Alexandria Univeristy
Faculty of Engineering
Computer and Communication Program

CCE: Computer Vision
Assigned: Mon, Dec 27, 2021
Due: Fri, Jan 14, 2022

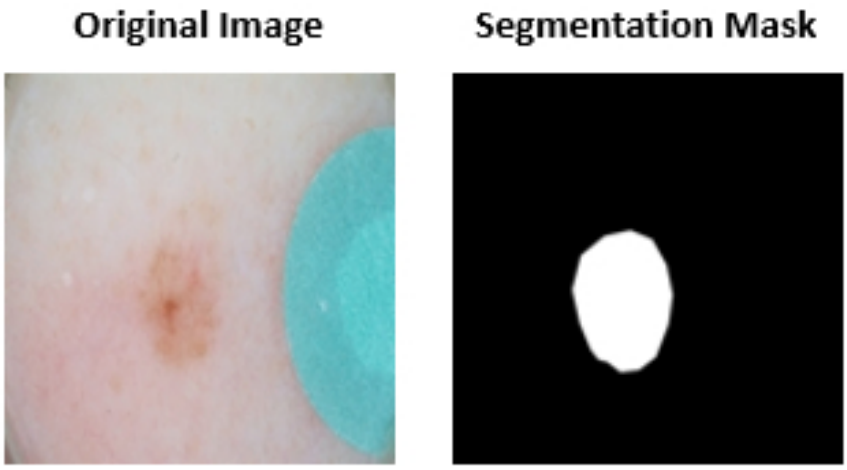
Assignment 4

1 Image Segmentation

Image segmentation is the task of assigning each pixel a label which is a class that it belongs to. In binary segmentation, you only have two classes: foreground and background. In this assignment you will work on a binary segmentation problem and you will implement and test two famous architectures Fully Convolution Network and U-Net.

1.1 Melanoma Diagnosis Using Lesion Segmentation

In this task you will work on ISIC challenge where you will segment lesions (foreground) out of dermoscopic images.



You will be using using ISIC's 2017 train, validation and test sets. The train set consists of 2000 images along with their ground truth masks and superpixel images(discard for this assignment). The mask should contain 2 values: 0 for background and 255 for foreground. During training you will convert the mask to 0, and 1 values before feeding it to the network.

1.2 Networks

1. Fully Convolution Network (FCN): It is implemented using a VGG-16 backbone but instead of the 3 fully connected classification layers, the first two are replaced with a 1x1 convolution with the same number of filters. The last layer is replaced with 1x1 convolution layer with the number of filters equals the number of classes. Finally a deconvolutional layer that upsamples the output to the original image size is added to produce the final prediction.

Good Luck!

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2. UNet: Instead of producing the output as a sever upsampling out of the last feature map, it designs a decoder that doubles the feature map size until it reaches the image size. Also it introduces the skip connection technique to combine the encoder and decoder learned features to produce finer segmentation masks. Refer to Figure 1 in the paper to implement the network arcitecture.

1.3 Training Details

The input to each network consists of the RGB image and the binary mask ground truth.

- You will train the model from scratch for 50 epochs minimum, you can adjust the number of epochs based on your observation of the train loss behaviour.
- The loss you will use is the Jaccard Loss which is 1-IoU score.
- The the learning rate of the network is hyperparameter you need to tune, try at least 3 values and provide an explanation of your final choice.
- repeat the training while using VGG's ImageNet pretrained weights in FCN.

1.4 Analysis

- You will use the IoU score as the evaluation metric
- you are required to identify some failure and success cases (predicted masks with low and high IoU scores)

2 Bonus

1. Use medical images pretrained weights for FCN and UNet.
2. Write the report using Latex.
3. Modify the UNet architecture with any module, providing an explanation for your intuition.
4. Highest 3 teams score will get a bonus mark.

3 Notes

You are required to deliver the following:

- Your code.

- Report including explanation, analysis and the metric output.

You can work in groups of 4.

4 References

1. FCN
2. U-Net
3. ISIC Challenge