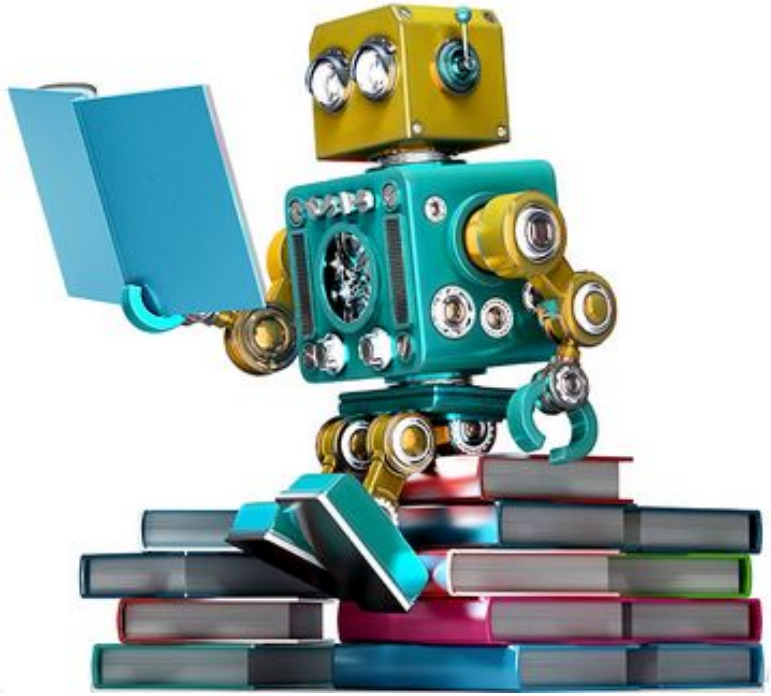
Machine Learning
Lecture 1

Dr. Muhammad Kamran Malik

What is Machine Learning

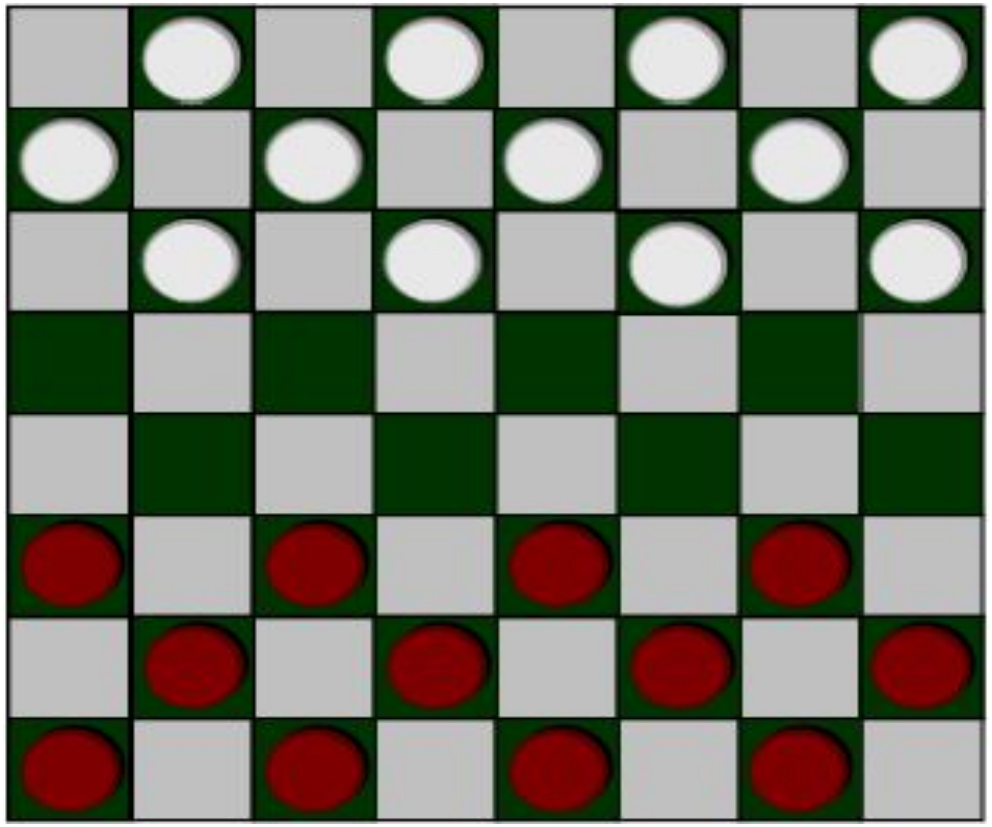
What is Machine Learning

- A subfield of computer science and AI
- Learn, make decisions and prediction from data.
- Enables computers to act and make data–driven decision rather than being explicitly programmed to carry out a certain task.



What is Machine Learning

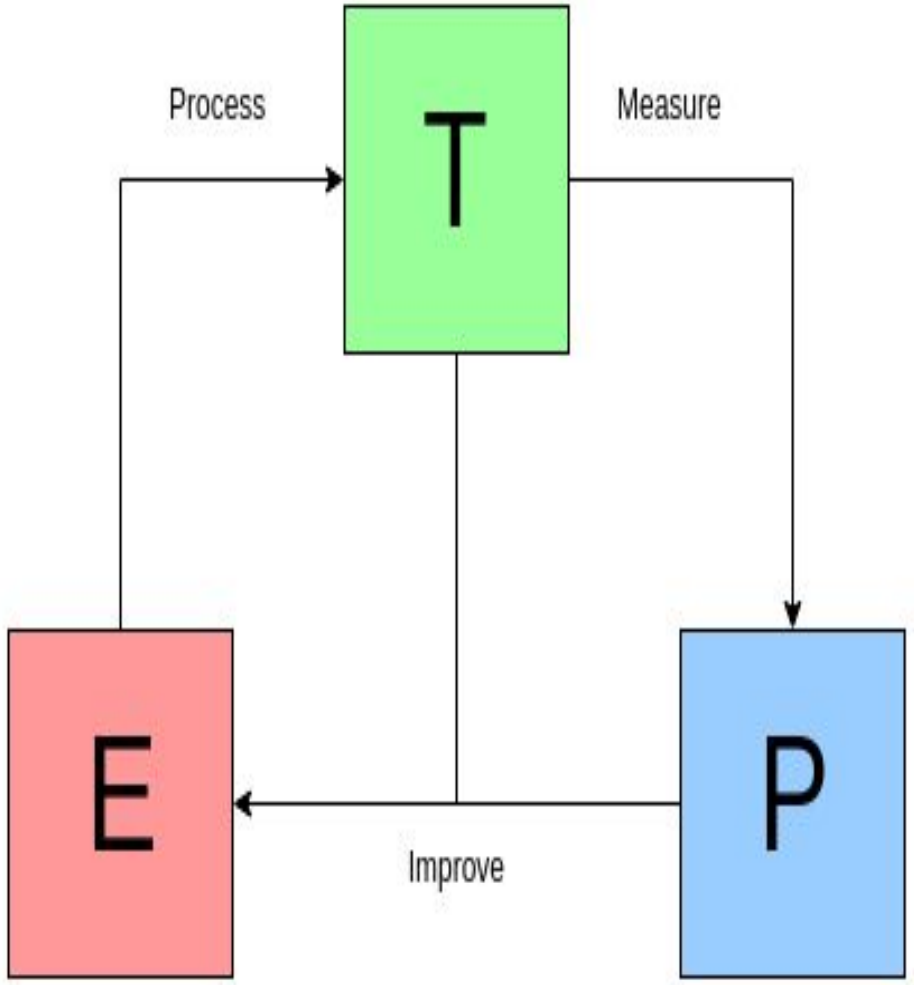
- The field of study that gives computers the ability to learn without being explicitly programmed. (Arthur Samuel-1959)



What is Machine Learning

- 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. (Tom Mitchell-1998)
- Playing checkers
  - E = the experience of playing many games of checkers
  - T = the task of playing checkers.
  - P = the probability that the program will win the next game.

What is Machine Learning

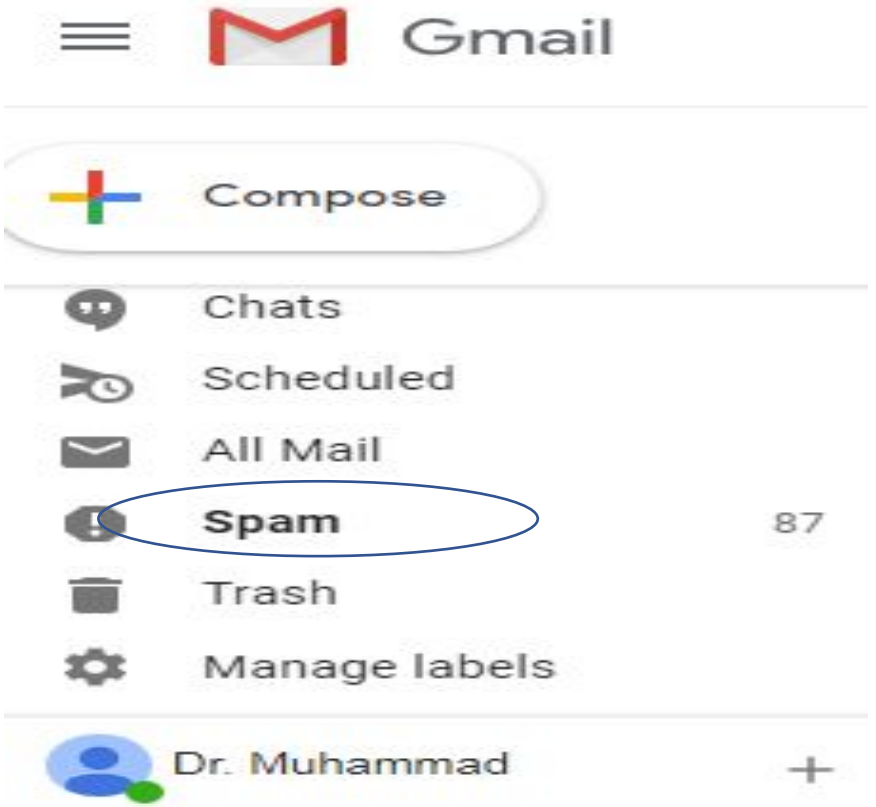


E * T = P

Experience	*	Task	=	Performance
Input Data: • Housing prices • Customer transactions • Clickstream data • Images		**Task:** • Predict prices • Segment customers • Optimize user flows • Categorize images		**Performance:** • Accurate prices • Coherent groupings • KPI lifts • Correctly sorted images

Example: Email Spam Checker

- "A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E."
- Suppose your email program watches which emails you do or do not mark as spam, and based on that learns how to better filter spam. What is the T, E and P in this setting?


Gmail
Compose
Chats
Scheduled
All Mail
Spam
87
Trash
Manage labels
Dr. Muhammad

Example: Email Spam Checker

- "A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E."
- Suppose your email program watches which emails you do or do not mark as spam, and based on that learns how to better filter spam. What is the task T in this setting?
  - Classify emails as spam or not spam.
  - Watching you label emails as spam or not spam.
  - The number (or fraction) of emails correctly classified as spam/not spam.
  - None of the above, this is not a machine learning algorithm.

When Machine Learning?

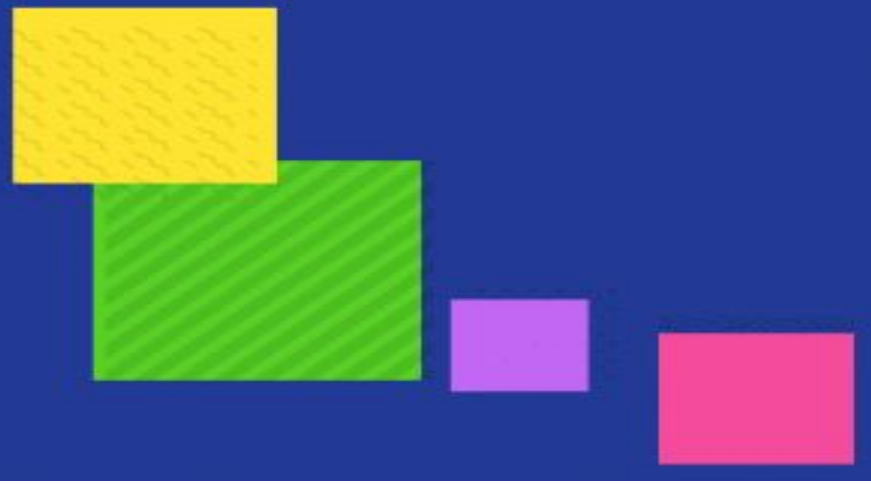
- Learning is used when:
  - Human expertise does not exist (navigating on Mars),
  - Humans are unable to explain their expertise (speech recognition, time series analysis)
  - Solution changes in time (routing on a computer network)
  - Solution needs to be adapted to particular cases (user biometrics)
  - Data is Big Data (Volume, Velocity, Variety)

Q & A

Machine Learning Applications

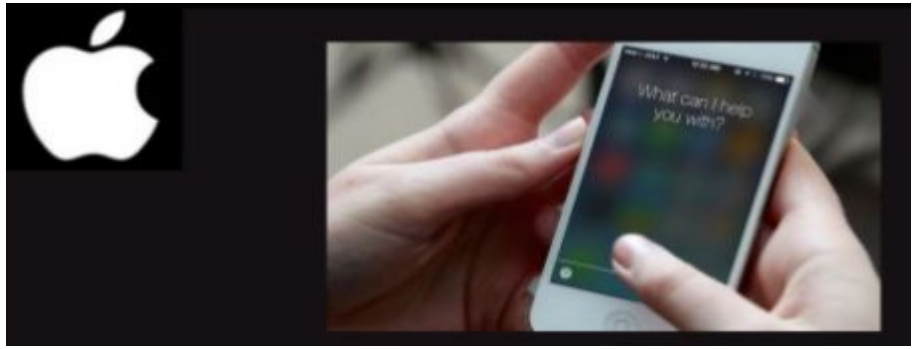
Machine Learning Applications (Virtual Personal Assistant)

- Calendar & Meeting Reminder
- Automation
- Natural Conversation
- Recommending
- Smarter Learning
- Integration



Machine Learning Applications (Virtual Personal Assistant)

Google Assistant



SILVIA

Viv

Bixby

Braina

Mycroft

Machine Learning Applications (Traffic Prediction)

Google Maps predicts whether the traffic is clear, slow-moving or heavily congested based on two measures:

- Average time taken on specific days at specific times on that route
- real time location data of vehicles from google maps application and Sensors

MOST POPULAR MAP SERVICES

Bing maps

MAPS.ME

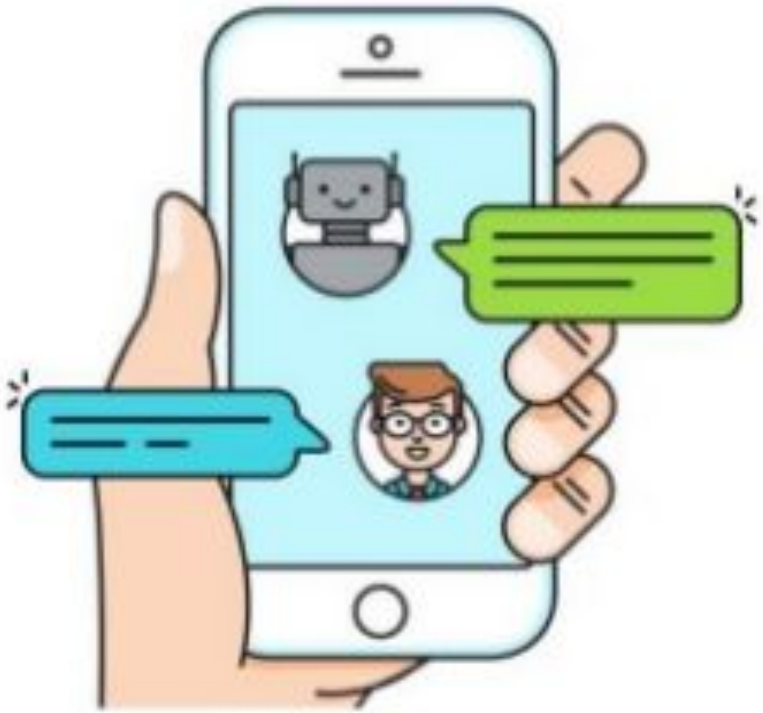
Machine Learning Applications (Email Spam Filtering)

Gmail is one of the many popular email providers who have an inbuilt spam filter:

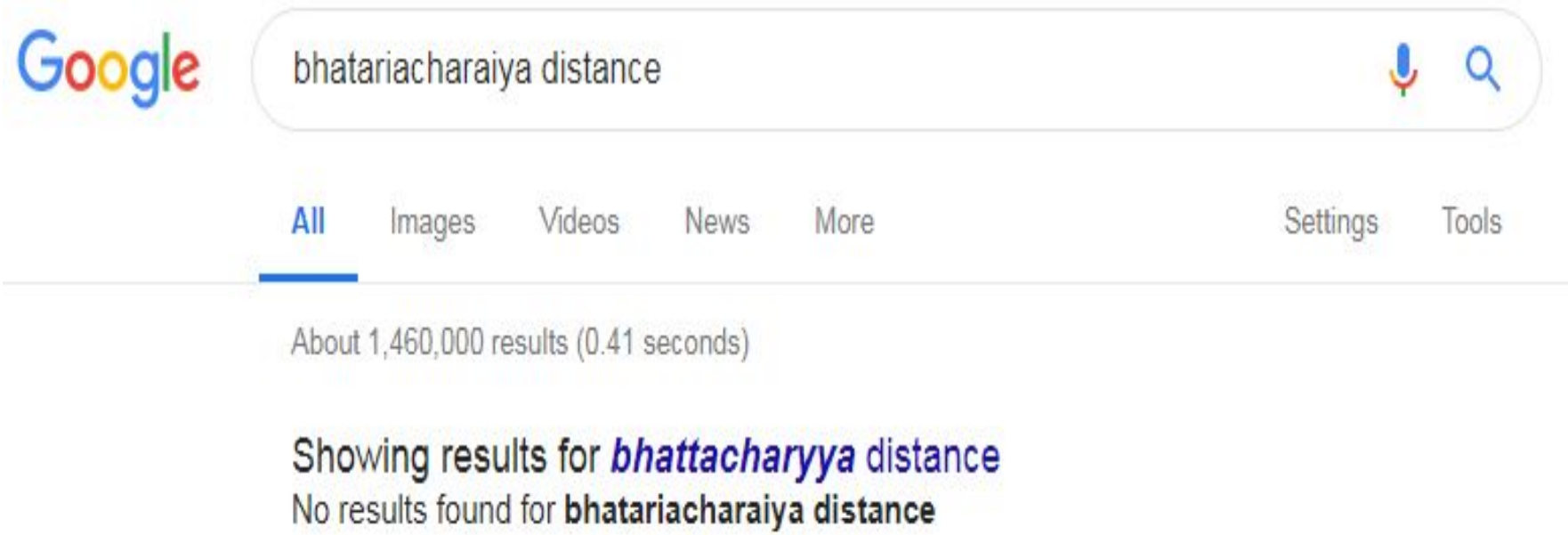
Spam filters are of the following types:

- Content filters
- Header filters
- General blacklist filters
- Rules-based filters
- Permission filters
- Challenge-response filters

Machine Learning Applications (chatbots)



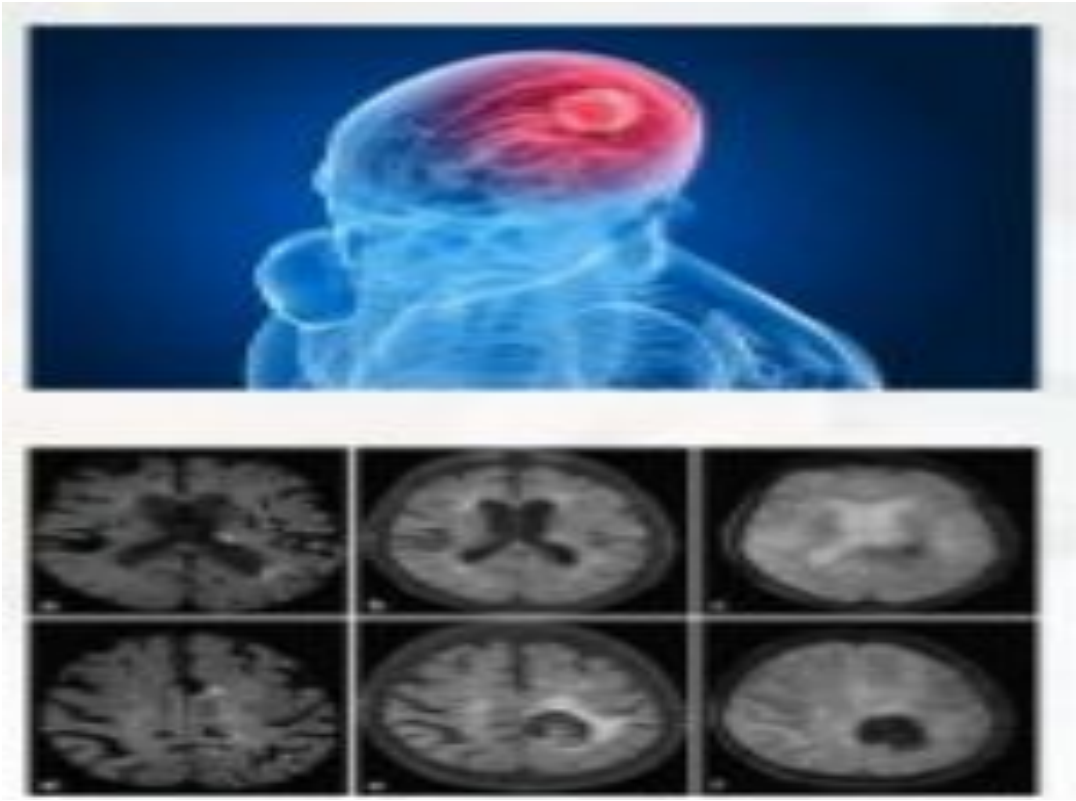
Machine Learning Applications (Search Engine Result Refining)



Machine Learning Applications (Online Fraud Detection)

Machine Learning Applications (Stock Market Trading)

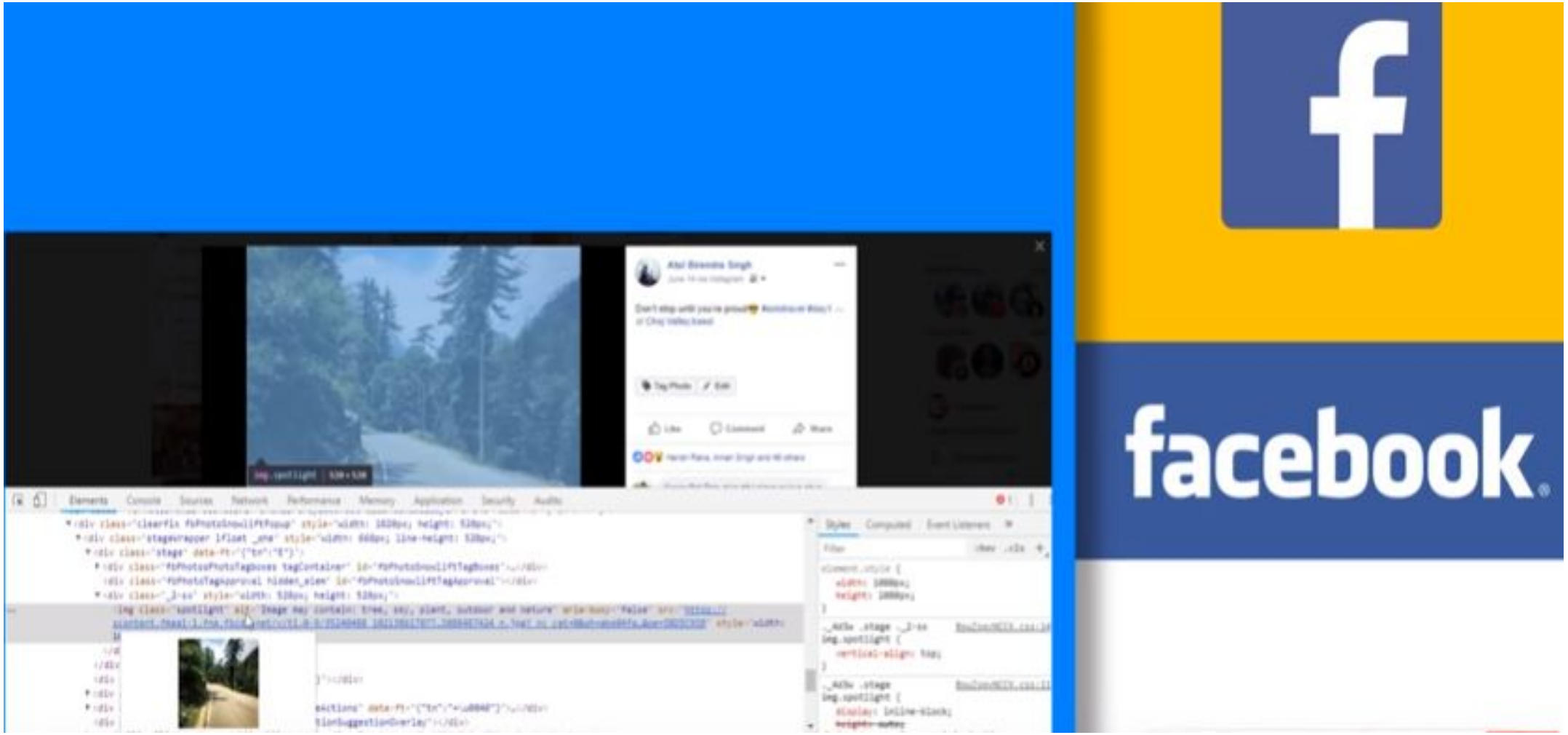
Machine Learning Applications (Assistive Medical Technology)



Machine Learning Applications (Automatic Translation)

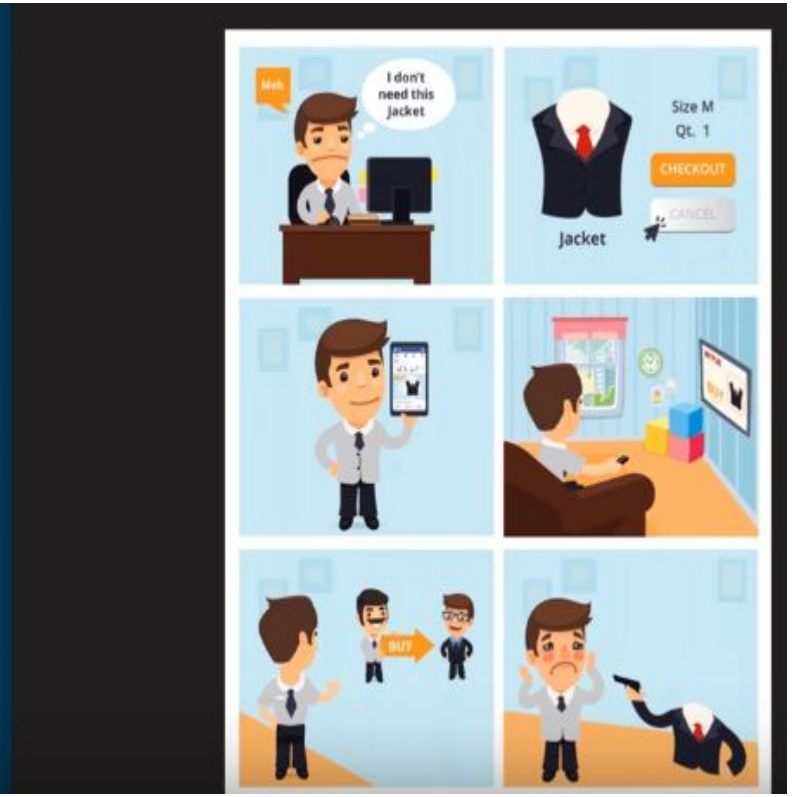
Machine Learning Applications (Automatic Friend Tagging suggestions)

Machine Learning Applications (Alt Tags)



Machine Learning Applications (Recommendation Systems)

Ads Recommendation



NETFLIX

Recommender System

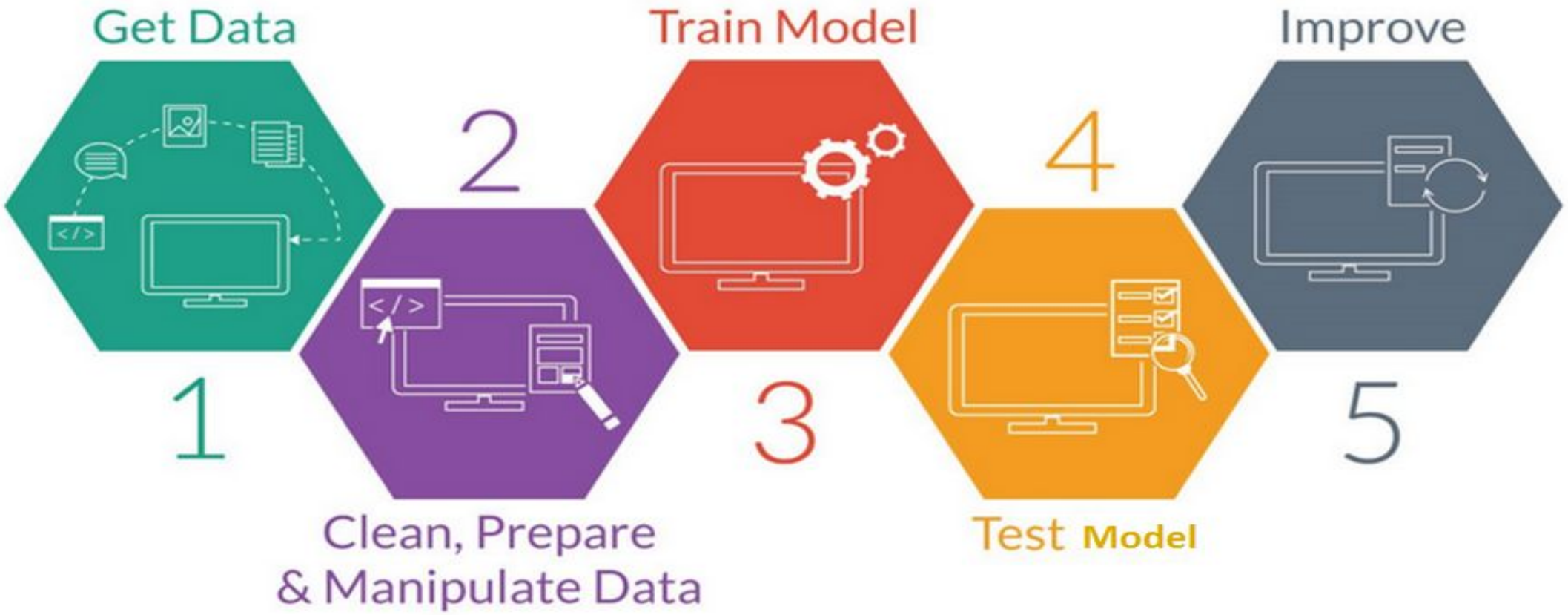
Machine Learning Applications

- Autonomous Cars (TESLA)
- Face Recognition app (Iphone)
- Moley (The Robotic Chef)
- KUKA (Robotic Automation)

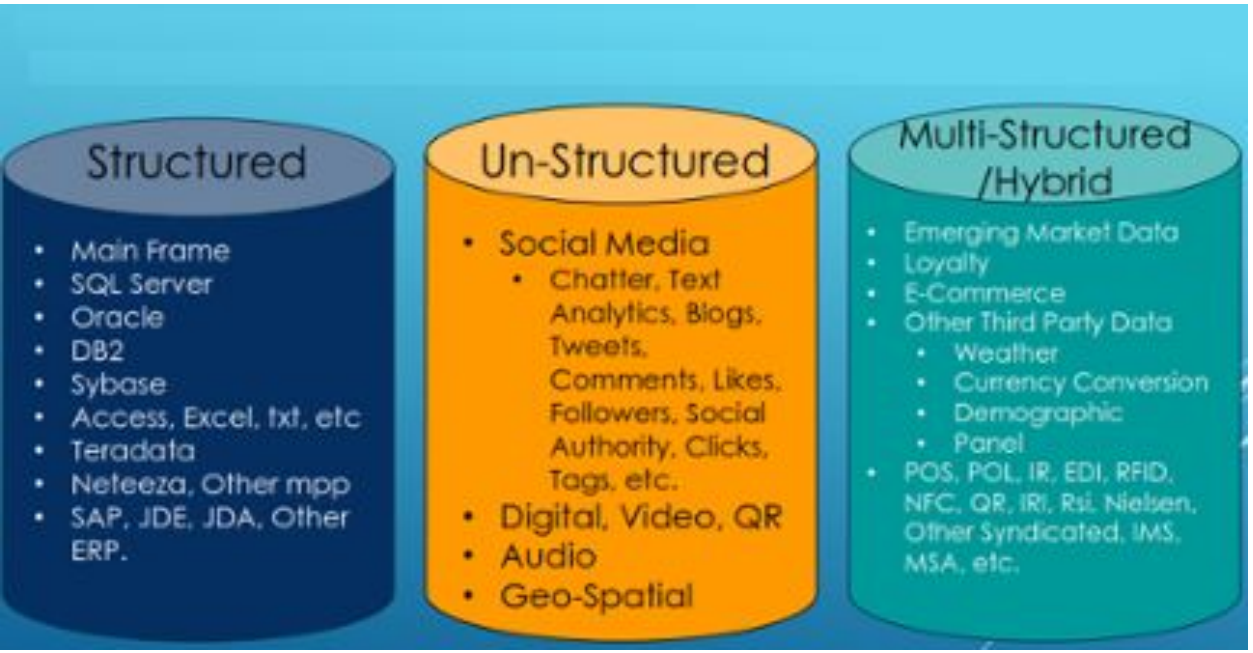
Q & A

Machine Learning Process Lifecycle

Machine Learning Process Lifecycle



Get Data



Sound

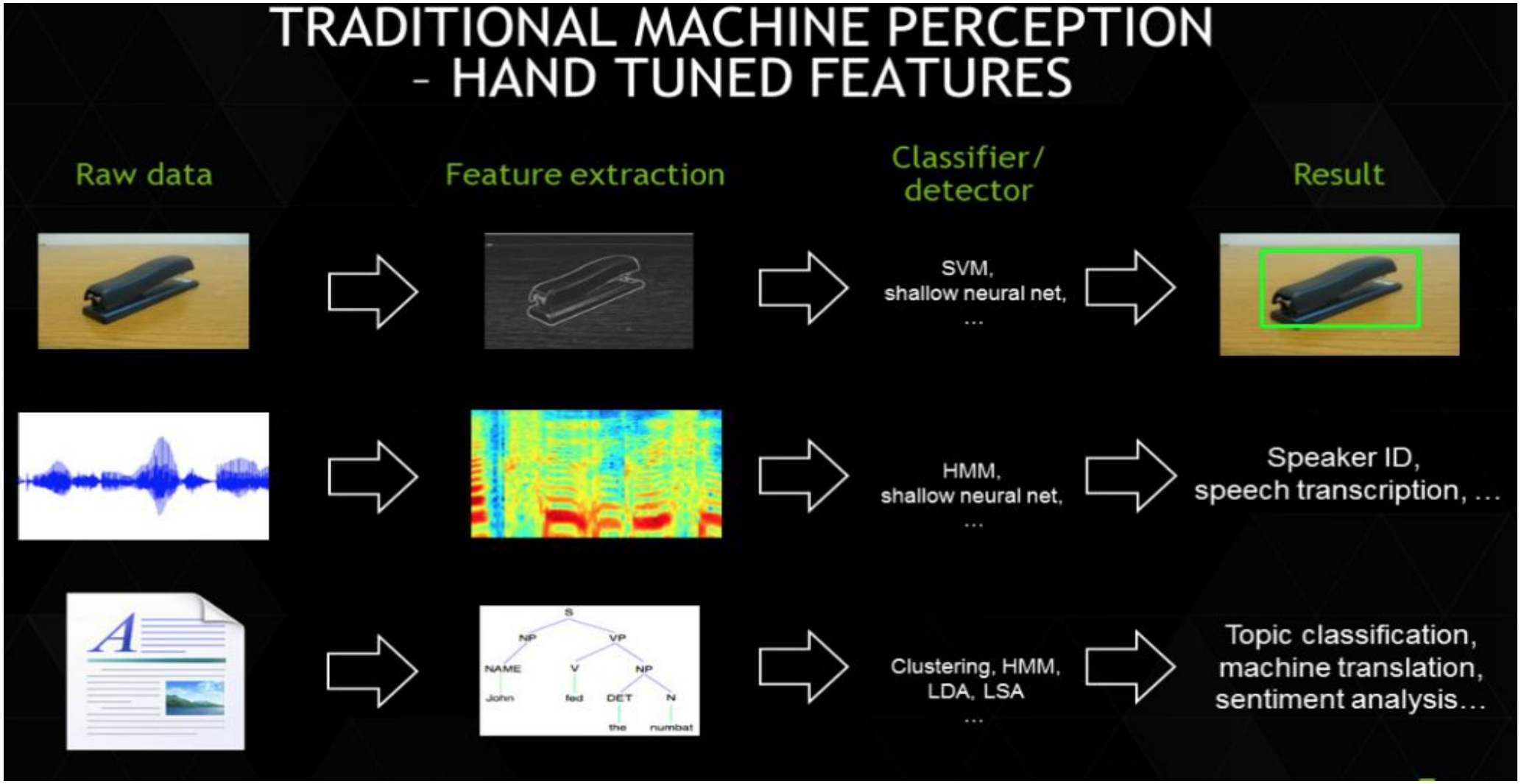
Number/Categorical

Age	Height	Weight	Gender
19	160	55	male
25	170	55	male
30	175	60	femal

Text

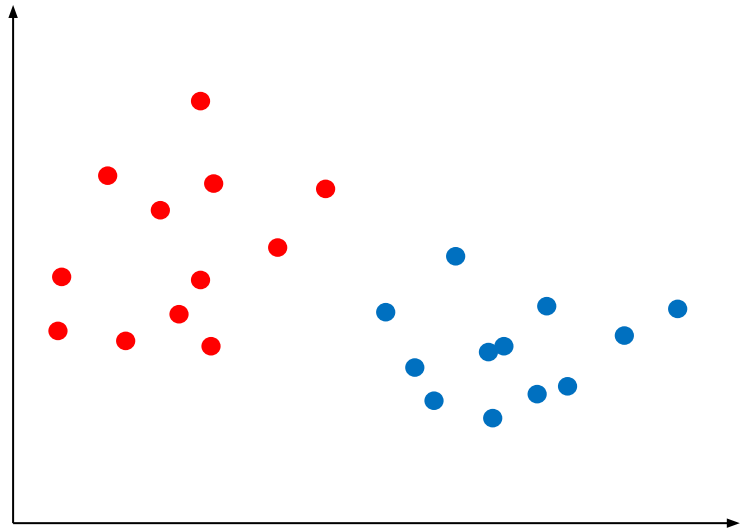
Image

Cleaning and preparing (Features)

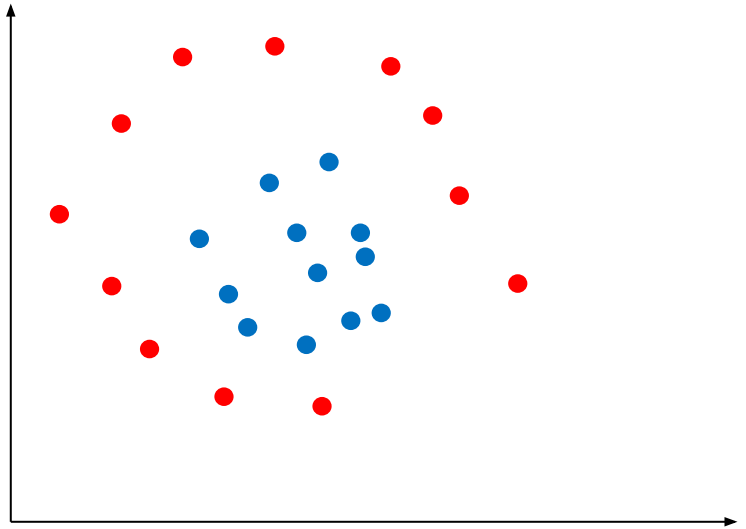


Train Model (Model Building – a search problem)

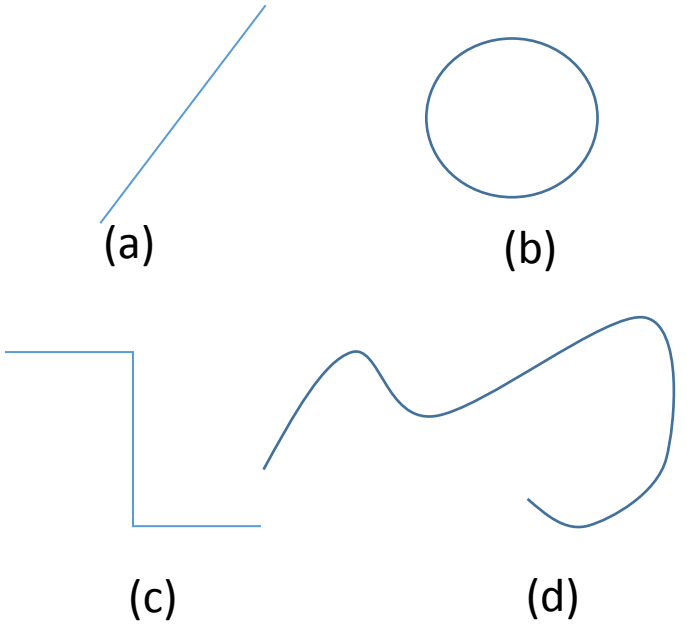
- Which type of model is most suitable for this data?



Dataset - 1



Dataset - 2



Test Model (Evaluation)

- Given prediction results, which model is better?

Model-1	Predicted		
Actual			
	100	50	50
	1000	100	900

Accuracy = 950 / 1100 = 86.4%

Model-2	Predicted		
Actual			
	100	0	100
	1000	0	1000

Accuracy = 1000 / 1100 = 91%

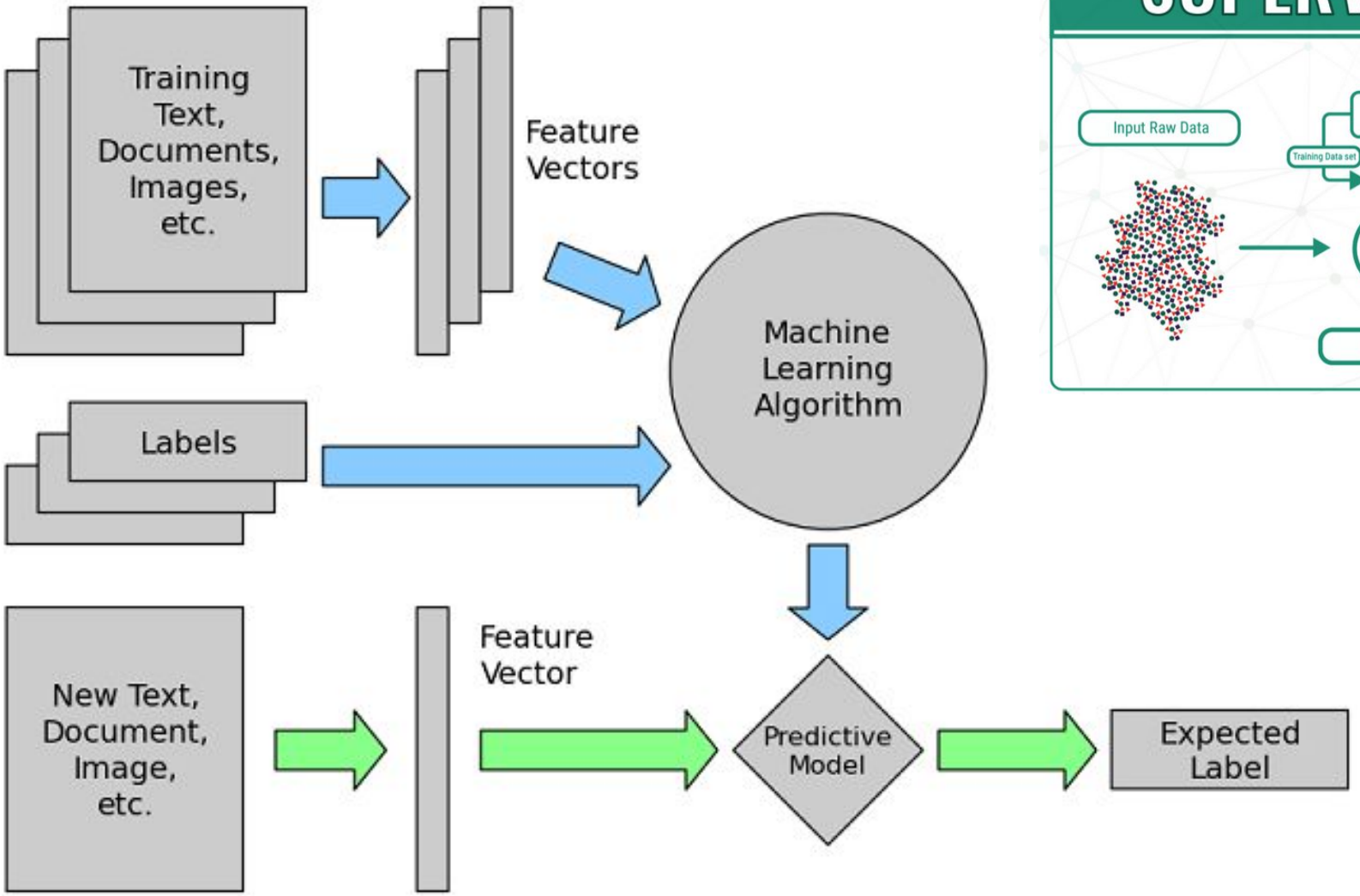
Q & A

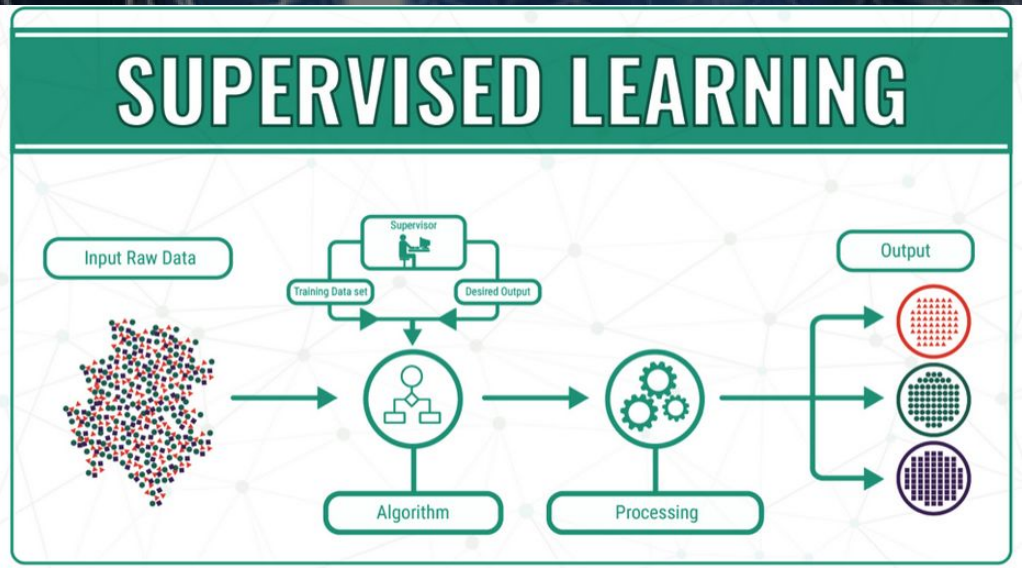
Types of Machine Learning Algo

Types of Machine Learning Algorithms

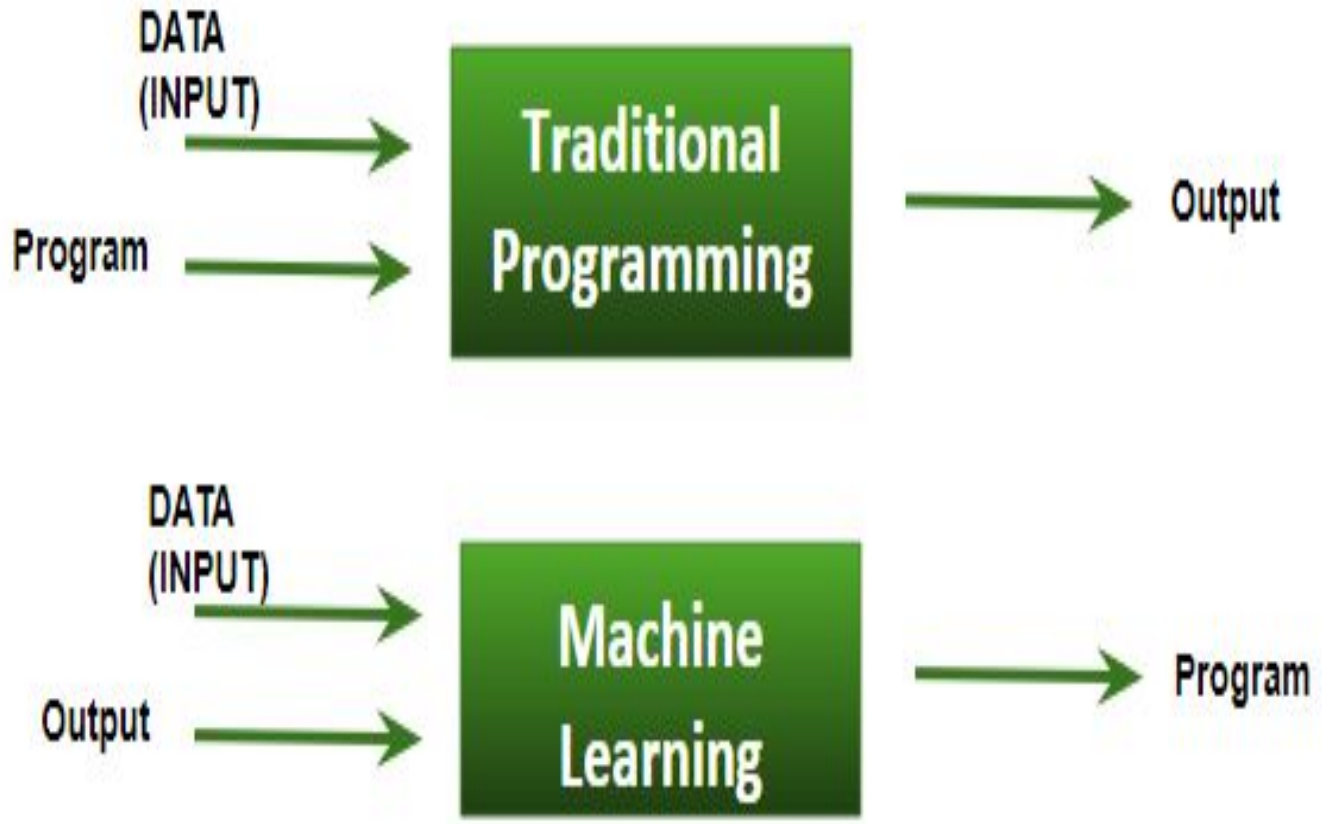
- Machine Learning
  - Supervised Learning [Task Driven]
    - Regression
    - Classification
  - Unsupervised Learning [Data Driven]
    - Clustering
    - Dimensionality Reduction
  - Reinforcement Learning [Environment Driven]
    - Fully observable environment
    - Partially observable environment

Supervised Learning

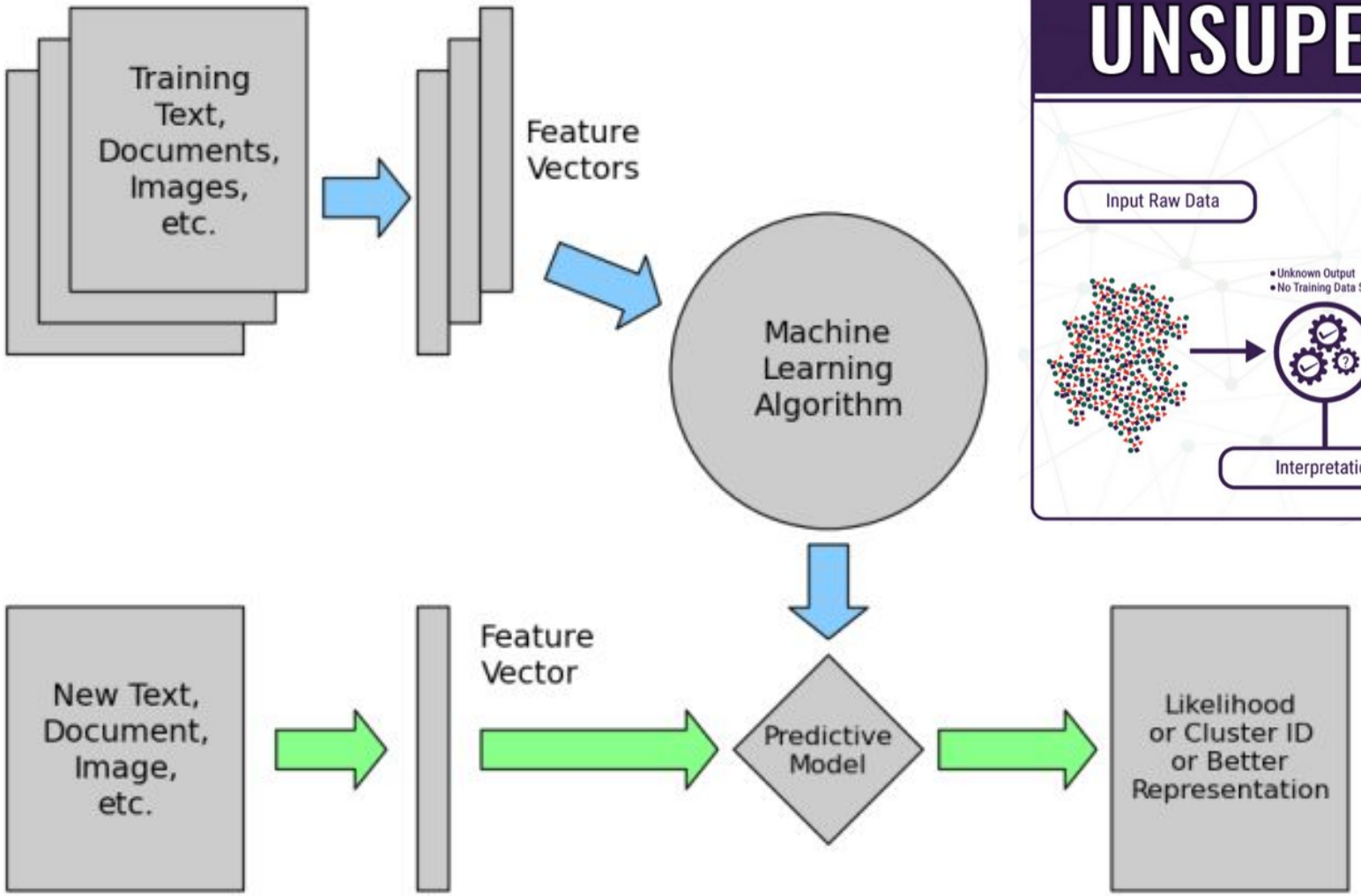


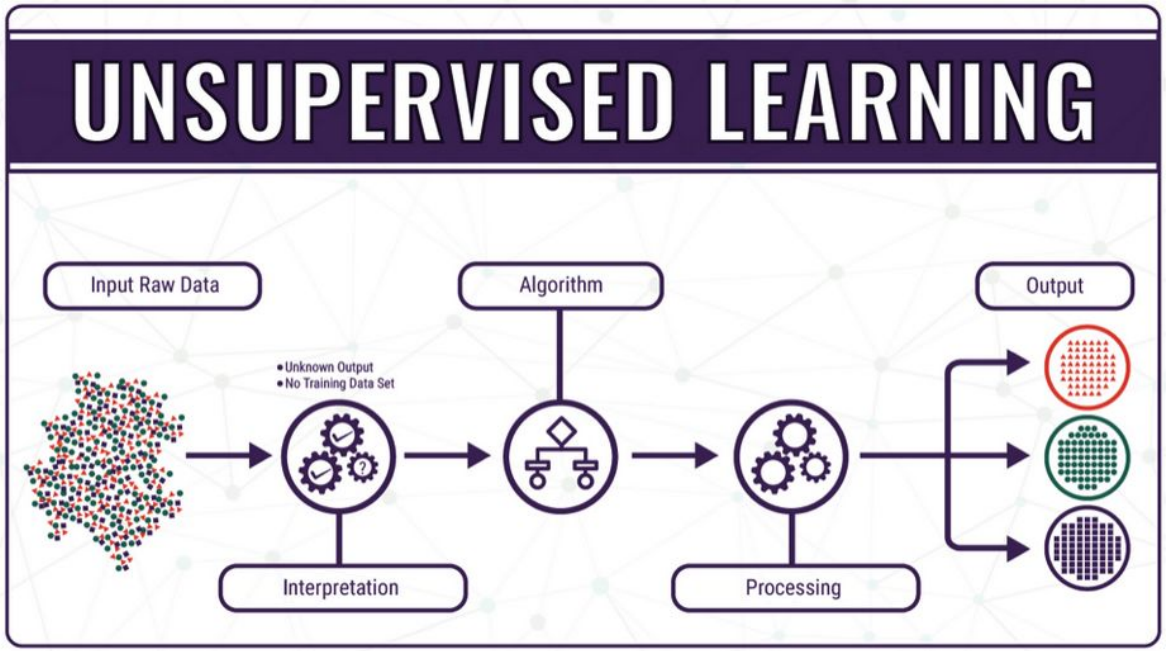


Supervised Learning

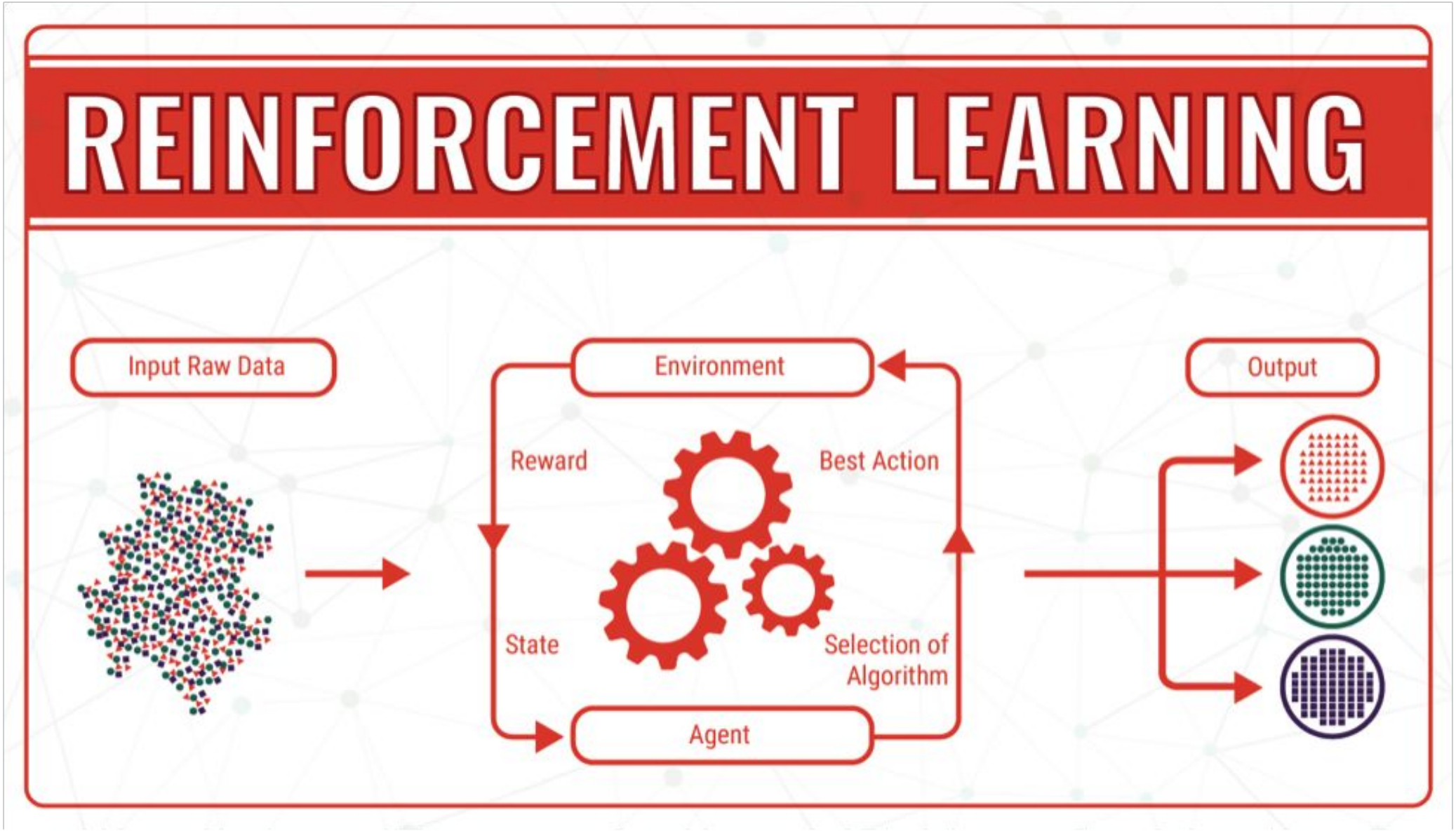


Unsupervised Learning

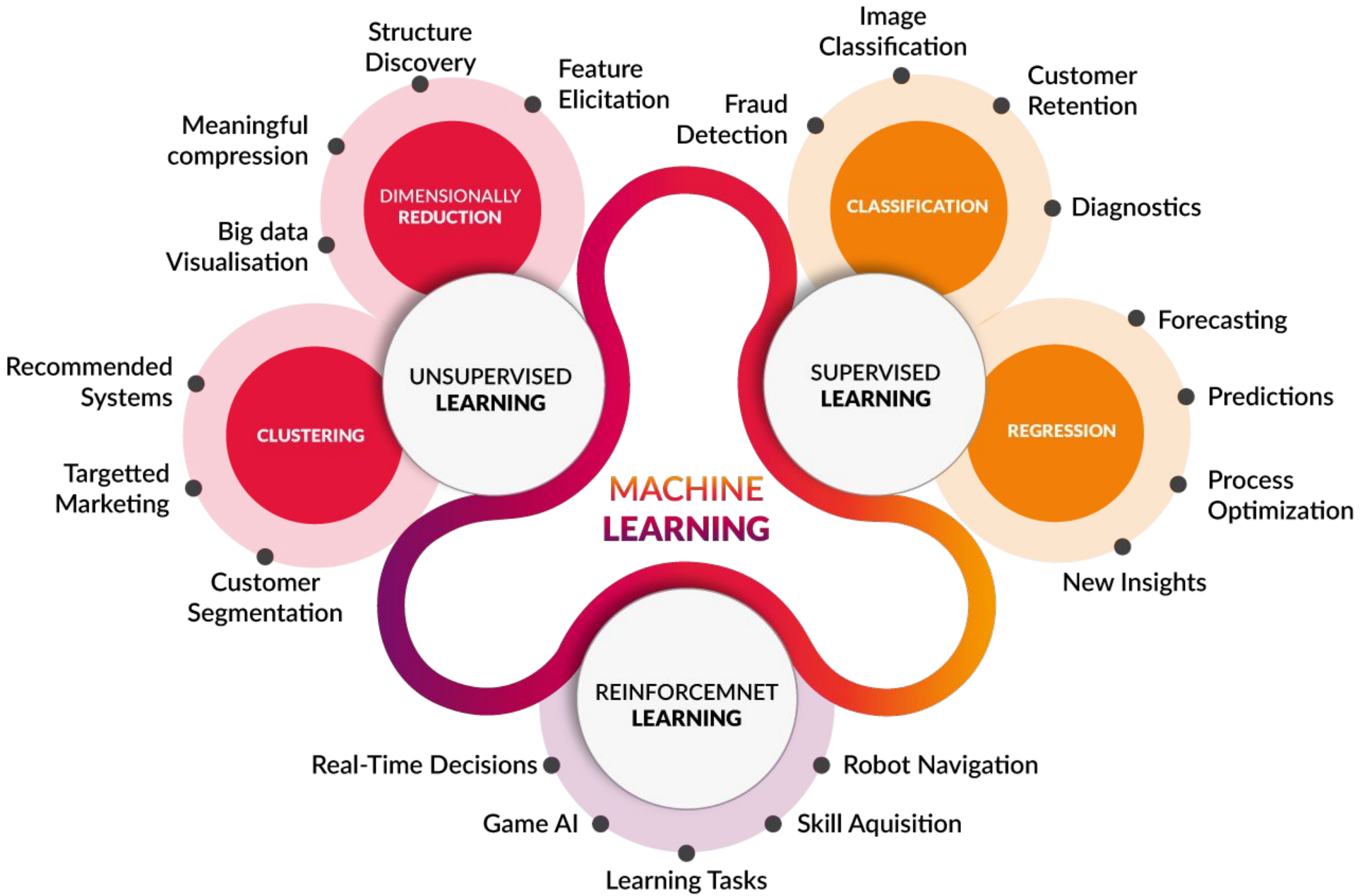




Reinforcement Learning



Machine Learning Extended



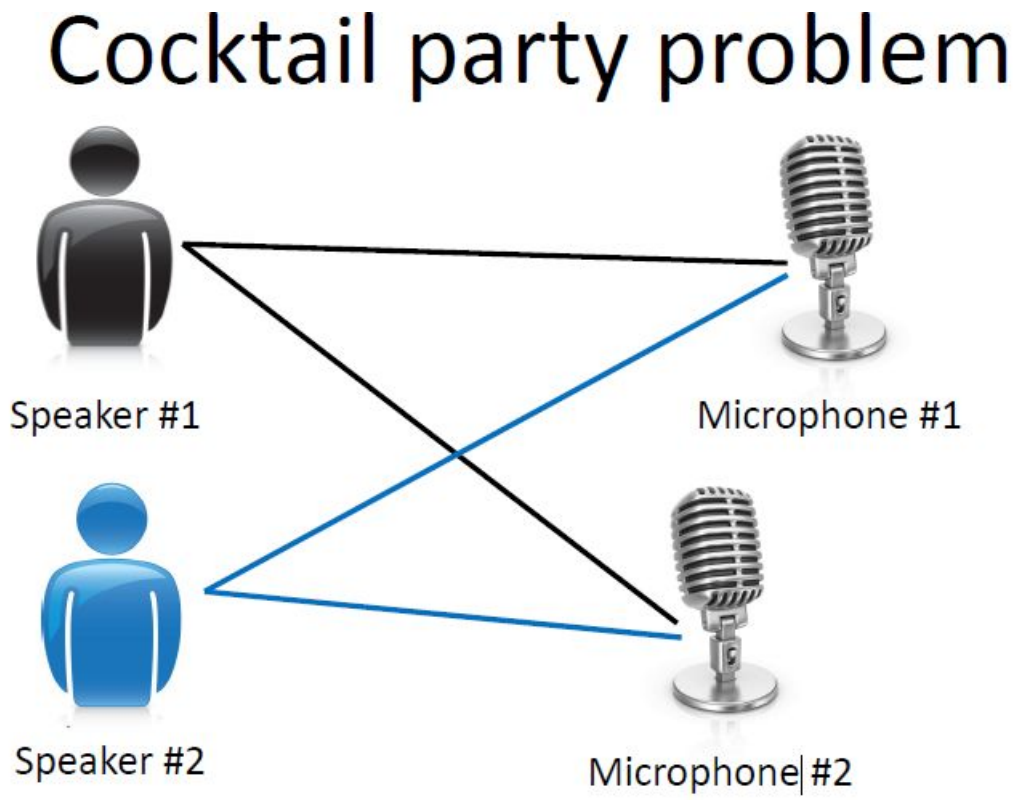
Q & A

Clustering / Classification / Regression

Clustering / Classification / Regression ??

- Given data about the size of houses on the real estate market, try to predict their price.
- Given a picture of a person, we have to predict their age on the basis of the given picture
- Given a patient with a tumor, we have to predict whether the tumor is malignant or benign.
- Building a system that predicts whether the house "sells for more or less than the asking price."
- Take a collection of 1,000,000 different genes, and find a way to automatically group these genes into groups that are somehow similar or related by different variables, such as lifespan, location, roles, and so on.

- The "Cocktail Party Algorithm", allows you to find structure in a chaotic environment. (i.e. identifying individual voices and music from a mesh of sounds at a cocktail party).



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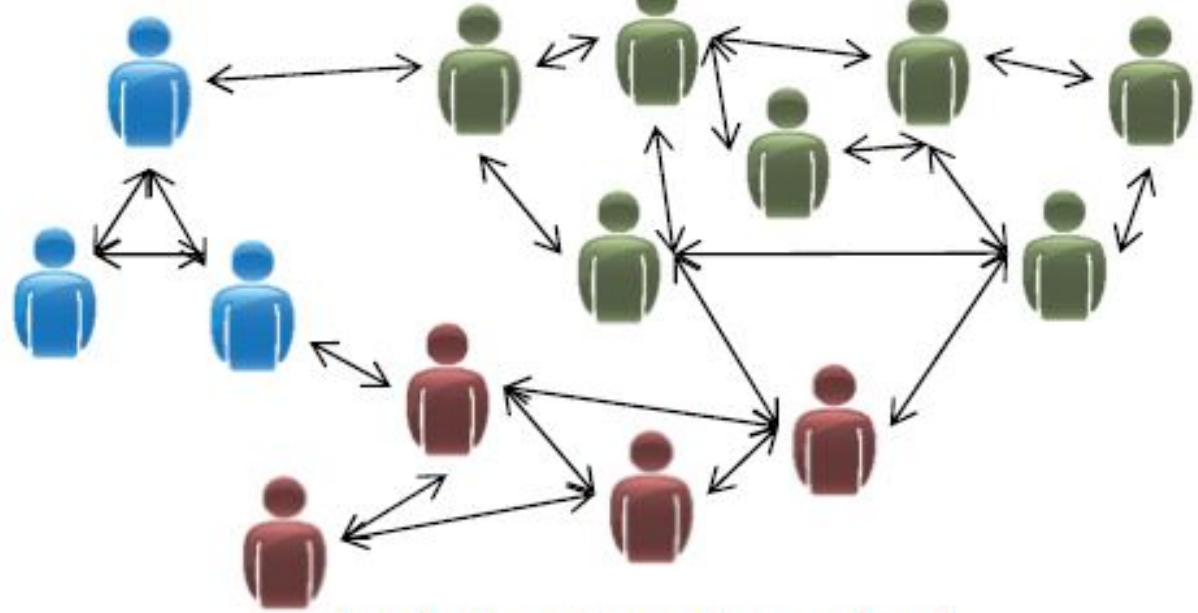
Organize computing clusters



Social network analysis

Market segmentation

Astronomical data analysis