Computer Vision and Aerial Photography for Animal Detection

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image credit: News Altas

Outlines

Introduction and Theory

- Machine Learning and Drones for Animal Conservation
- Computer Vision and Neural Network
- Object Detection and YOLO (You Only Look Once)

Methods and Results

- Implementation
- Data Collection and Training
- Live Streaming

Machine Learning and Drone for Animal Conservation

- **Animal research** requires monitoring the locations, ranges and sizes of animal populations
- Surveying cryptic, low-density animals or animals inhabiting unapproachable areas is challenging
  - --> **aerial images by drones**
- Processing data manually is inefficient and time-consuming
  - --> **object detection machine learning algorithms**
- The combination of technologies facilitate studies of **wildlife conservation**

image credit: Land Rover AFRICA Magazine

Computer Vision and Convolutional Neural Network

- **Computer vision**
  analysing and interpreting digital visual data to extract information and make predictions
- **Pattern Recognition**
  Visual data -->
  Feature profile for that object -->
  Recognition
- Great applicability and future potential
- Remarkable breakthrough in the past few years by using **convolutional neural networks**

Computer Vision and Convolutional Neural Network

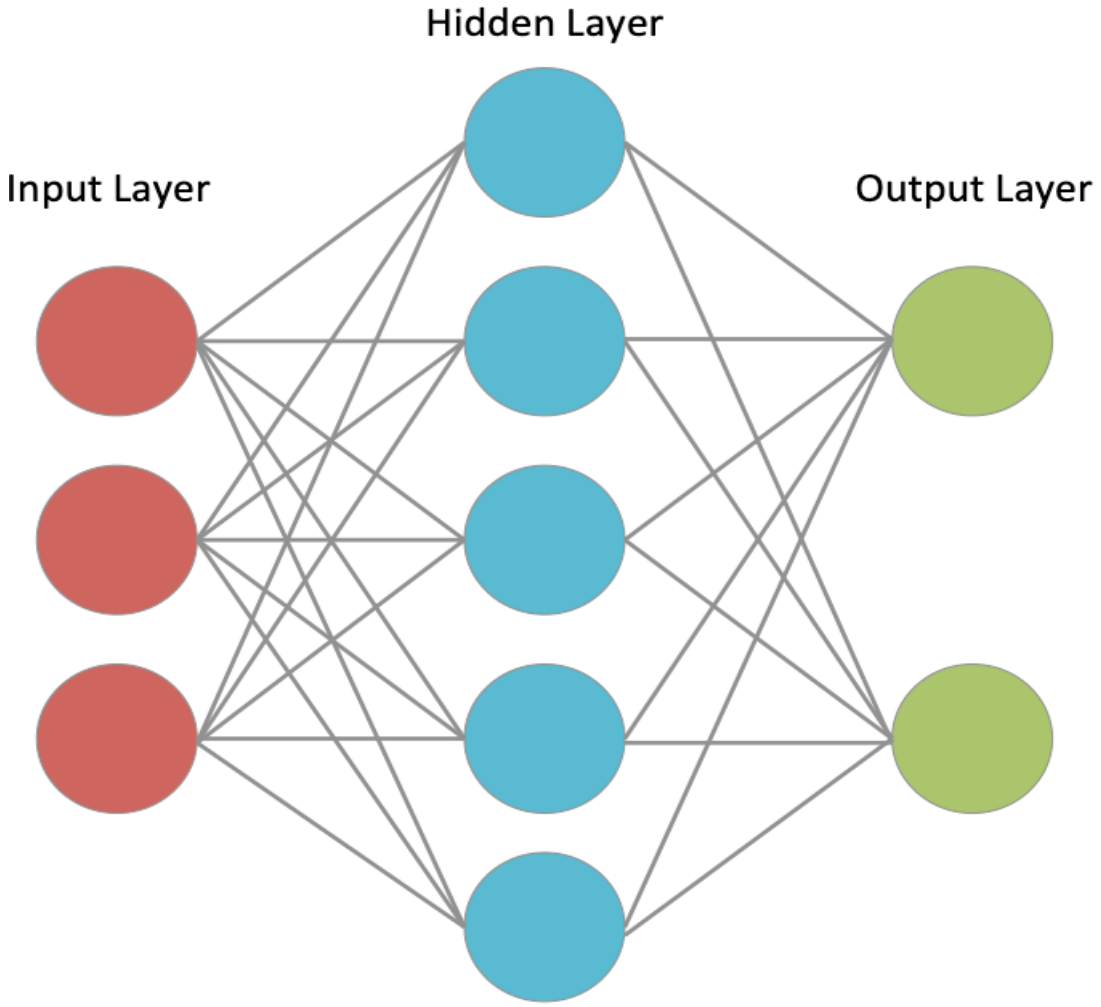
Neural networks – an architecture or framework

>> Layers – input, **hidden**, output

>> Nodes – point of computation

>> Weight and activation function

>> **Learning and predicting**



Object Detection and YOLO

Object detection – classification with localisation

>> Classification methods

– Slow and computationally expensive

>> **Regression methods**

YOLO (You Only Look Once)

– efficient, real-time

– reasoned globally predictions

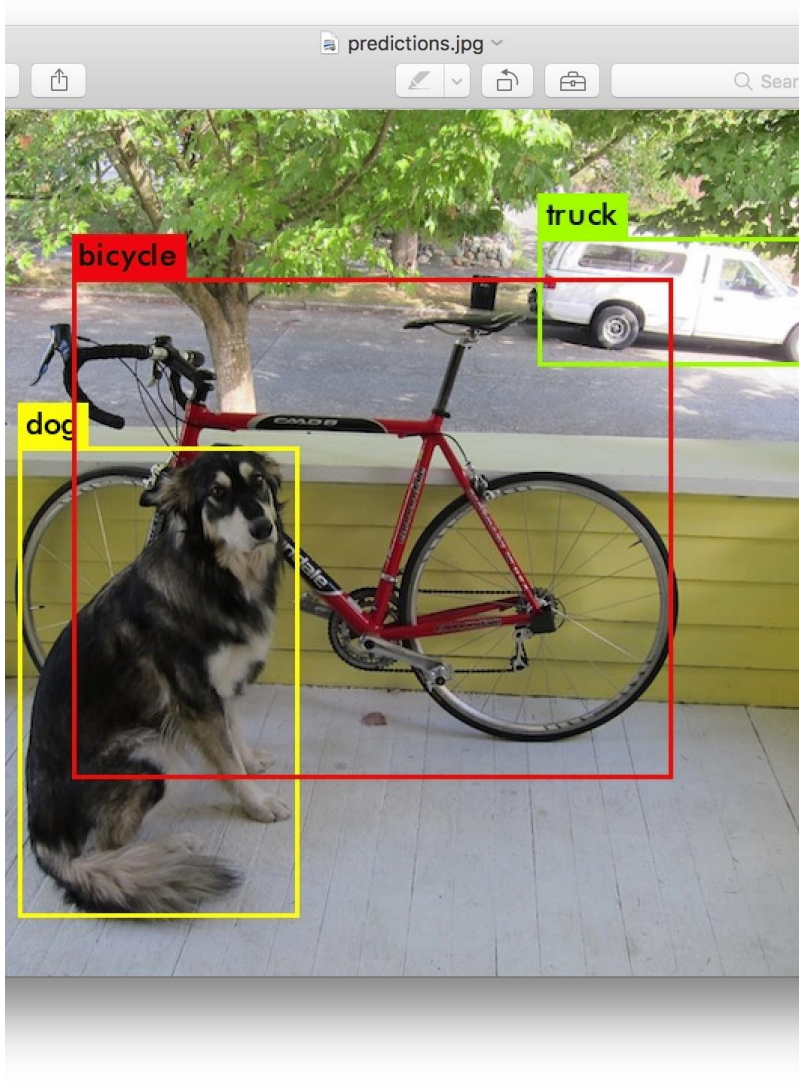
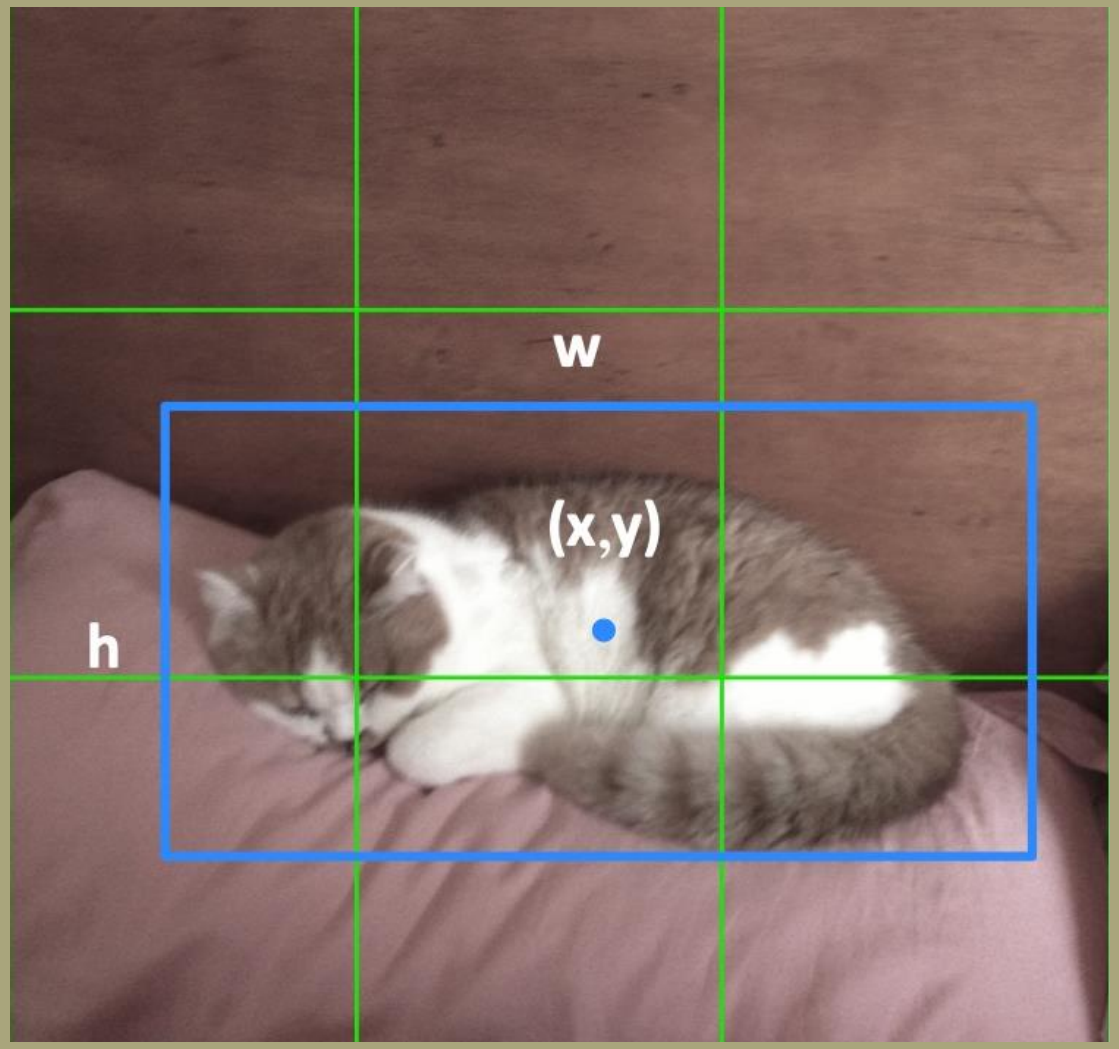


image credit: Erik Linder-Norén



Object Detection and YOLO

- an *SxS* grid cells
- Each grid cell:
  - detects one object
  - predicts a fixed number of **bounding boxes**
  - predicts **class probabilities** for all classes
- Bounding box predictions
  - normalised coordinates of the centre
  - height, width
  - **confidence score**

Object Detection and YOLO

For an object –

The bounding box with the highest confident score

--> Localisation

The greatest class probability among all classes

--> Classification

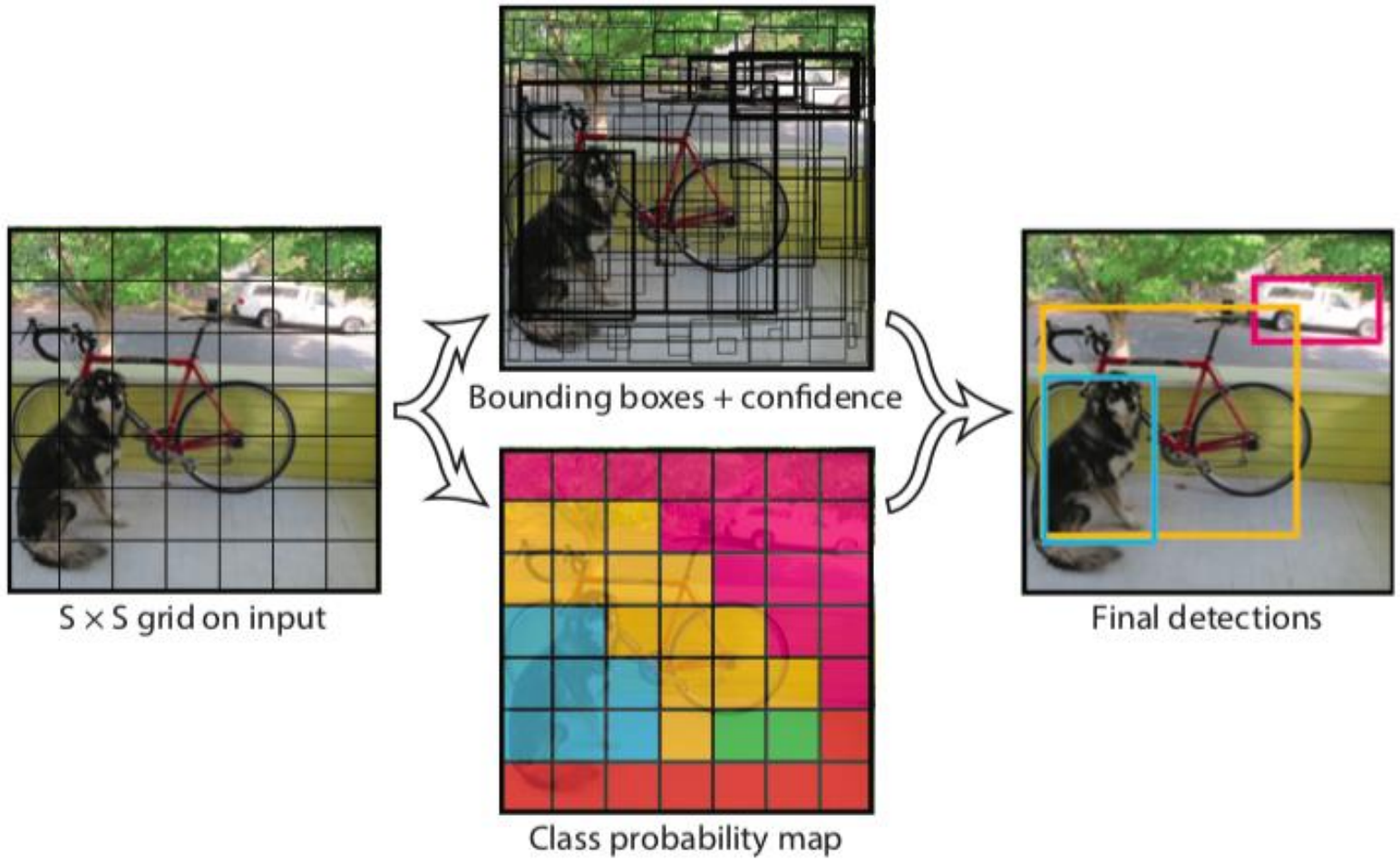


image credit: Towards Data Science

Implementation

>> YOLOv3 with Pytorch

>> The official pre-trained weights with 80 classes

>> The program was run on terminal and Google Colaboratory

>> 3 detection modes:
images, video, webcam

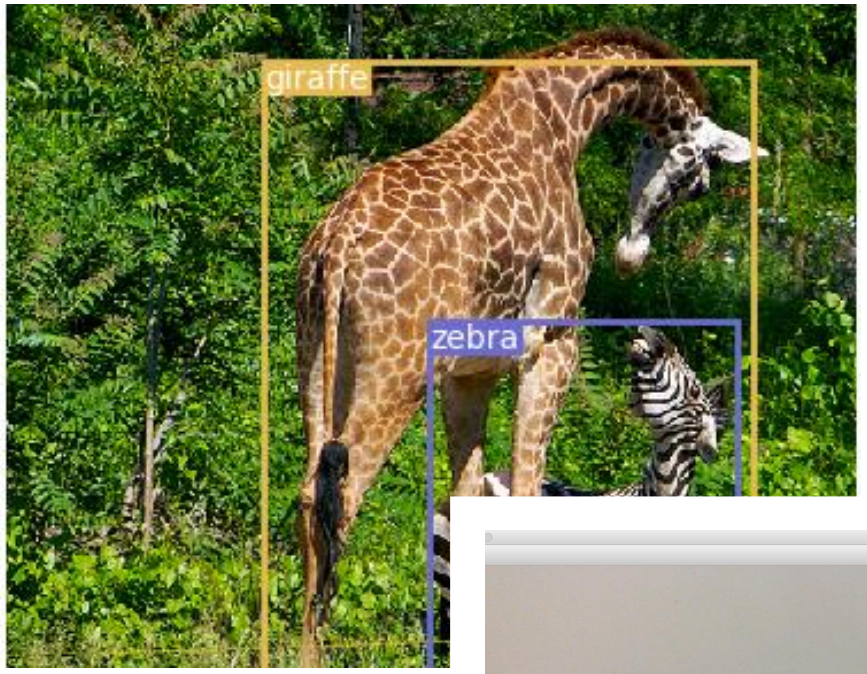
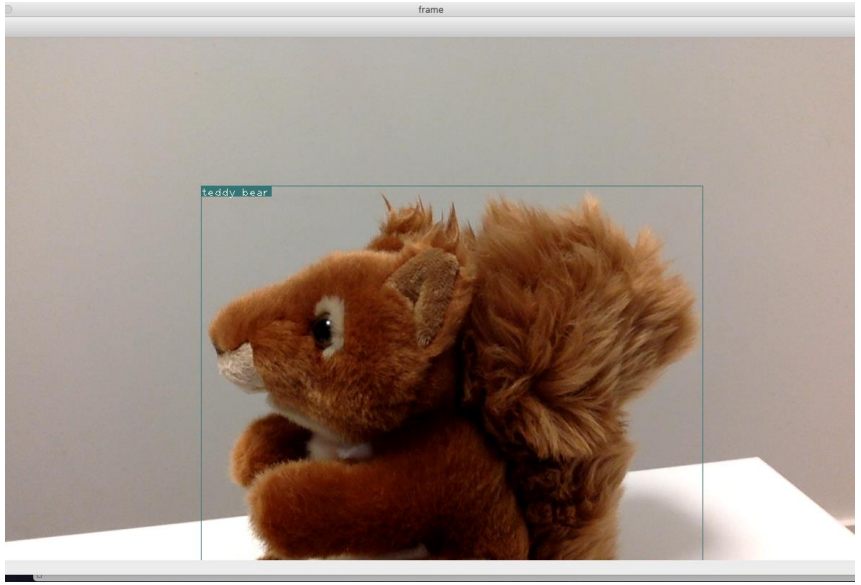


image (JPG)-

giraffe, zebra



webcam -

squirrel toy classified as teddy bear

image credit: Erik Linder-Norén

Data Collection and Training

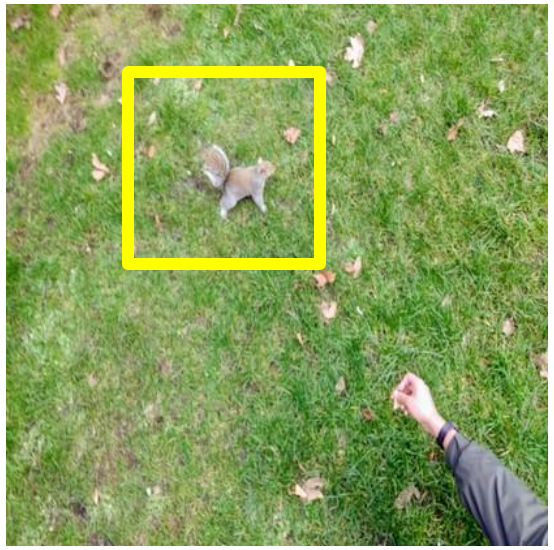
>> Squirrels – not a pretrained class

>> Data collection
Imitation of aerial images
– a small-scaled dataset of overhead images

>> Labelling – with ImageJ and convert to Draknet format

>> Retraining for a new class

>> Transfer Learning



Live Streaming and Real-Time Analysis

- Live streaming on Bambuser
- Real-time analysis on online videos – YOLO Live and Python MSS library
- Alternatives – embedded system or cloud server

Conclusion

What we learned:

- Concepts of Compter vision and neural network
- Basis of object detection algorithms

What we successfully achieved:

- Implemented YOLO v3 with PyTorch
- Collected and labelled overhead images of squirrels
- Established the drone video stream

What we tried and didn't work out:

- Transfer Learning of the YOLO model
- Real-time analysis on drone video