Melanoma Detection and Classification of Birthmarks

using Neural Networks and Genetic Programming

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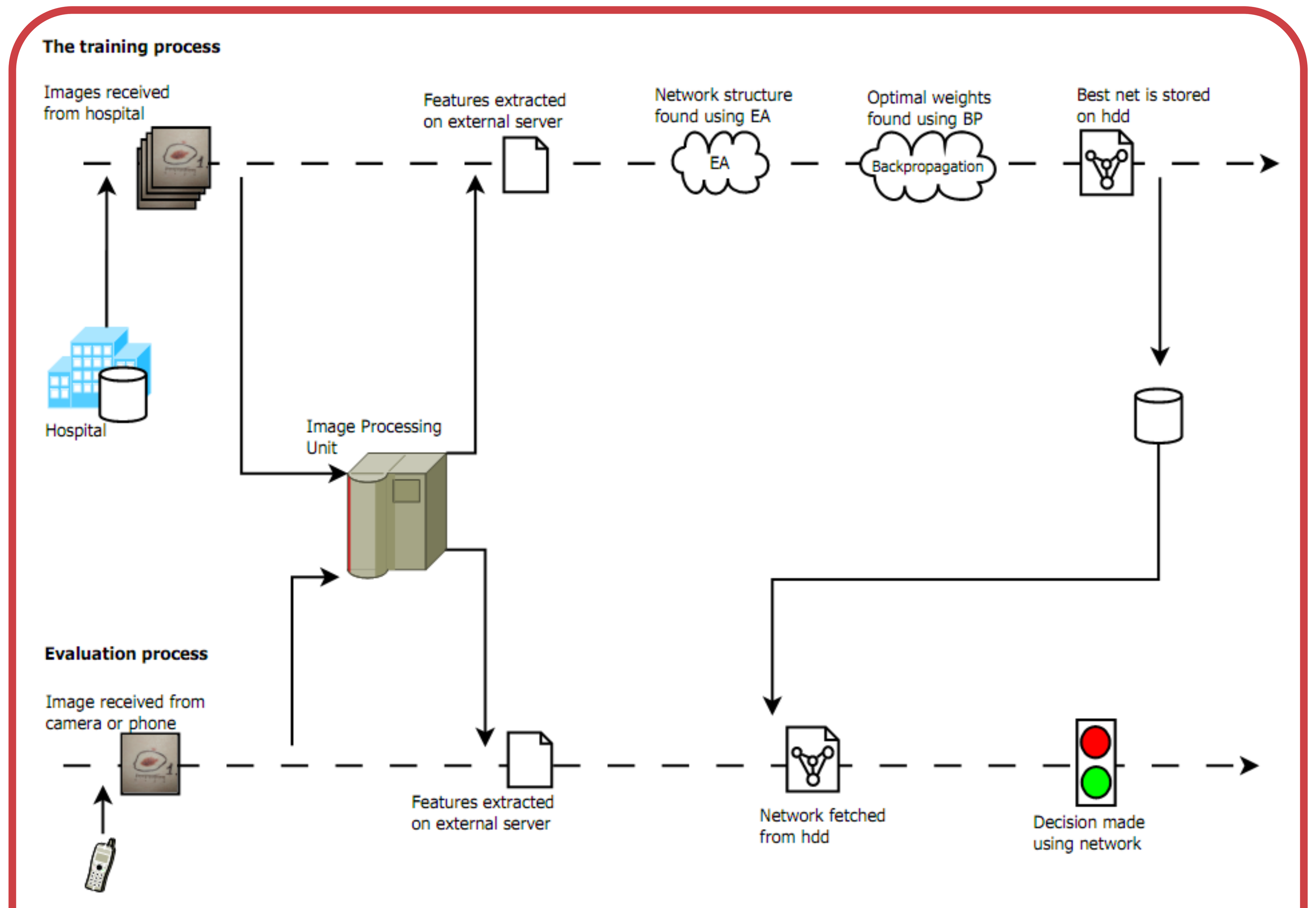
Introduction

Automating the classification of birthmarks can help the doctor in his decision making or to some degree skip him completely.
In this work neural networks and genetic programming are compared in order to find a good classification algorithm.



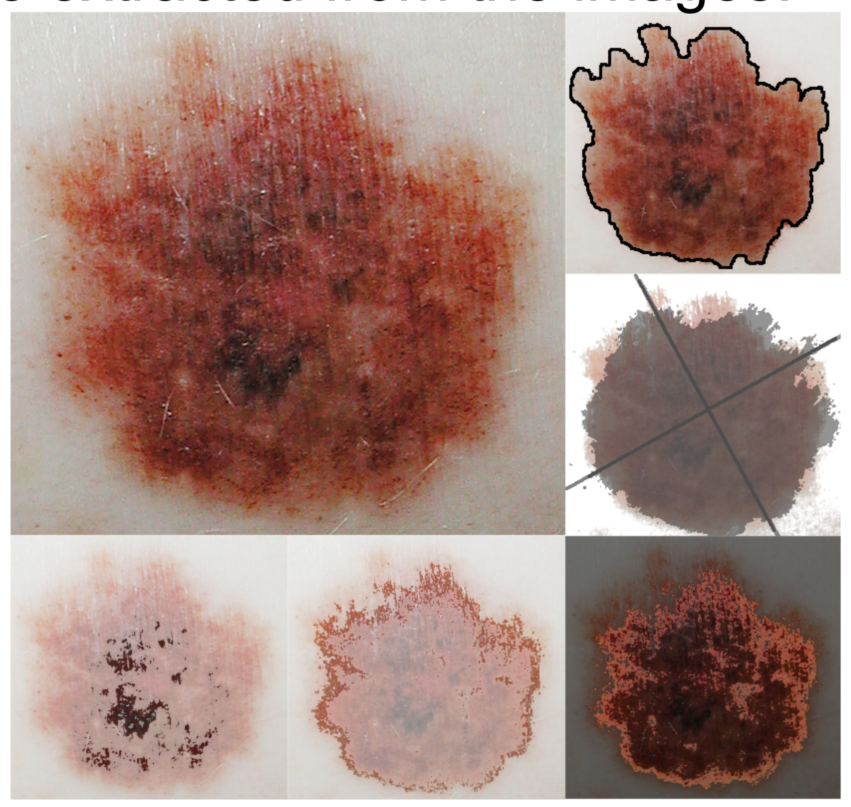
The Process

To classify a birthmark an image of the birthmark is first sent to a server which extracts the features.
The features are then sent to the classification algorithm (a neural network or a genetic program) which has been trained using a training set.
Depending on the classification appropriate action is taken, e.g. the doctor is notified of the presence of melanoma.

Feature Extraction

The following features are extracted from the images:

- asymmetry in the two principal axes
- edge abruptness
- edge-to-area ratio and area size
- the number of color classes present in the image
- ratio of black, blue and white colors



Finding the melanoma in the image is done by
- applying the Karhunen-Loève transformation
- applying a thresholding algorithm

The asymmetry of the melanoma is measured by
- flipping the region in the principal axis
  - axes are found using 2-D moments
- measuring how much of the regions is not overlapping

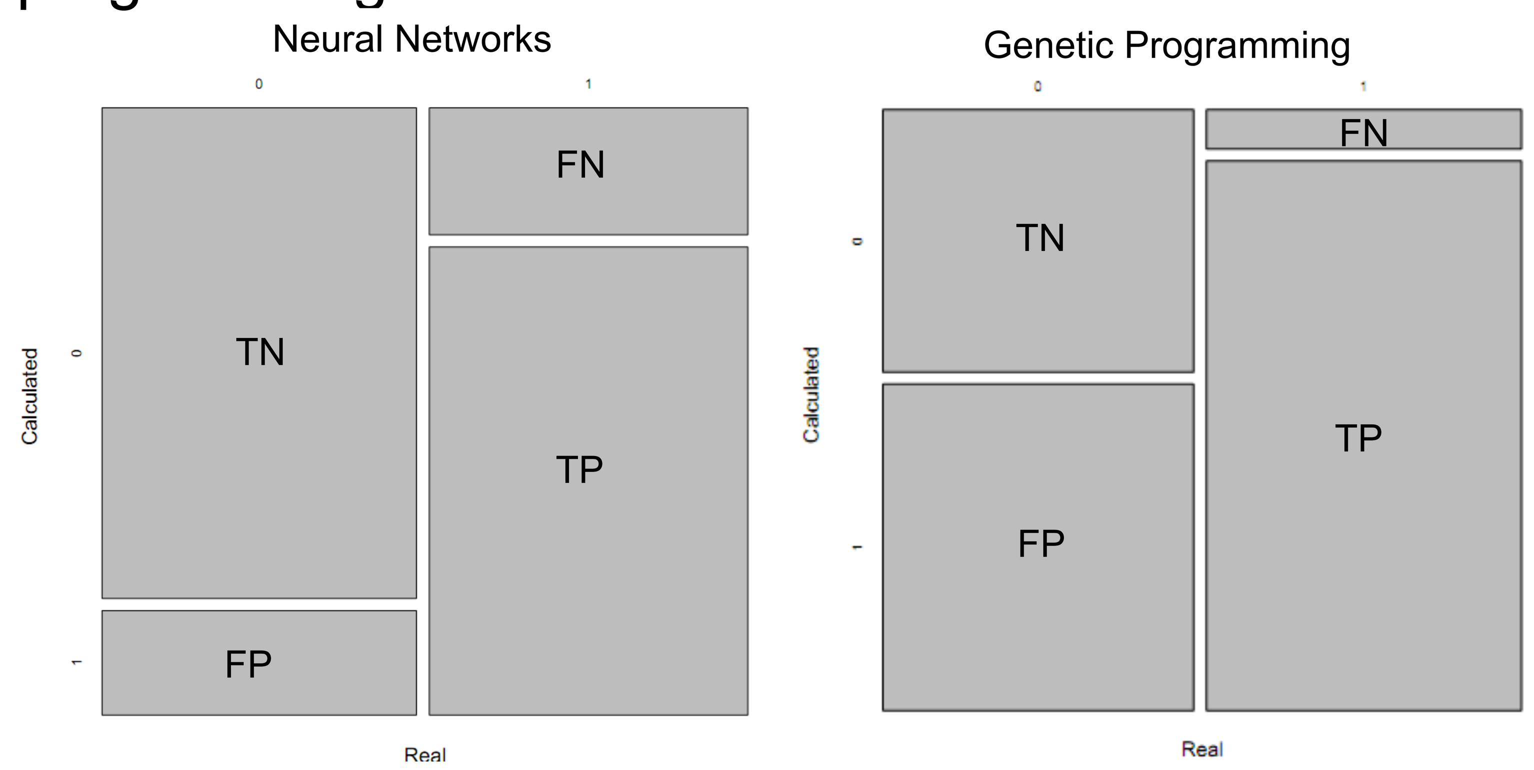
Finally the color features are found by comparing the individual RGB-pixels with some prototype colors and determining their color class using this measure.

Classification Algorithm

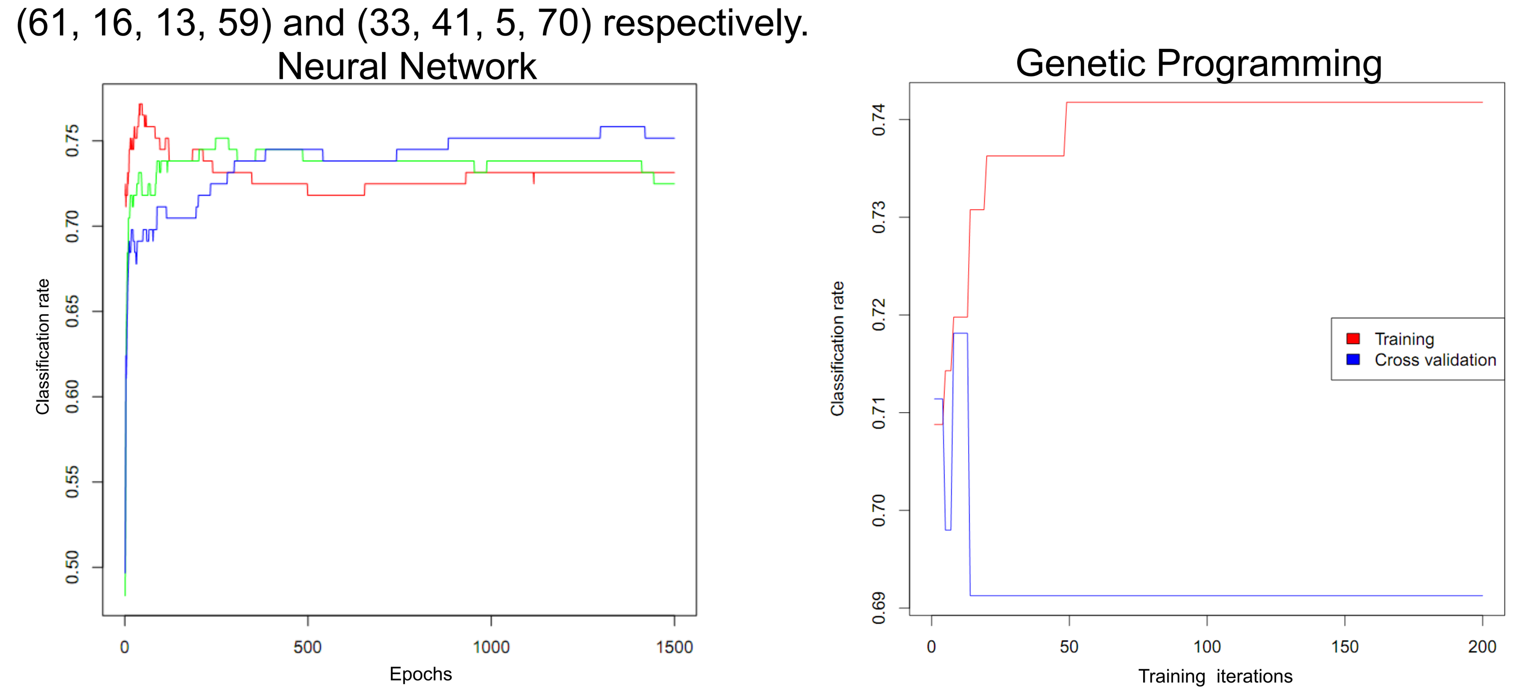
Two biologically inspired algorithms are tested:
- Neural Networks
  - imitating the brain structure
  - the structure of the net is found using a genetic algorithm
  - weights are found using backpropagation
- Genetic Programming
  - evolving a classification software using Darwin's principle: Survival of the fittest
  - functions: addition, subtraction and multiplication
  - terminals: random decimal in the interval [-10;10] and inputs

Current Results

Currently the classification rate of the algorithms used on the features extracted from the images are 74% for neural networks and up to 71% for genetic programming.



Share of true-/false- positive/negative. The current rate of (true negatives, false negatives, false positives, true positives) for the best run using NNs and GP are (61, 16, 13, 59) and (33, 41, 5, 70) respectively.



Classification rate. To the left: three runs showing the classification rate of the neural network as a function of the number of epochs (backpropagation iterations).
To the right the classification rate of the genetic program. 'Training' is on training data. 'Cross validation' is the actual classification rate on non-training data which can be compared to the classification rate of the Neural Network

Conclusion

Classifying images is possible and can be done at this stage with a classification rate of >70% for both NN and GP – a rate comparable to the doctor's.
Further work has to be done to increase the classification rate and to minimize the amount of false negative results.

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