Melanoma Detection using Deep Learning

Computer Vision

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1.Introduction

- Melanoma is the most dangerous type of skin cancer, affecting 91,270 adults in 2016 with an increase of 3% per year from 2004 to 2014. [1]
- Detecting Melanoma is challenging, thus, Dermatoscopy is used to obtain high quality images which helps in detecting cancer in its early stages.
- Due to the latest advances in Artificial Intelligence and Image Processing, it is possible to detect melanoma cancer with high accuracy.
- We can use deep learning models to improve the efficiency of oncologists.
- Our proposed model will be able to detect whether a skin patch is malignant or benign from a given input image.
- We have used VGG-19 and ResNet-50 Neural Network architectures.

2. Data Collection and Preprocessing

- Collected data provided by The International Skin Imaging Collaboration.[2]
- Dataset consisted of over 13,000 high resolution images, with a huge imbalance between classes.
- Consisted of 12668 images for benign and only 1173 images for melanoma images.
- Resized high resolution images to increase processing time and get optimized result from VGG-19 Neural Network.
- To have a balance class distribution we augmented the melanoma images by flipping the original image horizontally and vertically, and also by rotating them by 90, 180 and 270 degree.
- After augmenting the melanoma images, class distribution was about 3:4
- Divided the input data with a split of 95:5 to generate the train and test data.

Figure 1.a. : Benign Skin Patch

Figure 2.a. : Malignant Skin Patch

Figure 1.b. : Benign Skin Patch

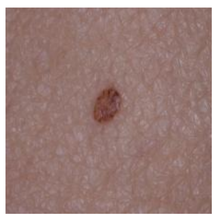

Figure 2.b. : Malignant Skin Patch

3. Neural Net Model

- We implemented both the neural net architectures using Keras Framework

VGG 19 Neural Network

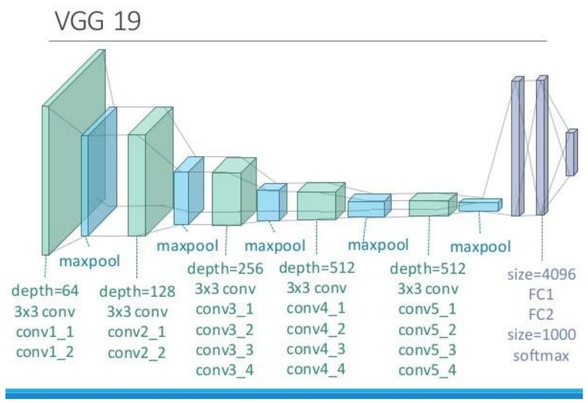

Figure 3 : VGG-19 Neural Net model with 16 convolution layers and 3 fully connected layers
Figure Reprinted from: Applied Deep Learning, Mark Chang

- VGG [3] architecture uses very small (3*3) convolution filters and a deep convolutional network with depth of 19 weight layers which include 16 convolution layers and three fully connected layers.
- Used Transfer Learning by leveraging a VGG 19 network pretrained on a ImageNet dataset.
- Replaced the original three fully connected layers with our modified layers, the first two layers having 1024 neurons and the last layer with a single neuron, as we are doing binary classification.
- VGG with its increased depth in the network provides a significant improvement in the detection accuracy.

ResNet-50 Neural Net Model

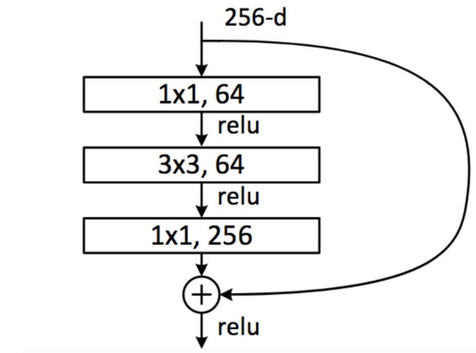

Figure 4 : ResNet50 building block
Figure reprinted from: Deep Residual Learning for Image Recognition, Kaiming He, Xiangyu Zhang, Shaoqing Ren, Jian Sun

- Residual Networks [4] are deep neural networks that are easier to optimize as compared to plain networks which were used prior to this.
- It reformulates the layers as learning residual function instead of learning unreferenced function.
- Used pretrained ResNet-50 architecture on ImageNet dataset by replacing the output layer by single neuron layer.
- We are training last 12 layers of ResNet-50 along with output layer.

4. Sample Results

Few of the melanoma images classified incorrectly as benign

5. Qualitative Results

Epoch	Number of Images	Learning Rate	Decay	Accuracy	Run Time(hrs)
100	2000	0.00001	0	93.00	~3
*100	20000	0.00001	0	94.47	~20
100	2000	0.00001	1.00E-06	97.02	~3

Table 1: The above table shows our results achieved for the mentioned parameters using the VGG-19 model.
*= Represents imbalanced Data, and its baseline is 60%.

Epoch	Number of Images	Learning Rate	Decay	Accuracy	Run Time(hrs)
100	2000	0.00001	1.00E-06	93.07	~3
200	4000	0.0001	1.00E-06	94.57	~5
200	16000	0.0001	1.00E-06	96.01	~22

Table 2: The above table shows our results achieved for the mentioned parameters using the ResNet model.

6. Conclusion

- We have used VGG-19 neural network and have achieved results with accuracy in range of 93% to 97% for classifying malignant and benign skin cancer.
- Currently, using ResNet network we have achieved results with accuracy in range of 90% to 96% for classifying malignant and benign skin cancer.
- We believe our model will be useful to oncologists to help them make their diagnosis faster.

References

1] American Cancer Society's (ACS) publication, Cancer Facts & Figures 2018

2] Image Dataset provided by The International Skin Imaging Collaboration

3] Very Deep Convolutional Networks For Large-scale Image Recognition, Karen Simonyan, Andrew Zisserman

4] Deep Residual Learning for Image Recognition, Kaiming He, Xiangyu Zhang, Shaoqing Ren, Jian Sun

5] Skin cancer reorganization and classification with deep neural network, Hao Chang

6] Skin Lesion Analysis towards Melanoma Detection Using Deep Learning Network, Yuexiang Li and Linlin Shen

7] Used BigRed2 for training the model

8] Poster template from PosterPresentations.com