REAL TIME PERSONAL PROSPECTIVE EQUIPMENT DETECTION

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (623.504, 22W)

PROJECT PRESENTATION

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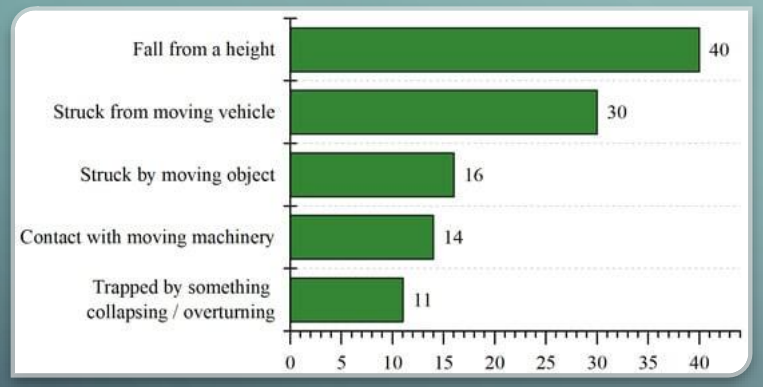
AGENDA

I. Learning Task
   i. Why it is important?
   ii. What is object detection?
   iii. Object detection applications
II. Preliminary Data Analysis
III. Literature Overview
IV. Performance Measure
V. YOLO
   i. Modelling YOLOv5
   ii. Modelling YOLOv7
VI. Results and Conclusions

LEARNING TASK

- Real time personal prospective equipment detection.
- Object Detection Task (Computer Vision)
- Hard Hat

WHY IT IS IMPORTANT?



- The most common cause of construction accidents is falling or becoming stuck in equipment, as well as collisions.
- The majority of these injuries can be avoided by using proper protective equipment.

WHAT IS OBJECT DETECTION

Object detection is a type of computer vision approach that detects occurrences of semantic items in digital photos and movies.

There are two types of object detection

- Image Level: Detecting presence of an object in an image.
- Instance Level: Additionally locates each occurrence of the object and drawing a bounding box around it.

Real time algorithms such as

- Faster R-CNN, YOLO, SSD, etc.

OBJECT DETECTION APPLICATIONS

Self-driving cars

Surveillance and security

Object tracking in videos

Augmented Reality (AR)

Medical imaging

Retail and e-commerce

PRELIMINARY DATA ANALYSIS

label	location
1	0.5456730769230769 0.3918269230769231 0.03125 0.038461538461538464
1	0.7307692307692307 0.39903846153846156 0.038461538461538464 0.04326923076923077
1	0.6730769230769231 0.40865384615384615 0.03365384615384615 0.038461538461538464
0	0.2980769230769231 0.41346153846153844 0.036057692307692304 0.04567307692307692
0	0.8942307692307693 0.3870192307692308 0.03125 0.04326923076923077
0	0.4423076923076923 0.39663461538461536 0.036057692307692304 0.040865384615384616

- Obtained from {roboflow}: Hard Hat Workers Dataset
- Shared by Northeastern University – China
- Totally 7035 Images
  - Train: 3688
  - Validation: 1581
  - Test: 1766
- 2 Classes
  - 0 – Head (Without Hard Hat)
  - 1 – Hard Hat
  - 2 – Person (Removed)

LITERATURE REVIEW

- Focus on developing Computer Vision algorithms in real time.
  - COVID-19 Real Time PPE Deteciton with YOLOv4 - mAP 79%
  - Deep Learning for Site Safety: Real-Time Detection of Personal Protective Equipment YOLOv3 with different methods - mAP 72.3%
  - Fast Personal Protective Equipment Detection for Real Construction Sites Using Deep Learning Approaches YOLOv5s - mAP 82.65
- Focus on developing wearable devices for detection.

PERFORMANCE MEASURE

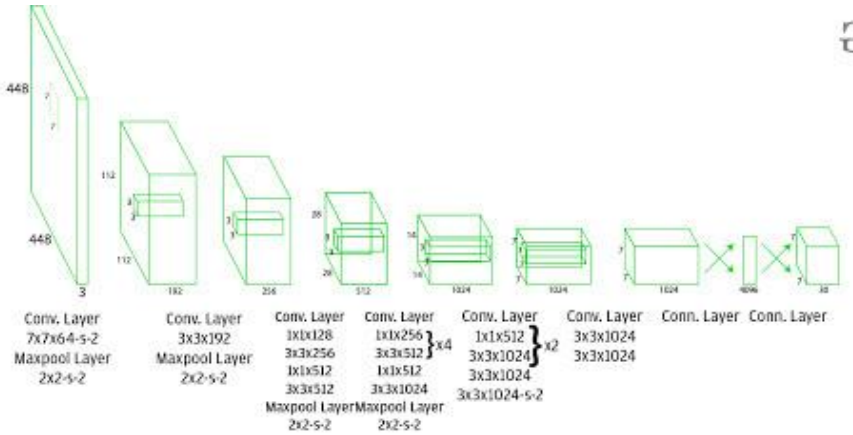
$$mAP = \frac{1}{n}\sum_{k=1}^{k=n} AP_k$$

$AP_k =$ the AP of class k

$n =$ the number of classes

- Purpose: Accuracy and efficiency
- Mean Average Precision (mAP): Gives overall measure of the accuracy.
- Processing Speed: Measure of the time taken by algorithm to process an image.

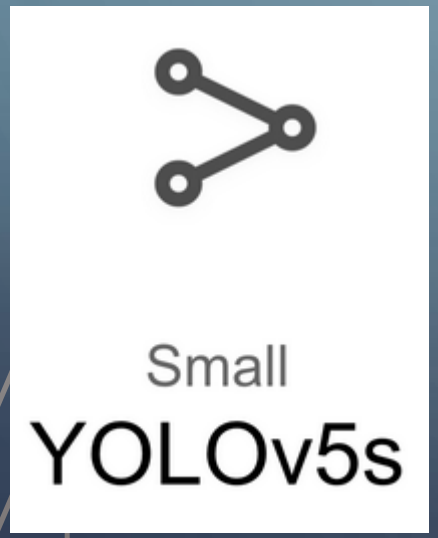
WHY AND WHAT IS YOLO (YOU ONLY LOOK ONCE) ARCHITECTURE

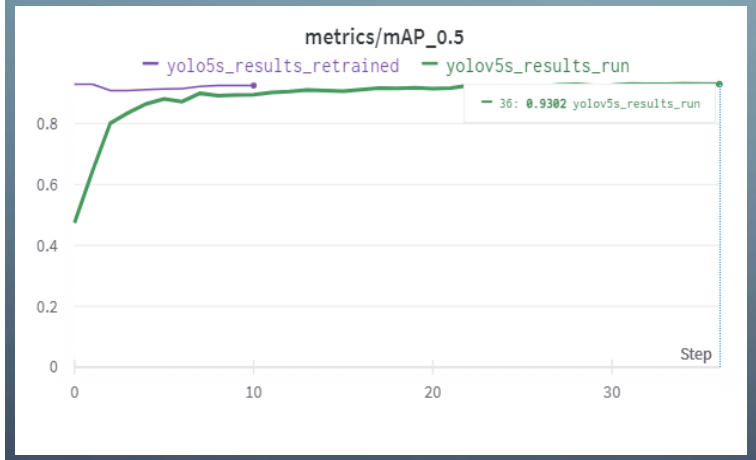


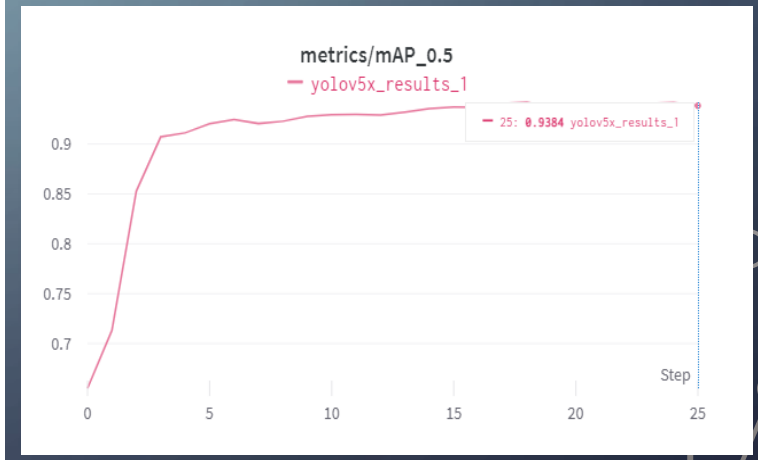
- Fast and Efficient
- Uses single neural network to predict bounding boxes and class probabilities directly from full images in one evaluation.
- Allows to run in real time on standard hardware such as CCT.
- Scalable architecture and simple to implement.
- YOLOV_x or YOLOV_s

MODELING YOLOV5

- YOLOV5S
  - Best mAP – 0.93
- YOLOV5X
  - Best mAP – 0.93 (non-completed)

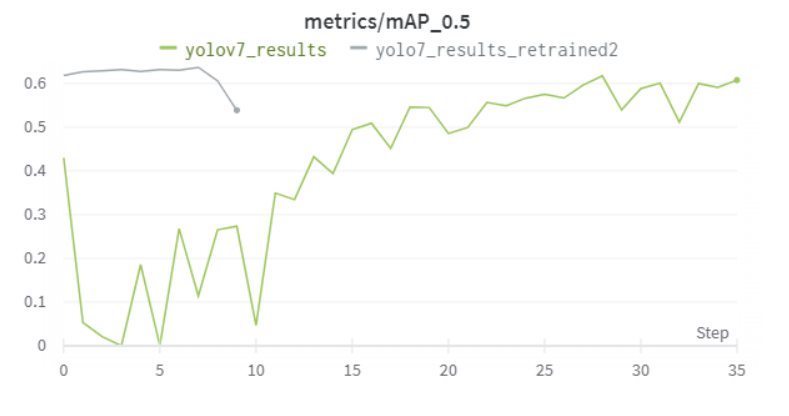


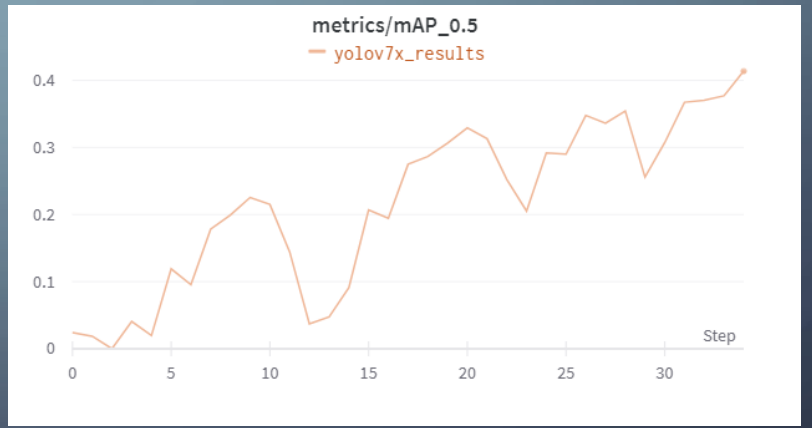




MODELING YOLOV7

- YOLOV7
  - Best mAP – 0.61
- YOLOV7X
  - Best mAP – 0.41 (non-completed)





RESULTS

- X models are so complex, and they are not fast as much as base models.
- v5 models are more accurate. (Research shows that v7 is much more accurate.)
- v5s model is the fastest (it depends on the system)
- v5s model is the optimal with new starting (fast and accurate)

THANK YOU FOR LISTENING