Convolutional Neural Networks For Semantic Segmentation

Course 3, Module 5, Lesson 2

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Learning Objectives

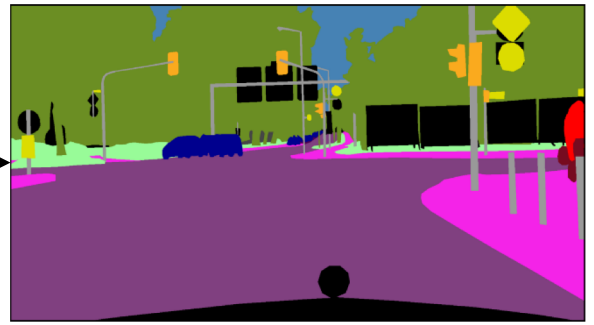
- Learn how to use convolutional neural networks to perform the semantic segmentation task
- Learn the different layers required for the good performance of semantic segmentation models

The Semantic Segmentation Problem

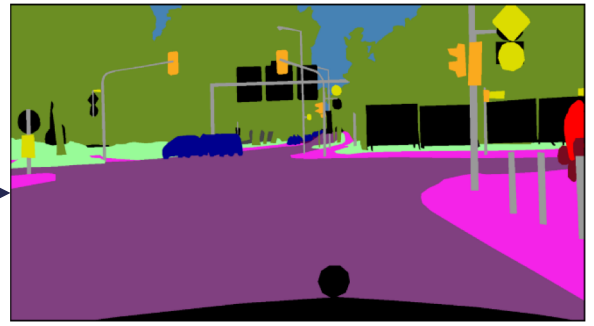
- Road
- Sidewalk
- Pole
- Traffic Light
- Traffic Signs
- Vegetation
- Terrain
- Sky
- Car
- Background

ConvNets For Semantic Segmentation

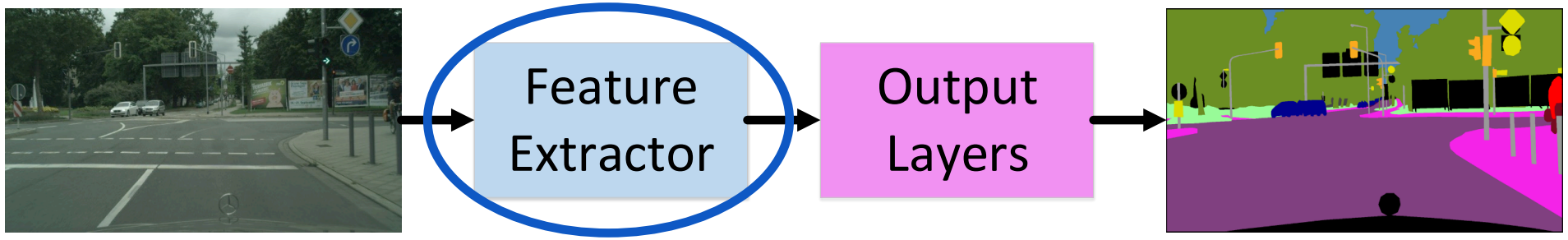
$$f(x;\theta)$$



ConvNet



ConvNets For Semantic Segmentation



The Feature Extractor

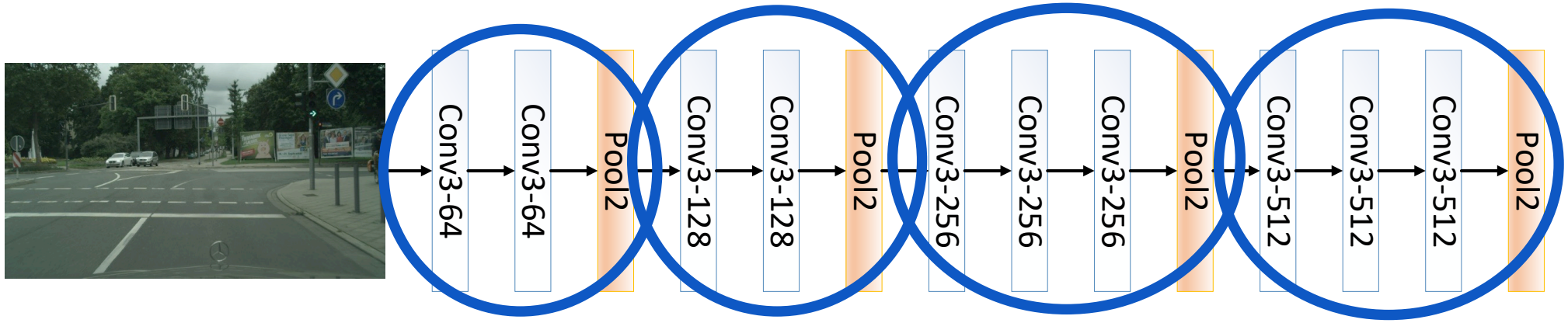
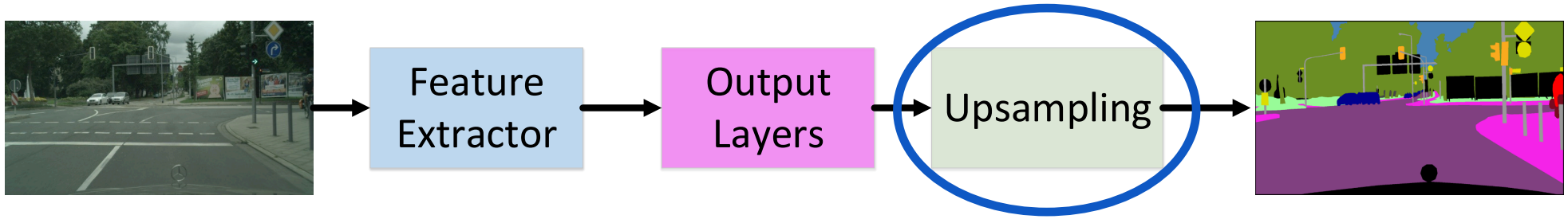


	Image	Conv1	Conv2	Conv3	Conv4
Width	M	M/2	M/4	M/8	M/16
Height	N	N/2	N/4	N/8	N/16
Depth	3	64	128	256	512

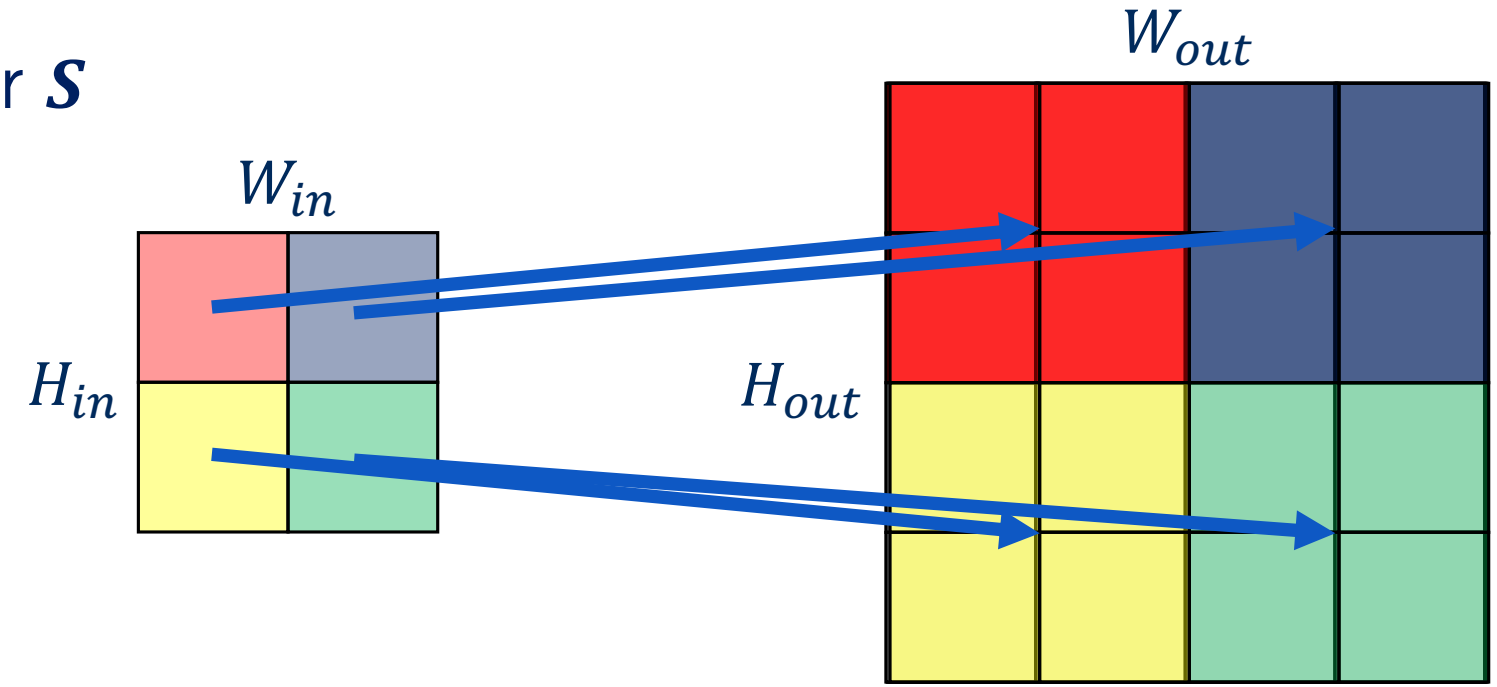
Upsampling the Output



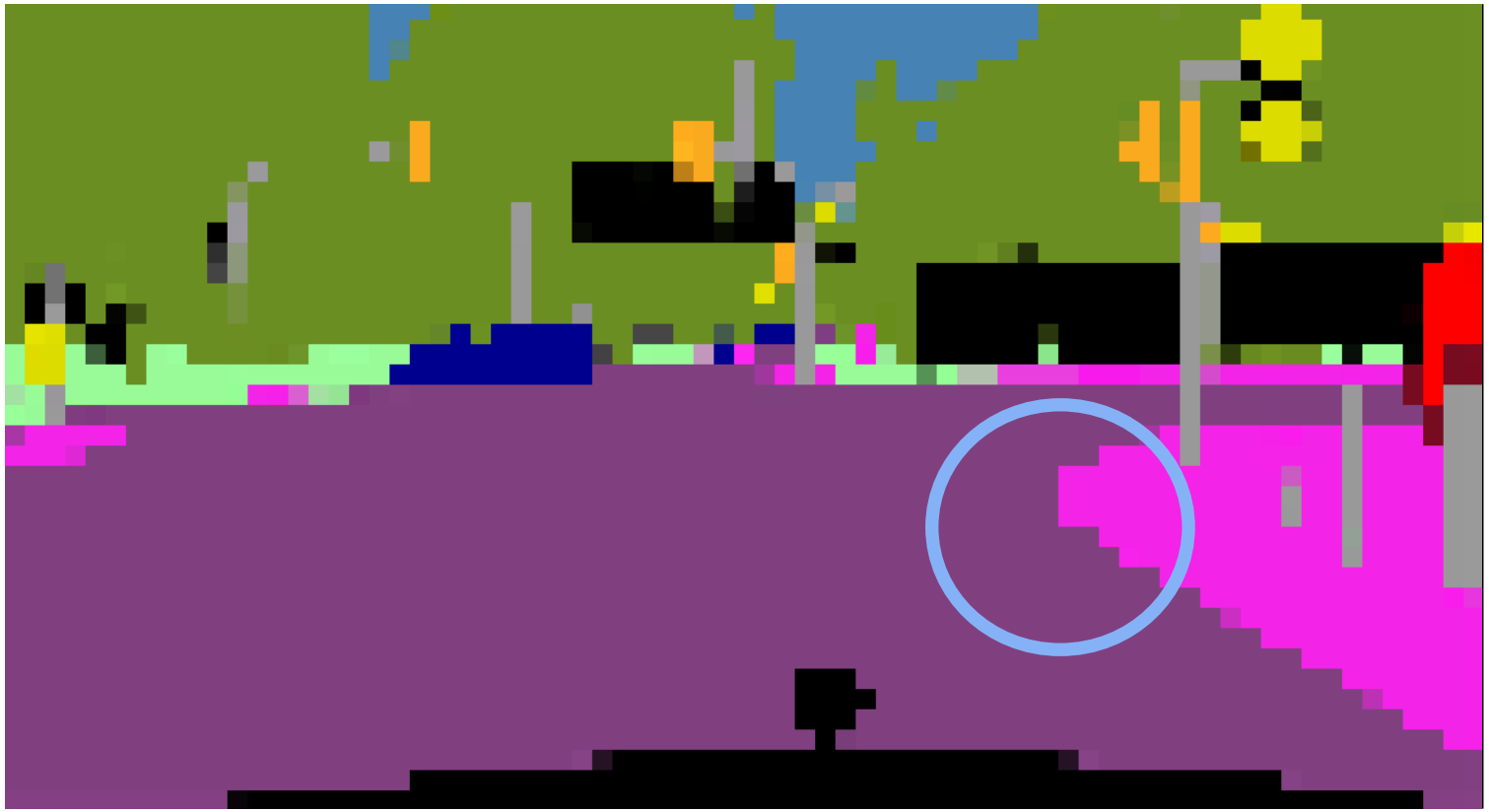
Upsampling Layer

- Upsampling Multiplier $\boldsymbol{S}$

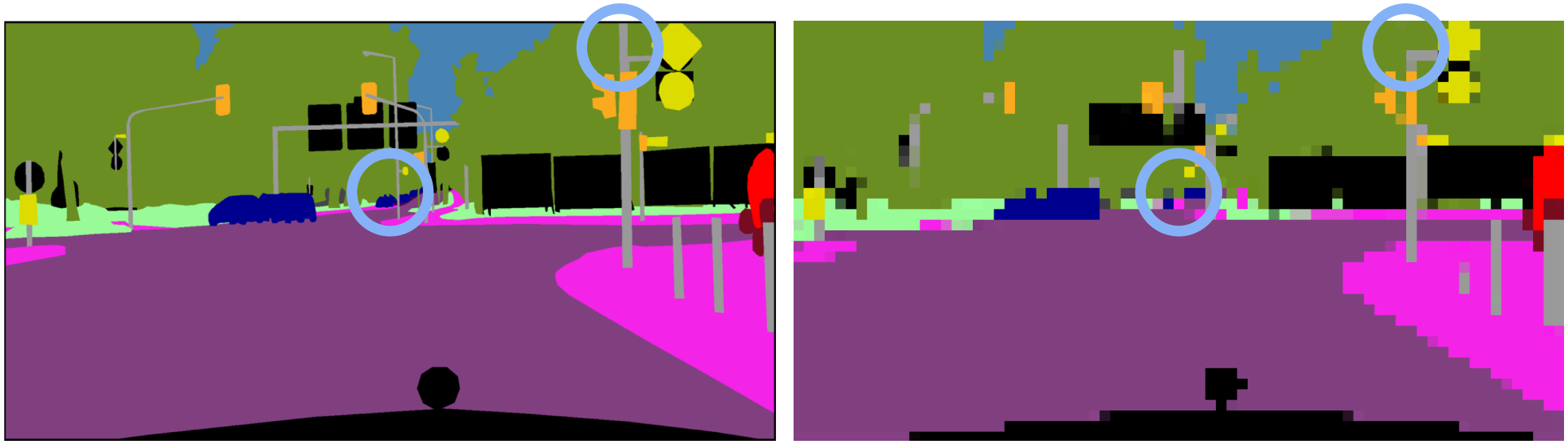
$$\boldsymbol{W_{out}} = S \times \boldsymbol{W_{in}}$$
$$\boldsymbol{H_{out}} = S \times \boldsymbol{H_{in}}$$
$$\boldsymbol{D_{out}} = \boldsymbol{D_{in}}$$



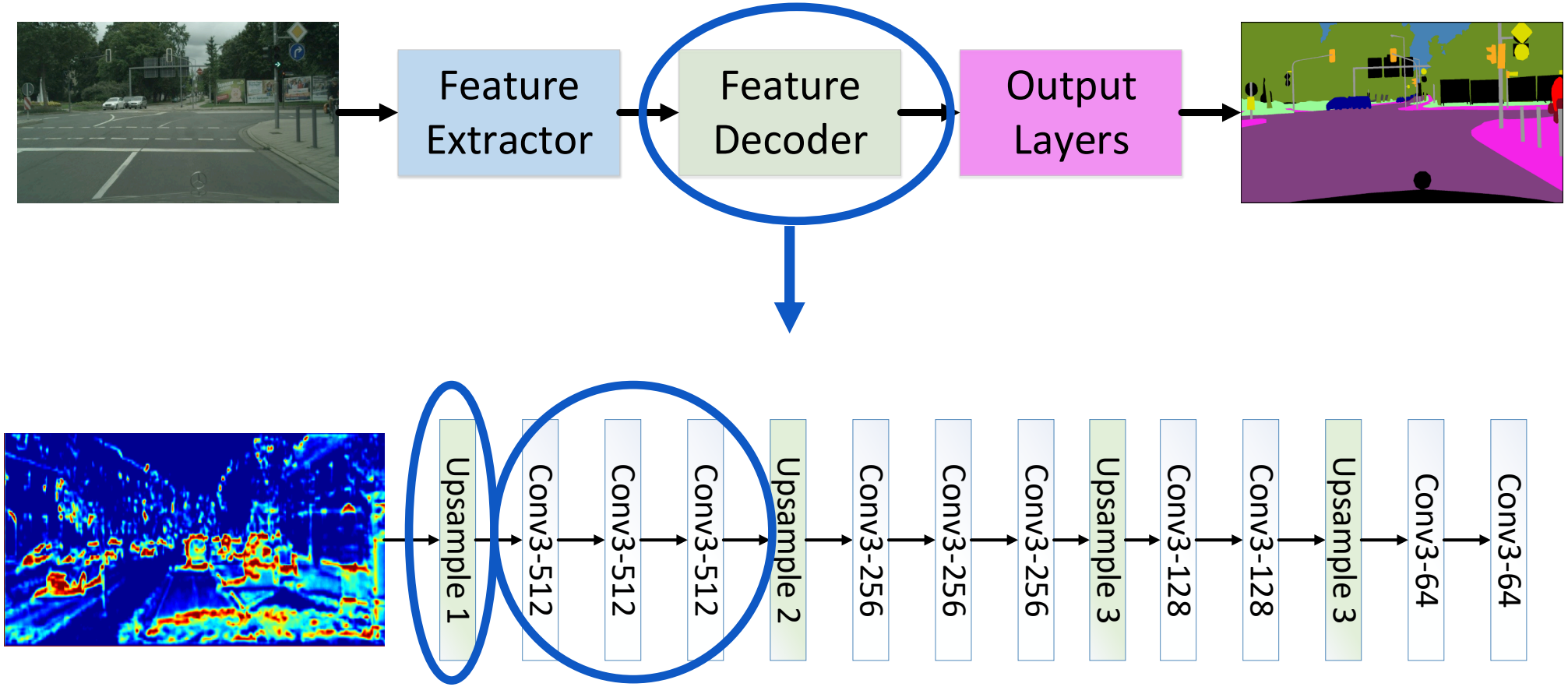
Upsampling The Output



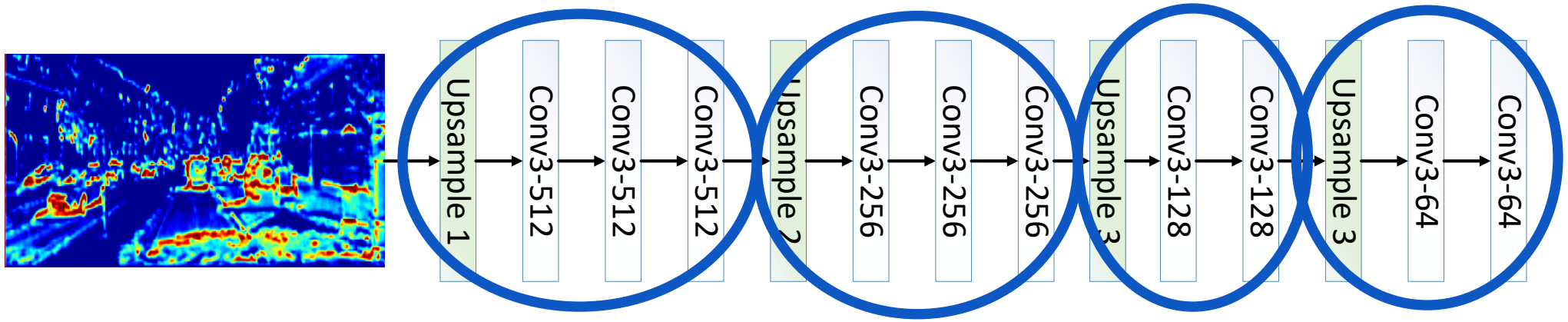
Upsampling The Output



Learning Same Resolution Feature Maps

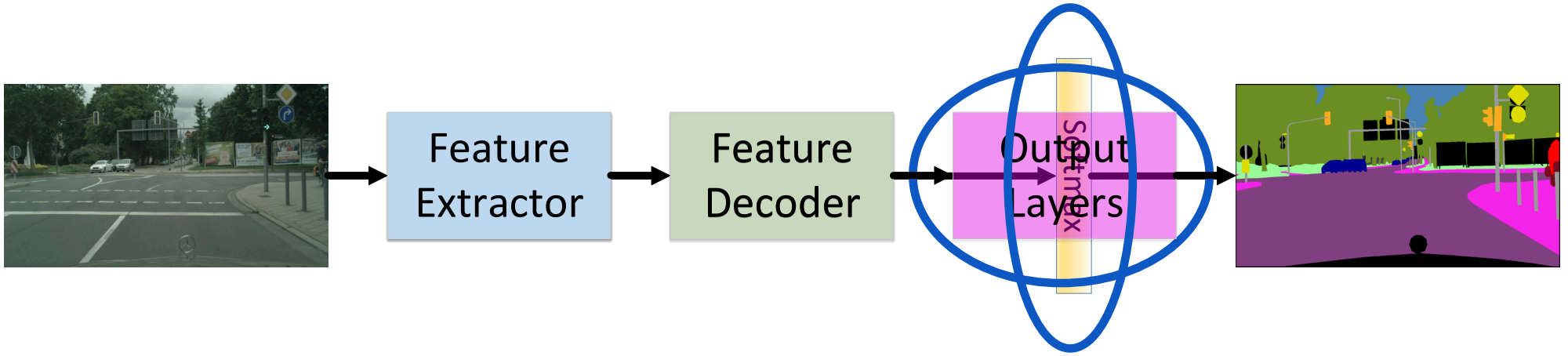


The Feature Decoder

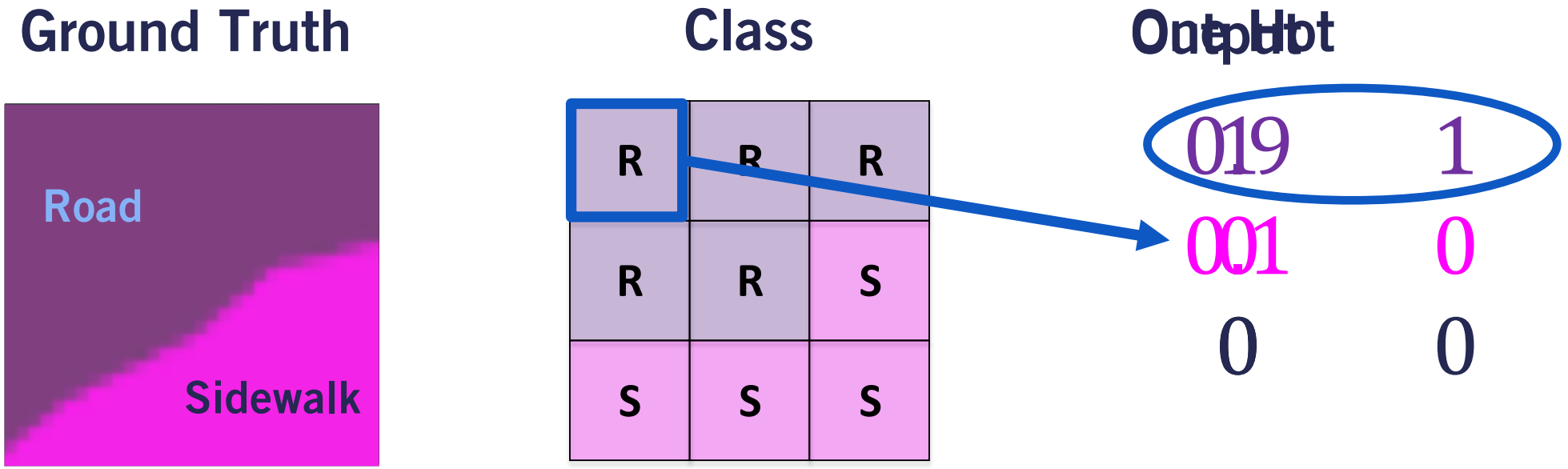


	Feature Map	Deconv1	Deconv2	Deconv3	Deconv4
Width	M/16	M/8	M/4	M/2	M
Height	N/16	N/8	N/4	N/2	N
Depth	512	512	256	128	64

Learning Same Resolution Feature Maps



Output Representation

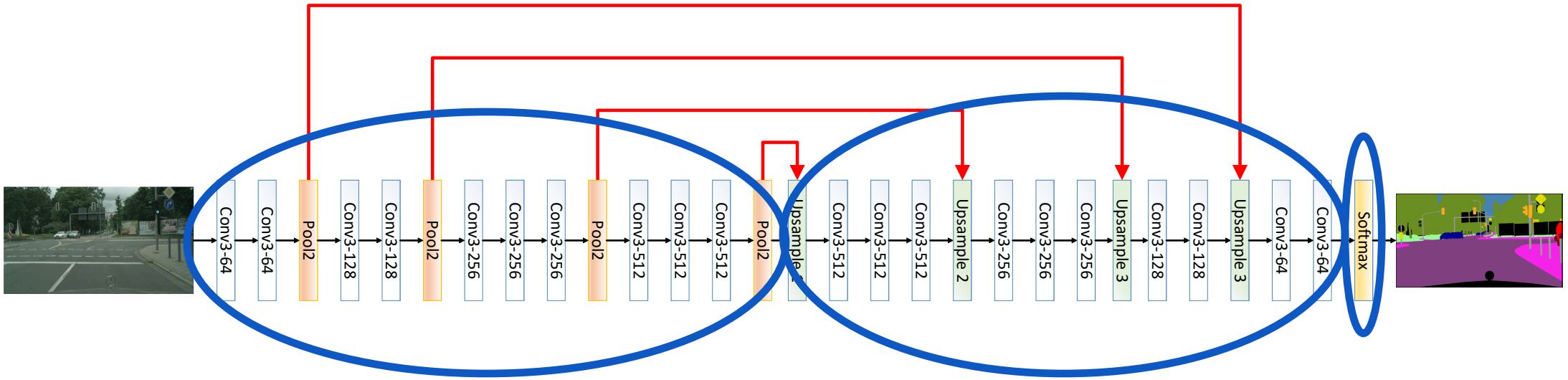


Classification Loss

$$L_{cls} = \frac{1}{N_{total}} \sum_{i} CrossEntropy(s_i^*, s_i)$$

- N_{total} is the number of pixels in all images of our **minibatch**
- s_i is the output of the neural network
- s_i^* is the ground truth classification

ConvNets For Semantic Segmentation



Summary

- Convolutional Neural Networks can be used to solve the semantic segmentation problem
- In a feature extractor and a feature decoder are required to provide the final output of semantic segmentation models

- **Next: Semantic Segmentation For Autonomous Driving**