DNN model evaluation metrics

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1 General

Public image datasets:
   http://www.cvpapers.com/datasets.html
   - Can reduce overfitting by adding noise.

2 Point Cloud info

- Recent literature on point cloud models:

  https://github.com/NUAAXQ/awesome-point-cloud-analysis-2021

- Point cloud deep learning. Compares different models and shows results with different datsets.

  https://on-demand.gputechconf.com/gtc/2018/presentation/s8453-point-cloud-deep-learning.pdf

3 Object Detection in DNN/CNN

Given an image, find the objects in it, locate their position and classify them. Object detection models are usually trained on a fixed set of classes, so the model would locate and classify only those classes in the image. Also, the location of the object is generally in the form of a bounding rectangle. So, object detection involves both localization of the object in the image and classifying that object.

3.1 About the Ground Truth

For any algorithm, the metrics are always evaluated in comparison to the ground truth data. We only know the Ground Truth information for the Training, Validation and Test datasets (Shah, 2018).
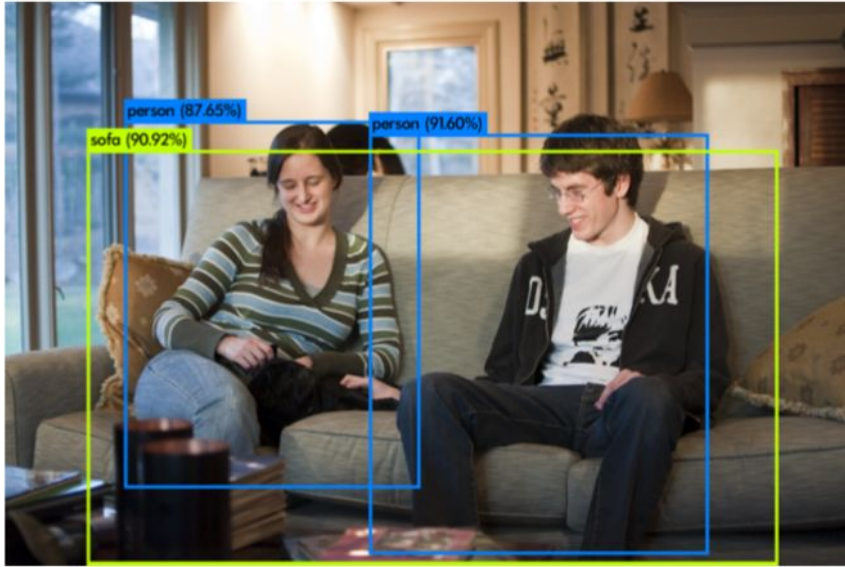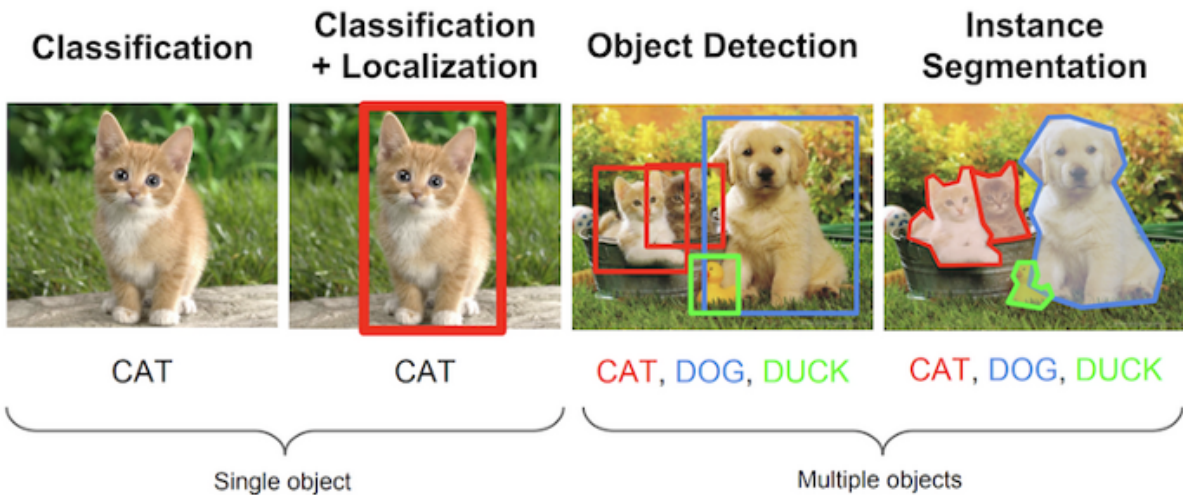
Figure 1: (Wadawadagi, 2020)

Figure 2: Common image processing problems (Shah, 2018)

We are given the actual image(jpg, png etc) and the other annotations as text(bounding box coordinates (x, y, width and height) and the class), the red box and text labels are only drawn on this image for us humans to visualize (Shah, 2018).

4 Working with data in neural networks

4.1 Edges as features

1. For us to be able to see an object, the object's color and associated properties must be different from the background

2. When so, the object gets a distinct boundary at overall level. Further, within the boundary of the
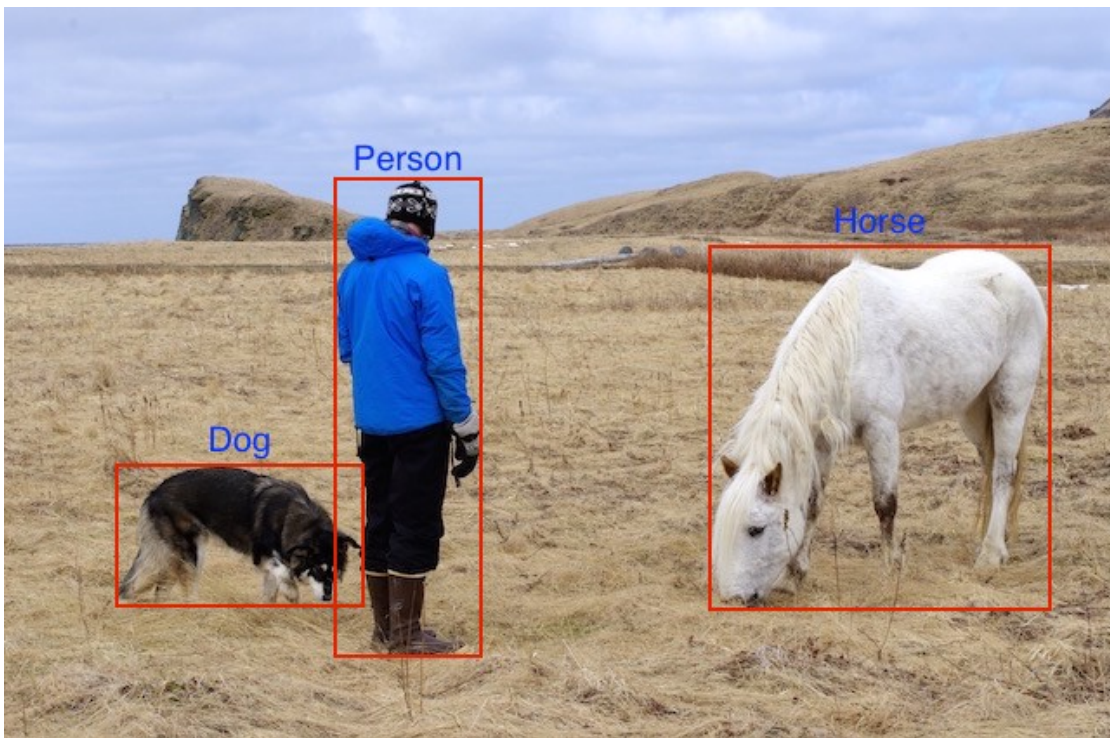
Figure 3: The actual image (Shah, 2018)

Figure 4: Human visualization of the ground truth (Shah, 2018)

object may be sub-boundaries marking separate regions such as eye

Class	X coordinate	Y coordinate	Box Width	Box Height
Dog	100	600	150	100
Horse	700	300	200	250
Person	400	400	100	500

Figure 5: The data defining the ground truth (Shah, 2018)

3. It is these boundaries that act as features in object detection and recognition. The main motive for computer vision

4. Boundaries, also known as edges are those positions in space where the characteristics of light change

5. Thus, detecting the changes in the light helps detect edge and edge detection is the key to computer vision

4.2   Pixel Intensity Gradient

1. Through the use of a filter function on the image function (convolution) , we try to detect edges.

2. The edges appear as a gradient at a pixel (is the direction in which intensity changes maximum in that pixel's neighborhood

3. The gradient is searched in both X and Y direction and a consolidated gradient is found using vector addition (gradients are vectors)

4. The larger the magnitude of the gradient, the stronger the evidence of presence of an edge / a feature