Biomedical Image Segmentation using U-Net

Miklovana Tuci

Nandakishor Prabhu

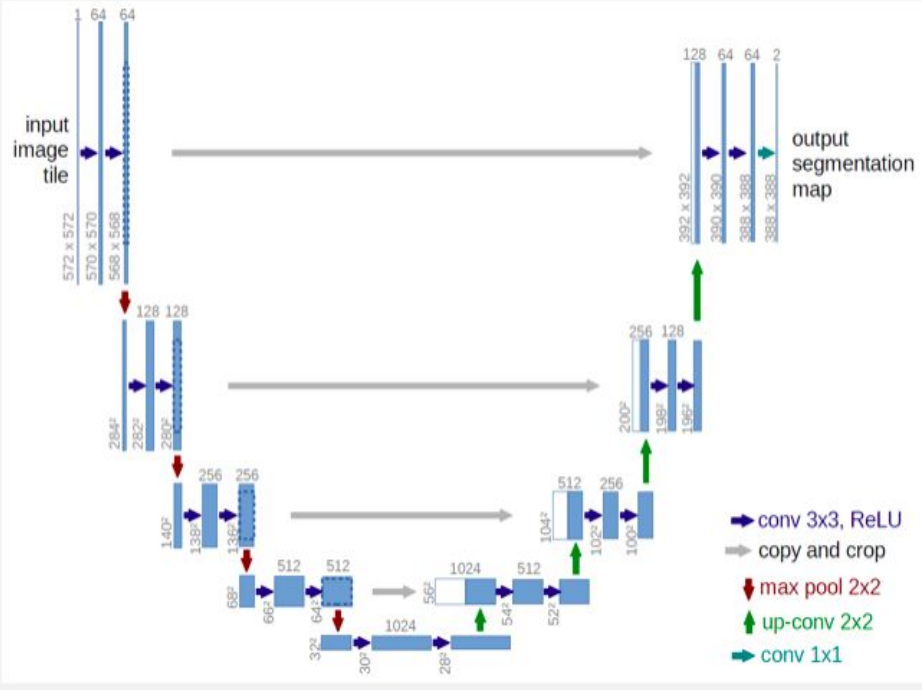
Neha Patil

Rohith Jayakumara Sarma

Introduction and Data

- Image Segmentation - Extracting the region of interest from an image
- Group together the pixels that have similar attributes
- Speeding up the clinical and diagnostic finding
- Speeding up medical research related to organs and tissues.
- Employing the U-Net model for the image segmentation task.

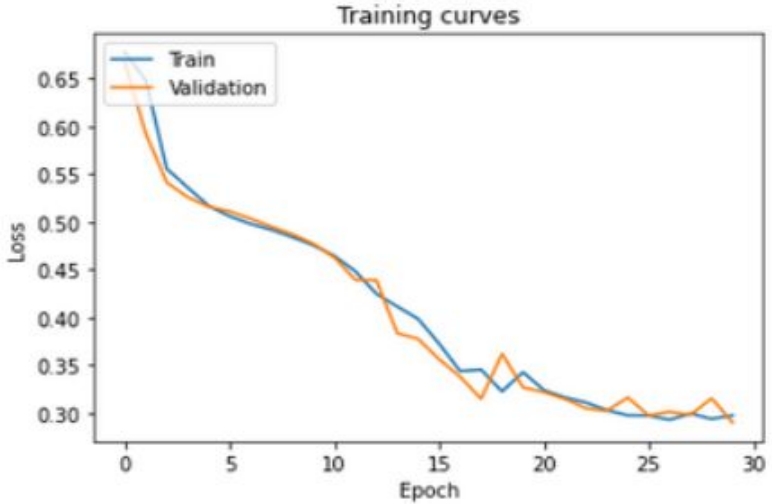
Model

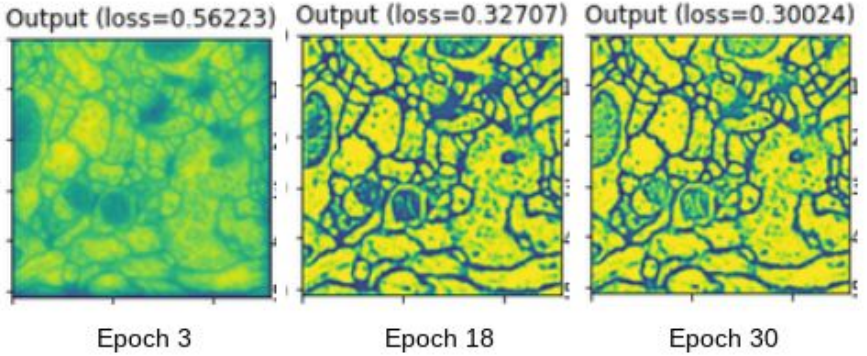

input image tile
output segmentation map
conv 3x3, ReLU
copy and crop
max pool 2x2
up-conv 2x2
conv 1x1

Experiments

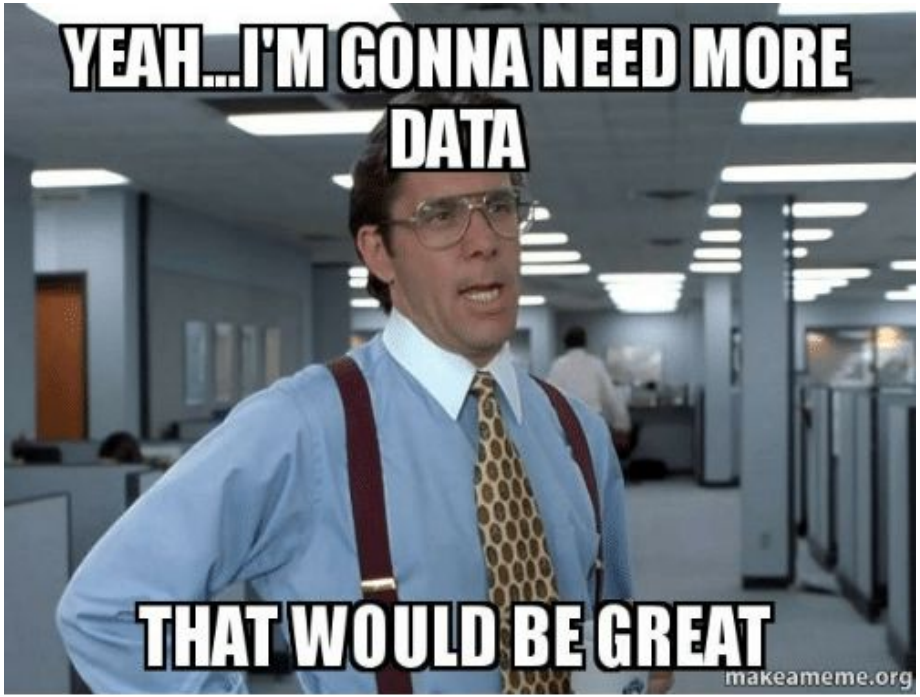
Training on ISBI2012 Dataset

- Default 30 images were used, without augmentation
- Converges after 30 epochs, but performs poorly in predicting the target segmentation mask.





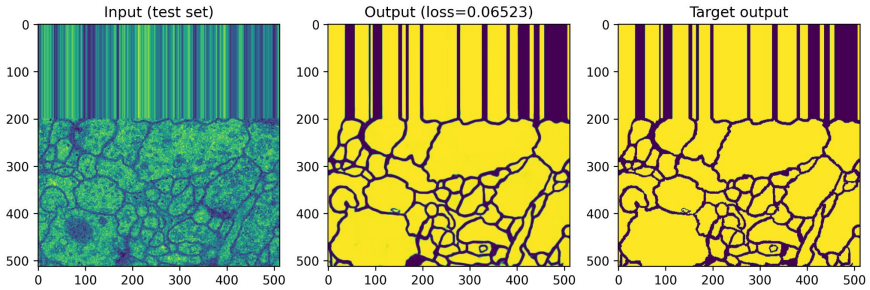
- Observed poor results due to the less training data.

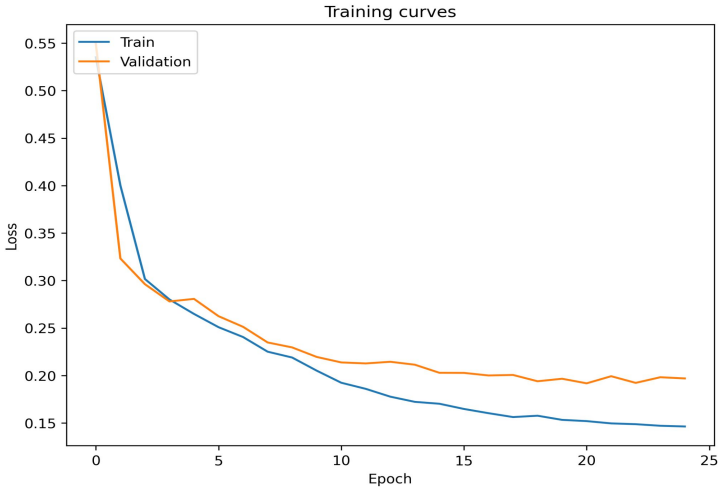


Source: Google images

Training on ISBI2012- with Data Augmentation

- Implemented data augmentation to increase the available training dataset to 1920 images.
- Observed slow training with better validation loss

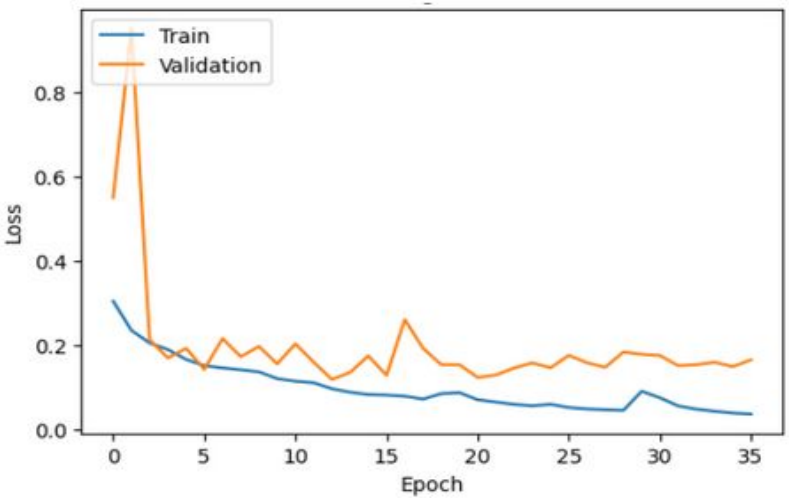


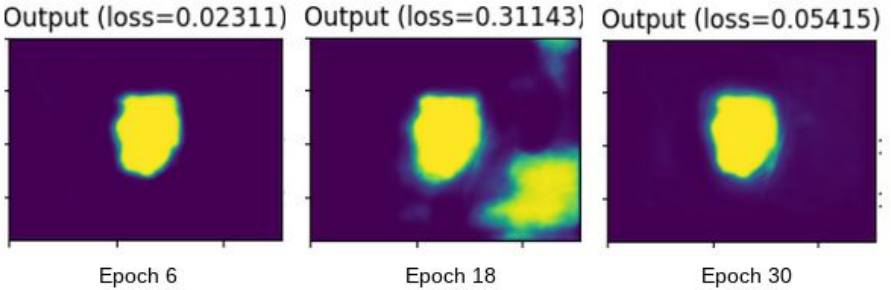


- Results were satisfactory
- With more training and optimization, the problem of cell segmentation can be solved with this method and architecture.

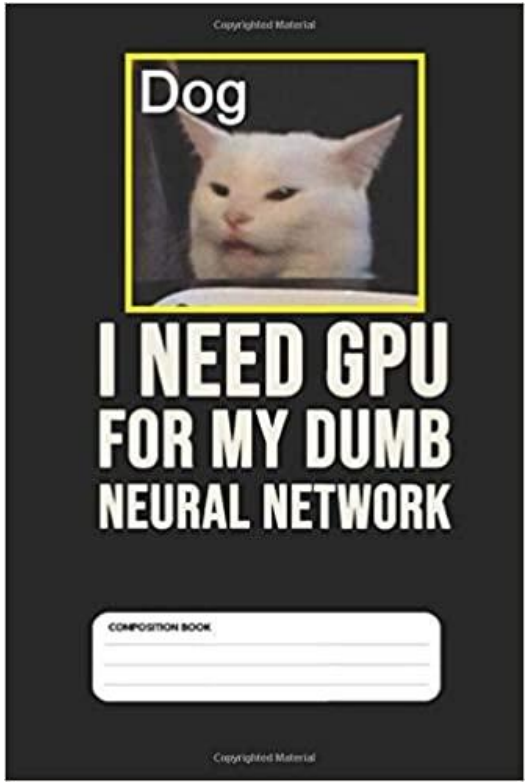
Training on ISBI2016 dataset-without Batch Normalization

- Default 900 images were used without data augmentation
- After 25 epochs, the network starts to overfit and the validation loss starts increasing.



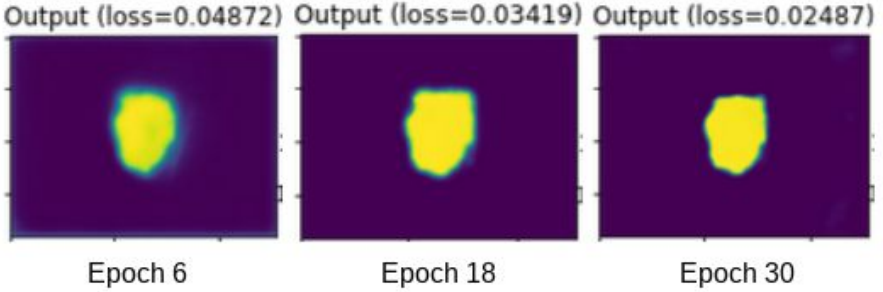


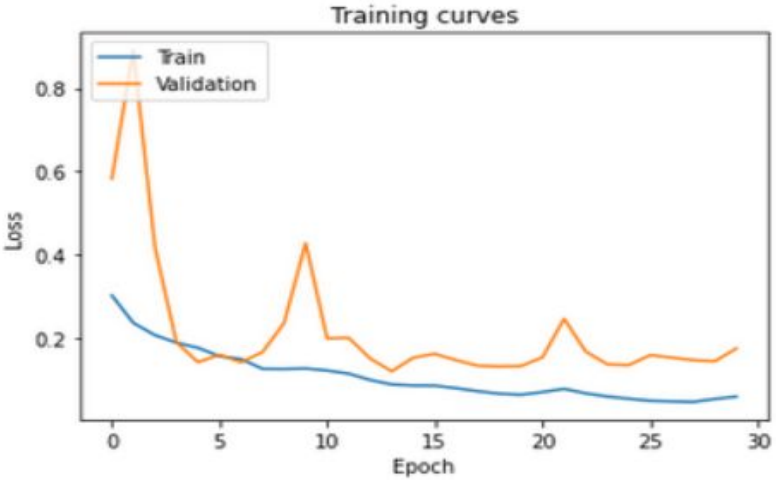
- Observed good results compared to ISBI2012 dataset(without data augmentation)
- Better performance is due to much bigger dataset and easier target


Copyrighted Material
Dog
I NEED GPU
FOR MY DUMB
NEURAL NETWORK
COMPOSITION BOOK
Copyrighted Material

Training ISBI2016 dataset with batch normalization

- Modified the U-Net architecture and implemented batch normalization
- Batch normalization intensifies the “peaking” and does not provide a great change in results.





- We came to the conclusion that the batch normalization does not provide better results, but increased computational overhead.

Conclusion

- U-Net performs well for the image segmentation task.
- Even for complex histopathological images, the model returns a good performance.
- Performance of the model can be improved using data augmentation techniques.
- Data augmentation helps us in improving the performance of the model even in the absence of adequate data.
- With optimizations, the performance of the model can be further improved.