MAIA

CAD System
Deep Learning Approach

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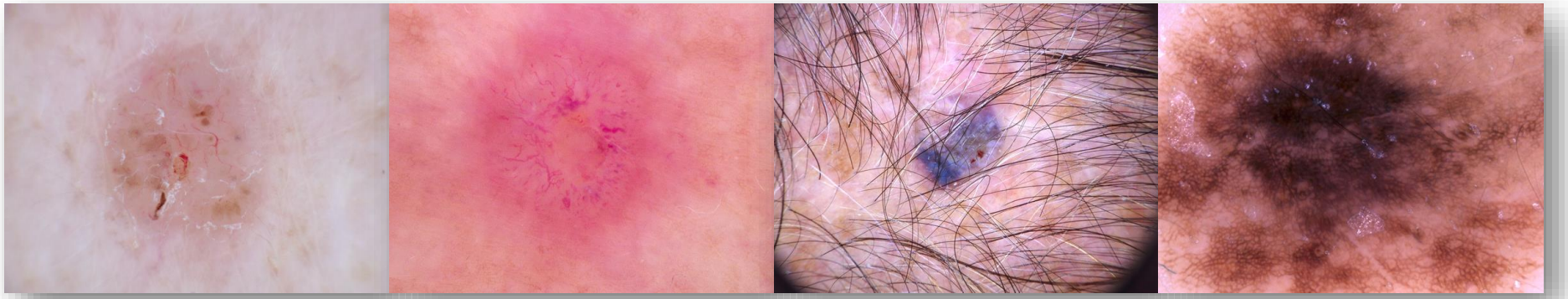
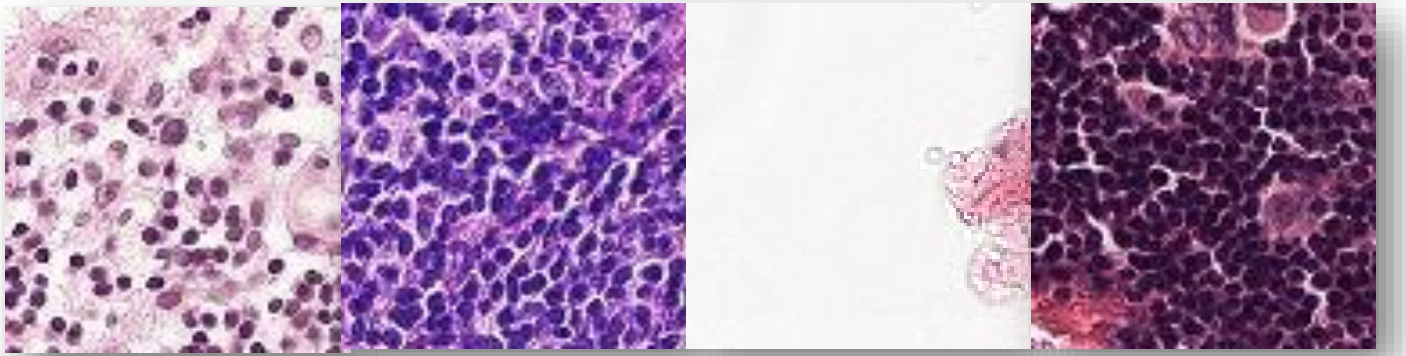
Project Objectives

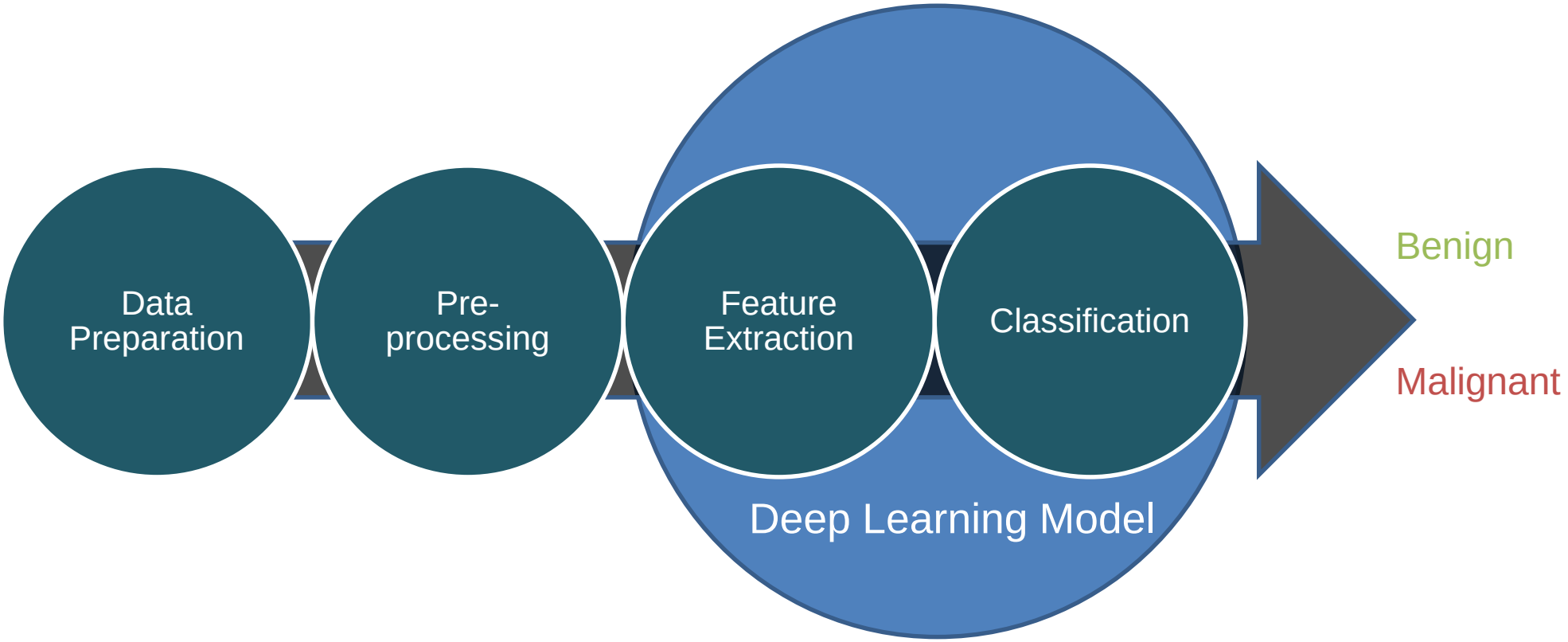
- Build a CAD system to address two main problems:
  - Skin Lesion Classification
    - 6000 images (half benign and half other classes)



  - Histopathology Classification
    - 29494 images (half benign and half malignant)



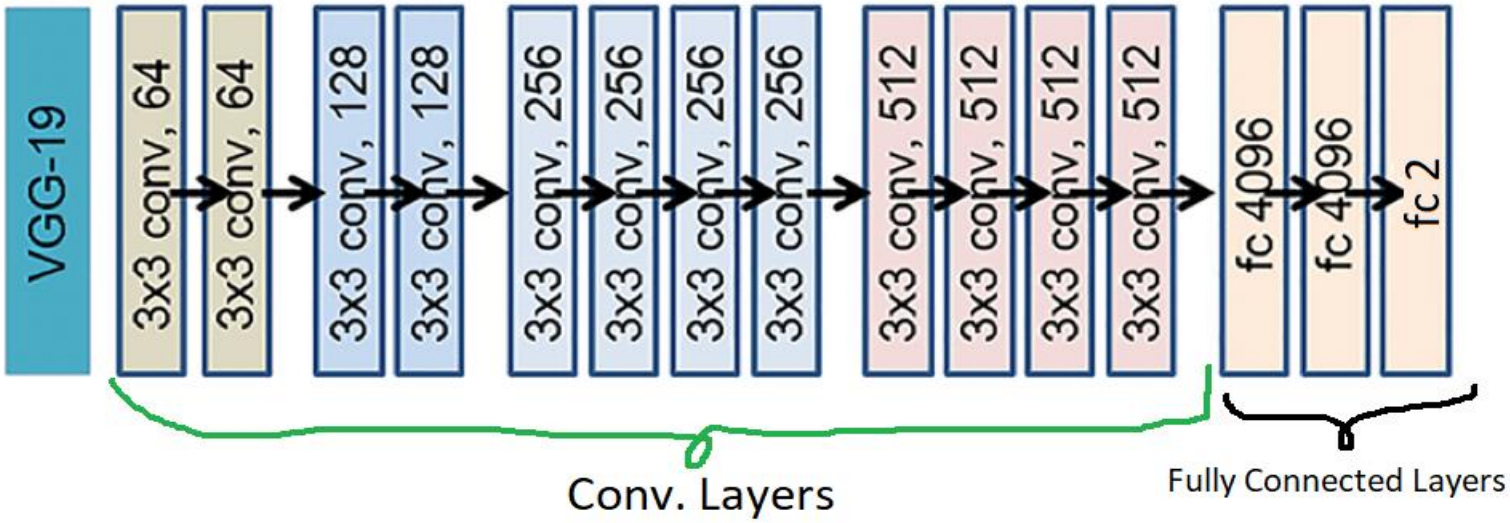
CAD System Framework



BaseLine

VGG - 19

Resize Image to 224*224 → Normalization → Transfer Learning → Classification

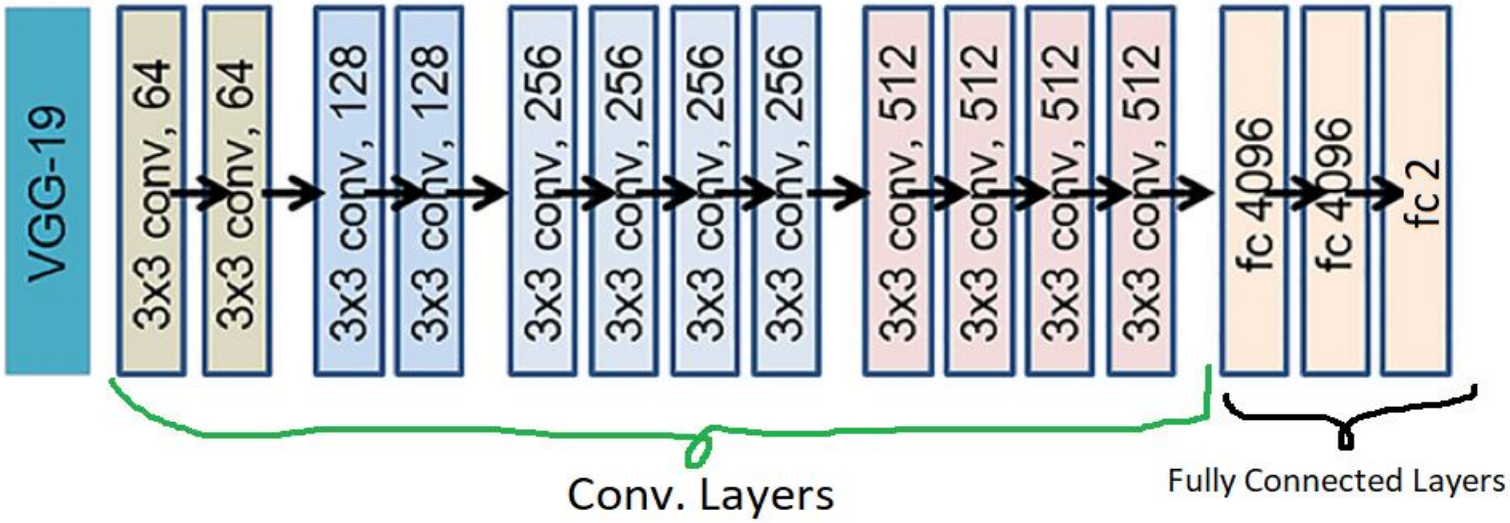


Sensitivity	Specificity	Accuracy
0.8150	0.7717	0.7933

Fine-Tuning

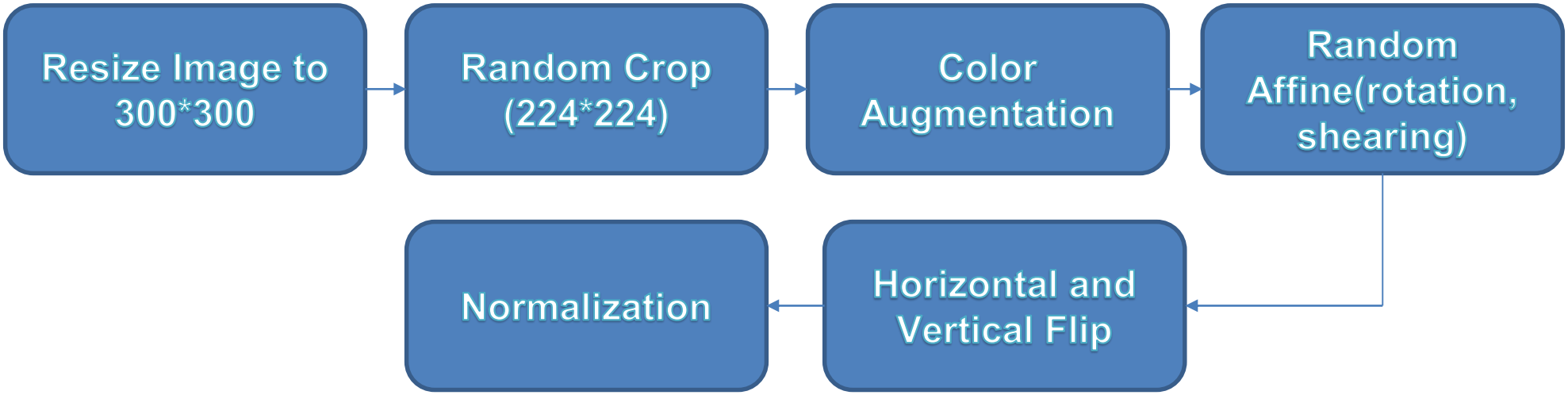
VGG - 19

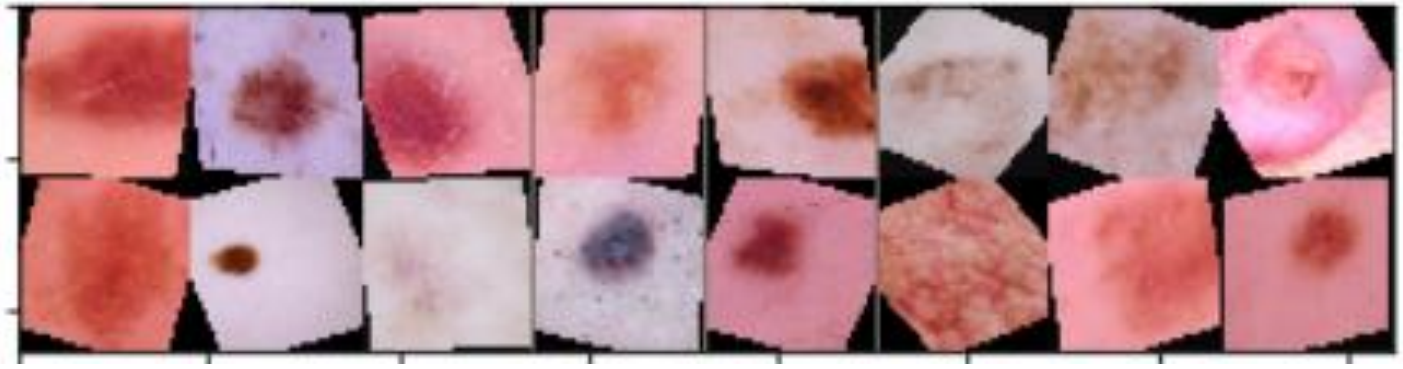
Resize Image to 224*224 → Normalization → Fine-Tuning → Classification



Sensitivity	Specificity	Accuracy
0.8767	0.9000	0.8883

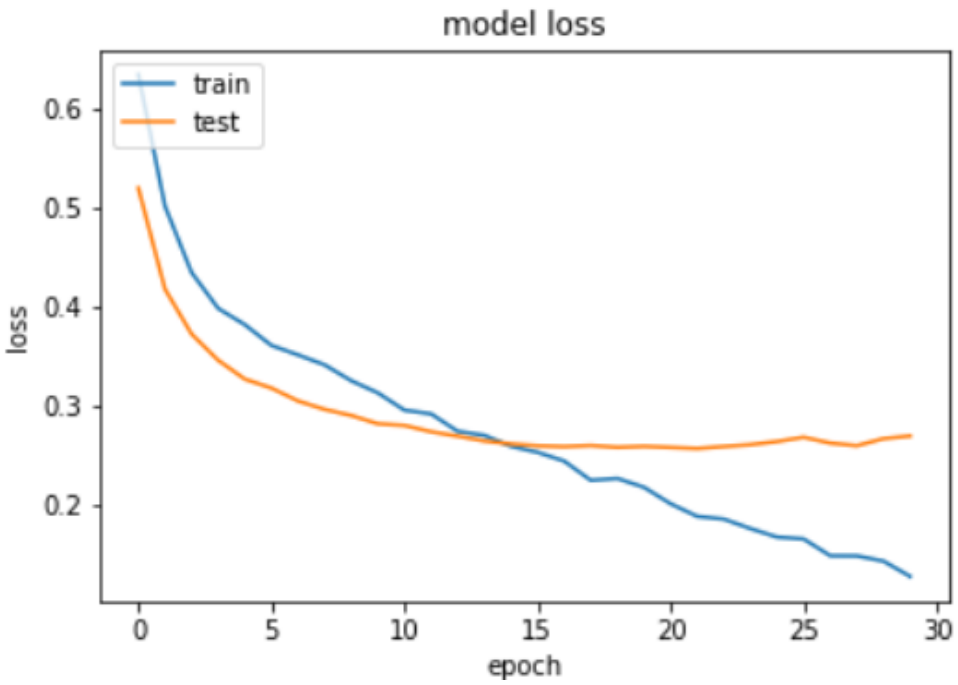
Data Augmentation



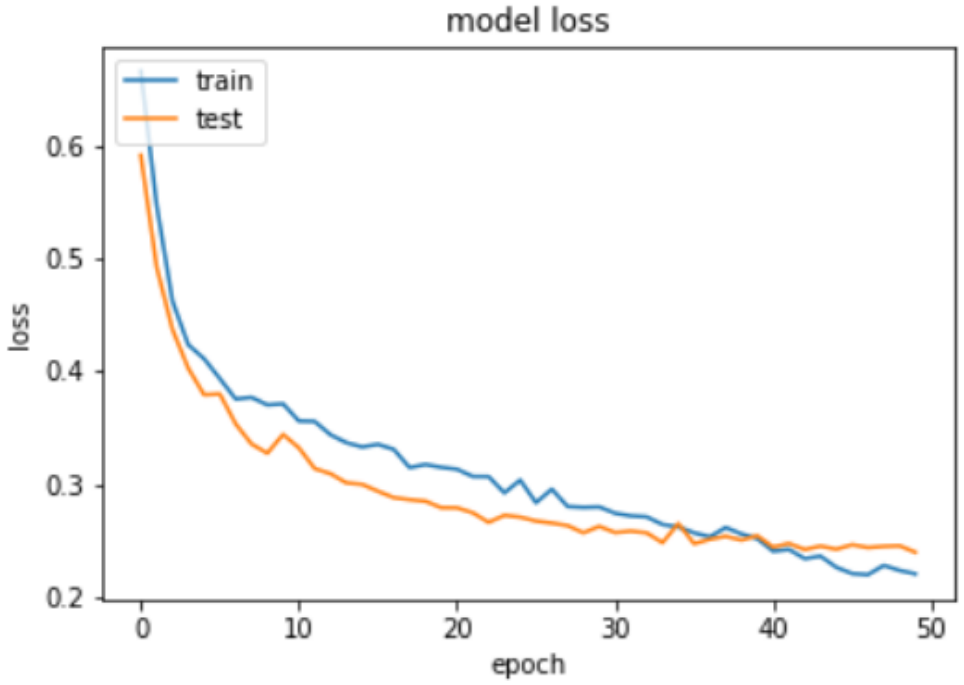


Data Augmentation

Before Data Augmentation

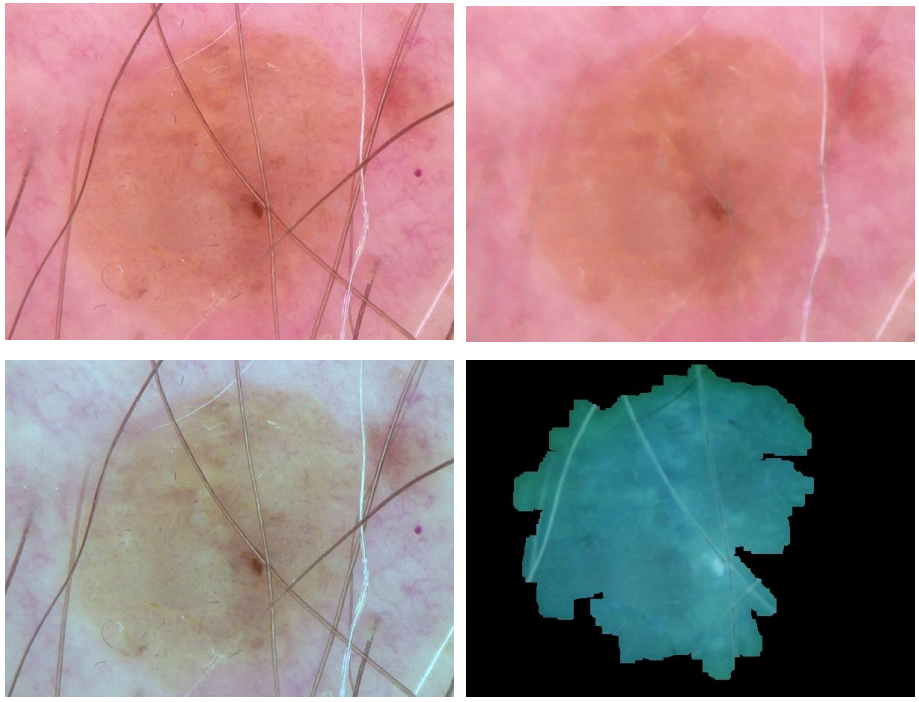


After Data Augmentation

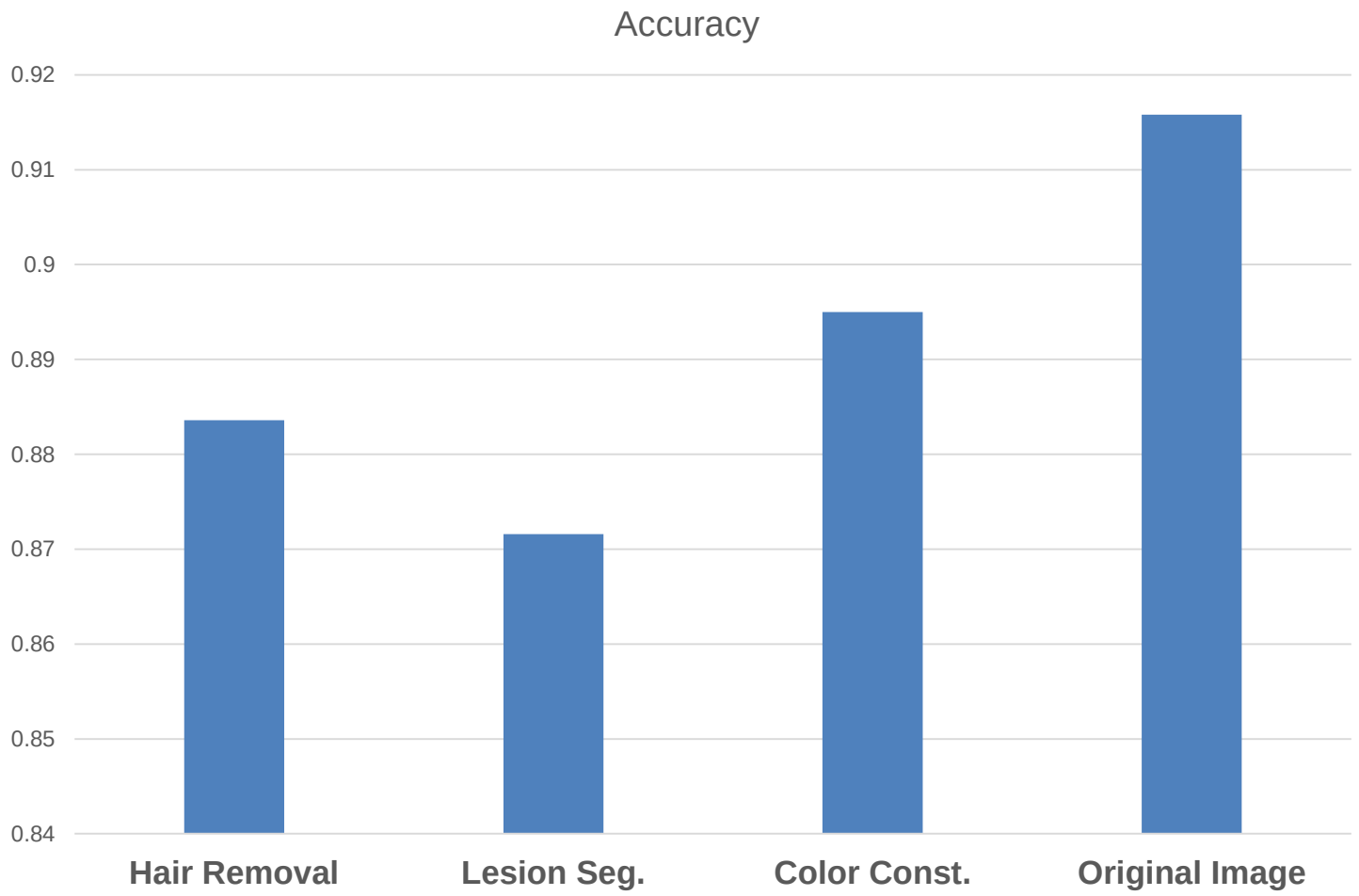


Preprocessing

- Original Image
- Hair Removal
- Color Constancy
- Lesion Segmentation



Preprocessing



Network Architectures

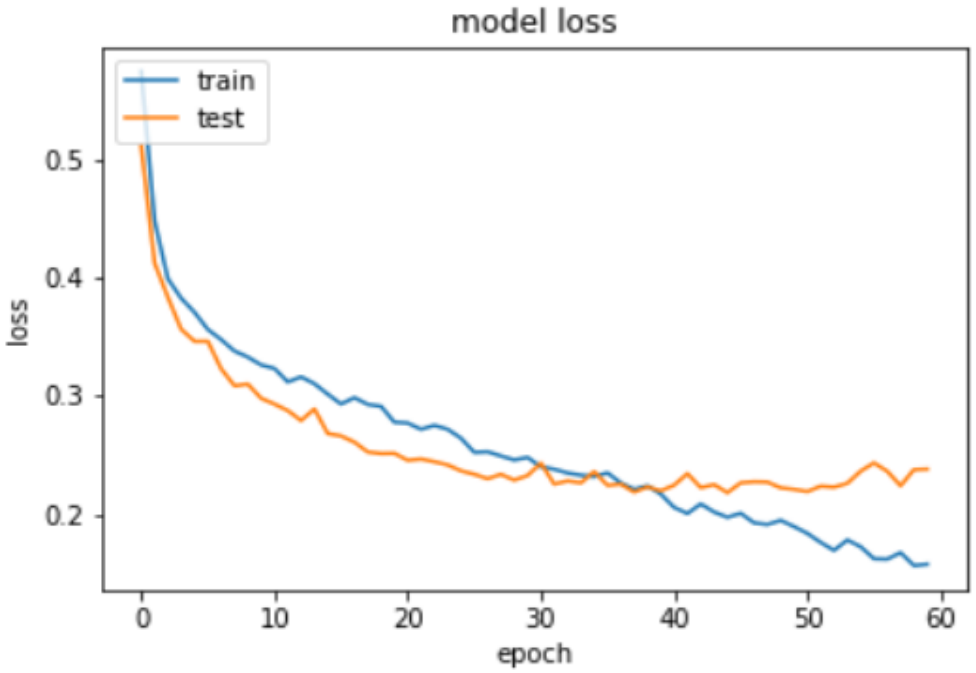
- VGG - 19
- Inception-V3
- MobileNet-V2
- Resnet(50,152)
- Senet
- Densenet-161

Model Comparison

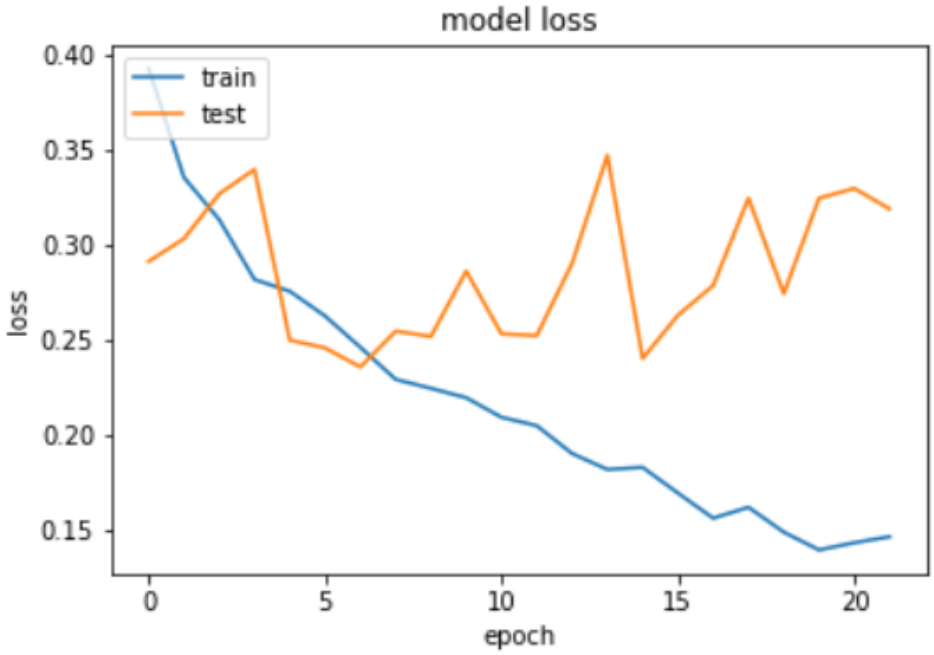
Model	Sensitivity	Specificity	Accuracy
VGG-19	0.900662	0.90604	0.9033
Inceptionv3	0.8567	0.875	0.8658
Resnet-152	0.9017	0.895	0.8983
SENET	0.8533	0.8383	0.8458
MobileNetV2	0.8962	0.905565	0.9008
Densenet-161	**0.9083**	**0.9235**	**0.9158**

Model Comparison

Densenet-161



MobileNet-V2



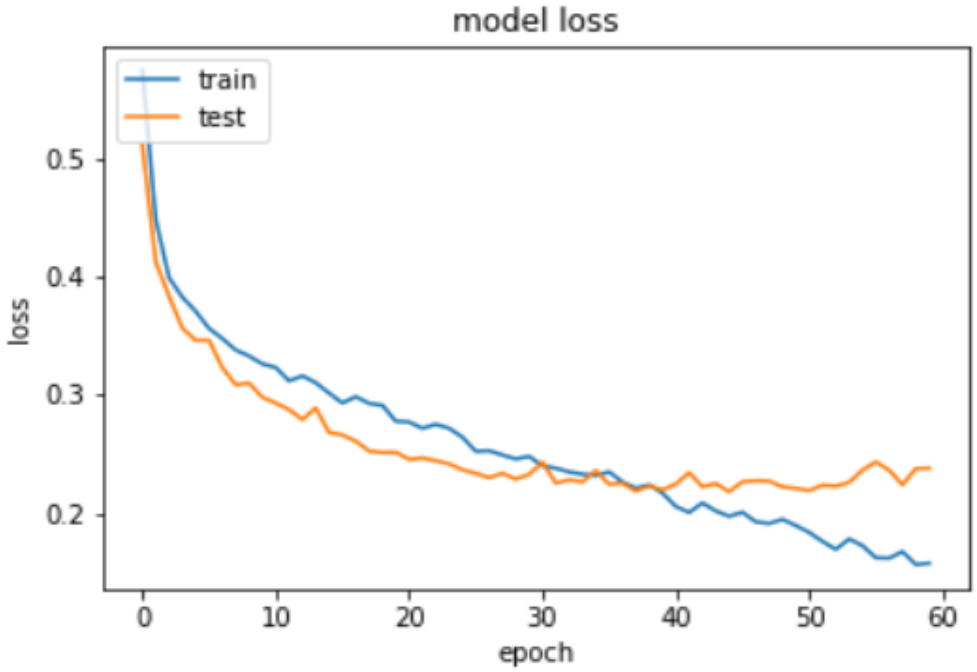
Hyperparameter Tuning

Loss	Optimizer	Weight Decay	BatchSize	Weight Init	Epochs	Accuracy
Crossentropy	Adadelta	1.00E-04	32	ImageNET	40	0.9025
Focal Loss	Adadelta	1.00E-04	16	ImageNET	40	0.8983
Crossentropy	Adadelta	1.00E-04	16	ImageNET	40	0.9158
Crossentropy	Adadelta	1.00E-04	8	ImageNET	40	0.9108
Crossentropy	Adam	1.00E-06	16	ImageNET	40	0.8817
Crossentropy	SGD	1.00E-06	16	ImageNET	10	0.8933
Crossentropy	Adadelta	1.00E-04	16	Uniform	40	0.7875

Hyperparameter Comparison

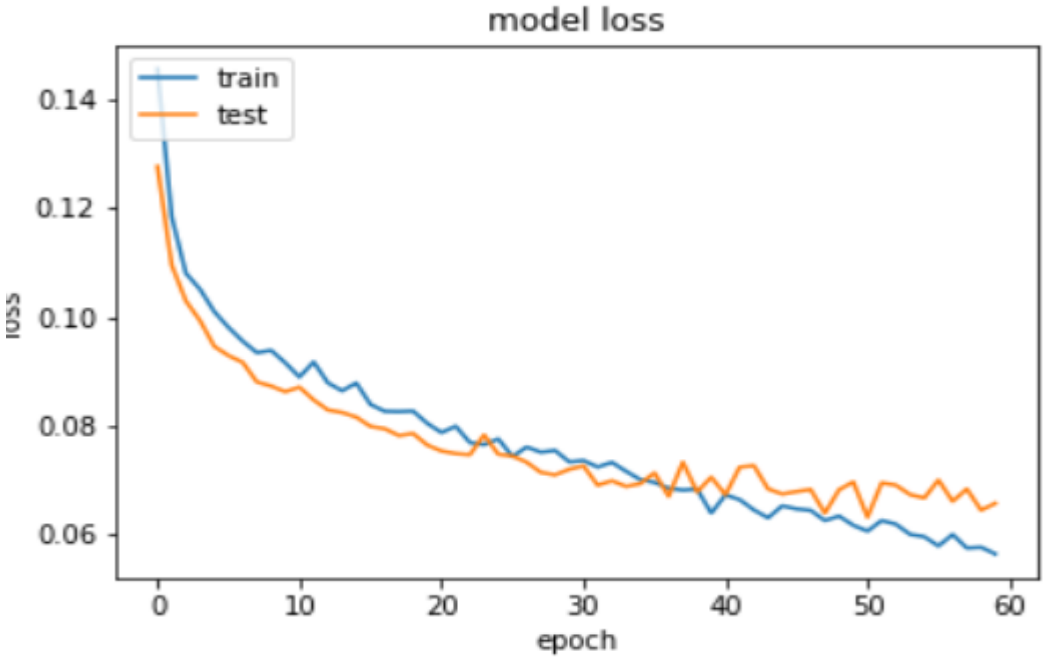
CrossEntropy

Sensitivity	Specificity	Accuracy
0.9083	0.9235	0.9158



Focal Loss

Sensitivity	Specificity	Accuracy
0.8916	0.905	0.8983

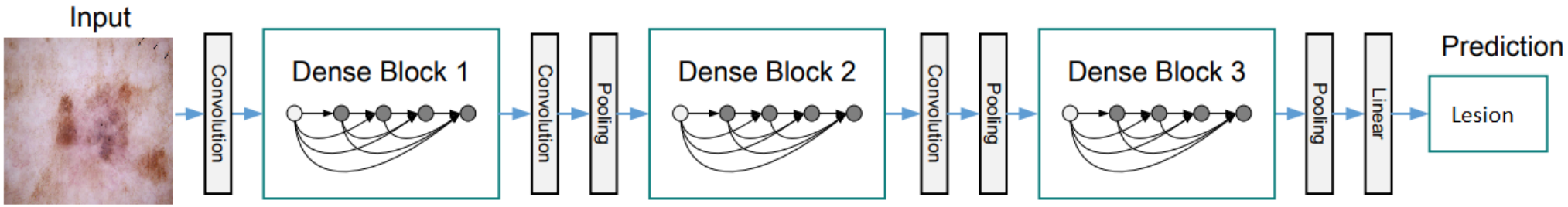


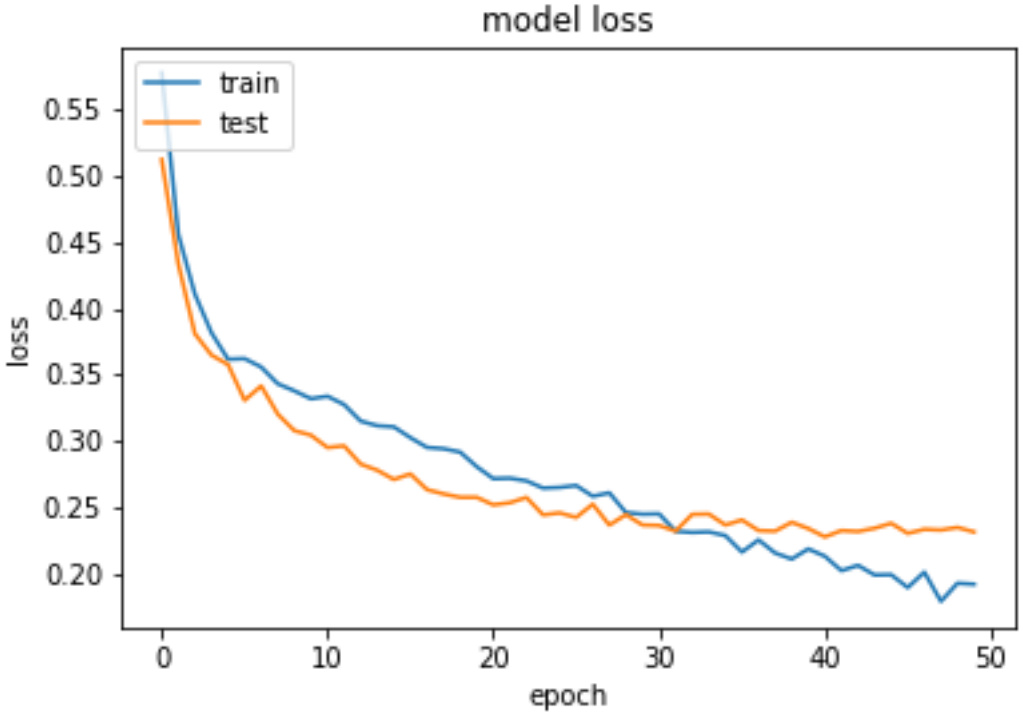
Universitat de Girona

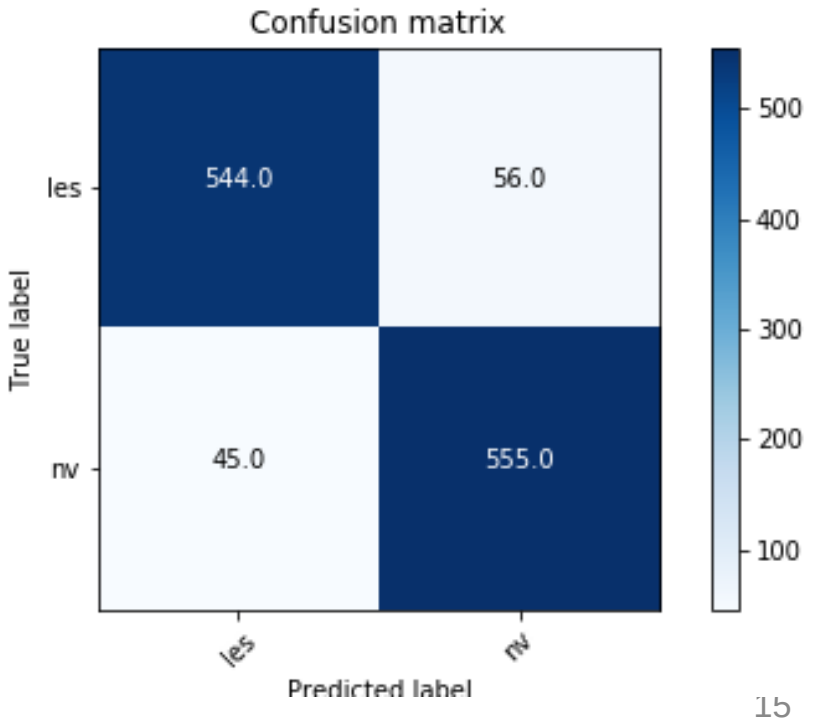
Best Model

Densenet-161

Sensitivity	Specificity	Accuracy
0.9083	0.9235	0.9158







Discussion

- SDG Optimizer converges faster than Adam
- Preprocessed Images didn’t improve the result
- Data Augmentation reduced overfitting and increased the accuracy