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

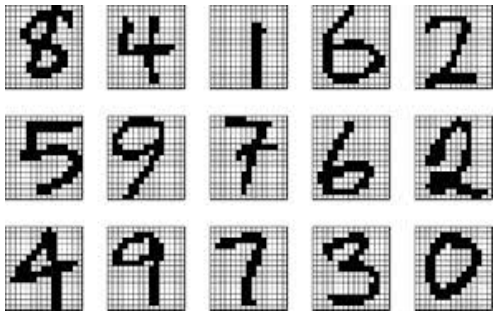
Topics

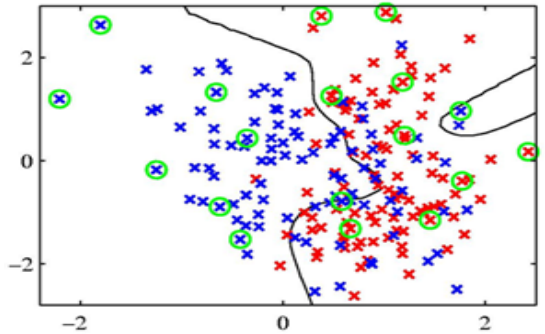
- What is Pattern Recognition?
- Machine Learning Basics
- Deep Learning Basics
- Applications of Pattern Recognition and Machine/Deep Learning Systems

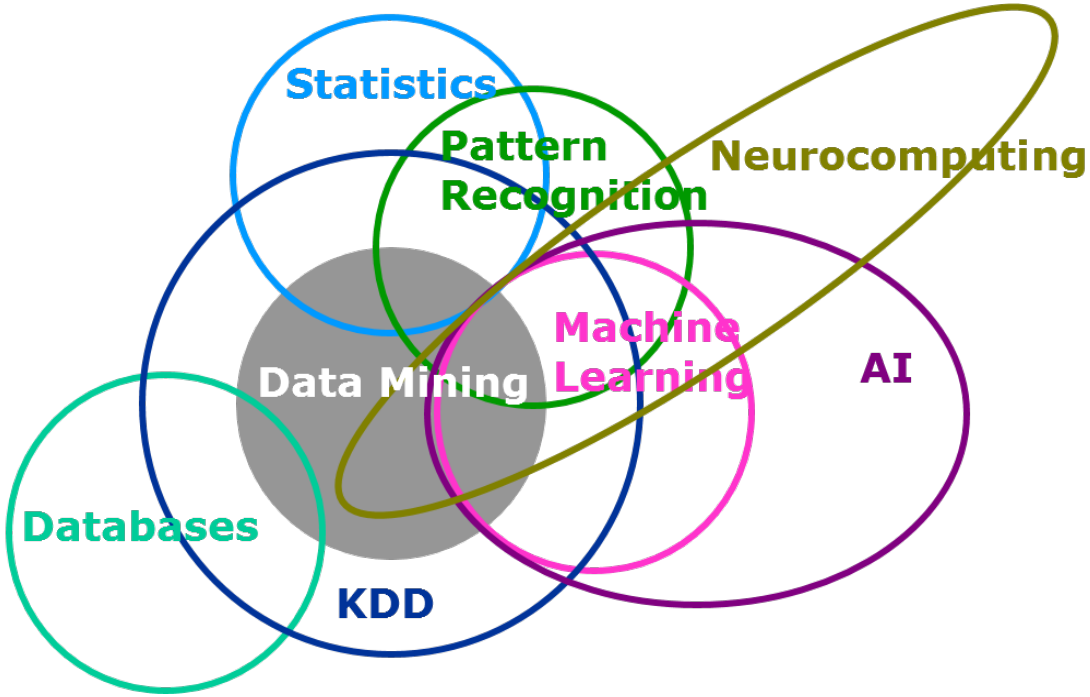
Pattern Recognition

- **Pattern is in everything around us in this digital world.**

  Visual, audio, text, temporal…



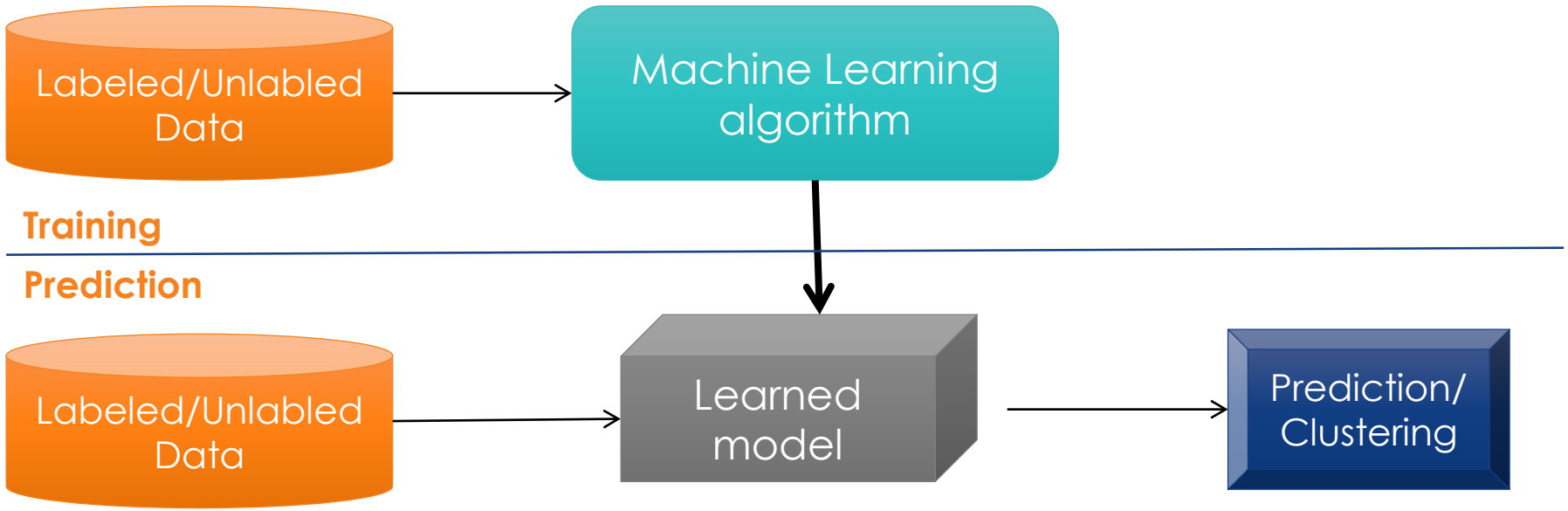




https://www.analyticsvidhya.com

Machine Learning Basics

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



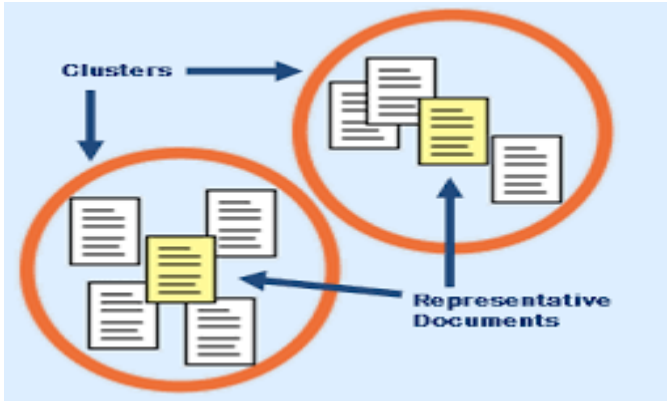
Types of Machine Learning

- **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**

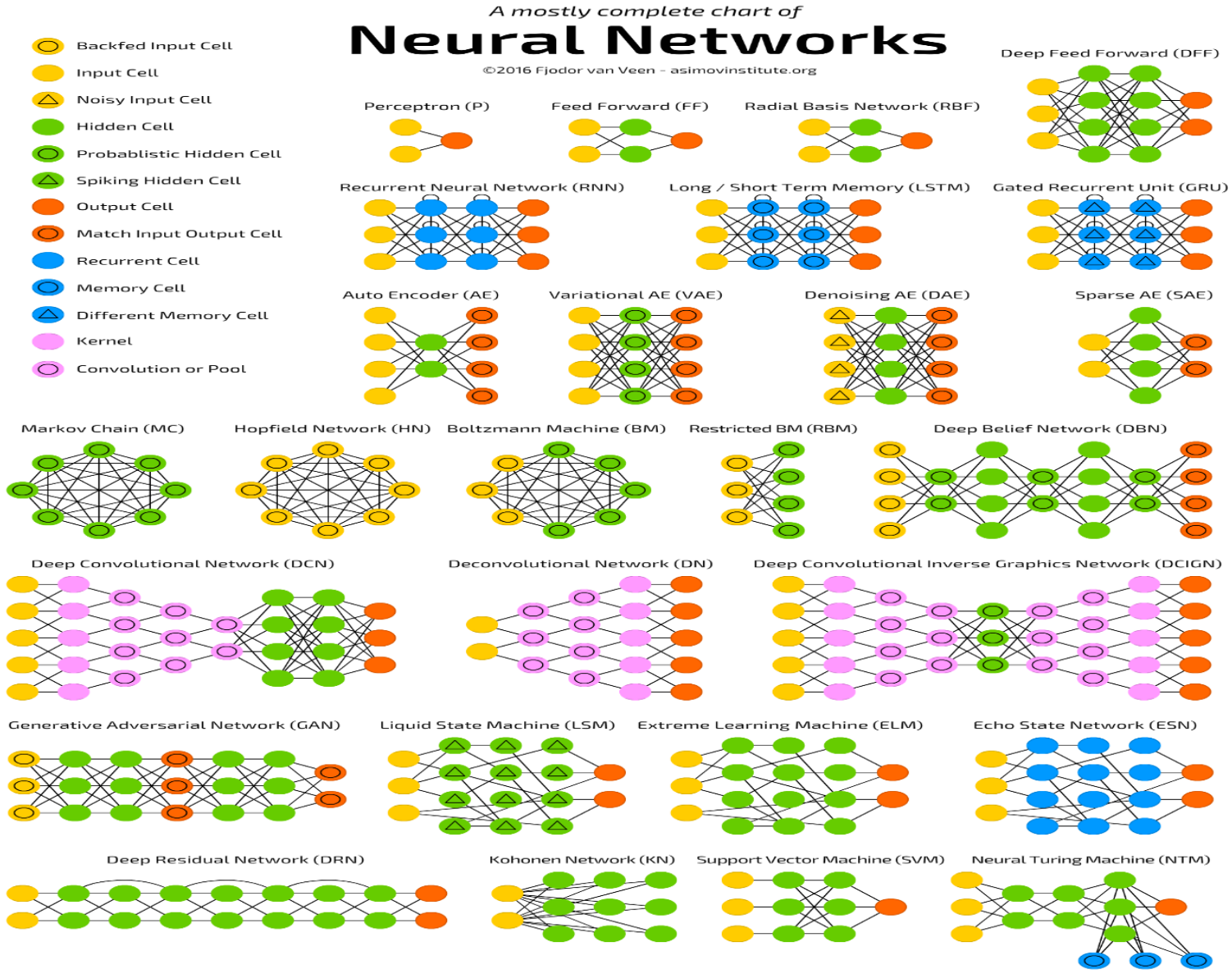
  eg: learn to play Go, reward: win or lose

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
- ……

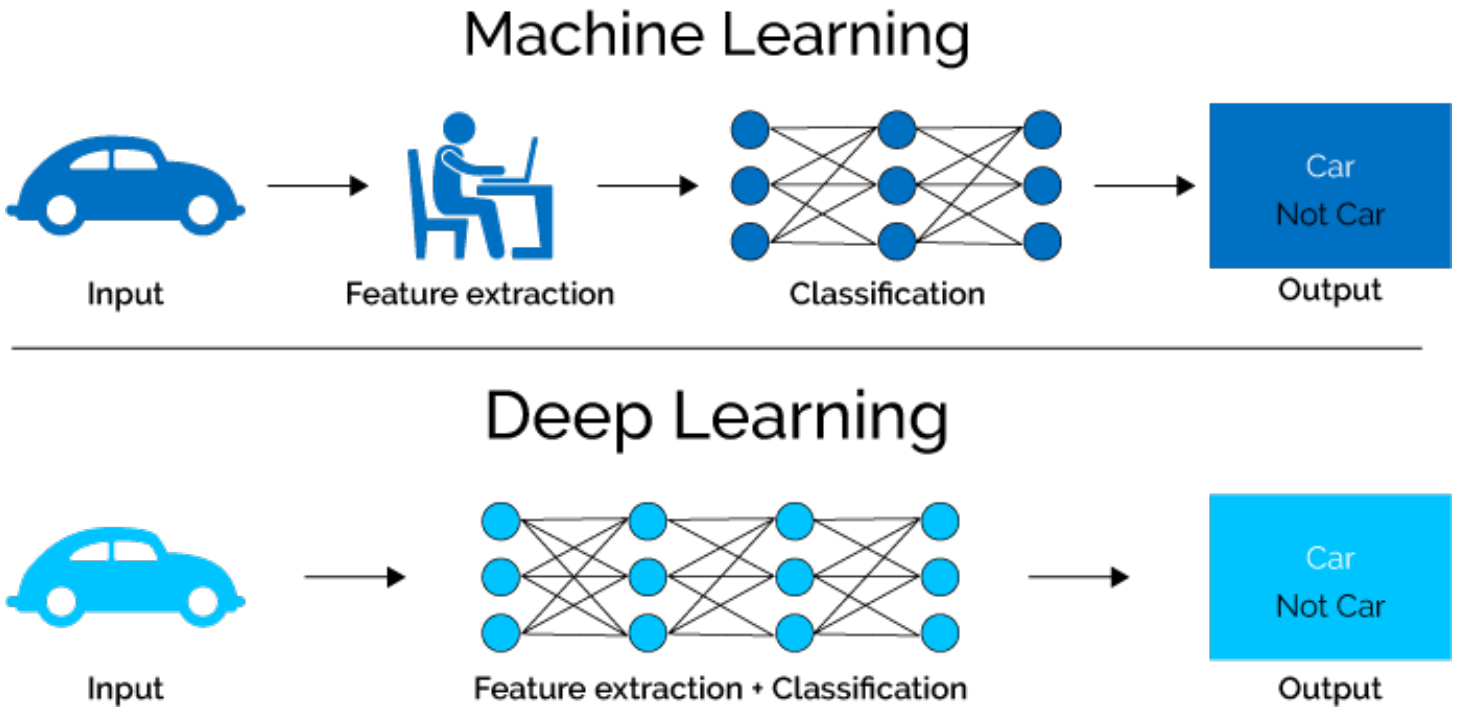
Source: https://machinelearningmastery.com/

Neural Networks



Deep Learning (DL)

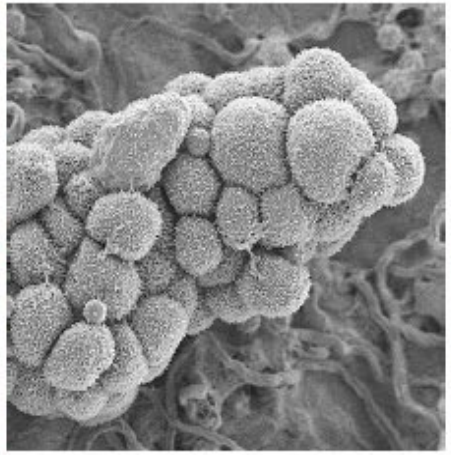
- A machine learning subfield of learning representations of data. Exceptional effective at learning patterns.
- Deep learning algorithms attempt to learn (multiple levels of) representation by using a hierarchy of multiple layers.



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

Deep Learning

DEEP LEARNING EVERYWHERE

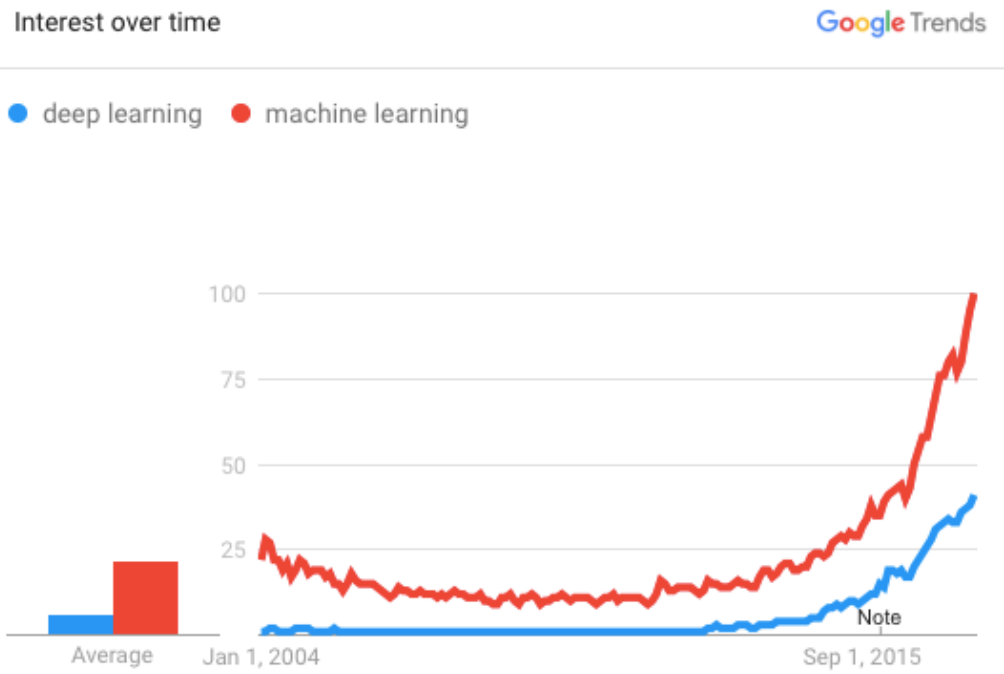

INTERNET & CLOUD	MEDICINE & BIOLOGY	MEDIA & ENTERTAINMENT	SECURITY & DEFENSE	AUTONOMOUS MACHINES
Image Classification	Cancer Cell Detection	Video Captioning	Face Detection	Pedestrian Detection
Speech Recognition	Diabetic Grading	Video Search	Video Surveillance	Lane Tracking
Language Translation	Drug Discovery	Real Time Translation	Satellite Imagery	Recognize Traffic Sign
Language Processing				
Sentiment Analysis				
Recommendation				

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

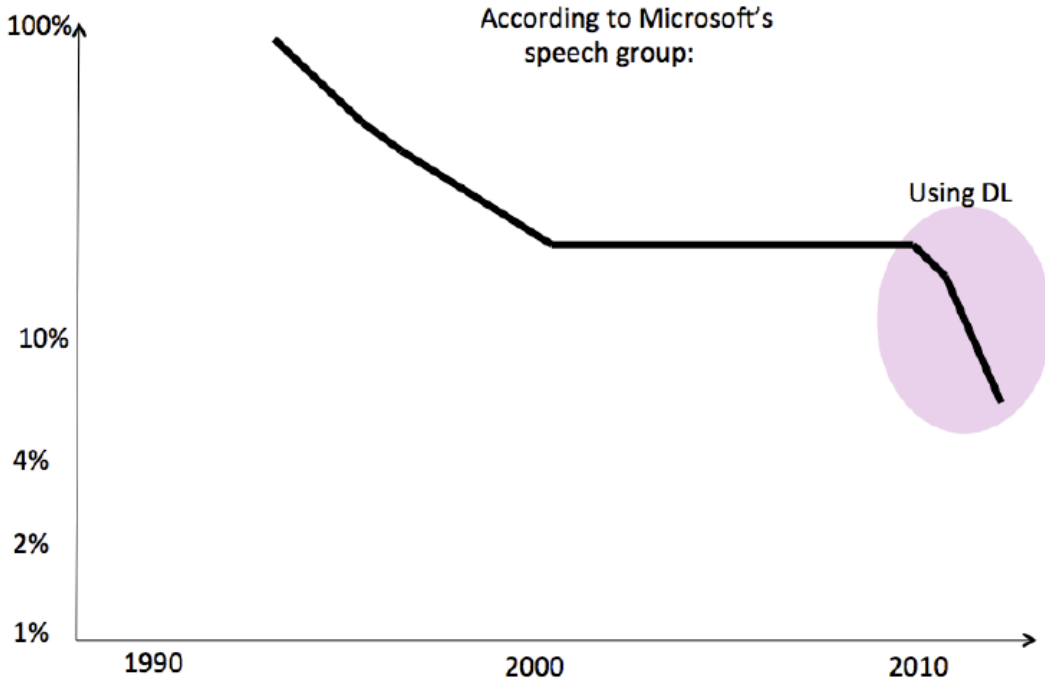
Deep Learning

- 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
- 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

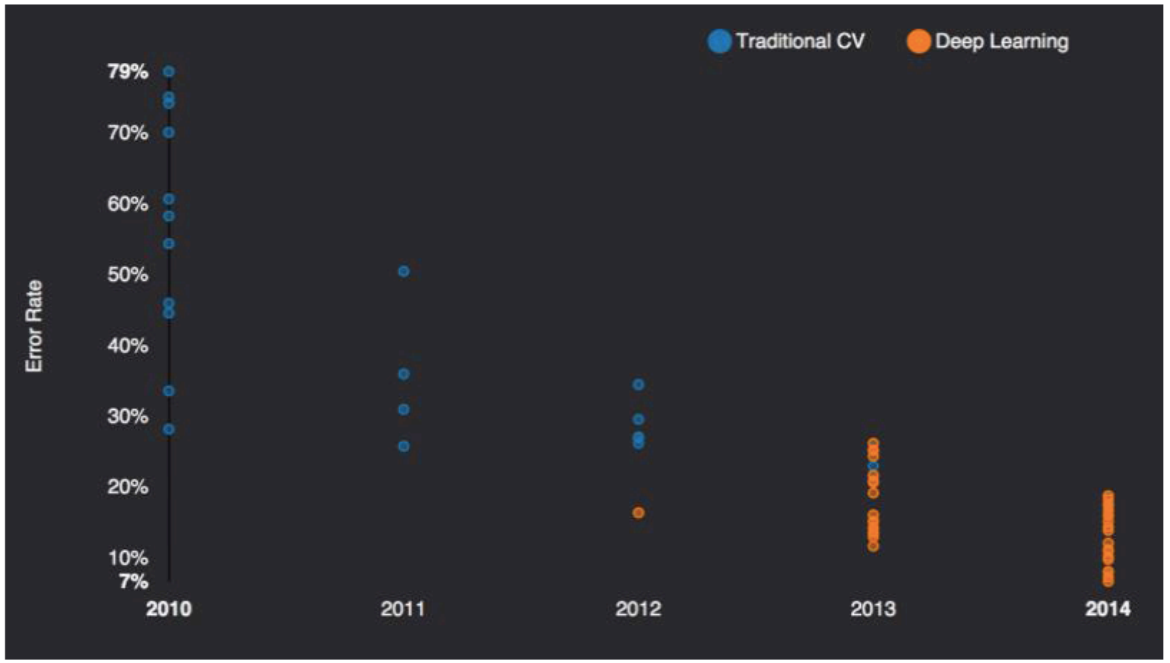
In ~2010 DL started outperforming other ML techniques
first in speech and vision, then NLP



Deep Learning



Deep Learning in Speech Recognition



ImageNet: The "computer vision World Cup"

Several big improvements in recent years in NLP

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

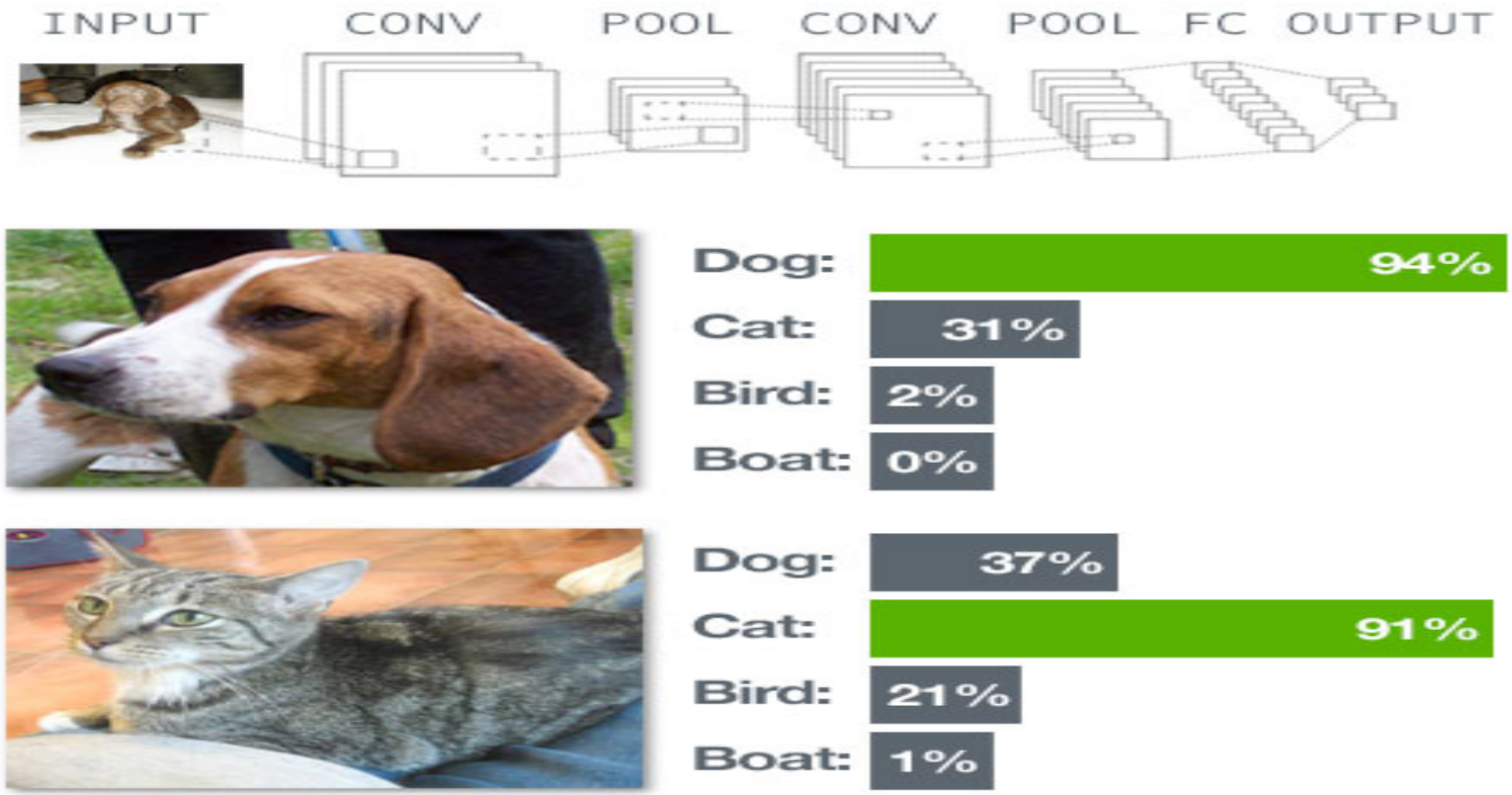
Leverage different levels of representation

- words & characters
- 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

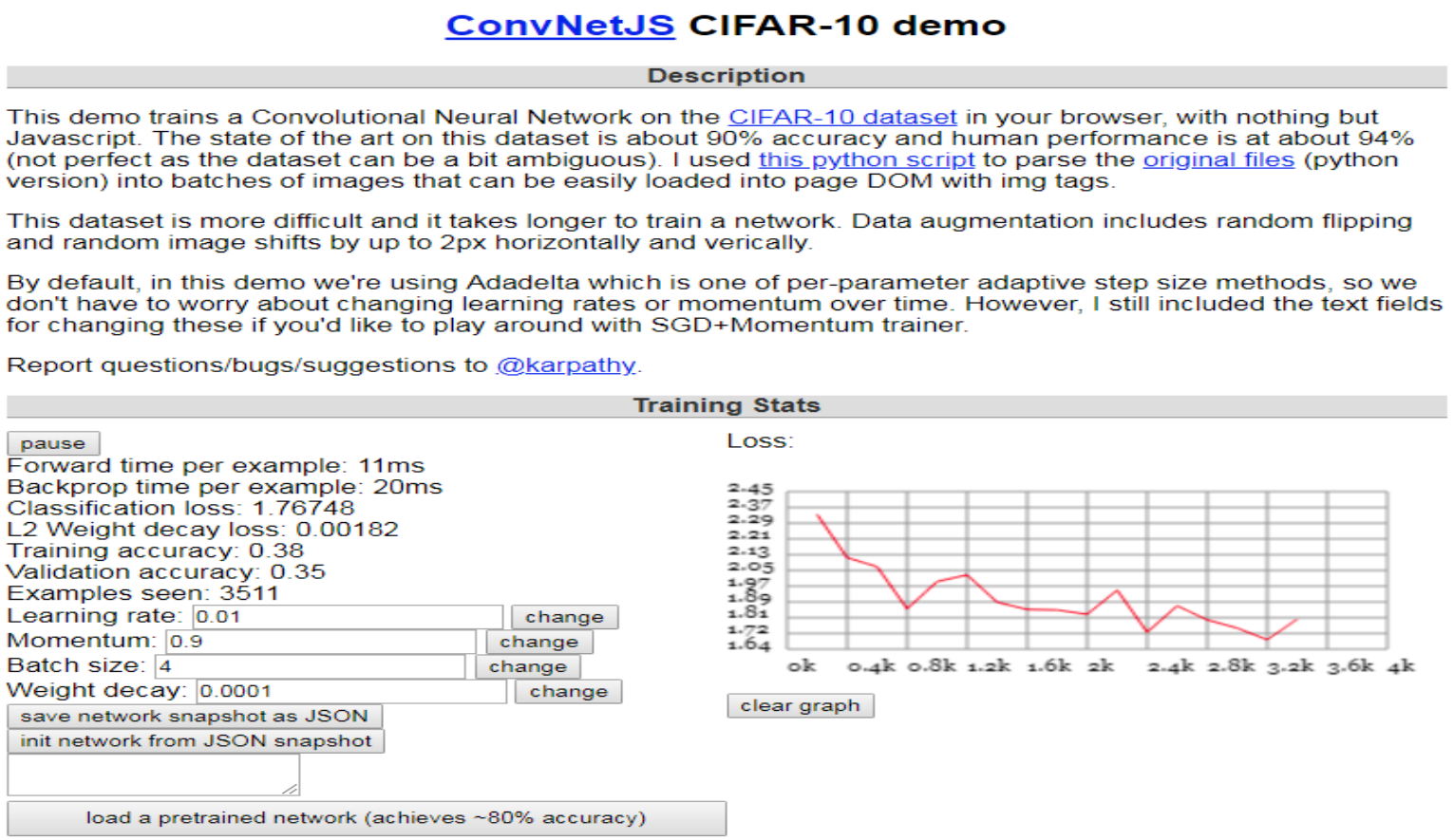


Source: pyimagesearch.com

PR and ML Systems: Image Classification

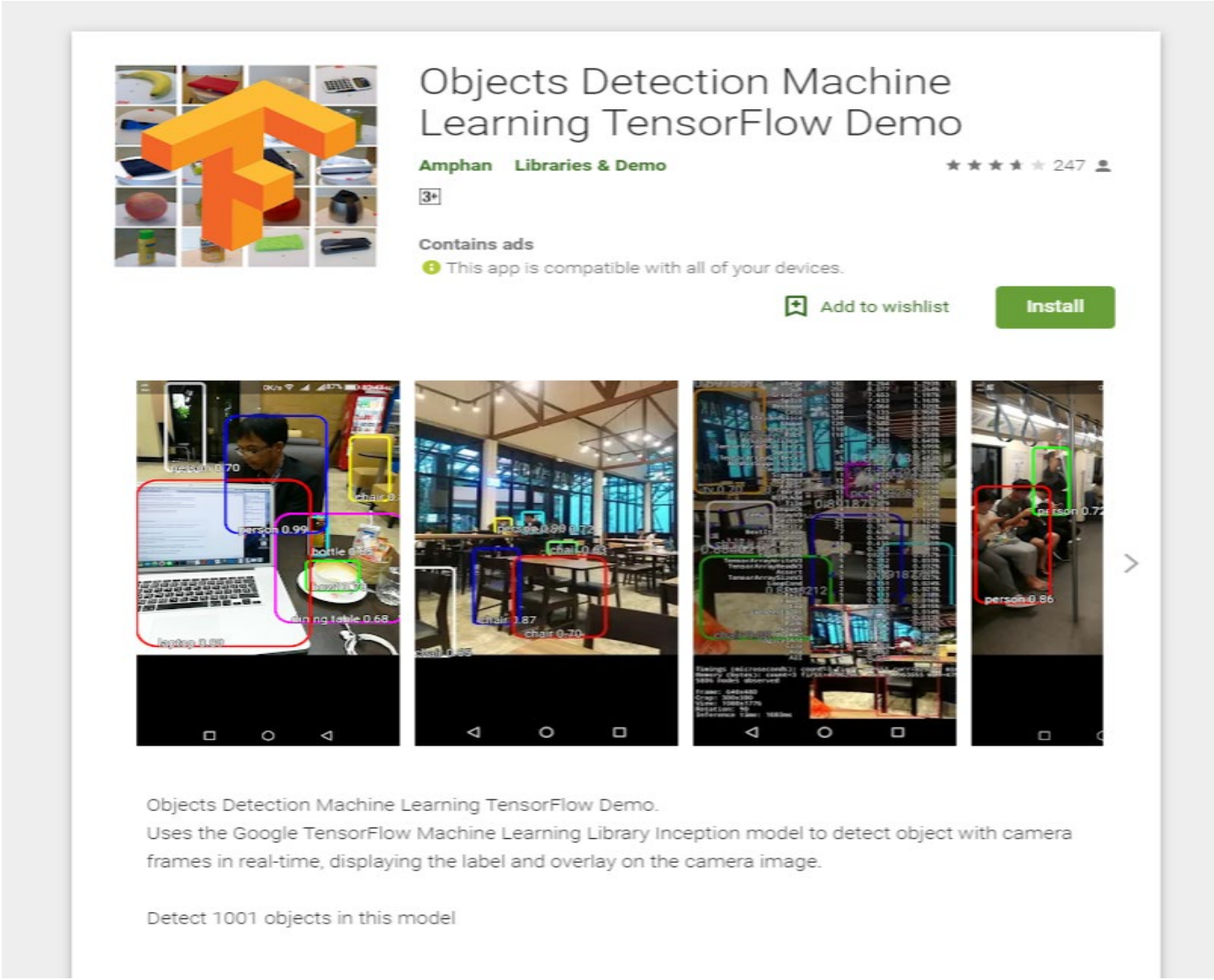
Try out a live demo at http://demo.caffe.berkeleyvision.org/

PR and ML Systems: Image Classification



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

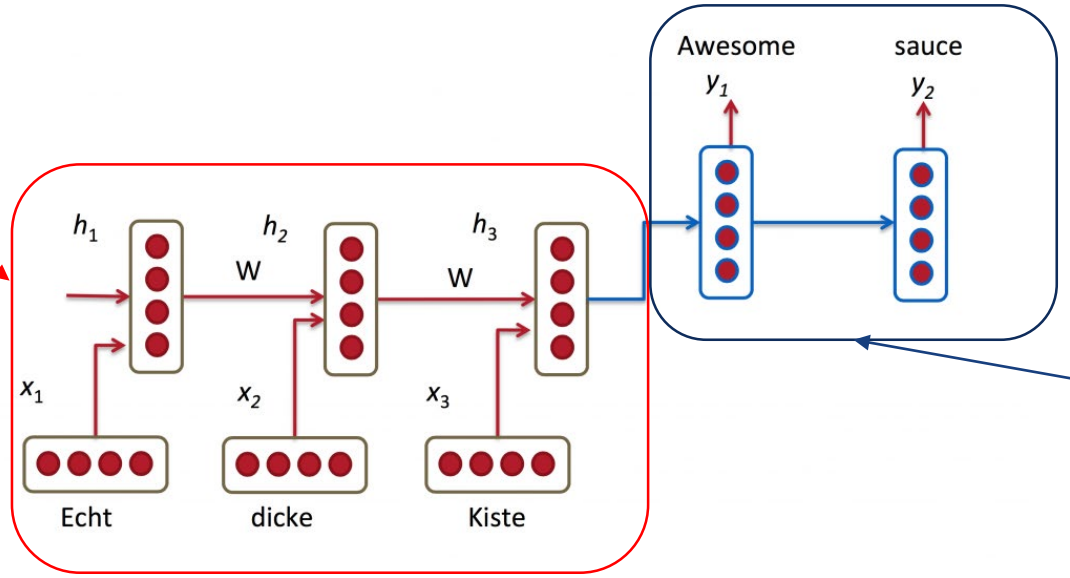
PR and ML Systems: Object Detection



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: An RNN to encode the input sentence into a hidden state (feature)

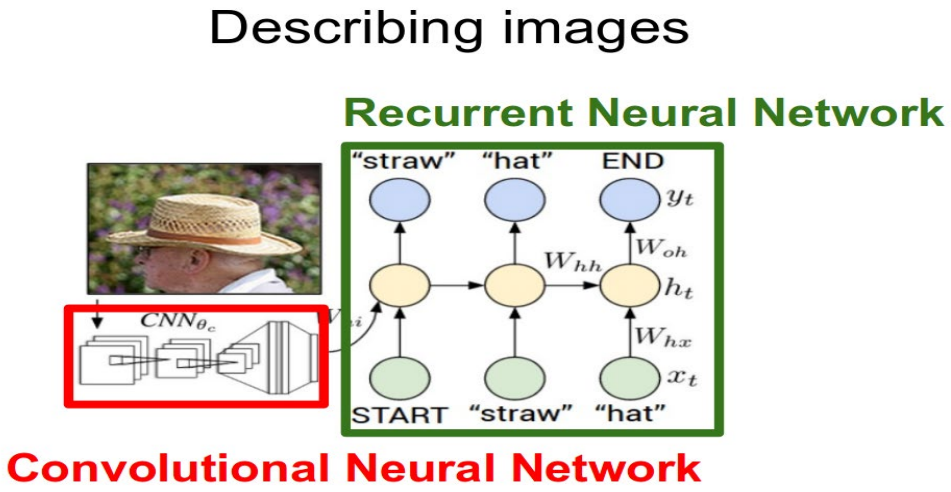


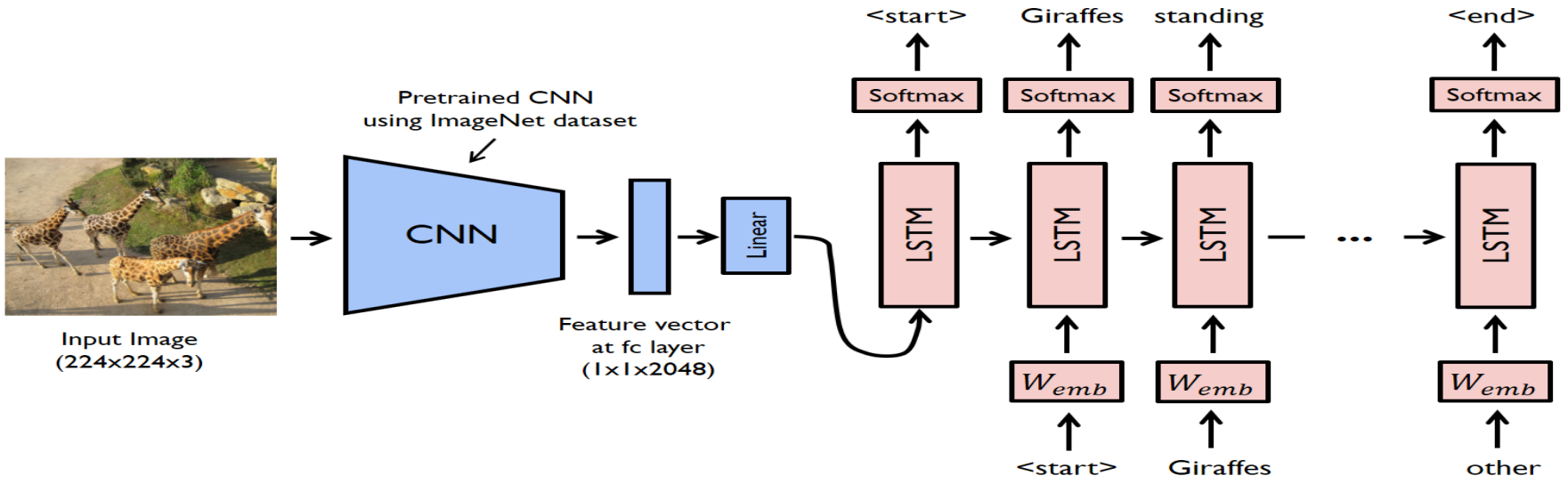
Decoder: An RNN with the hidden state of the sentence in source language as the input and output the translated sentence

Encoder-decoder architecture for machine translation

PR and ML Systems: Image Captioning

- **Image captioning: CNN+LSTM**





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

References

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