Deep Learning - the Key to Revolutionise Skin Cancer Diagnosis?

A popular science summary of the Master's thesis *Segmentation and Prediction of Mutation Status of Malignant Melanoma Whole-slide Images using Deep Learning*

Elin Johansson and Fanny Månefjord

Malignant melanoma is an aggressive type of skin cancer that develops from moles. Gene mutations can make the disease progress faster, but if the mutations are detected, it is possible to specialise the treatment. Using deep learning as a complement in diagnostics is state of the art in many medical fields. It is a type of artificial intelligence that can detect patterns that are invisible for the human eye. In our thesis we have shown that it is possible to use deep learning to predict the mutation status of melanoma using microscopy images. With further development, this method could possible replace advanced, expensive and time consuming lab analyses. The technique could contribute to more rapid and accessible diagnostics around the world.

Malignant melanoma is increasing at a high pace all over the world. With the exception of lung cancer in women, it is the cancer type that is increasing the most in prevalence. Specialised treatment is an important step of defeating cancer. Gene mutations in malignant melanoma enhance tumour growth which makes the disease progress faster. The two most common mutations are present in 40% and 20% of the cases, respectively. Since specialised treatment exists, detection of these mutations is crucial. Today, this is done with costly and time-consuming DNA analysis. However, recent studies show that deep learning can be used to detect the mutation status from tissue images alone. For a better chance at saving a patient's life, early detection and comprehensive patient investigation play vital roles. It is common to visually inspect cancer tissue in a microscope to mark out the tumour areas. However, this is a tedious task performed manually by a specialist.

Deep learning is a subfield of artificial intelligence and it can be used to automatically mark the different tissue types, without the need for human participation. In our thesis, we have trained a deep learning network that can identify four tissue types in melanoma biopsies which can assist in the segmentation procedure and save a great amount of time for the specialist. The segmentation network was trained and evaluated with a dataset from Skåne University hospital in Lund and its performance was visually evaluated on an independent dataset from the public database The Cancer Genome Atlas.

The segmentation network was used to find tumour-rich areas in the tissue and another deep learning network was trained to classify the mutation status. Even though further improvement is needed, the deep learning models developed in this thesis show high potential of being an integrated part of an automatic diagnostic tool. This tool would not only increase the speed but also make the melanoma diagnosis more accessible across the world since it only needs microscopy images and a computer.