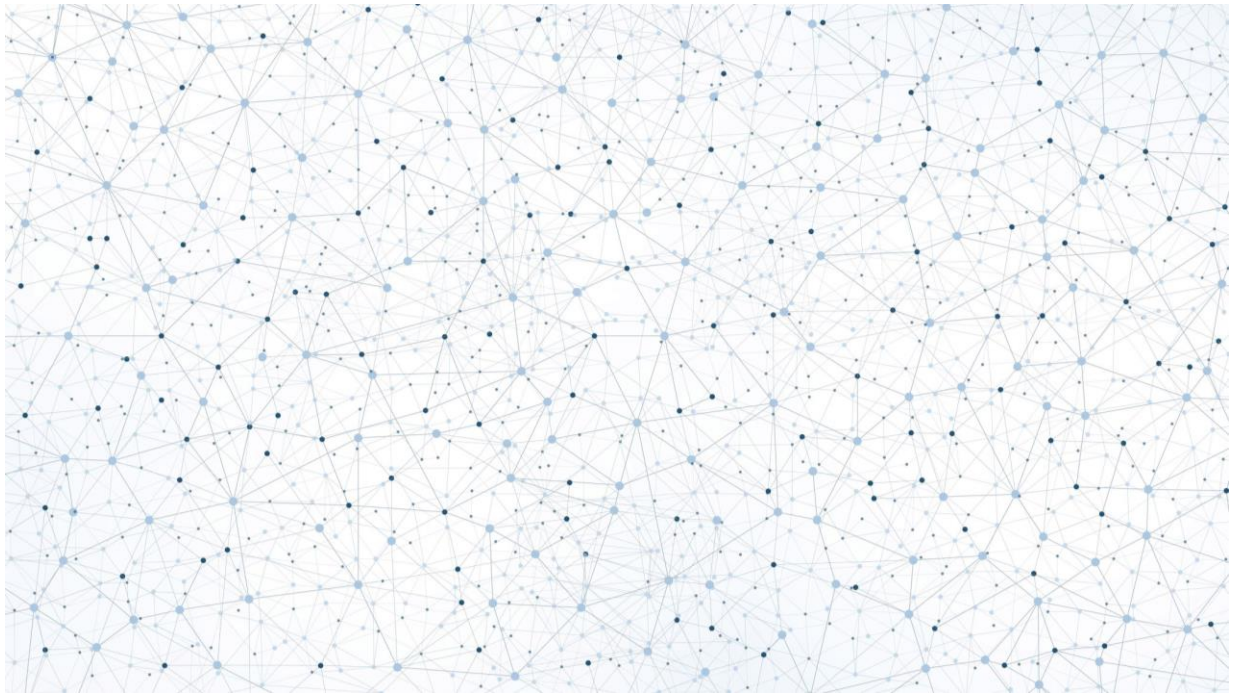
# Mākslīgā intelekta risinājumi ražošanas procesu uzlabošanai - datorredze

2024

Valdis Saulespurens



RBS
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# About Me

**Valdis Saulespurens**

**30+ Years programming**

**Run retail and e-commerce store in 90s California**

**Lector RTU RBS**

**Researcher National Library of Latvia – OCR model improvement**

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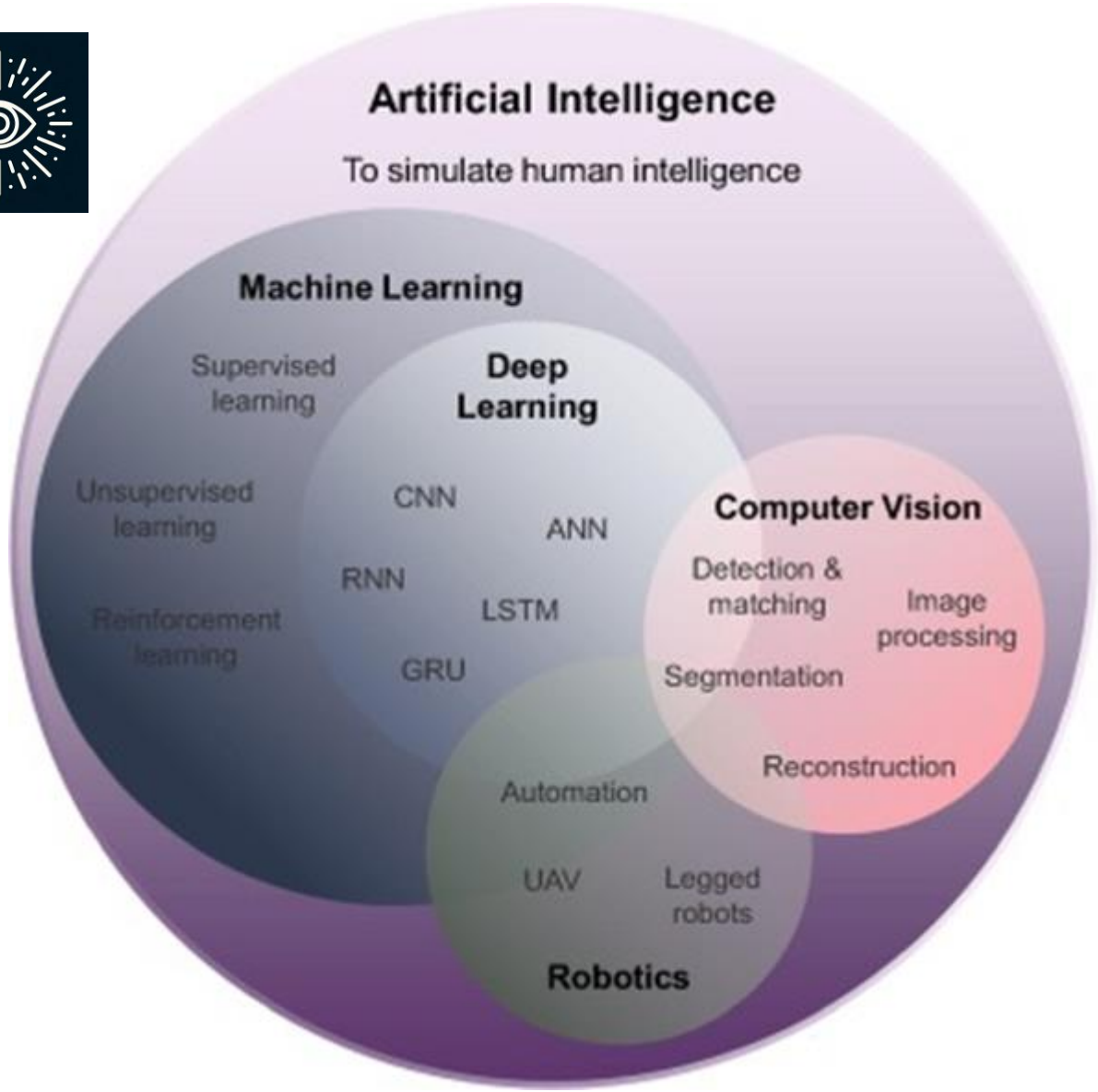
# Datorredze – Computer Vision

- Definition: A field of artificial intelligence(AI) that enables computers to interpret, analyze, and make decisions based on visual data from the real world, such as images and videos.
- Involves techniques for processing, understanding, and extracting meaningful information from visual inputs to automate tasks that typically require human vision.

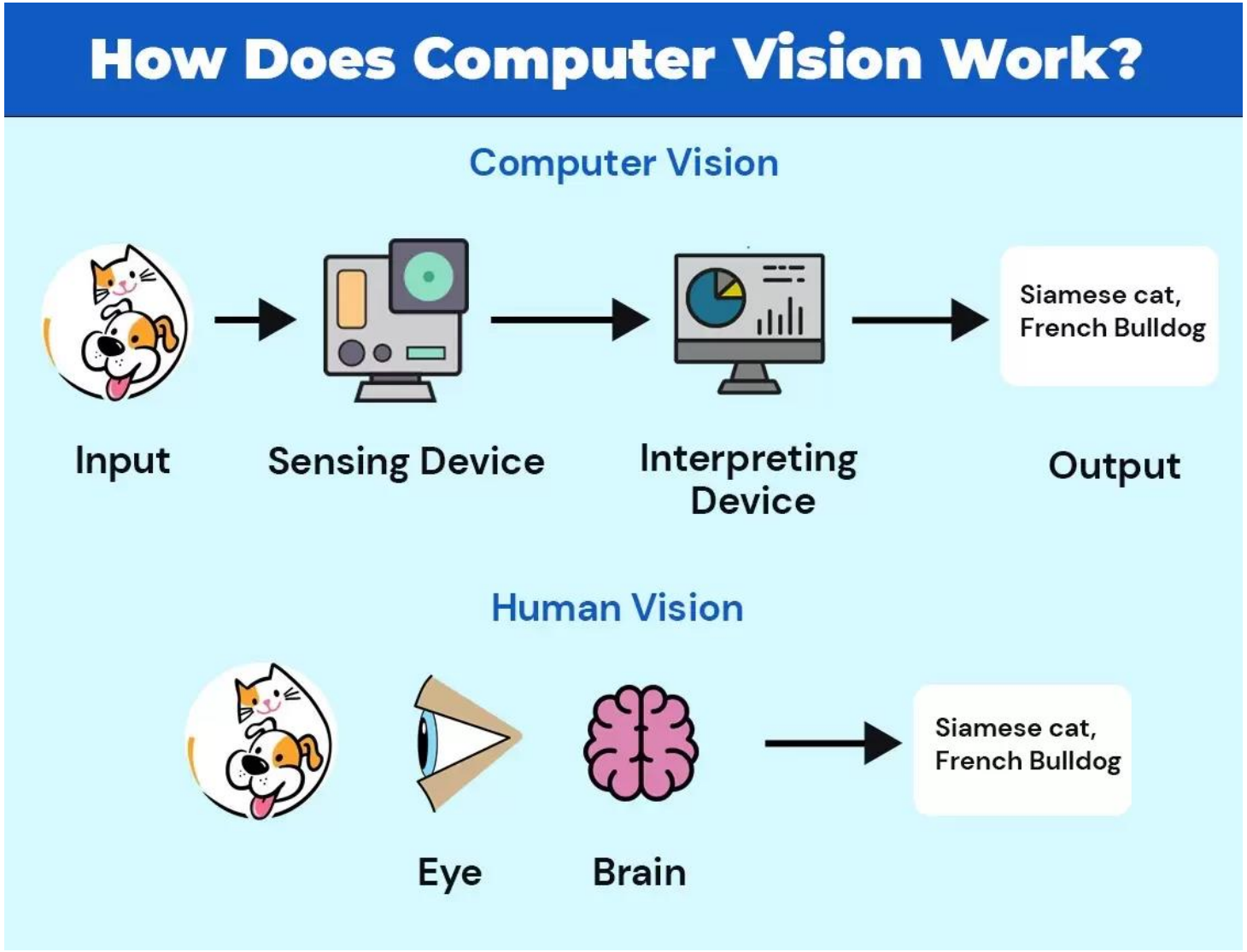
# Computer Vision within AI field

- **Artificial Intelligence (AI)** - Simulation of human intelligence in machines.
- **Machine Learning (ML)** - Subfield of AI focused on algorithms that learn from data.
- **Deep Learning (DL)** - Subfield of ML using neural networks with multiple layers.
- **Robotics** - Design, construction, and operation of robots.
- **Machine Vision** - Technology enabling machines to interpret and process visual information. Primarily used in industrial and manufacturing settings.



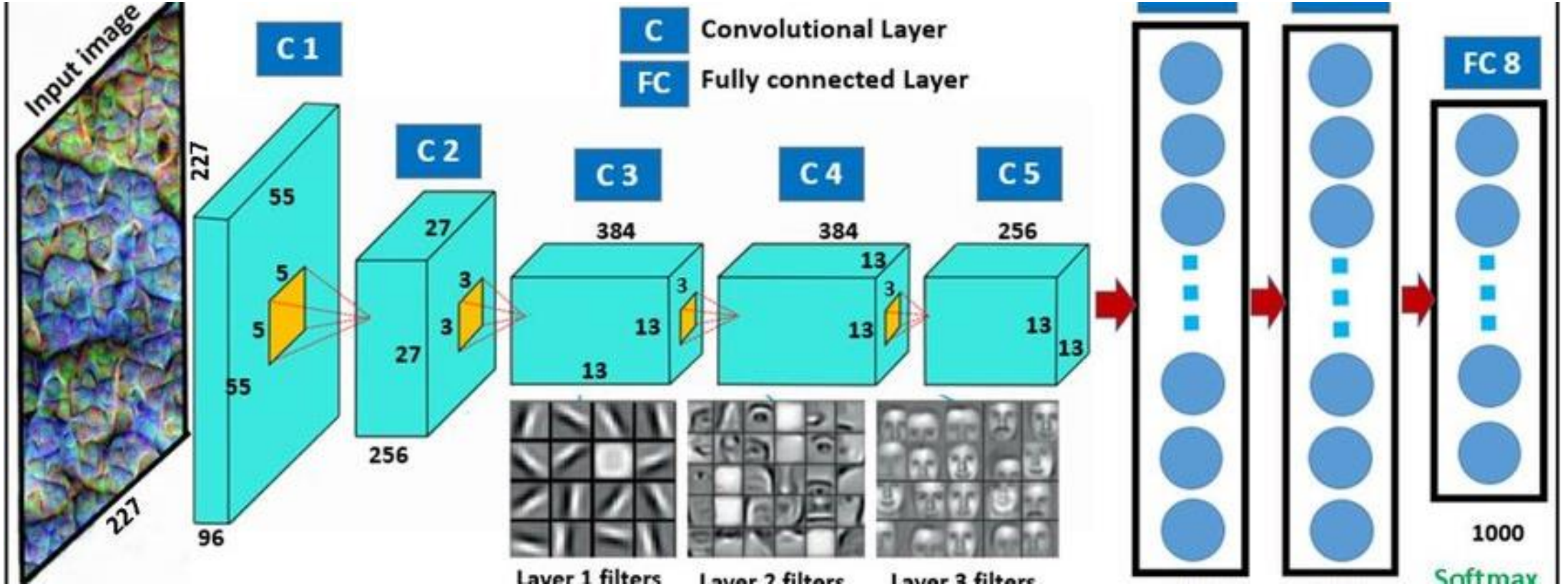

Img: https://medium.com/@su3230/computer-vision-cv-d204f81a9063

- **Input**
- Visual data such as images or videos.
- Acquired from real-world environments.
- Examples: photographs, live camera feeds, medical scans.
- **Sensing Device**
- Hardware capturing visual data.
- Converts real-world scenes into digital images.
- Examples: cameras, sensors, scanners.
- **Interpreting Device**
- Software or algorithms processing visual data.
- Extracts meaningful information from images.
- Examples: feature extraction, object detection, image classification.
- **Output**
- Processed results or actionable insights.
- Can be in various forms such as visualizations, decisions, or commands.
- Examples: labeled images, detected objects, autonomous vehicle navigation.



# Early History of Computer Vision (1950s to 1970s)

- **First Scanned Image(NIST 1957) – Russell A. Kirsch, others**
- 1957 – D.H. Hubel and Wiesel – how do cats see? Neural basis of vision, simple and complex cells. (Nobel 1981)
- 1966 – Marvin Minsky (MIT) – Summer of Computer Vision – Block World
- 1970s – Early OCR (Optical Character Recognition) systems. – special fonts, still used in some fields such as bank checks
- David Marr's Theory of Edge Detection (1976) – importance of edges

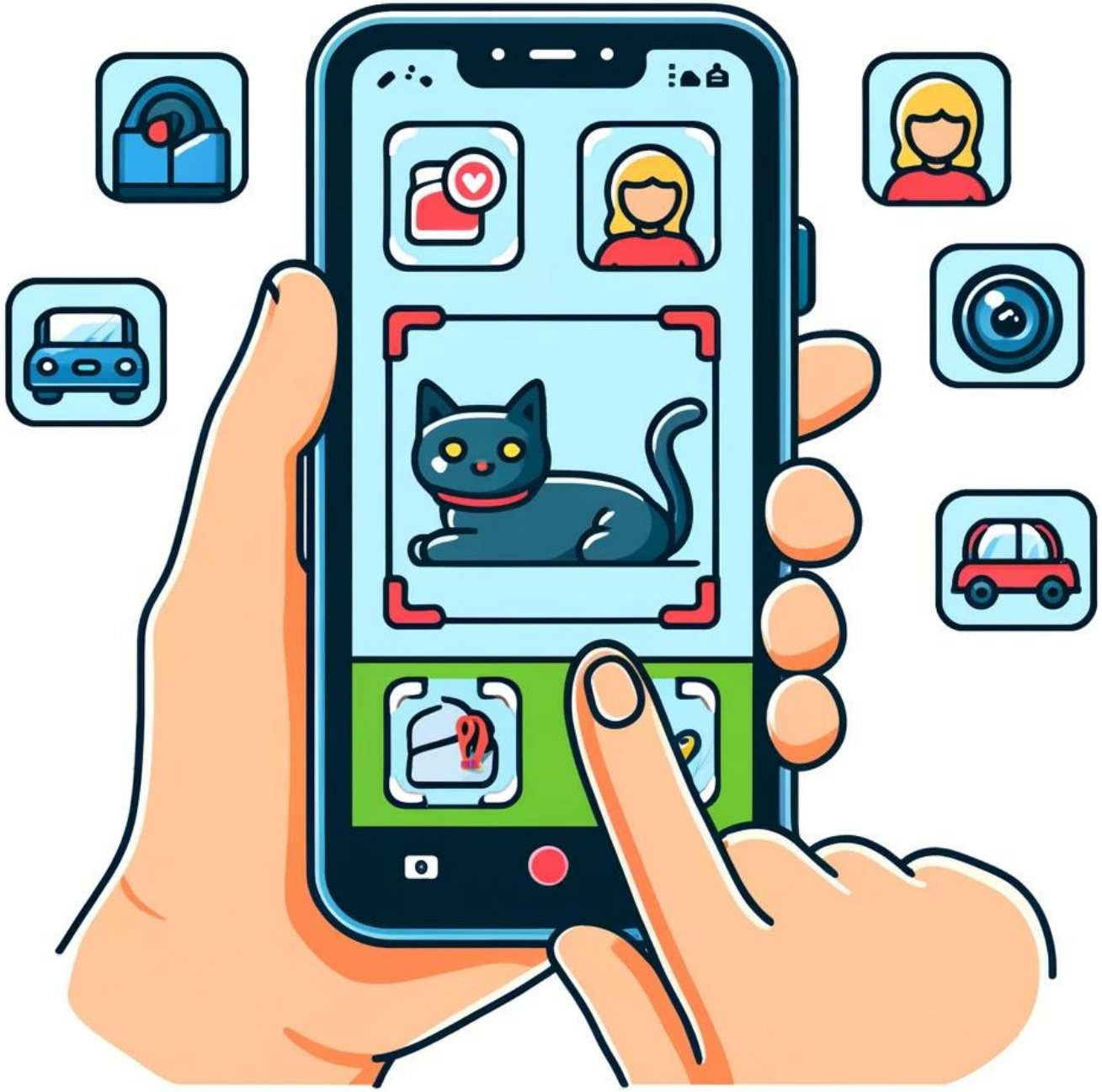



# 1980s to 2012

- **1980s –** Feature-Based Models (edges,corners, textures)
- 1990s – Early Experiments with Neural Networks and Deep Learning, backpropagation, 3D vision, advances in Face Recognition
- 2000s – Boosting Algorithms, Large Scale Image Datasets
- 2012 – ImageNet dataset (big labeled dataset), GPU acceleration, **AlexNet** top accuracy in the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) 2012, bringing Convolutional Neural Network (CNN) Architecture to forefront

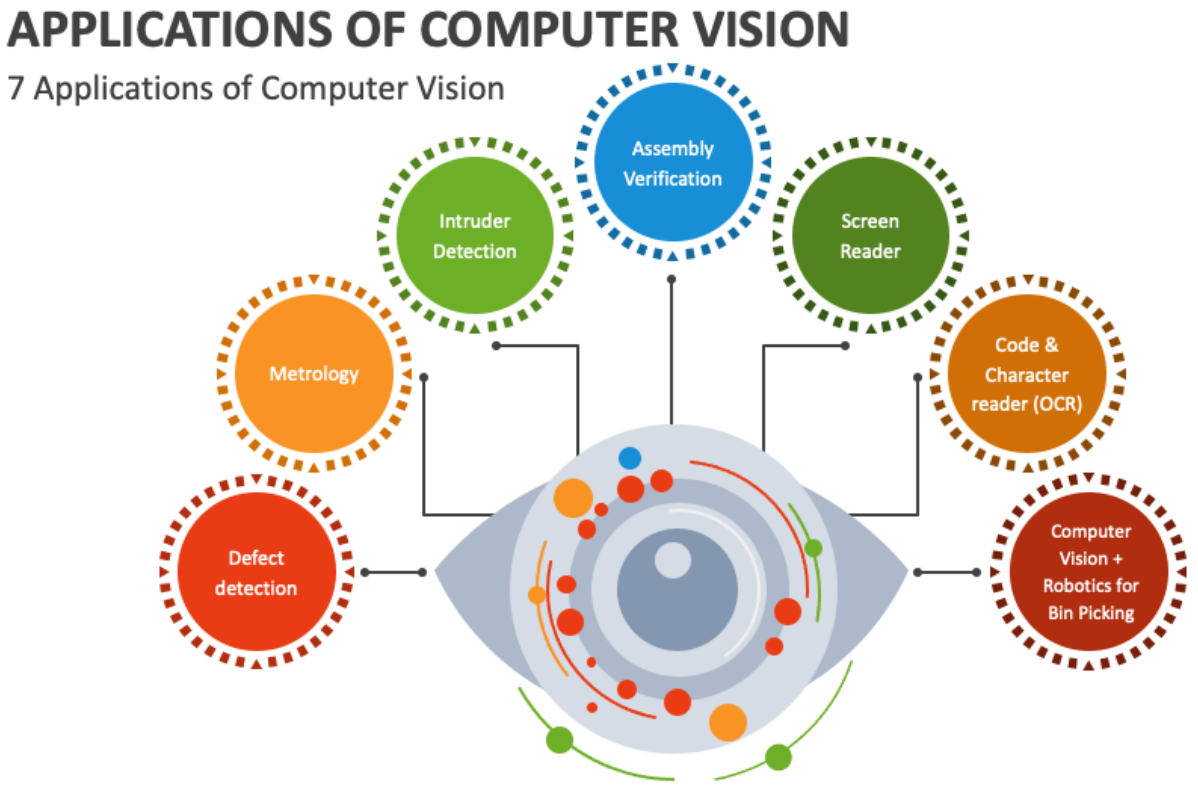
# 2012-Onwards

- Deeper Networks VGG(2013) Oxford, GoogleNet/Inception(2014), ResNet(2015)-Microsoft
- YOLO (You Only Look Once) Series (2016 onwards)
- Transformers in Vision (2017 onwards) – attention based models
- DALL-E and Generative Models (2021), Stable Diffussion, Midjourney, advances in GAN(Generative Adversarial Networks)
- Edge AI and On-Device Learning - complex vision models on edge devices like smartphones and IoT devices.



# Subfields of Computer Vision

- Image Classification
- Face Recognition
- Optical Character Recognition (OCR)
- Object Detection
- Image Segmentation
- Activity Recognition
- 3D Vision
- Scene Understanding

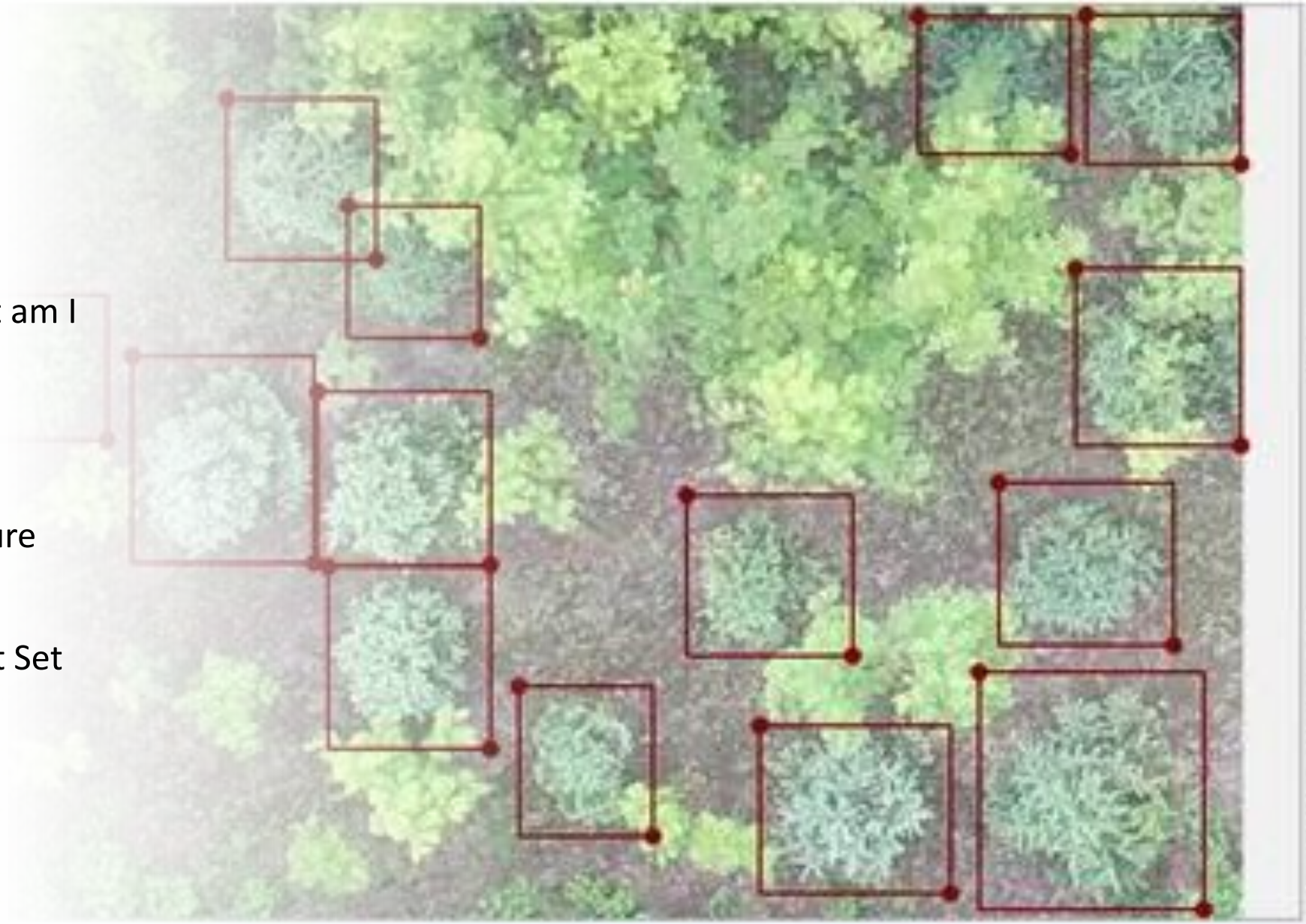


# Image Segmentation

- Segmentation – Object Detection
- Localization – Important Points
- Define Your Goals
- Gather and Prepare Data
- Preprocess Your Images
- Select a Segmentation Method (U-Net, Mask R-CNN others)
- Build and Train Your Segmentation Model
- Evaluate the Model
- Refine, Deploy, Monitor and Improve

# Image Classification

- Define the Problem – what am I trying to classify
- Collect and Prepare Data
- Preprocess the Data
- Choose a Model Architecture
- Build and Train the Model
- Evaluate the Model on Test Set
- Fine-tune and Optimize
- Deploy the Model
- Monitor and Maintain



Src: https://www.mdpi.com/2076-3417/13/2/895

# Optical Character Recognition

- Similar steps to General Classifier
- Well studied
- Rules based OCR overtaken by LTSM and other neural net architectures
- Business case for digitalization
- Open Source models such as Tesseract can achieve excellent results by performing supplemental training to existing models

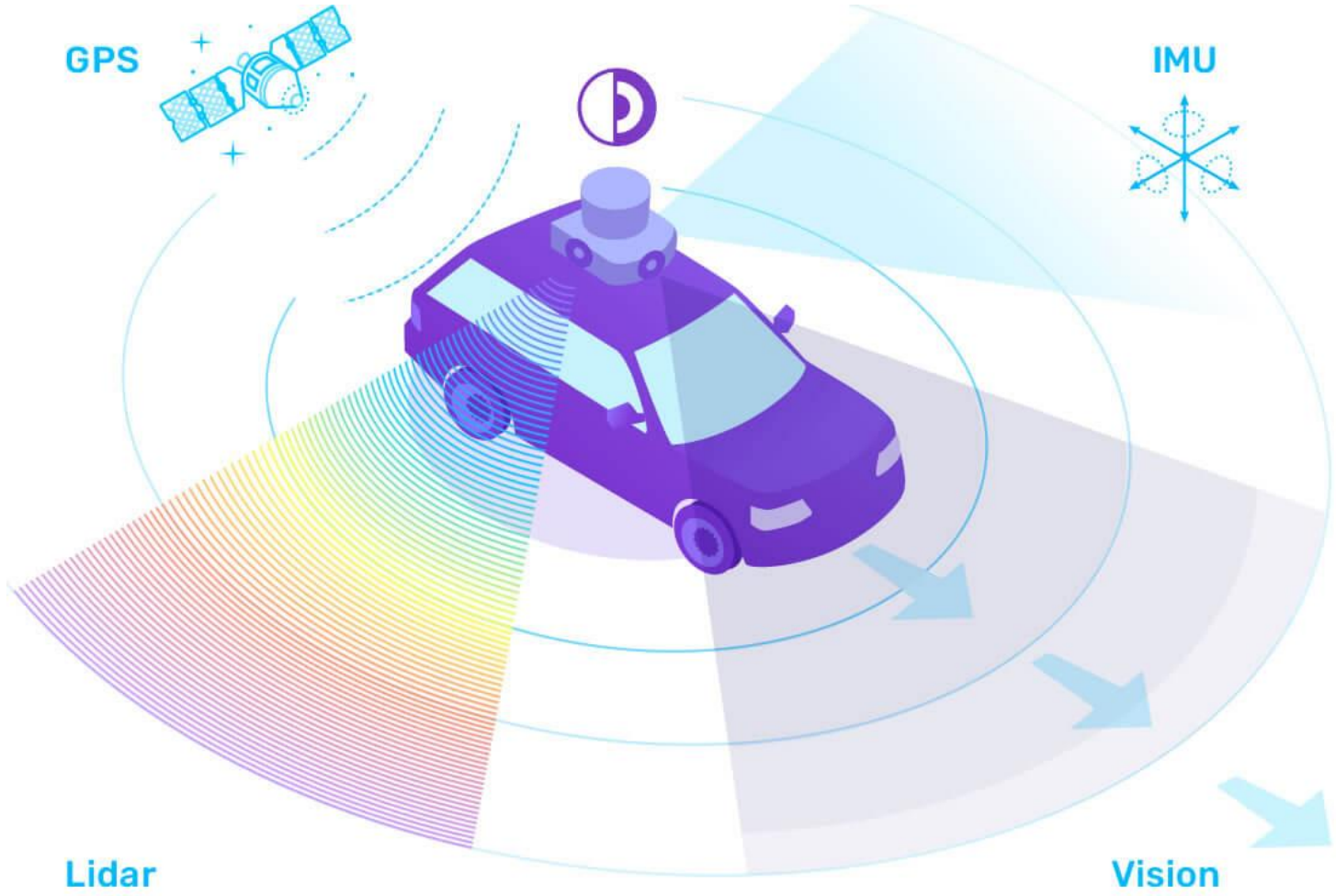
# Face Recognition

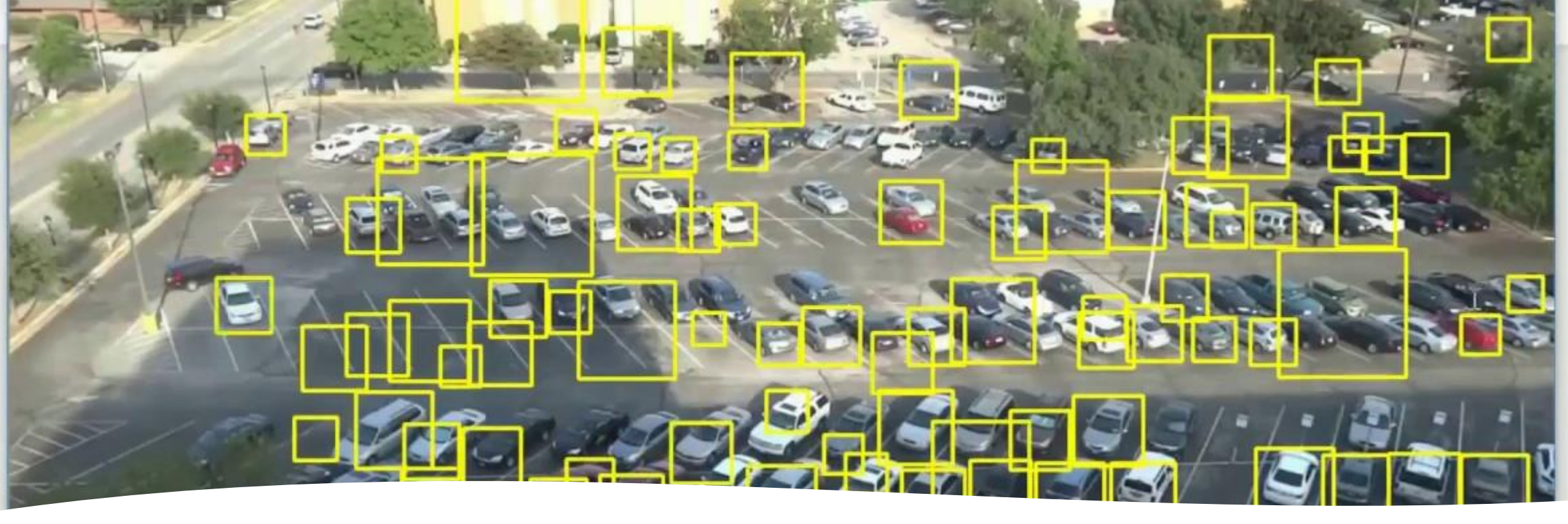
- Similar steps to General Classifier
- Well studied
- Privay and Ethics Concerns
- EU - GDPR

# Simultaneous Localization and Mapping(SLAM)

- **Localization**: Determining the precise position and orientation of the observer within the environment.
- **Mapping**: Creating a representation (map) of the environment based on sensor data.

- Computer Vision part of SLAM





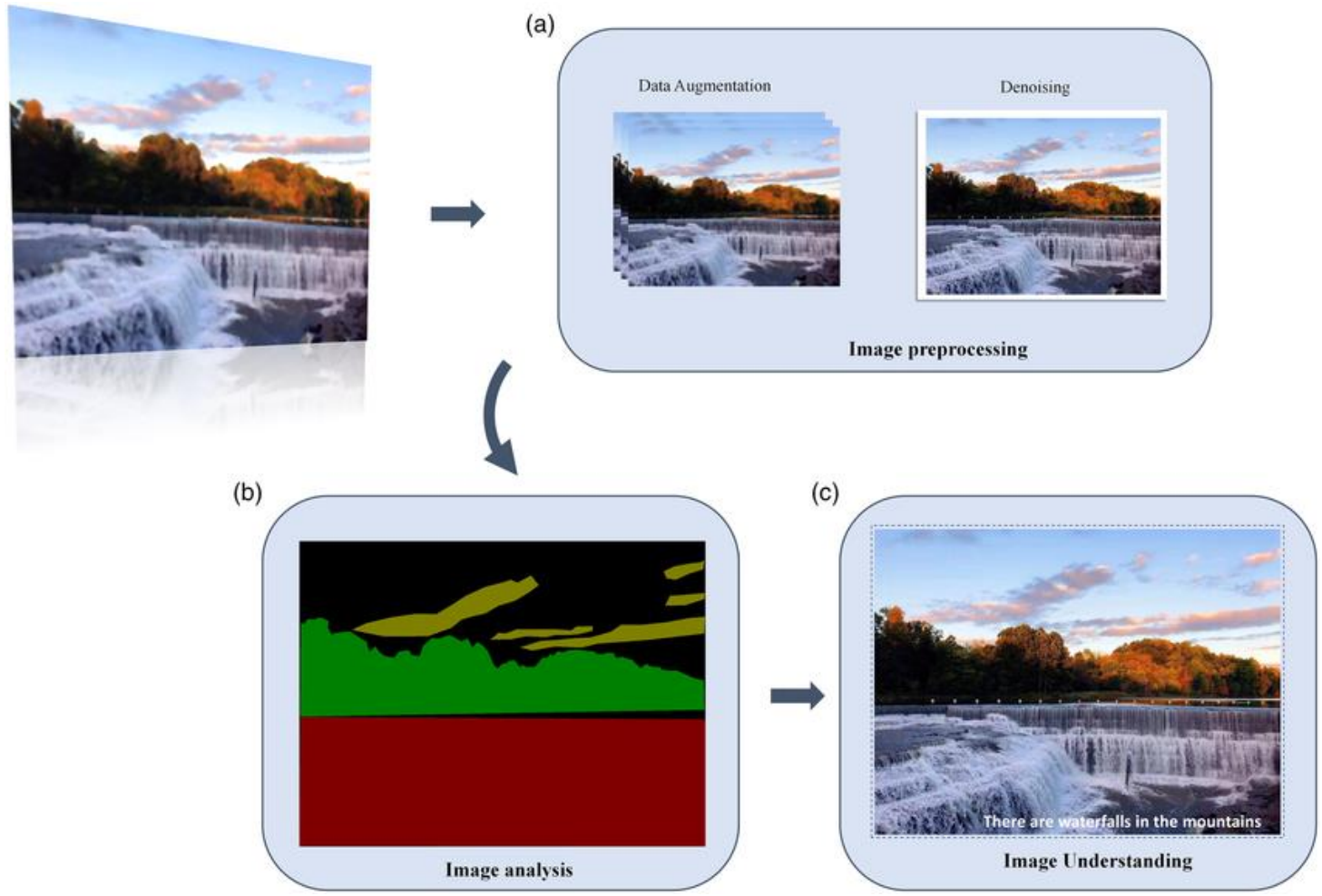
# Real-Time Video Processing in Computer Vision

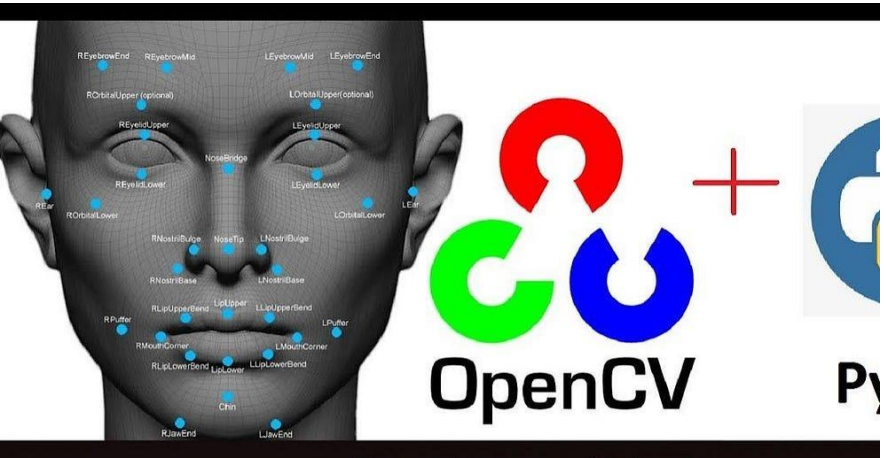
- **Real-time video processing involves analyzing and interpreting video data on-the-fly, enabling immediate decision-making and actions based on the visual input.**
- Frame-by-Frame Analysis
- Temporal Information Utilization – using multiple frames
- Applications in Security, Analytics, Autonomous Vehicles

Src: https://www.youtube.com/watch?v=y1M5dNkvCJc

# Preprocessing Pipeline Clean and Normalized Data is of Essence!

- Normalize: color, size
- Localize & crop
- Convert to intensity, normalize
- For Video might need to think about framerate




# Resources to play around:

- https://segment-anything.com/ - State of Art segmentation model developed by Meta
- https://roboflow.com/ - For developing your own models and supplemental training of existing ones
- https://chatgpt.com/ - Now supports integration with DallE, also does object detection with OCR support
- https://gemini.google.com/ - playing catchup
- https://www.heygen.com/ - VIDEO PRODUCER AI – expensive
- https://opencv.org/ - Open Computer Vision library, integrates with various languages, tooling

# Conclusion: CV goes along with other AI disciplines

Questions

Thank You!

https://github.com/ValRCS/AI_Studio_24