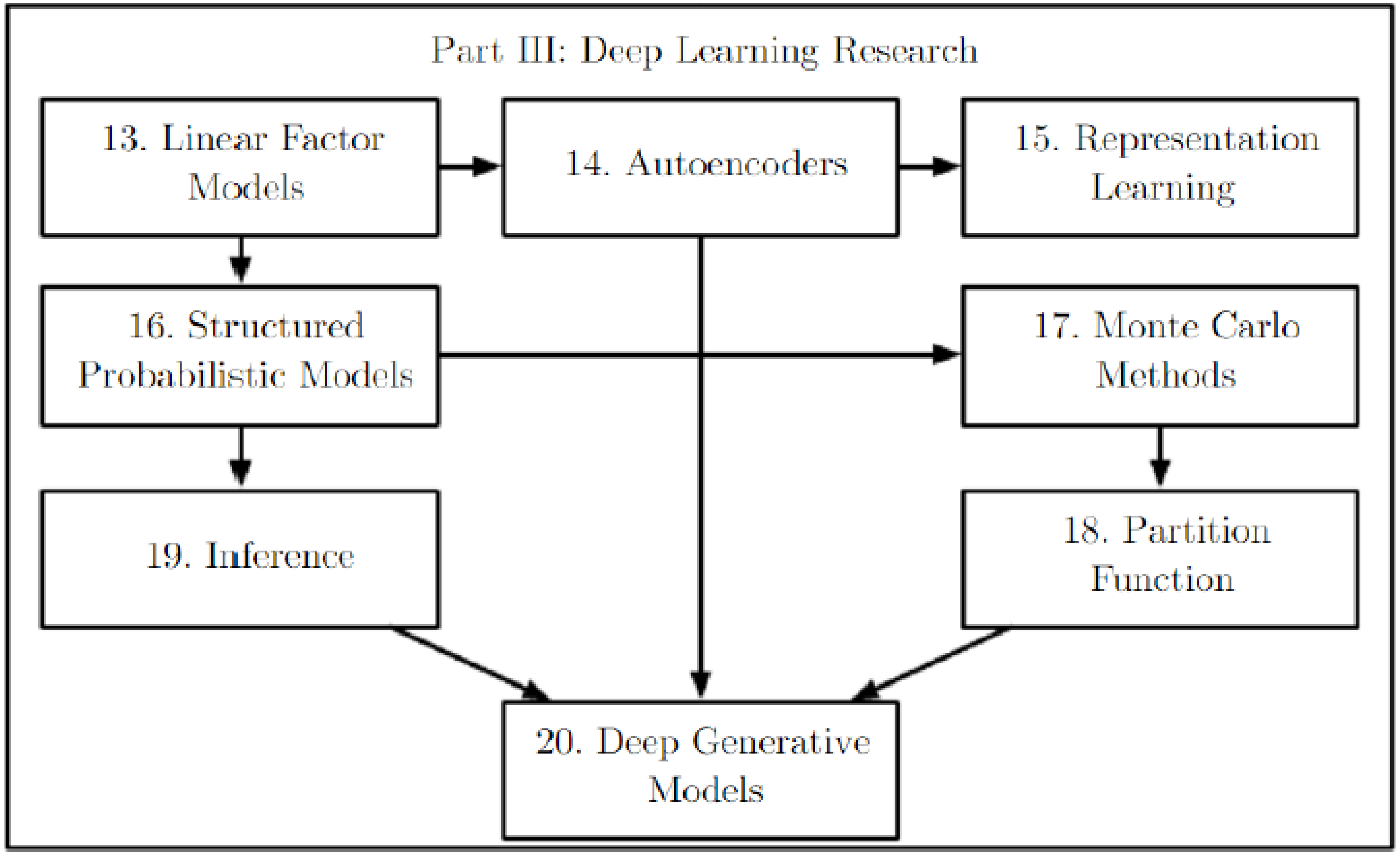
On line:
www.deeplearningbook.org

Deep Learning courses
Prof. Hung-yi Lee National Taiwan University (NTU)
Taipei

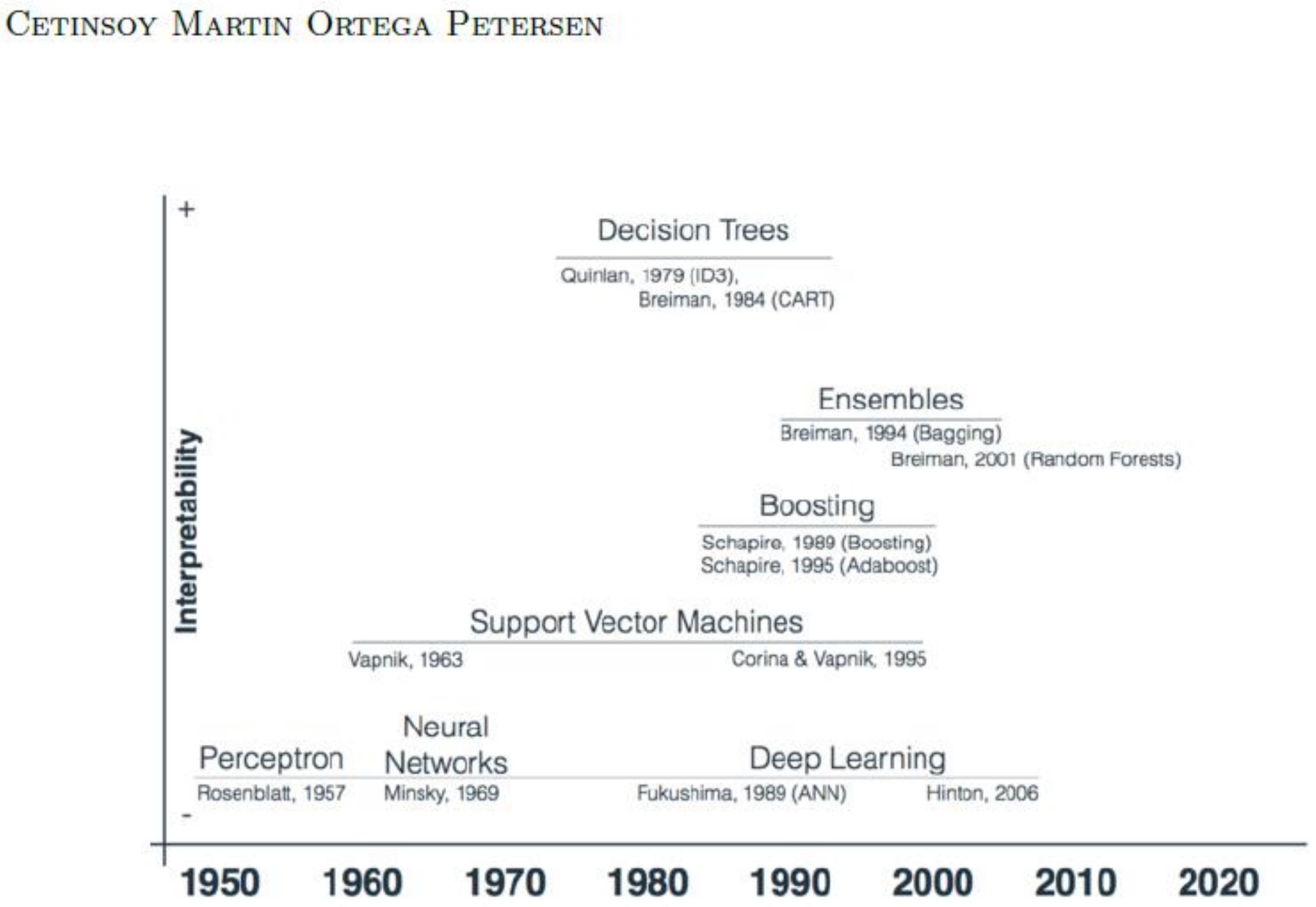
Introduction to Deep Learning
…the Machine Learning background…



Introduction to Deep Learning
…the Machine Learning background…



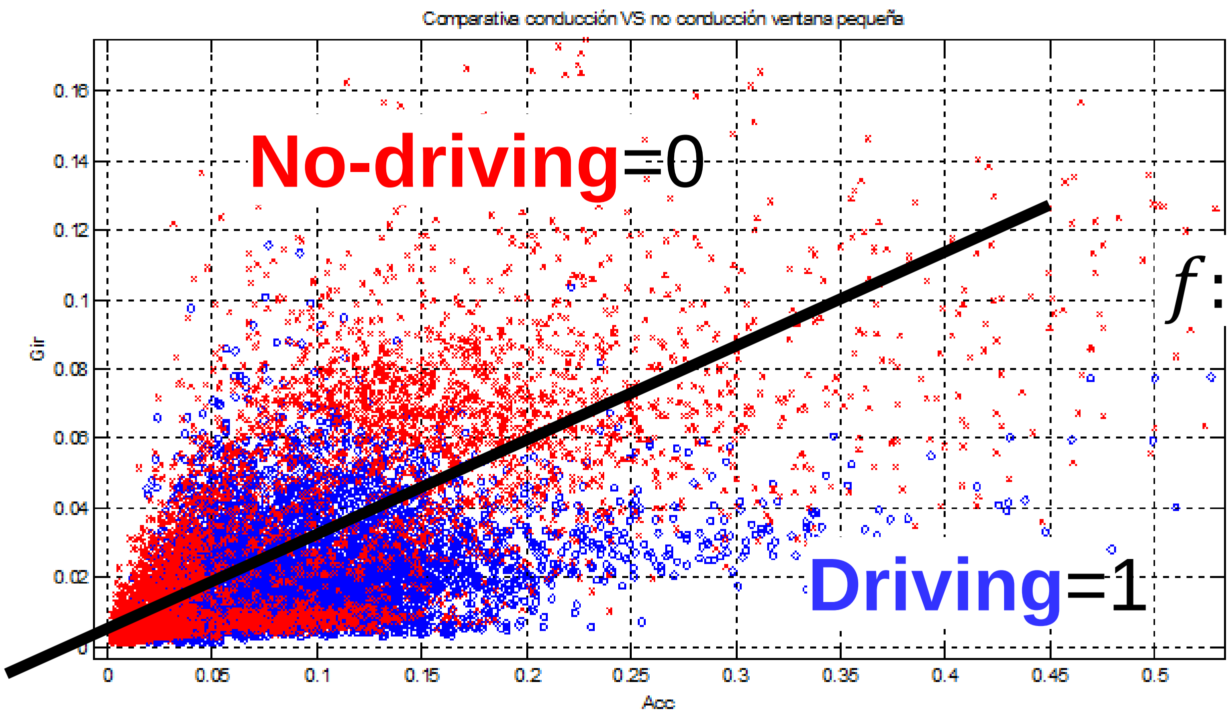
Model interpretability?



Driving detection (yes/no)
= define a **decision function**

Gyroscopes Energy

x_2

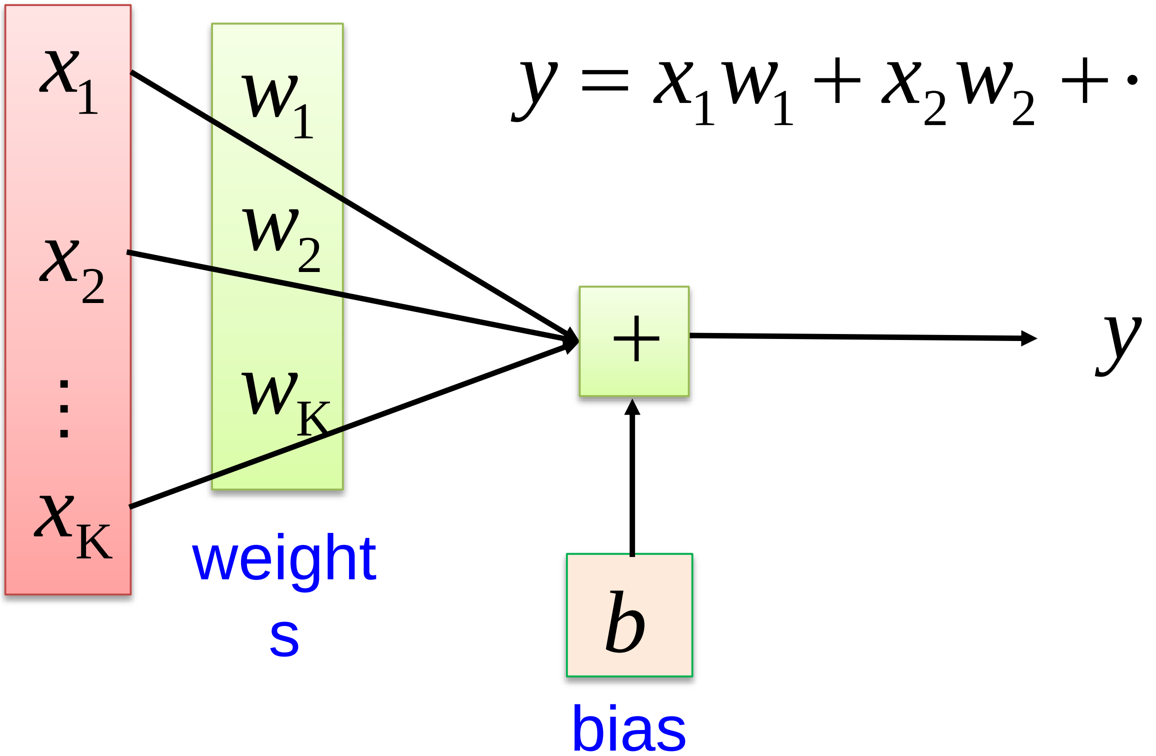


$f: R^K \rightarrow R$

x_1 **(Accelerometers Energy)**

A Linear **decision function**

$$y = x_1 w_1 + x_2 w_2 + \cdots + x_K w_K + b$$



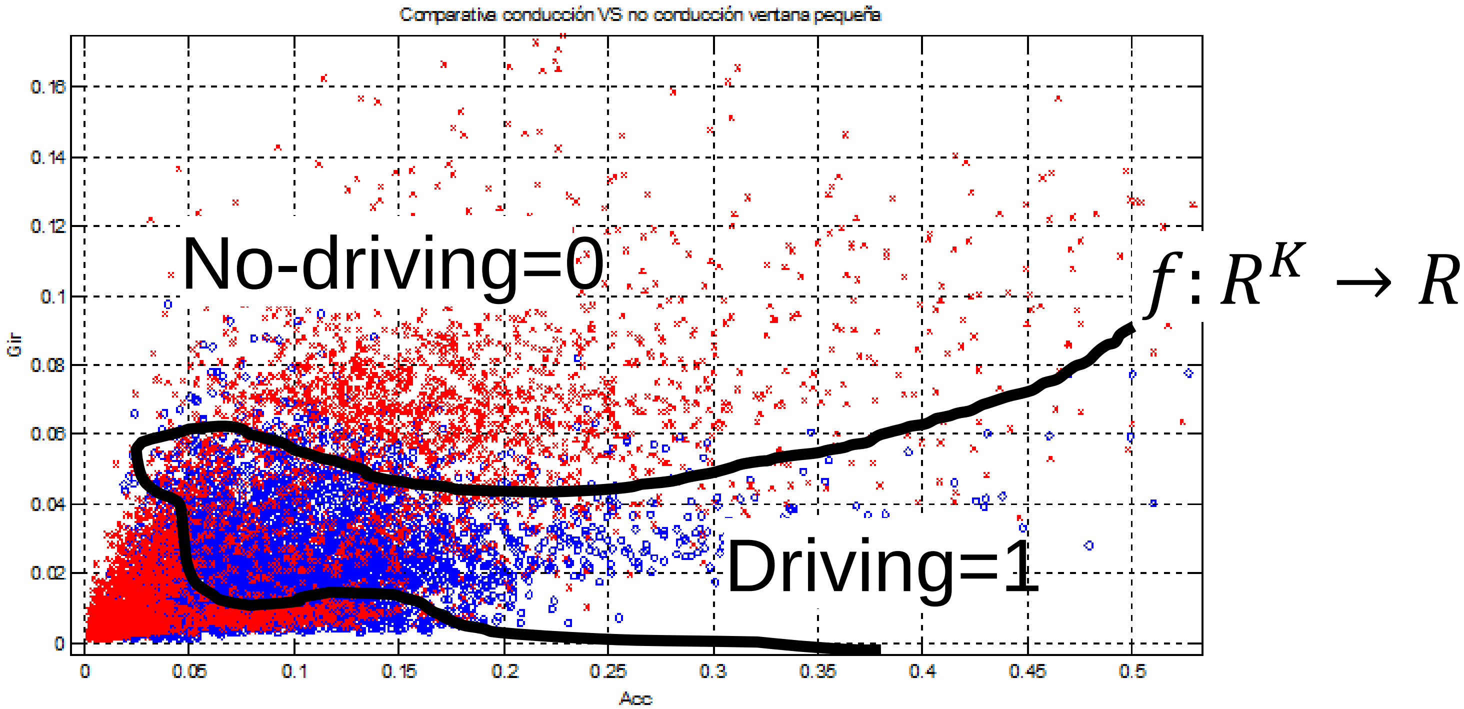
A Linear **decision function**

$$y = x_1 w_1 + x_2 w_2 + \cdots + x_K w_K + b$$

$$y = \mathbf{x}^{\mathrm{T}} \mathbf{w}$$

Nonlinear **decision function?**

x_2



x_1

Non-linear decision functions

$$y = x_1 w_1 + x_1^{\,2} w_2 + x_1^{\,3} w_3 + x_1 x_2 w_4 + \cdots + b$$

A linear model of transformed inputs:

$$y = \phi(\mathbf{x})^{\mathrm{T}} \mathbf{w}$$

$\phi(\mathbf{x})$ where ϕ is a non linear transformation

How choosing the mapping $\phi(.)$?

1. To feature engineer $\phi(.)$

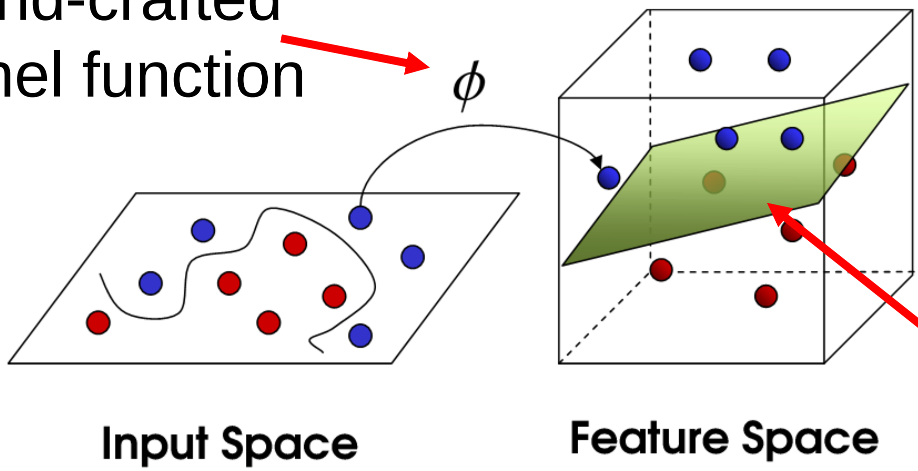
2. Use a very generic $\phi(.)$ as kernel machines (e.g. SVM, RBF kernel)

3. The strategy of **deep learning** : to learn $\phi(.)$

SVM

From: DL Tutorial
Hung-yi Lee

Hand-crafted
kernel function



Apply simple
classifier

Source of image: http://www.gipsa-lab.grenoble-inp.fr/transfert/seminaire/455_Kadri2013Gipsa-lab.pdf

The DL approach: learn $\phi(.)$

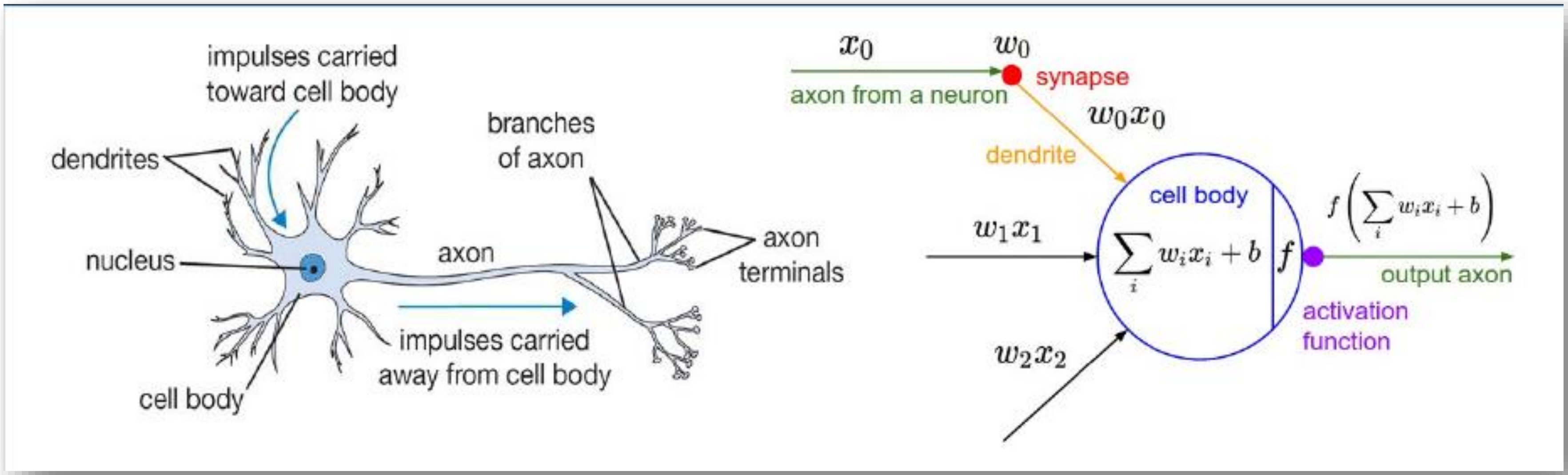
Now we have:

- Parameters $\boldsymbol{\theta}$ that we use to learn $\phi(.)$ from a broad class of functions

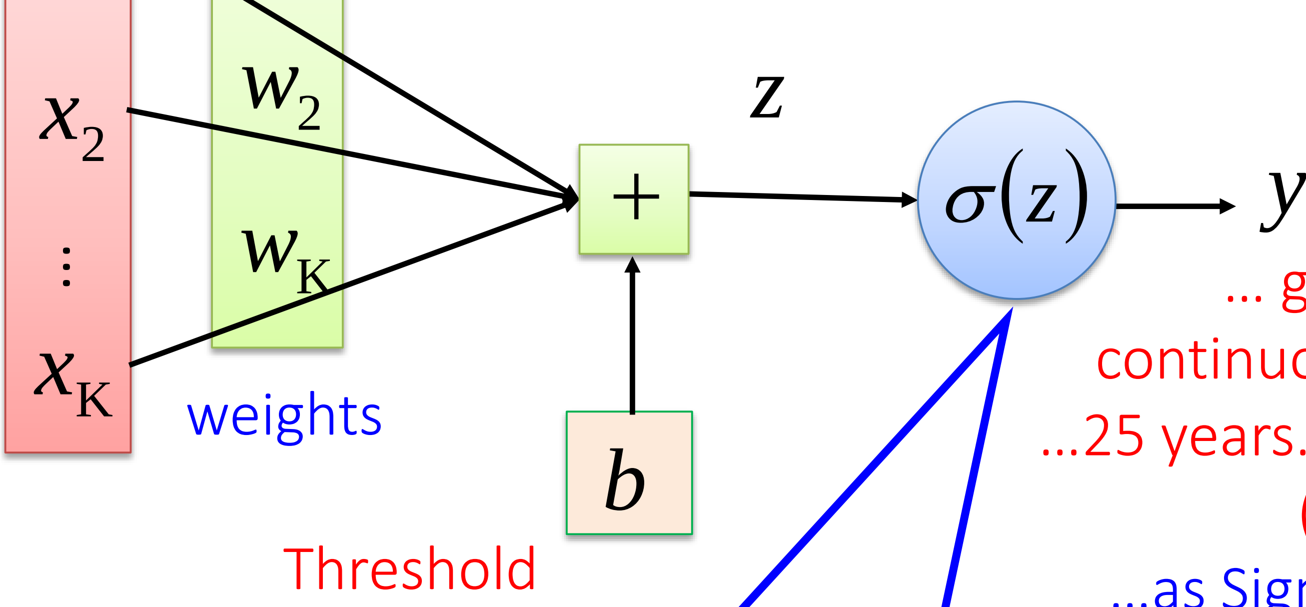
- Parameters $\mathbf{w}$ that map $\phi(\mathbf{x})$ to he desired output

$$y = f(\mathbf{x};\boldsymbol{\theta},\mathbf{w}) = \phi(\mathbf{x})^{\mathrm{T}}\mathbf{w}$$

Deep Learning



$$y = \sigma(x_1 w_1 + x_2 w_2 + \cdots + x_K w_K + b)$$



... gradients!

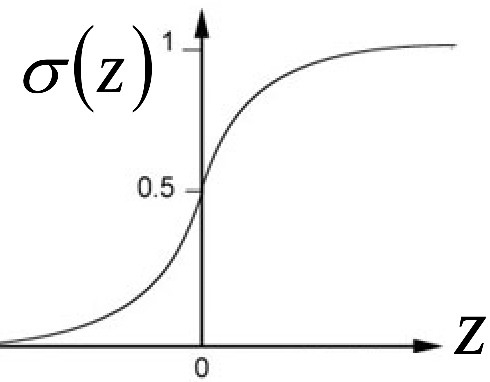
continuous activation!

...25 years... Paul J. Werbos (1974)

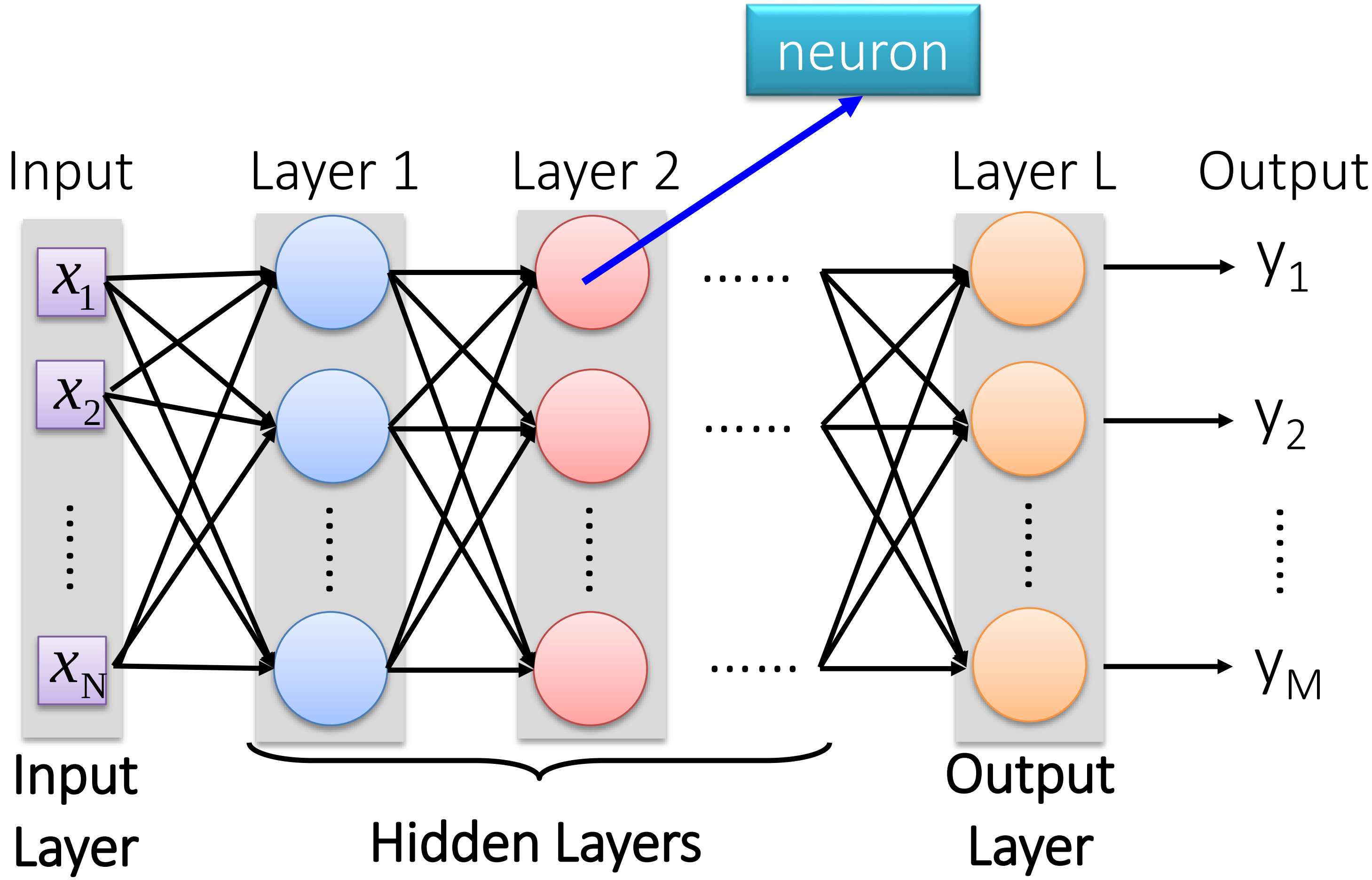
...as Sigmoid function

Sigmoid Function

$$\sigma(z) = \frac{1}{1+e^{-z}}$$



Neural Network (from Hung-yi Lee "Deep Learning Tutorial")



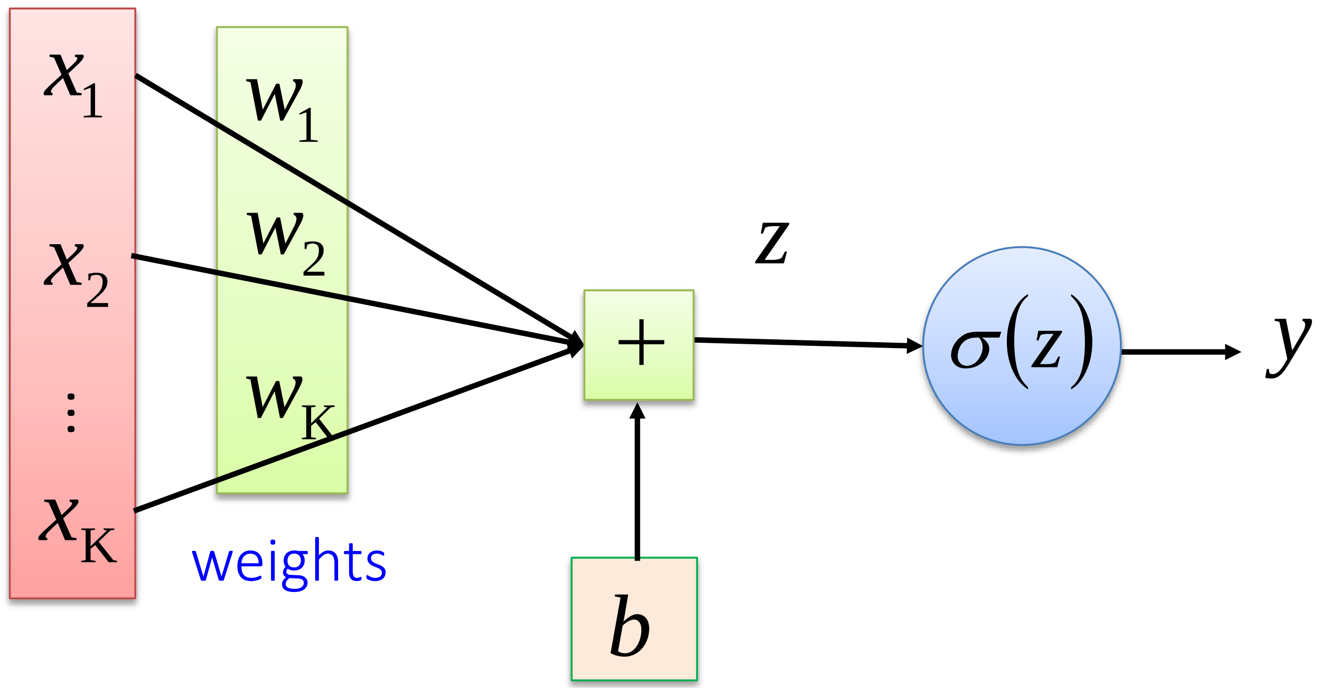
Deep means many hidden layers

From linear classifiers TO Neural Networks

- Parameters $\boldsymbol{\theta}$ that we use to learn $\phi(.)$ from a broad class of functions

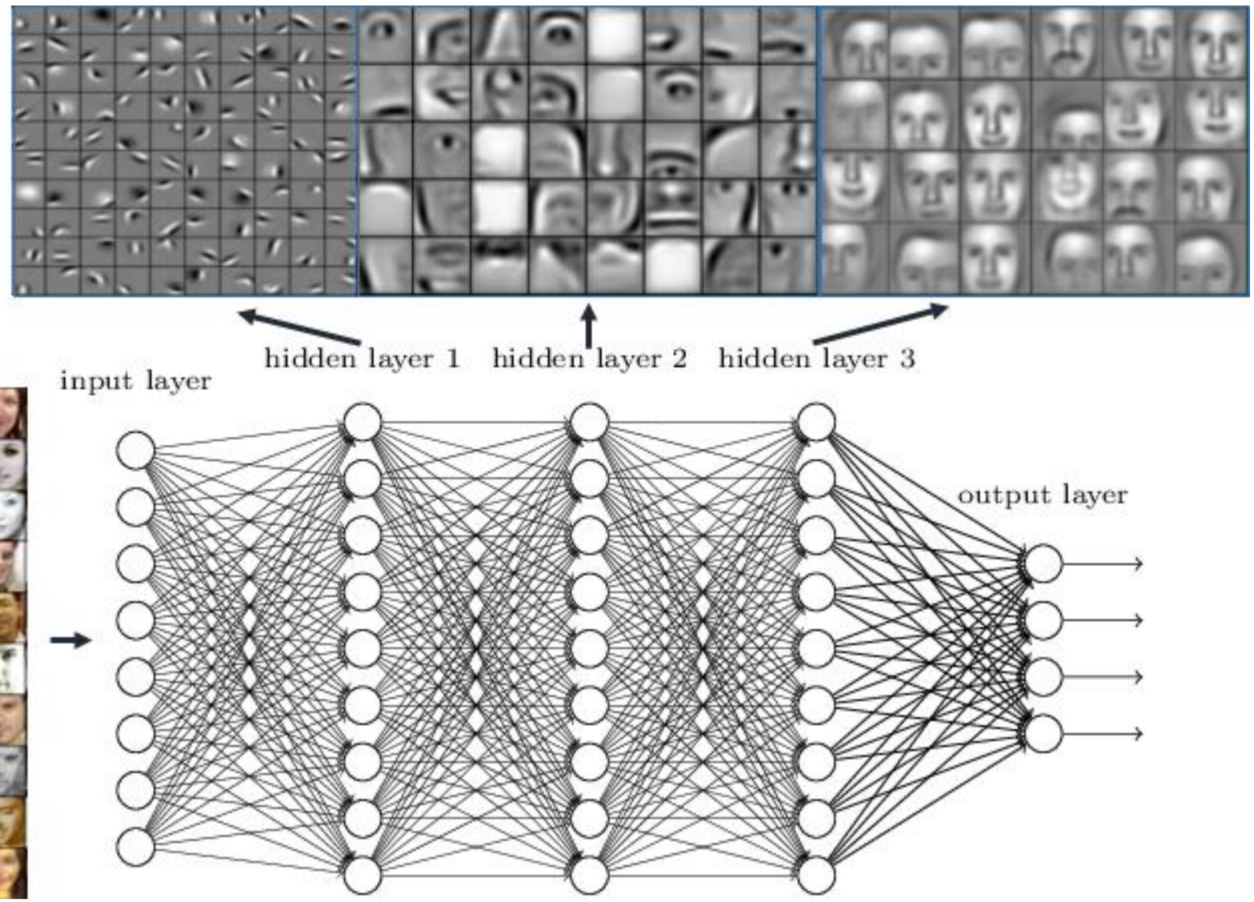
- Weights and thresholds are estimated from training examples:
  - to minimize a **loss function** (i.e. similarity between NN outputs y and desired outputs $\hat{y}$)

- But recall that this is also logistic regression!

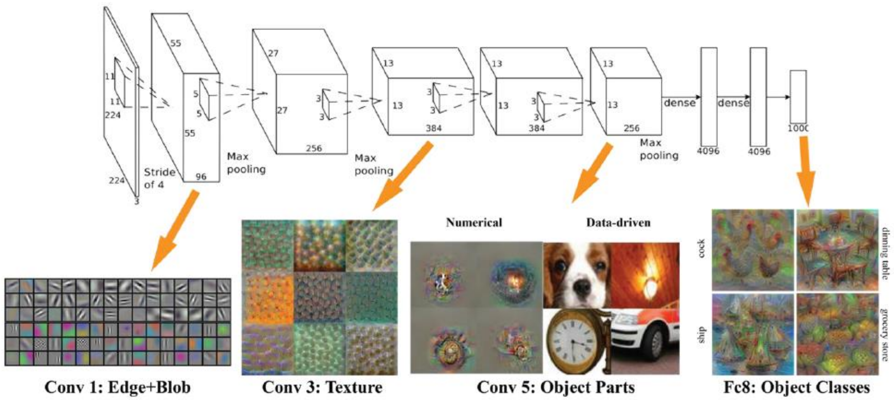


Deep Learning

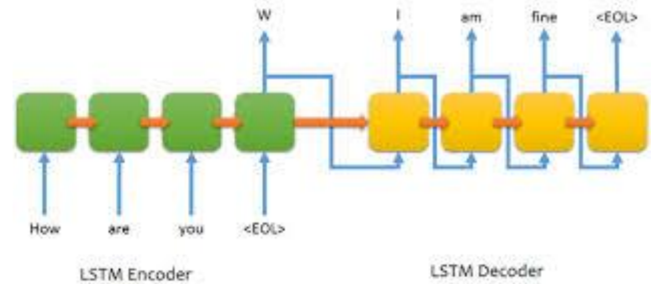
Deep neural networks learn hierarchical feature representations

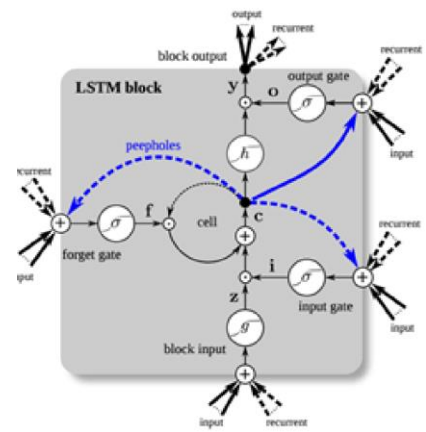


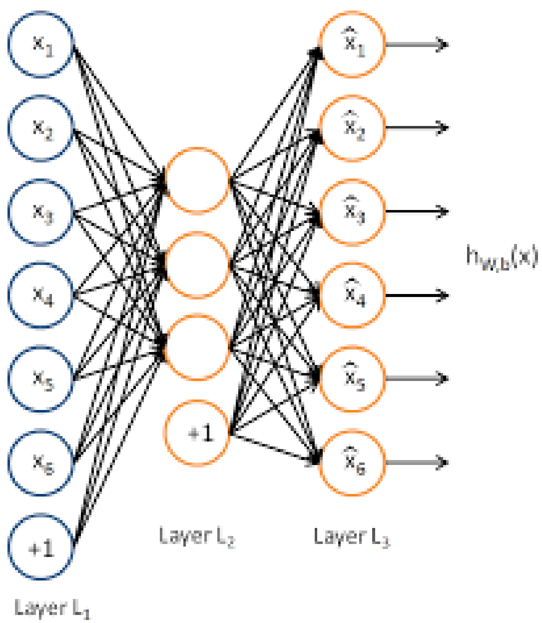
DL: architectures

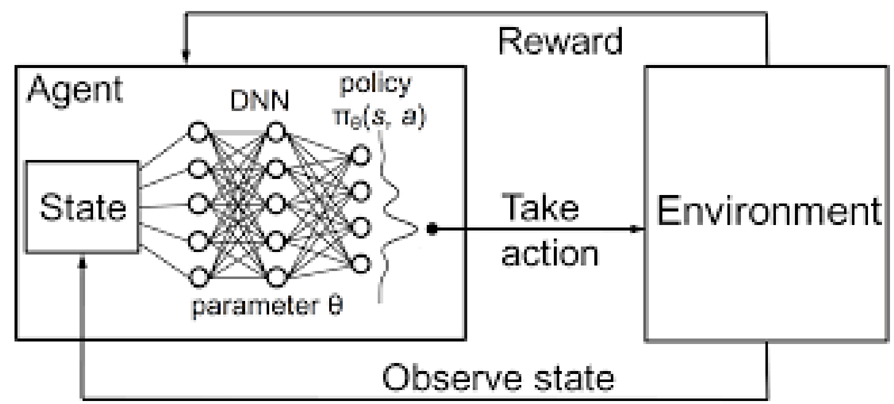


http://vision03.csail.mit.edu/cnn_art/data/single_layer.png

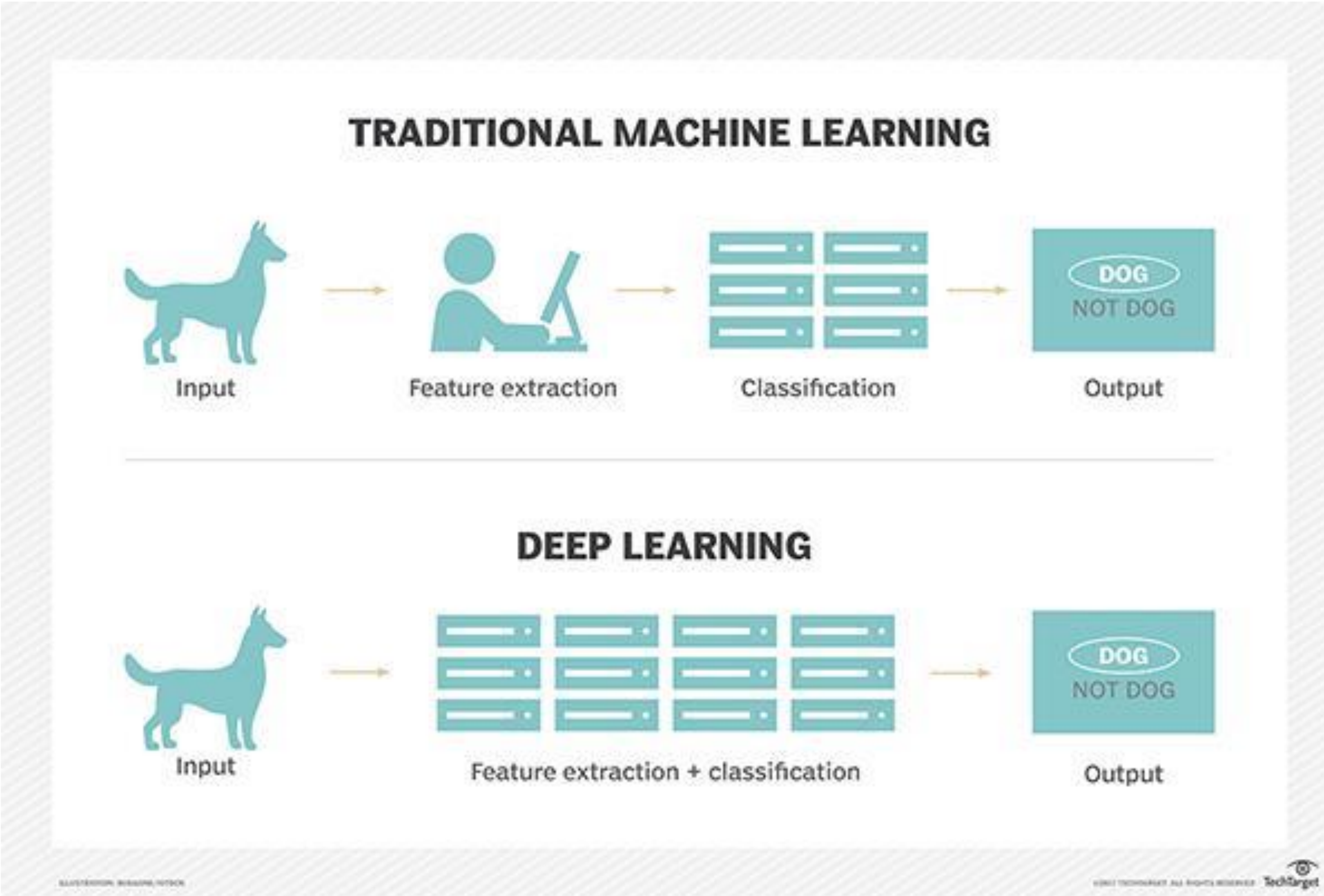








DL: no more feature engineering



What Changed?
Old wine in new bottles

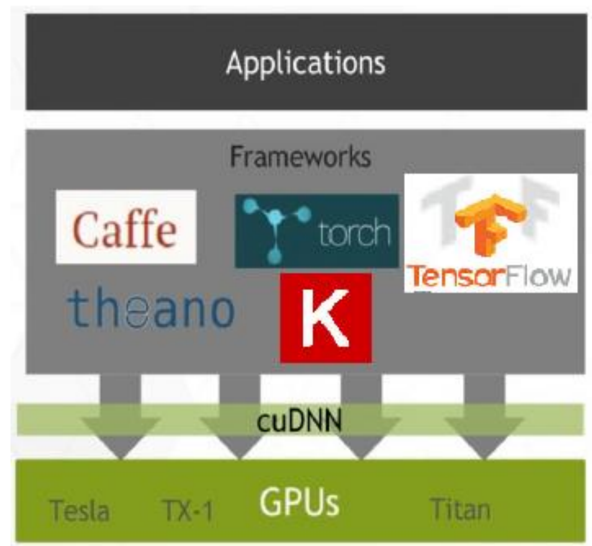
Big Data
(Digitalization)

Computation
(Moore's Law, GPUs)

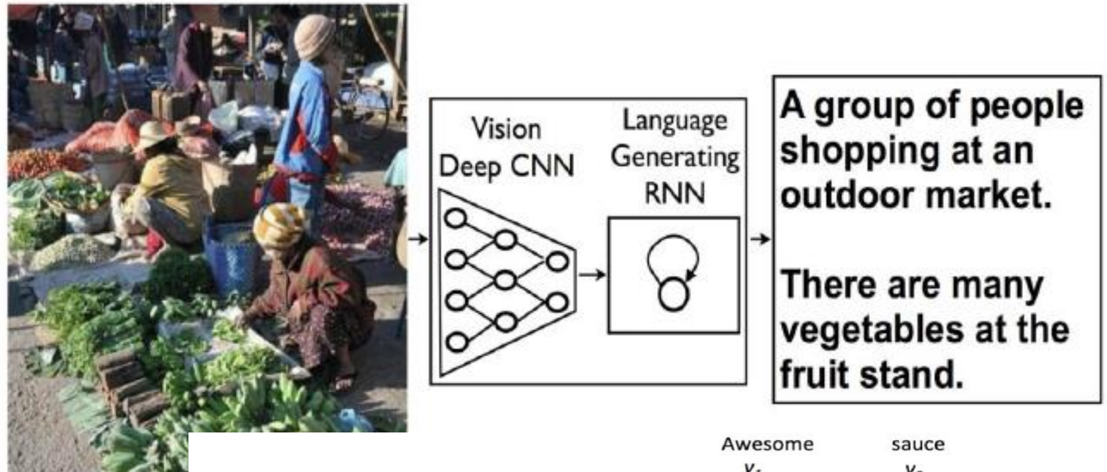
Algorithmic
Progress

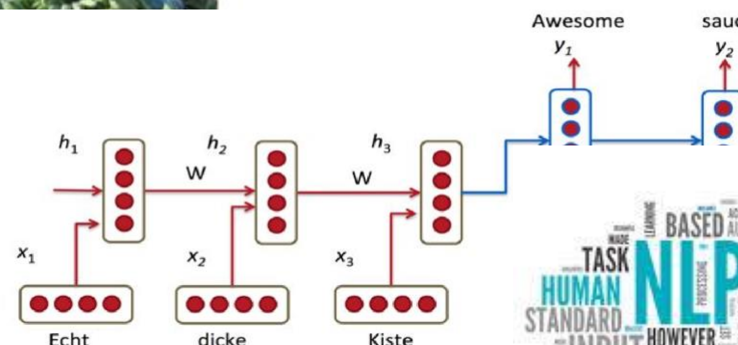
UDACITY
FREE COURSE
Deep Learning
by Google

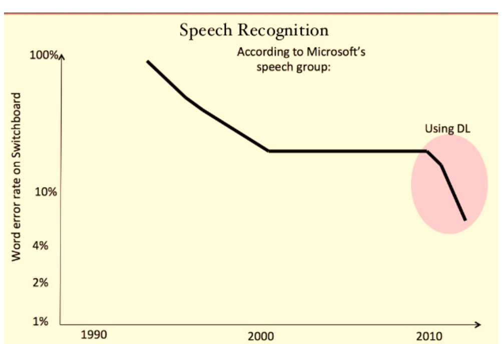
THANK YOU
GAMERS!!!
GPUs!



DL: super-human performance







Super-human speech

From linear classifiers TO Neural Networks

- So let’s stop here and start playing with

TensorFlow

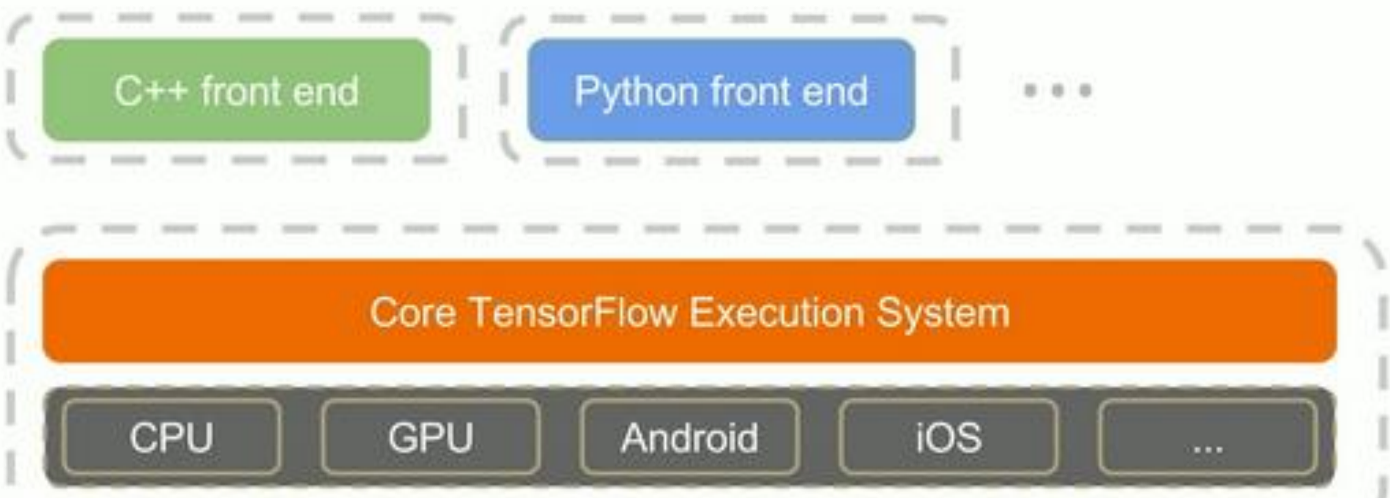
Google TensorFlow

- Library for writing “machine intelligence” algorithms
- Very popular for deep learning and neural networks
- Can also be used for general purpose numerical computations
- Interface in C++ and Python

TensorFlow: Expressing High-Level ML Computations

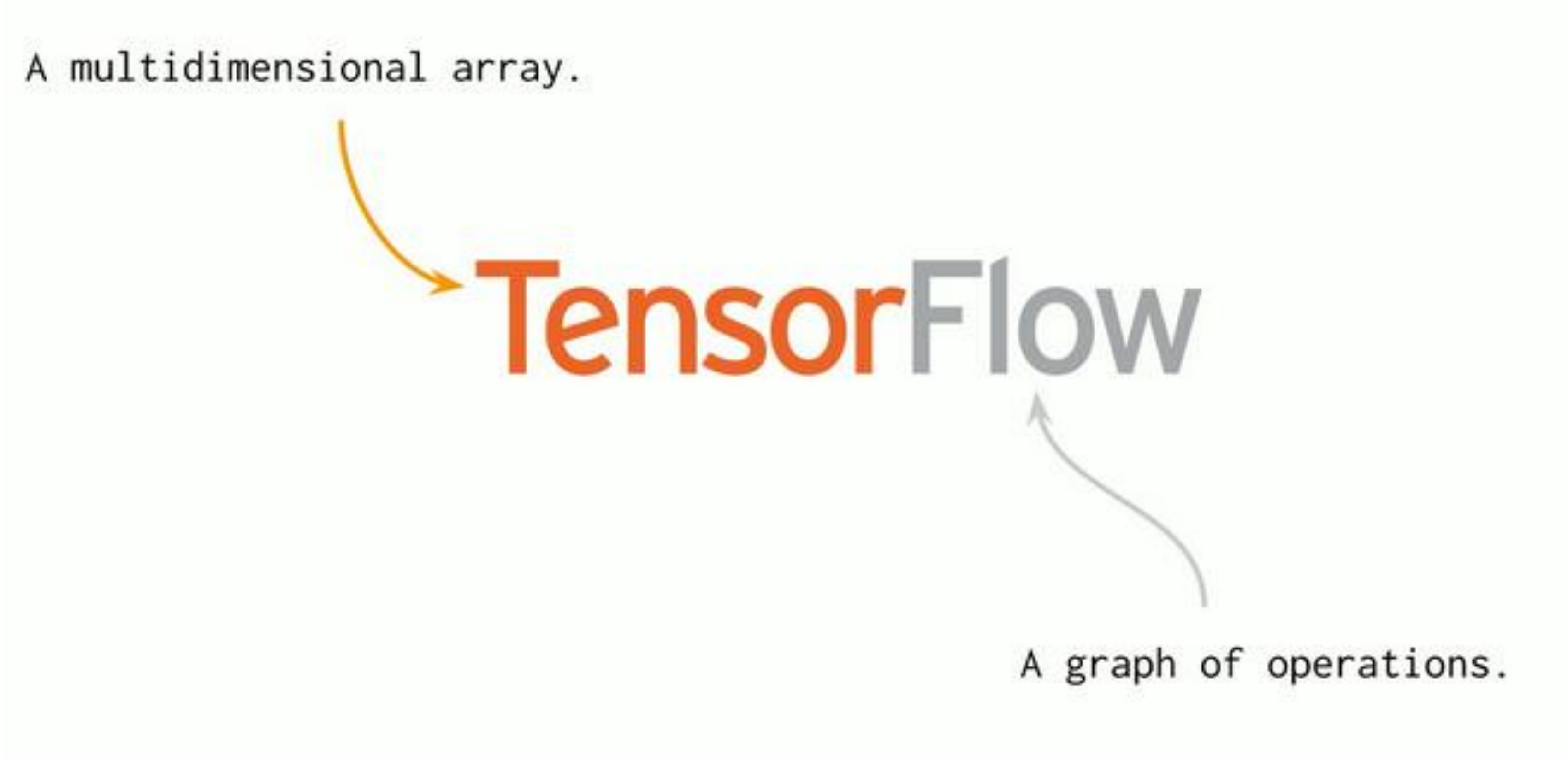
- Core in C++
- Different front ends for specifying/driving the computation

Keras



A word of caution: the APIs in languages other than Python are not yet covered by the API stability promises.

- Python
- C++
- Java
- Go

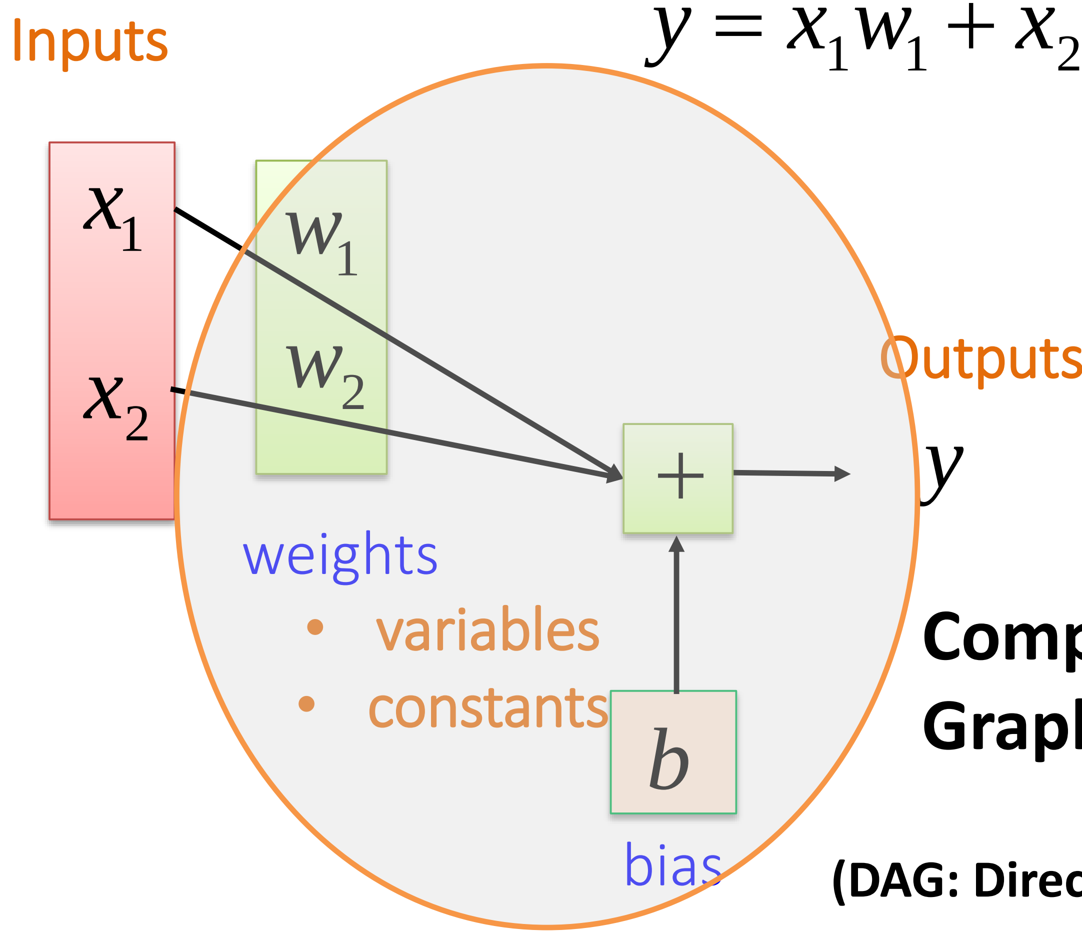


From Mihaela Rosca Talk (Deep Mind)

Generates a computational graph like Theano
Everything about TensorFlow is here:

https://www.tensorflow.org

$$y = x_1 w_1 + x_2 w_2 + b$$



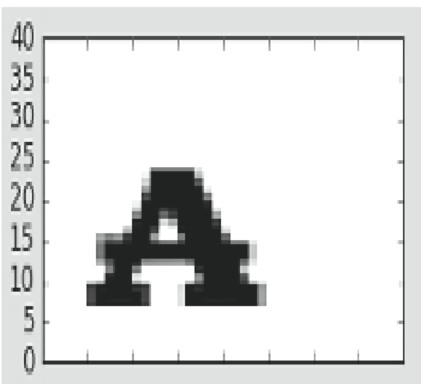
Computational Graph

(DAG: Directed Acyclic Graph)

Font type Recognition

Font type is "2"

Input	reShape	Output		
	x_1	0.1	is 1	0
	x_2	0.7	is 2	1
	⋮	⋮	⋮	⋮
	x_{1296}	0.2	is N	0



36 x 36 = 1296

Elements [0:255]

White pixel → 0

Black pixel → 255

OHE

One-Hot-Encoding

We recommend you try:

Colaboratory

It's a Jupyter notebook environment that requires no setup to use and runs entirely in the cloud.

Colaboratory is free to use.

Welcome to Colaboratory!

- Colaboratory is a Google research project created to help disseminate machine learning education and research.

- Colaboratory notebooks are stored in Google Drive and can

GPU Support (NEW!)

Colab now supports running TensorFlow computations on a

Eurielec_FontReco_LogisticRegression_2018.ipynb

Eurielec_ColaboratoryInfo_2018.ipynb

OPTIMIZATION

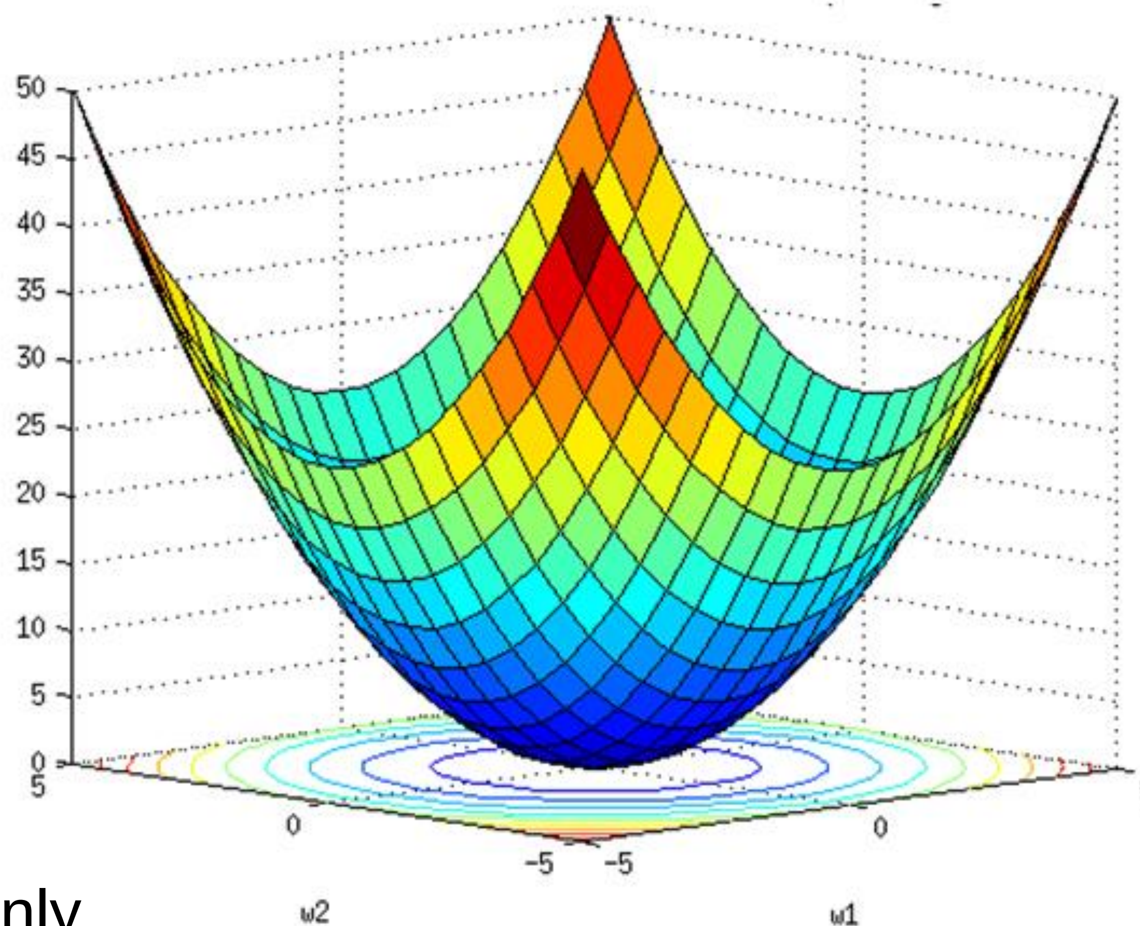
Gradient Descent

Cost

Or

Loss function

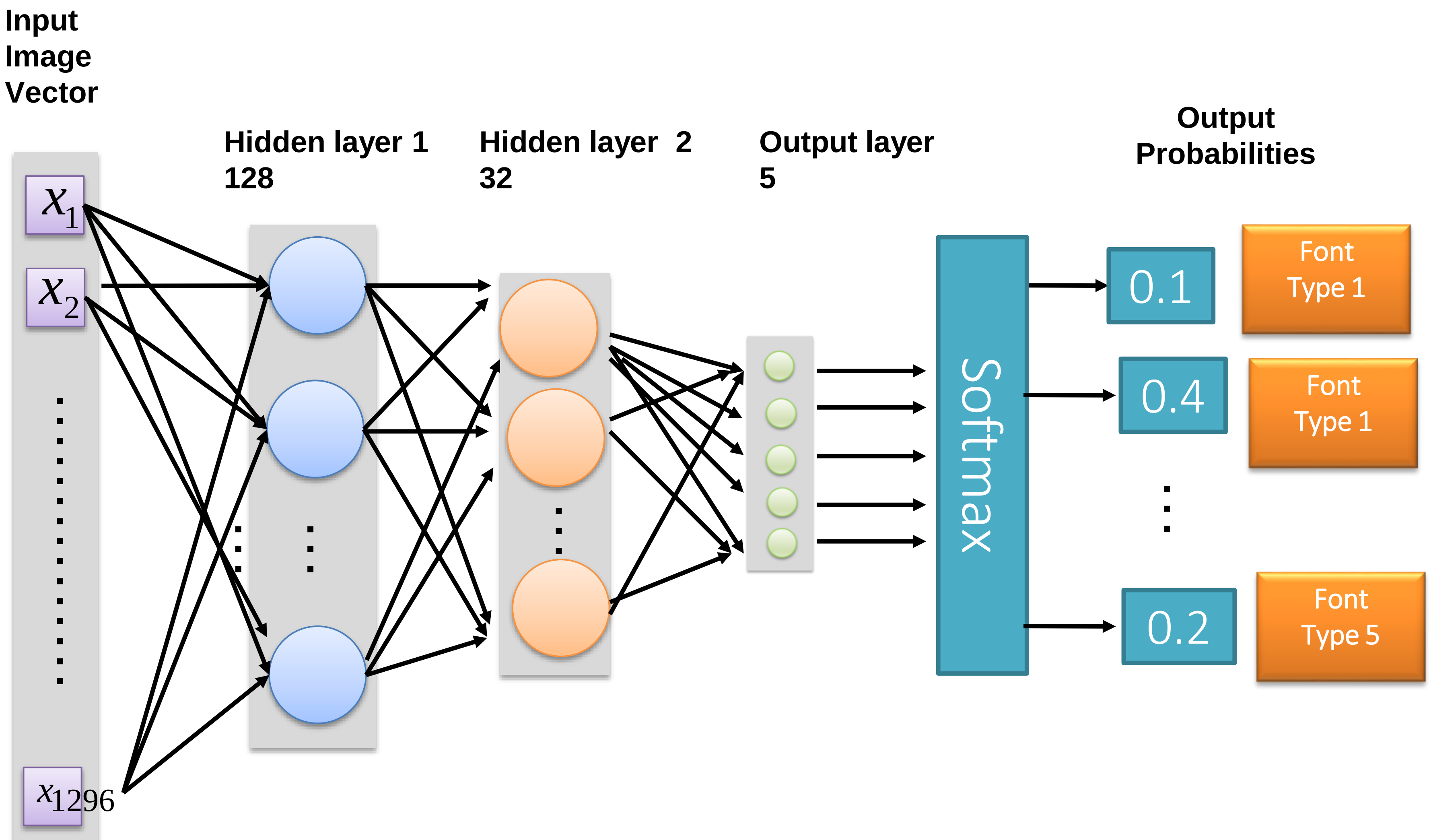
$C(\theta)$



Assume there are only two parameters w_1 and w_2 in a network.

$$\theta = \{w_1, w_2\}$$

Eurielec_FontReco_LogisticRegression_2018.ipynb



Keras: The Python Deep Learning library

Guiding principles

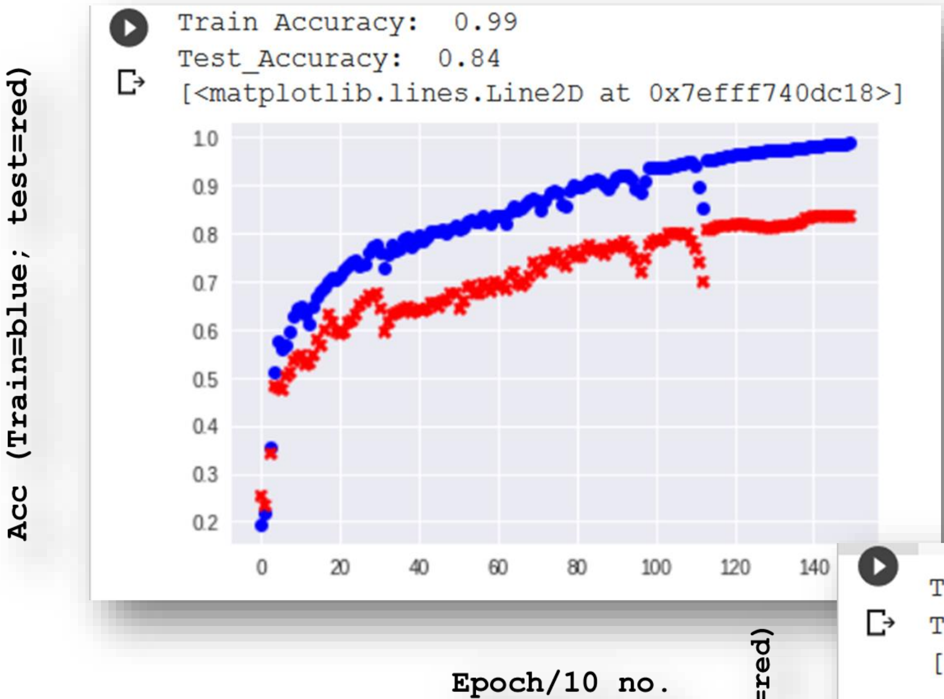
- User friendliness
- Modularity
- Easy extensibility
- Work with Python

Keras

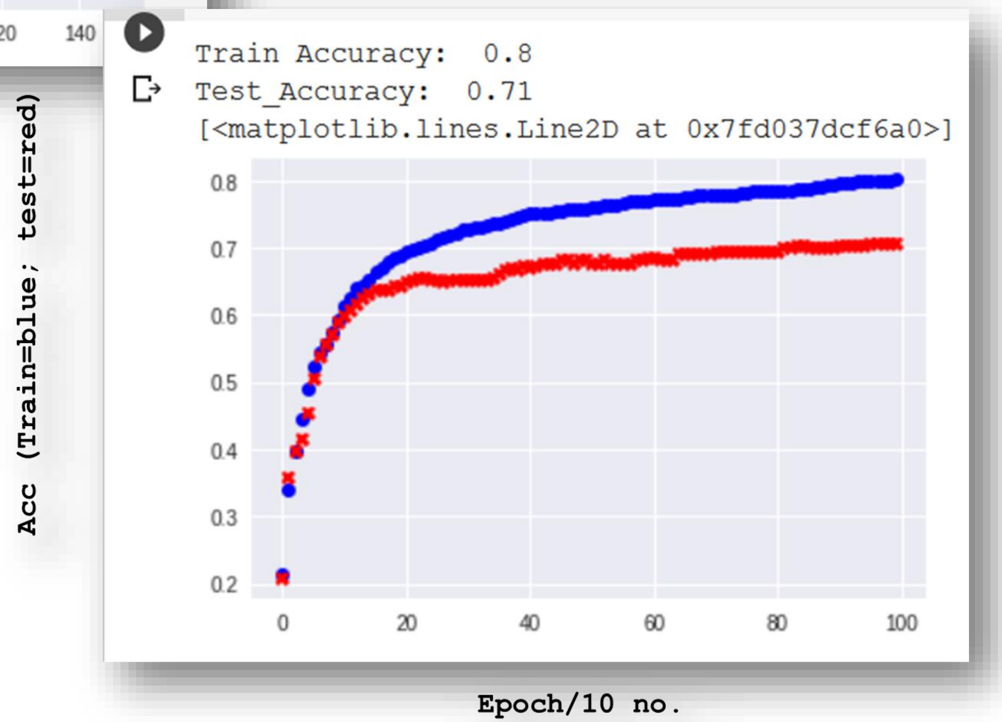
Activities:

Introduction to Keras: Font Recognition using:
Eurielec_Keras_FontReco_FeedFordward.ipynb

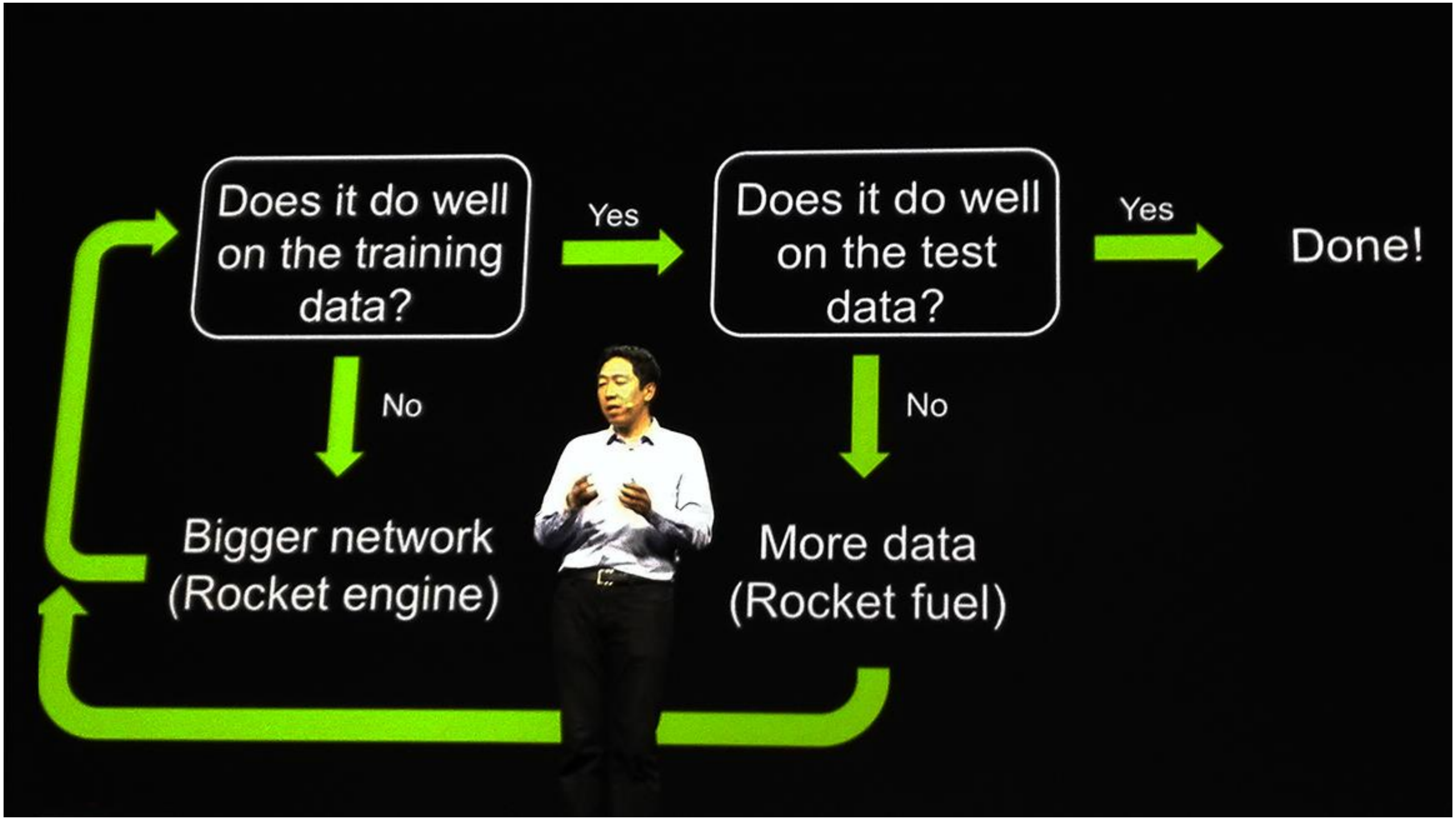
Feed Forward



Logistic Regressio

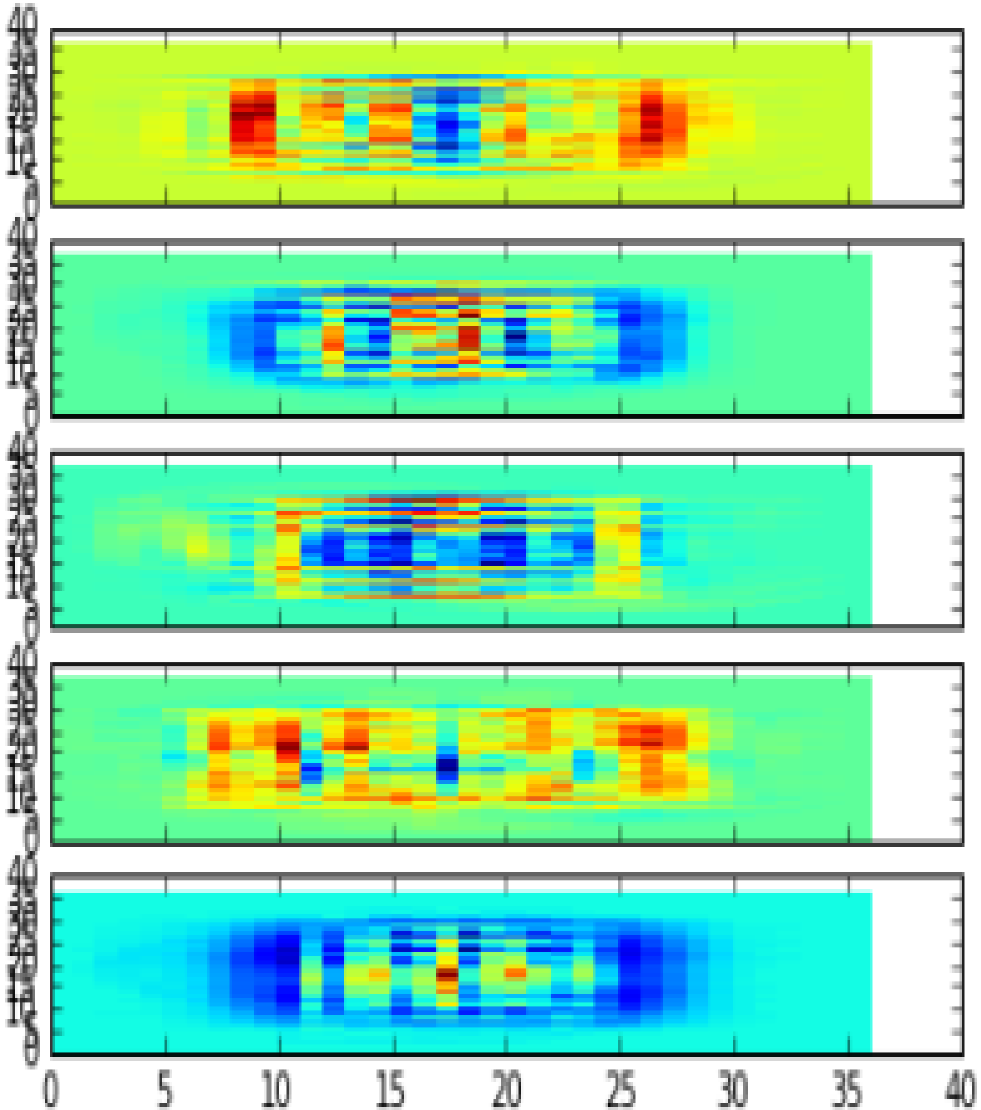


Recipe for Learning

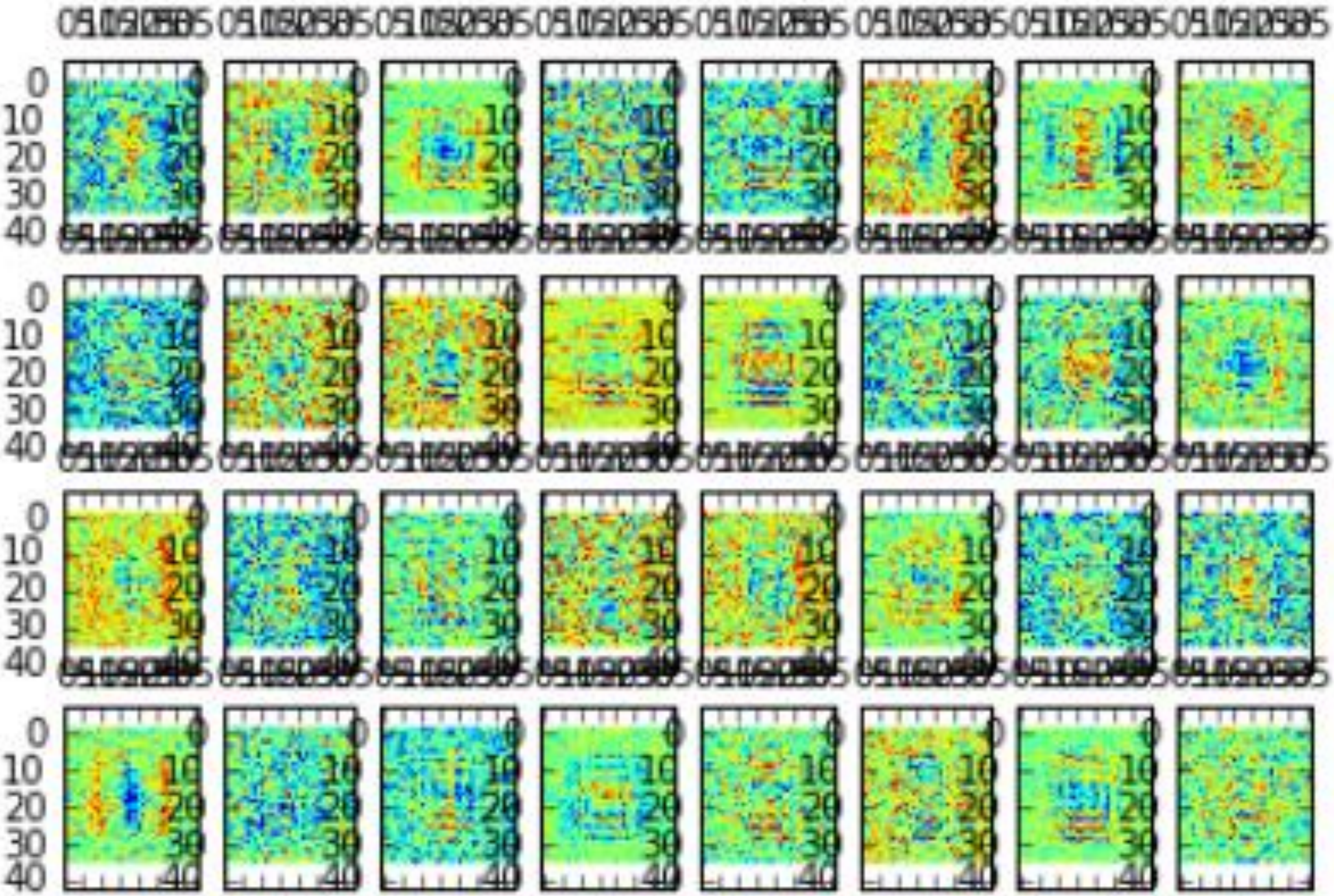


http://www.gizmodo.com.au/2015/04/the-basic-recipe-for-machine-learning-explained-in-a-single-powerpoint-slide/

Logistic Regression

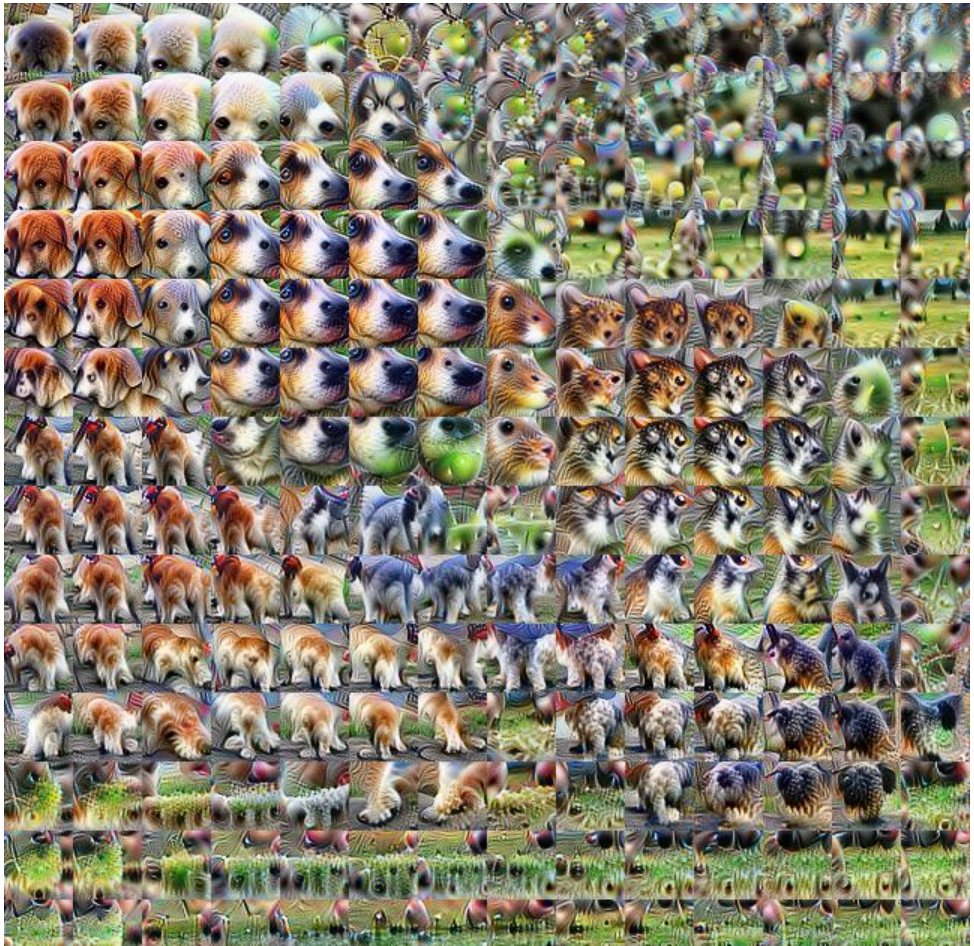


Feed Forward

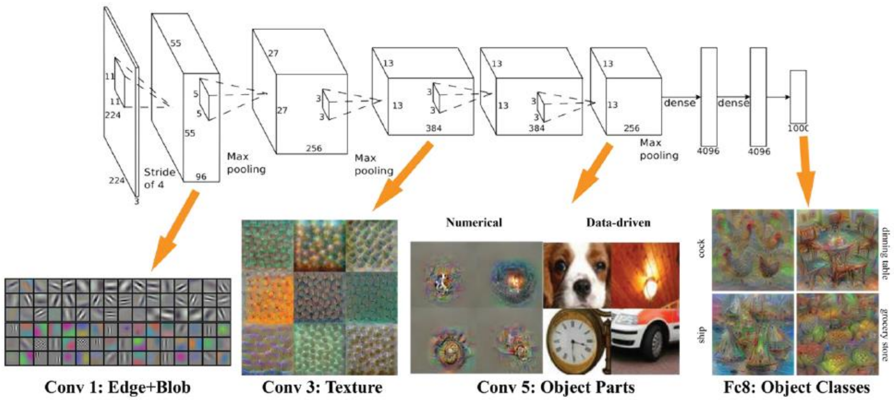


The Building Blocks of Interpretability
https://distill.pub/2018/building-blocks/

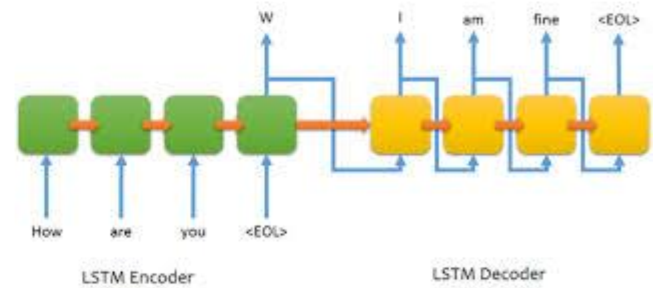
Interpretability techniques are normally studied in isolation.
We explore the powerful interfaces that arise when you combine them — and the rich structure of this combinatorial space

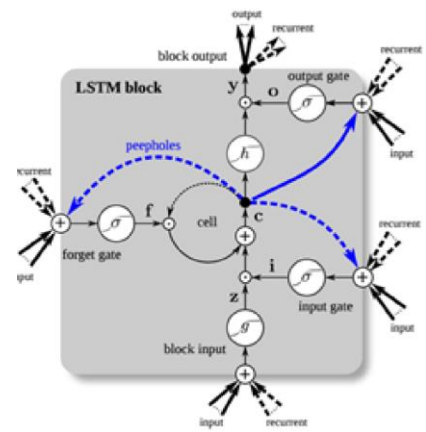


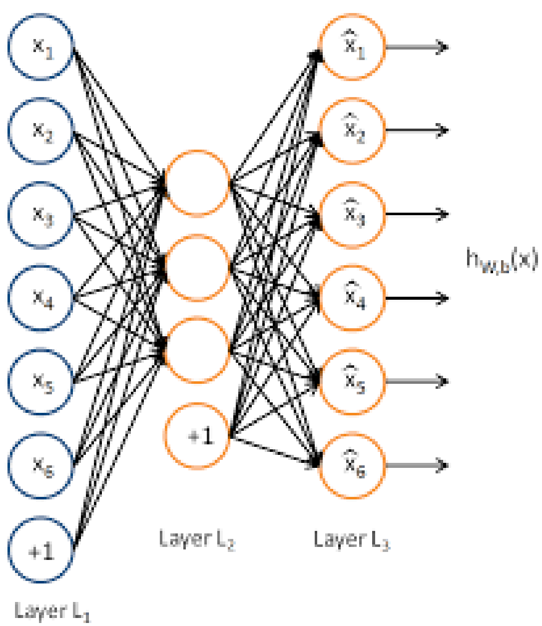
DL: architectures

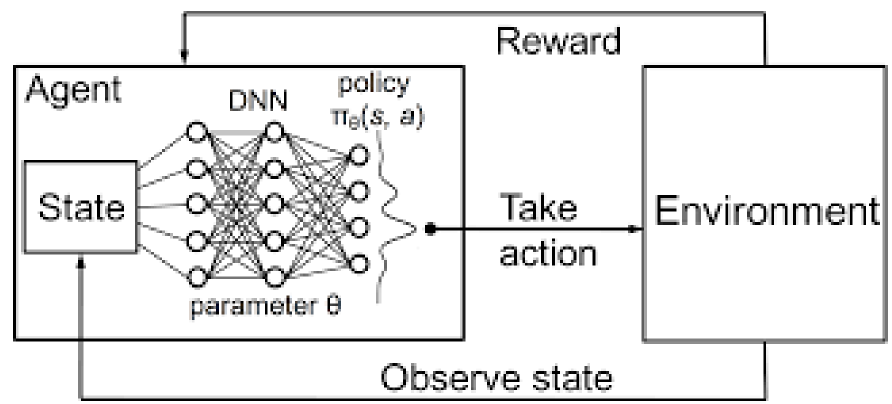


http://vision03.csail.mit.edu/cnn_art/data/single_layer.png









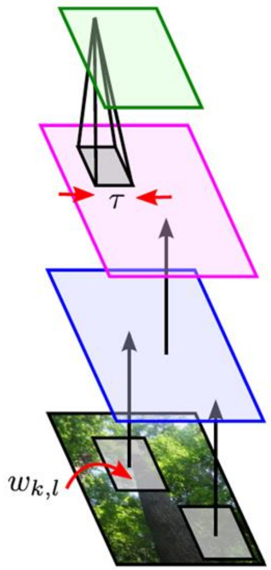
CNN / ConvNets:
Convolutional Neural Network

organizes neurons based on animal's visual cortex system, which allows for learning patterns at both local level and global level.

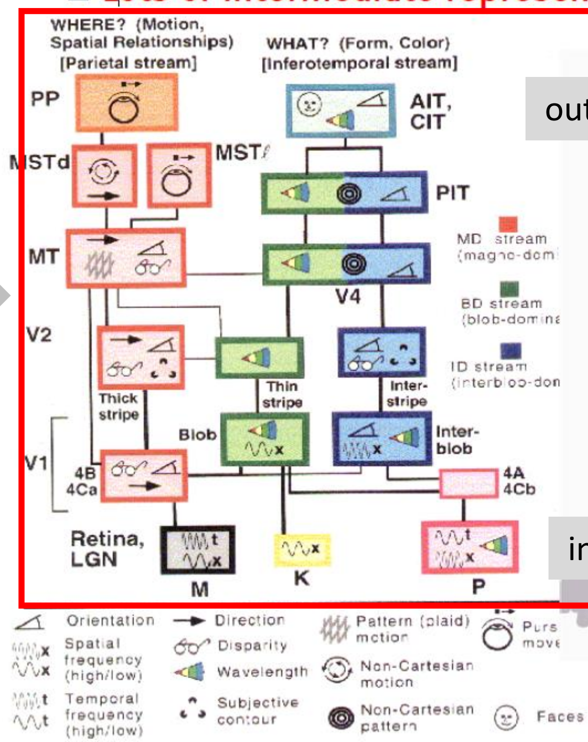
- Y. LeCun, L. Bottou, Y. Bengio and P. Haffner: Gradient-Based Learning Applied to Document Recognition, Proceedings of the IEEE, 86(11):2278-2324, November 1998

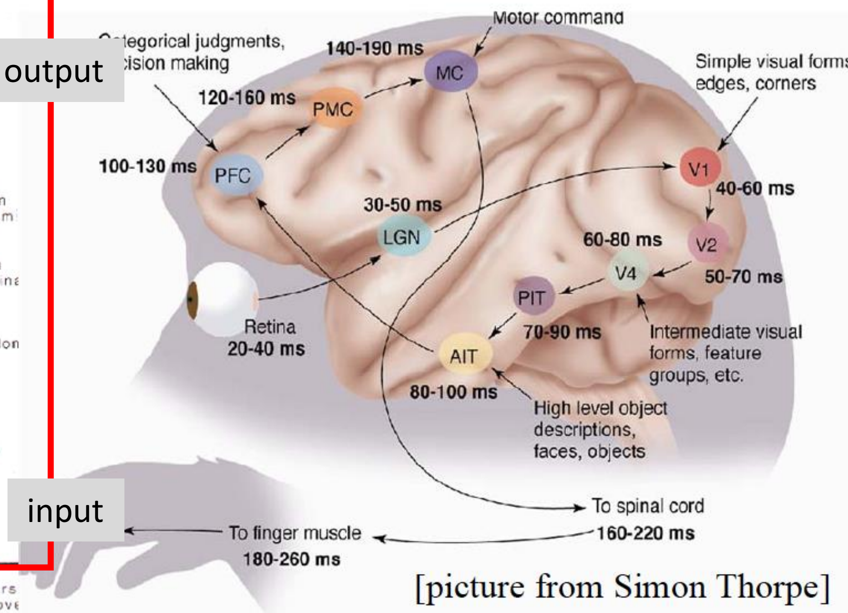
The Mammalian Visual Cortex Inspires CNN

Convolutional Neural Net



- The ventral (recognition) pathway in the visual cortex has multiple stages
- Retina - LGN - V1 - V2 - V4 - PIT - AIT ....
- Lots of intermediate representations



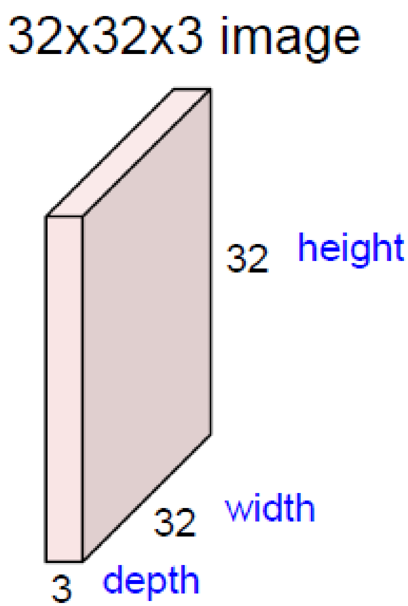


[Gallant & Van Essen]

Convolutional Neural Networks

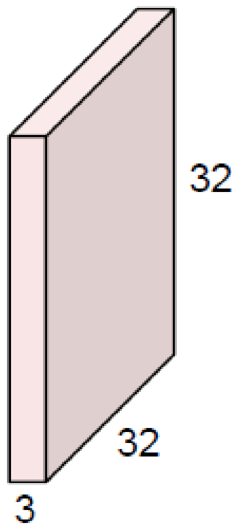
(First without the brain stuff)

Convolution Layer

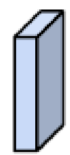


Convolution Layer

32x32x3 image



5x5x3 filter

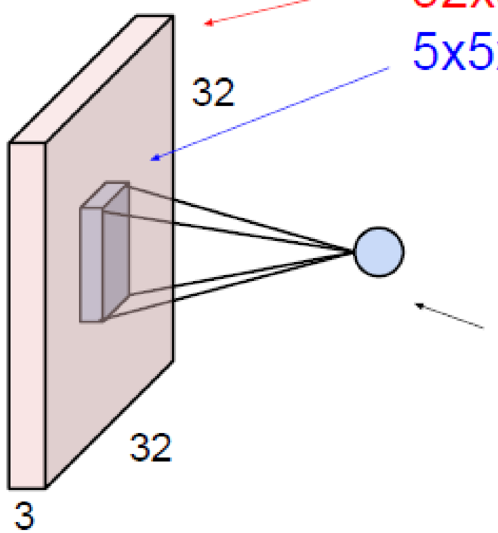


Convolve the filter with the image i.e. “slide over the image spatially, computing dot products”

Convolution Layer

32x32x3 image

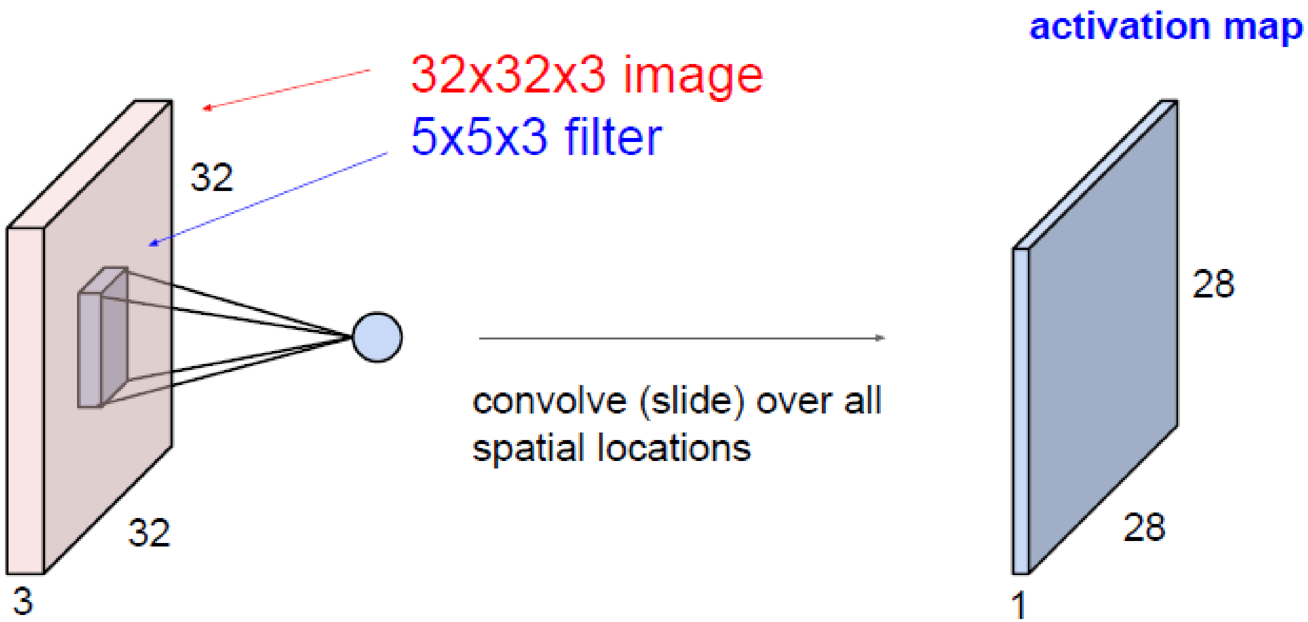
5x5x3 filter w



1 number:
the result of taking a dot product between the filter and a small 5x5x3 chunk of the image
(i.e. 5*5*3 = 75-dimensional dot product + bias)

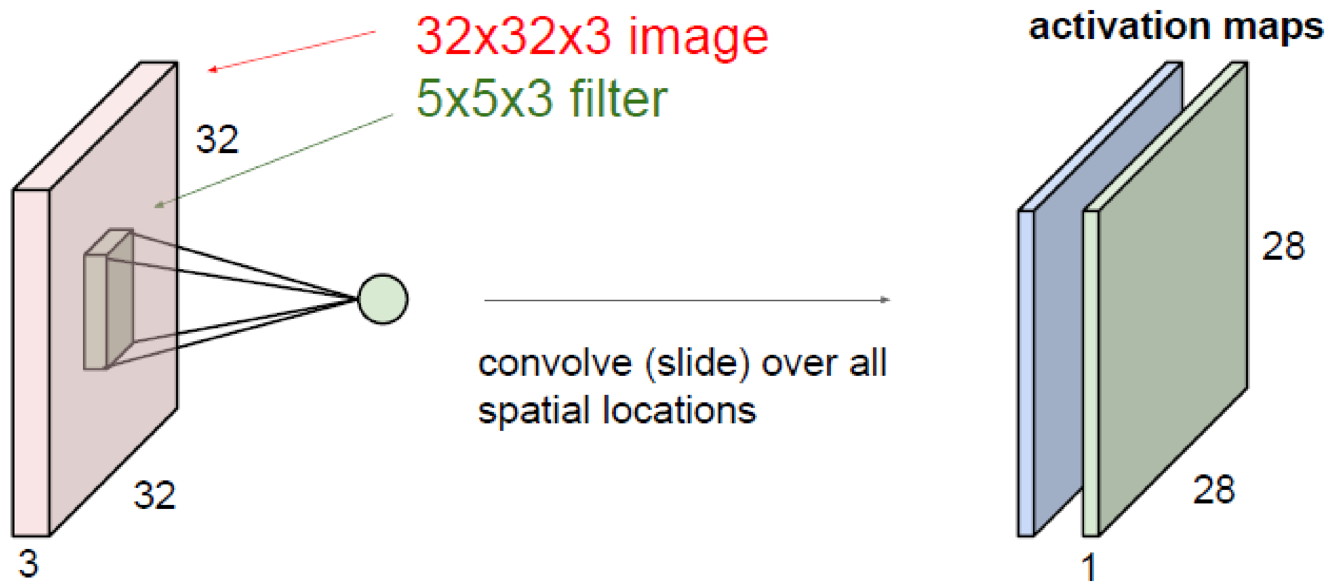
$$w^T x + b$$

Convolution Layer

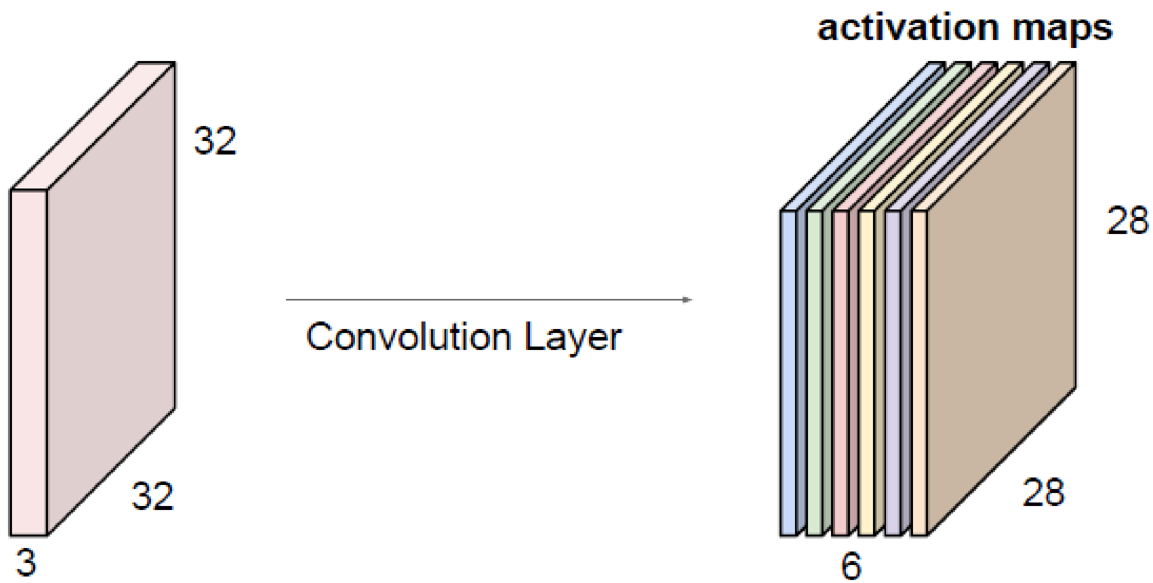


Convolution Layer

consider a second, green filter



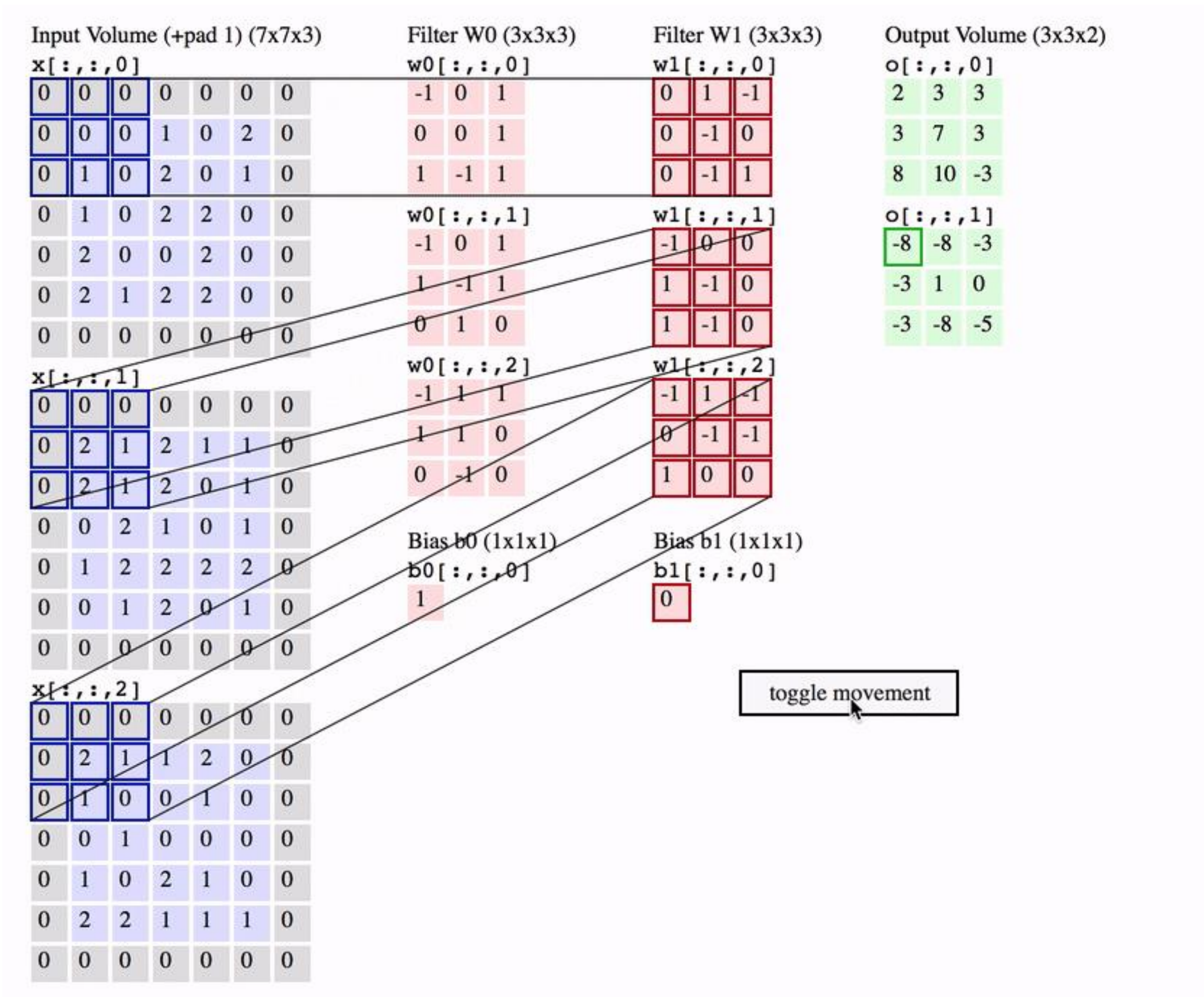
For example, if we had 6 5x5 filters, we'll get 6 separate activation maps:



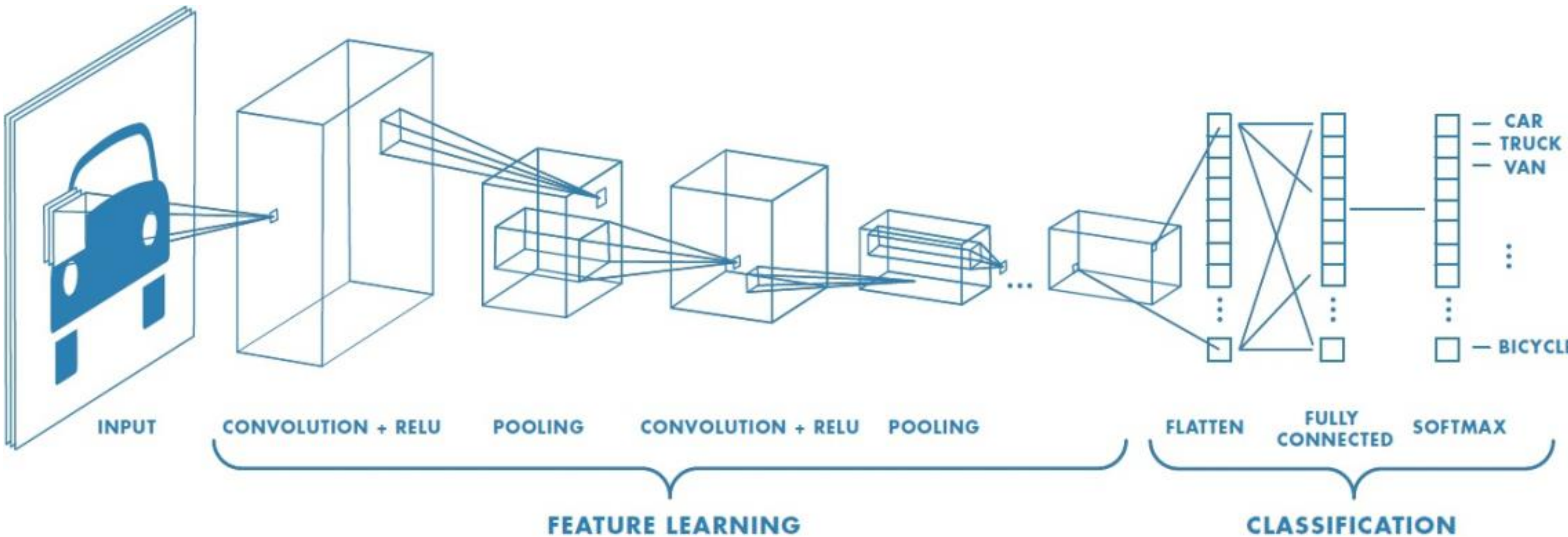
We stack these up to get a "new image" of size 28x28x6!

CNN nice visualization

http://cs231n.github.io/convolutional-networks/



CNN / ConvNet Architecture:



https://sefiks.com/2017/11/03/a-gentle-introduction-to-convolutional-neural-networks/

Keras

Play with:

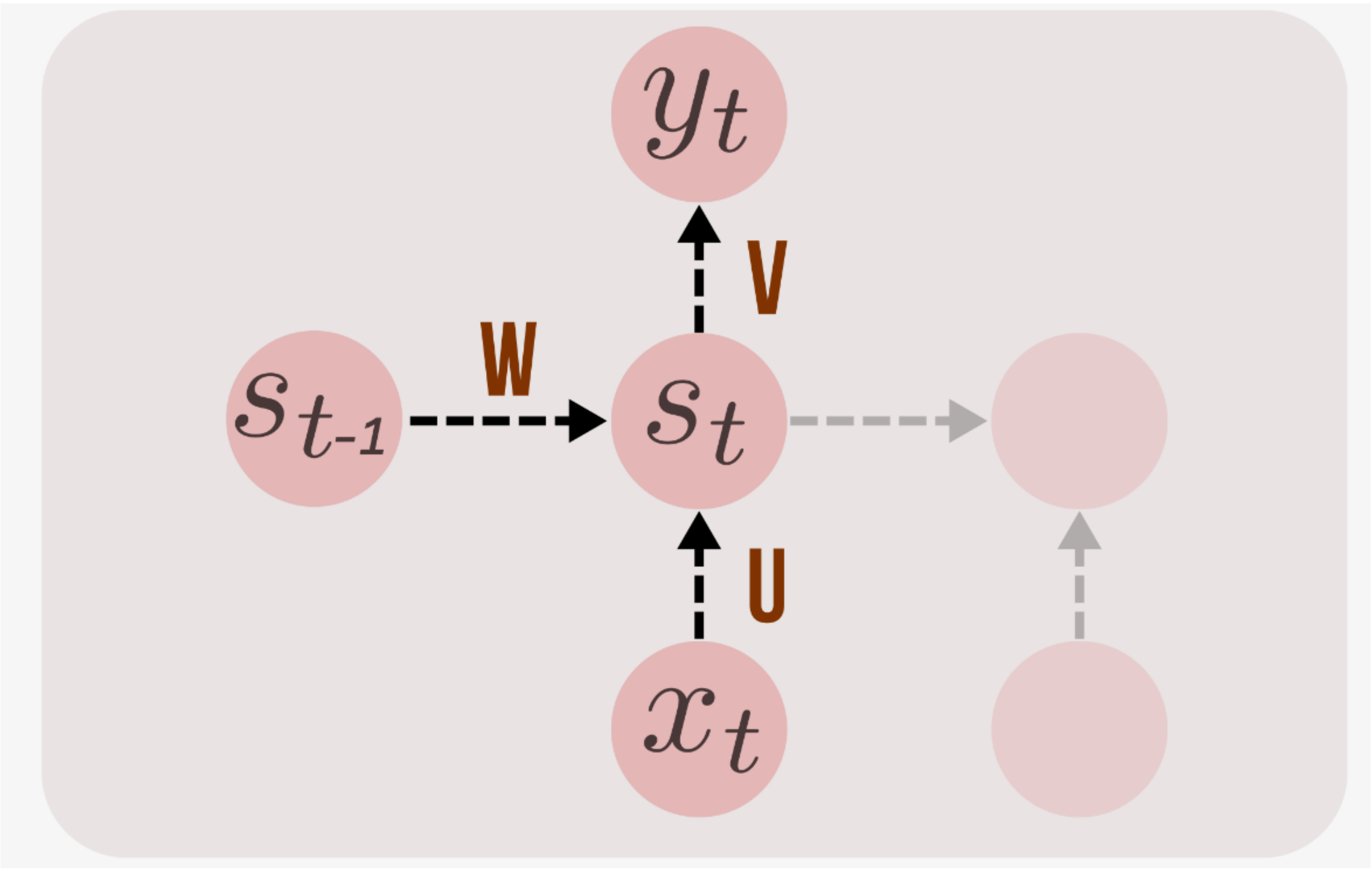
Eurielec_Keras_FontReco_CNN_2018.ipynb

… and much more to learn!!!

OUTPUT y_t

logits = tf.matmul(state, V) + b

predictions = tf.nn.softmax(logits)



RNN essentially describe programs:

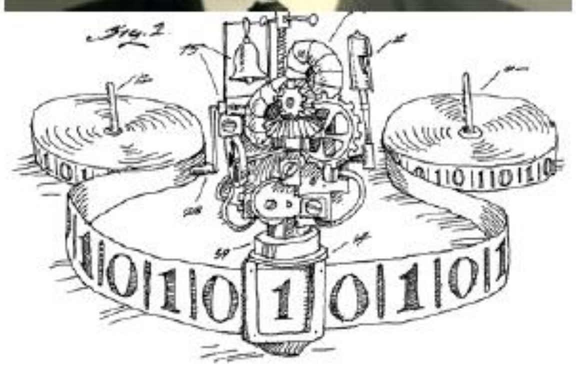
inputs + some internal variables.

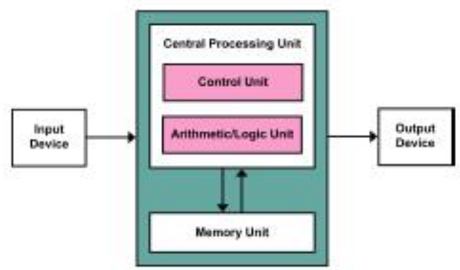
In fact, it is known that RNNs are Turing-Complete in the sense that they can to simulate arbitrary programs (with proper weights).

Neural Turing Machines

Can neural nets learn programs?

Alex Graves
Greg Wayne
Ivo Danihelka





…path to **AI**??

…. But " forget I said anything."

Andrej Karpathy
http://karpathy.github.io/2015/05/21/rnn-effectiveness

Recurrent Neural Networks Applications

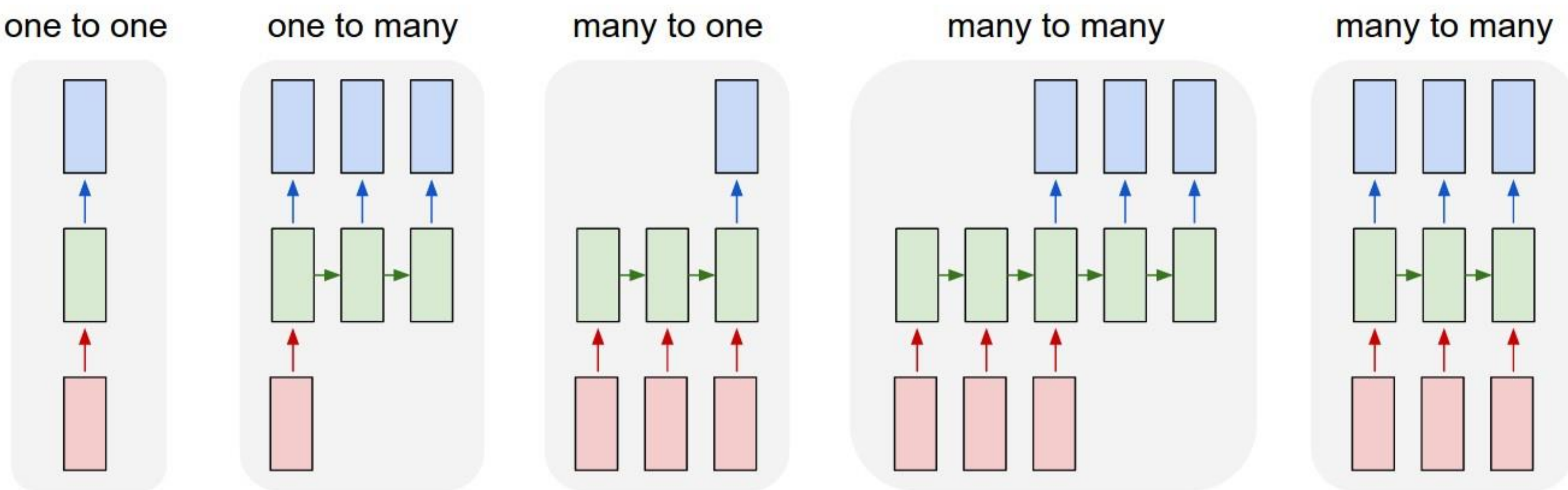


Image description using text

Emotion Recognition

Language Model

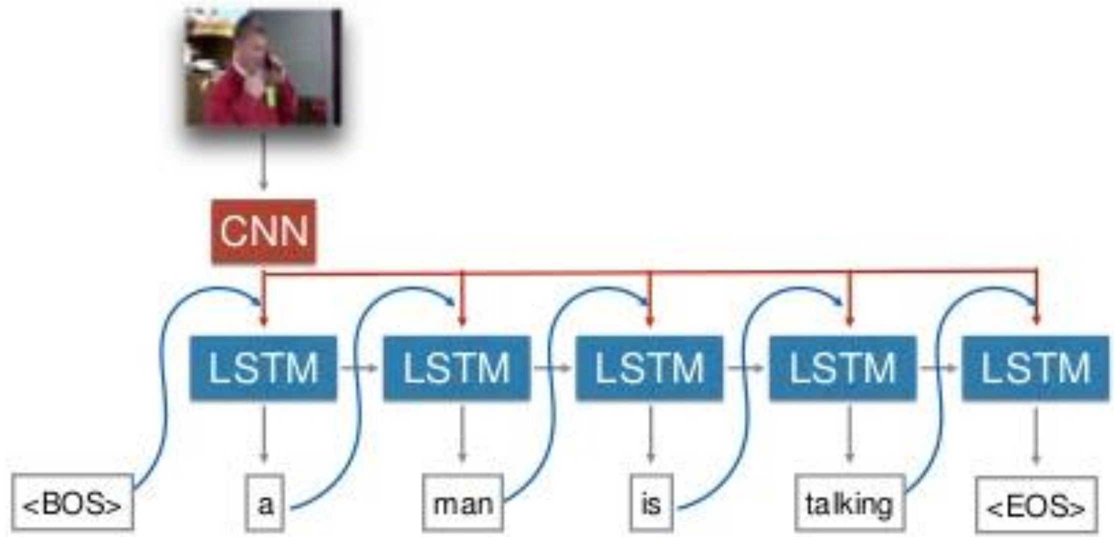
Machine Translation

Video frame labelling

Phoneme Recognition

Image Description

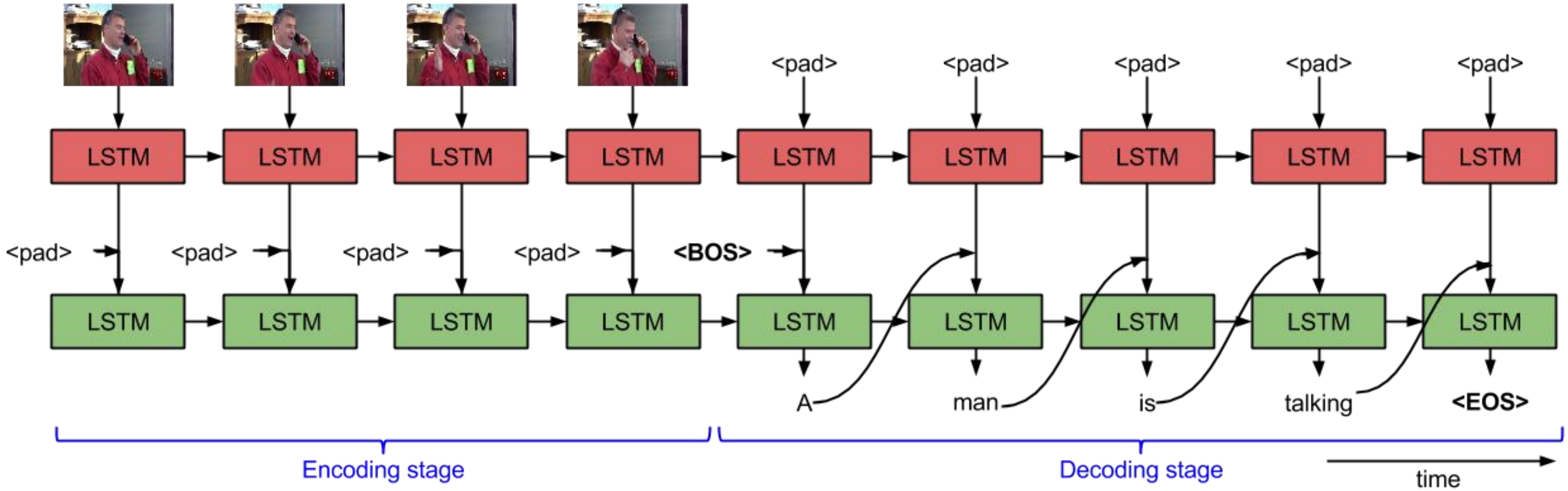
sequential
output



- Jeff Donahue, CVPR Caffe Tutorial, June 6, 2015

Sequence to Sequence - Video to Text

Subhashini Venugopalan, et al.



Text prediction & generation using RNN

Keras

Text Prediction/Generation with Keras using LSTM: *Long Short Term Memory* networks

```
In this example we will work with the book: Alice's Adventures in Wonderland by Lewis Carroll.

We are going to learn the dependencies between characters and the conditional probabilities of characters in sequences
so that we can in turn generate wholly new and original sequences of characters.
```

Adapted from:

Text Generation With LSTM Recurrent Neural Networks in Python with Keras

By Jason Brownlee

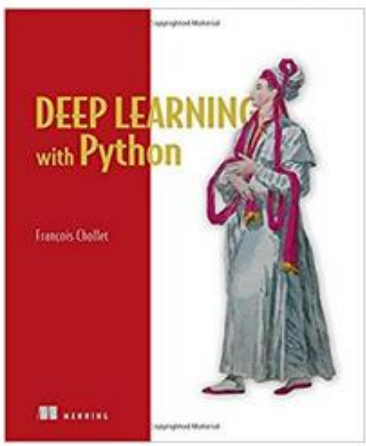
Embedding:

Indices by themselves, carry no **semantic** meaning

https://github.com/MasterMSTC/DeepLearning_TF_Keras

MSTC_Keras_RNN_3_Word_Embeddings_2018.ipynb

Word Embeddings with Keras

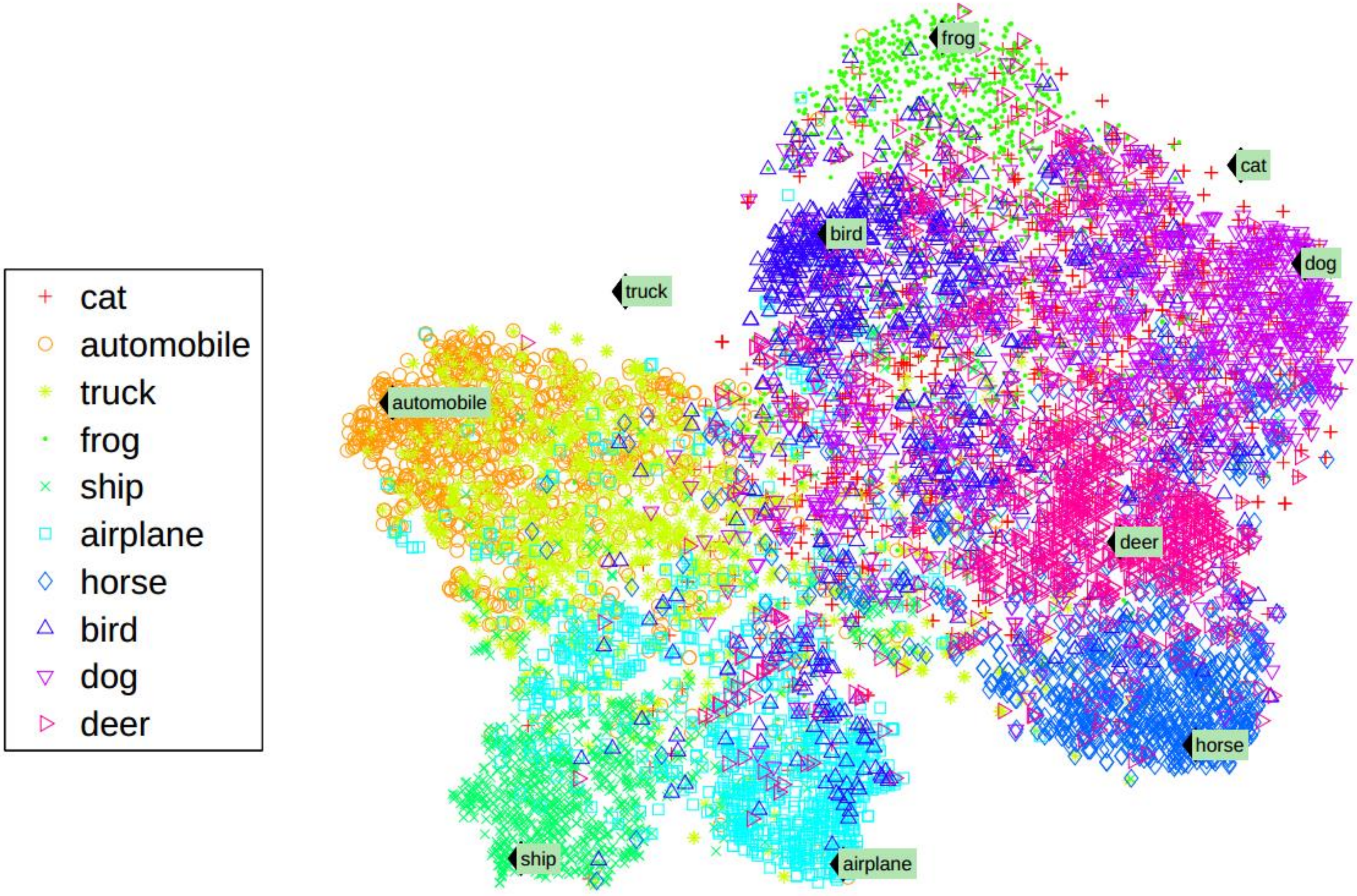


Adapted from:

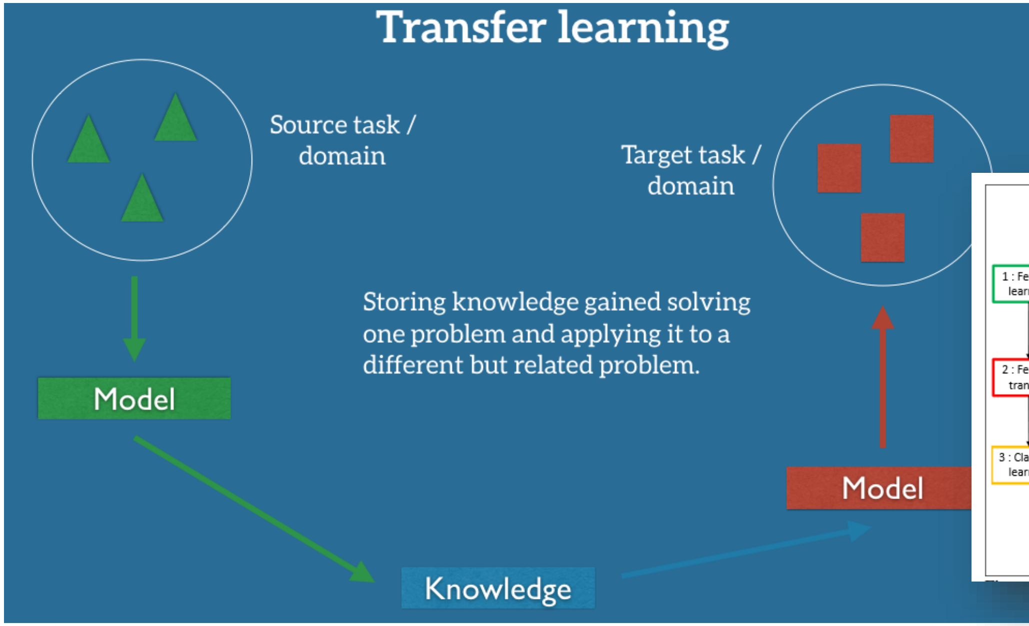
6.1-using-word-embeddings

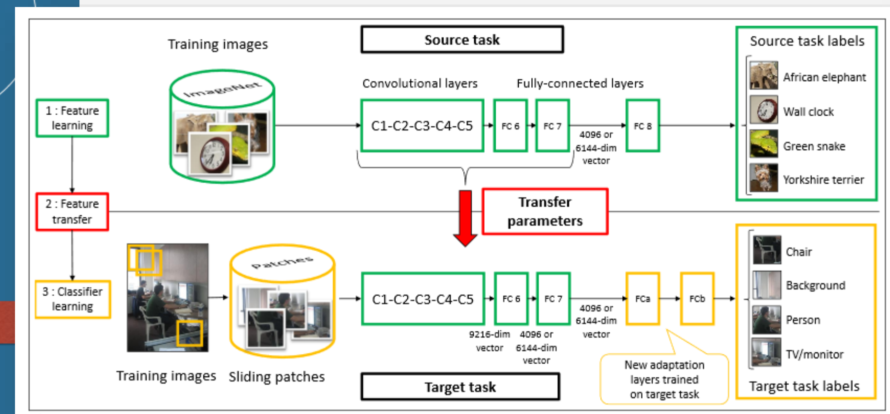
By François Chollet

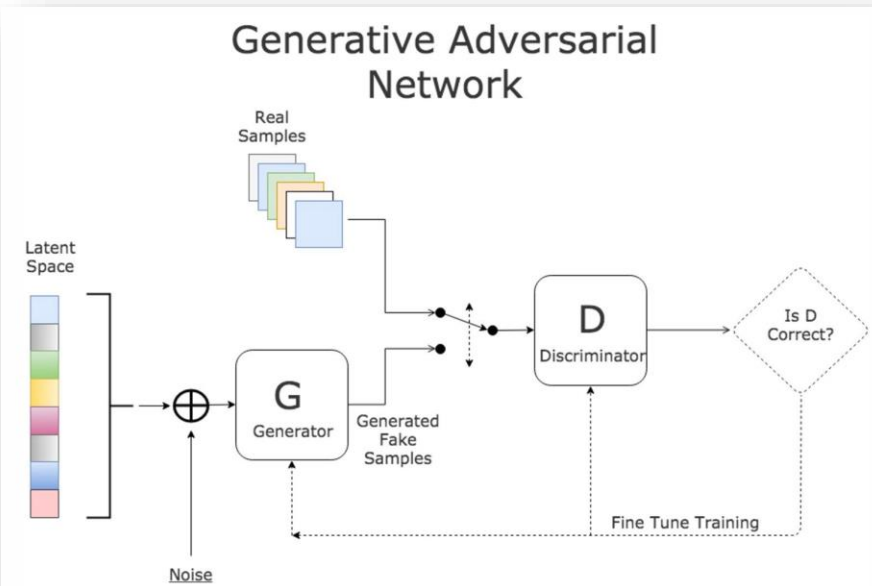
Keras

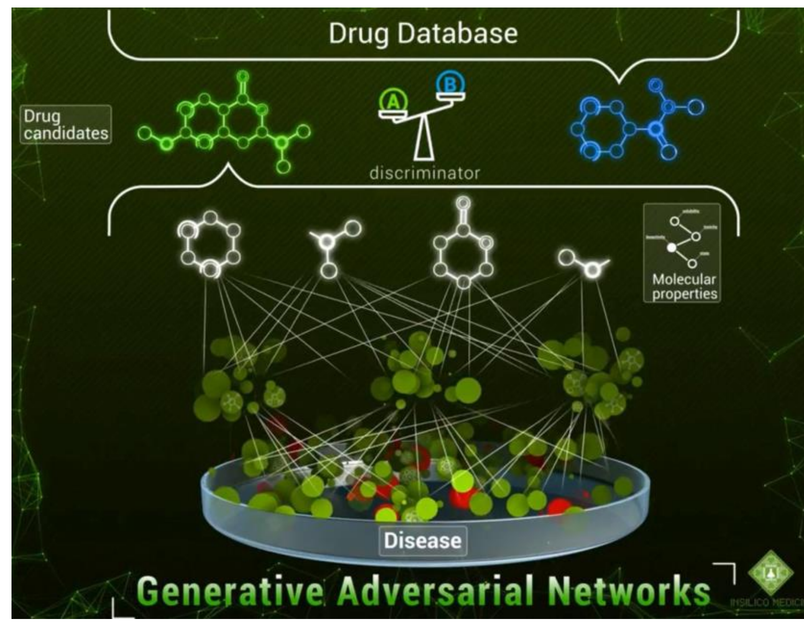


http://colah.github.io/posts/2014-07-NLP-RNNs-Representations/

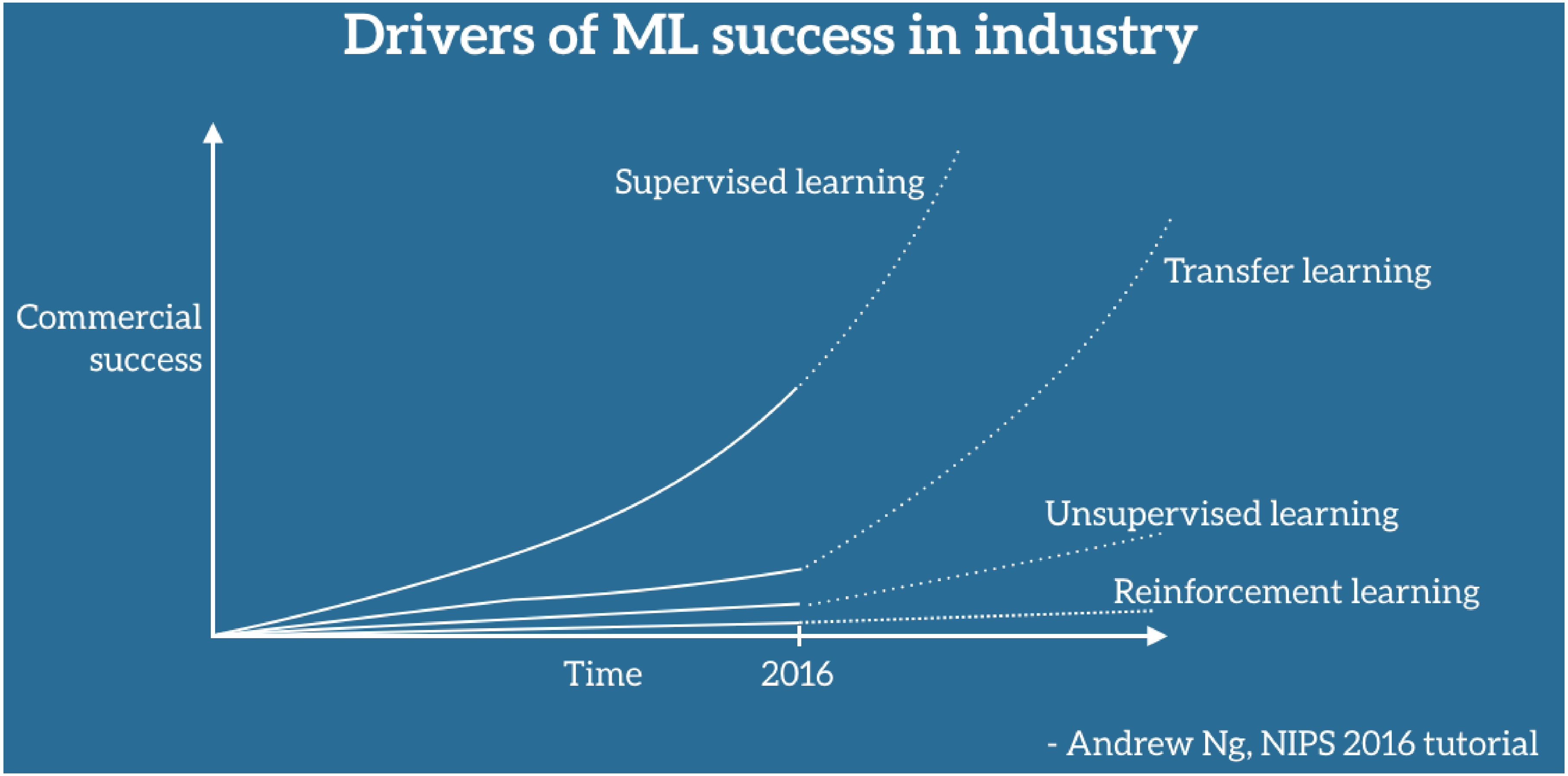

Transfer learning
Source task / domain
Target task / domain
Storing knowledge gained solving one problem and applying it to a different but related problem.
Model
Model
Knowledge


Training images
Source task
Source task labels
1 : Feature learning
Convolutional layers
Fully-connected layers
C1-C2-C3-C4-C5
FC 6
FC 7
FC 8
4096 or 6144-dim vector
African elephant
Wall clock
Green snake
Yorkshire terrier
2 : Feature transfer
Transfer parameters
3 : Classifier learning
C1-C2-C3-C4-C5
FC 6
FC 7
FCa
FCb
9216-dim vector
4096 or 6144-dim vector
4096 or 6144-dim vector
Chair
Background
Person
TV/monitor
Training images
Sliding patches
Target task
New adaptation layers trained on target task
Target task labels


Generative Adversarial Network
Real Samples
Latent Space
G
Generator
Generated Fake Samples
D
Discriminator
Is D Correct?
Fine Tune Training
Noise


Drug Database
Drug candidates
discriminator
Molecular properties
Disease
Generative Adversarial Networks

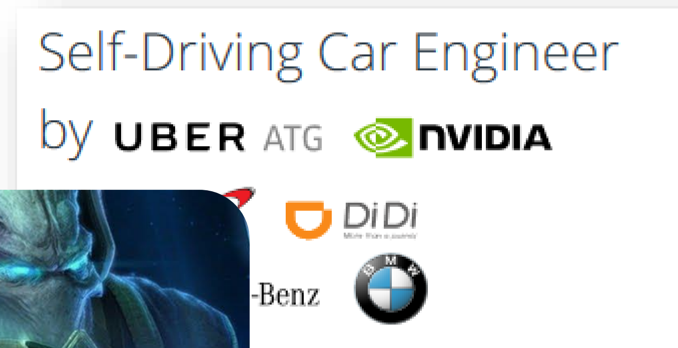
Progressive Growing of GANs, Karras2018. [link]



Unsupervised learning is a next frontier in artificial intelligence and we are moving towards it.


Deep Reinforcement Learning
OBSERVATIONS
GOAL
REWARD?
Agent
Environment
neural
network
ACTIONS
Google DeepMind
General Artificial Intelligence


EMBEDDED DEEP LEARNING
WITH NVIDIA JETSON
NVIDIA


Self-Driving Car Engineer
by UBER ATG NVIDIA
DiDi
-Benz


DEEP AI
REINFORCEMENT
STARCRAFT II
LEGACY OF THE VOID

Human-level control through deep reinforcement learning

Volodymyr Mnih, Koray Kavukcuoglu, David Silver, Andrei A. Rusu, Joel Veness, Marc G. Bellemare, Alex Graves, Martin Riedmiller, Andreas K. Fidjeland, Georg Ostrovski, Stig Petersen, Charles Beattie, Amir Sadik, Ioannis Antonoglou, Helen King, Dharshan Kumaran, Daan Wierstra, Shane Legg & Demis Hassabis

Nature volume 518, pages 529–533 (26 February 2015)

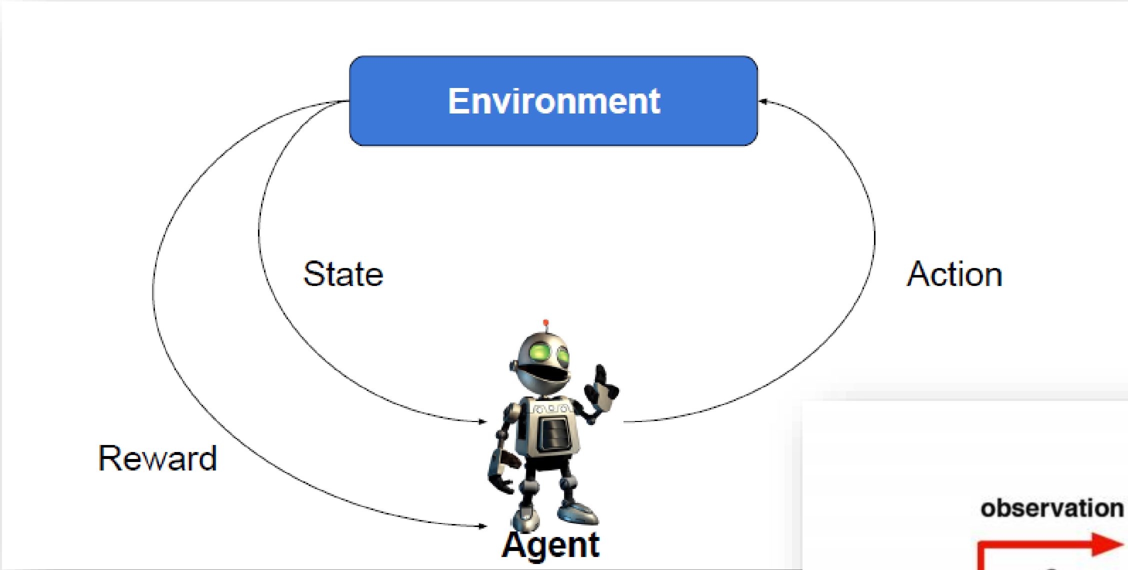
By combining:

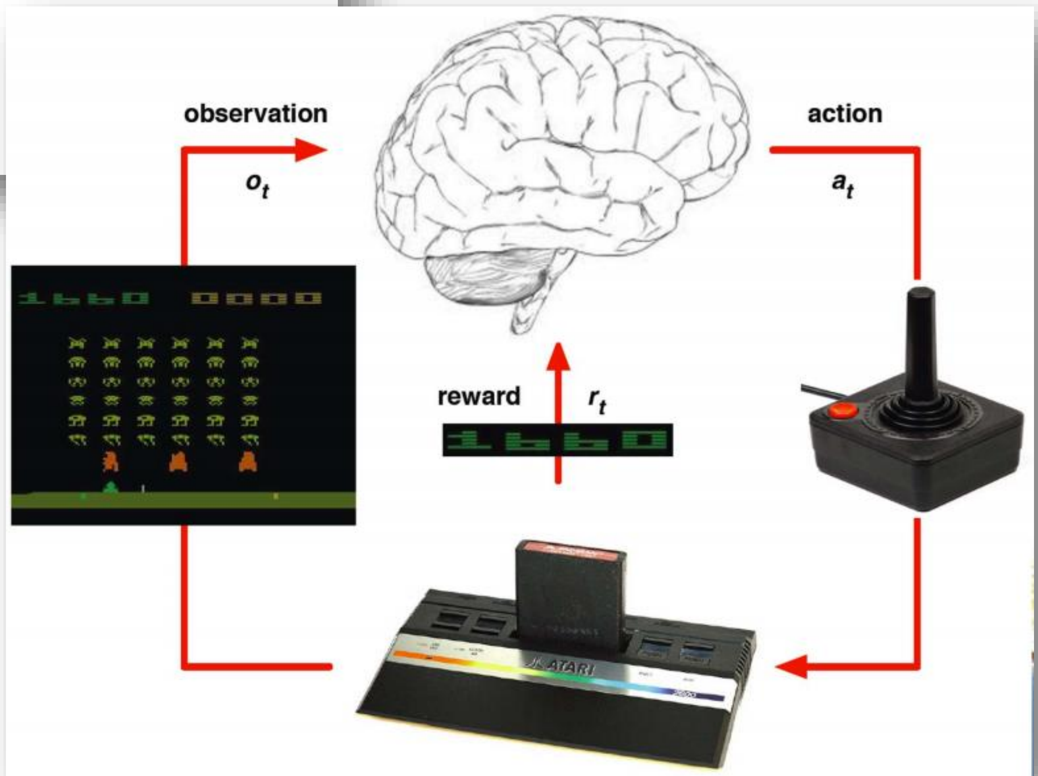
- ***Reinforcement Learning***: selecting actions that maximize reward in this case the game score

- with ***Deep Learning***: multilayered feature extraction from high-dimensional data in this case the pixels

the game-playing agent **takes artificial intelligence a step nearer** the goal of systems capable of learning a diversity of challenging tasks from scratch.

What's Reinforcement Learning?





- Agent interacts with an environment and learns by maximizing a reward.
- No labels or any other supervision is given.

Reinforcement Learning

ML		
	Supervised Learning	Target label for each training example
	Reinforcement Learning	Sparse and time-delayed labels
	Unsupervised Learning	No label at all

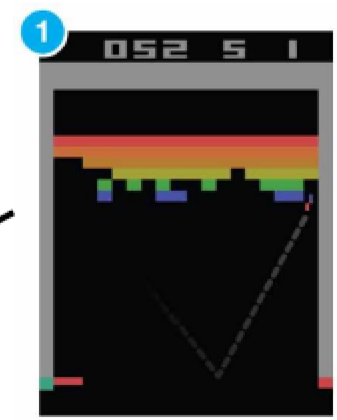
- Play games: Atari, poker, Go, ...
- Navigate worlds: 3D worlds, Labyrinth, ...
- Control physical systems: manipulate, walk, swim, ...
- Interact with users: recommend, optimise, personalise, ...

Universal approach!

State Representation

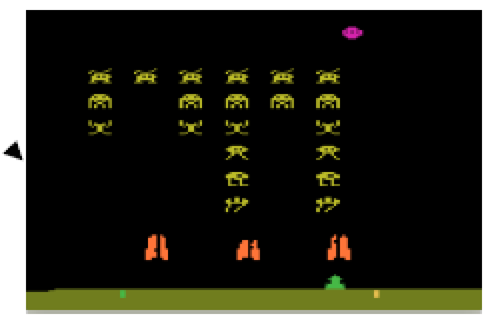
Think about the **Breakout** game

- How to define a state?



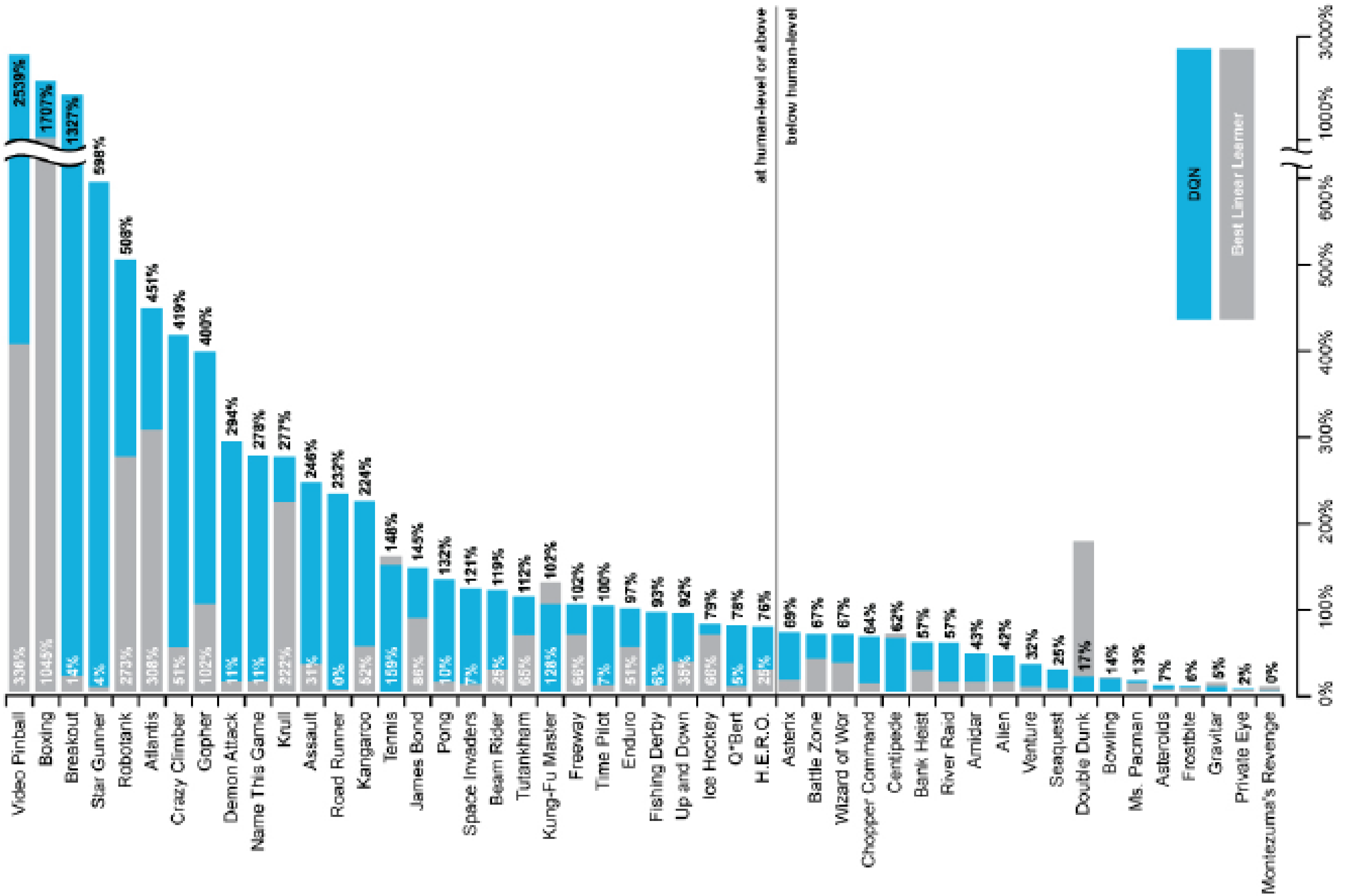
- Location of the paddle
- Location/direction of the ball
- Presence/absence of each individual brick

Let’s make it more universal!



Screen pixels

DQN Results in Atari

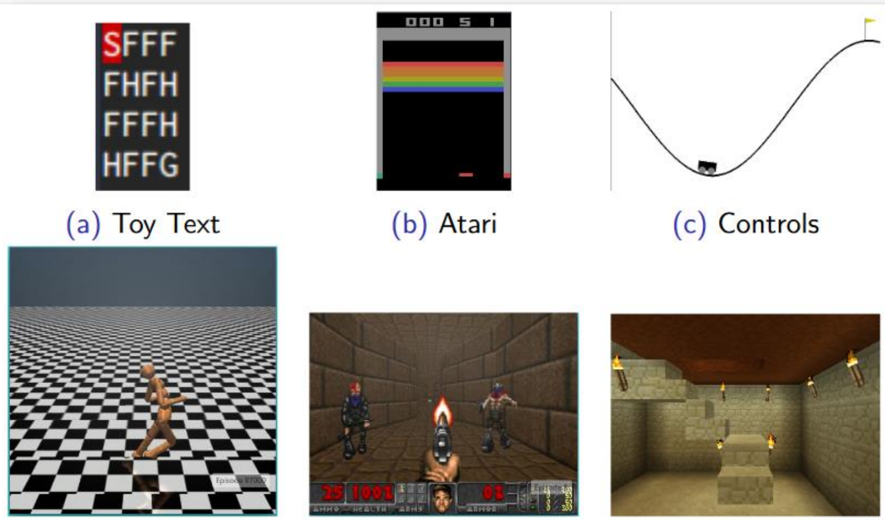


Hands-on practice!

There is a large number of environments

OpenAI Gym

- A standard Python API for RL environments
- A set of tools to measure agent performance
- An online scoreboard for comparing and benchmarking approaches
- `https://gym.openai.com/`



(a) Toy Text (b) Atari (c) Controls

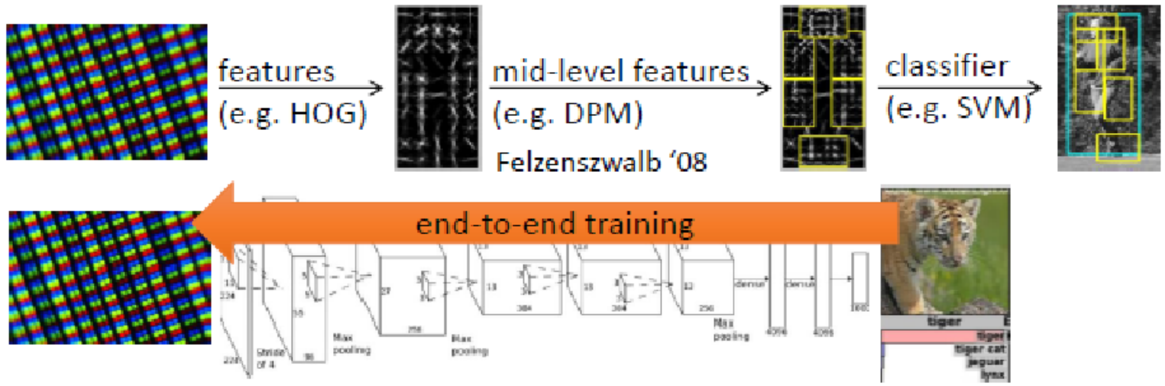
(d) MuJoCo (e) Doom (f) Minecraft

Environment libraries

- OpenAI Roboschool: Robot simulation
- OpenAI Universe: gym on VNC servers inside docker containers
- Intel Nervana Coach: Environments + DLR algorithms
- Deepmind Lab:
- Deepmind Pysc2: Star Craft 2 - like environments

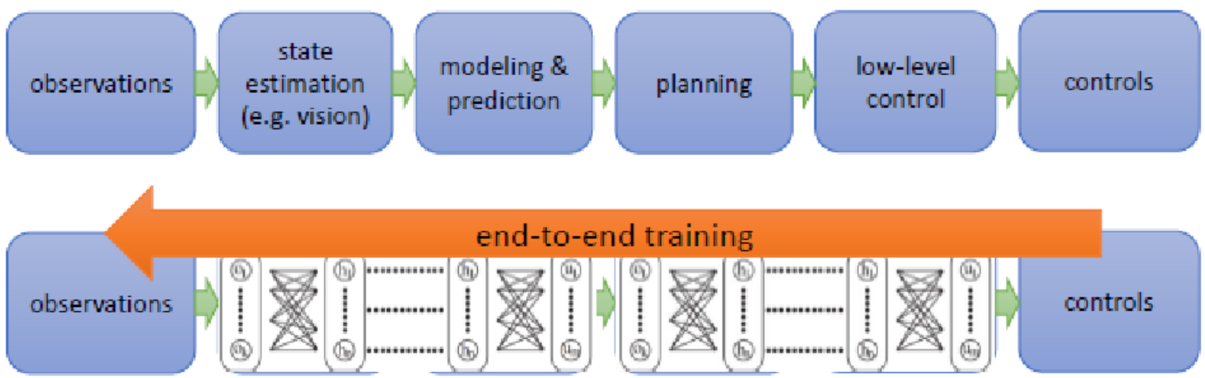
standard computer vision

deep learning



robotic control pipeline

deep robotic learning



Wide range of applications!

… but there are some "buts"!!!

… there are “some” important issues to consider!

and not “only” those related to data privacy,

…. and not only some particular cases….

United Airlines Passenger Is Dragged From an Overbooked Flight

…. each airline sets its own system and procedures for deciding whom to bump

Faceapp uses facial recognition technology to alter selfies.

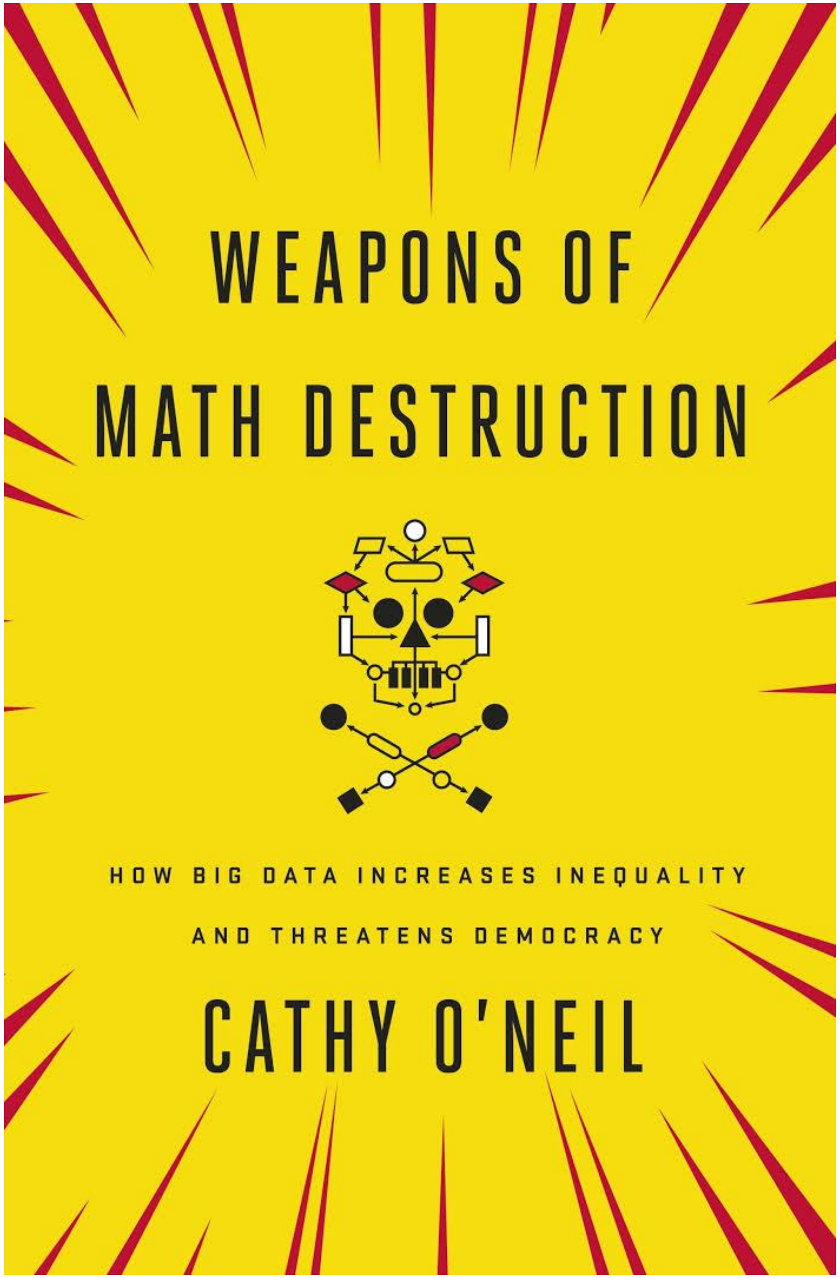
***Many took to Twitter to brand the app racist**, as they watched their skin turn lighter before their eyes.*

http://metro.co.uk/2017/04/26/face-changing-app-branded-racist-for-lightening-skin-on-selfies-6599159/

Yaroslav Goncharov, founder and chief executive of FaceApp said:

- ‘We are deeply sorry for this unquestionably serious issue.
- ‘It is an unfortunate side-effect of the underlying **neural network** caused by the training set bias, not intended behaviour.

…. but more serious issues when we can exclude some segments of population….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We often hear that the world is drowning in data. Yet, when you want to learn and experiment, finding open, easily-accessible data sets remains a major challenge. Open data is data that can be freely used, intermixed with other datasets, and distributed to others without restrictions. We have compiled a small selection of publicly accessible data sources that should give an aspiring data scientist a quick start. We will be constantly adding new data sources to this page:

- Medical research
- Air Traffic Controllers
- To detect diseases in Cassava plants to improving yield for farmers in Africa

https://medium.com/tensorflow/highlights-from-tensorflow-developer-summit-2018-cd86615714b2

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