Scope and opportunities in the areas of

Artificial Intelligence - Computer Vision

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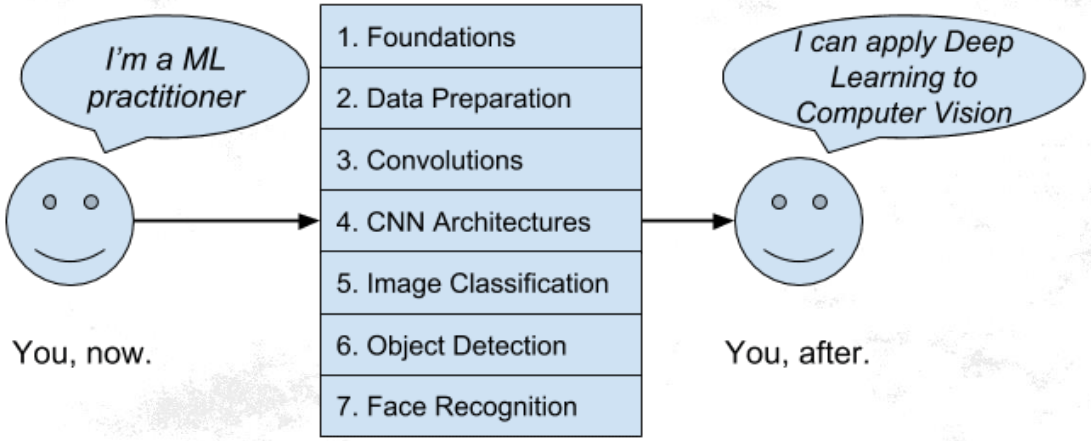
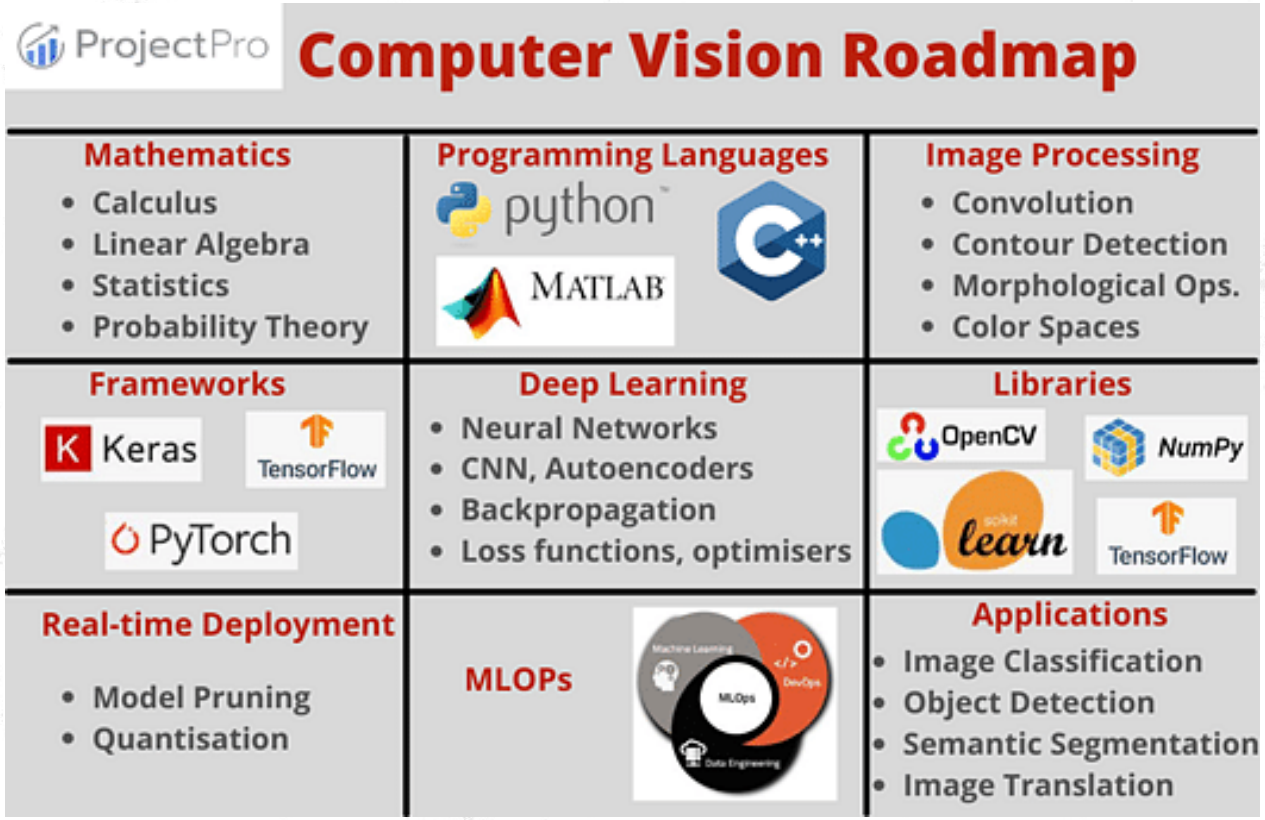
Computer vision Learning Roadmap





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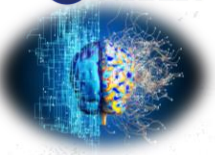
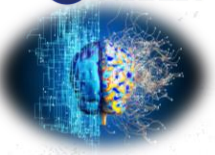


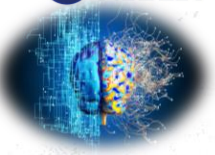
AI-Roadmap to Computer Vision

Step 1 :	Step 2 :	Step 3 :	Step 4 :	Step 5 :	Step 6 :	Step 7 :	Step 8 :	AI-Roadmap to Computer Vision
• Python & Statistics : Basics of computer vision	• Solving Image Classification : Basic Machine Learning Image pre-processing Techniques	• Introduction to Keras & Neural Networks: Fundamentals of Neural Networks (keras)	• Understanding CNNs, Transfer Learning : Convolutional Neural Networks (CNNs) Transfer learning	• Object Detection Algorithms	• Image Segmentation & Attention Models	• Deep Learning Tools : PyTorch & TensorFlow	• Generative Adversial Networks (GANs)	



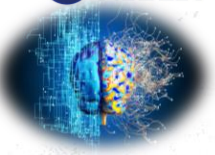
AI-Roadmap to Computer Vision

1. Python & Statistics : Basics of computer vision
2. Solving Image Classification : Basic Machine Learning Image pre-processing Techniques
3. Introduction to Keras & Neural Networks: Fundamentals of Neural Networks (keras)
4. Understanding CNNs, Transfer Learning : Convolutional Neural Networks(CNNs) Transfer learning
5. Object Detection Algorithms
6. Image Segmentation & Attention Models
7. Deep Learning Tools : PyTorch & TensorFlow
8. Generative Adversial Networks (GANs)



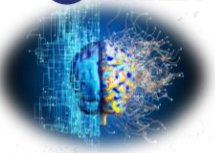
Computer vision Learning Roadmap

- **Introduction to Computer Vision, Image Processing**
- **Mathematics** (Linear Algebra, Calculus, Convex Optimization, Probability)
- **Programming Basics (** Python Basics, OpenCV)
- **Machine Learning (**Machine Learning Basics, Project Image Classification Using Machine Learning)
- **Deep Learning Foundations**
  - Deep Neural Network
  - CNN & Transfer Learning
  - Image Classification Project



Computer vision Learning Roadmap

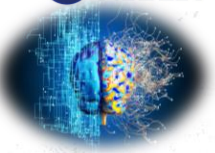
- **Deep Learning for Computer Vision Applications**
  - Object Detection
  - Image Segmentation
  - Project based on Object Detection , Image Segmentation
- **Advanced Computer Vision Algorithms**
  - Self-Attention Algorithms & Vision Transformers
  - Basics of NLP and Image Captioning
  - Generative Adversarial Networks (GANs)
  - Generative AI & Image Generation
  - Video Understanding & Analysis, 3D Computer Vision
- **Deep Learning Frames Works & Advanced Programming**
  - TensorFlow, Pytorch
- **Deployment & MLOps**



List of packages

- OpenCV — This package is essential for image and video manipulation. With a rich amount of built-in operations, it plays a significant role in computer vision
- NumPy — NumPy isn't limited to computer vision; it's used across various machine learning domains. Since computer vision involves working with matrices, NumPy is invaluable for efficient matrix computations.
- Tensorflow — Developed by Google, this machine learning framework allows you to work with images, videos, and ML architectures. It also supports GPU acceleration for faster computations. Explore a comprehensive tutorial on Tensorflow by freeCodeCamp.org.
- PyTorch — Developed by Meta, PyTorch is a strong competitor to TensorFlow, offering extensive functionality for computer vision-related architectures. Packt gives a gentle introduction to PyTorch for Computer Vision.

Some notable examples include Matplotlib, Pillow, Pandas, Scipy, ScikitLearn.



Applications

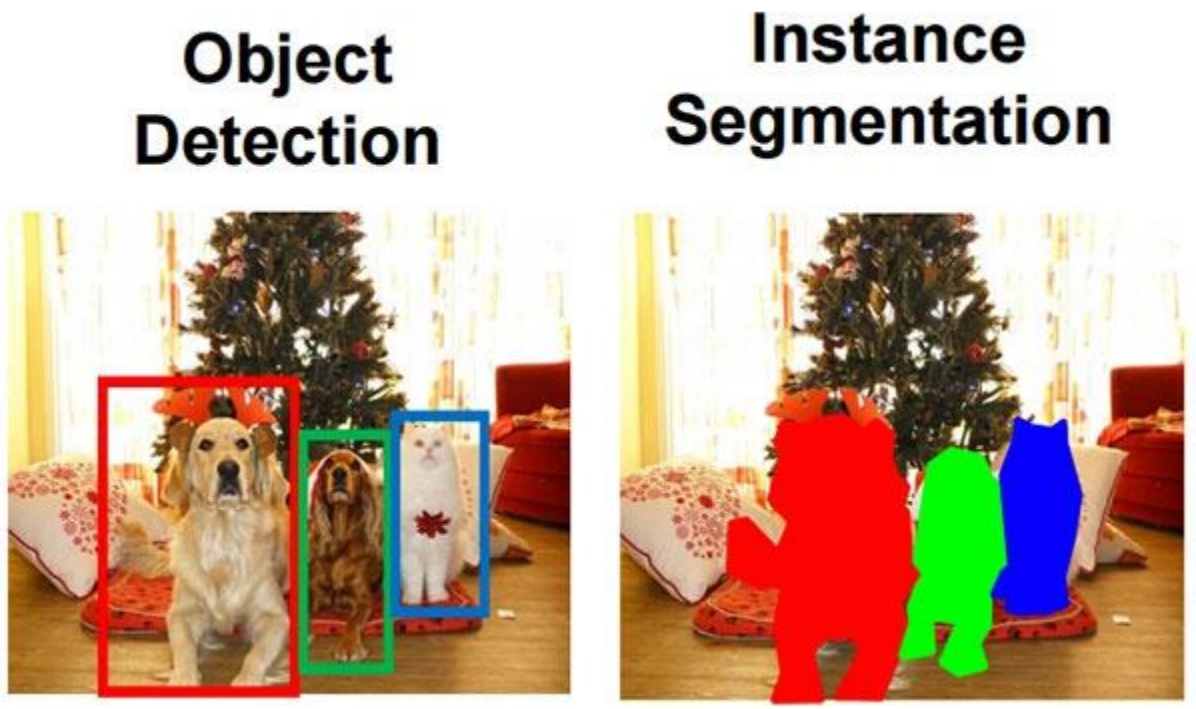
- Intruder Detection
- Traffic Flow Analysis
- Analysis of X-rays, MRI, and CT scans .
- Self-driving Vehicles
- PPE Detection etc.
- Defect detection .
- OCR .
- Crop Monitoring.
- Road Condition Monitoring.
- 3D model Building .
- Cancer Detection .

Segmentation vs Detection vs Classification in Computer Vision

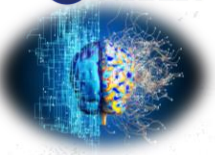
Segmentation models *provide the exact outline* of the object within an image. That is, pixel by pixel details are provided for a given object, as opposed to *Classification* models, where the model identifies what is in an image, and *Detection* models, which places a bounding box around specific objects.

Segmentation

- Segmentation is the process of partitioning an image or video into meaningful regions to identify and differentiate objects or regions of interest. It serves objectives such as understanding object boundaries, extracting fine-grained information, and enabling further analysis.



Source : picsellia.com



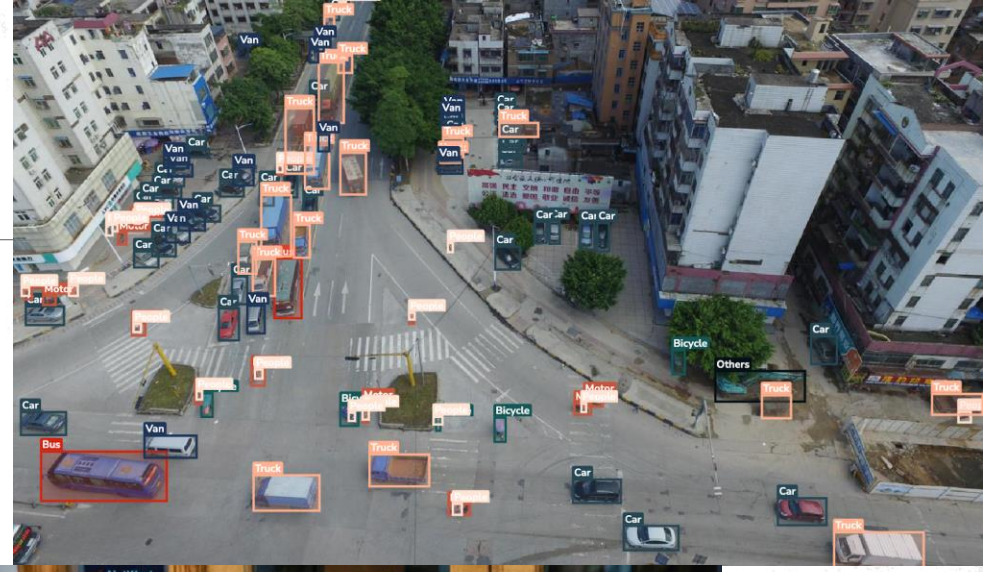
Segmentation

- Segmentation techniques include semantic segmentation, which assigns class labels to each pixel, and instance segmentation, which identifies individual instances of objects. Panoptic segmentation combines semantic and instance segmentation, labeling all pixels while distinguishing different instances.
- Real-world applications of segmentation span various domains, including medical image analysis for tumor detection and organ localization, manufacturing for defect identification, and robotics for precise object localization

Source : picsellia.com

Object Detection

- Object detection involves localizing and classifying objects within an image or video. It aims to identify specific objects of interest and provide their bounding boxes, crucial for tasks like object tracking and scene understanding.



Object Detection

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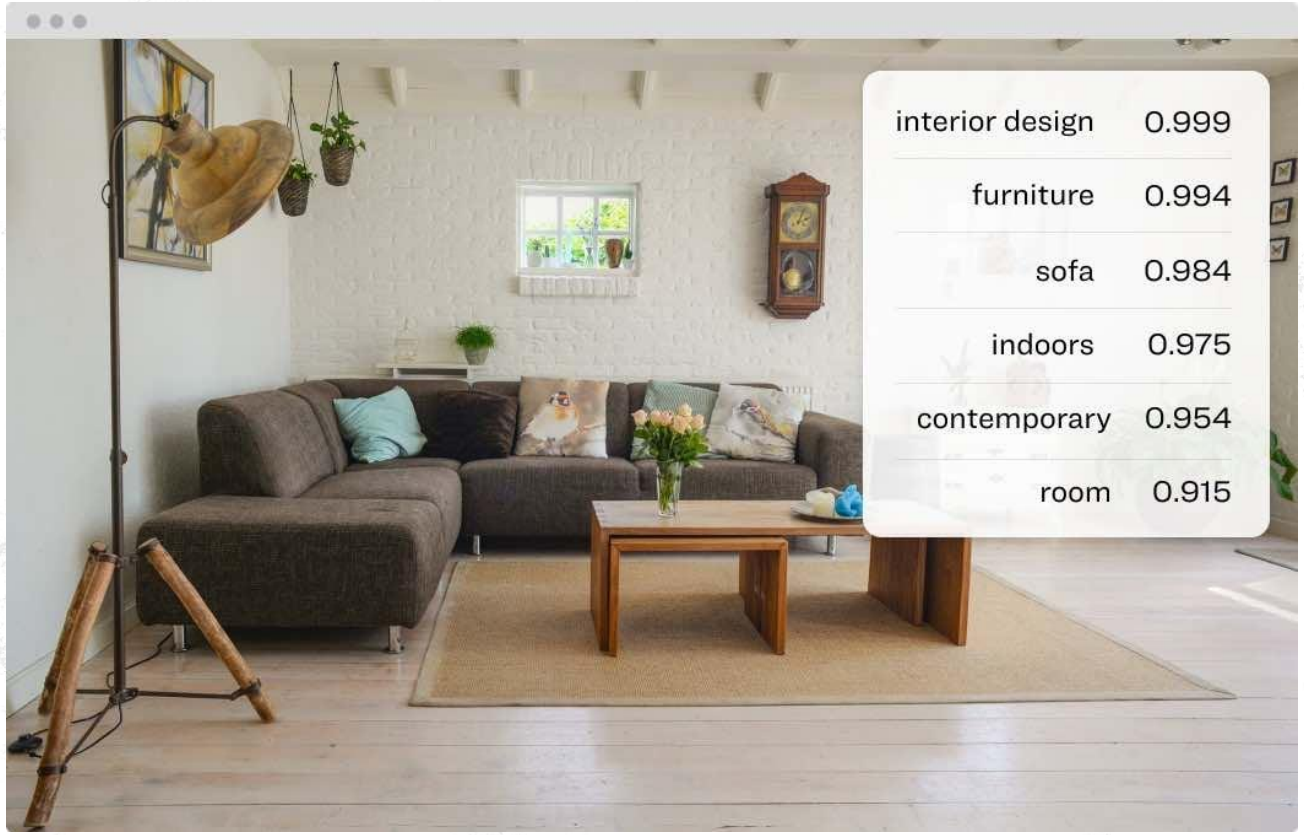
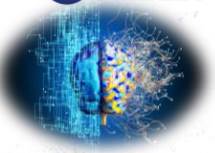
- Object detection comprises key components such as Region Proposal Networks (RPNs) for generating potential object proposals, feature extraction networks for analyzing proposals, and object classification networks for assigning class labels.
- Popular object detection algorithms include Faster R-CNN, YOLO (You Only Look Once), and SSD (Single Shot MultiBox Detector). These algorithms differ in terms of speed, accuracy, and trade-offs, catering to specific application requirements.
- Object detection finds applications in various fields, including video surveillance for identifying and tracking individuals or objects, agriculture for crop monitoring and pest detection, and retail analytics for customer behavior analysis

Classification

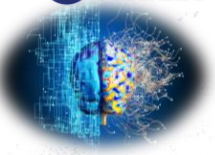
- Classification involves assigning labels or categories to images or specific regions. It provides a holistic understanding of image content and can be approached through traditional or deep learning-based methods.



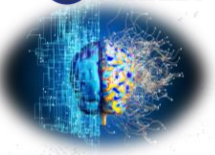


Classification

- Traditional classification methods utilize handcrafted features and machine learning algorithms. However, deep learning techniques, particularly Convolutional Neural Networks (CNNs), have revolutionized image classification, achieving remarkable accuracy by automatically learning hierarchical features.
- Popular classification architectures include AlexNet, VGGNet, and ResNet. Transfer learning and pretrained models leverage knowledge from large-scale datasets to solve specific classification tasks with limited labeled data.
- Classification finds applications in tasks like image tagging and labeling, face recognition for identifying individuals from facial images, and disease diagnosis in medical imaging

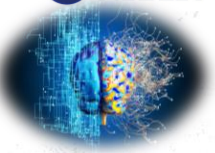


- Segmentation vs Detection: When to Choose Each Segmentation excels in providing fine-grained information about object boundaries and regions. It is ideal for tasks like medical image analysis, manufacturing defect detection, and robotics object localization. Detection, on the other hand, is suitable for identifying specific objects and their locations, making it prevalent in video surveillance, agriculture for crop monitoring, and retail analytics.



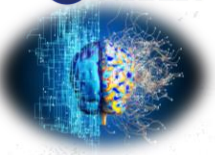
Detection vs Classification

- Differentiating Factors Detection provides not only class labels but also precise object locations through bounding boxes.
- It enables contextual understanding and interaction with the environment. Classification, in contrast, focuses on assigning labels to images or regions.
- It is faster and more suitable for scenarios where fine-grained information is not necessary.
- Detection is preferred in augmented reality for real-time interaction with objects, while classification excels in tasks like image tagging and labeling.



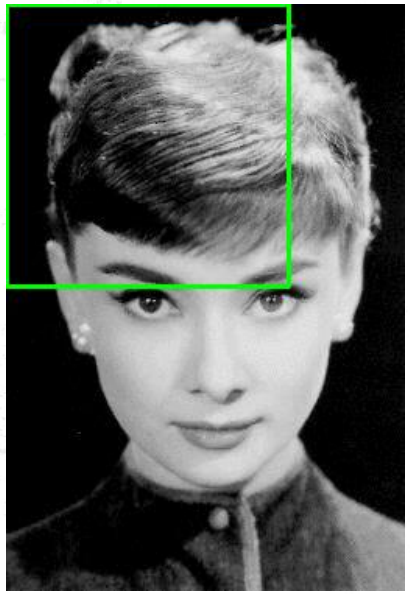
Combined Approaches

- Fusion of Segmentation, Detection, and Classification In advanced computer vision applications, a combination of segmentation, detection, and classification achieves higher accuracy and richer insights.
- By fusing the outputs, machines leverage the strengths of each approach. For example, in autonomous driving, segmentation identifies drivable areas and objects, detection identifies specific objects like pedestrians and vehicles, and classification assigns labels for further understanding



Face Detection – haar cascade classifier

- Face Detection with Haar Cascade. Exploring a bit older algorithm which… | by Girija Shankar Behera | Towards Data Science



Rise of Deep Learning

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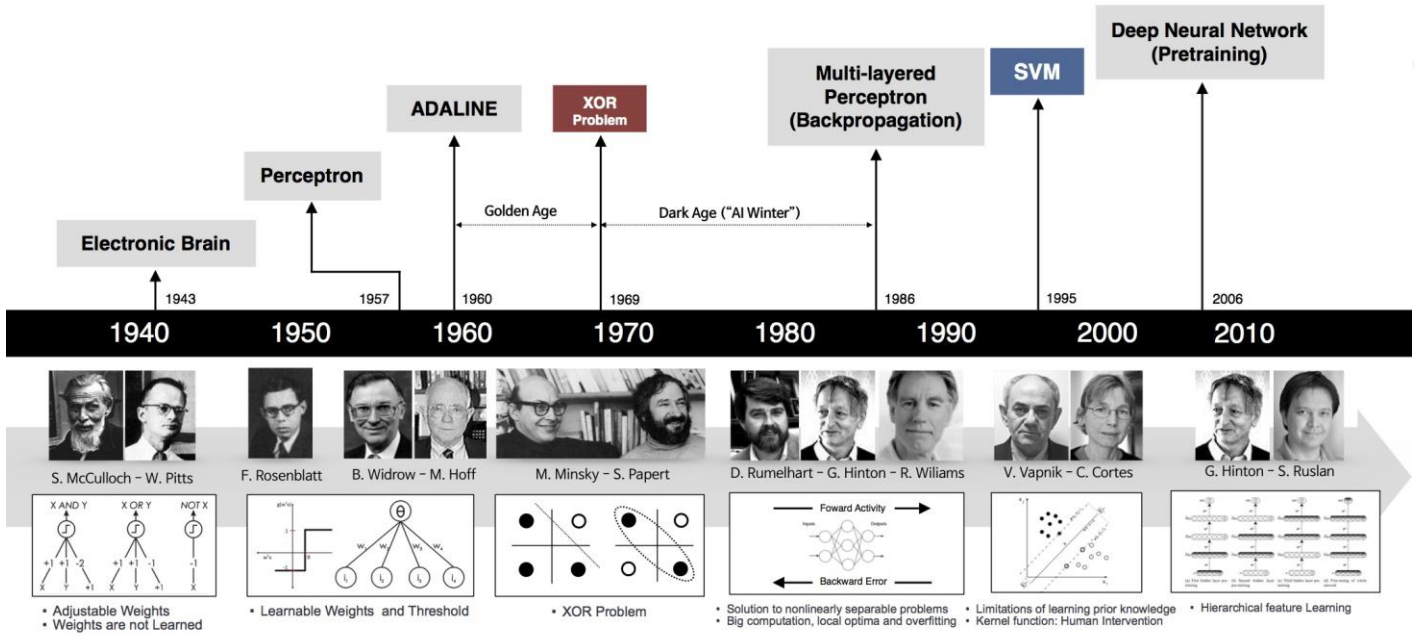
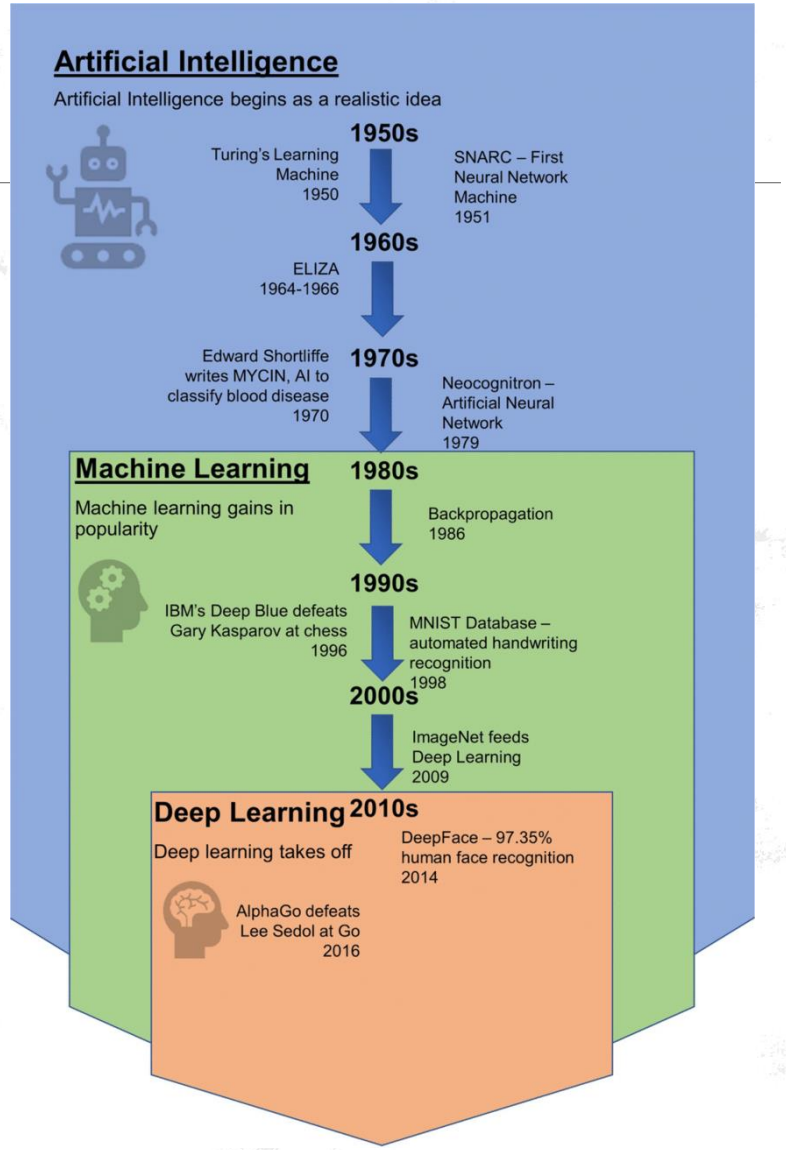
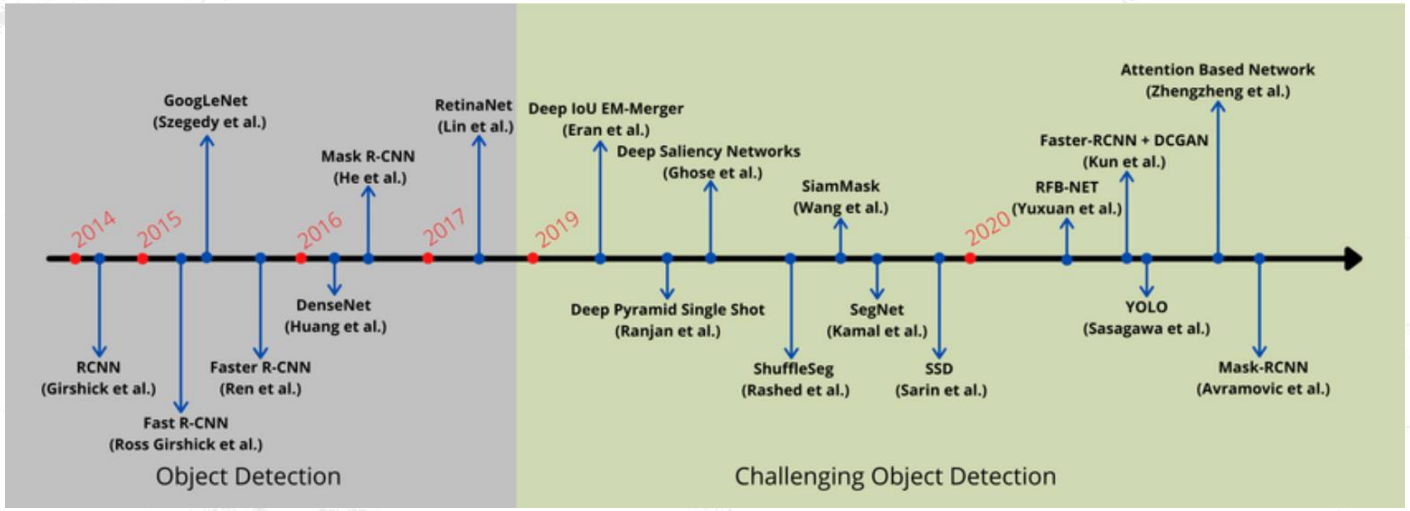




http://beamlab.org/deeplearning/2017/02/23/deep_learning_101_part1.html

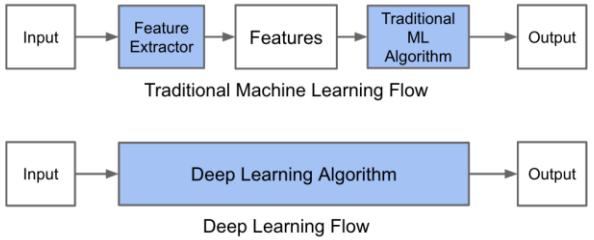
Deep Learning Frameworks

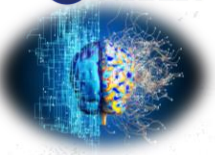


Face Detection – caffee framework

- Caffe is a deep learning framework, originally developed at University of California, Berkeley. It is open source, under a BSD license. It is written in C++, with a Python interface

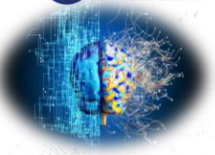
- https://colab.research.google.com/drive/1wKTXzew7LBJMfqC1oekDNUgMPj_eHoxW





Face Recognition using face_recognition package

- https://colab.research.google.com/github/louis030195/colabs/blob/master/face_recognition.ipynb



Emotion recognition with Tensorflow

- https://colab.research.google.com/github/omarsar/emotion_recognition_tensorflow/blob/master/Deep_Learning_Emotion_Recognition_TensorFlow_.ipynb

Face, Age & Gender Detection using pre-trained models

- https://colab.research.google.com/drive/180Lx5J7evMzTTLgkGAINDIJvKUUQe6k4#scrollTo=S9pBuGbZrxII