Training Neural Networks to Predict Cancer-Prone Regions within the Prostate
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INTRODUCTION

Multimodal magnetic resonance imaging (mMRI) is increasingly used in the detection of prostate cancer. However, a large number of prostate cancers often go undetected on MRI due to their similarity to the normal gland and benign conditions. With better prostate cancer detecting algorithms in place, we can benefit from a more confident-targeted approach. As we navigate through deep learning algorithms to better predict the location of prostate cancer on mMRI, we take a closer look at 40 different patients exhibiting clinically significant symptoms.

RESULTS

Convolution Neural Networks

Perceptrons take several inputs into account and produce a single binary output. For each neuron output, a weighted sum of every input is used to produce such binary output. The neuron’s output is either a 0 or 1 depending on whether this weighted sum is greater than a given threshold value. For any given input there may be more weight given to a particular variable if there is more confidence for such condition. Suppose we make some change to the weight, or bias, in the network - for example, a change in position of the cancerous region of the prostate – we will need to account for this small change in the output. However, we wouldn’t want this change to dramatically shift our output, as we would like for our algorithm to learn the slight changes that can occur with regards to the mpMRI patch in our given prostate cancer model. For this reason, the trend will lean more towards sigmoid neurons and not perceptrons; however, perceptrons are a basic neuron model used to learn the basics of convolution neural networks. For sigmoid neurons we will use a deeper complexity of \( e^{x - s + b} \), where \( s \) is the threshold.

Patients with prostate cancer with a Gleason score of 7 or higher were considered clinically significant cancers. Gleason score 6 cancers were considered non-significant. They are called well differentiated or low-grade and are likely to be less aggressive; that is, they tend to grow and spread slowly.

Axial, Coronal and Sagittal Views of Prostate Cancer Regions of the Prostate Gland

3D Convolution Neural Networks Design

CONCLUSIONS

In this project, consultant and development experience from RCC implement deep learning-based tools for automatic classification of the cancerous findings in multi-parametric MRI of prostate for the Radiology department of The University of Chicago. Other tools will be designed for automatic segmentation and prediction of the prostate cancer. This will have a great impact in the research studies of the department and can be further implemented for other datasets, imaging other types of cancer.

FUTURE OUTLOOK

• Improving prediction of Prostate Cancer using Risk Map (include new parameters, e.g., DCE signal kinetics parameters: signal enhancement rate).
• Automatic segmentation of different sectors of the gland.

REFERENCES