Segmentation of Breast Tissue Lesions Using Explainable Models

Emlőszöveti elváltozások szegmentálása magyarázható modellekkel

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Outline

Introduction

- Breast cancer is the most common cancer diagnosed in women
- Early detection through imaging (e.g., mammography) significantly improves outcomes
- Mammography is the most frequently used imaging technique to record the breast tissue

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- Tissue density has high impact on the lesion detection performance
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- The dataset is collected in collaboration with “Prof. Dr. Ion Chiricuță” Oncology Institute
- Contains:
  - Mammograms
  - Tomosinthesis
  - Histopathology
  - Reports from the doctors

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- The type of the tissue
- Presence of a lesion
- Type of the lesion
- Location of the lesion
- The original reports
- An English version of the report (translated with ChatGPT)

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Distribution of the data

- 289 patients:
  - 167 heterogeneous
  - 131 homogeneous
- 187 healthy scans, lesions: 195 benign and 254 malignant
- Age between 32 and 90

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- Ensuring compliance with privacy and clinical data standards
- All personal identifiers are removed from medical images and metadata
- Conversion and standardization of imaging formats

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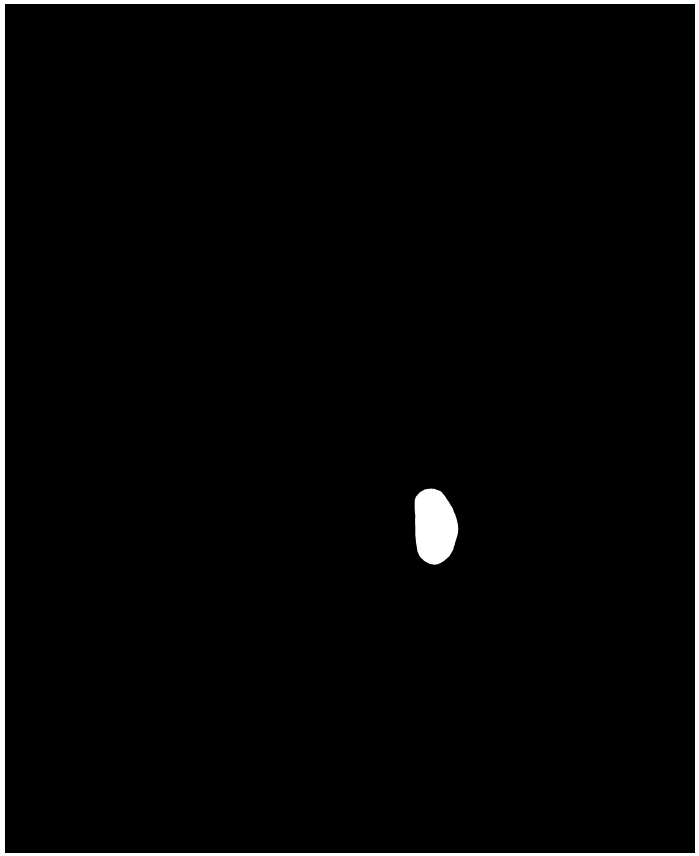
Extracting manual segmentation

(a) Manual segmentation



(b) Extracted lesion mask

Segmentation of Breast Tissue

- **Objective**: Distinguish lesion regions (foreground) from healthy breast tissue (background)
- Enhances the performance and reliability of automated breast cancer detection systems
  $\Rightarrow$ we propose the use of a convolutional neural network

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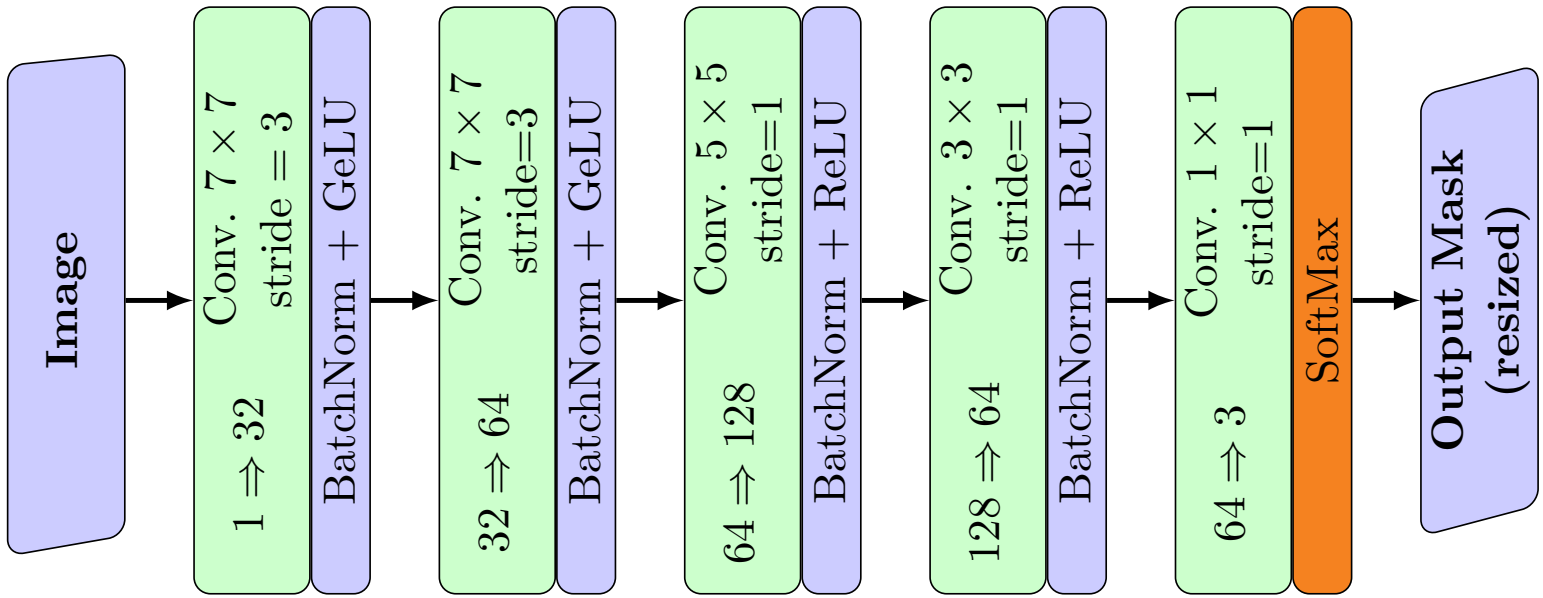

Ditmár Máté and Lehel Csató. "Salivary ferning segmentation with a lightweight CNN" (2025) *2025 27th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC)*

Lightweight Segmentation Model

Receptive field

- The region of the input space that contributes to a neuron's activation
- In convolutional networks, this receptive field expands progressively with each added layer
- Visualization of the receptive field produced by two consecutive convolutional layers using 3×3 kernels with a stride of 1

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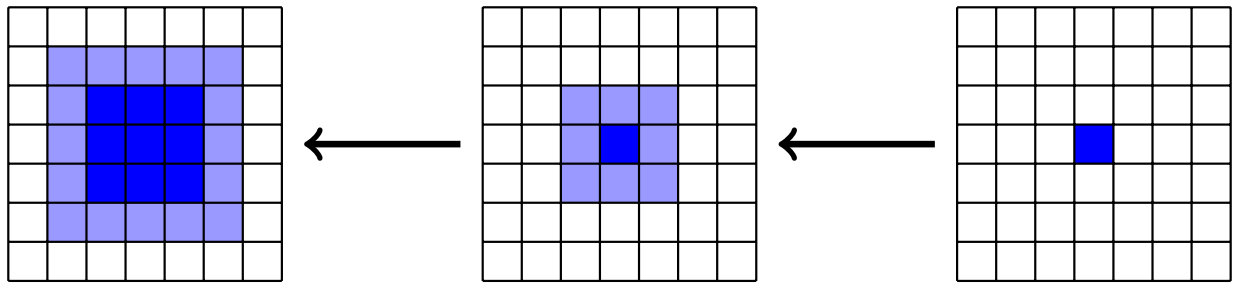
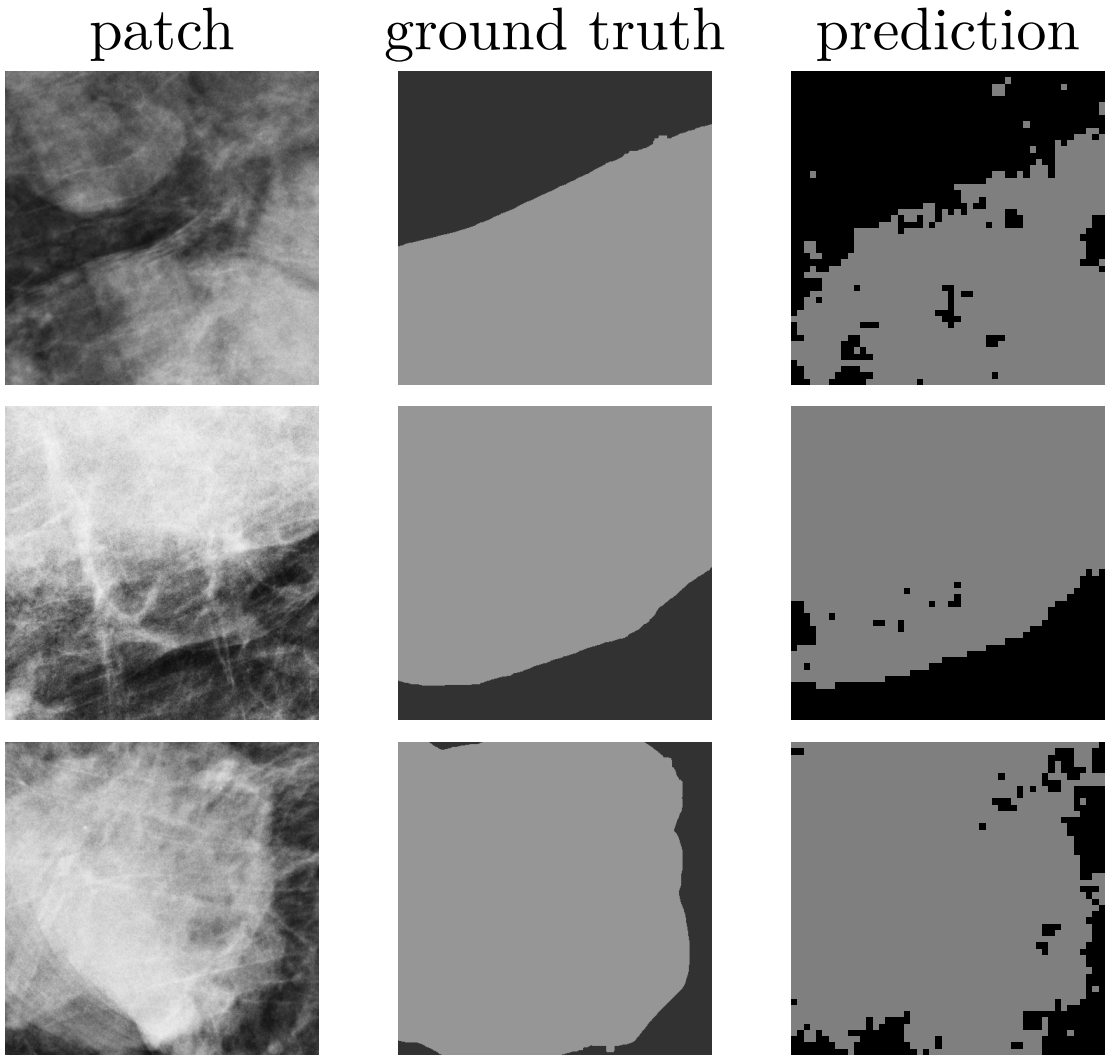


Lightweight Segmentation Model

Results



Conclusions and Future Work

- The manual segmentation must be revised
- The preliminary results of the lightweight CNN model are promising

- Fine-tuning the proposed lightweight model
- Training more complex self-explanatory models like ProtoSeg
- Training a multi-modal system, considering the histopathological reports

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[1] Máté, D. & Csató, L. (2025) Salivary ferning segmentation with a lightweight CNN, International Symposium on Symbolic and Numeric Algorithms for Scientific Computing (Accepted)

[2] Sacha, M., Rymarczyk, D., Struski, Ł., Tabor, J., & Zieliński, B. (2023). ProtoSeg: Interpretable Semantic Segmentation with Prototypical Parts (Version 2). arXiv. https://doi.org/10.48550/ARXIV.2301.12276