

CS424/CS904 - Assignment 3
Part III (Computational Pathology)
Submission Deadline: 12pm on Wed 13th Mar

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Background

Tumour-infiltrating lymphocytes (TILs) are an important biomarker in cancer prognosis [1, 2]. These particular type of immune cells play an important part in killing tumour cells and their role has been shown to be significantly prognostic in some types of cancers. Hence, identification and quantification of TILs can lead to better targeted treatments in these particular cancer types. However, mostly TILs quantification is done manually by pathologists using the recommendations from the International TILs Working Group established in 2015 [2].

Recently, a challenge competition was organised by a group of researchers in collaboration with the International TILs working group to develop fully automated assessment of tumour-infiltrating lymphocytes (TILs) in H&E breast cancer slides. In this coursework assignment, we have collected a subset of whole slide images from the TiGER challenge to develop an algorithm for TILs scoring. The data set for the assignment can be accessed at ‘/modules/cs904/Assignment3-2023-2024’ on the DCS system. The data set consists of a folder ‘wsitils’ and a csv file named ‘tiger-tils-scores.csv’. The ‘wsitils’ folder contains 50 whole slide images (WSIs), whereas ‘tiger-tils-scores.csv’ contains TILs scores for the WSIs in the ‘wsitils’ folder.

In your assignment, you will need to train an algorithm on the images labelled with Image Number 1 - 40 in the 'tiger-tils-scores.csv' file and report TILs scores for images with Image Number 41 to 50. The detailed requirements for the assignment are detailed in the section below.

Requirements

In this coursework, you are required to implement a complete computational pathology workflow. The task is to estimate TILs score by analysing whole-slide images (WSIs) of H&E-stained breast cancer tissue slides. You will be provided with a subset of the breast cancer cohort, which comprises of 50 H&E-stained WSIs. In addition to the WSIs, you will be provided with TILs score of 40 patients to train the algorithm. You will be required to estimate the TILs score for the remaining 10 WSIs.

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Task - 1 Tissue Segmentation (15 pts)

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1. You are required to segment the tissue regions from the WSIs for subsequent analysis. You are welcome to use the methods implemented in TIAToolbox [3] for this task. Alternatively, you can choose other methods or libraries you prefer.
2. Use matplotlib [4] or other libraries you prefer to visualise the tissue segmentation results.
3. You need to include the segmentation results of the 2 WSIs provided to you at 1× in your report.

Task - 2 TILs scoring Algorithm (40 pts)

You are required to train an algorithm for TILs scoring using WSIs with Image number 1 - 40 in the ‘tiger-tils-scores.csv’ file. You can choose to adopt any approach in the literature or develop your own algorithm which can estimate TILs scores.

1. You must train and implement at least one algorithm for TILs scoring.
2. You should include the hyperparameters (epochs, learning rate, model architecture, etc.) and the log (the convergence of loss, etc.) of your training process in your report.
3. You must explain your approach and the algorithm in detail for scoring TILs in your report.
4. You should report the evaluation metrics on the training/validation set in your report. You should at least: plot a scatter plot between the TILs scores provided in the ‘tiger-tils-scores.csv’ file and the estimated TILs score with a spearman correlation value.

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Task 3 – Visualisation of prediction results (25 pts)

1. You are required to select a few sample WSIs to generate a prediction heatmap overlay, highlighting the regions that are predicted with high TILs scores using different colours.
2. You must provide at least 1 visualisation results in your report.

You can use the TIAToolbox visualisation tool ¹ to generate the visualisation results.

¹<https://tia-toolbox.readthedocs.io/en/latest/visualization.html>

Code Quality (10 pts)

You code should be able to run on DCS machines or on other accessible public platforms (e.g., Google Colab). Submit all of your source code and include instructions on how to run them in your report. You should aim to write code of high quality, properly structured, formatted and documented.

Report (10 pts)

Submit a concise and clear report, properly structured with clear section headings. Figures and tables should be labelled with captions and have necessary descriptions. External sources should be properly referenced.

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References

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- [1] TiGER - Grand Challenge. Tumor infiltrating lymphocytes in breast cancer - tiger grand challenge. [Online]. Available: <https://tiger.grand-challenge.org/>
- [2] T. W. group. International tils working group. [Online]. Available: <https://www.tilsinbreastcancer.org/>
- [3] J. Pocock *et al.*, "TIAToolbox as an end-to-end library for advanced tissue image analytics," *Communications Medicine*, vol. 2, no. 1, p. 120, sep 2022. [Online]. Available: <https://www.nature.com/articles/s43856-022-00186-5>
- [4] Matplotlib. [Online]. Available: <https://matplotlib.org/>

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