

Course Project
**Machine learning techniques for image recognition in
medical diagnostics of skin cancer**

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MACHINE LEARNING TECHNIQUES FOR IMAGE RECOGNITION IN MEDICAL DIAGNOSTICS OF SKIN CANCER

BACKGROUND

In this project will be studied different machine learning (ML) algorithms (Convolutional Neural Networks (CNN) and Principle Component Analysis (PCA)) for image recognition.

- Convolutional Neural Networks (CNN) is the most popular technique for image recognition.
- Principal component analysis (PCA) is a machine learning technique which is widely used for data compression in image processing (data visualization) or in the determination of object orientation.
- PCA problem is closely related to the numerical linear algebra (NLA) problem of finding eigenvalues and eigenvectors for the covariance matrix.

The problem of image recognition arises in many real-life applications and we are going to concentrate our attention on the problem of image recognition of skin images from ISIC dataset. This Master's project is motivated by the major challenges in early medical diagnostics of skin cancer.

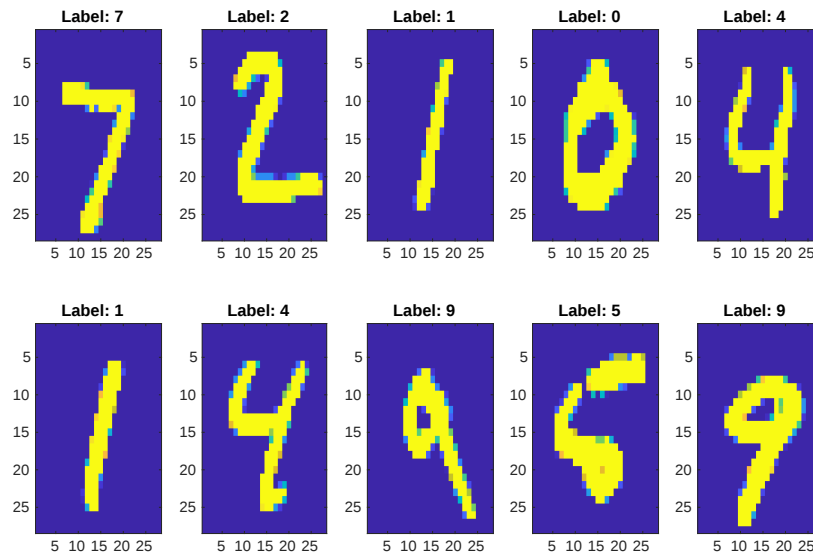


Figure 0.1: Images from MNIST dataset `mnist_test_10.csv` visualised via the program `loadmnist.matlab.m`. See details in the Project 4 for the course Numerical Linear Algebra, TMA265/MMA600.

DESCRIPTION OF THE PROJECT

The main goal of the project is develop or use already developed algorithms for image recognition using CNN and PCA. The algorithms will be compared and their performance will be tested on the recognition of : a) handwritten numbers from MNIST dataset and b) skin images from the ISIC project.

Study of different AI techniques for image recognition presented in [1, 2, 3] will be included in the project.

More precisely, main tasks in the project will be:

- Use CNN and PCA to find patterns (recognize handwritten numbers) in MNIST Dataset of Handwritten Digits. You can modify and test the MATLAB code for recognition of handwritten numbers available in the Project 4 for the course Numerical Linear Algebra, TMA265/MMA600.

The MNIST database can be downloaded from the link

<http://makeyourownneuralnetwork.blogspot.com/2015/03/the-mnist-dataset-of-handwritten-digits.html>

- Use CNN and PCA to classify skin images from the ISIC project, see link <https://www.isic-archive.com/#!/topWithHeader/wideContentTop/main>
- Compare CNN, PCA with other techniques used for image recognition.
- Compute missclassification rate E using the formula (see [3], p. 211-214):

$$E = \frac{\sum_{i=1}^K N_{F,i}}{\sum_{i=1}^K (N_{T,i} + N_{F,i})}, \quad (0.1)$$

where K is the number of classes, $N_{T,i}$ is the number of images of the class i which are classified correctly, $N_{F,i}$ is the number of images of the class i which are classified wrong. Precision for class i can be computed as

$$P(i) = \frac{N_{T,i}}{N_{T,i} + N_{F,j}}. \quad (0.2)$$

REFERENCES

- [1] Christopher M. Bishop, *Pattern recognition and machine learning*, Springer, 2009.
- [2] Ian Goodfellow, Yoshua Bengio and Aaron Courville, *Deep Learning*, MIT Press, 2016, <http://www.deeplearningbook.org>
- [3] Miroslav Kurbat, *An Introduction to Machine Learning*, Springer, 2017.