

MACHINE LEARNING



The A Team

Machine Learning

Group 9

Introduction

Regression

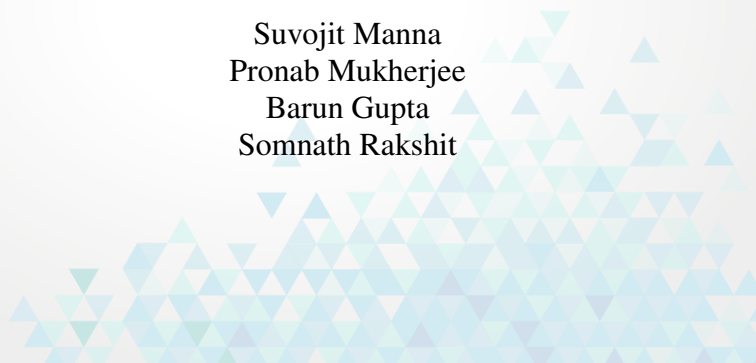
Classifications

Deep Learning

Conclusion

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Barun Gupta
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Let's Get Started

Machine Learning — What ?

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Field of study that gives computers the ability to learn without being explicitly programmed.

Instead of writing code, you feed data to the generic algorithm and it builds its own logic based on the data.



Figure: Classification Algorithms

Case Studies — Supervised Learning

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Bedroom	Sq.Ft	Neighbourhood	Price
3	2000	Uptown	\$350,000
2	800	Downtown	\$200,000
2	850	City Centre	\$150,000
1	550	Suburbs	\$75,000
4	2000	Suburbs	\$200,000

Bedroom	Sq.Ft	Neighbourhood	Price
3	2000	Uptown	???

Definiton

Supervised learning is the machine learning task of inferring a function from labeled training data.

Case Studies — Supervised Learning

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Math's Exam - Answer Keys

$$1) 2\ 4\ 5 = 3 \quad 5) 6\ 2\ 2 = 10$$

$$2) 5\ 2\ 8 = 2 \quad 6) 3\ 1\ 1 = 2$$

$$3) 2\ 2\ 1 = 3 \quad 7) 5\ 3\ 4 = 11$$

$$4) 2\ 2\ 4 = 6 \quad 8) 1\ 8\ 1 = 7$$

- The training data consist of a set of training examples.
- Training Data :
 - Input Object : Set of Features
 - Desired Output : Supervisory Signal
- A supervised learning algorithm produces an inferred function.
- An analogous task in human and animal psychology : Concept Learning.

Case Studies — Unsupervised Learning

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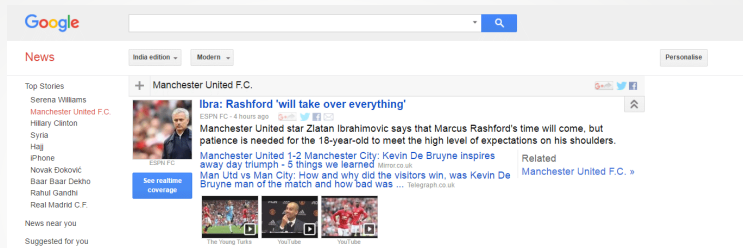


Figure: Google News grouping similar stories together.

Definiton

Unsupervised learning is the machine learning task of inferring a function to describe hidden structure from unlabeled data.

Cocktail Party Problem — Unsupervised Learning

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Sound from :

- *Microphone 1*
- *Microphone 2*

Output from Learning Algorithm :

- *Output 1*
- *Output 2*

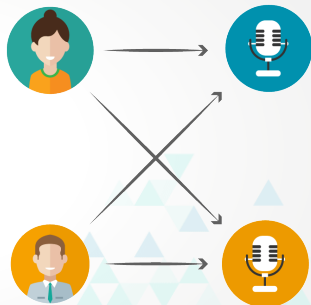


Figure: Overlapped Recordings

Case Studies — Unsupervised Learning

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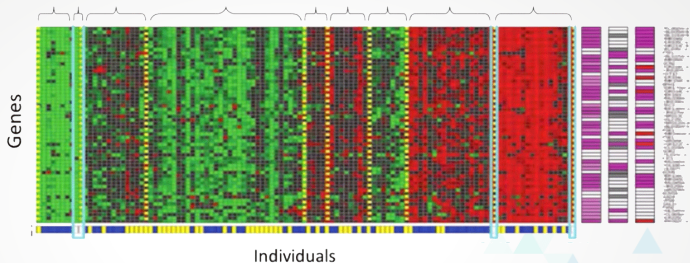


Figure: Gene Clustering

- Training Data given to the learner is unlabeled.
- No error or reward signal to evaluate a potential solution.
- Closely related to density estimation in statistics.

Machine Learning — Formal Definition

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The field of machine learning is concerned with the question of how to construct computer programs that automatically improve with experience.

A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P , if its performance at tasks in T , as measured by P , improves with experience E .

Evolved from :

- Pattern Recognition
- Computational Learning Theory
- Artificial Intelligence

Industry Trends

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Google Chauffeur : Self Driving Car by Google

A large U.S. bank used IBM machine learning technologies to analyze credit card transactions. It resulted in the following:



IBM Research : Credit Card Fraud Detection



Mail Services : Spam Filtering

Industry Trends

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Completed • \$1,000

 The Online Privacy Foundation

Psychopathy Prediction Based on Twitter Usage

Mon 14 May 2012 – Fri 29 Jun 2012 (4 years ago)

Dashboard ▼ Private Leaderboard - Psychopathy Prediction Based on Twitter Usage

This competition has completed. This leaderboard reflects the final standings. [See someone using multiple accounts? Let us know.](#)

#	Rank	Team Name	* in the money	Score	Entries	Last Submission UTC (Best - Last Submission)
1	15	y_tag *		0.86997	12	Tue, 26 Jun 2012 12:46:19
2	19	Bruce Cragin		0.86745	10	Fri, 29 Jun 2012 22:28:17 (-47.6h)
3	121	Indy Actuaries	1st	0.86700	6	Fri, 29 Jun 2012 03:40:38 (-3.4d)

Figure: Kaggle Challenge : Psychopathy Prediction

The aim of the competition is to determine to what degree it's possible to predict people with a sufficiently high degree of Psychopathy based on Twitter usage and Linguistic Inquiry.

Entertainment — Machine Learning

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Applications — Machine Learning

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- Adaptive websites
- Classifying DNA sequences
- Computer vision
- Internet fraud detection
- Natural language processing
- Online advertising
- Recommender systems
- Search engines
- Sentiment analysis
- Speech and handwriting recognition

Machine Learning — Why ?

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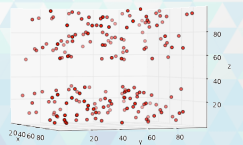
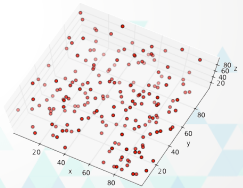
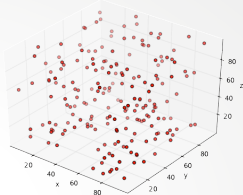
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- Can work with huge amount of data.
- Can make intelligent decisions by taking into account multiple features.
- Can find patterns in large amount of data which is almost impossible for human beings.
- These algorithms are self-modifying in nature, they get better over time as the usage increases.



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Usages — Regression

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In machine learning and statistics, classification is the problem of identifying to which of a set of categories (sub-populations) a new observation belongs.

On the basis of a training set of data containing observations (or instances) whose category membership is known.

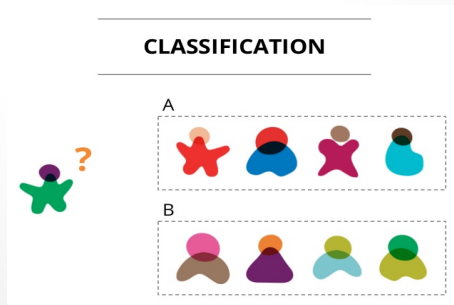


Figure: Classification

Usages — When it is used?

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Classification is considered an instance of supervised learning, i.e. learning where a training set of correctly identified observations is available..

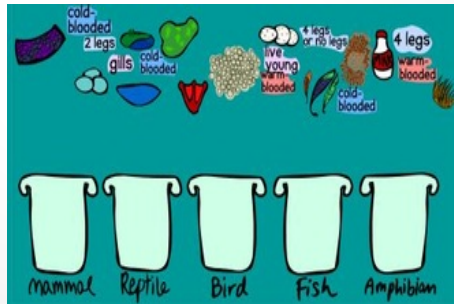


Figure: Training set is correctly Identified.

Usage — Types of Classifiers!!

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KNN algorithm :-

K-Nearest Neighbor Algorithm

- To determine the class of a new example E:
 - Calculate the distance between E and all examples in the training set
 - Select K-nearest examples to E in the training set
 - Assign E to the most common class among its K-nearest neighbors

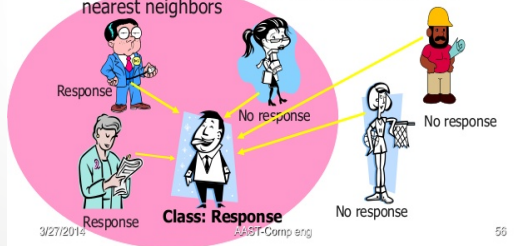


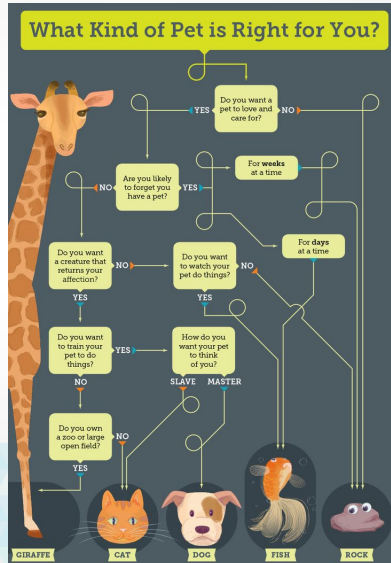
Figure: Example

Usage — Types of Classifiers!!

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Decision Tree :-



Example Cases — Real Life Examples

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Example Cases — Real Life Examples

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- Example 1:- An emergency room in a hospital measures 17 variables (e.g., blood pressure, age, etc) of newly admitted patients. A decision is needed: whether to put a new patient in an intensive-care unit. Due to the high cost of ICU, those patients who may survive less than a month are given higher priority.

Problem: to predict high-risk patients and discriminate them from low-risk patients.



Example Cases — Real Life Examples

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- Example 1:- An emergency room in a hospital measures 17 variables (e.g., blood pressure, age, etc) of newly admitted patients. A decision is needed: whether to put a new patient in an intensive-care unit. Due to the high cost of ICU, those patients who may survive less than a month are given higher priority.

Problem: to predict high-risk patients and discriminate them from low-risk patients.

- Example 2:- A credit card company receives thousands of applications for new cards. Each application contains information about an applicant, age Marital status annual salary outstanding debts credit rating etc.

Problem: to decide whether an application should approved, or to classify applications into two categories, approved and not approved.

Deep Learning — What is Deep Learning

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Meaning — Deep Learning

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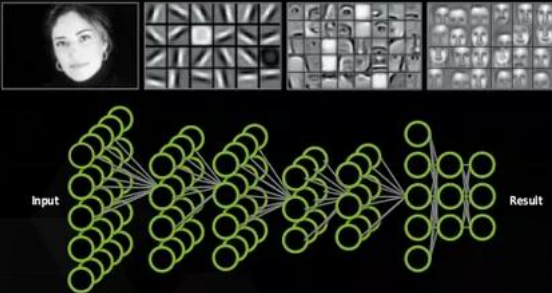
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WHAT MAKES DEEP LEARNING DEEP?



Today's Largest Networks

- ~10 layers
- 1B parameters
- 10M images
- ~30 Exaflops
- ~30 GPU days

Human brain has trillions of parameters - only 1,000 more.

Input

Result

11 NVIDIA

Neural Networks — What is ANN?

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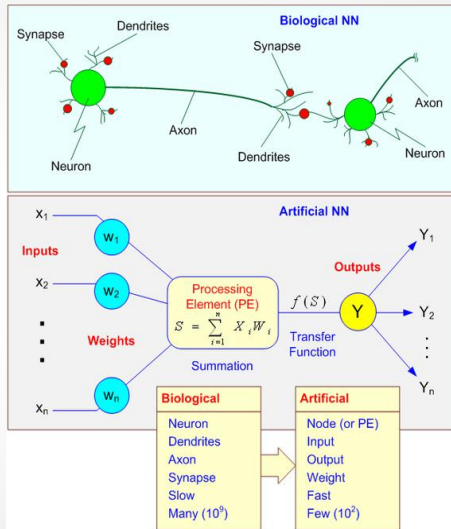


Figure: Artificial Neural Network

Traditional vs Deep learning — Deep Learning

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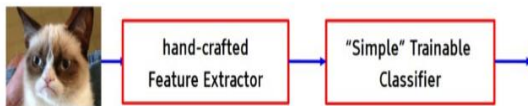
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TRADITIONAL APPROACH

The traditional approach uses fixed feature extractors.



DEEP LEARNING APPROACH

Deep Learning approach uses trainable feature extractors.

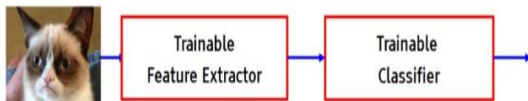


Figure: Tradition vs Deep Learning

Advantages — Deep Learning

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- Has best-in-class performance on problems that significantly outperforms other solutions in multiple domains. This includes speech, language, vision, playing games like Go etc. This isn't by a little bit, but by a significant amount. The current record is from 2013 where it classified 9979 out of 10,000 images accurately. This performance is human equivalent or even better. A Silicon Valley-based startup called Vicarious claims it created an artificial intelligence program so advanced it can solve CAPTCHAs with accuracy that, in many cases, approaches 100 percent.
- Reduces the need for feature engineering, one of the most time-consuming parts of machine learning practice.

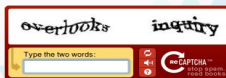


Figure: Captcha

Disadvantages — Deep Learning

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- Requires a large amount of data if you only have thousands of example, deep learning is unlikely to outperform other approaches.
- Is extremely computationally expensive to train. The most complex models take weeks to train using hundreds of machines equipped with expensive GPUs.
- Do not have much in the way of strong theoretical foundation. This leads to the next disadvantage.
- Determining the topology/flavor/training method/hyperparameters for deep learning is a black art with no theory to guide you.
- What is learned is not easy to comprehend. Other classifiers (e.g. decision trees, logistic regression etc) make it much easier to understand what's going on. .

Usages — Deep Learning

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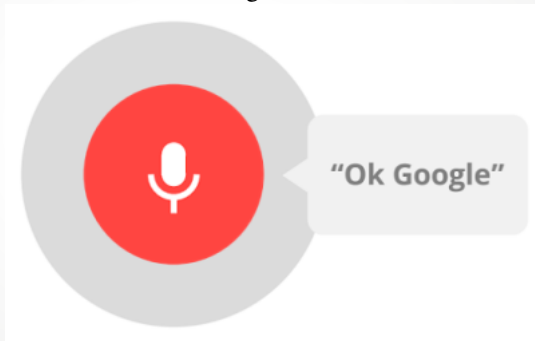
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Google Brain



Usages — Deep Learning

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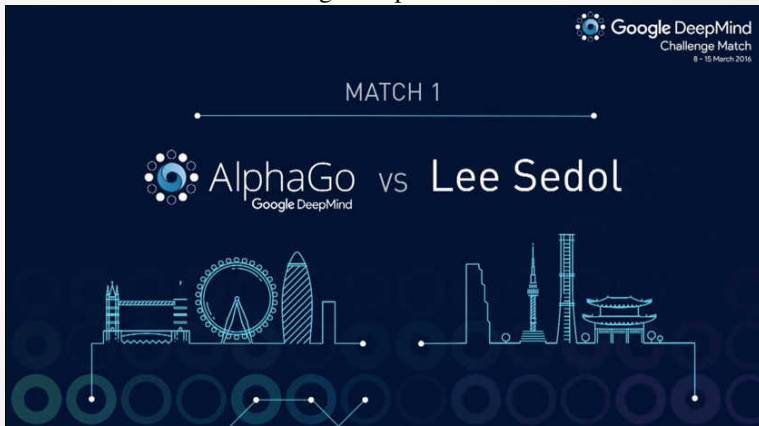
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Usages — Deep Learning

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Mageta

magenta

The pain is almost over

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Now that was very interesting!

The End