
# Data Analytics 4 - Project

## Yolo - algorithm with use case

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# Content

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- Introduction
- How YOLO works
- Types of YOLO
- Use case
- Model Description and Visualisation
- References
- Q&A

# Introduction

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- You Only Look Once (YOLO)  is an object detection algorithm
- Four versions - v1 in May 2016, v2 in December 2016, v3 in April 2018, v4 in April 2020
- Does not use region proposal based approach like the R-CNN family
- Developed using the Darknet framework
- Github Repo for this project work : https://github.com/rbewoor/DataAnalytics4_Project

# How YOLO works

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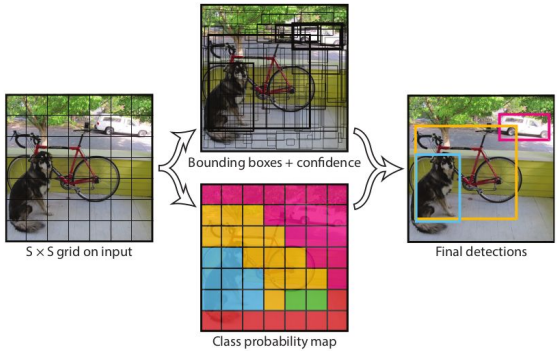
- Divides image into a grid of size S x S where S is an integer
- Each pixel evaluated as possible center point of an object
- All detections are evaluated in one pass - very fast algorithm
- Model is trained to identify C classes of objects
- B is the number of Bounding Boxes detected all over the image (without threshold consideration). Five values are output for each bounding box:
  - Two values for center coordinates
  - Two values for dimensions (height and width)
  - Confidence score
- Can handle multiple bounding boxes and aspect ratios (anchor box concept)
  - Anchor boxes are predefined boxes provided by the user to Darknet which gives the network an idea about the relative position and dimensions of the objects to be detected.
  - These are calculated using the training set Objects.




Source: YOLO v1 paper

# How YOLO works

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- Usually Non-max suppression used to remove redundant detections
- Total detections per image = ( S x S) * ( ( B * 5 ) + C
- For example, suppose that:
    - image is divided into 3 x 3 grid (i.e. S = 3)
    - we want to detect dog, cat and bird (i.e. C = 3)
    - 10 boxes predicted (B = 10)
    - #Detections = (3 x 3) * ( ( 10 * 5 ) + 3 ) = 477
- Threshold value used for Confidence Score to evaluate acceptance of object detection

# Types of Yolo

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| Model Type | YOLO v1 | YOLO v2 (aka YOLO9000) | YOLOv3 |
|---|---|---|---|
| Salient points | 26 total (24 Conv + 2 FC)<br><br>Problem detecting small objects | 30 layers (included batch norm after every Conv)<br><br>Anchor boxes introduced<br><br>No FC present<br><br>Still poor with small objects | 106 layers<br><br>Detection on 3 scales to handle small to large object sizes<br><br>9 anchor boxes (3 per scale) |

FC: Fully connected layer

Conv: Convolution layer

YOLOv4 is very recent and not been studied in depth

# Use Case

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**Objective**:
Use the YOLO model for desired use case and explain the architecture

**Use Case**:
Present a set of new images to a pre-trained YOLO v3 model.
For each image, capture the detected **object class** and the **confidence score**.
Store information in a neo4j graph database:

- Relationship format: (i:Image)-[r:HAS]->(o:Object)
- Confidence score is a property of the “HAS” relationship
- Python script: my_yolo3_one_file_to_detect_them_all_6.py

E.g. Image123.jpg HAS the objects:

- car (score 58.98),
- person (score 98.34)
- person (score 93.23)

# Neo4j representation

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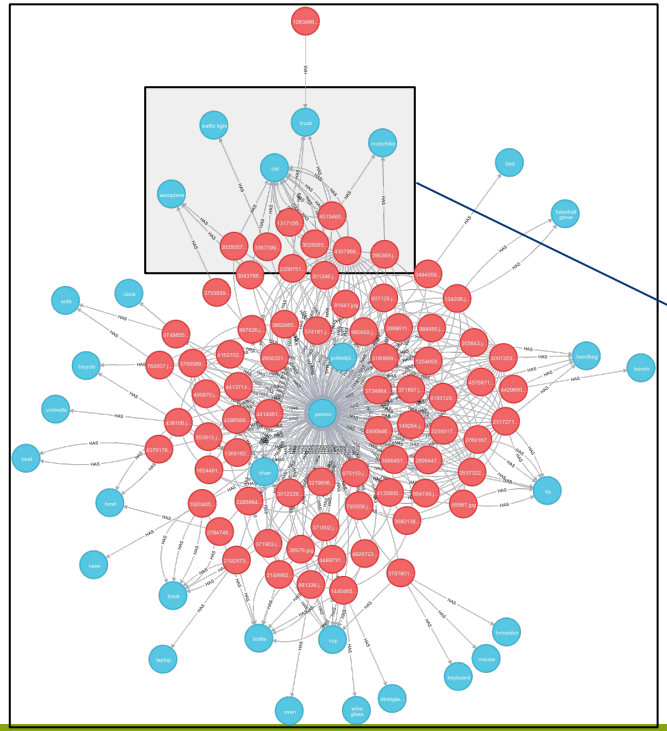
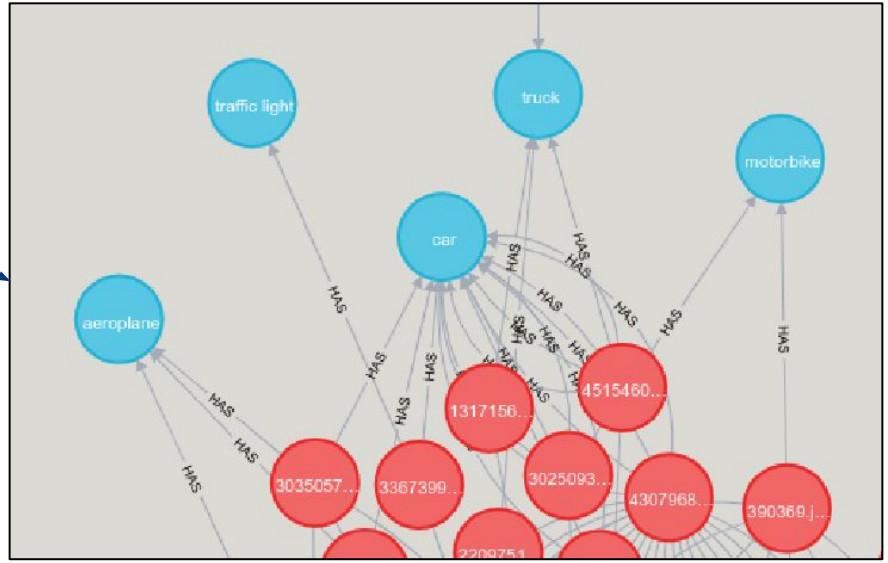
Image - HAS -> Object



Objects found in images: Traffic light, truck, motorbike, car, etc.

Many to many relationship could exist.



# Model description and visualisation

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- Darknet-53 block diagram taken from the YOLO v3 paper:
  - maps to Layers 0 - 74 of the source code

- Model description using Keras built in functions:
  - Python script: my_yolo3_model_stats_1.py
  - Textual description with model.summary function
    Link:
    https://github.com/rbewoor/DataAnalytics4_Project/blob/master/model_summary_1.txt
  - Visualisation with Plot_model function
    Link: https://github.com/rbewoor/DataAnalytics4_Project/blob/master/model_vis_1.png

| | Type | Filters | Size | Output |
|---|---|---|---|---|
| | Convolutional | 32 | 3 × 3 | 256 × 256 |
| | Convolutional | 64 | 3 × 3 / 2 | 128 × 128 |
| 1× | Convolutional | 32 | 1 × 1 | |
| | Convolutional | 64 | 3 × 3 | |
| | Residual | | | 128 × 128 |
| | Convolutional | 128 | 3 × 3 / 2 | 64 × 64 |
| 2× | Convolutional | 64 | 1 × 1 | |
| | Convolutional | 128 | 3 × 3 | |
| | Residual | | | 64 × 64 |
| | Convolutional | 256 | 3 × 3 / 2 | 32 × 32 |
| 8× | Convolutional | 128 | 1 × 1 | |
| | Convolutional | 256 | 3 × 3 | |
| | Residual | | | 32 × 32 |
| | Convolutional | 512 | 3 × 3 / 2 | 16 × 16 |
| 8× | Convolutional | 256 | 1 × 1 | |
| | Convolutional | 512 | 3 × 3 | |
| | Residual | | | 16 × 16 |
| | Convolutional | 1024 | 3 × 3 / 2 | 8 × 8 |
| 4× | Convolutional | 512 | 1 × 1 | |
| | Convolutional | 1024 | 3 × 3 | |
| | Residual | | | 8 × 8 |

# References

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# Q&A

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- Thank you.