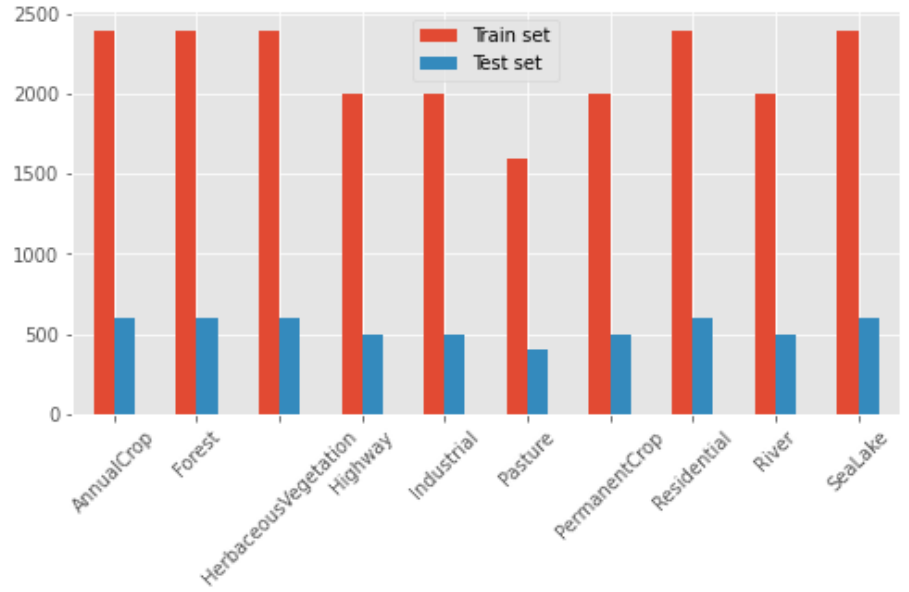
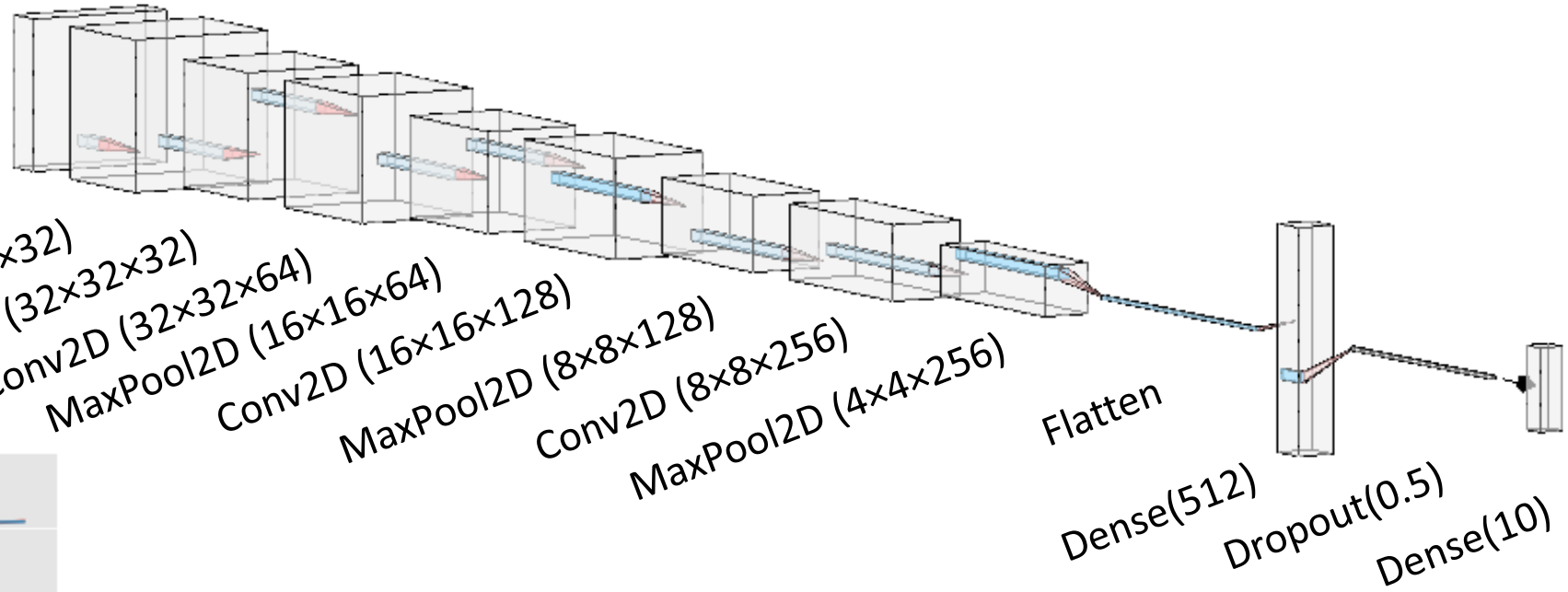
Classification of Satellite Images with Convolutional Neural Network

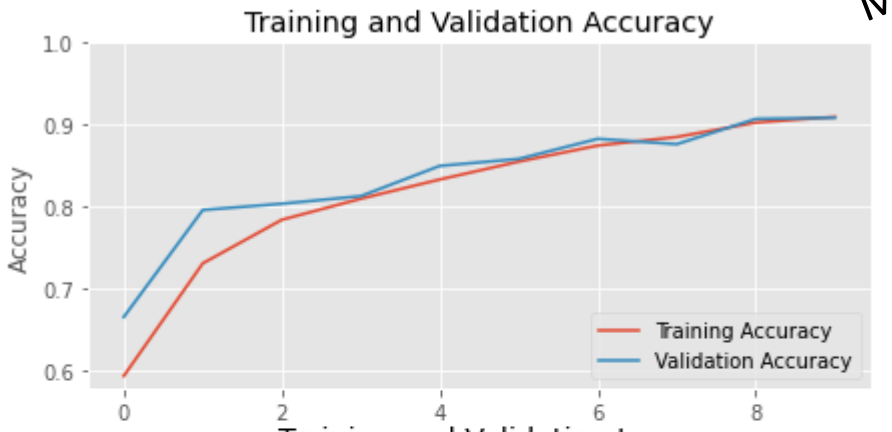
Dataset

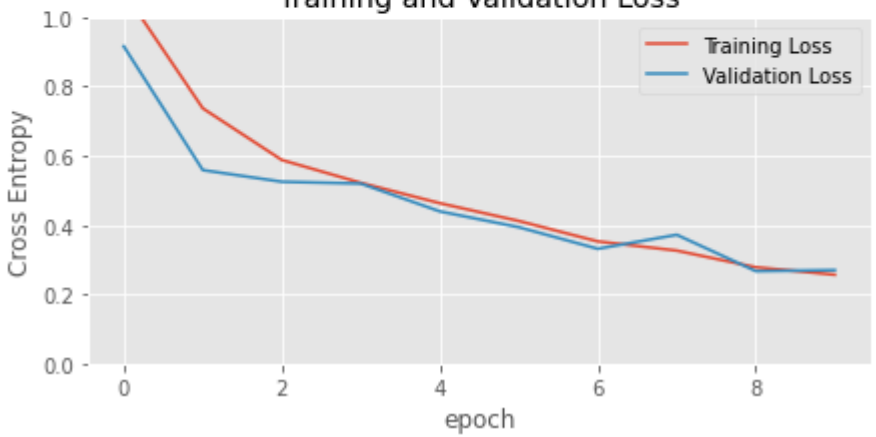
- 27.000 satellite images
- referenced in 10 classes
- jpeg format
- 64 × 64 px
- RGB



Modelling

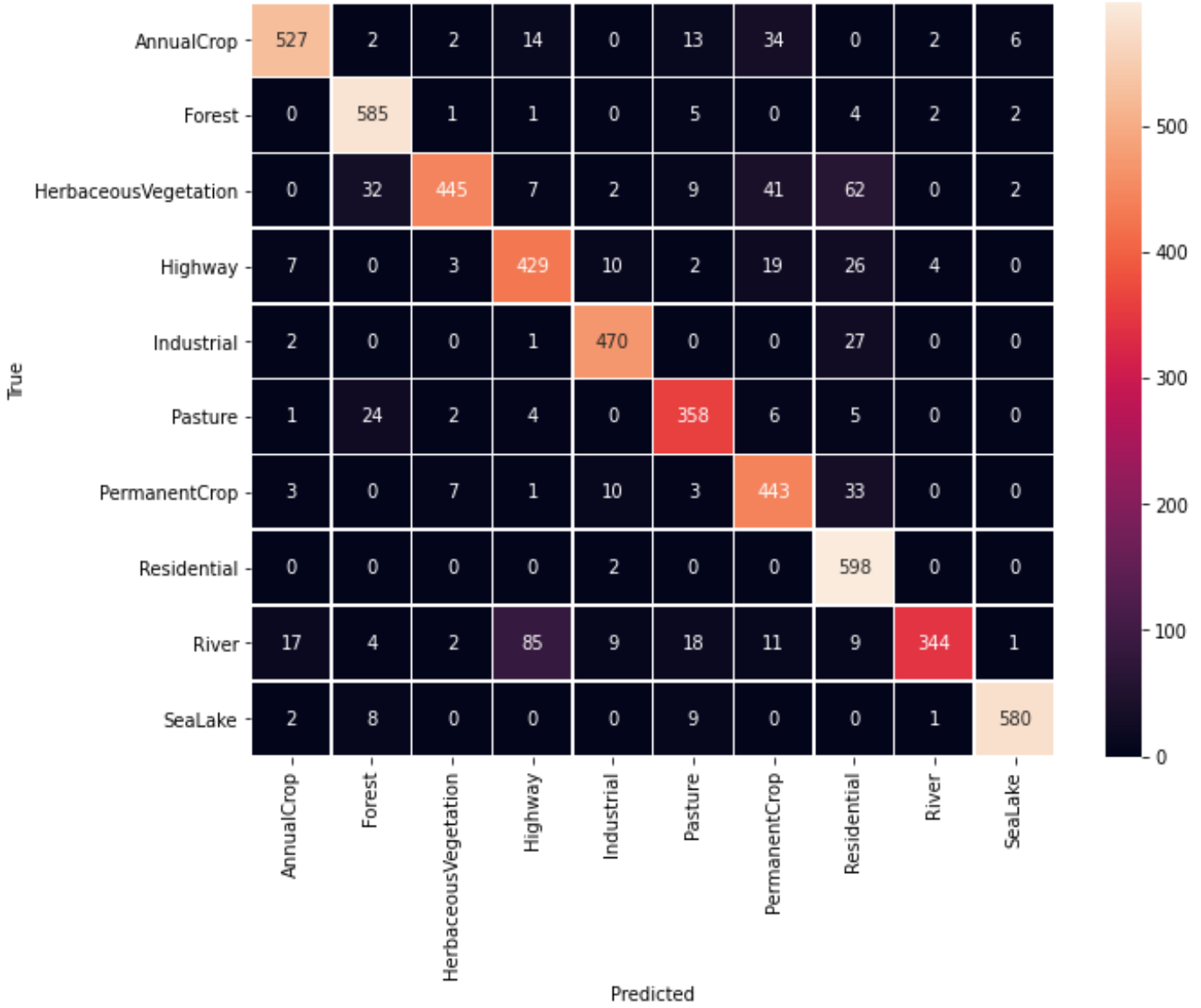






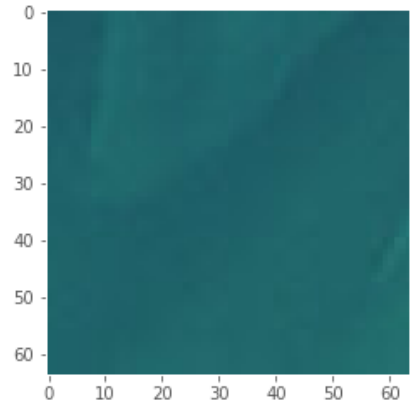
- 4 convolutional layers
- Max pooling after each layer
- Additional Dense layer and Dropout before the final layer

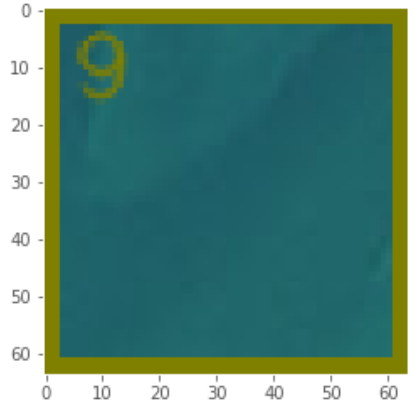
Model	Loss	Accuracy
Own configuration	0.3176	0.8893
Transfer learning (pretrained weights)		
MobileNetV2	0.5232	0.8474
VGG16	0.4214	0.8528
Fine-tuning (about 1/3 of (last) layers unfrozen/retrained)		
MobileNetV2	0.4929	0.8420
VGG16	0.2257	0.9250
Image augmentation in addition to fine-tuned models (against overfitting)		
MobileNetV2	0.3492	0.8870
VGG16	0.2788	0.9093
Early stopping (stop training when there is no improvement in validation loss)		
VGG16	0.2661	0.9143

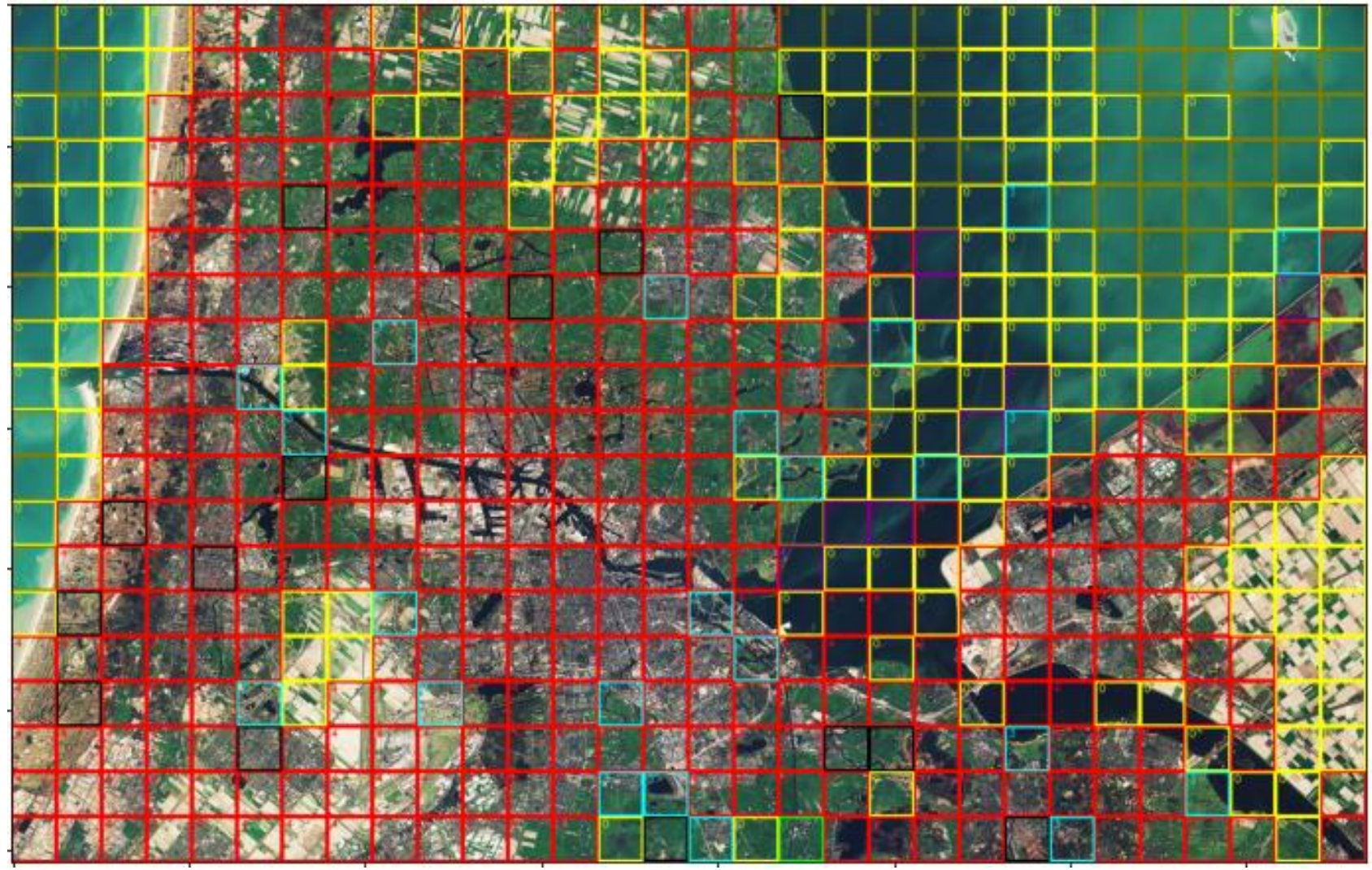


VGG16 fine-tuned (last 5 layers retrained) with image augmentation and early stopping

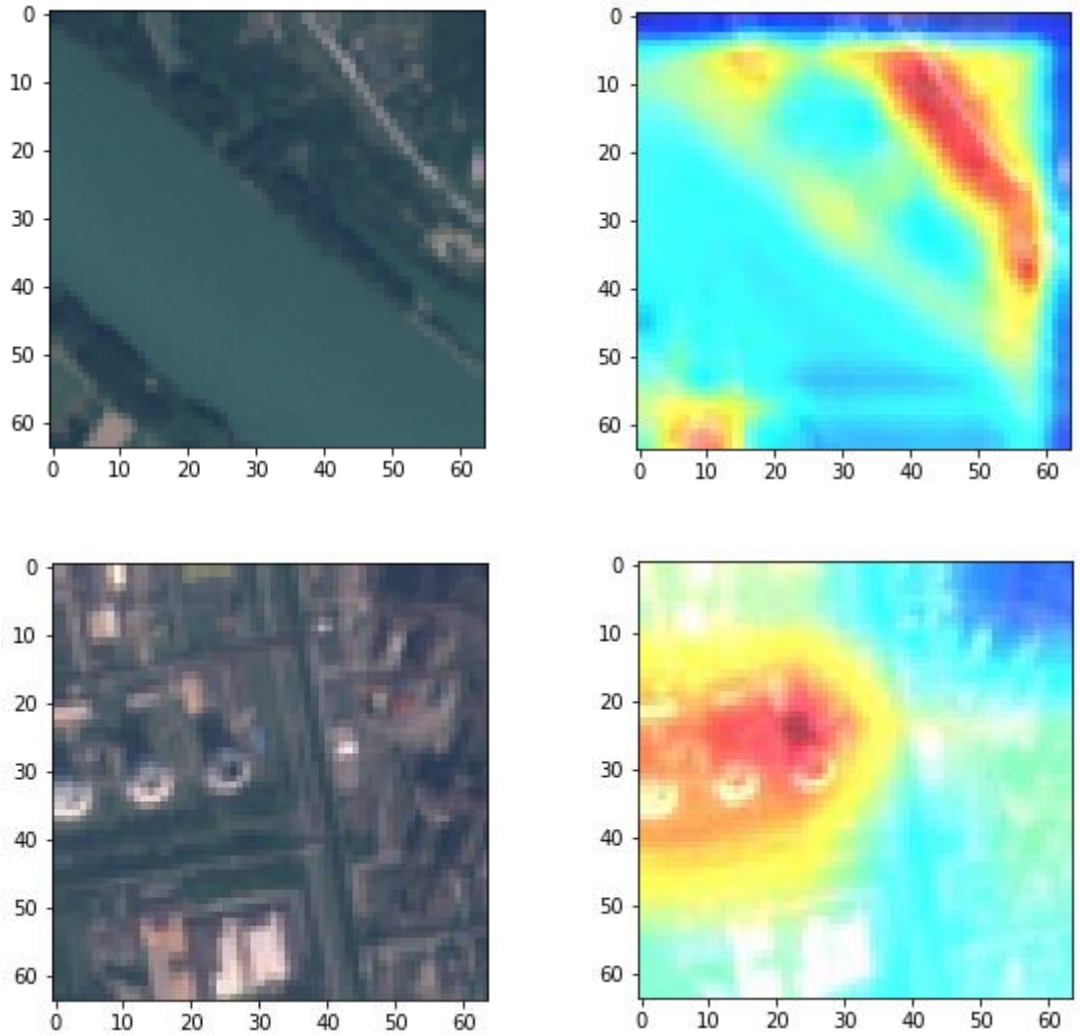
Segmentation

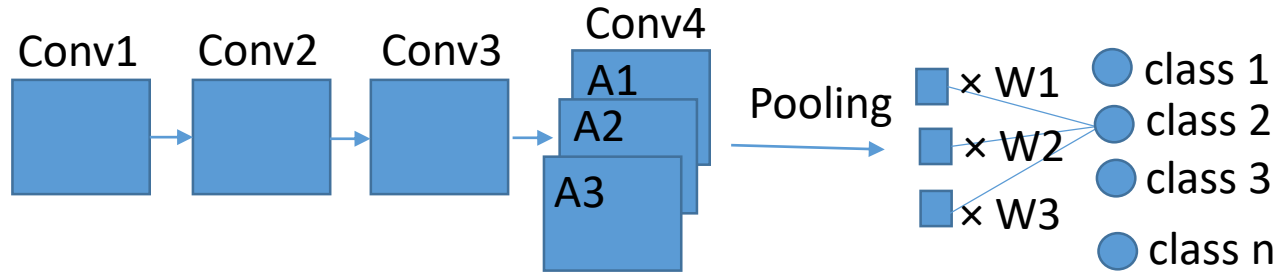






Class Activation Map





- The last convolutional layer produces K feature maps that are pooled and linearly transformed to produce a score for each class
- CAM computes the linear combination of the final feature maps using the learned weights of the final layer, normalized to lie between 0 and 1 for visualization
- CAM = W1A1 + W2A2 + W3A3+…+WnAn

Sources:

- EuroSAT: A land use and land cover classification dataset based on Sentinel-2 satellite images
  http://madm.dfki.de/downloads

- TensorFlow: Transfer learning with a pretrained ConvNet
  https://www.tensorflow.org/tutorials/images/transfer_learning

- Plotting CNN architecture:
  http://alexlenail.me/NN-SVG/AlexNet.html

- CNN Heat Maps: Class Activation Mapping (CAM)
  https://glassboxmedicine.com/2019/06/11/cnn-heat-maps-class-activation-mapping-cam/