HuStar AI Course: Computer Vision

Semantic Segmentation

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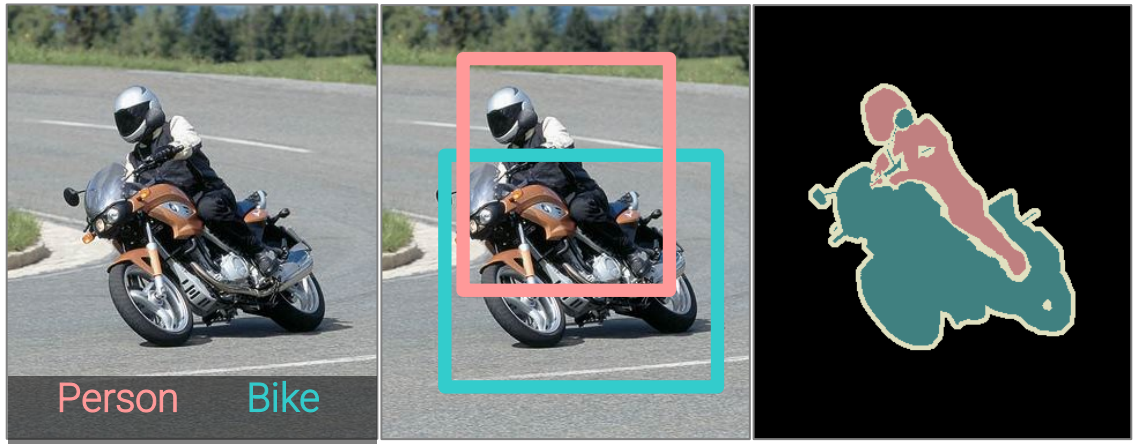
POSTECH

Semantic Segmentation with Fully Convolutional Networks

Overview

- Classification -> Semantic segmentation



- Semantic segmentation based on deep learning
  - FCN, DeepLab, DeconvNet, U-Net, Pyramid Scene Parsing Network

Image vs Semantic

- Classification - determine label of image
  - Find function: Image -> number of label
    - e.g. 32x32x3 -> 10x1

- Semantic segmentation - determine label of each pixel
  - Find function: Image -> number of label x Image width x Image height
    - e.g. 32x32x3 -> 10x32x32, harder ☹
    - But not 32x32 times harder problem because locality ☺
    - What is difference of two task?

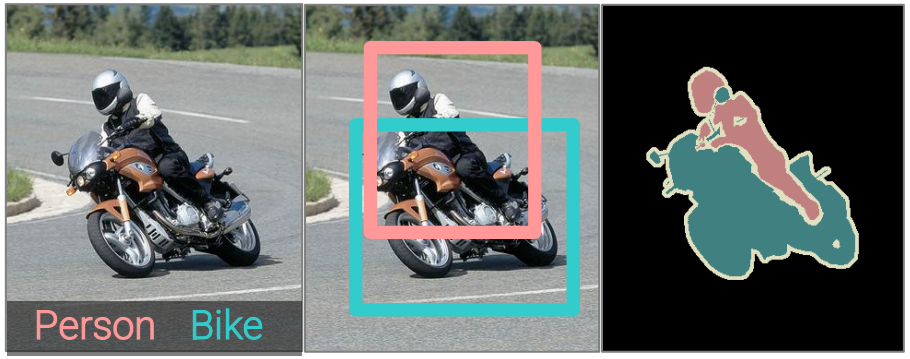


Image vs Semantic

- Image classification

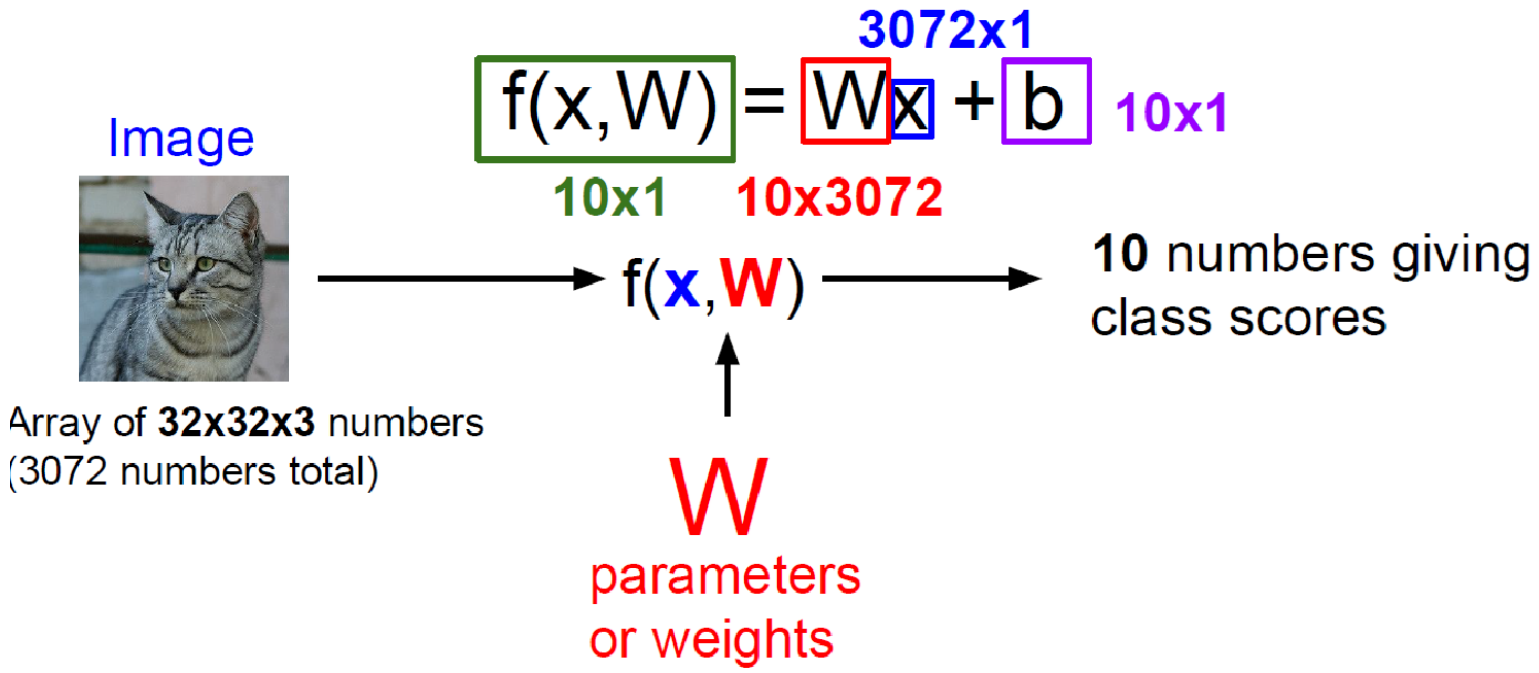


Image vs Semantic

- Semantic segmentation

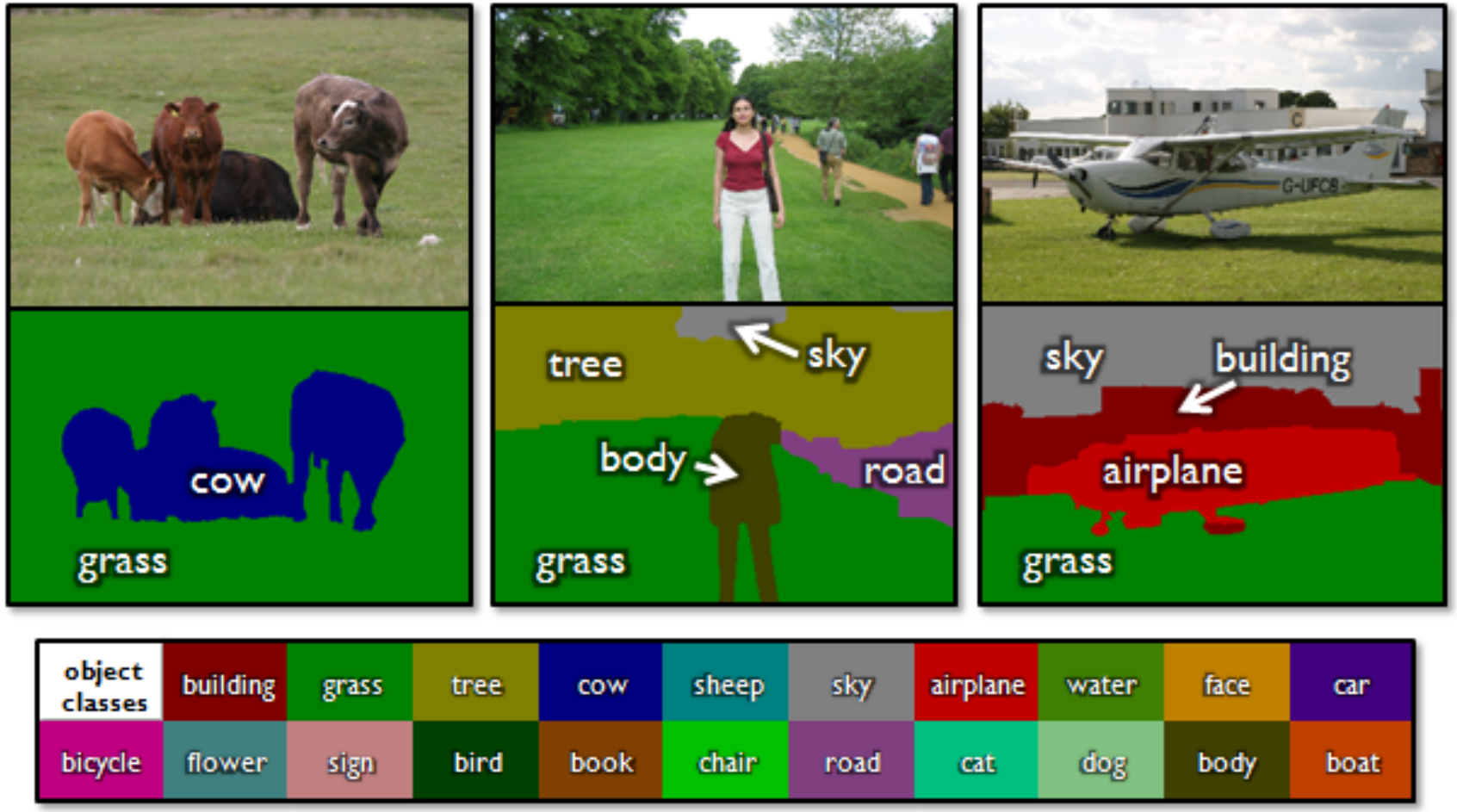
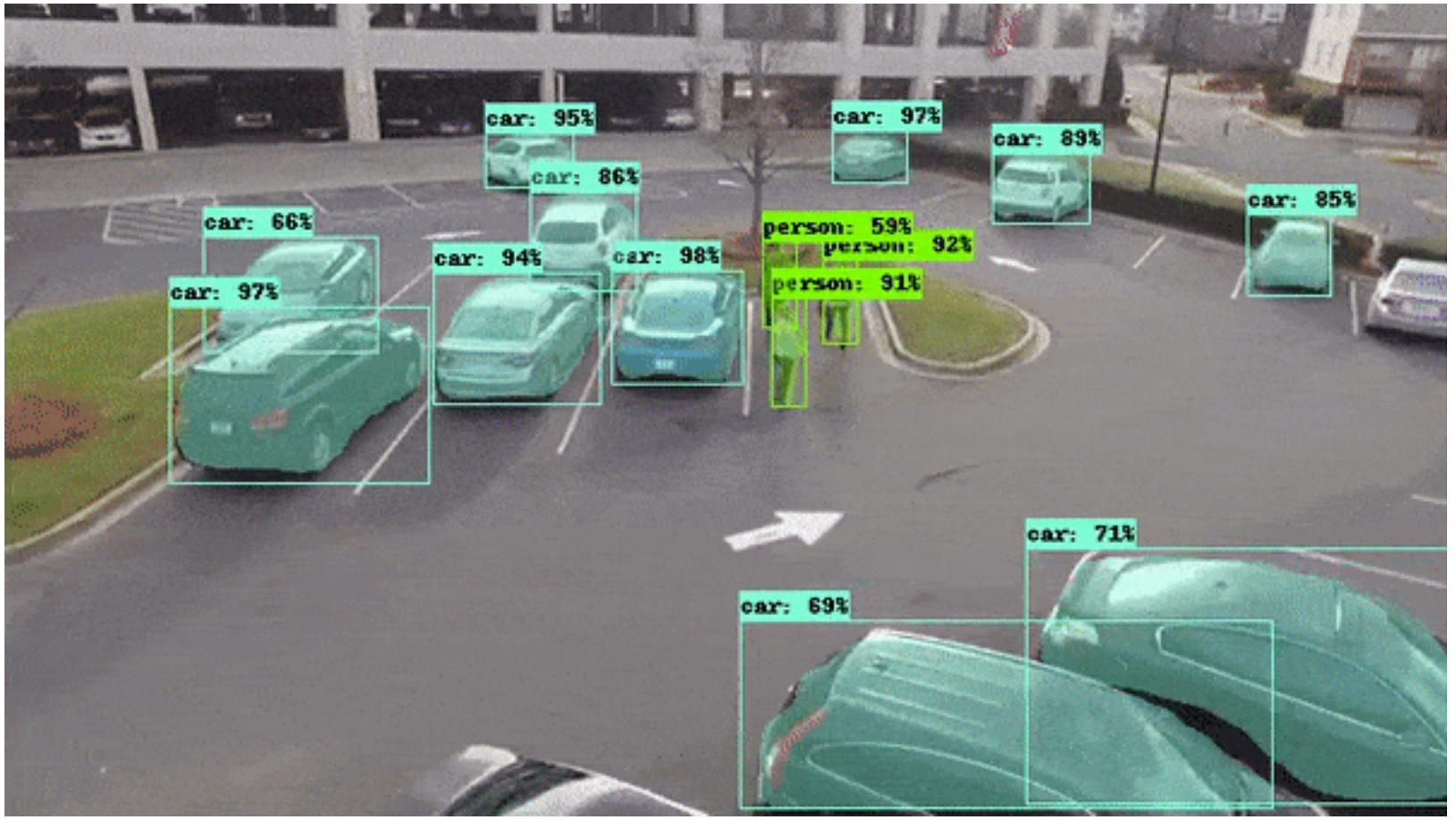


Image vs Semantic

- Semantic segmentation

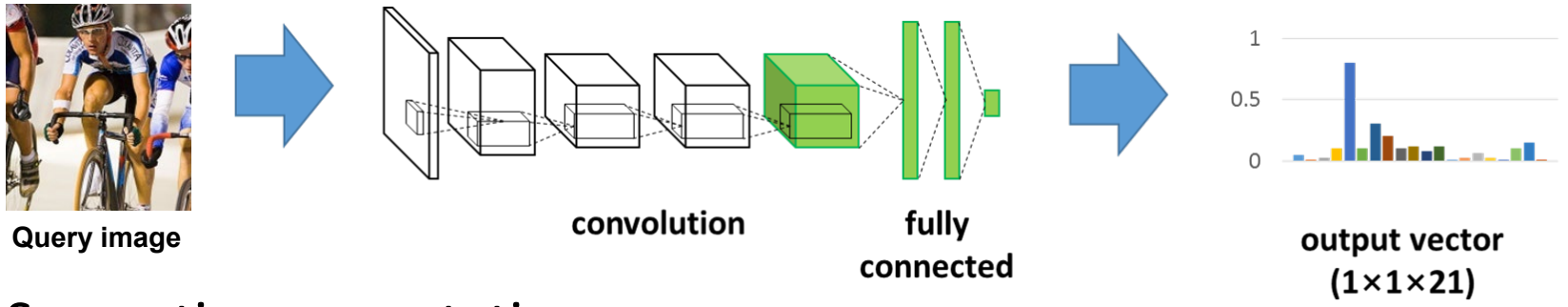
Image vs Semantic

- Instance Segmentation (Advenced)

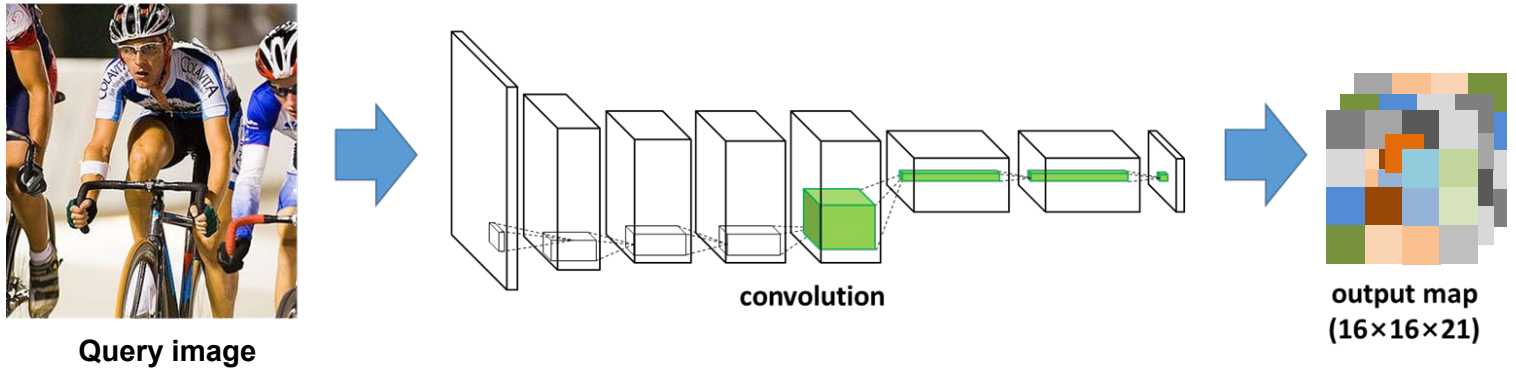


Fully Convolutional Network

- Image classification



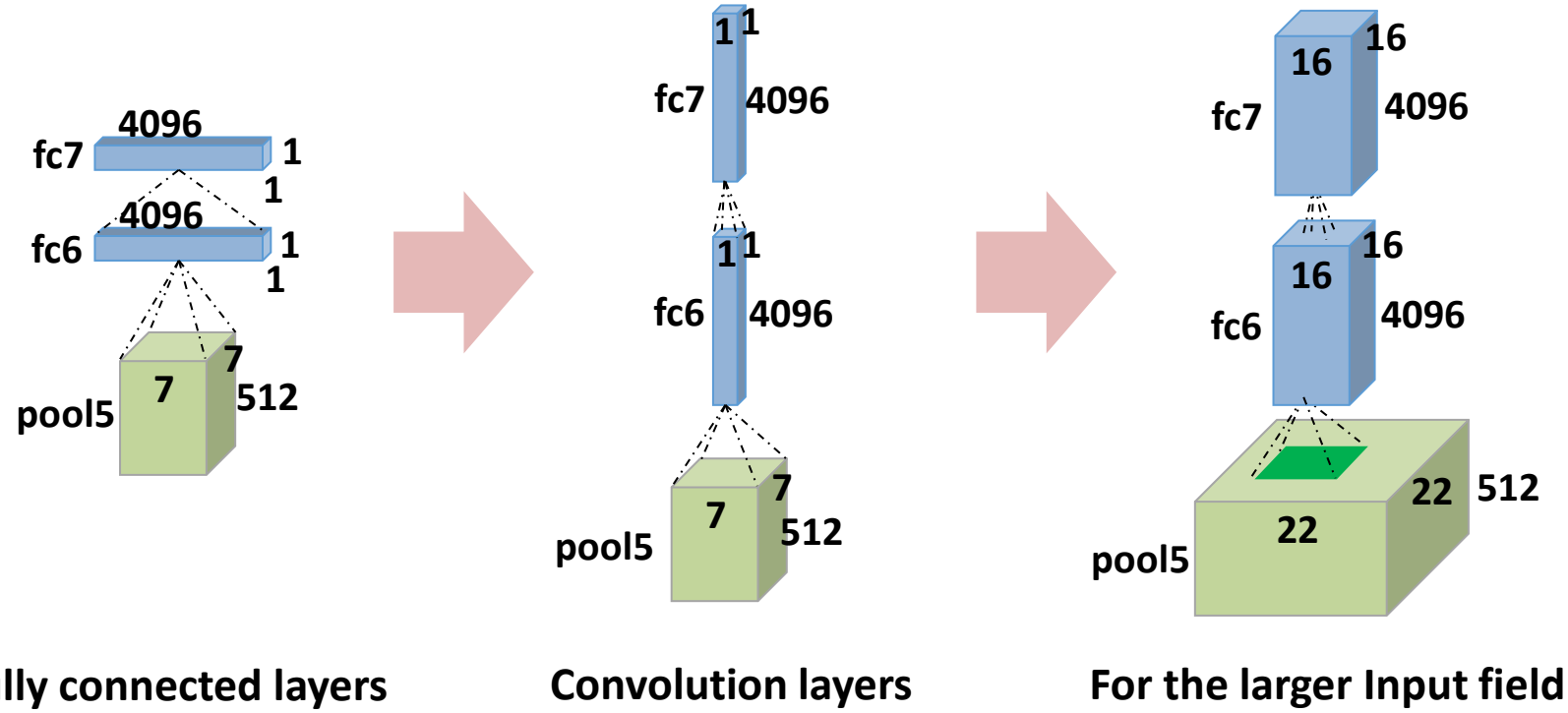
- Semantic segmentation
  - Given an input image, obtain pixel-wise segmentation mask using a deep Convolutional Neural Network (CNN)



Jonathan et al., Fully convolutional networks for semantic segmentation, *CVPR* 2015.

Fully Convolutional Network

- Converting fully connected layers to convolution layers
  - Each fully connected layer is interpreted as a convolution
    - spatial filter that covers entire input field

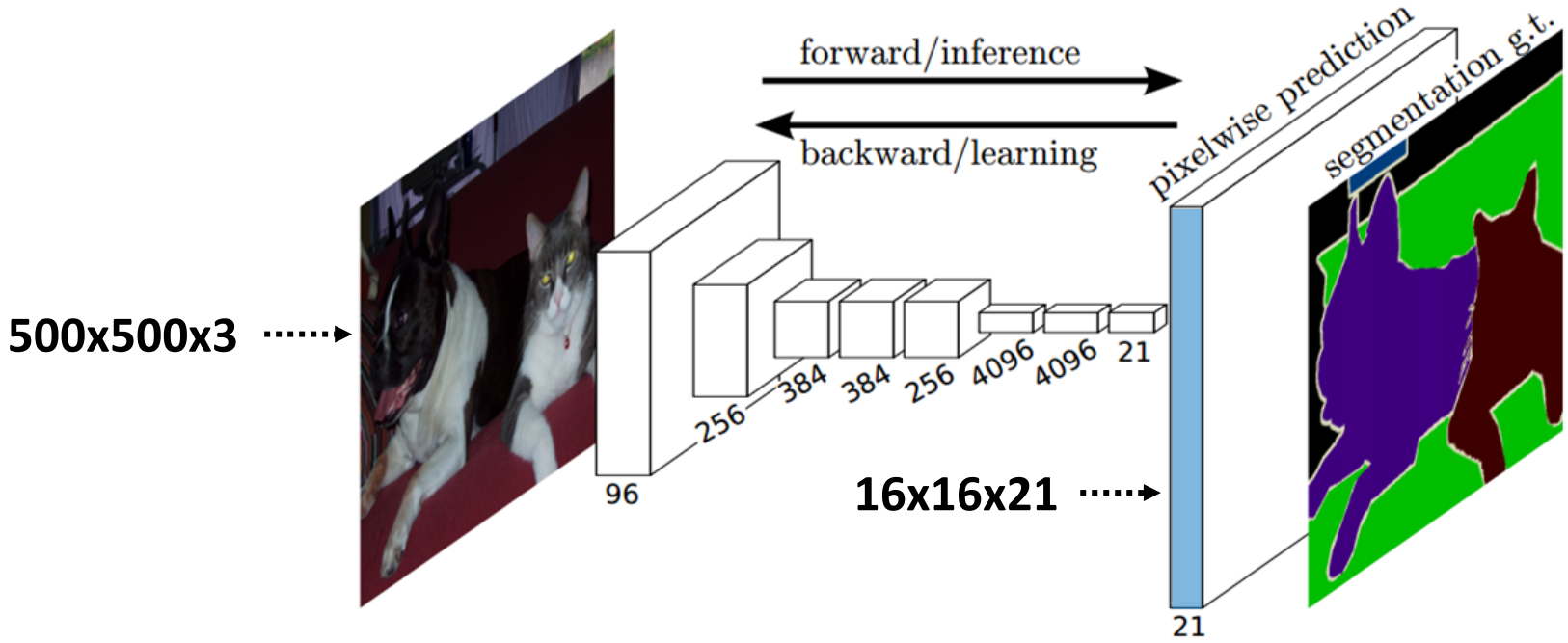


Fully connected layers **Convolution layers** **For the larger Input field**

Jonathan et al., Fully convolutional networks for semantic segmentation, *CVPR* 2015.

Fully Convolutional Network

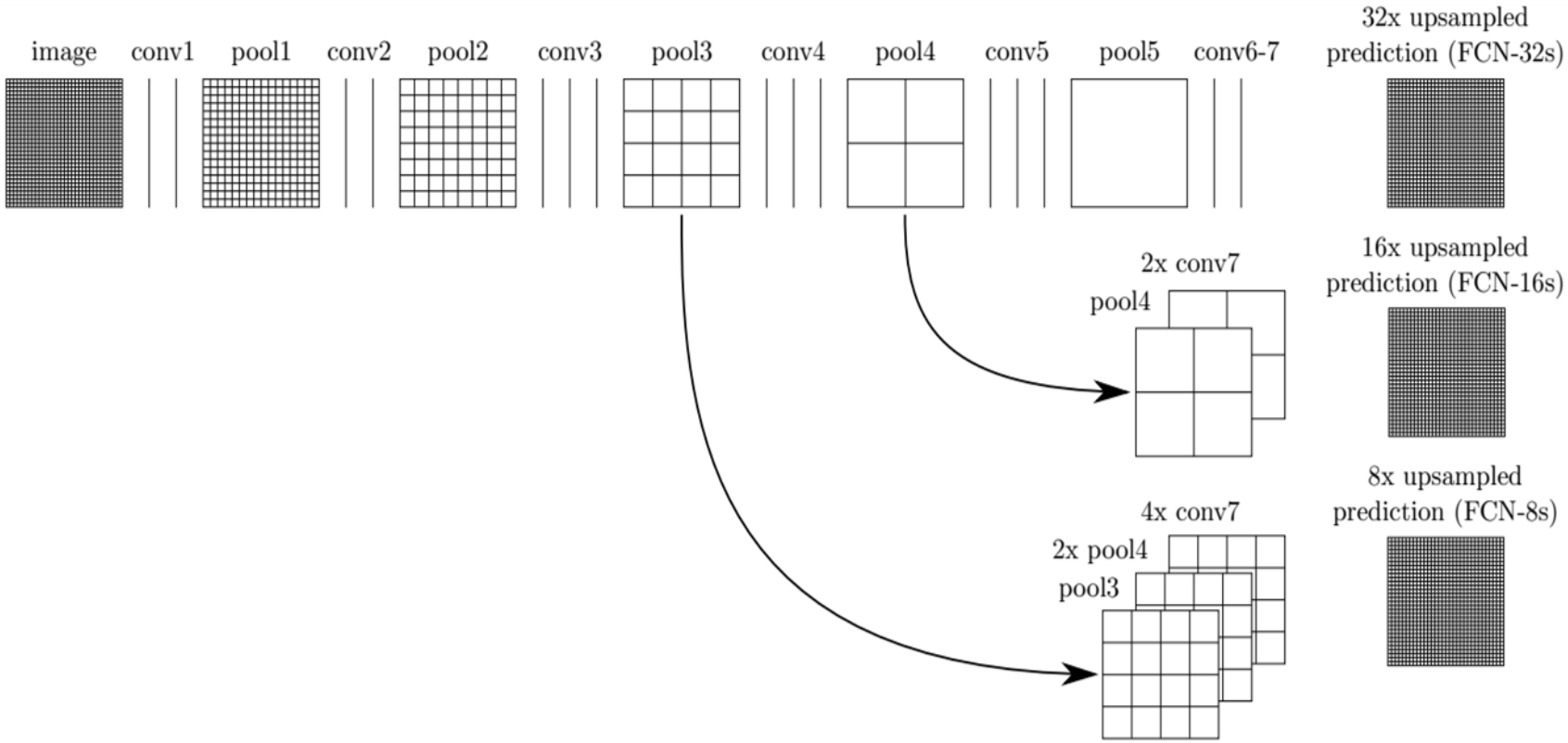
- Network architecture[Long15]
  - End-to-End CNN architecture for semantic segmentation
  - Convert fully connected layers to convolutional layers



Jonathan et al., Fully convolutional networks for semantic segmentation, *CVPR* 2015.

Fully Convolutional Network

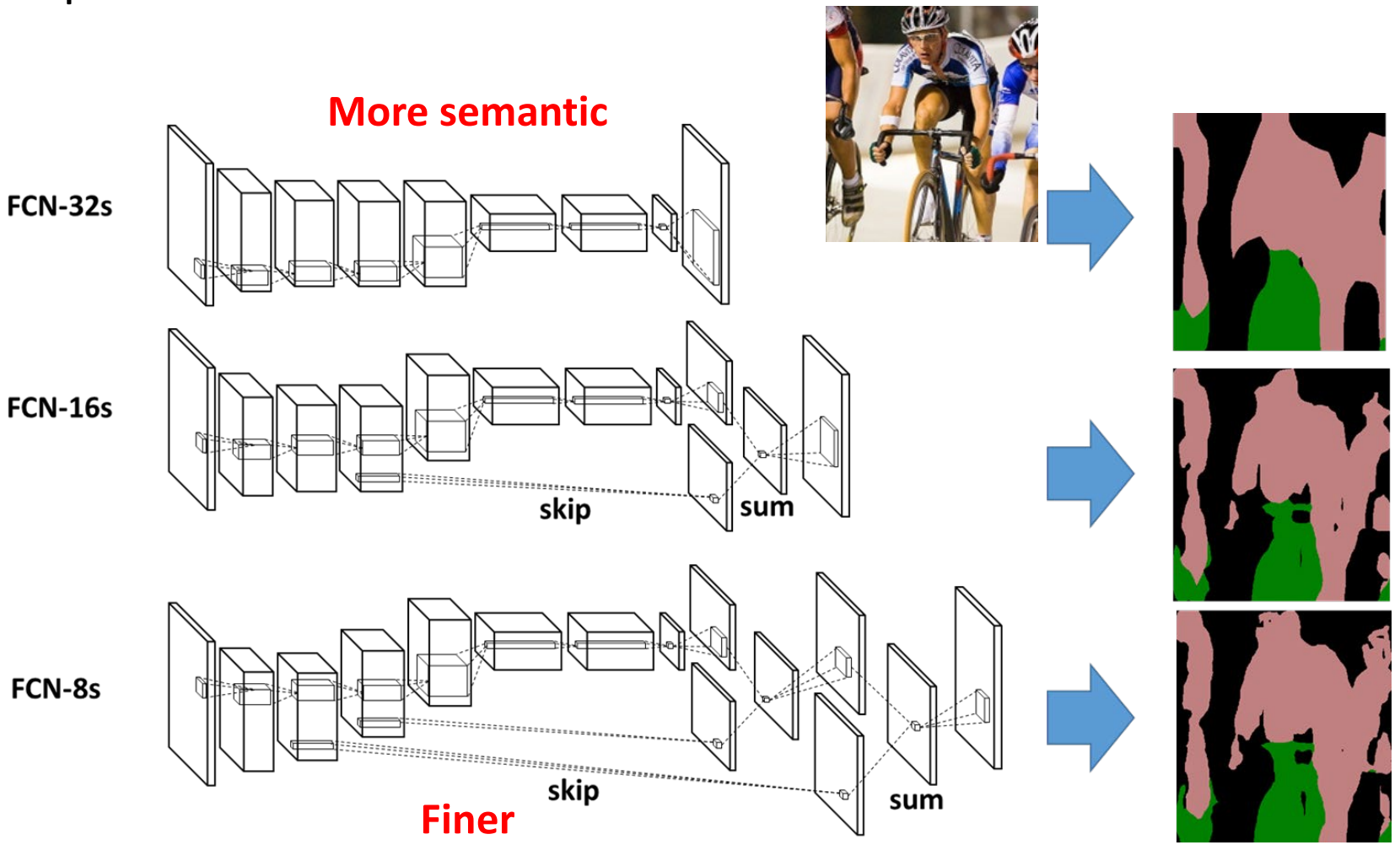
- Skip architecture



Jonathan et al., Fully convolutional networks for semantic segmentation, *CVPR* 2015.

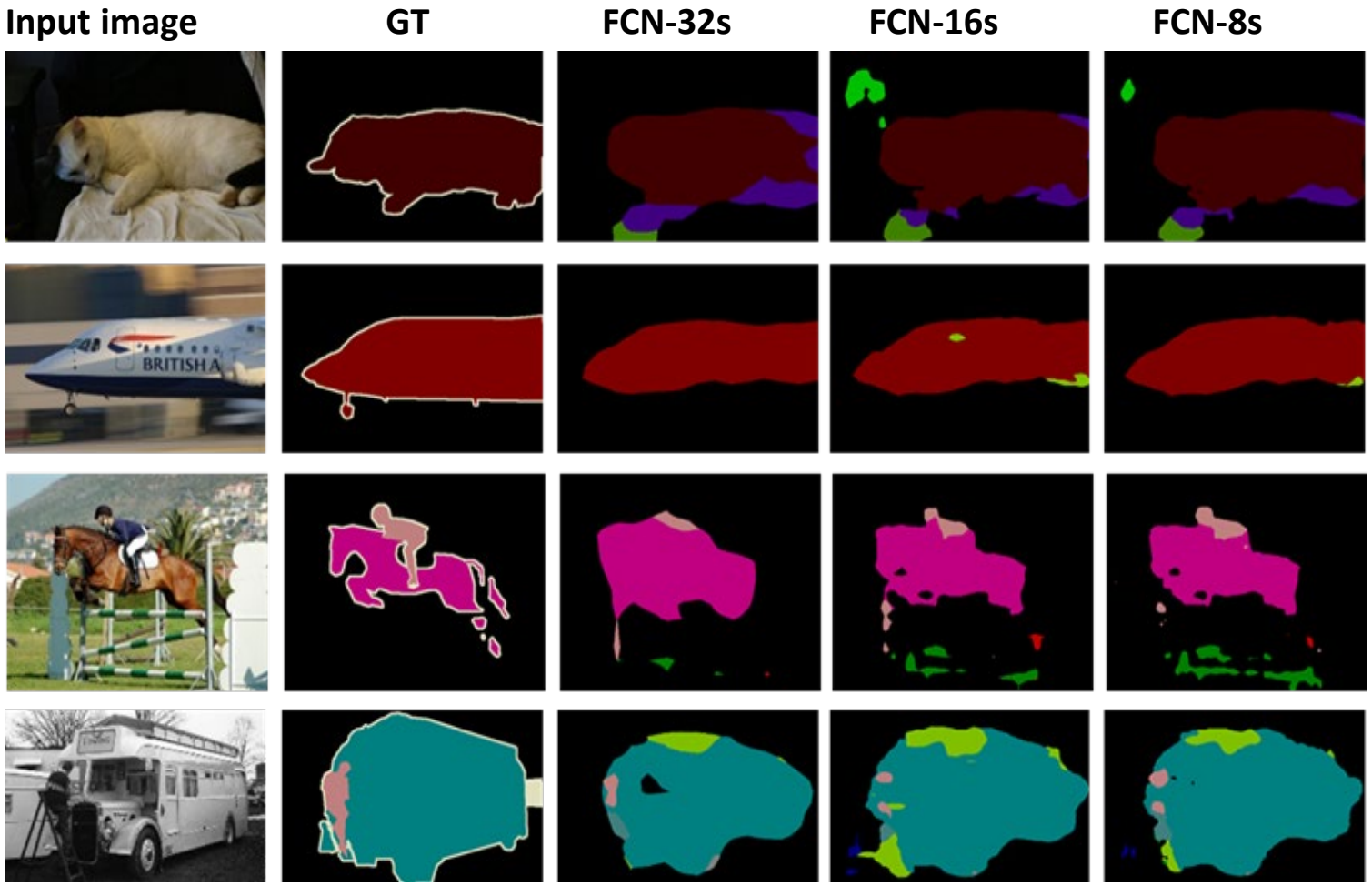
Fully Convolutional Network

- Skip architecture - Ensemble of three different scales



Jonathan et al., Fully convolutional networks for semantic segmentation, *CVPR* 2015.

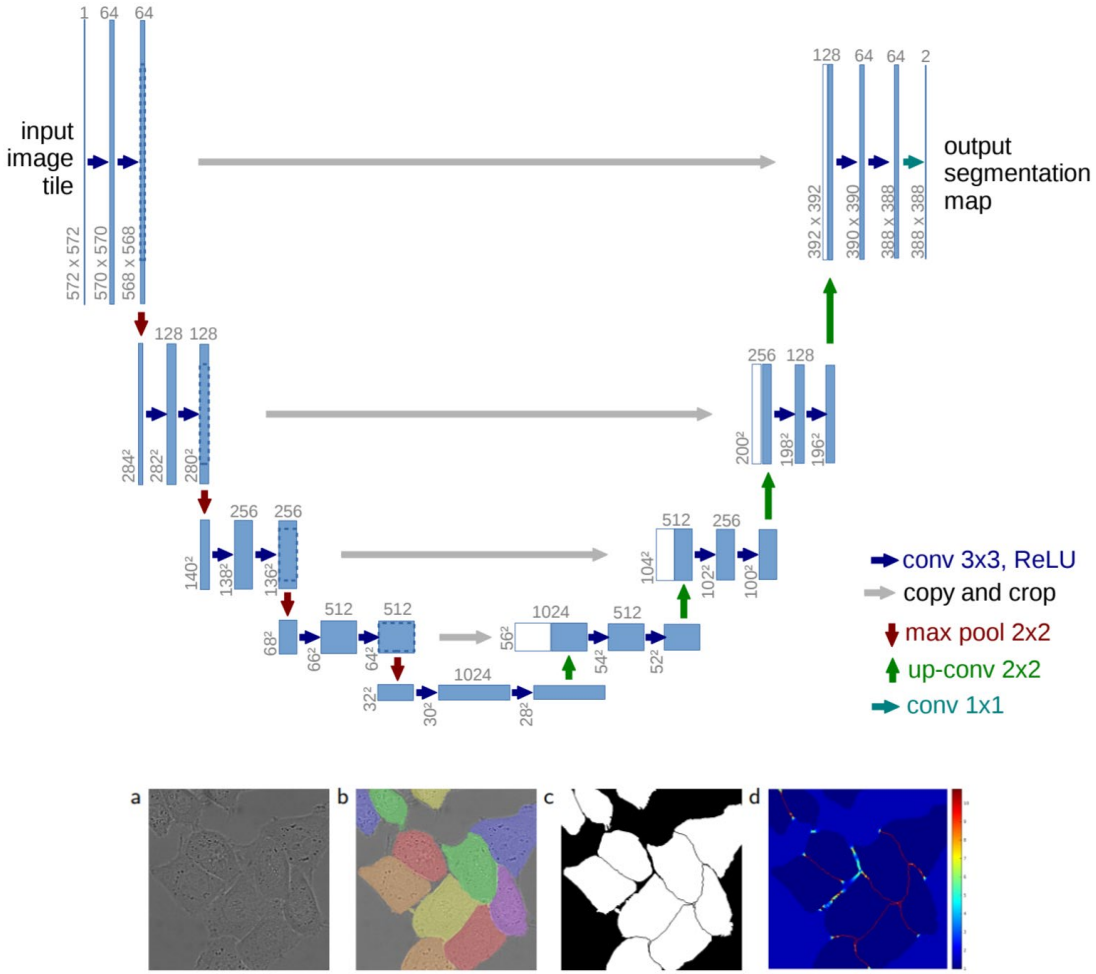
Fully Convolutional Network



Jonathan et al., Fully convolutional networks for semantic segmentation, *CVPR* 2015.

U-Net

- U-Net: Convolutional Networks for Biomedical Image Segmentation



*Ronneberger et al, U-Net: Convolutional Networks for Biomedical Image Segmentation, *MICCAI 2015*

U-Net

- U-Net: Convolutional Networks for Biomedical Image Segmentation
- Today's practice is based on U-Net.
  - To reduce computation, we reduce channel a lot