



PATTERN RECOGNITION AND MACHINE LEARNING SYSTEMS DAY 1A

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DAY 1 AGENDA





1.1 Introduction to Pattern Recognition and Machine Learning Systems

- 1.2 Neural Network Basics
- 1.3 Neural Network Workshop Building Multi-Layer Perceptron Neural Networks using Weka and Python





1.1 Introduction to Pattern Recognition and Machine Learning Systems

Topics





- What is Pattern Recognition?
- Machine Learning Basics
- Deep Learning Basics
- Applications of Pattern Recognition and Machine/Deep Learning Systems

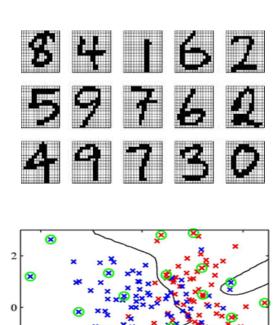
Pattern Recognition

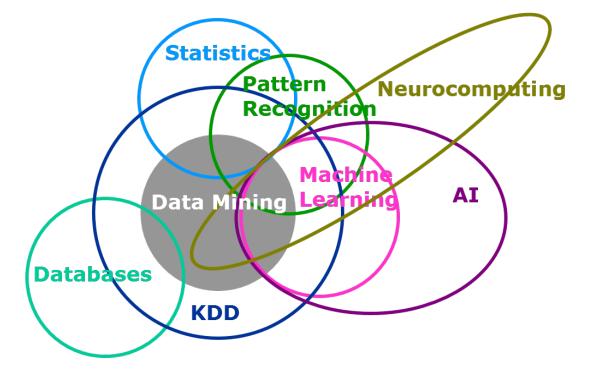




Pattern is in everything around us in this digital world.

Visual, audio, text, temporal...





https://www.analyticsvidhya.com

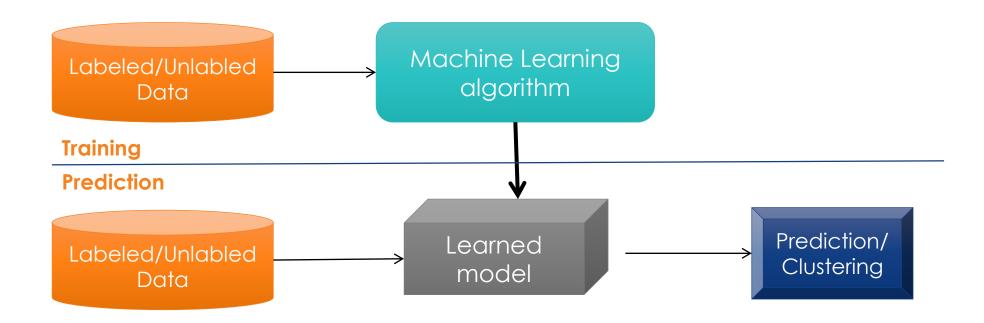
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Machine Learning Basics





"Pattern Recognition is a type of problem while Machine Learning is a type of solution."



Types of Machine Learning





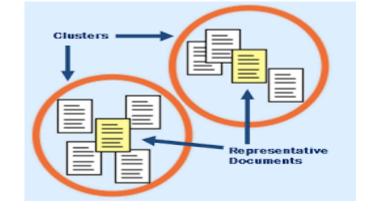
Supervised: Learning with a labeled training set

eg: Spam email classification - classify emails as legitimate or spam.



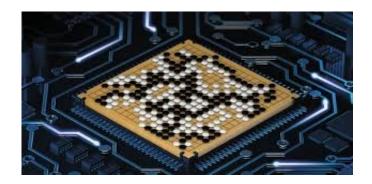
Unsupervised: Discover patterns in unlabeled data

eg: Document clustering- cluster similar documents based on text



Reinforcement learning: learn to act based on feedback/reward

eg: learn to play Go, reward: win or lose



Machine Learning Techniques





- Regression Algorithms (eg. Linear Regression, Logistic Regression)
- Instance-based Algorithms (eg. k-Nearest Neighbor (kNN))
- Decision Tree Algorithms
- Bayesian Algorithms
- Clustering Algorithms
- Association Rule Learning Algorithms
- Artificial Neural Network Algorithms
- Deep Learning Algorithms
- Dimensionality Reduction Algorithms
- Ensemble Algorithms

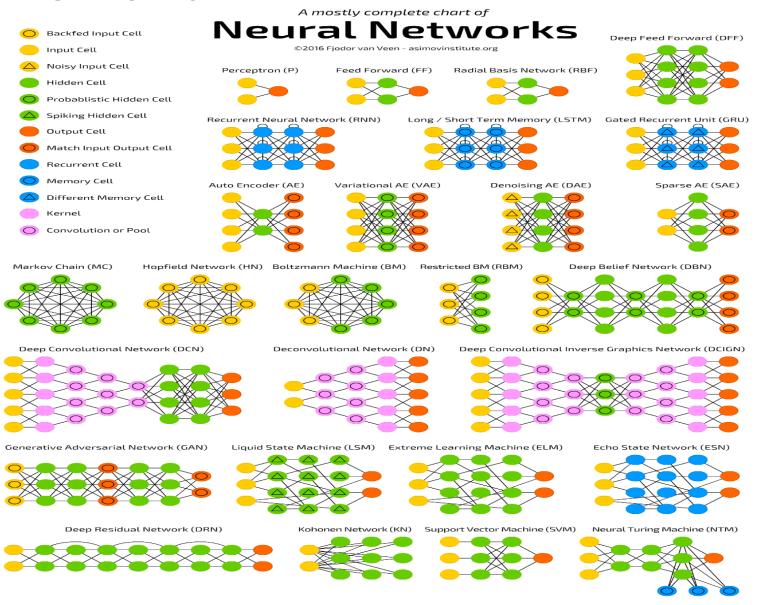
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Source: https://machinelearningmastery.com/

Neural Networks





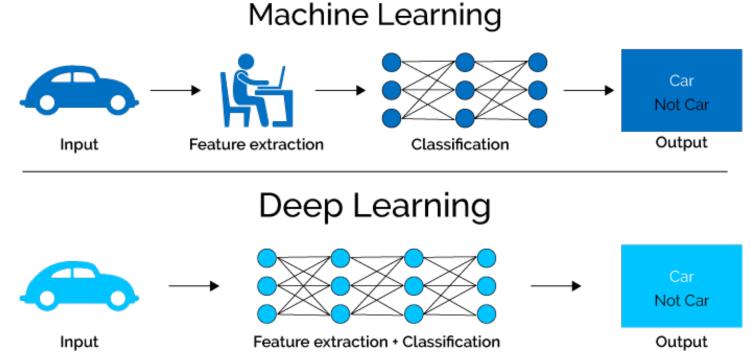


Deep Learning (DL)





- A machine learning subfield of learning representations of data. Exceptional effective at learning patterns.
- Deep learning algorithms attempt to learn (multiple levels of) representation by using a hierarchy of multiple layers.



https://www.xenonstack.com/blog/static/public/uploads/media/machine-learning-vs-deep-learning.png

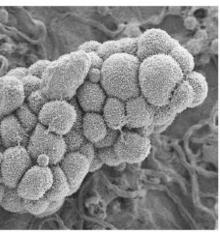
Deep Learning

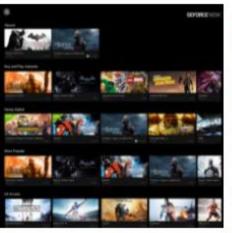




DEEP LEARNING EVERYWHERE











INTERNET & CLOUD

Image Classification
Speech Recognition
Language Translation
Language Processing
Sentiment Analysis
Recommendation

MEDICINE & BIOLOGY

Cancer Cell Detection Diabetic Grading Drug Discovery

MEDIA & ENTERTAINMENT

Video Captioning Video Search Real Time Translation

SECURITY & DEFENSE

Face Detection Video Surveillance Satellite Imagery

AUTONOMOUS MACHINES

Pedestrian Detection Lane Tracking Recognize Traffic Sign

source: developer.nvidia.com/deep---learning---courses

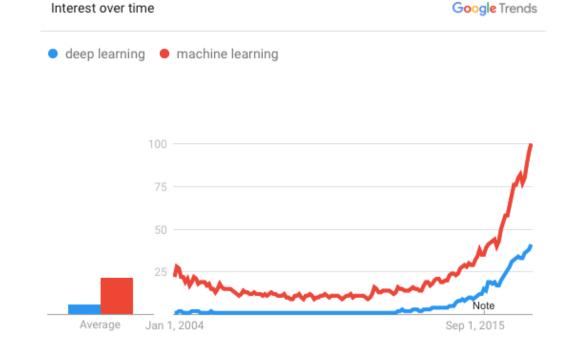
Deep Learning





- Manually designed features are often over-specified, incomplete and take a long time to design and validate
- Learned Features are easy to adapt, fast to learn
- O Deep learning provides a very flexible and learnable framework for representing information
- Can learn both unsupervised and supervised
- Effective end-to-end joint system learning
- Utilize large amounts of training data

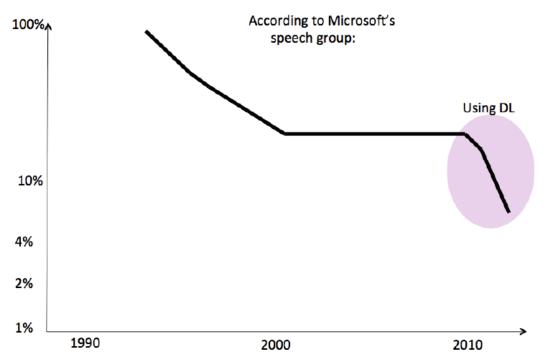
In ~2010 DL started outperforming other ML techniques first in speech and vision, then NLP

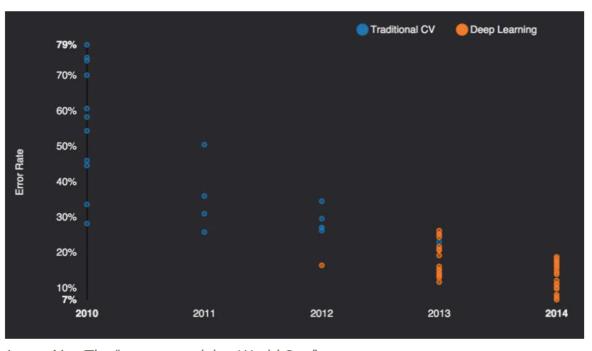


Deep Learning









ImageNet: The "computer vision World Cup"

Deep Learning in Speech Recognition

Several big improvements in recent years in NLP

- ✓ Machine Translation
- ✓ Sentiment Analysis
- ✓ Dialogue Agents
- ✓ Question Answering
- ✓ Text Classification

Leverage different levels of representation

- o words & characters
- o syntax & semantics

Applications of Machine Learning / Deep Learning



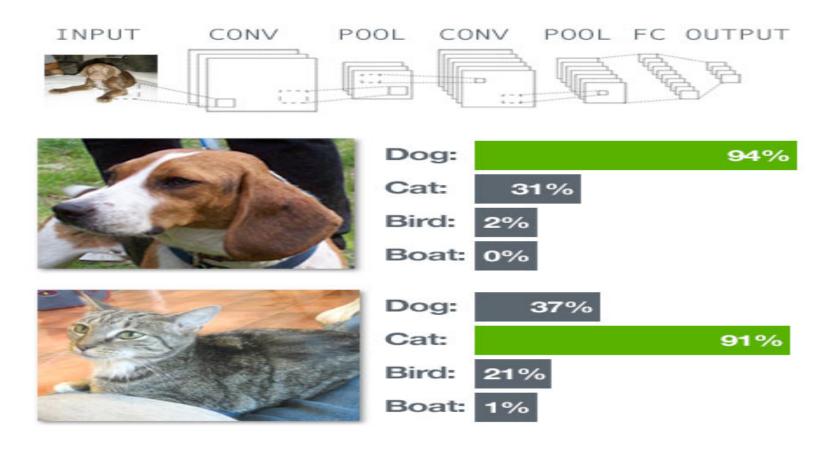


- Biomedical informatics
- Computer vision
- Customer relationship management
- Data mining
- Email filtering
- Natural language processing (NLP)
- Pattern recognition
 - Facial recognition system
 - Handwriting recognition
 - Image recognition
 - Optical character recognition
 - Speech recognition
- Recommendation system
- •

PR and ML Systems: Image Classification







Source: pyimagesearch.com

PR and ML Systems: Image Classification





Classification

Click for a Quick Example



Maximally accurate	Maximally specific
cat	1.79306
feline	(1.74269)
domestic cat	1.70760
tabby	0.94807
domestic animal	0.76846

CNN took 0.064 seconds.

Try out a live demo at http://demo.caffe.berkeleyvision.org/

PR and ML Systems: Image Classification





ConvNetJS CIFAR-10 demo

Description

This demo trains a Convolutional Neural Network on the <u>CIFAR-10 dataset</u> in your browser, with nothing but Javascript. The state of the art on this dataset is about 90% accuracy and human performance is at about 94% (not perfect as the dataset can be a bit ambiguous). I used <u>this python script</u> to parse the <u>original files</u> (python version) into batches of images that can be easily loaded into page DOM with img tags.

This dataset is more difficult and it takes longer to train a network. Data augmentation includes random flipping and random image shifts by up to 2px horizontally and verically.

By default, in this demo we're using Adadelta which is one of per-parameter adaptive step size methods, so we don't have to worry about changing learning rates or momentum over time. However, I still included the text fields for changing these if you'd like to play around with SGD+Momentum trainer.

Report questions/bugs/suggestions to <a>@karpathy.

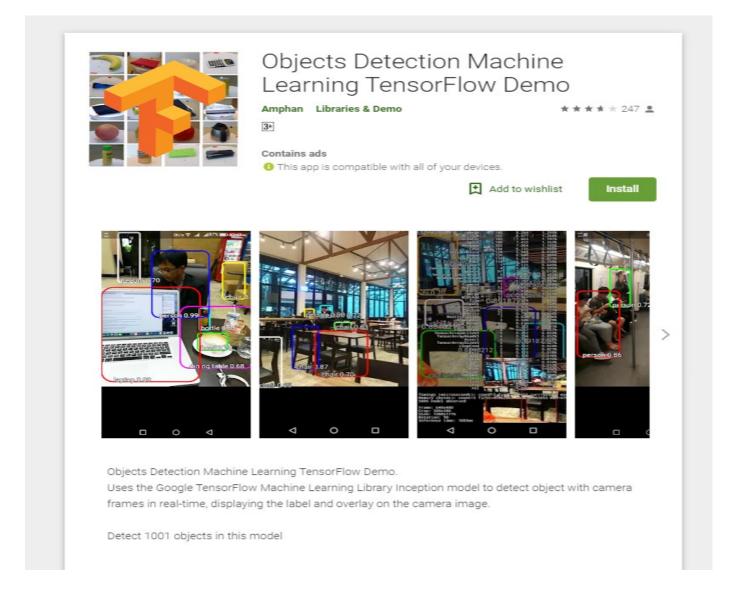


https://cs.stanford.edu/people/karpathy/convnetjs/demo/cifar10.html

PR and ML Systems: Object Detection





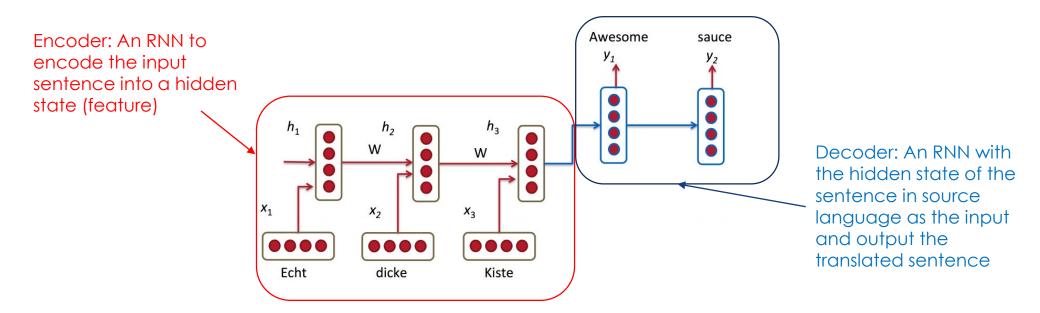


PR and ML Systems: Machine Translation





 The input is a sequence of words in source language, and the output is a sequence of words in target language.



Encoder-decoder architecture for machine translation

PR and ML Systems: Image Captioning

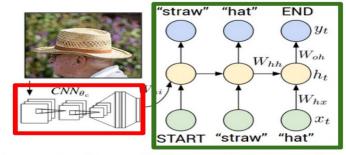




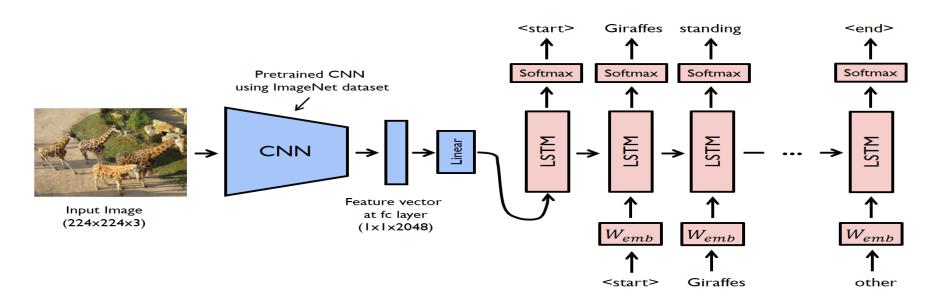
Image captioning: CNN+LSTM

Describing images

Recurrent Neural Network



Convolutional Neural Network



PR and ML Systems: Ensemble





 Active Random Forests: An application to Autonomous Unfolding of Clothes (ECCV 2014)



https://www.youtube.com/watch?v=ToAV_5mgN2Q

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