Classifying dermatological lesions using machine learning methods

Michel Marjamaa
Joosep – Henrich Soone

Background

Growing amount of medical procedures are being recorded in video and still image format. Dermatology has taken advantage of this phenomenon for a longer period than most other medical fields, therefore having a large digital database.[1]

A large database and the fact that a lot of dermatological pathologies are at first assessed through visual inspection make it a great field to implement machine learning methods.

With the constant advancement of photographical technology available to the common consumer via smartphones, the patients´ self-assessment availability via health and dermatological applications is also more than likely.

Objective

The aim is to create an algorithm based on a dataset of 10000 dermatoscopic images, capable of correctly classifying dermatologic lesions with 95% accuracy using machine learning methods.

Data: The HAM 10000 dataset

Data used was gathered and made public by Philipp Tschandl, Cliff Rosendahl & Harald Kittler. The images and their corresponding diagnoses were confirmed by pathology, follow-up expert consensus or by in-vivo confocal microscopy. [2]

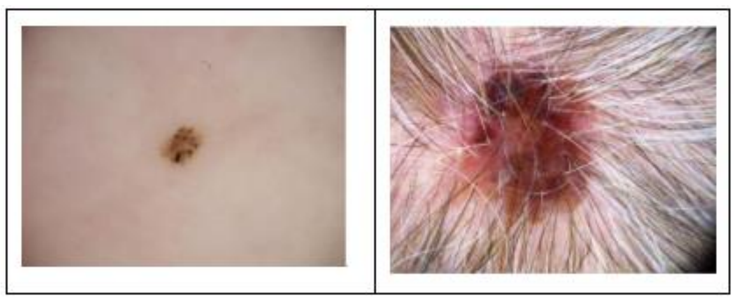
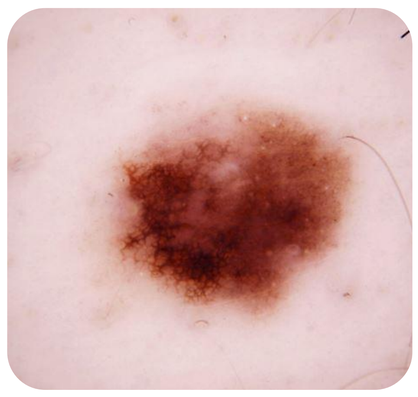


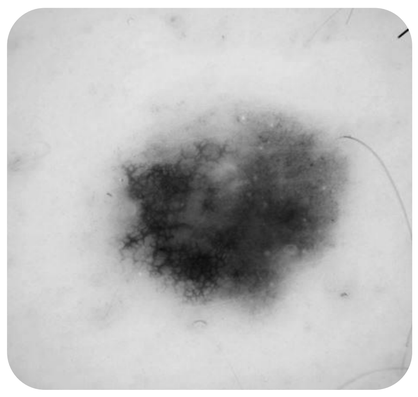
Figure 1. Demonstration of the variance of the images. [1]

Process

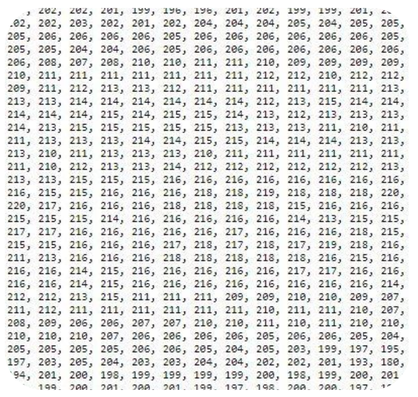
- Data preparation
  - Cleaning – PCA
- Data analysis
  - Machine learning - random forest classifier
- Data visualization
  - Histograms
  - Scatterplot



Original image

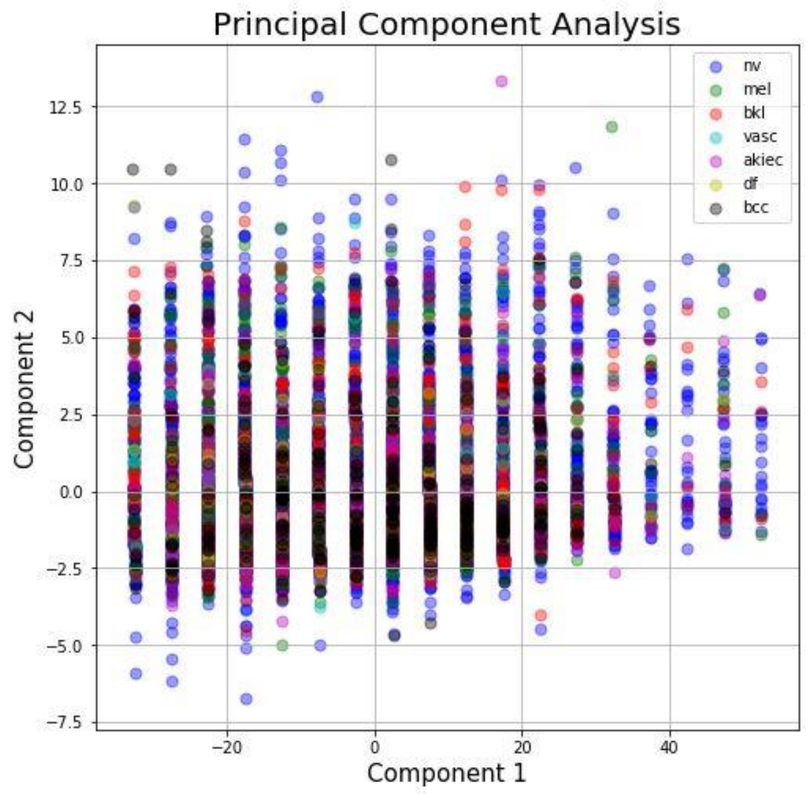


Grayscale copy



First row of the matrix

Conclusions



There are no distinguishable clusters in the scatterplot, however this does not mean the results are negative, as many of the dermatoscopic lesions are quite similar in appearance: round or slightly chaotic in shape, with lighter colours around the border of the lesion and opaque in the centre.

The final accuracy at which the algorithm is able to classify the skin lesion is **63%**

Discussion

Although the initial plan was to reach the accuracy of 95+ percentile with the dermatoscopic lesion distinguishing algorithm, we only reached the 62+ percentile.

There are multiple reasons for that:

- We used Random Forest Classifier to fit the model, even though similar projects insisted on using Convolutional Neural Network, as it tries to minimize the cost function to categorize the inputs correctly in classification tasks.
- We should have used OpenCV3's Saliency library instead of using grayscale to combat overfitting. Static Saliency gives a more dynamic grayscale image with more attention to the focus point, which in our case is the lesion. Although good in theory it is quite taxing to the memory of the computer, and is therefore inefficient in our case.
- We should have cropped the images and focused only on the centre area (the majority of the images had the lesion in the very centre), which would have decreased the noise and the amount of features, resulting with a more efficient model.
- An unseen bias towards nevi. Although a nevus is quite common in a dermatoscopic diagnosis, we did not notice that almost 70% of the data are nevi. It made us ignore the natural bias, which is roughly about 20% of the diagnosed lesion cases, and remain the data skewed.

Contact

Joosep – Henrich Soone
Email: joosephenrichsoone@gmail.com

References

1. Stanganelli I, Serafini M, Bucch L. A cancer-registry-assisted evaluation of the accuracy of digital epiluminescence microscopy associated with clinical examination of pigmented skin lesions. Dermatology 2000; 200:11.
2. Tschandl, P. et al. The HAM10000 dataset, a large collection of multi-source dermatoscopic images of common pigmented skin lesions. Sci. Data 5:180161 doi: 10.1038/sdata.2018.161 (2018).
3. Lott JP, Boudreau DM, Barnhill RL, et al. Population-Based Analysis of Histologically Confirmed Melanocytic Proliferations Using Natural Language Processing. *JAMA Dermatol*. 2017;154(1):24-29.
4. Man against machine: diagnostic performance of a deep learning convolutional neural network for dermoscopic melanoma recognition in comparison to 58 dermatologists; H A Haenssle, C Fink, R Schneiderbauer, F Toberer, T Buhl, A Blum, A Kalloo, A Ben Hadj Hassen, L Thomas, A Enk, L Uhlmann, Reader study level-I and level-II Groups ; *Annals of Oncology*, Volume 29, Issue 8, 1 August 2018, Pages 1836–1842