NPTEL ONLINE CERTIFICATION COURSES

Course Name: Deep Learning
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Topic

Lecture 53: Semantic Segmentation

CONCEPTS COVERED

Concepts Covered:

❑ Deconvolution

❑ Upsampling

❑ Semantic Segmentation

❑ Fully Convolutional Network

❑ Deconvolutional Network

Image Segmentation

❑ Image segmentation is the task of partitioning an image into multiple Regions.

❑ Grouping pixels together on the basis of specific characteristic(s).

❑ Characteristics can often lead to different types of image segmentation, which we can divide into the following:

➢ Semantic Segmentation

➢ Instance Segmentation

Image Courtesy :
https://www.ntu.edu.sg/home/asjfcai/Benchmark_Website/benchmark_index.html
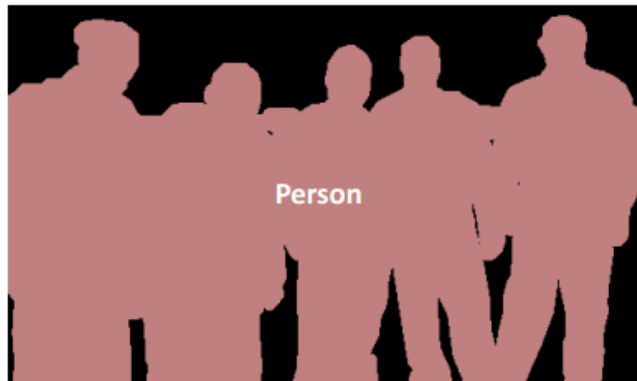
Semantic Segmentation

❑ Semantic segmentation refers to the process of linking each pixel in an image to a class label.

❑ We can think of semantic segmentation as image classification at a pixel level.

❑ In an image having many cars, segmentation will label all the objects as car objects.

❑ In the example image all the pixels belonging to different classes like; human, car, house and grass is labelled with different colours.
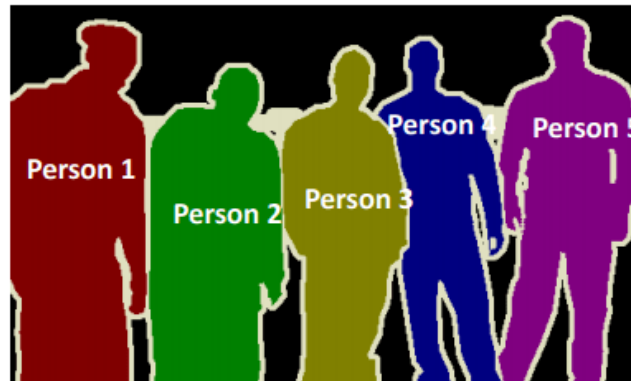
Image Courtesy :
https://github.com/CSAILVision/semantic-segmentation-pytorch

Instance Segmentation

Instance segmentation includes identification of boundaries of the objects at the detailed pixel level. Following example shows the difference between semantic segmentation and instance segmentation.

Use of Semantic Segmentation

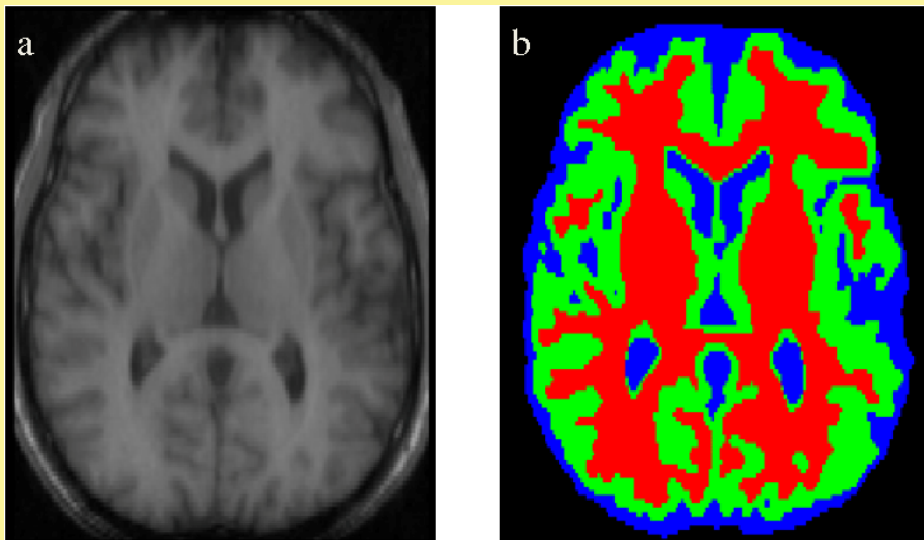**For Autonomous driving**

Use of Semantic Segmentation

For Medical Applications

Segmentation of white matter, grey matter and Cerebrospinal fluid from brain MRI image.
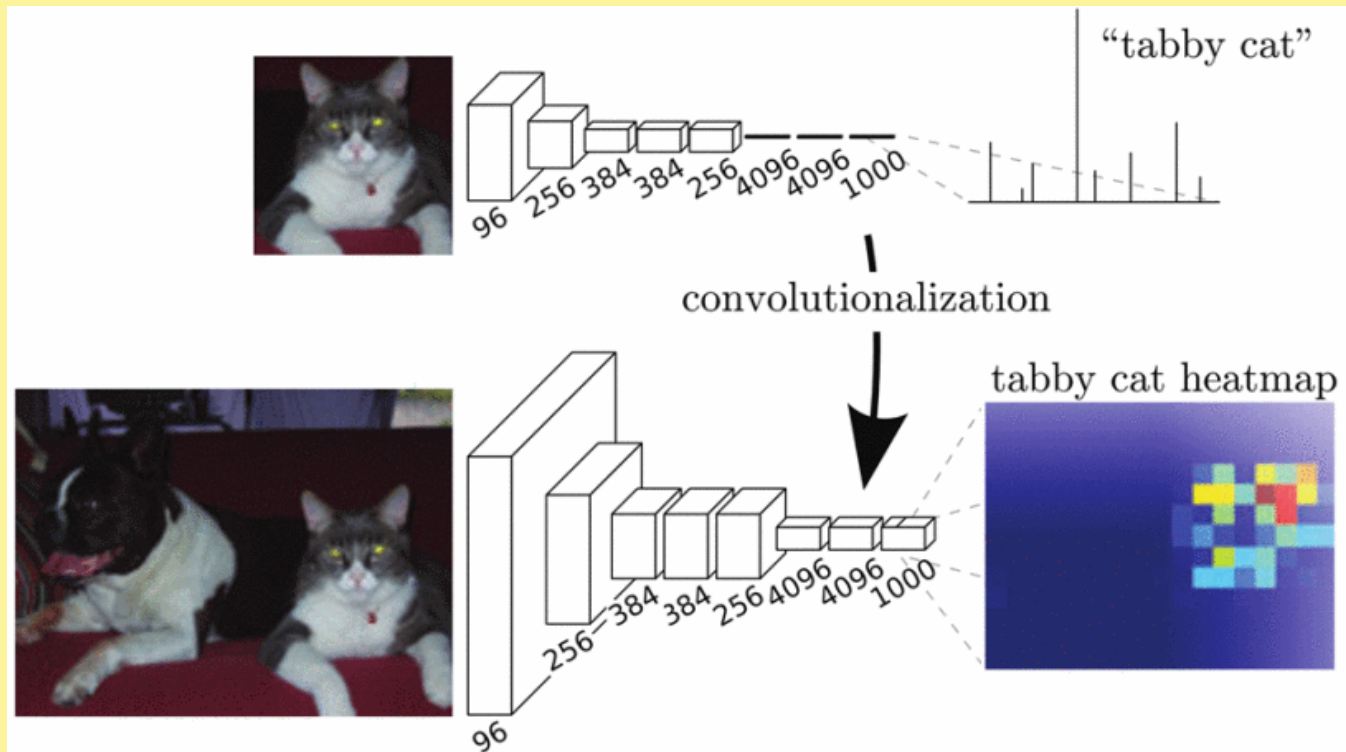
Withey, Daniel J., and Zoltan J. Koles. "A review of medical image segmentation: methods and available software." *International Journal of Bioelectromagnetism* 10, no. 3 (2008): 125-148.

Fully Convolutional Network
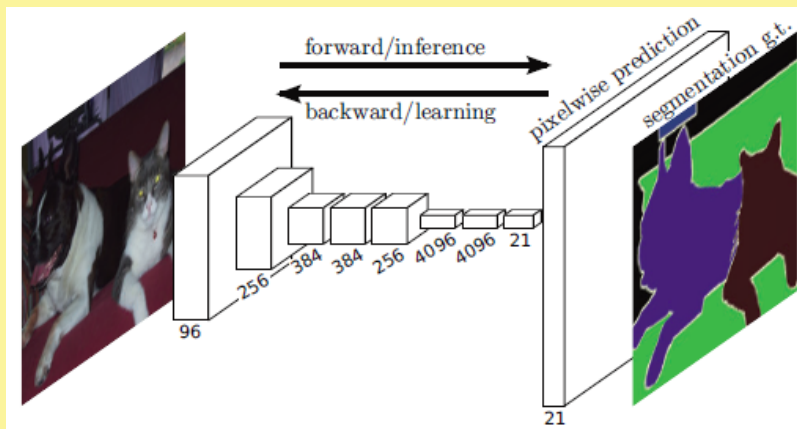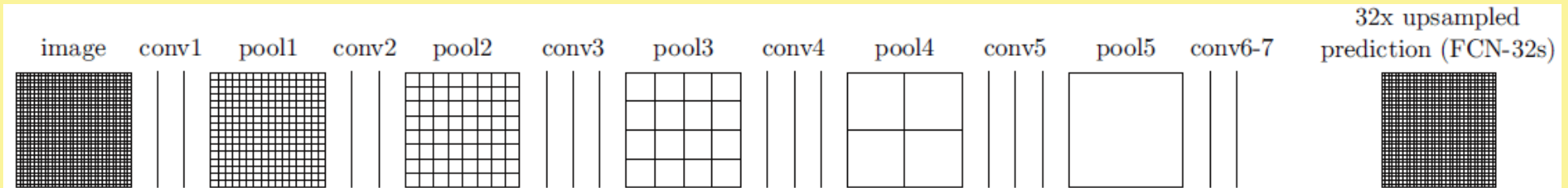## for
Semantic Segmentation

Fully Convolutional Network

Jonathan Long, Evan Shelhamer, Trevor Darrell,
"Fully Convolutional Networks for Semantic
Segmentation", CVPR 2015

Fully Convolutional Network

After going through conv7 the output size 1/32.

32× upsampling is done to make the output have the same size of input image.

But makes the output label map sparse.

It is called **FCN-32s**.

Jonathan Long, Evan Shelhamer, Trevor Darrell, "Fully Convolutional Networks for Semantic Segmentation", CVPR 2015

Fully Convolutional Network

Jonathan Long, Evan Shelhamer, Trevor Darrell,
"Fully Convolutional Networks for Semantic
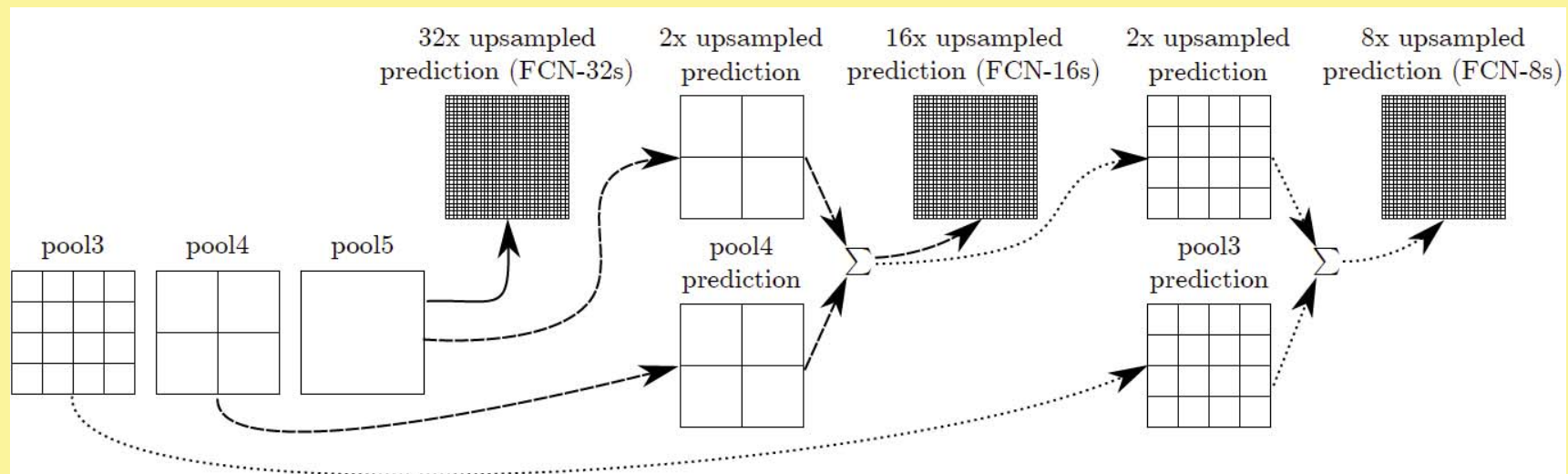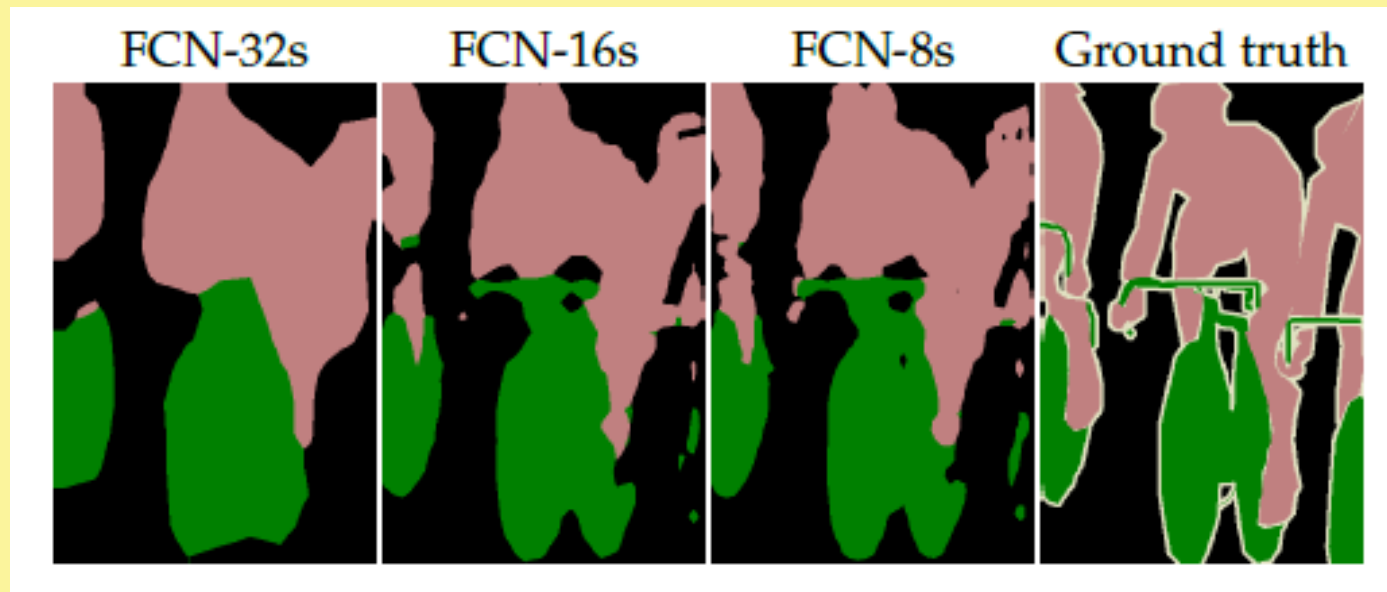Segmentation", CVPR 2015

Fully Convolutional Network

FCN-32s   FCN-16s   FCN-8s   Ground truth

Jonathan Long, Evan Shelhamer, Trevor Darrell, "Fully Convolutional Networks for Semantic Segmentation", CVPR 2015

References

❑ Dumoulin, Vincent, and Francesco Visin. "A guide to convolution arithmetic for deep learning." *arXiv preprint arXiv:1603.07285* (2016).

❑ http://cs231n.stanford.edu/

❑ Xu, Li, Jimmy SJ Ren, Ce Liu, and Jiaya Jia. "Deep convolutional neural network for image deconvolution." In *Advances in neural information processing systems*, pp. 1790-1798. 2014.

❑ Long, Jonathan, Evan Shelhamer, and Trevor Darrell. "Fully convolutional networks for semantic segmentation." In *Proceedings of the IEEE conference on computer vision and pattern recognition*, pp. 3431-3440. 2015.

❑ Milletari, Fausto, Nassir Navab, and Seyed-Ahmad Ahmadi. "V-net: Fully convolutional neural networks for volumetric medical image segmentation." In *2016 Fourth International Conference on 3D Vision (3DV)*, pp. 565-571. IEEE, 2016.

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Thank you