

Chapter 49

Applications of Machine Learning in Disease Pre-screening

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ABSTRACT

Computers in disease prescreening are utilized to interpret medical information. This is known as computer-aided pre-screening tool (CAPST). CAPST helps in improving the accuracy of diagnosis in medicine. The medical experts usually take the outcome of the CAPST as a second opinion to make the final diagnostic decisions. Fast and accurate prediction of disease risk and diagnosis is crucial step for the successful treatment of an individual. The AI-based machine learning technology has undergone significant developments over the past few years and is successfully used in many intelligent applications covering problems of variety of domains. One of the most stimulating questions is whether these techniques can be successfully applied to medicine in disease pre-screening and diagnosis and what kind of data it requires to be trained and learned. There are so many real-time examples of the problems where machine learning methods are applied successfully, especially in medicine. Many of them showed significant improvement in classification accuracy.

INTRODUCTION

It has been already observed that machine learning has revolutionized the field of computer vision. Hardly a few years ago, It has transformed this field into practically true, in-your-pocket technologies out of those technologies which were usually considered like science fiction. If nearly human-level accuracy can be achieved through modern computer vision system in identifying dog breeds or cars, why not the current disease diagnostic system might not be as much capable of learning to identify the disease (disease pre-screening) using medical data (medical images or biomedical signal)? For the past few years, the researchers have been working in collaboration with clinicians and doctors to explore it

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and trying to resolve this problem. Their research has shown that the solution to this problem is indeed possible, not in the future but today itself. The current state of arts has been established in two of the research areas, ophthalmology, and digital pathology, where the researchers are highly excited about what and where the significant progress in research to date has been made. The implementation of pre-screening diagnostic systems in both the fields has encouraged doctors to perform decisions in doing better diagnosis with higher efficiency. For example, one of the crucial diseases like diabetic retinopathy has emerged as one of the applications for disease pre-screening and diagnosis in the area of ophthalmology. Researchers have started to explore developing the computer-aided pre-screening diagnostic tools for a variety of diseases; one of those is a pre-screening tool for diabetic retinopathy. This disease is caused by high-intensity blood sugar levels which in turn damage to blood vessels of the retina. These blood vessels may lead to problems of swelling and leak. They may also stop blood flow from passing through the vessels. Sometimes abnormal new blood vessels may also grow on the retina. This may cause heavy damage to the eyesight of a human being. Nowadays, this problem has become common globally in the world and its' count is increasing exponentially day by day. In general, highly trained experts are required to diagnose the condition in examining the abnormality present in individual's organs. It is well known that effective treatments are available until and unless it is caught at its earlier stage. Any delay in disease detection may lead to progression of the disease to the irreversible stage, such as blindness in case of diabetic retinopathy. Considering a large amount of screening (pre-screening before diagnosis and treatment) required to protect the population from a variety of severe diseases, healthcare sector do not have sufficient number of diagnostic experts throughout the world. Similarly, in another field such as pathology, a microscope is used to look and observe the tissue slides by trained pathologists. The analysis only based on the microscope is subjected to enhance the contrast of microscopic images. Once, these microscopic images are digitized, can be shared among various experts, throughout the world (called telepathology). It can also be numerically analyzed with better accuracy using computer algorithms such as machine learning methods. Computer-aided technology can be used to automate the process of physical counting the structures present in slides and can also be used in the classification of tissues with varying conditions in order to grade tumors (tumor grades are described by four degrees of severity: 1, 2, 3, and 4.), which in turn make it easy to perform disease pre-screening for better diagnosis and prognosis.

MACHINE LEARNING METHODS APPLIED IN DISEASE RISK PREDICTION AND PROGNOSIS

Before starting with a thorough analysis of which machine learning methods work best for what kinds of problems, it is necessary to make a decent understanding of what machine learning and training is and what it isn't. Machine learning is the branch of research study comes under artificial intelligence which tries to learn from past experience by employing variety of tools from different fields such as statistics, probabilistic and optimization algorithms and then after training it can classify the newly input data, determine new patterns as well as predict novel trends (Mitchell, 1997). Machine learning method, like statistics, is employed to investigate and interpret knowledge from the dataset. Along with statistical parameters (unlike statistics based traditional methods), machine learning methods utilize other parameters also, such as Boolean logic (AND, OR, NOT), conditional probabilities (the likelihood of event A given event B), absolute restrictions (IF, THEN, ELSE), and unconventional optimization methods

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