

# Breast Mass Detection and Classification via YOLOv5

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# Outline

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# Problem Statement

# Breast Mass Detection and Classification

Breast Mass Detection and Classification means to detect the lumps from the breast mammogram and classify them into 'BENIGN' or 'MALIGNANT' mass.

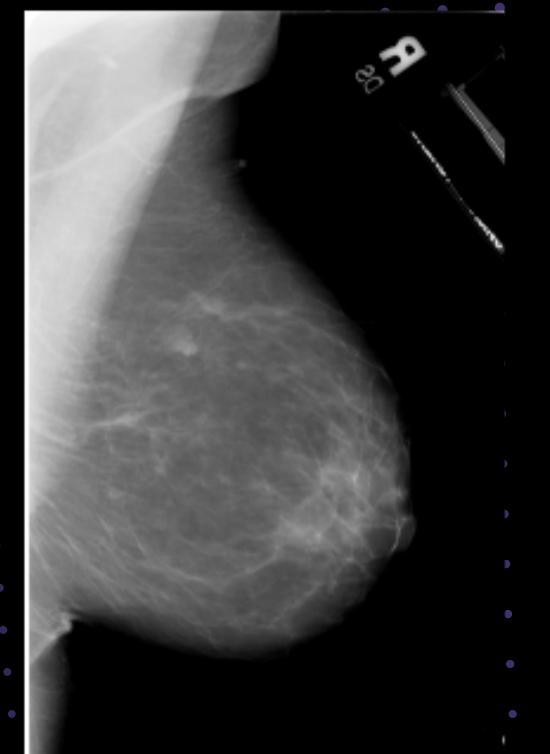
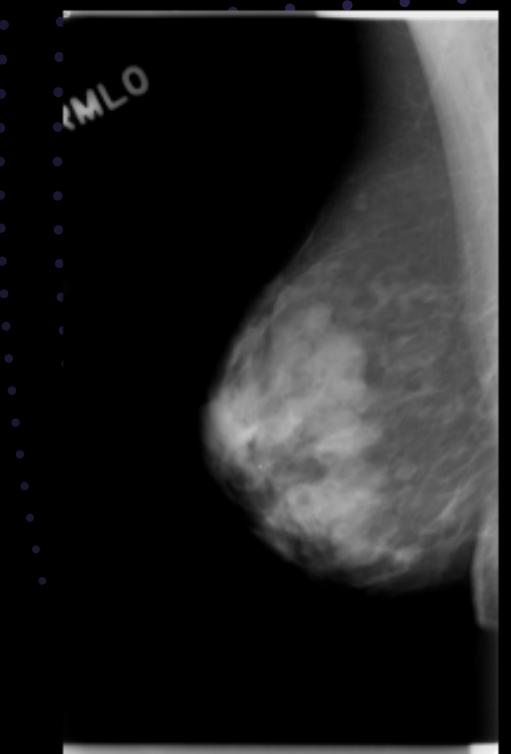
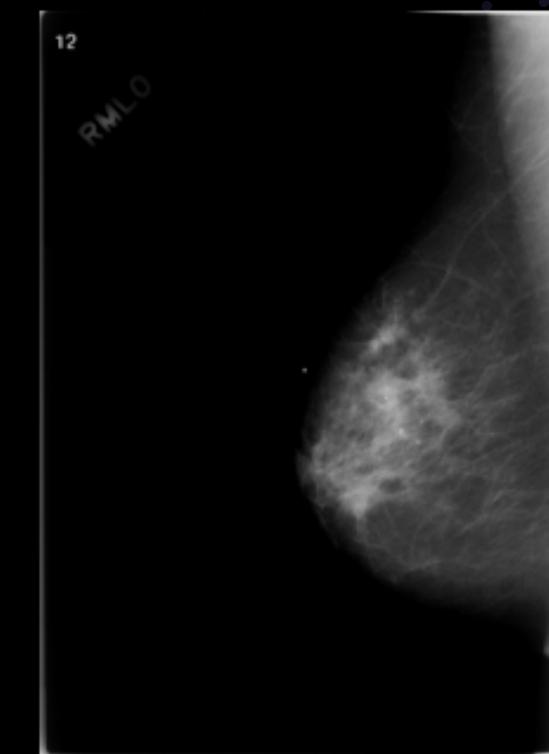
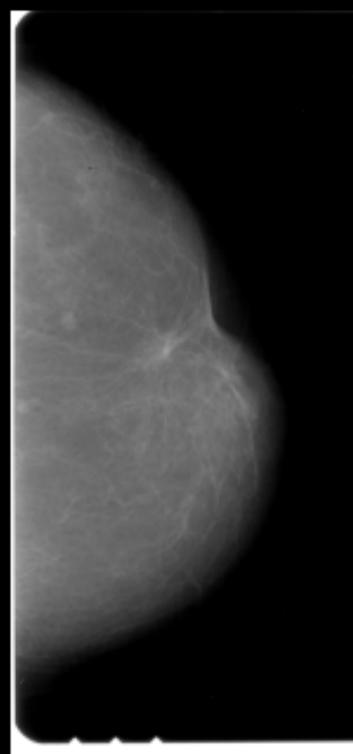
- Input
  - Breast Mammogram
- Output
  - Detected Mass' type and coordinates if its present



# Datasets

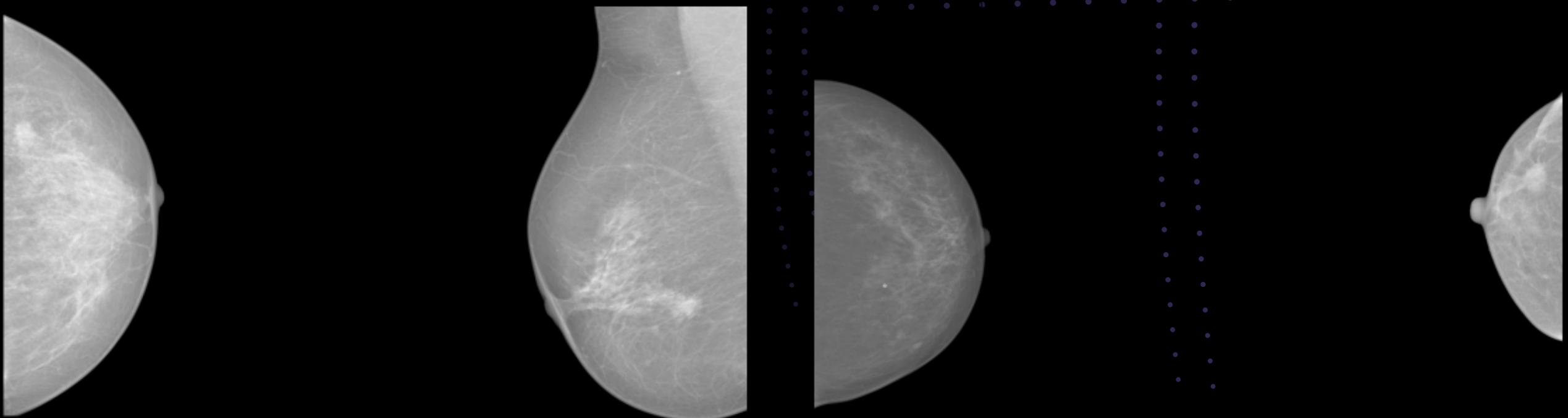
# CBIS-DDSM

- CBIS-DDSM is an updated and standardized version of the Digital Database for Screening Mammography (DDSM) dataset.
- We have taken only 1127 mammograms out of 2907 which contains masses.
- The images have an average size of 3000 x 4800 pixels and are linked to their pixel-level ground-truth for the location and type of suspicious spots.



# INbreast

- INbreast is a public dataset of images that are stored in DICOM format.
- It contains 410 mammograms where 235 cases include abnormalities in both MLO and CC views from 115 patients.
- Only those mammograms which contains masses are used which are total 107 mammograms.
- Images have an average size of 3328 x4084 pixels and come with their annotated ground-truth.



# Data Preparation

## Convert

Convert DICOM  
mammograms to  
JPEG format

## Rotate

Rotate image into 8 different  
images with random angles  
between 0 and 180

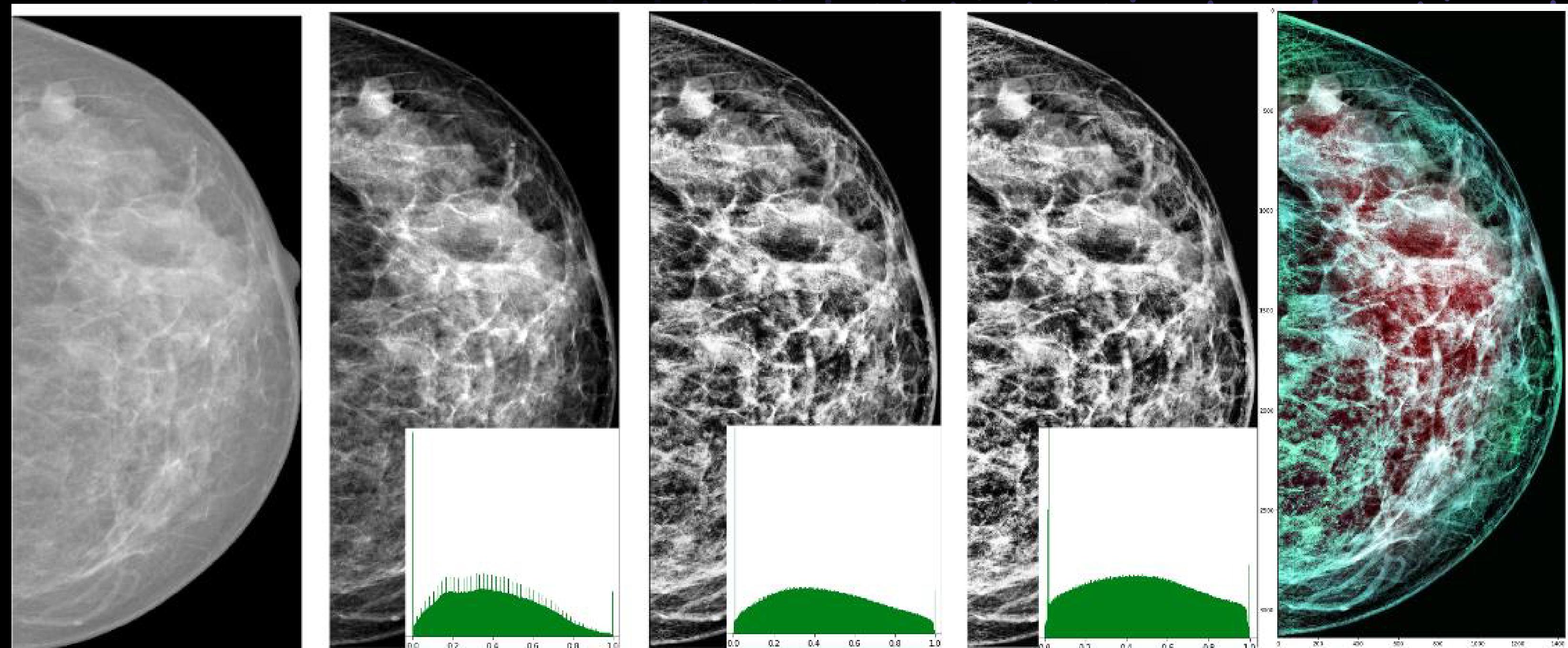
## CLAHE

Apply CLAHE  
method

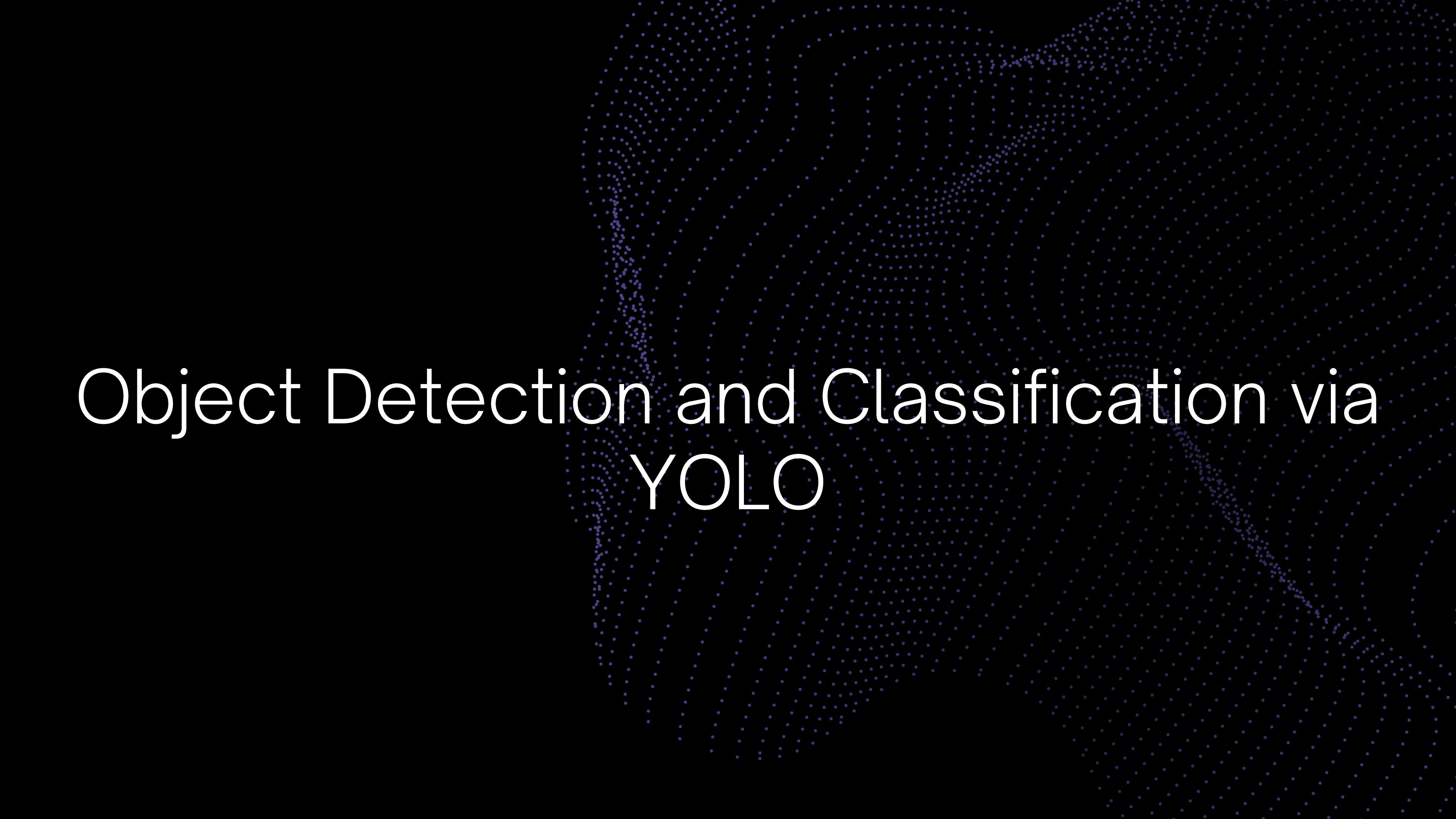
## Resize

Resize images into  
640x640

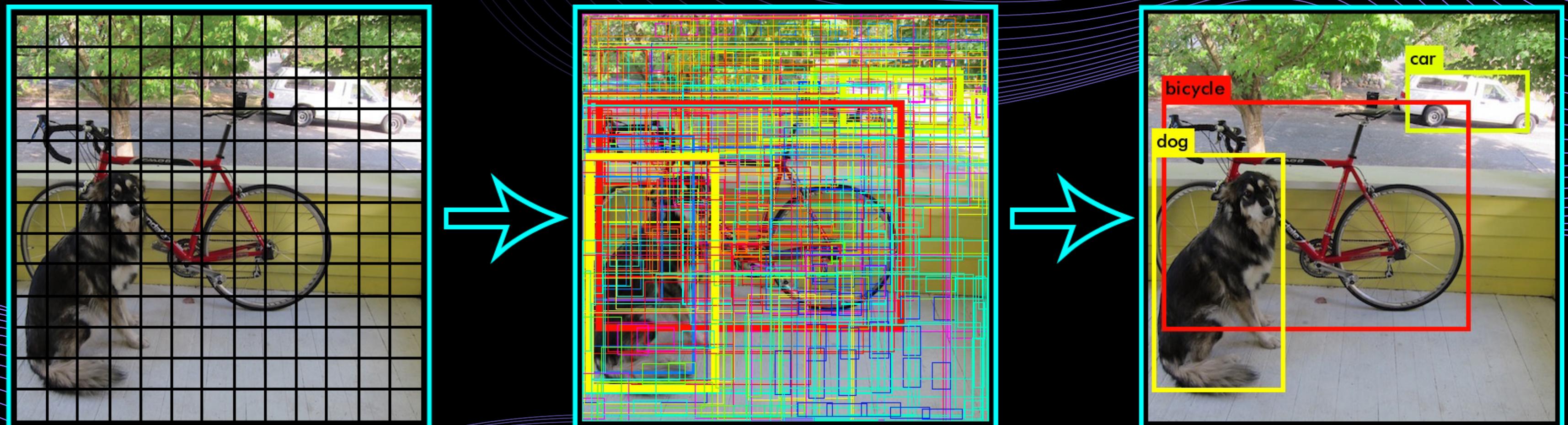
# Contrast Limited Adaptive Histogram Equalization (CLAHE)

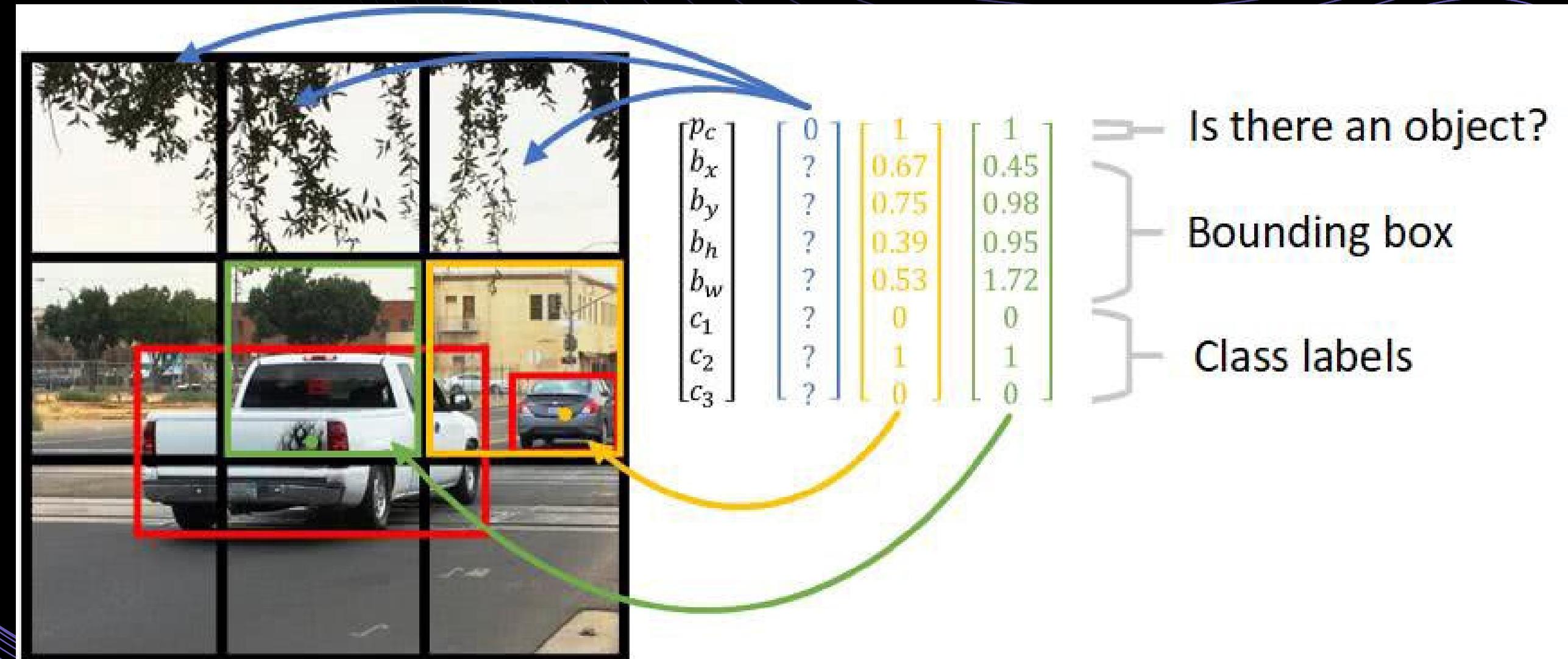


# Methodology



Object Detection and Classification via  
YOLO

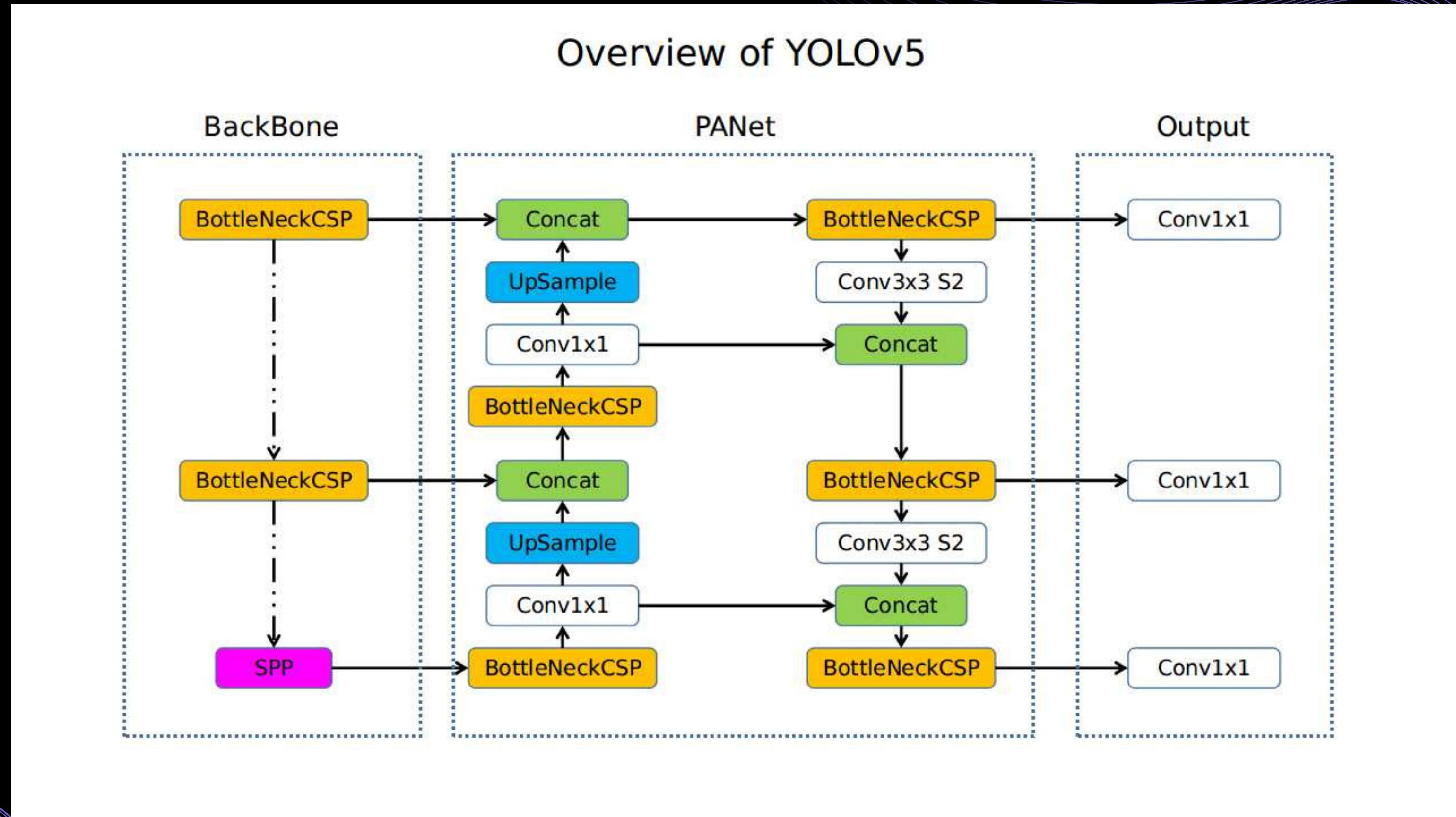




# YOLO structure

- **Backbone** : A CNN that aggregates and forms image features at different granularities. YOLOv5 uses CSP Bottleneck to formulate image features. The CSP model is based on DenseNet.
- **Neck** : A series of layers to mix and combine image features to pass them forward to prediction. YOLOv5 uses PA-NET for feature aggregation.
- **Head** : Consumes features from the neck and takes box and class prediction steps.

# Overview of YOLOv5



# Transfer Learning

- We have used the COCO models which were pre-trained on the [COCO](#) dataset for initialization of models.
- The yolov5 models were fully trained on CBIS-DDSM dataset without any fine-tuning.
- For INbreast dataset, The models were fully trained using initialization as well as the backbone of the CBIS-DDSM trained models were frozen and then trained on INbreast dataset.

# Results

# CBIS-DDSM Results

YOLOV5 MODEL	PRETRAINED	BATCH SIZE	BENIGN AP	MALIGNANT AP	MAP(%) @IOU=0.5	EXECUTION TIME(MS)
Small	COCO yolov5s	64	21.4%	41.2%	31.3%	12.3
Medium	COCO yolov5m	32	29.3%	43.3%	36.4%	25.3
Large	COCO yolov5l	20	22.9%	34.7%	28.8%	39.5
Extra Large	COCO yolov5x	16	8.53%	37.9%	23.2%	68.8

# INbreast Results

YOLOV5 MODEL	PRETRAINED	BATCH SIZE	BENIGN AP	MALIGNANT AP	MAP(%) @IOU=0.5	EXECUTION TIME(MS)
Small	COCO yolov5s	64	5.68%	9.02%	7.35%	16.2
Medium	COCO yolov5m	32	2.88%	11.7%	7.28%	23.4
Large	COCO yolov5l	16	5.28%	7.84%	6.56%	42.6
Extra Large	COCO yolov5x	16	3.75%	12.4%	8.07%	66
Small	CBIS-DDSM Small	128	3.86%	20%	11.9%	13.1
Medium	CBIS-DDSM Medium	114	1.04%	18.6%	9.82%	25.4
Large	CBIS-DDSM Large	64	4.11%	24.1%	14.1%	41.8
Extra Large	CBIS-DDSM XLarge	28	4.82%	11.5%	8.18%	68.7

# Work

- Done Image preprocessing in data preparation and generated extra data using data augmentation
- Trained all four yolov5 models with different parameters to evaluate the best suitable model
- Applied Transfer learning while training the models.

# Learnings

- Object detection
- YOLO algorithm
- CLAHE method
- Hyperparameter optimization
- Transfer Learning

# References

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Thank You

