

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

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Outline

① INTRODUCTION TO AI

② INTRODUCTION TO ML

③ REFERENCES

About Me

Yogesh Haribhau Kulkarni

Bio:

- ▶ 20+ years in CAD/Engineering software development
- ▶ Got Bachelors, Masters and Doctoral degrees in Mechanical Engineering (specialization: Geometric Modeling Algorithms).
- ▶ Currently doing Coaching in fields such as Data Science, Artificial Intelligence Machine-Deep Learning (ML/DL) and Natural Language Processing (NLP).
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 - ▶ LinkedIn (www.linkedin.com/in/yogeshkulkarni/)
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Introduction to Artificial Intelligence

“Houston, we have a problem!!”



50 Years Ago: “Houston, We’ve Had a Problem” – John Uri

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Whats the Problem?

- ▶ Along with some softer words like “disruption”, “passionate”, “excited” ...
- ▶ If you don't have word “innovation” in your talk/speech/conversation it's BIG problem.
- ▶ Irrespective of fields. You can be Corporate, Political, Social, etc.

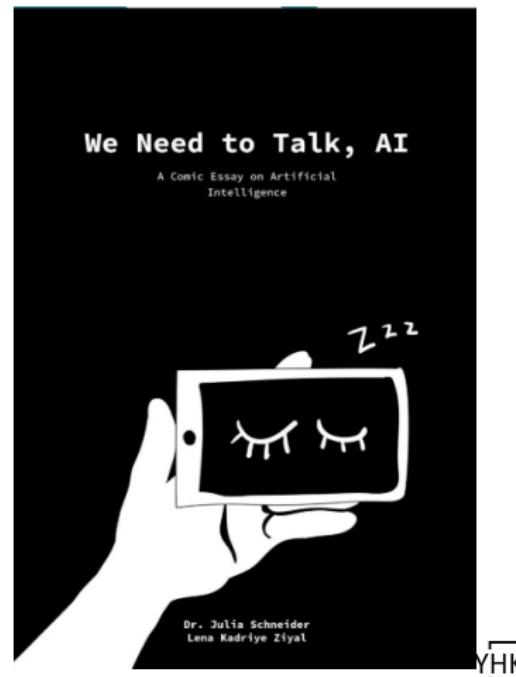
And there is an addition of one more word, which is a must in every talk...and that is?

The Problem

Every company is claiming to be working in AI-ML

- ▶ Is it really so?
- ▶ What exactly is AI (ML)?
- ▶ What is not AI?

Or is it just a plain BIG hype?



What is the Core Idea?

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What's the core idea?

- ▶ behind problem solving?
- ▶ behind writing software algorithms?
- ▶ solving research problems?



Desire

- ▶ To find a “function”
- ▶ To find a relation
- ▶ To find a transformation
- ▶ To build a model
- ▶ From given inputs to desired outputs.
That's it.



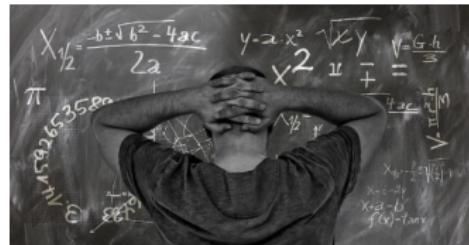
Functions

- ▶ Some functions are straight forward
- ▶ *"In summer, ice-cream sale goes up"*
- ▶ Cause and effect
- ▶ Relation (function, Mathematical model) is found out
- ▶ Here, simple rule based programming suffices



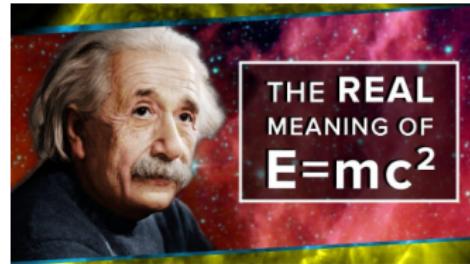
Functions

- ▶ But some functions are complex
- ▶ *"More you put efforts, your business flourishes."*
- ▶ Cause and effect again, but the relation is far too complex
- ▶ Too many variables
- ▶ Here, simple rule based programming not humanly possible.
- ▶ Lots of research needed to come up with equations.



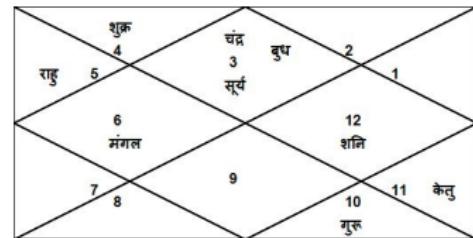
Functions

- ▶ $E = mc^2$
- ▶ What's this? a function?
- ▶ Input variable(s)?
- ▶ Output variable(s)?
- ▶ Parameters?
- ▶ How's the relation? linear?



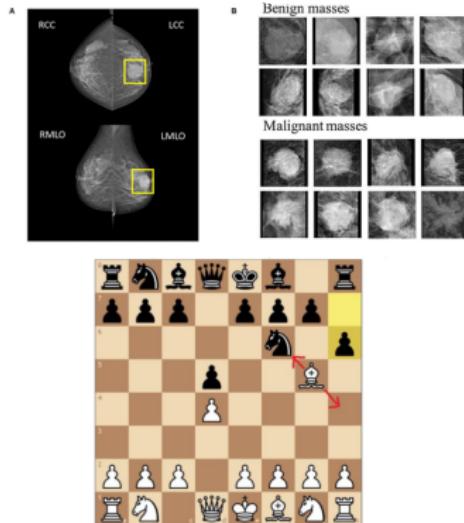
Controversial Example

- ▶ Even astrology is a model, based on the past cases.
- ▶ Could claim empirical evidence.
- ▶ Given this planetary position, it predicts.
- ▶ Represented by "Horoscope"
- ▶ Got weights for each planets (real or fictitious)
- ▶ Reliable??



Functions

- ▶ But most real-life functions are not deterministic
- ▶ Some are probabilistic, some non-linear.
- ▶ “*Detecting if the tumor is benign or malignant*”
- ▶ “*At any state in the game of chess, what's the next move?*”



Chess: next move?

- ▶ Needs extreme expertise
- ▶ Needs “intelligence”
- ▶ How do you get that?
 - ▶ Built by lots of training.
 - ▶ By studying lots of past games.
- ▶ This is how Humans build intelligence



Intelligence

- ▶ Can machine (software/program) also do the same?
- ▶ Can it play chess?
- ▶ Can it build intelligence?
- ▶ By looking at past experiences (data),
- ▶ Training Data: games played, moves used, etc.

Yes, it can!! That's Artificial Intelligence.



What is Artificial Intelligence?

My definition

“If machines (or computer programs) start doing some/all of these “intelligent” tasks, then that’s Artificial Intelligence”

Intelligence: the differentiation

- ▶ Ability to think various domains
- ▶ Ability produce something new
- ▶ Ability to detect the unseen
- ▶ Ability to enhance knowledge (rules, patterns)



All these, AI has started doing. The AI era has arrived!!

Everyday usage

Artificial intelligence seems to have become ubiquitous.

- ▶ Replying to our emails on Gmail
- ▶ Learning how to drive our cars,
- ▶ Sorting our holiday photos.
- ▶ etc.



Too good to be true, isn't it, sort of Magical !!

But then ...

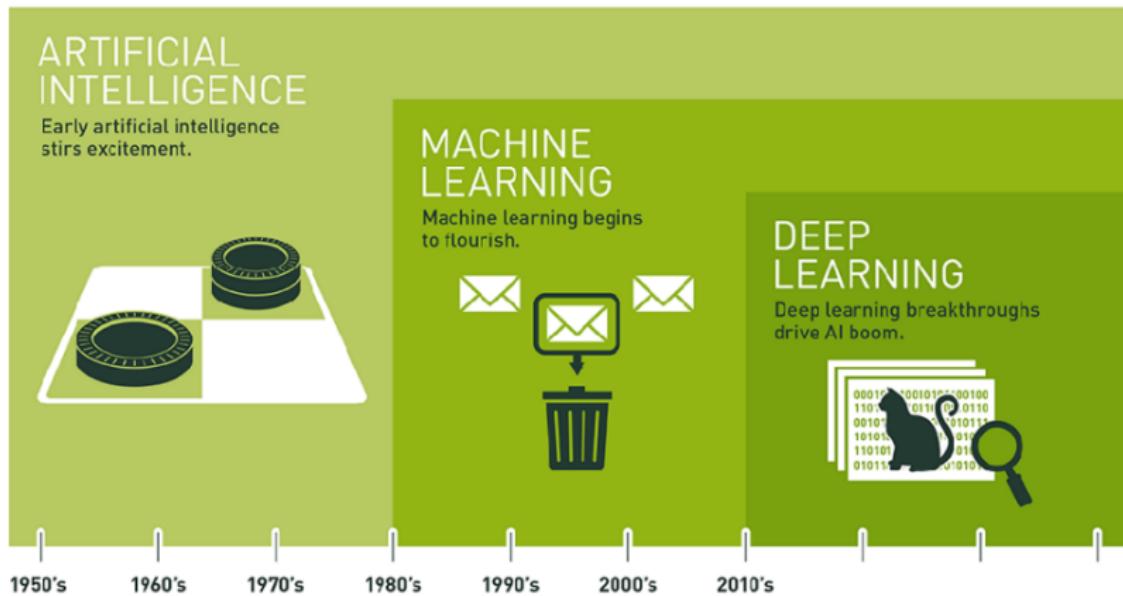
- ▶ When its too good, you start suspecting
- ▶ Is it for real!!
- ▶ How can such thing happen?
- ▶ How far will it go?



The next thing you know, people are worrying about exactly how and when AI is going to doom humanity.

AI, ML, DL ... Same?

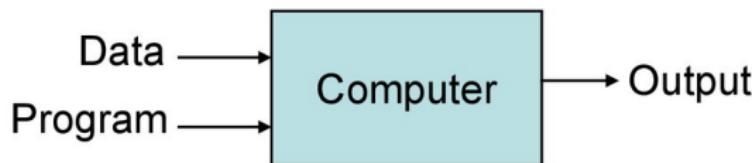
Or Relationship between them ?



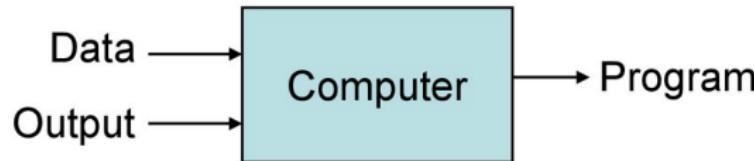
(Ref: <https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/>)

Traditional vs. Machine Learning?

Traditional Programming



Machine Learning



Why Machine/Deep Learning?

- ▶ Problems with High Dimensionality
- ▶ Hard/Expensive to program manually
- ▶ Techniques to model 'ANY' function given 'ENOUGH' data.
- ▶ Job \$\$\$

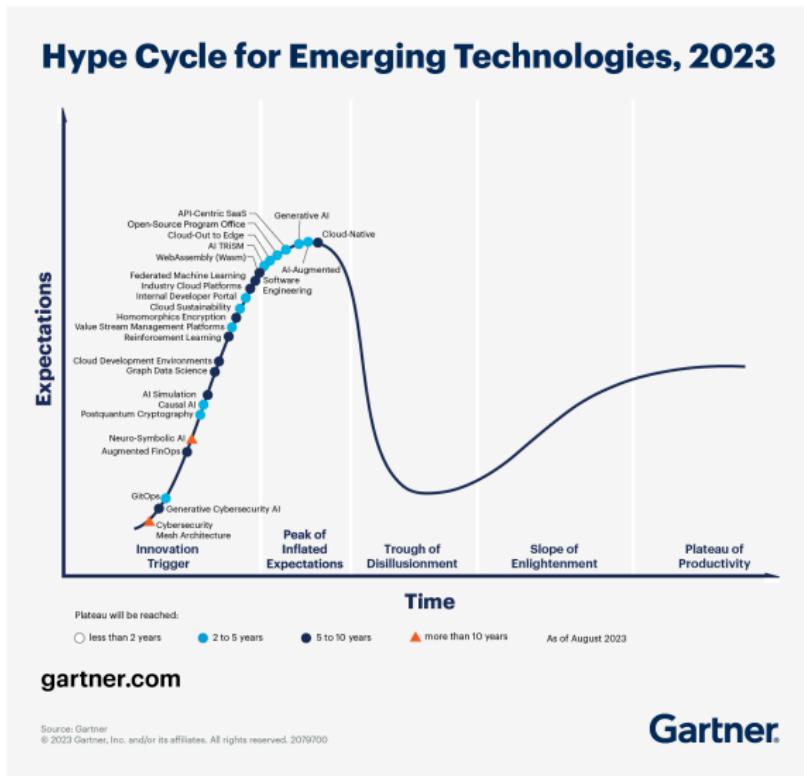


Why now?

- ▶ Flood of data (Internet, IoT)
- ▶ Increasing computational power
- ▶ Easy/free availability of algorithms
- ▶ Increasing support from industries



Gartner Hype Cycle Emerging Technologies 2023



Is AI a threat?

Is AI a threat?

If you believe in what Elon Musk says, then YES.



Elon Musk recently commented on Twitter that artificial intelligence (AI) is more dangerous than North Korea

(Ref: What is Artificial Intelligence — Artificial Intelligence Tutorial For Beginners — Edureka)

Is AI a threat?

If you believe in these movies, then YES.



The Terminator



I, Robot



The Matrix



Tron: Legacy



War Games



Ex Machina

Well, AI based War robots are not impossible anymore.

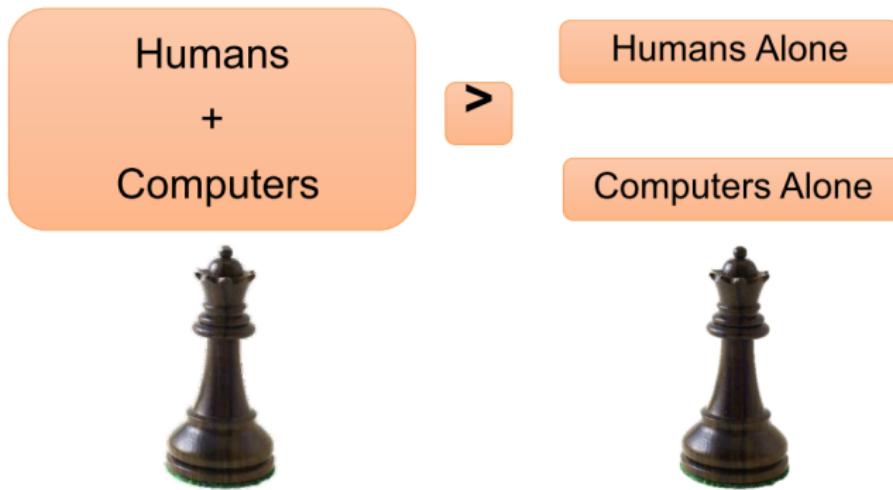
(Ref: What is Artificial Intelligence — Artificial Intelligence Tutorial For Beginners — Edureka)

Fear: Are we being replaced?

- ▶ Yes. in tasks that are repetitive
- ▶ But not which require complex thinking and creativity

Mostly

Technology Enhancing (Not Replacing) Humans



(Ref: "Artificial Intelligence Overview" - Harry Surden)

Limits on Artificial Intelligence

- ▶ Many things still beyond the realm of AI
- ▶ No thinking computers
- ▶ No Abstract Reasoning
- ▶ Often AI systems Have Accuracy Limits
- ▶ Many things difficult to capture in data
- ▶ Sometimes Hard to interpret Systems

Introduction to Machine Learning

How do we learn?

- ▶ What do we do when we have to prepare for an examination?
- ▶ Study. Learn. Imbibe. Take notes. Practice mock papers.
- ▶ Thus, prepare for the unseen test.

What is Learning?

"Learning is any process by which a system improves performance from experience."

- Herbert Simon, Turing Award 1975, Nobel in Economics 1978.

What is Machine Learning?

Machine learning is a type of artificial intelligence (AI) which:

- ▶ Learns function without being explicitly programmed.
- ▶ Can grow and change when exposed to new data.

So, What is Machine Learning?

- ▶ Ability of computers to “learn” from “data”
- ▶ Learn: Discover patterns, underlying structure
- ▶ Data: Comes from sensors, transactions, etc.

Mathematical Definition of Machine Learning

Machine Learning comes up with a Model given inputs and targets.

- ▶ Input data is available.
- ▶ Input data is transformed to get output.
- ▶ Output: something that needs to be predicted or estimated.
- ▶ Transformation engine is called Model or function.

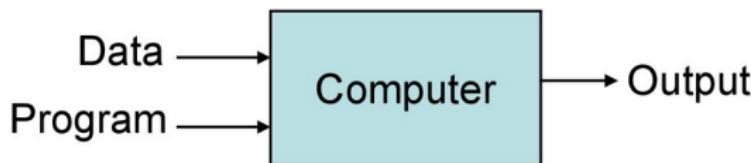
Model entities

For $income = c + \beta_0 \times education + \beta_1 \times experience$

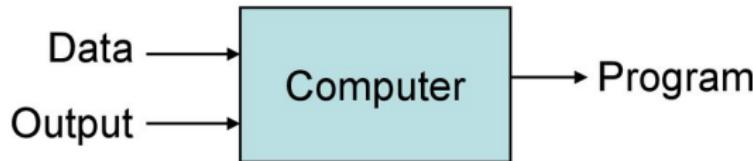
- ▶ Inputs: Education and experience, also called as features or attributes or dimensions or variables.
- ▶ Mathematical entities added to input data, are Parameters.. β_0 and β_1 are parameters
- ▶ Income is target, also called as outcome or class.

Traditional vs. Machine Learning?

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Machine Learning



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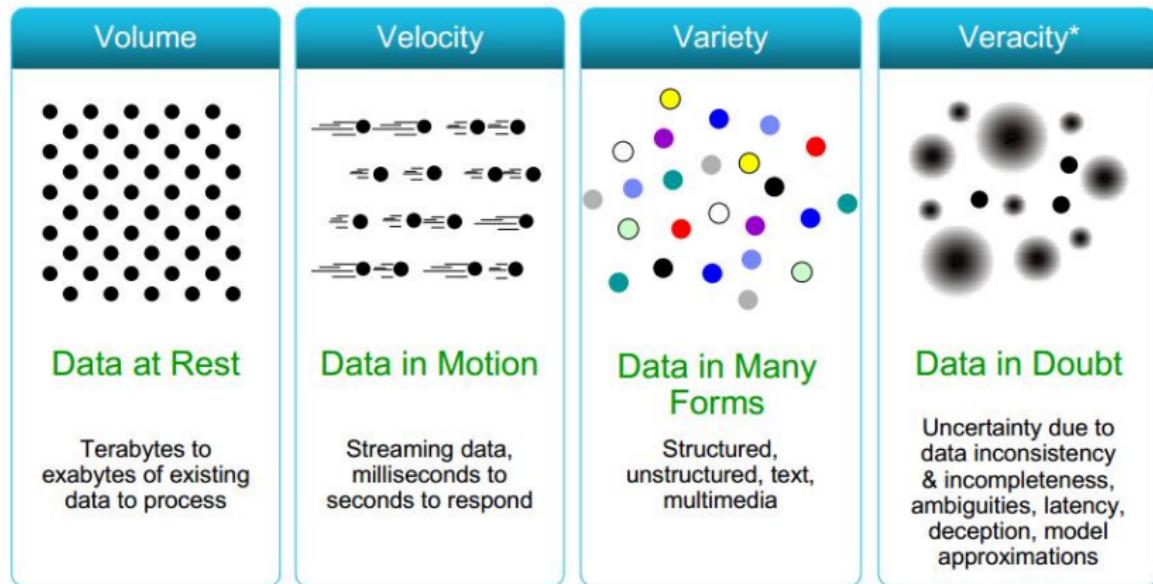
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The storm: The Big Data is coming

- ▶ In 2012, HBR put Data Scientists on the radar
- ▶ “The Sexiest Job of the 21st Century”.
- ▶ Industry, trying to be data-driven, than manual.

(Big) Data Characteristics



(Image Credit: <http://www.rosebt.com/blog/data-veracity>)

What's the answer?

AI-ML-DL

- ▶ Machines showing intelligence of Humans
- ▶ Machine Learning: part of AI
- ▶ Logic is not programmed by hand,
- ▶ Gets emerged in training with data.

A Puzzle

How different is Machine Learning?

Maths Puzzle

Math Quiz #1 - Teacher's Answer Key

$$1) \ 2 \ 4 \ 5 = 3$$

$$2) \ 5 \ 2 \ 8 = 2$$

$$3) \ 2 \ 2 \ 1 = 3$$

$$4) \ 4 \ 2 \ 2 = 6$$

$$5) \ 6 \ 2 \ 2 = 10$$

$$6) \ 3 \ 1 \ 1 = 2$$

$$7) \ 5 \ 3 \ 4 = 11$$

$$8) \ 1 \ 8 \ 1 = 7$$

Maths Puzzle

- ▶ Letting the computer work out that relationship for you.
- ▶ 'Learn' to solve such problems,
- ▶ 'Test' with any other problem of the same type!

Types of Machine Learning

Two kinds of learning

- ▶ Supervised
- ▶ Unsupervised

Supervised

- ▶ Training data with correct answers
- ▶ Both used to train the model
- ▶ Then apply unseen data on model

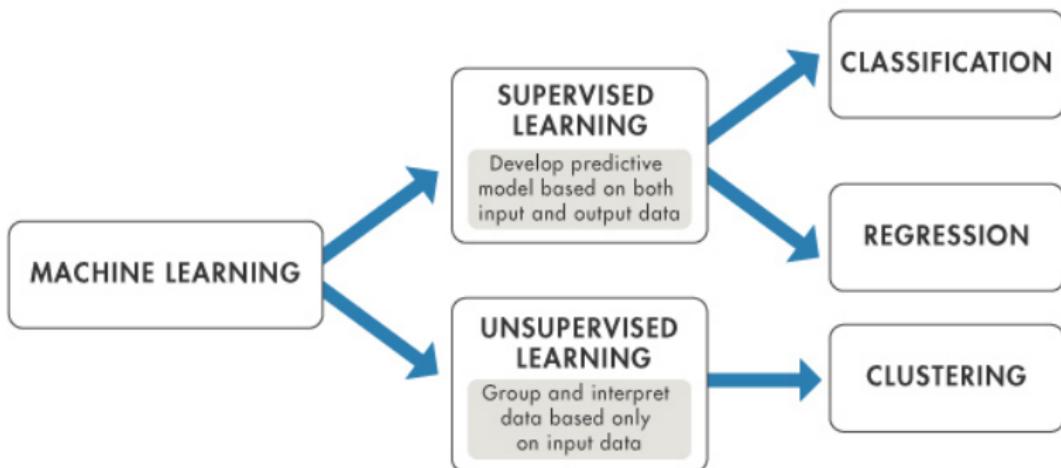
Unsupervised

- ▶ Training data with no answers
- ▶ Extract patterns, groups

Some types of algorithms

- ▶ Prediction: predicting a continuous variable from data
- ▶ Classification: assigning records to predefined groups
- ▶ Clustering: splitting records into groups based on similarity
- ▶ Association learning: seeing what often appears together

Machine Learning Learning Algorithms



(Reference: Machine Learning in MATLAB - MATLAB & Simulink - MathWorks)

Machine Learning Learning Algorithms

- ▶ Is this A or B? : Classification algorithms
- ▶ Is this weird? : Anomaly detection algorithms
- ▶ How much—or—How many? : Regression algorithms
- ▶ How is this organized? : Clustering algorithms, Dimensionality reduction
- ▶ What should I do next? : Reinforcement learning algorithms

(Ref: Brandon Rohrer's breakdown of the "5 questions data science answers")

Classification

- ▶ **Description:** Identifying the category an object belongs to.
- ▶ **Applications:** Spam detection, Image recognition.
- ▶ **Algorithms:** SVM, nearest neighbors, random forest, Logistic Regression

Regression

- ▶ **Description:** Predicting a continuous-valued attribute associated with an object.
- ▶ **Applications:** Drug response, Stock prices.
- ▶ **Algorithms:** Linear Regression

Clustering

- ▶ **Description:** Automatic grouping of similar objects into sets.
- ▶ **Applications:** Customer segmentation, Grouping experiment outcomes
- ▶ **Algorithms:** k-Means

Dimensionality Reduction

- ▶ **Description:** Reducing the number of random variables to consider.
- ▶ **Applications:** Visualization, Increased efficiency
- ▶ **Algorithms:** PCA, Singular Value Decomposition

Popular Algorithms in Machine Learning

- ▶ Linear, Logistic Regression
- ▶ Decision Trees
- ▶ SVM - Support Vector Machines, Naive Bayes
- ▶ K-Means

Applications of Machine Learning

Everyday Applications of Machine Learning

- ▶ Face Recognition (Facebook)
- ▶ Spam recognition in Emails
- ▶ Recommender Systems
- ▶ Feelings Analysis, Sentiments
- ▶ Natural language: Translate a sentence from Hindi to English, question answering, etc.
- ▶ Speech: Recognise spoken words, speaking sentences naturally
- ▶ Game playing: Play games like chess
- ▶ Robotics: Walking, jumping, displaying emotions, etc.
- ▶ Driving a car, flying a plane, navigating a maze, etc.

Cool-down: Summary

SO ...

- ▶ What is Machine learning, after-all?
- ▶ Its usage in your domain?

References

Many publicly available resources have been refereed for making this presentation. Some of the notable ones are:

- ▶ "What counts as artificially intelligent? AI and deep learning, explained" - The Verge
- ▶ "Artificial Intelligence Overview" - Harry Surden
- ▶ "8 ways artificial intelligence is going to change the way you live, work and play in 2018" - Catherine Clifford
- ▶ "Artificial intelligence and the future of our work" - UNDP , IBM Research

Thanks ...

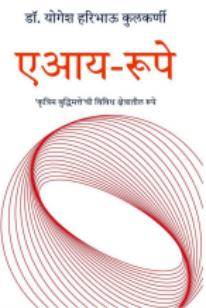
- ▶ Search "**Yogesh Haribhau Kulkarni**" on Google and follow me on LinkedIn and Medium
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(<https://www.linkedin.com/in/yogeshkulkarni/>, QR by Hugging Face

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