

Module 2 Notes for AIM100

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General Notes

- What we have that ancient philosophers didn't is **data**. Data is the fuel of AI.
- [AI Rock Paper Scissors](#)
- [ImageNet](#)
- [Emoji Scavenger Hunt](#)
- [Google's Vision AI](#)
 - An example of why a computer would inaccurately depict an image is due to something like pixelation from being behind a window, or some other hindrance.

Data



[Google Slides](#)

There are many different sources of data, such as:

- Web / social (*Facebook, Twitter, Instagram, YouTube*)
- Biometric Data (fitness, trackers, genetic tests)
- Internet of Things or **IOT** (*ID tags and smart devices*)
- Cloud Systems (*business applications like salesforce.com or Amazon*)
- Corporate databases and Spreadsheets

Types of Data

There are two ways to organize data:

Structured Data

- Financial information
- Social security numbers
- Addresses
- Product Information
- Phone numbers

Structured data is easier to work with and often comes from CRM's, and usually has lower volume, and they are straightforward.

- This type counts to about 20% of an AI project.
- You know how the data will be coming to you.

Unstructured Data

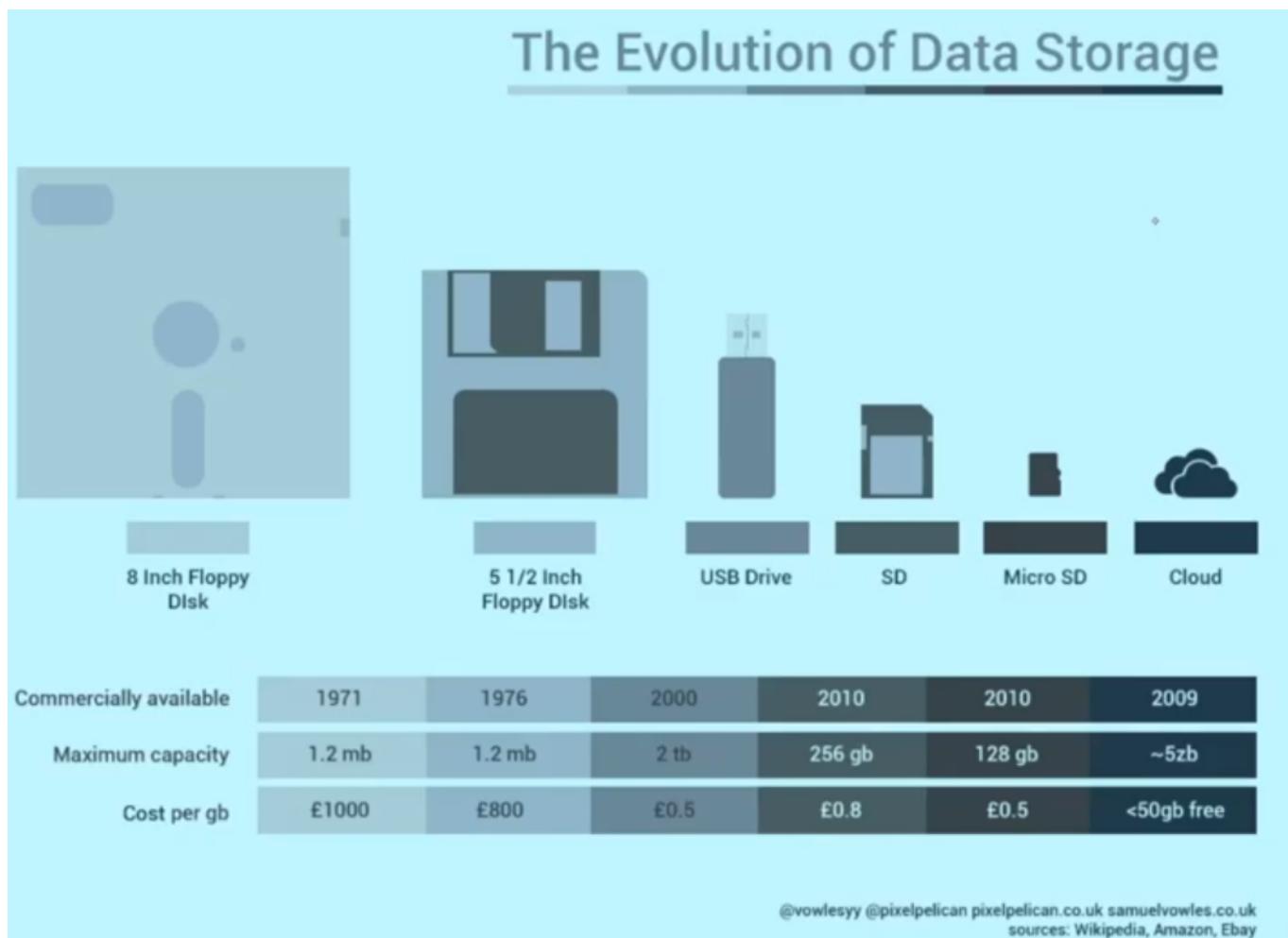
- Images
- Audio files
- Text files
- Tweets and posts
- Satellite images

The majority of the data comes from unstructured data, which is information that has no predefined formatting.

Types of Data Levels

Value	Abbreviation	Storage	Use Case
Bit	b	Binary Digit, Single 1 or 0	-
Nibble	-	4 bits	-
Byte / Octet	B	8 bits	-
Kilobyte	KB	1024 bytes or 10^3	-
Megabyte	MB	1024 KB or 10^6	A small book
Gigabyte	GB	1024 MB or 10^9	About 230 songs
Terabyte	TB	1024 GB or 10^{12}	500 hours of movies
Petabyte	PB	1024 TB or 10^{15}	Five years of the Earth Observing System (EOS)
Exabyte	EB	1024 PB or 10^{18}	The entire Library of Congress 3,000 times over
Zettabyte	ZB	1024 EB or 10^{21}	36,000 years of HD-TV video
Yottabyte	YB	1024 ZB or 10^{24}	This would require a data center the size of Delaware and Rhode Island combined.

Evolution of Data

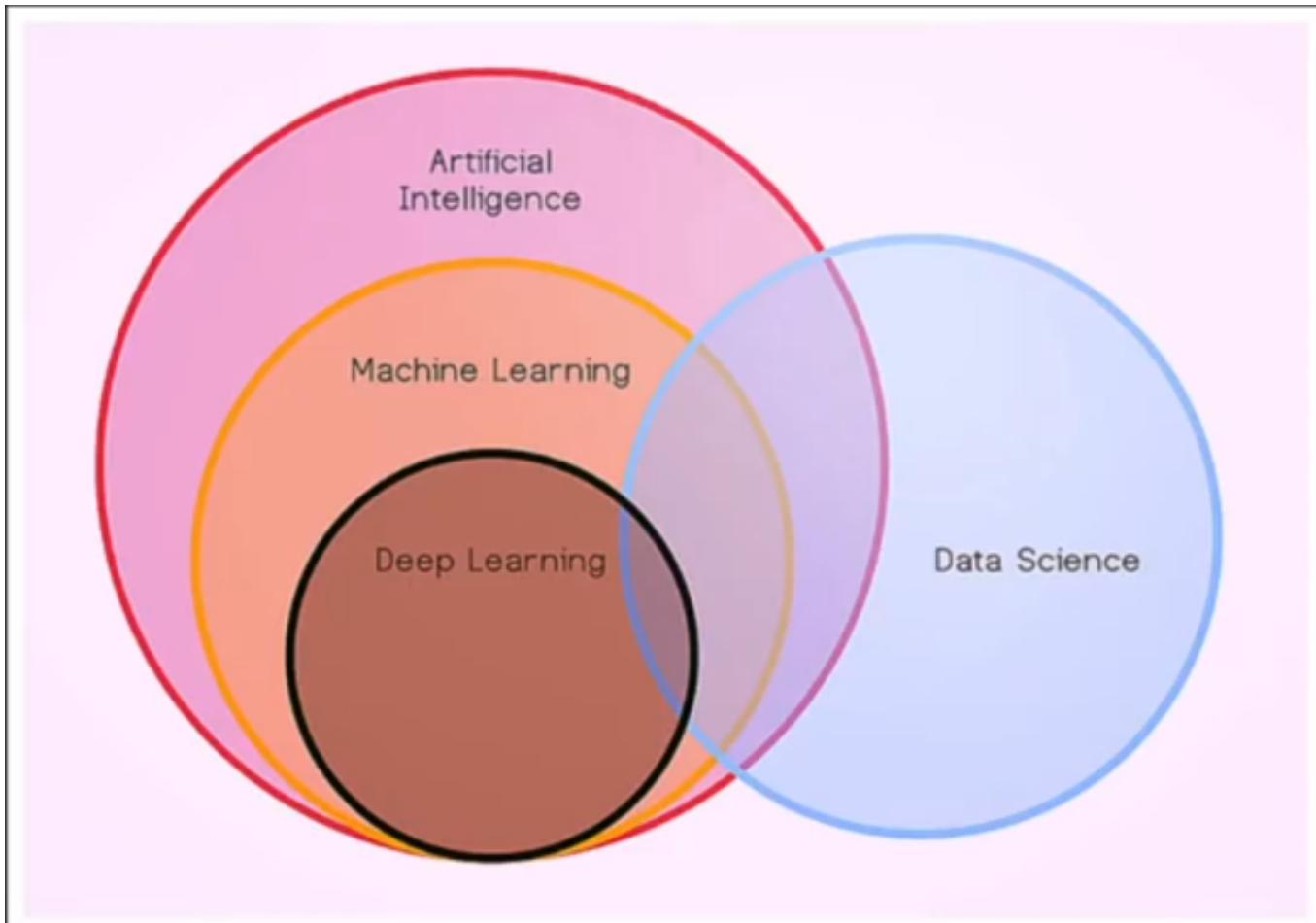


Big Data

Fun Facts:

- Every second, Google processes over 40,000 searches or 3.5 billion a day.
- On a minute-by-minute basis, Snapchat users share 527,760 photos.
- Every minute, there are 156 million email messages sent.
- 4.1 million video users watch on YouTube per minute.

Data Science Illustration



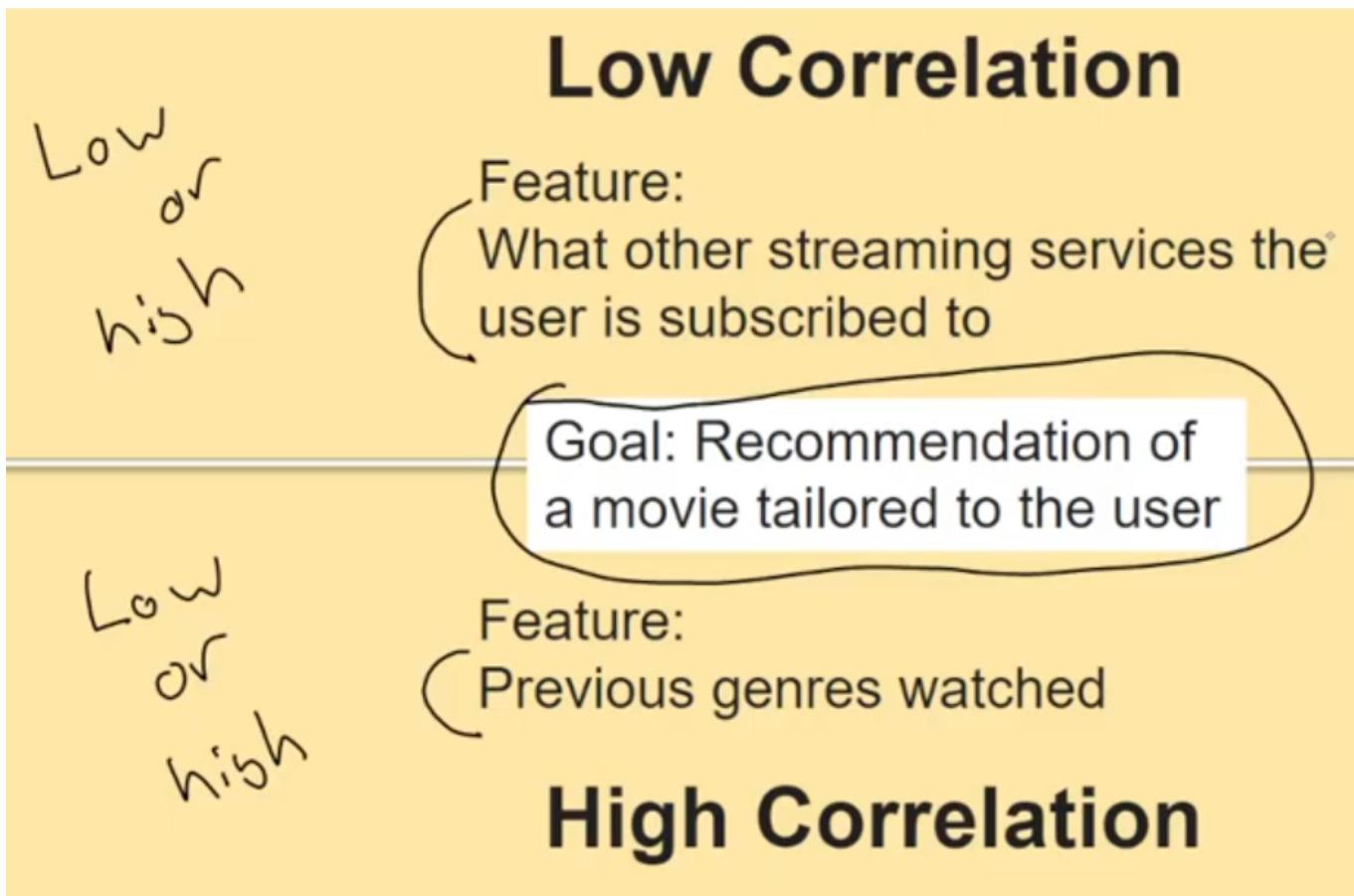
- **Artificial Intelligence:** Work and react like humans.
- **Machine Learning:** Create tools to extract knowledge from data.
- **Deep Learning:** Use the way our brain works to perform advanced analysis.

Data Characteristics

Features				
car make	car model	car year	milage	price
BMW	X3	2017	28322	\$27,598
BMW	320i	2017	23719	\$19,999
Ford	Fusion	2019	1889	\$20,785
Ford	F150	2019	5055	\$31,368
Honda	CR-V	2016	36641	\$17,998
Honda	Insight	2019	14701	\$22,998
Jeep	Wrangler	2018	14727	\$35,000
Jeep	Cherokee	2017	26106	\$25,573

- **Features:** Properties of the data used for prediction
- **Correlation:** How relevant the data is to the goal of the program
 - This is a broad definition.
- **AI Goal:** The goal of the AI.
 - In this case, it's to predict car prices.
- **Frequency of Data:** How quickly the data is updated.
 - Is high frequency of data important to the goal of the ai?
 - There are certain scenarios where it is a requirement, and other times when the frequency of data can be slower. This needs to be decided as well.
- **Period of Data:** The length of time we need to keep the data for our uses.
- **Trend of Data:** The story the data is telling us about our goal

Correlations - Examples



Different Scenarios For Highly Correlated Features

- Helping farmers determine best times for seeing / sowing their crops
 - Rainfall
 - Temperature
 - Humidity
 - Price of water
 - Location of farm
- Preserving the Great Wall of China more efficiently
 - Amount of rainfall
 - Images of the wall
 - Tourist Data
 - Temperature
- Reducing illegal poaching of elephant trunks
 - Sales price of tusks
 - Location of poachers
 - Location of elephants
 - Information about demand of tusks

- Predicting whether a song makes it to the billboard
 - Tempo of music
 - Current trends
 - Genre of music
 - Duration of song
 - Improving the exam scores of students
 - How far students live
 - How do students spend their time
 - Hobbies of students
 - How much time they spend in school
 - How enjoyable they find a lesson
-

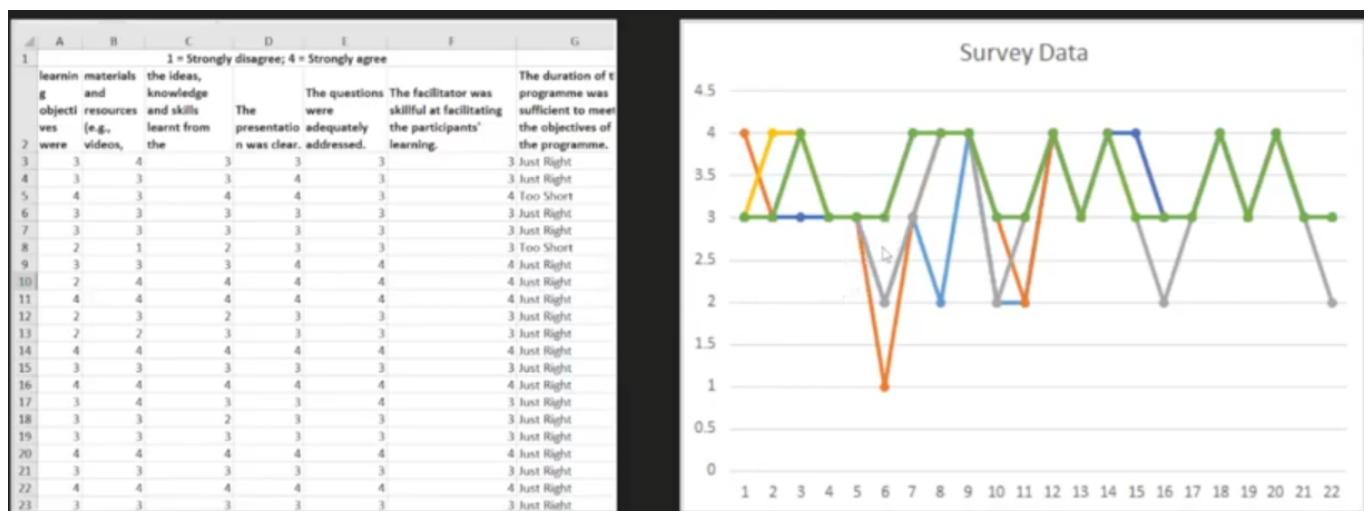
Data Exploration

Exploring Data - Gives us a sense of trends/patterns between other sets of data.

- When choosing a book, you look at the front cover / back cover, table of contents, and you may skim through. Building an idea of what its use will be to you.

Visualization - Data Exploration

Visualisation makes it easier to understand and communicate with others.



Summary

1. Structured data is labeled and formatted
2. Unstructured data is information that has no predefined formatting
3. Big data describes a way to handle huge amount of volumes of information
4. Quantity of data is certainly important, but there also needs to be much work on the quality. Even small errors can have a huge impact on the results of an AI model.

Computer Vision (Domains of AI)



[Google Slides](#)

YouTube

Video: [How computers learn to recognize objects instantly | Joseph Redmon](#)

- **Image Classification:** Is taking an image and applying a label to it.
- **Object Detection:** Finding the objects in an image, putting a bounding box around them, and identifying them.
- **YOLO:** You Only Look Once
 - The old methods of object detection used to take portions of images and look for similarities in photos, then combining all those found similarities, analyzing an image thousands of times. The new method of **YOLO** only looks at the image once.

CV Applications

- Autonomous vehicles
- Fingerprint sensor
- Facial recognition

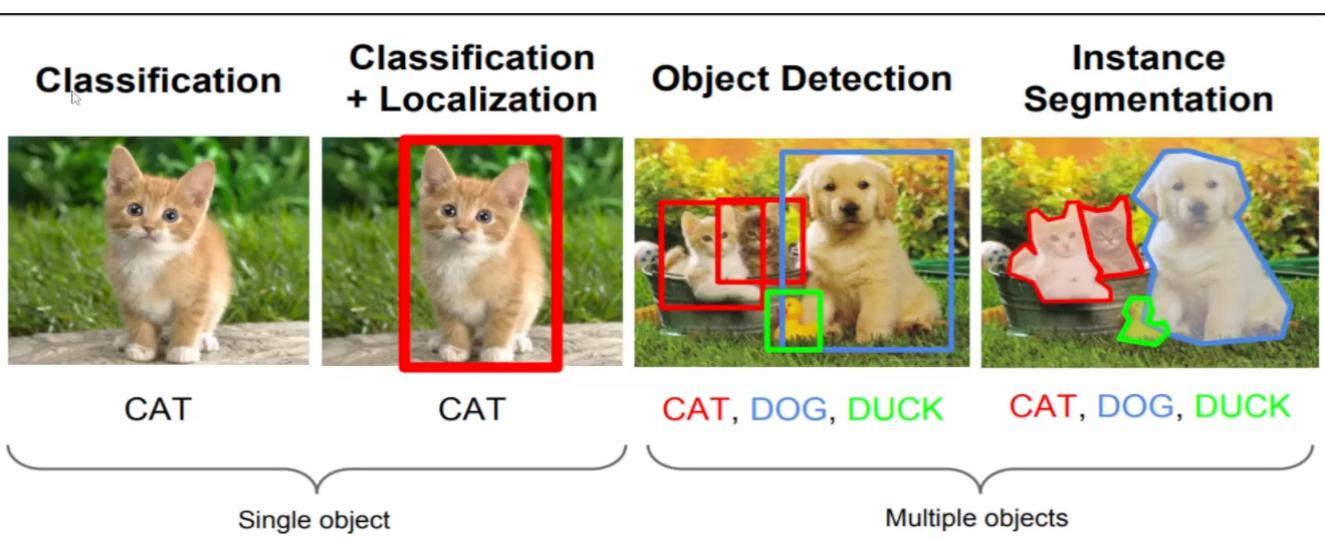
Computer Vision Definition

‘ Computer Vision as a field is an intellectual frontier. Like any frontier, it is exciting and disorganized, and there is often no reliable authority to appeal to. Many useful ideas have no theoretical grounding, and some theories are useless in practice; developed areas are widely scattered, and often one looks completely inaccessible from the other.

-- Computer Vision: A Modern Approach

- Traditional CV uses features to provide understanding of the context within the image data.

Computer Vision Tasks



- **Classification:** Says what selection in the photo out of all the possible selections that it has.
- **Localization:** Localizes the classified object to a specific place in the image.
- **Object Detection:** Depicts multiple objects in a photo.
 - Programs are designed to take what's most prominent in the photo and depict that back to the user.
 - It's better to have a space of where an object is and classify it than to have an outline.
- **Instance Segmentation:** When not only is an object detected in the photo, it's outlined as well.
 - With the precision, you lose a lot of efficiency.

In something like a self-driving car, a bounding box is better than instance segmentation, because you need efficiency. However, in something like surgery, you'd want very precise cutouts using instance segmentation.

Edge Detection (Traditional Task)

Edge detection takes the differences and intensity of the pixels in a photo, where there are large changes in color, and depicts it with a line and records all the large changes in the photo.

- Edge detection is a **traditional method**

Original Image



- Some methods to depict the girl in this photo:
 - Color
 - Edge detection

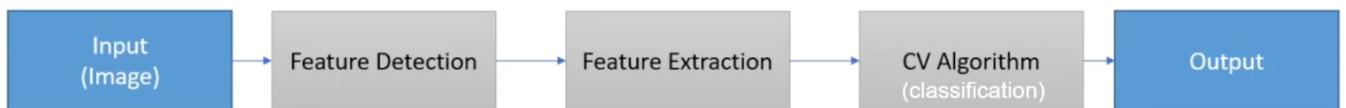
Edge Detection Applied



- This method is called **canny edge detection**.

Traditional Computer Vision

Provide some form of understanding of context within image data.



- **Features:** Measurable and quantifiable piece of information within forms of data that define certain characteristics of an observation.
 - Example: **Edge Detection**
 - Identify points within the image where pixel intensity changes sharply
- The efficiency of traditional CV techniques are heavily reliant upon the quality of the detected and extracted features.
- Also reliant upon the algorithms to tie those features together into a scenic understanding of the photo.
- Traditional methods are great for specified projects where it fits the specific scenario, but traditional methods are not very general purpose.

- Traditional methods may seem outdated because of generalized new methods, but they are better for specific domains, whereas generalized ones are great for general domains.
- With traditional, you need to specify what things matter, like the color, the edges of the image, the distance between the eyebrows, etc.

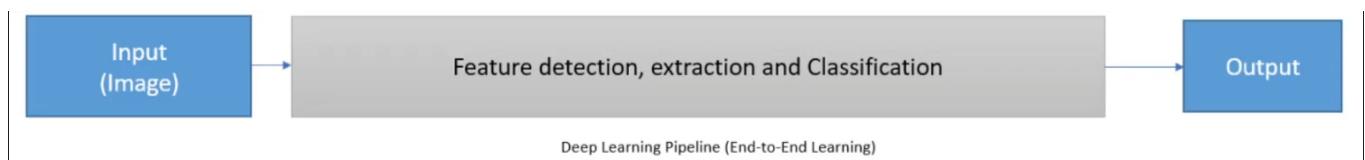
Example: Haar-like Features



- Two adjacent rectangles where the differences between the sum of pixel intensities in each rectangle are used to identify segments of the face.

Deep Learning Approach

- Most computer vision related tasks are solved using deep learning architectures (Neural Networks).
- Deep learning automates the process of feature engineering, extraction, and classification.

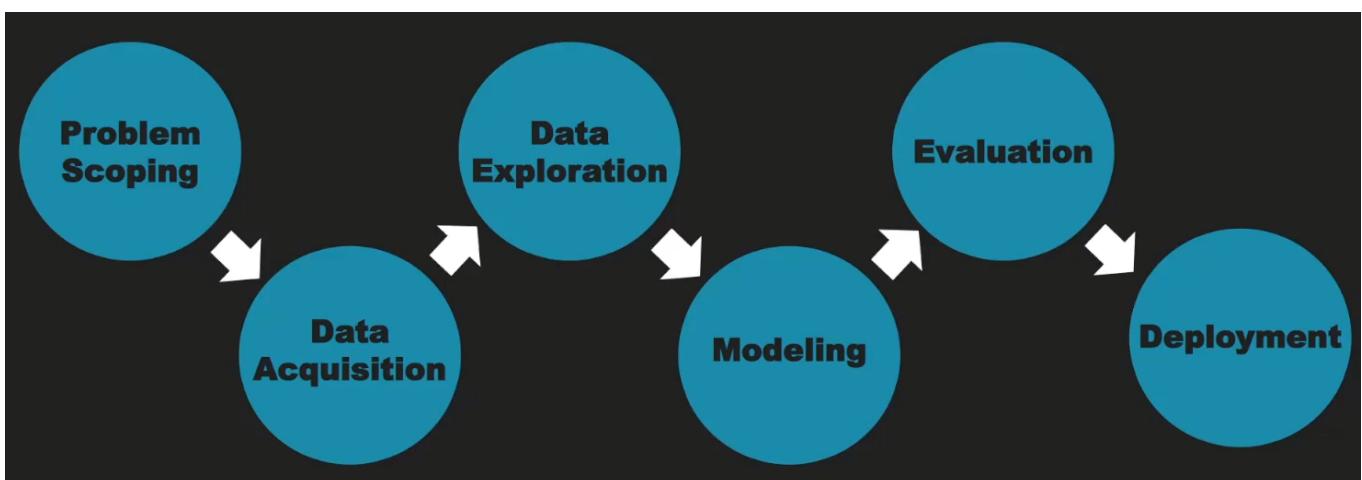


Deep Learning vs Traditional

Differences	Deep Learning	Traditional
Manual Feature Extraction Required?	X	✓
Is Training Computationally Resource Heavy?	✓	X
Requires Huge Labelled Datasets?	✓	X
Black Box Models?	✓	X
Easy To Deploy Even On Microprocessors?	X	✓
Yields High Accuracy Rates?	✓	X

- A **Black Box** is used in systems engineering. A black box is when you know the input & output of a system, but not the inner workings (such as a toaster).
- With deep learning, it takes an expert touch to backtrack and understand why a certain decision was made. With Traditional CV, you can backtrack and look at why a decision was made.
- When deep learning gets large, it needs a GPU.
 - This can be offloaded, after the model is created, to small devices.

The AI Process In CV



1. **Problem Scoping:** What do I want to accomplish with my computer vision task?

2. **Data Acquisition:** Acquiring the data and images for the model.
3. **Data Exploration:** Look at the data. For example, are there different conditions in the photos that you would need to consider.
4. **Modeling:** What is the thinking process for the computer? How is it depicting, and how does it know one sign from another? What are the methods that you would go about in instructing it?
5. **Evaluation:** How do I, after creating a model, evaluate the assigned tasks and how well it did?
6. **Deployment:** How do I take this data and model that I created, and deploy it?
 - It could be an app, something on the web, etc.

Discussions

What would matter in a photo to be used for recognition?

- Quality of photo
- Diverse set of angles
- Lighting conditions
- Object size / distance

What are some criteria for the image itself (regardless of content)?

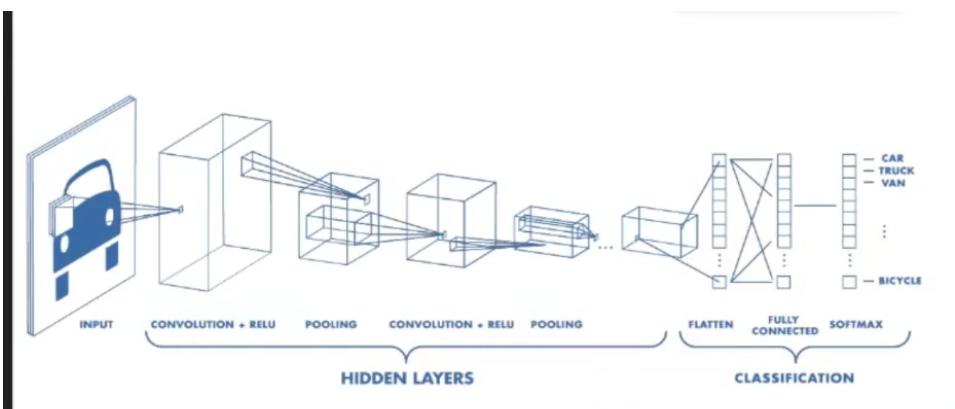
- Same size of images
- Same aspect ratios

Aspects To Consider

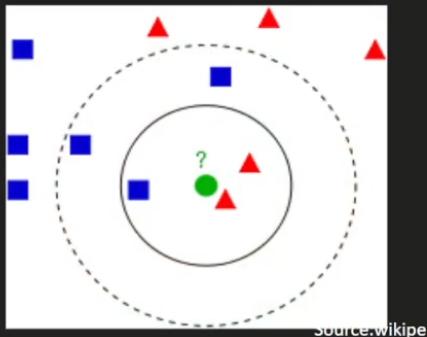
- Viewpoint variations
- Scale Variations
- Illumination Variations
- Intra-Class Variations

Modeling

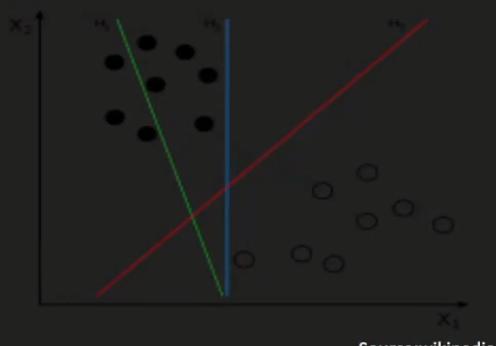
Modeling



Source: medium.freecodecamp.org



Source:wikipedia



Source:wikipedia

- The top one is deep learning and the bottom two are traditional CV.