Skin Cancer Diagnosis with Neural Networks

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What is skin cancer?

- The most common type of cancer
- Types:
  - basal cell carcinoma (BCC)
  - squamous cell carcinoma (SCC)
  - Merkel cell carcinoma (MCC)
  - melanoma
- Causes:
  - UV rays
- An early diagnosis can be life-saving!

- Goals: Automatized skin cancer detection, available everywhere

Data processing

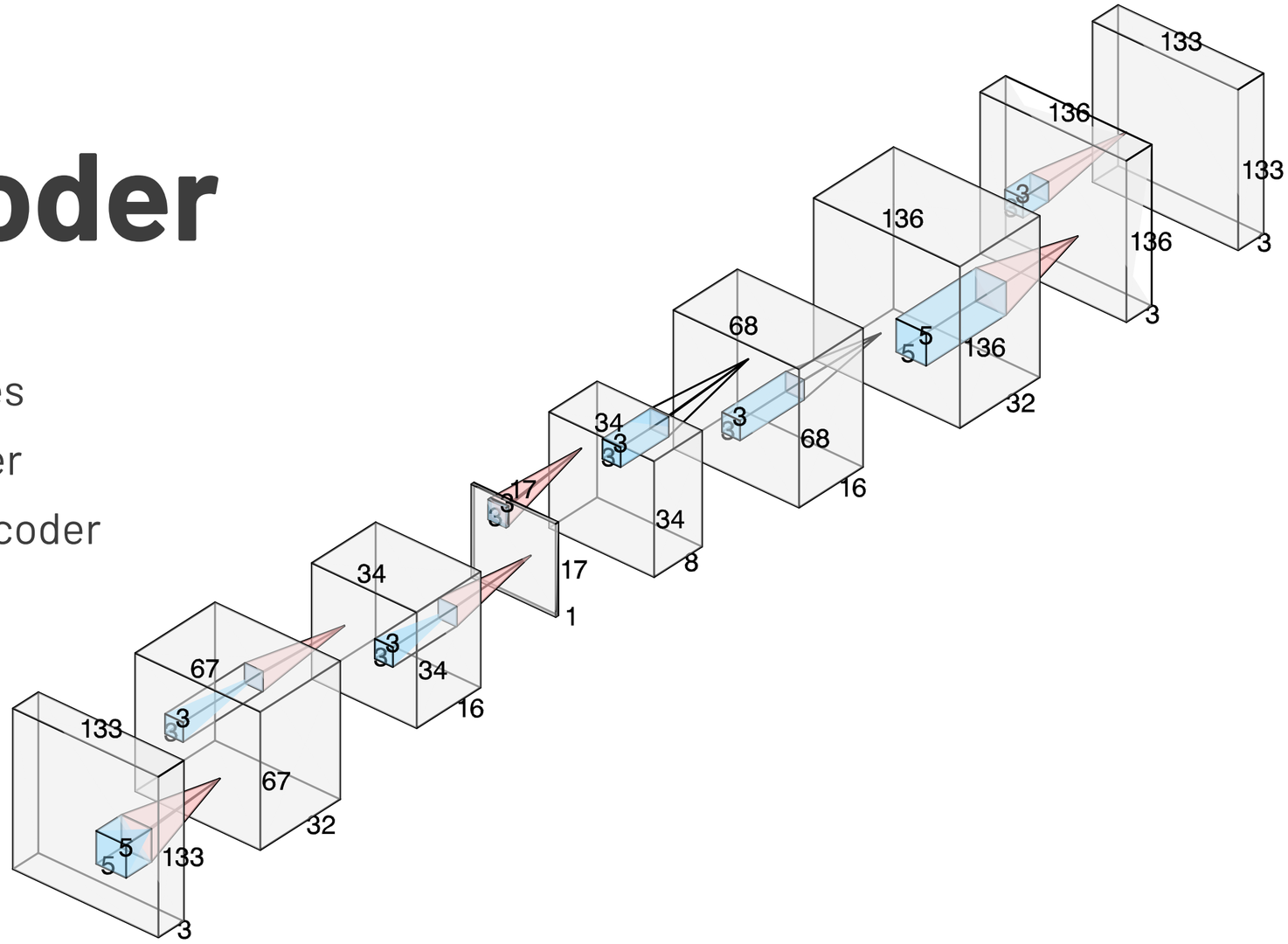
- Dataset:
  - More than 400K images
  - Additional metadata: age, sex, characteristics of the questionable area
  -
- Preprocessing:
  - Resizing images: 133x133 pixel
  - Handling different data types (numerical, binary, categorical)
    - imputing
    - scaling
    - encoding

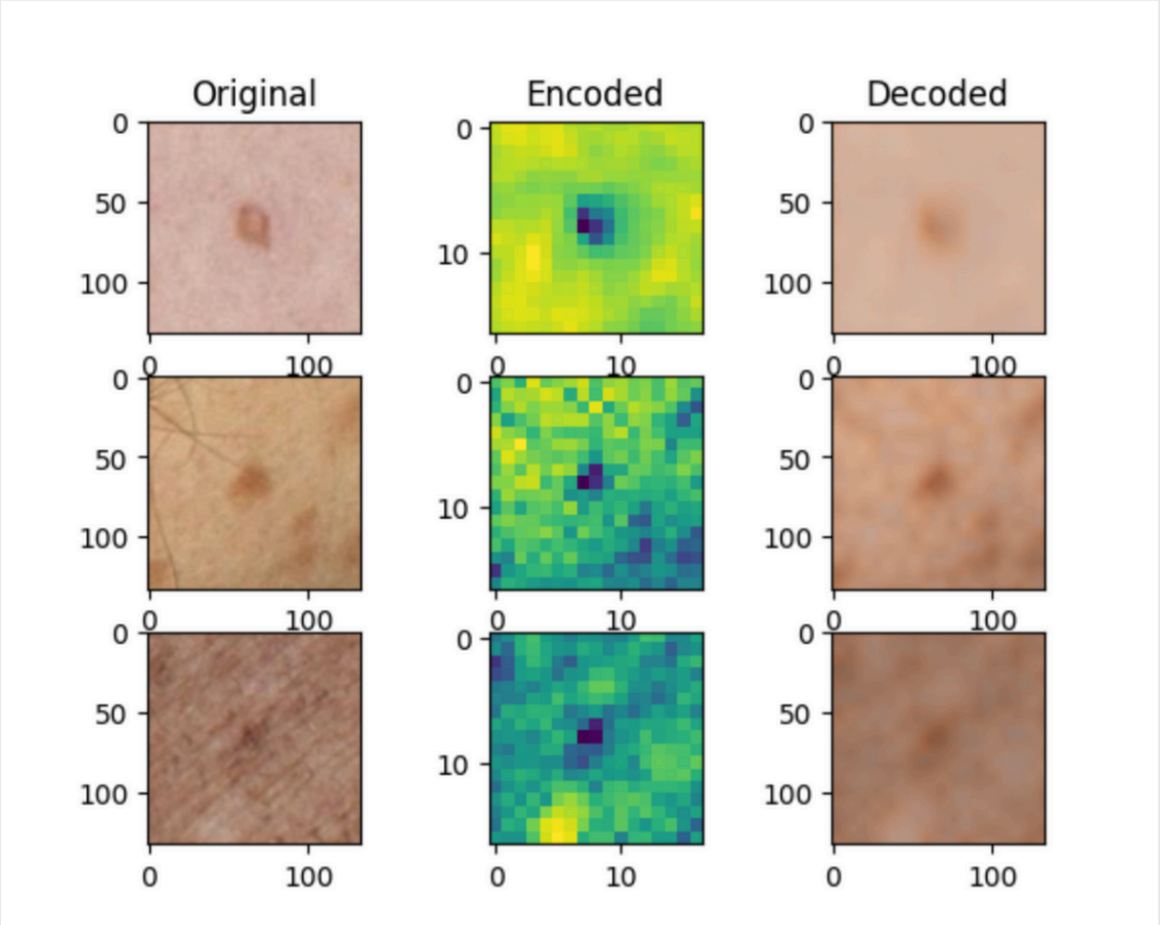
Solutions

- Modern solutions:
  - Convolutional neural networks (CNN)
  - Data augmentation: mirroring, rotating, scaling
  - Balancing the data: class weights and oversampling
  - Dynamic data loading: PyDataset generator class

Autoencoder

- Creating an encoder for the images
- Convolutional layers in the encoder
- Transposed Convolution in the decoder
- Encoder output: 17x17x1

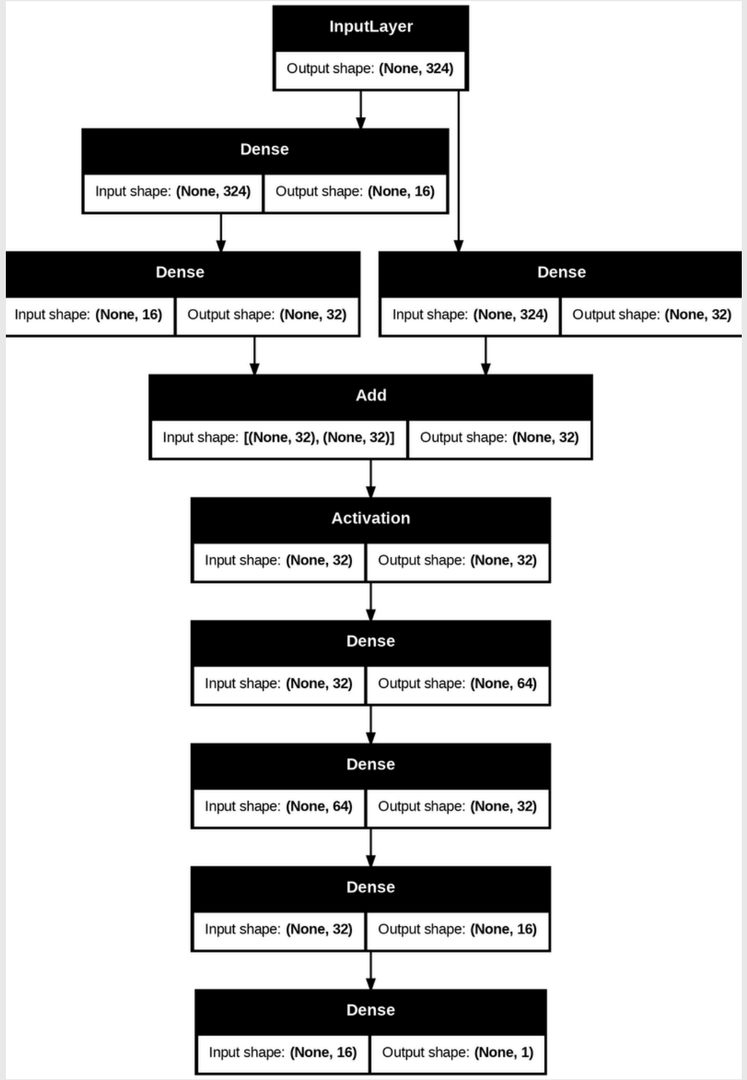


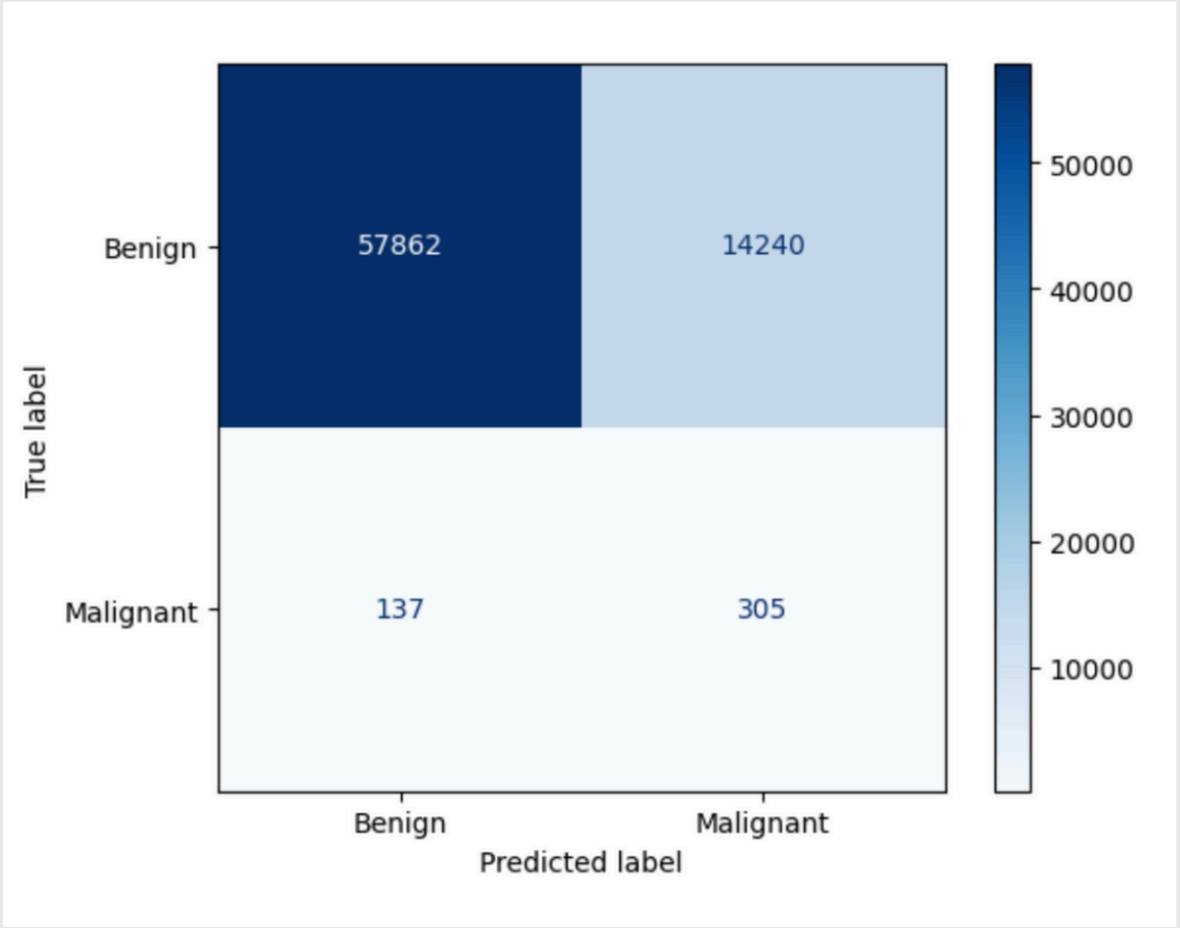


Examples of encoded and decoded images with the trained Autoencoder

Classification

- Concatenating the relevant metadata
- Dense layers
- Skip connections for mitigating the gradient problems





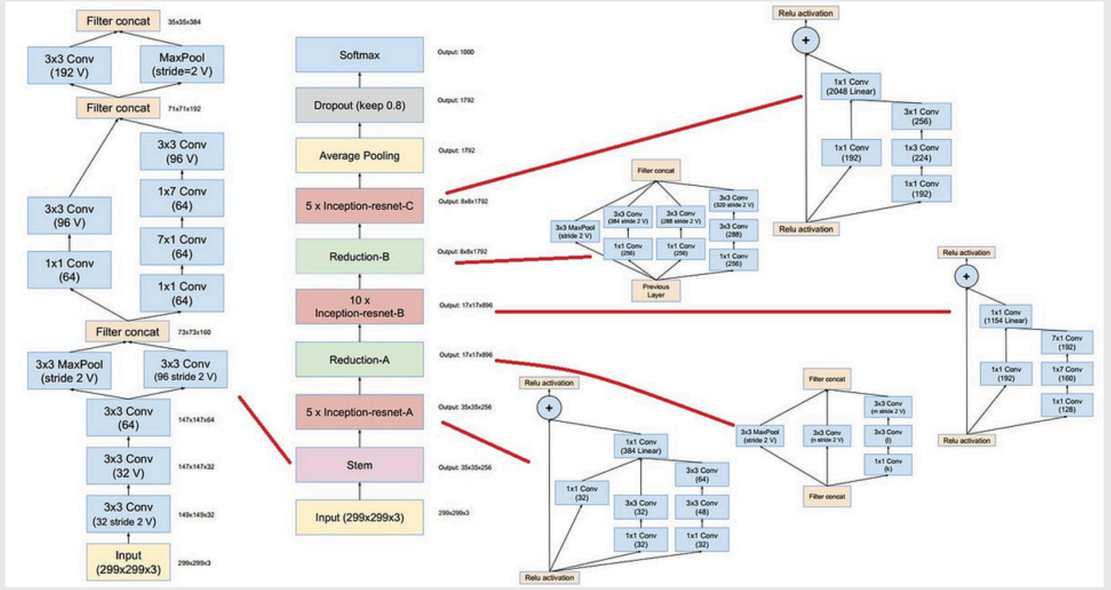
Confusion matrix on the test dataset

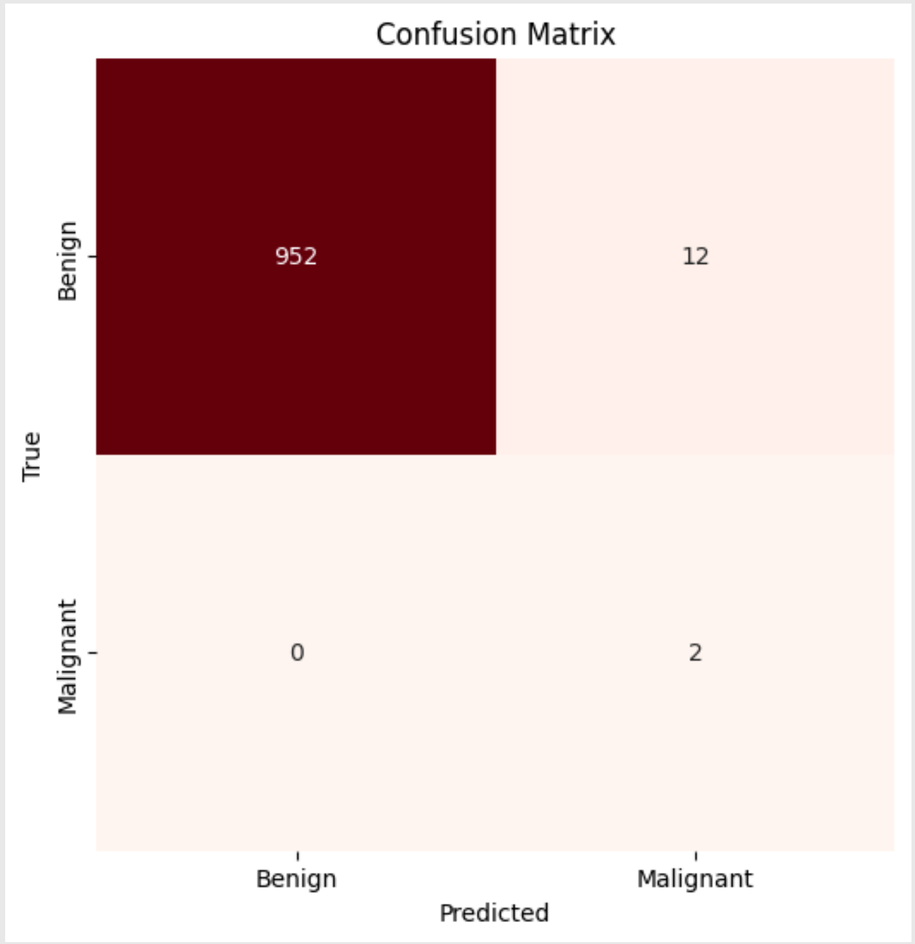
Results

- Accuracy: 80.18% on the test dataset
- The dataset might need additional balancing
- Possibilities for improvement: Dropout layers, fine-tuning
- Possible social effects: simple and accessible diagnostics

Transfer learning

- Creation of network with InceptionResnetV2 and additional convolutional layers
- Separate convolutional layers for the metadata
- Concatenating the images for the network and the metadata
- hyperparameter optimization with Keras-Tuner





Confusion matrix with the evaluation of the test data

Results

- Accuracy: 98.7% on the small test dataset, but in big test there is a fast dropping
- Recall is the most important metric in a real-world application

Thank you for your attention!