**Department of Electronics & Communication Engineering**

National Institute of Technology Karnataka, Surathkal, Karnataka, India

**EC460- Neural Networks and Deep Learning**

# Assignment 6: CNN Models for Image Segmentation and Classification

**Issue date: 03-11-2021 Submission date: 10-11-2021**

**Q.1.** Implement CNN(VGG16) model using Keras/Tensorflow library for Steel Defect Detection from dataset **(**<https://www.kaggle.com/c/severstal-steel-defect-detection/data>). For implementation, split dataset into training dataset (80%) and testing dataset (20%) ). Use a Adam gradient descent algorithm to learn model with parameters for α = 0.01 and random parameters of the CNN model for **Binary cross entropy loss function**. For better training performance, you can use batch-normalization and dropout if necessary.

(i)Plot a comparative loss curve for at least 50 epochs (ii) Print confusion matrix, calculate classification metrics such as precision, recall, F1-score, IoU and accuracy on test dataset and ROC curve.

**Q.2.** Implement CNN(VGG16) model for **Predicting Invasive** Ductal Carcinoma (IDC)  **in Breast Cancer Histology Images (**<https://www.kaggle.com/paultimothymooney/breast-histopathology-images>**).**For implementation, split dataset into training dataset (80%) and testing dataset (20%) ).Use an Adam gradient descent algorithm to learn model with parameters for α = 0.01 and random parameters of the parameters of the CNN model for **Focal loss function**. For better training performance, you can use batch-normalization and dropout if necessary.

(i) Plot a comparative loss curve for at least 50 epochs. (ii)Print confusion matrix, calculate classification metrics such as precision, recall, F1-score, IoU and accuracy on test dataset and ROC curve.

**Q.3.** Implement **FCN8 model** using Keras/Tensorflow library for Building footprint segmentation from aerial remote sensing images **(**[**https://github.com/menvuthy/building-footprint-dataset**](https://github.com/menvuthy/building-footprint-dataset)**)**.For implementation, split dataset into training dataset (80%) and testing dataset (20%) ). Use a Adam gradient descent algorithm to learn model with parameters for α = 0.01 and random parameters of the CNN model for **Dice Loss function**. For better training performance, you can use batch-normalization and dropout if necessary.

(i)Plot a comparative loss curve for at least 50 epochs. (ii) Print confusion matrix, calculate overall as well as classwise classification metrics such as bulding and Background accuracy, Segmentation Accuracy, Dice Coefficient, IoU) on test dataset.

**Q.4.**Implement **U-Net model** for the multi-class schematic segmentation of aerial images **(Dataset:** [**https://www.kaggle.com/humansintheloop/semantic-segmentation-of-aerial-imagery**](https://www.kaggle.com/humansintheloop/semantic-segmentation-of-aerial-imagery)**).** Use an Adam gradient descent algorithm to learn model with parametersfor α = 0.01 and random parameters of the model for **Focal loss function.** For better training performance, you can use batch-normalization and dropout if necessary.

(i)Plot a comparative loss curve for at least 50 epochs. (ii)Print confusion matrix, calculate overall as well as class-wise classification metrics such as precision, recall, F1-score, IoU, Accuracy on test datset.

**Q.5.(**a)Write python from scratch for 2D Depthwise Separbale convolution between input image(lena.jpg) and depthwise and pointwise filters are as follows and also compute number of multiplications and parameters required for 2D Depthwise Separbale convolutions

**depthwise filter array = np.array([[[1, 2, 1], [2, 4, 2], [1, 2, 1]], [[1, 2, 1], [2, 4, 2], [1, 2, 1]], [[1, 2, 1], [2, 4, 2], [1, 2, 1]]])/16**

**pointwise filter array = np.array([[1], [1], [1]])/512**

(b) Write python from scratch for 2D Atrous/Dilated cnvolution between input image(lena.jpg) and filter which is given below with rate 3: **filter= np.array([[1, 2, 1],[2, 4, 2], [1, 2, 1]])/16**