Project 3

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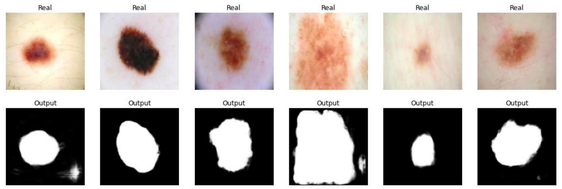
BASIC SEGMENTATION MODEL(UNET)

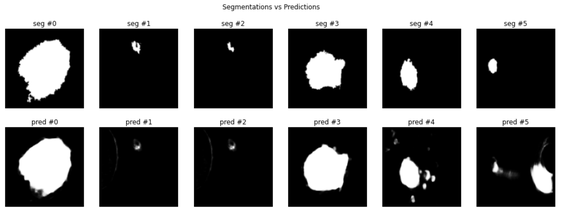
Trainset split: train (80%) - validation (20%)
Metrics: BCE loss & Pixel accuracy
# of epochs: 20

Train: Loss: 0.614 Accuracy: 0.877

Validation: Loss: 0.628 Accuracy: 0.861



Test: Loss: 0.669 Accuracy: 0.935



Remarks:

1. Difficulty identifying unique shapes,
2. Noise in the output segmentations,
3. Underestimate small segmentations,
4. Not very well-defined boundaries.

MAKING A BETTER MODEL

- **Data Augmentations**
  - *Random Horizontal Flip*
  - *Random Rotation [-45º, 45º]*
  - *Random Crop(on squared images)*
  - *Random Vertical Flip*
- **Different loss functions**
  - *Dice loss*

$$DSC = \frac{2|X \cap Y|}{|X| + |Y|}$$

  - *Binary Cross Entropy loss*

$$H_p(q) = -\frac{1}{N}\sum_{i=1}^{N} y_i \cdot log(p(y_i)) + (1 - y_i) \cdot log(1 - p(y_i))$$

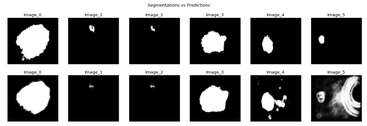
- **Different optimizers:** *ADAM & SGD*

- **SGD** results in more steady and gradual accuracy rise
- **ADAM** shows accuracy fluctuations
- **Best model** (Optimizer/Loss combination): SGD & BCE w. no augmentation - **Accuracy**: 0.872

BIAS FROM TRAINING DATA

Basic segmentation model

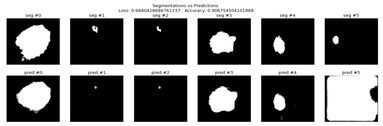
Loss: 0.671 Accuracy: 0.924



- Base model overestimates the masks. Since the model has been trained with both well-defined and coarse annotations, makes sense for it to present an overestimated prediction

Train with Style 1

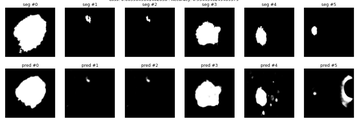
Loss: 0.684 Accuracy: 0.906



- Training with style 1 also resembles well the lesions but creates somewhat bigger predictions and identifies more objects than it should in certain cases

Train with Style 0

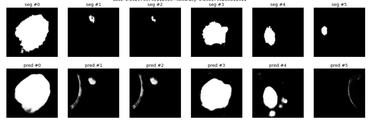
Loss: 0.665 Accuracy: 0.934



- Style 0 closely resembles the annotated lesions apart from certain cases where it fails to identify the segmentation.
- Train and test set have the same annotation style, easier to train

Train with Style 2

Loss: 0. 690 Accuracy: 0.898

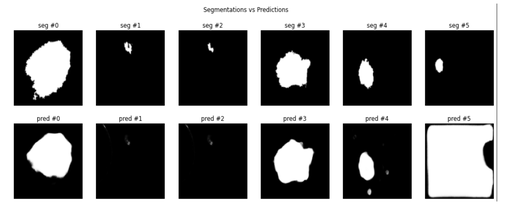


- The model overestimates the segmentantions. This is anticipated, since it is trained with style2 annotations and is not able to capture the edges.

WEAK ANNOTATIONS FOR SEGMENTATION

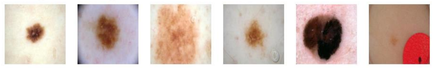
Validation metrics

Accuracy	IoU	Dice	Sensitivity	Specificity	BCE
0.920	0.551	0.786	0.789	0.211	0.657

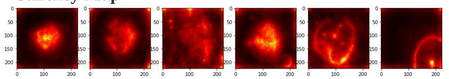


1. From **Resnet 152** to **VGG19** for clearer saliency map & better segmentation overall
2. Threshold value: **0.507** after tuning
3. **SmoothGrad** used to capture the saliency maps, with best noise level equal to **20%**.

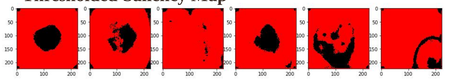
Original image



Saliency Map



Thresholded Saliency Map



Expert Segmentation