

Deep Learning Lab

Autonomous Intelligent Systems

Exercise 3

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Objective

The objective of this exercise is to grasp the concepts and components of a decoder module of a fully convolutional network. Another goal is to implement four different configurations, which are described below in the code implementation.

Fully Convolutional Network

A fully convolutional network consists of an encoder and a decoder. The encoder in this exercise consists of four convolutional layers with a stride of 2, that produces a feature map whose spatial resolution is 16 times lower than the input image. The

Decoder takes this feature map as input and upsamples it to a resolution equal to the input image. The upsampling function is done by using a transposed convolution. In other configurations, a skip connection is introduced after convolution to enable the subsequent block to extract more abstract, class-salient features from the previously pooled features.

Code Implementation

The following four configurations have been implemented in nets_definition.py file.

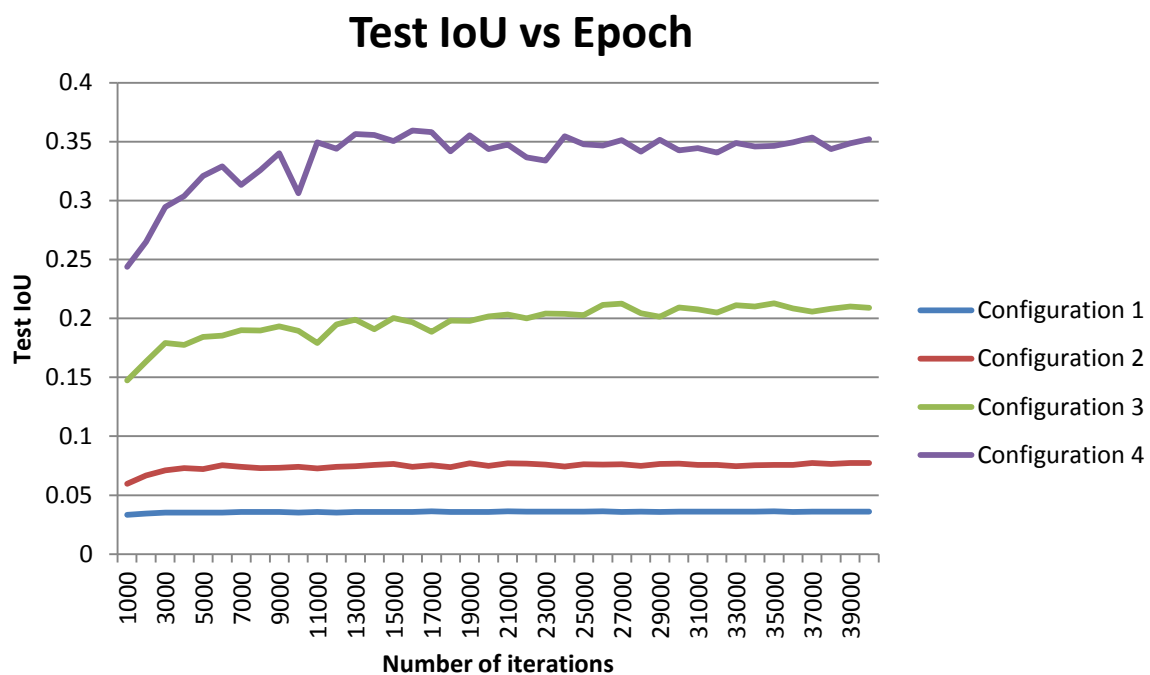
Configuration 1: A number of 120 upsampled feature maps are created using a stride of 16, as the output has to be upsampled by a factor 16. *Configuration 2:* A skip connection 'DB4_skipconnection' has been added to the decoder. *Configuration 3:* Two skip connections 'DB4_skipconnection' and 'DB3_skipconnection' are used in configuration 3. *Configuration 4:* Configuration 4 consists of the full decoder, which comprises three skip connections 'DB4_skipconnection', 'DB3_skipconnection' and 'DB2_skipconnection'.

Training and Testing

For training and testing, we use the CamVid dataset, which includes 468 training images and 233 testing images. For training, we use train_net.py file and for testing, we use test_net.py which produces a table of corresponding IoU value for every 1000th iteration. IoU value is an evaluation metric used to measure the accuracy. IoU value stands for Intersection over Union.

Results and Observations

Graph 3.1 shows the IoU value per epoch. As we observe the graph, we understand that the configuration 1 shows the lowest IoU value and accuracy. By adding one skip connection in configuration 2, it exhibits a better IoU value. The highest IoU value is observed in configuration 4, which has three skip connections in total. Thus, it can be said, the higher the number of skip connections, the better is the IoU value and accuracy.



Graph 3.1. Test IoU vs. Epoch

Table 3.1 shows the maximum IoU value for each configuration. Configuration 4 with three skip connections shows the highest IoU value, while configuration 1 having no skip connections shows the least IoU value.

Configuration	Maximum value of IoU
1	0.036360628
2	0.077444442
3	0.212936111
4	0.359382847

Table 3.1. Maximum IoU value