Eindhoven University of Technology

Project AI for MIA

8P361

Assignment 1

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February 21, 2025

1 Exercise 1

What is the clinical utility of evaluating the presence of metastases in sentinel lymph nodes in breast cancer patients? In other words, how is this information used in the clinical decision making process for breast cancer patients?

In breast cancer patients, invasive carcinomas have higher rates of metastases in sentinel lymph nodes than noninvasive carcinomas, thus in the clinical decision making process, the presence of metastases in sentinel lymph nodes signals a higher risk of invasive carcinoma and lower the prognosis of the patient. [1]
In histopathology images, metastasis can be categorized in different classes: micrometastases (MM) and isolated tumor cell clusters (ITCs) and macrometastases. MMs can be described by tumor deposits between 0.2-2.0 mm, ITCs can be described by a cell cluster or single cells with no single cluster larger than 0.2mm and macrometastases being larger than 2.0 mm. [2]

2 Exercise 2

How does the introduction of whole-slide imaging change the typical workflow of a pathology lab?

The introduction of WSI does not change the slide preparation process in the lab, but after this, it allows pathologists to analyze specimens on a computer instead of a microscope. This makes it possible to diagnose, analyze etc. without access to the physical slide and allows integration with artificial intelligence for diagnostic support. In return, pathology labs require the infrastructure for WSI and specified training for pathologists.
In addition, since the slides are digitally available, image analysis can be performed by for example AI-based algorithms for detection and decision making.

3 Exercise 3

The PatchCamelyon dataset is derived from the CAMELYON16 dataset of whole-slide images. Describe how a neural network classification model trained on small image patches can be applied to larger, whole-slide images with the goal of detecting metastases.

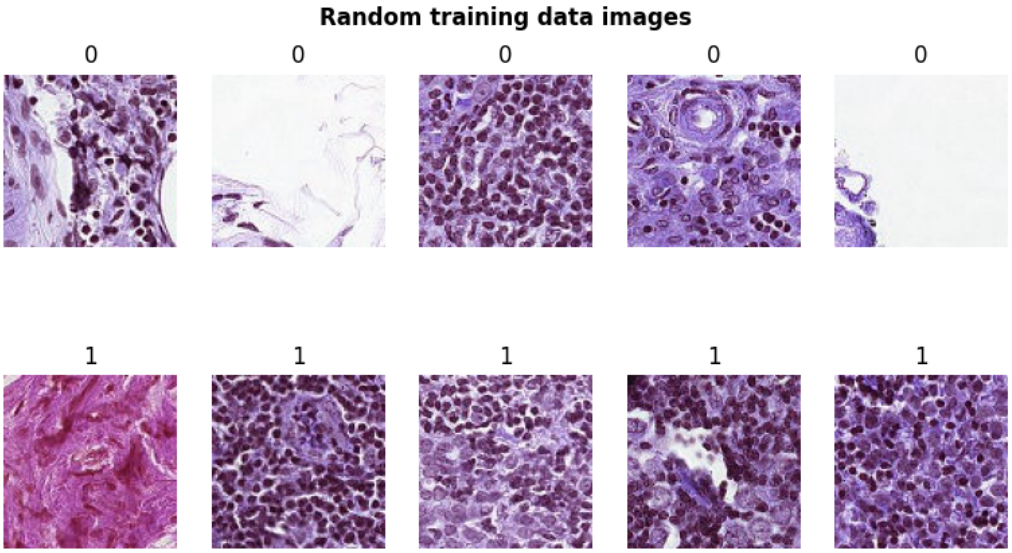
One option to apply a neural network like this to larger whole slide images is to segment the whole-slide images into a grid of patches, and classifying these patches with the neural network. This thus makes the neural network return multiple scores to each whole-slide image. These scores could then be turned into heatmaps for each slide indicating where on the slide there might or might not be metastases during post-processing.

4 Exercise 4

Download and unzip the training and validation (4 GB) and testing (1 GB) subsets of the PatchCAMELYON dataset. Note that the unzipping process might take a while due to the large number of files in the archives.

Write a small Python script that reads and displays a few images from the two classes. Visually describe and compare the appearance of the tissue in the patches with and without metastases.

Below this paragraph you can find the 10 images randomly displayed. The top five classified False/0 (no metastases) and the bottom five are classified True/1 (metastases present). The obvious difference immediately clear is that two images marked as clear of metastases are nearly empty. Though more subtly, the images marked with metastases seem to have more densely packed cells in general. As well as more clumped cell nuclei. Further than that, differences are hard to find, especially as the previously named distinctions seem to have outliers.



5 Exercise 5

Make an account on Kaggle and subscribe to the Patch-CAMELYON challenge. You will use this account to submit results for evaluation from your main project work. You can also make accounts for every team member and submit results as a team. Note that you do not have to download the dataset again from Kaggle (the version that we have prepared is a bit easier to work with and can still be used to submit results).

our team name is 'Group 3 8P631 2025'

6 Bibliography

References

[1] William L. Donegan. Tumor-related prognostic factors for breast cancer. *CA: A Cancer Journal for Clinicians*, 47(1):28–51, 1997.

[2] Donald L Weaver. Pathology evaluation of sentinel lymph nodes in breast cancer: protocol recommendations and rationale. *Modern Pathology*, 23:S26–S32, 2010.