TECHNISCHE UNIVERSITÄT DARMSTADT

Deep learning uncertainty for histopathological Image Classification on WSIs

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Deep learning, which has become widespread with the increase in the computational power of computers, has become an important tool for solving problems in many areas of life, from engineering to biology. Deep learning techniques, which are prominent in the field of health as in many other fields, widely use neural networks and convolutional neural networks, especially in medical image processing (as seen Fig.1). However, the following limitations, which make it difficult to rely on the inference results of deep neural networks consisting of millions of parameters and hidden layers, still await explanation; i) lack of expression and transparency, ii) inability to distinguish between in-field and out-of-field samples, and iii) inability to provide reliable uncertainty estimates [1]. These limitations are due to the uncertainty inherent in the data (data uncertainty) or neural network (model uncertainty) uncertainty.

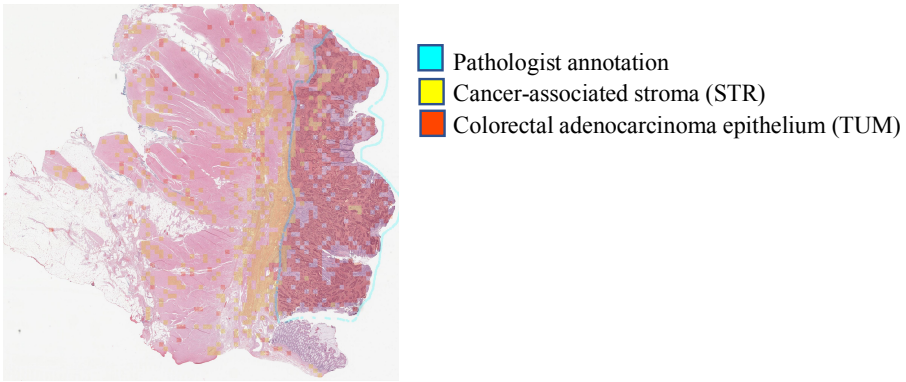

Figure 1: Cancer and cancer associated stroma detection using deep learning.

It is crucial to eliminate the uncertainties in the results of deep learning methods applied to the problems that need solutions, especially in the health field. For example, a well-trained and field-expert pathologist may miss small changes in the tissue, although he can detect the apparent tumors when examining a histopathological image. When performing the segmentation of the cancerous region on such an image, the model should yield the results as conspicuously as possible. Otherwise, an incorrectly analyzed medical image will cause an inaccurate treatment process.

In this thesis, a method will be developed to classify colon cancer on WSI under the uncertainty of the deep learning network. The student conducting the study will benefit from previously completed deep learning-based colon cancer classification study [2].

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[2] Ahmet Gokberk Gul, Oezdemir Cetin, Christoph Reich, Nadine Flinner, Tim Prangemeier, and Heinz Koeppl. Histopathological image classification based on self-supervised vision transformer and weak labels. In *Medical Imaging 2022: Digital and Computational Pathology*, volume 12039, pages 366–373. SPIE, 2022.