
**Universidad Nacional del Altiplano**
Escuela de Posgrado
Doctorado en Ciencias de la Computación

# Computer Vision

## Unit 2. Pattern recognition using deep learning:

- Semantic segmentation
- Instance segmentation
- Object detection
- Real applications

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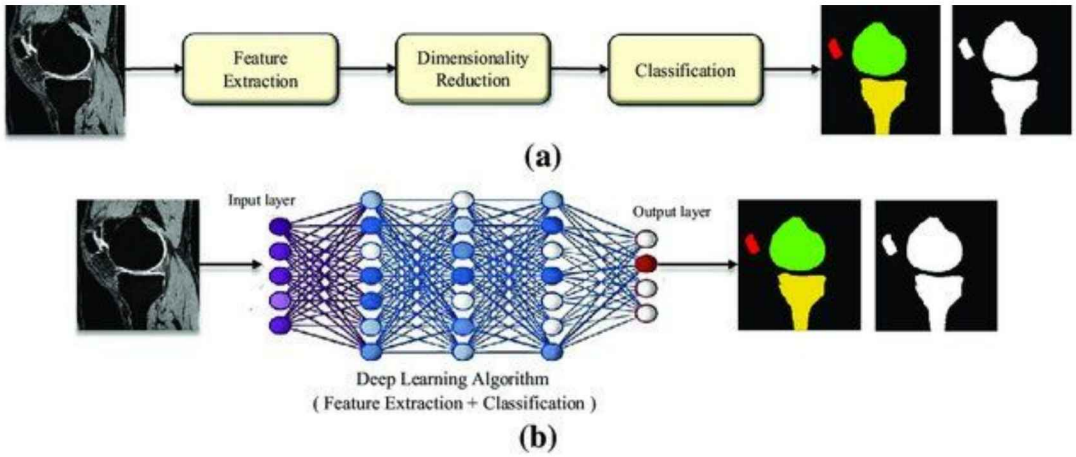
2025 - II

## Content

# Introduction

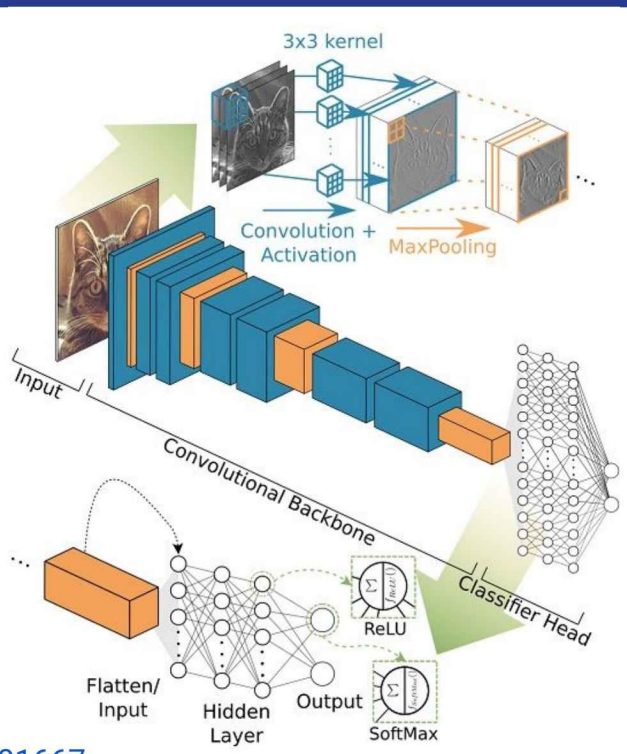



Segmentation of knee bone by using (a) **classical machine learning** and (b) **deep learning**. Feature engineering of classical machine learning involves handpicked feature representations and mapping. On the other hand, deep learning uses multiple hidden layers to extract hierarchical feature representations

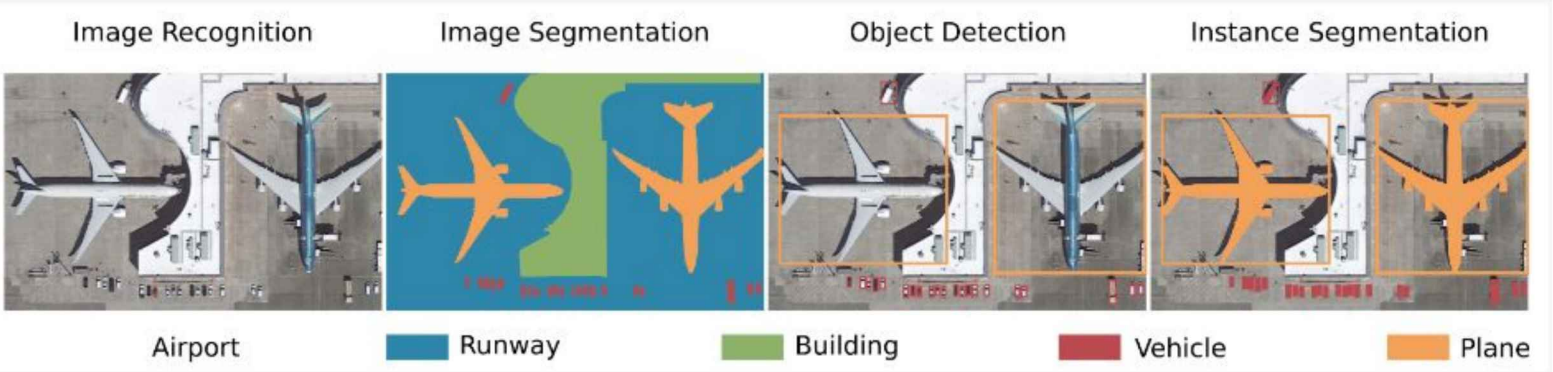
[14] https://doi.org/10.1007/s10462-020-09924-4



# Introduction




[15] https://doi.org/10.3390/rs12101667




[15] https://doi.org/10.3390/rs12101667



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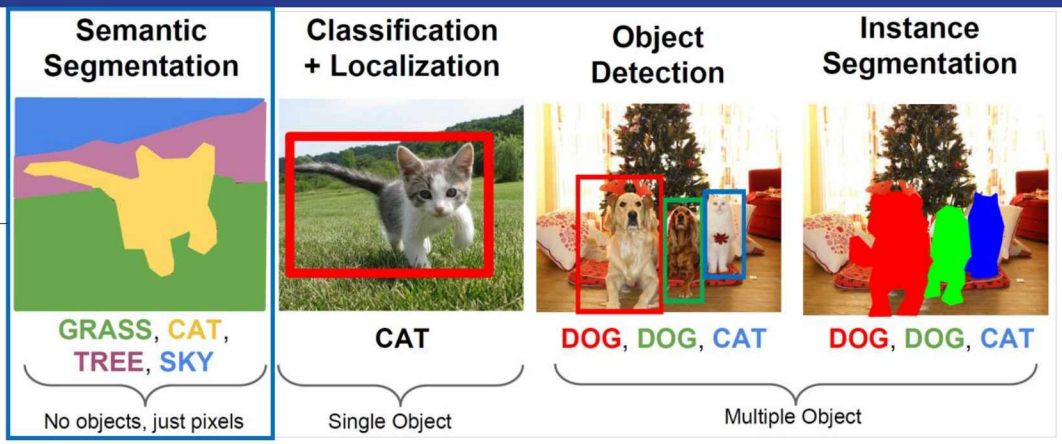
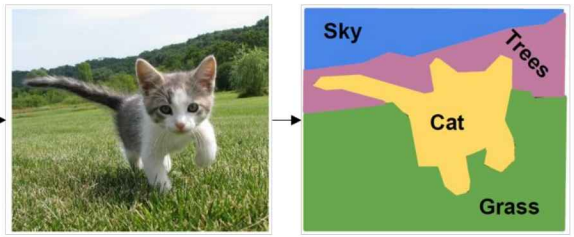
## Semantic Segmentation



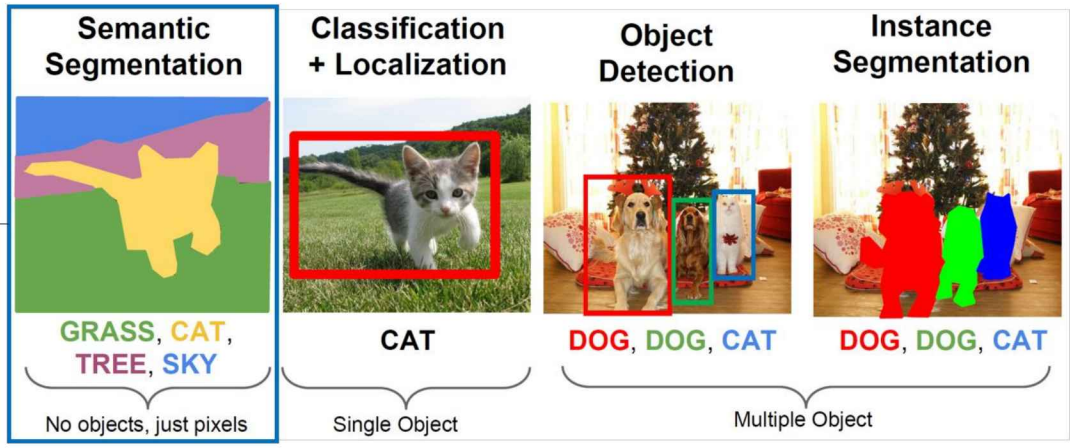



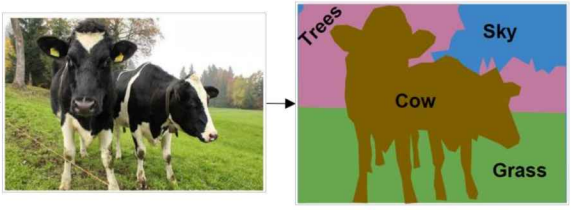

- Label each pixel in the image with a category label.
- Don't differentiate instances, only care about pixels.

https://oi.readthedocs.io/en/latest/computer_vision/segmentation/segmentation.html



## Semantic Segmentation

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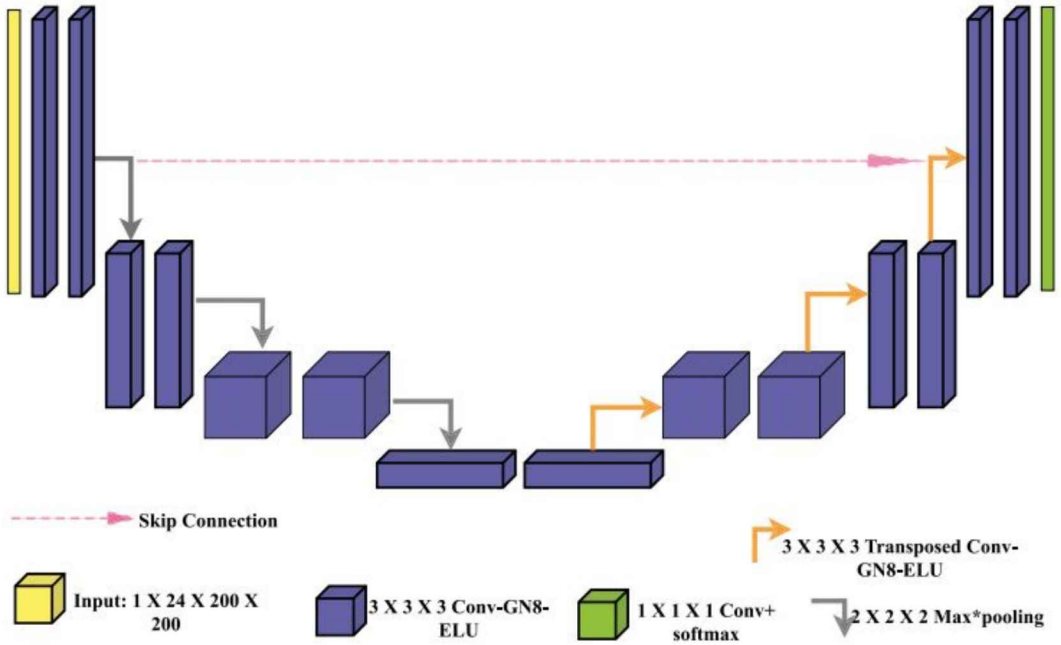
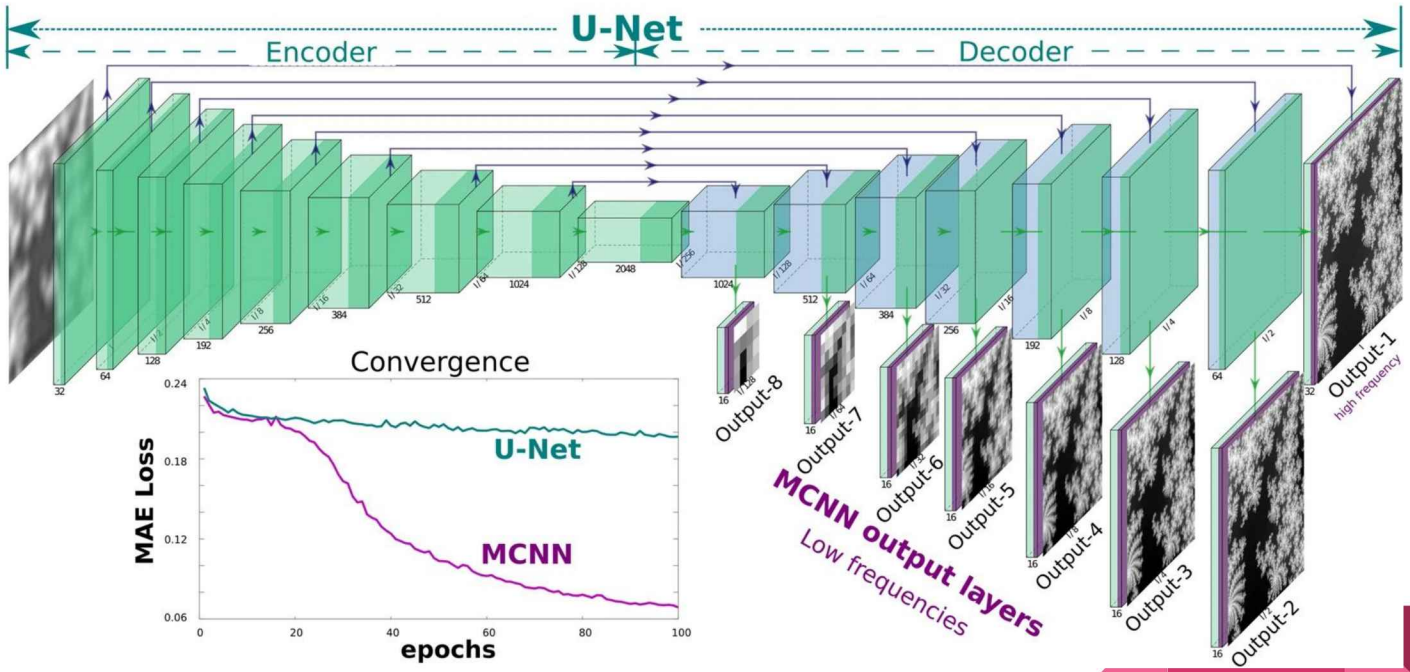
## Semantic Segmentation - UNet




[16] https://doi.org/10.1016/j.neunet.2023.11.006

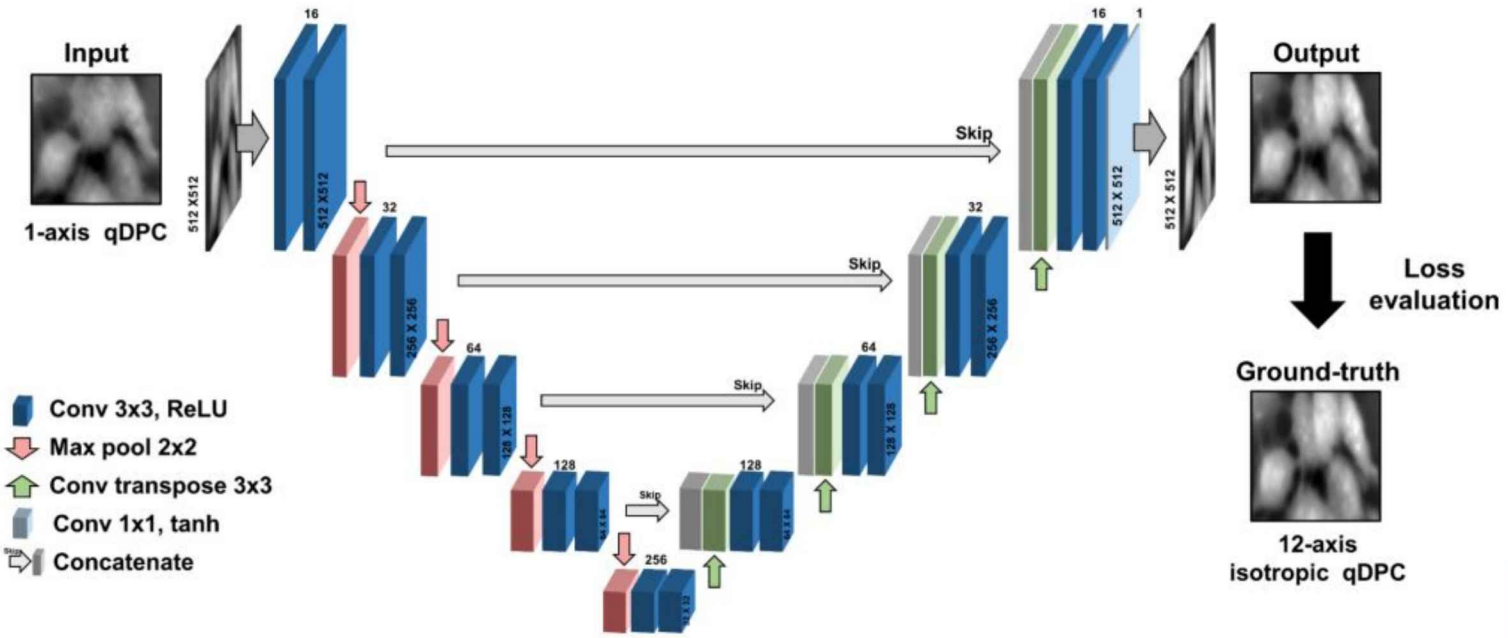


## Semantic Segmentation - UNet




[17] https://doi.org/10.1038/s41598-020-62484-z

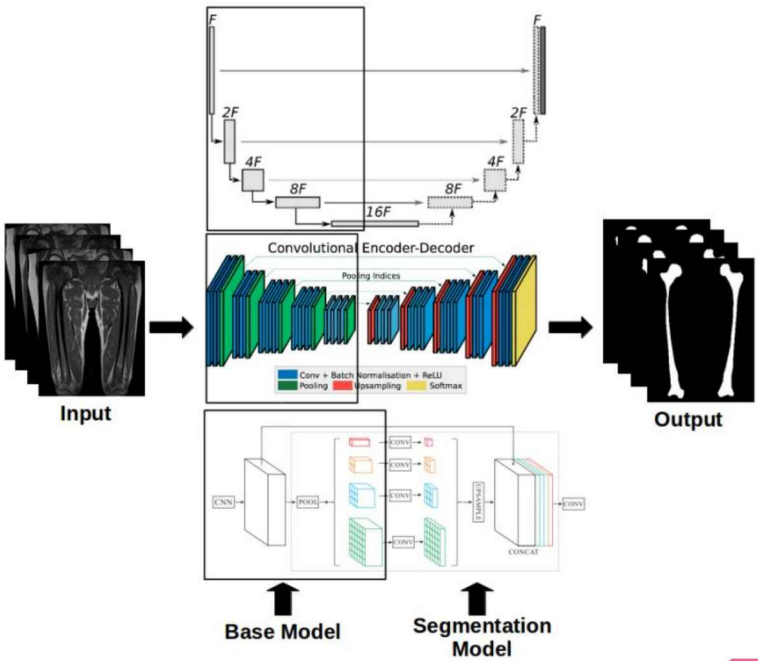
## Semantic Segmentation - UNet




[18] https://doi.org/10.1109/TMI.2021.3091207



## Semantic Segmentation - UNet




[19] http://dx.doi.org/10.1109/TENCON50793.2020.9293750

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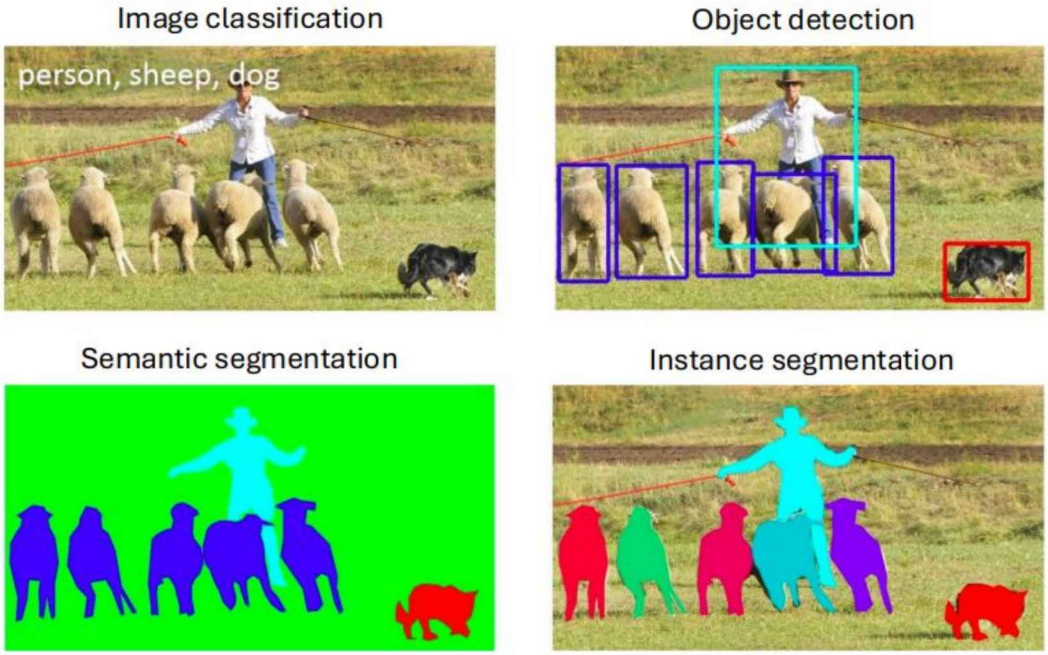
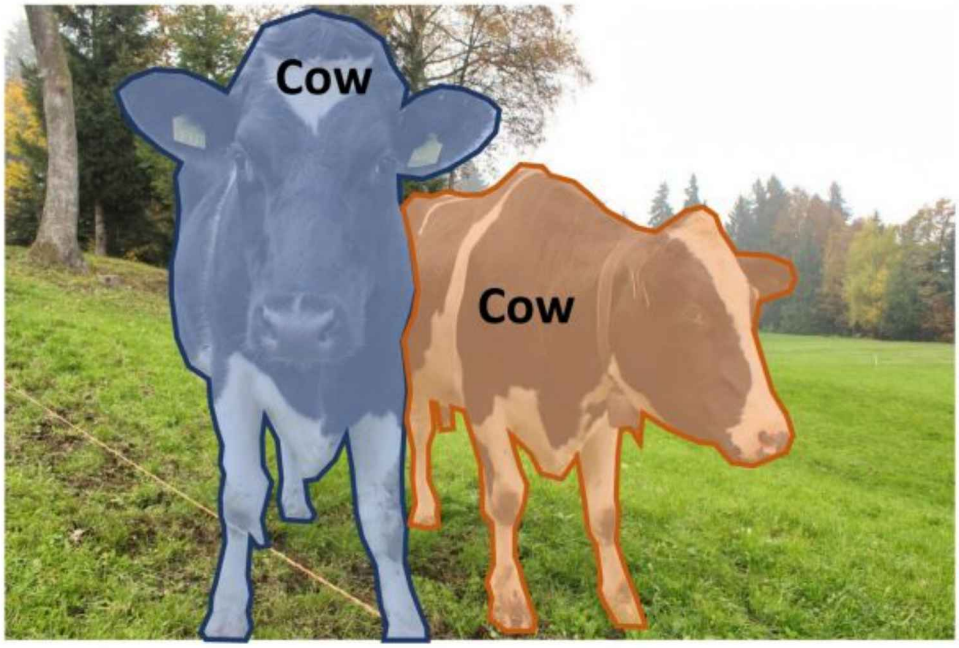
## Instance segmentation



## Instance segmentation

**Instance Segmentation**: Detect all objects in the image, and identify the pixels that belong to each object (Only things!)

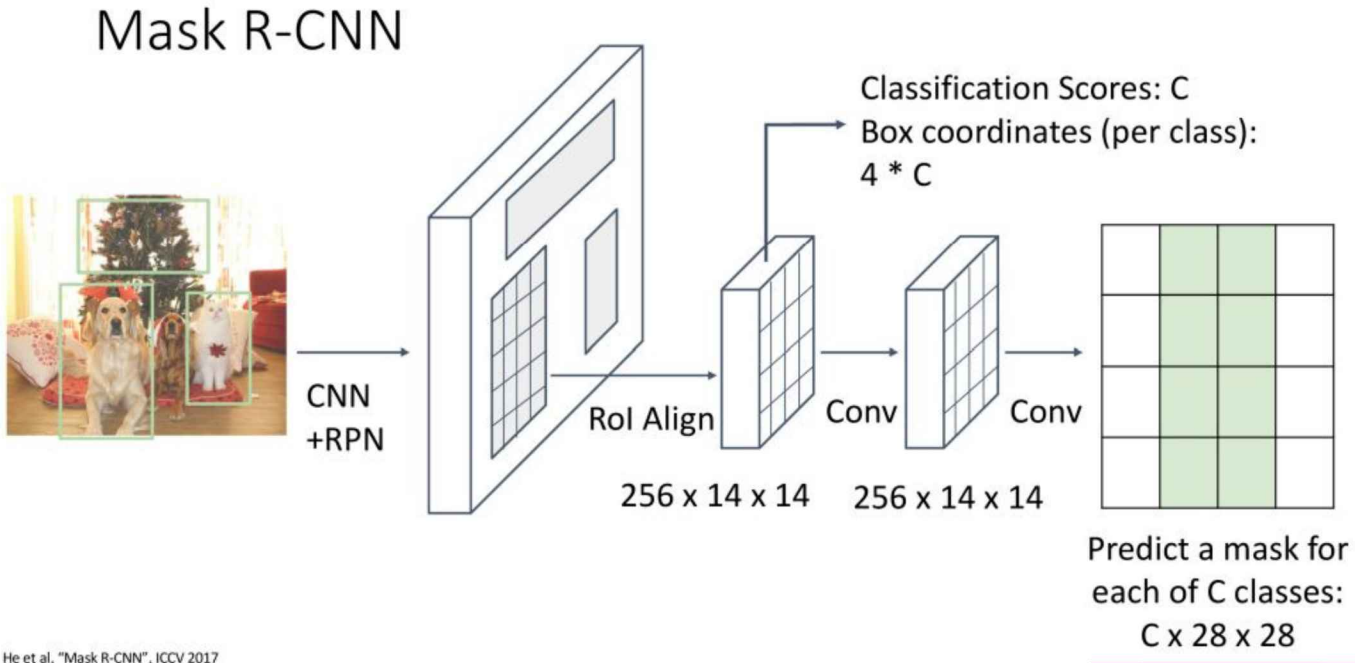
**Approach:** Perform object detection, then predict a segmentation mask for each object!




https://oi.readthedocs.io/en/latest/computer_vision/segmentation/segmentation.html

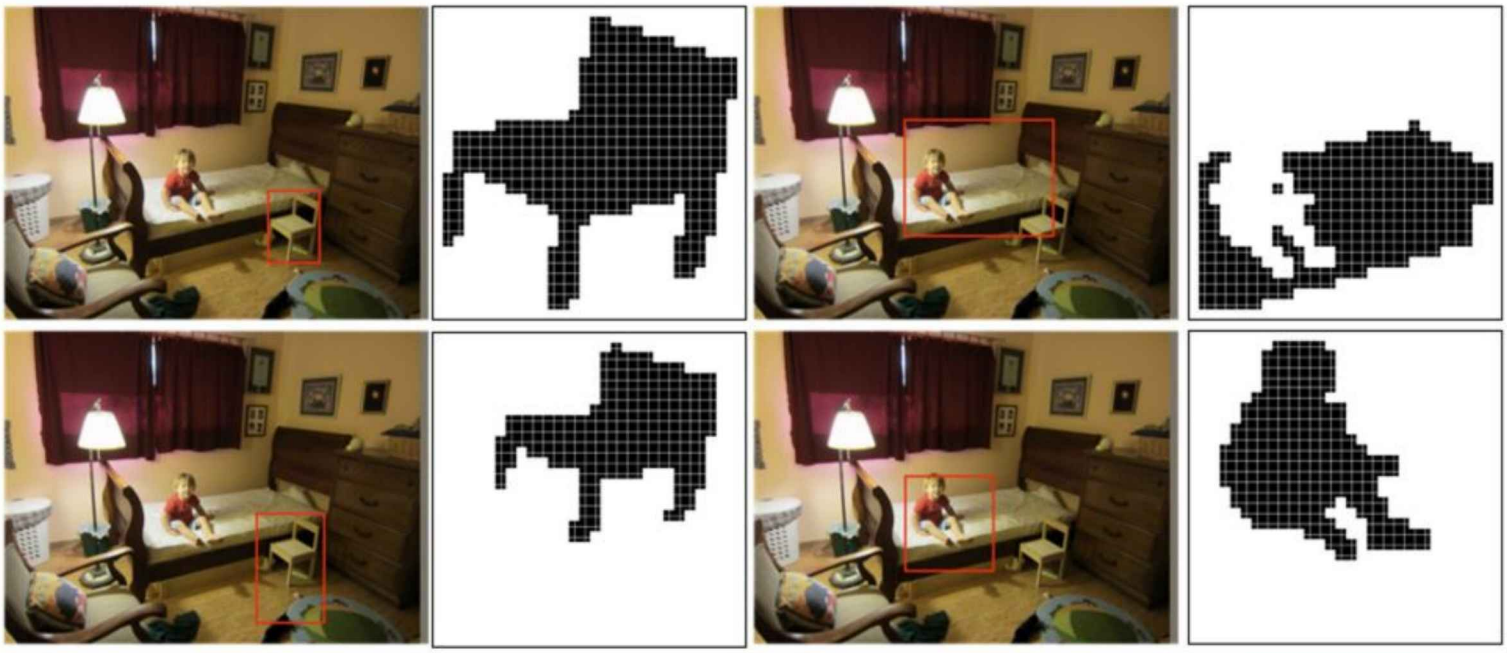


## Instance segmentation: Mask R-CNN




He et al. "Mask R-CNN". ICCV 2017

## Instance segmentation: Mask R-CNN - Examples Training Targets



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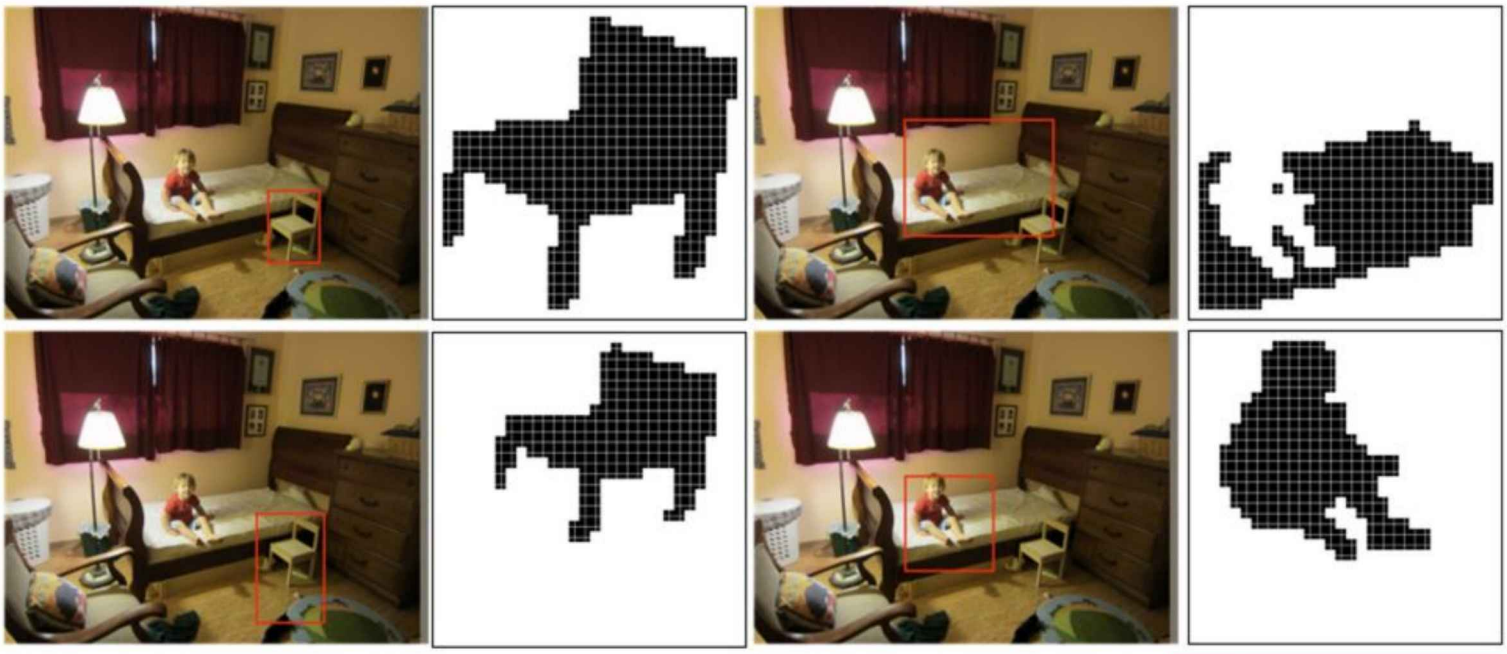
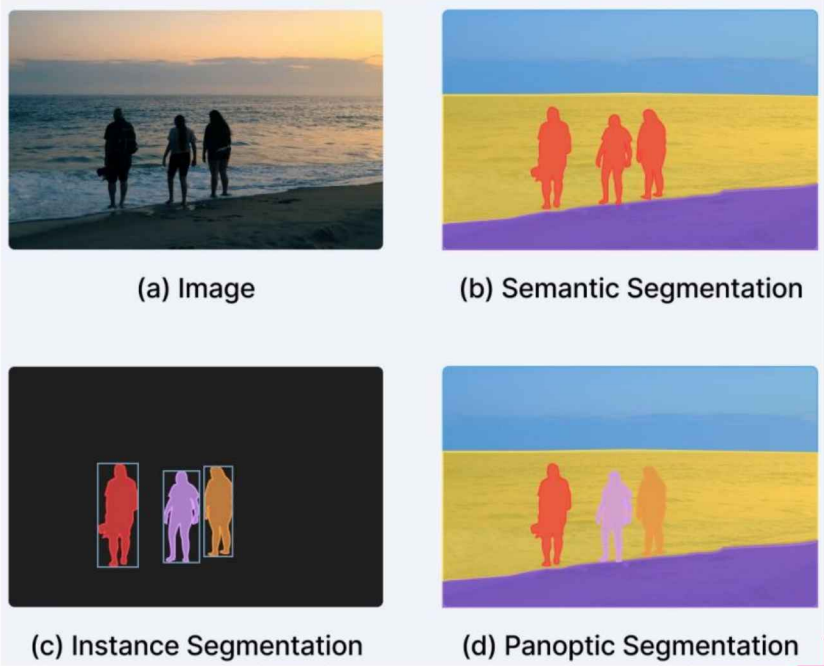


https://oi.readthedocs.io/en/latest/computer_vision/segmentation/segmentation.html

## Panoptic Segmentation



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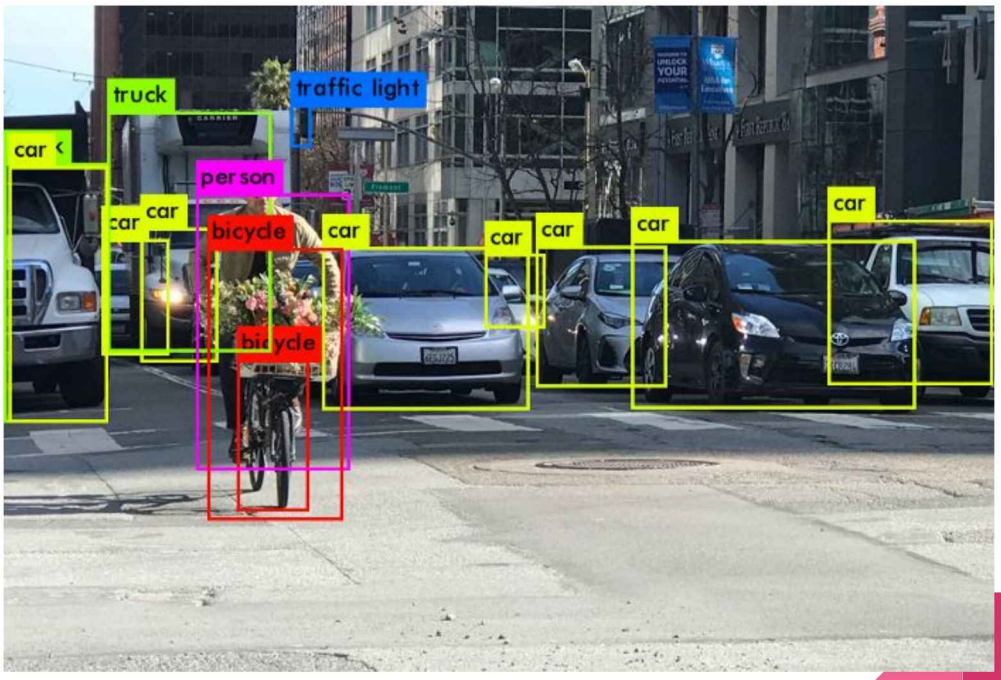
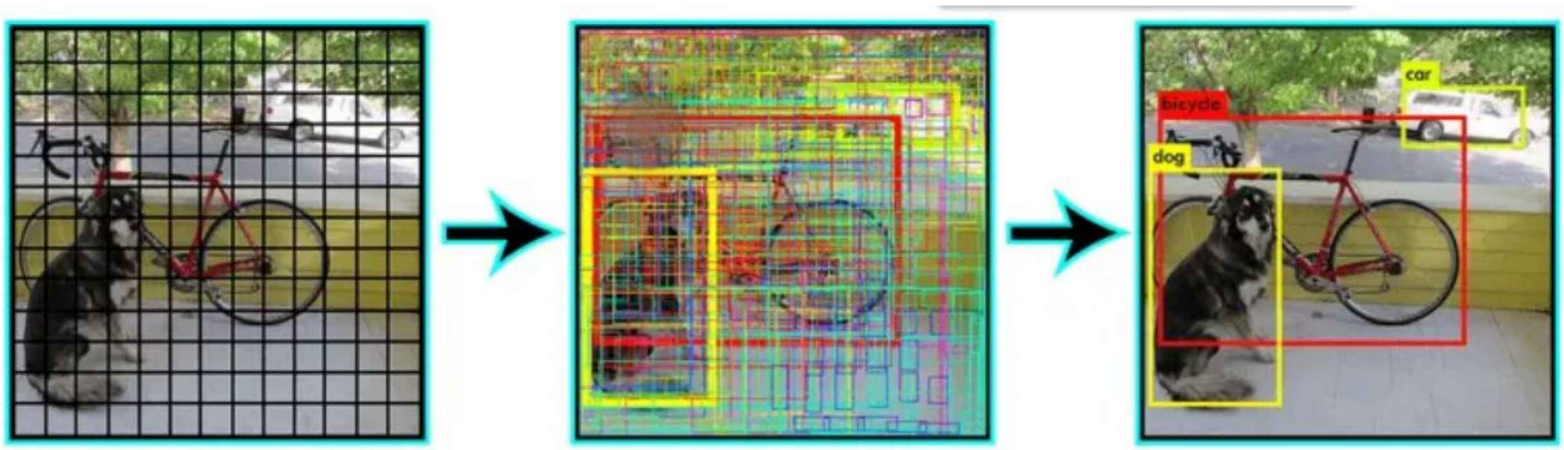
## Object detection - Yolo




https://medium.com/analytics-vidhya/yolo-explained-5b6f4564f31



## Object detection - Yolo

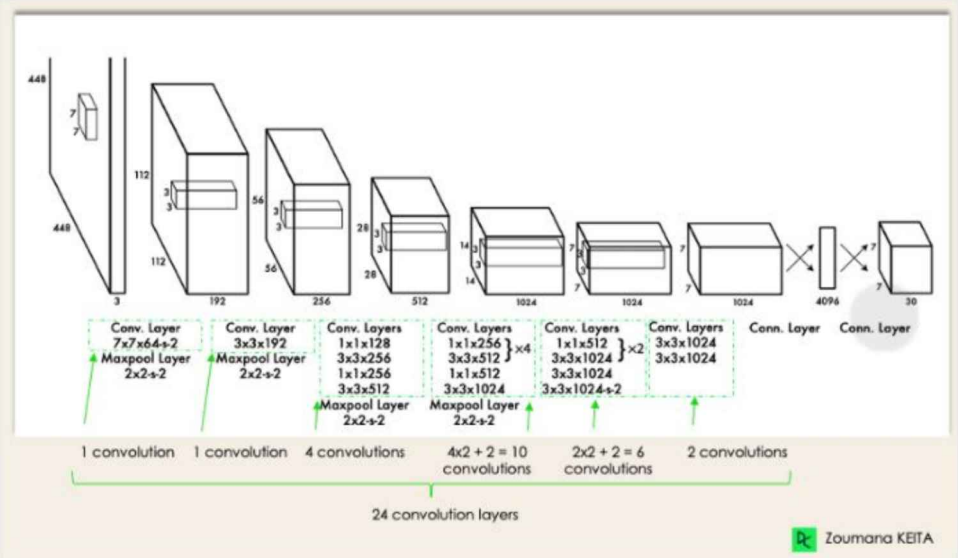



How YOLO algorithm helps in object detection?

https://www.labellerr.com/blog/why-is-the-yolo-algorithm-important/

# Object detection - YOLO Architecture

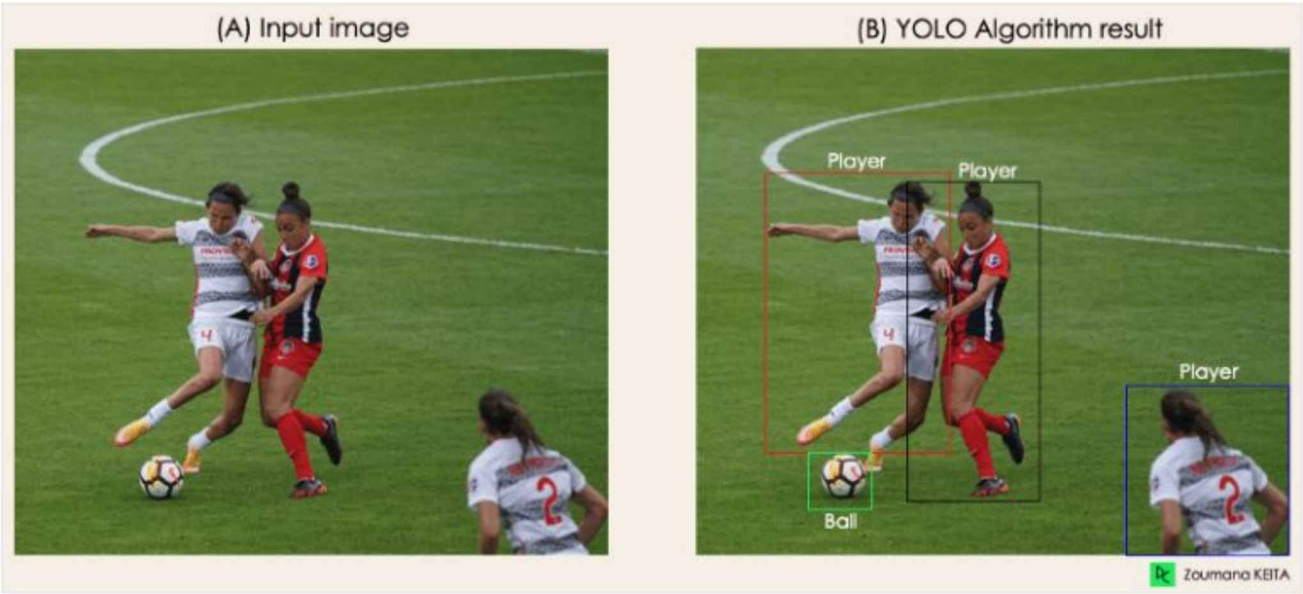
YOLO architecture is similar to GoogleNet. As illustrated below, it has 24 convolutional layers, four max-pooling layers, and two fully connected layers.




https://www.datacamp.com/blog/yolo-object-detection-explained



# Object detection - Yolo

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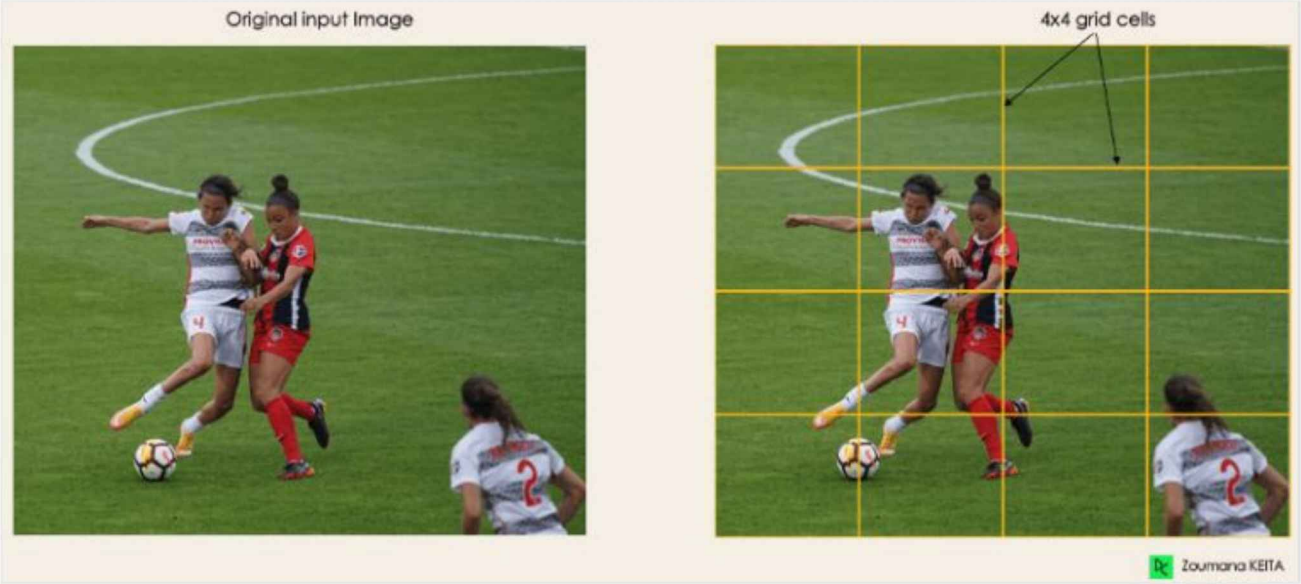


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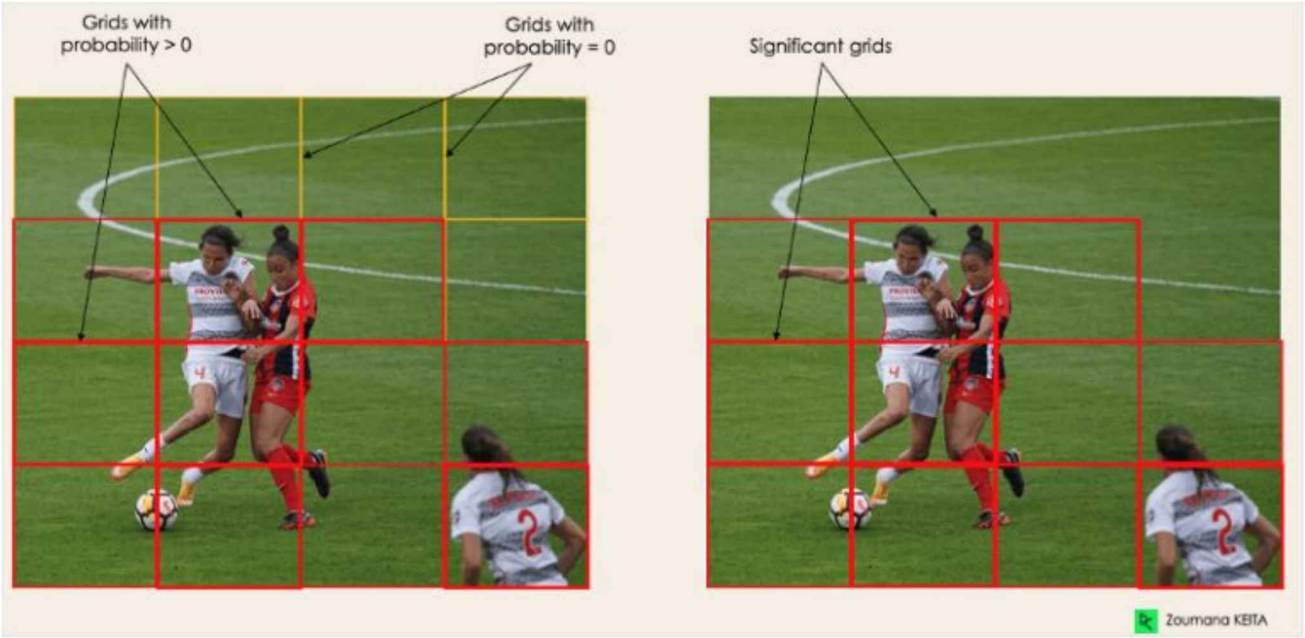


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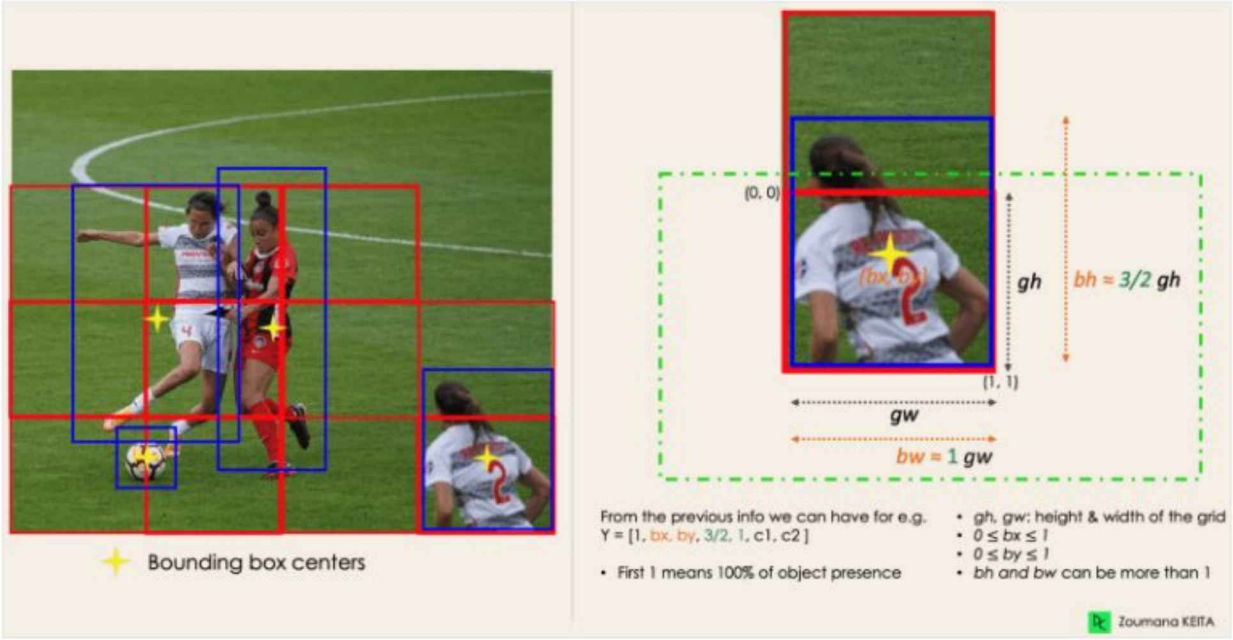
## Object detection - Yolo

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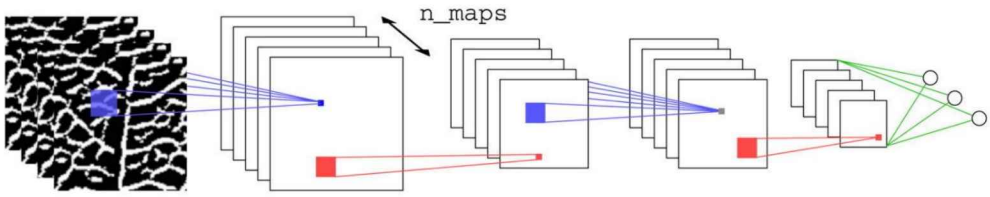
## Deep learning for plant identification using vein morphological patterns

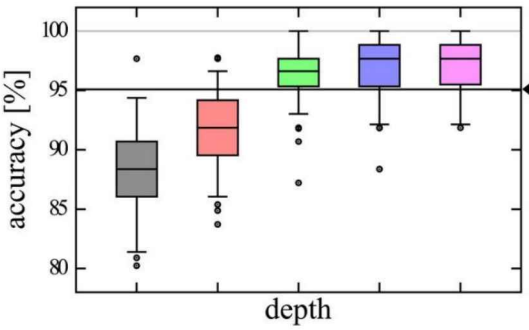
original image

vein segmentation



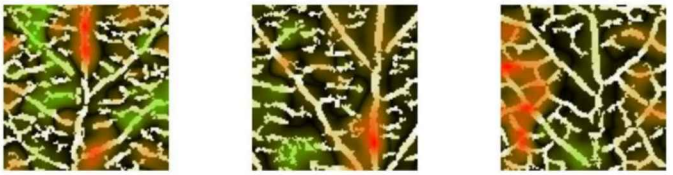

central patch

convolutional neural network




dataset's state-of-the-art accuracy

improved accuracy



relevant patterns visualization

[20] https://doi.org/10.1016/j.compag.2016.07.003



## Occlusion-Free Road Segmentation Leveraging Semantics for Autonomous Vehicles

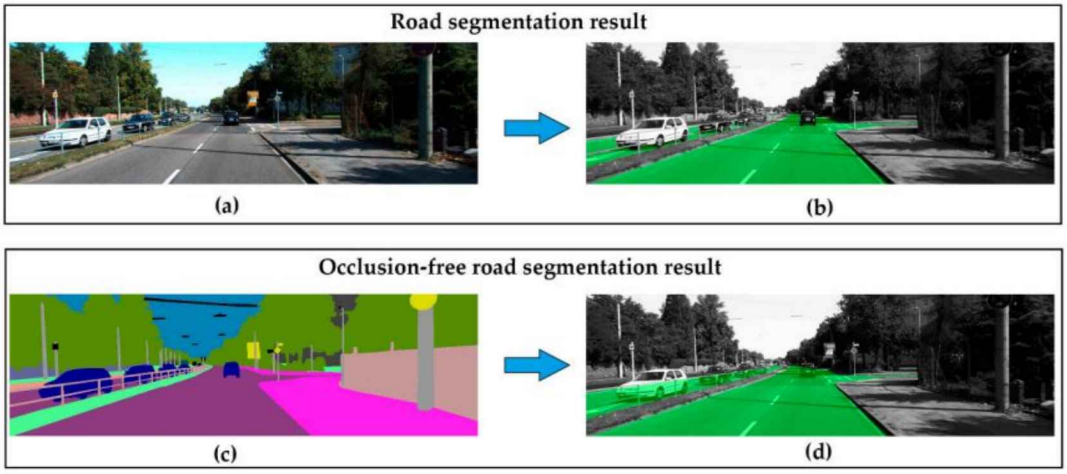
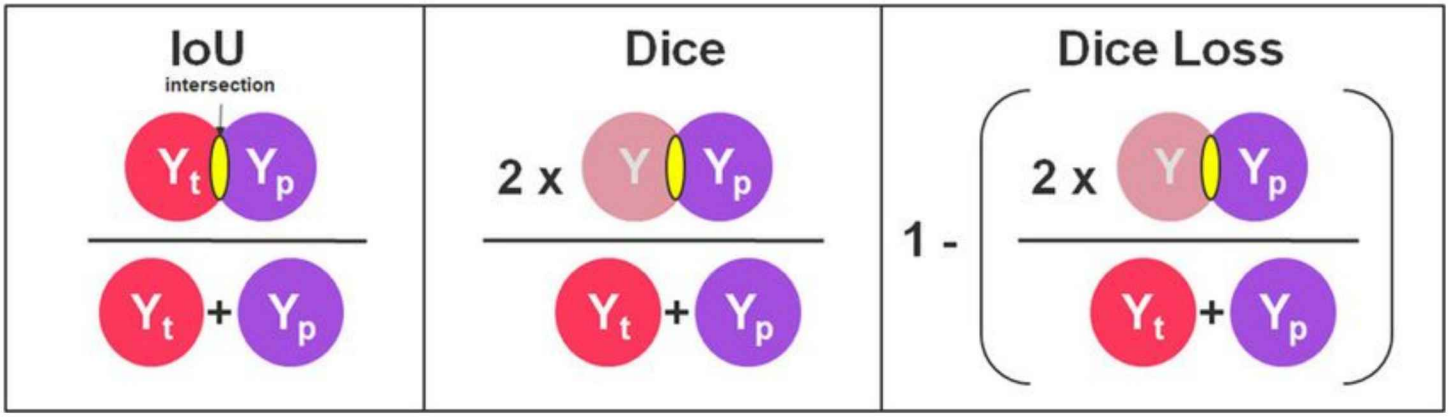



**Figure 1.** Comparison of road segmentation and proposed occlusion-free road segmentation. (**a**) RGB image; (**b**) visualization of the results of road segmentation; (**c**) visualization of the semantic representation of the scene, which could be obtained by semantic segmentation algorithms in real applications or human annotation in training phase; (**d**) visualization of the results of the proposed occlusion-free road segmentation. Green refers to the road area in (**b**) and (**d**).

[21] https://doi.org/10.3390/s19214711

# Metrics




[22] https://doi.org/10.1111/exsy.13588