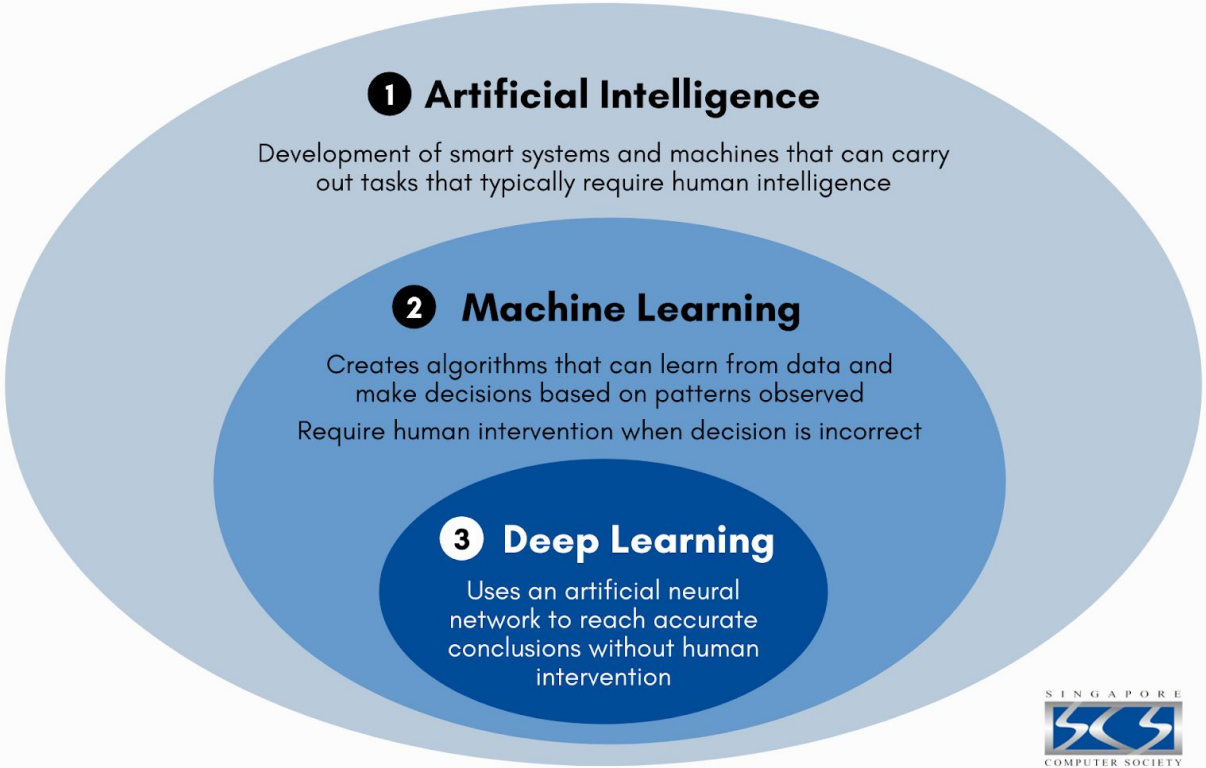
Artificial Intelligence

Shreeja Das

Possibilities With AI

ARTIFICIAL INTELLIGENCE VS MACHINE LEARNING VS DEEP LEARNING



SINGAPORE COMPUTER SOCIETY

ARTIFICIAL INTELLIGENCE.

WHAT IS AI?

- Simulation of human intelligence by machines
  - Ex: NLP, Computer vision, speech recognition, etc

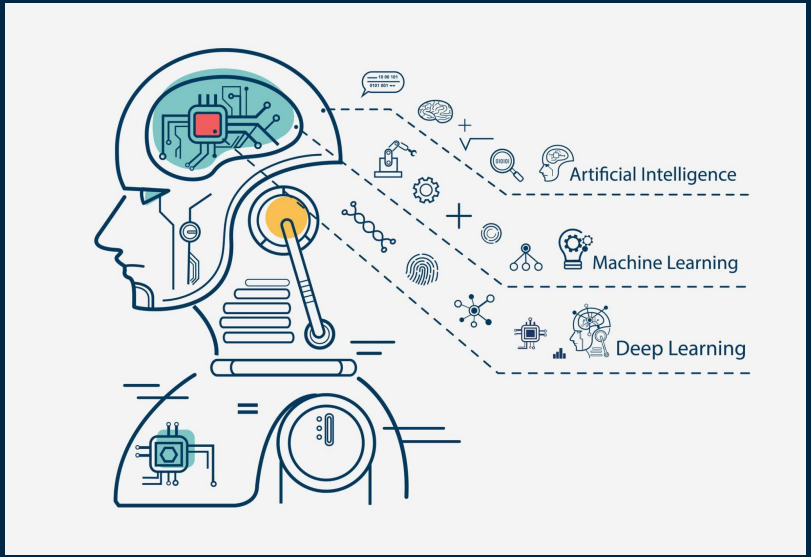
- Machine learning is a branch of artificial intelligence (AI)

- ML systems ingest large amounts of training data, analyzing the data for correlations and patterns
- These patterns are used to make predictions about future states
  - Eg: Chatbot is fed examples of text through which it can learn to generate similar text

MACHINE LEARNING

What is Machine Learning?

Machine learning is an important component of the growing field of data science. Through the use of statistical methods, algorithms are trained to make classifications or predictions, and to uncover key insights in data mining projects



- Machine learning algorithms are typically created using frameworks that accelerate solution development, such as TensorFlow and PyTorch

Timeline

Golden Age of Science Fiction

1938–1946

1949–1950

"Can Machines Think" - Alan Turing

The Enigma machine was decoded using AI in World War

"Logic Theorists" - the first true AI program is invented

John McArthy coins the term: AI

1955

1961–1995

Invention of the first industrial robot, chatbot, and general purpose mobile robot

Timeline

1997

Deep blue AI algorithm beats chess legend

2008-2014

Voice Recognition on IPhone and the birth of Siri + development of Alexa

2016

Sophia the Robot becomes the first robot to receive citizenship

2023

GPT-3 is introduced and continues to make huge strides in cyber security, and automation

Generative AI & Predictive AI

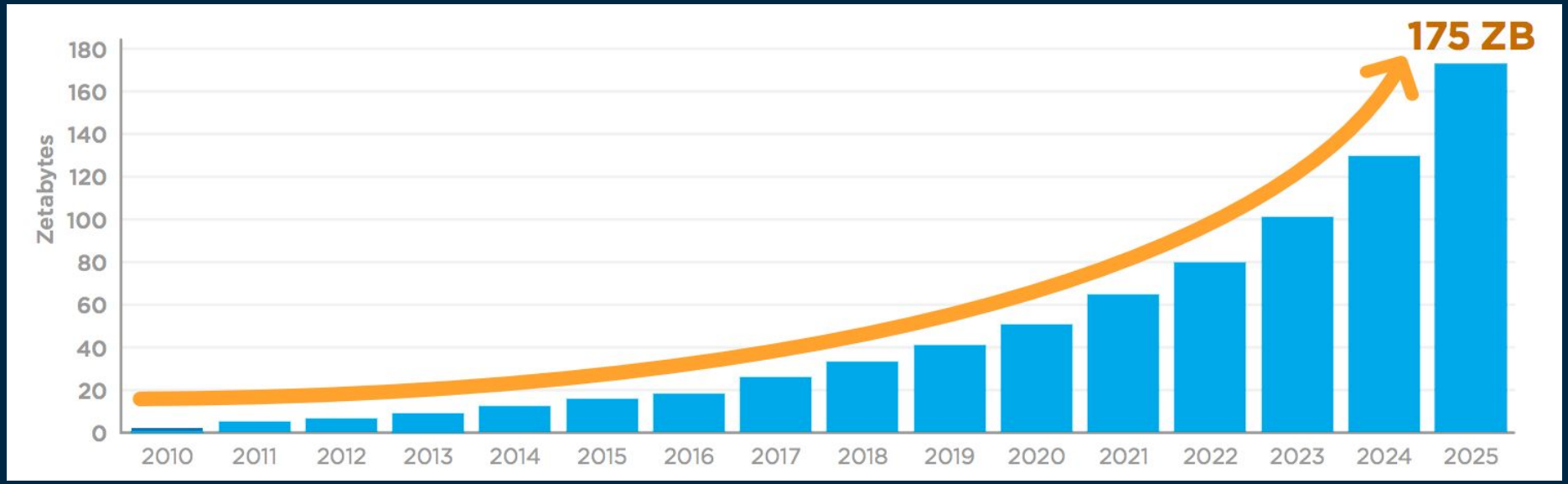
- Type of AI that can create a wide variety of data, such as images, videos, audio, text, and 3D models
    - Learns patterns from existing data
    - GPT (Generative Pre-trained Transformer)

- Predictive artificial intelligence (AI) refers to the use of machine learning to identify patterns in past events and make predictions about future events

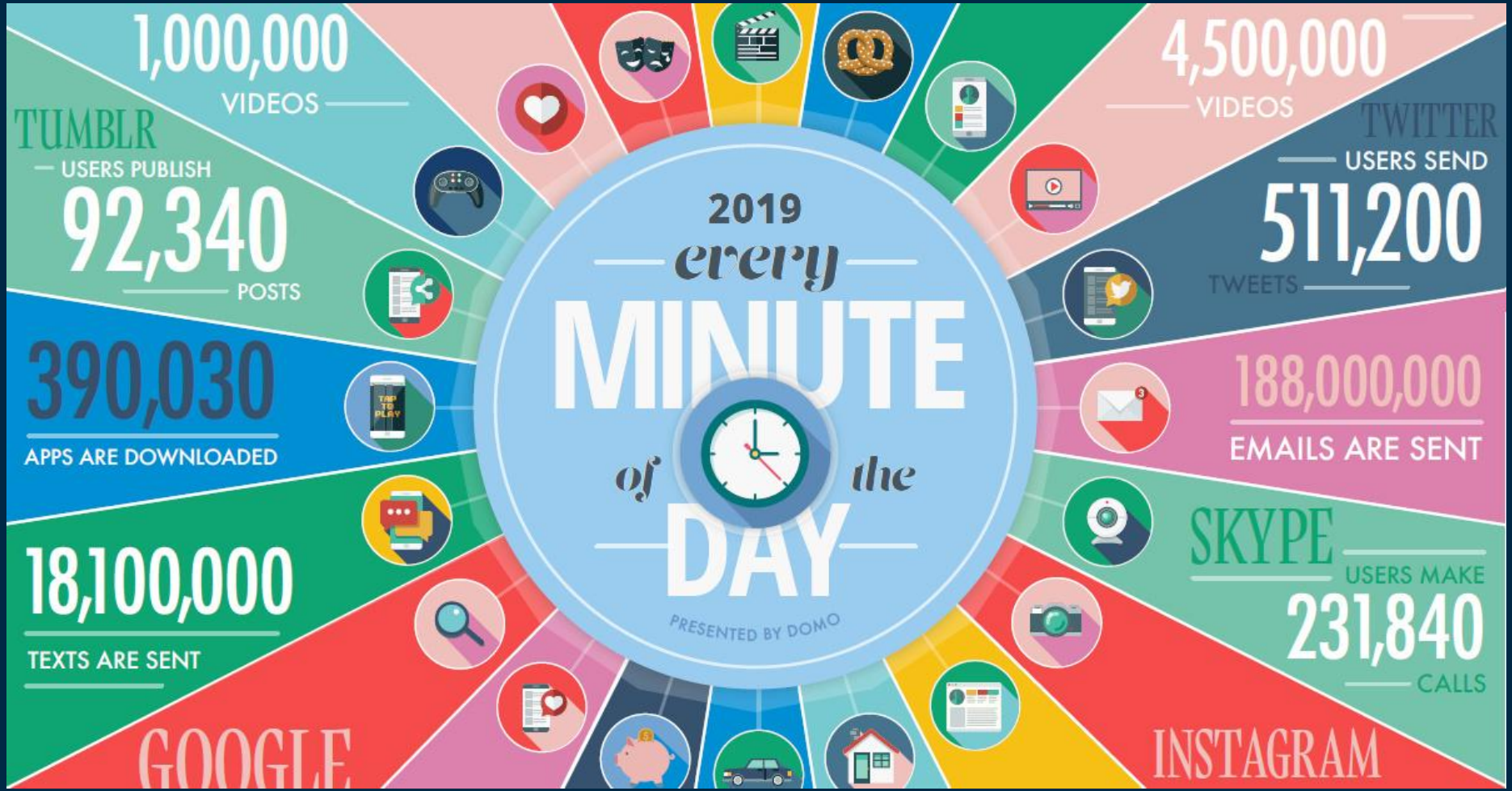
“Big Data”

Velocity, Veracity (variation), & Volume

In statistics more data generally results in more accurate analysis. For example, an opinion poll must have a minimum number of respondents to be considered reliable, and scientific studies need to be repeated several times to be considered statistically significant.



How big is “Big Data”


1,000,000
VIDEOS
TUMBLR
USERS PUBLISH
92,340
POSTS
390,030
APPS ARE DOWNLOADED
18,100,000
TEXTS ARE SENT
GOOGLE
4,500,000
VIDEOS
TWITTER
USERS SEND
511,200
TWEETS
188,000,000
EMAILS ARE SENT
SKYPE
USERS MAKE
231,840
CALLS
INSTAGRAM
2019
every
MINUTE
of the
DAY
PRESENTED BY DOMO

GPT 4 was trained on...

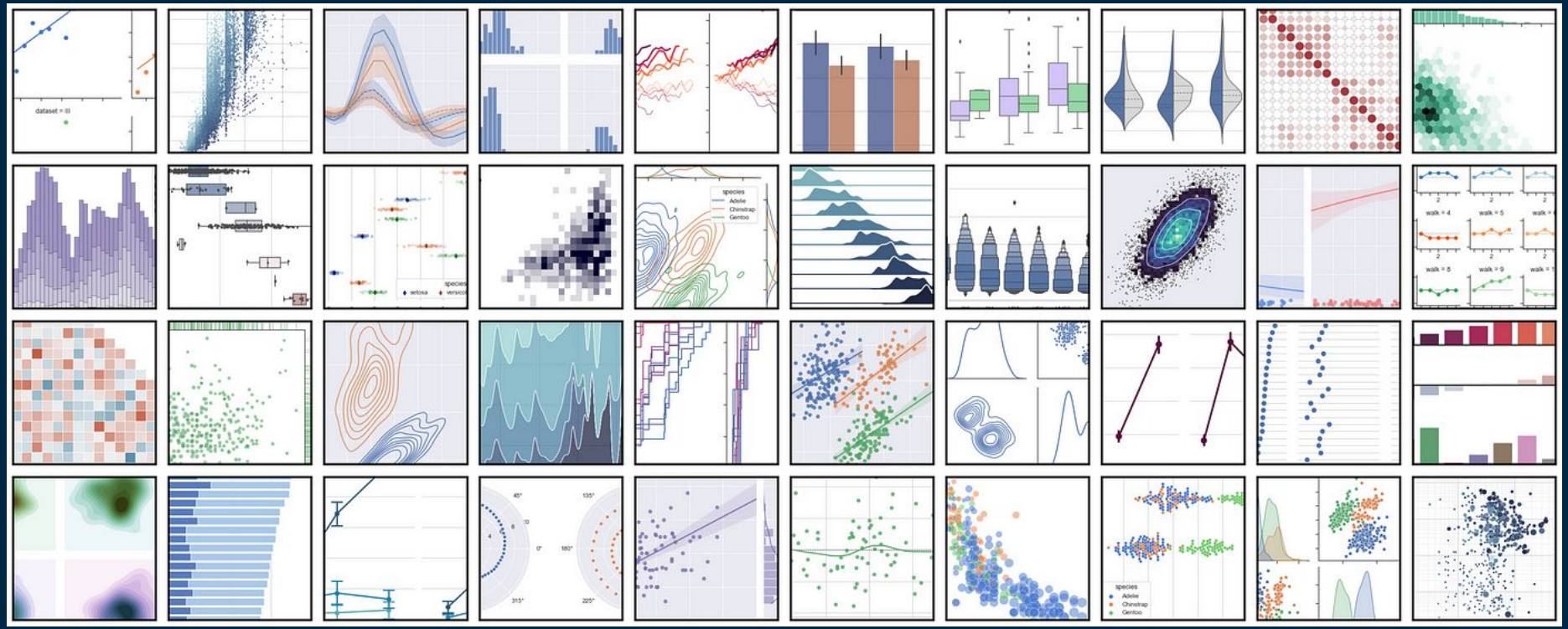
13 TRILLION TOKENS

This is why it’s known as a LLM

STEPS OF ML

- Writing, training, and testing machine learning algorithms → AI end products

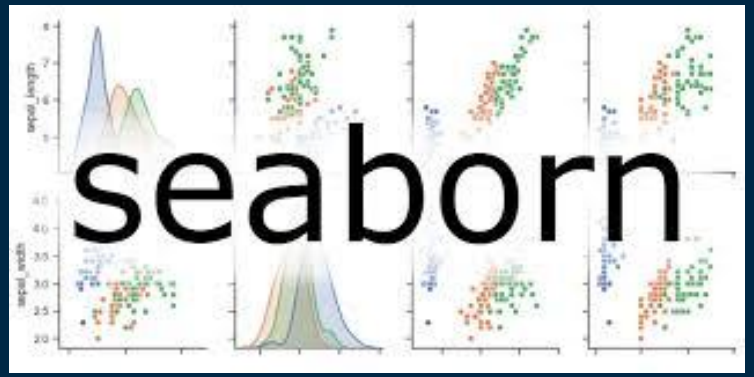
- **Learning**: acquiring data and creating rules for how to turn it into actionable information, algorithms provide computing devices with step-by-step instructions for how to complete a specific task
- **Reasoning:** choosing the right algorithm to reach a desired outcome.
- **Self-correction:** continually fine-tuning they provide the most accurate results possible.
- **Creativity**: using neural networks, rules-based systems, statistical methods and other AI techniques to generate new images, new text, new music and new ideas

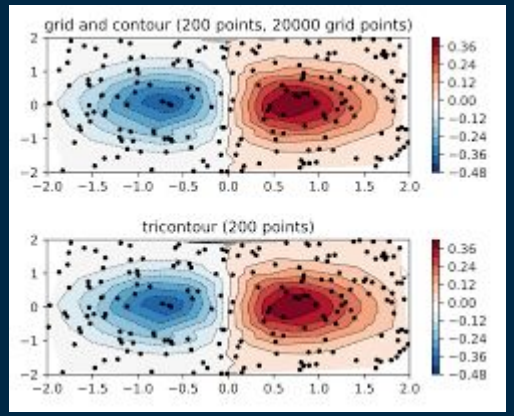


DATA VISUALIZATION & ANALYSIS

Further Breakdown

- Data Cleaning
- Exploratory Data Analysis





pandas

matplotlib

PyTorch

NumPy

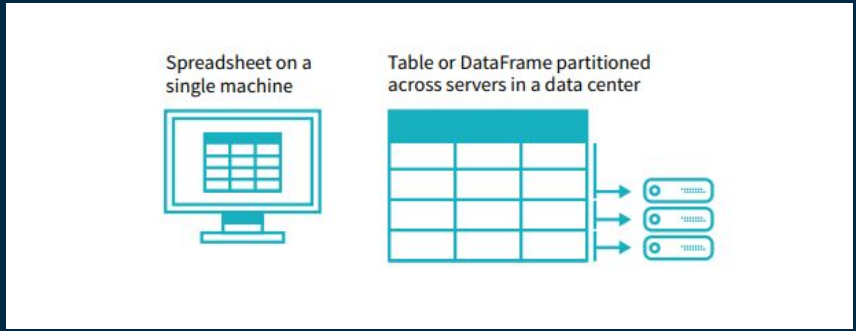
How is Data Processed in ML?

A DataFrame is a data structure that organizes data into a 2-dimensional table of rows and columns, much like a spreadsheet

DataFrame vs. Table:

They are similar.

Data tables are data frames but not all data frames are not necessarily data tables (data tables are an inheritance of dataframes)



Series

	apples
0	3
1	2
2	0
3	1

+

Series

	oranges
0	0
1	3
2	7
3	2

=

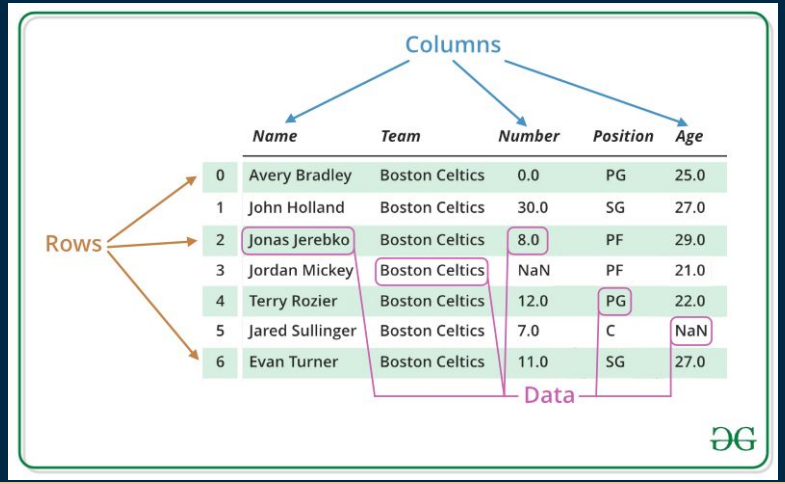
DataFrame

	apples	oranges
0	3	0
1	2	3
2	0	7
3	1	2

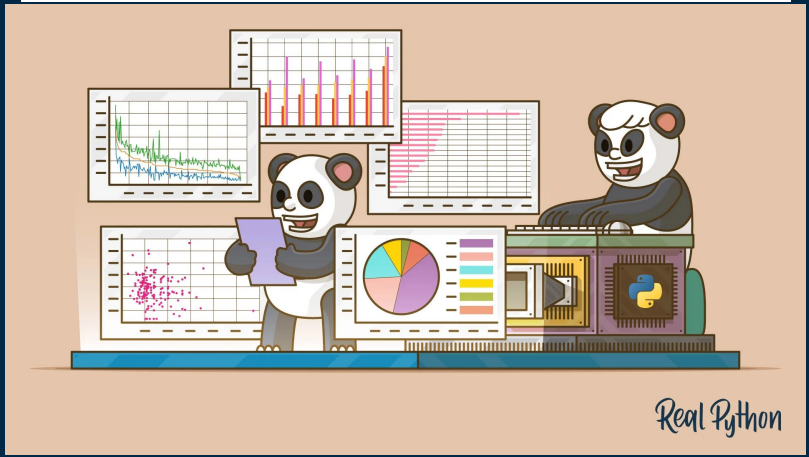
Pandas + Dataframe

How to process these dataframes?

https://images.datacamp.com/image/upload/v1676302204/Marketing/Blog/Pandas_Cheat_Sheet.pdf



	Name	Team	Number	Position	Age
0	Avery Bradley	Boston Celtics	0.0	PG	25.0
1	John Holland	Boston Celtics	30.0	SG	27.0
2	Jonas Jerebko	Boston Celtics	8.0	PF	29.0
3	Jordan Mickey	Boston Celtics	NaN	PF	21.0
4	Terry Rozier	Boston Celtics	12.0	PG	22.0
5	Jared Sullinger	Boston Celtics	7.0	C	NaN
6	Evan Turner	Boston Celtics	11.0	SG	27.0



Machine Learning Approaches

Supervised Learning

- Labeled datasets
- Classify and predict outcomes
- Can measure it's accuracy over time

- These datasets are designed to train and "supervise" algorithms to make accurate predictions

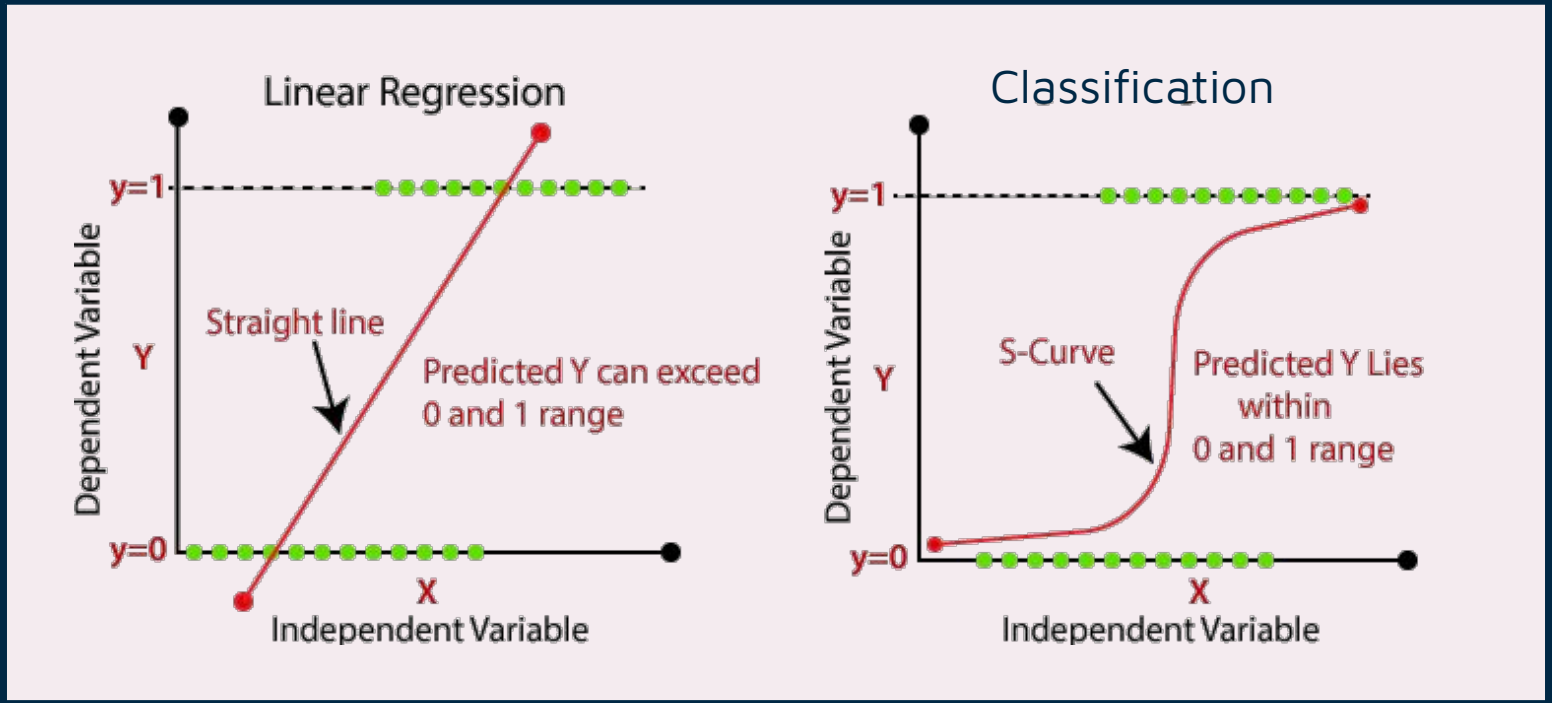
Unsupervised Learning

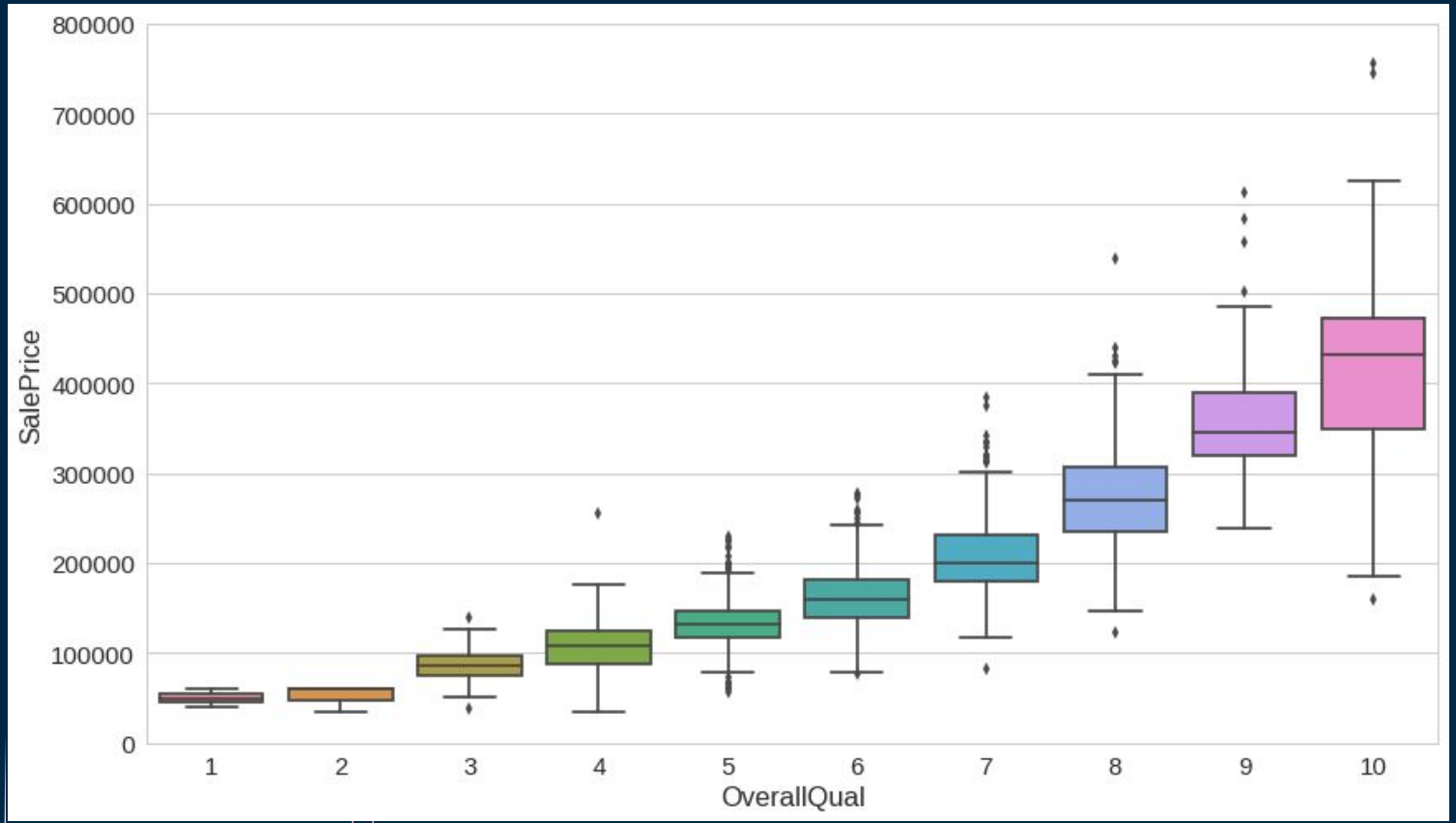
- Unlabeled datasets
- Used to analyze and classify unlabeled datasets
- Algorithms discover patterns in data without human intervention

Supervised Learning

- Classification
  - Accurately assign test data to categories (eg: separating apples from oranges)
  - Eg: Algorithm to classify spam emails from regular emails
  - Common Algorithms: Linear classifiers, SVM, Decision Trees, Random Forest
- Regression
  - Algorithm to understand the relationship between dependent and independent variables
  - Good for predicting numerical values based on different data points
  - Eg: Sales revenue projections for next quarter

Regression Vs. Classification





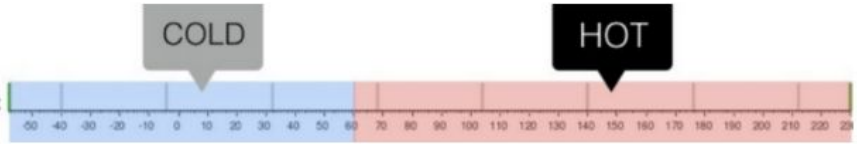
Eg: House Prices using Linear Regression

enjoy algorithms

What will be the temperature tomorrow?

Fahrenheit

Will it be hot or cold tomorrow?



Fahrenheit

POP QUIZ!

enjoy algorithms

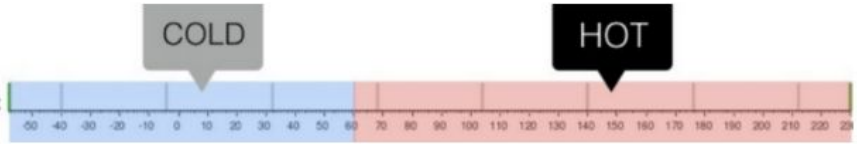
REGRESSION

What will be the temperature tomorrow?

Fahrenheit

CLASSIFICATION

Will it be hot or cold tomorrow?



Fahrenheit

POP QUIZ!

Unsupervised Learning

Clustering

Grouping unlabeled data based on their similarities or differences
Eg: K-means clustering algorithms assign similar data points into groups, where the K value represents the size of the grouping

Association

Uses different rules to find relationships between variables in a dataset
Eg: used for recommendation engines, along the lines of "Customers Who Bought This Item Also Bought" recommendations.

https://www.naftaliharris.com/blog/visualizing-dbscan-clustering/

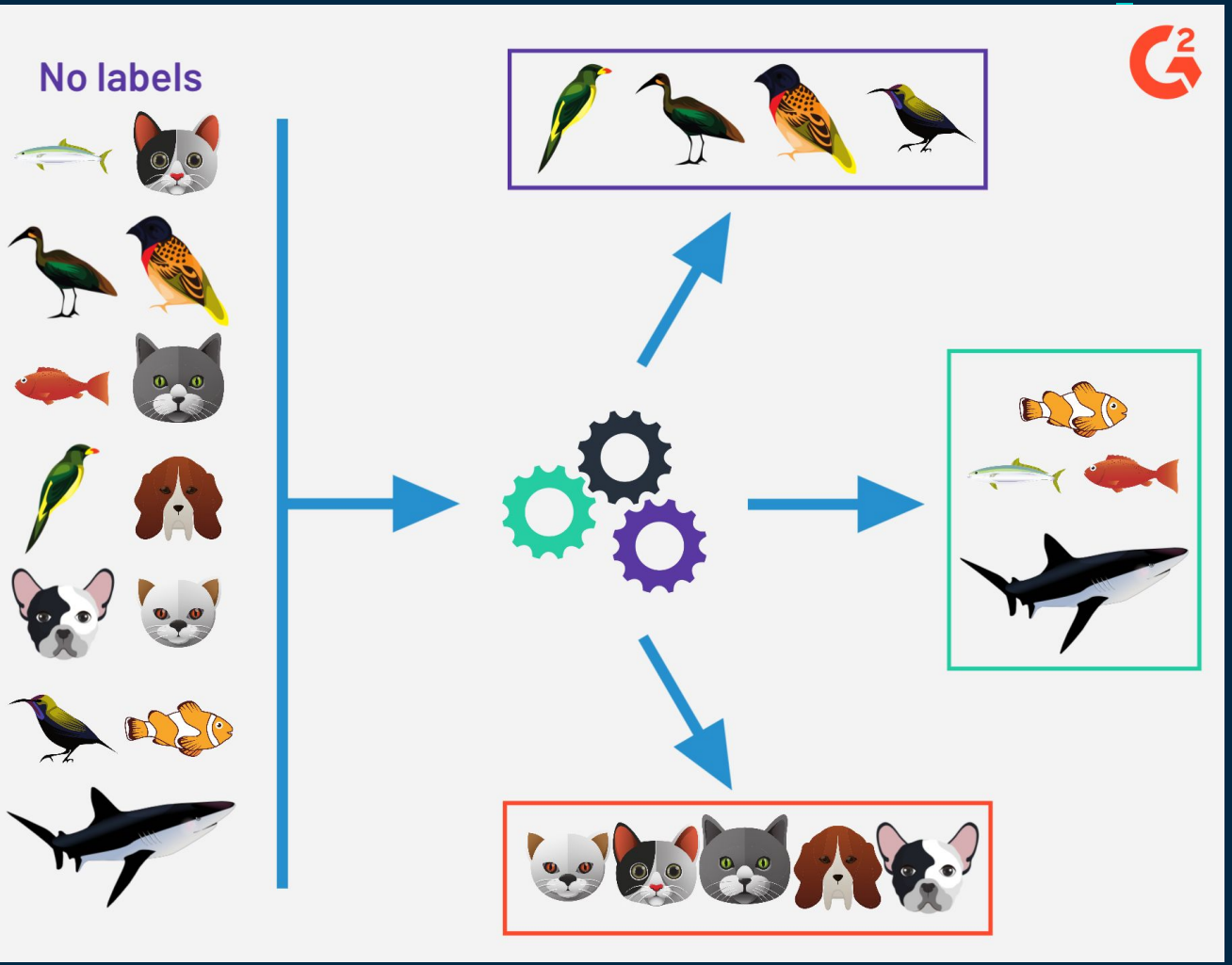
Even more types of ML!

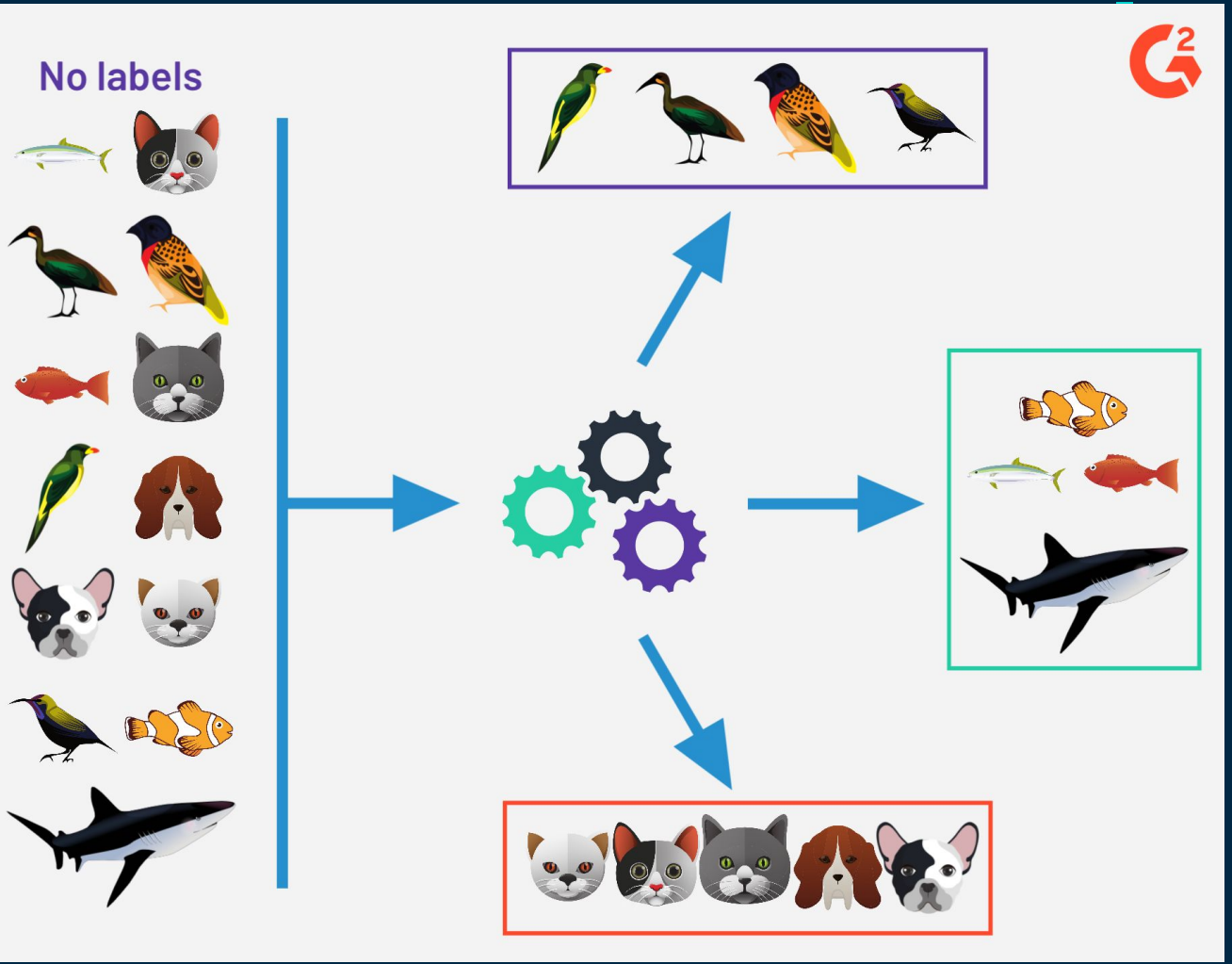
Semi Supervised Learning

- A medium between supervised and unsupervised learning
- During training, it uses a smaller labeled data set to guide classification and feature extraction from a larger, unlabeled data set. Semi-supervised learning can solve the problem of not having enough labeled data for a supervised learning algorithm

Reinforced Learning

Reinforcement machine learning is a machine learning model that is similar to supervised learning, but the algorithm isn't trained using sample data. This model learns as it goes by using trial and error. A sequence of successful outcomes will be reinforced to develop the best recommendation or policy for a given problem


No labels



UNSUPERVISED LEARNING

DEEP LEARNING

What is Deep Learning?

ML Algorithms:

- Leverage structured, labeled data for predictions
- Specific features are defined and organized into tables
- May involve pre-processing of unstructured data to structure it

Deep Learning Advantages:

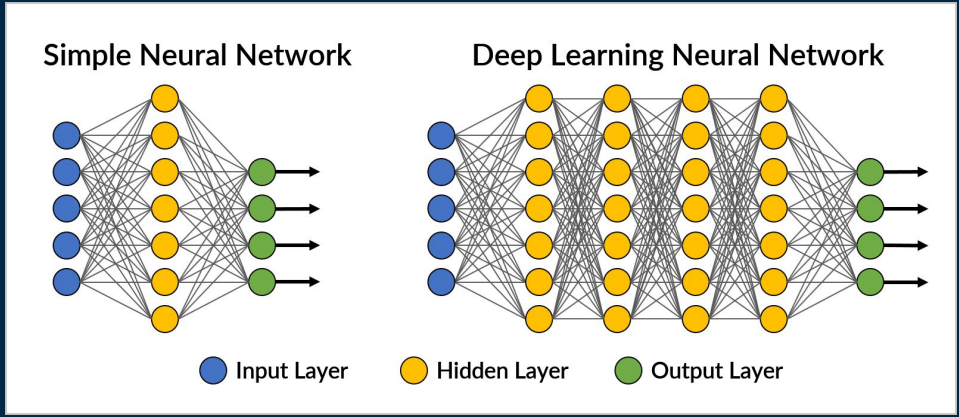
- Eliminates some data pre-processing in comparison to traditional ML
- Can ingest and process unstructured data (e.g., text, images)
- Automated feature extraction, reducing dependency on human experts

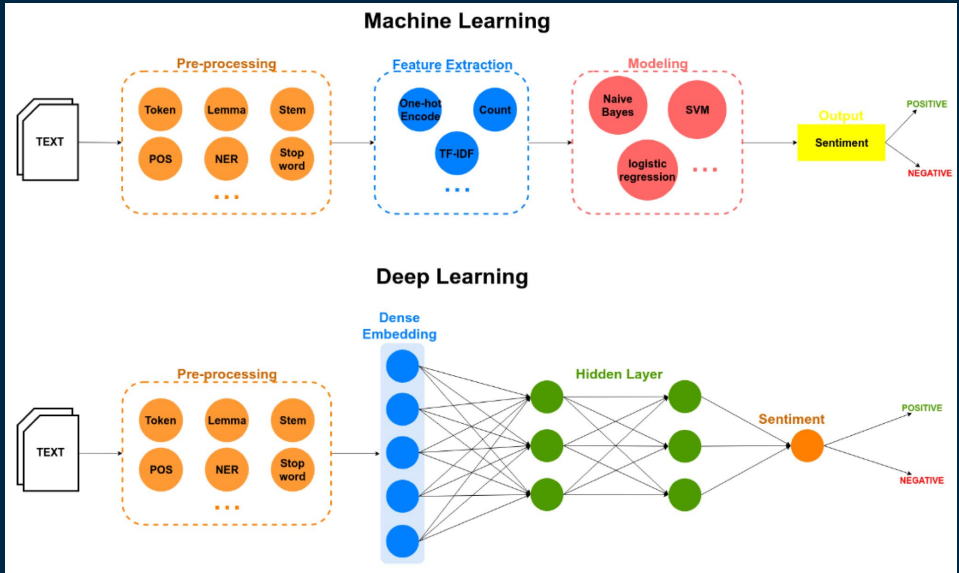
Example: Image Categorization:

- Set of pet photos categorized into "cat," "dog," "hamster," etc.
- Deep learning identifies crucial features (e.g., ears) for classification
- In machine learning, human experts manually establish feature hierarchies

Deep Learning

- Allows for the creation of complex neural networks





What is a Neural Network?

- Inspired by the human brain, mimics biological neurons' signaling.
- Comprised of node layers: input layer, one or more hidden layers, and an output layer.
- Nodes (artificial neurons) connect, each with weight and threshold.
- Need large amounts of training data & high GPU power
- Rapid clustering/classification (good at speech (RNN) and image recognition (CNN))
    a. Eg: Google's search algorithm is a prominent example of a neural network.

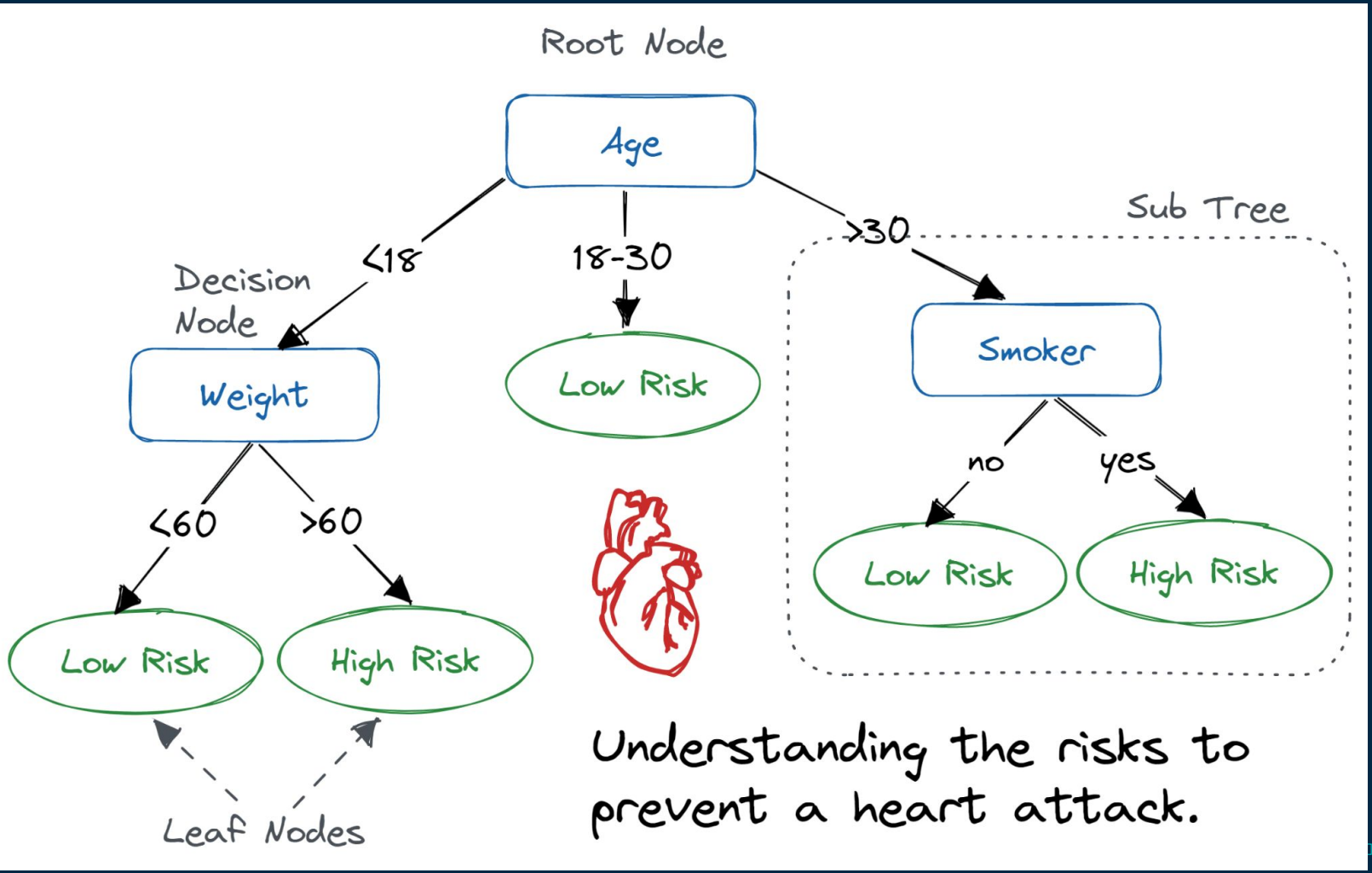
Popular Machine Learning Algorithms

Decision Trees:

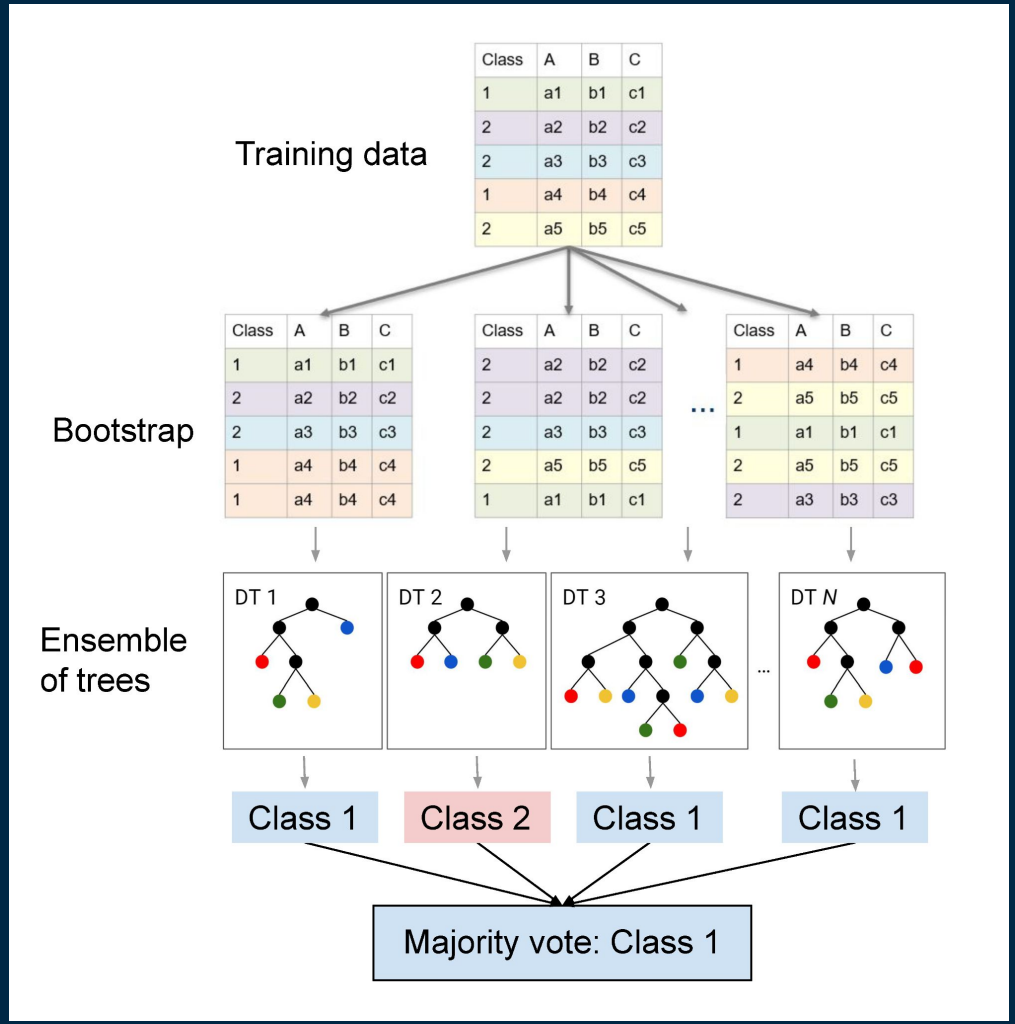
- Predicts numerical values (regression) and classifies data.
- Represents decisions in a branching tree diagram.

Random Forests:

- Machine learning algorithm combining results from multiple decision trees.
- Used for predicting values or categories.


Root Node
Age
<18
18-30
>30
Decision Node
Weight
Low Risk
Sub Tree
Smoker
<60
>60
no
yes
Low Risk
High Risk
Low Risk
High Risk
Leaf Nodes
Understanding the risks to prevent a heart attack.

Random Forest



Machine Learning

Python

A high-level, general-purpose programming language, that is easy and fast to learn (known for its readability)

Has many libraries like Tensorflow, Keras, PyTorch, NLTK for beginners and experts alike to train ML algorithms

PYTHON Review

```
print("Hello, World!")
```

Variables:
Store data
Ex:

```
x = 5
print(x)
y = “Hello World!”
```

Data Types
String, int, float, boolean, list

```
X = 5
print(type(x))
```

PYTHON (cont.)

String
str.len()
a = "Hello, World!"
print(a[1])

Boolean
print(10 > 9)
print(10 == 9)

Lists
thislist = ["apple", "banana", "cherry"]
print(thislist)
print(len(thislist))
print(thislist[0])
thislist[1] = "blackcurrant"
thislist.append("orange")
thislist.insert(1, "orange")
thislist.remove("banana") - remove occurrence
thislist.clear()

PYTHON (cont)

If/elif/else

```
a = 200
b = 33
if b > a:
  print("b is greater than a")
elif a == b:
  print("a and b are equal")
else:
  print("a is greater than b")

if not a > b:
        print(“a not greater than b”)
```

While loop

```
i = 0
while i < 6:
  print(“i = ” + i)
  i += 1
```

For loop:

```
for x in thislist:
  print(x)

for x in range(1,3)
        print(x)
```

PYTHON (cont)

Functions

```
def my_function():
  print("Hello from a function")

my_function()
```

```
def func(a, b):
        print(a>b)
```

CODE ALONG

01

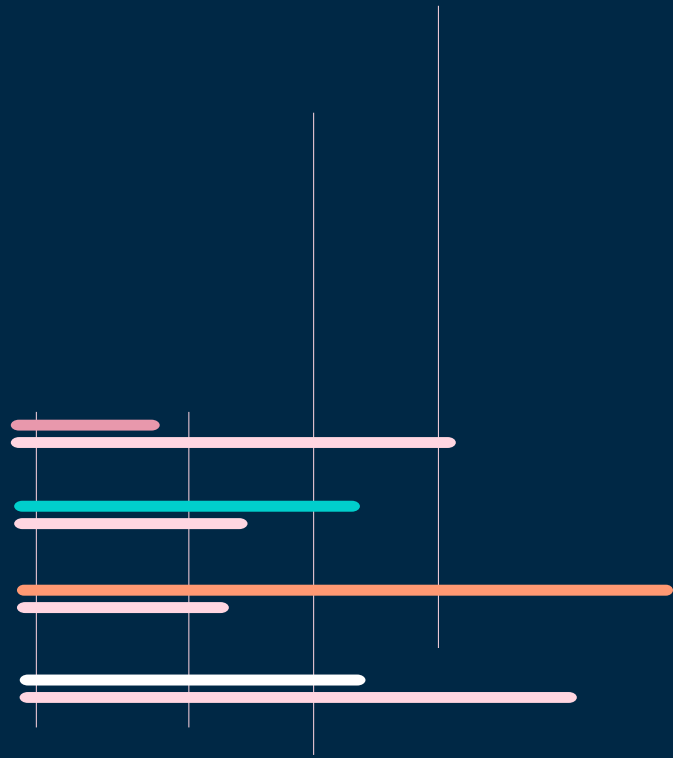
https://www.kaggle.com/shreelearn/codealong

Other Considerations

- Yay! We built our first ML model!!

Next steps?

- Data analysis
- Hypertuning
- Scaling
- Testing with different models
  - Overfitting vs. Underfitting?



Beware....

Overfitting

- Model fits training data too well.
- Learns noise and details, negatively impacting new data.
- Example: Decision trees prone to overfitting, addressed by pruning

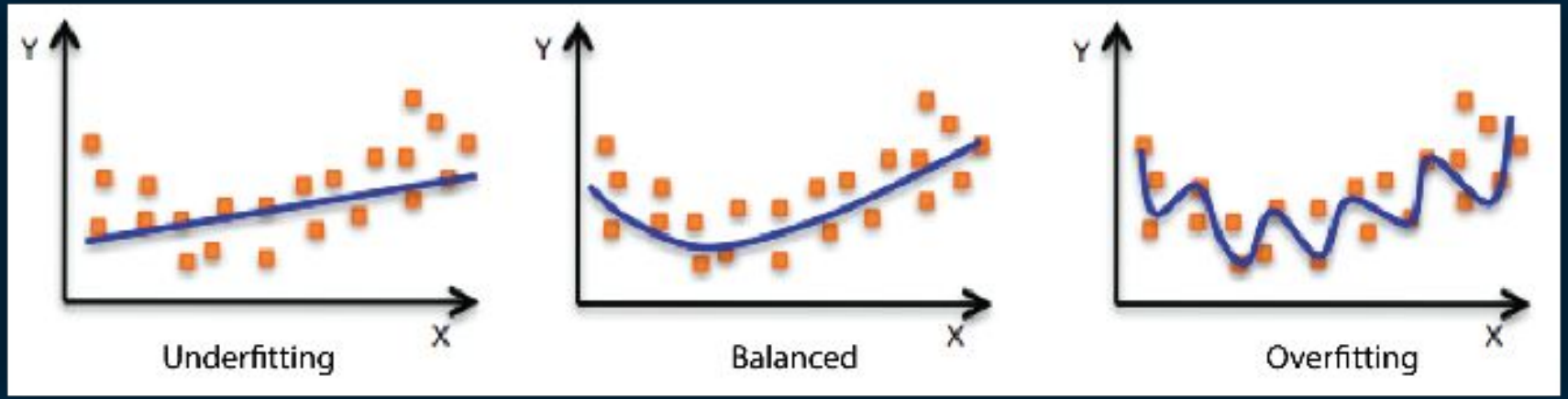
Perfect!

- Goal: Find a model between underfitting and overfitting.
- Difficult in practice to achieve a perfect balance.

Underfitting

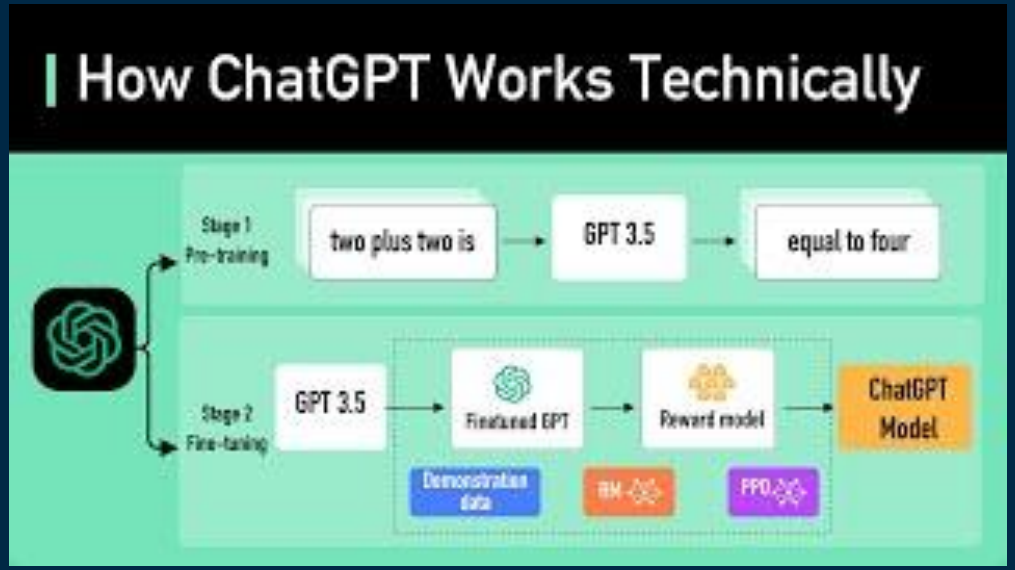
- Model can't model training data or generalize to new data.
- Poor performance on training data.
- Easily detectable with a good performance metric.
- Solution is to try alternate machine learning algorithms

Oh NO!



THANK YOU

EXTRA


How ChatGPT Works Technically
Stage 1
Pre-training
two plus two is
GPT 3.5
equal to four
Stage 2
Fine-tuning
GPT 3.5
Reward model
ChatGPT
Model
Demonstration
data
PPO