

# Application of neural nets and deep learning in clinical screening systems

## CHALLENGES

Health, demographic change and wellbeing

### The Industrial Problem

The investigations are expected to lead to marketable results in clinical decision support/automatic screening systems. The industrial partner wants to develop a reliable self-screening system.

### University of Debrecen

Research



UNIVERSITY of  
**DEBRECEN**

Here we list the fields of expertise of the members of the research team as medical image processing, machine learning, graph theory, ensemble systems, neural networks

### SightSpot Network Ltd.

Company

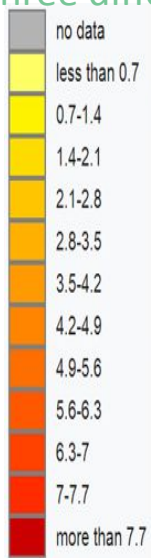


IT company with greater experience in the field of mobile application development.

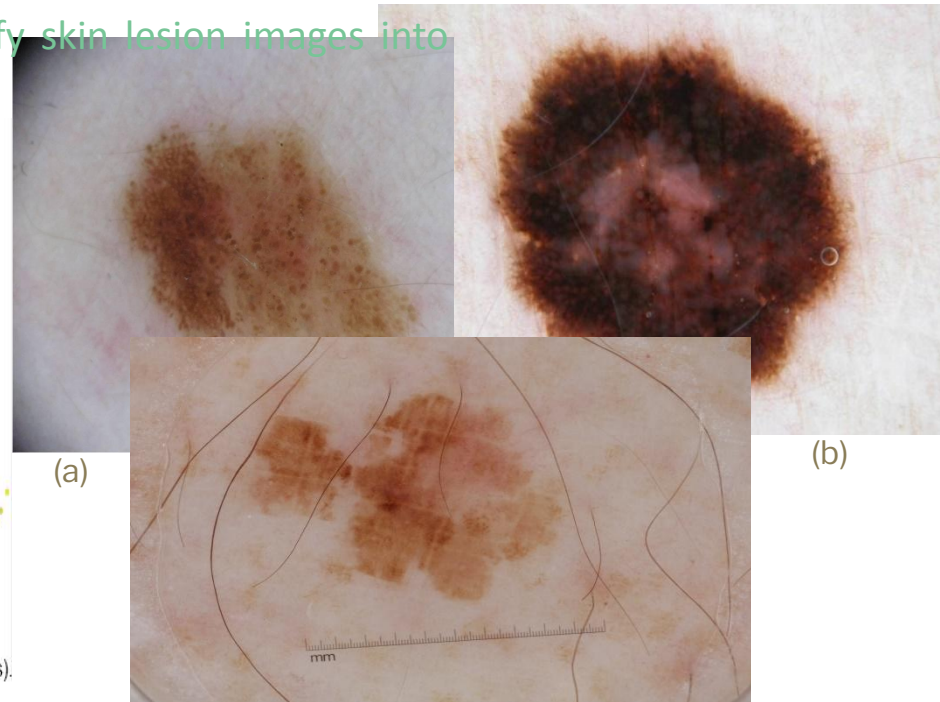
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## Challenges & Goals

- Can a single CNN be used effectively for a given task?
- Are the available CNN architectures efficiently applicable for a given task?
- Are the learned features reliable?
- Would the inclusion of handcrafted (conventional) features improve the performance?
- How we can develop efficient methods to classify skin lesion images into three different classes?



Death rates from Melanoma and other skin cancers by country (per 100,000 inhabitants).

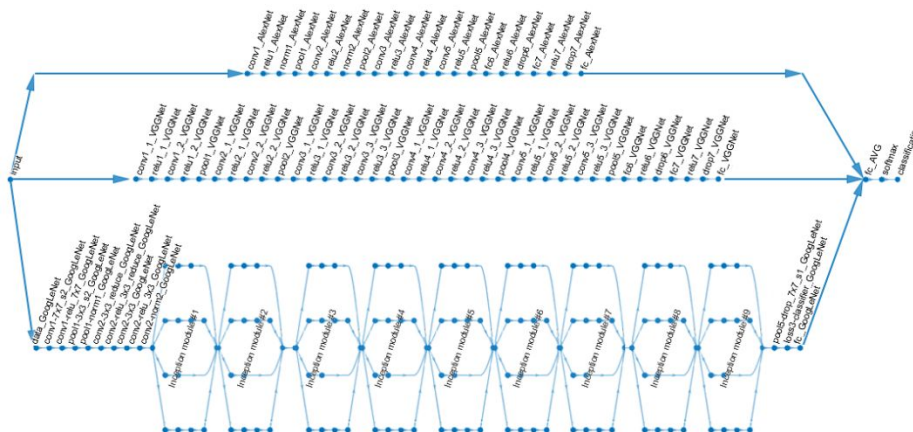


Three special types of skin lesions:  
(a) nevus; (b) melanoma; (c) seborrheic keratosis.

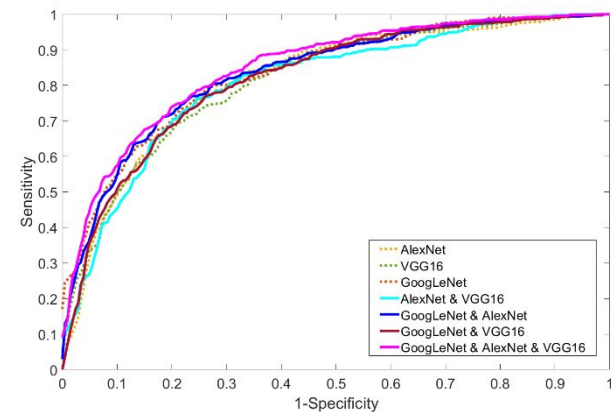
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## Mathematical and computational methods and techniques applied

- We investigated how we can create an ensemble of CNNs in order to outperform the accuracies of the individual ones.
- We worked out the theoretical background of the fusion of CNNs in the training stage.
- We examined the combination of the features extracted by CNNs and other conventional methods.
- We developed a new loss function to support the ensemble training



Architecture of the ensemble



Performances of different ensembles

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## Results & Benefits to the company

- We created an ensemble of deep convolutional neural networks to improve further their individual accuracies
- We proposed the aggregation of robust convolutional neural networks (CNNs) into one framework
- We considered different fusion-based methods and select the best performing one
- The applied fusion strategies outperformed the individual networks regarding classification accuracy.



*Screenshot from the devepoled mobile app.*

We developed an automated screening system which is built into a mobile application to provide a self screening tool for the users in the world-wide.