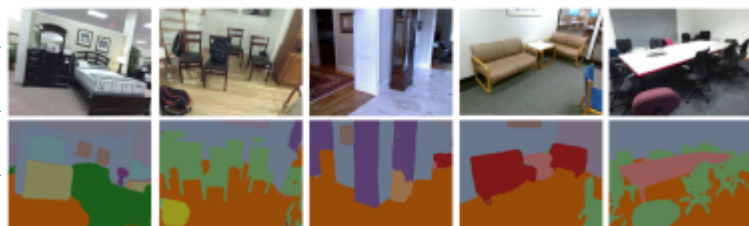


Now, Discussion On Semantic Segmentation. //

Bounding Box Based Object Recognition (YOLO) → Pixel Based Object Recognition

Example:



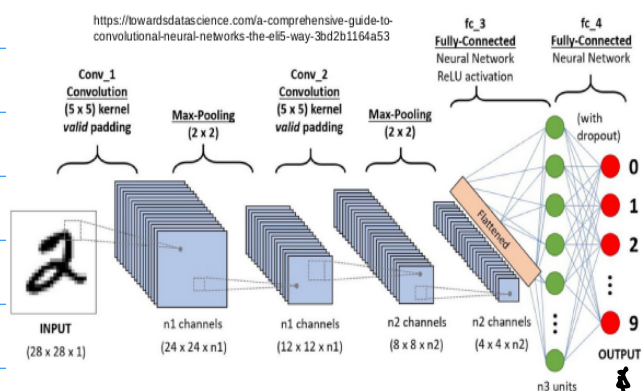
Before  
v.s.  
After.

2022F-109-semantic-seg-part1-HL-2022-11-10.pdf

Nov. 10 (Th). Deep Convolution Neural Networks for Semantic Segmentation.

Objectives: Object Recognition On pixel-by-pixel Basis.

Illustration of A CNN for Digits Recognition



Outputs are Numerical Values. In Case of YOLO CNN, the outputs are the Bounding Boxes.

Improve with pixel by pixel Object Recognition

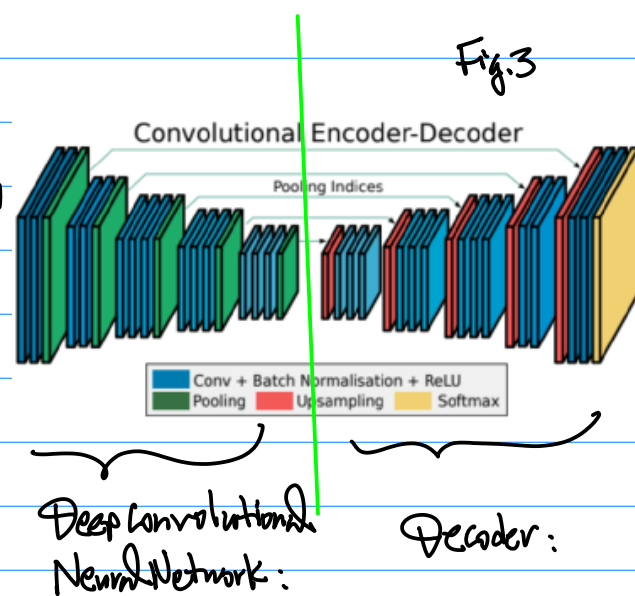


Fig.3

Encoder:

Feature Extraction — Convolutions  
Classification — Feedforward NN

To get  
Pixel by  
pixel

Recognition of Objects  
E.g. Segmentation

Note: The Design tasks for us to achieve this goal is to project feature maps back to higher resolution, eventually to its original size (Same Resolution as the input image).

The process of moving from Lower Resolution feature maps to higher Resolution feature map, eventually to the Resolution of the original image is what we called "Upsampling".

Fig.1.

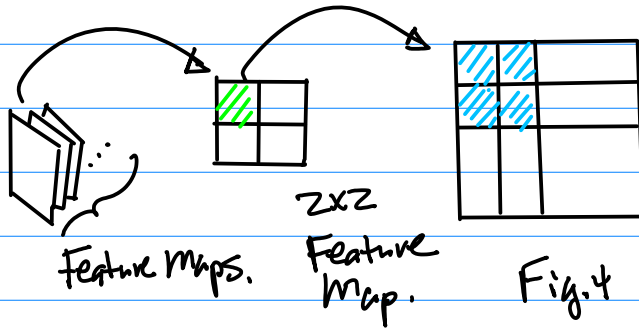


Fig.2

Nov. 10, 22.

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# Design of Example: Up Sampling Techniques



Consider A Design of The Simplest Up Sampling. Duplication of the pixel.

## Technique 1.

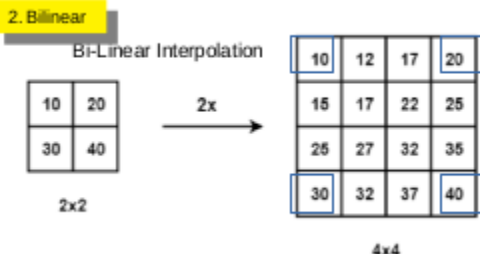


Fig. 5

## NN Nearest Neighbour Up Sampling.

The Need for Improvement of NN- Up Sampling: (1) Sudden Change from one 2x2 Region to its Neighbouring Regions  $\rightarrow$  which produces Visual Artifacts.  $\rightarrow$  propagation till the Output Image; (2) Lack of the consideration of Spatial correlations.

## Technique 2. Use Interpolation Technique



Step 1. place "Anchor Points" onto the higher resolution Patch.

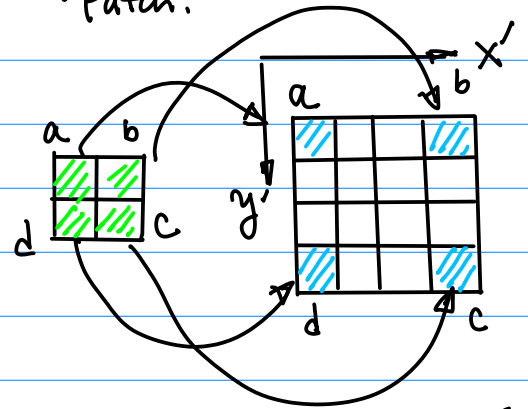
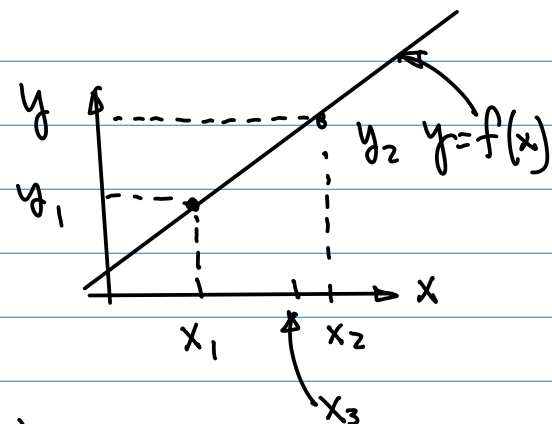


Fig. 6

## Step 2. Perform Interpolation

Background: Given  $(x_1, y_1)$ ,  $(x_2, y_2)$  and  $x_3$ , Find  $y_3 = ?$



$y = f(x)$ ,  $y = ax + b$  ... (1)  
Which is a linear function, (since  $x$  is Not in 2nd, 3rd, or higher order).

$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{y - y_1}{x - x_1} \quad \dots (2)$$

Solve for  $a$  and  $b$  in the Above equation

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1} (x - x_1)$$

$$y = \underbrace{\frac{y_2 - y_1}{x_2 - x_1} x}_a - \underbrace{\frac{y_2 - y_1}{x_2 - x_1} x_1}_b + y_1$$

$$a = \frac{y_2 - y_1}{x_2 - x_1}$$

$$b = -\frac{y_2 - y_1}{x_2 - x_1} x_1 + y_1$$