Chapter 2
Deep Learning for Medical Image Segmentation

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ABSTRACT

Pixel accurate 2-D, 3-D medical image segmentation to identify abnormalities for further analysis is on high demand for computer-aided medical imaging applications. Various segmentation algorithms have been studied and applied in medical imaging for many years, but the problem remains challenging due to growing a large number of variety of applications starting from lung disease diagnosis based on x-ray images, nucleus detection, and segmentation based on microscopic pictures to kidney tumour segmentation. The recent innovation in deep learning brought revolutionary advances in computer vision. Image segmentation is one such area where deep learning shows its capacity and improves the performance by a larger margin than its successor. This chapter overviews the most popular deep learning-based image segmentation techniques and discusses their capabilities and basic advantages and limitations in the domain of medical imaging.

INTRODUCTION

Image segmentation is the process in computer vision to assign a label to each pixel in an image. Image segmentation splits the input image into different connected components based on some user-defined high-level semantics. Image segmentation

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and object detection have numerous applications in medical imaging. This chapter would explain different types of image segmentation and their application in the domain of medical imaging. The chapter would mainly highlight the important contribution of deep learning in image segmentation. In this chapter, the author discusses various state-of-the-art image segmentation techniques, different evaluation metrics and their application in medical imaging. This chapter also highlights popular open-source tools that use for medical image segmentation data labelling. The chapter ends with an implementation detail of instance segmentation for medical image.

In existing cutting-edge technology of image segmentation, pixel-level dense prediction can achieve an extremely good accuracy which is safe and convenient for medical image processing purposes. Currently, some medical diagnosis tasks are searching for image segmentation technique's support, for example, lung disease diagnosis based on X-ray images, nucleus detection, and segmentation based on microscopic pictures and kidney tumour segmentation. And even some techniques like U-Net and etc. are designed specifically for medical image segmentation usage. Meanwhile, to make deep learning-based segmentation and such AI technology much quicker apply in the medical field, there are quite of competitions are hosted publicly.

For the same purpose, this chapter has a brief overview of segmentation technology and the state of the art models for different subtasks. First, the authors give an explanation for image segmentation types, mainly for discriminating between traditional and deep learning-based methods. The authors focus on the illustration of different kinds of deep learning-based image segmentation models that are suitable for different scenarios in medical imaging.

Usually, it is not enough for real application by just segmenting the objects, for which the authors introduce in the 3rd section some post-processing techniques to refine the segmentation mask. For completeness, in the last two parts, the chapter describes how to augment your own custom dataset that helps to get better results and how to implement 2-3 classical image segmentation models that help you do some quick experiments with your own dataset.

So, this complete chapter overviews the most popular deep learning-based medical image segmentation techniques and discusses their capabilities, their use cases in a medical imaging application, data labelling, data augmentation, post-processing of segmented mask, and basic advantages and limitations.

IMAGE SEGMENTATION

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