

UNets

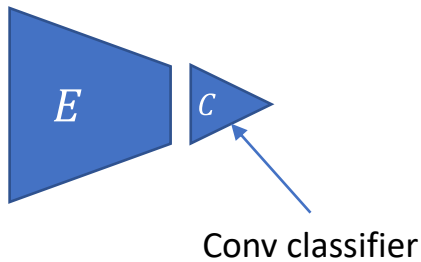
CNN4N Journal Club

Amr Elsayy

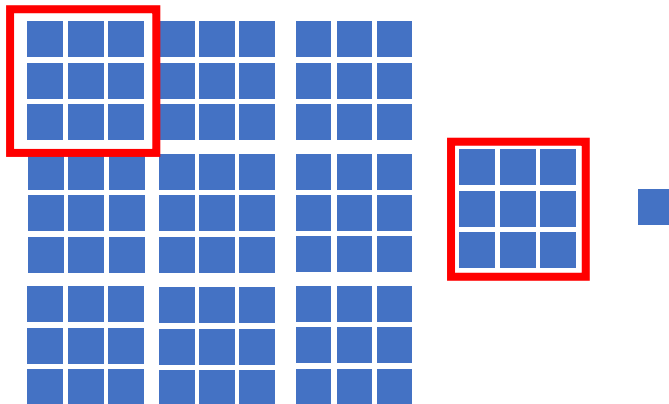
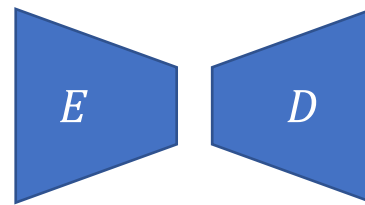
Fully Convolutional Network

- A deep neural network (DNN) that has only Conv layers (i.e., no fully connected layers).

Classification



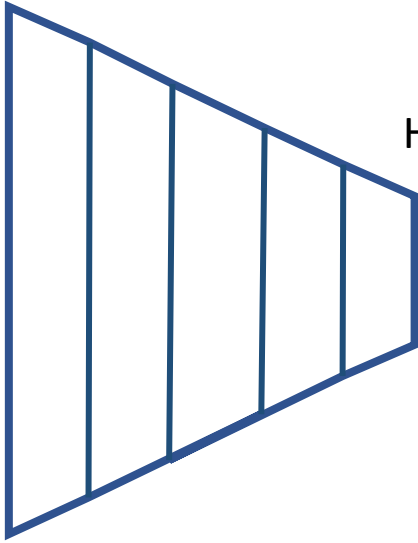
Autoencoder



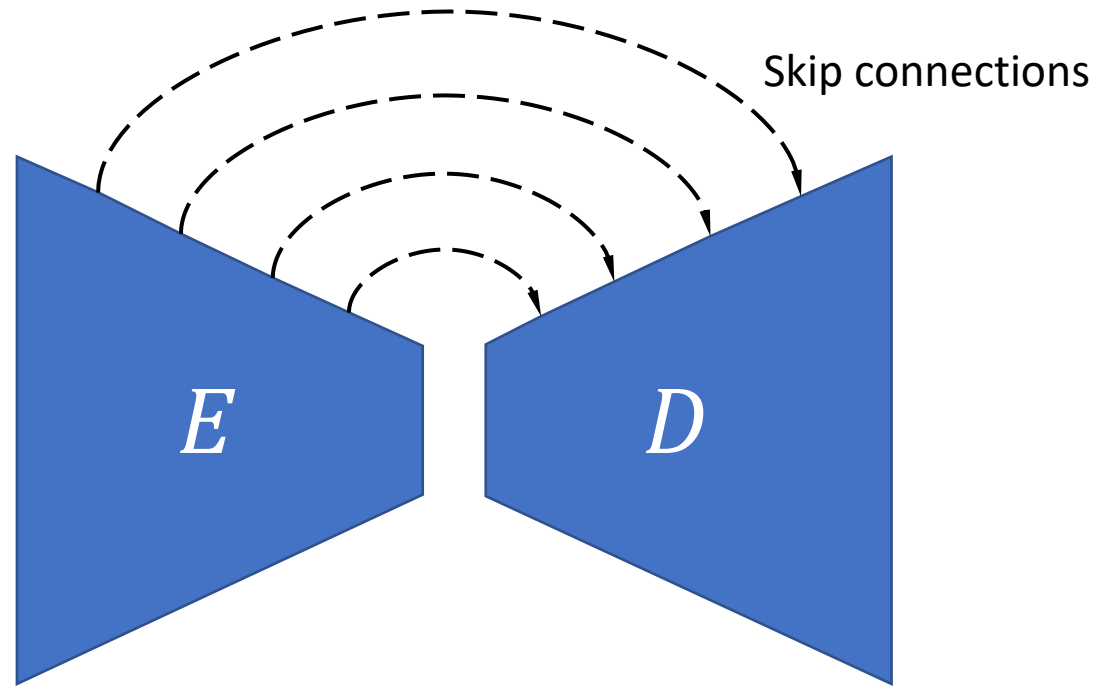
Problem

- Low level details vanish with pooling operations.



Low Level

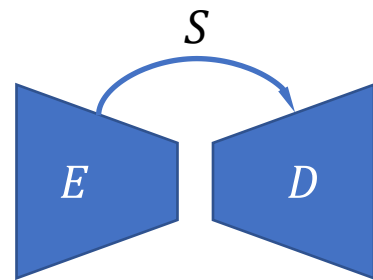


High Level



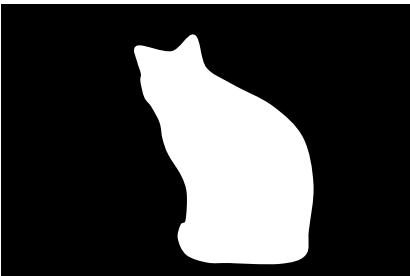
UNet

- *UNet* is a fully convolutional network that has U-like shape.
- *UNet* consists of two parts
 - encoder, encoding path, contracting path 
 - decoder, decoding path, expanding path 
- Additionally, skip connections are used to link between the E and D .



Cont.

- *UNet* is the common network used in segmentation tasks.
- In segmentation tasks, every pixel is labelled as background or foreground (i.e., object).
- *UNet* is used extensively for medical image segmentation.



Segmentation

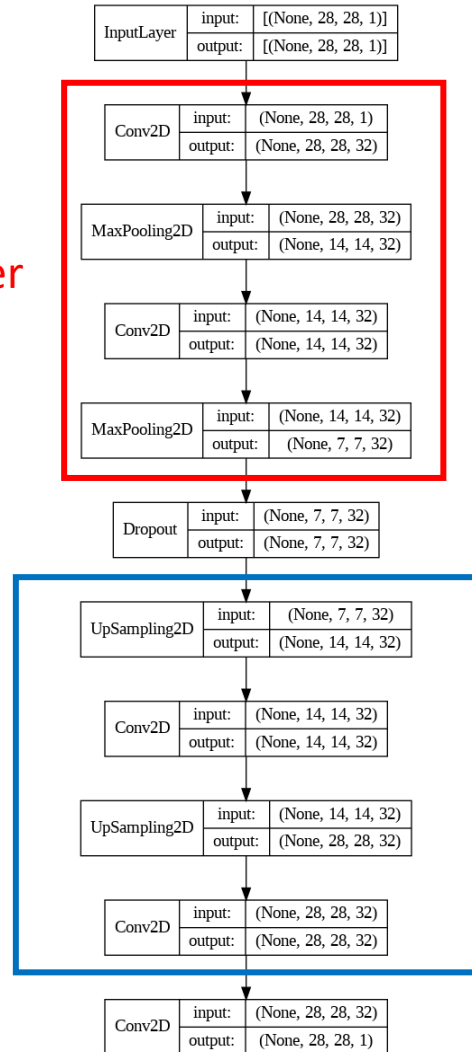
Cont.

- Think of E and D as two similar network.
- $UNet$ represents a mapping that reconstructs the mask m from the data x .

$$m = D(E(x))$$

Architecture

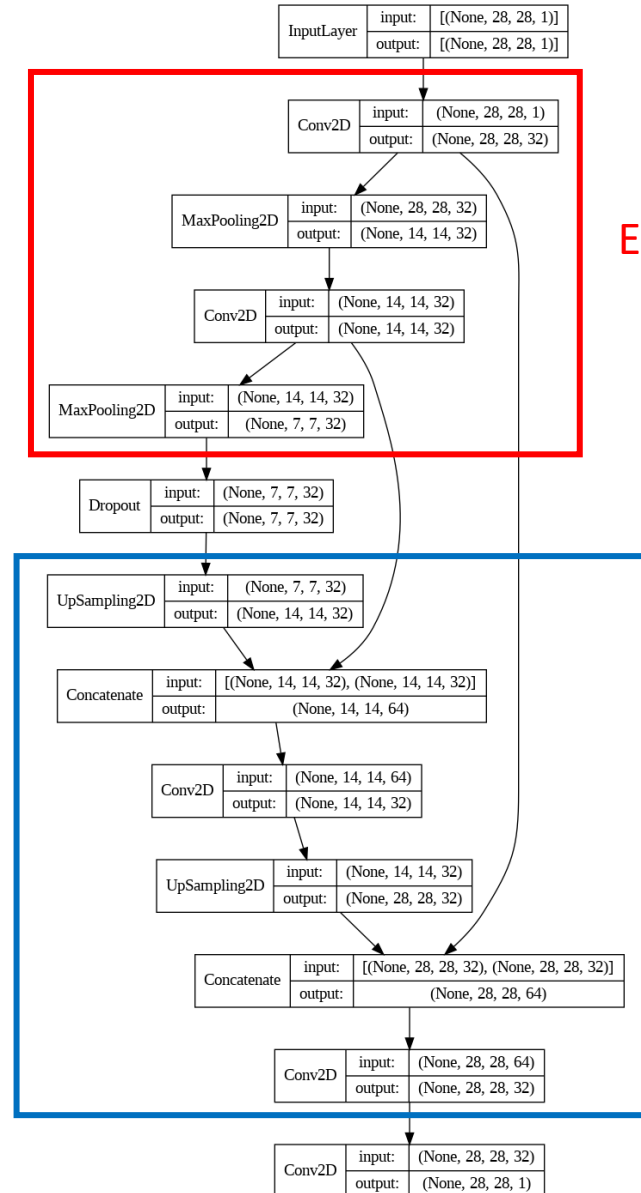
Encoder



Decoder

Autoencdoer

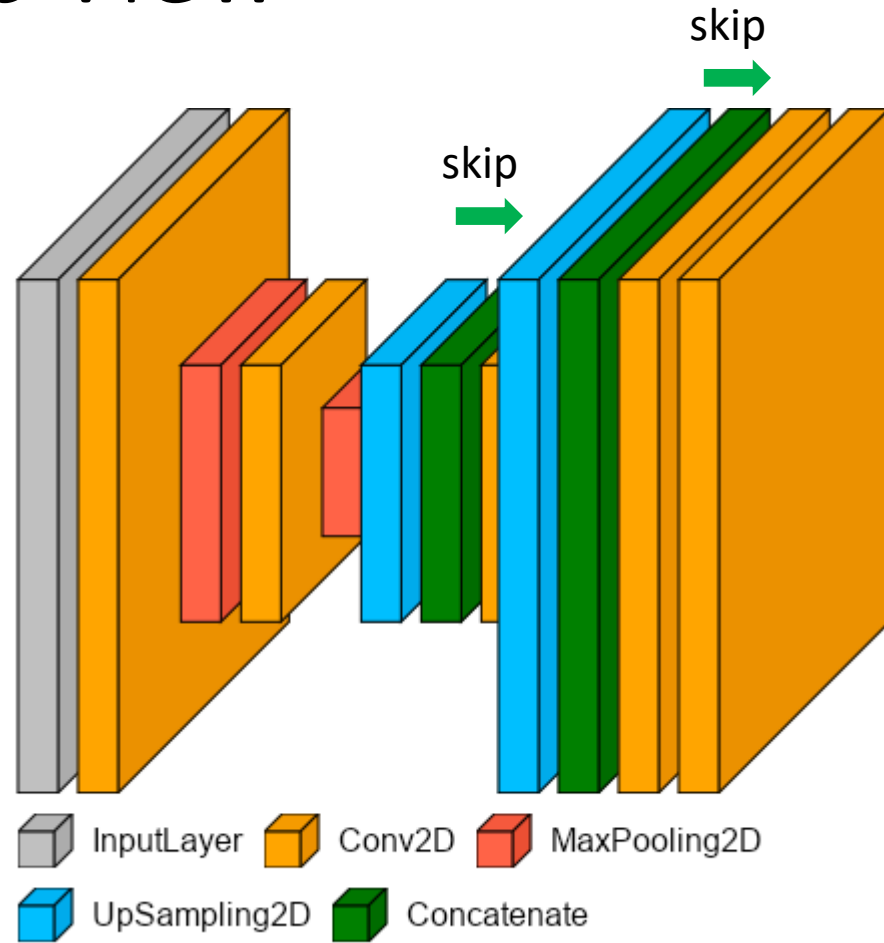
Encoder



Decoder

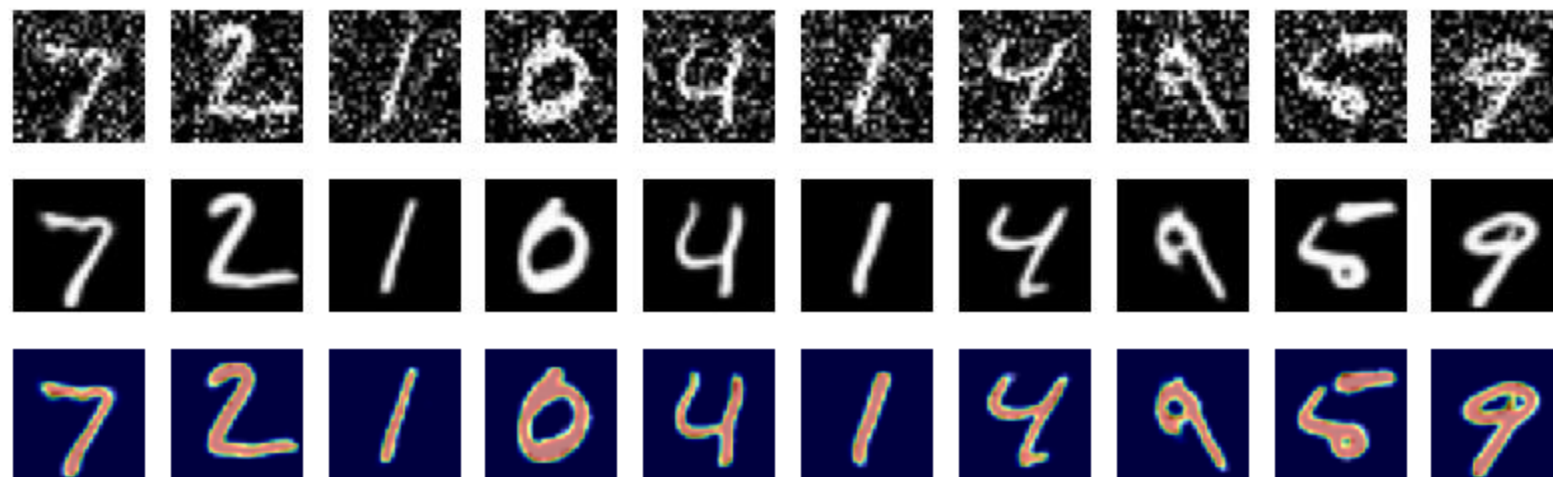
UNet

Schematic View

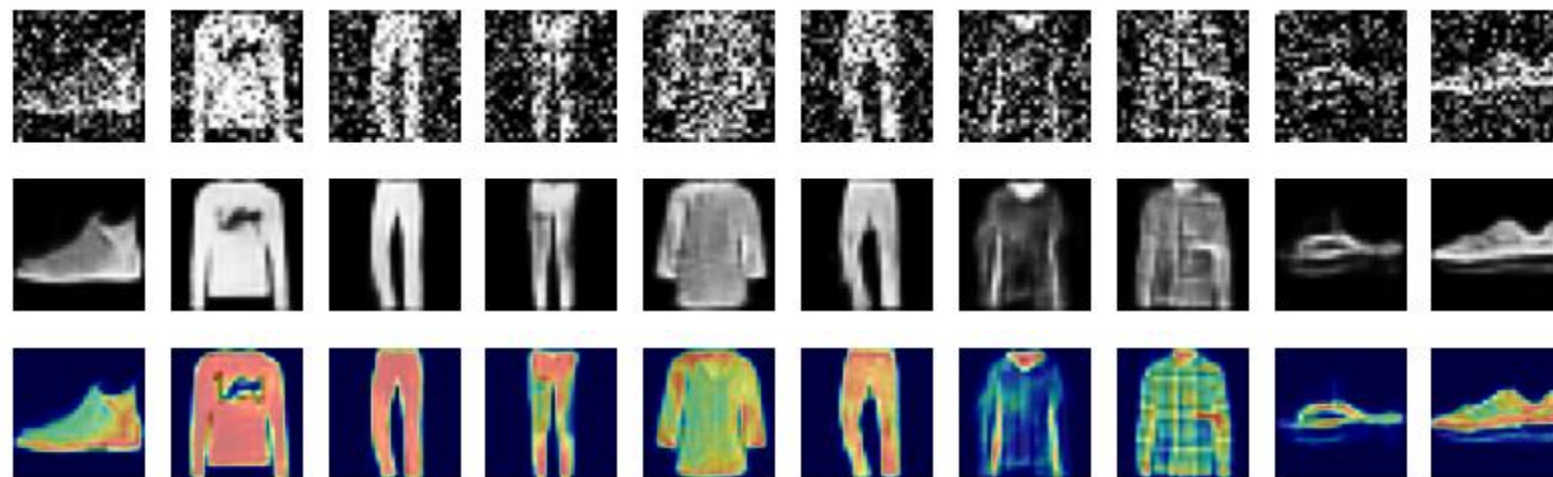


Results

MNIST

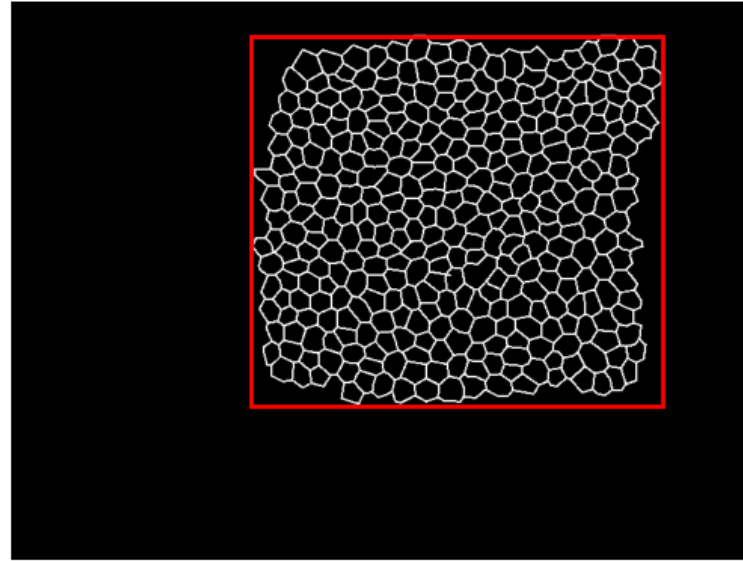
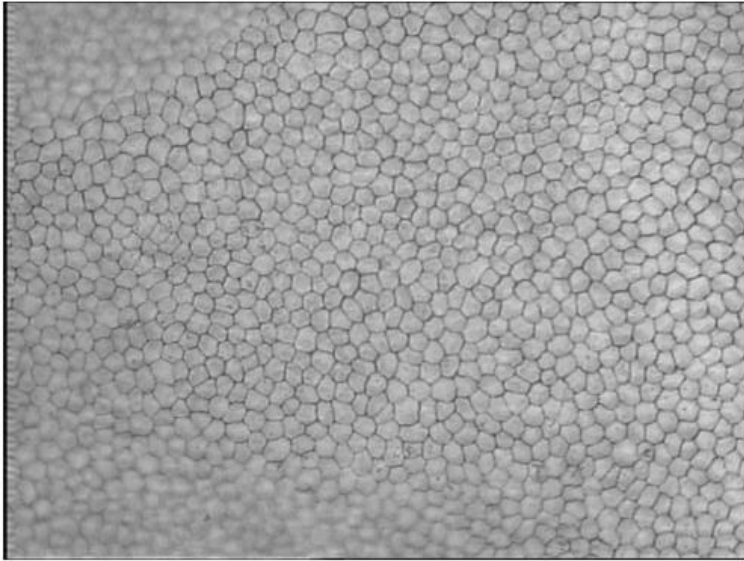


Fashion-MNIST



Endothelial Cell Alizarine Data Set

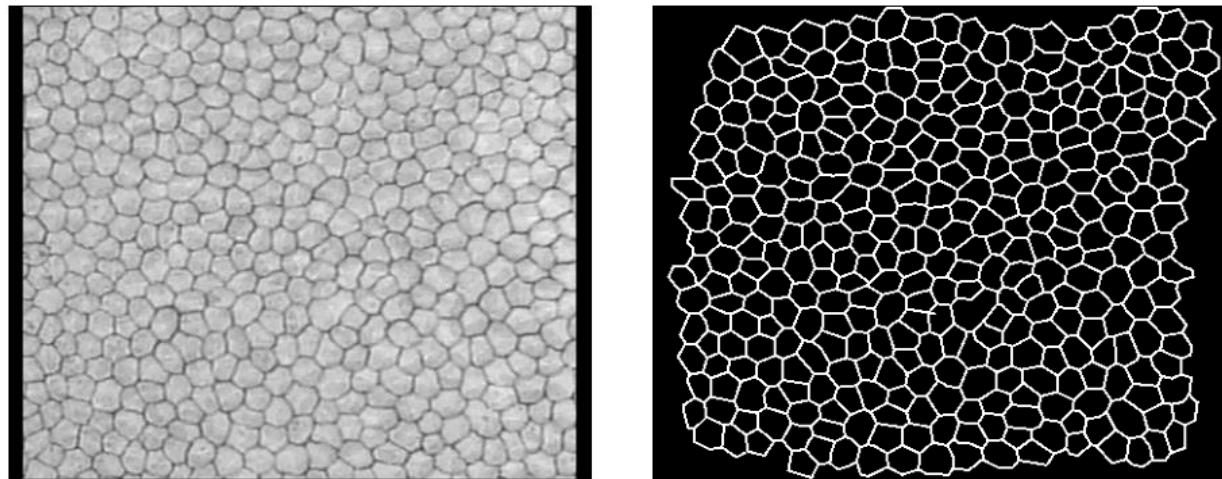
- The dataset consists of 30 images of corneal endothelium acquired from 30 porcine eyes stained with alizarine red and the corresponding manually segmented images.



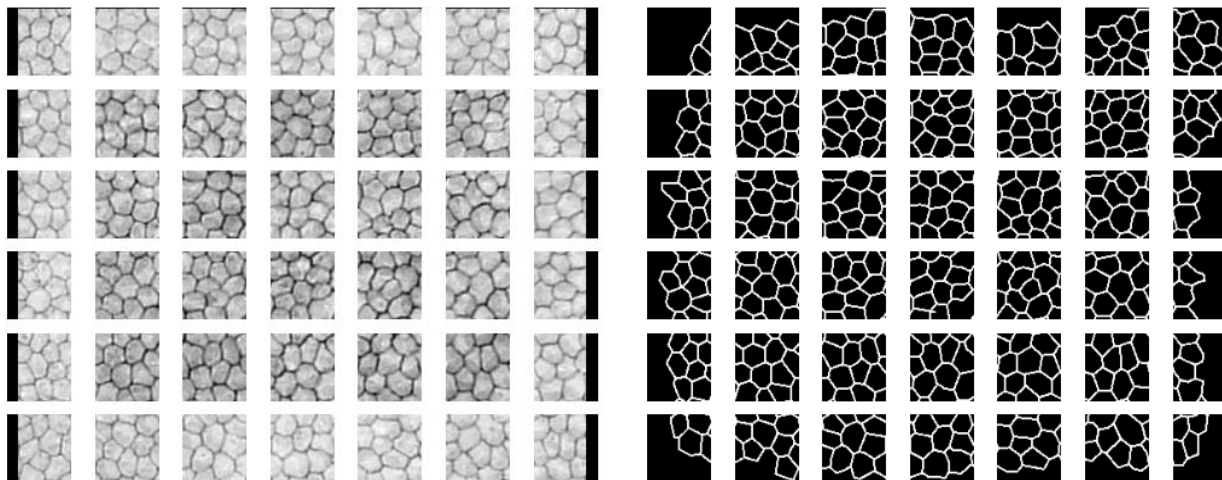
A. Ruggeri, F. Scarpa, M. De Luca, C. Meltendorf, J. Schroeter. "A system for the automatic estimation of morphometric parameters of corneal endothelium in alizarine red stained images", Br J Ophthalmol, 94:643-7, 2010.

Preprocessing

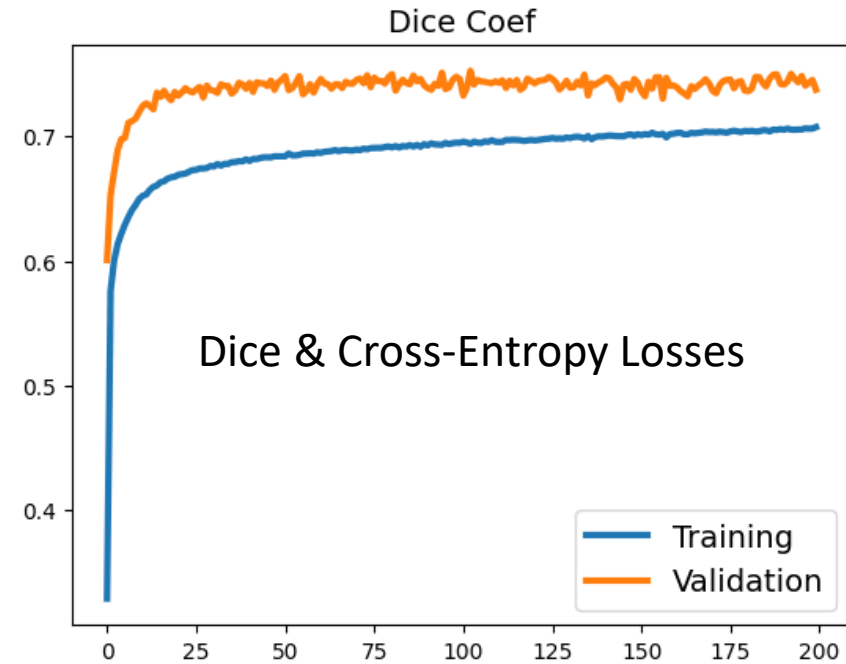
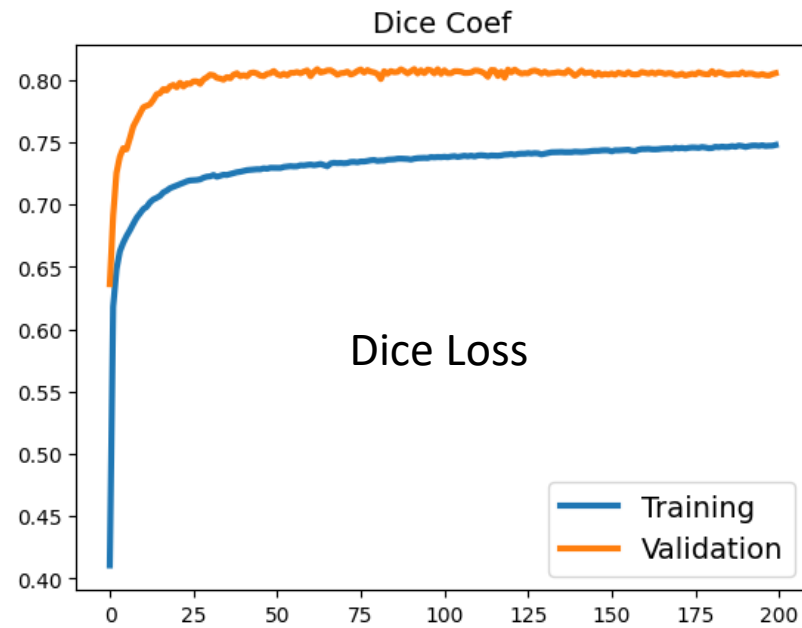
Cropping



Tiling



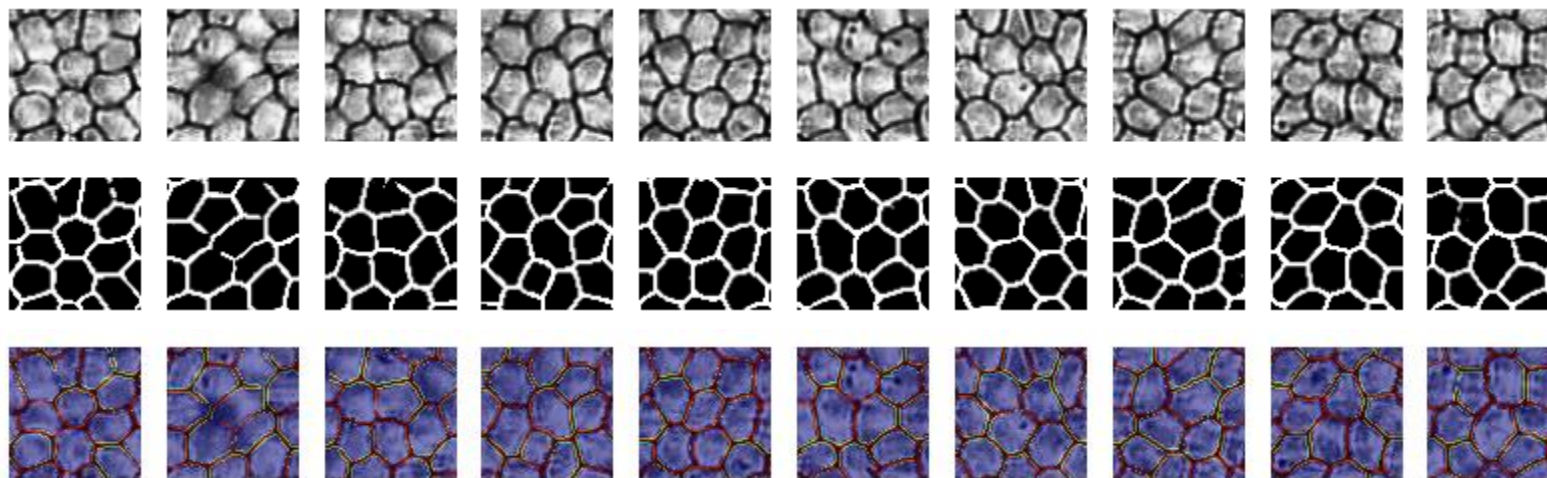
Results



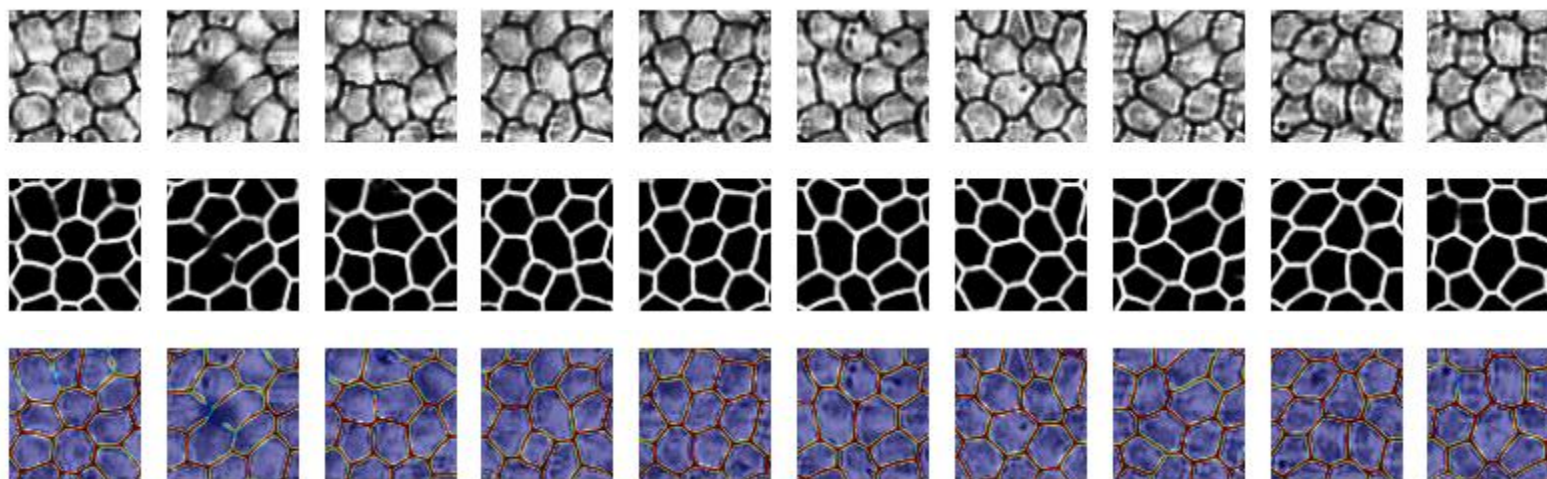
| | Training | Validation |
|------------------|----------|------------|
| Dice Loss | 0.7478 | 0.8054 |
| Dice + CE Losses | 0.7074 | 0.7375 |

Cont.

Dice Loss



Dice & Cross-Entropy Losses



Thanks!