

Chapter 3

Classification of Ovarian Cancer Subtype Using Histopathology Images

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ABSTRACT

Ovarian cancer is a common and reoccurring type of cancer. If detected early and treated properly, one can have a longer lifespan. We aim to provide robust alternative to the pre-existing system of manual diagnosis by automating the process using Deep Learning. In this paper we explore the three methods to classify histopathology images into its five corresponding types and outliers, possible cases of rare subtypes or healthy tissue misdiagnosed as cancerous. Previously, research made about detection and classification of other cancers have yielded significant results with several types of deep learning approaches, however the volume of data and annotations used for those is huge and difficult to obtain for all. Here, to make up for the lack of sufficient data, we have used transfer learning and fine tuning of pre-existing models trained for histopathological data.

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1 INTRODUCTION

Ovarian cancer affects almost 1 in every 87 women according to the American Cancer Society and every 1 in 130 has a probability of mortality (American Cancer Society, n.d.). The disease is asymptomatic at earlier stages and gets detected only in an advanced stage when it becomes difficult to treat and is often irresponsive to the commonly used chemotherapy. Examination of WSIs (Whole Slide Images) and TMAs (Tissue Microarray) is one of the ways in which this carcinoma can be classified into its subtypes.

Traditional methods of subtype classification based on manual histopathological assessment are labor-intensive, subjective, and prone to inter-observer variability. Machine learning based methods of CAD – which banks on the fact that the diagnostic errors made by humans and machines are fundamentally different and prevents overlooking by investigating all pixels, and CBIR – which works based on similarity in images and can accommodate weak and unlabeled data (Farahani et al., 2022) (Ibrahim et al., 2020).

While looking at these histopathological images the agreement between pathologists regarding the histotype is at best moderate (Cohen's kappa 0.54–0.67) (Farahani et al., 2022). There have been commendable results by using artificial intelligence to diagnose and histotype classification of breast cancer, lung cancer, and stomach cancer (Ibrahim et al., 2020)(Brunetti et al., 2022)(Ma et al., 2020). Using deep learning we aim to classify ovarian carcinomas into their histopathological subtypes to eliminate the confusion of categorizing manually.

In some previous works the various computer vision methods have yielded significant results in successfully categorizing the subtypes. However, these were done with much larger volumes of data or from a single source. Here, we shall deal with not only limited data and imbalanced data but also data collected from hospitals in 4 different competitions. This is the closest way to ensure the method produced can be applied universally.

Through empirical evaluations, this thesis aims to shed light on the utility of SSL and TL techniques as a viable solution for improving the accuracy and efficiency of ovarian cancer subtype classification. The findings from this research have the potential to impact clinical practice by facilitating more accurate diagnosis, personalized treatment planning, and prognostic assessment for patients with ovarian cancer. Furthermore, this work contributes to the broader field of digital pathology and machine learning by demonstrating the efficacy of machine learning in histopathological image analysis, with implications for other cancer types and biomedical applications.

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